Drought resilience for Nicola River salmon

Eight policy solutions to benefit wild salmon in an age of water scarcity.

2024 04 10 | Raincoast Conservation Foundation

Drought resilience for Nicola River salmon. Raincoast Conservation Foundation, 2024 https://doi.org/10.70766/912.482

RAINCOAST
CONSERVATION FOUNDATION

Executive summary

Drought is rapidly becoming a serious threat to water security and aquatic ecosystems in British Columbia. Droughts are driven both by climate change and unsustainable land use practices that exacerbate water scarcity. Drought impacts such as low streamflows and high water temperatures pose a serious threat to wild pacific salmon already facing cumulative stressors from habitat loss, climate change, and overexploitation.

Using publicly available hydrometric and water licence data, we conducted an ecological audit of BC's Water Sustainability Act to determine if current policies were adequately addressing drought in the semi-arid and highly agricultural Nicola basin. Our analysis determined that since the Act came into force, flows in salmon-bearing streams are consistently below the Critical Environmental Flow Threshold—the minimum amount of flow required to support salmon—during the summer spawning season. High water temperatures were also identified as a frequent occurrence.

Our analysis of provincial water licence data also shows that just three larger users account for over half of all water use in the Nicola basin. Provincial water restrictions intended to protect fish populations during drought have only occurred twice in history, in 2009 and 2015, and were significantly delayed in their implementation. We offer eight policy solutions to improve outcomes for salmon during droughts:

1. Establish a water withdrawal schedule for large users,
2. Legislate a trigger between low streamflows and water restrictions,
3. Place a moratorium on new water licences,
4. Expand the list of Sensitive Streams under section 17 of the Water Sustainability Act,
5. Introduce a universal water metering program,
6. Initiate an immediate review of large water licences,
7. Develop new ecosystem-based Environmental Flow Needs criteria,
8. Incentivize a shift away from water-intensive agriculture in drought-prone regions.

https://doi.org/10.70766/912.482

Background

The summer of 2024 is shaping up to be one of the most devastating drought years in history. The province's snowpack, which is the largest source of water in the summer, is on average 63% of normal levels, with some regions like Vancouver Island 46% of normal. Last summer, low rainfall records were set across the province, with many regions recording their driest summers in history. In BC, droughts are expected to get worse as a result of climate change as glaciers retreat, precipitation falls as rain in the winter instead of snow, and summer air temperatures rise.

The issue

Climate change

British Columbia is experiencing rapidly shifting weather patterns and hydrological regimes as a result of ongoing climate change. A reduction in snowpack, earlier spring melts and warmer summer temperatures will result in increased drought risk across the province[1]. As droughts become more prevalent, conflicts between human freshwater needs and the needs of aquatic ecosystems will also become more frequent. As a result, streams, rivers, and lakes located in historically arid regions of the province, like the Okanagan and Thompson-Nicola, are becoming increasingly water stressed.

Drought

Droughts are fueled both by climate change and land use practices that alter hydrological systems and make watersheds more vulnerable to drier conditions. In the semi-arid interior regions, water diversions for agricultural irrigation are the main land-use driver of drought conditions in the summer[2][3]. Urban sprawl, forestry, and industry also play a role in reducing water availability.

---

[1] Dierauer, JR., Allen DM., Whitfield PH (2021) Climate change impacts on snow and streamflow drought regimes in four ecoregions of British Columbia. Canadian Water Resources Journal 46(4): https://doi.org/10.1080/07011784.2021.1960894

[2] Okanagan Basin Water Board, Water Supply & Demand Project (2019) https://obwb.ca/wsd-index/key-findings/water-use/
[3]Nicola Watershed Community Round Table, Nicola Water Use Management Plan (2010) https://www.nwcrt.ca/water-use-management/

https://doi.org/10.70766/912.482

Drought has a number of serious consequences for aquatic ecosystems and wildlife. Droughts result in low streamflows, which impair salmon spawning activity, reduce juvenile survival, diminish available habitat, and disconnect migration routes[4]. Low streamflows are associated with high water temperature and low dissolved oxygen, which further disrupt the ecological processes that make a stream healthy. Impacts to wild salmon have cascading consequences for the broader ecosystem as well as human communities that are inextricably linked to healthy salmon returns.

Nicola River salmon

The Nicola River is a major tributary of the Thompson River and is part of the Fraser River basin. Located in the semi-arid interior in traditional Nlaka'pamux and Sylix territory, the Nicola watershed is home to several populations of wild Pacific salmon, some of which are listed as threatened or endangered[5]. Drought, and its impacts on river flows and water temperatures, has been identified as a key driver of decline for wild salmon populations in the Nicola.

