Received: 27 February 2023 | Revised: 21 June 2023 | Accepted: 8 July 2023

DOI: 10.1111/csp2.13001

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access
WILEY

RESEARCH NOTE

Talk is cheap: Direct evidence of conservation-based changes in angler behavior

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Funding information
Coastal Conservation Association-Texas; National Oceanic and Atmospheric Administration Cooperative Research Program, Grant/Award Number: NA19NMF4540065

Abstract

Post-release mortality threatens shark populations already imperiled by overfishing, capture stress, and a changing climate. Few studies have quantified post-release mortality for sharks captured in land-based recreational fisheries. From 2018 to 2021, a land-based shark post-release mortality study was conducted and identified water temperature and species-specific behavior as contributing factors to post-release mortality. The purpose of this study was to estimate the effectiveness of disseminating the recommendation for best practices to recreational shark anglers and to determine if this information influenced angler behavior. Awareness of our post-release mortality study influenced an angler's likely release behavior, with an increase in sharks landed in the water and corresponding decrease of sharks landed on dry sand. This study demonstrated direct evidence of conservation-based changes in angler behavior following effective research communication and involvement of anglers in research. Outreach and engagement initiatives aimed at providing best handling practices to recreational anglers should be easily digestible, widely available, and an important component of future research.

KEYWORDS

behavior, conservation, land-based shark fishing, recreational anglers, shark, survey

1 | INTRODUCTION

Approximately 33% of shark species are listed as "Threatened with extinction" by the International Union for the Conservation of Nature Red List (Dulvy et al., 2021). Recreational fisheries can influence the long-term population dynamics of these species (Pauly et al., 2003), but the consequences of commercial fishing are often more widely reported. Recreational anglers report a range of goals when fishing, including catching fish for consumption to enjoying the outdoors (Holland & Ditton, 1992). For land-based recreational anglers targeting sharks, trophy catches are a typical motivation, but rather than harvesting these large predators, anglers have shifted to a catch-photo-tag-release approach (Gallagher et al., 2017; Gibson et al., 2019). As popularity of recreational fishing for sharks increases (Cooke et al., 2014), the shift to catch-and-release practices might be important for the conservation of these populations. Accordingly, these anglers play an important role in managing fisheries for sustainability (Granek et al., 2008).

The extinction risk for sharks is largely attributed to overfishing (Worm et al., 2013), which is exacerbated by their relatively slow growth and low reproductive rates, making them particularly vulnerable to population declines (Hoenig & Gruber, 1990). Reversal of these declines for many species will require a variety of approaches, including protections of essential habitats, long-term monitoring programs, and reductions in fishing mortality (Ward-Paige et al., 2012). The shift into catch-and-release practices by many recreational anglers allows for national tagging programs (e.g., NOAA Fisheries Apex Predator Program) and local tagging initiatives (e.g., Center for Sportfish Science and Conservation Shark Tagging Program) to provide long-term monitoring on a large scale that otherwise would not be monetarily or physically feasible (Gibson et al., 2019).

Anglers participating in catch-and-release tagging programs are often well-informed on the issues of shark conservation and have positive attitudes toward sharks (Gallagher et al., 2017; Mcclellan Press et al., 2016). These anglers also assume that most, if not all, sharks released will survive (Cooke & Schramm, 2007), but research has demonstrated that this is not always the case (Binstock et al., 2023; Ellis et al., 2017). Survival is influenced by numerous factors, including gear used, handling practices, and environmental variables (Bartholomew & Bohnsack, 2005; Binstock et al., 2023; Muoneke & Childress, 1994; Weber et al., 2020). For example, previous studies on teleosts have shown that keeping gills submerged may help increase the rate of survival after release (e.g., Veldhuizen et al., 2018). While this is not well studied in elasmobranchs, studies have previously suggested that air exposure may influence survival rates of elasmobranchs after release (Ellis et al., 2017; Mohan et al., 2020). As research provides insight into better handling practices, effectively communicating those results with stakeholders is critical for successfully implementing conservation practices (Lundquist & Granek, 2005). The purpose of this study was to estimate the effectiveness of disseminating research results to recreational shark anglers and subsequently determine whether this conservation-based information transfer resulted in a quantifiable change in angler behavior.

2 | METHODS

Post-release mortality results were shared with participants of *Sharkathon*, a 3-day land-based fishing tournament that advocates for catch-photo-release with an emphasis on collecting data for the conservation of sharks (Sharkathon.com). Participating anglers range from novice (i.e., anglers with little land-based fishing experience) to expert (i.e., anglers who are licensed charter guides specializing in land-based fishing). Importantly, all anglers participating in the *Sharkathon* must release their catch and submit a photo along with length measurements for their catches to be entered into the tournament.

