

Rica Canyon, Elwha River
September 21, 2022

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Goal: The objective of this report is to provide an assessment of upstream fish passage through Rica Canyon. This assessment is based on extensive fish surveys for juvenile and adult salmonids using electrofishing, spawner, and snorkel surveys post dam removal, specifically from 2016 through 2022, and encompasses the area upriver of Glines Canyon. Additionally, we conducted a physical habitat assessment of Rica Canyon on September 21, 2022 (316 cfs).

Background:

- Removal of Glines Canyon Dam in summer of 2014, with adult Chinook observed above dam shortly after
- Rockfall in October 2014, with very few anadromous fish seen above Glines through 2015
- Blasting the rockfall into smaller chunks in late 2015 and 2016 helped reopen the channel
- Rica Canyon, the first major canyon above Glines Canyon, separates the former Mills area from Geyser Valley (~river mile 16 to 17.5)
- Adult Chinook observed above Glines in 2016, with 4 Chinook in Geyser Valley and one Chinook seen as far upstream as Goin Canyon (rm 30), along with 9 summer steelhead observed above Grand Canyon, the highest at Tipperary (rm 31)
- From 2016 to 2019, Chinook (adults and juveniles) were regularly observed in Geyser Valley with limited observations above Grand Canyon (see Figure 1). Other adult (steelhead, coho, sockeye) and juvenile (coho) species were also observed in Geyser.
- From 2016 to 2022, summer steelhead have been observed at or near the headwaters of the Elwha.

- From 2020 to 2022, no adult Chinook observed above Rica Canyon, although abundance in Lake Mills was stable or growing. Coho also not observed above Rica Canyon although, again, abundance below Rica seems to be increasing.
- For more details on surveys and observations in the upper Elwha, see Table 1 at the end of this report.

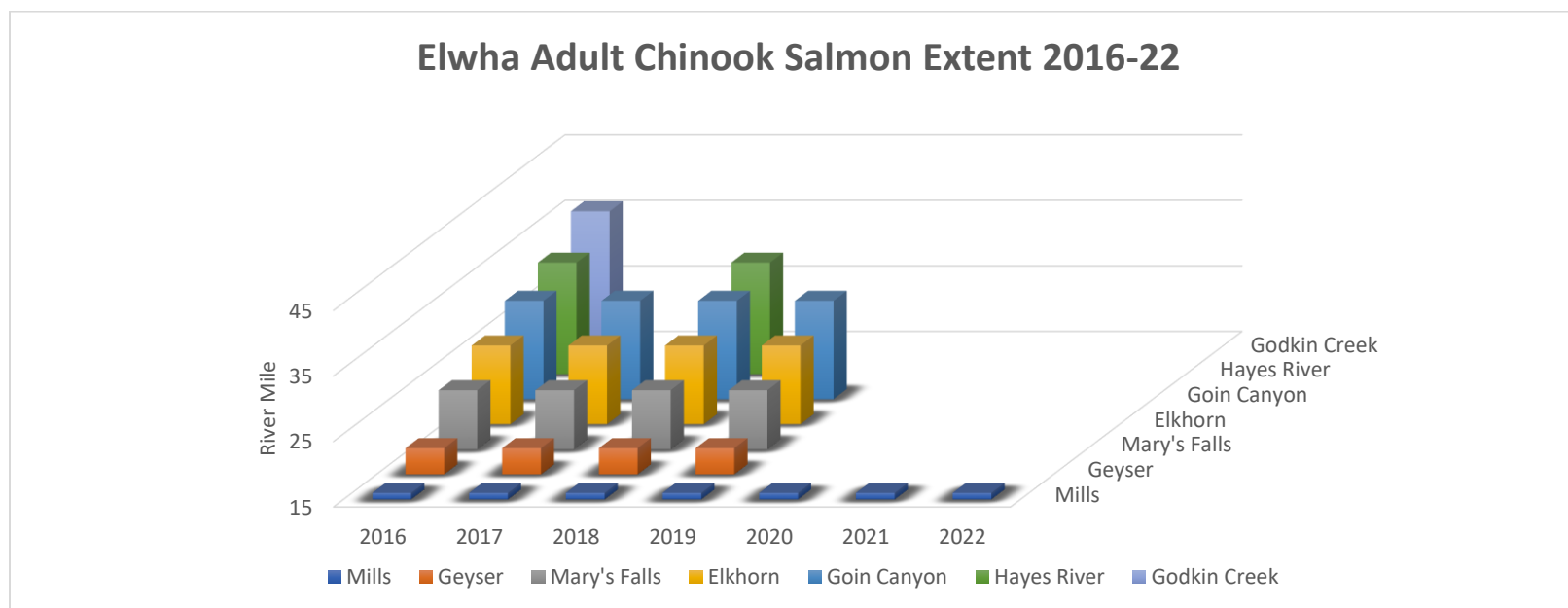


Figure 1. The upper extent of adult Chinook salmon based on surveys from 2016 – 2022.

