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FEATURE

Catch and Release: The Effectiveness of an Educational Class for Anglers Caught with Fishing Citations

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Formal regulatory structures, such as government-imposed size limits or bag limits, are standard tools used by managers to achieve fisheries management in most countries. Regulations are most effective if followed by the angling community, which is predicated upon anglers understanding and accepting the regulations. To enhance compliance with fishing regulations and improve the management of fisheries resources, Biscayne and Everglades National Parks established a Fisheries Education Class program that was open to the community and available to anglers cited with a fishing violation in exchange for a reduced or waived fine. Here, we describe this program and quantitatively evaluate its effectiveness by measuring and comparing the self-efficacy and attitudes of participants before and after the class using generalized linear models with repeated measures. Results showed that the Fisheries Education Class was effective at improving the self-efficacy of anglers toward understanding and applying the regulations and improved the attitudes of the participants toward fishing regulations.

INTRODUCTION

Biscayne and Everglades National Parks protect a subtropical marine ecosystem located at the southeastern tip of the Florida mainland, south of the city of Miami. Most of the areas within the boundaries of these parks consist of underwater environments with living coral reefs, seagrass meadows, and mangrove forests. The role played by ecologically balanced fish populations in maintaining the health and sustainability of coral reef ecosystem function is well documented (Glynn 1990; Montgomery 1990; Jackson et al. 2001). In addition, many of the fish species that inhabit park habitat also support an economically important recreational fishery, which contributes to a multimillion-dollar tourist industry in South Florida (Bhat 2003; Coleman et al. 2004; NMFS 2010).

Due to the parks' proximity to the city of Miami, recreational fishing is a popular pastime for park visitors, drawing both local residents and tourists to these natural areas throughout the year. Rapid growth and development in South Florida have caused the number of anglers who visit Biscayne and Everglades National Parks to exponentially increase over the past several decades (Ault et al. 2001). In general, both Biscayne and Everglades National Parks adopt State of Florida fishing regulations. Formal regulatory structures, such as government-imposed size limits or bag limits, are standard tools that managers invoke to achieve fisheries management in most countries. However, regulations are most effective if followed by the angling community, which is predicated upon anglers understanding and accepting the regulations.

To help improve visitor compliance with the local fishing regulations, the National Park Service developed the Fisheries Education Class. The Fisheries Education Class serves both as a mitigation option for individuals who receive a fishing citation within the parks and as a learning opportunity available to the South Florida angling community at no cost. The focus of this class is to help participants better understand the local fishing regulations and why they are biologically important, improve participants' fish identification skills, and provide information on ethical angling techniques. The curriculum serves to provide anglers with the knowledge they need for implementing regulatory best practices and to empower behavior modification in favor of ethical fishing practices.

Similar educational initiatives have existed to supplement more conventional wildlife management interventions. One example was the angler ethics education program established in the late 1980s by the National Marine Fisheries Service (NMFS). The NMFS program focused primarily on improving catch-and-release skills, increasing regulatory compliance, improving responsible and informed treatment of discards, eliminating littering behavior, and reducing the dependence on landed catch as a measure of trip success (Schmied and Ditton 1998). In Michigan, a Conservation Stewards Program provided adult education that focused on ecology and

ecosystem-based resource management in order to engage stakeholders in the hunting, trapping, and fishing communities (Van den Berg et al. 2011). Another study looked at angler experience level and highlighted the need for educational programs that target anglers with more limited skill sets (i.e., those less familiar with identifying, venting, and/or handling fish; Chizinski et al. 2014). An educational program for private lakes in New York State sought to educate lake owners and anglers about fisheries management techniques (Green et al. 1993).

Within Florida, several analogous programs have started since the inception of Biscayne National Park's fishing class in 2007. A private company called Court Options offers a similar but broader 4-h online course for individuals charged by a State of Florida officer outside of the national parks for a variety of boating, fishing, or other wildlife offenses (Court Options 2016). In partnership with Everglades National Park, the National Park Conservation Association launched an online boating safety program called Eco-Mariner. The program helps boaters navigate the shallow waters of Everglades and Biscayne National Parks, characterized by seagrass beds, shallow mud banks, mangrove islands, and offshore coral reefs (Bennis 2009). Finally, an in-person boating safety program was launched by Biscayne and Everglades National Parks, modeled after the Fisheries Education Class discussed in this article, as an option for those who receive a boating citation (Biscayne National Park 2016).

In general, educational initiatives are underutilized in comparison with conventional top-down regulations (Cooke et al. 2013). In most jurisdictions, considerable efforts are made to inform anglers of the regulations, such as through regular printing of pamphlets, dissemination of materials at tackle shops and marinas, newspaper announcements, development of smart phone apps, and the availability of regulations online. Despite this, angler awareness of regulations is often surprisingly low (Page and Radomski 2006). Thus, educational and communication efforts are important companions to traditional regulatory structures for achieving management goals.

Here, we describe the Fisheries Education Class in place at Biscayne and Everglades National Parks and measure its effectiveness by statistically comparing the self-reported self-efficacy and attitudes of participants before and after the class. One of the most difficult issues associated with implementing educational programs is measuring and quantifying intervention success (Carleton-Hug and Hug 2010; Flowers 2010). This is often an important metric needed to justify the support and funding of these activities, but it can be difficult to measure. A review of methods used to evaluate environmental education initiatives was provided by Carleton-Hug and Hug (2010).

To measure the performance of the Fisheries Education Class, people who participated in the program to mitigate a

citation were invited to complete a questionnaire. The survey, which was disseminated postintervention, asked respondents to recall their self-efficacy for following the fishing regulations (the degree to which a person believes they can perform a behavior successfully) and their attitudes toward the fishing regulations, both before and after completing the Fisheries Education Class (Bandura 1991). The study also evaluated whether class effectiveness was influenced by external factors, such as demographics and fishing frequency. In this article, we discuss the Fisheries Education Class in the context of previous fisheries educational efforts, describe the lessons learned during course development and implementation, and identify the limitations the reader should consider while interpreting the results of this study.

