Data Mining and Analysis

Study 7050 Completion Report
Federal Aid to Sportfish Restoration

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Period Covered: 1 July 2016 – 30 June 2019
Iowa Department of Natural Resources
Bruce Trautman, Acting Director

Executive Summary

Like many other states, Iowa faces dwindling fishing participation and increasing urbanization. The state has already experienced a 5.2% population increase in metro areas from 2010-2016, with a 21.2% increase in Dallas County (a suburban county in the Des Moines metro). Additional changes in population size and demographic composition are projected, with significant implications for the angling population and future fishery management. Iowa DNR's Community Fishing Program (CFP) was initiated in late 2016 to address the increasing disconnect between an urbanizing population and the outdoors. One objective of the CFP is to focus on recruitment, retention, and re-activation (R3) of anglers in urban areas. However, very little was known prior to this study about potential or unlicensed anglers in Iowa.

To guide the program, a general population survey was conducted in Iowa's urban and suburban communities. All locations were within the target area of the Iowa CFP, defined as any community with a population greater than 15,000 people; any community adjacent to such an area (i.e., a suburb); or a community with an annual growth rate over 2.7% based on 2016 U.S. Census Bureau projections. This encompassed over 30 communities and suburbs across Iowa. Survey questions focused on constraints to fishing participation, characterization of an ideal fishing trip, identification of important amenities, and identification of useful outreach and educational programs. A total of 2,500 Iowa residents were contacted to complete the survey, and 693 unique responses were received yielding a response rate of 27.7%.

Major survey findings include:

- A total of 71.7% of urban residents were interested in fishing at some level. Almost half were already active anglers, 40% were lapsed anglers, and 12% had never fished before but were interested. Interest in fishing was affected by early childhood exposure to fishing (χ^2 = 72.7936, p-value < 0.0001), gender (χ^2 = 31.3164, p-value < 0.0001), and age (Cochran-Armitage Z = 4.1905, p-value < 0.0001). It was not affected by where the respondent grew up (i.e., "city kids" versus "country kids"; χ^2 = 7.6964, p-value = 0.8084).
- Of those interested in fishing at some level, potential and lapsed anglers were more likely to be women (pairwise comparison p-values < 0.0001). Active anglers were younger than lapsed anglers (Z = 3.3223, p-value = 0.0004) and marginally more likely to be White than potential anglers (pairwise comparison χ^2 = 4.9299, p-value = 0.0264).
- Constraints affecting fishing included poor water quality, lack of opportunities, expense, lack of mentorship, marginality, safety of eating fish, family concerns, ethics, and accessibility. The most important constraint regardless of grouping was poor water quality. Many constraints differed by fishing interest level with active anglers consistently reporting lower levels of constraint than lapsed anglers for *Expense*, *Lack of Mentorship*, *Family Concerns*, *Ethics*, and *Accessibility* (all pairwise comparison p-values < 0.0167). Males were less constrained than females by *Expense*, *Lack of Mentorship*, *Family Concerns*, *Ethics*, and *Accessibility* (all p-values < 0.05), whereas Non-White respondents were less constrained than White respondents by *Poor Water Quality* , *Expense*, and *Accessibility* (all p-values < 0.05).

- The ideal fishing trip was defined by a combination of catch-related and experiential descriptors, with the most important descriptors revolving around experience rather than high or large catch. Generally, respondents wanted to fish in an aesthetically pleasing environment with a partner/group, and for that group to catch at least something. The ideal trip was also universally characterized by shore access. The least important descriptors were specialized (e.g., catching a trophy, ice fishing). The ideal fishing trip could be defined by five factors: *Specialization, Group Success, Harvest, Convenient Access,* and *Water Quality/Partner*. Significant differences existed on at least one factor based on fishing interest level (*Specialization*, *Group Success,* and *Harvest*), gender (*Specialization* and *Water Quality/Partner*), age group (*Group Success* and *Harvest*), and race group (*Group Success* and *Convenient Access*; all *p*-values < 0.05).
- The top preferred amenities were universal and revolved around logistics; pedestrian access, parking areas, and bathrooms were the most important regardless of grouping. However, numerous differences existed based on gender, age, and race as well as fishing interest level. Females in particular placed more importance on almost every amenity than did males (all *p*-values < 0.05), and respondents over age 65 focused more on logistic aspects than those age 25-44.
- Angler education and outreach programs were more variable, differing by interest level, gender, and age. The most popular programs overall were intermediate fishing skills, fish cleaning and cooking, and advanced skill seminars. However, those who had not fished before were significantly more interested than active or lapsed anglers in basic fishing skills seminars (p-values < 0.01), and their top cited programs included basic and intermediate fishing skills and fish cleaning and cooking. Females were also less interested in advanced skill programs than males (*p*-value = 0.0017), and interest in numerous programs declined with age (Cochran-Armitage trend *p*-values < 0.05).

Potential, lapsed, and active anglers differed in numerous ways:

- Potential anglers were marginally more affected by marginality than active anglers (pairwise comparison *p*-value = 0.0318). Potential anglers were more likely to be interested in programming focused on basic fishing skills (pairwise comparison *p*-values < 0.0167). They were less specialized, assigning less importance to many fishing trip descriptors and scoring lower on the *Specialization* factor (*p*-value < 0.0167) and being most likely to be interested in bass or bluegill fishing opportunities.
- Lapsed anglers were more sensitive to most constraints but may be the most cost-effective R3 targets (pairwise comparison *p*-values for 6 constraints < 0.0167). They were more focused on social experience, valuing "fishing with another person" as part of their ideal trip and experiencing more social constraints including family concerns and lack of mentorship. They were also marginally more harvest-oriented than active anglers (*Harvest* pairwise comparison *p*-value = 0.0217). Lapsed anglers were somewhat less interested in programming in general, but could benefit most from intermediate skill development and fish cleaning/cooking seminars.
- Active anglers experienced most constraints to a lesser degree than others (pairwise comparison p-values for 6 constraints < 0.0167), but were more demanding of catch-oriented and specialized ideal trip descriptors (all pairwise comparison *p*-values <

0.0167). Active anglers scored higher on *Specialization* than both lapsed and potential anglers (pairwise comparison *p*-values < 0.0167) and higher on *Group Success* than lapsed anglers (*p*-value = 0.0019). They likewise focused on specialized amenities (e.g., boat access: pairwise comparison *p*-value = 0.0296) and more challenging programs (e.g., advanced skill development, fishing competitions: pairwise comparisons with lapsed anglers *p*-values < 0.0167).

Management recommendations include:

- Ensure provision of quality fishery resources distributed throughout the CFP area.
    - Improve water quality in CFP areas, including rivers.
    - Continue developing more local public fishing opportunities through collaborative relationships with city and county governments, housing agencies, nonprofit groups, and others to facilitate early and convenient exposure of CFP residents to fishing.
    - Manage most fisheries to achieve basic performance metrics, such as a minimum catch rate of one fish/trip, with simple species composition (e.g., Largemouth Bass-Bluegill). Develop more specialized fisheries in areas with more active anglers.
    - Provide shoreline opportunities for the majority of anglers, and avoid creating fishing opportunities which are only accessibly by boat.
- Establish appropriate facilities and provide necessary amenities. Specifically, ensure marginalized groups have the necessary amenities to overcome structural constraints related to access, safety, and quality of facilities.
    - Logistics are always important regardless of target group, so easy access to the location (i.e., pedestrian access and parking areas) and bathrooms are essential.
- Provide relevant programming to meet R3 goals.
    - Tailor education and outreach topics to the targeted R3 group. For example, stocking events and advanced fishing skill seminars were very important to active anglers, but significantly less interesting to both lapsed and potential anglers. The broadest appeal in general can be achieved with intermediate fishing skills, fish cleaning and cooking, and advanced skills programs, but the broadest appeal to new recruits can be achieved with programs on basic and intermediate skills and fish cleaning and cooking.
    - Continue angler education efforts targeting children to create interest in fishing early in life, regardless of where they live.
- Provide extensive communications regarding where public fishing opportunities are located in the CFP area, what each fishery looks like and how to fish there, and what regulations govern each fishery. Ensure that information affecting public health is updated and easily available (e.g., consumption advisories, beach warnings).
- Generally, provide fishing opportunities where people live. As urbanization continues, investment in the CFP reflects investment in the future anglers of Iowa.

Survey findings revealed substantive differences in constraints and preferences among active, lapsed, and potential anglers, implying that surveying anglers alone provides an incomplete picture of fishing customers. Additional study is needed to better elucidate the unique set of motives, constraints, and preferences of novel angler groups, as well as better characterization of subgroups within the lapsed angler category.

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Differential constraints and preferences of anglers and non-anglers in urban areas of Iowa

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Abstract.—Like many other states, Iowa faces dwindling fishing participation and increasing urbanization. To better target urban and suburban anglers, the Iowa Department of Natural Resources created a community fishing program. To guide the program, a general population survey was conducted in Iowa's urban and suburban communities. Survey questions focused on constraints to fishing participation, characterization of an ideal fishing trip, identification of important amenities, and identification of useful outreach and educational programs. Interest in fishing was affected by early childhood exposure to fishing, gender, age, and race. Of those interested in fishing at some level, potential and lapsed anglers were more likely to be women and non-White. Constraints affecting fishing included poor water quality, lack of opportunities, expense, lack of mentorship, marginality, safety of eating fish, family concerns, ethics, and accessibility; most constraints differed by fishing interest level with active anglers consistently reporting different levels of constraint than lapsed anglers. The ideal fishing trip was predominantly defined by experiential descriptors, again with many ideal trip descriptors differing by interest level. Active anglers demanded more catch-oriented and specialized items, whereas potential anglers demanded little in terms of fishery performance. The top preferred amenities were universal and revolved around logistics, but numerous differences existed based on gender as well as other factors. Education and outreach programs were more variable, differing by interest level, gender, and age. Survey findings reveal substantive differences in constraints and preferences among active, lapsed, and potential anglers, implying that surveying anglers alone provides an incomplete picture of fishery customers. The results provide guidance to Iowa's community fishing program for more strategic fishery planning and communication.

Introduction

Iowa DNR's Community Fishing Program (CFP) was initiated in late 2016 to address the increasing disconnect between an urbanizing population and the outdoors. Although recreational fishing license sales are holding steady in Iowa, participation rates and license sales in fishing are dropping with the greatest loss in urban and suburban areas (USDOI and DOC 2001; Iowa DNR 2017; Figure 1). Participation rate in recreational fishing is expected to decline with urbanization, requiring dedicated and proactive intervention by fisheries managers and their agencies (Arlinghaus et al. 2015). One objective of the CFP is to focus on recruitment, retention, and re-activation (R3) of anglers in urban areas. However, very little was known prior to this study about potential or unlicensed anglers in Iowa; no survey had targeted these individuals before regarding their fishing participation or lack thereof.

The traditional Iowa angler, characterized by previous angler surveys, is a mid- to late-40s, White or Caucasian (95%; Responsive

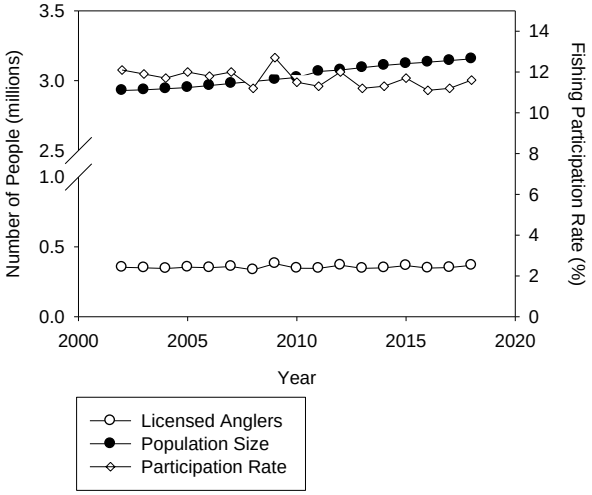

Figure 1. Number of licensed anglers, total population, and participation rate in fishing in Iowa from 2002-2018.

Management 2008) male (87%: Responsive Management 2019). This individual is most likely to fish an unnamed pond or gravel pit (Responsive Management 2008). Recently, anglers reported more than a 43% drop in pond use (Responsive Management 2019), likely reflective of the increasingly limited access to private farm ponds as families move to urban areas. This is of substantial concern as early childhood initiation into fishing is known to be important (Kuehn et al. 2006) and a major part of the R3 strategy in Iowa (Iowa DNR 2017). However, neighborhood or city public ponds may serve as a viable replacement to this experience. Although the majority of pond anglers specifically fished private farm ponds (60%), a notable 36% of pond anglers fished city, town, or local park ponds (Responsive Management 2019).

Urbanization in Iowa has already yielded a 5.2% population increase in metro areas from 2010-2016, with a 21.2% increase in Dallas County (a suburban county in the Des Moines metro; USCB 2018). Urban areas also attract greater diversity in ethnic and socioeconomic makeup. For example, Hispanics have increased in Iowa by 110.5% since 2000 (as of 2016), Asians have increased by 88.5%, and Blacks have increased by 71.5%. U.S. Census Bureau projections indicate that non-White groups should compose about one-quarter of Iowa's population by 2050. Similarly, Murdock et al. (1996) estimated that 85.8% of the net growth in angler numbers from 1990-2050 would be from non-White individuals. Based on the most recent demographic composition of licensed anglers in Iowa, which indicated about 95% of anglers were Caucasian (Responsive Management 2008), all of these groups may be underrepresented in the Iowa licensed angler population (2008 state population was 91.7% Caucasian: USCB 2018). As of 2018, Iowa's state population was 90.7% Caucasian (USCB 2019). Factors related to low participation rates of unrecruited individuals have never been examined in Iowa. To effectively connect with potential anglers in urban and suburban areas, the CFP must understand their constraints and preferences for fishing.

Likewise, urban areas are home to many lapsed anglers. Known constraints to greater fishing participation include a lack of time due to work and family obligations, other hobbies, poor water quality, and perception of a poor fishing resource (Responsive Management 2008, 2013). Casual anglers specifically were more likely than avid anglers to be constrained by a lack of skill and to be motivated by social reasons rather than catch-oriented reasons. Whether these constraints or preferences differ for lapsed anglers in urban areas is unknown.

Constraints are reasons, whether perceived or experienced, that limit participation in an activity. They can be intrapersonal (e.g., perception of gender role), interpersonal

(e.g., lack of a fishing mentor), or structural (e.g., lack of shoreline access). Previous studies addressing fishing showed that structural constraints were the most important factors inhibiting or reducing participation in recreational fishing (Ritter et al. 1992; Aas 1995; Fedler and Ditton 2000, 2001; Sutton 2007), although interpersonal and intrapersonal constraints have also been found to affect fishing participation (Ritter et al. 1992; Fedler and Ditton 2001). Individuals from underrepresented demographic groups, such as urban residents or women, tend to face greater and different leisure constraints than their counterparts (Ghimire et al. 2014).

