Venting and Reef Fish Survival: Perceptions and Participation Rates among Recreational Anglers in the Northern Gulf of Mexico

Steven B. Scyphers, F. Joel Fodrie, Frank J. Hernandez Jr., Sean P. Powers & Robert L. Shipp

SEDAR74-RD97

March 2022

North American Journal of Fisheries Management
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ujfm20

Venting and Reef Fish Survival: Perceptions and Participation Rates among Recreational Anglers in the Northern Gulf of Mexico

Steven B. Scyphers [a], F. Joel Fodrie [b], Frank J. Hernandez Jr. [c], Sean P. Powers [d] & Robert L. Shipp [d]

[a] Department of Marine and Environmental Sciences, Marine Science Center, Northeastern University, 430 Nahant Road, Nahant, Massachusetts, 01908, USA

[b] Institute of Marine Sciences and Department of Marine Sciences, University of North Carolina at Chapel Hill, 3431 Arendell Street, Morehead City, North Carolina, 28557, USA

[c] Department of Coastal Sciences, University of Southern Mississippi, 703 East Beach Drive, Ocean Springs, Mississippi, 39564, USA

[d] Department of Marine Sciences, University of South Alabama, LSCB Room 25, 5871 Drive North Boulevard, Mobile, Alabama, 36688, USA

To cite this article: Steven B. Scyphers, F. Joel Fodrie, Frank J. Hernandez Jr., Sean P. Powers & Robert L. Shipp (2013) Venting and Reef Fish Survival: Perceptions and Participation Rates among Recreational Anglers in the Northern Gulf of Mexico, North American Journal of Fisheries Management, 33:6, 1071-1078

To link to this article: http://dx.doi.org/10.1080/02755947.2013.824932

North American Journal of Fisheries Management 33:1071–1078, 2013

ISSN: 0275-5947 print / 1548-8675 online
DOI: 10.1080/02755947.2013.824932

MANAGEMENT BRIEF

Venting and Reef Fish Survival: Perceptions and Participation Rates among Recreational Anglers in the Northern Gulf of Mexico

Steven B. Scyphers*
Department of Marine and Environmental Sciences, Marine Science Center, Northeastern University, 430 Nahant Road, Nahant, Massachusetts 01908, USA

F. Joel Fodrie
Institute of Marine Sciences and Department of Marine Sciences, University of North Carolina at Chapel Hill, 3431 Arendell Street, Morehead City, North Carolina 28557, USA

Frank J. Hernandez Jr.
Department of Coastal Sciences, University of Southern Mississippi, 703 East Beach Drive, Ocean Springs, Mississippi 39564, USA

Sean P. Powers and Robert L. Shipp
Department of Marine Sciences, University of South Alabama, LSCB Room 25, 5871 Drive North Boulevard, Mobile, Alabama 36688, USA

Abstract

Fisheries scientists, managers, and industry have developed innovative tools and techniques to improve the survival of fishes captured and released in deepwater settings. Venting involves the insertion of a hollow needle to deflate a fish's swim bladder and is among the most widely promoted barotrauma mitigation techniques. However, its efficacy has been the subject of intense debate. In the northern Gulf of Mexico, venting tools are mandatory tackle for offshore reef anglers, but current mandates on usage are being reconsidered. We surveyed recreational and tournament anglers to understand the popularity and perceived effectiveness of venting and identify factors that affect these measures. Our survey results indicate that approximately two-thirds of anglers vent the fish they release offshore and most perceive it to be effective for improving survival rates. Among recreational anglers, we found that primary fishing locale (inshore, offshore) and experience were powerful predictors of perceptions and utilization rates. However, fishing experience did not appear to influence knowledge of proper venting techniques. While further ecological and physiological experimentation is needed to resolve many uncertainties that surround venting, our study demonstrates that angler perceptions and behaviors must also be considered and that aggressive education and outreach programs would be necessary to alter or improve current venting practices.

The fate of released fish is a complex and controversial topic (Arlinghaus et al. 2007; Cooke and Schramm 2007). The effects of capture can be especially harmful for fishes that are retrieved from deep waters and may suffer from barotrauma or internal injuries that result from gas expansion in blood, tissues, and organs (e.g., swim bladder, stomach, and eyes) (Casillas et al. 1975; Rogers et al. 1986; Arlinghaus et al. 2007). When the direct effects of barotrauma are sublethal, an inflated gas bladder makes a fish's return to preferred depth difficult and increases its vulnerability to predation, as well as heightens stress resulting from exposure to elevated surface water temperatures and ultraviolet light (Collins 1996; Keniry et al. 1996; Hannah et al. 2008; Overton et al. 2008). To mitigate the effects of barotrauma and increase survival rates of released fishes, novel tools and techniques (e.g., recompression cages and venting) have been developed and promoted by scientists, managers, and industries (Hannah and Matteson 2007; Wilde 2009a; Sumpton et al. 2010).

Venting, which involves the insertion of a hollow syringe into a fish's abdomen to release expanded gases in the swim bladder or abdominal cavity, has been mandated or promoted by some fishery management and extension agencies (GMFMC 2007;

*Corresponding author: s.scyphers@neu.edu
Received October 12, 2012; accepted July 4, 2013

FSG 2013), although the efficacy of venting has been the subject of scientific debate (Burns et al. 2009; Wilde 2009a, 2009b). A recent meta-analysis found that venting had no positive, and a potentially negative, effect on postrelease survival rates for many fishes that have experienced barotrauma (Wilde 2009a). Advocates of venting have contended that it may be beneficial for some species and in certain scenarios, and therefore should not be broadly discouraged (Burns et al. 2009; Sumpton et al. 2010). To the contrary, others have reasoned that barotrauma mitigation procedures of lacking or unknown biological benefit should not be mandated (Wilde 2009b). While scientific uncertainty still surrounds the efficacy of venting, the syringe-like tools necessary for this practice can be found in nearly all tackle shops and are often marketed as being required for reef fishing depending on which state and fishery management council governs the region.

