VALUES OF CONSUMPTIVE OUTDOOR-RECREATION PARTICIPANTS

by

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HETEROGENEITY OF PREFERENCE AND VALUES OF CONSUMPTIVE OUTDOOR RECREATION PARTICIPANTS

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Consumptive outdoor-recreational activities, representative of the various forms of recreational hunting and fishing, are heterogenous systems of leisure that millions of people participate in around the world. Further, animal conservation is fundamentally intertwined with consumptive outdoor recreation through funding generation, population control, and human diet supplementation. Monetizing the protection and use of natural resources within the ecosystem-services framework has been suggested as a functional approach for assessing tradeoffs in policy decisions that are imperative to maintaining stable social-ecological interactions within consumptive outdoor recreation. Though this approach allows for increased comparability and understanding of tradeoffs between policy decisions that emphasize specific ecosystem service benefits over others, the inherent heterogeneity of consumptive outdoor recreation participants introduces uncertainty. Describing the heterogeneity of consumptive outdoor recreational participants may ameliorate such uncertainty by identifying commonalities among segments of participants that better represent expected outcomes under different policy regimes.

Herein, we draw from multi-disciplinary theory and techniques to assess heterogeneity among participants in recreational angling within the state of Nebraska and to monetize the value of recreational sportfish catch within an ecosystem services framework. In the process of assessing angler heterogeneity, w evaluate the normative state of scientific theory used to describe sportspersons preferences, perceptions, and involvement across consumptive outdoor recreational activities and suggest novel changes within the context of the recruitment, retention, and reactivation (R^3). This dissertation is aimed as a descriptive and prescriptive explanation of how participant heterogeneity could influence conservation policy-decisions given our current understanding of how ecosystem services are valued, animals as resources are exploited, and conservation funding is generated into the future.

Glossary

Churn- The act of current participates in an activity choosing not to participate in subsequent time periods, often measured as a percentage rate of individuals from one year to the next.

Hypothetical bias- Respondent is unable or refuses to provide a reasonable answer because there is no consequences to responding with unrealistic answers

Sportsperson- A person who participates in outdoor recreational activities which functionally rely on fish and wildlife populations as a resource, includes both consumptive (e.g., hunting and angling) and non-consumptive (e.g., wildlife watching and wildlife photography).

Satisficing-Accept an available option as satisfactory, should not be confused with satisfying which relates to the fulfillment or pleasure associated with an option

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(black and white circles) because one places a higher premium on inherent value over instrumental value though they have the same views of moral extensionalism (Panel B). Figure 3-5-C includes the environmental ethics – Animal rights continuum further accounts for more variation in the individual's views (black and white triangle) and shows complete separation among all individuals.

Figure 3-6: Conceptual scenarios illustrating possible ranges of human population frequencies along interacting environmental philosophy continuums. Scenario A is indicative of minimal conflict in public opinion over most forms of recreational consumptive use of animals. Scenario B is indicative of a public that views most forms of recreational consumptive-use of animals as illegitimate, except for some subsistence or supplementation of diets. Scenario C is indicative of a wide range of public opinion dominated by philosophies that only consider subsistence or diet supplementation as legitimate uses of terrestrial animals but consider all consumptive uses of fish and invertebrates as legitimate. Scenario D is indicative of a bimodal distribution across the continuums with one majority group believing that most forms of consumptive-use of animals is legitimate and a separate majority group believing the opposite (i.e., consumptive-use of animals is illegitimate outside of some forms of subsistence or supplementation of diets).

Preface

In his opus work, The Sand County Almanac: And Sketches Here and There, Aldo Leopold included an essay describing his philosophical explanation of how people should interact with the natural world as a resource. In it, he said: *Examine each question in terms of what is ethically and aesthetically right, as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community.* (Leopold, A., The Land Ethic., 1949). While developing this dissertation, my interpretation of this quote fundamentally changed from when I first heard it. The methodological comparator, as I believe Leopold was suggesting, is to judge our actions based on their ethical and their aesthetic implications, weighting these implications against the economic benefits that may be accrued. My realization, that ethics, integrity, stability, and beauty are inherently relative to the individual assessing them, complicates what I previously saw as a simple statement on the importance of land stewardship. Most importantly, I was recognizing how the implications of heterogenous perceptions could be compounded by conservation decision-makers who are tasked with representing entire regions of peoples' assessments who may express disparate preferences, ethics, and opinions on natural aesthetics.

In this dissertation, I purposefully shy away from making judgements about what is ethically and aesthetically right in favor of discussing the implication of heterogeneity among those value judgements. Though an avid hunter and angler, developing this dissertation has convinced me that recognizing the implication of heterogenous perceptions of ethics and aesthetics among participants and nonparticipants alike, is imperative to addressing the future of how animal conservation is funded within the

North American Model of Conservation or any other model used around the world. Heterogenous perceptions were originally intended to be solely defined by those of recreational anglers, but as I continued to learn and develop this dissertation, I came to realize the value of cross-activity and non-participant perceptions and their role in the future of consumptive outdoor recreation within the North American Model of Conservation. As such, the frameworks and theories that I discuss and draw from are multi-disciplinary, broad philosophically, and I attempt to draw conclusions to all facets of consumptive and non-consumptive outdoor recreation.

In Chapter 1, "The Fisheries Manager's Dilemma," I quantify angler preferences of trip-specific catch-based outcomes for commonly sought sportfish in the state of Nebraska as monetized non-market values using a willingness-to-travel stated-preference approach. I use this information to show how the implications of angler catch-based preferences may be used in making policy decisions within the constraints of sportfish population dynamics. In Chapter 2, "The Management Implications of Heterogeneity among Angler Identities," I explore how heterogeneity among angler identity (i.e., perceptions) influences angler preferences for trip-specific catch-based outcomes. In Chapter 3, "The Extension of the Moral Domain among Sportspersons," I conduct a pilot assessment of how sportspersons vary their participation in outdoor recreation based on their views on the legitimate use of animals as resources with Nebraska recreational anglers acting as a population case study. Using these results, I develop and describe a novel theoretical conceptualization of how disparate environmental philosophies interact to predict how people perceive legitimate use of animals within consumptive outdoor recreation within the North American Model of Conservation. In Chapter 4, "Non-Linear

Specialization: The Implications for the Recruitment, Retention, And Reactivation of Sportspersons," I discuss the current state of the specialization framework assuming non-linear progression of involvement among sportspersons and provide a novel conceptualization of how non-linear specialization influences recruitment, retention, and reactivation efforts as described within the R^3 philosophy. In Chapter 5, "Management Implications and Conclusions," I discuss how the results of this dissertation may be applied to management and policy-making associated with outdoor consumptive recreation. I also provide conclusions for each chapter and reflect on potential research questions that will continue developing the work I presented.

The research and discussions that I present in this dissertation represent substantial investment of time and effort. Through that time and effort, I came to realize that Aldo Leopold's prescriptive assessment of how people should interact with the natural world as a resource was difficult to apply within a real-world context. Though correct in his intent, to assess economic benefits based on what is ethically and aesthetically right will result in a wide-range of responses because of the relative nature of interpreting ethical and aesthetic correctness. Doing so results in a range of policy-decision trajectories that only a portion of the population may agree with or accept. Though qualitative and quantitative approaches have been suggested to deal with this heterogeneity (e.g., structured-decision making and adaptive co-management), their aim is to reduce the dimensionality among heterogenous perceptions, not describe them. Therefore, in this dissertation I provide an initial assessment that may assist in redefining Aldo Leopold's Land Ethic to account for and integrate the relative nature of societal perceptions and culture.

CHAPTER 1. THE FISHERIES MANAGER'S DILEMMA

Introduction

Defining the motivational scope of recreational sportspersons, along with their satisfaction as it results from their individual expectations, has become increasingly important with the focus on recruitment, retention, and reactivation (R^3) (Organ et al. 2012). Fisheries and wildlife managers are increasingly being pressured to provide individually satisfying experiences with the hope of reducing churn in license sales and attracting new participants. The implications of marketing outdoor recreation participation as a product or commodity comes with unique functional and philosophical difficulties. Foremost, accommodating a wide range of motivations among participants requires managers to consider the mechanisms through which they can feasibly meet expectations and the variety of forms that encompasses. In the case of recreational angling, this often results in a dilemma of managing for high catch-rate-oriented fisheries biomass with smaller fish or managing for trophy-oriented fisheries with biomass aggregated in fewer, but larger fish.

The "manager's dilemma" as we have defined it, derives from tradeoffs in size structure of fish populations that are managed through restrictions on exploitation, supplementing populations through stocking, or biological manipulations of other trophic levels to encourage (or discourage) growth. The tradeoff occurs because basic fish-population dynamics infer a limitation on the total biomass of fish that may be produced due to resource limitation, or predatory controls (Swingle 1950). Increasing densities of

fish lead to individual resource limitation and a truncation of population length frequencies to smaller sizes, as does size structures that aggregate biomass within larger fish (Wilde 1997). Though landscape-based fisheries management strategies provide unique solutions to solving the manager's dilemma, the fact remains that information about whether size or catch rate is preferred among anglers is not well understood because of the limitations in assessing the stated-preferences of anglers directly as it relates to motivations and satisfaction (Hunt et al. 2011, 2013).

Angler motivations and satisfaction are intertwined via an individual participant's intrinsic expectation of what benefits are feasible to achieve from a fishing-trip (Beardmore et al. 2015). Anglers, for example, are motivated to achieve specific benefits for any given fishing trip weighing the outcome of the trip against what they expected to receive based on their investment of time and money(Oh et al. 2005, Bell et al. 2006, Hunt et al. 2007). Although clearly founded on basic economic theories (Anderson 1993), the misinterpretation of motivation and satisfaction in natural resource fields often leads to cynicism around the importance of sportsperson behavior and a perceived inability to satisfy participants (Lewin et al. 2006, Beardmore et al. 2015). However, it is important to realize that satisfaction is inherently associated with a specific event and its range of potential outcomes, thus anglers may never reach a maximum level of satisfaction within the context of the trip, and should not be expect to be completely satisfied (Beardmore et al. 2011a). Rather angler satisfaction need only regularly meet a threshold that is acceptable based on the expectations for a given trip (i.e., satisficing rather than satisfying).

Particularly in human dimensions of recreational fisheries research, a great deal of

scientific effort has been aimed at understanding how angler motivation leads to decisions about when, where, and by what method to fish (Arlinghaus et al. 2007, Hunt et al. 2013, Sutton and Oh 2015). For instance, meeting expectations for non-catch related motivations are often cited as highly important to overall angler satisfaction (Manfredo et al. 2004, Beardmore et al. 2011b). Motivations are often divided between catch-based and non-catch-based, where catch-based strictly regard motivations associated with catching or harvesting a fish, and non-catch-based are associated with (Hunt and Arlinghaus 2011, Hunt et al. 2013). Even so, anglers tend to account for non-catch-based motivation subconsciously while deciding when and where to take part in the activity (Beardmore et al. 2011b). For instance, if an angler derives benefits from being social while angling then he or she will take steps to fulfill this motivation prior to fishing (Beardmore et al. 2011b, 2015). Thus, during every fishing trip, some motivations are being fulfilled whether fish are caught and may not fall within the scope of fisheries managers control (Dorow et al. 2010, Arlinghaus et al. 2014). Given this, limiting the assessed benefits to only catch-based motivations provides a more manageable form to understand what anglers prefer within trip-specific contexts

Angler's tendency to account for non-catch-based motivation prior to their fishing trips provides a unique opportunity for applying methods to value nonmarket benefits as a proxy for catch-based preferences. In recreational angling, nonmarket benefits represent the physical and emotional outcomes anglers receive from realizing motivations and meeting or exceeding expectations which can be measured as the utility of the activity to the participants (Bockstael and Mcconnell 1999, Johnson et al. 2006). Most nonmarket benefits (e.g., opportunity to socialize and experience solitude) fall outside the scope of

fisheries managers but are none-the-less included within anglers' trip-specific preferences (Arlinghaus et al. 2014). Measuring individual angler's willingness-to-pay (*WTP*) within a hypothetical context, for a range of catch-based outcomes, will elucidate preferences for those catch-based outcomes in comparable units. Further, it will allow anglers to respond while accounting for their own non-catch-based motivations as they would in real-world settings.

Assessing nonmarket benefits within a hypothetical context provides a great deal of flexibility in assessing angler preferences for catch-based variables (e.g., species sought, length, or number caught) and several well-tested methods are available to do so. Unfortunately, such methods introduce the risk of hypothetical bias where angler's responses differ from what their actual behavior would be in the real world (Whitehead and Wicker 2018a). Hypothetical bias can underestimate *WTP* through systematic strategic responses as protest to new costs or overestimate *WTP* as a show of support for the benefit that they are being asked value.

Measuring willingness-to-travel (*WTT*) rather than *WTP* directly provides an important alternative to more classical measures of nonmarket benefits like contingent valuation (*CVM*) (Whitehead and Wicker 2018b). Whereas *CVM* asks respondents to consider a hypothetical scenario and determine a monetary value that they would be willing to pay given that scenario, the *WTT* approach asks respondents to make a nonmonetary decision using distance traveled as a bid currency. Doing so grounds the hypothetical context within a real-world situation that has been found to reduce hypothetical bias and allows investigators to assess preferences for different scenarios using methods that are more in-direct than simply asking for *WTP* (Whitehead and

Wicker 2018a). Further, measures of travel cost can still be converted to monetary values by collecting information about the costs that respondents incur from travel during normal fishing trips.

Applying the *WTT* approach to understanding angler preferences between catch-based trip-specific outcomes provides three-fold benefits to recreational fisheries management. It will demonstrate the usefulness of a comprehensive reference for the catch-based trip-specific outcomes as they are valued by recreational anglers, describe the range of alternative catch-based trip specific outcomes that may satisfice anglers by meeting alternatives to primary motivations, and provide an unique and in-direct measure of angler preference that is a valuable first step in solving the managers dilemma as we have described it. In this experiment, we conducted a stated-preference survey using a *WTT* approach to quantify angler preferences for commonly sought sportfish in the state of Nebraska and then estimated *WTP* values ranging across fish length (in) and number of fish caught (n). Using this information, we converted these catch-based trip-specific outcomes to biomass of representative of fish found in Nebraska to assess whether anglers value biomass derived from fish size higher when compared to number caught with all else being equal.

Methods

Survey design and implementation

An online survey was conducted from February through November 2017 consisting of 9 individual rounds encompassing a single fishing season (IRB project: 16156, Approval number: 20160616156). Contact emails used for the online surveys were drawn from the Nebraska Game and Parks Commission's electronic license

database. Potential respondents were limited to individuals19 years or older and that had purchased an annual fishing or hunting-and-fishing combination license at least once during 2010 - 2015. Both resident and non-resident license purchasers were included within each random sample. Per institutional requirement, respondents could opt-out of any individual question within the survey which resulted varying sample sizes between analyses. For each round of the survey, random samples of 2000 anglers were drawn from the database without replacement. Each survey remained open for 30 days following initial contact. Respondents were contacted with two reminder emails during the survey period.

The survey was designed to measure angler travel habits, *WTT*, and sociodemographic information. Travel habits were quantified by asking respondents to select how many days they fish in a typical year ranging from 0 to >300. If respondents selected 0 then the survey was concluded. Respondents that stated they participated in fishing at least once were asked to indicate the type of lodging used in over multi-day trips, the number of waterbodies they typically visited per year, and how often they fish inside and outside their state of residence. Respondents were also asked to provide a zip code associated with their home residence, which we used to determine whether they were resident of Nebraska. Typical travel expenditures were quantified by asking respondents the number of one-way miles they typically travel for a fishing trip (ranging from 0 to 500 or more; typical fishing trip travel miles were capped at 500 miles to prevent overestimation of travel cost), and an estimate of their typical expenditures on fuel, food, bait, and lodging. Respondents were also asked to provide their annual income by selecting from a range of categorical income brackets (i.e., Less than $10k, $10k –

$29k, $30k – $49k, $50k - $69k, $70k - $99k, $100k -$200k, Greater than $200k). For the purposes of calculating income, we used the middle-income value from each bracket and $250k was used for the greater than $200k bracket. Fish species was selected based on the 2012 Nebraska Game and Parks Commission Licensed Angler report, that documented that the four most ubiquitously popular sportfish in the state of Nebraska are Channel Catfish (*Ictalurus punctatus*), Crappie spp. (*Pomoxis spp.*), Largemouth Bass (*Micropterus salmoides*), and Walleye (*Sander vitreus*).

The *WTT* was estimated for each species using a double-bounded dichotomous-choice contingent valuation method (*DBDC*). Each respondent was asked two separate *DBDC* questions with randomly stratified variables representing fish species, fish length, and number caught for that hypothetical trip 9 (Figure 1-1). Random stratification of the *DBDC* variables was done to ensure adequate sample size across species, meaning that no respondents were asked about the same species in both questions. In keeping with the *WTT* approach, we used a sequential bid design representing additional travel distance, which was provided as one-way miles the respondent would be willing to travel further than a typical fishing trip, with the expectation that the scenario provided in the question would be a catch-based fishing trip outcome (Kanninen 1993). Initial bids were randomly selected, ranging from 10 to 250 additional one-way miles to better represent differences in small values. A secondary bid was provided to respondents for each question. On a yes response, the bid was randomly selected using a range of values greater than initial bid to a maximum of 500 miles. On a no response, the bid was randomly selected using a range of values less than the initial bid to 1 mile. This dichotomous form allowed us to quantify

a range of additional miles the anglers would be willing to travel with the expectation of the fishing trip resulting in the scenario provided.

Respondents were given a scenario representing a hypothetical fishing trip outcome with a randomly selected fish length, number of fish caught, and one of the four study species (Figure 1-1). Fish length was randomly selected using inch-length groups with an upper bound represented by 80% of world-record length (i.e., trophy classification that is commonly used when measuring fish quality) of the respective world record for that species, and the lower bounds represented 20% of the respective world record (i.e., stock classification) as suggest by Gabelhouse (1984). Fish number was determined based on the most liberal respective bag limits allowed in the state of Nebraska (i.e., *Channel catfish – 5, Crappie – 15, Largemouth bass – 10, Walleye – 5).* Using the *DBDC* method within a *WTT* approach allows for more robust estimates of *WTT* by estimating a range of *WTT* for each scenario expressed in the survey due to the non-monetary bidding within the survey tool (Hanemann 1994, Whitehead and Wicker 2018b).

Economic valuation analysis

Survey responses were modeled using a parametric form of a discrete choice logit model based on the utility difference approach (Hanemann et al. 1991). In this form, an individual probability was calculated for each the four possible combinations of responses to the two potential bids within the survey (i.e., *yy, yn, ny, nn*). A maximum log-likelihood estimation was used across all independent observations (i.e., 2 per survey respondent; Aizaki et al. 2015). Bids were converted from additional miles traveled to sum of out-of-pocket travel cost (US$) using the standard equation given as,

$$TC = 2 * c * (bv + tm)$$

where c = 0.13 (i.e., average operating cost per mile, American Automobile Association 2015), *bv* equals the bid value (i.e., additional miles traveled) provided to each respondent in each question, and *tm* being the distance traveled in miles the respondent reported traveling in each fishing trip.

We used a 2-step estimation process, which requires estimating coefficients based solely on the initial bids provided to respondents using a binomial logit generalized linear model. Initial coefficients are then used as starting parameters within an algorithm to optimize coefficients based on responses to the second bid. We used Bayesian information criterion (BIC) to test assumptions for different model error distributions (i.e., Log-logistic, Log-normal, and Weibull) (Aizaki et al. 2015). In parameterizing our model, we expected angler residency (i.e., resident or nonresident and the month in which they are responding to the survey would influence their willingness-to-pay across trip-specific catch-based outcomes would influence responses, thus data was weighted to be representative of the general population. For the selected model, we used the Krinsky-Robb method to calculate median *WTP* and 95% confidence intervals for each unique catch-based fishing-trip outcome based on respondent's probability of agreeing to travel the provided distance (Cooper 2013).

We measured willingness-to-pay based on the consumer surplus approach where respondents are assumed to maximize their utility while accounting for any budget constraints. As such, estimated willingness-to-pay represents the area under the probabilistic demand curve of a fishing trip with the expectations of an outcome representative of the provided scenario. Using the iterative bidding format within the

double-bounded contingent valuation method allows for more efficient estimation of consumer surplus and requires lower sample sizes (Hanemann et al. 1991).

Assessing manager's dilemma

To test whether Nebraska anglers place more value on fish size or number, we conducted a secondary model formulation where fish size and number caught are aggregated as total biomass. To compare angler median *WTP* for fish size versus fish number as it varies between species, we first converted the size and catch information used to predict *WTP* to total biomass. To do so, we parameterized the weight-based version of the von Bertalanffy growth equation given as

$$W_{t,s} = W_{\infty} * (1 - \exp(-K * (t - t_0)))^3$$

where $W_{t,s}$ represents the weight of species *s* at time *t*, *K* is a curvature parameter which represents the growth of the fish to its asymptotic length, *t* represents the time step at which $W_{t,s}$ is being calculated, and t_0 represents the time at which the fish has zero length but is held constant at 0 for all species *s*. W_{∞} is calculated as

$$W_{\infty} = q_s * L_{\infty,s}^3$$

where q is the condition coefficient used in cubic length-age equation for each species (s) and L_{∞} is the asymptotic length of each species *s* (provided in Appendix F). We then calculated a total biomass for scenarios provided to respondents in the *DBDC* survey. We then took that information and replaced the fish length and number caught variables used in the previous model formulation. A dummy variable was included to categorize biomass as being derived from a few, large fish (i.e., one fish within the memorable-trophy size category) and many, small fish (i.e., two-fifteen fish within the stock-quality).

To draw comparisons between species, we assumed that species and caught biomass interacted within the model. As with the previous model, angler residency and the survey month were weighted as to be representative of the general population. We again used the Krinsky-Robb method to calculate median *WTP* and 95% confidence intervals for each unique catch-based fishing-trip outcome based on respondent's probability of agreeing to travel the provided distance (Cooper 2013).

Results

After aggregating the 9 rounds of surveys into a single sample, ~17% of random samples had inactive email addresses, reducing our pool of potential respondents from 18,000 to 14,871. Overall survey responses were low (11%), but within the normal range of online surveys. though most completed the *DBDC* questions, 140 respondents did not provide a zip code within the survey resulting in the overall number of completed surveys of 1,206 individual respondents. As was expected because the study design was not balanced between resident and nonresident respondents, there was a large discrepancy between the number of resident angler respondents (n = 1104) and nonresident respondents (n = 102) (Table 1-1).

Trip characteristics were similar between resident and nonresident anglers. Resident anglers reported fishing an average of 37.33 days per year (SD 36.95), 1.7 days per trip (SD 1.82), and maintaining household sizes of 3.43 family members (SD 1.41). Nonresidents reported an average of 45.15 days per year (SD 45.41), 1.7 days per trip (SD 0.91), and maintaining household sizes of 3.23 family members (SD 1.41). Despite little difference in the average number of days per trip between residents and

nonresidents, as expected there was a large discrepancy in the estimated miles per trip and trip expenditures (Table 1-1).

Economic valuation analysis

The results of the three-way interaction model including species, fish length, and number caught showed that increasing fish length was associated with higher willingness-to-pay values (Table 1-2). Though none of the interaction terms met a threshold of significance of 0.05, the interaction between fish length, number caught for Crappie spp. was more influential within model predictions than the other three species in our experiment (Table 1-2). Overall, this model formulation better represented the data 272.2 times than the null model would on 20 degrees of freedom with a median willingness-to-pay of $27.79 per trip-specific catch-based outcome. The frequency of affirmative and negative bids were uniform between species across the initial and follow-up questions with the exception of initial responses to channel catfish where respondents were more likely to answer negatively at higher additional miles traveled (Figures 1-2 and 1-3). Similarly, the survival probability of yes bids across additional miles traveled decreased exponentially leveling at ~250 miles or greater (Figure 1-4).

Comparing respondent willingness-to-pay, all study species showed increasing willingness-to-pay with increasing length and number caught (Figure 1-5). Walleye was the highest valued between species across fish length and size where a single 10 in. and 20 in. walleye predicted value was valued at $19.11 and $34.95, respectively. In comparison, channel catfish were valued the least with a 10 in. and 20 in. fish only being valued at $8.67 and $14.95, respectively. Crappie and largemouth bass were valued similarly at small sizes with 10 in. crappie being valued at $16.37 and 10 in. largemouth

bass $14.81. Although, largemouth bass showed a higher marginal increase in value for large fish compared to large crappie relative to standard sizes (Figure 1-5). Interestingly, crappie was the only species to show no increase in value for increasing number of fish caught at very small sizes.

Assessing managers dilemma

In the model formulation using total biomass, rather then fish length and number caught, we saw similar results to the previous model formulation. Walleye biomass was valued most among the species, followed by crappie and largemouth bass, with channel catfish being valued the least (Table 1-3). The relationship between total biomass and willingness-to-pay was unique among crappie and largemouth bass but was nonsignificant for walleye (Table 1-3). Channel catfish showed very little increase in value with increasing biomass relative to the other study species (Figure 1-6).

The comparison between biomass derived from fish size or increasing numbers of fish caught was not definitive within the mode. The dummy variable represent fish size category was nonsignificant within the model (Table 1-3). Assessing the model predications, size-based biomass had a higher median willingness-to-pay than biomass derived from increasing number of fish caught but with overlapping 95% confidence intervals.

Discussion

Incorporating economic and fisheries science-methods, we enumerated catch-based willingness-to-pay to differentiate between two distinct interests of anglers, catch size and number. However, we were unable to differentiate between the relative importance of size and number-based biomass when accounting for the overall biomass

of our study species. Although, there was evidence that size-based biomass was valued slightly more than numbers-based biomass in the species we assessed. We consistently found that walleye was across all metrics (i.e., biomass, number caught, and fish length) than the other species we assessed, and channel catfish was valued least. Despite having a lower maximum size, crappie spp. expressed a higher marginal increase in value for fish size rather than fish number.

Within catch-based motivation it is expected that animals are not homogenously sought, rather certain sizes, numbers, and species are preferred depending on the motivation of the angler (Anderson et al. 2007). The subtle difference between preference and motivation is highly important to the context of angler satisfaction and the role that expectations plays in determining satisfaction (Holland and Ditton 1992). Preference describes the ordering of different alternatives that may be substituted for one another in differing amounts, meaning that there is an important distinction between motivations that may incentivize participating in an activity versus the actual trip-specific outcomes that will satisfice the individual given the cost (e.g., time or money) of participating (Champ et al. 2017). The difference between preference and motivation is controlled by the expectation of being able to achieve one's motivation (Arlinghaus et al. 2014). For instance, an individual may be highly motivated by the prospect of catching trophy-sized fish but have low expectations for fulfilling this motivation. Logic suggests this scenario should lead to the individual being unsatisfied and participating less, if at all. Luckily this participant likely has other trip-specific outcomes that are acceptable substitutes, in differing amounts, for the outcome they are most motivated to achieve. As such, our research describes equivalent and replaceable values among species, number, and fish

size. Low expectations mediate for the lack of success in fulfilling the motivation of catching a trophy fish and allow for satisficing via other trip-specific benefits, which include or may solely be non-catch-based benefits (Hanemann 1994, Shonkwiler and Barfield 2015).

The differences between preference and motivation allow participants to attain high levels of satisfaction by defining the breadth of preferences among disparate motivations and meeting a wider variety of expectations through careful management for the central tendency of catch-based motivations or creating a landscape of various fisheries through which anglers may travel to attempt to fulfill individual motivations (Lester et al. 2003, Hunt and Arlinghaus 2011). Understanding this is especially important with the recognition that anglers will communicate fishery information within a landscape scale and act on that information prior to fishing trips with the intentions of optimizing satisfaction and meeting non-catch-based motivations prior to fishing (Beardmore et al. 2011b, Martin et al. 2014). Such behavior results in an import - export dynamic across scales (i.e., waterbodies, regions, or states) where anglers consider site-specific expectations to meet non-catch-based motivations and increase the likelihood of meeting catch-based outcomes while minimizing travel costs (Ditton 2002, Hunt 2005, Martin et al. 2017). The results of this experiment suggest that the catch-based trip-specific outcomes that anglers consider in offsetting travel cost in their pre-trip considerations will not only vary across species, but whether they are in a role of imported anglers (i.e., higher *WTP* across species, fish size, and expected number caught for nonresidents).

In our experiment we demonstrated how the combination of stated-preference

DBDC survey methods with the *WTT* approach allows the estimation of robust and comprehensive assessment of how different angler segments prefer different fishing-trip outcomes. The *DBCV* methods have been widely applied and assessed within an equally wide variety of disciplines and successfully determined the non-market benefits of environmental and recreational activities, largely due to their flexibility in representing hypothetical markets (Loomis 1988, Hanemann 1994, Whitehead 2006, Kumar and Kumar 2008, Mahieu et al. 2014). The use of the *WTT* approach within stated-preference context is becoming more common because of the benefits of presenting a hypothetical market in a non-monetary context (Cameron 1992, Whitehead and Wicker 2018b). We believe that combining this commonly used method with the *WTT* approach provides investigators a flexible and robust method for measuring the value of nonmarket benefits that may be highly contextual or varied, like catch-based trip-specific outcomes. This methodology can be applied in a wide variety of environmental and recreational contexts to describe participant *WTP*, but more importantly the results represent a direct comparison of the potential attributes participants are motivated to achieve that may be manipulated by managers.

We believe this experiment was novel and will be useful in targeted management of recreational fisheries because most application of similar economic valuation methods within inland recreational fisheries are conducted using a trip-specific context where catch-based motivations and outcomes are generalized to represent the value of the trip itself, rather than the outcome of that trip as we have done (Lew and Larson 2012). In previous research, multi-attribute discrete-choice modeling has been used similarly to determine very specific relationships between angler *WTP* and other fisheries attributes

or limit valuation to the marginal increase in *WTP* for increasing units of individual covariates (e.g., number of fish caught and harvested) (Schumann 1998, Bergstrom et al. 2004, Rosenberger et al. 2005, Provencher and Moore 2006, Beardmore et al. 2011a). Estimated *WTP* is systematically sensitive to the attributes included within the experiment and the methods that are selected, which means that the context in which the survey tool is presented to anglers may influence the results of the experiment (Johnson et al. 2006).

Conclusions

Previous research has suggested that defining travel cost across temporal and spatial scales is necessary to understand how anglers will behave within a landscape of fisheries, especially as they respond to non-catch-based attributes. (Post et al. 2008, Pope et al. 2014, Harmon 2017, Martin et al. 2017). The results of this experiment suggest it is also important to recognize how the expectation of catch-based attributes will determine behavior as it pertains to the managers dilemma. Biomass derived from size was consistently more valued by anglers, although more study is needed to draw these conclusions definitively. Given the context of this assessment, anglers are willing to incur higher travel costs for fishing trips with the expectation of catching larger fish than for fishing trips with the expectation of catching many fish. The implications of such a result is not only that the manager's dilemma must be considered on a species-specific level, but efforts to tailor fisheries management to angler expectations will be expensive and difficult using traditional management action like length restrictions or stock enhancement and may need to be waterbody specific (Wilde 1997, van Poorten et al. 2013, Chizinski et al. 2014). The results of this experiment lend support to calls for effort

restrictions, which may be a more impactful means to creating fish populations dominated by larger individuals (Cox and Walters 2002, Cox et al. 2003, Camp et al. 2015).

As human dimensions of fisheries and wildlife becomes more ubiquitous and recognized for its importance in successfully meeting outdoor-recreational participants' expectations and ameliorating for their actions, a wider variety of discipline and methodology will be incorporated to meet those demands. Herein we extended human dimensions of fisheries research by incorporating economic valuation techniques that allow for a comprehensive representation of what anglers prefer and are seeking within a single fishery and describing how different trip-specific catch-based outcomes are replaceable. We believe that describing the preferences of heterogenous angler segments will be paramount to recruiting and retaining anglers in the future, as well as identifying the areas of overlap that can be used in simplifying fisheries management at landscape scales by reducing the dimensionality of what management outcomes are necessary to satisfy a heterogeneous group of participants.

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Table 1-1

Summary statistics of survey respondent's trip characteristics. Values were assessed using discrete categories that are representative of a continuous scale. The reported means and standard deviation are calculated from the median value of each category (Survey tool presented in Appendix E). Trip characteristics are compared between non-resident and resident anglers which are determined based on the type of fishing permit that respondents purchased

	Non-resident anglers (n=102)			Resident anglers (n=1104)		
Variable	Mean	SD	Max	Mean	SD	Max
Number of days fished per year	45.15	45.41	200	37.33	36.95	240
Number of days per trip	1.7	0.91	4	1.82	0.96	4
Miles travel per trip	140.45	89.62	390	83.05	84.84	490
Fuel expenditures (US$)	106.82	72.45	300	75.89	77.02	460
Food, bait, supplies, and lodging expenditures (US$)	128.33	88.39	400	84.49	85.6	400

Table 1-2

Logit model results that describes willingness-to-pay for commonly-sought species in the state of Nebraska quantified using a willingness-to-travel contingent behavior approach. Fish size as inch length groups and number caught are included to assess how respondent anglers' value different trip-specific catch-based outcomes. Data was weighted by month in which the survey was completed, and the type of license purchased by the angler (i.e., resident or nonresident) to be representative of the total survey population.

