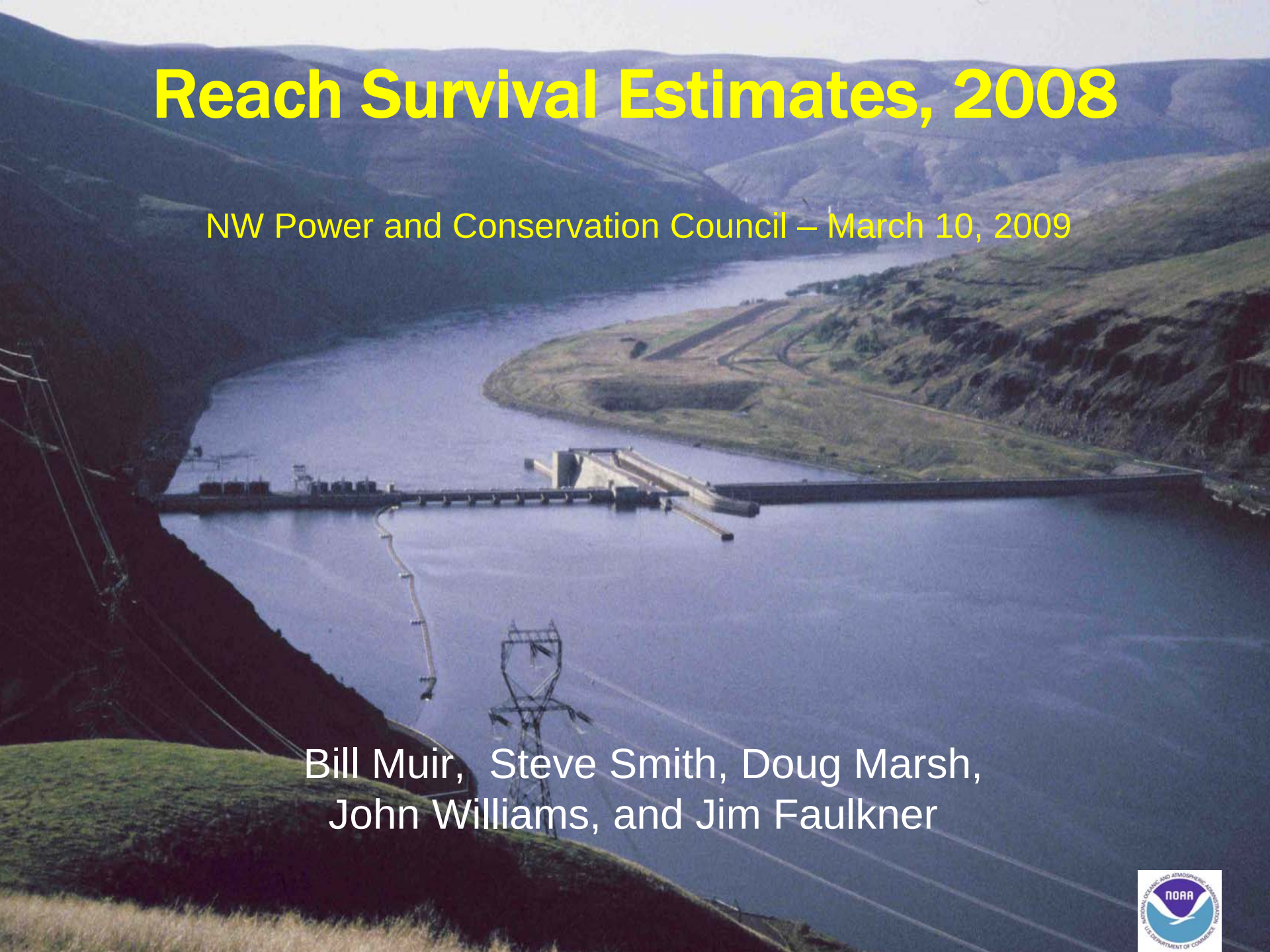
Reach Survival Estimates, 2008

NW Power and Conservation Council – March 10, 2009



Bill Muir, Steve Smith, Doug Marsh,
John Williams, and Jim Faulkner

Outline

- Juvenile travel time and survival through the hydropower system

Outline

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- **Data problem in lower river in 2008?**

Outline

- Juvenile travel time and survival through the hydropower system
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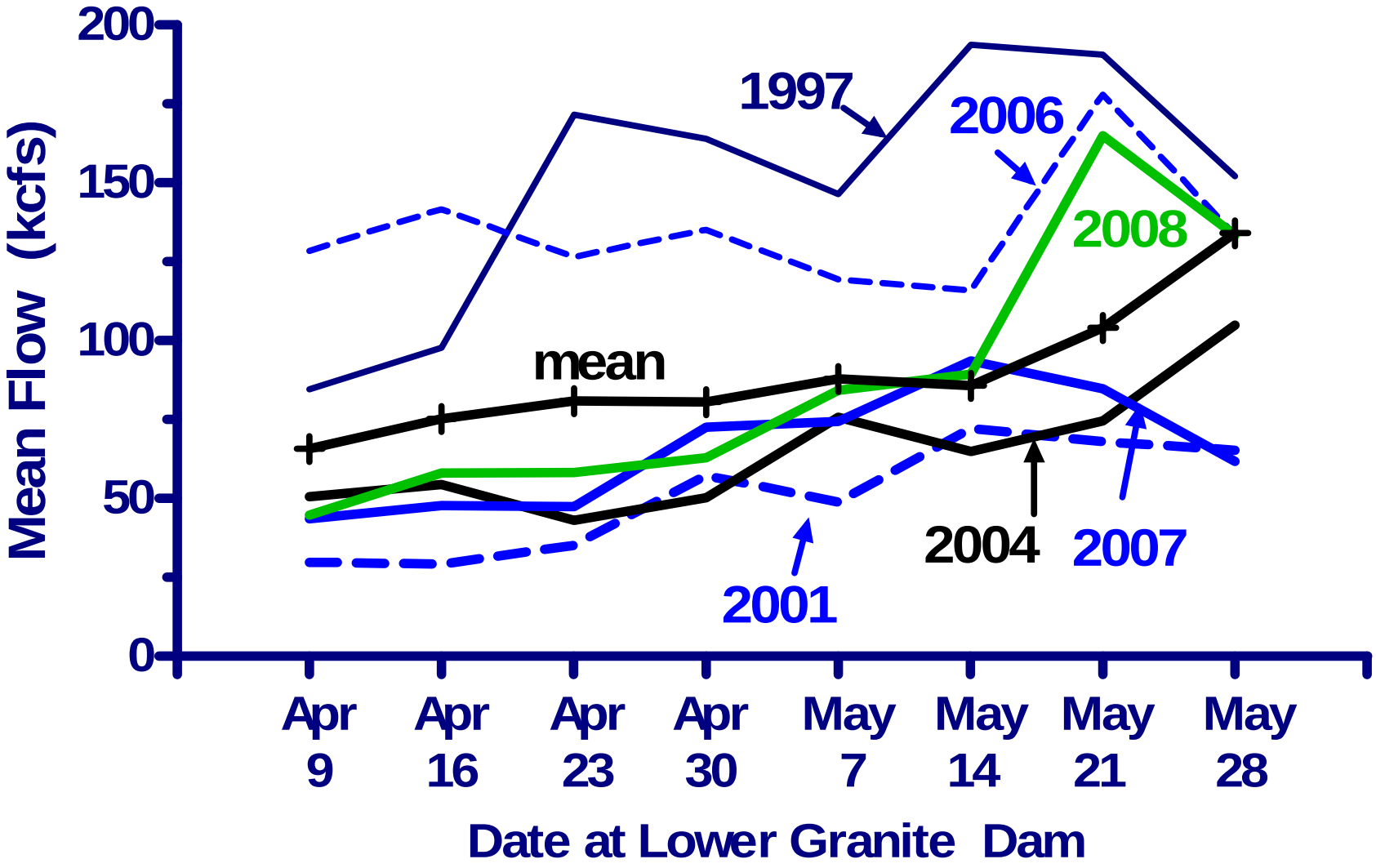
- **Percentage transported**