Likewise, preferences for particular fishing experiences, amenities, and programs may differ in urban areas. For instance, harvest orientation may be affected by gender (Schroeder et al. 2006) or race (Floyd et al. 2006; Hunt et al. 2007), and desired park amenities and features may be affected by gender and race (Ho et al. 2005). Urban anglers in general placed greater importance on certain catch characteristics, on-site amenities, and safety in a Texas study, whereas rural anglers placed greater importance on scenic beauty (Hutt and Neal 2010). These preferences can guide fishery management and programming specific to the CFP area.

The objective of this survey was to characterize active, lapsed, and potential urban anglers' preferences and constraints, and to develop predictive models of species preference for potential anglers to guide the CFP.

Methods

We designed a survey for the general public living in urban, suburban, and rapidly growing communities in Iowa. All locations were within Iowa CFP target areas, defined as any community with a population greater than 15,000 people; any community adjacent to such an area (i.e., a suburb); or a community with an annual growth rate over 2.7% based on 2016 U.S. Census Bureau projections (USCB 2018). This encompassed over 30 communities and associated suburbs across Iowa.

The survey was designed through extensive literature review, internal discussions, and consultation with survey experts at Iowa State University. Questions included interest and past experience fishing in Iowa, typical trip characteristics and species preferences, reasons for choosing not to fish, importance of specific amenities at fishing locations, characteristics of an ideal fishing trip, and interest in educational and outreach programs. All respondents were asked about constraints to fishing and preferences for fishing experiences; those who had fished before were also asked about specific fishing behaviors, including species preference, typical travel distance, and trip frequency and duration.

After an internal test with DNR headquarters staff (Des Moines, Iowa) for measurement scale consistency and completeness, several questions were adjusted to better reflect the wide spectrum of responses and attitudes. Overall, latent factors affecting fishing participation were effectively measured during the test round (Table 1). Initial constraints included Lack of Opportunities, Accessibility, Expense, Contaminants, Lack of Knowledge, Need for Social Interaction, Poor Resource Quality, and Social Stigmatization, each measured by a minimum of three items. Open-ended responses yielded additional constraints.

Constraints in the final survey version included Accessibility, Ethics, Expense, Family Concerns, Lack of Mentorship, Marginality, No Opportunities, Poor Water

Quality, and Safety of Eating Fishing (Table 1). Constraints to fishing were measured as Likert-type scales with multiple items per scale. Due to the length of this section, scales were blocked and randomly assigned to survey respondents so that no respondent had to answer more than 18 constraint-related questions.

Table 1. Constraint question composition and internal consistency (as measured by Cronbach's alpha [α]) based on pre-testing and survey results.

Constraint	Items	Code	Test α	Survey α
Accessibility	My health keeps me from fishing.	BADHEALTH	0.849	0.766
	It is difficult to find a place I can access with my injury/disability.	NOACCESS		
	I do not have enough mobility to fish easily.	MOBILITY		
	I have trouble getting to places I can fish due to my injury/disability.	DISABILITY		
Ethics[1]	I am uncomfortable putting a worm on the hook.	HOOKWORM	-	0.784
	I do not want to harm the fish.	NOHARM		
	My personal ethics/beliefs keep me from fishing.	BELIEFS		
Expense	The initial cost of buying fishing gear is too high.	GEARCOST	0.880	0.731
	Fishing equipment is too expensive.	EXPENSIVE		
	Start-up costs of fishing are too high.[2]	STARTUP		
Family concerns[1]	I do not know how to prepare my family for fishing.	PREPFAM	-	0.526
	I am concerned for my family's safety while fishing.	SAFEFAM		
	There are not enough fishing opportunities that are safe for my family.	SAFEOPP		
Lack of mentorship	I am not sure how to begin fishing.	HOW2BEGIN	0.891	0.821
	I do not know what equipment I need to go fishing.	WHATEQUIP		
	I do not know how to prepare for a fishing trip.	HOW2PREP		
	I am unsure of the fishing regulations.	FISHREGS		
	I do not know how to tell when fishing conditions are right.	RIGHTCOND		
	I do not like fishing alone.	NOALONE		
	No one asks me to go fishing.	NOONEASKS		
	I do not have anyone to fish with.	NOFRIENDS		
Marginality	I cannot afford to buy a fishing license.	LICENSECOST	0.894	0.790
	There are not enough fish to catch.	LOWCATCH		
	There are not enough fish worth bringing home.	LOWKEEPERS		
	The quality of fishing is poorly managed	POORMGMT		

Constraint	Items	Code	Test α	Survey α
	by authorities.			
	The facilities where I might fish are poorly kept.	POORFACIL		
	I do not feel safe enough to go fishing.	NOTSAFE		
	I feel unwelcome when fishing.	NOTWELCOME		
No opportunities	I do not know where to go fishing.	WHERE2GO	0.892	0.672
	It is difficult to find information on where to fish.	FINDINFO		
	There is nowhere to go fishing near me.	NOPLACES		
	There are not enough fishing opportunities near me.	NOOPPS		
Poor water quality[1]	I do not want to fish at a place with poor water quality	WATERQUAL	-	0.640
	The water is too dirty for fishing.	DIRTY		
	There is too much vegetation to fish.	PLANTS		
Safety of eating fish	I do not think fish are safe to eat.	NOTEDIBLE	0.887	0.721
	I am concerned about the contaminants in fish meat.	CONTAM		
	I think fish meat may contain too much mercury.	MERCURY		

[1]Constraint added after testing round based on open-ended comments. No test alpha value available.

[2] Item added after testing round to ensure a minimum of three items measuring each constraint.

All constraint items were rated in importance affecting the respondent's decision to fish less/not at all from -2 (not at all important) to 2 (very important). Desired features at a fishing location were rated from -2 (not at all important) to 2 (very important); similarly, characteristics of an ideal fishing trip were measured on a scale of -2 (not at all important) to 2 (very important). Interest in specific educational programs was Yes/No. A complete copy of the mailed survey is available in the **Supplemental Materials**.

Data Collection

A mailing list of 2,500 Iowa residents was obtained for areas within the CFP; recipients were selected to be representative of Iowa's 2018 demographic composition in those communities. The survey was initiated on 20 July 2018 via an invitation letter with a brief explanation of the survey, a link to the online form, and a $2 incentive. Complete paper surveys with postage-paid return envelopes were sent to non-respondents on 8 August 2018; minor mailing address errors were rectified and complete surveys sent with a $2 incentive the same day. Postcard reminders were sent to all non-respondents on 14 August 2018. Data collection was completed 30 October 2018, and entry and quality-checking was completed 12 December 2018.

Data Analysis

All responses were examined for completeness and duplication. Duplicate responses (in which the respondent submitted both an electronic and paper survey) were identified by respondent ID, and the first complete submission was accepted. Open-ended responses regarding

preferences for certain fish species and education programs were categorized and coded accordingly to incorporate them into subsequent analyses (Appendix).

Responses to individual questions were summarized using descriptive statistics. Respondents were grouped by urban/rural background, exposure to fishing as a child, current interest in fishing, and basic demographics (i.e., gender, race, and age); group-level comparisons to various questions were made using the χ^2 test if the dependent variable was binary and the Kruskal-Wallis test if the dependent variable was categorical (a = 0.05 for all tests). The effect of age group on interest in fishing was tested with the Cochran-Armitage trend test. Significant overall tests were followed by pairwise comparisons, in which case a Bonferroni correction was made; results were reported for one-sided tests.

Constraint latent factors were evaluated for measurement reliability using Cronbach's alpha coefficient for internal consistency (Cronbach 1951); alpha values exceeding 0.80 are considered good whereas values below 0.60 are considered questionable. Factor scores were then calculated by averaging the scores of all measurement items associated with that constraint. Score means and standard deviations were calculated using non-missing data overall and by current interest level in fishing, gender, age group, and race. Differences among groups were evaluated for each constraint using the Kruskal-Wallis test or Wilcoxon Rank Sum test.

Ideal fishing trip descriptors and preferred features were summarized by mean score overall and by interest level, gender, age group, and race. Differences among groups were evaluated using the Kruskal-Wallis or Wilcoxon Rank Sum test (a = 0.05 for all tests), followed by nonparametric multiple comparison tests (Dwass, Steel, Critchlow-Fligner method). Next, missing ideal trip values were estimated using multiple imputation in preparation for multivariate analyses; responses with more than five missing values were excluded. Spearman rank correlation was used on descriptor scores to develop a correlation matrix, and a factor analysis was applied to identify latent constructs describing trip ideals. The solution was rotated using the varimax method to improve interpretability. Differences among groups in mean factor scores were evaluated similar to trip descriptors.

Proportion of respondents interested in education and outreach programs was summarized overall and by level of interest, gender, age group, and race. Group-level comparisons were made using the χ^2 test if the dependent variable was binary and the Kruskal-Wallis test if the dependent variable was categorical (a = 0.05 for all tests). The effect of age group on interest was also tested with the Cochran-Armitage trend test.

A model for predicting fishery preferences was created using responses from those who had fished before. Interest in a specific taxon was indicated by reported fishing behaviors and interests; indicative fishery characteristics were taken from the respondent's description of an ideal fishing trip. Canonical discriminant analysis was then applied to predict interest in a single taxon using ideal fishing trip item scores. Significance was evaluated using Wilks' lambda, and model accuracy was assessed using cross-validation. Optimal cutoff for categorization using any function was zero, but the relative probability of taxon preference varied above and below the optimal cutoff based on how much overlap existed between the normal distributions of those who were interested and those who were not interested in a particular taxon.

Relative probabilities were calculated across discriminant function scores and summarized in the Appendix. Significant discriminant functions were then applied to the subset of respondents who had not provided species preferences to predict their interest in specific taxa.

Results

A total of 443 online responses and 264 paper responses were received, with 14 being duplicate responses in which the respondent used both formats to respond. Removal of duplicates yielded 693 unique surveys with a 27.7% response rate. Responses were received from every community targeted in the survey (Table 2; Figure 2). Respondents who had no interest in fishing (28.3% of all respondents) were more likely to be female than male (χ^2 = 31.3164, *p*-value < 0.0001) and older (Cochran-Armitage Z = 4.1905, *p*-value < 0.0001; Table 3). Race was not a significant factor when considering each group separately (χ^2 = 4.7631, *p*-value = 0.4455), but White respondents were marginally less likely to be interested in fishing than non-White respondents (χ^2 = 3.1232, *p*-value = 0.0772). Of the remaining 71.7% interested in fishing, 11.9% had never fished before but were interested, 39.8% had fished in the past, and 48.3% had fished in the past year. Interest in fishing was related to whether or not the respondent had been exposed to fishing as a child (χ^2 = 72.7936, *p*-value < 0.0001), wherein those respondents with no interest were less likely to have been exposed to fishing as a child than the other three groups (all pairwise comparisons *p*-value < 0.003; Figure 3). Interest in fishing was not related to where the respondent grew up (i.e., city size) (χ^2 = 7.6964, *p*-value = 0.8084).

Table 2. Number of survey responses received and 2016 U.S. census population estimate, by community. Further demographic breakdown is available in Table A 1.

Community	County	Population	Responses	Response Rate (%)
Des Moines	Polk/Dallas/Warren	418,587	189	27.4
Cedar Rapids	Linn	180,354	81	26.2
Davenport	Scott	146,511	66	25.6
Iowa City	Johnson	118,218	53	29.1
Waterloo	Black Hawk	116,468	53	28.8
Sioux City	Woodbury	87,417	39	29.5
Council Bluffs	Pottawattamie	66,308	30	26.8
Ames	Story	66,191	30	38.5
Dubuque	Dubuque	64,110	29	25.2
Ankeny	Polk	58,627	26	24.3
Clinton	Clinton	30,321	14	28.0
Burlington	Des Moines	28,222	13	26.5
Mason City	Cerro Gordo	27,430	12	24.5
Marshalltown	Marshall	27,328	12	29.3
Muscatine	Muscatine	24,899	11	36.7
Ottumwa	Wapello	24,487	11	28.9
Fort Dodge	Webster	24,441	11	30.6
Altoona/Bondurant	Polk	23,734	11	27.5

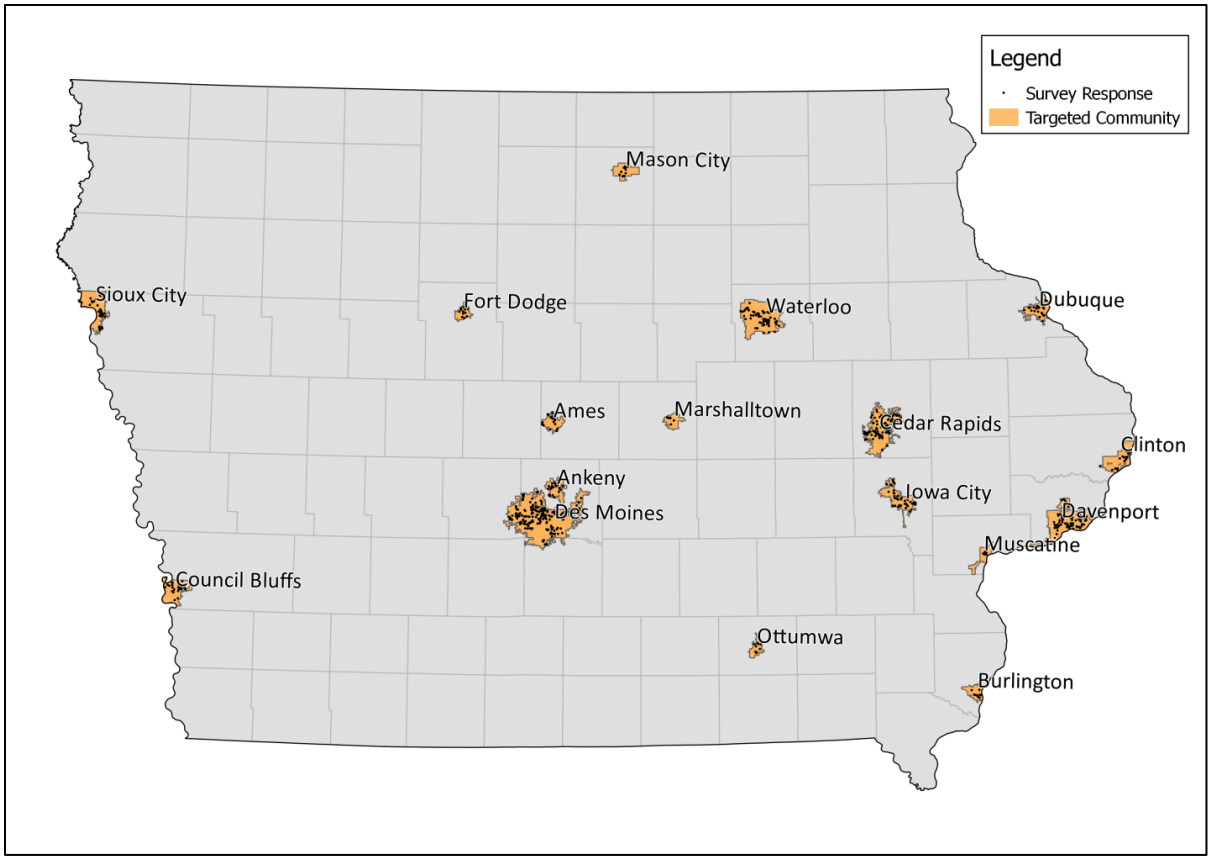

Figure 2. Responses to the 2018 Community Fishing Survey by targeted community.

