Fraser Chum Management Approach

PRESENTATION TO FORUM JTWG

JANUARY 27, 2025

Outline

1. Management process overview
2. Pacific Salmon Treaty Chapter 6 implications
3. Management breakpoints – sources and use
4. Management tools and process for 2024

Appendix – additional background material

1. Management process overview

Pre-season

- No formal quantitative forecasts
- Qualitative outlook

In-season

- Terminal return estimate (modelled)
  → preliminary and final
- Fisheries managed around terminal return breakpoints

Post-season

- Spawning escapement estimates
- Terminal return estimate (escapement plus catch)

1. Management process overview

Conservation objectives

- Maintain healthy and diverse populations by conserving functionally distinct groups of salmon, called *Conservation Units*.
- Protect the integrity of each conservation unit by ensuring sufficient escapement for component populations.
- Monitor the status of conservation units relative to formal benchmarks for conservation and long term production.

- Cautionary approach to Fraser Chum fisheries management; opportunities based on:
  - In-season abundance estimates
  - conservation measures that limit encounters of non-target species and minimize impacts on species of concern.

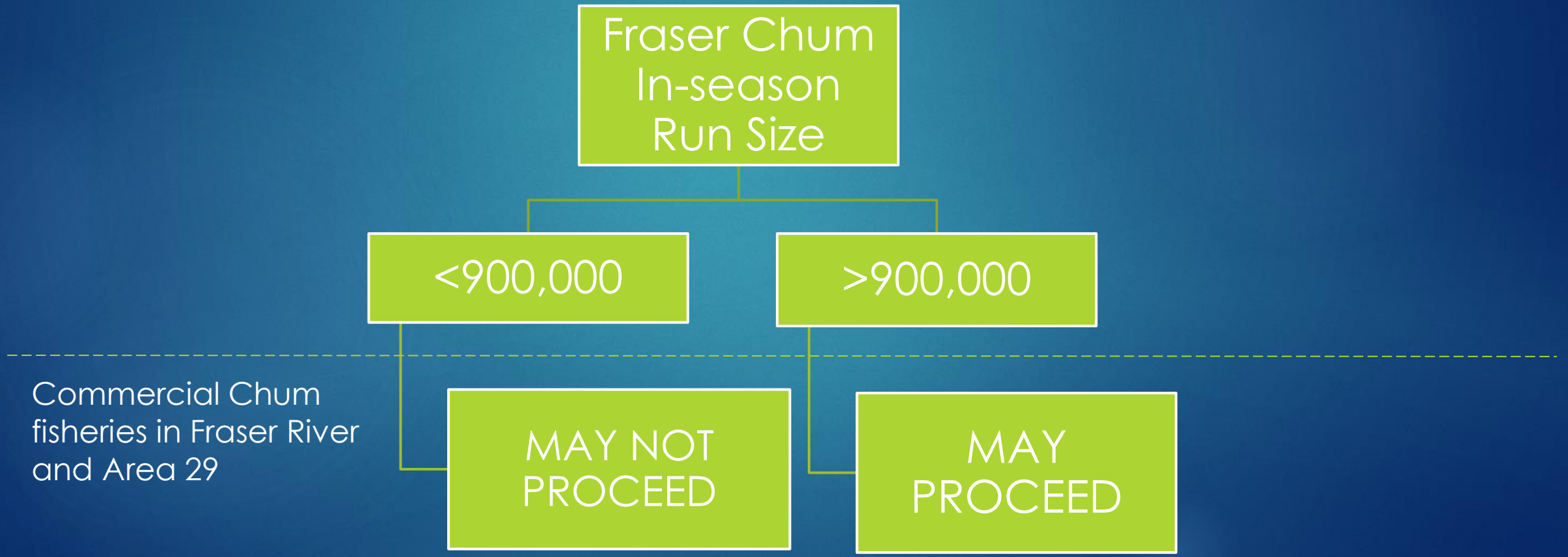
2. Pacific Salmon Treaty Chapter 6 implications

- Note: This is not "official" Treaty wording, it has been simplified for understanding

- Canada's management goals for Johnstone Strait, Strait of Georgia, and Fraser River Chum Salmon fisheries:
  - Provide continued rebuilding of depressed naturally spawning Chum Salmon stocks
  - As much as possible, don't increase interceptions of U.S. origin Chum Salmon
  - In terminal fisheries, minimize the interception of non-targeted stocks

2. Pacific Salmon Treaty Chapter 6 implications

- Canada's management of Fraser River fisheries for Chum Salmon



2. Pacific Salmon Treaty Chapter 6 implications

- Harvest of Chum by U.S. in Areas 7 and 7A is predominately Fraser stocks (approximately 80%); new management measures were added to Treaty in 2003

- U.S. management of Chum salmon fishery in Areas 7 and 7A key dates:
  - **October 10:** No commercial Chum Salmon fisheries prior to this date if ISC run size <1M
  - **October 22:** Canada must provide Fraser Chum run size estimate by this date

2. Pacific Salmon Treaty Chapter 6 implications

- The U.S. management of Chum salmon fishery in Areas 7 and 7A:

Fraser Chum Run Size	US catch ceiling (Area 7/7A)
< 1,050,000	20,000 after notification
1,050,000 to 1,600,000	125,000
> 1,600,000	160,000

