River Flows, Fish Migration and Survival

The Fish Passage Center

Main Points

- Decades of research and analyses establish the critical importance of flow for fish survival and migration
- How development affected migration conditions
- Relationship of flow to salmon and steelhead migration and survival
- Present flow targets established as minimums are rarely met in the summer period and often missed in the spring period

46 years
Fish Migration Data

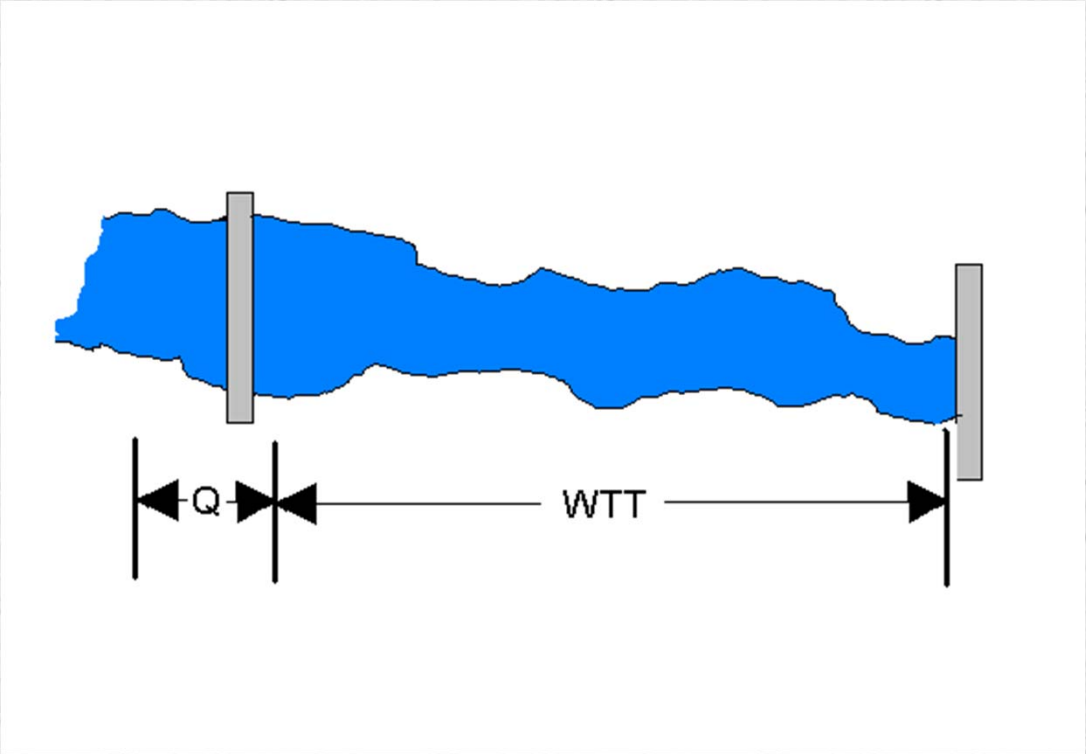
- Late 1960's - research studies at Brownlee, Pelton, Round Butte
- 1966-1975 - Extensive studies of salmon and steelhead migration in conjunction with the development of the Lower Snake River projects
- 1975 -1982 – NOAA Fisheries downstream migration research

- 1984-2012 Smolt Monitoring Program and Comparative Survival Study conduct extensive monitoring and analyses on fish survival and migration
- 1979, 1981,1990 - State/federal/tribal fishery managers agencies recommend increasing flows/velocity for fish survival.
- 1992 – Endangered Species Act Listing, Biological Opinion establishes minimum flow targets
- All of the monitoring and research studies all support the conclusion that increasing flow/water velocity will increase fish survival

Flow =Water Velocity=Water Transit Time

- Fish need high flow levels because increased water velocity, fast moving water, moves fish downstream
- The faster the velocity or water travel time the faster fish migrate downstream, the faster migration results in higher survival
- Water travel time/velocity varies depending on the flow and the cross sectional area of the river.

