



Pre-season Run-size Forecast for Fraser River Sockeye and Pink Salmon in 2023

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Presented to the FRPTC

Feb. 13, 2022

Summary of 2022 Sockeye Runs

| | Forecast Return | Estimated Return | Return Relative to Forecast |
|------------------------------|-----------------|------------------|-----------------------------|
| Bristol Bay ¹ | 75,270,000 | 79,000,000 | +5% |
| Nass ² | 471,000 | 487,000 | +3% |
| Skeena ³ | 2,054,000 | 4,333,344 | +111% |
| Somass ⁴ | 400,000 | 950,000 | +138% |
| Fraser River | 9,775,000 | 6,776,900* | -30%* |
| Baker Lake ⁵ | 27,081 | 35,000 | +29% |
| Lake Washington ⁶ | 10,165 | 43,289 | +326% |
| Columbia River ⁷ | 198,700 | 663,253 | +234% |

¹<https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareabristolbay.harvestsummary>

²<https://www.nisgaanation.ca/stock-assessments>

³<http://www.pac.dfo-mpo.gc.ca/fm-gp/northcoast-cotenord/skeenaatye-eng.html>

⁴<https://www.roundtables.westcoastaquatic.ca/area-23-barkley-harvest>

⁵<https://wdfw.wa.gov/fishing/reports/counts/baker-river#returns>

⁶<https://wdfw.wa.gov/fishing/reports/counts/lake-washington#sockeye>

⁷https://www.fpc.org/webapps/adultsalmon/Q_adultcounts_dataquery.php

*Fraser sockeye return incomplete (assessments ongoing). Run size presented is catch plus escapement as of Feb 9, 2023

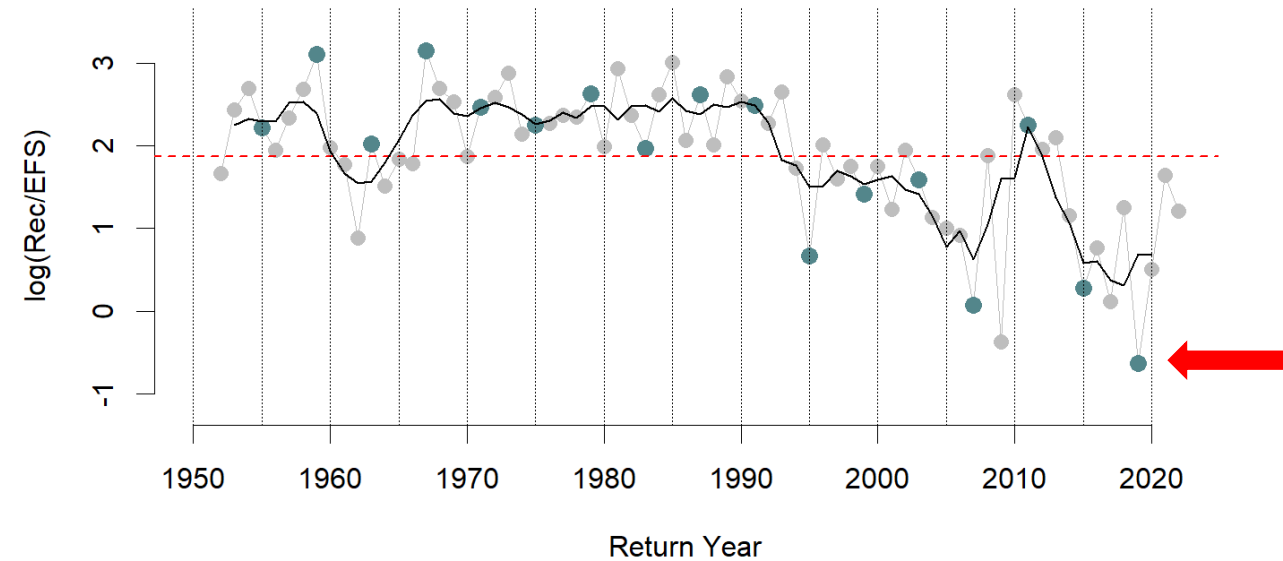
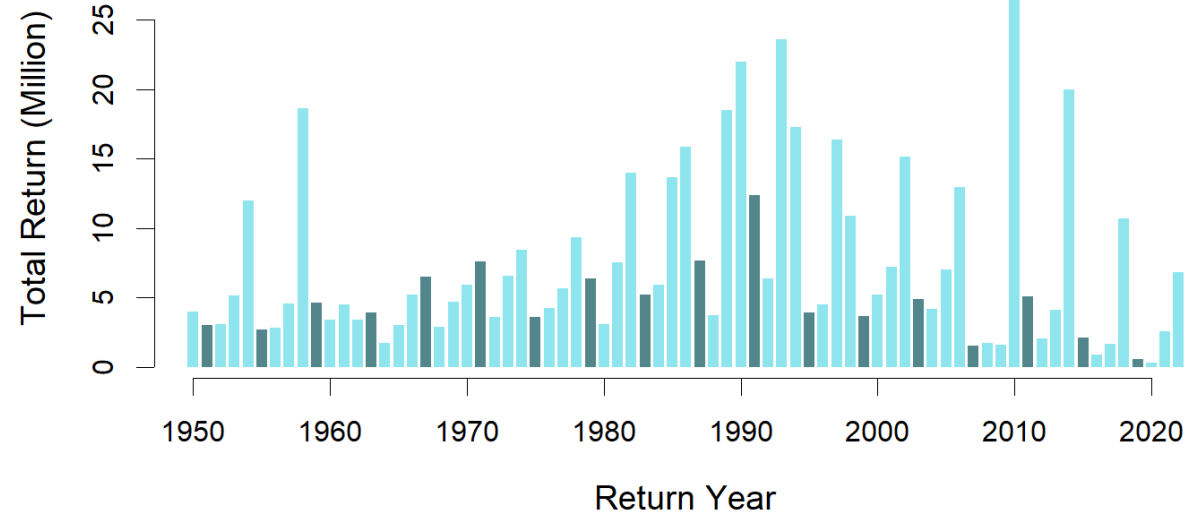
2022 Forecast Performance

- 2022 forecast fell between the p25 and p50 forecast
- Many stocks returned ~p50

