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Diversity In Motivations and Behavioral Response to Regulations in the Striped Bass Commercial Fishery

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Abstract

It is evident that fishery stakeholder groups are not homogenous, and that inter- and intra-group variation can exist in the form of unique perspectives, motivations for fishery participation, and receptiveness to management measures. However, management agencies often allocate quota and design regulatory plans around distinct groups, such as recreational versus commercial sectors. Our study used the commercial fishery Striped Bass *Morone saxatilis* as a case study to explore the motivations and behaviors of commercial fishers in Massachusetts. Results of an online and mail survey suggest that many commercial fishers maintain several motivations for fishing, including both monetary and non-monetary, like the desire to be outdoors. Intended behavior differences emerged in response to several hypothetical regulatory scenarios, and these disparate behaviors could be partly explained by heterogeneity in fisher motivations and other fishing and non-fishing attributes. Additionally, we uncovered spillover effects, whereby effort controls could impact other commercial and recreational fisheries. We recommend a relaxation of the assumption that commercial fishers are solely motivated by monetary outcomes, and that holistic approaches to management include information on fisher behavior and motivations.

INTRODUCTION

Effective fisheries management measures require accurate estimations of fishing mortality and the ability to make adjustments when required by fishery management plans (Mace 2001). The principal lever by which managers can control fishing mortality is via

alterations in fishing effort, such as through input or output policy controls. Our capacity to predict how fishers and fishing communities respond to new policies is likely to grow as fishery management agencies begin increasingly utilizing sources of stakeholder perspectives and knowledge as a proactive means of management strategy evaluation (Marshall et al. 2017; North Pacific Fishery Management Council 2019). Developing methods to forecast how fishing communities may respond to new policies requires a foundational understanding of the motivations of fishers and whether new policies alter the utility associated with fishing, potentially resulting in changes in behavior and fishing effort (Johnston et al. 2010; Pinsky and Fogarty 2012).

Research into recreational fishing behavior has revealed attitudinal links to behavior that, if synthesized for a given population, can help managers predict fishing effort shifts before implementing a new regulation under hypothetical scenarios (Sutton and Ditton 2001; Hunt et al. 2002; Beardmore et al. 2013). For example, preferences for activity-specific versus activity-general aspects of fishing correlate with numerous aspects of recreational behavior (Fedler and Ditton 1986; Sutton and Ditton 2005). Activity-specific preferences are the utility gained by fishers that can only be acquired via fishing activities such as their preferences towards catching many fish and for the sport of catching fish. On the other hand, activity-general preferences can potentially be fulfilled by non-fishing activities, like hiking or hunting. There is a tendency for fishers to prefer activity-specific motivations early in their fishing career (Ditton et al. 1992). As fishers age, they often shift towards activity-general preferences, like the ability to escape stressors from work or being able to relax and enjoy the outdoors (Ditton et al. 1992). Importantly, these shifts are sometimes linked to the development of positive attitudes towards conservation and increasingly restrictive fishery regulations (Oh and Ditton 2006). Moreover, characterizing the preferences of a fishing community can help managers understand if ranges of proposed alternative regulations will be effective (Murphy Jr. et al. 2019).

Much of the research into the effects of fisher motivations on behavior has focused on recreational fisheries (exceptions include Salas and Gaertner 2004; Holland et al. 2020). The relative paucity of information on the motivations of commercial fishers likely is a consequence

of the assumption that the primary motivation to fish is to earn money. Sociological research into the behavior of for-profit fishers may suffer from this overgeneralization if we assume that fishers are only influenced by monetary outcomes or have homogeneous risk preferences (Mistiaen and Strand 2000; Abernethy et al. 2007; Ali and Abdullah 2010). For example, commercial fishing can be deeply rooted in a community's history and overall wellbeing, so that it may contain not just economic value, but also cultural and heritage values (Miller and Van Maanen 1979; Smith et al. 2003; Pollnac and Poggie Jr 2006; Voyer et al. 2014). While the separation of recreational and commercial fishing sectors is necessary for management and quota allocation purposes, this division may be somewhat fuzzy, with similar attitudes and fishing motivations present within each sector. It is evident that significant variation in fisher perceptions and values can exist even within commercial fisheries, necessitating that efforts to understand fisher behavior accurately represents these diverse viewpoints (Smith and Wilen 2005; Murphy et al. 2020).

