Spring 2016

Fish Abundance and Habitat Recommendations of the Lake Whatcom Tributaries

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Spring 2016

Abstract

The tributaries of Lake Whatcom, Austin/Beaver, Anderson, Olsen, and Smith Creeks, provide essential habitat for many fish species native to the Pacific Northwest. However, development in the watershed has contributed to habitat alterations and even degradation of habitat quality. In this report, fish abundance and diversity, and habitat quality is compared both temporally, and among different streams. Anderson Creek was found to have the greatest species diversity. Cutthroat trout was the most abundant fish at each stream throughout the study period and was observed at every study site. Restoration recommendations for each stream were aimed at supporting existing native fish populations primarily by improving bank stability and restoring riparian zones. Future management plans should take into account the current and historical fish populations in the watershed and consider the recommendations identified within this report.

Introduction

The Lake Whatcom Watershed, located in Whatcom County of Washington state, is the primary source of drinking water for the county and consists of a large area of native fish habitat. All of the tributaries in the Lake Whatcom watershed have been subject to varying levels of anthropogenic influences, particularly from housing development. For example, the Austin/Beaver Creek basin has undergone vast disturbances since the development of Sudden Valley, establishing 5,000 residents along with roads and a golf course, beginning in 1969 (Smith 2009). The Olsen Creek watershed on the other hand, has experienced minimal housing development compared to the other tributaries, and is partially owned and protected by the city of Bellingham and the Department of Natural Resources (Olsen Creek Preserve, 2016). As future plans for development, restoration, and watershed management are considered for the Lake Whatcom watershed, it is important to consider the past and current habitat quality of these tributaries.

Lake Whatcom and its tributaries host a variety of fishes native to the Pacific Northwest, including Cutthroat trout (*Oncorhynchus clarkii*) and Prickly sculpin (*Cottus asper*). Native runs of Kokanee (*Oncorhynchus nerka*) are also present, although greatly depleted in recent years, in

Olsen, Anderson, and Smith Creeks (Fish Distribution and Periodicity, 2001). Historically, Kokanee have also been stocked in the watershed by the Brannian Creek state fish hatchery, located at the south end of the lake. Habitat quality of the tributaries is of particular concern for adfluvial species, such as Cutthroat trout and Kokanee, who utilize upper and lower stretches of their home streams.

This report focuses on the four main tributaries of Lake Whatcom, Smith, Olsen, Austin/Beaver, and Anderson Creeks. Beaver Creek converges with Austin Creek before flowing into the southwest side of the lake, Anderson Creek drains into the south end, and Smith and Olsen Creeks are situated on the northeast side of the lake (Figure 1).