Table 3. Demographic composition by fishing interest level of survey respondents. "Other" and "Prefer not to answer" responses were excluded for analysis purposes.

Category		Not interested	Never fished before	Fished in the past	Active angler
Gender					
	Male	107	39	128	207
	Female	86	19	63	30
Age					
	18-24 years	1	1	7	4
	25-44 years	36	15	40	83
	45-64 years	81	27	84	107
	65 years and older	74	15	61	40
Race					
	American Indian/Alaska Native	0	0	1	0
	Asian	0	2	1	4
	Black	2	1	7	3
	Hispanic	3	1	3	3
	White	184	49	177	221

Category		Not interested	Never fished before	Fished in the past	Active angler
Background					
	In a city with a population >20,000 people	98	25	94	122
	In a town with a population between 5,000 and 20,000 people	22	9	19	23
	In a small town with a population <5,000 people	29	13	37	43
	In a rural area, outside city limits	32	9	35	43
	Moved frequently between cities of different sizes	13	3	10	7

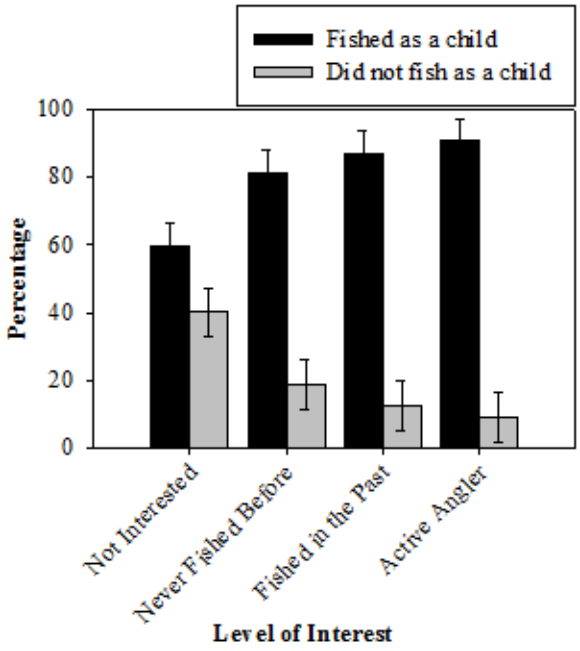

Figure 3. Percentage of respondents who fished as a child, by current level of fishing interest. 95% confidence intervals are shown.

Interest level in fishing was dependent on gender (χ^2 = 28.1431, *p*-value < 0.0001), age (χ^2 = 19.5358, *p*-value = 0.0033), and marginally on White/Non-White race (χ^2 = 4.8703, *p*-value = 0.0876). Active anglers were more likely to be male than either lapsed anglers (pairwise comparison χ^2 = 25.6924, *p*-value < 0.0001) or potential anglers (pairwise comparison χ^2 = 13.5918, *p*-value < 0.0001) and marginally more likely to be White than potential anglers (pairwise comparison χ^2 = 4.9299, *p*-value = 0.0264). Active anglers were also younger than lapsed anglers (*Z* = 3.3223, *p*-value = 0.0004).

Constraints to Fishing

Constraint factors were overall well-measured, with only one factor showing poor internal consistency (i.e., Family Concerns; Table 1). The two factors with lowest internal consistencies were both novel factors which had not been evaluated during the survey testing phase. Constraint scores were calculated for all respondents interested in fishing.

The most important constraint to fishing across respondents was Poor Water Quality, notably the only factor with a positive mean score (Figure 4). Significant differences between groups occurred by fishing participation and gender, but not by age group or race (Table 4). Some differences

were detected when race was grouped into White/Non-White categories.

Active anglers placed less importance compared to lapsed anglers on six constraints: Expense, Lack of Mentorship, Marginality, Family Concerns, Ethics, and Accessibility (all pairwise comparison *p*-values < 0.0167 except Marginality; Table A 2). Men placed less importance compared to women on five constraints, and Non-White respondents placed less importance than White respondents on three constraints (Table 4).

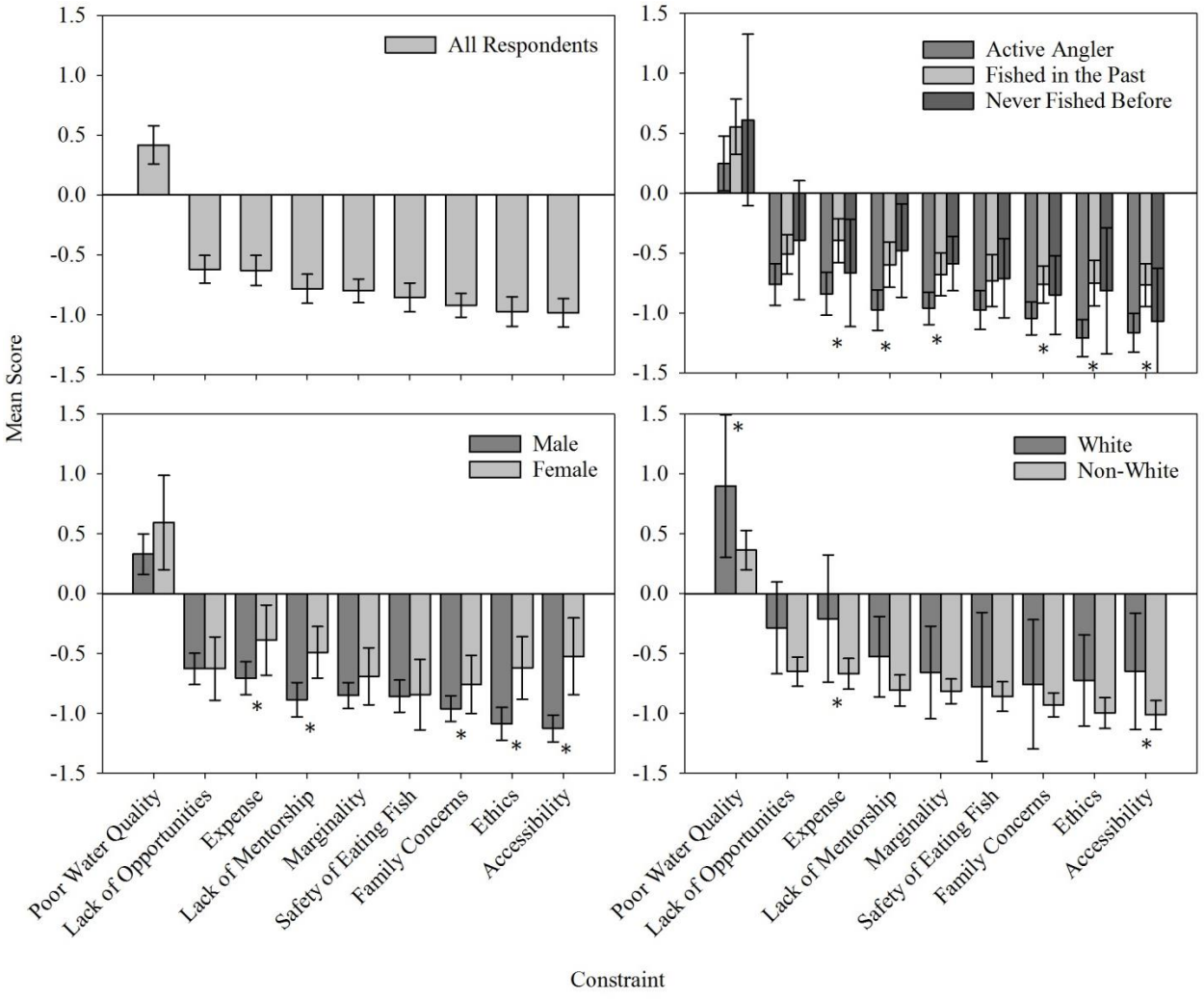

Figure 4. Mean score and 95% confidence intervals of constraints to fishing, overall and by level of interest in fishing, gender, and White/Non-White race. Significant differences are indicated with an asterisk (*).

Table 4. Differences in importance of fishing constraints, by fishing participation, gender, age, and race. Kruskal-Wallis test statistic and associated *p*-value shown for Fishing Interest, Age, and Race; Wilcoxon rank sum test statistic and associated one-sided *p*-value shown for Gender and White/Non-White.

Constraint	Fishing Interest	Gender	Age Group	Race	White/Non-White
Poor Water Quality	2.9209	1848	0.5780	4.8700	1062
	(0.2321)	(0.1043)	(0.9015)	(0.3009)	**(0.0283)**
Lack of Opportunities	5.097	2975	0.9245	6.5281	1554
	(0.0576)	(0.4928)	(0.8195)	(0.1630)	(0.0162)
Expense	11.4028	4563.5	1.2089	3.0697	1869.5
	(0.0033)	**(0.0219)**	(0.7509)	(0.3810)	**(0.0302)**
Lack of Mentorship	11.9821	3345	1.0950	1.6349	1269
	(0.0025)	**(0.0033)**	(0.7783)	(0.6515)	(0.0772)
Marginality	9.0454	3890	3.2098	4.4427	1764
	(0.0109)	(0.1412)	(0.3604)	(0.3494)	(0.2017)
Safety of Eating Fish	3.9535	3246	0.7002	3.4766	1179
	(0.1385)	(0.4304)	(0.8732)	(0.3238)	(0.3891)
Family Concerns	8.1497	3551.5	0.9984	2.1107	1173.5
	(0.0170)	**(0.0464)**	(0.8016)	(0.5498)	(0.2095)
Ethics	12.5672	4854	2.5429	3.7533	1882.5
	(0.0019)	**(0.0005)**	(0.4676)	(0.2894)	(0.0610)
Accessibility	10.7512	4756	4.9351	3.2161	1687
	(0.0046)	**(0.0002)**	(0.1766)	(0.2003)	**(0.0392)**

Preferences for Fishing Experiences

Ideal fishing trip descriptors ranged widely in mean value, with the most important descriptors revolving around experience rather than high or large catch (Figure 5**Error! Reference source not found.**). Specialized descriptors, such as catching a trophy or ice fishing, had the lowest mean value. Many descriptors differed by fishing interest level (Table 5), with active anglers rating catch-oriented and boat-related descriptors higher than others (all pairwise comparison *p*-values < 0.0167; Table A 3). Males rated numerous catch-oriented descriptors higher than did females, whereas females rated two experiential descriptors higher (i.e., one social and one environmental; Table 5). Most differences between age groups occurred between 25-44 year olds and older groups, with the younger group consistently rating group fishing with successful catch as more important to their ideal trip (Table 5; Table A 3). The youngest group, 18-24 year olds, had no significant pairwise differences from other age groups but had very low sample size; thus, additional analyses were conducted with 18-24 year olds bundled with 25-44 year olds.

Factor analysis of ideal trip predictors yielded five factors which explained 61.2% of variation (Table 6). Factors were named *Specialization, Group Success, Harvest, Convenient Access,* and *Water Quality/Partner.* Factor 5 was the weakest factor but did explain more variance than a single variable alone (eigenvalue > 1).

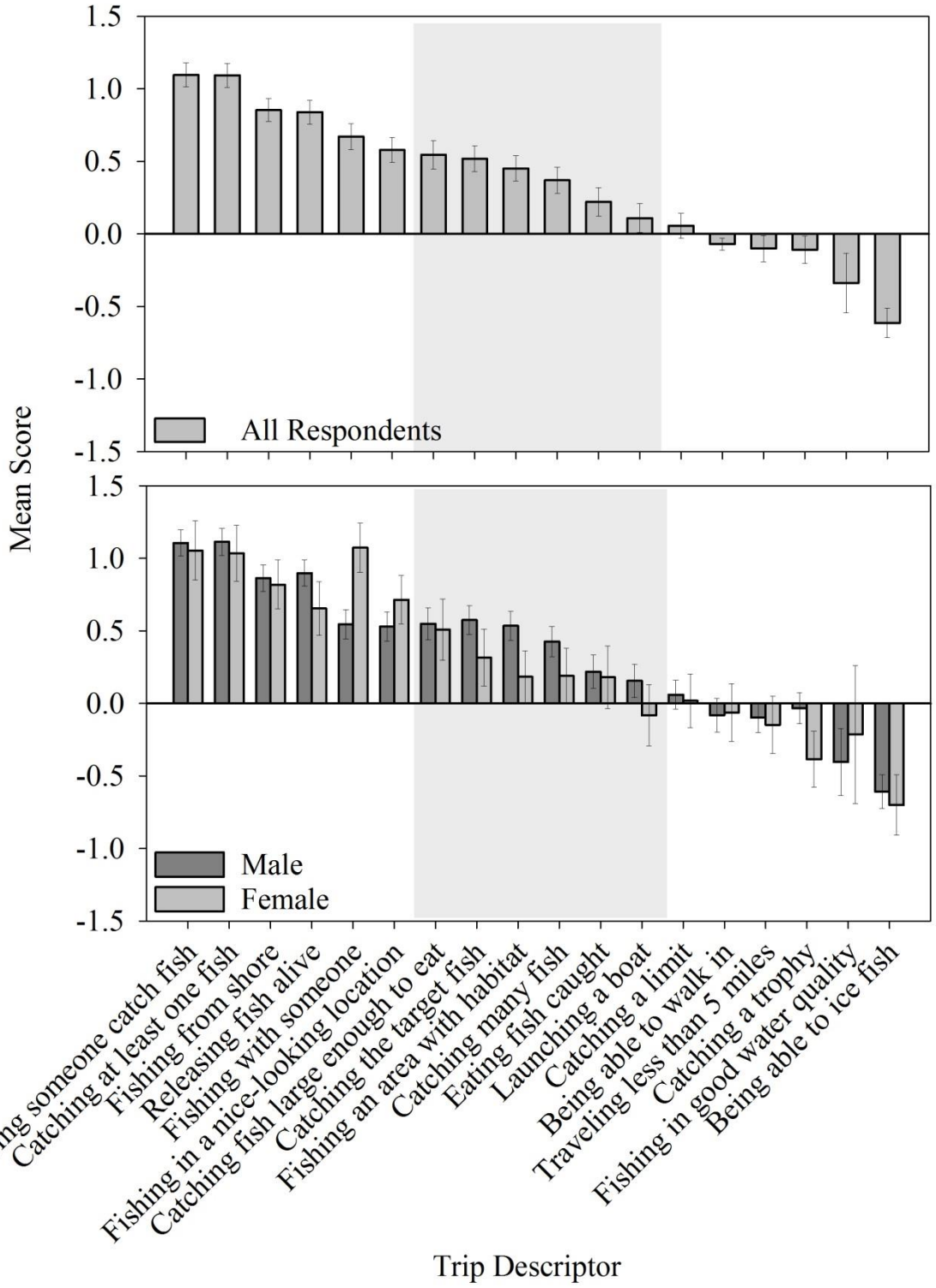

Figure 5. Mean score and 95% confidence intervals of ideal fishing trip descriptors, overall and by gender, level of interest in fishing, and age group. Alternating white and gray background is provided to assist with visual interpretation only.

