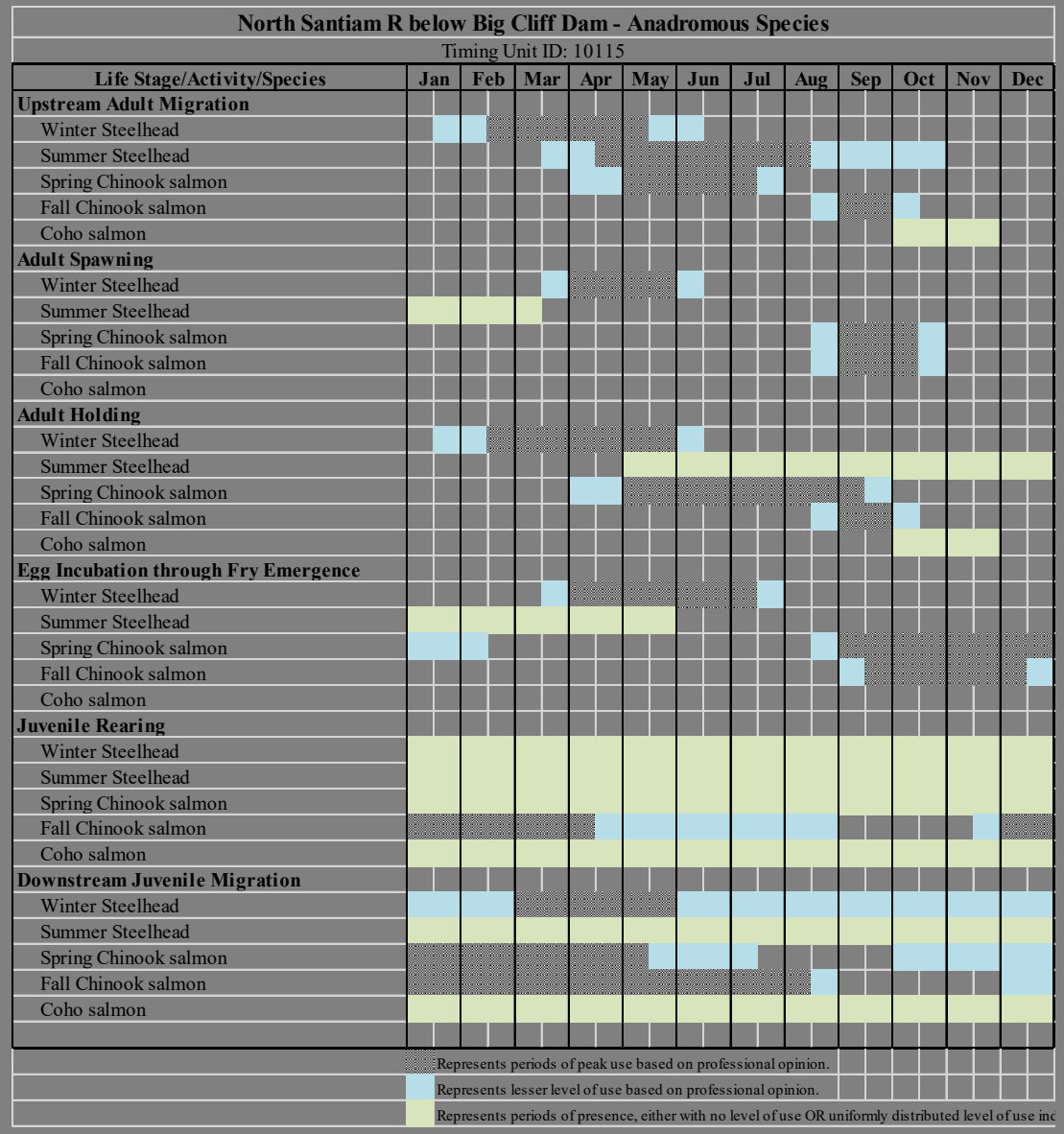
CHANGES IN HABITAT, WATER QUALITY, AND DAM OPERATIONS ASSOCIATED WITH ENVIRONMENTAL VARIABILITY: WATER YEAR 2021 V 2022

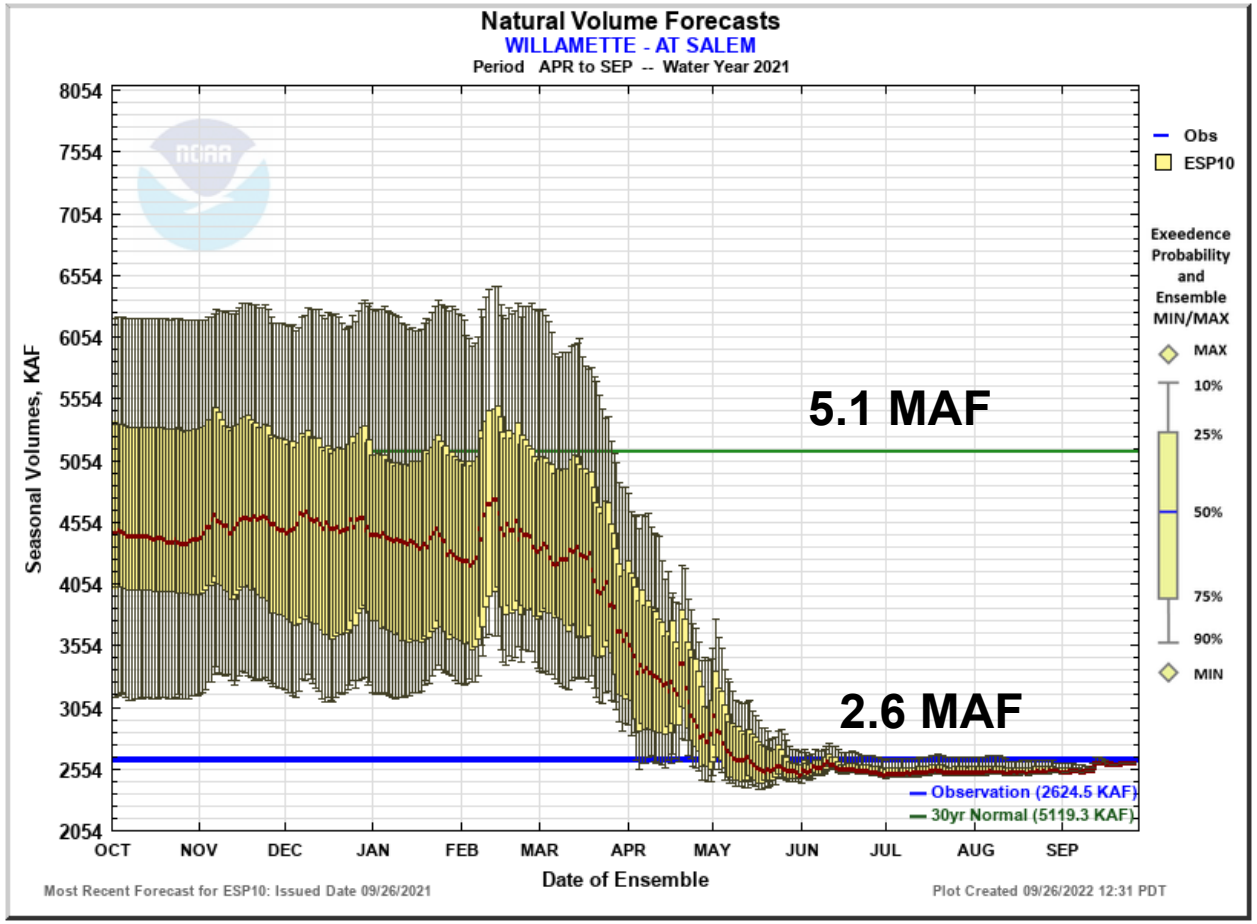
- Greg Taylor
- Supervisory Fisheries Biologist
- Willamette / Rogue Project

