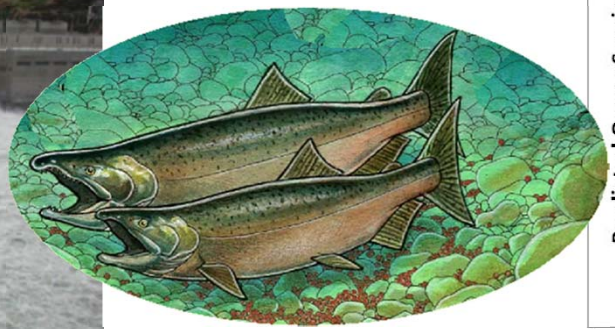
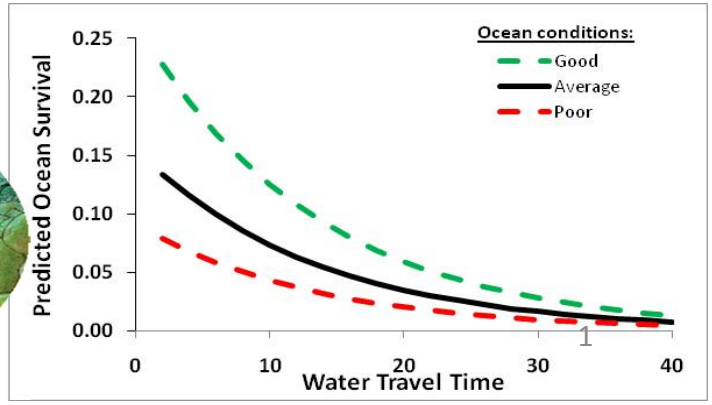
Comparative Survival Study
Experimental Spill Management Analyses

Charlie Petrosky – IDFG retired (mostly)
CSS Oversight Committee
LSRCP meeting
March 12, 2015





Topics for today

- CSS study
- Survival studies – historical & recent
- Background on spill
- Experimental Spill Management Design
- Simulation results and next steps

Comparative Survival Study

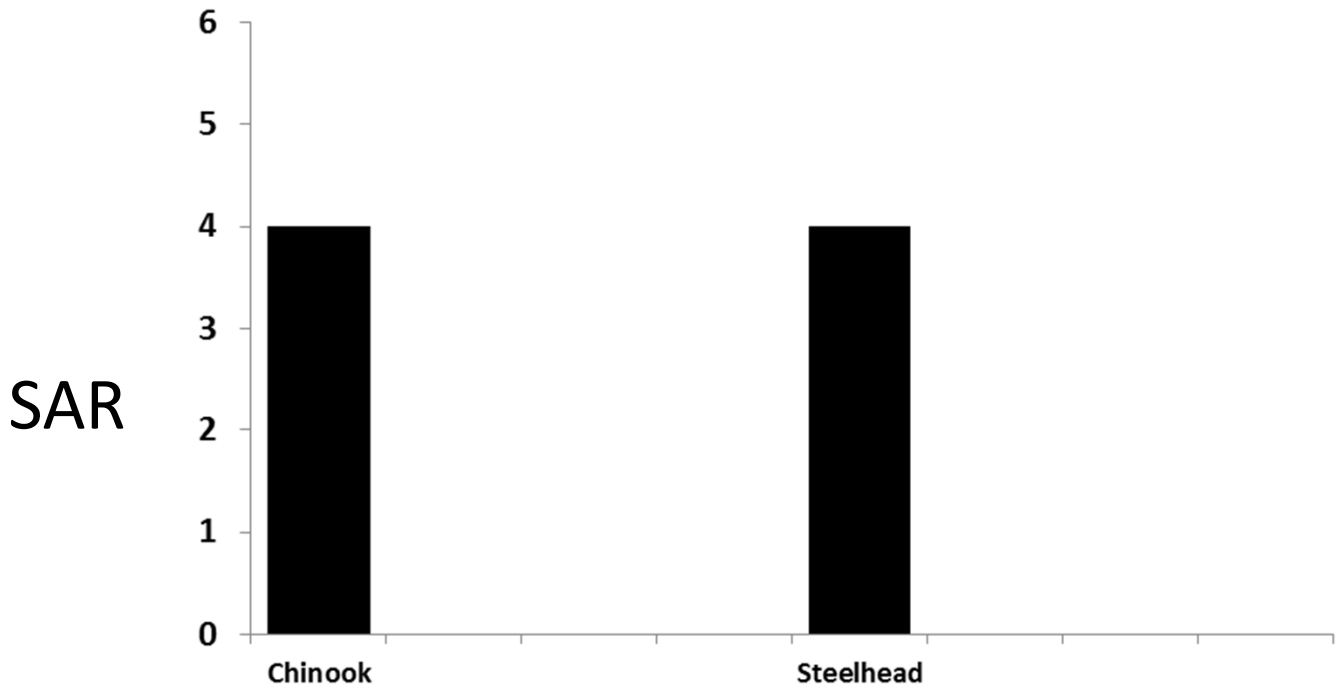
- A regional collaborative salmon and steelhead life cycle monitoring program
- Successfully implemented since 1998
- Annually reviewed by the NPCC Independent Scientific Advisory Board and the region
- Analyses published in peer reviewed scientific journals

History and Background

- Analyzed multiple lines of evidence - factors affecting survival
- 40 - 60 years of historical run reconstruction data
- 15+ years of Comparative Survival Study Data
- 15+ years of spill and dissolved gas data and effects on juvenile migrants
- Developed spill scenarios based on COE data

NPCC Smolt-to-Adult Survival Goal-Recovery

- Achieve SARs averaging 4% for Snake River Chinook salmon and steelhead



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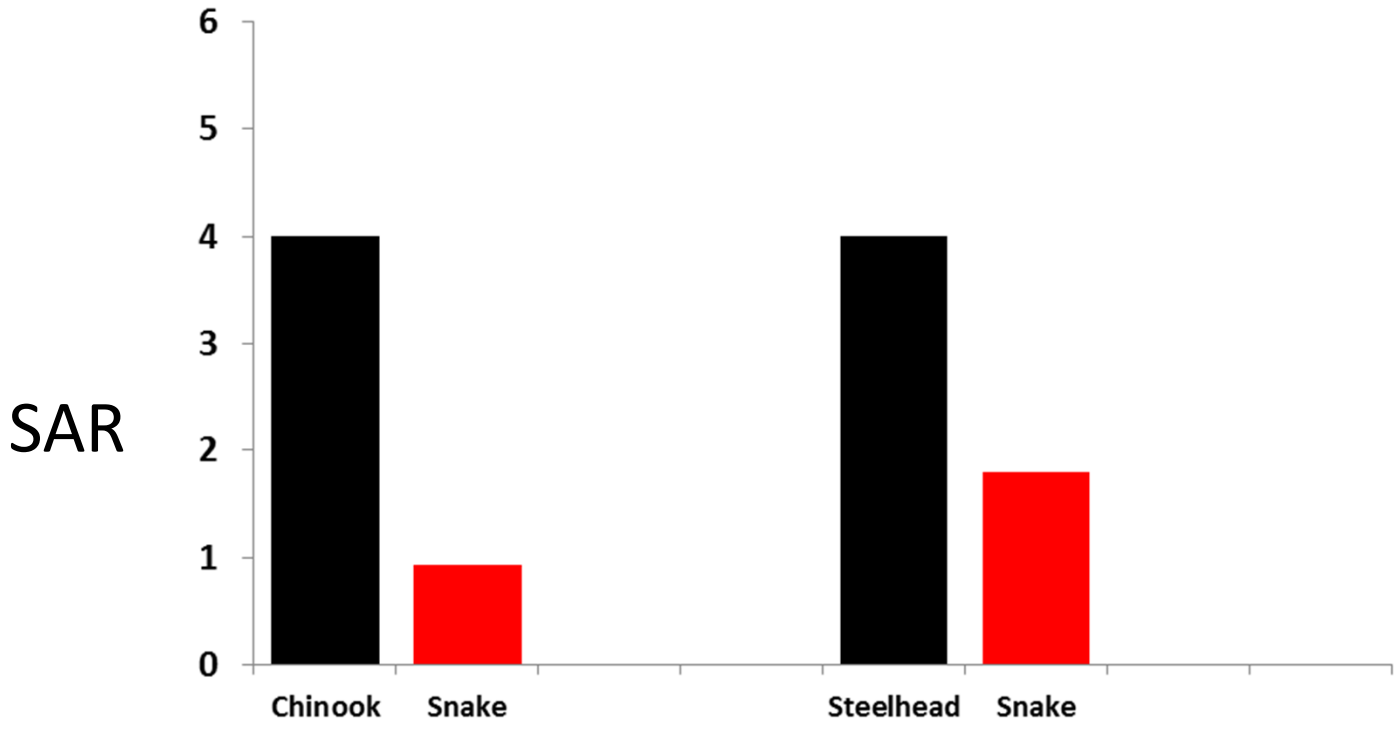