METHODS

Curriculum Structure and Development

A steering committee was established to develop the course curriculum. This group of stakeholders included Biscayne National Park's fishery biologist, chief of interpretation and education, two biotechnicians, the park science coordinator, members of National Park Service law enforcement, the assistant U.S. attorney from the environmental crime unit, and a group of local recreational anglers who regularly fish in the park. In addition, law enforcement data from the past decade were analyzed to understand which regulatory concepts and fish species required emphasis in the curriculum. After consulting with the steering committee, reviewing the data, and reading about similar initiatives, the course curriculum was established as four modules: introduction, fish identification, regulations and their purpose, and ethical angling. Within each module, different concepts are discussed, with an emphasis on why such concepts should be important or relevant to recreational anglers (Table 1).

The course takes approximately 3.5 h to complete and focuses on helping anglers to understand the regulations, know where to access them (as opposed to encouraging memorization), and understand their biological purpose using terminology the public can understand. The introduction to the course acquaints attendants with the concepts of the "tragedy of the commons" (Hardin 1968; Berkes 1985) and "shifting baselines" (Pauly 1995) to help participants understand how fishing regulations facilitate the sustainable and equitable use of a public resource. Fish identification is also taught to

participants, given that identifying the captured species is an important prerequisite to appropriately adhering to the regulations for that species. Participating anglers also learn new sustainable fishing techniques from a local fishing guide to improve their angling ethic, skill, and enjoyment while on the water. The class is instructed by the course coordinator (a part-time position), together with the park fisheries biologist. A local fishing guide, who volunteers, instructs the ethical angling section. A law enforcement representative often attends each class to assist individuals with legal issues related to their citation and to answer case-specific questions.

The delivery and presentation of course concepts are achieved using Microsoft PowerPoint in order to take advantage of the animation tools it provides, together with live, in-class demonstrations that employ real fishing gear and artificial, rubber fish. In addition, a multitude of handouts is disseminated to participants, including a booklet of the course curriculum, pamphlets detailing the most recent regulations, and a fish identification book; the materials are theirs to keep. During the early years of the program, the curriculum and its presentation were refined to improve the content and the presentation approach and style based on participant feedback. Currently, the curriculum is updated every 6 months in conjunction with the biannual updates to Florida's fishing regulations.

Course Recruitment

Participants are recruited for the class either by being issued a citation or through program advertisement. During routine patrols, Biscayne and Everglades National Park law enforcement officers conduct safety stops and fish checks to ascertain that park visitors are in compliance with boating safety and fishing regulations. During these checkpoints, a park biologist often participates to assist with the identification and measurement of regulated species and to collect data. When an officer finds that a violation has taken place, the officer may, at his or her discretion, offer the offender an opportunity to participate in the Fisheries Education Class as mitigation for the violation. If eligible, the violator receives a class brochure with information about the course and instructions on how to register. The hope is that attending the Fisheries Education Class will help to educate park visitors about the fishing regulations, how to interpret them, and why they are important in order to improve compliance and fisheries management within the parks.

Table 1. Outline and structure of the course curriculum for the Fisheries education class at Biscayne and Everglades National Parks, Florida.

Module	Concept	Purpose
Introduction	The roles of Biscayne and Everglades as national parks	Learn the protection that Biscayne and Everglades receive as components of the National Park System
	Why fishing regulations are necessary	Learn the purpose behind regulating fishing
Fishing regulations	Correctly interpreting and following the fishing regulations	Practice looking up fishing regulations and applying them to realistic scenarios
	Function of regulations	Learn the biological significance behind the different types of regulation
Fish identification	Correctly identify catch	Practice and learn how to identify fish commonly caught in Biscayne and Everglades so that the appropriate species-specific regulations can be followed
Responsible fishing techniques	Catch and release	Learn appropriate ways to handle a fish out of the water and how to safely release that animal alive
	Gear choice and maintenance	Learn how circle hooks provide for successful catch and release and how to select and maintain fishing gear

Individuals attending the course as mitigation must pass (80% or better) a short, open-book exam to practice and reinforce the skills they learn. If they are not able to pass the exam to this standard, they have the opportunity to repeat the course. Egregious violators and repeat offenders are not offered the course as a mitigation option. Participants attending to mitigate a violation are charged a US\$50 course fee, which is used to help offset some of the costs associated with facilitating the course (i.e., printing of handouts and course booklet, purchase of fish identification books for attendees, etc.). Despite the course fee, individuals who receive a citation still have an incentive to attend the class given that fine amounts are higher than the course fee (i.e., \$125 for the first fish over the bag limit or under the size limit, increasing with each additional fish in violation onboard).

The Fisheries Education Class also serves as a free educational opportunity for members of the local community. Fliers are distributed in the Biscayne and Everglades National Parks' visitor centers and are disseminated to local marinas, boat launching facilities, and tackle shops adjacent to the parks. A Web page describing and promoting the class is part of the National Park Service's website. Other efforts to promote the class include attending fishing-related community events, displaying advertisements for the program in the local newspapers, and delivering seminars to local civic groups. Finally, those attending the class for mitigation purposes are encouraged to bring family members and friends along with them.

Evaluating Program Success

One of the most difficult challenges associated with implementing such an initiative is measuring and quantifying its success. To accomplish this, a survey was developed. The questionnaire asked class participants about their knowledge of and ability to understand important course concepts (self-efficacy) before and after taking the Fisheries Education Class. Such concepts included their knowledge and understanding of the fishing regulations, fish identification skills, and ethical angling practices. The survey also asked participants about their attitudes toward fishing regulations before and after completing the program (DeLorme et al. 2015). Demographic questions were included in the questionnaire.

Survey questions were structured using a Likert scale (Likert 1932), and scores measuring self-efficacy and attitudes before and after taking the class were developed by adding the response values from each respective set of questions (see Appendix A to view the survey). Individuals were selected at random to participate in the study from among those who attended the class between June 2012 and June 2015 for the purpose of mitigating a fishing citation. Although the curriculum was refined over time based on participant feedback, during the time the survey was conducted the curriculum was not altered except to provide minor updates to the fishing rules portion of the class every 6 months in accordance with modifications made to State of Florida fishing regulations (also updated every 6 months).