Channel Assessment Survey 2022:

The complete lack of observations of adult salmon (Chinook, coho, and sockeye) above Rica Canyon beginning in 2020 led to questions as to possible causes. One hypothesis (of many) to help explain the lack of adult salmon observations after 2019 was that a partial barrier had developed in the river channel in Rica Canyon. In addition to potential obstructions, other factors have been discussed that may contribute to the fewer numbers of salmon in the upper watershed. Historically, the spring Chinook run (now considered extirpated) pushed higher into the upper reaches than did the summer/fall run. Hundreds of samples taken from summer/fall Chinook carcasses since dam removal have revealed that 90-95 percent of those fish were of hatchery origin: the instinct to home back to the hatchery in the lower river may still influence some fish. Another factor is the size difference: the summer/fall run is trending on the smaller side as compared with the adult Chinook that were originally documented in the Elwha prior to dam construction. Yet one more possibility is that there is a density dependent factor occurring in the former Lake Mills area: when we observe ~100 redds or more in that reach, we tend to see adult salmon upstream of Rica Canyon. The adult Chinook spawning in the former reservoir may push others to find more spawning habitat upriver. In the last few years, the number of Chinook redds in the former Mills reservoir has been close to but under 100.

Methods: Our objective for the September 2022 survey was to check for any possible barriers, conduct a snorkel survey, and document any recent significant changes in the Canyon. Our fisheries crew had conducted a snorkel survey through the entirety of this canyon in 2015 at 246 cfs. With the information from the previous survey, we ascertained the optimal conditions for surveying this canyon again and determined a flow safety threshold of 350 cfs or lower. We assembled the appropriate equipment for both surveying (rangerfinder, handheld GPS, cameras, and snorkel gear) and safety (throw ropes, rappelling gear, and first aid kits). A communication plan was established before the survey and entailed Garmin inReach and radio communication, check-in times, and reasonable start and end times.

We began our survey at Goblin Gates and snorkeled downstream. The river had carved this top section of the canyon down to bedrock. At approximately 100m from the entrance to the canyon we encountered the Goblin Gates Rapid.

