CSMEP Hydro Workgroup

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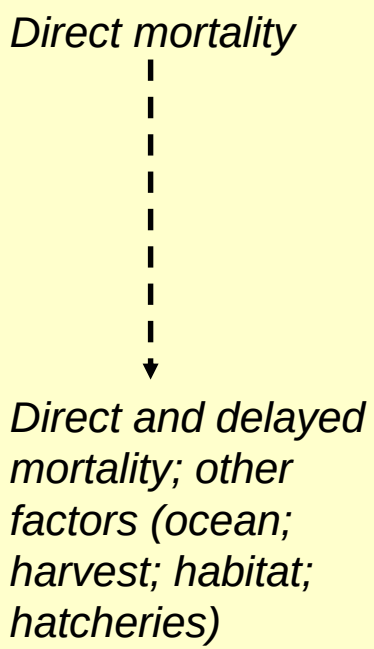
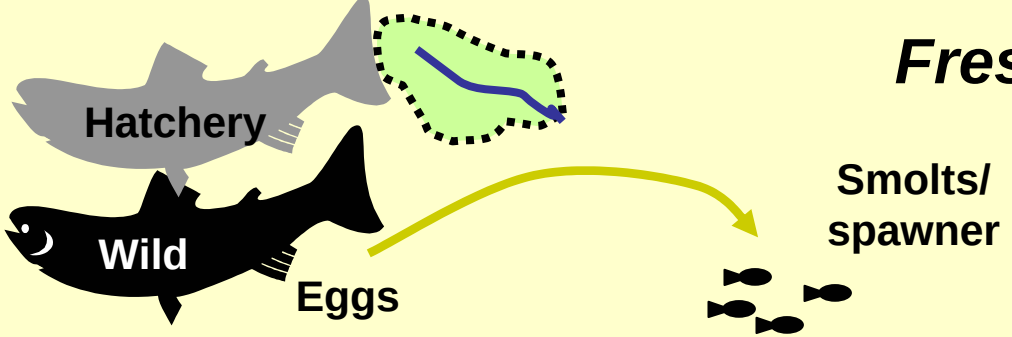
CBFWA RME Workshop
Bonneville Hot Springs
July 20-21, 2005

M&E Design

- **Hydro questions – multiple scales**
  - project scale
  - relative survival by passage routes
    - direct survival estimate or SAR contrast
  - life cycle survival

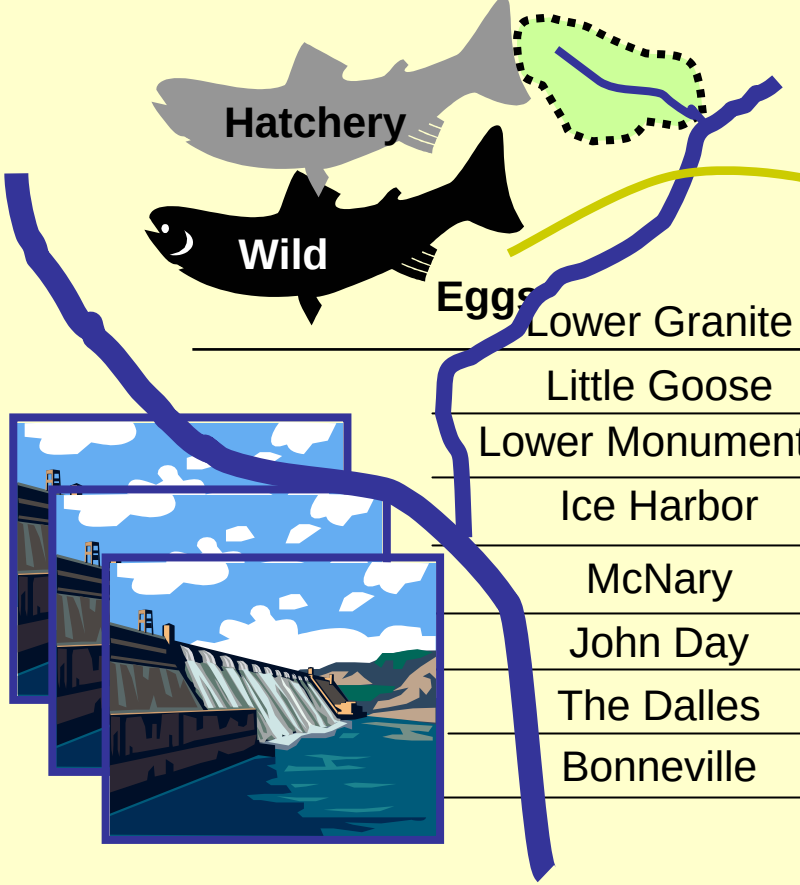
- **Performance measures**
  - direct survival
    - reach or through hydrosystem
  - SAR overall
  - SAR ratios
    - T/C, D, upriver/downriver stocks
  - recruit/spawner
    - spatial/temporal patterns





