Northwest Power and Conservation Council

January 8, 2013

MEMORANDUM

TO: Council Members

FROM: Jim Ruff -- Manager, Mainstem Passage and River Operations

SUBJECT: Presentation by NOAA's Northwest Fisheries Science Center on Preliminary 2012 Reach Survival Data

Background

At the January 15, 2013, Council meeting in Portland, Steven Smith from NOAA's Northwest Fisheries Science Center will present preliminary 2012 reach survival information for juvenile Snake River spring Chinook salmon and steelhead. Dr. Smith will also summarize this year's environmental conditions in the mainstem Snake and Columbia rivers, as well as provide preliminary estimates of the proportion of Snake River migrants that were collected and transported from mainstem Snake River hydropower dams this past spring. Comparisons will also be made between the preliminary 2012 reach survivals and previous years' survival rates.

Note this project (#1993-029-00, *Survival Estimates for the Passage of Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs*) is funded by the Bonneville Power Administration as part of the Council's Columbia River Basin Fish and Wildlife Program.

Summary of Methods

For this study, NOAA Fisheries PIT-tagged approximately 20,120 river-run hatchery steelhead, 20,120 wild steelhead, and 16,750 wild yearling Chinook salmon for release into the tailrace of Lower Granite Dam on the Snake River. Preliminary survival estimates are derived from PIT-tag data from fish tagged by or for NOAA Fisheries, as well as fish PIT-tagged by others within the Columbia River Basin, such as fish tagged under the Comparative Survival Study.

Seven of the eight mainstem dams that Snake River stocks pass during their downstream migration have PIT-tag detection systems within their juvenile fish bypass systems. In addition, NOAA Fisheries operates a two-boat trawl in the lower Columbia River downstream of Bonneville Dam, which has a PIT-tag detector installed in the cod end. NOAA researchers

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constructed a detection history for each tagged migrant[1] and used statistical models[2] for the mark-recapture data to estimate the survival probabilities of PIT-tagged juveniles through individual and combined river reaches.[3] PIT-tag detection data was also used to calculate fish travel times, estimate the proportion of fish transported from lower Snake River collector dams, and investigate relationships among these estimates and environmental conditions and management operations.

Summary of Results

Estimated survival for Snake River yearling Chinook salmon and steelhead through the hydropower system (from the Snake River trap near Lewiston to the Bonneville Dam tailrace) in 2012 was relatively high compared to recent years. The 2012 estimated hydropower system survival for yearling Chinook was 59.6%, which was the second highest survival rate observed in the 1999-2012 time series,[4] and greater than the 2011 survival estimate of 48.3%. When compared to the 14-year average survival, the estimated survival for yearling Chinook salmon in 2012 was 9.6% higher between the Snake River trap and Bonneville Dam tailrace.

For juvenile Snake River steelhead, the 2012 estimated survival through the federal hydropower system was 59.8%, which is the third highest survival in the historic time series.[5] When compared to the 14-year average survival, the estimated survival for Snake River steelhead in 2012 was 16.7% higher between the Snake River trap and Bonneville Dam tailrace, and nearly identical to the 2011 survival estimate of 59.2%.

For Snake River sockeye salmon migrants, NOAA's 2012 estimated survival through the federal hydropower system (from Lower Granite Dam to Bonneville Dam) was 47.2%, which was close to the long-term average survival rate of 47.9%. The 2012 estimated juvenile sockeye survival rate was, however, slightly less than the most recent outmigration survival rates measured in 2009 and 2010, both of which were estimated to be between 55-60%.

While the Snake River runoff volume in 2012 was slightly above average,[6] the timing of the runoff was unique among the last eight migration seasons. Specifically, the highest spring flows in the Snake River occurred in late April rather than in May, and flows during May were no higher than in early April. Although the seasonal spring average flow of about 108 Kcfs was slightly higher than the NMFS spring flow objective of 100 Kcfs, no other year's runoff pattern was similar to this year's timing.

Mean spring spill levels at the Snake River dams in 2012 were roughly equal to the 2006-2011 average for the first three weeks in April and then jumped to very high levels during the peak flow event in late April. In terms of percentage of flow that was spilled in 2012, the first three weeks of April were below average of recent years, jumped up to between 40-50% during the

[1] The detection history is the record of whether or not a PIT-tagged juvenile fish is detected at each detection site.
[2] "Cormack-Seber-Jolly" statistical models were used to analyze the mark-recapture data.
[3] One river reach is the combination of juvenile fish passage through one reservoir and one dam.
[4] The hydrosystem survival rate of 61% in 2006 for yearling Chinook was the only rate that was higher.
[5] Only the hydrosystem survival rates for steelhead in 2009 and 2010 of 67.8% and 61.8%, respectively, were higher.
[6] In 2012, April-July runoff volume for the Snake River at Lower Granite Dam was 22.7 million acre-feet, or 105% of average.

spike in flow in late April, and then returned to near or slightly below average for the month of May. Water temperatures in the Snake River in 2012 were near average for most of the spring season. Water temperature increased, however, relative to the long-term average during the peak flow event in April.

Estimated percentages of yearling Chinook salmon and steelhead transported from Snake River dams in 2012 were the lowest seen in 20 years of transport estimates (1993-2012). Collection for transportation began on May 2nd at Lower Granite Dam, May 4th at Little Goose Dam, and on May 6th at Lower Monumental Dam. However, the largest spike in smolt passage for both species was associated with the large spike in flow in late April. This resulted in a high percentage of juvenile fish (about 67% of yearling Chinook and 59% of steelhead) passing Lower Granite Dam before the transportation program began.

NOAA's preliminary estimates of the proportion transported of wild and hatchery spring-summer Chinook salmon smolts are 23% and 25%, respectively. For juvenile steelhead, the transport estimates are 28% and 27% for wild and hatchery fish, respectively. As noted above, these transport estimates for both yearling Chinook and steelhead are lower than in any year 1993-2012.[7] Thus about three-quarters of the yearling Chinook salmon juveniles and over 70% of the steelhead juveniles migrated in-river during 2012.

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[7] Note that differences in transport percentages among years for both yearling Chinook and steelhead are due to differences in collection probabilities at the three collector dams resulting from changes in dam operations and system configuration improvements, as well as differences in timing of the smolt migrations relative to the transportation start dates.

Survival and Travel Time of Migrating Salmonid Smolts in the Snake and Lower Columbia Rivers

Update with Preliminary 2012 Data

Northwest Power and Conservation Council
January 15, 2013

Steve Smith steven.g.smith@noaa.gov
Jim Faulkner, Doug Marsh, Bill Muir
Northwest Fisheries Science Center
NOAA Fisheries

Outline

- Summary of migration conditions, juvenile travel time, and juvenile survival through the hydropower system

