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## Angler Catch Rates, Opinions, and Abiotic Variable Relationships in the Lower Logan River, Utah

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# **Angler Catch Rates, Opinions, and Abiotic Variable Relationships in the Lower Logan River, Utah**

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## **Abstract**

Summer base flows for rivers are critical for maintaining water quality, healthy fish populations, and a functional aquatic ecosystem. Low summer base flows can increase water temperatures and lower dissolved oxygen levels. These conditions can cause Brown Trout (*Salmo trutta*) energetic stress and result in lower angler catch. The goal of this study was to determine if low river flows and higher water temperatures influence angler catch rates of Brown Trout on the lower Logan River, Utah and to better understand angler use of the lower river. We performed a creel survey on approximately 6.4 km of the lower Logan River from 1 April to 31 October 2019 to calculate mean monthly angler catch rates. We used continuous collection of stream temperature and flow from a river gage within the survey reach to calculate monthly means. Total Brown Trout caught were 1,481 and total angling effort was 2,147 hours for an overall catch rate of 0.7 fish per hour (fph) for the survey period. The highest angler catch rate (1.2 fph) was in June with the highest mean monthly discharge (16 m<sup>3</sup>/s) and a mean monthly water temperature of 9.6 °C. The lowest angler catch rate (0.41 fph) occurred in September with a mean monthly discharge of 2.12 m<sup>3</sup>/s and a mean monthly water temperature of 11.2°C. We found a positive correlation between flow rates and angler catch rates ( $R^2 = 0.37$ ), and a negative correlation between water temperatures and angler catch rates ( $R^2 = 0.42$ ), although neither were statistically significant. Our data suggest that even on a higher-than-average runoff year, angler success is impacted by low summer base flows. Maintaining increased river flow during typical summer low-flow time periods could increase angler catch rates and, ultimately, provide even greater satisfaction with this fishery. We also determined educational signage and outreach could be extremely influential, as anglers knew little about regulations of the fish community in general.

## Introduction

In addition to its intrinsic value as part of a nearly pristine mountain river above, the lower Logan River from First Dam to Cutler Reservoir is an asset to residents of Cache County, Utah and has supported many beneficial uses, including a substantial amount of irrigated agriculture and secondary water. In addition, Cache Valley citizens are attracted to the river to enjoy the aesthetics, recreational values, and wildlife resources associated with the river and its riparian and wetland habitats (Logan River Task Force 2016). However, the lower Logan River has been highly altered and is currently characterized by the Task Force to be in poor condition in terms of low summer base flows, flood plain function, riparian vegetation, and trout size. The Logan River Task Force developed a Conservation Action Plan for the lower Logan River with recommendations to improve water quality, water quantity, and habitat for fish and wildlife while retaining economic benefits to the local community. Therefore, the Task Force seeks to gather baseline data on many aspects of the river, such as angler use of the fishery, against which to measure the desired potential positive changes over time.

Angler surveys or “creel surveys” provide information on angler effort, catch, and catch rates and are an integral part of fisheries management. Past angler surveys have highlighted the importance and value of the Blue Ribbon Fishery in the upper Logan River (Budy et al. 2003; Budy et al. 2018) but there has not been a creel survey performed on the lower Logan River. Furthermore, there is no baseline information on angler satisfaction and opinions for the lower Logan River fishery.

Lower Logan River flows during the summer are critical for maintaining water quality, healthy fish populations, and a functional aquatic ecosystem (Logan River Task Force 2016). Low summer base flows ( $<0.87 \text{ m}^3/\text{s}$ ) increase water temperatures which in the latter part of the summer may lead to maximum stream temperatures exceeding the suitable range for Brown Trout (*Salmo trutta*; Armour, 1994). Water temperature is also known to lower catch rates for Brown Trout, and the percentage of anglers catching no trout increases significantly with temperature above  $19^\circ\text{C}$  (McMichael and Kaya 1991); however, relatively little data has been documented on water flow rate in relation to angler catch rates.

The objectives for our study on the Lower Logan River included: 1) quantifying angler effort, catch, and catch rates; 2) assessing angler satisfaction and opinions of the fishery; and 3) evaluating relationships between angler catch rates and water flows and temperature.

## Methods

### Angler survey design and counts

To determine angler effort, catch, and catch rates, we conducted a roving creel survey (Malvestuto 1996, Thomas, and Chamberlain 2000) of the Lower Logan River from April to October 2019. The upper extent of the surveyed reach began at the 100 East Road bridge and extended approximately 6.4 km downstream to Trapper Park, (Figure 1.) This is the most publicly accessible part of the lower Logan River because of several access points and a paved walkway along most of this reach.

Eight survey days per month were randomly selected by the Utah Division of Wildlife Resources, which consisted of four weekdays and four weekend days with two mornings and two afternoons per each of the four weekdays or weekend days. Survey periods ranged from six to eight hours, which varied based on seasonal changes to sunrise and sunset, with shorter survey periods during spring and autumn and longer survey periods during summer. This method results in an effort sampled equivalent to 10% percent of the total angler effort throughout the survey period. To determine angler effort, we counted all anglers during each survey period at three randomly selected count-times, except for in the month of April which had two randomly selected times. We conducted counts visually by riding a bike across a pre-determined path, which followed the river from one end of the survey reach to the other and took approximately 30 to 45 minutes. According to the schedule compiled by the Utah DWR, this creel survey consisted of approximately 388 hours of creel clerk time.

We interviewed anglers while they fished and counted individuals at randomly selected times during the survey period. Days fished (month and day of the week) data were stratified to obtain estimates of angler activity. Due the impracticality of having a creel clerk survey the full fishing period from sunrise to sunset, we also stratified time of day (morning and evening) for each day. Throughout the survey period, we randomly selected sampling and corresponding count times using Microsoft® Excel software.

### Angler interviews

We interviewed as many anglers as possible during each survey period was conducted when not doing the angler counts. The interview questions were close ended (e.g., yes/ no/ neutral, scale of 1-5, age, zip code) to reduce interview time as well as simplify our statistical analysis and interpretation. Our questions included: fishing type (bank or wading), gear type (fly, bait, or lure), whether they were finished fishing, hours fished, species sought, species caught, the number of fish released, the number of fish kept, and basic demographic information such as angler age and gender. If fish were harvested by an angler, then total length of each fish was measured (mm). We also recorded where anglers fished within the survey reach by delineating five river sections: (A) 100 East to upstream golf course bridge, (B) Upstream golf course bridge to middle bridge, (C) Middle bridge to Sixth West, (D) Sixth West to Tenth West and (E) Tenth West to Trapper Park (Figure 1).

Interviewed anglers were also asked several opinion questions:

- 1) How satisfied are you with your fishing experience? (Scale of 1 to 5 with 1 being very satisfied and 5 being very unsatisfied)
- 2) What best describes your level of satisfaction with your catch? (Scale of 1 to 5 with 1 being very satisfied and 5 being very unsatisfied)

Anglers were only asked these questions once per the study, i.e., no repeat interviews:

- 3) Do you fish the lower Logan River (First Dam to Cutler Reservoir) besides the surveyed reach? (100 East to Trapper Park) (Yes/ No)
- 4) What changes could be made that would increase your satisfaction with fishing on the Lower Logan River? (100 East to Trapper Park)
- 5) Would you be supportive of increasing the creel limit on grown trout (currently can keep four trout per day) to potentially increase the average size of Brown Trout? (Yes, No, Neutral)
- 6) Would you be supportive of a size limit (e.g., release everything  $\geq 15''$ ) on Brown Trout to potentially increase the average size of Brown Trout? (Yes, No, Neutral)
- 7) How many days per year do you fish the lower Logan River?
- 8) How many days per year do you fish all bodies of water?

