

**Summary of Recreation and Angling Use, Success, and Satisfaction  
On the Green River in 2018**



Ryan Mosley  
UDWR Project Leader

Lowell Marthe  
UDWR Project Biologist

Trina Hedrick  
UDWR Northeastern Region Aquatics Manager

Publication Number 20-19

Utah Department of Natural Resources  
Division of Wildlife Resources  
1594 West North Temple, Suite 2110  
Salt Lake City, Utah 84114

Mike Fowlks  
Director

*An Equal Opportunity Employer*

## List of Figures and Tables

Figure 1. Three flow patterns (stable, single peak, double peak) commonly observed on the Green River below Flaming Gorge Dam, 2018.....	5
Figure 2. Google Earth image of the study area, Green River, 2018. ....	6
Figure 3. Monthly angler pressure for the A and B sections of the Green River in 1992 and 2018.....	9
Figure 4. Monthly angler pressure by river section, Green River, 2018. ....	9
Figure 5. Percentage of fish caught by species (171,512 total fish), Green River, 2018. ....	10
Figure 6. Angler catch rate by method, Green River, 2018.....	10
Figure 7. Angler catch rate by river section, Green River, 2018. ....	11
Figure 8. Mean daily angler catch rate by survey date, March-September and December, Green River, 2018.....	11
Figure 9. Mean daily recreation and angler counts for both exit locations, Little Hole and Indian Crossing, Green River, 2018.....	12
Figure 10. Daily mean number of recreational users by month and river section, Green River, 2018.....	12
Figure 11. Composition of Utah resident anglers interviewed by county, Green River, 2018. ....	13
Figure 12. Mean expenses and trip days for resident and non-resident (NR) anglers fishing the Green River, 2018.....	14
Figure 13. Satisfaction ratings (1-5) by user group, anglers and recreationists, Green River, 2018.....	15
Figure 14. Percentage of responses and mean satisfaction value (1-5) for anglers fishing the Green River, 2018.....	15
Figure 15. Mean daily angler “Flow” and “Likeliness to Return” ratings by survey date, Green River, 2018. ....	16
Figure 16. Discharge (cfs) as measured at the Greendale gage below Flaming Gorge Dam from February 28 <sup>th</sup> -March 1 <sup>st</sup> , Green River, 2018. ....	17
Figure 17. Discharge (cfs) as measured at the Greendale gage below Flaming Gorge Dam from December 1 <sup>st</sup> -20 <sup>th</sup> , Green River, 2018.....	17
Figure 18. Percentage of additional comments by category (neutral, positive, negative), Green River, 2018. ....	18
Figure 19. Mean catch rate by flow type as measured in December, Green River, 2018.....	19
Figure 20. Fishery satisfaction ratings by flow type in December, Green River, 2018.....	19

Figure 21. Angler pressure with standard error by month, Green River, 2018. ....22

Figure 22. Angler pressure by river section (A&B) and month, Green River, 2018. ....22

Figure 23. Angler pressure by residency and month, Green River, 2018.....23

Figure 24. Total fish caught by month with standard error, Green River, 2018. ....23

Figure 25. Total fish caught by month with standard error, Green River, 2018. ....24

Figure 26. Mean catch rate (fish/hr) by day type and month, Green River, 2018. ....24

Figure 27. Mean catch rate (fish/hr) by month with sample size, Green River, 2018. ....25

Figure 28. Mean length of a fishing trip (hours) by month, Green River, 2018. ....25

Figure 29. Mean number of angler trips or days by month, Green River, 2018.....26

Figure 30. Percentage of guided trips by angler residency, Green River, 2018. ....26

Figure 31. Percentage of anglers by fishing method, Green River, 2018.....27

Figure 32. Percentage of anglers by gear type, Green River, 2018. ....27

Figure 33. Percentage of anglers by river section(s) fished, Green River, 2018. ....28

Figure 34. Percentage of species preference, Green River, 2018. ....28

Figure 35. Percent angler residency, Green River, 2018.....29

Figure 36. Percentage of non-resident license types, Green River, 2018. ....29

Figure 37. Satisfaction ratings (1-5) by angler type or method, Green River, 2018.....30

Figure 38. Mean monthly angler satisfaction ratings (1-5) for numbers and size of fish, Green River, 2018. ....31

Figure 39. Mean flow rating (1-5) by month, Green River, 2018. ....31

Figure 40. Pressure/crowding satisfaction rating (1-5) versus angler pressure (hours) by month, Green River, 2018.....32

Table 1. Estimated Non-resident License Sales during the 2018 Green River Survey.....30

## Introduction

The portion of the Green River reported in this study is entirely located in Daggett County, UT, below Flaming Gorge Dam near the town of Dutch John. Floating and fishing are the two most popular recreational activities, some of which are offered by commercial guides and outfitters and attract thousands of anglers and recreationists annually (Pratt et al. 1991). According to the recreational use survey completed in 1991 by the United States Forest Service (USFS), the Green River holds an annual economic value in excess of \$24 million. The Green River is classified as a Blue Ribbon Fishery by the Utah Division of Wildlife Resources' Blue Ribbon Fishery Council (BRFC), meeting the criteria for quality fishing, fish habitat, outdoor experience, and economic benefits. In the 2011 BRFC Economic Report, the Green River was the second highest rated fishing destination in Utah, slightly preceding the Middle Provo River. In 2011-12, the Green River had the third highest use among the lakes and rivers in Utah at 206,000 angler-days (Krannich et al. 2012). The Green River fishery is mostly comprised of Brown Trout (*Salmo trutta*), stocked Rainbow Trout (*Oncorhynchus mykiss*) and Mountain Whitefish (*Prosopium williamsoni*). Other less abundant species include Cutthroat Trout (*Oncorhynchus clarkii*), Mottled Sculpin (*Cottus bairdii*), Flannelmouth Sucker (*Catostomus latipinnis*), White Sucker (*Catostomus commersonii*), Common Carp (*Cyprinus carpio*), Northern Pike (*Esox lucius*), and Channel Catfish (*Ictalurus punctatus*).

Creel/angler surveys are used to monitor changes in fishing effort/pressure (sum of all the hours anglers fished), catch/harvest rates (fish/hour), total fish caught/harvested, species preference, and methods/gear used. Creel survey procedures used on the Green River have varied since they were first initiated in the 1960s. Once completed annually, the last creel survey conducted by Utah Division of Wildlife Resources (UDWR) occurred from February 1992 through February of 1993. During the 1992 creel, camera counts were used to estimate boat pressure while random counts were used to estimate shore pressure in each of the three river sections (A, B, C) (Brayton et al. 1993). Angler pressure was estimated at 315,925 angler hours (12-month) of which 70% was shore/wade fishing and 30% was boat fishing. Shore fishing was greatest in the B-section (64%) while boat fishing pressure was greatest in the A-section (64%). C-section had the least amount of the total fishing pressure (10%). Fishing pressure was greatest from March-September, comprising 91% of the total angling pressure. At that time, angler harvest was low due to conservative regulations set in 1985, including "artificial lure and fly only" and "two trout under 13-inches and one over 20-inches". Following the 1985 regulation change, harvest decreased by 85%.

Since 1992, only an online angler survey was completed in 2010. A variety of questions were posed, ranging from residency and income to opinions on flows and fish quality. In 2010, 95% of the respondents were fly anglers. Of those 49% were float anglers, 34% were wade/shore anglers and 17% hired a guide. Harvest was estimated at only 0.002%. Many of the additional comments at that time were related to flows (47%), followed by those regarding "overcrowding" or too much user pressure, fish overpopulation resulting in declining fish quality, and high numbers of fishing guides.

As a result of the 2010 online survey and monitoring data from biannual electrofishing, management changes were implemented by UDWR in 2012. The Rainbow Trout stocking quota was reduced by almost 60% and by 2018 was 14K 10-inch Rainbow Trout. Cutthroat Trout stocking was resumed at a rate of 10K per year in 2013, but due to poor returns was discontinued in 2016. As a result of those management changes, along with consistently higher

spring flows, the fishery itself changed. In 2016, total trout abundance had decreased by 50% since 2007. Inversely, mean total length of Brown Trout and Rainbow Trout increased by 25 mm (1.0 inches) and 81 mm (3.2 inches), respectively. Trout condition, or relative weight, also increased and was well over 100 for both species. During that time, concerns from Green River Outfitters and Guides Association (GROGA) were acknowledged. Those concerns included fewer fish, less optimal Rainbow Trout strains, poor flow management, and increased recreational pressure.

Public perception of this highly popular fishery is an obvious value to the agencies involved with the management of this resource. Part of the focus of this survey was to get wider based user opinions of the Green River, specifically the fishery, to help support and/or alter future management actions. In addition, basic creel metrics can also aid in refining management of a fishery to improve angling success and experience.

### *Survey Goals*

- Identify spatial and temporal angler and recreational use
- Determine catch and harvest rate by species
- Gather sufficient information to develop regulation or management recommendations regarding public attitudes towards overcrowding, flow management, gear restrictions, fish quality versus quantity, and species preference
- Collect sufficient information to revise stocking recommendations for Rainbow Trout
- Determine overall satisfaction towards the river as a fishery and recreational destination

### *Survey Area*

The Green River begins in Wyoming's Wind River Range and is the largest tributary to the Colorado River. The tailrace (focus of this study) includes approximately 27-miles of the Green River immediately below Flaming Gorge Dam down to the Colorado state line. Flaming Gorge Dam was completed in 1964 and is operated by the Bureau of Reclamation (BOR) as part of the Colorado River Storage Project (CRSP). River flows below the dam vary depending on the time of year and/or day. Mean daily releases are guided by current and forecasted hydrologic conditions according to the 2006 Record of Decision (ROD) from the Flaming Gorge Operations EIS. The Upper Colorado River Endangered Fish Recovery Program (RP) also develops flow recommendations to assist in the recovery of endangered fish downstream of Flaming Gorge Dam. Those include, but are not limited to: releasing the warmest water possible, high releases in the spring, and varying flows by season.

The dam is also one of four load following power plants used by Western Area Power Administration (WAPA) to respond to daily energy demands by power consumers. Depending on the season, daily electrical demands vary, therefore release volumes from the dam are altered to meet hourly energy needs. A typical summer daily release pattern is called a "single peak", meaning low in the morning and night when electrical demand is low, but increasing or peaking once during the day when electrical demand is high (Figure 1). Winter electrical demand is more variable, and is highest in the morning and evening, but low during the midday and night. Releases from the dam will mimic that same pattern, commonly referred to as "double peaking", increasing in the morning and evening but low the remainder of the day. Daily flows will occasionally be "stable", with no daily variation, usually when mean daily flows are either really low (800 cfs) or high (>4,200 cfs). During the 2018 survey, river temperatures and

flows at the USGS Greendale gage immediately below Flaming Gorge Dam ranged from 3.7-16°C (38.6-60.8°F) and 791-7,070 cfs, respectively.

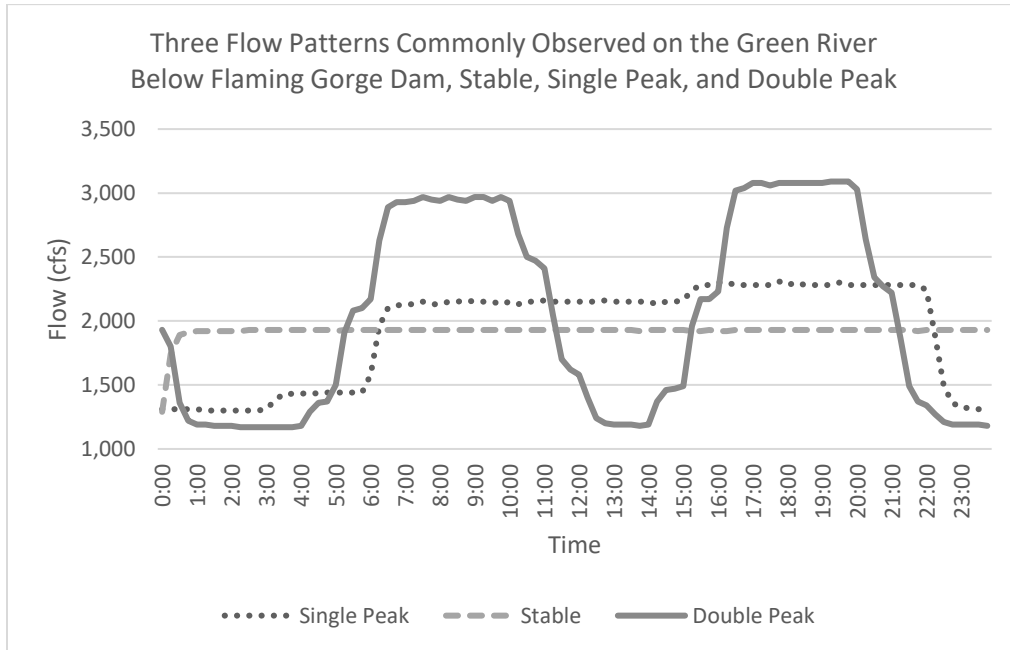


Figure 1. Three flow patterns (stable, single peak, double peak) commonly observed on the Green River below Flaming Gorge Dam, 2018.

For study and management purposes, the river is divided into three sections: A, B, and C. The A section extends 7.2 miles from the dam (Spillway Launch) down to the Little Hole recreation site (Figure 2). The Little Hole Trail is a National Recreation Trail which runs along the north shore providing access to hikers, bikers and most notably, anglers. The A section is commonly considered the most scenic of the three sections with steep canyon walls and abundant wildlife. Both Spillway and Little Hole include improved amenities such as water, restrooms, boat launches, and paved roads and parking areas. Little Hole is approximately 5.2 miles from Dutch John and has three launches, commonly termed ramps #1-3. The B section runs 8.4-miles down from Little Hole to Bridge Hollow boat launch in Brown’s Park. Shore access is limited in this section, but there is a foot trail in three areas including downstream of Little Hole, near Red Creek Rapid, and upstream of Indian Crossing recreation site. Indian Crossing and Bridge Hollow are about 32-miles from Dutch John and each provide dirt launches, campsites, restrooms, and water. The C section continues 11-miles down to the Colorado border near Swinging Bridge. There are several access points, all of which are unimproved, including the more popular Bridgeport (aka Cowboy Bar), Burnt Trees, Pipeline Crossing, and Swallow Canyon. This is historically the least used section by anglers and recreationists, and therefore is not included in this survey.