Freshwater

Spawning / Rearing Habitat Actions



Freshwater

Smolts/ spawner

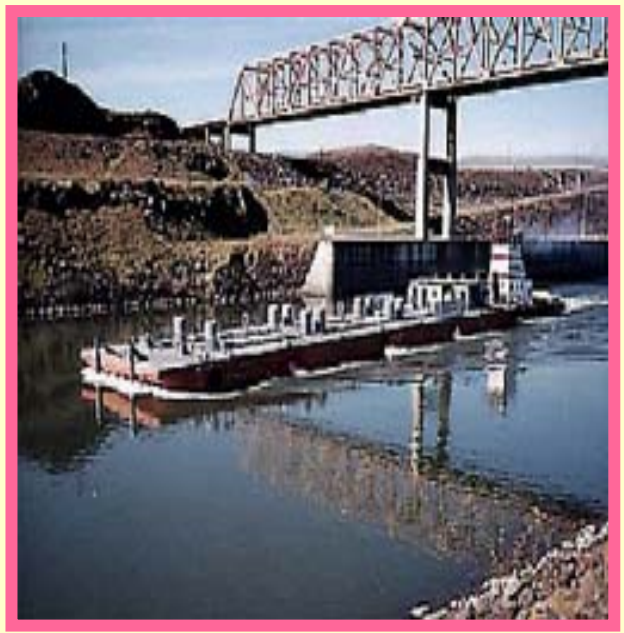
Direct survival through dams

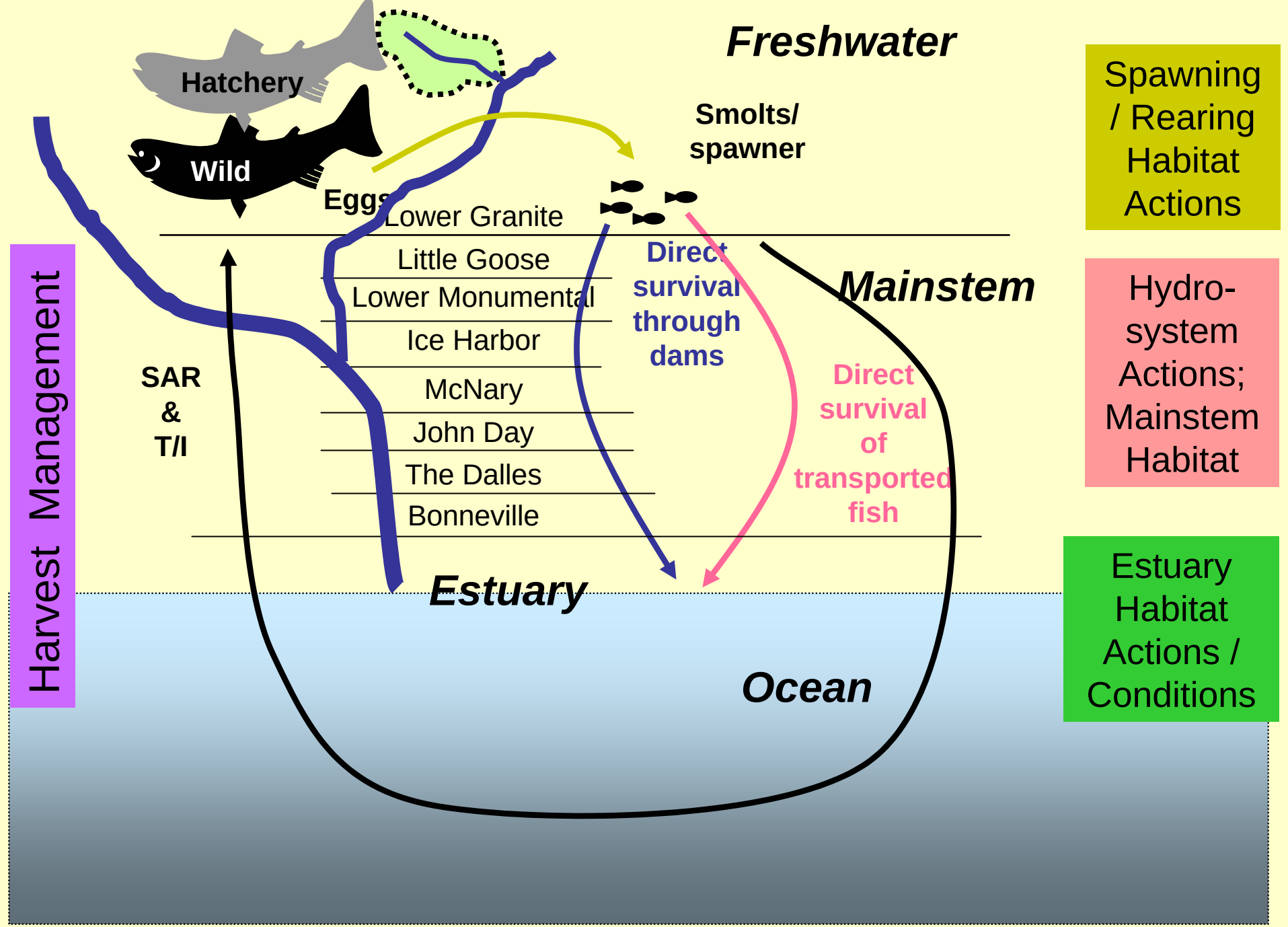
Mainstem

Direct survival of transported fish

Spawning / Rearing Habitat Actions

Hydro-system Actions; Mainstem Habitat




Freshwater
Hatchery
Wild
Smolts/
spawner
Eggs
Lower Granite
Little Goose
Lower Monumental
Ice Harbor
McNary
John Day
The Dalles
Bonneville
Direct
survival
through
dams
Mainstem
SAR
&
T/I
Direct
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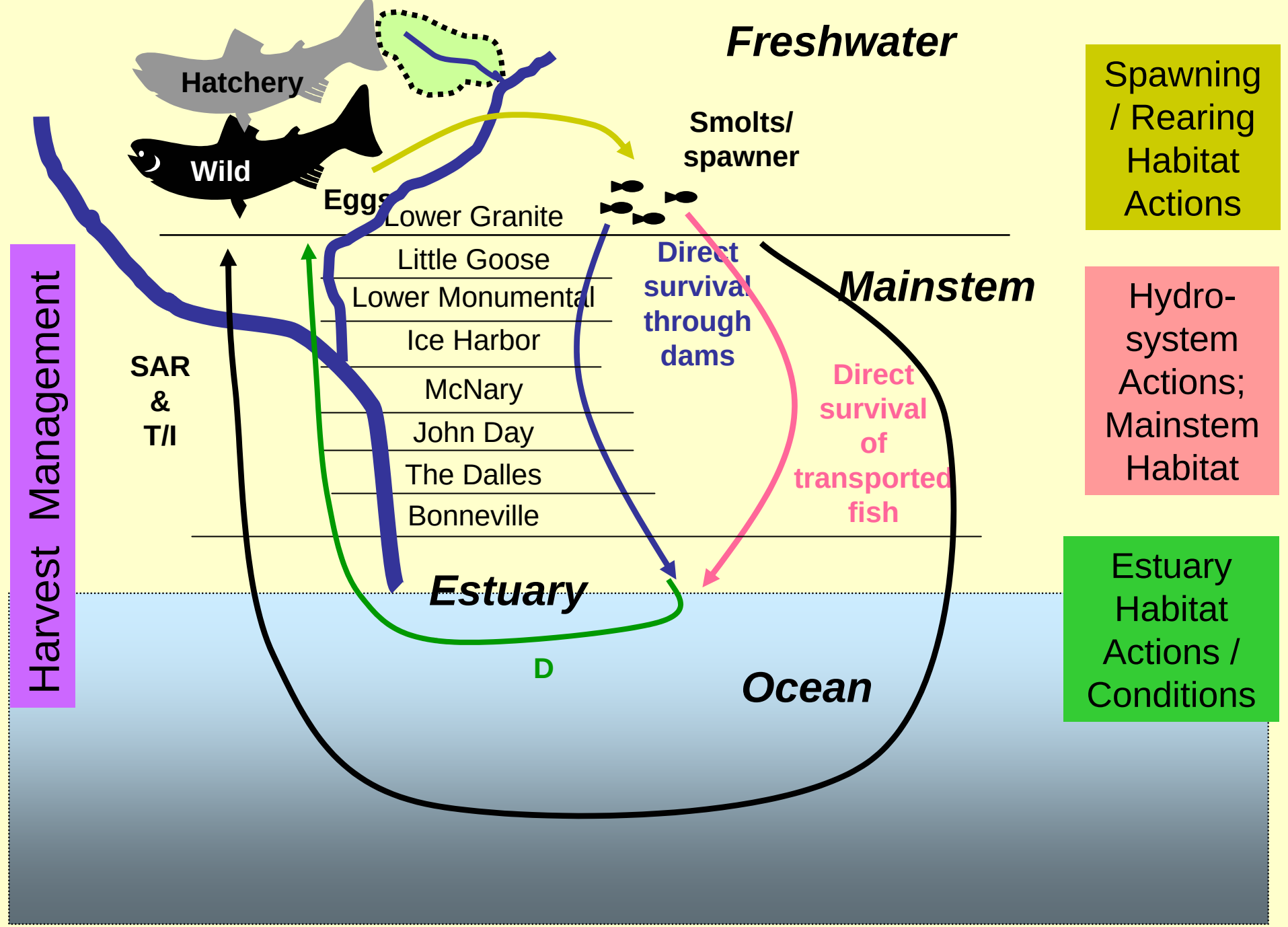
Estuary
Ocean
Harvest Management
Spawning / Rearing Habitat Actions
Hydro-system Actions; Mainstem Habitat
Estuary Habitat Actions / Conditions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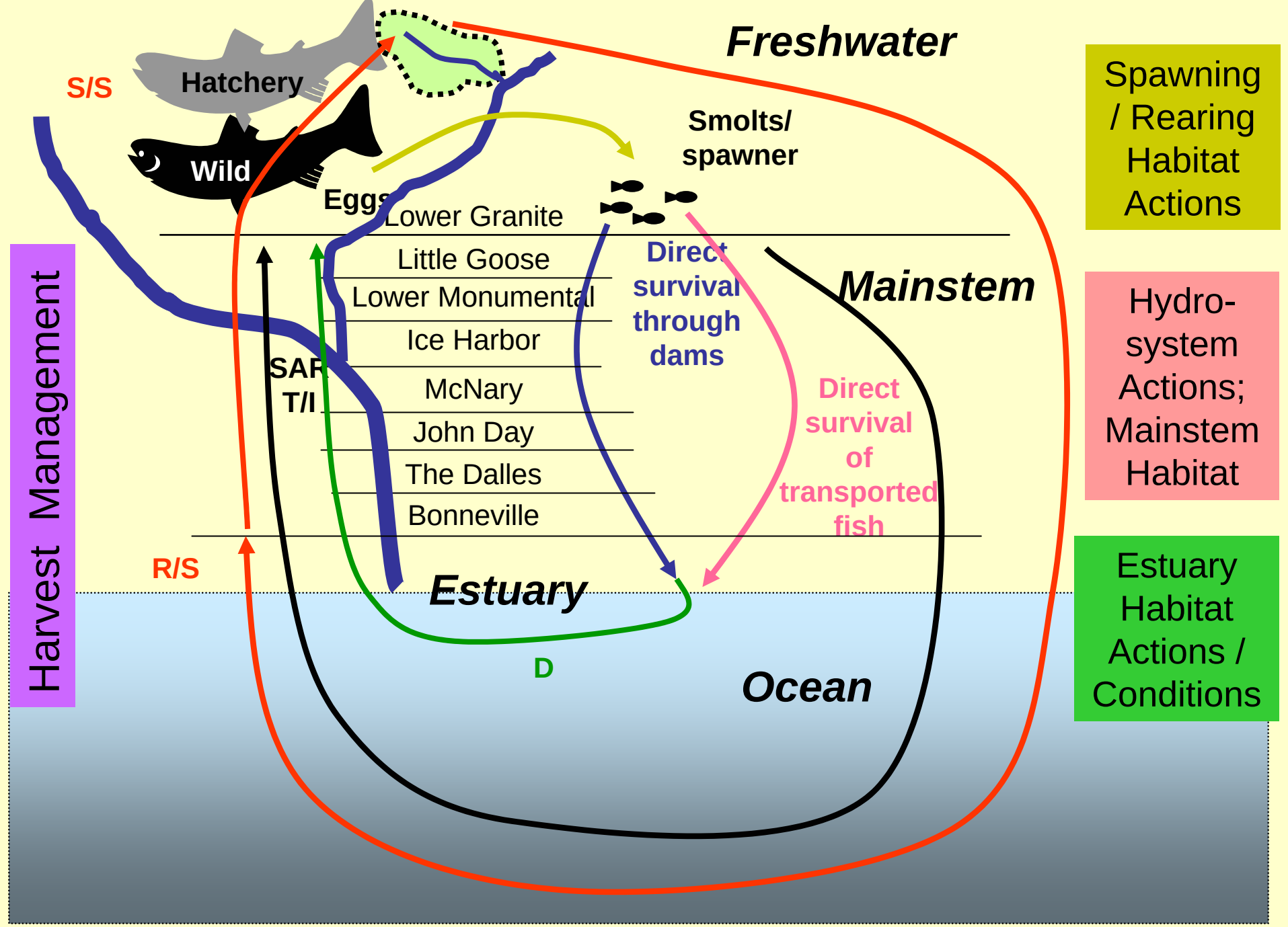
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Types of Data

