June 9, 2020

MEMORANDUM

TO: **Fish and Wildlife Committee Members**

FROM: **Leslie Bach and Patty O'Toole**

SUBJECT: **Update on Comparative Survival Study project**

BACKGROUND:

Presenters: Jerry McCann, Fish Passage Center; Robert Lessard, Columbia River Inter-tribal Fish Commission; Steve Haeseker, U.S. Fish and Wildlife Service

Summary: Staff from the Fish Passage Center and members of the Comparative Survival Study (CSS) Oversight Committee will provide an overview of the CSS. They will describe the background and goals of the CSS and its relationship to the Council and ongoing regional processes. The presentation will provide a general summary of the study's analysis methods and results, as well as specific information on the results from the CSS analysis of the Columbia River System Operations Draft EIS.

Relevance: The CSS provides data and analyses that support measures in the Mainstem hydrosystem flow and passage operations sub-strategy of the 2014 Columbia River Fish and Wildlife Program to improve fish passage and survival through the hydrosystem.

Background: The CSS is a long-term Columbia River mainstem life cycle monitoring program, initiated in 1996. CSS data and life cycle analyses are conducted by the Comparative Survival Study Oversight Committee, which is comprised of representatives of the Columbia River Intertribal Fish Commission, the Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, the Idaho Department of Fish

and Game, the US Fish and Wildlife Service and the Fish Passage Center. All CSS data and analyses are available to the public on the Fish Passage Center website. The CSS is reviewed on a regular basis by the Independent Science Advisory Board, as well as by others both within and outside the region.

More Info: CSS 2020 Annual Meeting Presentations

ISAB Review of the Comparative Survival Study Draft 2019 Annual Report

ISAB Review of Chapter 2 of the Comparative Survival Study 2019 Annual Report

Introduction to Comparative Survival Study

Jerry McCann

Presentation to NPCC June 2020

Background

- **CSS was initiated in 1996 by states, tribes & USFWS to estimate salmon survival rates at various life stages**
  - **Designed to assess effects of hydro-system operations on state, tribal, and federal fish hatcheries**
  - **To answer question posed by PATH –** "can transportation . . . compensate for the effect of the hydro-system?"
  - **Meets NPCC identified need to collect annual migration characteristics including survival**
  - **Provides research, monitoring and evaluation that NOAA biological opinions require**
- **Management-oriented large scale monitoring**
  - **Observational study – over a long period**

Background

- **GOALS**

  (1) Quantify the efficacy of transportation

  - **Develop a representative in-river control group**

  (2) Compare survival rates among populations

  (3) Establish long-term data sets

  (4) Collaboration and transparency

Background

- **Collaborative scientific process was implemented for study design and to perform analyses**

- **CSS project independently reviewed and modified many times as a result**
  - **Draft report typically posted – Aug 31st**
  - **Reviewed by Independent Scientific Advisory Board (ISAB), Independent Scientific Review Panel (ISRP) and other entities**

History of ISAB/ISRP Review

ISAB began reviewing CSS Annual Reports in 1997; and have recommended refinements and additions

1997 – 2002

- Extend method to other species & life history types (e.g., steelhead)
- Refine processes for variance estimation (Bootstrap)

2003 – 2006

- Evaluate the relation between reach survival and flow
- Develop finer scale analysis of survival and specific operational actions and environmental features
- Develop a ten year summary report
- Coordinate with other regional tagging/monitoring efforts

History of ISAB/ISRP Review

ISAB began reviewing CSS Annual Reports in 1997; and have recommended refinements and additions

2007 – present

- ISAB/ISRP Reviewed CSS 10 Year Report
- Continued reviews of Annual Reports with new recommendations

Other agencies, and individuals have reviewed the CSS over the years

- CSS responds to all comments and incorporates changes when appropriate

The CSS is a joint project of the state & tribal fishery managers and the USFWS

DESIGN

- WDFW, CRITFC, USFWS, ODFW, IDFG (Oversight Committee)

IMPLEMENTATION & TAGGING

- FPC: Logistics, coordination
- PTAGIS: Raw Data; FPC: Reports, Estimates

DATA PREPARATION & ANALYSIS

- CSS Oversight Committee
- Fish Passage Center

REGIONAL REVIEW

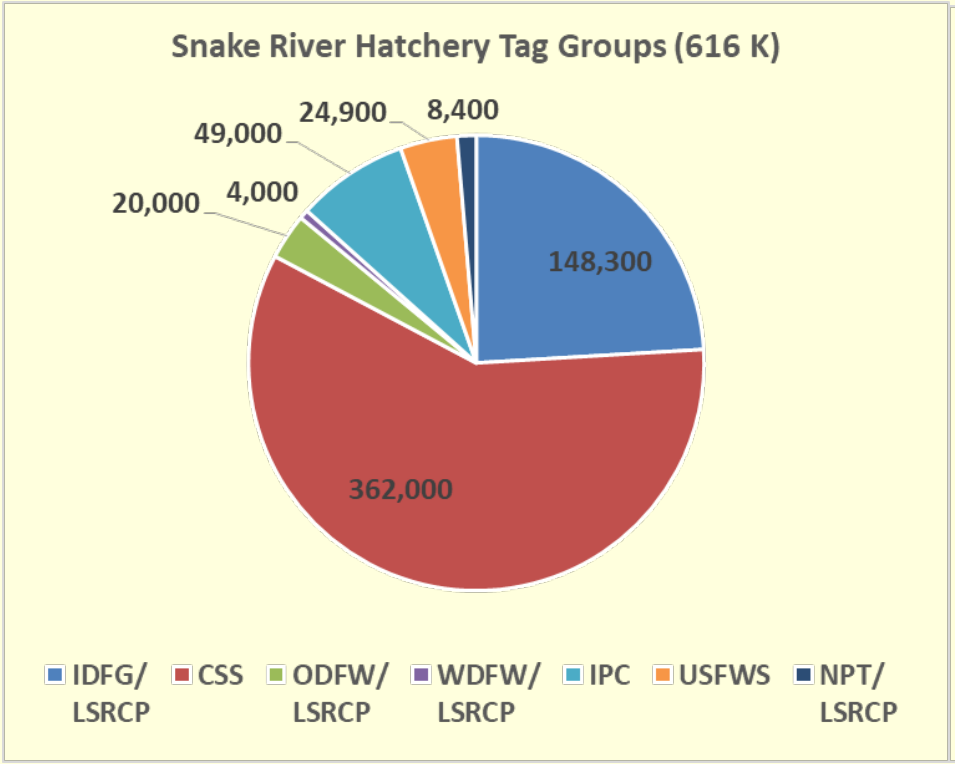
- Draft on BPA & FPC websites
- Regional Public Review; ISAB, ISRP, FPAC, NMFS, etc.

