Cowichan River Fish Mortality Event Summer 2023

Impacts to fish and how to avoid a repeat

Presentation to Cowichan Watershed Board

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BC Fisheries, West Coast Region, WLRS

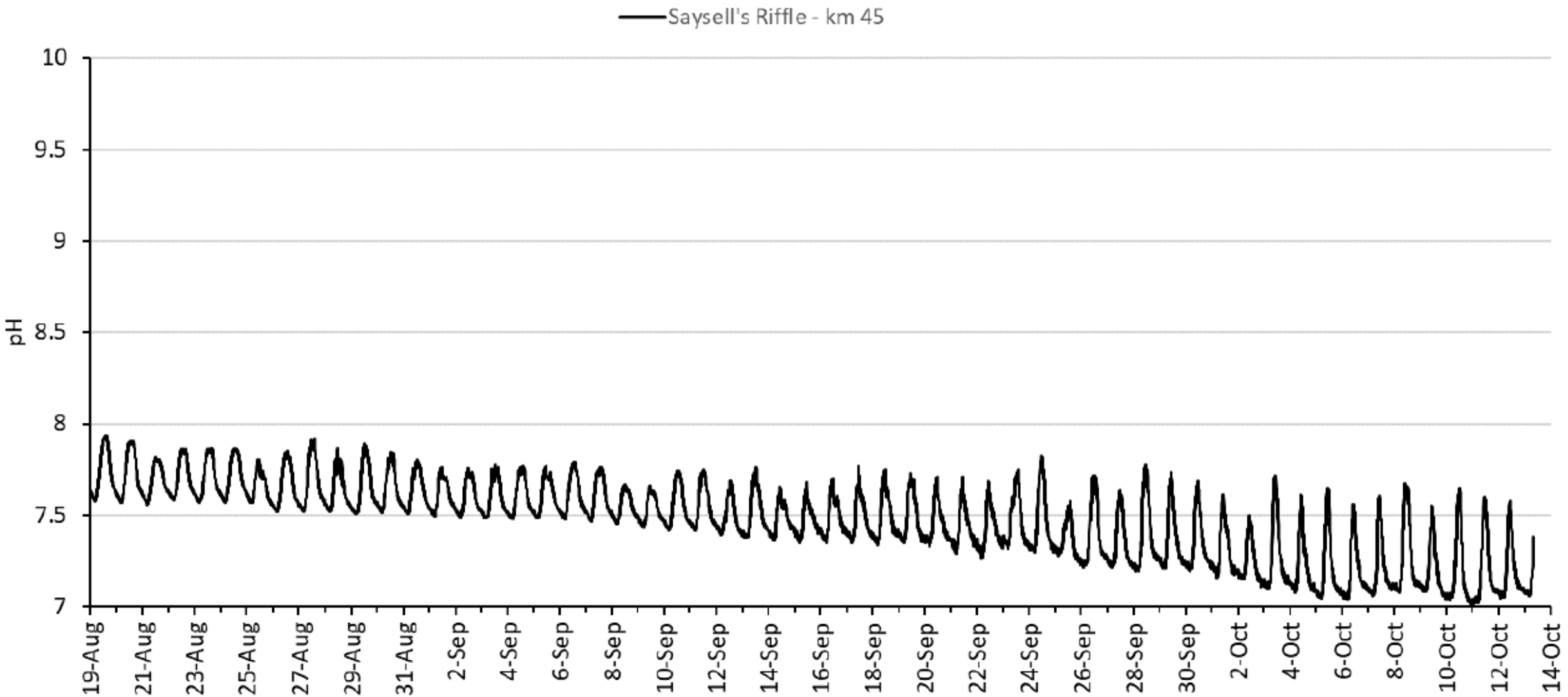
- Uncertainty in bio-data and interpretation