- **Freshwater survival**
- **Hydrosystem:**
  - Project survival, reach survival, upstream passage
  - $SAR_{LGR\text{-}LGR}$ of in-river & transported, hatchery & wild
- **Estuary, Ocean and Climate covariates**
- **Overall Survival:**
  - Recruits/spawner; Spawners/spawner

CSS Tagging Locations

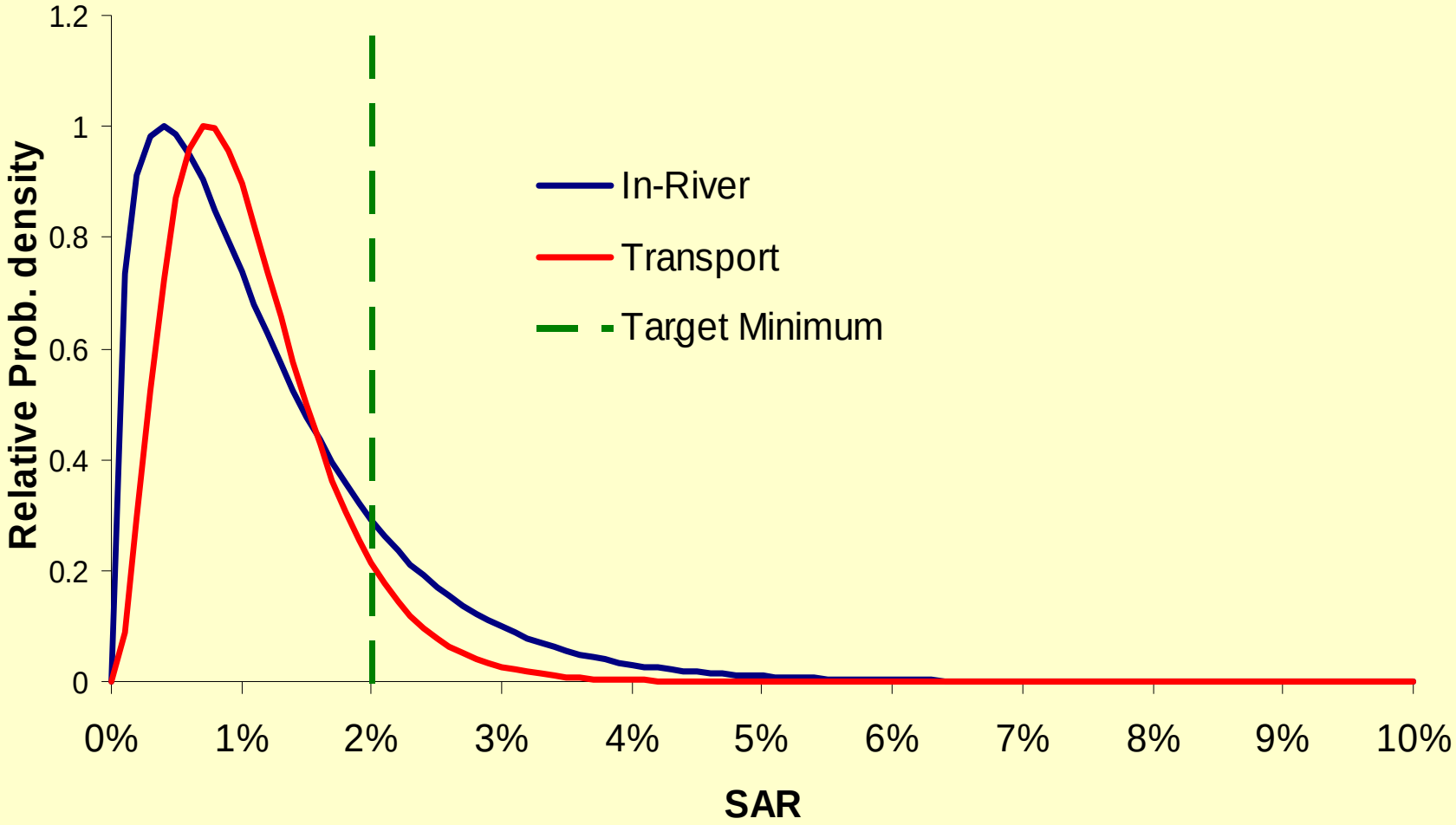
1. Winthrop Hatchery
2. Wells Hatchery
3. East Bank Hatchery
4. Leavenworth Hatchery
5. Dworshak Hatchery
6. Rapid River Hatchery
7. McCall Hatchery
8. Pahsimeroi Hatchery
9. Imnaha Acclim.
10. Catherine Creek Acclim.
11. Carson Hatchery
12. Warm Springs Hatchery

A. Salmon River Trap
B. Grande Ronde River Trap
C. Snake River Trap
D. Clearwater River Trap
E. John Day River Trap

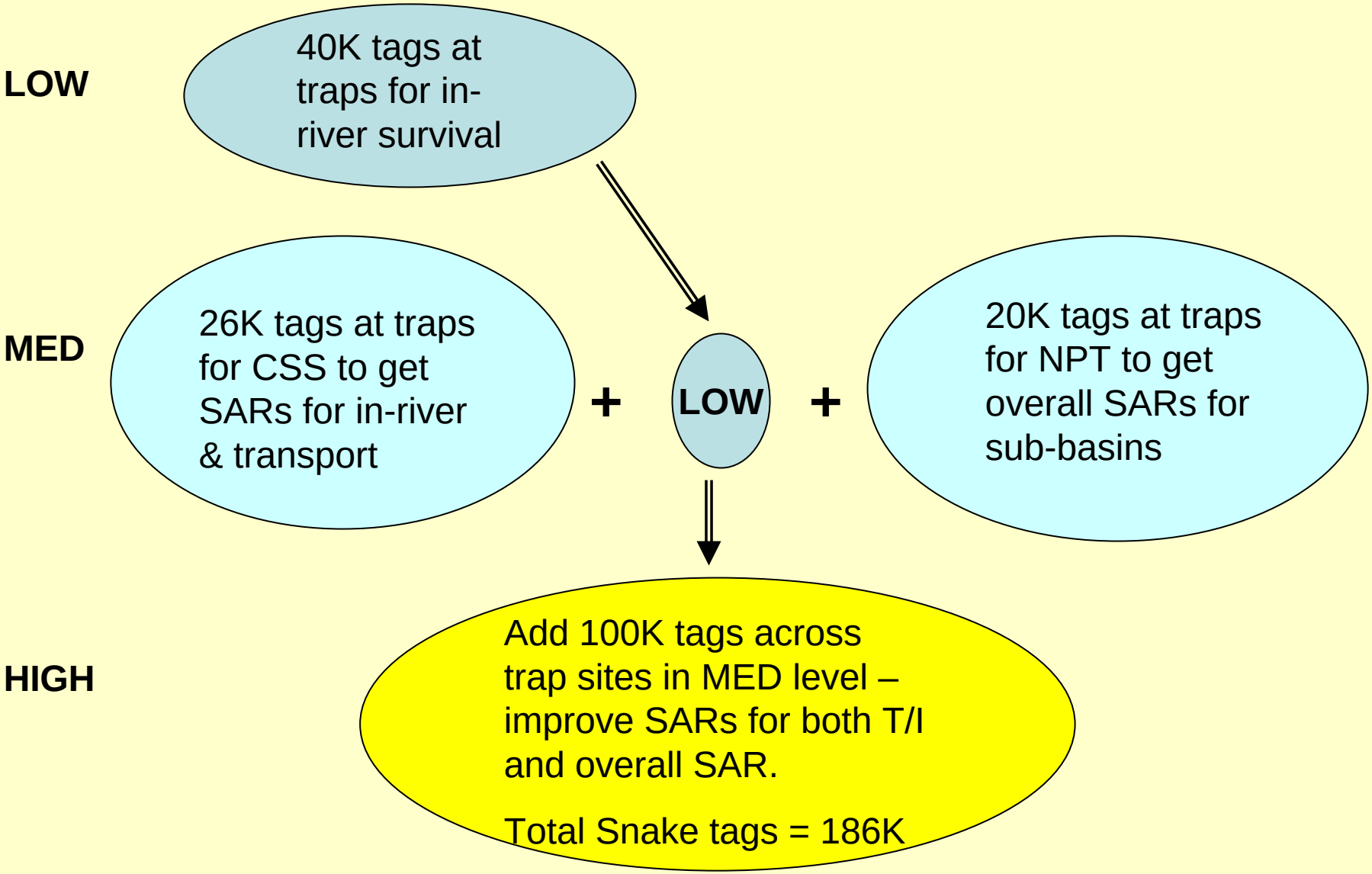
6.1 SARs and Transportation Effectiveness

- Is SAR in the range of NPCC interim SAR goal (i.e. 2-6%) and TRT SAR goals?
- Is transportation more effective than in-river migration? Is **T**ransport:**I**nriver Ratio (T:I) > 1?
- What is the relative survival of transported fish, post-BONN, compared to in-river fish?