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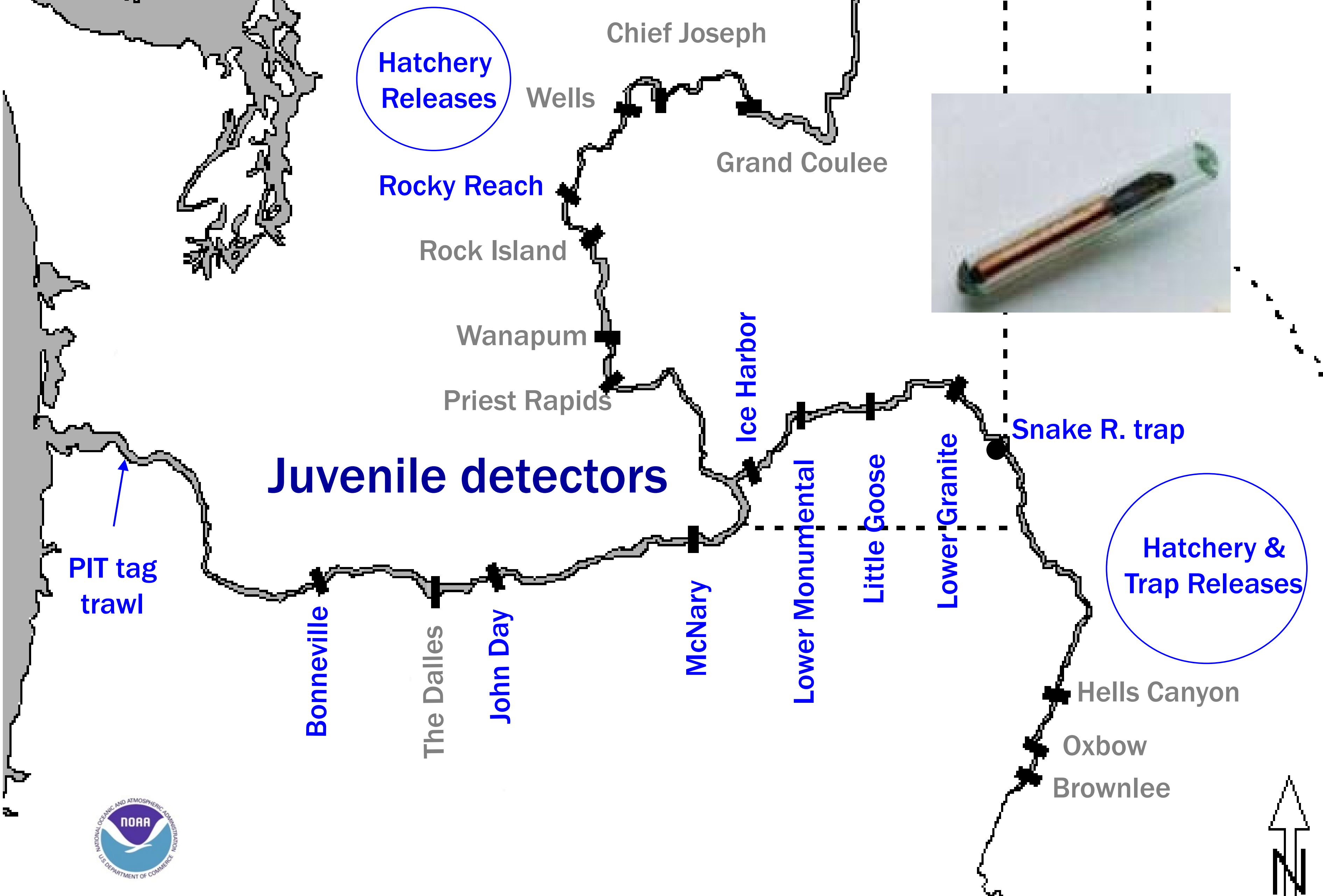
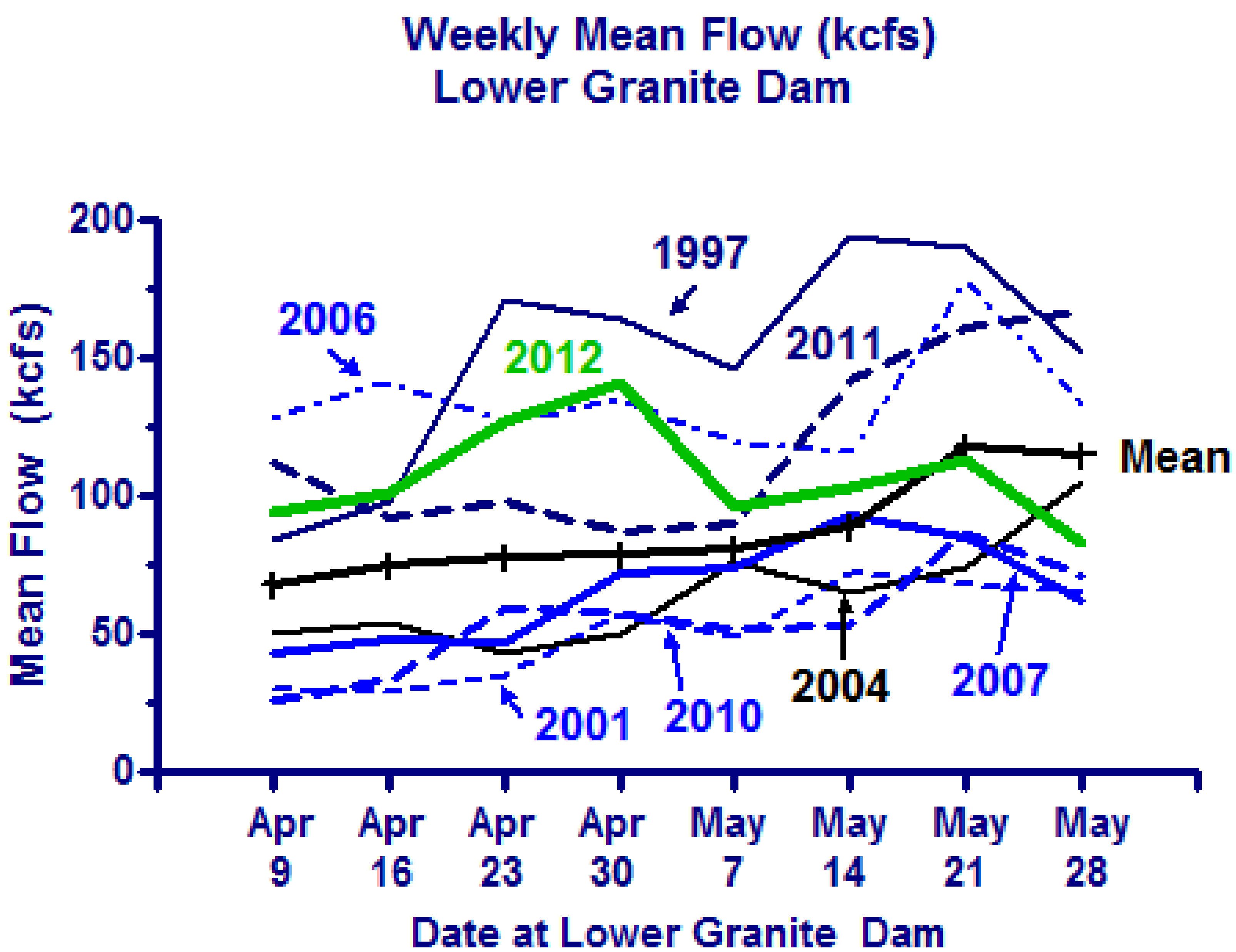
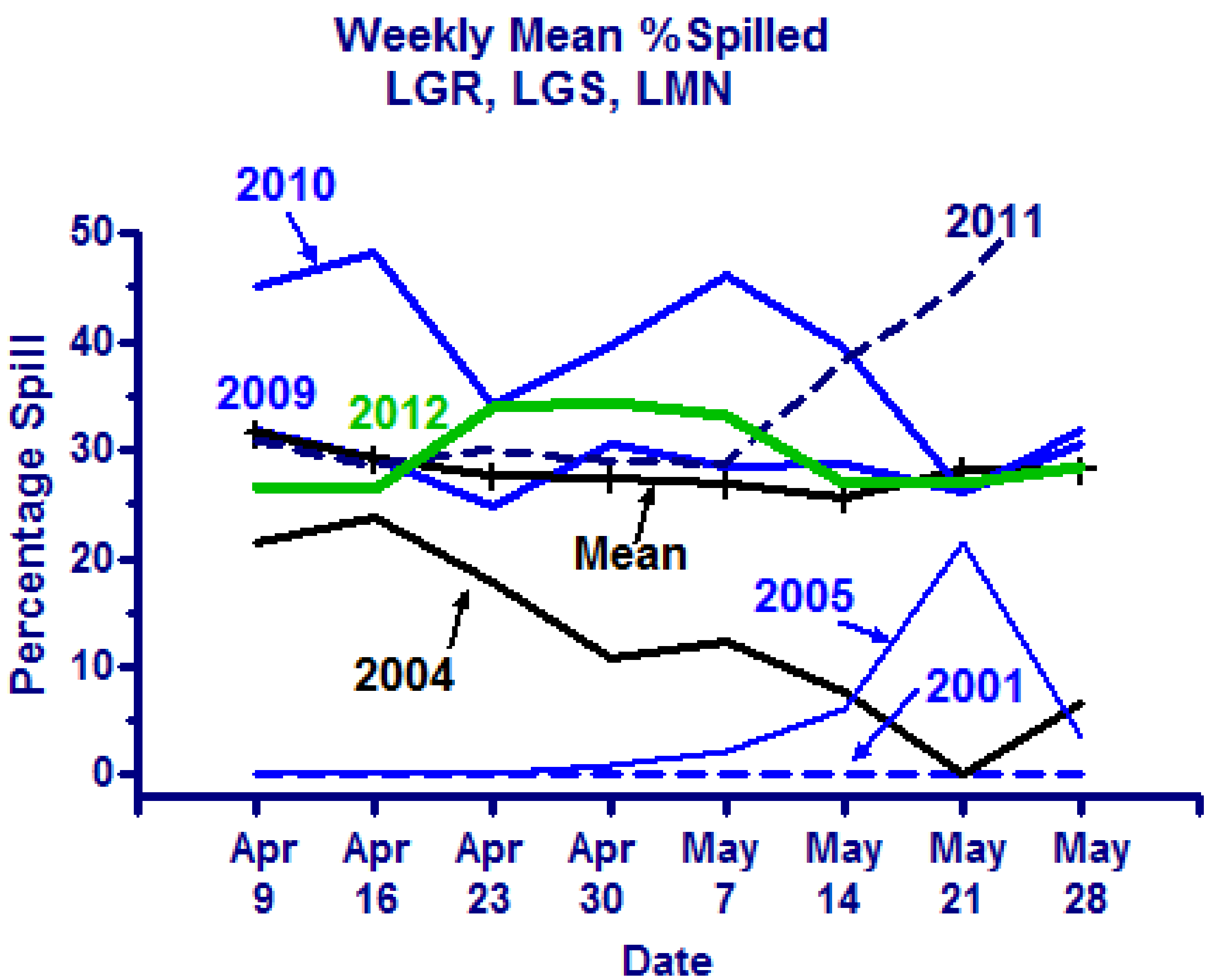
- Percentage transported
- Interplay of factors – what's new and interesting?