Two hundred individuals were invited to complete the survey: 100 who attended a class in English, and 100 who attended a class in Spanish. Participants who returned a completed survey received a \$10 gift certificate to Walmart. The survey was conducted by U.S. mail. Respondents were asked to recall back to before they took the fishing class to gauge initial levels of knowledge and attitude. This can understandably introduce

recall bias, which is addressed in the Discussion section. The time burden to complete the survey was estimated at 15 min.

Data were cleaned prior to analysis by plotting distributions of the responses and removing outliers that were beyond the 99th percentile. The 99th percentile was used instead of the 95th percentile because the latter removed too many legitimate observations due to the small sample size. Note that values reporting the sample size or degrees of freedom in this article reflect the number of responses after outlier removal. Data were analyzed using generalized linear models with repeated measures and a Gaussian error structure (Hardin and Hilbe 2018) as well as *t*-tests to understand whether the class had an effect on the self-efficacy and attitudes of participants (Sokal and Rohlf 1994). Repeated measures were used to represent the fact that participants were sampled twice: once to inquire about their attitudes and perceptions before taking the Fisheries Education Class, and a second time to evaluate these constructs after taking the class. Forward stepwise regression was used when fitting the generalized linear models (Hardin and Hilbe 2018), and factor model selection was based on Akaike's information criterion and likelihood ratio tests (Burnham and Anderson 1998). The R statistical environment was used to conduct this analysis (R Core Team 2016).

From the survey, we developed models to compare participants' reported self-efficacy for following the regulations and attitudes toward the fishing regulations before and after attending the Fisheries Education Class. Response variables were the summed respondent scores of questions asking about self-efficacy and attitudes toward the fishing regulations before and after participants took the class. Scores were derived by summing the individual items on the questionnaire for that metric. Four models tested possible effects of the class on attitudes or self-efficacy for following the regulations. These included instruction language (i.e., English or Spanish), demographic characteristics (age, income, and education), fishing frequency inside the park, or fishing frequency outside of the park. To measure the effect of the Fisheries Education Class on self-efficacy and attitudes, all models included a dummy predictor variable to represent whether the response scores reflected the participants' self-efficacy or attitudes before versus after taking the class. First-order interaction terms were considered when more than one main effect was statistically significant. Models were developed to address the following research questions:

1. Does the fishing class have an effect on self-efficacy toward following fishing regulations?
2. Does the fishing class have an effect on the attitudes people have toward fishing regulations?
3. Is there a difference between the Spanish and English classes in participants' response to self-efficacy and their attitudes toward fishing regulations?
4. Do angler demographic characteristics influence self-efficacy?
5. Do angler demographic characteristics influence an individual's attitude toward regulations?
6. Does the frequency of fishing influence an individual's attitude toward fishing regulations?

RESULTS

As of June 2015, 803 people who received fishing citations and 439 people without tickets attended the Fisheries Education Class (Figures 1, 2). Of the 803 individuals who took the class to mitigate a citation, only four were

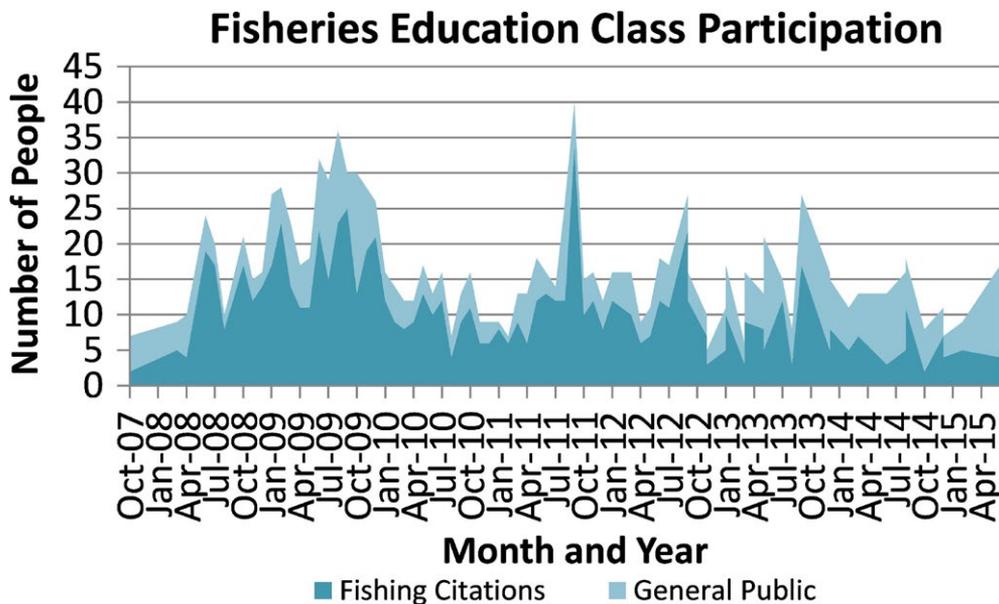


Figure 1. Attendance at the Fisheries Education Class, Biscayne and Everglades National Parks, Florida, from 2007 to 2015.



Figure 2. Fisheries Education Class attendees look on as Captain Gil Muratori, a local fishing guide, explains the importance of fish identification.

subsequently issued another fishing-related citation within the national parks during the study period (between 2012 and 2015). On average, one course per month is offered, alternating between English and Spanish. During times of higher demand (such as the summer months), multiple courses may be offered within a given month if needed (Figure 1).