Outline

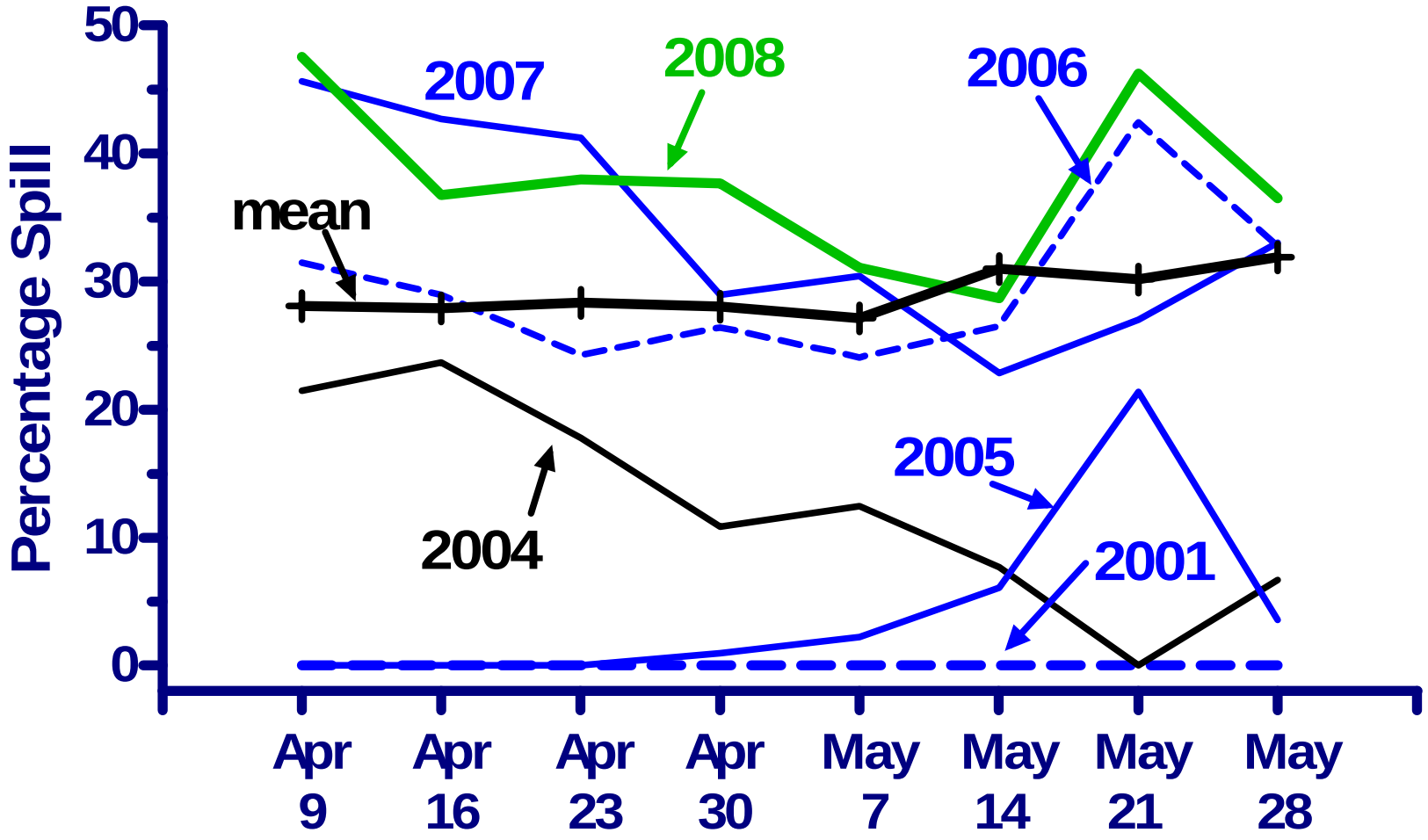
- Juvenile travel time and survival through the hydropower system
- Data problem in lower river in 2008?
- Percentage transported
- **Spill, transport, size of in-river population, and survival**

Survival and Travel Time for PIT-tagged Spring Migrants

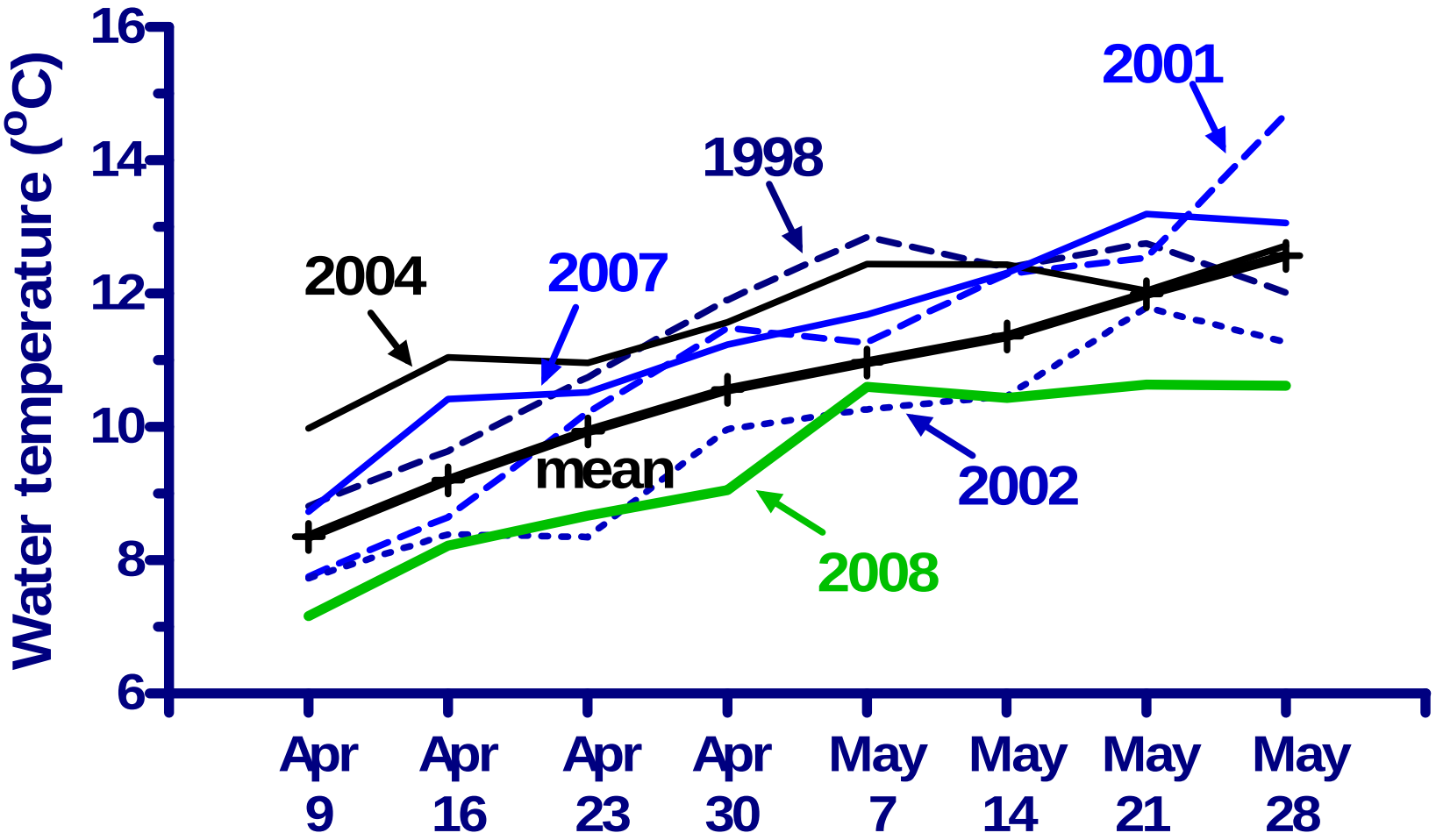
Weekly Mean Flow (kcfs)
Lower Granite Dam 1997-2008