Policy context

The Water Sustainability Act is the primary piece of provincial legislation governing the quantity and quality of fresh water in BC Introduced in 2016, the Act includes important provisions for the freshwater needs of aquatic ecosystems. Two key terms in the Act are Environmental Flow Needs (EFN) and Critical Environmental Flow Threshold (CEFT)[6]. These terms acknowledge the impact that water extraction has on streamflows and the health of aquatic ecosystems more broadly.

The Water Sustainability Act: Falling short

The Water Sustainability Act is intended to protect aquatic ecosystems from drought impacts. However, our analysis of streamflows and water temperature in the Nicola watershed shows that

[4] Fisheries and Oceans Canada, Extreme Environmental Impacts on Pacific Salmon (2023) https://www.pac.dfo-mpo.gc.ca/pacific-smon-pacifique/environmental-impacts-environnementaux-eng.html
[5] COSEWIC, List of Wildlife Species Assessed (2022) https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-list-species-assessed.html
[6] Ministry of Water, Land, and Resource Stewardship, Environmental Flow Needs Policy (2016) https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-licensing-and-rights/efn_policy_jan-2022_signed.pdf

https://doi.org/10.70766/912.482

salmon-bearing streams have consistently not been meeting EFN criteria since the Act was brought into force in 2016. Specifically, our study found the following:

1. Streamflows in salmon-bearing streams are consistently below the Critical Environmental Flow Threshold during the late-summer migration and spawning period.

In the Coldwater River, for example, streamflows have been below the CEFT during the salmon spawning and migration period every summer since 2016 (Figure 1). Flows below the CEFT result in "significant and irreversible impacts" on the aquatic ecosystem. In all streams analyzed, the number of days each year where streamflows are below the CEFT is increasing over time.

2. High water temperatures (> 18ºC) are a common occurrence each summer.

Our analysis of water temperature data in the Coldwater River, an important spawning stream for COSEWIC Committee on the Status of Endangered Wildlife in Canada) assessed Chinook salmon, determined that summer water temperatures are exceeding 18ºC, the threshold for stress in salmonids for more than half of summer days (Figure 2). Above 18ºC, salmonids experience physiological stress that can impact their survival, migration, spawning, and foraging behaviour.

3. Water restrictions, when used, are brought in too late, and happen very rarely.

Water restrictions were introduced in the summer of 2009 and 2015 to protect fish populations during drought. On both occasions, restrictions were brought in 1-2 months after streamflows had fallen below the CEFT (Figure 3). Despite the Nicola experiencing severe drought conditions each summer since 2016, water restrictions have not been re-implemented since 2015.

https://doi.org/10.70766/912.482

4. Water diversions are ongoing and not decreasing in an appreciable way, despite rapidly drying conditions associated with climate change.

Based on publicly available data, licenced water use is at its highest in history[7] and there are currently 32 active applications for water use in the Nicola[8]. In the Nicola, just three large licence holders account for over half of all licenced water in the watershed (Figure 4).

5. No monitoring of actual water usage is occurring in the watershed.

Water licences only represent the maximum allowable volume of water diversions, not the actual usage. Agricultural water use is not metered, and very rarely monitored and recorded. Certain water licences may include a clause for the water user to monitor their actual usage, however, there is no requirement for the user to regularly report these data to the province[9].

Policy solutions

Several policy solutions exist to better mitigate the effects of drought on wild salmon and the aquatic ecosystem. We provide recommendations below and an accompanying timescale that could be politically feasible.

Short-term (6-12 Months)

1. Scheduled water withdrawals

At the local level, there is concern that simultaneous water withdrawals from multiple users in the same stream could result in significant changes to water levels and streamflows, although more research is necessary to determine the temporal and volumetric relationship between streamflows and active water withdrawals. We recommend taking a precautionary approach and adopting a water withdrawal schedule for users pumping water directly from streams. For example, a water

[7] Warkentin L, Parken CK, Bailey R, Moore JR (2022) Low summer river flows associated with low productivity of Chinook salmon in a watershed with shifting hydrology. Ecological Solutions and Evidence 3(1): e12124 https://doi.org/10.1002/2688-8319.12124

[8] Ministry of Water, Land, and Resource Stewardship, Water Rights Licences (2023) https://j200.gov.bc.ca/pub/ams/Default.aspx?PossePresentation=AMSPublic&PosseObjectDef=o_ATIS_DocumentSearch&PosseMenuName=WS_Main

[9] Ministry of Water, Land, and Resource Stewardship, Water Office, Thompson Okanagan Region, Personal communication (2024).

https://doi.org/10.70766/912.482

withdrawal schedule could minimize potential risks from simultaneous water withdrawals without impacting agricultural water needs.