From 2018 to 2021, a post-release mortality study was conducted in conjunction with a subset of *Sharkathon* tournament participants (Binstock et al., 2023). The study reported on post-release mortality for four shark species: tiger shark (*Galeocerdo cuvier*), blacktip shark (*Carcharhinus limbatus*), bull shark (*Carcharhinus leucas*), and great hammerhead (*Sphyrna mokarran*), noting that water temperature and fighting behavior increased post-release mortality of the more sensitive species. For this study, the practice of keeping sharks in the water was used because it (1) has a high likelihood of increasing survivorship, (2) is clear and simple to communicate to anglers, (3) is something anglers can control (unlike water temperature), and (4) is quantifiable from photos without the need to have observers present or interview anglers. These findings, along with recommended handling practices to reduce post-release mortality (e.g., Ellis et al., 2017; Mohan et al., 2020; Veldhuizen et al., 2018) were highlighted in a whiteboard video (https://www.youtube.com/watch?v=ZPDMrboPTNA&feature=youtu.be) that was disseminated to 2022 *Sharkathon* participants via (1) social media (2) with a QR code that linked to the video placed on all 2022 *Sharkathon* participant registration packets, and (3) a TV monitor playing the video during registration at the 2022 *Sharkathon* tournament. This allowed numerous opportunities for the

video to be viewed prior to the official start of the 2022 tournament.

In addition, *Sharkathon* distributed anonymous surveys in registration packets and collected them when anglers returned from the beach during the "weigh-in" (i.e., where photos of catches are uploaded to the tournament server for confirmation of species identification and length). For catches to be successfully entered into the tournament, participants were required to submit a completed survey per tournament rules. Participants were asked: (1) Are you aware of Harte Research Institute's recent study investigating post-release mortality in the Texas recreational shore-based shark fishery? and (2) Findings from this study indicate that air exposure significantly increases post-release mortality. Knowing this, are you more likely to keep a shark's gills underwater between landing and release? Possible answers included, "Yes, very aware," "Yes, somewhat aware," or "No, not aware" and "Yes, very likely," "Yes, somewhat likely," and "No, not likely," respectively. A Fisher's exact test was used to determine if anglers aware of our study (combined "Yes, very aware" and "Yes, somewhat aware") were more likely to keep gills submerged between landing and release than those not aware of our study.

To determine whether the stated changes in angler behavior (i.e., responses to survey questions) were realized, we analyzed angler photo submissions from five *Sharkathon* tournaments prior to the whiteboard video (i.e., 2016–2021 except for 2020 which was canceled due to COVID-19 regulations) and one tournament after the whiteboard video was shared (i.e., 2022). From the photos, shark landing locations were classified into three categories: dry = on dry sand, gills not submerged; surf = in the surf zone, gills less than 2/3 submerged; submerged = gills are >2/3 submerged). A Fisher's exact test was used to determine if the proportion of sharks landed in the three categories differed pre- and post-whiteboard video. A *t*-test was used to determine differences in size of sharks landed pre- (i.e., 2016–2021) and post- (i.e., 2022) whiteboard video. All tests were conducted at the $\alpha = .05$ significance level. This research was conducted in accordance with approved guidelines of Texas A&M University—Corpus Christi (Institutional Review Board Protocol #2022–0690).

3 | RESULTS

During the 2022 *Sharkathon* tournament, 401 tournament participants completed the first question and 388 completed the second question (Table 1). Overall, responses indicated that anglers were aware of the post-release mortality study, with 69.1% of anglers answering that they were at least somewhat aware and 30.9% responding that they were not aware of the study. For the second question, most respondents said they were very likely (79.1%) or somewhat likely (18.0%) to keep a shark's gills underwater between landing and release. A very small percentage of respondents (2.8%) said they were not likely to keep a shark's gills underwater between landing and release.

Awareness of our study did influence an angler's likely release behavior (Fisher's exact test, $p = 0.001$, Table 2). For example, 71.3% of anglers who responded that they were very likely to keep a shark's gills underwater between landing and release were aware of our study compared to 28.7% that were not aware of the study. Similarly, 67.1% of those responding reported they were somewhat likely to keep the shark's gills submerged during the catch and release process were at least somewhat aware of our study. Although a few anglers (2.8%) said they were not likely to keep a shark's gills submerged between landing and release, most (81.8%) of these anglers were not aware of our study. Importantly, 73.3% of anglers reporting they were not aware of our study still responded that they were very likely to keep a shark's gills underwater between landing and release, highlighting the conservation-based mindset many land-based shark anglers now have.