Weekly Mean %Spilled
LGR, LGS, LMN 1997-2008



Weekly Mean Temperature
Little Goose Dam 1997-2008



PIT-tag Data Sources

Chief Joseph

Wells

Grand Coulee

Rocky Reach

Rock Island

Wanapum

Priest Rapids

Ice Harbor

Snake R. trap

Juvenile detectors

Lower Granite

Little Goose

Lower Monumental

McNary

John Day

The Dalles

Bonneville

Hatchery &
Trap Releases

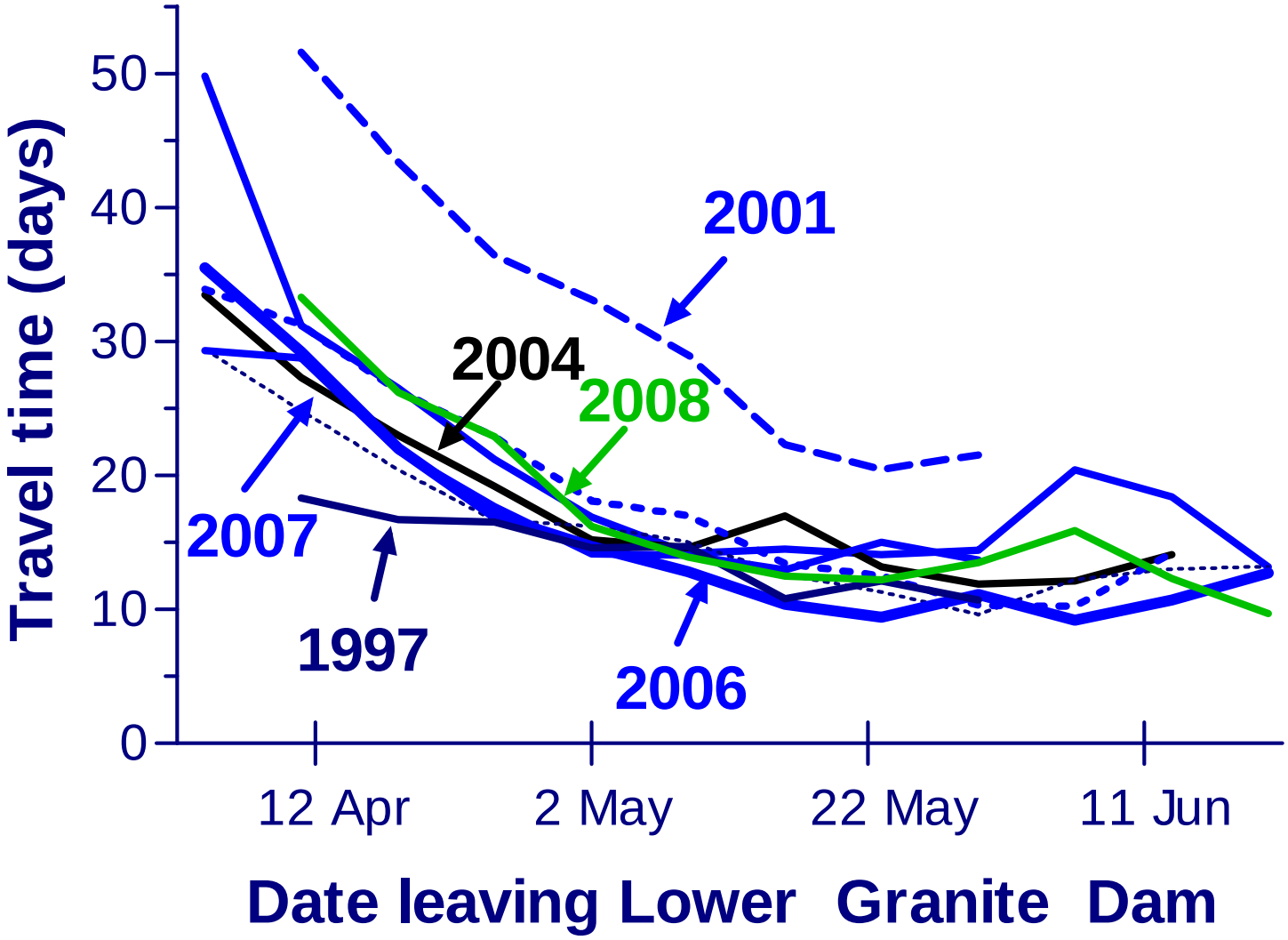
Hells Canyon

Oxbow

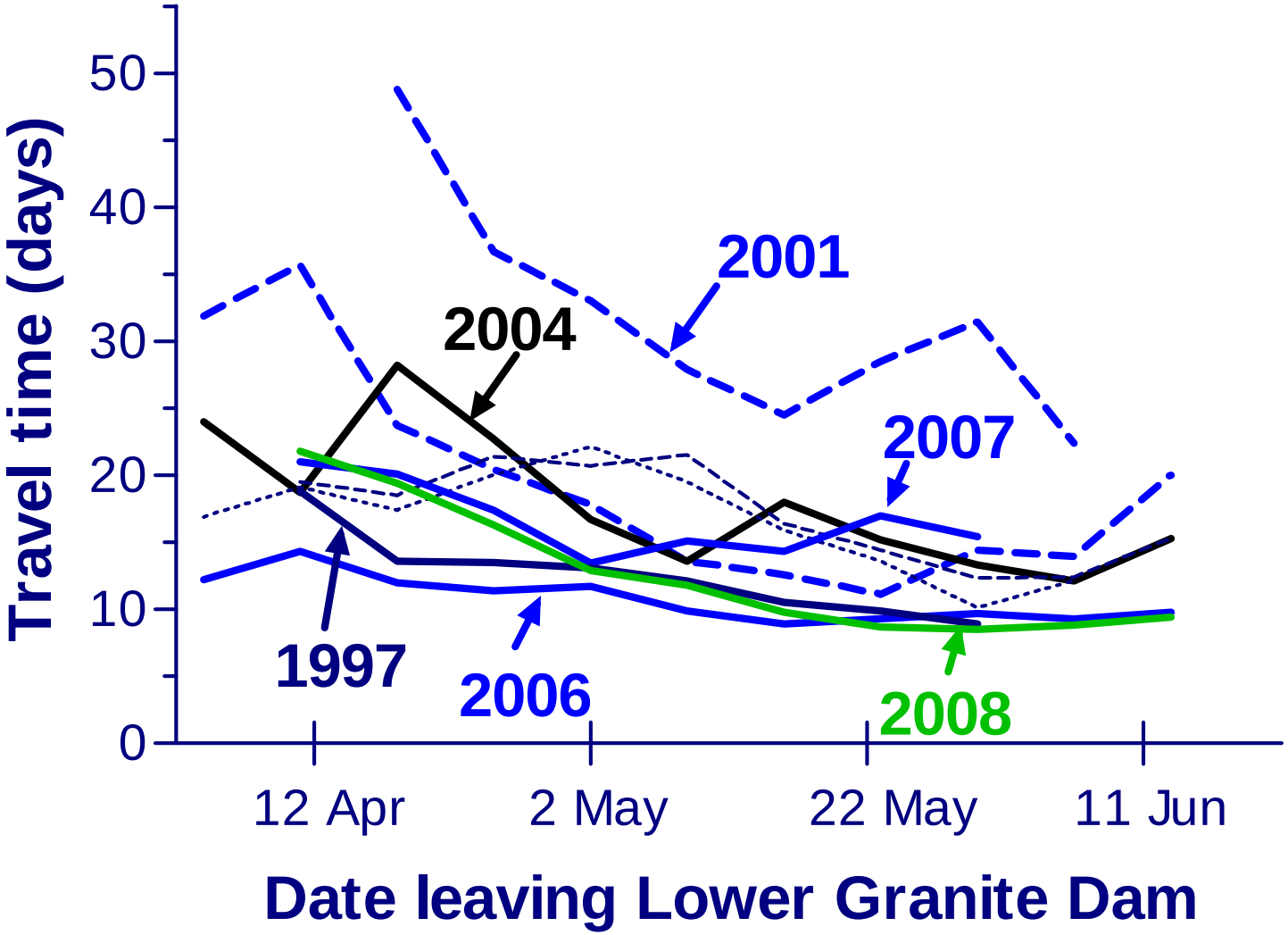
Brownlee

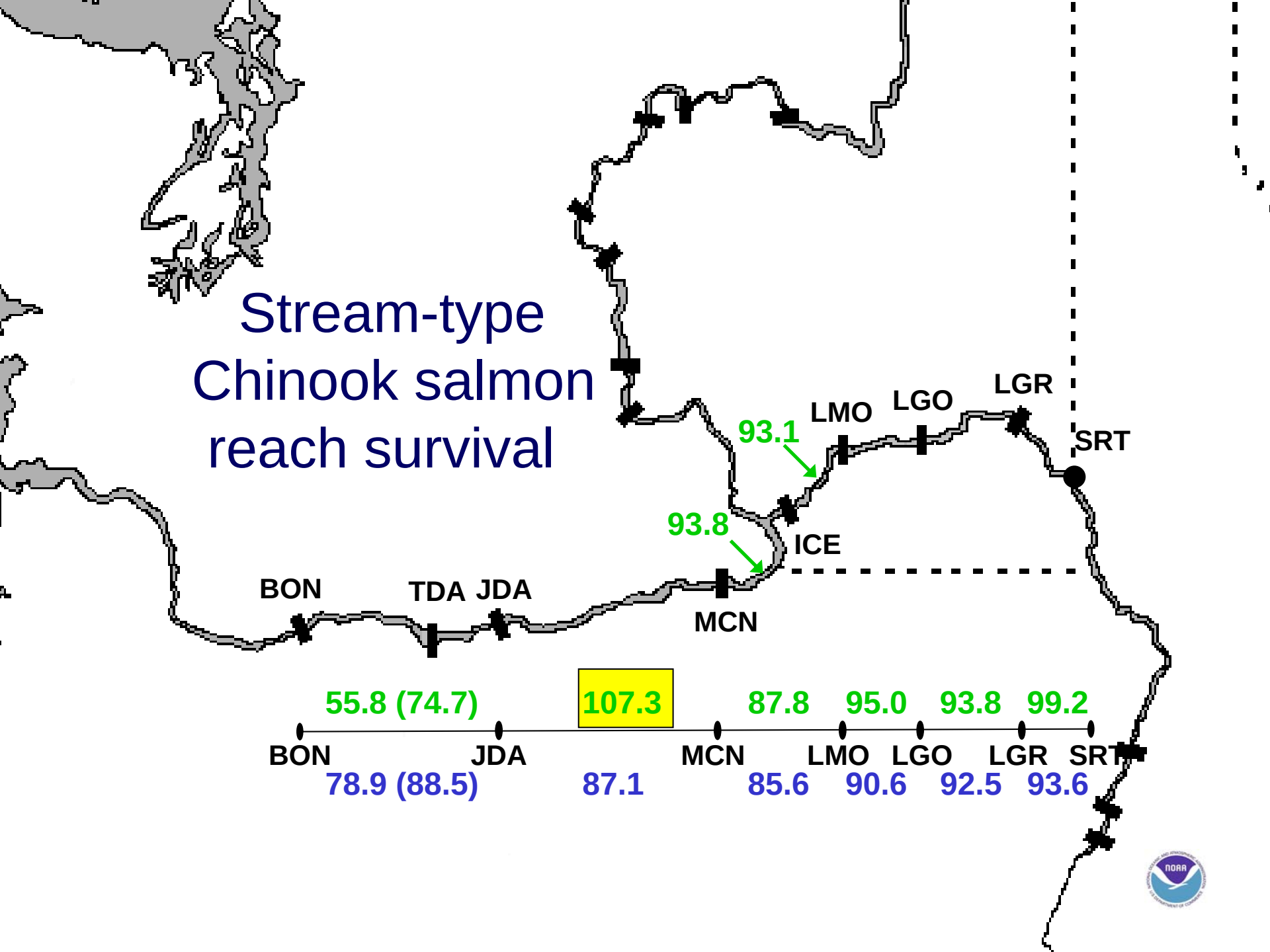
N

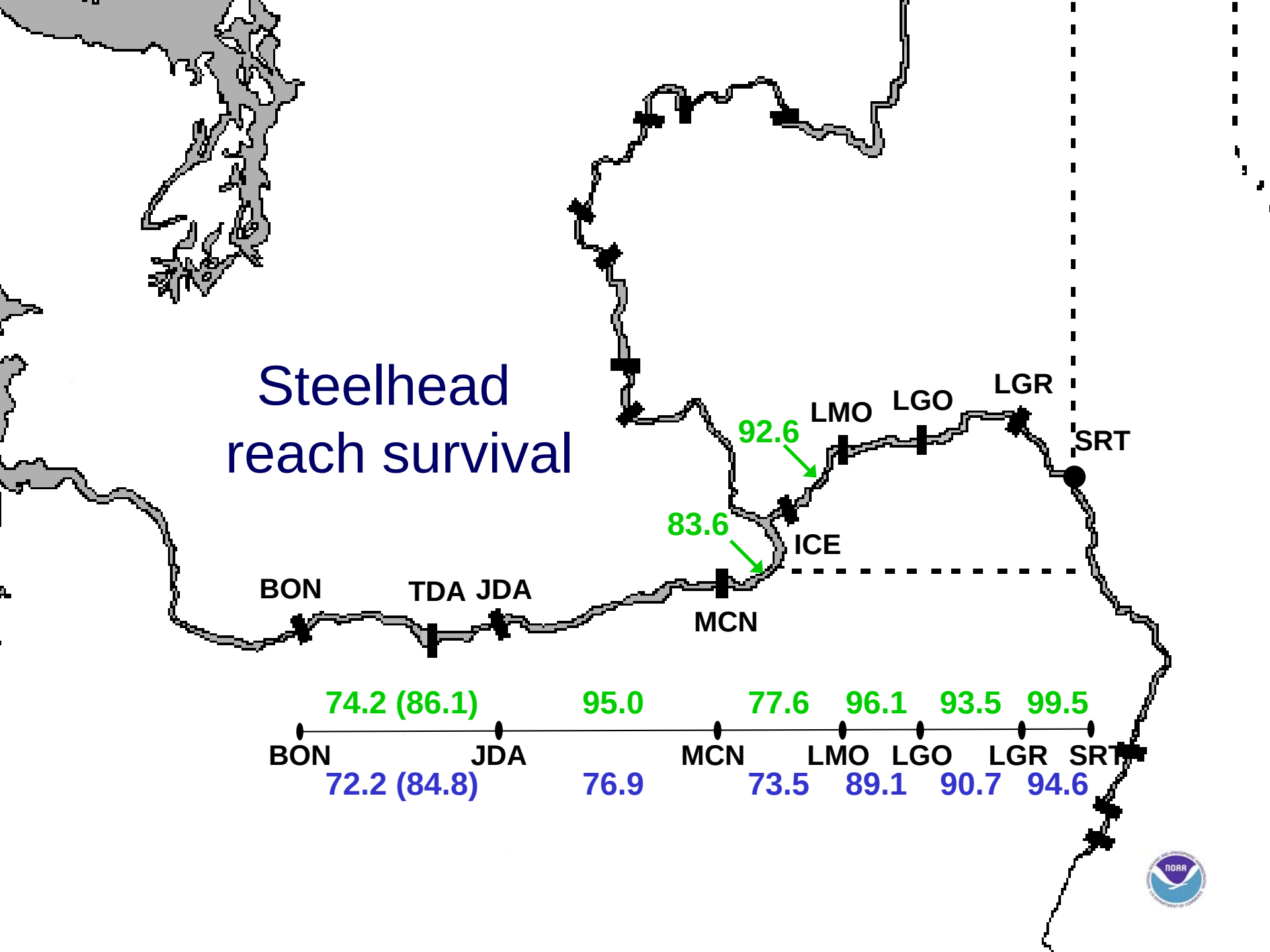