| Return Year | Forecast Probability Level | | | | | | Actual Returns |
|-------------|----------------------------|------------------------|------------|------------|------------|------------|----------------|
| | <10% | 10% | 25% | 50% | 75% | 90% | |
| 1998 | NA | 4,391,000 | 6,040,000 | 6,822,000 | 11,218,000 | 18,801,000 | 10,870,000 |
| 1999 | NA | 3,067,000 | 4,267,000 | 4,843,000 | 8,248,000 | 14,587,000 | 3,640,000 |
| 2000 | NA | 1,487,000 | 2,449,000 | 4,304,000 | 7,752,000 | NA | 5,200,000 |
| 2001 | NA | 3,869,000 | 6,797,000 | 12,864,000 | 24,660,000 | NA | 7,190,000 |
| 2002 | NA | 4,859,000 | 7,694,400 | 12,915,900 | 22,308,500 | NA | 15,130,000 |
| 2003 | NA | 1,908,000 | 2,742,000 | 3,141,000 | 5,502,000 | 9,744,000 | 4,890,000 |
| 2004 | NA | 1,858,000 | 2,615,000 | 2,980,000 | 5,139,000 | 9,107,000 | 4,180,000 |
| 2005 | NA | 5,149,000 | 8,734,000 | 16,160,000 | 30,085,000 | 53,191,000 | 7,020,000 |
| 2006 | NA | 5,683,000 | 9,530,000 | 17,357,000 | 31,902,000 | 56,546,000 | 12,980,000 |
| 2007 | NA | 2,242,500 | 3,602,000 | 6,247,000 | 11,257,000 | 19,706,000 | 1,510,000 |
| 2008 | NA | 1,258,000 | 1,854,000 | 2,899,000 | 4,480,000 | 7,057,000 | 1,740,000 |
| 2009 | NA | 3,556,000 | 6,039,000 | 10,578,000 | 19,451,000 | 37,617,000 | 1,590,000 |
| 2010 | NA | 5,360,000 | 8,351,000 | 13,989,000 | 23,541,000 | 40,924,000 | 28,250,000 |
| 2011 | NA | 1,700,000 | 2,693,000 | 4,627,000 | 9,074,000 | 15,086,000 | 5,110,000 |
| 2012 | NA | 743,000 | 1,203,000 | 2,119,000 | 3,763,000 | 6,634,000 | 2,050,000 |
| 2013 | NA | 1,554,000 | 2,655,000 | 4,765,000 | 8,595,000 | 15,608,000 | 4,130,000 |
| 2014 | NA | 7,237,000 | 12,788,000 | 22,854,000 | 41,121,000 | 72,014,000 | 20,000,000 |
| 2015 | NA | 2,364,000 | 3,824,000 | 6,778,000 | 12,635,000 | 23,580,000 | 2,120,000 |
| 2016 | NA | 814,000 | 1,296,000 | 2,271,000 | 4,227,000 | 8,181,000 | 853,000 |
| 2017 | NA | 1,315,000 ^R | 2,338,000 | 4,432,000 | 8,873,000 | 17,633,000 | 1,641,000 |
| 2018 | NA | 5,265,000 | 8,423,000 | 13,981,000 | 22,937,000 | 36,893,000 | 10,675,000 |
| 2019 | NA | 1,832,000 | 2,979,000 | 5,056,000 | 9,133,000 | 15,313,000 | 564,000 |
| 2020 | NA | 275,000 | 486,000 | 924,000 | 1,834,000 | 3,573,000 | 288,000 |
| 2021 | NA | 313,000 | 624,000 | 1,330,000 | 2,775,000 | 5,496,000 | 2,549,000 |
| 2022 | NA | 2,374,000 | 4,662,000 | 9,775,000 | 20,395,000 | 41,707,000 | 6,777,000* |

Fraser Sockeye Returns and Productivity

- Decreasing trend since 2011
- Historically low productivity in 2019 for this cycle line



Fraser Pink Returns and Productivity

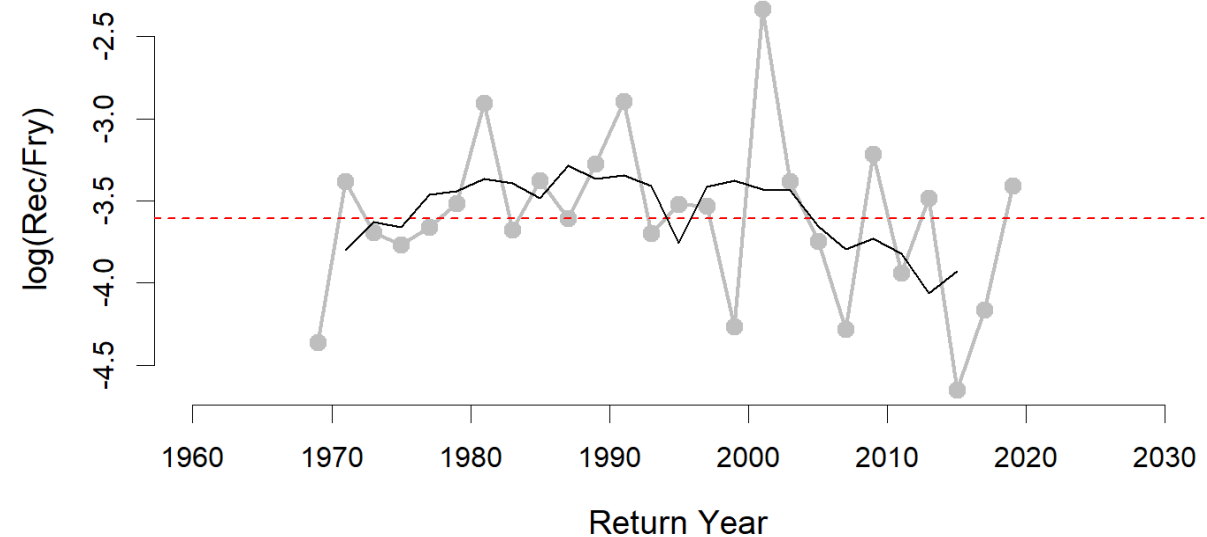
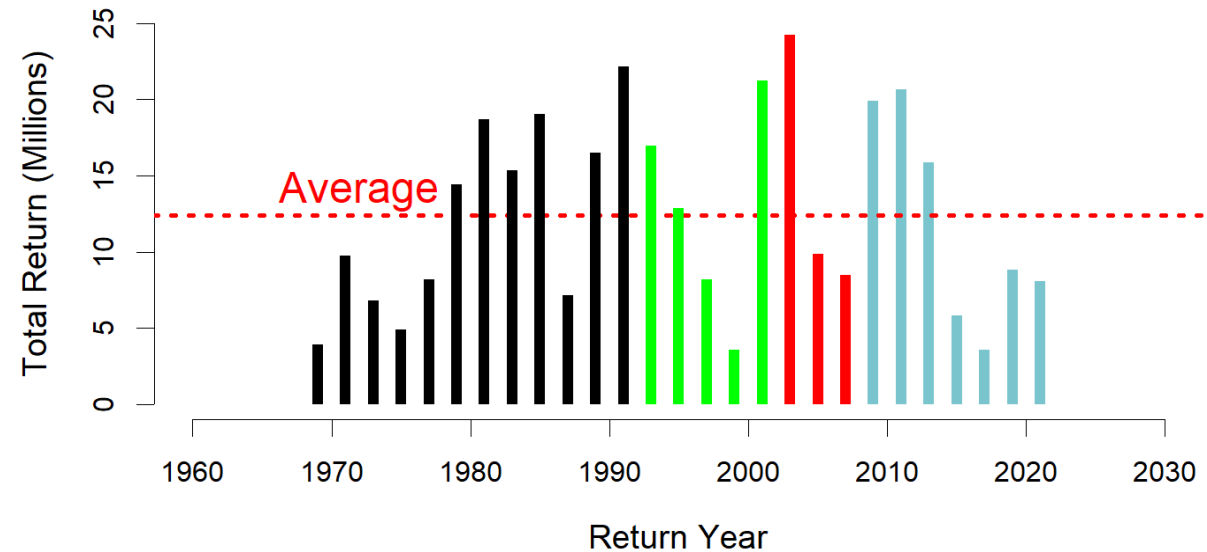
Recruitment data uncertainties:

1961-1991: Separate system-specific escapement estimates (DFO)

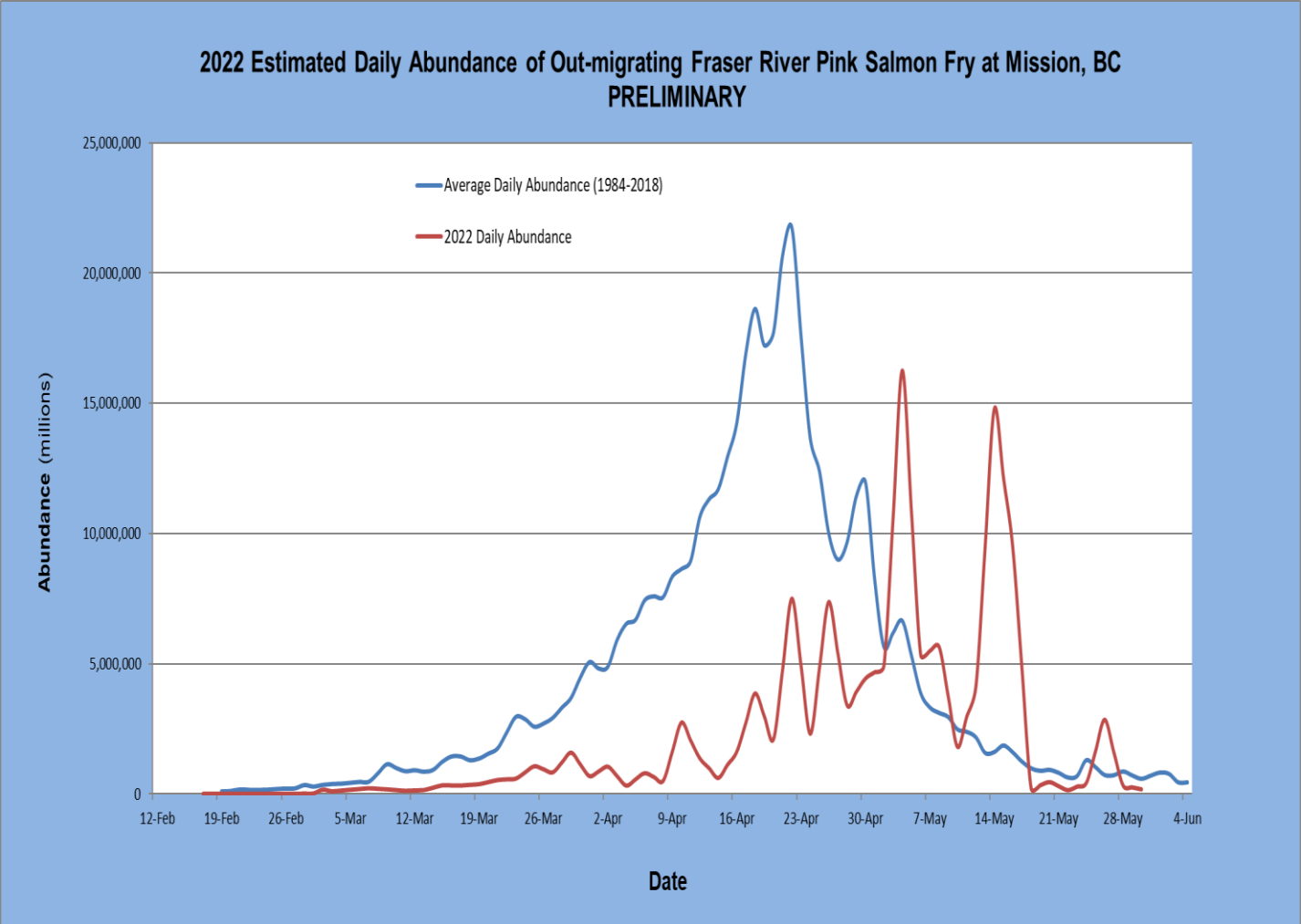
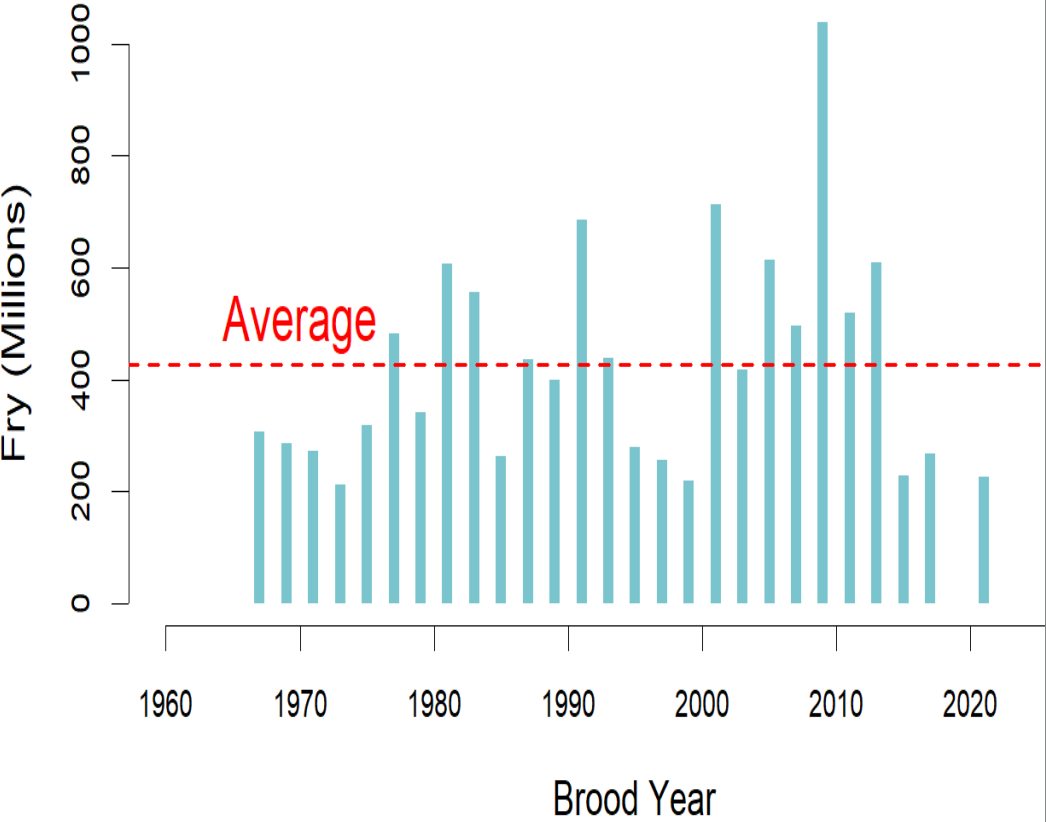
1993-2001: Single Fraser system Mark-Recaptures (DFO)

2003-2007: Indirect system-wide marine test fisheries estimates (PSC)

2009-Now: System-wide Mission hydroacoustic estimate (PSC)