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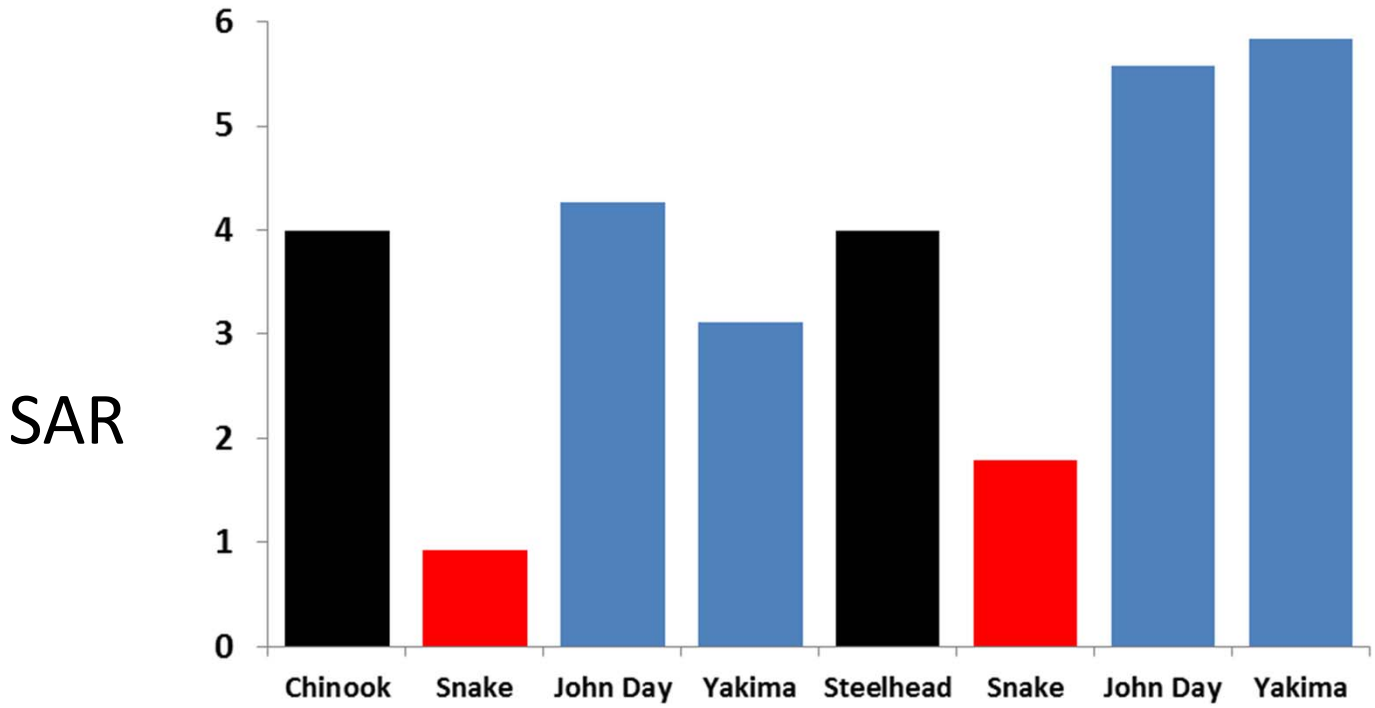
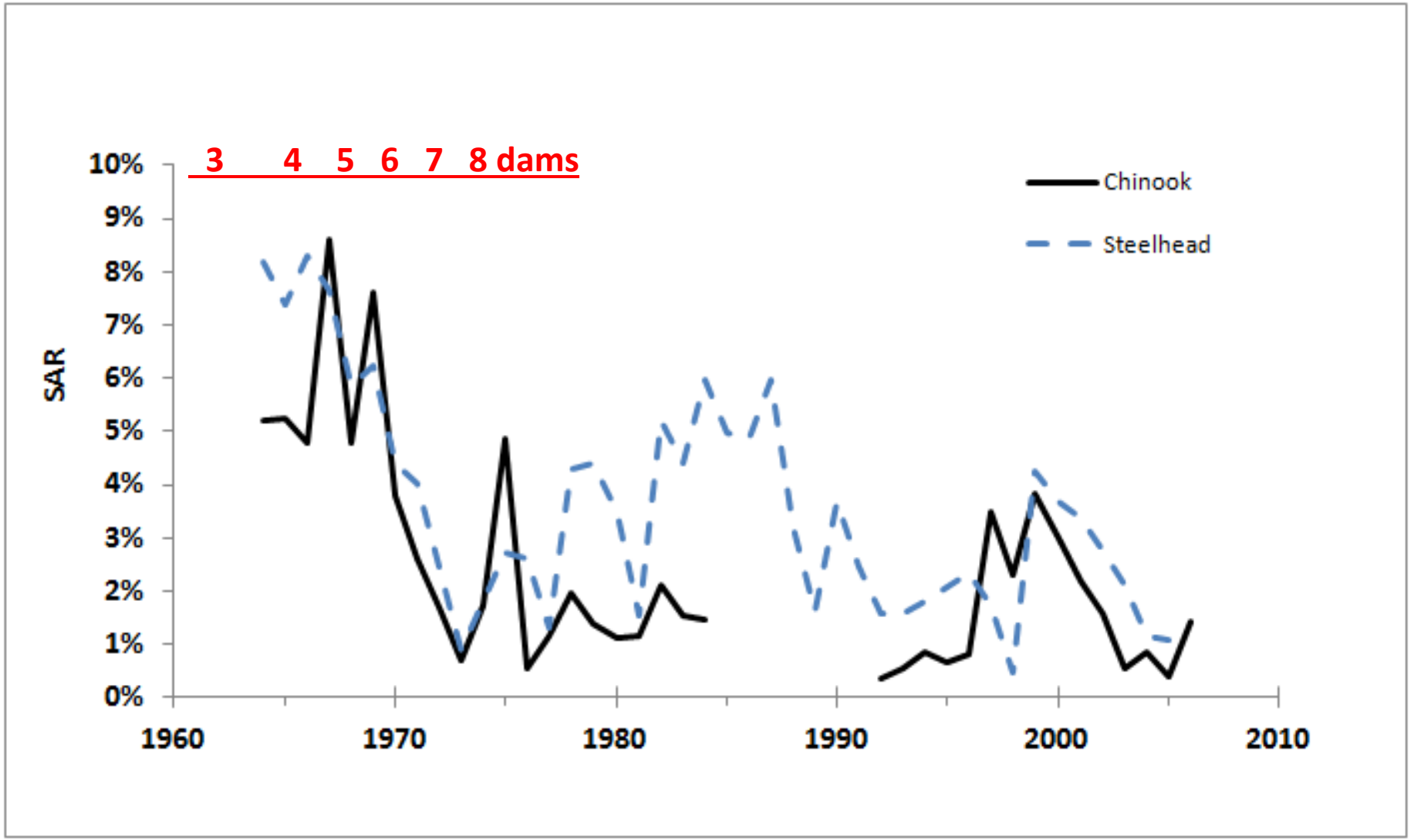


