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Catch and Release: the effectiveness of an educational class on anglers caught with fishing citations

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Abstract

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 by anglers understanding and accepting the regulations. In order to enhance compliance with fishing regulations and improve the management of fisheries resources, Biscayne and Everglades National Parks established a fishing education class program open to the community and available to anglers cited with a fishing violation in exchange for a reduced or waived fine. This study describes this program and quantitatively evaluates 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 show that the fishing education class is effective at improving the self-efficacy of anglers toward understanding and applying the regulations, and improves the attitudes of the participants toward fishing regulations.

1 **Introduction**

2 Biscayne and Everglades National Parks protect a sub-tropical marine ecosystem
3 located at the southeastern tip of the Florida mainland, south of the city of Miami. Most
4 of the areas within the boundaries of these parks consist of underwater environments with
5 living coral reefs, sea grass meadows, and mangrove forests. The role ecologically
6 balanced fish populations play in maintaining the health and sustainability of coral reef
7 ecosystem function is well documented (Glynn 1990; Montgomery 1990; Jackson et al.
8 2001). In addition, many of the fish species that inhabit park habitat also support an
9 economically important recreational fishery, which contributes to a multimillion dollar
10 tourist industry in South Florida (Bhat 2003; Coleman et al. 2004; National Marine
11 Fisheries Service 2010).

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

22 In order to help improve visitor compliance with the local fishing regulations, the
23 National Park Service developed the Fisheries Education Class. The Fisheries Education
24 Class serves both as a mitigation option for individuals who receive a fishing citation
25 within the Parks, and is also available to the South Florida angling community at no cost.
26 The focus of this class is to help participants better understand the local fishing
27 regulations and why they are biologically important, improve fish identification skills,
28 and provide information on ethical angling techniques. The curriculum serves to provide
29 anglers with the knowledge they need to implement regulatory best practices, and
30 empower behavior modification in favor of ethical fishing practices.

31 Similar educational initiatives have existed to supplement more conventional

1 wildlife management interventions. One example was the angler ethics education
2 program established in the late 1980's by the National Marine Fisheries Service (NMFS).
3 The NMFS program focused primarily on improving catch-and-release skills, increasing
4 regulatory compliance, improving responsible and informed treatment of discards,
5 eliminating littering behavior, and reducing the dependence on landed catch as a measure
6 of trip success (Schmied and Ditton 1998). In Michigan, a Conservation Stewards
7 Program provided adult education that focused on ecology and ecosystem-based resource
8 management in order to engage stakeholders in the hunting, trapping, and fishing
9 communities (Van den Berg et al. 2011). Another study looked at angler experience level
10 and highlighted the need for educational programs that target anglers with more limited
11 skillsets (i.e. less familiarity identifying, venting, and/or handling fish; Chizinski et al.
12 2014). An educational program for private lakes in New York State sought to educate
13 lake owners, and anglers about fisheries management techniques (Green et al. 1993).

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

26 In general, educational initiatives are underutilized in comparison to conventional
27 top-down regulations (Cooke et al. 2013). In most jurisdictions, considerable efforts are
28 made to inform anglers of the regulations, such as through regular printing of pamphlets,
29 dissemination of materials at tackle shops and marinas, newspaper announcements,
30 development of smart phone apps, and the availability of regulations online. Despite this,
31 angler awareness of regulations is often surprisingly low (Page and Radomski 2006).

1 Thus, educational and communication efforts are important companions to traditional
2 regulatory structures towards achieving management goals.

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

11 In order to measure the performance of the Fisheries Education Class, people who
12 participated in our program to mitigate a citation were invited to complete a
13 questionnaire. The survey was disseminated post intervention, and asked respondents to
14 recall their self-efficacy for following the fishing regulations (the degree to which a
15 person believes they can perform a behavior successfully), and their attitudes towards the
16 fishing regulations, both before and after completing the Fisheries Education Class
17 (Bandura 1991). The study also evaluated whether class effectiveness was influenced by
18 external factors such as demographics and fishing frequency. This article discusses the
19 Fisheries Education Class in the context of previous educational fisheries efforts,
20 describes the lessons learned during course development and implementation, and speaks
21 about the limitations the reader should consider while interpreting the results of this
22 study.

23 **Methodology**

24 *Curriculum Structure and Development*

25 A steering committee was established to develop the course curriculum. This
26 group of stakeholders included Biscayne National Park's fishery biologist, chief of
27 interpretation and education, two bio-technicians, the park science coordinator, members
28 of national park service law enforcement, the assistant U.S. attorney from the
29 environmental crimes unit, and a group of local recreational anglers who regularly fish in
30 the park. In addition, law enforcement data from the past decade was analyzed in order
31 to understand which regulatory concepts and fish species required emphasis in the

1 curriculum. After consulting with the steering committee, reviewing the data, and
2 reading about similar initiatives, the course curriculum was established as four modules:
3 introduction, fish identification, regulations and their purpose, and ethical angling.
4 Within each module, different concepts are discussed with an emphasis on why such
5 concepts are important or relevant to recreational anglers (Table 1).

