Lower Clark Fork River Population Monitoring
2023 Annual Project Update

Dissolved Gas Supersaturation Control, Mitigation, and Monitoring,
Appendix F5

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ABSTRACT

The Idaho Department of Fish and Game monitors the lower Clark Fork River fish assemblage with catch per unit effort monitoring (CPUE) electrofishing conducted annually, and salmonid abundance surveys conducted every three years. The lower Clark Fork River relative abundance monitoring was first implemented in 2021 to assess species composition and monitor any relative changes to the fish assemblage, and annual sampling continued in 2022 and 2023. In 2023, sampling resulted in 16 species, 1 hybrid, and 381 individual fish captured. The sample was dominated by Northern Pikeminnow *Ptychocheilus oregonensis* (n = 100), Largescale Sucker *Catostomus macrocheilus* (n = 82), Smallmouth Bass *Micropterus dolomieu* (n = 72), Brown Trout *Salmo Trutta* (n = 33) and Mountain Whitefish *Prosopium williamsoni* (n = 26). These species were the most prevalent across all three years. Catch rates were not significantly different for most species between the three years; however, catch rates significantly decreased for Rainbow Trout *Oncorhynchus mykiss* from 2022 to 2023. The observed length distributions by species were similar between the three years; however, there was a significant reduction in the proportion of fish less than 300 mm TL for Mountain Whitefish between years, and fish under 200 mm TL for Largescale Sucker and Northern Pikeminnow. These changes in relative abundance and size composition may be related to changes in species composition, predation, or environmental conditions. Environmental conditions (i.e., water temperature and discharge) varied greatly between survey years and may influence catchability of size and species. Further monitoring is warranted to relate changes in relative abundance and size composition to varying environmental conditions and species composition.

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INTRODUCTION

Cabinet Gorge Dam is located on the lower Clark Fork River just west of the Idaho border and approximately 32 km downstream of Noxon Rapids Dam in Montana (Figure 1). An agreement reached between Avista (formerly Washington Water Power) and the Idaho Department of Fish and Game (IDFG) in 1973 provided a 3,000 cubic feet per second (cfs) minimum flow below Cabinet Gorge Dam (Avista 1999). The agreement was based on field assessments of the river at varying flows, electrical generating requirements, a review of historic low-flow records, and a recommendation for a minimum flow of the same amount (i.e., 3,000 cfs) made by the U.S. Fish and Wildlife Service. However, minimum flow in the lower Clark Fork River below Cabinet Gorge Dam was still one issue of concern to the local stakeholders involved in a collaborative relicensing process conducted by Avista for Cabinet Gorge and Noxon Rapids dams. Avista applied for relicensing of these two hydroelectric facilities on the Clark Fork River in Idaho and Montana in 1999, and the Clark Fork Settlement Agreement was the product of the collaborative relicensing process (Avista 1999). A new minimum flow was negotiated for Cabinet Gorge Dam, which increased the base flow from 3,000 cfs to 5,000 cfs beginning March 1, 1999 (Avista 2001). The objective of the increased minimum flow was to increase the amount of permanently wetted river habitat to benefit the aquatic resources of the lower Clark Fork River. More specifically, the objectives were to reduce the range of depth and velocity fluctuations in the river, reduce the varial zone, reduce depositional bar dewatering to increase stability of shoreline rearing areas for fish, and enhance macroinvertebrate production. Photo documentation was used to estimate the minimum flow needed to provide a meaningful increase in permanently wetted perimeter of the lower Clark Fork River (Beak Consultants, Inc. 1997).

To assess the effectiveness of changes in minimum flow and the channel alteration of the Foster Bar side-channel, a 10-year monitoring program was conducted from 1999 through 2008. Fish populations were monitored throughout the entirety of a 6.6 km reach of the lower Clark Fork River via night jet boat electrofishing along both banks. Targeted species in the monitoring program included Brown Trout *Salmo Trutta* (BRN), Mountain Whitefish *Prosopium williamsoni* (MWF), Rainbow Trout *Oncorhynchus mykiss* (RBT), Westslope Cutthroat Trout *O. lewisi* (WCT), and Rainbow Trout x Westslope Cutthroat Trout hybrids (WRHY). Assessment focused on monitoring changes in abundance, size structure, and body condition of fish populations in the affected area. Abundance of target species was estimated during annual monitoring efforts using mark-recapture techniques. Results over this 10-year period suggested abundance, size structure, and body condition of fish populations in the lower Clark Fork River were largely unchanged following increases in minimum flow below Cabinet Gorge Dam (Ryan and Jakubowski 2012). No substantial increases in salmonid abundance were noted after this period, and it was agreed to eventually return to 3,000 cfs minimum flow except for September 15 through October 31 when minimum flows are increased to 5,000 cfs to improve conditions for downstream migrating juvenile Bull Trout. This agreement was finalized in 2017 and implementation began in 2018 (Avista 2017).

However, in an attempt to expand data collection to a more comprehensive species distribution without increasing personnel needs, an exploratory catch per unit effort (CPUE) monitoring, hereafter relative abundance, project was initiated in September of 2021. This project has been replicated on a yearly basis to monitor the composition and distribution of the entire fish community within the lower Clark Fork River with the goal to relate species trends to biotic and abiotic conditions. (Ransom 2022; Birdsall et al. 2023). This report provides results of this survey conducted in September of 2023.

STUDY AREA

The Clark Fork River is the largest tributary to Lake Pend Oreille, contributing an estimated 92% of the annual inflow (Frenzel 1991) and draining approximately 59,324 km^2 of western Montana (Lee and Lunetta 1990). Four tributaries enter the lower Clark Fork River downstream of Cabinet Gorge Dam (Twin, Mosquito, Lightning, and Johnson creeks; Figure 1). Peak flows in the Clark Fork River typically occur as a result of snow melt in May or June, but occasionally in April or July (PBTAT 1998). Physical habitat in the lower Clark Fork River below Cabinet Gorge Dam can be characterized as primarily low gradient laminar flow, with three major riffles and several deep pools (WWP 1995). Riffles are located near the mouths of Twin and Lightning creeks, as well as at Foster Bar side-channel. The study area encompasses the same area where the mark recapture study takes place; approximately 6.6 km of river habitat from the U.S. Geological Survey (USGS) gauging station below Cabinet Gorge Dam downstream to the inlet of Foster Bar side-channel (approximately river km 6.5–13.5; Figure 1).