2. Amend the Water Sustainability Act to allow CEFTs to trigger water restrictions

The Critical Environmental Flow Threshold is the streamflow below which significant and irreversible impacts to the aquatic ecosystem begin to occur. Therefore, preventing streamflows from falling below the CEFT should be the top priority of water managers. Currently, streamflows below CEFT do not "trigger" water restrictions, meaning that water restrictions are often brought in too late. During this lag period, salmon are experiencing both lethal and sublethal impacts and streamflows are less likely to recover above the CEFT the longer the lag period is. A legislated link between streamflows falling below the CEFT and the introduction of water restrictions would incentivize proactive water conservation and better protect salmon during their critical spawning period.

3. A moratorium on new water licences

In 1982, a federal report authored by Kosakoski & Hamilton recommended that no new water licences should be granted in the Nicola watershed given the state of streamflows, salmon populations, and expected climate impacts. Since then, the total volume of water licences has grown and there are 32 active applications currently being deliberated on. Our recommendation echoes the now 41 year old recommendation, a moratorium on all new water licences in the watershed.

Medium-term (1-3 years)

4. Add to the Sensitive Streams Designation

The Sensitive Streams Designation is a tool under section 17 of the Water Sustainability Act to protect a fish population in a particular stream from harm associated with water withdrawals. There are heightened restrictions on water licences in Sensitive Streams, including lower total volumes, mandatory mitigation measures, and stricter regulations.

There are 15 sensitive streams defined under the WSA, however, all were included in the previous Fish Protection Act. No sensitive streams are located in the Nicola River basin, despite the watershed supporting three salmon populations assessed by COSEWIC as endangered or threatened: Lower

https://doi.org/10.70766/912.482

Thompson Chinook, Interior Fraser steelhead, and Interior Fraser coho. Since the WSA came into force in 2016, no new sensitive streams have been added.

If the intent of the sensitive stream designation is to protect at-risk fish populations, then streams should be periodically re-evaluated as environmental conditions shift. COSEWIC conducts periodic reviews of salmon populations to re-assess current and future threats to their recovery in order to inform adaptive management. Including a requirement to designate spawning streams of COSEWIC assessed populations as a sensitive stream would be another tool to advance recovery efforts.

5. Introduce water metering for agricultural users

It is well established that water metering – the act of monitoring water use and charging a fee per unit of water – incentivizes water conservation and ultimately reduces consumption. Agricultural water metering has been in place in several interior BC regions, including: the Vernon Irrigation District, the Black Mountain Irrigation District, Glenmore-Ellison & Westbank Irrigation District, Summerland Irrigation Districts, and the South East Kelowna Irrigation Districts. BC's Budget 2024 announced $50 million for a pilot water metering program in 21 communities across BC. A universal, province-wide water metering system would further incentivize conservation, equitably charge users based on their consumption, and produce revenue for the province that could be used to fund water storage and conservation infrastructure.

6. Initiate a review of large, historical water licences

Water rights in BC follow a "First in time, first in right" (FITFIR) system during times of water scarcity or drought. This means that older water licences have priority over newer licences during water restrictions, and are allowed to use their full allocation first.

In the Nicola, the oldest water licences are held by the largest water users in the watershed, and many licences are nearly 100 years old. The current time period to review water licences under the Water Sustainability Act is 30 years, a timeframe that does not acknowledge the rapidly advancing impacts of ongoing climate change. Water licences, particularly those held by the largest users, must be reviewed immediately to adjust their total volume and re-assess their impacts on the surrounding watershed.

https://doi.org/10.70766/912.482

Long term (3-5 years)

7. Develop new EFN criteria for the Nicola

Current EFN criteria are based on work by Kosakoski & Hamilton (1982), over 40 years ago. Research by Warkentin et al. (2022) determined that in the mainstem Nicola River, the current Critical Flow Threshold of 5.56 cm/s, which informs drought management, is too low to support the recovery of an imperiled Chinook salmon population. The study determined that decisions must be based on a Critical Flow Threshold of at least 10.6 cm/s, almost double the current value.

Extensive field and desk-based research is needed to update the nearly half-century old EFN criteria in salmon-bearing streams across the Nicola watershed, such as Spius Creek, Guichon Creek, the Coldwater River, and the Upper Nicola River. This undertaking is already underway in the neighbouring Okanagan watershed, led by the Okanagan Nation Alliance.

8. Incentivize non-ranching agriculture in a rapidly drying region

Irrigated cattle ranching is the most water intensive form of agriculture. Due to the semi-arid climate of the Nicola and other interior BC regions, the type of grasses that cattle graze on do not naturally occur on the landscape. These fields depend on irrigation to grow and survive. As drought impacts continue to worsen, it is critical that agricultural practices shift from water-intensive crops towards more sustainable and locally-adapted produce.

