Estimates of Boat Angler Use and Commercial Guiding on Large Rivers in Wyoming

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ABSTRACT

Digital time-lapse cameras were utilized to estimate the amount of boat angler use occurring on many of the large, free-flowing rivers and tailwaters in Wyoming. This information was used in conjunction with intensified spot creel and angler interview data to derive estimates of the amount of commercial guiding occurring at these locations. Time-lapse camera images were collected on six large rivers at 13 sites during 2019 and 15 sites in 2020. Rivers studied included the Bighorn, Green, New Fork, North Platte, Salt, and Snake rivers. Cameras were operated continuously during the months of July and September in 2019 and July in 2020 to establish baseline indices. Cameras were also operated continuously during the entire ice-free fishing season at 13 sites on five river segments to quantify seasonal patterns in boat angler use. Metrics used to describe the amount of angler use (i.e., total angling boats and angling boats per day) varied from river to river and by year, but provided a defensible and repeatable approach for measuring activity and for comparing among sites. Average angling boat numbers in July varied from 5–10 boats/day on most waters, though average use on the Lower North Platte and Snake rivers exceeded 15 boats/day. Commercial guiding represents a significant amount of the boat angling pressure occurring on many large rivers and accounts for the majority of boat anglers on the Upper Green, Lower North Platte, and Snake rivers. This study provides a reliable and repeatable framework for monitoring boat angler pressure on large rivers in Wyoming and gives decision makers information to evaluate and monitor current or future regulation changes.

INTRODUCTION

Understanding angler use and angler demographics can be one of the most valuable forms of data available to fisheries managers. Without proper understanding of angling dynamics, many management actions that rely on participant use patterns would be subject to failure (Malvestuto 1996). Unlike traditional biological sampling methods, gathering accurate angler use information can be one of the most complex forms of data collected. It is labor intensive, leading to infrequent sample intervals, and it is often subject to variability that can lead to suspect results.

Creel surveys have become the most common approach for evaluating angler use patterns and have been applied frequently in Wyoming to estimate angler effort and catch-rate estimates (Whaley et al. 2002). Historically, the Wyoming Game and Fish Department (WGFD) relied largely on intermittent programmed creel surveys to monitor angling pressure and angler demographics on many of the fisheries in Wyoming. More recently, programmed creel surveys have become cost prohibitive and less frequent due to the large investment in manpower, logistical constraints, and the need for recurring aerial flights to generate instantaneous counts of anglers or boats. Subsequently, reliable data collected on angler use and angler activity on many popular fisheries has become less frequent.

Recent trends in angler use on many of the large rivers in Wyoming have increasingly become a topic of interest for the public, resources managers, and decision makers. Interest has been especially apparent with regard to the number of commercially guided angling trips, which are presumed by many to be increasing in Wyoming and perceived to be affecting popular fisheries. In 2019, legislation was proposed that would give the WGFD authority to regulate guided angling in Wyoming. Additional attempts were made in 2020 to mandate the creation of a committee to explore the amount of commercial guiding and consider management actions to regulate it. Though these attempts ultimately failed in the State Legislature, ongoing interest in the subject continues in course with increased public pressure to regulate float anglers and commercial guiding.

Most of the interest and speculation around guided angling pressure in Wyoming is centered on the largest and most prominent rivers, which provide the vast majority of non-motorized boat angling opportunity in the state. These rivers also tend to be among the most productive stream fisheries in Wyoming and have gained regional and national notoriety. Speculation has increased in recent years that angling pressure, in particular, watercraft-based angling pressure, has, or will impact these important resources. Given the popularity of large rivers in Wyoming, increased understanding of angler use levels and patterns of commercial guide use would benefit both managers and decision makers.

In recent years, time-lapse cameras have become increasingly studied as an alternative method to quantify angler use (e.g. Hining and Rash 2016; Stahr and Knudsen 2018). Using time-lapse cameras to capture images of anglers or boats may be more cost effective than using traditional methods such as roving clerks or manned aerial flights to record fishing pressure. Though more time may be needed to analyze camera images, the time needed may be less than traditional creel surveys and may allow for sampling to occur at more locations, allowing for broader survey coverage.

The purpose of this project was to develop a standardized approach to quantify and monitor boat-angling pressure on the large rivers in Wyoming, and provide decision makers with reliable data when attempting to address the regulation of angler user groups. The specific objectives of this project were to: 1) develop a standard approach to evaluate boater trends on large rivers in Wyoming and 2) determine the residency of anglers on large rivers in Wyoming and estimate the proportion of commercial guiding.

METHODS

Study Area

This project was conducted on six major rivers in Wyoming, representing six of the eight Fisheries Management Regions designated by the WGFD (Figure 1). Segments within each river were designated as free-flowing (those free of large impoundments) or tailwater (segments located directly below large, mainstem dams). Rivers and segments in this study included free-flowing segments on the Upper Green, New Fork, Upper North Platte, Salt, and Snake rivers, and tailwater segments on the Bighorn, Lower Green, and Lower North Platte rivers.

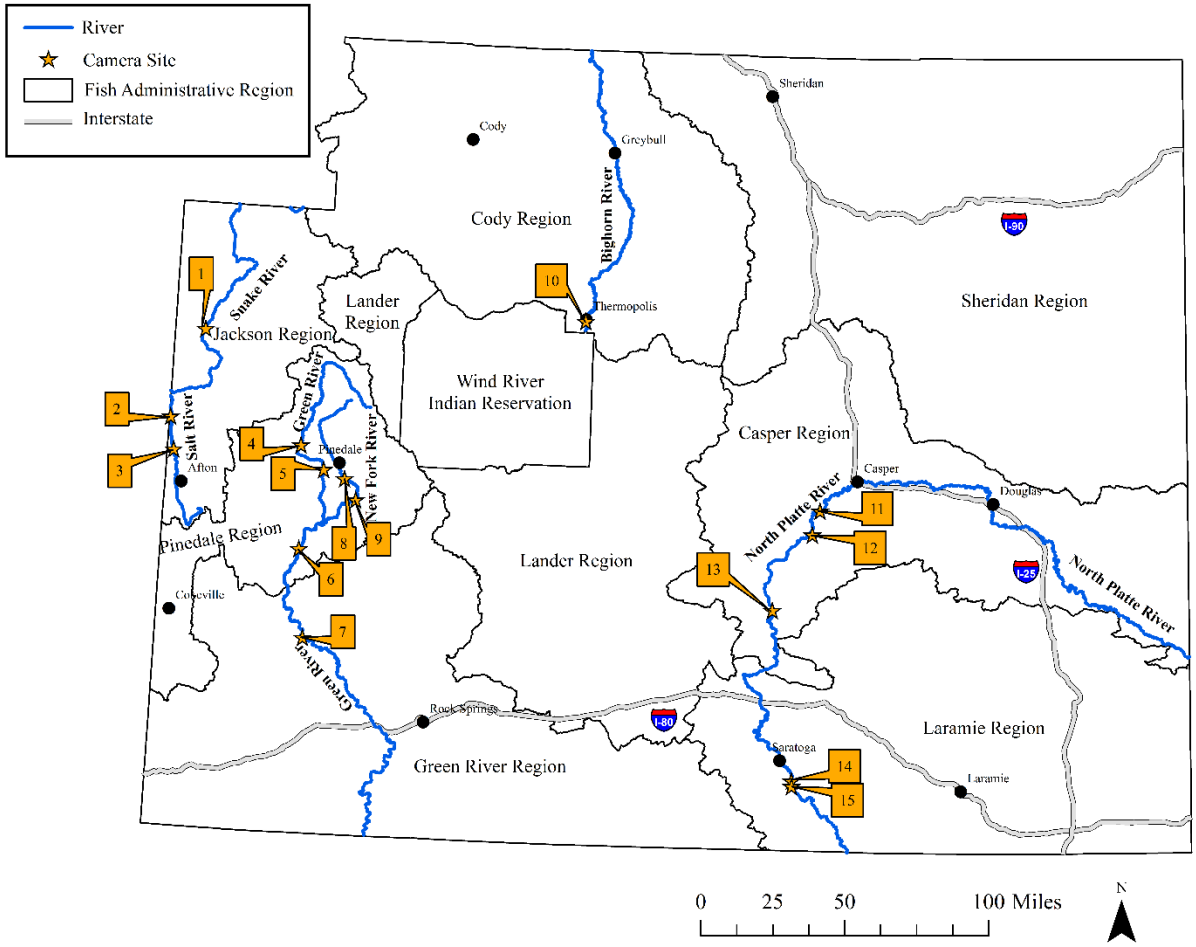

FIGURE 1. Study sites used to collect data during a 2019– 2020 investigation of boat angling pressure on major rivers in Wyoming. Camera locations are reported in Table 1.

