

## FEATURED PAPER

# Understanding and Enhancing Angler Satisfaction with Fisheries Management: Insights from the “Great Red Snapper Count”

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### Abstract

Management of Gulf of Mexico Red Snapper *Lutjanus campechanus* has been a topic of much scientific debate and intensive public scrutiny. In response to political, public, and management desires for more robust data on Red Snapper populations, a gulfwide initiative commonly referred to as the “Great Red Snapper Count” (GRSC) was funded to estimate the absolute abundance of Red Snapper in the U.S. Gulf of Mexico. Here, we describe the results of an online survey designed to (1) characterize the social dimensions of Red Snapper anglers, (2) measure satisfaction with current Red Snapper populations and regulations, (3) assess overall patterns of awareness of the GRSC, and (4) evaluate the potential benefits of GRSC stakeholder engagement videos. A key finding of our survey was that awareness of the GRSC was associated with up to three times higher satisfaction with fisheries management. Through an in-survey experiment, we found that anglers that were presented a video on specific GRSC project components reported slightly higher management satisfaction than those presented an overview video or no video. Collectively, our results indicate that angler awareness, when underpinned by effective engagement and outreach activities, can enhance angler satisfaction.

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In the U.S. Gulf of Mexico, populations of Red Snapper *Lutjanus campechanus* and their management have been subject to intense scientific debate and public scrutiny (Cowan 2011; Cowan et al. 2011). Over the past decade, Gulf of Mexico Red Snapper has undergone multiple formal assessments through the Southeast Data, Assessment, and Review program (SEDAR). The 2013 assessment suggested that Gulf of Mexico Red Snapper was overfished but not experiencing overfishing (SEDAR 2013). In contrast, the most recent assessment, completed in 2018 with a revised approach for stock status determination, deemed the stock as neither overfished nor experiencing overfishing yet needing to remain on a rebuilding plan (SEDAR 2018). Much of the controversy and angler disenfranchisement in the Red Snapper fishery can be attributed to a relatively unique problem of a rebounding fishery with very high catch per unit effort, coupled with decreasing season lengths for recreational sectors (i.e., access).

The recreational fishery for Red Snapper has undergone several management changes in recent years. Since 1990, Red Snapper recreational fishing regulations have generally become more restrictive with per-person bag limits decreasing from seven to two fish, minimum size limits increasing from 33.0 to 40.6 cm, and season lengths decreasing from a full calendar year down to as low as several days. Compounding the problem, a 2014 federal court ruling requiring greater accountability measures in the fishery led to the implementation of more conservative annual catch targets. In subsequent years, recreational fishing seasons in federal waters were as short as 3 to 4 d. However, studies of angler behavior revealed that the shorter seasons did not proportionally reduce catches, instead promoting “derby-style fishing” and worsening perceptions of angler dissatisfaction (Powers and Anson 2016; Farmer et al. 2019). In recent years, recreational season lengths have been extended and landings for Red Snapper have been at all-time highs, collectively providing a major source of concern and conflict within the fishery.

In 2016, the National Oceanic and Atmospheric Administration (NOAA) Sea Grant program invested approximately US\$9.5 million (plus an additional \$2.5 million in matching funds for a total budget of \$12 million) to provide an independent estimate of Red Snapper absolute abundance in the U.S. Gulf of Mexico (MASGP-18-019-01). Commonly referred to as the “Great Red Snapper Count” (GRSC), this research was largely in response to both scientific uncertainty and public interest in the Red Snapper fishery. The GRSC was implemented by academic research institutions in each of the five gulf states and involved four common components aimed at assessing Red Snapper populations: habitat characterization, direct counts using video, fishing depletion experiments, and tag-and-recapture studies. Through working directly with legislators and fisheries managers, the desired

outcomes of the study included an improved stock assessment, increased public and scientific confidence in the status of the fishery, and maximum access to the fishery for stakeholders.

Notably, the GRSC was designed with an angler engagement priority “to work directly with the gulf fishing community and engage stakeholders.” For instance, the GRSC’s tag-and-recapture study was modeled after long-standing and widely popular tagging programs throughout the Gulf of Mexico, where anglers report data on the tagged fish they catch. An overarching goal of the GRSC was to increase public understanding of the scientific tools and processes involved in estimating fish populations, such as Gulf of Mexico Red Snapper. One specific effort towards this goal involved the development of a series of whiteboard videos describing the GRSC and its various scientific components. The series of five videos included a project overview and four more focused videos detailing each of the GRSC’s scientific methodologies: habitat characterization, video counts, depletion experiments, and tag-and-recapture studies. While other studies have previously demonstrated that short educational videos can be effective tools for promoting stakeholder understanding and management support (Giglio et al. 2018; Jacobson et al. 2019), these strategies have not been explicitly tested or evaluated for diverse and contentious fisheries like Gulf of Mexico Red Snapper.

In this paper, we describe the results of a gulfwide survey focusing on four objectives: (1) characterizing the social dimensions of Red Snapper anglers, such as avidity and specialization; (2) measuring satisfaction with current Red Snapper populations and fishing regulations; (3) assessing overall patterns of awareness of the GRSC; and (4) evaluating the potential benefits of stakeholder engagement videos using an in-survey experiment.