6 The course takes approximately 3.5 hours to complete, and focuses on helping
7 anglers understand the regulations, know where they can be found (as opposed to
8 encouraging memorization), and understand their biological purpose using terminology
9 the public can understand. The introduction to the course acquaints attendants with the
10 concepts of “tragedy of the commons” (Hardin 1968; Berkes 1985) and “shifting
11 baselines” (Pauly 1995) to help participants understand how fishing regulations facilitate
12 the sustainable and equitable use of a public resource. Fish identification is also taught to
13 participants, given that identifying the species you capture is an important prerequisite to
14 appropriately adhering to the regulations for that species. Participating anglers also learn
15 new sustainable fishing techniques from a local fishing guide to improve their angling
16 ethic, skill, and enjoyment while on the water. The class is instructed by the Course
17 Coordinator (a part time position), together with the Park Fisheries Biologist. A local
18 fishing guide who volunteers instructs the ethical angling section. A law enforcement
19 representative often attends each class to assist individuals with legal issues related to
20 their citation and answer case-specific questions.

21 The delivery and presentation of course concepts are done using Microsoft
22 PowerPoint, in order to take advantage of the animation tools it provides, together with
23 live in-class demonstrations with real fishing gear and artificial, rubber fish. In addition,
24 a multitude of handouts are disseminated to participants, which are theirs to keep,
25 including a booklet of the course curriculum, the most recent regulations pamphlets, and
26 a fish identification book. During the first few years that the program was implemented,
27 the curriculum and its presentation were refined to improve content and presentation
28 approach and style, based on participant feedback. Currently, the curriculum is updated
29 every six months, in conjunction with the biannual updates to Florida’s fishing
30 regulations.

31 *Course Recruitment*

1 Participants are recruited for the class either by being issued a citation, or through
2 program advertisement. During routine patrols, Biscayne and Everglades law
3 enforcement officers conduct safety stops and fish checks to ascertain that park visitors
4 are in compliance with boating safety and fishing regulations. During these checkpoints
5 one of the park's biologists often participates to assist with the identification and
6 measuring of regulated species, and to collect data. When an officer finds that a violation
7 has taken place, the officer may, at their discretion, offer the offender the opportunity to
8 participate in the Fisheries Education Class as mitigation for the violation. If eligible, the
9 violator is given a class brochure with information about the course and instructions on
10 how to register. The hope is that attending the Fisheries Education Class will help
11 educate park visitors about the fishing regulations, how to interpret them, and why they
12 are important in order to improve compliance and fisheries management within the parks.

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

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

1 and friends along with them.

2 *Evaluating Program Success*

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

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

22 Two hundred individuals were invited to complete the survey, 100 who attended a
23 class in English, and 100 who attended a class in Spanish. A \$10 gift certificate to
24 Walmart was given to participants who returned a completed survey. The survey was
25 conducted by U.S. mail. To respond to questionnaire items that asked about knowledge
26 and attitudes before taking the class, respondents were asked to recall back to before they
27 took the fishing class. This can understandably introduce recall bias, which is addressed
28 in the discussion section. The time burden to complete the survey was estimated as about
29 15 minutes.

30 Data was cleaned prior to analysis by plotting distributions of the responses and
31 removing outliers that were beyond the 99th percentile. The 99th percentile was used

1 instead of the 95th percentile because the 95th percentile removed too many legitimate
2 observations due to the small sample size. Note that values which reported sample size
3 or degrees of freedom in the article reflected the number of responses after outlier
4 removal. Data was analyzed using generalized linear models with repeated measures and
5 Gaussian error structure (Hardin and Hilbe 2018), and t-tests to understand if the class
6 had an effect on the self-efficacy and attitudes of participants (Sokal and Rohlf 1994).
7 Repeated measures were used to represent the fact that participants were sampled twice:
8 once to inquire about their attitudes and perceptions before taking the Fisheries Education
9 Class, and a second time to evaluate these constructs after taking the class. Forward
10 stepwise regression was used when fitting the generalized linear models (Hardin and
11 Hilbe 2018), and factor model selection was based on Akaike Information Criterion and
12 likelihood ratio tests (Burnham and Anderson 1998). The R Statistical Program was used
13 to conduct this analysis (R Core Team 2016).

