NOAA FISHERIES
West Coast Region

NMFS PIT tag based adult conversion rate estimate methodology

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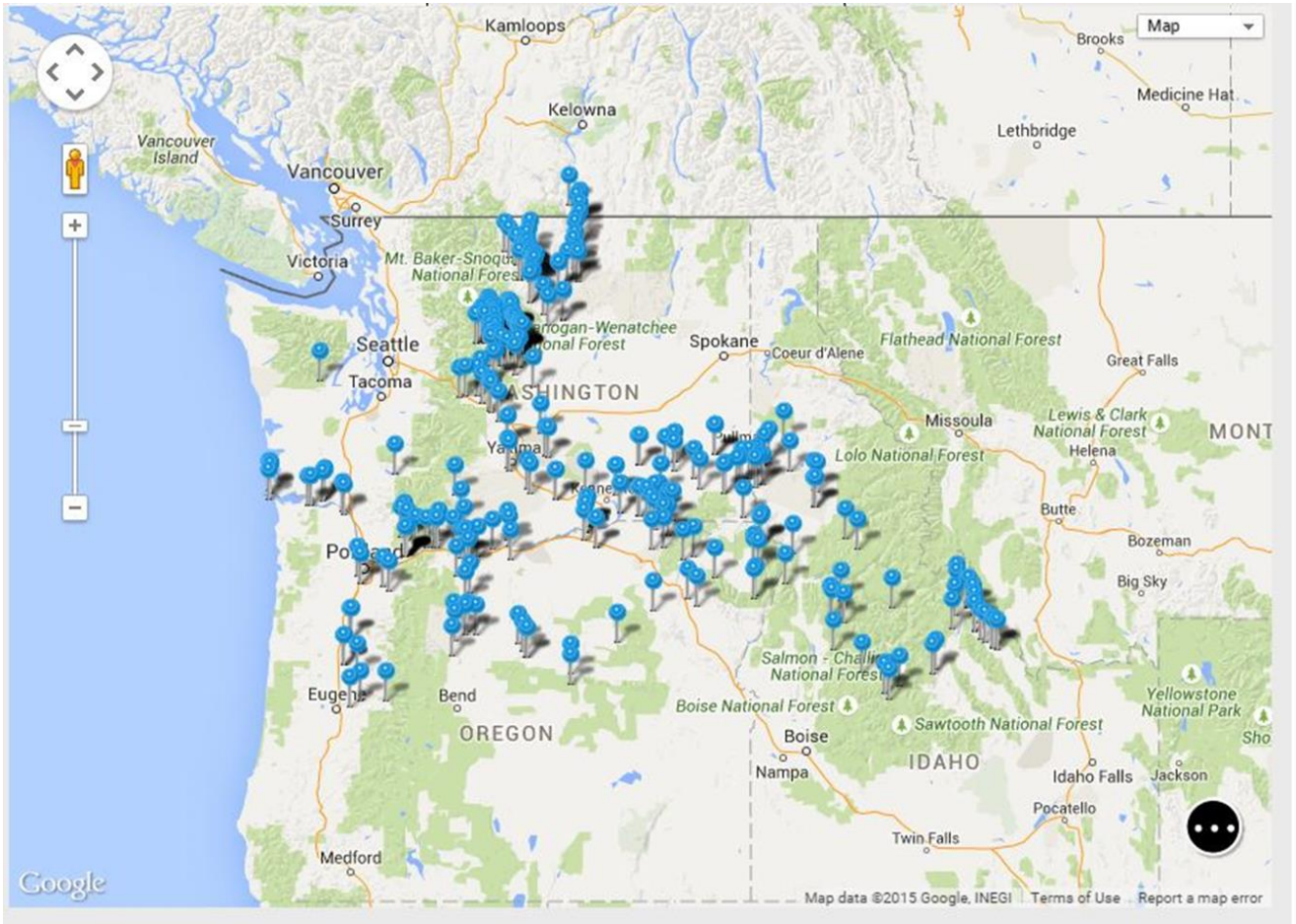
OBJECTIVES FOR ESTIMATING ADULT UPSTREAM SURVIVAL

