

Awareness, Attitudes, Perceptions, and Use of Best Fishing Practices by Recreational Reef Anglers in the Gulf of Mexico



SOUTHWICK
ASSOCIATES

PO Box 6435 ■ Fernandina Beach, FL 32035 ■ Office (904) 277-9765

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Executive Summary

The primary purpose of this study was to obtain baseline information from Gulf of Mexico recreational anglers about reef fishing behavior, awareness of barotrauma, and best fishing practices. This is the second report from a series of surveys that will be conducted for the Gulf States Marine Fisheries Commission (GSMFC) in 2021 and 2024. The first report covered the NOAA-permitted Gulf of Mexico Charter/Headboat sector for reef fish (RCG; Southwick Associates 2022). This research is a cross-sectional study and will encompass both the for-hire and recreational sectors across all five Gulf States. These results include three fishing sectors: NOAA RCG (data from the previous report), state licensed for-hire charters/headboats, and private recreational anglers. The state licensed for-hire and private recreational data were collected as part of this larger survey.

For the previous NOAA RCG survey, five waves were sent over a one-month period and a 30% response rate was obtained.

For this larger survey of private recreational anglers and state for-hire operators, up to 5 waves were sent (depending on state) and a 14% response rate was obtained. Overall, 4,194 individuals responded that they reef fished in 2021 and over 600 responses were received for each state (range = 654 to 1,087). Although some state and sector-level differences were evident, in general respondents were predominantly white (95%) and male (91%); the average age was 49 years with 15 (private recreational) to 25 (NOAA RCG) years of reef fishing experience in the Gulf of Mexico. Frequency of reef fishing varied by state and sector with most private recreational anglers fishing only a few times a season (62%). Conversely, state for-hire operators fished at a frequency of a few times a week to daily (52%), while NOAA RCG respondents fished daily (68%).

Overall Key Points

- Except for private recreational anglers in Florida (42%), most anglers fished in waters deeper than 60 feet, which would most likely warrant knowledge and use of barotrauma mitigation efforts (Table 8, Figure 8).
- Over 90% of anglers from all sectors recognized at least one scientifically recognized barotrauma symptom. (Table 10, Figure 9).
- Anglers who fished infrequently (Figure 12), had fewer years of experience (Figure 13), or fish in shallow water (<30 feet, Figure 14) were less likely to know about barotrauma symptoms.
- Even though shallow water anglers were less likely to recognize barotrauma symptoms, 95% were aware of at least one best fish handling protocol.
- 71% of private recreational anglers knew about venting and 32% were aware of fish descending devices (FDD). Higher percentages of state for-hire and NOAA RCG respondents knew about venting, but similar numbers were aware of FDDs (Table 11).
- Of the private recreational anglers who knew about FDDs, almost half (46%) don't use them (Table 18).
- For private recreational anglers, the strongest predictor of venting and FDD awareness was knowledge of barotrauma symptoms (Table 16).
- People who fish on someone else's private (non-charter) boat are less likely to know about venting or FDDs (Figure 21).

- Only 11% of those who were aware of venting never or rarely vent fish; conversely, 46% of those who were aware of FDDs never or rarely descended fish (Table 17). There were differences for venting tools and techniques across the sectors (Table 18).
- For those who vented, 11% to 15% used tools that would not comply under the recently passed DESCEND Act (Figure 26).
- The vast majority of respondents (88%) said they will help fish return to depth when needed (Table 22, Table 23, Table 24).
- Respondents believed fish needed help returning to depth when caught in deeper water (>60 feet; 67%) and believe that helping fish to return to depth leads to higher survival (66% to 74%) (Table 25).
- Despite believing that returning fish to depth provides more fish in the future, smaller percentages (37% to 53%) believed that longer seasons would be provided if more fish survived.
- Cost is not a barrier to FDD use and a majority believe devices help fish; however, there are concerns about predation (Figure 28).
- NOAA RCG (92%) and state for-hire (76%) respondents were most likely to have a venting tool on the boat, as compared to private recreational (61%) anglers. Similar percentages were observed when asked if they knew how to use a venting tool (Table 31).
- Less than half (30% to 49%) had a FDD on the boat, and most (52% to 66%) of those indicated that they knew how to use it properly (Table 31).
- Other anglers (56%), websites (52%), regulation books (39%), and fishing apps (39%) were used most often by respondents to get information on reef fishing (Figure 34, Table 32).
- Of the 31% who use social media, most used Facebook (56%) and YouTube (25%) (Figure 35).
- Seventeen percent of NOAA RCG respondents had already heard of the “Return ‘Em Right” program. A smaller percentage of private recreational anglers (4%) and state for-hire (10%) had heard of the program (Figure 37, Figure 38).

Outreach Recommendations

NOAA RCG and State For-Hire Sectors

Regardless of state, both NOAA RCG and state for-hire operators are aware of best release practices, barotrauma, and venting. To a lesser extent, they are aware of fish descending devices. They also believe additional training is not required and fish descending devices take too much time to use; however, cost was not an issue. Ultimately, charter/headboat captains have influence over the behavior of their crew and in many respects, the information that their clients receive. Only a small number of private recreational respondents fished from a charter/headboat (6%). These anglers had significantly less knowledge about the issues, as compared to anglers who use private boats. Simply, these anglers are paying to fish a day or two and may not be aware of the greater issues regarding reef fish survival. Given the repeat rate of reef fishing for these anglers is unknown and given they represent a pool of people where outreach could have positive effect, the GSMFC should consider the following:

- Consistent information should be disseminated to captains to either pass along to their clients or display onboard, when possible. Most communication is via email, so outreach staff could prepare a packet that captains could use as a matter of routine communication.
 - Be sure the materials are waterproof and emphasize the benefits of proper fish release to anglers. Consider offering display posters and similar items for posting at marinas and launch ramps educating anglers about the need for proper release techniques.
- Although captains indicated more training was generally not necessary, training modules should continue, given the changing nature of science and release methods as well as turnover within the for-hire sector.
- A notable percentage of for-hire respondents used venting devices that are not legal under the DESCEND Act, which went into effect after this survey was fielded. Messages to captains across the Gulf should strongly reinforce the need for and benefits from the use of appropriate devices.

Private Recreational Sector

This sector is by far the largest group of anglers. The highest benefit will be achieved through an effective outreach and communication program directed at this sector. However, a host of challenges exist related to educating a large population that turns over frequently (39% have 1 – 5 years of experience) and may only reef fish a few times a year (62%). The challenges are further exacerbated by the fact that states manage reef anglers differently, anglers' fish at different depths across the states, and anglers' knowledge varies based on a host of factors. However, there is a strong desire among anglers to return fish to depth and increase survival. Based on the data, the GSMFC should consider the following:

- Some anglers are less concerned with best release practices. Consider continuing efforts that explain the benefits to anglers from safely returning discarded fish back to the bottom.
- Many anglers reported using barotrauma mitigation techniques in situations where it may not be needed. Consider outreach messaging that first explains to anglers how to identify barotrauma symptoms, then explain how to decide when specific release methods should be engaged. Taking a step back to educate anglers about barotrauma symptoms in general, should

lead to higher awareness of methods as well as learning when simple release (without mitigation techniques) is likely the best course of action.

- Knowledge about barotrauma symptoms is not mutually exclusive of using best release practices. In many cases (particularly Florida), many anglers fish in less than 30 feet of water. While venting and descending are not necessary at these depths, other practices should be used. As part of the larger outreach about descending devices, a component could be included that focuses on what should be done, 1) all the time, 2) in shallower water and 3) in deeper waters when other practices are best.
- In some states, more than half of anglers fish on someone else's private boat and more than half of respondents get their information from other anglers. Thus, boat owners are a critical component of an outreach program because they can convey information to their friends and family members. This is particularly important in Texas, where reef anglers cannot be identified using license sales. Consider partnering with marinas, boat registration agencies, boat dealers, boating media and even boating insurance companies and others that regularly connect with boaters to help increase awareness of the benefits from using best release practices and where to find information.
- Almost 15% of private recreational anglers used venting tools that are not legal under the DESCEND Act. All communication materials, including state regulations books should contain an explanation of legal venting tools and the potential harm from using inappropriate tools and methods.

Introduction

Previous efforts to reduce barotrauma-related release mortality in Gulf of Mexico recreational reef fish fisheries, including venting and release tool requirements and recommendations for fish descending devices (FDDs), have been met with limited success. Simply requiring release tools to be on-board and readily available does not mean anglers will use them properly, or at all. Increased use of FDDs (and, secondarily, venting tools), as well as best practices for handling and releasing fish require educational outreach for both the public and private sectors. Such efforts have been conducted on small scales (e.g., less than 3,000 participants (Curtis, Tompkins, Loftus, & Stunz, 2019)), and others are currently underway, with more planned. However, large-scale educational strategies will be necessary to achieve measurable behavior changes across Gulf anglers (and associated conservation benefits), plus evaluations to identify improvements and measure success. Ultimately, the measurement of these changes should equate to a measure of conservation benefit, such as an increased number of fish that survive due to implementing the recommended tools and techniques. Curtis, et al. (2019) demonstrated that this is possible and extending this technique Gulf-wide may impart measurable conservation objectives as required under NOAA's Damage Assessment, Remediation, and Restoration Program.

The "Direct Enhancement of Snapper Conservation and the Economy through Novel Devices" (DESCEND) Act, requires people on commercial, for-hire, and private recreational vessels to have a venting tool or descending device rigged and ready to use when fishing for reef fish species in Gulf of Mexico federal waters. The DESCEND Act was effective January 13, 2022 (after this survey was fielded) and prescribes legal standards for a descending device or venting tool. For example, venting tools must be hollow, so possessing a knife or ice pick does not constitute compliance with the law.

Successful evaluation efforts and ultimately compliance with the DESCEND Act will first require a baseline understanding of anglers' current use of FDDs and other tools, their perceptions about the effectiveness, current practices regarding release procedures, plus barriers to adopting these practices. This study provides a baseline understanding and will be replicated in 2024. Once educational outreach efforts are implemented, follow-up surveys will measure changes in anglers' use and perceptions of FDDs and best practices while also measuring any change in their perceived barriers to greater adoption of descending devices. This study also provides feedback regarding communication and media channels to reach anglers, plus educational messages and approaches that would be most effective, will be collected to improve the success of future outreach and education campaigns.

This research is the first part of a cross-sectional study of recreational and for-hire anglers in the Gulf of Mexico. The study is designed to measure change in angler awareness, perceptions, and application of best fishing practices related to the Gulf of Mexico reef fishery. A baseline survey of recreational and state licensed charters conducted in Fall 2021 is presented here combined with the results of an earlier similar survey of NOAA Gulf of Mexico Charter Headboat for Reef Fish (RCG) permittees. The same survey will be fielded in Fall 2024 to measure any changes resulting from the Return 'Em Right outreach campaign. This project is funded by the Gulf States Marine Fisheries Commission (GSMFC) through the NOAA Damage Assessment, Remediation, and Restoration Program.

A detailed description of the NOAA RCG methods and results are provided in Appendix A. Unless otherwise noted, all methods and results are for the private recreational/state for-hire survey. In many cases NOAA RCG respondent data were added for comparison purposes.

Methods

The populations of interest for this survey were recreational and state-licensed for-hire reef anglers in the Gulf of Mexico who fished during 2021. Prior to survey development (and identification of a sampling scheme), meetings were held with fisheries experts in each Gulf states to discuss the overall project, data needs and availability, and how reef anglers are identified.

State-level sampling¹

Because the five Gulf states identify reef anglers differently, the sampling frame for each state was dependent on how their anglers were tracked and engaged by each agency. The targeted response was 400 adult reef anglers per state and given the differences (and availability) of state license data, the number of outgoing surveys by state were based on conversations with agency staff. For example, Florida routinely surveys holders of reef angler designations and has a good handle on response rates; thus, the number of surveys sent to Florida anglers reflects a goal of 400 responses, given the average response rate for that state (Table 1).

Specific to sampling, Alabama (AL) provided complete license data and a proportional sample was drawn based on residency status. Florida (FL) also provided complete data and the proportional sample was selected based on the stratification scheme used by the Florida Fish and Wildlife Commission (FWC) for holders of a 'State Reef Angler Designation' permit². The FWC frequently surveys these permittees, and our proposed methodology and final sample were shared to avoid issues, such as survey fatigue and inconsistencies with their on-going work. Louisiana (LA) provided data sufficient to select a proportional sample of Recreational Offshore Landing Permit holders based on residency status; they also fielded the survey through their email system. Mississippi (MS) fielded the survey using the population of individuals who were registered in their reporting system, Tails n' Scales. Agency staff routinely communicate with reef anglers through the app, but to avoid survey fatigue, the number and frequency of questions they ask are limited. Specific to Texas, there is no special reef angler permit or designation, so boat owners were used as a surrogate following the methods from a previously published study (Schuett, Ding, Kyle, & Shively, 2016).³ The entire population of individuals with an email on file who owned boats 24 feet or larger in the counties identified by Schuett et al. (2016) were sampled.

¹ As determined by each state, data sharing and privacy agreements were executed prior to obtaining study data.

² In Florida, strata 500 is non-residents from Alabama and Georgia. We only survey Georgia residents from this strata to avoid duplicating individuals from the Alabama sample.

³ Schuett et al. (2016) surveyed boat owners 26 feet and larger. We opted to use boats 24 feet and larger from the same counties.

Table 1. Permit types used to count reef anglers, permit cost, and sample sizes for each Gulf state surveyed.

State	Reef Angler Tracking Method	Required	Cost	Sample size		Total
				Recreational	State for-hire	
Alabama	Reef Fish Endorsement	X	\$10	7,000	141	7,141
Florida	State Reef Fish Angler Designation	X	Free	15,000	1,000	16,000
Louisiana	Recreational Offshore Landing Permit	X	Free	5,000	73	5,073
Mississippi	Tails 'n Scales App	X	Free	3,466		3,466
Texas	None			13,439		13,439
Total						45,119

Survey Design and Data

Survey recipients were contacted either four (Louisiana, Mississippi) or five (Alabama, Florida, Texas) times via email with invitations to complete a brief questionnaire, using the online survey platform Alchemer. Prior to fielding the survey, questions, content flow, and readability were tested with participating states and project partners. Multiple revisions were made, and the survey was fielded from 11 November through 6 December 2021.

The survey consisted of sections that addressed: 1) fishing experience, 2) fishing depth and practices for releasing reef fish, 3) knowledge and experience with barotrauma and mitigation techniques, 4) a series of items related to the theory of planned behavior (TPB)⁴, 5) sources of information respondents use, and 6) demographics (Appendix B). Louisiana and Mississippi requested several questions specific to their state, which were added for their respondents. Since boat owners were surveyed in Texas, they were presented with an additional question about how many anglers typically fish in their boat.

Throughout the survey, the term “barotrauma” was not used, the belief was that using that term may cause confusion and potentially bias results (Crandall, Garlock, & Lorenzen, 2018). In addition, there was concern among project managers that the word “barotrauma” may evoke negative reactions among survey recipients. Thus, the term “return to depth” was used as a surrogate. Similarly, the term “best practices” was generally not used in the survey but rather characterized in questions by behaviors being promoted in the "Return 'Em Right" program, supplemented with other practices that have been demonstrated to enhance survival of released fish (e.g., rubberized landing nets). This array of questions will facilitate the differentiation between exposure to the "Return 'Em Right" messaging and other messaging in the post-outreach survey.

⁴ The TPB postulates that attitudes, subjective norms, and perceived behavioral control all contribute to the influence of a person’s intention to perform a certain behavior (Ajzen, 1991). To measure behavioral intent (use tools to increase fish survival), a series of questions were used to measure attitudes (positive/negative evaluations), subjective norms (perceptions of social pressure), and perceived behavioral control (ability to engage in a behavior) for fish descending devices and venting tools. All items were measured on a scale from 1 = “Strongly disagree” to 5 = “Strongly agree”. Although we only present descriptive results in this report, a peer-reviewed paper on this topic is currently in preparation by the research team.

For this report, three angler sectors were identified,

- Private recreational
- State-licensed for-hire
- NOAA for-hire (RCG; data collected in an earlier effort)

To compare results across recreational sectors, data from the NOAA Gulf of Mexico Charter Headboat for Reef Fish (RCG) permittees were appended and re-analyzed as a complete dataset. A few individuals ($n = 17$) completed both this recreational and the earlier NOAA RCG for-hire survey, so they were removed from the recreational dataset. A separate report for the NOAA RCG survey was submitted to the Gulf States Fisheries Management Commission (Southwick Associates, 2022).

The Statistical Package for the Social Sciences (SPSS, V22) and Program R were used to analyze all data. Statistical differences were measured using analysis of variance, T-tests, and Chi-square tests with measures of effect size (eta, Cohen's d , Cramer's V). Effect size measures the biological importance (or practical importance) of a test statistic (Nakagawa & Cuthill, 2007). Values of 0.1 were interpreted as minimal, 0.3 as typical, and 0.5 or greater as substantial effect sizes (Vaske, 2008).

Multiple logistic regression was used to model knowledge of venting methods and fish descending devices. For regression analyses, we report β values and standard errors, significance values, odd ratios, and the Nagelkerke R^2 .

For all analyses, differences were considered significant when $P < 0.05$.

Data Weighting

Sufficient data were not available in all 5 states to apply weighting procedures consistently. The MS Tails n' Scales app requires only the person reporting their catch be registered in the system. This is typically the boat owner and is skewed strongly towards males.⁵ In TX, the boat registration data does not include date of birth or gender and is also skewed towards males.⁶ Population-level reef angler data was available for AL, FL, and LA, so we applied a rake weighting procedure (age and gender), by state, and determined weighting would not alter study results in any meaningful way. Thus, the study data were not weighted.

⁵ Trevor Moncrief, MDMR, personal communication.

⁶ Based on observations of first names in the boat registration dataset.

Results

Response Rate and Demographics

Of the 45,119 surveys distributed, 955 were undeliverable and 6,277 individuals responded, which yielded a total response rate of 14.2%. By state, Mississippi had the highest response rate (37%) and Texas the lowest (9%) (Figure 1). The lower response rate in Texas was expected given boat ownership was used as a surrogate for reef anglers.

Because of limited prior knowledge of whether a person reef fished (e.g., possession of a reef permit does not mean a person reef fished), the following screener question was used to disqualify people who did not reef fish,

"Did you recreationally fish or operate a charter or head boat for reef fish (snapper, grouper, triggerfish, amberjack, etc.) in the Gulf of Mexico during 2021? For this survey, "reef" fishing includes fishing on natural and artificial reefs and fishing on wrecks".

Overall, 4,362 respondents indicated that they had reef fished in 2021 and over 600 responses per state was achieved (range = 654 to 1,087). Consequently, a non-response survey was not conducted. Likely because registration through Tails n’ Scales is mandatory and the agency communicates with anglers through the application, Mississippi had the highest percentage of respondents who reef fished (85%; Figure 1).

Most respondents identified as private recreational anglers (89%; n = 3,905), while 6% (n = 241) were in the state-licensed for-hire sector, and 5% (n = 216) were NOAA RCG permittees (Figure 2). Reported percentages by item can vary among variables, interactions, and crosstabulations because of item non-response.

Figure 1. Response rate and percent of respondents who indicated they reef fished in the Gulf of Mexico during 2021.

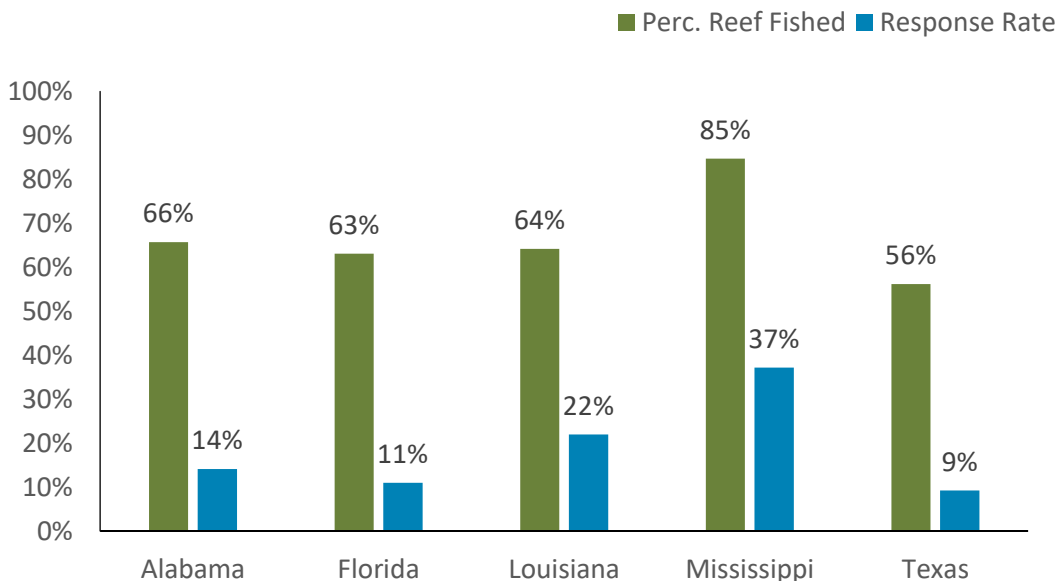
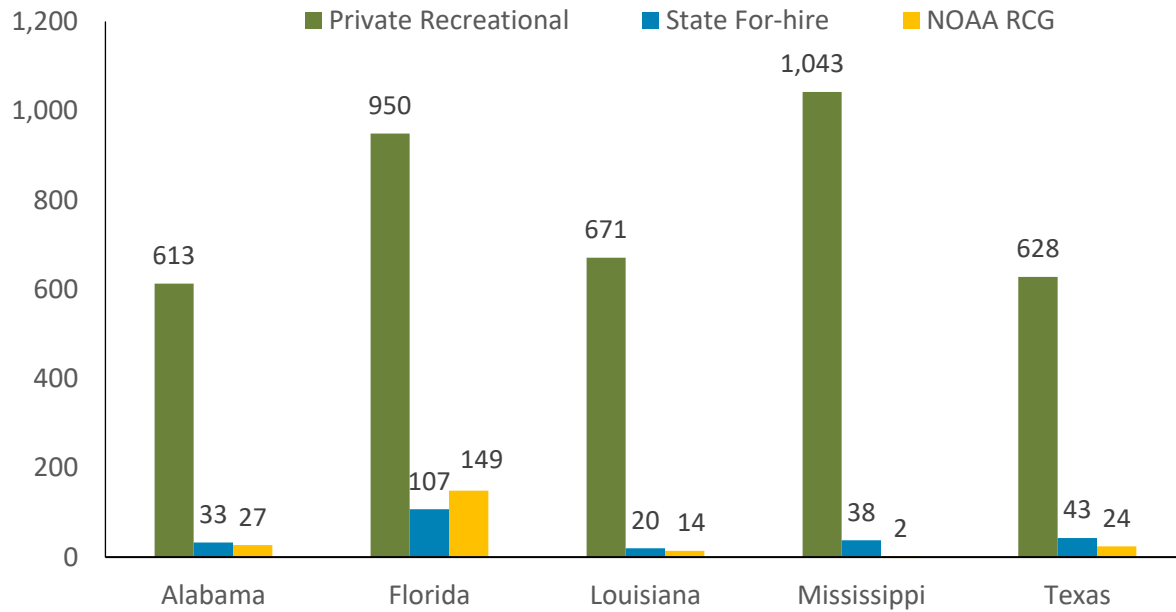


Figure 2. Number of respondents, by state and fishing sector, who indicated they reef fished in the Gulf of Mexico during 2021.



Most respondents were male (91%); MS (97%) and TX (96%) had the highest percentage of males, although it is important to note both datasets (MS: App users, TX: boat owners) were biased towards males. Male respondents in AL (89% sample vs. 70% population), FL (87% vs. 77%), and LA (85% vs. 74%) were slightly over-represented as compared to the license population. For-hire and NOAA RCG sector respondents were also mostly male (Table 2). Overall, respondents were also predominantly White/Caucasian (95%), with the highest percentage of Hispanic/Latino respondents in Texas (6.4%) and Florida (3.2%) (Table 3).

Table 2. Percent male respondents, by state and sector, 2021 reef angler survey.

State	Sector						Overall	
	Private Rec.		State For-hire		NOAA RCG		n	Perc. Male
	n	Perc. Male	n	Perc. Male	n	Perc. Male	n	Perc. Male
Alabama	431	89%	29	97%	20	95%	480	90%
Florida	616	84%	82	97%	127	98%	825	87%
Louisiana	426	84%	12	92%	11	100%	449	85%
Mississippi	942	97%	35	97%	2	100%	979	97%
Texas	485	96%	34	100%	18	95%	537	96%
Total	2,900	91%	192	97%	178	97%	3,448	91%
Statistical tests								
Chi-Square		124.0		2.11		1.24		108.2
<i>P</i>		<.001		0.715		0.872		<.001
Cramer's <i>V</i>		0.197		N/A		N/A		0.174

Table 3. Self-reported ethnicity of reef angler survey respondents, by state, all sectors combined.

State	White or Caucasian	Black or African American	Hispanic or Latino	American Indian	Asian	Native Hawaiian
Alabama	97%	0.2%	0.6%	1.4%	1.4%	0.2%
Florida	94%	0.7%	3.2%	0.9%	0.9%	0.6%
Louisiana	93%	1.6%	2.0%	1.0%	1.0%	0.4%
Mississippi	97%	0.8%	0.5%	0.4%	0.4%	0.3%
Texas	90%	1.2%	6.4%	1.0%	1.0%	0.2%
Total	95%	0.8%	2.3%	0.8%	0.8%	0.4%

The average age of all respondents was 50.4 years old. Among private recreational anglers, Texas respondents were the oldest ($\bar{X} = 56.2$) and Louisiana respondents were the youngest ($\bar{X} = 41.9$) ($F = 100.2$, $P < 0.001$, $\eta^2 = 0.331$). The age of Texas respondents was not surprising given boat owners were used as a surrogate for licensed reef anglers. Among sectors, NOAA RCG respondents were the oldest ($\bar{X} = 52.6$), followed by private recreational anglers ($\bar{X} = 50.0$) and state for-hire respondents ($\bar{X} = 48.7$). By state, there were no significant age differences for state for-hire or NOAA RCG respondents (Table 4). Overall, males were also significantly older than females ($\bar{X} = 50.4$ vs. 46.4; $t = 5.09$, $P < 0.001$, Cohen's $d = 0.297$) (Figure 3).

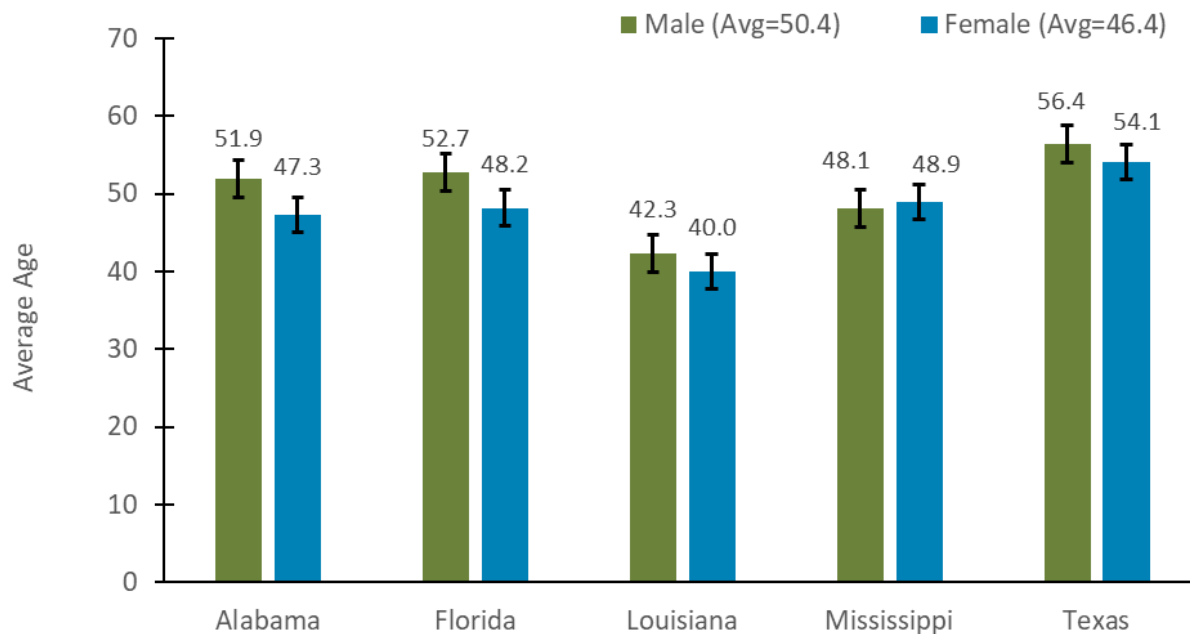
Table 4. Average ages (male and female combined) by state and fishing sector, 2021.

State	Sector						Overall	Avg. Age
	Private Rec.		State For-hire		NOAA RCG			
	n	Avg. Age	n	Avg. Age	n	Avg. Age	n	
Alabama	493	51.6	30	49.0	24	50.0	547	51.9
Florida	755	52.3	86	50.0	131	52.8	972	52.7
Louisiana	516	41.7	13	44.4	11	50.9	540	42.3
Mississippi	981	48.3	36	44.2	2	41.0	1,019	48.1
Texas	515	56.4	34	51.6	20	56.9	569	56.4
Total	3,260	50.0	199	48.7	188	52.6	3,647	50.4

Statistical tests

F	100.2	1.97	1.47	101.8
P	<.001	0.101	<0.001	<.0001
Eta	0.331	N/A	0	0.317

Figure 3. Average age of respondents, by gender and state, 2021.



Reef Fishing Experience

NOAA RCG respondents had the most reef fishing experience (\bar{X} = 25.4 years); there were no differences in experience among the 5 Gulf states (F = 0.443, P = 0.777). State-licensed for-hire respondents averaged 18.2 years of experience, and there were no differences among the 5 Gulf states (F = 2.31, P = 0.059). Private recreational anglers averaged 15.3 years of reef fishing experience, which varied considerably among states, with LA respondents averaging the fewest number of years (\bar{X} = 9.5) and TX anglers the most (\bar{X} = 21.7; F = 73.3, P < 0.001) (Table 5, Figure 4).

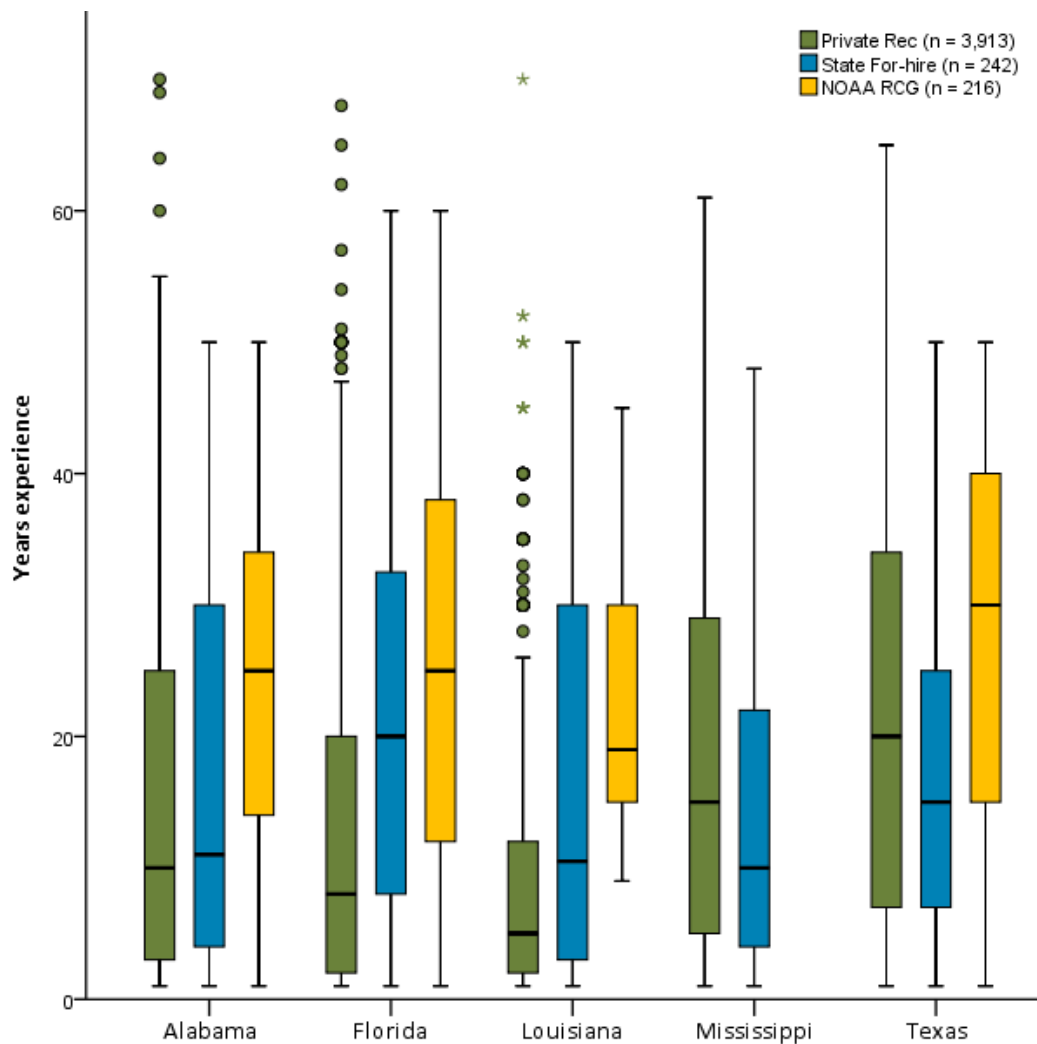
Table 5. Average years of reef fishing experience, by sector and state, 2021.

State	Sector						Overall n	Avg. Exp.
	Private Rec.		State For-hire		NOAA RCG			
	n	Avg. Exp.	n	Avg. Exp.	n	Avg. Exp.		
Alabama	613	15.4	33	17	27	23.9	673	15.8
Florida	950	12.8	107	21.2	149	25.9	1,206	15.2
Louisiana	671	9.5	20	15.7	14	22.9	705	10
Mississippi	1,043	17.3	38	13.8	2	15	1,083	17.2
Texas	628	21.7	43	16.8	24	26.4	695	21.6
Total	3,905	15.3	241	18.2	216	25.4	4,362	16.0

Statistical tests

F	73.3	2.31	0.448	59.4
P	<.001	0.059	0.774	<.001
Eta	0.267	N/A	N/A	0.229

Figure 4. Box plot of average years of reef fishing experience, by sector and state, 2021.



Reef Fishing Behavior

Private recreational anglers were asked what type of boat they used to reef fish. A majority (65%) fished from a boat they owned, followed by a boat they do not own (28%), a guided charter boat (5.5%), and finally a head/party boat (0.8%). Mississippi (87%) and TX (84%) anglers indicated they most often fished from their own boat, which is not surprising given the sampling frames for those states. Louisiana anglers were least likely to fish from their own boat (41%) and about half of FL (54%) and AL (52%) fished from their own boat. A small percentage of private anglers fished from a charter boat (5.5%) or head/party boat (0.80%) (Figure 5). Since boat owners were used as a surrogate for licensed anglers in Texas, those respondents were asked how many people, on average, reef fished on their boat, including them.⁷ For private recreational anglers, an average of 3.7 anglers were on the boat; as expected charter boats ($\bar{X} = 4.8$) and head/party boats ($\bar{X} = 20$) carried (on average) more anglers (Table 6).

Figure 5. Type of boat that private anglers used to target reef fish, by state.

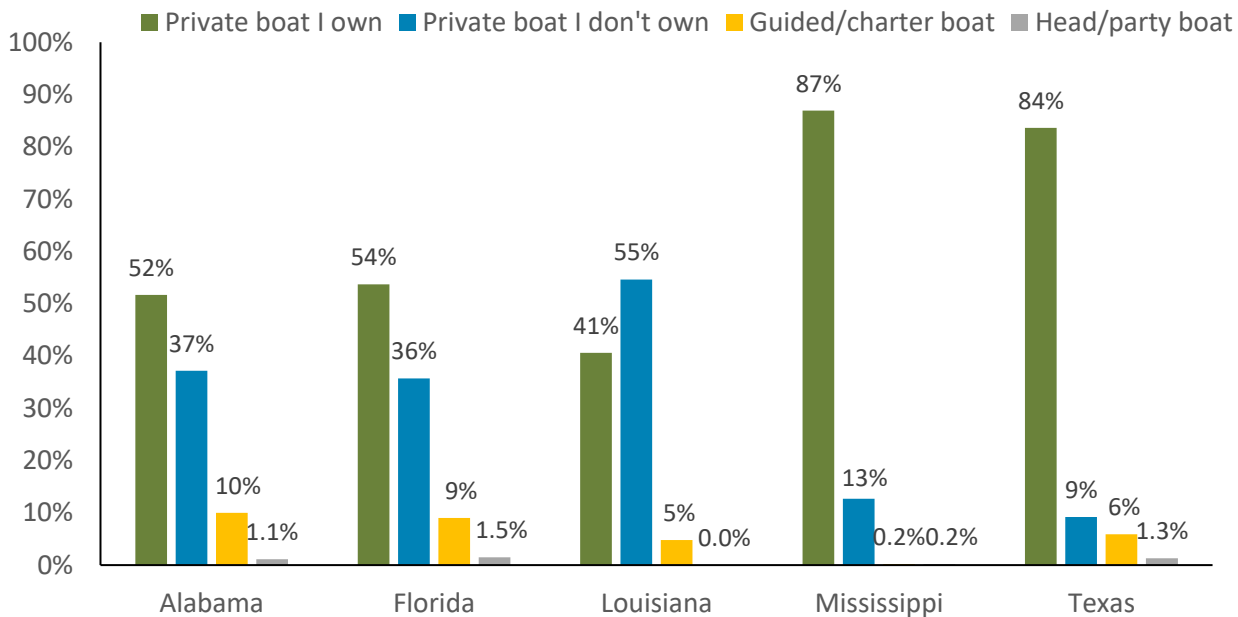


Table 6. Average number of private recreational anglers reef fishing with Texas respondents, 2021.

