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Understanding Resource-Conserving Behaviors Among Fishers: Barotrauma Mitigation and the Power of Subjective Norms in Florida's Reef Fisheries

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Abstract

Understanding the factors underlying fishers' decisions to adopt resource-conserving behaviors is important to successful fisheries management. This study used an online survey to explore factors motivating decisions to use alternative barotrauma mitigation measures (venting and descending) to improve discarded reef fish survival across recreational, charter, and commercial fishers in the state of Florida. A majority of respondents (66–69%) had experienced fish showing gross signs of barotrauma, and more than half of those (52–69%) reported using barotrauma mitigation most of the time when needed. Use of mitigation by other fishers was perceived to be lower (30–57%) and to have declined after removal of a venting tool requirement. Overall, respondents were more likely to have used venting tools (96–99%) than fish descenders (14–27%), and most respondents (81–86%) intended to use venting tools in the future. The theory of planned behavior was used to predict and explain intentions to use venting tools and/or fish descenders based on three variables: attitudes toward the method, subjective norms (i.e., social pressure), and perceived control (i.e., confidence in their ability to use the method). Fishers across sectors perceived venting tools and descenders to be similarly effective in improving released fish survival, but they felt that descenders were more time consuming, difficult to use, and expensive. Subjective norms and perceived control were stronger for venting tools than for descenders. Overall, subjective norms had the strongest influence on fishers' intention to use either form of mitigation; attitudes and perceived control were also important in the case of descenders. Outreach efforts focusing on re-enforcing subjective norms should have the greatest impact on increasing fishers' use of barotrauma mitigation methods. Comparatively greater efforts are required to increase the use of descending gear than to increase the use of venting, and care should be taken to avoid strategies that could result in an overall decline of barotrauma mitigation.

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Adoption of resource-conserving behaviors by fishers, whether voluntary or mandated by regulations, can make important contributions to fisheries sustainability (Granek et al. 2008; Cooke et al. 2013). Examples of such behaviors include abiding by legal or voluntary fishing restrictions (Sutinen and Kuperan 1999), releasing caught fish alive and taking measures to improve their postrelease survival (Bartholomew and Bohnsack 2005; Sims and Danylchuk 2017), stocking fish to replenish resources or avoiding stocking when it may be detrimental (Johnson et al. 2009; Lorenzen 2014; von Lindern and Mosler 2014), and conserving or restoring aquatic habitats (Granek et al. 2008). Adoption of resource-conserving behaviors is rarely universal, even when required by law, and may be less common or certain when it is voluntary. An understanding of the factors that underlie fishers' decision to adopt conserving behaviors is therefore crucial to assess overall levels of adoption and to design outreach campaigns and/or regulations aimed at maximizing adoption (Fulton et al. 2011; Howell et al. 2015; Danylchuk et al. 2017).

A useful theoretical framework for understanding resource-conserving behavior by fishers and other fisheries stakeholders is the theory of planned behavior (Ajzen 1991). According to the theory, intent to perform a behavior is informed by three variables: an individual's attitude toward the behavior (i.e., the degree to which the sum of their attitudes is a favorable or unfavorable evaluation or appraisal of the behavior), social or subjective norms (i.e., the social pressure to perform or not perform the behavior and the degree to which they care), and perceived behavioral control (i.e., their confidence in their ability to perform the behavior). Generally, the more favorable the attitudes and subjective norms and the greater the perceived behavioral control, the stronger is the intent of the individual to perform the behavior. Behavioral intent, in concert with perceived control, then informs whether or not a behavior is enacted. Due to the nature of self-reported surveying, we were unable to directly measure actual behavior with regard to barotrauma mitigation method use; therefore, this study focused on intention to use barotrauma mitigation gear. Other studies demonstrate that intention accounts for significant variance in actual behavior, indicating that a focus on intention is acceptable (Ajzen 1991).