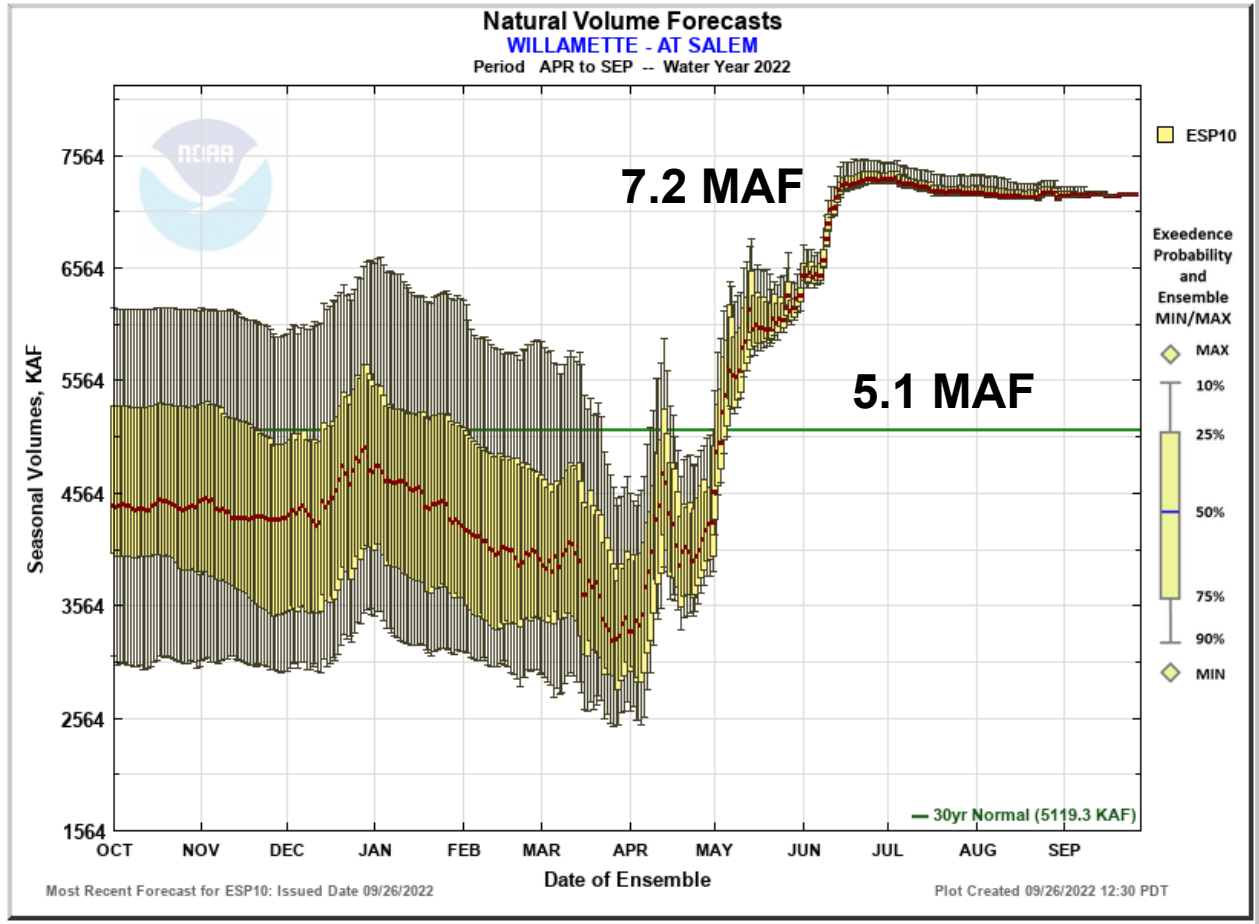
- 05 April 2023

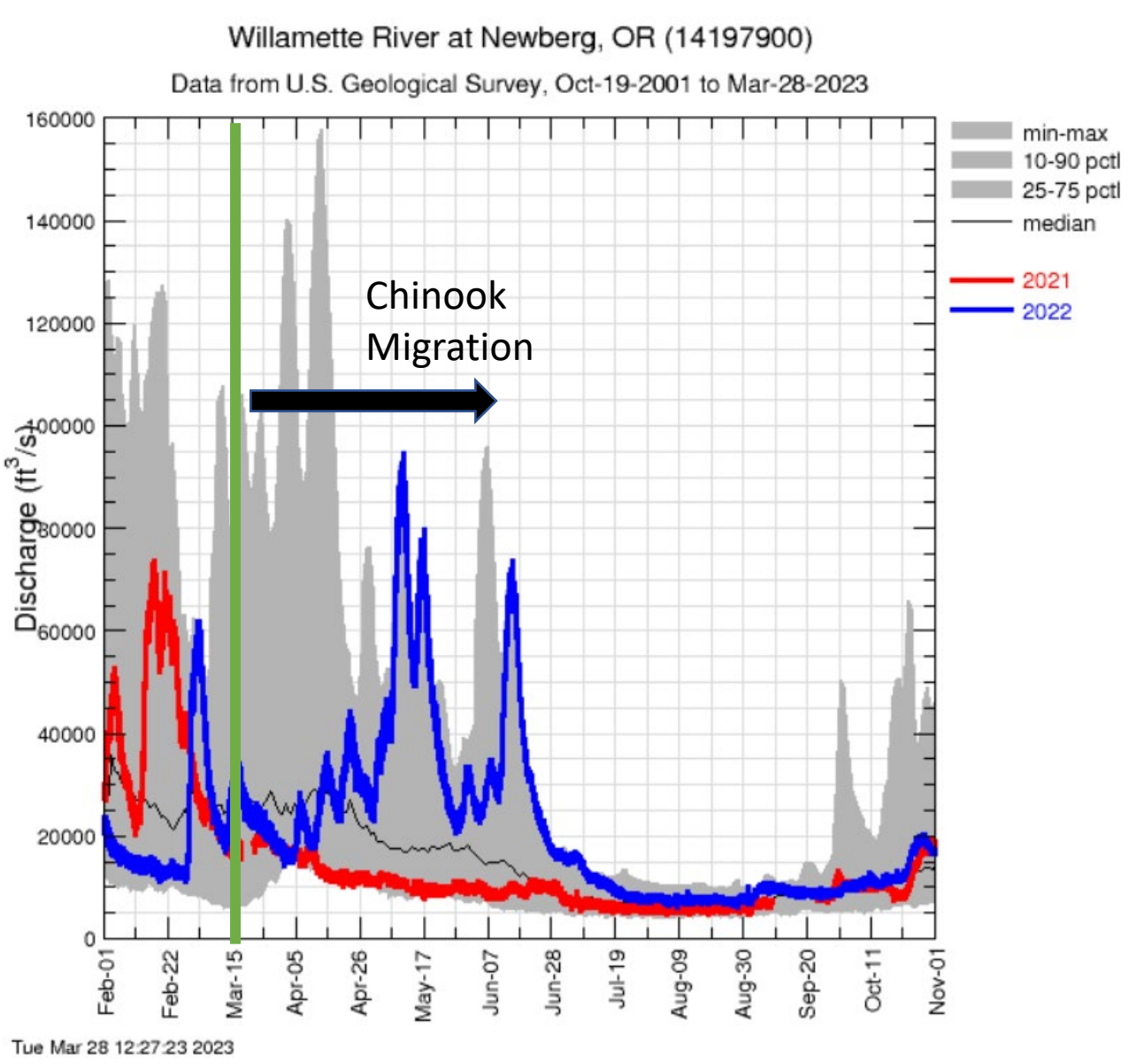
- Weather, water supply
- Rule curve
- Downstream control points
- Minimum flow
- Mainstem flow objectives
- Tributary flow objectives
- Hydropower, outage schedule
- Temperature operations
- Minimizing TDG
- Recreation - ramps
- Special operations request – RME, construction projects, maintenance
- Injunction operations – temperature control, fish passage
- Algae
- Downstream water users
- Fish life history requirements

