

Relative Abundance of Fish Populations in the Swan River: Snorkel Census 2014 – 2019



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Introduction

This report reviews the relative abundance of fish populations in the upper Swan River of Montana (Figure 1). The upper Swan River is defined as the 89 kilometer length (55.3 miles) from Lindbergh Lake to Swan Lake. Following pilot studies in 2014 and 2015, we determined that visual observation (snorkel surveys) is an effective sampling technique (Gardner and Stephens 2015) to understand spatial distribution across the river, monitor changes over time, search for large bodied/migratory Westslope Cutthroat Trout. The Flathead National Forest, Swan Valley Connections (previously called Northwest Connections), and Montana Fish, Wildlife & Parks (FWP) jointly conducted snorkel surveys in 2014, 2015, 2016 and 2019.

Native species in this river include Westslope Cutthroat Trout, *Oncorhynchus clarkii lewisi*, Bull Trout, *Salvelinus confluentus*, Mountain Whitefish, *prosopium williamsnoni*, Finescale Suckers *Catostomus catostomus*, Largescale Sucker *Catostomus macrocheilus*, Northern Pikeminnow, *Ptychocheilus oregonensis*, Redside Shiners, *Richardsonius balteatus* and an undescribed Sculpin species (*Cottidae*). Sculpins have traditionally assumed to be Mottled Sculpin but recent range-wide genetic sampling casts uncertainty on Swan River Valley distribution (Young et al 2013). Non-native species include include Rainbow Trout, *Oncorhynchus mykiss*, Brook Trout, *Salvelinus fontinalis*, hybridized *Oncorhynchus* and *Salvelinus* (Brook x Bull Trout and Rainbow x Cutthroat Trout) and Brook Stickleback *Culaea inconstans*. Lake Trout, *Salvelinus namaycush*, have been periodically captured in the river by anglers but never observed in this effort. We believe lake trout use of the river to be episodic.

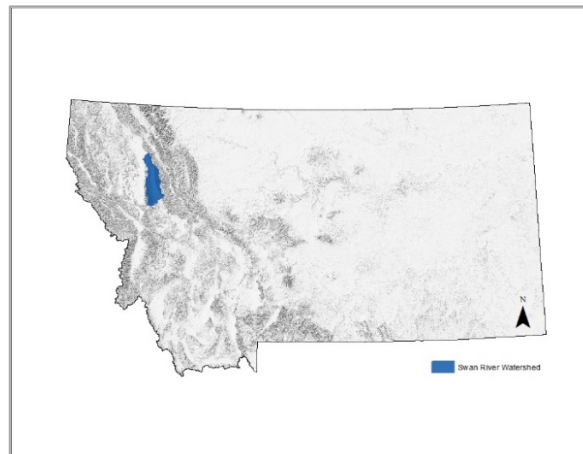


Figure 1. The Swan River Watershed.

Methods

Prior to sampling, a Forest Service hydrologist and fisheries biologist delineated the Swan River into reaches based on gradient, sinuosity and braiding observed from aerial imagery and GIS. A total of 15 reaches of varying lengths were identified. The reaches were assigned alphabetical names beginning with Reach A at the confluence with Swan Lake, to the Reach O to the outlet of Lindbergh and Cygnet Lake. The attached Appendix describes the location of each reach. Thirteen of 15 reaches were selected for fish population inventory while 2 were deferred due to short lengths. Within each of the 13 reaches, a smaller subset was sampled as shown on Figure 2. Sample areas varied from 258 meters to 2,723 meters in length, averaging around 786 meters. Divers examined all areas, including backwaters and side channels, as much as feasible but shallow riffles and hazardous areas were deferred. This undoubtedly resulted in bias towards species that occupy pools instead of riffles. Most sampled reaches had upstream and downstream locations flagged prior to work and divers only worked in those areas. However data collected by FWP in 2019 had much longer downstream floats than other surveys.

To standardize survey techniques divers practiced and reviewed snorkeling techniques including identification, size categorization, and safety prior to performing surveys. Fish length was sorted into four categories: < 10 centimeters, 10 – 20 centimeters, 20 – 30 centimeters, and > 30 centimeters. Fish were only counted when divers had confidence in species or at least genus. Divers could assign a fish to just “*Oncorhynchus*” if the fish appeared to be hybridized or identity was too uncertain. It is acknowledged that correctly identifying *Oncorhynchus* species based on morphology alone is impossible but that error is assumed to be tolerable for this project. Divers could also use “*Salvelinus*” when uncertain if an individual was a Bull Trout, Brook Trout, or hybridized Bull x Brook, however this was uncommon. Divers generally had much more confidence in identifying *Salvelinus* species than *Oncorhynchus*. Suckers were too challenging to identify to species while snorkeling, so divers just counted “*Catostomus*.”