14 From the survey, we developed models to compare participant reported self-
15 efficacy for following the regulations, and reported attitudes towards the fishing
16 regulations, before and after attending the Fisheries Education Class. Response variables
17 were the summed respondent scores of questions asking about self-efficacy and attitude
18 toward the fishing regulations, before and after participants took the Fisheries Education
19 Class. Scores were derived by summing the individual items on the questionnaire for that
20 metric. Four models were fit to test whether instruction language (i.e. English or
21 Spanish), demographic characteristics (age, income, and education), fishing frequency
22 inside the park, or fishing frequency outside the park had an effect on attitudes or self-
23 efficacy for following the regulations. All models included a dummy predictor variable
24 to represent whether the response scores were made before or after the Fisheries
25 Education Class was taken in order to measure the effect of the class on self-efficacy and
26 attitudes. First order interaction terms were considered when more than one main effect
27 was statistically significant. Models were developed to address the following research
28 questions:

- 29 1. Does the fishing class have an effect on self-efficacy towards following fishing
30 regulations?
- 31 2. Does the fishing class have an effect on the attitudes people have toward fishing

- 1 regulations?
- 2 3. Is there a difference between the Spanish and English class in participant response
3 to self-efficacy and their attitudes toward fishing regulations?
- 4 4. Do angler demographic characteristics influence self-efficacy?
- 5 5. Do angler demographic characteristics influence an individual's attitude toward
6 regulations?
- 7 6. Does the frequency of fishing influence one's attitude towards fishing
8 regulations?
- 9

10 **Results**

11 As of June 2015, 803 people who received fishing citations and 439 people
12 without tickets attended the Fisheries Education Class (Figure 1). Of the 803 individuals
13 who took the class to mitigate a citation, only four were subsequently issued another
14 fishing-related citation within the Parks during the study period (between 2012 and
15 2015). On average, one course per month is offered, alternating between English and
16 Spanish. During times of higher demand (such as the summer months), multiple courses
17 may be offered within one month if needed (Figure 1).

18 *Analysis of Fishing Infractions in Biscayne National Park*

19 Data on the violations that occurred in Biscayne National Park between 1998 and
20 2012 were used to help develop and refine the course curriculum and determine which
21 regulations and species need the greatest attention. After 2012, a new system was put in
22 place to log and track National Park Service violations, and thus we are no longer able to
23 access this information. Between 2009 and 2012, 30% to 40% of individuals issued
24 either a warning or violation for a fishing infraction attended the class (Figure 3). When
25 issued a fishing related warning or citation, park visitors may or may not be offered the
26 option to attend the Fisheries Education Class depending on the officer's discretion.
27 Individuals issued a warning who attended the class did so voluntarily, given the fact that
28 a warning does not carry any penalty. In addition, even when the class option was
29 offered, some individuals chose instead to pay for the fine or appear in court. During this
30 time period, the total absolute number of warnings and violations due to fishing increased
31 (Figure 4). This was due in part to an increase in the number of law enforcement rangers

1 working at the Parks during this time period, and their enthusiasm for having a third
2 sanctioning option (aside from issuing a fine or mandatory court appearance) for fishing
3 regulation offenders. In other words, rangers like to have the option to prevent future
4 violations from an individual by sending the individual to the Fisheries Education Class.

5 The majority of warnings and violations related to fishing were issued to anglers
6 for not having a fishing license, harvesting fish shorter than the legal minimum size,
7 harvesting fish over the bag limit, or fishing in a closed area (predominantly harvesting
8 lobster inside of the lobster sanctuary) (Figure 5). In addition, grouper, snapper, and
9 hogfish were identified as the fish families with the most common infractions (Figure 6).
10 Based on this information, the curriculum was designed to emphasize the regulations and
11 species most violated.

12 *Measuring Course Success*

13 The survey was disseminated to 200 individuals yielding 34 responses (response
14 rate of 17%). Four scores were generated to measure self-efficacy and attitudes both
15 before and after taking the fishing class. Eight items were used to assess participant level
16 of self-efficacy related to fishing regulations, and 20 items to assess attitudes also related
17 to fishing regulations. Self-efficacy before taking the fishing class was measured as the
18 sum of the eight items represented by questions 12 – 19, while self-efficacy after taking
19 the fishing class was measured as the sum of the scores from questions 40 – 47.

20 Participant attitudes towards the fishing regulations before taking the class were
21 measured as the sum of questions 20 – 39, while attitudes after taking the fishing class
22 were measured as the sum of questions 48 – 67. Thus upon completion of the
23 questionnaire, each participant had a score for self-efficacy (sum of 8 items) and a score
24 for attitude (sum of 20 items).

25 Negatively worded items were reverse coded prior to creating the summed score
26 (for example, item 51, which states “I think most people do not following fishing
27 regulations”). Note that responses indicating affirmation (i.e. “very well” or “strongly
28 agree”) were coded for analysis as low numbers (starting from the number 1), while
29 responses indicating disagreement (i.e. “very poorly” or “strongly disagree”) were coded
30 as high numbers (either as a “4” for self-efficacy questions or a “5” for attitude questions)
31 (see questionnaire in Appendix A). Records where questions were left blank for any of

1 the self-efficacy or attitude scores were eliminated from their respective analyses (i.e.
2 analysis of self-efficacy or attitude) in order to avoid biased results. Statistical
3 significance was determined by non-overlapping 95% confidence intervals.

