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Applying food systems thinking in recreational fisheries: The case of shore fishing in Detroit, Michigan

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ABSTRACT

Western fisheries management has long understood recreational fishing as a leisure activity. However, there is growing evidence for a food fun nexus or fuzzy boundary between fishery sectors that challenge this basic understanding. We explored this issue and applied food systems thinking in recreational fisheries in Michigan, United States. We used a mixed methods approach to answer the questions: (1) What role does fish consumption play in angler motivation and satisfaction, and does it differ between racial and ethnic groups? (2) How do shore fishers participate in their local fish food system? (3) What benefits do shore-based fishers derive throughout the fish food system? (4) What barriers do shore-based fishers face in accessing those benefits? We found that food-based motivations were the key component of angler motivation differentiating nonwhite and white shore fishers, with greater importance for nonwhite fishers in our study. Similarly, keeping fish was the key component of angler satisfaction differentiating nonwhite and white shore fishers, with greater importance for nonwhite fishers. Nonwhite fishers consumed recreationally caught fish more frequently and were less likely to follow consumption advisories. Shore fishers across groups obtained four key benefits throughout the food system – health, connection, knowledge, and food. However, we found that restricted physical access, fishers' intersecting identities, poor water quality and food safety concerns limited shore fishers' ability to access the benefits identified. We conclude that for some recreational fishers the importance of fish as food is related to food security, while for others it is related to food sovereignty.

1. Introduction

Recreational fisheries are remarkably diverse, encompassing a wide array of gear types (such as rod and reel, fly fishing, bow fishing, spear fishing, netting), fishing environments (ranging from urban to rural), and participants (from various socio-economic backgrounds and levels of specialization). This diversity also extends to motivations and values that drive participation in recreational fisheries. Yet recreational fisheries research and management have predominantly focused on understanding and regulating the activities of highly specialized rod-and-reel anglers[1] – typically white, middle- or upper-class individuals [1]. This focus has also emphasized a narrow range of motivations and values, including leisure, sport, and connection to nature [2–6]. Recent scholarship has drawn attention to management consequences of overlooking the diversity within recreational fisheries, particularly of angler subgroups, including marginalized, ethnic, racialized groups, and low-income communities [7,8], and food-based and other understudied motivations and values (e.g. culture) [9,10]. The concept of *provisioning fisheries* has been proposed to highlight the motivations and values of diverse angler subgroups that have been underrepresented in fisheries science and management [7].

Two recently proposed frameworks complement the concept of *provisioning fisheries* and can be used to guide a more holistic assessment of their value. The first is the diverse values framework put forward by the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES), which considers the value of nature beyond just economic value

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[1] We acknowledge that the term "angler" specifically refers to those who fish with rod and reel; however, we henceforth operationalize it in this paper to be inclusive of all individuals who fish, regardless of gear choice.

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[11]. Specifically, it integrates three value categories – instrumental, intrinsic, and relational; instrumental value is defined as the usefulness of a resource to people such as economic and nutritional value; intrinsic value is the inherent worth of a resource and includes non-use values like existence and bequest value; and relational value is defined as meaningful and often reciprocal relationships between and among people and natural resources [11]. The second is the food systems framework, which considers all activities from production to consumption [12]. The food systems approach understands the value of food resources like fisheries to be a composite of three activity areas – production, provision, and consumption. In fish food systems, production is defined as harvesting of fish and or other aquatic foods; provisioning activities include everything between production and consumption such as processing, packaging, storage, distribution, and the sale of fish, fish products, and or other aquatic foods; and consumption activities include procuring, preparing, cooking, and eating fish and or other aquatic foods [13,14]. From here forward, we refer to the "provisioning" activity area of food systems as "processing" to avoid confusion with the *provisioning fisheries* concept that we also draw on.

In this paper we build on the concept of *provisioning fisheries* and analyze them in the context of the diverse values and food systems. This approach allows us to consider diverse actors in recreational fisheries and understand diverse motivations and values – benefits anglers derive from the fishery – that recreational fisheries research has often overlooked. For example, much of the human dimensions research in recreational fisheries has excluded low-income anglers and anglers of color. Further, it has primarily focused on boat anglers while overlooking shore anglers, given that most creel surveys primarily target boat access sites. This bias is largely due to the ease with which boat anglers, who are generally white and middle class, can be readily sampled at boat launches compared to shore anglers who can be more difficult to reach due to geographic dispersion. As a result of this bias, angler motivation theory, which underpins the human dimensions of recreational fisheries management in the Global North, has focused primarily on the leisure based motivations and values of boat anglers (e.g. sport, connection to nature) while overlooking cultural, food-based, and other potential motivations of shore anglers [2–7,10]. For instance, despite growing evidence that recreational fisheries are an important mechanism for preserving culture, tradition, local heritage, knowledge, folkways and lore [15,16] and that they contribute to identity, sense of place, and feelings of care and belonging, such factors are often not considered in angler motivation studies [17–20].

Similarly, food-based motivations are often left out of angler motivation studies, despite being recognized as critical considerations in recreational fisheries [8–10]. While the health contributions of recreational fisheries have been examined, they focus primarily on physical exercise [4] and stress reduction (i.e. psychological benefits) [21], but do not consider potential nutritional motives of fish consumption. Although early research on angler motivation generally found fish consumption to be less important to anglers than other motivations [4], there is growing evidence that food is a primary motivator for some anglers' participation in recreational fisheries [15,22]. For example, studies have found that shore-based and non-white anglers are more likely to harvest fish caught under a recreational license for consumption [8,23–25]. Recent work also shows that participation in recreational fisheries can facilitate important social connections between family, friends, and community members through food, with many recreational anglers sharing their harvest for consumption [15,22,26]. Relatedly, most recreational fisheries literature focuses only on fishing (i.e. production) and overlooks the potential role of other activities within the food systems framework (i.e. processing and consumption) in shaping participation in the sector. While there are notable exceptions in the literature that acknowledge the nutritional value of recreational fish consumption [27], most studies that explore the consumption of recreationally caught fish are largely descriptive in nature, quantifying the volume of fish consumed in a specific place (i.e. magnitude of consumption) [26,28], or focusing heavily on the adverse health implications of fish consumption (i.e. contaminants) [29–31]. Although food systems thinking is growing in fisheries literature as a whole (especially in subsistence and commercial fisheries), it has yet to be explicitly applied in recreational fisheries.

To address these gaps, we integrated the diverse values and food systems frameworks to analyze consumption of recreationally caught fish in Michigan, United States (US). Focusing on shore-based anglers in the Detroit area, who have historically been underrepresented in recreational fisheries research and management, this mixed methods study aims to quantitatively assess fish consumption, angler motivation, and components of angler satisfaction, and qualitatively examine the diverse benefits of participation in the local fish food system. Given that angler motivation is linked to angler satisfaction, insufficient consideration of the diversity of benefits that anglers obtain throughout the fish food system may contribute to management decisions that do not meet public needs. By integrating quantitative and qualitative methodologies, food systems thinking, and the concept of diverse values, our research will inform important human dimensions information needs for fisheries managers in Michigan and the Laurentian Great Lakes Basin more broadly [32]. We aimed to answer the following questions: (1) What role does fish consumption play in angler motivation and satisfaction, and does it differ between racial and ethnic groups? (2) How do shore anglers participate in their local fish food system? (3) What benefits do shore-based anglers derive throughout the fish food system? And (4) What barriers do shore-based anglers face in accessing those benefits?

2. Methods

2.1. Study area

The Laurentian Great Lakes (here forward referred to as the Great Lakes) are among the largest freshwater systems in the world, consisting of five interconnected lakes that are shared between the US, Canada, and many US Tribes and Canadian Fist Nations. The Great Lakes support a high economic value recreational fishery, with an estimated contribution of over USD 50 billion to the US and Canadian economies annually [33–35]. The recreational fishing sector is more profitable today than the commercial fishing sector and comprises a larger share of harvest [36–40]. Participation trends in the region indicate increasing demographic diversity in recreational fisheries, with greater involvement among female anglers [41] and communities of color [42].