## METHODS

The human subjects research in our study was approved by Northeastern University’s Institutional Review Board (IRB #13-07-16), and informed consent was acquired from all participants.

*Survey instrument and experimental design.*—The general structure of our survey instrument and experimental design is shown in Figure 1. After screening for qualified participants and obtaining informed consent, the first three sections of the survey were presented identically to all participants. The questions in these sections spanned three general themes: (1) general fishing characteristics (e.g., location, specialization, etc.), including the importance of Red Snapper and other reef fishes as target species; (2) general attitudes and beliefs towards reef fishes; and (3) specific attitudes and beliefs regarding Red Snapper, including awareness of the GRSC.

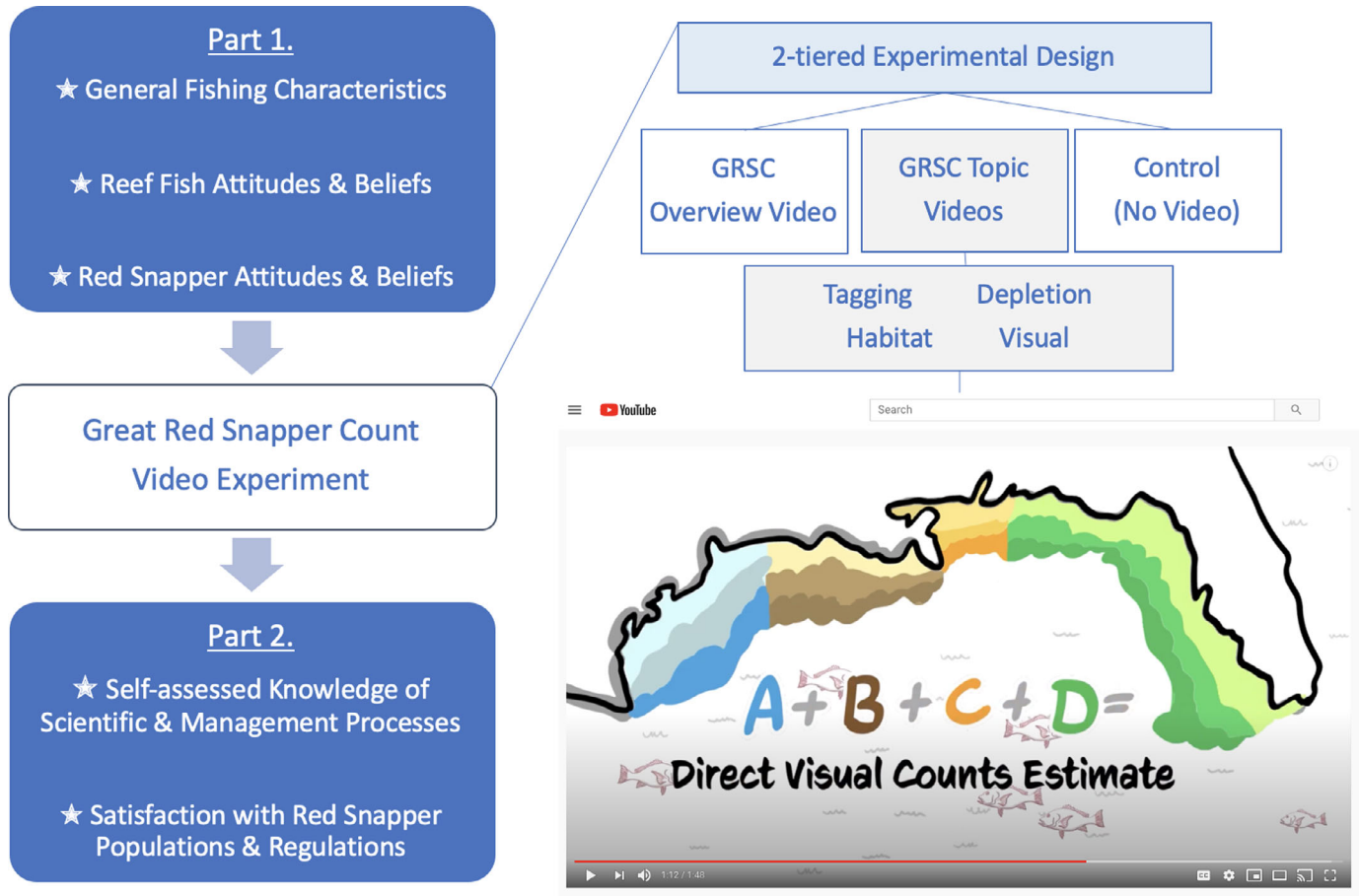


FIGURE 1. Schematic showing the core sections, survey flow, and experimental design of our study. The example video image shows one of the videos developed as part of the stakeholder engagement activities of the Great Red Snapper Count (GRSC).