Continuous collection of stream temperature and flow data was obtained from the Logan River Observatory's stream gage (iUTAH GAMUT Working Group. 2019), located at Main Street and the Logan River (Figure 1.) to calculate monthly means for temperature and stream flow. This gage is within the surveyed reach and provided consistent measurements.

### Data Analysis

Angler effort and catch rates were calculated by entering creel data such as angler counts, and fish caught into a series of Microsoft® Excel spreadsheets and analyzed using a Statistical Analysis System software program (SAS Institute 2013) and macros developed for the Utah Division of Wildlife Resources (Thomas and Chamberlain 2000).

Water flow and temperature data, at a 15 minute intervals, were obtained from the Logan River monitoring gauge at Main Street (Logan River Observatory, iUTAH GAMUT Working Group 2019), which began operation in 2014. Mean monthly catch rates of Brown Trout were regressed against mean monthly water temperatures and rivers flows using R statistical software.

## Results

### Angler effort, catch, and catch rates

Total angling effort during the seven-month study period was 2,145 hours (Table 1) with ~60% (1,283 hours) during weekdays and ~40% (862 hours) on weekends. Anglers made an estimated 1,480 trips to the study reach with an average duration of 1.5 hours per trip. Monthly angler effort was greatest in July (574 hours) followed by April (374 angler hours, Table 1, Figure 2). Angler effort was lowest (25 hours) in October.

Angler catch was estimated at 1,530 fish of three species (Brown Trout, Rainbow Trout (*Oncorhynchus mykiss*), and Common Carp (*Cyprinus carpio*) with an estimated harvest of 64 fish, for a harvest rate (total percent of fish kept by anglers) of 4.2% (Table 2). Angler harvest only occurred during April through June (Table 1, Figure 2). Brown Trout comprised about 97% of the fish caught and were the most harvested species (n=55) followed by Common Carp (n=9, Table 2). However, the harvest rate of Brown Trout was only 4%, whereas it was estimated that 69% of Common Carp were harvested. The overall catch rate of Brown Trout was 0.74 fish per hour with the highest mean monthly rate of 1.20 fish/hour in June and the lowest (0.41 fish/hour) in September (Table 3).

### Angler demographics and opinions

One hundred and fifteen individual anglers were interviewed that were primarily in-state (97%) and from Cache County (92%, Table 4). Most anglers interviewed were male (92%), and the majority of anglers (67%) were between the ages of 20 to 44 (Figure 3).

Anglers responded that 66% were satisfied with their fishing experience, whereas only 2% were not satisfied and the remainder of anglers were neutral (Figure 4A). Forty-six percent of anglers were satisfied with their catch, whereas only 11% were not satisfied, and the remainder of anglers were neutral (Figure 4B).

A large majority (81%) of anglers only fished the surveyed reach and not anywhere else on the lower Logan River (Figure 5). Thirty-nine percent of anglers interviewed reported they fished the lower Logan River between 11 and 20 days per year, 36% fished it from 21 to 100 days, and 25% fished it less than 10 days (Figure 6A). Thirty-eight percent of anglers interviewed reported they fished any location between 26 and 50 days per year, while 52% fished more than 51 days per year, and 10% fished fewer than 25 days per year (Figure 6B). The primary method of fishing within the survey reach was lure (41%) followed closely by fly (36%) and bait 22%, (Figure 7). Angler interviews were conducted most

frequently within section (C) from the Middle bridge to Sixth West (73%) with the remaining four sections experiencing between 4 to 10% of the interviews (Figure 8).

Anglers were supportive of regulation changes that might potentially increase the average size of Brown Trout, with 67% of those interviewed supporting increasing the creel limit on Brown Trout and (Figure 9A) and 90% supporting a potential size limit on harvest of Brown Trout (e.g., release everything  $\geq 15$ ") to potentially increase the average size of Brown Trout (Figure 9B).

Angler responses to the open-ended question of "What changes could be made that would increase your satisfaction with fishing on the lower Logan River? (100 East to Trapper Park), included:

- catching more fish
- enforcement of dogs on leash rule
- increased frequency of deeper pools and number of bends
- replanting of vegetation in areas where non-native trees were removed
- signage of available fish species present installed at Rendezvous Park
- additional trash cans along the trail
- picnic tables with shade structures
- a fish population estimate of the reach

#### Angler Catch Rate versus Water Flows and Temperature

Logan River mean daily water flows ranged from 1 m<sup>3</sup>/s to 24.3 m<sup>3</sup>/s during April through October in 2019, which were typically higher than previous years, except for 2017 which was an exceedingly high flow year (Figure 10). Logan River mean daily water temperatures ranged from 1.3°C to 14.6°C during April through October in 2019, which were typically lower than previous years (Figure 11). The highest angler catch rate (1.2 fph) was in June during the highest mean monthly discharge (16 m<sup>3</sup>/s (Table 3; Figure 12) and a mean monthly water temperature of 9.6 °C (Figure 13). The lowest angler catch rate (0.41 fph) occurred in September with a mean monthly discharge of 2.12 m<sup>3</sup>/s (Table 3; Figure 12) and mean monthly water temperature of 11.2° (Table 3; Figure 14). There was a positive correlation between angler catch rates (mean monthly fph) and river flow rates ( $r^2 = 0.37$ , Figure 15) and a negative correlation between angler catch rates (mean monthly fph) and water temperatures ( $r^2 = 0.42$ , Figure 16), though neither relationship was statistically significant.

## Discussion

A considerable amount of angler effort was documented on a relatively short reach of the Lower Logan River. Anglers spent over 2,145 hours of fishing within our 6.4 km study reach, totaling over 383 hour/km. Angler effort on the Lower Logan River during weekdays was roughly 33% higher than weekend angler effort with an average duration of 1.5 hours per fishing trip. This suggests that the lower Logan River is not a destination fishery, but rather a quick trip fishery, which is further supported by our finding that 92% of interviewed anglers were from Cache County.

Brown Trout made up the vast majority (97%) of angler catch, which is to be expected in this section that can support high densities ( $> 1,000$  fish per kilometer) of wild Brown Trout (Budy et al. 2010). The only other salmonid species caught by anglers during our study were Rainbow Trout (2.4%), and these fish likely originated from stocked fish that were planted in the three reservoirs on the upper Logan River and moved downriver to the study section. Surprisingly, no Mountain Whitefish (*Prosopium williamsoni*) were caught by anglers during our study, despite high numbers of larger fish being present during past electrofishing surveys in the study section (Knight et al. 1987, Budy et al. 2010).

In general, fisheries managers have set a statewide objective for angler catch rates at Utah waters to meet or exceed 0.5 fph. Similarly, the indicator of fishing success and catch rate, set by the Logan River Conservation Action Plan (Logan River Task Force 2016), defined angling success, and catch rate measured in salmonids per hour by the categories of “poor” less than or equal to 0.25 fph, “fair” range of 0.26 to 0.50 fph, “good” range of 0.51 to 0.75 fph and “very good” greater than or equal to 0.76 fph. By these standards the 0.7 fish per hour angler catch rate within our survey reach exceeded the general statewide objective and fell within the “good” range as defined for the lower Logan River.

