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Displacement, Place Attachment, and Other Characteristics of Anglers on the Yellowstone River

By

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B.S. Resource Management, University of Wisconsin Stevens Point, Stevens Point, WI, 2018

Thesis

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ABSTRACT

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Geography

Displacement, Place Attachment, and Other Characteristics of Anglers on the Yellowstone River

Chairperson: Dr. Jeremy L. Sage

The Yellowstone River has seen increasing recreational use as Montana has grown and out of state visitation has increased, leading to some locals voicing concerns of crowding. River recreation, as with many outdoor recreational activities, has participants that may be considered to be sensitive to crowded conditions and place a high value on solitude. Considering these perceptions, there is reason to believe that these participants may change their river use patterns if or when the perceived level of crowding exceeds their tolerance thresholds. Further, monitoring efforts conducted at river access sites often do not fully capture users that are already displaced due to crowding. Previous research supports the idea that displacement and other coping mechanisms are common among users in crowded recreation locations, these behaviors may be leading to artificially high ratings of satisfaction, as the users most likely to be dissatisfied are not being captured because they have changed their use patterns to avoid crowding. The goal of this study is to examine the nature of displacement on the Yellowstone River, and the thresholds of crowding that may cause recreationists to be displaced. The study seeks to expand the current understanding of river use patterns, and the existing monitoring projects that have been undertaken on the Upper Yellowstone. From this expanded understanding, managers may be better equipped to address the user experience and measures of satisfaction on rivers in Montana by also considering users displaced from their preferred recreation areas. More specifically, this study seeks to address three key questions: (1) What is the relationship, if any, between varying levels of crowding on the Upper Yellowstone River and the stated acceptability by anglers, and is that relationship affected by use type? (2) If a relationship is found to exist, what is the stated coping mechanism by anglers, and does the level of place attachment to the river influence the stated response and subsequent river use patterns? (3) How do anglers on the Upper Yellowstone River perceive potential policy and management actions aimed at addressing river use, and are there key attributes about the anglers that may influence their support of management actions?

Keywords: Crowding, Displacement, Coping Mechanisms, Place Attachment, People at one time, River Recreation

DEDICATION

This thesis is dedicated to my mother, whose endless and unceasing moral support was essential to my completion of graduate school and this study. I couldn't have done it without her.

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I would first like to thank and acknowledge my family, my mom, dad, sister, and brother-in-law for being so supportive during the years where I worked on this thesis. From a much-needed pep-talk, to helping me figure out how to word sections and editing some of my questionable grammar, I couldn't have done it without them.

I would also like to thank everyone I had the pleasure of working with at the Institute for Tourism and Recreation Research during my time in graduate school at the University of Montana. I could not have gotten any luckier with where I ended up for my research assistantship, and couldn't have asked for a more fun and down-to-earth group of people to work with.

I cannot thank my advisor, and committee chair Dr. Jeremy Sage enough for all the help and guidance he provided along the way. I certainly was not the easiest student to advise with several rounds of revisions, defense postponements, and my running off to do a through-hike of the Pacific Crest Trail even though the thesis wasn't done yet.

I would finally like to thank all my professors and student colleagues at the University of Montana, you all helped me make great strides in my academic and career development and I enjoyed the wide and varied discussions we had in and out of class.

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CHAPTER 1: INTRODUCTION

The Upper Yellowstone River has seen increasing recreational use as Montana has grown 8.7 percent in the decade 2010-2020 (US Census, 2021) and out of state visitation has increased, leading to some locals voicing concerns of crowding. From 2010 to 2019 traffic counts at the North Entrance of Yellowstone National Park in Gardiner increased 27.6 percent (National Park Service, 2021), showing more tourists are travelling through the Paradise Valley in Park County. River recreation, as with many outdoor recreational activities, has participants that are sensitive to crowded conditions and place a high value on solitude. On the nearby Gallatin River, anglers were the most likely to perceive conflict and least tolerant of crowding, similar results were also found among local recreationists in comparison tourists (Confer et all. 2005). Considering these perceptions, there is reason to believe that these participants are changing their river use patterns. Further, monitoring efforts conducted at river access sites on the Upper Yellowstone, such as those undertaken by the University of Montana's Institute for Tourism and Recreation Research are likely not capturing users that are displaced due to crowding and reported high levels of user satisfaction across the survey sites (Figure 1) (Nickerson and Grau, 2020).

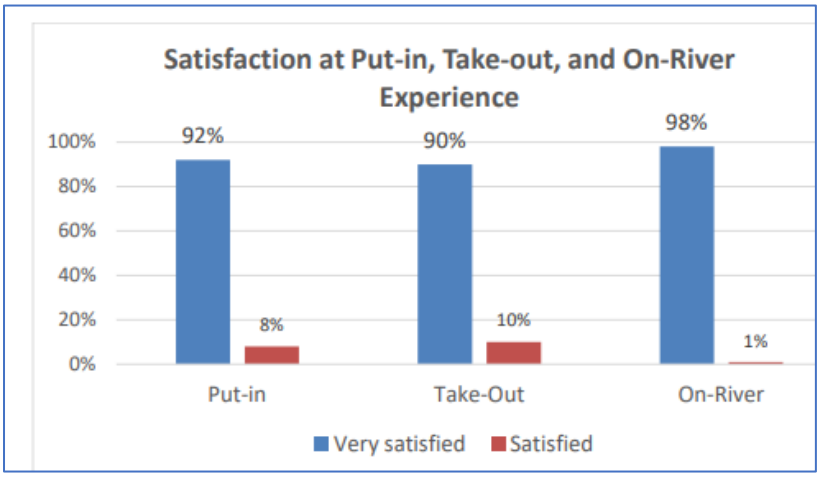


Figure 1. Satisfaction measure from 2020 study

Previous research supports the idea that displacement and other coping mechanisms are common among users in crowded recreation locations (Manning 2001). These behaviors may be leading to artificially high ratings of satisfaction, as the users most likely to be dissatisfied are not being captured because they have changed their use patterns to avoid crowding.

The goal of this study is to examine the nature of displacement on the Upper Yellowstone River, and the thresholds of crowding that may cause recreationists to be displaced. The study seeks to expand the current understanding of river use patterns, and the existing monitoring projects that have been undertaken on the Upper Yellowstone. From this expanded understanding, managers may be better equipped to address the user experience and measures of satisfaction on rivers in Montana by also considering users displaced from their preferred recreation areas.

More specifically, this study seeks to address three key questions: (1) What is the relationship, if any, between varying levels of crowding on the Upper Yellowstone River and the stated acceptability by anglers, and is that relationship affected by use type? (2) If a relationship is found to exist, what is the stated coping mechanism by anglers, and does the level of place attachment to the river influence the stated response and subsequent river use patterns? (3) How do anglers on the Upper Yellowstone River perceive potential policy and management actions aimed at addressing river use, and are there key attributes about the anglers that may influence their support of management actions?

CHAPTER 2: LITERATURE REVIEW

User Group Conflict

Conflicts between recreationists can be classified in several different ways. Gibson and Fix (2014) studied conflicts between user groups by examining motorized and non-motorized users on the Chena River near Fairbanks Alaska. Types of conflicts were divided into three groups, Latent-Behavior, Social Values, and Interpersonal. Latent Behavior conflict occurs when users do not observe a situation but perceive it to be a problem. Social Values Conflict occurs when users did not observe a situation, perceived it to be a problem, and were bothered by just knowing another user group is in the area. Interpersonal conflict occurs when users observe a situation and perceive it to be a problem but may or may not have been bothered. These conflict categories are not limited to motorized vs non-motorized as examined by Gibson and Fix, but can also readily apply to other recreation types, such as hikers and mountain bikers, horses and mountain bikers, or floaters and anglers, which would be the most relevant to the Upper Yellowstone. In addition to varying user types, the Yellowstone River also has the distinction between user groups of parties led by outfitters, and unguided private groups. These two different groups that are participating in the same activity, either floating or angling, sometimes come into conflict with each other, and sometimes blame each other for the issues facing the river.

Jacob and Schreyer (1980) define conflict for an individual as "goal interference attributed to another's behavior". This definition assumes that people recreate to achieve certain outcomes, or goals. Recreationists that are trying to achieve solitude may be affected by the presence of others, even if their specific behaviors are not objectionable. A recreationist that is displaced due to too much crowding could be said to be displaced from a type of conflict, even if there were no actual altercations with other recreationists. The authors (Jacob and Schreyer, 1980) also identified four major factors which produce conflict in outdoor recreation; (1) activity style- the various personal meaning assigned to an activity; (2) resource specificity– the significance attached to using a specific recreation resource for a given recreation experience; (3) mode of experience– the varying expectations of how the natural environment will be perceived, and; (4) lifestyle tolerance – the tendency to accept or reject lifestyles different from one's own.

As identified above, a major factor contributing to conflicts on rivers is the type or style of activity that recreationists are engaging in. This difference in activity types can also impact satisfaction, as exemplified by the North Umpqua River. The North Umpqua is a Wild Scenic River that is popular for whitewater rafting and fly fishing. A survey of anglers and boaters found a negative relationship between perceived crowding and satisfaction, with anglers' satisfaction more impacted by perceived crowding than the satisfaction of boaters (Kainzinger et al. 2015). Conflict between and within the user groups was

found to be relatively low, likely due to the zoning approach implemented in 1992 by the USFS and BLM, which includes voluntary restrictions for certain hours of the day and seasons of the year (Kainzinger et al. 2015).

Place Attachment

Place attachment is the extent to which an individual feels connected to a particular location (Canter 1977). Anglers and other types of outdoor recreationists commonly exhibit place attachment to the areas they recreate in, so it is worth investigating if this is occurring on the Upper Yellowstone and how it may be affecting other dynamics around river use such as displacement. Perry and colleagues examined the relationship between Place Attachment, Climate Change and Displacement within the Vermont State Parks system. A questionnaire was administered to state park visitors onsite, where respondents were asked to rank nine statements used to measure place attachment on a five point scale, from strongly disagree to strongly agree. Using these nine responses, each individual was assigned a value on a place attachment index, and the sample was divided into low and high place attachment groups, which were compared by their likelihood to displace from changed conditions such as those caused by climate change. They found that those with lower place attachment were more likely to be displaced temporally or spatially due to changed environmental conditions (Perry et al., 2021).

Kyle and colleagues investigated the effects of two dimensions of place attachment, place identity and place dependence on trail users' perceptions of social and environmental conditions on the Appalachian Trail (Kyle et al. 2004). Place identity is used to mean where the individual defines their own identity in relation to the physical environment, while place dependence is how well a setting is suited to meeting a recreationist's goals compared to alternative settings. As place identity of respondents increased, they were more likely to report the social and environmental condition along the trail such as facilities, erosion, litter, and human waste, as well as too many other hikers and behavior of hikers were a problem. As place dependency decreased, respondents were less likely to rate these social and environmental conditions as a problem. They were also less likely to negatively evaluate trail development, including facilities like shelters. While both place identity and dependence are a part of place attachment, they can have different effects in how the recreationist views and experiences the recreation setting.

Moulay and colleagues studied the relationships between place attachment, behavioral tendencies, and usage patterns in public parks in Tehran, Iran (Moulay et. al 2018). They found the level of attachment individuals feel towards a park is influenced by behavioral tendencies and usage patterns, people with stronger attachment levels were more likely to engage in pro-environmental behaviors and

visit the park more frequently. People who spent more time in the park were also more likely to develop a stronger attachment to it. Data was collected through a survey administered to visitors in the park, where visitors were asked to rate their agreement with statements on three dimensions of place attachment; place identity, place dependence, and affective attachment. The former two dimensions have been described in previous sections in this literature review, and the former, affective attachment refers to the emotional bond that individuals have with the park. The authors combined the scores from the three dimensions to create an overall score for place attachment. While the previous two articles discussed researched place attachment in non-river settings, the implications of recreationists with higher levels of place attachment tending to be more critical of negatively perceived conditions and more likely to engage in positive behaviors towards the recreational resource could be very important to resource managers.

Hammitt and Colleagues examined the relationship between experience use history (EUH), place bonding, and resource substitution in trout anglers on the Chattooga River, South Carolina. Based on how the authors use place bonding in this study, it can be viewed as a form of attachment primarily based on emotional ties to a place, while place attachment is usually a more complex concept involving cognitive, affective, and behavioral components. Resource substitution is another way to describe spatial displacement. Respondents with a greater EUH on the river tended to have higher levels of place bonding, and there was not a significant difference between EUH and substitution behavior (Hammitt et al. 2004).

Crowding and displacement

While river managers have multiple tools at their disposal that can be used to reduce crowding, some users already have coping methods they individually use to deal with the crowding they experience. The threshold of what is too crowded varies from person to person, and people respond to this perceived crowding differently. This can have implications for surveys conducted on the river, the visitors surveyed may not be likely to report perceived crowding, because the users most bothered by crowding may already be using coping methods to avoid crowded areas.

Manning and Valliere (2001) define ways people attempt to deal with perceived crowding at recreational sites, by using coping methods. The three primary mechanisms they identify are displacement, rationalization, and product shift. Displacement occurs when recreationists change their behavior to avoid crowded conditions and are “displaced” by recreationists less sensitive to crowding. Displacement can be further divided up into intersite, and intrasite. Intersite displacement is represented by a shift from one recreation area to another. Meanwhile, intrasite displacement is observed as a shift either, or both, within the same recreation area, or as temporal displacement; changing of the time of site use. Rationalization occurs when recreationists convince themselves that their experience was great,

because they may have invested a large amount of time, money, and effort to engage in their chosen activity and would not want to feel like conditions reduced their enjoyment of the experience. Lastly, product shift occurs when recreationists who experience higher use levels than they expected or preferred, alter their definition of the recreation opportunity to match the conditions they experienced. An example would be a backpacker that goes backpacking in a national park with the expectation of finding solitude, but instead finds the trails busy with many other hikers. Instead of becoming disappointed, they decided that they were not really recreating to find solitude, and it was not a big deal that they saw lots of other people, because after all it is a popular national park, and the scenery was still beautiful.

These three coping mechanisms may provide an explanation as to why measures of satisfaction tend to remain high in recreational settings despite increasing use levels and reports of crowded conditions. Jorgenson and colleagues (2019) found high levels of satisfaction among nearly all visitors in Yellowstone National Park, despite often crowded conditions, but found repeat visitors were more likely to say there were problems related to crowding. Displacement is the mechanism that was most expected to be relevant to this study, and the one for which data collection has been focused on, and further explanation is provided below.

The concept of displacement was suggested as early as 1971 when it was described as a process of "invasion and succession" (Clark et al. 1971). The authors suggested the increased popularity of more intensively developed and well used campgrounds has changed the nature of camping for many campers that used to go camping to seek isolation and communion with nature. These campers may then move their camping activities to more primitive sites, and the places they used to camp at are then occupied by campers more tolerant of crowding and less interested in solitude. The displaced “traditionalist” campers may trigger another wave of development and increased use at the once primitive conditions and may end up triggering another wave of invasion and succession if use levels grow high enough.

Anderson and Brown (1984) defined displacement as “the outcome of a behavioral response to changes in the recreation environment”. They conducted a mail survey of recreationists receiving permits for the Boundary Waters Canoe Area Wilderness in Minnesota and found that more than 70 percent of the respondents changed their use of the Boundary Waters. Of those that changed their use, 84 percent used different entry points, 75 percent selected different campsites, and 73 percent entered the Boundary Waters on a different day of the week. Reasons for these changes in use included seeing liter, worn out campsites and portages, others camping within sight, seeing other people, and seeing large groups. A common theme of these reasons is that they were all associated with impacts of visitors. However, not all of these changes could be attributed to displacement, and a need for further investigation, especially into the role of crowding in the displacement process was noted. Several other authors in this literature review

cited this study as an example of research into displacement in recreation, including Robertson and Regula (1994), Miller and McCool (2003), Shelby et al. (1988), and Manning and Valliere (2001).

R.H. Becker (1981) examined the relationship between density and satisfaction on the Lower St. Croix and the Upper Mississippi Rivers and found that there was no relationship on the individual rivers. It was found that Lower St. Croix River users sensitive to high use levels now favored the Upper Mississippi, suggesting displacement was occurring. He also suggested that changing crowding conditions of the recreational resource that may cause changes in the users of a site will affect the entire system by displacing users.

Shelby and colleagues (1988) collected data on the Rogue River in 1977 and 1984 and the Illinois River in 1979. The Rogue River had higher use levels than the Illinois, and it was hypothesized that displacement would occur from the Rogue to the Illinois River among some floaters. From 1977 to 1984 average daily use on the Rogue River increased 45 percent. Floaters were asked “If you saw more people than you expected, did you: 1) become unhappy or dissatisfied with the trip, 2) decide to go somewhere more remote next time, 3) change the way you thought about the Rogue, deciding it was less remote than you had believed."; the three possible responses indicate dissatisfaction, displacement, or product shift respectively. Data collection indicated product shift was the most common coping strategy, with 34 percent of Rogue River floaters in 1977 who saw more people than expected changing the way they thought about the river. There was evidence of displacement, and suggested displacement from the Rogue to the Illinois.

Using a stratified random sample, Robertson and Regula (1994) investigated the relationship between displacement and satisfaction among Iowa boat owners. Owners were contacted by mail in 1989 and asked nine questions representing different types of displacement and four questions about satisfaction, each made up of a five-point Likert scale. Forty-five percent of the boaters that had used the Lake Red Rock Reservoir at least once indicated that they used the lake less or quit using it entirely as a result of the undesirable conditions (in this case heavy siltation).