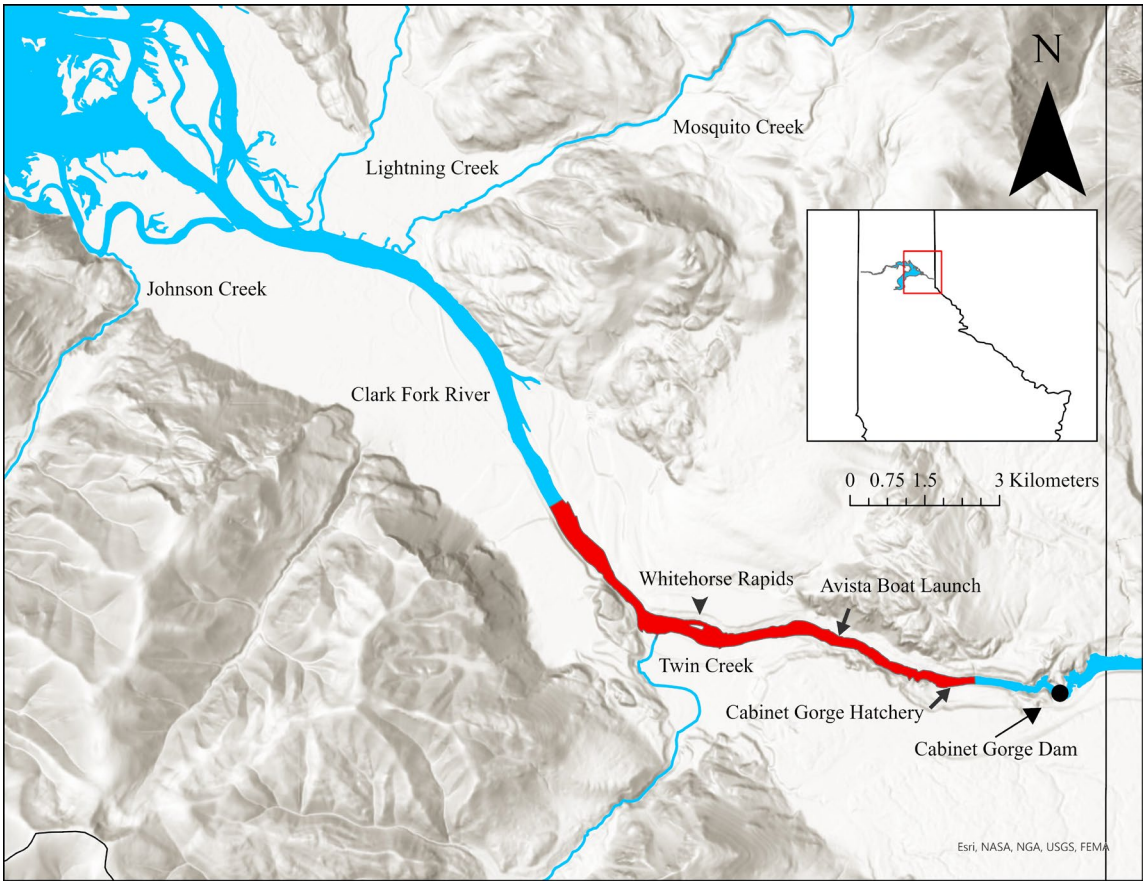

Figure 1. Fish abundance monitoring study area (red segment) on the lower Clark Fork River, a major tributary to Lake Pend Oreille.

METHODS

Sampling was conducted in September 2023 at eight 700-m reaches that were selected within the existing mark-recapture reach on the lower Clark Fork River and attempted to cover a representative distribution of available habitat types (i.e., cut banks, riffles, runs, and pools) (Figures 1 and 2). Boat-mounted, boom-type electrofishing equipment was used to sample fish at night. A Midwest Infinity rectifying unit was set to 60 Hz, 20% duty cycle, 300 volts, and 8–10 amps. The electrofishing boat drifted in fast flow areas or motored downstream slowly in areas of very slow flow, parallel with the shoreline. While electrofishing, attempts were made to keep the anode closest to shore in approximately 0.6 m of water depth. Total effort (time) from each electrofishing reach was recorded and used to estimate number of fish per minute sampled (i.e., relative abundance). Relative abundance was compared for a subset of species between years using a Kruskal-Wallis test and a Conover-Iman post hoc test ($P = 0.05$) (Welch et al. 1993; Iman and Conover 1987).

All fish were captured and identified to species, enumerated, and measured for total length (TL; mm). Characteristics used in identifying Rainbow Trout x Westslope Cutthroat Trout hybrids included throat slashes typically of light intensity or broken in

form and exhibiting heavy spotting below the lateral line and toward the anterior end of the fish (Bouwens and Jakubowski 2016). In addition, all captured Walleye *Sander vitreous* and Northern Pike *Esox Lucius* were euthanized in accordance with current predator suppression efforts (Bouwens et al. 2023). Total length was compared for a subset of species between years using an ANOVA and Tukey's HSD (honestly significant difference) test ($P = 0.05$) (Kahilainen and Lehtonen 2003).

We quantified the environmental conditions of water temperature (°C) and discharge (cfs) for the lower Clark Fork River for the three survey years. Environmental conditions were calculated as the observed water temperature and discharge between the 2000 hours and 0200 hours for days surveyed each year to assess variation between surveys. Water temperature was collected from the Temperature Station 2 downstream of Foster Bar side-channel and discharge was collected from the USGS stream gage below Cabinet Gorge Dam.

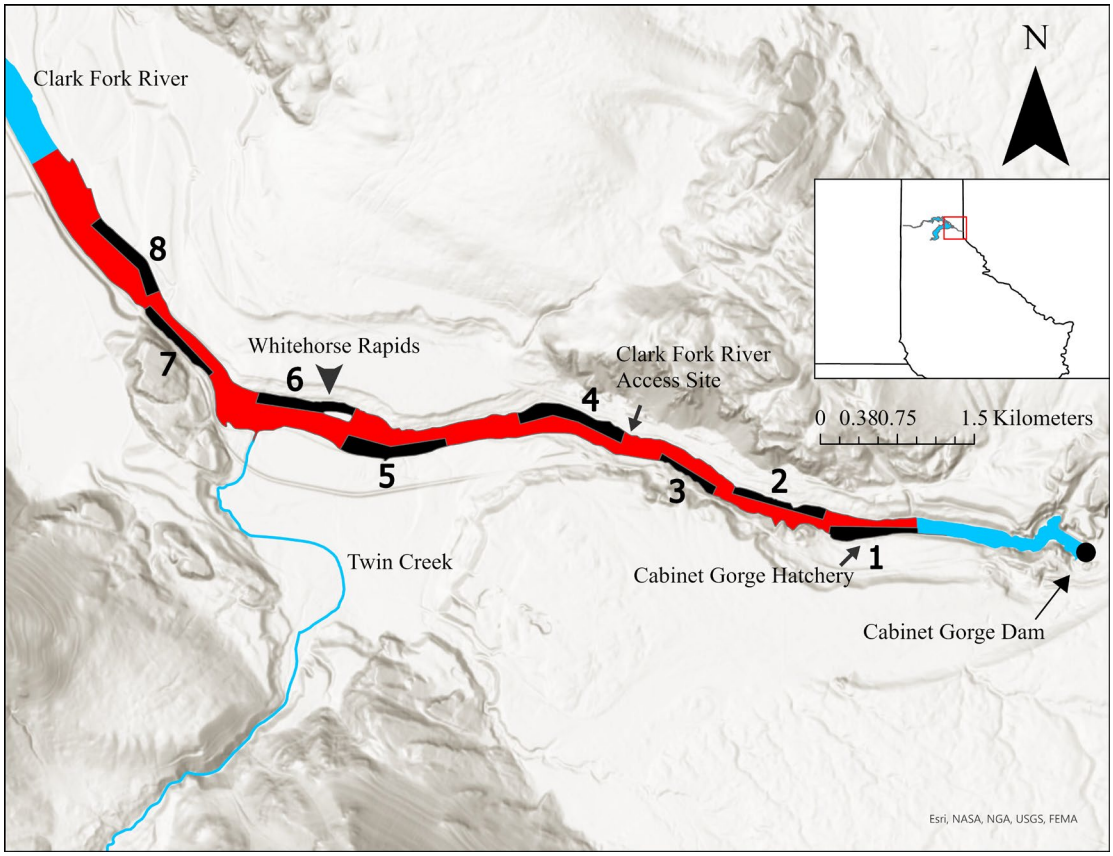

Figure 2. Map of the lower Clark Fork River surveyed in 2023 with specific sampling reaches identified in black.

RESULTS AND DISCUSSION

The relative abundance monitoring occurred September 18–20, 2023 under different environmental conditions than those observed for previous sampling years (Table 1,

Figures 3–4). For example, the water temperature downstream of Foster Bar side-channel varied > 1°C between sampling years (Figure 3). Additionally, discharge varied substantially between years, with the most extreme difference being observed between 2022 characterized by high flows with high variability and 2023 with relatively lower flows and little variability (Figure 4). There were little to no observations of extensive macrophyte growth throughout the study area in 2023, which is in contrast to previous surveys (Ransom et al. 2022, Birdsall et al. 2023). Overall, environmental conditions were not similar between years and could result in varying catchability for fish.

Table 1. Summary statistics for mean discharge (Mean CFS), the coefficient of variation of discharge (CV of CFS), the mean water temperature (Mean °C), and the coefficient of variation of water temperature (CV of °C) between 2000 hours and 0200 hours for the lower Clark Fork River across sampling days for 2021, 2022, and 2023. Data was collected from the USGS stream gage below Cabinet Gorge Dam and the Temperature Station 2 downstream of Foster Bar side-channel.