Probability density functions of CSS control and transport SARs of wild chinook for migration years 1994-2002



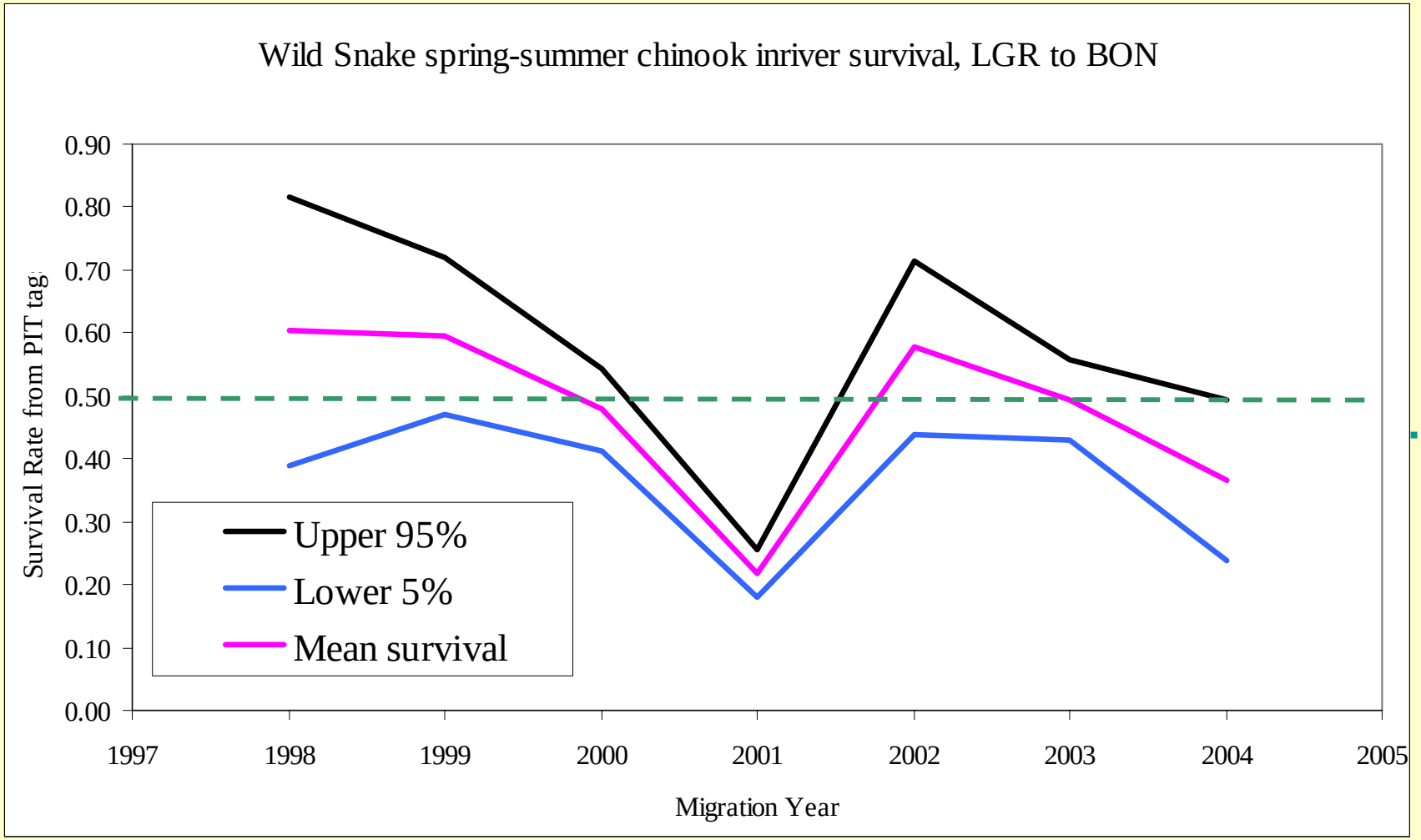
6.1 Low, medium and high monitoring level for wild spring/summer Chinook



6.2 Compliance of Hydrosystem with Performance Standards in 2000 BiOp

- 2000 BiOp requires inriver survival rate for Snake spring-summer chinook of about 50%.
- Problems:
  - Inter-annual variability
  - Imprecise estimates for any given year
  - Few years of pre-2000 empirical estimates

Survival estimates are imprecise and variable from year to year



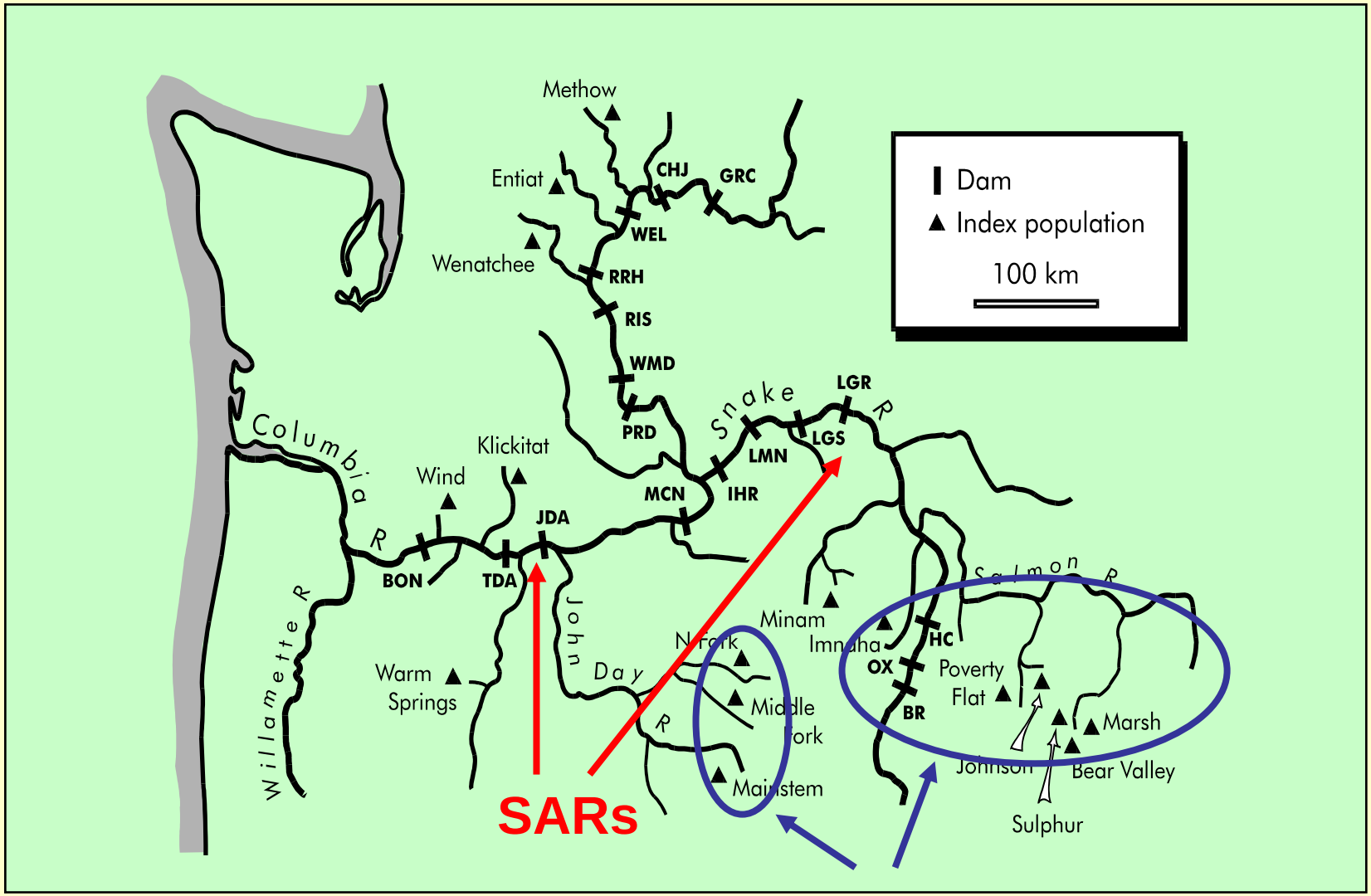
Alternatives to address problems

- Tag more fish
  - Fringe benefits would include better SAR estimates
- Increase towed array efforts
  - Would yield more precise inriver survival estimates for both steelhead and chinook
- Increase Bonneville detection efficiency
  - Difficult to do even if corner collector detection works as designed in 2006+.