	Coefficient	S.E.	z-value	p-value
Intercept (Channel catfish)	0.54	0.78	0.69	0.49
Crappie	1.44	1.09	1.31	0.19
Largemouth Bass	-1.09	1.16	-0.94	0.35
Walleye	-0.04	1.00	-0.04	0.97
Log-Transformed: Fish length	0.63	0.24	2.60	0.01
Log-Transformed: Number caught	0.66	0.70	0.95	0.34
Crappie : Fish length	-0.38	0.41	-0.92	0.36
Largemouth Bass : Fish length	0.50	0.39	1.30	0.19
Walleye : Fish length	0.27	0.33	0.82	0.42
Crappie : Number caught	-1.25	0.80	-1.57	0.12
Largemouth Bass : Number caught	-0.03	0.86	-0.04	0.97
Walleye : Number caught	0.21	0.90	0.23	0.82
Fish length : Number caught	-0.13	0.22	-0.58	0.56
Crappie : Fish length : Number caught	0.48	0.27	1.76	0.08
Largemouth Bass : Fish length : Number caught	0.00	0.28	0.01	0.99
Walleye : Fish length : Number caught	-0.09	0.30	-0.29	0.77
Log-Transformed: Travel distance bid	-0.89	0.02	-37.58	<0.001
Log-likelihood				*-3055.00*
Likelihood ratio			*272.2 on DF 20, p-value =*	*<0.001*
Mean				*52.31 (US$)*
Mean (Truncated to maximum bid)				*47.79 (US$)*
Median				*27.79 (US$)*

Table 1-3

Logit model results that describes willingness-to-pay for commonly-sought species in the state of Nebraska quantified using a willingness-to-travel contingent behavior approach. Biomass is the total weight (lbs) and aggregates fish length and number caught as a single variable. Categorical variables representing the month in which the survey was completed, and the type of license purchased by the angler (i.e., resident or nonresident).

Parameters	Coefficient	S.E.	z-value	p-value
Intercept (Channel catfish)	2.20	0.29	7.71	<0.01
Crappie	0.08	0.26	0.31	0.76
Largemouth Bass	-0.11	0.30	-0.38	0.71
Walleye	0.11	0.32	0.35	0.72
Log-transformed: Biomass	0.01	0.15	0.05	0.96
Size category	0.16	0.18	0.88	0.38
Crappie : Biomass	0.01	0.19	0.05	0.96
Largemouth Bass : Biomass	0.25	0.21	1.20	0.23
Walleye : Biomass	0.30	0.21	1.47	0.14
Log-transformed: Travel distance bid	-0.81	0.05	-17.87	<0.01
Log-likelihood				*-3445.85*
Likelihood ratio				*19.972 on DF 8, p-value = 0.01*
Mean				*40.65 (US$)*
Mean (Truncated to maximum bid)				*35.55 (US$)*
Median				*18.95 (US$)*

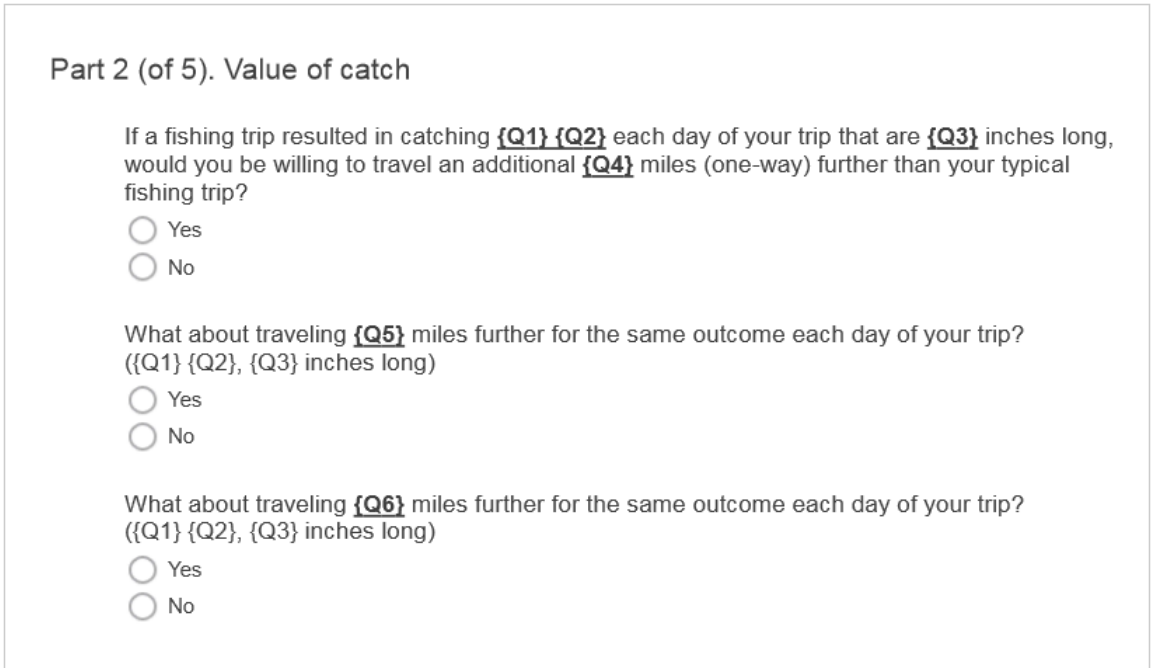

Figure 1-1

Example of contingent valuation questions included in survey tool. In each question, a number of fish expected to be caught (Q1), species (Q2), fish length (Q3), and additional miles traveled (Q4) were randomly selected. With a yes response, respondents were given a follow-up question with a longer distance (Q5) or an identical question and a shorter distance (Q6).

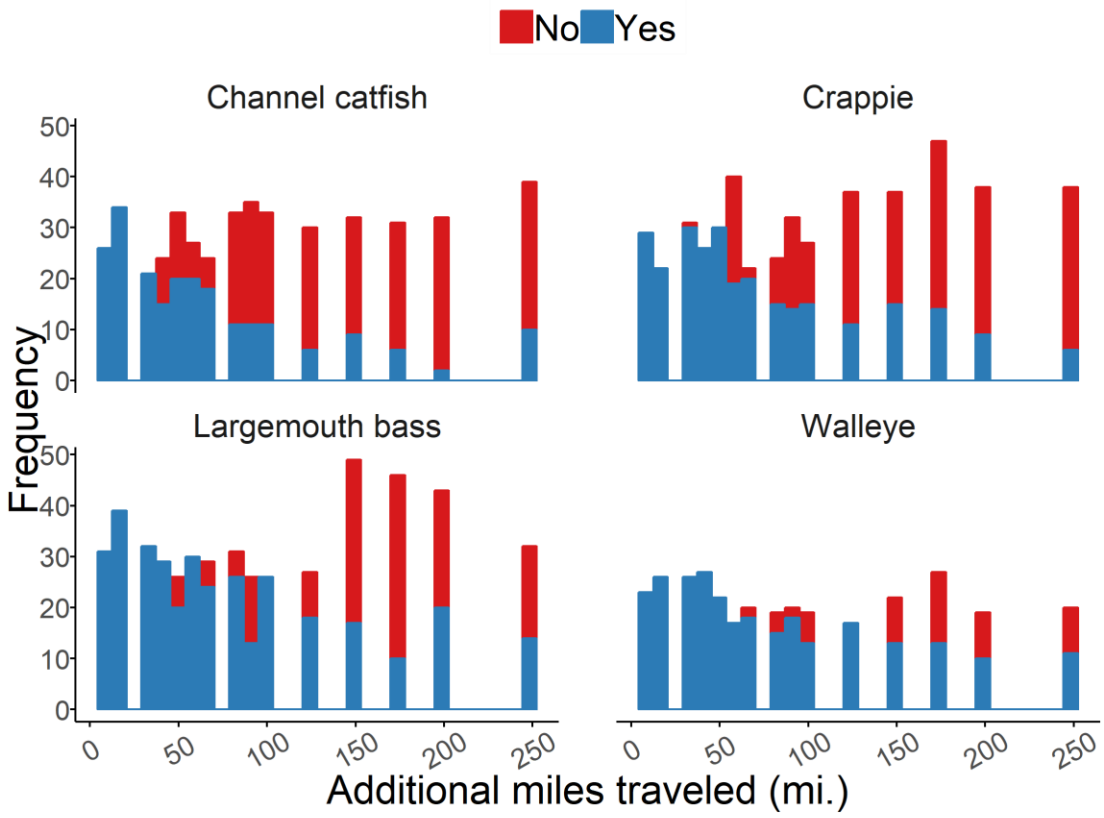

Figure 1-2

Frequency of No and Yes responses over survey bids given as additional miles traveled categories (mi.) for the initial DBDC question provided to respondents. Blue bars represent yes response and red bars represent a no response.

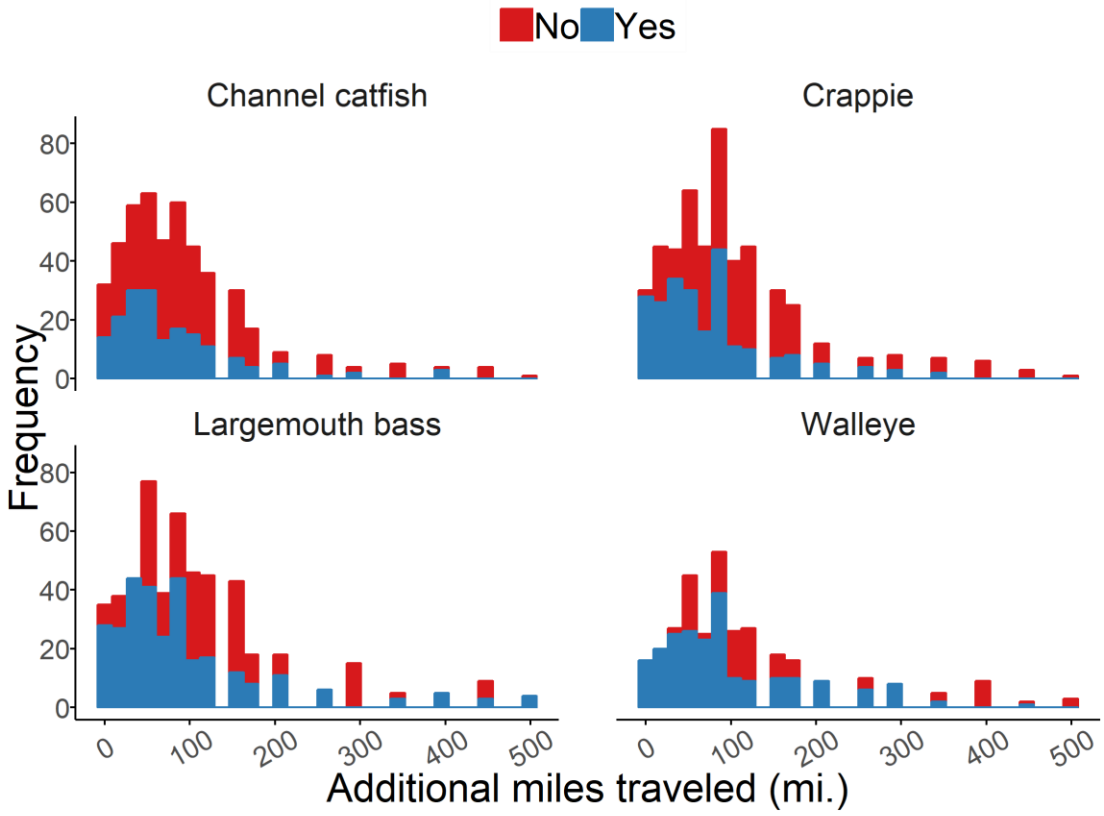

Figure 1-3

Frequency of No and Yes responses over survey bids given as additional miles traveled categories (mi.) for the follow-up DBDC questions provided to respondents. Blue bars represent yes response and red bars represent a no response.

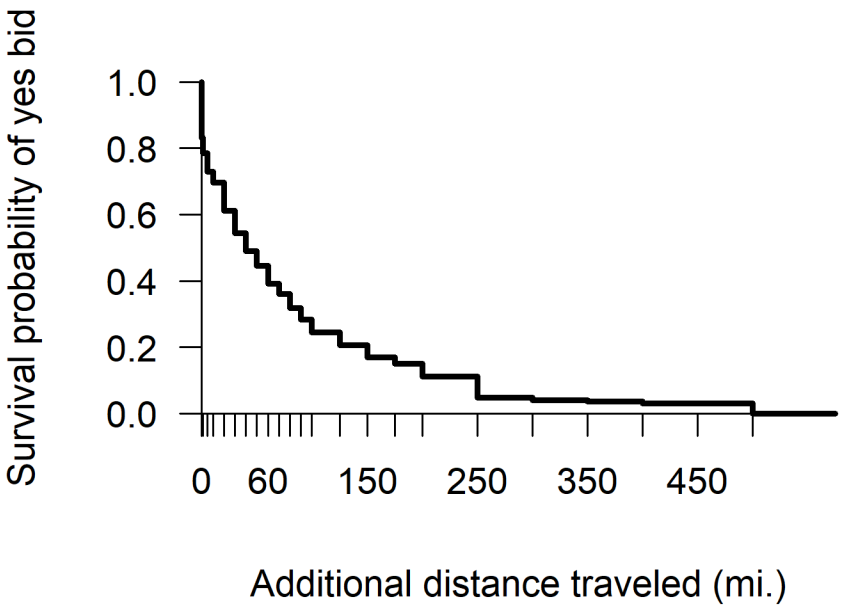

Figure 1-4

Probability of yes bids in survey across the additional miles traveled bids provided to respondents based on a Kaplan-Meier-Turnbull survivorship function approach. Black line represents the probability of a yes response at each additional miles traveled category.

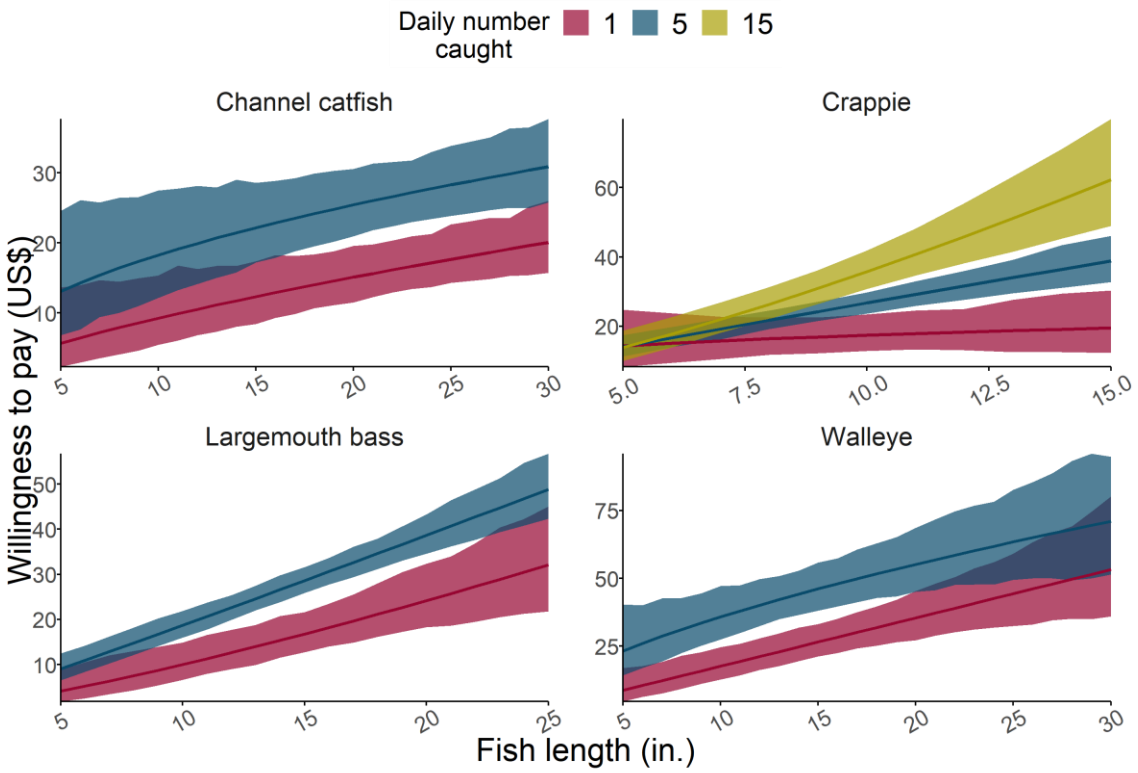

Figure 1-5

Nebraska angler median willingness-to-pay of those who purchased a fishing license in the state of Nebraska during 2010 – 2015. Solid lines represent double-bounded contingent valuation estimate willingness to pay across inch length groups for four commonly sought species, Channel Catfish, Crappie spp. (black and white crappie aggregated together), Largemouth Bass, and Walleye. Ribbons surrounding solid lines represent the 95% confidence intervals. The colored line represents an increasing number of fishes caught with red = 1 fish caught, blue = 5 fish caught, and green = 15 fish caught (only shown for crappie because scenarios evaluated within the survey were meant to represent real-world catches and were based on state bag limits for each species).

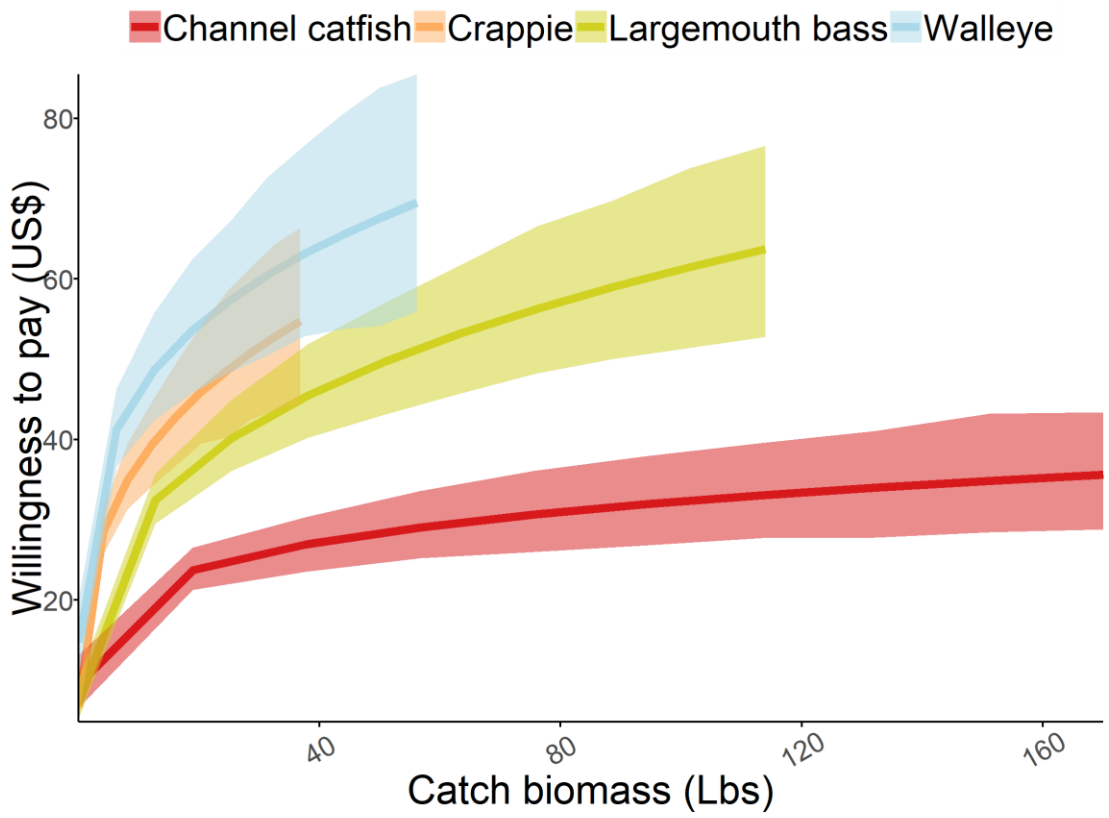

Figure 1-6

Nebraska angler median willingness-to-pay of those who purchased a fishing license in the state of Nebraska during 2010 – 2015. Colored lines represent double-bounded contingent valuation estimate willingness to pay across the total biomass of four commonly sought species, Red - Channel Catfish , Yellow - Crappie spp. (black and white crappie aggregated together), Green - Largemouth Bass, and Blue - Walleye. Ribbons surrounding solid lines represent the 95% confidence intervals.

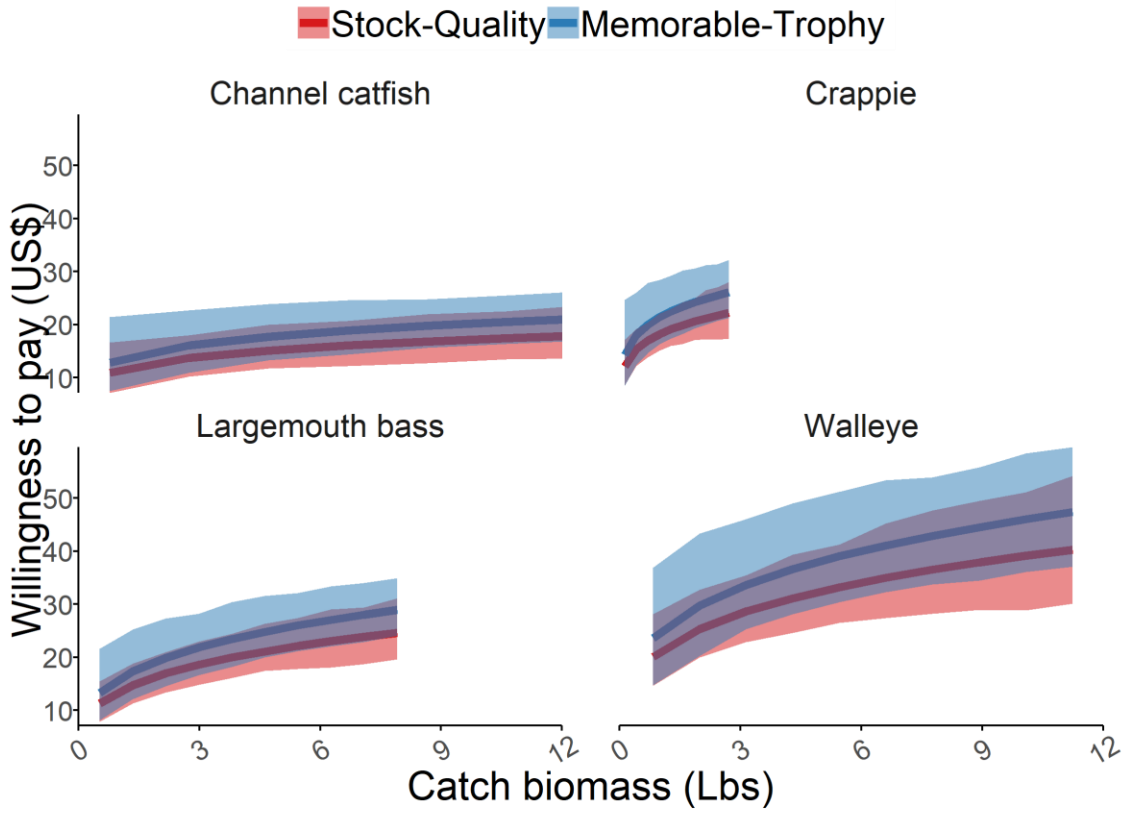

Figure 1-7

Nebraska angler median willingness-to-pay of those who purchased a fishing license in the state of Nebraska during 2010 – 2015 over catch biomass. Biomass derived from higher numbers caught of small fish (2-15 of stock-quality sized fish) are represented by the red line and biomass derived from few, large fish caught (1 memorable-trophy sized fish) are represented by the blue line (Gabelhouse 1984). The correspondingly colored ribbons represent 95% confidence intervals.

CHAPTER 2. MANAGEMENT IMPLICATIONS OF HETEROGENIETY AMONG ANGLER IDENTITIES

Introduction

The ecosystem services approach to natural resource management has increasingly gained favor a means to confer the importance of biodiversity and sustainability to policy-makers (Carpenter et al. 2009). A human-centric approach, quantifying ecosystems and the social, physical, and biological benefits provided to to society (i.e., instrumental value) in terms of monetary returns, has simplified the metrics of natural resource management and is increasingly applied to conservation decision-making (De Groot et al. 2002, Folke 2006, Gómez-Baggethun et al. 2010). Unfortunately, when value assessment is incomplete or not considered at the appropriate spatial or temporal scale, assessing ecosystem services as a monetary value introduces severe risk in supporting deleterious policy decisions based on misvaluation of resources or actions (Gunderson and Holling 2002, Gómez-Baggethun and de Groot 2010, Gomez-Baggethun and Ruiz-Perez 2011, Neuteleers and Engelen 2014). Risk of misvaluing ecosystem services exists across all categories, but is especially prevalent within cultural services (Daily 1997, Stets and Biga 2003),which represent the non-material benefits (e.g., capabilities and experiences) that arise from human-ecosystem relationships (Chan et al. 2012). The fundamental nature of cultural services is an inherent heterogeneity within the benefits that are obtained by individuals within society (Daily 1997, Stets and Biga 2003, Kumar and Kumar 2008). As such, the risk of misvaluation of cultural services ultimately

stems from an inability to generalize the quantity and quality of the benefits achieved by individuals within our society (Chan et al. 2012).

Economic approaches are widely used to characterize the societal value of ecosystem services by quantifying the non-market benefits as monetary value derived from a service (Whitehead et al. 2008, Baulcomb et al. 2014). Monetarily valuing ecosystem services as non-market benefits allows for ubiquitous definition and a quantifiable framework through which to assess policy decisions (Kumar and Kumar 2008, Baulcomb et al. 2014). An array of valid methods are available for valuing non-market benefits, but stated-preference methods provide a unique benefit by creating hypothetical markets that may better represent the complexity associated with how cultural services are evaluated by individuals, and the value they ascribe to each service (Hanemann 1994, Whitehead et al. 2008). Though the hypothetical nature of state-preference methods can reduce our ability to assess bias in survey responses, stated-preference methods may be useful in assessing how dissimilar individuals' value cultural services.

Recreational fishing and hunting are prime examples of activities where the cultural benefits provided by an ecosystem are difficult to generalize because the motivations, perceptions, and overall satisfaction participants are highly variable (Johnston et al. 2010, Gomez-Baggethun and Ruiz-Perez 2011, Chan et al. 2012). It is well-recognized that policy decisions inherently balance the tradeoffs in the services provided to user groups with disparate interests (Pope et al. 2014, 2016, Andersen et al. 2014). Angler motivations, for example, vary widely and result in an array of segments (i.e. trophy-seeking, non-trophy challenge-seeking, nature-oriented, meal-sharing, and

social anglers) that differentiate across cultures, individuals, or even among individual trips (Schroeder et al. 2008).

The behavior of an anglers may vary substantially depending on the importance placed on outcomes of angling (Fedler and Ditton 1994).A great deal of effort has been applied to characterizing the heterogeneity of angler populations, to understand motivation, expectation, involvement, commitment, and values (Holland and Ditton 1992, Fedler and Ditton 1994, Anderson et al. 2007, Beardmore et al. 2011b, 2015, Schroeder et al. 2013, 2018). The implications of such a far-reaching paradigm is that there is no average angler, but rather disparate angler identities that represent modalities within a complex system of participation within recreational fisheries where heterogeneity should be revealed in how anglers value the characteristics of specific fishing trips. (Fulton et al. 2011, Fenichel et al. 2013, Landon et al. 2018).

Given the implications of policy and management associated with recreational hunting and fishing as a cultural service, it is important to consider the tradeoffs between alternate uses of resources, and thus the diversity of alternative users (Pope et al. 2016). Adopting adaptive co-management strategies and incorporating stakeholder opinion into policy and management to develop broad, cross-scale management plans may allow for increased cooperation and ultimately greater balance among the ecosystem services provided (Pope et al. 2016). Unfortunately, shifting societal and philosophical values may be an arduous process, and impede the use of less human-centric forms of value in comparing ecosystem services (Manfredo et al. 2017a). Even quantifying the services provided to a relatively narrow stakeholder group, such as hunters or anglers, is challenging (Chan et al. 2012, Schröter et al. 2014). Given the importance stakeholders to

effective implementation of adaptive co-management of ecosystems services, there is a need to improve our understanding and characterization of stakeholder heterogeneity.

Grouping stakeholders based on social and psychological commonalities may be one approach to improving our understanding of the value of cultural services by reducing uncertainty associated with differing perceptions. Identity theory is increasingly being applied within recreation and leisure-science research as a fundamental basis for predicting how people behave across a wide variety of situations (Stets and Biga 2003, Jun et al. 2015). Fundamental to operationalizing identity theory in natural resources management, is understanding that an identity is not static. Rather, identity is a construct of standards that can be broke into sub-units representative of the socially defined roles an individual aspires to represent (i.e., role identity) and the inherent philosophies of the world that underlie a person's actions (i.e., person identity) (Burke and Stets 2009). As such, identity standards are predictive of the unique behaviors expressed by groups of people who share identity standards (Stets and Biga 2003)

We sought to assess the degree to which heterogeneity exists within common attributes used to characterize angler populations (i.e., angler avidity, urban-rural gradient, and angler permit type), and whether angler identity influences how anglers value cultural services. Specifically, we set out to describe whether angler identities differs among common angler characterizations, and to confirm that angler heterogeneity, as defined within identity theory, leads to different valuation of cultural ecosystem services. As such, we conducted an inter-disciplinary study where we quantified angler willingness-to-pay (*WTP)* via a willingness-to-travel approach and simultaneously

quantified angler identities through latent scales that are commonly used to segment recreational anglers. We hypothesized that:

H1: Anglers motivated by catch outcomes associated with specific aspects of fishing (i.e., catch large, trophy fish, catching specific types of fish, and high catch rates) will express unique *WTP* for trip-specific catch-based outcomes relative to the general angling population

H2: Anglers who express greater levels of involvement via centrality-to-life and commitment to angling will express unique *WTP* for trip-specific catch-based outcomes relative to the general angling population

H3: Anglers identities that confirm to the classical definition of a specialized anglers as described by (Bryan 1977) (i.e., Trophy-oriented, catch-rate-oriented, and committed) will express unique *WTP* for trip-specific catch-based outcomes relative to the general angling population

Methods

Survey design and implementation

An online survey was conducted from February through November 2017 consisting of 9 individual rounds encompassing a single fishing season (survey provided in Appendix E). Contact emails used for the online surveys were drawn from the Nebraska Game and Parks Commission's electronic license database. Potential respondents were limited to those who were 19 years or older and had purchased an annual fishing or hunting-and-fishing combination license at least once during 2010 - 2015. Both resident and non-resident license purchasers were included within each random sample using an unbalanced design.

For each round of the survey, random samples of 2000 anglers were drawn from the database without replacement. Each survey remained open for 30 days following initial contact. Respondents were contacted with 2 reminder emails during the survey period. The intervals for each reminder email ranged from 6 days to 16 days due to institutional constraints limiting the number of emails that could be sent in a single day and to avoid sending emails on weekends.

The survey was designed to assess two distinct sections: an angler-identity section and a stated-preference valuation section. The identity section assessed angler motivation, aspects of involvement, and eco-competitiveness. The stated preference valuation section assessed angler willingness-to-pay for trip-specific catch-based outcomes of recreational angling (i.e., species, fish size, and expected number caught). Respondents were also asked questions to assess their typical fishing trip characteristics, and sociodemographic. Respondents were asked to describe how often they fish inside their state of residence as well as travel to other states. Respondents were asked to provide a zip code associated with their home residence, which was then used to determine residency and to characterize the respondent as living in urban, suburban, or rural counties using on the USDA Rural-Urban continuum county code associated with the provided zip code (Breen 2012)

Measuring angler identity

Angler catch orientation is widely used to measure angler motivaition and is generally represented as four sub-categories including 1) catching large, trophy-sized fish, 2) catching many fish, 3) catching at least something, and 4) keeping the fish they catch (Schroeder et al. 2008, Fulton et al. 2011, Beardmore et al. 2011b, 2015) (Table 2-

2). We also included a fifth category to differentiate anglers who are species-seeking generalists from single species-seeking specialists (Pope et al. 2016). Using these five sub-categories we can represent assumptions within previous research which suggest that more specialized anglers (e.g., oriented to seeking trophy fish, less harvest oriented, and species specifists will value recreationally catching fish differently than less specialized anglers (e.g., just want to catch something, more harvest oriented, and species generalists).