Analysis of Fishing Infractions in Biscayne National Park

Data on the violations that occurred in Biscayne National Park between 1998 and 2012 were used to help develop and refine the course curriculum and to determine which regulations and species needed the greatest attention. After 2012, a new system was put in place to log and track National Park Service violations, and thus we are no longer able to access this information. From 2008 to 2012, 30–40% of individuals that were issued either a warning or violation for a fishing infraction attended the class (Figure 3). When issued a fishing-related warning or citation, park visitors may or may not be

offered the option to attend the Fisheries Education Class depending on the officer’s discretion. Among individuals who were issued a warning, those who attended the class did so voluntarily, given that a warning does not carry any penalty. In addition, even when the class option was offered, some individuals chose instead to pay the fine or appear in court. During the period 2008–2012, the total absolute number of warnings and violations due to fishing increased (Figure 4). This was attributable in part to an increase in the number of law enforcement rangers working at the national parks during that period and to their enthusiasm for having a third sanctioning option (aside from issuing a fine or mandatory court appearance) for fishing regulation offenders. In other words, rangers like to have the option to prevent future violations from an individual by sending that individual to the Fisheries Education Class.

The majority of warnings and violations related to fishing were issued to anglers for not having a fishing license,

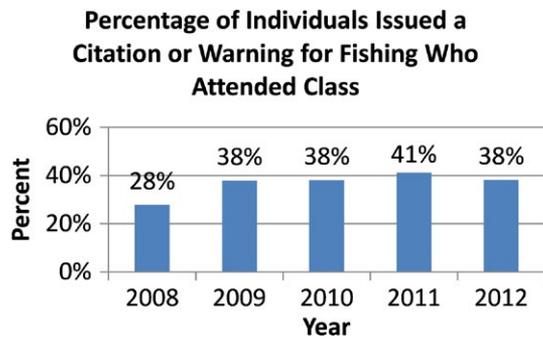


Figure 3. Percentage of individuals who received a fishing citation or warning in Biscayne National Park that attended the Fisheries Education Class, 2008–2012.

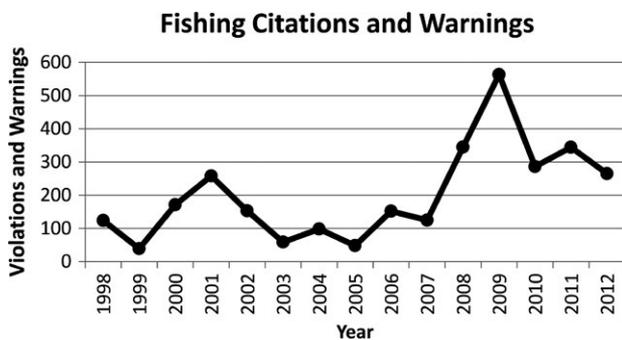


Figure 4. Number of fishing-related warnings and violations issued in Biscayne National Park, Florida, from 1998 to 2012.

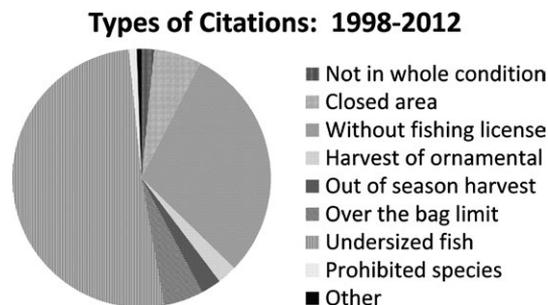


Figure 5. Types of citation issued in Biscayne National Park, Florida, from 1998 to 2012.

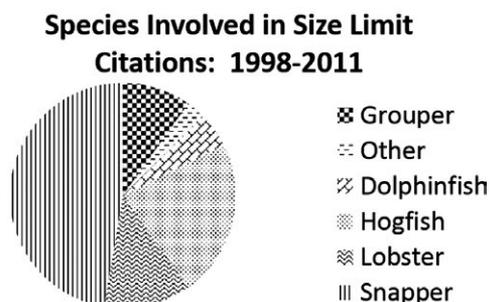
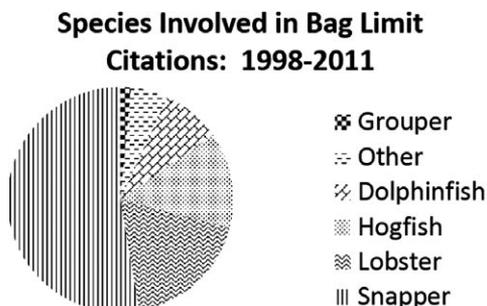


Figure 6. Fish families (including lobster) that were most affected by violations of bag limit or size limit regulations in Biscayne National Park, Florida, from 1998 to 2012.

for harvesting fish shorter than the legal minimum size, for harvesting fish over the bag limit, or for fishing in a closed area (predominantly harvesting lobster inside of the lobster sanctuary; Figure 5). In addition, groupers (*Epinephelidae*), snappers (*Lutjanidae*), and hogfishes (*Labridae*) were identified as the fish families with the most common infractions (Figure 6). Based on this information, the course curriculum was designed to emphasize the regulations that were most often violated and the species that were typically involved in those violations.

Measuring Course Success

The survey was disseminated to 200 individuals, yielding 34 responses (a response rate of 17%). Four scores were generated to measure self-efficacy and attitudes both before and after taking the Fisheries Education Class. Eight items were used to assess the participants' level of self-efficacy related to fishing regulations, and 20 items were used to assess attitudes also related to fishing regulations. Self-efficacy before taking the fishing class was measured as the sum of the eight items represented by questions 12–19 (Appendix A), while self-efficacy after taking the fishing class was measured as the sum of the scores from questions 40–47. Participant attitudes toward the fishing regulations before taking the class were measured as the sum of questions 20–39, while attitudes after taking the fishing class were measured as the sum of questions 48–67. Thus, upon completion of the questionnaire, each participant had a score for self-efficacy (sum of 8 items) and a score for attitudes (sum of 20 items).

Negatively worded items were reverse coded prior to creating the summed score (for example, item 51, states “I think most people do not follow fishing regulations”). Note that responses indicating affirmation (i.e., “very well” or “strongly agree”) were coded for analysis as low numbers (starting from the number 1), while responses indicating disagreement (i.e., “very poorly” or “strongly disagree”) were coded as high numbers (either as a “4” for self-efficacy questions or as a “5” for attitude questions; Appendix A). Records in which questions were left blank for any of the self-efficacy or attitude scores were eliminated from their respective analyses (i.e., analysis of self-efficacy or attitude) in order to avoid biased results. Statistical significance was determined based on non-overlapping 95% confidence intervals.