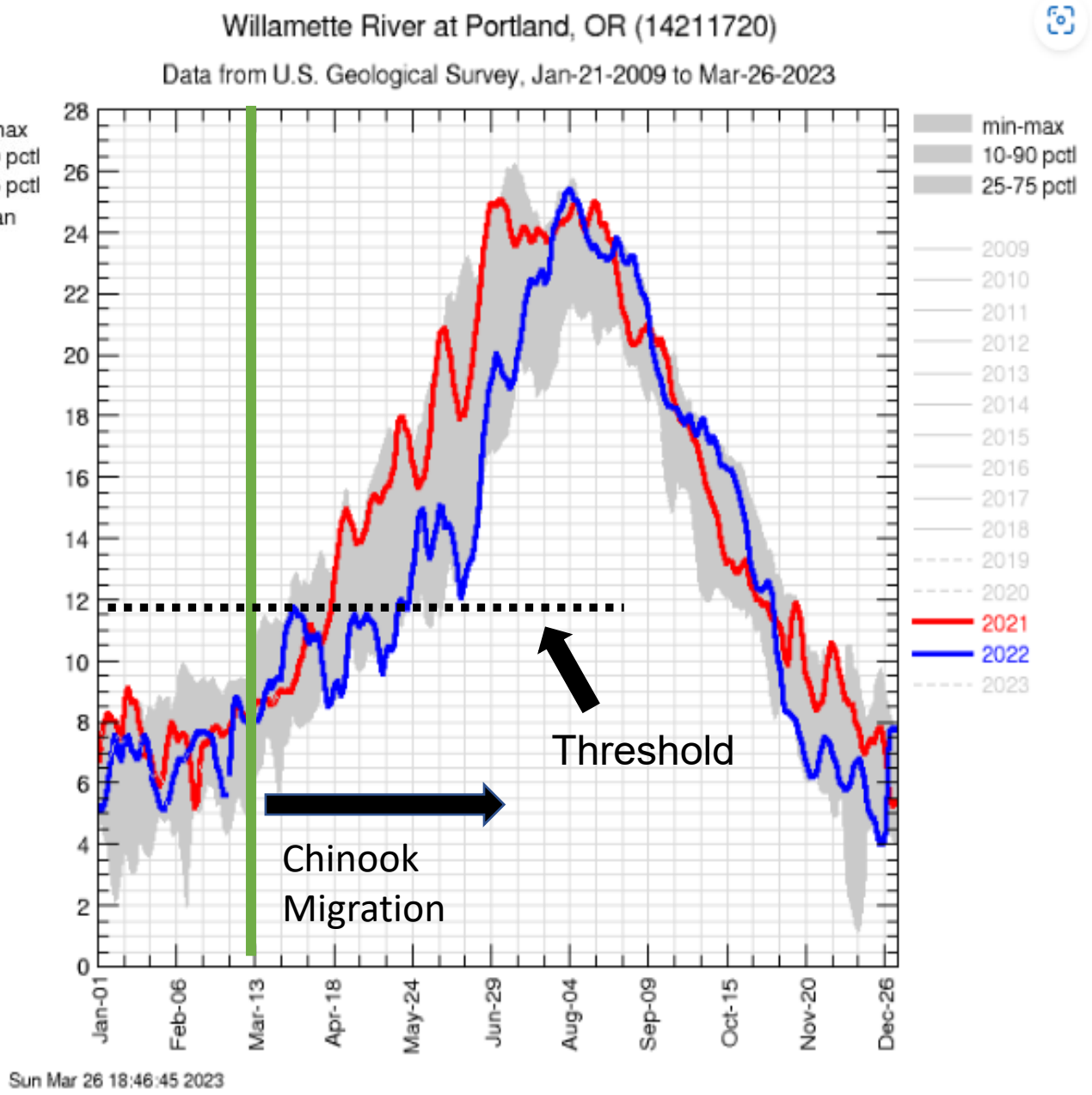


ESP10 NATURAL WATER SUPPLY FORECAST (SALEM)
2021 V 2022



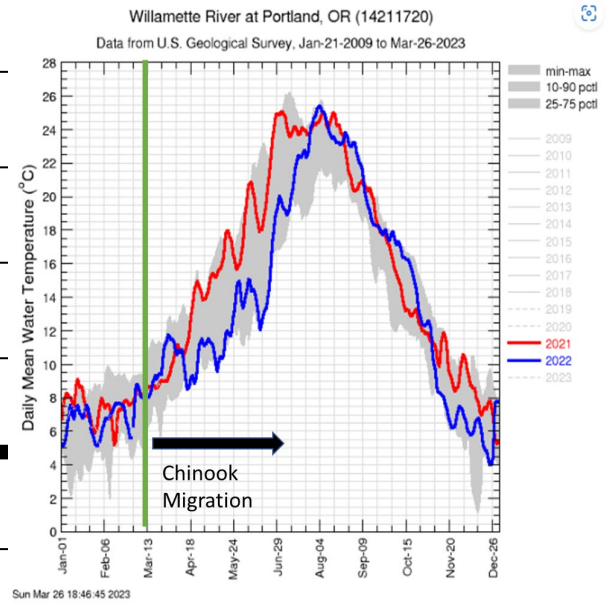


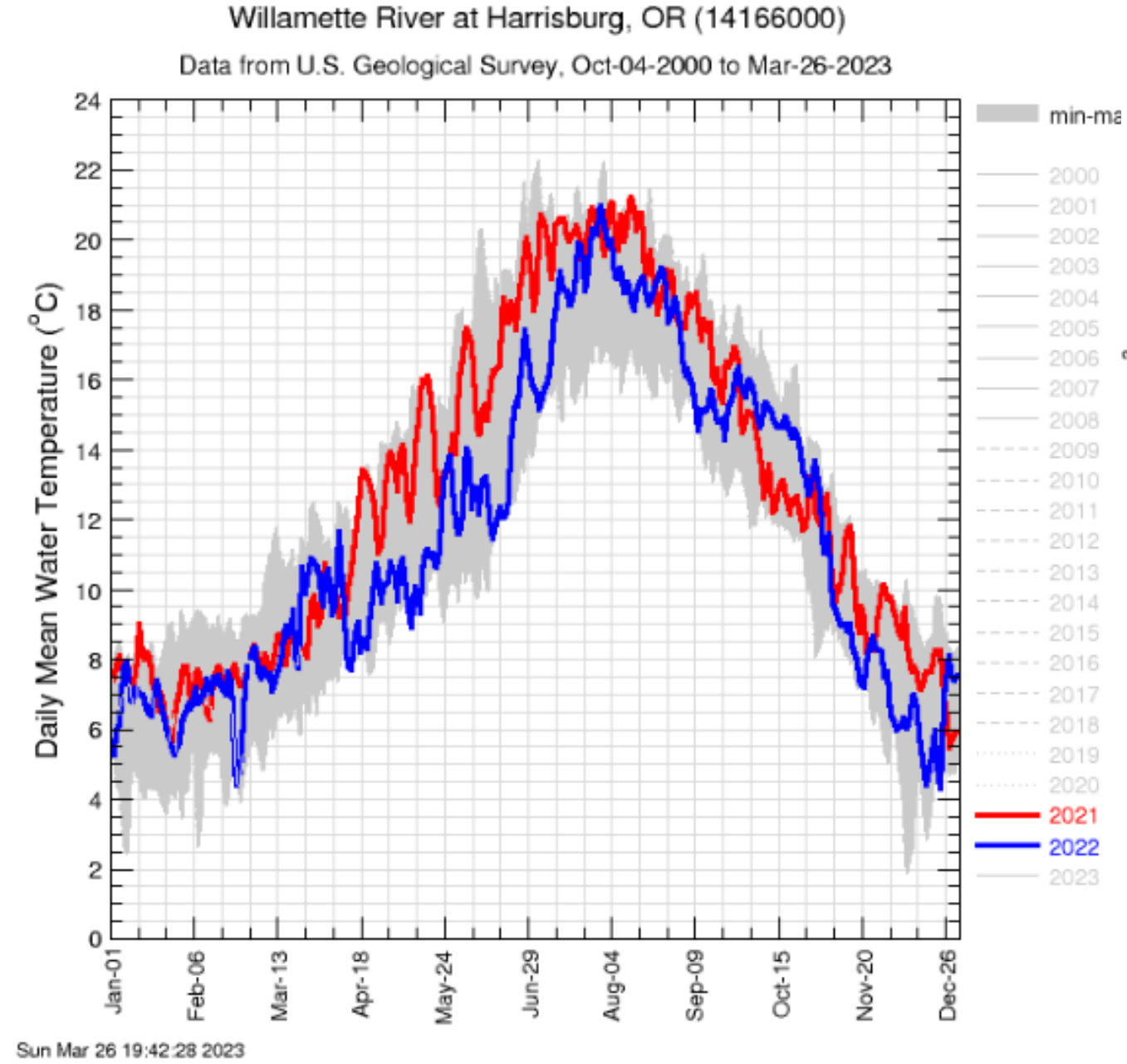

Willamette River at Newberg, OR (14197900)
Data from U.S. Geological Survey, Oct-19-2001 to Mar-28-2023
Discharge (ft3/s)
160000
140000
120000
100000
80000
60000
40000
20000
0
min-max
10-90 pctl
25-75 pctl
median
2021
2022
Chinook
Migration
Feb-01
Feb-22
Mar-15
Apr-05
Apr-26
May-17
Jun-07
Jun-28
Jul-19
Aug-09
Aug-30
Sep-20
Oct-11
Nov-01
Tue Mar 28 12:27:23 2023