Seven sample areas have had at least one replication monitoring with consistent start/stop locations and diel period (mid-day). Based on Gardner and Stephens (2015) pilot work, we selected early August as the best sampling period. Reaches C, D, K and M were sampled in 2014 and 2019. Reach A was sampled in 2015 and 2019 while Reach L was sampled in 2014, 2015 and 2019. Reach G was sampled all four years. The net of all sampled reaches were averaged into one value per year. Normally 4 divers snorkeled the area at similar pace but it was not precise. In order to standardize effort, the number of divers was multiplied by duration of survey to yield “diver minutes.” This allows trend data per unit effort.

Most surveys included a visual estimate of the percentage of the surface area that was a pool/glide contrasted to surface area of riffles. Pools/glides were generally deeper and slower velocities but no quantitative protocols were used. Observed fish were assigned to either a pool/glide or a riffle. Data collected by Montana FWP in 2019 did not distinguish habitat types so all observations were assumed to be pool/glide. Other habitat descriptions included general characteristics of substrate and water clarity. Water temperature was provided by Swan Valley Connections from a separate study. These data consisted of hourly measurements in submerged loggers that were then calculated to find the Maximum Weekly Average Temperature (average daily temperature of seven warmest consecutive days).

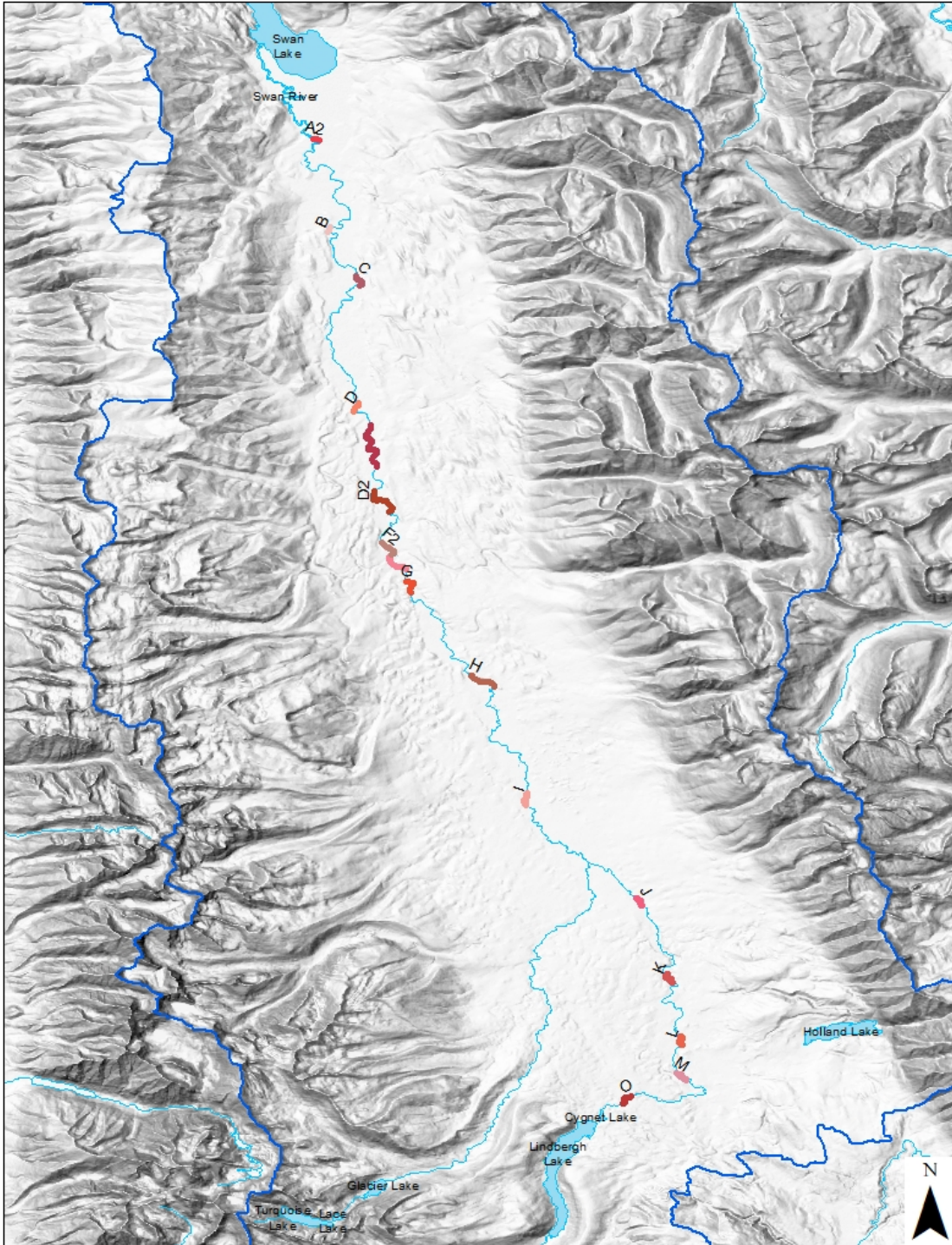


Figure 2. Swan River Sampled Reaches. Reach A begins at the confluence of Swan River and Swan Lake moving upstream to Reach O, ending at the headwaters of the Swan River. Red sections are where snorkel surveys were performed. Reaches with more than one sample are delineated with number suffix, eg. D1, D2