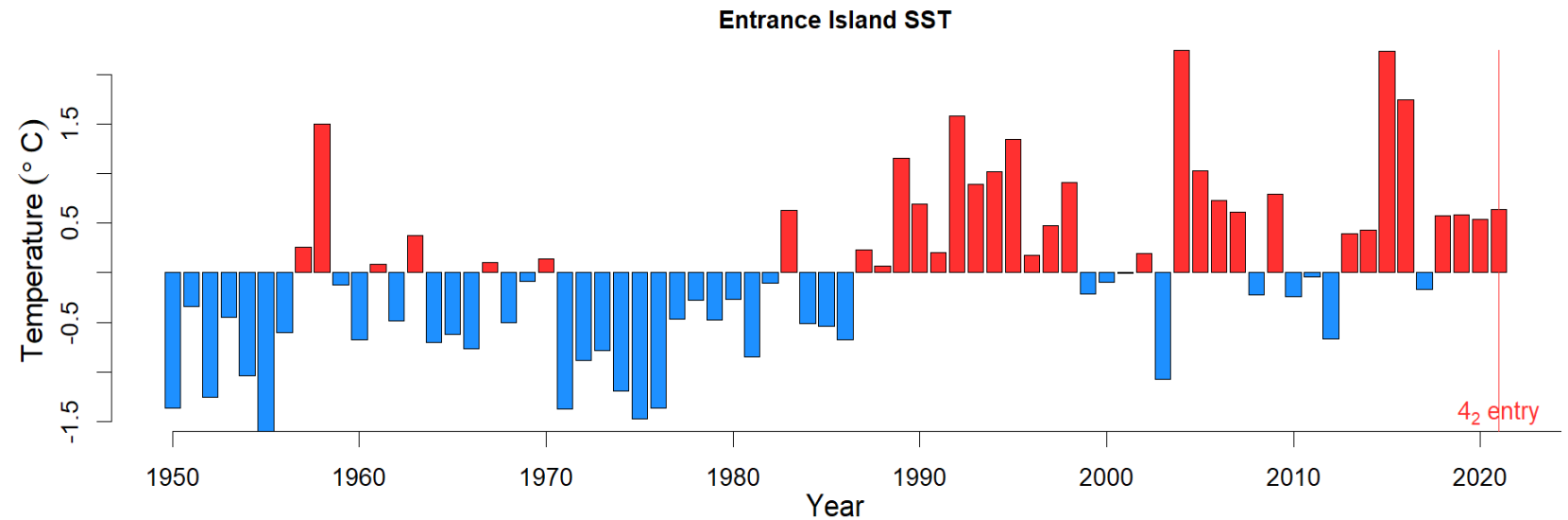
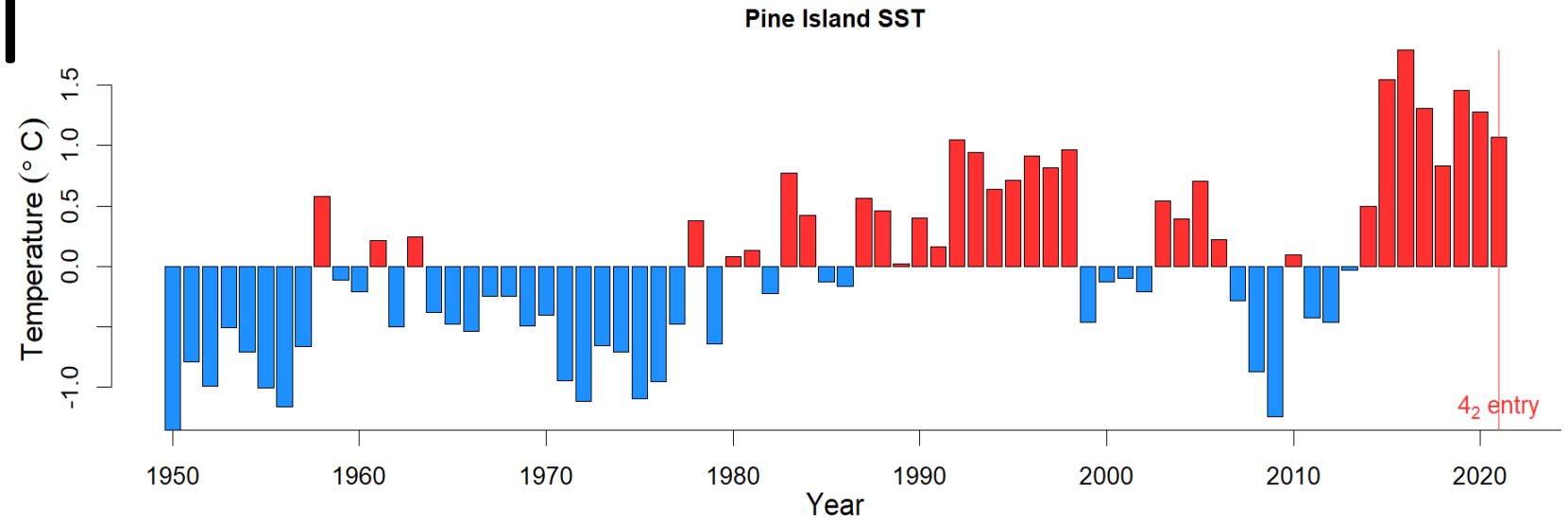
Fraser Pink Fry Outmigration 2022