Often lost in debates on the efficacy of mortality-reducing procedures are the knowledge, perceptions, and attitudes of anglers. The collective knowledge of stakeholders can provide accurate and reliable sources of information to guide management initiatives and further empirical studies (Aswani and Hamilton 2004; Boudreau and Worm 2010; Sáenz-Arroyo et al. 2005). In addition to using their knowledge as observational bases to formulate testable hypotheses (Huntington 2000; Drew 2005), understanding the perceptions and attitudes of stakeholders can serve as predictors of participation, compliance, or support of management initiatives (Cooke et al. 2012; Ford-Thompson et al. 2012). Whether venting helps, harms, or has no effect on fish survival may provide an interesting topic for scientific debate, but the continuing lack of consensus about venting adds to the uncertainty surrounding many fish stocks. Furthermore, the mandating of any policy or procedure that lacks measureable benefit or is ultimately deemed unnecessary may result in a lack of stakeholder trust in management agencies (Behnke 1987).

While fisheries scientists must continue to disentangle the pros and cons of venting (Brown et al. 2010), anglers continually face the venting question for each undersized or undesirable fish that is released. Determining the proportion of anglers that vent and how they perceive this controversial technique would be a useful step towards more effective inclusion of anglers in fisheries management discussions. Here, we examined the venting debate by conducting surveys of anglers in the northern Gulf of Mexico. Specifically, we focused our survey on estimating (1) familiarity and participation levels, (2) perceived effect on the survival of released reef fish in multiple contexts, and (3) the influence of fishing experience, practices, and other demographic descriptors on these first two estimates. In our approach, we randomly surveyed a broad recreational fishing community and specifically targeted more avid tournament participants.

METHODS

To determine how anglers perceive and utilize venting, we surveyed recreational licensees and fishing tournament participants in the northern Gulf of Mexico, a region that supports 31 federally managed reef fish species. Specifically, we coupled an online survey of licensed Alabama recreational saltwater anglers with intercept surveys of participants in the largest saltwater fishing tournament within the Gulf of Mexico. Recreational fishing attracts more than 500,000 resident and nonresident anglers to Alabama's coastal and offshore waters annually (NMFS 2009). The waters offshore of Alabama's coastline hosts an artificial structure permit zone of approximately 3,250 km^2, and 30% of the recreational effort targeting Red Snapper *Lutjanus campechanus* in the U.S. Gulf of Mexico occurs in this region (Porch et al. 2007).

The broadest sample of recreational anglers was reached using an online survey approach. We sent brief e-mail invitations with a link to the survey to 2,000 randomly selected licensees, of which all were over the age of 18 and had purchased an Alabama recreational fishing license in the fiscal years of 2009 or 2010. License descriptions and contact information were acquired through a cooperative partnership with the Alabama Department of Natural Resources, Marine Resources Division. Survey invitations were sent as a split sample where half included an option to participate in a prize raffle for gift cards to a fishing retail store (US$20 value) as an incentive to take the survey while the other half were offered nothing for their participation. The online survey was active from December 26, 2011, to January 9, 2012, and e-mail reminders were sent every 3 d. The e-mails and data collection were conducted using Qualtrics Survey Software Research Suite.

Our second survey targeted more avid or specialized anglers at the 2009 Alabama Deep Sea Fishing Rodeo (ADSFR). The ADSFR is located centrally in the northern Gulf of Mexico on Dauphin Island, Alabama, and is the oldest saltwater fishing tournament in the USA. In its 81st year, the 2009 ADSFR attracted over 3,000 anglers from throughout the Gulf region to waters south of Mobile Bay. The tournament offered prize money in 30 categories, 6 of which were offshore reef fishes. Survey participants were haphazardly approached near the weigh-in station and asked to participate in a short fishing survey.

Prior to data collection in either survey effort, we pretested our survey instrument among a group of 20 scientists and anglers to identify potential issues. Our survey instrument included two to five questions focused on venting and additional questions to describe the participant's fishing activities and experience, education, and household income (Supplement presented in the online version of this article). Additional demographic factors of age, gender, state of residence, and ZIP code (used to calculate distance from the coast) were acquired from the licensee database. For both the recreational and tournament surveys, the first question assessed familiarity and participation in venting. The second question, for all anglers except those who were unfamiliar with the concept of venting, asked participants if they perceived venting to increase a fish's chance of postrelease survival. The remaining questions were only included in the online survey focused on the broader recreational angler community.

The third question asked participants for their perception of the percentage of vented and nonvented fish that survive the experience of capture and release. The fourth question assessed whether anglers perceived there to be a minimum or maximum depth beyond which venting is not necessarily beneficial. Participants were able indicate if they did not believe a minimum or maximum depth exists. We considered no minimum depth as zero and excluded no maximum depth responses during analysis. The fifth and final question displayed an illustration of an adult Red Snapper, and participants were asked to select the precise location where he or she would insert the venting tool. This question was administered using the "Heat Map" function in Qualtrics, and the distance (in pixels) between participant's responses and an "ideal" insertion location was measured. The ideal venting location was considered to be below the fourth dorsal spine and in line with the top of the pectoral fin (Rummer 2007; Sumpton et al. 2010). Additionally, we consulted scientific literature and an expert on Red Snapper biology and ecology to supplement our interpretation of insertion location implications (Patterson et al. 2007; Rummer 2007; W. F. Patterson, University of South Alabama, Dauphin Island, personal communication).