Conclusion

It is clear that freshwater policy needs to rapidly adapt to respond to worsening climate change and water scarcity. The Nicola watershed is under severe water stress from both climate change and human water withdrawals, with detrimental impacts on struggling salmon populations. Wild, healthy salmon populations are integral to the health of the broader ecosystem and communities that depend on them. As droughts continue to worsen, human water demands and the freshwater needs of aquatic ecosystems are increasingly coming into conflict. This is a scenario that is playing out across the province. It has been 8 years since the enactment of the Water Sustainability Act, which was intended to better balance water demands for human use and ecosystem functioning. Our

https://doi.org/10.70766/912.482

research echoes the sentiment felt by many water users, scientists, and community members in water-stressed systems across the province;the Water Sustainability Act is falling short on these goals.

Adapting the Act into a new era of drought will require a paradigm shift in government and society. Freshwater ecosystems can not be treated as an inexhaustible resource for human benefit. Water needs to be valued, protected, and conserved as it is scarce, sensitive, and the foundation of all life.

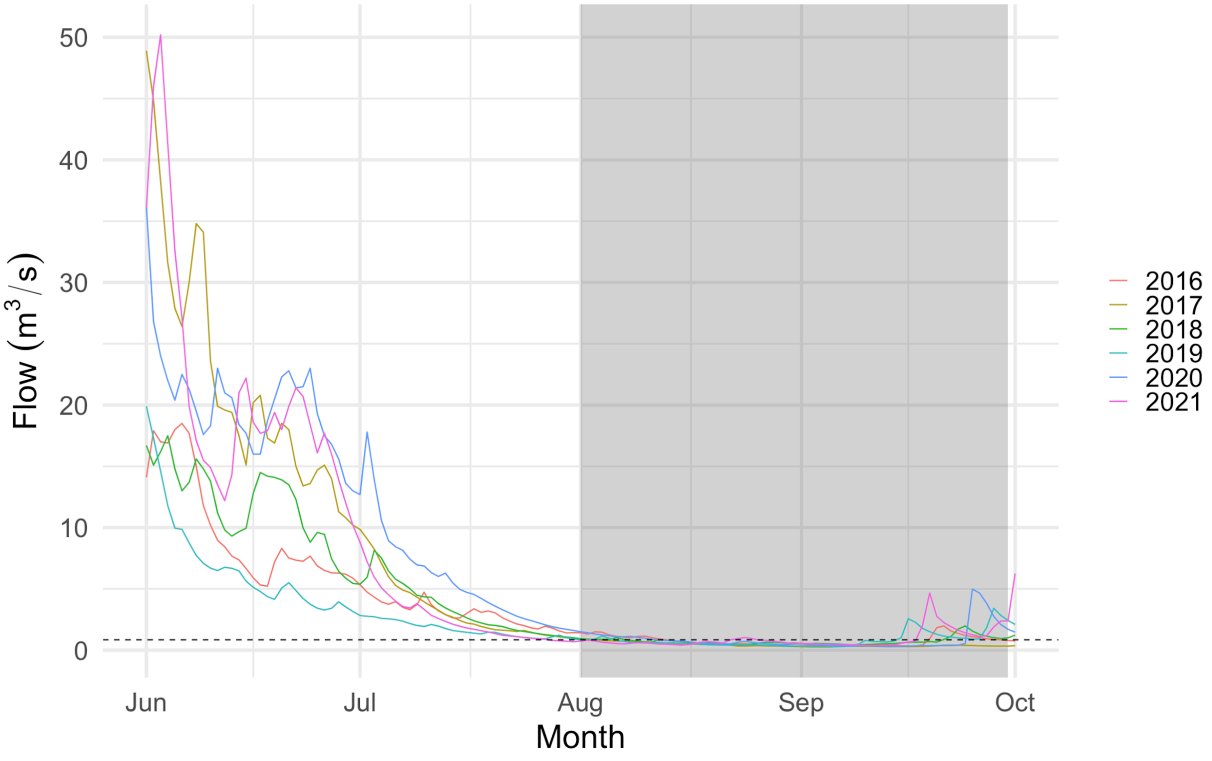
https://doi.org/10.70766/912.482

Appendix

Figure 1.