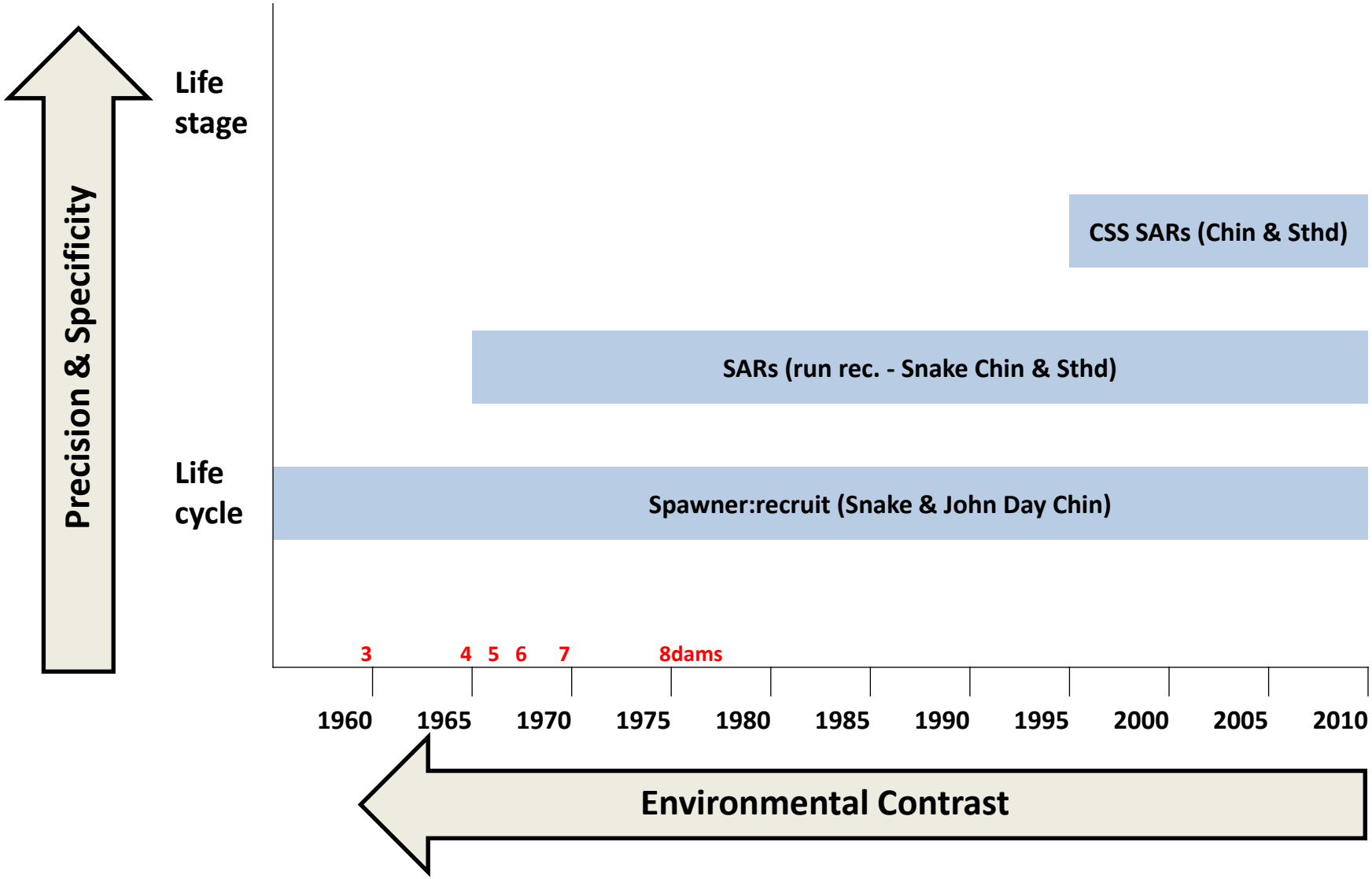
Declines in Snake R. spring/summer Chinook & steelhead survival rates associated with dams

Need to separate dam effects from ocean variability



CSS 2011 Workshop

Multiple lines of evidence for major factors influencing survival rates (weight of evidence approach)



Key Studies – 2011 Workshop

- SARs 1998 to recent (CSS PIT tag):
  - **Spill, water velocity and ocean conditions** influence SARs & marine survival rates
    - Haeseker et al. 2012; TAFS
- SARs 1960s to recent (run reconstruction):
  - **Spill, water velocity and ocean conditions** influence SARs & marine survival rates
    - Petrosky & Schaller 2010; Ecol FW Fish
- Spawner-recruit 1950s to recent:
  - **Spill, water velocity and ocean conditions** influence SARs and adult recruitment
    - Schaller et al. 2014; CJFAS
- Over a dozen peer reviewed publications

