Smolt Survival and Travel Time & Transportation Analyses

Update with 2020 Data

NOAA FISHERIES

Northwest Fisheries Science Center

Technical Management Team

2020 Year-End Review

December 2, 2020

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Outline – Smolt Survival

- Migration conditions, travel time and survival of PIT-tagged smolts through the hydropower system in 2020

  - Preliminary Results Memo: October 19, 2020;
  - Draft report to BPA in prep

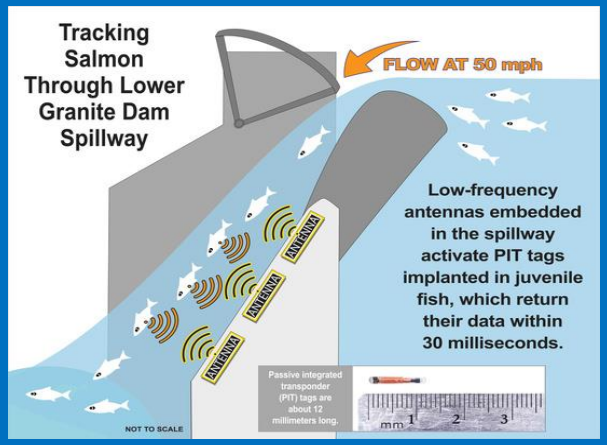
    - Only those fish left to migrate in-river

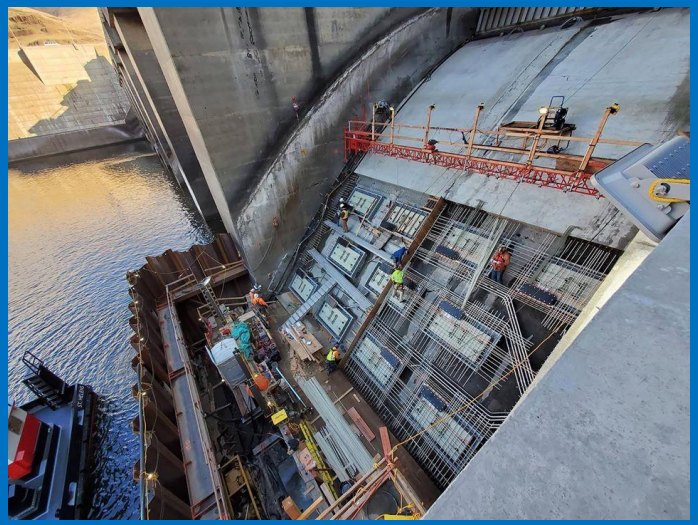
    - Only juvenile data, not survival to adult

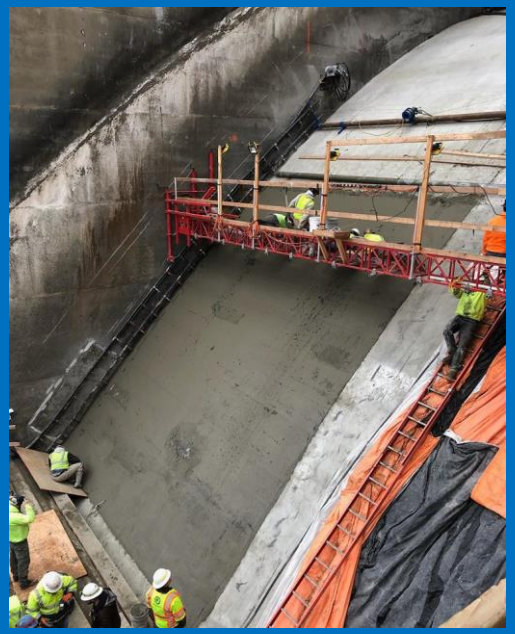
“Unprecedented”

- Restrictions on research/data collection
  - No tagging at Lower Granite Dam
  - Estuary PIT-trawl not operated
- PIT detector in spillway at Lower Granite Dam
- Record high spill percentage
- Alternative sources of “Post-Bonneville” data
  - Deposits by avian predators (also upstream)
  - PIT barge, Pile dikes, Bonneville ladders, Adult returns
- Statistical R&D: alternative sources not previously used for NOAA survival estimates

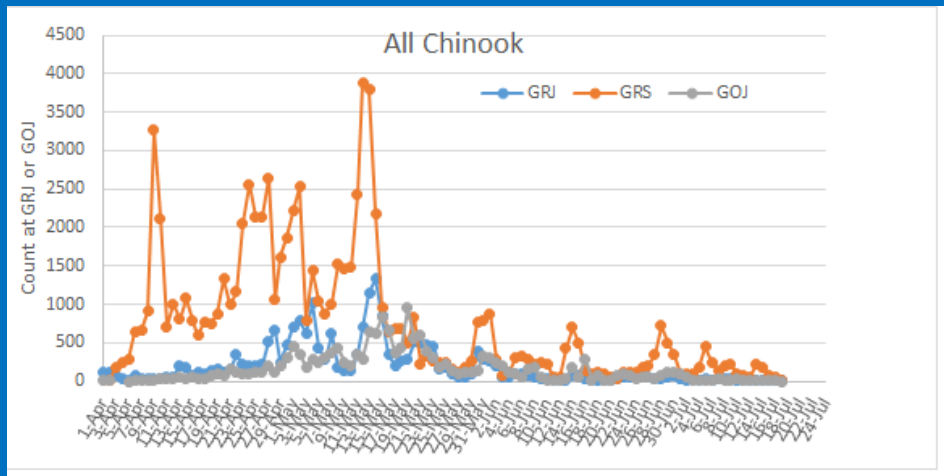
Spillway PIT Detection at Lower Granite Dam

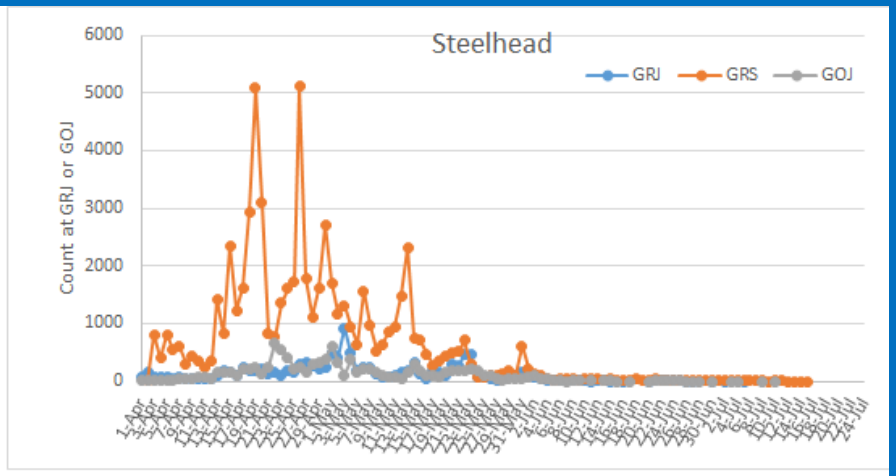


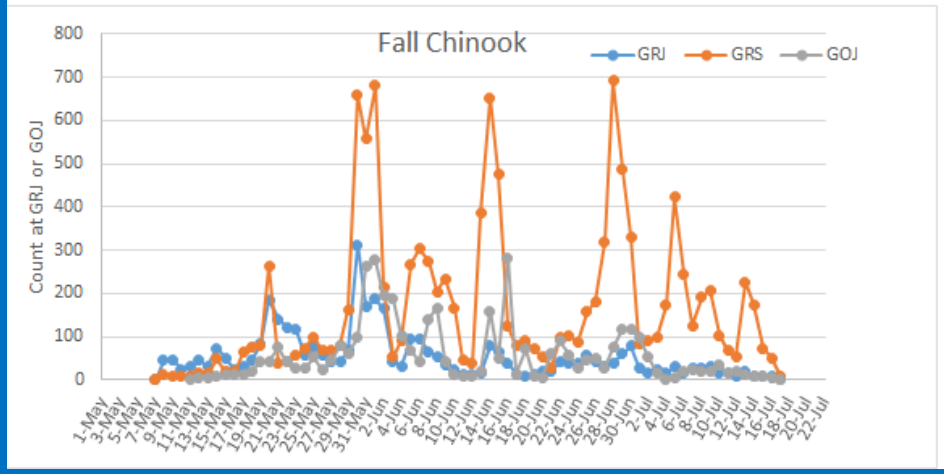


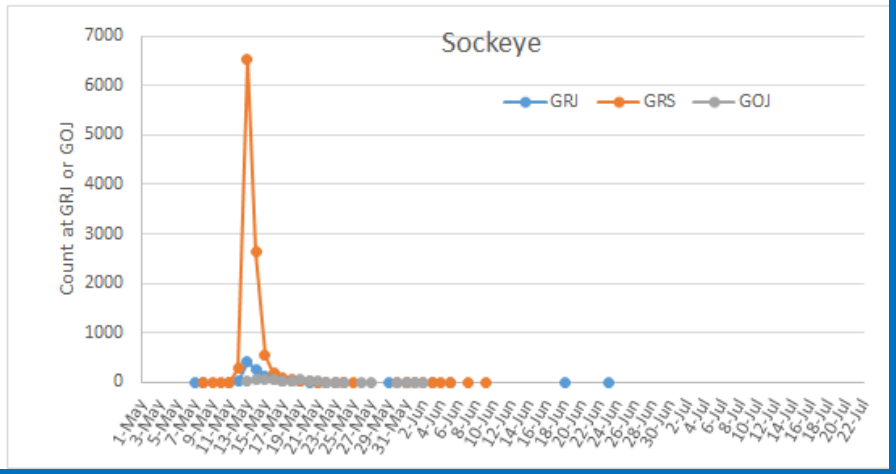


Spillway PIT Detection at Lower Granite Dam









Spillway PIT Detection at Lower Granite Dam

- Differences in fish using spillway vs. juvenile bypass system

- Increase number of detections at Lower Granite Dam
  - Larger sample sizes for estimation of survival and SAR beginning at LGR
  - Increased precision of survival estimates
  - Compare SAR and survival between LGR passage routes

- Time-stamp on non-bypassed fish (at Lower Granite Dam)
  - CJS estimates may allow estimates of daily numbers of C_0 fish

“Post-Bonneville” Data

	Chinook		Steelhead	
	2019	2020	2019	2020
Detected Passing BON	16,776	20,166	20,335	22,594
Trawl	2,944	0	3,263	0
	Avian Recovery			
East Sand Island	742	512	2,003	1,518
Astoria-Megler	0	284	0	162
Other Avian	0	57	0	118
Total Avian	742	853	2,003	1,798
	Live Detection			
Pile Dike 7	39	12	68	28
PIT Barge	0	198	0	134
BON ladder	715	1,560	27	33
Total Not Trawl	1,496	2,623	2,098	1,993
TOTAL	4,440	2,623	5,361	1,993

2020 Spring Conditions

- Flow ~ average throughout season
- Water temperature
  - warmer than average in April
  - cooler than average in May
- Record high spill percentage
- Travel times
  - short for steelhead, as in recent high-flow years
  - very short for Chinook, shorter than recent high-flow
- Less than 20% transported
  - low numbers collected

2020 Spring Survival Estimates

- Downstream of McNary: TBD for all stocks
- Generally imprecise because of low detection rates
  - some >100%, likely for same reason
- Survival to McNary Dam above average for all stocks