- Intersections
  - Management
  - Data collection

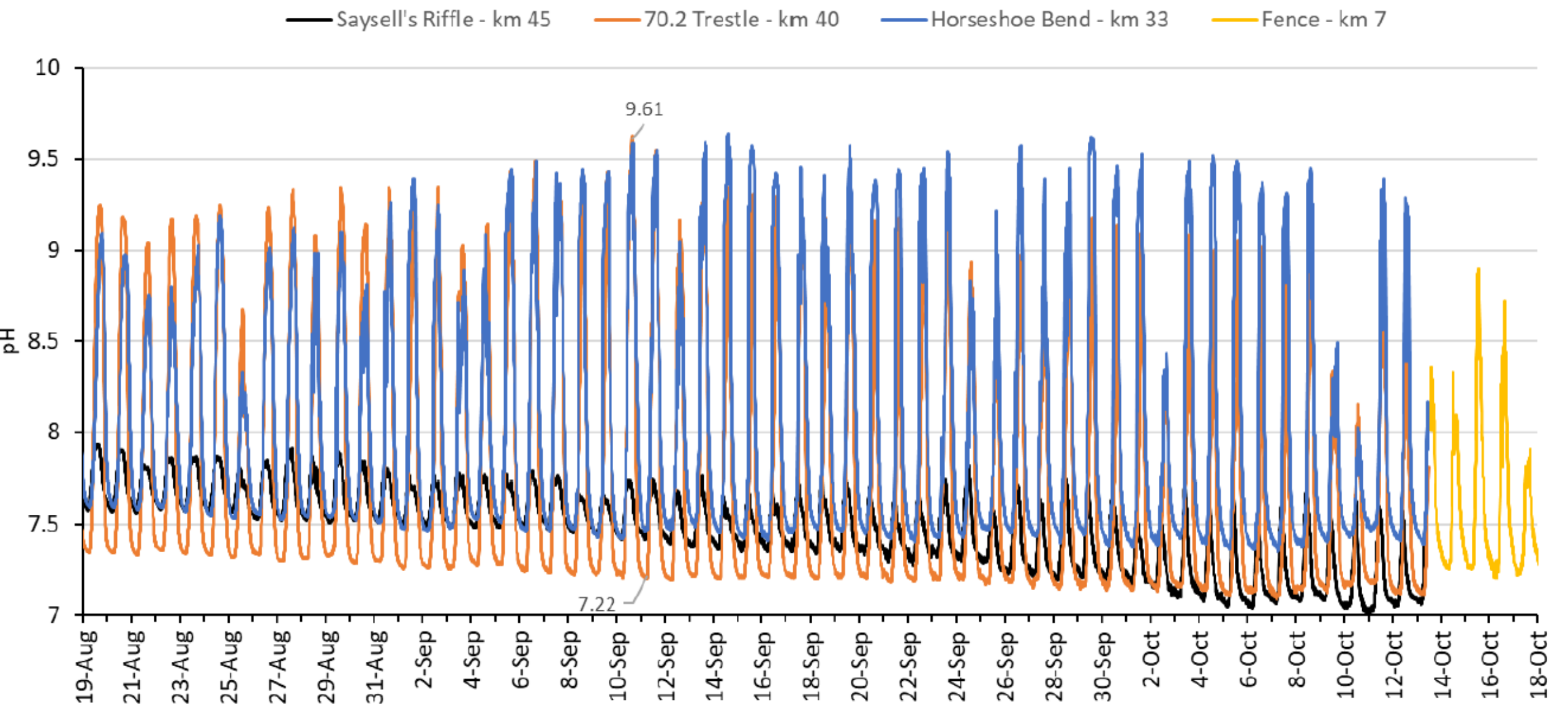
What happened in summer 2023?

- BC Gov and DFO became aware of a significant fish kill in early July 2023
- Preliminary investigation showed significant (ie bank to bank) filamentous green algal growth below the Willow Run shifting to thick brown “scummy” growth for several additional kilometers downstream
- Fish mortalities were directly observed at that time in multiple locations
  - Few fish (juveniles or adult) were observed below 70.2-Mile Trestle and only in discrete groundwater inflow “refuge” habitats
  - pH and O_2 measures were out-side of expected range for the Cowichan confirming ecosystem response to algal overgrowth was a likely cause for extreme water quality swings per day and fish mortality
- Underwater observations in late July during planned annual trout index swim revealed unusual algal growth
  - Juveniles were entirely absent between 70.2 and Skutz Falls with uncommon observations of stressed and dark resident trout
  - Electrofishing sites in October corroborated these preliminary observations on juvenile
- Episodic or unplanned water quality monitoring began with continuous loggers deployed in multiple locations

pH – Upstream (Control)