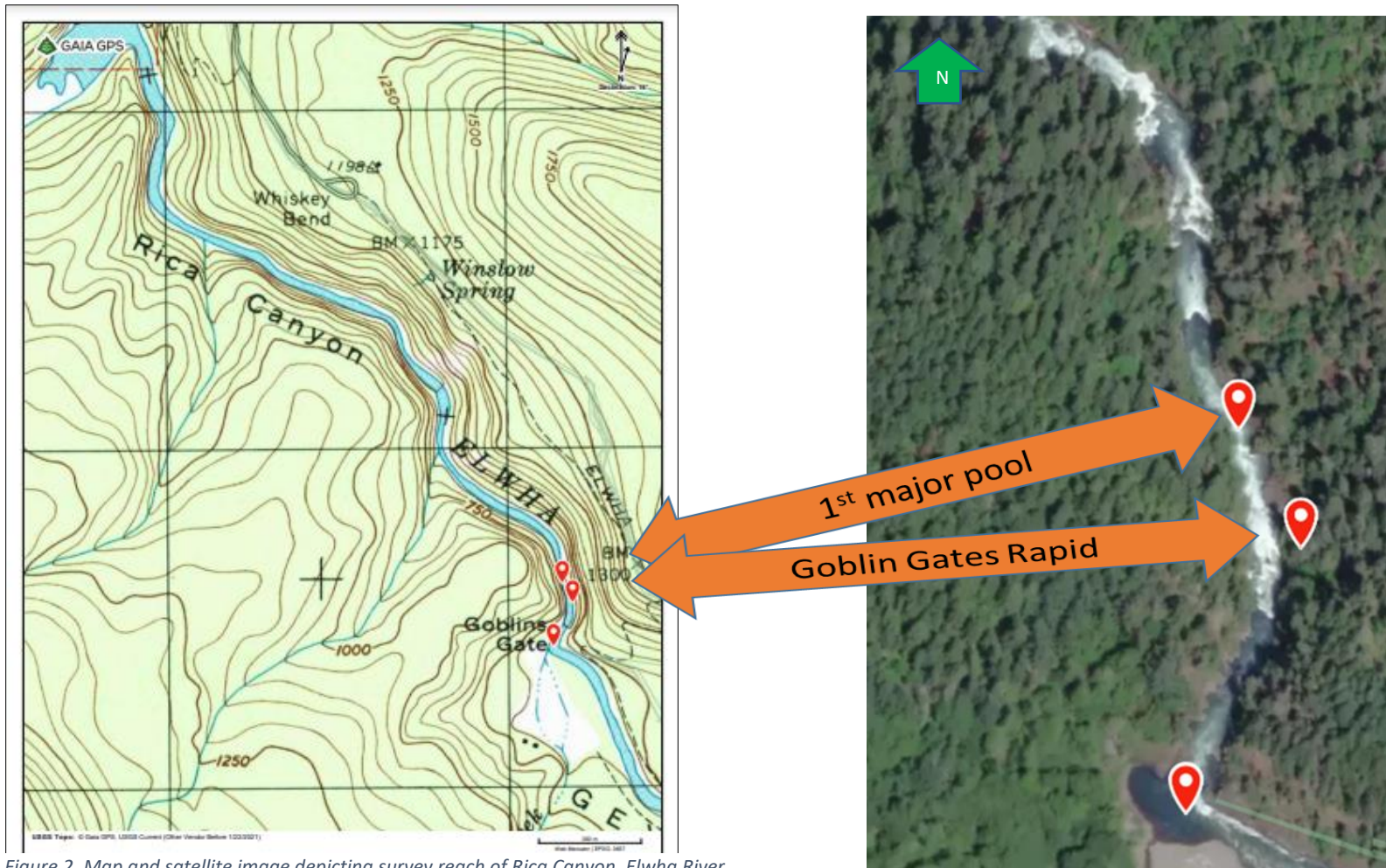
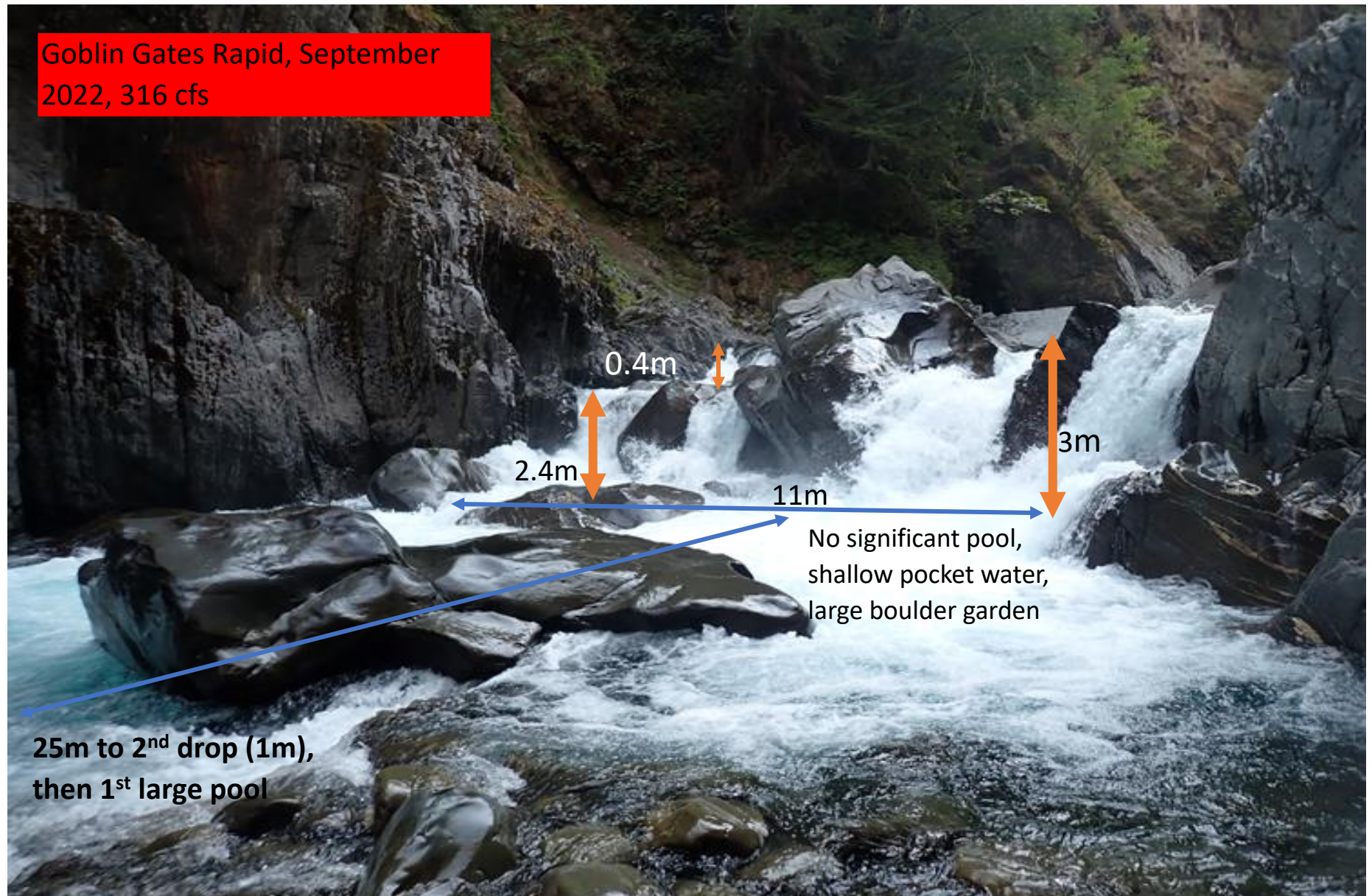


Figure 2. Map and satellite image depicting survey reach of Rica Canyon, Elwha River.

The rapid was a series of 2 drops or ledges, approximately 25m apart. A large bedrock pool could be seen just downstream of the second drop. The first drop measured 3m in height (water surface to water surface) on river left and had 2 steps on river right that measured 2.4m and 0.4 m. See photo. The second drop was measured to be 1m in height.