Miller and McCool (2003) used a transactional model of stress and coping to understand how recreationists deal with negative setting elements during their recreational experience. They focused on the relationship between levels of stress and types of coping strategies used by recreationists in Glacier National Park. Respondents to on-site surveys in the park and mail surveys indicated that high stress levels were related to absolute displacement behaviors (ceasing to visit the park entirely), lower stress levels were related to cognitive adjustments including product shift and rationalization, and moderate stress levels were associated with substitution behaviors (this includes temporal and spatial displacement

within the park). The highest levels of stress were also associated with direct action, which is where a recreationist attempts to change the situation by actions such as complaining to authorities, letter writing, or political action.

Fefer and colleagues (2021) examined the relationship between just one social detractor- crowding, and one coping strategy- displacement. On-site surveys were conducted in summer of 2016 in Delaware Water Gap National Recreation Area. Anyone who answered "yes" to the question "Have you ever not been able to or chosen not to visit Delaware Water Gap NRA because it was crowded?" was asked to further participate in interview questioning, which was done in a semi-structured format to attempt to identify their reasons for displacement, and how they responded after being displaced. 18.6 percent of visitors surveyed indicated they had been displaced at some point in the past. Interviewees were asked qualitative questions about how they felt about the displacement experience, as well as specific reactions to being displaced. Spatial changes in the form of intra-site movement, and continuing the same activity were most common. Temporal displacement was common, and all respondents who were temporally displaced avoided weekends and holidays.

One way that researchers have measured crowding is by using a visual approach in surveys administered to recreation area visitors, where they are shown pictures of a recreational setting (e.g. a trail, scenic overlook, or lakeshore) and asked questions to gauge their response to varying numbers of people in the picture. Acceptability ratings tend to decline with increasing people at one time (PAOT) in the photo, or in other words people tend to prefer recreation settings with less other people around. Manning and colleagues (1996) were one of the first groups of researchers to use PAOT in a recreational setting, where they used the measurement to determine carrying capacity based on the amount of crowding at the popular Delicate Arch site in Arches National Park. Visitors to Delicate Arch were intercepted for an interview survey, each respondent ranked all 16 of the photos by acceptability on a -3 to 3 scale, with -3 being very unacceptable and 3 being the most acceptable. Photographs had differing numbers of people in the foreground and midground, but this was not analyzed in the results. As the number of people at one time increased, the mean acceptability ranking tended to decrease. Results were displayed as an acceptability curve, which was modeled with a quadratic equation.

Arnberger and Haider (2007) extended the PAOT visual approach to apply to displacement, by surveying trail users on an urban forest trail to determine their displacement thresholds. As the number of persons in each image increased, the proportion of respondents answering they would be displaced tended to increase. The presence of unleashed dogs also increased the share of respondents with intended displacement, as well as more of the people in the photo located in the foreground. In the most undesirable scenario, with 50% joggers, dogs unleashed, singles, background, and even proportion facing

away or towards the camera, 54% of respondents indicate they would be displaced. It is apparent from this study that there are more variables affecting likelihood of displacement than just the total number of people at one time in a location. Context and specific activity also matter.

Rupf and colleagues (2019) used PAOT in a 2010 online survey of winter backcountry recreationists to examine the effect of perceived crowding, in particular if it causes displacement. Similar to previous studies using PAOT methods, respondents were shown four randomly selected scenes out of 32 different possible photos with different amounts of individuals in the photo. Two different mountain scenes were used. The question used a nine-point scale, ranging from far too few people, a pleasant number of people, and far too many people. They were then asked how they would react if they encountered the situation two-thirds of the way into their ascent by rating three statements with either yes, no, or unsure as possible responses. The statements were "I would stop and go back home.", "I would avoid this route in the future.", and "I would adjust my route to avoid the crowd." Unsurprisingly, respondents tended to rate the images with higher numbers of people having far too many people. The most common response to crowding was to avoid the route in the future, suggesting displacement was likely to occur. Very few respondents said they would stop and go back home, likely due to the time and energy already invested to ascend most of the route on their trip.

Sterl and colleagues (2004) interviewed canoeists in Danube Floodplains National Park in Austria about perceived crowding to investigate if the social carrying capacity of the park was exceeded. Respondents were asked to choose which image out of a set of four was the most and least pleasant. Like the previous studies mentioned, more crowded pictures were ranked as less pleasant. The presence of wildlife also tended to lead to more pleasant rankings, though the only picture with wildlife was also the only one with no other canoes in view. The authors also collected data by video observation and compared the preferences of respondents with observed use levels. It was found that the acceptable use level of twelve boats per day, based on the average level ranked as neither too much or two few boats, and the number of boats that can be in the river system at the same time, was exceeded on 22 days during the summer.

Gibson and colleagues (2014) investigated two potential sources of bias that could exist in a PAOT study aiming to construct an acceptability curve based on how acceptable varying amounts of people are rated. One sample group was presented PAOT photographs in six different orders, and another group was tested just for range effect, which is the primary acceptability criteria that most other PAOT studies have investigated. No significant effects of presentation order were found on the acceptability ratings of photographs.

Cribbs and colleagues (2019) also investigated the influence of the order of presentation for photographs, as part of a broader PAOT study on crowding perceptions on the Buffalo River in Arkansas. The order in which pictures are shown was thought to have a potential influence on how respondents would rate each picture, but no significant difference was found in average acceptability ratings of each photograph based on the order in which they were presented. Otherwise, acceptability ratings tended to decrease with increasing number of PAOT, similarly to most other PAOT studies.

Displacement has been well documented in the world of outdoor recreation, for many different activities and across wide geographic areas. However, little is known about the phenomenon in the context of the Yellowstone River. Lamborn and Smith (2019) noted that elements of displacement arose in their conversations with outfitters, guides, researchers, and managers, even though the focus was on how people perceive changing streamflow and runoff conditions. They did not focus on displacement due to crowding, but noted that it was mentioned at least some of the time. Interviews found that guides and outfitters use temporal and spatial adaptation strategies to reduce stress on fish and find better quality fishing opportunities in times of high water temperatures. A temporal adaptation strategy that can be used is where guides do a self-imposed hoot-owl regulation, taking the client fishing from around dawn to about 2 PM, avoiding the worst of the afternoon heat when fish are most stressed. A spatial adaptation strategy discussed is trying to fish in cooler waters, such as the spring creeks or higher mountain streams. This study did not classify these adaptive behaviors as displacement, and stated that displacement research has usually focused on social factors such as crowding. The authors did suggest future research should be undertaken on how anglers are responding to social and environmental changes, specifically if and how displacement is occurring, as well as the ecological consequences of spatial displacement and adaptation. It is important to note that both types of displacement are changing behaviors to find higher-quality experiences, and there seems to be at least some amount of displacement occurring on the Yellowstone.

As river use on the Upper Yellowstone continues to grow, it is important to consider the ability of all user groups to still have a high-quality experience. If measures of satisfaction are artificially high due to not accounting for displacement and other coping mechanisms, portions of user groups that are displaced due to crowding may not be factored into management decisions. The importance of the river to the local economy cannot be understated, and ensuring satisfaction is accurately measured to include possibly displaced users is essential to maintaining the quality of the recreational experience and the functioning of the local recreation-based economy.

CHAPTER 3: RESEARCH SETTING

The Yellowstone River is the longest free-flowing river in the Lower 48 United States. After avoiding the construction of several proposed dams, one of which would have inundated much of Montana's Paradise Valley, today the upper portion of the river is a major destination for floating and fishing, drawing recreationists from all around the country and the world.

The upper section in Montana from Gardiner to Livingston is the focus of this study and has seen increasing recreational use as cities and towns in Montana grow, spurring concerns of crowding by locals and visitors. Neighboring Gallatin County, MT has grown 23.3 percent, and Park County, MT where the Upper Yellowstone is located has grown 3.8 percent in the period from 2010 – 2019 (US Census 2020). The fastest growing and largest city in the region is Bozeman, MT which grew 28.3 percent and added 10,306 to its population, accounting for over half the total growth in Gallatin County from 2010 to 2019. The city of Livingston, MT grew 10.8 percent in the same period, adding 758 residents and accounting for 78 percent of the population growth in Park County. When spending time in the Paradise Valley it is easy to see why so many people are willing to travel long distances to recreate on the river, with its stunning views and excellent fishing. Immediately north of Yellowstone National Park and Gardiner, MT the river first passes through Yankee Jim Canyon, which has several rapids, and is used more by whitewater focused recreationists than anglers, so fishing pressure is lower in this first stretch. Moving north, the stretches making the Upper Yellowstone internationally known begin. Here the river earns its name as one of the premier trout waters in the world and draws substantial numbers of fishing enthusiasts to its waters each year. Adding to the fishing experience, while on the Yellowstone, recreationists are surrounded by scenic mountain views in all directions with the Gallatin Range to the west and the dramatic Absaroka Range to the east (refer to maps in methods chapter).

The lower section of the river from Livingston to Big Timber, MT contains both different and similar characteristics to the Upper Yellowstone. It is similar in size (growing larger further downstream as it collects the flow from tributaries), contains mostly the same fish species, and tends to stay reasonably cool yearlong. However, unlike the Upper Yellowstone, this portion is not located in a confined scenic valley, it runs through a prairie-like landscape with less trees. In this stretch, there is less fishing pressure, and fish tend to be larger than the upper section. Downstream from Big Timber, the river gets warmer, wider, flows slower, and the quality of trout fishing drops, and fishing pressure is even lower. Because of its proximity and similarity to the upper portion, the portion of the river from Livingston to Big Timber lent itself to be the best for conducting surveys to attempt to identify spatial displacement. Both stretches of the river have many access points, almost all of which are administered

and maintained by Montana Fish Wildlife and Parks (FWP), with several access sites near Gardiner maintained by the US Forest Service (USFS), and one site, Carbella, is maintained by the Bureau of Land Management (BLM).

In 2017, angler surveys recorded 72,306 angler days on the roughly 80 mile long Upper Yellowstone River stretch from Gardiner to Livingston, and 30,514 angler days on the roughly 34 mile long Livingston to Big Timber stretch (Montana Fish, Wildlife & Parks 2017). The Upper Yellowstone accounts for about 3.5 percent of the total angler days on streams for the state of Montana. The Yellowstone River is an integral part of the local economy and maintaining the high quality of the resource for recreation is very important to the economic health of the region. The tourism industry in Park County provides an estimated 2700 jobs, about 28 percent of all jobs in Park County (Swanson, 2016).

Regulations relating to the study site

On October 7, 2004, the Montana Fish, Wildlife & Parks Commission adopted administrative rules for river recreation management in Montana (Montana Fish, Wildlife, & Parks 2004). These provide guidelines for management decisions and established citizen advisory committees. Public comments were taken on the rules, with a wide variety of concerns and opinions on the best course of action to take to address river management. One rule of particular importance to making management decisions is:

"When determining how a river should be managed, the commission shall consider management methods in the following order: (a) nonrestrictive management methods; (b) restrictive management methods; and (c) rationing methods."

Non-restrictive options would include educational efforts to attempt to reduce conflict without changing the level of use of the river. "Restrict" means to regulate when and where the public or river service providers can recreate on a river, or the types of recreation that are allowed. Rationing means regulating the amount of use on a river, through permitting. This may or may not apply to all user groups (e.g., floaters could be required to obtain a permit, but anglers may not). This would be the management tool of last resort, only to be implemented after less restrictive management options have been tried, or decided to be ineffective to avoid wasting time while conditions worsen. Currently the Yellowstone River does not have any permitting system in place, but it may be an option that is considered in the future as river use continues to grow.

The 2004 administrative rules for river recreation have not been updated since their adoption, and Montana Fish Wildlife and Parks is not currently considering adopting any restrictive measures for the

Upper Yellowstone. This limits any future action to within the confines of the rules, which require the progression from non-restrictive to restrictive measures. This process was recently used on the Madison River, another popular river for fishing and floating located near the towns of Ennis and Three Forks. The rulemaking process was initiated by two separate petitions from a coalition of sporting groups, and from the Fishing Outfitters Association of Montana (FOAM), seeking to address concerns of fishery overuse and degradation, maintaining access for commercial and non-commercial use, and access site acquisition and maintenance (Montana Fish, Wildlife, and Parks 2020). On October 17th, 2019, Montana Fish Wildlife and Parks adopted permanent "hoot owl" restrictions from July 15th through August 15th each year, where fishing is prohibited each day from 2 PM to Midnight on the stretch of river from Warm Springs Boat Launch to the confluence with the Jefferson River. This was done to avoid the emergency restrictions that had often been enacted each summer when water temperatures grow too warm. On December 24th, 2020, the updated Madison River Recreation Rules officially went into effect. These rules include a cap on outfitter numbers based on 2019 and 2020 numbers, and a rest/rotation schedule as well as walk/wade restrictions for some sections. Most of the rules, including the rest/rotation schedule, walk and wade sections, and cap on commercial use did not start until 2022. The updated rules took almost three years to develop, and required many public meetings, comments, and work with interest groups, the public and Montana Fish Wildlife and Parks staff.

Most of the land bordering the Yellowstone River in the Paradise Valley is privately owned, but there are numerous public river access points. In Montana, per the Montana Code Annotated Title 23 Part 2 Chapter 3, recreationists have full use of most natural waterways, including the Yellowstone between the high-water marks. Therefore, river users can travel wherever they please in the river corridor below the high-water marks, despite bordering property being privately owned.

CHAPTER 4: METHODS

Data Collection

The primary method deployed for data collection was an on-site intercept survey designed to capture a convenience based sample of angler information, characteristics, and crowding perceptions. Anglers were intercepted while fishing on the Yellowstone using a tablet-based survey with the Qualtrics offline application. The intercept effort was initially designed such that the number of target intercepts by site was in approximate proportion to expected volume at each location. An effort was made to spend at least some time at almost every access site, with some sites having more time allocated because of expected higher angler volumes and greater opportunity to collect more surveys. While attempts were made to target sites with higher angler numbers based on conditions for the day, this proved to be harder than expected as angler use of individual sites on any given day was unpredictable and did not appear to follow any established pattern. Data collection locations were Fishing Access Sites (FAS) on the Yellowstone River, the farthest upstream site in-person surveying was done at was Yankee Jim (though five sites farther upstream were listed as options on the survey), the furthest downstream was Otter Creek. In total, intercepts were conducted across 13 locations: 1) Otter Creek; 2) Grey Bear; 3) Springdale; 4) Highway 89 Bridge; 5) Mayor's Landing; 6) Carter's Bridge; 7) Pine Creek; 8) Mallards Rest; 9) Grey Owl; 10) Emigrant; 11) Point of Rocks; 12) Carbella; and 13) Yankee Jim.

Data was collected during the period from July 9th, 2021, to September 26th, 2021 (Table 1). Anglers were typically intercepted while waiting to launch or take out, with care taken to not slow them down while their vehicle is sitting in the boat ramp to prevent delays.

Date	Access Site	Survey Period
9-Jul	Mayors Landing	1:30-3:00 PM
9-Jul	Pine Creek	3:50-6:00 PM
9-Jul	Mallards Rest	7:00-9:00 PM
10-Jul	Grey Owl	6:00-10:50 AM
10-Jul	Carbella	2:15-4:30 PM
10-Jul	Point of Rocks	6:10-7:40 PM
11-Jul	Carbella	7:30-8:30 AM
11-Jul	Grey Owl	9:20-10:20 AM
11-Jul	Springdale	1:40-3:00 PM
15-Jul	Carters Bridge	5:00-6:30 PM
21-Jul	Otter Creek	5:15-8:45 PM
22-Jul	Grey Bear	7:30-10:30 AM
22-Jul	Hwy 89 Bridge	10:45 AM-2:00 PM
23-Jul	Mallards Rest	6:45 AM-2:15 PM
24-Jul	Grey Owl	6:30-10:15 AM
24-Jul	Emigrant	10:30 AM-2:30 PM
13-Aug	Yankee Jim	6:15-11:00 AM
14-Aug	Emigrant	7:00 AM-1:00 PM
15-Aug	Mayors Landing	7:00 AM-2:50 PM
20-Aug	Springdale	7:15-10:45 AM
21-Aug	Hwy 89 Bridge	7:00-10:00 AM
22-Aug	Grey Bear	7:15-7:50 AM
4-Sep	Mallards Rest	8:15-11:45 AM
5-Sep	Carbella	8:00 AM-1:00 PM
5-Sep	Carbella	2:00-4:00 PM
6-Sep	Grey Bear	8:10 AM-2:00 PM
25-Sep	Point of Rocks	9:40 AM-1:30 PM
26-Sep	Carters Bridge	8:30-11:00 AM