To measure the effect of the Fisheries Education Class on the self-efficacy for the fishing regulations, a *t*-test for equal variances ($F = 1.931, P = 0.082$) was performed on the summed score of self-efficacy survey questions. Results suggested that the class improved the self-efficacy of participants

to understand and follow the fishing regulations ($t = 7.816$, $P < 0.001$). The effect of the class on the attitudes of participants toward the fishing regulations was measured in a similar way using a t -test for equal variances ($F = 1.506$, $P < 0.285$). Results indicated that the class improved the attitudes of participants toward the fishing regulations ($t = 2.151$, $P = 0.036$).

Generalized linear models with repeated measures were used to evaluate whether the language used in the class (English or Spanish) affected the self-efficacy or attitudes of participants. Tables containing model fit coefficients, SEs, and parameter statistical significance are provided in Appendix B (Tables A.1–A.3). Results showed that the language in which the Fisheries Education Class was instructed did not have an effect on participant self-efficacy for understanding and following the fishing regulations ($P = 0.296$) or on attitudes toward fishing regulations ($P = 0.187$). This suggests that the change in self-efficacy and attitudes after completion of the Fisheries Education Class was the direct result of the class and was not influenced by the instruction language (Table 2).

Next, generalized linear models with repeated measures were used to determine whether three demographic factors—age, income, and education level—had an effect independent from that of the Fisheries Education Class on the self-efficacy for participant understanding of or attitude toward the regulations. Results suggested that it was the fishing class alone, not the demographic factors, that influenced the change in self-efficacy toward better understanding and application of the fishing regulations (Table 2). Similarly, age, income, and education did not affect the attitudes of participants toward fishing regulations.

Finally, anglers' frequency of fishing both inside and outside of South Florida's national park boundaries was used to

determine whether fishing location or increased time engaging in the sport affected their self-efficacy to follow the fishing regulations or their attitudes toward and willingness to comply with the fishing regulations. Generalized linear models with repeated measures were also used for this analysis. We found that anglers' fishing frequency (number of days per month) and fishing location (inside or outside of the national parks) did not affect their self-efficacy or attitudes toward the fishing regulations (Table 2).

DISCUSSION

Success of the Fisheries Education Class is predicated on the fact that understanding and managing the behavior of fishers constitute a necessary component to successful fisheries management (Hilborn 1985, 2007; Lane 1988; Branch et al. 2006). The Fisheries Education Class is an effort to encourage change in angler behavior toward regulatory compliance and implementation of best fishing practices (Cooke et al. 2013). The course curriculum aims to improve participants' knowledge of fishing regulations, tries to help them understand the biological basis for regulations, and presents material to help improve their fish identification skills (Page et al. 2012). Ultimately, the goal of the class is to assist participants in better understanding the role that they play in fish population dynamics and the marine ecosystem. Moreover, the course structure endeavors to provide anglers with a positive encounter with park managers and law enforcement rangers, from whom participants receive the message that the parks are not against fishing but rather striving to achieve regulatory compliance and ethical angling practices within park boundaries.

Program Success

Analysis of survey results from class participants suggested that the Fisheries Education Class changed the self-efficacy of anglers in favor of better understanding and appreciating the fishing regulations and the purpose behind them. Potential evidence for this improvement in self-efficacy can be seen in the success of most individuals on the short quiz administered at the end of the class, which, among other things, asked participants to apply the knowledge they learned to different scenarios (i.e., looking up a fishing regulation for a given situation). Survey results also suggested that the fishing class may help to improve angler attitudes toward the fishing regulations. Providing participants with an understanding of the biological reasoning behind the fishing regulations and knowledge of how regulations are developed by scientists and managers may have helped to foster this behavioral and perceptual change in angler attitudes.

Survey results also indicated that the Fisheries Education Class improved the self-efficacy and attitudes of participants equally, regardless of the language used during class instruction (English or Spanish). As such, the class appeared to achieve its goals equally well regardless of the language in which it was taught. Demographic characteristics that were tested (age, income, and education level) also did not appear to influence the improved self-efficacy that the class provided.

It is noteworthy that several results bordered on the verge of statistical significance. These included the effect of income on attitudes toward the fishing regulations ($P = 0.093$) and whether fishing inside or outside of the national parks affected angler self-efficacy for adhering to Florida's fishing regulations ($P = 0.095$). A larger sample size, achieved either

Table 2. Summary of coefficient estimates for models examining the effects of language, demographics, and fishing patterns on the self-efficacy and attitudes of Fisheries Education Class participants toward the fishing regulations before and after taking the class at Biscayne and Everglades National Parks. Asterisks indicate parameters that were statistically significant at the 95th percentile ($n = 34$).

Factor	Self-efficacy	Attitudes
Language		
Fisheries Education Class	-9.55*	-3.32*
Instruction language	1.56	-2.23
Demographics		
Fisheries Education Class	9.44*	-2.70*
Age	0.10	-0.07
Income	0.50	0.94
Education	-0.86	0.87
Fishing Frequency: Inside National Parks		
Fisheries Education Class	9.69*	-3.25*
Fishing Inside National Parks	-0.83	-0.38
Fishing frequency: Outside of National Parks (Elsewhere in Florida)		
Fisheries Education Class	-9.57*	-3.17*
Fishing Outside of National Parks	0.53	-0.44

through sampling more individuals or improving the response rate, may or may not have helped to provide more robust analytical results.