pH – All Sites


Saysell's Riffle - km 45
70.2 Trestle - km 40
Horseshoe Bend - km 33
Fence - km 7
pH
10
9.5
9
8.5
8
7.5
7
9.61
7.22
19-Aug
21-Aug
23-Aug
25-Aug
27-Aug
29-Aug
31-Aug
2-Sep
4-Sep
6-Sep
8-Sep
10-Sep
12-Sep
14-Sep
16-Sep
18-Sep
20-Sep
22-Sep
24-Sep
26-Sep
28-Sep
30-Sep
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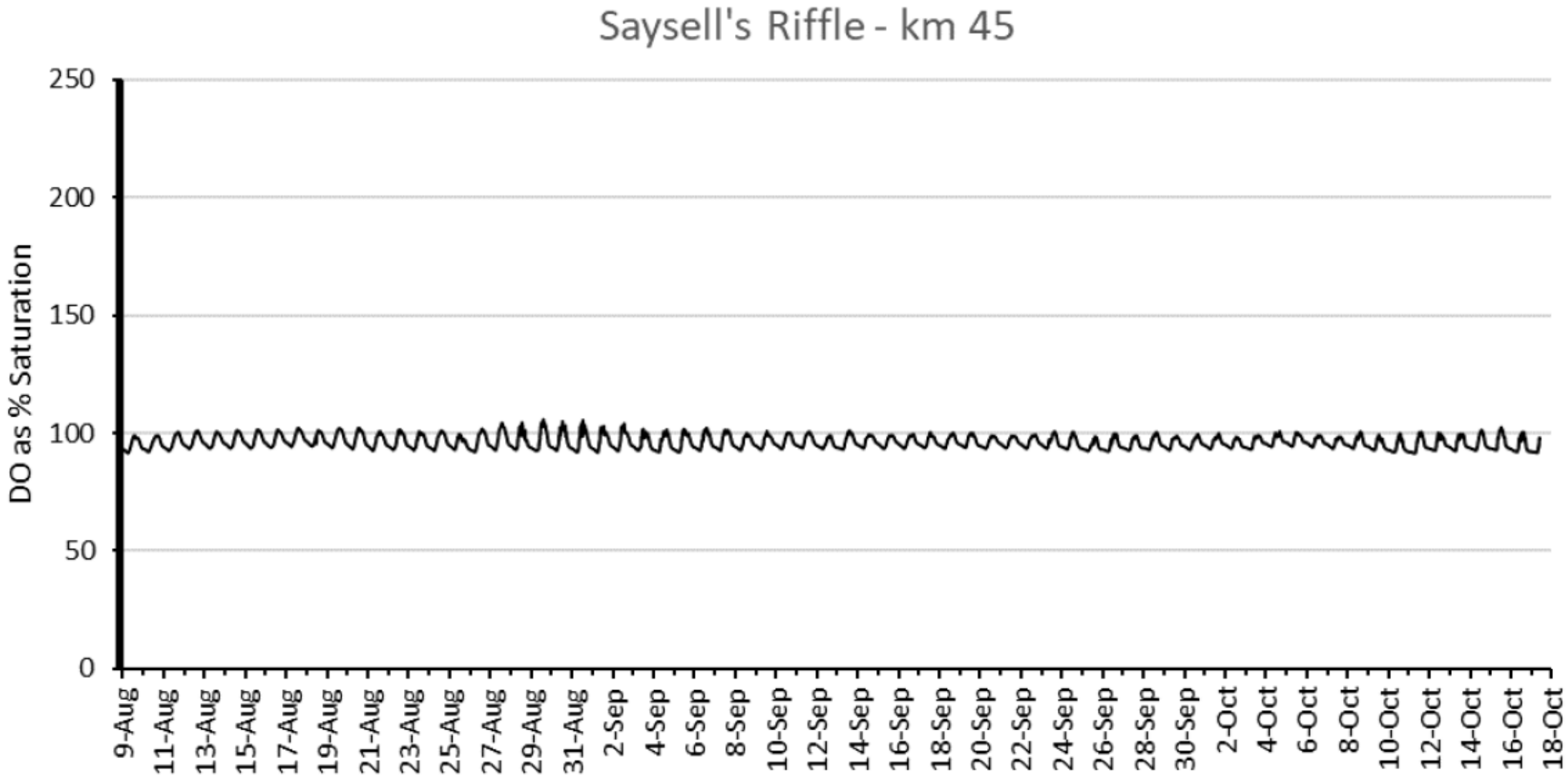
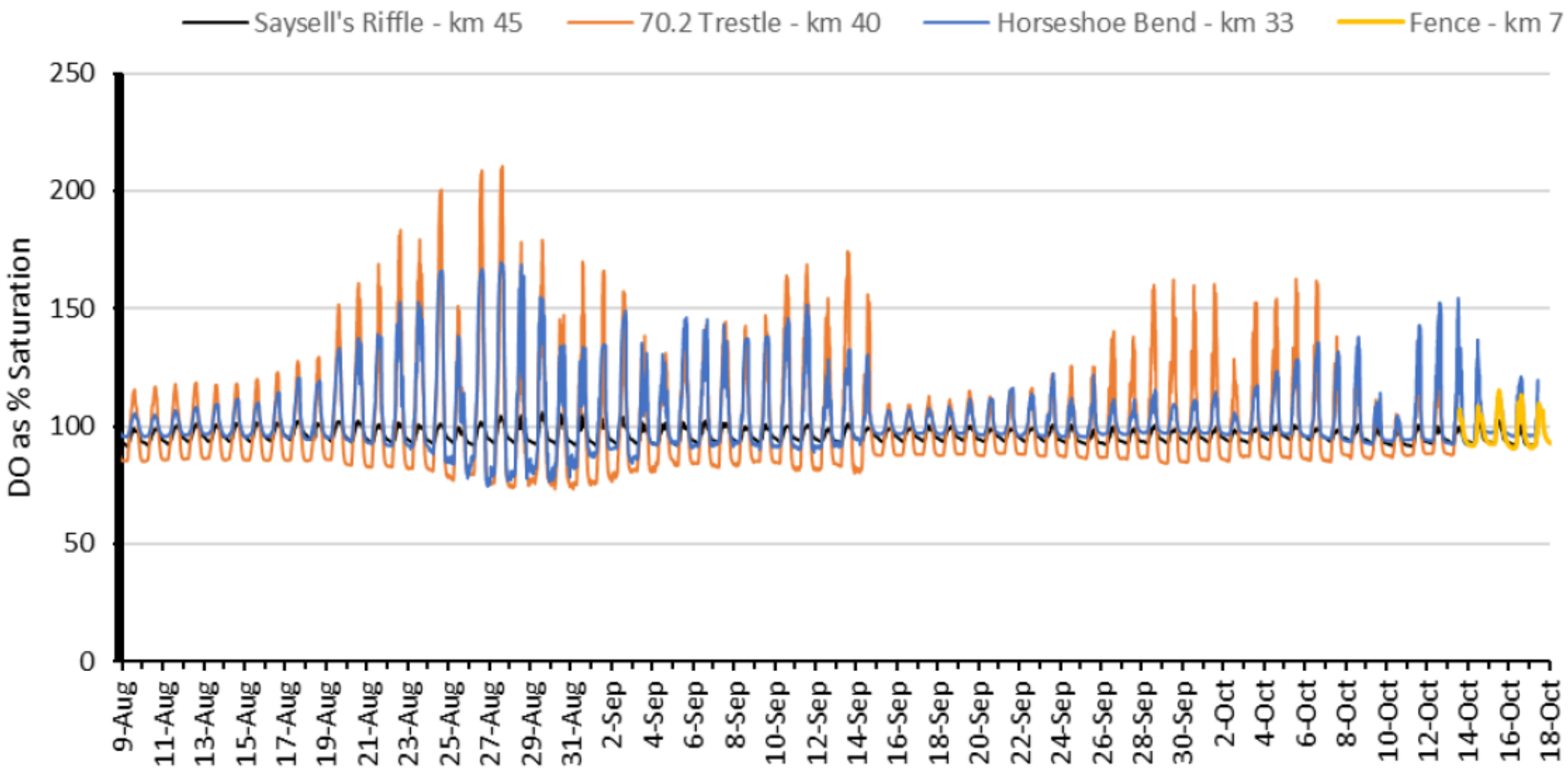
10-Oct
12-Oct
14-Oct
16-Oct
18-Oct

Dissolved Oxygen – Upstream Site (Control)



Dissolved Oxygen – All Sites



Why did it happen?