To explore the degree to which commercial fishers may harbor unique motivations for fishing and whether their attitudes correlate with their behavior, we used the Striped Bass *Morone saxatilis* fishery in Massachusetts as a case study. Personal communication with several fishers and managers suggested that some Striped Bass commercial fishers in Massachusetts may participate in the fishery for both financial and non-financial reasons and may harbor activity preferences similar to recreational fishers. Additionally, the average fisher only makes roughly 10% of their personal income from the commercial harvest of Striped Bass in Massachusetts (Murphy Jr. et al. 2015). However, the value that fishers place on various motivations for commercial fishing in the Striped Bass fishery is unknown. Therefore, the commercial Striped Bass fishery offers a unique case study to explore the preferences of fishers towards a species that does not derive significant economic returns for many of its fishers. Further, recreational and commercial fisheries along the Atlantic Coast have been subject to considerable policy changes in the past decade, as regional and state management agencies have attempted to reverse the recent decline in spawning stock biomass. Thus, understanding the potential consequences of various strategies is both timely and paramount (Atlantic States Marine Fisheries Commission 2016). As such, our study had three primary questions: (1) What

are the attitudes of Striped Bass commercial fishers regarding their motivations for fishing? (2) How might the enactment of new commercial fishing regulations change fisher behavior? (3) Can the attitudes and attributes of commercial fishers predict their behavior? Through an exploration of commercial fisher attitudes and behavior, we aim to provide an analytical framework to practitioners and managers who seek to better predict how diverse stakeholder groups are impacted by potential policy changes. In addition, we set out to understand the potentially heterogenous motivations of commercial fishers influence their responses to different management scenarios.

MATERIALS AND METHODS

A total of 1,750 licensed Massachusetts Striped Bass commercial fishers from 2016 (out of a population of ~3,900 fishers) were contacted via an emailing and mailing list provided by the Massachusetts Division of Marine Fisheries. The survey (approved by Northeastern University's Institutional Review Board, Project #13-11-25) was initially emailed to 1,500 randomly selected licensed fishers in the spring of 2017 using Qualtrics Survey Software Suite, an internet-based survey platform. Reminder emails were sent weekly and the survey ran for one month (Dillman 1978), after which, a mailed version was sent to 250 fishers that did not respond to the online survey and an additional 250 that did not provide an email address to the Massachusetts license database (i.e., they were not sent the online survey). The intent was to minimize forms of bias (under-coverage selection bias and non-response bias) that could potentially explain differences in respondent intended behavior. Raffle prizes of several US$25 gift cards were offered to increased response rates.

Licensing for commercial Striped Bass fishing in Massachusetts, which is considered an open access fishery (Nelson 2018), broadly falls into two categories: (1) boat and lobster permits and (2) all other commercial fishing activity, hereafter referred to as *boat* and *individual* permits, respectively. Under the former, fishers in 2016 were allowed to harvest 15 fish per day above 34 inches and were only allowed to fish on Mondays and Thursdays during the Striped Bass season. Other commercial fishing activity (i.e., *individual* permits) includes fishers with individual and rod and reel permits, who could only keep 2 fish per day, but were still regulated

under the same size and days per week limits (i.e., Monday and Thursday fishing only). For the survey, we randomly selected participants whereby we indiscriminately sampled *boat* and *individual* permit holders, resulting in 14% of surveys being sent to *individual* permit holders. The survey was tailored to each permit type as described below.

To explore the attitudes of Striped Bass commercial fishers about unique motivational aspects of fishing, we pulled from previously established indices from the recreational fishing literature and developed a new index specifically designed for Striped Bass commercial fishers (Driver and Knopf 1976; Fedler and Ditton 1994; Oh et al. 2013). In our survey, participants were asked to select the importance of each item on a five-point Likert scale from *not at all important* (1) to *extremely important* (5). To test activity-specific preferences, we used four scale items: (1) *for the challenge or sport,* (2) *for the fun of catching fish,* (3) *to develop my skills,* and (4) *to catch trophy fish*. An additional four scale items tested activity-general preferences: (1) *for relaxation,* (2) *to get away from the regular routine,* (3) *to be outdoors,* and (4) *to be close to the water*. These items were based on foundational work in recreational fisheries (Driver and Knopf 1976; Fedler and Ditton 1994; Oh et al. 2013) and were also tested via several semi-structured interviews with commercial Striped Bass fishers and managers to ensure item relevancy. Given that these items do not capture financial aspects of commercial fishing, we explored four additional items, potentially to be integrated into an index in our study pending internal reliability testing of item results: (1) *for financial gain,* (2) *to support myself and my family,* (3) *as a substantial source of income,* and (4) *for extra spending money*. Note, that other aspects of fishing may be important to commercial fishers, such as the culture and family legacy of commercial fishing (Miller and Van Maanen 1979). However, the purpose of our study was to examine whether participants valued the financial aspect of Striped Bass fishing in comparison to traditionally recreational fishing activity preferences.