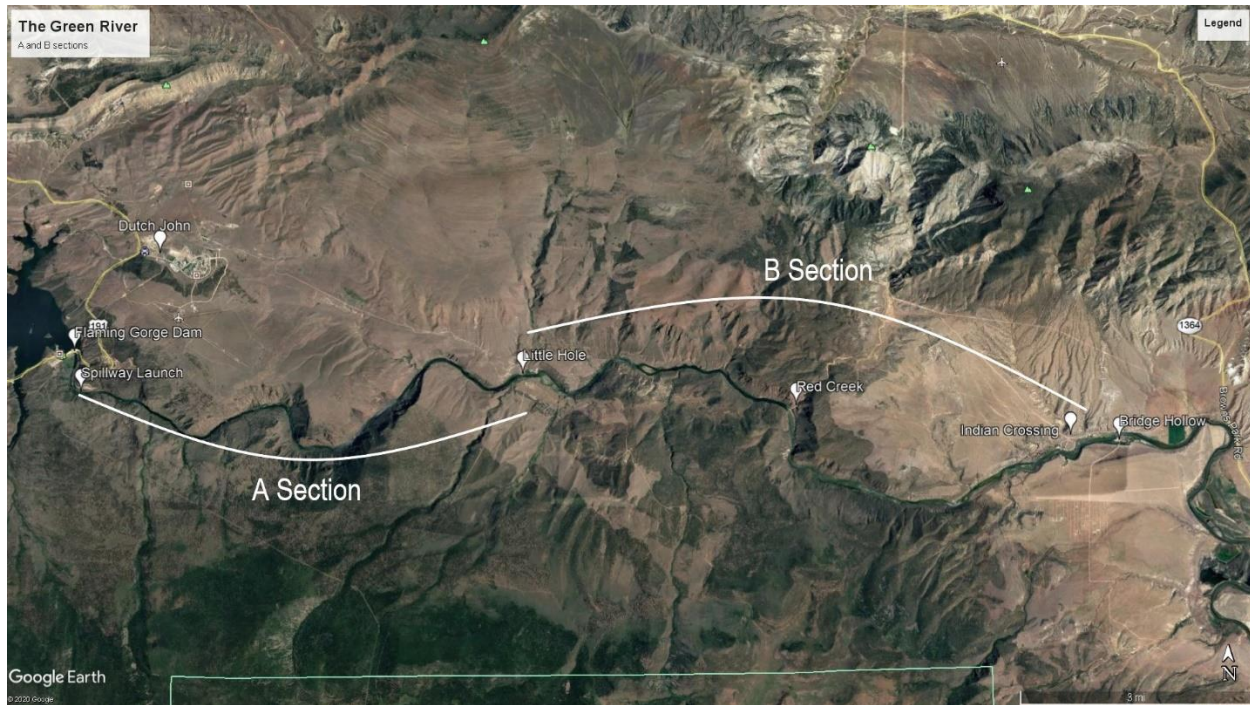


Figure 2. Google Earth image of the study area, Green River, 2018.

Land managers within these three sections include the USFS, the Bureau of Land Management (BLM) and UDWR. The USFS manages the first 12-miles of river, down to about Red Creek Rapid. The BLM manages from there down through most of B and C sections. UDWR manages wildlife management areas near Little Hole and within the C section in Brown's Park.

### Methods

Due to the inflated cost of operating a 12-month creel survey, the 2018 survey was designed to cover the highest use period and river sections determined by previous creels, including: March through September and both A and B-sections. December was added for a monthly comparison of winter to summer, but also to capture angler trends during days with varying flow types (stable versus double peak). The survey was stratified by month and day type (weekday and weekend day), and four survey days per month were randomly selected, including two from each day type (Appendix 2). Holidays were treated as weekend days. Three non-random days were added to capture additional data. The first occurred on May 24<sup>th</sup> during the high spring flow event when dam releases averaged 4,800 cfs. Users were not counted, and therefore not included in the pressure estimate, but interviews were conducted to assess the impact of high flows on user opinions and angler catch rates. In addition, two weekend days were added in December to provide a comparison of two consecutive weekend days, each with different flow patterns (stable vs. double peak). December 1<sup>st</sup> and 16<sup>th</sup> were added, both of which had stable flows averaging 2,000 cfs. In all, the survey encompassed 7-months and 31 survey days.

Each survey day, exit interviews were conducted at two locations, Little Hole and Indian Crossing, to capture users utilizing A and B sections, respectively. All individuals using the river were counted throughout the survey day and classified as either recreational or angling. Shore anglers that accessed the Little Hole Trail at Spillway Launch were not accounted for, but periodic counts conducted via floating or biking in this reach showed low use (0-5% of the total

angler count for A-section) and it was therefore considered negligible. Shuttle drivers frequently drove through the exit locations but were not counted. Users that were sightseeing, hiking, etc. were also not counted. Due to the high amount of traffic at Little Hole, exit counts were regularly performed by USFS employees at the entrance booth. Actual interviews were conducted by roving UDWR creel clerks, capturing as many interviews as possible during the survey day. The survey day started no later than 10AM and ended a half hour after sunset or when all visitors had departed. Survey day length therefore varied by season and the amount of visitors, ranging from 10-11.5 hours per day in March through September and 7.5-8.5 hours in December. The late start time each day allowed morning users to complete their trips before being contacted, thereby maximizing the amount of completed trip interviews. Interviews collected were 96% completed trips. During busy days at Little Hole, such as weekends and holidays, two interviewers were employed including one near ramp #1 and #2, and the other at ramp #3.

Four agencies assisted with the survey design and development of interview questions, including the USFS, WAPA, GROGA and UDWR. The interview itself was unique to most in-field surveys or creels conducted by UDWR, being it included counting and interviewing both angling and recreational users (rafters, kayakers, etc.). Several questions were also developed to help meet the survey goals, including rating aspects of the river experience. Those questions included:

1. What is your state of residence?
2. If from UT, what is your zip code? If not, what license did you purchase?
3. What river section did you use, A, B, or a combination? (A, B, AB)
4. In what way did you use the river, wade/shore (W), float (FT), guided (G) or recreational float (R)? If just a recreational float, proceed to question #13.
5. What fishing technique or gear type did you use, spin (S), fly (F) or both (SF)?
6. What time did you start fishing? (To calculate time spent fishing.)
7. Are you done fishing? Incomplete (I) or Complete (C)
8. What species do you prefer, Brown Trout (BN), Rainbow Trout (RT), Cutthroat Trout (CT), or any/all (AN)?
9. How many of each species did you catch?
10. How many of each species did you harvest? If trout greater than the slot of 22-inches add (G), for example BN-G.
11. How would you rate numbers of fish caught, 1-5 with 1 being too few, 5 being adequate?
12. How would you rate the size of fish caught, 1-5 with 1 being small, 5 being great?
13. How would you rate your overall satisfaction with today's fishing or recreational experience, 1-5 with 1 being poor, 5 being great?
14. How would you rate the overall angling and/or recreational pressure, 1-5 with 1 being too high or bad, 5 being low or good?
15. How would you rate flow conditions, 1-5 with 1 being poor, 5 being good?
16. How would you rate access and facilities, 1-5 with 1 being poor, 5 being good?
17. How likely are you to return to the Green River? 1-5 with 1 being not likely, and 5 being very likely.
18. How much did you spend on food, travel, lodging, and tackle related to this trip? 1- \$0-250, 2- \$250-500, 3- \$500-1000, 4- >\$1000
19. If on a multiple day trip, how many days are you spending on the river?
20. What is your age?
21. Do you have any comments for me?



In December, three additional questions were added for the flow evaluation. Those included:

22. Are you aware of stable flows this weekend?
23. Did you come fish the Green River specifically for stable flows?
24. If yes, how did you learn about this opportunity? Social media, Radio, Person, Other

In addition to the interview questions, weather conditions and river flow data were also recorded each survey day. An interview generally took 2-4 minutes to complete, but longer if the interviewee had questions or comments. During busy periods, like afternoons on weekends or holidays, the angler interview was sometimes reduced to questions #1-10. This allowed the interviewer to prioritize fish creel information and not delay masses of users trying to exit the river. When this occurred it was typically for an hour or two and at Little Hole when guided fishing trips and/or large float groups were exiting the river. For large float groups (>10 people) only a subsample of interviews were conducted.

Data were entered and analyzed in Excel. Pressure (angler hours), total catch and total harvest was calculated with SAS using formulas for an access point survey developed for completed trip interviews as used at Lake Powell and based on formulas reported by Bernard et al. (1998). Reported species include Brown Trout, Rainbow Trout, Mountain Whitefish, and Cutthroat Trout. Methods include Wade/Shore, Float and Guided. Gear types include Fly, Spin, and both. River sections include A, B, and AB.

## **Results and Discussion**

### *Angler Pressure*

Total fishing pressure for the A and B sections of the Green River in March-September and December of 2018 was 250,900 angler hours (SE 7,302). This is comparable to 259,541 angler hours (no stats) for the same months in the 1992 creel survey (Figure 3). Angler pressure in March was noticeably higher in 1992 compared to 2018. According to weather data collected in March of 2018 all four survey days were unseasonably cold (0-40°F) and windy (breezy-strong wind). Those weather conditions are less favorable for spring mayfly hatches and flyfishing, likely resulting in low angler pressure that month. In 2018, 26% of the angling pressure occurred in April (65,844 hours) while only 1% occurred in December (2,735 hours). The largest portion of the angling pressure also occurred on weekends (57%) versus weekdays (43%) and in the A section (78%) versus the B section (22%) (Figure 4).

Angler pressure by acreage is a value used to compare fishery use across lakes and reservoirs in Utah. The estimate for the A and B-sections of the Green River (332 acres) was 756 angler hours per acre for the 7-month survey. In recent creels conducted in UDWR's Northeastern Region, Calder Reservoir was 93 angler hours per acre, Matt Warner Reservoir was 75 angler hours per acre, Starvation Reservoir was 25 angler hours per acre and Flaming Gorge Reservoir was 8 angler hours per acre (3-month survey).

Mean trip length in 2018 was 6.2 hours. In a similarly designed survey conducted on the middle Weber River (UT) in 2013, mean trip length was 2.0 hours (Nadolski et al 2013). Nadolski et al. (2013) concluded trip length was short due to resident anglers living close to the fishery. The higher trip length recorded on the Green River suggests anglers spent more time fishing due to the travel time associated with a fishing trip.

### Catch and Harvest

A total of 171,512 (SE 17,003) fish were caught in the 7-month survey, dominated by Brown Trout (55%), Rainbow Trout (43%), and Mountain Whitefish (2%) (Figure 5). Cutthroat Trout only comprised 0.13% of the total catch. An estimated 406 fish were harvested or 0.24% of the total catch. All of the harvested fish were Brown Trout and only 25 of those were over the slot limit of 22-inches. Most of the fish were caught by fly fishermen (157,105) followed by spin fishermen (7,547) or those using a combination of the two gears (6,860).

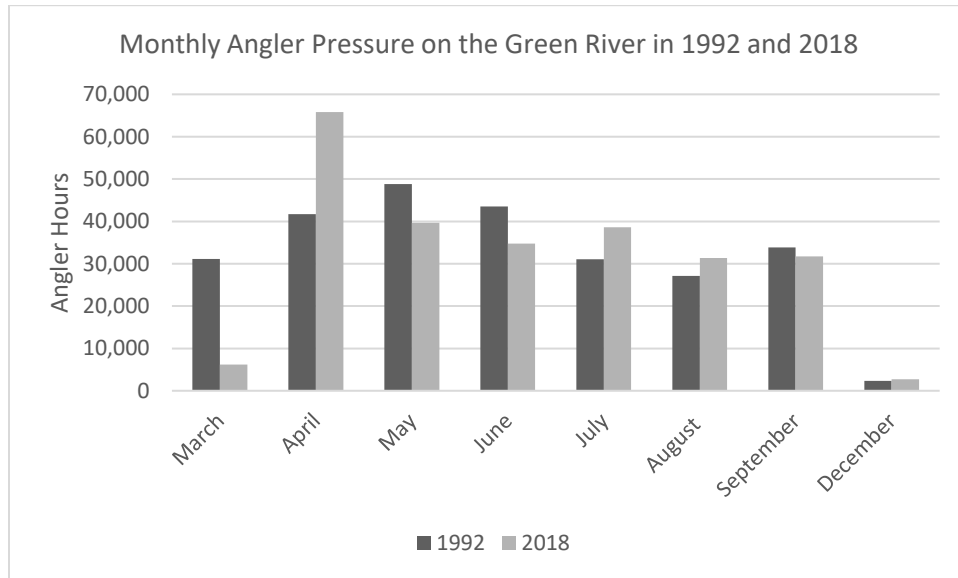


Figure 3. Monthly angler pressure for the A and B sections of the Green River in 1992 and 2018.

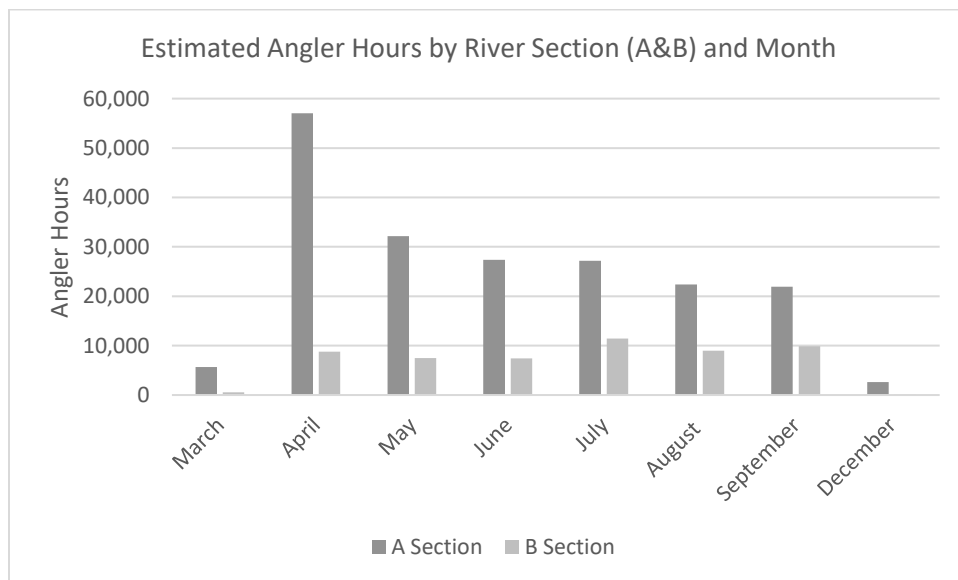


Figure 4. Monthly angler pressure by river section, Green River, 2018.