Year	Date	Survey Day	Mean CFS	CV of CFS	Mean °C	CV of °C
2021	9/14	1	11642.50	34.39	18.25	0.81
	9/15	2	7899.29	2.51	17.96	0.87
2022	9/12	1	10322.50	60.74	19.38	1.18
	9/13	2	7707.50	47.98	19.26	0.49
	9/14	3	8439.29	46.87	19.13	0.77
2023	9/18	1	5832.14	1.82	18.45	0.79
	9/19	2	7815.36	38.69	18.30	0.92
	9/20	3	6270.36	12.13	18.31	0.67

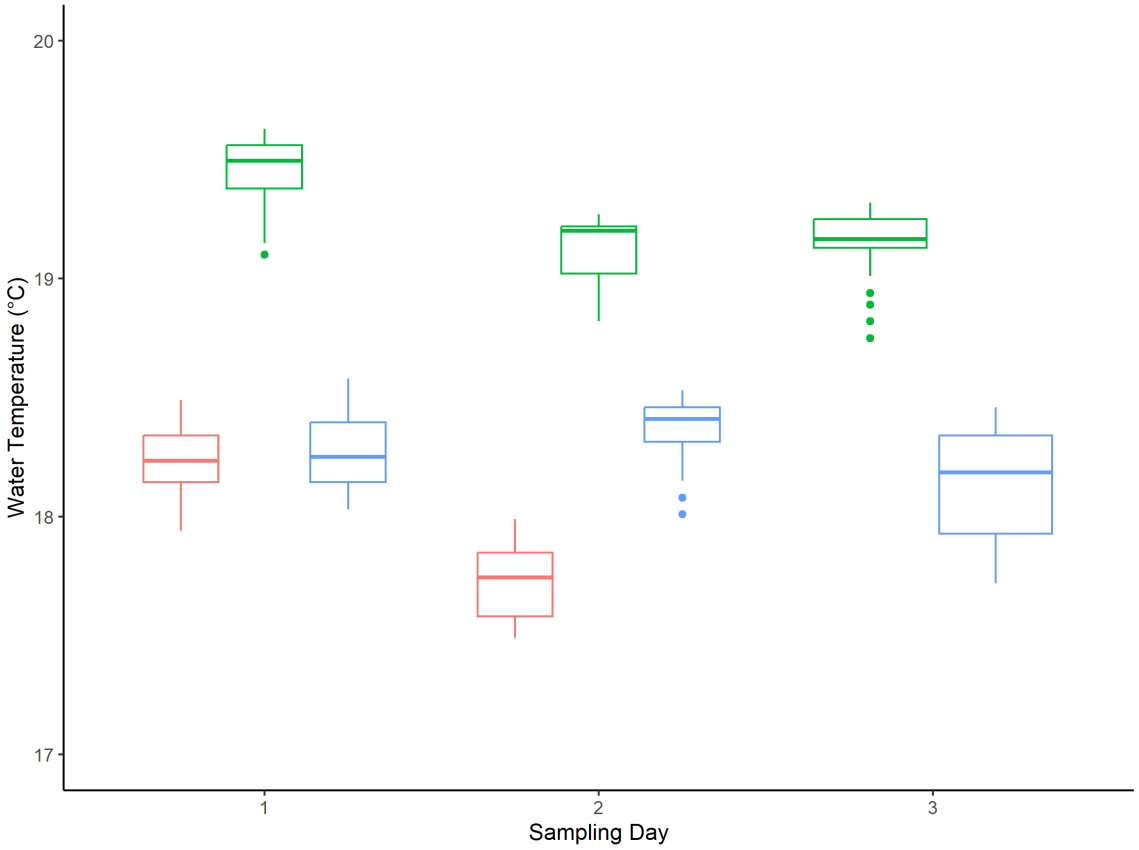

Figure 3. Observed water temperature (°C) between 2000 hours and 0200 hours for the lower Clark Fork River across sampling days for 2021 (red), 2022 (green), and 2023 (blue) collected from the Temperature Station 2 downstream of Foster Bar side-channel.

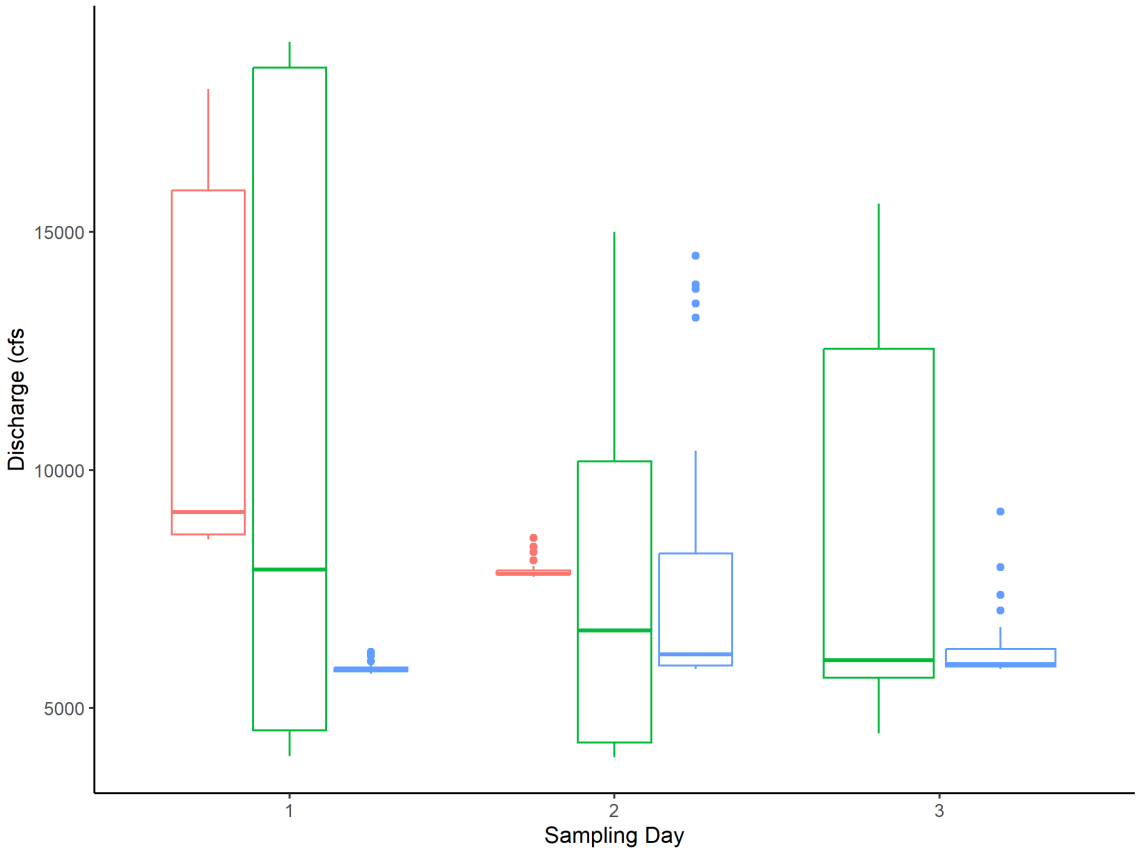

Figure 4. Observed discharge (cfs) between 2000 hours and 0200 hours for the lower Clark Fork River across sampling days for 2021 (red), 2022 (green), and 2023 (blue) collected from the USGS stream gage below Cabinet Gorge Dam.

We sampled 16 species and 1 hybrid during the 2023 relative abundance survey. A total of 381 individual fish were captured, the majority of which were Northern Pikeminnow *Ptychocheilus oregonensis*, Largescale Sucker *Catostomus macrocheilus*, Smallmouth Bass *Micropterus dolomieu,* Mountain Whitefish, and Brown Trout (Table 2). Due to the relatively new implementation of this project, only comparisons between years could be conducted. As more years of sampling are conducted relative abundance trends can be related to biotic and abiotic conditions within the lower Clark Fork River. There was no significant difference between years for most species ($P > 0.05$), however there was a significant difference between years for Rainbow Trout (RBT) (Kruskal–Wallis; $\chi 2 = 6.51$, $df = 2$, $P = 0.038$) (Table 3). Furthermore, the Conover-Iman post hoc test indicated that relative abundance of Rainbow Trout significantly decreased from 2022 to 2023 ($P = 0.008$) (Table 3; Figure 5). Black Crappie *Pomoxis nigromaculatus* and Kokanee *Oncorhynchus nerka* were observed for the first time during the relative abundance sampling (Tables 2 and 3). A wide range of size classes was observed for most species with the largest fish sampled being an 875 mm Northern Pike and the smallest being a 72 mm Smallmouth Bass (Table 2). The overall size of fish sampled was similar between the three years (Figures 5–13); however, there was a significant reduction in the proportion of fish less than 300 mm TL for Mountain Whitefish between years ($P = 0.02$) (Figure 7)

and fish under 200 mm TL for Largescale Sucker ($P < 0.001$) and Northern Pikeminnow ($P < 0.001$) (Figures 8 and 9). Distribution across sampling reaches varied among species with Northern Pikeminnow, Largescale Sucker, and Brown Trout sampled in most reaches (Table 4). Mountain Whitefish and Westslope Cutthroat Trout were less evenly distributed being observed in four of the eight sampling reaches (Table 4).