6.3 Incremental mortality of Snake R stocks vs Lower Columbia stocks

- Are SARs of Snake River stocks (upriver) less than SARs for downriver stocks, as suggested by incremental patterns in R/S data?
  - Incremental mortality from spawner to adult recruit: upriver stocks survive only 1/4 - 1/3 as well as downriver stocks (Deriso et al. 2001)
  - Does this pattern hold for part of lifecycle measured by SARs?

Comparing R/S and SARs

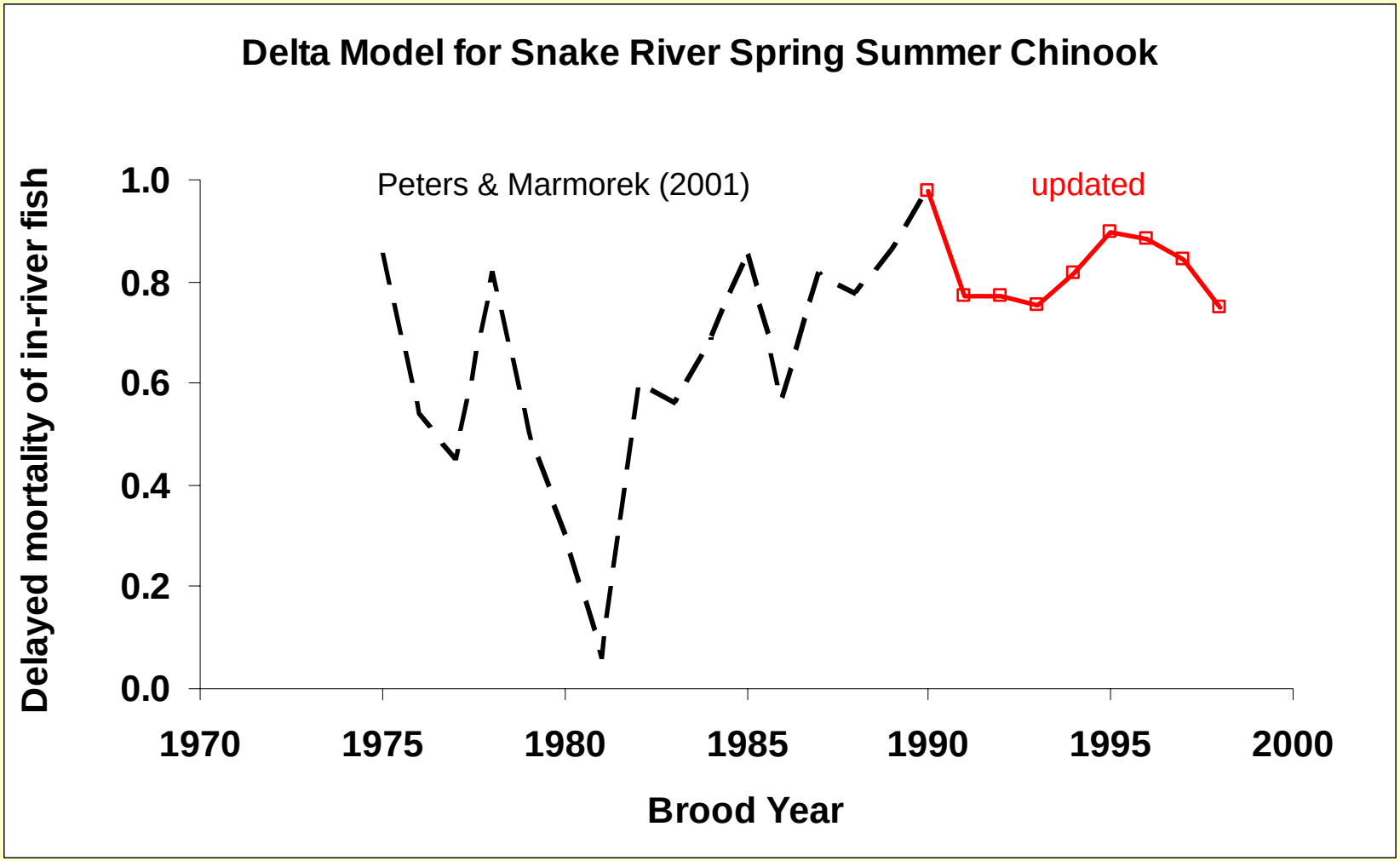


(Schaller et al. 1996)

6.4 What is the inferred estuary and ocean mortality of in-river fish?

- We can infer this mortality from estimates of:
  - incremental mortality between upriver and downriver stocks
  - direct mortality; and
  - delayed mortality of transported fish (D)
- Previous estimates of estuary and ocean mortality were much less precise
- PIT-tags give direct estimates of survival to BON, and D $\Rightarrow$ more precise estimates of estuary and ocean mortality
- Results confirm that mortality remains high

6.4 Updated estimates of estuary and ocean mortality of in-river fish: spawner & recruit data (updated run reconstruction); -CSS estimates of direct survival and D

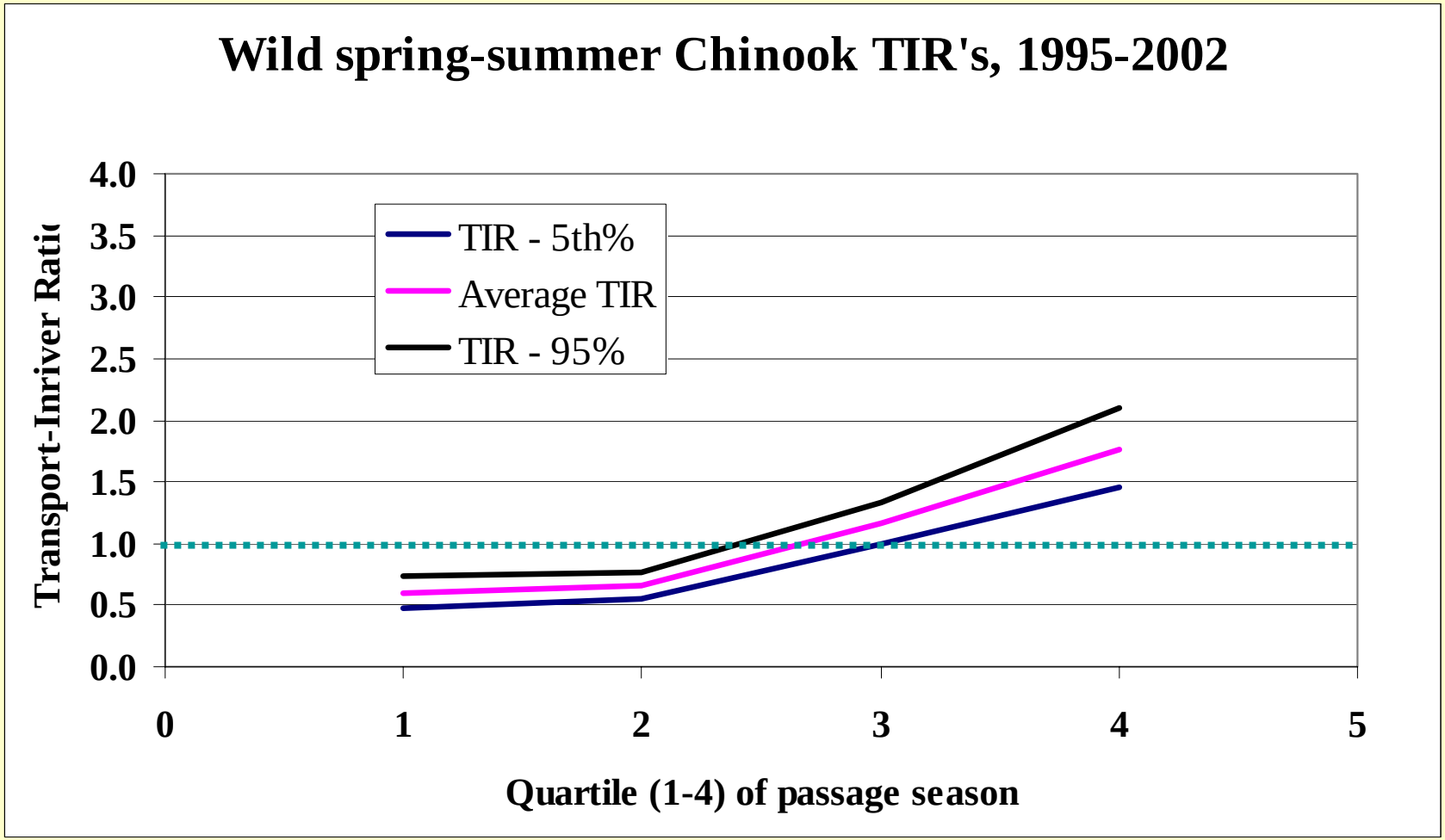


6.5 What's the effect of different in-season transportation management actions of Post-Bonneville survival of transported fish?