Overall catch rate during the survey was 0.71 fish/hour. The highest catch rate was by guided anglers (1.11 fish/hour) followed by wade/shore anglers (0.60 fish/hour) and float anglers (0.45 fish/hour) (Figure 6). By removing guided anglers, the overall catch rate decreases to 0.52 fish/hour, which is just above the UDWR statewide management goal for trout fisheries of 0.5 fish/hour. The catch rate measured in 2018 is also comparatively lower than the mean catch rate of 1.3 fish/hour or 0.9 fish/hour measured by creels conducted on the middle Weber River (Nadolski et al, 2013) or the middle Provo River, respectively (Hepworth and Wiley, 2004).

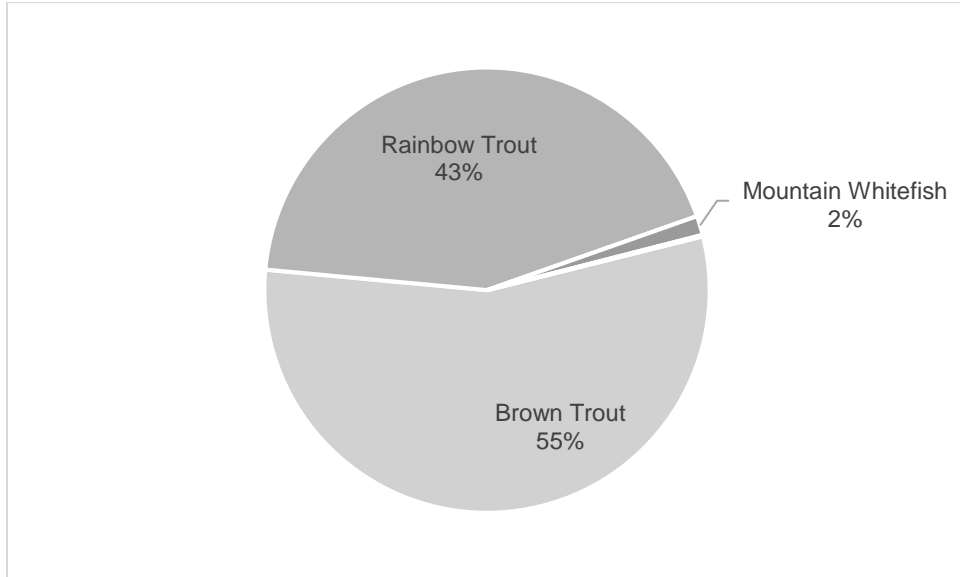


Figure 5. Percentage of fish caught by species (171,512 total fish), Green River, 2018.

Catch rates were highest for anglers fishing B-section (1.04 fish/hour) followed by a combination of A and B sections (0.72 fish/hour) and A-section (0.57 fish/hour) (Figure 7). The higher catch rate in B-section is likely attributed to having only 22% of the total angling pressure (Figure 4).

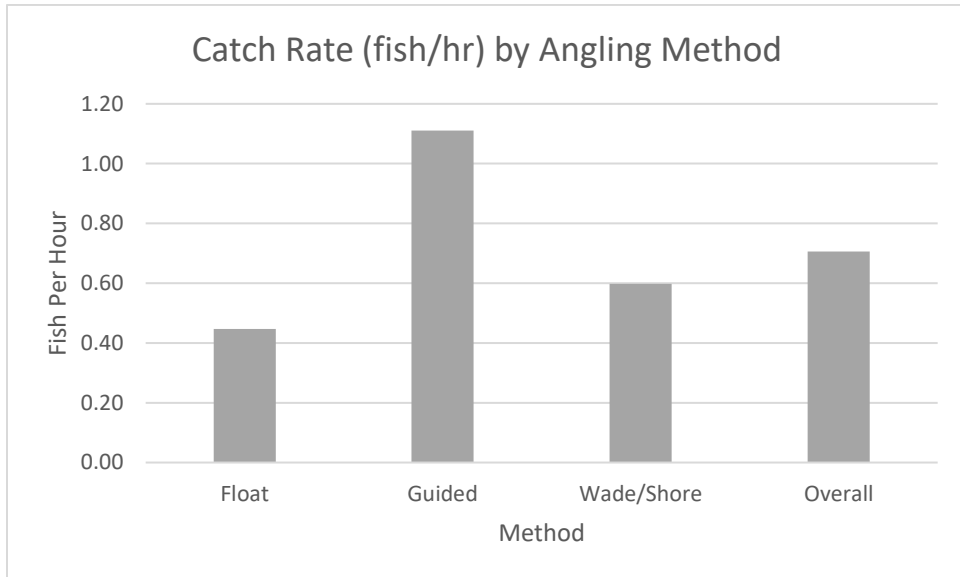


Figure 6. Angler catch rate by method, Green River, 2018.

Catch rates were slightly higher on weekdays (0.77 fish/hour) than weekend days (0.65 fish/hour), also inversely associated to angler pressure which was highest on weekends (57%).

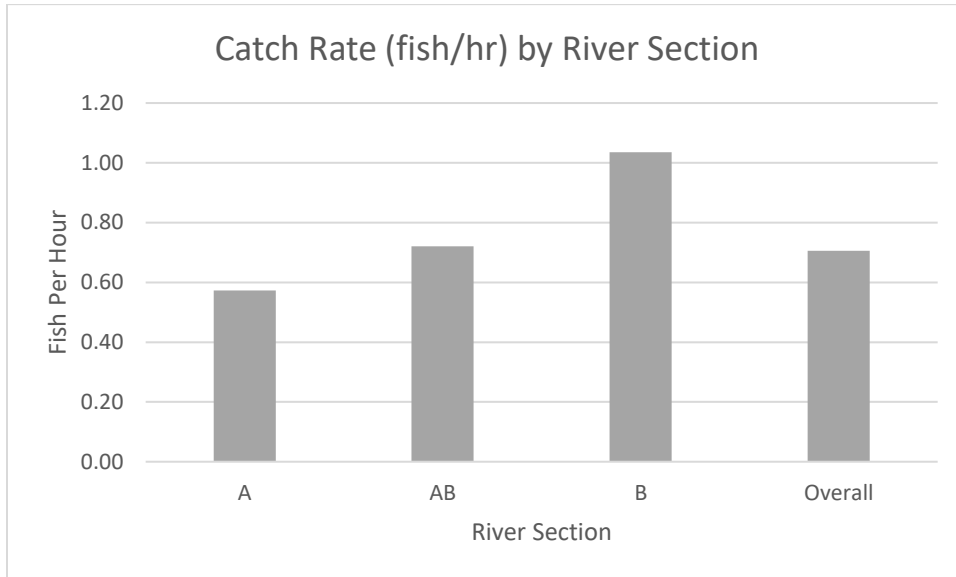


Figure 7. Angler catch rate by river section, Green River, 2018.

Mean daily catch rate was variable by survey day, averaging 0.70 fish/hour in March through September and 1.57 fish/hour in December (Figure 8). Variation in mean catch rate was more pronounced in December due to the high catch rates observed on the two days of stable flows, December 1<sup>st</sup> and 16<sup>th</sup>, when catch rates were 2.99 and 2.37 fish/hour, respectively. The highest mean daily catch rate of 2.99 fish/hour occurred on December 1<sup>st</sup> when flows were a stable 2,000 cfs. The lowest occurred on May 24<sup>th</sup>, during the span of the high spring flow release (4,800 cfs), when the mean daily catch rate was only 0.28 fish/hour.

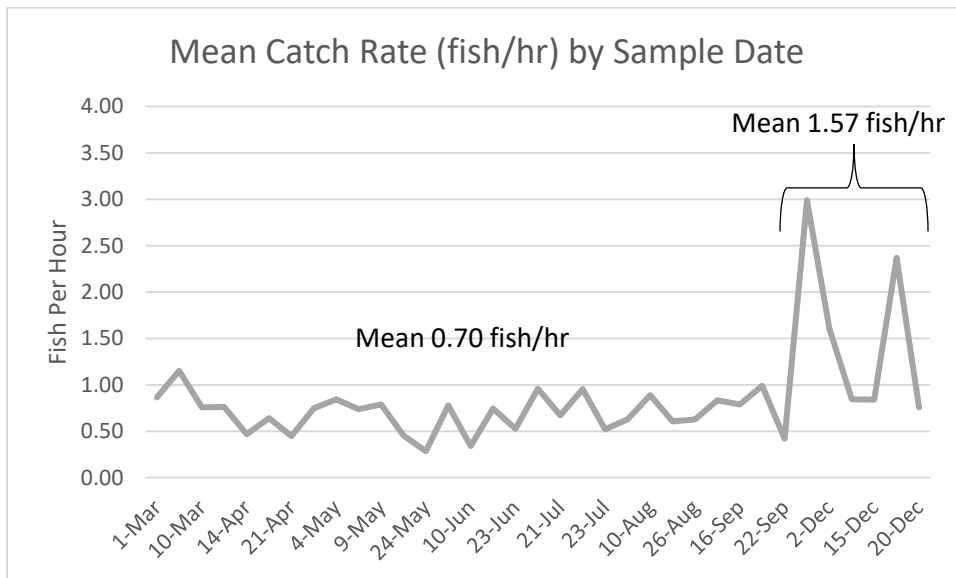


Figure 8. Mean daily angler catch rate by survey date, March-September and December, Green River, 2018.

## Recreation and Angling Trends

Based on mean daily counts at both exit locations, recreational use was highest in the summer, from June through August, peaking at an average of 254 users per day in July (Figure 9). The majority of the recreational users counted also occurred in the A-section (91.5%) versus B-section (8.5%) (Figure 10). No recreational users were counted in March or December likely due to cold daytime temperatures. Mean daily angler counts peaked in April at 126 users per day, during the peak of the spring mayfly or blue winged olive hatch, and remained relatively high averaging from 80-106 users per day through September. Mean daily angler counts were lowest in December at 8 users per day.

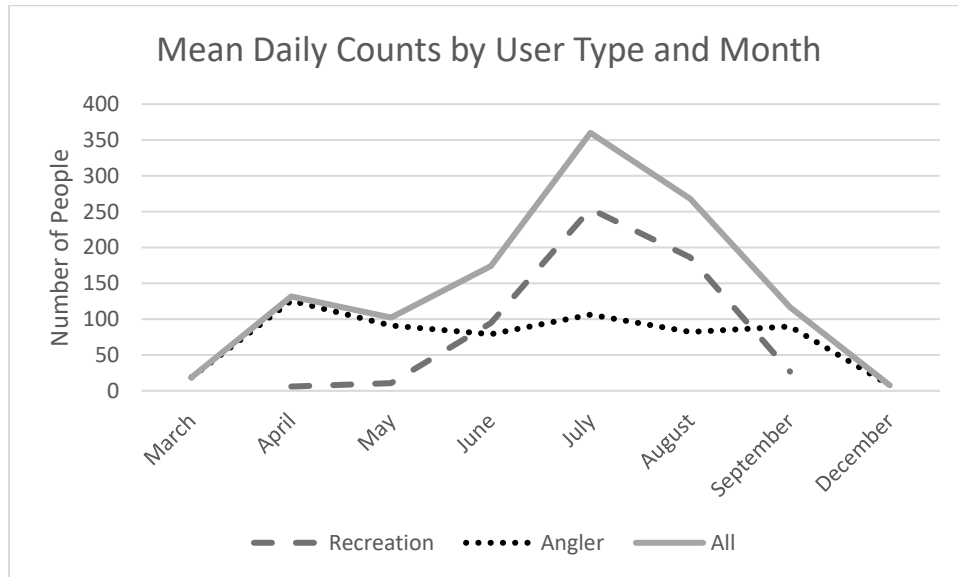


Figure 9. Mean daily recreation and angler counts for both exit locations, Little Hole and Indian Crossing, Green River, 2018.

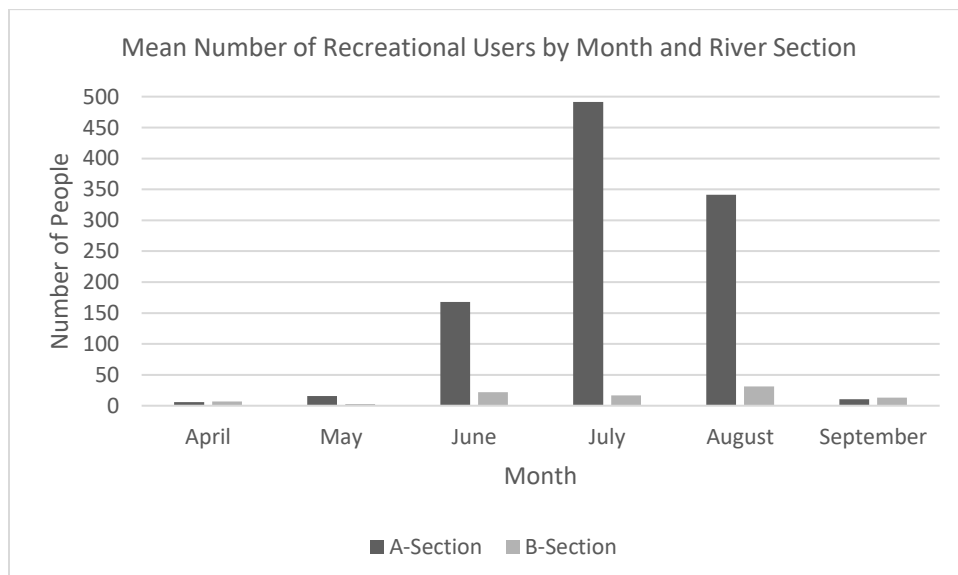


Figure 10. Daily mean number of recreational users by month and river section, Green River, 2018.

Most anglers that were interviewed fished the Green River by boat (35%) followed closely by wade/shore (34%) and guided (31%). All guided anglers were also fishing by boat, so collectively 69% of the anglers interviewed fished by boat. This contrasts the 1992 creel survey when 70% of the anglers shore/wade fished and 30% fished by boat.

The largest portion of anglers were fly fishing (87%), followed by spin fishing (8%) and combination of both gears (5%). Of the anglers interviewed, 63% fished the A section, 25% the B section, and 12% fished both A and B sections. Species preference was 48% for any or all species, followed by Brown Trout (37%), Rainbow Trout (13%), and Cutthroat Trout (2%). Mountain Whitefish were only preferred by 0.11% of the anglers interviewed.