Angler involvement as a latent variable is commonly used to represented centrality-to-life (i.e., the interrelatedness of an individual's sense-of-self and social group dynamics within being a recreational angler) (Kim et al. 1997, Jun et al. 2015) and commitment of ones social group to angling (hereafter, commitment to angling) (Table 2-2). Centrality-to-life was measured as a latent variable using questions that asks anglers to state the degree to which recreational angling is important with different aspects of their time and the degree to which it compares to other activities. The latent variable, commitment to angling was measured as the cost to the individual social standing by not conforming to the identity of recreational angler, quantified via the importance of being seen and recognized as skilled within recreational angling by friends and family (Stets and Biga 2003). Further, commitment to an alternate outdoor recreational activity (i.e., Hunting, Camping, Nature walking, and Boating) was included to differentiate cross-activity commitment in relation to recreational angling.

We used environmental identity metric to measure the meaning of being a certain type of angler as stated by each respondent. Questions drawn from (Burke and Stets 2009) were adapted to be recreational angling specific (Table 2-2). The environmental

identity metric measures the degree to which a person tends to be competitive or cooperative with natural environments. Environmental identity is similar to value orientation metrics commonly used within human dimensions of fisheries and wildlife but designed to measure the degree to which a person prefers a natural environment versus a highly altered environment by human activity. In the context of this activity, naturalness is contextualized by the site characteristics of the waterbodies in which respondents tend to select as participation sites and their perceptions of the fish within those waterbodies.

The angler identity factors catch orientation, involvement, and environmental identity were measured on a scale of 1 (strongly disagree) to 5 (strongly agree) with 3 being considered neutral (neither agree or disagree). Commitment to angling was measured on an increasing scale of 1 (Never important) to 4 (Always important) with no neutral level. Angler sociodemographic were measured using multiple choice questions which grouped age, level of education, and primary field or occupation as ordered discrete categories, but a miscellaneous or open-ended upper category was provided for each question allowing the questions to encompass all possible responses. Further, trip dynamics questions were also asked to assess avidity (i.e., number of days fished in a typical year) and tendency to fish in their resident state or to travel out-of-state for a typical fishing trip.

Economic valuation

Typical travel expenditures were quantified by asking respondents the number of one-way miles they typically travel for a fishing trip (ranging from 0 to 500 or more; typical fishing trip travel miles were capped at 500 miles to prevent overestimation of

travel cost), the typical expenditures on fuel in US$ during a typical fishing trip, and the typical expenditures on food, bait, and lodging during a typical fishing trip. Respondents were also asked to provide their typical annual income by selecting from a range of categorical income brackets (i.e., Less than $10k, $10k – $29k, $30k – $49k, $50k - $69k, $70k - $99k, $100k -$200k, Greater than $200k). For the purposes of calculating income, the middle-income value (*Y*) from each bracket was used and $250k for the greater than $200k bracket.

Fish species was selected based on the 2012 Nebraska Game and Parks Commission Licensed Angler report which suggest that the four most ubiquitously popular sportfish in the state of Nebraska are Channel catfish (*Ictalurus punctatus*), Crappie spp. (*Pomoxis spp.*), Largemouth bass (*Micropterus salmoides*), and Walleye (*Sander vitreus*). The *WTP* was estimated for each species using a double-bounded dichotomous-choice contingent valuation method (*DBDC*). Each respondent was asked two separate *DBDC* questions with randomly stratified variables representing fish species, fish length, and number caught for that hypothetical trip. Random stratification of the *DBDC* variables was done so that no respondents were asked about the same species in both questions (survey provided in Appendix E).

In this assessment we used a willingness-to-travel approach to a contingent behavior analysis. Measuring willingness-to-travel (*WTT*) rather than *WTP* directly provides an important alternative to more classical measures of nonmarket benefits like contingent valuation (*CVM*). Whereas *CVM* asks respondents to consider a hypothetical scenario and determine a monetary value that they would be willing to pay given that scenario, the *WTT* approach asks respondents to make a nonmonetary decision using

distance traveled as a bid currency. Doing so grounds the hypothetical context within a real-world situation that has been found to reduce hypothetical bias and allows investigators to assess preferences for different scenarios using methods that are more indirect than simply asking for *WTP*. Further, measures of travel cost can still be converted to monetary values by collecting information about the costs that respondents incur from travel during normal fishing trips.

As such, we used a sequential bid design representing additional travel distance, which was provided as one-way miles the respondent would be willing to travel further than a typical fishing trip, with the expectation that the scenario provided in the question would be catch-based fishing trip outcome. Initial bids were randomly selected, ranging from 10 additional miles to 250 additional one-way miles to better represent difference in small values. A secondary bid was provided to respondents for each question. On a yes response, the bid was randomly selected using a discontinuous range of values greater than initial bid to a maximum of 500 miles. On a no response, the bid was randomly selected using a range of values less than the initial bid to 1 mile. This dichotomous form allowed us to quantify a range of additional miles the anglers would be willing to travel with the expectation of the fishing trip resulting in the scenario provided.

In each scenario respondents were given a scenario representing a hypothetical fishing trip outcome with a randomly selected fish length, number of fish caught, and one of the four study species. Fish length was randomly selected using inch-length groups with an upper bound represented by 80% of world-record length (i.e., trophy classification that is commonly used when measuring fish quality) of the respective world record for that species, and the lower bounds represented 20% of the respective world

record (i.e., stock classification) as suggest by Gabelhouse (1984). Fish number was determined based on the most liberal respective bag limits allowed in the state of Nebraska (i.e., *Channel catfish – 5, Crappie – 15, Largemouth bass – 10, Walleye – 5).* Using the *DBDC* method within a *WTT* approach allows for more robust estimates of *WTT* by estimating a range of *WTT* for each scenario expressed in the survey that are theoretically less influenced by hypothetical bias due to the non-monetary bidding within the survey tool (Hanemann 1994, Whitehead and Wicker 2018b).

Angler identity analysis

Each grouping of independent factors used to represent latent aspects of angler identity were tested for initial construction reliability using the Cronbach-alpha test which determines the degree of association of each question within each factor. An alpha level of 1 suggests that the questions are perfectly associated with each other (i.e., redundant) and 0 suggests the questions are perfectly disassociated. In standard practice, factors with alpha levels of 0.7 are considered most appropriate and individual questions should be deleted to refine the factor scale to achieve 0.7. We accepted alpha levels of 0.7±0.1 within our assessment.

Although we were using common methods, we choose to assess the latent variable metrics using three individual exploratory factor analysis models (EFA). An EFA model was parameterized to represent angler catch orientation under the assumption that each sub-category within catch orientation (e.g., seeking trophy fish and keeping fish) act as correlated continuums. Using EFA in this way, allowed us to identify whether cross-category interactions were occurring that differed from our initial hypotheses. We also created exploratory factor models for the involvement and environmental identity

latent variables. For each model, we predicted the initial number of factors that were appropriate using a scree plot analysis where the eigenvalues for successively increasing number of extracted factors are plotted. We used an oblique rotation method (i.e., promax) which does not constrain correlation between variables within each model. Generally, an eigenvalue of less than one is used as a cutoff, but the scree plot analysis allows for qualitative assessment to assess the number of factors where adding new factors does not account for more of the variation within the data. We visually assessed factor loadings for each factor and attempted to minimize cross-loading between the extracted factors using a factor loading score of 0.2 as an initial cutoff (Figure 2-1 and 2-2). Factors were named based on their association with individual variables that are representative of each latent variable.

Using the final model forms, we predicted factor scores for each survey respondents using a regression-based maximum likelihood method. In this method, predictor variables are weighted via coefficients derived from an underlying least squares multivariate regression and accounts for correlations between the factor loadings. Unfortunately, we were unable to include of the environmental identity latent variable within the analysis due to sample size limitations relative to the other latent variables. Respondents appeared to selectively choose not to respond to questions that were associated with the environmental identity latent variable metric.

Using our predicted factor scores we standardized each as a z-score to assess their distribution throughout the pool of respondents and assess the consistency of angler identity across angler avidity (number of days fished in a typical year), urban-rural gradient (based on USDA rural-urban continuum designation of the county associated

with the zipcodes provided by survey respondents), and fishing permit type (purchasing a resident or nonresident fishing permit. We used a multivariate analysis of variance (MANOVA) to assess whether angler identities differed between each variable.

Economic valuation analysis

Analysis of *DBDC* data collected in this experiment was based on statistical methods suggested by Aizaki et al. (2015). Survey responses were modeled using a parametric form of a discrete choice logit model based on the utility difference approach (Hanemann 1994). In this form, an individual probability was calculated for each the four possible combinations of responses to the two potential bids within the survey (i.e., *yy, yn, ny, nn*). A maximum log-likelihood estimation was used across all independent observations (i.e., 2 per survey respondent) as described in Aizaki et al. (2015). Bids were converted from additional miles traveled to sum of out-of-pocket travel cost (US$) and opportunity cost of time using the standard equation given as

$$TC = 2 * c * (bv + tm)$$

where c = 0.13 (i.e., average operating cost per mile, American Automobile Association 2013), *bv* equals the bid value provided to each respondent in each question, and *tm* being the distance traveled in miles the respondent reported traveling in each fishing trip. In this study, respondents were asked to assess their willingness-to-travel distances relative within a trip context that is normative. As such, we opted to not including opportunity cost of time (i.e., the value of time that could have been allocated to an alternate activity or lost potential utility from alternate activities) in our travel cost assessment as it may vary by participant in a way that is not accounted for by the survey tool.

In this method there is a 2-step estimation process, which requires estimating coefficients based solely on the initial bids provided to respondents using a binomial logit generalized linear model. These initial coefficients are then used as starting parameters within a routine to optimize coefficients based on responses to the second bid. A base model was selected based on previous research which included each of the trip-specific catch-based variables as blocking variables and the residency of each angler (i.e., resident or nonresident). Using this base model, model testing was conducted where each angler identity category was grouped and included within successive models resulting in 4 distinct models ranging from the based model to a global model. Model selection was conducted using Bayesian information criterion (*BIC*), comparing all four models to determine whether the heterogeneity that angler identity represents within Nebraska angler population is necessary to accurately quantify angler *WTP* trip-specific catch-based variables.

Results

With our initial survey efforts, we found our respondents were largely dominated by older individuals with 35% of respondents being 50 years or older. 49% of respondents had achieved a four-year degree or higher and 21% of respondents characterized their primary occupation as retired (Table 2-1). We found that 47% of respondents has 3 or fewer individuals in their household and characterized 1 or fewer of those individuals as dependents (Table 2-1). These response values largely met our expectations given the respective mean values within the state of Nebraska during the 2010 US Census with 30% of Nebraskans who are 25 years or older achieving a four-year degree or higher and an average of 2.47 persons per household. The median

household annual income for the state of Nebraska is $54,384, whereas 43% of our respondents reported annual incomes of $70,000 dollars or greater (13% chose not to share their income) (Table 2-1). The age of our respondents was slightly higher than average in the state of Nebraska with 15.45 of the population being 65 years or older.

As expected, the latent variables we chose as representative of angler identities were reliable indicators. All latent variables had Cronbach-alpha values between 0.65 and 0.76 except the species specialist scale (0.56) (Table 2-2).

We found our latent variable indicators were suitable for factor analysis of both catch orientation and involvement (Table 2-4). We assessed Bartlett's test of sphericity (Bartlett), which determines whether there is enough correlation between variables for factoring (catch orientation – χ^2 239.48, DF 105, p-value <0.001, involvement – χ^2 828, DF 66, p-value <0.001). We also used Kaiser-Meyer-Olkin's measure of sampling adequacy to determine the proportion of variance within our data that factoring will account for (catch orientation – 0.73, involvement – 0.68). For the catch orientation model, we found 5 unique factors represented by the latent variable indicators, of which four factors had eigenvalues greater than 1 and we chose to include a fifth factor with an eigenvalue of 0.99 (Figure 2-1). For the involvement model, we extracted 3 distinct factors, each with eigenvalues greater than 1.

To obtain a simple-structure form within each efa model, we visually assessed the factor loadings (measures degree of association between indicator and extracted factor) associated with each factor and established cutoffs of 0.4 which limited the number of indicators associated with each extracted factor (Figure 2-1 and 2-2). Using the simple-structure models, we named each factor based on the latent variable indicators associated

with each respective factor (Figure 2-1 and 2-2). The final model formulations, sum of squares aggregate factor loadings, latent variable indicator uniqueness, and the cumulative variances are presented for catch orientation and involvement (Table 2-3 and 2-4).

To assess the composition of angler identity among Nebraska anglers, we standardized the predicted factor scores for each respondent using a z-score. Z-scored factor scores were plotted as violin plots that describe both the maximum and minimum values for the data and the frequency of values within the distribution (Figure 2-3). Using the same approach, we segmented the angler identity composition by angler avidity, urban-rural gradient, and permit type but did not find angler identity compositions to differ between the associated groups (Figures 2-4, 2-5, and 2-6). Although in each case, where p-values were less than an alpha of 0.05, that is a result of the high sample size, not differences between each population. For each of the three variables, Wilks λ was found to be low indicating that very little of the associated variance between each group was accounted for by the associated angler identity compositions (Figures 2-4, 2-5, and 2-6).

In conducting the model selection exercise, we found that the base model which assumed a homogenous population of anglers had the lowest BIC score out of our model hypotheses (ΔBIC – 0), suggesting that anglers may value recreationally caught fish similarly across different angler identities. We found the model representing angler identity as only catch orientation to be the next best model (ΔBIC - 17), then involvement (ΔBIC – 21), and finally comprehensive specialization model (ΔBIC – 37) (Table 2-5). Within the model selection process, we also conducted likelihood ratio tests to determine

the degree of improvement in goodness-of-fit without penalization for parsimony. We found a 20.62 times better representation of the data in the catch orientation only model and 22.62 times better representation of the data in the specialization model.

Discussion

Understanding the heterogeneity inherent both within and among stakeholder populations is presumed to improve our ability to affect the management of ecosystem services, particularly social services. However, contrary to our predictions we did not find that he addition of angler specific identities improved our ability to understand the Nebraska angler population. Indeed, angler *WTP*, when constrained by latent variables representative of angler identities among Nebraska anglers (i.e., catch orientation and angler involvement) did not differ significantly from angler *WTP* estimated for the general population. Furthermore, angler identities did not vary across common angler policy characteristics like angler avidity, urban-rural gradient, and fishing permit type. Our results suggest that anglers express similar valuation of trip-specific catch-based outcomes across angler identity scales despite the differences in behavior associated with motivation, commitment, and involvement in fishing.

To compare these studies to our findings, it is important to understand the distinctions between pre-trip forces like motivations, preferences, expectations, and post-trip forces like satisfaction. Understanding these differences will add context to how anglers *WTP* should be used in recreational fisheries management and decision-making. Motivation has been defined as *an ex-ante underlying force that act on a tendency to engage in an activity based on its expected outcome* and satisfaction as *the ex-post state that results from achieving an expected outcome* (Beardmore et al. 2015). This definition

glosses over the importance of expectation as a determining factor of satisfaction, which is distinct from motivation because anglers' express motivations based on their preferences for certain outcomes, but those preferences are fundamentally moderated by expectations. In other words, preference is the ordering of different alternatives that may be substituted for one another in differing amounts (Champ et al. 2017). Intuitively, an angler would be expected to prefer to catch a world record sportfish within most trip-specific contexts but that does not necessarily imply that catching a world record sportfish is always a strong motivator for going fishing. Similarly, an angler has little expectation for catching a world record sportfish and thus, not doing so will have little affect an angler's overall satisfaction from the trip. In our study, we are directly quantifying the substitutability of different trip-specific catch-based outcomes meaning we are measuring angler preferences within the constraints of Nebraska recreational fisheries. Not only does this method provide important context to previous research that focuses on angler catch-based motivations but also infers the level of satisfaction that would be derived different trip-specific catch-based outcomes.

Our results add further evidence that motivations to catch fish of larger sizes and to have higher catch rates are among primary determinates of angler satisfaction across most species, levels of progression, and motivations (Oh et al. 2005, Beardmore et al. 2013, Arlinghaus et al. 2014); however, we also definitely demonstrate that angler *WTP* is directly tied to the expectation of catching many fish and large fish no matter how expectations may vary in a trip-specific context. Previous research also suggested that characteristics of specialization as in the centrality-to-life and commitment by social group variables we used in this study should illicit a moderating effect on satisfaction

from catching many fish relative to other anglers (Schroeder et al. 2008, Dorow et al. 2010, Beardmore et al. 2011b). Given that, we would have expected to see angler *WTP* for different numbers of fish to differ when compared to the general angling populations. In particular, (Dorow et al. 2010) suggested that the effect of angler specialization may differ greatly based on the specific characteristics of the fishery so we would have expected these differences to occur in our study as well.

The counterintuitive nature of our results does not make their interpretation any less impactful when considering the implications to valuing ecosystem services and recreational fisheries management. Given the fundamental relationships between preference and motivation, we expected angler *WTP* to mirror the relationships that between how angler heterogeneity of motivations and specialization influence angler satisfaction. We believe that angler expectations are a key reason why we did not see those relationships hold true here. Our experiment was largely focused on understanding whether angler heterogeneity would influence how anglers' value different trip-specific outcomes using a contingent behavior approach. Using this approach, we set the expectations for the anglers within a hypothetical context and found that heterogeneity among angler segments had little effect on angler *WTP*. This suggests that when anglers are limited to valuing trip-specific catch-based outcomes, they will prefer to catch as many fish and as large of fish as possible no matter what their generalized motivations may be or their level of involvement in the activity. This is an intuitive result that seems to be largely unrecognized in previous research because of the methodological designs used.

As such, the results of this study suggest that the median angler *WTP* assessed within the general Nebraska angler population is likely a valid representation of the partial replacement value of sportfishing in the state of Nebraska. It is important to note that this only relates to partial replacement value. Legitimate questions have been raised about the validity and reliability of approaches that are focused on instrumental value over other value forms (i.e., intrinsic, existence, and relational) (Gomez-Baggethun and Ruiz-Perez 2011, Chan et al. 2012, 2016).This valuation method only represents the utility of recreational catching the associated sportfish, not the total economic value of the sportfish to the state. Additional research must be conducted to quantify the total economic value of Nebraska's sportfish that expand the scope of the study to include all Nebraska citizens, including those that are not using Nebraska sportfish directly in the context of recreational angling.

A common theme within human dimensions of fisheries and wildlife research is that understanding participant heterogeneity over generalizing across populations is important to elucidating the dynamics and feedbacks of consumptive recreational activities like angling and hunting. Previous research has shown that the context of different trips and the motivations and progression of the participants can be strong determents of behavior and satisfaction. The results of this study do not refute the importance of characterizing that recreational participant heterogeneity is important but rather show that within some contexts the functional importance of certain activity-specific variables is ubiquitous across all segments of participants.

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Table 2-1

Proportion of membership to categories of socioeconomic indicators. Proportions are based on the individual number of responses in each category as respondents could skip individual questions within the survey per institutional requirements.

Age group	Prop.	Level of education	Prop.	Primary Field of occupation	Prop.
<20	0.01	Some high school	0.01	Medical	0.05
20-29	0.08	High school degree or GED	0.12	Public works or service	0.08
30-39	0.15	Some college coursework	0.22	Student	0.01
40-49	0.19	Two-year college degree	0.16	Teaching or education	0.07
50-59	0.22	Four-year college degree	0.31	Business, sales, or marketing	0.17
60-69	0.24	Master's degree	0.13	Other	0.12
>70	0.11	Professional degree	0.06	Retired	0.21

Table 2-2

Summary statistics of metrics assessed within survey that comprise angler identity. Metrics given as 4-point scales ranging from 1 - Never important to 4 - Always important are marked with an *, all other metrics were given as a 5-point scale ranging from 1 – Strongly disagree to 5 – Strongly agree with 3 being neutral. Low and high categories provide the percent membership within the aggregated lower and upper portions of each scale, respectively.

Metric	Code	Low	Neutral	High	Mean	SD
Many-Some continuum α=0.68± 0.02						
A fishing trip can be successful even if no fish are caught	M-S 1	18.55	15.91	65.53	3.7	1.18
When I go fishing I am not satisfied unless I catch at least something	M-S 2	32.09	23.74	44.17	3.14	1.2
When I go fishing I am just as happy if I don't catch any fish	M-S 3	40.68	26.04	33.28	2.92	1.14
If I thought I would catch only 1 fish, I would still go fishing	M-S 4	16.17	14.47	69.36	3.83	1.18
A successful trip is one in which many fish are caught	M-S 5	20.09	25.62	54.3	3.47	1.12
The more fish I catch the happier I am	M-S 6	15.83	23.57	60.6	3.58	1.05
Trophy-Harvest continuum α=0.65± 0.03						
I would rather catch 1 or 2 big fish than 10 smaller fish	T-H 1	22.55	29.28	48.17	3.37	1.1
The bigger the fish I catch, the better the fishing trip	T-H 2	16.26	24.77	58.98	3.57	1.06
I am happiest with the fishing trip if I catch a challenging game fish	T-H 3	12	27.91	60.09	3.68	1.04
I generally don't want to keep the fish I catch	T-H 4	40.26	18.98	40.77	3.01	1.4
A full stringer is the best indicator of a successful fishing trip	T-H 5	45.79	26.64	27.57	2.68	1.2
I usually eat the fish I catch	T-H 6	33.36	13.96	52.68	3.31	1.49
Species specialization α=0.56 ± 0.03						
It does not matter what type of fish I catch	SS 1	36.77	18.04	45.19	3.12	1.28
I like to fish where there are several fish to catch	SS 2	5.45	15.15	79.4	4.02	0.86
When I go fishing I target only 1 type of fish	SS 3	50.89	18.55	30.55	2.68	1.23
Centrality-to-life α=0.73 ± 0.02						
Fishing is very important to my family and friends*	Inv 1	19.06	25.19	55.74	3.5	1.11
Many of my social interactions involve fishing	Inv 2	33.96	28.77	37.28	3.01	1.18

Table 2-2 (Continued)

Metric	Code	Low	Neutral	High	Mean	SD
Because of my passion for fishing, I have very little time of other hobbies	Inv 3	69.02	19.66	11.32	2.08	1.08
Going fishing is my favorite recreational activity	Inv 4	26.13	27.57	46.3	3.34	1.2
Commitment $\alpha=0.72 \pm 0.02$						
Family views me as a fisherman	Inv 5	65.27		34.73	2.15	0.91
Friends view me as a fisherman*	Inv 6	66.53		33.47	2.13	0.91
Skill level as a fisherman family thinks I am	Inv 7	44.94		55.06	2.61	0.79
Skill level as a fisherman friends thinks I am	Inv 8	47.71		52.29	2.55	0.77
Environmental identity $\alpha=0.76 \pm 0.03$						
I draw a sense of satisfaction from competing with and outsmarting the fish I catch	Env 1	13.28		86.72	4.09	1.06
I don't think much about the day-to-day life of the fish I catch	Env 2	68.75		31.25	2.38	1.43
I am opposed to anything that may negatively affect the waterbodies I fish	Env 3	8.59		91.41	4.51	1.05
I prefer waterbodies that remain as natural as possible even if my fishing is more difficult	Env 4	10.94		89.06	4.23	1.01
I would feel less fulfilled if I had to fish in waterbodies that seemed artificial or urban	Env 5	25.78		74.22	3.77	1.35
The health of the fish I seek is at least as important as the needs of the general public	Env 6	20.31		79.69	3.98	1.37
I generally don't think much about the fish I catch	Env 7	80.47		19.53	1.99	1.15
I often feel more positive about life after going fishing or being on a waterbody	Env 8	4.69		95.31	4.5	0.85
I am very conscious of how my actions affect the waterbody I fish	Env 9	3.91		96.09	4.73	0.76
I would not be concerned if the waterbodies I fish were less natural than they are now	Env 10	83.59		16.41	1.86	1.18
I try to appreciate and understand the behavior of the fish I catch	Env 11	4.69		95.31	4.48	0.85
I believe that a waterbody should be managed for increased access and fishing quality even it means the waterbody is less pristine	Env 12	64.06		35.94	2.6	1.38
While fishing is important to me, I rarely feel emotional while fishing	Env 13	64.06		35.94	2.55	1.45
I often think about how the fish I catch fit within their environment	Env 14	17.19		82.81	3.94	1.2
I am not concerned if there are moderate impacts from other industries to the waterbodies I fish	Env 15	92.97		7.03	1.41	0.9

Table 2-3

Exploratory factor analysis results summary for catch orientation question metrics. The Bartlett Test of sphericity and the Kaiser-Meyer-Olkin test values are provided as measure of the suitability of the data for factor analysis. Further, sum of square loadings and the cumulative variance represented by each factor are provided.

Diagnostic statistics	Factor	Variable code	Score	Uniqueness
Bartlett = 239.48, DF 105, p-value <0.001)				
KMO = 0.73				
SS loading = 1.68	Many fish	M-S 5	0.7	0.55
Cumulative Var. = 0.11		M-S 6	0.73	0.48
		M-S 2	0.52	0.55
SS loading = 1.27	Keep fish	T-H 5	0.44	0.78
Cumulative Var. = 0.20		T-H 6	0.97	0.1
SS loading = 1.19				
Cumulative Var. = 0.28	Trophy fish	T-H 1	0.83	0.43
		T-H 2	0.54	0.47
SS loading = 1.12		T-H 3	0.44	0.74
Cumulative Var. 0.35	Catch something	M-S 1	0.59	0.66
		M-S 3	0.56	0.65
SS loading = 1.10		M-S 4	0.44	0.77
Cumulative Var. 0.42	Species specialist	SS 3	1.01	0

Table 2-4

Exploratory factor analysis results summary for involvement orientation question metrics. The Bartlett Test of sphericity and the Kaiser-Meyer-Olkin test values are provided as measure of the suitability of the data for factor analysis. Further, sum of square loadings and the cumulative variance represented by each factor are provided.

Descriptive statistics	Factor	Variable code	Score	Uniqueness
Bartlett = 828, DF 66, p-value <0.001)				
MSA = 0.68				
	Angling-high involvement	Inv 4	0.53	0.7
		Inv 5	1.01	0.12
SS loading = 3.32		Inv 6	1.01	0.1
Cumulative Var. = 0.28		Inv 2	0.45	0.77
		Inv 3	0.46	0.78
	Alternate-high involvement	Inv 9	0.94	0.16
SS loading = 2.37		Inv 10	0.95	0.13
Cumulative Var. = 0.47				
	Intermediate	Inv 11	0.93	0.1
SS loading = 2.01		Inv 12	0.92	0.1
Cumulative Var. = 0.64				

Table 2-5

Results of logit model selection exercise testing how heterogeneity within angler identities influences the monetary valuation of cultural ecosystem services as represented by trip-specific catch-based outcomes. Base model is indicative of the general angler population, alternative hypotheses are tested where models include potential angler identity compositions.

Model parameterization	Log Lik.	Median WTP	Likelihood ratio test	BIC	ΔBIC
Base model: Species + Fish length + Number caught	-1831.73	34.86		3714	0
Base model + Trophy + Many	-1824.64	34.76	Df 2, 14.18, p < 0.001	3715	1
Base model + Keep + Something	-1830.39	34.81	Df 2, 2.69, p = 0.26	3726	12
Base model +Trophy + Harvest + Many + Some+ Keep	-1821.4	34.68	Df 5, 20.62, p < 0.001	3731	17
Base model + Ang. high involvement + Alt. high involvement + Intermediate	-1830.83	34.88	Df 3, 1.81, p = 0.61	3735	21
Base model +Trophy + Harvest + Many + Some + Keep + Ang. high involvement + Alt. high involvement + Intermediate	-1820.2	34.76	Df 8, 22.62, p < 0.001	3751	37

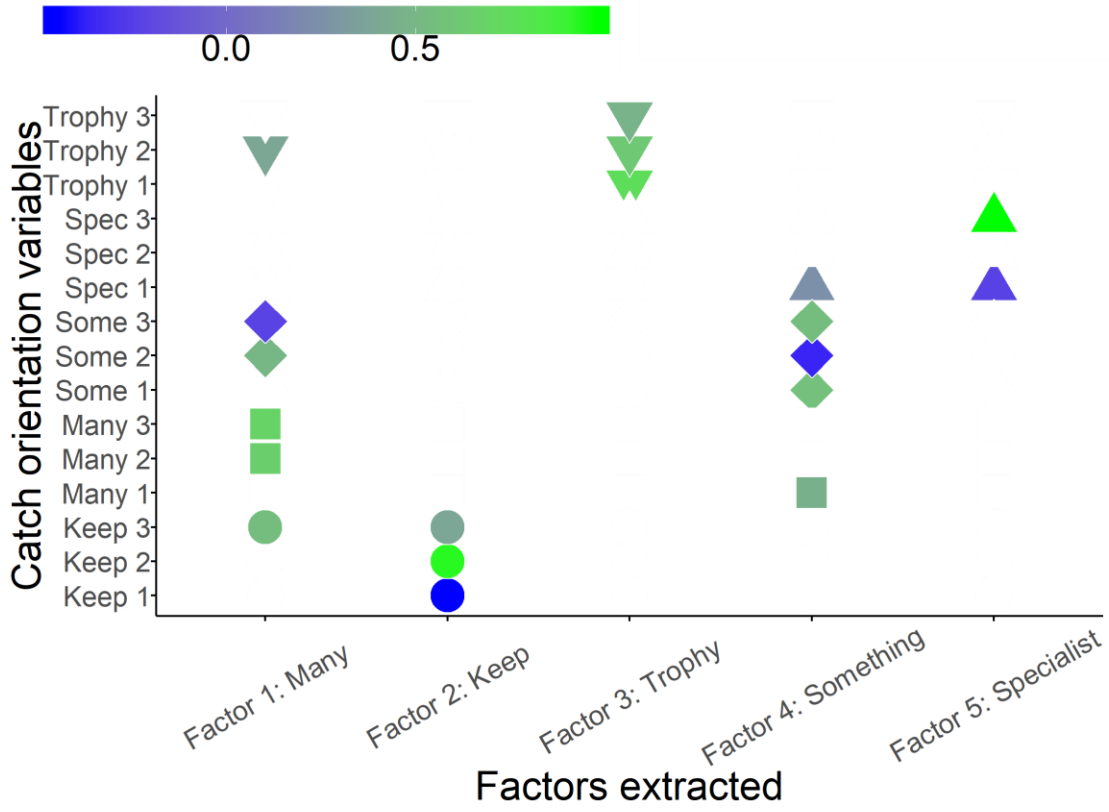

Figure 2-1

Visual representation of initial explanatory factor analysis loadings and the factors extracted within catch orientation variables. Loadings between -0.2 and 0.2 are not shown as we considered them to be neutral. Shapes are associated with the involvement variable groupings along the y-axis. The color of each shape represents the magnitude of the factor score for that involvement variable. As such, green colors should be interpreted as variables with higher associations with that factor, but blue colors represent lower associations.