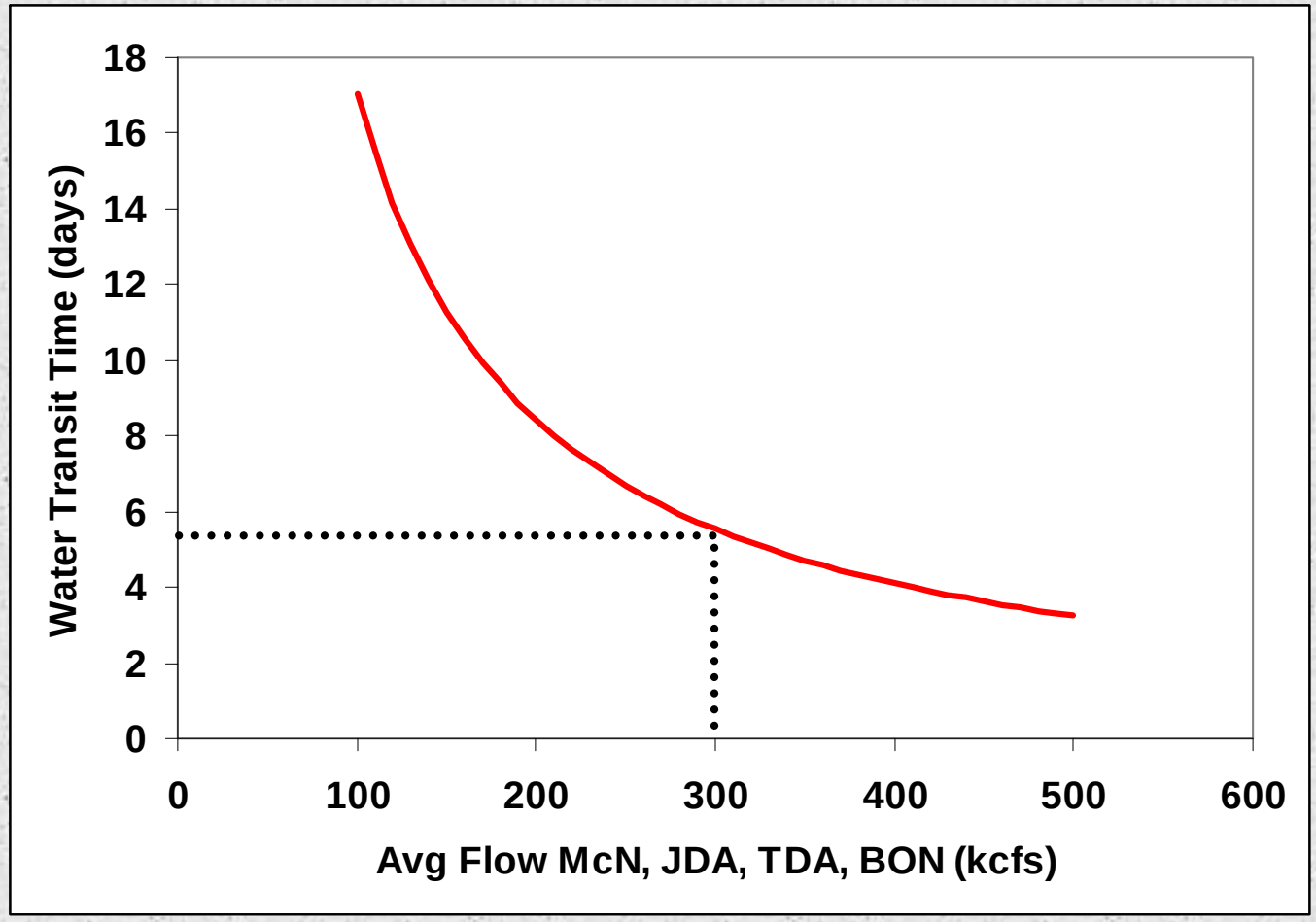
Water Transit Time



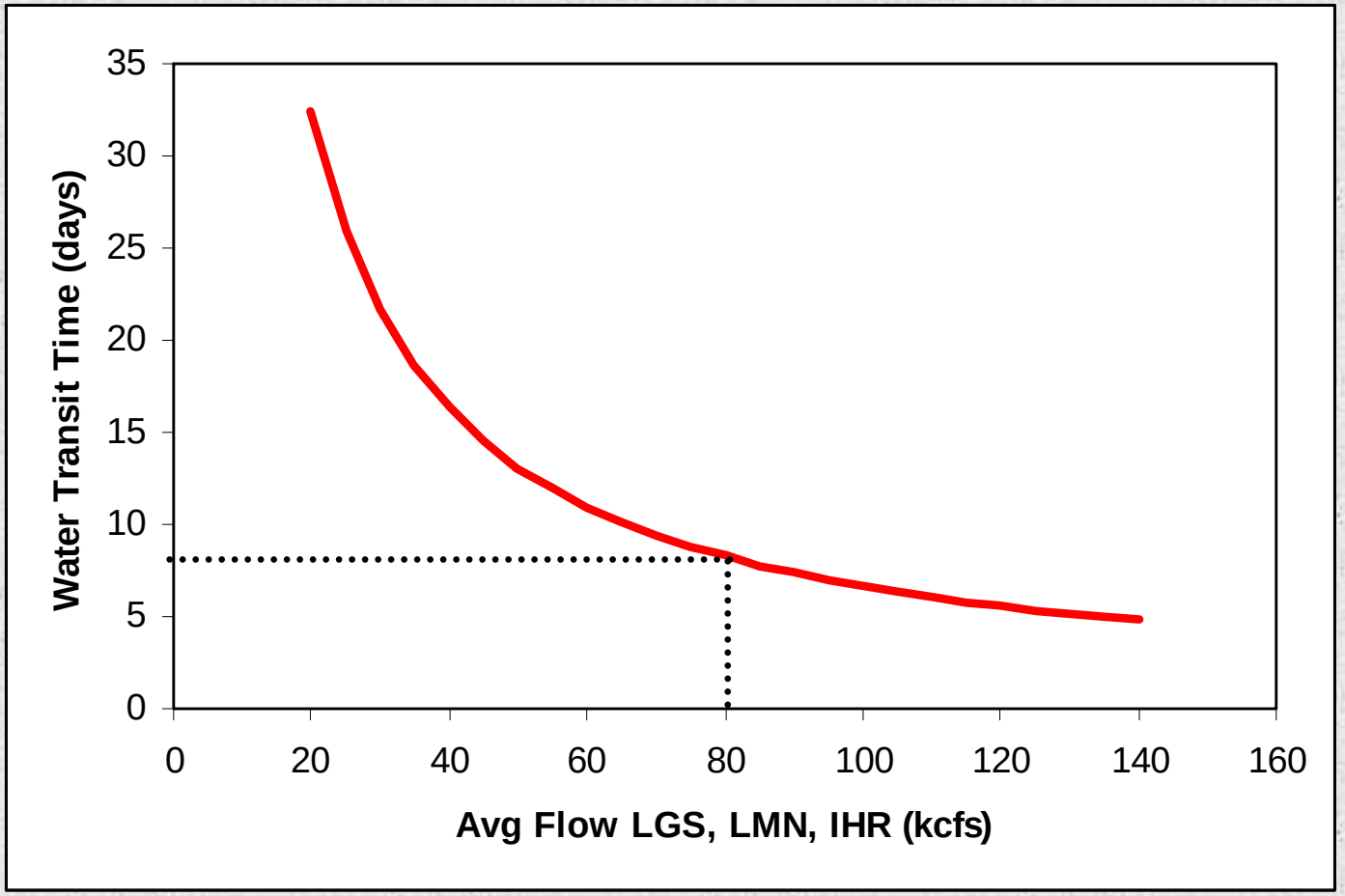
WTT (s) = Reservoir Volume (ft3) / Flow (ft3/s)

- WTT--Avg Time for Water Particle to Transit Reservoir
- Q – discharge at dam

Converting Flows to Water Transit Time Lower Columbia River



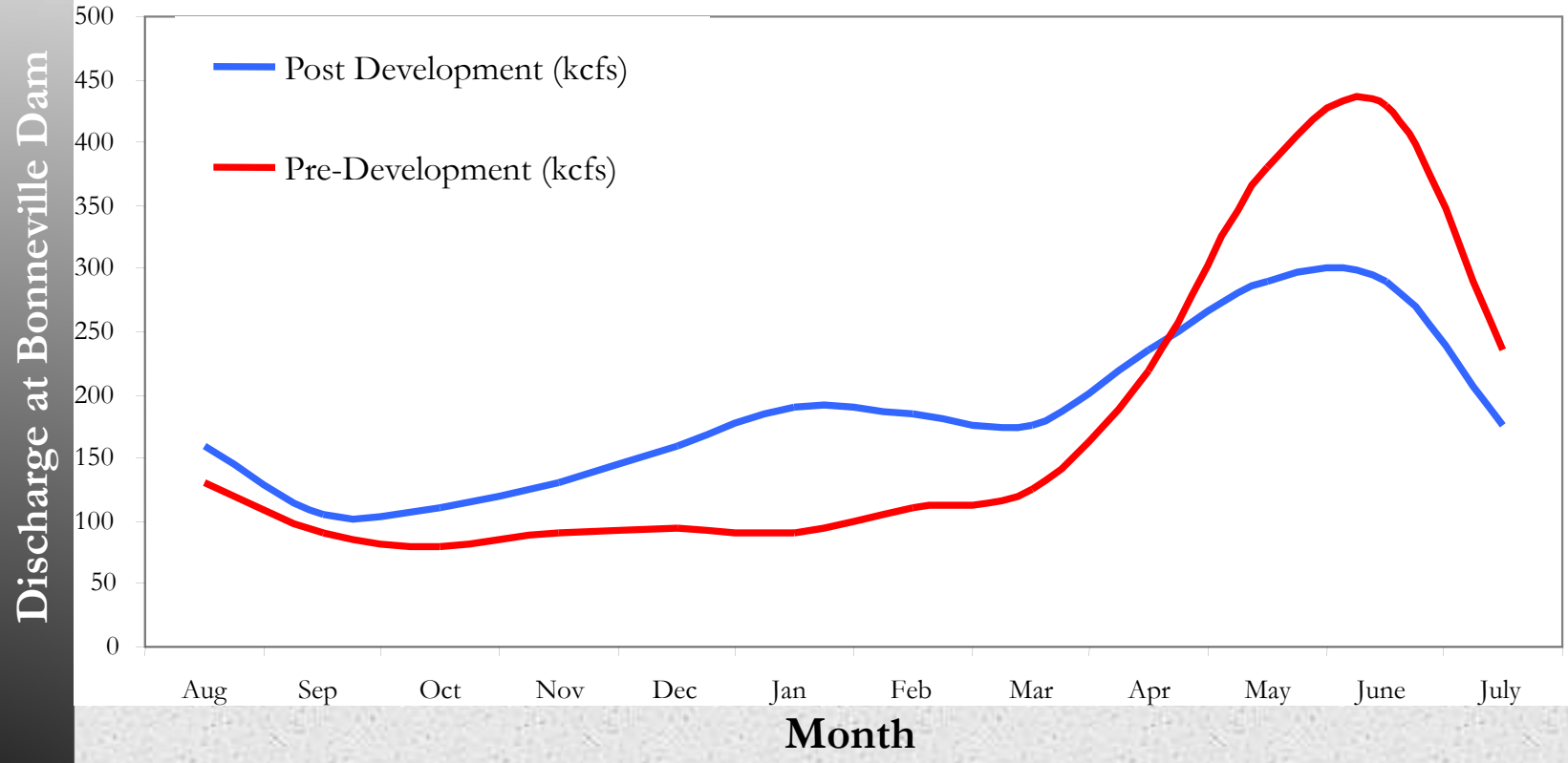
Converting Flows to Water Transit Time Snake River