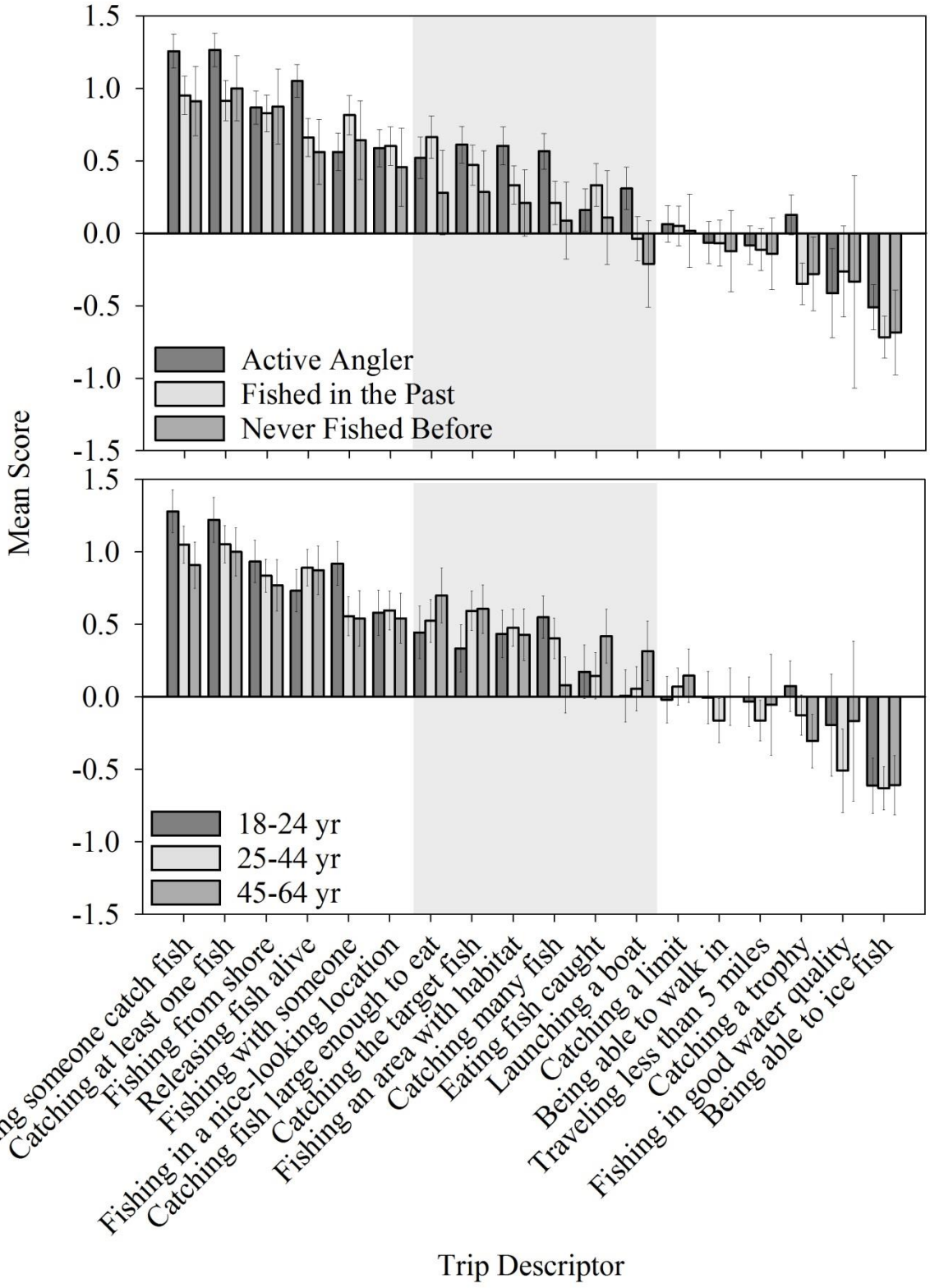

Figure 5 continued.

Table 5. Differences in importance placed on various ideal trip descriptors, by fishing interest level, gender, age group, race, and White/Non-White group. Kruskal-Wallis test statistic and associated *p*-value shown for Fishing Interest, Age Group, and Race; Wilcoxon rank sum test statistic and associated one-sided *p*-value shown for Gender and White/Non-White.

Variable	Code	Interest Level	Gender	Age Group	Race	White/Non-White
Having someone in my group catch at least one fish	GROUPCATCH	19.2188 **(<0.0001)**	26381 (0.4136)	21.1800 **(<0.0001)**	5.7980 (0.2147)	3955.5 **(0.0409)**
Catching at least one fish	ONEFISH	18.9435 **(<0.0001)**	25714.5 (0.3398)	9.1420 **(0.0275)**	2.2425 (0.6912)	10302 (0.3858)
Being able to fish from shore	SHOREFISH	0.3494 (0.8397)	26074 (0.3287)	8.5241 **(0.0363)**	7.4605 (0.1135)	10631 (0.4699)
Releasing fish alive	RELEASEFISH	28.2417 **(<0.0001**)	23314 **(0.0090)**	3.2034 (0.3613)	5.9364 (0.2040)	8779 **(0.0268)**
Fishing with another person	FISHTOGETHER	7.4118 **(0.0246)**	32124.5 **(<0.0001)**	13.6404 **(0.0034)**	5.6463 (0.2272)	10978 (0.4585)
Being able to fish in a visually appealing place	PRETTYOPP	0.8151 (0.6653)	27756.5 **(0.0488)**	2.9031 (0.4068)	3.5542 (0.4697)	10589.5 (0.3792)
Catching fish large enough to eat	EDIBLEFISH	5.6646 (0.0589)	25830.5 (0.4013)	6.9115 (0.0748)	2.7724 (0.5966)	10917 (0.1547)
Catching the type of fish I am targeting	TARGETFISH	5.6793 (0.0584)	23307.5 **(0.0059)**	10.8163 **(0.0128)**	6.6309 (0.1567)	11114.5 (0.1732)
Being able to fish an area with underwater habitat	HABITAT	15.8711 **(0.0004)**	21534 **(0.0001)**	4.1030 (0.2506)	22.8884 **(0.0001)**	7927 **(0.0015)**
Catching many fish, regardless of size	MANYFISH	16.7076 **(0.0002)**	24021 **(0.0196)**	16.1747 **(0.0010)**	3.5561 (0.4694)	9938.5 (0.1938)
Bringing fish home to eat	EATFISH	2.8884 (0.2359)	26383.5 (0.4708)	5.1958 (0.1580)	4.0040 (0.4055)	11323 (0.1382)
Being able to launch a boat	BOATLAUNCH	16.3287 **(0.0003)**	23660.5 **(0.0273)**	6.0687 (0.1083)	14.1559 **(0.0068)**	8678 **(0.0103)**
Catching a limit of fish	LIMITFISH	0.1455 (0.9298)	25406 (0.2592)	5.0889 (0.1654)	7.6309 (0.1061)	11000.5 (0.2286)
Being able to walk to my fishing location	WALKIN	0.4929 (0.7816)	26063.5 (0.4961)	5.6995 (0.1272)	3.4143 (0.4910)	11407.5 (0.1237)

Variable	Code	Interest Level	Gender	Age Group	Race	White/Non-White
Traveling less than 5 miles to get to my fishing location	TRAVELLESS	0.4398 (0.8026)	25087 (0.3501)	3.1102 (0.3749)	7.2546 (0.1230)	12135 **(0.0136)**
Catching a large trophy fish	TROPHYFISH	23.9910 **(<0.0001)**	22123.5 **(0.0009)**	9.5242 **(0.0231)**	6.4219 (0.1698)	10682.5 (0.2406)
Being able to fish a location with good water quality	H2OQUALITY	0.4727 (0.7895)	1839 (0.2324)	2.5709 (0.4626)	3.2796 (0.5122)	918 (0.2419)
Being able to ice fish	ICEFISH	2.7635 (0.2511)	25170 (0.2033)	1.3869 (0.7086)	3.8331 (0.4291)	11051 (0.3086)

Table 6. Factor loadings for ideal fishing trip descriptors. For descriptor code definitions, see Table 5.

Item	Factor				
	1	2	3	4	5
MANYFISH	**0.54858**	0.42676	-0.08471	0.24292	-0.30879
LIMITFISH	**0.58945**	0.04868	0.28347	0.32126	-0.04468
TROPHYFISH	**0.67660**	0.16199	0.02836	0.18815	-0.11847
TARGETFISH	**0.49182**	0.36048	0.37917	-0.05686	0.16366
BOATLAUNCH	**0.66733**	0.09036	0.13025	-0.10054	0.22623
ICEFISH	**0.56838**	-0.20239	0.14612	0.16495	0.39481
ONEFISH	0.09242	**0.78401**	0.17824	0.14595	-0.10635
GROUPCATCH	0.15591	**0.83586**	0.07715	0.08606	0.05811
HABITAT	0.44197	**0.46116**	0.14379	-0.07477	0.25267
SHOREOPP	-0.15838	**0.54677**	0.08275	0.53884	0.11491
EDIBLEFISH	0.24284	0.20159	**0.84584**	0.05532	0.11234
RELEASEFISH	0.35048	0.38491	**-0.40727**	0.06172	0.29369
EATFISH	0.14858	0.09912	**0.88021**	0.09135	0.12623
TRAVELLESS	0.26307	0.08214	0.01131	**0.70551**	0.14616
WALKIN	0.03227	0.06468	0.06785	**0.83256**	0.08573
PRETTYOPP	0.27769	0.31982	-0.00925	**0.34619**	0.23459
WATERQUAL	0.01218	-0.13295	0.14339	0.18069	**0.82596**
FISHTOGETHER	0.09274	0.32873	0.03376	0.12854	**0.60432**

Echoing differences in individual trip descriptors, mean factor scores significantly differed among groups including interest level (*Specialization*: χ^2 = 28.6855, *p*-value < 0.0001; *Group Success*: χ^2 = 14.3332, *p*-value = 0.0008; *Harvest*: χ^2 = 7.0200, *p*-value = 0.0299), gender (*Specialization*: Wilcoxon statistic = 23,993.5, *p*-value < 0.0001; *Water Quality/Partner*: Wilcoxon statistic = 33,074.5, *p*-value = 0.0038), age group (*Group Success*: χ^2 = 15.4369, *p*-value = 0.0004; *Harvest*: χ^2 = 6.1603, *p*-value = 0.0460), and race group (*Group Success*: Wilcoxon statistic = 9,115.5, *p*-value = 0.0093; *Convenient Access*: Wilcoxon statistic = 13,604.5, *p*-value = 0.0063).

Visualization of mean ideal scores using the first three factors and average group scores helped elucidate patterns (Figure 6). Active anglers scored higher on *Specialization* than both lapsed and potential anglers (pairwise comparison *p*-values < 0.0167) and

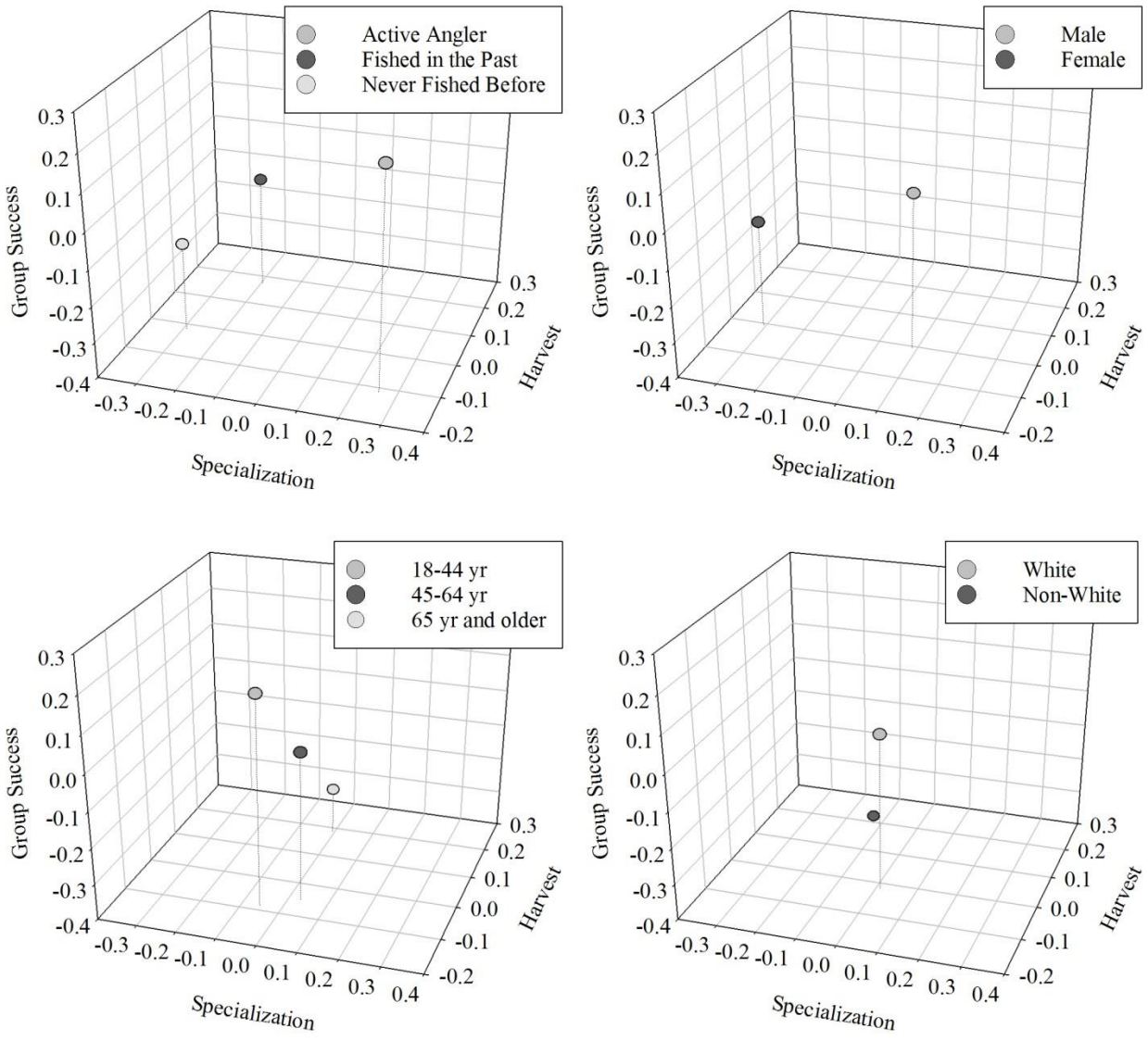

Figure 6. Mean factor scores for trip ideals, by fishing interest level, gender, age group, and race group. Only the first three factors are shown.