PIT-tag Data Sources

Hatchery Releases

Chief Joseph

Wells

Grand Coulee

Rocky Reach

Rock Island

Wanapum

Priest Rapids

Ice Harbor

Lower Granite

Little Goose

Lower Monumental

McNary

John Day

The Dalles

Bonneville

Snake R. trap

Hatchery & Trap Releases

Hells Canyon

Oxbow

Brownlee

PIT trawl

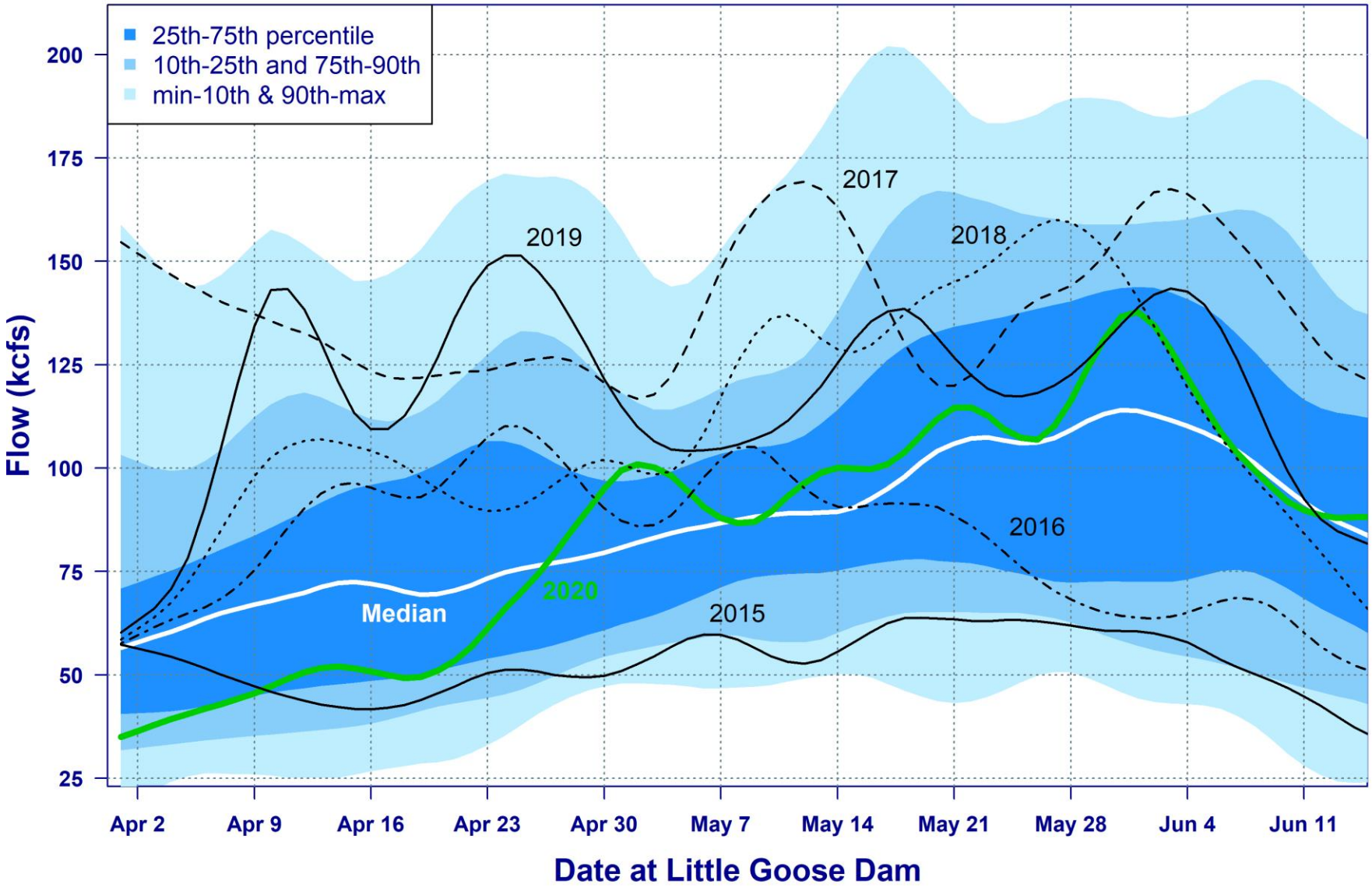
Bird colonies

PIT barge

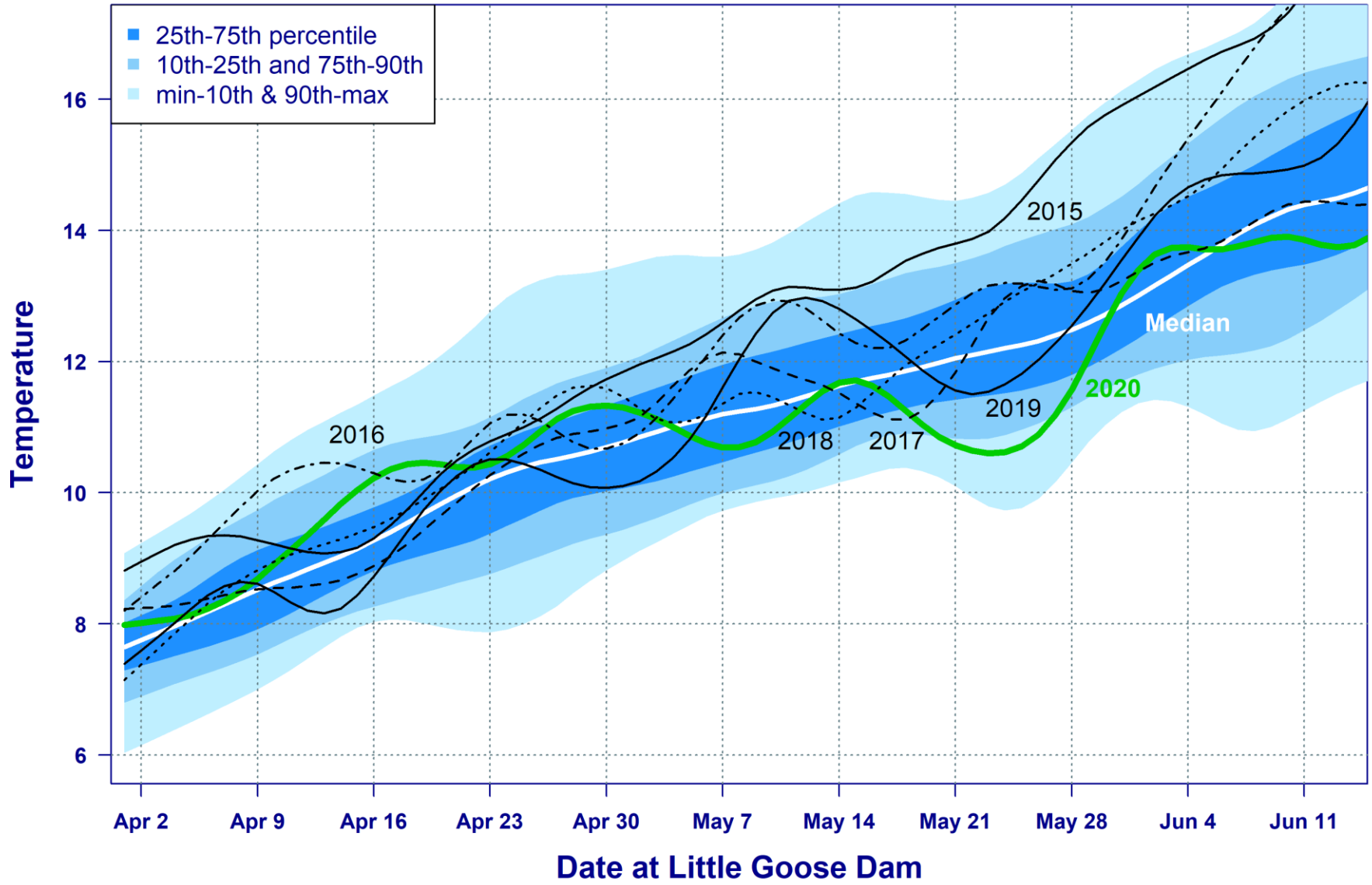
etc.

Juvenile detectors

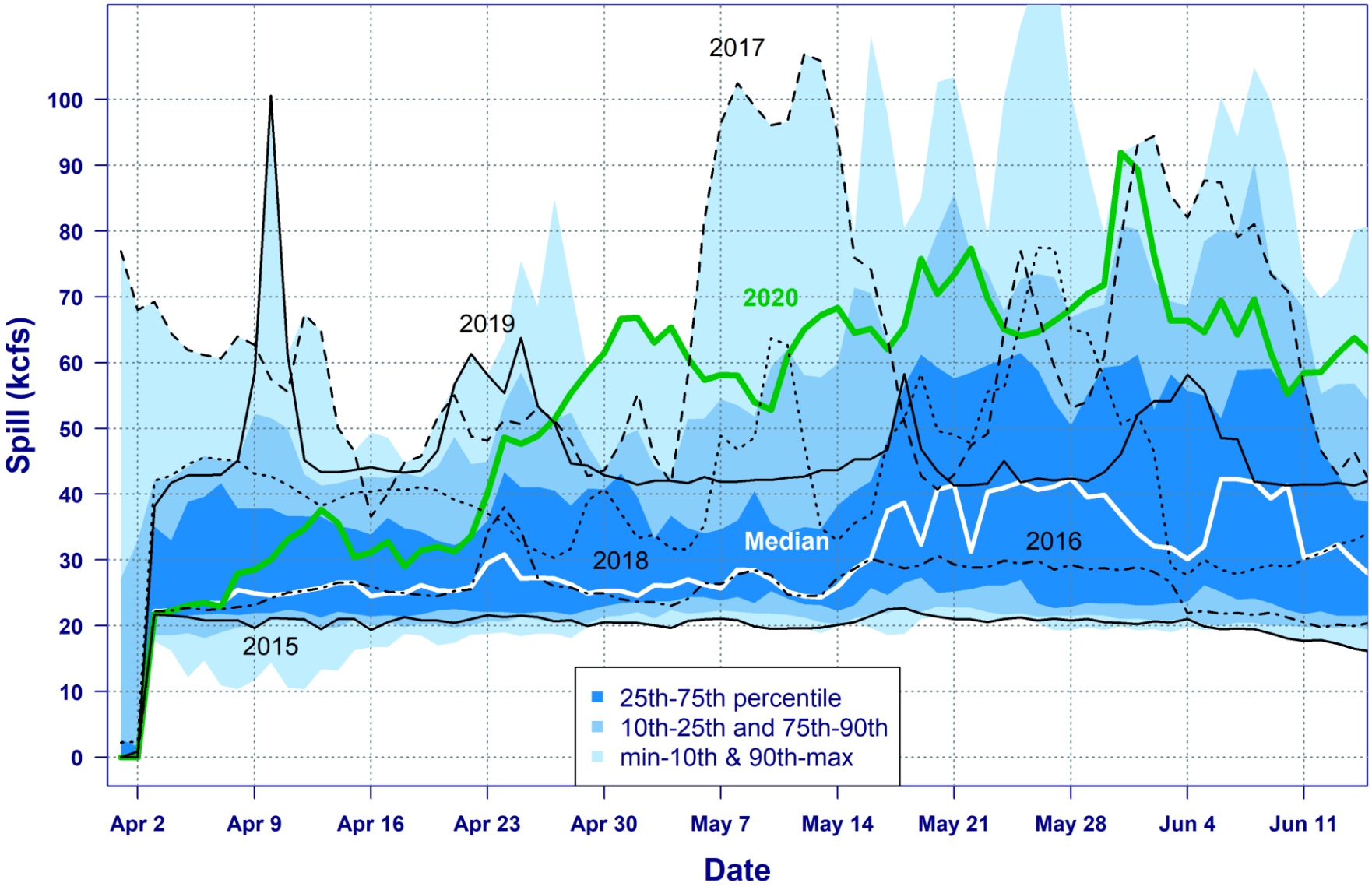
Daily Flow (kcfs) 1989-2020
Little Goose Dam



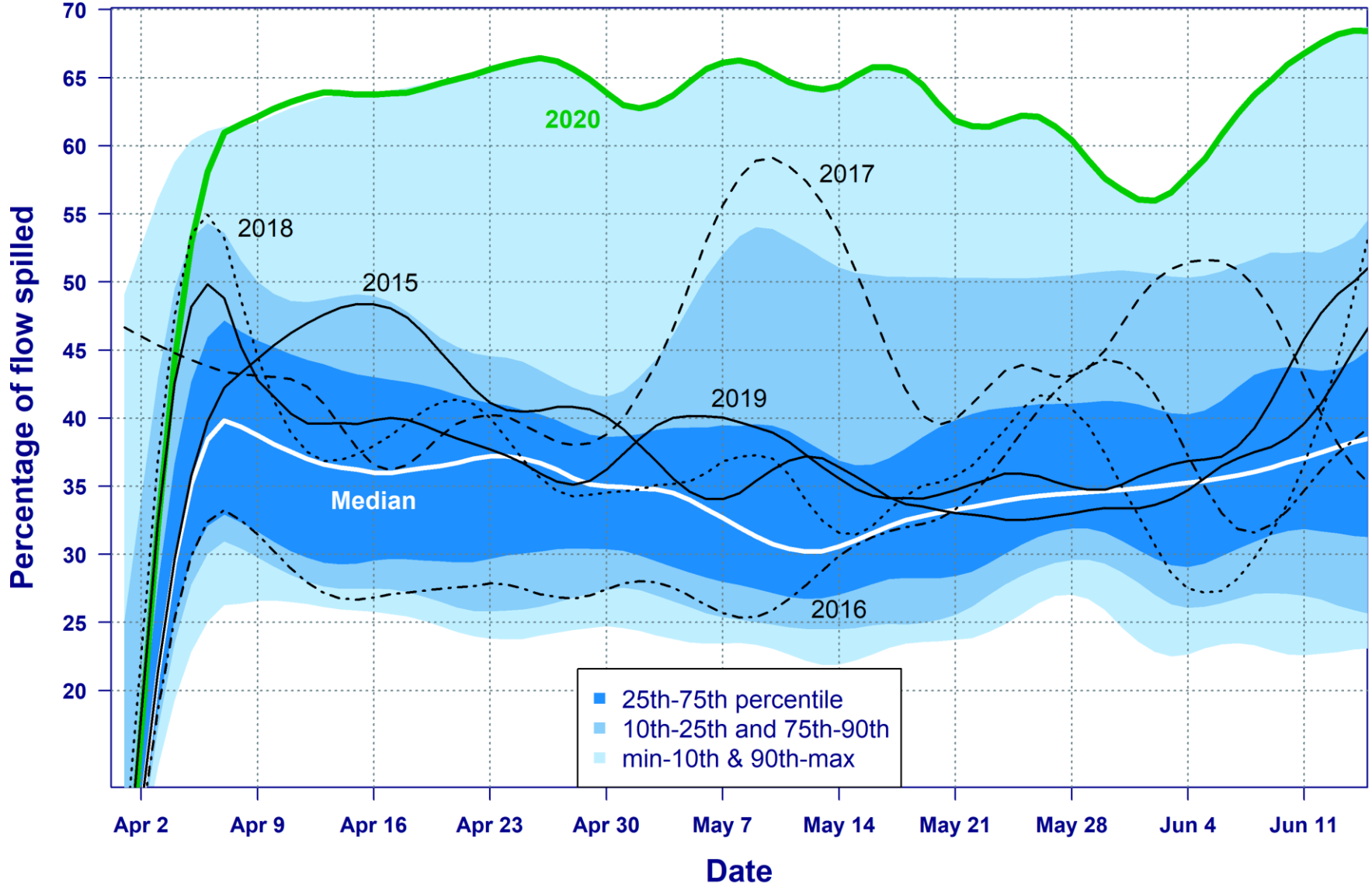
Daily Temperature 1990-2020
Little Goose Dam