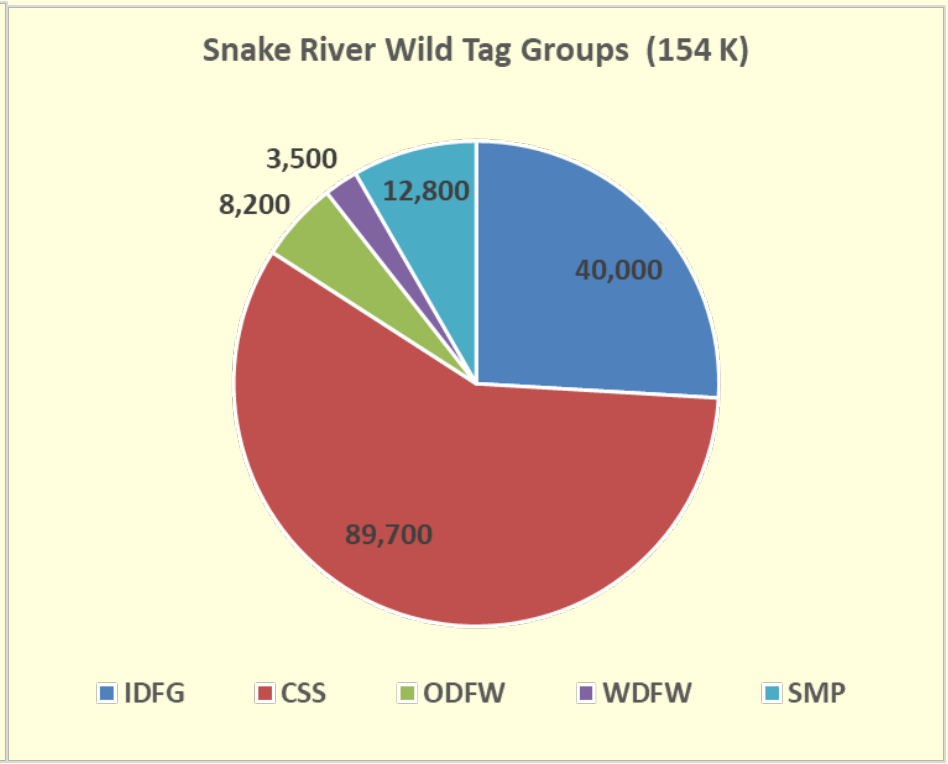
FINAL REPORT

- Posted on BPA & FPC websites

Background

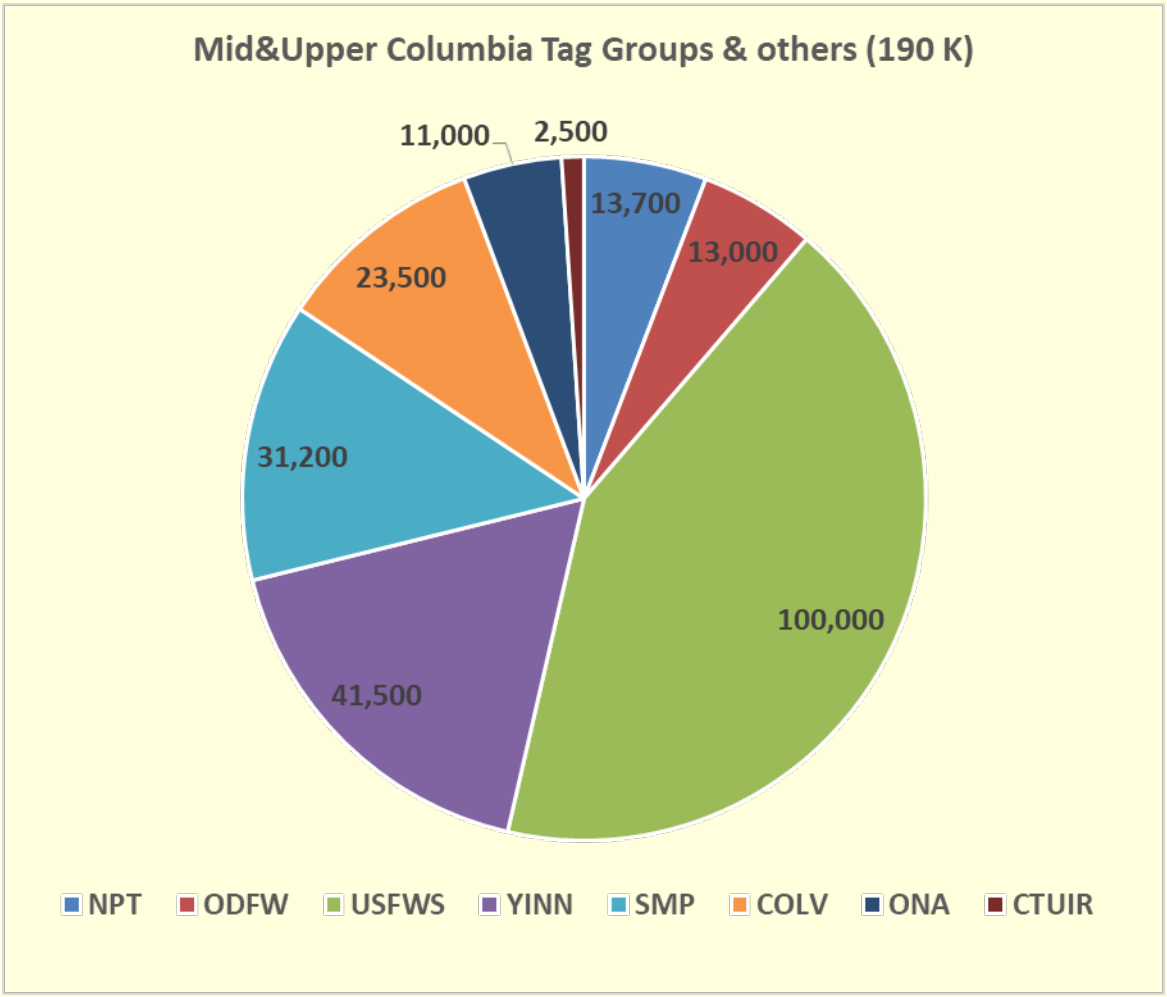
- **CSS data and analyses are derived from PIT tags (~1 million in 2019)**
  - **Tagged cooperatively and preassigned for use in CSS (616K Hatchery, 154K Wild)**