Next, the fourth section of the survey involved a video experiment that was designed to evaluate the GRSC stakeholder engagement videos on the overall GRSC program and specific research components. For this part of the survey, we used a split sample design with randomization. First, each survey participant was randomly assigned to one of three top-tier treatments, where they were presented either a GRSC overview video, a video about a specific research topic, or no video as a control. Within the research topic video treatment, participants were randomly shown one video describing one of the four core project components: habitat characterization, direct counts using video, fishing depletion experiments, and tag-and-recapture studies. All videos are available at <https://www.youtube.com/channel/UCEjpASgofRSoaFvul-N-Kmw>.

Finally, following the video experiment, the survey included two additional sections of questions that were identical for all respondents. The fifth section measured self-assessed knowledge and satisfaction with Red Snapper populations and regulations (Table 1). The sixth block of questions collected demographic information, including

age, gender, education, and income. The survey instrument with all the questions described in the paper is provided in the Supplement (available in the online version of this article).

*Data collection, quality assurance, and quality control.*—We used Qualtrics research panels to recruit a sample of 1,000 individuals (200 per gulf state) who saltwater-fish in the Gulf of Mexico. Panel samples have rapidly gained popularity over the past decade as a quick and cost-effective approach to online surveys, and Qualtrics research panels have been described as among the most robust tools (Zack et al. 2019). As with all nonprobability sampling methodologies, it is important to consider and minimize potential issues of data quality. The panel sample was proportioned to the general public and randomized before the survey was deployed. To evaluate and assure data quality, we applied a multistep process during and after survey implementation. First, we used a self-affirmation screening question, where only participants who committed “to providing their best answers” were allowed to proceed with the survey. Additionally, we

TABLE 1. Key concepts and associated questions included in the survey. The survey instrument with all the questions described in the paper is provided in the Supplement (available in the online version of this article).

Concept	Question	Responses
Satisfaction with Red Snapper populations	How would you describe your overall level of satisfaction with Red Snapper <i>population levels</i> ?	Very dissatisfied (1) to very satisfied (5)
Satisfaction with Red Snapper regulations	How would you describe your overall level of satisfaction with <i>current fishing regulations</i> for Red Snapper?	Very dissatisfied (1) to very satisfied (5)
Self-assessed scientific knowledge	How would you describe your overall level of knowledge on the <i>scientific processes</i> involved in assessing Red Snapper populations?	Not knowledgeable (1) to extremely knowledgeable (5)
Self-assessed management knowledge	How would you describe your overall level of knowledge on the <i>management processes</i> involved with setting regulations for Red Snapper fisheries?	Not knowledgeable (1) to extremely knowledgeable (5)

included two “attention check” questions to detect “straight-lining” (i.e., respondents who repeatedly selected the same answer), and we set a completion time threshold of 50% of the mean completion time to identify “speeders” (i.e., respondents who rapidly answer questions without closely reading them) (Zhang and Conrad 2014). After the survey closed, we reviewed all open-ended responses using a three-category system: *definitely bad*, *possibly bad*, or *not suspicious*. All cases of duplicate entry were coded as *definitely bad*. As a second step, we reviewed all *possibly bad* and *not suspicious* responses for duplicate entry, such as a respondent pasting the same answer into multiple questions. From this process, we flagged 16% of responses as *definitely bad* and 11% as *possibly bad*, leaving 73% as *not suspicious*. Following this review, all bad responses were replaced by Qualtrics and new responses were subsequently reviewed.

**Analysis.**—We used Fisher’s exact tests to assess potential relationships among recreational fishing specialization and Red Snapper importance. We used nonparametric Kruskal–Wallis tests to evaluate whether awareness of the GRSC was associated with differing levels of satisfaction. Among respondents not previously aware of the GRSC, we also used Kruskal–Wallis tests to explore potential influences of the video treatments on self-assessed knowledge and satisfaction. All data were analyzed using the Statistical Package for the Social Sciences (SPSS version 26), and results were considered statistically significant at  $P \leq 0.05$ .

## RESULTS

### Panel Sample Demographics and Fishing Characteristics

All 1,000 anglers in our study had completed at least one saltwater fishing trip within the past 2 years. Compared to the general population of each state, the survey panel sample was generally similar for household income,

education, and race. However, as is common in panel surveys, our data set was overrepresented by female participants. Using a self-classification measure for “recreational fishing specialization” (Needham et al. 2009), 37.8% of anglers were generalist/casual, 33.7% intermediate, and 28.5% specialist/veteran. In the context of all saltwater fishing, offshore fishing for reef fishes was considered extremely important by 25.5%, very important by 25.3%, moderately important by 27.7%, slightly important by 11.2%, and not at all important by 10.3%. Among a list of 32 reef fishes, Red Snapper was considered the most important reef fish species, with 65.6% of anglers considering it at least “important” for their fishing and among these 49.7% considering it the single most important species.

We calculated crosstabs and created a Sankey plot to visualize the relationship between recreational fishing specialization and Red Snapper importance (Figure 2). Among anglers who considered Red Snapper their single most important target species, 26.6% self-classified as specialist/veteran, 39.8% as intermediate, and 33.6% as generalist/casual anglers. From the sorting direction of recreational fishing specialization, Red Snapper was considered the single most important target species among 46.3% of specialist/veteran, 58.8% of intermediate, and 44.2% of generalist/casual anglers.