Cronbach's alpha (α) scores were used to test the internal reliability of each index, which were considered reliable at $\alpha > 0.7$ (Hammitt et al. 2006). Single items were removed from the index if their elimination significantly improved index internal reliability. Pending the adequacy of each index, item scores were averaged (mean) for each index, whereby *not at all important* equals 1 and *extremely important* equals 5.

To test whether the enactment of new commercial regulations could alter fisher behavior, we used a modified discrete choice experiment (Murphy Jr. et al. 2019). Survey participants were offered two regulatory scenarios, where we manipulated four policies: the minimum size limit of harvestable fish, maximum size limit, number of days per week fishers were allowed to harvest commercial fish, and the commercial daily bag limit. The first scenario was always the status quo regulations; this is the set of regulations that fishers were required to follow under Massachusetts law for the previous fishing season. For fishers with *boat* permits, the status quo included a minimum size limit of 34 inches, no maximum size limit, a 2-day per week cap, and a daily bag limit of 15 Striped Bass. The size limits and days per week limit under the status quo were the same for fishers with *individual* permits, but they could only keep 2 fish per day. The second scenario included one of five options that were randomly assigned to survey participants (Table 1). Four scenarios manipulated either the days per week or daily bag limit policy and held other policies constant. The fifth scenario was the implementation of a slot limit, whereby the days per week and daily bag limit matched the status quo, but the minimum size limit was lowered to 28 inches and a 40-inch maximum size limit was instituted. Overall, these scenarios were selected because they are representative of realistic policy options available to Striped Bass fishery managers (G. Nelson, Massachusetts Division of Marine Fisheries, personal communication).

For each scenario separately, participants were asked to allocate a full week (i.e., 7 days) to (1) commercial fishing for Striped Bass, (2) commercial fishing for other species, (3) recreational fishing, and (4) not fishing at all. The survey specified that if participants would do two or more of the activities on the same day (for example, commercially fishing for Striped Bass and another species on the same day), they should select the activity that would be their priority. The number of days participants assigned to each activity under the alternative scenarios were compared to the status quo. Here, Wilcoxon Signed Rank tests were used to compare paired samples. First, however, we validated that the alternative scenarios did not influence respondent choices under the status quo. This was confirmed via a Kruskal–Wallis test comparing the number of days allocated to Striped Bass fishing under the status quo in all pairs of experimental scenarios (*p-value* = 0.58). We then calculated the proportion of survey

participants for each activity that either increased, decreased, or did not change effort when moving from the status quo to the alternative policy scenario.

Lastly, we tested whether fisher attitudes, along with various fishing and demographic attributes, could help predict intended behavior using Classification Tree Analysis (partition method in JMP version 13.0.0). Indices of activity preferences were assessed as predictors, given their importance in the recreational literature and the potential significance of non-monetary fishing factors to commercial fishers as well (e.g., Fedler and Ditton 1986; Salas and Gaertner 2004; Sutton and Ditton 2005). Factors related to demographics and general fisher attributes, including proxies for the importance of Striped Bass and fishing in general for commercial fishers, were included as predictors, given their relevance in explaining possible differences in perceptions between fisher types (Dimech et al. 2009). These factors include: effort allocated from shore versus from a boat (%), number of years of commercial Striped Bass fishing experience, commercial effort allocated to Striped Bass versus other saltwater species last year (percent; we refer to this variable as *specialization* on Striped Bass), number of days commercially fishing for any species last year, number of Striped Bass commercially harvested last year, birth year, ethnicity (white versus non-white), education (ordinal), percent of total household income generated from Striped Bass fishing (percent), and gender. The respondent type was included as well (online respondent, mail respondent that did NOT receive an online survey originally, and mail respondent that did receive an online survey originally) to explore whether various forms of survey bias could have influenced survey outcomes. A minimum split size of 5 was used to eliminate the potential for meaningless groupings.

RESULTS

The survey received an overall 24% response rate, which included a total of 476 responses, of which 438 were from online responses and 36 from mail responses. Response rates for online and mail surveys (after accounting for 11 mail surveys that were returned to the sender) were 29% and 7%, respectively. Subsequently, 109 respondents were excluded from the dataset because they did not classify themselves as a commercial Striped Bass fisher, they did not primarily fish commercially for Striped Bass in Massachusetts, or they did not select a

fishing permit type in the survey. Of the remaining participants, 283 and 84 fishers selected that they fish using a *boat* versus an *individual* permit, respectively. The median birth year of these participants was 1963; 98% were male, 90% were White/Caucasian, the total household income mode was between $100,000 and $150,000, and more participants completed a 4-year college degree compared to other education categories.