We used multivariate and univariate statistics, as well as qualitative analysis, of our surveys to evaluate the relationship between anglers and venting. To evaluate potential factors contributing to heterogeneity in venting utilization and perceived effectiveness among recreational anglers, we used tree-based classification models constructed by using the chi-square automatic interaction detection (CHAID) growing method. The CHAID method identifies the independent variable with the strongest interaction at each step of the process and merges categories that are not significantly different with respect to the dependent factor. In the CHAID tree-growing method, scale-independent variables are automatically banded into discrete groups prior to the analysis. Our tree models considered three ordered scale variables (age, distance from coast, recent experience), five nominal variables (education, gender, state of residence, primary fishing locale, tournament participation), and one ordinal variable (income category).

When applicable, we used factors identified by classification trees as independent variables in univariate analyses. To compare perceived survival rates of vented and nonvented fish, we first used the paired Wilcoxon's signed rank test to test for overall differences. Next, we calculated the ratio between vented and nonvented fish to allow nonparametric Kruskal–Wallis tests using an independent variable identified by tree analysis. We also used this independent variable and Kruskal–Wallis tests for analyzing perceived minimum and maximum effective depths at which venting is beneficial. Finally, we used regression to assess the relationship between recent experience and accuracy of venting tool insertion location. Recent experience level was calculated as the mean number of days fished annually from 2009 to 2011. All data were analyzed using the Statistical Package for the Social Sciences (SPSS), and data were considered statistically significant at $P \leq 0.05$.

RESULTS

We surveyed 604 recreational and tournament anglers to document their knowledge and perceptions of, and their behaviors involving the venting of offshore reef fishes. The online survey of recreational license holders yielded 336 responses of which 301 were completed, while the intercept survey of participants in the 2009 ADSFR resulted in 268 being completed. The majority of respondents were Alabama residents (73%), while 10% resided in other Gulf states, and residents of 14 other states comprised the remaining 17%. Nearly 98% of survey participants were white, 88% were male, and the average age was 46. The split-sample approach for the online survey was used to examine the effect of a raffle incentive on response rates. Overall response rates were similar among anglers offered an incentive raffle (17.1% response rate; $n = 171$) and those offered nothing (16.5% response rate; $n = 165$). The overall sampling error was $\pm 5.8\%$. From the intercept surveys of tournament anglers, the overall participation rate was greater than 90%.

The first two questions of both the recreational and tournament surveys focused on the use and perceived effectiveness of venting captured and released reef fishes. Venting was used by 64% of recreational and 67% of tournament survey participants (Figure 1) and was perceived to increase survival by 60% of recreational and 83% of tournament anglers (Figure 1). Classification tree analysis identified "primary fishing locale" as the variable having the greatest power to predict whether a

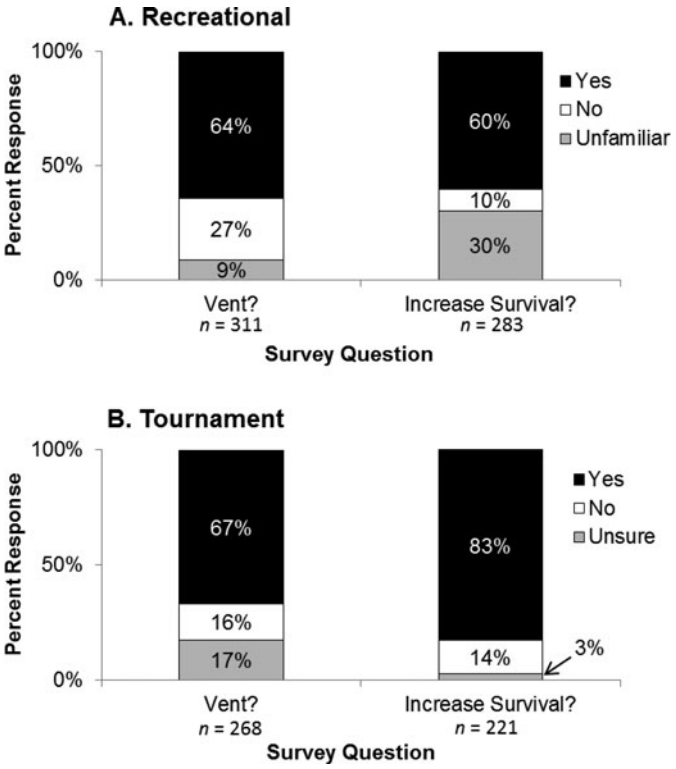

FIGURE 1. Response of (**A**) recreational and (**B**) tournament survey participants when asked whether they vent reef fish before they release them and whether they believe it increases the fish's survival.