Lake Erie is the southernmost of the five lakes and supports an important recreational fishery for the region; walleye (*Stizostedion vitreum*) and yellow perch (*Perca flavescens*) are among the most studied sport fish in the lake (e.g. [43]). Lake Erie is fed by the Detroit River, which serves as a natural boundary between the US and Canada with Detroit, Michigan on the US side and Windsor, Ontario on the Canadian side. Both waterbodies provide many fishing opportunities, including shore-based fishing on piers, along the Detroit Riverwalk, and at other public access points. Due to the legacy of the industrial era, the Detroit River is listed as an Area of Concern (AOC) by the United States Environmental Protection Agency (EPA). Therefore, fish consumption advisories have been implemented in both the Detroit River and Lake Erie due to the adverse health effects of carcinogenic chemicals including polychlorinated biphenyl (PCB), dioxins, and emerging contaminants like PFOS and PFOA (e.g. [44–47]). Nonetheless, there remains an active fishing community in the Detroit area, with many Detroiters regularly supplementing their diet with fish caught from these waterbodies under a recreational license [48].

2.2. Data collection

2.2.1. Site selection & sampling

As part of a larger study examining urban fisheries in the lower Great Lakes (Lake Erie and Lake Ontario) across the US and Canada, we

collected quantitative and qualitative data. First, key informant interviews were conducted, then they were used to inform the design of survey instruments and focus group discussion guides. All data collection instruments were approved by IRB 24–227 at Virginia Tech and 117473 at Carleton University.

Data were collected within two counties in the Detroit area in Michigan, US: Wayne County and Monroe County (Fig. 1). Wayne County is home to the City of Detroit and Monroe County is located south of the city on Lake Erie (Fig. 1). The two counties were chosen because they capture biophysical differences between waterbodies (e.g. fishing capacity and shore access) and socio-economic differences between the communities (e.g. race, income), making our findings more generalizable.

2.3. Key informant interviews

We conducted twelve total key informant interviews over zoom in spring 2023 (April-May) with fisheries managers, creel clerks, and conservation officers in Michigan Department of Natural Resources (MDNR) and the Great Lakes Fishery Commission (GLFC), as well as leaders of local community-based organizations. First, we identified key informants through existing working relationships with state employees, then through snowball sampling. At the end of each interview, key informants were asked to refer the research team to any colleagues that may also be knowledgeable and willing to participate in an interview. The key informant interviews (Appendix 1) were conducted to provide insight into gaps in state level knowledge regarding fishing, processing, and consumption practices of shore-based anglers and to inform site

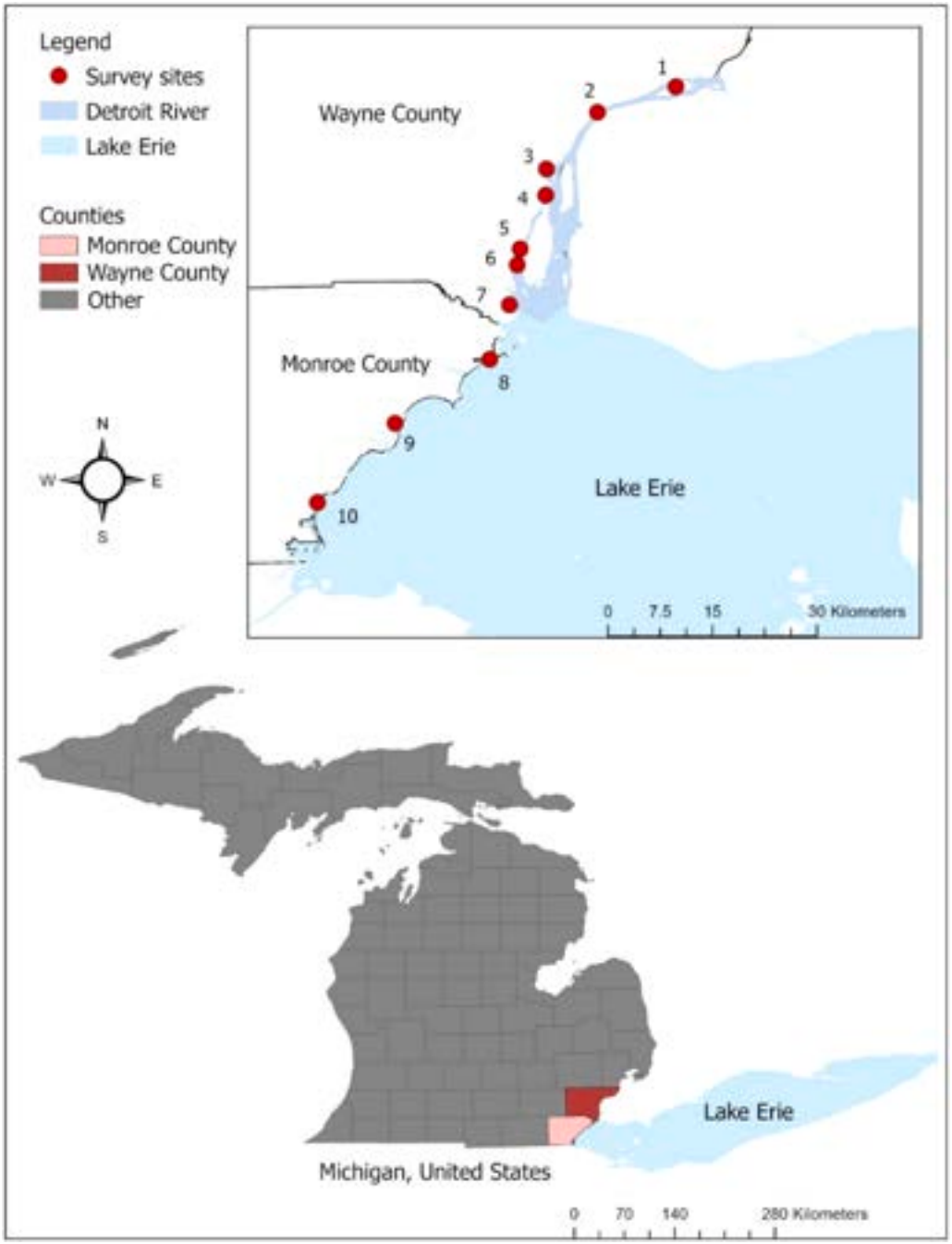

Fig. 1. Map of Survey Study Sites.

selection for both quantitative and qualitative data collection.

2.4. Quantitative data collection

Surveys were used to collect quantitative data to answer research question one – what role does fish consumption play in angler motivation and satisfaction, and does it differ between racial and ethnic groups? Specifically, the survey instrument collected data on anglers' motivation and satisfaction (Likert type questions), catch and consumption behavior, and socio-economic and demographic information (Appendix 2). We measured angler satisfaction by modifying the catch orientation scale established by Anderson et al. [49] given we are largely focused on food systems in this study. We used the four statements established by Anderson et al. [49] and one additional statement to understand if anglers are eating their catch after harvesting fish: "Bringing fish home to the table is an important outcome of fishing".

We deployed the survey instrument in person (i.e. intercept surveys) at ten field sites based on information obtained from the key informant interviews. The ten sites were selected based on the popularity of fishing sites with shore-based anglers due to the ease of shore access and high catch rates, as well as safety of the sites. The research team conducted surveys at the following ten sites: 1- Belle Isle, 2- Milliken State Park, 3- Riverside Park, 4- Bishop Park, 5- John D. Dingell Park, 6- Elizabeth Park, and the 7- Detroit International Wildlife Refuge, 8- Pointe Mouillee State Game Area, 9- Sterling State Park, and 10- Luna Pier (listed from north to south; Fig. 1).

We conducted intercept surveys in the Detroit area with shore-based anglers approximately once a week beginning in May 2023 and ending in October 2023. The research team conducted intercept surveys on different days of the week (weekdays and weekends), different times of day (morning, afternoon, and evening), and different times of year (spring, summer, fall) to capture different types of anglers who may be available to fish at different times. We used a convenience sampling approach to identify research participants in the field. While the use of a non-probability convenience sample limits the generalizability of the findings, convenience sampling is a well-established methodology in fisheries and is regularly used by government agencies to collect creel data. Further direct distribution has been recommended to reach anglers of underrepresented groups [1]. Therefore, we approached all shore-based anglers encountered at our ten study sites and carried out the survey with all those willing to participate (n = 58) with a total of 28 anglers (35%) declining to be surveyed. Participants were given a small fishing lure or jig for their time and were provided with a business card with more information about the project. To increase our sample size, additional survey participants were recruited through the distribution of flyers in Facebook groups and at local bait and tackle shops to be completed online (n = 27). Online participants were entered into a drawing for one of four $100 Amazon gift cards. Including in person and online responses, a total of 85 shore anglers in the Detroit area participated in the survey.