4 In order to measure the effect of the Fisheries Education Class on the self-efficacy
5 for the fishing regulations, a t-test for equal variances ($F=1.931$; $p=0.082$) was performed
6 on the summed score of self-efficacy survey questions. Results suggest that the class
7 improved the self-efficacy of participants to understand and follow the fishing regulations
8 ($t=7.816$; $p<0.001$). The effect of the fishing class on the attitudes of participants
9 towards the fishing regulations was measured in a similar way, using a t-test for equal
10 variances ($F=1.506$; $p<0.285$). Results indicated that the fishing class improved the
11 attitudes of participants towards the fishing regulations ($t=2.151$; $p=0.036$).

12 Generalized linear models with repeated measures were used to evaluate whether
13 the language used in the class (English or Spanish) affected the self-efficacy or attitudes
14 of participants. Tables containing model fit coefficients, standard error, and parameter
15 statistical significance are provided in Appendix B. Results showed that the language in
16 which the Fisheries Education Class was instructed did not have an effect on participant
17 self-efficacy for understanding and following the fishing regulations ($p=0.296$), or
18 attitudes toward fishing regulations ($p=0.187$). This suggests that the change in self-
19 efficacy and attitudes before and after completion of the fishing class was the direct result
20 of the Fisheries Education Class, and not influenced by the instruction language (Table
21 2).

22 Next, generalized linear models with repeated measures were used to see if the
23 demographic factors age, income, and education level had an effect independent from
24 that of the Fisheries Education Class on the self-efficacy for participant understanding of
25 or attitude towards the regulations. Results suggest that it was the fishing class alone,
26 and none of the demographic factors, which influenced the change in self-efficacy
27 towards better understanding and application of the fishing regulations (Table 2).
28 Similarly, age, income, and education did not affect the attitude of participants toward
29 fishing regulations.

30 Finally, the fishing frequency of anglers both inside and outside South Florida's
31 national park boundaries was used to determine whether increased time engaging in the

1 sport, or one's fishing location, affected self-efficacy to follow or one's attitude towards
2 and willingness to comply with the fishing regulations. Generalized linear models with
3 repeated measures were also used for this analysis. The frequency that an angler fished
4 (how many days per month), and the location where they fish (inside or outside the
5 national park) did not affect their self-efficacy or attitude towards the fishing regulations
6 (Table 2).

8 **Discussion**

9 Success of the fisheries education class is predicated on the fact that
10 understanding and managing the behavior of fishers is a necessary component to
11 successful fisheries management (Hilborn 1985; Lane 1988; Branch et al. 2006; Hilborn
12 2007). The fisheries education class is an effort to encourage change in angler behavior
13 towards regulatory compliance and implementation of best fishing practices (Cooke et al.
14 2013). The course curriculum aims to improve one's knowledge of fishing regulations,
15 tries to help participants understand the biological basis for regulations, and presents
16 material to help improve fish identification skills (Page et al. 2012). Ultimately the goal
17 of the class is to help participants better understand the role that they play in fish
18 population dynamics, and the marine ecosystem. Moreover, the course structure strives
19 to provide anglers with a positive encounter with park managers and law enforcement
20 rangers, from whom participants receive the message that the parks are not against
21 fishing, but rather striving to achieve regulatory compliance and ethical angling practices
22 within park boundaries.

23 *Program Success*

24 Analysis of survey results from class participants suggested that the Fisheries
25 Education Class changed the self-efficacy of anglers in favor of a better understanding
26 and appreciation for the fishing regulations and the purpose behind them. Potential
27 evidence for this improvement in self-efficacy can be seen by the success of most
28 individuals on the short quiz at the end of the class, which among other things, asks
29 participants to apply the knowledge that they learned to different scenarios (i.e. look up a
30 fishing regulation for a given situation). Survey results also suggested that the fishing
31 class may help improve angler attitudes toward the fishing regulations. Providing

1 participants with an understanding of the biological reasoning behind the fishing
2 regulations, and knowledge of how regulations are developed by scientists and managers,
3 could have helped foster this behavioral and perceptual change in angler attitudes.

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

10 It is noteworthy that several statistical results bordered on the verge of statistical
11 significance. These included the effect of income on attitudes towards the fishing
12 regulations ($p=0.093$) and whether fishing inside or outside the National Park affected
13 angler self-efficacy for adhering to Florida's fishing regulations ($p=0.095$). A larger
14 sample size, achieved either through sampling more individuals or trying to improve
15 response rate, may or may not have helped provide more robust analytical results.