Standard approach to evaluate boater trends

Digital time-lapse cameras (PlotWatcher Pro, Day Six Outdoors) were used to quantify boat angler use on six large rivers at 13 sites (covering 22 reaches) in 2019 and 15 sites (covering 24 reaches) in 2020 (Table 1). Cameras were set to run continuously during daylight hours for the entire months of July and September, 2019, and April and July, 2020, to generate an index of boat angler use on each river section (index month). A subset of cameras were also set to run continuously during the entire year (or ice-free fishing season) at 13 reaches on five river sections to evaluate year-long trends and compare to data from index months.

Cameras were set to take a photograph every 10–30 seconds, with 1280x720 resolution, and able to store up to 32 GB of data. Most cameras were checked weekly to download pictures and check or replace batteries, thus ensuring proactive data security and continuous operation. Ultimately, most cameras were found to operate for at least 4 weeks without interruption when utilizing lithium batteries and the maximum amount of digital memory. Images taken from time-lapse cameras were automatically compressed into a seamless video file and analyzed using the *Game Finder* (Day Six Outdoors) media player. Videos were analyzed to quantify boats as they passed the camera's location. Every boat passing the camera was recorded along with a date and time, and each boat was classified as a "fishing boat" or a "non-fishing boat" (unknown boats were included in estimates of all boats). A fishing boat was defined as: (1) any boat or vessel designed specifically for fishing purposes, such as a drift boat or skiff; (2) any boat or vessel containing specific fishing equipment such as fishing rods or nets; (3) any boat or vessel with individuals displaying behavior that would indicate they were fishing, such as casting or rigging gear, or wearing waders. Data from each river-reach was entered into a shared workbook document to ensure consistency among regions, and all data was summarized and analyzed together using Program R. Use on each river-reach was calculated as an index of the total number of boats per day and the total number of fishing boats per day.

TABLE 1. Camera sites (UTM NAD27) used to monitor boat angling pressure on different sections of large rivers in Wyoming 2019 - 2020.

Site	River Section	Reach(s)	Zone	Easting	Northing
1	Snake River	Moose/Wilson	12T	522827	4832817
2	Salt River	Freedom/Etna	12T	514327	4783482
3	Salt River	Special Regs/Diversion	12T	510013	4765191
4	Upper Green River	Warren/40Rod	12T	81249	4767404
5	Upper Green River	Swain/Huston	12T	93953	4753574
6	Upper Green River	Fear/Dry Piney	12T	80092	4709429
7	Lower Green River	Dam/Seven - Eleven	12T	82028	4659690
8	New Fork River	Tyler/Airport	12T	105682	4748458
9	New Fork River	Boulder/Confluence	12T	111873	4736626
10	Bighorn River	Wedding of the Waters/8th Street Bridge	12T	240634	4836432
11	Lower North Platte River	Sechrist/Trappers Rt.	13T	371891	4729671
12	Lower North Platte River	Gray Reef/Lusby	13T	367438	4716964
13	Lower North Platte River	Miracle Mile	13T	344971	4674674
14	Upper North Platte River	HWY 130 Bridge	13T	355668	4579366
15	Upper North Platte River	Treasure Island	13T	355734	4576293

Angler residency and commercial guiding

Traditional spot-creel methods and angler interviews were used to determine the origin of boat anglers using the large rivers and to identify the proportion of anglers on guided or unguided trips. Intensive spot-creel was utilized to collect angler interviews during July and September of 2019 and July of 2020. Interviews were intended to occur during the same time that time-lapse cameras were operating so that both forms of data could be combined and/or compared. Each region attempted to accumulate four weekdays and four weekend days of intensive spot creel on each river segment during the index months surveyed. Boaters were asked if they were participating in a guided fishing trip, acting as a guide, or recreationally angling without a guide. They were also asked their residence (state or Wyoming County), and subsequently asked to complete the "Red Book" spot-creel interview to collect standard creel information, including hours fished, method, tackle, and species kept and released. Commercial guides were also asked the origin of their guiding operation so that patterns in guide sources could be tracked. All information was entered into a shared workbook document to ensure consistency among regions, and all data was summarized and analyzed together using Program R. To account for low interview numbers within individual river-reaches, interviews were stratified into broader river-sections. River-sections included the Bighorn River, the Upper Green River (above Fontenelle), Lower Green River (below Fontenelle), New Fork River, Upper Platte River (above Seminoe Reservoir), Lower Platte River (below Seminoe) and the Salt River.

Angler interviews were used in combination with camera estimates of boat use to estimate the amount and proportion of commercial guiding occurring on each river. Multiple anglers participating in a single boat trip were combined to generate an estimate of the number of commercial boat trips occurring on each river-section. The number of commercial fishing trips per day was estimated by applying the proportion of commercial boat trips derived from creel surveys to camera estimates of fishing boat use among river-reaches.

RESULTS

Standard approach to evaluate boater trends

Cameras were operated continuously for 31 days during July 2019, and 30 days during September 2019, at 13 segments. Exceptions included the Green River at Huston and Swain (only 16 days in July), the New Fork River at Boulder (only 18 days in July), and at the Confluence (only 21 days in September) where partial camera failure (batteries or SD cards) limited operation. Cameras were again operated for 31 days during July 2020, at 16 sites. The primary differences between 2019 and 2020 was the addition of one monitoring site (two reaches), on the Snake River – Moose/Wilson, one site (two reaches) on the Lower North Platte River – Sechrist/Trappers Rt., and the discontinuation of one monitoring site (two reaches) on the Upper Green River – Fear/Dry Piney. Cameras were also operated continuously from April through November at two sites on the Upper Green, one on the Lower Green, two on the New Fork, two sites on the Upper North Platte, and one site on the Lower North Platte.

Boat use varied considerably by river-reach and by boat type (Figures 2 and 3). Highest use among all boats occurred on the Bighorn River, where average boats per day at the Wedding of the Waters and the 8th St. Bridge exceeded all other river reaches monitored in July 2019 and 2020, and September 2019. Use by fishing boats was generally the same across rivers and reaches, with a couple of exceptions. Use across rivers typically averaged between 5–10 boats/day during July and 0–5/day in September. River-reaches on the Upper and Lower North Platte River, Lower Green River, and the Snake River were the only sites to average more than 10 fishing boats/day in July (12.1/day at Treasure Island, 2019, 18.5 and 16.5/day at Gray Reef 2019 and 2020, 10.6/day at Lusby, 2020, 10.3 at Dam, 2020, and 20.0 boats/day at Wilson, 2020). In general, the number of fishing boats using each river was greater in July than in September. Fishing boat use in July exceeded that in September on every river-reach sampled, except for both reaches on the Bighorn River in 2019 (Figure 3).

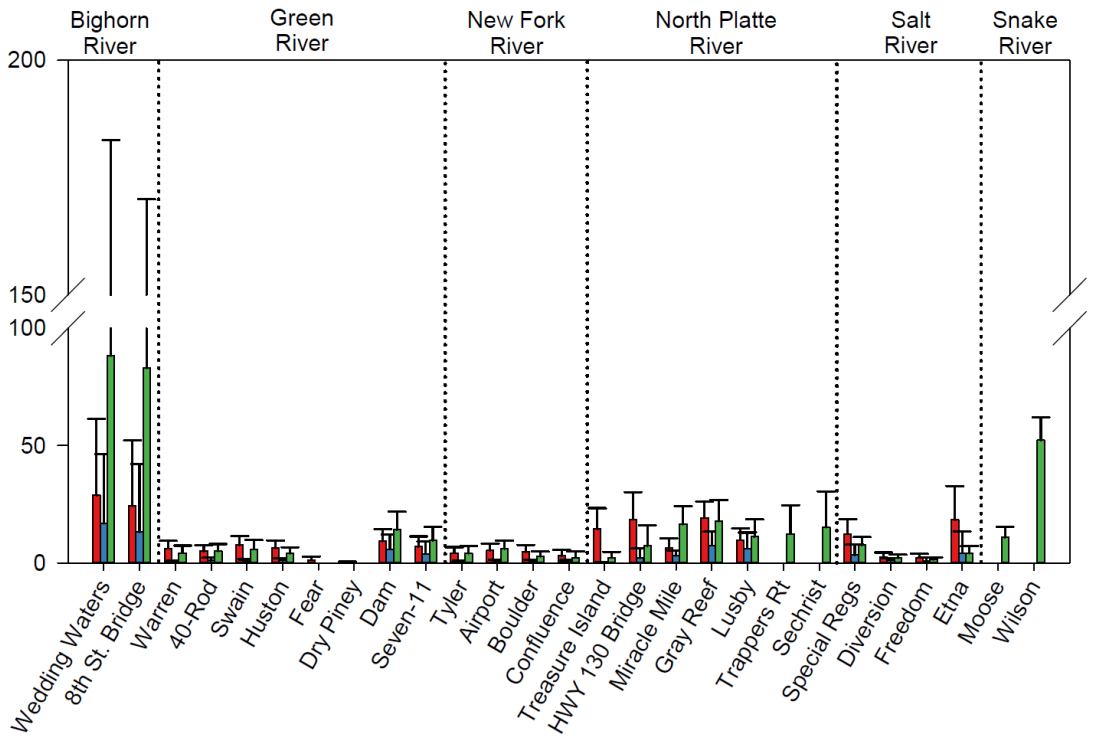

FIGURE 2. Average (SD) number of boats (fishing and non-fishing) per day observed at individual reaches of large rivers during July 2019 (red), Sept 2019 (blue), and July 2020 (green) using time-lapse cameras.