The present study assesses factors underlying the use of barotrauma mitigation tools by reef fishers in the southeastern United States. Reef fishes are often caught at depths of 30 m or greater (SEDAR 2013; Drumhiller et al. 2014; Garner and Patterson 2015) and may therefore suffer major stressors that arise from capture at such depths, collectively known as barotrauma. Barotrauma results from the expansion of internal gases due to declining pressure during rapid ascent from depth (such as that experienced by angled fish). Visible symptoms related to fish barotrauma include bulging eyes, distention of the abdomen, and stomach eversion from the buccal cavity (Rummer and Bennett 2005; Campbell et al. 2010). In addition, barotrauma makes it difficult for fishes to return to depth due to increased buoyancy; these "floaters" are subjected to additional stress from temperature and sunlight. Furthermore, impairment of reflexes and behavioral responses may hinder anti-predatory responses (Brown et al. 2010), which—along with difficulties in submerging—may make fish more vulnerable to predation. Unsurprisingly, the probability of survival for discarded fish affected by barotrauma is often estimated to be low.

The reef fish complex in the southeastern United States includes an assemblage of snapper, grouper, amberjack, and triggerfish species in addition to other finfishes and is a primary target for offshore fishers (Sauls and Ayala 2012). Reef fishes are economically important in the region (Adams et al. 2006; Agar and Carter 2014) and support major commercial and recreational (private boat and charter) fisheries. The reef fisheries are subject to intense fishing pressure and are managed through a combination of harvest control measures, such as bag and size limits, seasonal closures, and catch shares (specifically, the Atlantic Wreckfish *Polyprion americanus* individual transferable quota; and the Gulf of Mexico Red Snapper *Lutjanus campechanus* and grouper–tilefish individual fishing quotas). As a result of these harvest control measures, fishers discard (release) a substantial proportion of the fish they catch (Bartholomew and Bohnsack 2005; Hanson and Sauls 2011).

The mortality of released fish (discard mortality) has important implications for the effectiveness of regulations, which are based on the premise that a good proportion of discarded fish survive, and discard mortality can make a substantial contribution to fishing mortality rates. For example, in the Gulf of Mexico fishery for Red Snapper (a notably controversial fishery: Cowan et al. 2011), the percentage of dead discards (i.e., those that experienced discard mortality) relative to the total number of killed Red Snapper (i.e., all mortalities combined) has reached as high as 56.2% (GMFMC 2015). Therefore, reducing barotrauma-related discard mortality of reef fish is an important stock conservation priority.

There are two options currently recommended to fishers to help mitigate the effects of barotrauma and increase the survival of discarded fish: (1) venting to release expanded gases from the swim bladder; and (2) rapidly returning fish to depth through the use of fish descending gear. In venting, a tool is used to puncture the swim bladder wall; venting tools can range from specifically designed needles to filet knives. Fish descending gear returns fish quickly to depth; a wide variety of descending gears is available, including cages, descending hooks, and lip grips. There

has been considerable debate in the literature regarding the efficacy of barotrauma mitigation (and, in particular, venting tools) in improving the survival of released fishes, with many studies showing conflicting results (Wilde 2009; Campbell et al. 2014). Recent studies of Australian Snapper *Pagrus auratus* (Butcher et al. 2012) and Red Snapper in the U.S. Gulf of Mexico (Drumhiller et al. 2014; Curtis et al. 2015) suggest that both venting tool use and descending gear use can improve postrelease survival relative to that of fish released without mitigation. For example, the use of fish descending gear and venting tools increased the survival of released Red Snapper by 3.0 and 1.9 times, respectively (Curtis et al. 2015).

Outreach efforts have been made in the reef fisheries for over 15 years to promote the use of barotrauma mitigation tools. Initially, outreach was focused on the promotion of venting tools. Regulations requiring venting tool possession and use "when needed" were debated for federal waters in both the south Atlantic and the Gulf of Mexico but were enacted only for the Gulf of Mexico in 2008. Soon after enactment of the venting tool rule, fish descending tools gained popularity as an alternative to venting and were increasingly promoted in outreach programs (Stevely et al. 2014). The venting tool rule in federal waters of the Gulf of Mexico was removed in 2013 to allow fishers to use the barotrauma mitigation method of their choice (venting or descending). At present, little is known about levels of barotrauma mitigation use or the factors underlying the decisions of fishers to use or not use such measures. Outreach efforts have attempted to increase use by fishers, but little is known about outreach efficacy, what motivates fishers to use such gears, or which methods the fishers are using. This study aimed to elucidate factors underlying fishers' decisions to use such practices by means of an online survey of recreational, charter, and commercial reef fishers in the state of Florida.