16 *Study Limitations*

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

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

12 It is important to acknowledge that this is a cross-sectional and self-reported
13 study. As such, the survey was administered by U.S. mail to respondents sometime after
14 they already took the Fisheries Education Class (i.e. in some cases, months afterwards).
15 As a result, respondents had to consider their past attitudes towards fishing regulations,
16 and recall their ability to properly interpret and follow the fishing regulations, both before
17 and after they attended the Fisheries Education Class. This methodology had the
18 potential to introduce recall bias, which could have altered a respondent's perception of a
19 past experience they had, either in a more positive or negative direction (Hassan 2005).
20 For example, a respondent may not have wanted to admit that they never considered
21 following the fishing regulations prior to taking the class, because they perceived their
22 past behaviors or mindset as not being socially desirable (Herbert et al. 1995; van de
23 Mortel 2008). Recall bias has been shown to be an issue in prior angler mail
24 questionnaires (Tarrant et al. 1993; Connelly and Brown 1995; Osborn and Matlock
25 2010). In addition, as reported in the Results section, sample size and survey return rates
26 were somewhat low. This low return of samples could have been indicative of
27 nonresponse bias, which had also been shown to occur in angler mail surveys (Tarrant et
28 al. 1993; Fisher 1996). Due to the low sample size, the results of this study may not be
29 representative of the whole population of participants who attended the Fisheries
30 Education Class to mitigate a citation. As a result, readers should take care when
31 considering the statistical results, and drawing conclusions about the long-term efficacy

1 of this educational program.

2 *Similarities and Differences with Prior Fisheries Educational Initiatives*

3 In comparison to published studies documenting similar educational initiatives in
4 fisheries, our course was most similar to the NMFS angler ethics program (Schmied and
5 Ditton 1998), the Court Options online program in the State of Florida (Court Options
6 2016), and as expected, the boating educational course launched in Biscayne National
7 Park (2016), given that it was modeled after the program described herein. Similar to the
8 NMFS angler ethics program, the Fisheries Education Class also addresses catch and
9 release skills including handling fish to be discarded and focuses on increasing regulatory
10 compliance. The NMFS angler ethics program also sought to eliminate littering behavior
11 and encouraged predicating the success of a fishing trip on metrics other than the quantity
12 of fish one lands. Our program touches very briefly on littering, mostly in the context of
13 derelict fishing gear, however does not directly discuss metrics for trip success that are
14 different from using landed catch. Another important difference between the two
15 programs is that ours includes fish identifications skills. Correctly identifying fish has
16 been shown to be a critical knowledge gap among anglers (Page et al. 2012; Chizinski et
17 al. 2014); this is also the case in South Florida where many of the citations people receive
18 are due to misidentifying fish species.

19 Several online initiatives with similar objectives were highlighted in the
20 introduction to the article. These included Court Options, a private company which
21 offers an all-encompassing, less in-depth four hour online course, addressing boating,
22 fishing, and other wildlife offenses. Court Options also offers other courses for legal
23 mitigation, unrelated to environmental issues, such as driving school, theft remediation,
24 etc. Similar to the program introduced in this article, the Court Options program also
25 serves individuals who receive a fishing citation in Florida, provided the citation was
26 issued by a state official outside of the national park boundaries. However, the Court
27 Options curriculum is much broader in scope, covering fisheries, boating, and other
28 wildlife offenses within nearly the same timeframe as our program (about four hours).
29 Due to the complexity of the State of Florida fishing regulations (which differ by region
30 and are updated every six months), and the multitude of similar looking fish species in
31 Florida's waters, National Park Service resource managers felt that it was important to

1 establish two separate courses, one for fisheries infractions as described herein, and
2 another for boating infractions, as mentioned in the introduction.

3 Though we considered launching an online application of the fisheries program,
4 we felt that it would not have been as effective. Although many online courses are well
5 packaged using the latest in web design technologies, a review of these courses
6 demonstrated that their instructional design is often poor (Margaryan et al. 2015). Other
7 reasons we decided not to develop a web-based distance learning approach included
8 reduced effectiveness due to social isolation of the learner, failure to adapt to the needs of
9 the learners (much easier to recognize and accommodate in a classroom setting),
10 technical problems, and significant time and financial costs, especially when starting a
11 new course online (Cook 2007; Zhang et al. 2004). Other research shows that programs
12 which aim to change the attitudes of the participants, as is the case with ours, do not work
13 as well online (Taylor 2002). Finally, dropout rates from online courses tend to be much
14 higher than traditional in person classes (Onah et al. 2014). Some combat this by
15 developing hybrid courses that meet both in person and online (Potosky 2004) and by
16 developing best practices for online curriculums (Vai and Sosulski 2016; Hendricks and
17 Bailey 2016).

18 *Lessons Learned*

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

30 Second, when anglers attended the class, many seemed to be unaware of the
31 biological rationales behind different types of regulations (i.e. size limits, bag limits,

1 closed seasons). This is an important course component because research suggests
2 people are more likely to comply with laws if they understand the purpose behind the
3 regulations, and feel that the regulations are fairly designed. Knowledge of why a
4 regulation was implemented provides a sense of legitimacy to the fishing rules, and the
5 agencies responsible for their creation and enforcement (Tyler 1997; Tyler and Jackson
6 2014). In addition, research suggests that individuals are more likely to adapt legally
7 sanctioned and proactive environmental practices if they understand the regulations being
8 enforced and their purpose (Yee et al. 2016).