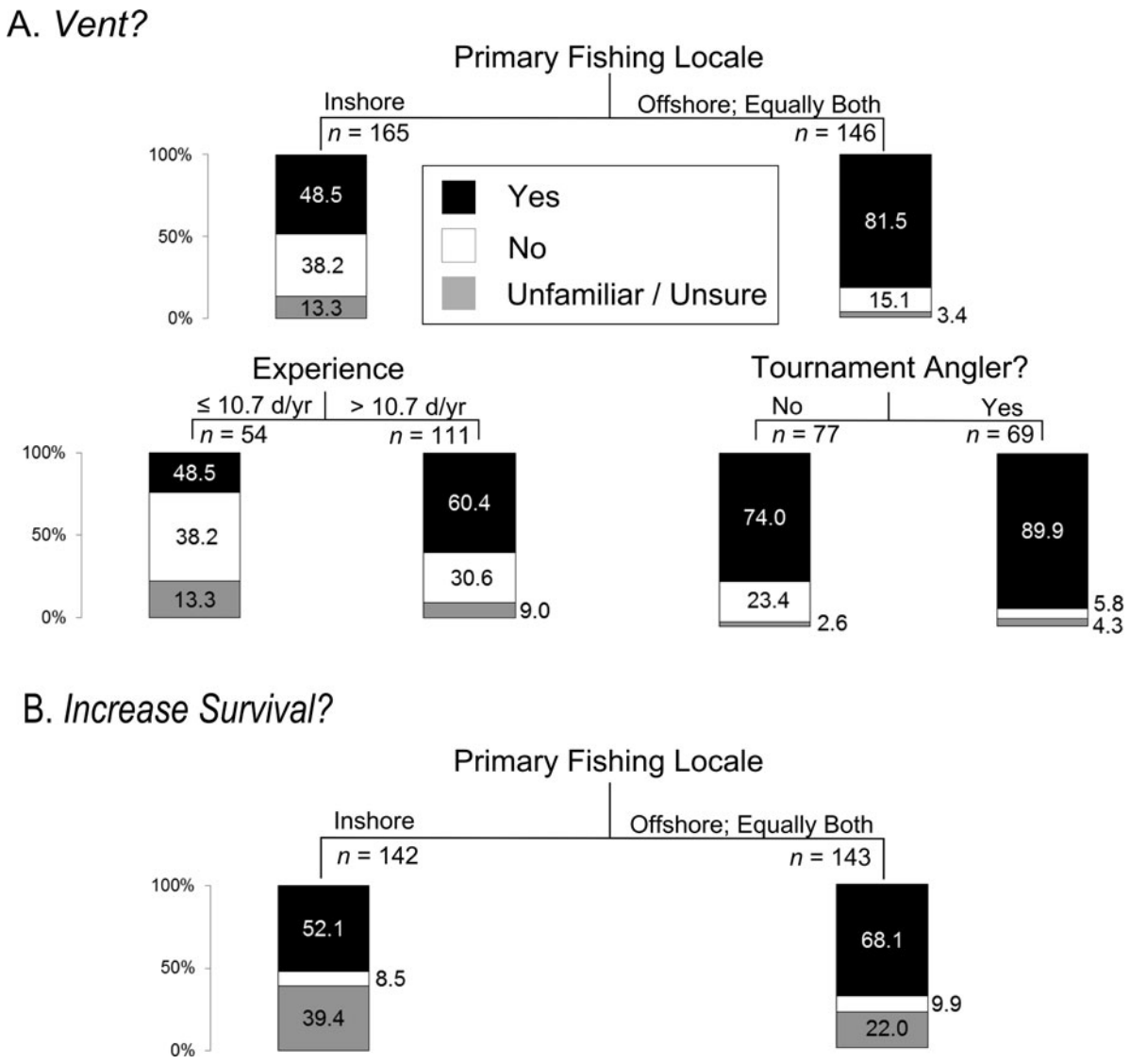

FIGURE 2. Classification trees showing the most influential of nine descriptors for predicting whether anglers vent fish and perceive it to be effective at enhancing the fish's survival. Separate branches indicate statistically significant differences at $P \leq 0.05$. Values shown within bars are percent response.

recreational angler vents the fish before releasing it (Figure 2A). Anglers that focused half or more of their fishing effort offshore were more likely to vent the fish they released than were anglers that primarily fished inshore. Among online survey respondents, offshore anglers that participated in fishing tournaments were more likely to vent fish than nontournament anglers. Among anglers that primarily fish inshore, venting was more common among anglers that fished more than 10.7 d/year. Primary fishing locale was also identified as the variable with the greatest power to predict whether a recreational angler perceived venting to increase postrelease survival rates (Figure 2B).

The next two questions of the online recreational survey focused on the perceived effects of venting on survival rates and the influence of depth on venting effectiveness. Survival rates of vented fish were perceived to be higher than those for nonvented fish ($n = 288$, $Z = -10.189$, $P < 0.001$; Figure 3), and this perception was not affected by target fishing locale ($n = 284$, Kruskal–Wallis test: $P = 0.281$). Perceived survival rates between 70% and 100% were much more commonly chosen for vented fish; whereas, 40–60% survival was most often chosen for nonvented fish. The perceived absence of a minimum or maximum effective depth was represented by 7% and 60% of anglers, respectively. Among anglers that perceived a minimum beneficial depth to exist, venting was perceived most effective at depths greater than 15.3 m (SD, 7.4) on average, and predominately inshore anglers perceived venting to be most effective at slightly shallower depths than did anglers that equally fished inshore and offshore waters ($n = 129$, Kruskal–Wallis test: $P = 0.044$; Figure 4). A perceived maximum beneficial depth existed at approximately 36 m (SD,