METHODS

This survey focused on fishers in Florida, which borders both the Atlantic Ocean and the Gulf of Mexico. The survey was created using Qualtrics version 3.0 (Qualtrics, Provo, Utah) and was distributed via e-mail in December 2015 and January 2016. Prior to distribution, the survey was first pilot tested with a total of 18 individuals, including 5 fisheries scientists, 10 offshore recreational anglers, 2 commercial fishers, and 1 charter captain. Three versions of the survey were then distributed to three stakeholder groups: recreational anglers, fishing charter operators, and commercial fishers. In the case of fishing charter operators and commercial fishers, there was no way to distinguish reef fishers at the time of sampling; therefore, the entire population of Florida charter and commercial fishing license holders who had registered their e-mail addresses at the time of license application (1,245 and 3,939, respectively) was invited to participate in the survey. The recreational angler sample was generated by pulling a subset of anglers who had self-identified as reef fishers in a previous stakeholder survey (see Garlock and Lorenzen 2017), enabling sampling to focus on reef fishers, with a sample size of 2,162. Survey distribution included personalized e-mails, and e-mail reminders were sent 1 week after initial contact in accordance with Dillman et al. (2009).

The survey questionnaire consisted of five main sections. The first section characterized respondents' general reef fishing habits and included questions about fishing frequency, gear use, species targeted, and discarding behavior. The second section focused on respondents' experiences with barotrauma and barotrauma mitigation when reef fishing, with questions about their awareness and use of venting tools and fish descending gear. The next section characterized the respondents' general attitudes about barotrauma mitigation and associated regulation and included a question about their sources of information about fisheries. The fourth section comprised questions related to the theory of planned behavior, and the final section covered general demographic information, such as age and gender. Reporting here will focus on those results that are relevant to understanding fishers' experiences with and intention to use barotrauma mitigation.

Based on the theory of planned behavior, it was hypothesized that attitudes, subjective norms, and perceived control would all influence a fisher's intention to use either venting tools or fish descending gear. To test this, scales were created to measure attitudes, perceptions of subjective norms, and perceived control for venting tools and fish descending gear. The scales originally contained five, six, and five items, respectively, and reliability (i.e., internal consistency) was tested for each scale using Cronbach's alpha. Assuming a cut-off value of 0.70 or greater (Vaske 2008), analysis found acceptable Cronbach's alpha values for both venting tool and fish descending gear attitude (0.76 and 0.75) and subjective norm (0.83 and 0.85) scales, but low scores (0.31 and 0.40) for the perceived control scales. Further analysis showed that removal of two of the items restored reliability, with final Cronbach's alpha values of 0.75 and 0.85; therefore, the final perceived control scale consisted of three items. Responses to each item were compared within sectors to test for differences in attitudes, norms, perceived control, and intention between venting tools and descending gear by using a *t*-test (Vaske 2008). Multiple linear regressions were then used to evaluate the ability of attitudes, subjective norms, and perceived control to predict stated intent to use venting tools and fish descending gear. The survey contained a skip logic

function so that only those individuals who stated that they were familiar with venting tools answered the attitude, subjective norm, and perceived control questions related to venting tools (and similarly for fish descending gear).

The decision was made to exclude the word "barotrauma" from the survey and instead to describe instances when respondents "encountered a fish that could not return to bottom." This decision was made based on the understanding that not all stakeholders are familiar with the term barotrauma, leading to concern that use of the term might confuse respondents or discourage them from completing the survey. For example, Hazell et al. (2016) found that 54% of Florida angler survey respondents who had experienced "floaters," or fish that could not return to depth, were unfamiliar with the term "barotrauma"; however, almost all correctly identified the symptoms—bulging eyes, swollen belly, and organ protruding from the mouth—as visible signs associated with a floater. Therefore, we assumed that referencing fish that could not return to bottom could serve as a rough proxy for fish suffering from gross barotrauma or those gross barotrauma symptoms that would be most easily identifiable by fishers. After distribution, nonresponse bias was assessed by comparing the demographics of respondents to that of the sampled population (as in Garlock and Lorenzen 2017). All procedures were approved by the Institutional Review Board at the University of Florida.