Angler satisfaction was relatively high for both their overall fishing experience and catch rates. Common responses to the question regarding what improvements could be made to the lower Logan River fishery with common answers including more fish, bigger fish, and more in-stream? habitat where fish could be found. Time of interview in the angler’s trip may influence responses to these questions. For example, an angler who just started fishing in comparison to an angler who has been fishing for many hours may have a different opinion on satisfaction with catch or the experience.

Densities of Brown Trout in the study section are generally high but with few large fish. During four years of electrofishing from 2001 to 2004, only 2 of the 491 captured Brown Trout greater than 100 mm were greater than 375 mm (Utah State University, Fish Ecology Lab, lower Logan River monitoring site data). In order to potentially increase the average size of Brown Trout, anglers were supportive of increasing both the creel limit and size limit on Brown Trout. However, harvest rates of Brown Trout are currently low (4%), and this may not be limiting the size of Brown Trout, or it may be difficult to encourage anglers to harvest more fish, or both. Many anglers were unfamiliar with harvest regulations for this area of the Logan River.



Most angler interviewed (73%) were within a single section (Middle bridge to Sixth West) which is only about 20% of the entire surveyed length. This section contains Rendezvous Park that has a paved parking lot, public restrooms, quick access to walking and bike paths in addition to extensive river restoration work. The restoration included a river realignment project which created deep pools, removed the thick crack willows, and created river access paths. We interviewed the lowest percentage of anglers (4%) in section D, which has no parking or access available within a close distance to the river. Angler access improvements likely facilitated greater angler use in the Rendezvous Park section, especially because anglers are primarily fishing the river for quick trips. Similarly, most anglers surveyed only fish the study reach of the lower Logan River which has the most developed public access, whereas the rest of the lower Logan River does not have many developed angler access sites. Additional improvements along the lower Logan River may increase and spread angler use to parts of the river that appear to be underutilized.

Of the anglers interviewed, 56% said they were targeting trout while 39% were targeting any species and two percent were targeting Common Carp. Three percent of the anglers stated they were specifically targeting Brown Trout. Although Brown Trout make up the vast majority of trout residing in our survey reach, a small percent of anglers stated they were directly targeting this species. This could suggest that the anglers interviewed do not know what species are present or that Brown Trout are the predominant species, in the lower Logan River.

From the comments and results of the question portion of the survey, we found it may be beneficial to install educational signage at Rendezvous Park. We suggest the signage included information regarding species present within the lower Logan River, images to aid in identification of the species and regulations regarding their harvest.

Through our study we found a positive correlation between river flow rates and angler catch rates, and a negative correlation between river water temperatures and angler catch rates, despite an apparent higher-than-average summer base flow in 2019, although neither relationship was statistically significant. In prior years, summer-time flows are often less than 0.6 m<sup>3</sup>/s (Figure 10), which are known to increase water temperatures and potentially decrease angler catch rates.

Stream flow influences peak water temperatures, and their frequency, during summer low flow periods which can be reduced with increased in-stream flow (Bashar and Gulliver, 2000). In addition to lowering water temperatures, minimizing low flow periods increases macroinvertebrate survival providing a more consistent food source, increases water velocity, depth and available habitat which decreases potential competition thus supporting Brown Trout growth and survival (Patterson et al. 2022). A base flow target of at least 0.87 m<sup>3</sup>/s is suggested the Logan River Conservation Action Plan to achieve “Good” conditions (Logan River Task Force 2016). Maintaining or increasing river flow during typical summer low-flow time periods will increase Brown Trout abundance and condition which may positively impact angler success, catch rates and, ultimately, provide even greater satisfaction with this potential Blue Ribbon fishery.

### **Management Recommendations**

Explore options to increase summer base flows to increase angler catch rates during this time period.

Continue electrofishing sampling of the surveyed reach to provide updated species composition and population estimates.

Installment of signage regarding fish species presence within the lower Logan River, images to aid in identification of these species and regulations regarding their harvest located at Rendezvous Park, Trapper Park, and future angler access locations.

Construction of additional angler access amenities, such as parking lots, public restrooms, and additional pathways to increase and spread angler use of the Lower Logan River.

Public outreach within the community, such as working with Logan City and the Utah DWR social media accounts as well as, partnering with the local Trout Unlimited chapter (Cache Anglers) to provide free clinics on fishing the lower Logan River, to share research findings and potential Blue Ribbon Fisheries status of the lower Logan River.

Consideration of trying to get a sub-population of native Bonneville cutthroat trout re-established.

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## Tables

**Table 1.** Estimated total catch, harvest, and angling effort by month for all fish species in the lower Logan River, Utah 2019.

Month	Total catch (# fish)	Total harvest (# fish)	Total angling effort (hours)
April	326	8	374
May	133	18	181
June	406	25	332
July	362	0	574
August	138	0	304
September	145	0	357
October	26	0	25
Totals	1,536	51	2,147

**Table 2.** Estimated catch and harvest by species. Note: Estimates of catch and harvest by species were made using a different calculation than that used to estimate monthly catch and harvest; thus, estimates of total catch and harvest among tables 1 and 2 are slightly different in the lower Logan River, Utah 2019.

Species	Total catch (fish)	Total harvest (fish)	% Harvested
Brown Trout	1,480	55	4
Rainbow Trout	37	0	0
Common Carp	13	9	69
Totals	1,530	64	4.2

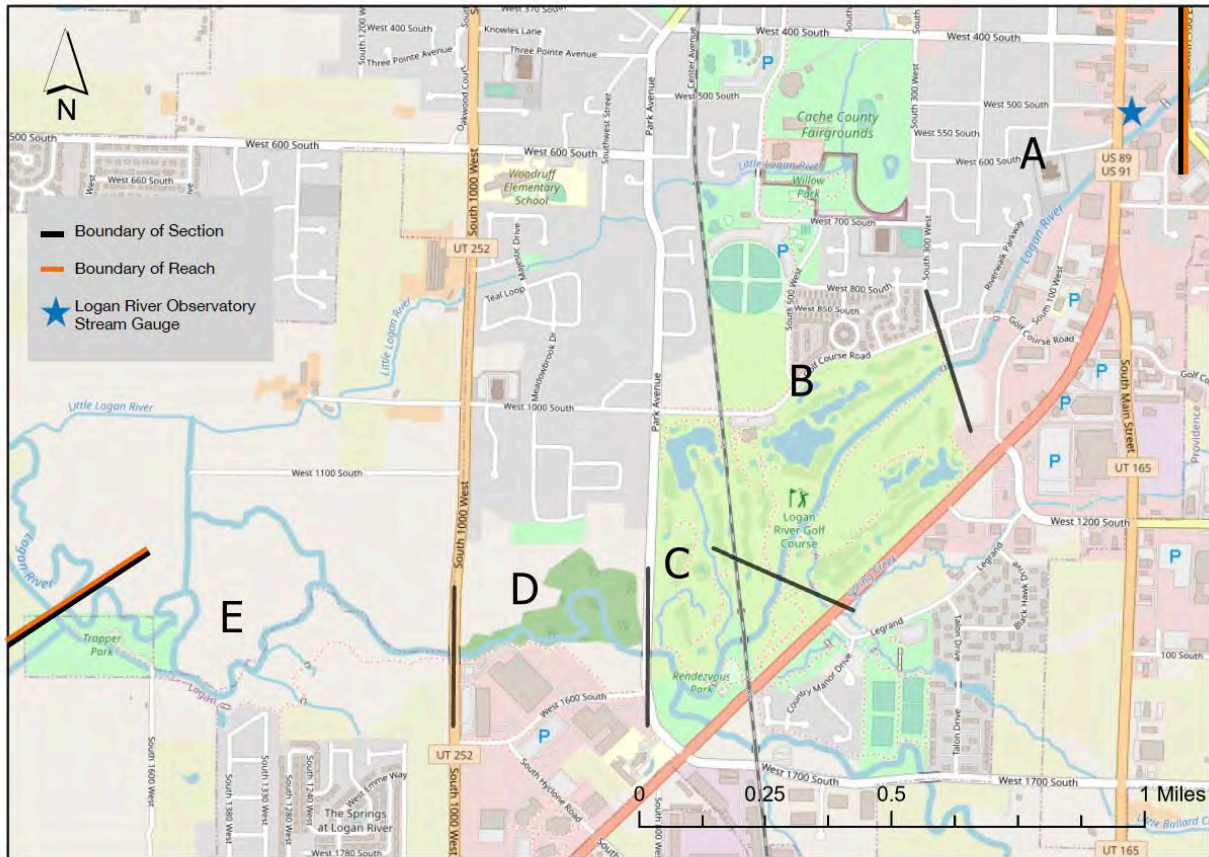
**Table 3.** 2019 Brown Trout catch statistics by angler per month in lower Logan River, Utah.

