# The Economic Impact and Benefits of Utah's Blue Ribbon Fisheries*

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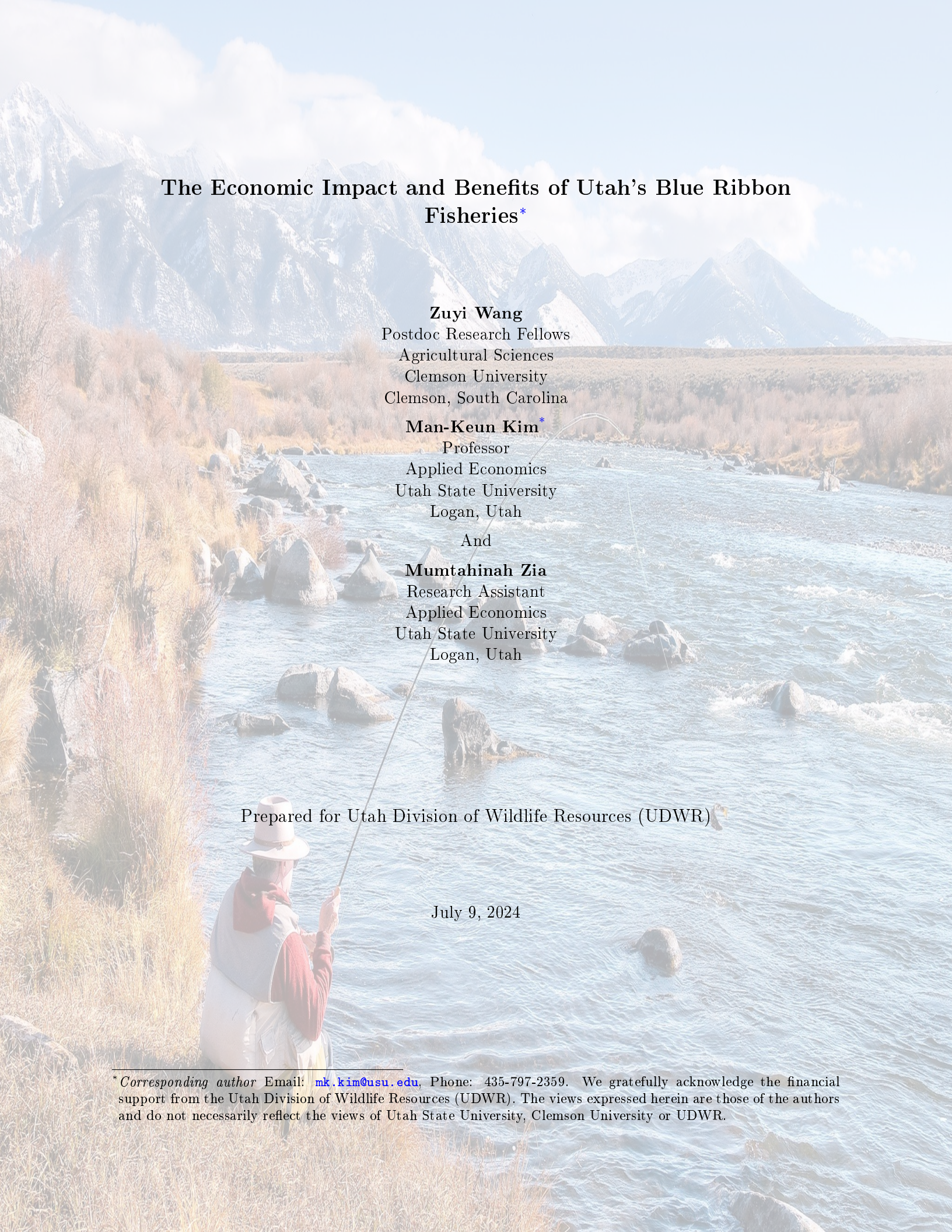

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## Executive Summary

This report presents an updated analysis of the economic contributions and benefits of Utah's Blue Ribbon Fisheries (BRF), expanding on the foundational work by Kim and Jakus (2013). Utilizing data from the 2024 Statewide Utah Angler Survey, the study offers insights into angler preferences, expenditures, and the economic impact of fishing in Utah.

- **Survey overview**: An online survey conducted from late February to May 2024 garnered 750 responses. Key demographic insights reveal that the majority of respondents were male (90%) and employed full-time (72%), with an average age of 50 years and an average of 41 years of fishing experience. Anglers reported fishing an average of 20 times per year, with a median of 14 trips.
- **Economic Impact**: The survey findings indicate that in 2023, Utah anglers spent an average of $188 per fishing trip, with significant expenditures on gas, convenience stores, and lodging. With an estimated 418,000 licensed resident anglers and a median of 14 trips per year, the total direct expenditure related to angling in Utah was calculated at $1.079 billion annually. This expenditure supports a total industry output of $2.180 billion, substantial labor income of $0.861 billion, and employment for over 17,800 individuals. The fiscal impact includes $426 million in fiscal revenues.
- **Angler Preferences**: The survey's five-star rating system for fish species revealed a strong preference for cutthroat trout, rainbow trout, brook trout, and kokanee salmon. These species received the highest ratings, underscoring their importance to the angling experience in Utah.
- **Best-Worst Scaling (BWS) and Cluster Analysis**: Using BWS and cluster analysis, the study identified key fishing site attributes valued by anglers. Attributes like catching a large number of fish and enjoying nature and wildlife were highly preferred. Cluster analysis categorized anglers into two distinct groups: one prioritizing environmental quality and the overall fishing experience, and the other focusing on catching a large number of fish and trophy-sized fish.

- **Choice Experiment**: The conditional logit models applied to the survey data highlighted that anglers prioritize BRF-designated sites for their higher quality experience and are sensitive to additional costs. Specific fish species, particularly rainbow trout and kokanee salmon, have a significant influence on site preferences.

Based on the findings, several policy implications are recommended: (i) *Enhancing BRF Designation*: Increase the number of BRF-designated sites to capitalize on their perceived higher quality and economic value, (ii) *Targeted Conservation Efforts*: Focus on the conservation and management of high-preference species like rainbow trout, cutthroat trout, brook trout, and kokanee salmon, (iii) *Marketing and Promotion*: Highlight the BRF designation and preferred fish species in marketing materials to attract more anglers, and (iv) *Balancing Access and Quality*: Consider the complex trade-offs between improving site access and maintaining site quality to avoid overcrowding and environmental degradation.

# Contents

# Chapter 1. Introduction

Zuyi Wang and Man-Keun Kim

This study provides a comprehensive assessment of Utah's Blue Ribbon Fisheries (BRFs), focusing on their economic and recreational importance. It begins with the 2024 Statewide Utah Angler Survey, analyzing angler expenditures to trace economic impacts and multiplier effects in local economies. The study also explores Utah anglers' preferences for fish species and site attributes using Best-Worst Scaling, and estimates the economic benefits of BRFs through a Choice Experiment. These insights are crucial for informing policymakers and stakeholders in the fishing and tourism sectors, offering recommendations to enhance the economic contributions of BRFs and suggesting future research directions.

## 1.1. Introduction

The primary goal of this study is to update Kim and Jakus (2013)'s research titled *The Economic Contribution and Benefits of Utah's Blue Ribbon Fisheries*, which estimated the economic impact of fishing in Utah and evaluated the economic value of Blue Ribbon Fisheries (BRF). The updated research incorporates data from the *2024 Statewide Utah Angler Survey – Blue Ribbon Fisheries*, providing a current analysis of the economic contributions and benefits associated with BRFs. A notable addition to this study is the exploration of angler preferences for fishing site attributes using Best-Worst Scaling (BWS) and cluster analysis. Additionally, the survey includes a question asking respondents to rate various fish species or groups using star ratings, offering new insights into angler preferences.

## 1.2. Overview

Recreational fishing plays a significant role in Utah's outdoor recreation, offering both personal enjoyment and substantial economic benefits to local and regional economies (American Sportfishing Association, 2021). This study aims to update the economic contributions and benefits of Utah's Blue Ribbon Fisheries (BRFs)[1] using the latest survey data and advanced valuation methods. Our

[1] Utah's Blue Ribbon Fisheries (BRF) are waters known for providing highly satisfying fishing and outdoor experiences for diverse groups of anglers and enthusiasts. The key criteria for selecting Blue Ribbon waters include: (1) fishing

goal is to comprehensively understand the economic impact and net economic value that these high-quality fishing waters provide to anglers and surrounding communities.

The specific objectives of this research are to estimate the economic impact of fishing in Utah, evaluate the economic contributions of Blue Ribbon Fisheries, and ascertain the overall economic value of fishing in the state. Additionally, this study aims to analyze anglers' preferences for various fishing site attributes, employing methods like Best-Worst scaling to identify the most and least preferred fish groups and other site features. Through these objectives, we aim to offer a comprehensive understanding of the economic and recreational value of fishing in Utah.

### 1.3. Methods of Measuring Economic Impact and Value

Economic impacts stem from consumer expenditures on goods and services such as fishing equipment, food, lodging, and transportation. These expenditures ripple through the economy, creating multiplier effects that are captured through Input-Output (IO) analysis. IO models track these expenditures across various sectors, estimating the resulting changes in economic output, employment, and income (Schaffer, 1999; Miller and Blair, 2009). For example, expenditures by anglers on items like gas and food stimulate business-to-business transactions and generate further economic activity through the spending of wages earned by employees in these sectors. To assess the economic impact of anglers' expenditures, we surveyed anglers about their spending on their most recent fishing trip. These expenditures typically include fishing equipment and rentals, food and beverages purchased at restaurants or grocery stores, gas, lodging (hotel/motel/cabin/camping), and other transportation expenses. When anglers purchase fishing equipment, it stimulates economic activity in the retail sector. Retailers may then purchase goods from wholesalers, who subsequently increase orders from manufacturers. This ripple effect continues throughout the economy, generating additional economic activity and employment. IO analysis tracks these indirect and induced effects, illustrating multiplier effects throughout the economy.

Net economic value, also known as consumer surplus, differs fundamentally from economic impacts as it signifies the disparity between what an angler values a fishing experience and what they actually pay (Freeman III, 1999). For instance, if an angler values a fishing trip at $150 but pays only

quality, (2) quality fish habitat, (3) a quality outdoor experience, and (4) economic benefits to surrounding communities (UDWR, 2021). More information on BRFs can be found at wildlife.utah.gov/hotspots/blueribbon.php.

$100, the net economic value is $50. This measure is pivotal for evaluating the recreational quality and the added value provided by high-quality fishing sites such as BRFs compared to standard fishing locations (Jakus et al., 2011; Avitt, 2021). To comprehensively assess the value of recreational fishing, various methodologies can be employed. Among these, the choice experiment method stands out for its robust design and capacity to capture complex preferences in willingness to pay (WTP). However, traditional approaches like bidding games also contribute insights, despite their inherent limitations.

### 1.4. Structure of the Report

This report is structured into seven chapters, each focusing on distinct aspects of the study. The next chapter outlines the design and execution of the 2024 Statewide Utah Angler Survey, encompassing the sampling methodology, survey distribution, and types of questions posed. Additionally, this chapter profiles the demographics and characteristics of the survey respondents.

Chapter 3 delves into the economic impact of angler expenditures in Utah, tracing how spending on items such as fishing equipment, food, lodging, and transportation ripples through the local economy, generating multiplier effects. Chapter 4 explores Utah anglers' preferences for different fish species, identifying the most and least favored species. These insights shed light on how angler preferences influence fishing site selection and the overall fishing experience. Chapter 5 utilizes Best-Worst Scaling (BWS) to investigate the key attributes influencing fishing site selection. This method captures the relative importance of various site attributes, such as fishing quality, accessibility, and amenities, enriching our understanding of the factors most critical to anglers. Chapter 6 presents the findings from the Choice Experiment conducted to estimate the economic benefits of Blue Ribbon Fisheries (BRF). This method quantifies the additional value that anglers attribute to high-quality BRFs compared to standard fishing sites, providing insights into the economic contributions of BRFs.

The concluding chapter synthesizes the study's key findings, discussing their implications for policymakers and stakeholders in the fishing and tourism sectors. It also proposes recommendations for enhancing the economic contributions and benefits of BRFs and suggests avenues for future research.

# Chapter 2. 2024 Statewide Utah Angler Survey

Zuyi Wang, Man-Keun Kim, and Mumtahinah Zia

An online survey was conducted from late February to May 2024 using Qualtrics. By May 31, 750 responses were received, with varying response counts across different sections due to incomplete submissions. Approximately 73% of respondents were invited via email, while 27% were invited via Facebook. On average, anglers reported fishing 20 times per year, with a median of 14 times. Notably, 36% of anglers were unaware whether they had visited a Blue Ribbon Fisheries (BRF) location. The favorite BRF destinations were Strawberry Reservoir, Deer Creek Reservoir, and Flaming Gorge Reservoir. Additionally, 19% of respondents fished at Utah Lake in 2023, but only 8% considered Utah Lake a frequent fishing spot. The majority of respondents were male (90%) and employed full-time (72%). The average age of respondents was 50 years, with an average of 41 years of fishing experience.

## 2.1. Introduction

To achieve our research objectives, we conducted an online survey from late February to May 2024 to collect data on anglers' expenditures and willingness to pay, aiming to estimate economic benefits. The questionnaire gathered information on visitation patterns, including fishing site preferences and frequency, as well as trip-related and equipment expenditures. Additionally, we collected standard socio-economic data such as gender, age, educational attainment, and income. The survey was administered using Qualtrics, a web-based survey tool.

We randomly sampled over 17,000 licensed anglers from UDWR license records. Each angler received an initial email explaining the survey's purpose and providing a link to the online survey. A follow-up message was sent to thank respondents and encourage non-respondents to participate. A total of 542 surveys were completed through email invitations, yielding a response rate of 3.2%. Additionally, we utilized UDWR's Facebook page to invite more participants, resulting in 208 responses. As of May 31, we had received a total of 750 responses (542 email invitations + 208 Facebook). However, not all respondents completed every question, leading to varying response counts across different sections and questions.

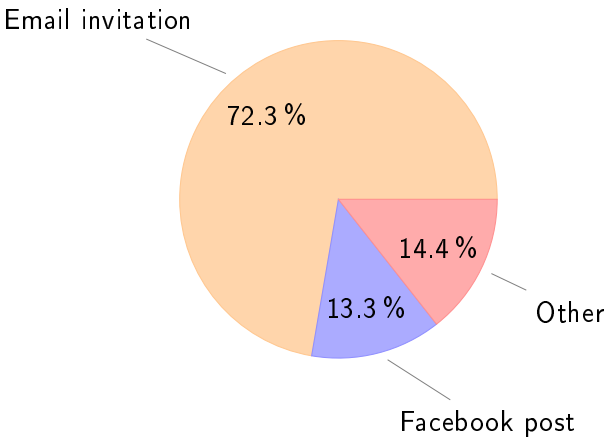



Figure 2.1: **Where Did You Learn About This Survey?**
(Response count: 693)

## 2.2. Survey Results

### *2.2.1. Fishing in Utah in General*

The first question asks respondents if they would like to participate in the survey, with only those who answer “yes" being able to proceed. The second question inquires about how the respondent was invited to participate in the survey. Initially, we used a randomly sampled email list of licensed anglers obtained from UDWR. However, due to a low response rate, we also posted about the survey on the UDWR Facebook page to encourage participation. Approximately 72% of respondents were invited via email, 13% through the Facebook post, and 14% by other means[1], which may include respondents who received email invitations, saw the Facebook post, or were invited by friends (see Figure 2.1).

Among the respondents, approximately 95% of anglers engaged in fishing activities in Utah during the calendar year 2023, while about 5% of license holders did not fish in Utah during that year (see Figure 2.2). On average, Utah anglers went on approximately 20 fishing trips per year (standard deviation = 23), with a median of 14 trips. This suggests that while the typical (or median) angler fished about once a month, those who fished more frequently skewed the overall average upwards. The maximum number of trips reported was 300, highlighting the presence of outliers that significantly affect the mean (see Figure 2.3). This distribution reflects diverse fishing

[1] These respondents selected the “Other” option, not “Facebook post” in response to the question about how they were invited to participate in the survey. They used the link to the survey posted on Facebook, so it is unclear whether they also received an email invitation.

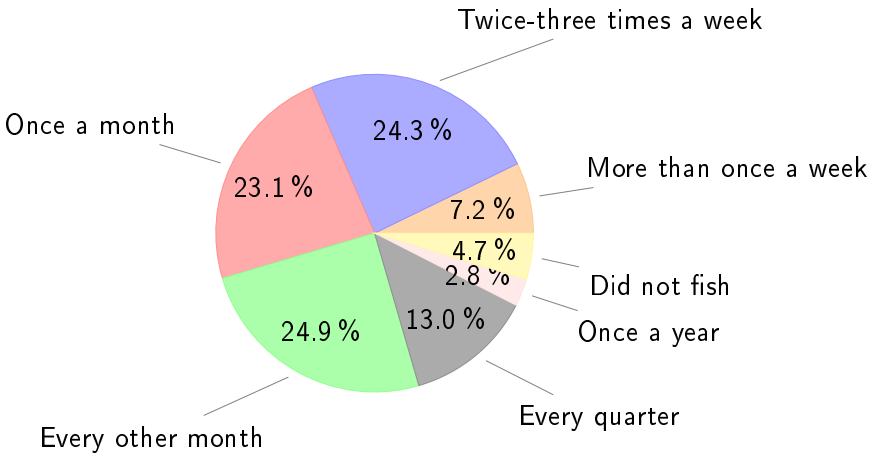



Figure 2.2: **How Many Fishing Trips in 2023 Did You Make?**
(Response count: 679)

Note: On average, anglers went fishing in Utah approximately once a month, with an average of 20 fishing trips (standard deviation = 23) and a median of 14 (roughly once a month).

habits among Utah anglers, ranging from occasional participants to highly dedicated enthusiasts. More than 31% of anglers reported fishing more than once a month (more than 24 trips) (see Figure 2.3). For comparison, Kim and Jakus (2013) reported in 2011 that the average number of fishing trips was 10, with a standard deviation of 11. This suggests that Utah anglers fished more frequently in 2023, approximately twice as much as in 2011.