A total of 1,448 non-resident and 1,312 resident anglers were interviewed in 2018. Angler age ranged from 5 to 86 years of age with a mean of 48 years. Most anglers were non-resident (52.5%), of which 41% were from Colorado and 16% were from California. The remaining 43% of the non-resident anglers were from all other states or countries combined. Utah resident anglers comprised 47.5% of anglers, with 70% coming from counties along the Wasatch Front, including Salt Lake (40%), Utah (13%), Davis (9%) and Weber (8%) counties (Figure 11). This composition matches the most populated counties in Utah in 2018 including Salt Lake (1.1 million), Utah (590K), Davis (341K), and Weber counties (248K) (US Census Bureau, 2019). Non-resident anglers generally purchased a non-resident 3-day fishing license (58%) followed by a 7-day license (25%), a 365-day fishing license (15%) and other (2%). Other license types included youth, combination, multi-year, and elk permits. Note: a non-resident big game permit (not antlerless) also served as a fishing license. The estimated contribution of all non-resident license sales for the 7-month survey period was \$808,092 (Table 1, Appendix 1).

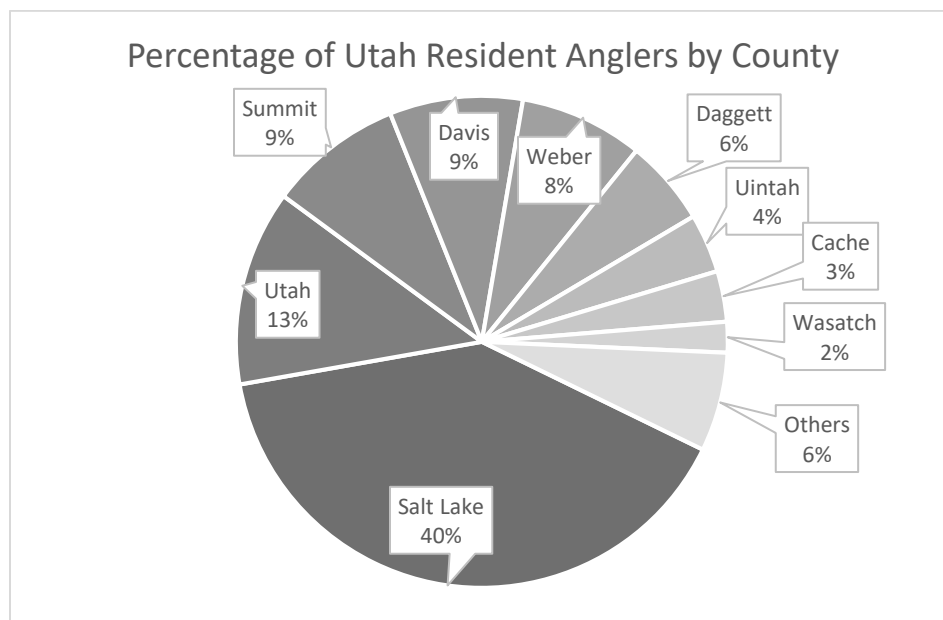


Figure 11. Composition of Utah resident anglers interviewed by county, Green River, 2018.

Non-resident anglers spent more time (trip days) and money to fish the Green River than resident anglers (Figure 12). Expenses included their own estimate of travel, lodging, license, guide (if used) and food expenditures. Likely due to the close proximity of the Green River, resident anglers spent less than \$250 and an average of 2.0 days fishing. Anglers from



Colorado spent between \$250-500 and 3.0 days fishing, while those from California spent between \$500-1000 and 3.4 days fishing. Anglers from California were more inclined to hire fishing guides, with 65% of them using guide services in 2018. Utah and Colorado anglers utilized guide services 20% and 27% of the time, respectively.

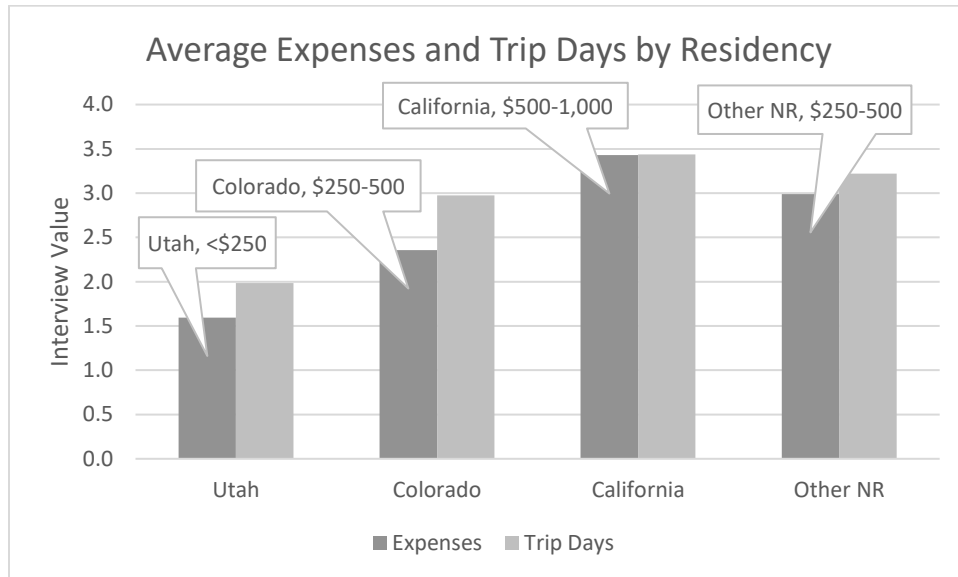


Figure 12. Mean expenses and trip days for resident and non-resident (NR) anglers fishing the Green River, 2018.

### Satisfaction Ratings

Anglers and recreationists were also asked to rate their river experience from 1-5 based on 1) Numbers of fish, 2) Size of fish, 3) Their overall experience on the river, 4) The amount of pressure or crowding (5 being low or good), 5) River flows, 6) Access and amenities, and 7) Likelihood to return. Anglers were asked questions #1-7 while recreationists were only asked questions #3-7, as they did not fish. Sample sizes varied by user group and questions answered but in general more than 1,883 responses were collected from anglers and more than 340 were collected from recreationists. Overall, mean satisfaction for both recreational and angling users was higher than average, with nothing below 3.6 on a scale of 1-5 (Figure 13). The lowest ratings given by anglers were “Numbers of fish” (3.62) and “Pressure or crowding” (3.69), but they still rated their “Overall experience” (4.65), and most notably, “Likelihood to return” (4.93) very high. Recreationists were very satisfied with their river experience overall, providing mean ratings all over 4.4, the highest being 4.96 for “Likelihood to return”.

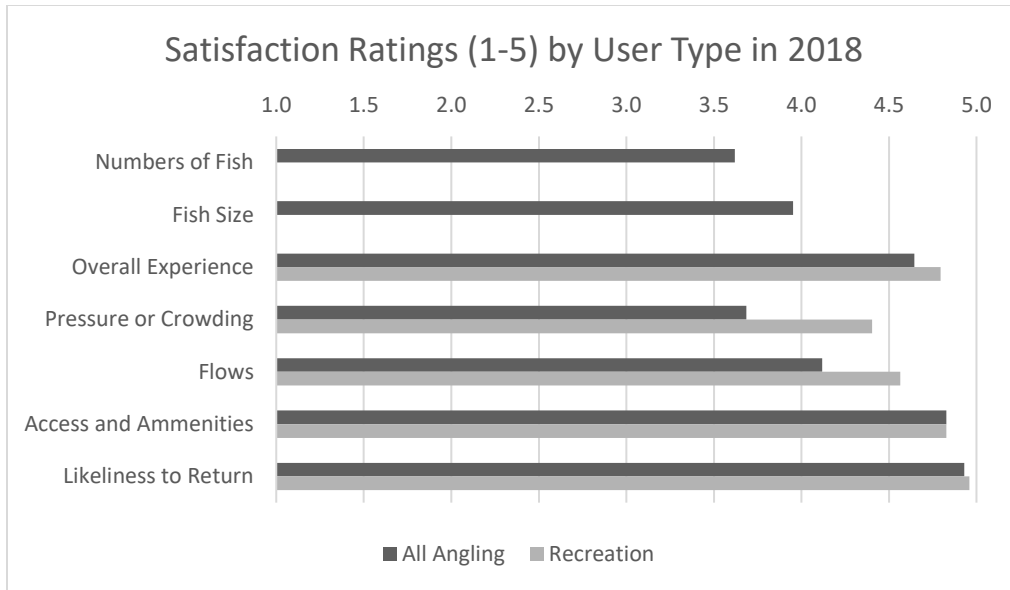


Figure 13. Satisfaction ratings (1-5) by user group, anglers and recreationists, Green River, 2018.

For anglers, the highest proportion (greater than 35%) of responses were “5” for all of the questions (Figure 14). A total of 680 or 36% of anglers interviewed gave “Numbers of fish” a satisfaction rating of a 5. “Size of fish” was rated 5 by 727 or 39% of the anglers. Given the high ratings for these two fishery related questions, it appears most anglers are satisfied with the current status of the fishery. In the past, anglers have expressed concerns about flow management related to their fishing experience. Overall in 2018, 1,903 anglers gave “Flows” a mean rating of 4.1 on a scale of 1-5, and 53% of them provided a flow rating of 5. However, “Flows” were the most misunderstood category, and unless the angler was familiar with flow management in the Green River, he or she was not likely to be concerned about this topic.

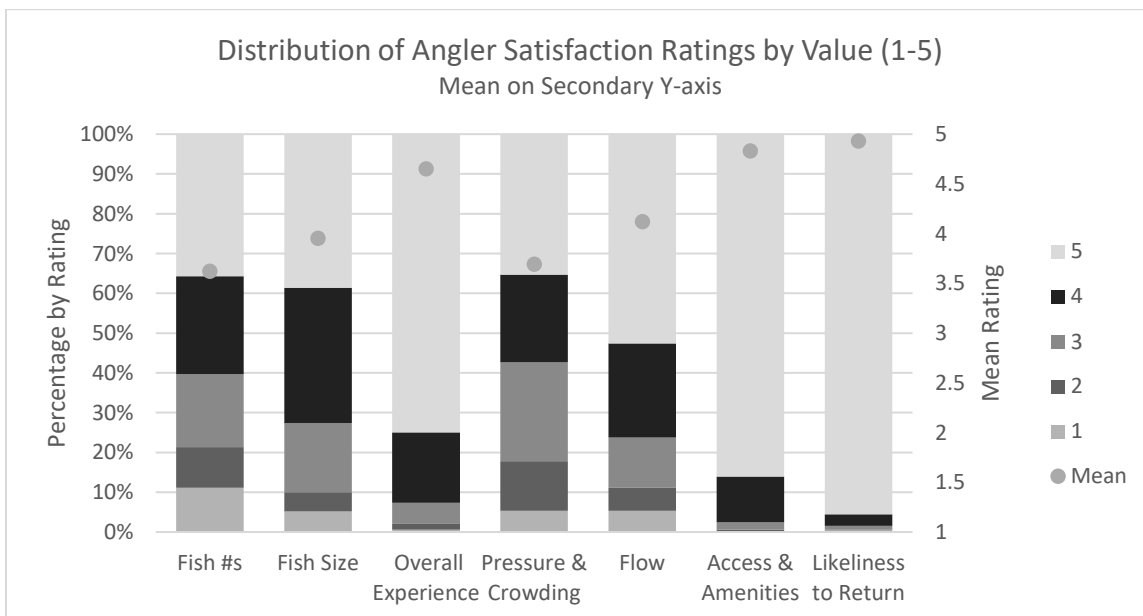


Figure 14. Percentage of responses and mean satisfaction value (1-5) for anglers fishing the Green River, 2018.

Angler satisfaction ratings for “Flows” were variable across survey days with some distinct lows. The lowest “Flow” ratings occurred on survey days after a change in mean daily flow, high flows (spring high flow event), and double peaking (Figure 15). On March 1<sup>st</sup>, the “Flow” rating averaged 2.8 after the daily flow dropped from a relatively stable flow ranging from 1,950-2,940 cfs on February 28<sup>th</sup> to a single peak flow ranging from 1,490-2,970 cfs (Figure 16). On March 10<sup>th</sup>, the “Flow” rating was 2.0 while flows were a single peak pattern ranging from 1,490-2,970 cfs. Most of the interviewees on March 10<sup>th</sup> were wade/shore anglers (67%). Of those interviewed, four specifically expressed concerns about the flows, even indicating “it was difficult to cross the river once the flows increased”. Safety issues while wading or crossing the river, by mostly wade/shore fishermen that given day, might have impacted the low “Flow” rating. On May 24<sup>th</sup>, during the spring high flow event, the “Flow” rating was 2.6 when flows were at 4,800 cfs. High flows are typically characterized by large amounts of debris in the drift, making fishing more difficult and therefore disadvantaging anglers. On December 15<sup>th</sup> and 20<sup>th</sup>, the flow rating was 2.3 and 2.2, respectively, during double peak flows ranging from 1,170-3,090 cfs twice daily (Figure 17). Anglers may be more sensitive to flow changes as seen in March and December, specifically when the magnitude and frequency of flow change is greater. During this time, the “Likeliness to return” rating remained high, but unfortunately it was not determined exactly when those anglers may return (Figure 15). It is possible they planned to return when flows were more favorable to their fishing experience.

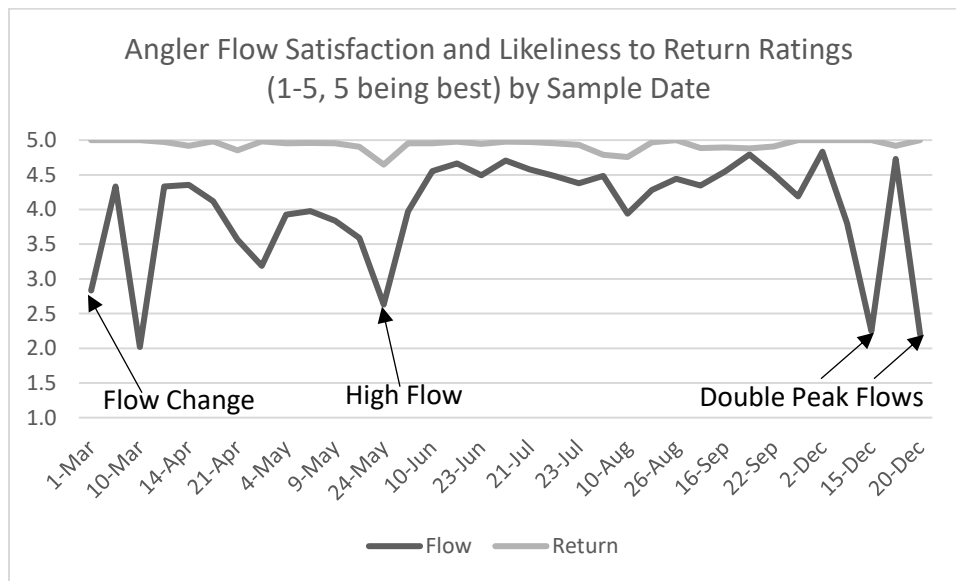


Figure 15. Mean daily angler “Flow” and “Likeliness to Return” ratings by survey date, Green River, 2018.