Results and Discussion

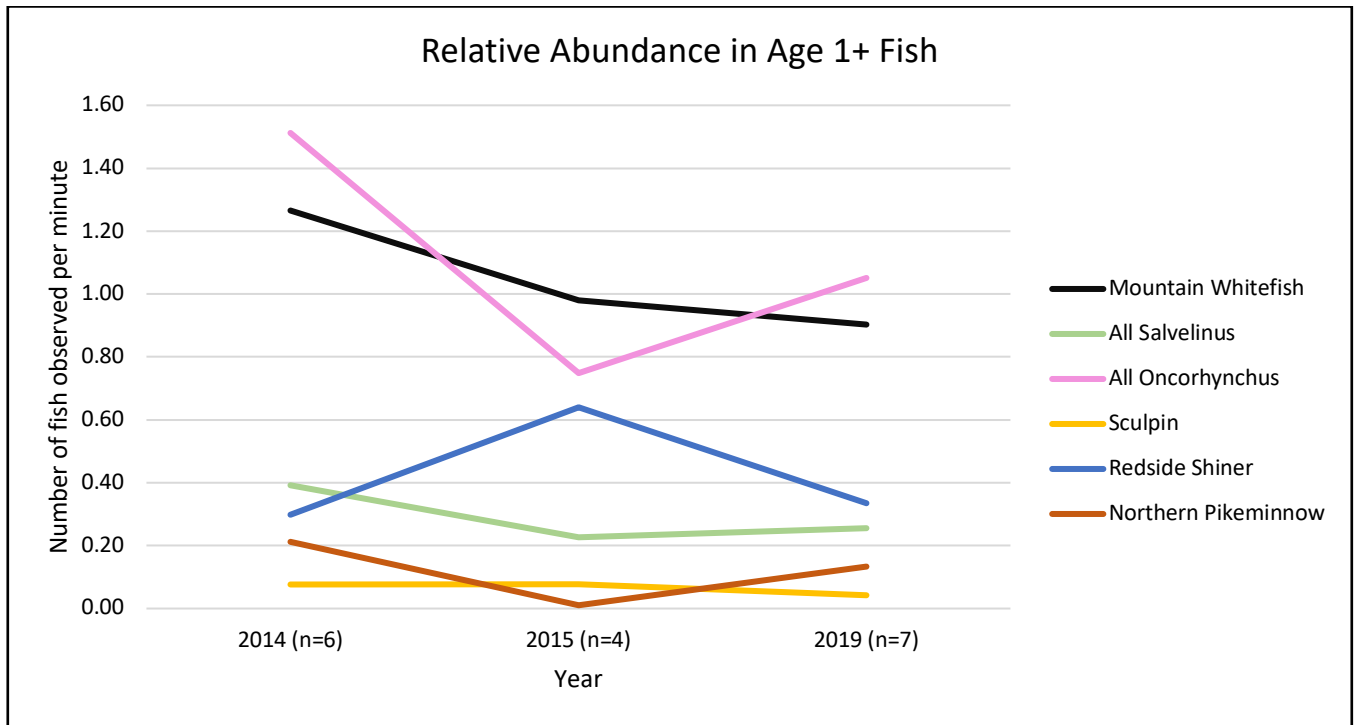
A total 22,000 meters of river surveyed over the four years, resulting in 7,138 fish observations. Table 1 summarizes all fish observations during August sampling periods. Mountain Whitefish were the most numerous (36.8 percent) of all fish observed. When undetermined *Oncorhynchus* and undetermined *Salvelinus* fish are removed, divers tallied 1,697 trout. Rainbow Trout are the most abundant trout (63 percent of total), followed by Brook Trout (21 percent), Westslope Cutthroat Trout (8 percent), Bull Trout (6 percent) and Brook x Bull Trout hybrids (2 percent). Undetermined *Oncorhynchus* and *Salvelinus* could be either native or non-native species. When they are removed from the dataset, 77.6 percent of fish observed were native species.

Table 1. Total observations for all August samples 2014-2019. Species listed in descending abundance. Percentage values are rounded to nearest whole number.