- Any catch greater than the ceiling results in an overage that will reduce the U.S. catch ceiling in up to two subsequent years
- If the Fraser Chum run size is revised downward after Oct. 22 and the catch ceiling has been reached, U.S. fisheries in Area 7/7A will be terminated

3. Management breakpoints

Terminal Run Size	Harvest Plan	Lower Fraser First Nations	Commercial	Recreational
<500,000 in Fraser	<10%	Limited (reduced hours and days/week fishing)	Closed	Mainstem Fraser River closed, restricted openings on tributaries
500,000 to 800,000 in Fraser	Directed fisheries limited to FSC	Normal	Closed	Mainstem Fraser River closed, restricted openings on tributaries
800,000 to 916,000 in Fraser	Catch not to exceed 91,800 (82,800 First Nations* and 9,000 test fishing)	Normal	Closed	Mainstem Fraser River open, restricted openings on tributaries
916,000 to 1,050,000 in Fraser	Commercial catch not to exceed 10% for Chum.	Normal	Open (35,000-105,000)	Open
>1,050,000 in Fraser	Commercial catch not to exceed 15% for Chum.	Normal	Open (105,000 plus)	Open

3. Management breakpoints

- Where did the breakpoints come from?
- 500,000 → Palmer 1972 habitat-based escapement goal; minimum level, below which is considered conservation concern
- 800,000 → Ryall et al. 1999 stock-recruit analysis, management escapement goal
- 916,000 → minimum terminal run size needed to provide full FSC and Treaty allocations (72,000), test fishery catch (9,000), and min. 35,000 commercial TAC
- 1,050,000 → Clockwork strategy; identified 550K for early Chum run, 500K for lates required for 15% TAC

4. Management tools

- Clockwork Strategy (Fraser River)
- In-season run size model (Fraser River terminal estimate)
- ChumGEM

4. Management tools

Clockwork Strategy (Fraser River)

- Objective: rebuild wild Chum stocks within a defined time frame to the estimated optimum escapement levels by limiting annual harvest rates
  - Stepped harvest rate strategy, applied against in-season estimates of assessed Clockwork total run size
  - Relies on ability to accurately assess run size in-season
- Fraser strategy implemented in 1987 (Gould et al. 1991)
- Provided management goals and fishing limits for the harvest of Fraser River Chum, independent of the Johnstone Strait fishery

4. Management tools

Clockwork Strategy (Fraser River)

- Two runs to the Fraser assessed and managed separately (early and late)
- Gross escapement goal increased as the run to the river increased
- No directed harvesting unless predicted run size exceeded the gross escapement goal for that portion of the run
- Catch prediction required for a directed Chum fishery was 35,000
- Gross escapement goal = Spawning escapement goal +
  First Nations FSC catch (21K) +
  Test fishery catch (19K) +
  Commercial fishery catch (35K)

4. Management tools

Clockwork Strategy (Fraser River)

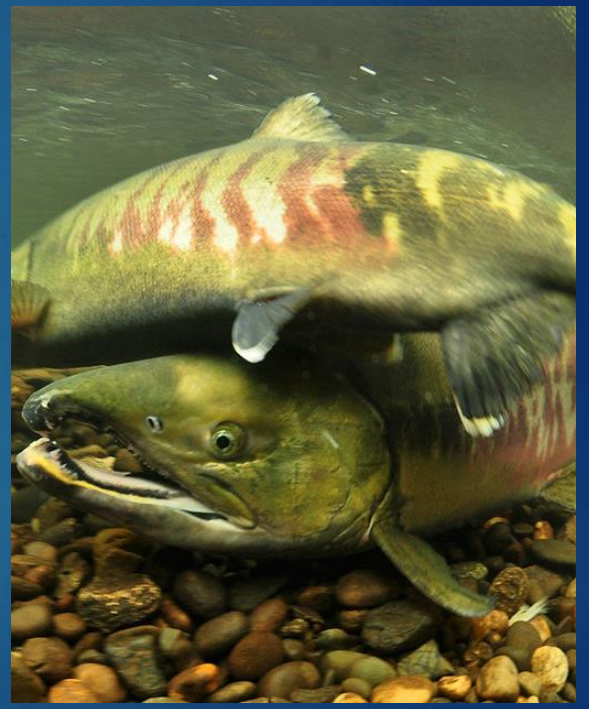
Run to River	Spawning Escapement Goal		
	Total	Early Run	Late Run
<800,000	700,000	365,000	335,000
801 - 850,000	730,000	380,000	350,000
851 - 900,000	760,000	395,000	365,000
901 - 950,000	785,000	410,000	375,000
951 - 1,000,000	810,000	420,000	390,000
1,000 - 1,050,000	835,000	430,000	405,000
1,051 - 1,150,000	860,000	450,000	410,000
1,151 - 1,250,000	960,000	500,000	460,000

Run to River	Gross Escapement Goal		
	Total	Early Run	Late Run
800,000	740,000	390,000	350,000
801 - 850,000	770,000	405,000	365,000
851 - 900,000	800,000	420,000	380,000
901 - 950,000	825,000	435,000	390,000
951 - 1,000,000	850,000	445,000	405,000
1,000 - 1,050,000	875,000	460,000	415,000
1,051 - 1,150,000	900,000	470,000	430,000
1,151 - 1,250,000	1,000,000	520,000	480,000

- Not in use as of 2002, but continue to use some of the elements that informed this strategy