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

22 Fourth, through our experience with this program, we have observed that external
23 variables seemed to affect class recruitment. For example, recruiting individuals with a
24 citation is dependent on the time, personnel, and equipment resources that law
25 enforcement agencies have to dedicate toward monitoring fishing violations. During
26 times when law enforcement must focus their efforts on other legal issues (common
27 occurrence given proximity to major city of Miami), are short staffed, or patrol boats are
28 out of order, referrals to the class tend to decrease. In addition, attendance fluctuates
29 seasonally, with more individuals fishing during the summer months, characterized by
30 calm ocean conditions, in comparison to winter months characterized by long periods
31 with breezy conditions and rough seas. Fifth, local stakeholder involvement in the

1 project seems to be important, from early conceptualization, through curriculum
2 development, course execution, and instruction. The use of local stakeholders to help
3 deliver course material seems to help attain endorsement for the program by the
4 recreational fishing community.

5 Sixth, we try not to present the course with a punishment focus, as under this
6 pretense, we are concerned that participants may not respond with an open mind to the
7 information being presented. Sometimes class participants will vent to the instructors
8 about their violation, and a limited amount of this is sometimes entertained in order to
9 help participants feel like their concerns are heard and validated; this ultimately seems to
10 render participants more likely to listen to the information that you have to offer.

11 Finally, two additional but unrelated lessons learned from this process include
12 presentation style and course fees. Participants appear to respond better to slides with
13 visuals and animations as opposed to slides populated with many words. For example,
14 when helping participants understand and distinguish between the concepts of species
15 specific, and aggregate (at the taxonomic family level) bag limits, we use an animation
16 which shows different partitions in one's cooler that can be filled by recreational anglers.
17 Once those partitions are filled at the species or aggregate level, the bag limit has been
18 reached.

19 Individuals who receive a citation and decide to participate in the course are
20 charged a \$50 fee to help offset the cost of course materials, such as printing and binding
21 the class booklet, developing handouts, and purchasing fish identification books for
22 participants. The amount of this fee was selected based on the financial needs of the
23 program, and because it is substantially less than the lowest fine amounts: \$75 for not
24 having a valid fishing license, and \$125 for catching one fish in violation of either the
25 bag or size limit; fine amounts increase for additional fish in violation. Overall, despite
26 the cost, participants still find the course worth taking. One anecdotal reason for this we
27 have observed is financial savings given the difference between the class fee and the fine.
28 The second anecdotal reason people with a violation have incentive to attend the class
29 despite the fee is because they don't want the citation on their permanent record.
30 Receiving a fishing citation in one of the National Parks remains on your criminal record
31 as a permanent federal misdemeanor, which may preclude some anglers from certain

1 employment opportunities.

2 **Conclusions**

3 This study described an educational initiative that is in place in two national parks
4 in South Florida, to complement and enhance compliance of the fishing regulations
5 within park boundaries and beyond. Such educational initiatives, in concert with more
6 traditional regulatory structures can serve to improve compliance of and cooperation with
7 resource management initiatives. This is particularly the case in communities such as
8 South Florida, which have complex regulations and a consistent influx of both new
9 residents and tourists to the community who might be unfamiliar with the regulations.
10 Results show that a Fisheries Education Class could be effective at improving the self-
11 efficacy of anglers toward understanding and applying the regulations, and may help
12 improve the attitudes of the participants toward fishing regulations, irrespective of
13 external factors such as demographics, instruction language, or fishing frequency.

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26 water enforcing the fishing regulations and referring individuals to the class. A very
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21

22 **Tables**

23 **Table 1: Outline and structure of course curriculum.**

| Module | Concept | Purpose |
|---------------------|--|---|
| Introduction | Biscayne and Everglades roles as National Parks | Learn the protection that Biscayne and Everglades receive as a component of the National Park Service |
| | Why fishing regulations are necessary | Learn the purpose behind regulating fishing |
| Fishing Regulations | Correctly interpreting and following the fishing regulations | Practice looking up and applying the fishing regulations to realistic scenarios |
| | Function of regulations | Learn the biological significance |

| | | |
|--------------------------------|-----------------------------|---|
| | | behind the different types of regulations |
| Fish Identification | Correctly identify catch | Practice and learn how to identify fish commonly caught in BNP so that the appropriate species-specific regulations can be followed |
| Responsible Fishing Techniques | Catch and release | Learn appropriate way 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 |

1

2 **Table 2: Summary of coefficient estimates for models that look at the effects of language,**
3 **demographics, and fishing patterns on the self-efficacy and attitudes of participants toward the**
4 **fishing regulations before and after taking the fishing education class. Asterisks next to parameter**
5 **estimates indicate that the parameter was statistically significant at the 95th percentile ($n=34$).**

| | Self-Efficacy | Attitudes |
|---|---------------|-----------|
| Language | | |
| Fishing Class | -9.55* | -3.32* |
| Instruction | 1.56 | -2.23 |
| Language | | |
| Demographics | | |
| Fishing Class | 9.44* | -2.70* |
| Age | 0.10 | -0.07 |
| Income | 0.50 | 0.94 |
| Education | -0.86 | 0.87 |
| Fishing Frequency: Inside National Park | | |
| Fishing Class | 9.69* | -3.25* |
| Fishing Inside Park | -0.83 | -0.38 |
| Fishing Frequency: Outside National Park | | |
| Fishing Class | -9.57* | -3.17* |

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Figure Captions

Figure 1: Fishing education class attendance.