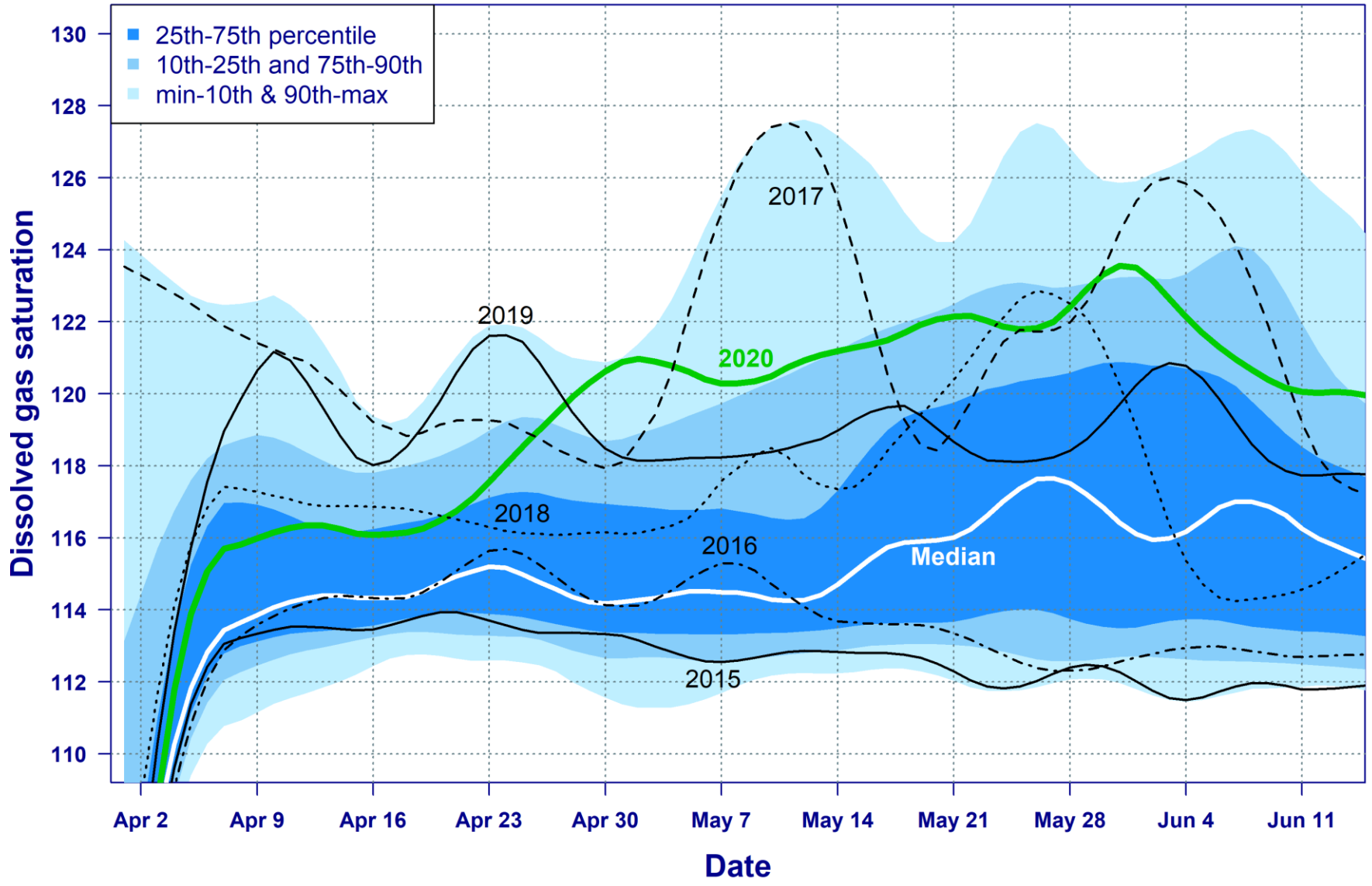
Daily Spill (kcfs) 2006-2020
Mean LGR, LGS, LMN



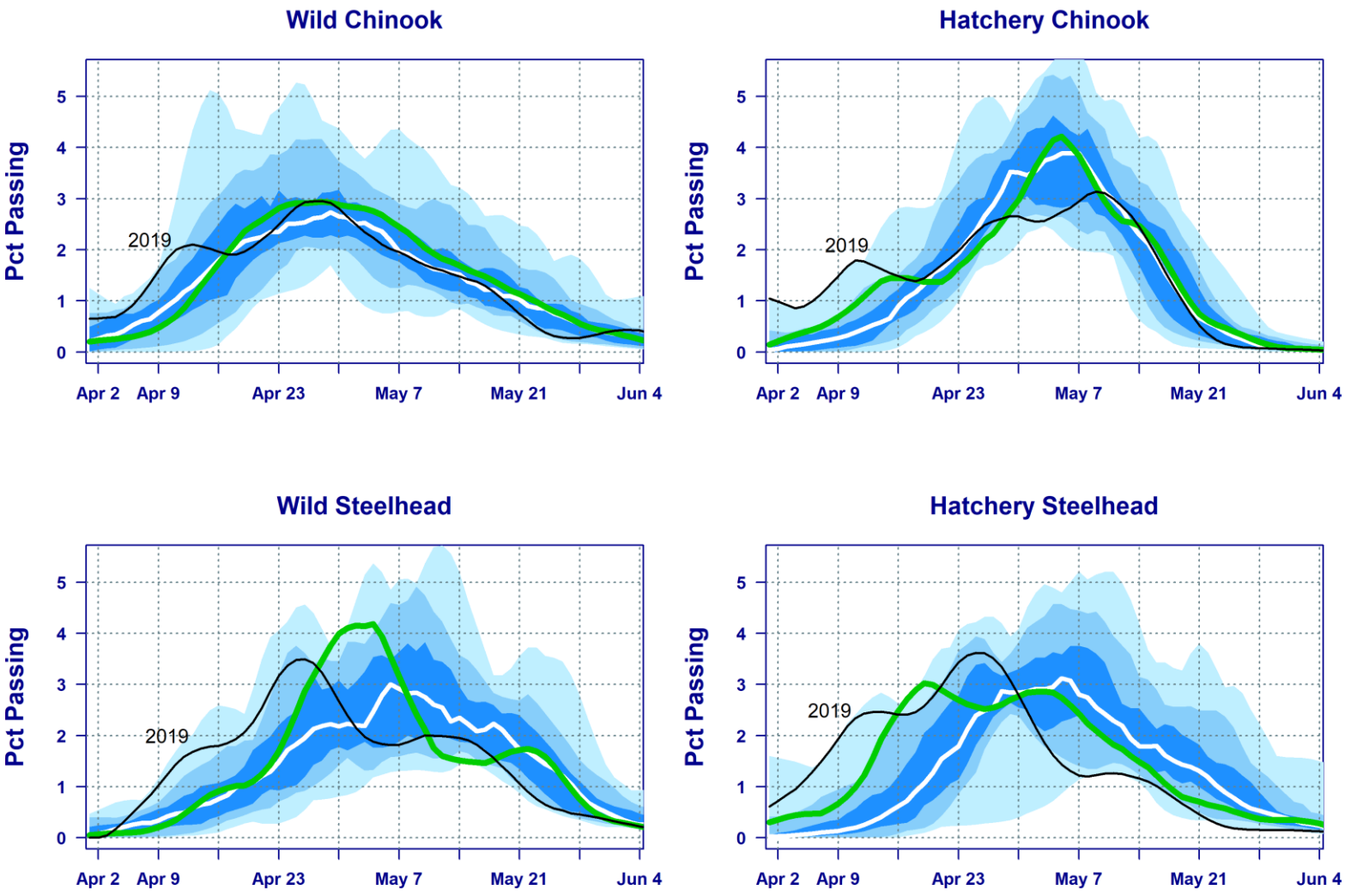
Daily %Spill 2006-2020
Mean LGR, LGS, LMN



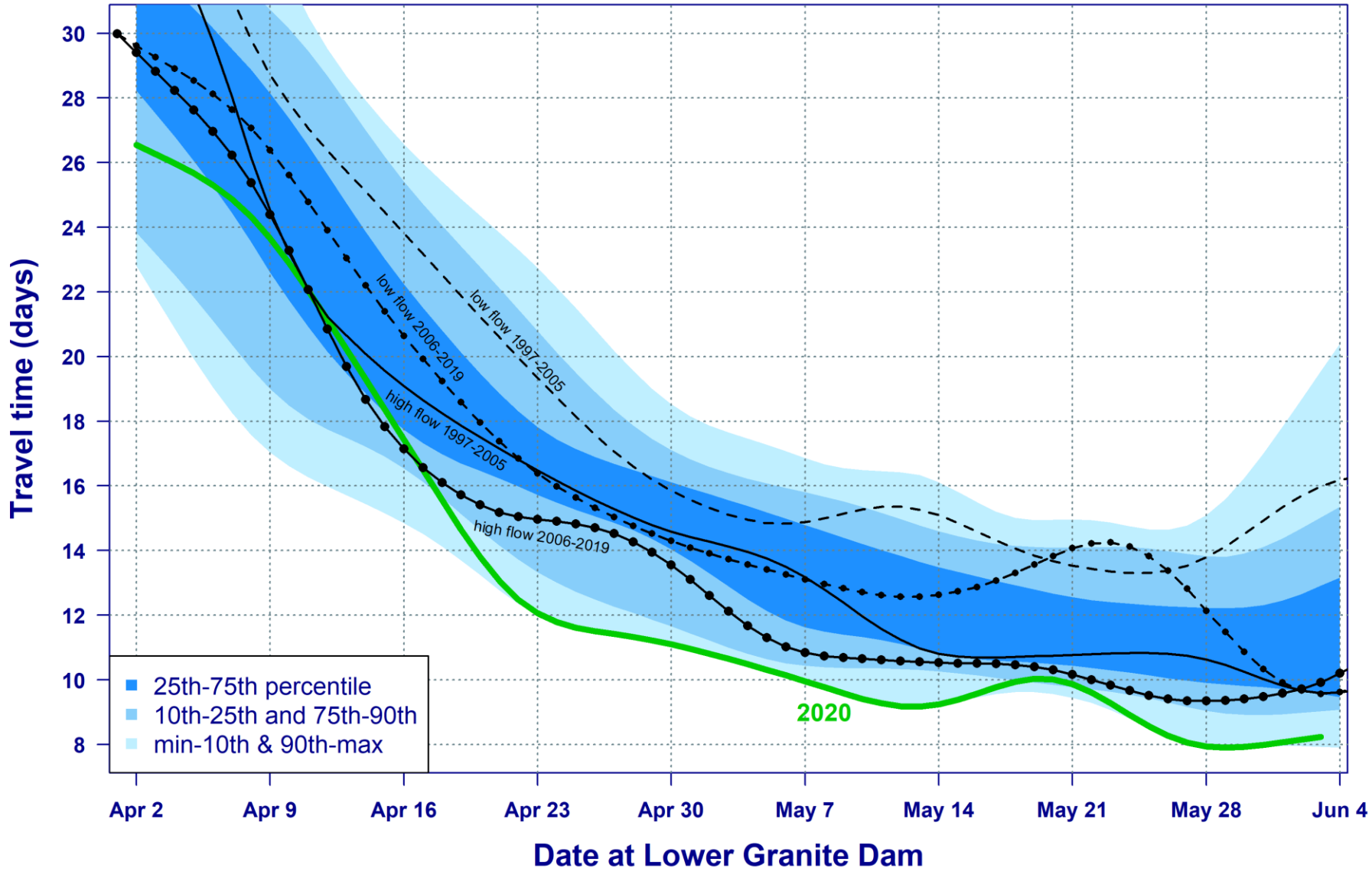
Daily Dissolved Gas Saturation 2006-2020
Mean LGR, LGS, LMN