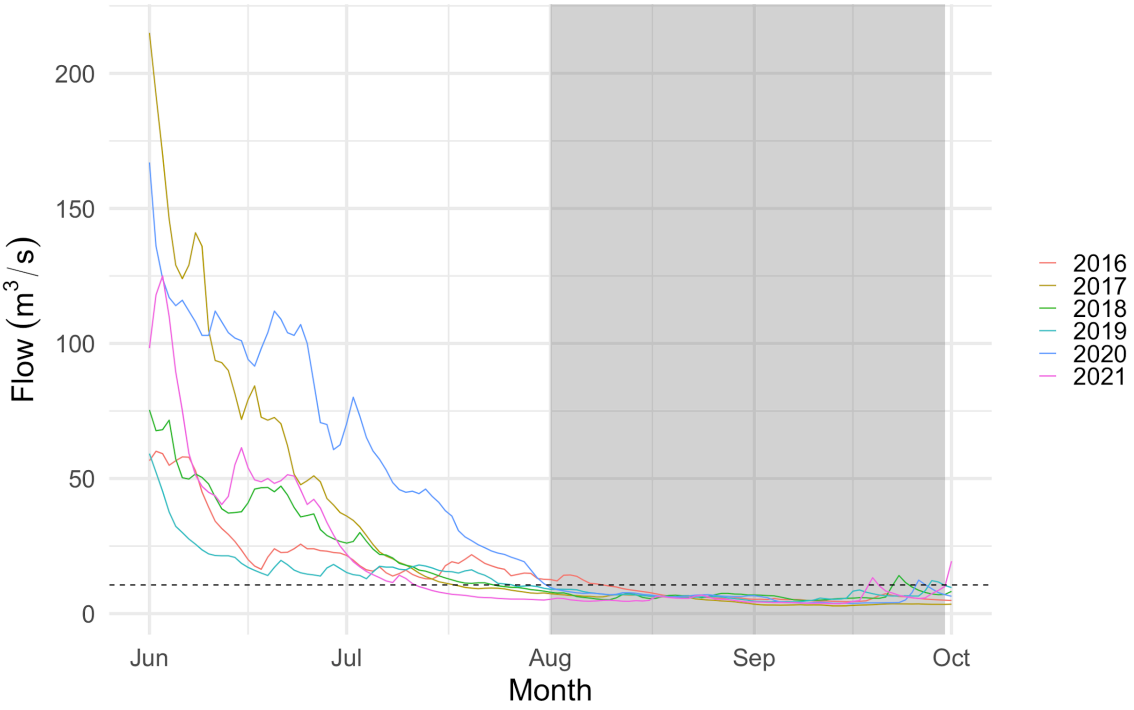
Summer (June 1 -Oct 1) streamflows (cubic meters/second) in the Coldwater River, Lower Nicola River, Spius Creek, and the Upper Nicola River between 2016 and 2021. Dashed horizontal line indicates the Critical Environmental Flow Threshold of the stream. Gray shading indicates approximate timing of salmon spawning in the Nicola watershed.