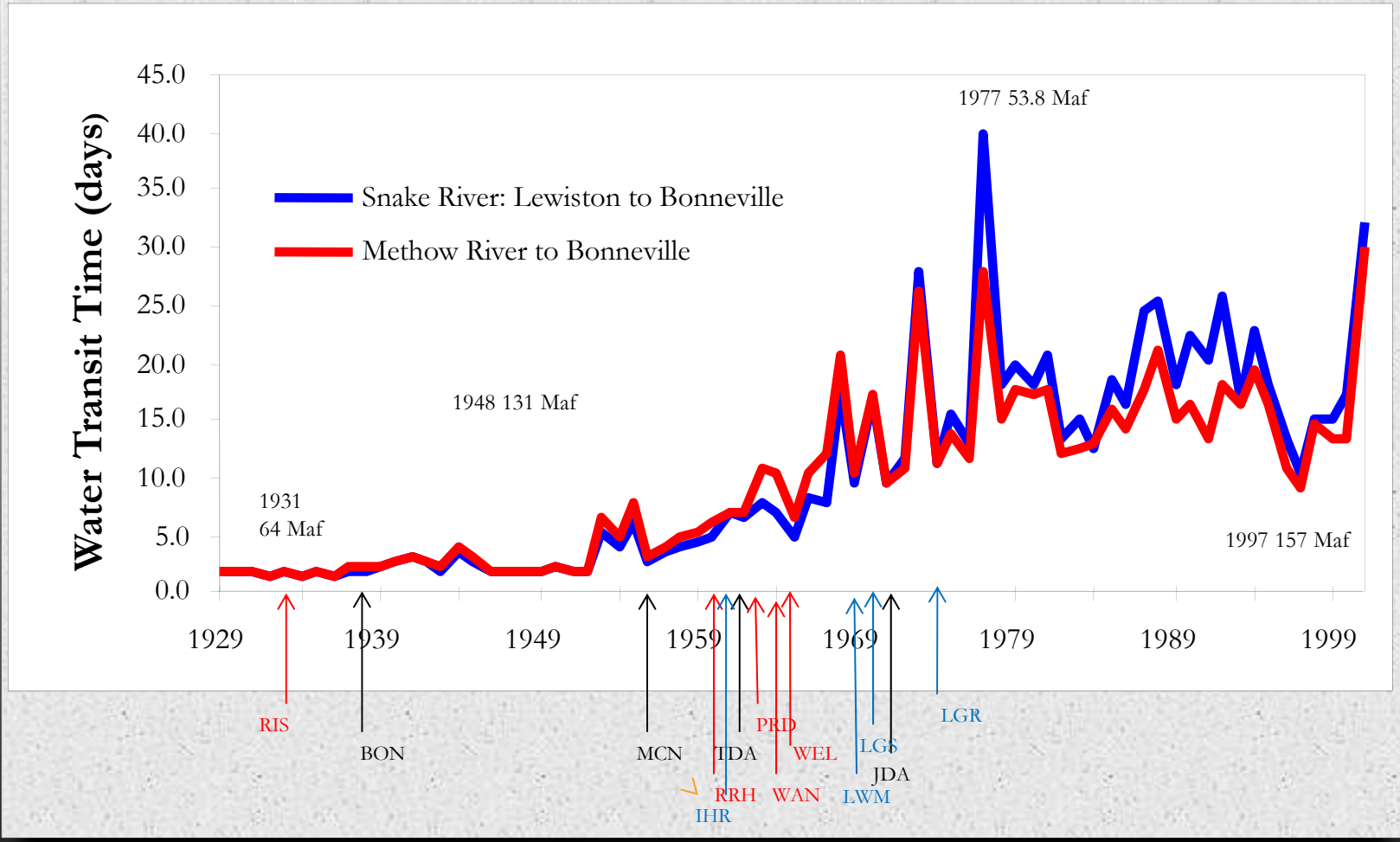
How did we get here?

- Development of large storage reservoirs for power, flood control and irrigation changed the shape of the natural hydrograph, reducing spring and summer flows
- Development of run-of-river projects for power production and navigation increased the cross sectional area of the river resulting in lower water velocities