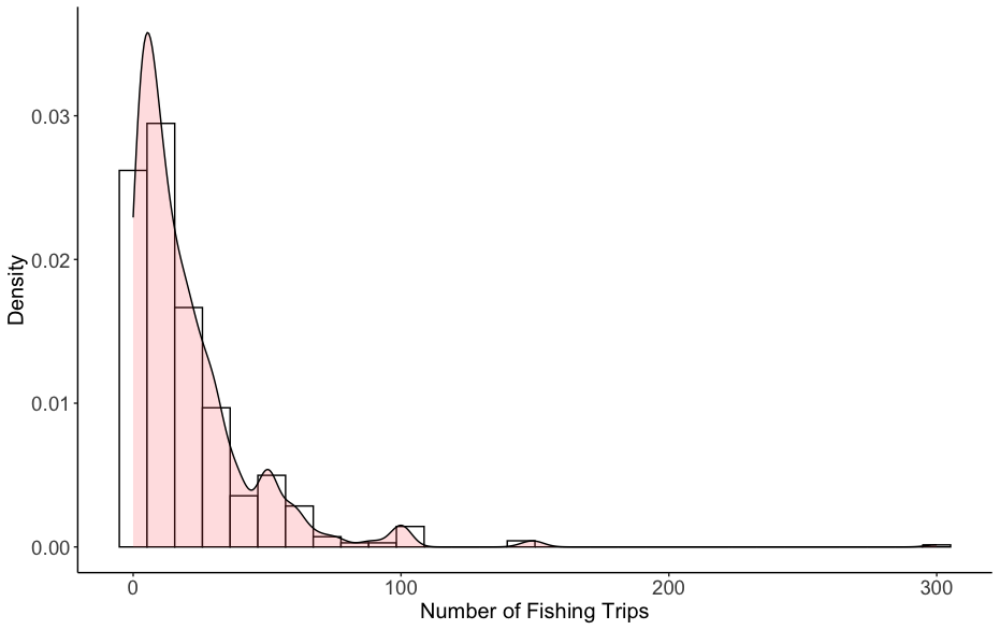



Figure 2.3: **Histogram of Number of Fishing Trips**

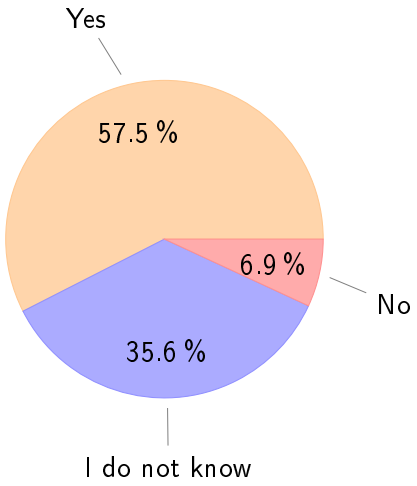



Figure 2.4: **Did You Visit Any Blue Ribbon Fisheries?**
(Response count: 644)

Next, we asked anglers if they had visited any Blue Ribbon Fisheries. Surprisingly, many anglers were unsure whether they had visited Blue Ribbon Fisheries (36%) or may not have paid attention to whether the fishing sites they visited were designated as such (see Figure 2.4). However, more than half of the respondents, 58%, did visit BRFs in 2023.

We then asked anglers if they remembered where they fished and provided a list of Blue Ribbon Fisheries (BRFs), allowing them to choose multiple answers to identify their favorite fishing destinations among the BRFs. The results revealed the favorite fishing destinations in 2023, as presented in Figure 2.5. Strawberry Reservoir, a BRF located in Wasatch County, was the most popular destination among anglers in 2023, with over 46% of respondents who had fished that year reporting that they had visited Strawberry Reservoir. Other favorite fishing destinations included Deer Creek Reservoir (29%), Flaming Gorge Reservoir (20%), and Jordanelle Reservoir (20%). For comparison, a 2011 report by Kim and Jakus (2013) listed Strawberry Reservoir, Green River, and Middle Provo River as the top three favorite destinations, with Deer Creek Reservoir not included in the top list. However, in 2023, Deer Creek Reservoir emerged as a popular destination, while Green River and Middle Provo River saw a slight decrease in popularity compared to the 2011 report (Kim and Jakus, 2013).

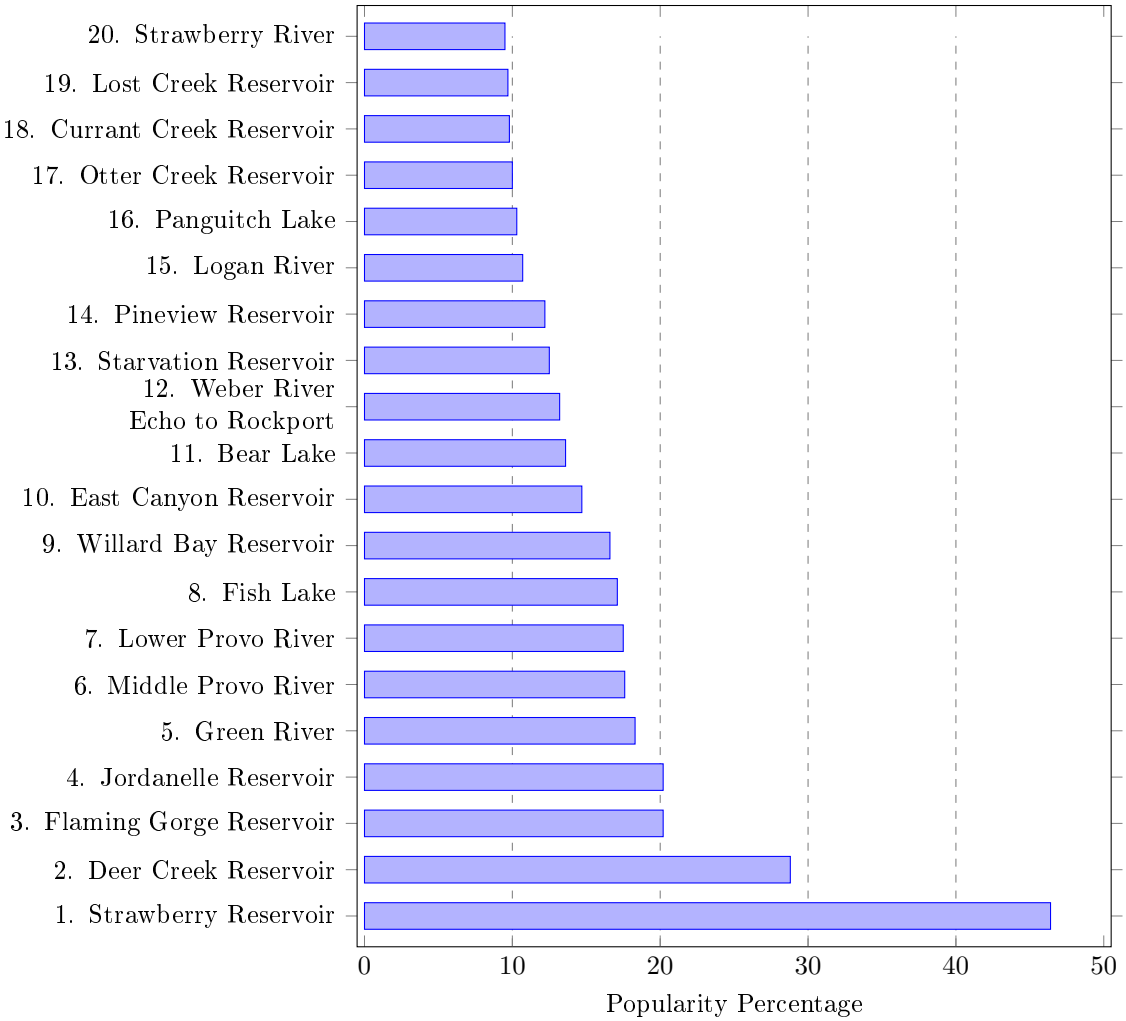



Figure 2.5: **Favorite Destination (Blue Ribbon Fisheries)**
(Response count: 590)

Note: Responses to the survey question where anglers were asked to recall their fishing locations from a provided list of Blue Ribbon Fisheries (BRFs). They could select multiple answers to identify their favorite fishing destinations among the BRFs.

### *2.2.2. Fishing in Utah Lake*

We are interested in Utah Lake, a shallow freshwater lake in the center of Utah County, Utah, surrounded by the Provo-Orem metropolitan area. To understand the preferences of Utah anglers regarding Utah Lake, we asked if they had taken any fishing trips to Utah Lake in 2023 (Figure 2.6). Surprisingly, the majority of respondents (81%) reported that they did not take any fishing trips to Utah Lake in 2023. However, around 8% of respondents indicated that Utah Lake was a frequent destination for their fishing trips. Further details on fishing in Utah Lake, particularly expenditures, will be discussed in section 3.2.2 in Chapter 3.

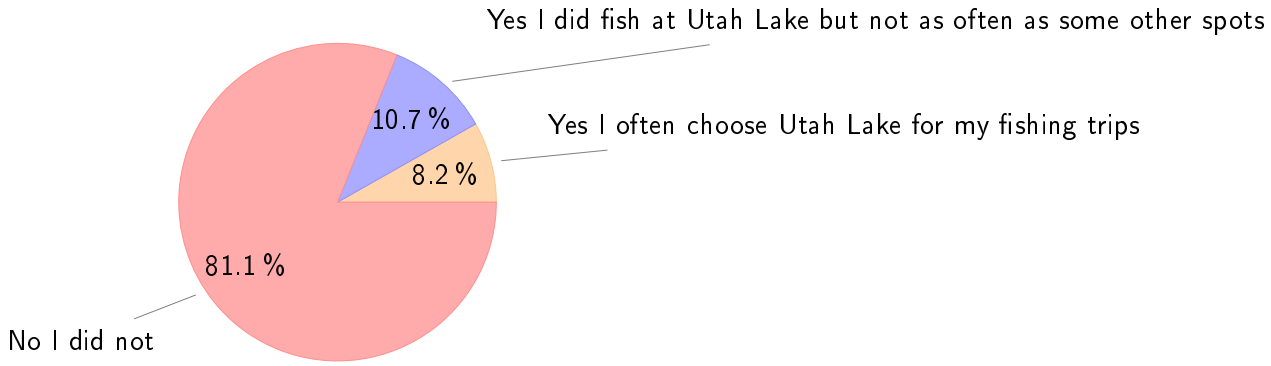
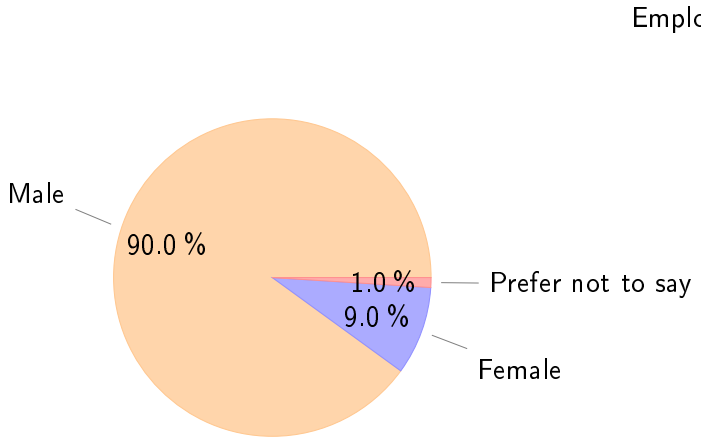



Figure 2.6: **Did You Take Any Fishing Trips to Utah Lake in 2023?**
(Response count: 597)

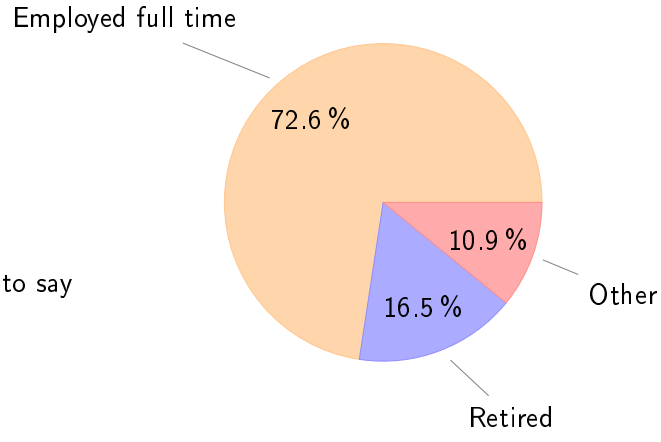
### 2.3. Demographic Profiles of Respondents

This section presents the demographic profiles of the respondents. The survey results indicate a significant gender disparity among respondents, with 90% identifying as male, 9% as female, and 1% preferring not to disclose their gender (see Figure 2.7a). This skewed distribution suggests a predominance of male anglers in Utah, which may have implications for targeted outreach and marketing strategies within the fishing community.

Employment status varied among respondents, with the majority (73%) being employed full-time. Retirees comprised 17% of the respondents, while the remaining 11% fell into the "Other" category, which includes part-time employment, unemployment, and students (see Figure 2.7b).




(a) **Gender**
(Response count: 510)




(b) **Employment**
(Response count: 504)

Figure 2.7: **Survey Respondents Gender and Employment**

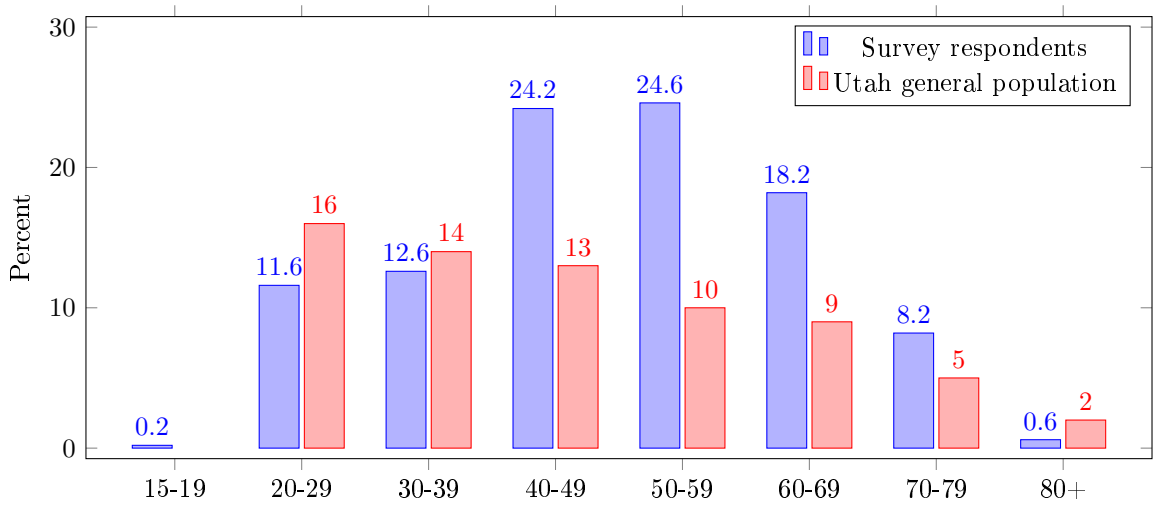



Figure 2.8: **Age Distribution**
(Response count 501)
Note: Age distribution for Utah general population is based on data from the US Census (source: http://censusreporter.org/profiles/04000US49-utah/)

This distribution highlights the diverse economic backgrounds of anglers, providing insights into their spending behaviors and availability for fishing activities.

The age distribution of respondents shows that fishing in Utah is popular across a wide range of age groups. The largest segments were those aged 40-49 and 50-59, each constituting 24.2% and 24.6% of the sample, respectively. This was followed by anglers aged 60-69 (18.2%) and those aged 30-39 (12.6%). Younger anglers aged 20-29 made up 11.6%, and those in the 70-79 age group comprised 8.3%. Very few respondents were in the 15-19 (0.2%) and 80+ (0.6%) age brackets (see Figure 2.8). Comparatively, Utah's general population shows a different age distribution pattern. In the general population, based on data from the US Census (source: http://censusreporter.org/profiles/04000US49-utah/), the percentages are notably different: 16% are aged 20-29, 14% are 30-39, 13% are 40-49, 10% are 50-59, 9% are 60-69, 5% are 70-79, and 2% are 80 and above. This indicates that the survey respondents exhibit a higher concentration among middle-aged groups (40-59 years) compared to the general population of Utah.