- Only those fish left to migrate in-river
- Only juvenile data, not survival to adult

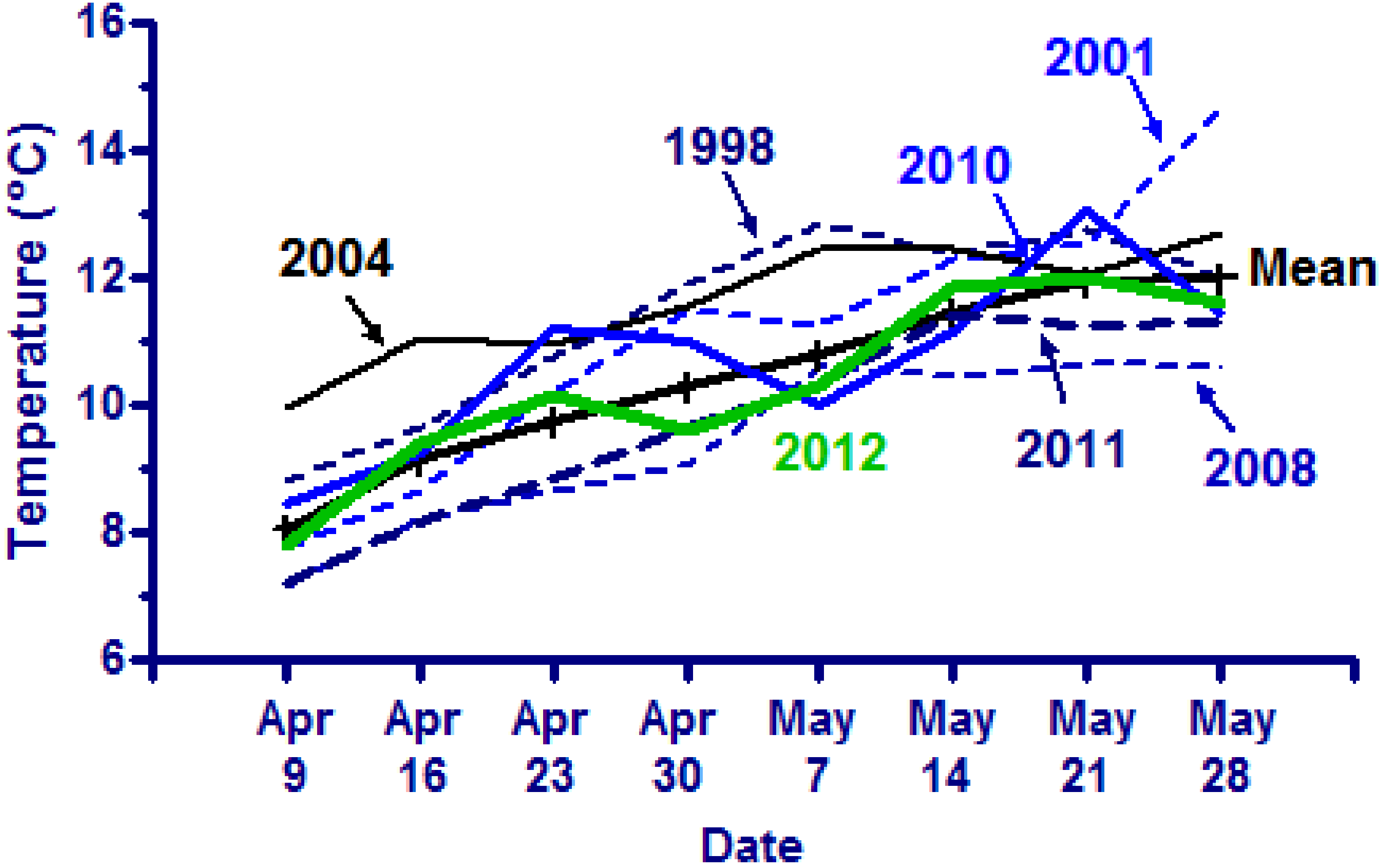
PIT-tag Data Sources



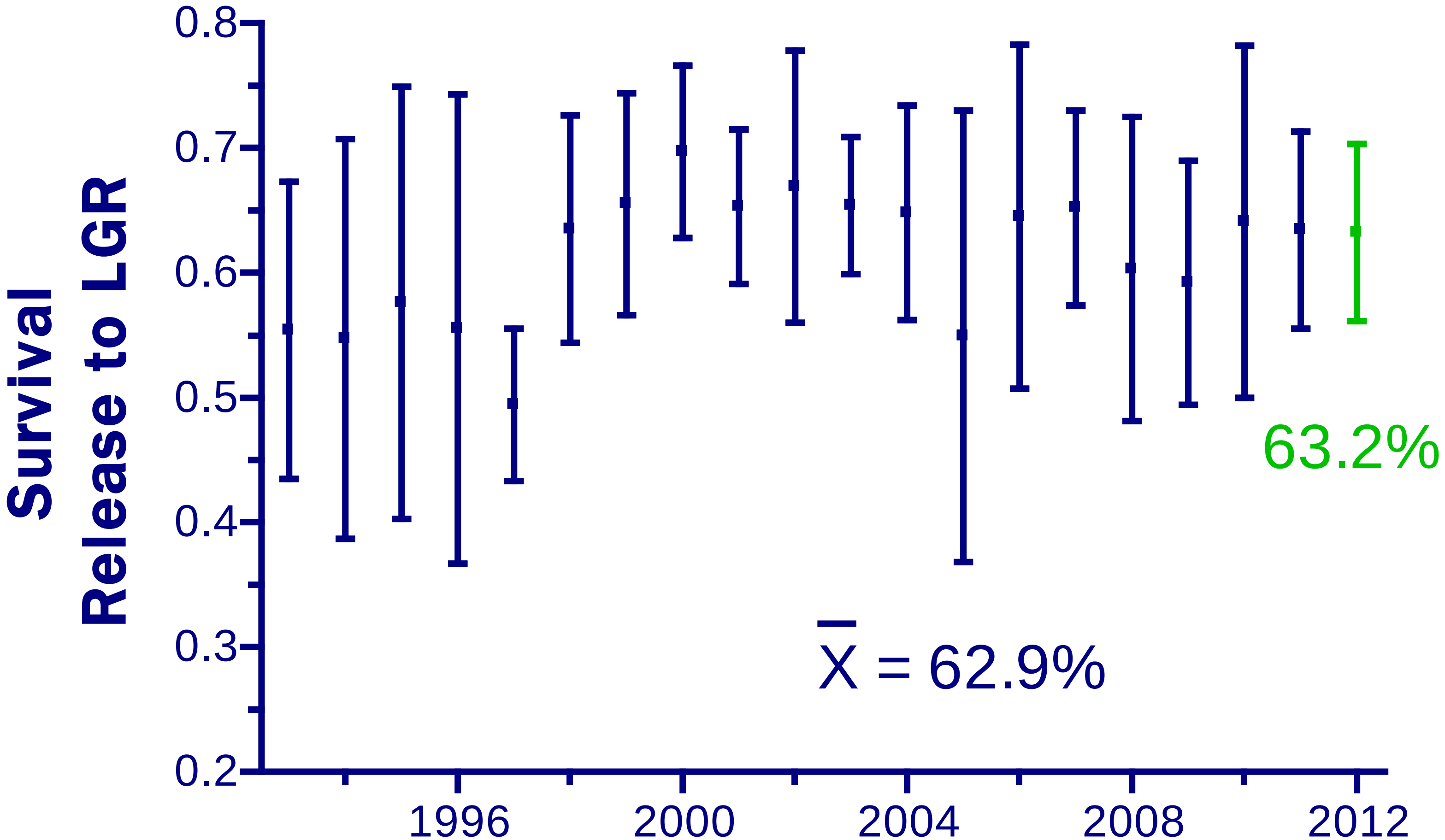

Weekly Mean Flow (kcfs)
Lower Granite Dam
Mean Flow (kcfs)
200
150
100
50
0
1997
2006
2012
2011
Mean
2001
2010
2004
2007
Apr 9
Apr 16
Apr 23
Apr 30
May 7
May 14
May 21
May 28
Date at Lower Granite Dam


Weekly Mean % Spilled
LGR, LGS, LMN
2010
2011
2009
2012
Mean
2005
2004
2001
50
40
30
20
10
0
Percentage Spill
Apr 9
Apr 16
Apr 23
Apr 30
May 7
May 14
May 21
May 28
Date

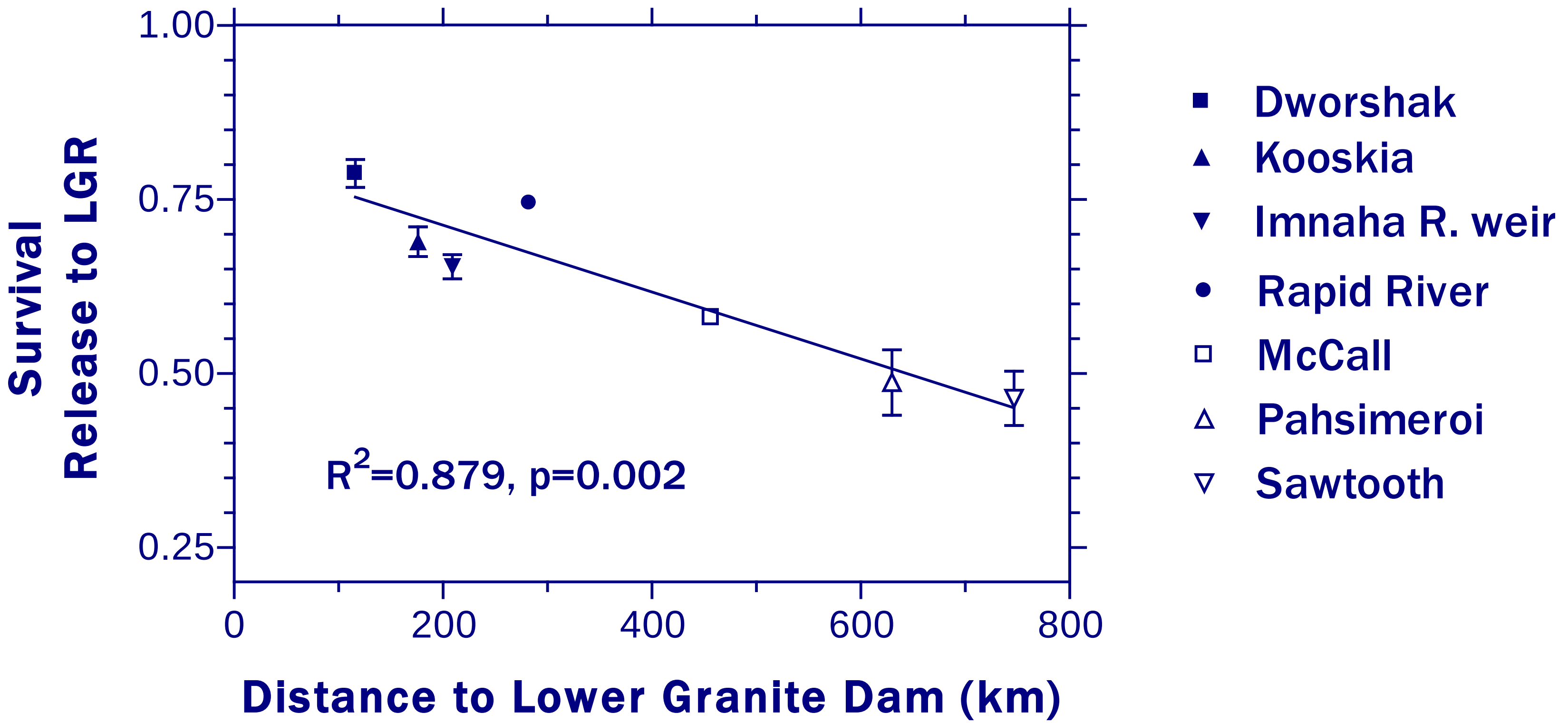
Weekly Mean Temperature
Little Goose Dam