RESULTS

Response Rates and Demographics

A total of 573 recreational anglers, 146 charter license holders, and 270 commercial fishers completed the survey, resulting in response rates of 27%, 12%, and 7%, respectively. The notably lower response rates for charter and commercial samples were likely a result of our inability to directly target reef fishers in those sectors. In order to focus on reef fishers specifically, we excluded from analyses those individuals who reported "never" reef fishing in the past 12 months; thus, the final sample sizes were 556 recreational anglers, 137 charter license holders, and 174 commercial fishers.

Overall, the majority of respondents were white (recreational: 89%; charter: 94%; commercial: 91%) males (recreational: 90%; charter: 99%; commercial: 95%) with an average age of 50–52 (recreational: 52; charter: 50; commercial: 51). Demographic analysis showed little nonresponse bias, although males were slightly overrepresented in the recreational sector, with females comprising 18% of the sampled population but only 10% of the respondents.

Experiences with Barotrauma and Barotrauma Mitigation

A majority of recreational anglers (69%), charter operators (67%), and commercial fishers (67%) reported encountering fish that were "unable to return to bottom" (i.e., suffering from gross barotrauma symptoms) when reef fishing in the past 12 months. Of those, the majority (>80% across sectors) indicated that barotrauma was relatively infrequent (occurring 0–25% of the time). Almost all (96–99%) respondents across sectors were aware of barotrauma mitigation tools; of these, most (98–99%) were familiar with venting tools, while fewer (recreational: 32%; commercial: 34%; charter: 51%) were familiar with fish descending gear. Of those respondents who indicated that they had encountered fish they perceived to be unable to return to depth, 77–80% replied "yes" when asked if they had used barotrauma mitigation in the past 12 months. Of these, almost all (96–99%) reported using venting tools, whereas approximately 25% or less (commercial: 14%; recreational: 16%; charter: 27%) reported using fish descending gear. The majority of individuals who reported using descending gear also reported using venting tools; very few (<5% of respondents across sectors) reported only using fish descending gear.

Use of barotrauma mitigation measures was assessed via three survey questions regarding (1) the respondent's self-reported (own) use of such measures, (2) their perception of the use of such measures by others in their own sector, and (3) their perception of use by others in their own sector when possession of a venting tool was legally required in the Gulf of Mexico. In all cases, the questions referred to the use of mitigation tools when needed (i.e., when they perceived that a fish could not return to depth), and response options were given as 0–25, 26–50, 51–75, or 76–100% of the time. More than half (52–69%) of respondents in all sectors reported using barotrauma mitigation most of the time (i.e., 76–100% of the time) when needed; only 15–27% reported rarely using barotrauma mitigation (0–25% of the time), with the remainder (17–21%) reporting intermediate levels of use (Figure 1). Current perceived use by others was substantially lower, with only 30% of recreational anglers, 33% of commercial fishers, and 57% of charter operators perceiving that others used barotrauma mitigation most of the time (76–100%) when needed. In all sectors, more respondents perceived use by others had been frequent when venting tool possession and use when needed were required.

General Attitudes Toward Barotrauma Mitigation and Regulation

Respondents were asked about their general attitudes toward barotrauma mitigation and regulation in a 5-point, Likert-type scale, with response options ranging from "strongly disagree" to "strongly agree" (responses coded as 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 =

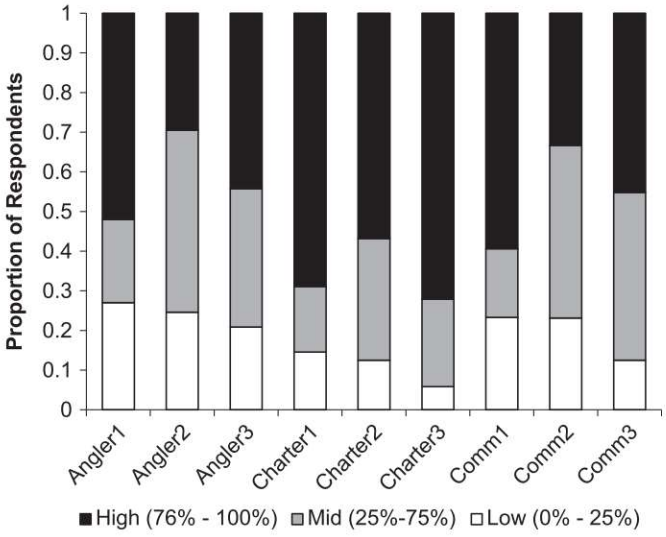

FIGURE 1. Reported proportion of the time fishers used barotrauma mitigation when necessary (i.e., with a fish suffering from barotrauma) across the recreational (angler), charter, and commercial (comm) sectors, according to (1) the respondent's own use of barotrauma mitigation tools in the past 12 months;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