2.5. Qualitative data collection – focus group discussions

We designed the focus group questionnaire to collect qualitative data to answer research questions 2–4: (2) How do shore anglers participate in their local fish food system? (3) What benefits do shore-based anglers derive throughout the fish food system? And (4) What barriers do shore-based anglers face in accessing those benefits? The focus group discussion guide was developed based on the diverse values and food systems frameworks to understand the benefits of and barriers to production, processing, and consumption activities for provisioning anglers (Appendix 3).

We used a purposive sampling approach, coupled with snowball sampling, to recruit focus group participants. First, we used purposive sampling to recruit participants through community-based organizations, Facebook groups, and physical flyers posted at parks and distributed in person. Interested participants completed an online screening questionnaire via Google Forms (Appendix 4) which allowed potential participants to self-identify (e.g., race and/or ethnicity, gender) and affirm that they fish for food in our study area.

Three months prior to conducting the focus group discussions, we reached out to community organization leaders via email including fishing specific groups (e.g. Black to the Land Coalition, Friends of Fishing, We Fixin to Fish), and non-fishing organizations focused on creating community for specific racial or ethnic groups (e.g. Association of Chinese Americans). At the same time, we reached out to Facebook group administrators (e.g. Detroit River Fishing, HOOKED ON – Detroit River Shore fishing), and local government agencies (e.g. Michigan Department of Natural Resources Outdoor Adventure Center in Detroit and the United States Fish and Wildlife Service Detroit River International Wildlife Refuge). Two months prior to conducting the focus groups, a field visit was made to build community connections and meet with community organization leaders and local fisheries managers in person. Meeting in person was a critical step for the success of the focus group discussions as the local leaders then recruited focus group participants within their personal networks (i.e. snowball sampling).

Six total focus group discussions were held with 6–9 participants each (46 total) in the summer of 2024 (May-July). Four of the focus groups were comprised of individuals that belong to the same community organization given that the literature indicates participants are more likely to be comfortable and honest in discussions with participants that have established trust and share key demographic characteristics (e.g., race or ethnicity) [50]. The other two focus groups consisted of participants that were recruited through flyers posted at parks, distributed in person at popular fishing sites, and on Facebook groups to capture anglers that do not belong to formal organizations. Focus group discussions were held at locations most convenient for the research participants including community organization offices, the MDNR Outdoor Adventure Center, and public parks. Six focus groups are likely to be sufficient as research into theoretical saturation indicates that 90% of themes are discoverable within six focus groups [51]. Each focus group discussion took between 1 and 1.5 h to complete and was facilitated by two researchers. Each of the 46 research participants received food during the discussion and USD 50 in cash for their participation at the end of the discussion.

2.6. Analysis

This study used a mixed methods approach, analyzing quantitative data to assess fish consumption, angler motivation and angler satisfaction across racial or ethnic groups, and qualitative data to characterize the diverse benefits of and barriers to participation in the local fish food system.

2.6.1. Quantitative analysis

To answer research question one, quantitative analysis, conducted in R version 4.3.1, consisted of summary statistics and statistical tests. First, outliers were assessed for each variable based on Equation 1 [52]. While no outliers were removed from analysis, identification can provide valuable information.

$$\textit{Upper outliers} : Q3 + 1.5 \quad IQR$$

$$\textit{Lower outliers} : Q1 - 1.5 \quad IQR$$

$$\textit{Where } Q1 \textit{ is the first quartile,}$$
$$Q3 \textit{ is the third quartline and IQR is the inter quartile range} \quad (1)$$

Second, means, medians and other summary statistics were used to describe the survey data. Third, due to the use of a non-random sampling approach, non-parametric Mann-Whitney *U* tests were used to understand whether variation in income, consumption frequency, and Likert type variables related to angler motivation, angler satisfaction, and food

uses are statistically significant between racial or ethnic groups (Equation 2). Racial or ethnic groups were aggregated into two categories, white and nonwhite (African American or Black, Latine or Hispanic, Native or Indigenous, Asian, mixed race), due to sample size constraints. Epsilon-squared was applied using the R package "rcompanion" to calculate effect size for each Mann-Whitney *U* test to indicate strength of the pattern.

$$U_w = n_n n_w + \frac{n_w \quad (n_w + 1)}{2} - \quad R_w$$

$$U_n = n_n n_w + \frac{n_n \quad (n_n + 1)}{2} - \quad R_n$$

Where n_w and n_n are the sample size for the white and nonwhite, respectively;

R_w and R_n are the sum of ranks for white and nonwhite groups; and U_w and U_n are the Mann − Whitney statistics

A Sidak multiple comparison correction was applied to adjust the significance thresholds for the Mann-Whitney U tests (Equation 3). Each significance threshold was adjusted at a 95% confidence level and applied to each family of Likert type questions. The angler motivation section of the questionnaire included 8 comparisons (adjusted p-value needed for test to be considered significant: $p < 0.006$); the food uses section included 6 comparisons (adjusted p-value needed for test to be considered significant: $p < 0.009$); the angler satisfaction section included 5 comparisons (adjusted p-value needed for test to be considered significant: $p < 0.010$); and the consumption behavior section included 3 comparisons (adjusted p-value needed for test to be considered significant: $p < 0.017$).

$$alphaPC = 1.0 - (1.0 - alphaFW)^{1/K}$$

Where alphaPC is the per comparison alpha, alphaFW is the family wide significance threshold, and K is the number of comparisons being made.

Further, covariate adjustment of each Mann-Whitney *U* test was accomplished via probabilistic index models (PIM) using the "pim" package in R [53,54]. Each Mann-Whitney *U* test was adjusted to control for the distribution channel of the survey (in person or online).

2.6.2. Qualitative analysis

We conducted thematic content analysis on transcribed key informant interview and focus group data to (1) describe how actors participate in the fish food system, (2) understand the benefits they derive from participation, and (3) synthesize barriers to participation. We used a deductive approach structured on the diverse values and food systems frameworks to describe participation in production, processing, and consumption activities and understand the benefits associated with each, answering research questions two and three. To answer research question four, we used inductive content analysis to investigate barriers to accessing the diverse benefits identified.

3. Results

Our sample was representative of the study site. Of all the participants in our study, 53.8% were white and 46.2% were nonwhite (Table 1). In Wayne County, 54.7% of people identify as white alone (V2024). Further, given a near equal split between nonwhite and white anglers, this sample enabled comparative analysis between groups.

3.1. RQ1. What role does fish consumption play in angler motivation and satisfaction, and does it differ between racial and ethnic groups?

Our main quantitative finding was that food was more important for nonwhite than white anglers across measures. Specifically, we found that: (1) fish consumption was the key component of angler motivation that differed between nonwhite and white anglers, (2) keeping fish was the key difference between nonwhite and white anglers among angler satisfaction measures, (3) all food uses in our study were more prevalent among nonwhite anglers, and (4) fish consumption was significantly more frequent among nonwhite anglers.