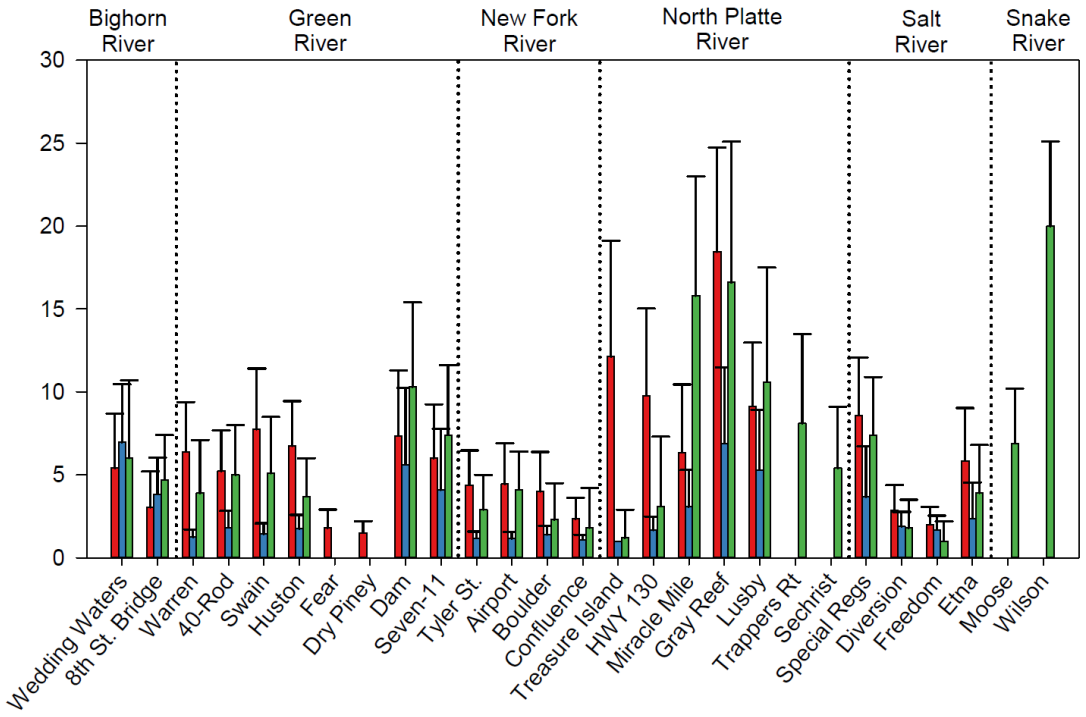

FIGURE 3. Average (SD) number of fishing boats per day observed at individual reaches of large rivers during July 2019 (red), Sept 2019 (blue), and July 2020 (green) using time-lapse cameras.

Use by angling boats also varied by year at several of the reaches evaluated. For example, the average number of fishing boats/day was lower at every site on the Upper Green, New Fork, Upper North Platte, and Salt rivers in 2020 compared to 2019. Alternatively, use was higher at all sites on the Lower Green and Bighorn rivers in July 2020 compared to 2019.

Angler use on weekends was almost always higher than weekdays on all of the rivers and reaches surveyed, with few exceptions (data for all sites presented in Appendix B). The most profound differences were observed on the Lower Green, where weekend use could be as much as double or triple weekday use. Other rivers and reaches varied, but no examples of significantly lower weekend angler use were observed. The Snake River was the only waterway with equal numbers of weekday and weekend users at all sites, though data was only collected during July 2020.

Diel patterns in boat use were evaluated by plotting the launch (or takeout) time of every fishing boat over the length of the sampling period in 2019 and 2020 (Figure 4 and 5). On most reaches, peak fishing boat use occurs over a period of 2–3 hours, whether boats were captured launching, passing a camera in the middle of a floatable reach, or taking out. This phenomenon of concentrated use helps to illustrate some of the concern among angler groups of crowding on individual rivers. That is, peak use over a period of 2–3 hours could give many floaters the impression of crowding.

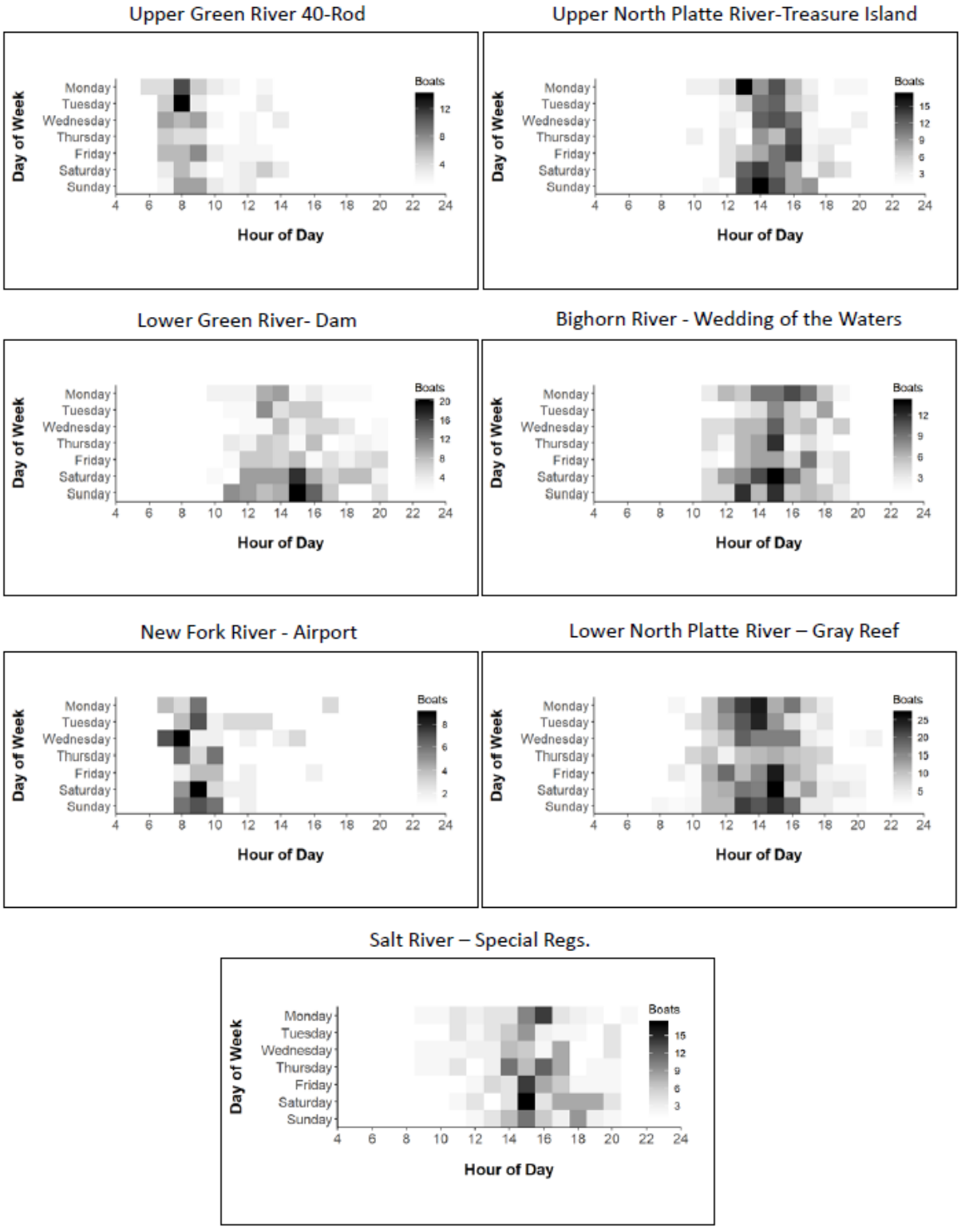

FIGURE 4. Daily timing of fishing boat use on the busiest river-reaches of the Upper Green, Lower Green, New Fork, Upper North Platte, Bighorn, Lower North Platte, and Salt rivers during July, 2019.