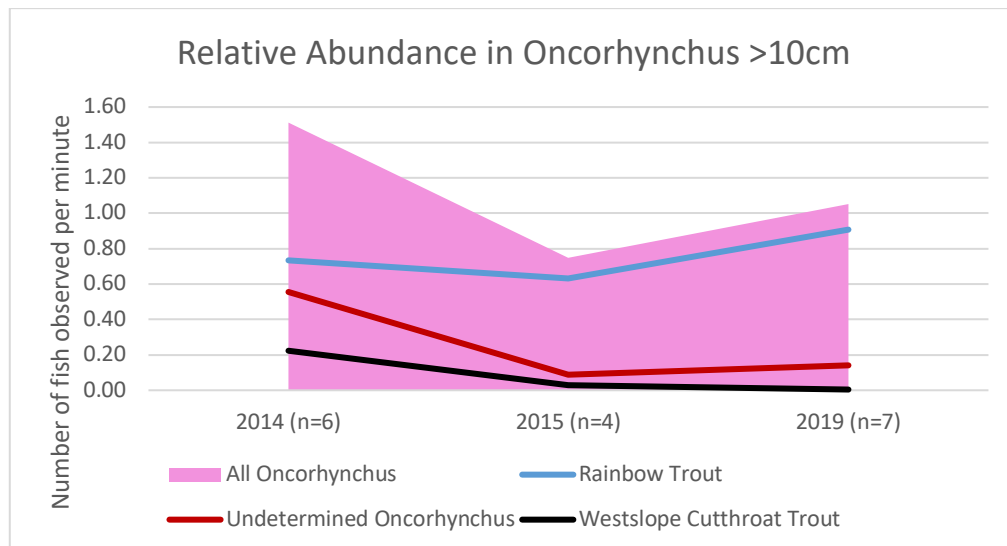
Species	Total Observed	Avg Density (fish per 100 sq m)	Percentage <10cm	Percentage >10cm	Percent Observed in Pools (all sizes)
Mountain Whitefish	2477	0.763	47	53	71
Undetermined <i>Oncorhynchus</i>	1684	0.474	66	34	69
Rainbow Trout	1161	0.363	14	86	77
Redside Shiner	612	0.442	95	5	95
Brook Trout	416	0.125	22	78	85
<i>Cottus</i> spp.	186	0.045	96	4	13
Northern Pikeminnow	161	0.096	6	94	100
Westslope Cutthroat Trout	152	0.033	23	78	64
Bull Trout	109	0.0	0	100	83
Brook stickleback	90	0.012	100	0	100
Brook x Bull Trout hybrid	32	0.006	0	100	94
Undetermined <i>Catostomus</i>	32	0.008	28	72	78
Undetermined <i>Salvelinus</i>	26	0.005	15	85	73

Relative abundance for all species has fluctuated over time but no clear trend is observed. Figure 3 shows overall trends of the 7 monitored reaches. Because only one reach was sampled in 2016, that year is not included. Because of excessive variability in observing young-of-year fish, Figure 3-5 only displays fish that are assumed to be at least one year old. Other than Redside Shiner and *Cottus*, fish under 10cm are assumed to be less than one year old. Figure 6 provides total percentage of each species for each year (all reaches, all sizes). Westslope Cutthroat Trout were uncommon in all years and may be declining. In 2014, Westslope Cutthroat Trout accounted for 5% of all observations but declined to just 2% in 2015 and then 1% in 2019. However, due to difficulty in visually distinguishing this species from Rainbow Trout we are uncertain if this is a real change.

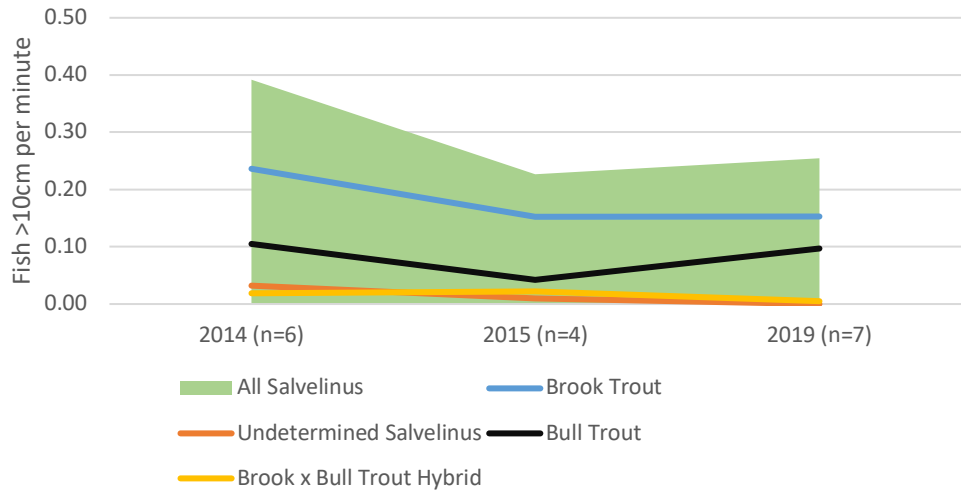
Figure 3. Trends in age 1+ fish numbers per diver minute. All 7 monitored reaches are averaged together. All *Salvelinus* species are combined in this chart, as are *Oncorhynchus*. Brook stickleback and *Catostomus* were uncommon and not shown.



Figures 4 and 5. Trends in age 1+ fish (greater than 10cm) for *Oncorhynchus* and *Salvelinus* genus, respectively. Shaded areas represent sum of all individual species.