Month	Monthly Catch	Mean Catch Rate (fish per hour)
April	316	0.84
May	106	0.59
June	398	1.2
July	352	0.61
August	138	0.45
September	145	0.41
October	26	1.04
Total Average		0.74

**Table 4.** Counties of origin for anglers interviewed in this 2019 survey of the lower Logan River, Utah.

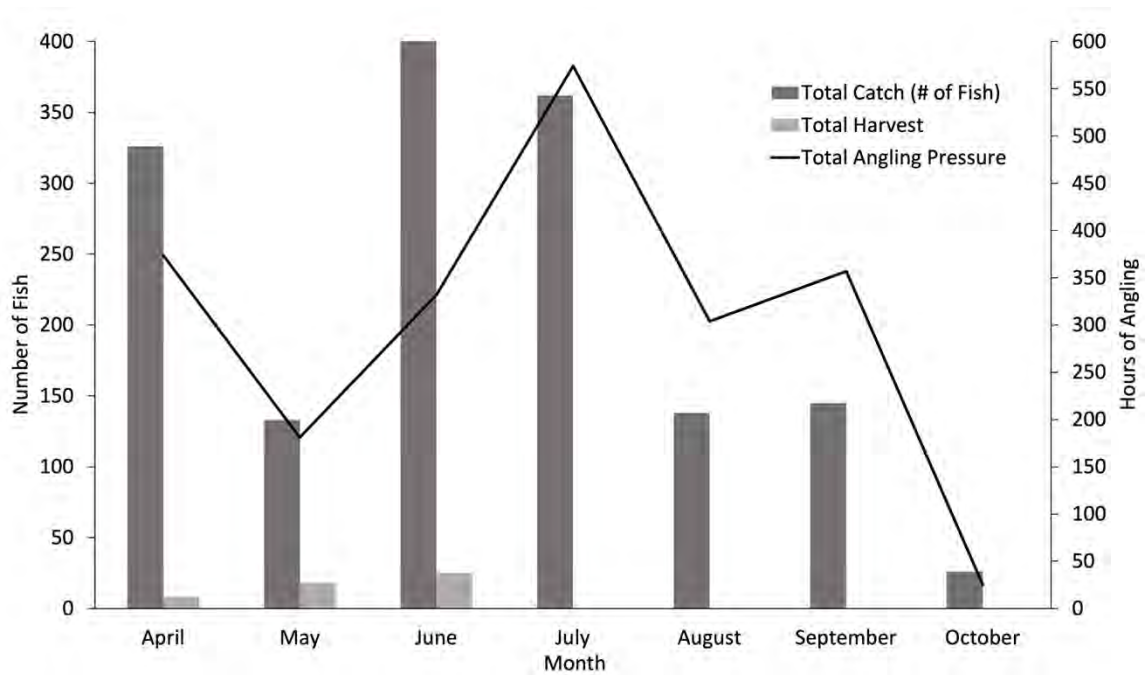
County	Parties sampled	Percent
Cache	106	92
Box Elder	3	3
Weber	1	1
Salt Lake	1	1
Out of State	4	3