The educational attainment of respondents indicates a fairly high level of education among Utah anglers. About 35% had completed some graduate education or higher, while 30% had some college or technical school experience. Those with an undergraduate degree accounted for 23%, and high school graduates or those with a GED made up 11% of the respondents (see Figure 2.9). In

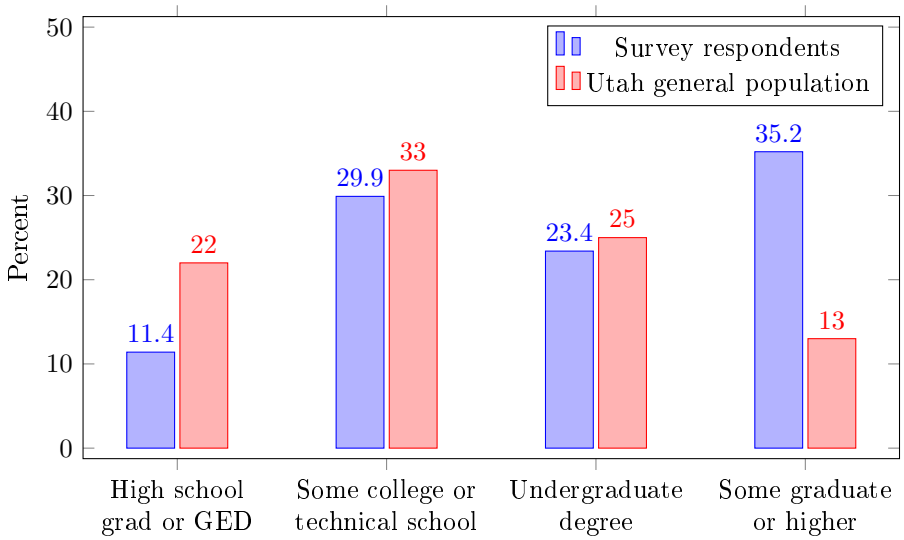



Figure 2.9: **Education**
(Response count 408)
Note: Educational attaiment distribution for Utah general population is based on data from the US Census (source: http://censusreporter.org/profiles/04000US49-utah/)

comparison, according to the Utah profile from the US Census, 33% of Utah residents have some college education, 25% hold a bachelor's degree, and 13% have completed post-graduate education (source: http://censusreporter.org/profiles/04000US49-utah/).

The survey data revealed that the majority of respondents have substantial fishing experience. Anglers with 50-59 years of experience were the largest group, representing 23% of the sample, closely followed by those with 40-49 years (23%) and 30-39 years (16%) of experience. Anglers with 60+ years of experience made up 17%, while those with 20-29 years and 10-19 years comprised 12% and 6%, respectively. Only 4% had less than 10 years of fishing experience (see Figure 2.10). The average fishing experience is estimated to be 41 years (standard deviation = 16.5 years) with a median of 43 years. This data underscores a deep-rooted fishing culture in Utah, with many anglers having decades of experience.

Income distribution among respondents varied across several brackets. Anglers earning between $125,000-$150,000 represented the largest group at 17.1%, followed by those earning $50,000-$75,000 at 15.7%. A smaller segment of respondents earned less than $50,000, comprising 8.9% of the sample (see Figure 2.11). This broad income distribution indicates that fishing is a recreational activity enjoyed by individuals across various economic levels. Comparatively, the general population of

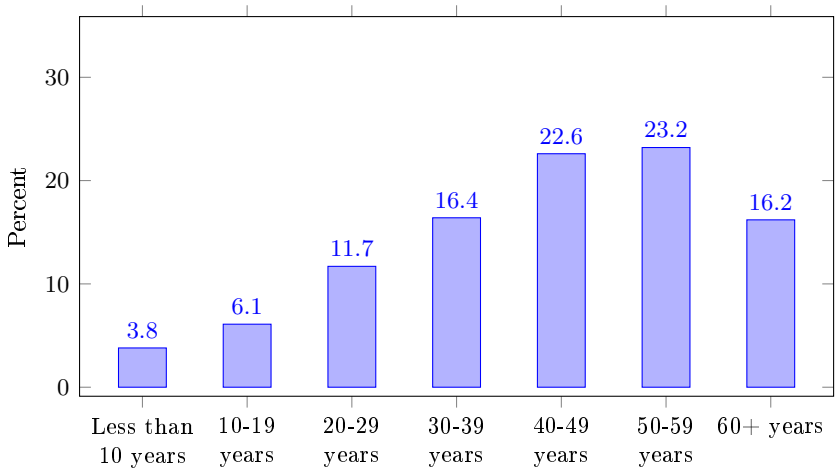



Figure 2.10: **Fishing Experience**
(Response count 505)

Utah, as documented by the US Census, displays a somewhat different income distribution. The general population shows higher percentages in the income brackets of $75,000-$100,000 (26%) and $50,000-$75,000 (17%), indicating a broader representation across middle-income ranges. This divergence between survey respondents and the general population highlights variations in economic demographics that may influence spending patterns and recreational activities among Utah anglers.

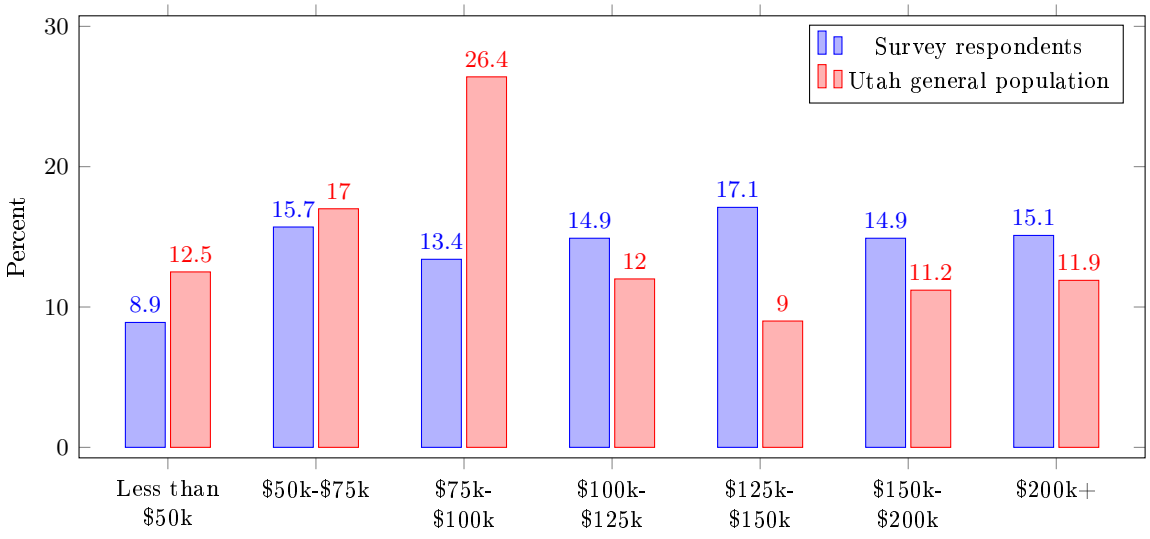



Figure 2.11: **Income**
(Response count 491)
Note: Educational attaiment distribution for Utah general population is based on data from the US Census (source: http://censusreporter.org/profiles/04000US49-utah/)

# Chapter 3. Anglers' Expenditures and Economic Impact

Man-Keun Kim, Zuyi Wang, and Mumtahinah Zia

The economic and fiscal impacts of angling in Utah are substantial, as revealed by our survey findings. In 2023, Utah anglers spent an average of $188 per fishing trip, with the majority of expenditures allocated to purchases at gas stations and convenience stores ($73 per trip), followed by lodging ($41 per trip). Anglers visiting "Utah Lake" spent an average of $53 per fishing trip, with the largest portion of their expenditures going to gas and convenience store purchases ($24 per trip). Based on the survey's expenditure data and assuming 418,000 licensed resident anglers with a median of 14 trips per year, the total direct expenditure related to angling in Utah was estimated at $1.079 billion annually. These expenditures significantly impact the Utah economy, contributing to a total industry output of $2.180 billion. Moreover, angling supports substantial labor income, totaling $0.861 billion, and provides employment to over 17,800 individuals across various sectors. The fiscal impact is also notable, with angling activities contributing $426 million in fiscal revenues.

## 3.1. Introduction

Anglers' expenditures during fishing trips have substantial economic implications, benefiting not only local communities where fishing takes place but also the broader regional economy. This section examines the average expenditure per fishing trip based on data from the 2024 Statewide Utah Angler Survey. Additionally, we utilize Input-Output analysis to estimate the regional economic impact of these expenditures. By analyzing categories such as food and beverage, lodging, transportation, and angling equipment, we gain insights into how angler spending supports local businesses and contributes to economic growth. This analysis offers valuable insights for policymakers, resource managers, and local businesses interested in promoting economic development and sustainable natural resource management.

### 3.2. Expenditures for Fishing Trip

#### *3.2.1. Expenditures for the Recent Fishing Trip*

The average expenditure on anglers' most recent fishing trip in 2023 across all fisheries in Utah was estimated to be $188 per trip[1] (Table 3.1). The largest expenditure category was purchases at gas stations and convenience stores, totaling $73 per trip. Additionally, anglers spent approximately $41 per trip on lodging in hotels, motels, cabins, or camps, suggesting that most fishing trips were day-trips. Other significant expenditures included $30 per trip for food and beverages purchased at grocery stores, $17 per trip at restaurants and fast-food chains, and $23 per trip on equipment rentals (e.g., RV or boat rental). Expenditures in the "Other" category, which includes souvenirs like T-shirts, hats, and mugs, averaged about $4 per trip.

The average expenditure for fishing trips involving Blue Ribbon Fisheries (BRF) was estimated at $217 per trip (Table 3.1). Once again, purchases of gas and food at convenience stores accounted for the largest expenditure category, totaling $79 per trip. Anglers also spent approximately $50 on lodging, $28 on equipment rentals, $34 at grocery stores, and $21 on food and drinks in restaurants per trip. In comparison, the average expenditure for trips to non-BRF fishing locations was $139 per trip, which is about $78 less per trip relative to BRF. It's worth noting that Table 3.1 includes data from all fisheries, including BRF, non-BRF, and responses where anglers were unsure of the fishing location ("I do not know"). The total response count for this question was 571, with 356 responses for BRF, 194 for non-BRF, and 21 for "I do not know" responses. Confidence intervals in Table 3.1 were derived using bootstrap simulations (resampling) with 1000 replications, allowing us to estimate the expenditure distribution and compute confidence intervals directly from the sample data (Efron, 1979; Ramachandran and Tsokos, 2021).

For comparison, we reference the Haaland et al. (2023) report, which provides insights from interviews with U.S. residents about their fishing, hunting, and wildlife watching activities in 2022. The survey covers U.S. residents aged 16 and older who engaged in fishing or hunting activities during that year. According to the report, 39.9 million U.S. residents enjoyed various fishing opportunities throughout the country in 2022. These anglers collectively spent 785 million days fishing and took

[1] The survey question asked respondents how much they spent on their latest fishing trip, not individual per-person spending. We do not have information on how many companions, friends, or family members accompanied the respondent on their latest fishing trip, so per trip does not necessarily equate to per angler spending.

Table 3.1: **Average Expenditure on Angler's Most Recent Trips in 2023 (Dollars)**

| Fisheries | Expenditure category | Average | Confidence intervals* | |
|---|---|---|---|---|
| | | | 95% low | 95% up |
| All fisheries | Lodging | 41.16 | 23.92 | 61.61 |
| | Gas station/convenience stores | 72.91 | 57.18 | 91.58 |
| | Grocery | 30.20 | 24.20 | 36.87 |
| | Restaurant/fast food | 17.39 | 13.98 | 21.19 |
| | Rentals | 22.64 | 12.60 | 35.75 |
| | Others | 3.58 | 1.20 | 6.96 |
| | **Total** | **187.90** | **149.00** | **230.30** |
| BRF only | Lodging | 50.04 | 26.23 | 81.48 |
| | Gas station/convenience stores | 78.53 | 62.50 | 98.24 |
| | Grocery | 34.01 | 25.98 | 44.78 |
| | Restaurant/fast food | 20.98 | 15.88 | 26.95 |
| | Rentals | 27.97 | 16.20 | 44.25 |
| | Others | 5.43 | 1.69 | 10.56 |
| | **Total** | **217.00** | **162.70** | **282.70** |
| non-BRF | Lodging | 25.46 | 6.63 | 57.69 |
| | Gas station/convenience stores | 65.77 | 36.57 | 108.23 |
| | Grocery | 21.63 | 15.55 | 28.62 |
| | Restaurant/fast food | 10.51 | 7.38 | 13.80 |
| | Rentals | 14.84 | 2.19 | 43.18 |
| | Others | 0.57 | 0.00 | 1.29 |
| | **Total** | **138.80** | **90.10** | **200.20** |

1 All fisheries includes Blue Ribbon Fisheries (BRF), Non-BRF, and "I do not know" responses, with a response count of 571. Specifically, there were 356 responses for BRF, 194 for non-BRF, and 21 for "I do not know".
2 * Confidence intervals were derived from the bootstrap simulation (resampling) with 1000 replications; the bootstrap allows estimation of the sampling distribution (expenditure distribution) to compute the confidence interval using the sample data themselves (Efron, 1979; Ramachandran and Tsokos, 2021).

a total of 463 million fishing trips. The report also indicates that anglers spent a total of $99.4 billion on fishing-related expenses for the year. When comparing these figures, we found that the expenditure per trip averaged around $207, which is quite close to our survey's findings showing an average expenditure of $188 per trip among Utah anglers (Table 3.1). It's important to note, however, that according to the Haaland et al. (2023) report, the average number of fishing trips per year was 12, whereas our survey reveals that Utah anglers took an average of 20 fishing trips per year (median = 14)

Additionally, we asked respondents in the survey whether their most recent fishing trip felt more valuable to them than the money they spent. About 84% of respondents answered affirmatively (Figure 3.1).

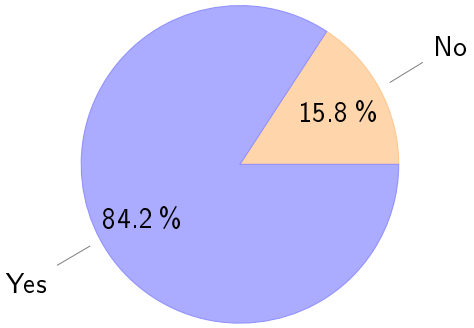



Figure 3.1: **Was Your Most Recent Fishing Trip Worth More than You Spent?** (Response count: 571)

### *3.2.2. Expenditures to Visit Utah Lake*

As previously mentioned in the survey section 2.2.2 in Chapter 2, our focus includes Utah Lake to understand the preferences of Utah anglers. We asked respondents if they had taken any fishing trips to Utah Lake in 2023 (Figure 3.2). Surprisingly, the majority of respondents (81.1%) reported that they did not fish at Utah Lake during that year. However, 8.2% indicated that Utah Lake was a frequent destination, and 10.7% stated that they fished there occasionally but not as often as other spots (Figure 3.2).

In 2023, a total of 106 respondents visited Utah Lake and provided their expenditure details in the survey. This section summarizes their expenditures specifically for trips to Utah Lake, as shown in Table 3.2. The average expenditure per fishing trip to Utah Lake in 2023 was $53, with 95% confidence intervals ranging from $37 to $69 per trip. This average expenditure is notably

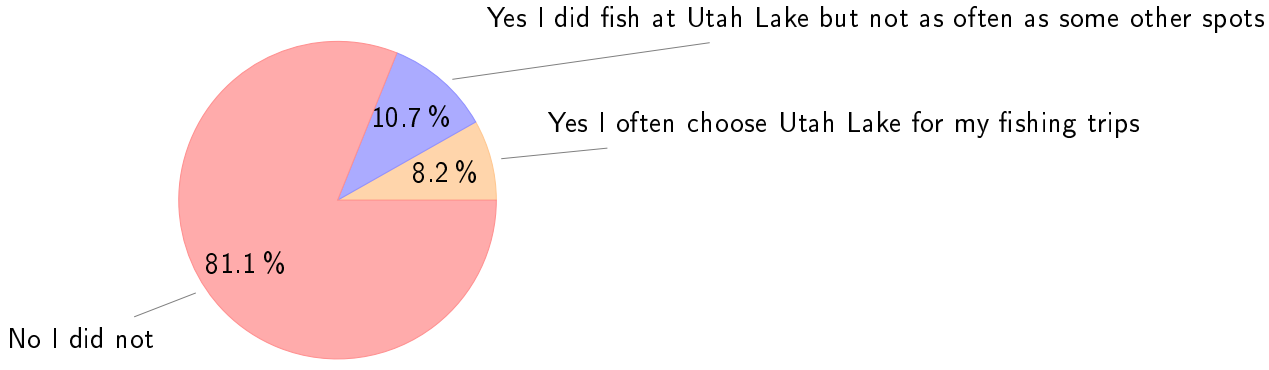



Figure 3.2: **Did You Take Any Fishing Trips to Utah Lake in 2023?** (Response count: 597)

Table 3.2: **Average Expenditure on Trips to Utah Lake in 2023 (Dollars)**

| Fisheries | Expenditure category | Average | Confidence intervals* | |
|---|---|---|---|---|
| | | | 95% low | 95% up |
| Utah Lake | Lodging | 0.75 | 0.00 | 1.98 |
| | Gas station/convenience stores | 24.13 | 18.40 | 30.26 |
| | Grocery | 10.79 | 6.03 | 16.55 |
| | Restaurant/fast food | 6.38 | 3.98 | 9.28 |
| | Rentals | 10.18 | 3.57 | 18.21 |
| | Others | 0.26 | 0.00 | 0.72 |
| | **Total** | **52.50** | **36.96** | **68.89** |

1 Based on 106 respondents who visited Utah Lake in 2023.
2 * Confidence intervals were derived from the bootstrap simulation (resampling) with 1000 replications; the bootstrap allows estimation of the sampling distribution (expenditure distribution) to compute the confidence interval using the sample data themselves (Efron, 1979; Ramachandran and Tsokos, 2021).

lower than the overall average expenditure of $188 per trip reported in Table 3.1, indicating that anglers are more likely to visit Utah Lake for day trips. The largest expenditures were on gas and convenience store purchases, averaging $24 per trip, followed by $11 per trip on groceries, and $10 per trip on rentals. Expenditures on lodging, restaurant/fast food, and other miscellaneous expenses were relatively lower.

The low average expenditure on lodging, which was less than $1, suggests that many anglers likely fish for just one day at Utah Lake. This is further supported by the relatively low expenditure on other categories such as restaurants. Overall, these findings indicate that Utah Lake primarily serves as a destination for day trips among anglers, as reflected in their spending patterns and its proximity to the urban area.