Stream-type Chinook median travel time
Lower Granite to Bonneville (461 km)



Steelhead median travel time
Lower Granite to Bonneville (461 km)

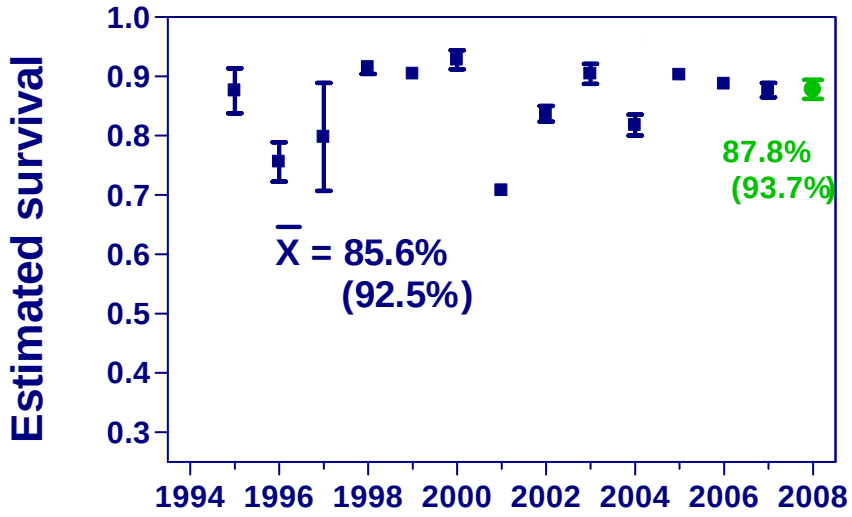



Stream-type
Chinook salmon
reach survival
LGR
LGO
LMO
SRT
93.1
93.8
ICE
BON
TDA
JDA
MCN
55.8 (74.7)
107.3
87.8
95.0
93.8
99.2
BON
JDA
MCN
LMO
LGO
LGR
SRT
78.9 (88.5)
87.1
85.6
90.6
92.5
93.6

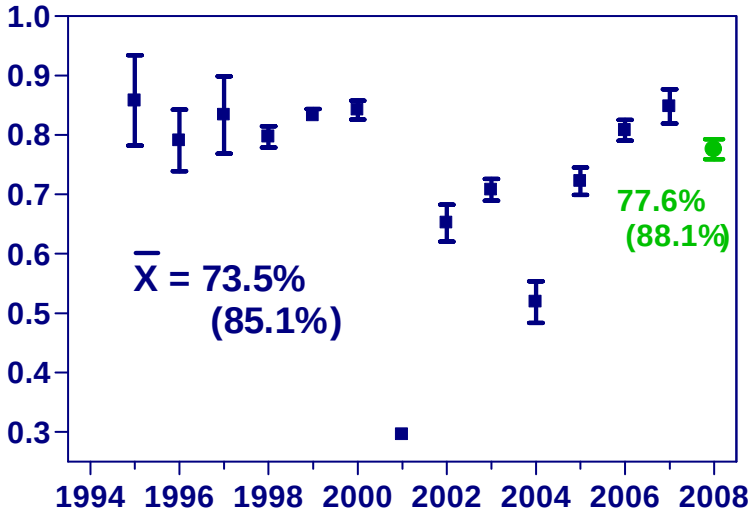

Steelhead
reach survival
92.6
83.6
LMO
LGO
LGR
SRT
ICE
BON
TDA
JDA
MCN
74.2 (86.1)
95.0
77.6
96.1
93.5
99.5
BON
JDA
MCN
LMO
LGO
LGR
SRT
72.2 (84.8)
76.9
73.5
89.1
90.7
94.6