higher on *Group Success* than lapsed anglers (*p*-value = 0.0019). Active anglers also scored marginally higher than potential anglers on *Group Success* (*p*-value = 0.0275) and marginally lower than lapsed anglers on *Harvest* (*p*-value = 0.0217). Males scored higher than females on *Specialization*, whereas females scored higher on *Water Quality/Partner*. Respondents 18-44 years old scored higher than 65+ year olds (*p*-value = 0.0003) and marginally higher than 45-64 year olds (p-value = 0.0221) on *Group Success*. Whites scored higher than non-Whites on *Group Success*, whereas Non-Whites scored higher on *Convenient Access*.

Preferred Amenities

The most important amenities to have at a fishing location were pedestrian access, parking areas, and bathrooms, whereas the least important amenity was public transportation to the fishing location (Figure 7). Preference for some amenities differed by fishing interest level, gender, age group, and race group (Figure 8; Table 7). Those who fished in the past rated public transportation as more important than did active anglers, but rated boat access as marginally less important (Table A 5). Females placed more importance on almost every amenity than males. Older respondents had a significantly stronger preference for ADA-accessible facilities and parking areas than 18-44 year olds, and marginally significant preference for parking and bathrooms. Finally, White respondents placed greater importance on boat access than Non-White respondents. Non-White respondents placed greater importance on lighting and picnicking areas.

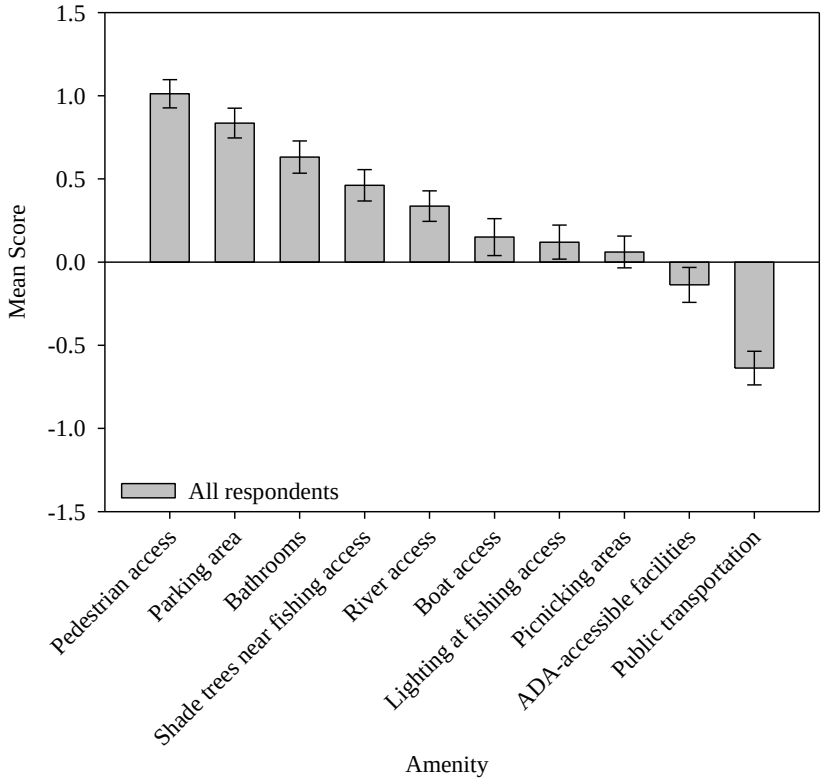

Figure 7. Mean score and 95% confidence intervals of preferred features to have at a fishing location.

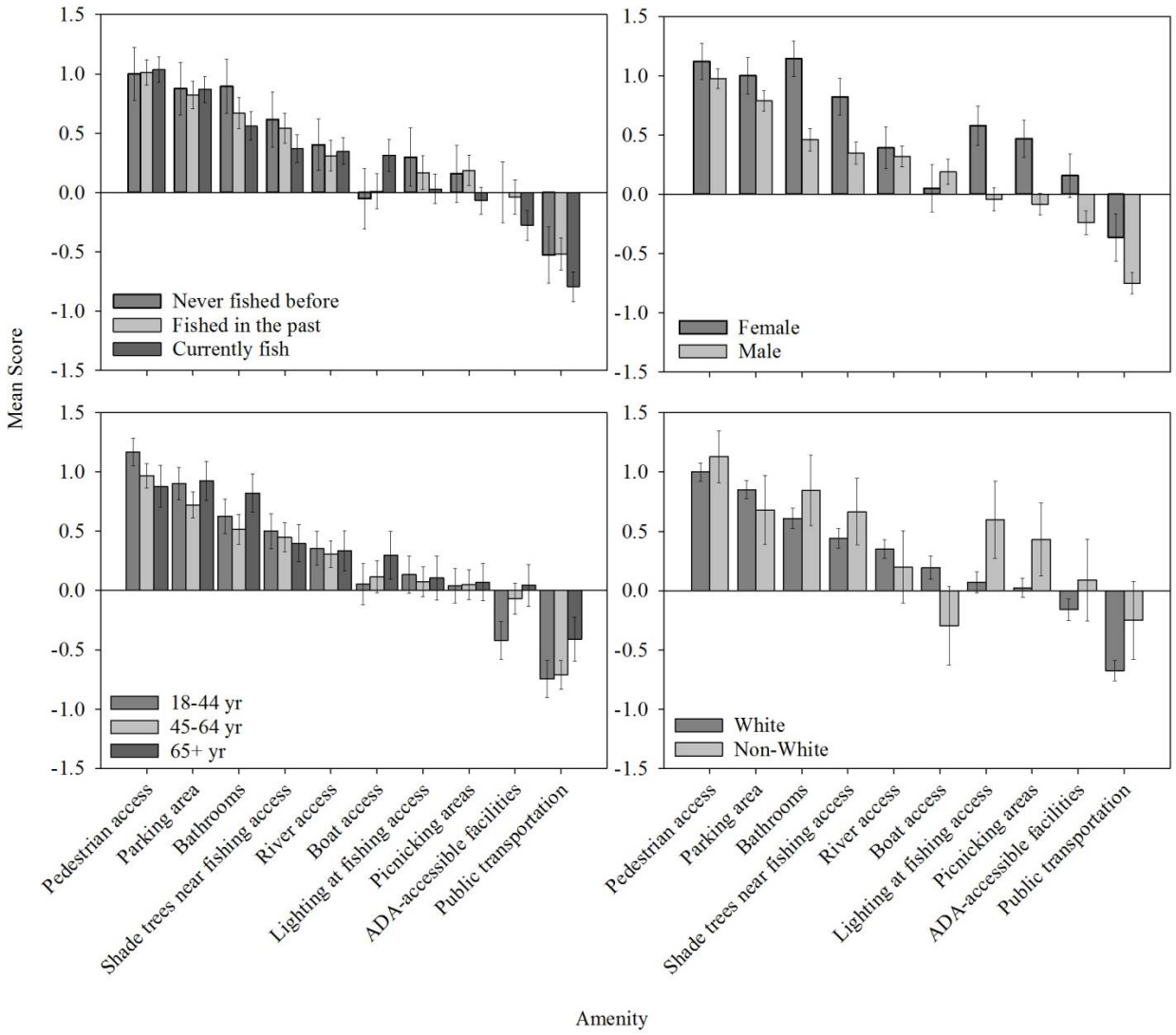

Figure 8. Mean scores and 95% confidence intervals of preferred features to have at a fishing location by fishing interest level, gender, age group, and White/Non-White race.

Program Interests

The most popular educational and outreach programs were intermediate fishing skills, fish cleaning and cooking, and advanced skill seminars (Figure 9). Program preference differed by interest level, gender, and age (Table 8). Those who had not fished before were significantly more interested than active or lapsed anglers in basic fishing skills seminars, whereas active anglers were more interested in advanced species- or method-specific seminars, stocking events, and fishing tournaments (Table A 6). Women were less interested in advanced skill programs and marginally more interested in programs designed to help you find a fishing partner or peer group. Interest in numerous programs declined with age, including basic and intermediate fishing skill seminars, family- and partner-oriented programs, fishing competitions, and programs on preparing, cooking, and sustainability.

Table 7. Differences in importance placed on various features to have at a fishing location, by fishing interest level, gender, age group, race, and White/Non-White group. Kruskal-Wallis test statistic and associated *p*-value shown for Fishing Interest, Age Group, and Race; Wilcoxon rank sum test statistic and associated one-sided *p*-value shown for Gender and White/Non-White.

Feature	Interest Level	Gender	Age Group	Race	White/Non-White
Boat access	8.5430	27585	2.4491	13.9542	4179.5
	(0.0140)	(0.1653)	(0.2939)	**(0.0074)**	**(0.0004)**
Pedestrian access	0.4610	30740.5	5.2164	3.5204	7570.5
	(0.7941)	**(0.0296)**	(0.0737)	(0.4748)	(0.1576)
Public transportation	9.3279	31755.5	6.4749	2.7847	6847
	(0.0094)	**(0.0029)**	**(0.0393)**	(0.5945)	(0.2716)
Parking areas	0.6140	32573.5	8.1243	3.9613	6527.5
	(0.7356)	**(0.0086)**	**(0.0172)**	(0.4113)	(0.2469)
Bathrooms	5.4292	37534	6.8619	3.7241	7530
	(0.0662)	**(<0.0001)**	**(0.0324)**	(0.4446)	(0.1167)
Lighting	3.1517	35685	0.2089	7.7272	8294.5
	(0.2068)	**(<0.0001)**	(0.9008)	(0.1021)	**(0.0090)**
River access	0.1597	29624	0.3288	7.75	6315
	(0.9233)	(0.2261)	(0.8484)	(0.1012)	(0.2760)
Shade trees	5.3766	34566	0.6735	8.1828	7604.5
	(0.0680)	**(<0.0001)**	(0.7141)	(0.0851)	(0.0966)
Picnicking areas	6.4806	34613.5	0.0196	5.8182	7677.5
	(0.0392)	**(<0.0001)**	(0.9902)	(0.2131)	**(0.0317)**
ADA access	5.0796	31118	11.3050	4.6236	6356
	(0.0789)	**(0.0011)**	**(0.0035)**	(0.3281)	(0.4825)

Prediction of Fish Species Preference

Significant discriminant functions were determined for Bluegill, Channel Catfish, Muskellunge and Anything; marginally significant functions were determined for Largemouth Bass and Hybrid Striped Bass (Table 9). A total of 378 responses were used to compute functions in discriminant analysis, and discriminant scores were calculated for an additional 123 respondents (Figure 10). The most popular fish taxon was Largemouth Bass, followed by Bluegill and Walleye. The least popular fish taxa were Flathead Catfish and Yellow Perch. Potency of each ideal trip variable differed by taxon (Table 10).

An ideal fishing trip for Channel Catfish was defined as catching and harvesting many fish, whereas an ideal fishing trip for Hybrid Striped Bass, Muskellunge, or Largemouth Bass excluded harvest. An ideal trip for Muskellunge was most strongly defined by catching a trophy-sized fish, whereas an ideal trip for Hybrid Striped Bass was most strongly defined by catching many fish. An ideal Bluegill trip was defined by shore fishing opportunities in which someone in the group catches fish, preferably many fish. Generalists, those targeting Anything, defined an ideal fishing trip as a shoreline opportunity within close traveling distance, in which a group fishing together catches something. The relative

probability of species preference is provided for discriminant function values in the Appendix (Figure A 1).

Discussion

Residents in Iowa's urban and suburban areas were overall interested in fishing if not already actively fishing. Our estimated proportion of active anglers (34.6% of all respondents) was slightly lower than reported by the most recent outdoor recreation survey (41%: Responsive Management 2018), but that survey covers activities for two years prior rather than one and is a statewide survey. According to Responsive Management (2018), the proportion of people who participated in fishing decreased with city size, as did the proportion of people interested in fishing as a new activity. Nonetheless, we found that potential new recruits represented 8.5% of the total urban population, equating to over 170,000 people (USCB 2018).