Environmental Data: SST

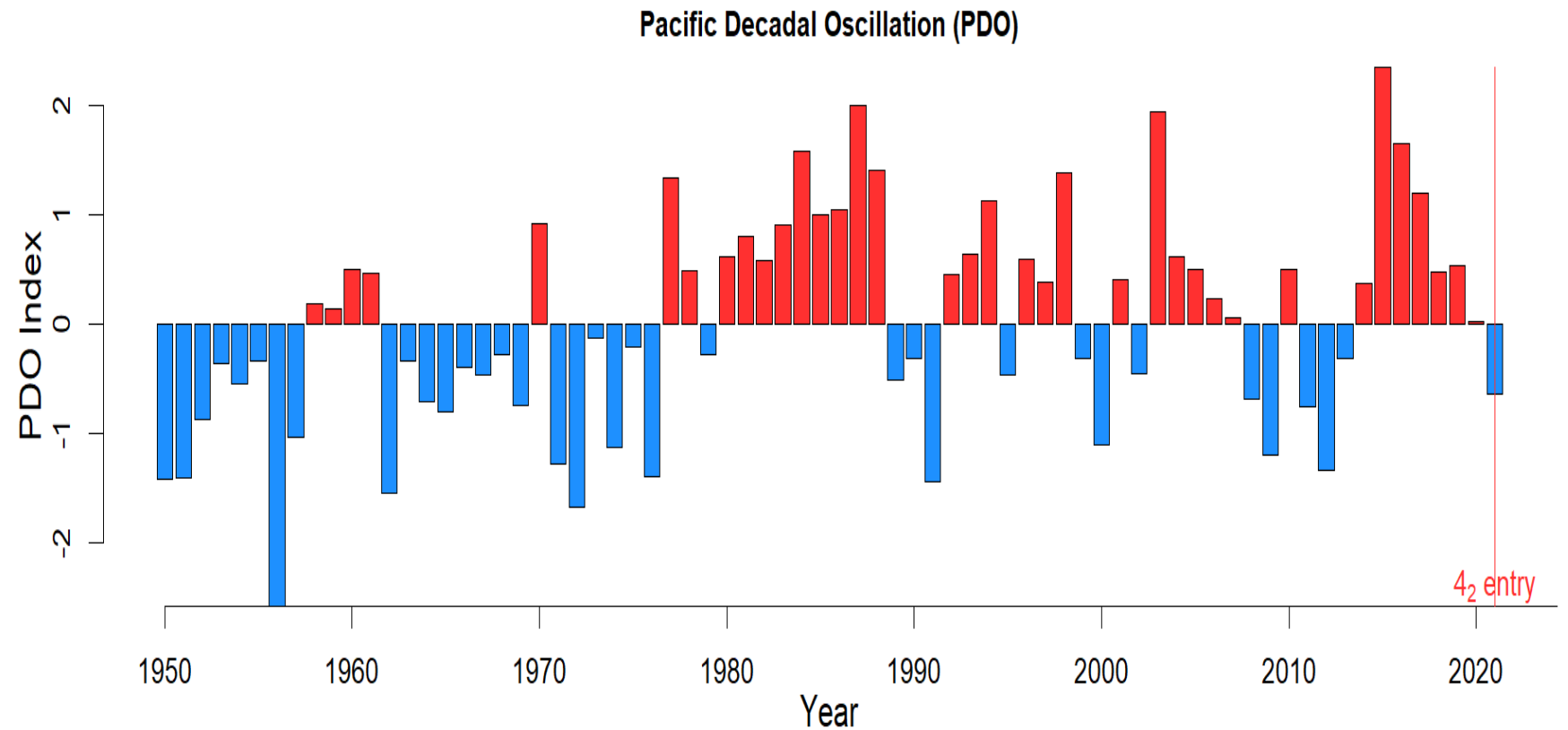
- Pine Island (April-June) and Entrance Island (April-July) SST:

- Warm temperature anomalies relative to historic average
- Departure Bay was substituted for Entrance Island as data were unavailable



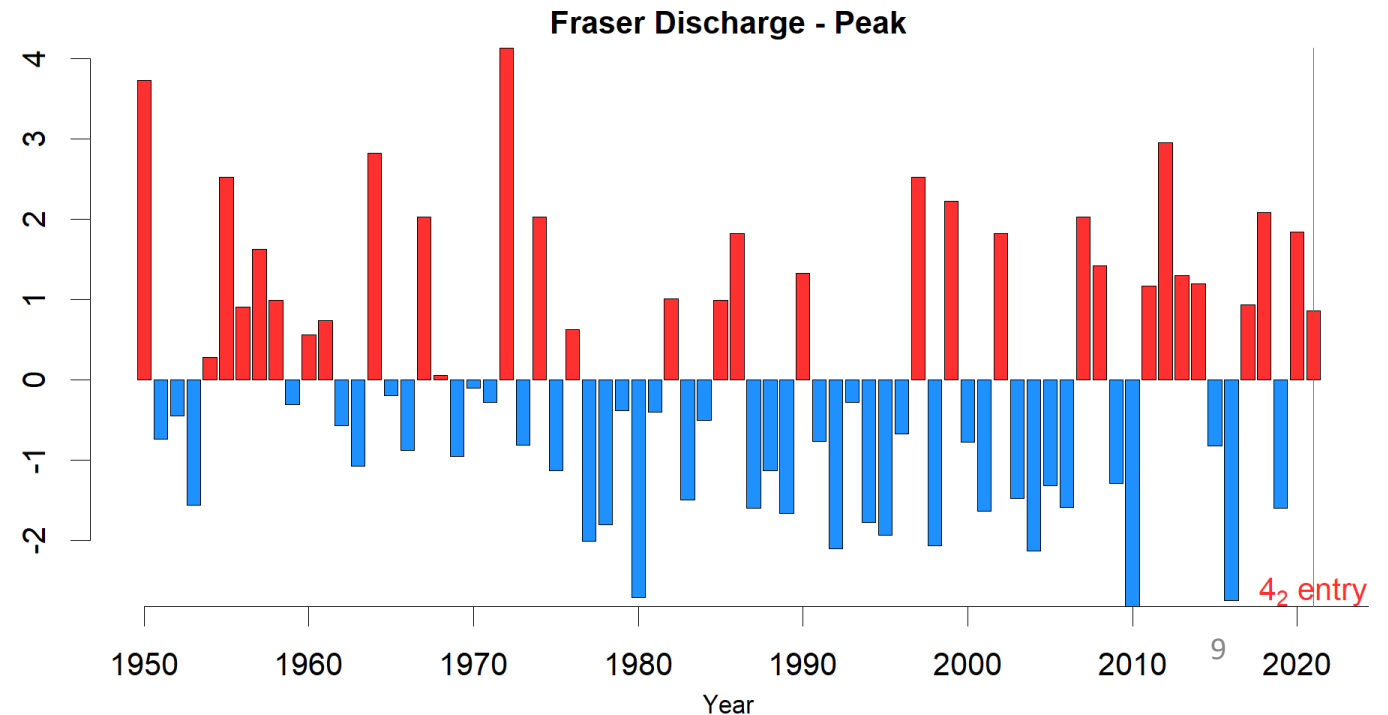
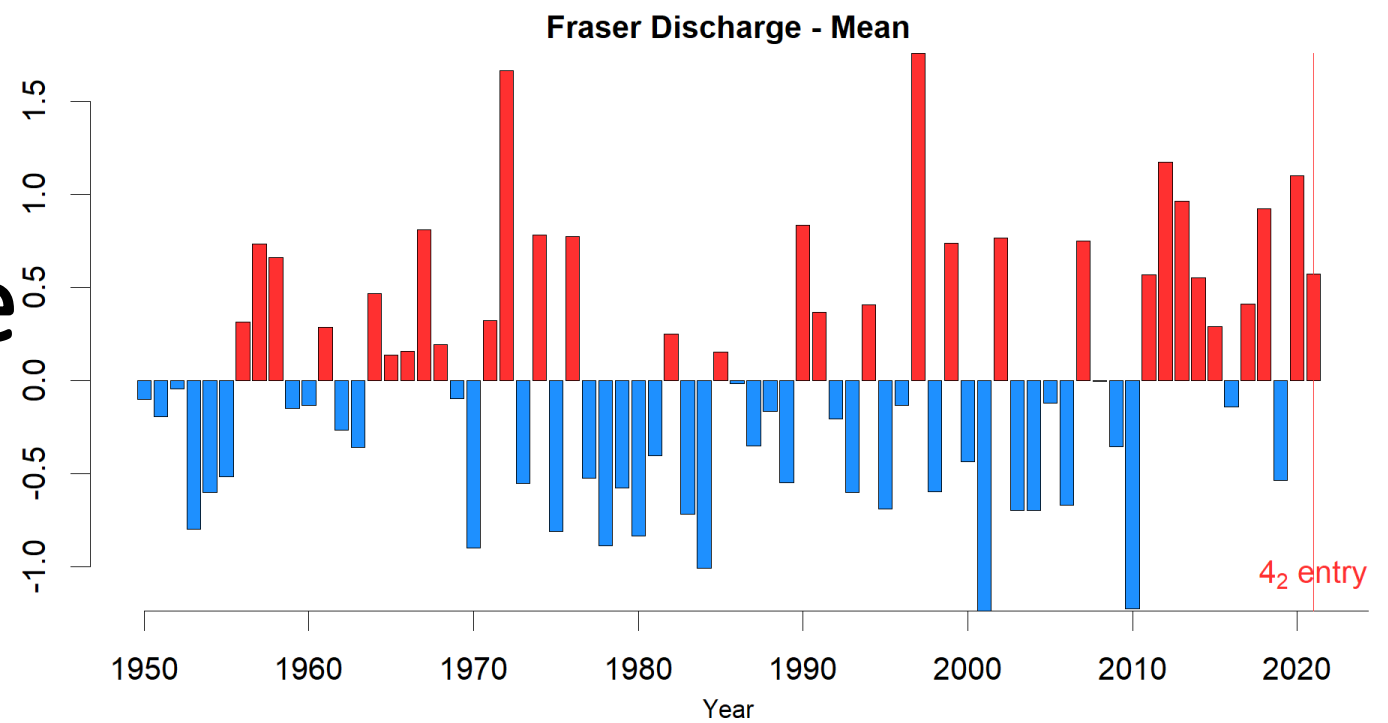
Environmental Data: PDO