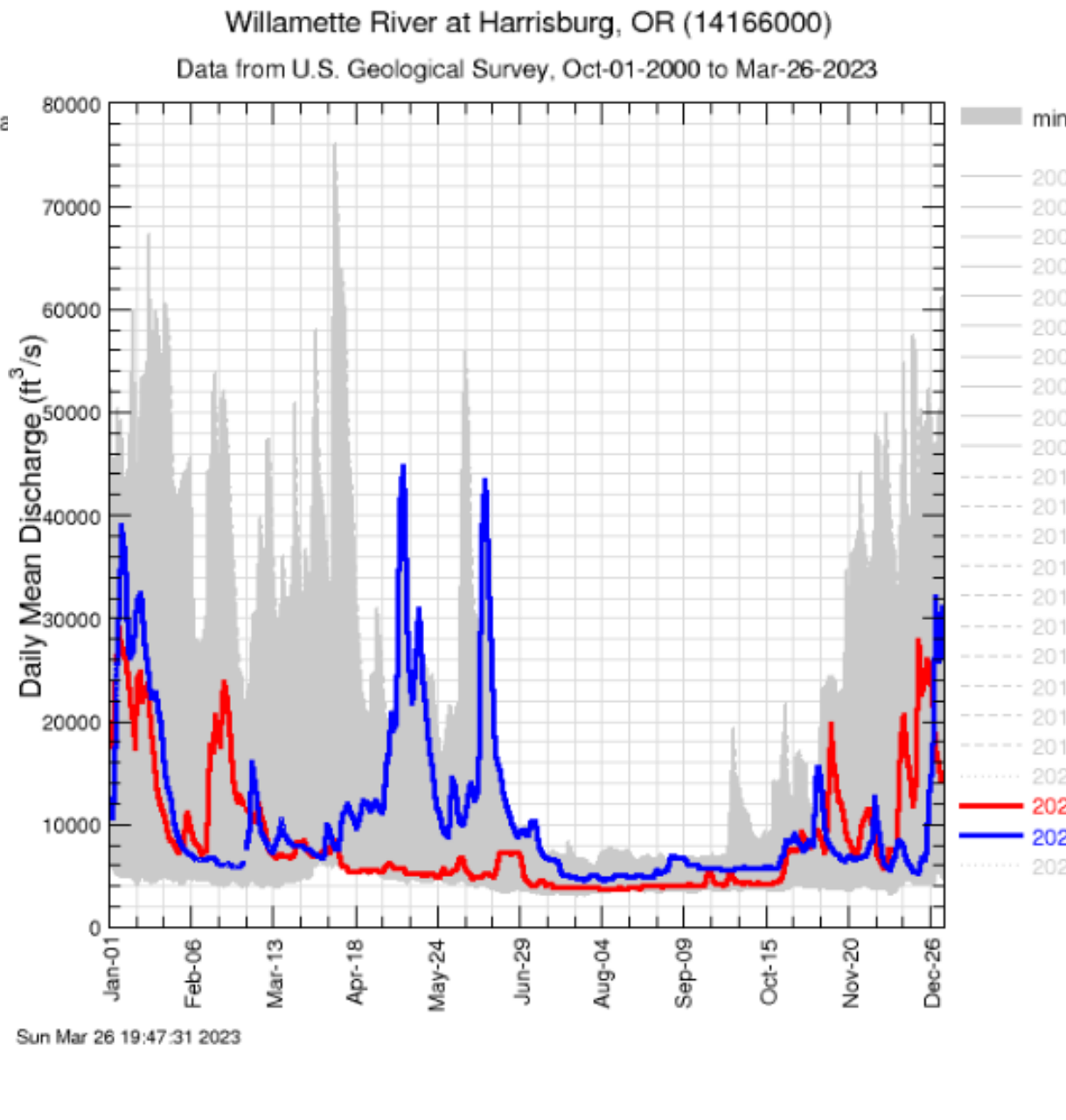

Willamette River at Portland, OR (14211720)
Data from U.S. Geological Survey, Jan-21-2009 to Mar-26-2023
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
min-max
10-90 pctl
25-75 pctl
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Threshold
Chinook
Migration
Jan-01
Feb-06
Mar-13
Apr-18
May-24
Jun-29
Aug-04
Sep-09
Oct-15
Nov-20
Dec-26
Sun Mar 26 18:46:45 2023

Migration Timing Spring Chinook

(Willamette Falls)

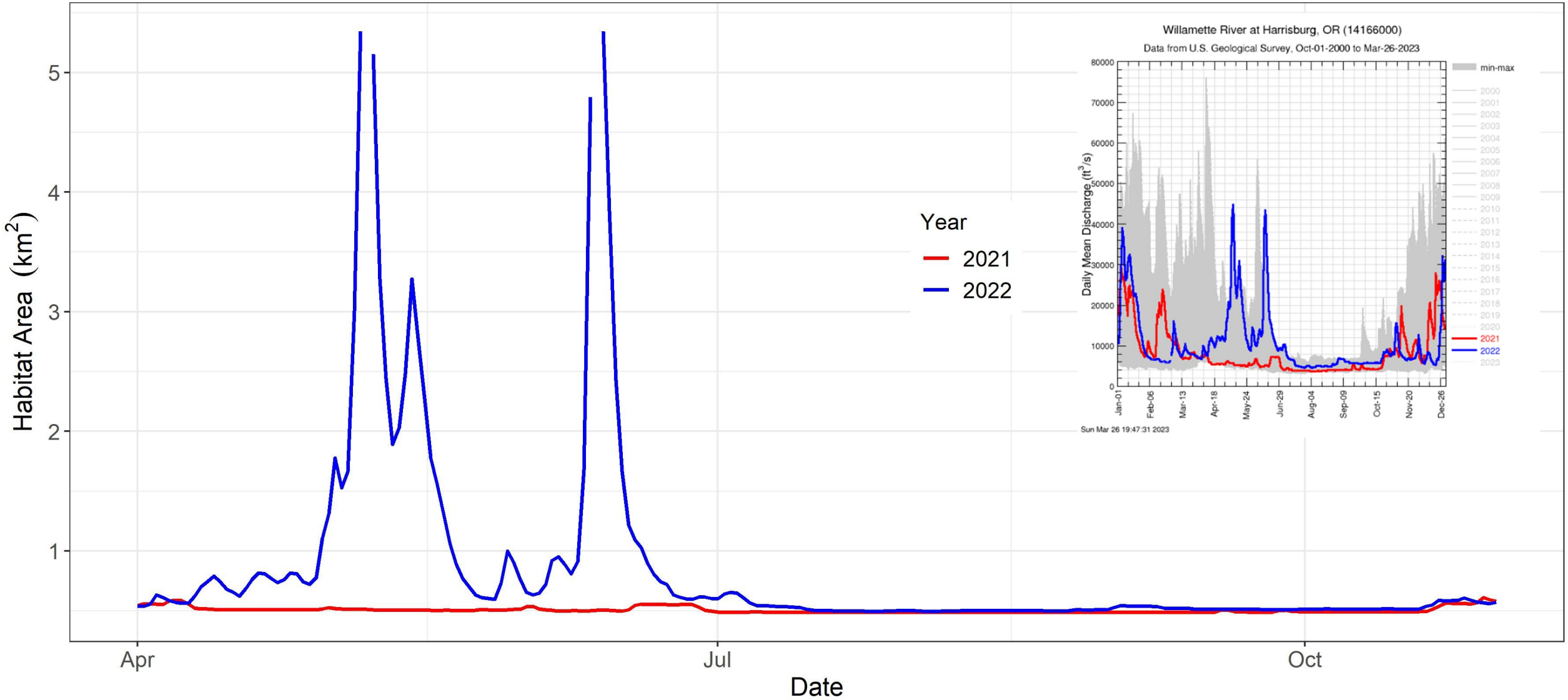



Willamette River at Harrisburg, OR (14166000)
Data from U.S. Geological Survey, Oct-04-2000 to Mar-26-2023
Daily Mean Water Temperature (°C)
0
2
4
6
8
10
12
14
16
18
20
22
24
Jan-01
Feb-06
Mar-13
Apr-18
May-24
Jun-29
Aug-04
Sep-09
Oct-15
Nov-20
Dec-26
min-ma
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Sun Mar 26 19:42:28 2023


Willamette River at Harrisburg, OR (14166000)
Data from U.S. Geological Survey, Oct-01-2000 to Mar-26-2023
Daily Mean Discharge (ft3/s)
0
10000
20000
30000
40000
50000
60000
70000
80000
Jan-01
Feb-06
Mar-13
Apr-18
May-24
Jun-29
Aug-04
Sep-09
Oct-15
Nov-20
Dec-26
min
2021
2022
Sun Mar 26 19:47:31 2023

Chinook Habitat Area

McKenzie Confluence - Harrisburg



Source: James White - USGS

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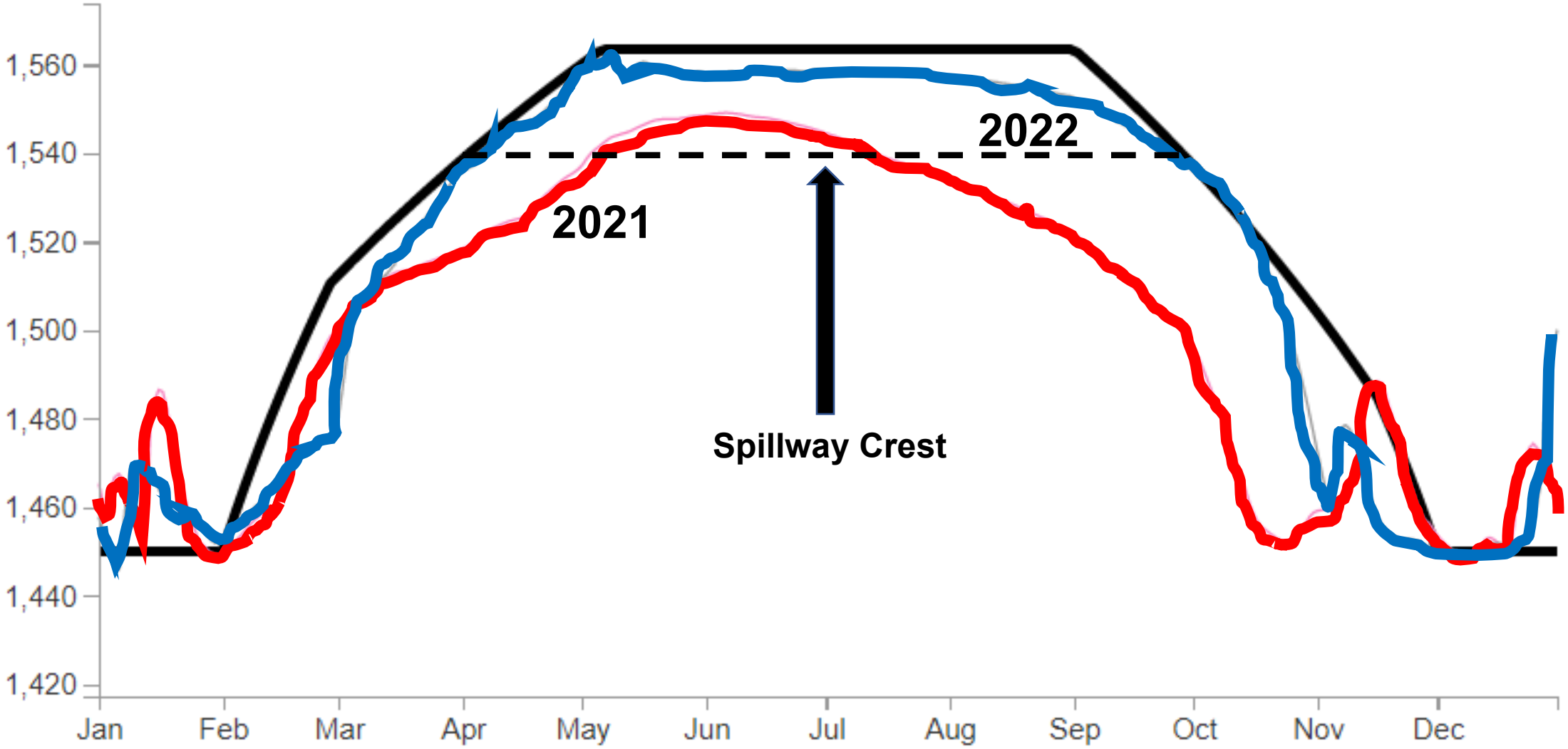