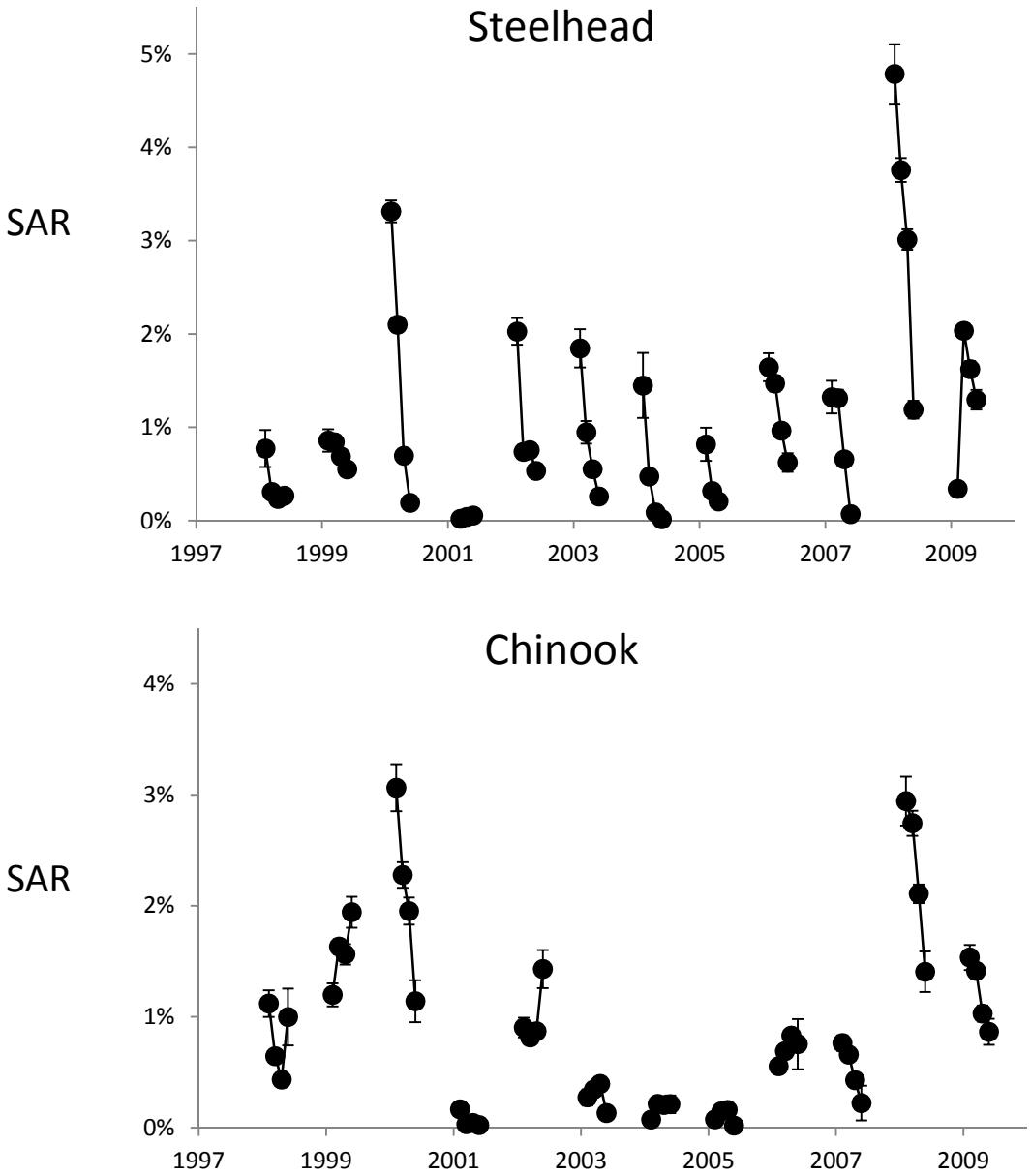
Summary of 2011 Workshop

- SARs and marine survival rates increase:
  - faster water velocity
  - increased spill
  - lower % transported
- Delayed hydrosystem mortality:
  - Chinook: 3X decrease in marine survival rate
  - Steelhead: 2X decrease in marine survival rate
- **Conclusions**:
  - *"The evidence presented for … delayed mortality arising from earlier experience in the hydrosystem is strong and convincing."*
  - *" It is difficult to imagine how [other factors] would align so well both in time and space with the establishment of the hydro system."*

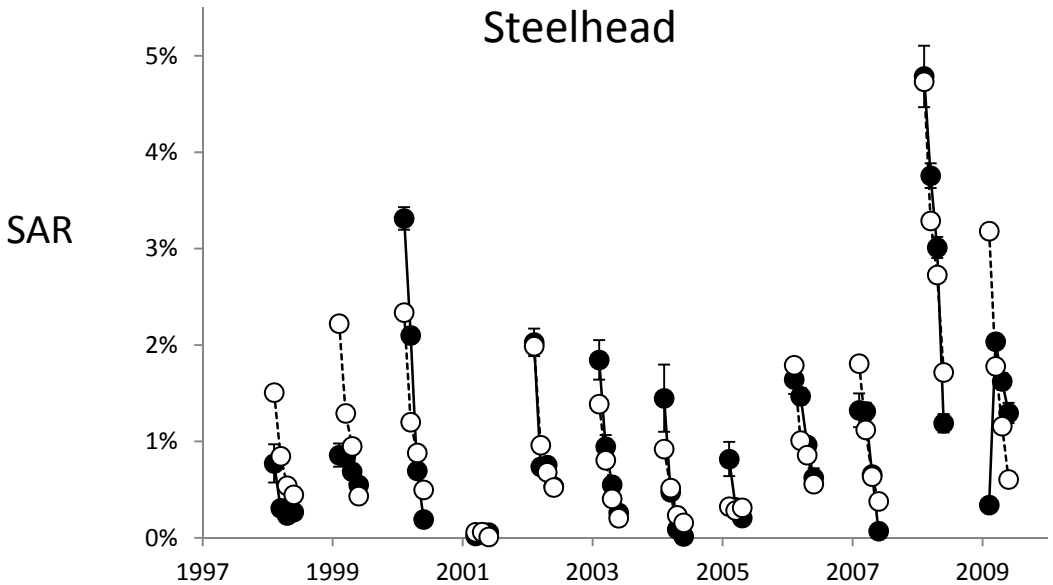
Summary of 2011 Workshop

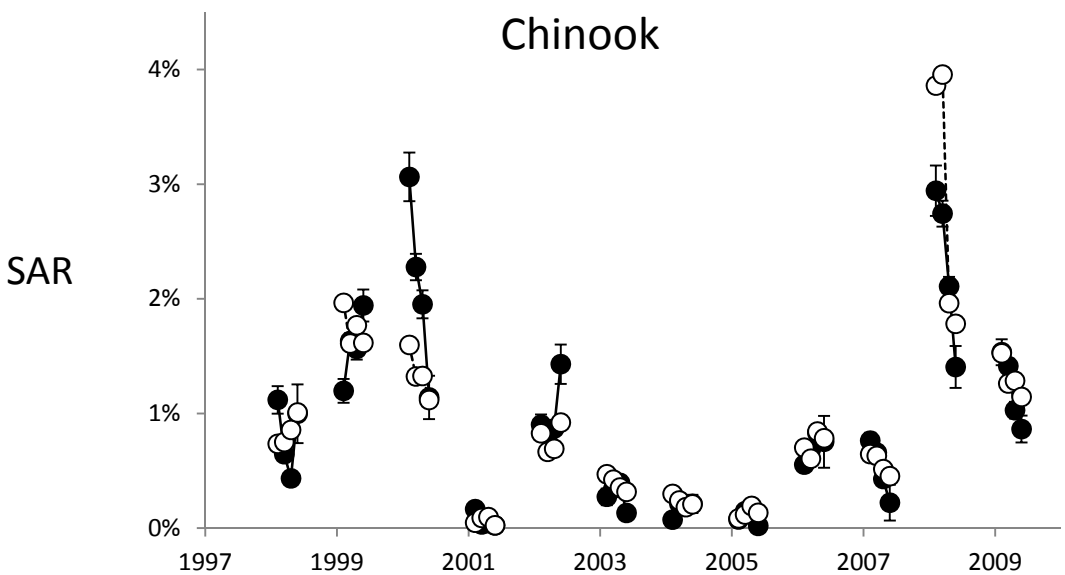
- **Current FCRPS configuration**:
  - Little ability to speed water velocity
  - Opportunity to further manage spill combined with surface passage to reduce powerhouse passages

- **Promising approach**:
  - Develop a management experiment to evaluate potential improvements to SARs by increasing voluntary spill
  - Adaptive Management
  - CSS role - provide a framework for regional consideration
  - CSS 2013 Workshop



- **SARs vary within and between years**





o **Develop models that describe SAR variation:**

<u>Steelhead SARs</u>

- Decrease thru season
- Increase with spill
- Increase with water velocity
- Decrease with warm PDO

<u>Chinook SARs</u>

- Decrease thru season
- Increase with spill
- Increase with water velocity
- Decrease with warm PDO

In-river Passage Routes

Non-powerhouse = Spill (traditional or surface spillway weirs)

Powerhouse = Turbine or juvenile collection/bypass

Direct survival:

spill ≥ bypass > turbine

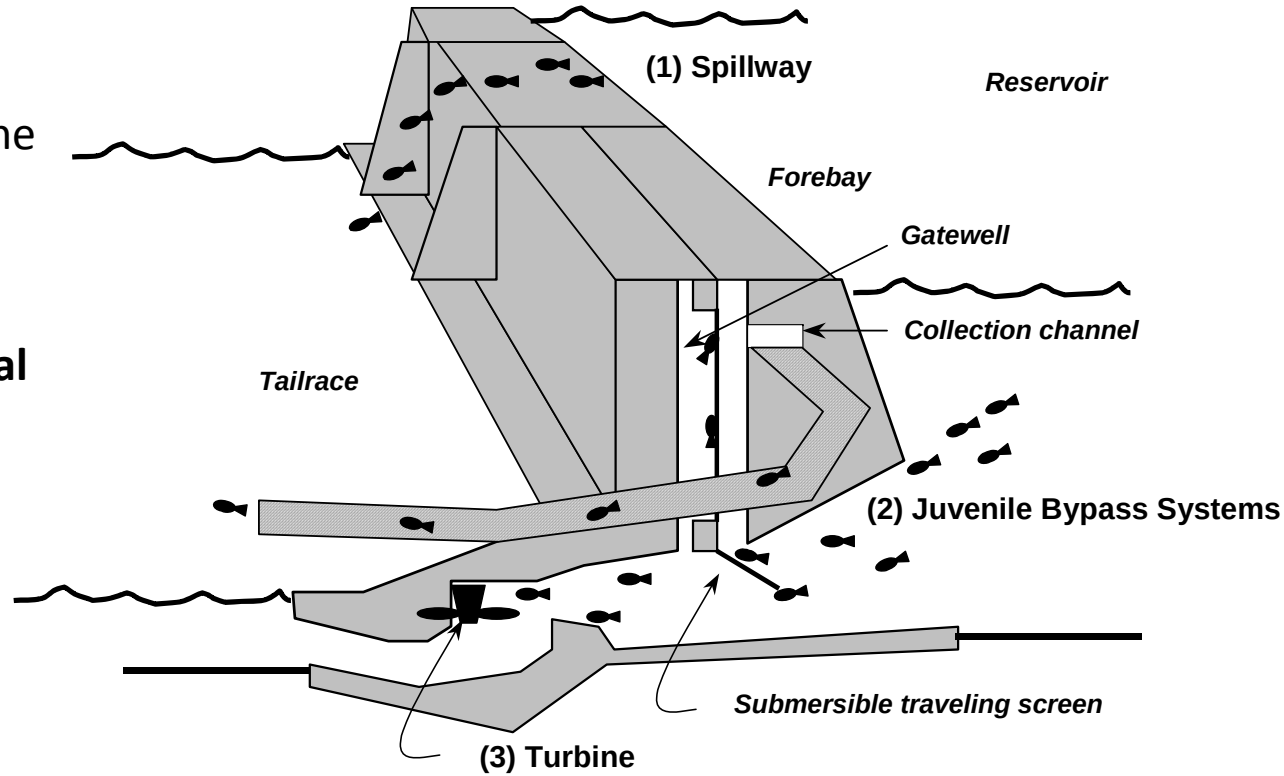
Direct & indirect survival (delayed mortality):