Table 2. Summary statistics for each species captured during September 2023 relative abundance sampling. Variables reported are number captured (n), min total length (mm), max total length (mm), mean total length (mm), and standard deviation of total length (SD TL; mm).

Species	n	Min TL	Max TL	Mean TL	SD TL
Northern Pikeminnow	100	84	660	297	86.57
Largescale Sucker	82	86	591	470	88.39
Smallmouth Bass	72	72	311	219	56.35
Brown Trout	33	155	473	353	75.62
Mountain Whitefish	26	290	432	376	37.35
Yellow Perch	21	121	196	156	23.80
Walleye	11	165	748	456	241.32
Black Crappie	10	152	186	171	11.55
Westslope Cutthroat Trout	9	288	434	339	47.05
Rainbow Trout	4	290	561	437	99.04
Largemouth Bass	3	112	121	116	3.74
Northern Pike	3	771	875	809	47.05
Westslope Cutthroat Trout x Rainbow Trout hybrid	3	412	550	476	56.84
Brown Bullhead	1	245	245	-	-
Kokanee	1	349	349	-	-
Peamouth	1	281	281	-	-
Tench	1	214	214	-	-

Table 3. Summary statistics for all species (Brown Bullhead [BBH], Black Crappie [BCR], Bull Trout [BLT], Brown Trout [BRN], Kokanee [KOK], Largemouth Bass [LMB], Largescale Sucker [LSS], Lake Whitefish [LWF], Mountain Whitefish [MWF], Northern Pike [NPK], Northern Pikeminnow [NPM], Peamouth [PEA], Rainbow Trout [RBT], Redside Shiner [RSS], Sculpin [SCL], Smallmouth Bass [SMB], Tench [TEN], Walleye [WAE], Westslope Cutthroat Trout [WCT], Westslope Cutthroat Trout x Rainbow Trout hybrid [WRHY], and Yellow Perch [YLP[) captured during the lower Clark Fork River relative abundance sampling efforts conducted in September of 2021, 2022, and 2023. Variables reported are relative abundance (CPUE [fish/minute]), and the standard devotion (SD) by year (2021, 2022, and 2023)

Species	CPUE 2021	SD 2021	CPUE 2022	SD 2022	CPUE 2023	SD 2023
BBH	0.05		0.14		0.03	
BCR	0.00		0.00		0.13	0.10
BLT	0.00		0.04		0.00	
BRN	0.17	0.16	0.28	0.19	0.21	0.10
KOK	0.00		0.00		0.03	
LMB	0.43	0.47	0.09		0.17	
LSS	0.61	0.27	0.49	0.36	0.56	0.38
LWF	0.04		0.00		0.00	
MWF	0.57	0.49	0.41	0.64	0.40	0.43
NPK	0.04		0.05		0.10	
NPM	0.61	0.38	0.93	1.02	0.64	0.51
PEA	0.20	0.15	0.08	0.01	0.04	
RBT	0.17	0.18	0.23	0.17	0.06	0.04
RSS	0.05		0.05	0.00	0.00	
SCL	0.00		0.04		0.00	
SMB	0.61	0.43	0.35	0.25	0.46	0.38
TEN	0.04		0.00		0.03	
WAE	0.13	0.06	0.16	0.06	0.10	0.06
WCT	0.14		0.21	0.15	0.09	0.08
WRHY	0.58		0.21	0.20	0.15	
YLP	0.35	0.43	0.31	0.16	0.21	0.11

Table 4. Summary statistics for each species (Northern Pikeminnow [NPM], Largescale Sucker [LSS], Smallmouth Bass [SMB], Brown Trout [BRN], Mountain Whitefish [MWF], Yellow Perch [YLP], Walleye [WAE], Black Crappie [BCR], Westslope Cutthroat Trout [WCT], Rainbow Trout [RBT], Largemouth Bass [LMB], Northern Pike [NPK], Westslope Cutthroat Trout x Rainbow Trout hybrid [WRHY], Brown Bullhead [BBH], Kokanee [KOK], Peamouth [PEA], and Tench [TEN]) captured during September 2023 lower Clark Fork River relative abundance sampling. Variables reported are number captured (n) and the proportion of each species captured for each section (i.e., 1–8).

Species	n	1	2	3	4	5	6	7	8
NPM	100	0.05	0.11	0.11	0.06	0.02	0.16	0.22	0.27
LSS	82	0.06	0.05	-	0.35	0.10	0.17	0.07	0.20
SMB	72	0.46	0.22	0.17	0.07	-	-	0.07	0.01
BRN	33	0.31	0.06	0.21	-	0.18	0.09	0.06	0.09
MWF	26	0.04	-	-	-	0.50	0.42	-	0.04
YLP	21	-	0.14	0.52	-	-	-	0.14	0.20
WAE	11	-	-	0.09	0.36	0.09	0.18	-	0.27
BCR	10	-	-	-	0.70	-	-	0.10	0.20
WCT	9	0.33	-	-	0.11	0.45	-	-	0.11
RBT	4	0.25	-	0.25	-	0.50	-	-	-
LMB	3	-	-	-	-	-	-	1.0	-
NPK	3	-	-	-	1.0	-	-	-	-
WRHY	3	-	-	-	-	1.0	-	-	-
BBH	1	-	-	-	1.0	-	-	-	-
KOK	1	1.0	-	-	-	-	-	-	-
PEA	1	-	-	-	-	-	-	-	1.0
TEN	1	-	-	-	1.0	-	-	-	-

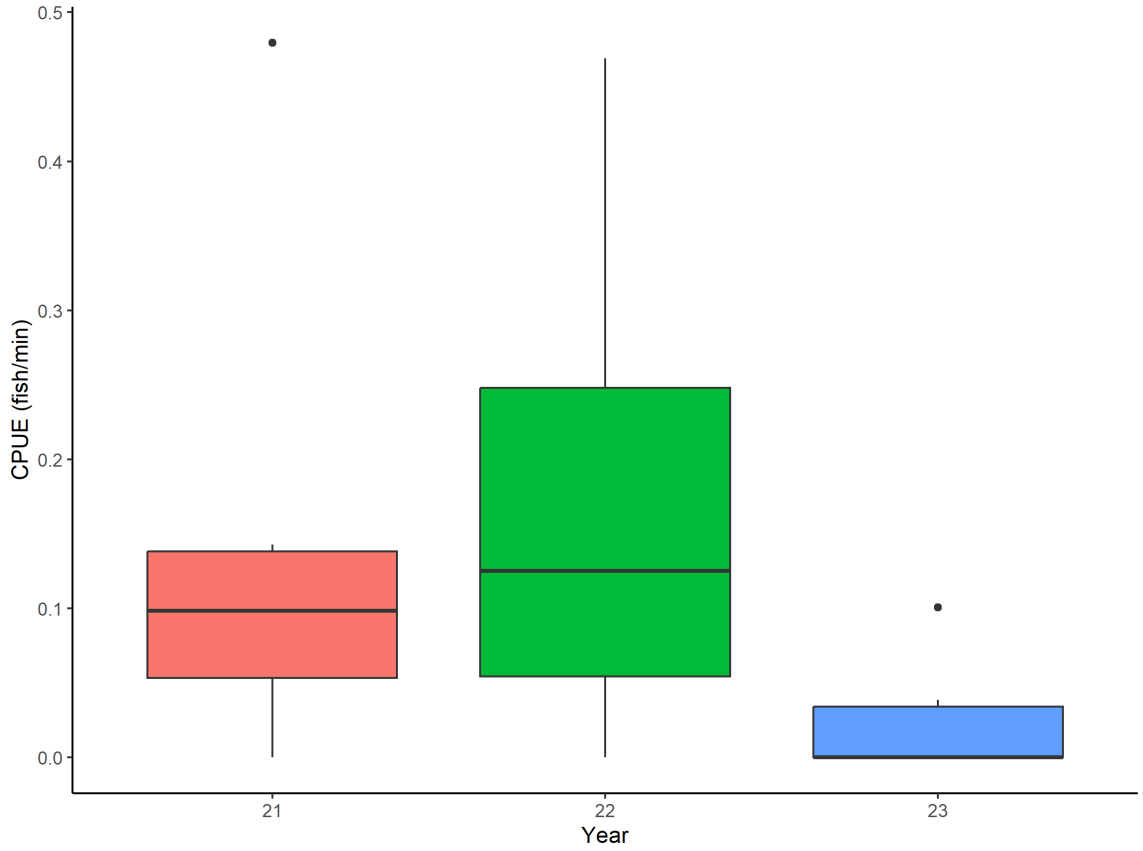

Figure 5. Relative abundance trends for Rainbow Trout captured during September electrofishing in the lower Clark Fork River. Sampling occurred in 2021 (red), 2022 (green) and 2023 (blue).