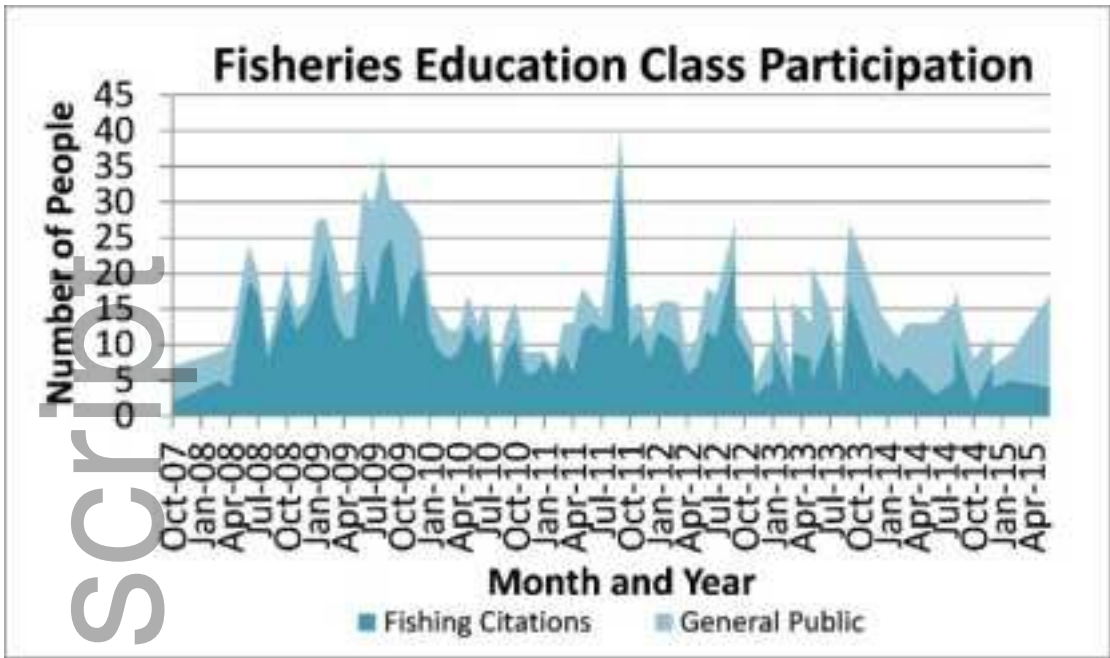
Figure 2: Fishing class attendees look on as local fishing guide Captain Muratori explains the importance of fish identification.

Figure 3: Percent of individuals in Biscayne National Park who received a fishing citation or warning, and attended the class.

Figure 4: The number of fishing related warnings and violations issued in Biscayne National Park.

Figure 5: The types of citations issued in Biscayne National Park.

Figure 6: The fish families that are most affected by violations of bag limit or size limit regulations.