spill > bypass

spill > turbine

Management strategy:

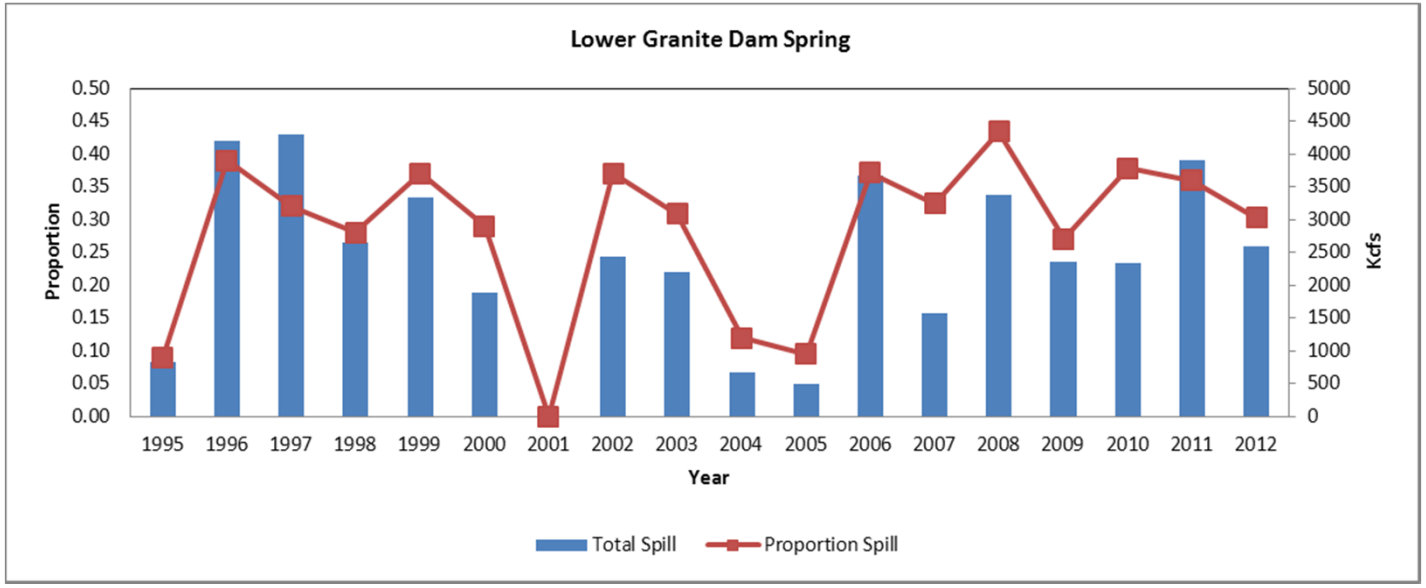
reduce powerhouse passage exposure

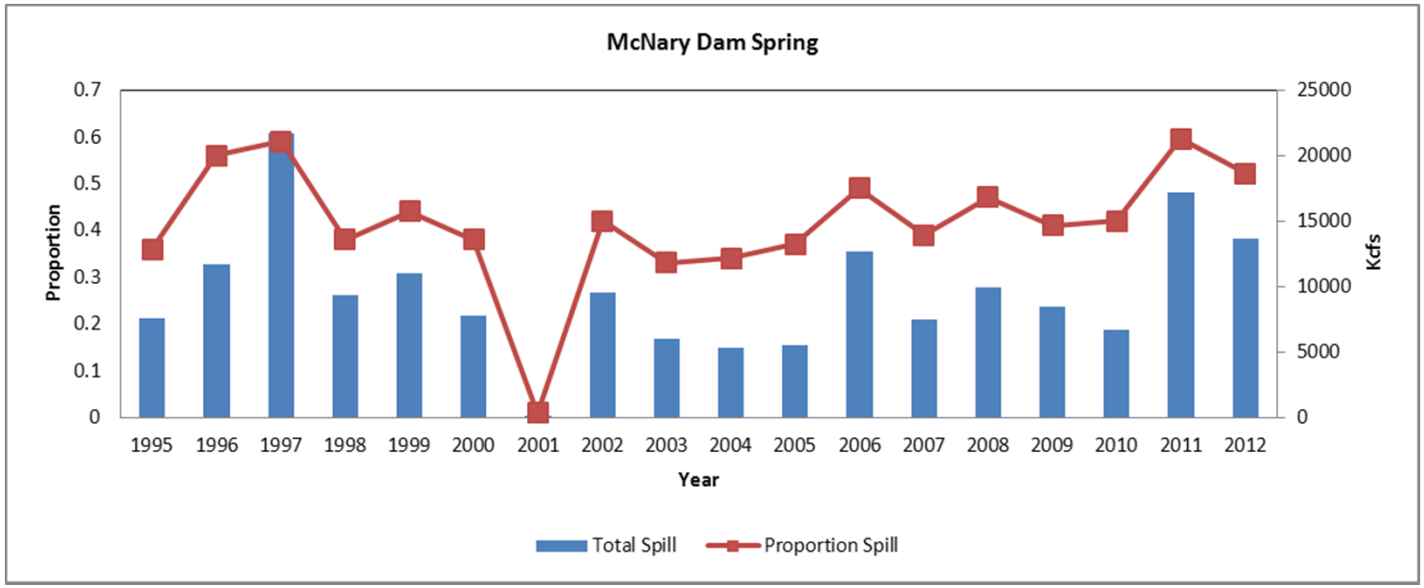


Spill Benefits

- Historic data has consistently shown a juvenile survival advantage
- Spill is a mitigation measure that can be provided in every flow year
- Spill can be provided without impact to reservoir elevations