4. Management Tools
Run Size Model

- Model is a Bayesian non-linear regression model that produces a run size estimate to the mouth of the Fraser.
- Data inputs include:
  - Past data on return timing, abundance, expansion line*, and length of the return (spread)
  - In-season Albion test fishery CPUE
- Model is run twice in-season, typically in mid-October
  - Results are posted via Fishery Notice
- Outputs provide information in-season on probable range of run size, peak migration date, and spread of the run

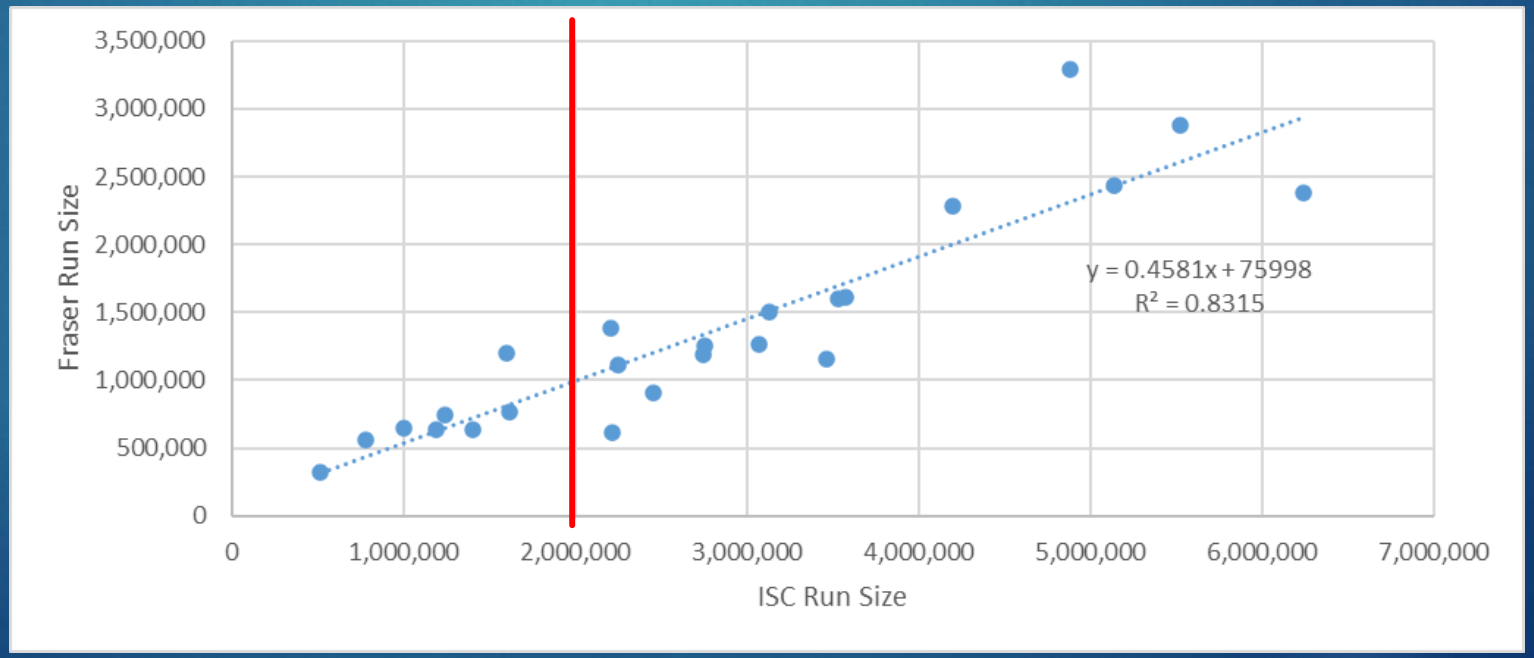


https://www.flickr.com/photos/fishasart/15097944224

*relationship between Albion catch and what is estimated to be in the river at that time