### Awareness of GRSC and Satisfaction

Overall, our results indicate that roughly 60% of anglers were aware of the GRSC prior to taking the survey, with 18.8% stating they were very familiar (Figure 3). Among the four core GRSC components, overall awareness of the tagging and rewards program was the highest at 35.2%, followed by habitat characterization (21.5%), visual and camera fish counts (21.2%), and fish depletion experiments (17.7%). Overall GRSC awareness generally increased with recreational fishing specialization, with 76.1% of specialist/veteran anglers at least somewhat

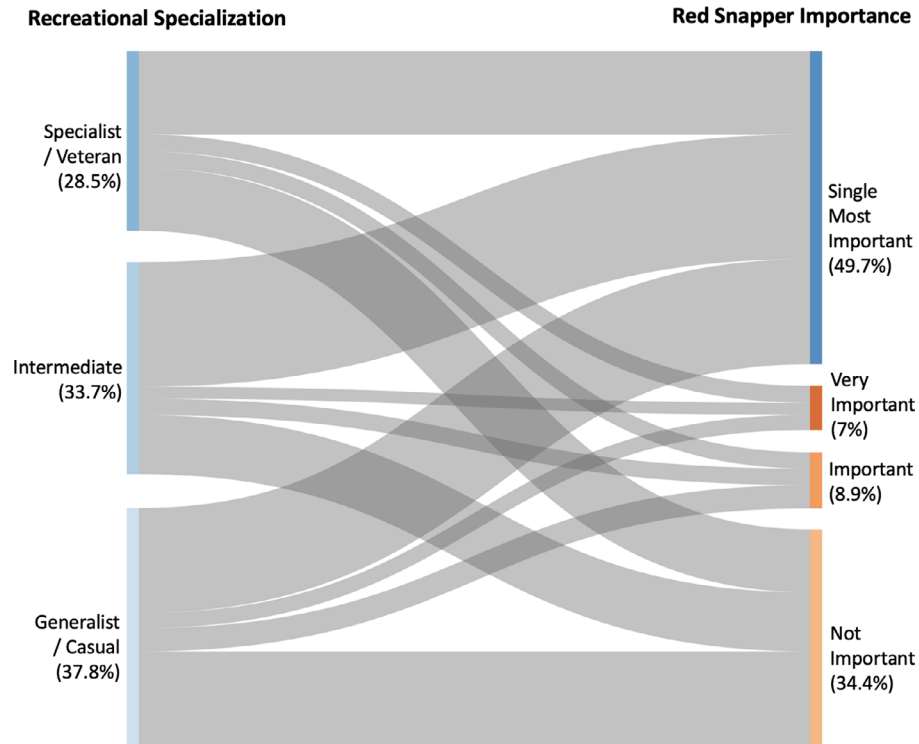


FIGURE 2. Sankey diagram showing relationships between recreational fishing specialization (left) and the importance of Red Snapper as a target species among reef fishes (right). Line width represents the numerical crosstabs between these two survey questions.

familiar with the program and 31.2% very familiar. However, awareness across categories of Red Snapper importance was more complex, with the lowest familiarity existing among the group of anglers that considers Red Snapper as their most important target species.

Two other core questions in our survey measured angler satisfaction with current Red Snapper populations and current regulations. To assess overall patterns of satisfaction, we looked at responses among anglers within the control treatment (i.e., respondents who did not view any videos during the survey). We found that most of these anglers were satisfied with both current populations and regulations; moreover, these factors were significantly related ( $\chi^2 = 202.991$ ,  $df = 16$ ,  $P < 0.001$ ; Figure 4).

Overall, our results show that angler awareness of the GRSC was positively associated with higher satisfaction with both Red Snapper populations (Figure 5;  $n = 333$ ,  $H = 36.751$ ,  $df = 2$ ,  $P < 0.001$ ) and current regulations (Figure 5;  $n = 333$ ,  $H = 11.535$ ,  $df = 2$ ,  $P = 0.03$ ). For satisfaction with Red Snapper populations, there were large differences across categories, with 61.9% of individuals very familiar with the GRSC reporting that they were very satisfied with Red Snapper populations compared with only 21.3% of individuals who had never heard of the GRSC. Likewise, for satisfaction with current regulations, there were also substantial differences across awareness

levels, with 46% of individuals very familiar with the GRSC also very satisfied with current regulations compared with only 18.7% of individuals who had never heard of the program.

### Stakeholder Engagement Video Experiment

Our survey design involved an experiment to assess potential influences of the GRSC angler engagement videos on angler knowledge and satisfaction. Among survey participants who were somewhat or not at all familiar with the GRSC prior to taking the survey, our analyses found that respondents in video treatments self-rated their knowledge of scientific processes significantly higher ( $n = 812$ ,  $H = 11.734$ ,  $df = 2$ ,  $P = 0.003$ ) and their knowledge of management processes marginally higher ( $n = 812$ ,  $H = 5.428$ ,  $df = 2$ ,  $P = 0.066$ ) than respondents in control treatments (Figure 6).