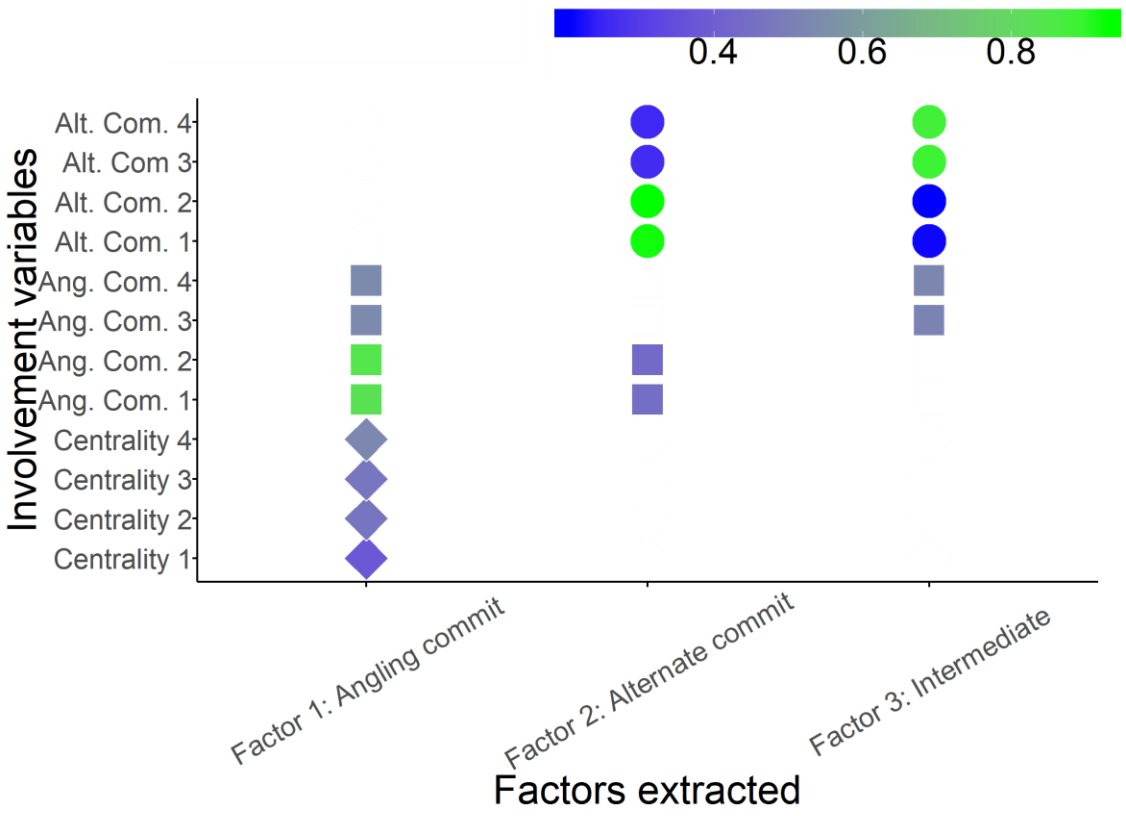

Figure 2-2

Visual representation of explanatory factor analysis loadings and the factors extracted within involvement variables. Loadings between -0.2 and 0.2 are not shown as we considered them to be neutral. Shapes are associated with the involvement variable groupings along the y-axis. The color of each shape represents the magnitude of the factor score for that involvement variable. As such, green colors should be interpreted as variables with higher associations with that factor, but blue colors represent lower associations.

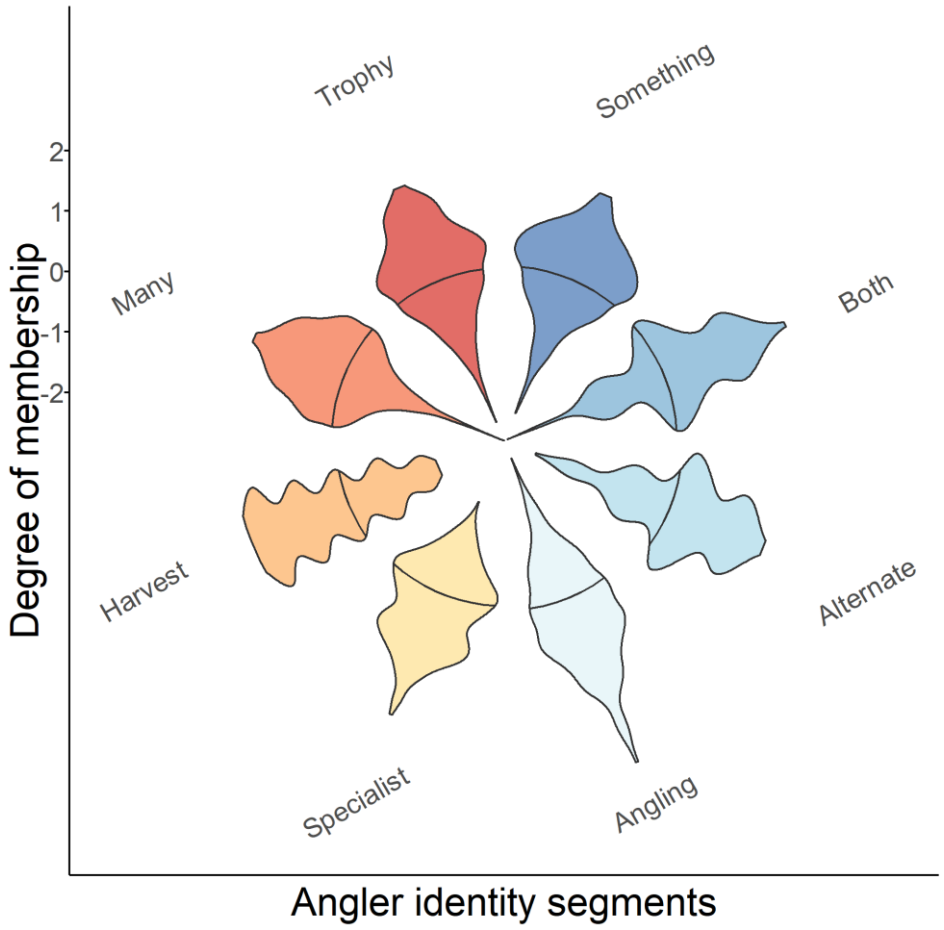

Figure 2-3

Degree of membership (Z-scored factor scores) for the general population of Nebraska anglers. The center radial represents the minimum value across all metrics and the outer ring represents the maximum value. The density of angler responses for each scale are shown going clockwise with red = Trophy – Harvest continuum, blue = Commitment continuum, yellow = Centrality-to-life continuum, and orange = Many – Some continuum. Wider shapes represent higher densities at that degree of membership.

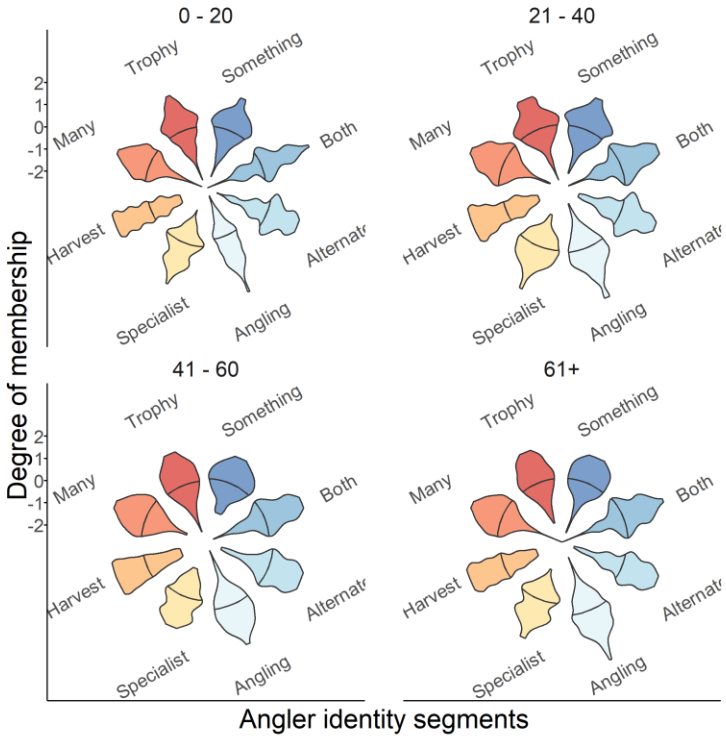

Figure 2-4

Degree of membership (Z-scored factor scores) of the angler identity scores across angler avidity (represented as the stated number of days fished per typical year). The center radial represents the minimum value across all metrics and the outer ring represents the maximum value. The density of angler responses for each scale are shown going clockwise with red = Trophy – Harvest continuum, blue = Commitment continuum, yellow = Centrality-to-life continuum, and orange = Many – Some continuum. Wider shapes represent higher densities at that degree of membership. Overall angler identity segments did not vary significantly across angler avidity (Manova: DF 3, Wilks λ 0.812, F 11.76, p-value < 0.001).

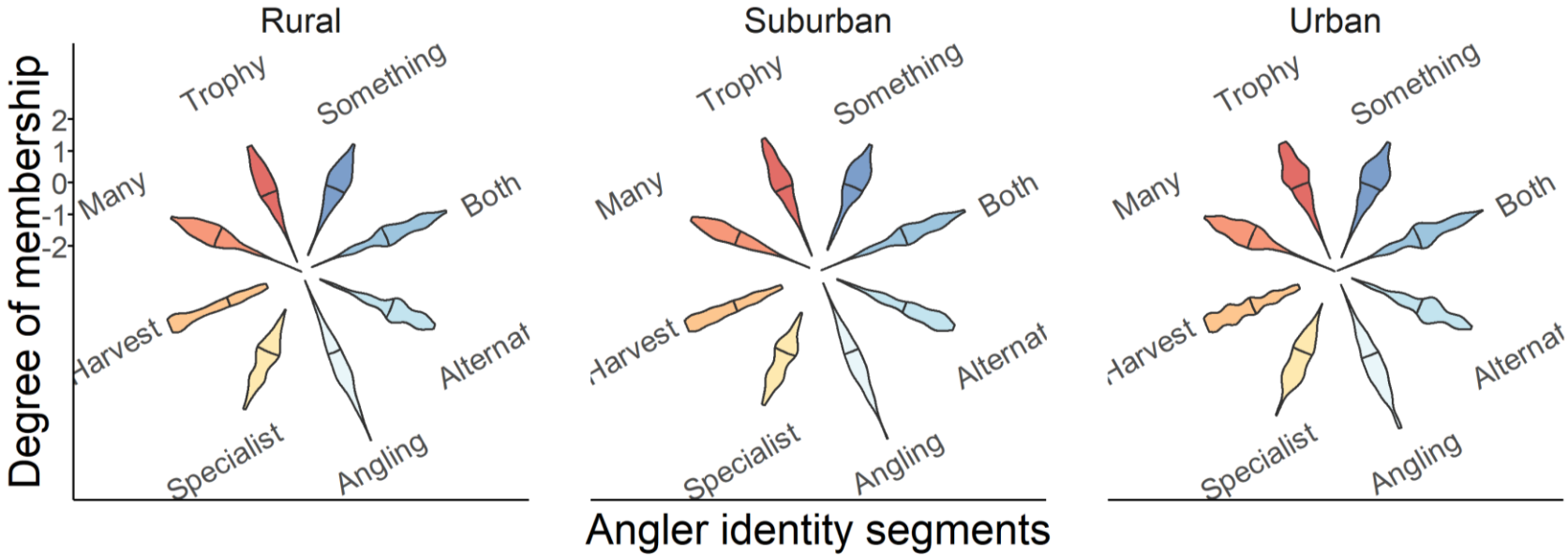

Figure 2-5

Degree of membership (Z-scored factor scores) of the angler identity scores across the urban – rural gradient (residency occurring in the USDA Rural – Urban Continuum county codes; Rural = 1, 2, and 3, Suburban = 4, 5, and 6, and Urban = 7, 8, and 9. The center radial represents the minimum value across all metrics and the outer ring represents the maximum value. The density of angler responses for each scale are shown going clockwise with red = Trophy – Harvest continuum, blue = Commitment continuum, yellow = Centrality-to-life continuum, and orange = Many – Some continuum. Wider shapes represent higher densities at that degree of membership. Overall angler identity segments did not vary significantly across the urban-rural gradient (Manova: DF 2, Wilks λ 0.941, F 6.02, p-value < 0.001).

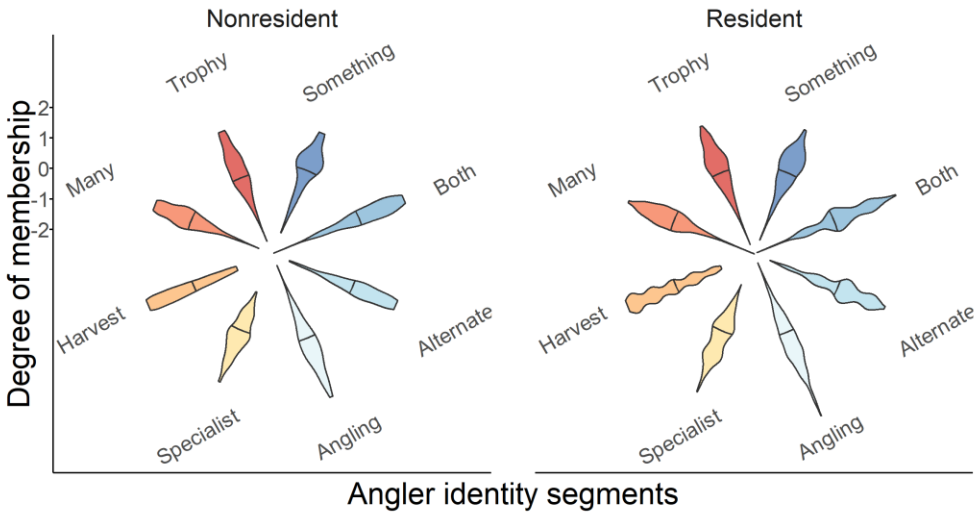

Figure 2-6

Degree of membership (Z-scored factor scores) of the angler identity scores across angler residency (resident = zip code of resident of Nebraska, nonresident = zip code out-of-state) and tendency to travel for fishing. Sessile refers to anglers expressing that most of their fishing trips occurred inside their home state and transient refers to the opposite. The center radial represents the minimum value across all metrics and the outer ring represents the maximum value. The density of angler responses for each scale are shown going clockwise with red = Trophy – Harvest continuum, blue = Commitment continuum, yellow = Centrality-to-life continuum, and orange = Many – Some continuum. Wider shapes represent higher densities at that degree of membership. Overall angler identity segments did not vary significantly between anglers that bought resident or nonresident fishing licenses (Manova: DF 1, Wilks λ 0.986, F 2.35, p-value 0.017).

CHAPTER 3: EXTENSION OF THE MORAL DOMAIN AMONG SPORTSPERSONS

Introduction

Outdoor recreation in the USA is constructed as a user-pay, user-benefit system and is intertwined with a public trust doctrine that is ambiguous and state-specific by design, creating conflict between competing constituent groups (Teel and Manfredo 2010, Organ et al. 2012, Peterson and Nelson 2017). Consumptive outdoor recreation (i.e., hunting and fishing) license and access fees, and excises taxes associated with the Pittman-Robertson and Dingle-Johnson Acts comprise 60 - 90% of most state fish and wildlife agency budgets (Organ et al. 2012). Unfortunately, the documented decline in participation in fishing and hunting left the system underfunded and ill-equipped to deal with the challenges of an increasingly conflict-driven North American Model of Conservation (Larson et al. 2014, Manfredo et al. 2016, 2017b). With the need for new funding sources, non-consumptive outdoor recreation (i.e., hiking, birdwatching, and camping) are being recognized as promising areas to enact excise taxes similar to those associated with hunting and fishing (Organ et al. 2012, Peterson and Nelson 2017).

Similar user-pay, user-benefit funding models within non-consumptive outdoor recreation seemingly lacks grass-root support, which has been attributed to political constraints around new taxation and a potential lack of interest in user fees by participants in non-consumptive recreational activities (Organ et al. 2012). Non-governmental organizations like The Nature Conservancy and the World Wildlife Fund

reported donation-based revenue of approximately US$800 and US$300 million, respectively in 2017 alone. These organizations are often anecdotally represented as proponents of non-consumptive outdoor recreation and more specifically, ecotourism (i.e., sustainable, nature-based tourism catered primarily around learning about and contributing to conservation). Given donation-based revenue of such magnitudes, it is surprising there is not more interest in including non-consumptive outdoor recreation within the current user-pay, user-benefit system of the North American Model of Conservation despite what is a clear vested interest in conservation and the environment.

The lack of cohesive support between consumptive and non-consumptive outdoor recreation participants is indicative of a cultural and communication divide between competing constituent groups (Feldpausch-Parker et al. 2017). This divide may relate to how the non-consumptive and consumptive outdoor recreation activities are represented within the scientific community. Non-consumptive outdoor recreation is defined by nature-based experiences and grounded in a philosophy of preservationist like John Muir (Eckersley 1992, Fennell and Nowaczek 2010). Alternatively, consumptive outdoor recreation is grounded in conservationist philosophies, an amalgamation of views expressed by forestry and game managers like Gifford Pinchot and Aldo Leopold (Carter 2007, Breakey and Breakey 2015). Key differences exist between the underlying assumptions and perceptions of the philosophies of the two groups that set the foundation for the apparent conflict. Preservationist views are based around the value of experiencing wilderness in a natural state, the intrinsic value of wilderness, and the desire for that state to persist. In contrast, while resource conservationist views argued for similar protections through ethical and sustainable practices, their intentions are much

more focused on the long-term allocation of resources for human exploitation (Eckersley 1992). In the context of each philosophy, terms like ethical , non-invasive, and protection have slightly different definitions that function uniquely and result in different interpretations of what is moral and ethical behavior within all forms of outdoor activity (e.g., consumptive and non-consumptive) (Arlinghaus et al. 2007, Jacobson et al. 2010, von Essen 2017).

Unfortunately, differences in interpretations and perspectives of natural resource management resulting from differing environmental philosophies can mask the contribution of all outdoor recreation activities to conservation and even inhibit participation in the North American Model of Conservation (Feldpausch-Parker et al. 2017, Peterson and Nelson 2017). Asking decision-makers to appreciate the relative nature of moral and cultural differences between these divergent perspectives within the context of their decision-making processes could provide a means for identifying common ground between constituent groups that may pave the way for alternate systems of conservation funding (Teel and Manfredo 2010).

Identifying the varying degrees of what could be considered legitimate consumptive-use of natural resources is a clear starting point in describing differences between constituents within the North American Model of Conservation. There is a complex set of dynamic rules from which people draw to determine legitimate use of natural resources, especially consumptive-use of animals, and those rules are relative to the culture and environmental philosophy ascribed. “Enforcing legitimate use and take” is listed as one of the 7 major tenets of the North American Model of Conservation (Organ et al. 2012), but no definition of legitimate is provided. For many participants in

consumptive outdoor recreation, such a definition is likely ‘well-known’ and socially agreed upon within the context of their group. Unfortunately, what may be well-known to one group may be unknown to another. The relative and contextual nature of socially agreed upon definitions creates conflict when competing constituents are working off different definitions and drawing from unique sets of rules (Caduff 2011).

Moral extensionalism, a latently determined continuum, is commonly used to define the ethics of consumptive-use of animals and the considerations that should be provided to animals (Arlinghaus et al. 2007, Fennell and Nowaczek 2010, De Backer and Hudders 2015). The continuum suggests that a moral domain (i.e., the sphere of concern and ethical consideration all humans are afforded by right) may be extended beyond humans to different taxonomic groups of animals and plants. The degree to which an individual may extend the moral domain depends on their belief that certain taxonomic groups are sentient and possess the potential to experience pain and suffering (Carter 2007, Arlinghaus et al. 2007, Fennell and Nowaczek 2010). Theory suggests that people fall into varying categories of extension ranging from anthropocentrist (i.e., extends moral domain only to other humans), pathocentrist (i.e., extends moral domain to animals perceived to portray high intelligence and reasoning), biocentrist (i.e., extends moral domain to all animals) and ecocentrist (i.e., extends moral domain to all living things, including plants). Further, it is assumed that peoples’ behaviors likely differ based on these relative views (Carter 2007). For example, public opinions of marine mammal captivity and tourism has undergone an ongoing negative shift as people have recognized the high capacity for intelligence and emotion in many marine mammal species, potentially suggesting an increase in the number of pathocentrist individuals who include

marine mammals within those animals that should be included within the moral domain (Hughes 2001).

To elucidate the extent to which the variation in moral domain is present within outdoor recreation and how it shapes participation in and communication among outdoor recreation activities, we chose to consider moral domain within a recreational fishing community. Although fishing is generally perceived as a consumptive activity, catch-and-release angling allows for individuals to participate in non-consumptive fishing providing a unique opportunity to consider moral domain within a population with highly overlapping interests but potentially unique moral perspectives. Specifically, we segment Nebraska anglers based on the degree to which they extend the moral domain across animals and associate those unique segments of anglers with alternate outdoor activities in which they most prefer to participate. Then we assess the identity commitment of each angler segment to angling and their preferred alternate activity to understand whether the degree to which anglers extend the moral domain is indicative of their choices within outdoor recreation (Provided within appendix). We hypothesize that if moral extensionalism is an effective means for assessing relative divides in culture and communication among outdoor recreational participants, then we would see a direct relationship between the degree that different segments of anglers extend the moral domain and the alternate outdoor recreational activities in which they participate. In response to these empirical results, we draw from a wide range of subjects to develop a novel and inter-disciplinary theoretical conceptualization of the role that environmental philosophy plays in determining people's perceptions of consumptive and non-consumptive outdoor recreation. Our conceptualization provides context to the

implications of this experiment and potential experiments like it, that can be applied in revaluating and improving the North American Model of Conservation for sustainable conservation practices and culturally relevant outdoor recreation.

Methods

Data collection

An online survey was conducted from February through November 2017 consisting of 9 individual rounds encompassing a single fishing season. Contact emails used for the online surveys were drawn from the Nebraska Game and Parks Commission's electronic license database. Potential respondents were limited to those who were 19 years or older and had purchased an annual fishing or hunting-and-fishing combination license at least once during 2010 - 2015. Both resident and non-resident license purchasers were included within each random sample.

For each round of the survey, random samples of 2000 anglers were drawn from the database without replacement. Each survey remained open for 30 days following initial contact. Respondents were contacted with 2 reminder emails during the survey period. The intervals for each reminder email ranged from 6 days to 16 days due to institutional constraints limiting the number of emails that could be sent in a single day and to avoid sending emails on weekends.

Survey metrics

Though all respondents included in the survey were active anglers during 2010 - 2015, we expected that the environmental philosophies of those anglers and their investment of time and money into outdoor recreational activities would vary. That is, we expected some anglers to place a high degree of importance on fishing, but others to

place a lower degree of importance on fishing when compared to alternate outdoor recreational activities. Therefore, we expected respondents' environmental philosophies would be commensurate with both their preferred alternate outdoor recreational activities and their levels of importance expressed for different outdoor recreational activities.

Respondents were asked to select their most preferred outdoor recreational activities, alternative to fishing. The options provided were hunting, birdwatching, hiking, camping, paddlesports enthusiast, and water sports enthusiast. Following initial analysis efforts, we realized that responses were highly skewed to only a few of the possible responses. To avoid sample size issues as a covariate within the final model set, we chose to aggregate hiking and birdwatching into a single category called nature walking, and paddlesports enthusiasts and watersports enthusiasts into boating. Respondents were asked about their commitment to fishing and their selected alternate activity by measuring their potential social costs of not participating in the activity (i.e., strength of ties in one's social network to each activity) (Burke and Stets 2009). These questions were designed to determine the relative importance to them that their friends and family view them as a participant in fishing and their preferred alternate activity and their own assessment of how skilled at fishing, and their preferred alternate activity their friends and family view them. Comprehensively, these values measure respondent's qualitative commitment to fishing and their selected preferred alternate activity (Burke and Stets 2009).

Survey respondents were asked a series of 5-point questions to assess the degree to which they extend the moral domain. To measure the extension of the moral domain within outdoor recreation, the questions were phrased to measure how respondents

extended consideration of rights possessed by humans, the potential to feel pain, and importance of needs relative to humans. These questions were intentionally phrased to be grounded within everyday scenarios that might be encountered by respondents and their choices within outdoor recreation. Questions were generally asked as a level of agreement (i.e., strongly disagree to strongly agree) with the prompts provided in each question. Some questions were provided as categorical assessments, (e.g., "Of the following groupings of animals, which do you regularly feel concerned may feel pain and fear like a human being?" with possible choices ranging from only humans to all animals).

Survey analysis

We applied several statistical techniques for segmenting survey respondents and assessing relationships using mixed categorical and continuous multivariate data. We relied heavily on methods for modeling latent class membership (described in Ward et al. 2008 and Finch and French 2015). Latent class membership refers to an unobserved variable that is directly correlated with a series of observed indicator variables. For example, it is difficult to directly measure whether some individuals fit in the anthropocentric class on the moral extension continuum because it is highly complex and relative within groups. However, there are correlated variables that represent certain positions on the moral extension continuum and, when measured together, can be used to predict a probability of membership to a given class.

We began by segmenting all survey respondents using a latent class regression model and an assumed log-normal error distribution. In this model formulation, each of the 5-point likert-type questions are included as dependent variables (multivariate

generalized linear model) and regressed against the associated respondents preferred alternate activity. An integral component of latent class regression is the ability to specify and test an assumed number of latent classes. Though direct statistical tests for measuring the appropriate number of classes has yet to be developed, model selection theory is commonly applied to maximize goodness-of-fit and parsimony (Finch and French 2015). We compared models ranging from a single homogenous population to a heterogenous population comprised of 4 unique classes, and selected our top model using Bayesian information criterion (BIC). The BIC is commonly used in latent class regression over alternate model selection criterion, like Akaike information criterion and likelihood ratio chi-squared statistic, because it takes into account effects of sample size (Boxall and Adamowicz 2002). Quantified latent segments were then qualitatively assessed and named based on the associated predicted probability of agreement with each variable. We then used the model predictions to calculate the predicted probability of membership with each segment based on the preferred alternate activity selected.

Results

After aggregating the 9 rounds of surveys into a single sample, ~17% of random samples had inactive email addresses reducing, our pool of potential respondents from 18,000 to 14,871. Overall survey responses were low (11%) but within the normal range of online surveys. Per institutional requirement, respondents could opt-out of any individual question within the survey. Unfortunately, there was a clear bias with many respondents choosing not to complete questions associated with moral extension, which further reduced overall sample size to 847 respondents.

Hunting was the dominate alternate outdoor recreational activity among Nebraska anglers (selected by 473 respondents), followed by camping (207), nature walking (103), and boating (67) (Figure 3). These responses were used as a covariate within the final latent class regression model set used in the model selection process. We ran each model assuming 1 to 4 latent classes and selected the model that assumed 2 latent classes because it had the lowest BIC value of 11390 (as compared to 1 segment --- 11562, 3 segments --- 11415, and 4 segments --- 11491). Based on the probability of choice associated with the 2 segments, we characterized the first segment to be indicative of a pathocentrist view and the second to be indicative of an anthropocentrist view (Figure 4). The anthropocentrist segment selected strongly disagree or slightly disagree 98% of the time when asked whether they sometimes find fishing difficult because they inflict pain on a fish, selected strongly disagree or slightly disagree 92% of the time when asked whether they sometimes find hunting difficult because they may inflict pain on the animal, and selected strongly disagree or slightly disagree 21% of the time when asked whether animals should have the same rights as humans. In comparison, the pathocentrist segment strongly disagreed or slightly disagree that they found fishing difficult 58% of the time, selected strongly disagree or slightly disagree that they find hunting difficult because they may inflict pain on the animal 32% of the time, and selected strongly disagree or slightly disagree that animals should have the same rights as humans only 43% of the time. Further, individuals falling in the anthropocentrist segment have 35% chance of believing that only humans can feel pain and fear, as opposed to individual falling in the pathocentrist segment that has a 0.3 percent chance of believe that only humans can feel fear. The pathocentrist segment had a 45% chance of believing that all

animals had the capacity to feel pain as compared to only 14% in the anthropocentrist segment. A biocentrist view was not prevalent enough within the sample to be broken out as a unique segment, despite our direct efforts to test more assumed latent segments outside the model selection process. If a biocentrist segment was present, we would have expected to identify a segment that showed a high degree of agreement opposing responses to the anthropocentrist segment. In testing an increasing number of assumed segment models, we found that the respondents within the anthropocentrist group were more likely to diverge than respondents closer to biocentrist views on the moral extension continuum.

In assessing how predictive moral extension segments were in determining preferred alternate outdoor recreational activity, we predicted that hunting was dominated by the anthropocentric segment, but not to the degree we expected based on the theoretical basis of the continuum. Respondents who selected hunting as their preferred alternate activity had a 29% predicted probability of being pathocentrist (71% anthropocentrist), those who selected camping as their preferred alternate activity had a 91% predicted probability of being pathocentrist (9% anthropocentrist), and those who selected nature walking as their preferred alternate activity had a 97% probability of being pathocentrist (3% anthropocentrist)

Discussion

Our findings are directly in line with expectations drawn from a wide breadth of disciplines (e.g., leisure science, environmental philosophy, and socio-ecological systems). In this study, we determined that even within a subpopulation of outdoor recreator (inland recreational angling), there is evidence of both anthropocentrist and

pathocentrist moral extension views, and little evidence of biocentrist views. Further, we determined that inland recreational anglers' preference for outdoor recreation alternatives to fishing were strongly influenced by their moral extension segment membership.

The empirical relationships we quantified were in support of the hypothesis that outdoor recreator's behavior and preferences are a function of the environmental philosophies they ascribe. Therefore, the perceived legitimacy of benefits obtained from varied outdoor recreation may exist across a culturally and morally relative continuum determined by interactions between other known environmental continuums (Figure 3-1). If true, solving the current conservation funding issues that plague the North American Model of Conservation may require more than just increasing participation in hunting and fishing, but rather understanding the prevalence of different environmental philosophies across North America. In doing so, the functional, social, and cultural relevance of the North American Model can be maintained by tailoring conservation policy and outdoor recreation practices to be inclusive of a wide variety of participants with disparate views.

Previous work assessing perceptions of outdoor recreators had comparable conclusions, although to our knowledge moral extensionalism and its relationship to participation in outdoor recreation has not been previously tested. Although, moral domain has been hypothesized to relate to outdoor recreation and has been empirically applied outside of outdoor recreation research. Moral extensionalism is an effective predictor for diet choice of people (De Backer and Hudders 2015) and their political party affiliation (Feinberg and Willer 2013). Arlinghaus (2007) provided an in-depth description of moral extensionalism, providing a logical argument for catch-and-release

fishing to not conflict with an anthropocentrist view or a physiocentrist view (i.e., humans should not be viewed independent of the animal kingdom).

Conceptualizations such as that in Arlinghaus et al. (2007) are common in environmental philosophy and environmental tourism literature, used both to argue for and against the mainstream morality of hunting and fishing. Within such hypotheses, different environmental philosophies and continuums are rarely integrated, or described in an interdisciplinary context. Rather, there is a tendency to consider environmental philosophies within a vacuum, relying on paradigm-based foundations that are assumed to be well know and apparent. For instance, the application of moral extensionalism is generally limited to understanding the intrinsic-value based perception of animals and animal rights (Balon 2000, Fennell and Nowaczek 2010, Lute et al. 2016). As such moral extensionalism is generally applied as an antithesis of conservation and management benefits commonly touted by fisherman and hunters-- like population control, conservation dollar generation, and cultural connection to nature (citations). Such benefits are seen as immaterial to the costs to the individual animal, but in practice moral extensionalism transcends such artificial boundaries. The benefits of outdoor recreation to the recreationist and the environment lie upon a continuum of morals, ethics, and norms.. Inherent within such a continuums is a fundamental difference in how ethics and morality are defined by commensurate groups. Cultural and moral relativism encapsulates these processes by suggesting that moral standards are highly contextual and that culture itself is relative to the society or community in which it exists (Boas 1896, Caduff 2011). Given these anthropological doctrines, the cultural and communication

divide between participants in consumptive and non-consumptive outdoor recreation is likely a result of diverging definitions of analogous terms and ethical views.

In scientific inquiry, similar issues of relativity and diverging definitions occur within normal paradigm-based science (Kuhn 1970). The pitfalls of paradigm-based science are widely accepted within normal scientific inquiry, but the cultural ramifications can easily be forgotten. It is important to consider that within groups of participants and even within decision-making conservation organizations there are often widely accepted assumptions and terms that are believed to be true and self-explanatory within that group, but not among outside groups. Numerous philosophical and empirical assessments of people's perceptions of nature and environment have been completed, many seeking to define legitimate use of natural resources, or the legitimate consumptive-use of animals (e.g., Soderbaum 1999, Carter 2007, Shani and Pizam 2008, Breakey and Breakey 2015, Meinard 2017). Such assessments are conducted based on a variety of underlying and agreed upon theory within an associated paradigm.

Integrating Environmental Philosophies

Recognizing the role that scientific and cultural paradigms may play in our experiment, we developed a novel theoretical conceptualization to describe how the interaction of differing environmental philosophies can alter the legitimacy of perceived benefits from distinct types of outdoor recreation. Important to our conceptualization is the recognition that many environmental philosophies coincide with each other or the acceptance of one environmental philosophy may underly the acceptance of another (Figure 3-1). Herein, we describe these interactions and the roles played in altering perceived benefits of different outdoor recreational activities. In our conceptualization,

we provide three distinct continuums that originate from a variety of disciplines and are representative of the breadth of environmental viewpoints (Figure 3-1).

The environmental ethics–animal rights continuum describes the progression of belief at which level of organization within an ecosystem management actions should be considered important. For example, environmental ethics is largely concerned with processes and management action occurring at the species level. Environmental ethics differs greatly from animal rights, which is concerned with processes at the individual level. In between these two beliefs, animal welfare is concerned with the population. Ultimately, these views are concerned with protecting and conserving natural ecosystems, but fundamentally disagree on the basic assumptions of how that should be conducted and what metrics are important to measure success. The importance of species-level management associated with environmental ethics leads to a focus on population parameters like survivorship and fecundity. This focus can place a premium on the generation of conservation revenue through hunting or fishing for some individuals within a population, especially individuals unlikely to contribute to fecundity. The animal rights view conflicts with the views of environmental ethics because of its emphasis on managing individuals and the underlying value of importance placed on individual animal life (Figure 1). Differing underlying assumptions of importance results in an inability to weigh the importance of management actions and results in impaired communication between conservationists with similar goals.