4. Management Tools
Run Size Model

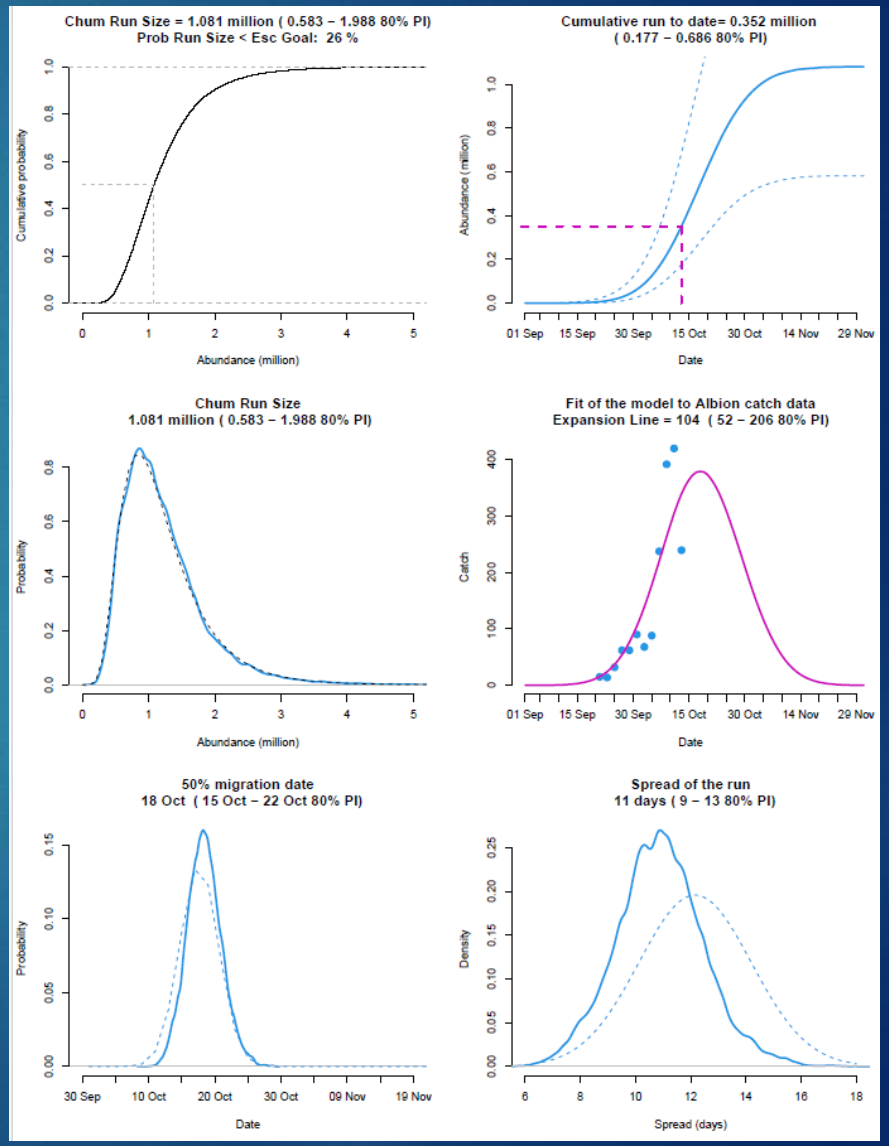
- Choice of priors is partly based on observations from the Johnstone Strait test fishery
- Good relationship between Fraser run size and Inside Southern Chum run size (2000-2023)



4. Management Tools
Run Size Model

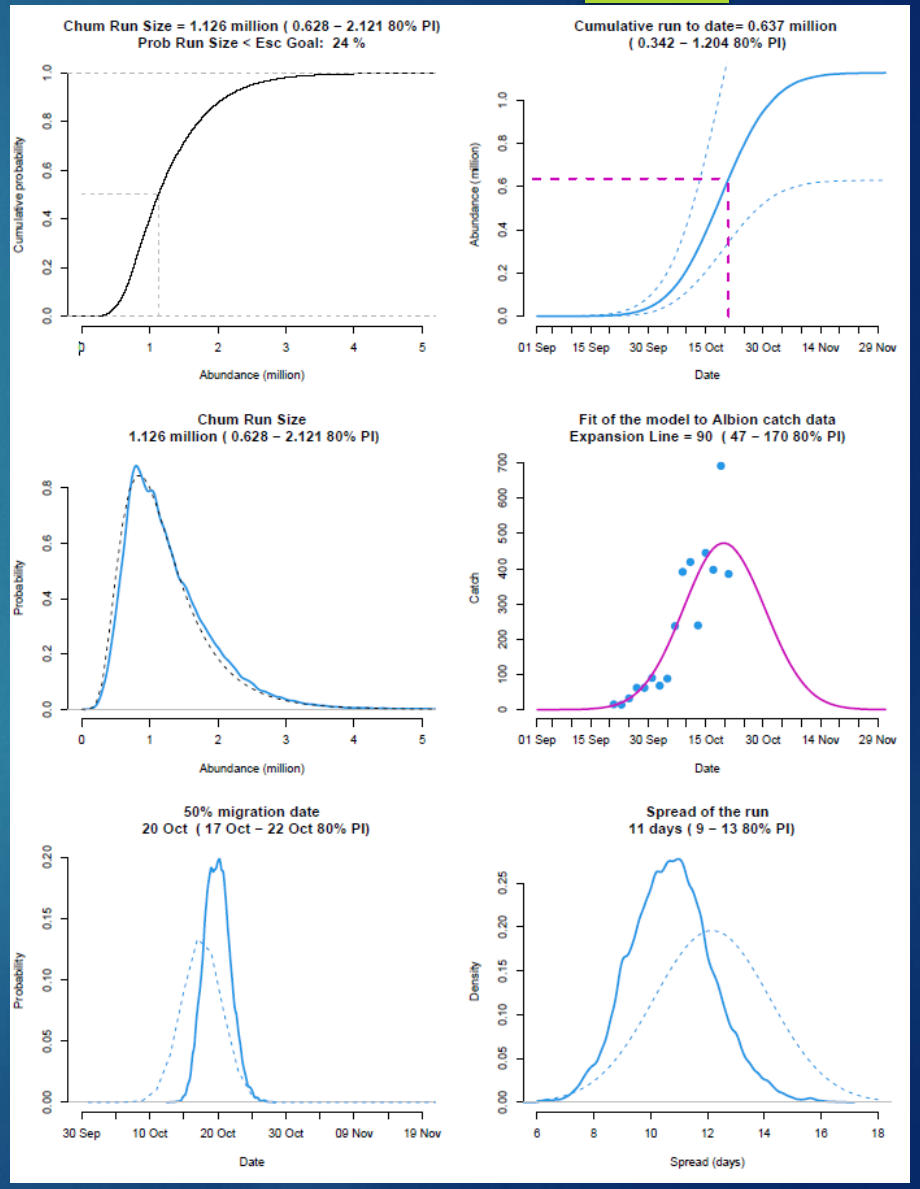
- Preliminary estimate
  - Ran on October 15 with base case priors
  - Outputs looked good, no reason to change priors