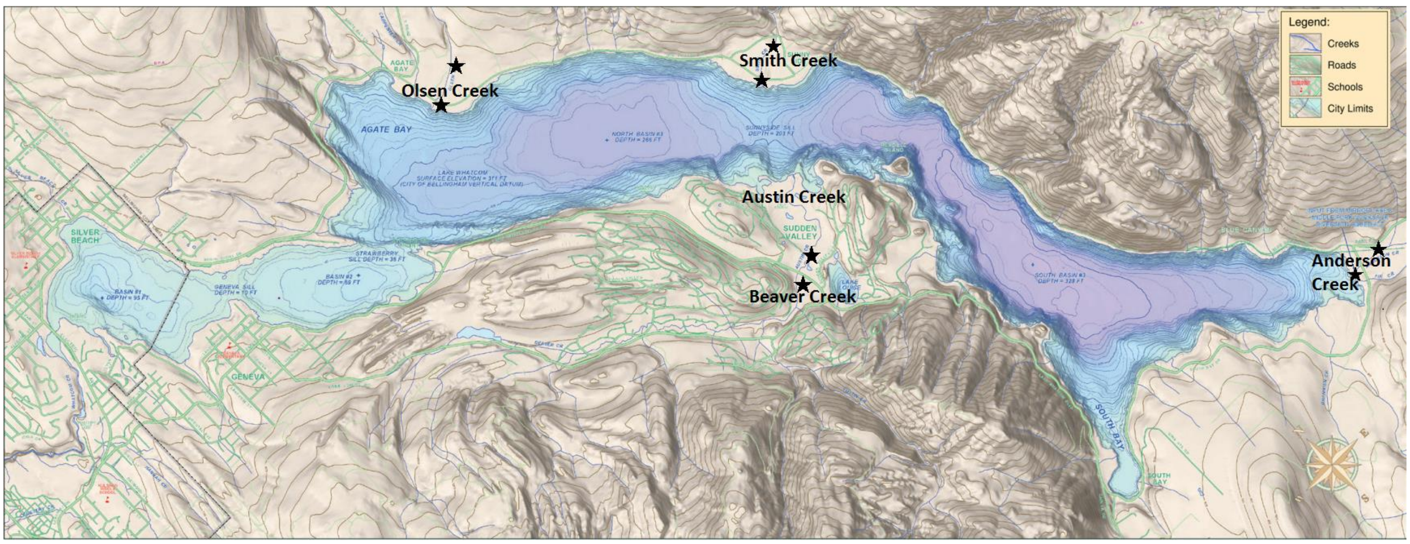

Figure 1. Lake Whatcom basin, showing where the tributaries drain into the lake. Sample sites are located at each star.

Methods

Information was gathered from student reports from the Fish Habitat Assessment course at Western Washington University, instructed by Dr. Leo Bodensteiner. Habitat quality is determined by fish abundance, species diversity, and habitat measurements in the four tributaries during varying years from 2008 to present. Austin/Beaver Creek was sampled in 2011, 2012, 2015, and 2016. Olsen Creek's sampling period included 2008, 2011, and 2016. Smith and Anderson Creek data were collected in the years 2009, 2011, 2013, and 2016. In addition, recommendations for each tributary from each study year was compiled and tracked through time to determine areas of particular concern at each stream.

Data collection was conducted at two sites, an upper and lower reach, at each stream (Table 2). For the Austin/Beaver system, Austin Creek was sampled as the lower reach, and Beaver Creek as the upper. At each stream, a series of standard habitat assessments were conducted as outlined in Bain and Stevenson's *Aquatic Habitat Assessment: Common Methods*. Cover and refuge, substrate composition, streambank condition, and macrohabitat analysis was completed at each site. These results were used to formulate recommendations for each stream to improve fish habitat quality.

Electrofishing surveys were also completed at each site using a DC electrofishing backpack. One person created an electric field with two charged poles connected to the backpack, while the other group members netted and collected the fish. Fish species were identified, and each specimen's total length, tip of mouth to tip of caudal fin, was measured. Fish were promptly released back into their home streams.

Results

At the four tributaries of Lake Whatcom, Cutthroat trout is the most consistently observed fish across all sample years (Figures 2-5). Cutthroat trout are also the most abundant species observed for every sample year at Austin/Beaver, Olsen, and Smith Creeks (Figures 2, 4, 5). Anderson Creek is also the only stream where Three-spined sticklebacks have been observed. Overall abundance in Anderson Creek has decreased in the past two sample years, 2013 and 2016 (Figure 3).

The most frequent size of observed Cutthroat trout ranges between 60-90mm for all tributaries (Figures 6-9). Both Smith and Austin/Beaver Creeks measured at least one Cutthroat trout over 300mm in size over the sample period.

Fish diversity is greatest in Anderson Creek, with five species observed in the upper reach and seven in the lower over the sample period. Species diversity was lowest in the upper reach of Smith Creek, with only Cutthroat trout collected, followed closely by Beaver and the upper reach of Olsen Creek (Table 1). All of the creeks except Anderson had a greater observed diversity in their lower sites, as compared to their upper sites (Table 1).