A by-product of the differences in metrics for success within the environmental ethics–animal rights continuum is a difference in how animals are valued as individuals and as resources. Hughes (2001) suggested a continuum exists in the measurement of

value based on how animals relate to human society. In this continuum, the value of an animal can be measured as instrumental value, which relates solely to the benefits an animal provides to human society. On the other hand, the value of an animal may be independent of benefits to society; The animal may be valuable in and of itself, which is referred to as having intrinsic value. Between those two extremes, inherent value exists when value is still largely based on the benefits provided to society, but additionally recognizes the indirect benefits (e.g., positive emotions) that may occur independent of any direct benefit. Therefore, the continuum of instrumental and intrinsic values is correlated with the environmental ethics-animal rights continuum because it describes why a person may place a higher importance of conservation at the individual level rather than the population level or species level (Figure 3-1). When an animal's value is perceived to be grounded in the simple fact that it exists and is a living thing (i.e., intrinsic value), then there is a higher cost with harvesting that animal than would be perceived if the value is derived from its benefits to people (i.e., instrumental value) or even from the positive emotions gained by people seeing it in the wild or knowing it exists (i.e., inherent value) (Carter 2007).

To connect moral extensionalism we used in our empirical experiment to the environmental ethics–animal rights continuum and instrumental value–intrinsic value continuums leads to the conclusion that people may not apply these environmental philosophies equally across all taxonomic groups. For example, an individual may perceive high intrinsic value and conclude that individual-level metrics are important for many species of mammals and birds, but not afford those same views to fish and invertebrates. This incongruence is not a hypocritical fallacy, but rather an important

distinction based on the perceived sentience of different taxonomic groups and their associated potential for pain and suffering.

While all three continuums are interrelated, the interactions between each continuum result in variable and contextually relative individual perceptions among people. People's alignment on each continuum will result in very different views of what management actions are beneficial or detrimental. Recognizing that the interaction of all three continuums will increase variability in people's perspectives is important because it defines the tradeoffs that people find acceptable. For example, measuring a single environmental philosophy continuum may show only three clusters of perceptions among a population of people (Figure 3-5-A). Measuring the second or third continuum may spread those three clusters to a continuous, overlapping population of perceptions with diverging views of what tradeoffs are acceptable (Figure 3-5-B, Figure 3-5-C). We contend that defining this population will allow conservation decision-makers to understand what tradeoffs are truly acceptable and under what assumptions outreach activities should be communicated to the general populous.

Quantifying the distribution of public perceptions across our conceptualized framework would provide a great deal of insight about the future of conservation funding within the North American Model of Conservation, and the efficacy of the model in its current state. Further, empirically describing patterns in public perceptions will provide proponents of hunting and fishing in its current form relative understanding of the beliefs of detractors and vice-versa. Understanding and describing these beliefs in an interdisciplinary fashion will provide common ground for productive decision-making within natural resources governance and a means to redefine current social and cultural

practices of disparate groups. For example, there has been instances of social and popular media backlash against large-game trophy hunting (e.g., Cecil the lion) that have cast recreational hunting in a negative light. When considering the interaction of different environmental philosophies, it is easy to see how rationalizing these hunts with arguments of generating conservation dollars or the removal of a low-fecundity animal may not be impactful if a large portion of the populace does not adhere to the environmental philosophies that place a premium on those benefits. Further, moral or ethical issues with those hunts may result from any one environmental philosophy that is incongruent with those prescribed benefits or potentially all of them.

Given the implications of our conceptualization, we contend that understanding and defining the composition of perspectives as defined by the previously described continuums and further, how those views relate to perceived benefits of different forms of recreational consumptive-use of animals may be integral to the future success of the North American Model of Conservation. For instance, if U.S. communities and counties are dominated by perceptions framed through anthropocentrist views and environmental ethics (Figure 3-6-A), then one would expect very little conflict centered on consumptive-use of animals that include hunting and fishing solely for trophy or sport. If the opposite perceptions (i.e., biocentrist and animal rights) are in the majority, then one would expect a great deal of conflict centered on most forms of consumptive-use of animals conducted in recreational hunting and fishing, putting the long-term viability of these forms of recreation in jeopardy (Figure 2-6-B). Given the results of this pilot experiment, a scenario where much of public opinion falls in the center of the continuums may be more likely (Figure 2-6-C). If true, most Americans perceive consumptive-use of

animals through a pathocentrist and animal welfare view and both ends of the continuums are representative of highly-vocal but never the less minority groups. Finally, the composition of public opinion may be more representative of the current political dynamics with a bimodal majority (Figure 2-6-D). In this scenario, public perception is equally prevalent among either end of the continuums with a minority group falling in the middle.

Our conceptualization suggests that further research is needed to understand how environmental philosophies and individual perceptions of the legitimate use of animals determine what outdoor recreational activities in which people choose to participate. Participating in outdoor recreation creates a connection to natural resources and defined importance for fish and wildlife conservation efforts. The relationship between participation in outdoor recreational activities and environmental philosophies of participants is likely indicative of political and social divides in North America among conservationists. We contend that explicitly defining how those divisions occur and the composition of different philosophical views in North America is imperative to solving conservation funding limitations into the future.

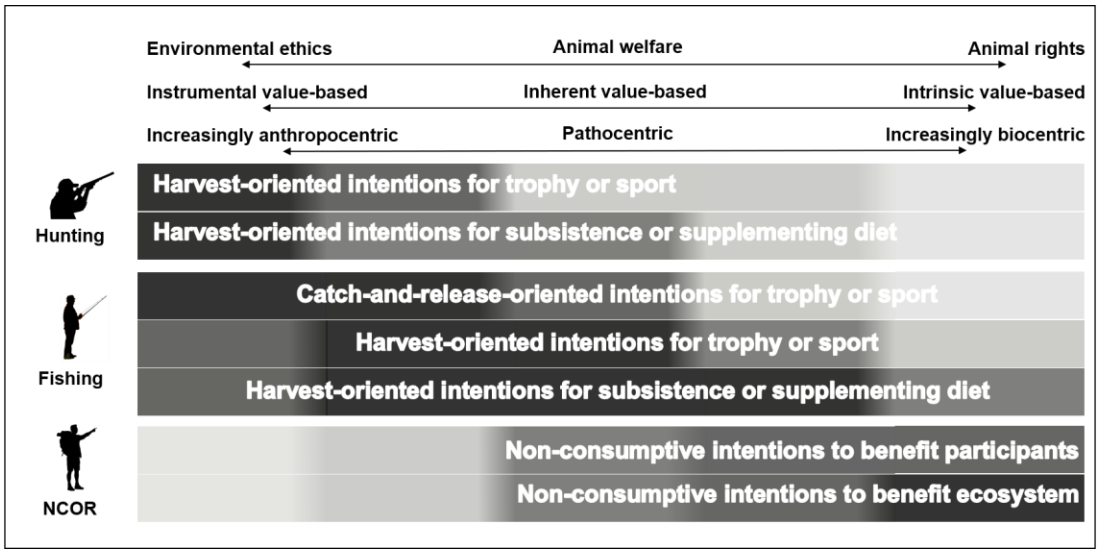

Figure 3-1

Conceptual model illustrating influence of interacting environmental philosophy continuums on an individual's perceptions regarding legitimacy of benefits achieved by hunting, fishing, and non-consumptive outdoor recreational activities. Greyscale indicates perceived benefits associated with each form of outdoor recreation based on the philosophical views associated with environmental ethics-animal rights, instrumental value-intrinsic value, and moral extension continuums. Darker shaded boxes indicate benefits as perceived by those upholding views relative to each point along the continuums. See text for explanation of continuums and for distinctions of individuals' intentions. This conceptualization explains differences in public opinion toward issues such as animal-population control, harboring animals in captivity, and trophy hunting for exotic animals.

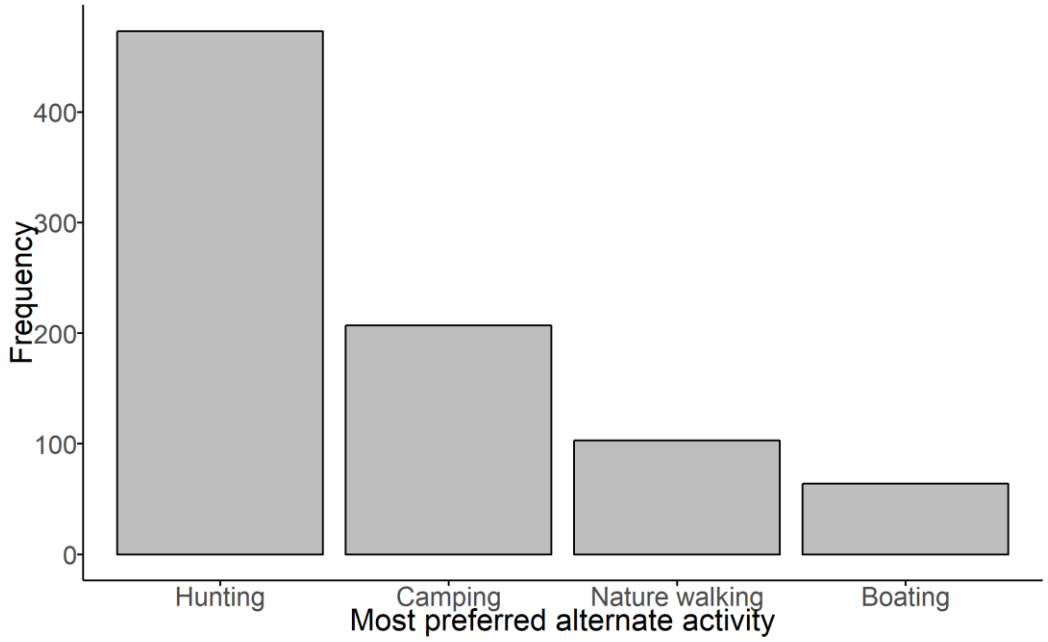

Figure 3-2

Frequencies of most preferred alternate activity of Nebraska anglers. To account for disparities in sample size, the categories: nature walking and boating are aggregates of categories initial categories that were provided to respondents where hiking and birdwatching were collapsed together to form nature walking and paddlesports and watersports were collapsed together to form boating

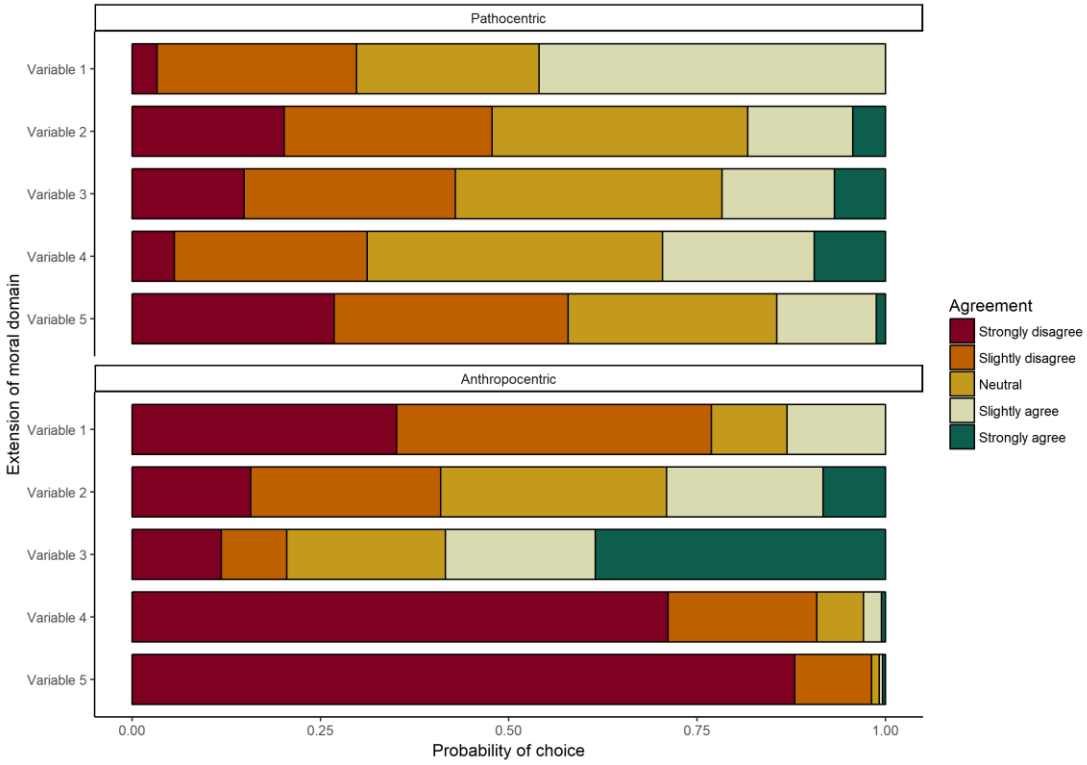

Figure 3-3

Nebraska angler probability of agreement with different portions of the extension of moral domain continuum. Pathocentric (upper) represents the those that extend the moral domain to humans and a select number of animals that are intelligent, social, and able to feel physical pain. Anthropocentric (lower) represents those that extend the moral domain to only humans. The range of agreement for each variable goes from red (Strongly disagree) to green (strongly agree). A biocentric group is normally included within the extension of the moral domain continuum but was not prevalent enough to be broke out as a separate group within our sample.

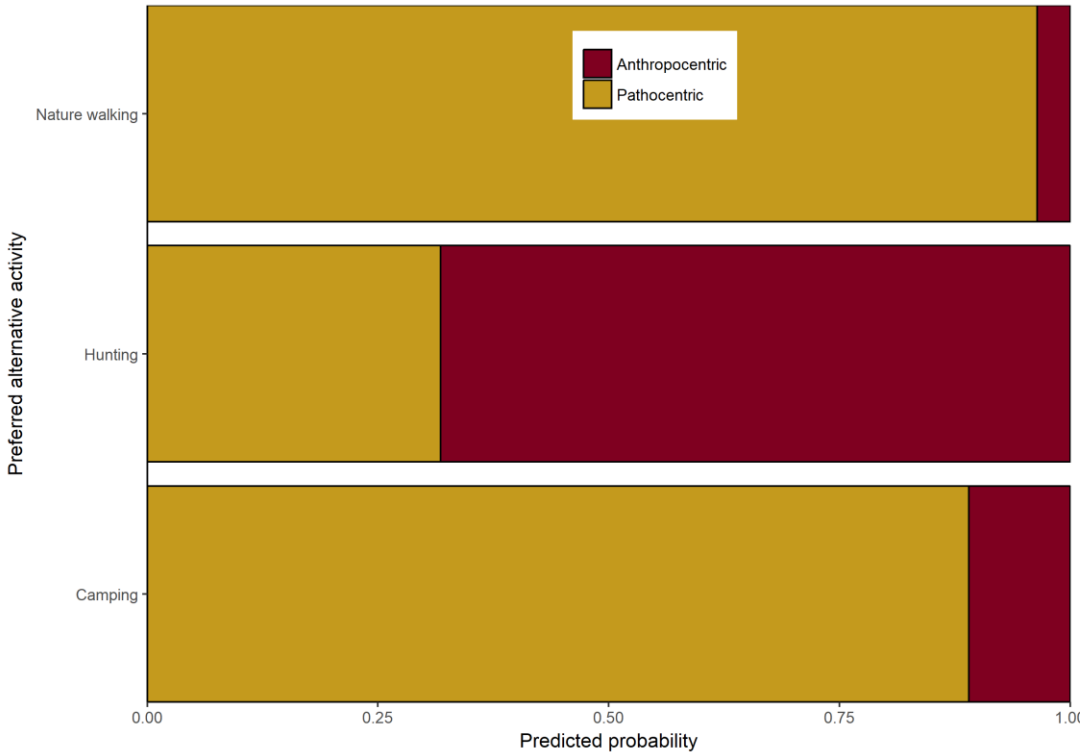

Figure 3-4

Predicted probability of Nebraska anglers preferred alternate activity based on membership with the extension of moral domain segments, pathocentric and anthropocentric. Pathocentric is represented by gold bars and anthropocentric is represented by red bars.

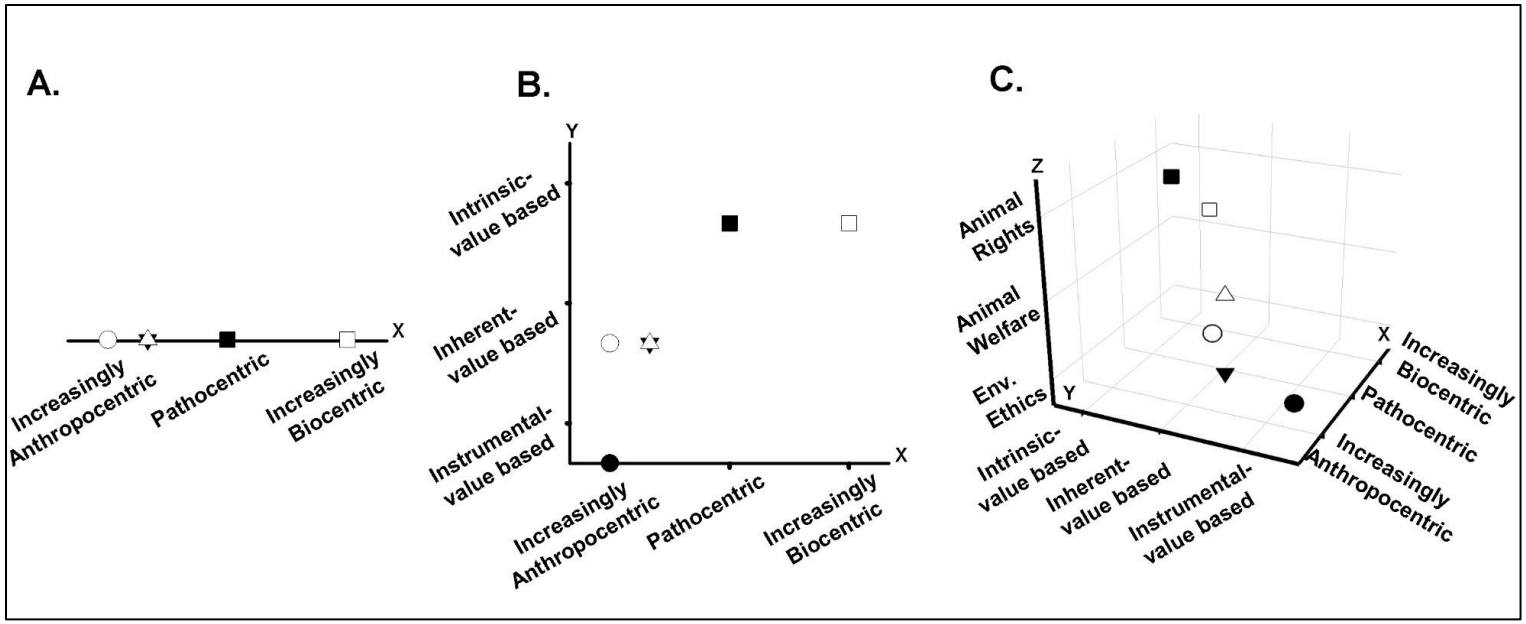

Figure 3-5

Illustration of how assessing environmental philosophy continuums together may account for unexplained variation among individual's perceptions and views by recognizing that the subtle differences between each continuum could lead to differing assumptions of and definitions for legitimate consumptive-use of animals. Each unique shape represents a single individual and their relative position on each continuum. Figure 3-5-A, individuals are only described using the continuum of moral extensionalism and only shows 3 general groupings. Figure 3-5-B, the instrumental – intrinsic value continuum is included which shows how two individuals (black and white circles) views separate because one places a higher premium on inherent value over instrumental value but have the same views of moral extensionalism. Figure 3-5-C includes the environmental ethics – Animal rights continuum which further accounts for more variation in the individual's views (black and white triangle) and shows complete separation among all individuals.

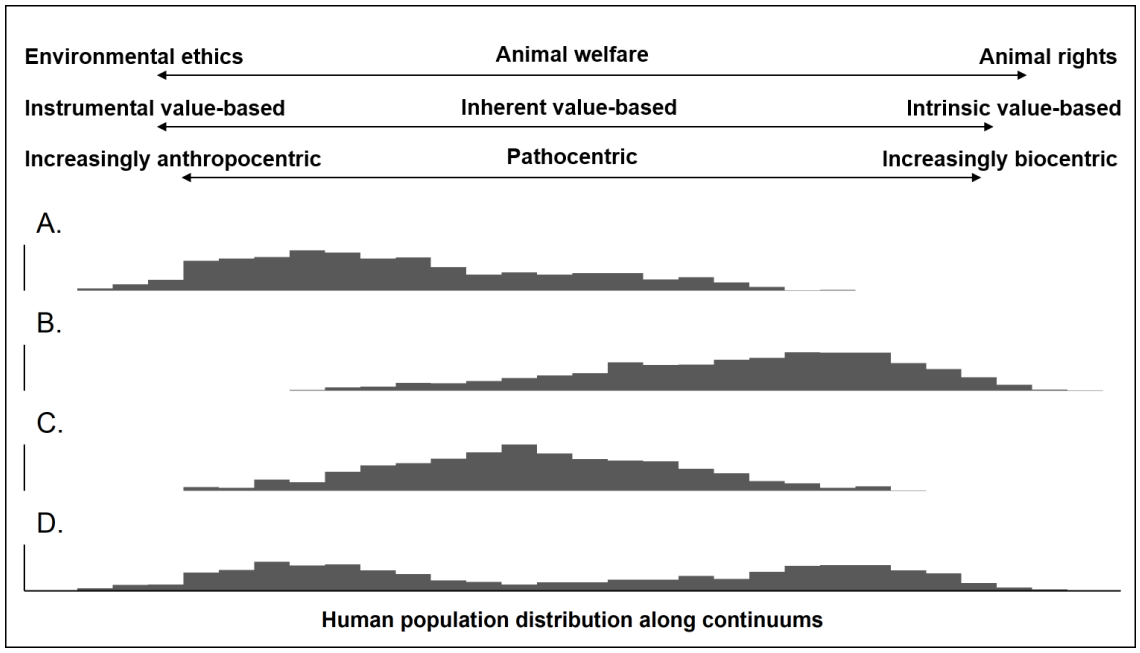

Figure 3-6

Conceptual scenarios illustrating possible ranges of human population frequencies along interacting environmental philosophy continuums. Scenario A. is indicative of a scenario where there is little conflict in public opinion over most forms of recreational consumptive use of animals. Scenario B. is indicative of a scenario where most forms of recreational consumptive-use of animals is considered illegitimate, except for some subsistence or supplementation of diets. Scenario C. is indicative of a wide range of public opinion dominated by philosophies which allow for some consumptive use of terrestrial animals (i.e., subsistence or diet supplementation) and most consumptive uses of fish and invertebrates are considered legitimate. Scenario D. is indicative of a bimodal distribution across the continuums with one majority group believing that most forms of consumptive-use of animals is legitimate and a separate majority group believing the opposite (i.e., consumptive-use of animals is illegitimate outside of some forms of subsistence or supplementation of diets).

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CHAPTER 4: NON-LINEAR SPECIALIZATION: IMPLICATIONS FOR RECRUITMENT, RETENTION, AND REACTIVATION OF SPORTSPERSONS

Background

Scientists are rarely aware of the moments where a normative scientific paradigm shifts to an alternative, where the fundamental framework from which assumptions are amended to define the paradigm in a new way (Kant 1929, Kuhn 1970). The recreational specialization framework as it has been historically applied, especially within consumptive outdoor recreation (i.e., hunting and fishing) research, may be a rare example of a scientific paradigm that has begun the process of transitioning from its original conceptualization, though a new framework has yet to be adopted within the scientific community.

In the original conceptualizations of specialization theory, it was hypothesized that specialization resulted from participants progressing through a linear path of involvement within the activity over time, which exerted a direct influence on their behavior and motivations (Bryan 1977, Ditton et al. 1992, Fedler and Ditton 1994). For instance, in the seminal research of the framework, Bryan (1977) demonstrated that more specialized anglers were less likely to be consumptive and tended to prefer large or rare fish over simply catching any fish, suggesting a direct relationship between anglers' motivations and their level of involvement. Given his results, Bryan theorized that anglers progressed in their involvement with recreational activities, much the same way one progresses through a career. The implication of theory as he proposed it suggested

that there is a linear path from novice to expert that is initialized through participation and develops through time to culminate in highly specialized state (Miller and Graefe 2000). In an era where recruitment, retention, and reactivation (R3) of consumptive outdoor recreators has been highlighted as a major focus for state fish and wildlife management agencies, linear progression of involvement (hereafter, linear specialization framework) is attractive because it allows for a simplified approach toward increasing participation within the activity (Ryan and Shaw 2011, Everett and Nelson 2016). In applying the framework, outreach and marketing specialists may focus on introducing new participants to the activity and invest less effort towards incentivizing current participants to continue to participate each year, with the expectation that new participants will progress to an increasingly involved and committed state (Larson et al. 2014, Quartuch et al. 2017).

Until recently, the assumption that consumptive outdoor recreators progress linearly to higher levels of involvement was widely accepted without broad confirmation within the scientific community (Scott and Shafer 2001, Kuentzel and Heberlein 2006). Recent studies based around longitudinal, rather than cross-sectional data, have demonstrated that linear progression is likely the exception rather than the rule (Kuentzel and Heberlein 2006, 2008, Oh et al. 2011, Oh and Sutton 2017). As such, the progression-over-time model may be an incorrect representation of how involvement changes through time (Backlund and Kuentzel 2013), the methodological limitations of cross-sectional data collection may have skewed our interpretation of how participants progress (Oh et al. 2011), or the complexity of consumptive outdoor recreation as a social-ecological system may limit researchers' abilities to quantify progression (Hunt et

al. 2013). Herein, we explore the implications of highly heterogeneous segments of participants in consumptive outdoor recreation and how that influences our understanding of the specialization framework moving forward.

The Progression of Specialization

Though the origin of the specialization framework is important, comprehensive literature reviews have been conducted recently that highlight how the framework developed and call for the acceptance of a non-linear specialization framework by not assuming that participants will progress to higher levels of involvement with more time spent participating in the activity (in opposition to the historically linear specialization framework) (Scott and Shafer 2001, Scott 2012). As such, we will largely focus on the research that follows and the attempts to reconcile the implications of a non-linear specialization framework within consumptive outdoor recreation. Substantial research effort is still needed to evaluate the implications of a non-linear specialization framework and to describe a generalized theory that represents how participant involvement progresses over time.

Currently, the non-linear specialization framework is in a state of flux without a clear path forward, but it does appear that the non-linear progression has been widely accepted within consumptive outdoor recreation (Kuentzel and Heberlein 2008, Oh et al. 2011, Backlund and Kuentzel 2013, Schroeder et al. 2013, Jun et al. 2015, Oh and Sutton 2017). In response, researchers have largely stopped using the specialization framework as it was originally theorized and measure participant involvement using individual components that were considered representative of specialization (e.g., centrality-to-life, commitment, capital investment, and social group connections) (Beardmore et al. 2013,

Schroeder et al. 2018). Although, attempts have been made at identifying multidisciplinary approaches, which attempt to account for non-linear progression by coupling the specialization framework with alternate theories.

Identity theory has been suggested as a means for explaining why outdoor consumptive participant involvement may progress, stagnate, or regress within an activity (Schroeder et al. 2013, Jun et al. 2015). Identity theory suggests a person's sense of self-worth and happiness is directly determined by their ability to express situationally appropriate identities indicative of the person's sense-of-self (Burke and Stets 2009). Within this theory, an identity is composed of a set of meanings that characterize a person as a member of a group, a role, or a unique person (Burke and Stets 2009, Jun et al. 2015). The identities are expressed based on standards which can be socially or internally defined (i.e., referred to as role or person identities) (Ryan and Deci 2000). People may view recreation as an arena within which they can construct situations that facilitate expressing identities that affirm their sense-of-self (Haggard and Williams 1992). Because people are active in attempting to maintain the compatibility of their physical and social interactions with the identity standards from which they are expressing their identity, it would be expected that their ability to maintain congruency with their identity standards would determine future decisions to participate or continue to participate within an activity (Stets and Burke 2000). Studies that apply identity theory to the non-linear recreational specialization framework have hypothesized that the role identity of being an outdoor recreation participant (i.e., waterfowl hunter and hiker) superseded other components of the framework, but with mixed results. Self-identifying as a participant within an activity exerted a strong influence on common measures of specialization (e.g.,

commitment, centrality-to-life, and self-perceived skill), but it did not account for non-linear progression (Schroeder et al. 2013, Jun et al. 2015). Further, identifying with the role of a participant may not be indicative of continued participation within the activity (Schroeder et al. 2013).

Other studies have highlighted the effects of changing lifestyles and lifestyle constraints as forces that may lead to a non-linear recreational specialization framework (Kuentzel and Heberlein 2008, Backlund and Kuentzel 2013). Underlying these ideas are assumptions that throughout the course of a participant's life, disruptions occur that may constrain both progression within an activity and even participation (Unkel 1981, Kuentzel and Heberlein 2008). Though some life-course disruptions (e.g., marriage, illness, and finances) do appear to influence specialization within recreational boating, it does not appear that life course disruptions have a comprehensive effect that would fully explain non-linear progression (Kuentzel and Heberlein 2008, Backlund and Kuentzel 2013). In response, Backlund and Kuentzel (2013) introduced a novel framework integrating specialization and cultural capital that they refer to as leisure capital. Here, capital investment occurs as it would within a financial economy; people increase cultural capital by accumulating training, knowledge, and social connections within a network (Bourdieu 1986). Most importantly, change in leisure capital over time is assumed to be dynamic, meaning that people must continue to invest time and effort into maintaining capital in order to reap future benefits, resulting in multiple trajectories based on the participants activity diversification, activity constraints, routines, and the occurrence of major life-course events over time (Backlund and Kuentzel 2013). The leisure capital framework suggests that altering these state categories ultimately determines the

likelihood that an individual participates in an activity, progresses further or regresses within in that activity.

Increasing numbers of disruption events in participants lives is assumed to result in regression of involvement within the activity and decreased participation (Scott and Lee 2010). Although, this assumption is largely unproven and appears to have little effect on participants level of skill or if they continue to self-identify as a participant in the activity (Scott and Lee 2010, Schroeder et al. 2013). Given this, attempts have been made to draw comparisons between the recreational specialization framework and serious leisure theory, the latter having been applied substantially within non-consumptive recreational activities (Tsaur and Liang 2008, Scott 2012). Serious leisure represents a bimodal state framework that suggests participants transition from amateur to serious participants (Stebbins 1982, Tsaur and Liang 2008).

Unlike recreational specialization, serious leisure does not exist along a continuum, but rather assumes that participants progress from an amateur state to an expert state upon meeting six pre-defined qualifications. These qualifications represent the differences between being serious about the activity versus being a causal participant: participants must express a willingness to persevere over the challenging parts of an activity (e.g., ski a steep downhill slope or fire a gun accurately), maintain a career in the activity through long-term involvement, make significant personal investments of times and money, experience a number of durable psychological benefits from participating, adhere to a subculture with unique beliefs, values, and norms, and finally, to identify strongly with the activity as a personal identity (Stebbins 1982, Tsaur and Liang 2008). Commonalities between recreational specialization framework and serious leisure theory

have been noted with discussions of whether the conceptualizations represent the same idea, but so far remain two disparate paradigms (Scott 2012). Most attempts to incorporate the two conceptualizations have recognized that serious leisure is more effective at differentiating between novices and experts but does not effectively describe variation between these participants (Scott and Lee 2010, Scott 2012).

Clearly, Bryan's original intentions of creating a simple framework that would allow managers of consumptive outdoor-recreational activities to assess the dynamics of participation and expectations within the activity have fallen to the wayside. We contend that assuming non-linear progression of involvement within consumptive outdoor recreation drastically changes the implications of R3 efforts aimed at recruiting and maintaining participation to maintain conservation funding levels and protect the heritage of recreational hunting and fishing. Hereafter, we explore the importance of non-linear recreational specialization as a base assumption with the recruitment of consumptive outdoor-recreation participants and describe additional considerations for addressing the usefulness of non-linear recreational specialization going forward.