Relative Abundance of Salvelinus >10cm



Swan River Snorkel 2014 - 2019: Fish / 100 m²

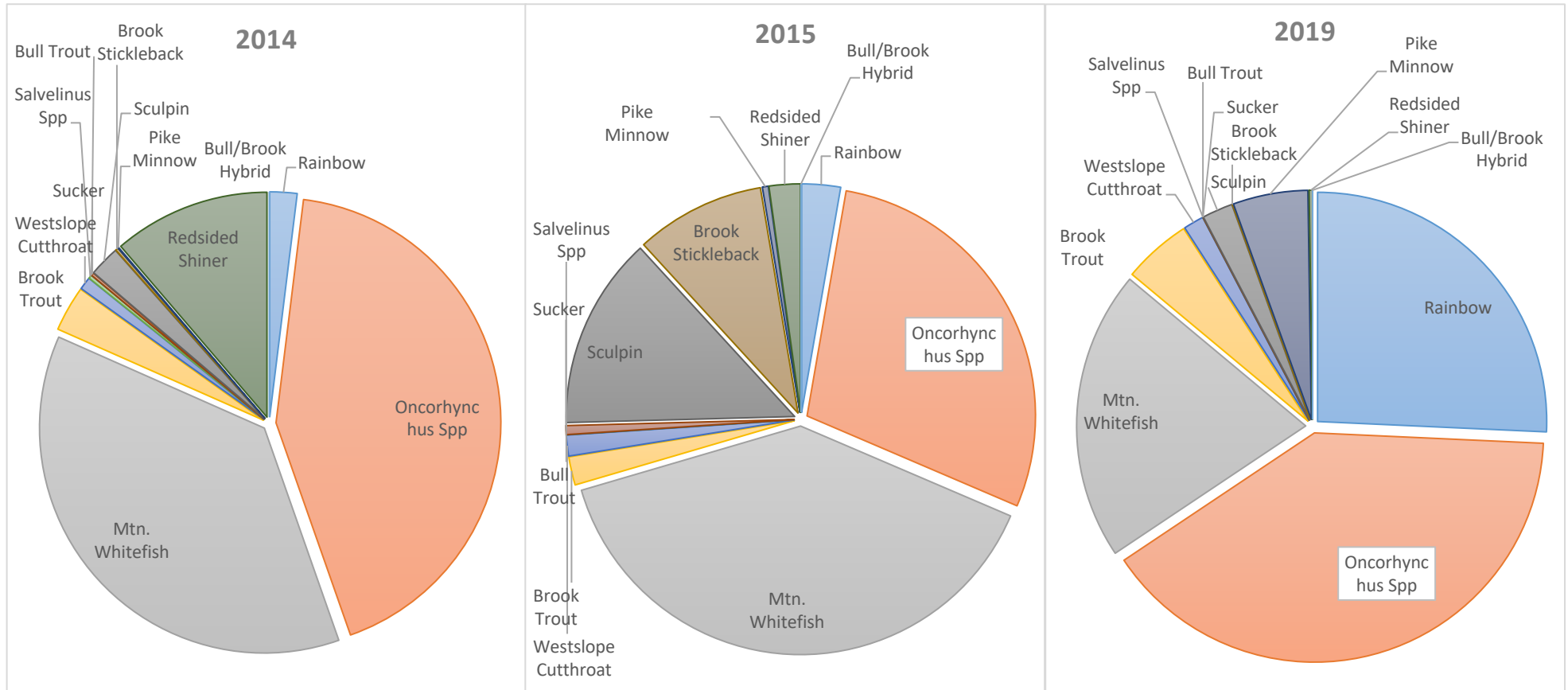
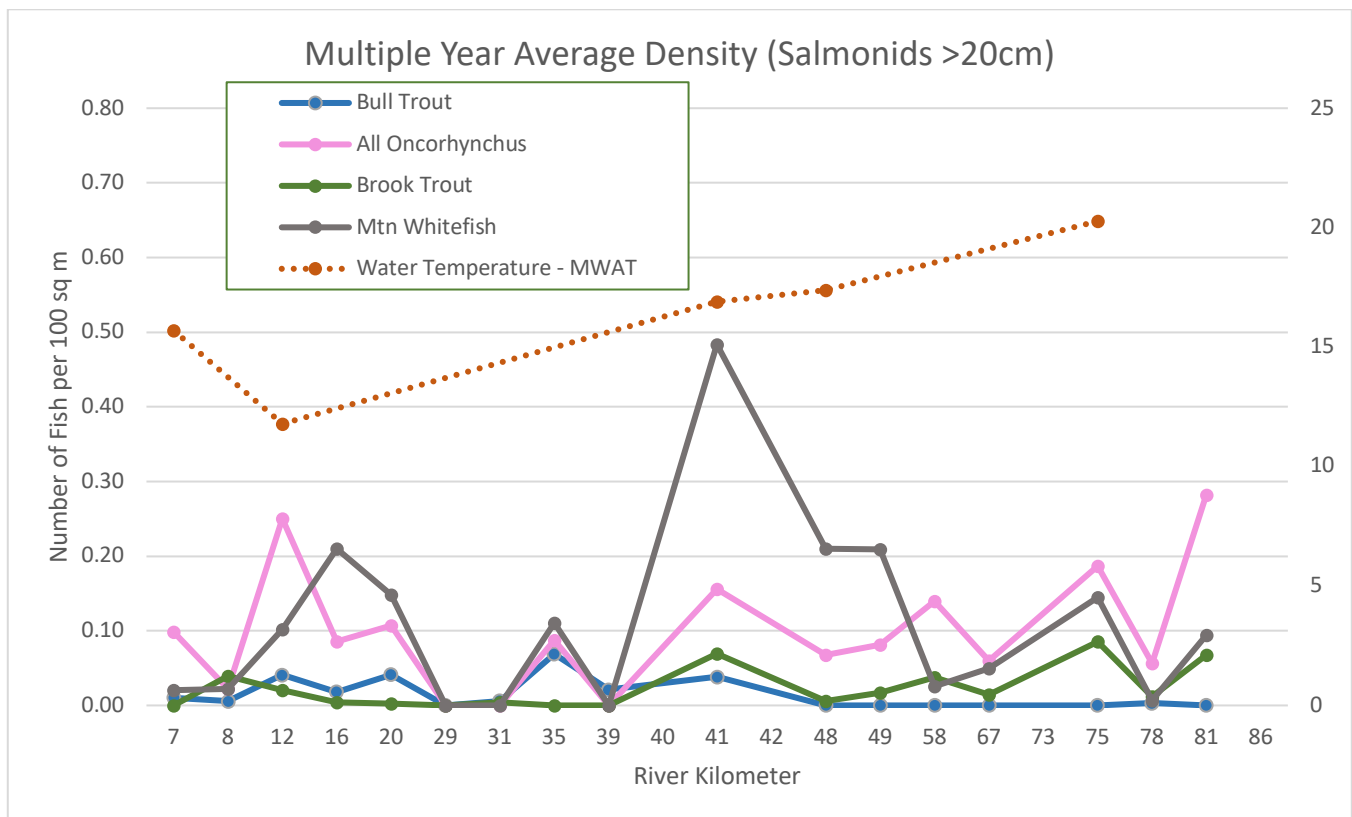