Boat type	n	Mean	Min	Max	Std. Dev.
Private boat that I own	494	3.65	1	10	1.24
Private boat that I do not own	61	4.02	2	7	1.10
<i>Private boat (ownership combined)</i>	555	3.69	1	10	1.23
Guided/charter boat	26	4.77	2	15	2.63
Head/party boat	8	20	20	20	0

⁷ This question was asked so the Return 'Em Right program could assess how many anglers they might reach by focusing outreach efforts on boat owners. The question was asked of all respondents who indicated they launched from Texas.

The 2021 Gulf of Mexico reef fishing seasons varied considerably by species and state, as indicated simply by the red snapper seasons:

- **Alabama.** Every Friday, Saturday, Sunday, and Monday started on May 28, 2021, and closed on December 27, 2021.
- **Florida.** June 4 to July 28. Applies to Florida's state waters in the Gulf of Mexico.
- **Louisiana.** Every Friday, Saturday, and Sunday starting May 28, plus Memorial Day (May 31) and Labor Day (September 6). Season closed on September 7 but reopened from September 23 - December 31, 2021.
- **Mississippi.** Every day from May 28 – July 5, August 6 – 8, August 13 to September 6, and October 1 – November 21, 2021.
- **Texas.** Every day from January 1 until November 15, 2021.
- **Gulf (Federal).** Every day from June 1 - August 3, October 15 - November 6, 2021.

Recognizing the inherent variation that exists among the states, respondents were asked how often they reef fish in a 'typical' season. As expected, fishing frequency varied depending on fishing sector. Private recreational anglers tended to fish a few times a season (62%) or a few times a month (23%). Conversely, state for-hire tended to fish a few times a week (31%) or a few times a month (22%). As expected, NOAA RCG anglers fished daily or a few times a week (38% each) (Table 7).

Table 7. Reef fishing frequency, by state and sector, 2021.

Sector	Fish Frequency	State											
		Alabama		Florida		Louisiana		Mississippi		Texas		Total	
		n	Perc	n	Perc	n	Perc	n	Perc	n	Perc	n	Perc
Private Rec.													
	A few times a season	342	60%	552	63%	502	80%	544	53%	353	58%	2,293	62%
	Once a month	27	5%	83	9%	39	6%	75	7%	55	9%	279	8%
	A few times a month	150	26%	179	20%	66	11%	322	31%	153	25%	870	23%
	Once a week	27	5%	33	4%	13	2%	62	6%	25	4%	160	4%
	A few times a week	23	4%	33	4%	10	2%	29	3%	18	3%	113	3%
	Daily	1	0%	2	0%	1	0%	1	0%	0	0%	5	0%
	Total	570		882		631		1,033		604		3,720	
State For-hire													
	A few times a season	9	29%	18	18%	11	58%	11	29%	10	25%	59	26%
	Once a month	0	0%	2	2%	0	0%	0	0%	1	3%	3	1%
	A few times a month	3	10%	14	14%	7	37%	13	34%	14	35%	51	22%
	Once a week	3	10%	5	5%	0	0%	1	3%	0	0%	9	4%
	A few times a week	8	26%	41	41%	1	5%	10	26%	10	25%	70	31%
	Daily	8	26%	21	21%	0	0%	3	8%	5	13%	37	16%
	Total	31		101		19		38		40		229	
NOAA RCG													
	A few times a season	0	0%	2	1%	2	14%	0	0%	2	9%	6	3%
	Once a month	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	A few times a month	4	16%	23	16%	3	21%	0	0%	2	9%	32	15%
	Once a week	1	4%	8	5%	1	7%	0	0%	3	13%	13	6%
	A few times a week	3	12%	58	40%	7	50%	1	50%	11	48%	80	38%
	Daily	17	68%	56	38%	1	7%	1	50%	5	22%	80	38%
	Total	25		147		14		2		23		211	

Like reef fishing frequency, the depth that people fish is dependent on a variety of factors, including boat size and type, targeted species, fish locations, distance from shore, and how often anglers simply change depths. Attempting to learn precisely what depths were fished would have resulted in a complicated ranking exercise that would have negatively impacted response rates. Consequently, respondents were presented a generalized question, and were asked to select one option,

"When fishing for reef fish in the Gulf of Mexico, what is your most often targeted range of fishing depth? We recognize that people may fish at different depths on the same trip. We would like to know the depth range you fish most often."

The depth respondents fished most often was dependent on where they launched and to a lesser extent, their fishing sector. Anglers who fished in deeper water tended to launch from areas where deep water was closer to shore (Figure 6). Among the private recreational anglers, nearly 60% of FL respondents fished in less than 60 feet of water. The exception was Panhandle respondents, who fished from deeper water. Conversely, Louisiana and Texas anglers fished deeper than other recreational respondents (Figure 7, panel a). Although sample sizes for the state for-hire and NOAA RCG sectors are smaller, they tended to fish in deeper water than private recreational anglers, regardless of state (Figure 7, panels b, c). Most important, except for Florida private recreational anglers, a majority of respondents fished in water deeper than 60 feet (Table 8).

Table 8. Percent of respondents who fish in water deeper than 60 feet, by angler sector.

State	Private Recreational		State For-hire		NOAA RCG	
	n	>60 feet	n	>60 feet	n	>60 feet
Alabama	405	71%	24	75%	27	93%
Florida	366	42%	66	65%	145	87%
Louisiana	456	73%	12	63%	14	86%
Mississippi	756	74%	27	73%	2	50%
Texas	432	72%	29	74%	24	83%
	2,415	65%	158	69%	212	87%

Figure 6. Gulf of Mexico depth contours.

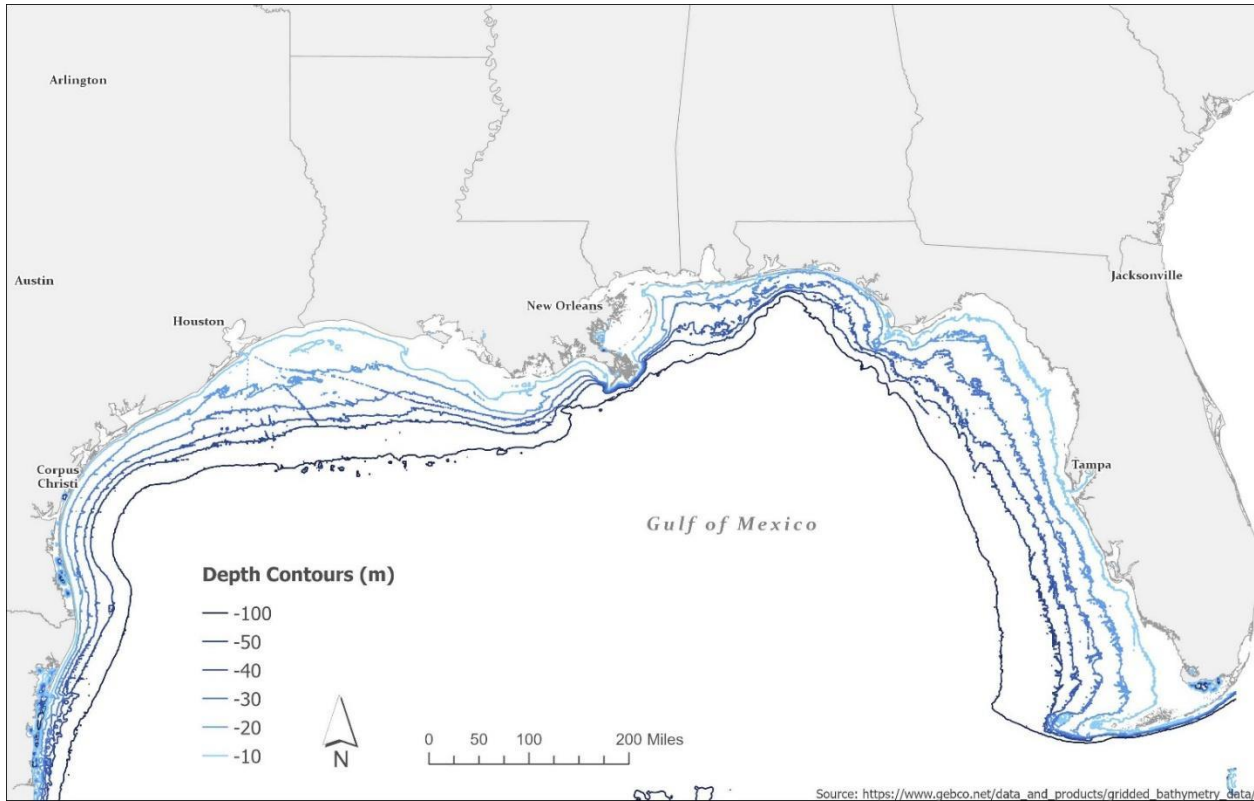
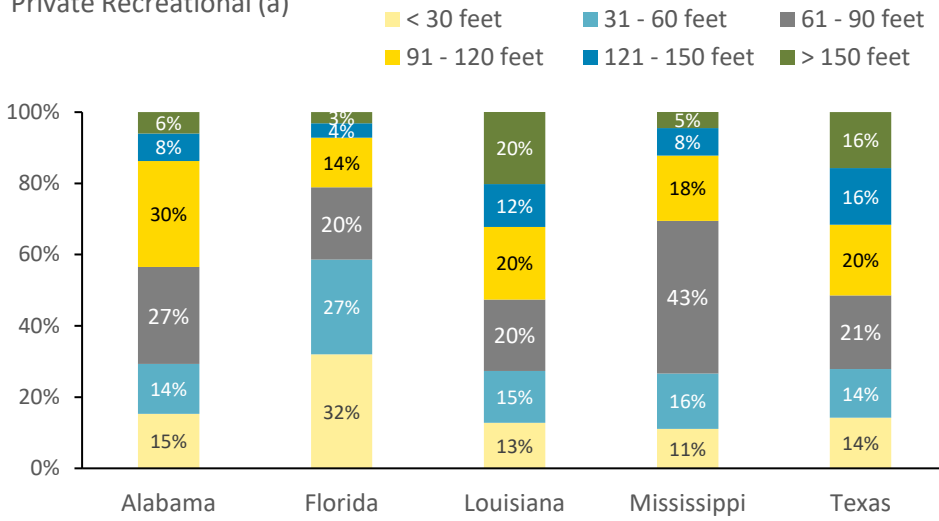
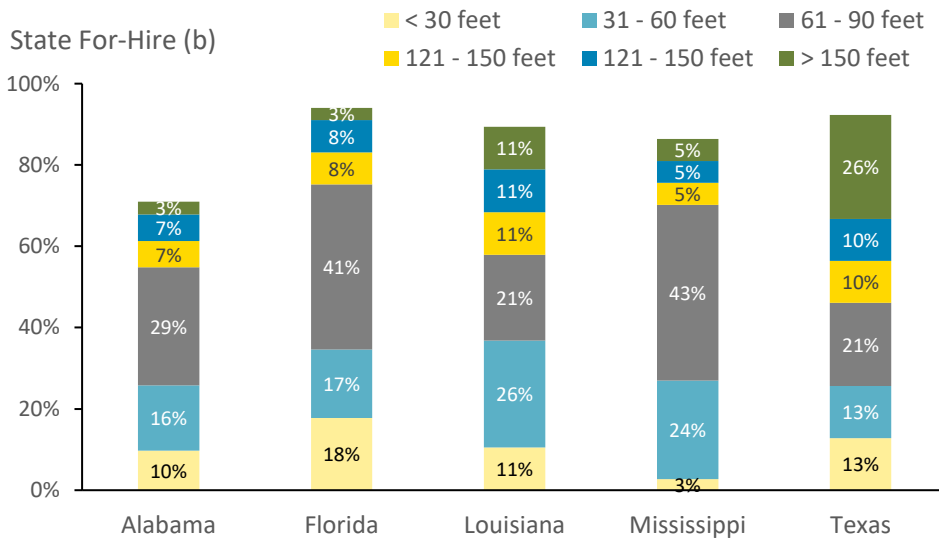


Figure 7. Depth fished most often by recreational (a), state for-hire (b), and NOAA RCG (c) reef fishing sectors, 2021. Mississippi was not included in NOAA RCG sector because n = 2.

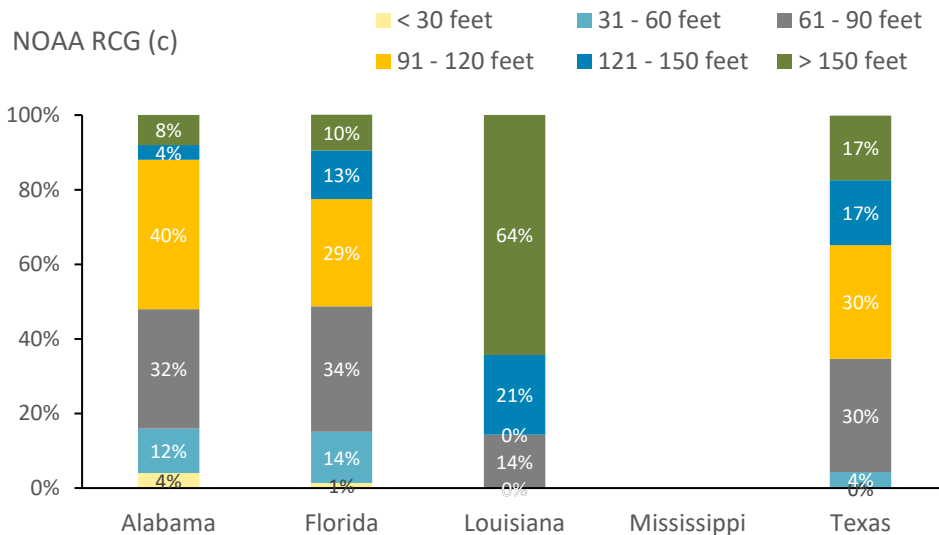
Private Recreational (a)



State For-Hire (b)



NOAA RCG (c)



Knowledge of Barotrauma Symptoms

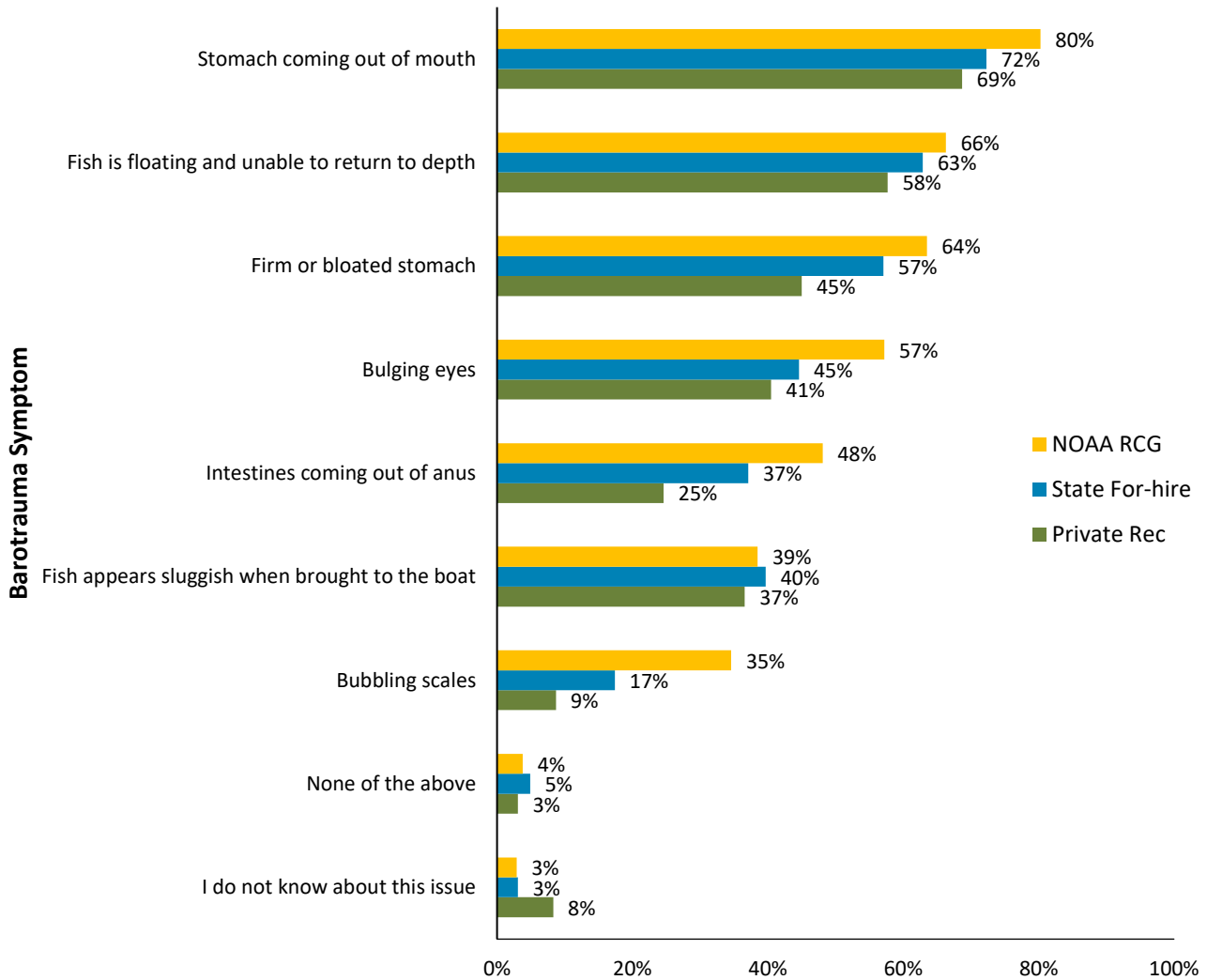
Knowledge of barotrauma and best release practices was assessed using three questions related to 1) recognizing the symptoms, 2) awareness of best release practices (as described in the Methods), and 3) how often they used best release practices. For individuals who vented fish, the type of tool they most often used was also asked.

Respondents were posed the question, “Which of the following signs do you use to recognize that a fish may need help returning to depth? Please check all that apply”. Overall, over 90% of respondents recognized at least one of the seven presented barotrauma symptoms. NOAA RCG and state for-hire anglers (97% each) were most likely to recognize at least one symptom as compared to private recreational anglers (92%; $\chi^2 = 15.09$, $P = 0.002$, Cramer’s $V = 0.061$). In nearly all cases, a higher percentage of NOAA RCG respondents recognized barotrauma symptoms (Table 9). The stomach coming out of the mouth (69% to 80%), fish floating on the surface (58% to 66%), and firm/bloated stomach (45% to 64%) were noted most often, while bubbling scales (35%) was noted least often (Figure 8). There were no state-level differences between the state for-hire or NOAA RCG sectors for any of the 7 symptoms (Chi-square test, $P > 0.05$ in all cases).

Table 9. Barotrauma symptoms recognized by Gulf of Mexico reef angler respondents, by fishing sector.

Barotrauma Symptom	Private Rec	State For-hire	NOAA RCG	Chi-square (χ^2)	P	Cramer's V
Stomach coming out of mouth	69%	72%	80%	13.3	<0.001	0.057
Fish is floating and unable to return to depth	58%	63%	66%	8.03	0.018	0.044
Firm or bloated stomach	45%	57%	64%	37.5	<0.001	0.096
Bulging eyes	41%	45%	57%	23.5	<0.001	0.076
Intestines coming out of anus	25%	37%	48%	69.6	<0.001	0.130
Fish appears sluggish when brought to the boat	37%	40%	39%	1.11	n.s.	
Bubbling scales	9%	17%	35%	152.4	<0.001	0.193
None of the above	3%	5%	4%	2.45	n.s.	
I do not know about this issue	8%	3%	3%	15.1	<0.001	0.061

Figure 8. Barotrauma symptoms recognized by Gulf of Mexico reef angler respondents, by fishing sector.



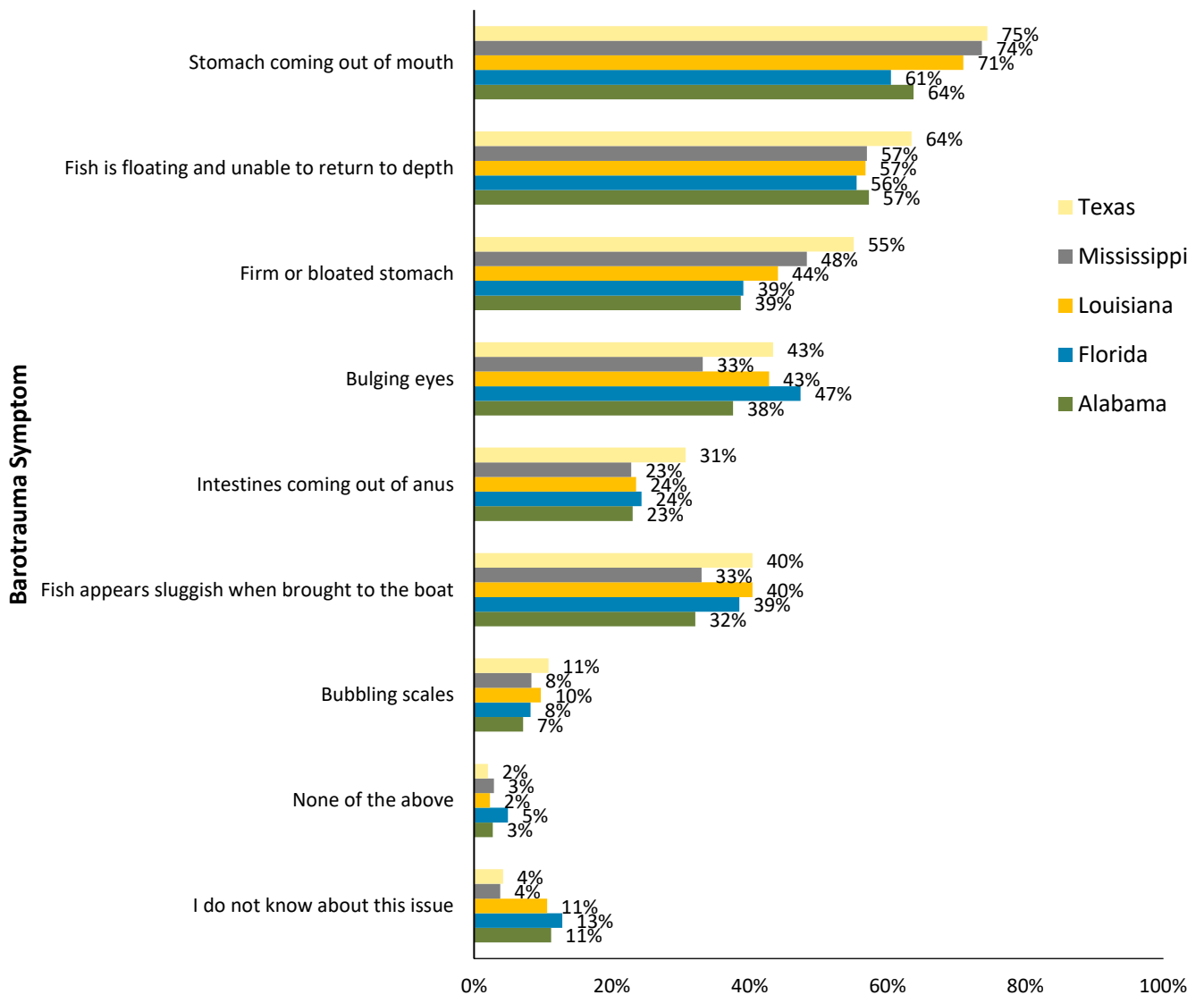
Conversely, there were differences among the private recreational sector for the 5 Gulf states. Overall, 8% of respondents (range = 4% to 11%) were not aware of symptoms related to returning fish to depth. Of the 7 symptoms presented, only ‘bubbling scales’ was not statistically significant (Table 10). Graphically, a pattern emerges in that TX and MS were generally more aware of symptoms, as compared to AL, FL, and LA respondents (Figure 9).

Table 10. Barotrauma symptoms recognized by recreational respondents, by state.

Barotrauma Symptom	State (Private Recreational anglers only)					Total
	Alabama	Florida	Louisiana	Mississippi	Texas	
Stomach coming out of mouth*	64%	61%	71%	74%	75%	69%
Fish is floating and unable to return to depth*	57%	56%	57%	57%	64%	58%
Firm or bloated stomach*	39%	39%	44%	48%	55%	45%
Bulging eyes*	38%	47%	43%	33%	43%	41%
Fish appears sluggish when brought to the boat*	32%	39%	40%	33%	40%	37%
Intestines coming out of anus*	23%	24%	24%	23%	31%	25%
Bubbling scales	7%	8%	10%	8%	11%	9%
I do not know about this issue*	11%	13%	11%	4%	4%	8%
None of the above*	3%	5%	2%	3%	2%	3%

*Significant chi-square result at the $P < 0.05$ level.

Figure 9. Barotrauma symptoms recognized by private recreational angler respondents, by state.



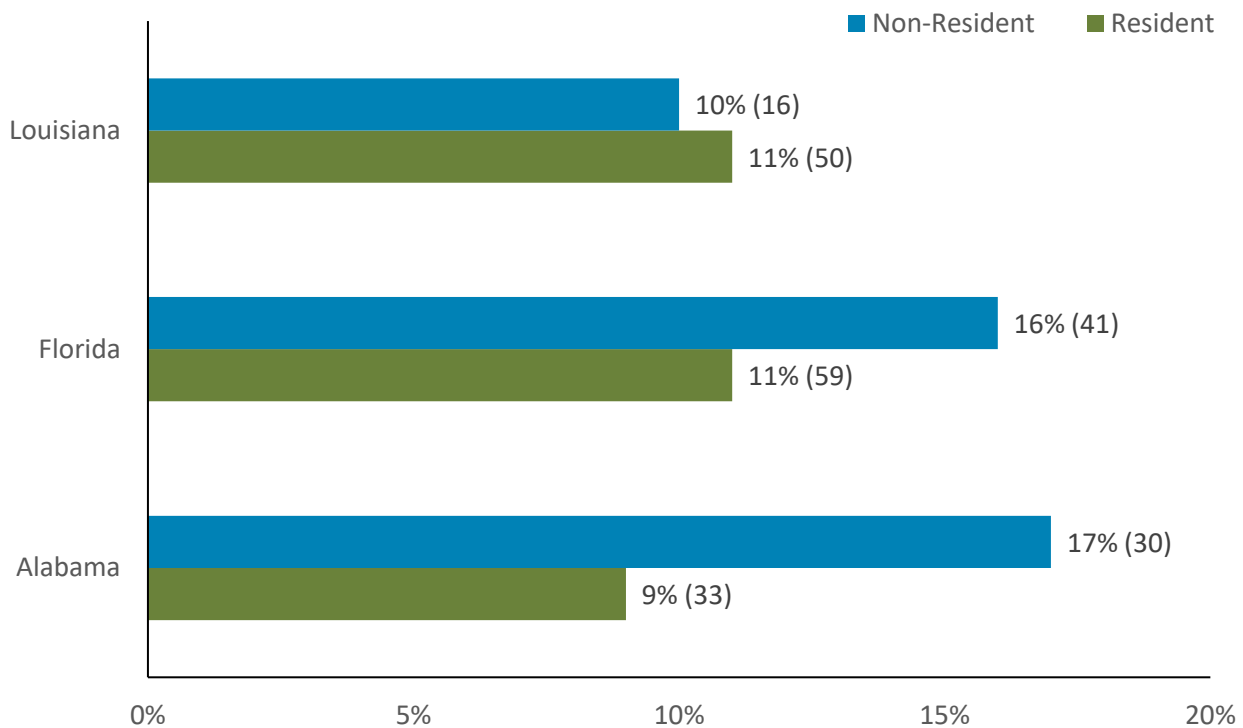
Breakdown of knowledge about barotrauma symptoms

One important factor of an effective outreach campaign is the ability to deliver pertinent content to the right audience. In AL, LA, and FL, lack of knowledge about barotrauma exceeded 10% and while that is a low percentage, only 4% of MS and TX responded similarly. Because state, residency status, and strata-level data were available for AL, FL, and LA, crosstabs were used to examine where those knowledge insufficiencies potentially exist. The results below are only for individuals in AL, FL, and LA who indicated they did not know about symptoms related to returning fish to depth. Although sample sizes get smaller as the data are parsed, some patterns developed with respect to barotrauma knowledge.

Residency⁸ status and Florida-specific strata

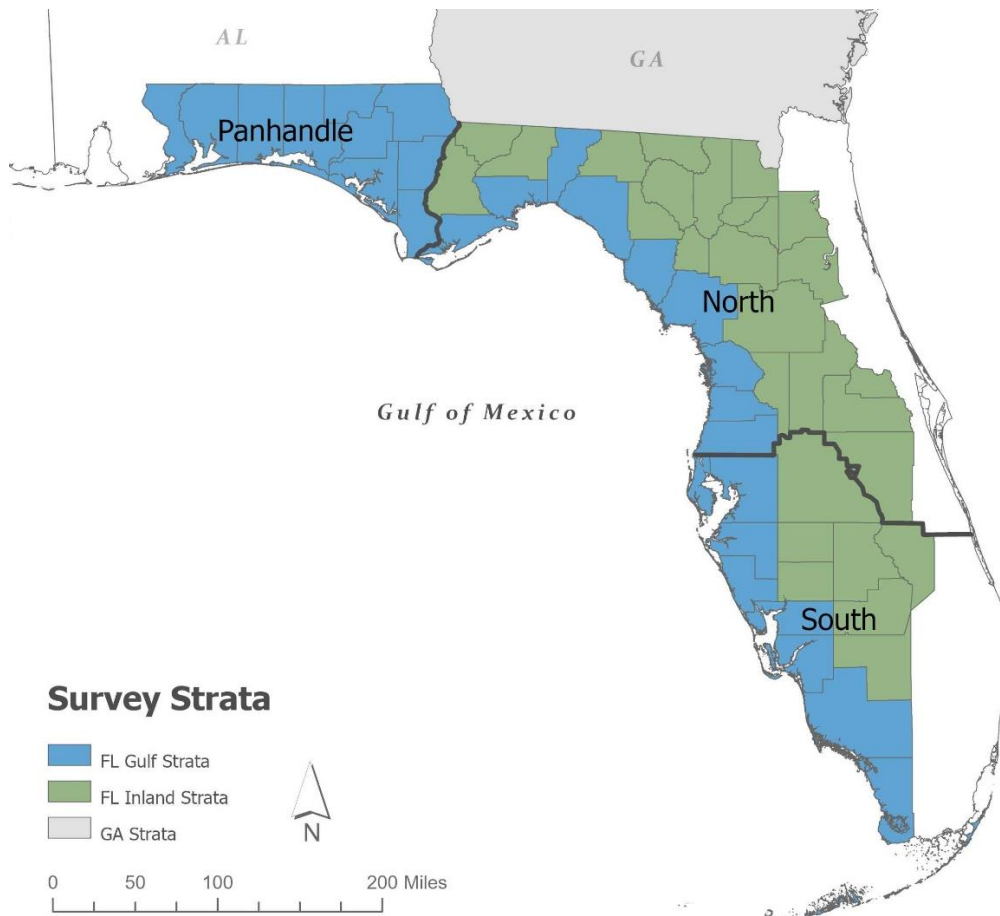
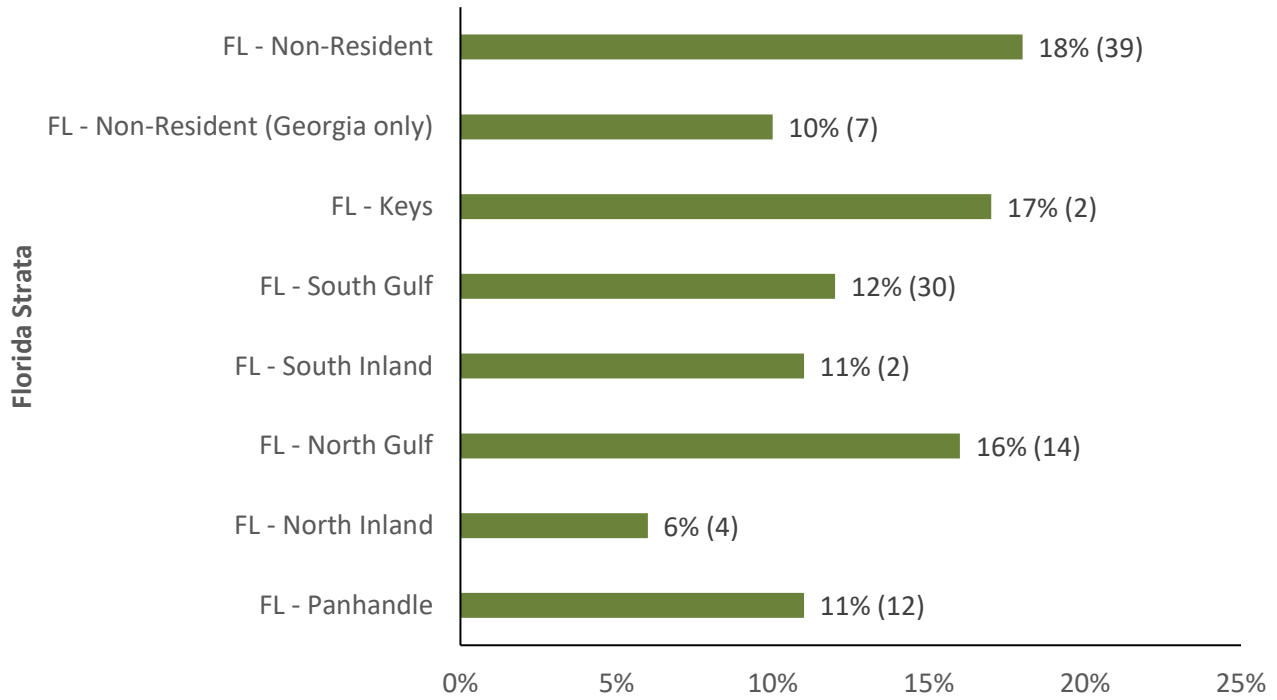
A much higher percentage of AL and FL non-residents were not aware of the issues related to returning fish to depth (Figure 10). For Florida, sample sizes were small; however, there were no statistical differences among their strata, although the highest percentage of respondents who were unaware of barotrauma symptoms were non-residents, outside of Georgia (18%) (Figure 11).

Figure 10. Graph of state and residency status for the percentage and number of individuals who were not aware of symptoms related to returning fish to depth.



⁸ Residency status was available for Alabama, Florida, and Louisiana.

Figure 11. Graph of Florida survey strata for the percentage and number of individuals who were not aware of symptoms related to returning fish to depth.



Reef fishing-specific variables

Most respondents know at least 1 symptom of barotrauma. However, respondents who fished once a month to a few times a season were significantly less knowledgeable about barotrauma symptoms, than those who fished more frequently ($\chi^2 = 358.57, P < 0.001, \text{Cramer's } V = 0.147$) (Figure 12). By state, 74% (AL = 63%, FL = 72%, LA = 87%) of anglers fished infrequently, and 13% of those individuals were not aware of barotrauma symptoms (Table 11, Figure 12). Since most respondents from these three states fish infrequently, there is potentially a large pool of anglers who would benefit from an outreach campaign.

Figure 12. Number of private recreational respondents and their reef fishing frequency and awareness of at least 1 symptom related to returning fish to depth.