agree; and 5 = strongly agree). On average, respondents across sectors agreed that returning fish to depth improves fish survival (average score = 2.28–2.45 out of 5.0 across sectors for the item "returning fish to depth will not improve the survival of released fish"), that helping fish return to depth will mean more fish to be caught in the future (average score = 3.69–3.93), and that improving survival will enable them to catch more fish in the future (average score = 3.80–4.16). However, they did not believe that increasing fish survival would lead to greater harvest allowances, with 62–65% agreeing or strongly agreeing that "even if survival of released fish is improved, management will not allow a greater harvest" (average score = 3.77–3.84).

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

Theory of Planned Behavior Scales and Analysis

Response options to the attitude, subjective norm, perceived control, and intention scales were given on a 5-point scale ranging from strongly disagree to strongly agree; results are summarized in Figures 2–5. The majority (61–82%) of respondents across sectors agreed or strongly agreed that both venting tools and fish descending gear help the fish return to depth and increase fish survival. However, attitudes regarding the practicality and costs associated with the two types of mitigation device differed significantly (t = 5.96–13.46, P 0.001): 43–56% agreed that fish descending gear takes a lot of time, and approximately one-quarter to one-third agreed that it is difficult to use (21–34%) and expensive (26–30%). Conversely, only 9–14% agreed that venting tools take a lot of time, 5–10% agreed that venting tools are difficult to use, and 2–5% agreed that they are expensive.

More respondents perceived subjective norms associated with venting tool use than with fish descending gear use, and levels of agreement with subjective norm items were significantly greater for venting tools across sectors for almost all items (t = 2.48–9.89, P = <0.001 to 0.013). For example, 68–74% agreed or strongly agreed that "fishers like me use venting tools," while only 23–32% agreed that "fishers like me use fish descending gear." Similarly, 50–58% agreed that "other fishers expect me to use venting tools," while only 8–26% agreed that "other fishers expect me to use fish descending gear." This suggests stronger norms associated with venting tools. Notably, fewer fishers agreed that they felt social pressure when asked explicitly (13–17% for venting tools), even though their agreement with the other items shows that they feel such pressure, suggesting that social pressures may in this case be subtle (e.g., they are not commonly asked outright about their barotrauma mitigation behavior).

Across sectors, 82–94% and 57–65% of respondents agreed that they feel confident in their use of venting tools and fish descending gear, respectively, with only 3–7% agreeing that they do not know how to use venting tools and only 7–12% agreeing that they do not know how to use fish descending gear. Relatively few respondents (6–17% and 9–21%, respectively) felt that they needed more training in the use of either mitigation method. Agreement with perceived control items differed significantly for all items across sectors (t = 2.6–4.46, P = <0.001 to 0.01).

The majority of respondents (81–86% across sectors) agreed that they intend to use venting tools next time they encounter barotrauma (t = 10.21–22.29, P 0.001). Conversely, only 20–27% agreed that they intend to use fish descending gear. Of those reef fishers who were familiar with both venting tools and fish descending gear, 71–80% indicated intent to use venting tools, while only 32–39% indicated intent to use fish descending gear.

Results of the regression indicated that subjective norms predicted the highest increase in intention to use both fish descending gear and venting tools across sectors (standardized regression coefficient β = 0.38–0.52) and