Table 1. Survey Schedule by Location

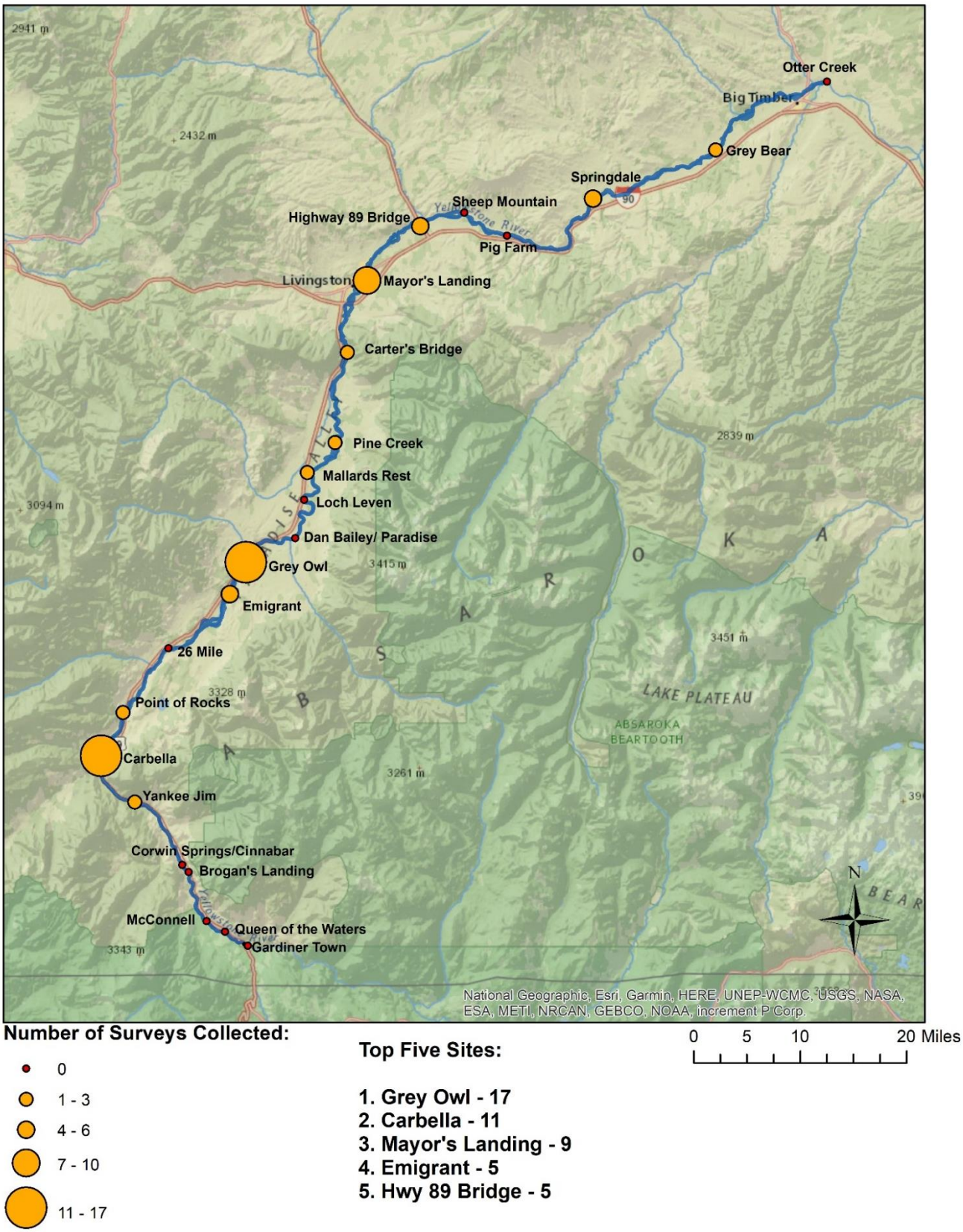


Figure 2. Location and Volume of Collected In-person Surveys

Initially, in accordance with standard intercept survey practice, anglers were approached and asked to take the roughly 10-minute survey. I identified myself as a graduate student at the University of Montana conducting a survey for my thesis, and would appreciate their input, which may be important for the future management of the river. For the vast majority of the time spent at access sites, it was not busy enough to require skipping anglers, I was able to approach nearly every fishing group. If the respondent agreed to take the survey in-person, they were asked the questions out loud, and shown images on the tablet as needed, while they went about their activity of waiting or preparing to launch. Locations are shown proportionally to how many surveys were collected on the map above (Figure 2).

Starting during the July 21st -24th survey period, if the potential respondent refused the onsite intercept, they were asked if they would be willing to provide their email to take an identical online version of the survey after their outing. Two emails were also collected during the first round of survey periods from July 9th-11th, but this was not initially planned. Following each data collection period an email was sent to all collected addresses with an invitation to participate and link to the online survey. The angler was asked about their last trip on the Yellowstone River. A reminder was sent to all 103 collected emails on October 1st to complete the survey if not already taken.

On July 20th Hoot Owl restrictions were put into effect due to warm water temperatures. This closed fishing on the river from 2PM to 12 AM and restricted the time available to survey anglers at the fishing access sites. It also seemed to have the effect of pushing start times for day trips earlier and seemed to make anglers act more rushed and less likely to take the intercept survey in the earlier morning hours. In an attempt to increase responses for time spent, additional effort was applied to collecting emails, instead of in person responses, as few people were willing to take the survey in person and spend 5-15 minutes of their time.

Further, beginning on August 20th, in an effort to contact more anglers and achieve a greater response number, I placed fliers under the windshield wipers of vehicles parked at fishing access sites (Figure 3).

Figure 3. Flier placed on windshield of vehicles at FAS

Using this method, I was able to visit numerous access sites along the river and cover a much greater portion of the river traffic for the day. Fliers were primarily placed on vehicles with trailers in order to not repeatedly contact the same party, as most groups will have one car for a shuttle, or use a shuttle service to move their vehicle and trailer from the put-in site to the take-out site. Data collection periods started as early as 6AM in order to contact possibly displaced early morning anglers, and simply to contact as many anglers as possible, and typically stopped around 2PM during the period of hoot owl restrictions from late July to August 24th when the restrictions were lifted.

River access sites were typically the most active from 8-10AM, and in the afternoon around 1-3PM as anglers had to stop fishing due to hoot owl restrictions. When restrictions where not in effect, surveying went later into the afternoon or evening, but numbers of angler contacts were usually not as high as in the morning or early afternoon hours.

Response Rates

While the initial method of data collection was an on-site intercept survey, over the survey period the focus shifted to collecting e-mails of anglers to send the survey to fill out after their trip and placing fliers with a link to the survey under vehicles wind-shield wipers. 161 total responses were collected, 66 of which were in-person surveys and 95 were responses from emails or windshield fliers. An estimated 75% of the approached anglers were willing to provide their e-mail, and less than half were willing to take the survey in person, when that was the sole method in use. 103 emails were obtained, which were then contacted later and sent a link to the survey to take it at their leisure. 520 fliers were distributed by placing under windshield wipers of vehicles at fishing access sites. In total, 623 non-in-person contacts were made, and 95 survey responses were gathered from this group, for a 15% non-in person response rate. There were several responses on the online survey which were empty, these were omitted from the results. Many surveys were also incompletely filled out, but answered questions were still included in the results, resulting in questions with different response totals.

Survey Instrument

Demographics

Basic information about respondents was gathered, including age and gender, home zip codes, fishing experience level, time spent fishing in Montana and on the Yellowstone River, and type of group they were with. Home zip code is of particular importance as this data is used to divide the sample into local and non-local responses, which is used to compare how each group answered select questions.

Location Characteristics

Information was collected about the popularity of access sites, put in and take out locations, and site preference, in order to understand which sections of the river face the highest use levels, and to compare if these are the most preferred areas.

Activity Characteristics

Information was collected about type of fishing, such as guided or private, or wade/shore fishing. Respondents were also asked if fishing is the primary activity, if this is their primary fishing river, and if they participate in any other non-fishing activities on the Yellowstone River. Respondents were asked to rate how important several conditions were in choosing to fish on the Yellowstone, and their preferences on weekdays vs. weekends and time of day. Data was collected on the top three months in time spent fishing, and months where no time is spent fishing on the Yellowstone.

People at One Time

PAOT is applied in this study approximating approach developed by Manning and colleagues (1996). Perceptions of crowding and displacement thresholds are evaluated by including pictures of a section of river with varying amounts of people. Fifteen pictures (See Appendix for Images) were created using stock images in photoshop, all with the same background photo of the Yellowstone River but with differing amounts of people and user types. Five pictures in each of three categories were created, one group only has only anglers in the scene, one has only non-anglers, and one group has a mix of both (Table 2). In each group of five pictures there is a range of people from a relatively uncrowded scene with only two groups of users to a very crowded scene with as many as twelve groups or individuals on the river (Figure 4). Each of the pictures is given a mean acceptability rating, which is a simple average score from the sample that ranked the picture. All the photos will be plotted together to create an acceptability curve, where quadratic relationships can be modeled similar to the Manning study.

Picture Number	User Type	Number of Anglers	Number of Non-Anglers	Total PAOT
PAOT Fish 1	Only Anglers	3	0	3
PAOT Fish 2	Only Anglers	5	0	5
PAOT Fish 3	Only Anglers	9	0	9
PAOT Fish 4	Only Anglers	11	0	11
PAOT Fish 5	Only Anglers	14	0	14
PAOT Mix 1	Mix Anglers and Non-Anglers	1	3	4
PAOT Mix 2	Mix Anglers and Non-Anglers	2	8	10
PAOT Mix 3	Mix Anglers and Non-Anglers	4	6	11
PAOT Mix 4	Mix Anglers and Non-Anglers	5	14	19
PAOT Mix 5	Mix Anglers and Non-Anglers	6	21	27
PAOT No Fish 1	Only Non-Anglers	0	4	4
PAOT No Fish 2	Only Non-Anglers	0	10	10
PAOT No Fish 3	Only Non-Anglers	0	20	20
PAOT No Fish 4	Only Non-Anglers	0	23	23
PAOT No Fish 5	Only Non-Anglers	0	30	30

Table 2. Type and number of people in each PAOT picture

Figure 4. PAOT Mix 3 Image

Of the 15 PAOT images created for the survey, each respondent was shown four randomly selected images (selected by Qualtrics, the survey software) and asked to rate the acceptability of each. Additionally, three additional PAOT questions asked about the number of people the respondent expected to see, their desired conditions, and maximum amount of people they would be willing to tolerate. For these questions the five images with a mix of anglers and non-anglers were shown. This was done to increase sample size for each image and increase the reliability of results by having a standard set of possible responses for the three questions so they can be compared with each other. The maximum they would be willing to tolerate can be viewed as a displacement threshold.

This methodology was applied on the Niobrara River by USFS researchers Davis and Lindvall (2000) to assess the relationship between crowding and satisfaction, I used a similar approach to assess the relationship between crowding and satisfaction on the Yellowstone while also expanding the scope to include displacement.

Perceptions and Responses to Crowding

This section is where respondents are most directly asked about displacement, by asking how they would respond to a river that was more crowded than they normally find acceptable. They were also asked where they pictured the crowding occurring. Where they picture the crowding is also an indication of where crowding tends to be most problematic, and likely to cause displacement. The preceding PAOT section attempts to establish expected and desired crowding levels, as well as a maximum willing to

tolerate or a displacement threshold, this section attempts to narrow down specifics on how the respondent would be displaced.

Place Attachment to the Yellowstone River

Place attachment can be an important part of why people may choose to recreate where they do. Using a set of questions drawn from the National Park Service's 2020 Pool of Known Questions on place attachment used in an earlier river use study on the Salmon River in Idaho (Armatas, Mudford, and Thomsen, Unpublished 2023), respondents were asked to rate their level of agreement with three statements. The goal of this is to investigate how attached to the Yellowstone River anglers tend to be, and to understand if it influences displacement. Groups from the "response to crowded conditions" question are compared by their answers to the place attachment questions.

Perceptions of Policy and Management Actions

Respondents were asked to rate their level of agreement with nine statements about tourism, use limits, protecting scenery, and river flows for different reasons, as well as irrigation and water consumption restrictions. These questions were also based on the Salmon River Use Study (Armatas, Mudford, and Thomsen, Unpublished 2023). Responses were compared between the groups of locals and non-locals to investigate if the higher level of experience and familiarity of the river influences the perceptions of different policy and management options. Respondents were also asked how important eight different statements were to their acceptance of management decisions. This information may be useful to river managers when considering future management options.

CHAPTER 5: RESULTS

5.1 Demographics

Age and Gender

Question: "What is your age?" and "What is your gender?"

Figure 5 shows the age and gender of respondents, ranging in age from 19 to 76, with a mean age of 44.8 (s.d = 14.3) years (n=143). Eighty five percent of respondents (n=119) self-identified as male, fifteen percent (n=21) self-identified as female. Respondents were provided open response for gender and were subsequently coded as male or female based on their entries. Two observations were removed due to nonsensical answers.

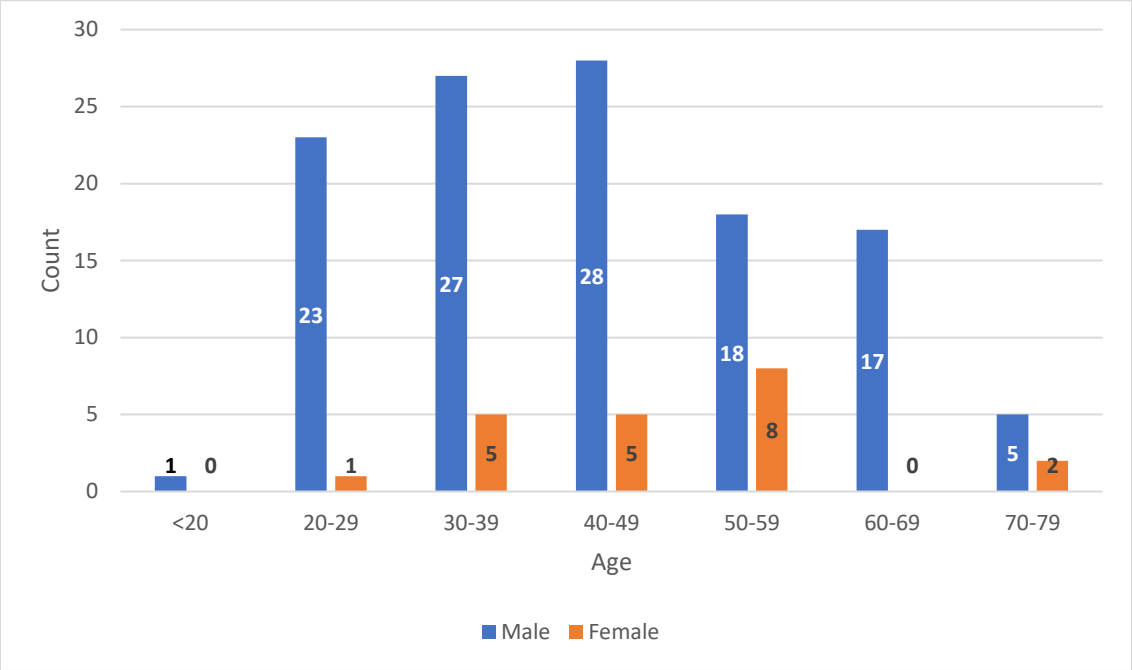


Figure 5. Age and Gender of Survey Respondents

Visitor Home Zip Codes

Question: "What is your zip code?"

A local area was identified to differentiate groups by their residency (figure 6). They were categorized as local or non-local respondents. The local area contains all zip codes that are at least partly within a 50-mile radius centered on downtown Livingston. This center point was chosen because its location as the central hub of the study area and its importance to the Yellowstone River corridor. A large portion of local residents I spoke to live in the Livingston or the Bozeman area (which includes Belgrade and Four Corners). Additionally, this local area captures the major population centers. Zip codes of respondents are displayed in Figures 7 and 8. Figure 8 shows the wide geographic range of people that come to fish on the Yellowstone River. Of the 140 respondents that provided valid zip codes, 94 (67.1%) of those were from Montana and 46 (32.9%) were from another state. Of the 94 respondents with Montana zip codes, 77 (81.9%) were from the local area, and 17 (18.1%) were not from the local area.