Variability of Spill 1995-2012

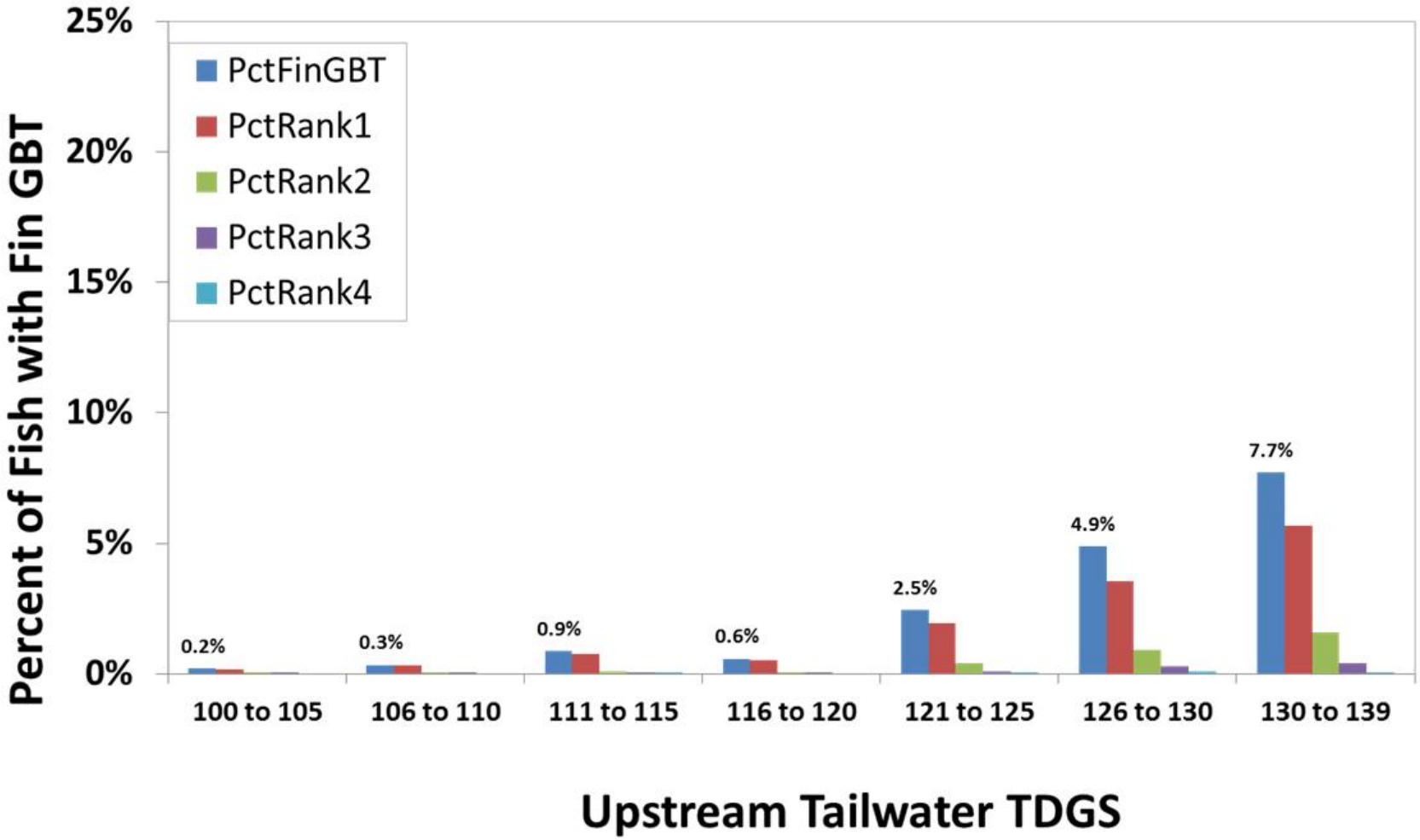




Risk Based Spill Program

- Survival benefits of managed spill > risk of potential TDG related mortality
- Adaptive Management approach- supported by empirical observations:
  - Juvenile survival rates
  - SARs
  - TDG effects

Summary of GBT Samples (1995-2012) as a function of TDG



In Preparation for 2013 Workshop

- Develop estimates of the amount of water that could be spilled (spill caps) at each of the hydroprojects on the Lower Snake and Columbia rivers for the various scenarios modeled for the 2013 workshop.

- Choose representative flow years for prospective modeling.

Summary of 2013 Workshop

- Reviewed historical dissolved gas effects.

- Presented and reviewed draft Experimental Spill Management Design.

- Evaluated four spill levels:
  - Biological Opinion-current
  - 115/120% - current gas cap, lowest increase
  - 120% Tailrace -moderate increase
  - 125% Tailrace - greatest increase

What is experimental design?

Plan **for measuring** ***response*** **to a** ***treatment***

- ***Treatment*** **= increase in spill for fish passage**
- ***Response*** **= change in survival**
- ***Plan*** **= implement CSS monitoring methods**

Elements of "good" experimental design

- **Large contrast (perturbation)**
- **High precision of measured response variable**
- **High degree of replication**
- **Minimize and account for confounding factors**