## 3.3. Estimating Direct Expenditures

### *3.3.1. Direct Expenditures for All Fisheries*

Based on the expenditure information collected in the survey (Table 3.1), we estimated the total direct expenditure related to angling in Utah, assuming there are 418,000 licensed resident anglers, as reported by Utah Division of Wildlife Resources (2021). With a median of 14 trips per year (the average number of fishing trips was 20 per year, but the median is used to mitigate the influence of high outliers, as seen in Figure 2.3), the total direct expenditure was estimated at $1.10 billion ($187.90 per trip×14 trips×418,000 anglers), with a 95% confidence interval ranging from $0.87 billion to $1.35 billion.

Table 3.3: **Total Direct Expenditure - All Fisheries** (in millions of dollars)

| Expenditure category | Estimates | Confidence intervals* | |
|---|---|---|---|
| | | 95% low | 95% up |
| Retail stores - food and beverage | 177 | 142 | 216 |
| Retail stores - gas stations | 427 | 335 | 536 |
| Equipment rental and leasing | 132 | 74 | 209 |
| Lodging - hotel/motel/cabin/camp | 241 | 140 | 361 |
| Restaurants | 102 | 82 | 124 |
| Total | 1,079 | 773 | 1,446 |

1 Total direct expenditure was estimated by multiplying the per trip expenditure by the median number of fishing trips per year (14 trips) and the estimated number of anglers in Utah (418,000).
2 Confidence intervals in parentheses were derived from the bootstrap simulation (resampling) with 1000 replications; the bootstrap allows estimation of the sampling distribution (expenditure distribution) to compute the confidence interval using the sample data themselves (Efron, 1979; Ramachandran and Tsokos, 2021).

The largest expenditure category was purchasing gas from retail stores, totaling $427 million. Anglers also spent significantly on lodging ($241 million) and food and beverage purchases from retail stores ($177 million). Equipment rental and leasing accounted for $132 million, while restaurants contributed $102 million to the total direct expenditure. The wide 95% confidence intervals reflect the variability in expenditure patterns among anglers. For instance, the confidence interval for gas station purchases ranged from $335 million to $536 million, indicating substantial uncertainty in this expenditure category.

### *3.3.2. Direct Expenditures for Utah Lake*

Estimating direct expenditures for Utah Lake presents challenges due to the difficulty in determining the exact number of anglers visiting the lake. Based on survey results, about 18.9% of respondents reported visiting Utah Lake in 2023 (see Figure 3.2). Among these, 8.2% are frequent visitors, while 10.7% visit less often. Assuming frequent visitors fish at the lake 14 times per year (the median number of fishing trips in the survey) and less frequent visitors fish 5 times per year (the first quartile of fishing trips), we can estimate the total number of visits. With an estimated 418,000 licensed anglers in Utah, the frequent visitors account for approximately 479,864 visits ($= 418,000$ anglers $\times$ 14 visits $\times$ 8.2%), and the less frequent visitors account for about 223,630 visits ($= 418,000$ anglers $\times$ 5 visits $\times$ 10.7%). In total, we estimate that there were approximately 703,494 fishing visits to Utah Lake in 2023. Using the average expenditure per trip reported in Table 3.2, we estimate total direct expenditures for Utah Lake to be $37 million, as detailed in Table 3.4.

Table 3.4: **Total Direct Expenditure - Utah Lake** (in millions of dollars)

| Expenditure category | Estimates | Confidence intervals* | |
|---|---|---|---|
| | | 95% low | 95% up |
| Retail - food & beverage | 7.77 | 4.24 | 12.16 |
| Retail - gasoline stores | 16.98 | 12.94 | 21.29 |
| Equipment rentals | 7.16 | 2.51 | 12.81 |
| Lodging - hotel/motel/cabin/camp | 0.53 | 0.00 | 1.39 |
| Restaurants | 4.49 | 2.80 | 6.60 |
| Total | 36.93 | 22.50 | 54.25 |

1 With an estimated 418,000 licensed anglers in Utah, the frequent visitors account for approximately 479,864 visits (= 418,000 anglers × 14 visits × 8.2%), and the less frequent visitors account for about 223,630 visits (= 418,000 anglers × 5 visits × 10.7%). In total, we estimate that there were approximately 703,494 fishing visits to Utah Lake in 2023. Using the average expenditure per trip reported in Table 3.2, we estimate total direct expenditures by multiplying these fishing visits by the average expenditure per trip.
2 Confidence intervals in parentheses were derived from the bootstrap simulation (resampling) with 1000 replications; the bootstrap allows estimation of the sampling distribution (expenditure distribution) to compute the confidence interval using the sample data themselves (Efron, 1979; Ramachandran and Tsokos, 2021).

This estimate is derived by multiplying the number of fishing visits by the average expenditure per trip.

### 3.4. Economic Contribution for Fishing in Utah

Economic impacts or contributions are determined by anglers' expenditures associated with fishing trips, as detailed in Table 3.3. These expenditures encompass fishing equipment and rentals, food and beverages purchased at restaurants or grocery stores, gas, lodging (hotel/motel/cabin/camping), and other transportation expenses. For instance, when anglers purchase fishing equipment, it stimulates economic activity in the retail sector. Retailers, in turn, may increase orders from wholesalers, who in response might expand production, creating a ripple effect throughout the economy that stimulates additional economic activity and employment.

Input-output (IO) analysis tracks these indirect effects and induced effects across the economy, resulting in multiplier effects. Multipliers can be described as follows:

- Direct effects (or direct expenditures) are the changes in the industries associated with anglers' fishing trips. This includes impacts from hotel/motel/cabin lodging, grocery purchases from local stores, restaurants, gasoline purchases, fishing equipment rentals, etc. (Table 3.3)
- Indirect effects are the changes in inter-industry purchases as they respond to the new demands

of the directly affected industries. The direct effect creates increases in economic activity for additional businesses in the region that support these direct industries.

- Induced effects are the increases in household income expenditures generated by the direct and indirect effects.
- Total economic contribution equals Direct effects + Indirect effects + Induced effect.
- Multiplier equals Total effect/Direct effect.

To estimate the local (e.g., Utah) industry output, labor income, and employment generated by fishing expenditures, the survey collected data on various types of angler expenditures such as food and beverage, lodging, transportation (e.g., gasoline purchases), angling equipment, and rentals (refer to Tables 3.1 and 3.3). Different economic sectors generate varying numbers of jobs per dollar of spending and have different multipliers. Our regional economic model, which computes direct, indirect, induced, and total effects, is based on models utilizing the IMPLAN (IMPLAN.com) framework, using industry relationships in 2020.

The economic contribution of angler expenditures to the Utah economy is substantial, as evidenced by the sector-wise breakdown presented in Table 3.5. Most of the economic effects were generated in retail sectors, particularly in food and beverage stores, gasoline stations, and recreation services such as lodging. These expenditures not only directly supported businesses but also generated additional economic activity by stimulating local service providers, such as restaurant and hotel employees. Overall, angling contributed a total industry output of $2.180 billion to the Utah economy, with a value-added (regional output) contribution of $1.25 billion. Angling also supported significant labor income, totaling $0.861 billion, and provided employment to over 17,800 individuals across various sectors. This is further supported by the fact that the $1.079 billion in direct expenditures (total direct expenditure in Table 3.3) made by anglers for Utah goods and services generated an additional $1.101 billion in economic output, resulting in a total output of $2.180 billion.

The output multiplier was 2.02, indicating that every dollar spent on fishing generated an additional $2.02 in total economic output. Among the sectors, retail food and beverage stores and gasoline stations showed the highest industry outputs, amounting to $185 million and $430 million,

Table 3.5: **Economic Contribution of Angling in Utah** (in millions of dollars)

| Sector | Industry output | Value-added | Labor income | Employment |
|---|---|---|---|---|
| | (millions of dollars) | | | (persons) |
| Agriculture | 3.39 | 1.41 | 0.98 | 38 |
| Mining | 1.95 | 0.92 | 0.29 | 4 |
| Utilities | 38.13 | 18.90 | 6.60 | 28 |
| Construction | 15.44 | 8.73 | 5.55 | 83 |
| Manufacturing | 31.47 | 9.57 | 4.92 | 62 |
| Wholesale | 53.89 | 29.41 | 16.14 | 167 |
| Retail | 53.69 | 33.36 | 20.42 | 463 |
| Retail - food & beverage | 184.53 | 103.48 | 82.58 | 2,318 |
| Retail - gasoline stores | 429.91 | 236.08 | 192.03 | 4,357 |
| Transportation | 34.36 | 18.41 | 15.68 | 247 |
| FIRES | 801.16 | 459.19 | 267.76 | 4,613 |
| Equipment rentals | 133.90 | 96.69 | 84.20 | 787 |
| Lodging | 241.17 | 154.95 | 104.89 | 2,767 |
| Restaurants | 129.04 | 56.50 | 38.10 | 1,646 |
| Government | 28.46 | 26.20 | 20.51 | 270 |
| Total | 2,180.49 | 1,253.78 | 860.65 | 17,848 |

FIRES = Finance, Insurance, Real estate, Education and Service sectors

respectively. These sectors also made significant contributions to value-added and employment. Furthermore, the lodging sector benefited considerably from angling, with an industry output of $241 million, reflecting the importance of overnight stays for anglers. Similarly, the restaurant sector saw an industry output of $129 million, highlighting the expenditure on food and beverages by anglers during their fishing trips.

The fiscal impacts of angling on the Utah economy are significant, as detailed in Table 3.6. State and local governments benefited from various revenue sources, including employee compensation, taxes on production and imports (primarily sales tax and property tax), and revenues from households and corporations. Employee compensation contributed $87 million to state and federal revenues, while proprietor income generated $7 million in federal revenues. Taxes on production and imports contributed a total of $219 million, with $105 million going to state and local governments and $115 million to federal revenues. Households contributed $101 million in total, with $23 million going to state and local revenues and $79 million to federal revenues. Corporations contributed $11 million in total, with $1.8 million going to state and local revenues and $9.6 million to federal revenues. Overall, angling in Utah generated a total of $426 million in fiscal revenues, with $129 million going to state and local governments and $297 million to federal revenues.

Table 3.6: **Fiscal Impacts of Angling in Utah**

| Description | State/local revenues | Federal revenues | Total |
|---|---|---|---|
| | million dollars | | |
| Employee compensation | 0.09 | 86.83 | 86.92 |
| Proprietor income | | 7.00 | 7.00 |
| Taxes on production and imports | 104.63 | 114.76 | 219.39 |
| Households | 22.74 | 78.67 | 101.41 |
| Corporations | 1.79 | 9.57 | 11.36 |
| Total | 129.24 | 296.84 | 426.08 |

1 Employee compensation includes social insurance tax (employee and employer contributions)
2 Proprietor income includes social insurance tax (employee contribution)
3 Tax on production and imports includes sales tax, property tax, motor vehicle license, severance tax, other taxes for state/local and excise taxes, custom duty, fed non-taxes for federal
4 Households include income tax, property tax and other tax (fish/hunt) for state/local and income tax for federal
5 Corporations include corporate profits tax.

### 3.5. Concluding Remark

The findings presented in this section underscore the significant economic contributions of angling to the Utah economy. Anglers' expenditures during fishing trips have a substantial impact, not only on the immediate communities where fishing occurs but also on the broader regional economy. With an average expenditure of $188 per fishing trip in 2023, anglers contribute significantly to various sectors, including retail, food and beverage, lodging, and transportation. This spending pattern supports local businesses and stimulates economic activity through a ripple effect across different sectors.

In Utah, angling supports substantial labor income, totaling $0.860 billion, and provides employment to over 17,800 individuals across various sectors. The total industry output attributed to angling amounts to $2.180 billion, highlighting the significant economic contribution of this recreational activity beyond direct expenditures. This industry output encompasses both direct spending and multiplier effects, underscoring the broad and far-reaching economic impact of angling on Utah's economy. Additionally, angling activities contribute a total of $426 million in fiscal revenues, highlighting the fiscal benefits associated with this recreational pursuit. These revenues support public services and infrastructure development, benefiting communities statewide.

These findings underscore the importance of angling to the Utah economy and provide valuable insights for policymakers, resource managers, and local businesses. By understanding the economic

impact of angling, stakeholders can make informed decisions to enhance economic development and promote sustainable natural resource management. Strategies may include infrastructure improvements at popular fishing spots, conservation efforts to preserve fish populations, and targeted marketing campaigns to attract more anglers to the state. These initiatives not only enhance recreational opportunities but also ensure the continued growth and prosperity of Utah's recreational fishing industry.

# Chapter 4. Preferred Fish Species among Utah Anglers

Zuyi Wang, Man-Keun Kim, and Mumtahinah Zia

The 2024 Statewide Utah Angler Survey – Blue Ribbon Fisheries included a question where respondents rated various fish species or groups using star ratings. Cutthroat trout emerged as the most preferred species, receiving an average rating of 3.94 stars (median = 4.5) with a relatively low standard deviation, indicating widespread preference among anglers. Other highly preferred species included rainbow trout, brook trout, brown trout, mountain whitefish, lake trout, splake, tiger trout, and kokanee salmon (fish groups 1, 2, 3, and 4), which had average ratings of 3.83, 3.94, 3.82, and 3.83 (median ratings of 4, 4.5, 4, and 4), respectively. Conversely, preferences varied significantly for other species, with star ratings below the mean and higher standard deviations. Boxplots illustrated strong preferences for groups 1, 2, 3, and 4, while group 10 received notably lower ratings.

## 4.1. Introduction

Understanding the factors contributing to angler satisfaction is crucial for effective recreational fisheries management. While high catch rates and large fish are generally preferred by anglers, the importance of these outcomes for satisfaction can vary across species and among different types of anglers (Beardmore et al., 2013). According to the most recent survey from the U.S. Fish and Wildlife Service's National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, the most popular game fish in the U.S. include black bass, panfish, trout, catfish, crappie, and white bass-striped bass hybrid (Zinke et al., 2018).

To better understand the preferences of Utah anglers, our survey asked respondents to rate their level of interest in each fish species or group of species by adding stars, as shown in Figure 4.1.

## 4.2. Survey Results - Preferred Fish Species

Figure 4.2 presents the mean star ratings and standard deviations for each fish species or group. Cutthroat trout (Group 2) emerged as the most preferred fish species among Utah anglers, with an average rating of 3.94 (median = 4.5) and a relatively small standard deviation (SD = 1.32). Alongside cutthroat trout (Group 2), Groups 1, 3, and 4—which include rainbow trout, brook trout,

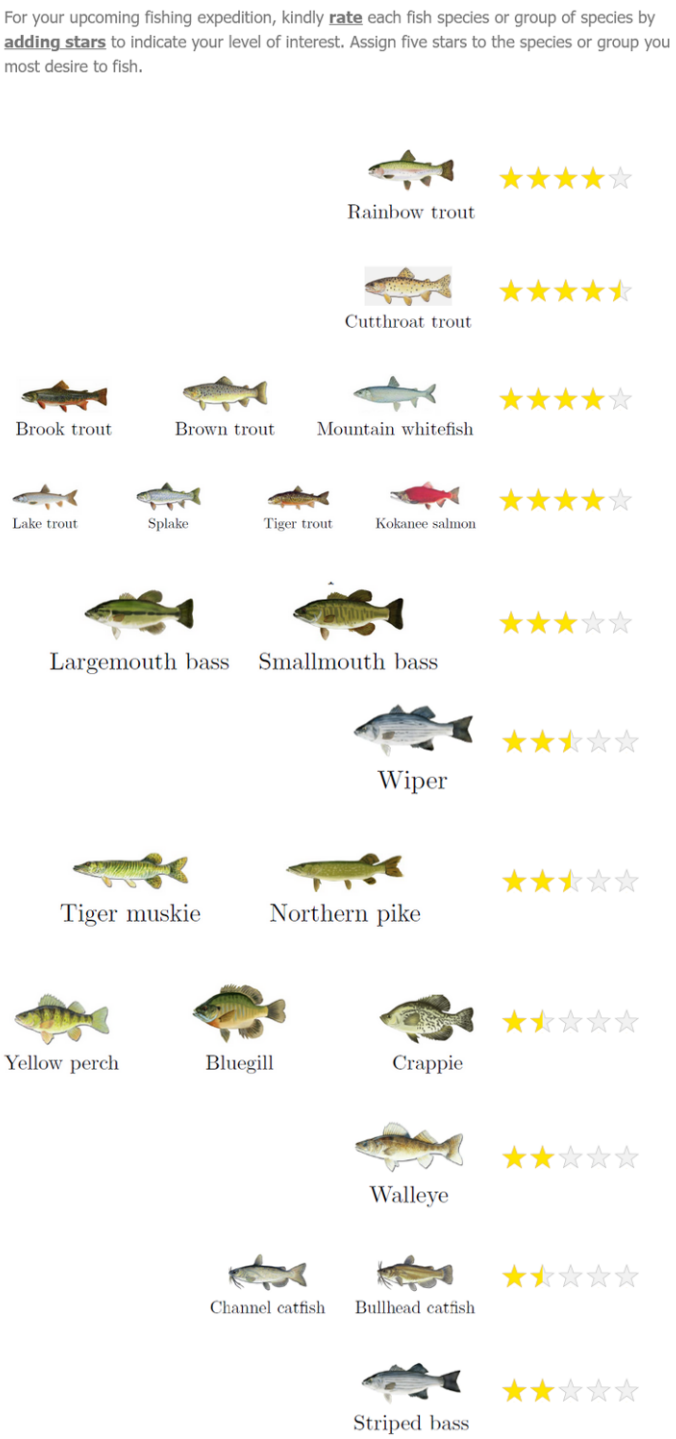



Figure 4.1: **Utah Angler Preferences: Fish Species Rating Questionnaire**

brown trout, mountain whitefish, lake trout, splake, tiger trout, and kokanee salmon—also showed high preference, with average ratings of 3.83, 3.82, and 3.83, respectively (median ratings are all 4). The star ratings for these four groups are statistically similar. However, Groups 5, 6, 7, 8, 9, and