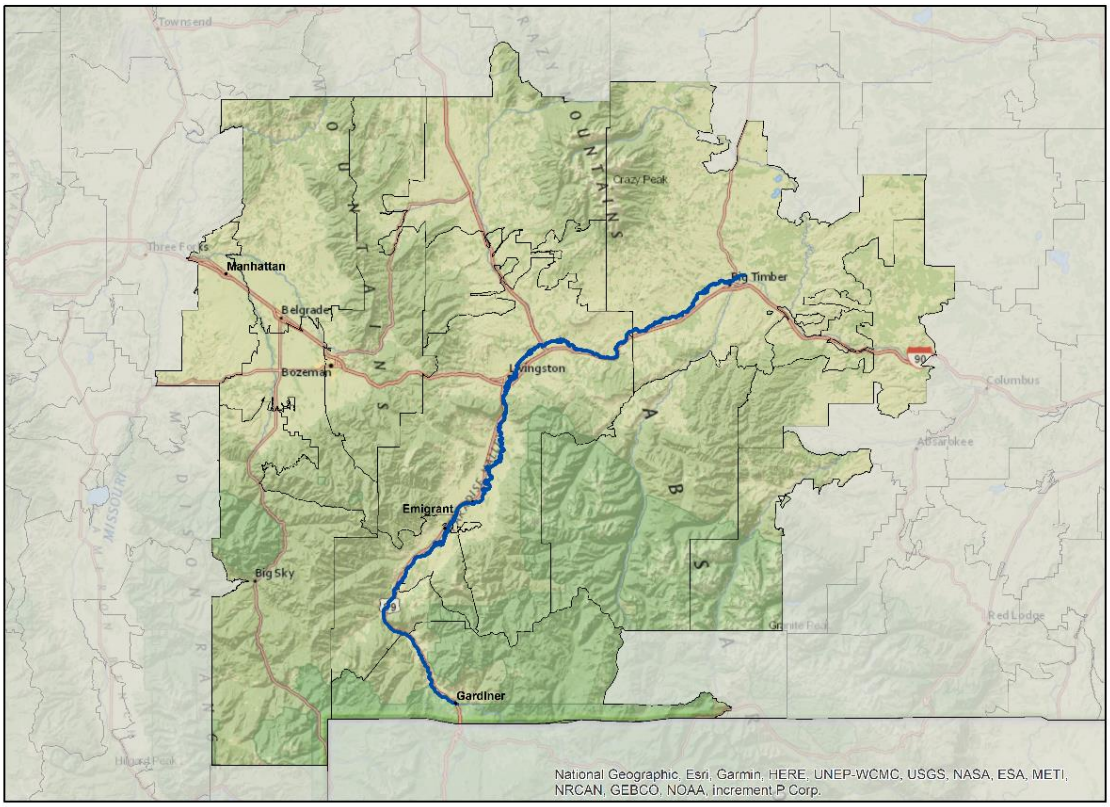


Figure 6. Local Area Zip Codes

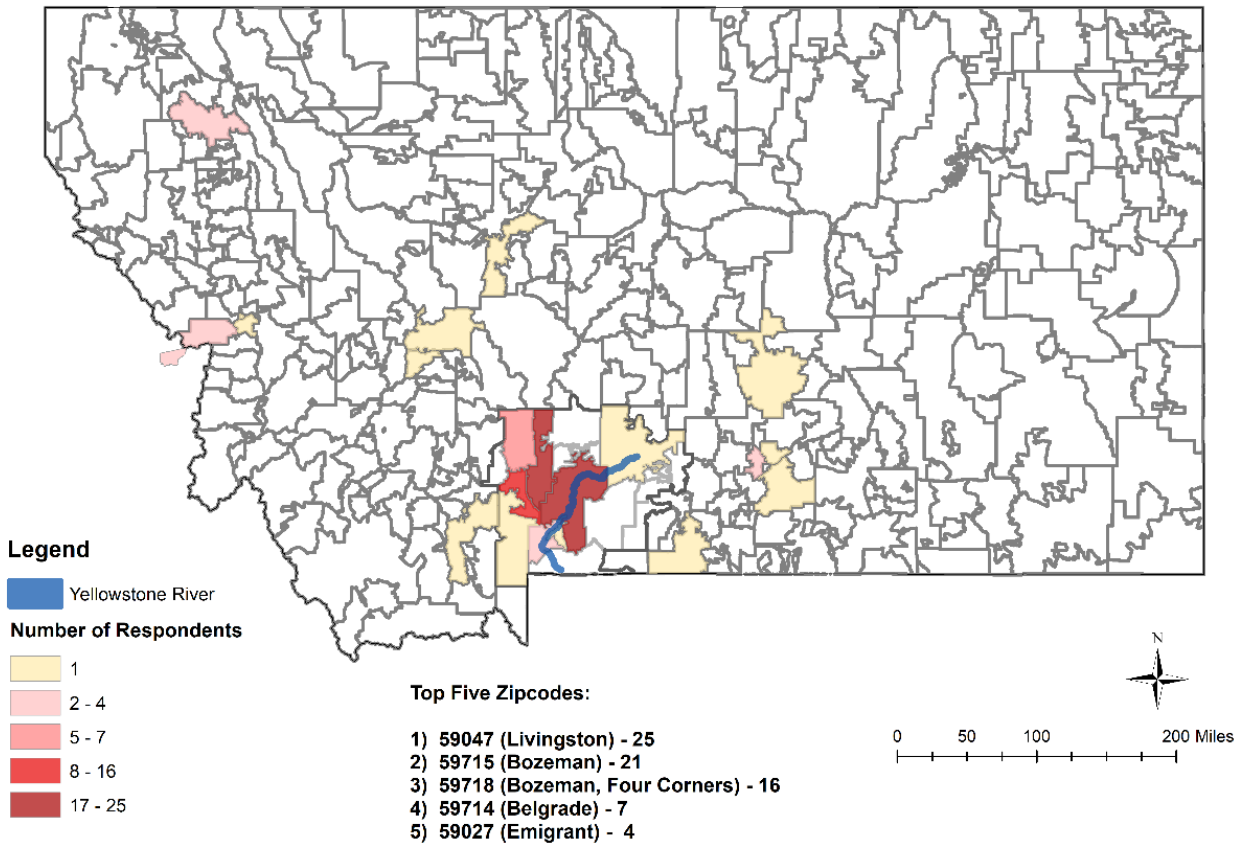


Figure 7. Montana Home Zip Codes of Survey Respondents

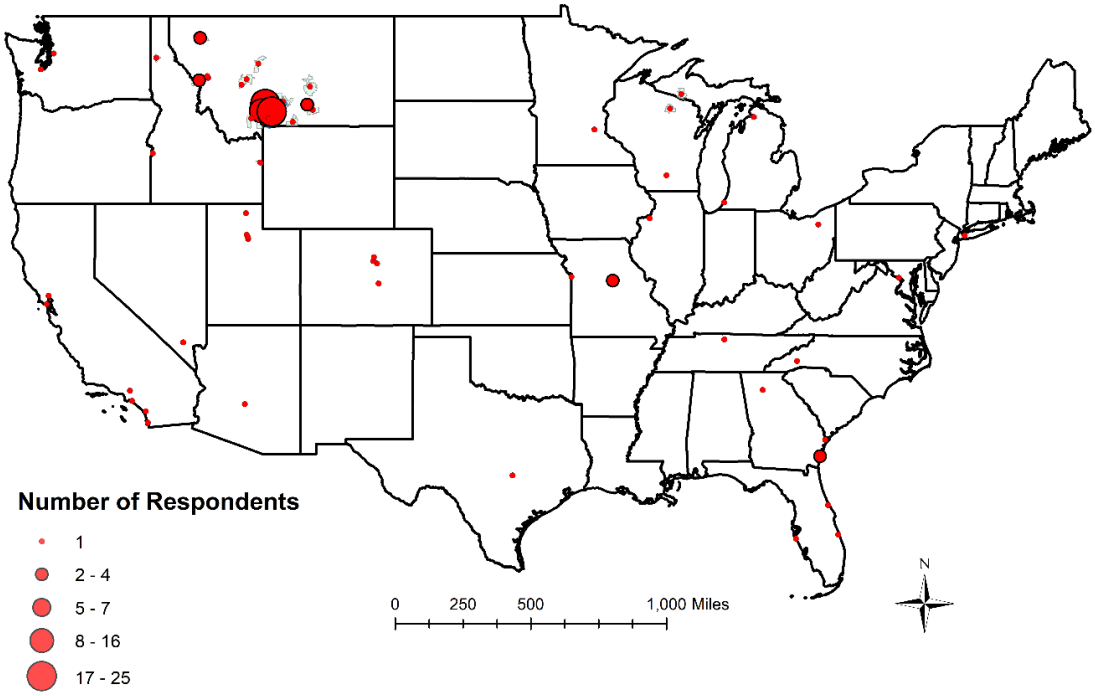


Figure 8. United States Home Zip Codes of Survey Respondents

Fishing experience level

Question: "How long have you been fishing?"

Experience Level	Proportion	Count
Less than a year	4.20%	6
1-4 years	6.29%	9
5-9 years	2.80%	4
10-14 years	4.90%	7
15-19 years	11.89%	17
20+ years	69.93%	100
Total	100%	143

Table 3. Fishing Experienced Level of Survey Respondents

Table 3 shows over two thirds of the sample have been fishing for twenty years or more, indicating that most of the people I surveyed were relatively experienced anglers. Locals tended to have a higher experience level, 63 out of 75 locals answering this question had been fishing for 20+ years, while only 37 out of 68 non-locals answering this question had been fishing for 20+ years.

Time spent fishing in Montana

Question: "How long have you been fishing on rivers in Montana?"

Only 38.89% of respondents have been fishing in Montana for more than twenty years, when compared with the total experience level of the sample (Table 4) this suggests that many anglers surveyed have spent a substantial amount of their fishing careers on bodies of water outside the state. Of the 76 locals that answered this question, 41 had been fishing on rivers in Montana for at least 20 years, compared to non-locals where only 15 out of 68 respondents had been fishing on rivers in Montana. The most popular choice for this question for non-locals was less than one year, with 20 respondents.

Experience Level	Proportion	Count
Less than a year	15.28%	22
1-4 years	9.72%	14
5-9 years	13.89%	20
10-14 years	13.19%	19
15-19 years	9.03%	13
20+ years	38.89%	56
Total	100%	144

Table 4. Time Spent Fishing on Montana Rivers

Time spent fishing on the Yellowstone River

Question: "How long have you been fishing on the Yellowstone River?"

Table 5 shows the greatest variance in their time spent fishing on only the Yellowstone compared to fishing in the state and fishing anywhere. It is interesting to note that while the time spent is more spread out than tables three and four, over 80% of the sample has been fishing on the Yellowstone for at least one year. Out of the 76 locals that answered this question, 33 answered over 20 years, which was the most popular selection. For the 68 non-locals that answered this question, only 11 selected over 20 years, while the most popular response was less than a year with 25 responses.

Experience Level	Proportion	Count
Less than a year	19.44%	28
1-4 years	14.58%	21
5-9 years	12.50%	18
10-14 years	14.58%	21
15-19 years	8.33%	12
20+ years	30.56%	44
Total	100%	144

Table 5. Survey Respondents Time Spent Fishing on the Yellowstone River

Number of people in personal group (not including guides)

Question: "Including yourself, how many people are in your personal group while fishing today (not including guides)?"

Table six shows the average group size of respondents' parties. Two outlier responses (55 and 67 adults in group) were omitted from average and standard deviations, as respondents likely included people in their group that they were not actually fishing with. The sample size for this question was 162.

	Adults	Children	Total
Average	2.87	0.25	3.12
Standard Deviation	1.96	0.62	1.97

Table 6. Group Size of Survey Respondents

Group Type

Question: "What type of group are you with today?"

Table 7 shows the type of group the survey respondent was in on the day they took the survey, or their last trip. There were 20 "Other" responses, those were coded and included into the Friends, Family, or a newly created (not on original survey) Guided Group categories. It is likely that all guided groups did not select other and write that they were in a guided group, some may have selected other responses according to who else was in their group.

Group Type	Proportion	Count
Friends	29.27%	48
Family	27.44%	45
Family and Friends	14.63%	24
Significant other/spouse	13.41%	22
Guided Group	9.76%	16
Alone	5.49%	9
Total	100%	164

Table 7. Type of group the survey respondent was with when contacted, or on last trip

5.2 Location Characteristics

Information on where survey responses were collected is available in the methods section (Table 1) with a map of the study area displaying which sites had the most surveys collected from (Figure 2). The top three sites I spent the most time surveying at were Mallards Rest (13 hours), Carbella (10.25 hours), and Emigrant (10 hours). Time spent at the other access sites surveyed ranged from 3.5 hours to 9.5 hours.

Popularity of Access Sites

Question: "In a typical year, which three access sites on the Yellowstone River do you use the most?"

The most popular selections were Mallards Rest (33.79%), Grey Owl (32.41%), and Carter's Bridge (28.97%) (Table 8). 145 people responded to this question, and most respondents selected three sites as the question requested, but some selected only one or two sites. Some respondents were fishing on the Yellowstone for the first time, and could not choose three sites, they could only choose two which were the ones they were using on that float.

Fishing Access Site	Proportion	Count
Mallards Rest	33.79%	49
Grey Owl	32.41%	47
Carter's Bridge	28.97%	42
Pine Creek	23.45%	34
Emigrant	22.76%	33
Point of Rocks	20.00%	29
Carbella	17.93%	26
Loch Leven	13.10%	19
Mayor's Landing	13.10%	19
Springdale Bridge	11.03%	16
Highway 89 Bridge	10.34%	15
McConnell	7.59%	11
Yankee Jim	5.52%	8
26 Mile	5.52%	8
Grey Bear	5.52%	8
Otter Creek	4.83%	7
Brogan's Landing	3.45%	5
Other (please specify)	3.45%	5
Dan Bailey	2.76%	4
Corwin Springs/ Cinnabar	2.76%	4
Emigrant West	2.07%	3
Queen of the Waters	1.38%	2
Sheep Mountain	0.69%	1
Total		395

Table 8. Access sites selected as top three most used by survey respondents

Note: Other responses were Pig farm (2), Pelican – This site is located outside the study area east of Big Timber, Deputy spring creek – This is likely a typo of Depuy spring creek, located in the Paradise Valley south of Livingston, and Gardner town.

Put-in Locations

Question: "If floating, what site did you (or are you) putting in today?"

Respondents were asked to select where they put-in on their current trip to the river, or if the survey was taken online they were asked to select where they put-in on their last trip to the river (Table 9). Respondents were then asked if this site is their preferred put-in site on the Yellowstone River (Table 10). Grey Owl is the most popular put in site, it marks the start of what is commonly called the "bird float", a very popular stretch from Grey Owl to Mallards Rest. This was likely a difficult question for many to answer unless they tend to stick to floating the same stretch of river. Options with zero responses that were not listed in the table include Queen of the Waters, Brogan's Landing, Emigrant West, Dan Bailey, Sheep Mountain, Otter Creek, and Corwin Springs/Cinnabar. Nearly half (47.79%) of respondents indicated they were not using their preferred put-in site (Table 10).

Fishing Access Site	Proportion	Count
Grey Owl	27.94%	19
Carter's Bridge	11.76%	8
Yankee Jim	8.82%	6
Carbella	8.82%	6
Point of Rocks	7.35%	5
Emigrant	5.88%	4
Highway 89 Bridge	5.88%	4
Mayor's Landing	4.41%	3
Springdale Bridge	4.41%	3
Loch Leven	2.94%	2
Mallards Rest	2.94%	2
Pine Creek	2.94%	2
26 Mile	1.47%	1
Grey Bear	1.47%	1
McConnell	1.47%	1
Other (Pig Farm)	1.47%	1
Total	100%	68

Table 9. Put-in locations selected by survey respondent

Note: The two original "Other" responses were re-coded from Joe brown and Pig farm to Yankee Jim and Other (Pig Farm), respectively. Joe Brown is an alternate name for the Yankee Jim USFS access site, while Pig Farm is an unmarked site on FWP owned land between the Highway 89 Bridge and Springdale Bridge access sites. 26 mile is an unofficial access site on private land between the Point of Rocks and Emigrant access sites.

Question: ""Is this your preferred put-in site on the Yellowstone River?"

Preferred Site	Proportion	Count
Yes	47.79%	65
No	52.21%	71
Total	100%	136

Table 10. Put in site preference of respondents

Take-out Location

Question: "If floating, what site did you (will you) take out today?"

Table 11 shows Mallards Rest is the most popular take-out site and is the end of the "Bird Float" mentioned in the above put in question. Emigrant West is a walk-in site, and it is unlikely people actually took out there, selections were likely a mistake where the respondent actually took out at Emigrant. Respondents were then asked if this site is their preferred take-out site on the Yellowstone River (Table 12). Similar to their responses about preferred put-in sites, nearly half indicated they were not using their preferred take-out location. This was likely a difficult question for many to answer unless they tend to stick to floating the same stretch of river. Options with zero responses that are not listed in the table include Queen of the Waters, Brogan's Landing, Yankee Jim, Dan Bailey, Sheep Mountain, McConnell, and Corwin Springs/Cinnabar.

Fishing Access Site	Proportion	Count
Mallards Rest	22.06%	15
Mayor's Landing	14.71%	10
Carbella	11.76%	8
Emigrant	10.29%	7
Springdale Bridge	5.88%	4
Point of Rocks	4.41%	3
Loch Leven	4.41%	3
Carter's Bridge	4.41%	3
Highway 89 Bridge	4.41%	3
Grey Bear	4.41%	3
Emigrant West	2.94%	2
Pine Creek	2.94%	2
Otter Creek	2.94%	2
26 Mile	1.47%	1
Grey Owl	1.47%	1
Other (please specify)	1.47%	1
Total	100%	68

Table 11. Take out locations selected by survey respondent

Note: The one other response was Yellowstone Valley Lodge, which is a private resort located on the river between Mallards Rest and Loch Leven access sites.

Question: "Is this your preferred take-out site on the Yellowstone River?"

Preferred Site	Proportion	Count
Yes	52.21%	71
No	47.79%	65
Total	100%	136

Table 12. Take out site preference of respondents

5.3 Activity Characteristics

Question: "What type of fishing are you here to participate in today? – mark all that apply"

All respondents were asked to indicate the type of fishing they were doing on the day they were contacted to take the survey, or their last fishing trip if they took the online survey. Respondents were provided the opportunity to indicate multiple types of fishing. More than half of all respondents (52.33%) indicated they were in a private boat/float, while 34.88% indicated a guided boat/float (Table 13). The "other" responses listed indicating the respondent was not fishing are the result of the respondent still considering themselves an angler but just not fishing today, so still took the survey, or someone in a group in which a member was fishing filled out the survey for the group but was not actually an angler themselves.

Type of Fishing	Proportion	Count
Private boat/float fishing	52.33%	90
Guided boat/float fishing	34.88%	60
Wade/shore fishing	8.72%	15
Other (please specify)	4.07%	7
Total	100%	172

Table 13. Type of fishing respondent participated in

Note: Other responses were Rafting, Private white water rafting, fishing, General floating, no fishing today, Not fishing today, Photo

Question: "Is fishing your primary activity on the Yellowstone River (i.e., the activity you participate in most often)?"

Fishing is the primary activity for the majority (86.96%) of respondents (Table 14), many anglers may still participate in other activities (Table 17) but are more focused on fishing.

Response	Proportion	Count
Yes	86.96%	140
No	13.04%	21
Total	100%	161

Table 14. Fishing as primary Yellowstone River activity

Question: "Would you consider this river to be your primary fishing river (i.e., the river you fish most often)?"

Over two thirds of respondents selected the Yellowstone as their primary or one of several primary rivers (Table 15). There are several other popular rivers for fishing in the region, including the Gallatin and Madison, which may contribute to the "One of several" responses.

Response	Proportion	Count
Yes	37.89%	61
One of several	31.06%	50
No	31.06%	50
Total	100%	161

Table 15. Yellowstone River as primary fishing river

Question: "What would you consider to be your primary river"?

Only respondents who answered no to the previous question of if the Yellowstone is their primary river were shown this question, were not prompted with any choices and filled in what they considered to be their primary river (Table 16). Montana Rivers are well represented in the list, but there are numerous other rivers from all over the United States Listed because many non-locals were intercepted.