- This event happened during normal “warm” thermal conditions and peak daylight; conditions important for algal growth– although algal overgrowth at this scale has not been documented in the Cowichan River.
- A change in algal community was noted immediately downstream of the discharge pipe for the Village of Lake Cowichan which shifted in nature from filamentous green species to scummy brown clumping forms and eventually sloughing off into piles of small particular organic matter (SPOM).
- Fish mortality occurred kilometers downstream as water quality degraded in response to algal overgrowth, sloughing and decay.
- Nutrients are critical to algal growth with nutrient loading broadly established as a primary causative factor in nuisance algae growth globally.
- Flows in the Cowichan were lower (4.5 CMS) than target values (7 CMS), reducing dilution of effluent of an unknown level of effluent discharge; 2017 permit allows for a maximum of 4500 m^3/day.
- As the **underlying conditions have occurred historically without previously described harm to fish**, it is not clear why the ecosystem responded in the way it did in 2023 but there are likely several important factors.


Lake Cowichan July 19


Upper River July 19


70.2 Trestle July 14


Vimy July 19

COWICHAN RIVER AT LAKE COWICHAN (08HA002)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	mad
2022	85.8	47.7	53.3	53	45.6	25	7.37	7.23	8.7	8.21	20.3	36.2	33.2
2021	134	43.9	46.7	29.2	16.4	12.4	7.11	4.92	6.63	68.9	154	105	52.4
2020	135	124	34.5	25.2	24.8	11.9	7.37	7.35	13	31.8	70.7	86.3	47.7
2019	134	44.3	17.4	23.7	15.8	6.28	4.46	4.45	4.65	25.8	34.7	49.5	30.4
2018	98.5	105	31.8	57.8	24.3	12.5	6.59	4.75	6.07	18.8	64.1	134	47
2017	53.3	74.5	86	105	47.4	13	7.29	6.78	6.8	23	104	89.7	51.4
2016	82.9	120	116	35.8	10.7	4.53	4.54	4.51	4.62	52.2	128	68.3	52.7
2015	71.7	96.3	43.4	43	11	5.93	5.85	5.02	8.94	24.1	78.6	138	44.3
2014	49.4	41	84	65.6	28.3	10.8	5.02	4.74	4.73	28.3	86.5	123	44.3
2013	48.1	47.4	87.9	58.3	31.9	15.5	7.4	7.03	14.7	42.6	28.2	21.6	34.2
2012	97.9	76.9	67.4	69.7	48.3	18.5	13.1	7.9	6.79	14.9	71.9	93.7	48.9
2011	108	71.3	84.5	67.1	48.8	29	10.4	8	8.69	36.3	52.4	62.8	48.9
2010	125	71	54.5	74.8	37.8	26.4	6.58	6.2	6.15	34.2	63.8	115	51.8
2009	55.7	29.2	38.1	45.6	32.2	10.4	6.54	6.21	5.97	15.8	147	97	40.8
2008	72.5	41	45.7	29.2	41.3	21	10.1	7.78	14.1	20.9	62.7	35.3	33.5
2007	127	67.2	112	60.7	29.5	14.5	8.06	8.8	10.2	53.6	75.3	108	56.2
2006	161	92.9	45.3	39	25.9	18.8	5.96	6.17	4.3	5.72	143	118	55.5
2005	96	62.8	20.2	74.5	33.4	16.2	9.32	7.02	7.39	18.3	80	55.1	40
2004	86.3	70.3	41.1	30.4	14.1	7.68	4.7	4.77	7.55	22.3	73.8	86.3	37.4

Impacts to Fish in the Upper Cowichan River, Summer 2023

Species	Ecotype	Impact on sub-adults	Impact on Adults	Future Recruitment	Conservation Objective
Rainbow	Steelhead	Severe	N/A	Moderate / High	• Maximise adult distribution, survival and future recruitment in upper Cowichan River in impacted reach
	Stream Resident	High	High	Moderate	• Maximise survival in Upper Cowichan in impacted zone through constrained fisheries and reduced interception in non-targeted fisheries
	Lake Type	Low	Low	Low	• This abundant ecotype appears to have low overall exploitation in lake and should be able to support C+R in-river fisheries during the spring period
Brown Trout	Stream Resident	Low	High	Moderate / Low	• Reduce interception in non-targeted fisheries that represent a significant component of overall catch. • Future recruitment from key tributaries should be unimpacted
Cutthroat Trout	All	Low	Low	Low	• Limited impact to CCT where abundance is driven by a highly regulated, sustainable, lake-based fishery • Low adult numbers in all years

Definition of impact: Low =< 10%, Moderate =10 – 20%, Moderate/High = 20 – 40%, Severe = > 40%