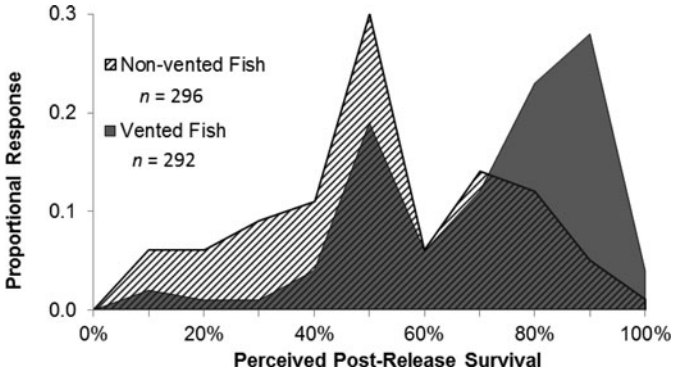

FIGURE 3. Perceived postrelease survival rates of vented and nonvented fish by recreational survey participants.

27.2), but values varied considerably with no effect of fishing locale ($n = 46$, Kruskal–Wallis test: $P = 0.879$; Figure 4).

The final question of the online survey asked participants to locate the ideal location for insertion of the venting tool. The majority of respondents selected a location posterior of the pectoral fin insertion and below the lateral line (Figure 5). More than half of all points were clustered below the ideal insertion point and between the pectoral and anal fin insertions. Fewer anglers identified points near the fish's mouth, operculum, near or above the lateral line, or posterior of the anal fin. The proximity insertion points to the ideal location did not appear to be closely related to their recent fishing experience measurement, measured as the mean number of days fished annually over the previous 3 years (Figure 6).

DISCUSSION

The efficacy of venting released reef fishes has been the subject of critical evaluation, review, and debate, and nearly all studies agree that the benefits of venting are highly context dependent (i.e., species, capture depth, water temperature) (Render and Wilson 1994; Gitschlag and Renaud 1994; Rummer 2007; Burns et al. 2009; Wilde 2009a, 2009b). Our study provides a window into how recreational anglers perceive and use venting amid resounding scientific uncertainty. Overwhelmingly, the anglers surveyed in our study used venting tools and techniques, and most perceived it to be an effective strategy for enhancing postrelease survival rates. If future studies determine that venting is not beneficial or potentially harmful for reef fishes, our results suggest that aggressive education and outreach programs will be required to alter current angler behavior. To the contrary, if future studies find that venting does enhance the survival of released fish, our study shows that initiatives will be required to educate anglers currently unfamiliar or misinformed regarding proper venting techniques. Furthermore, these efforts would need to be designed to broadly reach the recreational fishing community since age, gender, education, income, state of residence, and distance from the coast did not significantly affect venting practices or perceptions. One potential weakness of our study was that it focused on licensed Alabama anglers and tournament participants and had lower sample sizes for nonAlabama residents and some other subgroups. We are also hopeful that our findings motivate more comprehensive and broader-scale studies of angler behavior to further reduce the many uncertainties surrounding the practice of venting.

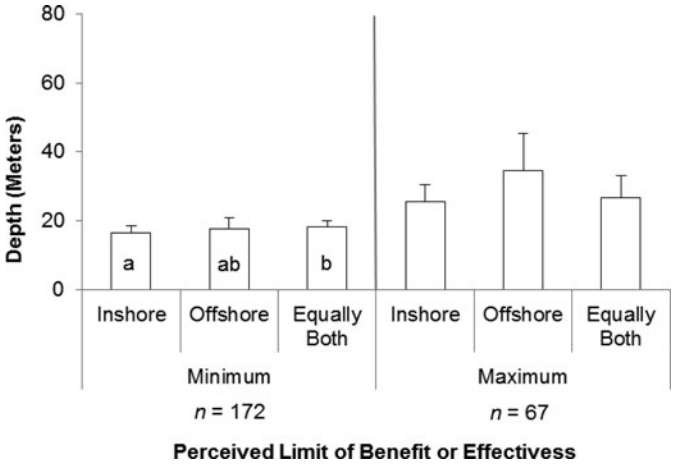

FIGURE 4. Minimum and maximum depths (+ SE) for which venting of fish is perceived by anglers to be effective, separated by primary fishing locale. Different letters within bars indicate statistically significant differences at $P \leq 0.05$ from Kruskal–Wallis tests.

While our study does highlight increased use and perceived effectiveness among more experienced offshore anglers, we found that fishing experience was unrelated to knowledge of proper venting technique. This was evident based upon the lack of a relationship between the mean days fished annually and the accuracy of venting tool insertion. Moreover, we found that misinformation on how to properly vent was common among anglers of all experience levels. These findings agree with Wilde (2009a), that very little evidence supports the premise of fisheries scientists or expert anglers being more proficient at venting than novice anglers. Furthermore, our heat map question showed that even some highly experienced anglers misperceived a distended stomach as the cause of barotrauma instead of a consequence of it, and use venting tools to puncture the protrusion. Similarly, some anglers vent fish anterior to the pectoral fin, which could potentially damage the heart, gills, or liver, and a large proportion of anglers vent more ventrally than prescribed, which could potentially puncture the stomach, intestines, or anus. Considering that a large proportion of anglers use venting techniques, and many do so improperly, our study highlights potentially unforeseen consequences of the venting mandate and further supports the argument that educating anglers of all experience levels is necessary when participatory fisheries management strategies are initiated (Cooke et al. 2012).