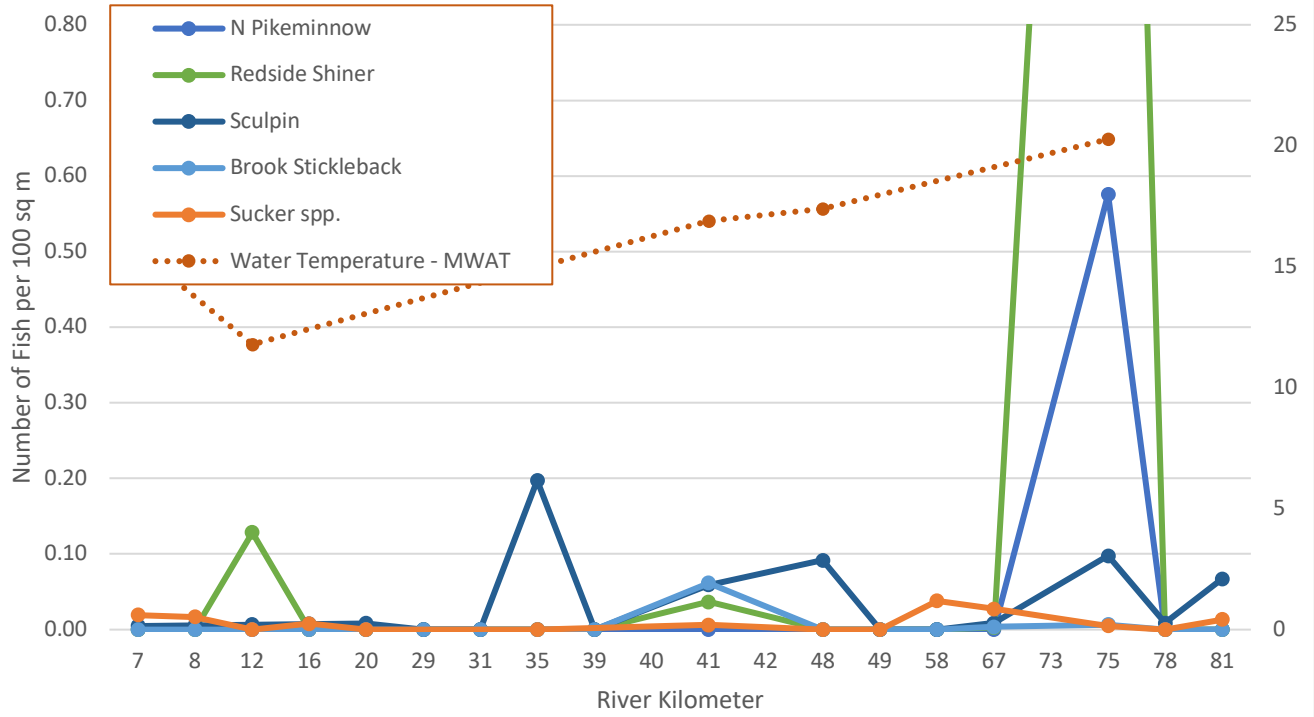
Figure 6. Distribution of fish species observed during Swan River Snorkel Surveys from 2014, 2015 and 2019.