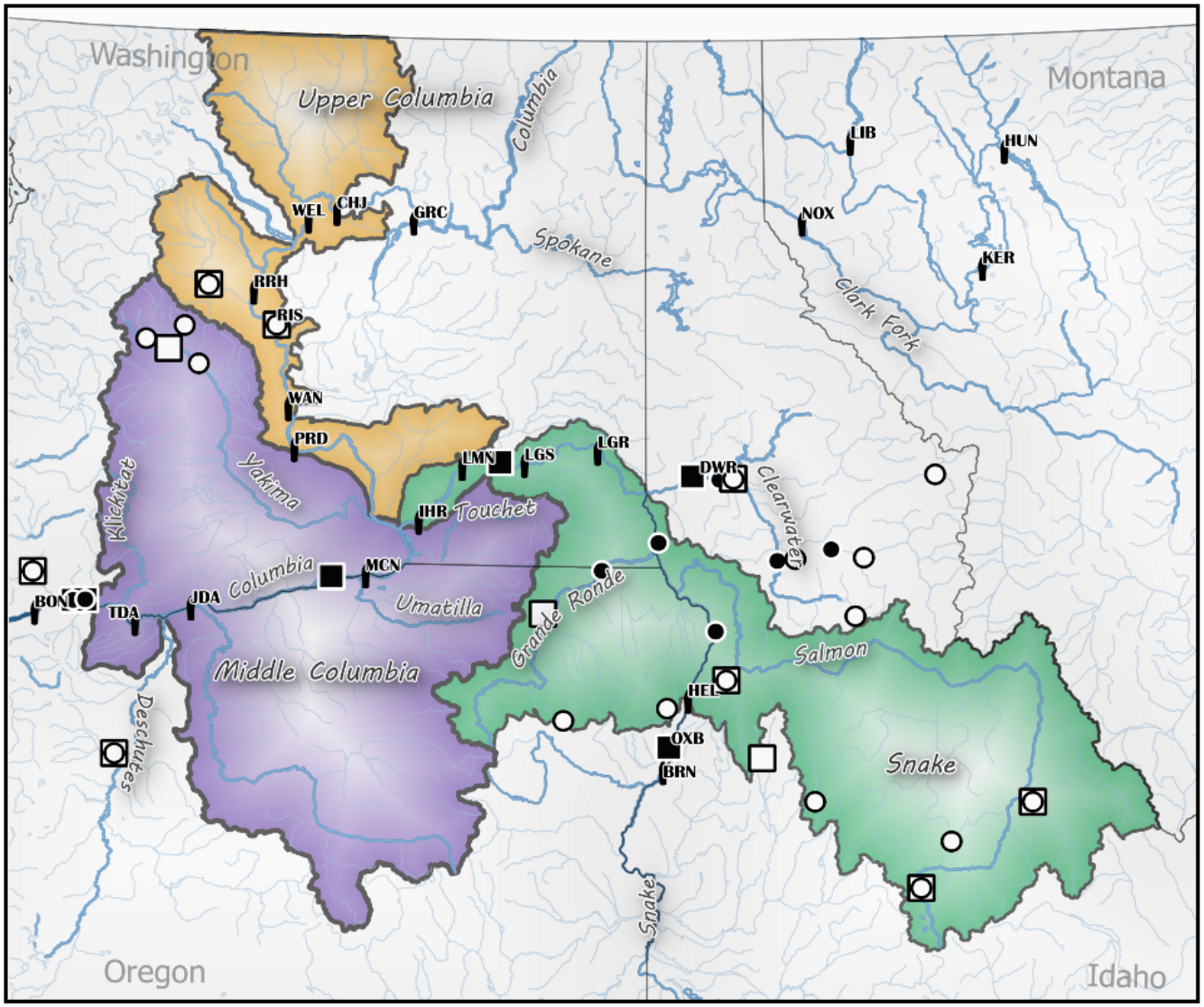


Background

- **CSS data and analyses are derived from PIT tags (~1 million in 2019)**
  - **Tagged for other studies (190 K)**