Historic and Present Flow

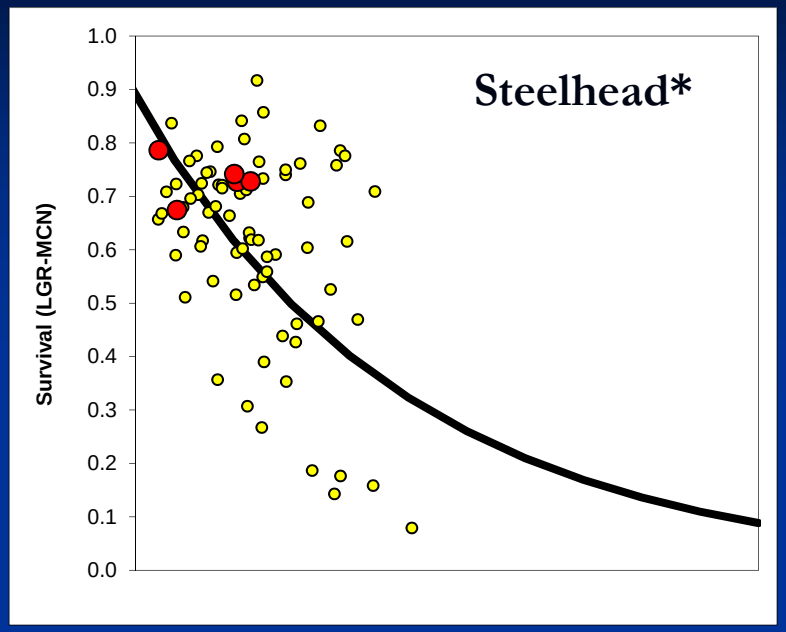


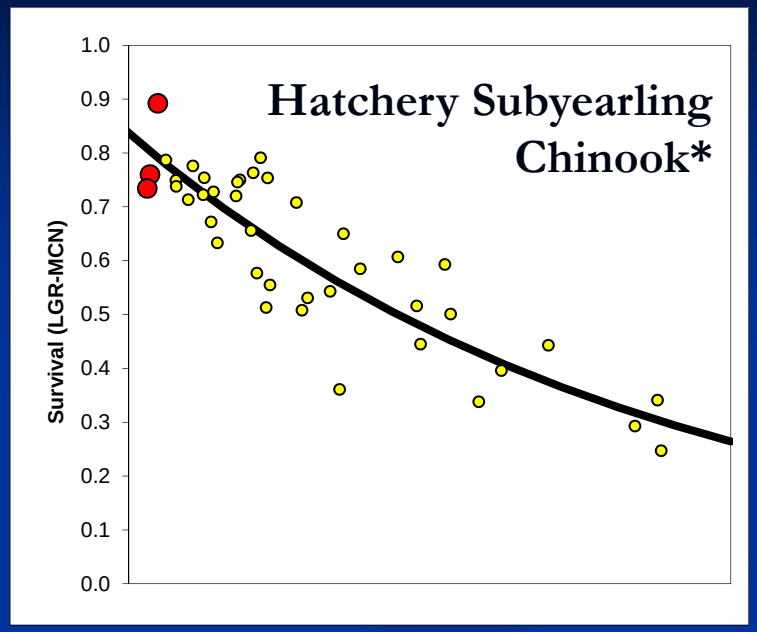
Water Transit Time Slowed With Development



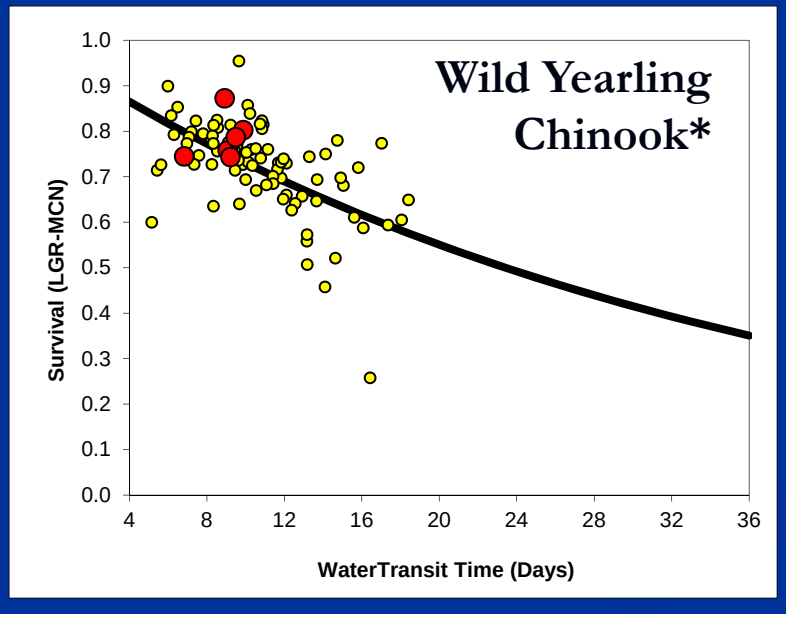
Snake River

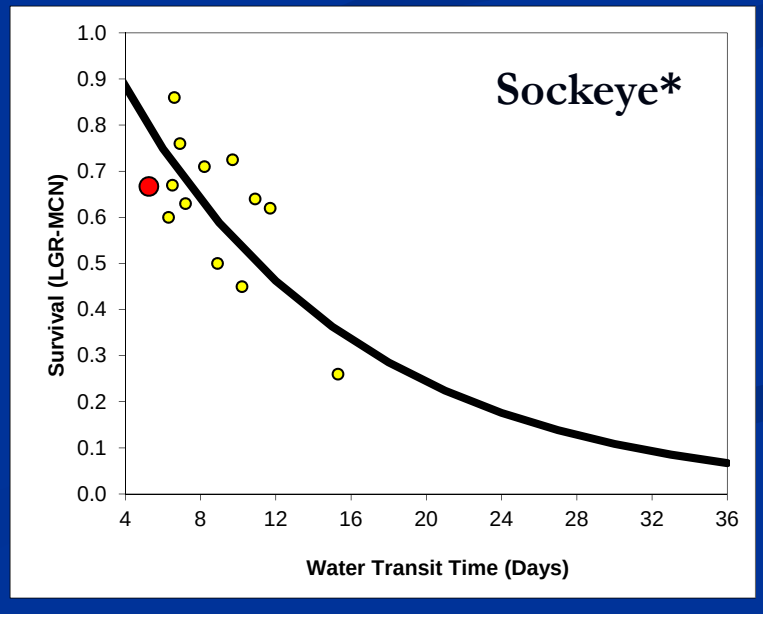
Juvenile Survival (LGR-MCN) vs. Water Transit Time





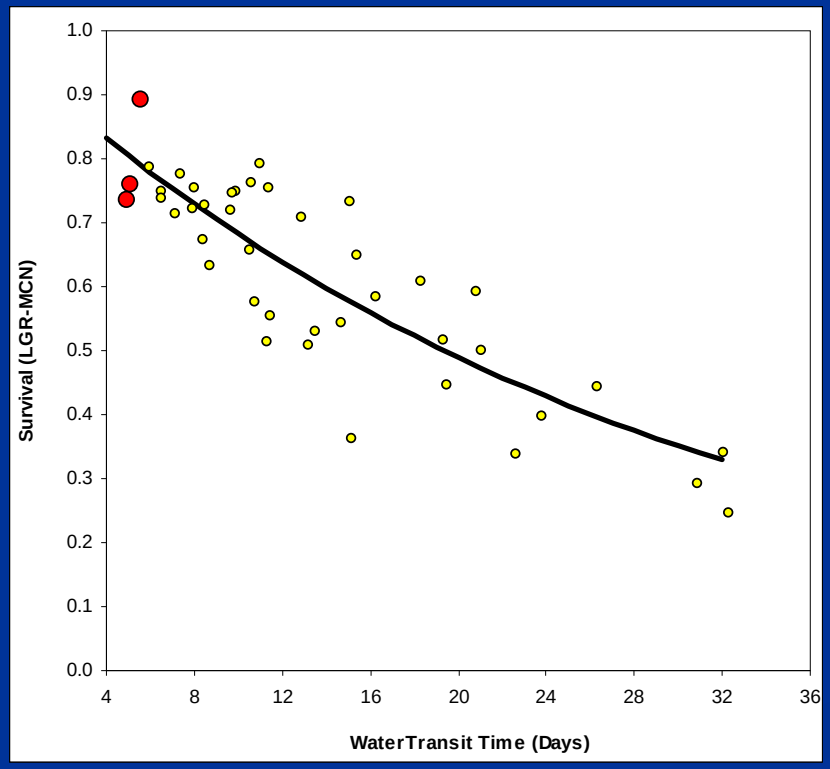
* Statistically significant at α=0.05 level