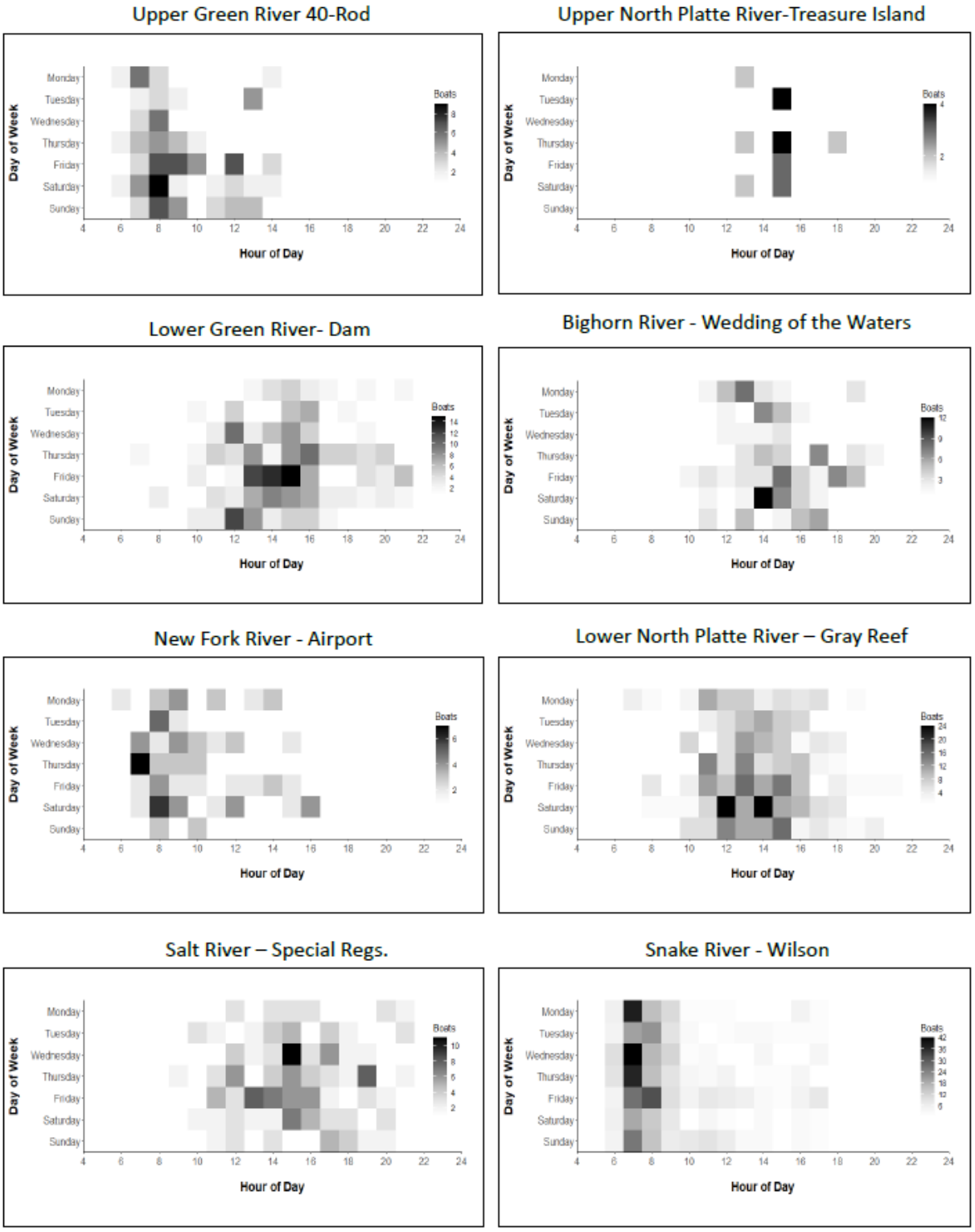

FIGURE 5. Daily timing of fishing boat use on the busiest river-reaches of the Upper Green, Lower Green, New Fork, Upper North Platte, Bighorn, Lower North Platte, Salt and Snake rivers during July, 2020. Note scale differences at each river-reach.

Cameras were operated on 13 reaches of five river segments for the entire ice-free fishing season to evaluate seasonal patterns in use and the value of monitoring during pre-determined index months. During 2020, continuous monitoring occurred from May–October on the New Fork River, April–November on the Upper Green, Lower Green, and Upper North Platte rivers, and January–December on the Lower North Platte River (Figures 6-10). Patterns of use on individual reaches and river segments varied and showed differences in the timing of peak use, both annually and weekly. For example, the Lower Green River at the Dam showed significant peaks during the weekends throughout the ice-free period (Figure 8). Conversely, reaches on the Upper Green, 60 river miles upstream, showed no discernable pattern of weekend and weekday use (Figure 7). Seasonally, some segments showed distinct peaks over short periods of time, such as the Upper North Platte, which saw nearly all of its use in 2020 occur during the month of June (Figure 9). While others, such as the New Fork River saw less pronounced use over a longer period of time (Figure 6).

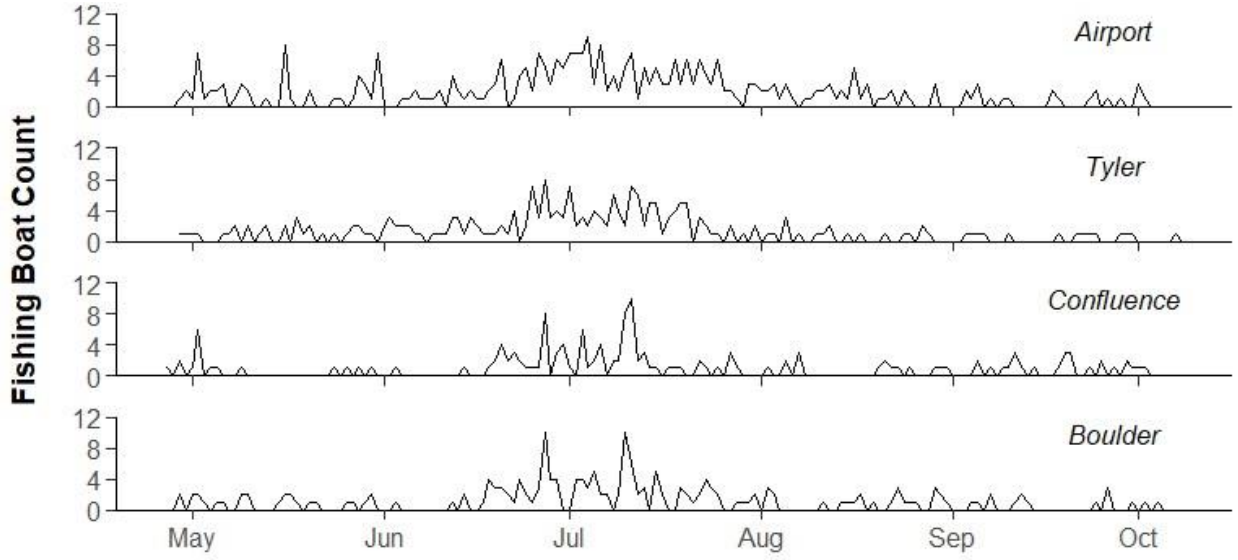

FIGURE 6. Number of fishing boats observed on four reaches of the New Fork River in 2020 using time-lapse cameras operated continuously from May – October.

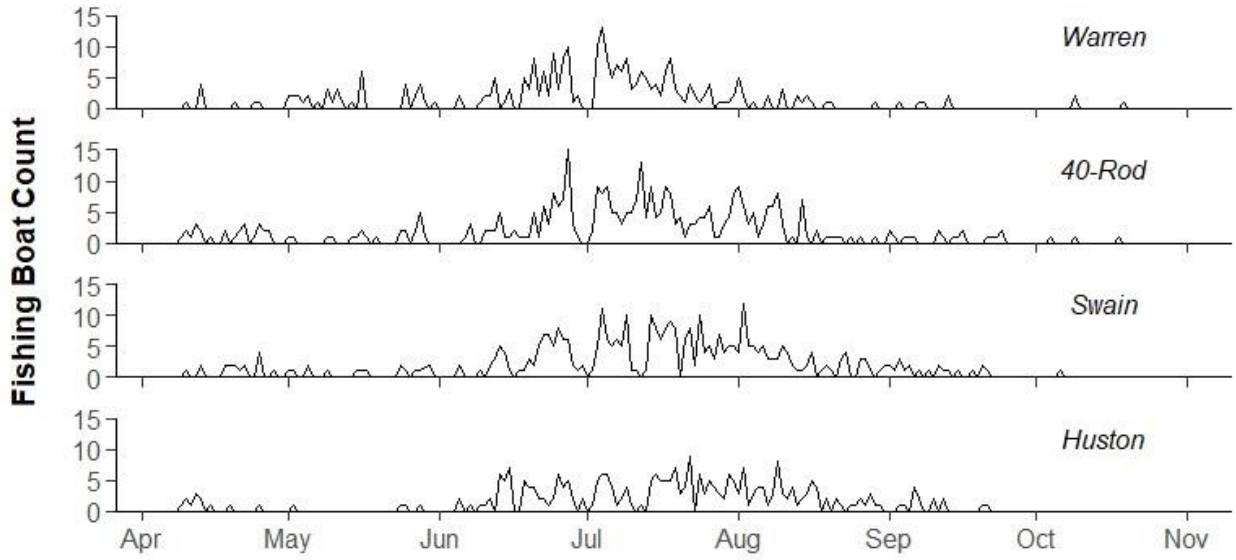

FIGURE 7. Number of fishing boats observed on four reaches of the Upper Green River in 2020 using time-lapse cameras operated continuously from April – November.