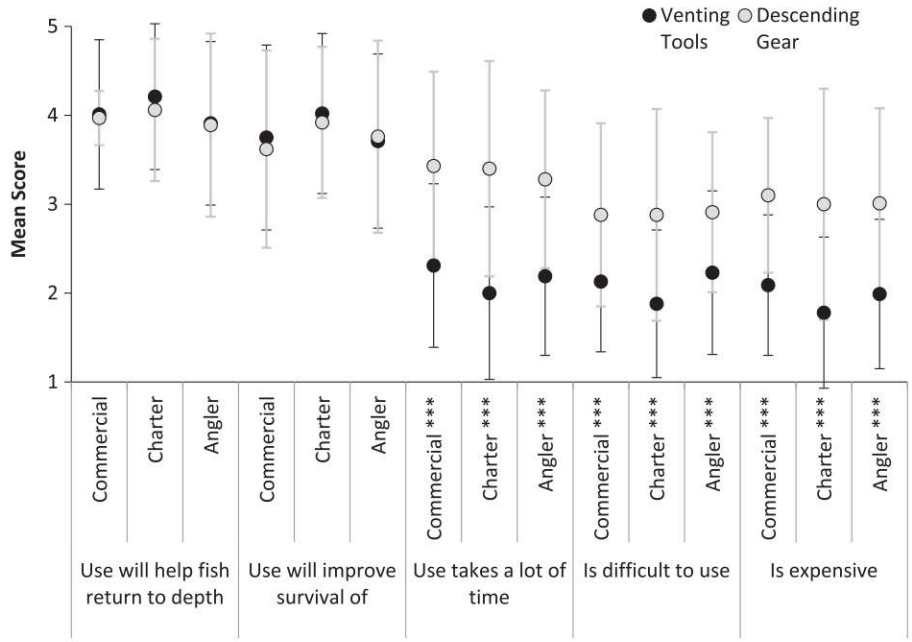

FIGURE 2. Mean (±SD) response to each attitude scale item (i.e., based on the theory of planned behavior) across the recreational (angler), charter, and commercial sectors. Response options were given on a 5-point agreement scale (1 = strongly disagree to 5 = strongly agree). Responses were compared between venting tools and fish descending gear for each sector by using a *t*-test; significant differences are indicated with asterisks (***$P < 0.001$).

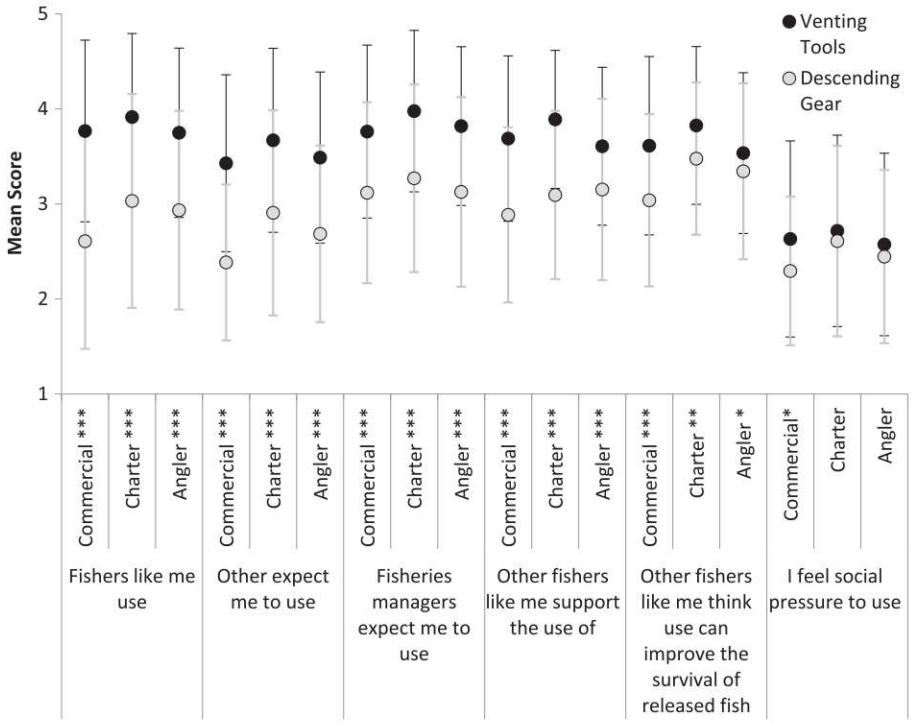

FIGURE 3. Mean (±SD) response to each subjective norm scale item (i.e., based on the theory of planned behavior) across the recreational (angler), charter, and commercial sectors. Response options were given on a 5-point agreement scale (1 = strongly disagree to 5 = strongly agree). Responses were compared between venting tools and fish descending gear for each sector by using a *t*-test; significant differences are indicated with asterisks (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$).