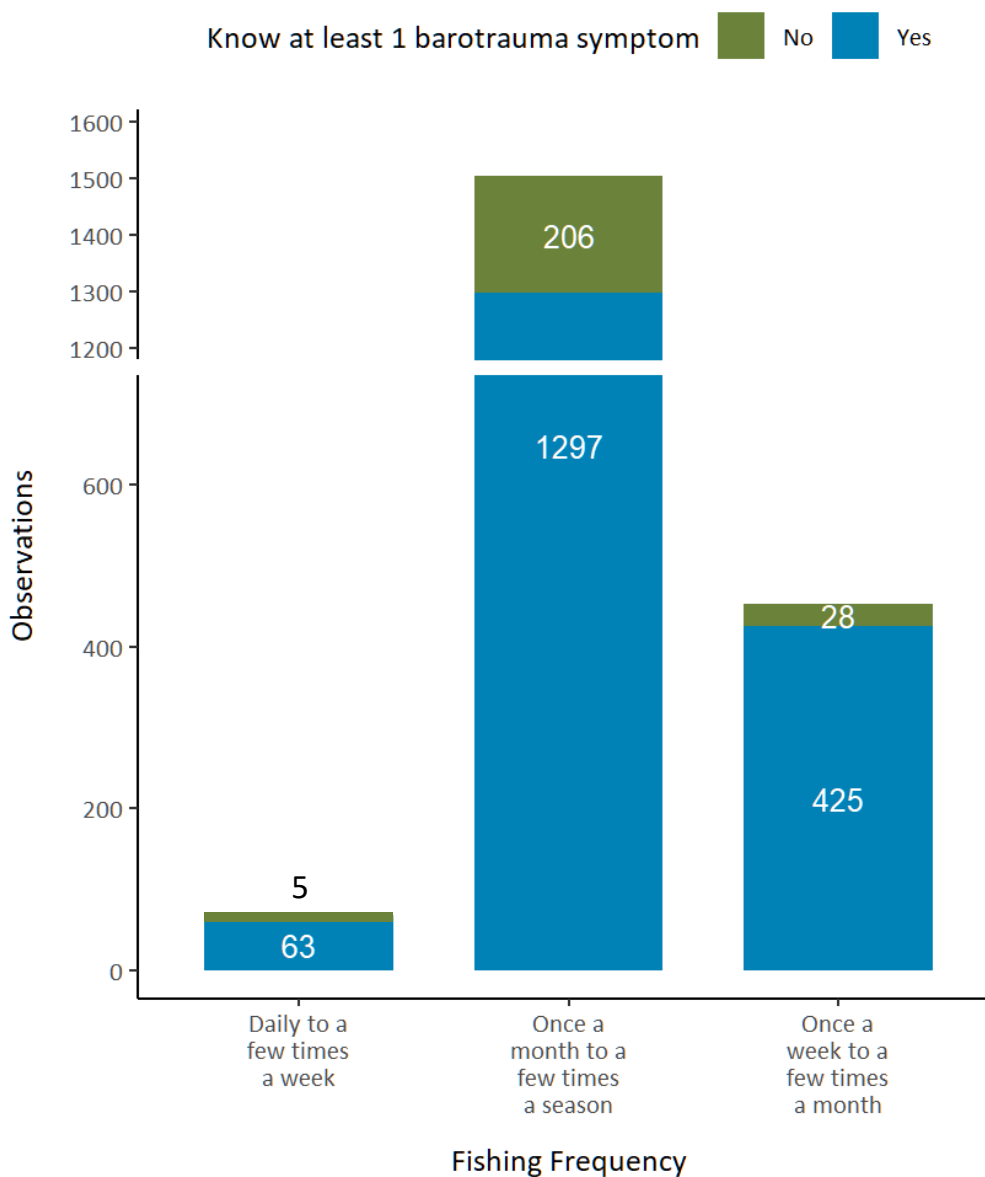


Table 11. Reef fishing frequency of private recreational anglers, percentage who were not aware of barotrauma, and overall percentage of the recreational angling sector who may not be aware of symptoms related to returning fish to depth.

Fishing Frequency / State	Perc. of all Anglers	Perc. not aware of symptoms	Overall perc. of anglers not aware
Once a month to a few times a season			
Alabama	63%	14%	9%
Florida	72%	14%	10%
Louisiana	87%	12%	11%
Overall	74%	13%	10%
Once a week to a few times a month			
Alabama	33%	2%	1%
Florida	24%	9%	2%
Louisiana	12%	4%	1%
Overall	23%	6%	1%
Daily to a few times a week			
Alabama	5%	7%	0.4%
Florida	4%	9%	0.3%
Louisiana	2%	0%	0.0%
Overall	3%	7%	0.2%

Similarly, almost half of respondents (47%) had 1 – 5 years of experience and they were much more likely to not know about barotrauma symptoms, as compared to people with more experience (Figure 13). This also represents a potentially large pool of reef anglers who would benefit from an outreach program.

Respondents who fished most often in less than 60 feet of water were most likely to not know about barotrauma symptoms (37%; Figure 14). Although sample sizes were small, the same pattern was present for all three states (Figure 15).

Figure 13. Percentage and number of individuals and their reef fishing experience, who were not aware of symptoms related to returning fish to depth.

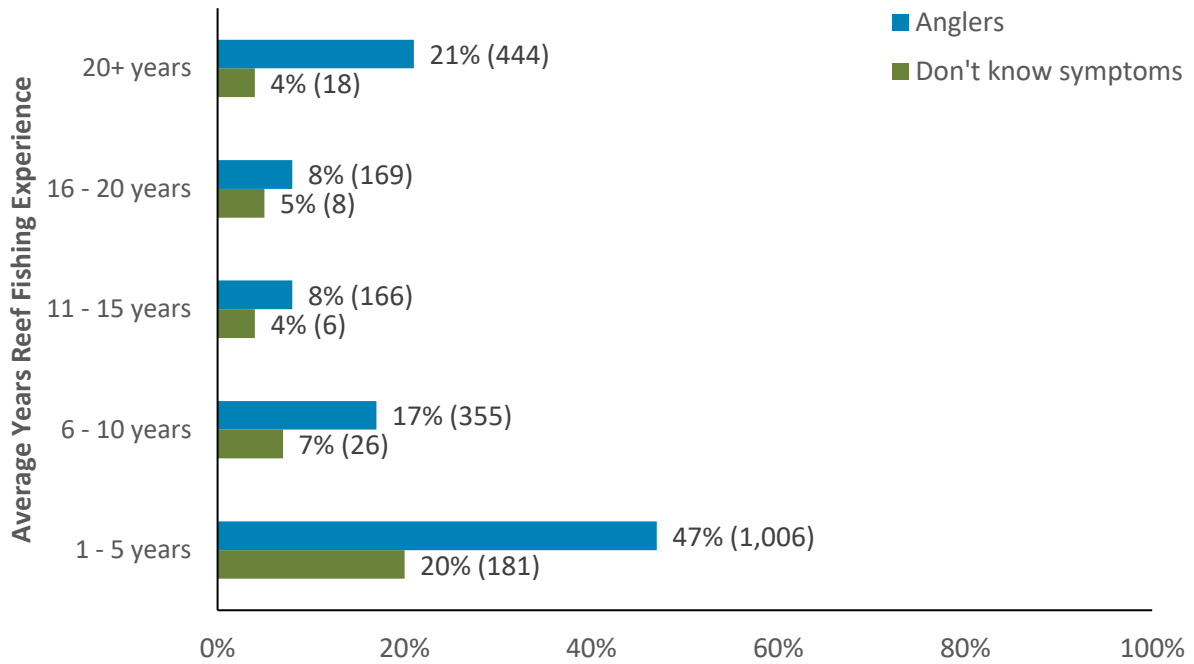


Figure 14. Percentage and number of individuals and depth fished most often, who were not aware of symptoms related to returning fish to depth.

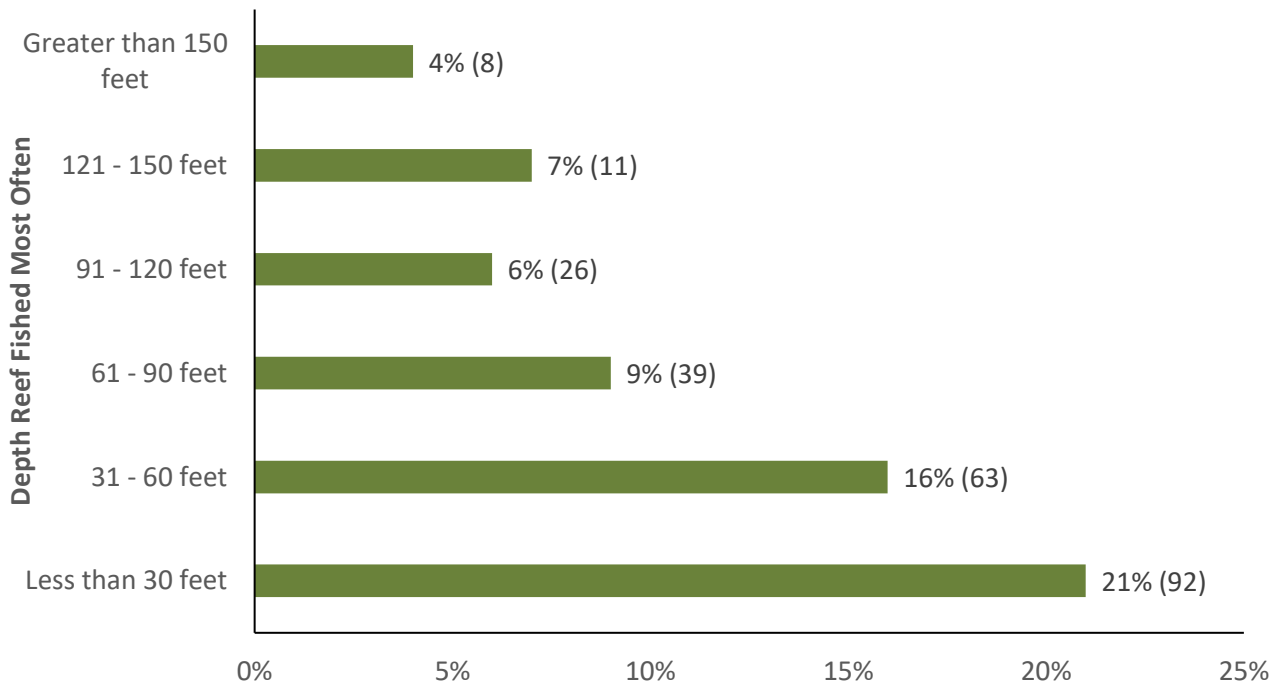
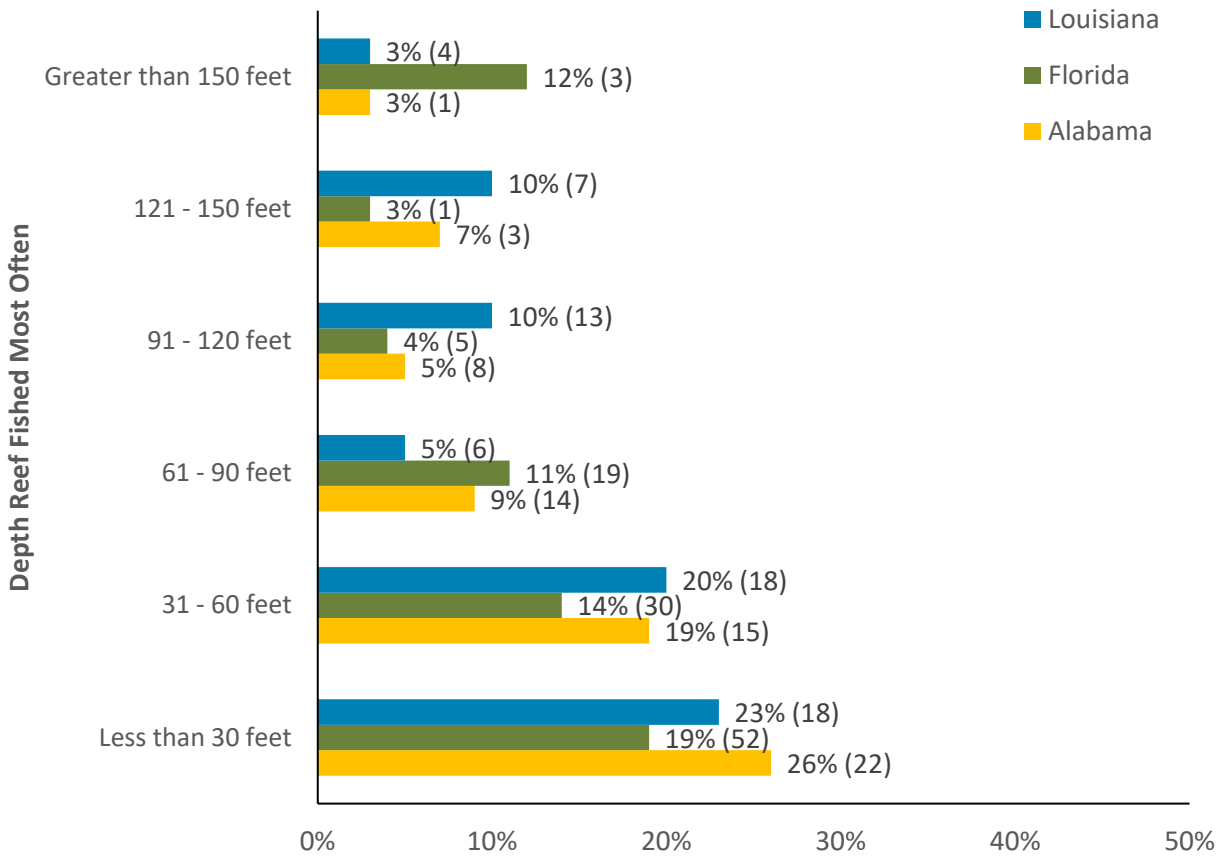
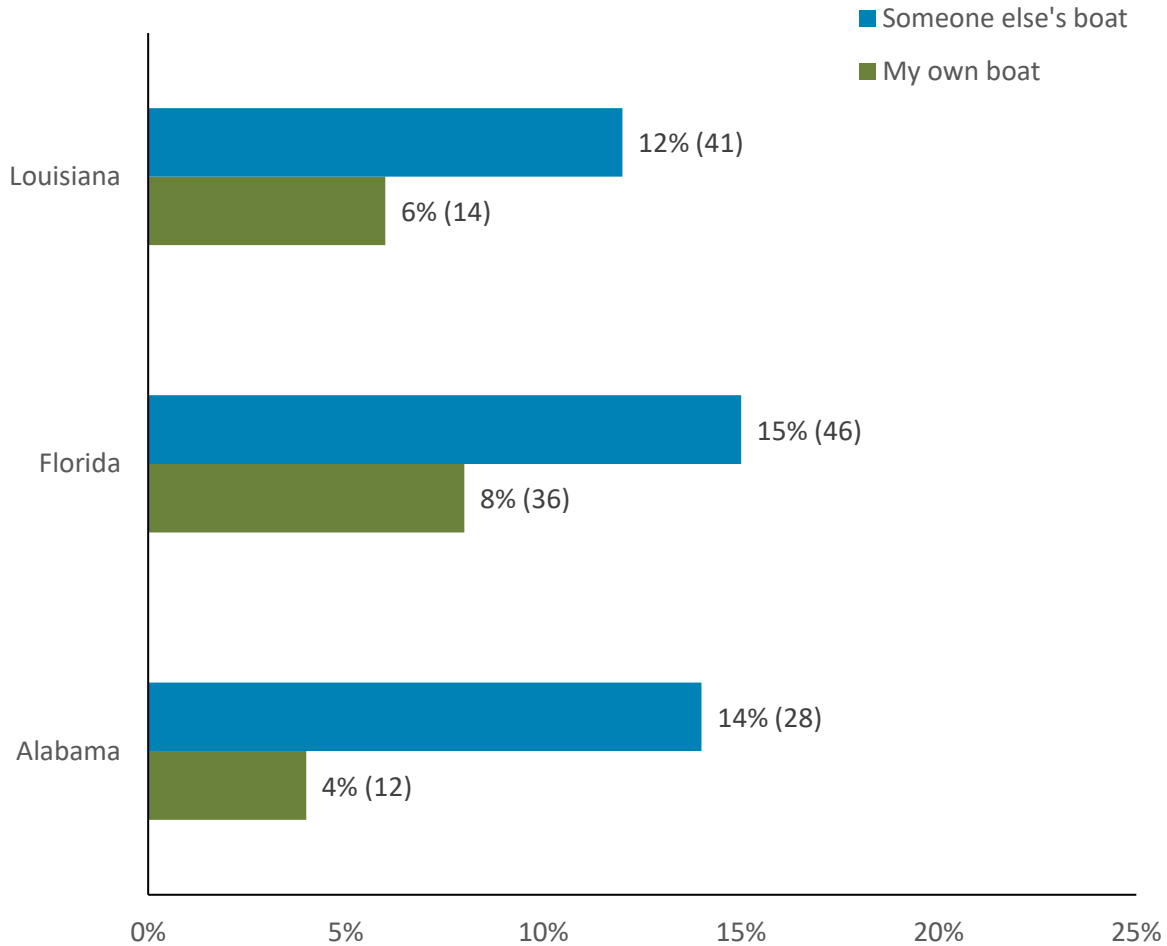


Figure 15. Percentage and number of individuals and depth fished most often, by state, who were not aware of symptoms related to returning fish to depth.



A high percentage of AL (48%), LA (59%), and FL (46%) private recreational anglers fished from a boat they did not own. Those individuals were twice as likely (14% vs 6.5%) to not know about barotrauma symptoms, and those trends were independent of state ($\chi^2 = 38.28, P < 0.001, \text{Cramer's } V = 0.146$) (Figure 16).

Figure 16. Percentage and number of individuals and whether/not they fished from their own boat, by state, who were not aware of symptoms related to returning fish to depth.



Knowledge of Best Release Protocols

To establish the baseline awareness of best release practices, respondents were asked the question, “Are you aware of the following reef fish handling protocols? Please check the box for each of the protocols you are familiar with (even if you don't use them)”. Overall, (95%) of respondents were aware of at least one of the nine protocols presented. NOAA RCG (99.5%) and state for-hire (97%) were the most aware, followed by private recreational anglers (94%; $\chi^2 = 14.30$, $P = 0.003$, Cramer’s $V = 0.060$). Of note is the effect size was small, which indicates no real practical difference.

Overall, NOAA RCG respondents had the highest awareness for six of the nine protocols, followed by state for-hire, and private recreational respondents (Table 12). Of note, there were notable differences the NOAA RCG and private recreational sectors for venting methods⁹ (92% vs. 71%) and fish descending devices (59% vs. 32%).

Table 12. Awareness of best fish handling protocols, by sector (sorted by NOAA RCG sector).

Best Management Practice	Sector			Overall
	Private Rec	State For-hire	NOAA RCG	
Venting methods	71%	84%	92%	73%
Dehooking devices	77%	87%	88%	79%
Minimize fish handling	74%	78%	81%	74%
Non-stainless steel circle hooks	66%	69%	79%	67%
Change fishing locations	47%	62%	65%	49%
Cut the line	55%	61%	60%	55%
Descending devices	32%	48%	59%	35%
Rubberized landing nets	36%	49%	32%	37%
Hold the fish horizontally	25%	32%	30%	26%

Among the private recreational sector, over 70% of respondents were aware of dehooking devices (77%), minimizing fish handling (74%), or venting methods (71%). A much lower percentage of these respondents knew about rubberized landing nets (36%), fish descending devices (32%), or to hold the fish horizontally (25%) (Table 13). Although there were statistical differences across all five states (Table 14); graphically, there were small practical differences (Figure 17).

Of note, the option “Throw the fish up in the air or hard against the surface to get them back to depth” was presented to respondents. Overall, 12% of NOAA RCG, 6.4% of state for-hire, and 4% of private recreational respondents had heard this was a practice used to return fish to depth. For those who were aware of the practice, 67% of all respondents indicated they did it at least sometimes.

⁹ Between 2008-2013, venting and release tools were required in the Gulf of Mexico reef fish fishery.

Table 13. Awareness of reef fish best handling protocols for the private recreational sector, by state.

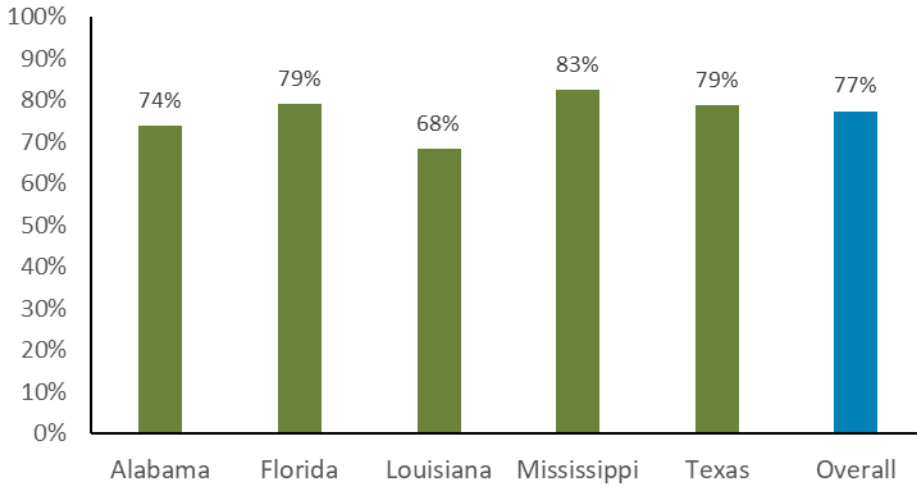
Best Practice	State					Overall
	Alabama	Florida	Louisiana	Mississippi	Texas	
Dehooking devices	74%	79%	68%	83%	79%	77%
Minimize handling	69%	79%	65%	74%	81%	74%
Vent methods	69%	60%	65%	82%	78%	71%
Non-stainless steel circle hooks	64%	64%	55%	72%	70%	66%
Cut the line	47%	64%	47%	55%	57%	55%
Change fishing locations	54%	49%	47%	45%	41%	47%
Rubberized landing nets	30%	35%	37%	41%	35%	36%
Fish Descending Devices	26%	35%	33%	30%	38%	32%
Hold the fish horizontally	20%	32%	26%	20%	27%	25%

Table 14. Statistical differences in awareness of best handling protocols for the private recreational sector, by state.

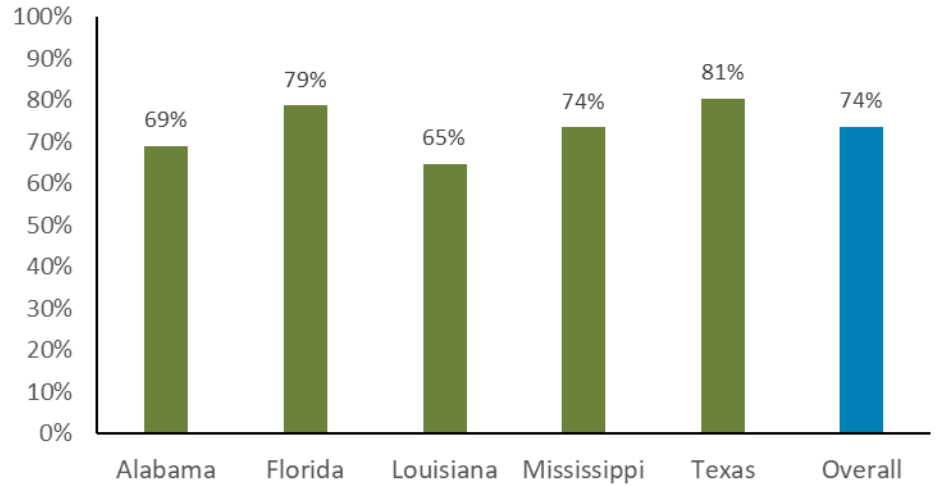
Best Handling Protocol	Chi-square	<i>P-value</i>	Cramer's <i>V</i>
Take efforts to minimize the handling of fish	56.07	0.001	0.125
Use descending devices	23.45	0.001	0.081
Use venting method	135.37	0.001	0.194
Use dehooking devices	49.99	0.001	0.118
Use non-stainless steel circle hooks	56.38	0.001	0.125
Change locations	24.04	0.001	0.082
Use rubberized landing nets	19.46	0.001	0.073
Cut the line	55.64	0.001	0.124
Hold the fish horizontally	44.43	0.001	0.111

Figure 17. Awareness of reef fish best handling protocols for the recreational sector, by state.

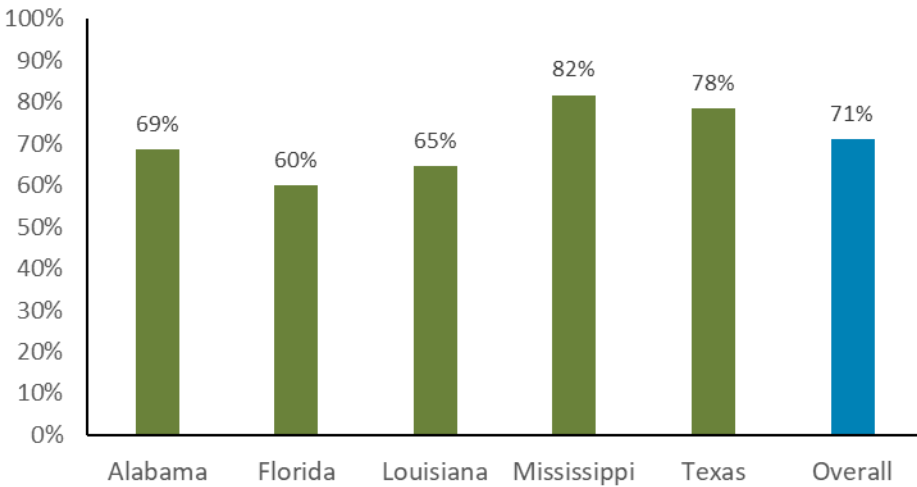
Dehooking device



Minimize fish handling



Venting methods



Non-stainless steel circle hooks

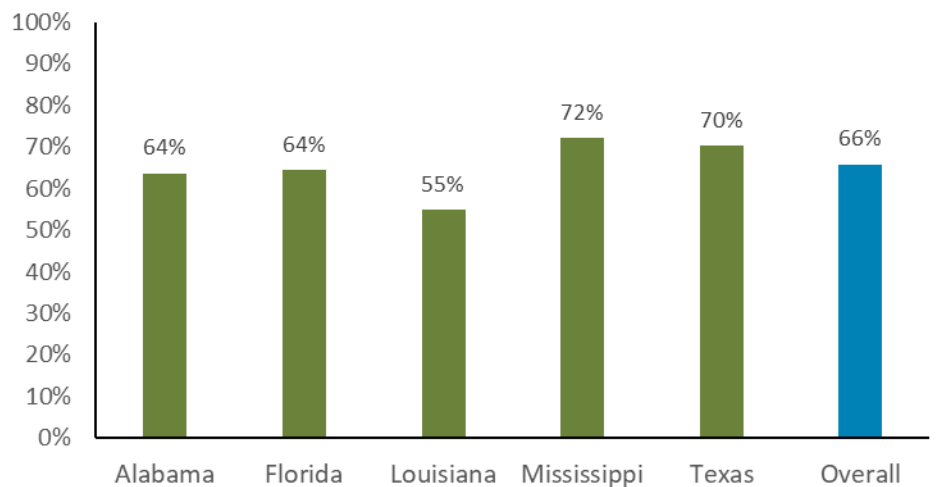
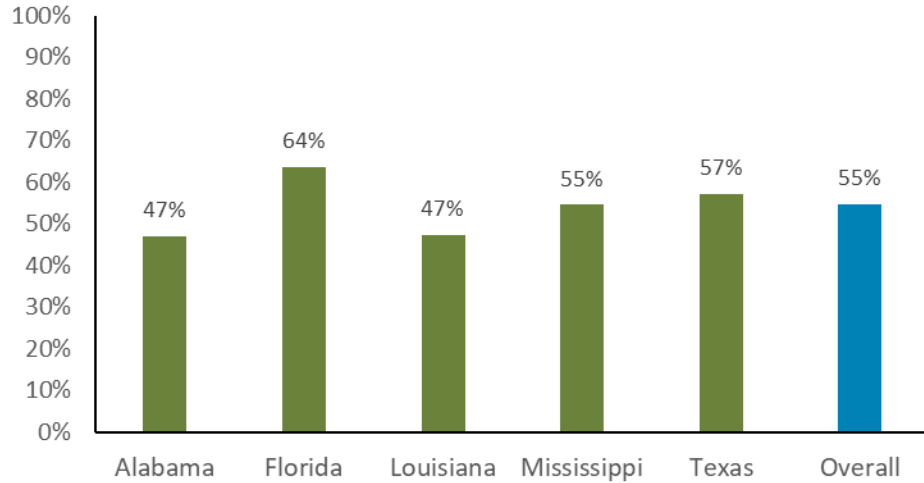
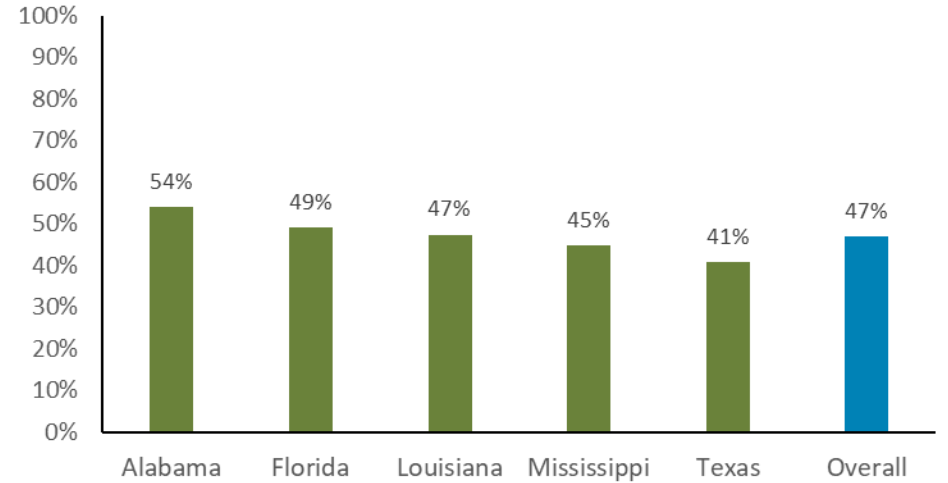


Figure 17 (cont). Awareness of reef fish best handling protocols for the recreational sector, by state.

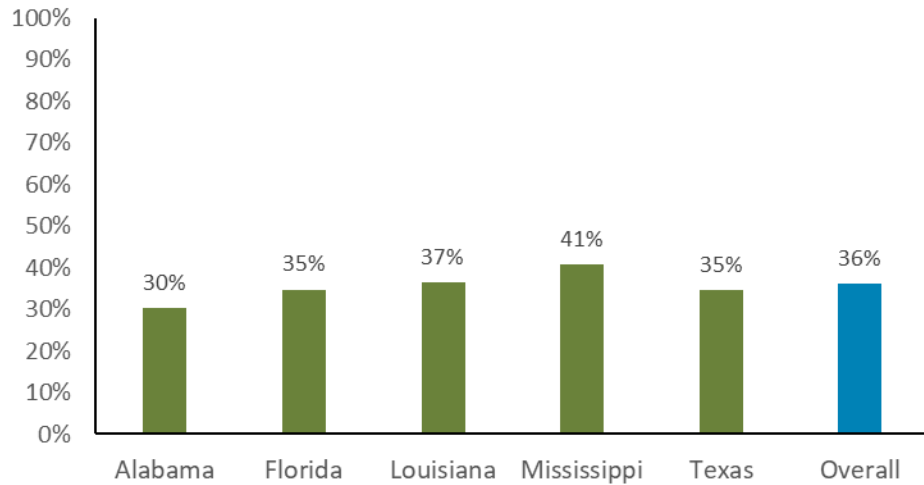
Cut the line



Change fishing locations



Rubberized landing nets



Fish descending devices

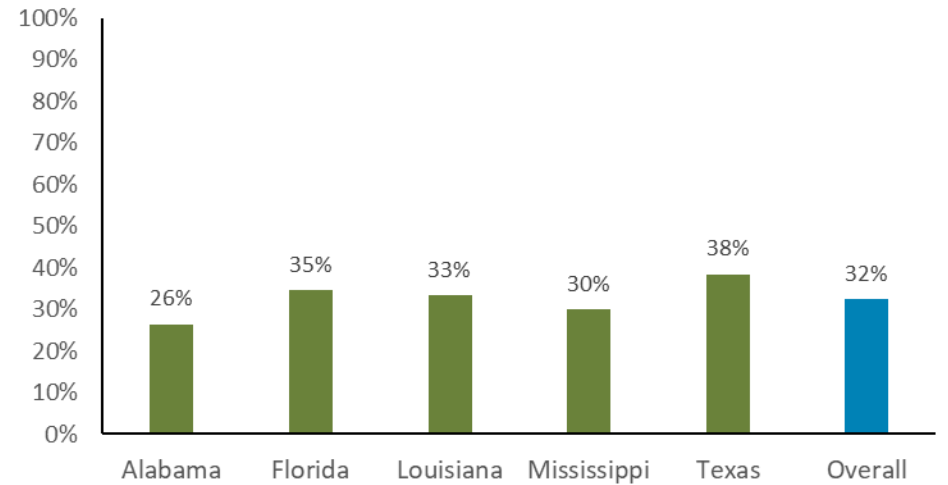
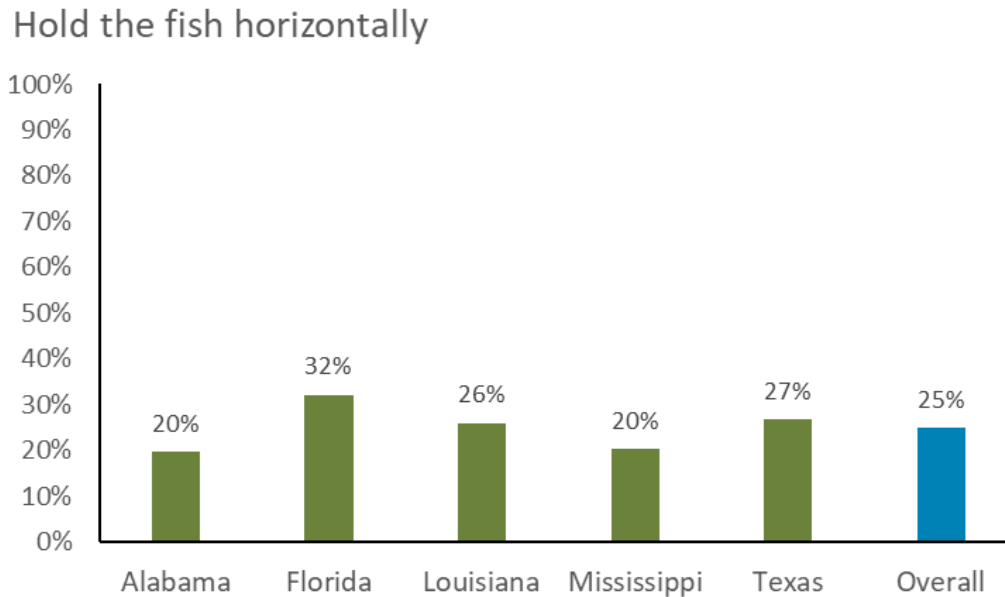


Figure 17 (cont). Awareness of reef fish best handling protocols for the recreational sector, by state.



Breakdown of knowledge about venting and descending devices – private recreational anglers

A major focus of the study was to measure knowledge of venting tools and fish descending devices, particularly among private recreational anglers. Consequently, crosstabs were generated for private angler respondents to determine where knowledge insufficiencies may exist. In most cases, the states were combined because of sample size and lack of meaningful differences among the states.

Awareness of venting techniques (66% vs. 69%) and fish descending devices (34% vs. 32%) was similar between residents and non-residents¹⁰. Given a majority of respondents were unaware of fish descending devices, the outreach focus would be beneficial to private recreational anglers, regardless of where they live.

As expected, respondents who fished more frequently were more knowledgeable about venting techniques ($\chi^2=138.7, P < 0.001, \text{Cramer's } V = 0.100$) and/or fish descending devices ($\chi^2=36.4, P < 0.001, \text{Cramer's } V = 0.196$) (Figure 18). Similarly, respondents with 1 – 5 years of experience were much less likely to know about venting tools ($\chi^2=245.8, P < 0.001, \text{Cramer's } V = 0.261$) and/or fish descending devices ($\chi^2=34.7, P < 0.001, \text{Cramer's } V = 0.098$), as compared to people with more experience. Among this group, the disparity was particularly apparent for venting techniques among respondents with 1 – 5 years of experience (56% vs. 75% - 83%). Knowledge of fish descending devices, by reef fishing experience, was lower overall, regardless of reef fishing experience (27% - 37%) (Figure 19).

¹⁰ Mississippi and Texas were not included because residency status was unknown.

Figure 18. Percentage and number of private recreational anglers and their reef fishing frequency, who were aware of venting techniques and/or fish descending devices.