Non-linear specialization within consumptive outdoor recreation

Broad and comprehensive research has been conducted tying together indicators of specialization that are useful and easily manipulated by managers (e.g., participation, satisfaction, and site-selection) (Fisher 1997, Miller and Graefe 2000, Needham et al. 2007, Dorow et al. 2010, Beardmore et al. 2013, Schroeder et al. 2013). Unfortunately, the implications of non-linear recreational specialization suggest that the composition of participants who express those indicators may be highly dynamic. When specialization indicators are not reliable over time it drastically reduces researcher's ability to account

for the complexity of consumptive outdoor-recreation participation as a system and unexpected changes. As we have shown, alternative multi-disciplinary conceptualizations have been suggested with the potential to describe when progression or regression of participant involvement may occur (i.e., life disturbances, leisure capital, and identity theory) but these conceptualizations are unproven to date.

Further, the intentions and preferences of participants can vary widely because within individual activities a wide variety of formulations with participation may occur (Beardmore et al. 2013). For example, though downhill and cross-country skiers might both self-identify as a "skier," the expertise, equipment, participation cost, and cultural norms differ widely between the two forms of skiing. As such, just measuring participants level of specialization within a general activity (e.g., skiing) may not be indicative of specialization characteristics when these sub-activities are assessed separately via comparisons of motivation, investment, and behavior.

In recreational angling, it has been shown that when specialization is assessed within a multi-attribute survey framework, a person's responses may differ based on whether they are being asked about their general angling identity or specific forms of angling. A range of species-seeking, catch orientation, or non-catch based motivations may result in a range of different sub-activities (Dorow et al. 2010, Beardmore et al. 2013). Beardmore et al. (2013) suggested that cognitive measures of specialization (i.e., centrality-to-life, social group commitment) were appropriate when assessing the general activity (e.g., recreational angling), but measures of investment and expertise might be more effective when applied to the specific sub-activities (e.g., bass angler, crappie angler, or catch-and-release-oriented angler). While intuitive, these conclusions are

drawn with the assumption that each sub-activity is not perceived as a unique activity unto itself that may vary widely in what anglers are expressing when they self-identify as an “angler.” We contend that the heterogeneity in how participants progress in their involvement within an activity may be indicative of specializing within completely unique sub-activities and transitioning between these sub-activities over time.

Operationalizing non-linear specialization for sportspersons

We suggest that operationalizing non-linear specialization to generalize the progression of activity involvement within consumptive outdoor recreation requires meeting three main criteria. Future studies must develop reliable longitudinal study designs that are effective in quantifying how participant involvement changes over time. General theories must be identified that predict how activity involvement is constrained or facilitated and results in progression, stagnation, or regression. Finally, the effect of heterogeneous sub-activities within consumptive outdoor-recreation must be addressed within specialization frameworks, which historically have contextualized involvement within a general-activities by including motivations or preferences as covariates to specialization.

Addressing the lack of longitudinal study designs has the clearest benefits but is likely most difficult to achieve. Longitudinal designs are rare because studying a single respondent pool over a long period is difficult, expensive, and introduces additional biases relative to contemporary cross-sectional design. Institutional constraints can make long-term longitudinal designs difficult to accommodate. Within consumptive outdoor-recreation research, longitudinal designs are rare but have been accomplished successfully (Butler et al. 2003, Manfredo et al. 2003, Kuentzel and Heberlein 2006,

2008, Catlin and Jones 2010). Consequently, these studies are rarely conducted continuously, but rather by re-contacting previous survey participants and asking them to complete cross-sectional surveys multiple times (Manfredo et al. 2003, Kuentzel and Heberlein 2006, 2008). Multi-contact cross-sectional designs may be more feasible for assessing participant specialization over multi-year scales than classic longitudinal designs under the current research constraints of consumptive outdoor-recreation.

The second criterion (i.e., identify generalizable predications of involvement constraints) is more nebulous, but work is already being done to address it. The combination of leisure capital and identity theory are promising in their ability to describe how non-activity related constraints can influence involvement and identification with an activity (Backlund and Kuentzel 2013, Schroeder et al. 2013, Jun et al. 2015). Identity theory provides a framework that allows for disparate identities (e.g., recreational angler – spouse, recreational hunter – student, and birdwatcher – retiree) to be compared. As the prominence of one identity increases within a person's life, identity theory suggests this may affect the salience of other identities (Burke and Reitzes 1991). Coupling these ideas with leisure capital may result in identifiable changes in how a person enacts different recreational identities, via involvement, over time based on the leisure capital they have accrued. Quantifying these relationships may provide clear and generalizable explanations for how participants may be expected to progress in their involvement within an activity.

The third criterion (i.e., effects of heterogenous sub-activities) has been well identified within consumptive outdoor-recreational activities, but few solutions have been presented within the context of non-linear specialization (Dorow et al. 2010, Beardmore

et al. 2013, Oh and Sutton 2017). Herein we provide a conceptual model that describes our hypothesis of how this criterion may be resolved. We contend that a long-term focus on consumptive outdoor-recreational activities as singular identities (i.e., angler or hunter) has confounded specialization assessments where participates modify the general-activity through activity-specific variables (e.g., species-seeking behavior, motivation, and value orientations). These activity-specific variables are represented as modifiers for what participation occurs or what outcomes will result in a satisfying experience, but largely ignore the functional differences in equipment, skill, and social connections that occur between sub-activities (Figure 1). Of course crossover exists between different sub-activities where certain equipment and skills may be used in both sub-activities (e.g., ownership of and accurate use of a shotgun for both waterfowl and upland-game-bird hunting), but major investments to accrue equipment and skill are made that are indicative of involvement progression in individual sub-activies (e.g., waterfowl hunting – ownership and skill using waterfowl decoys and calls) that are unrelated to other sub-activities (Figure 1).

Additionally, we suggest that the intentional investment of time and money to be more involved in multiple sub-activities within a general-activity allow for crossover in equipment and skill that may be indicative of increased overall general-activity specialization; this hypothesis may explain why cognitive measures of involvement, like centrality-to-life, may be a better measure of activity-general than activity-specific variables (Beardmore et al. 2013, Schroeder et al. 2013). For instance, a highly specialized waterfowl hunter likely has substantial leisure capital investments in equipment, skill, and social groups (Schroeder et al. 2013). A highly specialized upland-

game-bird hunter also likely has similar leisure capital investments, but differences likely exist in the investment of owning and training a dog to retrieve (i.e., waterfowl hunting) versus owning and training a dog to find and point upland game birds (i.e., upland-game-bird hunting) (Miller and Graefe 2000). Based on the crossover between waterfowl hunting and upland game bird hunting, leisure capital theory suggests that either hunter should be able to begin participating and specializing within the alternate sub-activity with fewer constraints than someone who is not specialized in either sub-activity (Miller and Graefe 2000). That said, a participant whose involvement has progressed in both waterfowl and upland game bird hunting may have invested in multiple breeds of dogs trained to retrieve or point individually, or even may have invested in a breed trained to hunt-point-retrieve specifically to accommodate both sub-activities. Conventional wisdom within the linear specialization framework would not differentiate between investing in leisure capital associated with one sub-activity over another that may ultimately be very different (Bryan 1977, Ditton et al. 1992, Miller and Graefe 2000). Recent research has shown that specialization within a sub-activity can be expressed very differently where characteristics of one sub-activity (i.e., being harvest-oriented) may be associated with a low degree of specialization but may be associated with a high degree of specialization in a different sub-activity (Dorow et al. 2010, Beardmore et al. 2013, Oh and Sutton 2017). As such, it may be necessary to assess progression of specialization within sub-activities as unique activities, which cumulatively represent progression of specialization within a general-activity (Figure 1).

Conclusions related to recruitment and retention of sportspersons

A non-linear specialization framework has important implications for the recruitment and retention of sportspersons moving forward. Thus far, we have discussed how non-linear specialization may occur in consumptive outdoor recreational activities, how progression may be interrupted, and how heterogenous sub-activities within consumptive outdoor recreational activities may result in progression across sub-activies rather than within them resulting in a complex pattern of participation over time. For better or worse, conservation funding in North America is fundamentally tied to participation via license sales and excise taxes related to consumptive outdoor recreation. As such, these complex participation patterns and the associated recruitment and retention of participants may determine the effectiveness of long-term conservation efforts and sustainable natural systems.

The importance of recruiting and retaining participants within consumptive outdoor recreation has been well recognized within many fish and wildlife management agencies, resulting in an emphasis on marketing consumptive outdoor recreation participation. Such marketing efforts must recognize that once non-participants are recruited, there is no guarantee that this will result in continued progress within the activity. Considerations must be made at all levels of involvement within the activity and retaining participants is as important as recruiting non-participants given the implications of a non-linear specialization framework. Participants who are already specialized within an activity are likely to possess greater leisure capital, and thus will be more reliable participants if effort is made to offset life disturbance events which will result in specialization regression. Further, participants that are already possess leisure capital

within one sub-activity will be less constrained from participating in other sub-activities, potentially resulting in progression of involvement within the general-activity.

A great deal of work is still necessary to fully characterize the dynamics and implications of non-linear specialization. The recent focus on recruitment, retention, and reactivation of sportspersons and its role in stabilizing conservation funding provides a great opportunity to develop study designs which will improve our understanding of non-linear specialization. Fish and wildlife management agencies, non-governmental organizations associated with consumptive outdoor recreation, and academic institutions should carefully consider how marketing and research may be integrated within adaptive frameworks. Doing so will provide a treasure-trove of information which will assist in redefining the specialization framework as a paradigm and solidify conservation funding into the future.

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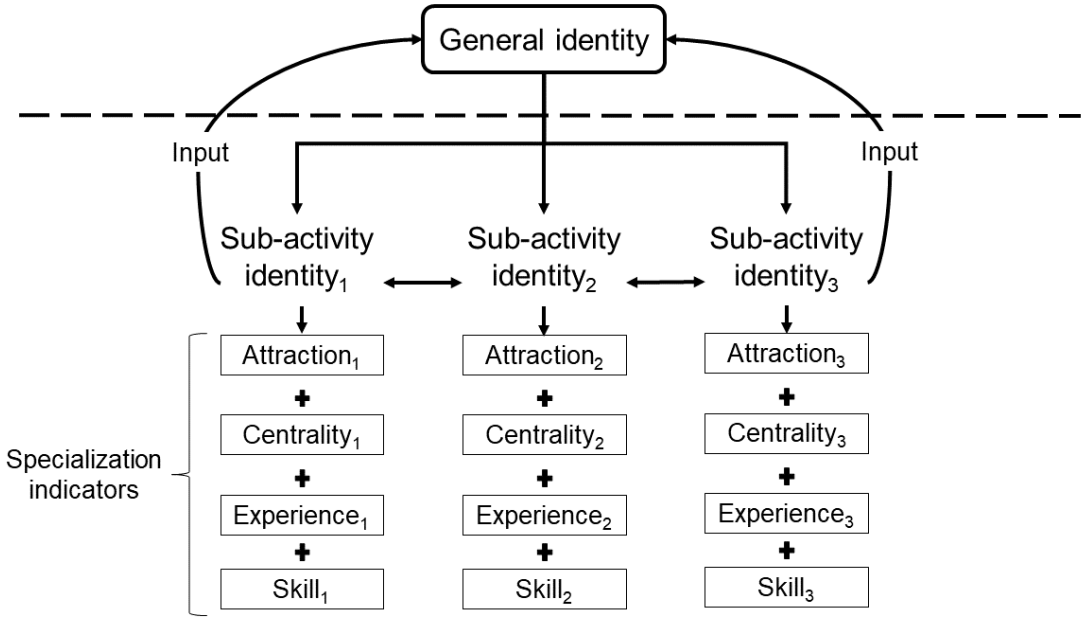

Figure 4-1

Novel reconceptualization of the progression of specialization within a consumptive outdoor recreational activity (e.g., recreational angling). The general identity acts as an aggregate representation of the sub-activities; sub-activities interact through inter-general-activity substitution of expertise, equipment, and commitment. Progression of involvement occurs individually within each sub-activity but quantifiably influences progression (or regression) within the general identity as inputs to general identity involvement.

CHAPTER 5: REFLECTIONS ON IMPLICATIONS AND FUTURE RESEARCH NEEDS

Overview

In this dissertation, we developed a comprehensive assessment of angler heterogeneity of preference and identity in the state of Nebraska. Our results showed angler preferences for trip-specific catch-based variables are greater for fish size than fish number when compared on a relative scale. We quantified angler preferences for trip-specific catch-based variables and showed that willingness-to-pay is largely indifferent to heterogeneity in angler identity relative to the general angling population. We were able to describe how among Nebraska anglers, their preferred outdoor recreational activities varied based on how they extended the moral domain across different groups of animals. Given the implication of this result, we developed a novel conceptualization that combines disparate environmental philosophies to explain why definitions of legitimate use of animals within the context of outdoor recreation may vary widely and why that is important to the future of consumptive outdoor recreation. Finally, we provided a comprehensive review of recent advances associated with the Recreational Specialization Framework and describe how previous consumptive outdoor recreation research should be reinterpreted given that linear progression of involvement within recreational activities may be far from the norm. Based on this review, we developed a novel conceptualization of how non-linear progression of involvement may occur within the context of consumptive outdoor recreation. Hereafter, we discuss the implications of these results

and list important extensions of this research, that may solidify or contextualize the results presented in this dissertation.

Management implications

In Chapter 1, “The Fisheries Manager’s Dilemma”, our results may be interpreted to suggest that anglers are willing to pay higher travel costs to recreationally catch fish biomass derived from increasing fish size relative to biomass derived from increasing fish number. As such, management activities aimed at structuring fish population size structures so that biomass is aggregated within larger size categories (e.g., Trophy, Memorable, and Preferred) may result in higher net angler utility across species-seeking and catch-orientation segments. Previous research suggests that this may be achieved using slot limits that protect fish from harvest until they reach a relevant size to the fishery and then protect larger fish, allowing them to persist within the fishery once they have reached valued size (Wilde 1997, Gwinn et al. 2015). Stock enhancement through stocking is also known to influence population size structures but may have unintended consequences on wild fish populations, acting as a replacement more than an enhancement (Camp et al. 2014). Although, biomass derived from increasing fish size is more valuable, managing for it may create unintended consequences because our assessment did consider potential negative effects on net angler utility from an expected increase in zero-catch trips due to fewer fish available to be caught, potential emergent effects from angler-induced behavior change within fish populations, or effects on angler satisfaction derived solely from changes in fisheries regulations.

We chose not to include zero-catch trips because a major objective for the Chapter 1 was specifically to provide robust estimates of angler willingness-to-pay for

recreationally caught fish across increasing fish size and number caught in the state of Nebraska. Including zero-catch trips would have unnecessarily increased sample size requirements given the scope of this chapter. Previous research suggests that angling-induced behavior change can have unexpected effects on angler catch rates independent of fish population densities (Alós et al. 2014, Arlinghaus et al. 2017, Fedele 2017). If fish vulnerability to angling changes over time or with increasing pressure despite stable population densities, then this would be expected to negate increase in utility achieved by structuring fish population to be dominated by larger fish sizes. Additionally, previous research has shown that angler satisfaction and site-selection can be impacted by fishing regulation and policy changes (Aas et al. 2000, Johnston et al. 2011, Carlin et al. 2012, Dedual et al. 2013, Gwinn et al. 2015). Changing regulations to increase densities of larger fish may result in decreased satisfaction from fishing waterbodies with novel regulations or even result in anglers avoiding those waterbodies despite higher catch rates. The method we used is a "double-edge sword" in that it quantifies angler preference using an in-direct stated-preference method, that is more resilient to bias, but also does not account for participants acting in irrational ways within the context of classic economic theory (Laibson and List 2015, Whitehead and Wicker 2018b). That said, the results of this chapter provide important context in considerations for landscape-scale fisheries management that call for providing for a wide variety of fishing trip outcomes to meet heterogenous expectations of recreational anglers(Hunt and Arlinghaus 2011, Camp et al. 2015).

In Chapter 2, "The Management Implications of Heterogeneity among Angler Identities", our results counter natural resources management perspectives that suggest

monetarily valuing cultural ecosystem services may be sensitive to heterogenous perspectives among those benefiting. In our results there was little difference between the general angling population's willingness-to-pay for trip-specific catch-based outcomes and alternate angler segments based on catch-orientation, commitment, and involvement. That said, we only assessed the instrumental value of recreationally catching fish and chose not to explore alternate forms of valuation that may alter how the cultural services of recreationally caught perceived (Gómez-Baggethun and de Groot 2010, Chan et al. 2012, 2016). Given the scope and limitations of this research project, we did not feel it was appropriate to assess other forms of value (i.e., intrinsic or existence value) or to quantify how non-participants who are not directly benefiting from recreationally caught fish may value sportfish. Despite that, it is important to recognize that the monetary values presented within this dissertation relate only to the replacement value (i.e., value necessary to recoup losses by a group) for recreationally caught fish by anglers in the state of Nebraska. The monetary values presented are not representative of total economic value for fish of specific sizes or species in the state of Nebraska as they do not represent the general population of Nebraska citizens or those represented by other forms of value.

In Chapter 3, "The Extension of the Moral Domain among Sportspersons", the results provide important implication to the recruitment, retention, and reactivation of consumptive outdoor recreation participants in the state of Nebraska. Currently, recruiting new participants in recreational hunting and angling to maximize license sales and stabilize conservation funding has become a major focus among state fish and wildlife agencies. Our pilot results suggest that the recruitment of new outdoor

recreational participants may be constrained by how they extend the moral domain to different groups of animals. Our research focused solely on recreational anglers that limited our ability to extrapolate the results to broader Nebraska population groups but if this relationship is similar across participation patterns in hunting and non-consumptive outdoor recreational activities then there may be a portion of the general Nebraska population that may be constrained from certain consumptive outdoor-recreational activities based the environmental philosophies they express. Our study was to our knowledge the first to assess the relationship between environmental philosophy and participation in outdoor recreational activity, although value orientation metrics have been applied extensively within a single activity (Manfredo et al. 2003, 2016, Teel and Manfredo 2010). Given our results, there may also be important implications for potential cultural backlash in marketing consumptive outdoor recreation using contexts that are more congruent with patho- and biocentric environmental philosophies (Manfredo et al. 2017b).

In Chapter 4, "Non-Linear Specialization: The Implications for the Recruitment, Retention, And Reactivation of Sportspersons", we provided a descriptive explanation for the current state of specialization and how to incorporate new findings that suggest linear specialization rarely occurs and assumptions of non-linear specialization should be considered. We also discuss the current state of the framework and new conceptualizations that account for non-linear specialization within the participation in consumptive outdoor recreational activities. The most important implication of this work recognizing that many of the historical assumptions of how specialization occurs are being reevaluated that poses important implications for recruitment, retention, and

reactivation of participants. We can no longer assume that initializing involvement into consumptive outdoor recreational activities will result in linear progression to higher degrees of participation, avidity, or investment of time and money (Kuentzel and Heberlein 2006, 2008, Scott and Lee 2010, Oh et al. 2011). Further, those that do specialize and become more involved within an activity will likely exhibit different preferences, motivations, and value orientations based on the sub-activity (i.e., seeking species or certain motivational orientations) in which they are participating (Beardmore et al. 2013, Oh et al. 2013). Relating to these new assumptions, we proposed a novel conceptualization that describes how participants may express individual specialization trajectories within sub-activities of consumptive outdoor recreation. We proposed that these trajectories have been misrepresented within the normative application of the specialization framework, where specialization is assumed to be a general activity process that ignores the variability in experience, skill, and equipment needed in different sub-activities. The implications of this framework support suggestions within R^3 efforts to emphasize cross-buying activities and market for participation in sub-activities that share equipment and skill to increase overall involvement and potentially, long-term retention.

Future research needs

Joint estimation of willingness-to-travel to assess preferences in a fisheries landscape

In this dissertation we used contingent behavior, a stated-preference method, to assess the angler preferences and willingness-to-travel for different trip-specific catch-based outcomes. We used this method because it allows for comprehensive, cost-effective assessments of non-market benefits across broad spatial scales. Joint estimation

methods are available that quantify non-market benefits via both stated- and revealed-preferences but are also costlier because they impose higher logistical costs in collecting data, ideally through in-person interviews. Conducting a joint-estimation within more narrow spatial scales would allow researchers to quantify angler preferences dynamically over time. If angler expectations are also assessed then angler satisfaction may by assessed indirectly, reducing bias and quantify net utility achieved from fishing trips. When assessed within a landscape scale, this information will elucidate how anglers respond to previous trips by selecting certain sites or participating at all.

Define composition of environmental philosophies within general population of Nebraskan citizens and relationship to leisure participation

The pilot assessment we conducted (how the extension of the moral domain influences participation in alternate outdoor recreation by Nebraska anglers) suggested that people's environmental philosophies may constrain their participation in certain types of outdoor recreation. We presented a novel framework that described how these constraints may occur and the effects they may have at the societal level when considering how the general population perceives legitimate use of animals within outdoor recreation. Assessing the perceptions and philosophies of the general population of Nebraska citizens would provide insight about the philosophies of consumptive outdoor recreation of nonparticipants – important information that would aid programs aimed at recruitment, retention, and reactivation of sportspersons within the North American Model of Conservation. Many assumptions have been made about how nonparticipants perceive the legitimate use of animals within recreational hunting and

fishing. Assessing the general population within the context of our proposed framework will provide important empirical testing of those assumptions.

Assess potential for cultural backlash among sportspersons

Fish and wildlife governance agencies are beginning to fund marketing efforts to reach out to those that do not participate in hunting or fishing using nomenclature that may appear to be more palatable to these nonparticipants. Manfredo et al. (2017) suggested that marketing efforts like these may have unintended consequences by creating cultural backlash among current participants that may decrease trust of fish and wildlife governance agencies. Cultural backlash implies current participants being opposed to perceived changes of the current *status quo* with their respective recreational activity. Given this assumption, it would be expected that more avid and specialized anglers would be more likely to express cultural backlash given their higher level of participation and involvement within the activity. As such, quantifying sportsperson approval of different cultural aspects of their respective activities based on their level of avidity of involvement may provide early indication of potential cultural backlash as agencies market consumptive outdoor recreation specifically to more heterogenous nonparticipants.

Longitudinal assessment of specialization among sportsperson participation

Non-linear progression of specialization within outdoor recreational activities is commonly accepted, but there is a data gap representing how and why non-linear specialization occurs. We presented a review and novel conceptualization that described the current state of non-linear specialization as it has been empirically understood. Conducting longitudinal assessments that quantify how sportsperson specialization

changes over time and across sub-activities (e.g., waterfowl hunting under the activity of " hunting") within consumptive outdoor recreational activities will fill a knowledge gap with wide-ranging implications. Though longitudinal assessments are logistically more difficult, taking on those challenges will characterize assumptions based on previous research.

Leisure capital framework-based assessment of constraints to entering and progressing within hunting and angling

Leisure capital is an important sociological framework that describes how groups progress and behave given the problems and tasks of their everyday lives. Applying the leisure capital framework to consumptive outdoor recreation has promising potential that may explain patterns of participation and progression within the activity. Leisure capital is composed of state categories that represent investment in the leisure activity including their knowledge and habits, gear and equipment, and social recognition. The leisure capital framework describes how altering these state categories ultimately determines the likelihood that an individual participates in an activity or further progresses (i.e., invests more leisure capital) in that activity. Working under the assumption that leisure capital strongly influences participation and progression patterns across leisure activities, the framework provides a simple means of evaluating how to decrease the marginalization of underrepresented minorities within the historical culture of consumptive outdoor recreation and increase the effective attachment of individuals perceiving barriers to participation.

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APPENDICES

Appendix A. Median willingness-to-pay ($US) for trip-specific catch-based outcomes as expressed by anglers who purchased a resident fishing license between 2010-2015

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Channel catfish	5	1	5.03	2.09	12.55
Channel catfish	6	1	5.8	2.78	12.85
Channel catfish	7	1	6.55	3.24	12.25
Channel catfish	8	1	7.28	3.92	13.52
Channel catfish	9	1	7.98	4.54	14.19
Channel catfish	10	1	8.67	5.27	14.23
Channel catfish	11	1	9.35	5.81	14.76
Channel catfish	12	1	10.01	6.69	15.55
Channel catfish	13	1	10.66	7.21	16.12
Channel catfish	14	1	11.3	7.83	16.06
Channel catfish	15	1	11.92	8.38	16.69
Channel catfish	16	1	12.55	9.09	17.42
Channel catfish	17	1	13.16	9.85	17.42
Channel catfish	18	1	13.76	10.46	18.28
Channel catfish	19	1	14.36	10.98	18.51
Channel catfish	20	1	14.95	11.84	18.73
Channel catfish	21	1	15.53	12.32	19.66
Channel catfish	22	1	16.11	12.91	19.94
Channel catfish	23	1	16.69	13.43	20.9
Channel catfish	24	1	17.25	13.94	21.36
Channel catfish	25	1	17.82	14.61	22.07
Channel catfish	26	1	18.37	14.72	22.83
Channel catfish	27	1	18.93	15.1	23.6
Channel catfish	28	1	19.48	15.68	24.68
Channel catfish	29	1	20.02	15.55	24.91
Channel catfish	30	1	20.56	16.37	25.78
Channel catfish	31	1	21.1	16.41	26.51

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Channel catfish	32	1	21.63	16.56	27.64
Channel catfish	33	1	22.16	17.14	28.36
Channel catfish	34	1	22.69	17.14	29.45
Channel catfish	35	1	23.21	17.62	29.94
Channel catfish	36	1	23.73	17.82	32.19
Channel catfish	5	2	7.65	4.89	12.08
Channel catfish	6	2	8.59	5.84	12.67
Channel catfish	7	2	9.48	6.44	13.75
Channel catfish	8	2	10.32	7.37	14.11
Channel catfish	9	2	11.12	8.34	15.4
Channel catfish	10	2	11.9	9.16	15.62
Channel catfish	11	2	12.64	9.71	16.36
Channel catfish	12	2	13.36	10.44	16.95
Channel catfish	13	2	14.06	11.23	17.18
Channel catfish	14	2	14.74	12.06	17.85
Channel catfish	15	2	15.41	12.53	18.4
Channel catfish	16	2	16.05	13.59	18.85
Channel catfish	17	2	16.69	14.2	19.48
Channel catfish	18	2	17.31	15.05	20.01
Channel catfish	19	2	17.91	15.52	20.37
Channel catfish	20	2	18.51	16.21	20.95
Channel catfish	21	2	19.1	16.88	21.77
Channel catfish	22	2	19.67	17.21	22.26
Channel catfish	23	2	20.24	17.97	22.85
Channel catfish	24	2	20.79	18.35	23.59
Channel catfish	25	2	21.34	18.81	24.16
Channel catfish	26	2	21.88	19.42	24.76
Channel catfish	27	2	22.42	19.86	25.59
Channel catfish	28	2	22.94	20.09	25.96
Channel catfish	29	2	23.46	20.38	26.55
Channel catfish	30	2	23.97	20.92	27.24
Channel catfish	31	2	24.48	21.58	27.97
Channel catfish	32	2	24.98	21.59	28.76
Channel catfish	33	2	25.48	22.22	29.44
Channel catfish	34	2	25.97	22.47	29.84
Channel catfish	35	2	26.45	22.82	31.05
Channel catfish	36	2	26.93	23	31.79
Channel catfish	5	3	9.77	6.25	14.58
Channel catfish	6	3	10.8	7.68	15.61
Channel catfish	7	3	11.76	8.25	16.9

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Channel catfish	8	3	12.66	9.38	17.21
Channel catfish	9	3	13.51	10.01	17.65
Channel catfish	10	3	14.31	11.04	18.38
Channel catfish	11	3	15.09	12.03	18.78
Channel catfish	12	3	15.83	12.85	19.4
Channel catfish	13	3	16.54	13.58	20.13
Channel catfish	14	3	17.23	14.24	20.81
Channel catfish	15	3	17.9	15.17	20.84
Channel catfish	16	3	18.55	15.82	21.72
Channel catfish	17	3	19.18	16.65	21.97
Channel catfish	18	3	19.79	17.22	22.89
Channel catfish	19	3	20.39	17.91	23.07
Channel catfish	20	3	20.97	18.69	23.46
Channel catfish	21	3	21.55	19.19	24.38
Channel catfish	22	3	22.11	19.77	24.82
Channel catfish	23	3	22.65	20.08	25.44
Channel catfish	24	3	23.19	20.58	25.95
Channel catfish	25	3	23.72	21.29	26.42
Channel catfish	26	3	24.24	21.66	27.19
Channel catfish	27	3	24.75	22.02	27.93
Channel catfish	28	3	25.25	22.4	28.22
Channel catfish	29	3	25.74	22.82	29.07
Channel catfish	30	3	26.23	23.3	29.61
Channel catfish	31	3	26.7	23.71	30.53
Channel catfish	32	3	27.18	23.73	31
Channel catfish	33	3	27.64	24.21	32.01
Channel catfish	34	3	28.1	24.08	32.35
Channel catfish	35	3	28.55	24.57	32.89
Channel catfish	36	3	29	25.08	33.49
Channel catfish	5	4	11.63	7.01	20.09
Channel catfish	6	4	12.71	8	19.8
Channel catfish	7	4	13.71	9.43	20.42
Channel catfish	8	4	14.63	10.09	21.68
Channel catfish	9	4	15.5	10.64	21.65
Channel catfish	10	4	16.32	12.11	21.86
Channel catfish	11	4	17.1	12.89	22.3
Channel catfish	12	4	17.85	13.77	22.5
Channel catfish	13	4	18.56	14.78	23.35
Channel catfish	14	4	19.25	15.56	24.16
Channel catfish	15	4	19.91	16.13	24.15

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Channel catfish	16	4	20.55	17.14	24.55
Channel catfish	17	4	21.17	17.86	25.41
Channel catfish	18	4	21.77	18.5	25.41
Channel catfish	19	4	22.35	19.12	25.95
Channel catfish	20	4	22.92	19.72	26.71
Channel catfish	21	4	23.47	20.34	27.22
Channel catfish	22	4	24.01	21	27.6
Channel catfish	23	4	24.54	21.4	27.98
Channel catfish	24	4	25.06	22.18	28.57
Channel catfish	25	4	25.56	22.06	29.1
Channel catfish	26	4	26.06	22.6	29.68
Channel catfish	27	4	26.55	22.95	30.42
Channel catfish	28	4	27.02	23.15	31.08
Channel catfish	29	4	27.49	23.82	31.7
Channel catfish	30	4	27.95	24.25	32.26
Channel catfish	31	4	28.4	24.2	33.02
Channel catfish	32	4	28.85	24.78	33.61
Channel catfish	33	4	29.29	24.66	34.3
Channel catfish	34	4	29.72	25.2	34.89
Channel catfish	35	4	30.14	25.69	35.94
Channel catfish	36	4	30.56	25.26	36.51
Channel catfish	5	5	13.3	7.57	24.77
Channel catfish	6	5	14.42	8.33	25.17
Channel catfish	7	5	15.44	9.52	25.76
Channel catfish	8	5	16.38	10.48	26.07
Channel catfish	9	5	17.25	11.64	25.94
Channel catfish	10	5	18.07	12.27	25.75
Channel catfish	11	5	18.85	13.5	26.34
Channel catfish	12	5	19.59	14.28	26.77
Channel catfish	13	5	20.29	15.4	26.8
Channel catfish	14	5	20.97	15.93	27.28
Channel catfish	15	5	21.62	17.05	27.21
Channel catfish	16	5	22.24	17.61	28.08
Channel catfish	17	5	22.85	18.59	28.48
Channel catfish	18	5	23.43	19.26	28.41
Channel catfish	19	5	24	20.01	29.15
Channel catfish	20	5	24.55	20.89	29.31
Channel catfish	21	5	25.09	21.17	29.64
Channel catfish	22	5	25.61	21.54	30.33
Channel catfish	23	5	26.11	22.26	30.79

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Channel catfish	24	5	26.61	22.48	31.15
Channel catfish	25	5	27.09	23.06	31.85
Channel catfish	26	5	27.57	23.23	31.99
Channel catfish	27	5	28.03	23.53	33.37
Channel catfish	28	5	28.49	23.99	33.84
Channel catfish	29	5	28.93	24.29	34.02
Channel catfish	30	5	29.37	24.71	35.87
Channel catfish	31	5	29.8	24.62	35.78
Channel catfish	32	5	30.22	25.32	37.04
Channel catfish	33	5	30.63	25	37.12
Channel catfish	34	5	31.04	24.94	37.73
Channel catfish	35	5	31.44	25.22	38.43
Channel catfish	36	5	31.83	25.42	39.09
Crappie	5	1	15.09	8.56	25.35
Crappie	6	1	15.41	10.55	23.57
Crappie	7	1	15.7	11.04	21.89
Crappie	8	1	15.95	11.57	21.49
Crappie	9	1	16.17	12.17	21.49
Crappie	10	1	16.37	12.28	21.73
Crappie	11	1	16.56	12.12	22.51
Crappie	12	1	16.73	12.13	23.5
Crappie	13	1	16.88	11.96	24.43
Crappie	14	1	17.03	11.59	25.63
Crappie	15	1	17.17	11.49	27.25
Crappie	5	2	14.66	10.27	21.09
Crappie	6	2	15.88	11.61	20.97
Crappie	7	2	16.99	13.12	21.32
Crappie	8	2	18.01	14.59	22.25
Crappie	9	2	18.96	15.46	22.91
Crappie	10	2	19.86	16.21	24.25
Crappie	11	2	20.71	16.88	25.59
Crappie	12	2	21.51	17.12	26.72
Crappie	13	2	22.28	17.54	28.07
Crappie	14	2	23.01	17.28	30.09
Crappie	15	2	23.72	17.66	31.71
Crappie	5	3	14.41	11.01	18.87
Crappie	6	3	16.15	12.83	20.22
Crappie	7	3	17.79	14.8	21.71
Crappie	8	3	19.34	16.46	22.49
Crappie	9	3	20.82	18.11	24.16