Goblin Gates Rapid 2022

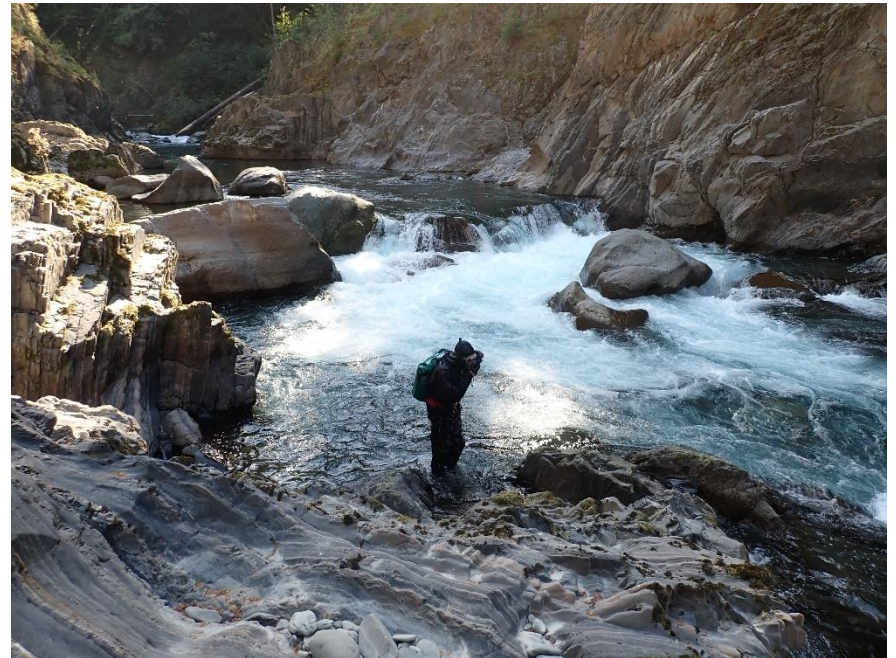


Just downriver of the second drop was a deep, long pool (see left and bottom photos). Here we observed 2 large adult Chinook, 5 Chinook jacks, 1 sockeye, and 9 bull trout. This is the highest observation of adult salmon since 2020. Over the previous two weeks, Josh and I snorkeled ~13 miles upriver of Rica Canyon in the mainstem Elwha, from the Hayes River confluence to Baltimore Camp (downstream of Mary's Falls) and then from the bottom mile of the Grand Canyon to the entrance of Rica. While we did see summer steelhead, bull trout and rainbow/cutthroat trout, we did not see any salmon until this pool. Also, in the tail out of this pool was one Chinook redd (see photo below with redd circled in purple). This is the highest observation of a Chinook redd since 2020.

Based on what we observed during this and previous surveys over the last few years, the Goblin Gates Rapid appears to be a barrier or, at the very least, a significant obstacle to Chinook and other salmon species.



The rest of Rica Canyon is not without challenges for fish passage. Much of the canyon has very large boulders, bedrock ledges, and narrow chutes of high velocity whitewater (see photos from 2022 below). However, the Goblin Gates Rapid was the most formidable feature of the canyon. There was also LWD present, but at these low summer flows, it was not significantly interacting with the wetted channel.



The bottom right photo on the previous page shows a drop that is 2m in height with a deep pool at its base. This is located about 0.25 miles above the exit of the canyon. The narrowest constriction of the canyon, which could be a velocity barrier at high flows, is just downstream of this. It was measured to be 3-3.5m in width (see top photos).



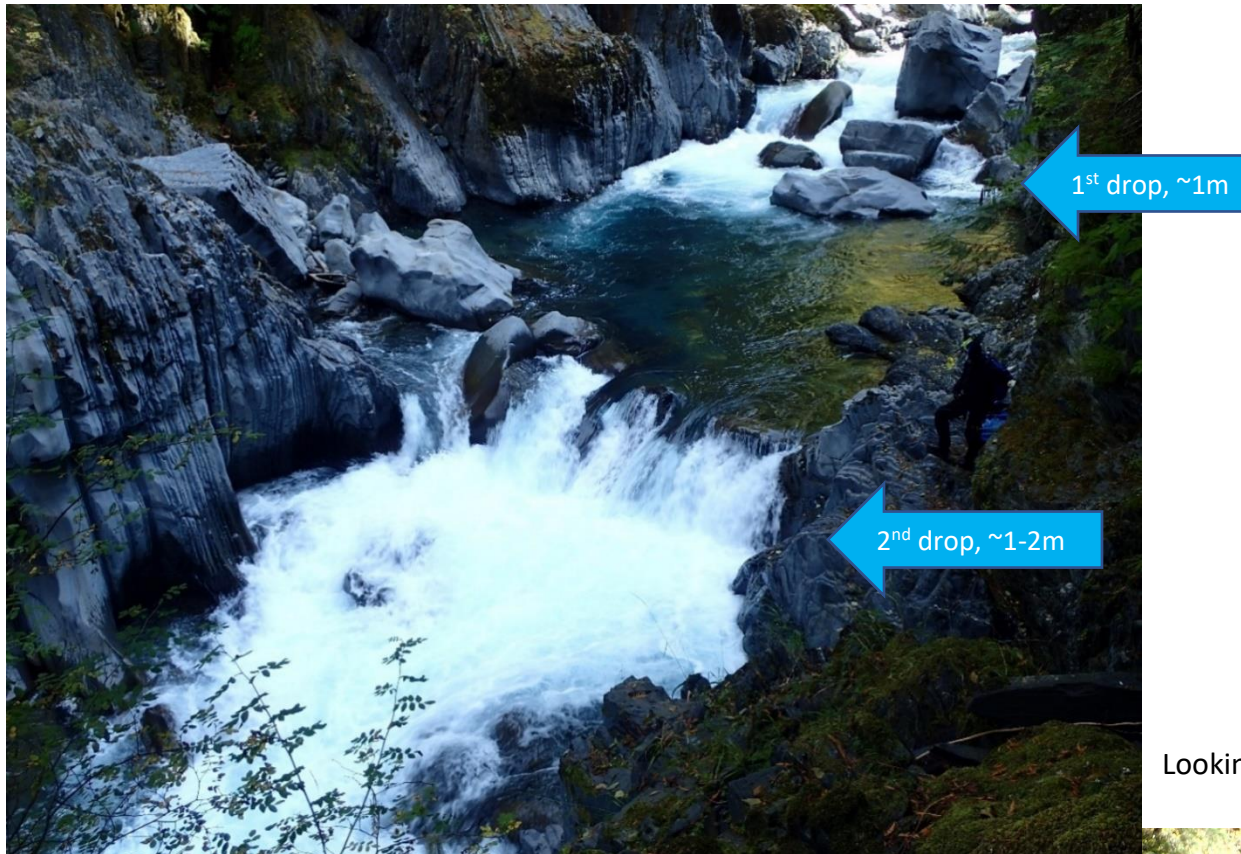
Total Fish Observations from just below the Goblin Gate Rapid:



From the base of the Goblin Gates Rapid to the end of the canyon, we had a total count of 13 adult Chinook plus 1 carcass, 5 Chinook jacks, 1 sockeye, 55 bull trout, and 574 rainbow/cutthroat trout. We also observed 7 Chinook redds. On the left is a photo of an adult Chinook in proximity to a redd. This observation occurred near the middle of the canyon where we came across a series of pools (see photo on right).



Discussion: The Goblin Gates Rapid had changed considerably from the last time our crew was at this location in October of 2015 (246cfs). In 2015, this first drop or ledge was shorter in height, approximately 1m, and much easier to navigate; there was also a pool just below. The second drop in 2015 was more significant at 1-2m in height and had a large pool at its base. See the following two photos from October 2015 (246 cfs) for reference.



Looking upstream in 2015 at Goblin Gates Rapid:



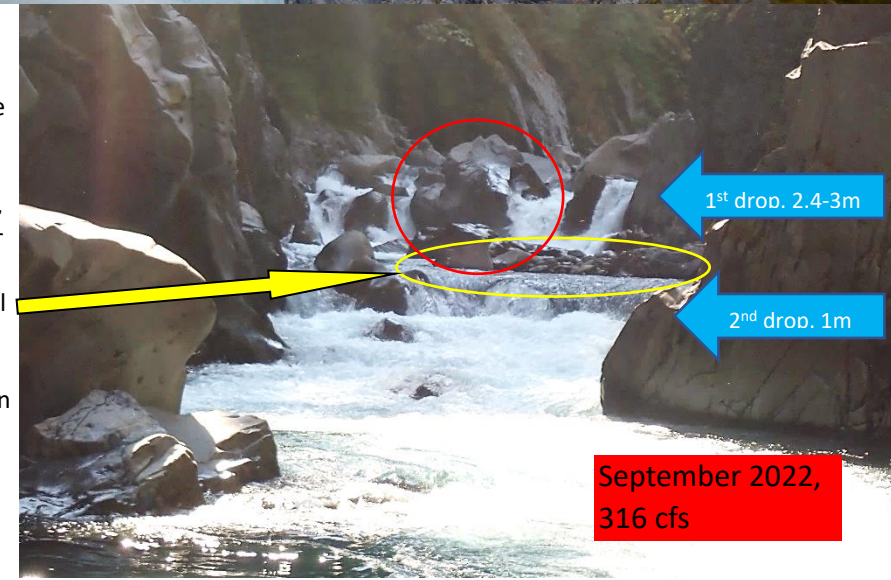
In the photos below, we compared the current conditions to those of 2015 and 2018 (the 2018 photo is from a packraft trip report: <https://www.timkelleyimages.com/post/packrafting-the-grand-canyon-of-the-elwha>). It appears that the first drop has backfilled with large boulders and is creating a more significant feature that migratory fish must attempt if moving upstream.