Study Limitations

The preferential selection of survey participants that attended the class to mitigate a citation was intentional in order to measure the success of the program at improving visitor compliance with the local fishing regulations. Different from members of the community, those who attended the class to mitigate a citation were somewhat compelled to attend (although they had the option to pay their ticket or go to court). Compulsory attendance, coupled with the fact that participants received their citation from the very institution hosting the educational program, could have biased study participants toward a more negative outlook on anything associated with the National Park Service. Although not quantified, individuals who received a citation may have been more likely to report a more significant gain in knowledge and change in attitudes related to fishing regulations. This assumes that the subset of recreational anglers in South Florida that were issued a fishing ticket were less informed than their compliant counterparts. Individuals with a more favorable perception of fishing regulations, the Fisheries Education Class, and/or the National Park Service may have been more willing to complete and return the survey and thus could have biased the results.

Analysis suggested that the class—not the fishing frequency or location—affected the self-efficacy and attitudes of course participants. The results were almost statistically significant for the effect of fishing frequency within the national parks, such that perhaps increased fishing may have led to an improvement in self-efficacy for the fishing regulations. Increased sample size would be needed to properly evaluate whether or not fishing frequency in the national parks was an important construct. One could hypothesize that perhaps the more an individual fished, the more attachment they would have to the ocean and its resources (Kim et al. 1997; Sutton and Ditton 2001). Thus, frequency could have been a proxy for attachment, which the model did not account for and we did not measure. Thus, anglers who were more attached to the sport itself may have been more conservation minded.

It is important to acknowledge that this was a cross-sectional and self-reported study. As such, the survey was administered by U.S. mail to respondents some time after they had already taken the Fisheries Education Class (i.e., in some cases, months afterwards). As a result, respondents had to consider their past attitudes toward fishing regulations and had to recall their ability to properly interpret and follow the fishing regulations both before and after they attended the Fisheries Education Class. This methodology had the potential to introduce recall bias, which could have altered a respondent's perception of a past experience, either in a more positive or more negative direction (Hassan 2005). For example, a respondent may not have wanted to admit that they never considered following the fishing regulations prior to taking the class, because they perceived their past behaviors or mindset as not being socially desirable (Herbert et al. 1995; Van de Mortel 2008). Recall bias has been an issue in prior angler mail questionnaires (Tarrant et al. 1993; Connelly and Brown 1995; Osborn and Matlock 2010). In addition, as reported in the Results section, sample size and survey return rates were somewhat low. This low return of samples could have been indicative of nonresponse bias, which has also been shown to

occur in angler mail surveys (Tarrant et al. 1993; Fisher 1996). Due to the low sample size, the results of this study may not be representative of the whole population of participants who attended the Fisheries Education Class to mitigate a citation. As a result, readers should be cautious when considering the statistical results and in drawing conclusions about the long-term efficacy of this educational program.

Similarities and Differences Relative to Prior Fisheries Educational Initiatives

In comparison with published studies documenting similar educational initiatives in fisheries, the Fisheries Education Class was most similar to the NMFS angler ethics program (Schmied and Ditton 1998); the Court Options online program in the State of Florida (Court Options 2016); and, as expected, the boating educational course launched by Biscayne National Park (2016), which was modeled after the program described herein. Similar to the NMFS angler ethics program, the Fisheries Education Class addressed catch-and-release skills, including handling fish to be discarded, and focused on increasing regulatory compliance. The NMFS angler ethics program also sought to eliminate littering behavior and encouraged predicating the success of a fishing trip on metrics other than the quantity of fish landed. The Fisheries Education Class touched very briefly on littering, mostly in the context of derelict fishing gear, but did not directly discuss metrics for trip success that are different from using landed catch. Another important difference between the two programs is that the Fisheries Education Class included fish identification skills. Correct identification of fish has been shown to be a critical knowledge gap among anglers (Page et al. 2012; Chizinski et al. 2014); this is also the case in South Florida, where many of the citations people receive are due to misidentifications of fish species.

Several online initiatives with similar objectives were highlighted in the introduction. These included Court Options, a private company that offers an all-encompassing (but less in-depth), 4-h online course addressing boating, fishing, and other wildlife offenses. Court Options also offers other courses for legal mitigation unrelated to environmental issues, such as driving school and theft remediation. Similar to the program described in this article, the Court Options program serves individuals who receive a fishing citation in Florida, provided the citation was issued by a state official outside of the national park boundaries. However, the Court Options curriculum is much broader in scope, covering fisheries, boating, and other wildlife offenses within nearly the same time frame as our program (about 4 h). Due to the complexity of the State of Florida fishing regulations (which differ by region and are updated every 6 months) and the multitude of similar-looking fish species in Florida's waters, National Park Service resource managers felt that it was important to establish two separate courses: one for fisheries infractions as described herein; and another for boating infractions, as mentioned in the introduction.

Although we considered launching an online application of the fisheries program, we felt that it would not have been as effective. Many online courses are well packaged using the latest in web design technologies, but a review of such courses demonstrated that their instructional design is often poor (Margaryan et al. 2015). Other reasons we decided not to develop a web-based distance-learning approach included reduced effectiveness due to social isolation of the learner,

failure to adapt to the needs of the learners (their needs are much easier to recognize and accommodate in a classroom setting), technical problems, and significant time and financial costs, especially when starting a new course online (Zhang et al. 2004; Cook 2007). Other research shows that programs aiming to change the attitudes of the participants, as is the case with the Fisheries Education Class, do not work as well online (Taylor 2002). Finally, dropout rates from online courses tend to be much higher than traditional, in-person classes (Onah et al. 2014). Some combat this by developing hybrid courses that meet both in person and online (Potosky 2004) and by developing best practices for online curricula (Hendricks and Bailey 2016; Vai and Sosulski 2016).

Lessons Learned

Since the program's inception in 2007, a variety of limitations and challenges has been confronted, and these are documented in this section together with the solutions we have trialed, when applicable. First, based on responses to particular survey questions along with anecdotal information from conversations, participants were generally aware that fishing regulations exist, but they lacked the proper interpretation of the regulations and how to apply them. This may have been due to the complexity of the State of Florida regulations and the multiple marine jurisdictions and agencies that manage marine resources in South Florida. In response, part of the course curriculum is dedicated to demonstrating the structure of the regulations pamphlet and how to read and interpret the regulations within the brochure. We encourage anglers to carry a laminated copy of the regulations at all times for reference as opposed to fostering memorization.