Data were then screened prior to analysis. Of fishers with *boat* permits, 53 respondents were excluded because they did not complete the regulation scenarios properly (i.e., they did not complete both scenarios or selected more days Striped Bass fishing than would be allowed by the specific regulation scenario that they were presented in the survey; we explicitly asked participants to consider the regulations) and 46 were excluded because they did not complete a significant portion of the survey (i.e., did not make it to the scenarios). The same screening process was executed for *individual* permit holders, resulting in 32 usable responses for *individual* permit holders. This small sample size precluded a meaningful analysis given that these responses would need to be further separated by the five regulatory scenarios. As such, the remainder of the results only includes *boat* permit holders (n = 184). Of these respondents, the median total household income generated from Striped Bass was 5%, while approximately 68% of these respondents selected that they also participate in the recreational Striped Bass fishery.

(1) What are the attitudes of Striped Bass commercial fishers regarding their motivations for fishing?

Internal reliability tests for activity preference indices indicated good support for both the activity-specific and activity general-preference metrics (Chronbach's alpha > 0.7; Table S1). Analysis of the four items under the financial preferences index indicated that the item fishing *for extra spending money* be removed (i.e., Cronbach's alpha improved to 0.88 with item removal; Table S1). As such, the remaining three items were included in the financial preferences index, while the item fishing *for extra spending money* was analyzed as a separate factor (hereon referred to as *spending money*). Considerable variation was evident for all four metrics (Figure 1). Notably, fishers placed the most emphasis on activity-general preferences,

revealing a right-skewed distribution with a median score of 3.75 out of a possible 5. Preferences were closer to a normal distribution for the other three metrics, with median scores of 3.25, 3.00, and 3.00 for activity-specific, financial, and spending money metrics, respectively.

(2) How might the enactment of new commercial fishing regulations change fisher behavior?

Fisher effort in response to alternative regulations was generally inelastic, such that the vast majority of fishers only changed behavior when forced to because of shifts in the number of fishing days per week allowed (Figure 2). When provided the opportunity to increase the number of days respondents could fish for Striped Bass in the experimental scenarios, most participants allocated more time to Striped Bass (54% of fishers), which was accompanied by similar decreases in effort across the other activity options; commercial fishing for other species, recreational fishing, and days they would have not fished at all. When the days per week limit was reduced from 2 days to 1 day, 90% of fishers reduced their commercial Striped Bass fishing effort and increased effort into one of the three other activity options. Alternatively, however, changes to the daily bag limit and the implementation of a slot limit did not result in substantial changes. Under these scenarios, only 9–11% of fishers changed their commercial Striped Bass effort after the implementation of a new regulation. Across all regulatory scenarios, when fishers did change behavior into and out of other commercial fisheries, they were most likely to be the Bluefish *Pomatomus saltatrix* and Bluefin Tuna *Thunnus thynnus* fisheries.

(3) Can the attitudes and attributes of commercial fishers predict their behavior?

Classification Tree Analysis revealed that different fisher attributes predicted intended behavior for each regulation, except for the implementation of a slot limit whereby no significant predictors were identified (Figure 3). When the days per week limit was increased from 2 days to 3 days, younger fishers (born later than 1976) were much more likely to increase effort into the commercial Striped Bass fishery, while older fishers had a higher propensity to maintain constant effort. Of these older fishers, a small subset fishes quite a bit during the year (≥ 45 days) and was more likely to increase effort into the commercial Striped Bass fishery.

277 Under the increased daily bag limit scenario, aspects of fisher attitudes were the strongest
278 predictors of intended behavior. Here, a small contingent of fishers maintained very high
279 activity-general preferences (i.e., selected the maximum importance for all four activity-general
280 scale items) and was the only group to actually decrease effort under this less restrictive
281 scenario. All fishers decreased effort when forced to for the decreased daily bag scenario,
282 except a small subset of fishers with very low specialization on Striped Bass who already fished
283 on fewer days than allowed (i.e., they remained constant in their effort after the regulation
284 change). Lastly, the decreased daily bag limit scenario revealed only one significant predictor of
285 intended behavior: the only fishers that decreased effort included those that harvested 40 or
286 more fish the previous year.