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Crappie	10	3	22.23	19.2	25.81
Crappie	11	3	23.6	20.12	27.67
Crappie	12	3	24.92	21.05	29.68
Crappie	13	3	26.2	21.54	31.78
Crappie	14	3	27.44	22.44	33.18
Crappie	15	3	28.65	22.81	35.84
Crappie	5	4	14.24	11.02	17.97
Crappie	6	4	16.35	13.67	19.64
Crappie	7	4	18.38	15.8	21.37
Crappie	8	4	20.34	17.76	23.04
Crappie	9	4	22.24	19.55	24.99
Crappie	10	4	24.09	21.22	27.21
Crappie	11	4	25.9	22.89	29
Crappie	12	4	27.66	24.22	31.55
Crappie	13	4	29.39	25.08	34.06
Crappie	14	4	31.09	26.21	36.57
Crappie	15	4	32.76	27.45	38.72
Crappie	5	5	14.11	11.47	17.29
Crappie	6	5	16.51	14.05	19.57
Crappie	7	5	18.86	16.48	21.71
Crappie	8	5	21.15	18.88	23.63
Crappie	9	5	23.41	21.11	25.93
Crappie	10	5	25.64	23.15	28.36
Crappie	11	5	27.83	24.79	31.15
Crappie	12	5	29.99	26.5	33.87
Crappie	13	5	32.14	28.19	36.91
Crappie	14	5	34.25	29.71	39.85
Crappie	15	5	36.35	30.74	42.99
Crappie	5	6	14.01	11.6	16.84
Crappie	6	6	16.64	14.29	19.38
Crappie	7	6	19.25	16.94	21.87
Crappie	8	6	21.84	19.58	24.42
Crappie	9	6	24.42	21.96	27.03
Crappie	10	6	26.97	24.23	29.59
Crappie	11	6	29.52	26.62	32.71
Crappie	12	6	32.05	28.81	35.71
Crappie	13	6	34.57	30.42	38.92
Crappie	14	6	37.07	32.63	42.36
Crappie	15	6	39.57	34.56	46.02
Crappie	5	7	13.92	11.42	16.62

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Crappie	6	7	16.75	14.42	19.6
Crappie	7	7	19.59	17.31	22.27
Crappie	8	7	22.44	20.19	25.08
Crappie	9	7	25.3	22.9	27.84
Crappie	10	7	28.16	25.42	30.89
Crappie	11	7	31.02	27.71	34.31
Crappie	12	7	33.89	30.19	38.15
Crappie	13	7	36.76	32.49	41.72
Crappie	14	7	39.64	34.73	45.28
Crappie	15	7	42.52	36.45	49.53
Crappie	5	8	13.84	11.27	17.1
Crappie	6	8	16.85	14.18	19.72
Crappie	7	8	19.89	17.35	22.64
Crappie	8	8	22.97	20.63	25.76
Crappie	9	8	26.09	23.4	29
Crappie	10	8	29.22	26.39	32.47
Crappie	11	8	32.39	29.11	36.26
Crappie	12	8	35.57	31.68	39.87
Crappie	13	8	38.78	33.66	43.93
Crappie	14	8	42.01	36.75	48.63
Crappie	15	8	45.25	38.71	52.51
Crappie	5	9	13.77	11.36	17.13
Crappie	6	9	16.93	14.45	20.08
Crappie	7	9	20.16	17.54	23.1
Crappie	8	9	23.45	20.75	26.33
Crappie	9	9	26.8	23.92	29.87
Crappie	10	9	30.2	26.89	33.75
Crappie	11	9	33.64	29.81	37.59
Crappie	12	9	37.13	32.61	42.17
Crappie	13	9	40.65	35.56	46.55
Crappie	14	9	44.21	37.97	51.01
Crappie	15	9	47.8	40.25	55.9
Crappie	5	10	13.71	11.05	17.04
Crappie	6	10	17.01	14.33	20.39
Crappie	7	10	20.41	17.47	23.66
Crappie	8	10	23.89	21	26.86
Crappie	9	10	27.46	24.47	30.59
Crappie	10	10	31.1	27.98	34.92
Crappie	11	10	34.81	30.87	39.37
Crappie	12	10	38.57	33.68	44.19

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Crappie	13	10	42.4	36.76	48.81
Crappie	14	10	46.28	39.65	54.45
Crappie	15	10	50.21	42.37	59.68
Crappie	5	11	13.66	10.88	17.31
Crappie	6	11	17.08	14.32	20.4
Crappie	7	11	20.63	17.69	23.86
Crappie	8	11	24.3	21.32	27.69
Crappie	9	11	28.07	24.65	31.54
Crappie	10	11	31.94	27.84	36.05
Crappie	11	11	35.89	31.87	40.75
Crappie	12	11	39.93	34.94	45.69
Crappie	13	11	44.05	37.75	51.15
Crappie	14	11	48.23	40.41	56.58
Crappie	15	11	52.49	43.35	62.3
Crappie	5	12	13.61	10.51	17.09
Crappie	6	12	17.14	14.04	20.77
Crappie	7	12	20.83	17.58	24.47
Crappie	8	12	24.67	21.61	28.12
Crappie	9	12	28.64	25.22	32.7
Crappie	10	12	32.72	28.94	37.05
Crappie	11	12	36.91	31.87	41.97
Crappie	12	12	41.21	35.8	47.95
Crappie	13	12	45.61	38.54	54.29
Crappie	14	12	50.09	42.11	60.44
Crappie	15	12	54.66	44.34	66.59
Crappie	5	13	13.56	10.61	17.71
Crappie	6	13	17.2	13.82	21.07
Crappie	7	13	21.02	17.73	24.68
Crappie	8	13	25.02	21.58	29.18
Crappie	9	13	29.17	25.3	33.42
Crappie	10	13	33.46	28.87	38.35
Crappie	11	13	37.88	32.72	43.79
Crappie	12	13	42.43	35.7	49.32
Crappie	13	13	47.09	39.29	55.78
Crappie	14	13	51.86	42.63	63.35
Crappie	15	13	56.74	45.98	69.83
Crappie	5	14	13.52	10.28	17.86
Crappie	6	14	17.25	13.91	21.31
Crappie	7	14	21.2	17.84	25.4
Crappie	8	14	25.35	21.8	29.54

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Crappie	9	14	29.67	25.81	34.05
Crappie	10	14	34.16	30.02	39.49
Crappie	11	14	38.8	33.44	44.54
Crappie	12	14	43.58	37.25	51.53
Crappie	13	14	48.51	40.68	58.44
Crappie	14	14	53.56	43.58	64.5
Crappie	15	14	58.73	46.98	73.41
Crappie	5	15	13.48	10.33	17.9
Crappie	6	15	17.31	13.88	21.5
Crappie	7	15	21.37	17.78	25.59
Crappie	8	15	25.66	21.83	29.68
Crappie	9	15	30.14	25.91	35.32
Crappie	10	15	34.82	30.22	40.31
Crappie	11	15	39.67	33.41	46.17
Crappie	12	15	44.69	37.34	52.77
Crappie	13	15	49.86	41.25	60.53
Crappie	14	15	55.18	43.64	68.06
Crappie	15	15	60.65	48.65	76.56
Largemouth bass	5	1	6.11	2.92	13.79
Largemouth bass	6	1	7.24	3.56	14.1
Largemouth bass	7	1	8.37	4.79	14.82
Largemouth bass	8	1	9.48	5.7	15.82
Largemouth bass	9	1	10.58	6.79	16.15
Largemouth bass	10	1	11.68	8.02	17.33
Largemouth bass	11	1	12.77	9.12	17.88
Largemouth bass	12	1	13.85	10.14	18.98
Largemouth bass	13	1	14.93	11.2	20.06
Largemouth bass	14	1	16	12.6	21
Largemouth bass	15	1	17.06	13.15	21.65
Largemouth bass	16	1	18.12	14.16	23.38
Largemouth bass	17	1	19.18	15.2	24.41
Largemouth bass	18	1	20.23	15.84	25.41
Largemouth bass	19	1	21.28	16.87	27.75
Largemouth bass	20	1	22.33	17.12	28.6
Largemouth bass	21	1	23.37	17.34	29.83
Largemouth bass	22	1	24.41	18.42	32.06
Largemouth bass	23	1	25.45	18.76	34.18
Largemouth bass	24	1	26.48	19.54	36.42
Largemouth bass	25	1	27.51	19.72	38.53
Largemouth bass	5	2	7.76	4.77	13.03

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Largemouth bass	6	2	9.2	6.07	13.95
Largemouth bass	7	2	10.62	7.36	15.78
Largemouth bass	8	2	12.03	8.6	16.97
Largemouth bass	9	2	13.42	10.08	17.87
Largemouth bass	10	2	14.81	11.49	19.12
Largemouth bass	11	2	16.18	13.01	19.68
Largemouth bass	12	2	17.55	14.37	21.33
Largemouth bass	13	2	18.9	16.09	22.72
Largemouth bass	14	2	20.25	17.25	23.8
Largemouth bass	15	2	21.6	18.39	25.35
Largemouth bass	16	2	22.94	19.88	26.87
Largemouth bass	17	2	24.27	20.8	27.99
Largemouth bass	18	2	25.6	21.94	29.99
Largemouth bass	19	2	26.92	22.9	31.57
Largemouth bass	20	2	28.23	23.74	33.1
Largemouth bass	21	2	29.55	24.62	35.22
Largemouth bass	22	2	30.85	25.32	37.52
Largemouth bass	23	2	32.16	26.14	39.09
Largemouth bass	24	2	33.46	26.96	41.14
Largemouth bass	25	2	34.76	27.81	42.78
Largemouth bass	5	3	8.94	6.25	12.52
Largemouth bass	6	3	10.58	7.7	14.24
Largemouth bass	7	3	12.21	9.19	16.06
Largemouth bass	8	3	13.83	10.88	17.41
Largemouth bass	9	3	15.43	12.51	18.9
Largemouth bass	10	3	17.01	14.2	20.51
Largemouth bass	11	3	18.59	15.78	22.16
Largemouth bass	12	3	20.15	17.41	23.46
Largemouth bass	13	3	21.71	19.12	24.7
Largemouth bass	14	3	23.25	20.48	26.1
Largemouth bass	15	3	24.79	22.09	27.88
Largemouth bass	16	3	26.32	23.3	29.42
Largemouth bass	17	3	27.85	24.83	31.19
Largemouth bass	18	3	29.37	26.1	32.51
Largemouth bass	19	3	30.88	27.27	34.61
Largemouth bass	20	3	32.39	28.7	36.59
Largemouth bass	21	3	33.89	29.82	38.49
Largemouth bass	22	3	35.38	30.87	40.62
Largemouth bass	23	3	36.88	31.52	42.77
Largemouth bass	24	3	38.36	32.74	44.92

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Largemouth bass	25	3	39.85	33.77	47.04
Largemouth bass	5	4	9.87	7.18	13.51
Largemouth bass	6	4	11.69	8.88	15.04
Largemouth bass	7	4	13.49	10.82	16.74
Largemouth bass	8	4	15.26	12.4	18.64
Largemouth bass	9	4	17.03	14.47	20.22
Largemouth bass	10	4	18.77	16.02	21.93
Largemouth bass	11	4	20.51	18.02	23.17
Largemouth bass	12	4	22.23	19.73	25.13
Largemouth bass	13	4	23.94	21.48	27
Largemouth bass	14	4	25.65	23.18	28.33
Largemouth bass	15	4	27.34	24.55	30.21
Largemouth bass	16	4	29.03	26.45	32.09
Largemouth bass	17	4	30.7	27.97	33.77
Largemouth bass	18	4	32.38	28.95	35.62
Largemouth bass	19	4	34.04	30.77	37.78
Largemouth bass	20	4	35.7	32.25	39.79
Largemouth bass	21	4	37.35	33.24	41.65
Largemouth bass	22	4	39	34.93	43.97
Largemouth bass	23	4	40.64	36.06	46.19
Largemouth bass	24	4	42.27	37.09	48.69
Largemouth bass	25	4	43.9	38.23	50.47
Largemouth bass	5	5	10.67	7.99	13.93
Largemouth bass	6	5	12.63	9.67	16.08
Largemouth bass	7	5	14.56	11.53	17.99
Largemouth bass	8	5	16.48	13.65	19.99
Largemouth bass	9	5	18.38	15.55	21.91
Largemouth bass	10	5	20.26	17.56	23.13
Largemouth bass	11	5	22.13	19.37	25.04
Largemouth bass	12	5	23.99	21.43	27.05
Largemouth bass	13	5	25.84	23.18	28.55
Largemouth bass	14	5	27.67	24.95	30.6
Largemouth bass	15	5	29.5	26.74	32.31
Largemouth bass	16	5	31.31	28.64	34.32
Largemouth bass	17	5	33.12	29.87	36.48
Largemouth bass	18	5	34.92	31.56	38.64
Largemouth bass	19	5	36.71	33.01	40.63
Largemouth bass	20	5	38.5	34.53	42.77
Largemouth bass	21	5	40.28	36.06	44.94
Largemouth bass	22	5	42.05	37.1	47.08

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Largemouth bass	23	5	43.82	38.25	50.16
Largemouth bass	24	5	45.58	40.02	51.78
Largemouth bass	25	5	47.33	41.17	54.12
Largemouth bass	5	6	11.36	8.25	15.03
Largemouth bass	6	6	13.45	10.28	17.34
Largemouth bass	7	6	15.51	12.45	19.55
Largemouth bass	8	6	17.55	14.54	21.68
Largemouth bass	9	6	19.57	16.38	22.89
Largemouth bass	10	6	21.57	18.6	25.05
Largemouth bass	11	6	23.56	20.44	27.07
Largemouth bass	12	6	25.53	22.69	28.72
Largemouth bass	13	6	27.49	24.59	30.32
Largemouth bass	14	6	29.44	26.69	32.86
Largemouth bass	15	6	31.38	28.34	34.88
Largemouth bass	16	6	33.31	30.12	36.76
Largemouth bass	17	6	35.23	31.75	38.71
Largemouth bass	18	6	37.15	33.41	41
Largemouth bass	19	6	39.05	35.07	43.68
Largemouth bass	20	6	40.95	36.24	46.13
Largemouth bass	21	6	42.84	37.84	48.44
Largemouth bass	22	6	44.72	39.03	50.66
Largemouth bass	23	6	46.6	40.46	53.73
Largemouth bass	24	6	48.47	42.42	55.76
Largemouth bass	25	6	50.34	43.18	58.72
Largemouth bass	5	7	11.98	8.61	16.68
Largemouth bass	6	7	14.18	10.84	18.32
Largemouth bass	7	7	16.35	12.76	20.68
Largemouth bass	8	7	18.5	15.24	22.89
Largemouth bass	9	7	20.63	17.1	24.85
Largemouth bass	10	7	22.74	19.41	26.83
Largemouth bass	11	7	24.83	21.46	29.01
Largemouth bass	12	7	26.91	23.84	30.81
Largemouth bass	13	7	28.98	25.8	32.55
Largemouth bass	14	7	31.03	27.76	34.81
Largemouth bass	15	7	33.07	29.61	37
Largemouth bass	16	7	35.1	31.56	39.18
Largemouth bass	17	7	37.13	33.12	41.45
Largemouth bass	18	7	39.14	35.2	43.88
Largemouth bass	19	7	41.15	36.7	46.62
Largemouth bass	20	7	43.14	37.67	48.85

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Largemouth bass	21	7	45.13	39.56	51.33
Largemouth bass	22	7	47.11	41.14	54.28
Largemouth bass	23	7	49.09	42.16	56.84
Largemouth bass	24	7	51.06	43.99	59.7
Largemouth bass	25	7	53.02	45.11	63.17
Largemouth bass	5	8	12.55	8.78	17.79
Largemouth bass	6	8	14.85	10.82	20.19
Largemouth bass	7	8	17.12	13.09	22.81
Largemouth bass	8	8	19.37	15.25	25.09
Largemouth bass	9	8	21.6	17.66	26.46
Largemouth bass	10	8	23.8	19.97	28.6
Largemouth bass	11	8	25.99	22.16	30.37
Largemouth bass	12	8	28.17	24.27	32.34
Largemouth bass	13	8	30.33	26.55	34.88
Largemouth bass	14	8	32.47	28.57	36.77
Largemouth bass	15	8	34.61	30.73	39.08
Largemouth bass	16	8	36.73	32.65	41.69
Largemouth bass	17	8	38.85	34.44	43.96
Largemouth bass	18	8	40.95	36.09	46.33
Largemouth bass	19	8	43.05	37.63	48.48
Largemouth bass	20	8	45.14	39.38	51.57
Largemouth bass	21	8	47.22	40.75	53.95
Largemouth bass	22	8	49.29	41.7	58.16
Largemouth bass	23	8	51.35	43.7	60.24
Largemouth bass	24	8	53.41	45.05	63.07
Largemouth bass	25	8	55.46	46.02	66.95
Largemouth bass	5	9	13.07	8.66	19.29
Largemouth bass	6	9	15.47	11.09	21.84
Largemouth bass	7	9	17.83	13.28	23.49
Largemouth bass	8	9	20.17	15.37	26.39
Largemouth bass	9	9	22.49	17.83	27.6
Largemouth bass	10	9	24.78	20.71	30.35
Largemouth bass	11	9	27.06	22.82	32.45
Largemouth bass	12	9	29.32	24.87	34.51
Largemouth bass	13	9	31.57	27.23	36.78
Largemouth bass	14	9	33.8	29.71	38.83
Largemouth bass	15	9	36.02	31.44	41.19
Largemouth bass	16	9	38.23	33.39	44.12
Largemouth bass	17	9	40.43	35.48	46.15
Largemouth bass	18	9	42.62	37.49	49.15

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Largemouth bass	19	9	44.8	38.83	51.41
Largemouth bass	20	9	46.97	40.34	54.78
Largemouth bass	21	9	49.13	41.72	57.29
Largemouth bass	22	9	51.29	42.96	60.81
Largemouth bass	23	9	53.44	44.84	63.12
Largemouth bass	24	9	55.58	46.62	66.36
Largemouth bass	25	9	57.71	46.83	70.59
Largemouth bass	5	10	13.56	8.88	21.01
Largemouth bass	6	10	16.04	10.95	23.3
Largemouth bass	7	10	18.49	13.46	25.39
Largemouth bass	8	10	20.92	15.84	27.16
Largemouth bass	9	10	23.31	18.38	29.43
Largemouth bass	10	10	25.69	20.52	32.14
Largemouth bass	11	10	28.05	23.11	33.55
Largemouth bass	12	10	30.4	25.69	35.71
Largemouth bass	13	10	32.72	27.85	38.51
Largemouth bass	14	10	35.04	30.02	40.52
Largemouth bass	15	10	37.34	32.34	43.14
Largemouth bass	16	10	39.63	34.42	45.55
Largemouth bass	17	10	41.9	36.12	48.65
Largemouth bass	18	10	44.17	38.13	50.84
Largemouth bass	19	10	46.43	39.57	54.14
Largemouth bass	20	10	48.68	41.21	56.7
Largemouth bass	21	10	50.92	42.55	60.01
Largemouth bass	22	10	53.15	44.18	63.68
Largemouth bass	23	10	55.37	45.84	67.9
Largemouth bass	24	10	57.59	46.73	70.41
Largemouth bass	25	10	59.8	48.98	72.86
Walleye	5	1	10.45	5.7	17.88
Walleye	6	1	12.25	7.59	20.29
Walleye	7	1	14.01	9.15	21.61
Walleye	8	1	15.73	10.57	23.31
Walleye	9	1	17.43	12.6	24.41
Walleye	10	1	19.11	13.93	26.24
Walleye	11	1	20.76	15.82	27.43
Walleye	12	1	22.4	17.22	28.43
Walleye	13	1	24.02	19.2	30.02
Walleye	14	1	25.62	20.63	32.14
Walleye	15	1	27.2	21.79	33.91
Walleye	16	1	28.78	23.63	35.88

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Walleye	17	1	30.34	25.08	37.64
Walleye	18	1	31.88	26.02	39.66
Walleye	19	1	33.42	26.67	42.04
Walleye	20	1	34.95	27.76	43.84
Walleye	21	1	36.46	28.98	46.61
Walleye	22	1	37.97	29.87	48.65
Walleye	23	1	39.47	30.48	50.39
Walleye	24	1	40.96	30.78	54.06
Walleye	25	1	42.44	32.13	57.31
Walleye	26	1	43.92	32.74	59.31
Walleye	27	1	45.39	33.05	63.91
Walleye	28	1	46.85	34.54	63.34
Walleye	29	1	48.3	35.21	68.27
Walleye	30	1	49.75	34.1	69.26
Walleye	5	2	14.84	10.68	20.5
Walleye	6	2	17.01	12.77	22.42
Walleye	7	2	19.08	15.04	24.93
Walleye	8	2	21.09	16.94	26.51
Walleye	9	2	23.03	18.83	27.86
Walleye	10	2	24.92	21.15	29.88
Walleye	11	2	26.76	22.88	30.86
Walleye	12	2	28.56	24.54	33.01
Walleye	13	2	30.32	26.5	34.39
Walleye	14	2	32.04	28.45	36.3
Walleye	15	2	33.74	29.74	38.09
Walleye	16	2	35.41	31.48	40.48
Walleye	17	2	37.05	32.52	41.62
Walleye	18	2	38.67	34.15	43.86
Walleye	19	2	40.26	35.84	45.3
Walleye	20	2	41.84	37.02	47.23
Walleye	21	2	43.39	38.07	49.62
Walleye	22	2	44.93	38.76	51.94
Walleye	23	2	46.44	39.71	54.34
Walleye	24	2	47.95	41.45	56.31
Walleye	25	2	49.43	41.32	58.49
Walleye	26	2	50.9	43.07	60.98
Walleye	27	2	52.36	43.67	62.81
Walleye	28	2	53.8	44.31	65.17
Walleye	29	2	55.23	45.85	68.53
Walleye	30	2	56.65	46.32	69.81

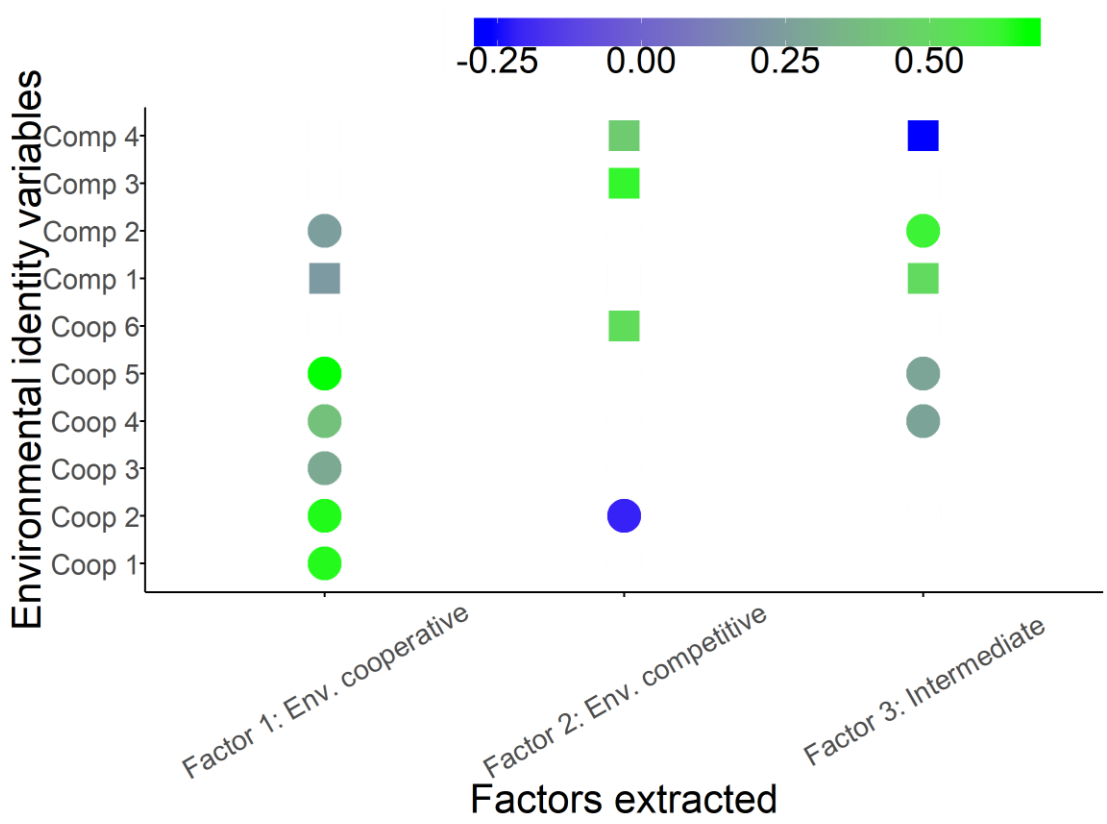
Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Walleye	5	3	18.22	13.41	24.66
Walleye	6	3	20.61	15.3	26.65
Walleye	7	3	22.87	18.04	28.86
Walleye	8	3	25.03	20.09	30.83
Walleye	9	3	27.1	22.21	32.18
Walleye	10	3	29.1	24.72	34.09
Walleye	11	3	31.04	26.78	35.7
Walleye	12	3	32.92	28.92	37.98
Walleye	13	3	34.74	30.69	39.56
Walleye	14	3	36.53	32.44	40.8
Walleye	15	3	38.27	33.89	42.79
Walleye	16	3	39.98	35.33	44.7
Walleye	17	3	41.65	36.96	46.75
Walleye	18	3	43.29	38.4	48.97
Walleye	19	3	44.9	39.62	51.19
Walleye	20	3	46.48	40.88	53.38
Walleye	21	3	48.04	41.32	54.66
Walleye	22	3	49.57	42.55	57.12
Walleye	23	3	51.08	44.01	59.11
Walleye	24	3	52.57	45.39	61.17
Walleye	25	3	54.04	45.71	63.95
Walleye	26	3	55.49	46.68	65.66
Walleye	27	3	56.93	47.94	67.49
Walleye	28	3	58.34	48.48	70.09
Walleye	29	3	59.74	49.7	71.59
Walleye	30	3	61.13	49.82	75.02
Walleye	5	4	21.08	14.34	31.35
Walleye	6	4	23.62	17.05	33.04
Walleye	7	4	26	19.85	34.6
Walleye	8	4	28.26	22	36.93
Walleye	9	4	30.42	24.12	38.08
Walleye	10	4	32.49	26.58	39.56
Walleye	11	4	34.48	28.99	41.64
Walleye	12	4	36.41	30.68	42.72
Walleye	13	4	38.27	32.78	44.68
Walleye	14	4	40.08	34.67	46.86
Walleye	15	4	41.85	36.13	47.6
Walleye	16	4	43.57	37.72	50.31
Walleye	17	4	45.25	39.62	52.88
Walleye	18	4	46.89	40.05	54.82

Appendix A. (Continued)

Species	Fish length	Number caught	Median willingness-to-pay ($US)	Upper 95%	Lower 95%
Walleye	19	4	48.51	41.67	56.28
Walleye	20	4	50.08	42.84	58.63
Walleye	21	4	51.63	43.88	61.07
Walleye	22	4	53.15	44.83	63.8
Walleye	23	4	54.65	45.86	65.07
Walleye	24	4	56.12	46.83	68.71
Walleye	25	4	57.57	47.03	70.43
Walleye	26	4	59	48.59	72.42
Walleye	27	4	60.4	48.89	75.88
Walleye	28	4	61.79	48.87	76.75
Walleye	29	4	63.16	50.02	80.33
Walleye	30	4	64.51	51.26	83.36
Walleye	5	5	23.6	15.14	36.31
Walleye	6	5	26.25	17.65	39.6
Walleye	7	5	28.73	20.52	40.95
Walleye	8	5	31.06	22.41	42.04
Walleye	9	5	33.27	25.69	43.24
Walleye	10	5	35.39	27.8	45.49
Walleye	11	5	37.41	30.05	46.83
Walleye	12	5	39.37	32.71	47.13
Walleye	13	5	41.25	34.23	49.77
Walleye	14	5	43.08	36.14	52.22
Walleye	15	5	44.85	37.81	53.39
Walleye	16	5	46.58	39.95	55.81
Walleye	17	5	48.26	40.62	56.88
Walleye	18	5	49.9	42.25	59.75
Walleye	19	5	51.5	43.19	62.36
Walleye	20	5	53.07	43.84	64.75
Walleye	21	5	54.61	44.92	67.09
Walleye	22	5	56.11	45.02	71.07
Walleye	23	5	57.59	46.56	72.49
Walleye	24	5	59.04	46.91	72.97
Walleye	25	5	60.47	47.4	76.77
Walleye	26	5	61.87	47.85	80.57
Walleye	27	5	63.25	49.08	83.29
Walleye	28	5	64.61	50.47	85.29
Walleye	29	5	65.95	49.99	89.26
Walleye	30	5	67.27	49.49	87.71

Appendix B. Visual representation of EFA extracted factors for angler involvement metric.



Appendix C. Angler diary survey tool assessing sub-activity longitudinal specialization

ID.date Date of interview

ID.start Time interview started

ID.end Date Completion date of interview

ID.end I

ID.time Duration of interview

ID. name Name, login or ID of respondent

Nebraska Recreational Angler Diary Survey

Information gathered in this survey is being used solely to understand how anglers' actions vary across different motivations for fishing. There are no known direct risks or benefits to your participation. You must be 19 years or older to participate. The answers you provide will only be used to inform fisheries management and will not reflect any additional costs to you. Your responses will be kept anonymous and the results of this survey will be reported in aggregate. Sensitive or personal information will not be asked for or recorded. You may refuse to complete this survey at any point with no negative consequences to you.

You have the right to ask questions about this survey and to have those questions answered. Questions directed in person or over email (nwcole@huskers.unl.edu) will be promptly answered. If we cannot answer your questions, we will refer you to the lead project investigator, Dr. Kevin Pope (402-472-7028, kpope2@unl.edu). Sometimes study participants have questions or concerns about their rights. In that case you should call the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965.

Q1 Email address

Q2 Password

1. Date and time of your fishing trip.

Q3 When did you leave your home, beginning the trip?

Date:

Q4 Hour in the day:

Q5 When did you return home, completing the trip?

Date:

Q6 Hour in the day:

Q7 During your trip, about how many hours did you spend fishing (lines in the water)?

2. Waterbodies that you fished.

Q8 Select all waterbodies that you fished on this particular trip ({Q3a} to {Q5a})

- ☐ Babcock
- ☐ Bennington
- ☐ Bluestem
- ☐ Bowling
- ☐ Branched Oak
- ☐ Boxed Butte
- ☐ Calmus
- ☐ Carter
- ☐ Conestoga
- ☐ Cottentail
- ☐ Czechland
- ☐ Elkhorn River
- ☐ Fremont Lakes
- ☐ Glen Cunningham
- ☐ Halleck
- ☐ Harlan
- ☐ Holmes
- ☐ Homestead
- ☐ Iron Horse
- ☐ Kildeer
- ☐ Loup River
- ☐ McConaughy
- ☐ Meadowlark
- ☐ Memphis
- ☐ Merritt
- ☐ Missouri River
- ☐ Nehmaha River
- ☐ Niobrara River
- ☐ Nishnabotna River
- ☐ Oak
- ☐ Olive Creek Lake
- ☐ Papillion Creek
- ☐ Pawnee
- ☐ Platte River
- ☐ Prairie Queen
- ☐ Red Willow
- ☐ Rock Creek
- ☐ Salt Creek
- ☐ Shadow
- ☐ Sherman
- ☐ Stagecoach
- ☐ Standing Bear
- ☐ Wagon Train
- ☐ Walnut Creek
- ☐ Wanahoo
- ☐ Wehrspann
- ☐ Wildwood
- ☐ Yankee Hill
- ☐ Zorinsky
- ☐ **Other**

Please describe the other waterbody you visited most often on this trip.