Shore anglers that completed our survey were diverse and represented a variety of social positions (e.g., immigration status, gender, age, employment status, and income). Our surveys included immigrants from Bangladesh, Canada, England, Puerto Rico, and Thailand with 24% of all survey respondents coming from immigrant communities (either immigrants or children of immigrants). While all shore anglers surveyed were provided with gender categories beyond the gender binary, all participants identified as either a man (82%) or a woman (18%). The median age of a shore angler in our survey was 39 years old; on average, women and nonwhite anglers were younger than men and white anglers respectively. Most shore anglers surveyed were full-time employees (51%), followed by retirees (20%), self-employed workers (16%), part-time employees (10%), disabled or unable to work (2%), and currently looking for work (1%). While the amount of money spent on fishing each year by shore anglers in our survey ranged from USD 50–11,000, the median expenditure on fishing expenses such as car fuel, fishing license, and fishing gear (e.g. rods, lines, lures, jigs) was USD 300 annually. However, we identified six annual fishing expenditure outliers that were above the upper threshold; not considering these six outliers, annual expenditure ranged from USD 50–2000 and median expenditure was USD 250 annually. Fieldnotes from research assistants conducting intercept surveys indicated that some of these upper outliers may be boat anglers in addition to shore anglers, helping to explain their higher spending (e.g. boat fuel, storage, and maintenance) and providing insight into the fact that these two groups are not mutually exclusive. The most frequently reported annual household income category was $20,000-$39,999 and the median was $40,000-$59,999. We found no difference in income between nonwhite and white anglers ($p = 0.672$); therefore, we interpret the following differences to be largely explained by socio-cultural factors.

3.2. Angler motivation

We found angler motivation to be similar between nonwhite and white shore anglers across the six of the eight factors measured, with sport motivations and food-based motivations being different (Table 2a). We found sport dimensions to be a larger component of angler motivation for white anglers than nonwhite anglers, although the effect size was small ($p = 0.030$). Further, we found eating fish as food to be 17% more important for nonwhite anglers than for white anglers, with a moderate effect size ($p = 0.021$). Fishing for food is the most different component of angler motivation between nonwhite and white anglers in our study.

Table 1
Percent (%) of research participants who identify with different racial or ethnic groups across surveys and focus groups.

	African American or Black	Asian	Indigenous or Native	Latine or Hispanic	White or Caucasian
Survey	18.1	4.8	3.6	10.8	62.7
Focus Groups	34.7	20.4	4.1	2.0	38.8
Total	24.2	10.6	3.8	7.6	53.8

Table 2
Quantitative evidence that angler motivation, satisfaction, and consumption behavior differ between nonwhite and white shore anglers in the Detroit area. The table includes summarized responses to Likert-type survey questions and Mann-Whitney U-test (MWU) results comparing responses between nonwhite and white anglers. MWU results include p-values, covariate adjusted p-values (PIM) to account for the distribution channel of the survey (in person or online), significance thresholds, adjusted significance thresholds based on the Sidak multiple comparison correction for each question family, and effect size (epsilon-squared). Effect sizes for all table items are defined as follows: negligible (< 0.01), small (0.01 < 0.08), moderate (0.08 < 0.26), and large (> 0.26).

	Mean			MWU by white (1 =white, 0 =nonwhite)			PIM
	Overall	Nonwhite	White	p-value	Epsilon-squared	Effect size	p-value
a. Why do you fish? Rate each statement from 1 being "not important" to 5 being "very important" Sidak Multiple Comparison Correction Significance Threshold: $p < 0.006$ Significance level: $p < 0.05$ *, $p < 0.006$**							
I fish because I enjoy being outdoors or close to nature	4.58	4.50	4.63	0.347	0.01	Small	0.703
I fish to relax (reduce anxiety, stress, and/or depression)	4.45	4.55	4.39	0.610	0.00	Negligible	0.229
I fish to spend time with my family and/or friends	4.05	4.16	3.98	0.554	0.00	Negligible	0.336
I fish because it connects me to my past and childhood memories	4.01	4.00	4.02	0.680	0.00	Negligible	0.532
I fish for the sport, excitement, or thrill of catching fish	3.84	3.59	4.00	0.046*	0.05	Small	0.030*
I fish because it's part of my culture and traditions	3.81	3.94	3.73	0.488	0.01	Small	0.160
I fish to work on my fishing skills	3.17	4.00	3.00	0.166	0.02	Small	0.388
I fish to eat fish as food for myself and/or my family	3.06	3.59	2.73	0.011*	0.08	Moderate	0.021*
b. What generally makes a good fishing day? Rate your level of agreement with each statement from 1 "strongly disagree" to 5 "strongly agree" Sidak Multiple Comparison Correction Significance Threshold: $p < 0.01$ Significance level: $p < 0.05$ *, $p < 0.01$**							
The more fish I catch, the happier I am	4.18	4.45	4.02	0.106	0.03	Small	0.067
When I go fishing, I'm happy even if I don't catch fish	4.04	3.84	4.16	0.120	0.03	Small	0.234
The bigger fish I catch, the better the fishing trip	3.70	3.81	3.63	0.544	0.00	Negligible	0.573
Bringing fish home to the table is an important outcome of fishing	3.10	3.50	2.84	0.29*	0.06	Small	0.083
I need to keep the fish I catch for the trip to be successful	2.88	3.50	2.49	0.002**	0.12	Moderate	0.004**
c. What do you do with the fish you keep or harvest? Please rate each statement by how frequently you do it from 1 being "never" to 5 being "always". Sidak Multiple Comparison Correction Significance Threshold: $p < 0.009$ Significance level: $p < 0.05$ *, $p < 0.009$**							
I use fish as food (for myself)	3.19	3.53	2.96	0.083	0.04	Small	0.311
I share fish with my friends, neighbors, and/or relatives for free	3.15	3.74	2.78	0.002**	0.11	Moderate	0.009**
I use fish to have a fresh meat	3.11	3.42	2.92	0.123	0.03	Small	0.329
I use fish to feed my family	2.96	3.41	2.68	0.032*	0.05	Small	0.095
I use fish as extra food for later	2.83	3.25	2.55	0.029*	0.06	Small	0.094
I use fish to save money on food	2.36	2.87	2.04	0.010*	0.08	Small	0.050*
d. Consumption frequency, and consumption advisory awareness and adherence Sidak Multiple Comparison Correction Significance Threshold: $p < 0.017$ Significance level: $p < 0.05$ *, $p < 0.017$**							
On average, how often do you eat fish? (1 =Never, 2 =Less than once a month, 3 =Once a month, 4 =2–3 times a month, 5 =Once a week, 6 =Twice a week, 7 =More than twice a week)	4.47	5.25	3.98	0.001**	0.14	Moderate	0.001**
Are you aware of any fish consumption (eating) guide or advisory? (1 =Yes, 0 =No)	0.86	0.78	0.90	0.132	0.03	Small	0.113
How often do you follow the fish consumption (eating) advice in the Guide? (1 =Never, 2 =Sometimes, 3 =Usually, 4 =Always)	3.12	2.58	3.40	0.003**	0.11	Moderate	0.006**

3.3. Angler satisfaction

Using survey data, we found that angler satisfaction is similar in four of five measures in our study (Table 2b). Overall, angler satisfaction was driven primarily by catching more fish, although white anglers agreed most with the statement: "When I go fishing, I'm happy even if I don't catch fish". We found differences between nonwhite and white shore anglers regarding the role of keeping fish in shaping angler satisfaction ($p = 0.004$). Nonwhite anglers, on average, agreed 20% more with the statement "I need to keep the fish I catch for the trip to be successful". This finding had a moderate effect size and remained statistically significant when accounting for the distribution channel of the survey and using the Sidak significance threshold, indicating the strength of the difference between nonwhite and white shore anglers.

3.4. Consumption behavior

Given that food measures were the key components differentiating nonwhite and white anglers for both angler motivation and angler satisfaction, we further investigated consumption behavior, including food uses, consumption frequency, species preferences, and knowledge of and adherence to local consumption advisories. We found that all six food uses were higher on average among nonwhite anglers (Table 2c). Using fish for personal consumption was the most common food use among white anglers, while sharing fish was the most common food use among nonwhite anglers. We found differences between nonwhite and white shore anglers in their consumption of fish to save money on food ($p = 0.05$) and sharing of fish with their community ($p = 0.009$). While the difference in using fish to save money on food had a small effect size, the difference in frequency of sharing fish with friends, neighbors, and/or relatives had a moderate effect size. Sharing fish was 19% more frequent among nonwhite anglers than white anglers in our study and remained statistically significant at the Sidak threshold and when accounting for survey distribution channel.

We also found that nonwhite shore anglers generally consume fish more frequently than white shore anglers ($p = 0.001$), with nearly three quarters of nonwhite respondents consuming fish at least once a week (Fig. 2). The difference in consumption frequency between nonwhite and white shore anglers had a moderate effect size and remained statistically significant when accounting for the distribution channel of the

Table 3
Summary of qualitative results.