287 **DISCUSSION**

288 Reducing uncertainty and unintended consequences of policy outcomes requires that
289 managers understand the preferences, needs, and potential behaviors of fishers (Suuronen et
290 al. 2010; Emery et al. 2014). Binning stakeholders into recreational and commercial
291 constituency groups is potentially not sufficient enough, however, as the scope of motivations
292 and attitudes can be highly diverse within these groups. Here we found that commercial fishers
293 can maintain a diversity of motivations and preferences for Striped Bass fishing. Moreover,
294 these ideologies can help elucidate how fishers may respond to various policies, thereby
295 enhancing their efficacy by accounting for fisher behavioral responses to them.

296 The financial motivation for commercial fishing is perhaps easiest to understand and
297 appreciate, as fishers are finely tuned and adaptive to economic pressures that affect their
298 financial return (Eales and Wilen 1986). However, our results revealed that non-monetary
299 incentives can be just as or potentially even more important. In our survey, we found that
300 commercial fishers participate in the fishery for many other reasons, such as “to get away from
301 the regular routine” or simply “to be outdoors” (Figure 1). While some survey respondents use
302 the fishery as a primary means of income generation, the vast majority participate in the
303 commercial harvest of Striped Bass as supplemental income; the median total household
304 income generated from Striped Bass was 5% in our survey. These findings likely cannot be

generalized to other fisheries whose participants are primarily driven by economic incentives. However, other case studies illustrate that a multitude of non-monetary measures of commercial fisher job satisfaction exist, such as being outdoors (Holland et al. 2020). Young et al. (2016) also identified analogous motivations between recreational and artisanal fishers in Australia and the Solomon Islands. This collectively suggests that fishing motivations likely exist on a spectrum, from traditional economic motivations to those illustrated in the Striped Bass fishery, wherein many commercial fishers harbor motivations similar to recreational fishers (Murphy Jr. et al. 2019).

The history of Striped Bass populations fluctuating dramatically along the East Coast, coupled with the resultant regulatory structure today, likely contributed substantially to this phenomenon (Richards and Rago 1999). Today, a modest bag limit and days per week restriction potentially make it difficult for Striped Bass fishers to generate sizeable financial returns. Financial motivations ranked lowest among the experience preferences tested in our survey. This includes both the financial motivation index and *spending money* as a separate item, further supporting the notion that fishers participate in the commercial harvest of Striped Bass for multiple reasons. Importantly, however, some fishers did indicate preferences for financial motivations; approximately one-third of participants had a financial index score between 4 and 5 (5 indicating that financial aspects of Striped Bass fishing are *extremely important*). Assuming that these fishers are homogenous in their preferences for other aspects of commercial fishing would be overly reductionist. Many fishers in our study valued activity-specific and activity-general preferences on par with financial motivations. It is clear that motivations for commercial fishing can be varied and even comparable to recreational fishers, especially in cases such as the Striped Bass fishery where the target fish comprises a minor proportion of most participants' livelihoods.

Examination of participant behavior in response to a variety of potential regulatory scenarios revealed that fishers generally only changed behavior when mandated. Specifically, overall fishing effort was relatively inelastic and non-responsive to changes in regulations that did not affect the days per week limit. Given the restrictive effort controls that existed in Massachusetts at the time of the survey, most fishers were already fishing at the 2 days per

week limit. As a result, they didn't have room to increase effort when favorable regulations were enacted. Interestingly, however, even when the more restrictive, "decreased daily bag limit," was put in place, only 3 of 34 fishers decreased their effort in the commercial Striped Bass fishery. This finding suggests that fishers are either not catching the daily bag limit of 15 fish on average or further supports the finding that most fishers do not regard high catch rates as a principal motivator for their participation. However, responses to policy changes in our survey correspond with each fisher's intentions, such that factors not explored in this study, such as changes in weather or other regulatory pressures, may alter the realized behaviors of fishers (Ajzen 1991).

When scenarios required fishers to increase or decrease fishing effort, survey respondents re-allocated time to and from other commercial fisheries, recreational fishing, and days where they would not fish. Of these three alternatives, the re-allocated effort was spread evenly, suggesting that a diversity of fishers who responded to the survey maintain variable portfolios of fishing and non-fishing activities. Our findings also revealed important spillover effects, whereby effort controls in one fishery could impact another. In this study, the bulk of effort re-allocation in other commercial fisheries was linked to the Bluefish or Bluefin Tuna fisheries Additionally, these species have large recreational user groups, highlighting links not just between commercial fisheries, but also between commercial and recreational sectors. Holistic approaches to management will need to consider these spillover effects to avoid unintended outcomes with negative potential socioeconomic and conservation impacts to other fisheries (Cunningham et al. 2016).