CSS PIT-Tag & Release Sites
Hatchery Chinook

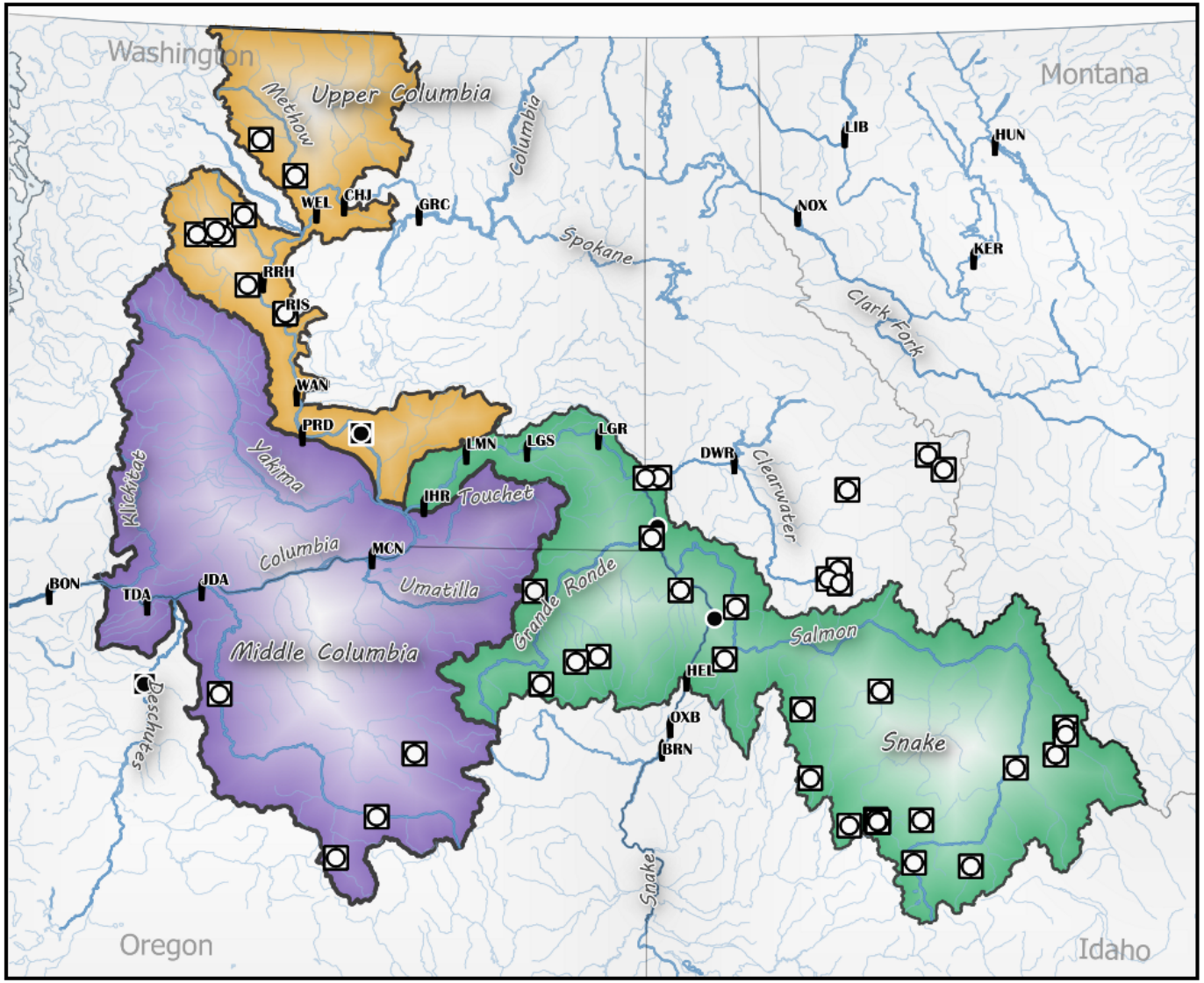


Spring/Summer Chinook Release Sites
Spring/Summer Chinook Tag Sites
Fall Chinook Release Sites
Fall Chinook Tag Sites
Dams

Chinook ESUs
Upper Columbia
Middle Columbia
Snake

25 0 25 50 75 100 Miles

CSS PIT-Tag & Release Sites
Wild Chinook



○ Spring/Summer Chinook Release Sites
□ Spring/Summer Chinook Tag Sites
● Fall Chinook Release Sites
■ Fall Chinook Tag Sites

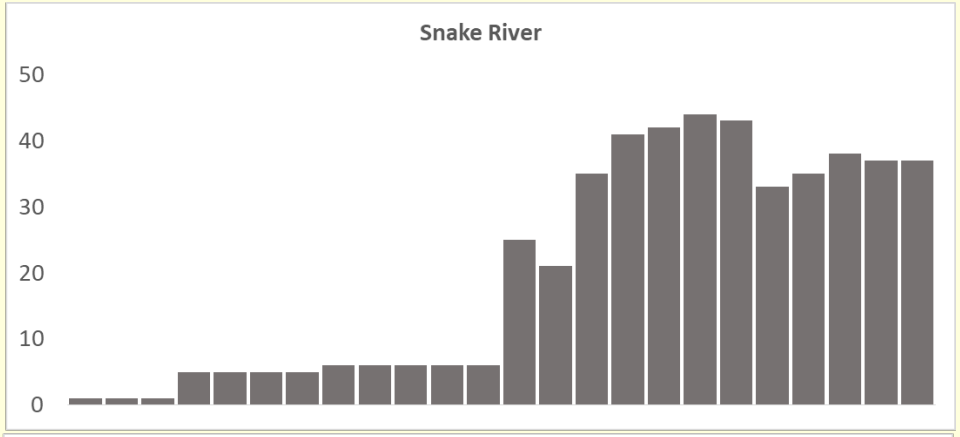
Chinook ESUs
- Upper Columbia
- Middle Columbia
- Snake