- Adaptive Management: Detect changes in adult upstream survival
- BiOp Adult upstream survival standards monitoring
- CRS BiOp analysis and baseline
- More detailed explorations of survival and

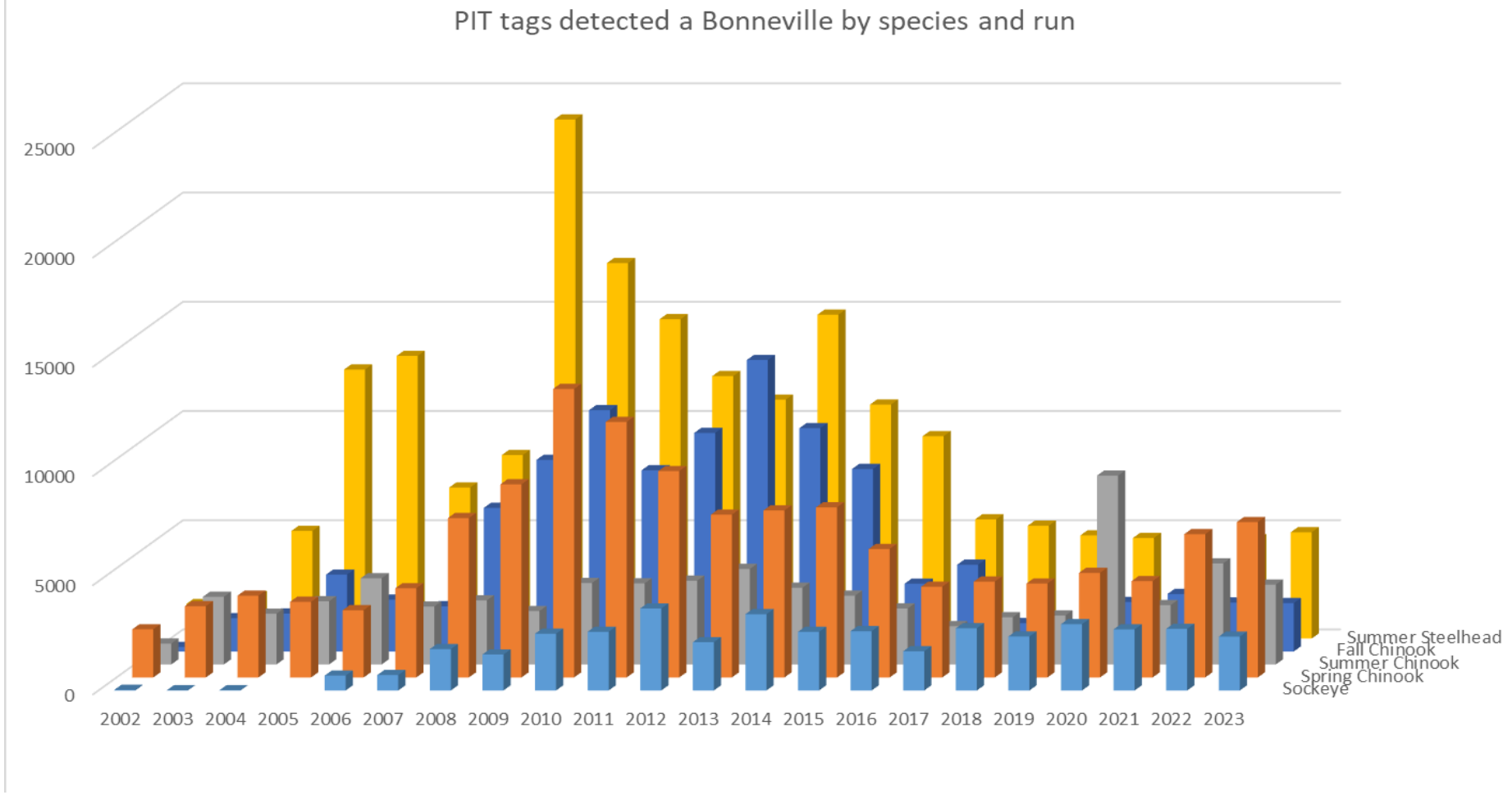
The Columbia basin has unique advantages for estimating upstream survival