Second, when anglers attended the class, many seemed to be unaware of the biological rationales behind different types of regulation (i.e., size limits, bag limits, and closed seasons). This is an important course component because research suggests that people are more likely to comply with laws if they (1) understand the purpose behind the regulations and (2) feel that the regulations are fairly designed. Knowledge of why a regulation was implemented provides a sense of legitimacy to the fishing rules and the agencies responsible for their creation and enforcement (Tyler 1997; Tyler and Jackson 2014). In addition, research suggests that individuals are more likely to adopt legally sanctioned and proactive environmental practices if they understand the regulations being enforced and their purpose (Yee et al. 2016).

Third, across the multiple years of facilitating the class, it has been anecdotally observed that participants seemed to respond better to participatory and collaborative learning. Recreational anglers who attended each class shared similar interests in fishing and boating, and this common ground helped to promote participation in the class as well as dialogue and discussion among attendees. Although it is sometimes challenging for the instructor to foster, research demonstrates that participation during a class improves learning outcomes (Prince 2004; Rocca 2010; Abdullah et al. 2012). In addition, discussion among attendees and between the attendees and the course instructors who represent park management may help to improve compliance. This is because people tend to behave according to their perceptions of what others may approve or disapprove or according to the way others around them are behaving (St. John et al. 2015). Thus, the group dynamics within a class could play a powerful role in helping to change angler behaviors, norms, and attitudes.

Fourth, through our experience with this program, we have observed that external variables seemed to affect class recruitment. For example, recruiting individuals with a citation is dependent on the time, personnel, and equipment resources that law enforcement agencies have to dedicate toward monitoring fishing violations. During times when law enforcement must focus their efforts on other legal issues (a common occurrence given proximity to a major city like Miami), when enforcement agencies are short-staffed, or when patrol boats are out of order, referrals to the class tend to decrease. In addition, attendance fluctuates seasonally, with more individuals fishing during the summer months, characterized by calm ocean conditions, than during winter months, characterized by long periods with breezy conditions and rough seas. Fifth, local stakeholder involvement in the project—from early conceptualization through curriculum development, course execution, and instruction—seems to be important. The use of local stakeholders to help deliver course material helps to attain endorsement for the program by the recreational fishing community.

Sixth, we try not to present the course with a punishment focus, as under this pretense, we are concerned that participants may not respond with an open mind to the information being presented. Sometimes, class participants will “vent” to the instructors about their violation; a brief discussion of this may be allowed in order to help participants feel like their concerns are heard and validated, which ultimately seems to render the participants more likely to listen to the information offered during the course.

Finally, two additional but unrelated lessons learned from this process include presentation style and course fees. Participants appeared to respond better to slides with visuals and animations as opposed to slides populated with many words. For example, when helping participants understand and distinguish between the concepts of species-specific and aggregate (at the taxonomic family level) bag limits, we used an animation showing different partitions that can be filled in a recreational angler's cooler. Once those partitions have been filled at the species or aggregate level, the bag limit has been reached.

Individuals who receive a citation and decide to participate in the course are charged a \$50 fee to help offset the cost of course materials, such as printing and binding the class booklet, developing handouts, and purchasing fish identification books for participants. The amount of this fee was selected based on the financial needs of the program and because it was substantially less than the lowest fine amounts: \$75 for not having a valid fishing license, and \$125 for catching one fish in violation of either the bag limit or size limit, with fine amounts increasing for additional fish in violation. Overall, despite the cost, participants still find the course worth taking; anecdotally, we have observed two reasons for this. The first is financial savings given the difference between the class fee and the fine; the second is that the anglers wish to avoid having the citation on their permanent record. Receiving a fishing citation in one of the national parks remains on your criminal record as a permanent federal misdemeanor, which may preclude some anglers from certain employment opportunities.

CONCLUSIONS

We have described an educational initiative that is in place at two South Florida national parks to complement and enhance compliance with the fishing regulations within park

boundaries and beyond. Such educational initiatives, in concert with more traditional regulatory structures, can serve to improve compliance and cooperation with resource management initiatives. This is particularly the case in areas that, like South Florida, have complex regulations and a consistent influx of both new residents and tourists who might be unfamiliar with the regulations. Results demonstrated that the Fisheries Education Class or similar programs can be effective at improving the self-efficacy of anglers toward understanding and applying the regulations and may help to improve the attitudes of the participants toward fishing regulations irrespective of external factors, such as demographics, instruction language, and fishing frequency.

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APPENDIX A: FISHERIES EDUCATION CLASS SURVEY

Demographics

1. Please indicate your age _____
2. What is your gender? Male Female
3. Please indicate your race and/or ethnicity?
 Race _____ Ethnicity _____
4. What language do you mostly use at home?
 English Spanish Other: _____ (specify)
5. Where were you born? _____ (specify)
 - a. If you were not born in the U.S., how long have you been living in the U.S.?
 _____ years _____ months

6. Select the bracket that best represent your home’s annual income:

- Less than \$9,999 \$10,000 - \$24,999
 \$25,000 - \$34,999 \$35,000 - \$49,999
 \$50,000 - \$75,000 More than \$75,000

7. What is the highest level of education you have achieved?

- High School Diploma or less Master’s Degree
 Associate or Technical Degree Professional Degree (MD, JD, MBA, etc.)
 Some college Doctorate (Ph.D., Ed.D., etc.)
 Bachelor’s Degree

8. Do you own your own boat? Yes No If yes, what is your vessel length? _____ (feet)

9. How many times per month do you fish in Biscayne National Park? _____

10. How many times per month do you fish in Everglades National Park? _____

11. How many times per month do you fish in other Florida waters? _____

Fishing Class Survey

To answer questions 12–19, please rate your level of understanding **BEFORE coming to the class**. Put a mark under the level that best describes your understanding.