Montana Rivers	Other Rivers	Non-River Responses
Big Hole River	Arkansas River, CO	N/A
Bitterroot River	Caddy	None
Blackfoot River (3)	Chattahoochee River	I don't have one. I'm a tourist.
Clark Fork River	Cuyahoga River, OH	Lakes and ponds
Gallatin River (7)	Fall River	Visiting
Madison River (4)	French Broad, NC	
Missouri River (4)	Henry's Fork, ID	
	Lewis River, WA	
	Logan River, UT	
	North Fork	
	Middle Provo River, UT	
	Owens River, CA	
	Provo River, UT	
	Rapid Creek	
	Sacramento River, CA	
	Salt River, AZ	
	San Juan River	
	Tennessee River	
	Teton River, ID	
	The White River, AR	
	Wisconsin River, WI	
	Wood River	

Table 16. Primary river of respondents

Question: "Do you ever participate in any of these other river activities on the Yellowstone River? Mark all that apply."

Respondents could select multiple options on this question, 111 people selected at least one activity (Table 17). Interestingly, nobody selected kayaking, canoeing, or paddleboarding, indicating that most anglers surveyed are mostly dedicated to fishing when floating the river. Many of the activities can also be done during a fishing trip (such as swimming, camping, picnicking, and birding, and wouldn't require separate trips to participate in.

Activity	Proportion	Count
Camping (at river access campsite)	54.95%	61
Private group non-fishing raft trip	41.44%	46
Swimming	37.84%	42
Picnicking (at river access site)	27.03%	30
Exercise/dog walking (at river access site)	27.03%	30
Tubing	20.72%	23
Birding/nature observation (at river access site)	16.23%	18
Guided non-fishing raft trip	13.51%	15
Other	11.71%	13
Kayaking, canoeing, paddleboarding	0.00%	0
Total		278

Table 17. Non-fishing activities respondents participate in

Note: Other responses were Rock collecting (4), N., biking along river, Islands, Camping from raft, guided floats, Hunting (2), No, and Photography.

Fishing Condition Preferences

Question: "For the following set of conditions, please rate how important each is to you in choosing to fish on this river."

The most important conditions to the sample as a whole were good water conditions, which are highly relevant to good fishing conditions, scenic value and nature experience, and solitude or few people on the river (Table 18). The latter two conditions suggest that a fishing trip is about more than just catching fish, anglers also value the nature-based experience and opportunities for solitude. It makes sense that good water conditions were rated as the most important with over one quarter of respondents selecting extremely important, as they are probably the single most determining factor in the quality of fishing that can be found on a particular day. While it was still ranked as moderately important, it also makes sense that the reputation of the river is ranked the least important of all the conditions, as the sample had a majority of locals and Montanans, who may be less likely to be drawn to the river by reputation and more for the conditions themselves.

Condition	Not at all important (1)		Slightly important (2)		Moderately important (3)		Very important (4)		Extremely important (5)		Mean (Std. Dev.)
Good water conditions (temperature, flow)	3.82%	6	1.91%	3	19.75%	31	47.13%	74	27.39%	43	3.92 (0.94)
Scenic value and nature experience	5.10%	8	7.01%	11	27.39%	43	35.67%	56	24.84%	39	3.68 (1.08)
Solitude or few people on the river	4.40%	7	10.69%	17	32.08%	51	35.85%	57	16.98%	27	3.50 (1.03)
Favorable timing for fishing (hatches occurring, etc.)	10.69%	17	15.09%	24	29.56%	47	31.45%	50	13.21%	21	3.21 (1.17)
Previous successful trips	15.09%	24	10.06%	16	31.45%	50	29.56%	47	13.84%	22	3.17 (1.23)
Good weather	11.32%	18	17.61%	28	33.33%	53	31.45%	50	6.29%	10	3.04 (1.09)
Reputation of the river	23.42%	37	8.23%	13	29.11%	46	27.85%	44	11.39%	18	2.96 (1.32)

Table 18. Importance of favorable conditions in choosing to fish on the Yellowstone River

Question: "Assuming all days have similar environmental conditions, what days would you prefer to fish on this river? (Please select one)"

Weekdays were much more popular stated preference than weekends (Table 19). Though they were not asked why, this may suggest anglers anticipate weekends to be busier and would like to avoid this and have a quieter experience. This would also be supported by the high degree of importance placed on solitude by the sample, shown in the previous question. (Table 18). Differences between local and non-local responses were compared with no significant differences identified (p-value=0.591).

Day	Proportion	Count
Weekdays	82.23%	130
Weekends	18.67%	28
Total	100%	158

Table 19. Preferred time of week for fishing

Question: "Assuming all times have similar environmental conditions (e.g., water conditions), what time of day would you prefer to fish on this river? (Please select one)"

The morning hours were by far the most popular choices, with over two thirds (70.89%) selecting early or mid-morning as their preferred fishing time on the Yellowstone (Table 20). Differences between local and non-local responses were compared through the Chi-square test, which did find a significant difference between groups (p-value=0.049). While roughly one-third of both groups suggested they preferred the early morning period, non-locals were more likely to prefer later mornings, and locals spread their activity out more across the day (Table 21).

Time	Proportion	Count
Early morning (before 9 AM)	33.96%	54
Mid-morning (9 AM - 12 PM)	37.11%	59
Mid-day (12 PM - 3 PM)	8.81%	14
Afternoon (3 PM - 6 PM)	10.06%	16
Evening (after 6 PM)	10.06%	16
Total	100%	159

Table 20. Preferred time of day for fishing

Time	Locals Count	Locals Proportion	Non-Locals Count	Non-Locals Proportion
Early morning (before 9 AM)	26	34.67%	28	33.33%
Mid-morning (9 AM - 12 PM)	20	26.67%	39	46.43%
Mid-day (12 PM - 3 PM)	10	13.33%	4	4.76%
Afternoon (3 PM - 6 PM)	10	13.33%	6	7.14%
Evening (after 6 PM)	9	12.00%	7	8.33%
Total	75		84	

Table 21. Locals vs. non-locals preferred time of day for fishing

Question: "In a typical year, which are your top three months in time spent fishing on the river?"

Given the opportunity to select up to three months, respondents indicated that summertime months of August and July are the most popular, with September edging out June for third (Figure 9). There is also a small dip in numbers for the month of May, this may be because during parts of May and June on most years' runoff is very high and conditions are not favorable for fishing or water recreation. This would line up well with the high importance ranking of good water conditions in choosing to fish on the Yellowstone River.

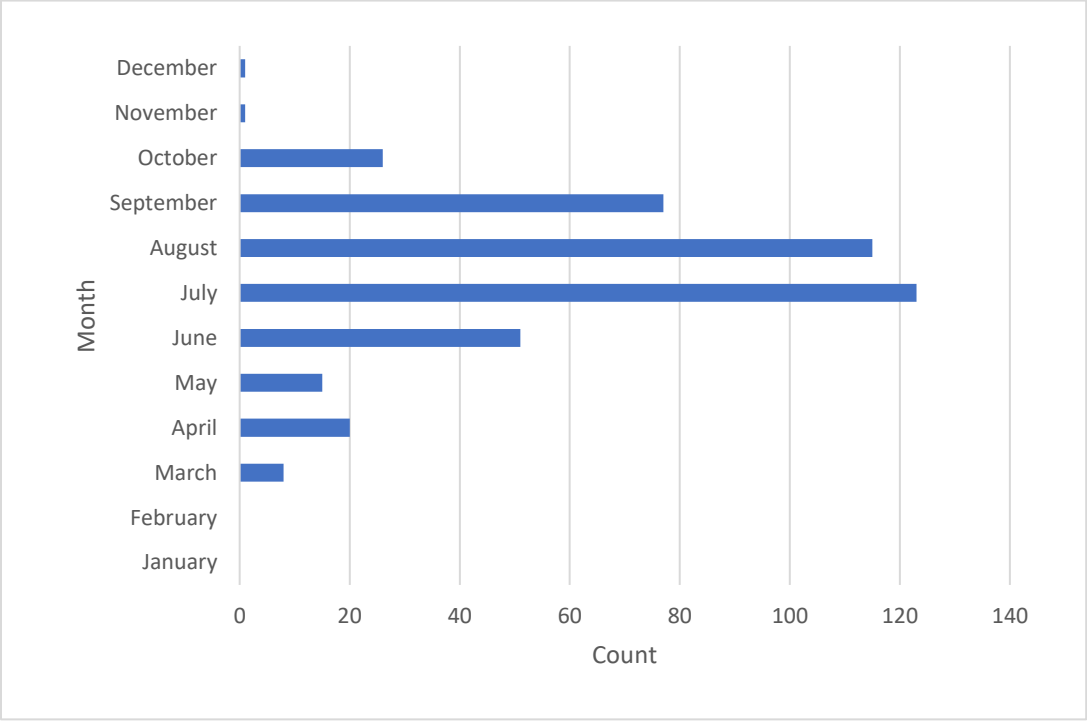


Figure 9. Top months in time spent fishing on the Yellowstone

Question: "In a typical year, are there any months where you do not spend any time fishing on the river?"

In addition to the top months for fishing, respondents were asked about any months in which they do not fish on the Yellowstone (Figure 10). As should be expected, results produced a rough mirror image of the previous question. Many anglers do not fish on the Yellowstone during the coldest months of the year, with over 100 respondents not fishing at all in January (115) and February (105).

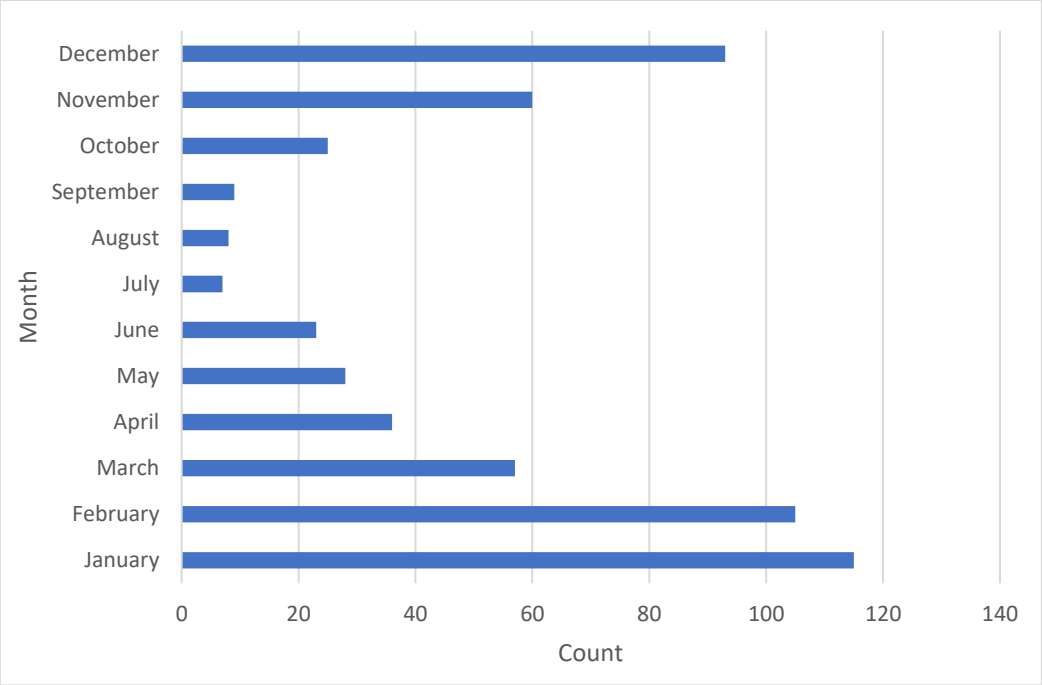


Figure 10. Months where no time is spent fishing on the Yellowstone River

Most anglers on the Yellowstone fish more often in the warmer months, and many don't at all during the colder months. Fishing pressure data from Montana Fish, Wildlife, and Parks for 2020 agrees with this, showing all sections but one of the Upper Yellowstone having much larger pressure numbers in the summer than the winter. In section 10 angler pressure was slightly higher in winter than in summer, with 10,728 and 10,561 angler days respectively. Total angler days for winter in sections 06B-10 (where I conducted my study) were 59,719, and total angler days for summer in the same sections were 112,403 (Montana Fish, Wildlife, & Parks 2020). In the FWP data, the winter months are October through April, and the summer months are May through September.

5.4 People at One Time (PAOT) Questions

Acceptability of different use levels

To begin to explore the first research question "What is the relationship, if any, between varying levels of crowding on the Upper Yellowstone River and the stated acceptability by anglers, and is that relationship affected by use type?", respondents were asked a series of acceptability questions based on produced images of varying river usage. These were then followed by questions relative to their expected usage levels, desired conditions, and their maximum willingness to tolerate high usage.

Question: "Please rate this photo on how acceptable the level of use is to you."

Respondents were each asked to rank the acceptability of four randomly selected images out of the 15 created for this survey (Figure 11). A ranking of 1 is very unacceptable, 2 is moderately unacceptable, 3 is neutral, 4 is moderately acceptable, and 5 is very acceptable. They were also asked to choose which of the five mixed user group images was the closest to what they expected to see, which is closest to what they desired, and which is closest to the maximum amount of people they would be willing to tolerate while going through with their planned fishing activity (Figure 12). The five mixed user group images were chosen for these three questions to create a standard set of possible responses for the three questions so they can be compared with each other.

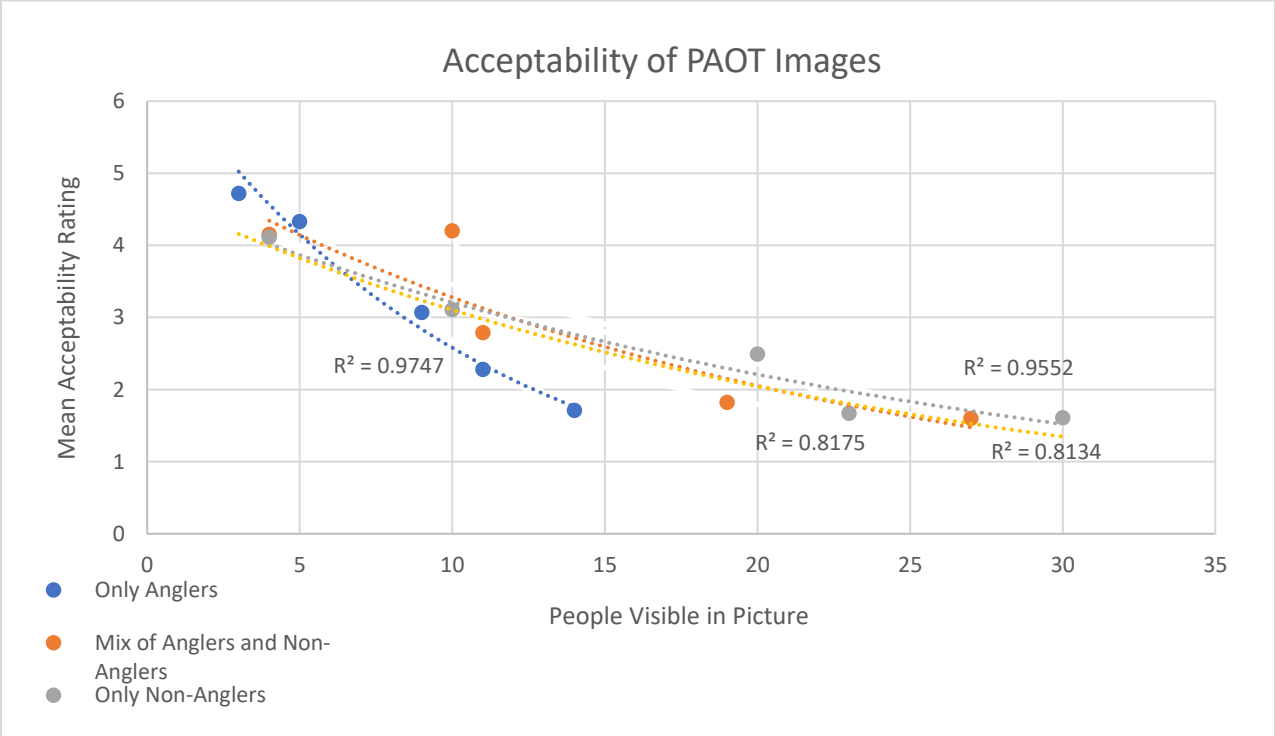


Figure 11. Acceptability of PAOT Images, trendlines and R^2 values

In Figure 11, four trendlines are shown, one for each image group by user type. The R^2 values are fairly high for each group, indicating that substantial variation in the acceptability ratings can be explained by the number of people visible in the picture. As should be expected, the lowest R^2 (0.8134) was for the trendline for all 15 images, and closely approximates the slope and distribution of the mix of anglers and non-anglers image results. The trendline for the images with only anglers has the highest explanatory power, resulting in an R^2 of 0.9747. This group also and also has the steepest negative slope, showing people ranked images with more anglers as more unacceptable with a relatively lesser increase in number of people in the image. The acceptability rating stays higher with more non-anglers added to the image, showing people ranked images with more non-anglers as relatively more acceptable as more were in an image. Given the common courtesy practices often described among anglers that encourage providing other anglers adequate space, the maximum number of anglers in any given image were capped at a lower value than that of non-anglers. The table below (Table 22) shows how many people were in each image, the mean acceptability rating of each, and the sample size that ranked each image.