Data to Inform Impacts and Future Management Decisions

- Annual summer snorkel observations over decades counting large fish (Browns, CCT, Rb and Chinook) and recording juvenile fish abundance (low-high) by life-stage
- Annual steelhead juvenile density surveys (25 years) throughout Cowichan River mainstem
- Annual Steelhead Harvest Questionnaire tracking use and catch over time
- Intensive water quality monitoring, reporting and monitoring sites
- Lake-based investigations of CCT habitat use, abundance and exploitation
- Preliminary RBT exploitation study with strong inference into river-based fisheries

Juvenile Steelhead Electrofishing

- 10 total population removal electrofishing sites completed annually for 25 years at fixed-location stations
- Sites spaced from Highway Bridge in Duncan (Site#1) to Saysell's Riffle in the upper river (Site#10)
- Densities or fry recruitment relate to adult steelhead/rainbow spawned in that Brood Year
- Densities will not exceed the limit of carrying capacity. This biomass level is rarely observed elsewhere as Cowichan has the highest capacity of any known **steelhead** stream on VI at about 1000 g/100 m^2 per Age or Size Class; higher values are observed in some CCT streams
- Fry recruitment and counts highly sensitive to number of large bodied-steelhead that contain more eggs per female spawner


10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
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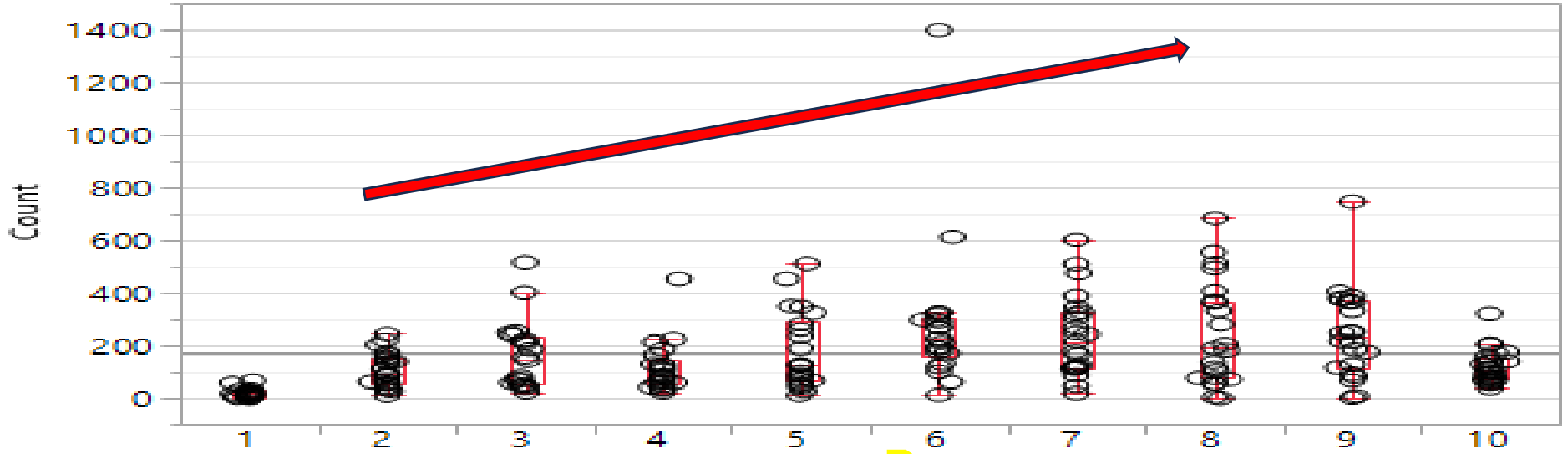
photarium@wildfishconservancy.org

Fixed stations along the mainstem Cowichan River EF Sites

Site	Site Description	Site Reference (km)
1	90 m u/s of Silver Bridge/Allenby	6.0
2	Vimy Boat Launch	13.9
3	200 m d/s Bible Camp/Sandy Pool	21.8
4	400 m u/s Rip-rap corner	25.8
5	150 m u/s Stoltz launch	26.7
6	50 m d/s Horseshoe Bend	32.3
7	750 m u/s Skutz Falls	33.7
8	Block 51 Log Jam/3 firs (d/s 100 m)	38.7
9	100 m u/s 70.2 Mile Trestle	40.0
10	Saysell's Riffle	45.0