We also compared satisfaction levels across treatments in our video experiment. In this context, video experiment treatment was associated with satisfaction with current regulations ( $n = 812$ ,  $H = 7.362$ ,  $df = 2$ ,  $P = 0.025$ ) but not satisfaction with population levels ( $n = 812$ ,  $H = 0.293$ ,  $df = 2$ ,  $P = 0.864$ ) (Figure 7). When comparing patterns across the specific component videos, some additional trends were visible. For instance, satisfaction with Red Snapper populations was qualitatively highest among the

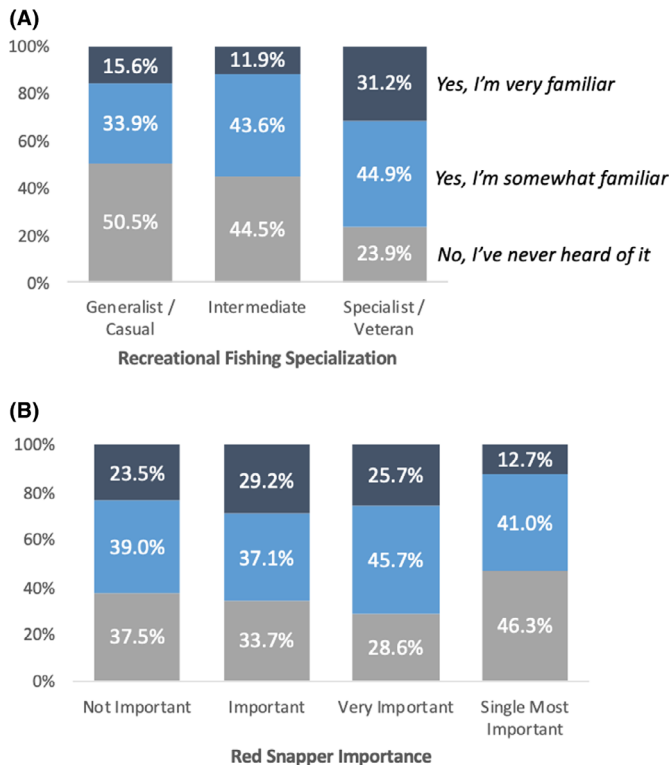


FIGURE 3. Awareness of the Great Red Snapper Count by (A) recreational fishing specialization and (B) the importance of Red Snapper as a target species among reef fishes.

group of individuals presented a short video about the habitat characterization component of the GRSC at 74.6% compared with 58.2% among those not shown a video as part of the control treatment. Similarly, the four component video treatments qualitatively aligned as having the highest levels of satisfaction with current regulations.

## DISCUSSION

As one of the most socially important and economically valuable fisheries in the Gulf of Mexico, Red Snapper poses many challenges for scientists and managers (Cowan et al. 2011; Powers and Anson 2016; SEDAR 2018). Consequently, the overarching goal of the GRSC was to reduce public uncertainty on the status of Gulf of Mexico Red Snapper populations. A top priority of our study focused on understanding how these issues, and the GRSC initiative, were perceived by Gulf of Mexico anglers. In particular, the video experiment component of our study presented a unique opportunity to test how specific stakeholder engagement materials influenced self-assessed angler knowledge and satisfaction. From our survey results, we identified a series of key findings relevant to the current management of Gulf of Mexico Red Snapper.

Awareness of the GRSC was generally associated with higher satisfaction with Red Snapper fisheries. As

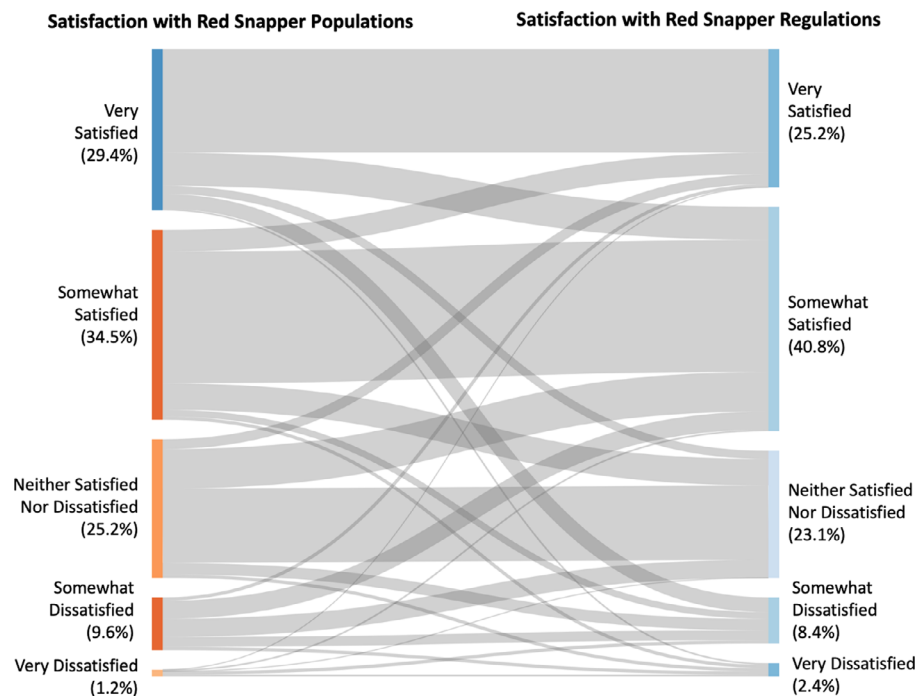


FIGURE 4. Sankey diagram showing relationships between satisfaction with current Red Snapper populations (left) and satisfaction with current Red Snapper regulations (right). Line width represents the numerical crosstabs between these two survey questions.