Downstream Passage – Juvenile Chinook

Cramer Fish Sciences

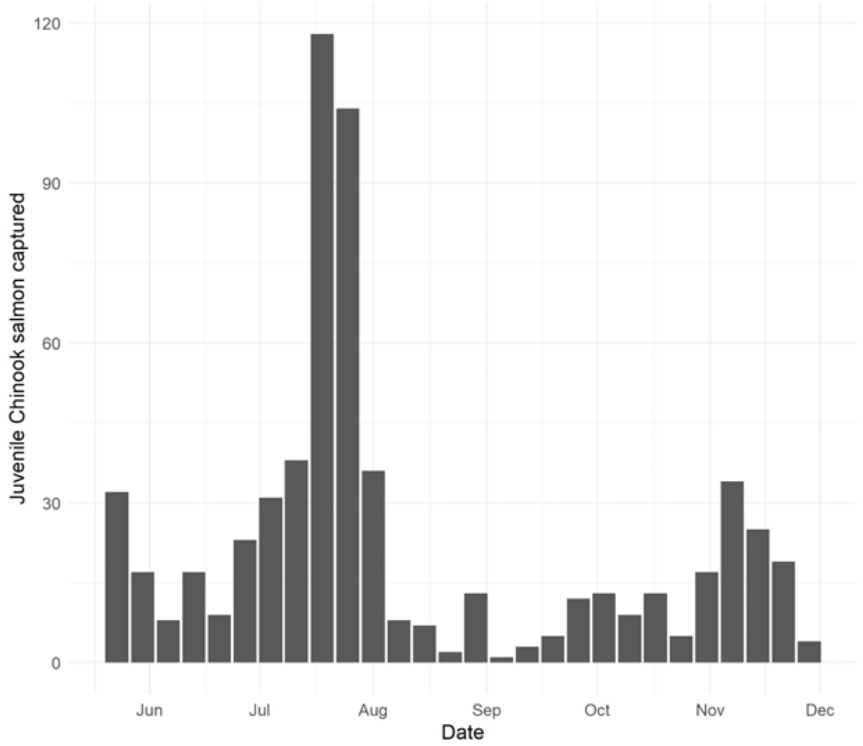
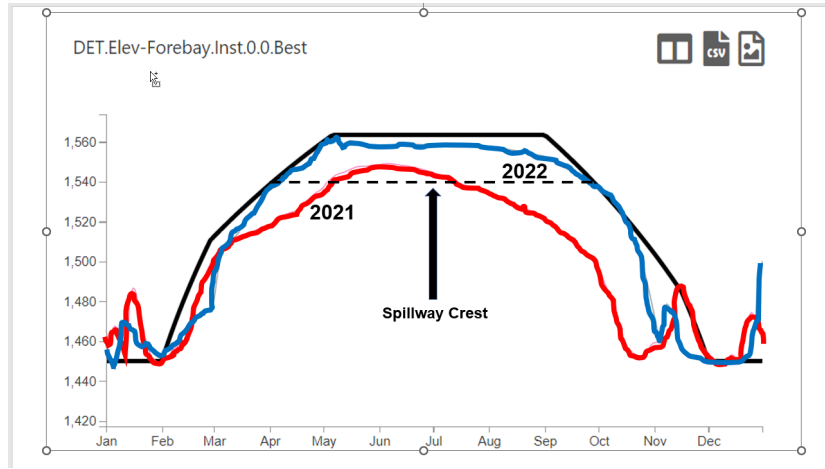


Figure 14. Weekly catch of juvenile Chinook salmon captured in the Big Cliff trap below Big Cliff Reservoir, 2021.

EAS



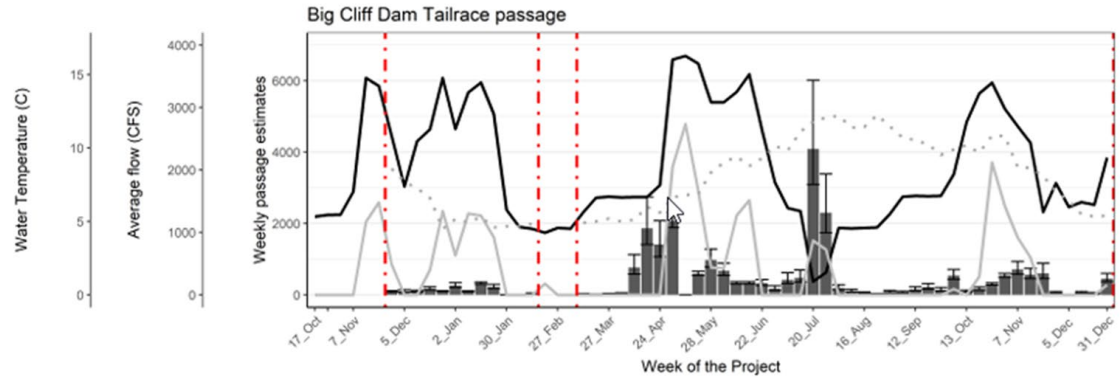
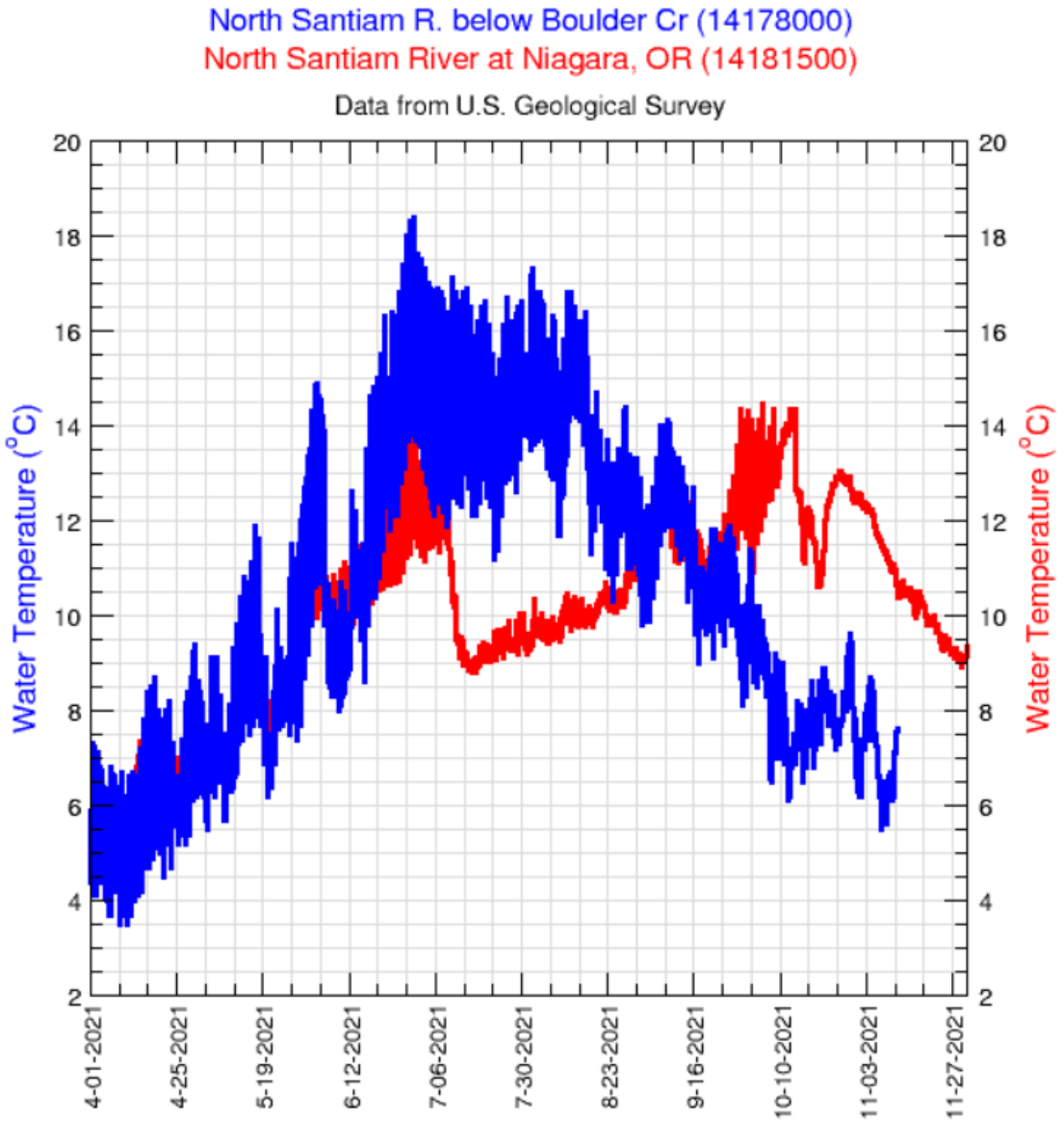
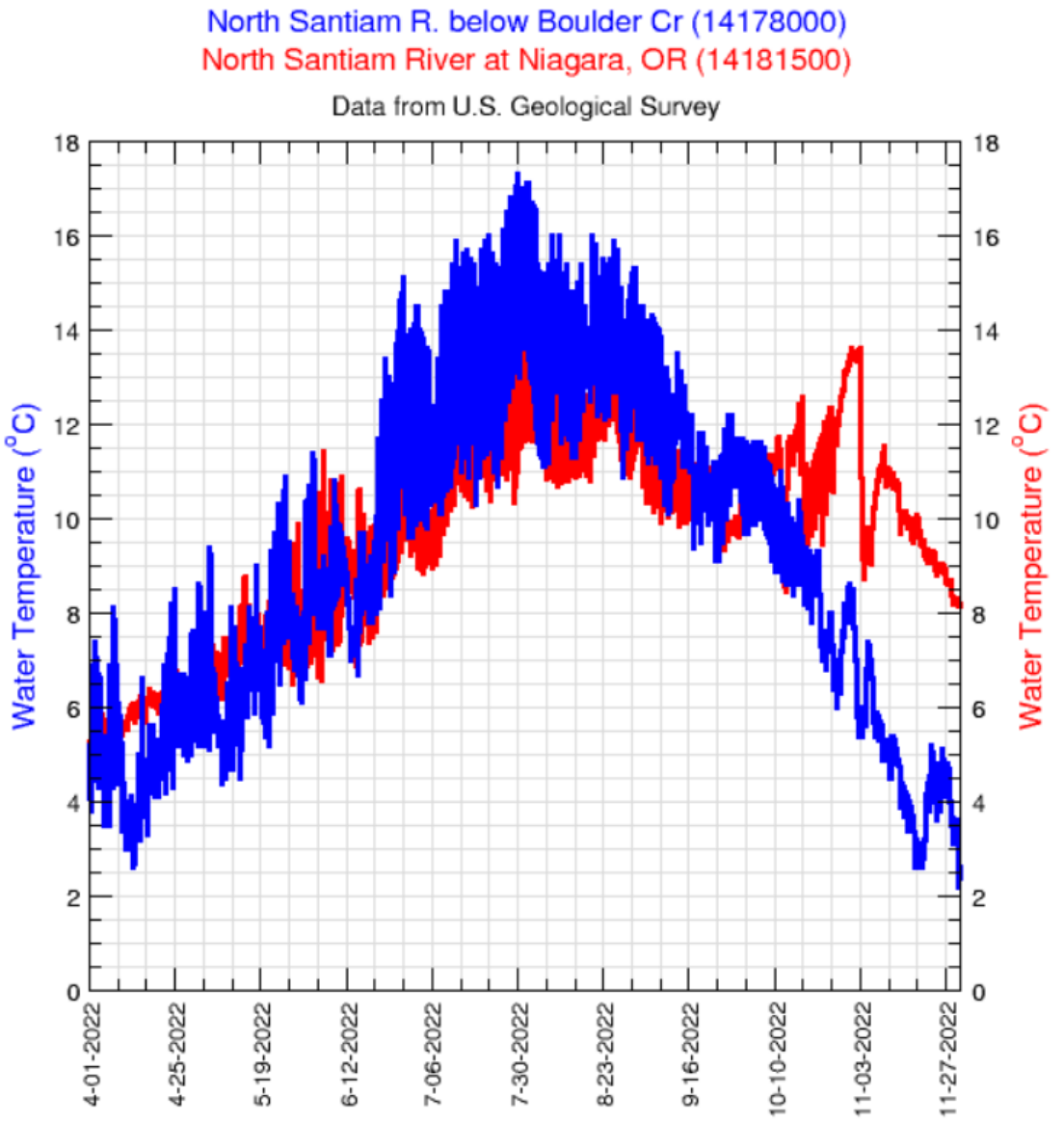
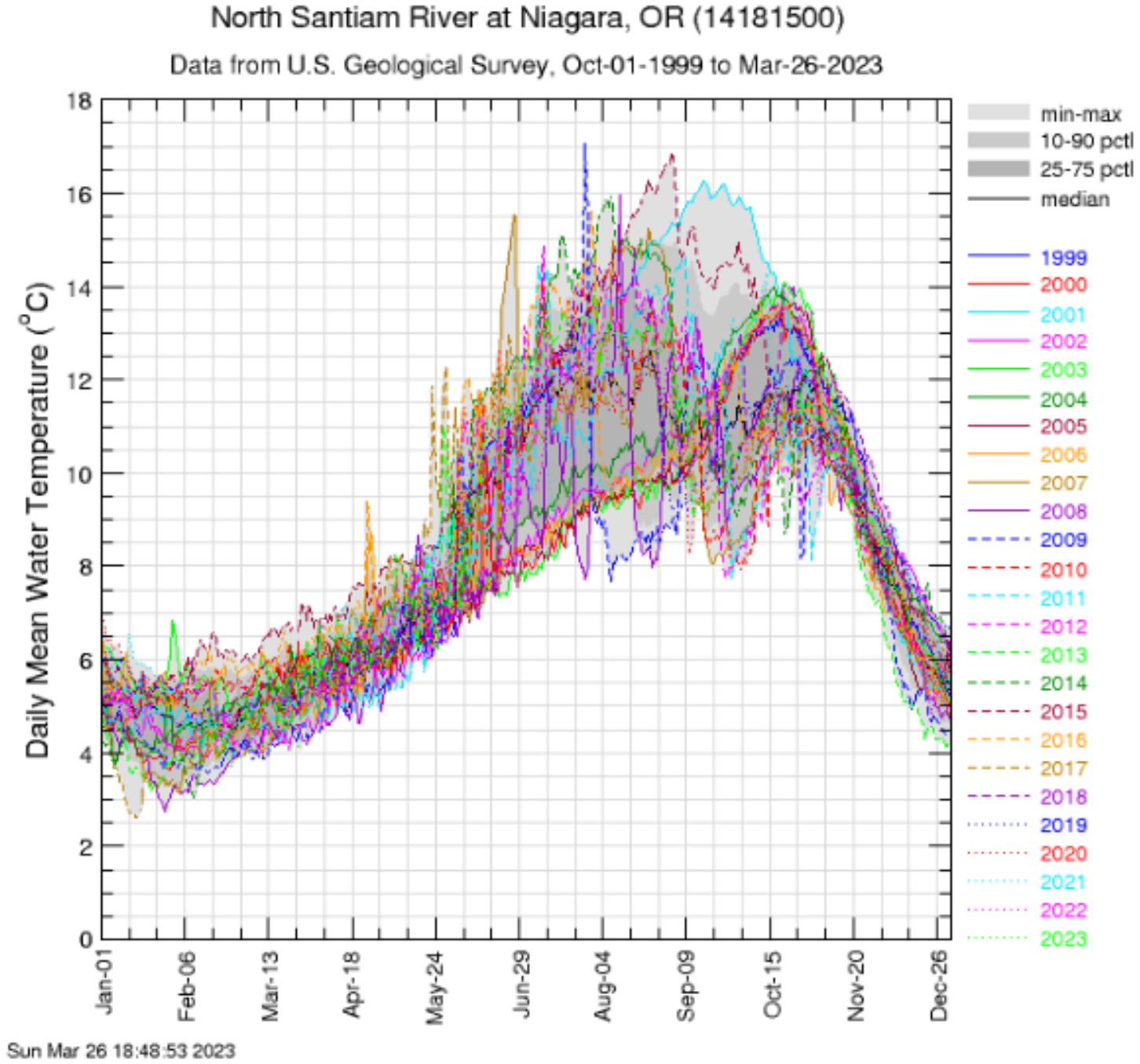