## Figures

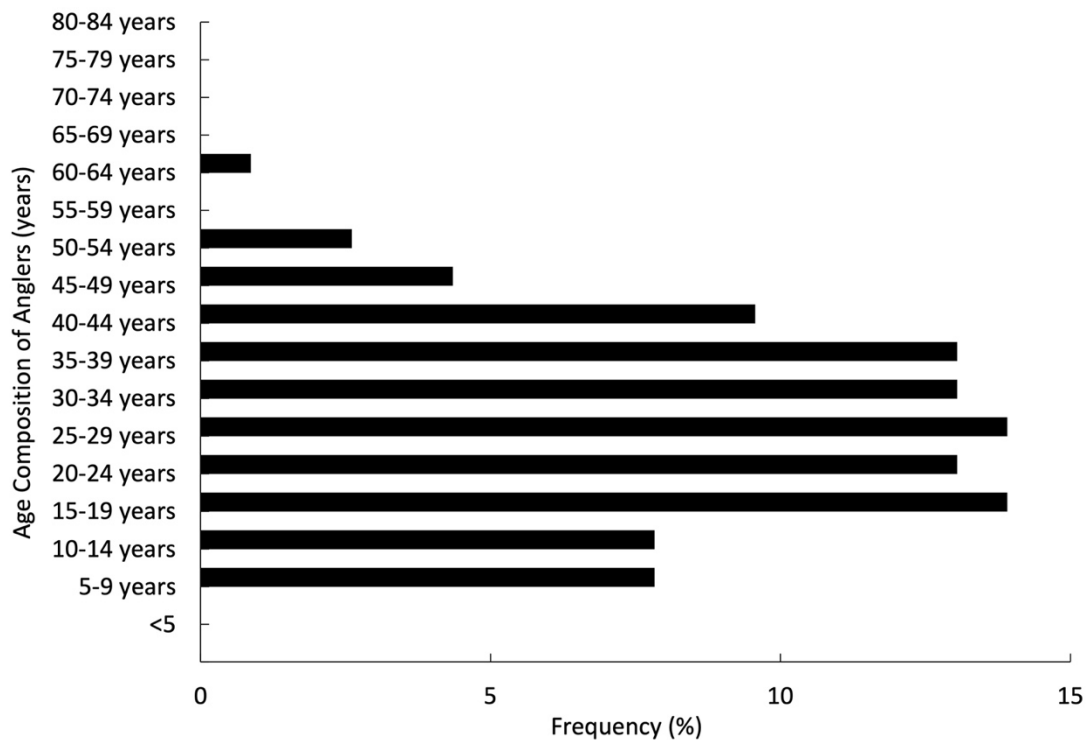


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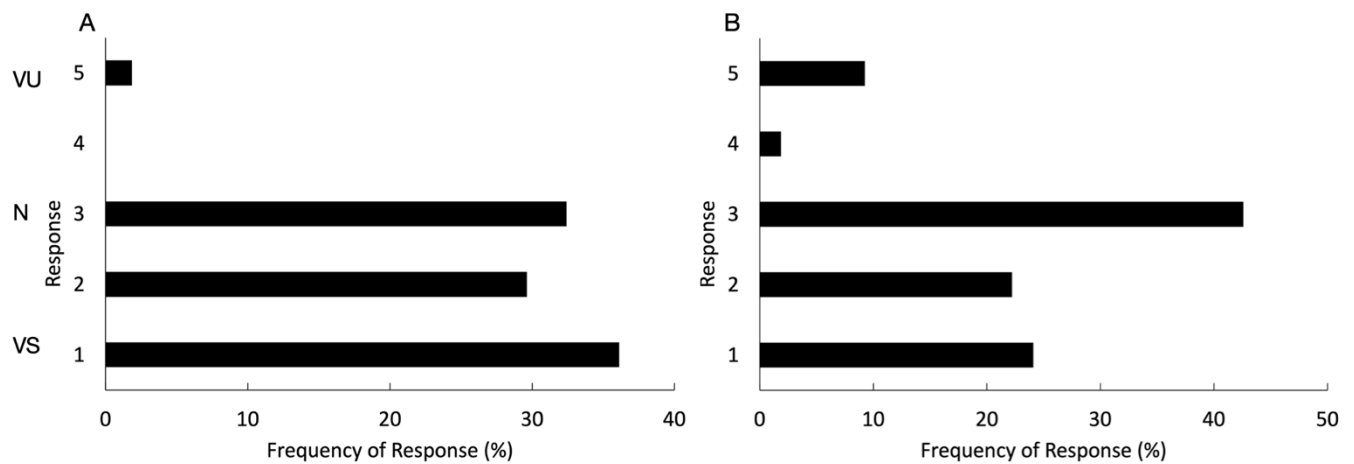
**Figure 1.** Lower Logan River, Utah map of the total survey reach from 100 East (upstream) to Trapper Park (downstream) and the five delineated sections: (A) 100 East to upstream golf course bridge, (B) Upstream golf course bridge to middle bridge, (C) Middle bridge to Sixth West, (D) Sixth West to Tenth West and (E) Tenth West to Trapper Trail Park.



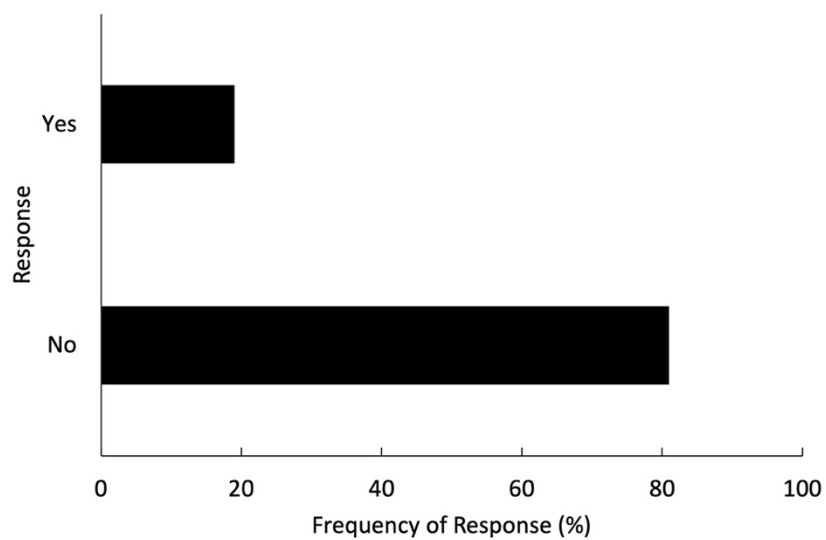
**Figure 2.** Estimated total monthly catch, harvest, and angling effort at the lower Logan River from April 1 through October 31, 2019.



**Figure 3.** Age composition (years) of anglers interviewed during the lower Logan River creel survey, 2019.

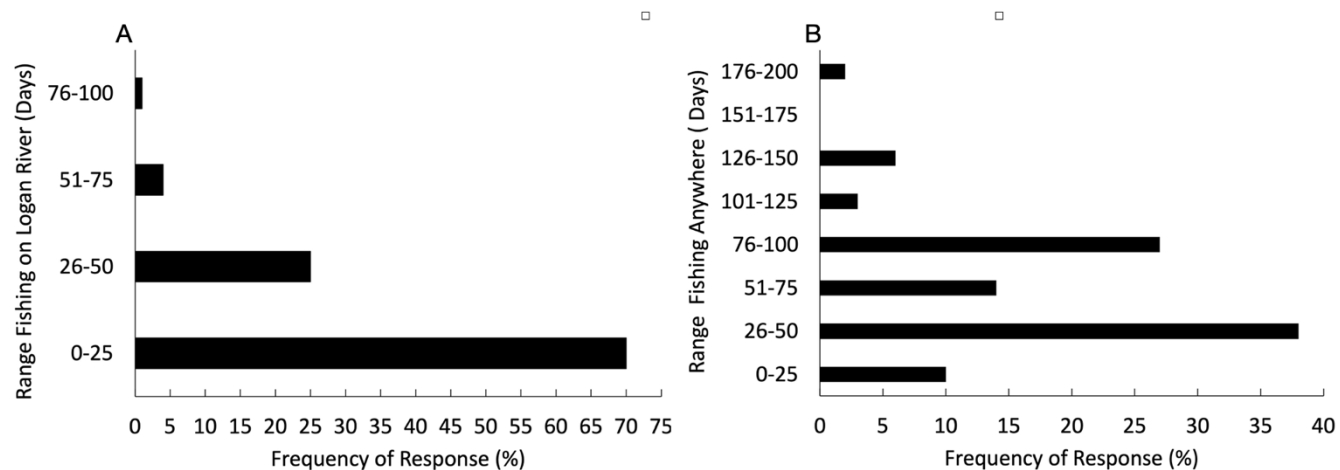


**Figure 4.** Angler response frequencies for their satisfaction with the angling experience (A) and catch (B) on a Scale of 1 to 5 with 1 being very satisfied (VS) and 5 being very unsatisfied (VU), and 3 being neutral (N).

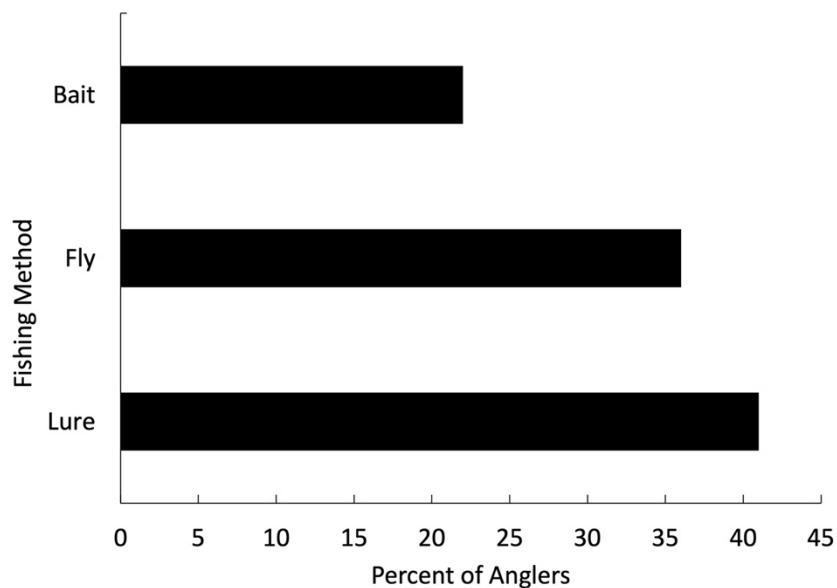


**Figure 5.** Angler responses (Yes/ No) when asked, do you fish the lower Logan River (First Dam to Cutler Reservoir) besides the surveyed reach (100 East to Trapper Park)?