Our findings revealed that a better understanding of stakeholder characteristics could help predict how fishers respond to regulatory changes. Specifically, fisher demographics, attributes of participants' fishing activities, and their motivations for commercial fishing were aligned in our survey. Importantly, different regulations altered the fishing effort of unique groups of fishers. For example, younger fishers from the survey (~40 years old and younger) appear most eager to capitalize on more generous effort controls, as they were more likely to increase effort after the implementation of a 3 day per week limit. It is plausible that younger fishers have more capacity to increase their effort and thereby have an elevated ability to adapt

363 to changes in regulatory structures, which aligns with research that revealed higher resilience
364 to change among young commercial fishers in Australia (Marshall and Marshall 2007).

365 The degree to which respondents specialize and engage with the commercial Striped
366 Bass fishery were also potential predictors of behavior. This was the case for both days per
367 week policy changes and the decreased daily bag limit scenario, whereby fishers that fished
368 more, caught more fish, or targeted Striped Bass more than other fishers were increasingly
369 likely to change behavior. It is evident that aspects of activity specialization can influence
370 decisions among recreational fishers, while species portfolio diversification (i.e., having licenses
371 for many species) can aid in the adaptability of commercial fishers as well (e.g., Sutton and
372 Ditton 2001; Stoll et al. 2016). This hypothesis is supported in our findings, in fishers
373 demonstrating a relatively high degree of participation in the Striped Bass commercial fishery
374 were more likely to incur negative impacts as a result of increasingly restrictive policy controls.

375 Lastly, we found that aspects of motivations for commercial fishing correlate with
376 intended behavior. This finding extends a large body of literature on recreational fishing
377 behaviors into the commercial sector (e.g., Fedler and Ditton 1986; Sutton and Ditton 2005; Oh
378 and Ditton 2006). In our study, the only fishers that decreased effort upon the implementation
379 of a less restrictive daily bag limit harbored high activity-general preferences, such as their
380 desire to fish for relaxation or to be close to the water. This is clearly counter to the principal
381 financial incentive to commercially fish but suggests that some fishers who assign high
382 importance to activity-general preferences envision negative consequences to their fishing
383 experience from relaxed policies. While speculative, fishers may foresee a net increase in effort
384 from other fishers resulting in the crowding of fishing spots or increased overall resource
385 competition. It is also important to note that while we did implement a minimum split size of 5
386 for classification tree analyses, small sample sizes for several splits suggest that results should
387 be interpreted cautiously. However, the disparity in behavior between fisher types enhances
388 confidence in these interpretations. For example, for the increased daily bag limit scenario all
389 fishers that decreased effort were in one group, and for the decrease in days per week
390 scenario, only the low specialization group had fishers that maintained constant effort.

In summary, this work illustrates the utility in avoiding characterizing the perceptions of commercial fishers as a homogenous group with singular reactions to shifting regulations. We found that commercial fishers can harbor a diverse suite of preferences that include both financial and non-financial motivations. Heterogeneity in the motivations and attributes of Striped Bass commercial fishers helped to explain differences in responses to hypothetical policy changes. Moreover, an understanding of the perceptions of fishers can help managers better align policies with stakeholder motivations, potentially improving their overall satisfaction and decreasing the uncertainty associated with fisher behavior after new policies.

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Tables

Table 1. Regulation scenarios for fishers with *boat permits*. Status quo regulation was shown to all participants in addition to one of the other five hypothetical regulations. For fishers with *individual* permits, regulation changes mimicked those in Table 1, with the exception of the daily bag limit, which was 2 days under the status quos, slot limit, and days per week changes. The bag limit was manipulated to 3 under the increased daily bag limit and 1 under the decreased daily bag limit.

	Status-quo	Increase days per week	Increase daily bag limit	Decrease days per week	Decrease daily bag limit	Slot limit
Minimum size limit	34 inches	34 inches	34 inches	34 inches	34 inches	34 inches
Maximum size limit	None	None	None	None	None	40 inches
Days per week	2	3	2	1	2	2
Daily bag limit	15	15	20	15	10	15