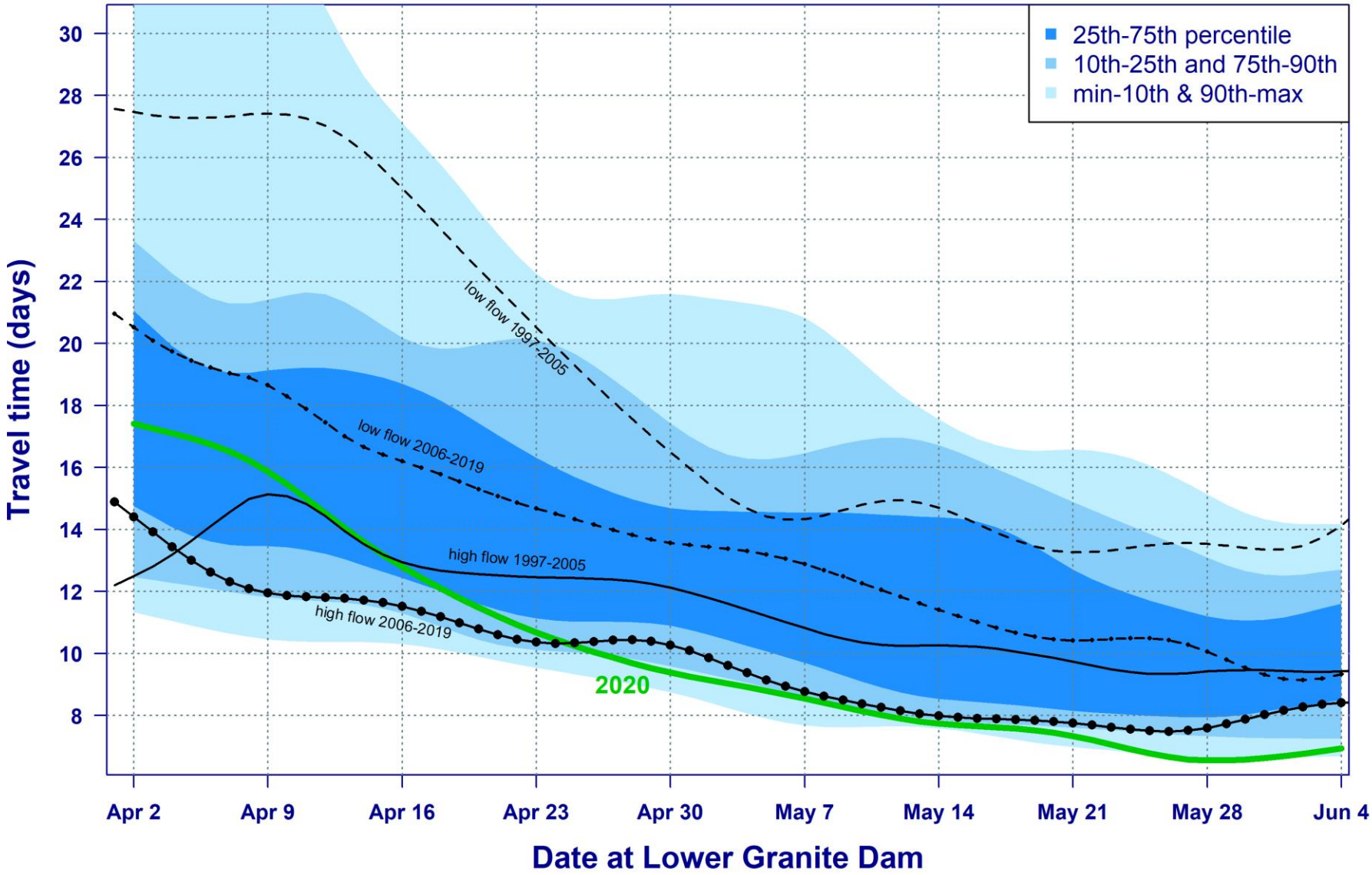
Passage Timing at Lower Granite Dam



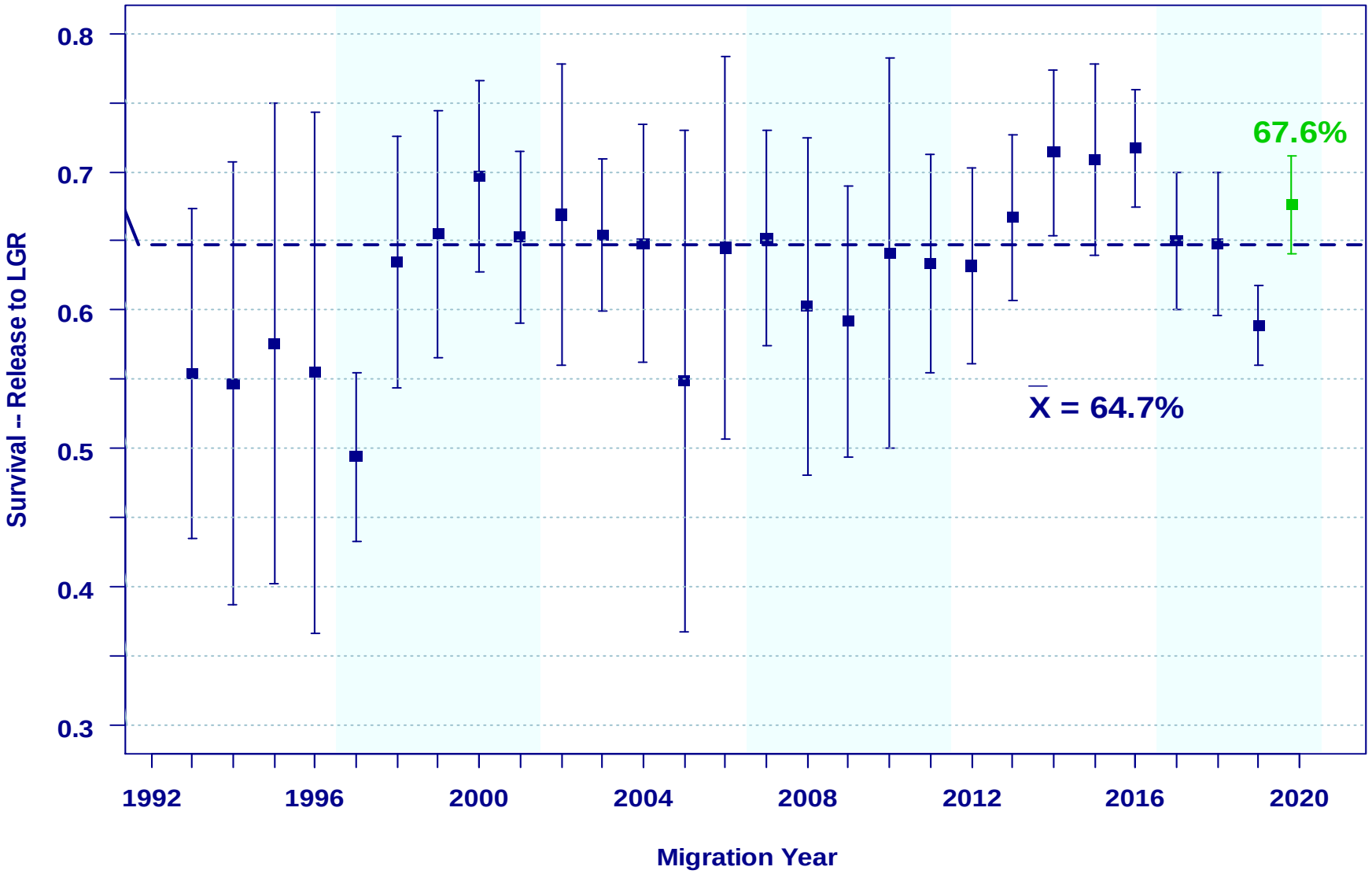
Chinook Travel Time 1997-2020 (exc. 2001)
Lower Granite to Bonneville (461 km)

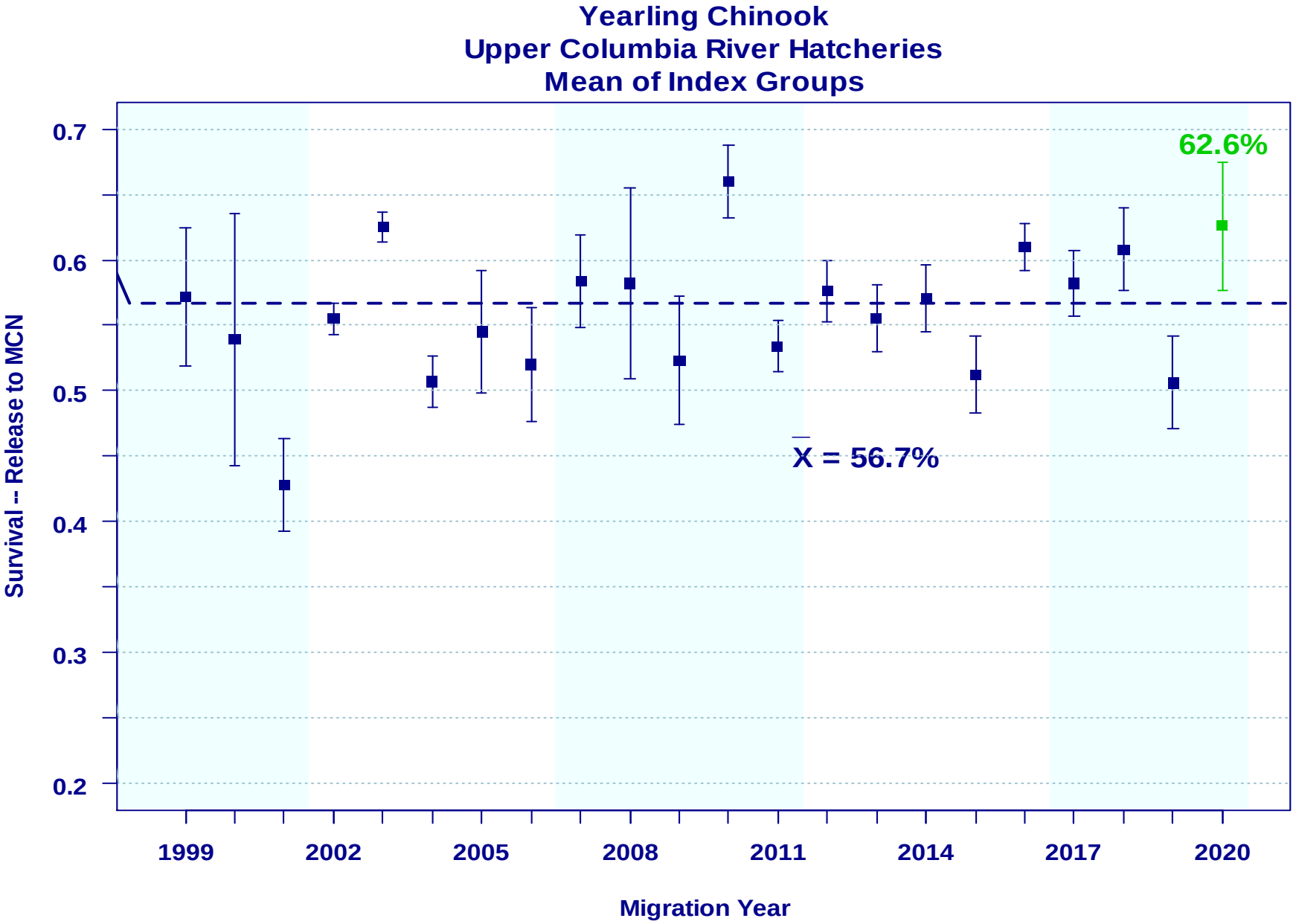


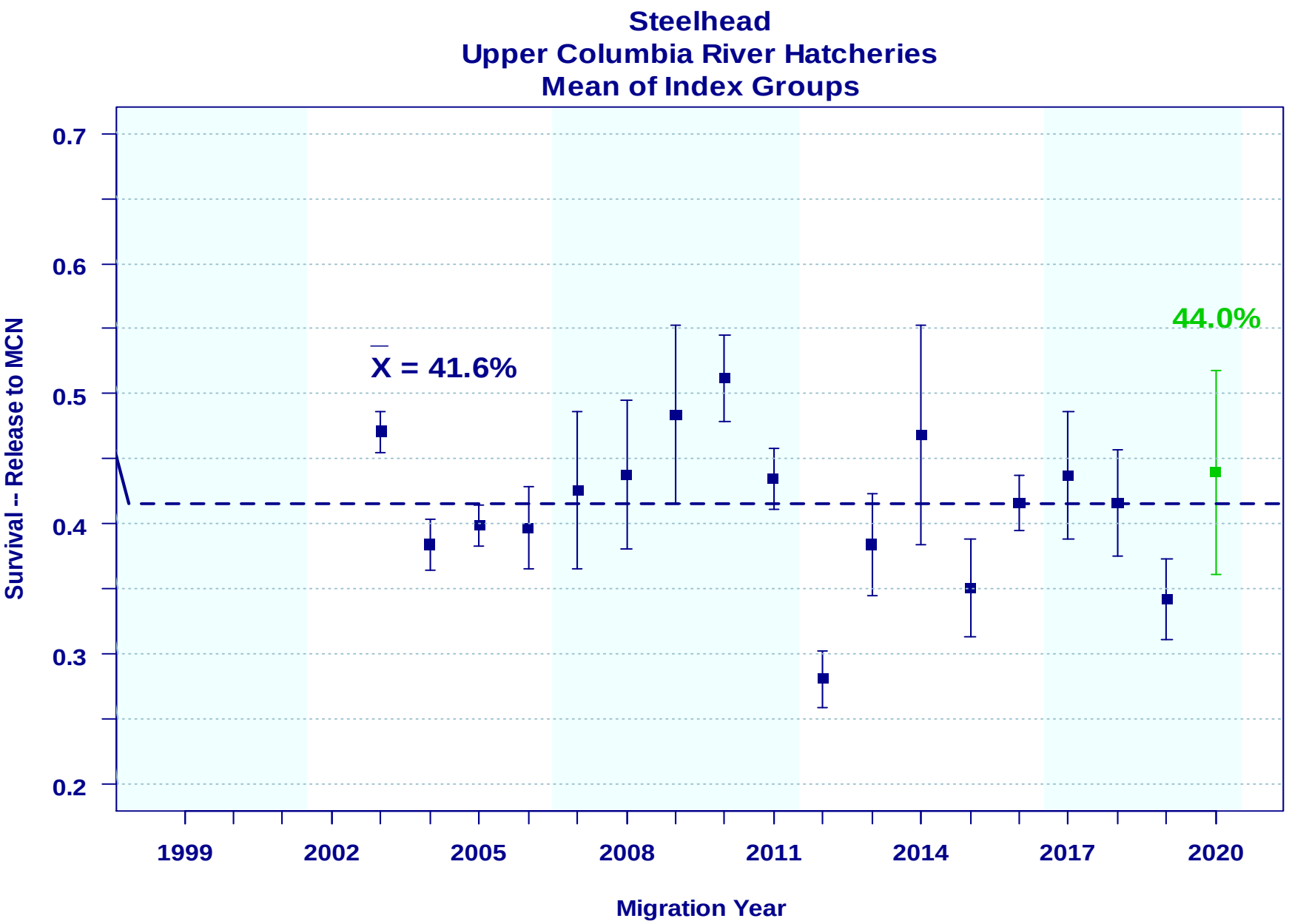
Steelhead Travel Time 1997-2020 (exc. 2001)
Lower Granite to Bonneville (461 km)