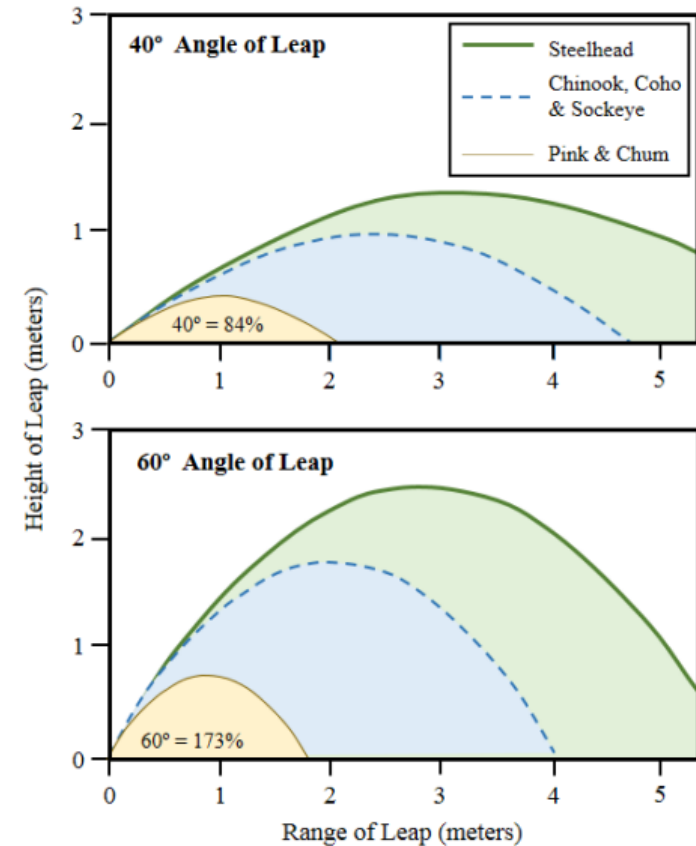
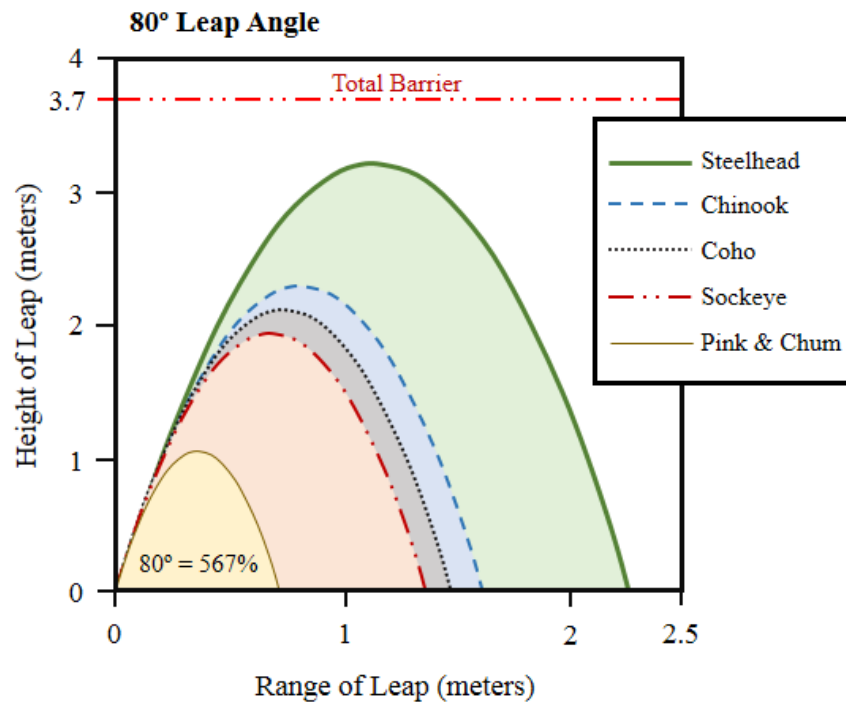


- Large center boulder appears to have tipped forward post 2015, 1st drop was ~1m
- More significant drop (see packrafters scouting) was just DS, ~1-2m in 2015 and 2018



- Other large material has filled in the space behind the central boulder
- 3m drop on river left, 2.4m + 0.4 m on river right
- More coarse material has filled in plunge pool below this rapid
- Second drop is ~1m in height





Figures 3 & 4. Washington State salmon and steelhead leaping abilities. The figure above illustrates the leap height and range of healthy fish at maximum burst speed leaving the water at an 80° leap angle above (or 567% slope, waterfall); the figure to the right: 40° and 60° (for cascades). Figures are from WDFW Fish Passage Inventory, Assessment, and Prioritization Manual [adapted from Ruggerone (2006) and Powers and Orsborn (1985)].

According to the *WDFW Fish Passage Inventory, Assessment, and Prioritization Manual* (2019), at a vertical trajectory, steelhead generally have the highest leaping (3.3m, 10.9ft) and swimming potential of the salmonids, but Chinook (2.4m, 7.8ft) are not far behind. Coho have a maximum leap of 2.2m (7.2ft), sockeye 2m (6.6ft), and pink/chum 1m (3.5ft). At the Goblin Gates Rapid, the shortest leap on the first drop that a fish would need to make is 2.4m (7.9ft). A steelhead could presumably clear the river right (2.4m) or left (3m) side of the first drop if the conditions were optimal (deep pool below drop, an adequate holding pool just above the right side, slower velocity above the rapid, maximum body condition, etc.), and indeed we have observed summer steelhead in all our upper river snorkel surveys each summer since 2016. Additionally, the run timing of summer and winter steelhead may also be an advantage for upstream passage as those fish are entering the river earlier in the summer or later in the fall/winter, respectively; increased river discharge could minimize vertical heights and create deeper launching pools. On the contrary, sockeye, Chinook, and coho salmon are migrating through this area later in the summer and early fall when river flows are typically lower. In September 2022, the plunge pool depth at the base of the first drop was rather shallow and had filled in with large boulders. Because of this and the taller vertical heights, salmon species might encounter more difficulty when ascending these features.