Discussion

Cutthroat trout are widely considered the hardiest of the Pacific salmonids, which may explain why they are so prolific in these developed streams. Cutthroat trout can either adhere to a resident or adfluvial life cycle. Residents rear and spawn in the same stream, while adfluvial trout will migrate from streams to the lake for better feeding habitat, and then return to the stream to spawn (Machtinger 2007). Because these trout were observed in winter and were mostly of juvenile size, it is likely that these are resident Cutthroat trout, or perhaps the trout will rear in the streams and migrate downstream as they mature. It is difficult to say for sure what lifestyle type, resident or adfluvial, these Cutthroat trout are exhibiting and a full year study, possibly tagging specific trout to monitor, would be the only way to know the life cycle indefinitely.

Kokanee runs were not observed during the study periods. This is due to Kokanee spawning occurring between October and January and sampling beginning in late January at earliest (Bogue, et al. n.p 2009). Overall, Cutthroat trout was the only salmonid to be observed in the streams during the study period.

Peak abundance and diversity is greatest in Anderson Creek, especially in 2009 (Table 2, Figure 3). However, abundances are subject to human error and variability, especially considering the data were collected by a wide variety of students with little prior electrofishing experience. Variances in species diversity among creeks is notable.

The noticeable decrease in abundance throughout the years at Anderson Creek, especially in 2013 and 2016, may be due to the Middle Fork Nooksack diversion delivering unusually large loads of silt leading to increased embeddedness near the mouth of the creek (Smith 2009). Siltation in the stream reduces available spawning habitat, thereby decreasing habitat for native fishes. However, the diversion dam, used to manage Lake Whatcom water levels by the city, has been in use since 1962, so it seems unlikely that this would be the sole reason for the decline in abundance.

Variations in diversity between lower and upper reaches is likely due to habitat complexity, and the type of fish observed. It is not surprising that the lower reaches had greater species diversity, as this habitat is more accessible from Lake Whatcom. Upper reaches only contained migrating fish, specifically Cutthroat trout and some Prickly sculpin, who travel between upper and lower reaches of the river as part of their life cycle and in order to find more productive feeding grounds.

Recommendations

Despite varying in size and habitat complexity, all of the four tributaries of Lake Whatcom studied exhibit sub-optimal conditions for several fish habitat characteristics examined. The six habitat characteristics specifically rated for each stream throughout the years include bottom substrate, habitat complexity, pool quality, bank stability, bank protection, and canopy cover. While all of these characteristics are important to improve, bank stability has consistently been a concern for all four tributaries for nearly every year studied. Bank stability is imperative to a healthy stream habitat, as it prevents the input of sediment and nutrients into the stream in harmful quantities. Bank instability often leads to siltation of the stream, which increases turbidity, smothers eggs, and can fill in important pool habitats (Bain 115). An increase in turbidity can be harmful for fish relying on visual predation, and can also increase stream temperatures through absorption, which can be very detrimental for fish populations. Unstable banks, as are currently apparent at Olsen, Anderson, Smith, and Austin creeks, should be improved and managed to better the overall stream habitat.

Bank stability can be improved through several means, but perhaps the most effective and long-lasting method would be to establish a wider and more diverse riparian zone around the creek. Riparian vegetation, such as Red Alders or Willows, contribute to bank stability through their extensive root systems, which anchor sediment from being washed into streams. These four tributaries are especially at risk of reduced riparian zones, due to extensive development in the watershed, which often pushes right up to the stream edge. In fact, riparian zone restoration and expansion is also an important recommendation at every site studied. Development along the creeks, particularly the lower reaches closer to the lake, have increased impervious surfaces and decreased riparian buffer size at all of the creeks. The riparian zone offers many benefits to a stream, including shading, nutrient inputs, large woody debris (LWD) inputs, and increased infiltration to reduce stormflow (Bain 1999).