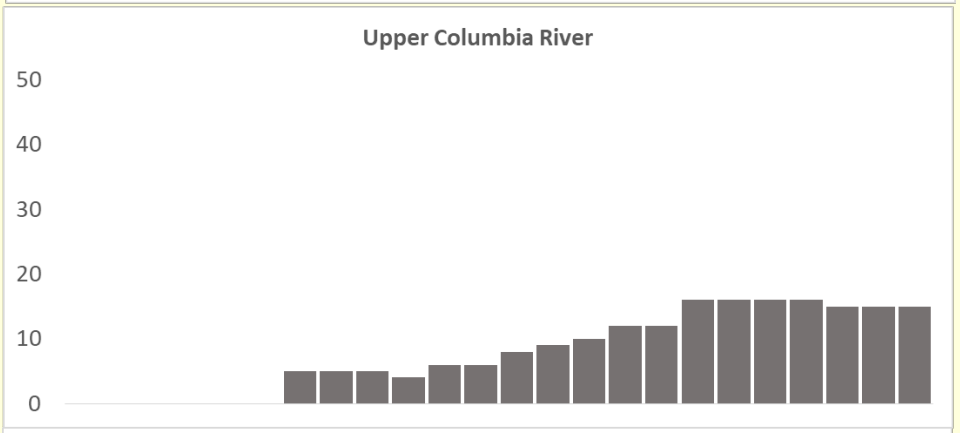
N

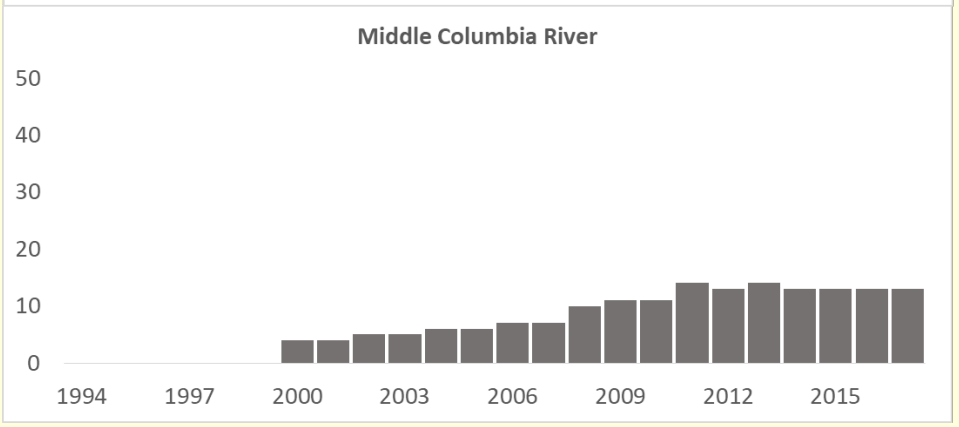
25 0 25 50 75 100 Miles

TIME SERIES OF SARS

- Snake River
  - Longest time series
  - More groups developed
    - Increasing w/ time (38 for 2017 Migr. Yr.)
      - Sp/su Chinook, fall Chinook, steelhead, sockeye
- Upper Columbia R.
  - Began in Migr. Yr. 2000 (BON detects)
  - 15 groups
- Middle Columbia R.
  - Began in Migr. Yr. 2000 (BON detects)
  - 13 groups