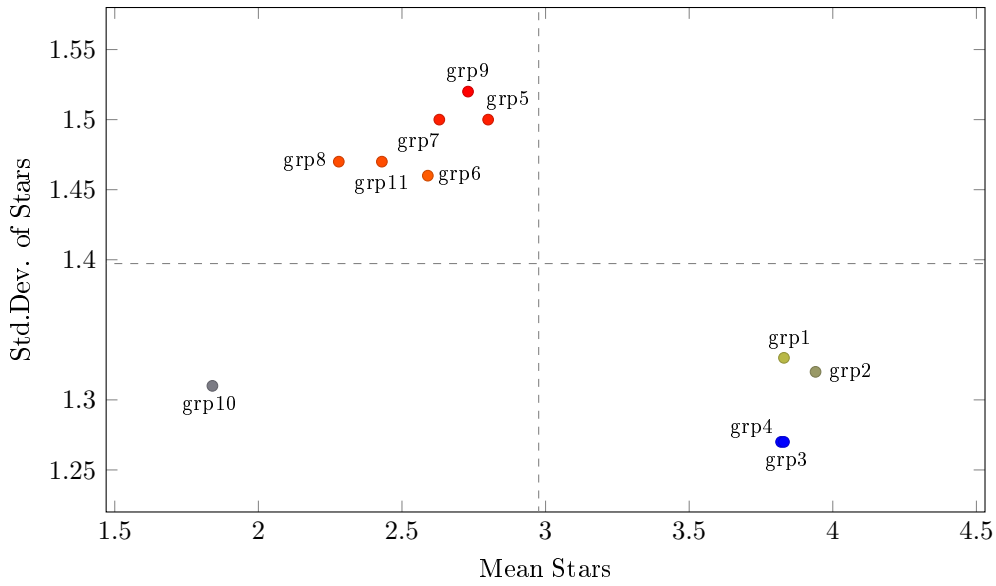



Figure 4.2: **Preferred Fish Species: Mean Star Score and its Standard Deviation**
Note: Grp 1: Rainbow trout, Grp2: Cutthroat trout, Grp3: Brook trout, Brown trout, Mountain whitefish, Grp4: Lake trout, Splake, Tiger trout, Kokanee salmon, Grp5: Largemouth bass, Smallmouth bass, Grp6: Wiper, Grp7: Tiger muskie, Northern pike, Grp8: Yellow perch, Bluegill, Crappie, Grp9: Walleye, Grp10: Channel catfish, Bullhead catfish, Grp11: Striped bass

11 received lower ratings with relatively high standard deviations, indicating diverse preferences among anglers for these fish species.

Figure 4.3 presents boxplots displaying the distribution of star ratings for each fish species or group. The black dots represent the frequency, and the red dots indicate the mean star ratings. The thick bar in the middle of each box represents the median rating. Groups 1, 2, 3, and 4 are preferred, as evidenced by the high number of 5-star ratings, while Group 10 is less preferred, with many anglers giving it a 1-star rating.

### 4.3. Analysis of Variance

This section provides the results of the analysis of variance (ANOVA) conducted to assess whether there were statistically significant differences in the mean ratings among different fish species or groups. The ANOVA results, presented in Table 4.1, indicate a significant difference among the groups, suggesting substantial variations in the mean ratings. The large F-value suggests that the differences between group means are larger than what would be expected by random chance alone. With a p-value of less than 1%, these differences are unlikely to be due to sampling vari-

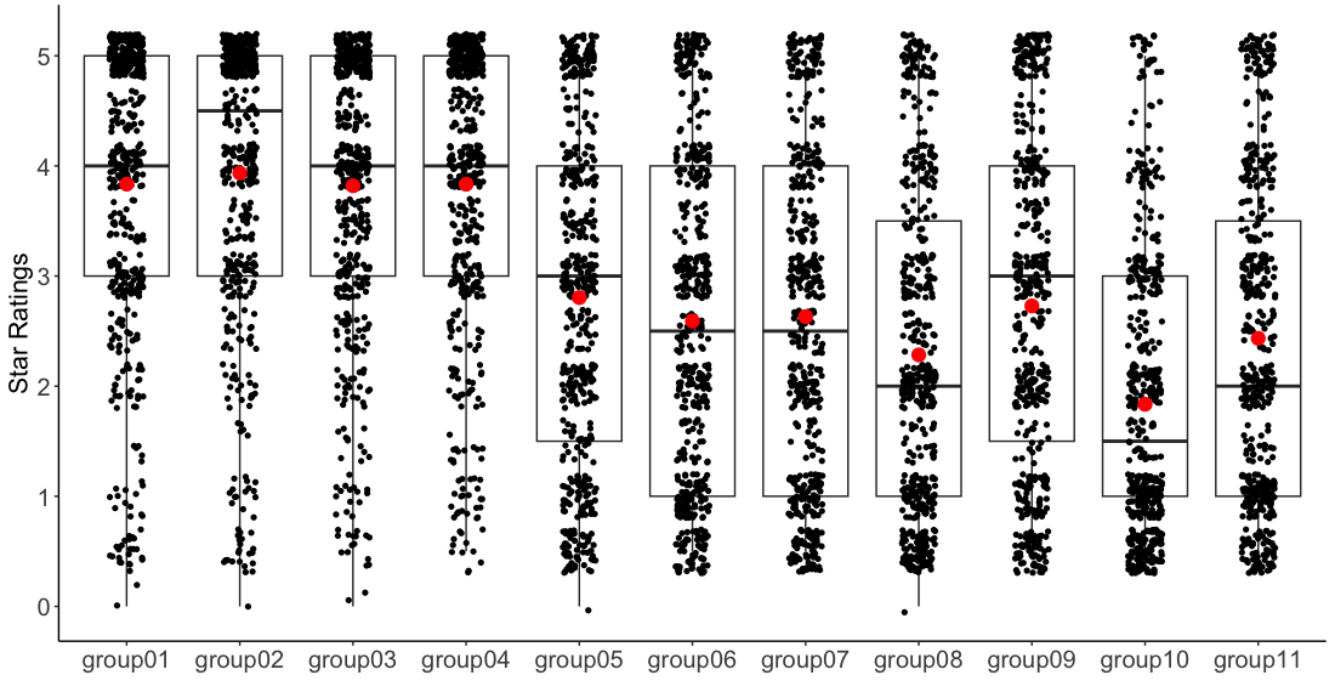



Figure 4.3: **Preferred Fish Species: Box Plots**

Note 1: Grp 1: Rainbow trout, Grp2: Cutthroat trout, Grp3: Brook trout, Brown trout, Mountain whitefish, Grp4: Lake trout, Splake, Tiger trout, Kokanee salmon, Grp5: Largemouth bass, Smallmouth bass, Grp6: Wiper, Grp7: Tiger muskie, Northern pike, Grp8: Yellow perch, Bluegill, Crappie, Grp9: Walleye, Grp10: Channel catfish, Bullhead catfish, Grp11: Striped bass
Note 2: The red dot represents the mean (average) of the data set. The horizontal bar inside the box represents the median of the data set. The length of the box represents the interquartile range (IQR), which is the range within which the middle 50% of the data lies. The IQR is calculated as the difference between the third quartile (Q3) and the first quartile (Q1).

ability. Therefore, we reject the null hypothesis, concluding that there are significant differences in preference among the fish species or groups. Table 4.2 presents mean differences between groups with statistical significance. A star above the mean difference indicates that they are statistically different; otherwise, the groups are not distinguishable statistically.

Cutthroat trout (group 2) had significantly higher ratings compared to all other groups (mean differences are all negative in the Group 2 column). Rainbow trout, brook trout, brown trout, mountain whitefish, lake trout, splake, tiger trout, and kokanee salmon (groups 1, 3, and 4) also had high ratings, with no statistically significant differences among them.

In short, based on the pairwise comparison in Table 4.2, the fish species or groups can be categorized into three groups based on the statistical significance of their differences in mean ratings, as discussed in Figure 4.2 earlier.

Table 4.1: **ANOVA Results for Preferred Fish Groups**

| Source | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|---|---|---|---|---|---|
| Group | 10 | 2829 | 282.90 | 143.3 | 0.000 |
| Residuals | 5610 | 11075 | 1.97 | | |
| Total | 5620 | 13904 | | | |

- Group 1 includes Cutthroat trout (group 2) as well as Rainbow trout, Brook trout, Brown trout, Mountain whitefish, Lake trout, Splake, Tiger trout, and Kokanee salmon (groups 1, 3, and 4).
- Group 2 includes groups 5,6,7,8,9 and 11
- Group 3 include group 10, channel catfish and bullhead catfish, which is less preferred.

Table 4.2: **Pairwise Comparison with ANOVA for Preferred Fish Groups**

| | Group1 | Group2 | Group3 | Group4 | Group5 | Group6 | Group7 | Group8 | Group9 | Group10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Group2 | 0.10 | | | | | | | | | |
| Group3 | -0.01 | -0.12 | | | | | | | | |
| Group4 | -0.00 | -0.10 | -0.01 | | | | | | | |
| Group5 | -1.03$^{***}$ | -1.13$^{***}$ | -1.02$^{***}$ | -1.03$^{***}$ | | | | | | |
| Group6 | -1.24$^{***}$ | -1.34$^{***}$ | -1.23$^{***}$ | -1.24$^{***}$ | -0.21 | | | | | |
| Group7 | -1.20$^{***}$ | -1.30$^{***}$ | -1.19$^{***}$ | -1.20$^{***}$ | -0.17 | 0.04 | | | | |
| Group8 | -1.55$^{***}$ | -1.65$^{***}$ | -1.54$^{***}$ | -1.55$^{***}$ | -0.52$^{***}$ | -0.31$^{**}$ | -0.35$^{***}$ | | | |
| Group9 | -1.11$^{***}$ | -1.20$^{***}$ | -1.09$^{***}$ | -1.10$^{***}$ | -0.08 | 0.14 | 0.10 | 0.45$^{***}$ | | |
| Group10 | -2.00$^{***}$ | -2.10$^{***}$ | -1.98$^{***}$ | -2.00$^{***}$ | -0.97$^{***}$ | -0.76$^{***}$ | -0.79$^{***}$ | -0.45$^{***}$ | -0.89$^{***}$ | |
| Group11 | -1.40$^{***}$ | -1.50$^{***}$ | -1.39$^{***}$ | -1.40$^{***}$ | -0.37$^{**}$ | -0.16 | -0.20 | 0.15 | -0.29$^{**}$ | 0.60$^{***}$ |

Based on pairwise comparison we can group fish groups to three stiatiscally different groups. Most preferred group = {Group1, Group2, Group3, Group4 } Gropu 2 =Group 5, Group 6, Group 7

# Chapter 5. Best-Worst Scaling to Explore Key Attributes Influencing Fishing Site Selection

Mumtahinah Zia, Man-Keun Kim, and Zuyi Wang

This chapter examines angler preferences for fishing site attributes using Best-Worst Scaling (BWS) and cluster analysis. Based on responses from 395 survey participants, attributes such as *Catching a large number of fish* and *Enjoying scenery and nature, viewing wildlife* emerged as the most preferred. Analysis of the mean and standard deviation of Best-Worst scores (difference between the best and worst frequency) revealed significant variability in preferences among respondents. Utilizing the k-means algorithm, cluster analysis categorized anglers into two clusters based on their preferences, offering insights into diverse preferences and facilitating targeted resource management and marketing strategies. Cluster 1 demonstrates a strong environmental consciousness and prioritizes the overall quality of the fishing experience, including environmental considerations and avoiding overcrowding at fisheries. In contrast, Cluster 2 places greater emphasis on the fishing experience itself, particularly on catching a large number of fish and landing trophy-sized catches.

## 5.1. Introduction

To explore the key attributes influencing fishing site selection among anglers in Utah, we employed Best-Worst Scaling (BWS), a survey method used to assess individuals' relative preferences for items (Finn and Louviere, 1992; Aizaki et al., 2015). BWS has gained popularity as a preference elicitation method across various research fields (Loose and Lockshin, 2013), offering advantages over traditional rating scales by avoiding scale bias (Soutar et al., 2015). In our survey, respondents used BWS to indicate their most and least preferred attributes when choosing a fishing site.

In the Blue Ribbon Fisheries survey, anglers were asked to identify the most and least important fishing characteristics influencing their decision to visit specific fisheries. The survey comprised 15 questions, each presenting 4 attributes, as illustrated in Table 5.1. While the number of attributes remained consistent, the specific combinations varied across questions. The 10 attributes were selected based on consultations with angling experts and are listed below:

- Availability of dock or boat launch
- Bag limit

Table 5.1: **An Example Question in Best-Worst Choice Set for Fishing Site Selection**

| Most | Fishing site attributes | Least |
|---|---|---|
| ◯ | Enjoying scenery and nature, viewing wildlife | ◯ |
| ◯ | Catching large number of fish | ◯ |
| ◯ | Crowding at the fishery | ◯ |
| ◯ | Catching trophy sized fish | ◯ |

In the survey, respondents were asked to specify the most and least important fishing characteristics influencing their decision to embark on a fishing trip to the fishery. There are a total of 15 questions, each featuring 4 items as listed in the example in Table 5.1.

- Catching large number of fish
- Catching trophy-sized fish
- Crowding at the fishery (number of anglers at the fishery)
- Distance from home
- Enjoying scenery and nature, viewing wildlife
- Other recreational possibilities such as camping, biking, or group activities
- Visitor service, information center, and
- Water quality

The responses from the BWS questions also help identify potential distinct groups among anglers, revealing heterogeneity in preferences between these groups. By analyzing the BWS survey responses, we assessed whether there is variability among respondents regarding the importance they assign to different fishing characteristics. This analysis aims to uncover if there are multiple segments of anglers with divergent preferences. Understanding these differences is crucial for informing policy implications, as various groups may respond differently to the same policy measures. Therefore, policies and initiatives should be carefully crafted to ensure equitable outcomes across all angler segments.

This chapter has two objectives:

- Investigating the most and least important fishing site attributes for site selection by anglers using Best-Worst Scaling (BWS) and
- Examining any heterogeneity in the responses of the anglers to understand potential significant differences between distinct groups of anglers.

To achieve our objectives, we conducted a comprehensive online survey using the `Qualtrics` platform from February to May 2024 to collect data from Utah anglers. For further details on the survey methodology and socio-demographic characteristics of respondents, please see Chapter 2: 2024 Statewide Utah Angler Survey.

### 5.2. Statistical Analysis

There are two approaches for analyzing responses to BWS questions: a counting approach and a modeling approach (Aizaki et al., 2015).

In the counting approach, we calculate frequency counts for the number of times each attribute was chosen as the most and least important across the series of choice sets presented to each respondent. Additionally, we calculate a standardized score for each attribute. This score is calculated as the difference between the frequency of being chosen as most important and least important, divided by the total number of times the attribute was presented to the respondent. The counting approach yields several types of scores based on the frequency with which each attribute is selected as most important ($B_i$) and least important ($W_i$) across all choice sets for each respondent. These scores can be disaggregated (individual-level) or aggregated (total-level) (Finn and Louviere, 1992; Louviere et al., 2008, 2013).

The first category includes a disaggregated BW score and its standardized score:

- Disaggregated BW Score ($BW_{ij} = B_{ij} - W_{ij}$): The difference between the frequency of being chosen as most important ($B_{ij}$) and least important ($W_{ij}$) for each attribute, where $i$ indicates fishing site attributes and $j$ indicates respondents.
- Standardized BW Score: Calculated as the difference between the frequency of being chosen as most important and least important ($B_{ij} - W_{ij}$), divided by the total number of times the attribute was presented to the respondent, (std.$BW_{ij} = \frac{BW_{ij}}{r}$).

The maximum value of disaggregated BW score is $+r$, where $r$ is the number of times attributes $i$ appears in all the question. In the Blue Ribbon Fisheries (BRF) survey, each attribute appears six times, so the maximum $BW_{ij}$ will be +6.This occurs when the respondent selects the item as the best in all the questions where it's presented. Conversely, the minimum value of $BW_{ij}$ is $-6$, which happens when the respondent chooses the item as the worst in all the questions where it's

presented. When the respondent selects the item as the best and worst with the same frequency or doesn't choose it as either, the $BW_{ij}$ value is zero. The standardized BW score ranges from $-1$ to $+1$, making it easy to understand.

Aggregated scores, the second category of scores, are useful for interpreting "trends" in the responses of all respondents. The frequency with which item $i$ is selected as the best in all the questions for all the respondents is denoted as $B_i$, and that with which item $i$ is selected as the worst is denoted as $W_i$ (i.e., $B_i = \sum_j B_{ij}$, $W_i = \sum_j W_{ij}$). The aggregated versions of BW scores and its standardized score are defined as:

- Aggregated BW score: $BW_i = B_i - W_i = \sum_j B_{ij} - \sum_j W_{ij}$.
- Standardized BW score or average BW score: $\text{std.}BW_i = \frac{BW_i}{Nr}$, where $N$ is the number of respondents.

We also introduce two additional metrics, sqrt.BW and std.sqrt.BW. The sqrt.BW is calculated as the square root of the ratio of the number of times an attribute is chosen as the most preferred to the number of times it is chosen as the least preferred, that is, $\text{sqrt.}BW_i = \sqrt{\frac{B_i}{W_i}}$. If sqrt.BW $= 1$, then the number of times that respondents selected the attribute as most important and the number of times that it was not important were the same. If sqrt.BW $> 1$, then the number of times that respondents selected the attribute as most important is greater than the number of times that respondents selected the attribute as least important. On the other hand, if sqrt.BW $<$ 1, then the number of times that respondents chose the attribute as least important was greater than the number of times those respondents selected the attribute as most important. In std.sqrt.BW, the first-priority attribute has a value of 1, and other attributes have a value less than 1. The std.sqrt.BW is calculated as sqrt.BW divided by the maximum sqrt.BW value observed in the dataset, or $\text{std.sqrt.}BW_i = \frac{\text{sqrt.}BW_i}{\max \text{sqrt.}BW_i}$. These metrics are useful for understanding the relative importance among attributes.