Figure 5. Passage estimates with 95% confidence for juvenile Chinook salmon at Big Cliff Dam with spill (black line) and powerhouse (gray line) outflow, and stream temperature (gray dots) for December 1, 2021, through the end of 2022.



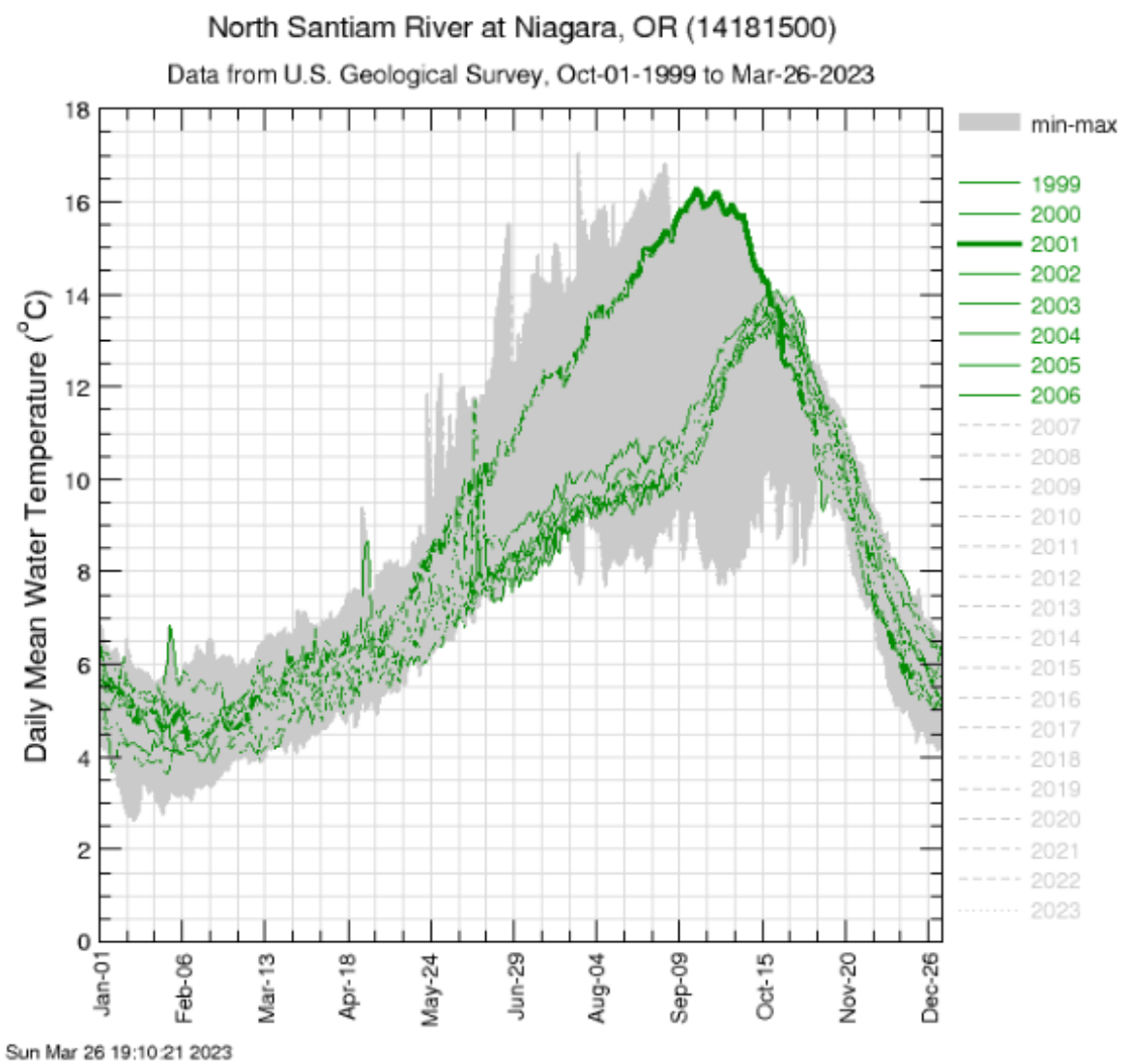


Source: USGS Data grapher; data available at https://or.water.usgs.gov/

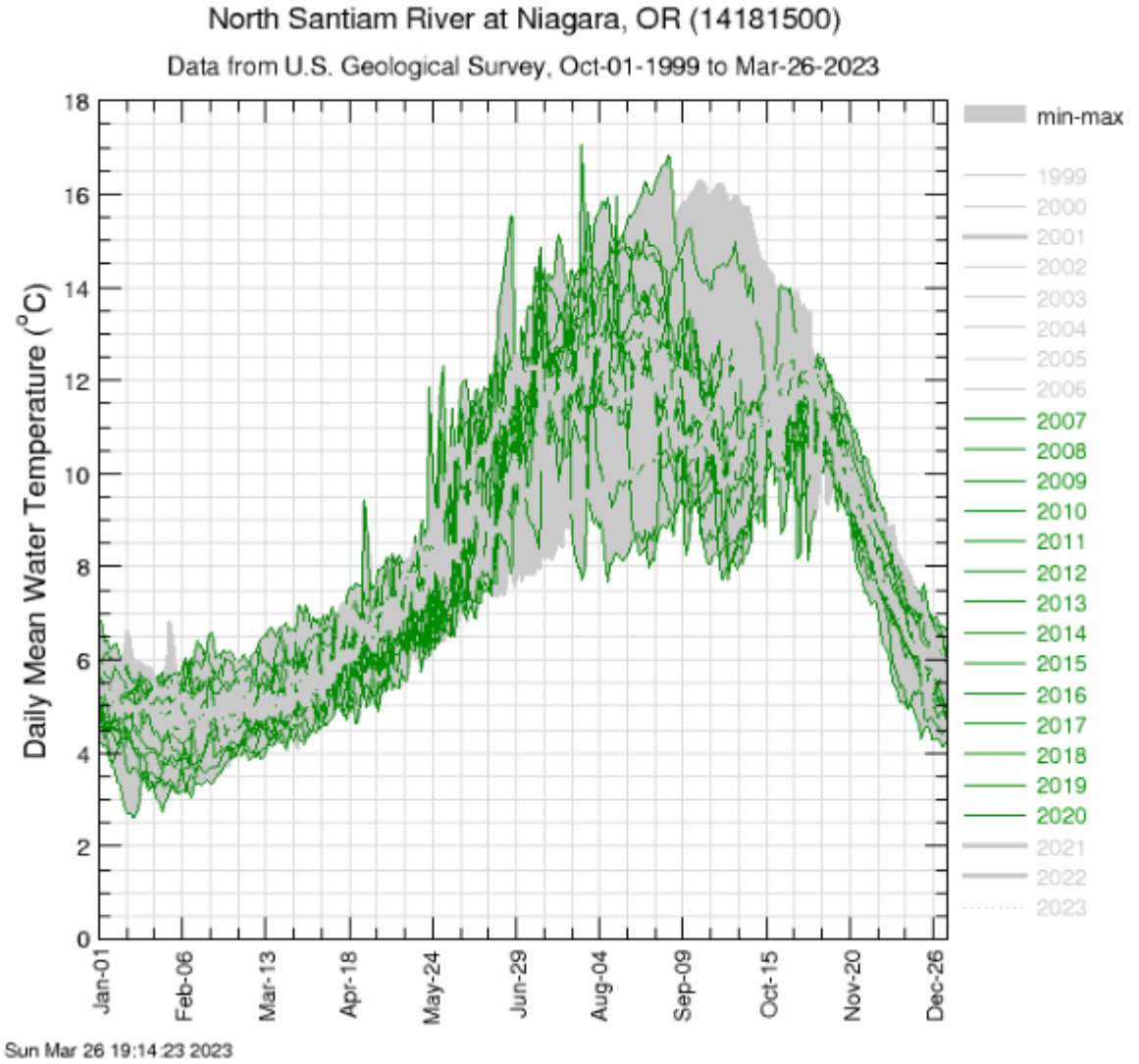

North Santiam River at Niagara, OR (14181500)
Data from U.S. Geological Survey, Oct-01-1999 to Mar-26-2023
Daily Mean Water Temperature (°C)
0
2
4
6
8
10
12
14
16
18
Jan-01
Feb-06
Mar-13
Apr-18
May-24
Jun-29
Aug-04
Sep-09
Oct-15
Nov-20
Dec-26
min-max
10-90 pctl
25-75 pctl
median
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Sun Mar 26 18:48:53 2023

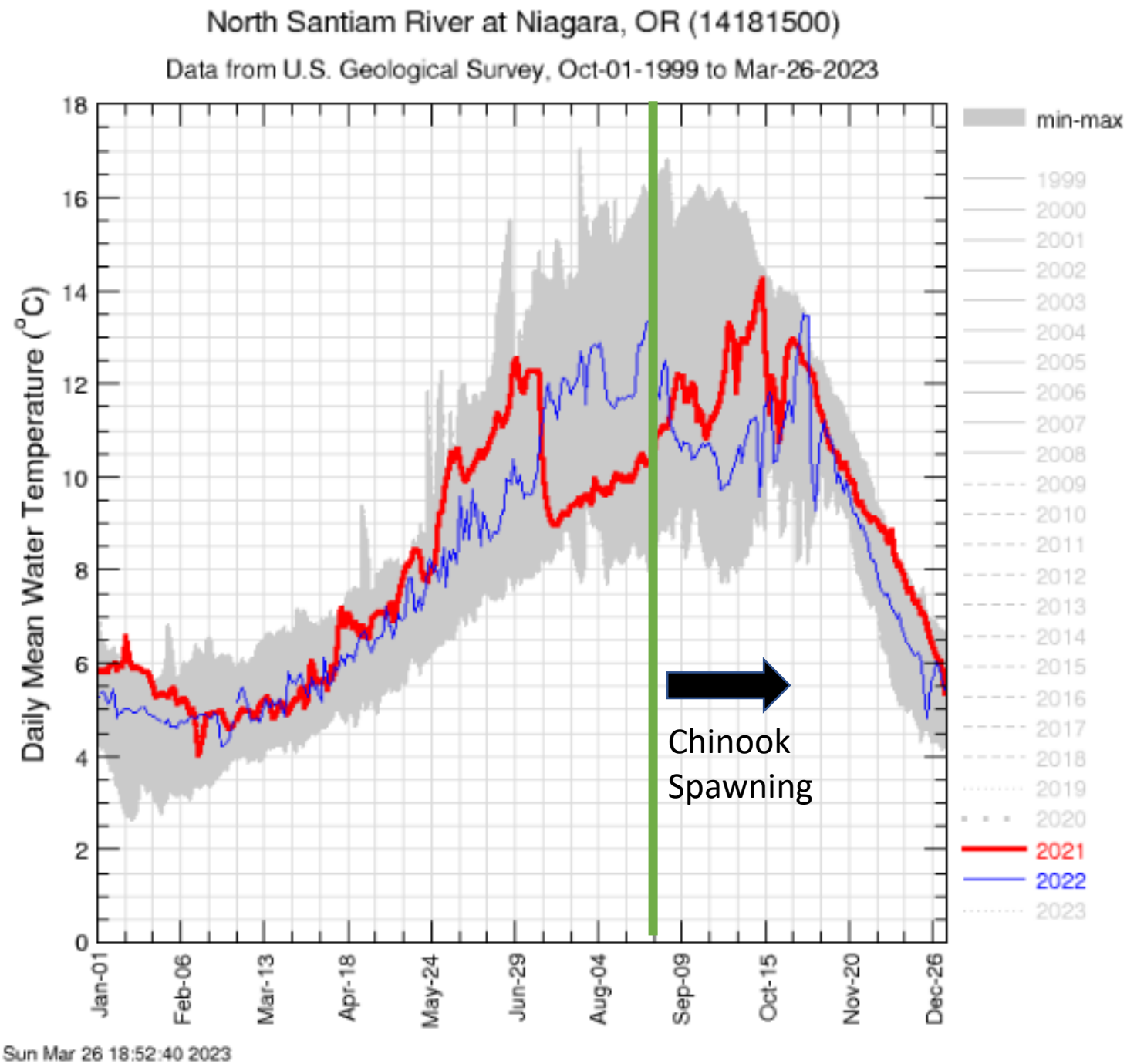
1999-2006 (pre-spill)

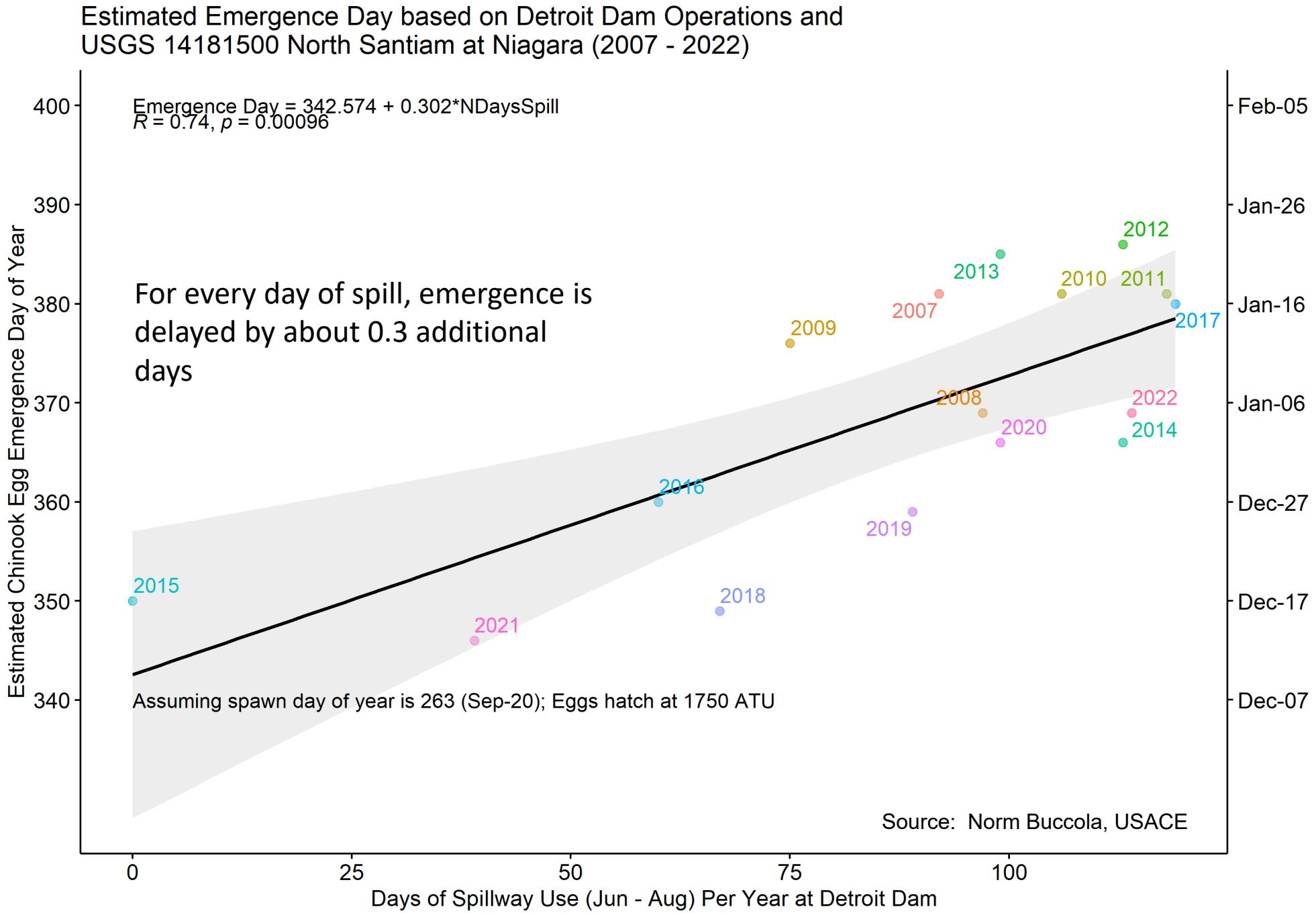
Grey blob is the range of values (min-max) 1999-2022