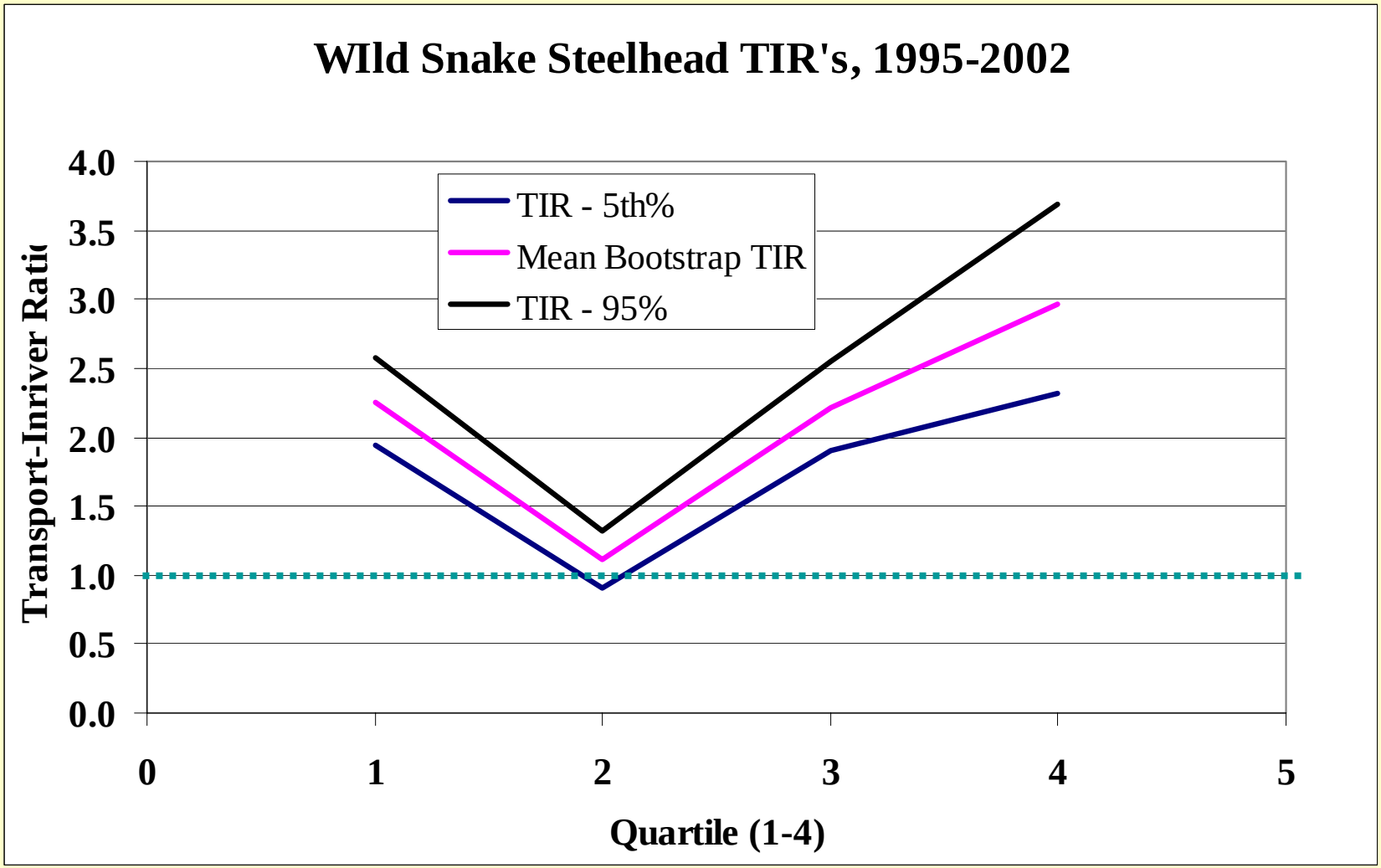
- Preliminary NOAA, CSS work suggests that Transport/In-river ratios (T:I or TIR) may vary within a season

- For Snake River spring-summer chinook – early migrants may do better in-river, later ones in barges

6.5 Within-season T:I of chinook smolts tagged or detected at LGR (PIT tag data from multiple sources)



Same graph for steelhead smolts



Tradeoffs

Leave wild spring / summer chinook in-river early in season, barge later?

Barge wild steelhead throughout year?

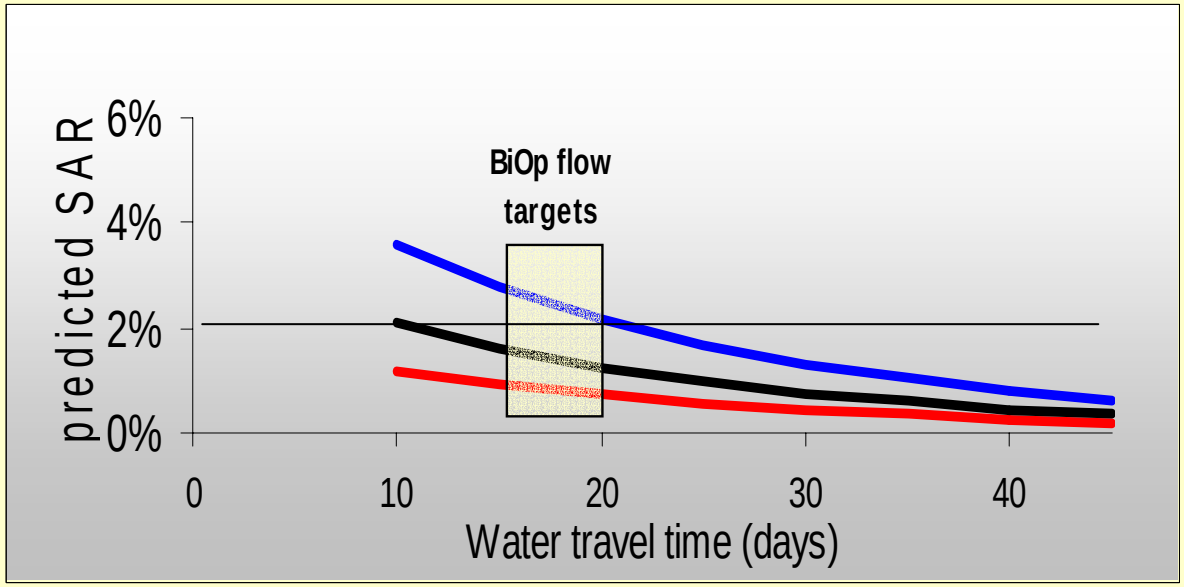
Need to explore implications of these choices in different years

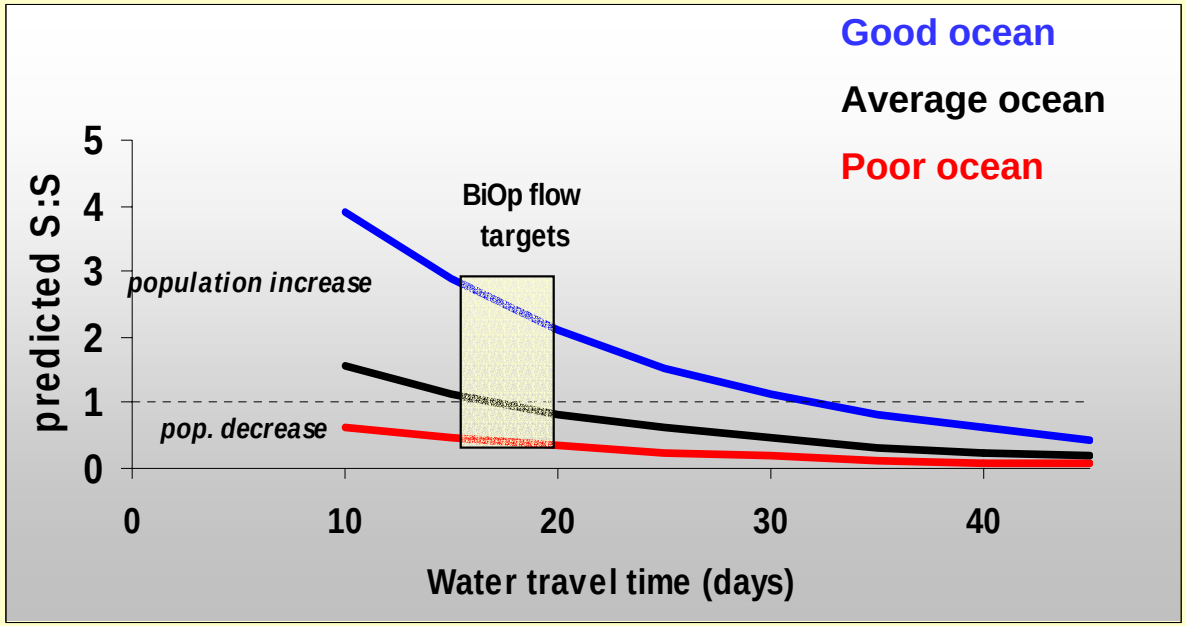
Does marking at LGR really represent the overall run?