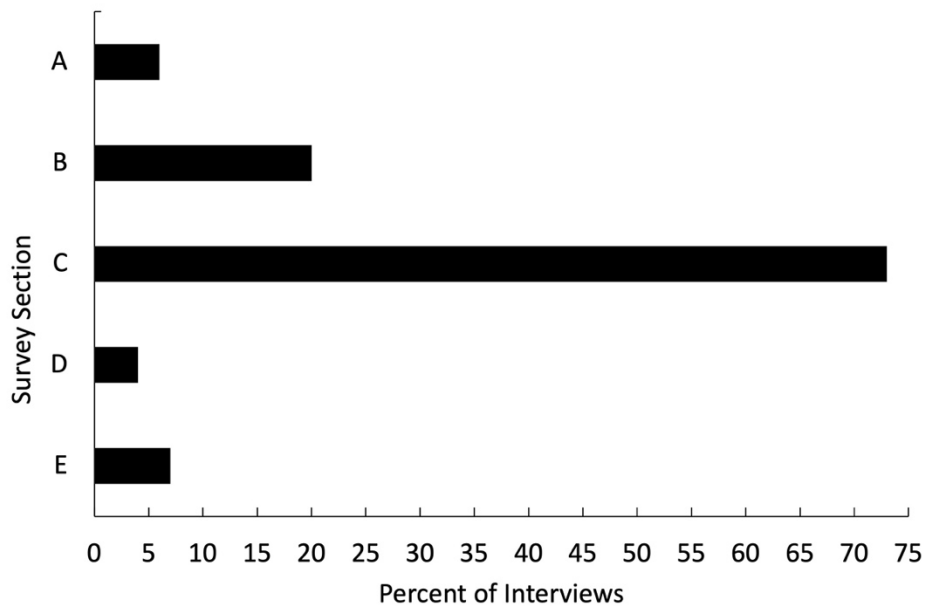




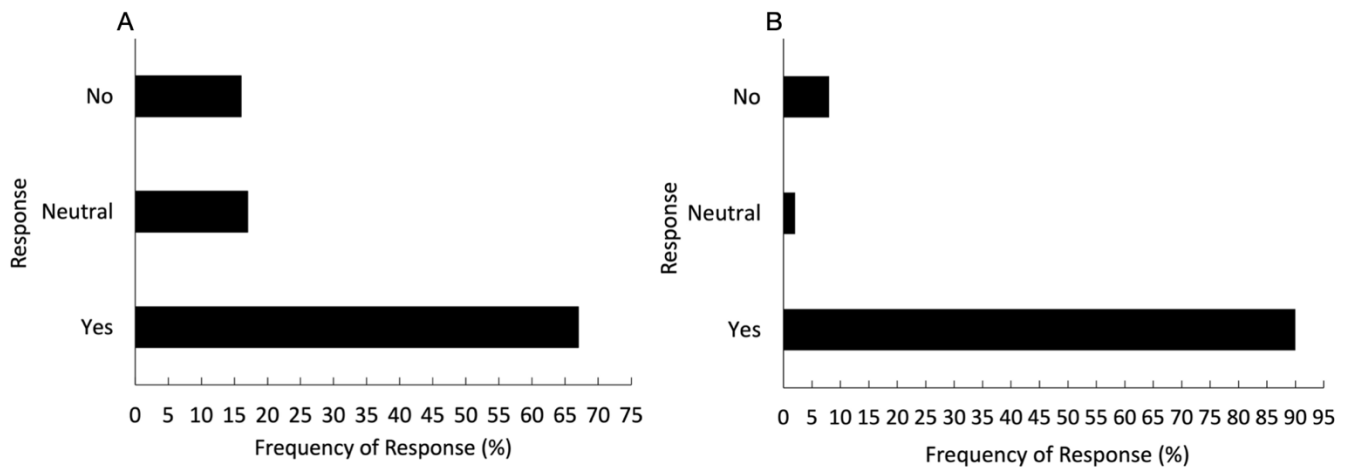
**Figure 6.** Angler response frequencies to the questions of: A) “How many days per year do you fish the lower Logan River?” within the survey reach and B) “How many days per year do you fish all bodies of water?”



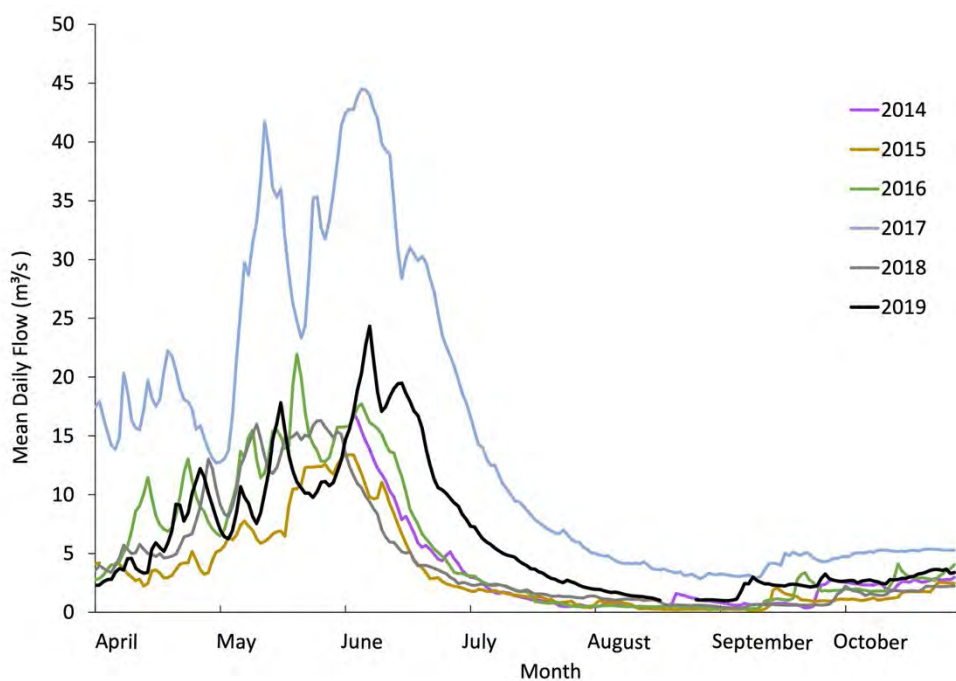
**Figure 7.** Angler method of fishing (bait, fly fishing, or lure) when encountered during the 2019 survey interview on the lower Logan River, Utah.