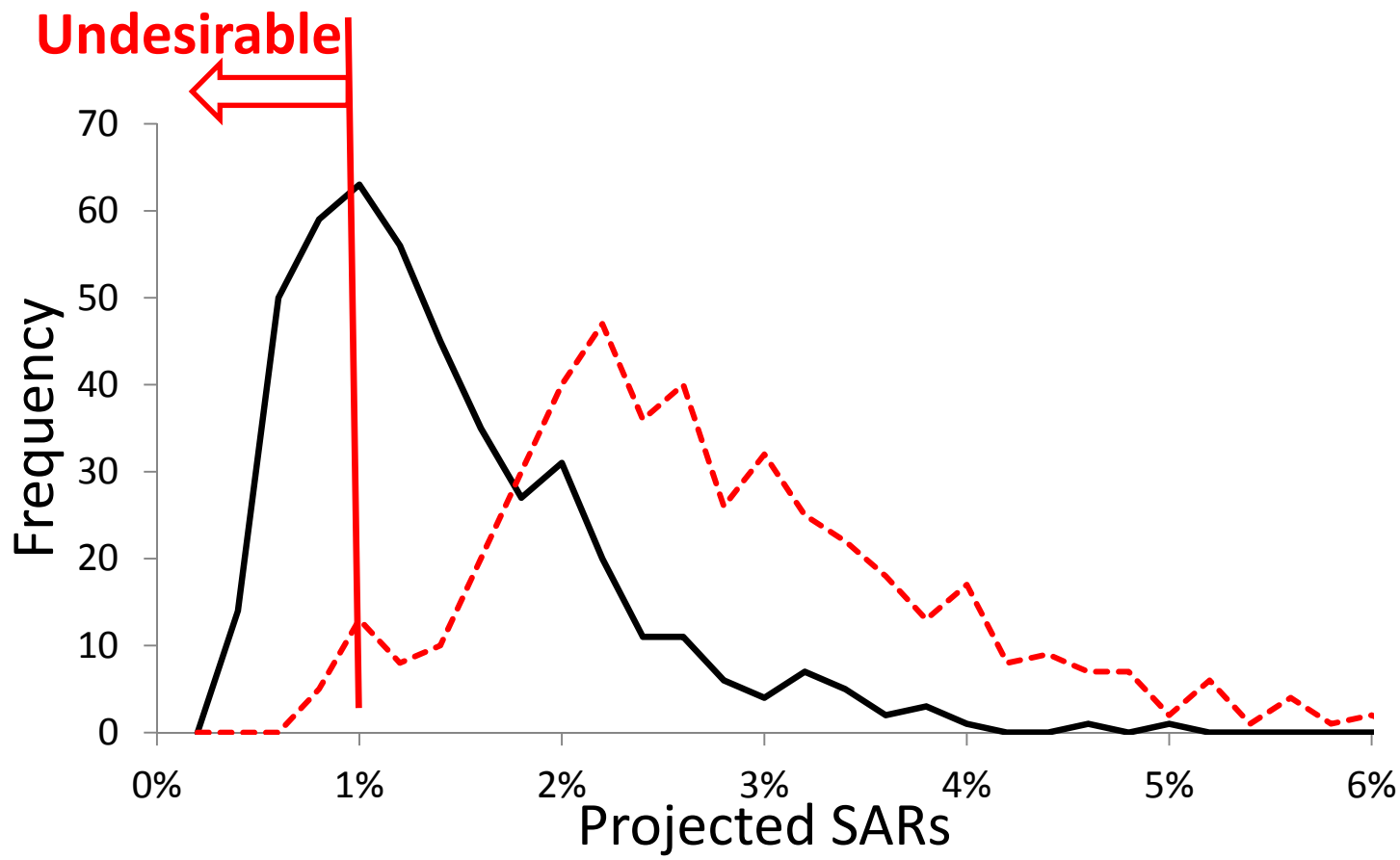
Summary of 2013 Workshop

- Applied peer-reviewed models to spill levels

Prospective tools –

integrating across river and ocean conditions

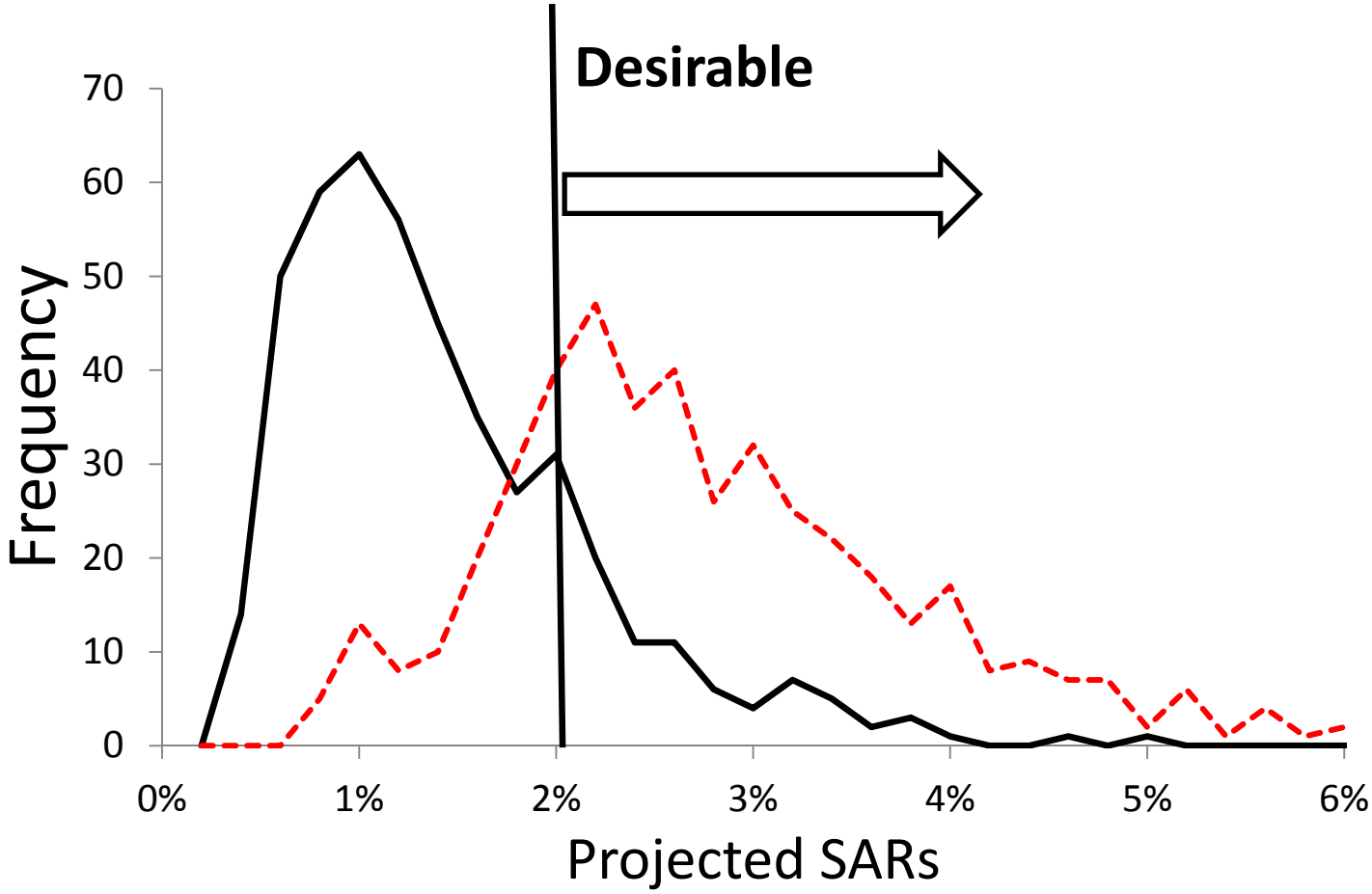
- Summarize distributions relative to desired goals (e.g., population viability)