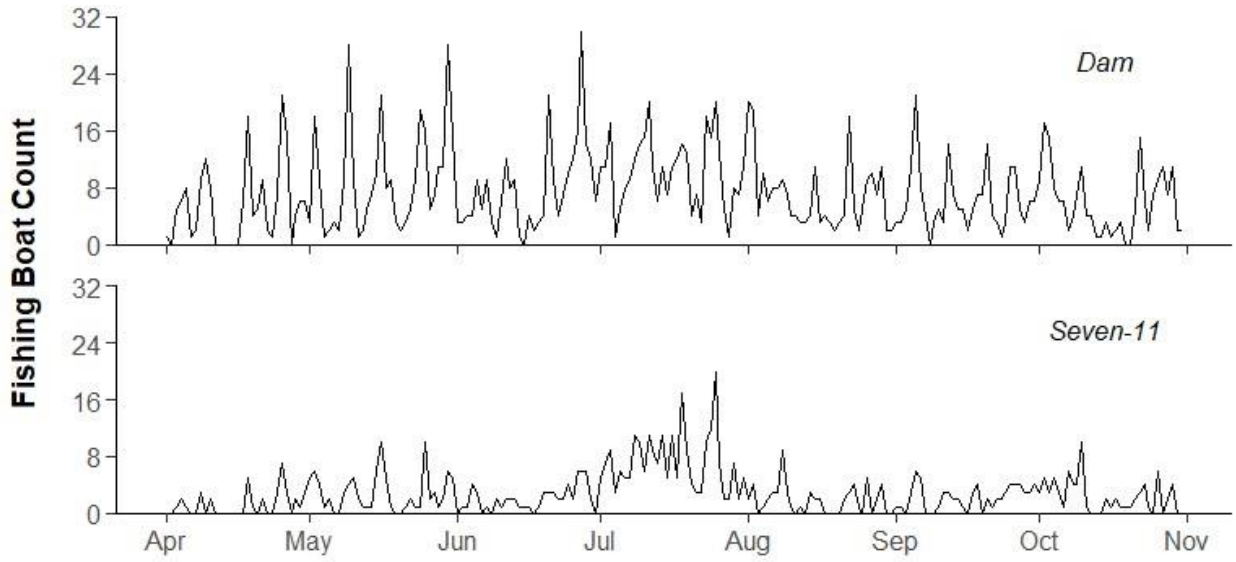

FIGURE 8. Number of fishing boats observed on two reaches of the Lower Green River in 2020 using time-lapse cameras operated continuously from April – November.

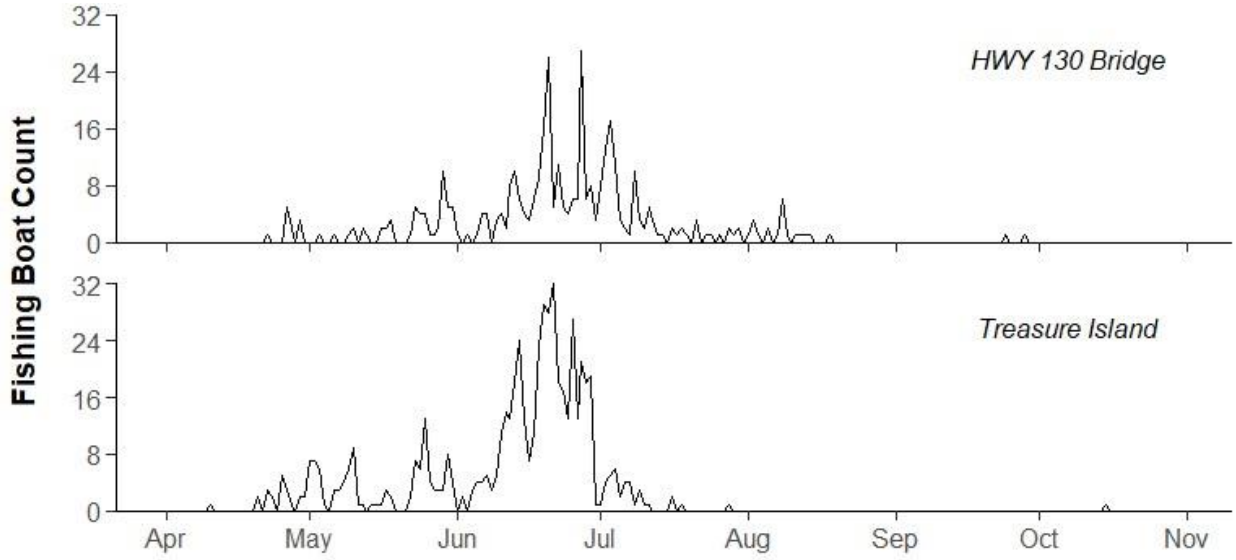

FIGURE 9. Number of fishing boats observed on two reaches of the Upper North Platte River in 2020 using time-lapse cameras operated continuously from April–November.

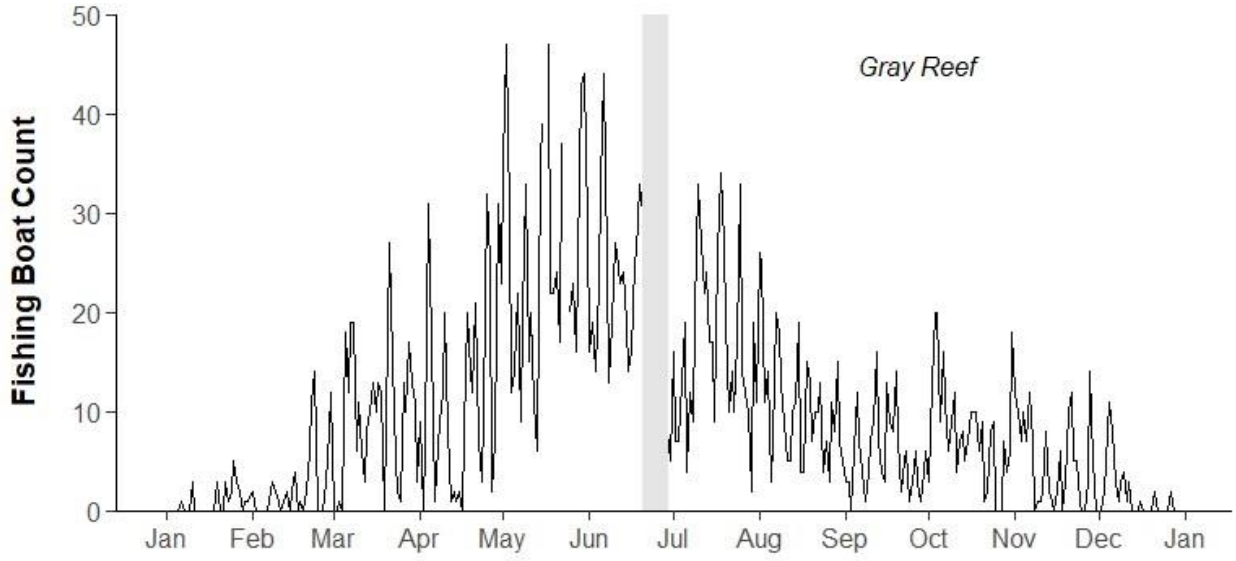

FIGURE 10. Number of fishing boats observed on the Gray Reef of the Lower North Platte River in 2020 using time-lapse cameras operated continuously from January–December.

Angler residency and commercial guiding

A total of 1,117 anglers floating rivers were interviewed state-wide in 2019, including 882 in July and 233 in September. The number of interviews varied from 87 (New Fork River) to 256 (Upper North Platte) on each river-section. Total anglers interviewed in 2020 was 955,

and varied from 33 on the Upper North Platte to 376 on the Lower Platte. Interviews were only collected during the July index period in 2020 (not September), but included some interviews conducted in June and August, which increased sample sizes on the Upper Green, Lower Green and Upper North Platte. Non-Resident anglers outnumbered resident anglers on all reaches except the New Fork in 2019 and on all river segments surveyed in 2020 (Table 2). The Lower Platte River and the Snake River had the highest proportion of non-resident anglers and the New Fork and Salt rivers had the highest proportion of resident anglers.