Data indicates that fish are unequally distributed throughout the Swan River. The majority of fish species and individuals were observed were in the upper half of the river (Figure 7 and 8). These charts convert sampling locations into riverine kilometer markers, with kilometer 0 at Swan Lake. For example, Porcupine Bridge is at kilometer 7, Piper Creek Bridge at kilometer 48 and Kraft Creek Bridge at kilometer 75. The Swan River fish population seems to change around kilometer 40 (near Piper Creek confluence). We observed more Brook Trout in the upper half than lower while Bull Trout were only found below kilometer 48. We speculate that water temperature is the key factor in this distribution. Note that the Swan River is unusual in that the lower portions of the river are much colder than the headwaters. This is presumably due to the influx of considerable groundwater.

Figures 7 and 8. Average density of Salmonids >20cm and average density of non-game fish observed throughout the Swan River Snorkel in all reaches, all years. All *Oncorhynchus* observations, regardless if exact species is identified, are combined in this figure. Redside Shiner density at Kilometer 78 was 2.59 fish per 100 sq m and exceeded chart scale. A multiple year average of MWAT (Celsius) at five bridge crossings is superimposed with a secondary scale on the right side.



Multiple Year Average Density (non-game species)



Rainbow Trout are very common in the Swan River and presumed to be the primary recreational fishery. Figure 9 details their distribution, averaged for all years. During this study, harvest of all Rainbow Trout downstream of Piper Bridge (approximately 41 Km) was prohibited. However the distribution of catchable size (we assume >20cm) and memorable size (>30cm) is fairly consistent throughout the river and suggests that restricting harvest was not needed to maintain the fishery. Juvenile Rainbow Trout (<10cm) tend to be more abundant upstream of Kilometer 75 (Kraft Bridge) and this suggests the importance of the upper portion of the river for reproduction.

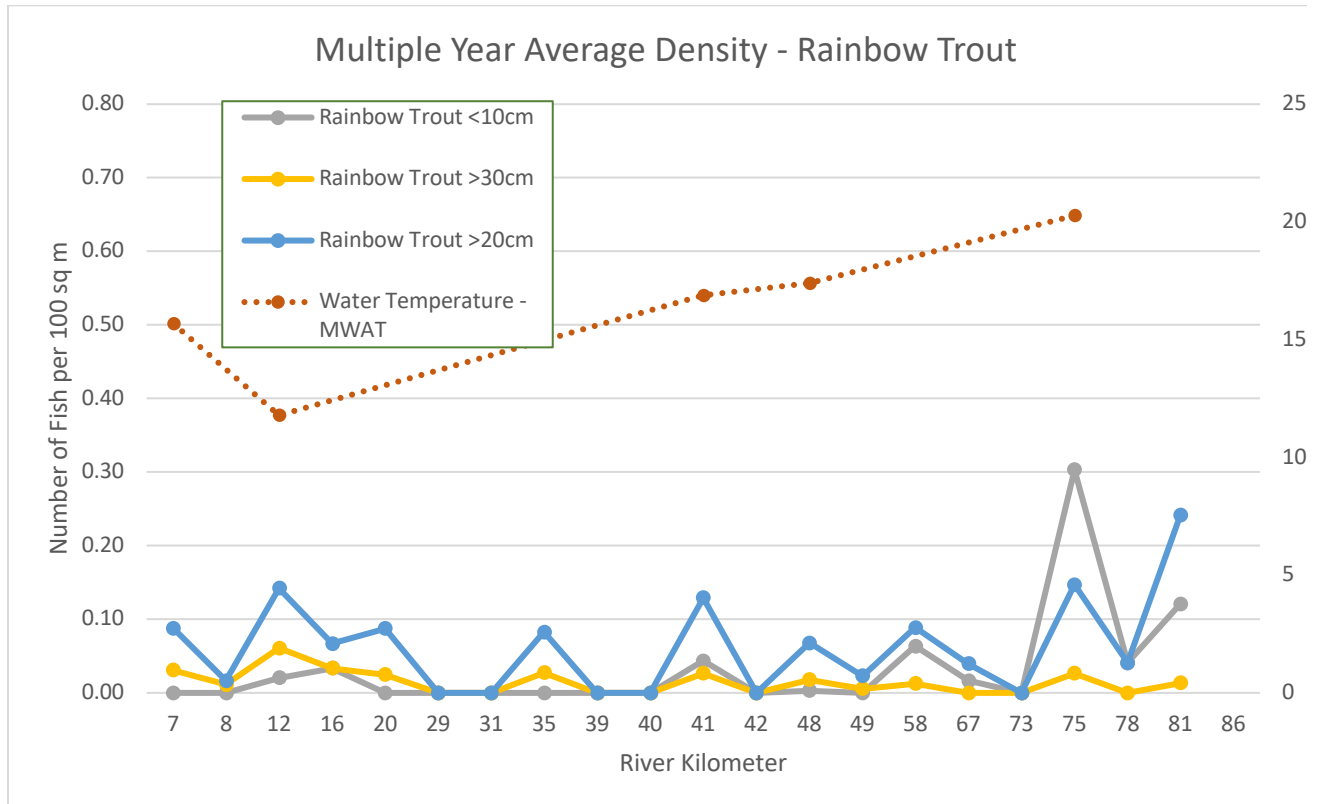


Figure 9. Spatial distribution of rainbow trout, all years.