Understanding the diverse preferences of anglers is essential for effective resource management and marketing strategies. To uncover underlying patterns in angler preferences, we examine both the mean BW score and its standard deviation. A higher mean BW score indicates a more preferred fishing site attribute, while a larger standard deviation suggests diversity in preferences among anglers, with some favoring the attribute and others opposing it. To gain deeper insights, we employ

cluster analysis, a machine learning technique. Cluster analysis helps identify natural groupings or clusters within a dataset by grouping similar observations together and dissimilar ones apart.

One widely used method for cluster analysis is k-means clustering (Lloyd, 1982). In k-means clustering, the algorithm divides the dataset into a predefined number of clusters, each represented by its centroid. The algorithm assigns data points to the nearest cluster centroid based on a distance measure, typically using Euclidean distance. This iterative process continues until the centroids stabilize, indicating convergence. The resulting clusters consist of data points that are similar to each other within the cluster and dissimilar to those in other clusters. By identifying these clusters, we can gain insights into the diverse preferences among anglers and understand the distinguishing characteristics of each cluster. We employ the `kmeans` algorithm in R to conduct this analysis.

### 5.3. Results

The results of the BWS analysis offer valuable insights into the preferences of Utah anglers and the attributes they prioritize when selecting fishing sites. This section presents the findings from the BRF survey, highlighting the most and least important fishing site attributes as identified by the respondents. Additionally, we delve into the heterogeneity of responses to uncover potential significant differences between distinct groups of anglers.

#### *5.3.1. Aggregated Best-Worst Scores*

Table 5.2 presents the results from the counting approach. Column B indicates the total number of times a specific attribute was chosen as the most preferred fishing site attribute by all respondents. From the table, we observe that *Catching a large number of fish* was selected 1,222 times as the most preferred fishing attribute by 438 respondents, which is the highest frequency among all attributes. The second most frequently chosen most important fishing site attribute is *Catching trophy-sized fish*, followed by *Crowding at the fishery* and *Enjoying scenery and nature, viewing wildlife*, respectively. *Visitor service information center* was chosen the least number of times as the most preferred fishing site attribute by all respondents.

Column W shows the total number of times each fishing site attribute was chosen as the least preferred criterion by all respondents. It is evident from the scores that *Visitor service information*

Table 5.2: **Aggregated Best-Worst Scores**

| Fishing site attributes | B | W | BW | std.BW | sqrt.BW | std.sqrt.BW |
|---|---|---|---|---|---|---|
| Availability of dock or boat launch | 330 | 1,042 | -712 | -0.27 | 0.56 | 0.22 |
| Bag limit | 204 | 962 | -758 | -0.29 | 0.46 | 0.18 |
| Catching large number of fish | 1,222 | 224 | 998 | 0.38 | 2.34 | 0.92 |
| Catching trophy sized fish | 1,133 | 495 | 638 | 0.24 | 1.51 | 0.60 |
| Crowding at the fishery | 1,037 | 281 | 756 | 0.29 | 1.92 | 0.76 |
| Distance from home | 617 | 412 | 205 | 0.08 | 1.22 | 0.48 |
| Enjoying scenery and nature, viewing wildlife | 956 | 149 | 807 | 0.31 | 2.53 | 1.00 |
| Other recreational possibilities | 362 | 843 | -481 | -0.18 | 0.66 | 0.26 |
| Visitor service, information center | 7 | 1,924 | -1,917 | -0.73 | 0.06 | 0.02 |
| Water quality | 702 | 238 | 464 | 0.18 | 1.72 | 0.68 |

Note: Aggregated BW scores are constructed based on the responses of 438 respondents who completed all the BWS questions.

*center* was chosen as the least preferred fishing site attribute the highest number of times, 1,924. The second highest number of times a fishing site attribute was chosen as the least preferred is *Availability of dock or boat launch*, selected 1,042 times.

Column BW indicates the difference between B and W, where $BW_i = B_i - W_i$, and the std.BW column reports the average BW scores. We visualize the std.BW scores from Table 5.2 in Figure 5.1, which range between $-1$ and $+1$, to illustrate the relative importance of different fishing site attributes. In Figure 5.1, the std.BW scores are sorted from the most preferred to the least preferred fishing site attributes. A positive std.BW score indicates that the fishing site attribute is preferred, while a negative score indicates the opposite. A score close to $+1$ suggests that the fishing site attribute is highly preferred, whereas a score close to -1 indicates that the attribute is least preferred. This visualization offers a clear understanding of the relative importance of each fishing site attribute based on the survey participants' responses.

The values of sqrt.BW and std.sqrt.BW in Table 5.2 provide further insights into the relative importance of different fishing site attributes. The sqrt.BW scores, ranging from 0.06 to 2.53, offer a comparative measure of respondents' preferences for each attribute. For instance, *Enjoying scenery and nature, viewing wildlife* has the highest sqrt.BW score of 2.53, indicating that respondents preferred this attribute over others. Conversely, *Visitor service, information center* has the lowest sqrt.BW score of 0.06, suggesting that it was the least preferred attribute among the respondents.

The std.sqrt.BW scores standardize the sqrt.BW values to facilitate easier interpretation and comparison. Ranging from 0.02 to 1.000, std.sqrt.BW offers a more nuanced understanding of

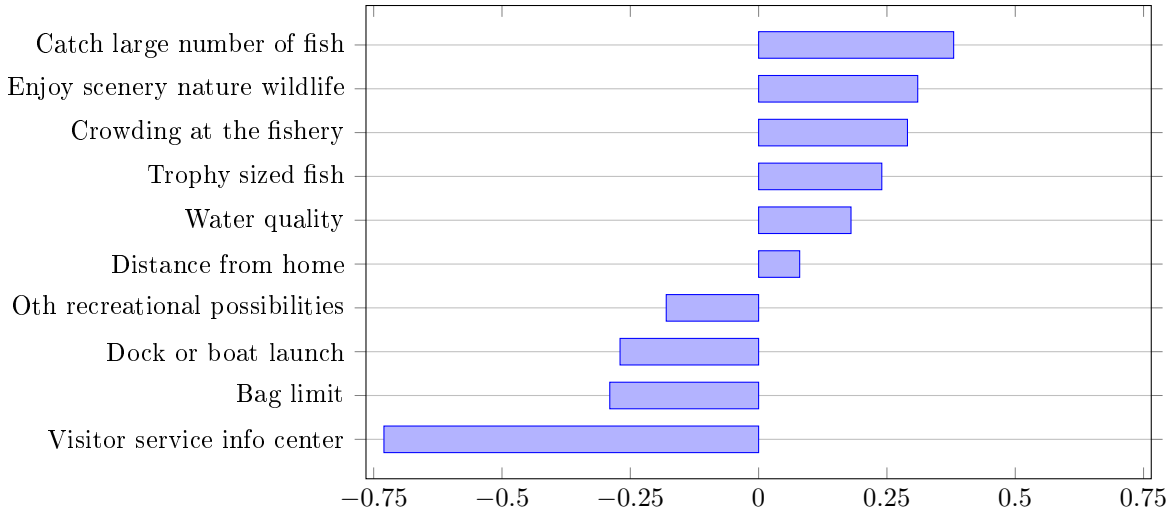



Figure 5.1: **Standardized BW scores for Fishing Site Selection**

Note: The standardized BW scores are constructed based on the responses of 438 respondents who completed all the BWS questions. These scores range from $-1$ to $+1$. A score of $+1$ indicates that the respondent selected the item as the best in *all* the questions where it's presented, while a score of $-1$ indicates that the respondent chose the item as the worst in all the questions where it's presented. A score of zero indicates that the respondent selected the item as the best and worst with the same frequency, or didn't choose it as either.

attribute importance. A score close to 1 indicates higher relative importance, while closer to 0 suggests lower relative importance. For instance, *Enjoying scenery and nature, viewing wildlife* has the highest std.sqrt.BW score of 1.000, making it the most important attribute. Conversely, *Visitor service, information center* has the lowest std.sqrt.BW score of 0.02, indicating its low importance. As an example, the std.sqrt.BW for *Distance from home* is 0.48, implying that *Enjoying scenery and nature, viewing wildlife* is approximately twice as important as *Distance from home* ($\frac{1.000}{0.48} \approx 2.08$).

The rankings based on std.BW and std.sqrt.BW scores provide complementary insights into the relative importance of different fishing site attributes. While std.BW scores offer a direct measure of the respondents' preferences, std.sqrt.BW scores standardize these values to facilitate easier interpretation and comparison. Comparing the rankings based on std.BW and std.sqrt.BW scores, we observe some similarities and differences. Attributes with higher std.sqrt.BW scores are generally ranked higher in terms of importance, indicating a stronger preference among respondents. For example, *Enjoying scenery and nature, viewing wildlife* and *Catching a large number of fish* consistently have high rankings in both std.BW and std.sqrt.BW measures.

However, some differences in rankings may also emerge. Attributes with relatively low std.BW

scores but higher std.sqrt.BW scores indicate that while they may not be the most frequently chosen attributes, they are highly preferred when considered relative to the other attributes. For instance, *Water quality* and *Avoiding crowding at the fishery* may have lower frequencies in terms of being selected as the most preferred attributes (as indicated by std.BW scores), but they rank higher in terms of relative importance (as indicated by std.sqrt.BW scores).

Overall, by examining both std.BW and std.sqrt.BW scores, policymakers and fisheries managers can gain a comprehensive understanding of the attributes that are most important to anglers. These insights can inform decision-making processes related to site management and resource allocation, ensuring that the preferences of anglers are effectively addressed.

### *5.3.2. Heterogeneity of Preference*

The disaggregated best-worst scores provide valuable insights into the heterogeneity of preferences among survey respondents. By examining the mean and standard deviation of the disaggregated BW scores for each fishing site attribute, we can identify the variability in preferences across the respondent population as visualized in Figure 5.2. Attributes with higher mean BW scores (Mean.BW) and lower standard deviations (Std.Dev.BW) indicate more consistent preferences among respondents. For instance, attributes like *Catching a large number of fish*, *Enjoying scenery and nature, viewing wildlife*, and *Crowding at the fishery* have relatively high mean BW scores with relatively lower standard deviations, suggesting broad agreement among respondents regarding their importance.

On the other hand, attributes with higher standard deviations indicate more diverse preferences among respondents. For example, *Catching trophy-sized fish* has a relatively large Std.Dev.BW, indicating heterogeneity in this attribute. Even though it has a positive mean BW, suggesting that it is a preferred attribute, anglers show diversity in their preferences for this attribute. Some anglers place more emphasis on trophy-sized fish, while others do not. Overall, *Visitor service information center* is chosen as the least preferred fishing site attribute, while *Enjoying scenery and nature, viewing wildlife* and *Catching a large number of fish* are chosen as the most preferred fishing site attributes.

Understanding this heterogeneity in preferences is crucial for policymakers and fisheries managers when making decisions related to resource allocation and site management. By considering

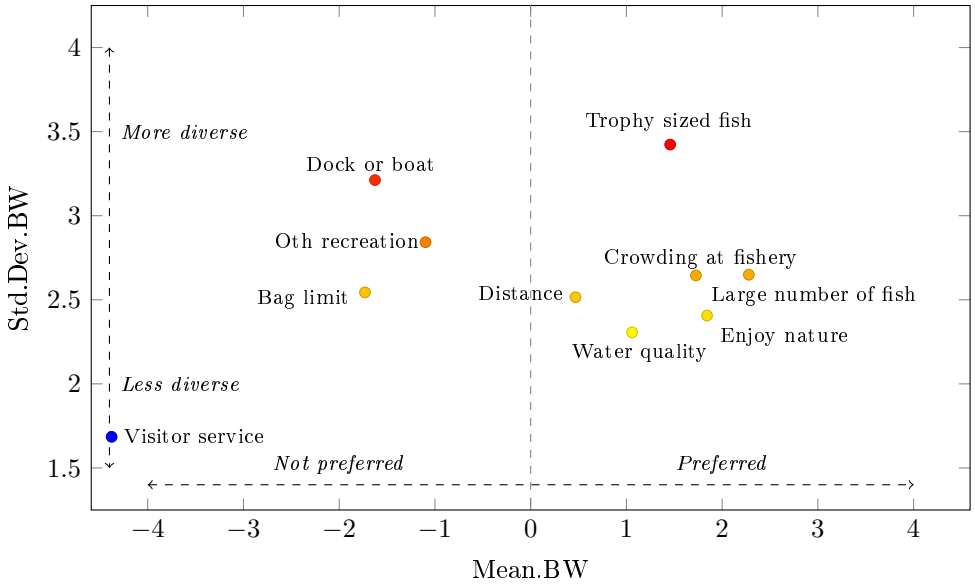



Figure 5.2: **Relationship between the Mean BW score and its Standard Deviation**
Note: By examining the mean and standard deviation of the disaggregated BW scores for each fishing site attribute, we can identify the variability in preferences across the respondent population. Attributes with higher mean BW scores (Mean.BW) and lower standard deviations (Std.Dev.BW) indicate more consistent preferences among respondents such as *Enjoying scenery and nature, viewing wildlife*. Attributes with higher standard deviations indicate more diverse preferences among respondents. For example, *Catching trophy-sized fish* has a relatively large Std.Dev.BW, indicating heterogeneity in this attribute.

the variability in preferences, they can tailor management strategies to better meet the diverse needs of anglers and ensure the sustainability and attractiveness of fishing sites.

### 5.4. Cluster Analysis

With the `kmeans` algorithm in R, we performed k-means clustering to divide anglers into two groups based on their preferences for fishing site attributes. For example, consider a dataset containing angler preferences for various fishing site attributes such as *Catching a large number of fish*, *Enjoying scenery and nature, viewing wildlife*, and *Avoiding crowding at the fishery*. Using k-means clustering, we grouped anglers based on similarities in their preferences for these attributes. This clustering provides insights into the diverse preferences among anglers, allowing for tailored resource management and marketing strategies. Figure 5.3 illustrates the results, depicting two distinct groups of anglers identified through the clustering process.

From Figure 5.3 we observe:

- Cluster 1 shows a strong preference for attributes such as

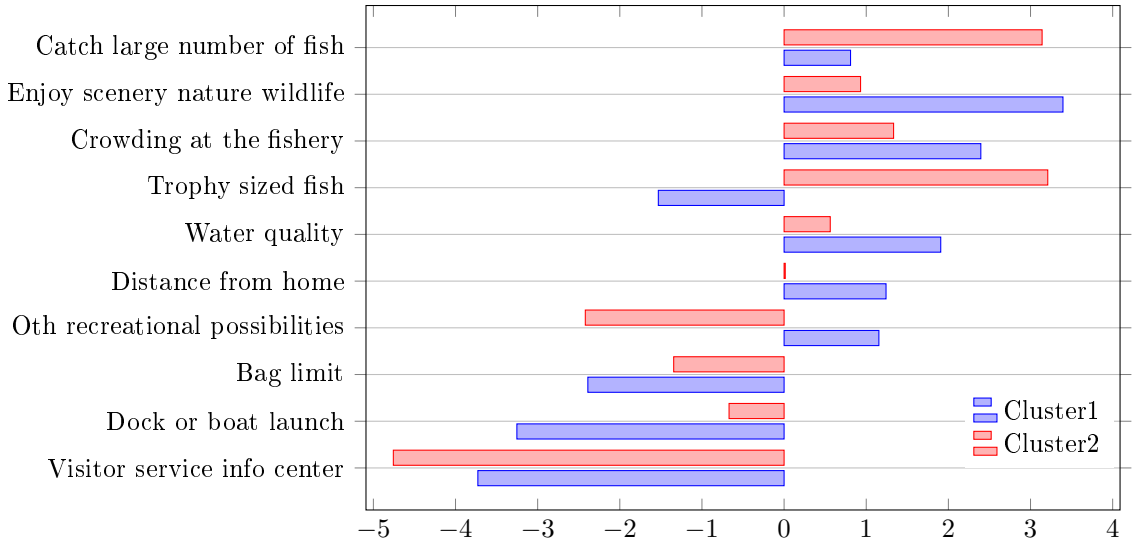



Figure 5.3: **Mean BW Scores with Two Angler Clusters**

Note: The figure illustrates the mean BW scores with two clusters of anglers identified using k-means clustering. Cluster 1 exhibits a strong preference for attributes related to *enjoying scenery and nature*, *water quality*, and the *crowding at the fishery*. In contrast, Cluster 2 prioritizes attributes associated with *catching a large number of fish* and *catching trophy-sized fish*.

  - Enjoying scenery and nature, viewing wildlife
  - Water quality
  - Avoiding crowded fisheries

- Anglers in cluster 2 have a different set of preferences compared to cluster 1. They highly prioritize
  - Catching a large number of fish
  - Catching trophy-sized fish

## 5.5. Conclusion

This chapter delves into angler preferences for fishing site attributes using Best-Worst Scaling (BWS) and cluster analysis. Based on responses from 395 survey participants, attributes such as *Catching a large number of fish* and *Enjoying scenery and nature, viewing wildlife* emerged as the most preferred. Analysis of the mean and standard deviation of disaggregated BW scores revealed significant diversity in preferences among respondents. Cluster analysis employing the k-means algorithm classified anglers into two distinct groups based on their preferences. Cluster 1 shows a strong inclination towards environmental consciousness and emphasizes the overall quality of the fishing experience, prioritizing factors like natural environment preservation and *avoiding overcrowding at*

*fisheries*. In contrast, Cluster 2 places greater importance on the fishing outcomes itself, focusing on *catching a large number of fish* and *catching trophy-sized fish*.