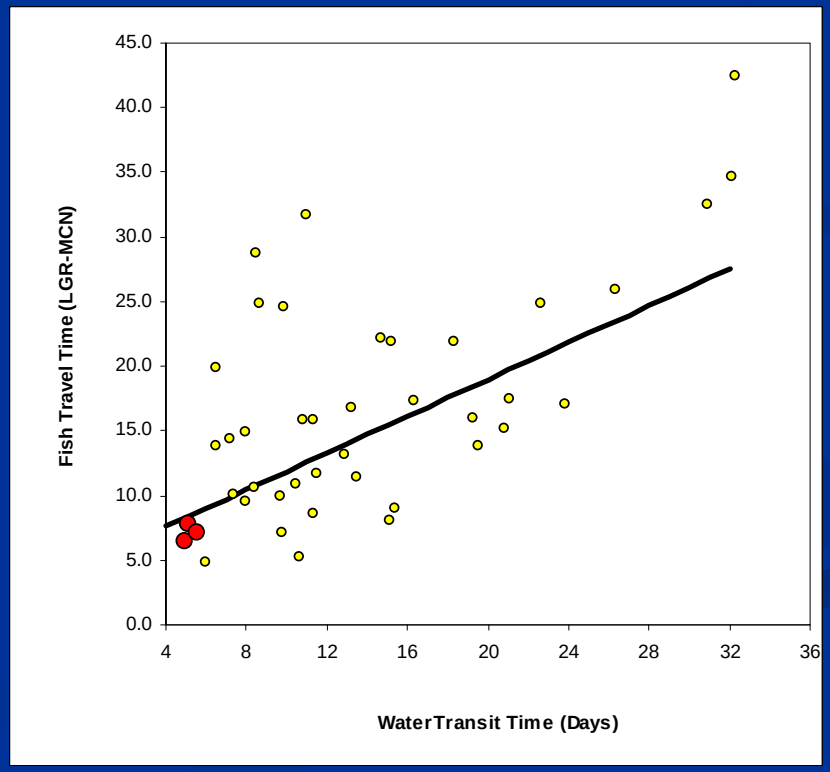


Subyearling Chinook Survival and FTT (LGR to MCN) vs. Water Transit Time

Survival



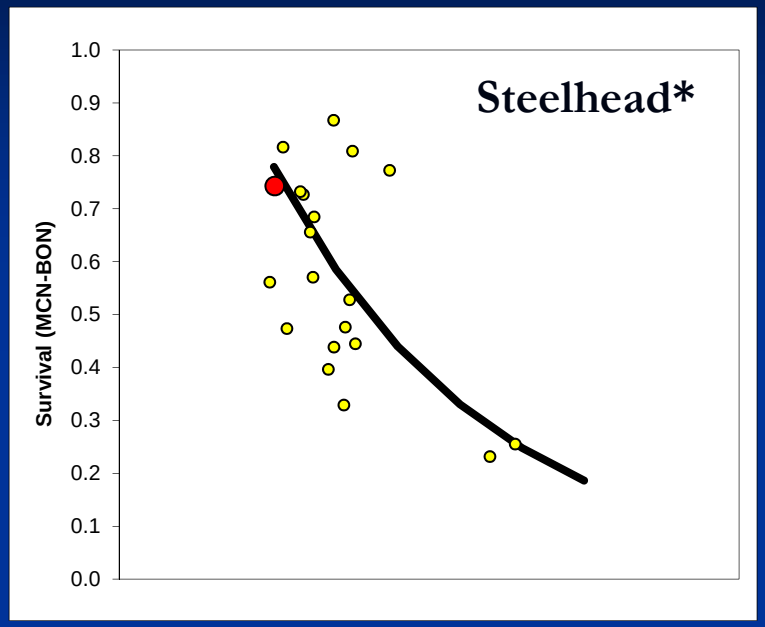
Fish Travel Time