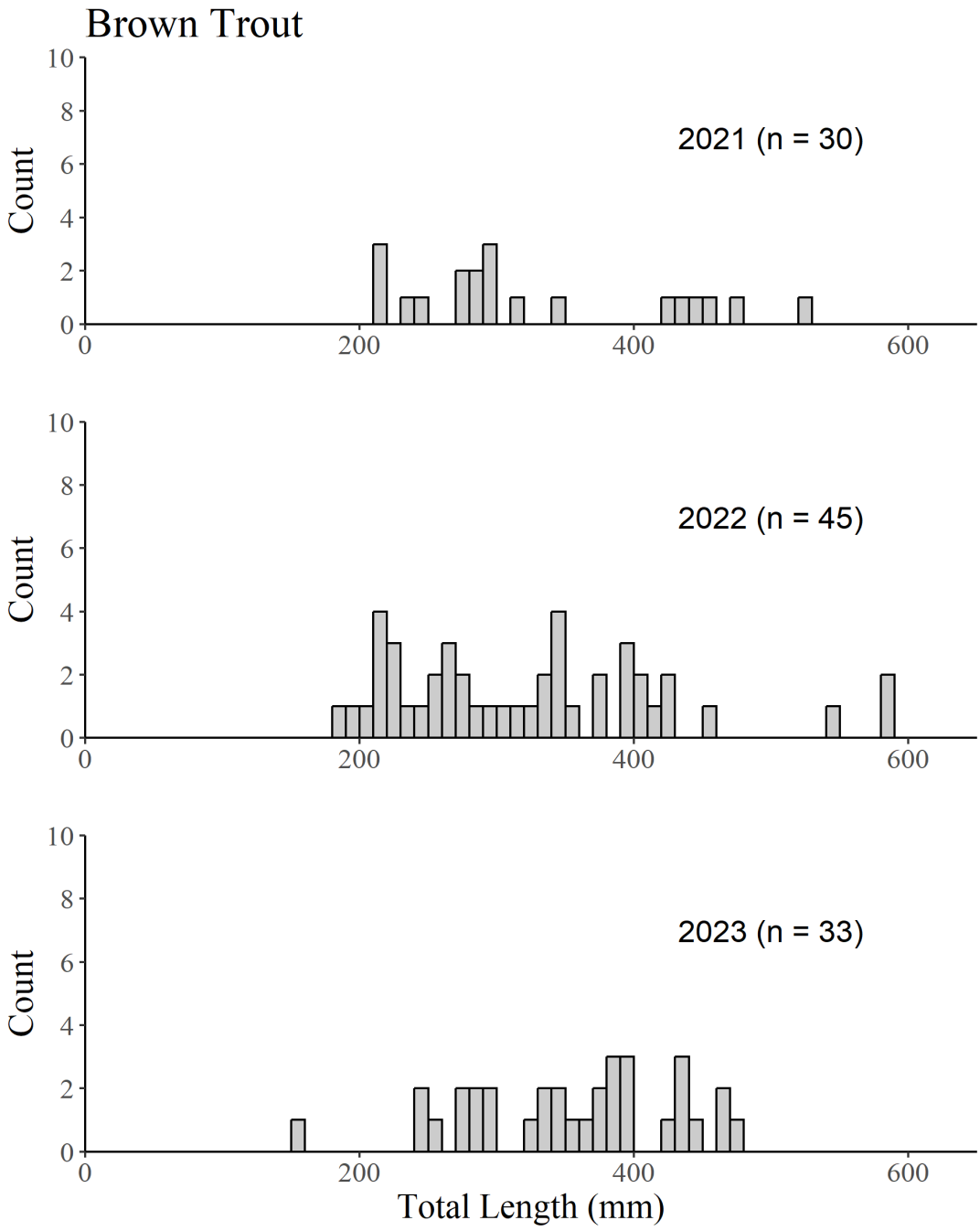

Figure 6. Length-frequency histogram for Brown Trout captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (top panel), 2022 (middle panel) and 2023 (bottom panel).

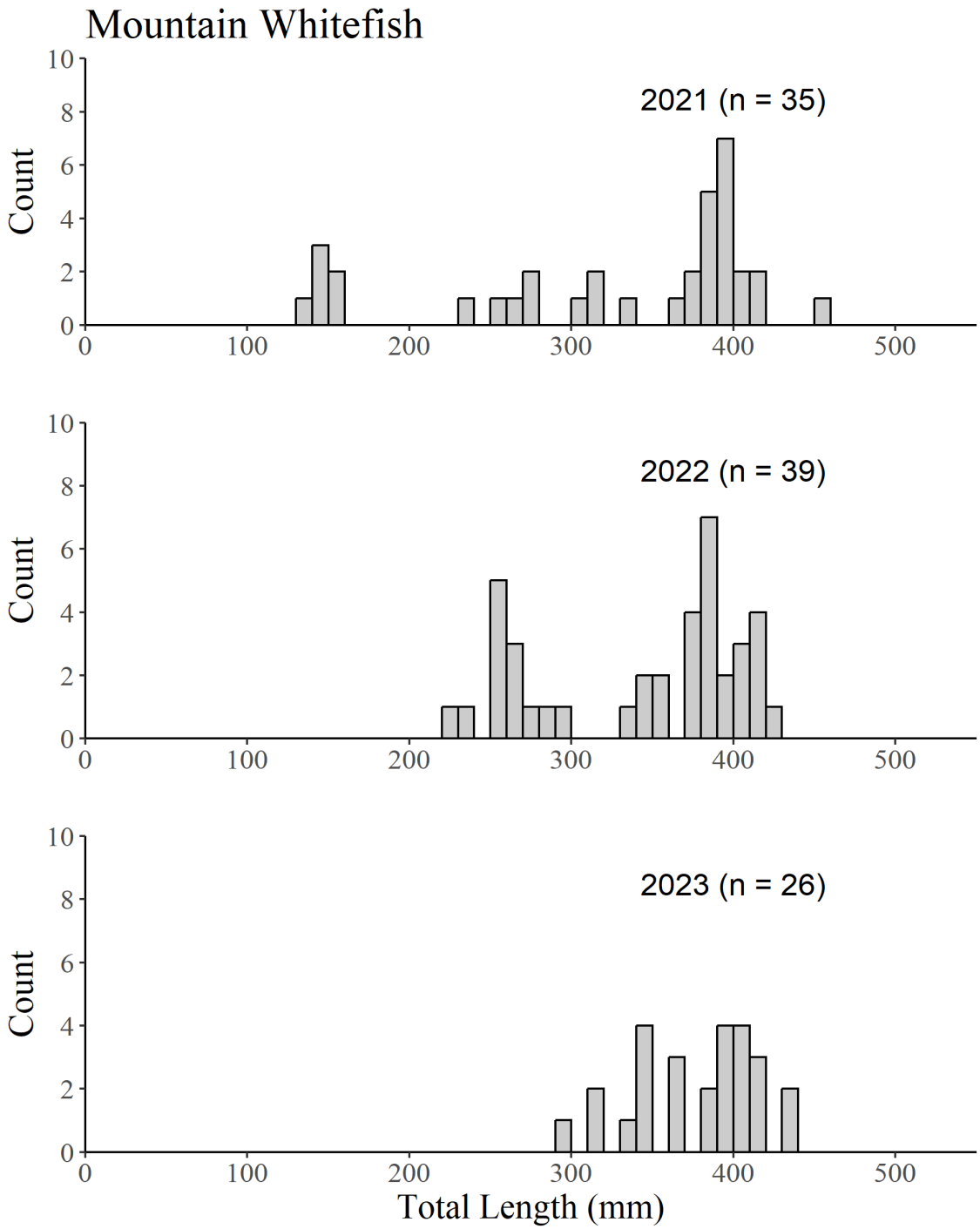

Figure 7. Length-frequency histogram for Mountain Whitefish captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (top panel), 2022 (middle panel) and 2023 (bottom panel).