Of the 905 photos used to classify landing locations of sharks caught in *Sharkathon*, 685 were prior to 2022 and

TABLE 1 Responses of *Sharkathon* tournament participants in 2022 regarding best handling practices.

(1) Are you aware of Harte Research Institute's recent study investigating post-release mortality in the Texas recreational shore-based shark fishery?		
Responses	**Number**	**Percent**
Yes, very aware	177	44.1
Yes, somewhat aware	100	24.9
No, not aware	124	30.9
TOTAL	401	100.0
(2) Findings from this study indicate that air exposure significantly increases post-release mortality. Knowing this, are you more likely to keep a shark's gills underwater between landing and release?		
Responses	**Number**	**Percent**
Yes, very likely	307	79.1
Yes, somewhat likely	70	18.0
No, not likely	11	2.8
TOTAL	388	100.0

TABLE 2 Responses of *Sharkathon* tournament participants in 2022. Responses to the questions of awareness of the previous post-release mortality study was condensed into two categories: Yes, at least somewhat aware (yes, very aware + yes, somewhat aware) and no, not aware. Responses to likelihood to change behavior was then analyzed based on these condensed categories.

		Likely to keep gills underwater			
	Responses	**No, not likely**	**Yes, somewhat likely**	**Yes, very likely**	**TOTAL**
Awareness of the PRM study	No, not aware	9	23	88	120
	Yes, at least somewhat aware	2	47	219	268
	TOTAL	11	70	307	388

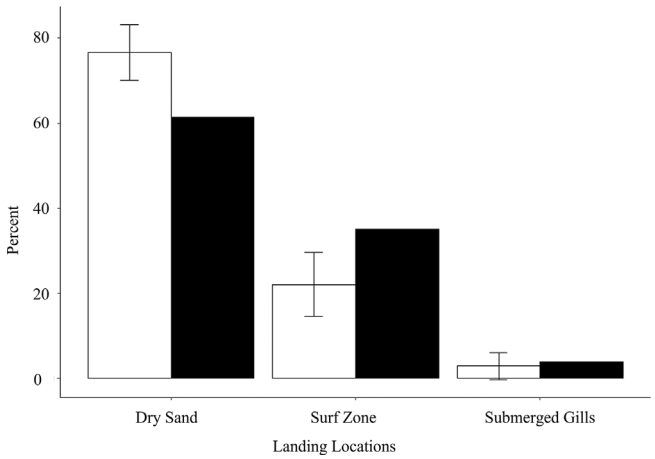

FIGURE 1 Shark landing locations before and after dissemination of post-release mortality study results. Pre-whiteboard video pictures (white) were submitted between 2016 and 2021 and post-whiteboard video pictures (black) were submitted in 2022. Error bars represent standard deviation for the pre-whiteboard video time period.

217 were submitted in 2022. The proportion of sharks landed on dry sand, in the surf zone, or with gills submerged was significantly different during the five tournament years prior to 2022 compared to the 2022 tournament year, the year our study results and suggested release practices were shared with tournament participants before registration (Fisher's exact test, $p < 0.001$). There was a decrease in the proportion of sharks landed on dry sand and a corresponding increase in the proportion of sharks landed in the surf zone or with gills remaining submerged between landing and release (Figure 1). Specifically, in the five-year pre-study period, the percentage of sharks landed on dry sand was consistently high, averaging 76.6% (standard deviation [SD]: 6.6%) and ranging from 67.5% to 83.0%. Four of those 5 years were above 72.5%. In addition, the proportion of sharks that remained in the surf zone during catch and release increased from 22.0% (SD: 7.5%) to 35.0% following our study, suggesting anglers responded to the study findings and made a concerted effort to keep the gills of the sharks wet during catch and release. Mean total length (TL) of sharks landed was not significantly different (*t*-test, $p = 0.073$) pre- (mean ± SD = 125 ± 47 cm) versus post- (103 ± 46 cm) study. As size increased, sharks were less likely to be dragged onto dry sand.

4 | DISCUSSION

This study demonstrated direct evidence of conservation-based changes in angler behavior following simple communication of research results. Overall, most anglers surveyed were not only somewhat knowledgeable about the previous post-release mortality study but also stated a willingness to leave sharks' gills underwater based on these results. Photo documentation of landings provided a unique opportunity for us to test whether these stated commitments to keep gills submerged translated into realized behavior. This supports previous studies that identified recreational anglers as strong proponents of conservation efforts (Cooke et al., 2014; Drymon & Scyphers, 2017), who not only enact voluntary conservation measures, but conceive them as well (Cooke et al., 2013).