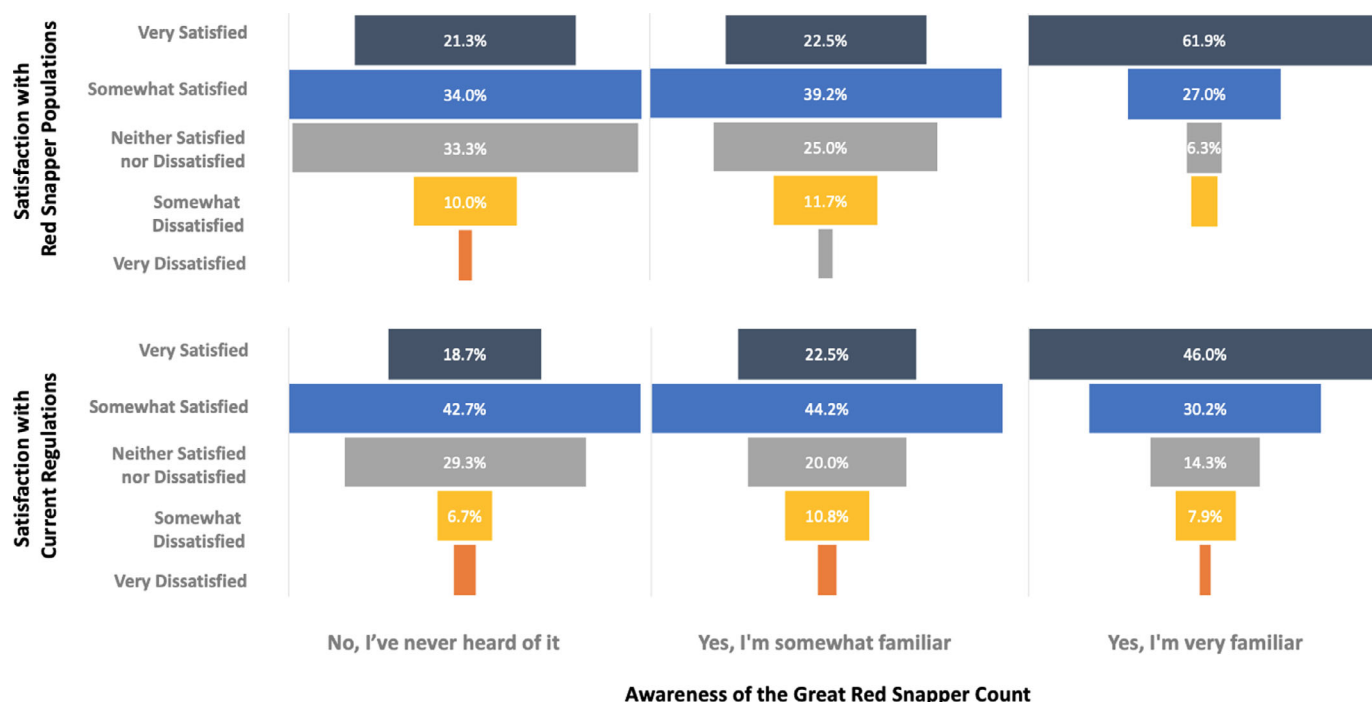


FIGURE 5. Funnel plots showing the categorical response to survey questions measuring angler satisfaction with Red Snapper populations (top row) and current regulations (bottom row) across categories of awareness of the Great Red Snapper Count.

expected, GRSC awareness was highest among the most avid and specialized anglers who consider fishing to be their primary outdoor activity. Given the widespread use of social media among this subset of the fishing community (e.g., fishing forums), high awareness among this group was not particularly surprising. Conversely, however, the lowest awareness of the GRSC was among anglers who considered Red Snapper to be their most important target species. One plausible explanation for this pattern is that many casual anglers only saltwater-fish a few times per year, for example during summer vacations to coastal areas, yet many of these individuals consider Red Snapper as very important for their fishing satisfaction. Given the diverse constituency of the Red Snapper fishery, adequately engaging all of these stakeholders presents a substantial challenge. However, our results highlight the need to understand and connect with these diverse individuals.