The input of LWD in streams to increase habitat complexity is another frequently mentioned recommendation for the Lake Whatcom tributaries. Increased riparian vegetation is an effective way to provide the stream with a long-term source of LWD, but until these forests are established the manual input of LWD would be beneficial for these systems. LWD is particularly needed to form scour or plunge pools, which provide fish with refuge from warm stream temperatures, fast currents, and predators. Ultimately, riparian forest improvements would be the most effective method to improve bank stability, habitat complexity, and overall fish habitat in these streams, and should be considered with future development plans in the Lake Whatcom watershed.

Tables and Figures

Table 1. Fish species observed at every sample site, upper and lower for each stream, of the Lake Whatcom tributaries throughout the years of study.

Stream	Species observed				
	Cutthroat trout	Pacific lamprey	Prickly sculpin	Coastrange sculpin	Three-spined stickleback
Austin	X	X		X	
Beaver	X		X		
Anderson (lower)	X	X	X	X	X
Anderson (upper)	X	X	X	X	X
Olsen (lower)	X		X	X	
Olsen (upper)	X		X		
Smith (lower)	X	X	X	X	
Smith (upper)	X				

Table 2. Coordinates of sample sites in Lake Whatcom watershed.

Creek	Lower		Upper	
Anderson	48° 40.413'N	122° 16.108'W	48° 40.409'N	122° 15.865'W
Beaver	NA	NA	48° 42.731'N	122° 20.472'W
Austin	48° 42.747'N	122° 19.923'W	NA	NA
Olsen	48° 44.962'N	122° 20.747'W	48° 45.242'N	122° 20.758'W
Smith	48° 43.793'N	122° 18.838'W	48° 43.925'N	122° 18.487'W

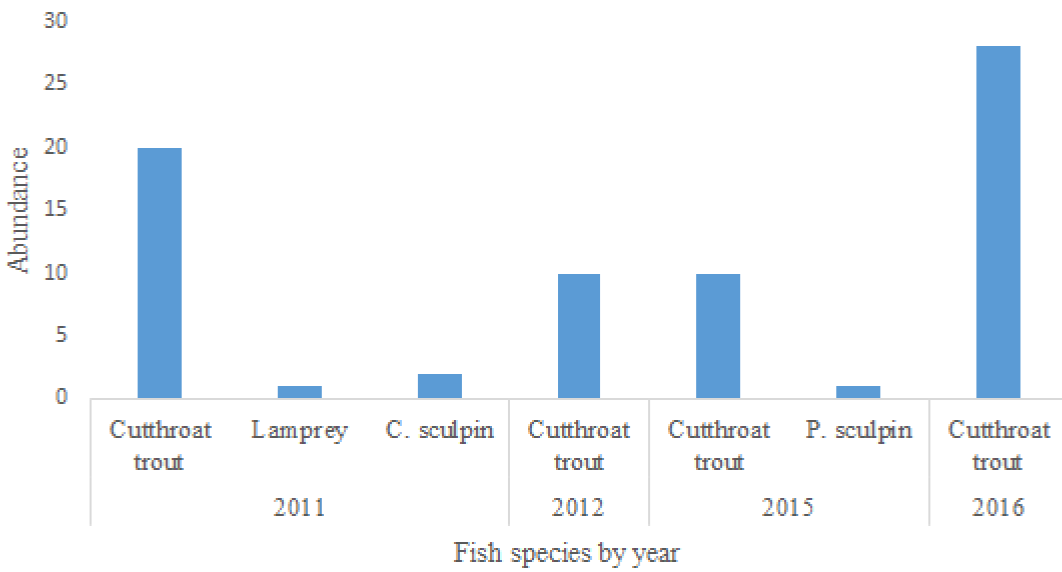

Figure 2. Fish abundance at Austin/Beaver Creek during the winters of 2011, 2012, 2015, and 2016.