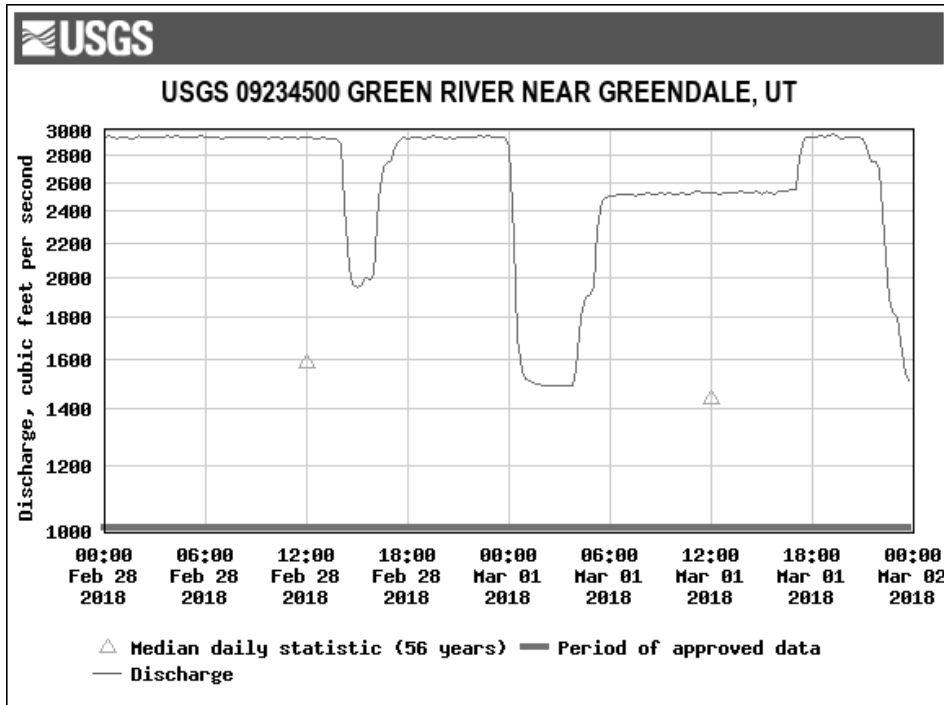


Figure 16. Discharge (cfs) as measured at the Greendale gage below Flaming Gorge Dam from February 28<sup>th</sup>-March 1<sup>st</sup>, Green River, 2018.

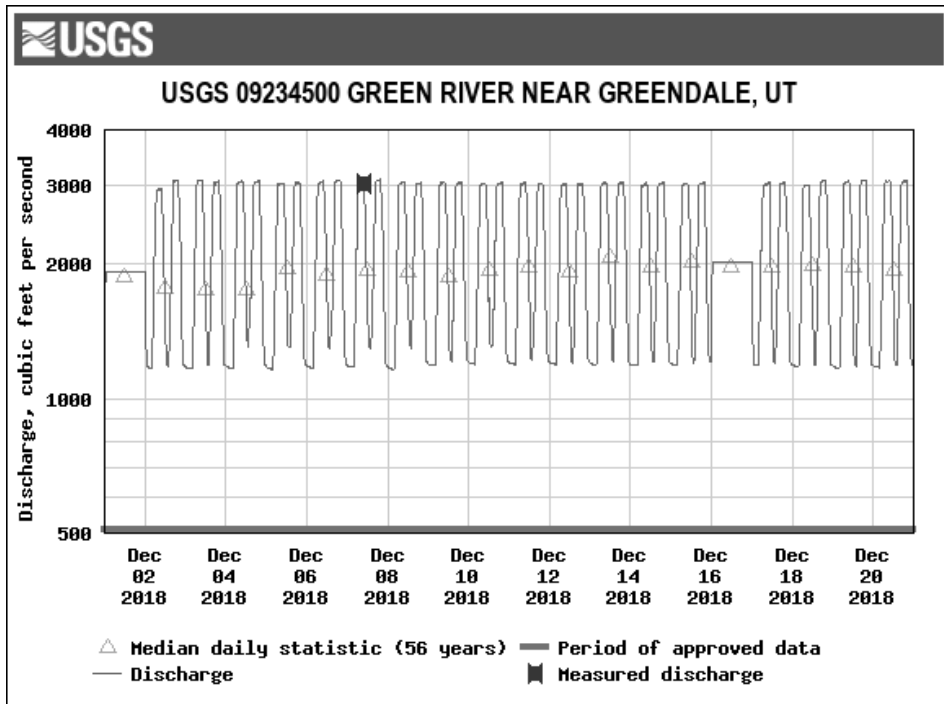


Figure 17. Discharge (cfs) as measured at the Greendale gage below Flaming Gorge Dam from December 1<sup>st</sup>-20<sup>th</sup>, Green River, 2018.

### *Additional Comments*

A total of 420 additional comments were documented during interviews, which were categorized by neutral, positive or negative (Figure 18). Most (62%) were neutral, meaning the interviewee just provided a suggestion about flows, the fishery, or the fishing gear they were using. Positive comments (19%) included those showing appreciation for the fishery, the river experience, and even the survey or surveyor. Negative comments (19%) included complaints about facilities like restrooms, fishery trends, and too many recreationists and/or fishing guides.

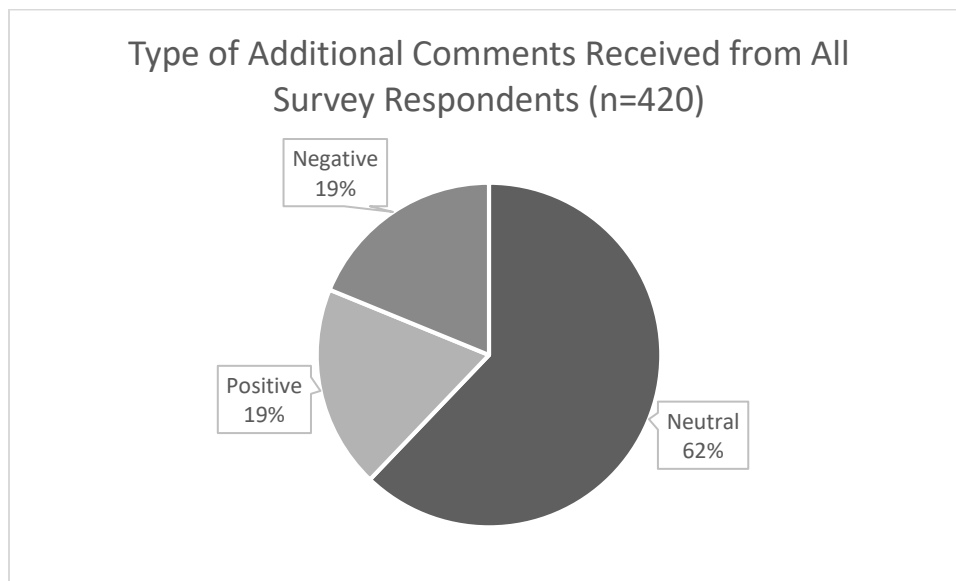


Figure 18. Percentage of additional comments by category (neutral, positive, negative), Green River, 2018.

### *December Flow Comparisons*

A total of 6 survey days were completed in December, two weekdays and four weekend days. Two weekends were scheduled to study the impacts of flow patterns on fishing success and angler satisfaction, including back-to-back days, one with stable flows and the other with double peak flows. Stable flows averaging 2,000 cfs occurred on Saturday, December 1<sup>st</sup> and again on Sunday, December 16<sup>th</sup>. Double peak flows ranging from 1,170-3,090 cfs occurred on Sunday, December 2<sup>nd</sup> and Saturday, December 15<sup>th</sup>. The two weekdays were also characterized by the same double peak flow range.

Due to low angling pressure in the winter, relatively few anglers were interviewed (n=92) but catch rates were much higher than those measured in the peak season. The mean catch rate in December was 1.57 fish/hour compared to 0.70 fish/hour measured in March through September. Catch rate across the four days with a double peak flow pattern averaged 1.08 fish/hour but almost tripled during the two days with stable flows, averaging 2.78 fish/hour (Figure 19). Only one guided angler was interviewed during the December surveys.

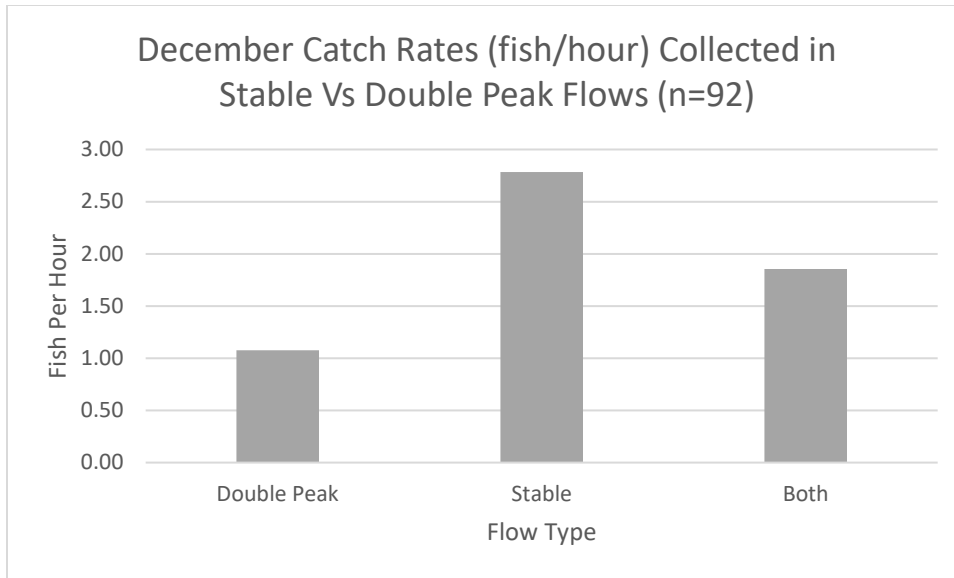


Figure 19. Mean catch rate by flow type as measured in December, Green River, 2018.

Flow satisfaction varied by daily flow type (Figure 20). On days with stable flows, the mean flow rating was 4.36, whereas on days with double peak flows, the rating dropped to 2.66. Anglers still rated their “Likeliness to return” very high at 4.99 (mean for both flow types), but unfortunately it is unknown when they would return.

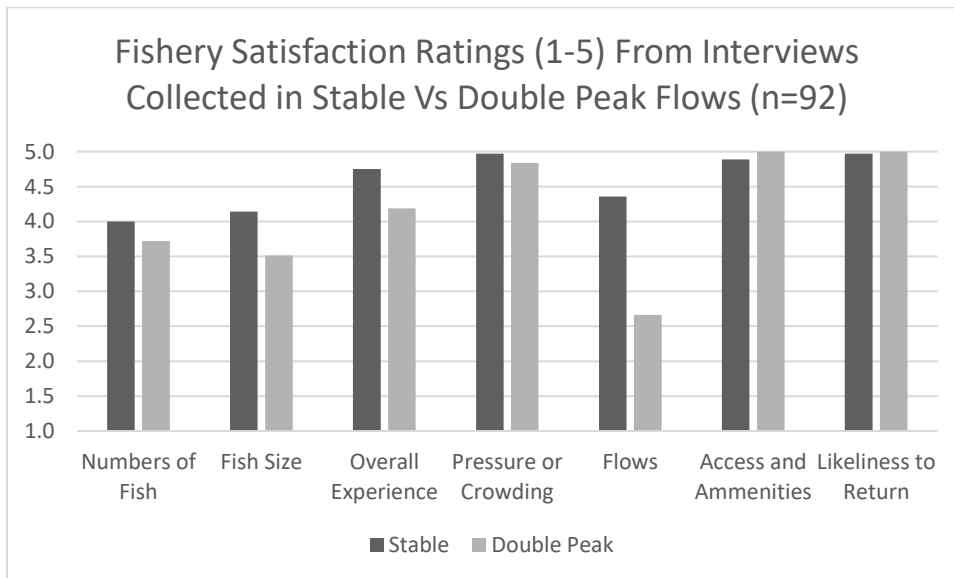


Figure 20. Fishery satisfaction ratings by flow type in December, Green River, 2018.

Of the 77 anglers interviewed during the weekend with stable flows, 66% were aware of the flows, but only 16% stated it was the determining reason they came to fish. Of the anglers aware of the stable flow prescription, most learned about it through another person (33%) or social media (27%), followed by a local fly shop (20%), email/fishing report (18%) and radio broadcast (2%). Stable flows were first announced by UDWR through social media on November 27<sup>th</sup>, followed by fly shops, radio broadcast, etc. Anglers that learned about the opportunity had only four days to schedule a trip for the first weekend. Angler success was high



on the two days of stable flows, and if they're prescribed again in the future, it may help to provide more notice thereby increasing awareness and willingness of anglers to utilize desirable flows when they are scheduled.

### *Conclusions and Recommendations*

Creel, angler, and in this case, user surveys allow managers to acquire a broad range of opinions, measure success, and monitor trends, which can be used to make prudent decisions about the resource they manage. This summary highlights the value of the Green River for recreationists and anglers and those that benefit from it economically. Although a lot of information has been interpreted and presented, there remain numerous ways to analyze the more than 80K cells of collected data. As agencies continue to partner in management and look for ways to meet the desires of the public, these types of surveys will continue to be a valuable tool to timely track success and satisfaction. Some recommendations include:

- ✓ Conduct outreach to educate anglers on the status of the Green River fishery and that “fewer fish equates to bigger fish”.
- ✓ Direct anglers to time periods and sections of the river with lower pressure but higher angling success to maintain or even bolster satisfaction (i.e. B-section and/or fall-winter months).
- ✓ Propose continued “days of rest” or days with stable flows to benefit angling success. If approved by WAPA, measure and compare angling success through spot creel surveys.
- ✓ Coordinating with the USFS, propose projects through Boating Access, Blue Ribbon Fisheries Council, and Habitat Council for increased launch preparation areas, launch ramps (personal float craft), parking, restrooms, trail renovation, etc. to reduce congestion during high use periods in the summer months at Spillway and Little Hole.
- ✓ Implement the next creel survey in 2024 and continue on a 5-year cycle or more frequent if a major change is implemented or observed. Consider doing a separate roving creel survey on C-section in the meantime to measure angler pressure and success.
- ✓ The current river stocking quota is 11K 10-inch Fish Lake Desmet strain Rainbow Trout. Relative weights remain high for both Brown Trout (112) and Rainbow Trout (102) indicating suitable forage for both species (2019 unpublished data). Based on the angler catch rate (0.52 fish/hour) and high angler use (251K angler hours, 756 angler hours/acre) measured during the 2018 creel, it would be prudent to increase stocking by 25%, potentially improving angler opportunity and satisfaction. While stocking Rainbow Trout, continue to monitor strain and cohort success through external dye marks and return rates via boat electrofishing. Make necessary stocking adjustments after the next creel in 2024.