1a. Coldwater River

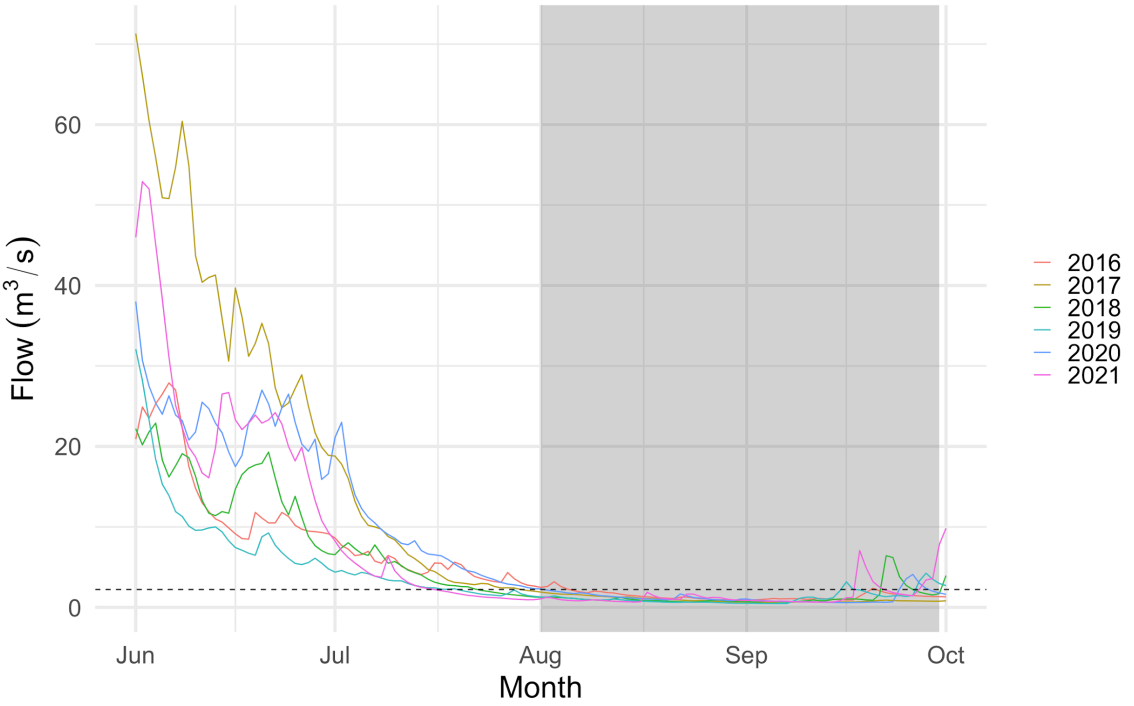


https://doi.org/10.70766/912.482

1b. Lower Nicola River



1c. Spius Creek



https://doi.org/10.70766/912.482

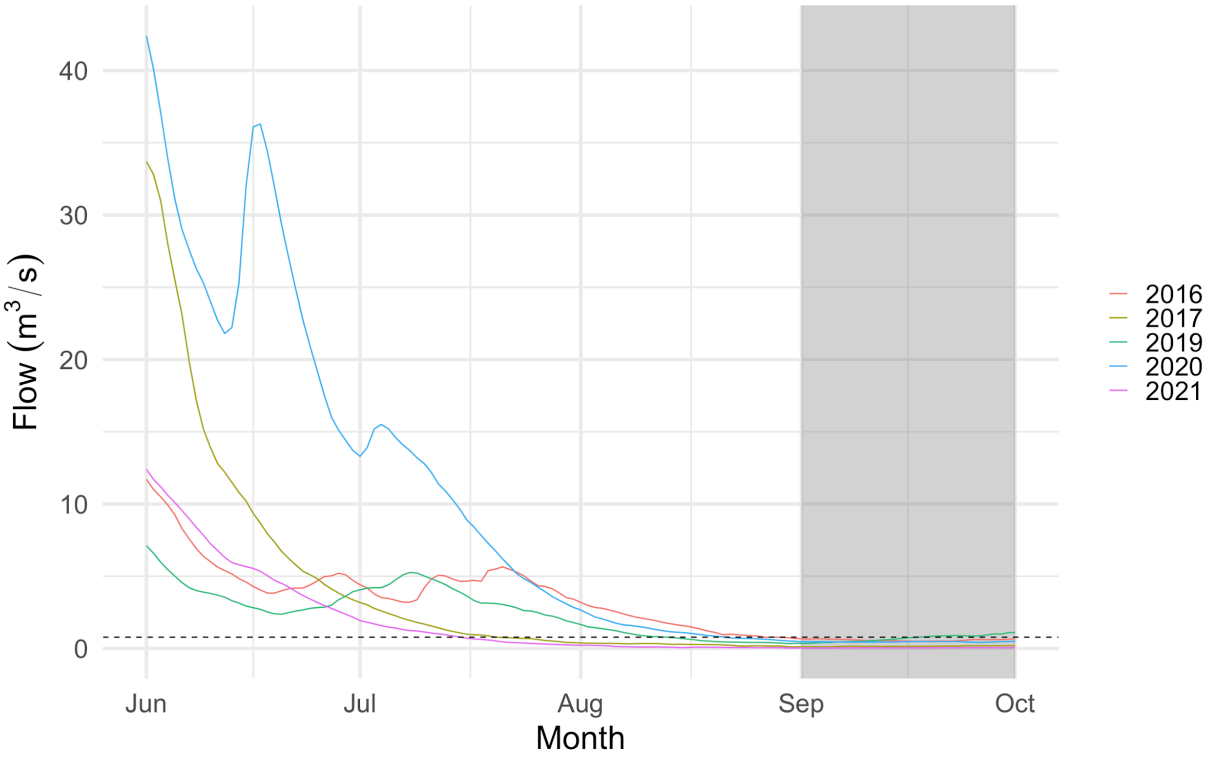


Figure 2.

Proportion of summer days (%) where water temperature in the Coldwater River is above 18°C, 2003-2022.