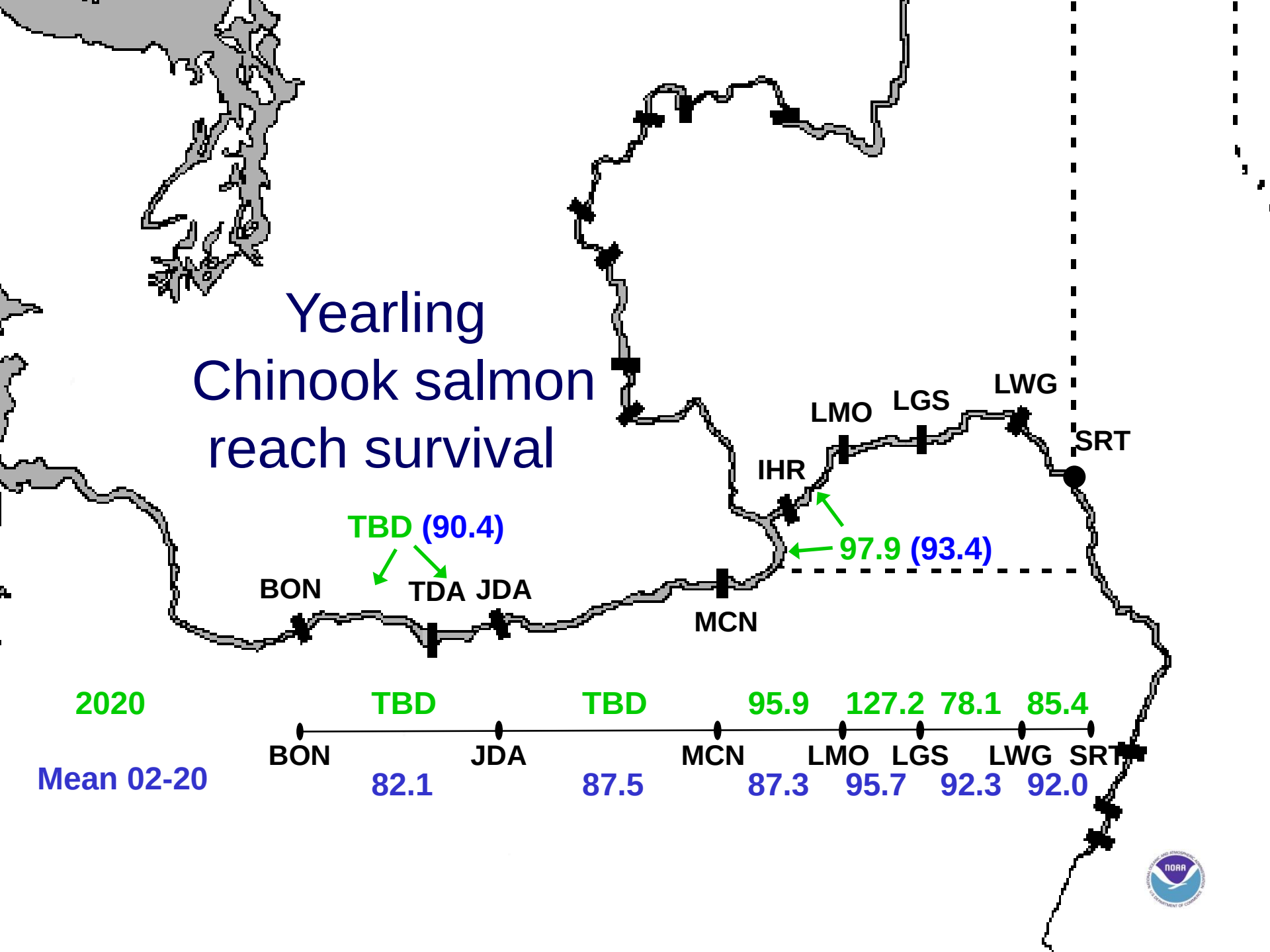


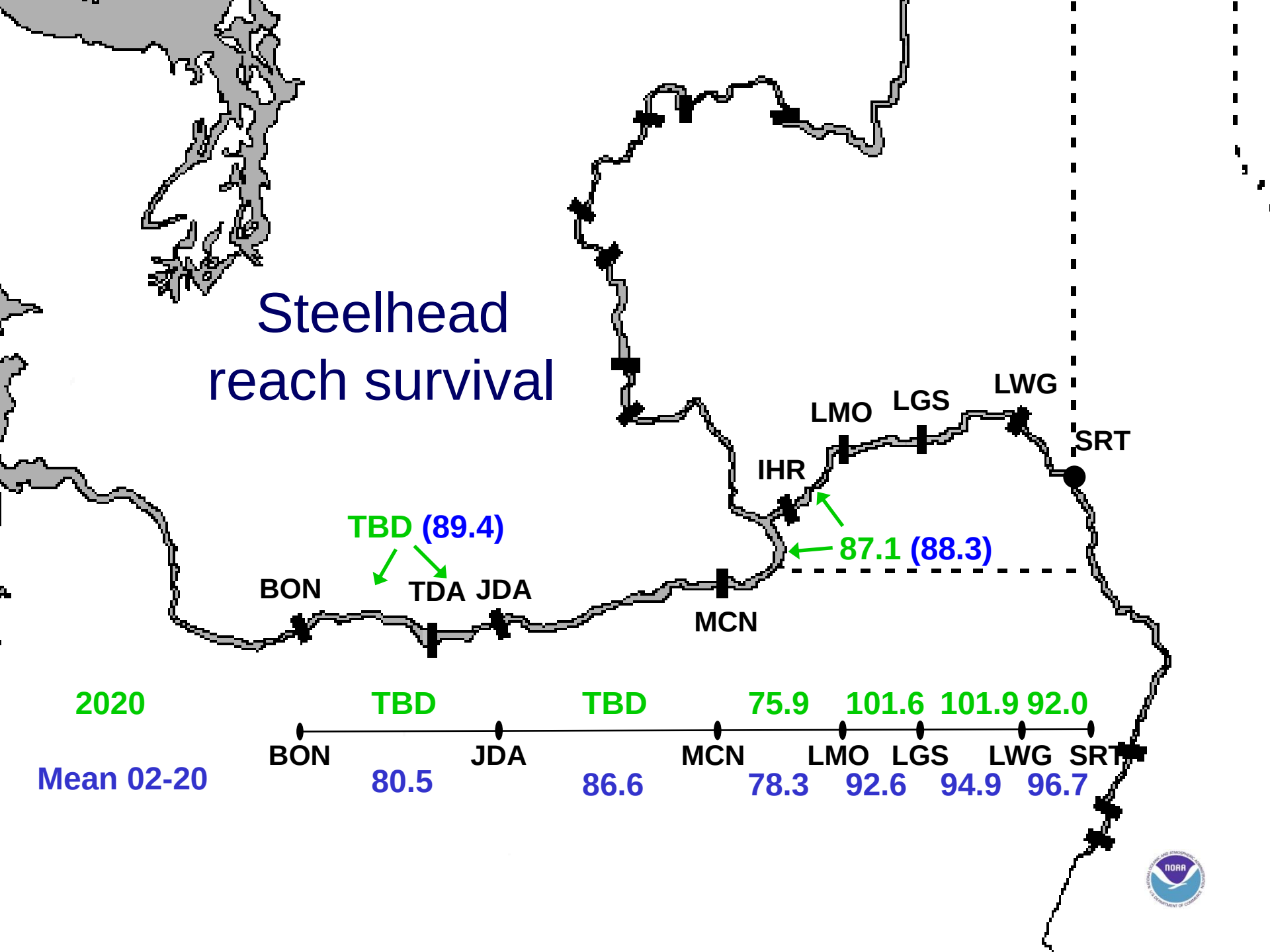
Yearling Chinook
Snake River Basin Hatcheries
Mean of Index Groups




Yearling Chinook
Upper Columbia River Hatcheries
Mean of Index Groups
Survival -- Release to MCN
0.7
0.6
0.5
0.4
0.3
0.2
62.6%
X = 56.7%
1999
2002
2005
2008
2011
2014
2017
2020
Migration Year

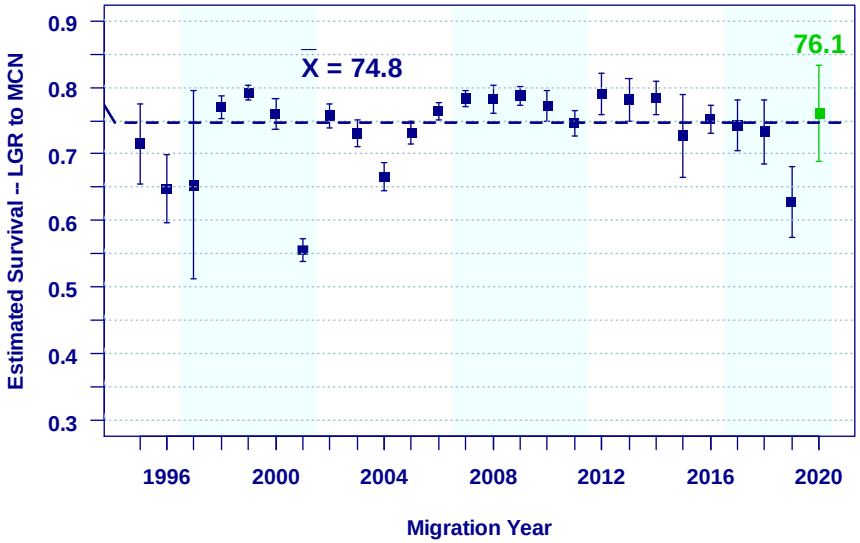

Steelhead
Upper Columbia River Hatcheries
Mean of Index Groups
Survival -- Release to MCN
0.7
0.6
0.5
0.4
0.3
0.2
X = 41.6%
44.0%
1999
2002
2005
2008
2011
2014
2017
2020
Migration Year


Yearling
Chinook salmon
reach survival
LWG
LGS
LMO
SRT
IHR
TBD (90.4)
97.9 (93.4)
BON
TDA
JDA
MCN
2020
TBD
TBD
95.9
127.2
78.1
85.4
BON
JDA
MCN
LMO
LGS
LWG
SRT
Mean 02-20
82.1
87.5
87.3
95.7
92.3
92.0

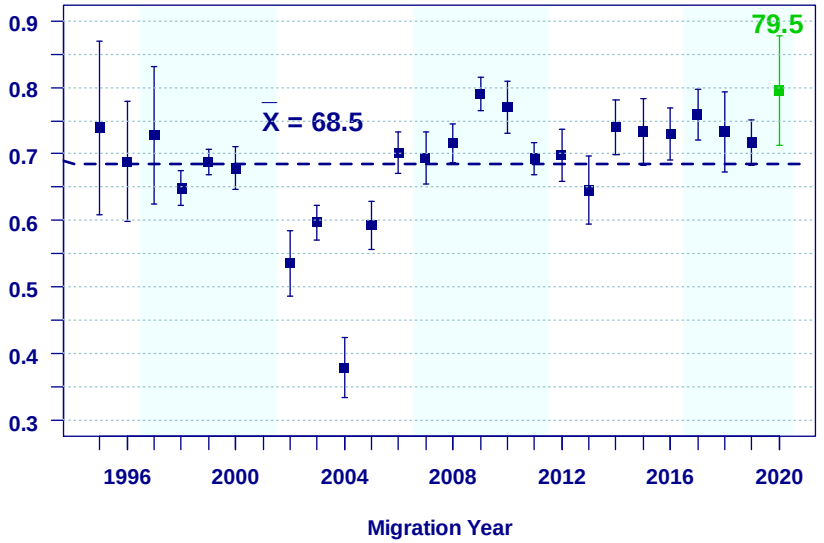

Steelhead
reach survival
LWG
LGS
LMO
SRT
IHR
TBD (89.4)
87.1 (88.3)
BON
TDA
JDA
MCN
2020
TBD
TBD
75.9
101.6
101.9
92.0
BON
JDA
MCN
LMO
LGS
LWG
SRT
Mean 02-20
80.5
86.6
78.3
92.6
94.9
96.7