Series of high efficiency detectors (97-100%) along reaches of primary interest, BON to MCN, MCN to LGR, BON to LGR

PTAGIS database and Columbia Basin PIT tag network



Large numbers of known origin PIT tagged adults arriving at Bonneville Dam every year



Methodology used in adult survival estimates
The "Binomial" method

#upstream / # downstream = conversion estimate

Conversion = survival x detection probability

Since ladder detectors are 97-100% efficient, conversion is a good estimate of survival

Key Assumption: All fish expected to arrive at upstream detector

(no turnoff- use fish of known origin)

Databases used for Estimates

- PTAGIS- data query, basic filtering, downloads

- Downloaded data entered into custom Access database, for further filtering, data assembly, and analysis
- Reporting by Excel Spreadsheet (legacy product)

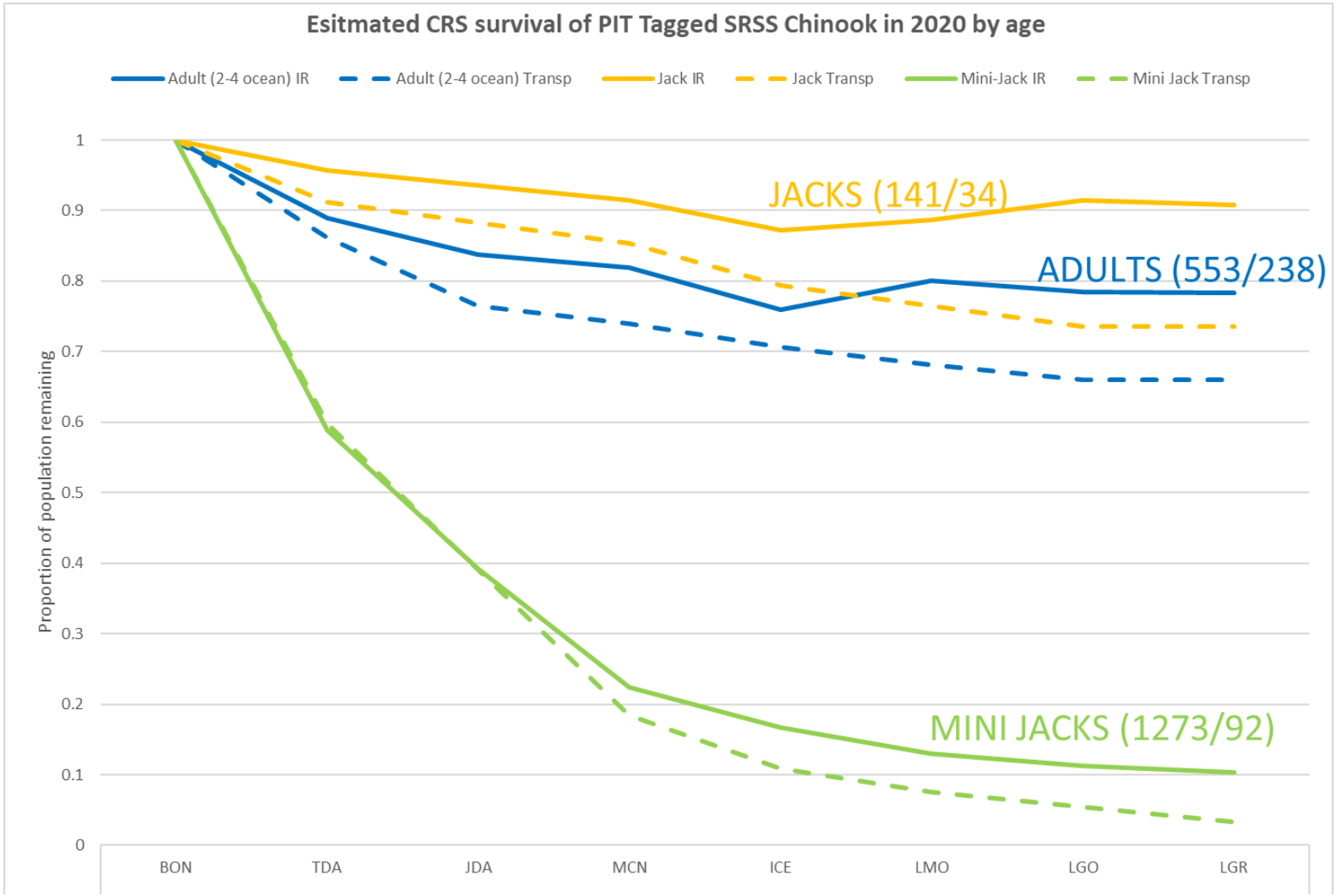
Selecting data for analysis

1. Query PTAGIS for a list of detections at Bonneville for a particular year for the species/ run of interest
2. Eliminate duplicates (Bonneville has 4 detectors, also potential fallback/re-acensions)

Applying filters to data list (Access)

1. Filter by age (mini-Jacks, Jacks, and adults)- PTAGIS meta data: “First Year”-”Migration Year” = ocean age. Adults >1 ocean year
2. Assign fish to ESU: PTAGIS metadata “release site” x custom access crosstalk table
3. Identify juvenile migration history (IR, Transp) from DART transport history files.