Lower Monumental to McNary

Stream type Chinook

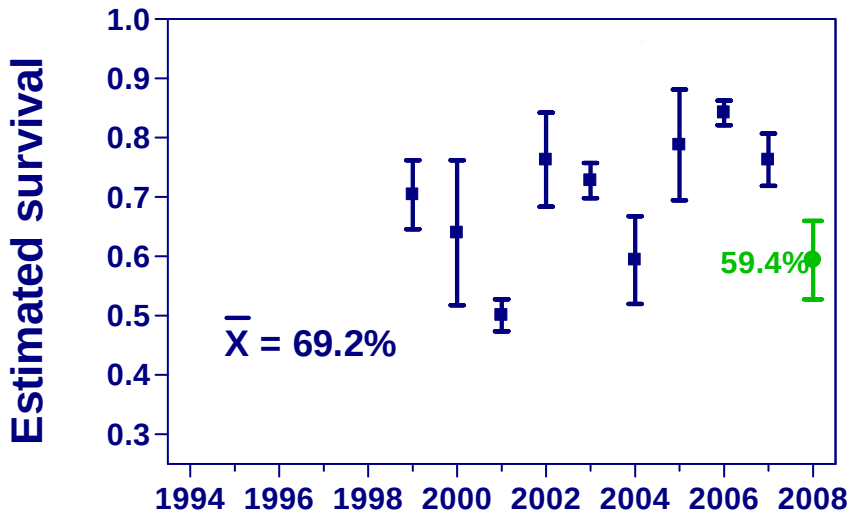


Steelhead

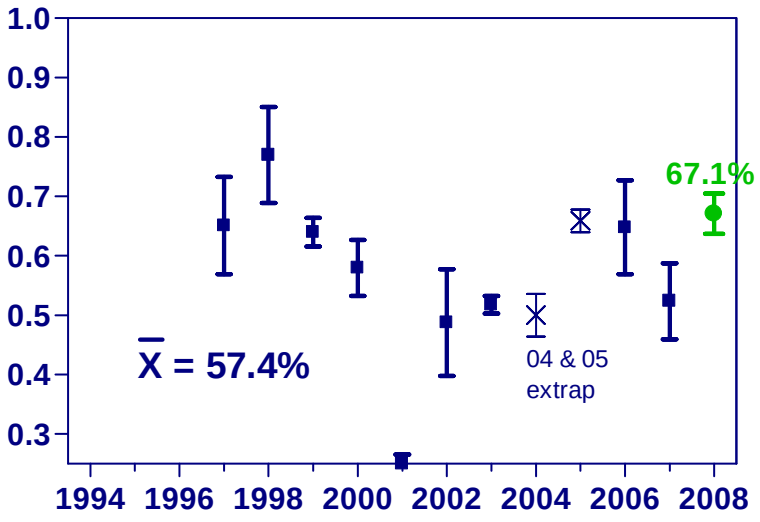


McNary to Bonneville

Stream type Chinook

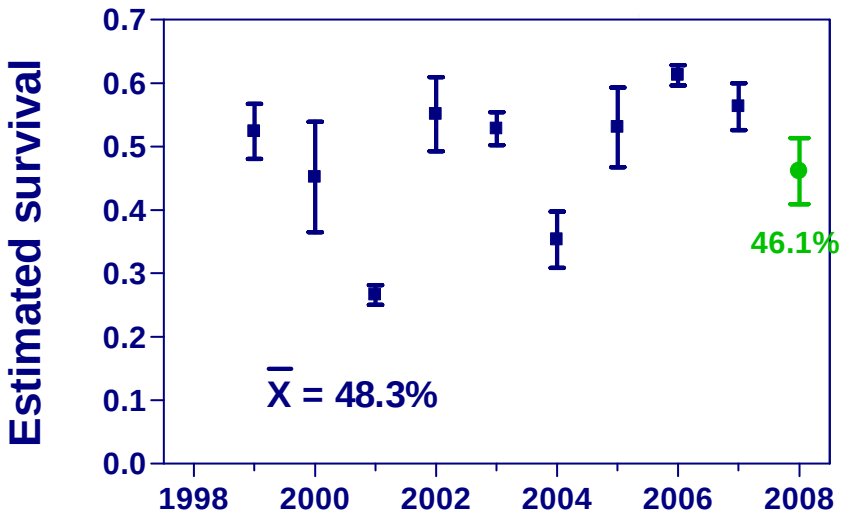


Steelhead

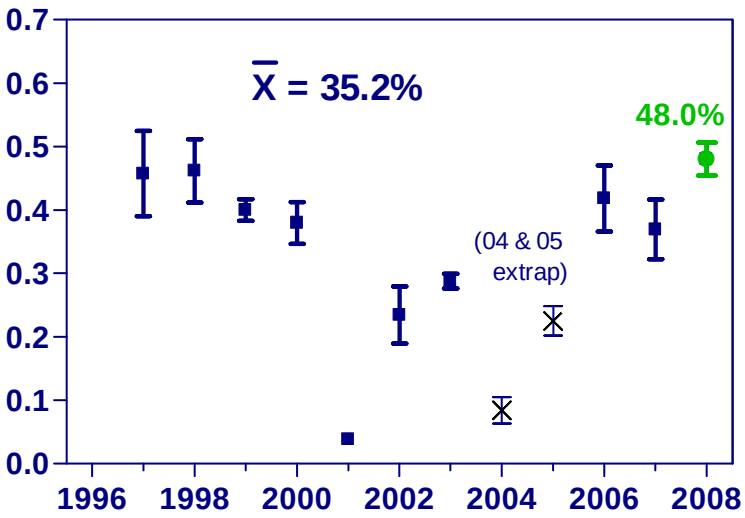


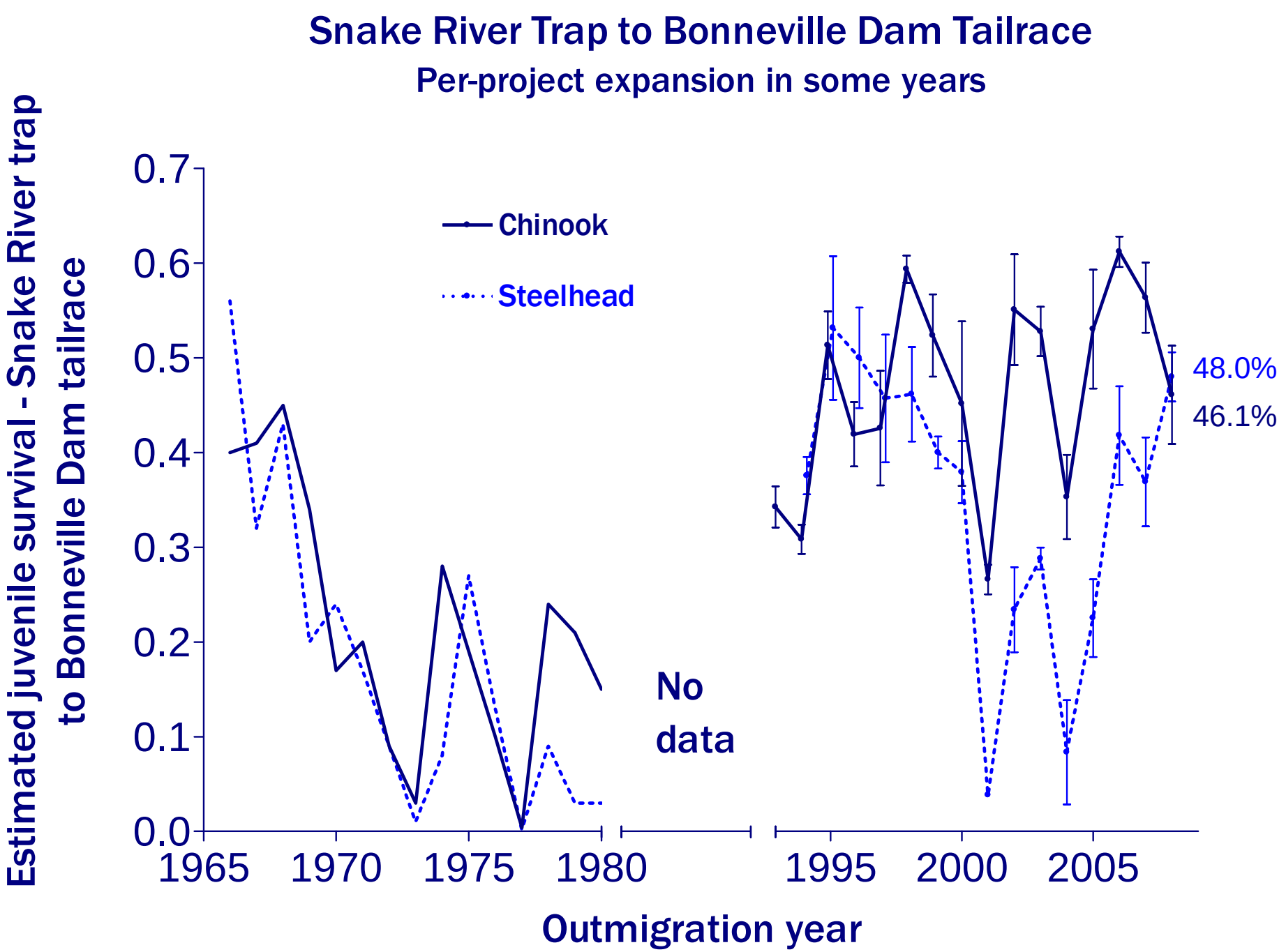
Snake River Trap to Bonneville

Stream type Chinook



Steelhead



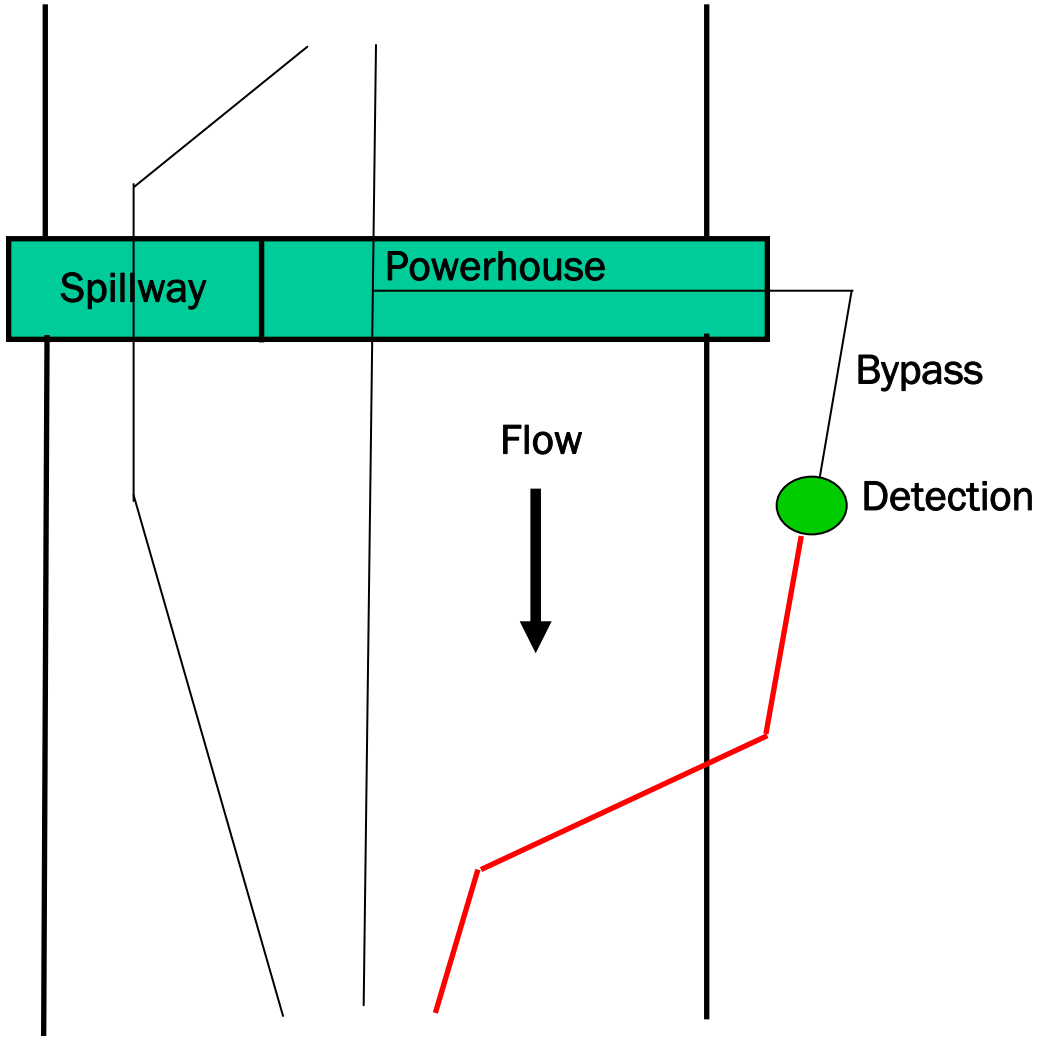

Snake River Trap to Bonneville Dam Tailrace
Per-project expansion in some years
Estimated juvenile survival - Snake River trap to Bonneville Dam tailrace
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Chinook
Steelhead
No data
48.0%
46.1%
1965
1970
1975
1980
1995
2000
2005
Outmigration year

Data problem in lower river in 2008?