### Literature Cited

- Bernard, D. R., A. E. Bingham and M. Alexandersdottir. 1998. The mechanics of onsite creel surveys in Alaska. Sport Fish Restoration Act. Project F-10-13, Job No. RT-4. Alaska Dept of Fish and Game. Anchorage, AK. Special Publication No. 98-1. 126 pp.
- Brayton, S., R. Schneidervin and V. Keddy. 1993. Estimated Angling Pressure on the Green River, Flaming Gorge Tailwater, February 1992 Through February 1993. Sport Fish Restoration Act. Grant F-28-R. Utah Division of Wildlife Resources. Salt Lake City, UT. 7 pp.
- Hepworth, R. D. and D. E. Wiley. 2004. Middle Provo River Creel Survey. Utah Division of Wildlife Resources. Salt Lake City, UT.
- Krannich, R. S., R. J. Lilieholm and J. Unger. 2012. 2011-2012 Utah Angler Survey. Utah Division of Wildlife Resources, Salt Lake City, UT. 153 pp.
- Nadolski, B. and C. Penne. 2013. Weber River Creel Survey. Sportfish Restoration Act. Grant F-44-R. Utah Division of Wildlife Resources. Salt Lake City, UT. 27 pp.
- Pratt, J., J. Nielsen, and A. Nordstrom. 1991. The recreation use capacity of the Green River Corridor below Flaming Gorge Dam. Final report to Flaming Gorge Ranger District, Ashley National Forest, USDA Forest Service, Dutch John, UT. 272 pp.
- United States Census Bureau. Annual Estimates of the Resident Population: April 2010 to July 1, 2018. US Census Bureau, Population Division. Web. May 2019.  
<http://www.census.gov/>.

## Appendix 1. Additional Tables and Figures

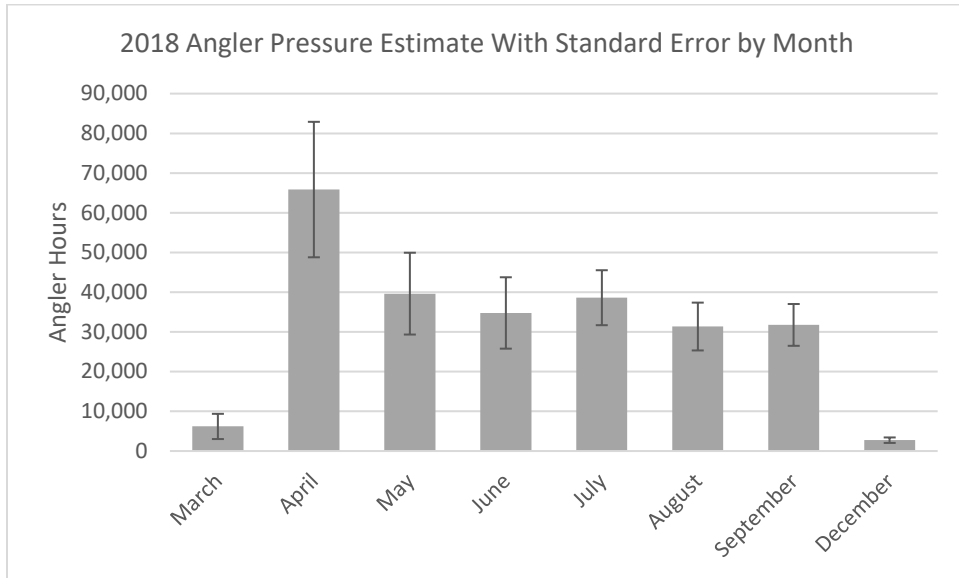


Figure 21. Angler pressure with standard error by month, Green River, 2018.

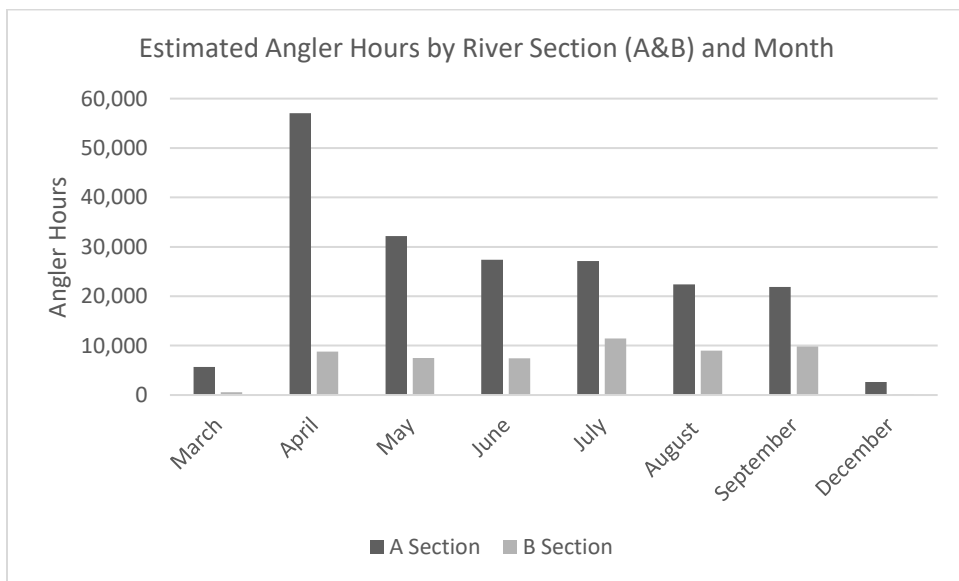


Figure 22. Angler pressure by river section (A&B) and month, Green River, 2018.

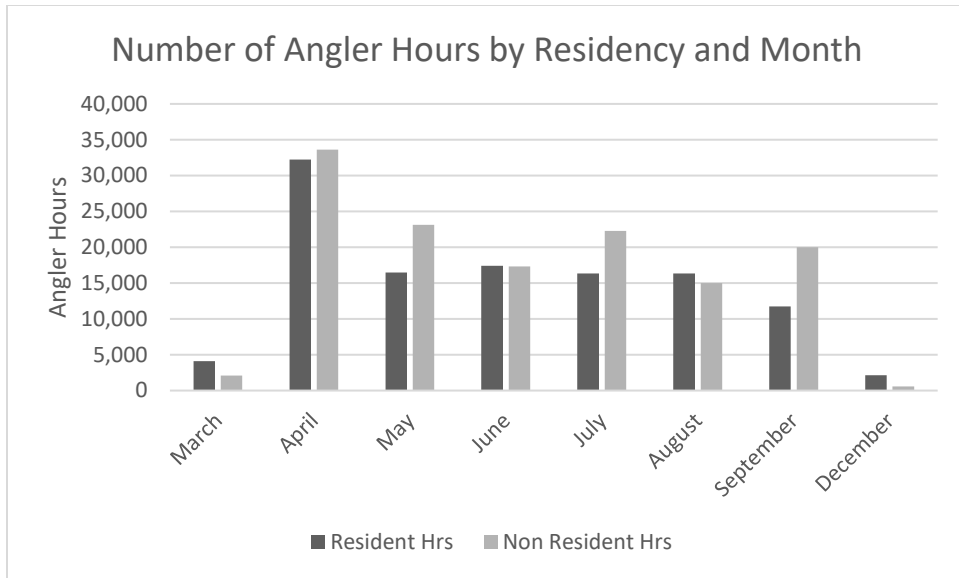


Figure 23. Angler pressure by residency and month, Green River, 2018.

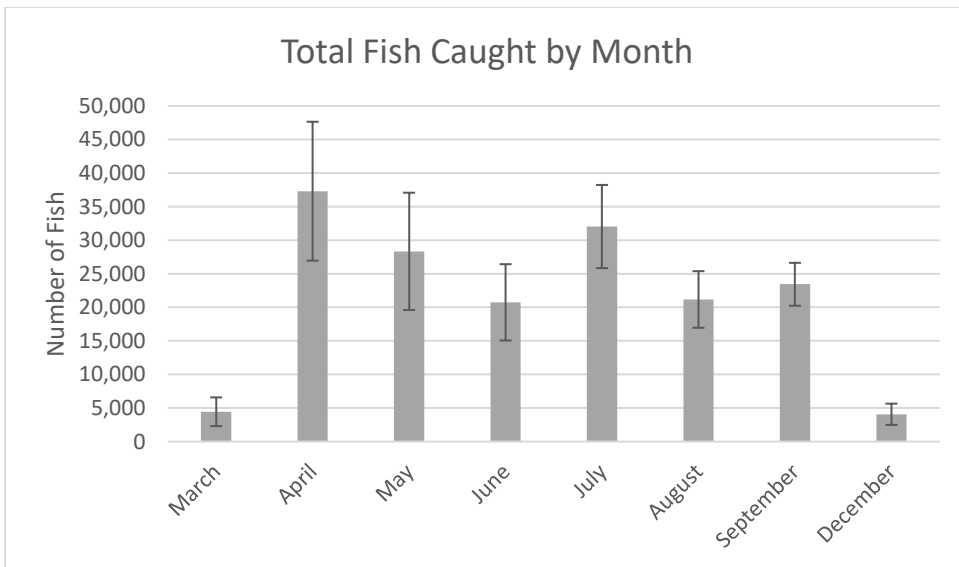


Figure 24. Total fish caught by month with standard error, Green River, 2018.

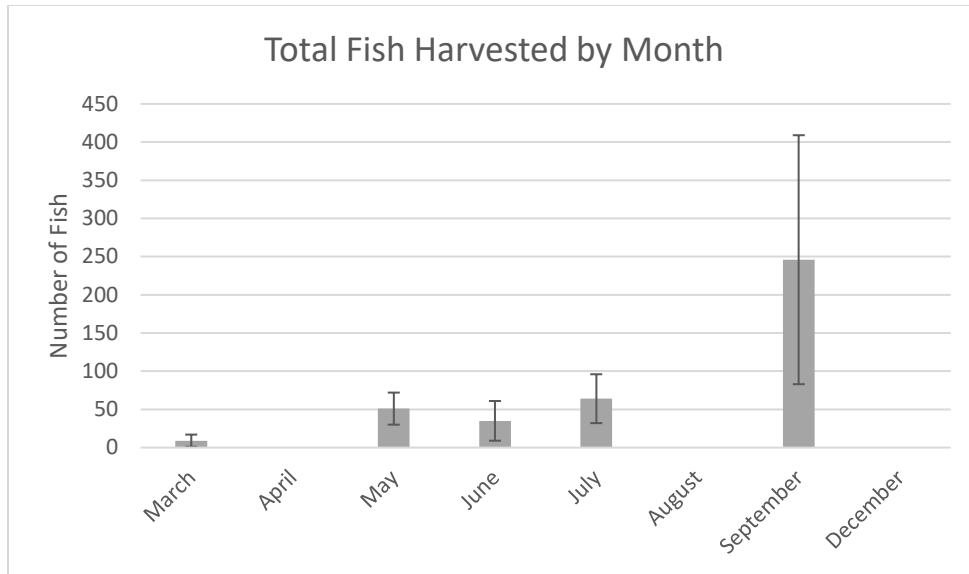


Figure 25. Total fish caught by month with standard error, Green River, 2018.

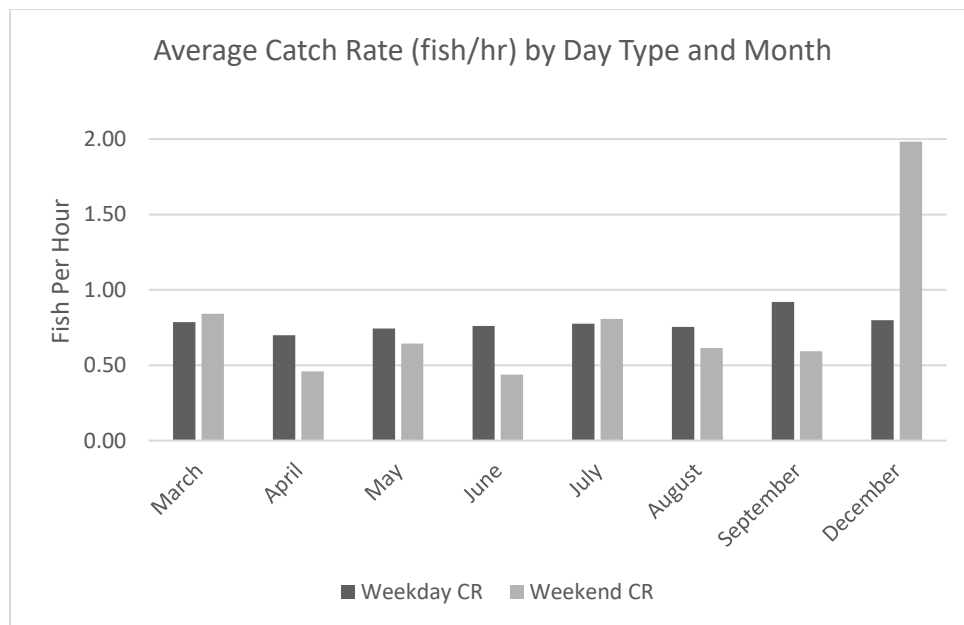


Figure 26. Mean catch rate (fish/hr) by day type and month, Green River, 2018.

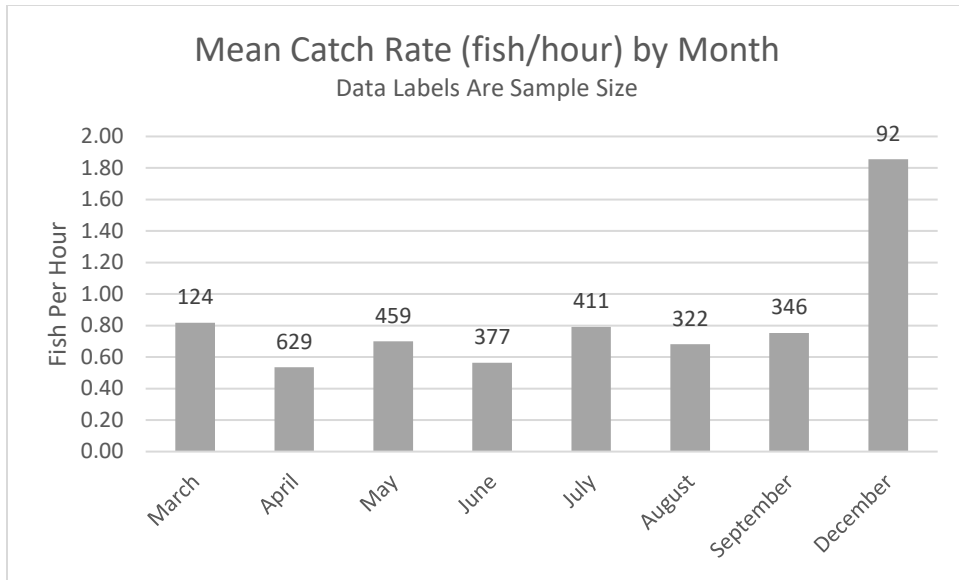


Figure 27. Mean catch rate (fish/hr) by month with sample size, Green River, 2018.