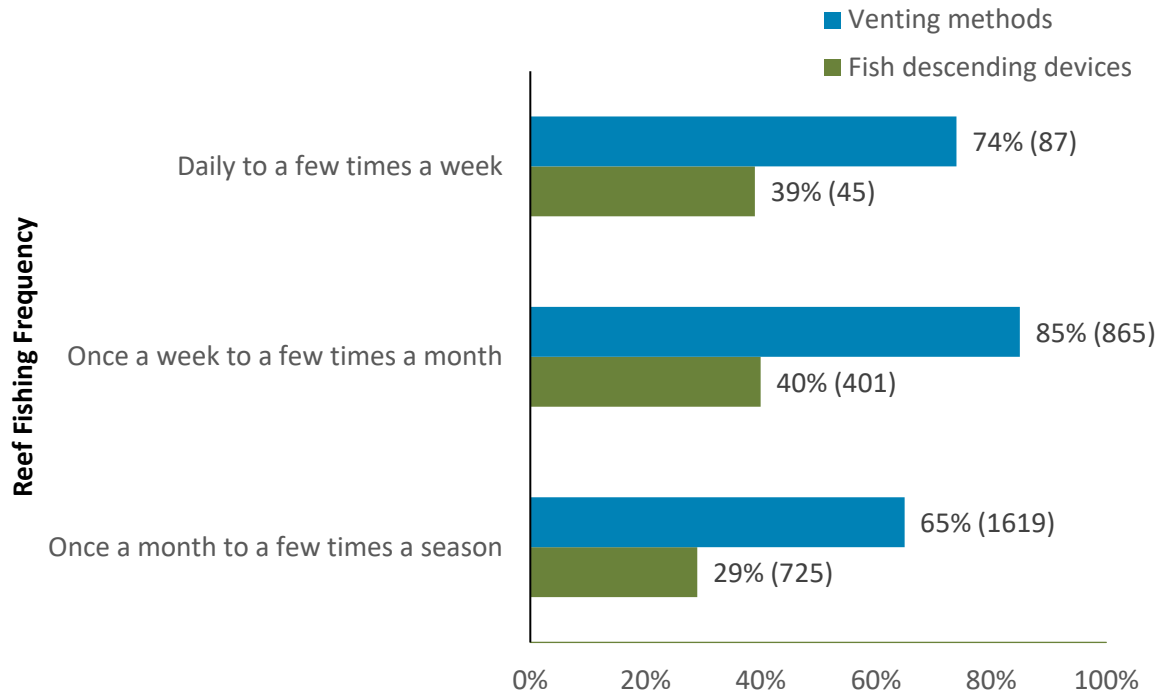
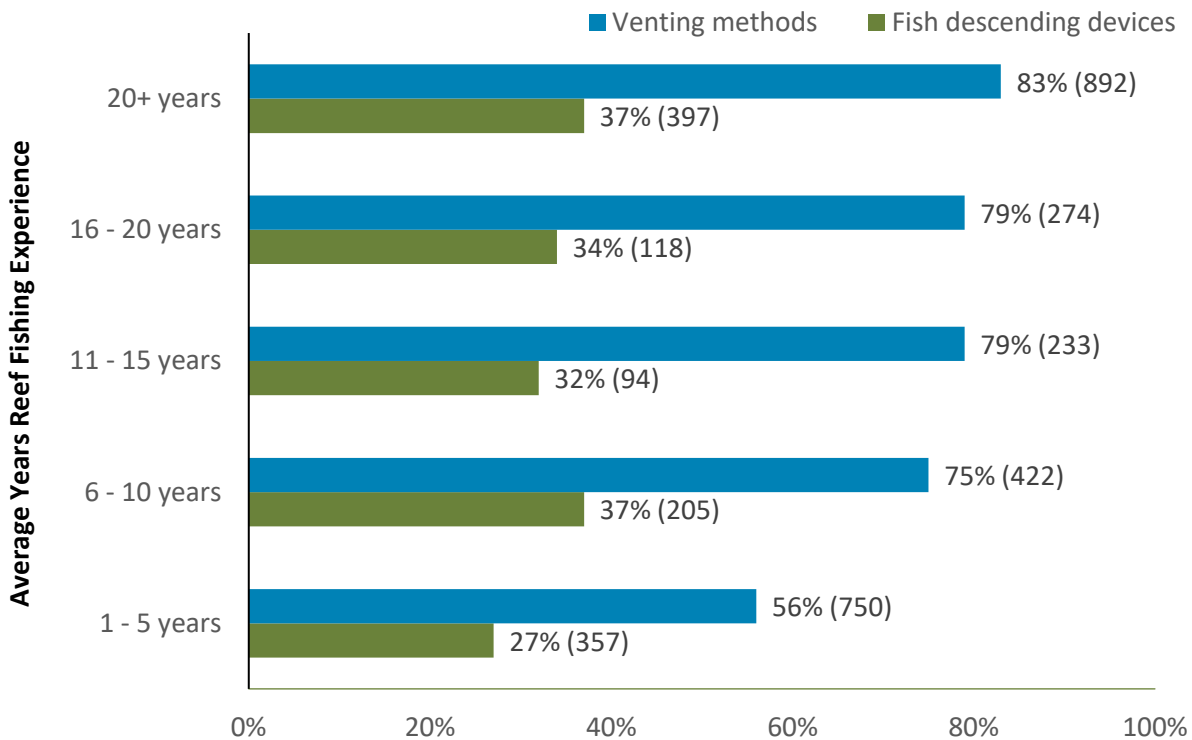
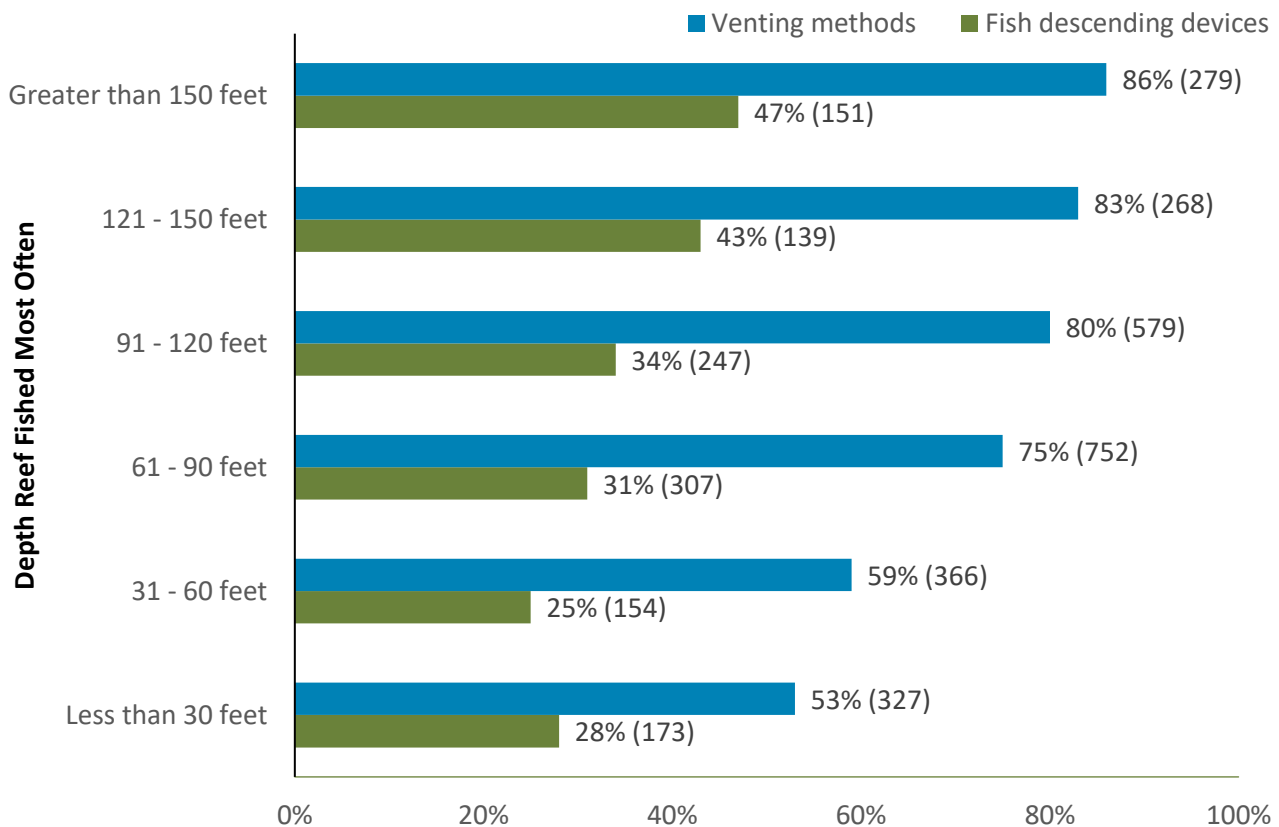


Figure 19. Percentage and number of private recreational anglers and their reef fishing experience, who were aware of venting methods and/or fish descending devices.



Depth fished most often was also influential as to whether/not respondent knew about venting tools or fish descending devices. As fishing depths increased, knowledge about venting tools ($\chi^2=245.4, P < 0.001, \text{Cramer's } V = 0.261$) and fish descending devices ($\chi^2=72.6, P < 0.001, \text{Cramer's } V = 0.142$) also increased (Figure 20). In both cases, the knowledge divide was for anglers fishing deeper than 60 feet, especially as it pertains to venting.

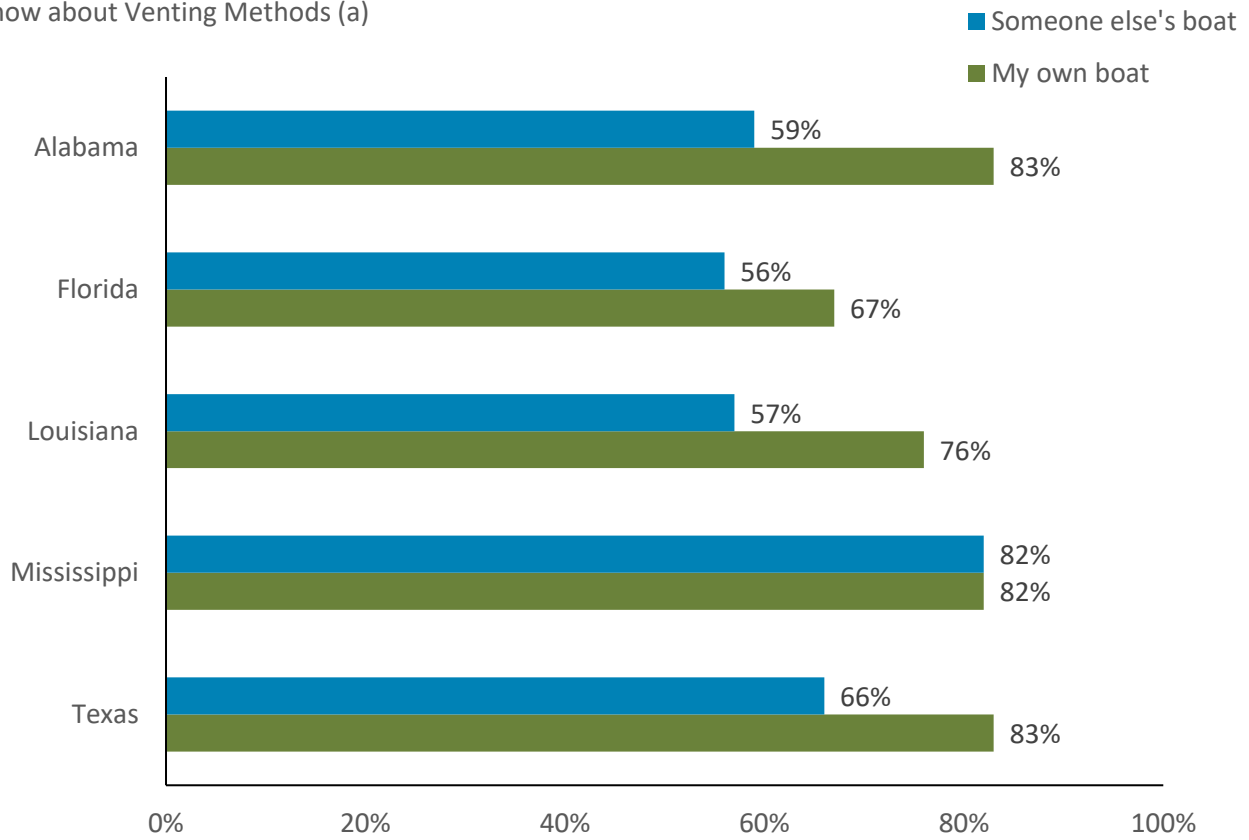
Figure 20. Percentage and number of private recreational anglers and depth fished most often, who were aware of venting methods and/or fish descending devices.



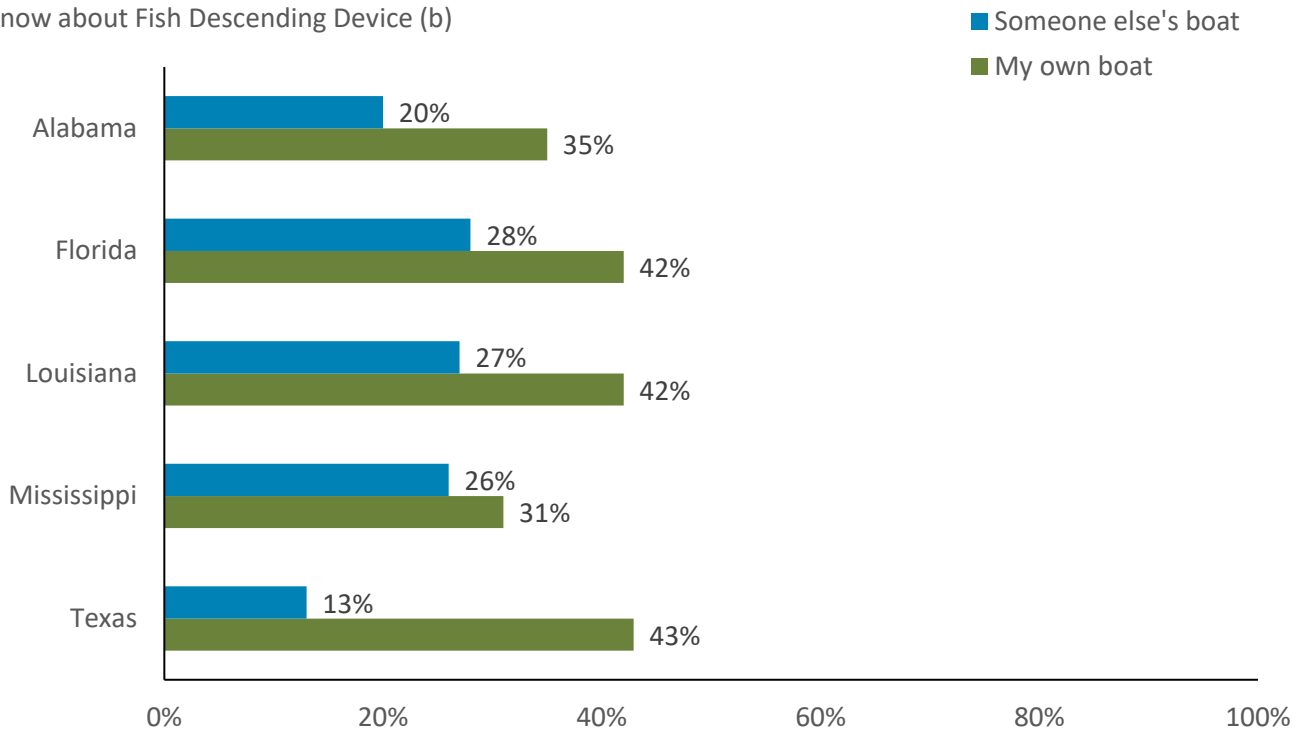
Overall, whether a respondent fished from their own boat also influenced knowledge of venting techniques (76% vs. 61%; $\chi^2=113.9, P < 0.001, \text{Cramer's } V = 0.185$) and fish descending devices (37% vs. 25%; $\chi^2=46.6, P < 0.001, \text{Cramer's } V = 0.118$). Of note, these results were similar for each state, even a much higher percentage of MS and TX anglers fished from their own boats, as compared to the other three states (Figure 21).

Figure 21. Percentage of private recreational anglers who were aware of venting methods (a) and/or fish descending devices (b) based on boat ownership, by state.

Know about Venting Methods (a)



Know about Fish Descending Device (b)



Logistic Regression Models for Knowledge of Venting Methods and FDDs – Recreational Sector

Multiple logistic regression models were used to examine the influence of several independent variables on awareness of venting methods and fish descending devices for private recreational anglers. These anglers were chosen because they represent most reef anglers and outreach efforts will be focused on this sector. For each model, the dependent variables were awareness of venting methods (73% of respondents) and fish descending devices (33% of respondents). Several iterative models using an array of independent variables were tested to determine which variables best explained knowledge of venting methods and FDDs.

For both models, 13 independent variables¹¹ were tested (Table 15), using a stepwise process as outlined in Agresti (2018). A more thorough explanation of model selection is presented in Appendix C. The final models evaluating venting methods ($R^2 = 0.452$) explained more variance than the fish descending device model ($R^2 = 0.218$).

For venting, women and people who fished on someone else's boat were significantly less likely to know about venting; whereas respondents who were older, had more experience and who also knew about FDDs, best handling practices, and barotrauma symptoms were much more likely to know about venting methods. In fact, respondents who knew about barotrauma were 11 times more likely to know about venting methods than respondents who were unaware of symptoms (Table 16 (a)). The take home message is that if people know how to recognize when fish need help returning to depth, they will likely also know about venting.

For fish descending devices, younger anglers and people who fished on someone else's boat were significantly less likely to know about FDDs. Conversely, more frequent anglers and people who knew about venting and barotrauma were more likely to know about FDDs (Table 16 (b)). Although the relationship is not as strong, a person is three times more likely to know about FDDs if they know about barotrauma symptoms, so similar educational messages related to barotrauma in general, may help teach people about descending devices.

¹¹ Each model used 'know vent' and 'know FDD' as both independent and dependent variables, depending on the model. Also, fish frequency was tested at both the original 6 levels and recoded to 2 levels.

Table 15. Coding of independent variables used in logistic regression models to measure awareness of venting methods and fish descending devices by private recreational anglers.

Variable	Variable type	Coding
Age	Continuous	Age of respondent in years
Gender	Categorical	Gender 1 = Male 2 = Female
Experience	Continuous	Years of reef fishing experience
Residency	Categorical	License residency status 1 = Resident 2 = Non-resident
Often fish	Categorical	How often respondents reef fish 1 = A few times a season 2 = Once a month 3 = A few times a month 4 = Once a week 5 = A few times a week 6 = Daily
Fishing frequency	Categorical	How often respondents reef fish (recoded) 1 = A few times a month or less 2 = Once a week or more
State	Categorical	Departure State
Boat type	Categorical	Boat used to fish 0 = My own boat 1 = Someone else's boat
Depth fished	Categorical	Depth fished most often 1 = 60 feet or less 2 = Greater than 60 feet
Knowledge of barotrauma	Categorical	Knowledge of at least 1 symptom 0 = No 1 = Yes
Knowledge of release practices	Categorical	Knowledge of at least 1 best release practice 0 = No 1 = Yes
Know about venting	Categorical	Knowledge of venting methods 0 = No 1 = Yes
Know about FDDs	Categorical	Knowledge of FDDs 0 = No 1 = Yes

Table 16. Results of logistic regression analysis for variables predicting knowledge of (a) venting methods and (b) fish descending devices, private recreational sector.

Venting Methods (a)				
Parameter	β	SE	Odds ratio	p-value
(Intercept)	-2.22	0.36		
Age	-0.01	0.00	0.99	<0.001
Years reef fishing	0.02	0.00	1.02	<0.001
Boat type	-0.62	0.10	0.54	<0.001
Depth fished most often	0.83	0.10	2.28	<0.001
Know trauma	2.39	0.23	10.97	<0.001
Gender	-0.55	0.16	0.58	<0.001
Know about FDDs	0.90	0.12	2.47	<0.002
Know one best practice	0.75	0.22	2.13	<0.003

Chi-square 606.23
Nagelkerke R² 0.452

Fish Descending Devices (b)				
Parameter	β	SE	Odds ratio	p-value
(Intercept)	-1.60	0.30		<0.001
Age	-0.01	0.00	0.99	<0.001
Boat type	-0.42	0.09	0.66	<0.001
Know trauma	0.96	0.26	2.60	0.020
How often reef fish	0.32	0.14	1.38	<0.001
Know about venting	0.98	0.11	2.67	<0.001

Chi-square 207.35
Nagelkerke R² 0.218

Use of Best Handling Protocols

Respondents who indicated awareness of a specific best handling protocol were then asked how often they personally used that protocol. Important to note is if a respondent did not indicate they were aware of a particular protocol, they were not asked how often it was used. The frequency of use was measured on a five-point Likert scale from “1 - Never” to “5 - Always”. For reporting, the categories were collapsed to “Never-Rarely”, “Sometimes”, and “Often-Always” so they are more efficiently interpreted. Among the sectors, nearly all respondents (99%, $\chi^2=5.51$, $P = n.s.$) indicated they took some effort to minimize the handling of fish. Interestingly, a minority of respondents (regardless of sector) were aware of holding the fish horizontally (26%) or using rubberized landing nets (38%). However, nearly all those respondents used them at least ‘sometimes’ (Table 17). This speaks to a larger outreach message that includes a suite of best handling protocols, regardless of sector, depth fished, or fishing frequency.

To return fish to depth, NOAA RCG respondents were more likely to use venting methods (93%), compared to either state for-hire (88%) or private recreational (85%) anglers (Table 18, Figure 22 (a)). Conversely, there were no statistical differences for use of fish descending devices among the three sectors (46%, Table 18, Figure 22(b)).

Table 17. Overall use of best handling protocols by angler sectors. Only respondents who were aware of a protocol handling protocols, including statistical significance and measure of effect size among the were asked to indicate how often they used that protocol.

Use of best handling protocol	Overall				Chi-square	P	Cramer's V
	n	Never-Rarely	Some-times	Often-Always			
Take efforts to minimize the handling of fish	2,947	1%	8%	91%	5.51	n.s.	NA
Descending devices	1,370	46%	26%	29%	3.05	n.s.	NA
Venting methods	2,895	14%	30%	56%	33.67	<0.001	0.201
Dehooking devices	3,119	4%	18%	78%	24.73	<0.001	0.103
Non-stainless steel circle hooks	2,644	5%	4%	92%	2.65	n.s.	NA
Change locations if or when predators arrive	1,932	2%	16%	82%	10.76	0.029	0.319
Rubberized landing nets	1,447	12%	14%	74%	6.77	n.s.	NA
Cut the line when the fish is hooked too deeply	2,199	12%	16%	71%	10.76	0.029	0.116
Hold the fish horizontally while on deck	1,018	3%	18%	79%	1.00	n.s.	NA

Table 18. Use of best handling protocols by angler sector. Only respondents who were aware of a protocol were asked to indicate how often they used that protocol.

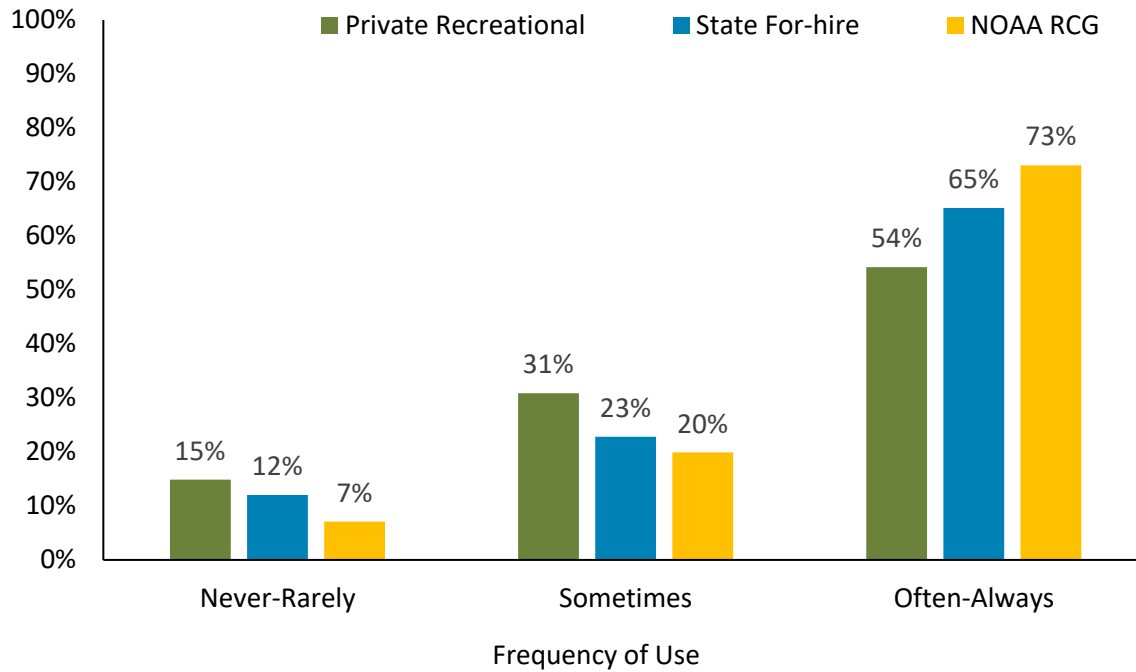
Private Recreational				
Use of best handling protocols	n	Never-Rarely	Sometimes	Often-Always
Take efforts to minimize the handling of fish	2,643	1%	8%	91%
Descending devices	1,164	47%	25%	28%
Venting methods	2,555	15%	31%	54%
Dehooking devices	2,776	4%	19%	76%
Non-stainless steel circle hooks	2,357	5%	4%	92%
Change locations if or when predators arrive	1,684	2%	17%	81%
Rubberized landing nets	1,285	11%	14%	75%
Cut the line when the fish is hooked too deeply	1,961	13%	17%	71%
Hold the fish horizontally while on deck	892	4%	18%	79%

State For-hire				
Use of best handling protocols	n	Never-Rarely	Sometimes	Often-Always
Take efforts to minimize the handling of fish	170	1%	4%	95%
Descending devices	104	47%	26%	27%
Venting methods	184	12%	23%	65%
Dehooking devices	191	2%	12%	87%
Non-stainless steel circle hooks	152	3%	4%	93%
Change locations if or when predators arrive	135	2%	13%	86%
Rubberized landing nets	107	16%	16%	68%
Cut the line when the fish is hooked too deeply	133	9%	14%	77%
Hold the fish horizontally while on deck	71	3%	17%	80%

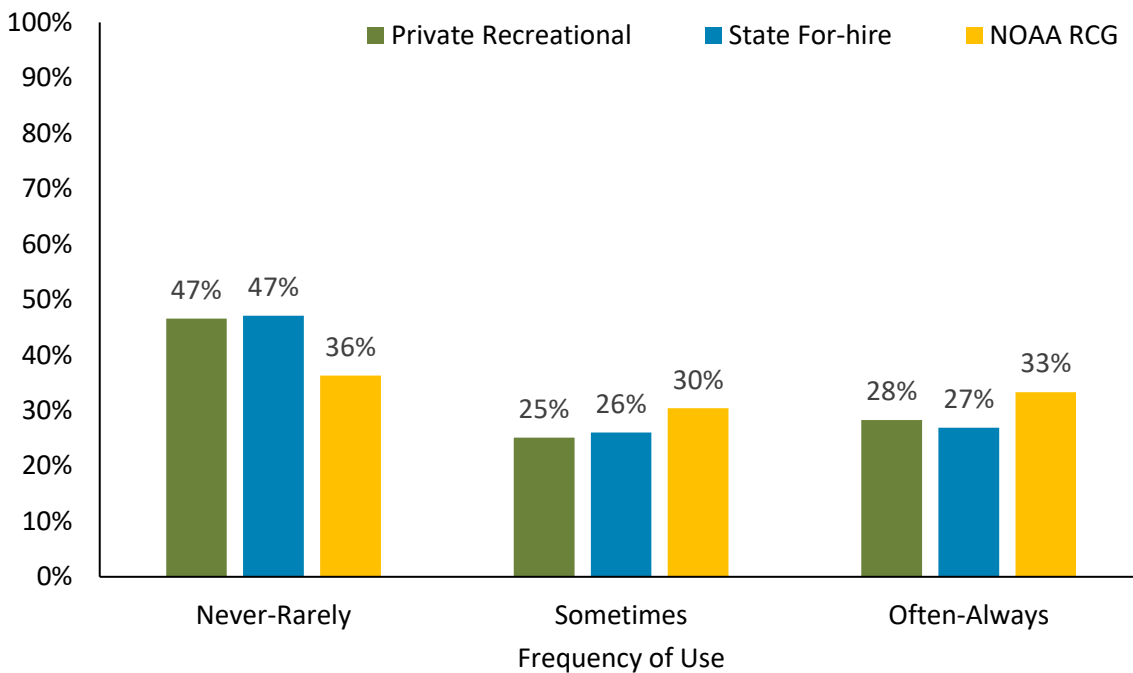
NOAA RCG				
Use of best handling protocols	n	Never-Rarely	Sometimes	Often-Always
Take efforts to minimize the handling of fish	134	1%	9%	90%
Descending devices	102	36%	30%	33%
Venting methods	156	7%	20%	73%
Dehooking devices	152	1%	10%	90%
Non-stainless steel circle hooks	135	7%	3%	90%
Change locations if or when predators arrive	113	0%	9%	91%
Rubberized landing nets	55	16%	20%	64%
Cut the line when the fish is hooked too deeply	105	10%	14%	76%
Hold the fish horizontally while on deck	55	2%	18%	80%

Figure 22. Use of venting methods (a) and fish descending devices (b), by fishing sector by those who were aware of the protocol.

Venting Methods (a)



Fish Descending Devices (b)



Tools used to vent fish

For respondents who indicated they vented at least “Sometimes”, most (76%) used a tool specifically purchased for venting. A hypodermic needle was used by 10% of respondents, followed by a knife (8%), ice pick (4%), and hook (2%) (Figure 23). Although the use of a venting device among sectors was not significantly different, NOAA RCG respondents used a knife (11%) more often than private recreational (8%) or state for-hire (6%) respondents (Table 19). Of note, the DESCEND Act, which went into effect January 13, 2022 specifically prohibits tools that are not hollow. Tools such as a knife, hook, or ice pick do not meet the requirements of a venting tool¹².

Figure 23. Tools used most often to vent fish; all angler sectors combined (differences were not significant at P < 0.05).

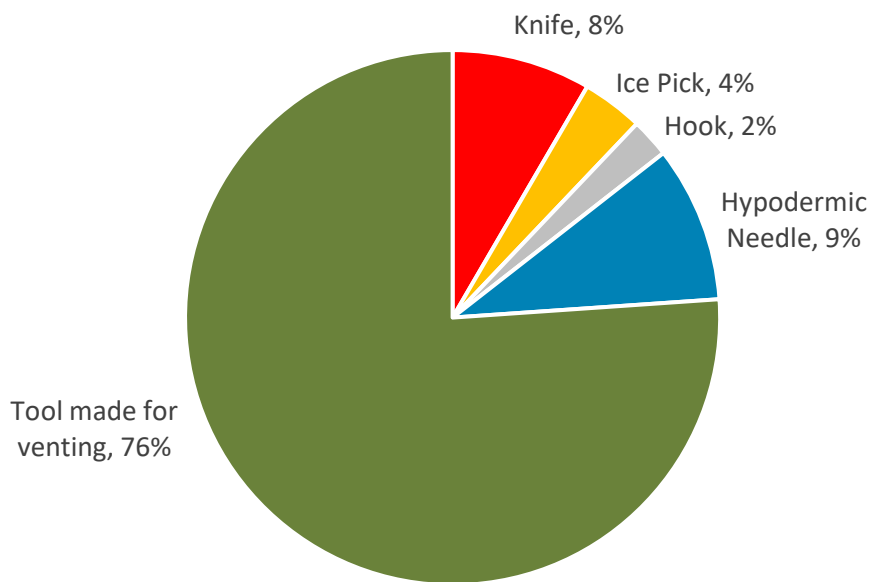


Table 19. Tools used most often to vent fish, by angler sector.

Tool	Sector			Total
	Private Recreational	State For-hire	NOAA RCG	
Tool made for venting	76%	82%	72%	76%
Hypodermic Needle	9%	7%	13%	9%
Knife	8%	6%	11%	8%
Ice Pick	4%	4%	4%	4%
Hook	3%	1%	0%	2%

$\chi^2 = 11.47, 8 \text{ df}, P = 0.176$

¹² [NOAA DESCEND Act news release, January 13, 2022](#)

Influence of fishing depth on use of best handling practices

For this section, the data were pooled across angler sectors. While there were some statistical differences in use of best handling practices, they were not substantial, and any outreach should be consistent across sectors. Respondents were asked the following question,

“When fishing for reef fish in the Gulf of Mexico, what is your most often targeted range of fishing depth? We recognize that people may fish at different depths on the same trip. We would like to know the depth range you fish most often”.

Crosstabulations of fishing depth against the frequency of use, measured on a five-point Likert scale from “1 - Never” to “5 - Always”. For reporting, the categories were again collapsed to “Never-Rarely”, “Sometimes”, and “Often-Always”.

Fishing depth should have an influence on the frequency of use for a particular device or release method and those trends were generally apparent. The qualifier is anglers were asked “most often”, recognizing they may not “always” fish at a particular depth range. Consequently, while they might fish in shallow water most of the time, they may fish in deeper water “sometimes” and then use devices (e.g., venting, FDD) when they fish in those waters. This research was not designed to specifically identify what anglers did at every point during their reef fishing season; rather, it was designed to establish trends and answer questions that lead to a comprehensive outreach program that can be evaluated over time.

Overall, most handling practices were used by anglers who were aware of the protocols regardless of fishing depth. Specifically, anglers consistently minimized fish handling, held fish horizontally while on deck, used non-stainless steel circle hooks, and changed locations when predators were in the area (Table 20; Figure 24). The use of dehooking devices ($\chi^2 = 22.29$, $P = 0.014$, Cramer’s $V = 0.052$) and rubberized landing nets ($\chi^2 = 25.72$, $P = 0.004$, Cramer’s $V = 0.073$) varied by depth fished; however, the effect size was small in both cases (<0.1), which indicated few practical differences (Table 21; Figure 25).

Differences were most apparent for venting methods ($\chi^2 = 131.13$, $P = <0.001$, Cramer’s $V = 0.111$) and fish descending devices ($\chi^2 = 35.29$, $P = <0.001$, Cramer’s $V = 0.167$). As expected, use of both practices increased as fishing depth increased (Table 21; Figure 25).

Table 20. Use of best handling practice by depth fished most often, all sectors combined by anglers (all sectors combined) who were aware of the protocols. Practices were not statistically different (by depth) at the P < 0.05 level.

Minimize fish handling

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	439	1%	6%	93%
31 - 60 feet	497	1%	5%	94%
61 - 90 feet	810	1%	9%	90%
91 - 120 feet	552	1%	10%	89%
121 - 150 feet	261	1%	6%	93%
Greater than 150 feet	254	2%	7%	91%
Total	2,813	1.1%	7%	92%

Chi-square = 12.91
P = n.s.

Hold the fish horizontally

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	178	4%	17%	79%
31 - 60 feet	192	1%	15%	84%
61 - 90 feet	280	5%	18%	77%
91 - 120 feet	211	5%	19%	76%
121 - 150 feet	98	3%	20%	77%
Greater than 150 feet	109	7%	15%	78%
Total	1,068	4%	17%	79%

Chi-square = 11.85
P = n.s.

Non-stainless steel circle hooks

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	361	6%	7%	88%
31 - 60 feet	430	5%	4%	91%
61 - 90 feet	787	5%	3%	92%
91 - 120 feet	566	4%	4%	93%
121 - 150 feet	257	5%	3%	93%
Greater than 150 feet	262	2%	5%	93%
Total	2,663	4%	4%	92%

Chi-square = 16.46
P = n.s.

Change locations

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	257	4%	18%	79%
31 - 60 feet	316	3%	18%	80%
61 - 90 feet	550	3%	17%	80%
91 - 120 feet	437	1%	15%	84%
121 - 150 feet	196	2%	11%	87%
Greater than 150 feet	198	4%	14%	82%
Total	1,954	3%	16%	82%

Chi-square = 17.83
P = n.s.

Cut the line

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	325	13%	16%	71%
31 - 60 feet	378	11%	14%	75%
61 - 90 feet	618	14%	20%	66%
91 - 120 feet	430	11%	15%	73%
121 - 150 feet	201	16%	14%	69%
Greater than 150 feet	197	11%	16%	74%
Total	2,149	13%	17%	71%

Chi-square = 16.06
P = n.s.

Table 21. Use of best handling practice by depth fished most often, all sectors combined by anglers who were aware of the protocols. Practices were statistically different (by depth) at the $P < 0.05$ level.