https://doi.org/10.70766/912.482

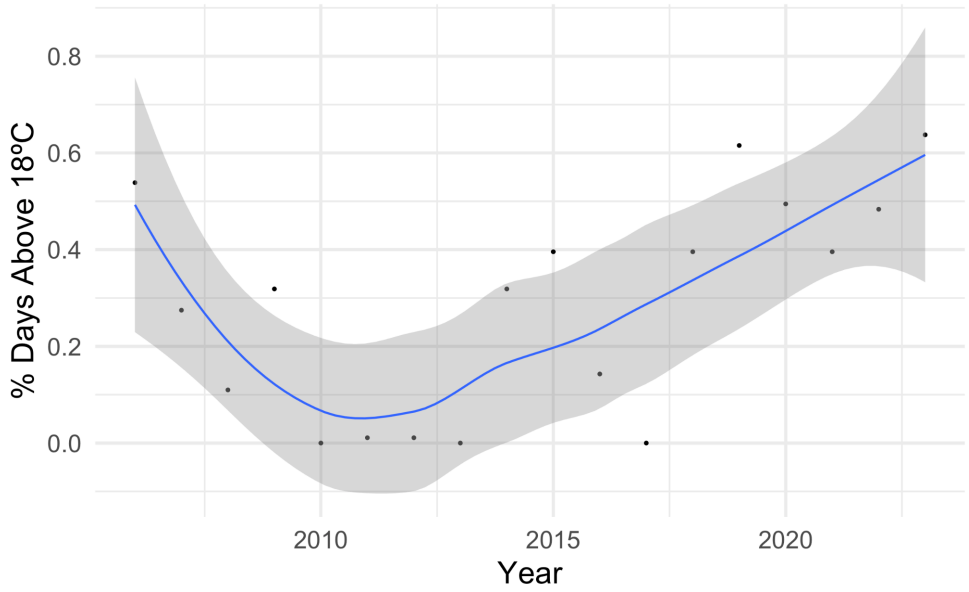
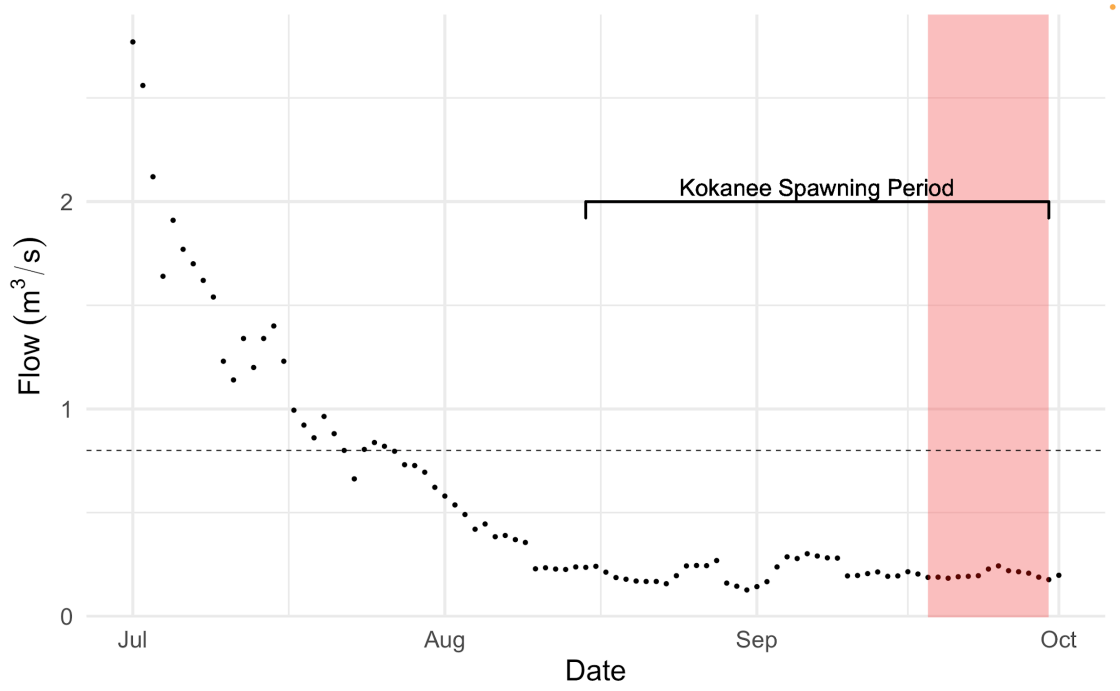


Figure 3.

Streamflows in the Nicola River and Coldwater River during the summers of 2009 and 2015 respectively. Horizontal dashed line indicates the CEFT of the stream. Red shading indicates the duration of the Fish Protection Order (FPO). The 2009 FPO in the Nicola River was intended to protect spawning Kokanee, which spawn in Nicola Lake between mid-August and October. The 2015 FPO in the Coldwater River was intended to protect spawning Chinook salmon, which spawn in the Coldwater River between June and October.