The open-ended "comments" section of our surveys provided an opportunity for anglers to describe their personal perspectives, observations, and opinions on the practice of venting. While the structured questions of our survey showed that anglers overwhelmingly use venting and perceived it to be

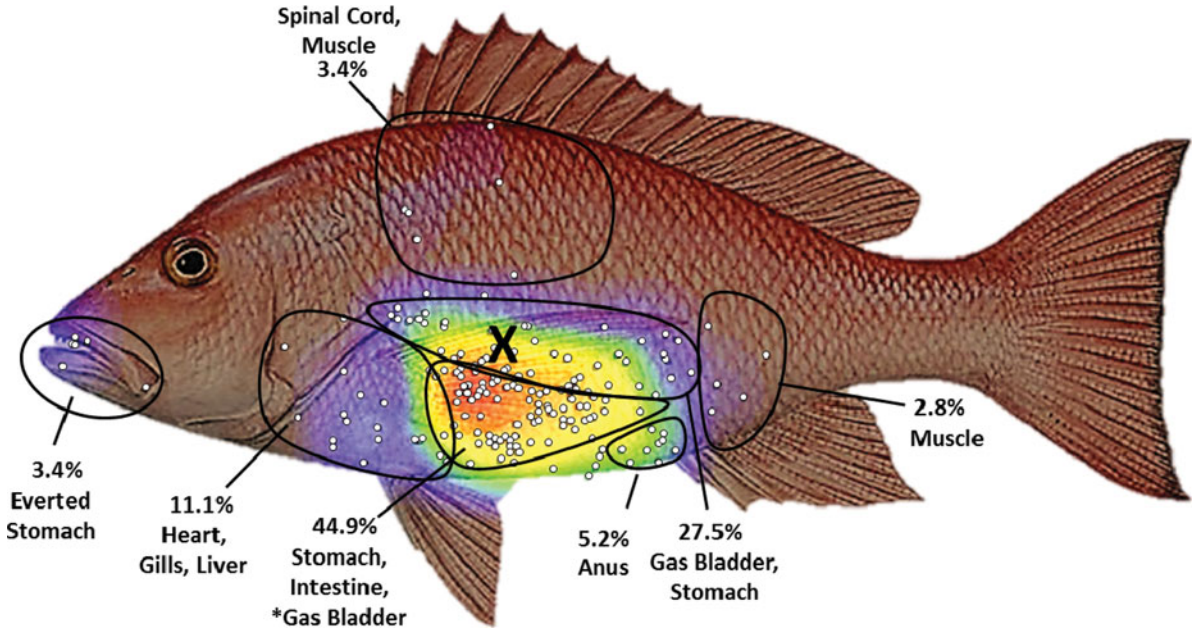

FIGURE 5. Ideal needle insertion locations selected by recreational survey participants during the online survey ($n = 191$). Extrapolated colors were generated by the Heat Map function of Quatrics, and outlines with percentages manually overlaid. *The anatomical extent of the gas bladder is dependent upon the extent of barotrauma. The bold "X" indicates the ideal insertion location used for analysis. [Figure available in color online.]

beneficial, their anecdotes suggested that many anglers perceived the benefits of venting to be highly context-specific. Specifically, two-thirds of the comments from the online survey identified a scenario where venting may be more or less beneficial, and several common themes emerged from these comments. First, the majority of anglers perceived a minimum depth to exist where the venting of fish shallower than such depth is not necessary or beneficial, but a perceived maximum depth was again much less clear. A second common perspective suggested that some anglers only vent visibly injured or distressed fish and perceive venting to require a certain level of skill or experience to be effective. For example, one angler stated, "I only vent fish if there is a protrusion from the mouth or anus, and I would prefer not to vent at all." Several anglers associated the effectiveness of venting with the experience level of individuals with statements such as, "If not done right, venting can hurt more than help." However, we found little evidence that angler knowledge of proper venting techniques was related to fishing experience level. Finally, five anglers stated that venting does not benefit the survival of released fish if bottlenose dolphins *Tursiops truncatus* are present. Collectively, these insights highlight the diverse array of issues facing efforts to assess the effects of venting on reef fish survival and reemphasize the importance of incorporating stakeholder knowledge and perceptions to help design experimental studies and account for angler behavior and compliance.

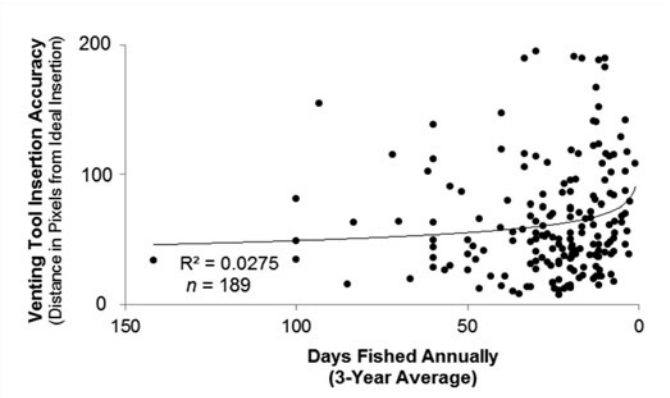

FIGURE 6. Relationship between mean annual days fished during 2009–2011 and needle insertion proximity to ideal insertion point on the fish. Solid line represents a logarithmic fit to the data.