Picture Number	Number of Anglers	Number of Non-Anglers	Total PAOT	Mean Acceptability Rating	Sample Size
PAOT Fish 1	3	0	3	4.72	32
PAOT Fish 2	5	0	5	4.33	33
PAOT Fish 3	9	0	9	3.07	42
PAOT Fish 4	11	0	11	2.28	40
PAOT Fish 5	14	0	14	1.71	45
PAOT Mix 1	1	3	4	4.15	40
PAOT Mix 2	2	8	10	4.2	46
PAOT Mix 3	4	6	11	2.79	52
PAOT Mix 4	5	14	19	1.82	34
PAOT Mix 5	6	21	27	1.6	42
PAOT No Fish 1	0	4	4	4.11	45
PAOT No Fish 2	0	10	10	3.11	45
PAOT No Fish 3	0	20	20	2.49	45
PAOT No Fish 4	0	23	23	1.67	40
PAOT No Fish 5	0	30	30	1.61	36

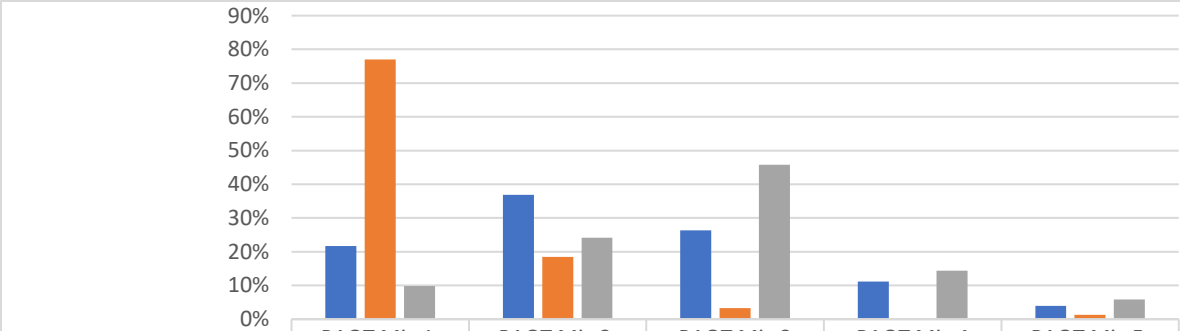
Table 22. Number and type of river users in PAOT Pictures

Question: Which of these images most closely matches the number of people you expected to see on the river today?

Question: Which of these images most closely matches your desired conditions for your river recreation activity?

Question: Which of these images most closely matches the maximum amount of people you would be willing to tolerate on the river, and continue with your planned fishing?

For ease of interpretation of Figure 12, information from Table 22 is also shown below. Figure 12 shows the expected, desired, and maximum amount of people on the river respondents would be willing to tolerate. Unsurprisingly, almost all respondents would like to see few people on the river, but many expected to see about how many they desired or somewhat more people than they desired. The maximum amount people were willing to tolerate had a wide variation, but the middle picture with 11 total PAOT was the most common choice, which also contained more people than the majority of the sample expected to see. This may indicate that the level to cause displacement for most anglers is not something they expect to see on the river.



	PAOT Mix 1	PAOT Mix 2	PAOT Mix 3	PAOT Mix 4	PAOT Mix 5
Expected	21.71%	36.84%	26.32%	11.18%	3.95%
Desired	76.97%	18.42%	3.29%	0.00%	1.32%
Max willing to Tolerate	9.80%	24.18%	45.75%	14.38%	5.88%

Figure 12. Expected, desired, and maximum amount of people willing to tolerate PAOT images

Below: Excerpt from Table 22. Number and type of river users in PAOT Pictures

Picture Number	Number of Anglers	Number of Non-Anglers	Total PAOT
PAOT Mix 1	1	3	4
PAOT Mix 2	2	8	10
PAOT Mix 3	4	6	11
PAOT Mix 4	5	14	19
PAOT Mix 5	6	21	27

5.5 Perceptions and Responses to Crowding

The previous section explored the first research question and identified the existence of relationship between the level of perceived crowding on the Yellowstone River and the stated acceptability of those conditions by anglers. In this next section (and the one that follows), the second research question, "If a relationship is found to exist, what is the stated coping mechanism by anglers, and does the level of place attachment to the river influence the stated response and subsequent river use patterns?" is explored. This section gauges the response to conditions that exceed their stated level of acceptability.

Question: Imagine that you discovered during your next planned trip to the Yellowstone River, that the river was more crowded than you normally find acceptable. What would you be most likely to do? (Select only one)

Answer	Proportion	Count
I would still fish, but elsewhere on the Yellowstone	30.00%	45
I would make an exception and still fish in this area at this time	26.00%	39
I would still fish, but on a different river or river segment	16.67%	25
I would still fish in this area, but on a different day of the week	10.00%	15
I would still fish, but at a different time of day	8.00%	12
I would participate in a different activity elsewhere	6.00%	9
Other	2.67%	4
I would participate in a different activity on the Yellowstone	0.67%	1
Total	100%	150

Table 23. Response to hypothetical crowded conditions

Note: Other Responses were CANCEL TRIP, Fish different section, Depends on the day, and MTN lake.

Table 23 shows the response an individual would have to a crowded river. Given the effort required to get to the river is likely different based on the respondent being local or non-local; differences in their responses were compared. For this comparison the other responses of "CANCEL TRIP", "Depends on the day", and "MTN lake" were all from non-locals and omitted from the analysis because they did not fit well with any other responses, and it was not possible to compare other responses between the groups. The "Fish different section" response was from a local, and was recoded to "I would still fish,

but elsewhere on the Yellowstone". Differences between local and non-local responses were compared through the Chi-square test, with no significant differences identified (p-value=0.629). Nearly a third of respondents selected "I would still fish, but elsewhere on the Yellowstone", which indicated that the imagined crowding would cause them to spatially displace. "I would still fish, but on a different river or river segment" selected by 16.67% of respondents represents an even more severe spatial displacement response. The responses "I would still fish, but at a different time of day" and "I would still fish in this area, but on a different day of the week" would be two types of temporal displacement and were only selected by a combined 18% of respondents. This response may be less likely because the anglers have already planned a day of fishing and made the trip out to the river, so coming back later would likely be a large waste of time. 26% of respondents would simply deal with the crowding and stick with their original plans for the trip, these individuals could be said to be resistant to displacement.

Question: "When imagining the crowding in the above question, where did you picture the crowding occurring?"

For this question, more than one selection could be chosen, and 150 people responded to this question. Respondents may have answered this question how they did for several reasons, one possibility could be that the area(s) selected are where they have observed crowding during past river trips, another possibility could be they selected the areas that they would find most disruptive. Either way, the parking area was selected much less often than the boat ramp and on the river, this may be because anglers don't typically spend much time in the parking area, and crowding in the boat ramp and on the river may cause more of an unpleasant effect on their trip.

Answer	Proportion	Count
Boat ramp	61.33%	92
On the river	58.00%	87
Parking area	18.67%	28
Other	0.67%	1
Total		208

Table 24. Where respondents picture the crowding occurring

Note: The one other response was "All"

5.6 Place Attachment to the Yellowstone River

Place attachment is a phenomenon where people create a bond between themselves or their group and their meaningful surroundings. People that spend a large amount of time in an area, often doing activities they find enjoyable frequently develop feelings of place attachment, and those who feel place attachment are often more supportive of conservation and planning measures that attempt to preserve a place (Walker and Ryan, 2008). Survey respondents were asked a to rank their agreement with a series of statements used to evaluate their degree of place attachment, and the possible relationship between place attachment and displacement was investigated.

Question: "Please rate your level of agreement or disagreement with the following statements:"

Average response for the first place attachment statement was very high, with about two thirds of respondents selecting strongly agree (Table 25). The average response second statement was closer to neutral but still in agreement, indicating that the Yellowstone River is not necessarily most angler's favorite river above all others, but is a good option out of other places they also fish. The average response for the third statement was somewhat disagree, but many people chose either strongly disagree or neither agree no disagree, with very few in agreement. This indicates that few anglers have chosen to fish on the Yellowstone because they have gotten displaced from another river.

Statement	Strongly disagree (-2)		Somewhat disagree (-1)		Neither agree nor disagree (0)		Somewhat agree (1)		Strongly agree (2)		Mean, (Std. Dev), Count
Being able to fish on the Upper Yellowstone River means a lot to me	2.07%	3	2.07%	3	10.34%	15	19.31%	28	66.21%	96	1.46 (0.91) 145
I enjoy fishing on the Upper Yellowstone River more than any other place	4.11%	6	8.90%	13	37.67%	55	23.29%	34	26.03%	38	0.58 (1.09) 146
I am fishing here because my preferred river is too crowded	46.58%	68	13.70%	20	28.77%	42	8.22%	12	2.74%	4	-0.93 (1.15) 146

Table 25. Agreement with place attachment statements

Place Attachment and Response to Crowded Conditions

The relationship between place attachment and response to crowded conditions was examined by finding mean place attachment scores for groups created from the response to crowded conditions question. The hypothesis and reason for investigating this relationship is that individuals with a high level of place attachment would be less likely to be displaced due to changing undesirable conditions. Observations along these lines have been previously seen in response to phenomena such as climate change (Perry et al. 2021). Here, this is explored based on river crowding. To establish if differences are present at significant levels, an ANOVA test is used to compare how the different groups from the crowded conditions question answered the place attachment questions.

Place attachment statement: Being able to fish on the Upper Yellowstone River means a lot to me.

In Table 26, the count is the number of people in each group, created by grouping respondents according to how they answered the crowded conditions question, and the average is the mean level of agreement with the place attachment statemen, where -2 is strongly disagree, 0 is neither agree nor disagree, and 2 is strongly agree.

Groups	Count	Average
I would make an exception and still fish in this area at this time	39	1.64
I would still fish, but elsewhere on the Yellowstone	44	1.61
I would still fish, but on a different river or river segment	23	1.43
I would still fish in this area, but on a different day of the week	15	1.40
I would still fish, but at a different time of day	12	1.17
I would participate in a different activity elsewhere	8	0.88
I would participate in a different activity on the Yellowstone	1	-1.00

Table 26. Response to crowded conditions question and level of agreement with first place attachment statement

For the first place attachment statement, an ANOVA test returned (F-value= 2.66, F-crit=2.17, p value=0.018). Because the F value is greater than the F critical value, and the P-value is less than 0.05, we can reject the null hypothesis, which is that there is no difference in this measure of place attachment among the groups created from answers to the response to crowded conditions question. Those who selected the first two responses had a high level of agreement with the place attachment statement, which was significantly higher than the other groups created from answers to the response to crowded conditions question.

Place attachment statement: I enjoy fishing on the Upper Yellowstone River more than any other place.

In Table 27, the count is the number of people in each group, created by grouping respondents according to how they answered the crowded conditions question, and the average is the mean level of agreement with the place attachment statemen, where -2 is strongly disagree, 0 is neither agree nor disagree, and 2 is strongly agree.

Group	Count	Average
I would still fish in this area, but on a different day of the week	15	0.87
I would still fish, but on a different river or river segment	23	0.83
I would still fish, but elsewhere on the Yellowstone	44	0.61
I would make an exception and still fish in this area at this time	39	0.59
I would participate in a different activity elsewhere	8	0.25
I would still fish, but at a different time of day	12	0.17
I would participate in a different activity on the Yellowstone	1	-1.00

Table 27.Response to crowded conditions question and level of agreement with second place attachment statement

For the second place attachment statement, An ANOVA test returned (F-value= 1.16, F-crit=2.17, p value=0.331). Because the F value is less than the F critical value, and the P-value is greater than alpha (0.05), we cannot reject the null hypothesis, which is that there is no difference in this measure of place attachment among the groups created from answers to the response to crowded conditions question.

Place Attachment and Time Spent Fishing on the Yellowstone River

The relationship between place attachment and time spent fishing on the Yellowstone River was examined by finding mean place attachment scores for the first two place attachment statements for each group created from the time fishing on Yellowstone River question (Tables 28 and 29). This was then tested for significance with the ANOVA test, which is used to compare how the groups based on experience level on the Yellowstone answered the place attachment questions.

Place attachment statement: Being able to fish on the Upper Yellowstone River means a lot to me.

Age Group	Count	Average
<1yr	27	1.11
1-4 yr	21	1.10
5-9 yr	18	1.61
10-14 yr	21	1.71
15-19 yr	11	1.64
20+ yr	44	1.64

Table 28. Time spent fishing on the Yellowstone and average response to first place attachment statement

For the first place attachment statement, An ANOVA test returned (F-value= 2.41, F-crit=2.28, p value=0.039. Because the F value is greater than the F critical value, and the P-value is less than alpha (0.05), we can reject the null hypothesis, which is that there is no difference in this measure of place attachment among the groups created from time spent fishing on the Yellowstone River.

Place attachment statement: I enjoy fishing on the Upper Yellowstone River more than any other place.

Age Group	Count	Average
<1yr	28	0.43
1-4 yr	25	0.24
5-9 yr	18	0.83
10-14 yr	21	0.81
15-19 yr	12	0.75
20+ yr	44	0.68

Table 29. Time spent fishing on the Yellowstone and average response to second place attachment statement

For the second place attachment statement, An ANOVA test returned (F-value= 1.12, F-crit=2.28, p value=0.350). Because the F value is less than the F critical value, and the P-value is greater than alpha (0.05), we cannot reject the null hypothesis, which is that there is no difference in this measure of place attachment among the groups created from answers to question 32.

5.7 Perceptions of Policy and Management Actions

To assess the third research question., "How do anglers on the Upper Yellowstone River perceive potential policy and management actions aimed at addressing river use and are there key attributes about the anglers that may influence their support of management actions?", respondents were asked to rank their agreement with nine statements relating to hypothetical policies or management actions on the Yellowstone River. Their answers are displayed in the tables below, along with an analysis of differences between locals and non-locals.

Question: "We would like to find out your opinions on policies and management related to the Yellowstone River and the social experience. Please indicate your level of agreement or disagreement with each statement:"

Overall, the average respondent agreed with each statement that made some reference to restrictions that would be proposed for a protective purpose (Table 30). Interestingly, protecting river flows for wildlife habitat was even more likely to be agreed with than scenic easements or protecting flows for fishing opportunities, the latter of which one might expect to be highest when surveying anglers. The average respondent did not agree with the statements of use limits and restrictions on irrigation should never be imposed, which makes sense as they are essentially inverse statements of the above statements. The average respondent was also somewhat in disagreement with the statement that there is room for tourism growth in the river corridor. Locals were in significantly greater disagreement with this statement than non-locals (Table 31), likely because they see additional tourism as a threat to the solitude of the river experience as more people would be doing recreational activities on the river with increased tourism. Differences between locals and non-locals are discussed below Table 31.

Statement	Strongly Disagree (1)		Somewhat Disagree (2)		Neither Agree or Disagree (3)		Somewhat Agree (4)		Strongly Agree (5)		Mean (Std.D) Count
If needed to protect river flows for wildlife habitat, restrictions on irrigation and water consumption should be imposed	3.40%	5	4.10%	6	13.70%	20	37.00%	54	41.80%	61	4.1, (1.01), 146
To protect scenery, easements that prevent more human development should be negotiated	1.40%	2	4.10%	6	20.70%	30	37.20%	54	36.60%	53	4.03, (0.93), 145
If needed to protect river flows for fishing opportunities, restrictions on irrigation and water consumption should be imposed	4.10%	6	6.20%	9	19.20%	28	37.70%	55	32.90%	48	3.89, (1.06), 146
If visitor-caused resource impacts are high, use limits should be imposed	5.50%	8	7.50%	11	13.70%	20	43.20%	63	30.10%	44	3.85, (1.10), 146
If needed to protect river flows for boating opportunities, restrictions on irrigation and water consumption should be imposed	3.40%	5	12.30%	18	21.20%	31	41.10%	60	21.90%	32	3.66, (1.06), 146
If people feel crowded, use limits should be imposed	12.50%	18	14.60%	21	21.50%	31	34.70%	50	16.70%	21	3.28, (1.26), 144
I believe there is room for tourism growth in the river corridor	25.50%	37	28.30%	41	22.80%	33	19.30%	28	4.10%	6	2.48, (1.18), 145
Use limits should never be imposed, even if use is high	26.70%	39	33.60%	49	20.60%	30	11.00%	16	8.20%	12	2.4, (1.22), 146
Restrictions on irrigation and water consumption should never be imposed	38.40%	56	24.70%	36	15.10%	22	11.60%	17	10.30%	15	2.31, (1.35), 146

Table 30.Opinions on policies and management related to the Yellowstone River

Statement	Strongly Disagree (1) %, n	Somewhat Disagree (2) %, n	Neither Agree or Disagree (3) %, n	Somewhat Agree (4) %, n	Strongly Agree (5) %, n	Mean (Std. Dev)
I believe there is room for tourism growth in the river corridor Locals n=76	32.9%, 25	28.9%, 22	18.4%, 14	14.5%, 11	5.3%, 4	2.3 (1.24)
Non-Locals n=65	16.9%, 11	26.2%, 17	27.7%, 18	26.2%, 17	3.1%, 2	2.7 (1.73)
If people feel crowded, use limits should be imposed Locals n=76	15.8%, 12	11.8%, 9	15.8%, 12	34.2%, 26	22.4%, 17	3.4 (1.94)
Non-Locals n=64	7.8%, 5	18.8%, 12	26.6%, 17	37.5%, 24	9.4%, 6	3.2 (0.96)
If visitor-caused resource impacts are high, use limits should be imposed Locals n=76	7.9%, 6	3.9%, 3	7.9%, 6	46.1%, 35	34.2%, 26	3.9 (2.75)
Non-Locals n=66	3.0%, 2	10.6%, 7	19.7%, 13	40.9%, 27	25.8%, 17	3.8 (2.14)
To protect scenery, easements that prevent more human development should be negotiated Locals n=75	1.3%, 1	4.0%, 3	21.3%, 16	26.7%, 20	46.7%, 35	4.1 (0.77)
Non-Locals n=66	1.5%, 1	4.5%, 3	18.2%, 12	50.0%, 33	25.8%, 17	3.9 (1.29)

Table 31. Locals vs. non-locals on select policies and management related to the Yellowstone River

In Table 31, each statement has two rows, the top contains the responses of locals, the bottom contains the responses of non-locals.