Table 2. Estimated survival probabilities for Snake River yearling Chinook salmon (hatchery and wild combined) detected and released to the tailrace at McNary Dam in 2008. Daily groups pooled weekly. Estimates based on the single-release model. Standard errors in parentheses. .

Date at McNary	Number released	McNary to John Day Dam	John Day to Bonneville Dam	McNary to Bonneville Dam
27 Apr–03 May	588	1.103 (0.190)	0.507 (0.167)	0.559 (0.156)
04 May–10 May	7,576	0.983 (0.054)	0.761 (0.080)	0.748 (0.067)
11 May–17 May	24,299	1.195 (0.060)	0.379 (0.036)	0.453 (0.036)
18 May–24 May	13,541	1.175 (0.099)	0.682 (0.189)	0.802 (0.212)
25 May–31 May	3,244	0.731 (0.084)	NA	NA
01 Jun–07 Jun	1,239	0.962 (0.164)	0.795 (0.544)	0.764 (0.507)
08 Jun–14 Jun	716	0.747 (0.202)	0.640 (0.606)	0.478 (0.434)
Weighted mean*		**1.073 (0.058)**	**0.558 (0.082)**	**0.594 (0.066)**

Post-detection bypass (PDB) mortality



Data Effects of PDB Mortality

- Detected at dam 1 = Counted alive in tailrace, but actually dead
- Too few detected fish show up at dam 2
- Dam 1 detection probability underestimated
- Reach 1 Survival probability overestimated

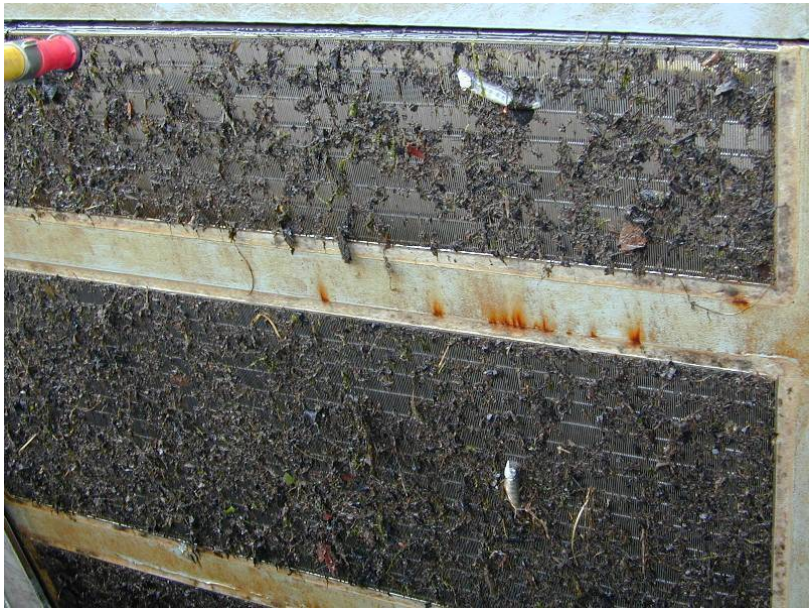
Data Effects of PDB Mortality

- Effect on Reach 2 survival estimate depends on Dam 2:
  - If no PDB mortality at Dam 2, Reach 2 survival is underestimated, *but combined Reach 1 & 2 survival is unbiased*
  - If PDB mortality at Dam 2, effect is uncertain

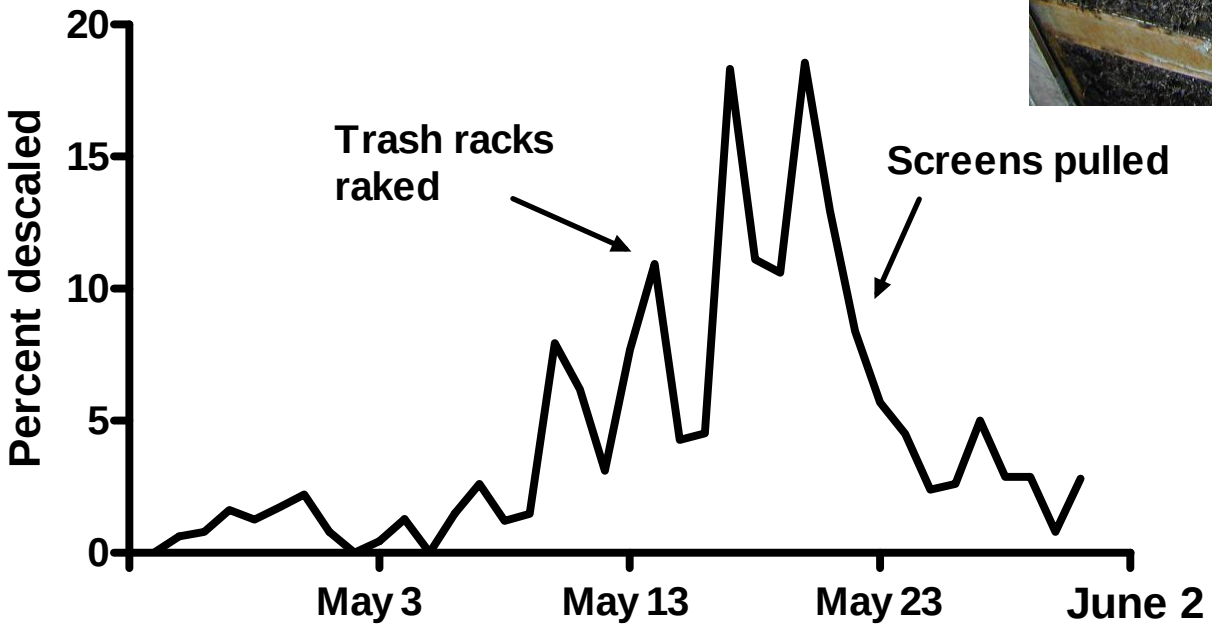
Lower River Conditions

- MCN-JDA and JDA-BON estimates affected by PDB mortality, but MCN-BON ok?
  - MCN-BON estimate lower than average for Chinook

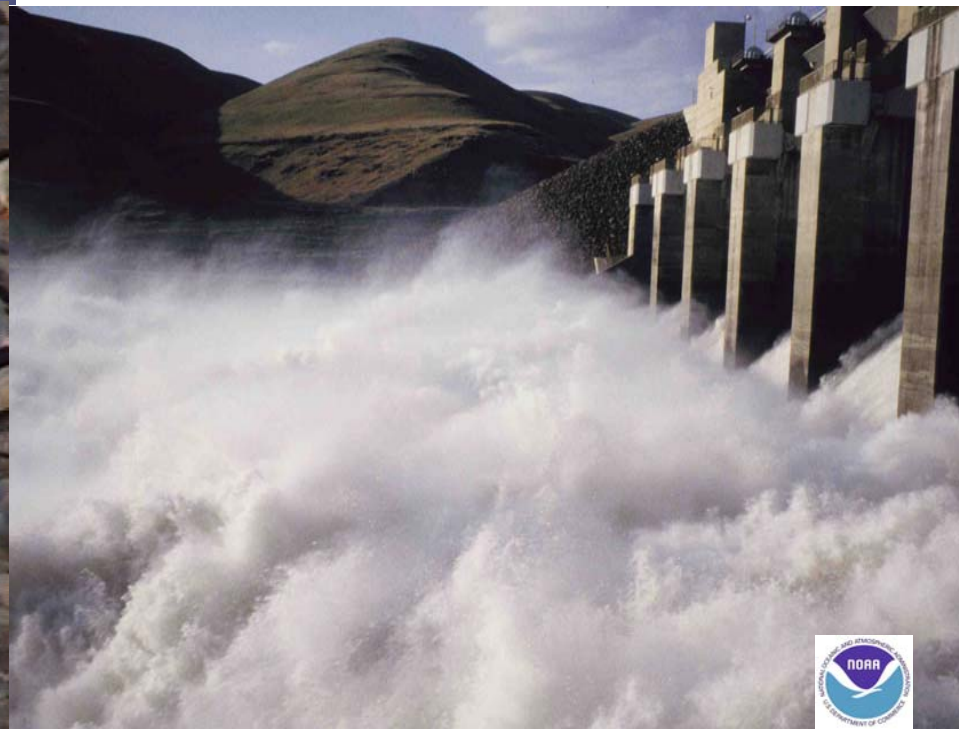
Increased Avian Predation?