Before coming to the class...	Very well	Well	Poorly	Very poorly
12. I could identify different fish				
13. I knew which characteristics to use to tell fish apart				
14. I knew the difference between “fork length” and “total length”				
15. I knew what “aggregate bag limit” means				
16. I knew what “species bag limit” means				
17. I knew how to interpret the regulations table				
18. I knew how to use a dehooking tool				
19. I knew how to use a venting tool				

For questions 20–39, please rate how much you agree or disagree with the statements **BEFORE coming to the class**. Put a mark under the level that best describes your opinion.

Before coming to the class...	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
20. I thought fishing regulations had little effect on fish populations					
21. I seldom followed fishing regulations					

(Continued)

Before coming to the class...	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
22. I thought fishing regulations were important for the future of fishing in Florida					
23. I thought most people did not follow fishing regulations					
24. I thought fishing regulations were arbitrary					
25. I thought fishing regulations had biological basis					
26. I thought fishing regulations prevented overfishing					
27. I thought most people followed fishing regulations					
28. I thought fishing regulations had no effect on fish populations					
29. I followed fishing regulations to avoid citations					
30. I thought fishing regulations helped protect fish populations					
31. I thought fishing regulations negatively affected fish populations					
32. I thought recreational fishing had little impact on fish populations					
33. I thought fishing regulations were based on science					
34. I followed fishing regulations most times					
35. I thought overfishing impacted fish populations					
36. I thought fishing regulations helped protect future fishing					
37. I thought fishing regulations positively affected fish populations					
38. I thought only commercial fishing contributed to overfishing					
39. I followed fishing regulations to keep a healthy fish population					

To answer questions 40–47, please rate your level of understanding **AFTER attending the class**. Put a mark under the level that best describes your understanding.

After coming to the fishing class...	Very well	Well	Poorly	Very poorly
40. I can identify different fish				
41. I know which characteristics to use to tell fish apart				
42. I know the difference between “fork length” and “total length”				
43. I know what “aggregate bag limit” means				
44. I know what “species bag limit” means				
45. I know how to interpret the regulations table				
46. I know how to use a dehooking tool				
47. I know how to use a venting tool				

For questions 48–54, please rate how much you agree or disagree with the statements **AFTER attending the class**. Put a mark under the level that best describes your opinion.

After coming to the fishing class...	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
48. I think fishing regulations have little effect on fish populations					
49. I seldom follow fishing regulations					
50. I think fishing regulations are important for the future of fishing in Florida					
51. I think most people do not follow fishing regulations					
52. I think fishing regulations are arbitrary					
53. I think fishing regulations have biological basis					
54. I think fishing regulations prevent overfishing					

(Continued)

(Continued)

After coming to the fishing class...	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
55. I think most people follow fishing regulations					
56. I think fishing regulations have no effect on fish populations					
57. I follow fishing regulations to avoid citations					
58. I think fishing regulations help protect fish populations					
59. I think fishing regulations negatively affect fish populations					
60. I think recreational fishing has little impact on fish populations					
61. I think fishing regulations are based on science					
62. I follow fishing regulations most times					
63. I think overfishing impacts fish populations					
64. I think fishing regulations in the present protect future fishing					
65. I think fishing regulations positively affect fish populations					
66. I think only commercial fishing contributes to overfishing					
67. I follow fishing regulations to keep a healthy fish population					

APPENDIX B: COMPLETE MODEL FITS FROM REGRESSION ANALYSES

Table A.1. Model results illustrating the effect of the language (English or Spanish) in which individuals took the Fisheries Education Class on changes in self-efficacy and attitudes toward fishing regulations.

Factor	Estimate	SE	t	Pr(> t)
Effect of Language on Self-Efficacy				
Intercept	21.043	1.134	18.559	<0.001
Fisheries Education Class	-9.552	1.015	-9.407	<0.001
Language	1.555	1.459	1.066	0.296
Effect of Language on Attitudes				
Intercept	53.348	1.256	42.460	<0.001
Fisheries Education Class	-3.321	1.230	-2.557	0.017
Language	-2.229	1.643	-1.357	0.187

Table A.2. Model results illustrating the effect of demographic characteristics of Fisheries Education Class participants on changes in self-efficacy and attitudes toward fishing regulations.

Factor	Estimate	SE	t	Pr(> t)
Effect of Demographics on Self-Efficacy				
Intercept	7.501	3.350	2.239	0.034
Fisheries Education Class	9.444	1.073	8.800	<0.001
Age	0.102	0.062	1.634	0.116
Income	0.498	0.526	0.948	0.353
Education	-0.858	0.613	-1.400	0.175
Effect of Demographics on Attitudes				
Intercept	49.511	2.987	16.574	<0.001
Fisheries Education Class	-2.704	1.210	-2.235	0.034
Age	-0.072	0.059	-1.224	0.234
Income	0.938	0.535	1.754	0.093
Education	0.873	0.671	1.300	0.207

Table A.3. Effect of fishing frequency, both inside and outside of national parks, on Fisheries Education Class participants' self-efficacy and attitudes toward fishing regulations.

Factor	Estimate	SE	t	Pr(> t)
Effect of Fishing in National Parks on Self-Efficacy				
Intercept	13.266	1.065	12.461	<0.001
Fisheries Education Class	9.690	1.007	9.618	<0.001
Fishing in National Parks	-0.831	0.481	-1.729	0.095
Effect of Fishing in National Parks on Attitudes				
Intercept	53.096	1.281	41.449	<0.001
Fisheries Education Class	-3.250	1.530	-2.124	0.038
Fishing in National Parks	-0.383	0.469	-0.817	0.418
Effect of Fishing Outside of National Parks (Elsewhere in Florida) on Self-Efficacy				
Intercept	21.370	1.091	19.595	<0.001
Fisheries Education Class	-9.567	0.981	-9.751	<0.001
Fishing outside of National Parks	0.530	0.660	0.804	0.428
Effect of Fishing Outside of National Parks (Elsewhere in Florida) on Attitudes				
Intercept	53.106	1.279	41.523	<0.001
Fisheries Education Class	-3.172	1.262	-2.513	0.018
Fishing outside of National Parks	-0.435	0.575	-0.757	0.456