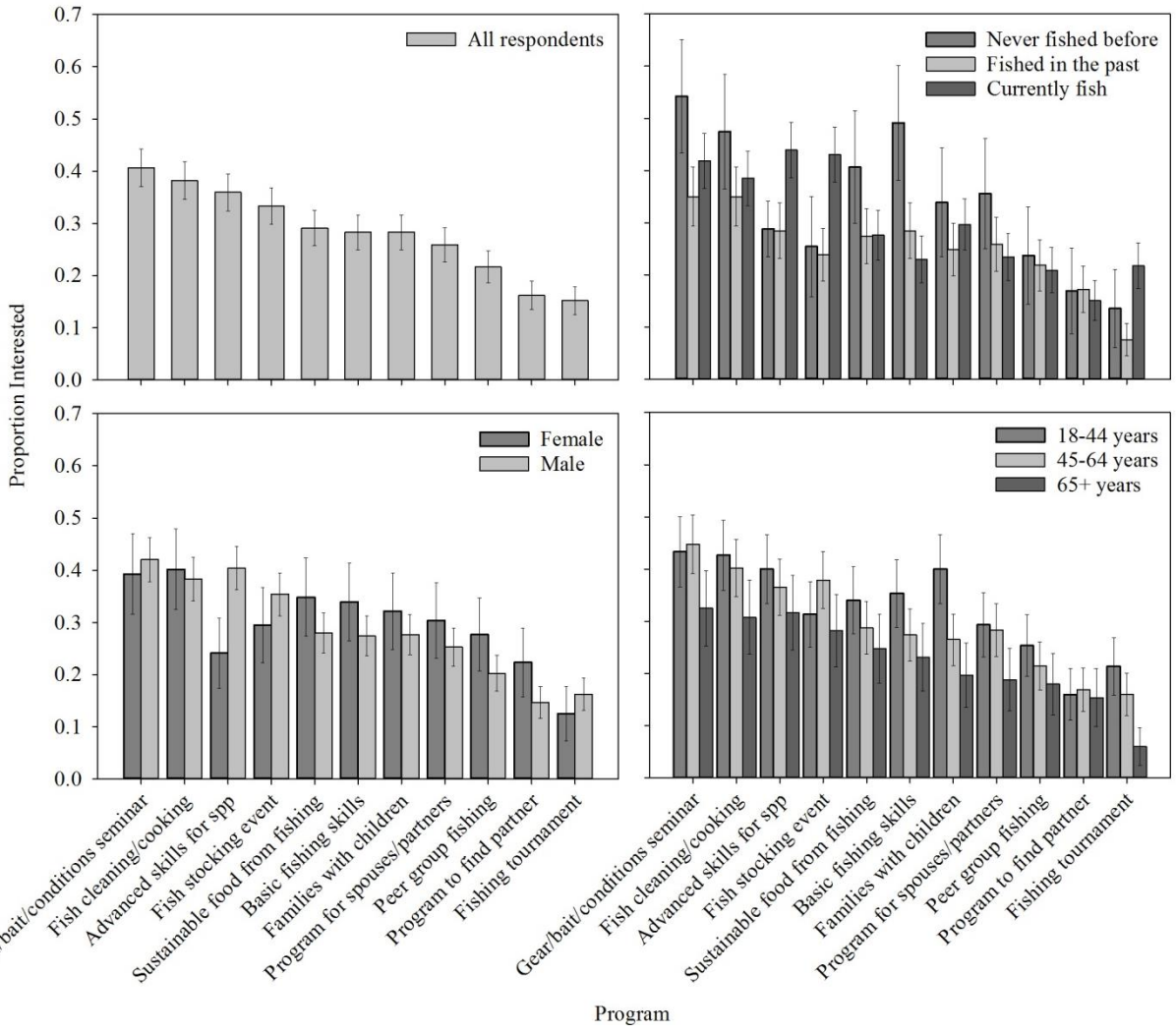

Figure 9. Proportion of respondents interested in education and outreach programs, overall and by interest level, gender, and age group.

Table 8. Differences in interest in various programs, by fishing interest level, gender, age group, and race. Results for the Chi-square test and associated *p*-value are shown. The Trend column shows the Cochran-Armitage trend test statistic and associated one-sided test *p*-value for Age Groups.

Program	Interest Level	Gender	Age Group	Trend	Race	White/Non-White
A basic fishing skills seminar	15.9437 **(0.0003)**	1.7938 (0.1805)	5.1900 (0.0746)	2.2384 **(0.0126)**	4.9472 (0.2928)	2.6073 (0.1064)
A program for families with children	2.2854 (0.3190)	0.8478 (0.3572)	14.4139 **(0.0007)**	3.7141 **(0.0001)**	1.9573 (0.7436)	0.5971 (0.4397)
A program for spouses/partners	3.6510 (0.1611)	1.1502 (0.2835)	4.5471 (0.1029)	1.8569 **(0.0317)**	0.4057 (0.9820)	0.0095 (0.9222)
A program in which you could fish with a peer group	0.2289 (0.8919)	2.8098 (0.0937)	2.1260 (0.3454)	1.4588 (0.0723)	0.9187 (0.9219)	0.0419 (0.8378)
A program that helps you find others to fish with	0.4150 (0.8126)	3.7270 (0.0535)*	0.1379 (0.9334)	0.1059 (0.4578)	8.8082 (0.0661)	2.4418 (0.1181)
A fishing competition or tournament	16.9343 **(0.0002)**	0.9198 (0.3375)	12.1503 **(0.0023)**	3.4170 **(0.0003)**	1.3124 (0.8593)	0.3970 (0.5287)
A fish stocking event	19.8715 **(<0.0001)**	1.3420 (0.2467)	3.6812 (0.1587)	0.3817 (0.3514)	3.7281 (0.4440)	2.5057 (0.1134)
A fish cleaning/cooking seminar	2.9921 (0.2240)	0.1286 (0.7199)	4.2916 (0.1170)	1.9224 **(0.0273)**	5.3303 (0.2551)	0.6988 (0.4032)
A program for sustainable food from fishing	4.3619 (0.1129)	1.9728 (0.1601)	2.7641 (0.2511)	1.6575 **(0.0487)**	2.1039 (0.7167)	0.0498 (0.8235)
A seminar on appropriate gear, bait and fishing conditions	7.2407 **(0.0268)**	0.2662 (0.6059)	5.0726 (0.0792)	1.6662 **(0.0478)**	1.9946 (0.7367)	0.0245 (0.8757)
An advanced fishing skills seminar for your preferred species	12.7611 **(0.0017)**	9.8939 **(0.0017)**	1.9895 (0.3698)	1.4025 (0.0804)	3.6780 (0.4513)	0.4072 (0.5234)

*Fisher's exact one-sided test was significant <0.05.

Table 9. Discriminant analysis results for fish preference using ideal trip descriptors. Sample size (n), mean (xbar), and standard deviation (Std) are shown for respondents interested (I) or not interested (N) in a particular taxon.

Taxon	Code	Wilk's λ	df	P-value	n_N	$xbar_N$	StD_N	n_I	$xbar_I$	StD_I
Bluegill	BLG	0.899	18	**0.0027**	195	0.3242	1.0034	183	-0.3854	0.9964
Crappie	CRP	0.936	18	0.1525						
Yellow Perch	YEP	0.939	18	0.1863						
Walleye	WAE	0.961	18	0.7010						
Largemouth Bass	LMB	0.926	18	**0.0578**	153	-0.3424	1.0133	225	0.2328	0.9909
Smallmouth Bass	SMB	0.950	18	0.4023						
Hybrid Striped Bass	HSB	0.929	18	**0.0808**	224	-0.2281	1.0543	154	0.3318	0.9151
Trout	TRT	0.939	18	0.1824						
Muskellunge	MUE	0.910	18	**0.0110**	188	-0.3146	0.9726	190	0.3113	1.0264
Channel Catfish	CCF	0.923	18	**0.0424**	245	-0.2127	1.0347	133	0.3918	0.9324
Flathead Catfish	FCF	0.935	18	0.1403						
Anything	ANY	0.863	18	**<0.0001**	272	-0.2485	0.9348	106	0.6376	1.1513

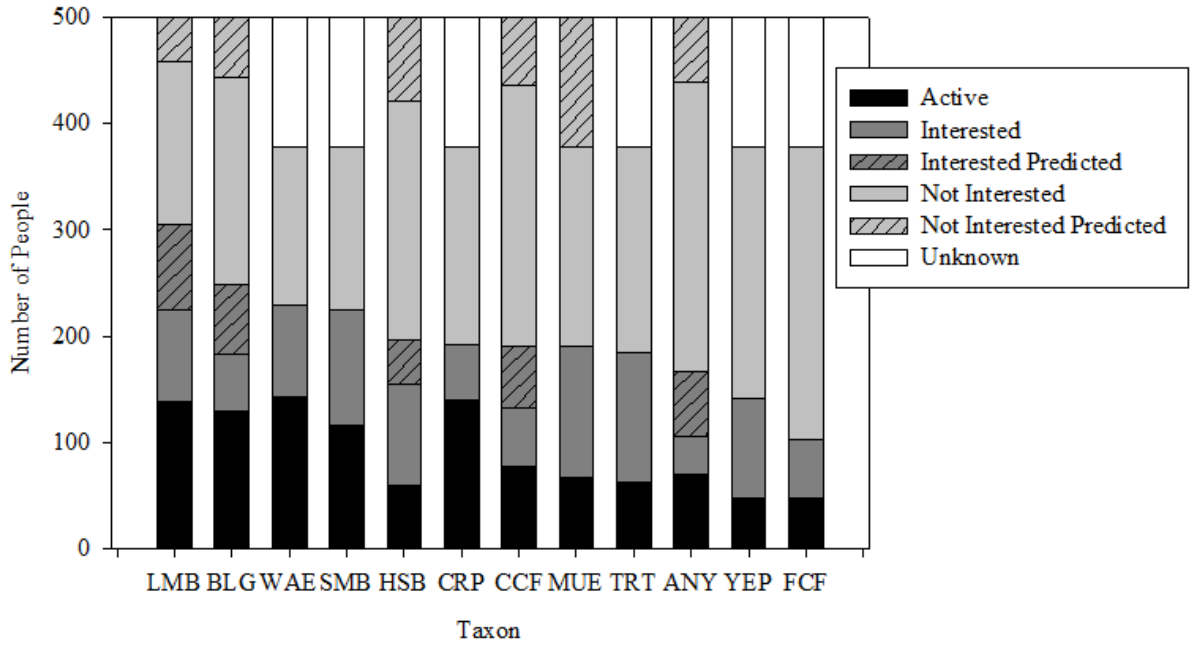

Figure 10. Preference for specific fish taxa by survey respondents who provided ideal trip indicators. Refer to Table 9 for taxon codes.

Table 10. Discriminant function coefficients by taxon. Potency is calculated as the square of the coefficient value. Refer to Table 5 for variable definitions.

Variable	ANY	BLG	CCF	HSB	LMB	MUE
MANYFISH	0.330	-0.295	0.316	0.764	0.463	0.438
LIMITFISH	-0.300	0.198	0.004	0.232	-0.124	-0.046
TROPHYFISH	0.079	0.163	0.204	0.431	0.160	0.747
EDIBLEFISH	-0.300	-0.118	0.151	-0.158	-0.175	-0.337
TARGETFISH	-0.406	0.404	-0.097	0.130	0.040	0.062
RELEASEFISH	0.130	0.424	-0.260	0.260	-0.035	0.239
EATFISH	-0.374	-0.033	0.296	-0.258	-0.265	-0.307
ONEFISH	0.363	-0.092	0.126	0.440	0.401	0.339
GROUPCATCH	0.485	-0.232	0.330	0.347	0.450	0.266
HABITAT	0.024	-0.038	0.394	0.222	0.205	0.119
TRAVELLESS	0.329	0.065	-0.042	0.260	-0.207	0.117
WALKIN	0.138	0.237	-0.037	-0.043	-0.133	-0.180
SHOREOPP	0.402	-0.244	-0.147	0.084	0.265	-0.192
BOATLAUNCH	-0.065	0.024	0.131	0.017	0.195	0.085
PRETTYOPP	0.121	0.041	-0.414	0.047	-0.076	0.079
WATERQUAL	0.138	-0.052	-0.044	-0.010	0.374	-0.021
ICEFISH	-0.002	-0.045	0.357	0.382	-0.381	0.141
FISHTOGETHER	0.315	-0.019	-0.026	-0.072	-0.219	-0.081

Interest in fishing was dependent on childhood exposure, not on whether the individual was raised in an urban or rural area. As a traditional activity typically passed from one generation to the next, fishing requires socialization and mentorship which is most successful during childhood (Kuehn et al. 2006). Reduced exposure to outdoor experiences early in life can lead to reduced participation, as demonstrated for African Americans in national parks (Krymkowski et al. 2014).

Active anglers were demographically distinct from potential and lapsed anglers, indicating that past R3 efforts have been variably effective for unique demographic groups (e.g., gender and age). Other studies have similarly documented lower levels of fishing participation by women (Dargitz 1988; Duda 1993; Floyd et al. 2006; U.S. DOI and DOC 2017) and non-White individuals (Floyd and Lee 2002; Hunt and Ditton 2002; Harris 2012). Likewise, the most recent Iowa angler survey found that anglers in the CFP area were predominantly male (89%: Responsive Management 2019). Similar to our study, Fedler and Ditton (2001) found that lapsed anglers in Texas were significantly more likely to be women, and participation was less likely as age increased (Floyd et al. 2006). In Iowa, a disproportionate number of first-time license buyers who lapse are female (Kopaska 2014). Continued improvement in R3 of anglers requires acknowledgment of differences in constraints and preferences between the existing and potential angler populations in urban and suburban areas. Fisheries management and programming must be adjusted accordingly.

Numerous differences in fishing-related constraints and preferences defined current anglers from lapsed or potential anglers. Potential anglers were more affected by marginalization and a lack of mentorship. Marginalized groups in a national study perceived more constraints to outdoor recreation in general than non-marginalized groups and were concerned with personal safety, language barriers, money and time, and access to acceptable recreation locations (Ghimire et al. 2014). Marginality can also contribute to a sense of "not belonging," whether perceived or real, and manifests as a fear of discrimination, violence, or stigmatization (Shaw 1994; Schroeder et al. 2008). Marginalized groups may be defined by gender, age, race, socioeconomic status, or other variables (Culp 1998; Adkins 2010; Ghimire et al. 2014). The second constraint emphasized by potential anglers, a lack of mentorship, reflects the need for basic knowledge traditionally passed through repeated socialization from mentors. Urban anglers in general may have greater difficulty in procuring information about fishing due to a lack of mentorship, peer encouragement, and access (Finn and Loomis 1997). This constraint coincided with the repeated demand by potential anglers for programming focused on basic fishing skills. Potential anglers also had unique preferences. They were less demanding in a number of ideal trip descriptors and were far less specialized than active anglers. Their predicted taxon preferences were accordingly simple, with the greatest number of potential anglers being interested in Largemouth Bass-Bluegill fisheries. The least preferred taxa were fairly specialized and typically required a boat: Hybrid Striped Bass and Muskellunge, "the fish of 10,000 casts." These fisheries are probably inappropriate for recruiting potential anglers as they require more learning and patience to achieve success.