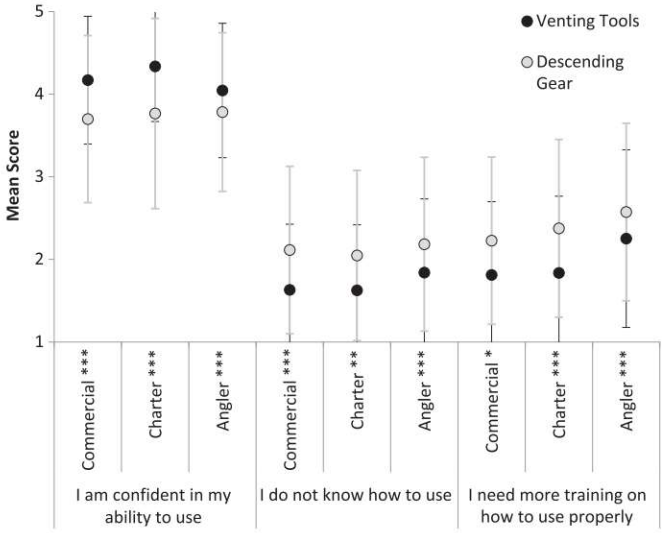

FIGURE 4. Mean (±SD) response to each perceived control scale item (i.e., based on the theory of planned behavior) across the recreational (angler), charter, and commercial sectors. Response options were given on a 5-point agreement scale (1 = strongly disagree to 5 = strongly agree). Responses were compared between venting tools and fish descending gear for each sector by using a *t*-test; significant differences are indicated with asterisks (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$).

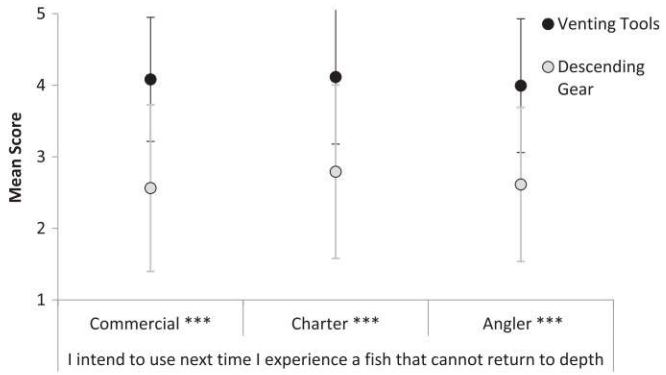

FIGURE 5. Mean (±SD) response to the intention item (i.e., based on the theory of planned behavior) across the recreational (angler), charter, and commercial sectors. Response options were given on a 5-point agreement scale (1 = strongly disagree to 5 = strongly agree). Responses were compared between venting tools and fish descending gear for each sector by using a *t*-test; significant differences are indicated with asterisks (***$P < 0.001$).

that subjective norms were always a significant predictor of intention ($P < 0.001$; Table 1). Conversely, perceived control predicted the lowest increase in intention across sectors (β = 0.08–0.27) and was not significant for either barotrauma mitigation method among charter respondents. Attitude was also a significant predictor except in the case of the charter and commercial venting tool models, but it predicted a lower increase in intention relative to subjective norms (β = 0.13–0.38).

TABLE 1. Results of multiple linear regression (β = standardized regression coefficient) showing the relative ability of attitudes, subjective norms, and perceived control to predict fishers' intention to use either venting tools or fish descending gear as barotrauma mitigation methods across sectors (commercial, charter, and recreational [angler]).

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

DISCUSSION

Almost all survey respondents across sectors were aware of barotrauma mitigation tools, with results suggesting that a high proportion use mitigation when they perceive it to be needed. For example, more than half of respondents reported using barotrauma mitigation most of the time when they encountered a fish suffering from barotrauma—or, in this case, one that they perceived would be unable to return to the bottom—in the previous year. However, given that there appear to be strong norms associated with barotrauma mitigation (and, in particular, venting tools), it is possible that social desirability bias led respondents to over-report their own use of barotrauma mitigation in order to conform with subjective norms (Fisher 1993; Nuno and St. John 2015). For this reason, respondents were also asked about their perception of barotrauma mitigation use by others, and overall reported use was somewhat lower (with 30–57% reporting that they believe others use it most of the time when needed). The perception of use by others was highest in the charter sector; this agrees with the finding that subjective norms were highest in the charter sector, although the difference was minor (for example, 58% of charter operators agreed that other fishers expect them to use venting tools compared with 52% of recreational fishers and 50% of commercial

fishers). It is likely that the actual use of barotrauma mitigation lies somewhere in between self-reported use and the reported use by others, which still indicates that fishers are using barotrauma mitigation with at least moderate frequency when they perceive it to be needed.