TABLE 2. Percentage of resident versus non-resident anglers and guided versus non-guided anglers among all boat anglers interviewed at individual river-sections during 2019 and 2020.

River-section	Year	N	Resident	Non-res.	Guided	Non-guided
Bighorn	2019	112	33.9	66.1	37.5	62.5
	2020	43	39.5	60.5	39.5	60.5
Upper Green	2019	152	27.0	73.0	67.8	32.2
	2020	132	38.6	61.4	41.7	58.3
Lower Green	2019	137	20.4	79.6	24.8	75.2
	2020	166	21.1	78.9	2.4	97.6
New Fork	2019	87	49.4	50.6	20.7	79.3
	2020	33	39.4	60.6	42.4	57.6
Upper Platte	2019	256	35.2	64.8	41.0	59.0
	2020	42	40.5	59.5	47.6	52.4
Lower Platte	2019	160	13.8	86.2	75.6	24.4
	2020	376	16.8	83.2	55.6	44.4
Salt	2019	213	45.5	54.5	24.9	75.1
	2020		-	-	-	-
Snake	2019		-	-	-	-
	2020	163	11.7	88.3	87.7	12.3

The proportion of anglers participating in a commercial guide trip varied from river to river. For example, nearly 90% of all anglers interviewed on the Snake River in 2020 were guided, while only 2% of anglers on the Lower Green were guided. All other river segments showed levels of commercial guiding varying from 20–75% for all anglers interviewed (Figure 11). Three river segments, the Upper Green, Lower Platte, and Snake, had a higher proportion of guided anglers than non-guided anglers. Commercial guide use varied some from 2019 to 2020, but was remarkably similar on some rivers.

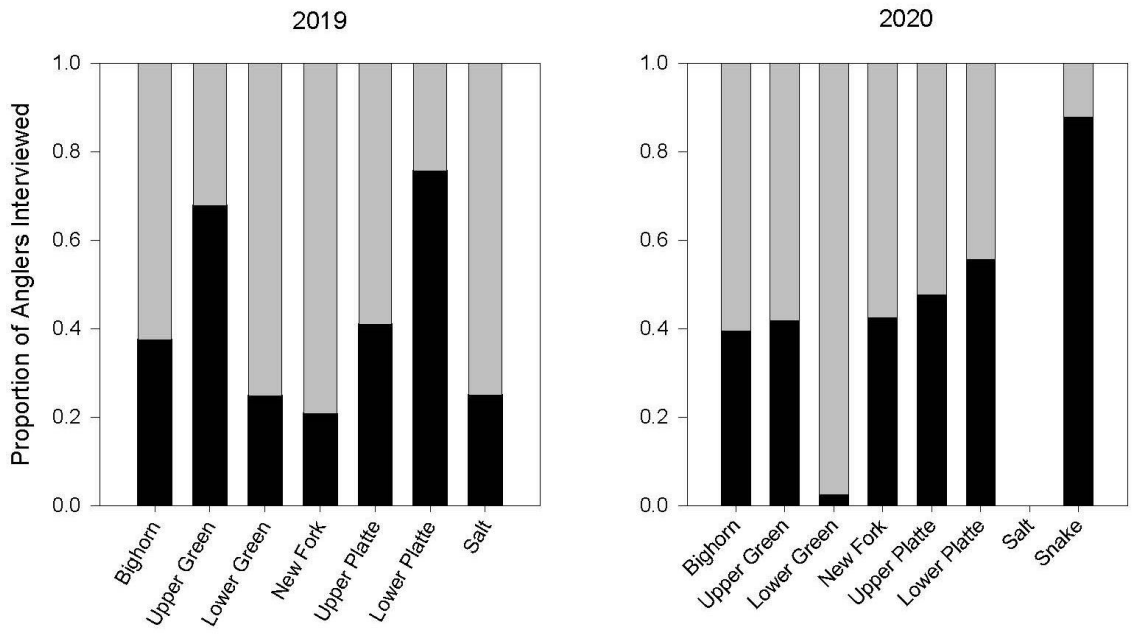

FIGURE 11. Proportion of commercial (black) and non-commercial (gray) boat trips on individual river-sections for all interviews collected in July and September 2019, and June–Aug 2020.

The average number of commercial boat trips per day in 2019 was higher in July than September for all river reaches except for the two sites established on the Bighorn River. The Lower North Platte River had the highest number of commercial fishing boat trips in 2019 (Figure 12). Commercial boat trips were typically less than five per day on all reaches, except for river-reaches on the North Platte River. Commercial boat trips per day during July on the Gray Reef were notably higher than any other reach surveyed in 2019. Data from 2020 was similar to 2019, with the exception of the Snake River, where the number of commercial boat trips per day leaving at Wilson Bridge was higher than the total number of boat trips per day on any other reach.

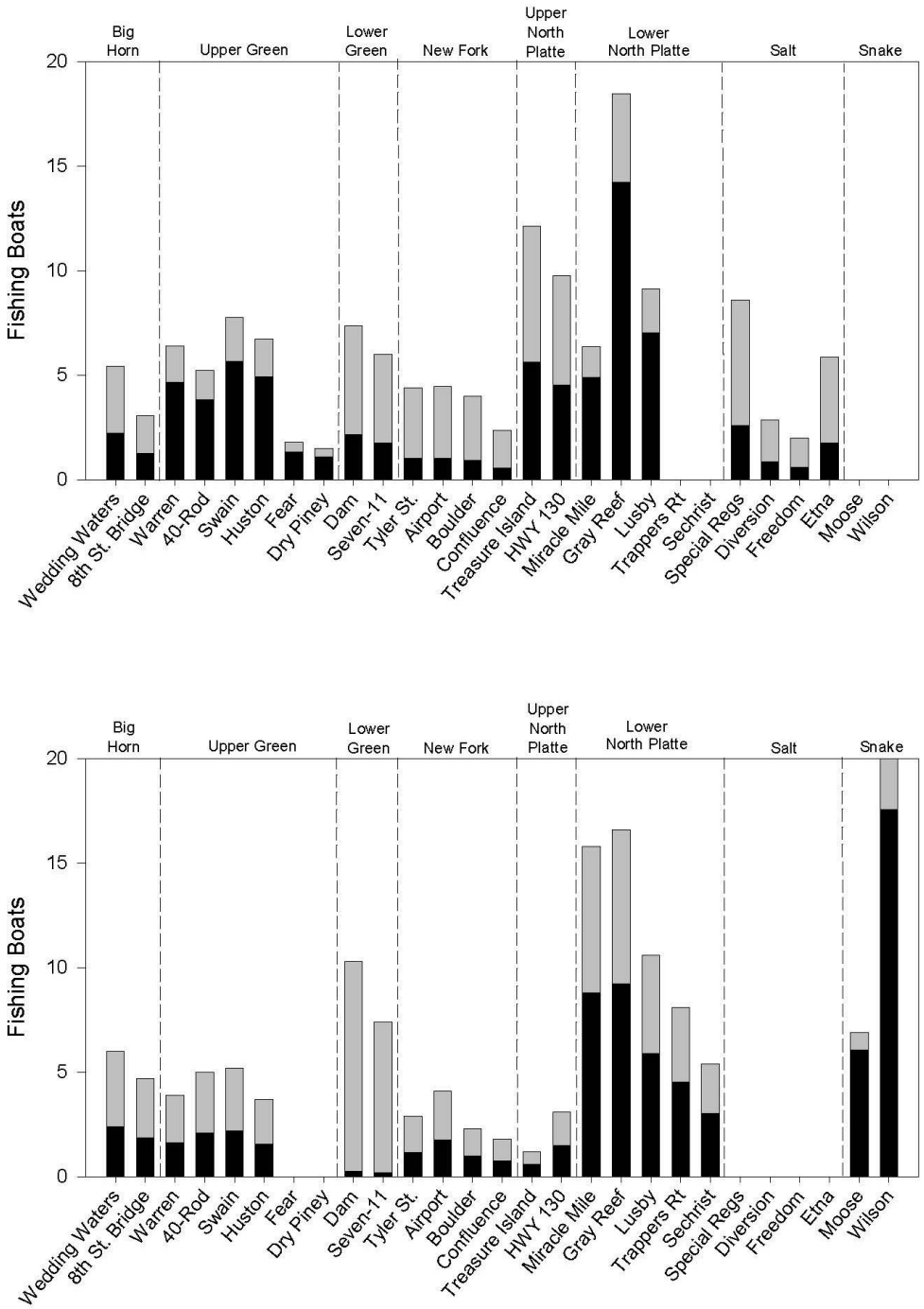

FIGURE 12. Number of commercial (black) and non-commercial (gray) boat trips per day on individual river-reaches during 2019 (upper) and 2020 (lower).