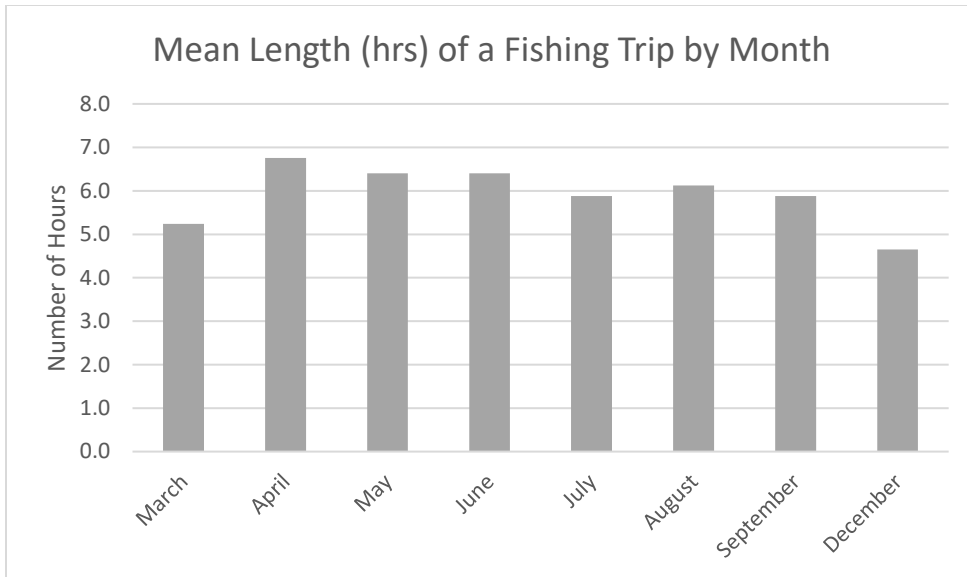


Figure 28. Mean length of a fishing trip (hours) by month, Green River, 2018.



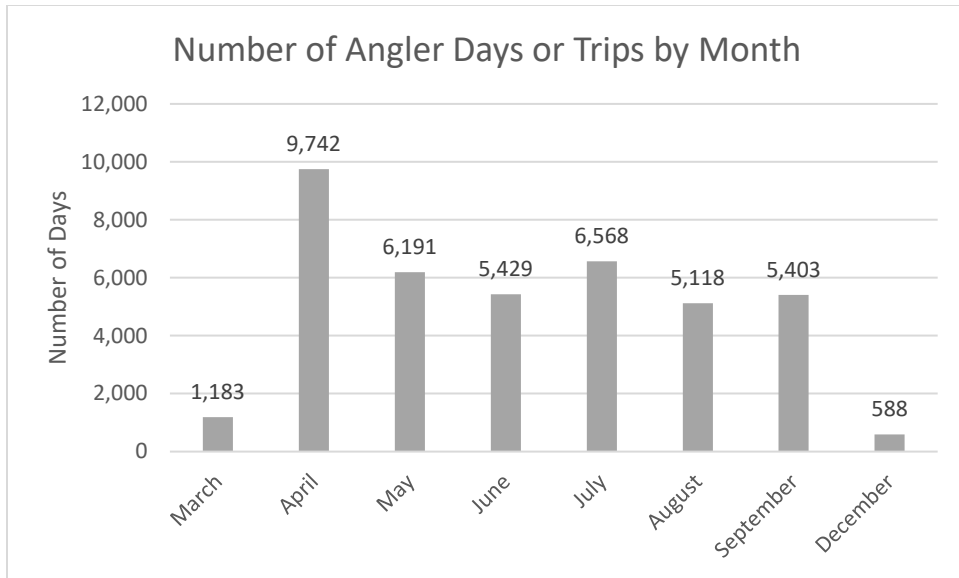


Figure 29. Mean number of angler trips or days by month, Green River, 2018.

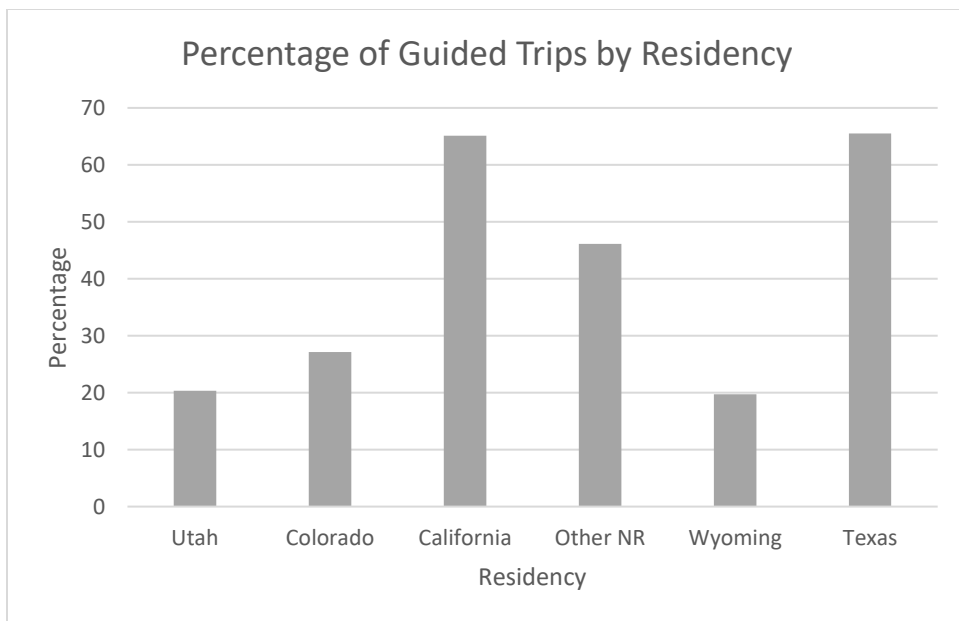


Figure 30. Percentage of guided trips by angler residency, Green River, 2018.

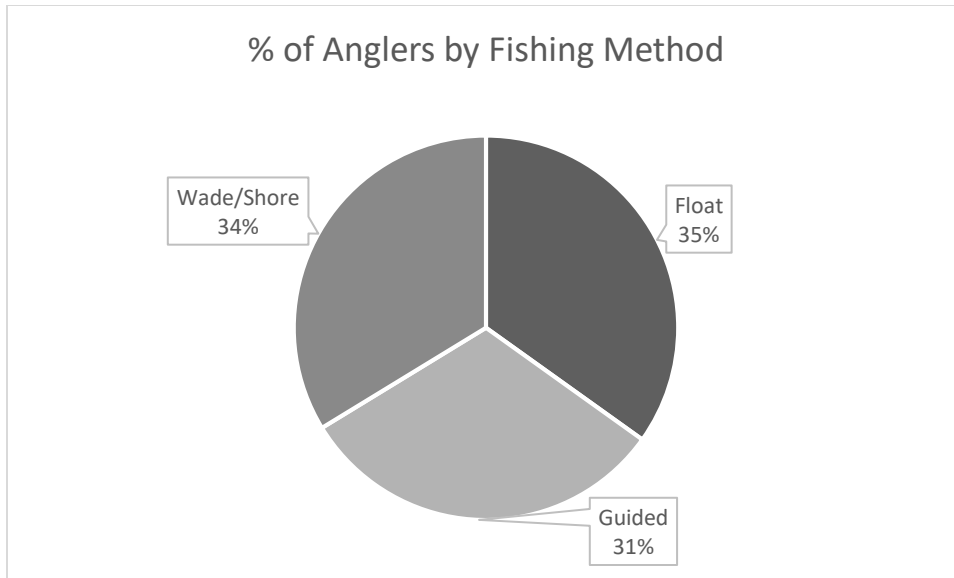


Figure 31. Percentage of anglers by fishing method, Green River, 2018.

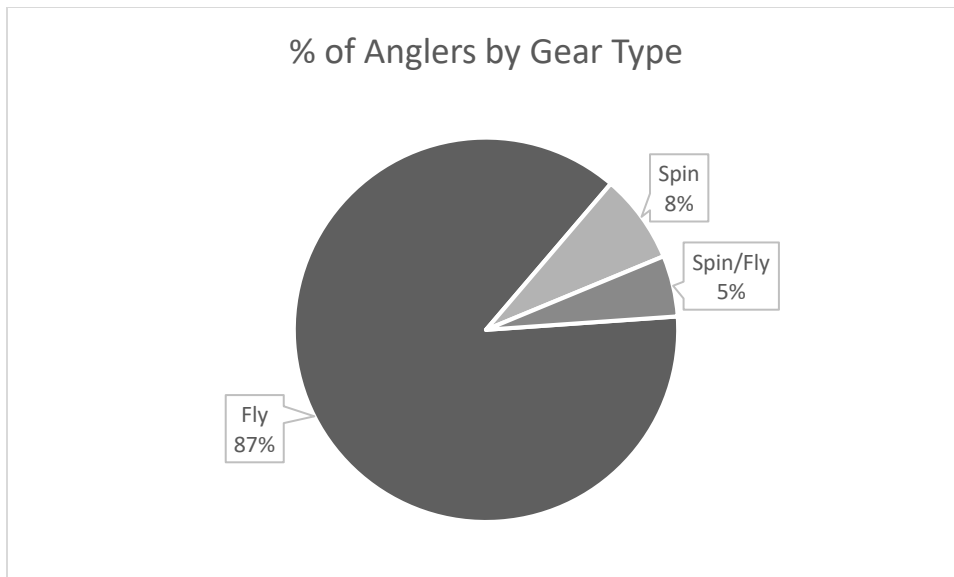


Figure 32. Percentage of anglers by gear type, Green River, 2018.

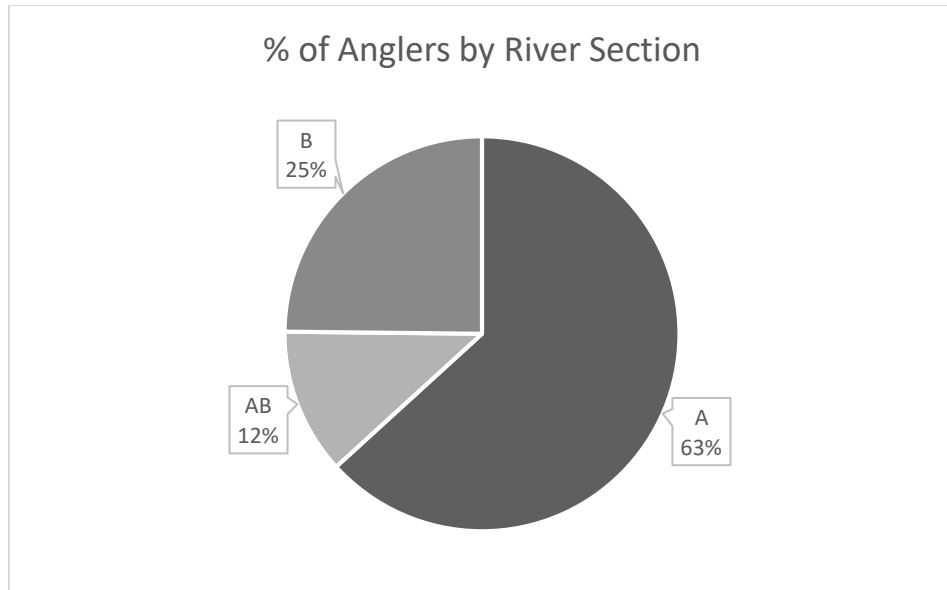


Figure 33. Percentage of anglers by river section(s) fished, Green River, 2018.

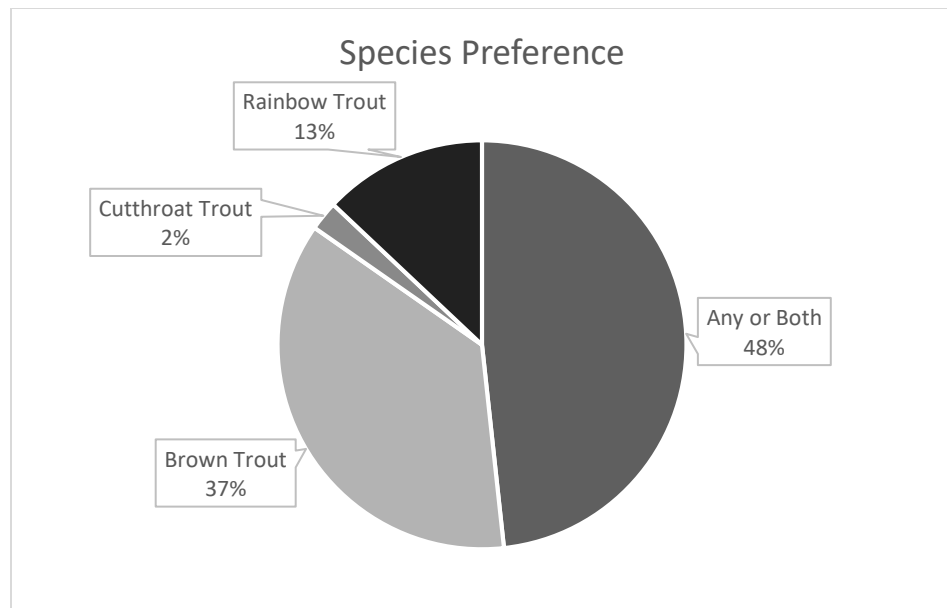


Figure 34. Percentage of species preference, Green River, 2018.