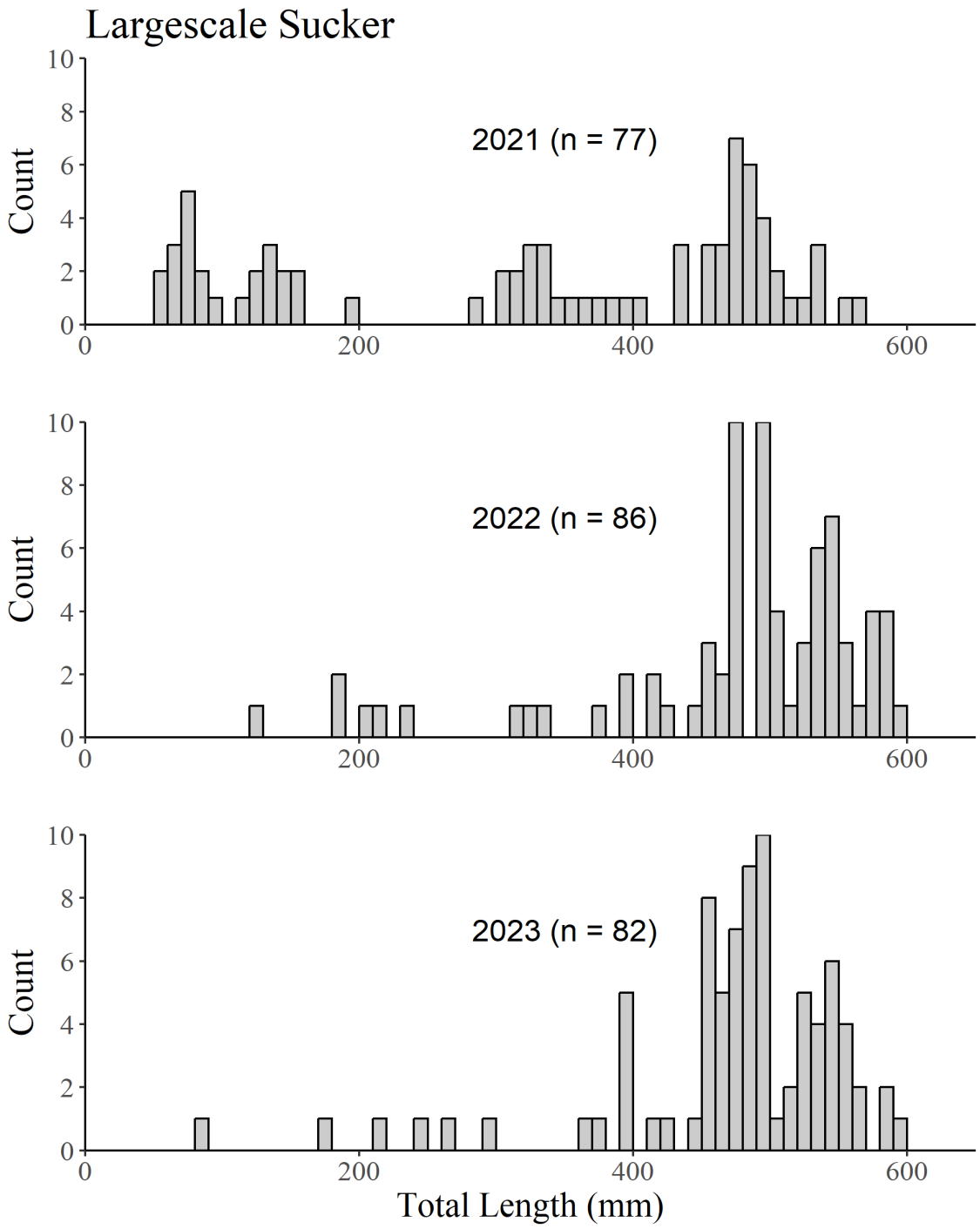

Figure 8. Length-frequency histogram for Largescale Sucker captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (top panel), 2022 (middle panel) and 2023 (bottom panel).

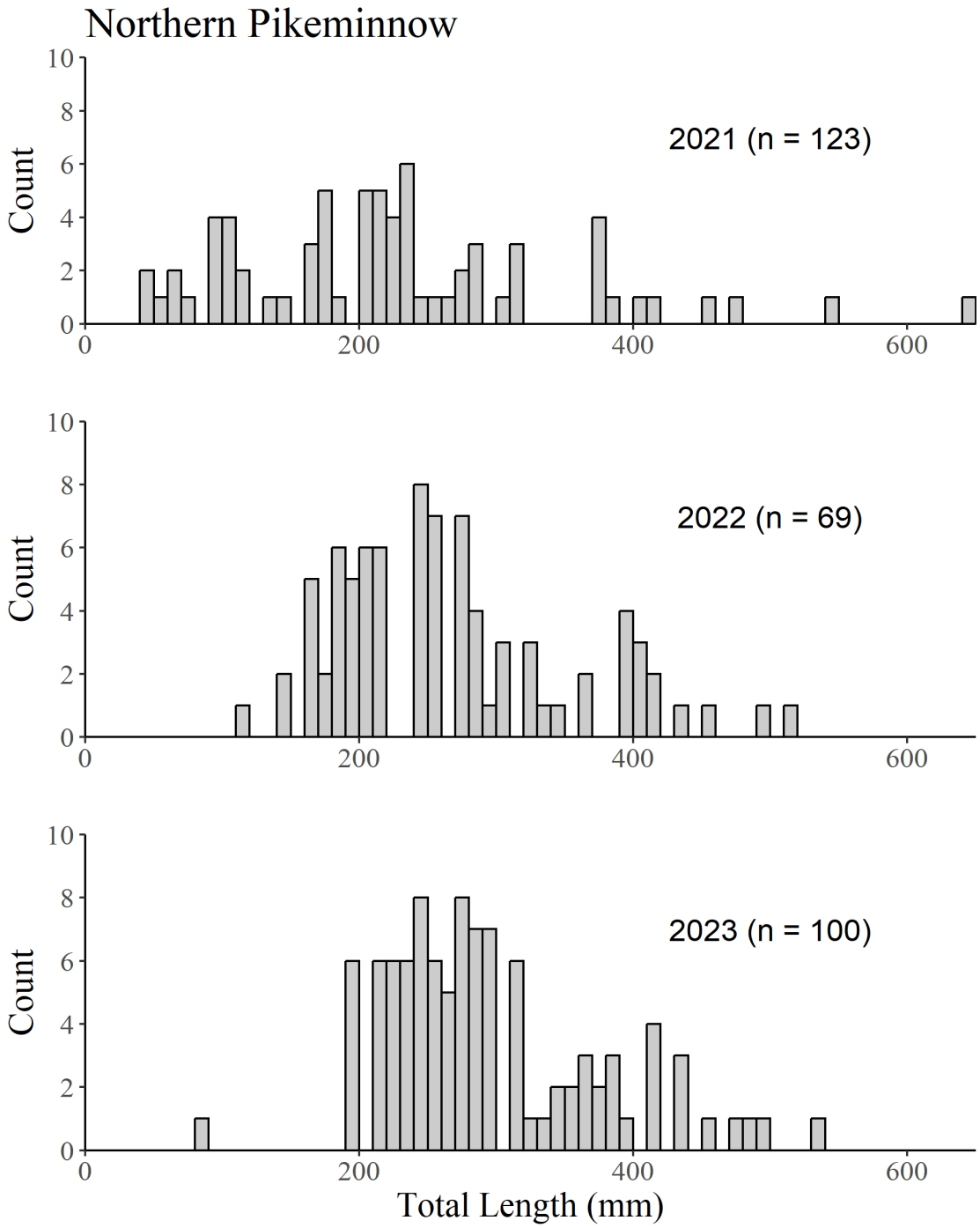

Figure 9. Length-frequency histogram for Northern Pikeminnow captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (top panel), 2022 (middle panel) and 2023 (bottom panel).