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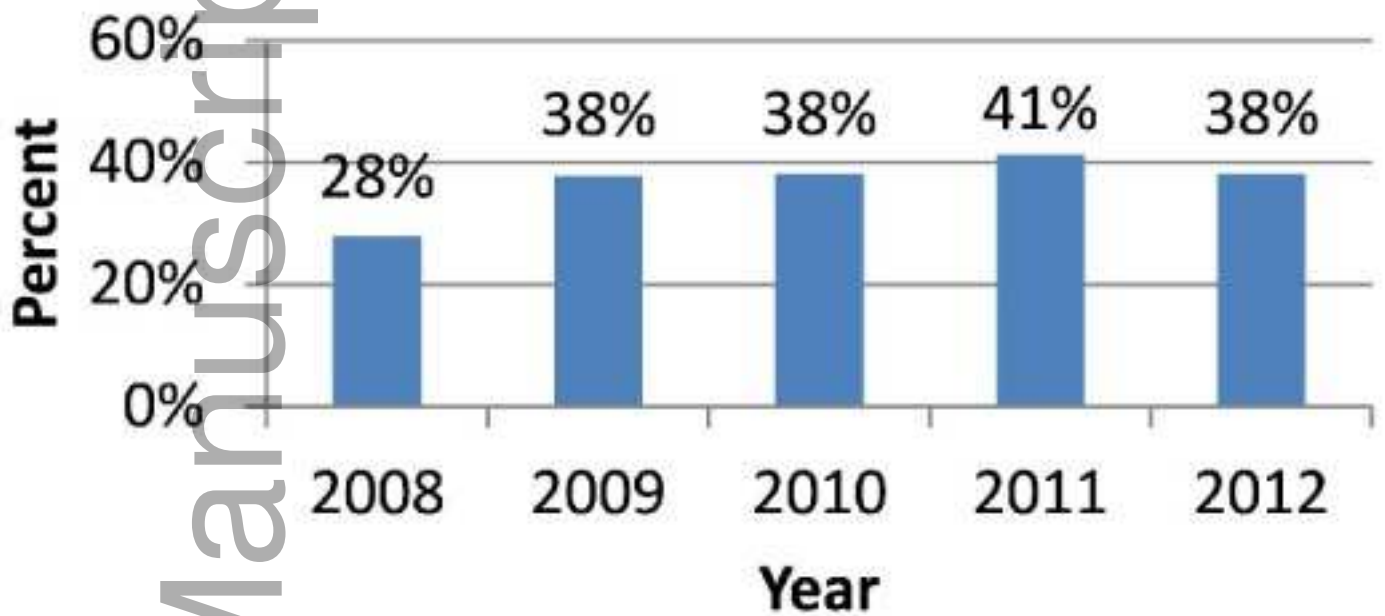
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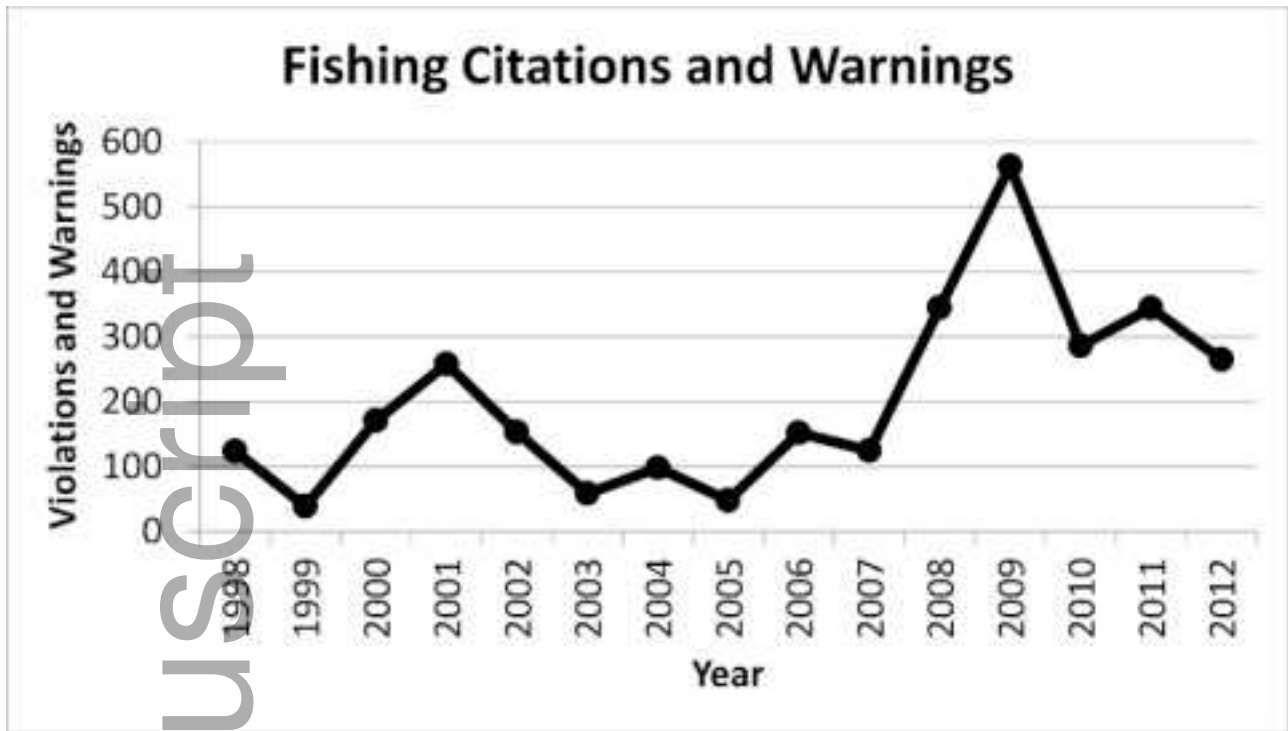
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Percentage of Individuals Issued a Citation or Warning for Fishing Who Attended Class



fsh_10178_f3.jpg



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Types of Citations: 1998-2012



- Not in whole condition
- Closed area
- Without fishing license
- Harvest of ornamental
- Out of season harvest
- Over the bag limit
- Undersized fish
- Prohibited species
- Other

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