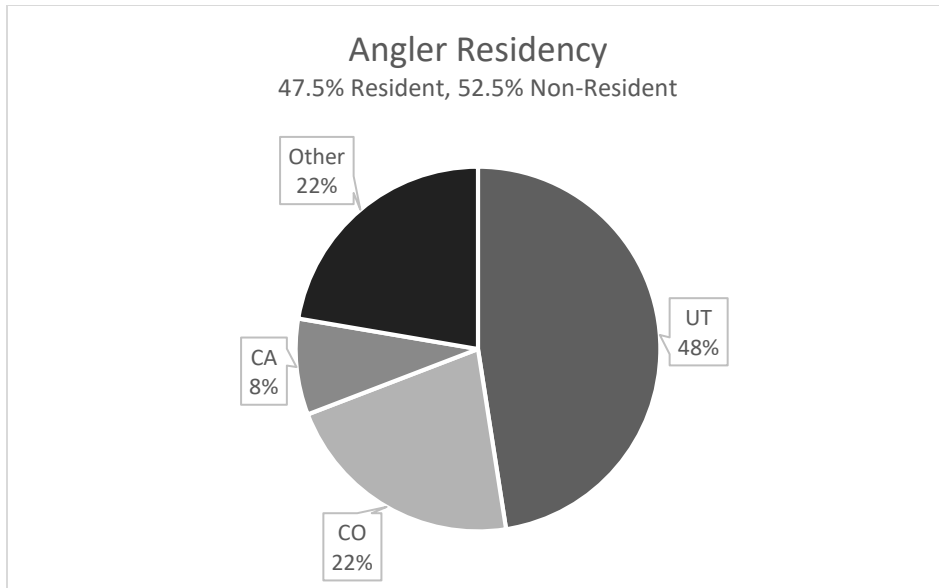


Figure 35. Percent angler residency, Green River, 2018.

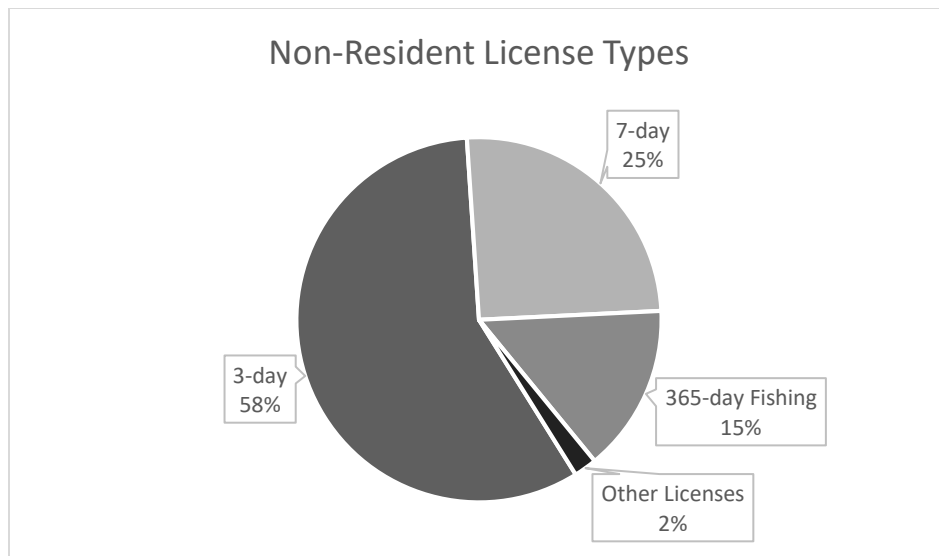


Figure 36. Percentage of non-resident license types, Green River, 2018.

Table 1. Estimated Non-resident License Sales during the 2018 Green River Survey

NR License Type	Count of License Type	% of License Type	License \$ Value	Total \$ by License Type
<b>3-day</b>	654	57.82	\$24	\$15,696
<b>7-day</b>	286	25.29	\$40	\$11,440
<b>365-day Fishing</b>	168	14.85	\$75	\$12,600
<b>Youth 365-day Fishing</b>	2	0.18	\$25	\$50
<b>2-year Fishing</b>	1	0.09	\$148	\$148
<b>5-year Fishing</b>	7	0.62	\$370	\$2,590
<b>Total</b>	1118	98.85		\$42,524
<b>Average Cost/Angler</b>	\$38.04			
<b>Total Angler Hours</b>	250,900			
<b>Average Day Length</b>	6.2			
<b>Ratio of NR Anglers</b>	0.525			
<b>Number of NR Anglers</b>	21,246			
<b>Estimated NR License Sales</b>	\$808,092			

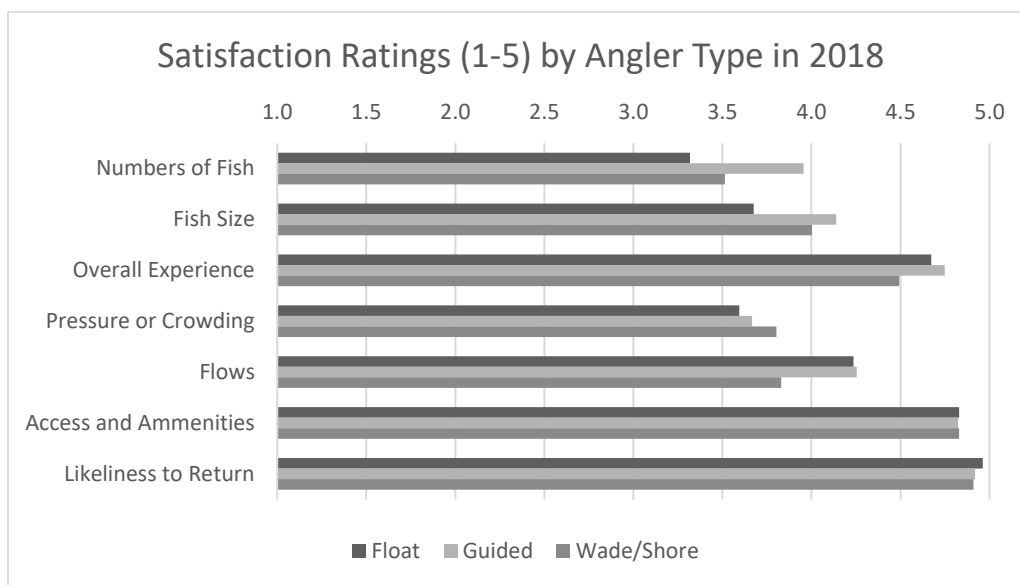


Figure 37. Satisfaction ratings (1-5) by angler type or method, Green River, 2018.

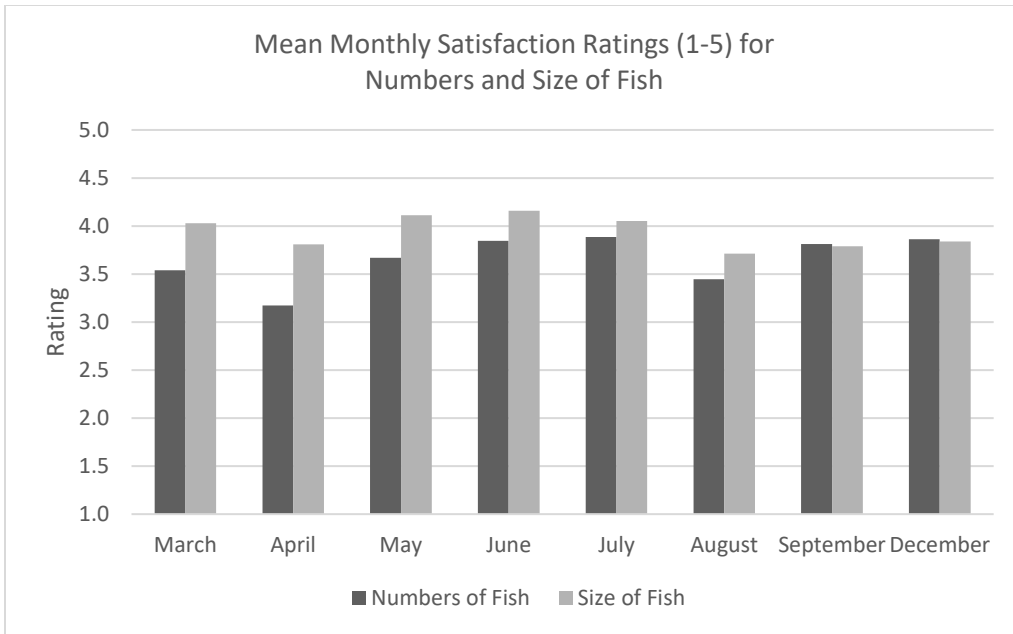


Figure 38. Mean monthly angler satisfaction ratings (1-5) for numbers and size of fish, Green River, 2018.

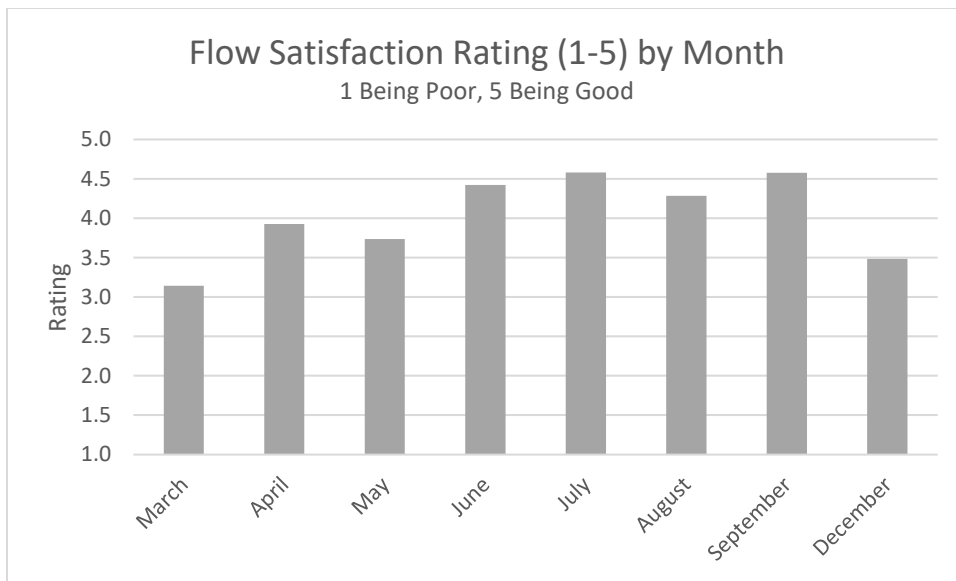


Figure 39. Mean flow rating (1-5) by month, Green River, 2018.



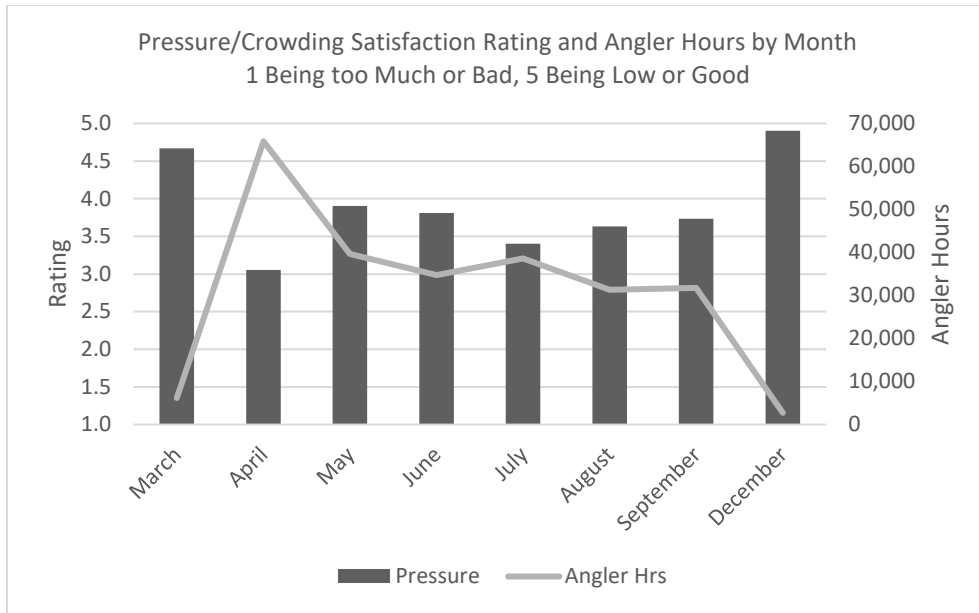


Figure 40. Pressure/crowding satisfaction rating (1-5) versus angler pressure (hours) by month, Green River, 2018.

## Appendix 2. Creel Calendar, Forms, and Codes

Indicates creel survey date

### MARCH

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5	6	7	8	9	10
DAYLIGHT SAVINGS	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

### APRIL

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
EASTER	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

### MAY

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	MEMORIAL	29	30	31		

### JUNE

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

**JULY**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	INDEPENDENCE	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	PIONEER	25	26	27	28
29	30	31				

**AUGUST**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

**SEPTEMBER**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	LABOR	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

**DECEMBER**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	XMAS	26	27	28	29
30	31					





### Interview Codes

Sky		Wind		Temp		Flow Type	
Sunny	SY	Calm	CM	Below 0	FR	S	Stable
Partly Cloudy	PC	Breezy	BR	0-40	CD	SP	Single Peak
Overcast	OC	Strong Wind	SW	40-60	CL	DP	Double Peak
Foggy	FG			60-80	WM		
Rainy	RN			80+	HT		
Snowy	SN						

Section	Method		Gear		Species	
A	Wade	W	Fly	F	Brown Trout	BN
B	Float	FT	Spin	S	Rainbow Trout	RT
C	Guide	G	Both	SF	Cutthroat Trout	CT
Combo of	Rec	R			Whitefish	WF
					Northern Pike	NP
					Any	AN
					>SLOT	-G

State Abbreviations					
Alabama	AL	Louisiana	LA	Ohio	OH
Alaska	AK	Maine	ME	Oklahoma	OK
Arizona	AZ	Maryland	MD	Oregon	OR
Arkansas	AR	Massachusetts	MA	Pennsylvania	PA
California	CA	Michigan	MI	Rhode Island	RI
Colorado	CO	Minnesota	MN	South Carolina	SC
Connecticut	CT	Mississippi	MS	South Dakota	SD
Delaware	DE	Missouri	MO	Tennessee	TN
Florida	FL	Montana	MT	Texas	TX
Georgia	GA	Nebraska	NE	Utah	UT
Hawaii	HI	Nevada	NV	Vermont	VT
Idaho	ID	New Hampshire	NH	Virginia	VA
Illinois	IL	New Jersey	NJ	Washington	WA
Indiana	IN	New Mexico	NM	West Virginia	WV
Iowa	IA	New York	NY	Wisconsin	WI
Kansas	KS	North Carolina	NC	Wyoming	WY
Kentucky	KY	North Dakota	ND	Country	C