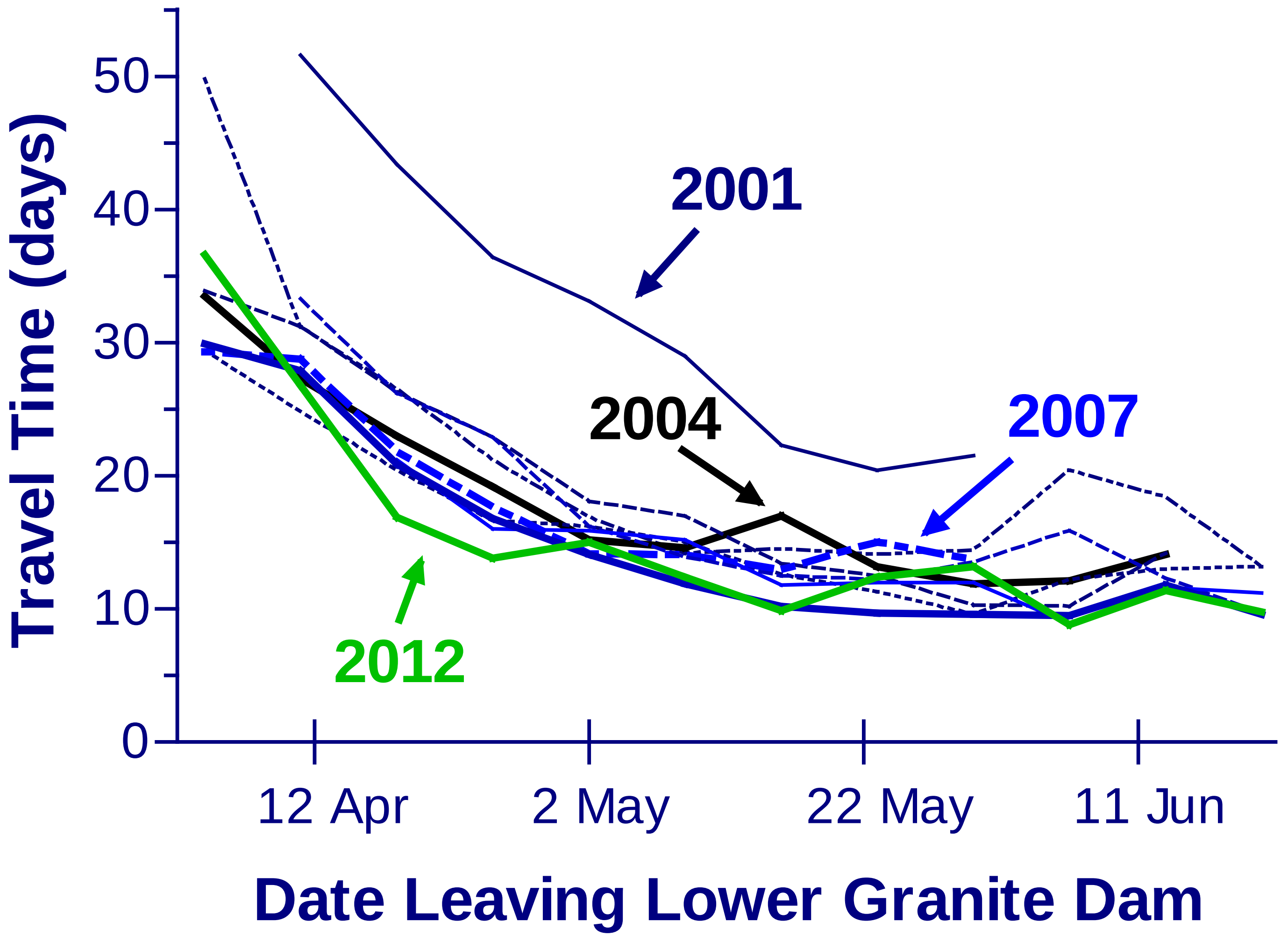
Yearling Chinook
Snake River Basin Hatcheries
Mean of Index Groups



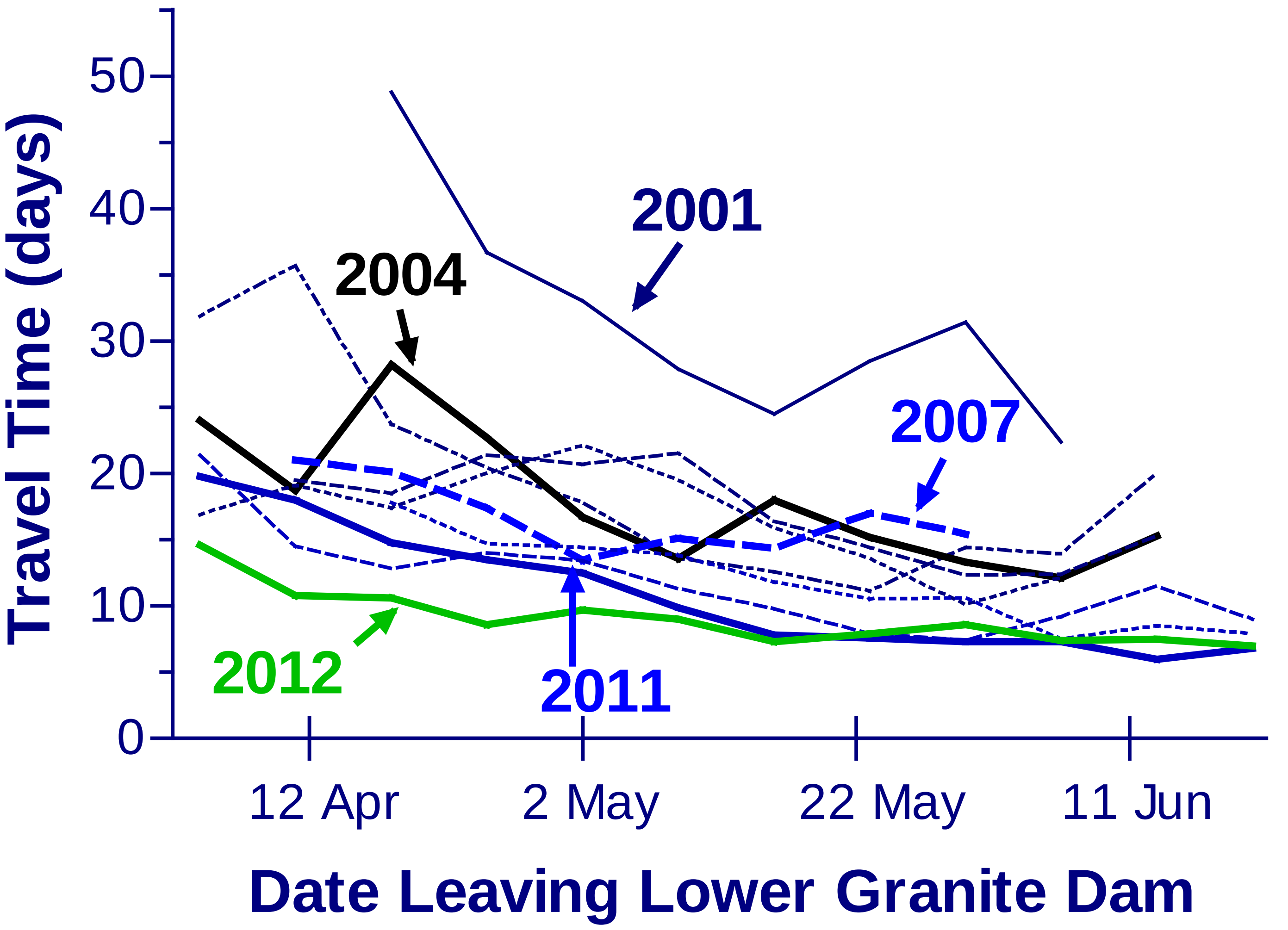
Hatchery yearling Chinook (2002-2012)