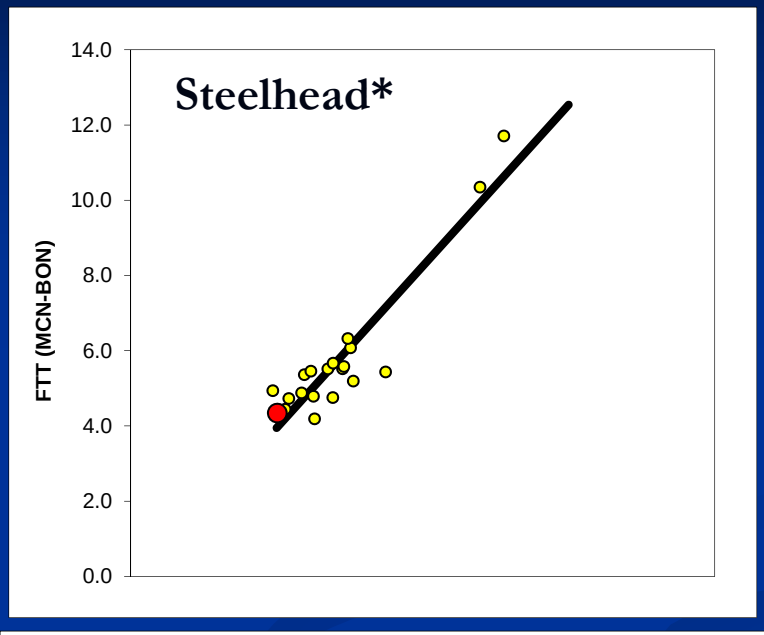


Columbia River Juvenile Survival and FTT (MCN to BON) vs. Water Transit Time

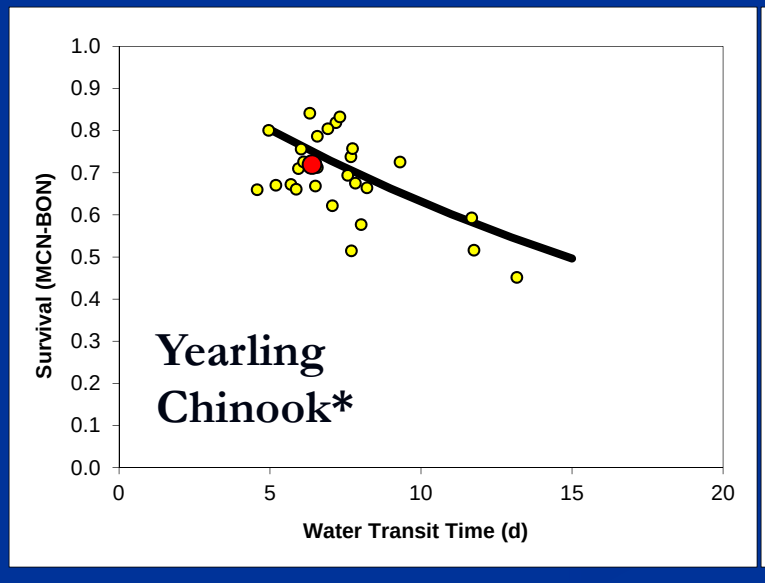
Survival

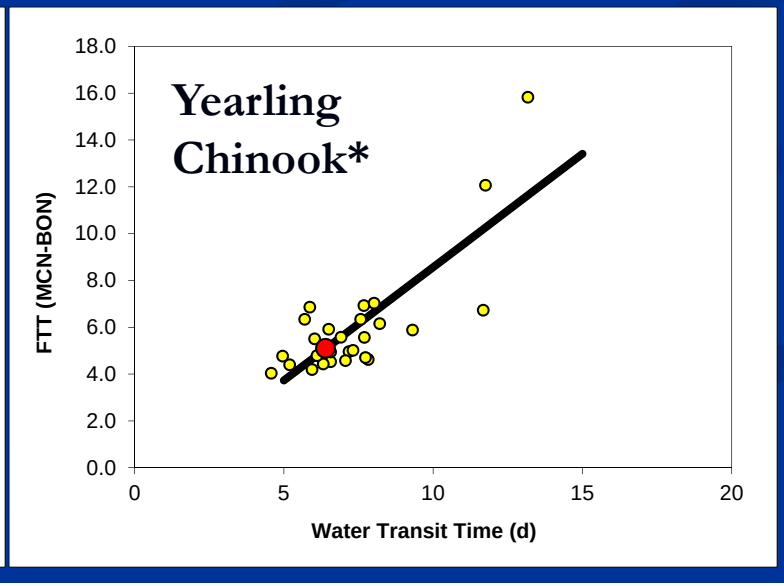