Dehooking devices

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	451	5%	22%	73%
31 - 60 feet	451	4%	18%	78%
61 - 90 feet	511	6%	21%	74%
91 - 120 feet	907	3%	18%	79%
121 - 150 feet	656	3%	16%	81%
Greater than 150 feet	301	5%	14%	80%
Total	3,277	4%	19%	77%
Chi-square = 22.29				
P = 0.014				
Cramer's V = 0.052				

Rubberized landing nets

Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	216	12%	16%	73%
31 - 60 feet	248	6%	17%	77%
61 - 90 feet	438	11%	11%	78%
91 - 120 feet	314	10%	15%	76%
121 - 150 feet	147	11%	12%	77%
Greater than 150 feet	142	20%	13%	68%
Total	1,505	11%	14%	76%
Chi-square = 25.72				
P = 0.004				
Cramer's V = 0.073				

Venting methods

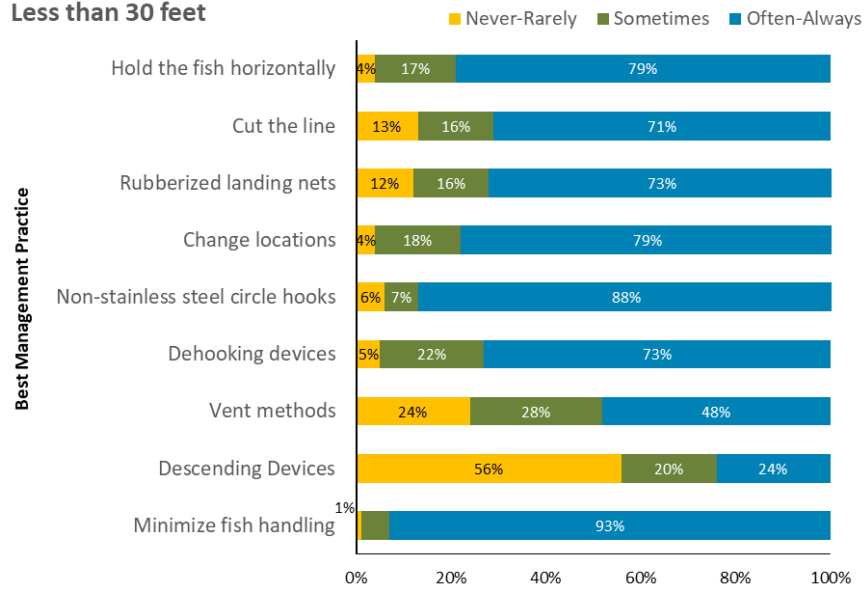
Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	344	24%	28%	48%
31 - 60 feet	411	23%	32%	45%
61 - 90 feet	843	20%	33%	47%
91 - 120 feet	643	8%	31%	61%
121 - 150 feet	291	6%	24%	69%
Greater than 150 feet	311	10%	28%	62%
Total	2,843	16%	30%	54%
Chi-square = 131.13				
P = <0.001				
Cramer's V = 0.111				

Descending devices

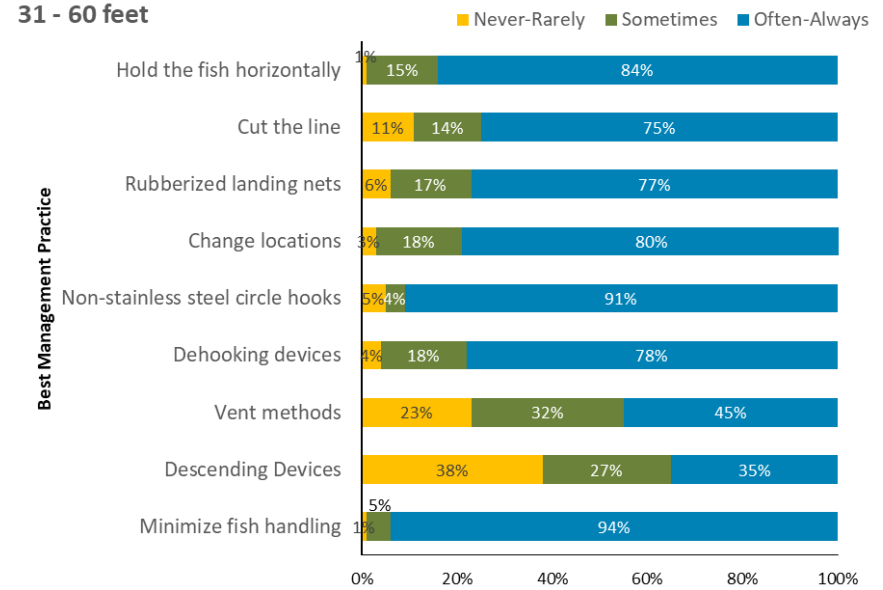
Depth Fished	n	How Often Used		
		Never-Rarely	Some-times	Often-Always
Less than 30 feet	182	56%	20%	24%
31 - 60 feet	189	38%	27%	35%
61 - 90 feet	379	47%	23%	30%
91 - 120 feet	310	42%	22%	36%
121 - 150 feet	165	33%	23%	44%
Greater than 150 feet	177	33%	28%	40%
Total	1,402	42%	24%	34%
Chi-square = 35.29				
P = <0.001				
Cramer's V = 0.167				

Figure 24. Graphical representation of use of best handling practice by depth fished most often, all sectors combined. Practices were not statistically different (by depth) at the P < 0.05 level.

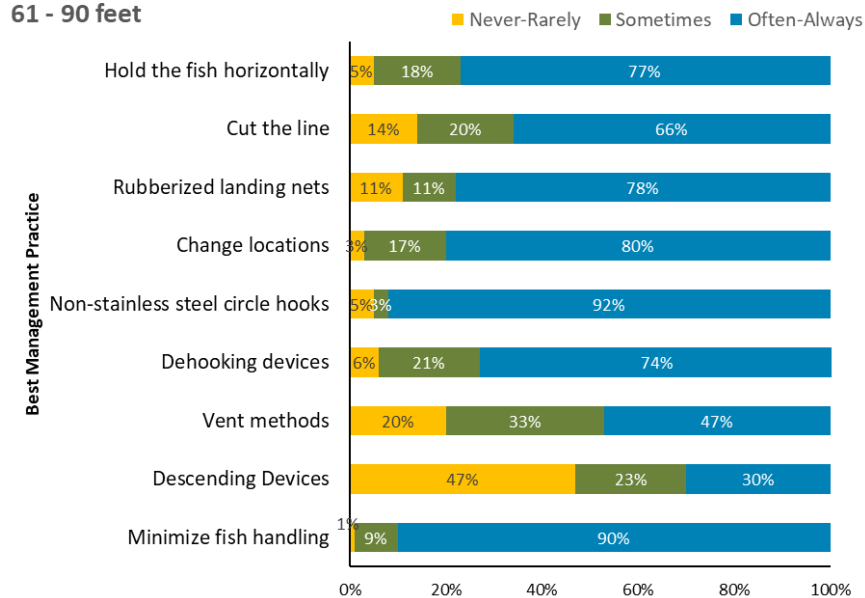
Less than 30 feet



31 - 60 feet



61 - 90 feet



91 - 120 feet

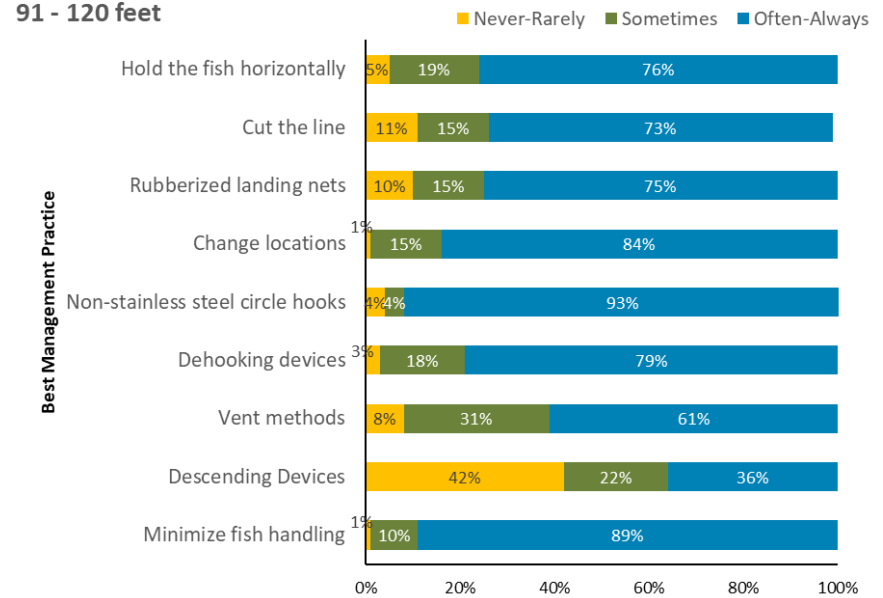
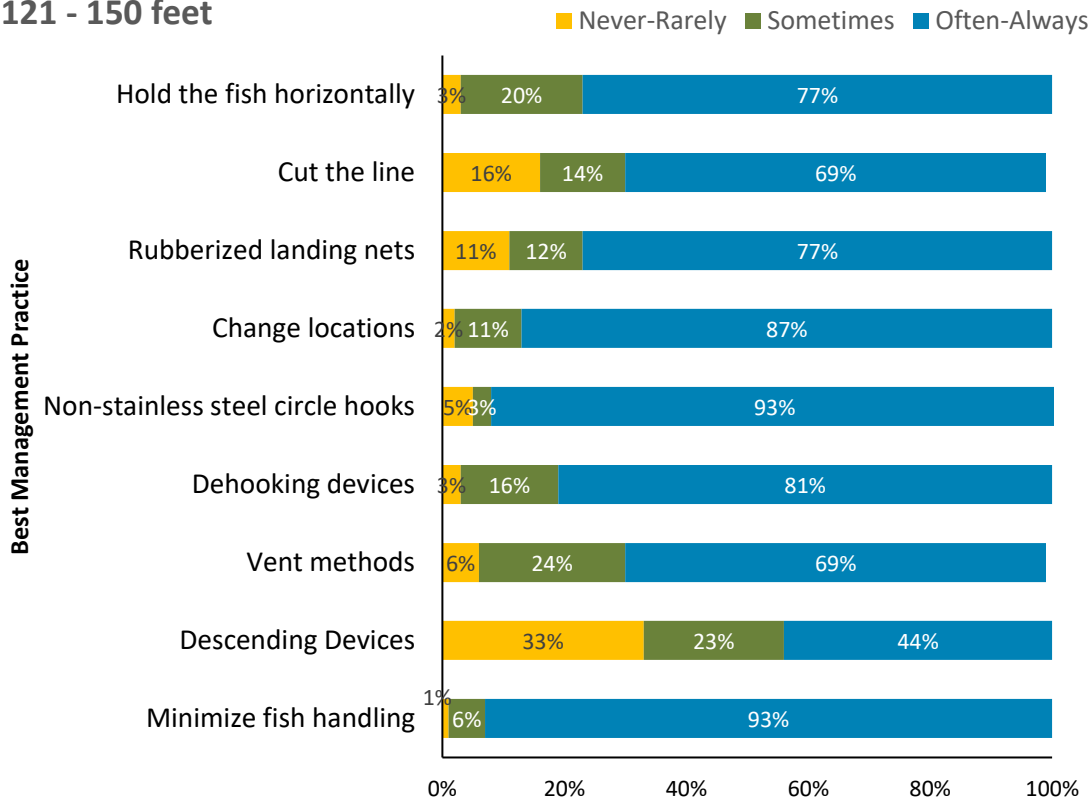


Figure 24 (Cont.)

121 - 150 feet



Greater than 150 feet

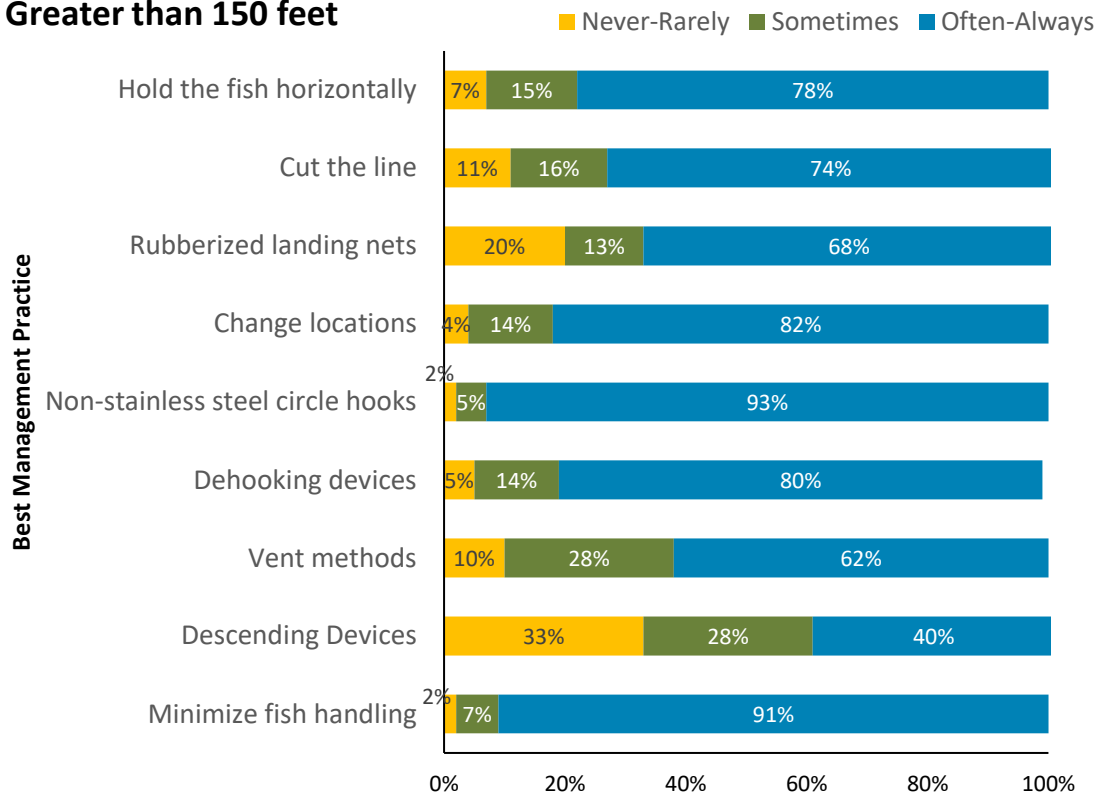
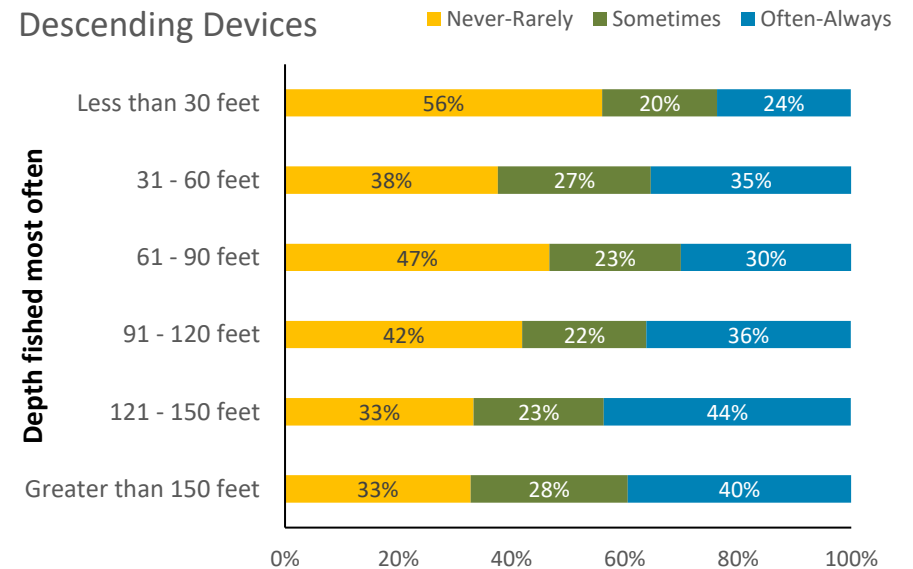
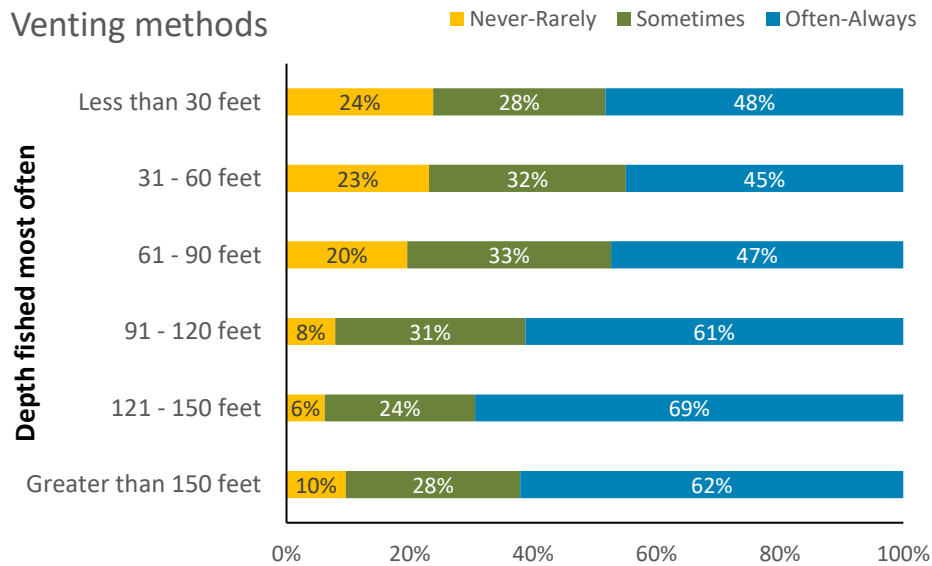
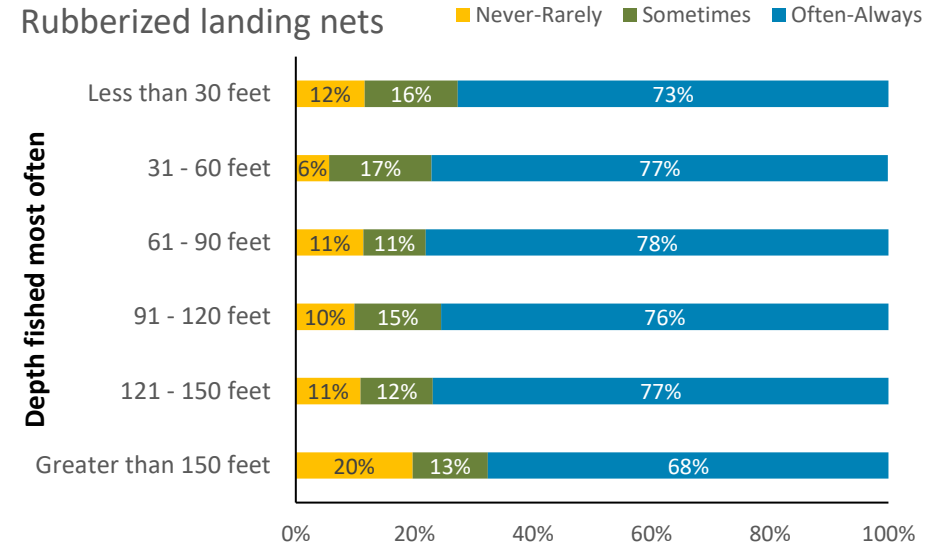
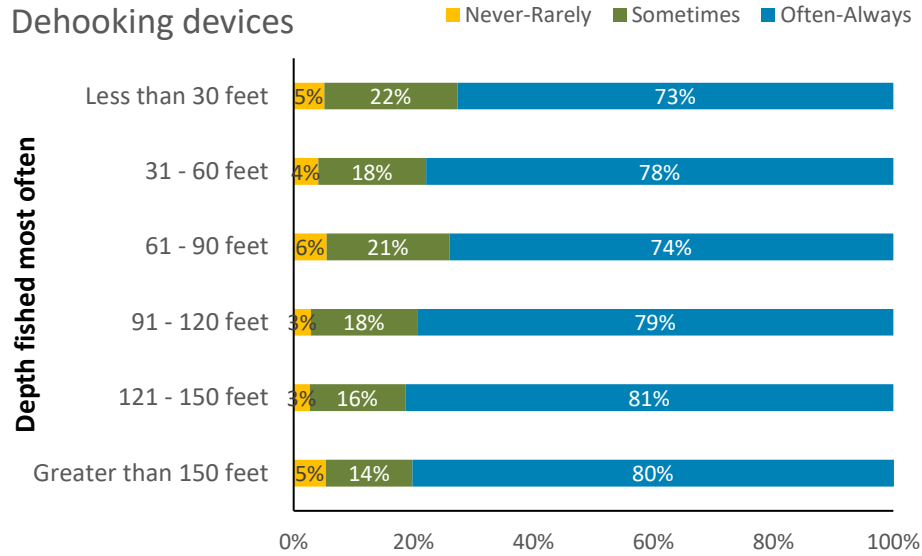


Figure 25. Graphical representation of use of best handling practice by depth fished most often, all sectors combined for anglers who were aware of the protocols. Practices were statistically different (by depth) at the P < 0.05 level.



General Attitudes towards Barotrauma

Respondents were asked a series of six general barotrauma-related questions and the impact of angler conservation of reef fish, to ascertain their opinions on a variety of items. All questions were measured on a five-point Likert scale from, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”.

Respondents were asked the question, “I will help fish return to depth when needed”. Respondents from all angler sectors strongly agreed with that statement ($M = 4.47 - 4.71, S.D. = 0.787$). Although sector-level results were statistically significant, the effect size was small ($\eta = 0.080$), indicating an overall desire to positively impact fish survival (Table 22). This desire was shared regardless of the state where they launched ($M = 4.43 - 4.63, F = 6.88, P < 0.001, \eta = 0.088$, Table 23) or their years of reef fishing experience¹³ ($M = 4.39 - 4.56, F = 7.85, P < 0.001, \eta = 0.094$, Table 24). Functionally, regardless of how the data area analyzed, effect size was small in all cases ($\eta < 0.1$), so there are no real differences in desire among respondents to help fish survive.

Table 22. Degree of agreement with the statement, "I will help fish return to depth when needed", by angler sector.

Angler Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,152	2%	11%	87%	4.47	0.791
State For-hire	203	1%	6%	93%	4.71	0.674
NOAA RCG	195	2%	7%	91%	4.63	0.792
Total	3,550	1.6%	11%	88%	4.49	0.787

$F = 11.516, P < 0.001, \eta = 0.080$

Table 23. Degree of agreement with the statement, "I will help fish return to depth when needed", by state and angler sector.

State	Private Recreational			State For-hire			NOAA RCG		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Alabama	491	4.41	0.872	31	4.65	0.709	24	4.58	0.929
Florida	766	4.48	0.770	87	4.74	0.637	136	4.63	0.796
Louisiana	499	4.43	0.771	14	4.64	0.745	11	4.64	0.674
Mississippi	867	4.44	0.818	35	4.54	0.919	2	5.00	0
Texas	529	4.61	0.694	36	4.89	0.319	22	4.59	0.734
Total	3,152	4.47	0.791	203	4.71	0.674	195	4.63	0.792

$F = 6.88, P < 0.001, \eta = 0.088$

¹³ Years of reef fishing experience was transformed into a categorical variable of 6 incremental ranges.

Table 24. Degree of agreement with the statement, "I will help fish return to depth when needed", by reef fishing experience and angler sector.

Years experience	Private Recreational			State For-hire			NOAA RCG		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
1 - 5 years	1,128	4.38	0.787	46	4.61	0.745	20	4.55	0.759
6 - 10 years	493	4.51	0.761	30	4.67	0.844	25	4.72	0.458
11 - 15 years	263	4.53	0.780	21	4.95	0.218	16	4.56	0.512
16 - 20 years	297	4.53	0.754	26	4.69	0.618	19	4.84	0.501
20+ years	970	4.53	0.814	80	4.73	0.656	111	4.63	0.863
Total	3,151	4.47	0.79	203	4.71	0.674	191	4.65	0.752

F = 7.85, P < 0.001, eta = 0.094

Regardless of sector, respondents agreed that fish need help returning to depth when caught in deeper water (66%; $M = 3.26$, $S.D. = 1.09$, $F = 0.531$, n.s.) and returning fish to depth improves fish survival (74%; $M = 4.08$, $S.D. = 1.086$, $F = 2.39$, n.s.). NOAA RCG respondents were slightly less inclined to agree that helping fish return to depth will restore Gulf fish populations (55%; $M = 3.64$, $S.D. = 1.164$) as compared to private recreational (72%; $M = 4.01$, $S.D. = 1.094$) or state for-hire (71%; $M = 3.97$, $S.D. = 1.130$) respondents.

Although a minority in all cases, private recreational (30%; $M = 2.85$, $S.D. = 1.245$) and state for-hire (27%; $M = 2.51$, $S.D. = 1.349$) respondents were more inclined to agree that current practices and available gear that help fish return to depth don't work as compared to NOAA RCG (15%; $M = 2.51$, $S.D. = 1.349$, $F = 18.024$, $P < 0.001$, $\eta = 0.097$) respondents.

There were a few differences with respect to the regulatory questions. Most private recreational respondents (53%; $M = 3.53$, $S.D. = 1.24$) believed that helping fish return to depth would prevent future restrictions. Conversely, state for-hire (45%; $M = 3.33$, $S.D. = 1.310$) and NOAA RCG (37%; $M = 3.03$, $S.D. = 1.342$) were less inclined to agree with this question. Finally, there were no differences among respondents who agreed that helping fish return to depth would result in longer fishing seasons (42%; $M = 3.28$, $S.D. = 1.256$, $F = 1.970$, $P = \text{n.s.}$) (Table 25, Figure 26).

Table 25. Degree of agreement with general attitudes about returning fish to depth, by angler sector.

Question: *Fish need help returning to depth, especially when caught in deep water (>50ft)*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,394	11%	23%	66%	3.86	1.096
State For-hire	214	14%	20%	66%	3.83	1.167
NOAA RCG	204	17%	17%	67%	3.78	1.168
Total (F = 0.531, P = n.s.)	3,812	11%	23%	66%	3.85	1.104

Question: *Helping fish return to depth will mean more fish to be caught in the future*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,396	9%	17%	74%	4.08	1.086
State For-hire	214	12%	11%	77%	4.06	1.185
NOAA RCG	204	11%	23%	66%	3.91	1.143
Total (F = 2.391, P = n.s.)	3,814	9%	17%	74%	4.07	1.095

Question: *Helping fish return to depth will restore Gulf fish populations*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,397	9%	19%	72%	4.01	1.094
State For-hire	214	11%	19%	71%	3.97	1.13
NOAA RCG	204	16%	28%	55%	3.64	1.164
Total (F = 10.509, P < 0.001, eta = 0.074)	3,815	10%	19%	71%	3.98	1.102

Question: *Current practices and gear available to return fish to depth don't work*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,396	36%	34%	30%	2.85	1.245
State For-hire	214	51%	22%	27%	2.51	1.349
NOAA RCG	204	50%	35%	15%	2.43	1.166
Total (F = 29.748, P < 0.001, eta = 0.126)	3,814	38%	33%	29%	2.81	1.253

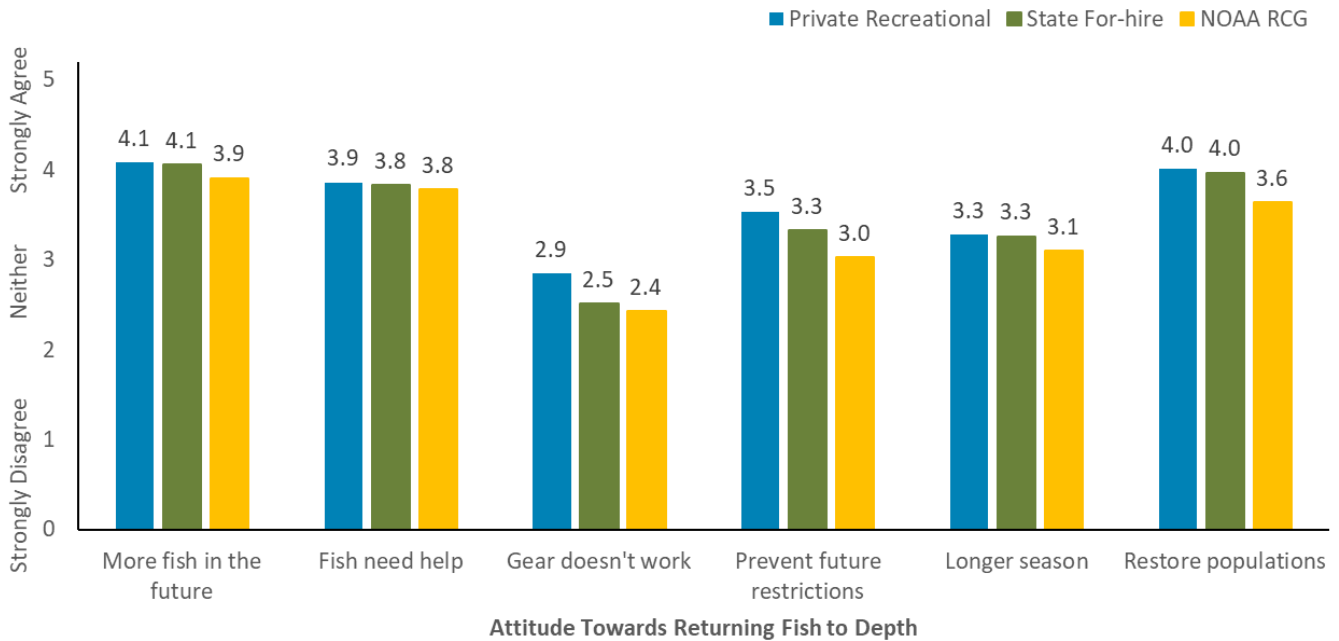
Question: *Helping fish return to depth will prevent future reef fishing restrictions*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,394	18%	29%	53%	3.53	1.24
State For-hire	214	24%	30%	45%	3.33	1.31
NOAA RCG	204	33%	29%	37%	3.03	1.342
Total (F = 17.449, P < 0.001, eta = 0.095)	3,812	19%	29%	52%	3.49	1.255

Question: *Helping fish return to depth will provide for a longer fishing season*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,396	24%	34%	42%	3.28	1.256
State For-hire	214	26%	32%	42%	3.26	1.335
NOAA RCG	204	31%	32%	37%	3.1	1.307
Total (F = 1.970, P = n.s.)	3,815	24%	34%	42%	3.27	1.263

Figure 26. Mean response to general attitudes towards the impact of angler actions on the conservation of reef fish, by sector. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”, by angler sector.



Attitudes Towards Venting Tool and Fish Descending Device Use

Respondents were asked a series of 11 questions about their attitudes towards the use of FDDs and venting. These questions focused items that could be considered barriers to adoption. All questions were measured on a five-point Likert scale from, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”.

Overall, three-quarters of respondents (from all sectors) strongly (53%) or slightly (21%) disagreed that helping fish get back to depth is unnecessary ($M = 1.83, S.D. = 1.067, F = 1.243, n.s.$) (Table 26). Specific to venting, there were statistical differences among the angler sectors for all the questions. Private recreational respondents were less likely (57%) to agree that using venting tools help return fish to depth when needed, as compared to state for-hire (74%) and NOAA RCG (82%) respondents. Similarly, private recreational respondents were more inclined to believe venting takes too much time (25%), as compared to state for-hire (19%) and NOAA RCG (5%) respondents. Although it was significant, a relatively small percentage of private recreational (9%), state for-hire (7%), and NOAA RCG (4%) respondents thought venting tools were difficult to use. Tools intended specifically for venting (and which meet DESCEND Act requirements) range in price from around \$10 to over \$50, and a relatively small percentage of private recreational and for-hire (13% each) and NOAA RCG (6%) believe they were too expensive (Table 27, Figure 27).

Table 26. Degree of agreement with the statement, "Helping fish return to depth is unnecessary", by angler sector.

Angler Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,306	74%	19%	7%	1.84	1.062
State For-hire	211	78%	15%	7%	1.72	1.079
NOAA RCG	199	75%	15%	10%	1.84	1.13
Total (F = 1.243, n.s.)	3,716	74%	19%	7%	1.83	1.067

Table 27. Degree of agreement with 4 venting-related questions that could be perceived as barriers, by angler sector.

Question: *The use of venting tools helps fish return to depth when needed*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,306	9%	35%	57%	3.72	1.067
State For-hire	211	8%	19%	74%	4.07	1.098
NOAA RCG	199	6%	12%	82%	4.20	0.957
Total (F = 28.03, P < 0.001, eta = 0.122)	3,716	9%	33%	59%	3.76	1.071

Question: *Using venting tools takes too much time*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,308	44%	30%	25%	2.65	1.321
State For-hire	211	60%	22%	19%	2.24	1.339
NOAA RCG	199	74%	21%	5%	1.81	0.954
Total (F = 45.55, P < 0.001, eta = 0.155)	3,718	47%	30%	24%	2.58	1.321

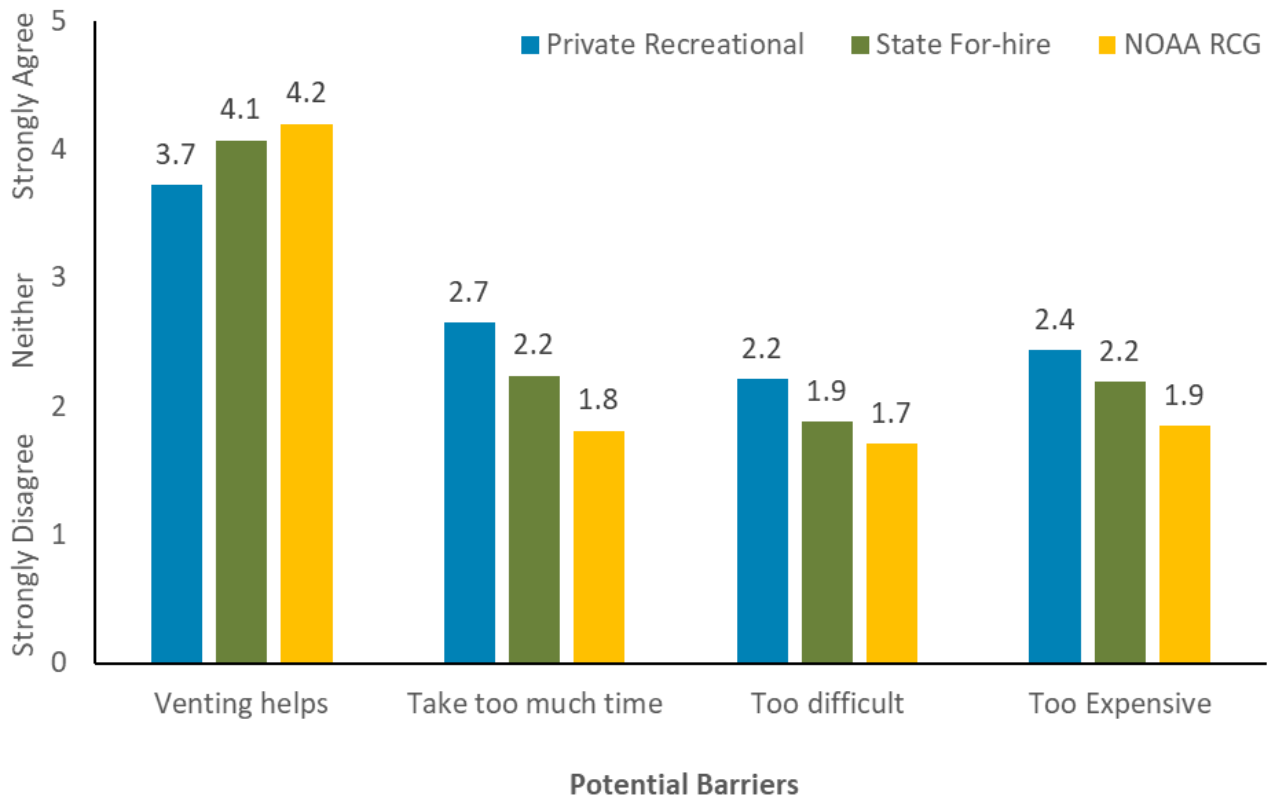
Question: *Venting tools are too difficult to use*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,307	57%	34%	9%	2.21	1.045
State For-hire	211	69%	24%	7%	1.88	1.066
NOAA RCG	199	76%	20%	4%	1.71	0.924
Total (F = 29.75, P < 0.001, eta = 0.126)	3,717	58%	33%	9%	2.16	1.048

Question: *Venting tools are too expensive*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,306	44%	43%	13%	2.44	1.113
State For-hire	211	56%	32%	13%	2.19	1.173
NOAA RCG	199	68%	26%	6%	1.85	1.024
Total (F = 30.34, P < 0.001, eta = .0127)	3,716	46%	42%	13%	2.40	1.121

Figure 27. Mean response towards 4 venting-related questions that could be perceived as barriers, by angler sector. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”, by angler sector.



Half of all respondents believed descending devices helped fish return to depth, albeit to a lower degree than venting. Respondents disagreed (23%) or were neutral (54%) that descending devices took too much time. They were also evenly split on the ease of use of descending devices (27% disagreed vs. 23% agreed), and half were neutral. A minority of respondents (18% - 24%) believed they were too expensive. State for-hire (64%) and NOAA RCG (60%) were slightly more inclined to indicate predators often attack fish as they are being descended, as compared to recreational (55%) respondents (Table 28, Figure 28).

Table 28. Degree of agreement with 5 descending device-related questions that could be perceived as barriers, by angler sector.