Understanding these nuanced preferences is pivotal for effective fishery management. Tailoring strategies to meet the specific needs of each cluster can enhance angler satisfaction and potentially boost participation in fishing activities. For example, initiatives aimed at preserving natural scenery and wildlife may attract environmentally conscious anglers, while strategies ensuring ample fish stocks and opportunities for trophy-sized fish catches could appeal more to those focused on the fishing experience. By aligning resource management and marketing strategies with these distinct preferences, managers can optimize the overall fishing experience, promote sustainable practices, and conserve natural resources effectively for both clusters of anglers.

# Chapter 6. Net Economic Value of Blue Ribbon Fisheries

Zuyi Wang and Man-Keun Kim

The conditional logit models applied to the 2024 Utah Angler Survey reveal that anglers prioritize sites designated as Blue Ribbon Fisheries (BRF), which signify higher quality, and are sensitive to additional costs. Specific fish species such as rainbow trout and kokanee salmon exert significant influence on site preferences, with anglers demonstrating a willingness to pay over $140 more for sites where these species are prevalent. The interactions observed between cost and BRF designation underscore the complexity of factors shaping anglers' decisions. Furthermore, significant coefficients for the BRF attribute indicate anglers' readiness to pay a premium for BRF sites known for exceptional fishing conditions, with a willingness to pay estimated at approximately $15.

## 6.1. Introduction

When assessing the significance of angling in Utah, it is crucial to distinguish between economic impact and economic value. Economic impact measures the direct and indirect financial contributions that angling activities make to local and regional economies, including job creation, income generation, and business revenue. For a detailed exploration of these contributions, refer to Chapter 3: Angler Expenditures and Their Local Economic Impact in Utah.

In contrast, economic value encompasses the broader benefits that anglers derive from angling, such as recreational enjoyment, environmental quality, and enhanced biodiversity[1]. To quantify the economic value of BRF, we utilize a choice experiment methodology. This approach allows us to estimate anglers' willingness to pay (WTP) for various attributes of fishing sites, thereby providing a comprehensive measure of the value these fisheries offer beyond mere economic transactions. Through this method, we gain insights into the preferences and priorities of anglers, which can inform better management and conservation strategies for BRF in Utah.

[1]Net economic value reflects the difference between what an angler is willing to pay for a fishing trip and what they actually pay. For example, if an angler is willing to pay $150 but only pays $100, the net economic value is $50. This concept, also known as consumer surplus, highlights the benefits of high-quality recreational experiences. To illustrate, consider two fisheries: one is a regular fishing site, and the other is a Blue Ribbon Fishery (BRF) known for its exceptional quality. If the cost to visit either site is the same (say, $100), an angler is likely to enjoy a greater economic benefit from the BRF due to its superior fishing conditions. Therefore, net economic value is crucial in measuring the benefits of recreational quality, as it captures the additional value anglers derive from higher quality fishing experiences.

Understanding the economic value provided by different fisheries across the state enables decision-makers to allocate resources more efficiently, ensuring the highest return on investment. For a detailed review of how to measure the net economic value of changes in recreational site quality, see Bowker et al. (2005).

### 6.2. Bidding Games for Eliciting Willingness to Pay

There are various methods used to assess willingness to pay (WTP), such as open-ended questions, bidding games, payment cards, and more (Atkinson et al., 2021). Choice experiments are highly regarded for their robustness in capturing complex preferences, yet bidding games also hold merit in specific contexts. The bidding game, prevalent in the 1970s and 1980s (Atkinson et al., 2021), invovles an interactive process where an investigator proposes a WTP value that the respondent can accept or decline. Subsequent offers are adjusted based on the respondent's previous responses, aiming to encourage thoughtful consideration of preferences (Atkinson et al., 2021; Frew et al., 2004). However, drawbacks include potential anchoring bias where initial bids influence subsequent responses, and a tendency towards "yea-saying" to avoid refusal.

In contrast to choice experiments, which are discussed in the next section and provide detailed insights by analyzing trade-offs between different attributes, the bidding game offers a straightforward approach that is accessible even to participants unfamiliar with more complex methodologies. This accessibility ensures accurate WTP estimates and directly reveals distribution details, such as instances where anglers indicate zero or low willingness to pay (WTP). This visibility into WTP distribution, including dissatisfaction with current fishing experiences, may not be as evident in choice experiments. By employing both methods, researchers can cross-validate results, thereby enhancing the comprehensive understanding of WTP from diverse perspectives.

Figure 6.1 displays a histogram and box plot based on 424 responses illustrating WTP from the bidding game. The histogram depicts the distribution of WTP, highlighting that the majority of bids cluster around lower values, with a noticeable decline as bid amounts increase. Specifically, 47 respondents (approximately 11%) indicated a WTP of \$0, suggesting dissatisfaction with their current angling experiences. About 30% of respondents indicated a WTP less than \$50, which was the initial bid amount. These findings underscore significant preferences among anglers, revealing that a substantial proportion (about 41%), including those with a WTP of \$0, may not continue

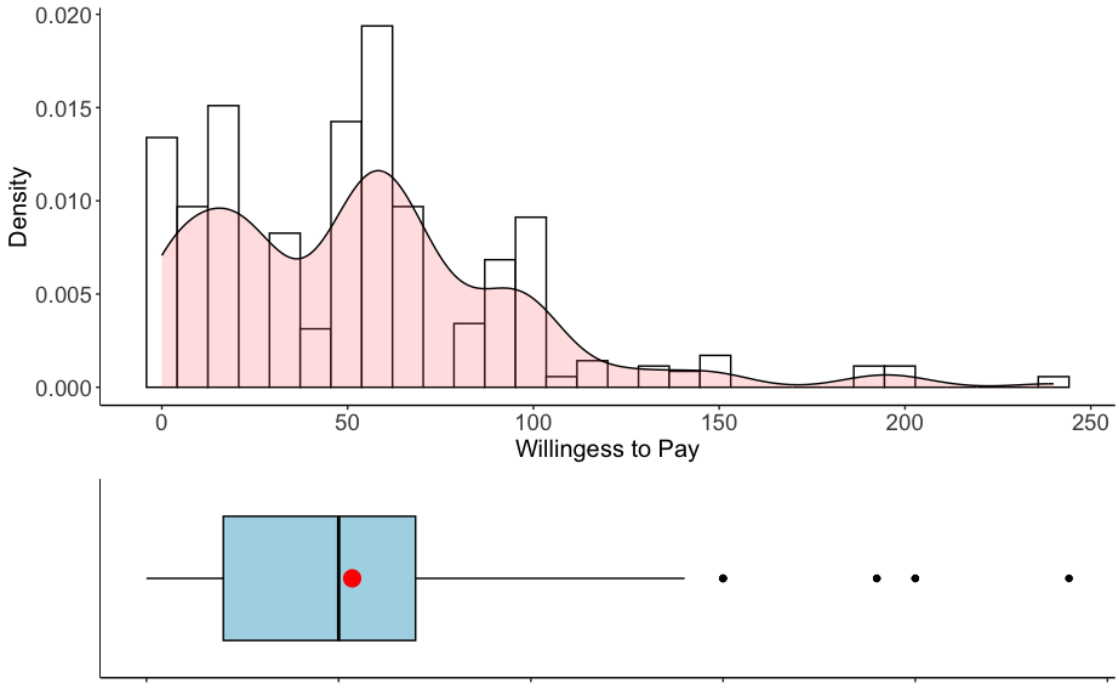



Figure 6.1: **Histogram of Willingness to Pay (WTP) Bids**
(Response count: 424)

their fishing trip if costs were to increase by $50.

The box plot below the histogram provides a visual summary of the WTP data. In the box plot, the red dot indicates the mean WTP value, offering an average bid amount. The size of the box represents the interquartile range (IQR), which spans from the 25th percentile (Q1) to the 75th percentile (Q3). The vertical line inside the box denotes the median WTP, providing a measure of central tendency. Outliers, shown as individual dots outside the whiskers, represent WTP values significantly higher than the rest of the data. The whiskers extend to the minimum and maximum values within 1.5 times the IQR from Q1 and Q3, respectively, capturing the range of most of the data while excluding outliers.

Descriptive statistics offer further insights: the minimum WTP is $0, the mean WTP is approximately $53.51, and the maximum WTP is $240. This suggests a right-skewed distribution, indicating that most respondents' WTP values are concentrated at the lower end, with a few higher values pulling the mean above the median, which is $50. This pattern indicates that while some anglers are willing to pay considerably higher amounts, the typical WTP for improvements or spe-

cific features at fishing sites tends to be moderate, with most respondents indicating a willingness to pay between $20 (Q1) and $70 (Q3).

### 6.3. Choice Experiment

A choice experiment (CE) survey, also known as conjoint analysis, is employed to assess the willingness to pay (WTP) for Blue Ribbon Fisheries (BRFs) in Utah. This statistical technique, widely used in market research to analyze consumer demand for multi-attribute goods, such as automobiles with varying features like style, engine size, color, and accessories. Unlike the bidding game, the choice experiment compares various attributes of fishing sites, allowing us to determine which attributes influence site selection. By incorporating multiple attributes and levels, it provides insights into how different combinations of attributes impact WTP. Moreover, this method enhances behavioral realism by simulating real-world choices, resulting in more accurate representations of consumer preferences and WTP. Our primary objective is to derive WTP estimates from the choice experiment.

In this study, the multi-attribute good under consideration is the recreational fishing experience. Respondents in the angler survey were presented with several hypothetical fishing destination choices, each varying in important attributes. CE surveys utilize experimental design techniques to systematically create fishing site profiles with different combinations of attributes and levels. This approach enables the assessment of how anglers perceive and value various aspects of their fishing experience.

#### *6.3.1. Experiment Design*

The survey for this research presented respondents with pairs of hypothetical fisheries that differed in the following attributes: the type of fishing location (river/stream or lake/reservoir), whether the site had been designated as a BRF (yes/no), whether the fishing site had been improved for angler access (yes/no), the primary species caught (11 fish groups), and the additional cost of accessing the fishing site (relative to the cost of their most recent trip). By systematically varying these attributes, we can observe how changes in each attribute influence the anglers' choices. The respondents were given the following question with an example question:

> For the following questions, **imagine** you are trying to decide whether to go fishing and where. In each question please consider two different trips (trip A and trip B) that vary in a number of ways including fishery characteristics and trip costs. Assume that everything else about the trip is the same as your most recent trip including time of year. **What do you prefer? Trip A, Trip B or to Not Fish?** Please check ONE box at the bottom of the table to indicate whether you prefer trip A, trip B or Not Fish.

The example question is presented in the table below (Table 6.1), where respondents are asked to select from one of three alternatives: two different fishing trip options (Trip A or Trip B) and a third option where neither Trip A nor Trip B is preferred.

Each fishing trip option is characterized by five attributes: (1) type of site, (2) Blue Ribbon Fisheries designation, (3) improved angler access to the site, (4) primary species caught, and (5) additional cost:

- Site: Reservoir/lake and River/stream (two levels)
- Blue Ribbon Fishery: Yes and No (two levels)
- Has angler access been improved: Yes and No (two levels)
- Primary species caught: Eleven fish species (groups)[2]
  - River/stream: Fish groups 1, 2, 3
  - Lake/reservoir: Fish groups 1 to 11
- Additional cost of fishing trip: \$0 to \$100 (\$10 increments; 21 levels)

To manage the large number of potential combinations efficiently, we employed a block design strategy despite the full factorial survey design theoretically encompassing $2 \times 2 \times 2 \times 11 \times 21 = 1,848$ possible profiles. This strategy involved organizing the profiles into 24 blocks, each containing 11 questions. Furthermore, for scenarios where the fishing site is specified as a river or stream, only fish groups 1, 2, and 3 from Table 6.2 were assigned. These species are typically found in river and stream environments. This approach ensured that the survey remained manageable for respondents while still capturing essential variation in attributes.

[2] Twenty one fish species are grouped into 11 fish groups. List of species caught is available at https://deq.utah.gov/fish-advisories/fish-species-utah-fish-advisories

Table 6.1: **Example of a Question for Choice Experiment to Assess WTP**

| **Trip Characteristic** | **Trip A** | **Trip B** | **Not Fish** |
|---|---|---|---|
| Site | River/Stream | Reservoir/Lake | |
| Blue Ribbon Fishery | No | Yes | |
| Improved angler access to the site | No | Yes | |
| Primary species caught | Group 1  Rainbow Trout | Group 3  Brown Trout  Brook Trout | I would not choose to take a fishing trip if these were my only choices |
| **Additional** cost of fishing trip relative to your last trip | $10 | $25 | |
| I would choose (check one) | Trip A ☐ | Trip B ☐ | Not Fish ☐ |

### *6.3.2. Analyzing Choice Experiment Survey Data*

In the realm of understanding angler behavior in selecting fishing sites, we frequently employ a Random Utility Model (RUM) framework alongside the conditional logit model. The RUM posits that the utility or satisfaction an angler derives from choosing a particular option is influenced not only by its observable attributes but also by unobservable or random factors. In our fishing site choice scenario, this implies that an angler's preference for a specific location may be shaped by factors beyond the type of water body, Blue Ribbon Fisheries (BRF) designation, improved angler access, and additional cost such as personal experiences, individual preferences, or even random chance.

The conditional logit model based on RUM posits that the utility ($U_{ij}$) that respondent $i$ derives from choosing trip $j$ in Table 6.1 is a function of the observed attributes of the option and

Table 6.2: **Grouping of Fish Species**

| Group | Species | | | |
|---|---|---|---|---|
| 1 |  Rainbow trout | | | |
| 2 |  Cutthroat trout | | | |
| 3 |  Brook trout |  Brown trout |  Mountain whitefish | |
| 4 |  Lake trout |  Splake |  Tiger trout |  Kokanee salmon |
| 5 |  Largemouth bass |  Smallmouth bass | | |
| 6 |  Wiper | | | |
| 7 |  Tiger muskie |  Northern pike | | |
| 8 |  Yellow perch |  Bluegill |  Crappie | |
| 9 |  Walleye | | | |
| 10 |  Channel catfish |  Bullhead catfish | | |
| 11 |  Striped bass | | | |

a random error term. Formally, this can be expressed as:

$$\begin{aligned} U_{i,j} &= \beta X_{i,j} + \varepsilon_{i,j} \\ &= \beta_0 + \beta_1 \texttt{Site}_j + \beta_2 \texttt{BRF}_j + \beta_3 \texttt{Improved access}_j + \beta_3 \texttt{Cost}_j + \sum_q \texttt{Fish group}_{q,j} + \varepsilon_{i,j} \end{aligned} \tag{6.1}$$

where $U_{ij}$ is the utility that respondent $i$ gets from option $j$, $X_{ij}$ represents the vector of observed attributes of option $j$ for respondent $i$, $\beta$ is the vector of coefficients to be estimated, indicating the importance or weight of each attribute, and $\epsilon_{ij}$ is the random error term, capturing unobserved

factors affecting the choice of fishing trip. In our case, the attributes might include the type of fishing location (`Site`) (river/stream or lake/reservoir), Blue Ribbon Fisheries designation (`BRF`) (yes/no), improved angler access (yes/no), primary species caught (various fish groups), and additional cost.

In the conditional logit model, the probability that individual $i$ chooses alternative trip $j$ out of $J$ alternatives is given by

$$P_{i,j} = \frac{\exp(\beta X_{i,j})}{\sum_{j=1}^{J} \exp(\beta X_{i,j})} \tag{6.2}$$

This probability formula is used to estimate the $\beta$ coefficients using maximum likelihood estimation (MLE). These coefficients reveal the direction and magnitude of the impact of each attribute on the probability of an option being chosen. For instance, a positive coefficient for the Blue Ribbon Fisheries (BRF) attribute indicates that anglers have a higher probability of choosing sites designated as BRF.

The estimated $\beta$ coefficients provide valuable insights into anglers' preferences. Statistically significant coefficients (e.g., p-value $< 0.05$) indicate that the corresponding attribute significantly influences choice. The magnitude of the coefficient indicates the strength of the preference or aversion towards an attribute. By taking the ratio of the attribute coefficients to the cost coefficient, we can derive the willingness to pay (WTP) for each attribute, indicating how much anglers are willing to pay for specific improvements or features in their fishing experiences.

In summary, by applying the conditional logit model to the CE survey data, we can quantify how different fishing site attributes (like BRF designation, access improvements, and primary species) impact anglers' choices. This analysis helps to identify which attributes are most valued by anglers, providing essential information for policymakers and resource managers aiming to enhance the fishing experience and manage fisheries resources effectively.

### 6.4. Conditional Logit Regression Results and WTP

In this section, we present the estimation results and discussions from the conditional logit model, based on data gathered in the 2024 Utah Angler Survey as detailed in the Chapter 2: 2024 Statewide Utah Angler Survey – Blue Ribbon Fisheries. This survey provided comprehensive insights into anglers' preferences across various fishing site attributes. By employing the conditional logit model, our goal is to quantify how these attributes influence anglers' decisions when selecting fishing sites.

The estimated coefficients will reveal the relative importance of attributes such as the designation of a site as a Blue Ribbon Fishery (BRF), the type of fishing location, improvements in angler access, primary species caught, and additional costs. These findings will deepen our understanding of angler preferences and contribute to the development of more effective management and conservation strategies for Utah's fisheries. Table 6.3 presents the results from four conditional logit models investigating factors influencing anglers' site selection and their willingness to pay (WTP) for fishing site attributes and fish species.