Box Plot of Cowichan Steelhead Fry Counts (#/100m^2) by Site—Focus on Medians

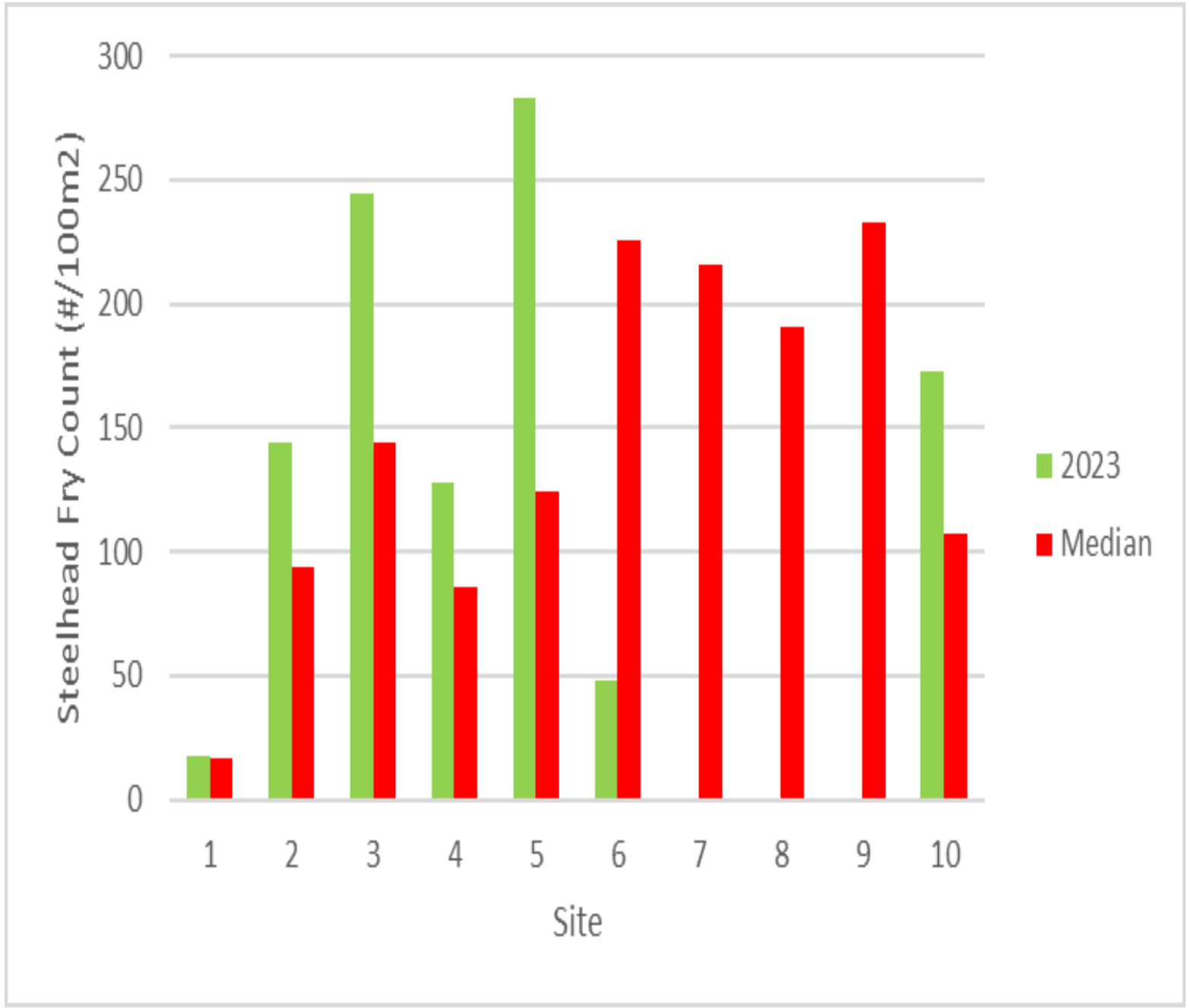
Oneway Analysis of Count By Site



Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
1	0	1.2	7	17	24.5	53	67
2	10	30.6	56	94	155	213.6	244
3	23	26.4	5	144	30.5	372.4	516
4	23	33.8	53.	86	7.5	222	454
5	11	31.5	64.	124.5	29 .75	423.1	511
6	12	73.7	161.2	225.5	30 75	526.9	1399
7	18	63.4	11	216	29	496	602
8	0	24.8	7	191	69	538.2	684
9	2	25.7	111	233	370 25	400.6	747
10	38	55.5	71.25	107	54	205.5	322

Missing Rows 25

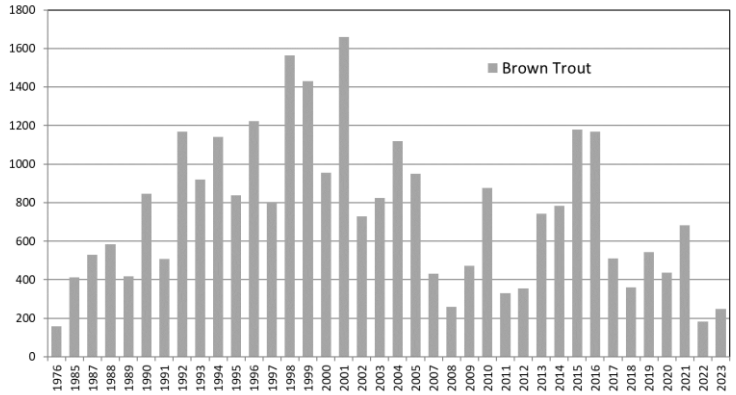


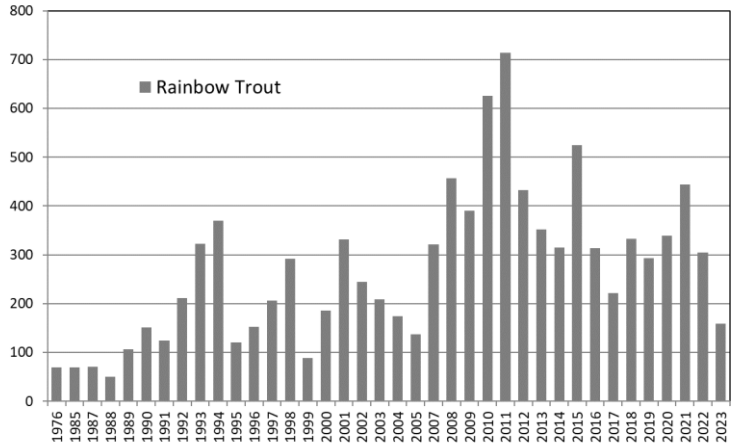
1. Perhaps some missing fish at Sites 6-9?
2. Very nice 2023 abundance at remaining sites compared to 25-year historic data.
3. The “Kill Zone” had the highest steelhead fry counts under “normal” conditions. Kill Zone is below Site 10 to Site 6 minimally. Site 5 below Stolz is healthy.
4. The fishery response has been to curtail angling through the winter and early spring to protect ST and Rb in the impacted zone.