Differences in Survival by age

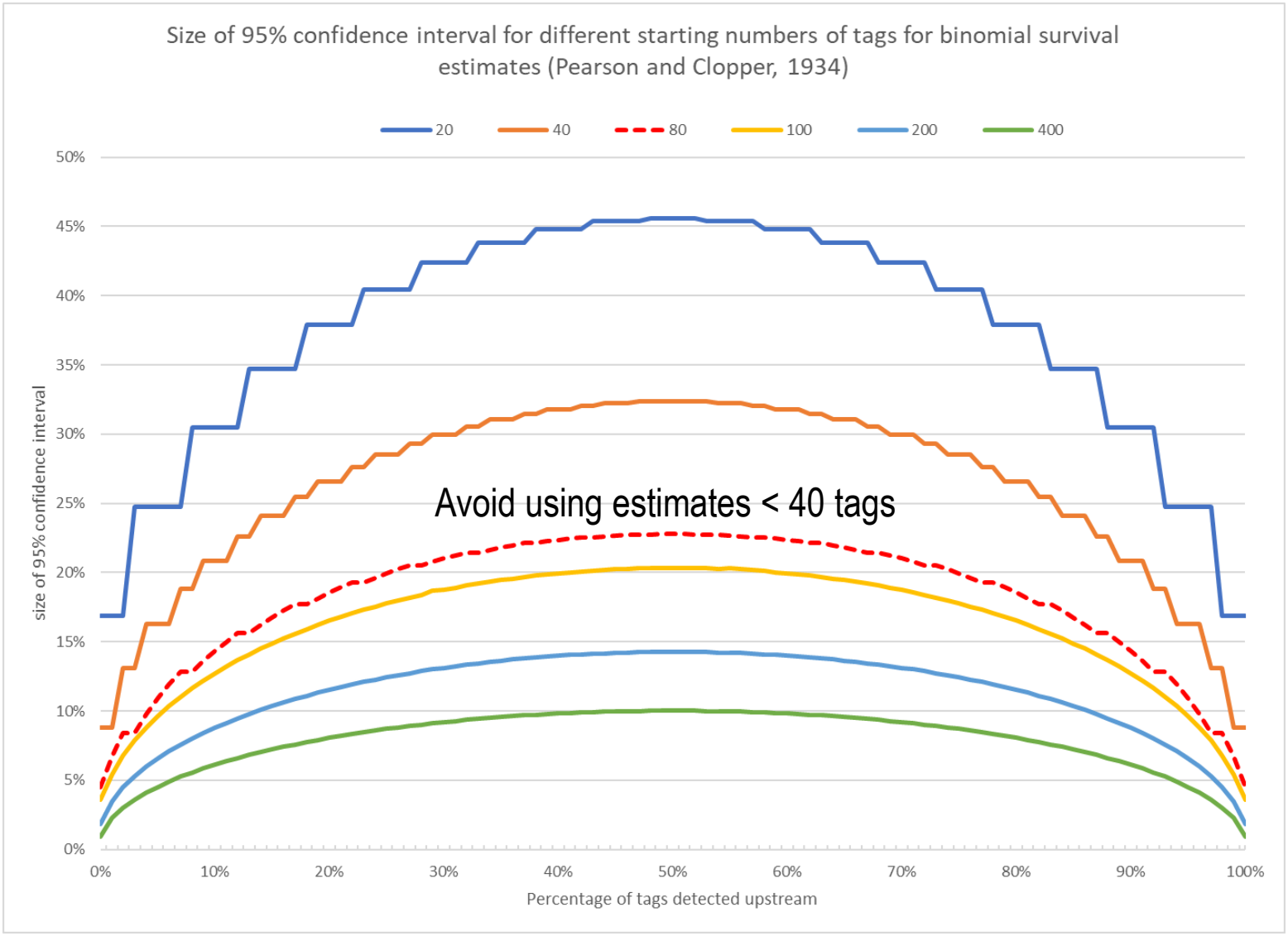


Not corrected for harvest or straying

Conversion analysis

- Upload Bonneville tag list to PTAGIS, query for all observations in year they were observed at Bonneville
- Download list to Access database
- Using queries assemble a CRS trace for each PIT tag in Bonneville list (beware of duplicate observations at upstream dams). Compile traces into number of fish observed at each ladder
- Calculate reach survivals using binomial method

Sample Size considerations



Reporting ESU, DPS and Reaches

BON to LGR, BON to MCN, MCN to LGR

Snake River Spring/Summer Chinook (IR/TR)
Snake River Steelhead (IR/TR)
Snake River Fall Chinook (IR/TR)
Snake River Steelhead(IR/TR)
Snake River Sockeye

BON to MCN

Upper Columbia Spring Chinook
Upper Columbia Steelhead
Middle Columbia Steelhead

Reporting Spreadsheet

Snake River Spring Summer Chinook

SR Spring/Summer Chinook - Conversion Rate Estimates from Bonneville to McNary and Lower Granite Dams 7/23/2008

Red values represent changes from values used in the 2008 FCRPS BiOp

Based on PIT tag detections of known origin adults (excluding one-ocean jacks) that migrated inriver or were transported as juveniles.

Adjusted conversion rates are calculated as (# at MCN or LGR / # at BON) / ([1-Harvest Rate]*[1-Stray Rate])