Lower Granite to McNary

Yearling Chinook



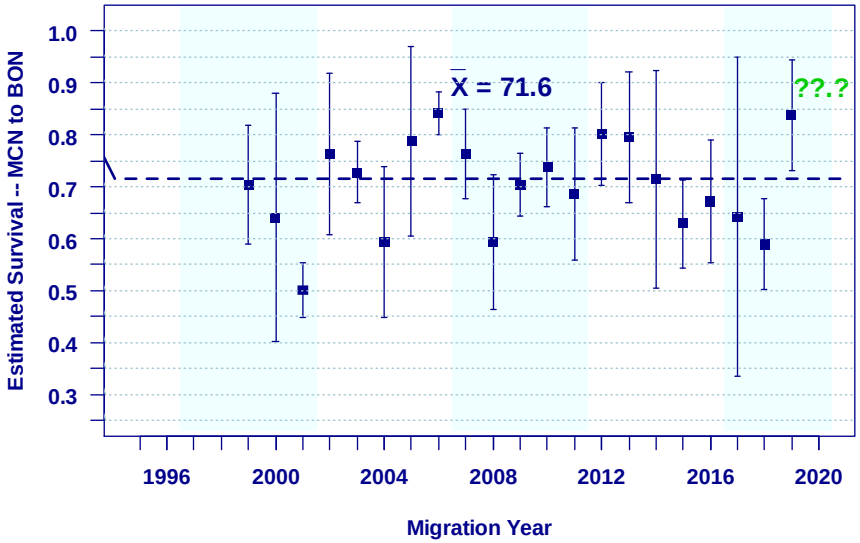
Steelhead



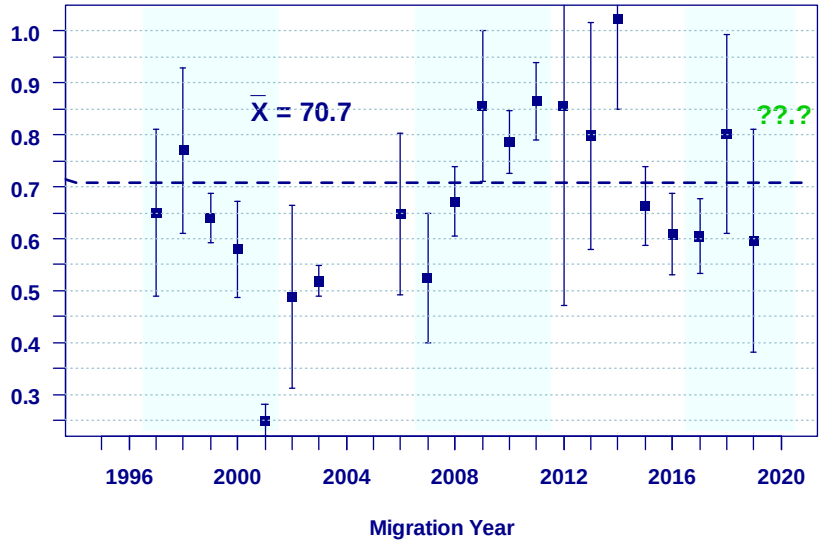
McNary to Bonneville

Fish from Snake River

Yearling Chinook



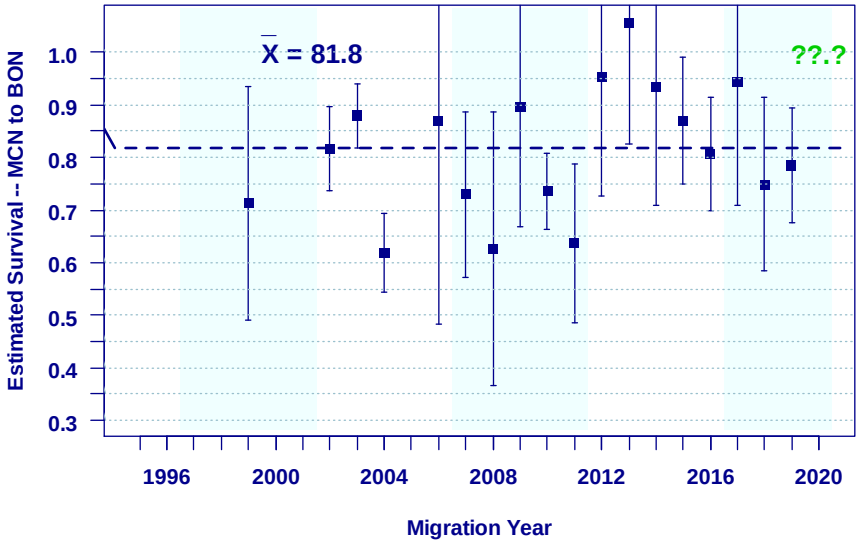
Steelhead



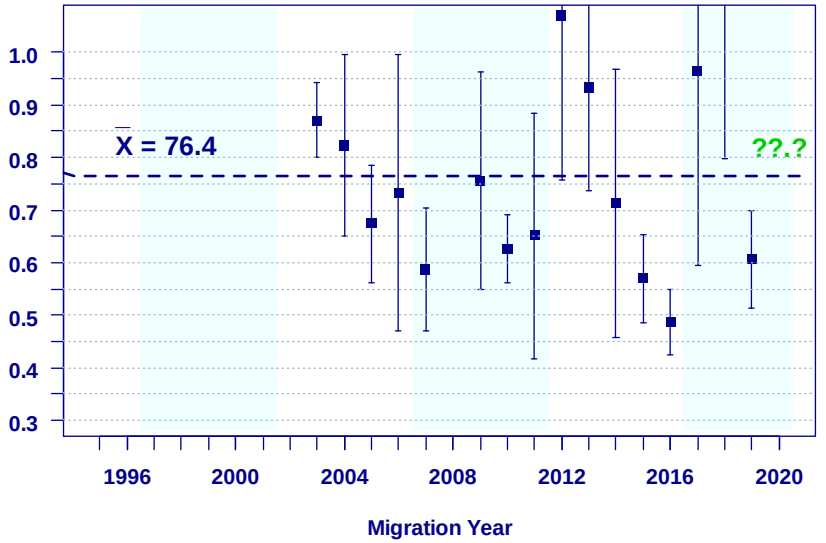
McNary to Bonneville

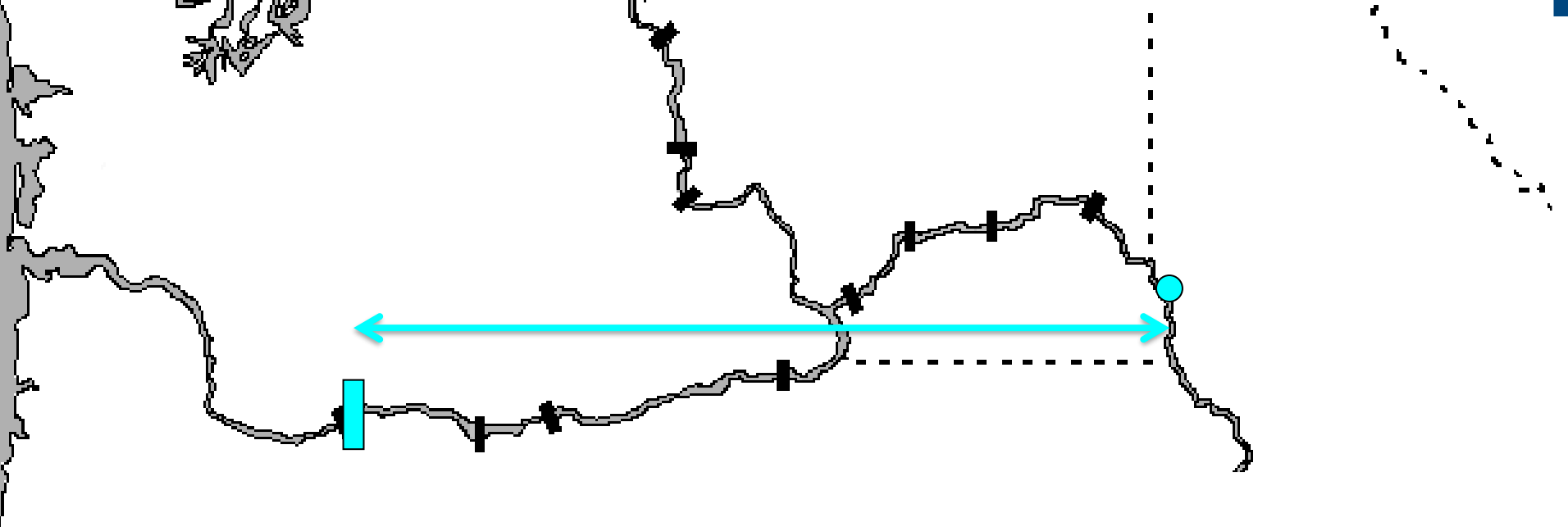
Fish from Upper Columbia

Yearling Chinook



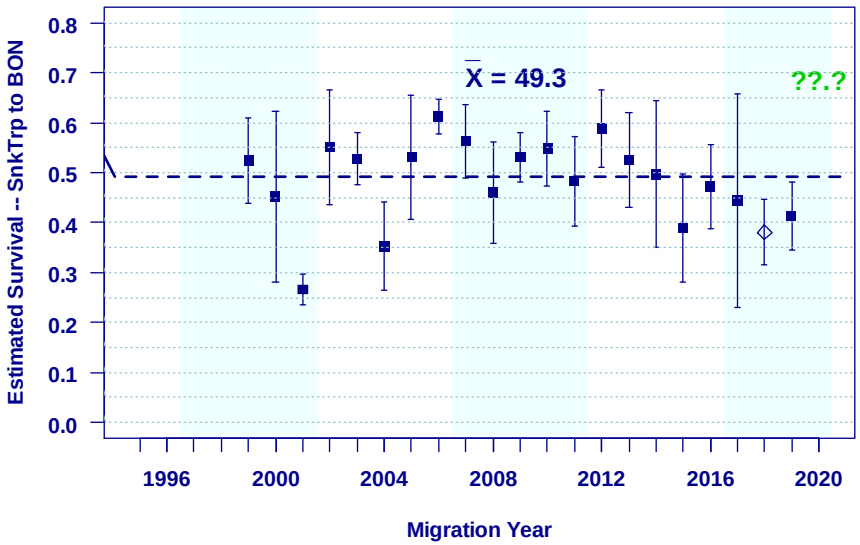
Steelhead



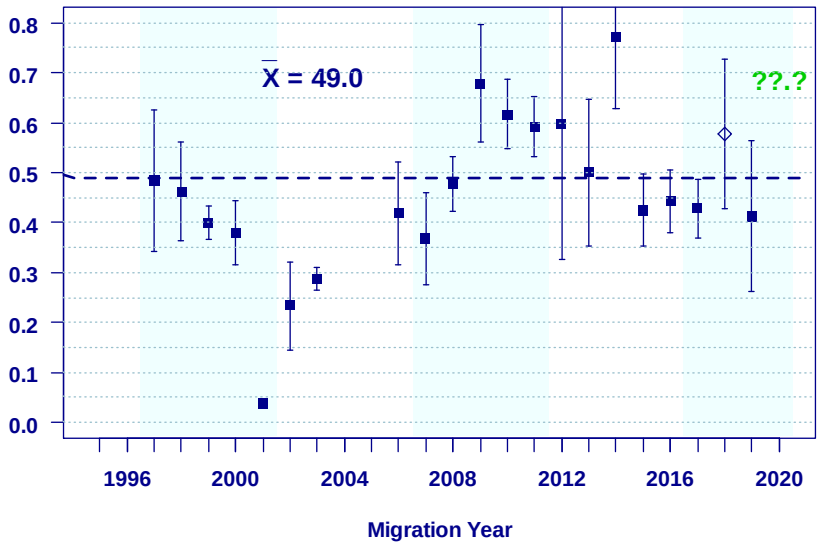


Snake River Trap to Bonneville

Yearling Chinook

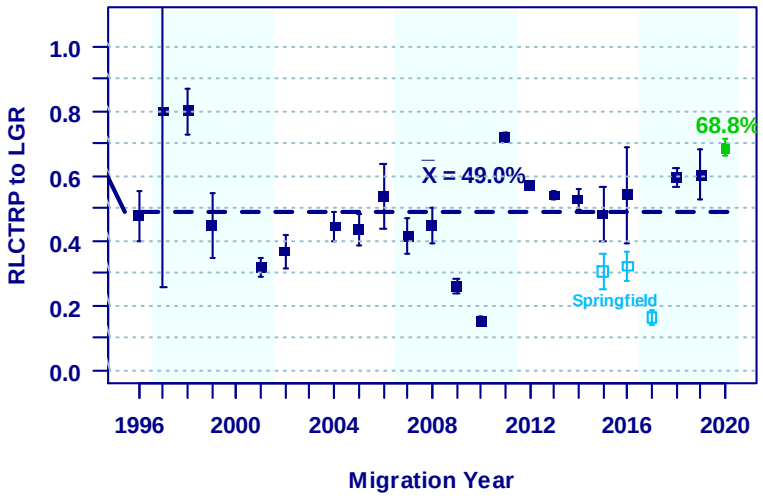


Steelhead

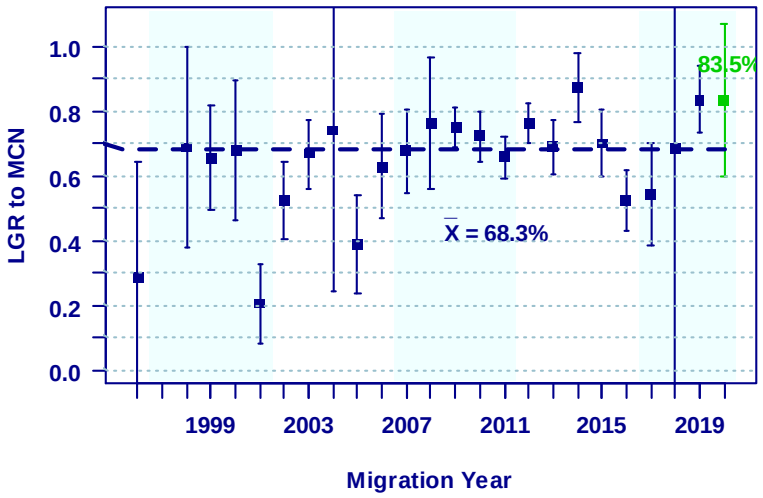


Snake River Sockeye: Estimated Survival

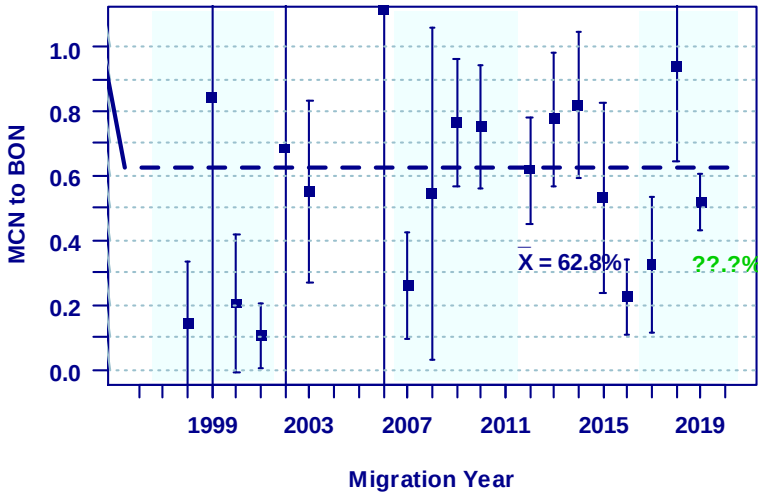
Redfish Lake Trap to Lower Granite



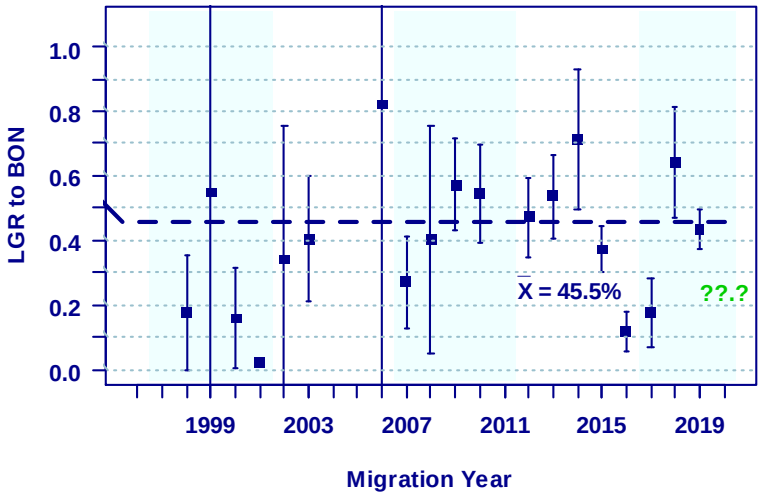