- Negative condition signalling cooler ocean conditions



Environmental Data: Fraser River Discharge

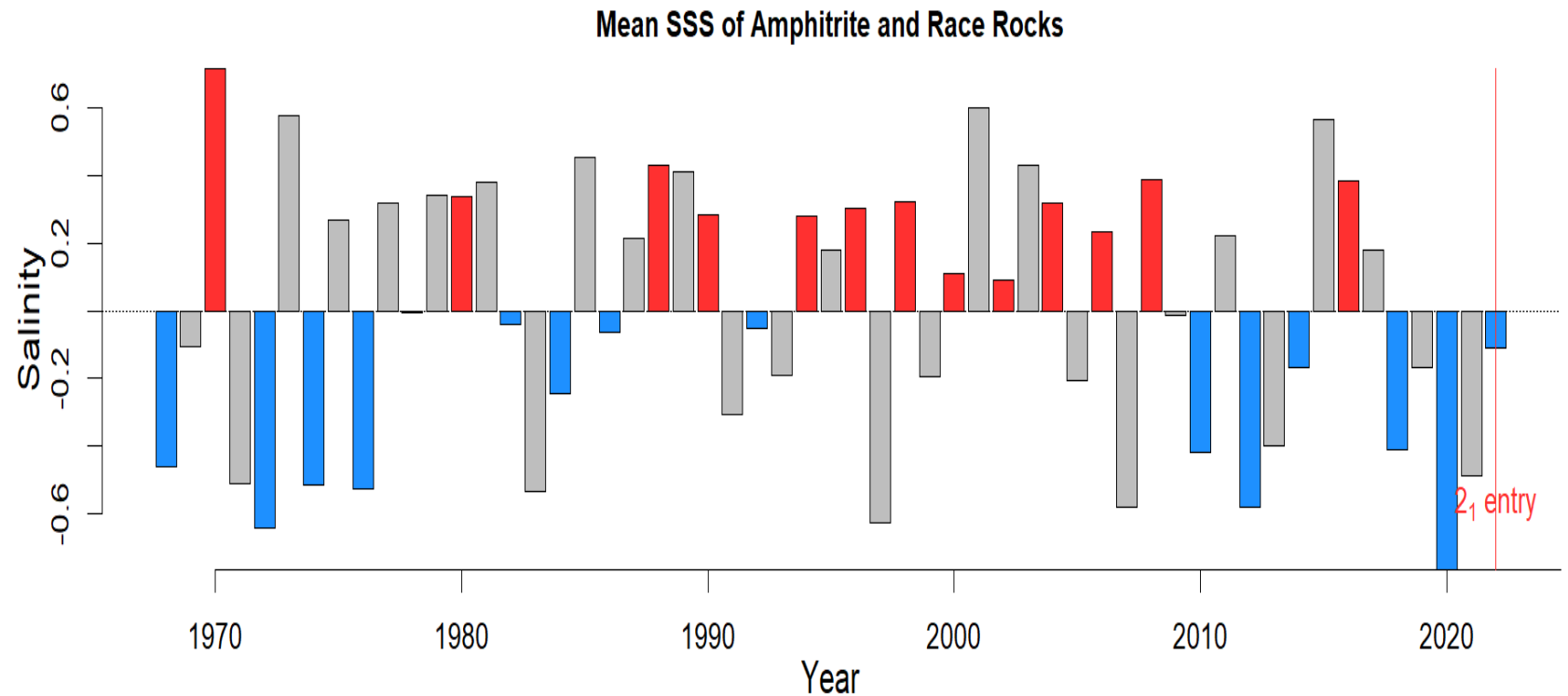
- Above average discharge in 2021 smolt outmigration year