Another key finding of our study emerged from the video experiment. We found that anglers that were presented a video on specific GRSC project components reported higher scientific knowledge and higher management satisfaction than individuals presented an overview video or no video. While the project overview video provided the most comprehensive project description, one potential explanation for this pattern is that anglers may desire both in-depth yet understandable insight on the scientific methodologies for assessing fish populations. For

instance, while modern stock assessments are generally transparent (e.g., the SEDAR process), the assessments themselves are incredibly complex and focus on data analyses and modeling.

A number of other studies have also shown that educational videos can be effective tools for promoting management support and conservation objectives (Giglio et al. 2018; Jacobson et al. 2019). For instance, Giglio et al. (2018) conducted a video experiment with recreational scuba divers and found that divers who were shown an educational video were more likely to implement conservation-oriented diving behaviors than a control group. In another study, Jacobsen et al. (2019) used short 1–2-min videos in a large experiment of college students and found that positively framed messages were more effective at motivating willingness to donate money to conservation organizations than negatively framed videos. In our study, it is worth noting that the overview video was more negatively framed than the component videos as it highlighted the general landscape of angler dissatisfaction.

Angler engagement and participation have been widely described as key components of satisfaction (Arlinghaus 2006; Hutt and Bettoli 2007; Beardmore et al. 2015; Crandall et al. 2019). Considering that the tagging and rewards component of the GRSC had the highest awareness, it is important to recognize that the GRSC is a short-term program built upon many previous and ongoing fisheries-

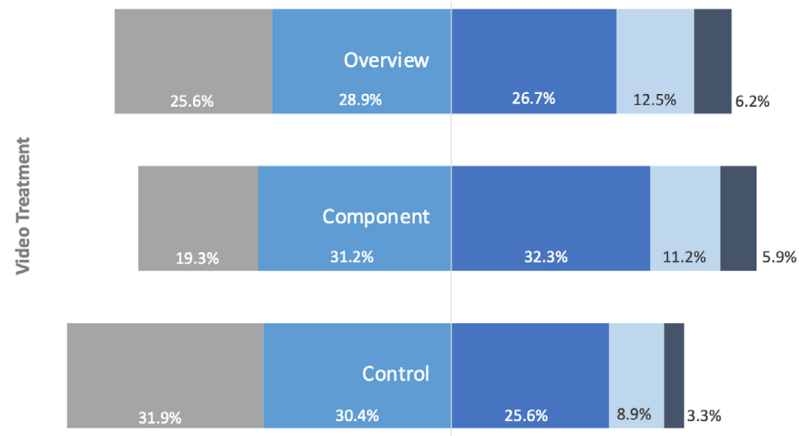
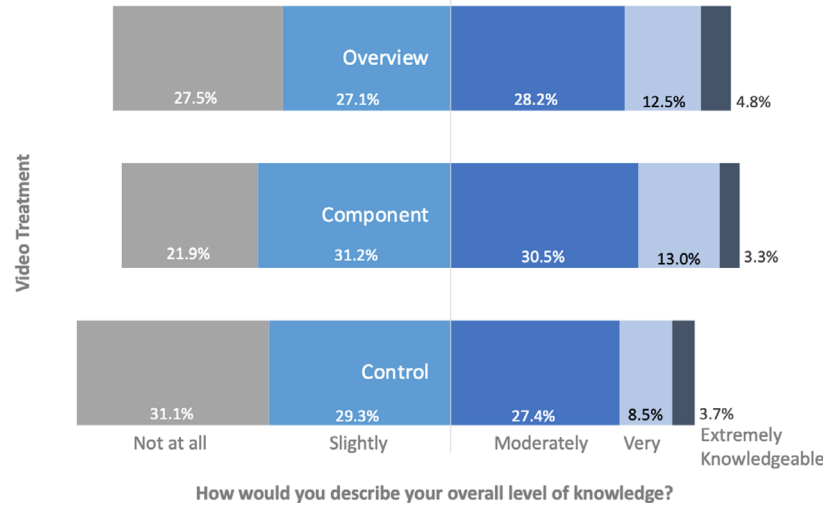
**(A) Self-assessed Scientific Knowledge x Video Treatment****(B) Self-assessed Management Knowledge x Video Treatment**

FIGURE 6. Categorical response to survey questions measuring self-assessed angler knowledge of (A) scientific processes and (B) management processes across video treatments.

independent research studies (Scott et al. 1990; Sackett and Catalano 2017; Grüss et al. 2018). For instance, the fishery for reef fish in the Gulf of Mexico has a long history of engaging and relying on anglers for the success of tagging programs (Szedlmayer and Shipp 1994; Patterson et al. 2001) and other management strategies that provide relatively high buy-in through angler participatory opportunities (Scyphers et al. 2013; Crandall et al. 2017). However, satisfaction is most common when angler engagement or input in management processes is followed by meaningful action (Crandall et al. 2019), as well as when the expected benefits of proposed management adjustments are clear and realistic (Seeteram et al. 2019).