For fisheries managers to effectively assess the survival of released fish, we must develop a thorough understanding of how venting and other barotrauma mitigation techniques affect reef fish survival and how venting is perceived and used by anglers. There have been resounding calls for fisheries management to better incorporate human dimensions and to use a "precautionary approach" for balancing biological and social objectives (FAO 1995; Rice 2009; Cowan et al. 2012). Specifically, it has been argued that if a fisheries management measure does not produce demonstrable biological gains, it should not be implemented to avoid unnecessary social costs (Schill and Scarpella 1997) or the loss of agency credibility (Behnke 1987). The effect of venting on the survival of released reef fish represents a fisheries management issue surrounded by scientific uncertainty. In the Gulf of Mexico, the mandatory use of venting tools is currently being reconsidered, and the proposed actions would

make their use discretionary. Specifically, the proposed framework states that "the Science and Statistical Committee felt that fishermen should have the option of deciding the most appropriate way to release fish" (GMFMC 2013). Our study shows that in the northern Gulf of Mexico, there is high "buy-in" among recreational fishers and considerable belief that venting is beneficial for released reef fish. With the efficacy of venting still presently unclear and current mandates being reconsidered, it is important to understand the current behavior, knowledge, and perceptions of anglers for decision making, assessments, and education initiatives. We do not propose that the venting debate can be solved by simply including the perceptions of anglers, but it could only benefit if such a group of stakeholders, who may also hold a wealth of knowledge on the issue, were included in the scientific and management processes. Along with empirical studies targeted at reducing the biological uncertainty, we believe more attention should be directed towards angler considerations and the social costs of venting mandates to avoid losing the trust of anglers.

ACKNOWLEDGMENTS

We thank W. Patterson for advice on interpreting venting tool insertion points. We are grateful to the Mobile Jaycees and the Alabama Deep Sea Fishing Rodeo for their continued support of the University of South Alabama's Fisheries Ecology Lab and this survey, and thank K. Anson and C. Denson at the Alabama Department of Conservation and Natural Resources, Marine Resources Division, for access to the license holder information. We appreciate M. Johnson, R. Gamble, and the Marine Vertebrate Zoology class from the Dauphin Island Sea Lab for assistance administering the survey. We appreciate comments from M. Drymon, C. Griswold, an associate editor, and three anonymous reviewers that helped improve earlier drafts of this manuscript. Special thanks to Diane Peebles for allowing us to use her excellent Red Snapper illustration (copyright 1992, Diane Rome Peebles [with permission from D. R. Peebles, artist and biological illustrator, St. Petersburg, Florida]). Funding support was provided by a National Oceanic and Atmospheric Administration, Marine Fisheries Initiative grant (NA08NMF4330404).

REFERENCES

Arlinghaus, R., S. J. Cooke, J. Lyman, D. Policansky, A. Schwab, C. Suski, S. G. Sutton, and E. B. Thorstad. 2007. Understanding the complexity of catch-and-release in recreational fishing: an integrative synthesis of global knowledge from historical, ethical, social, and biological perspectives. Reviews in Fisheries Science 15:75–167.

Aswani, S., and R. J. Hamilton. 2004. Integrating indigenous ecological knowledge and customary sea tenure with marine and social science for conservation of Bumphead Parrotfish (*Bolbometopon muricatum*) in the Roviana Lagoon, Solomon Islands. Environmental Conservation 31:69–83.

Behnke, R. J. 1987. Catch-and-release: the last word. Pages 291–299 *in* R. A. Barnhart and T. D. Roelofs, editors. Catch-and-release fishing: a decade of experience. California Cooperative Fishery Research Unit, Humbolt State University, Arcata.

Boudreau, S. A., and B. Worm. 2010. Top-down control of lobster in the Gulf of Maine: insights from local ecological knowledge and research surveys. Marine Ecology Progress Series 403:181–191.

Brown, I., W. Sumpton, M. McLennan, D. Mayer, M. Campbell, J. Kirkwood, A. Butcher, I. Halliday, A. Mapleston, D. Welch, G. A. Begg, and B. Sawynok. 2010. An improved technique for estimating short-term survival of released line-caught fish, and an application comparing barotrauma-relief methods in Red Emperor (*Lutjanus sebae* Cuvier 1816). Journal of Experimental Marine Biology and Ecology 385:1–7.

Burns, K., J. Stevely, S. Theberge, and C. Adams. 2009. Letter to the editor: does venting promote survival of released fish? Fisheries 34:454–455.

Casillas, E., S. E. Miller, L. S. Smith, and B. G. D'Aoust. 1975. Changes in hemostatic parameters in fish following rapid decompression. Undersea Biomedical Research 2:267–276.

Collins, M. R. 1996. Survival estimates for demersal reef fishes released by anglers. Proceedings of the Gulf and Caribbean Fisheries Institute 44:259–269.

Cooke, S. J., V. M. Nguyen, K. J. Murchie, A. J. Danylchuk, and C. D. Suski. 2012. Scientific and stakeholder perspectives on the use of circle hooks in recreational fisheries. Bulletin of Marine Science 88:395–410.

Cooke, S. J., and H. L. Schramm. 2007. Catch-and-release science and its application to conservation and management of recreational fisheries. Fisheries Management and Ecology 14:73–79.

Cowan, J. H. Jr., J. C. Rice, C. J. Walters, R. Hilborn, T. E. Essington, J. W. Day Jr., and K. M. Boswell. 2012. Challenges for implementing an ecosystem approach to fisheries management. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science [online serial] 4:496–510.

Drew, J. A. 2005. Use of traditional ecological knowledge in marine conservation. Conservation Biology 19:1286–1293.