	Production	Processing	Consumption
RQ 2. How do shore anglers participate in their local fish food system?	• Variety of gears, not just rod and reel	• Personal processing • Informal economies	• Fillets, whole fish • Personal consumption, community fish fries
RQ 3. What benefits do they derive?	• *Health*: physical exercise, mental health benefits of being outside • *Connection*: social connection • *Knowledge*: learn fishing techniques • *Food*: motivation for fishing	• *Connection*: preservation of culture and traditions • *Knowledge*: learn processing techniques • *Food*: necessary activity to enable consumption	• *Health*: nutrition • *Connection*: preservation of culture and traditions, social connection • *Knowledge*: learn new recipes • *Food*: consumption
RQ 4. What barriers do they face?	• *Physical access*: limited access to shore fishing sites • *Identity*: race, (dis)ability, and class further limit physical access • *Water quality*: diminishes fishing experience (e.g. smell, aesthetic value)	• *Water quality*: changes in processing practices due to contaminant concerns may limit cultural benefits	• *Water quality*: food safety concerns limit consumption

survey and using the Sidak significance threshold.

Aggregated by family, the most frequently consumed fish by shore anglers in our study are *Percidae* (yellow perch, walleye, zander), *Centrarchidae* (bluegill, sunfish, crappie, smallmouth bass, largemouth bass, rock bass), *Ictaluridae* (catfish), *Salmonidae* (salmon, trout), *Moronidae* (white bass, white perch), *Cyprinidae* (carp), *Esocidae* (muskie, pike), *Osmeridae* (smelt), *Sciaenidae* (freshwater drum, silver perch), *Catostomidae* (suckers), and *Clupeidae* (shad) (Fig. 3). The top recreationally caught species consumed by shore anglers, in order of frequency, were walleye, yellow perch, white bass (also called silver bass), and catfish. We found that around 20% more nonwhite anglers eat white bass and catfish than white anglers. While consumption of freshwater drum, shad, and suckers were only reported by nonwhite anglers in our study, only white anglers reported eating smelt.

We found that 85% of the shore anglers who completed our survey were aware of the consumption advisories in the Michigan Department of Health and Human Services (MDHHS) Eat Safe Fish Guide; 44% always followed them, 35% usually followed them, 10% sometimes followed them, and 10% never followed them. Of the shore anglers that never followed the consumption guidelines, 71% were African American or Black. We found that nonwhite respondents followed consumption advisories less often than white respondents ($p = 0.006$) with a moderate effect size. The difference in adherence to consumption advisories remained significant at the Sidak threshold and when accounting for survey distribution channel (Table 2d). This aligns with the finding that nonwhite anglers rely more on information from their personal experience and personal networks to inform their consumption decisions, while white anglers rely primarily on government resources like the MDHHS Eat Safe Fish Guide (Fig. 4). It is also noteworthy that nonwhite anglers indicated high reliance upon university resources (Fig. 4). While this result may be indicative of social desirability bias given their participation in university research, it may also reveal an opportune entry point for improved science communication efforts.

3.5. RQ 2. How do shore anglers participate in their local fish food system?

We found that (1) production, (2) processing, and (3) consumption practices among research participants shared many commonalities with a few key differences.

First, we found that shore anglers in the Detroit area typically fish with a rod and reel with a variety of bait and tackle. However, focus

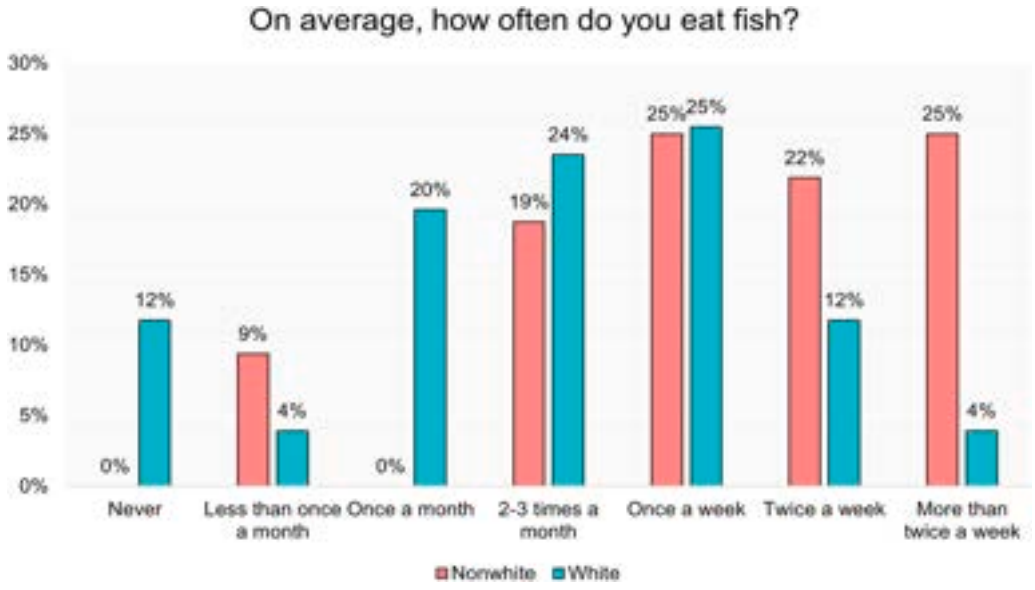

Fig. 2. Consumption frequency (%), disaggregated by nonwhite and white shore anglers.

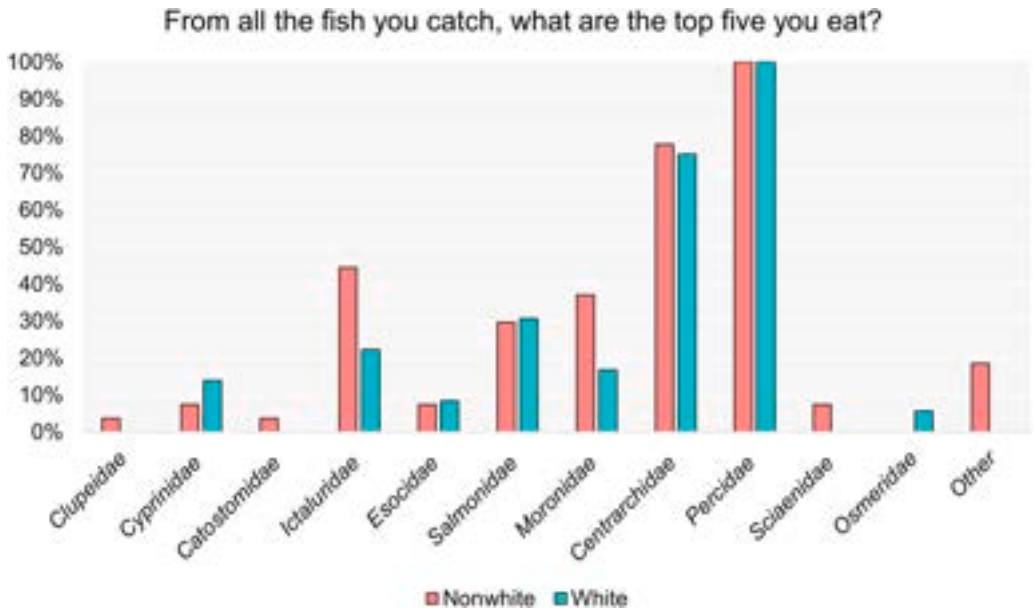

Fig. 3. Bar chat displaying the percentage of survey respondents (disaggregated by nonwhite and white) who choose to eat a given family of recreationally caught fish.