Source: David Patterson, DFO
Environmental Watch Program

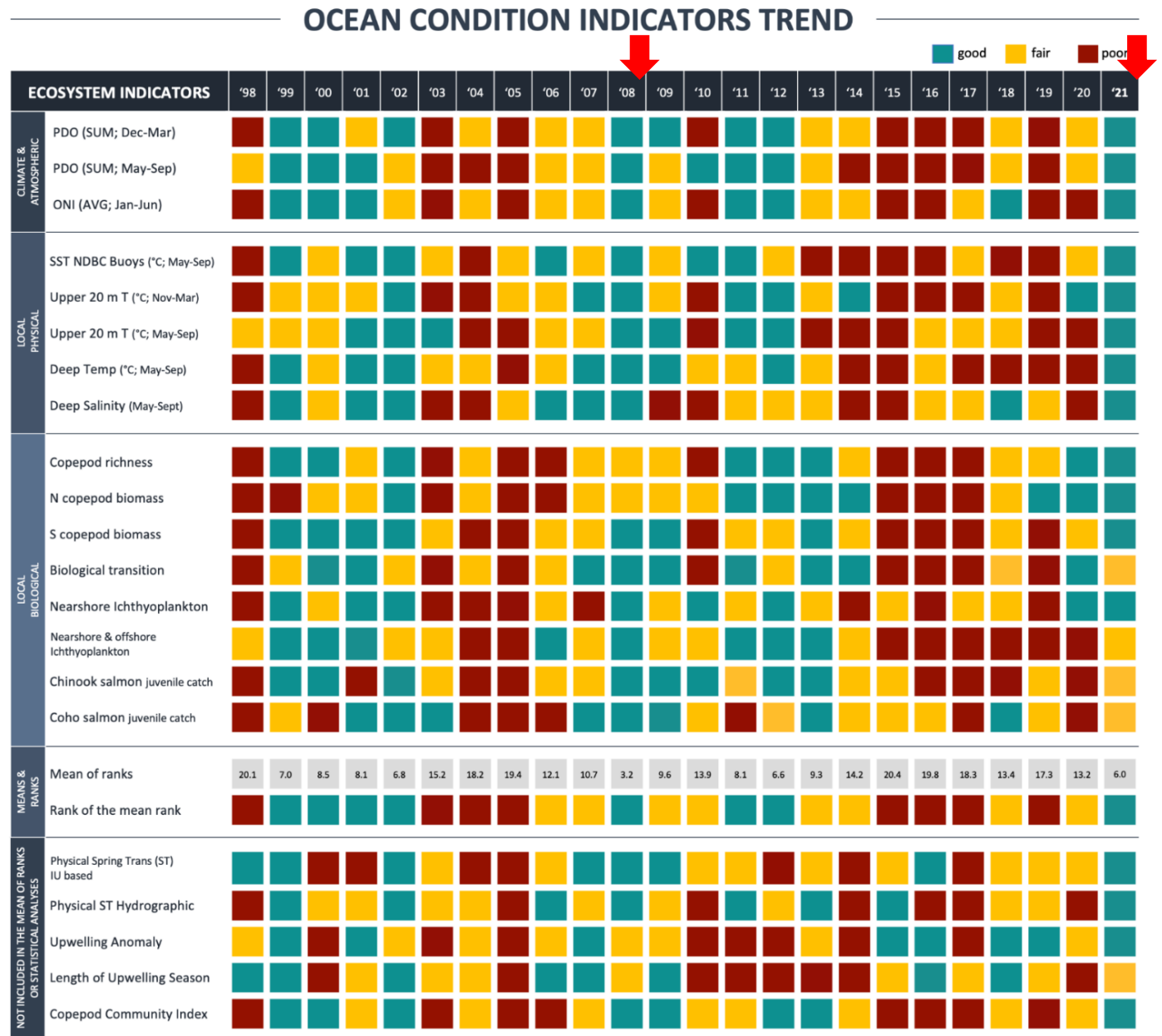
Environmental Data: SSS

- Slightly below historic average; negative condition
- Utilized for the Fraser Pink forecast only



Stoplight chart of ocean conditions in 2021:

- Summary of ocean ecosystem indicators used to characterize juvenile marine salmon survival in the Northern California Current
 - 2021 Ranked second best in the 24-year time series (2008 ranked first).

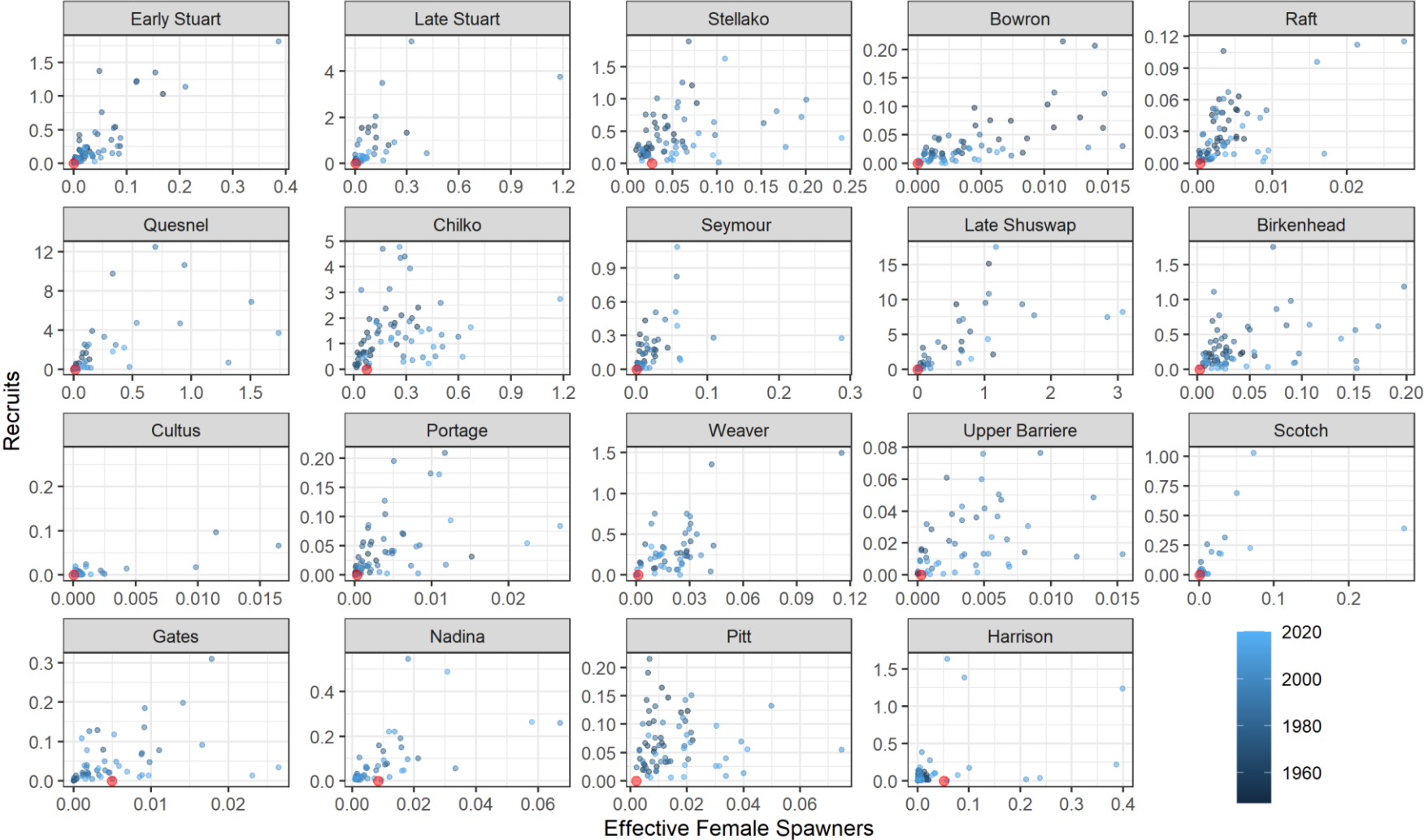


2023 Fraser Sockeye Forecast Table

- Total Sockeye: 1.6 M [453K, 6.0M]
 - Early Stuart: 23K [6K, 86K]
 - Early Summer: 186K [47K, 665K]
 - Summer: 1.2M [349K, 4.4M]
 - Late: 188K [50K, 796K]
- Total Pink: 6.1 M [3.2M, 11.6M]