Adults (wild and hatchery) that migrated inriver as juveniles

	PIT Tag Detections at BON and upstream redetections			Unadjusted Conversion Rate			Adjustment Estimates			Adjusted Conversion Rates			Adj. Conversion Rates		
Year	Number at BON	Redet. @ MCN*	Redet. @ LGR	BON to MCN (%)	MCN to LGR (%)	BON to LGR (%)	Zone 6 Harvest Rate**	Above MCN Harvest Rate**	Stray Rate	BON to MCN (%)	MCN to LGR (%)	BON to LGR (%)	BON to MCN (3rd root)	MCN to LGR (4th root)	BON to LGR (7th root)
2002*	1136	989	963	87.1%	84.8%	84.8%	11.4%	1.1%	2.0%	100.2%	98.4%	98.7%	100.1%	99.6%	99.8%
2003	913	774	749	84.8%	96.8%	82.0%	8.5%	0.7%	2.0%	94.6%	97.5%	92.2%	98.2%	99.4%	98.8%
2004	1774	1527	1481	86.1%	97.0%	83.5%	9.5%	1.6%	2.0%	97.1%	98.6%	95.7%	99.0%	99.6%	99.4%
2005	608	533	509	87.7%	95.5%	83.7%	6.8%	0.3%	2.0%	96.0%	95.8%	91.9%	98.6%	98.9%	98.8%
2006	267	213	198	79.8%	93.0%	74.2%	7.2%	0.8%	2.0%	87.7%	93.7%	82.2%	95.7%	98.4%	97.2%
2007	168	142	133	84.5%	93.7%	79.2%	8.4%	1.0%	2.0%	94.1%	94.6%	89.1%	98.0%	98.6%	98.4%
BiOp Avg				85.0%	93.4%	81.2%	8.6%	0.9%	2.0%	94.9%	96.4%	91.6%	98.3%	99.1%	98.7%
2008	1115	829	794	74.3%	95.8%	71.2%	14.7%	1.0%	2.0%	88.9%	96.7%	86.0%	96.2%	99.2%	97.9%
2009	916	711	659	77.6%	92.7%	71.9%	7.7%	0.8%	2.0%	85.8%	93.4%	80.2%	95.0%	98.3%	96.9%
2010	840	634	587	75.5%	92.6%	69.9%	14.9%	1.6%	2.0%	90.5%	94.1%	85.2%	96.7%	98.5%	97.7%
2011	1874	1363	1259	72.7%	92.4%	67.2%	8.7%	2.8%	2.0%	81.3%	95.0%	77.2%	93.3%	98.7%	96.4%
2012	1691	1352	1279	80.0%	94.6%	75.6%	10.6%	3.2%	2.0%	91.3%	97.7%	89.2%	97.0%	99.4%	98.4%
2013	719	612	560	85.1%	91.5%	77.9%	6.1%	0.9%	2.0%	92.5%	92.3%	85.4%	97.4%	98.0%	97.8%
2014	1649	1221	1169	74.0%	95.7%	70.9%	11.9%	1.8%	2.0%	85.8%	97.5%	83.6%	95.0%	99.4%	97.5%
2015	2210	2042	1737	92.4%	85.1%	78.6%	12.4%	2.1%	2.0%	107.6%	86.9%	93.5%	102.5%	96.5%	99.0%
2016	1143	894	836	78.2%	93.5%	73.1%	9.9%	2.1%	2.0%	88.6%	95.5%	84.6%	96.0%	98.9%	97.6%
2017	747	561	528	75.1%	94.1%	70.7%	7.5%		2.0%	82.8%	94.1%	78.0%	93.9%	98.5%	96.5%
2018	525	387	350	73.7%	90.4%	66.7%	10.2%	1.1%	2.0%	83.8%	91.4%	76.6%	94.3%	97.8%	96.3%
2019	432	335	307	77.5%	91.6%	71.1%	6.6%	1.3%	2.0%	84.7%	92.8%	78.7%	94.6%	98.2%	96.6%
2020	330	278	265	84.2%	95.3%	80.3%	5.9%	1.4%	2.0%	91.4%	96.7%	88.3%	97.0%	99.2%	98.2%
2021	418	337	322	80.6%	95.5%	77.0%	6.3%	1.5%	2.0%	87.8%	97.0%	85.2%	95.8%	99.2%	97.7%
2022	864	685	644	79.3%	94.0%	74.5%	10.2%	2.3%	2.0%	90.1%	96.2%	86.7%	96.6%	99.0%	98.0%
2023															