Historic Runsize		
mu_N	1.08	2012-2023
CV_N	0.52	2012-2023
50% migration date		
mu_T	48	1998-2023
CV_T	0.06	1998-2023
Spread of the run		
mu_S	12	1998-2023
CV_S	0.17	1998-2023
River Expansion factor		
mu_EXPANDRIVER	4.8	1998-2023
CV_EXPANDRIVER	0.50	1998-2023



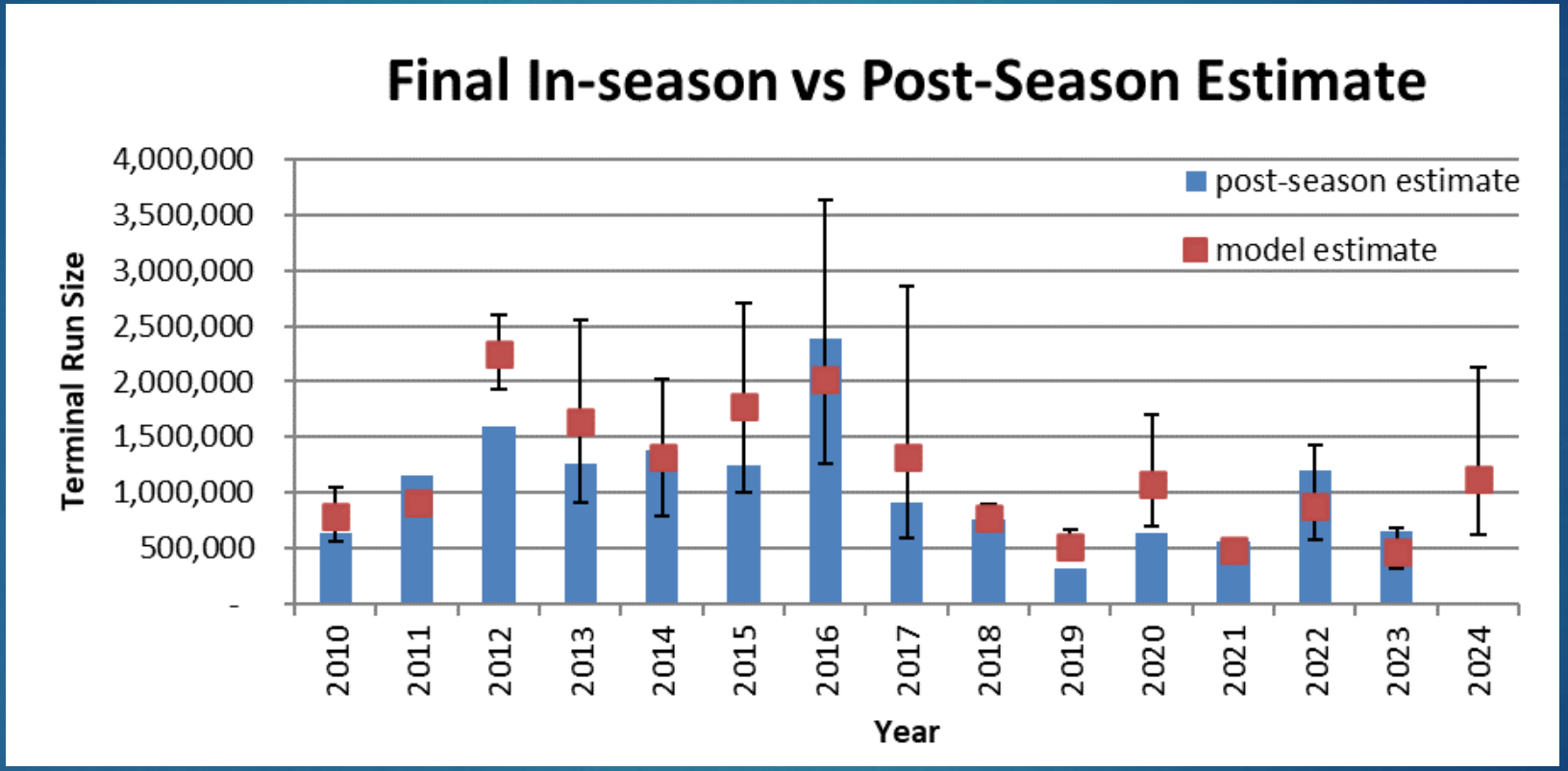
4. Management Tools
Run Size Model

- Final estimate
  - Ran on October 22 with base case priors
  - JSt estimate was indicating ~ 2 million ISC
  - Outputs looked good, no reason to change priors
  - Did try a scenario with later 50% date (Oct. 23), which resulted in a lower expansion and run size
  - No real evidence to suggest later run timing, so used the base case for final notice



4. Management tools

Run Size Model



Comparison of Fraser run size estimates produced by the model pre-season and post-season estimates of run size based on reconstructed escapement plus catch