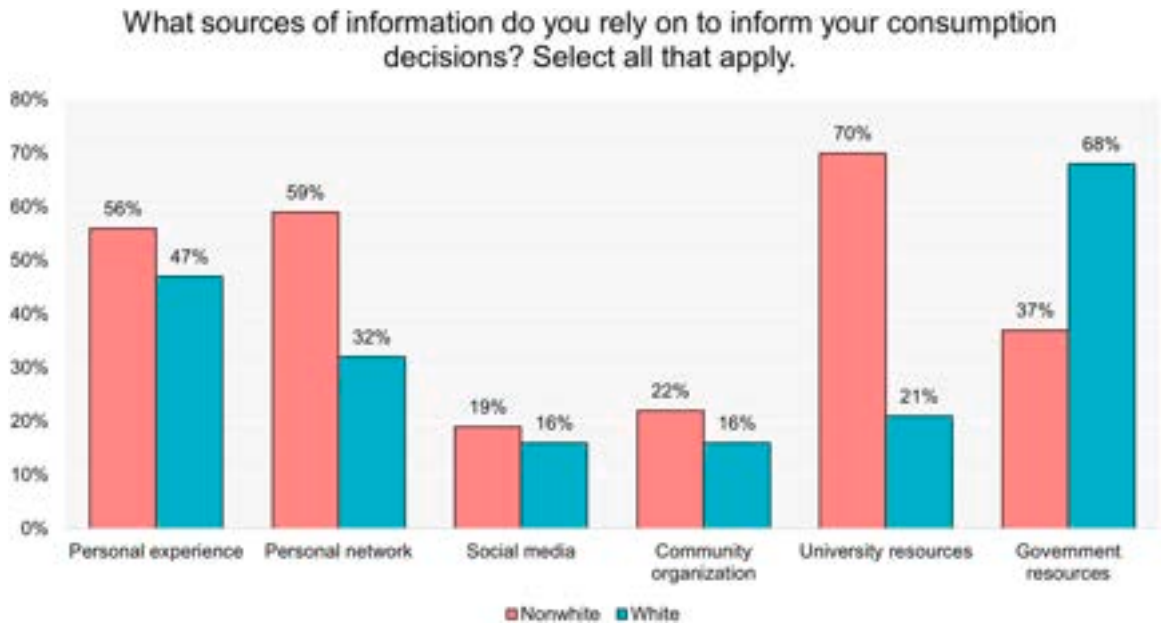

Fig. 4. Bar chat displaying the source(s) of information anglers rely upon to inform their consumption decisions (Source: Focus group discussion screening questionnaire data 2024).

group data indicated that some anglers preferred to use cast nets, a legal gear in Michigan on the Great Lakes (e.g. Lake Erie) and their connecting water (e.g. Detroit River) for select species (minnows, alewife, smelt, shad); "spinning rod and reel is not the only way to fish" (KII, Community leader). Regarding seasonality, we found that shore anglers in Detroit tended to fish the most in the spring during the walleye and white bass runs. Focus group data indicated that the spring runs provide shore anglers with unique opportunities to access food fisheries, only accessible by boat in other seasons. Local managers acknowledged the importance of the white bass run as a food fishery, explaining that shore anglers "come in droves" during the spring to "fill up coolers" (KII, MDNR). Further, we found that some shore anglers were "out there scouting every day" and "pre fish a lot" to determine the best locations to spend their fishing efforts (FGD 4), while others relied on social media to determine where fish may be biting on a given day.

Second, we found that shore anglers typically processed their fish in two ways. The first approach was for shore anglers to process their catch themselves. Many shore anglers preferred to process their own fish, from filleting and freezing to salting and smoking their fish, because it provided them with knowledge and control over the handling of their food. Further, some shore anglers enjoyed processing their own fish because it helped them feel connected to family and/or ancestors, either by processing alongside them or using their equipment. For example, one focus group participant shared that their fillet knife was a gift from their father (FGD 1). The second approach that emerged from the focus group data was relying upon others to process their fish for them. Some shore anglers had family and/or friends that do the job for free while others contributed to informal economies by paying other shore anglers at

fishing sites to process their fish. For example, one research participant explained that they paid other anglers to fillet their catch because "a lot of people, me included, don't fillet very good. It's like here's five bucks if I have a handful of fish, they zip through them and put them in the bag for you" (FGD 3).

Third, we found that shore anglers in our study cooked and ate fish in a variety of ways and for a variety of reasons. One common reason focus group participants chose to eat locally caught fish was that it provided them with access to fresh fish and local species that many had developed taste and preference for. Second, we found that consuming locally caught fish created a connection with nature for many anglers. One focus group participant explained that "there's something very satisfying from eating like what you've caught and it's a deep, I think it's a big deep connection to nature" (FGD 6). We found that shore anglers cooked their locally caught fish in a variety of ways including fried, steamed, boiled, smoked, baked, and grilled. One participant shared that "Walleye is my favorite, and you can cook it so many ways. You can fillet it, you can poach it, and you can make it all spicy or just steam it, deep fry it. All sorts of things" (FGD 1). Most shore anglers in Detroit ate only the fillets of fish; however, we found that there were preferences for whole fish among some Asian and Black fishing communities, whose members explained that they "want to eat all of it from the bone" (FGD 1). We also found that many shore anglers ate their fish with family and/or friends at small dinners, while others ate it with their neighbors at large community fish fries. For example, one research participant shared that each year they "have a big neighborhood fish fry the weekend of Memorial Day. I catch… [white bass] and fillet them… and I just cook until it's gone. It's for the whole neighborhood" (FGD 2).

3.6. RQ 3. What benefits do shore-based anglers in Detroit derive throughout the fish food system?

Thematic content analysis of focus group data revealed four key benefits that shore anglers derived from participating in their local fish food system, namely (1) health, (2) connection, (3) knowledge, and (4) food.

The first benefit shore anglers derived from participating in their local fish food system was health, including physical health, mental health and wellbeing. First, shore anglers indicated that they believed fishing contributed to their physical health by keeping them active. Several research participants identified production practices like walking to fishing sites and standing while shore fishing as important to their physical health, particularly among elderly shore anglers. Focus group participants also indicated that their consumption practices contributed to their physical health. For instance, shore anglers described fish as nutritious and healthy to eat, saying that "fish is good for you, man. It lowers your blood pressure" (FGD 4). Second, focus group participants identified several mental health benefits related to their participation in the local fish food system. For example, research participants shared that shore fishing contributes to their "spiritual health" (KII, Community leader) and "helps with PTSD" (FGD 2) for veterans and others that may experience post-traumatic stress disorder. Similarly, many shore anglers described fishing as therapy and one credited it for getting them "through some really depressing, you know, high anxiety times," and acknowledged that they are a "better parent when I have a consistent fishing schedule. I am a better partner" (KII, Community leader). Further, one focus group participant shared how shore fishing helped them in their recovery following a stroke, physically and mentally, saying "I had a stroke. I can't do a lot of stuff now, but I can go fishing, so it's good therapy. I can do that" (FGD 3).

The second benefit that shore anglers derived from participating in their local fish food system was connection to community members, friends, and family. We found that some shore anglers used fishing as an opportunity to connect with their family and friends, while others went fishing by themselves and connected with other anglers they encountered on the shore (i.e. community). For example, one research participant explained that production activities (i.e. fishing) are "the way that we connect with people" (KII, Community leader), and another shared that "they might not even know the guy they're fishing next to but they're having a great conversation" (KII, MDNR). We also found that consumption activities provided meaningful connections between friends and family members, including ancestors. For instance, one research participant shared that "I use my great grandfather's batter recipe" when frying fish (KII, Community leader). We found that continuing consumption practices like these helped anglers to maintain familial connections and contributed to preserving culture and traditions. One research participant explained that fishing and eating fish "is a huge part of our culture, of who we are, of our identities" (KII, Community leader).

The third benefit shore anglers derived from participating in their local fish food system was knowledge, including opportunities to learn new things and to share their knowledge with others. Research participants explained that they liked learning new fishing techniques, improving their processing skills, and cooking fish in new ways. For example, participants explained that they liked "that aspect of learning how to fish so I can eat forever" (FGD 6), that they "wanted to learn all the ways that I could catch enough food, clean enough fish, to feed people" (KII, Community leader), and that they liked "the process of learning to fillet, or learning to cook fish in different ways, try new recipes, just kind of that aspect of learning as you go" (FGD 3). Similarly, another focus group participant said that "I enjoy it you know, even though the piers are packed. I enjoy watching other people catch fish, teaching other people how to catch fish, you know, exchanging ideas" (FGD 5).