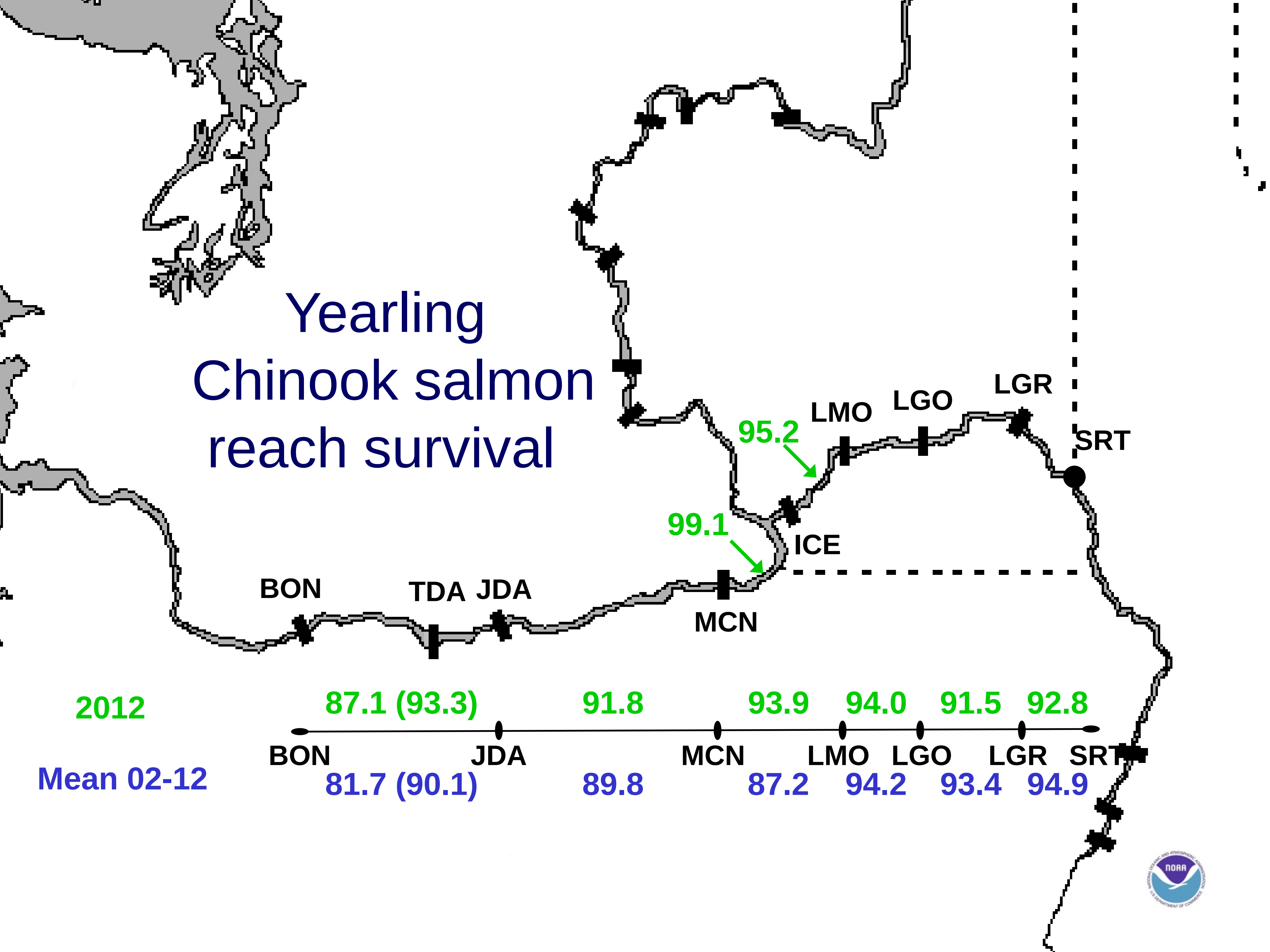


Yearling Chinook Median Travel Time
Lower Granite to Bonneville (461 km)

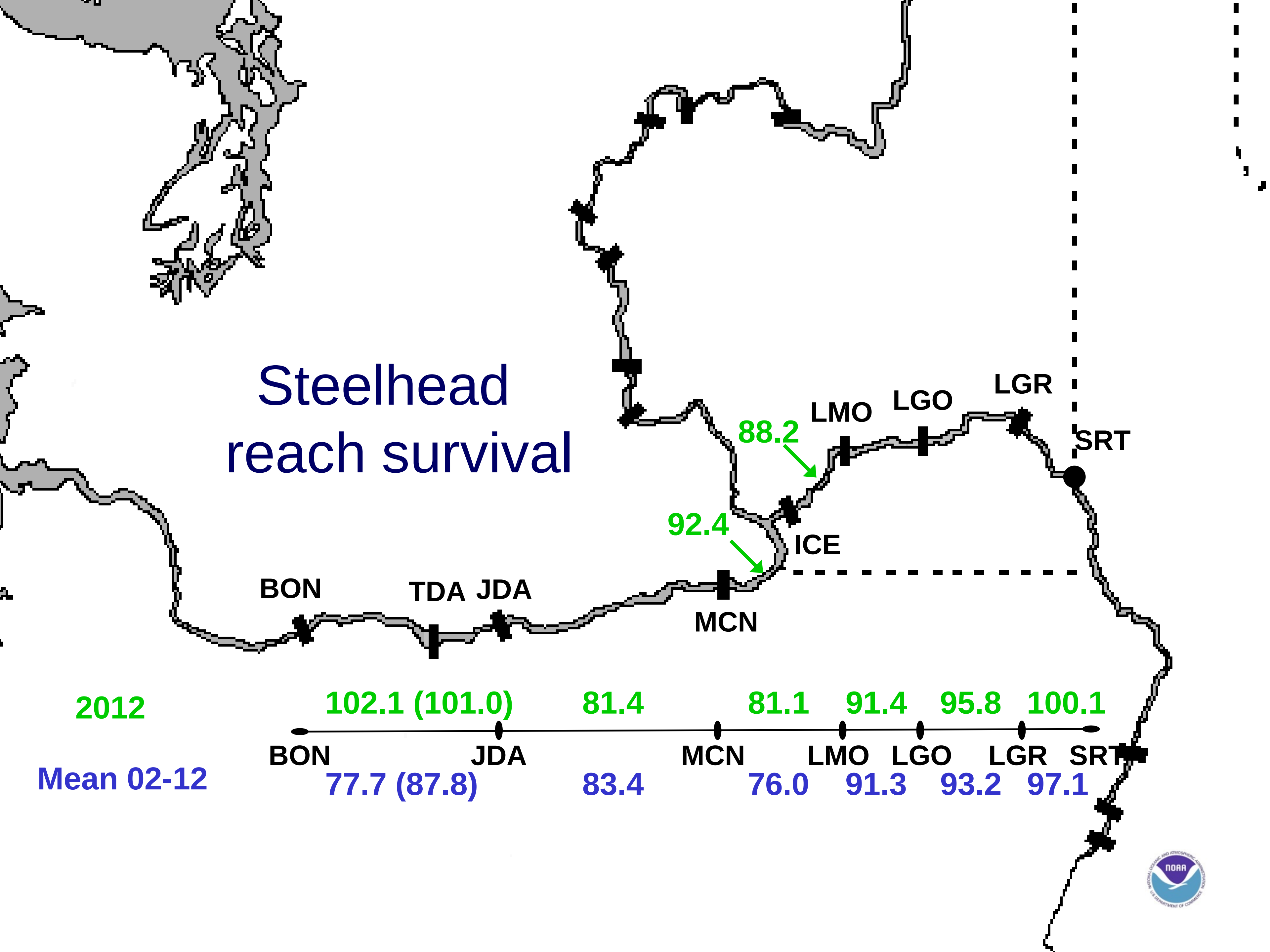


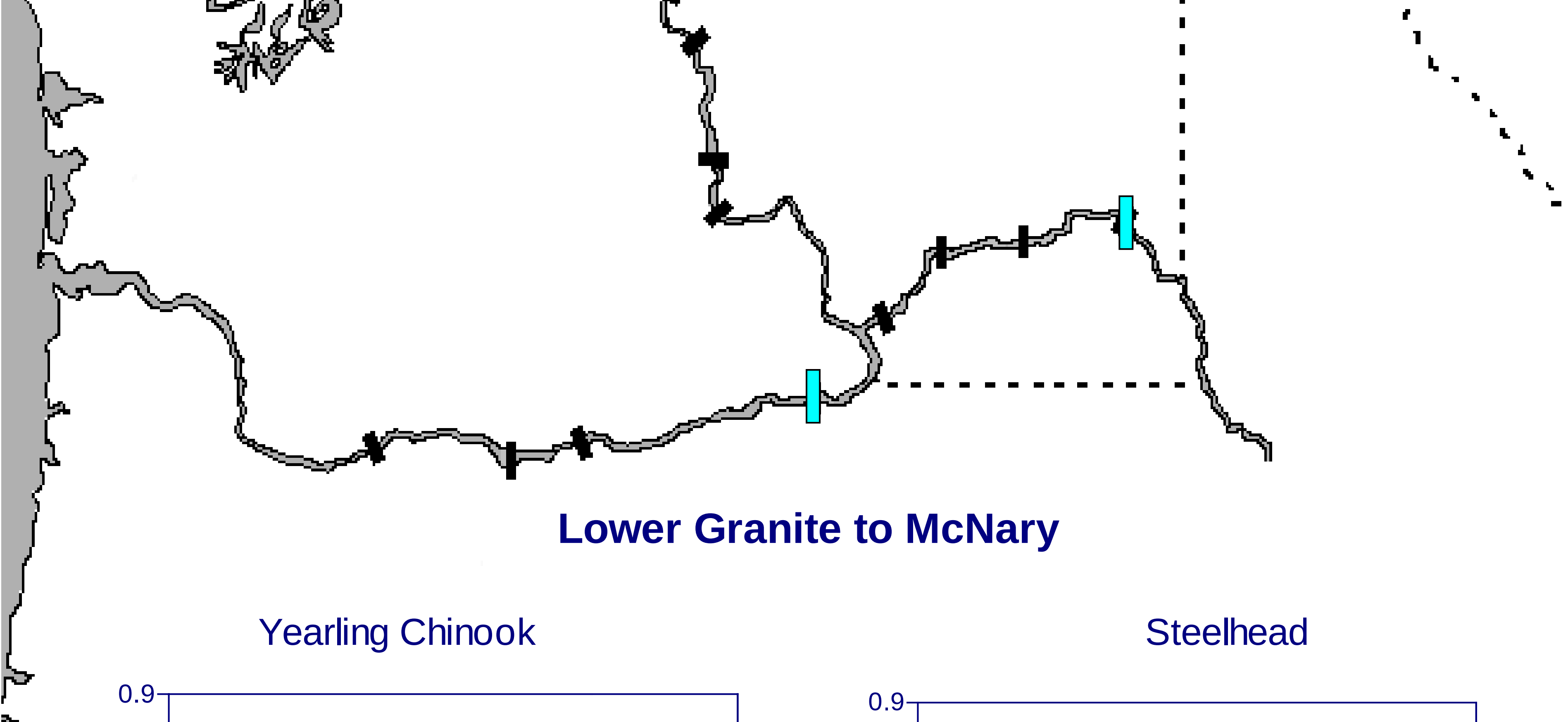
Steelhead Median Travel Time
Lower Granite to Bonneville (461 km)