Q9 Type of waterbody: ☐ Reservoir or lake ☐ Private impoundment ☐ River or stream ☐ Saltwater

Q9 Waterbody name:

Q9 Nearest town:

3. Information about your trip.

Q10 How many people did you fish with on this trip (excluding yourself)?

Q11 Please select any of following types of fishing you engaged in on this fishing trip (all that apply).

- ☐ Conventional fishing
- ☐ Flyfishing
- ☐ Bowfishing or spearing
- ☐ Trot-lining, jug-lining, or netting
- ☐ Ice fishing

Q12 Please select any of the following fishing stratagies you engaged in on this fishing trip (all that apply).

- ☐ Fishing from a gas-powered vessel
- ☐ Fishing from a paddling vessel
- ☐ Fishing from shore or wading
- ☐ Fishing from a ice house

The following selection of equipment represent a subset of the wide variety of equipment used in different types of recreational fishing. Please select all the items you own and used or allowed others to use on this trip?

Q13	Rod and reels:	Baitcast combo ☐	Cane pole ☐	Spincast combo ☐	Spinning combo ☐					
Q14	Electronics:	Depthfinder ☐	Underwater cameras ☐	GPS ☐	Fishfinder or sonar ☐	Fish attractors ☐				
Q15	Miscellaneous:	Waders ☐	Electric filet knife ☐	Cooler ☐	Camera ☐	Rain gear ☐				

4. Objectives for your fishing trip

Q16 Select the type of fish **you** were primarily seeking.

--Click Here--
American eel
Crappie
Blue catfish
Bluegill
Buffalo
Bullhead
Burbot
Channel catfish
Common carp
Flathead catfish
Gar
Green sunfish
Largemouth bass
Muskellunge
Northern Pike
Orangespotted sunfish
Paddlefish
Pickeral
Pumpkinseed
Redear sunfish
Rock bass
Sauger
Silverfin
Smallmouth bass
Spotted bass
Striped bass
Sturgeon
Trout
Walleye
Wiper
White bass
White perch
Yellow perch
Other

Q16 Species name:

Q17 What was your primary motivation in seeking this fish?

- ◯ catching the largest fish possible
- ◯ catching as many fish as possible
- ◯ connecting with nature
- ◯ harvesting fish with the intent to eat them
- ◯ enjoying time with family and friends
- ◯ being challenged or tested while fishing
- ◯ providing fishing trips for others
- ◯ escapeing or enjoying solitude

Q18 If you sought a second type of fish on this trip, select it below, **if not** click next.

--Click Here--

American eel
Crappie
Blue catfish
Bluegill
Buffalo
Bullhead
Burbot
Channel catfish
Common carp
Flathead catfish
Gar
Green sunfish
Largemouth bass
Muskellunge
Northern Pike
Orangespotted sunfish
Paddlefish
Pickeral
Pumpkinseed
Redear sunfish
Rock bass
Sauger
Silverfin
Smallmouth bass
Spotted bass
Striped bass
Sturgeon
Trout
Walleye
Wiper
White bass
White perch
Yellow perch
Other

Q18 Fish name:

Q19 What was your primary motivation in seeking this fish?

- ◯ catching the largest fish possible
- ◯ catching as many fish as possible
- ◯ connecting with nature
- ◯ harvesting fish with the intent to eat them
- ◯ enjoying time with family and friends
- ◯ being challenged or tested while fishing
- ◯ providing fishing trips for others
- ◯ escaping or enjoying solitude

Q20 If you sought a third type of fish on this trip, select it below, **if not** click next.

--Click Here--
American eel
Crappie
Blue catfish
Bluegill
Buffalo
Bullhead
Burbot
Channel catfish
Common carp
Flathead catfish
Gar
Green sunfish
Largemouth bass
Muskellunge
Northern Pike
Orangespotted sunfish
Paddlefish
Pickeral
Pumpkinseed
Redear sunfish
Rock bass
Sauger
Silverfin
Smallmouth bass
Spotted bass
Striped bass
Sturgeon
Trout
Walleye
Wiper
White bass
White perch
Yellow perch
Other

Q20 Fish name:

Q21 What was your primary motivation in seeking this fish?

- ◯ catching the largest fish possible
- ◯ catching as many as fish possible
- ◯ connecting with nature
- ◯ harvesting fish with the intent to eat them
- ◯ enjoying time with family and friends
- ◯ being challenged or tested while fishing
- ◯ providing fishing trips for others
- ◯ escaping or enjoying solitude

Q22

- ◯ regularly catches large, trophy fish?
- ◯ easily catches many fish?
- ◯ is connected to nature?
- ◯ harvests and consumes the fish they catch?
- ◯ is social and friendly while fishing?
- ◯ wants to be challenged by their fishing?
- ◯ helps and teaches others to fish?
- ◯ is a solitary and independent fisherman?

Q23

- ◯ skilled at catching large, trophy fish.
- ◯ skilled at catching many fish.
- ◯ connected with nature.
- ◯ skilled at catching fish that are good to eat.
- ◯ fun and enjoyable to fish with.
- ◯ skilled at challenging types of fishing.
- ◯ skilled at helping and teaching others to fish.
- ◯ self-reliant and independent.

Q24 Select how important it is that your friends and family view you...

		Never important	Rarely important	Sometimes important	Always important
	As someone who {Q22}	○	○	○	○
Q24	As a {Q16} fisherman?	○	○	○	○
Q24	As a {Q16a} fisherman?	○	○	○	○

Q25 Select how much you agree with the following statements.

		Strongly disagree	Disagree	Agree	Strongly agree
	I am {Q23}	○	○	○	○
Q25	I often invest time and money, trying to be more {Q23}	○	○	○	○
Q25	Most of my friends are also motivated by {Q17}	○	○	○	○
Q25	I am a skilled {Q16} fisherman.	○	○	○	○
Q25	I am a skilled {Q16a} fisherman?	○	○	○	○
Q25	Most of my friends are also {Q16} fisherman.	○	○	○	○
Q25	Most of my friends are also {Q16a} fisherman.	○	○	○	○
Q25	I often invest time and money, trying to be a better {Q16} fisherman.	○	○	○	○
Q25	I often invest time and money, trying to be a better {Q16a} fisherman.	○	○	○	○

5. Information about catch and harvest.

The following questions ask you to list the types of fish you caught on your trip (up to five). This includes fish that you were not specifically seeking and caught unintentionally. If you did not catch any fish on this trip, check the box below and click next.

Q26 I did not catch any fish on this trip. ☐

Q27 Fish type 1. --Click Here--

- American eel
- Crappie
- Blue catfish
- Bluegill
- Buffalo
- Bullhead
- Burbot
- Channel catfish
- Common carp
- Flathead catfish
- Gar
- Green sunfish
- Largemouth bass
- Muskellunge
- Northern Pike
- Orangespotted sunfish
- Paddlefish
- Pickeral
- Pumpkinseed
- Redear sunfish
- Rock bass
- Sauger
- Silverfin
- Smallmouth bass
- Spotted bass
- Striped bass
- Sturgeon
- Trout
- Walleye
- Wiper
- White bass
- White perch
- Yellow perch
- **Other**

Q27 Unlisted fish name:

Q28 Fish type 2. --Click Here--

- American eel
- Crappie
- Blue catfish
- Bluegill
- Buffalo
- Bullhead
- Burbot
- Channel catfish
- Common carp
- Flathead catfish
- Gar
- Green sunfish
- Largemouth bass
- Muskellunge
- Northern Pike
- Orangespotted sunfish
- Paddlefish
- Pickeral
- Pumpkinseed
- Redear sunfish
- Rock bass
- Sauger
- Silverfin
- Smallmouth bass
- Spotted bass
- Striped bass
- Sturgeon
- Trout
- Walleye
- Wiper
- White bass
- White perch
- Yellow perch
- **Other**

Q28 Unlisted fish name:

Q29 Fish type 3. --Click Here--

- American eel
- Crappie
- Blue catfish
- Bluegill
- Buffalo
- Bullhead
- Burbot
- Channel catfish
- Common carp
- Flathead catfish
- Gar
- Green sunfish
- Largemouth bass
- Muskellunge
- Northern Pike
- Orangespotted sunfish
- Paddlefish
- Pickeral
- Pumpkinseed
- Redear sunfish
- Rock bass
- Sauger
- Silverfin
- Smallmouth bass
- Spotted bass
- Striped bass
- Sturgeon
- Trout
- Walleye
- Wiper
- White bass
- White perch
- Yellow perch
- **Other**

Q29 Unlisted fish name:

Q30 Fish type 4. --Click Here--

- American eel
- Crappie
- Blue catfish
- Bluegill
- Buffalo
- Bullhead
- Burbot
- Channel catfish
- Common carp
- Flathead catfish
- Gar
- Green sunfish
- Largemouth bass
- Muskellunge
- Northern Pike
- Orangespotted sunfish
- Paddlefish
- Pickeral
- Pumpkinseed
- Redear sunfish
- Rock bass
- Sauger
- Silverfin
- Smallmouth bass
- Spotted bass
- Striped bass
- Sturgeon
- Trout
- Walleye
- Wiper
- White bass
- White perch
- Yellow perch
- **Other**

Q30 Unlisted fish name:

Q31 Fish type 5. --Click Here--

- American eel
- Crappie
- Blue catfish
- Bluegill
- Buffalo
- Bullhead
- Burbot
- Channel catfish
- Common carp
- Flathead catfish
- Gar
- Green sunfish
- Largemouth bass
- Muskellunge
- Northern Pike
- Orangespotted sunfish
- Paddlefish
- Pickeral
- Pumpkinseed
- Redear sunfish
- Rock bass
- Sauger
- Silverfin
- Smallmouth bass
- Spotted bass
- Striped bass
- Sturgeon
- Trout
- Walleye
- Wiper
- White bass
- White perch
- Yellow perch
- **Other**
- **I caught no fish**

Q31 Unlisted fish name:

How many of each fish did **you** catch (excluding others in your party)?

Q32 {Q27}

Q33 {Q28}

Q34 {Q29}

Q35 {Q30}

Q36 {Q31}

Of the fish **you** caught, how many did you harvest (including fish you gifted to others)?

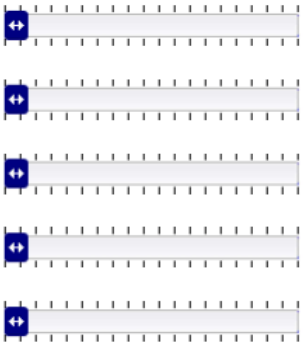
Q37 {Q27}

Q38 {Q28}

Q39 {Q29}

Q40 {Q30}

Q41 {Q31}



6. Information about your investment in the trip.

Please estimate the **current** monetary value (in US dollars) of the gear you own and was used during **this** trip. Please include gear you own but allowed others in your fishing party to use.

Q41	Gas-powered vessel including trailer, outboards, and accessories	
Q41	Paddling vessel including trailer or rack and accessories	
Q41	Rod, reel, lures, tackle, and bait	
Q41	Flyfishing equipment, rod, reel, flies...etc.	
Q41	Ice fishing equipment, including auger, icehouse... etc.	
Q41	Bow fishing equipment	
Q41	Cost of fuel traveling to the waterbody and during the trip.	
Q41	Electronics ({Q14a})	
Q41	Nets, clips, hooks, and floats	
Q41	Miscellaneous items ({Q15a})	

Appendix D. Survey tool used to assess angler identities and willingness-to-pay associated

Nebraska Recreational Angler Survey

Information gathered in this survey is being used solely to understand what motivates anglers in the act of fishing. There are no known direct risks or benefits to your participation. You must be 19 years or older to participate.The answers you provide will only be used to inform fisheries management and will not reflect any additional costs to you.Your responses will be kept anonymous and the results of this survey will be reported in aggregate. Sensitive or personal information will not be asked for or recorded. You may refuse to complete this survey at any point with no negative consequences to you or your relationship with the University of Nebraska-Lincoln.

You have the right to ask questions about this survey and to have those questions answered. Questions directed in person or over email (nwcole@huskers.unl.edu) will be promptly answered. If we cannot answer your questions, we will refer you to the lead project investigator, Dr. Kevin Pope (402-472-7028, kpope2@unl.edu). Sometimes study participants have questions or concerns about their rights. In that case you should call the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965.

Part 1 (of 5). General motivations

In a typical year, which of these best describes where you fish?

--Click Here--

- Only in my resident state
- Only outside my resident state
- Equally in and out of my resident state
- Mostly in my resident state but a few trips out of state
- Mostly out of state but a few trips in my resident state

In a typical year, how many days do you fish? **(Slide left or right)**

When you travel multiple days, what form of lodging do you use?

--Click Here--

- Hotel or motel
- RV or camper
- Primitive campsite
- Home of friend or relative

How many waterbodies do you visit during a typical fishing trip?

How many miles (one-way) do you travel during a typical fishing trip?

How much do you spend (US dollars) on fuel (boat, automobile, and RV) during a typical fishing trip?

How much do you spend (US dollars) on food, bait, supplies, and lodging during a typical fishing trip?

In addition to fishing, which of the following outdoor activities do you most consider yourself?

- ○ Bird watcher
- ○ Hunter
- ○ Camper
- ○ Paddlesports enthusiast
- ○ Hiker
- ○ Watersports enthusiast
- ○ Other

Part 2 (of 5). Value of catch

If a fishing trip resulted in catching **{Q1} {Q2}** each day of your trip that are **{Q3}** inches long, would you be willing to travel an additional **{Q4}** miles (one-way) further than your typical fishing trip?

- ◯ Yes
- ◯ No

What about traveling **{Q5}** miles further for the same outcome each day of your trip? ({Q1} {Q2}, {Q3} inches long)

- ◯ Yes
- ◯ No

What about traveling **{Q6}** miles further for the same outcome each day of your trip? ({Q1} {Q2}, {Q3} inches long)

- ◯ Yes
- ◯ No

If a fishing trip resulted in catching **{Q7} {Q8}** each day of your trip that are **{Q9}** inches long, would you be willing to travel an additional **{Q10}** miles (one-way) further than your typical fishing trip?

- ◯ Yes
- ◯ No

What about traveling **{Q11}** miles further for the same outcome each day of your trip? ({Q7} {Q8}, {Q9} inches long)

- ◯ Yes
- ◯ No

What about traveling **{Q12}** miles further for the same outcome each day of your trip? ({Q7} {Q8}, {Q9} inches long)

- ◯ Yes
- ◯ No

Part 3 (of 5). Your fishing preferences

Please select your level of agreement or disagreement with the following statements

	Strongly disagree	Slightly disagree	Neither agree or disagree	Slightly agree	Strongly agree
A fishing trip can be successful even if no fish are caught	○	○	○	○	○
I would rather catch 1 or 2 big fish than 10 small fish	○	○	○	○	○
I generally don't want to keep the fish I catch	○	○	○	○	○
If I thought I would catch only 1 fish, I would still go fishing	○	○	○	○	○
It does not matter what type of fish I catch	○	○	○	○	○
The bigger the fish I catch, the better the fishing trip	○	○	○	○	○
A successful trip is one in which many fish are caught	○	○	○	○	○
I usually eat the fish I catch	○	○	○	○	○
I am happiest with the fishing trip if I catch a challenging game fish	○	○	○	○	○
I am a very skilled angler compared to others	○	○	○	○	○

Continued. Please select your level of agreement or disagreement with the following statements.

	Strongly disagree	Slightly disagree	Neither agree or disagree	Slightly agree	Strongly agree
I like to fish where there are several types of fish to catch	○	○	○	○	○
The more fish I catch the happier I am	○	○	○	○	○
When I go fishing, I am not satisfied unless I catch at least something	○	○	○	○	○
When I go fishing I target only 1 type of fish	○	○	○	○	○
A full stringer is the best indicator of a successful fishing trip	○	○	○	○	○
When I go fishing I am just as happy if I don't catch any fish	○	○	○	○	○
Fishing is very important to my friends and family	○	○	○	○	○
Because of my passion for fishing, I have very little time for other hobbies	○	○	○	○	○
Going fishing is my favorite recreational activity	○	○	○	○	○
Many of my social interactions with friends involve fishing	○	○	○	○	○

Please rate how often the provided motive is an **important** reason for you to go fishing.

	Never important	Rarely important	Sometimes important	Always important
To catch the largest fish possible	○	○	○	○
To catch as many fish as possible	○	○	○	○
To connect with nature	○	○	○	○
To harvest fish with the intent to eat them	○	○	○	○
For enjoyment with friends or family	○	○	○	○
To escape or enjoy solitude	○	○	○	○
To facilitate a fishing trip for others	○	○	○	○
To be challenged or tested	○	○	○	○

Part 3 (of 5). Your social network

Select how important each of the following prompts are to you.

	Never important	Rarely important	Sometimes important	Always important
My family view me as a fisherman	○	○	○	○
My friends view me as a fisherman	○	○	○	○

How skilled of a fisherman does each group think you are?

	Not skilled	Somewhat skilled	Skilled	Extremely skilled
My family	○	○	○	○
My friends	○	○	○	○

Select how important each of the following prompts are to you.

	Never important	Rarely important	Sometimes important	Always important
My family view me as a {Q20}	○	○	○	○
My friends view me as a {Q20}	○	○	○	○

How skilled of a {Q20} does each group think you are?

	Not skilled	Somewhat skilled	Skilled	Extremely skilled
My family	○	○	○	○
My friends	○	○	○	○

Part 4 (of 5). Your views of the outdoors

Please select your level of agreement or disagreement with the following statements.

	Strongly disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Strongly agree
I draw sense of satisfaction from competing with and outsmarting the fish I catch	○	○	○	○	○
I don't think much about the day-to-day life of the fish I catch	○	○	○	○	○
I sometimes find fishing difficult because I worry I may cause a fish to feel pain	○	○	○	○	○
I am opposed to anything that may negatively affect the waterbodies I fish.	○	○	○	○	○
I prefer waterbodies that remain as natural as possible even if my fishing is more difficult	○	○	○	○	○
I would feel less fulfilled if I had to fish in waterbodies that seemed artificial or urban	○	○	○	○	○
The health of the fish I seek is at least as important as the needs of the general public	○	○	○	○	○
I generally don't think much about the fish I catch	○	○	○	○	○
I often feel more positive about life after going fishing or being on a waterbody	○	○	○	○	○
I am very conscious of how my actions affect the waterbody I fish	○	○	○	○	○

Please select your level of agreement or disagreement with the following statements.

	Strongly disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Strongly agree
I would not be concerned if the waterbodies I fish were less natural than they are now	○	○	○	○	○
I try to appreciate and understand the behavior of the fish I catch	○	○	○	○	○
I believe that a waterbody should be managed for increased access and fishing quality even it means the waterbody is less pristine	○	○	○	○	○
I sometimes find hunting difficult because I worry I may cause an animal to feel pain	○	○	○	○	○
While fishing is important to me, I rarely feel emotional while fishing	○	○	○	○	○
I often think about how the fish I catch fit within their environment	○	○	○	○	○
I am not concerned if there are moderate impacts from other industries to the waterbodies I fish	○	○	○	○	○
Animals should not have the same rights and welfare as people	○	○	○	○	○
The needs of the general public should always be considered over the needs of the fish I seek to catch	○	○	○	○	○

Part 5 (of 5). General information about yourself.

What is your age group?

- ○ Less than 20 years old
- ○ 20-29
- ○ 30-39
- ○ 40-49
- ○ 50-59
- ○ 60-69
- ○ 70 years or greater

What is the zipcode of your primary residence?

Of the following groupings, which do you regularly feel concerned may feel pain and fear similar to a person?

- ○ All animals
- ○ A few highly intelligent animals *(ex. dogs, elephants)*
- ○ All animals except invertebrates *(ex. insects, lobster)*
- ○ None

What level of education you have completed?

- ○ Some high school
- ○ High school degree or GED
- ○ Some college coursework
- ○ Two-year college degree (Associates)
- ○ Four-year college degree (Bachelors)
- ○ Master's degree
- ○ Doctoral degree
- ○ Professional graduate degree (MD, JD, etc.)

How many people are in your immediate family? (Including yourself)

1	2	3	4	5	6	7+
○	○	○	○	○	○	○

Of these, how many do you claim as dependents?

0 1

Of these, how many do you claim as dependents?

0 1 2

Of these, how many do you claim as dependents?

0 1 2 3

Of these, how many do you claim as dependents?

0 1 2 3 4

Of these, how many do you claim as dependents?

0 1 2 3 4 5

Of these, how many do you claim as dependents?

0 1 2 3 4 5 6 7+

What is your primary field of occupation?

- Business, sales, or marketing
- Medical
- Construction, repair, or manufacturing
- Public works or service
- Agricultural production
- Teaching or education
- Engineering, technology, or research
- Student
- Retired
- Other

What is your typical annual income level?

- ○ Less than 10,000
- ○ 10,000-29,000
- ○ 30,000-49,000
- ○ 50,000-69,000
- ○ 70,000-99,000
- ○ 100,000-200,000
- ○ Greater than 200,000
- ○ I prefer not to share my income

Additional comments:

The survey is now complete.

Thank you for taking the time and assisting with this important research.

Your contributions are very valuable to us.

Appendix E. Biological parameters used to convert fish length to biomass

Species	Size category	Upper length bound (mm)	Upper length bound (in.)
Channel catfish	Substock	< 280	< 11
Channel catfish	Stock	280	11
Channel catfish	Quality	410	16
Channel catfish	Preferred	610	24
Channel catfish	Memorable	710	28
Channel catfish	Trophy	910	36
Crappie	Substock	< 130	< 5
Crappie	Stock	130	5
Crappie	Quality	200	8
Crappie	Preferred	250	10
Crappie	Memorable	300	12
Crappie	Trophy	380	15
Largemouth bass	Substock	< 200	< 8
Largemouth bass	Stock	200	8
Largemouth bass	Quality	300	12
Largemouth bass	Preferred	380	15
Largemouth bass	Memorable	430	17
Largemouth bass	Trophy	630	25
Walleye	Substock	< 250	< 10
Walleye	Stock	250	10
Walleye	Quality	380	15
Walleye	Preferred	510	20
Walleye	Memorable	630	25
Walleye	Trophy	760	30

Appendix F. Longitudinal sub-activity assessment of specialization case study

Table F-1

Longitudinal assessment of how specialization varies by species sought over a fishing season for a single angler. All responses are given within the context of species sought. Value of equipment is estimated by the respondent including boat if applicable, rods and tackle, electronics, and miscellaneous supplies.

Species sought	Value of equipment ($US)	Boat used	Commitment	Self-skill assessment	Importance to social group	Time and money investment
Bluegill	550	1	Never important	Strongly agree	Disagree	Agree
Crappie	700	1	Rarely important	Agree	Strongly disagree	Agree
Walleye	1400	1	Never important	Strongly disagree	Strongly disagree	Strongly agree
Bluegill	500	1	Rarely important	Agree	Strongly disagree	Agree
Walleye	700	1	Rarely important	Disagree	Disagree	Agree
Trout	450	0	Rarely important	Strongly agree	Strongly disagree	Disagree
Channel catfish	800	1	Rarely important	Disagree	Disagree	Agree
Channel catfish	900	1	Never important	Disagree	Strongly disagree	Agree
Channel catfish	900	1	Never important	Disagree	Strongly disagree	Agree
Crappie	550	1	Rarely important	Agree	Disagree	Agree
Walleye	100	0	Never important	Strongly disagree	Disagree	Agree
Channel catfish	900	1	Rarely important	Disagree	Strongly disagree	Agree
Crappie	200	0	Never important	Agree	Disagree	Agree
Walleye	750	1	Rarely important	Disagree	Disagree	Agree
Smallmouth bass	100	0	Never important	Strongly disagree	Strongly disagree	Disagree
Bluegill	600	1	Sometimes important	Agree	Disagree	Disagree
Bluegill	600	1	Rarely important	Agree	Disagree	Disagree

Table F-2 (Continued)

Motivation orientation	Value of equipment ($US)	Boat used	Commitment	Self-skill assessment	Importance to social group
Providing fishing trips for others	550	1	Always important	Agree	Disagree
enjoying time with family and friends	700	1	Always important	Agree	Agree
Harvesting fish with the intent to eat them	1400	1	Sometimes important	Agree	Disagree
Enjoying time with family and friends	500	1	Never important	Agree	Agree
Harvesting fish with the intent to eat them	700	1	Sometimes important	Agree	Disagree
Connecting with nature	450	0	Rarely important	Strongly agree	Agree
Catching as many fish as possible	800	1	Rarely important	Disagree	Disagree
Catching the largest fish possible	900	1	Never important	Disagree	Strongly disagree
Catching the largest fish possible	900	1	Never important	Disagree	Strongly disagree
Enjoying time with family and friends	550	1	Rarely important	Agree	Agree
Being challenged or tested while fishing	100	0	Sometimes important	Disagree	Strongly disagree
Escaping or enjoying solitude	900	1	Never important	Strongly agree	Agree
Escaping or enjoying solitude	200	0	Never important	Strongly agree	Agree
Being challenged or tested while fishing	750	1	Always important	Disagree	Agree
Escaping or enjoying solitude	100	0	Never important	Agree	Disagree
Escaping or enjoying solitude	600	1	Sometimes important	Agree	Disagree
Escaping or enjoying solitude	600	1	Sometimes important	Agree	Disagree

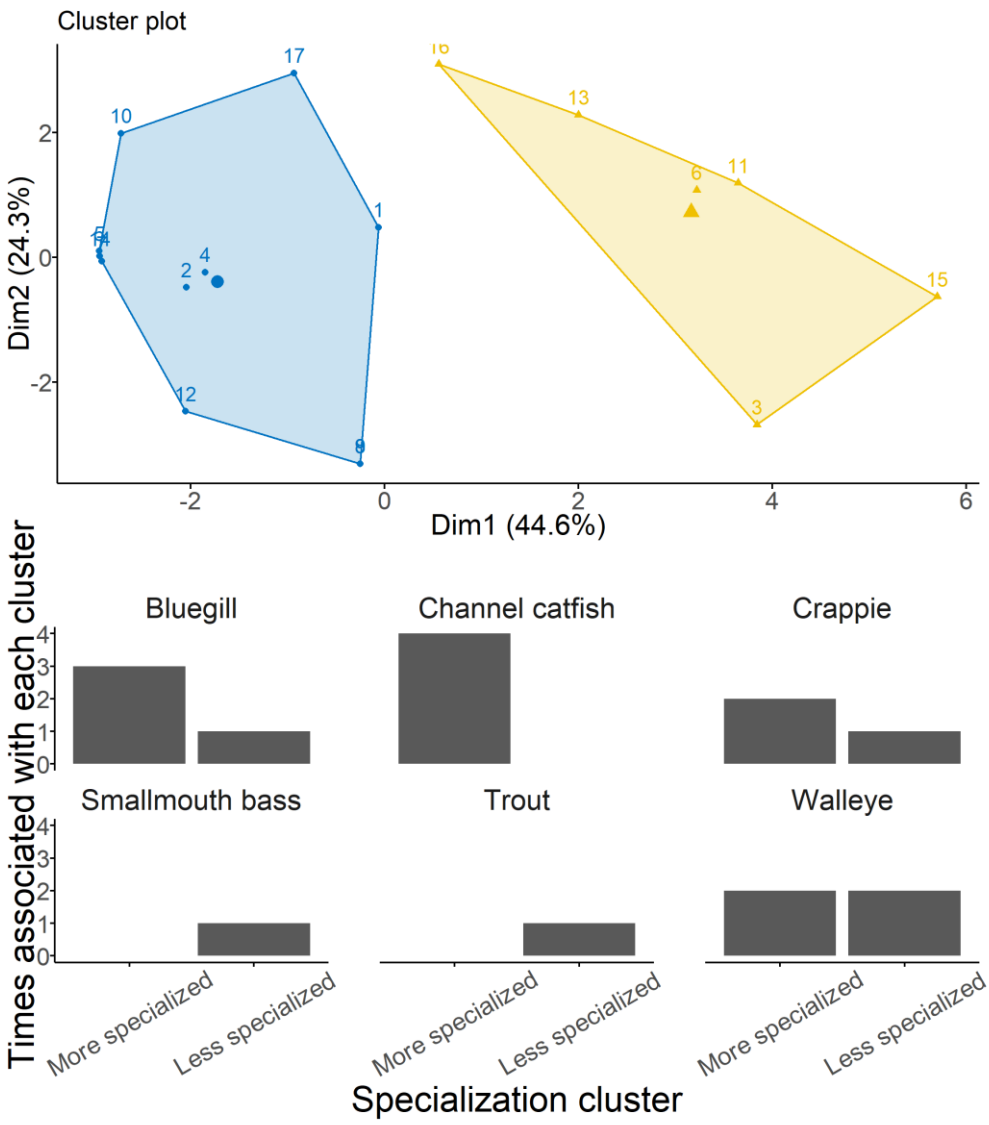


Figure F-1

Cluster analysis of specialization metric and the named clusters association with species sought.

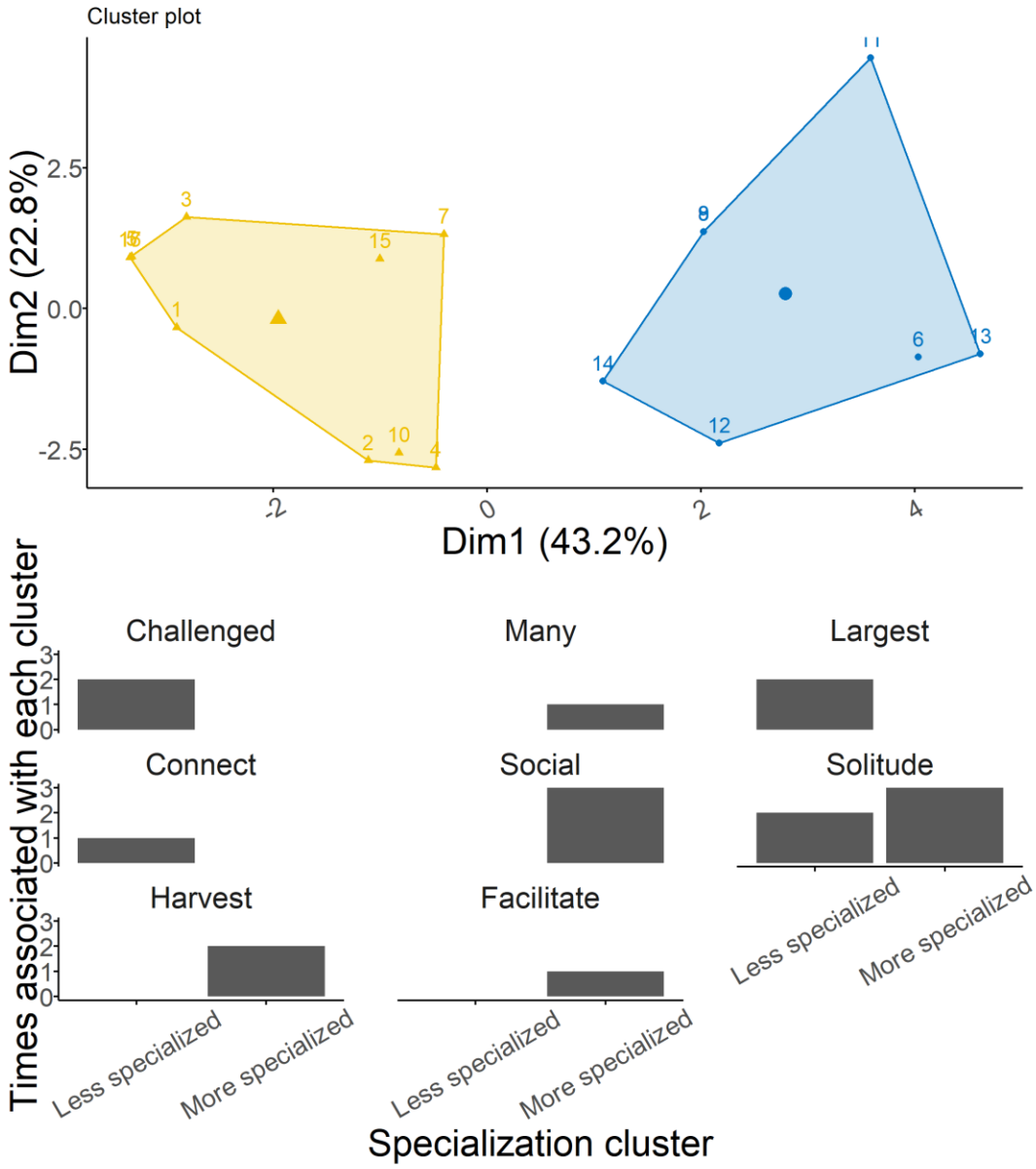


Figure F-2

Cluster analysis of specialization metric and the named clusters association with the respondents trip specific motivations.