Fish Travel Time

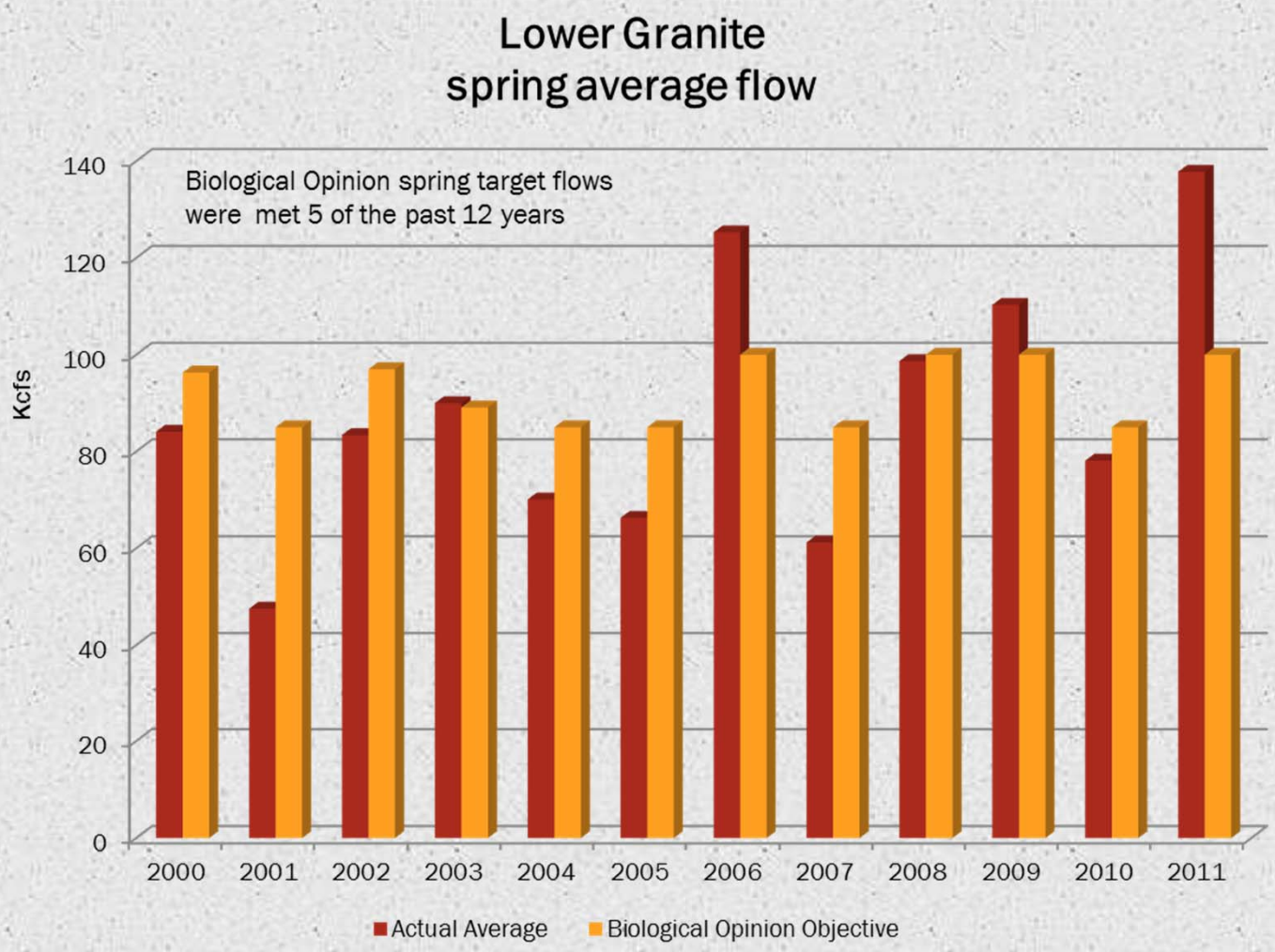


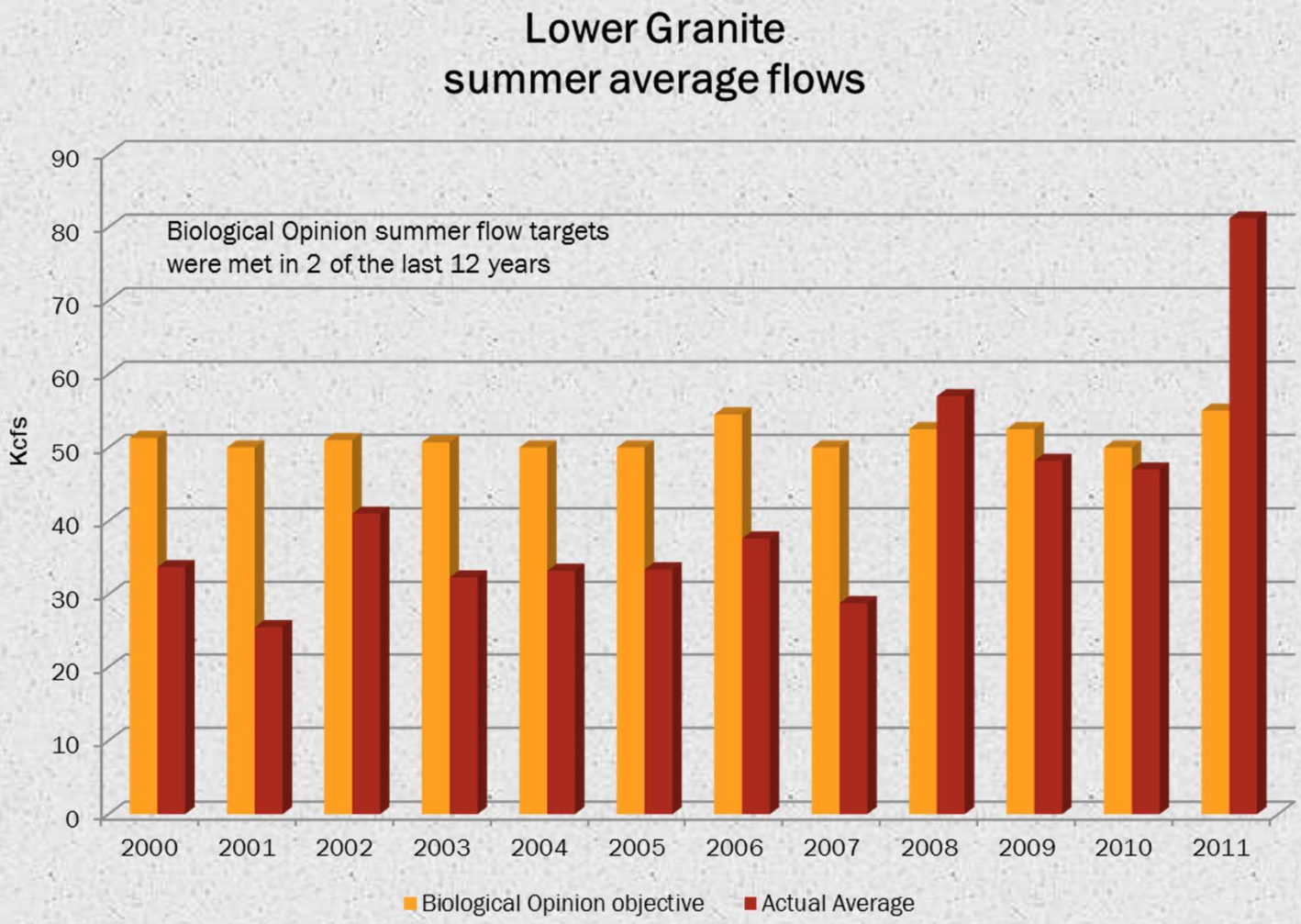


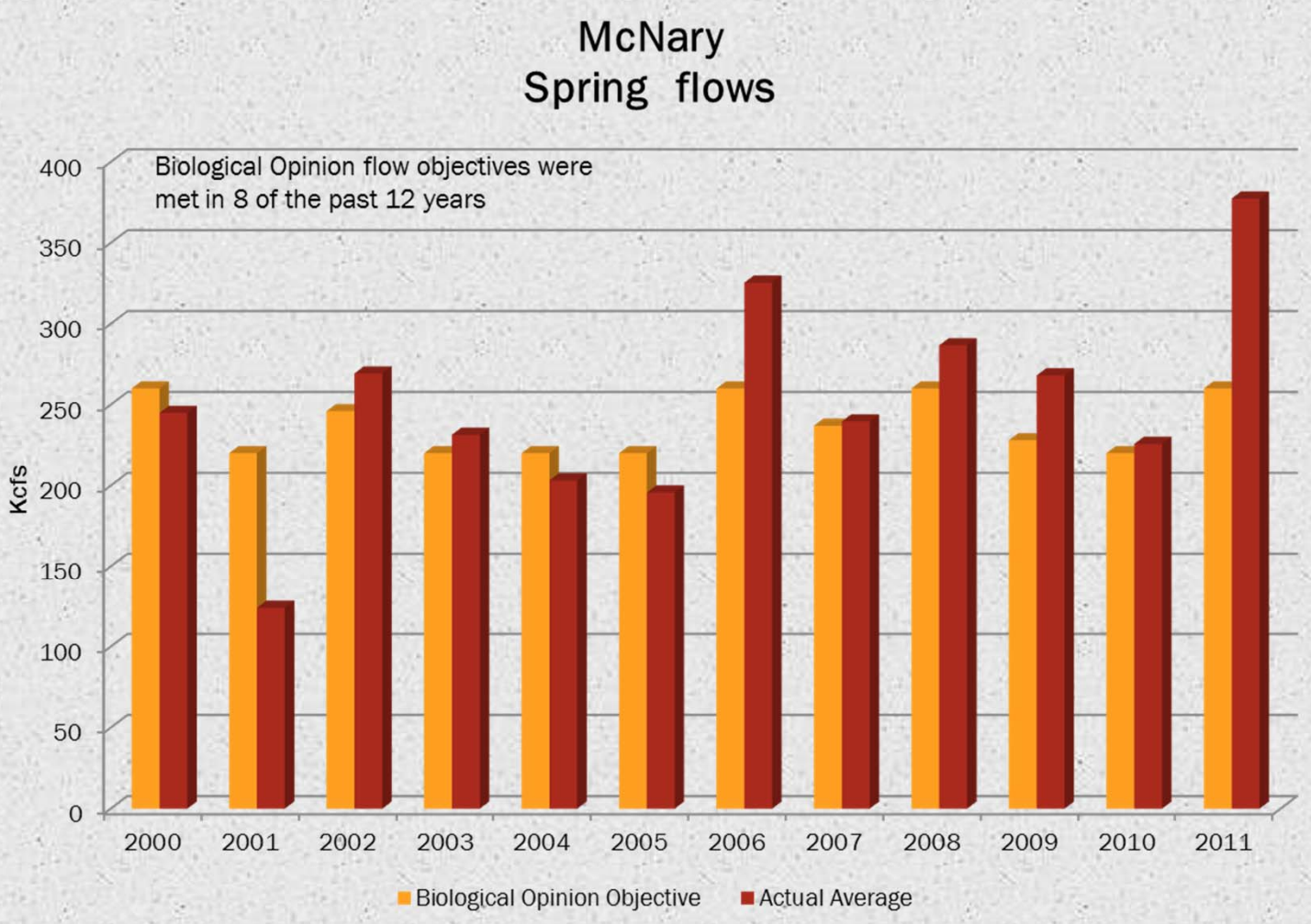
* Statistically significant at α=0.05 level