Bonneville Dam
Yearling Chinook salmon



Spill, Transport, In-River Population Size, and Survival

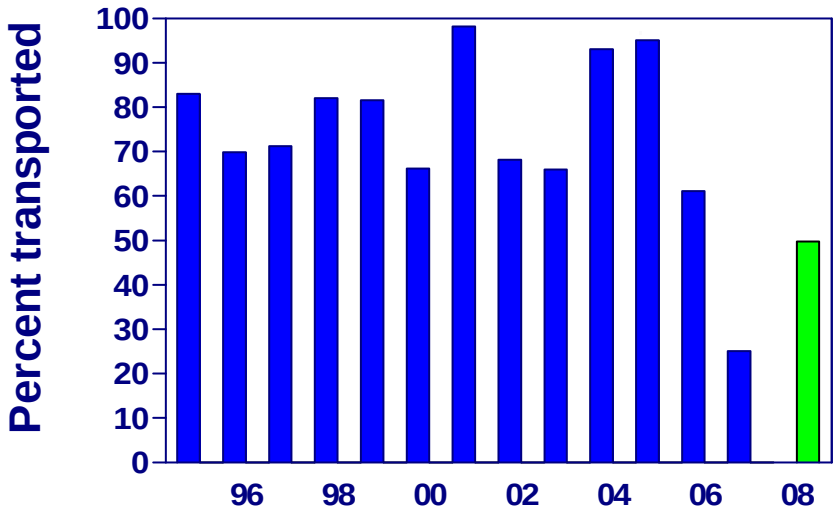


Preliminary estimates of transport % for 2008 based on PIT-tag data:

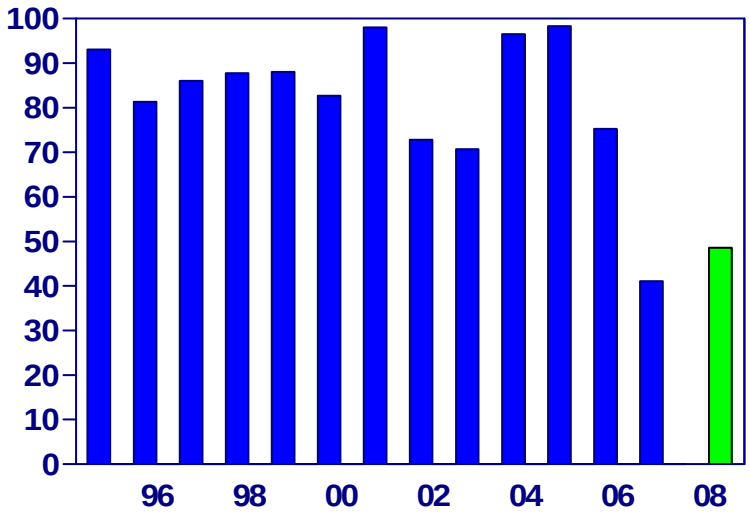
- 54.3% wild Chinook
- 45.3% hatchery Chinook
- 50.5% wild steelhead
- 46.6% hatchery steelhead

Percent Transported to Below Bonneville

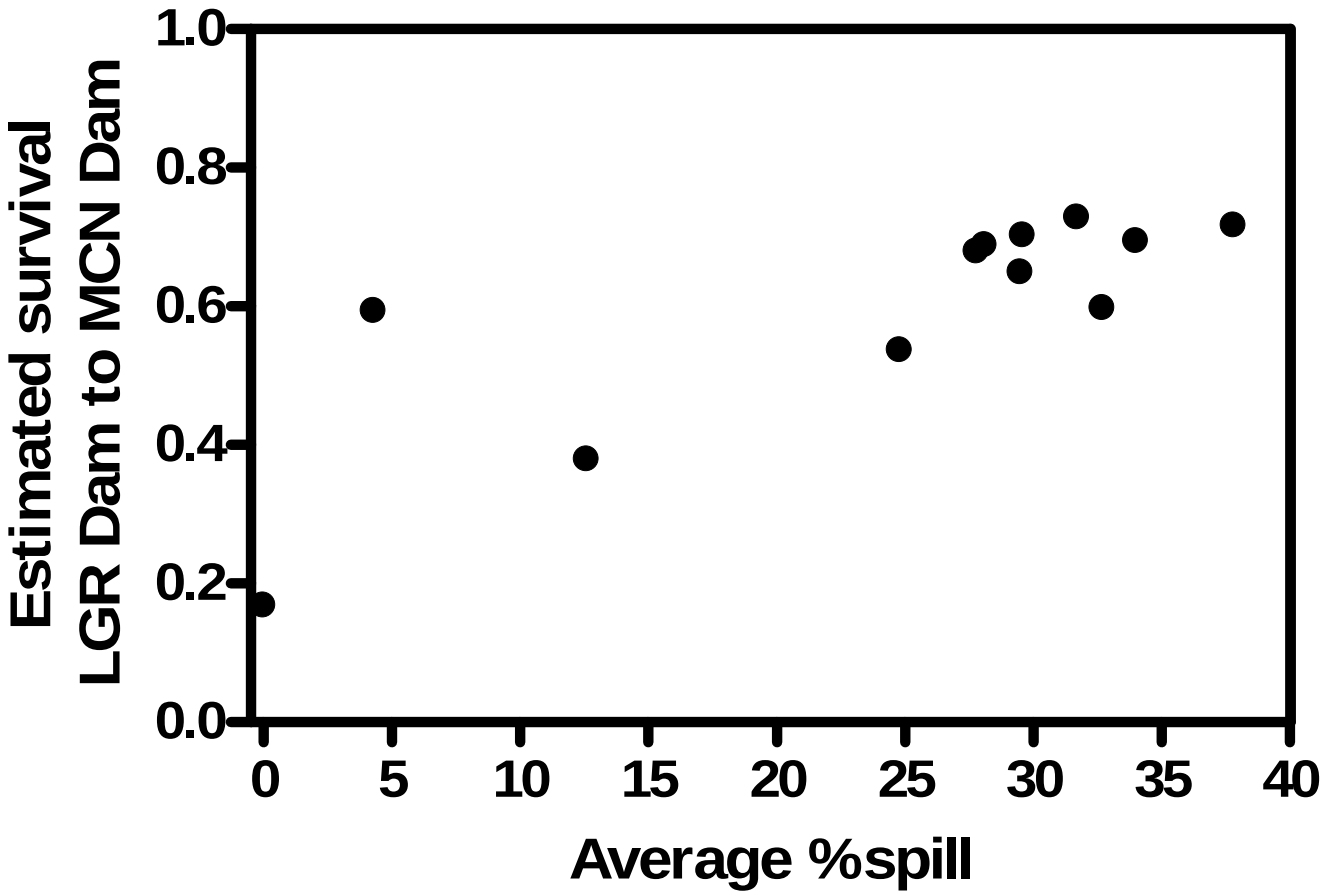
Stream type Chinook



Steelhead



Steelhead Survival & Spill%



Passage-Route Survival
Spill vs. Bypass

- Recent radio telemetry studies
  - Little Goose 2005-2007
    - spill & bypass both > 95-96%
  - Lower Monumental 2007
    - spill 93.9%, bypass 98.6%
  - Ice Harbor
    - spill 96-97%, bypass 97-98%