Lower Granite to McNary



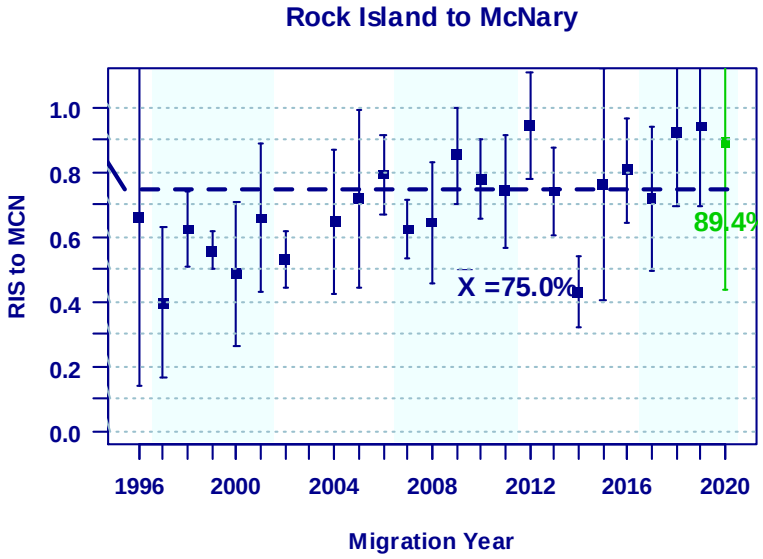
McNary to Bonneville

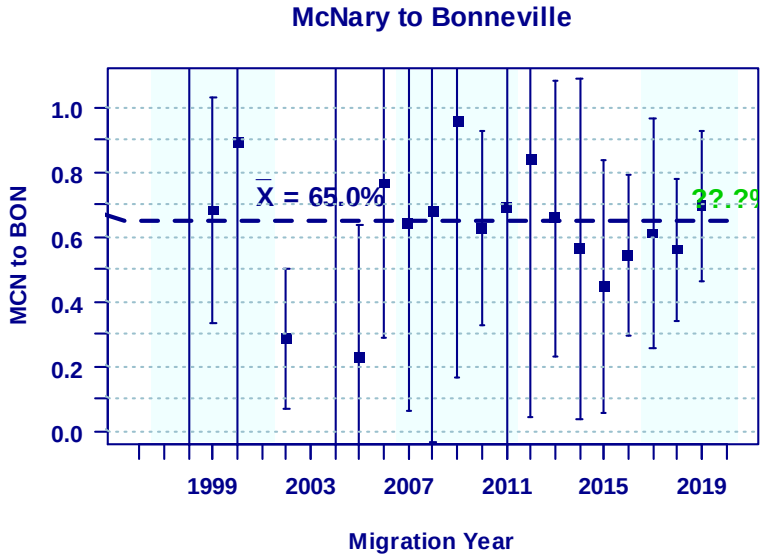


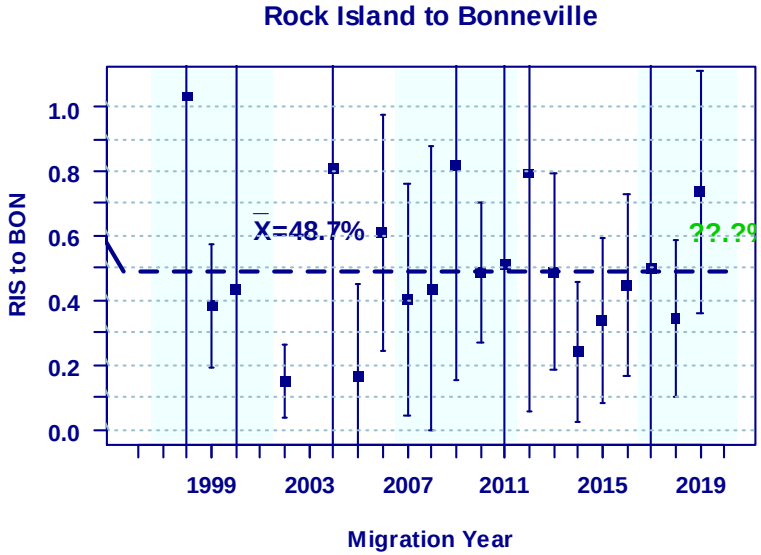
Lower Granite to Bonneville



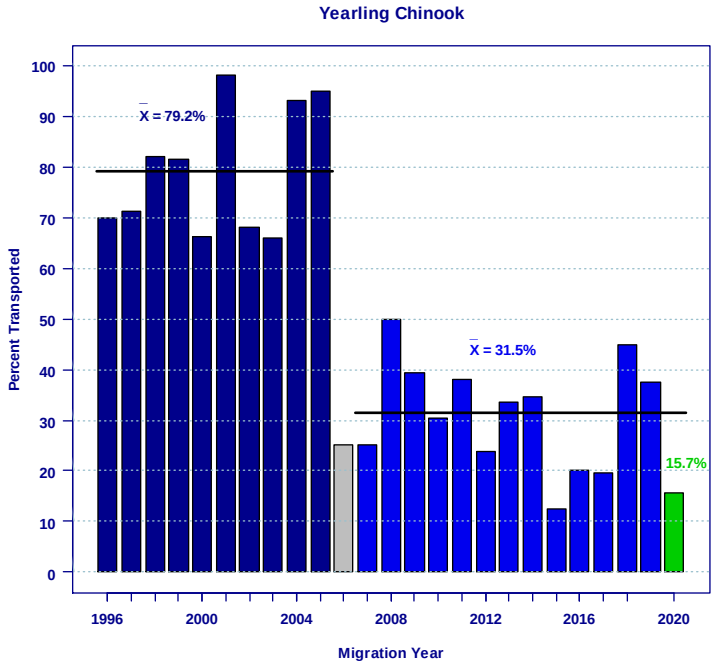
Columbia River Sockeye: Estimated Survival

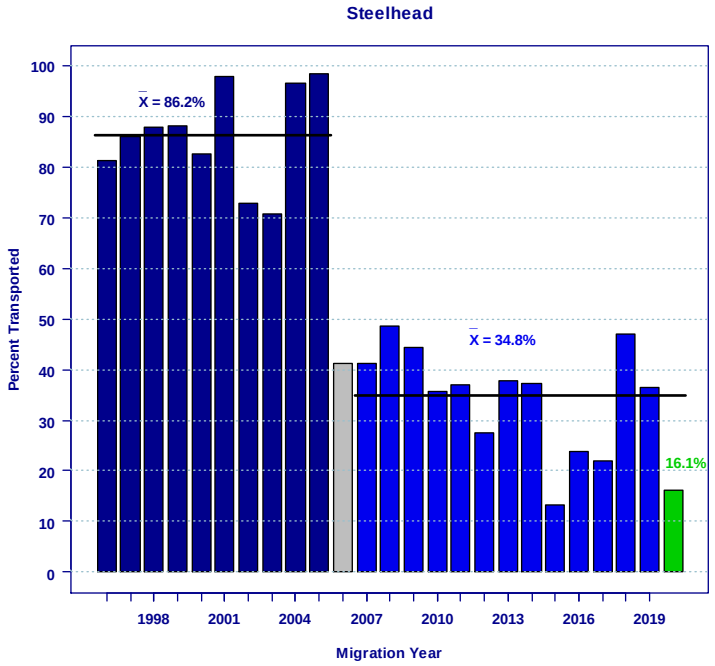


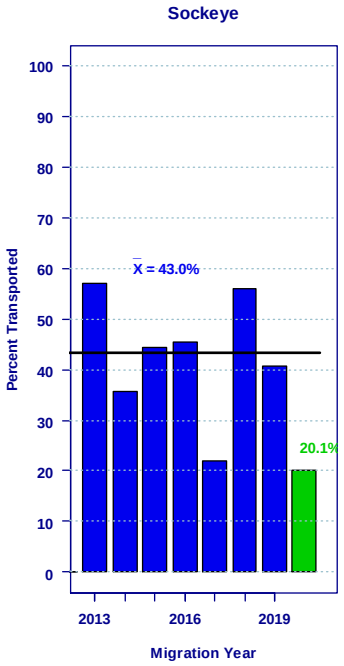




Estimated Percent Transported







Acknowledgments

- Bonneville Power Administration
- PTAGIS – Pacific States Marine Fisheries Commission
- Avian Predation Detection Project
  - Real Time Research -- Astoria-Megler Bridge (!) etc.
  - Corps of Engineers Fish Field Units – East Sand Island
- DART – University of Washington Columbia Basin Research
- NOAA Colleagues: Jim Faulkner, Dan Widener
- Legions of Taggers, Coordinators, Agencies, etc.