Preliminary estimate

Adults (wild and hatchery) that were transported as juveniles

	PIT Tag Detections at BON and upstream redetections			Unadjusted Conversion Rate			Adjustment Estimates			Adjusted Conversion Rates			Adj. Conversion Rates		
Year	Number at BON	Redet. @ MCN*	Redet. @ LGR	BON to MCN (%)	MCN to LGR (%)	BON to LGR (%)	Zone 6 Harvest Rate**	Above MCN Harvest Rate**	Stray Rate	BON to MCN (%)	MCN to LGR (%)	BON to LGR (%)	BON to MCN (3rd root)	MCN to LGR (4th root)	BON to LGR (7th root)
2002*	1142	901	863	78.9%	95.8%	75.6%	11.4%	1.1%	2.0%	90.8%	96.8%	87.9%	96.9%	99.2%	98.2%
2003	1196	952	903	79.6%	94.9%	75.5%	8.5%	0.7%	2.0%	88.8%	95.5%	84.8%	96.1%	98.9%	97.7%
2004	525	424	403	80.8%	95.0%	76.8%	9.5%	1.6%	2.0%	91.1%	96.6%	88.0%	96.9%	99.1%	98.2%
2005	502	416	403	82.9%	96.9%	80.3%	6.8%	0.3%	2.0%	90.7%	97.2%	88.2%	96.8%	99.3%	98.2%
2006	396	297	265	75.0%	89.2%	66.9%	7.2%	0.8%	2.0%	82.4%	89.9%	74.1%	93.8%	97.4%	95.8%
2007	416	341	314	82.0%	92.1%	75.5%	8.4%	1.0%	2.0%	91.3%	93.0%	84.9%	97.0%	98.2%	97.7%
BiOp Avg				79.8%	94.0%	75.1%	8.6%	0.9%	2.0%	89.2%	94.9%	84.7%	96.2%	98.7%	97.6%
2008	859	655	618	76.3%	94.4%	71.9%	14.7%	1.0%	2.0%	91.2%	95.3%	86.9%	97.0%	98.8%	98.0%
2009	357	287	270	80.4%	94.1%	75.6%	7.7%	0.9%	2.0%	88.9%	94.9%	84.4%	96.1%	98.7%	97.6%
2010	3487	2696	2524	77.3%	93.6%	72.4%	14.9%	1.6%	2.0%	92.7%	95.1%	88.2%	97.5%	98.8%	98.2%
2011	949	712	627	75.0%	88.1%	66.1%	8.7%	2.8%	2.0%	83.9%	90.6%	76.0%	94.3%	97.6%	96.1%
2012	453	350	298	77.3%	85.1%	65.8%	10.6%	3.2%	2.0%	88.2%	88.0%	77.6%	95.9%	96.8%	96.4%
2013	257	192	178	74.7%	92.7%	69.3%	6.1%	0.9%	2.0%	81.2%	93.6%	75.9%	93.3%	98.3%	96.1%
2014	409	291	276	71.1%	94.8%	67.5%	11.9%	1.8%	2.0%	82.4%	96.6%	79.6%	93.8%	99.1%	96.8%
2015	668	462	410	69.2%	88.7%	61.4%	12.4%	2.1%	2.0%	80.6%	90.6%	73.0%	93.0%	97.6%	95.6%