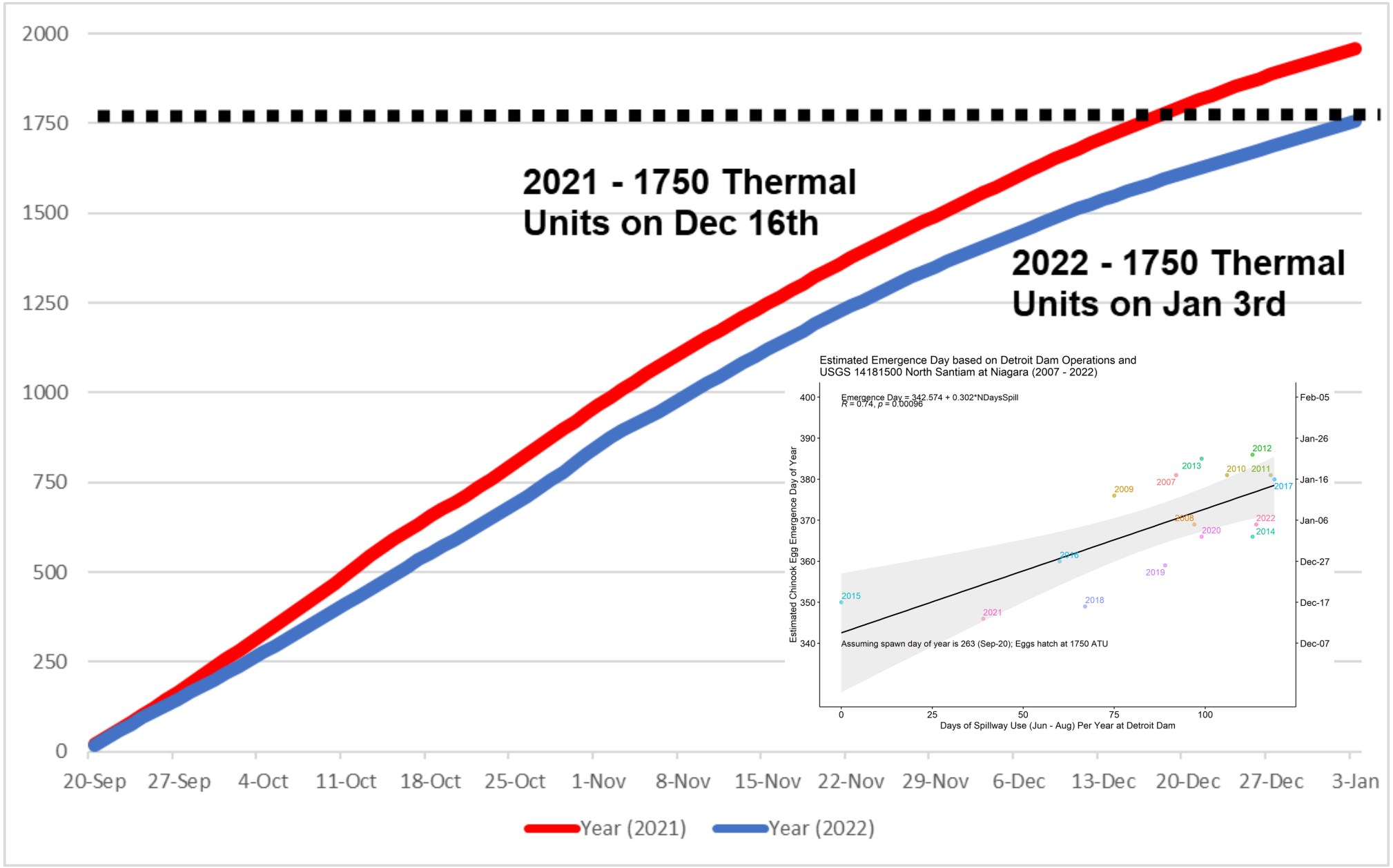
2007-2020

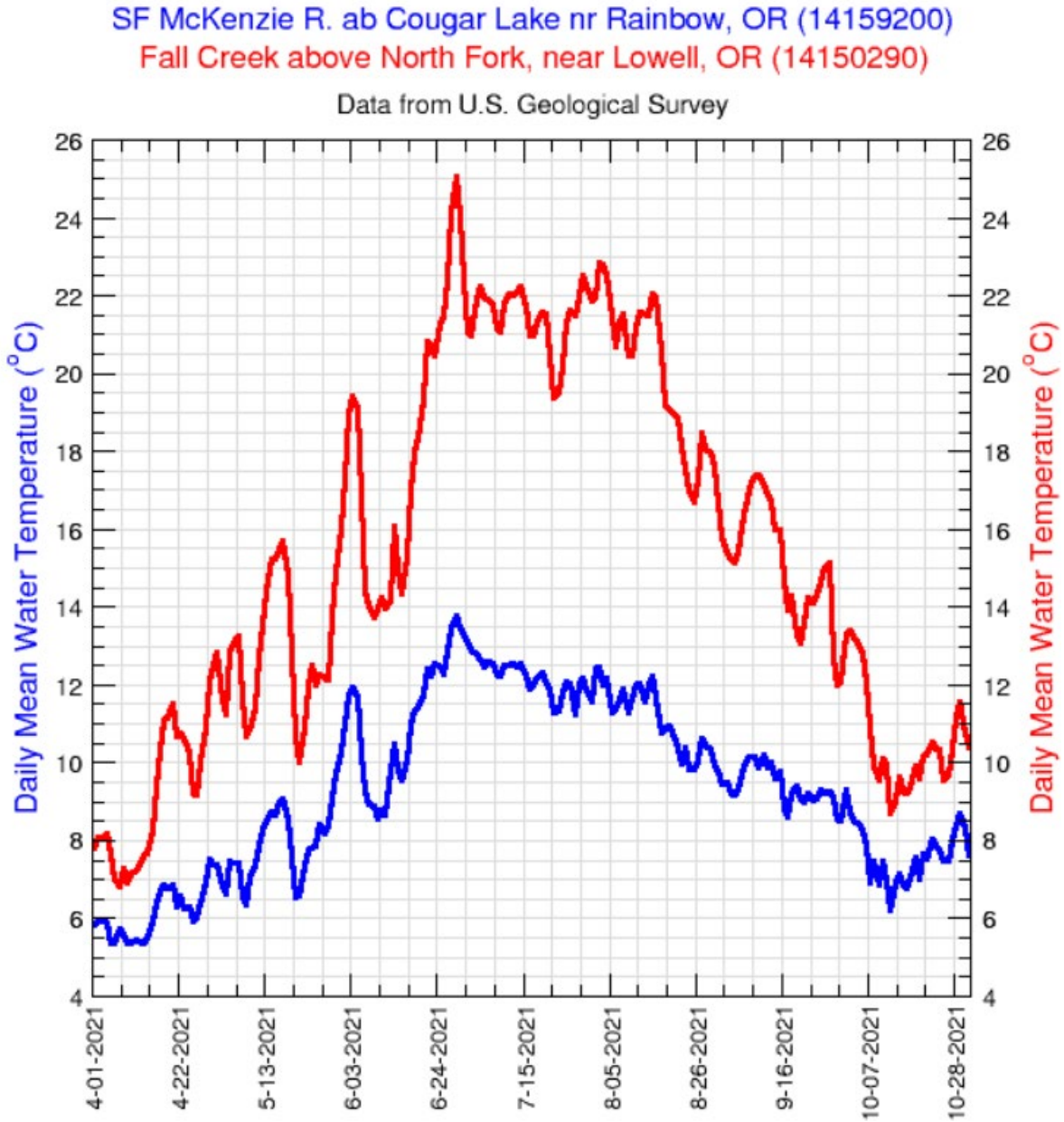


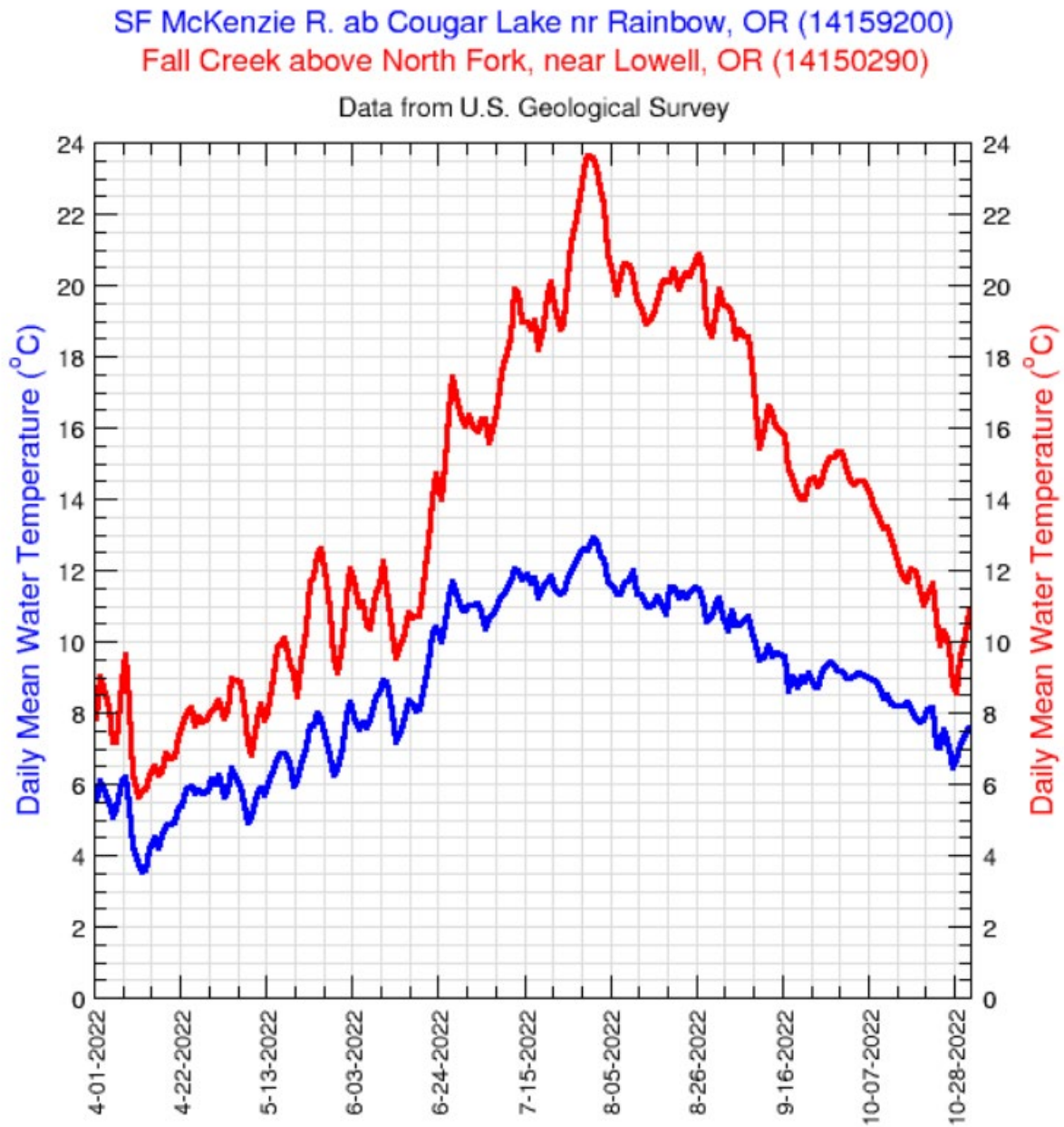

North Santiam River at Niagara, OR (14181500)
Data from U.S. Geological Survey, Oct-01-1999 to Mar-26-2023
Daily Mean Water Temperature (°C)
0
2
4
6
8
10
12
14
16
18
Jan-01
Feb-06
Mar-13
Apr-18
May-24
Jun-29
Aug-04
Sep-09
Oct-15
Nov-20
Dec-26
Chinook
Spawning
min-max
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Sun Mar 26 18:52:40 2023


Estimated Emergence Day based on Detroit Dam Operations and
USGS 14181500 North Santiam at Niagara (2007 - 2022)
Emergence Day = 342.574 + 0.302*NDaysSpill
R = 0.74, p = 0.00096
For every day of spill, emergence is delayed by about 0.3 additional days
Assuming spawn day of year is 263 (Sep-20); Eggs hatch at 1750 ATU
Source: Norm Buccola, USACE
Estimated Chinook Egg Emergence Day of Year
Days of Spillway Use (Jun - Aug) Per Year at Detroit Dam
400
390
380
370
360
350
340
0
25
50
75
100
Feb-05
Jan-26
Jan-16
Jan-06
Dec-27
Dec-17
Dec-07
2012
2013
2010
2011
2007
2017
2009
2008
2022
2020
2014
2016
2019
2015
2018
2021