| Run timing group | Forecast Model | Probability that Return will be at/or Below Specified Run Size | | | | |
|---|-----------------------|--|-----------|-----------|-----------|------------|
| | | 10% | 25% | 50% | 75% | 90% |
| Stuarts | | | | | | |
| Early Stuart | Ricker (Ei)4/Sibling5 | 6,000 | 11,000 | 23,000 | 46,000 | 86,000 |
| Early Summer Total | | 47,000 | 81,000 | 186,000 | 354,000 | 665,000 |
| Total excluding misc. stocks | | 40,000 | 71,000 | 141,000 | 284,000 | 552,000 |
| Bowron | Ricker (Pi) | 100 | 400 | 2,000 | 6,000 | 15,000 |
| Upper Barriere (Fennell) | Ricker (Pi)4/Sibling5 | 700 | 1,000 | 2,000 | 5,000 | 9,000 |
| Gates | LLY4/Sibling5 | 3,000 | 6,000 | 12,000 | 25,000 | 48,000 |
| Nadina | RickerCyc4/Sibling5 | 19,000 | 37,000 | 76,000 | 157,000 | 315,000 |
| Pitt | Larkin4/Sibling5 | 12,000 | 19,000 | 31,000 | 49,000 | 77,000 |
| Scotch | Larkin4/Sibling5 | 3,000 | 5,000 | 11,000 | 23,000 | 42,000 |
| Seymour | Ricker(Pi) | 2,000 | 3,000 | 7,000 | 19,000 | 46,000 |
| Misc (EShu) | R/S | 7,000 | 9,000 | 41,000 | 64,000 | 100,000 |
| Misc (Taseko) | R/S | 0 | 0 | 10 | 10 | 10 |
| Misc (Chilliwack) | R/S | 300 | 400 | 2,000 | 3,000 | 6,000 |
| Misc (Nahatlatch) | R/S | 300 | 500 | 2,000 | 3,000 | 7,000 |
| Summer Total | | 349,000 | 614,000 | 1,167,000 | 2,398,000 | 4,405,000 |
| Total excluding misc. stocks | | 349,000 | 614,000 | 1,166,000 | 2,396,000 | 4,401,000 |
| Chilko | Larkin4/Sibling5 | 210,000 | 343,000 | 591,000 | 1,013,000 | 1,651,000 |
| Late Stuart | R1C4/Sibling5 | 10,000 | 19,000 | 39,000 | 85,000 | 180,000 |
| Quesnel | Ricker(Ei) | 63,000 | 137,000 | 319,000 | 882,000 | 1,836,000 |
| Stellako | Ricker(Ei)4/Sibling5 | 51,000 | 87,000 | 157,000 | 288,000 | 476,000 |
| Harrison | TSA3/LLY4 | 12,000 | 23,000 | 51,000 | 111,000 | 228,000 |
| Raft | LLY4/Sibling5 | 3,000 | 5,000 | 9,000 | 17,000 | 30,000 |
| Misc (N. Thomp. Tribes) | R/S | 20 | 40 | 100 | 200 | 300 |
| Misc (N. Thomp River) | R/S | 200 | 300 | 800 | 2,000 | 3,000 |
| Misc (Widgeon) | R/S | 20 | 60 | 80 | 200 | 700 |
| Late Total | | 50,000 | 93,000 | 188,000 | 387,000 | 796,000 |
| Total excluding misc. stocks | | 50,000 | 93,000 | 188,000 | 386,000 | 793,000 |
| Cultus | PowerJuvPi | 0 | 10 | 20 | 60 | 100 |
| Late Shuswap | Ricker(Pi)4/Sibling5 | 3,000 | 9,000 | 25,000 | 65,000 | 162,000 |
| Portage | Ricker(Ei) | 900 | 2,000 | 7,000 | 20,000 | 56,000 |
| Weaver | RickerCyc4/Sibling5 | 15,000 | 30,000 | 64,000 | 140,000 | 306,000 |
| Birkenhead | Ricker(Pi)4/Sibling5 | 31,000 | 52,000 | 92,000 | 161,000 | 269,000 |
| Misc Harrison/Lillooet | R/S | 70 | 200 | 300 | 900 | 3,000 |
| TOTAL SOCKEYE SALMON | | 453,000 | 800,000 | 1,564,000 | 3,185,000 | 5,952,000 |
| Total Sockeye excluding misc. stocks | | 445,000 | 789,000 | 1,518,000 | 3,112,000 | 5,832,000 |
| TOTAL PINK SALMON | MRJ | 3,247,000 | 4,389,000 | 6,135,000 | 8,575,000 | 11,591,000 |

Raw relationship between recruits and EFS



Age Specific Forecast Table

- With the exception of the Summer run timing group, forecasts are dominated by age 5 returns

| Sockeye stock/timing group | 2023 Fraser Sockeye Forecasts | | | | |
|----------------------------|-------------------------------|--------------------------|------------------|--------------------------|--------------------------|
| | Four-year-old return 50% | Five-year-old Return 50% | Total Return 50% | Four-Year-Old Proportion | Five-Year-Old Proportion |
| Early Stuart | 200 | 22,800 | 23,000 | 1% | 99% |
| Early Summer | | | | | |
| Bowron | 30 | 1,970 | 2,000 | 2% | 98% |
| Upper Barriere (Fennell) | 800 | 1,200 | 2,000 | 40% | 60% |
| Gates | 11,200 | 800 | 12,000 | 93% | 7% |
| Nadina | 32,000 | 44,000 | 76,000 | 42% | 58% |
| Pitt | 2,000 | 29,000 | 31,000 | 6% | 94% |
| Scotch | 6,000 | 5,000 | 11,000 | 55% | 45% |
| Seymour | 2,000 | 5,000 | 7,000 | 29% | 71% |
| Misc (EShu) | 4,000 | 37,000 | 41,000 | 10% | 90% |
| Misc (Taseko) | 0 | 10 | 10 | 0% | 100% |
| Misc (Chilliwack) | 1,400 | 600 | 2,000 | 70% | 30% |
| Misc (Nahatlatch) | 1,400 | 600 | 2,000 | 70% | 30% |
| Summer | | | | | |
| Chilko | 486,000 | 105,000 | 591,000 | 82% | 18% |
| Late Stuart | 18,000 | 21,000 | 39,000 | 46% | 54% |
| Quesnel | 73,000 | 246,000 | 319,000 | 23% | 77% |
| Stellako | 120,000 | 37,000 | 157,000 | 76% | 24% |
| Harrison | 14,000 | 37,000 | 51,000 | 27% | 73% |
| Raft | 6,000 | 3,000 | 9,000 | 67% | 33% |
| Misc (N. Thomp. Tribs) | 80 | 20 | 100 | 80% | 20% |
| Misc (N. Thomp River) | 100 | 700 | 800 | 13% | 87% |
| Misc (Widgeon) | 50 | 30 | 80 | 62% | 38% |
| Late | | | | | |
| Cultus | 0 | 20 | 20 | 0% | 100% |
| Late Shuswap | 6,000 | 19,000 | 25,000 | 24% | 76% |
| Portage | 2,000 | 5,000 | 7,000 | 29% | 71% |
| Weaver | 6,000 | 58,000 | 64,000 | 9% | 91% |
| Birkenhead | 6,000 | 86,000 | 92,000 | 7% | 93% |
| Misc(Non-Shuswap) | 20 | 280 | 300 | 7% | 93% |
| Total | 798,000 | 766,000 | 1,564,000 | 51% | 49% |

Key Messages: Sockeye

- Brood for 2018 is ~10x higher than for 2019
- 2019 cycle line had the poorest productivity on record
- Marine conditions have been better in the last few years than they have over the last decade
- Uncertainty in the forecast as we're very near the origin of the stock-recruit curve
- Updated retrospective analysis is likely capturing the more recent trends in productivity

Key Messages: Pink

- The forecast for Fraser Pink should be approached with caution due to several reasons:
 - Uncertainty in escapement time series
 - Uncertainty in impact of flooding in 2021
 - The third lowest fry outmigration on record
- Environmental conditions appear to be near neutral but in a negative condition