510

511

512 **Figure Legends**

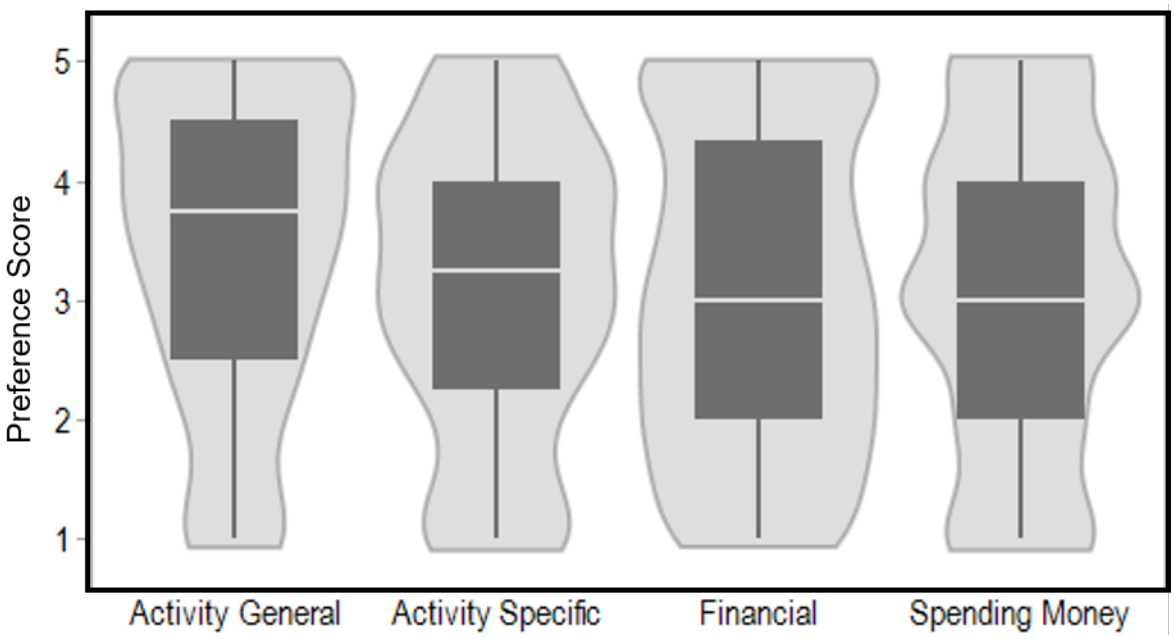
513 **Figure 1.** Summary plot depicting activity preferences of commercial Striped Bass fishers in
514 Massachusetts**.** Responses to the attitudes of fishers with Boat Striped Bass permits are
515 displayed as violin plots overlaid with box-and-whisker plots, whereby *not at all important*
516 equals 1 and *extremely important* equals 5.

517

518 **Figure 2.** Shift in effort upon the implementation of a new regulation for Striped Bass fishers in
519 Massachusetts with a Boat Permit**.** Bars represent the number of fishers that select they would
520 either decrease (red), remain constant (yellow), or increase (green) their effort in each
521 respective category after the implementation of a new regulation. Number in each bar indicate
522 the number of participants in each category.

523 **Figure 3.** Classification tree analysis for each regulatory scenario. The following variables were
524 included as possible predictors: respondent type, the effort allocated from shore versus from a
525 boat (percent), number of years of commercial Striped Bass fishing experience, commercial
526 effort allocated to Striped Bass versus other saltwater species last year (percent), number of
527 days commercially fishing for any species last year, number of Striped Bass commercially

harvested caught last year, birth year, how often Striped Bass is consumed during the fishing season (ordinal), ethnicity (white versus non-white), education (ordinal), percent of total household income generated from Striped Bass fishing (percent), gender, and activity preference scores. The respondent type was included as well (online respondent, mail respondent that did NOT receive an online survey originally, and mail respondent that did receive an online survey originally) to explore whether various forms of survey bias could have influenced survey outcomes. A minimum split size of 5 was used to eliminate the potential for meaningless groupings.