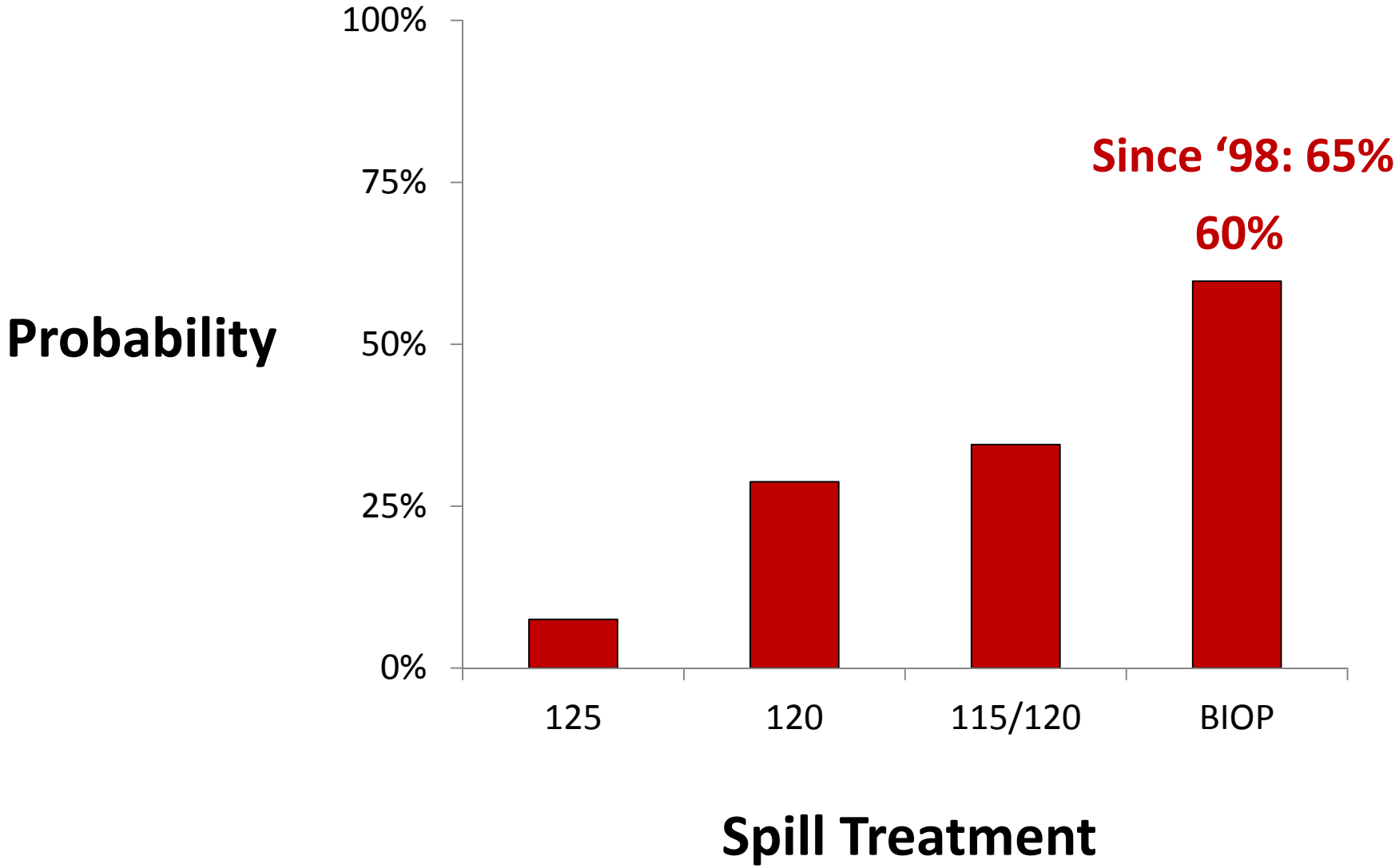
Prospective tools –

integrating across river and ocean conditions

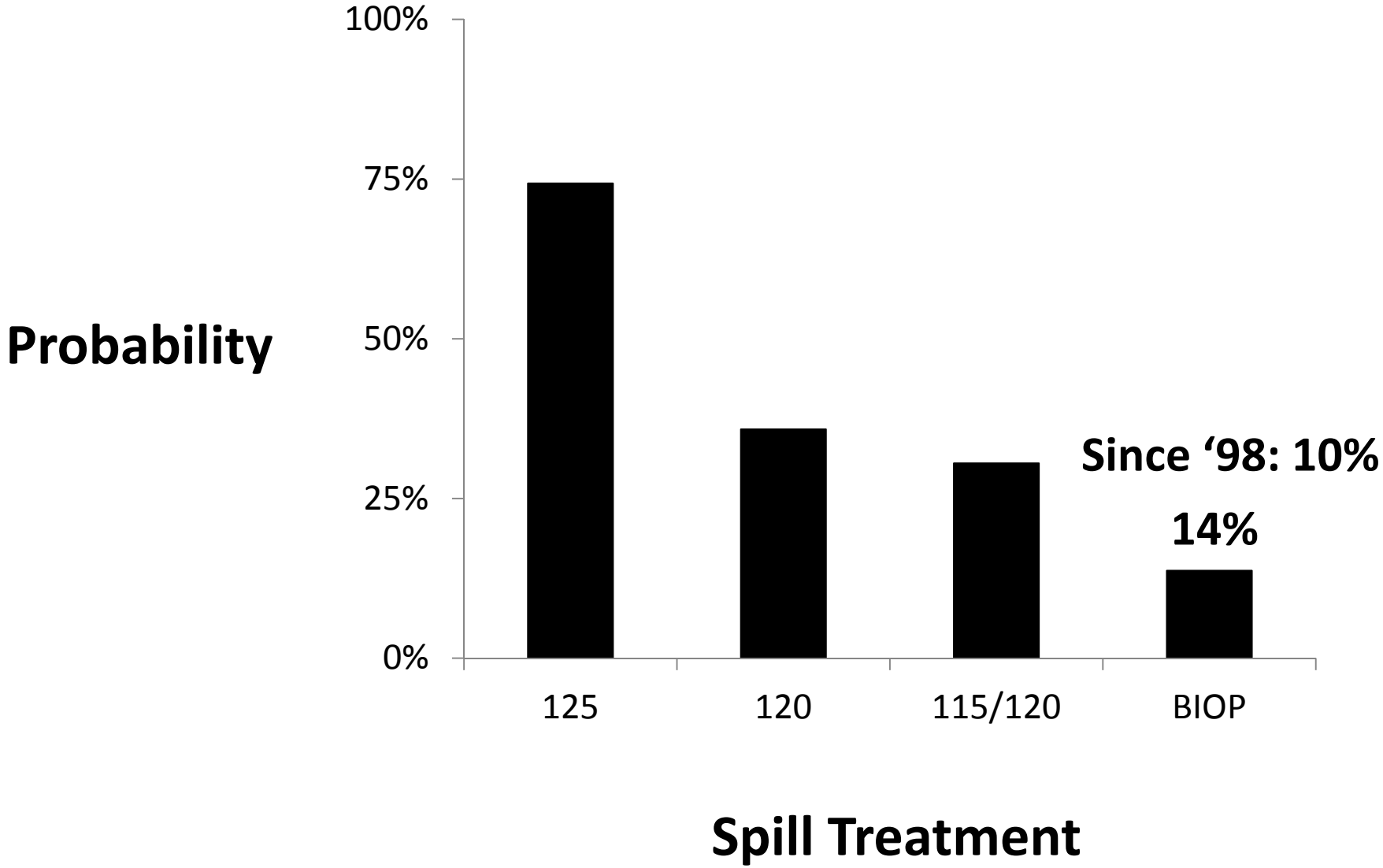
- Summarize distributions relative to desired goals (e.g., NPCC SAR goals, Recovery)



Chinook- Undesirable (< 1% SARS)

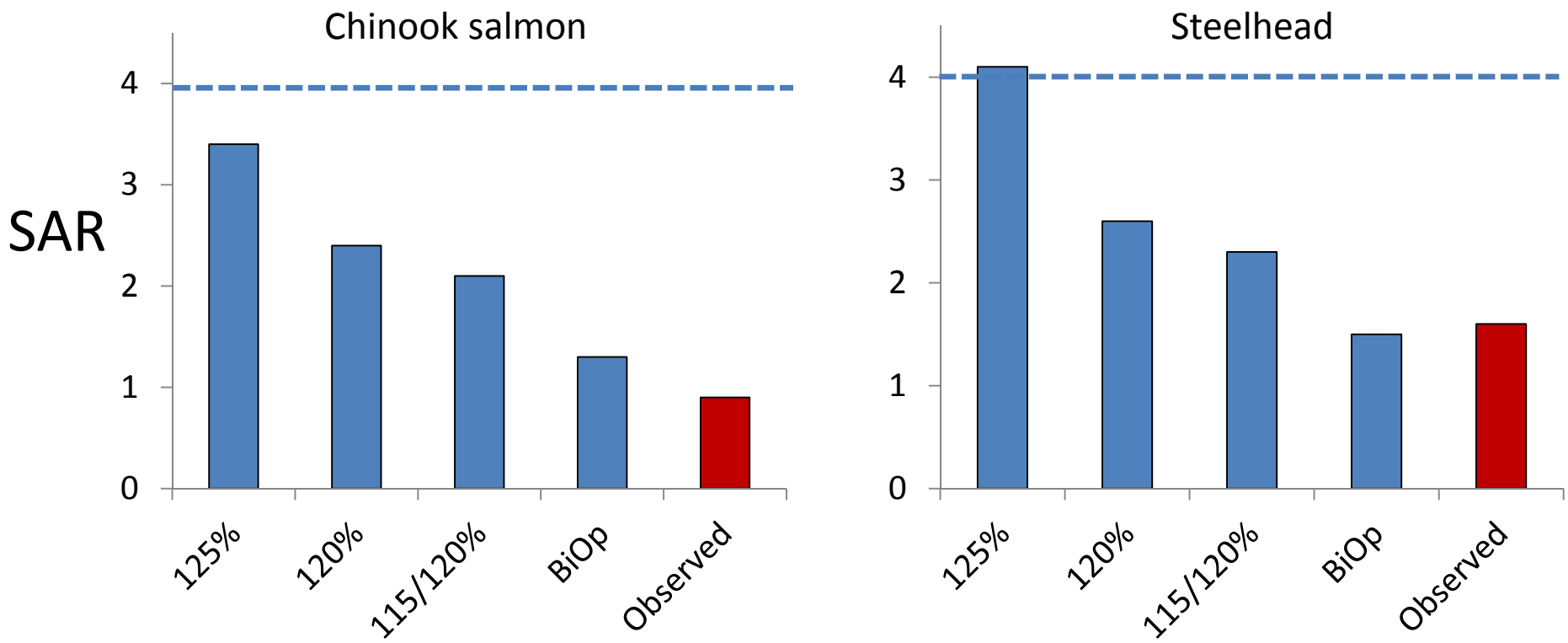


Chinook- Desirable (> 2% SARS)



Summary of 2013Workshop

- Projected mean SARs vs. spill scenario:



Summary:

- Definition of spill scenarios for simulations based on what appears technically possible with current FCRPS configuration
- Biological Planning tool indicates 125% spill level most likely to achieve SAR objectives
- Ongoing CSS analyses provide rigorous monitoring framework
- Expected benefits to Upper- & Mid-Columbia stocks
  - These stocks provide for additional monitoring/learning
- Simulations are encouraging in terms of:
  - expected response (conservation benefit)
  - likelihood of detecting response (learning)

Questions?