Question: *The use of descending devices help fish return to depth when needed*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,304	5%	45%	50%	3.65	0.914
State For-hire	211	7%	40%	53%	3.64	0.983
NOAA RCG	199	12%	36%	53%	3.6	1.101
Total (F = 0.280, n.s.)	3,714	5%	45%	50%	3.64	0.929

Question: *Fish descending devices are too time consuming to use*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,307	23%	56%	22%	2.94	0.99
State For-hire	211	30%	38%	31%	2.94	1.219
NOAA RCG	199	25%	37%	38%	3.16	1.256
Total (F = 4.053, P = 0.017, eta = 0.047)	3,717	23%	54%	23%	2.96	1.021

Question: *Fish descending devices are easy to use*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,307	27%	51%	22%	2.91	1.053
State For-hire	210	29%	43%	28%	2.96	1.165
NOAA RCG	199	31%	38%	31%	2.99	1.193
Total (F = 0.775, n.s.)	847	27%	50%	23%	2.91	1.067

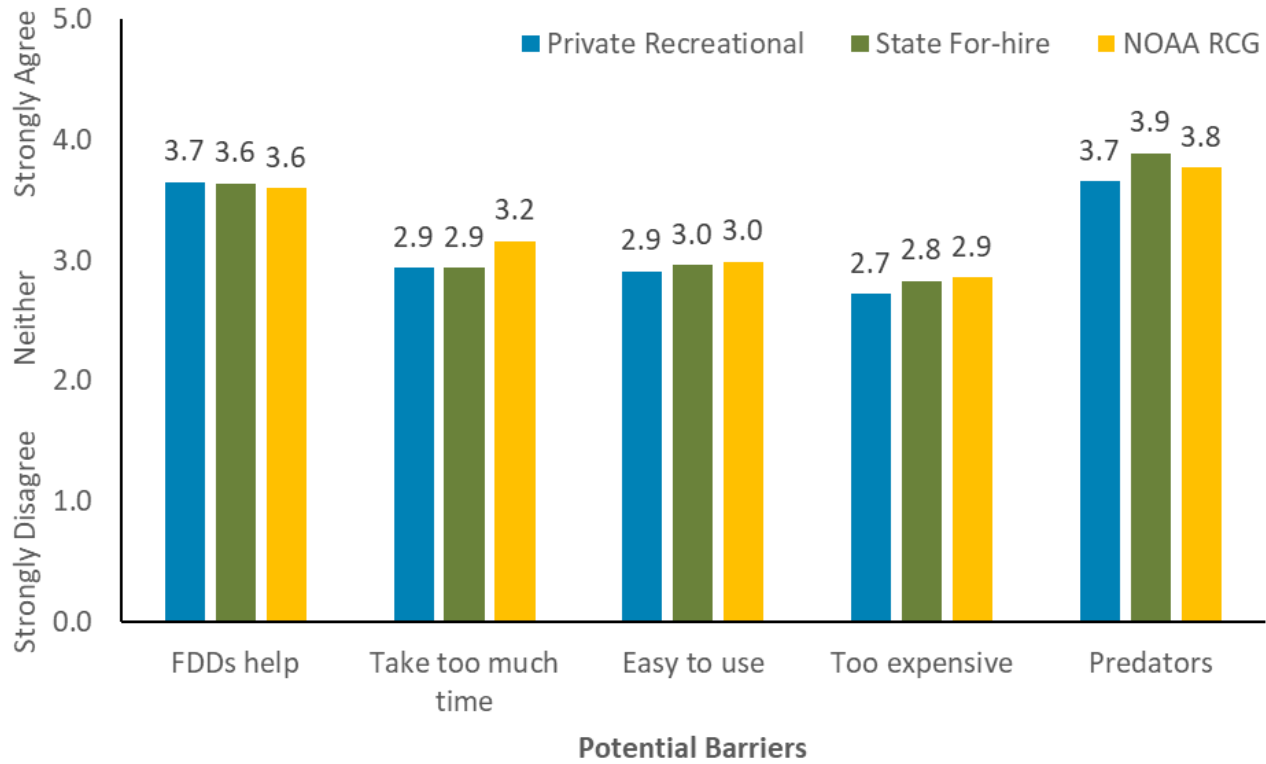
Question: *Fish descending devices are too expensive*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,307	31%	51%	18%	2.72	1.07
State For-hire	211	31%	45%	24%	2.83	1.15
NOAA RCG	199	28%	48%	24%	2.86	1.136
Total (F = 2.558, n.s.)	3,717	31%	51%	18%	2.73	1.079

Question: *Predators often attack fish that are being descended*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,307	8%	37%	55%	3.66	0.964
State For-hire	210	7%	29%	64%	3.89	0.957
NOAA RCG	199	12%	28%	60%	3.77	1.107
Total (F = 6.481, P = 0.002, eta = 0.059)	3,716	9%	36%	56%	3.68	0.974

Figure 28. Mean response towards 5 descending device-related questions that could be perceived as barriers, by angler sector. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”, by angler sector.



Differences between venting methods and descending devices

Given there were differences among the three sectors with respect to both venting methods and fish descending devices, we examined the degree to which those differences occurred among those sectors. While all respondents believed both methods helped return fish to depth (less so for fish descending devices), the perceived barriers of venting were much smaller than fish descending devices. Overall, respondents believed venting methods took less time, were less difficult to use, and were less expensive. In some cases, the effect sizes were large enough to indicate substantial difference in what respondent could perceive as barriers between these two methods of releasing fish. These differences were most apparent for the NOAA RCG respondents (Table 29, Figure 29).

Table 29. Difference in agreement of items that could be considered barriers between venting methods and fish descending devices, by sector. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”.

Question: *Helps fish return to depth when needed*

Sector	n	Venting Methods		Descending Devices		T-value	P	Cohen's D
		Mean	SD	Mean	SD			
Private Recreational	3,302	3.72	1.07	3.65	0.93	3.21	<0.001	0.070
State For-hire	211	4.07	1.10	3.64	0.98	6.56	<0.001	0.413
NOAA RCG	199	4.20	0.96	3.60	1.10	6.56	<0.001	0.582
Total	3,712	3.76	1.07	3.64	0.93	5.66	<0.001	0.120

Question: *Takes too much time*

Sector	n	Venting Methods		Descending Devices		T-value	P	Cohen's D
		Mean	SD	Mean	SD			
Private Recreational	3,305	2.65	1.32	2.94	0.99	-12.66	<0.001	0.248
State For-hire	211	2.24	1.34	2.94	1.22	-5.77	<0.001	0.547
NOAA RCG	199	1.81	0.95	3.16	1.26	-12.77	<0.001	1.210
Total	3,715	2.58	1.32	2.96	1.02	-16.29	<0.001	0.322

Question: *Too difficult to use*¹

Sector	n	Venting Methods		Descending Devices		T-value	P	Cohen's D
		Mean	SD	Mean	SD			
Private Recreational	3,306	2.21	1.05	3.09	1.05	-33.07	<0.001	0.839
State For-hire	210	1.87	1.07	3.04	1.17	-10.77	<0.001	1.048
NOAA RCG	199	1.71	0.92	3.01	1.19	-12.10	<0.001	1.218
Total	3,715	2.16	1.05	3.08	1.07	-36.47	<0.001	0.870

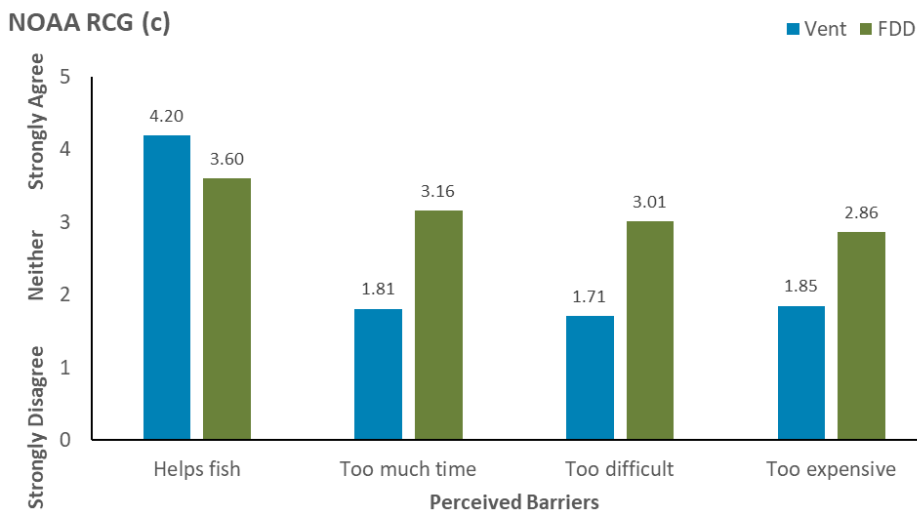
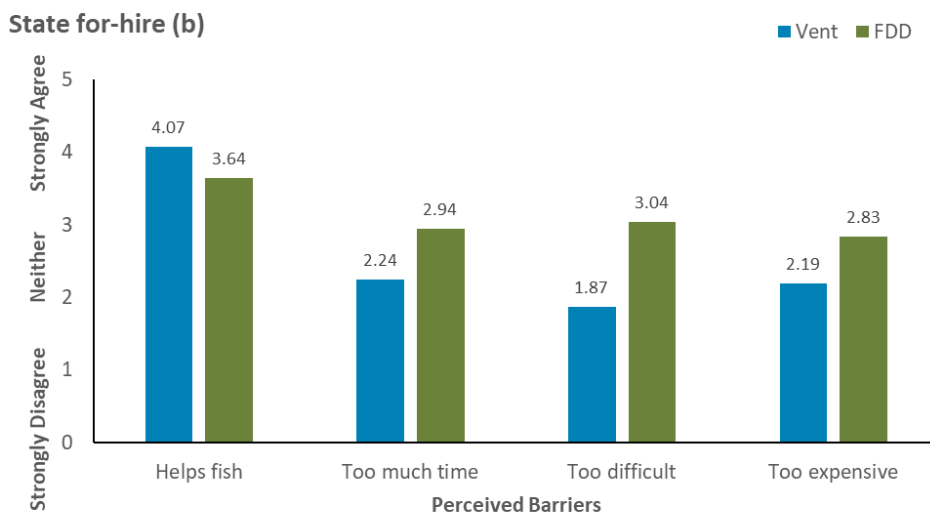
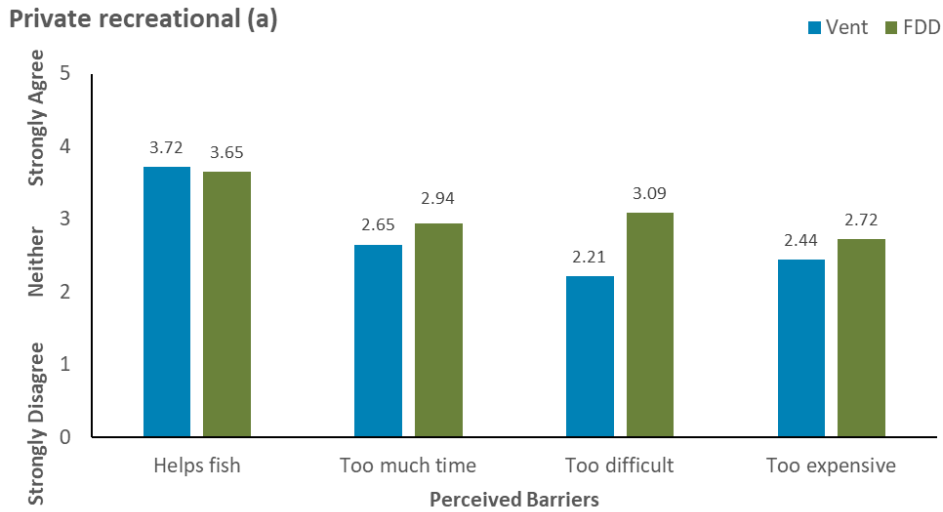
¹FDD ease of use was reverse coded for this comparison

Question: *Too expensive*

Sector	n	Venting Methods		Descending Devices		T-value	P	Cohen's D
		Mean	SD	Mean	SD			
Private Recreational	3,305	2.44	1.11	2.72	1.07	-11.65	<0.001	0.256
State For-hire	211	2.19	1.17	2.83	1.15	-6.44	<0.001	0.551
NOAA RCG	199	1.85	1.02	2.86	1.14	-10.27	<0.001	0.934
Total	3,715	2.40	1.12	2.73	1.08	-14.83	<0.001	0.300

¹FDD ease of use was reverse coded for this comparison

Figure 29. Comparison between venting and descending device mean response towards 4 questions that could be perceived as barriers, by angler sector. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”, by angler sector.



Social Norms

Norms can be referred as what people do, or *ought* to be doing. In this context, social norms can be defined as how members of a person's group believe we should behave. In essence, they can be an expectation of behavior conveyed by our friends, family, or other people we rely on for information. For this study, seven questions were asked about a respondent's belief about how social norms could possibly influence the behavior of using venting methods or FDD to return fish to depth. All questions were measured on a five-point Likert scale from, "1 = Strongly Disagree" to "5 = Strongly Agree", with "3 = Neither Agree or Disagree".

Although there were statistical differences, most respondents agreed that fisheries managers expect them to help fish return to depth when needed (72%, $M = 4.10$, $F=8.27$, $P < 0.001$, $\eta^2 = 0.067$). Most also agreed that anglers help fish return to depth when needed (65%, $M = 3.92$, $F=28.95$, $P < 0.001$, $\eta^2 = 0.125$). Among the sectors, NOAA RCG respondents agreed with this statement (83%) more so than state for-hire (76%) and private recreational (63%) respondents. Of note, respondents indicated they generally did not feel social pressure from others (32% agreed, $M = 3.08$); however, they generally agreed with the other questions related to what others think about returning fish to depth, venting methods, and fish descending devices (Table 30, Figure 30).

This series of questions reinforced that most people want to help fish return to depth, and there is an expectation on the part of the individual to do so (whether to appease fisheries managers or because it is the right thing to do). However, although they did not express outside pressure to do so, most believed other anglers also felt the same way about increasing fish survival and use of the tools that can help accomplish that goal.

Table 30. Degree of agreement with social norms related to returning fish to depth, by angler sector.

Question: *Fisheries managers expect me to help fish return to depth*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,236	3%	26%	71%	4.07	0.92
State For-hire	207	1%	20%	79%	4.31	0.85
NOAA RCG	197	4%	20%	77%	4.22	0.94
Total (F = 8.27, P<0.001, eta=0.067)	3,640	3%	25%	72%	4.1	0.92

Question: *Other anglers think that helping fish return to depth can improve the survival of released fish*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,238	6%	36%	58%	3.75	0.93
State For-hire	207	2%	29%	69%	3.99	0.88
NOAA RCG	197	5%	31%	65%	3.88	0.96
Total (F = 8.21, P<0.001, eta=0.067)	3,642	6%	35%	59%	3.77	0.93

Question: *I feel social pressure from others to help fish return to depth*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,236	23%	44%	33%	3.11	1.18
State For-hire	207	23%	49%	28%	3.04	1.18
NOAA RCG	197	35%	46%	19%	2.65	1.23
Total (F = 14.03, P<0.001, eta=0.087)	3,640	24%	45%	32%	3.08	1.19

Question: *Other anglers support the use of fish descending devices*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,237	9%	53%	37%	3.38	0.87
State For-hire	207	15%	44%	41%	3.36	1.07
NOAA RCG	197	21%	51%	28%	3.11	1.02
Total (F = 8.47, P<0.001, eta=0.068)	3,641	10%	53%	37%	3.36	0.89

Question: *Anglers like me help fish return to depth when needed*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,236	5%	32%	63%	3.88	0.97
State For-hire	207	4%	20%	76%	4.2	0.99
NOAA RCG	197	4%	14%	83%	4.32	0.91
Total (F = 28.95, P<0.001, eta=0.125)	3,641	5%	30%	65%	3.92	0.98

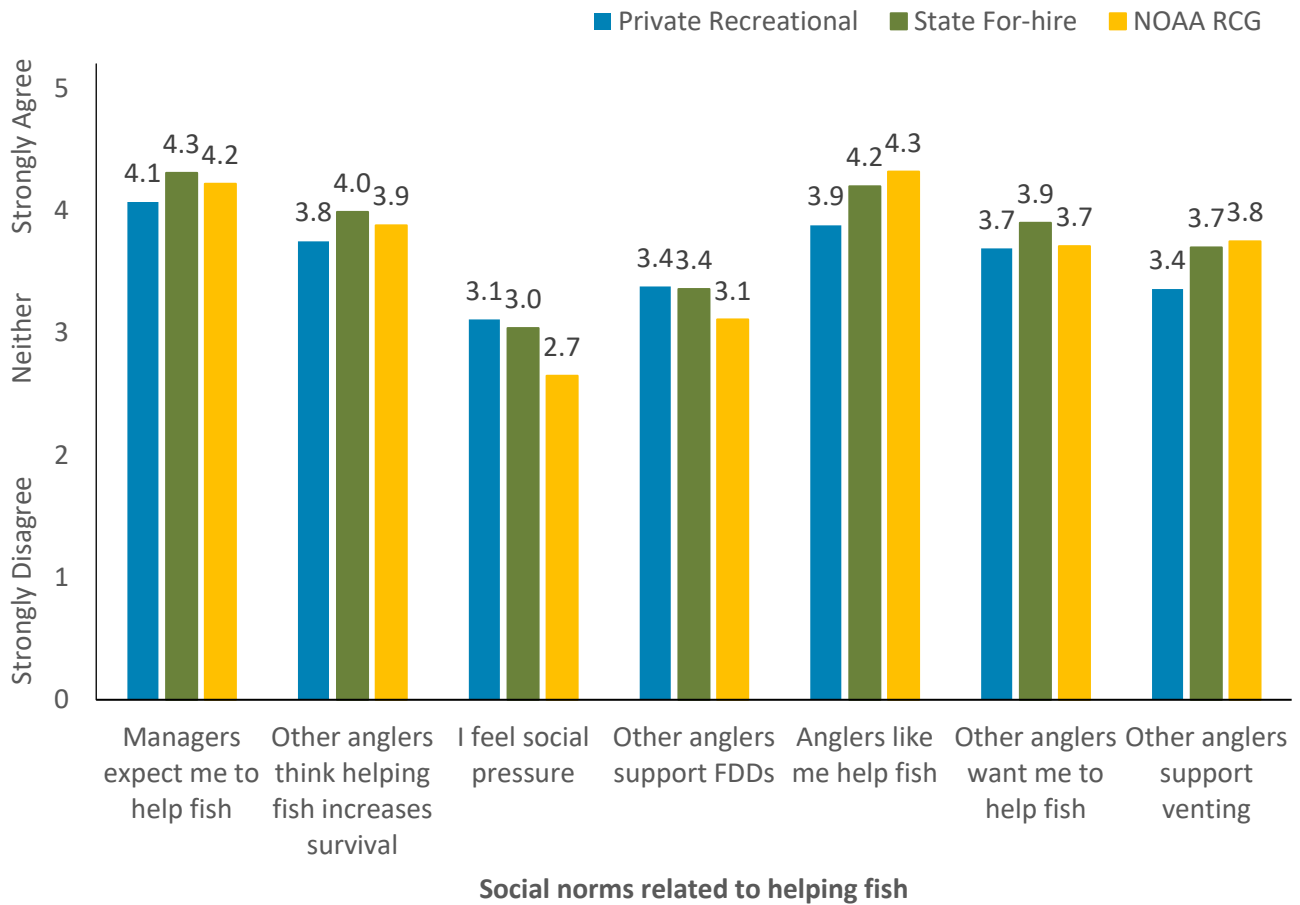
Question: *Other anglers expect me to help fish return to depth when needed*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,236	6%	39%	55%	3.69	0.92
State For-hire	206	6%	32%	62%	3.9	1.04
NOAA RCG	197	8%	39%	54%	3.71	1.00
Total (F = 4.83, P=0.008, eta=0.051)	3,639	6%	38%	55%	3.71	0.93

Question: *Other anglers support the use of venting tools*

Sector	n	Disagree	Neither	Agree	Mean	SD
Private Recreational	3,235	13%	47%	40%	3.36	1.02
State For-hire	207	8%	36%	56%	3.7	1.01
NOAA RCG	197	9%	34%	57%	3.75	1.06
Total (F = 23.38, P<0.001, eta=0.113)	3,639	12%	46%	42%	3.4	1.03

Figure 30. Mean response to social norms related to helping reef fish survive, by sector. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”, by angler sector.



Perceived Behavioral Control

Ten questions were asked about a respondent's belief in their ability to control fish survival and the tools they might use. Specifically, they were asked about perceptions of reef fish survival in general, their role in survival, and knowledge/use of tools designed to return fish to depth. As expected, there were differences among the three sectors, with private recreational anglers differing more than either state for-hire or NOAA RCG respondents.

Slightly more than half of private recreational anglers (56%) believed they were confident in their abilities to return fish to depth. Conversely, 74% of state for-hire and 84% of NOAA RCG individuals responded similarly. A relatively small percentage of respondents ($\leq 12\%$) believed helping fish return to depth was out of their control, and a majority do not agree that most reef fish die anyway.

Regarding training, only 9% of NOAA RCG respondents indicated they needed more, while 20% of state for-hire and 39% of private recreational respondents believed they would benefit from more training. NOAA RCG (32%) and state for-hire (26%) respondents also believed tools used to return fish to depth get lost, while 16% of private recreational anglers responded similarly (Table 28).

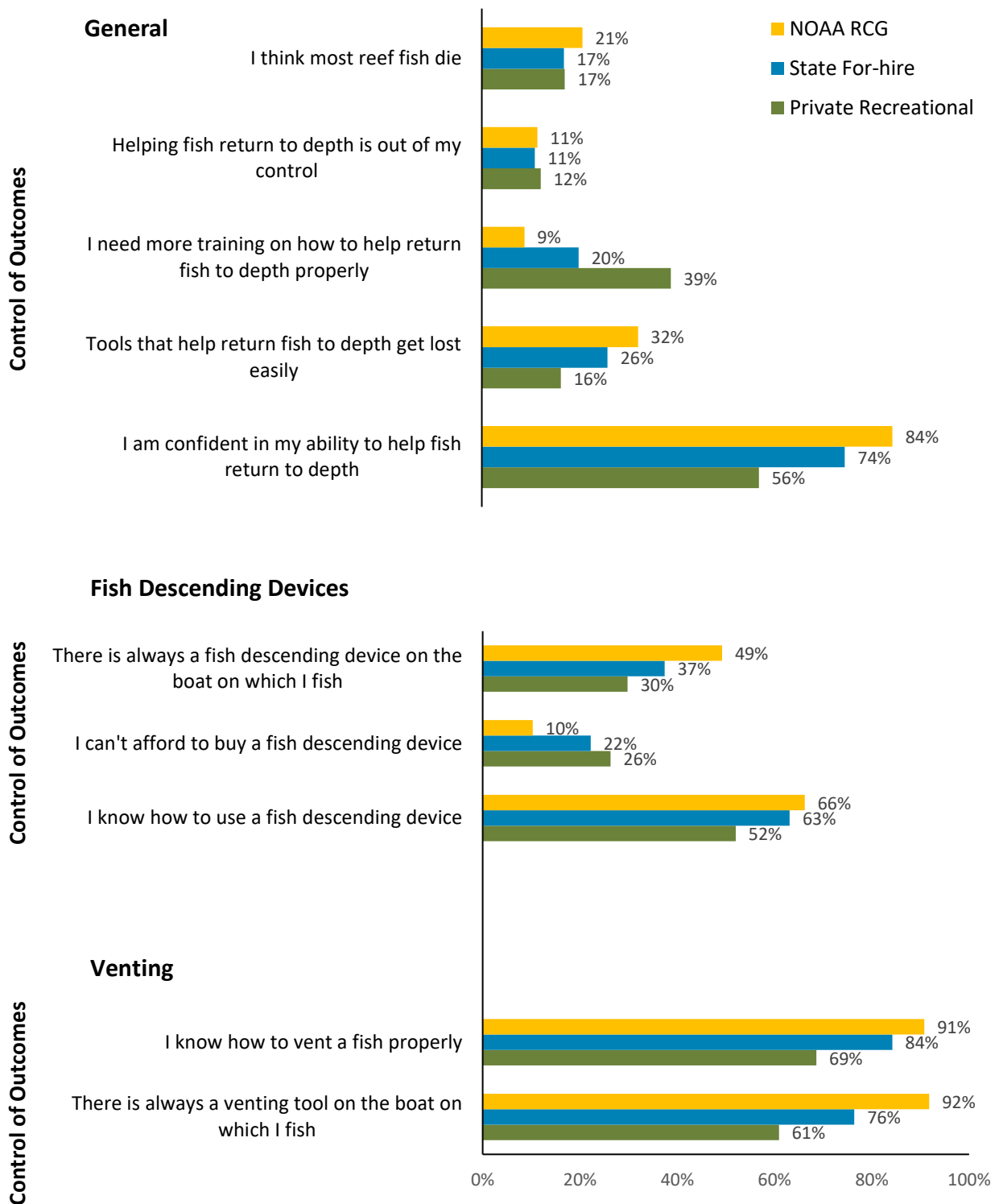
Nearly all NOAA RCG respondents always had a venting tool on the boat when they fished (92%) and they believed they know how to properly vent a fish (91%). The percentages were slightly lower for state for-hire (76% had a device onboard and 84% knew how to vent properly) and private recreational anglers (61% had a device onboard and 69% knew how to vent properly).

Conversely, less than half of all respondents had a descending device on the boat (30 - 49%) and half (private = 52%) to two-thirds (NOAA RCG = 66%) believed they know how to use a FDD. Only 10% of NOAA respondents agreed with the question, "I can't afford to buy a fish descending device"; however, 22% of state for-hire and 26% of private recreational indicated similarly (Table 31, Figure 31).

Table 31. Knowledge about returning fish to depth and use of venting tools and fish descending devices, by angler sector.

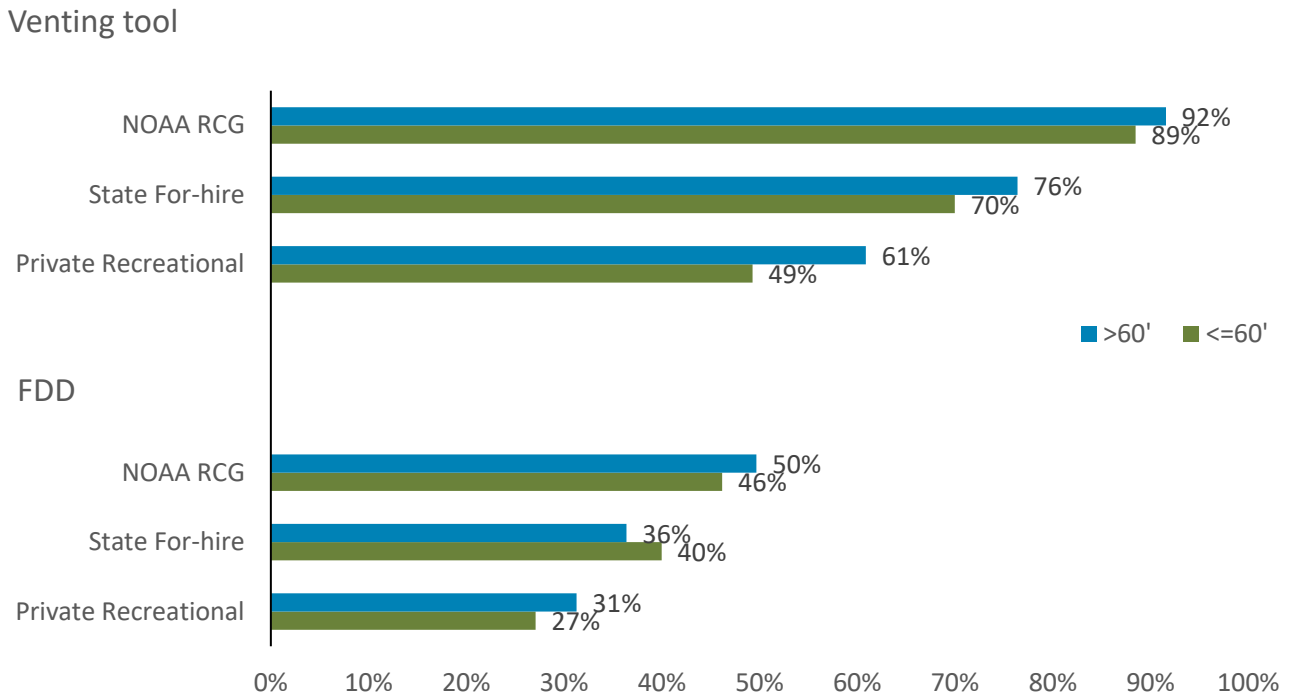
Question	Private		State for-hire		NOAA RCG	
	Recreational					
	% Agree	Mean	% Agree	Mean	% Agree	Mean
General						
I am confident in my ability to help fish return to depth	56%	3.57	74%	4.09	84%	4.50
Tools that help return fish to depth get lost easily	16%	2.64	26%	2.84	32%	3.00
I need more training on how to help return fish to depth properly	39%	3.03	20%	2.40	9%	1.96
Helping fish return to depth is out of my control	12%	2.30	11%	2.08	11%	2.05
I think most reef fish die	17%	2.46	17%	2.33	21%	2.45
Venting						
There is always a venting tool on the boat on which I fish	61%	3.82	76%	4.31	92%	4.72
I know how to vent a fish properly	69%	3.89	84%	4.44	91%	4.68
Descending Devices						
There is always a fish descending device on the boat on which I fish	30%	2.91	37%	3.20	49%	3.47
I know how to use a fish descending device	52%	3.50	63%	3.96	66%	4.06
I can't afford to buy a fish descending device	26%	2.84	22%	2.65	10%	2.32

Figure 31. Knowledge about returning fish to depth and use of venting tools and fish descending devices, by angler sector.



Of note, the depth fished most often had a small effect as to whether or not respondents had a venting tool or fish descending device on board when they fished. NOAA RCG and state for-hire anglers were most likely to have a venting tool on board whenever they fished, while private recreational anglers were slightly more likely to have one if they fished in water deeper than 60 feet (49% vs. 61%). Fish descending devices were less likely to be onboard in general, regardless of depth fished (Figure 32).

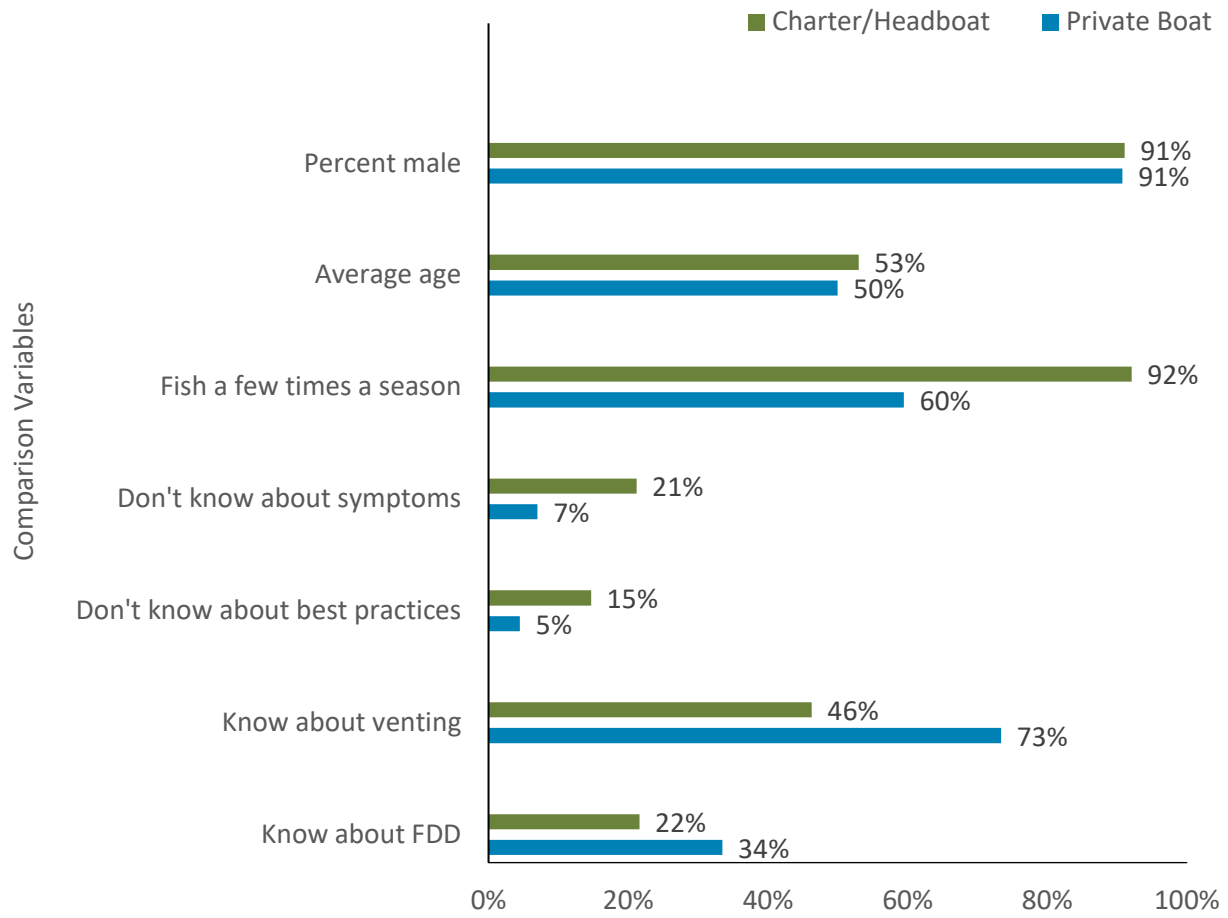
Figure 32. Likelihood of having a venting tool or fish descending device onboard while fishing, by depth fished most often and angler sector.



Private Recreational Anglers who fish on a Charter or Headboat

Although the percentage of private recreational respondents who fished on a charter or headboat was small (6%), there were differences worth highlighting between this group and anglers who fished from a private boat. Although there were no differences in gender (91% male, $\chi^2 = 0.011$, $P = 0.915$), charter/headboat anglers were significantly older (52.7 vs. 49.8 years; $t = -2.089$, $P = 0.005$, Cohen’s $D = 0.219$). The vast majority (92%) only fished a few times a season, compared with 60% of private boat anglers. More importantly, they were most likely to not know about barotrauma symptoms (21% vs. 7%) or to not know of any of the presented options to return fish to depth (15% vs. 5%). There were also differences between knowledge of venting methods (46% vs. 73%) and fish descending devices (22% vs. 34%) (Figure 33).

Figure 33. Differences between selected variables for private recreational anglers who fished on either a charter/headboat or from a private boat.



General Sources of Information

Where individuals seek information is critical to designing an outreach program that is both efficient and effective, especially for a multi-year outreach project. Respondents were asked to indicate all the sources where they get their information about reef fishing in general. Overall, over half of respondents got their information from other anglers (56%) or websites (52%). This was followed closely by regulation books (39%), fishing apps (39%), and social media (31%). Much smaller percentages used more traditional channels, such as television (12%), radio (10%), or clubs/seminars (7% each) (Figure 34). Among sectors, the only real difference was that NOAA RCG respondent relied more heavily on information from state/federal offices (Table 32).

Of those using social media, a majority (56%) used Facebook, 25% used YouTube, and 13% used Instagram. No other social media platform was higher than 2% (Figure 35). Nearly all individuals who noted ‘other’ said their personal fishing experience was the source of their information. The only difference among sectors is NOAA RCG respondents used Facebook more often (73%), state for-hire used Instagram (21%), and private recreational anglers used YouTube (27%) more often (Figure 36).

Figure 34. Where respondents seek information about reef fishing in general.

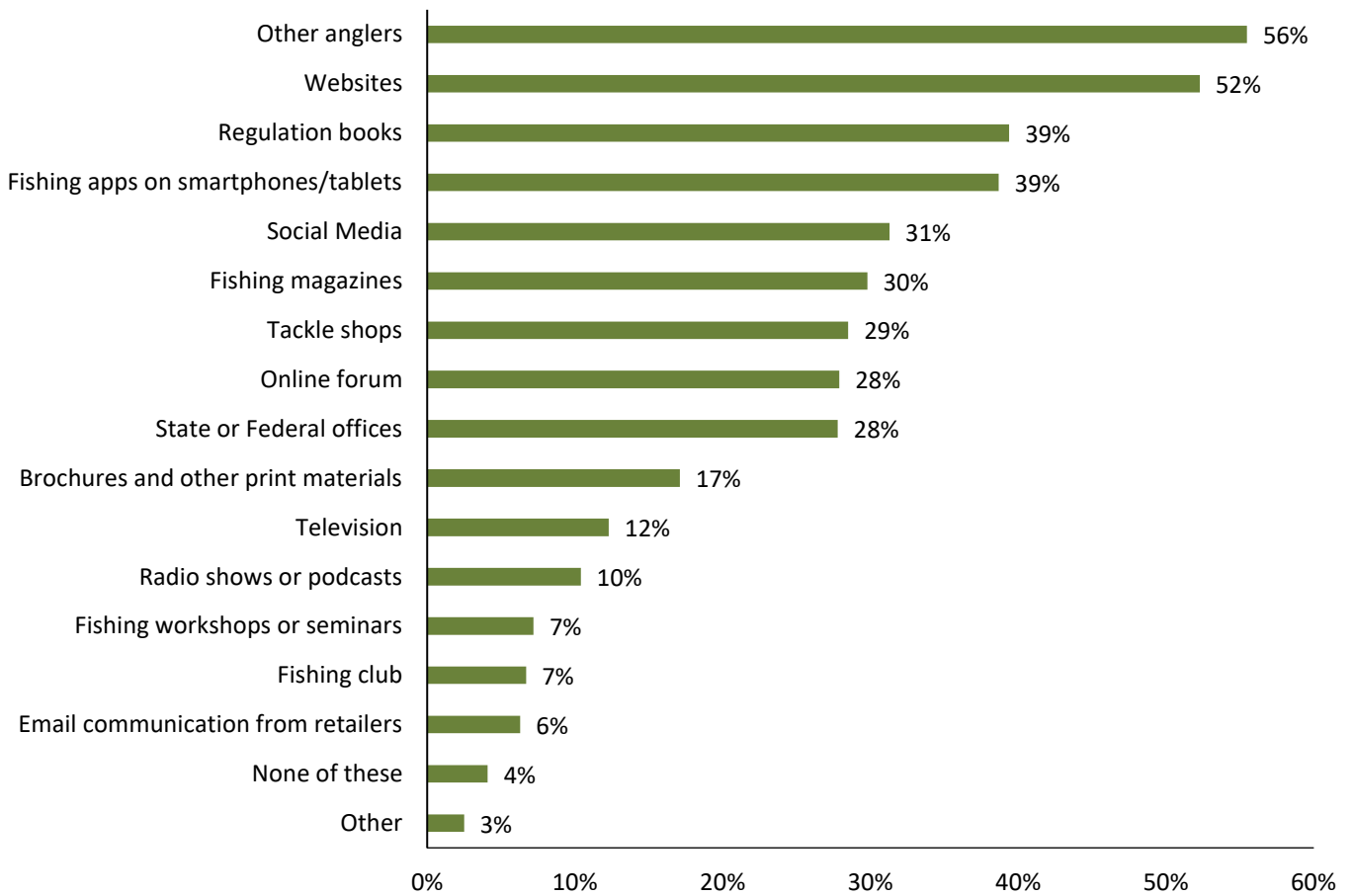


Table 32. Where respondents get their information about reef fishing, by angler sector. Ranks for each sector are shown in parentheses.