FAO (Food and Agriculture Organization of the United Nations). 1995. Precautionary approach to fisheries—part 1: guidelines on the precautionary approach to capture fisheries and species introductions. FAO Fisheries Technical Paper 350/1.

Ford-Thompson, A. E. S., C. Snell, G. Saunders, and P. C. L. White. 2012. Stakeholder participation in management of invasive vertebrates. Conservation Biology 26:345–356.

FSG (Florida Sea Grant). 2013. Venting: a guide to releasing reef fish with ruptured swimbladders. FSG, University of Florida, Gainesville. Available: www.flseagrant.org/fish-venting. (March 2013).

Gitschlag, G. R., and M. L. Renaud. 1994. Field experiments on survival rates of caged and released Red Snapper. North American Journal of Fisheries Management 14:131–136.

GMFMC (Gulf of Mexico Fishery Management Council). 2007. Final amendment 27 to the reef fish fishery management plan and amendment 14 to the shrimp fishery management plan. GMFMC, Tampa, Florida.

GMFMC (Gulf of Mexico Fishery Management Council). 2013. Framework action to set the annual catch limit and bag limit for Vermilion Snapper, set annual catch limit for Yellowtail Snapper, and modify the venting tool requirement: framework action to the fishery management plan for reef fish resources of the Gulf of Mexico. GMFMC, public comment draft, Tampa, Florida.

Hannah, R. W., and K. M. Matteson. 2007. Behavior of nine species of Pacific rockfish after hook-and-line capture, recompression, and release. Transactions of the American Fisheries Society 136:24–33.

Hannah, R. W., S. J. Parker, and K. M. Matteson. 2008. Escaping the surface: the effect of capture depth on submergence success of surface-released Pacific rockfish. North American Journal of Fisheries Management 28:694–700.

Huntington, H. P. 2000. Using traditional ecological knowledge in science: methods and applications. Ecological Applications 10:1270–1274.

Keniry, M. J., W. A. Brofka, W. H. Horns, and J. E. Marsden. 1996. Effects of decompression and puncturing the gas bladder on survival of tagged Yellow Perch. North American Journal of Fisheries Management 16:201–206.

NMFS (National Marine Fisheries Service). 2009. Fisheries economics of the United States, 2006: economics and sociocultural status and trends series. NOAA Technical Memorandum NMFS-F/SPO-97.

Overton, A. S., J. Zabawski, and K. L. Riley. 2008. Release mortality of undersized fish from the snapper–grouper complex off the North Carolina coast. North American Journal of Fisheries Management 28:733–739.

Patterson, W. F. III, J. H. Cowan Jr., G. R. Fitzhugh, and D. L. Nieland, editors. 2007. Red Snapper ecology and fisheries in the U.S. Gulf of Mexico. American Fisheries Society, Symposium 60, Bethesda, Maryland.

Porch, C. E., G. R. Fitzhugh, M. S. Duncan, L. A. Collins, and M. W. Jackson. 2007. Modeling the dependence of batch fecundity on size and age for use in stock assessments of Red Snapper in U.S. Gulf of Mexico waters. Pages 229–243 *in* W. F. Patterson III, J. H. Cowan Jr., G. R. Fitzhugh, and D. L. Nieland, editors. Red Snapper ecology and fisheries in the U.S. Gulf of Mexico. American Fisheries Society, Symposium 60, Bethesda, Maryland.

Render, J. H., and C. A. Wilson. 1994. Hook-and-line mortality of caught and released Red Snapper around oil and gas platform structural habitat. Bulletin of Marine Science 55:1106–1111.

Rice, J. C. 2009. A generalization of the three-stage model for advice using the precautionary approach in fisheries, to apply broadly to ecosystem properties and pressures. ICES Journal of Marine Science 66:433–444.

Rogers, S. G., H. T. Langston, and T. E. Targett. 1986. Anatomical trauma to sponge-coral reef fishes captured by trawling and angling. U.S. National Marine Fisheries Service Fishery Bulletin 84:697–704.

Rummer, J. L. 2007. Factors affecting catch and release (CAR) mortality in fish: insight into CAR mortality in Red Snapper and the influence of catastrophic decompression. Pages 123–144 *in* W. F. Patterson III, J. H. Cowan Jr., G. R. Fitzhugh, and D. A. Nieland, editors. Red Snapper ecology and fisheries in the U.S. Gulf of Mexico. American Fisheries Society, Symposium 60, Bethesda, Maryland.

Sáenz-Arroyo, A., C. M. Roberts, J. Torre, M. Cariño-Olvera, and R. R. Enríquez-Andrade. 2005. Rapidly shifting environmental baselines among fishers of the Gulf of California. Proceedings of the Royal Society of London B 272:1957–1962.

Schill, D. J., and R. L. Scarpella. 1997. Barbed hook restrictions in catch-and-release trout fisheries: a social issue. North American Journal of Fisheries Management 17:873–881.

Sumpton, W. D., I. W. Brown, D. G. Mayer, M. F. McLennan, A. Mapleston, A. R. Butcher, D. J. Welch, J. M. Kirkwood, B. Sawynok, and G. A. Begg. 2010. Assessing the effects of line capture and barotrauma relief procedures on post-release survival of key tropical reef fish species in Australia using recreational tagging clubs. Fisheries Management and Ecology 17:77–88.

Wilde, G. R. 2009a. Does venting promote survival of released fish? Fisheries 34:20–28.

Wilde, G. R. 2009b. The author responds: does venting promote survival of released fish? Fisheries 34:455.