Wells

Rocky Reach

Rock Island

Wanapum

Priest Rapids

Crescent Island

Ice Harbor

Lower Monumental

Little Goose

Lower Granite

McNary

Bonneville

The Dalles

John Day

Oxbow

Brownlee

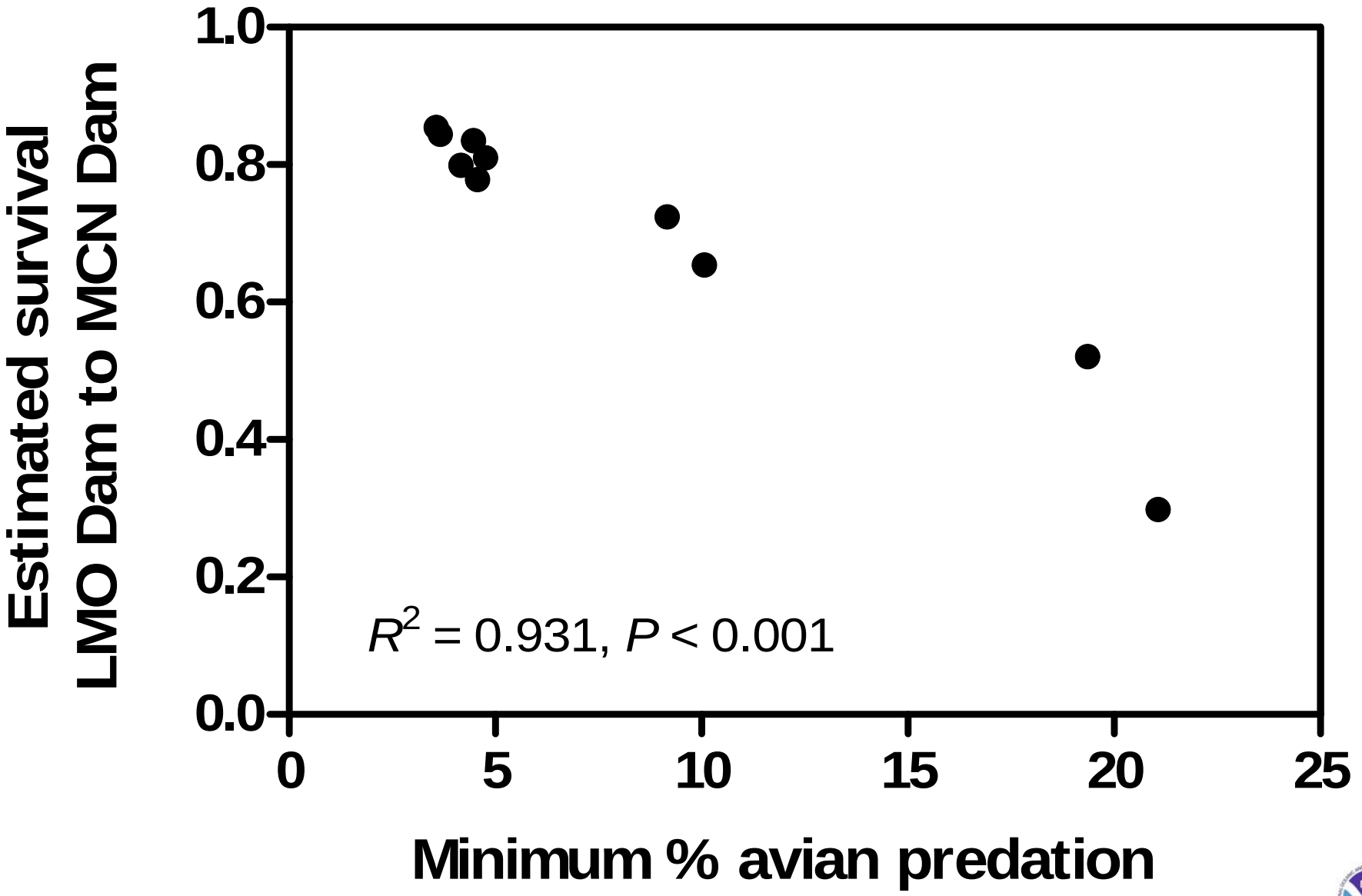
N

Minimum Estimate of Mortality from Avian Predation

- Percentage of PIT-tagged steelhead detected at LMN eventually recovered on nesting colonies

1998	4%	2004	19%
1999	5%	2005	9%
2000	4%	2006	5%
2001	21%	2007	4%
2002	10%	2008	5%
2003	4%		

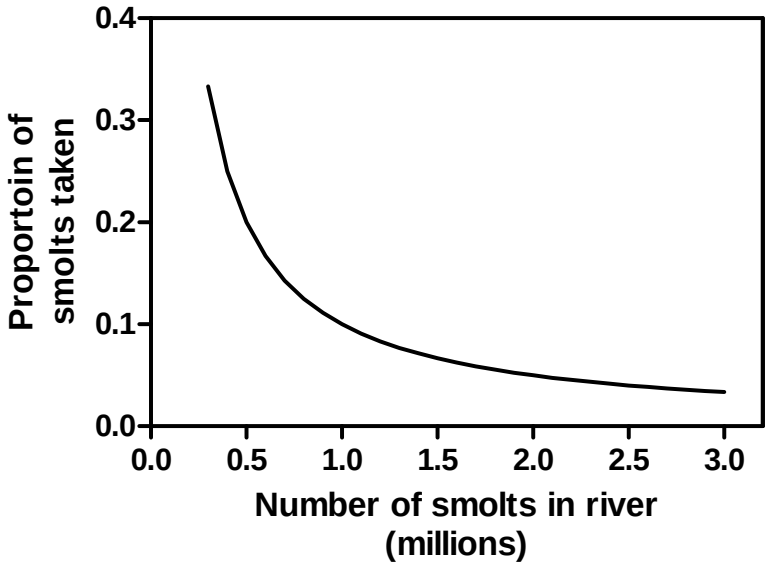
Steelhead

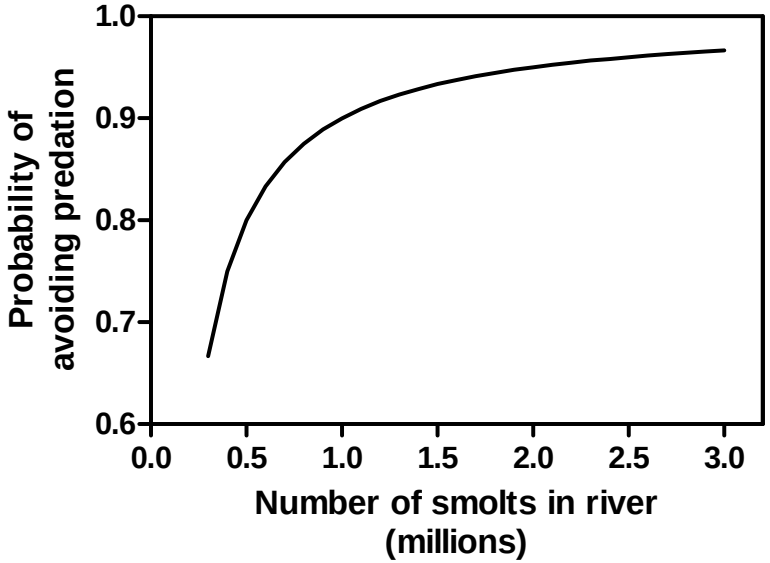

Estimated survival
LMO Dam to MCN Dam
1.0
0.8
0.6
0.4
0.2
0.0
$R^2 = 0.931$, $P < 0.001$
0
5
10
15
20
25
Minimum % avian predation

Maximum transport

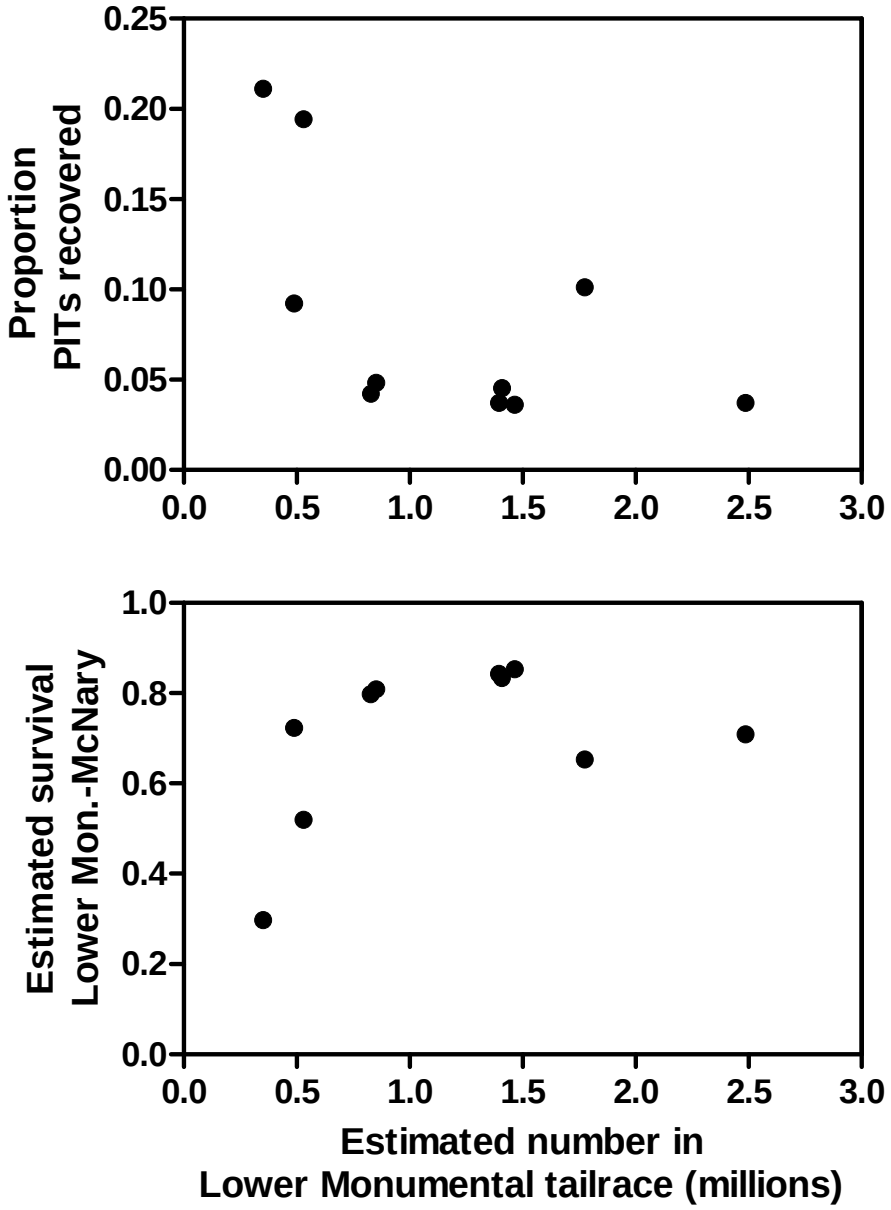
Transport with spill

Idealized Relationships





Steelhead


Proportion PITs recovered
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Estimated survival Lower Mon.-McNary
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Estimated number in
Lower Monumental tailrace (millions)

Conclusions

- In low-spill (high transport) years, lower survival results, in part, simply from fewer fish in the river

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- In low-spill (high transport) years, lower survival results, in part, simply from fewer fish in the river
  - In-river survival would have been higher if non-tagged bypass fish had been returned to the river

Conclusions

- In low-spill (high transport) years, lower survival results, in part, simply from fewer fish in the river
  - In-river survival would have been higher if non-tagged bypass fish had been returned to the river

- Converse is also true: in-river survival increases with increasing spill through indirect effect of reducing individual vulnerability to predation

Conclusions

- Direct or indirect effects of increased spill may not improve smolt-to-adult survival for the population

Conclusions

- Direct or indirect effects of increased spill may not improve smolt-to-adult survival for the population
  - Cumulative effect must offset effect of transporting fewer steelhead


Questions