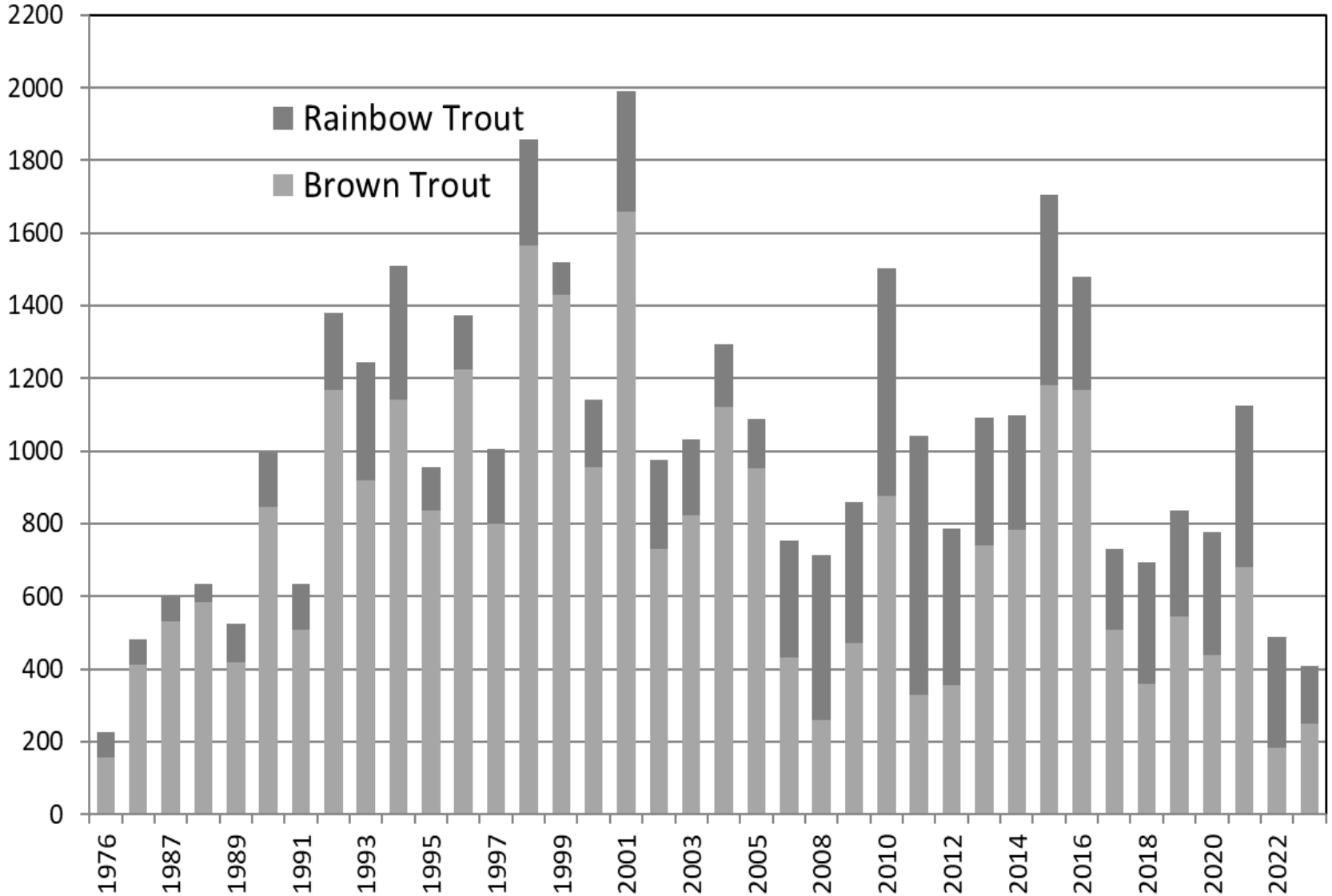
A focused view of partial impact

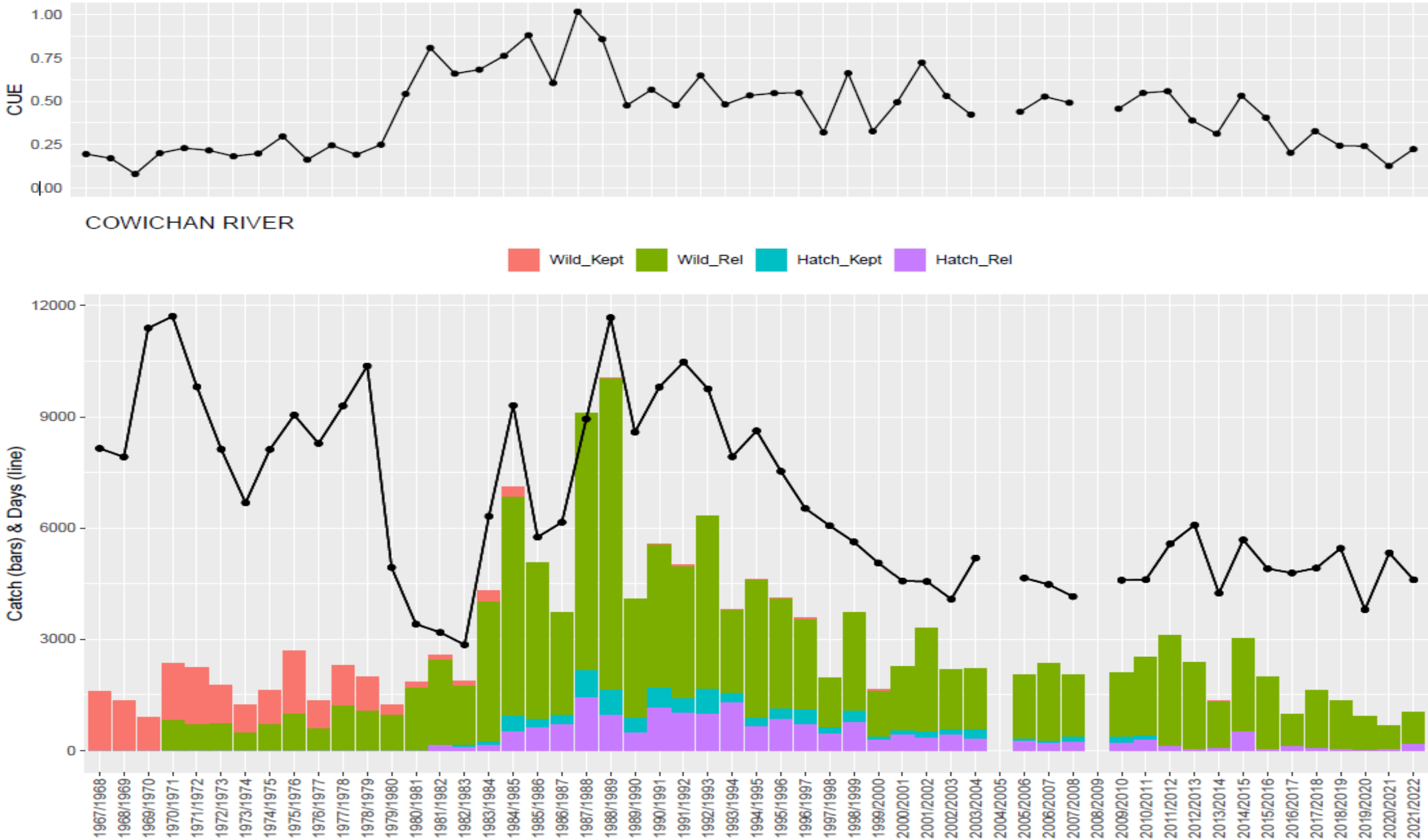
- The magnitude of the steelhead fry killed in the Upper Cowichan River is near **84 thousand**.
- The lost fry number is based on the amount of suitable space for 0+ RB in Riffles of the upper Cowichan in the dead zone at 4.5 cms. There is a trend of more fry habitat at decreasing flows.
- The magnitude of fish loss in summer 2023 is significant and has implications for continued recreation angling in the short term and long term if marine survival remains low
- This review does not address the other species and life-stages we typically account for in the annual snorkel survey. Adult RB and BT mortality could be in the low hundreds.

Upper Cowichan River – July Swim Data








CUE
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0.75
0.50
0.25
0.00
COWICHAN RIVER
Wild_Kept
Wild_Rel
Hatch_Kept
Hatch_Rel
Catch (bars) & Days (line)
12000
9000
6000
3000
0
1967/1968
1968/1969
1969/1970
1970/1971
1971/1972
1972/1973
1973/1974
1974/1975
1975/1976
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2021/2022

Regulatory Response

- All regulations imperfectly protect all values and population components while facilitating diverse fisheries
- Ad-fluvial trout fisheries appear to be a driver for use in the upper Cowichan and happen to be least impacted by the mortality event; however fluvial Rb were impacted
- Uncertainty in forward looking steelhead fisheries although they tend to be highly autoregulating (auto scale with abundance) suggest limited value in watershed wide fishery curtailment but we would like a good distribution and maximised spawning potential in currently unseeded habitats

Regional Fisheries has adopted management action(s) that will:

- Allow a reasonable opportunity to angle for unimpacted steelhead adults in the majority of the Cowichan River
- Allow a sustainable catch and release fishery on ad-fluvial rainbow trout and brown trout to occur in some times and places
- Protect stream resident trout in the areas most severely impacted by the fish kill in the summer of 2023
- Maximize steelhead distribution and facilitate protection of steelhead in the most impacted zone of the Upper Cowichan

Avoiding Future Fish kills

- Promote sewage treatment facility upgrades and adopt interim and long-term solutions to reduce nutrient concentrations in effluent (focus on P and N).

- Support a flow management process that will support target base flow conditions to dilute effluent and maximize instream productivity (ie 7 CMS) for the longest possible duration through the summer months.

    - Based on climate uncertainty, we may not be able to reasonably meet target conditions for all species and life-history stages, but part of active flow management is triaging needs based on known and likely harms to fish.

    - This may mean early decline from spring target conditions that are generally thought to facilitate fish and ecosystem benefits.