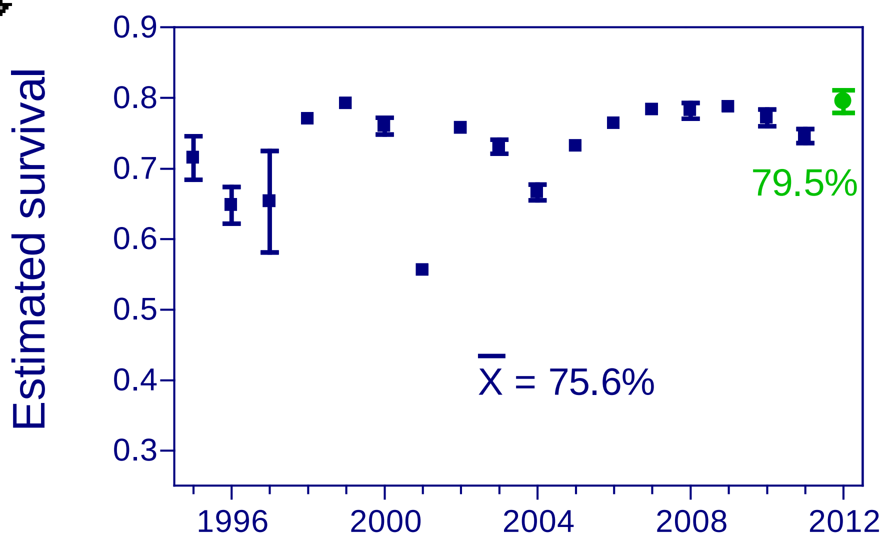
Yearling Chinook salmon reach survival
LGR
LGO
LMO
SRT
95.2
99.1
ICE
BON
TDA
JDA
MCN
2012
87.1 (93.3)
91.8
93.9
94.0
91.5
92.8
BON
JDA
MCN
LMO
LGO
LGR
SRT
Mean 02-12
81.7 (90.1)
89.8
87.2
94.2
93.4
94.9


Steelhead
reach survival
LGR
LMO
LGO
SRT
88.2
92.4
ICE
BON
TDA
JDA
MCN
2012
102.1 (101.0)
81.4
81.1
91.4
95.8
100.1
BON
JDA
MCN
LMO
LGO
LGR
SRT
Mean 02-12
77.7 (87.8)
83.4
76.0
91.3
93.2
97.1