2024 Preliminary Run Size not yet available

References

- Gould, A.P., Luedke, W.H, Farwell, M.K, and Hop Wo, L. (1991) Review and analysis of the 1987 chum salmon season in the Johnstone Strait to Fraser River Study Area. Can. Man. Rep. Fish. Aquat. Sci. 2107: 87p.
- Grant, S. and Pestal, G. (2009) Certification Unit Profile: Fraser River Chum Salmon. Can. Man. Rep. Fish. Aquat. Sci. 2874: vii + 40p.
- Joyce, M. and Cass, A. (1992) Assessment of Fraser River Chum Salmon. PSARC Working Paper S92-02: 41p.
- Palmer, R.N. (1972) Fraser River chum salmon. Dept. Env. Fish. Ser. Pacific Region Tech. Rep. No. 1972-1: 284p.
- Pearse, P.H. (1982) Turning the tide: A new policy for Canada's Pacific fisheries. Commission of Pacific Fisheries Policy Report. 292p.
- Ryall, P. Murray, C., Palermo, V., Bailey, D., and Chen, D. (1999) Status of Clockwork Chum Salmon Stock and Review of the Clockwork Management Strategy. CSAS Res. Doc. 99/169: 134 p.

Appendix

- Additional background material – some data are a few years out of date, apologies. Please send a request to Brittany Jenewein (Brittany.Jenewein@dfo-mpo.gc.ca) if you would like an updated dataset.

1. Biology, life history, distribution

- Fraser River supports the largest Chum aggregate in BC.
  - Two CUs: Lower Fraser, Fraser Canyon
- Fraser Chum adults return to spawn in natal streams after 2 to 5 winters at sea.
  - Greatest proportion of Chum returning at age 4.
- Spawning occurs between September – December (i.e. Fall run timing).
  - Fecundities usually range between 2 and 3 thousand eggs per female.
- Chum emerge from the gravel as early as February and immediately migrate downstream

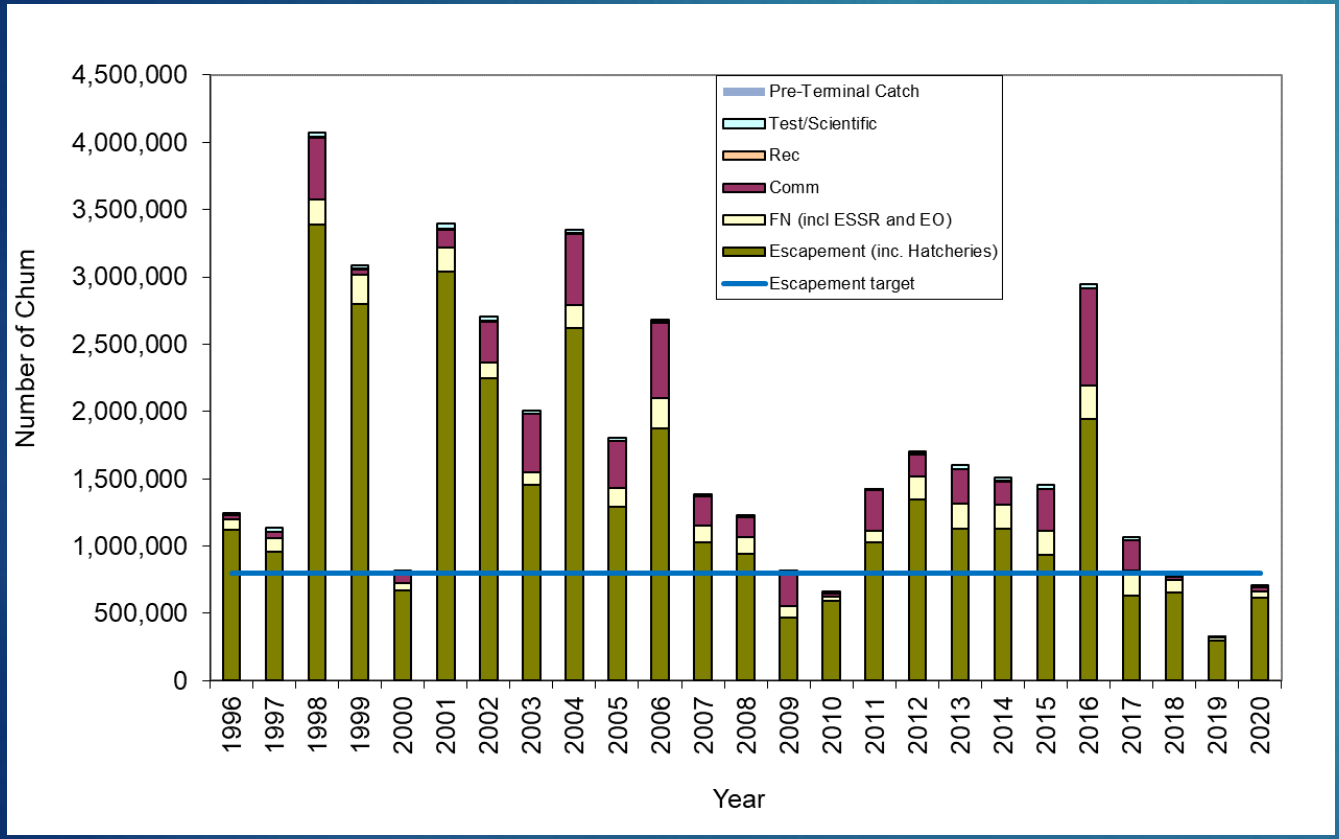
https://www.zoology.ubc.ca/~keeley/chumfry.jpg

https://www.centralcoastbiodiversity.org/chum-salmon-bull-oncorhynchus-keta.html

1. Biology, life history, distribution

- Juveniles rear in the Strait of Georgia for up to 6 months prior to migrating north.
- Primarily located along the coast and into the Gulf of Alaska during first year in the North Pacific.
- Most adults migrate back to the Fraser through Johnstone Strait and to a lesser extent Juan de Fuca Strait via WCVI.
- Spawning occurs in the lower Fraser (i.e. Fraser Canyon downstream).
- Although approximately 110 spawning streams are utilized by Chum in the Fraser, major tributaries are responsible for 90% of production which include:
  - the Harrison/Chehalis/Weaver system
  - the Chilliwack/Vedder system
  - the Stave River