2016	289	230	213	79.6%	92.6%	73.7%	9.9%	2.1%	2.0%	90.1%	94.6%	85.3%	96.6%	98.6%	97.7%
2017	218	176	160	80.7%	90.9%	73.4%	7.5%	0.0%	2.0%	89.1%	90.9%	81.0%	96.2%	97.6%	97.0%
2018	228	160	149	70.2%	93.1%	65.4%	10.2%	1.1%	2.0%	79.7%	94.2%	75.1%	92.7%	98.5%	96.0%
2019	78	64	59	82.1%	92.2%	75.6%	6.6%	1.3%	2.0%	84.7%	92.8%	78.7%	94.6%	98.2%	96.6%
2020	151	114	106	75.5%	93.0%	70.2%	5.9%	1.4%	2.0%	91.4%	96.7%	88.3%	97.0%	99.2%	98.2%
2021	86	70	66	81.4%	94.3%	76.7%	6.3%	1.5%	2.0%	87.8%	97.0%	85.2%	95.8%	99.2%	97.7%
2022	126	103	99	81.7%	96.1%	78.6%	10.2%	2.3%	2.0%	90.1%	96.2%	86.7%	96.6%	99.0%	98.0%

CORRECTIONS

- Applied to raw survival/conversion estimate to account for known causes of mortality
- Harvest- Harvest % for BON to MCN and MCN to LGR reaches from TAC annual reports
- Straying- Standard percentage applied from study:
  M.L. Keefer, C.A. Peery, J. Firehammer, and M.L. Moser. 2005 Straying Rates of known-origin adult Chinook salmon and steelhead within the Columbia River basin, 2000-2003. Technical Report 2005-5.

Other issues

- A significant number of SR Steelhead do not cross LGR until the spring after the year they were observed at LGR (assigned spawn year-1)
- Before 2010 and 2018-2020 insufficient PIT tagged SR Sockeye were observed to make a reliable estimate. UC Sockeye were used as surrogates

Limitations

- Survival estimate is an average for the entire migration period of the ESU/DPS
- Is the sample representative of the ESU/DPS? Some populations or portions of the run may be under/over represented
- Not enough tags to get a reliable estimate for small populations (use surrogates?)
- No plan to assure all groups of interest are tagged at rates to provide reliable adult survival estimates (we take what shows up)