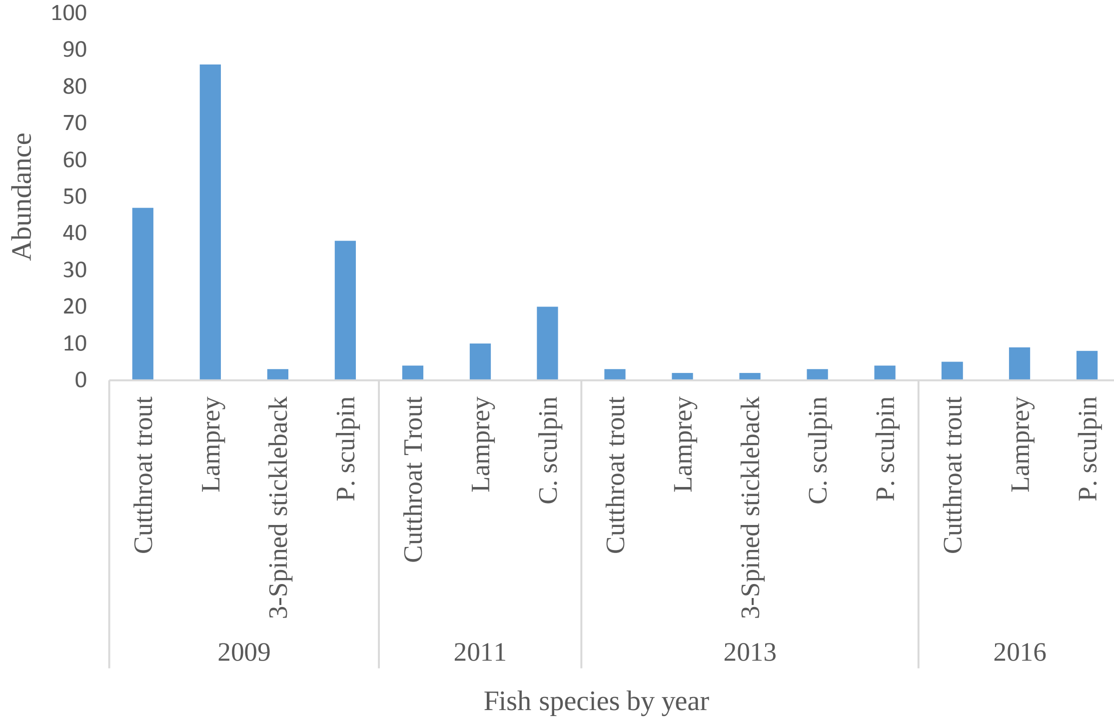

Figure 3. Fish abundance at Anderson Creek from winter 2009 to 2016.

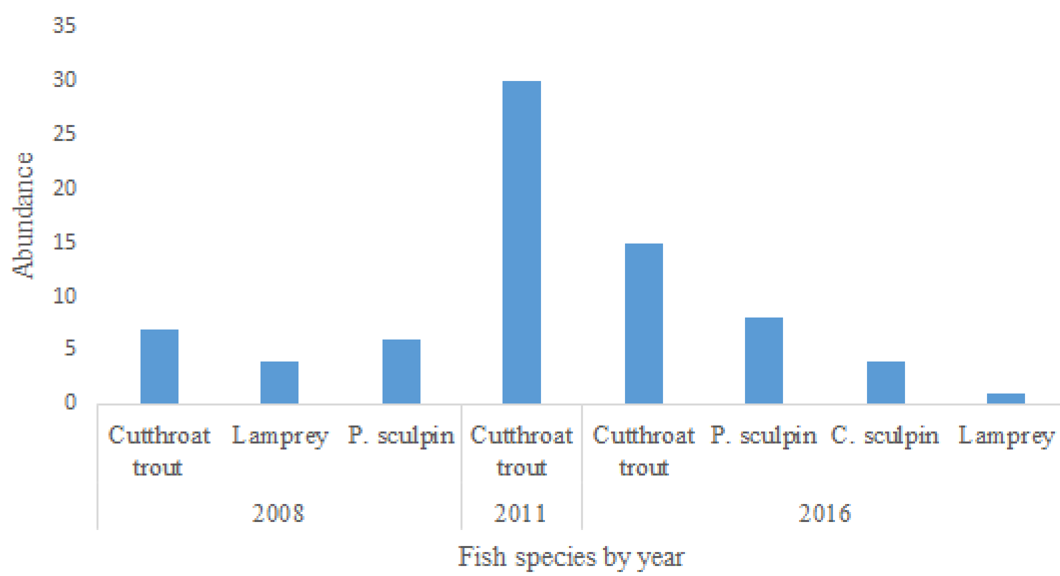

Figure 4. Fish abundance at Olsen Creek during the winters of 2008, 2011, and 2016.