2. Stock Assessment
Abundance Trends



- Escapement goal is fixed at 800,000 fish (blue line).
- Escapement goal has not been met in the last 4 years.
  - 2017 esc. fell below the 800,000 goal for the first time since 2010
- 2021 outlook estimated escapement at category 2 (below average)
  - Due to low returns for the 2017 brood year
- **2020 data is preliminary**

2. Stock Assessment

Albion Chum Test Fishery

- Operated since 1979 in the lower Fraser River at Albion, BC (near Fort Langley).
- The fishery begins in early September, and fishes until the end of November.
  - The Chum test net fishes every other day from September 1 - October 20, alternating days with the Chinook net.
  - From October 21 through the end of November, the Chum net operates daily.
- The gill net is 150 fathoms long, constructed from 6.75" mesh.
- The boat fishes two sets each day, timed to coincide with the daily high tides.
- Fish are sampled for biological information

2. Stock Assessment

Extensive Chum Survey

- Weekly surveys of ~20 spawning locations (systems) in the lower Fraser Valley counting live Chum & biosampling carcasses
- Create spawning escapement estimates, by system, with the counts using AUC methodology
- Biosamples:
  - Any tissue collected is for a GSI reference sample for the system
  - Scales are collected to begin to understand the variation in age structure, by system and as a Fraser aggregate

2. Stock Assessment

Stave River Survey

- Recently added; originally performed by Inch Creek hatchery
- Visual counts from ~weekly aerial surveys are used in the methodology SEP has used since 1994
- The methodology is a bit of a blend of count calibrations with years when a mark-recapture assessment of spawning abundance was conducted
- SEP and StAD have been looking at using AUC methodology
- Abundances we normally see in the Stave do not lend themselves well to either methodology
  - the large abundances in the Stave really require a more robust estimation program like a mark-recapture for accurate and unbiased estimates.

2. Stock Assessment

Fraser-basin Assessment

- Escapement enumeration to the entire Fraser watershed using Chilliwack assessment and Albion Test Fishery; started in 2016

- **Objective:** combining a high precision mark-recapture estimate of Chilliwack River Chum escapement with the GSI ratio of Chilliwack Chum to the total Fraser Chum captured in the Albion Test Fishery

- **Rationale:** Chilliwack Chum have historically contributed significantly to the abundance of the Fraser River Chum aggregate (2% - 42%) and are the most genetically distinct among Fraser Chum populations

2. Stock Assessment

Other assessments that collect Fraser Chum information:

- Recreational Fishery Creel Surveys: Fraser mainstem, Chilliwack, Nicomen-Norrish, and occasionally in the past Stave and Harrison
- Mission Juvenile Pink Assessment: every even year, trap fry-sized migrants at Mission
- Mission Juvenile Sockeye Assessment: annually trap fry- and smolt-sized migrants at Mission
- Harrison / Chehalis / Weaver system escapement estimates derived from a mark-recapture program run by Chehalis First Nation and DFO jointly since 1991 (also with J.O. Thomas and Associates)

2. Stock Assessment

Escapement Goals

1970s

- Total 700K target escapement (365K early run, 335K late run)

Palmer 1972

- Habitat-based analysis
- Spawning gravel estimates
- Target 500,000 escapement
- Considered under-estimates of Chum spawning capacities, minimum target level

Pearse 1982

- Stock-recruit analysis
- Target escapement 1.0M (600K-3M)
- Narrow range of observed spawners

Joyce and Cass 1992

- Stock-recruit analysis
- Could not evaluate density-dependent effects → need more years of escapements >800K
- Suggest optimum escapement >800K
- Smsy 485,320

Ryall et al . 1999

- Updated Joyce and Cass stock-recruit analysis
- Density dependence appeared present
- Smsy 738,690 (479,000 – 2,482,000)
- Formally adopted Management Escapement Goal of 800K in 1999

3. Enhancement

Historical Hatchery Production

Timeframe	Total Fry Releases
Mean 1978-1981	2,900,000
Mean 1982-1996	23,600,000
Mean 1987-1997	20,400,000