Emergence Timing – North Santiam Below Detroit Dam







Source: USGS Data grapher; data available at https://or.water.usgs.gov/

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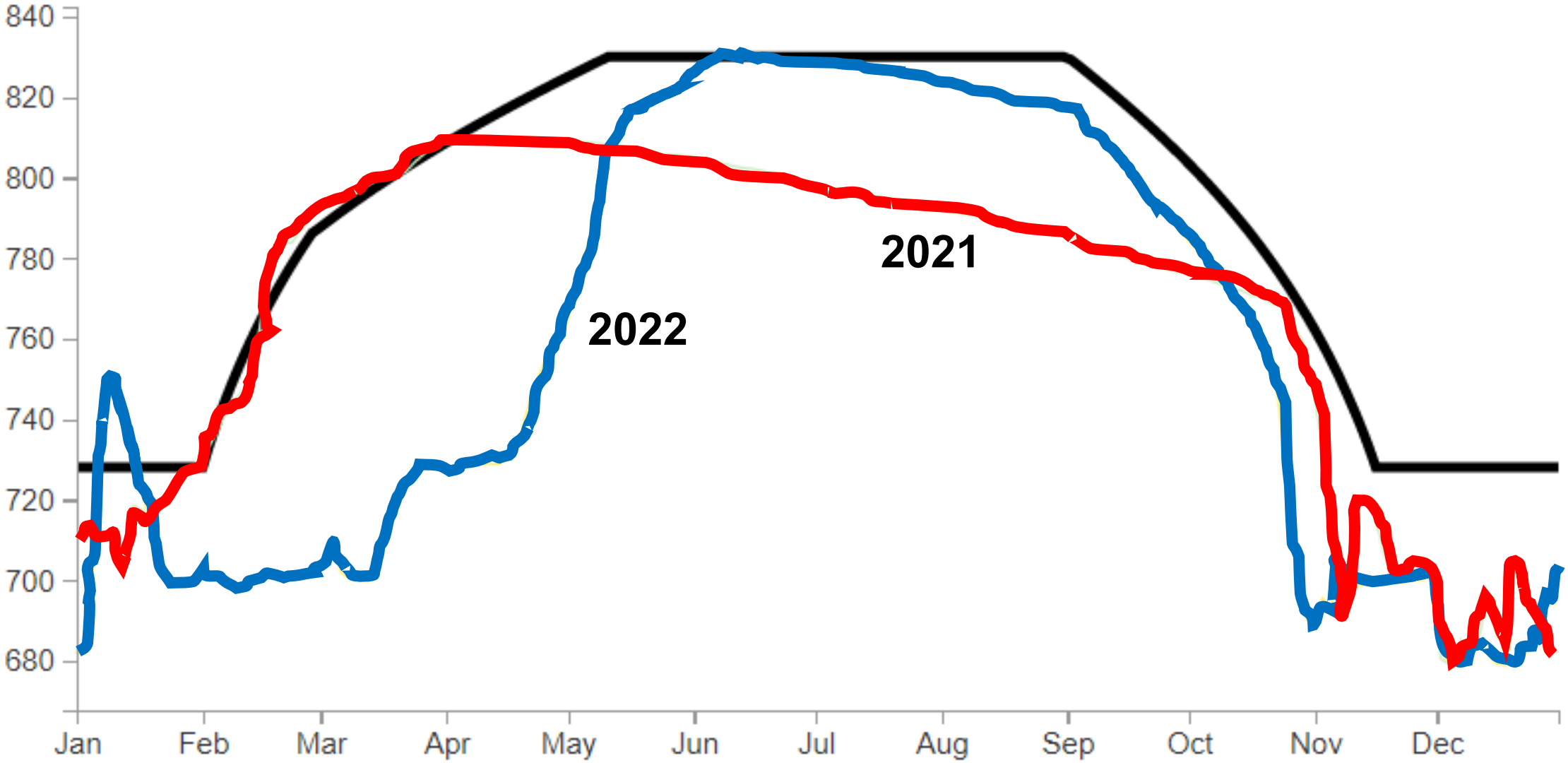


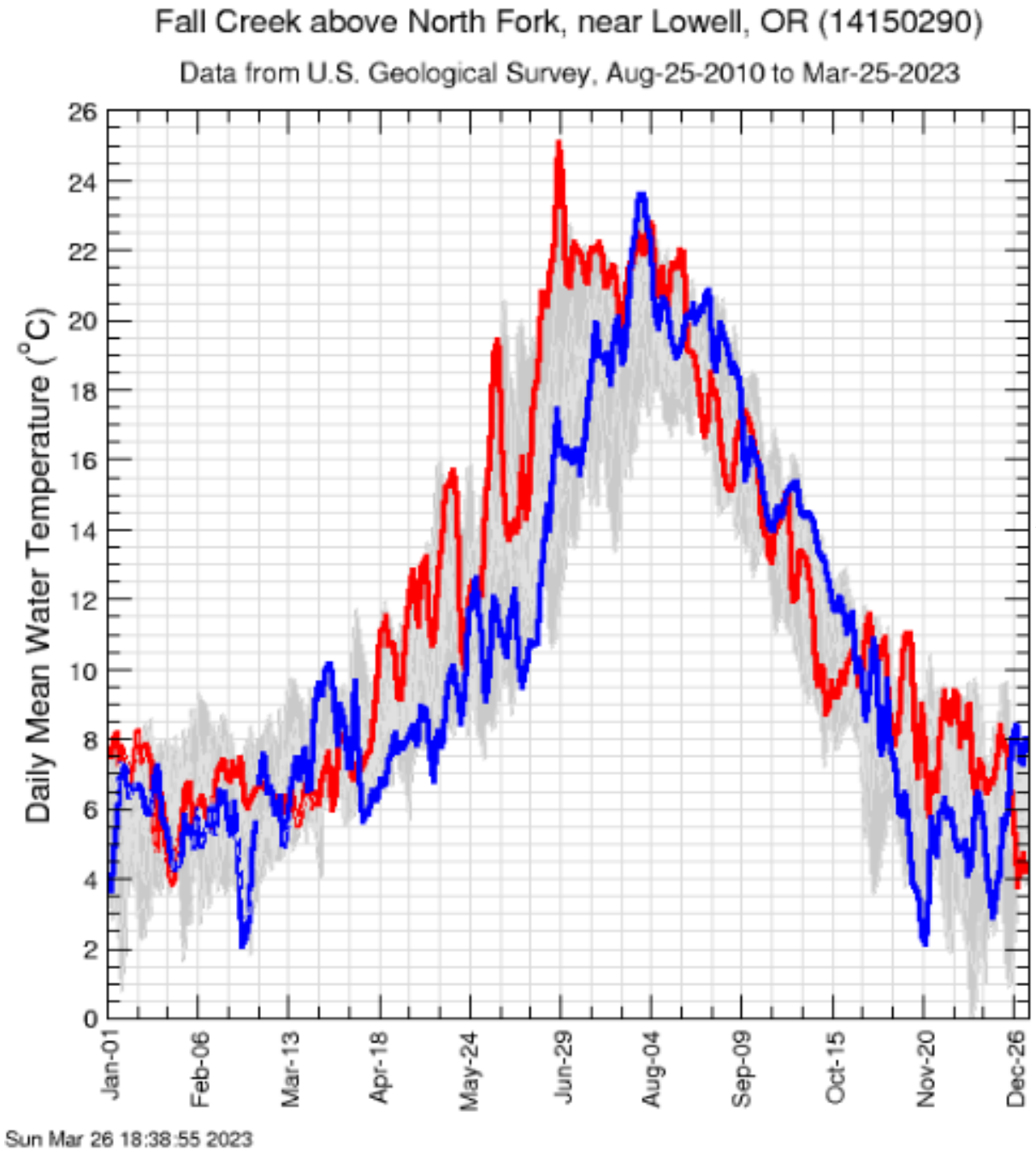


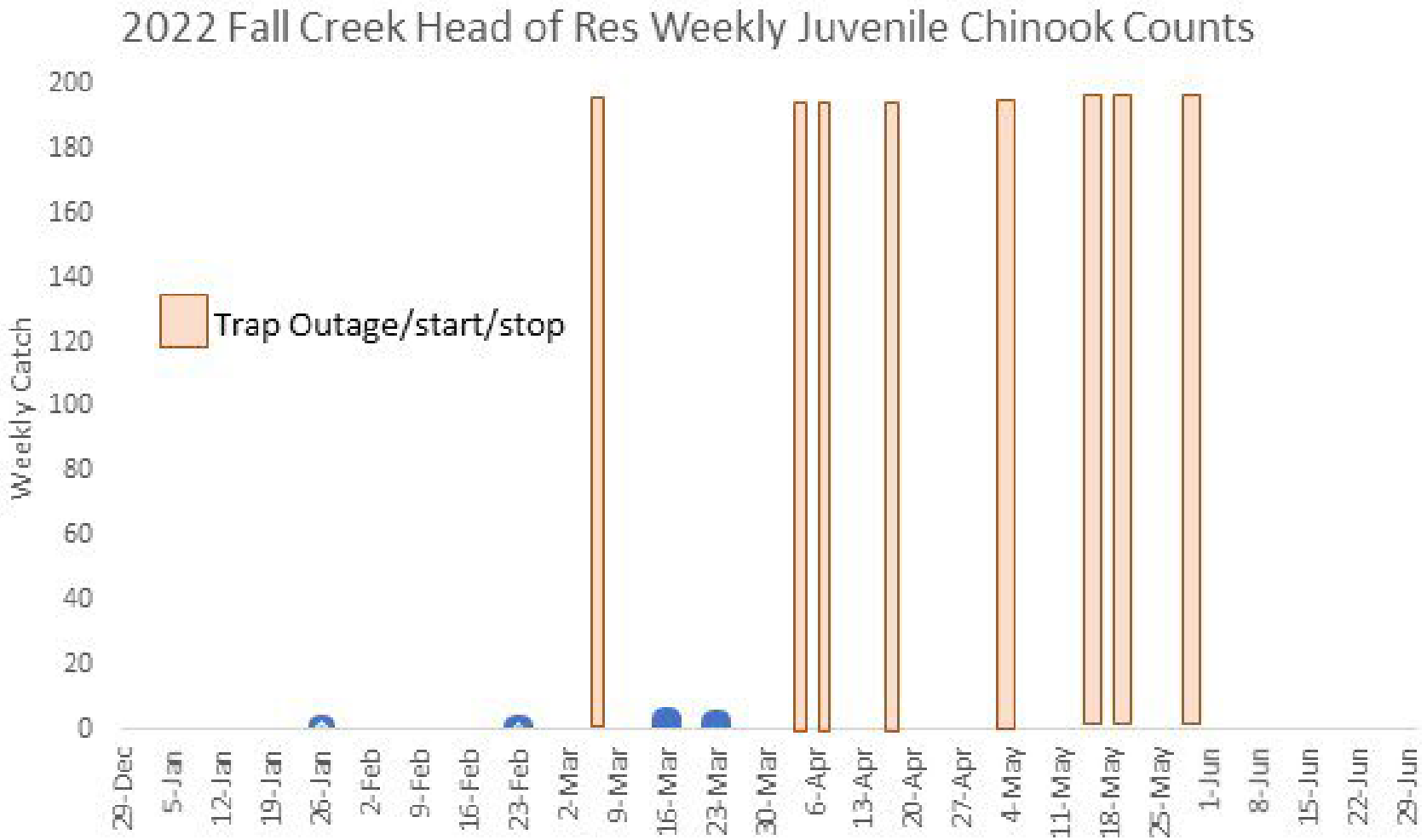
Table 2.1. Water temperature thresholds for juvenile and adult Chinook salmon for use in habitat assessments in the Willamette River, northwestern Oregon.

[**Abbreviations:** ≥, greater than or equal to; ≤, less than or equal to; °C, degrees Celsius]

Juvenile rearing and growth		Adult migration	
Effects on fish	Temperature range (°C)	Effects on fish	Temperature range (°C)
Mortality	≥24.1	Mortality	≥23.1
Increased stress, decreased growth, disease	20.1–24	Migration impaired	19.1–23
Optimal	10.1–20	Optimal	12.1–19
Safe, but decreased growth	≤10	Safe, preferred for spawning	≤12

Source: USGS Data grapher; data available at https://or.water.usgs.gov/

“Absence of BY 2021 catch above and below Fall Creek Reservoir suggests a year-class failure occurred.” (Willamette Basin Bi-Annual Status Report February 28, 2023 (EAS))



Summary

- Water supplies in 2021 and 2022 were significantly different
- Variable water supply resulted in significant changes in flows, water temperatures, and habitat above and below the dams.
- Earlier migration timing in low flow and warm temps in 2021
- Dam operations to support fish survival are influenced by water supply (length of spill operations to support passage and temperature control)
  - Shorter fish passage window with less spill
  - Increased water temperatures during incubation resulting in early emergence with less spill
- Sites that support Chinook have variable resistance to the changing water supply
- Evaluation of dam operations to support fish need to consider the influence of the environment on above/below dam temps and flow