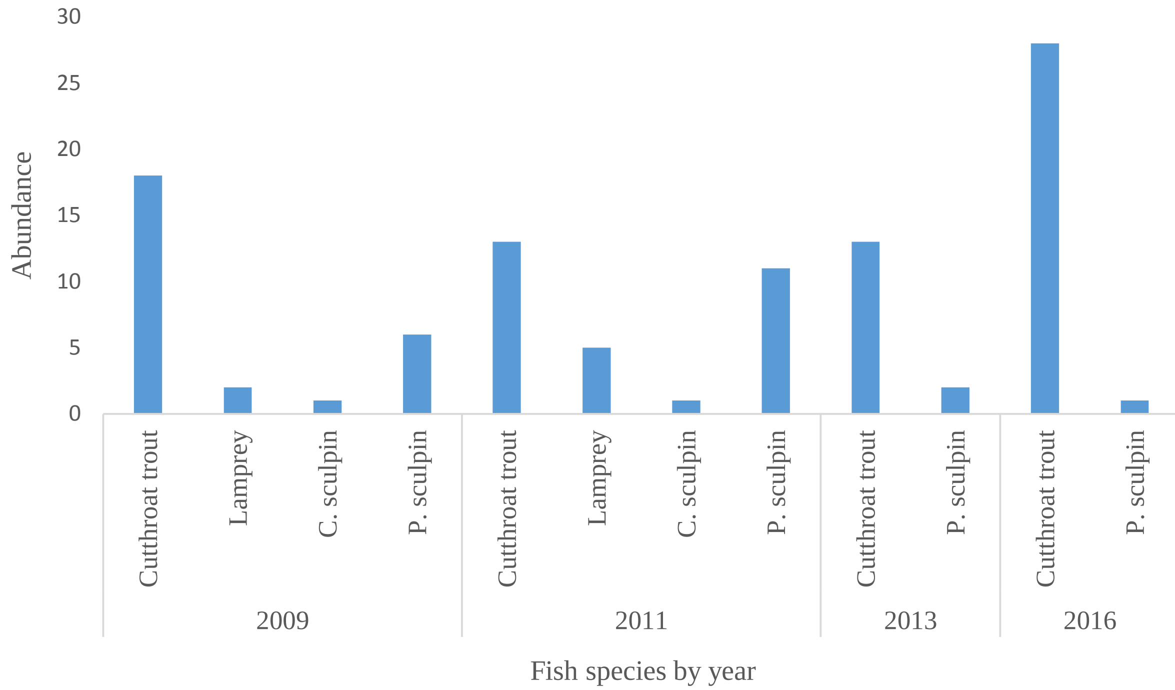

Figure 5. Fish abundance at Smith Creek during the winters of 2009, 2011, 2013, and 2016.