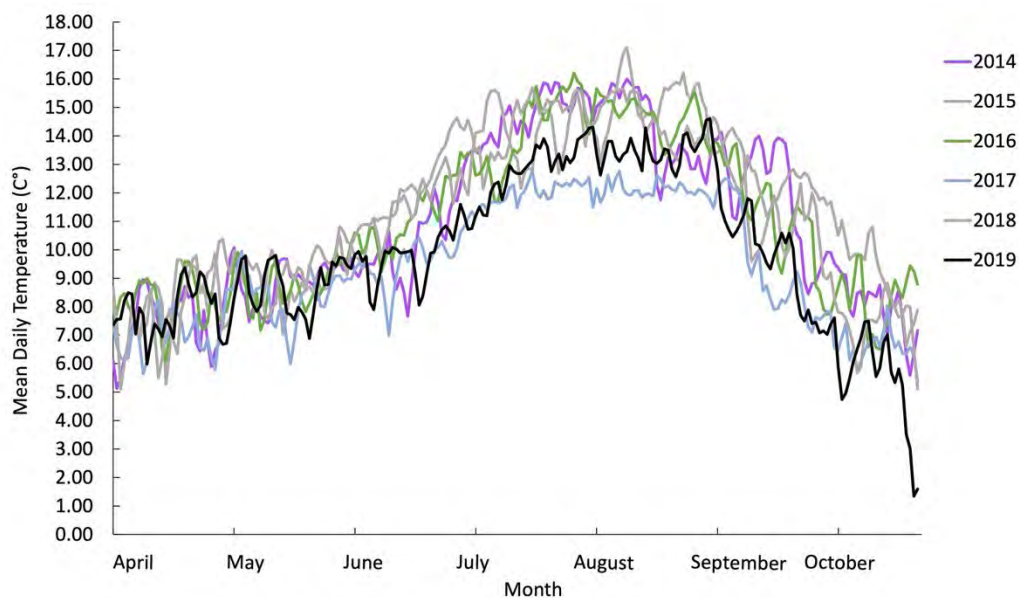
**Figure 8.** Frequencies of angler interviews (n=115) from each section of the surveyed reach: (A) 100 East to upstream golf course bridge, (B) Upstream golf course bridge to middle bridge, (C) Middle bridge to Sixth West, (D) Sixth West to Tenth West and (E) Tenth West to Trapper Trail Park.



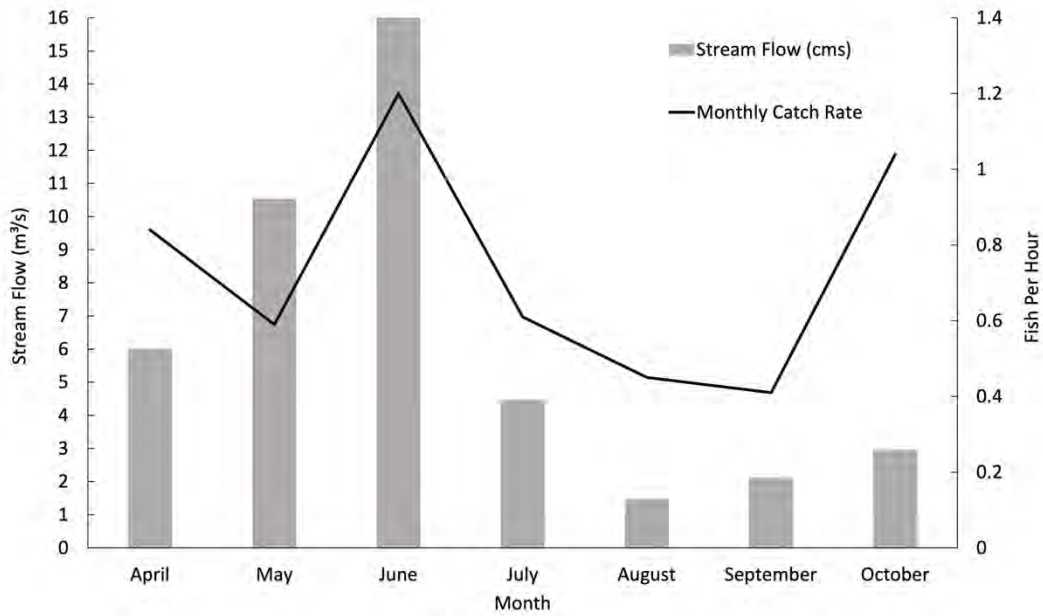
**Figure 9.** Angler response frequencies for support (Yes, No, Neutral) of regulation changes to potentially increase the average size of Brown Trout: A) increasing the creel limit on Brown Trout (currently can keep four trout per day) and B, changing the size limit (e.g., release everything  $\geq 15'$  (380mm)).



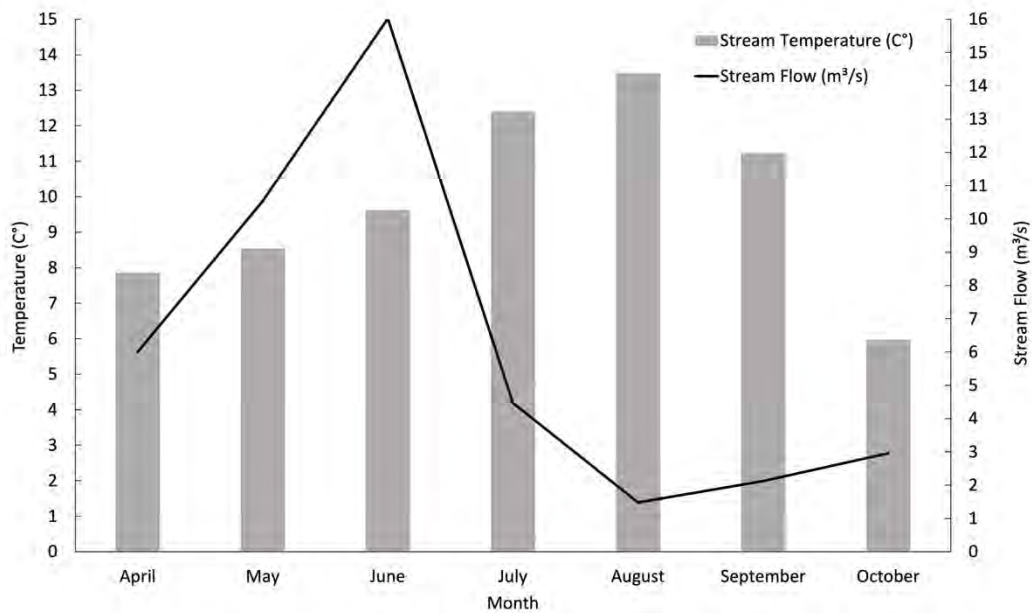
**Figure 10.** Logan River mean daily flow (m<sup>3</sup>/s) at Main Street for April through October 31 for the years 2014 through 2019.