Precise results for any given year would require 2-10 fold increase in tagging effort at or above LGR.

6.6 What is the effect of different flow management actions in the hydrosystem on SAR and Sp/Sp?

Regression models: [Sp/Sp] or SAR vs. water travel time and common year effect (climate)





6.7 What's effect of different flow & spill management actions on in-river survival?

- USFWS has done some statistical power analyses of ability to detect flow-survival relationships (Feb 2003)
- NMFS is now completing similar analyses
- These analyses will be compared in a later CSMEP report

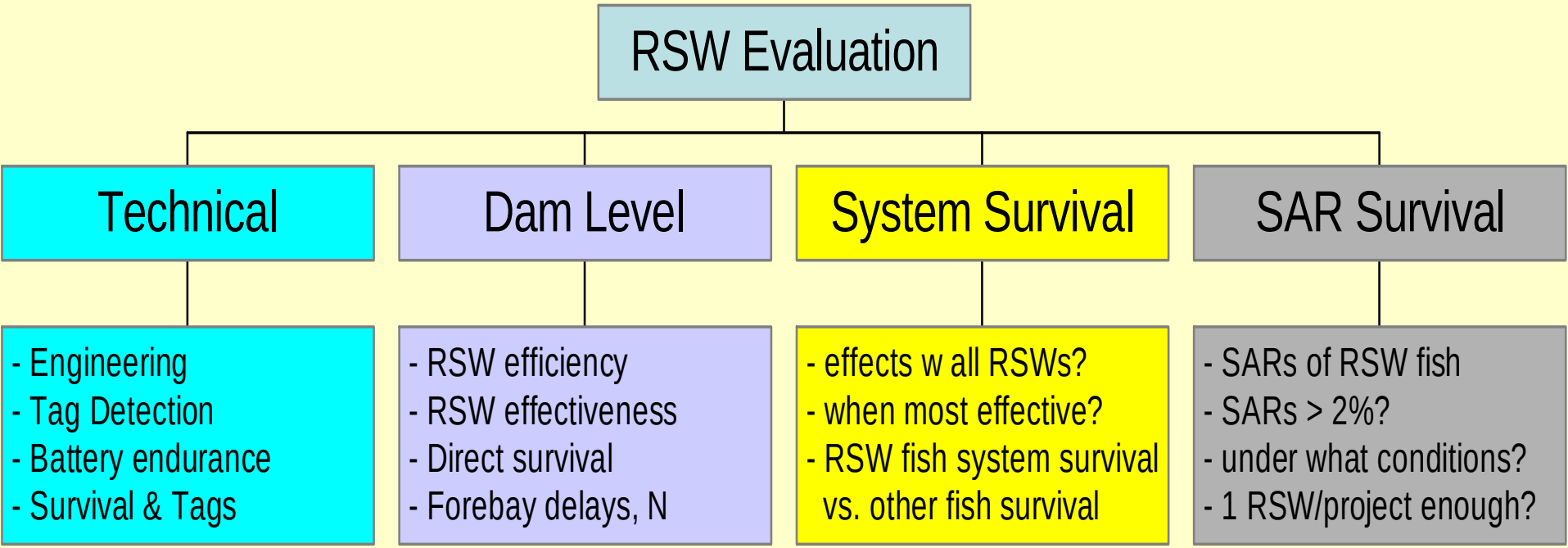
6.8 Would Removable Spillway Weirs (RSWs) improve SARs, Sp/Sp sufficiently to meet recovery targets? Are RSWs an effective alternative to transportation?

- Goals of RSWs:
  - Provide spill nearer to the surface and increase efficiency (entrainment)
  - Reduce forebay delays
  - Improve spill efficiency ($$$)

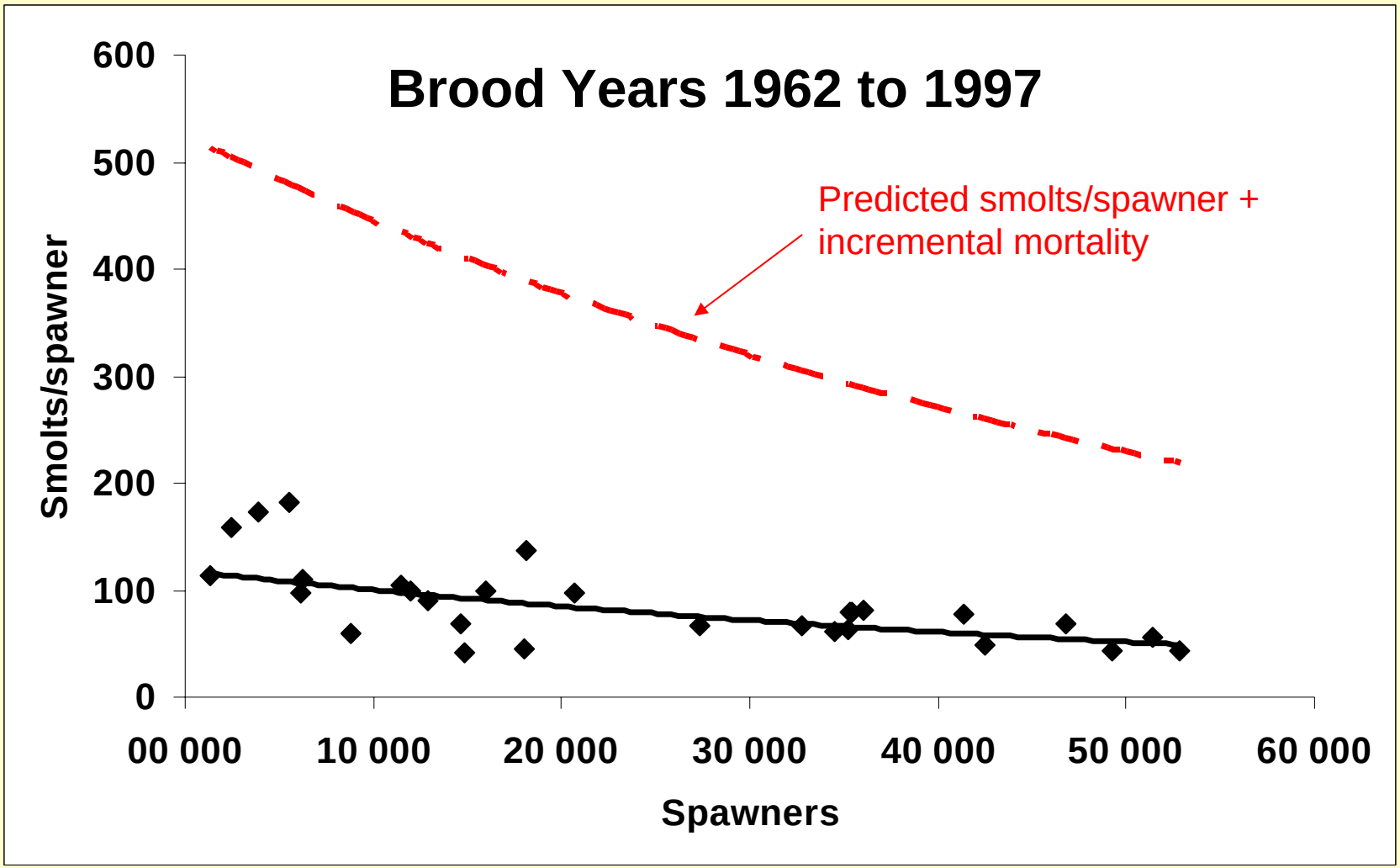

Ice Harbor Spillway Weir
Removed Position
(during major flood events)


Ice Harbor Spillway Weir
Fish pass over weir
to tailrace
Operating Position

6.8 RSW Evaluation Questions



6.9 Have freshwater habitat actions been sufficient to compensate for incremental mortality? (as measured on the Snake River aggregate spring/summer Chinook stock)



Risk of Decision Errors

Factors in M&E Design:

– # years data

– # stocks

– ability to filter annual noise from signal of management action

– # tags applied

Risk of Decision Error

Decisions:

Change hydro operations or configuration? (6.1)

BiOp compliance? (6.2)

Recovery actions adequate? (6.1, 6.3, 6.6, 6.8)

Change flow management? (6.6, 6.7)

Change when transport w/in season? (6.5)

Install RSWs? (6.9)