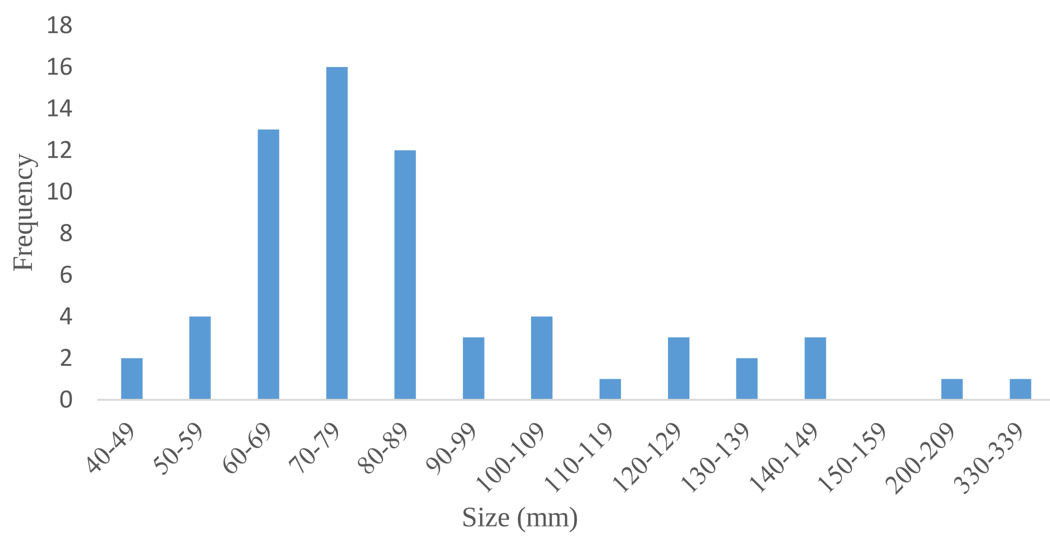

Figure 6. Size distribution of Cutthroat trout in Austin and Beaver Creeks in years 2011, 2012, 2015, and 2016. (n=65)

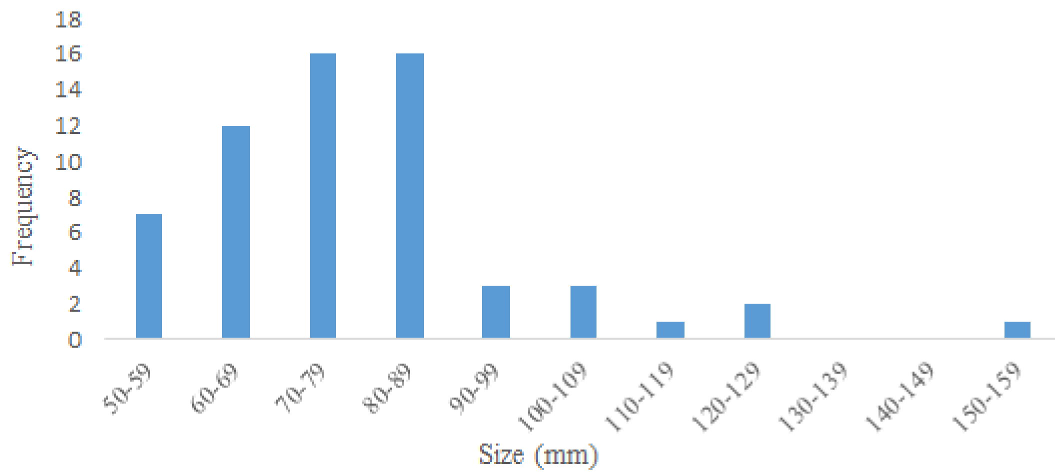

Figure 7. Size distribution of Cutthroat trout in Anderson Creek in the years 2009, 2011, 2013, and 2016. No Cutthroat trout observed, or of unknown size in 2005 and 2006. (n=61)