https://doi.org/10.70766/912.482

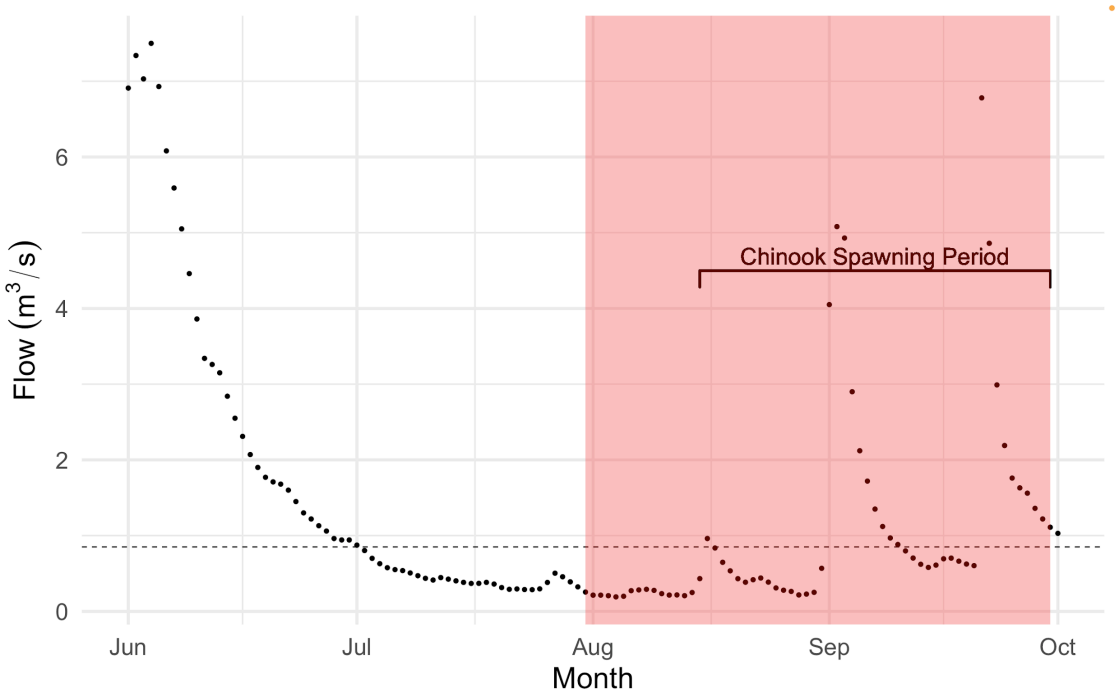
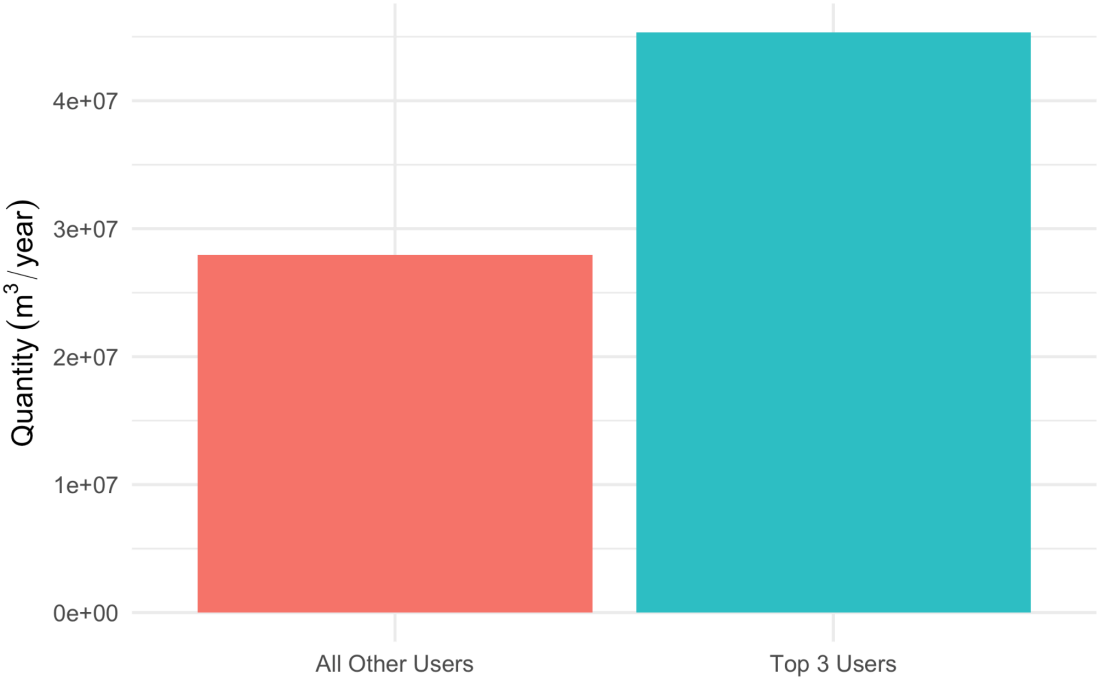


Figure 4.

Total volume (cubic meters per year) of water allocations held by the three largest users compared to all other water licence holders in the Nicola watershed.

https://doi.org/10.70766/912.482



https://doi.org/10.70766/912.482