The vast majority of commercial guides operating on the large rivers in Wyoming are residents, the only exception exists on the Lower Green River where roughly half of the guides

are coming from out of state (Table 3). In addition, most of the resident commercial guides are from the same Wyoming County in which they are operating. The only noticeable exception is on the Upper Green and New Fork rivers, where anywhere from 50–85% of the commercial guides are coming from out of the county. This is largely driven by the influx of guides and anglers coming to Sublette County from Teton County.

TABLE 3. Origin of commercial fishing guides operating on individual river-sections during 2019 and 2020. Non-resident and resident indicate the percent of guides that originated within or outside of Wyoming. Resident County indicates the percent of resident guides that were guiding within their Wyoming County of origin.

River-section	Year	N	Non-resident	Resident	Resident County
Bighorn	2019	21	4.8	95.2	75
	2020	8	12.5	87.5	85.7
Upper Green	2019	54	1.9	98.1	15
	2020	29	0	100	31
Lower Green	2019	19	42.1	57.9	18
	2020	2	50	50	100
New Fork	2019	9	0	100	44
	2020	7	0	100	57
Upper Platte	2019	57	15.8	82.5	66
	2020	10	10	90	89
Lower Platte	2019	62	6.5	93.5	95
	2020	108	0	100	94
Salt	2019	30	16.7	83.3	76
Snake	2020	67	10	90	100

DISCUSSION

The use of time-lapse cameras provided a simple, effective, and repeatable way to monitor and evaluate boat use and angling boat use on many large rivers in Wyoming. The continuous operation of time-lapse cameras during the months of July in 2019 and 2020 provided an index of pressure during two years and provides insight into patterns within and among the most popular river fisheries in the state. Data collected in 2019 and 2020 provides insight into current use patterns throughout Wyoming and establishes a baseline for monitoring changes in future use patterns. Repeating the application of time-lapse cameras developed during this study should be conducted state-wide on a regular interval (3–5 years) to ensure changes in river use are adequately monitored. Angler creel surveys added a level of complexity that required more

time and effort, and could be completed less frequently to ensure that remote monitoring is repeated more often.

Remote monitoring strategies, including the use of time-lapse or motion sensing cameras, have become more common for evaluating angler use (van Poorten et al. 2015). For example, the use of time-lapse cameras has been described for the purposes of monitoring pressure on large lakes and reservoirs (Stahr and Knudsen 2018), small streams (Hining and Rash 2016), and small lakes (Greenberg and Godin 2015). However, this study is one of the few published examples describing the use of time-lapse cameras on large rivers. Previous efforts have attempted to utilize video cameras and motion sensing triggers (e.g., Gelwicks et al. 2002), however, these efforts involved cumbersome video equipment and batteries and were fraught with complications. The protocol described in this study provides an example of how to effectively utilize this technology to estimate boater use and angler use on large rivers and could be further explored to answer additional questions. While the collection and processing of photographs was relatively rapid and simple, additional questions about angler demographics and commercial guide use required more intense effort, primarily traditional spot creel interviews. Aspects of this work can be used together or individually to monitor specific characteristics of angler use in the future, depending on the question and the amount of effort required.

Monitoring during the month of July provided an index of use during one of busiest months on most rivers and made a useful comparison among rivers throughout the state. Indices are used throughout the fisheries sciences as a way to summarize data for multiple metrics into a simple number or variable, or to stratify data collection to simplify effort or analysis (e.g., Guy and Brown 2007). Index counts are a common approach used to estimate angling pressure in Wyoming (Whaley et al. 2002). Stratifying the collection of data during the month of July allowed us to compare the amount of angler use throughout the state. The month of July was given special consideration because it is generally the period on free-flowing rivers in Wyoming when snow-melt runoff ends and angling peaks (e.g., Figures 6–7). This allowed us to collect data during a period of high use to maximize efficiency and data utility.

However, the month of July did not reflect the period of highest use on all rivers, and was subject to annual variability in angler use on some individual rivers, specifically tailwaters. Although July is often considered the period of highest or increasing use on free-flowing rivers, it may not accurately reflect the most use on tailwaters. Based on season-long monitoring for example, float angler use on the Lower North Platte River was highest in May – June and began to decline in July. Similarly, on the Lower Green River, some peaks in angler use were higher in May than July. Additionally, monitoring in July may not always account for the most use on all free-flowing rivers. For example, on the Upper North Platte River, index monitoring in July 2020 largely missed almost all of the recorded float angler use for the season (Figure 9). This was largely due to discharge on the river, which dropped precipitously in July (WGFD 2021). While data collected in July 2019 was largely considered representative of the peak use on the Upper North Platte, annual variation in conditions lead to considerable variation from year-to-year. Season long monitoring implemented in 2020 helped elucidate these phenomenon, and should be a strategy used in conjunction with index monitoring in the future.

Overall, total boat use and fishing boat use varied from river to river. Some of the busiest river-reaches in the state saw boat use exceeding 50 boats/day and fishing boat use from 15–20 boats per day or more. Most fishing boat use ranged from 5–10 boats/day in July, though at many sites, the maximum number of boats observed in a single day often exceeded 20 boats/day (unreported data). There were also obvious differences in the amount of angler use that occurred over weekdays and weekends on almost every river. Almost every river and reach saw an increase in use over the weekends, though some were more significant than others. These peak periods of angler use might be having the most influence on angler perceptions and leading to the general attitude among many people that rivers are becoming too crowded. Another phenomenon observed on many rivers was the tendency for the majority of floaters to launch within a short period of time each day (e.g., Figures 4–5). Because floaters are subject to downstream travel at or near the rate of flow, several boats launching at the same time would inevitably be travelling downstream at roughly the same speed. This likely increases encounter rates among many floaters and might further inflate their perception of crowding.

Commercial guiding on many of the large rivers in Wyoming contributes to a significant number of anglers during the summer. Commercial guiding made up over 20% of the boat anglers on all of the rivers surveyed, and on the Upper Green, Lower North Platte, and Snake rivers, commercially guided anglers comprised the majority of those surveyed. Few other examples exist within Wyoming where commercial guiding represents such a large proportion of the angler participation. Commercial guiding is so uncommon on large lakes and reservoirs that it is often not even a consideration during large programmed creel surveys (e.g., Mavrakis 2001; Stephens 2007). Similarly, no examples exist to compare commercial guiding on small lakes and streams. By all accounts, the majority of commercial guiding in Wyoming occurs on large rivers and tailwaters. It was not until relatively recently, however, that commercial guiding was given much consideration on these fisheries. Recent creel surveys on many large rivers did not even attempt to quantify commercial guiding, including the most recent efforts on the Salt River (Gelwicks et al. 2002) and the Upper Green River (Cavalli 2007). Gipson (1995) provides some of the first estimates of commercial guiding on the Snake River; estimating that 76% of boat anglers fishing the Moose section and 80% of the anglers fishing the Wilson section were commercially guided. Hahn (2013) conducted one of the first attempts to quantify commercial guiding on the Gray Reef section of the North Platte River in 2009. He estimated more than 8,000 boat anglers floated the river in 2009 and at least 47% of those were commercially guided.

Though not a stated objective of this study, angler catch rates and angler harvest indicate almost universal adoption of voluntary catch-and-release angling on all of the large rivers in Wyoming. During 2019 and 2020 we interviewed over 2,072 boat anglers who reported catching 7,895 fish. Among those, anglers reported harvesting four (4) trout for an overall harvest rate of 0.05%.

MANAGEMENT RECOMMENDATIONS

- Re-evaluate angler use and commercial guiding using the approach outlined here every 3–5 years, including index monitoring and season-long monitoring of fishing boats and the use of intensified angler creel. Long-term study design should include monitoring periods of peak use during May on tailwaters and July on free-flowing rivers. Creel surveys can be conducted less frequently and should be done at least every-other sampling event.
- Investigate angler opinions and attitudes about crowding on large rivers in Wyoming and the need or desire to regulate commercial guiding or boat angling.

ACKNOWLEDGEMENTS

This project relied on countless hours of data collection and data processing provided by several biologists and technicians throughout Wyoming who are too numerous to accurately list here. However, their contribution to this effort should not go unrecognized. This project was completed on the heels of Rob Gipson's 30-year career with the Wyoming Game and Fish Department. Among his many qualities, he was widely regarded by both guides and anglers for his ability to interact fairly and professionally with the public and represent the Department with enjoyment and pride. It is only fitting that he served as an investigator in this effort and left his mark on our knowledge and understanding of angler use in Wyoming, particularly in Teton County.

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APPENDICES

APPENDIX A. Number of boats observed (total, recreational, and fishing) by river and section during July and September 2019, and July 2020.