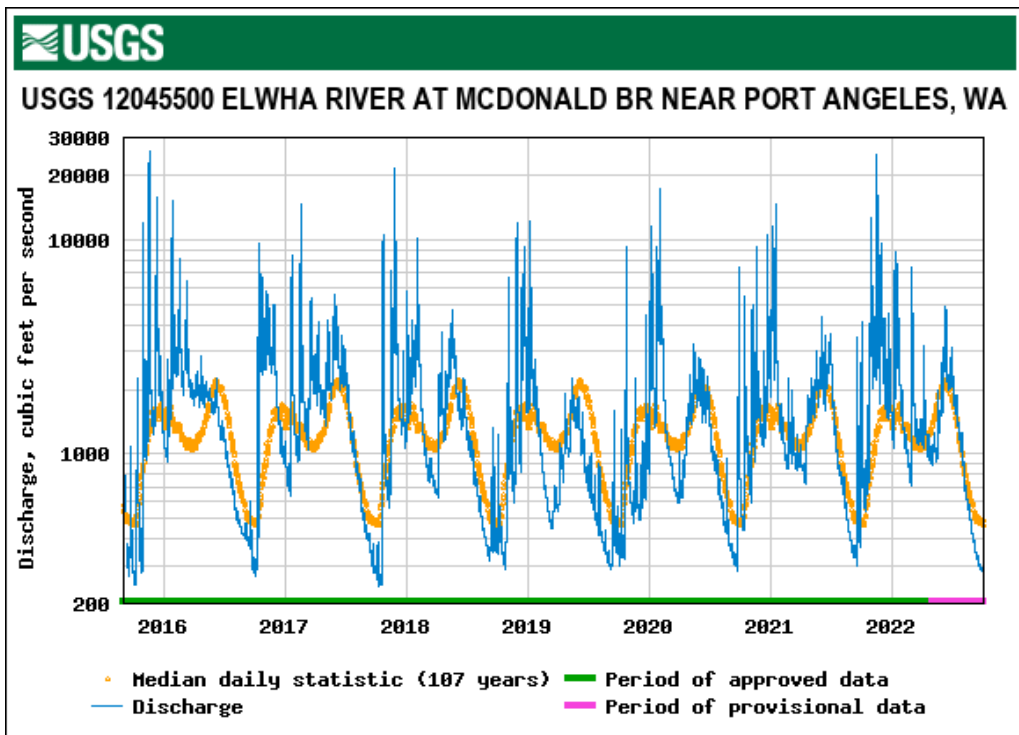


Figure 5. The Elwha River hydrograph from September 2015 through September 2022.

We also evaluated whether dam removal activities had influenced the channel in Rica Canyon to significantly impact fish passage. Prior to dam removal, the accumulation of sediment in the Mills reservoir had created a backwater effect at least as far upriver as the Fitzhenry Creek confluence (approximately 1 mile upstream of the canyon exit). Once dam removal was complete, the canyon walls revealed evidence of headcutting that appears to end around that same location (Fitzhenry Creek). The photo on the right (taken 9/21/22) is highlighting the former waterline (shown with a green arrow) from when the dams were in place. The top of the headcut, or nickpoint, can be observed in this same area and is approximately 0.5 mi downriver of the Goblin Gates Rapid.

The Elwha hydrograph from September 2015 through 2022 was included (figure 2) to show that the high flow events in late 2019/early 2020 were not necessarily unique for that time of year, at least within the 2015-2022 timeframe. However, in late 2015, the area experienced a series of large storms and in 2017, another large storm event. While upstream migration of Chinook didn't seem to be fully impacted until 2020, the number of redds in Geyser Valley did decline between 2018 and 2019, and it takes time for large material to move downstream. Conceivably, the 2017 storm (or even 2015 storm) could have recruited material into the channel that didn't become a problem in Rica Canyon until after the winter of 2019.



Summary: Our surveys reveal that a barrier may exist for returning adult Chinook, coho, and sockeye salmon based on lack of detection of those species and life stage in the upper river beginning in 2020. While we continue to see summer steelhead in the upper reaches of the Elwha, we have not observed salmon adults or redds from 2020 through 2022, and we have not documented any juvenile salmon in those same reaches in 2021 and 2022. Sometime around late 2019 or early 2020, the substrate must have shifted in the Goblin Gates Rapid area *or* the rapid could have been



recruiting material over time. Additional material appears to have backfilled behind the first drop which had previously been more of a cascade. Large boulders and cobble had also been flushed into what was once a pool between the first and second drop. The addition of this material reduces the pool depth that fish would need to gather speed and launch over or through a vertical drop or cascade. Furthermore, no salmon were observed during our snorkel surveys in mid-September from the Hayes River confluence to Baltimore Camp and from the Lillian River confluence to the top of Rica Canyon (~13 total river miles). The observation the following week of adult Chinook and sockeye just below the Goblin Gates Rapid provides more evidence that the Goblin Gates Rapid in its current state is a barrier to salmon upriver migration at low summer flows. While other factors likely contribute to this passage issue, our surveys above and below Rica Canyon reveal a stark difference in salmon counts.

Furthermore, based on the timing of when the potential barrier formed and the location of the headcut nickpoint from dam removal (~0.5 mi downriver of the potential barrier), the changes that have occurred at the Goblin Gates Rapid appear to be natural and not associated with dam removal related activities. As such, our intentions in the coming years are to monitor any changes to the fish species composition above and below Rica Canyon.