One important consideration for interpreting our study is understanding our survey methodology using Qualtrics panels, which has several key strengths but also a few

known limitations. For instance, the overarching strength of our approach was the ability to rapidly and cost-effectively survey diverse anglers engaged in Red Snapper fisheries in the Gulf of Mexico across multiple states. For instance, when compared with e-mail-based surveys, our study was not limited to anglers who met licensing criteria, which vary across states and many saltwater anglers are not required to purchase licenses. Moreover, when compared with address-based mail sampling, our approach targeted a similarly broad population of coastal anglers yet was significantly faster and more cost-effective. Some criticism of nonprobability survey panels, such as Qualtrics panels, focuses on their representativeness (Zack et al. 2019); however, recent studies have increasingly shown that effective panel design and sampling can lead to robust and representative samples, with many of these



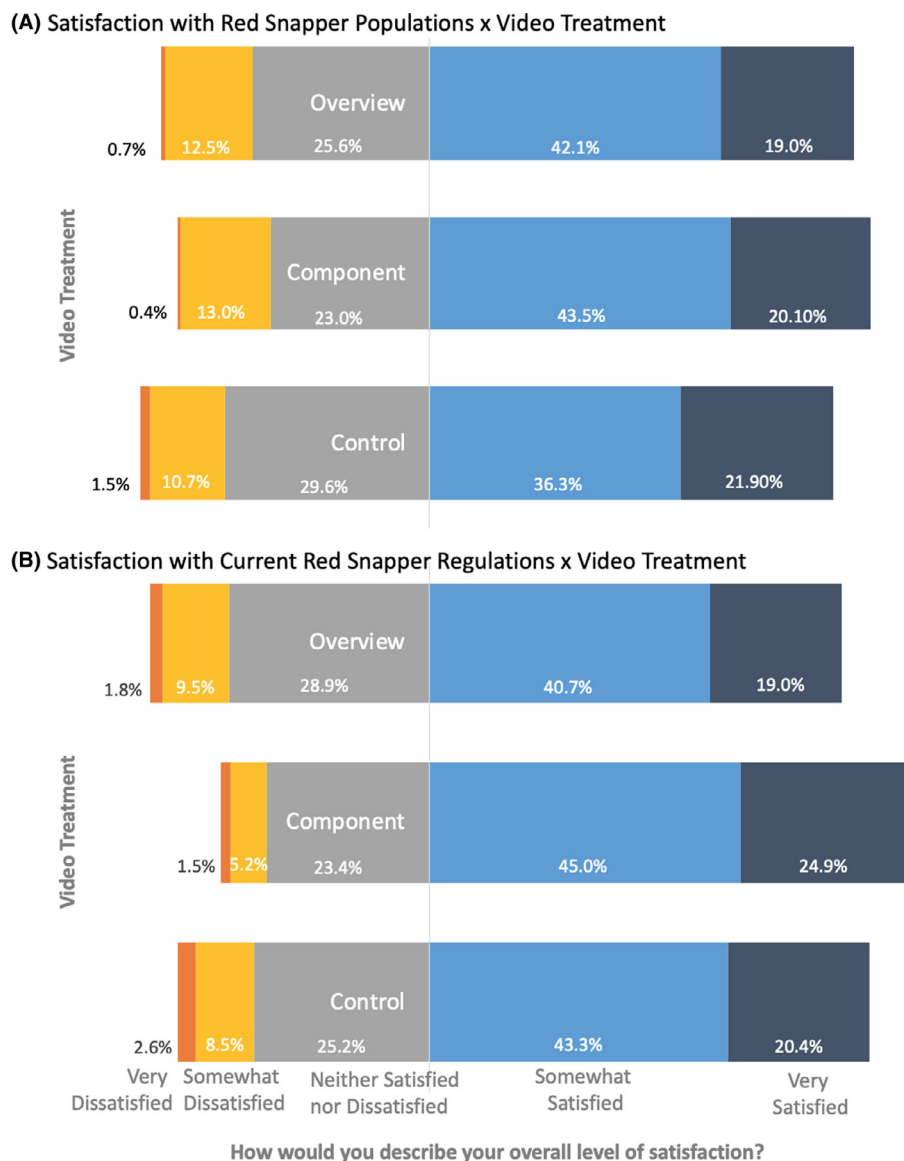


FIGURE 7. Categorical response to survey questions measuring angler satisfaction with Red Snapper (A) populations and (B) current regulations across video treatments.

studies involving Qualtrics panels (Harlan et al. 2019; Boas et al. 2020; Miller et al. 2020).

In summary, recreational fishing satisfaction is complex, multidimensional, and generally defined as “the difference between the outcomes an angler desires or thinks should be received and the perceived fulfillment of the desired outcomes” (Fedler and Ditton 1986; Graefe and Fedler 1986). The GRSC was designed and implemented to reduce public consternation on the population size and sustainability of Red Snapper. Our survey results indicate that the program may have had ancillary benefits for fisheries management by increasing satisfaction among anglers, at least initially, independent of those biological-

related outcomes. However, it is also important to consider that recently increased season lengths and high catch rates are likely underpinning the currently high satisfaction with Red Snapper populations and regulations. In the broader perspective and longer term, angler satisfaction is likely to continually evolve with perceptions of management and access to the fishery.

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## **SUPPORTING INFORMATION**

Additional supplemental material may be found online in the Supporting Information section at the end of the article.