Model 1 establishes a baseline by examining the relationship between additional cost and fundamental site attributes such as river/stream versus lake/reservoir, BRF designation, and improved access for anglers. Model 2 extends the analysis by focusing on the relationship between fish groups and anglers' choices, revealing significant coefficients for various fish species. Model 3 combines variables from Models 1 and 2, integrating specific fishing site attributes with fish group preferences. Model 4 further enhances the analysis by introducing an interaction term between additional cost and BRF (Cost×BRF). This interaction addresses scenarios where BRF designation, which generally entails higher additional costs, aims to prevent dominant choices among anglers. We expect a negative coefficient for Cost×BRF which suggests that the impact of additional cost on WTP diminishes when BRF designation is present, indicating that anglers may perceive higher value or quality associated with BRF sites despite their higher costs.

From Table 6.3, we observe

1. Additional cost: Across all models, the coefficient for additional cost is consistently negative and highly significant. This indicates that as the additional cost of accessing a fishing site increases, the probability of that site being chosen decreases. In Model 4, which includes an interaction between additional cost and BRF designation, the coefficient for additional cost becomes slightly less negative, suggesting that the presence of BRF designation moderates the negative effect of cost to some extent.

2. Type of site (river/stream = 1): In Model 1, the coefficient for the type of site (river/stream) is positive and significant, suggesting a preference for river or stream fishing sites. However, this effect becomes insignificant in Models 3 and 4, indicating that the preference for river or stream sites diminishes when additional variables, especially fish groups, are included in the

Table 6.3: **Regression Results for Conditional Logit Models**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Additional cost | $-0.018^{***}$ | $-0.016^{***}$ | $-0.016^{***}$ | $-0.011^{***}$ |
| | (0.001) | (0.001) | (0.001) | (0.004) |
| Cost×BRF | | | | $-0.006^{+}$ |
| | | | | (0.004) |
| Site (River/stream = 1) | $0.471^{***}$ | | $-0.029$ | $-0.026$ |
| | (0.045) | | (0.056) | (0.056) |
| BRF (Yes = 1) | $0.142^{**}$ | | 0.060 | $0.156^{*}$ |
| | (0.056) | | (0.060) | (0.085) |
| Improved acess (Yes = 1) | $-0.075^{*}$ | | $-0.011$ | $-0.010$ |
| | (0.042) | | (0.045) | (0.045) |
| Fish group 1 (Rainbow trout) | | $1.571^{***}$ | $1.577^{***}$ | $1.571^{***}$ |
| | | (0.104) | (0.107) | (0.107) |
| Fish group 2 (Cutthroat trout) | | $1.720^{***}$ | $1.722^{***}$ | $1.705^{***}$ |
| | | (0.107) | (0.110) | (0.111) |
| Fish group 3 (Brook trout etc) | | $2.024^{***}$ | $2.032^{***}$ | $2.033^{***}$ |
| | | (0.108) | (0.111) | (0.111) |
| Fish group 4 (Kokanee salmon etc) | | $2.412^{***}$ | $2.404^{***}$ | $2.396^{***}$ |
| | | (0.125) | (0.125) | (0.125) |
| Fish group 5 (Largemouth bass) | | $1.001^{***}$ | $0.994^{***}$ | $0.987^{***}$ |
| | | (0.120) | (0.121) | (0.121) |
| Fish group 6 (Wiper) | | $0.677^{***}$ | $0.677^{***}$ | $0.660^{***}$ |
| | | (0.125) | (0.125) | (0.125) |
| Fish group 7 (Tiger muskie etc) | | $1.160^{***}$ | $1.155^{***}$ | $1.147^{***}$ |
| | | (0.118) | (0.118) | (0.118) |
| Fish group 8 (Yellow perch, Bluegill) | | $0.913^{***}$ | $0.903^{***}$ | $0.888^{***}$ |
| | | (0.119) | (0.120) | (0.120) |
| Fish group 9 (Walleye) | | $0.881^{***}$ | $0.870^{***}$ | $0.855^{***}$ |
| | | (0.126) | (0.127) | (0.127) |
| Fish group 11 (Striped bass) | | $0.867^{***}$ | $0.859^{***}$ | $0.834^{***}$ |
| | | (0.123) | (0.123) | (0.124) |
| ASC | $1.030^{***}$ | $-0.174^{*}$ | $-0.197^{*}$ | $-0.271^{**}$ |
| | (0.052) | (0.099) | (0.103) | (0.112) |
| Observations | 17,787 | 17,787 | 17,787 | 17,787 |
| $R^2$ | 0.054 | 0.097 | 0.098 | 0.098 |

Note: 1.Numbers in parentheses are standard errors, and symbols indicate significance levels: $^{+}$p<0.15; $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

2. Model 1 establishes the baseline by examining the relationship between additional cost and basic site attributes. Model 2 extends the analysis by focusing on the relationship between fish groups and anglers' choices. Model 3 combines the variables from Model 1 and Model 2, incorporating specific fishing site attributes alongside fish group preferences. Model 4 further enhances the analysis by introducing an interaction term between additional cost and BRF (Cost×BRF).

model.

3. Blue Ribbon Fisheries (BRF): The coefficient for the BRF attribute is positive and significant in Models 1 and 4, indicating that anglers prefer sites designated as BRFs. This preference remains consistent and is reinforced when the cost interaction term (Cost×BRF) is included in Model 4, although the interaction term itself shows marginal significance at 15% (p-value = 0.107).

4. Improved angler access: The coefficient for improved angler access is negative and marginally significant in Model 1 at 10%, but it becomes statistically insignificant in subsequent models (Models 3 and 4). This result is somewhat unexpected, as one might intuitively expect that improved access would positively influence site selection preferences among anglers.

5. Fish groups: The coefficients for fish groups are consistently positive and highly significant across Models 2 and 4, indicating strong preferences for fishing sites with specific fish species compared to fish group 10 (catfish)[3], which serves as the reference category. Notably, fish group 4 (Kokanee salmon etc.) exhibits the highest coefficients among all models, suggesting it is the most preferred fish group. This preference is followed by fish group 3 (Brook trout etc.), fish group 2 (Cutthroat trout), and fish group 1 (Rainbow trout), which is consistent with the results discussed in Chapter 4[4]. These coefficients, detailed in Table 6.3, provide a basis for comparing the relative preferences among different fish species. Larger coefficients within the same model indicate stronger preferences and higher willingness to pay (WTP) for fishing sites with those particular fish species.

The results highlight that anglers are highly responsive to the additional cost associated with accessing fishing sites and show strong preferences for specific fish species, particularly kokanee

[3] If we use a different reference for the fish group dummy variable, the interpretation of the coefficients for the other fish groups will change accordingly. Currently, with fish group 10 (catfish), which is the least preferred, serving as the reference, the coefficients for the other groups reflect their relative preference compared to catfish. Changing the reference group would shift this baseline, causing the sign and magnitude of the coefficients to adjust, but the preferred fish group ranking—meaning which groups are more or less preferred—would remain unchanged. We selected fish group 10 as the reference to ensure all coefficients are positive. If fish group 4 were chosen as the reference instead, all coefficients would be negative, yet the ranking of preference among the fish groups would remain consistent.

[4] More accurately, the top four fish groups are consistent with those identified in Chapter 4, thought the rankings differ. Fish group 4 (Lake trout, splake, tiger trout, Kokanee salmon) was identified as the most preferred in this chapter. Chapter 4 identified fish group 2 (Cutthroat trout) as the most preferred, although its preference was not statistically different from that of fish groups 1, 3, and 4.

salmon, brook trout, and cutthroat trout. Designating a site as a BRF positively influences site selection, suggesting that BRFs are perceived as high-quality fishing locations. However, the implications of improved angler access remain less conclusive and require further investigation. The significant coefficients for fish groups underscore the critical role of species availability in anglers' decision-making processes. These insights can guide managers and policymakers in enhancing fishing site appeal by prioritizing preferred species and ensuring the designation and upkeep of Blue Ribbon Fisheries.

Table 6.4 presents the mean willingness to pay (WTP) for attributes. WTP is an economic measure that signifies the maximum amount an individual is willing to spend to acquire a good or service or to avoid something undesirable. In this study, WTP quantifies the value anglers place on various attributes of fishing sites offering insights into their preferences and priorities. Using the conditional logit model reported in Table 6.3, we calculated the WTP for different fishing site attributes by analyzing anglers' choices among hypothetical fishing trips. The model enables us to determine the marginal rate of substitution between cost and other attributes, essentially translating the utility gained from these attributes into monetary terms. The formula used to calculate WTP is:

$$\text{WTP}_{\text{attribute}} = -\frac{\beta_{\text{attribute}}}{\beta_{\text{cost}}} \tag{6.3}$$

The WTP estimates reported in Table 6.4 provide insights into the monetary value anglers assign to various fishing site attributes. For instance, anglers are willing to pay over 100 dollars for fishing sites where the primary species caught belong to fish groups 1, 2, 3, and 4. This high WTP indicates the significant value anglers place on the opportunity to catch these particular species. More specifically,

- Type of site (river/stream = 1): In Model 1, the estimated WTP for fishing at river/stream sites is \$26.59 (not reported in Table 6.4), indicating that anglers value these locations more highly than lakes/reservoirs. This positive and statistically significant value suggests that river/stream sites provide a better fishing experience or higher utility to anglers. However, in Model 4, the site variable shows a minimal and statistically insignificant impact after controlling for fish groups and other attributes.

Table 6.4: **Mean Willingness To Pay (WTP): Model 4**

| Attribute | Model 4 |
|---|---|
| | (Dollars) |
| Site (River/stream = 1) | -2.50 |
| BRF (Yes = 1) | 14.82* |
| Improved access (Yes = 1) | -0.91 |
| Fish group 1 (Rainbow trout) | 148.83*** |
| Fish group 2 (Cutthroat trout) | 161.59*** |
| Fish group 3 (Brook trout etc) | 192.67*** |
| Fish group 4 (Kokanee salmon etc) | 227.07*** |
| Fish group 5 (Largemouth bass) | 93.55*** |
| Fish group 6 (Wiper) | 62.56*** |
| Fish group 7 (Tiger muskie etc) | 108.71*** |
| Fish group 8 (Yellow perch, Bluegill) | 84.19*** |
| Fish group 9 (Walleye) | 80.98*** |
| Fish group 11 (Striped bass) | 70.08*** |

Note: *p<0.1; **p<0.05; ***p<0.01

- BRF (Yes = 1): In Model 4, the WTP estimate for sites designated as BRF is $14.82. This suggests that anglers are willing to pay a premium for the enhanced quality and reputation associated with BRF sites. The statistically significant value emphasizes the importance anglers place on high-quality fishing environments.

- Improved Access (Yes = 1): In Model 4, the WTP estimate for improved angler access is -$0.91. This result is not statistically significant, suggesting that improved access may not significantly influence anglers' site choices. Possible reasons could include concerns such as increased crowding or perceived environmental impacts.

- Primary Fish Species: The WTP estimates for various fish groups are notably high, particularly for fish groups 1 to 4. Anglers are willing to pay $149, $162, $193, and $227. for rainbow trout, cutthroat trout, brook trout, and kokanee salmon, respectively. These values underscore the strong preferences anglers hold for these species. The substantial WTP for specific fish groups reflects their desirability and the enhanced fishing experience they offer.

## 6.5. Conclusion

The analysis of the 2024 Utah Angler Survey using the conditional logit model has yielded valuable insights into anglers' preferences and willingness to pay (WTP) for various attributes of fishing

sites. The estimation results, summarized in Table 6.3, highlight significant preferences for specific attributes such as Blue Ribbon Fishery (BRF) designation and particular fish species.

Our findings demonstrate that anglers assign considerable monetary value to high-quality fishing experiences. For instance, they are willing to pay over $140 more (relative to catfish) for fishing sites where primary species like rainbow trout, cutthroat trout, brook trout, and kokanee salmon are predominant. This substantial WTP underscores the critical importance of these species to anglers and underscores the necessity for targeted management and conservation efforts to sustain these valuable resources. The significant coefficients for the BRF attribute across models indicate that anglers are willing to pay a premium for sites recognized as Blue Ribbon Fisheries, renowned for their exceptional fishing conditions. This suggests that the BRF program effectively enhances the perceived value of these sites among anglers.

In summary, the WTP estimates derived from our conditional logit models provide a clear monetary quantification of anglers' preferences. These insights are crucial for policymakers and stakeholders in developing effective strategies for fisheries management and resource allocation. By understanding which attributes anglers value most, efforts can be better targeted towards enhancing these aspects, thereby maximizing both the recreational benefits and economic impact of Utah's fishing sites.

# Chapter 7. Summary and Policy Implications

Zuyi Wang and Man-Keun Kim

The primary objective of this study is to update Kim and Jakus (2013), *The Economic Contribution and Benefits of Utah's Blue Ribbon Fisheries*, which assessed the economic impact of fishing in Utah and the value of Blue Ribbon Fisheries (BRF). Utilizing data from the *2024 Statewide Utah Angler Survey – Blue Ribbon Fisheries*, this updated research provides a contemporary analysis of BRF economic contributions and benefits. The study expands on previous work by exploring angler preferences for fishing site attributes through Best-Worst Scaling (BWS) and cluster analysis. Additionally, the survey includes a component where respondents rated various fish species or groups using star ratings, offering fresh insights into angler preferences.

## 7.1. Summary of the Report

Conducted online via Qualtrics from late February to May 2024, the survey garnered 750 responses, with varying counts across sections due to incomplete submissions. Notably, 73% of respondents were invited via email, and 27% via Facebook. On average, anglers reported 20 fishing trips annually, with a median of 14 trips. A significant finding was that 36% of anglers were unsure if they had visited a BRF location, with top preferences being Strawberry Reservoir, Deer Creek Reservoir, and Flaming Gorge Reservoir.

In 2023, anglers spent an average of $188 per trip, with major expenditures at gas stations and convenience stores ($73 per trip) and lodging ($41 per trip). For those fishing at Utah Lake, average spending per trip was $53, predominantly on gas and convenience store purchases ($24 per trip). Based on survey data and assuming 418,000 licensed resident anglers with a median of 14 trips per year, annual direct expenditure related to angling in Utah was estimated at $1.079 billion. These expenditures significantly impact the Utah economy, contributing to a total industry output of $2.180 billion. Moreover, angling supports substantial labor income, totaling $0.861 billion, and provides employment to over 17,800 individuals across various sectors. The fiscal impact is also

notable, with angling activities contributing $426 million in fiscal revenues.

The 2024 survey included a five-star rating question for various fish species or groups, revealing cutthroat trout as the most preferred species, with an average rating of 3.94 stars. Similarly, rainbow trout, brook trout, brown trout, mountain whitefish, lake trout, splake, tiger trout, and kokanee Salmon also received high ratings. In contrast, other species received lower ratings with higher variability. Notably, catfish was rated as the least preferred fish group.

Using the Best-Worst Scaling (BWS) method, we explored angler preferences for fishing site attributes through BWS and cluster analysis. Based on 395 survey responses, attributes such as C*atching a large number of fish* and *Enjoying scenery and nature, viewing wildlife* emerged as highly preferred. Cluster analysis classified anglers into two distinct groups: Cluster 1 emphasizes environmental quality and overall fishing experience, while Cluster 2 prioritizes catching a large number of fish and trophy catches. These findings provide nuanced insights into diverse angler preferences, which are essential for tailored resource management and marketing strategies in fisheries.

The conditional logit models applied to the 2024 Utah Angler Survey highlight that anglers highly value sites designated as BRF and are sensitive to additional costs. Specific species such as rainbow trout and kokanee salmon significantly influence site preferences, with interactions between cost and BRF designation revealing the complex factors shaping anglers' decisions. Anglers demonstrate a willingness to pay over $140 more for fishing sites where primary species like rainbow trout, cutthroat trout, brook trout, and kokanee salmon are prevalent, underscoring the critical importance of these species and advocating for targeted conservation efforts. Additionally, significant coefficients for the BRF attribute indicate anglers' readiness to pay a premium for BRF sites known for exceptional fishing conditions, with a moderate willingness to pay around $15.

### 7.2. Policy Implications

Based on the comprehensive analysis throughout the report, several policy implications can be derived to optimize fisheries management and maximize economic benefits:

- **Species Management and Conservation**: Angler preferences, as evidenced by the star ratings and willingness to pay (WTP) for specific fish species (Figure 4.3, Tables 6.3 and 6.4), highlight the importance of managing populations of rainbow trout, cutthroat trout, brook

trout, and kokanee salmon.

- **Marketing and Promotion**: The star ratings and preferences identified through Best-Worst Scaling (BWS) and cluster analysis (Chapter 5)) provide insights into which attributes and species resonate most with anglers. Marketing efforts should emphasize the unique qualities of BRF sites and favored fish species to attract more anglers and enhance tourism-related economic activities.

- **Enhancing Blue Ribbon Fisheries (BRF) Program**: The significant coefficients for the BRF attribute in the conditional logit models indicate that anglers are willing to pay a premium for BRF-designated sites known for exceptional fishing conditions (Table 6.3 and 6.4). Investing in expanding and maintaining BRF sites aligns with anglers' preferences, enhancing their recreational experience and economic impact.

- **Public Awareness and Education**: The survey revealed a significant portion of anglers were unaware of BRF locations (Chapter 2). Public outreach and educational campaigns can bridge this awareness gap, informing anglers about the benefits of BRF sites for both recreational enjoyment and conservation, thereby increasing visitation and stewardship.

- **Incorporating Angler Preferences in Management Plans**: Cluster analysis insights (Chapter 5) highlight distinct preferences among anglers, such as those prioritizing environmental quality versus catch quantity. Tailoring management plans to these preferences ensures sustainable resource use and enhances angler satisfaction, contributing to long-term site viability and economic benefits.

These policy implications are grounded in the empirical findings and analytical approaches discussed in the report, providing a robust foundation for optimizing fisheries management strategies in Utah. By aligning policies with these insights, policymakers can maximize both the recreational benefits and economic contributions derived from angling activities across the state.

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