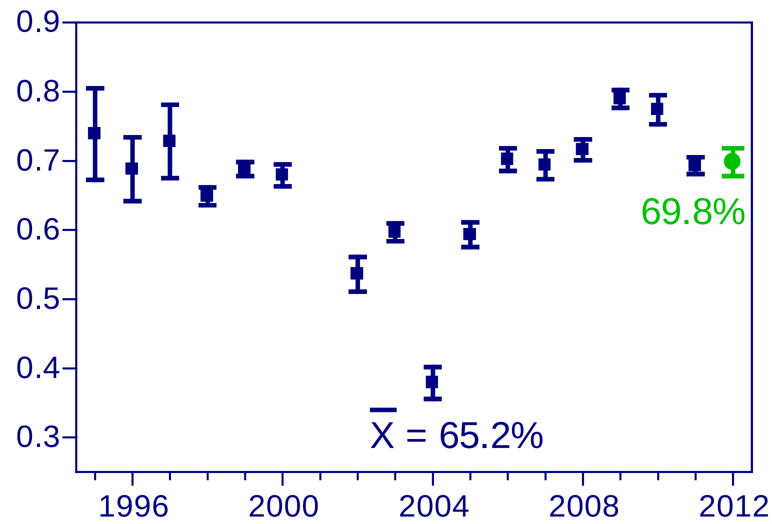


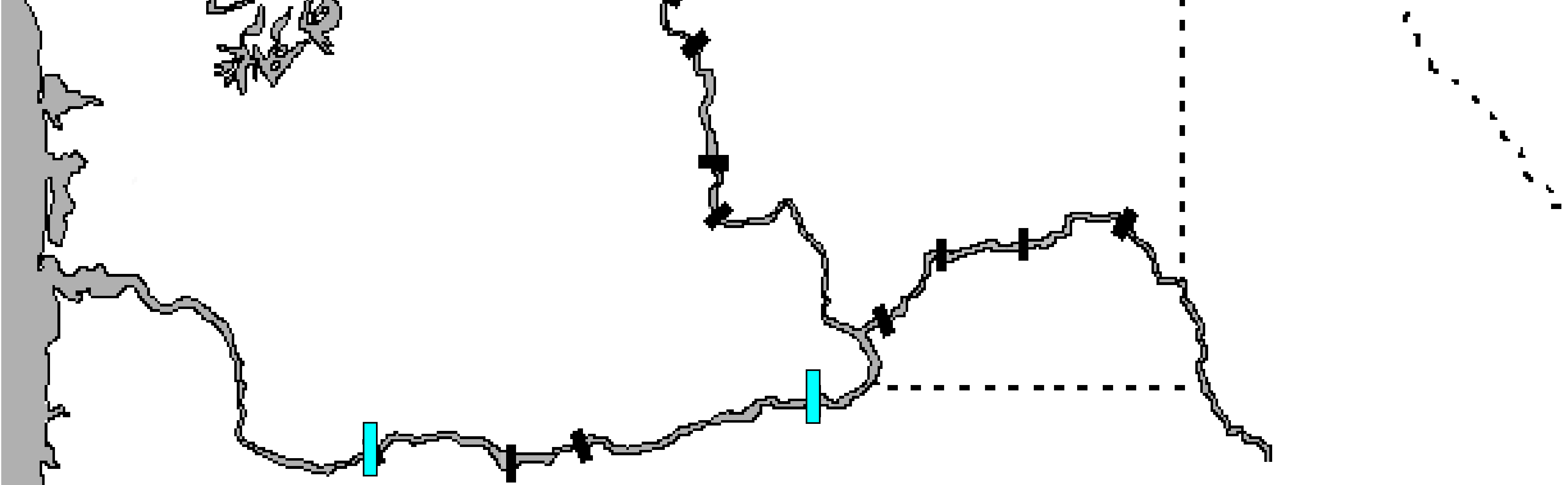
Lower Granite to McNary

Yearling Chinook



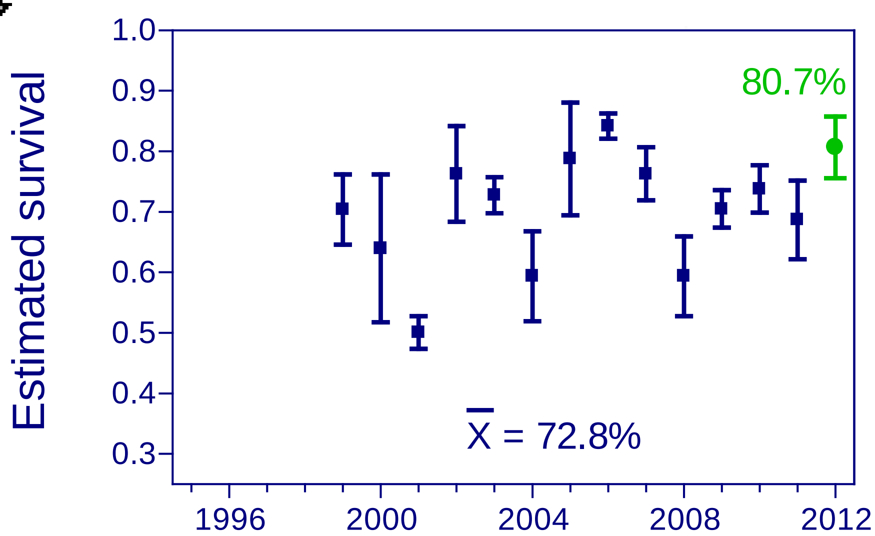
Steelhead



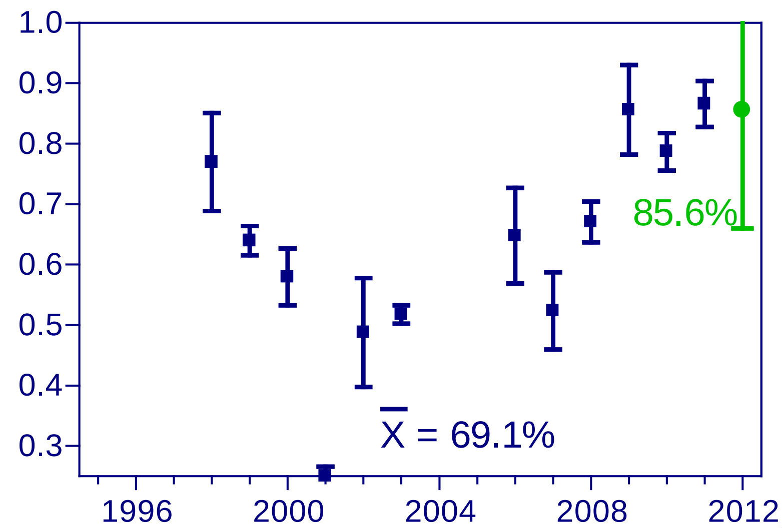


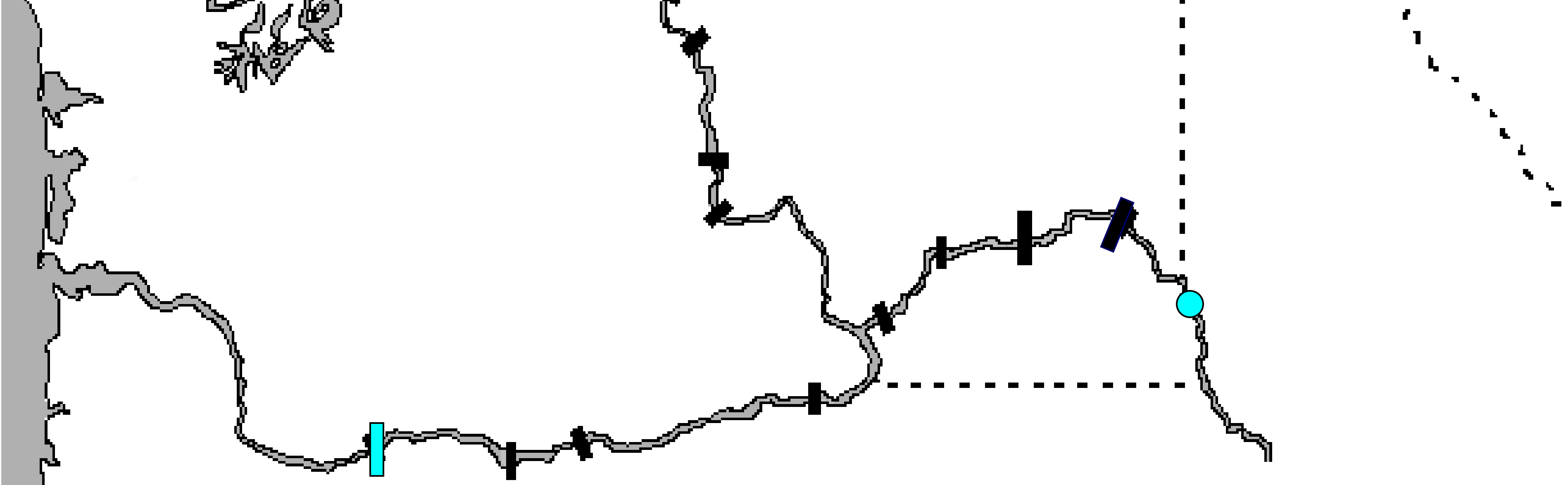
McNary to Bonneville
Fish From Snake River

Yearling Chinook



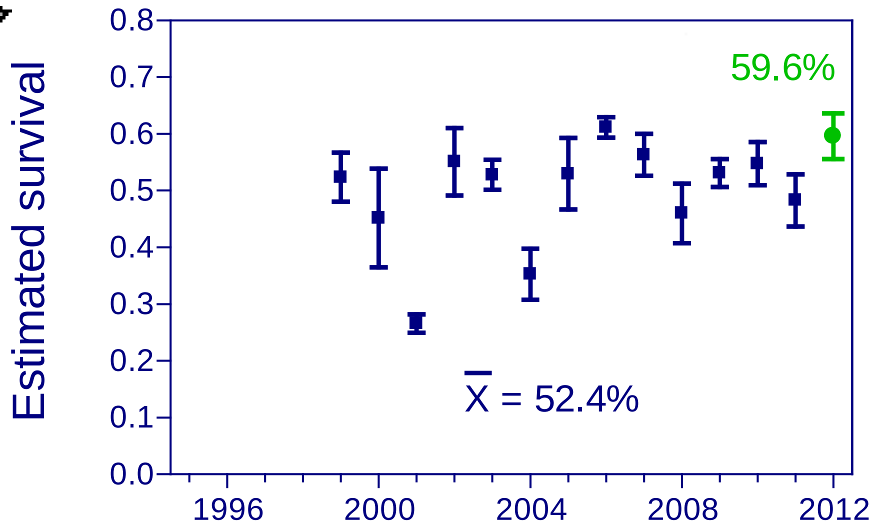
Steelhead



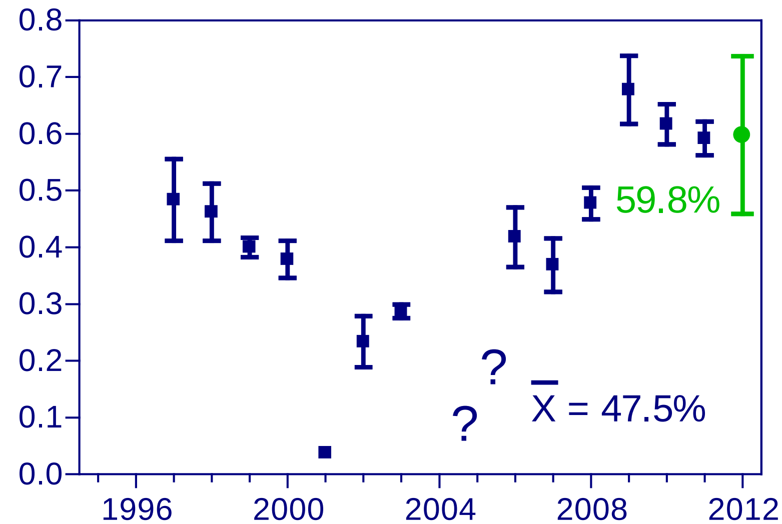


Snake River Trap to Bonneville

Yearling Chinook



Steelhead



Detection in Lower River

- Detection of steelhead at Bonneville about 12% in 2011, and less than 10% in 2012

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  - Detection in PIT trawl is low relative to bypass systems
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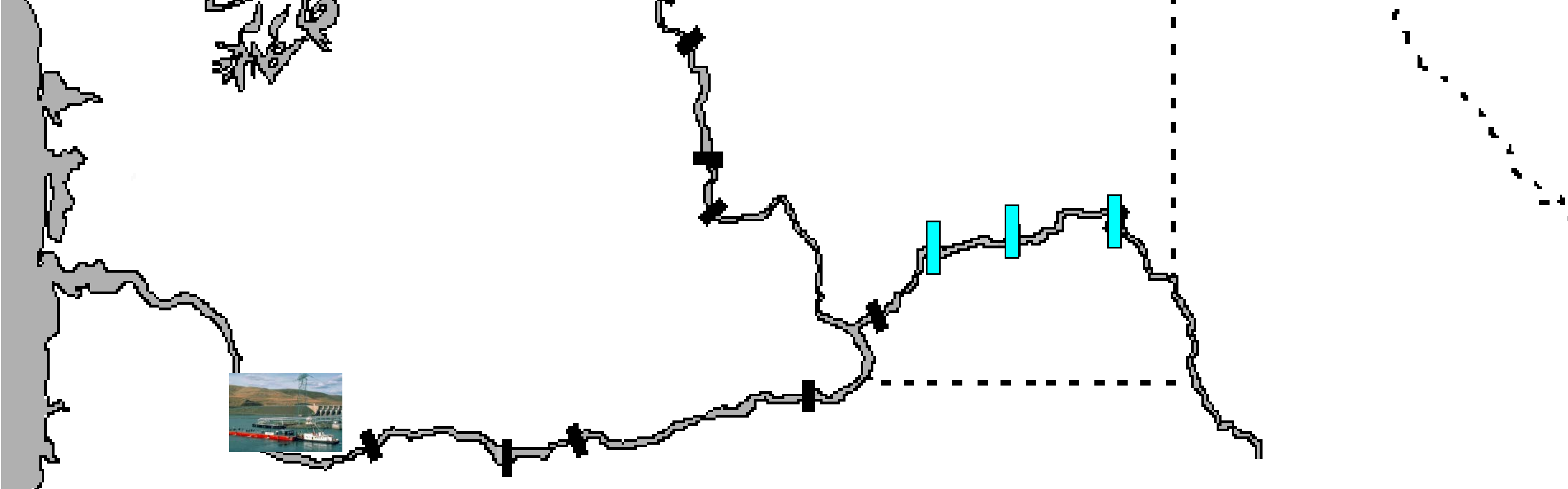
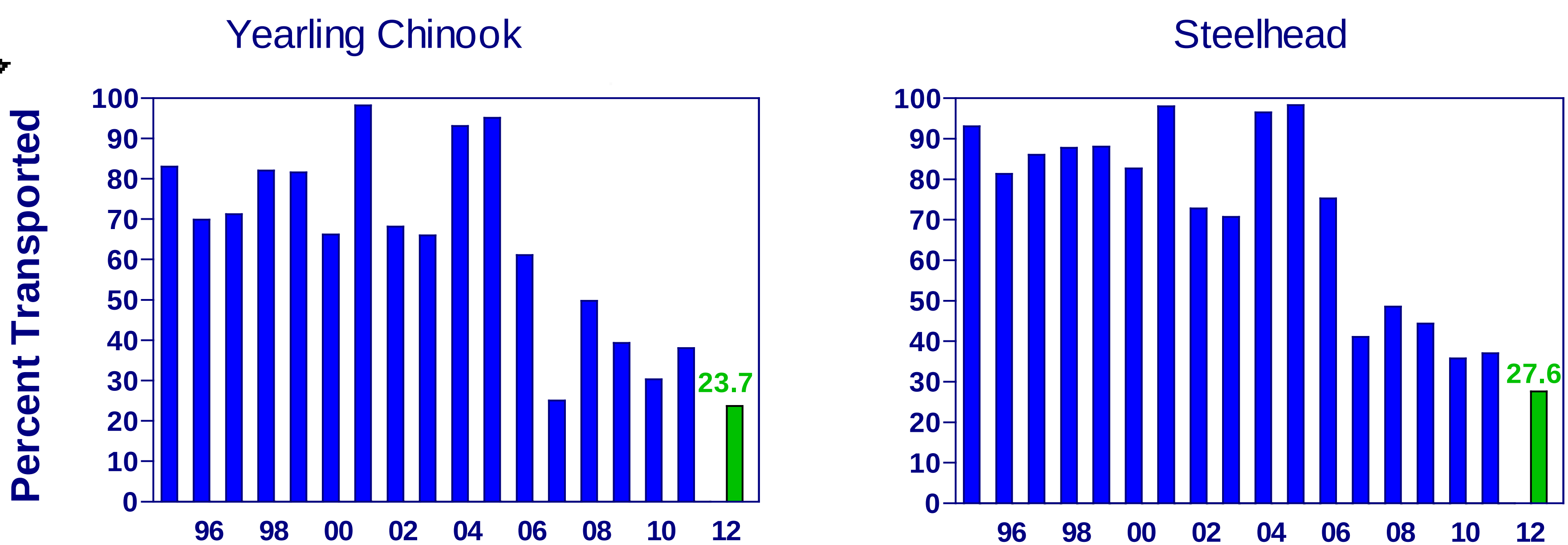
  - Adult detections possibly useable, but it takes several years!
  - PIT trawl remains essential to estimate to Bonneville