Works Cited

Gardner, B. and A. Stephens. 2014. 2014-2015 Swan River Snorkel Census. Report to the Swan Native Fish Committee. Flathead National Forest. Unpublished report. 8 pages.

Young, M.K., K.S. McKelvey, K.L. Pilgrim and M.K. Schwartz. 2013. DNA Barcoding at riverscape scales: assessing biodiversity among fishes of the genus *Cottus* (Teleostei) in northern Rocky Mountain streams. *Molecular Ecology Resources* 13: 583-595. doi: 10.1111/1755-0998.12091

Appendix

Swan River Reach Delineation from Aerial Photos (2014)		
Reach	Description	Start Reach
A	Swan Lake to Soup Creek Braids. Single Thread, Public Land. Survey at Cilly Creek Confluence.	47.929, -113.881
B	Soup Creek Braids, About 1 Mile long.	47.845, -113.837
C	Whitetail Creek to Due East of Metcalf Lake. Highly braided. PCTC/ State lands. Survey at woodward confluence.	47.823, -113.844
D	Metcalf to Sec 31 to just North of Shay Lake. Single thread. Public land. Survey at Goat Creek Station.	47.757, -113.835
E	Shay Braids. Sec 5/6 area.	47.701, -113.818
F	Single thread. Shay Lake area to just upstream of Piper Creek Bridge.	47.693, -113.819
G	Piper Creek Bridge to just downstream of Salmon Prairie Bridge, braided. Only 1 mile on FS. Survey in Sec 17, FS land.	47.673, -113.810
H	Salmon Prairie Bridg to Dog Creek. Braided. Only 1/2 miles on FS. Survey on bridge upstream of Pony Creek.	47.629, -113.786
I	Dog Creek to Elk Creek. Braided, mixed ownership. Survey at Cold Creek Bridge.	47.611, -113.768
J	Elk Creek to Guest Ranch Road Bridge. Survey at Condon Work Center. Mostly Private.	47.544, -113.743
K	Guest Ranch Road Bridge to just upstream of Kraft Creek Bridge, all private land.	47.505, -113.693
L	Kraft Creek Bridge to Holland Creek Confluence. Survey just downstream of Holland Creek Confluence.	47.463, -113.685
M	Holland Creek Confluence to Lindbergh Lake Road Bridge, survey just below bridge	47.441, -113.676
N	Lindbergh Lake Road Bridge to Section 7/8. Fairly short, all public land. Survey at Beaver Creek confluence.	47.422, -113.671

Swan River Snorkel Observations by Species: 2014 – 2019

Swan Snorkel 2014	Fish > 10 cm	Fish < 10 cm	All Fish
	Total	Total	Average Density (Fish/100 m ²)
Rainbow	337	30	0.371
<i>Oncorhynchus</i> Spp	306	655	0.963
Mtn. Whitefish	357	568	0.894
Brook Trout	127	50	0.180
Westslope Cutthroat	65	14	0.067
Salvelinus Spp	19	4	0.012
Bull Trout	21	0	0.012
Sucker	6	3	0.009
Sculpin	2	34	0.034
Brook Stickleback	0	3	0.004
Pike Minnow	123	1	0.230
Redsided Shiner	0	173	0.321
Bull/Brook Hybrid	2	0	0.001

Swan Snorkel 2015	Fish > 10 cm	Fish < 10 cm	All Fish
	Total	Total	Average Density (Fish/100 m ²)
Rainbow	350	26	0.390
<i>Oncorhynchus</i> Spp	94	272	0.421
Mtn. Whitefish	605	370	1.179
Brook Trout	93	19	0.140
Westslope Cutthroat	29	14	0.032
Salvelinus Spp	3	0	0.003
Bull Trout	40	0	0.029
Sucker	0	6	0.005
Sculpin	4	129	0.089
Brook Stickleback	0	87	0.034
Pike Minnow	0	4	0.036
Redsided Shiner	17	21	1.106
Bull/Brook Hybrid	24	0	0.016

Swan Snorkel 2019	Fish > 10 cm	Fish < 10 cm	All Fish
	Total	Total	Average Density (Fish/100 m ²)
Rainbow	199	107	0.335

<i>Oncorhynchus Spp</i>	154	166	0.156
Mtn. Whitefish	194	85	0.260
Brook Trout	48	20	0.054
Westslope Cutthroat	6	6	0.003
Salvelinus Spp	0	0	0.000
Bull Trout	37	0	0.016
Sucker	14	0	0.014
Sculpin	1	9	0.011
Brook Stickleback	0	0	0.000
Pike Minnow	39	22	0.080
Redsided Shiner	1	1	0.242
Bull/Brook Hybrid	1	0	0.001