Lapsed anglers in particular were more sensitive than active anglers to most surveyed constraints. Participation in fishing typically declines throughout life to some degree (Arlinghaus et al. 2015), but could be mitigated by removal of accessibility and physical safety barriers including family-related safety. Additional constraint by ethical concerns, marginality, lack of mentorship, and lack of opportunity may be overcome with greater one-on-one teaching from a knowledgeable mentor, especially if the potential angler is a first- or second-time buyer (Responsive Management 2013). Aas (1995) also reported differences between interested nonanglers (which may have included many lapsed anglers) and active anglers in their rating of economic limitations, family obligations, personal health, and age as constraints. These lists imply that re-activation of lapsed anglers could be more challenging that recruitment of new anglers; these findings were similar to an evaluation of several years of marketing campaigns in lapsed Iowa anglers (Kopaska 2014). However, there are unique subgroups within the lapsed angler population who may respond differently to re-activation efforts, namely one-time recruits versus inconsistent anglers (Responsive Management 2013). Re-activation of a previous customer has been shown to give a 214% return on investment compared to a 23% return on investment for a new customer (Stauss and Friege 1999). According to Griffin and Lowenstein (2001), the chances of re-activating a previous customer are between 1 and 8 times greater than the chances of recruiting a new customer. Lapsed anglers were more focused on social experience, valuing "fishing with another person" more than others and experiencing social constraints including family concerns, lack of

mentorship, and marginality. Responsive Management (2008) similarly reported that casual anglers were more likely than avid anglers to fish to "be with family" rather than "for sport." Lapsed anglers were less interested than others in several education and outreach programs, but could benefit most from intermediate skill and fish cleaning/cooking seminars. Further characterization of lapsed angler subgroups may be useful to separate those who need minimal encouragement from those who are permanently lapsed.

Interest in fish harvest as part of an ideal trip also defined lapsed anglers from others. Although the vast majority of anglers considered Iowa's fish to be safe to eat, those who lived in the CFP area were less likely to consume fish caught and more likely to identify a variety of contaminants or pollutants of concern (Responsive Management 2019). Concerns for mercury and heavy metals may be convoluted with concerns for poor water quality in general and litter, creating a perception of unsafe conditions for fish consumption (Beehler et al. 2001). Respondents in the current study did not identify safety of fish consumption as a major constraint, but did consistently identify water quality. This emphasizes the importance of fish tissue testing and communication of results in urban areas, which may include non-State-owned waterbodies.

Active anglers experienced most constraints to a lesser degree than others, indicating that they had evaluated fishing to be a worthy activity despite the constraints that exist. This negotiation is dependent on the individual recognizing the benefits of fishing, emphasizing the importance of studying motives and preferences for different interest levels. Avid Iowa anglers were most focused on good weather and better access to fishing locations as constraints which limited but did not stop their fishing behavior (Responsive Management 2013). Active anglers were more specialized than other interest levels and thus focused on more demanding fishery performance metrics, which included catching the target fish, catching many fish, catching a trophy, and launching a boat. They were likewise focused on specialized amenities (boat access) and challenging programs (advanced skills, fishing competitions). Similar demand for higher quality of fishing was found by Aas (1995) for Norwegian anglers compared to interested (including lapsed) non-anglers, and for Iowa anglers (Responsive Management 2013).

Other constraints and preferences were universally shared. For instance, poor water quality was a shared concern, constraining fishing participation more than any other factor, followed by a lack of opportunities. These were both frequently cited constraints in the recent outdoor recreation survey as well, along with uncontrollable factors like weather and lack of time (Responsive Management 2018). These types of constraints are structural in nature. Structural constraints are frequently the most important factors reducing fishing participation, but should be the easiest to overcome or mitigate (Ritter et al. 1992; Aas 1995; Fedler and Ditton 2001; Sutton 2007).

An ideal fishing trip was generally defined by feasible catch-related descriptors combined with a few experiential descriptors, not exclusively one or the other. People wanted to fish in a nice environment with a group, and for that group to catch at least something. The ideal fishing trip was universally characterized by shore access, a finding mirrored by the most recent Iowa Angler Survey which indicated better shore access would make fishing easier for anglers (Responsive Management 2019).

Many desired amenities at fishing locations were also universally shared and revolved around logistics; pedestrian access, parking areas, and bathrooms were the most important regardless of grouping. These findings were similar to the Iowa angler survey (Responsive Management 2019) and previous urban recreation research (Ho et al. 2005). Active anglers again underrated the importance of several amenities relative to others. Extensive significant differences existed for women compared to men, and several differences existed based on age group and White/Non-White race. Likewise, Ho et al. (2005) reported that women valued amenities like bathrooms and parking higher than did men, and African-Americans and Hispanics were more likely than other ethnic groups to value cooking and picnic areas. If these groups are to be targeted in recruitment efforts, appropriate amenities should be made available at fishing locations. In terms of cost, anglers in Oklahoma City were willing to pay more for physical infrastructure improvements like modern bathrooms than for a "higher quality" fishery (Mahasuweerachai et al. 2010).

Management Implications

Urban and suburban fishery management is essential for continued progress in angler R3. Successful development of an urban fishing program includes provision of a quality resource, establishment of appropriate facilities and amenities, and communication of the opportunities available (Balsman and Shoup 2008).

Actions to improve the fishery resource should focus on providing appropriate fisheries for the local audience and improving water quality in urban areas including rivers (Responsive Management 2018), as well as educating interested parties regarding water quality, contaminant issues, and current conditions that may affect public safety. Protecting water quality in Iowa's waters was the most important priority identified by anglers in the most recent angler survey (Responsive Management 2019). Anglers in the CFP area were less aware of current or past water quality conditions than anglers outside the CFP area (Responsive Management 2019), implying a need for education on the topic. Collaboration with outside partners (e.g., city and county governments, housing agencies, nonprofit groups) should be pursued to create more local public fishing opportunities, thereby facilitating early and convenient exposure of urban residents to fishing. In terms of providing an appropriate fishery, simple fisheries based on Largemouth Bass and Bluegill will likely have the broadest appeal. Again, the least preferred taxa were fairly specialized and typically required a boat; these fisheries are probably inappropriate for recruiting potential anglers and re-activating inconsistent anglers who may not have such equipment.

Appropriate amenities should be provided at fishing locations, with emphasis on ensuring marginalized groups have the necessary amenities to overcome structural constraints related to access, safety, and quality of facilities. Amenities are prioritized differently by different demographic groups, and urban fishing locations should be designed to maximize friendliness to targeted R3 groups.

Fishing education and outreach programs also target different audiences based on fishing interest level, and program choice should reflect R3 goals. For example, stocking events and advanced fishing skill seminars were very important to active anglers, but significantly less interesting to both lapsed and potential anglers. Provision of these program topics may help with

retention of active anglers, but may not be the most effective choice for recruiting or re-activating anglers. The broadest appeal in general can be achieved with intermediate fishing skills, fish cleaning and cooking, and advanced skills programs, but the broadest appeal to new recruits can be achieved with programs on basic and intermediate skills and fish cleaning and cooking. Younger individuals are more interested in angler education programs in general. Outreach and fishing education efforts should continue to target children and families with children to create interest early. Importantly, these efforts should not be curtailed in urban areas; rather, community fishing programs which provide urban and suburban fishing opportunities should be established or expanded.

Finally, communication efforts must proactively address the dearth of knowledge on when, where, and how to fish to ameliorate constraint by a perceived lack of opportunities and to reduce constraint by lack of mentorship. Paired with appropriate outreach programs, messaging to the public should focus on where public fishing opportunities are located, what the fishery looks like, and what regulations govern the fishery. Appropriate avenues for this communication may differ by target audience (see Kopaska 2014). Without this knowledge, a potential angler may not realize that an opportunity is even available (Balsman and Shoup 2008).

Future research should continue to focus on the unique set of motives, constraints, and preferences of novel customer groups. Potential recruits may include individuals who have not traditionally fished and are not well-represented by angler surveys. For example, there is room for growth in new markets such as the sustainable foods movement and with new ethnic groups that have recently immigrated to the state. Lapsed anglers also require further characterization to identify why they stopped fishing and what could induce them to return. Some subgroups within the lapsed category may be more susceptible to R3 efforts than others due to timing and circumstances of life (Responsive Management 2013). Again, small gains in reducing angler churn could represent greater gains in angler numbers than small gains in recruitment rate. Rather than applying the generalized categories of basic demographic composition, we may more effectively study these groups using a business marketing approach. Customer segments are defined not only by gender, age, and race, but by lifestyle as a whole. Segmentation of lapsed and potential anglers is spatial in nature, allowing not only characterization of survey respondents but also prediction of expected constraints and preferences in new neighborhoods. Predictive models would also enable strategic planning into the future based on projected population changes.

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Appendix

Open-ended Responses and Categorization

Open-ended responses were grouped as much as possible, with common suggestions added to the analysis as an additional category. Terminology differences were rectified by placing terms such as "wiper" into the appropriate category. Uncommon suggestions and suggestions for species that do not occur in Iowa were grouped as "Other." Questions and associated open-ended responses and categorization are listed below.

Please indicate your interest in fishing for each of the species listed below:

Other (please specify): _____

Response	n	Categorization
Bullhead	1	Other
Carp	2	Other
Cod	1	Other
Halibut	1	Other
Salmon	2	Other
Sturgeon	1	Other
Wiper	1	Hybrid Striped Bass

Would you be interested in attending the following types of programs?

Other (please specify): _____

Response	n	Categorization
Boat and river safety	1	Other
Boy Scout Fishing Clinic	1	A program for families with children
Finding places to fish	1	A basic fishing skills seminar
Fishing Conservation/ Environmental Stewardship	2	Other
Fly fishing	2	An advanced fishing skills seminar
Handling, cleaning fish	1	A fish cleaning/cooking seminar
Women only	1	A program in which you could fish with a peer group

Table A 1. Basic demographic composition and fishing interest category of all survey respondents.

Factor	Value	Frequency
Fishing interest level		
	Not interested	195
	Never fished before	59
	Fished in the past	197
	Active angler	239
	Missing	3
Gender		
	Female	198
	Male	483
	Other	1
	Prefer not to answer	6
	Missing	5
Age		
	18-24 years	13
	25-44 years	174
	45-64 years	300
	65 years and older	191
	Prefer not to answer	10
	Missing	5
Race		
	American Indian or Alaska Native	1
	Asian	7
	Black	13
	Hispanic	10
	White	633
	Prefer not to answer	22
	Missing	7
Background		
	In a city with a population >20,000 people	339
	In a town with a population between 5,000 and 20,000 people	75
	In a small town with a population <5,000 people	122
	In a rural area, outside city limits	119
	Moved frequently between cities of different sizes	33
	Missing	5

Pairwise Comparisons of Constraints and Ideal Trip Descriptors

Table A 2. Pairwise comparisons for constraints to fishing, by fishing interest level. Nonparametric Dwass-Steel-Critchlow-Fligner value is shown with associated *p*-value in parentheses.

Comparison	**Access**	**Ethics**	**Expense**	**Family Concerns**	**Lack of Mentorship**	**Marginality**	**Opportunity**	**Poor Water Quality**	**Safety of Eating Fish**
				Fishing Interest Level					
Active Angler vs. Fished in the Past	4.4641 **(0.0045)**	5.0046 **(0.0012)**	4.7279 **(0.0024)**	3.9817 **(0.0135)**	4.2980 **(0.0067)**	3.4238 (0.0410)	3.0282 (0.0817)	2.2729 (0.2425)	2.3901 (0.2090)
Active Angler vs. Never Fished Before	0.3395 (0.9687)	1.9879 (0.3379)	0.7487 (0.8569)	1.8489 (0.3910)	3.3845 (0.0441)	3.5587 *(0.0318)*	2.1610 (0.2777)	1.4326 (0.5686)	2.1258 (0.2894)
Never Fished Before vs. Fished in the Past	2.5662 (0.1648)	0.7753 (0.8474)	2.0765 (0.3062)	0.5389 (0.9231)	0.6990 (0.8741)	0.6469 (0.8911)	0.9398 (0.7841)	0.2178 (0.9870)	0.2674 (0.9805)

Table A 3. Pairwise comparisons for ideal fishing trip descriptors, by fishing interest level and age group. Nonparametric Dwass-Steel-Critchlow-Fligner value is shown with associated *p*-value in parentheses.

Comparison	**Having someone catch fish**	**Catching at least one fish**	**Fishing from shore**	**Releasing fish alive**	**Fishing with someone**	**Fishing in a nice-looking location**	**Catching fish large enough to eat**	**Catching the target fish**	**Fishing an area with habitat**
				Interest Level					
Active Angler vs. Fished in the Past	**5.6196 (0.0002)**	**5.8635 (0.0001)**	0.3837 (0.9602)	**6.4598 (<0.0001)**	*3.8292 (0.0186)*	0.4066 (0.9555)	1.8940 (0.3734)	2.1821 (0.2709)	**4.5799 (0.0034)**
Active Angler vs. Never Fished Before	**4.2129 (0.0081)**	3.5859 (0.0302)	0.5189 (0.9285)	**5.5980 (0.0002)**	0.9704 (0.7716)	1.0058 (0.7569)	2.0581 (0.3127)	3.0679 (0.0765)	**4.4499 (0.0047)**
Never Fished Before vs. Fished in the Past	0.5858 (0.9098)	0.3893 (0.9591)	0.9098 (0.7961)	1.2865 (0.6341)	1.5724 (0.5067)	1.3153 (0.6212)	3.3395 (0.0478)	1.6966 (0.4533)	1.4548 (0.5587)
				Age Group					
18-24 vs. 25-44	2.2603 (0.3795)	1.6169 (0.6626)	3.3955 (0.0769)	0.0000 (1.0000)	0.9941 (0.8960)	2.0456 (0.4703)	2.4787 (0.2965)	2.1204 (0.4378)	2.6772 (0.2310)
18-24 vs. 45-64	1.1425 (0.8508)	0.6880 (0.9621)	2.9017 (0.1692)	0.9262 (0.9139)	2.4878 (0.2933)	2.2189 (0.4342)	2.6806 (0.2299)	3.1383 (0.1180)	2.8021 (0.1950)
18-24 vs 65+	0.4758 (0.9869)	0.3731 (0.9936)	2.5411 (0.2748)	0.7484 (0.9520)	2.4197 (0.3179)	1.7401 (0.6074)	3.3310 (0.0859)	3.2340 (0.1011)	2.5508 (0.2715)
25-44 vs. 45-64	**4.4239 (0.0095)**	**3.3448 (0.0839)**	2.4211 (0.3173)	2.3820 (0.3319)	**4.3702 (0.0108)**	0.2997 (0.9966)	0.5345 (0.9816)	3.3040 (0.0899)	0.0350 (1.0000)
25-44 vs. 65+	**6.3894 (<0.0001)**	*3.9510 (0.0268)*	2.4218 (0.3171)	1.6904 (0.6298)	*3.8987 (0.0298)*	0.8497 (0.9318)	2.3172 (0.3569)	2.9333 (0.1616)	0.5545 (0.9796)
45-64 vs. 65+	2.6033 (0.2542)	1.0639 (0.8757)	0.4602 (0.9881)	0.3809 (0.9932)	0.2632 (0.9977)	1.2020 (0.8305)	1.9565 (0.5097)	0.1148 (0.9998)	0.5886 (0.9757)

Table A 3. Continued.