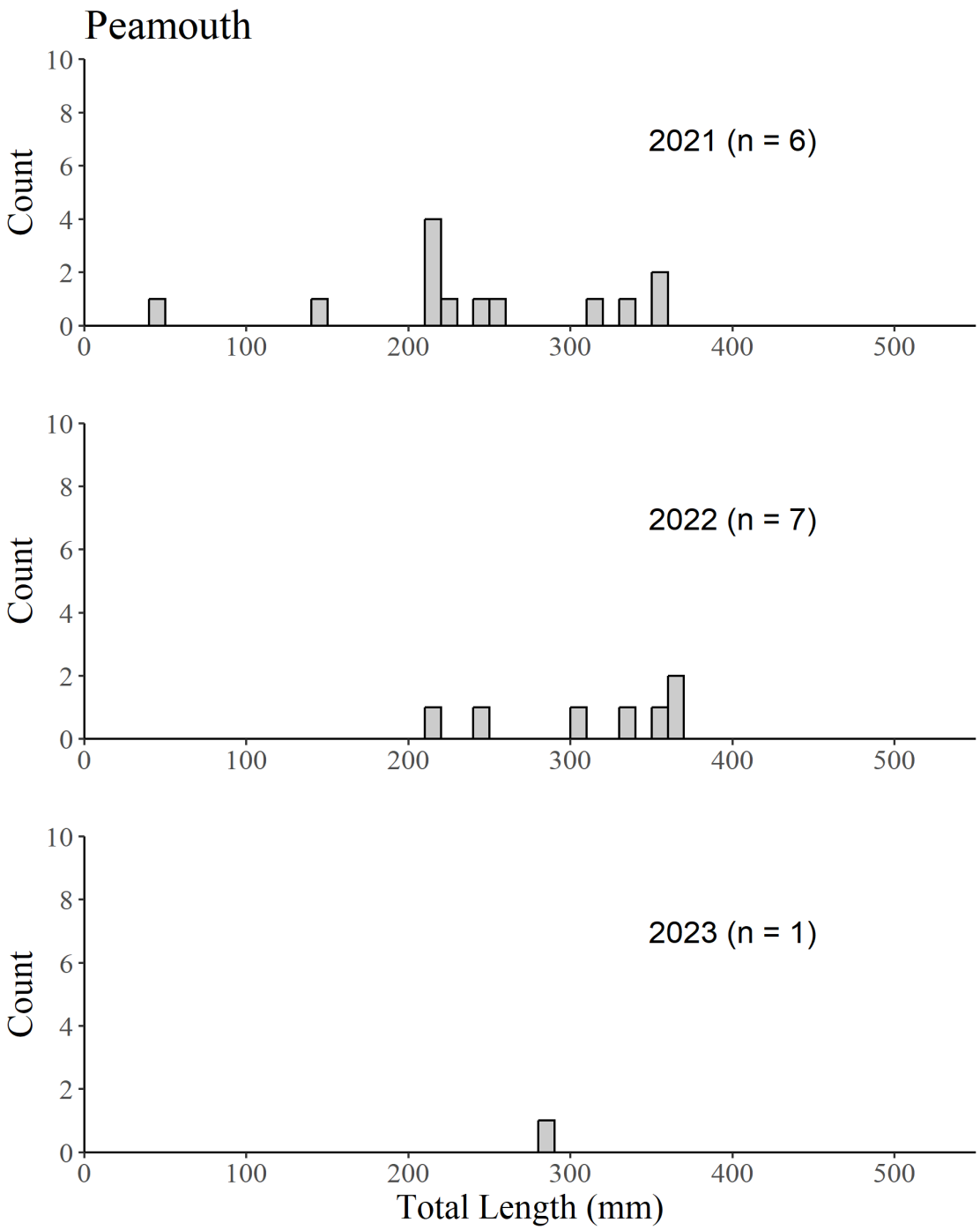

Figure 10. Length-frequency histogram for Peamouth captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (2022; top panel), 2022 (middle panel) and 2023 (bottom panel).

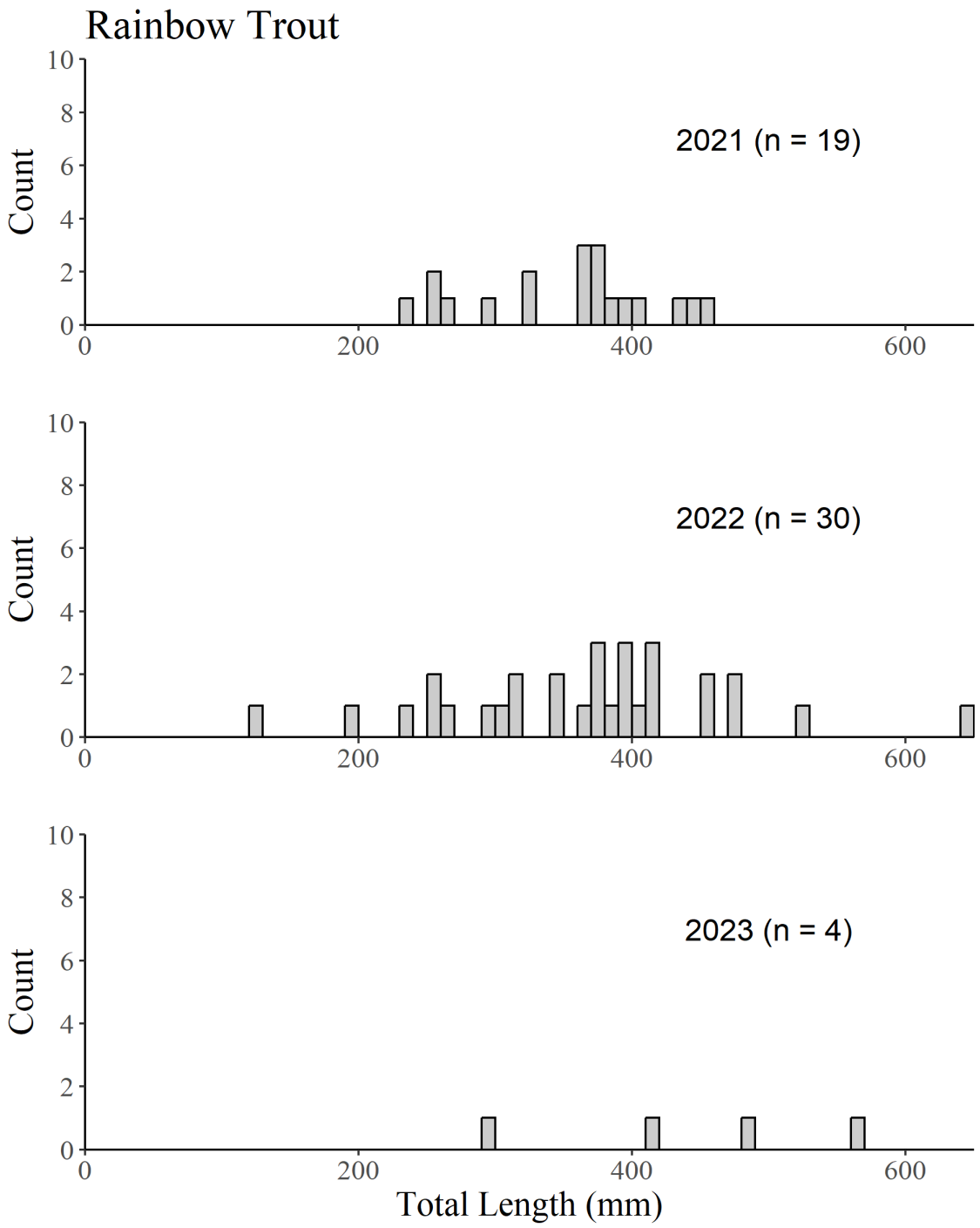

Figure 11. Length-frequency histogram for Rainbow Trout captured in September in the lower Clark Fork River relative abundance monitoring during 2021, 2022 (middle panel) and 2023 (bottom panel).