For the first statement in the table, "I believe there is room for tourism growth in the river corridor" differences between local and non-local responses were compared through the two-sample t-

Test assuming equal variances, (t-statistic=-2.11, df=139, p-value=0.04), indicating the null hypothesis of no difference between the groups can be rejected, and there is a significant difference between the groups.

For the second statement in the table, "If people feel crowded, use limits should be imposed" differences between local and non-local responses were compared through the two-sample t-Test assuming unequal variances, (t-statistic=0.65, df=138, p-value=0.52), indicating the null hypothesis of no difference between the groups can be accepted. The unequal variance test was used because the p-value returned from a F-Test two-sample for variances was significant to reject the null hypothesis that there was no difference in variance between the local and non-local groups.

For the third statement in the table, "If visitor-caused resource impacts are high, use limits should be imposed" differences between local and non-local responses were compared through the two-sample t-Test assuming equal variances, (t-statistic=1.02, df=140, p-value=0.31), indicating the null hypothesis of no difference between the groups can be accepted.

For the fourth statement in the table, "To protect scenery, easements that prevent more human development should be negotiated" differences between local and non-local responses were compared through the two-sample t-Test assuming equal variances, (t-statistic=1.23, df=139, p-value=0.22), indicating the null hypothesis of no difference between the groups can be accepted.

Question: "How important are each of these statements to your acceptance of management decisions on the Yellowstone River?"

Table 32 shows how people viewed the importance of eight statements in their acceptance of management decisions. Every statement had a mean score of at least moderately important, with the top four out of the eight statements scoring even higher than very important (4) on average. This may be because it is hard to view any of these statements negatively, and any management decision affecting such a popular recreational resource and people's livelihoods as well as the health of the ecosystem should consider all of the above factors. Perhaps the most interesting is the economic consequences statement, which ranked as relatively less important than all the other statements on average. This indicates that the sample as a whole is more concerned about management being based on science and environmental consequences as well as supporting the local community than economic consequences (though that latter two are certainly linked). It doesn't mean that the sample doesn't care about decision making based on economic consequences, as the statement is still ranked as moderately important on average, it is just less important than the other factors.

Statement	Not at all important (1)		Slightly important (2)		Moderately important (3)		Very important (4)		Extremely important (5)		Mean (Std. D.) Count
Science plays a role in the management decisions	5.5	8	7.5	11	13.7	20	43.2	63	30.1	44	4.33 (0.77) 143
The decision is based on environmental consequences	1.4	2	4.1	6	20.7	30	37.2	54	36.6	53	4.15 (0.88) 142
The decision maintains access for fishing	3.4	5	4.1	6	13.7	20	37	54	41.8	61	4.11 (0.86) 143
The decision has clearly stated objectives	12.5	18	14.6	21	21.5	31	34.7	50	16.7	21	4.03 (0.89) 143
The decision maintains and protects natural resources over human uses	4.1	6	6.2	9	19.2	28	37.7	55	32.9	48	3.97 (1) 143
The decision helps support the local community	25.5	37	28.3	41	22.8	33	19.3	28	4.1	6	3.76 (0.96) 143
The decision maintains access for other recreation	3.4	5	12.3	18	21.2	31	41.1	60	21.9	32	3.59 (1.08) 143
The decision is based on economic consequences	26.7	39	33.6	49	20.6	30	11	16	8.2	12	3.18 (1.03) 142

Table 32. Importance of a stated reason for a management decision on the Yellowstone River

5.8 Problematic Issues and Behaviors

Question:" During your current visit to the river, how problematic have each of the following issues been?"

Mean problematic ratings for each listed issue were under 2, indicating no issue was perceived as greater than a small problem on average across the sample (Table 33). Based in responses to this question, most river recreationists are well behaved.

Issue	Not at all a problem (1)	Small problem (2)	Moderate problem (3)	Very big problem (4)	Mean (Std. Dev), Count
Too many people on the river	41.78%	29.45%	19.86%	8.90%	1.96 (0.99) 146
Long wait to take out	52.48%	21.28%	21.99%	4.26%	1.78 (0.93) 141
Behavior of people at put in/take out	57.34%	16.78%	18.18%	7.69%	1.76 (1.00) 143
Long wait to put in	57.64%	27.08%	13.19%	2.08%	1.60 (0.79) 144
Availability of parking	61.38%	24.14%	11.03%	3.45%	1.57 (0.82) 145
Behavior of people on the river	65.73%	21.68%	9.09%	3.50%	1.50 (0.80) 143

Table 33. Problematic issues on a river trip

Question: "If any, what problematic behaviors do you commonly observe at the put in/take out?"

Responses were coded to fit common themes identified in Table 33. Four responses mentioned behavior of guides (fishing or whitewater) as problematic. By far the greatest problematic behavior indicated is people getting their boats ready on the ramp, or other poor ramp etiquette (Table 34).

Problem	Count
Getting boat ready on the ramp/ poor ramp etiquette	33
Being Slow	8
Cutting in line for take out	4
Inexperience/poor parking/ trailer driving	3
Selfish/lacking courtesy or ethics/ rudeness	5
Swimming near access	1
Boat ramp conflict, bumping into or arguments	2
Jetboats early season	1

Table 34. Problematic behaviors at put in/take out

Question: "If any, what problematic behaviors do you commonly observe on the river?"

Responses were coded to fit common themes identified below in table 33. Oftentimes a single response mentioned several problematic behaviors, so it was counted in multiple categories. By far the greatest problematic behavior indicated is poor river etiquette, which could encompass many behaviors and some of the other responses (Table 35).

Problem	Count
Poor river etiquette (passing to close, etc.)	22
Poor fish handling, overfishing when warm	4
Too Noisy/ Loud music	4
Foul Language	2
Drunkenness	7
Poor safety (no PFDs, tubing)	2
Ignoring Hoot Owl restrictions	1
Too large groups of floaters	1
Crowding wildlife/not respecting nature	2
Trash	1
Rudeness/Aggressiveness/Considering others	6
Low holing (several by guides)	3
Poor guide behavior/crowding	6

Table 35. Problematic behaviors on the river

Fifty-two respondents provided answers for the above two questions, there did not appear to be any pattern to how these respondents answered which sites they tend to use the most. Ten were non-locals, and 41 were locals, indicating locals were more likely to report problematic behaviors than non-locals. One of the 52 respondents did not provide their zip code.

CHAPTER 6: DISCUSSION

Setting out, the goal of this study was to examine the nature of displacement on the Upper Yellowstone River, and the thresholds of crowding that may cause recreationists to be displaced. Specifically, anglers on the river were surveyed with regard to three key questions: (1) What is the relationship, if any, between varying levels of crowding on the Upper Yellowstone River and the stated acceptability by anglers, and is that relationship affected by use type? (2) If a relationship is found to exist, what is the stated coping mechanism by anglers, and does the level of place attachment to the river influence the stated response and subsequent river use patterns? (3) How do anglers on the Upper Yellowstone River perceive potential policy and management actions aimed at addressing river use, and are there key attributes about the anglers that may influence their support of management actions? The research questions are ordered in increasing specificity to the potential opportunity or need of management actions based on currently perceived conditions by anglers. By following this line of inquiry, managers on this or other rivers facing growing usage may be better equipped to assess the user experience and potential user response as an input to overall management decision making processes.

Research Question One- What is the relationship, if any, between varying levels of crowding on the Upper Yellowstone River and the stated acceptability by anglers, and is that relationship affected by use type?

In exploring the first question of crowding and potential displacement on the Yellowstone, we know displacement has been well documented in the world of outdoor recreation; across multiple activities and wide geographic areas (e.g., Jacob and Scheryer, 1980; Kainzinger et al., 2015; Manning et al., 1996; Sterl et al., 2004). Yet, the literature is thin relative to anglers and riverways, but has been anecdotally noted by Lamborn and Smith (2019) who indicate that elements of displacement arose naturally in their conversations with Yellowstone River outfitters, guides, researchers, and managers, despite it not being a focus of their study. It is here that we first see alignment with those previous studies across recreation types. Consistent with those other settings and observations by Lambron and Smith, a clear trend is observed among anglers on the Yellowstone River in the acceptability ratings of the PAOT images used in the survey, increasing numbers of people visible in the image results in a decreased acceptability rating.

Similar to the findings of Arnberger and Haider (2007), who found that context and specific activity or behavior matter on trail user ratings of crowding and thus displacement, it does appear there may be an effect where other anglers are perceived more negatively than non-anglers. Anglers could be

perceived as more negative for several reasons. Anglers may be more sensitive to the presence of other anglers due to a sense of competition, and that others fishing in the same area may scare away fish or make them more wary of their own flies and less likely to bite. Anglers may also tend to spend more time in particular spots on the river that they think are more likely to hold fish, while non-anglers would quickly float by. If desirable fishing holes are often occupied by other anglers on a float, this could have a greater impact on the anglers' experience than non-fishing river users, though they can come with their own set of issues. Increased numbers of anglers and other river users coming into contact with each other on the river has the potential to increase conflict, defined as "goal interference attributed to another's behavior" (Jacob and Schreyer, 1980). The common goals of catching fish, experiencing solitude, and enjoying time in nature could all be easily interfered with by the presence of other anglers or floaters. Even if there is no verbal or physical altercation this could be considered a type of conflict.

In the summer of 2021, when data for this study was collected, anglers and non-anglers were often separated by timing due to the hoot owl restrictions that were in place a large portion of the summer, starting on July 20th. This likely lead to less frequent interactions between anglers and non-anglers, as anglers had to stop fishing at 2PM, and other river users typically would not start their day floating until temperatures have warmed up in the afternoon. Less frequent interactions could have had the effect of less of a negative perception of non-anglers, as people tend to remember recent experiences better, and if most interactions or simply seeing others on the river were with anglers, they could be viewed as less acceptable.

Research Question Two- If a relationship is found to exist, what is the stated coping mechanism by anglers, and does the level of place attachment to the river influence the stated response and subsequent river use patterns?

Unsurprisingly, when asked which image matches their desired conditions, respondents readily selected the picture with the least amount of people, accounting for 77% of the responses. Moving on, the question of how many people they expected to see had a wider range of responses; though, 85% of the responses were in the lower three of the five pictures shown, with 4, 10, and 11 people shown in the images. Finally, the maximum amount of people a respondent would be willing to tolerate resulted in a higher average, with the third photo claiming 46% of the responses. So, on average, respondents desired to see about 4 people, but would be willing to tolerate about 10 people, based on the most popular responses to the discussed questions. This begins to suggest that most anglers are willing to tolerate more people than their desired conditions, but only to a point.

It cannot be concluded from the questions asked by this survey, but these anglers may be using coping mechanisms other than displacement to help deal with an undesirable amount of people, this could include mechanisms such as product shift or rationalization (Manning and Valliere, 2001). The point where anglers would not be willing to tolerate more people and would change their river use plans could be considered the displacement threshold for the individual, depending on their response to the crowded conditions. For the majority of anglers, the crowding in their selected expected conditions falls under the maximum they would be willing to tolerate, so most anglers would be expected to not have their river use patterns greatly altered under the current use levels. It is important to consider which images were used for the desired, expected, and maximum willing to tolerate questions, each asked only about the mixed user group pictures. Results may have been different if the only anglers or only non-angler pictures were used for these questions.

Anglers were asked their response *to "Imagine that you discovered during your next planned trip to the Yellowstone River, that the river was more crowded than you normally find acceptable. What would you be most likely to do?"* to see if they would displace or simply deal with the crowded conditions and not change their plans. Roughly one-quarter of respondents answered that they would still fish in the area at the time under those conditions. The remaining respondents (74%) indicated they would modify their plans in some way. Of these, 30% indicated they would fish elsewhere on the Yellowstone, revealing they would spatially displaced. Another 17% indicated they would fish on a different river or river segment; again, representing a spatial displacement. Lastly, 18% suggested they would fish at a different time of day or different day of the week, indicating they would be temporally displaced. Because anglers have already invested the time and resources to travel out to the river for a day of fishing, it is not surprising that spatial displacement is a more common response to the hypothetical crowding in the question than temporal displacement, which would require abandoning the day's plans and making another trip back to the river at another time.

When the anglers were asked where they picture the hypothetical crowding in the above question occurring, respondents were closely balanced between being on the river (61.33%) or at the boat ramp (58%). This question had the option to select more than one response, 30 anglers selected both the boat ramp and on the river. While a crowded boat ramp and access site with a long wait to put in or take out can be unpleasant, it typically will only be a small portion of the anglers' trip to the river. Anglers may be willing to overlook crowding at the access site if the on-river experience remains relatively uncrowded. When speaking to anglers during the survey periods, I often heard comments that while access sites can be busy, people tend to spread out on the river, and it is usually not crowded feeling once on the water.

The question which asked "*Which of these images most closely matches the maximum amount of people you would be willing to tolerate on the river and continue with your planned fishing?"* attempts to identify a displacement threshold. When responses of locals and non-locals were compared, no significant difference was found, indicating that the two groups have on average similar displacement thresholds.

Respondents that selected the responses *"I would make an exception and still fish in this area at this time"* and *"I would still fish, but elsewhere on the Yellowstone"* for the response to crowded conditions question tended to have a higher level of agreement to the place attachment statement *"Being able to fish on the Upper Yellowstone River means a lot to me."* This may indicate that those with higher levels of place attachment are less likely to displace, which would make sense as those people appear more connected specifically to the Yellowstone River and may not be as interested in spending time fishing on a river they do not have a high level of place attachment to. Similarly, Perry and Colleagues found place attachment to be a moderating factor decreasing the likelihood of displacement in Vermont State Parks due to climate change (Perry et al., 2021). However, there was no apparent significant relationship between the groups and the second place attachment statement; *"I enjoy fishing on the Upper Yellowstone River more than any other place."* When Hammit and colleagues (2004) studied experience use history (EUH), place bonding, and resource substitution, it was found that those with longer EUH tended to have higher place bonding, and there was no significant effect on resource substitution, which is a type of displacement. In a future study, it may be useful to ask questions that ask more directly about place attachment and displacement and analyze results by comparing EUH groups.

Ultimately, the question of if an individual would displace, use another coping mechanism, or not is highly dependent on the individual and their preferences and goals that they are aiming to achieve from their fishing experience. Some anglers are more willing to tolerate crowding and are less likely to displace, while some are more sensitive, but still may or may not displace. This decision depends on a wide array of factors, only some of which were investigated or discussed in this thesis.

Research Question Three- How do anglers on the Upper Yellowstone River perceive potential policy and management actions aimed at addressing river use, and are there three key attributes about the anglers that may influence their support of management actions?

One series of questions in the survey asked about respondents' opinions on several statements about hypothetical policies or management actions on the river. This data may be useful to managers when considering future management actions, though further investigation into specific issues would be necessary before instituting any management actions. Overall, the sample was somewhat wary of tourism growth in the river corridor, with an especially notable skew of locals being much less approving than

non-locals. This suggests that local anglers may be more aware or concerned of perceived negative impacts from tourism than non-locals, which is unsurprising as the locals likely spend more time on the river and in their communities than the non-locals. The respondents were overall slightly supportive of use limits to limit crowding and resource impacts, and very supportive of the use of easements to prevent additional development along the river. Respondents were also overall very supportive of restrictions on irrigation to protect wildlife, as well as fishing and boating opportunities. With the current water rights doctrine of prior appropriation in Montana, it is unlikely that any management actions could be undertaken to address this possible problem, but it is useful to know that most anglers would be supportive of possible actions if they became necessary in the future.

Differences between locals and non-locals were not significant for three of the four questions where means of the two groups were compared. I would have assumed that locals would be less supportive of any policy creating use limits than non-locals, because it would impact the ability of locals to get out for a trip with minimal planning due to having to obtain permits, but they were actually slightly more supportive (though not significantly so) than non-locals were. It could be that locals' desire to have an uncrowded river experience may be stronger than their desire for easy access and not having to deal with permits or use limits. Kainzinger and colleagues (2015) found a significant negative relationship between crowding and satisfaction, which is in line with the results of this study and common sense. Both locals and non-locals were very supportive of easements to protect scenery, suggesting both groups place a high value on the scenery of the Yellowstone River, matching with results from the fishing condition preferences question (Table 18).

Respondents were also asked about how important a set of statements were to their acceptance of management decisions on the river, and nearly every statement was answered with a high level of agreement. Anglers were in greatest agreement of the importance of basing a decision on environmental consequences, maintaining fishing access, and science playing a role in the decision. Respondents ranked as less important, but still above moderately important, that the decision is based on economic consequences, that the decision maintains access for other recreation, and that the decision helps support the local community. This set of data suggests that the anglers who answered the survey think it is very important to manage the river to maintain a high-quality fishery and angling experience, which is unsurprising as the entire activity of fishing is dependent on having a healthy fishery.