Source of Information	Sector (Rank)			Total
	Private Recreational	State For-hire	NOAA RCG	
Other anglers	56% (1)	57% (1)	43% (3)	56%
Websites	53% (2)	52% (2)	48% (1)	52%
Regulation books	39% (3)	43% (3)	41% (4)	39%
Fishing apps on smartphones/tablets	38% (4)	42% (4)	39% (5)	39%
Social Media	32% (5)	33% (6)	24% (6)	31%
Fishing magazines	31% (6)	26% (8)	16% (8)	30%
Tackle shops	29% (7)	33% (6)	15% (10)	29%
Online forum	29% (7)	24% (9)	19% (7)	28%
State or Federal offices	26% (9)	39% (5)	45% (2)	28%
Brochures and other print materials	17% (10)	20% (10)	16% (8)	17%
Television	13% (11)	10% (12)	5% (16)	12%
Radio shows or podcasts	11% (12)	10% (12)	6% (15)	10%
Fishing workshops or seminars	7% (13)	12% (11)	14% (11)	7%
Fishing club	7% (13)	8% (14)	7% (14)	7%
Email communication from retailers	6% (15)	8% (14)	8% (12)	6%
None of these	4% (16)	4% (16)	8% (12)	4%
Other	2% (17)	4% (16)	5% (16)	3%

Figure 35. Social media platform used most often by for-hire respondents (n = 2,750).

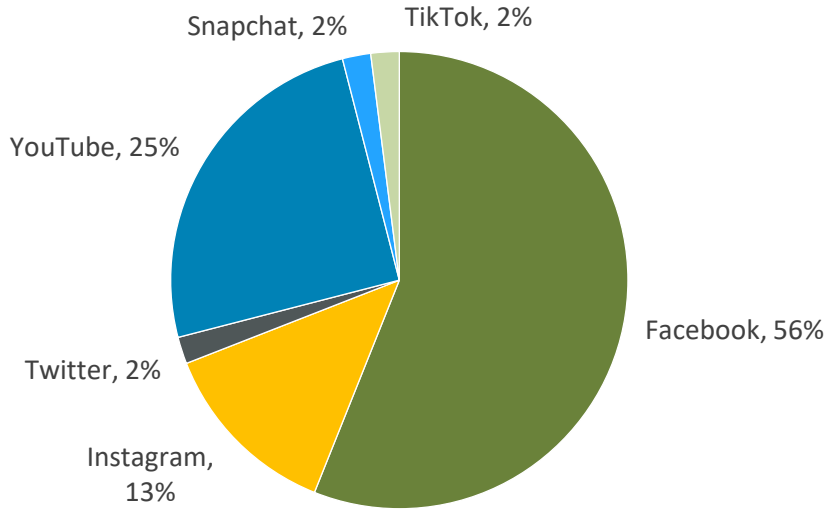
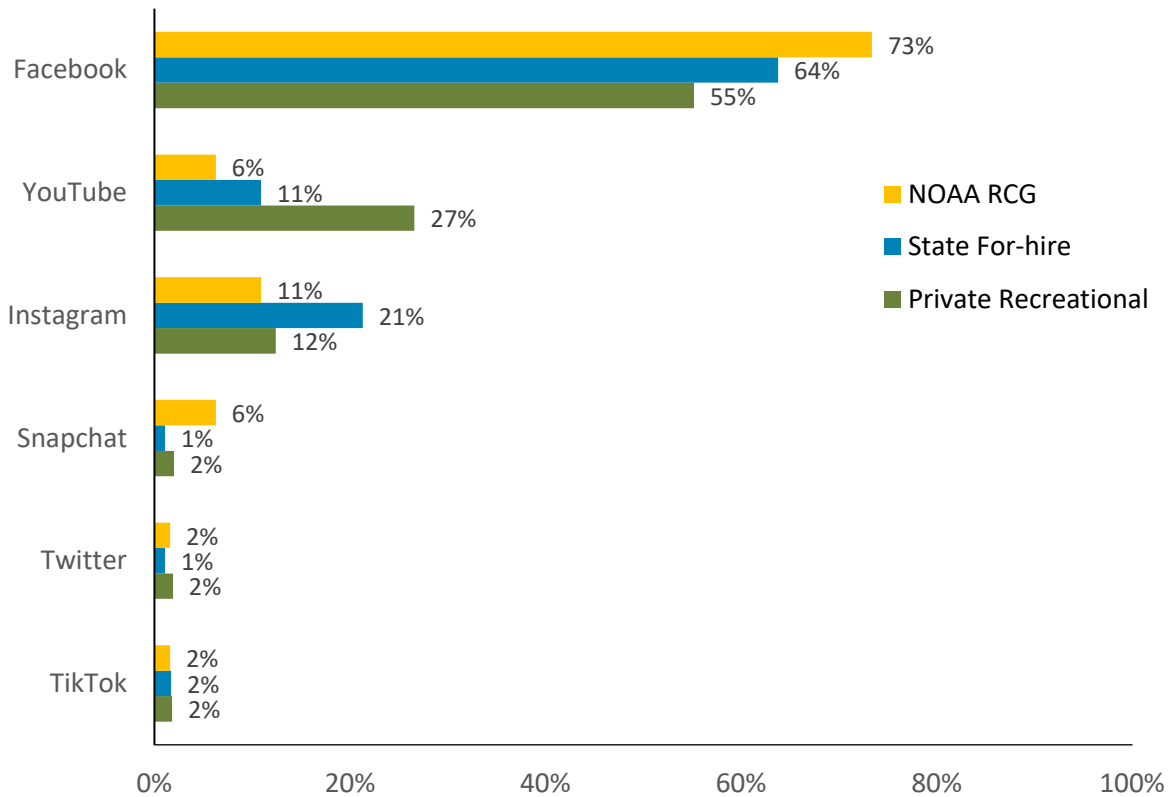


Figure 36. Use of social media channels, by angler sector.



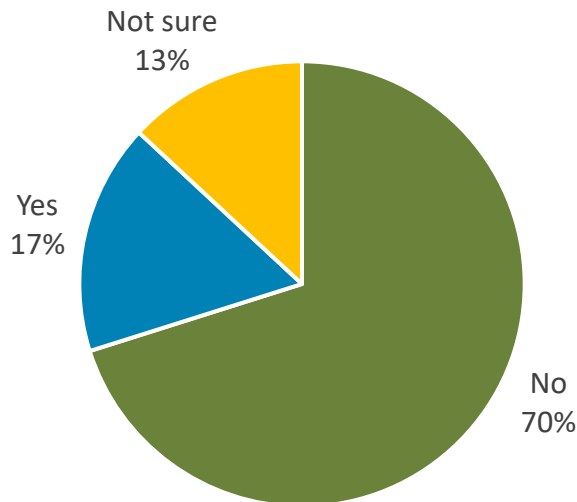
Return 'Em Right Program

An integral component of this project is to evaluate the effectiveness of communication messaging through the “Return 'Em Right” program on behavioral change (change in use of fish descending devices). The NOAA RCG survey was fielded September 25 – October 25, 2021, with the knowledge that some outreach would occur prior to survey fielding (Table 33). For the NOAA RCG sector, the public launch was on September 14th and this survey fielded two weeks later, there is a possibility some respondents would have heard of the program. Indeed, 17% of respondents had already heard of the RER program, 70% had not, and 13% were not sure (Figure 37).

Table 33. Dates and outreach conducted through the Return 'Em Right program.

Approximate Date	Outreach
July 30	Florida Sportsman Call to Action piece published in print magazine
August 3	Florida Sportsman Call to Action posted on social media and online
September 14	Website live, press releases distributed, public launch of Return 'Em Right
September 17	Dylan Hubbard Fox News Report
October 6	Presentation to ASA Government Affairs Committee at ASA Sportfishing Summit
October 15	Launch of education training/gear distribution to federally permitted captains, email to federal group, mailer sent out
October 16	Dylan Hubbard Reel Animals Podcast with Emily Muehlstein
November 9	Follow-up email sent

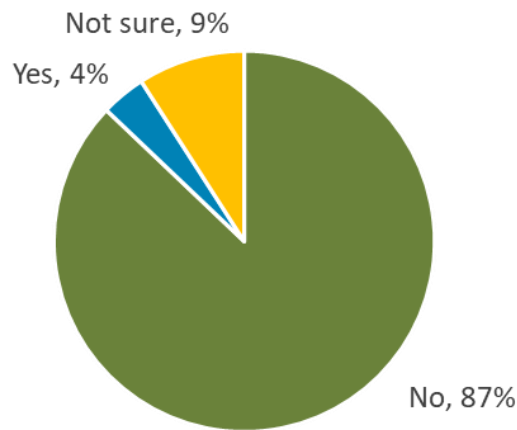
Figure 37. Percent of NOAA RCG respondents who have heard of the Return 'Em Right program.



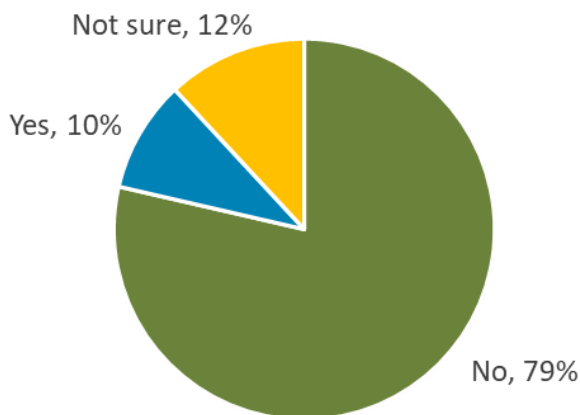
The recreational survey (private recreational and state for-hire) was fielded 11 November through 6 December 2021, which was before any direct outreach was conducted with these sectors. As expected, a smaller percentage of private recreational (4%) and state for-hire (10%) had heard of the Return 'Em Right program by the time the survey was fielded (Figure 38). Respondents (n = 143)¹⁴ were also asked where they heard about the Return 'Em Right program. Of the list provided, most heard from social media (29%) or from another angler (24%). Smaller percentages heard about it from a magazine/newspaper (13%), direct email (11%), or a website (11%) (Figure 39).

Figure 38. Percentage of private recreational (a) and state for-hire (b) respondents who had heard of the Return 'Em Right program.

Private recreational (a)

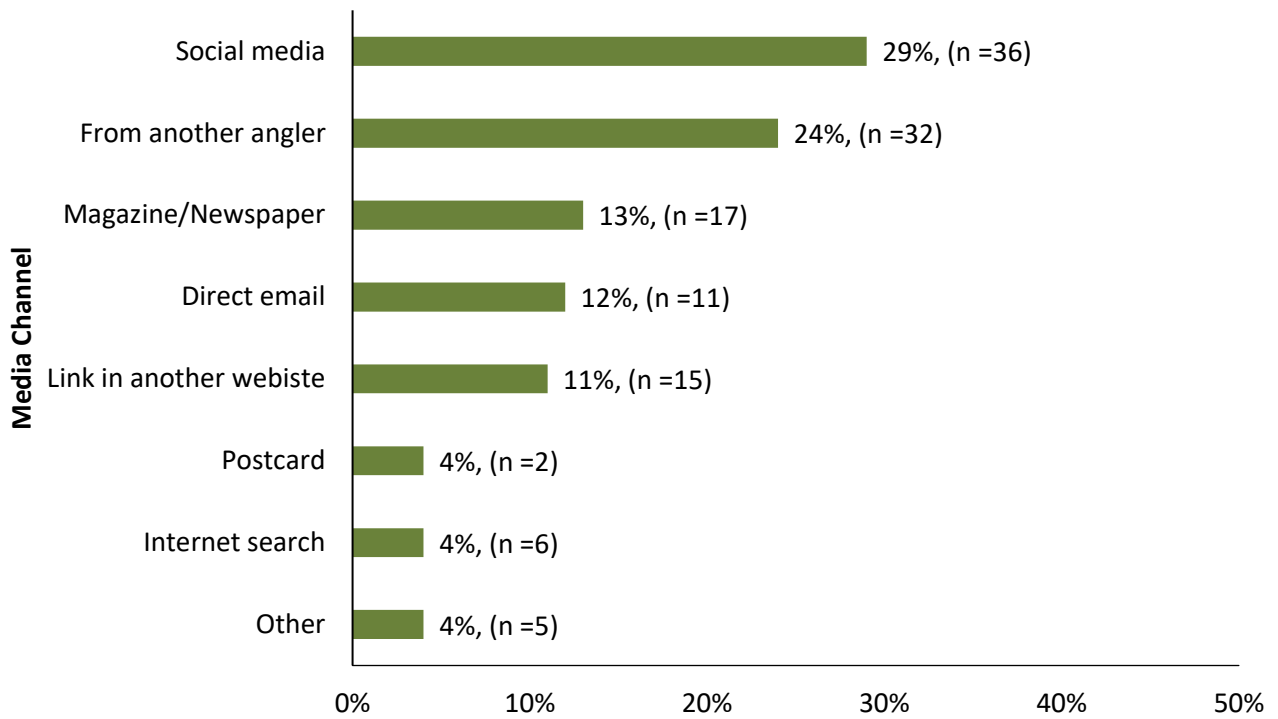


State for-hire (b)



¹⁴ Due to small sample sizes, private recreational and state for-hire respondents were combined.

Figure 39. Where respondents (percentage and number) had heard of the Return 'Em Right program.



Open-ended Comments – private recreational respondents

Respondents were offered the opportunity to provide open-ended comments, and several indicated a desire to help fish survive. The most frequent themes among private recreational respondents were concerns about red snapper, regulations, conservation, and commercial fishing. Predation from sharks and dolphins was mentioned less frequently (Figure 40).

Figure 40. Word cloud based on open-ended comments received by private recreational respondents.



Acknowledgments

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Appendix A. NOAA RCG For-Hire Gulf of Mexico Angler Survey Report.

Angler Awareness and Use of Fish Descending Devices – NOAA Charter/Head Boat Permittees



PO Box 6435 ■ Fernandina Beach, FL 32035 ■ Office (904) 277-9765

January 18, 2022

Gulf States Marine Fisheries Commission
Ocean Springs, Mississippi

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Executive Summary

The primary purpose of this study was to obtain baseline information from NOAA-permitted Gulf of Mexico reef fish charter and head boat operators about barotrauma and best fishing practices. This is the first report from a series of surveys that will be conducted for the Gulf States Marine Fisheries Commission (GSMFC) in 2021 and 2024. This research is a cross-sectional study and will encompass both the for-hire and recreational sectors across all five Gulf States. As part of the study, data from this report will be aggregated with a recreational/state-licensed charter survey and re-analyzed once that study is completed.

The survey was distributed via email to the population of NOAA-permitted Gulf of Mexico reef fish Charter/Headboat permittees with an email on file (n = 910). Five survey waves were sent over a one-month period and a 30% response rate was obtained. Overall, respondents were predominantly white (95%) and male (97%); the average age was 53 years and they had 25 years of reef fishing experience in the Gulf of Mexico.

Key Points

- 87% fished in waters deeper than 60 feet that would potentially warrant barotrauma mitigation efforts (use of descending or venting tools).
- 97% recognized at least one scientifically recognized barotrauma symptom.
- 99.5% recognized at least one best fish handling protocol; 92% knew about venting and 59% were aware of fish descending devices (FDD).
- Only 2.6% of those who were aware of venting had never vented fish; conversely, 23% of those who were aware of FDDs had never used one.
- Respondents had a desire to return fish to depth when needed (67%) and believe that helping fish leads to higher survival (66%).
- Despite believing that returning fish to depth provides more fish, only 37% believed that longer seasons would be provided.
- Venting tools were most often carried on the boat (92%) and most (91%) indicated they could properly vent a fish.
- Less than half (49%) had a FDD on the boat, and 66% of those indicated that they knew how to use it properly.
- Information about reef fishing was obtained from State/Federal offices (48%) and websites (48%) most often. Social media was used by 24% of respondents. Of those, Facebook was used most often (73%).
- 17% of respondents had already heard of the “Return ‘Em Right” program, which is encouraging given the timing of outreach and this survey.
- Respondents were concerned about the impacts of predation on fish that were returned to depth using descending devices.

Introduction

This research is the first part of a cross-sectional study of recreational and for-hire anglers in the Gulf of Mexico. The study is designed to measure change in angler awareness, perceptions, and application of best fishing practices related to the Gulf of Mexico reef fishery. A baseline survey of NOAA-permitted charter and head boat operators (Federal for-hire sector) conducted in Fall 2021 is presented here. The same survey will be fielded in Fall 2024 to measure any changes resulting from the Return Em' Right outreach campaign. While this report will stand alone, these data will be later aggregated with the recreational/state-permitted commercial survey, re-analyzed, and included in a larger report. This project is funded by the Gulf States Marine Fisheries Commission (GSMFC) through the NOAA Damage Assessment, Remediation, and Restoration Program.

Previous efforts to reduce barotrauma-related release mortality in Gulf of Mexico recreational reef fish fisheries, including venting and release tool requirements and recommendations for fish descending devices (FDDs), have been met with limited success. Simply requiring release tools to be on-board and readily available does not mean anglers will use them properly, or at all. Increased use of FDDs (and, secondarily, venting tools), as well as best practices for handling and releasing fish require educational outreach for both the public and private sectors. Such efforts have been conducted on small scales (e.g., less than 3,000 participants as in Curtis et al., 2019) in the past and others are currently underway with more planned. However, large-scale educational strategies will be necessary to achieve measurable behavior changes across Gulf anglers (and associated conservation benefits), plus evaluations to identify improvements and measure success. Ultimately, the measurement of these changes should equate to a measure of conservation benefit, such as an increased number of fish that survive due to implementing the recommended tools and techniques. Curtis et al., (2019) demonstrated that this is possible and extending this technique Gulf-wide may impart measurable conservation objectives as required under NOAA's Damage Assessment, Remediation, and Restoration Program.

Successful evaluation efforts will first require a baseline understanding of anglers' current use of FDDs and other tools, their perceptions about the effectiveness of these, current practices regarding release procedures plus barriers to adopting these practices. Once a baseline is established and educational outreach efforts are implemented, follow-up surveys will measure any changes in anglers' use and perceptions of FDDs and best practices while also measuring any change in their perceived barriers to greater adoption of descending devices. In addition, feedback regarding communication and media channels to reach anglers, plus which educational messages and approaches would be most effective, will be collected to improve the success of future outreach and education campaigns.

Methods

A complete list of NOAA Gulf of Mexico Charter Headboat for Reef Fish (RCG) permittees (n = 1,244) was obtained by the GSMFC, who shared the data with permission from NOAA. Of those, 910 individuals had an email on file and served as the sample population for this study. We contacted recipients five times via

email with invitations to complete a brief questionnaire, using the online platform Alchemer. Prior to fielding the survey, questions, content flow, and readability with participating states and project partners was tested. Multiple revisions were made and the survey was fielded five times from 25 September through 25 October 2021.

The survey consisted of sections that addressed fishing experience, fishing depth and practices for releasing reef fish, knowledge and experience with barotrauma and mitigation techniques, sources of information, and demographics.

Throughout the survey, the term “barotrauma” was not used. Similar to Crandell et al. (2018), the belief was that using that term may cause confusion and potentially bias results. In addition, there was concern among reviewers that the term may evoke negative reactions among survey recipients. Thus, the term “return to depth” was used instead. Similarly, the term “best practices” was generally not used in the survey but rather characterized in questions by behaviors being promoted in the "Return 'Em Right" program, supplemented with other practices that have been demonstrated to enhance survival of released fish (e.g., rubberized landing nets). This array of questions will facilitate the differentiation between exposure to the "Return 'Em Right" messaging and other messaging in the post-outreach survey.

The Statistical Package for the Social Sciences (SPSS, V22) and Program R were used to analyze all data. Statistical differences were measured using T-tests, Analysis of Variance (ANOVA) and Chi-square tests. Differences were considered significant when $P < 0.05$. Because there were only two responses from Mississippi, those data are included in the general summaries, but not in any state-level analyses.

Results

Response Rate and Demographics

Of the 910 surveys distributed, 58 were undeliverable, which resulted in a delivered sample size of 852. A total of 257 respondents returned a survey; of those, 191 were completed fully, 35 were partially completed, and 31 indicated they did not operate a charter/head boat during 2021, resulting in a 30.2% response rate. The 31 respondents who did not operate a charter were disqualified after the first question and are not represented in this report.

Nearly all respondents were white (95%) and male (97%); the average age was 53 years. Respondents averaged 25 years of reef fishing experience in the Gulf of Mexico. The vast majority (91%) operated a charter boat, 6% operated a head boat, and 3% identified as recreational anglers (even though they held a NOAA reef fish permit). We observed no differences in age ($F = 1.493$, $P = 0.206$) or years of reef fishing experience ($F = 0.443$, $P = 0.777$) among the angler types.

Over two-thirds (70%) identified Florida as the state from which they primarily launched for reef fishing in the Gulf of Mexico, followed by Alabama (12%), Texas (11%), Louisiana (6%), and Mississippi¹⁵ (1%). These proportions align closely with the total population of RCG permittees with mailing addresses in a Gulf State (96%; $n = 1,191$; Figure 1).

Most respondents reef fished either daily (38%) or a few times a week (38%), with those from Alabama most often indicating they fished daily (68%). Nearly three quarters of respondents most often fished at depths between 61 and 150 feet (73%) and as expected a small percentage fished at depths less than 60 feet (13%). Louisiana anglers tended to fish in over 150 feet of water most often, which may be an artifact of small sample size (64%, $n = 14$, Figure 2).

¹⁵ There were only 2 responses from Mississippi, so those data are not included in state-level analyses.

Figure 1. Percent of RCG permittees residing in a Gulf State (96%) and state launched by for-hire respondents. Graph indicates that incoming survey responses were in-line with outgoing invitations.

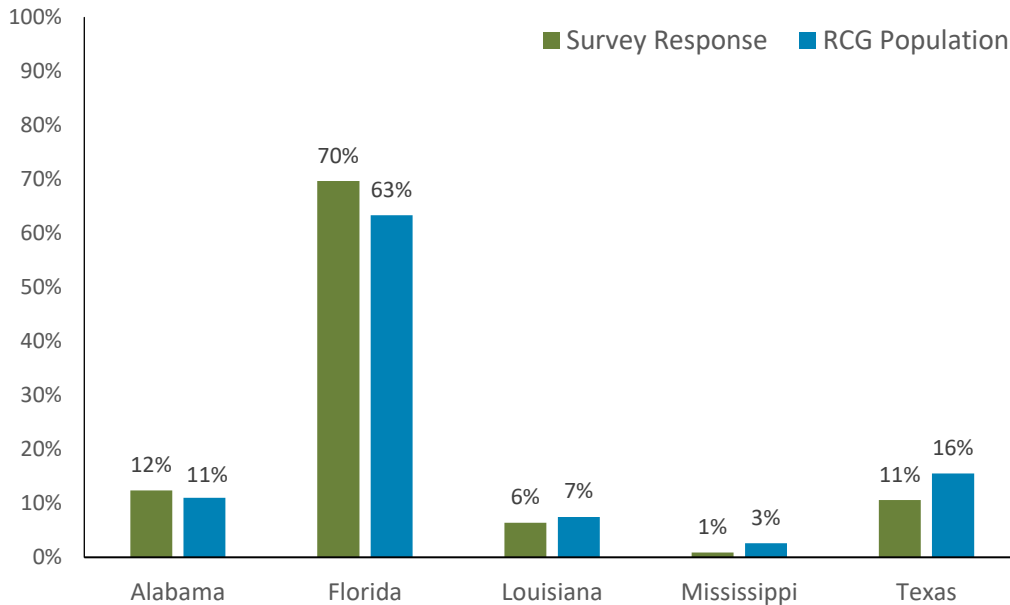
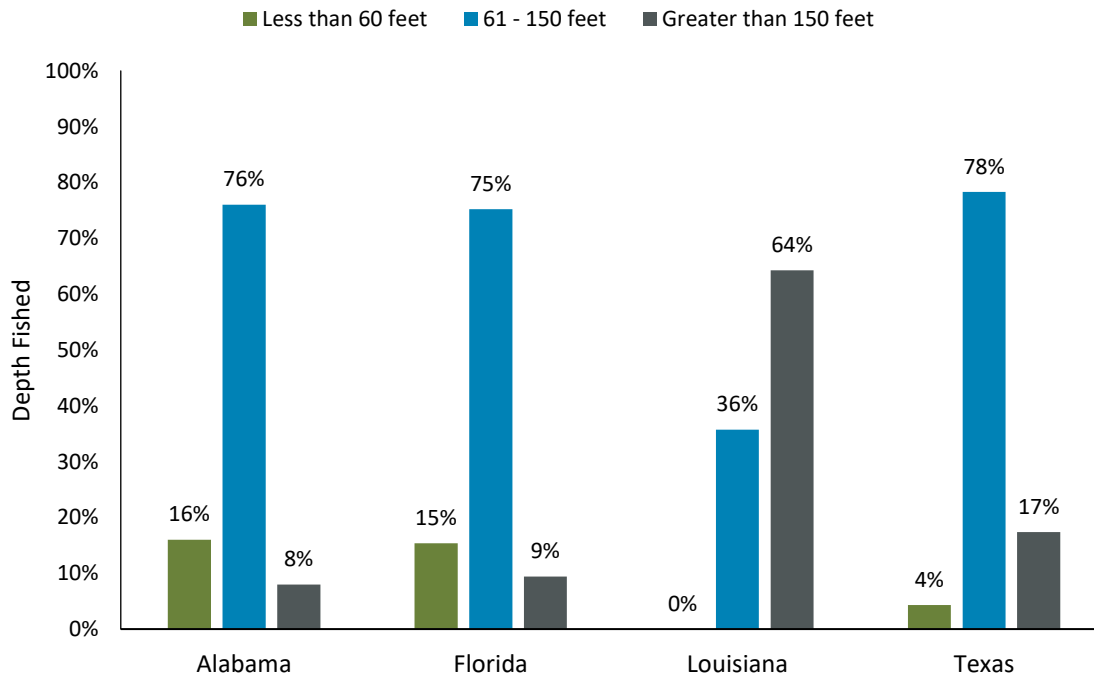


Figure 2. Depth fished most often by for-hire respondents, by state.

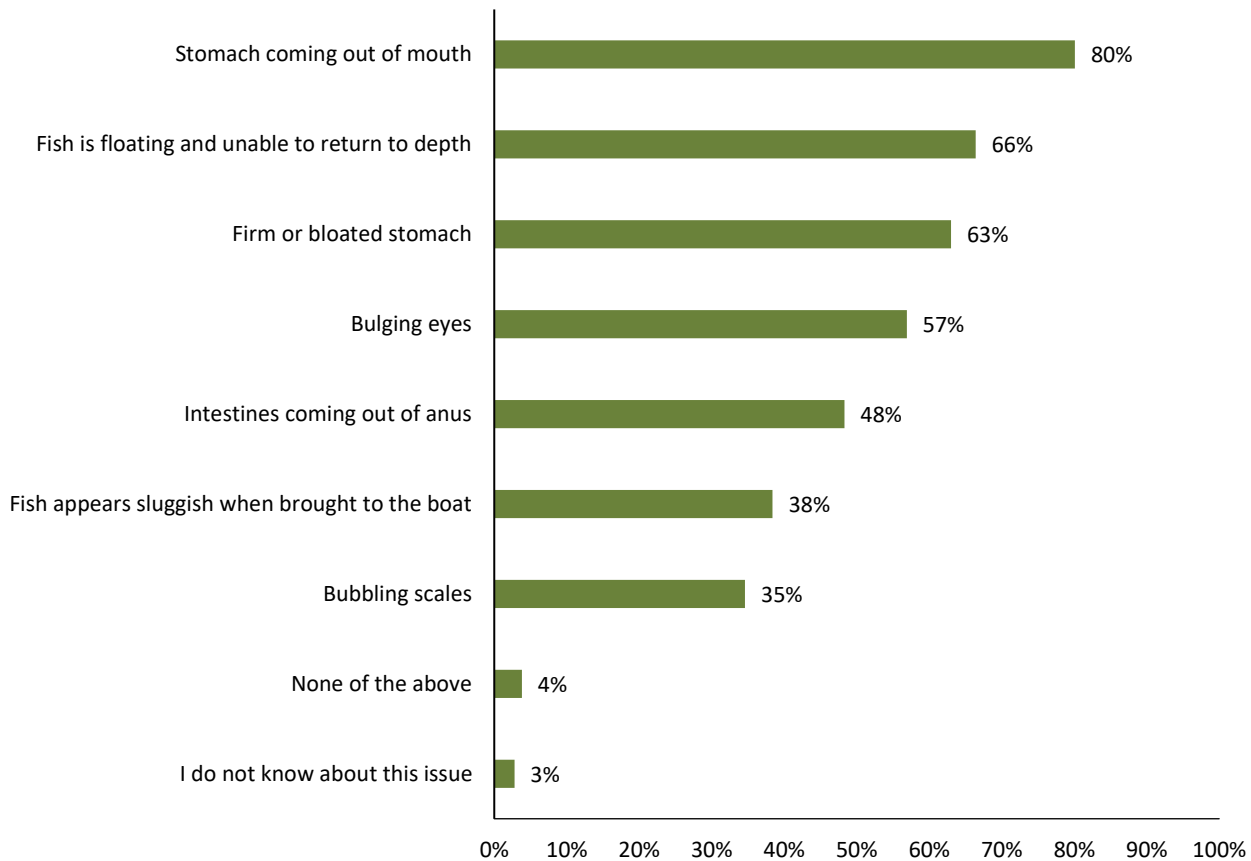


Knowledge and Use of Barotrauma and Best Release Protocols

Knowledge of barotrauma and best release practices was assessed using three questions related to 1) recognizing the symptoms, 2) awareness of best release practices (as described in the Methods), and 3) how often they used best release practices. For individuals who vented fish, the type of tool they most often used was also asked.

Respondents were posed the question, “Which of the following signs do you use to recognize that a fish may need help returning to depth? Please check all that apply”. Overall, 97% of respondents recognized at least one of the seven presented barotrauma symptoms. The stomach coming out of the mouth (80%), fish floating on the surface (66%), and firm/bloated stomach (63%) were noted most often, while bubbling scales (35%) was noted least often (Figure 3). There were no state-level differences (Chi-square test, $P > 0.05$ in all cases) for any of the 7 symptoms.

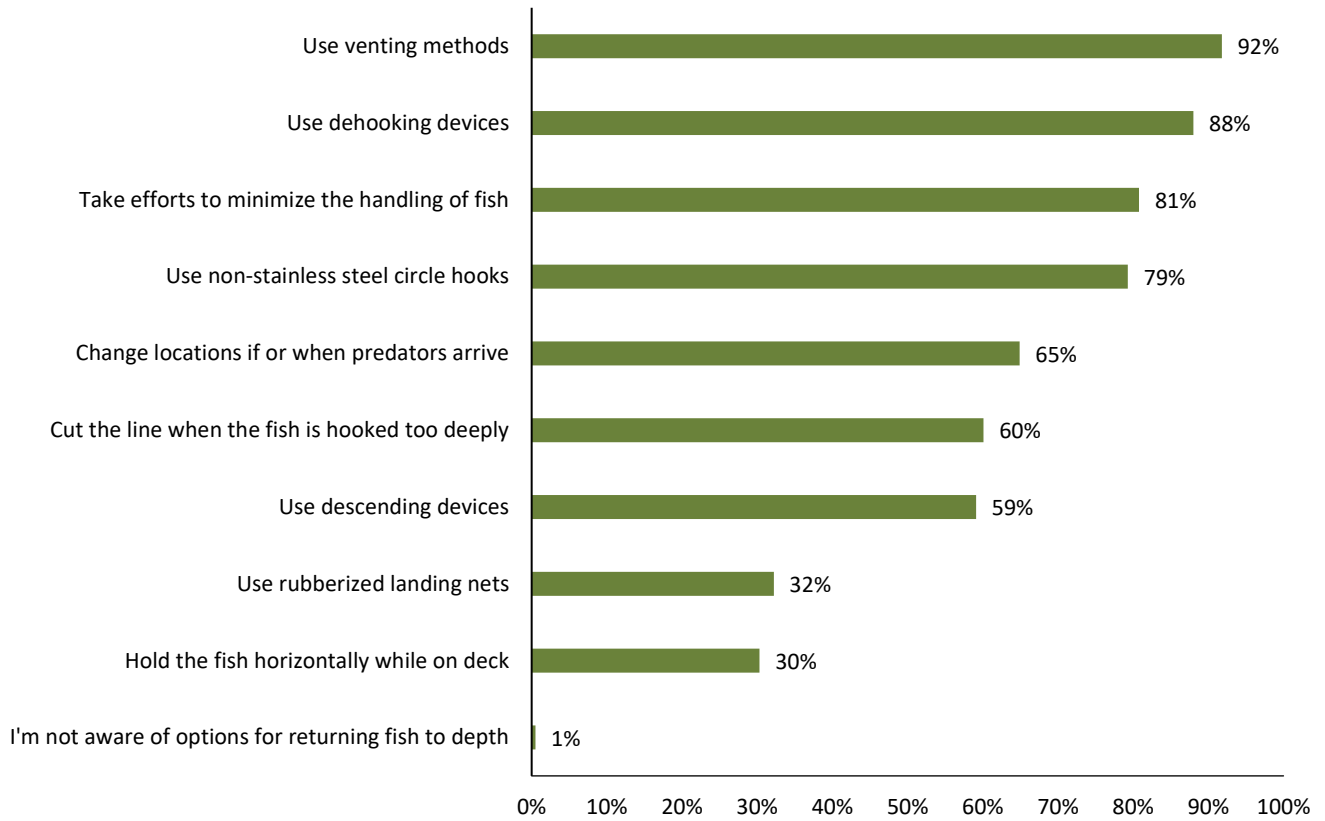
Figure 3. Barotrauma symptoms recognized by for-hire survey respondents.



Next, respondents were asked the question, “Are you aware of the following reef fish handling protocols? Please check the box for each of the protocols you are familiar with (even if you don't use them)”. Nearly all respondents (99.5%) were aware of at least one of the nine protocols presented. Of those, respondents were most aware of venting (92%) and dehooking (88%) methods¹⁶. More than half (59%) were aware of descending devices (Figure 4). There were no state-level differences (Chi-square test, $P > 0.05$ in all cases) for any of the nine protocols.

¹⁶ Between 2008-2013, venting and release tools were required in the Gulf of Mexico reef fish fishery.

Figure 4. Overall awareness of best handling protocols related to reef fishing, for-hire survey respondents.

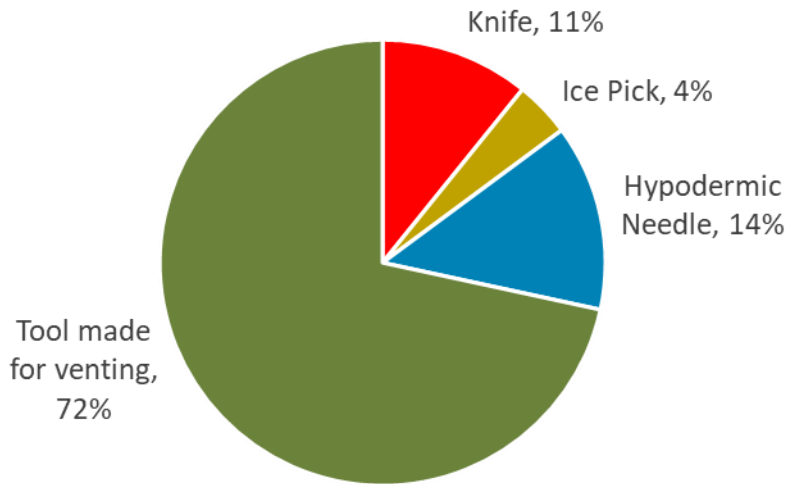


Respondents who indicated awareness of a specific best handling protocol were then asked how often they personally used that protocol. Important to note is if a respondent did not indicate they were aware of a particular protocol, they were not asked how often it was used. The frequency of use was measured on a five-point Likert scale from “1 - Never” to “5 - Always”. Nearly all respondents (99%) indicated they took some effort to minimize the handling of fish. To return fish to depth, respondents most often used a venting tool (24% = Rarely-Sometimes, 34% Often, 39% Always); conversely FDDs were used less frequently (44% = Rarely-Sometimes, 23% Often, 11% Always). Respondents also indicated they ‘always’ used non-stainless steel circle hooks more than any other protocol (81%; Table 1). For respondents who indicated they vented at least rarely, most (72%) used a tool specifically purchased for venting. Of those who vented, 11% indicated they did so with a knife (Figure 5), which is generally not recommended by fisheries managers and scientists for use as a venting tool.