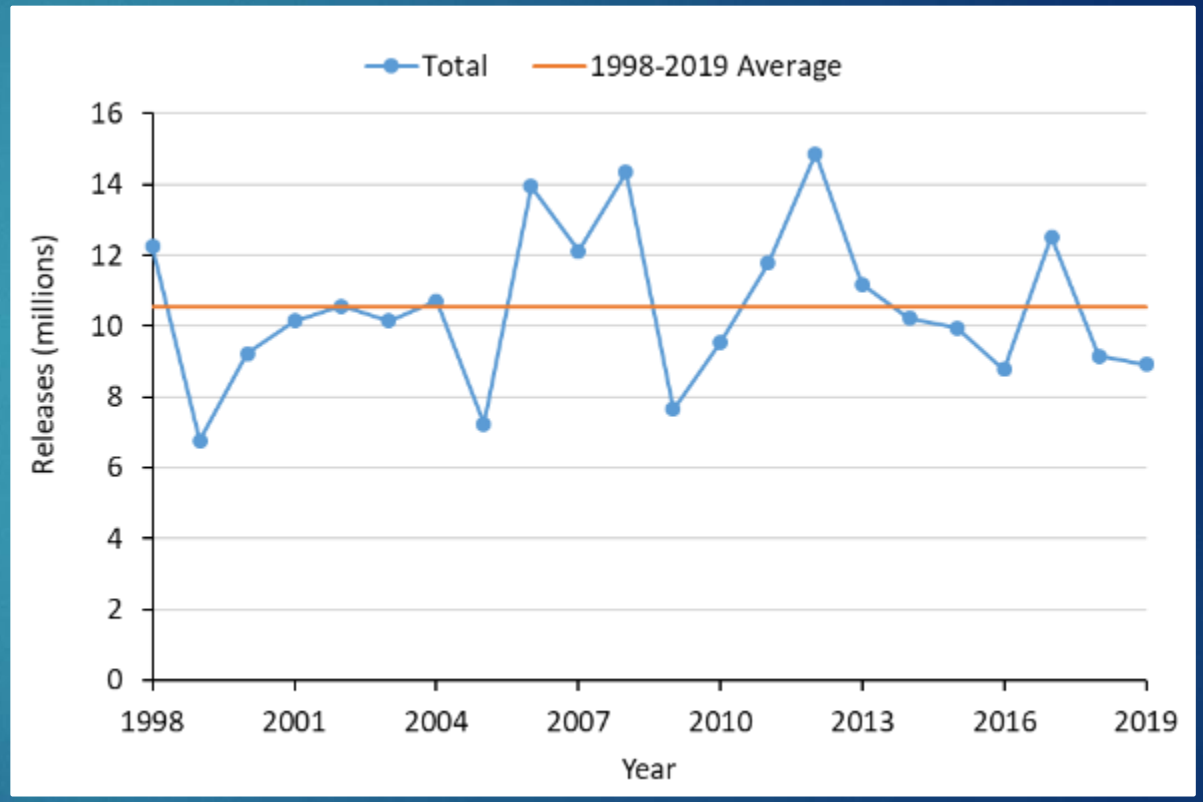
Data from Ryall *et al.* 1999. Number of fed and unfed Chum salmon fry releases (1978 – 1997 brood year) in the Lower Fraser DFO major operating hatcheries.

- Increase in releases due to new facilities constructed in the Fraser from 1980-1983
- 1987-1997 saw reductions in production in due to Chinook priorities
- Historically Chehalis and Inch Creek hatcheries tagged a proportion of released fry with coded wire tags (CWTs) and Chilliwack hatchery released Chum marked with adipose fin clips (AFC)

3. Enhancement

Current Hatchery Production

- Hatchery programs produce Chum to both supplement harvest and for population rebuilding
- No Chum have been tagged with CWTs or marked AFC since 2001
- Overall hatchery outputs have declined ~50% since 1997
- Average from 1998-2019: 10,548,040
- 2021 brood year production plan totals 9,720,000 releases from Chilliwack, Chehalis, Inch Creek, and Weaver Spawning Channel



Total Fraser Chum released from major DFO operations

3. Enhancement

Hatchery Releases 1998-2019

Year	Total	Unmarked	% Marked
1998	12,252,372	12,099,079	1%
1999	6,768,274	6,718,350	1%
2000	9,235,976	9,185,953	1%
2001	10,157,362	10,107,331	0%
2002	10,567,893	10,567,893	0%
2003	10,145,290	10,145,290	0%
2004	10,709,647	10,709,647	0%
2005	7,233,646	7,233,646	0%
2006	13,941,134	13,941,134	0%
2007	12,122,379	12,122,379	0%
2008	14,352,041	14,352,041	0%
2009	7,647,099	7,647,099	0%
2010	9,558,258	9,558,258	0%
2011	11,778,082	11,778,082	0%
2012	14,878,296	14,878,296	0%
2013	11,174,806	11,174,806	0%
2014	10,218,605	10,218,605	0%
2015	9,952,947	9,952,947	0%
2016	8,770,186	8,770,186	0%
2017	12,514,461	12,514,461	0%
2018	9,164,543	9,164,543	0%
2019	8,913,572	8,913,572	0%

Summary of data gaps

- Updates to Chum Salmon GSI baseline
  - Move from mSAT to SNPs required new collections
  - Many collections are old and enhancement (both new and terminated) may have altered the populations' genetic signal
  - There were gaps or collections with small sample sizes; some significant systems did not have any or enough samples for SNP analysis
- No juvenile program explicitly for Chum, mainly due to lack of funding
- Unknown hatchery contribution to production and escapement
- Escapement goal of 800K is for wild spawners, not hatchery spawners
- Lack of resolution on other possible Fraser River Chum CUs [e.g. early Chum, Fraser Canyon Chum, Winter Chum (blackheads)].
- Unknown escapement to systems downstream of Albion, especially Alouette River watershed