Recreational shark fishing has transitioned from primarily catch and kill to primarily catch and release. This practice has been supported within the shark fishing community and promoted as the new "norm" by popular shark fishing tournaments like *Sharkathon* that mandate catch and release. In addition to the conservation benefit for shark populations, the acceptance of catch and release highlights the mindset of many shark anglers today and their desire to be responsible stewards of this natural resource. This was evident in the current study, where most anglers, even if they were not aware of our post-release mortality study, still responded that they were likely to keep a shark's gills underwater between landing and release. Moreover, anglers also changed their behavior by landing a greater proportion of sharks in the surf zone or with gills submerged rather than on dry sand following the communication of our study results.

For land-based shark fishing, our analysis of tournament photos to classify landing locations indicates there is still room for improvement in handling practices of captured sharks. Most sharks are still landed on dry sand despite the negative effects of air exposure on post-release mortality rates. There are numerous reasons why landing sharks on dry sand is still most common, including angler experience, increased ability to control the shark, and safety concerns. For example, anglers may worry they will lose control of a captured shark if it remains in the water during the catch and release process, therefore resulting in a lost tournament entry. Angler experience could also play a role with experienced anglers more familiar with handling sharks potentially more likely to keep sharks in the water. Understanding why most sharks are landed on dry sand was not the purpose of this study, but clearly, additional insights into this handling practice and continued efforts to increase the likelihood of anglers maintaining the shark's gills in the water between landing and release are needed.

While not a direct objective of this study, this study also demonstrated the efficacy and importance of publishing and communicating the results of scientific research in a manner that is palatable to the general public. The majority of participants that were unlikely to keep sharks' gills in the water were not aware of our post-release mortality study, highlighting the need for more effective communication of scientific findings. Research published in scientific journals are often not easily accessible or comprehensible outside the scientific community (Leshner, 2003). Results from our post-release mortality study were condensed into a short whiteboard video that was published via social media sites and made available in conjunction with the tournament. This concerted effort allowed for the results to be shared with a large group of stakeholders in a short time period. Outreach initiatives aimed at providing best handling practices to recreational anglers should be easily digestible, widely available, and an important component of future research.

Our study and others also highlight the potential value of angler-generated media (e.g., photos, videos, text) for conservation. For instance, rapidly emerging interest in so-called "culturomics" focuses on analyzing trends in word frequencies in large volumes of digital information to assess change, such as perceptions of society-environment relationships or trends in pro-conservation behaviors (Correia et al., 2021; Ladle et al., 2016). While these data sources must be carefully screened and interpreted, fishing tournaments such as the *Sharkathon* could be valuable study systems considering the consistent rules and requirements applied to participants, especially if videos and surveys are directly linked.

While the outcome of this study suggests anglers may be more likely to practice conservation-based methods once informed, we cannot directly link the observed change in behavior to conservation-based motivations. Unfortunately, based on the anonymous nature of the survey, we are unable to link surveys with individual participants to determine if those anglers that stated they were more likely to leave gills submerged did in fact leave sharks gills submerged. Ultimately, the *a-posteriori* nature of this study further limited our ability to implement a robust experimental design, include additional questions, or format questions for open-ended answers (i.e., less leading answer choices). Future efforts attempting to link changes in behavior to conservation motivations would benefit from showing videos like the one in this study to a subset of anglers and comparing those to a control (sensu Scyphers et al., 2021). In addition, detailed demographics would allow us to examine if angler age/sex/avidity (etc.) could be used to predict behavior changes. Regardless, the results presented herein indicate the potential for shore-based shark anglers to serve as conservation advocates for these species.

AUTHOR CONTRIBUTIONS

All authors contributed to the design of the study, interpretation of the results, and writing the manuscript. Kesley Gibson Banks, Matthew K. Streich, J. Marcus Drymon, and Steven B. Scyphers contributed to the data analyses.

FUNDING INFORMATION

This research was funded in part by the Coastal Conservation Association-Texas and NOAA Cooperative Research Grant award number NA19NMF4540065. This research was approved by the Texas A&M University—Corpus Christi Institutional Review Board under protocol TAMU-CC-IRB-2022-0690.

CONFLICT OF INTEREST STATEMENT

Authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

Data can be found within the manuscript.

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How to cite this article: Gibson Banks, K., Streich, M. K., Drymon, J. M., Scyphers, S. B., Mohan, J. A., Wells, R. J. D., Binstock, A. L., Richards, T. M., White, C. F., Whitney, N. M., & Stunz, G. W. (2023). Talk is cheap: Direct evidence of conservation-based changes in angler behavior. *Conservation Science and Practice*, e13001. https://doi.org/10.1111/csp2.13001