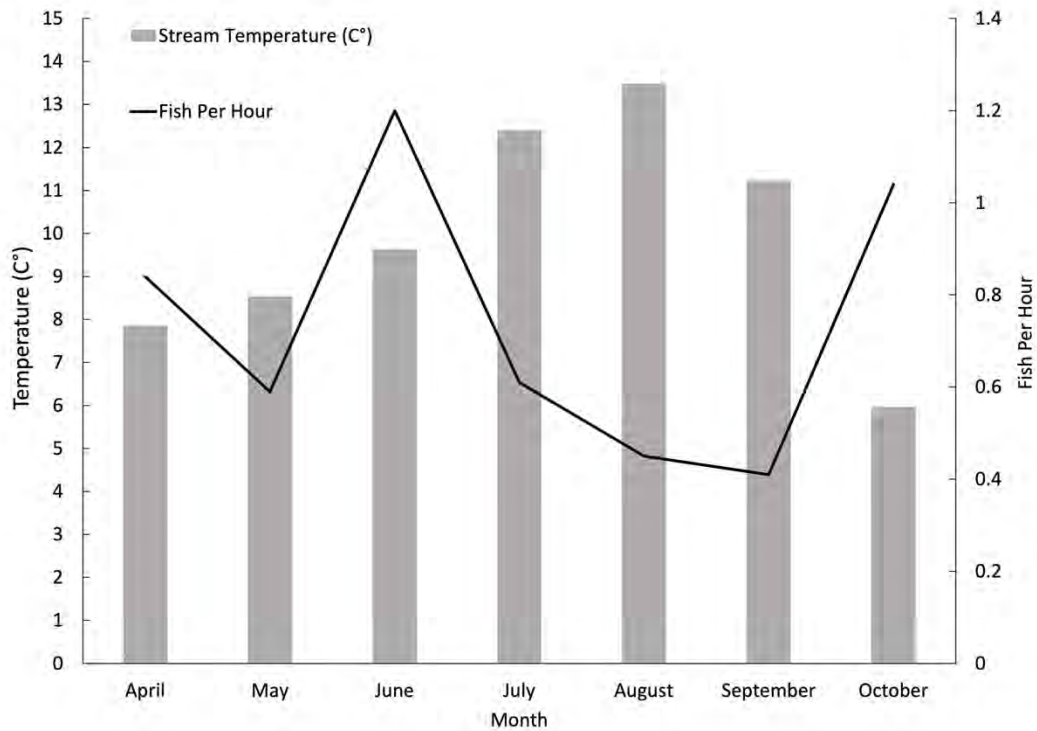
**Figure 11.** Logan River mean daily temperature (degrees Celsius) at Main Street for April through October 31 for the years 2014 through 2019.



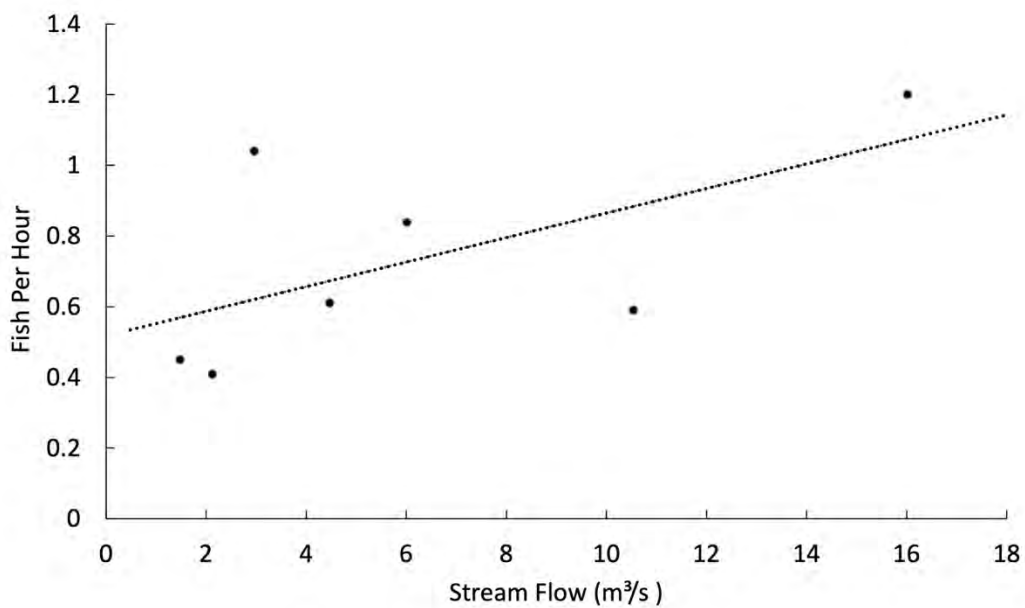
**Figure 12.** Comparison of monthly catch rate (fish per hour) of Brown Trout and stream flow ( $\text{m}^3/\text{s}$ ) from April 1 to October 31, 2019, in the Logan River.



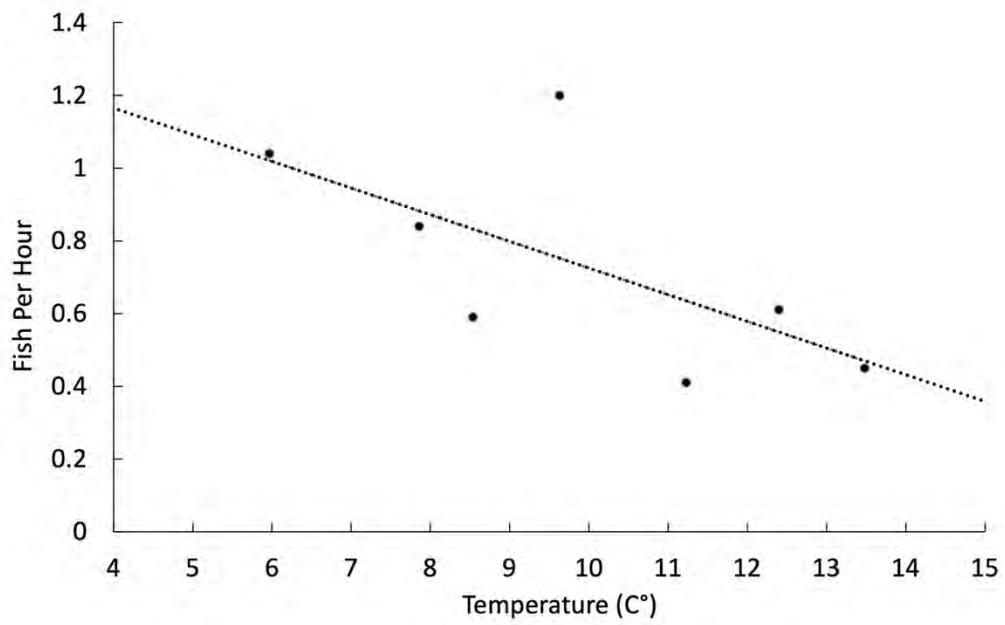
**Figure 13.** Comparison of monthly stream flow ( $\text{m}^3/\text{s}$ ) and stream temperature (degrees Celsius) from April 1 to October 31, 2019, in the Logan River.



**Figure 14.** Comparison of monthly catch rate (fish per hour) of Brown Trout and stream temperature (degrees Celsius) from April 1 to October 31, 2019, in the Logan River.



**Figure 15.** Comparison of monthly catch rate in (fish per hour) of Brown Trout as a function of stream flow in m³/s in the lower Logan River, Utah ( $y = -0.0733x + 1.4583$ ,  $R^2 = 0.4189$ ).



**Figure 16.** Comparison of monthly catch rate (fish per hour) of Brown Trout as a function of stream temperature (degrees Celsius) in the lower Logan River, Utah ( $y = 0.0347x + 0.5183$ ,  $R^2 = 0.371$ ).