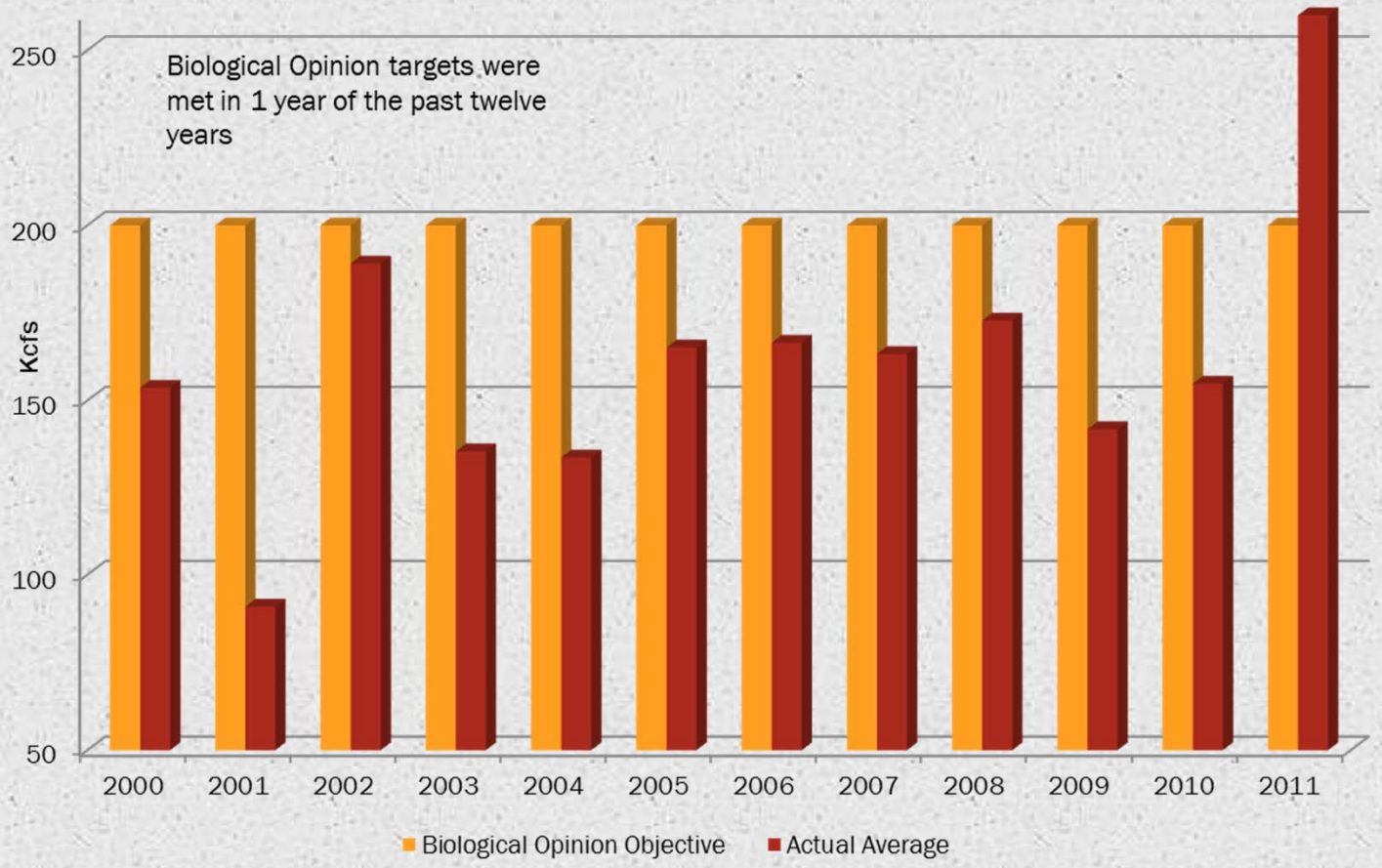
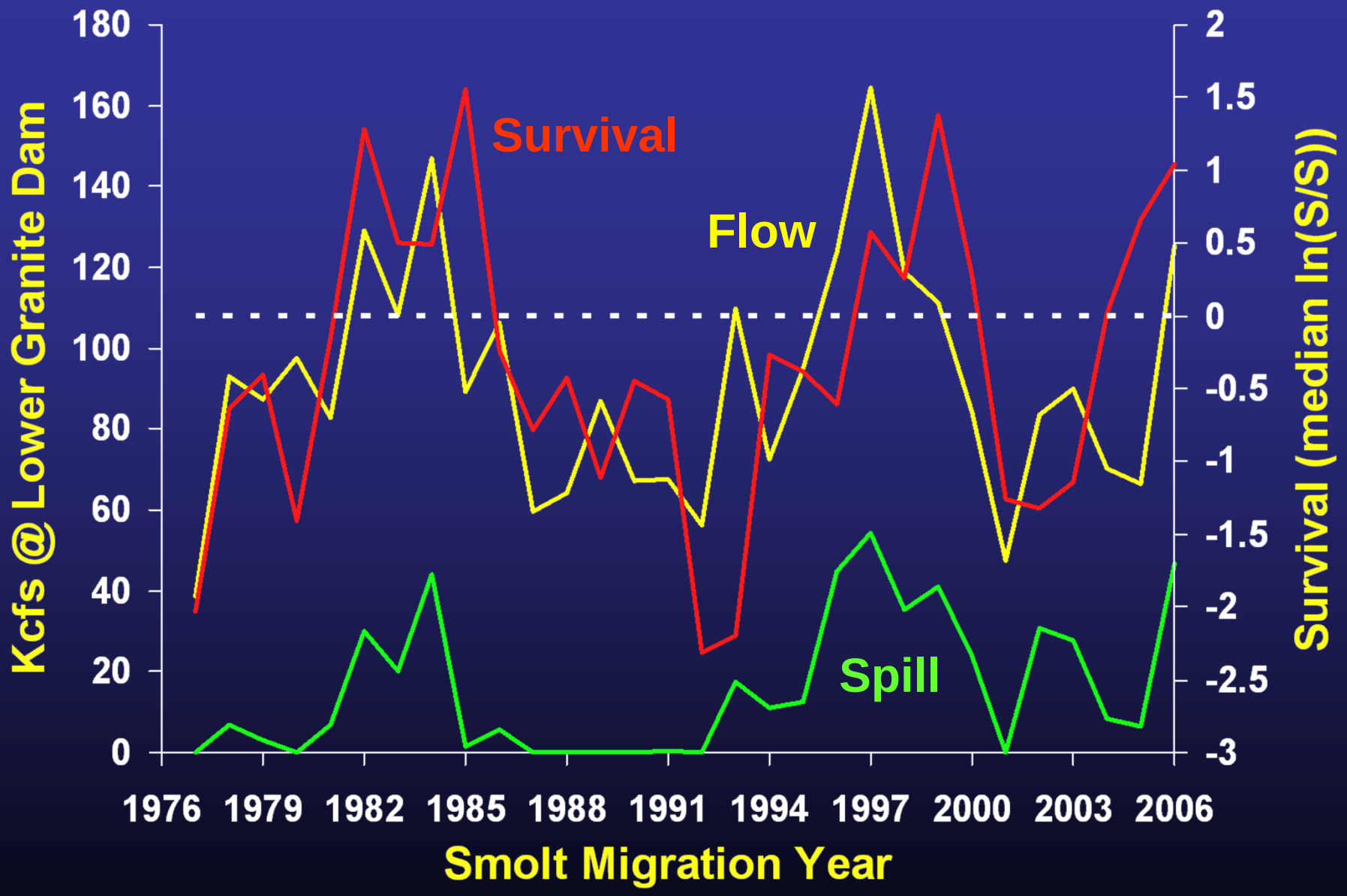



Lower Granite
spring average flow
Biological Opinion spring target flows
were met 5 of the past 12 years
Kcfs
140
120
100
80
60
40
20
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Actual Average
Biological Opinion Objective


Lower Granite
summer average flows
Biological Opinion summer flow targets
were met in 2 of the last 12 years
Kcfs
90
80
70
60
50
40
30
20
10
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Biological Opinion objective
Actual Average


McNary
Spring flows
Biological Opinion flow objectives were
met in 8 of the past 12 years
Kcfs
400
350
300
250
200
150
100
50
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Biological Opinion Objective
Actual Average

McNary
Summer Flows



Snake River Wild Spring/Summer Chinook