This study found that despite the increasing availability of a variety of fish descending gears, venting tools are the primary barotrauma mitigation method used by Florida reef fishers. Of those who had used barotrauma mitigation in the past year, almost all (96–99%) had used venting tools, while relatively few (14–27%) had used fish descending gear. In addition, most (81–86%) intended to use venting tools the next time they encountered a fish suffering from barotrauma, while only 20–27% intended to use fish descending gear.

Fishers across sectors in the survey had positive attitudes regarding the impact of barotrauma mitigation on fish survival. Respondents on average agreed that both venting tools and fish descending gear help the fish return to depth and improve fish survival. In addition, fishers agreed that (1) returning fish to depth improves survival, (2) helping fish return to depth will mean more fish to be caught in the future, and (3) improving fish survival will enable them to catch more fish in the future. Similarly, recreational and tournament anglers in the northern Gulf of Mexico that were surveyed before removal of the venting tool requirement agreed that venting tools increase fish survival (Scyphers et al. 2013). Notably, this perception of positive impacts does not translate directly into the use of barotrauma mitigation. For example, only 61% of commercial fishers who agreed or strongly agreed that venting tools improve fish survival reported using barotrauma mitigation with great frequency (more than 76% of the time when needed), and 23% reported using it rarely (0–25% of the time when needed). This supports the finding that attitudes are neither the only factor nor the most important factor influencing an individual's intention to use barotrauma mitigation.

Although fishers agreed that both barotrauma mitigation methods had positive impacts on fish survival, they differed in their attitudes regarding use of each method. Respondents overall had more favorable attitudes toward the use of venting tools than toward fish descending gear. A greater proportion of fishers felt that descending gear is difficult to use, time consuming, and expensive.

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

Theory of planned behavior analysis showed that fishers perceived stronger subjective norms associated with venting tools than with fish descending gear. In addition, subjective norms constituted the most important predictor of intention to use either method. The lower preference for using fish descending gear compared to venting tools is influenced (in order) by weaker subjective norms, a less-positive attitude, and lower perceived control. Although subjective norms, attitudes toward the effectiveness of tools, and perceived control can be influenced by outreach and information campaigns, descending gears are likely to remain at a disadvantage with respect to attitudes surrounding their practicality of use and expense. It is also worth noting that outreach efforts in the past have primarily focused on fish descending gear, yet the use of venting tools remains the most common form of barotrauma mitigation. In future outreach and rulemaking, it is therefore important not to weaken the overall level of barotrauma mitigation use by promoting descending gear at the expense of venting tools.

Interestingly, survey results indicated that relatively few respondents were opposed to a regulation requiring possession or use of barotrauma mitigation devices, suggesting that reinstating such a regulation would be met with little opposition from stakeholders. In addition, respondents across sectors perceived that the use of barotrauma mitigation by others was higher when the historic venting tool requirement was in place. Reinstatement of such a regulation would therefore likely increase use of barotrauma mitigation by fishers. Regulation would also show management support for barotrauma mitigation and would serve to enforce subjective norms.

Results of this study show that outreach campaigns focused on emphasizing and re-enforcing norms should have the greatest impact on increasing fishers' intention to use barotrauma mitigation measures. Subjective norms have been found to be significant predictors of fisher behavior in other contexts (for example, compliance with regulations), and campaigns targeting norms have been

shown to be effective in producing desired behaviors (Schultz et al. 2007). Key drivers of change in subjective norms include communication, education, and governance. Given the strong influence of subjective norms on intention to use barotrauma mitigation, fishery managers should take advantage of the social influence of industry leaders to educate and encourage the use of barotrauma mitigation practices. Attitudes and behavior differed little across sectors in this study, suggesting that outreach messages need not be tailored differently for each audience.

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