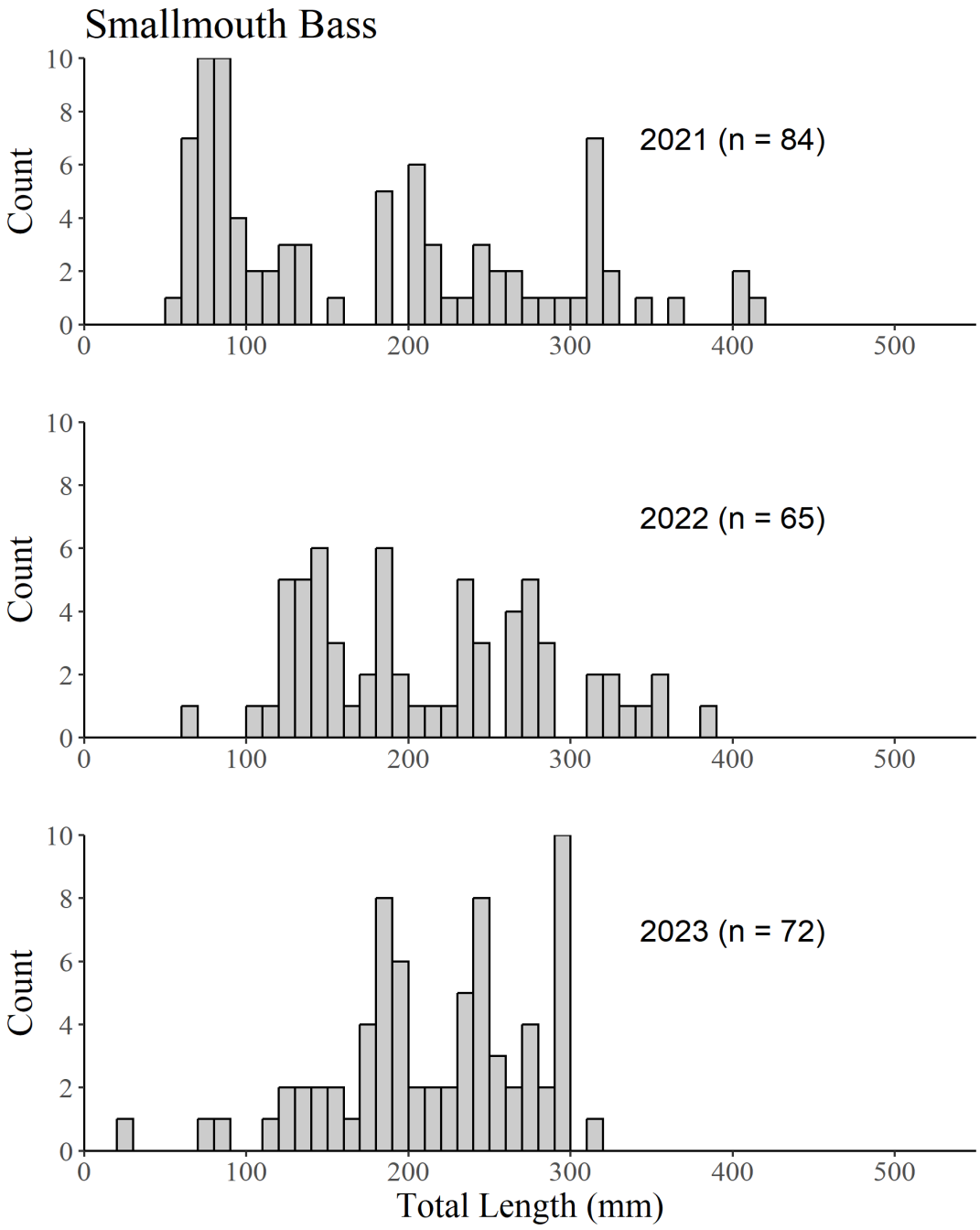

Figure 12. Length-frequency histogram for Smallmouth Bass captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (top panel), 2022 (middle panel) and 2023 (bottom panel).

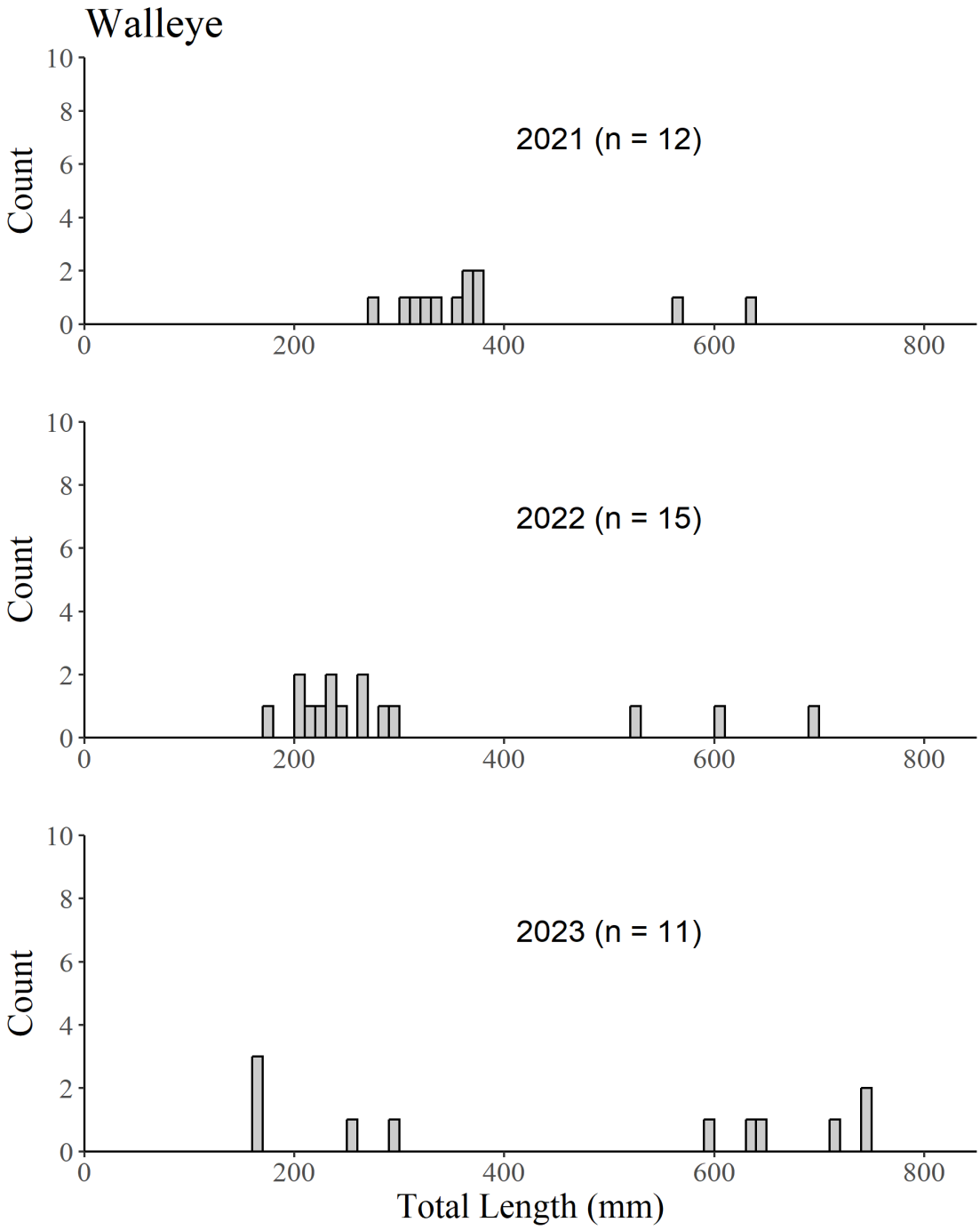

Figure 13. Length-frequency histogram for Walleye captured in September in the lower Clark Fork River relative abundance monitoring during 2021 (top panel), 2022 (middle panel) and 2023 (bottom panel).

The significant decrease in RBT relative abundance could be a response from changes in species composition or related to changing catchability, fish behavior, or environmental conditions between years (Table 1, Figures 3-4). The overall assemblage relative abundance changes from 2022 to 2023 resembled a relatively stable fish community, except for the reduction in RBT. However, relative abundance is a coarse tool for monitoring abundance and another year of mark-recapture abundance estimates is recommended to determine if the appeared reduction in abundance of RBT is occurring or if it is related to changes in sampling efficiency (i.e., differing flows during relative abundance sampling years).

The reduction of smaller size classes for Northern Pikeminnow, Largescale Sucker, and Mountain Whitefish is not entirely specific to the lower Clark Fork River. Nearshore netting conducted on Lake Pend Oreille on a three-year rotation has demonstrated a similar phenomenon for Peamouth (Birdsall and Ransom 2023). The reduction of smaller Peamouth in Lake Pend Oreille is hypothesized to be related to increasing predation by invasive Walleye and Northern Pike as observed in Noxon and Cabinet Gorge reservoirs and other systems (Vander Zanden and Vadeboncoeur 2002; Scarnecchia et al. 2014; Mumby et al. 2018; Rehm et al. 2023). The truncated size structure of these three species in the lower Clark Fork River may be related to increased predation, inconsistent recruitment, or varying rearing habitat (i.e., the perceived reduction in macrophyte growth). Continued relative abundance sampling is warranted to monitor the shifting size composition of these species and assess if it is related to alterations of species composition, inconsistent recruitment, or environmental change.

RECOMMENDATIONS

1) Continue relative abundance monitoring on the lower Clark Fork River in 2024.
2) Repeat mark-recapture sampling in 2024 as part of the standard 3-year sampling rotation to assess the possible change in abundance of RBT.

ACKNOWLEDGEMENTS

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