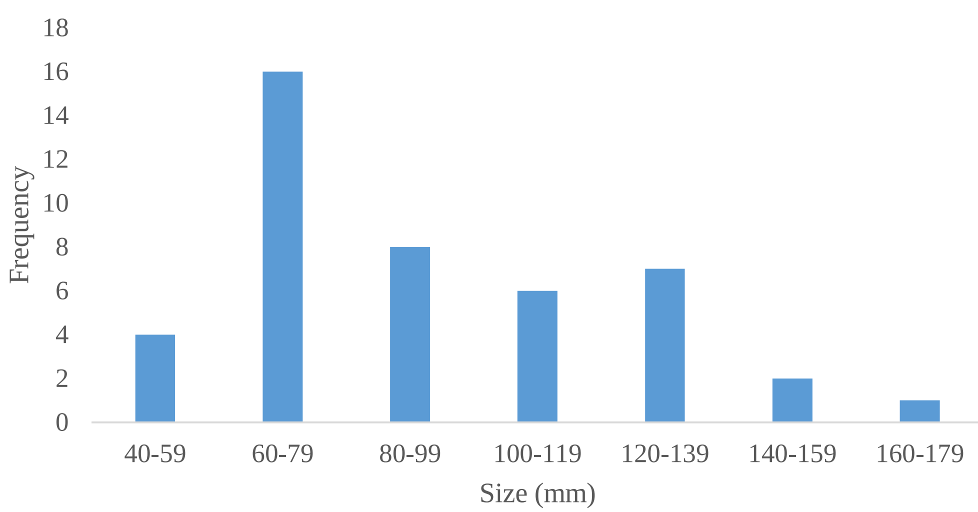

Figure 8. Size distribution of Cutthroat trout at Olsen Creek in the years 2008, 2011, and 2016. (n=44)

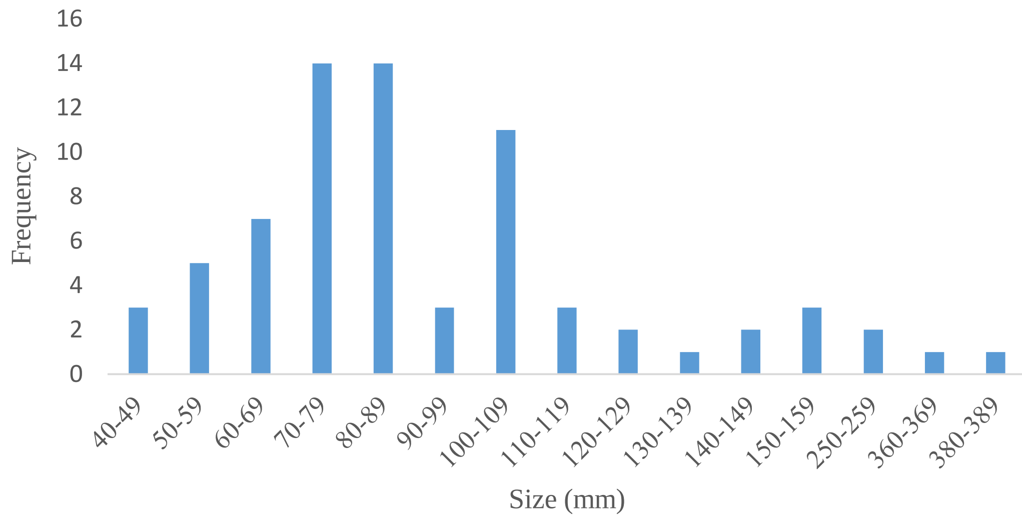

Figure 9. Size distribution of Cutthroat trout at Smith Creek in the years 2009, 2011, 2013, and 2016. (n=72)

Sources:

Bain, M.B., and N.J. Stevenson, editors. 1999. Aquatic Habitat Assessment: Common Methods. American Fisheries Society, Bethesda, Maryland.

"Fish Distribution and Periodicity in WRIA 1: Final Draft." 2001. Anchor Environmental, L.L.C. City of Bellingham, Public Works Department.

Machtinger, Erika T. 2007. Cutthroat Trout (*Oncorhynchus clarkii*). Fish and Wildlife habitat management leaflet, no. 47. Natural Resources Conservation Service and Wildlife Habitat Council.

"Olsen Creek Preserve." Lake Whatcom Reservoir. City of Bellingham, WA, Web. 12 Mar. 2016.

Smith, Ian F. 2009. The effects of introduced warm water fishes to the native kokanee population of Lake Whatcom, WA. Master's thesis, Western Washington University.