Comparison	Catching many fish	Eating fish caught	Launching a boat	Catching a limit	Being able to walk in	Traveling less than 5 miles	Catching a trophy	Fishing in good water quality	Being able to ice fish
Interest Level									
Active Angler vs. Fished in the Past	**4.5792 (0.0022)**	2.1306 (0.2878)	**4.7983 (0.0020)**	0.2066 (0.9883)	0.1302 (0.9953)	0.6066 (0.9036)	**6.5991 (<0.0001)**	0.9650 (0.7738)	2.1992 (0.2654)
Active Angler vs. Never Fished Before	**4.5792 (0.0034)**	0.4726 (0.9403)	**4.3255 (0.0063)**	0.5299 (0.9255)	0.9964 (0.7608)	0.8739 (0.8103)	**3.8865 (0.0165)**	0.3862 (0.9597)	1.4341 (0.5679)
Never Fished Before vs. Fished in the Past	1.3022 (0.6271)	1.7877 (0.4156)	1.4136 (0.5771)	0.4017 (0.9565)	0.8494 (0.8198)	0.4259 (0.9512)	0.6930 (0.8761)	0.1844 (0.9907)	0.1710 (0.9920)
Age Group									
18-24 vs. 25-44	2.7773 (0.2018)	1.0299 (0.8858)	0.9925 (0.8964)	2.5478 (0.2725)	2.8640 (0.1787)	1.9867 (0.4963)	0.7519 (0.9514)	1.2668 (0.8071)	1.5655 (0.6852)
18-24 vs. 45-64	1.9421 (0.5162)	0.9313 (0.9126)	1.2517 (0.8126)	2.8176 (0.1908)	2.0632 (0.4626)	1.4444 (0.7369)	1.6337 (0.6552)	2.0555 (0.4659)	1.5804 (0.6787)
18-24 vs 65+	0.6217 (0.9716)	1.6813 (0.6339)	2.2191 (0.3964)	2.9984 (0.1466)	2.7155 (0.2195)	1.9650 (0.5059)	2.2435 (0.3864)	0.7265 (0.9558)	1.6985 (0.6262)
25-44 vs. 45-64	2.1643 (0.4192)	0.5788 (0.9769)	0.7372 (0.9540)	0.6861 (0.9624)	2.1274 (0.4349)	1.6791 (0.6349)	2.5289 (0.2789)	1.0235 (0.8877)	0.1017 (0.9999)
25-44 vs. 65+	**5.4427 (0.0007)**	2.2149 (0.3981)	3.0059 (0.1450)	1.3826 (0.7622)	0.4416 (0.9895)	0.5825 (0.9764)	*3.9962 (0.0244)*	0.5605 (0.9789)	0.1326 (0.9997)
45-64 vs. 65+	3.6221 (0.0511)	2.9201 (0.1647)	2.57333 (0.2640)	0.9292 (0.9131)	1.5817 (0.6781)	1.0202 (0.8886)	2.1223 (0.4370)	1.5688 (0.6838)	0.2425 (0.9982)

Oblique Cluster Analysis of Ideal Trip Descriptors

Table A 4. Ideal trip factors and internal consistency (as measured by Cronbach's alpha [α]) based on survey results.

Ideal	Items	Code	Initial	Last	Included	Survey α
Group Success		MANYFISH	0.621	0.810		0.810
		ONEFISH	0.534	0.592	x	
		GROUPCATCH	0.430	0.536	x	
		FISHTOGETHER	0.742			
Specialization		LIMITFISH	0.686		x	0.722
		TROPHYFISH	0.686		x	
		TARGETFISH	0.663		x	
		HABITAT	0.683		x	
		BOATLAUNCH	0.683		x	
		ICEFISH	0.699		x	
Convenient Access		RELEASEFISH	0.642		x	
		TRAVELLESS	0.523	0.531	x	0.642
		WALKIN	0.522	0.516	x	
		SHOREOPP	0.551	0.606	x	
		PRETTYOPP	0.574	0.630	x	
Consumption		EDIBLEFISH	0.380	-	x	0.865
		EATFISH	0.218	-	x	
		WATERQUAL	0.865			

Pairwise Comparisons of Amenities and Program Interests

Table A 5. Pairwise comparisons for amenities at a fishing location, by fishing interest level and age group. Nonparametric Dwass-Steel-Critchlow-Fligner value is shown with associated p-value in parentheses.

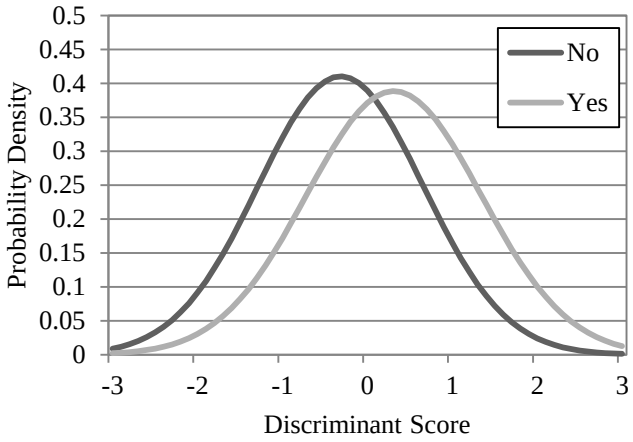
Comparison	Boat access	Public transportation to the location	Picnicking areas	Parking area	ADA access	Bathrooms
		Interest Level				
Active Angler vs. Fished in the Past	3.5959 *(0.0296)*	3.9717 **(0.0138)**	3.5270 (0.0338)			
Active Angler vs. Never Fished Before	3.0069 (0.0846)	2.8106 (0.1153)	1.7705 (0.4226)			
Never Fished Before vs. Fished in the Past	0.5921 (0.9079)	0.0516 (0.9993)	0.4928 (0.9353)			
		Age Group				
18-44 vs. 45-64		0.9481 (0.7807)		3.0520 (0.0786)	3.9649 **(0.0140)**	1.1017 (0.7159)
18-44 vs. 65+		3.3844 (0.0441)		0.7510 (0.8561)	4.2881 **(0.0069)**	2.4893 (0.1832)
45-64 vs. 65+		2.9279 (0.0960)		3.5889 *(0.0300)*	0.8437 (0.8220)	3.6932 *(0.0245)*

Table A 6. Pairwise comparisons for program interests, by fishing interest level and age group. Chi-square statistic is shown with associated one-sided exact test *p*-value in parentheses.

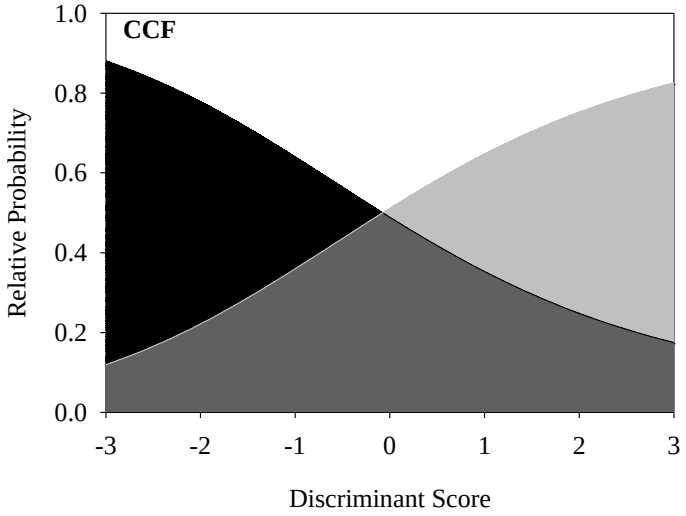
Comparison	Basic fishing skills	Families with children	Spouses/ partners	Fish with peer group	Find friends	Competition	Stocking Event	Cooking	Sustainability	Bait/gear/ conditions	Advanced skills
Interest Level											
Active Angler vs. Fished in the Past	1.8243 (0.4008)	1.5888 (0.4996)	0.8382 (0.8240)	0.3250 (0.9713)	0.8781 (0.8086)	5.7569 **(0.0001)**	5.9447 **(<0.0001)**	1.0550 (0.7361)	0.0670 (0.9988)	2.0535 (0.3143)	4.7166 **(0.0025)**
Active Angler vs. Never Fished Before	5.6426 **(0.0002)**	0.8838 (0.8064)	2.6983 (0.1364)	0.6641 (0.8856)	0.5071 (0.9316)	1.9855 (0.3388)	3.5094 (0.0349)	1.7751 (0.4207)	2.7632 (0.1239)	2.4236 (0.2000)	2.9862 (0.0875)
Never Fished Before vs. Fished in the Past	4.1856 **(0.0087)**	1.9344 (0.3579)	2.0529 (0.3145)	0.4347 (0.9493)	0.0781 (0.9983)	1.9773 (0.3419)	0.3476 (0.9672)	2.4373 (0.1964)	2.7413 (0.1280)	3.7384 *(0.0224)*	0.0816 (0.9982)
Age Group											
18-44 vs. 45-64	2.2943 (0.2362)	3.8617 *(0.0174)*	0.3012 (0.9753)	1.2254 (0.6615)	0.3211 (0.9720)	1.8499 (0.3906)	1.8317 (0.3979)	0.6725 (0.8828)	1.5091 (0.5346)	0.3798 (0.9610)	0.9530 (0.7787)
18-44 vs. 65+	3.0619 (0.0773)	5.0296 **(0.0011)**	2.7935 (0.1183)	2.0369 (0.3202)	0.1934 (0.9897)	4.9741 **(0.0013)**	0.7815 (0.8451)	2.8131 (0.1148)	2.3018 (0.2340)	2.5519 (0.1681)	1.9931 (0.3360)
45-64 vs. 65+	1.2162 (0.6656)	1.9679 (0.3453)	2.7074 (0.1346)	1.0781 (0.7262)	0.5034 (0.9325)	3.7282 *(0.0228)*	2.5144 (0.1770)	2.4056 (0.2048)	1.1009 (0.7163)	3.0826 (0.0747)	1.2698 (0.6416)

Discriminant Functions by Fish Preference

For fish taxa with significant or marginally significant discriminant functions, a probability density curve was developed for those interested and not interested in each taxon. Relative probability was determined by adding the curves together and calculating the proportion of each group across the range of discriminant scores. An example is shown here:



↓



Relative probability curves are intended to facilitate use of the presented discriminant functions for classifying new survey respondents. Given ideal trip preferences, preference for a particular taxon can be predicted with recognition of the amount of uncertainty in the prediction.

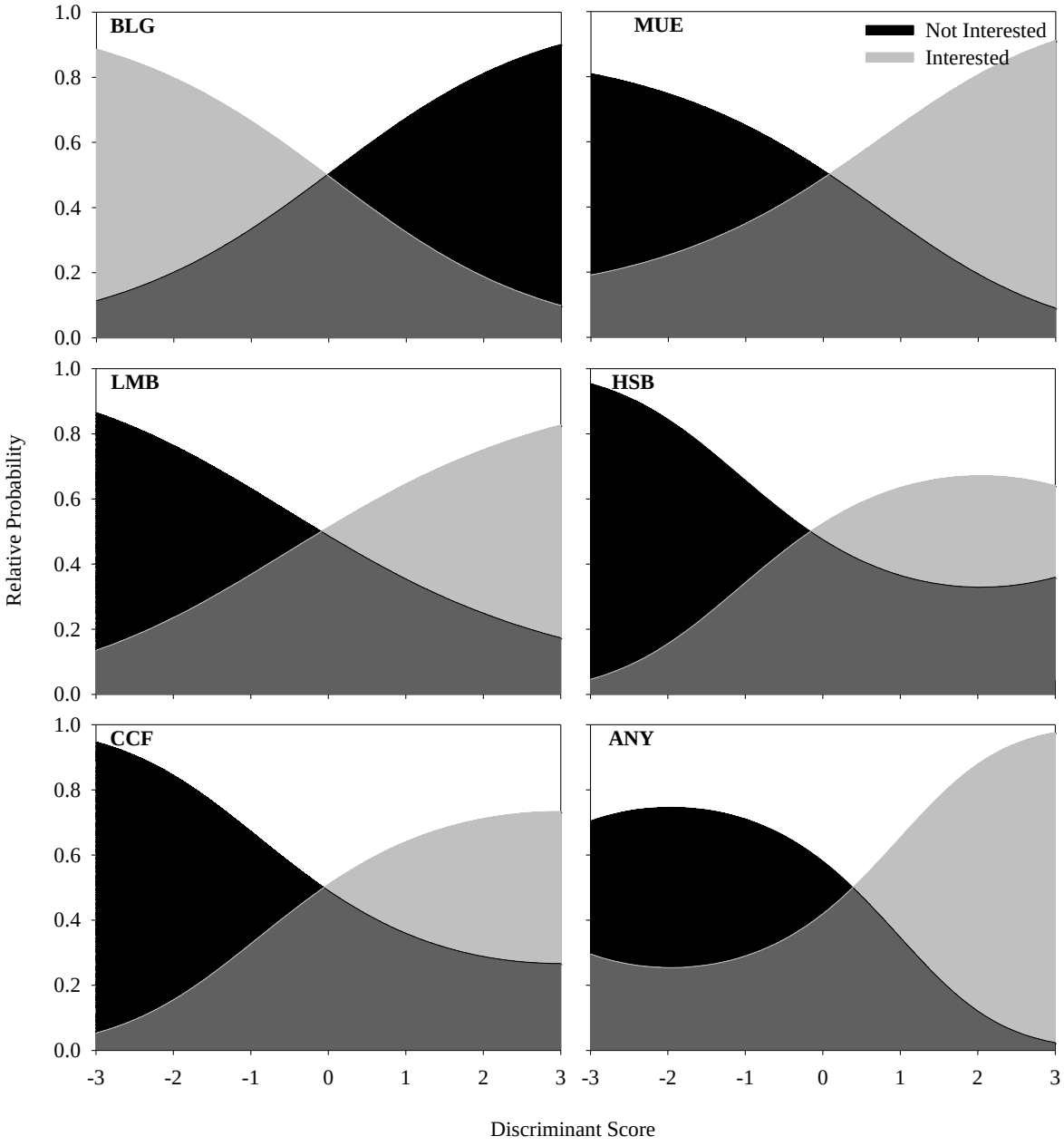


Figure A 1. Relative probabilities of interest in fish taxa based on discriminant function score.