Smolt Transportation Seasonal Analyses

Yearling Chinook & Steelhead
Migration Years 2015-2018

- Updated with adult returns through Nov 30, 2020
- Added smolt migration year 2018
- Data from LGR, LGS, and LMN

Estimating Patterns of SAR vs. Date

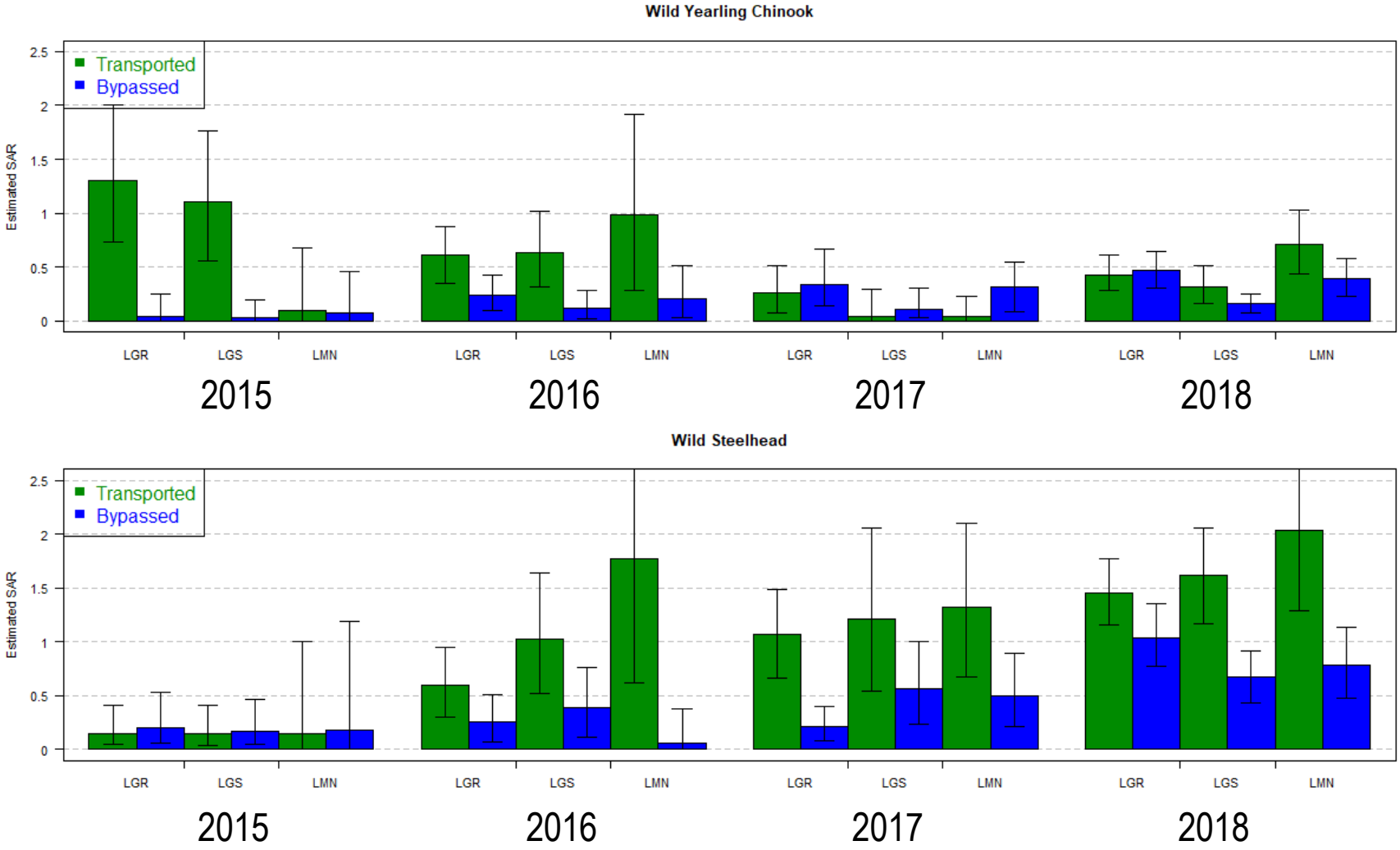
- Need a “time-stamp” – date of passage/detection.
- Annual summaries only today, but time-stamp still necessary.
- These analyses use fish that entered JBS at LGR, LGS, or LMN
  - tagged upstream of LGR or at LGR
  - either transported (T) or bypassed (B or “C1”)
  - can adjust “standards” based on observed C0 > C1
  - e.g.: if (C0/C1 = 1.1)
    and (T/C1 > 1.1)
    then (T/C0 > 1)

Snake River Conditions

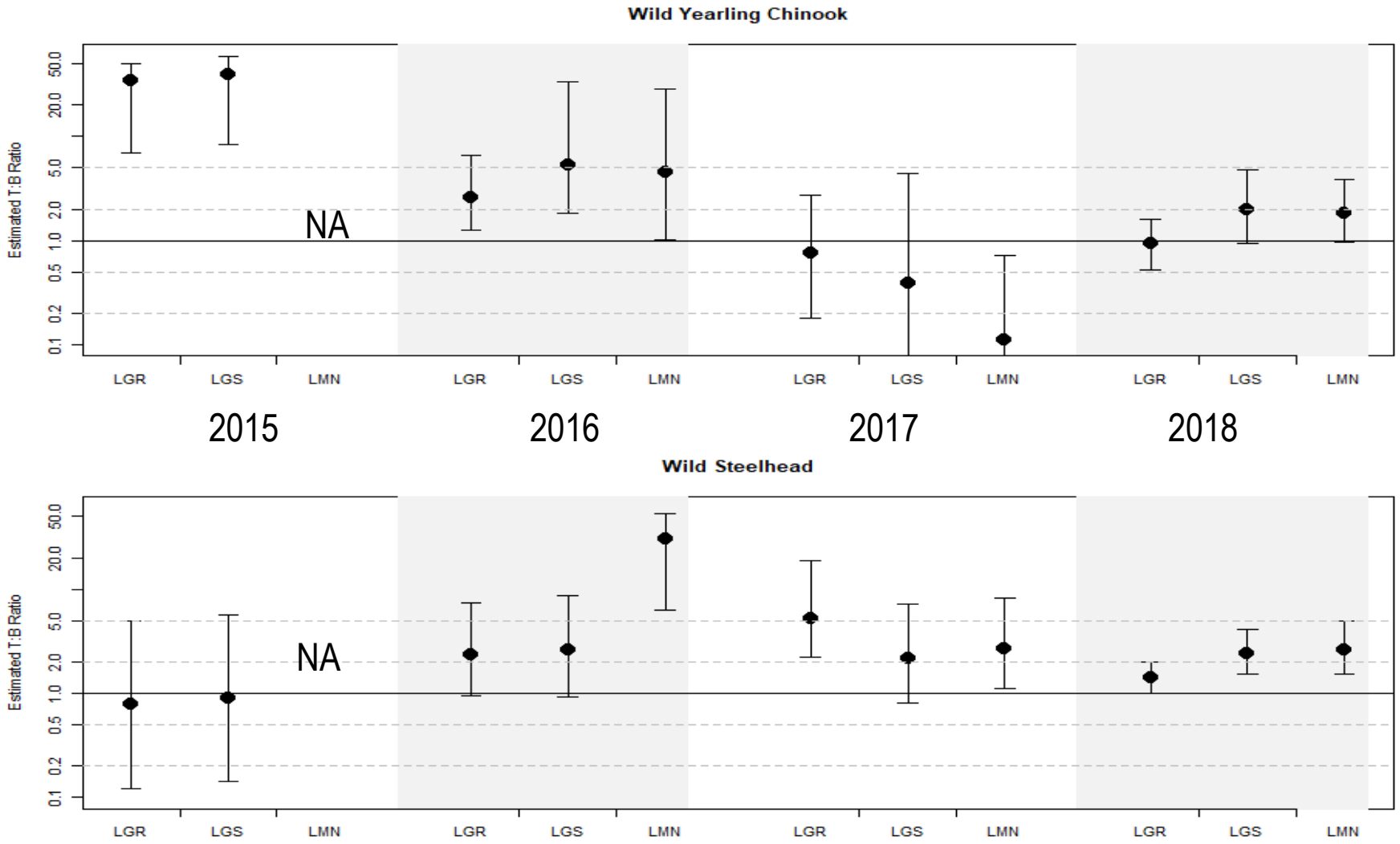
Migration Year	Flow	Spill%	Temperature	Dissolved gas
2015	Very low	High (35-50%)	Very warm	Below average (112-113%)
2016	Above average (flat)	Average (~30%)	Warm	Average (112-115%)
2017	Very high	Very high (40-50%)	Average	Very high (118-126%
2018	High	High (35-55%)	Warm	Above average (116-122%)

Annual Summaries

Annual Estimated SARs – Transport Period



Annual Estimated T:B – Transport Period



Wild Chinook – Tagged Upstream of LGR

	Before Transport Began	During Transportation Period		
	SAR-Bypass (90% CI)	SAR-Transport	SAR-Bypass	T:B Ratio
2015				
LGR	0.30 (0.13-0.50)	1.30 (0.73-2.00)	0.04 (0.00-0.25)	34.4 (6.97-50.3)
LGS	0.21 (0.06-0.41)	1.11 (0.56-1.76)	0.03 (0.00-0.19)	39.6 (8.42-58.7)
LMN	0.29 (0.08-0.78)	0.10 (0.00-0.68)	0.07 (0.00-0.46)	NA (NA-NA)
2016				
LGR	0.35 (0.26-0.44)	0.61 (0.35-0.87)	0.24 (0.10-0.42)	2.57 (1.27-6.57)
LGS	0.31 (0.22-0.40)	0.63 (0.32-1.02)	0.12 (0.02-0.28)	5.30 (1.85-33.3)
LMN	0.38 (0.25-0.56)	0.98 (0.28-1.92)	0.21 (0.03-0.51)	4.59 (1.01-28.8)
2017				
LGR	0.18 (0.10-0.27)	0.26 (0.07-0.51)	0.34 (0.14-0.67)	0.75 (0.18-2.70)
LGS	0.17 (0.11-0.25)	0.04 (0.00-0.29)	0.11 (0.03-0.30)	0.39 (0.00-4.38)
LMN	0.15 (0.08-0.25)	0.04 (0.00-0.23)	0.32 (0.09-0.55)	0.11 (0.00-0.71)
2018				
LGR	0.57 (0.39-0.75)	0.43 (0.28-0.61)	0.47 (0.31-0.65)	0.93 (0.52-1.61)
LGS	0.38 (0.24-0.56)	0.32 (0.16-0.51)	0.16 (0.07-0.25)	2.00 (0.95-4.79)
LMN	0.44 (0.24-0.67)	0.71 (0.44-1.03)	0.39 (0.23-0.58)	1.83 (0.96-3.82)

Wild Steelhead – Tagged Upstream of LGR

	Before Transport Began	During Transportation Period		
	SAR-Bypass (90% CI)	SAR-Transport	SAR-Bypass	T:B Ratio
		2015		
LGR	0.27 (0.08-0.74)	0.15 (0.05-0.41)	0.20 (0.06-0.53)	0.78 (0.12-4.90)
LGS	0.12 (0.00-0.79)	0.15 (0.04-0.41)	0.17 (0.05-0.46)	0.90 (0.14-5.65)
LMN	0.66 (0.00-4.42)	0.15 (0.00-1.00)	0.18 (0.00-1.19)	NA (NA-NA)
		2016		
LGR	0.73 (0.52-1.01)	0.60 (0.30-0.95)	0.26 (0.07-0.51)	2.31 (0.95-7.34)
LGS	0.55 (0.36-0.78)	1.02 (0.52-1.64)	0.39 (0.11-0.76)	2.62 (0.92-8.75)
LMN	0.55 (0.28-0.88)	1.77 (0.62-2.92)	0.06 (0.00-0.38)	30.7 (6.26-53.5)
		2017		
LGR	0.67 (0.30-1.10)	1.07 (0.66-1.49)	0.21 (0.08-0.40)	5.21 (2.24-18.6)
LGS	0.18 (0.07-0.36)	1.21 (0.54-2.06)	0.56 (0.24-1.00)	2.15 (0.80-7.24)
LMN	0.13 (0.04-0.34)	1.32 (0.67-2.10)	0.50 (0.21-0.89)	2.64 (1.12-8.10)
		2018		
LGR	1.01 (0.36-1.67)	1.45 (1.16-1.77)	1.04 (0.77-1.35)	1.39 (1.00-2.01)
LGS	0.72 (0.30-1.27)	1.62 (1.17-2.06)	0.67 (0.43-0.91)	2.43 (1.54-4.05)
LMN	0.76 (0.28-1.48)	2.03 (1.29-2.88)	0.78 (0.48-1.13)	2.62 (1.52-4.88)

Summary

- Chinook: Mixed Results
  - SARs mostly <1% for both groups all years
  - Very high T:B in 2015; low in 2017
  - Moderate transport benefit otherwise, except LGR in 2018

- Steelhead:
  - Except for 2015, SARs for transported >1%, some >1.5%
  - SARs for bypassed <1%
  - T:B ratio near 1.0 in 2015; >2.0 in almost all other cases

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Questions