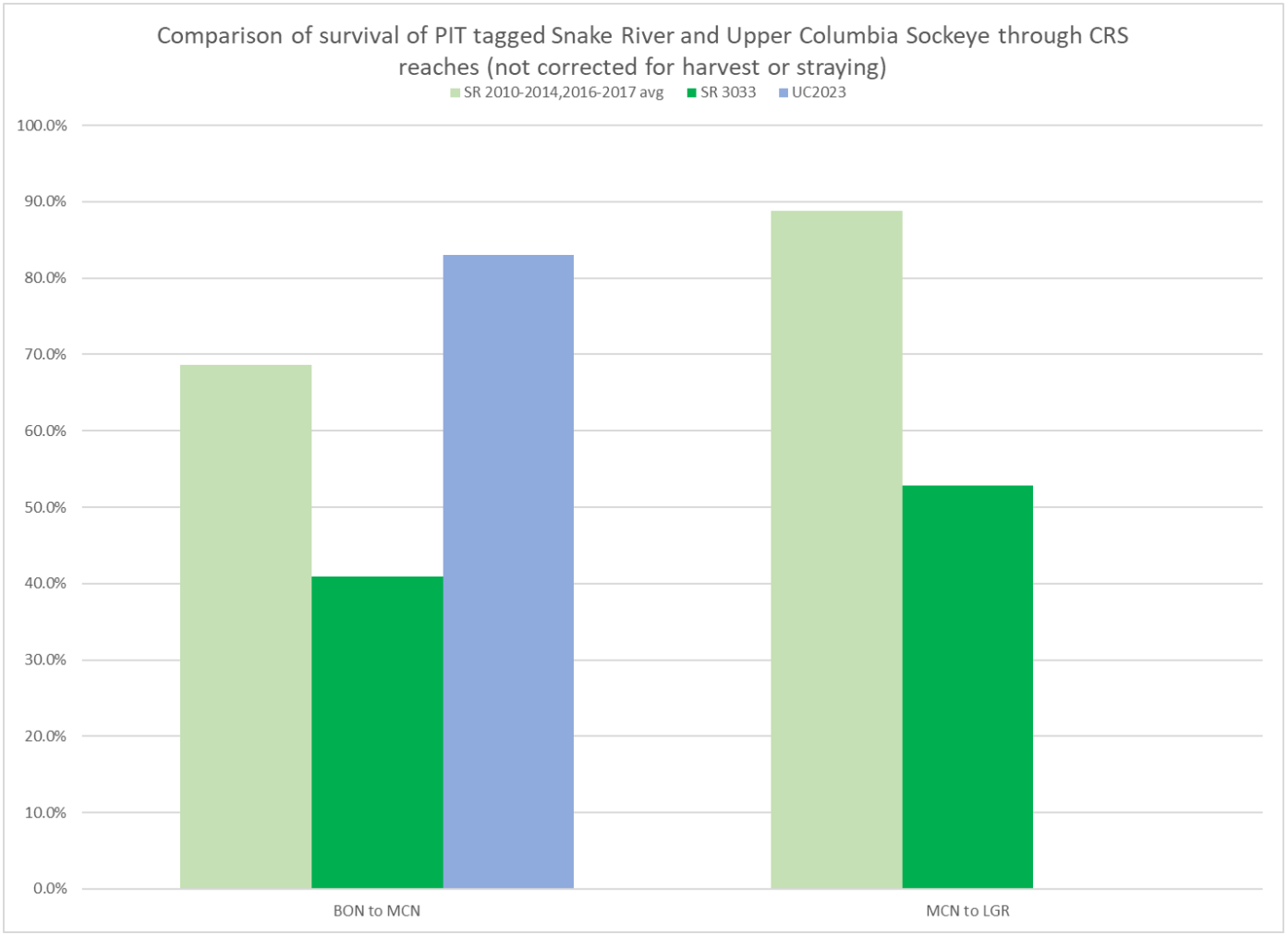
Other methodologies/options

- Cormak, Jolly, Seber (CJS) methodology (currently used for juvenile estimates)
- DART Conversion Rate tool
- PITTag Pro and SURPH software (DART)

Acknowledgements

- PTAGIS
- Northwest Fisheries Science Center
- Columbia Basin Research/DART
- Charlie Paulsen
- Everyone conducting PIT tagging operations in Columbia River Basin

Preliminary analysis of 2023 Sockeye survival



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