The final benefit shore anglers derived from participating in their local fish food system was food. Focus group participants generally identified recreationally caught fish as being an important source of food to feed their families, saying "that's how we fill our freezer" (FGD 4) and "I don't ever order or buy fish – ever, ever. If I don't catch it, I don't eat it" (FGD 2). While these practices were widespread among our focus group participants, we found that for some shore anglers these practices were driven by economic motivations, while for others they were driven by diverse values beyond economics. For example, some anglers perceived recreationally caught fish to be free and relied upon it to reduce their grocery bill. Focus group participants explained that "fish is expensive to buy. When you can get a free fish, you save money" (FGD 1), "we couldn't afford to eat fish like we eat fish" (FGD 4), and "when the silver bass run was here in May and we got down to our last groceries, that was our dinner, right? That was our dinner for like a week because it was free food" (FGD 6). On the other hand, many anglers indicated a preference for recreationally caught fish due to a desire for fresh fish, knowing where their fish came from, and how it has been handled. One focus group participant explained, "It's definitely more fresh, for sure. Yeah, and it's just different, it's like live music or listening to the CD" (FGD 1). Their desire for knowledge over the origin and handling of the fish they ate came from dissatisfaction with the broader food system. Many shore anglers expressed concern over knowing what is in the fish they buy at the grocery store (e.g. added chemicals), where it comes from, the environmental impacts of commercial fishing and aquaculture, and an incompatibility between commercial fishing and aquaculture and their personal values and beliefs (e.g. commodification of living things). One focus group participant explained that, for them "it's like chain of custody too, you know. You don't know how that grocery store handled that fish, how long it's been sitting in that case, how many days. Like when I'm done, you know, I'll bleed out my fish, I get them on ice, I get them in refrigeration very quickly, you know, and I know that they've been held at the right temperature" (FGD 3). Similarly, a key informant shared that "I don't buy a fish in the store, just because like, I've seen how it's handled, like it's my job, so. It's not bad, but I'd rather have like fresh caught fish" (KII, MDNR).

3.7. RQ 4. What barriers do shore-based anglers face in accessing those benefits?

While we found a range of benefits that shore anglers obtained from participating in their local fish food system, we also identified three primary barriers that prevented them from accessing those benefits. The three key barriers were (1) physical access, (2) identity, and (3) water quality and food safety.

Physical access to the local fish food system was the primary barrier identified by focus group participants across racial and ethnic groups. Shore anglers in the Detroit area felt that there was very limited shore access. Focus group participants discussed challenges with increasing privatization, lack of piers, and overcrowding and lack of facilities at existing sites (e.g. parking for those with mobility challenges, trash cans, cleaning stations). One research participant shared that they "have shit for access, we have like three little spots to fish and we all have to jam in here and there's no access for us. Period. That's it. That's the number one problem with fishing. Nowhere to go… Everything's owned by someone or a corporation, you can't get to it. Period." (FGD 4). Key informants also identified this issue in the Detroit area. For example, one individual shared that the Detroit River has "miles and miles and miles and miles of shoreline, but because everybody wants to live on the river, there's very little public property open to, you know, the fishing. So people concentrate into those areas where they're allowed to be" (KII, MDNR). Further, we found that anglers typically preferred fishing early in the morning and late in the evenings; however, limited park hours in the City of Detroit restricted shore anglers' ability to access most public shore fishing sites at these peak times (dawn and dusk).

Identity – including race, ability, and class – emerged from the focus group data as exacerbating barriers to physical access. First, we found that race plays a role in mediating access. Although shore anglers across racial and ethnic groups repeatedly shared concerns about negative interactions with law enforcement while fishing, it is important to consider historical and contemporary social context in the Detroit area to understand how such interactions may disproportionately impact anglers of color. Shore anglers shared a general sense of frustration in how law enforcement handled removing them from public parks after hours. They reported being ticketed up to USD 500 and said that "they come in, start writing people tickets, getting real aggressive. It's like, what did we do to deserve this?" (FGD 5). We also found that Asian anglers in the Detroit area felt their participation was hindered by negative perceptions and racial stereotypes related to fish consumption and fishing methods. They indicated that "in every culture this is a fun activity, it should not be a stigma to certain groups or ethnicity" (FGD 1). Second, we found that (dis)ability mediates anglers' capacity to access the local fish food system. For instance, shore fishing is particularly important for anglers who have mobility challenges and cannot balance on boats. One focus group participant shared that they "used to have a boat and I can't use the boat anymore because I have no balance. So, I am shore fishing, I shore fish, but it's much more challenging, especially for food" (FGD 3). However, we found that lack of facilities at shore sites in the Detroit area, particularly parking, made it difficult for people with mobility challenges to access the water. Third, we found that socio-economic class mediates anglers' ability to access their local fish food system. Anglers of higher economic status who can afford fishing gear, licenses, and personal modes of transportation (i.e. automobiles) have greater access to shore fishing in Detroit than individuals that rely upon public transportation. Access to transportation was noted as a key barrier to participation by local community-based organizations in the focus group discussions; "transportation, that is a hinderance for our group" (FGD 6).

Water quality and food safety were also identified as barriers to accessing the local fish food system by focus group participants. Contaminants in the study area (e.g. PCB, dioxins, mercury, PFAS) and other pollutants restricted anglers' access to production, processing, and consumption activities, preventing some from fishing in certain locations or eating as much recreationally caught fish as they would have liked. One research participant explained that they did not fish in certain areas due to the smell, saying that "it smells like poop, literally it smelled like sewage… this is nasty, like, I don't want to be here" (KII, Community leader). Further they indicated that contamination concerns have changed the way they process and cook their fish. One research participant, that has personal and cultural preferences for whole fish, shared that they have started filleting their recreationally caught fish in recent years to cut "out the pieces that were likely to be more contaminated" (KII, Community leader). Another research participant explained that they eat less recreationally caught fish than they would like to because there is a lot of "mercury and contaminants in it" that "could be PFAS and medicine" (FGD 6). Further, several anglers shared stories of food poisoning and even hospitalization after eating recreationally caught fish. For example, one angler said that they "ate some fish one time and I had *E. coli* poisoning and that's not fun when you're in the hospital for two weeks, you know, fighting for your life" (FGD 4).

4. Discussion

In using a food systems approach, we expanded the scope of inquiry in recreational fisheries beyond production activities and considered the importance of production, processing, and consumption practices in shaping aspects of angler motivation, satisfaction, and consumption behavior. Our main findings are that angler motivation, satisfaction, and consumption behavior vary by race. To better account for this heterogeneity, we identify topic areas that warrant greater management attention and the focus of future research, specifically: fish consumption, food sovereignty, environmental justice, and one health.

First, we encourage fisheries managers and scientists to look beyond leisure and take fish consumption into account as an important factor shaping angler motivation and angler satisfaction. Our finding that fish consumption plays a significant role in angler motivation, particularly for nonwhite recreational anglers, supports recent work that found the provision of food to be an important motivator for some anglers across recreational fishing contexts [15,22]. Further, comparative work has found that fishing motivations among subsistence and recreational anglers can be parallel [55], highlighting the importance of considering food and nutrition in recreational fisheries management and research. While we found that fish consumption plays a larger role in angler motivation for nonwhite than white anglers in the Detroit area, we understand that no group is homogeneous and acknowledge the importance of recreational fish consumption for some white anglers, many of whom eat exclusively recreationally caught fish according to our data. Further, our finding that nonwhite angler satisfaction is closely linked to food provision suggests that recreational fisheries managers should consider managing species commonly consumed as food in addition to those that are primarily fun to catch (e.g. sport fish). Though the top two consumed species in our study area (walleye and yellow perch) are already management priorities, other species primarily consumed by nonwhite anglers (e.g. white bass, catfish, freshwater drum, shad) may warrant further attention. For example, freshwater drum and shad are not actively managed by MDNR (e.g. possession limits and seasons; [56]), and while shad are often assumed to be targeted as bait fish, our data indicate that some anglers consume them directly. Further, using the lens of food provision can change the interpretation of common angler satisfaction measures. For instance, our study shows that catching bigger fish has a larger impact on angler satisfaction for nonwhite anglers than for white anglers. While the dominant discourse around large fish in recreational fisheries has been based on the trophy fish narrative (i.e. sport, catch records), our study may indicate that for some recreational anglers, the satisfaction of catching large fish may be related to the fact that they provide more food.