Yellowstone River resource managers may be interested in user satisfaction, which can be indirectly examined through the results of this study. The 2020 Nickerson and Grau study referenced in Figure 1 suggests that satisfaction levels were very high, with all but two people stating they were very satisfied or satisfied with their experience, and the vast majority of responses being very satisfied. In this

study, anglers were not directly asked about satisfaction, but it can be inferred that most anglers feel satisfied with their experiences from some of the questions. When anglers were asked how problematic six different common issues were, none of the six had a mean score above two, which was the score for small problem. The issue with the highest mean score was *"Too many people on the river"*, with a score of 1.96. 8.9% of respondents selected this issue was a very big problem (4), the highest of any issue. Respondents were also asked if they commonly observe problematic behaviors at put-ins, on the river, or at take-outs. Because these behaviors were observed by respondents, they could be a source of interpersonal conflict (Gibson and Fix, 2014). Latent-behavior and social values conflict are not as relevant in this study, as both of these conflict types occur when users do not observe a situation themselves but still perceive it to be a problem. Witnessing these behaviors could be a source of dissatisfaction especially if the respondent is directly affected. The behaviors with the largest number of responses were "*Getting boat ready on the ramp/ poor ramp etiquette*" in the put-in/ take-out question, and "*Poor river etiquette (passing to close, etc.)*" in the on the river question. These had 33 and 22 responses respectively, and made up 57.9% and 36.1% of responses in their respective questions. Of the 161 responses that were collected, only 52 provided answers to both the problematic behaviors at the put in/take out and on the river questions. It cannot be inferred from the data how these witnessed problematic behaviors impacted the respondents' satisfaction, but one would assume that they would have at least a small negative impact. In similar future studies investigating problematic behaviors, river managers should grow more concerned if a greater portion of the sample is indicating there are problematic behaviors and may consider targeted management interventions to address impacts from these behaviors. This could include but is not limited to redesigning boat launches, signage to inform river users of proper etiquette, and staffing boat launches with paid staff or volunteers to help educate newer river users on etiquette and answer any questions they may have.

Conclusion

While acceptability of different use levels was the primary area of focus in this study, questions were asked which help give a wider understanding of the experience of anglers on the Yellowstone River. Overall, most anglers seem to have a positive, enjoyable experience on their fishing trips, and as only a casual angler myself it was informative and fun to talk to many experienced anglers during my time surveying. There are many more questions which could have been asked to further investigate the issue of displacement, some of which were discussed in the section above, and many more questions could have been asked about other coping mechanisms anglers use to deal with crowding or other problems they encounter.

Ideally, the survey in a future study would ask anglers if they have ever found themselves changing their plans for the day due to crowded, or other undesirable conditions. Anglers should be asked if their use patterns have changed over a longer time scale, such as several years, and if so, why? It would also ask why they would not be displaced if conditions were undesirable, and ask questions targeted towards other coping mechanisms. More questions could be asked about place attachment, and specific questions should be designed to target the relationship between place attachment and coping mechanisms.

Investigating other coping mechanisms such as rationalization and product shift could be a worthwhile opportunity on the Yellowstone or other rivers in Montana, especially the most popular rivers such as the Madison. It may also be worthwhile to investigate if displacement and use of other coping mechanisms is occurring on rivers other than the Yellowstone. Recreational river use will likely continue to grow into the future which may increase the likelihood of displacement if it gets too crowded for some anglers or other river recreationists. If there is little understanding of displacement while it is occurring, many anglers may be suffering from a sub-par recreational experience or taking their activities to increasingly remote or unpopular locations, while river managers are not aware of and not addressing the problem.

The results of this study can help river managers conclude that currently, no additional restrictive management steps need to be taken to ensure that anglers have a satisfactory experience on the Upper Yellowstone River. If river use levels and angling pressure significantly increase and monitoring shows a sustained trend, it may be necessary to start considering restrictive management options. Managers may be more likely to implement restrictive management if an increase in use is accompanied by decreased satisfaction and an increase in reported problematic behaviors. These management decisions should be based on another study looking at topics like what this study investigated, with additional questions about coping mechanisms. To increase efficiency and collect a larger number of responses, different methods

beyond the intercept survey may be used. This could include hiring more staff to conduct intercept surveys, reaching out to angler organizations to seek more responses from knowledgeable anglers that are especially interested in the long term sustainability of fishing on the river and the recreational experience, and using the list of licensed anglers in the State of Montana to distribute surveys.

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APPENDIX A – PAOT PHOTOGRAPHS

PAOT Fish 1

PAOT Fish 2

PAOT Fish 3

PAOT Fish 4

PAOT Fish 5

PAOT Mix 1

PAOT Mix 2

PAOT Mix 3

PAOT Mix 4

PAOT Mix 5

PAOT No Fish 1

PAOT No Fish 2

PAOT No Fish 3

PAOT No Fish 4

PAOT No Fish 5

APPENDIX B – FIELD NOTES AND OBSERVATIONS

During each survey period field notes on start and stop times, weather, site conditions, and notable encounters were gathered.

7/9/21 Mayors Landing - 1:30 PM Start

About 81 degrees, partly cloudy, a bit hazy. Nice afternoon, lots of cars at access site but it seems fairly quiet. Water feels nice and cool. 3:00 PM Stop, not very busy, getting windy.

7/9.21 Pine Creek – 3:50 Start

About 80 degrees, partly cloudy, hazy but windy. Site seems pretty quiet. 6:00 PM Stop

7/9/21 Mallards Rest - 7:00 PM Start

Pretty quiet, similar weather as above, wind died down. One lady said the Lower Yellowstone where she spends a lot of time has gotten busier this year. 9:00 PM Stop

7/10/21 Grey Owl – 6:00 AM Start

Calm, cool sunny morning. Looks like I missed a couple put-ins before I got here. First survey was a guided group, mentioned avoiding crowds (and the upper Madison) and how the river will get regulated within 6-7 years. About 48 degrees, starting to get pretty warm when done. 10:50 AM Stop

7/10/21 Carbella – 2:15 PM Start

About 88 degrees, warm, sunny, and hazy. Drove to Gardiner and looked at access sites, popular ones seem to be Point of Rocks, Carbella, Yankee Jim and to a lesser extent Brogan's Landing. Lots of trailers parked at Carbella, hope to catch people taking out this afternoon. 4:30 PM Stop

7/10/21 Point of Rocks – 6:10 PM Start

Still warm and hazy, didn't get windy today. Updated survey earlier to include McConnel and Corwin Springs. One guy who I surveyed earlier at Carbella said they caught plenty of whitefish but did not seem enthused by this. 7:40 PM Stop

7/11/21 Carbella – 7:30 AM Start

Cool, very windy. A couple boats came to the lot and left, maybe due to wind? Boats started arriving more from 8-8:30. Lots of people didn't want to do survey, were "in a rush" even though they were just sitting and waiting for guides. One guide did not want me to bother clients. 8:30 AM Stop

7/11/21 Grey Owl - 9:20 AM Start

Drove by emigrant on way here, not as busy as grey owl, looks like a bunch of boats already put in about 9 AM. Warming up, getting pretty smoky. Lots of trailers already in lot, probably missed most anglers. Not windy here. One guy said the survey had good questions. 10:20 AM Stop

7/11/21 Springdale Bridge – 1:40 PM Start

About 91 degrees, smoky. One guy said river temp was in the upper 60's according to his thermometer. 3:00 PM Stop

7/15/21 Carters Bridge – 5:00 PM Start

About 91 degrees, would be sunny but is smoky. Air quality "unhealthy for sensitive groups". Some trailers parked here but seems pretty quiet. Got a couple surveys, a bunch of people took out that weren't fishing. 6:30 PM Stop

7/21/21 Otter Creek – 5:15 PM Start

84 degrees, partly cloudy, feels a bit more humid than usual. Boat ramp and river seem quiet, but several people camping here (free camping). Seems less smoky than a lot of recent days. No one fishing or taking out here… wasted time. 8:45 Stop Note: Hoot owl restrictions started this day, explaining why there was no fishing activity in the evening.

7/22/21 Grey Bear – 7:30 AM Start

68 degrees, mostly clear. 5 trailers here, talked to 3 of them and nobody would take survey. Hoot Owl started yesterday; people eager to get on the water. Deathly quiet after those people put in.10:30 AM Stop

7/22/21 Hwy 89 Bridge – 10:45 AM Start

86 degrees, mostly sunny, not very smoky. Lots of trailers and some cars/trucks here, is probably a more popular morning put-in than Grey Bear. Hoping to catch some taking out by end op open fishing hours (2 PM). 2:00 PM Stop

7/23/21 Mallards Rest – 6:45 AM Start

About 55 degrees, rained last night then cleared up, cool morning. Lots of people camping here, but put-in is quiet, several dropped cars to take boats probably to Grey Owl to start "bird float". One guide said this is the worst he's seen for water conditions in 20 years and is expecting a full closure sometime soon. Lots of guided groups today, handing out card with link seems to be a good plan. One said the water temp up to 72 degrees by about 2 PM, which is not good. Lots of people taking out right around 2, end of open fishing hours (hoot owl). Need to make more link cards. 2:15 PM Stop

7/24/21 Grey Owl – 6:30 AM Start

About 52 degrees, cool sunny morning, steadyish stream of put-ins, I think more people are trying to start earlier due to hoot owl and warm water temps. First time running into same person twice about 8 AM. Seems pretty slow for Saturday morning at Grey Owl, leaving for somewhere else about 10. About 70 degrees at 10 AM. 10:15 AM Stop

7/24/21 Emigrant – 10:30 AM Start

About 72 degrees, nice sunny morning, moderately hazy. This site seems a lot less busy than Mallards and Grey Owl, still a fair amount of activity here. Hoping to catch some take outs. Lots of boats went by, probably taking out at Grey Owl, but caught a bunch from 1-2:30. 2:30 PM Stop

8/13/21 Yankee Jim – 6:15 AM Start

Cool morning, low 50's and clear, minimal smoke/haze. No one at brogans landing/cinnabar, two guide boats dropped off truck for take-out at about 7 AM, first family to put in about 6:45 AM. Water looking very low. First guy I surveyed says river is very not busy below Livingston. Several people came by to use the bathroom or look around. More trailers being dropped by shuttles after 10. Must be more people taking out here later. Only got 2 surveys, one guy commented on importance of irrigation restrictions, especially during drought. Pine Creek and Mill Creek don't even make it to the Yellowstone River. 11:00 AM Stop

8/14/21 Emigrant – 7:00 AM Start

Cool morning, low 50's and clear, somewhat smoky/hazy. Emigrant sort of busy this morning, lots of cars and trailers already here. Several boats/guided groups showed up after 7, one big guide group. Probably a lot of trailers dropped here for take outs. One very large camping group at gravel bar just south (upstream) from launch, seems to be popular a spot for camping. More comments on irrigation and dry creeks… not much activity after 10 AM, take outs starting more a bit before noon. One guide guy curious about irrigation questions, comes from a ranching family and told me allotments/water use won't change due to water rights system (I know). Ran into "Josh Guide" for 4th time. One guide (Mike) told me a story about a creepy client wanting to watch women in swimsuits on the Madison River.

8/15/21 Mayors Landing – 7:00 AM Start

Cool and smoky morning, about 55 degrees. Air quality unhealthy. Site is pretty quiet, one group putting in right when I got here. A couple people here to walk dogs, hopefully gets busier later. One guy told me the Madison River can handle more pressure because river is similar depth and structure across most of it, whereas the Yellowstone is more varied and often has one side/bank or middle more favorable to fish. Lots of people dropping off cars or trailers here for take-out later. Site gets a lot of non-fishing use from dog walkers, people wade fishing across the river. Good amount of people took out, surveyed almost until 3 PM. 2:50 PM Stop

8/20/21 Springdale Bridge – 7:15 AM Start

Cool and rainy morning, about 52 degrees. Rained yesterday and most of last night. Caught a couple boats with guides and one other party right away, a couple vehicles already here. Will probably be a pretty quiet day today. Water is kind of dark, not clear and dirty, not good fishing conditions. I'm starting to realize that a lot of people pay to have someone shuttle their trailer from put-in to take out (guides too I think), I often see someone drop off a trailer, then hop in a car and drive away, often with a yellow and black hat on. 10:45 AM Stop Driving to other sites to drop fliers on windows. Stop fliering at 1:30.

8/21/21 Hwy 89 Bridge – 7:00 AM Start

Partly cloudy, cool morning about 50 degrees, water conditions slightly murky but guides say not bad, it is bad up in paradise valley from rains. I may have missed one put in but started getting guides and clients shortly after arrival. I don't think I had any arrivals from 8:30-10, going to go flyer at 10 grey owl – otter creek. 10:00 AM Stop

Lower river seems more popular today, probably due to mud upstream. At carters Bridge water clarity looks about the same, but only two trailers were there at 12:30. Good amount of trailers at Mallards, less than previous weekends though. Water clarity looks a bit worse than Carters. Much less trailers than usual at Grey Owl and Emigrant, more at Emigrant than Grey Owl. Ran out of fliers at Grey Owl, water is even less clear than at Emigrant. Water looks about the same at Point of Rocks, much less trailers here than all other weekends. 1:30 PM Stop flyering

8/22/21 Grey Bear – 7:15 AM Start

Partly cloudy, cool morning about 55 degrees, nice sunrise this morning. Smoky driving down through Paradise Valley, not too bad east of Livingston. May have picked bad site for today, no trailers and only one van parked here. Windy. Heard guides come in, surveyed one then they left due to poor water condition (muddy). Going to leave and survey further upstream at 7:50. 7:50 AM Stop

Some boats at Springdale, none at Mayors Landing but talked to one wade fisherman there. 4 trailers and lots of cars at Carters, a couple boats and trailers at Pine Creek. About 9:30-45 a surprising number of trailers at Loch Leven, maybe I should actually spend a day surveying here sometime. A few but low for a weekend trailers at Mallards and Grey Owl (4 and 7). No trailers at Emigrant. 5 trailers at 26 mile. Only one trailer at Point of Rocks. 3 non-commercial rafts at Carbella, one more showed up as I left. Water

starting to look clearer at Carbella. 2 trailers, lots of cars (white water trips?) at Yankee Jim. 3 trailers at Corwin, left as I pulled in. None at McConnell. Not sure where Gardiner town access is, tried and failed to find it. Sites got much busier driving back down the valley, lots of late starts today, Not sure if fishing though. Put out 40 total fliers today, 120 for 3-day weekend. 1:00 PM Stop

9/4/21 Mallards Rest – 8:15 AM Start

Cold morning, only about 40 degrees, not windy at all, mostly sunny or partly cloudy, air is mostly clear and only a little hazy. Start times have definitely moved later probably due to later sunrise and cooler temps. Only one trailer here already, saw a couple boats at Grey Owl on way here. I was informed by a guide that it is college football Saturday, may be reason for it being less busy than I would have thought. Water is pretty clear, most boats seem t be guides. A couple went past onward probably to Pine Creek. Leaving to flyer at 11:45. 11:45 AM Stop

Lots of trailers at Loch Leven at 2 PM, otherwise river seems not busy for a good weather Saturday (holiday weekend too!). Got smoky throughout late morning and afternoon. Fliered McConnell to Hwy 89. 3:30 PM Stop

9/5/21 Carbella – 8:00 AM Start

Windy, about 50 degrees, cool but warmer than yesterday. Very windy as it tends to be at Carbella. Already several trailers here. Still smoky but less so than yesterday afternoon. Got first emails at 8:55. Leaving at 1 to flyer and lunch, wind still here but calmed down throughout the morning. 1:00 PM Stop

2:00 PM Start

Surveyed 2-4, got several take outs The Yankee Jim to Carbella section is less popular with anglers, but a good displacement location. Left to flyer at 4. 4:00 PM Stop

Fliered Carbella to Grey Owl. Stopped to save 20 fliers for tomorrow. Was told of the “Thoroughfare” by one guy, it is the Yellowstone above Yellowstone Lake, is apparently pretty cool. Got hot and smoky during the afternoon, about 88 degrees at 5 PM.

9/6/21 Grey Bear – 8:10 AM Start

Warm morning, smoky and about 60 degrees. Site is quiet, only one trailer who I think got their email right when I got here. At 11 no one else has come, warm already temps in 70s. I may have struck out on site picking. Will stay here until 2, hen flyer. Talked to one guy, former game warden who was very anti-outfitter, he said they've increased fishing pressure a ton, and essentially write the rules to regulate themselves (paraphrasing, not a direct quote). Talked to shuttle drivers (and owner) who said they cannot determine consistent use pattern at sites or stretches, seems random. Hot and windy in afternoon, temps in upper 80s. Talked to guy who wats the owner of Sweetcast Angler in Big Timber, he was cool and told me to stop by if I need any info. May try and interview him at some point. Leaving to flyer at 2, dropped 3 fliers off here. 2:00 PM Stop

Springdale busier than Grey Bear, seems to be general trend. Decent amount of trailers at Pig Farm, first time here. May want to survey here in future, seems kind of popular, dropped last fliers at Pig Farm.

9/25/21 Point of Rocks – 9:40 AM Start

Nice very windy morning, started off cool in the 40s, but warming up quick, No smoke! Arrived late, a few trailers already here but not too many, got a couple right away to give emails. Talked to some college students at 10 AM. Got one in person survey from guy who works for USFWS. Left to flyer at 1:30. 1:30 PM Stop

Access sites much busier in warm afternoon, but still not that busy for such a nice warm weekend day. Lower river below Livingston not as busy. Water feels much cooler than Labor Day weekend. Fliered entire area Gardiner to Big Timbe, temps in 80s, 84 at Big Timber at 5:20 PM. 5:20 PM Stop

9/26/21 Carters Bridge – 8:30 AM Start

Cool sunny morning, temps in 40s, somewhat breezy but much less than yesterday. Only one trailer here, many more cars. Pretty quiet to start. A couple guided boats showed up about 9 that I already talked to yesterday. One group on non-fishing rafters took out and another put in about 10 AM. Leaving to flier lower river at 11. 11:00 AM Stop

Paradise Valley starting to get a little hazy in the afternoon. Ran out of fliers at Mallards Rest at 2:20. Fliered Grey Bear to Mallards Rest, 200 total fliers for the weekend. 2:20 PM Stop