Preliminary estimates of transport % for 2012 based on PIT-tag data

- 23% wild Chinook
- 25% hatchery Chinook
- 28% wild steelhead
- 27% hatchery steelhead



Percent Transported to Below Bonneville



Preliminary estimates of transport %

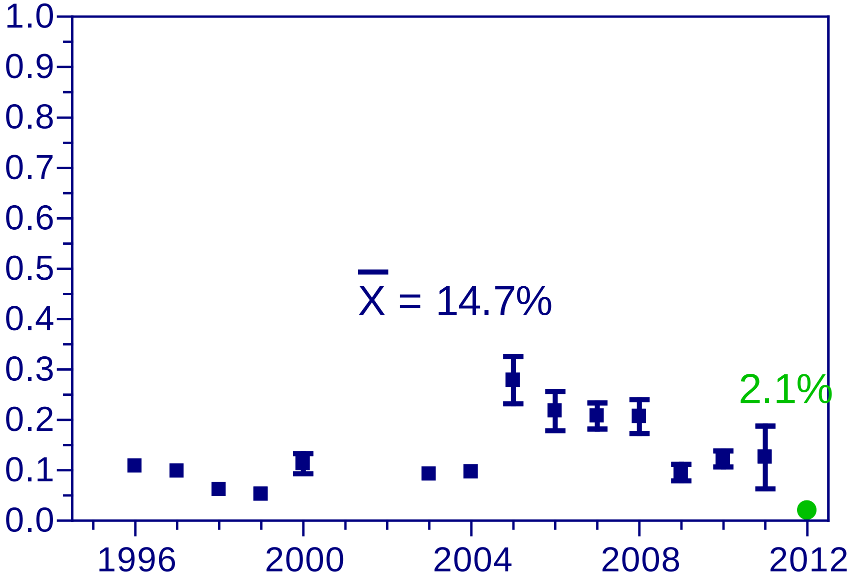
- **67% of Chinook and 59% of steelhead passed LGR before transportation began on May 2**

- **After transportation started: about 58% of smolts that arrived at LGR were transported**

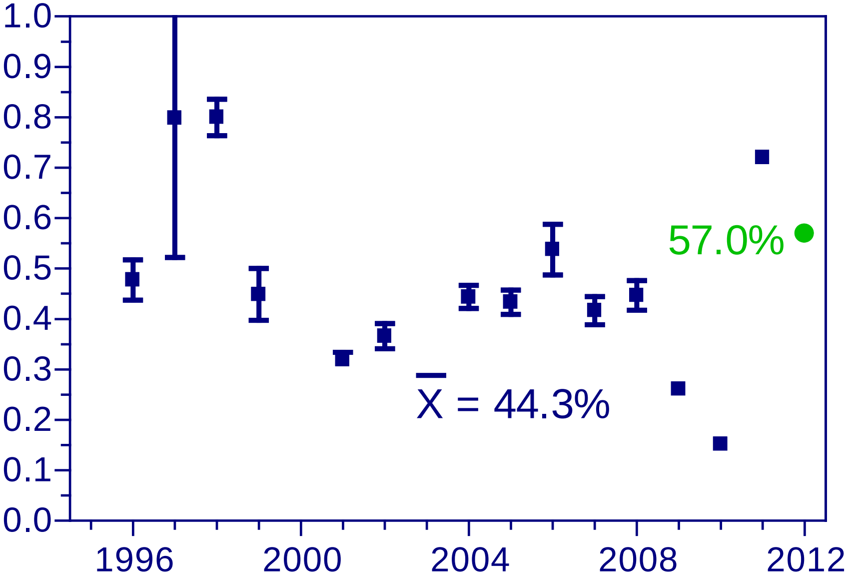
Sockeye Survival

Snake River Sockeye
Redfish Lake to Lower Granite

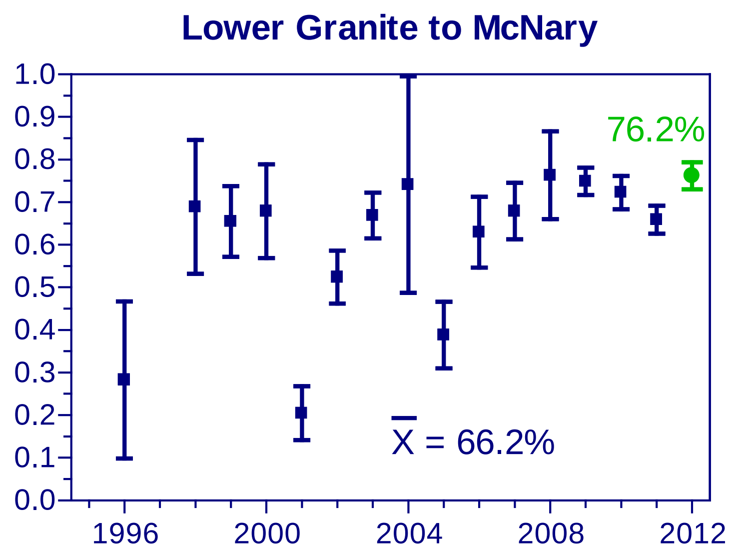
Released as parr in fall

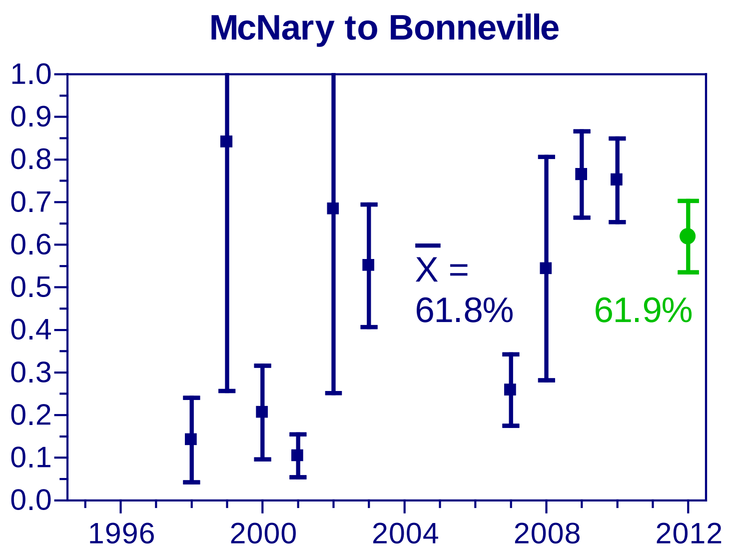


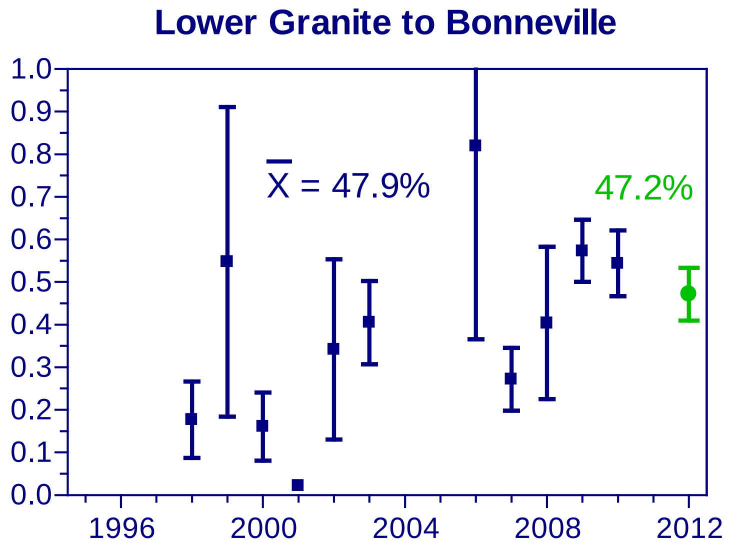
Released as smolts in spring



Snake River Sockeye
Smolts Migrating in Spring







Conclusions

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- High spill rates result in higher direct survival and increased migration rate, promoted by additional surface passage structures

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  - increased number of in-river migrants
  - increased survival of those remaining in-river
  - not necessarily increased smolt-to-adult survival for the population
  - to improve survival to adult for population, in-river increases have to exceed benefit of transport


Questions