River	Section	Month	Total	Recreational	Fishing
Bighorn	W. of Waters	July 2019	896	739	157
		Sept 2019	507	312	195
		July 2020	2653	2473	180
	8th St. Bridge	July 2019	757	687	70
		Sept 2019	507	312	195
		July 2020	2495	2352	140
Upper Green	Warren	July 2019	194	2	192
		Sept 2019	10	0	10
		July 2020	128	6	122
	40-Rod	July 2019	158	1	157
		Sept 2019	32	1	31
		July 2020	158	3	155
	Swain	July 2019	124	0	124
		Sept 2019	20	0	20
		July 2020	176	16	160
	Huston	July 2019	102	1	101
		Sept 2019	30	0	30
		July 2020	123	9	114
	Fear	July 2019	40	4	36
	Dry Piney	July 2019	3	0	3
Lower Green	Dam	July 2019	289	61	228
		Sept 2019	176	30	146
		July 2020	441	121	320
	Seven-11	July 2019	215	35	180
		Sept 2019	117	27	90
		July 2020	301	72	229
New Fork	Tyler	July 2019	131	8	123
		Sept 2019	13	0	13
		July 2020	122	32	90
	Airport	July 2019	164	26	138
		Sept 2019	21	0	21
		July 2020	189	60	129
	Boulder	July 2019	86	14	72
		Sept 2019	14	0	14
		July 2020	81	9	72
	Confluence	July 2019	55	15	40
		Sept 2019	13	1	12
		July 2020	61	7	54
Upper North Platte	Treasure Island	July 2019	450	74	376
		Sept 2019	4	0	4
		July 2020	56	20	36
	HWY 130	July 2019	576	283	293
		Sept 2019	65	40	25

APPENDIX A. Continued.

		July 2020	223	126	97
Lower North Platte	Miracle Mile	July 2019	197	0	197
		Sept 2019	92	0	92
		July 2020	132	6	126
	Gray Reef	July 2019	599	27	572
		Sept 2019	226	19	207
		July 2020	552	38	514
	Lusby	July 2019	302	28	274
		Sept 2019	187	39	148
		July 2020	345	17	328
	Trappers Rt.	July 2020	385	135	250
	Sechrist	July 2020	470	302	168
Salt River	Special Regs	July 2019	384	118	266
		Sept 2019	103	22	81
		July 2020	235	5	230
	Diversion	July 2019	80	6	74
		Sept 2019	30	0	30
		July 2020	57	1	56
	Freedom	July 2019	71	23	48
		Sept 2019	26	4	22
		July 2020	31	0	31
	Etna	July 2019	573	392	181
		Sept 2019	127	82	45
		July 2020	126	4	122
Snake River	Moose	July 2020	339	125	214
	Wilson	July 2020	1625	1004	620

APPENDIX B. Average number of fishing boats (SD) observed using time-lapse cameras during weekdays and weekends, and the percent difference between the two estimates, by river and section during the months of July and September, 2019 and 2020. Bold indicates a significant difference ($\alpha = 0.05$) between weekday and weekend averages within reaches.

River	Section	Month	Weekday	Weekend	Diff (%)
Bighorn	W. of Waters	July 2019	4.3 (2.5)	7.3 (3.6)	**+ 70**
		Sept 2019	7.1 (2.8)	6.9 (4.3)	- 3
		July 2020	4.8 (3.1)	7.5 (6.1)	**+ 56**
	8th St. Bridge	July 2019	2.9 (2.2)	3.2 (2.2)	+ 10
		Sept 2019	3.4 (1.7)	4.6 (2.8)	+ 35
		July 2020	4.0 (1.7)	5.5 (3.4)	+ 38
Upper Green	Warren	July 2019	5.4 (2.6)	7.8 (3.0)	+ 44
		Sept 2019	1.5 (0.6)	1.0 (0.0)	- 33
		July 2020	2.9 (2.5)	5.4 (3.5)	**+ 86**
	40-Rod	July 2019	4.9 (2.5)	5.8 (2.5)	+ 18
		Sept 2019	1.9 (1.1)	1.7 (1.0)	- 11
		July 2020	3.4 (2.1)	7.1 (2.7)	**+ 110**
	Swain	July 2019	6.6 (3.6)	9.7 (3.2)	**+ 47**
		Sept 2019	1.5 (0.5)	1.3 (0.8)	- 14
		July 2020	4.8 (3.1)	5.6 (3.5)	+ 16
	Huston	July 2019	6.3 (3.0)	7.3 (2.3)	+ 16
		Sept 2019	1.8 (0.9)	1.8 (0.8)	0
		July 2020	3.2 (2.5)	4.2 (2.2)	+ 31
	Fear	July 2019	1.5 (0.5)	2.2 (1.5)	+ 47
	Dry Piney	July 2019	1.0 (0.0)	2.0 (1.0)	+ 100
Lower Green	Dam	July 2019	5.9 (2.9)	9.8 (4.4)	**+ 66**
		Sept 2019	2.9 (2.0)	8.8 (4.8)	**+ 300**
		July 2020	8.5 (4.1)	12.8 (5.3)	**+ 51**
	Seven-11	July 2019	4.8 (2.3)	7.8 (3.8)	**+ 63**
		Sept 2019	2.3 (1.3)	5.3 (4.3)	**+ 230**
		July 2020	6.1 (3.3)	9.1 (4.9)	+ 49
New Fork	Tyler	July 2019	4.6 (2.2)	4.2 (2.0)	- 8
		Sept 2019	1.0 (0.0)	1.4 (0.6)	+ 40
		July 2020	2.8 (2.1)	3.1 (2.1)	+ 11
	Airport	July 2019	4.2 (2.2)	4.8 (2.8)	+ 14
		Sept 2019	1.1 (0.3)	1.3 (0.5)	+ 18
		July 2020	3.9 (2.2)	4.5 (2.4)	+ 15
	Boulder	July 2019	3.1 (1.4)	5.4 (3.0)	**+ 74**
		Sept 2019	1.4 (0.5)	1.3 (0.6)	- 7
		July 2020	1.8 (1.5)	3.1 (2.8)	**+ 72**
	Confluence	July 2019	2.1 (1.1)	2.7 (1.5)	+ 29
		Sept 2019	1.2 (0.5)	1.0 (0.0)	- 17
		July 2020	1.2 (1.2)	2.8 (3.3)	**+ 133**
Upper North Platte	Treasure Island	July 2019	10.7 (6.8)	14.4 (7.0)	+ 35
		Sept 2019	1.0 (0.0)	-	
		July 2020	1.1 (1.6)	1.2 (2.0)	+ 9
	HWY 130	July 2019	6.9 (3.5)	14.1 (4.5)	**+ 104**
		Sept 2019	1.7 (0.9)	1.7 (0.9)	0
		July 2020	2.8 (3.7)	3.6 (4.9)	+ 29

APPENDIX B. Continued.

Lower North Platte	Miracle Mile	July 2019	5.7 (4.0)	7.3 (4.3)	+ 28
		Sept 2019	2.5 (2.1)	3.8 (2.2)	+ 52
		July 2020	13.0 (7.8)	20.3 (2.5)	**+ 54**
	Gray Reef	July 2019	16.5 (5.8)	21.6 (6.0)	+ 31
		Sept 2019	5.7 (4.9)	8.5 (3.7)	+ 49
		July 2020	12.8 (5.8)	21.8 (9.0)	**+ 70**
	Lusby	July 2019	8.1 (4.1)	10.7 (2.9)	+ 32
		Sept 2019	4.3 (3.5)	6.4 (3.6)	+ 49
		July 2020	7.9 (4.7)	14.3 (7.8)	**+ 81**
	Trappers Rt.	July 2020	6.7 (3.7)	10.0 (6.7)	+ 49
	Sechrist	July 2020	4.4 (3.3)	6.8 (3.9)	+ 54
Salt River	Special Regs	July 2019	7.5 (3.1)	10.3 (3.5)	+ 37
		Sept 2019	3.9 (3.1)	3.4 (3.1)	- 13
		July 2020	7.1 (4.3)	7.9 (1.9)	+ 11
	Diversion	July 2019	2.9 (1.8)	2.8 (0.8)	- 3
		Sept 2019	1.7 (0.9)	2.1 (0.9)	+ 24
		July 2020	1.8 (1.6)	1.8 (1.9)	+ 1
	Freedom	July 2019	2.1 (1.1)	1.9 (1.0)	- 10
		Sept 2019	1.6 (0.5)	2.0 (1.4)	+ 25
		July 2020	0.5 (0.9)	1.6 (1.3)	**+ 300**
	Etna	July 2019	5.0 (2.8)	7.2 (3.5)	+ 44
		Sept 2019	2.4 (2.7)	2.3 (1.5)	- 4
		July 2020	3.2 (2.6)	5.0 (3.1)	+ 56
Snake River	Moose	July 2020	7.2 (3.4)	6.4 (3.1)	- 12
	Wilson	July 2020	19.4 (5.5)	20.8 (4.5)	+ 7