Conclusions

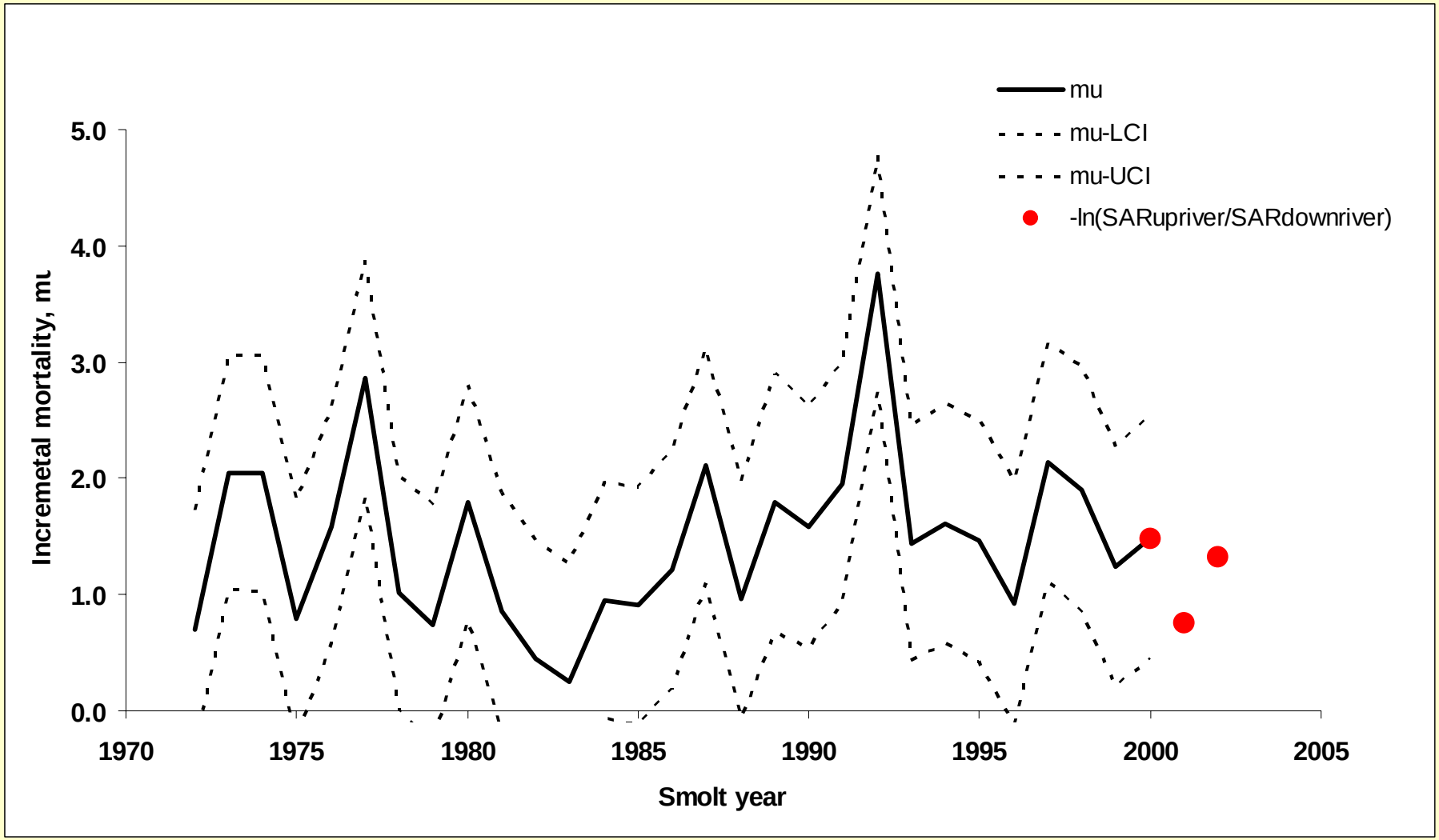
- {PIT-tag + other data} $\rightarrow$ {strong inferences on relative effects of different actions}
- **BUT:**
  - Such data not available for all sub-basins
  - Sample size problems for some wild stocks
  - Lots of year to year variation
- **THEREFORE:**
  - Filter out year to year variation and do multiple-year tests
  - Combining multiple treatments and locations
  - Explore what inferences possible now;
  - Plan ahead to ensure right data collected for future questions

Extra Slides

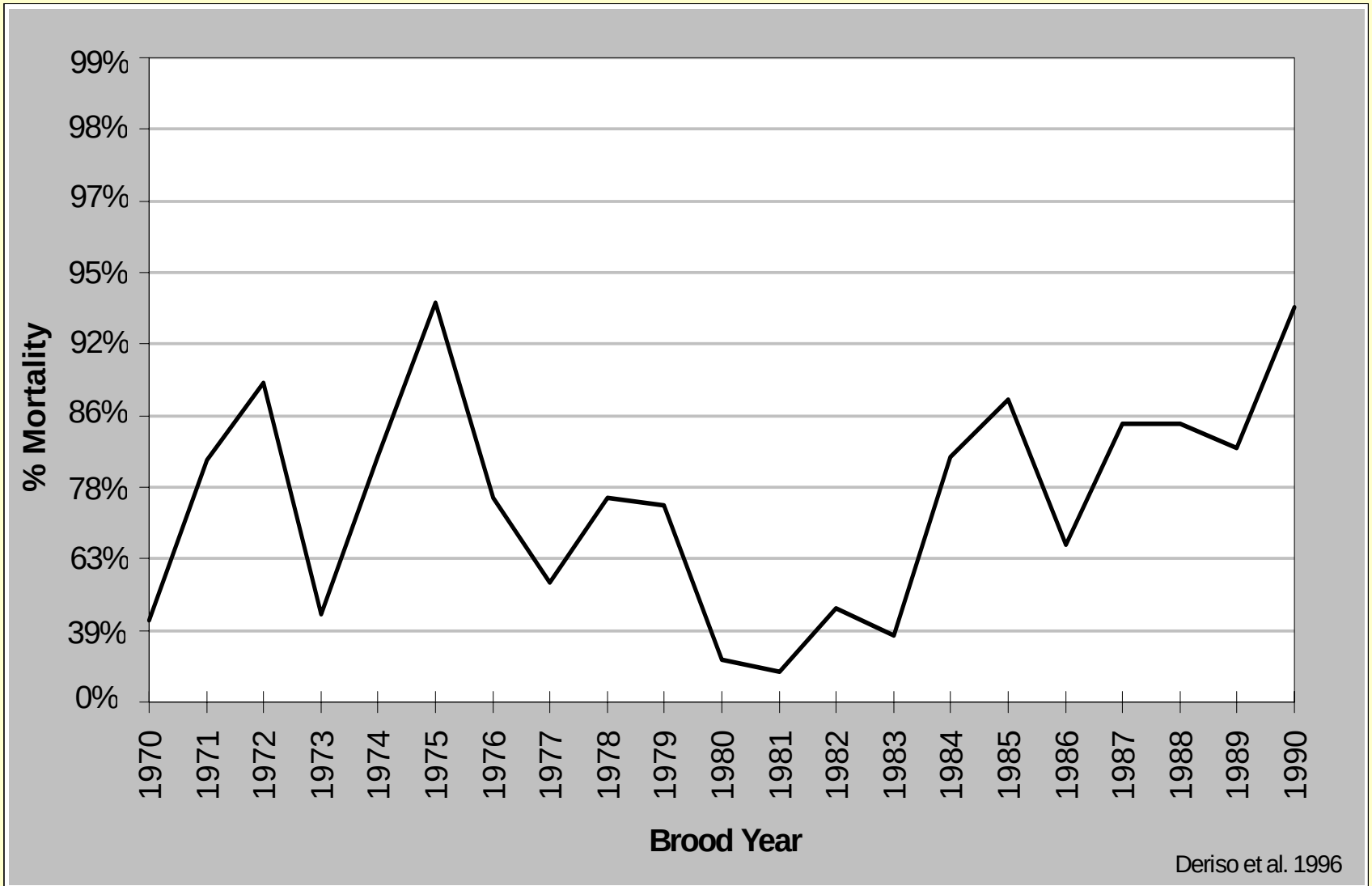
Estimates of Survival from PIT tags (Comparative Survival Study (CSS), NMFS)

- Lots of relevant data now available from CSS and NMFS; CSMEP pilot analyses of M&E completed using CSS data (easily available)
- CSS started 1996 by states, tribes, Fish Passage Center, USFWS
  - estimate survival rates at various life stages
  - compare survival rates for chinook from 3 major areas
  - develop more representative control for transport evaluations
  - PIT tag wild, natural and hatchery juveniles

6.3 Incremental Mortality from R/S analysis, and $SAR_{upriver}/SAR_{downriver}$ from CSS, wild sp/su Chinook



Retrospective analysis: incremental mortality of Snake River stocks over lower Columbia R. stocks



Deriso et al. 1996