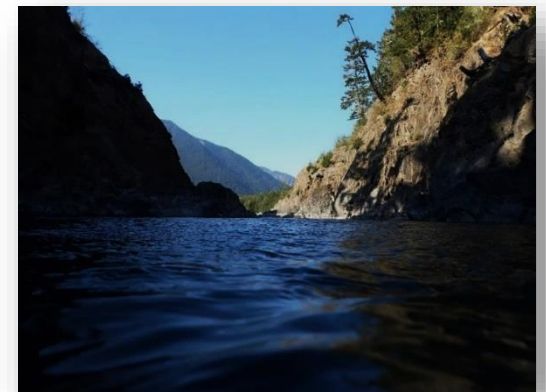


TABLE 1. Summer Anadromous Fish Observations Above Rica Canyon Since Dam Removal: 2016 to 2022

TABLE 1. Summer Anadromous Fish Observations Above Rica Canyon Since Dam Removal: 2016 to 2022				Summer Steelhead	Chinook			Sockeye	Coho
Year	Month	Method	Reach	Adults	Juveniles	Adults	Redds	Adults	Juveniles
2016	Aug	Snorkel	Above Grand Canyon (AGC): Hayes River (rm 32) to Elkhorn (rm 27)	5 (1 Tipperary*)	0	1 (Goin)	0	0	0
	Sept	Foot	AGC: footbridge (rm 38) to Baltimore Camp (rm 23.5)	4	0	0	1 (Godkin)	0	0
	Sept	Foot	Geyser (rm 17.5-20)	0	0	4	10	0	0
2017	Sept	snorkel/foot	AGC: footbridge to Baltimore Camp	72	0	3 (1 Goin)	2 (Goin)	0	0
	Aug	Snorkel	Geyser	2	0	5	0	1	0
	Sept	Snorkel	Geyser	9	present	11	0	1	0
	Sept	snorkel/foot	Geyser	1	present	9	2	1	0
2018	June-Sept	Electrofish	AGC: Hayes, Elkhorn	0	0	0	0	0	0
	Sept	Riverscape	AGC: Chicago Camp (rm 40.6) to Baltimore Camp, minus Carlson (rm 34)	208	0	6 (2 Hayes)	5 (1 Hayes)	0	0
	June-Sept	Electrofish	Geyser	0	9	0	0	0	0
	Aug	Snorkel	Geyser	7	68	5	0	0	0
	Sept	Riverscape	Geyser	6	0	33	5	3	0
	Sept	Foot	Geyser	0	0	6	6	0	0
2019	July-Sept	Electrofish	AGC: Hayes, Elkhorn	0	14 (Hayes)	0	0	0	0
	Sept	Riverscape	AGC: Chicago Camp to Baltimore Camp, minus Carlson	309	21	2 (Mary's Falls)	1 (Goldie)	0	0
	July-Sept	Electrofish	Geyser (Long Creek)	0	19	0	0	0	4
	Sept	Riverscape	Geyser	12	0	49	0	0	Present
	Sept	Foot	Geyser	0	0	8	5	0	0
	Dec	Foot	Geyser	0	0	0	0	0	**
2020	July-Aug	trib snorkel	AGC: Godkin (rm 36), Hayes, Goldie (rm 29.5)	0	0	no <i>adult</i> salmon or redds above Rica (some coho and Chinook <i>juveniles</i> present in Geyser Valley)			0
	Sept	Snorkel	AGC: Godkin to Elkhorn	89	0				0
	July-Aug	trib snorkel	Geyser (Long Creek)	0	6				0
	Sept	Snorkel	Geyser	8	16				Present
	Sept	Snorkel	Geyser	0	0				0
2021	Aug	Snorkel	AGC: Godkin to Carlson, Hayes to Goin (rm 30), Remann's (rm 28) to Canyon Camp (rm 25.5)	24	no salmon or redds above Rica Canyon				
	Sept	Snorkel	AGC: Godkin to Carlson, Hayes to Baltimore Camp	68					
	Aug	Snorkel	Geyser	5					
	Sept	Snorkel	Geyser	5					
	Sept	Snorkel	Geyser	2					

	Sept	Foot	Geyser	0	
2022	Aug	Snorkel	AGC: Hayes to Baltimore Camp	197	
	Sept	Snorkel	AGC: Hayes to Baltimore Camp	277	
	Aug	Snorkel	Geyser	15	no salmon or redds above Rica Canyon
	Sept	Snorkel	Lillian River confluence (rm 21) to Geyser	3	
	Sept	Snorkel	Geyser	12	

Notes: Location in parentheses indicates highest observation for that year. Juvenile Chinook and coho salmon were observed above Rica Canyon from 2017 through 2020 but not in 2021 or 2022; adult salmon and/or salmon redds were observed above Rica Canyon from 2016 through 2019, but not in 2020 through 2022. Winter steelhead counts are not displayed on this table (surveys are not as extensive), but redds have been observed above Rica Canyon since 2017 and as high as Hayes River (rm 32).

*Summer steelhead are consistently observed at/near the Elwha headwaters in our snorkel surveys.

**3 coho redds were observed in Geyser Valley in December 2019 (highest observation).

References:

Powers, P.D., and Orsborn, J.F. 1985. An Investigation of the Physical and Biological Conditions Affecting Fish Passage Success at Culverts and Waterfalls. Albrook Hydraulics Laboratory, Department of Civil and Environmental Engineering. Washington State University. Pullman, WA.

Ruggerone, G.T. 2006. Evaluation of Salmon and Steelhead Migration Through the Upper Sultan River Canyon Prior to Dam Construction. Natural Resources Consultants, Inc. Seattle, WA. 23 pp.

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