Table 1. Use of best handling protocols by for-hire survey respondents. Only respondents who were aware of a protocol was offered the opportunity to indicate how often they used that protocol.

Use of best handling protocols	<i>n</i>	How often used			
		Never	Rarely - Sometimes	Often	Always
Take efforts to minimize the handling of fish	134	1%	9%	25%	66%
Descending devices	102	23%	44%	23%	11%
Venting methods	156	3%	24%	34%	39%
Dehooking devices	152	1%	10%	28%	61%
Non-stainless steel circle hooks	135	6%	4%	9%	81%
Change locations if or when predators arrive	113	0%	9%	37%	54%
Rubberized landing nets	55	5%	31%	24%	40%
Cut the line when the fish is hooked too deeply	105	3%	21%	25%	51%
Hold the fish horizontally while on deck	55	0%	20%	44%	36%

Figure 5. Tools used most often to vent fish, Federal for-hire respondents (n = 148).



Fishing depth should have an influence on the decision whether or not to use a particular device or release method. For example, anglers fishing in shallow water (<60 feet) may not use venting or descending devices; conversely, they may focus on using dehooking devices. Although sample sizes were small for some responses, a few patterns emerged. For example, respondents tended to vent fish, even when they indicated that they most often fished in less than 60 feet of water. They also tended to ‘always’ vent fish as depth ranges increased. Conversely, the percentage of respondents who ‘always’ used descending devices was low, regardless of depth. As expected, most respondents used non-stainless steel circle hooks, regardless of fishing depth (Table 2).

Table 2. Best handling protocols used by for-hire respondents, by depth fished most often. Summary data are included in Table 1. Only respondents who were aware of these protocols answered this question.

Depth Fished most often ¹⁷ / Protocol Used	How Often Used				
	<i>n</i>	Never	Rarely - Sometimes	Often	Always
60 feet or less (n = 28)					
Take efforts to minimize the handling of fish	19	0%	11%	26%	63%
Descending devices	15	7%	53%	20%	20%
Venting methods	20	5%	35%	40%	20%
Dehooking devices	21	0%	14%	33%	52%
Non-stainless steel circle hooks	18	6%	6%	6%	83%
Change locations if or when predators arrive	14	0%	14%	7%	79%
Rubberized landing nets	7	0%	0%	29%	71%
Cut the line when the fish is hooked too deeply	17	0%	12%	24%	65%
Hold the fish horizontally while on deck	10	0%	30%	30%	40%
61 to 150 feet (n = 156)					
Take efforts to minimize the handling of fish	96	1%	8%	24%	67%
Descending devices	68	24%	40%	26%	10%
Venting methods	114	3%	25%	40%	40%
Dehooking devices	110	1%	8%	65%	65%
Non-stainless steel circle hooks	100	4%	4%	81%	81%
Change locations if or when predators arrive	80	0%	8%	51%	51%
Rubberized landing nets	40	8%	8%	35%	35%
Cut the line when the fish is hooked too deeply	74	3%	33%	50%	50%
Hold the fish horizontally while on deck	38	0%	22%	34%	34%
Greater than 150 feet (n = 29)					
Take efforts to minimize the handling of fish	19	0%	11%	26%	63%
Descending devices	19	32%	53%	11%	5%
Venting methods	22	0%	14%	36%	50%
Dehooking devices	21	0%	14%	33%	52%
Non-stainless steel circle hooks	17	18%	0%	0%	82%
Change locations if or when predators arrive	19	0%	11%	42%	47%
Rubberized landing nets	8	0%	50%	13%	38%
Cut the line when the fish is hooked too deeply	14	7%	29%	21%	43%
Hold the fish horizontally while on deck	7	0%	14%	43%	43%

General Attitudes towards Barotrauma

Respondents were asked a series of general barotrauma-related questions and the impact of angler conservation of reef fish, to ascertain their opinions on a variety of items. All questions were measured on a

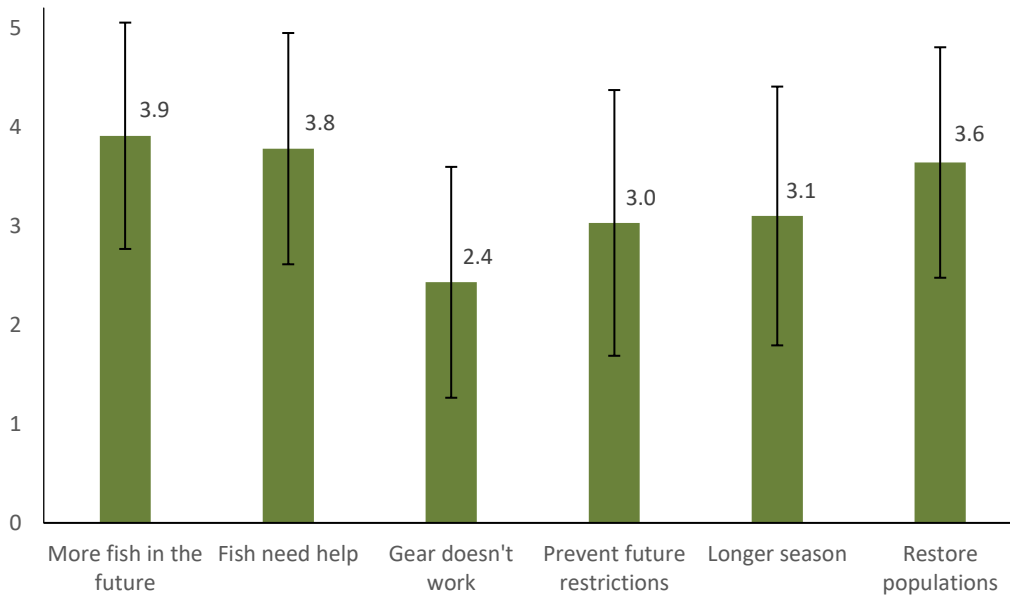
¹⁷ Because of small sample sizes, several depths were collapsed for this report. Specifically, 0–30, 31–60 = < 60 feet and 61–90, 91–120, 121–150 = 61–150 feet. A full breakdown of depth categories will be presented in the recreational report.

five-point Likert scale from, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”.

Respondents were asked the question, “I will help fish return to depth when needed”. Respondents strongly agreed with that statement ($M = 4.63, S.D. = 0.792$), indicating their desire to positively impact fish survival. This desire was shared regardless of the state where they launched ($M = 4.45 - 4.79, F = 0.557, P = 0.644$) or their years of reef fishing experience¹⁸ ($F = 0.346, P = 0.884$).

Respondents generally agreed that fish need help returning to depth when caught in deeper water ($M = 3.78, S.D. = 1.168$) and returning fish to depth improves fish survival ($M = 3.91, S.D. = 1.143$). They also agreed that helping fish return to depth will restore Gulf fish populations ($M = 3.64, S.D. = 1.164$). Respondents disagreed that current practices and available gear that help fish return to depth don’t work ($M = 2.43, S.D. = 1.166$), indicating they were generally satisfied with current tools. On the regulatory side, only 37% agreed ($M = 3.03, S.D. = 1.342$) that helping fish return to depth would prevent future restrictions; the same percentage agreed (37%, $M = 3.10, S.D. = 1.307$) longer fishing seasons would be provided (Figure 6). There were no statistical differences among respondents by launch state for any of the general attitude items.

Figure 6. Mean response (\pm SD) to general attitudes towards the impact of angler actions on conservation of reef fish, for-hire respondents. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”.



Attitudes Towards Venting Tool and Fish Descending Device Use

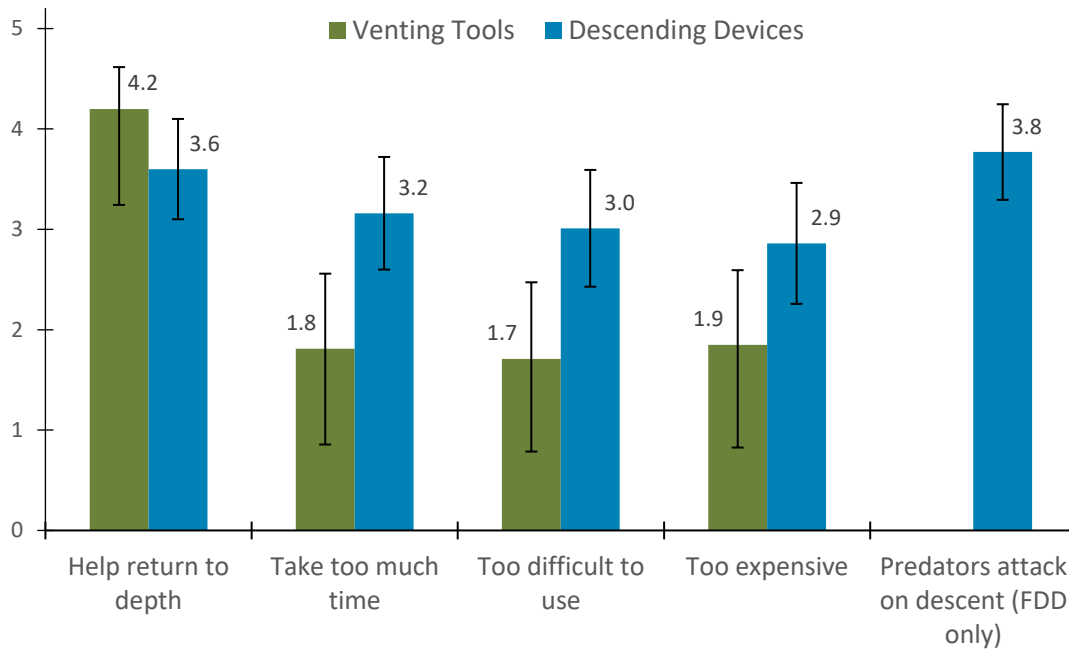
Respondents were asked a series of questions about their attitudes towards the use of FDDs and venting. All questions were measured on a five-point Likert scale from, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 = Neither Agree or Disagree”.

¹⁸ Years of reef fishing experience was transformed into a categorical variable based on 10 year ranges from 1 = 1 to 10 years to 6 = 51 – 60 years.

Overall, three-quarters of respondents strongly (55%) or slightly (21%) disagreed that helping fish get back to depth is not necessary ($M = 1.84, S.D. = 1.130$). Specific to venting, respondents strongly believed that venting helps fish return to depth ($M = 4.20, S.D. = 0.957$). Overall, they disagreed that venting tools were too difficult to use ($M = 1.71, S.D. = 0.924$), took too much time to use ($M = 1.81, S.D. = 0.954$), or were too expensive ($M = 1.85, S.D. = 1.024$) (Figure).

For FDDs, respondents also believed they helped fish return to depth, albeit to a lower degree than venting ($t = 6.56, P < .001, M = 3.60, S.D. = 1.110$). However, there were significant differences in agreement for the questions related to difficulty ($M = 3.01, S.D. = 1.193, t = 12.04, P < 0.001$), time to use ($M = 3.16, S.D. = 1.256, t = 12.78, P < 0.001$), and expense ($M = 2.86, S.D. = 1.136, t = 10.27, P < 0.001$). Finally, respondents believed predators (depredation, although this term was not used in the survey) often attacked fish as they were being descended¹⁹ ($M = 3.77, S.D. = 1.107$) (Figure 7).

Figure 7. Mean (\pm 95% upper and lower confidence limits) for each attitude item scale related to the use of venting tools and fish descending devices, for-hire respondents. For the scale, “1 = Strongly Disagree” to “5 = Strongly Agree”, with “3 =Neither Agree or Disagree”.



Knowledge and Use of Venting Tools and Descending Devices

A majority of respondents (84%) believed they were confident in their abilities to return fish to depth ($M = 4.50, S.D. = 0.833$). Only 9% indicated they needed more training to return fish to depth ($M = 1.96, S.D. = 1.091$). Similarly, only 11% ($M = 2.05, S.D. = 1.168$) agreed that helping fish return to depth was out of their control and 21% believed most reef fish die ($M = 2.45, S.D. = 1.176$).

Nearly all respondents always had a venting tool on the boat when they fished (92%) and they know how to properly vent a fish (91%). Conversely, less than half of respondents had a descending device on the boat (49%) and two-thirds (66%) knew how to use an FDD. Cost was not an issue, as only 11% of respondents agreed with the question, “I can’t afford to buy a fish descending device” (Table 3).

¹⁹ A comparable question was intentionally not asked about venting.

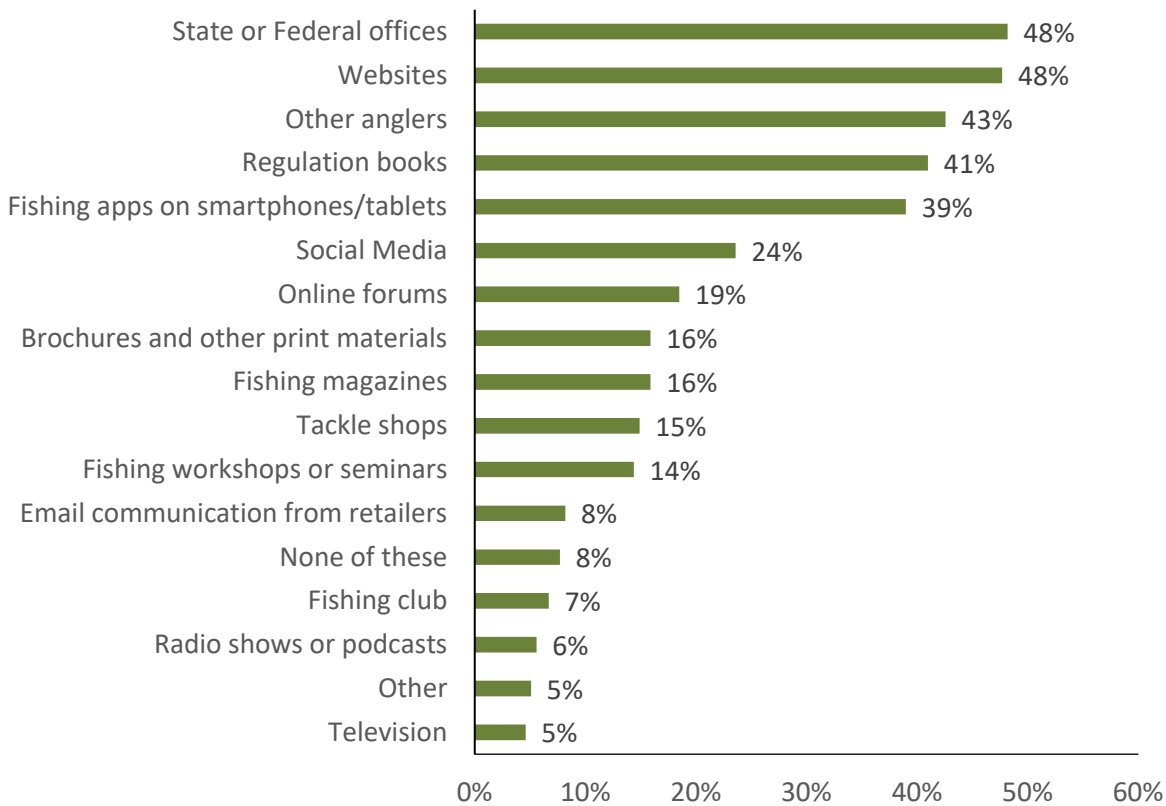
Table 3. Knowledge about returning fish to depth and use of venting tools and FDDs, for-hire respondents.

Question	Mean	Std. Error	Std. Dev	Percent Agree
General				
I am confident in my ability to help fish return to depth	4.50	0.060	0.833	84%
Tools that help return fish to depth get lost easily	3.00	0.081	1.131	32%
I need more training on how to help return fish to depth properly	1.96	0.078	1.091	9%
Helping fish return to depth is out of my control	2.05	0.084	1.168	11%
I think most reef fish die	2.45	0.084	1.176	21%
Vent				
There is always a venting tool on the boat on which I fish	4.72	0.046	0.638	92%
I know how to vent a fish properly	4.68	0.053	0.740	91%
FDD				
I know how to use a fish descending device	4.06	0.081	1.136	66%
I can't afford to buy a fish descending device	2.32	0.084	1.167	10%
There is always a fish descending device on the boat on which I fish	3.47	0.106	1.476	49%

General Sources of Information

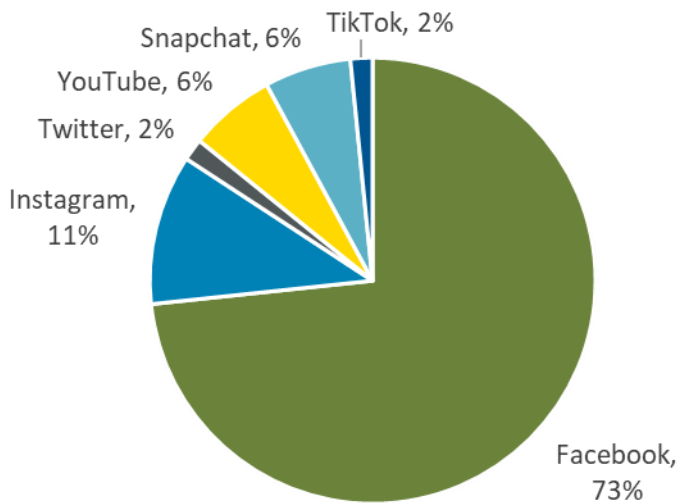
Where individuals seek information is critical to designing an outreach program that is both efficient and effective, especially for a multi-year outreach project. For-hire recipients were asked to indicate all the sources where they get their information about reef fishing in general. Overall, nearly half of respondents got their information from State or Federal offices (48%) or websites (48%). This was followed closely by other anglers (43%), regulation books (41%), and fishing apps (39%). Only about one-quarter (24%) used social media to get their information (Figure 8). Of those, a majority (73%) used Facebook and 11% used Instagram. No other social media platform (e.g., Twitter, YouTube) was higher than 3% (Figure 9). Nearly all individuals who noted ‘other’ said their personal fishing experience was the source of their information.

Figure 8. Where for-hire respondents seek information about reef fishing in general.



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Figure 9. Social media platform used most often by for-hire respondents (n = 64).



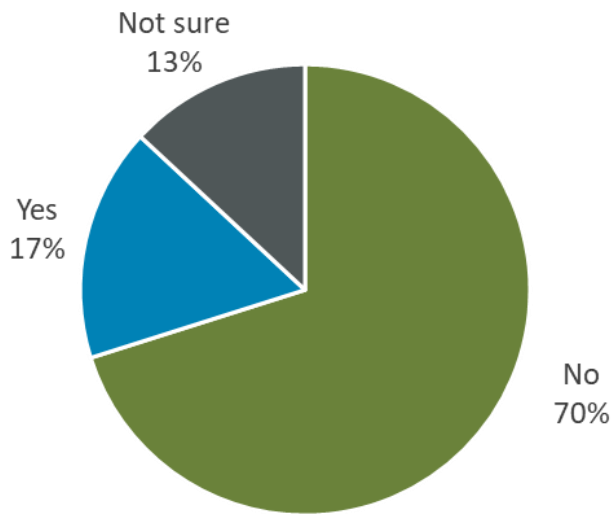
Return ‘Em Right Program

An integral component of this project is to evaluate the effectiveness of communication messaging through the “Return ‘Em Right” (RER) program on behavioral change (change in use of fish descending devices). This survey was fielded September 25 – October 25, 2021, with the knowledge that some outreach would occur prior to survey fielding (Table 4). Given the public launch was on September 14th and this survey fielded two weeks later, there is a possibility some respondents would have heard of the program. Indeed, 17% of respondents had already heard of the RER program, 70% had not, and 13% were not sure (Figure 10). Sample sizes were too small use the five survey waves to assess as a determinant of where respondents heard of RER, or if knowledge differed based on state launched.

Table 4. Dates and outreach conducted through the Return 'Em Right program, federally-permitted for-hire respondents. The survey was fielded five times from 25 September through 25 October 2021.

Approximate Date	Outreach
July 30	Florida Sportsman Call to Action piece published in print magazine
August 3	Florida Sportsman Call to Action posted on social media and online
September 14	Website live, press releases distributed, public launch of Return 'Em Right
October 6	Presentation to ASA Government Affairs Committee at ASA Sportfishing Summit
October 15	Launch of education training/gear distribution to federally permitted captains, email to federal group, mailer sent out
November 9	Follow-up email sent

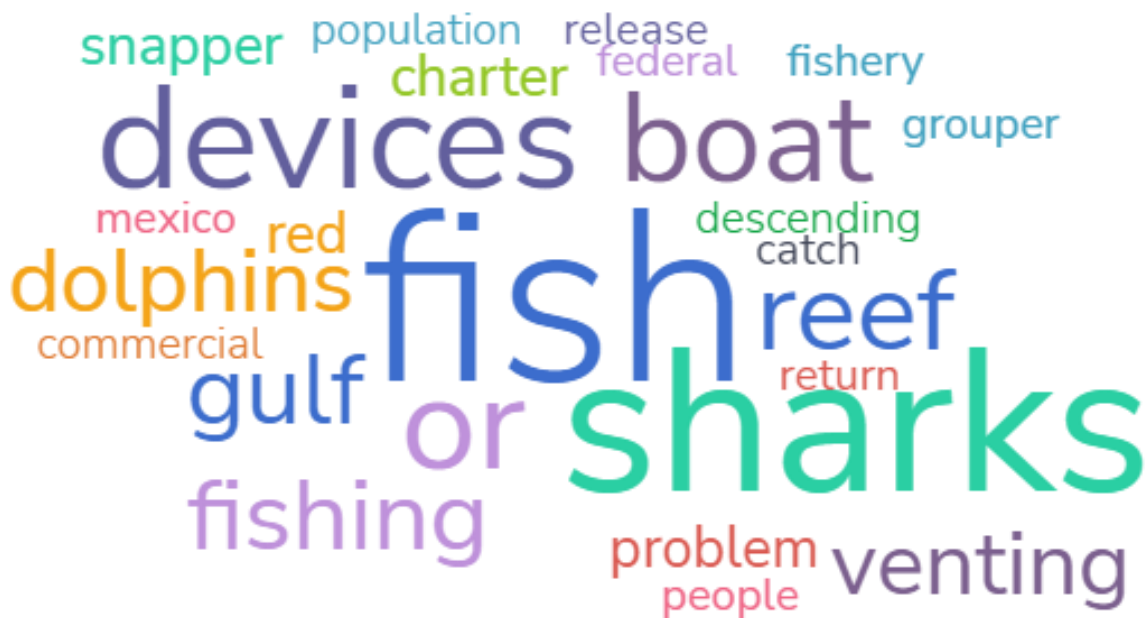
Figure 10. Percent of for-hire respondents who have heard of the Return 'Em Right program.



Open-ended Comments

Respondents were offered the opportunity to provide open-ended comments and several indicated a desire to help fish survive. The most frequent themes among respondents were concerns about predation from sharks and dolphins. Specifically, the use of descending devices was noted as contributing to fish mortality. Other comments were regulatory (e.g., limits, reporting, seasons closures), while some were environmental (e.g., red tide, pollution) (Figure 11).

Figure 11. Word cloud based on open-ended comments received by for-hire respondents.



Literature Cited

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- Vaske, J. J. 2019. *Survey Research and Analysis*. (2nd Edition). Sagamore-Venture, Urbana, Illinois, USA.

Appendix B. Gulf of Mexico Angler Survey – Private recreational and State for-hire sectors.

The Gulf States Marine Fisheries Commission is conducting research about saltwater fishing to help state Fisheries agencies improve communications. You have been randomly selected to participate and we ask that you take a few minutes to complete this important survey. Your response and identity will be kept strictly confidential and will never be used for any purpose beyond this study. Your individual responses will never be shared.

By completing the survey, you will be automatically entered into a random drawing to win one of 10 \$100 VISA gift cards.

This survey should take about 10 minutes to complete. Your participation is completely voluntary, and you can withdraw at any time.

You must be at least 18 years old to participate. Are you at least 18?

Yes

No

ID: Introduction

This survey has been sent to anglers in all 5 Gulf states. Seasons vary among the states for species and opening/closing dates. Please answer the question based on your state's season.

Did you recreationally fish or operate a charter or head boat for reef fish (snapper, grouper, triggerfish, amberjack, etc.) in the Gulf of Mexico during 2021? For this survey, "reef" fishing includes fishing on natural and artificial reefs and fishing on wrecks.

Yes

No

ID: Angler role.

Which of the following best represents YOUR PRIMARY ROLE as a Gulf reef fish angler?

Private recreational angler

Charter boat captain/owner/operator

Head boat captain/owner/operator

Other - Write In: _____

ID: State.

From which state do you typically depart to reef fish in the Gulf of Mexico?

- Alabama
- Florida
- Louisiana
- Mississippi
- Texas
- None

ID: Years reef fishing.

How many years have you fished for reef fish in the Gulf of Mexico? If this is your first year, please enter 1.

ID: Reef fishing frequency.

How often do you fish for reef fish in a typical season in the Gulf of Mexico?

- Never
- A few times a season
- Once a month
- A few times a month
- Once a week
- A few times a week
- Daily

ID: Mississippi DMR specific question for their reef anglers.

In 2020 and 2021, how many times did you fish for reef fish south of the Mississippi barrier islands while Red Snapper Season was CLOSED?

- I did not take any trips outside of the red snapper season
- 1 - 2 trips
- 3 - 5 trips
- 6 - 10 trips
- more than 10 trips

ID: How they reef fish.

How do you typically reef fish in the Gulf of Mexico?

- On a private boat that I own
- On a private boat that I do not own
- On a guided/charter boat
- On a head/party boat
- Other - Write In: _____

ID: Specific question for TX respondents because boat owners were used as a surrogate for reef anglers.

On a typical trip, how many anglers are fishing with you on your boat, including yourself.

ID: Depth fished.

When fishing for reef fish in the Gulf of Mexico, what is your most often targeted range of fishing depth? We recognize that people may fish at different depths on the same trip. We would like to know the depth range you fish most often.

- Less than 30 feet
- 31 – 60 feet
- 61 – 90 feet
- 91 – 120 feet
- 121 – 150 feet
- Greater than 150 feet

ID: Knowledge of barotrauma symptoms.

Which of the following signs do you use to recognize that a fish may need help returning to depth? Please check all that apply.

- Stomach coming out of mouth
- Bulging eyes
- Bubbling scales
- Firm or bloated stomach
- Intestines coming out of anus
- Fish appears sluggish or unresponsive when brought to the boat
- Fish is floating and unable to return to depth
- None of the above
- I do not know about this issue
- Other - Write In: _____

ID: Awareness of reef handling protocols.

Are you aware of the following reef fish handling protocols? Please check the box for each of the protocols you are familiar with (even if you don't use them).

- Take efforts to minimize the handling of fish
- Use descending devices
- Use venting methods
- Use dehooking devices
- Use non-stainless steel circle hooks when using natural bait
- Change locations if or when predators arrive
- Use rubberized landing nets
- Cut the line when the fish is hooked too deeply
- Hold the fish horizontally while on deck
- Throw the fish up in the air or hard against the surface to get them back to depth
- I'm not aware of options for returning fish to depth

ID: How often protocols are used. Only presented to people who selected protocol.

When fishing for reef fish, how often do you ...

	Never	Rarely	Sometimes	Often	Always
Take efforts to minimize the handling of fish	()	()	()	()	()
Use descending devices	()	()	()	()	()
Use venting methods	()	()	()	()	()
Use dehooking devices	()	()	()	()	()
Use non-stainless steel circle hooks when using natural bait	()	()	()	()	()
Change locations if or when predators arrive	()	()	()	()	()
Use rubberized landing nets	()	()	()	()	()
Cut the line when the fish is hooked too deeply	()	()	()	()	()
Hold the fish horizontally while on deck	()	()	()	()	()
Throw the fish up in the air or hard against the surface to get them back to depth	()	()	()	()	()
I'm not aware of options for returning fish to depth	()	()	()	()	()

ID: Vent tool used. Only presented to respondents who indicated they vented fish at least 'rarely'.

What tool do you use most often for venting fish? (Select one)

- Knife
- Ice Pick
- Hook
- Hypodermic Needle
- Tool that I purchased specifically for venting
- Other - Write In: _____

ID: General attitude questions.

Please indicate the level to which you agree or disagree with the statements below:

	Strongly Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Strongly Agree
Helping fish return to depth will mean more fish to be caught in the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fish need help returning to depth, especially when caught from deep water (>50ft)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Current practices and gear available to help return fish to depth don't work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping fish return to depth will prevent future reef fishing restrictions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping fish return to depth will provide for a longer fishing season	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping fish return to depth will restore Gulf fish populations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ID: Attitude questions related to barriers.

Please indicate the level to which you agree or disagree with the statements below.

	Strongly Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Strongly Agree
Using venting tools takes too much time	()	()	()	()	()
Venting tools are too difficult to use	()	()	()	()	()
Venting tools are too expensive	()	()	()	()	()
Helping fish return to depth is unnecessary, even when I see they can't swim down on their own	()	()	()	()	()
The use of venting tools help fish return to depth when needed	()	()	()	()	()
Fish descending devices are too expensive	()	()	()	()	()
Fish descending devices are easy to use	()	()	()	()	()
Fish descending devices are too time consuming to use	()	()	()	()	()
Predators often attack fish that are being descended	()	()	()	()	()
The use of descending devices help fish return to depth when needed	()	()	()	()	()

ID: Social norm questions.

Please indicate the level to which you agree or disagree with the statements below.

	Strongly Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Strongly Agree
Fisheries managers expect me to help fish return to depth when needed	()	()	()	()	()
Other anglers think that helping fish return to depth can improve the survival of released fish	()	()	()	()	()
I feel social pressure from others to help fish return to depth	()	()	()	()	()
Other anglers support the use of fish descending devices	()	()	()	()	()
Anglers like me help fish return to depth when needed	()	()	()	()	()
Other anglers expect me to help fish return to depth when needed	()	()	()	()	()
Other anglers support the use of venting tools	()	()	()	()	()

Perceived behavior control questions.

Please indicate the level to which you agree or disagree with the statements below.

	Strongly Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Strongly Agree
I am confident in my ability to help fish return to depth	()	()	()	()	()
I know how to use a fish descending device	()	()	()	()	()
I can't afford to buy a fish descending device	()	()	()	()	()
Tools that help return fish to depth get lost easily (e.g. fall off boat, cut off by predators)	()	()	()	()	()
I need more training on how to help return fish to depth properly	()	()	()	()	()
There is always a venting tool on the boat on which I fish	()	()	()	()	()
Helping fish return to depth is out of my control	()	()	()	()	()
There is always a fish descending device on the boat on which I fish	()	()	()	()	()
I know how to vent a fish properly	()	()	()	()	()
I think most reef fish die, even when best release practices are used	()	()	()	()	()

ID: Question to assess respondent ultimate behavior to help reef fish.

Please select the degree to which you agree or disagree with the following statement:

	Strongly Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Strongly Agree
I will help fish return to depth when needed	()	()	()	()	()

ID: Where people get their reef fishing information

Which sources do you use most frequently to find information regarding reef fishing in general? Check all that apply.

- Fishing magazines
- Brochures and other print materials
- Regulation books
- Television
- Radio shows or podcasts
- Websites
- Online forum
- Social Media
- Fishing workshops or seminars
- Fishing apps on smartphones/tablets
- Tackle shops
- Other anglers
- State or Federal offices
- Fishing club
- Email communication from retailers
- None of these
- Other - Write In: _____

ID: Social media platform used. Only individuals who selected social media were presented with this question.

Which of the following social media platform do you use the most? (choose one)

- Facebook
- Instagram
- Twitter
- YouTube
- Snapchat
- TikTok
- Other - Write In: _____
- I don't use social media

ID: Knowledge about Return 'Em Right program

Have you ever heard of, or received outreach information from the "Return 'Em Right" program?

- Yes
- No
- Not sure

ID: Where they first heard of the program. Only presented to people who checked 'Yes' above.

Where did you first hear about the "Return 'Em Right" program? (choose one)

- Direct email
- Magazine/Newspaper
- Site search engine
- Postcard
- Social media (Instagram, Facebook, etc.)
- Link in another webiste
- From another angler
- Other - Write In: _____

ID: Year of birth.

What year were you born? _____

ID: Gender.

What is your gender?

- Male
- Female
- Prefer not to answer

ID: Race/Ethnicity.

What is your primary race/ethnicity?

- White or Caucasian
- Black or African American
- Hispanic or Latino
- American Indian or Native Alaskan
- Asian
- Native Hawaiian or Pacific Islander
- Other - Write In: _____
- Prefer not to answer

Alabama specific questions

ID: Heard of Snapper check

Have you heard of Alabama's Snapper Check Program?

Yes

No

ID: Awareness of fish that should be reported

Are you aware that three reef fish: Gray Triggerfish, Greater Amberjack, and Red Snapper are required to be reported through Snapper Check?

Yes

No

ID: Reporting frequency.

How often do you report your catch through Snapper Check?

Always

Sometimes

Never

Prefer not to answer

ID: Why they don't report.

If you don't always report your catch through Snapper Check, please indicate why? (Select all that apply).

Lack of trust in Government

I was concerned about the season getting shortened

I thought dockside validation was the report

It's too burdensome

I forgot

Prefer not to answer

Mississippi specific questions

ID: Additional launch sites

Are there any launch sites you would like to have added to Tails n' Scales for trip registration?

ID: Information request

Is there any information you find important to fisheries management that MDMR is NOT currently collecting through Tails n Scales?

Appendix C. Logistic regression model tested and methods behind final model selection.

Overall, 13 independent variables were used to develop a logistic regression model to predict an individual's knowledge of 1) Venting tools, and 2) Fish descending devices.

Variable Selection

Independent variables	Code table
Age	A
Experience	E
Boat (own/else)	B
Resident (yes/no)	R
State (5 states)	S
Often_Fish (few to daily 6 cat)	F
Depth (<60/>60)	D
Trauma(no, yes)	T
Know BMP (yes/no)	KB
Gender (male/female)	G
Frequency of Fishing (low(1-3)/high(4-6)	F2
Know Venting (yes/no)	KV
Know FDD (yes/no)	KFDD

One of the potential limitations of logistic regression is using independent variables that are highly correlated (multicollinearity). For these models, most variables were correlated; however, multicollinearity was low in all cases.

Vent Model

Variables	P-value	Result
Know_VEN * Age	<0.05	Correlated
Know_VEN * Years	<0.05	Correlated
Know_VEN * Boat	<0.05	Correlated
Know_VEN * Depth_2	<0.05	Correlated
Know_VEN * Residency	0.91	Not correlated
Know_VEN * State	<0.05	Correlated
Know_VEN * FreqFish	<0.05	Correlated
Know_VEN * Know_BMP	<0.05	Correlated
Know_VEN * Gender	<0.05	Correlated
Know_VEN * Know_FDD	<0.05	Correlated
Know_VEN * Trauma	<0.05	Correlated

FDD Model

Variables	P-value	Result
Know_VEN * Age	<0.05	Correlated
Know_VEN * Years	<0.05	Correlated
Know_VEN * Boat	<0.05	Correlated
Know_VEN * Depth_2	<0.05	Correlated
Know_VEN * Residency	0.91	Not correlated
Know_VEN * State	<0.05	Correlated
Know_VEN * FreqFish	<0.05	Correlated
Know_VEN * Know_BMP	<0.05	Correlated
Know_VEN * Gender	<0.05	Correlated
Know_VEN * Know_FDD	<0.05	Correlated
Know_VEN * Trauma	<0.05	Correlated

Model Testing

Models were tested with variables entered as factors (Often fish and Depth) and another model with the same variables but as integers (considering their ordinal nature). The likelihood ratio test was not significant, so either model could be used. Ultimately, the simpler model (variables as integers) was selected.

To select the best model, Akaike Information Criterion (AIC) and Nagelkerke R² were used. For AIC, the smaller value is preferred; for the R² a higher value is preferred.

Venting

The variables tested are shown in the table below. The variables state, fish frequency, and residency were not significant at $P < 0.05$.

Dependent = Know about venting (KNOW_VENT)	AIC	Nagelkerke R ²
Null model	3,858	na
A	3,352	0.21
A + E	3,230	0.26
A + E + B	3,157	0.29
A + E + B + D	3,040	0.33
A + E + B + D + T	2,838	0.40
A + E + B + D + T + G	2,767	0.43
A + E + B + D + T + G + KFDD	2,701	0.45
A + E + B + D + T + G + KFDD + KB (FINAL)	2,691	0.45

Fish descending devices

The variables tested are shown in the table below. The variables residency, gender, and knowledge of BMP were not significant at $P < 0.05$.

Dependent = Know about fish descending devices (KNOW_FDD)	AIC	Nagelkerke R ²
Null model	4,241	na
A	3,890	0.15
A + E	3,870	0.15
A + E + B	3,830	0.17
A + E + B + D	3,818	0.18
A + E + B + D + T	3,780	0.19
A + E + B + D + T + S	3,727	0.21
A + E + B + D + T + F	3,724	0.22
A + E + B + D + T + F2	3,725	0.22
A + E* + B + D* + T + F + KV	3,706	0.22
A + B + T + F + KV (FINAL)	3,708	0.22