Second, we identify food sovereignty as a relevant concept for framing future research as well as informing management interventions

in recreational fisheries. Our qualitative findings on the diversity of values driving the consumption of recreationally caught fish among provisioning anglers indicate that food sovereignty is a critical concept for understanding fish consumption in the sector. Food sovereignty can be defined as "the right of peoples to healthy and culturally appropriate food produced through ecological sound and sustainable methods, and their right to define their own food and agriculture systems" [57]. The concept of food sovereignty arose from Indigenous Peoples who sought to reclaim control over their food systems and has grown in scope to include small-scale food producers like farmers and fishers – including recreational anglers [57]. For many recreational anglers in our study, consumption of recreationally caught fish is not motivated by economic drivers (i.e. food security), but by diverse values ranging from spiritual beliefs to a desire for knowledge of the origin and handling of their food and/or dissatisfaction with the broader food system (e.g. food sovereignty). For example, many recreational anglers view consumption of recreationally caught fish as a more sustainable alternative to purchasing and consuming commercially harvested fish and as more aligned with their personal values [55]. While current literature acknowledges the role of recreational fish in food security and nutrition [23,27,58], there has yet to be acknowledgement of food sovereignty in the sector to the authors knowledge. In understanding food-based motivations to be multidimensional, including food sovereignty and food security, we build upon existing angler motivation literature that recognizes subdimensions of consumptive orientation of recreational anglers [49,59,60]. Further, by applying considerations of food sovereignty (typically included in conversations about Indigenous fisheries) and food security (typically included in conversations about subsistence fisheries) to recreational fisheries, we build upon the concept of the "fuzzy boundary" that exists between fishery sectors [10].

In the context of food sovereignty, we acknowledge the need for the incorporation of diverse values into recreational fisheries management to provide a more nuanced understanding of benefits and risks. For example, while filleting fish is well understood to reduce contaminant exposure, our data also indicates that it may contribute to the loss of cultural practices and connection to ancestors for some nonwhite anglers that prefer to eat whole fish. Further, while contaminant exposure is a real public health concern, recreational fish consumption also provides nutritional benefits. Research has shown that Lake Erie fish can be a good source of essential fatty acids [61]. Further, recreational fish consumption provides relational benefits that contribute to culture among angling communities. Specifically, we found that sharing fish with friends, family, and neighbors was important for nonwhite shore anglers in the Detroit area. Sharing food can be understood as a form of resistance capital which is connected to strong histories of community organizing in communities of color [62]. Therefore, while restricted fish consumption may reduce long term health risks, it may also take away from diverse values for some communities, potentially helping to explain low nonwhite adherence to consumption advisories.

Therefore, in the context of fish consumption and food sovereignty, we recommend that recreational fisheries managers and scientists draw on the concepts of environmental justice and one health to better support diverse values. The principles of environmental justice are a call to action to protect the right to food and fair access to healthy natural resources for all [63]. However, we found that nonwhite anglers are more exposed to contaminants from fish consumption than white anglers. Species consumed by a larger percentage of nonwhite than white anglers (e.g. catfish, white bass, suckers, and freshwater drum) have more restrictive consumption advisories in place on the Detroit River (limited) than the top species consumed by both nonwhite and white anglers (walleye and yellow perch) [64]. The MDHHS defines "limited" consumption as two times per year for healthy populations but recommends that individuals under age 15, those with health problems like cancer or diabetes, or those that are pregnant or breastfeeding avoid eating "limited" fish altogether [64]. This aligns with a large body of environmental justice literature in the sector which has found that marginalized, ethnic, and racialized groups of anglers tend to consume species with higher contaminant loads, consume recreationally caught fish more frequently, and make consumption decisions primarily based on their personal lived experiences and those of their family and friends [65–68].

The concept of one health can complement the principles of environmental justice in this context, as ecosystem health (e.g. contaminated waterways) has direct implications on fish health and human health. Therefore, ecosystem restoration may be an area worthy of further attention from both managers and scientists in this system. While restoration efforts by the Detroit Riverfront Conservancy have improved water quality conditions in recent years [69], further restoration efforts may enable anglers to consume their desired amount of recreationally caught fish and derive the diverse benefits of production, processing, and consumption practices that contribute to wellbeing without having to assess potential risk to their physical health. For example, restoration of riparian vegetation has been found to improve water quality by filtering pollutants and regulating water temperature in other systems [70–72] and other studies have found that water quality positively influences angler site choice [73] with consumptive anglers preferring less developed sites [74]. Therefore, riparian vegetation may contribute both to one health and to the creation of additional good fishing sites, potentially enabling anglers to spread out along the shoreline and reduce overcrowding at existing sites. While there is need for future research in this area to determine the optimal approach for ecosystem restoration, research and management in the Detroit area can draw on other successful river restoration projects in the region that have already resulted in improved water quality and increased fish populations, like the floating gardens project on the Chicago River [75,76].

While not the focus of our study, other notable areas for future research that emerged from our data include the role of community-based organizations in facilitating access to recreational fisheries and opportunities for improving science communication in the sector. Our focus group data revealed that community-based organizations in Detroit can play a key role in facilitating access to the local fish food system by providing anglers with education, resources (fishing gear, bait, and tackle), transportation, and community building opportunities. However, future work in this area could further illuminate these contributions. Second, we identify collaboration between local universities and government agencies as a potential avenue toward improving science communication, given that nonwhite anglers in our study were more likely to rely on university resources than government resources to inform their consumption decisions. While there is a large body of literature that investigates the role of race in the distrust of government generally (e.g. [77]; [78]; [79]; [80]), our data do not explain why nonwhite anglers may be more likely to trust university resources than government resources in this context. We therefore recommend that future research examine this finding more deeply, using perspectives and frameworks from communication studies.

Finally, we acknowledge our data limitations. First, while we found no significant difference in income between nonwhite and white anglers in our study, we did not collect data on household size, which mediates the financial situation of a household and potentially its economic reliance on fish for food. Second, our study did not investigate season-specific angler motivation, angler satisfaction, and consumption behavior but rather explored these factors generally. Collecting season-specific data on these factors in future studies may illuminate potential variation in motivations and attitudes throughout the year in line with different fishing opportunities (e.g. spring runs of walleye and white bass).

5. Conclusion

This research contributes to the literature by applying a food systems approach in a recreational fisheries context. We advance the concept of *provisioning fisheries* [7] and the "fuzzy boundary" between fishery

sectors [10] by recognizing elements of small-scale fisheries (e.g. food security), Indigenous fisheries (e.g. food sovereignty), and commercial fisheries (e.g. informal economies) in recreational fisheries. This work highlights the importance of including the perspectives of underrepresented angler groups for more equitable and inclusive fisheries management and identifies important topic areas for future research and management focus.

In conclusion, we found that for many recreational anglers, fishing is more than fun. Fishing provides an important food source; for different anglers, its importance may be related to food security (e.g. saving money on food at the grocery store) or food sovereignty (e.g. cultural significance, connection to nature, connection to family/ancestors, knowledge over origin and handling of food, freshness, taste, and/or species preferences). Nonetheless, a key finding is that food is a factor motivating many anglers' participation in the recreational fisheries sector and is a driver of angler satisfaction across racial and ethnic groups. Further, we found that the range of benefits anglers obtain from participating in their local fish food system (health, connection, knowledge, and food) come not only from fishing (i.e. production), but also from processing and consumption activities. This research demonstrates the value of employing a food systems approach in recreational fisheries and has the potential to recenter food in recreational fisheries science and management.

CRediT authorship contribution statement

Elizabeth A. Nyboer: Writing – review & editing, Supervision, Methodology, Conceptualization. **Mahatub Khan Badhon:** Writing – review & editing, Methodology, Data curation, Conceptualization. **Leandro Castello:** Writing – review & editing, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Vivian M. Nguyen:** Writing – review & editing, Software, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Emma D. Rice:** Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2026.107144.

Data availability

"The authors do not have permission to share data" is appropriate for the qualitative data, but "data will be made available on request" is accurate for the quantitative data.

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