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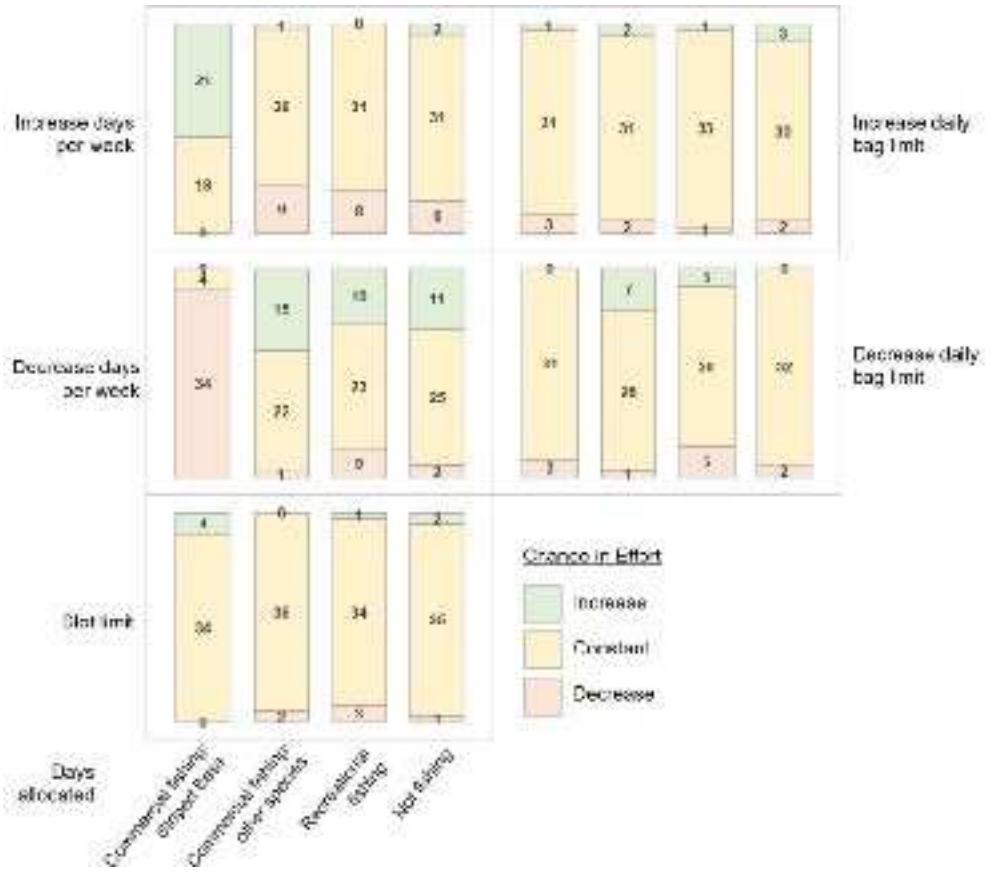

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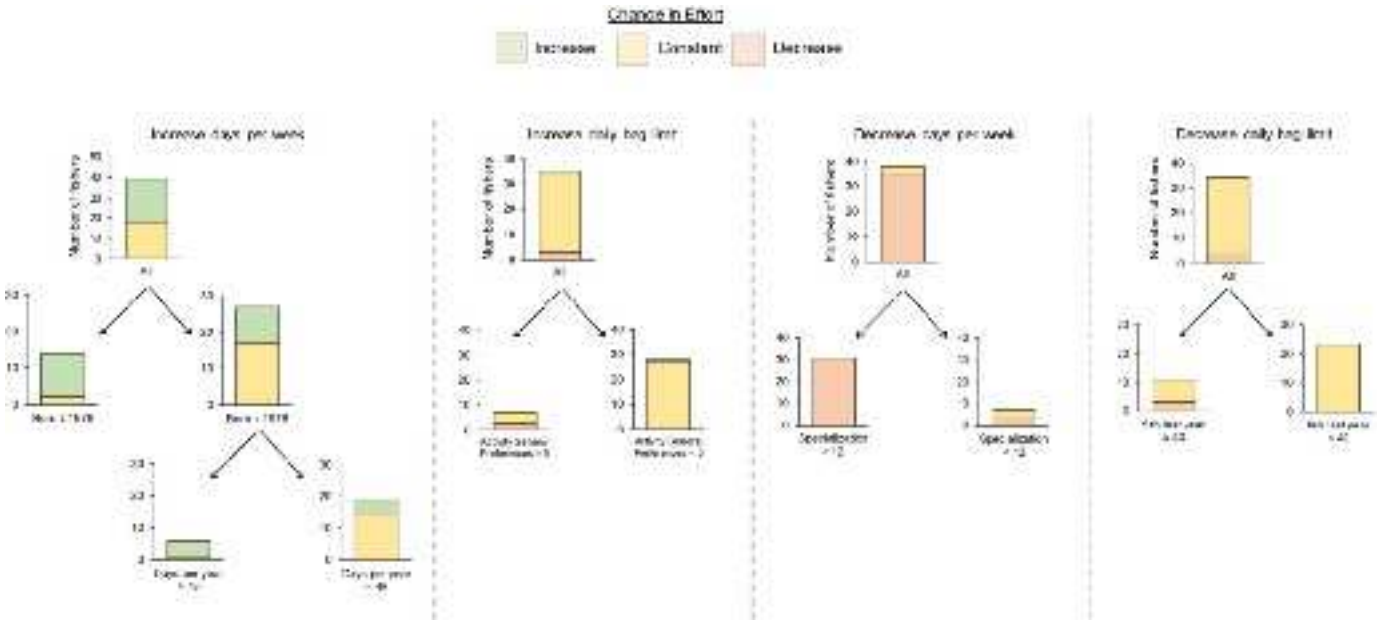

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