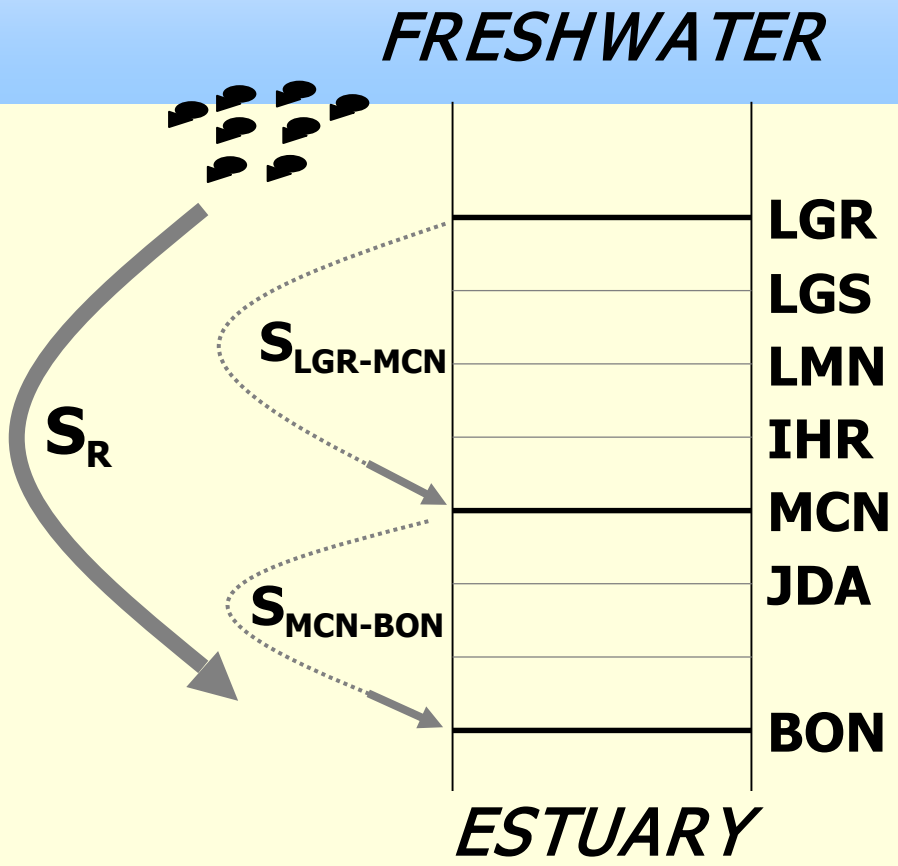






Smolt Survival

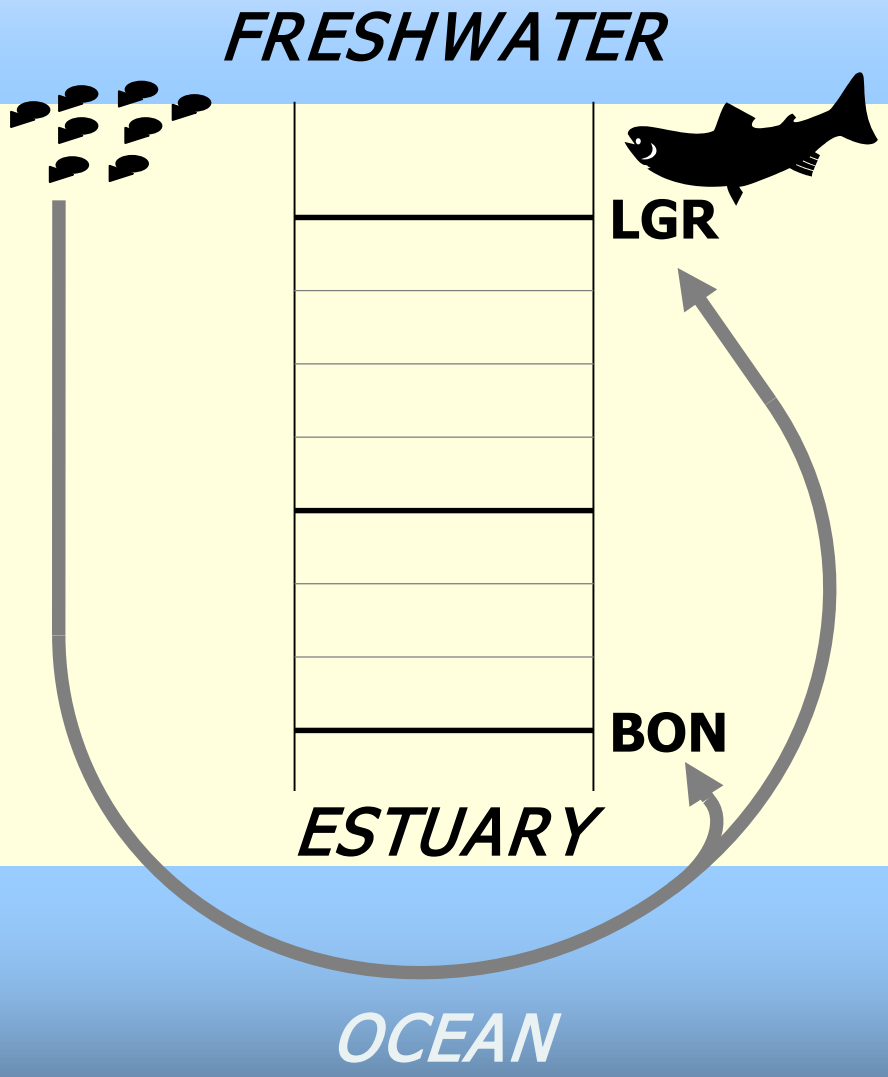
Rearing Habitat Actions



Hydro-system Actions

OCEAN

Snake River SARs



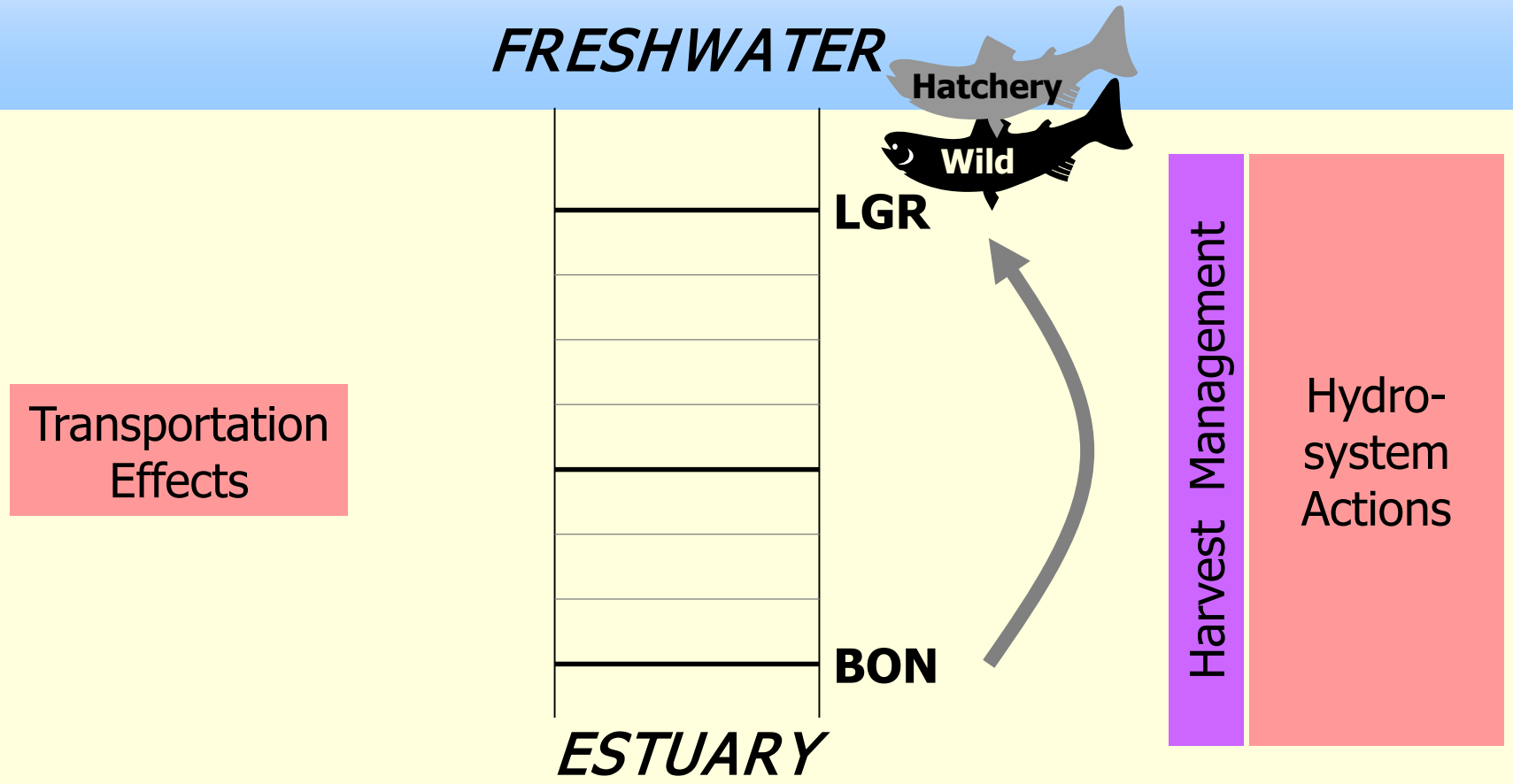
Transportation or bypass effects

Harvest Management

Hydro-system Actions

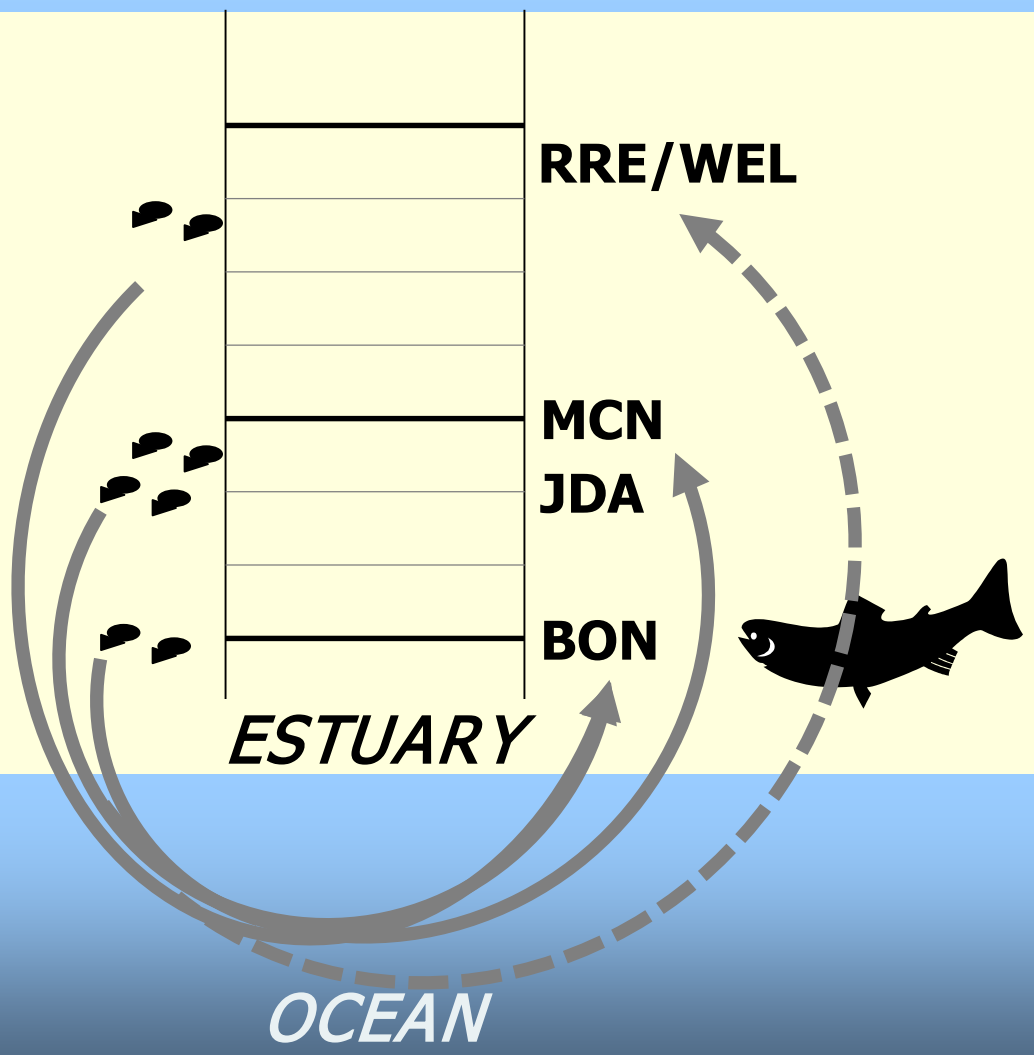
Estuary Habitat Actions

Adult Success



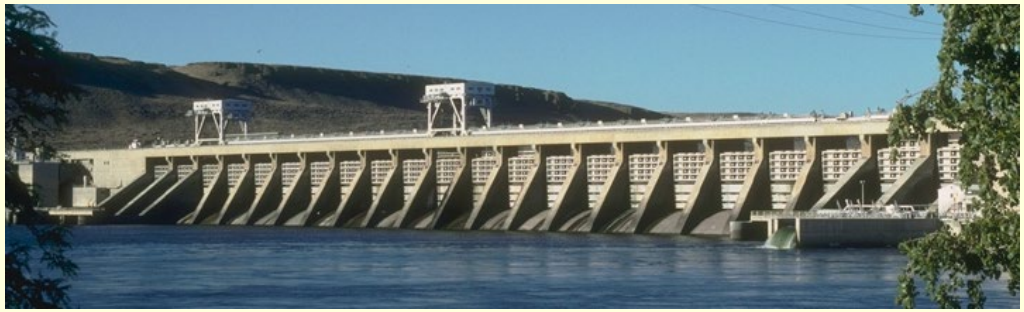
Mid and Upper Columbia R. SARs

Regional Monitoring & Evaluation



What does CSS provide for the region?

- **Long time series of data that is consistently collected; analytical program developed and implemented in a collaborative process**
- **Information easily accessible and transparent**
  - **CSS PIT-tags accessed by any PTAGIS users, including fisheries managers, researchers, and academics**
  - **Metrics derived from tags are published via FPC website**
- **Long term indices (identify bottlenecks):**
  - *Travel Times*
  - *In-river Survival Rates*
  - *In-river SARs by route of passage*
  - *Transport SARs*
  - *Adult success, conversion*
- **Comparisons of SARs**
  - *Transport to In-River*
  - *NPCC Regional SAR goal*
  - *By geographic location*
  - *By hatchery group*
  - *Hatchery to Wild*
  - *Chinook to Steelhead*



- *<u>Management questions:</u> hydropower operations, hatchery evaluations, habitat evaluations*

CSS metrics, models, and CRSO alternatives

Over a decade of research on factors influencing biological performance of salmon and steelhead:

2011 CSS Workshop
- Identify freshwater and marine factors
- Develop tools to optimize hydropower operations

2013 CSS Workshop
- Review and refine draft design of spill management experiment

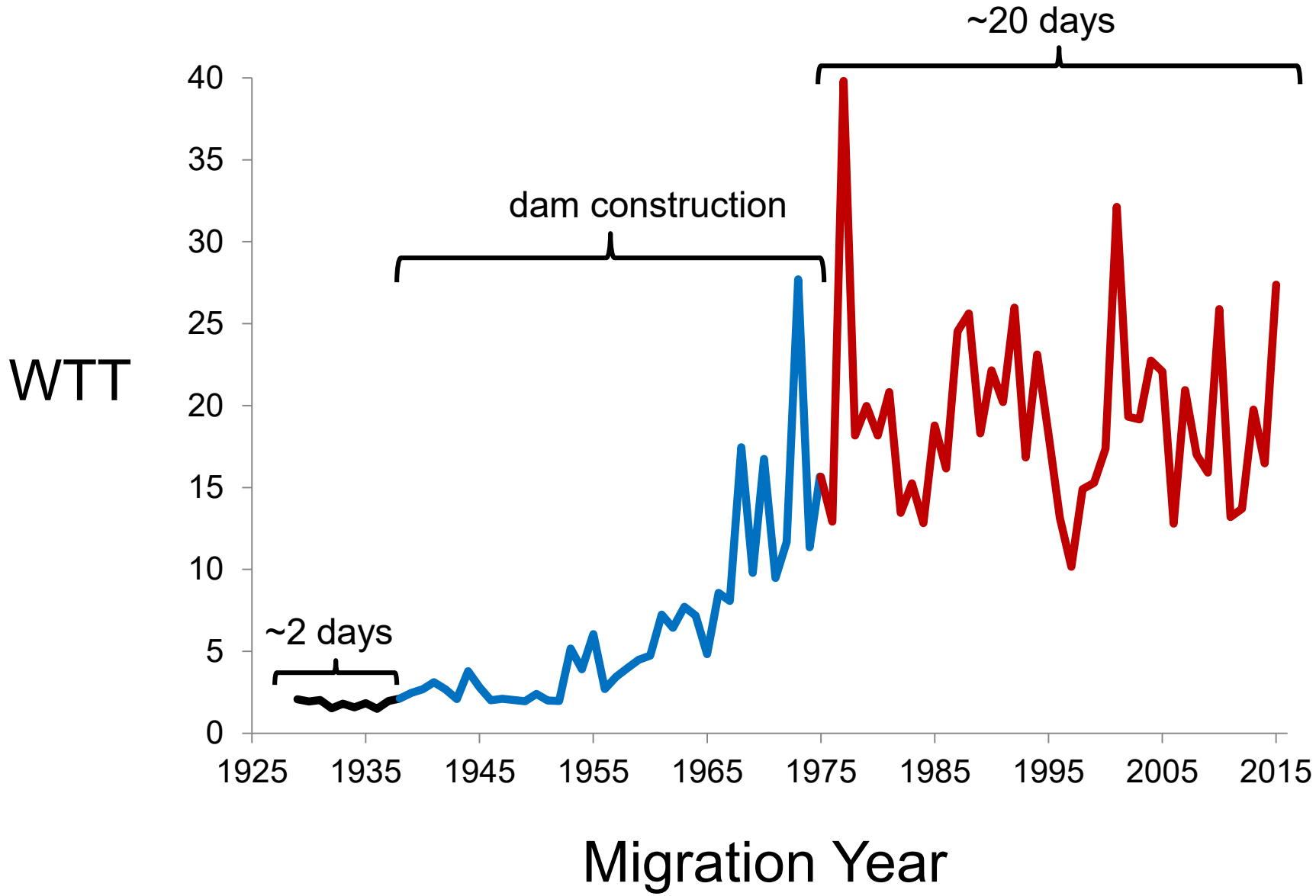
2017 CSS response to ISAB
- Describe models to evaluate experimental spill management
- Quantify expected performance of spill management scenarios

Cohort Model Response Metrics:

(Snake River yearling Chinook and steelhead)

- Juvenile fish travel time
- Juvenile survival
- Ocean survival
- Smolt-to-Adult Return
- Transport:In-river Ratio

Long-term changes in Lewiston-BON WTT



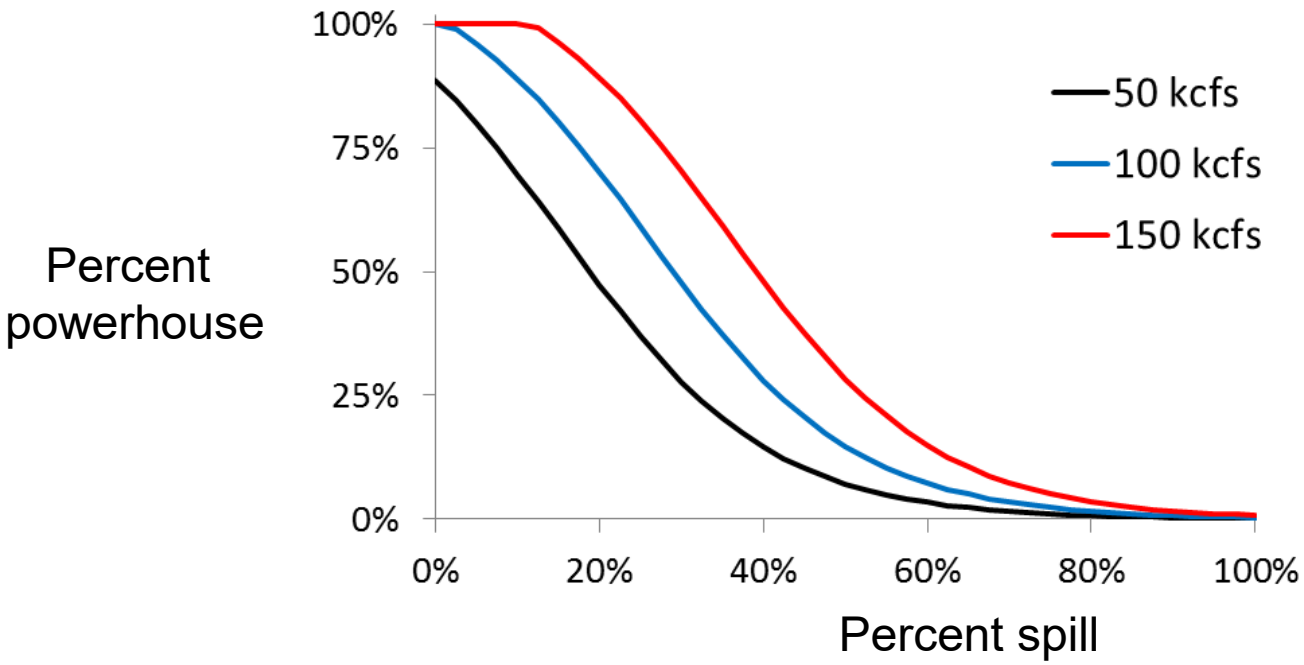
Characterizing fish passage through dams

PowerHouse passage experiences (PITPH)

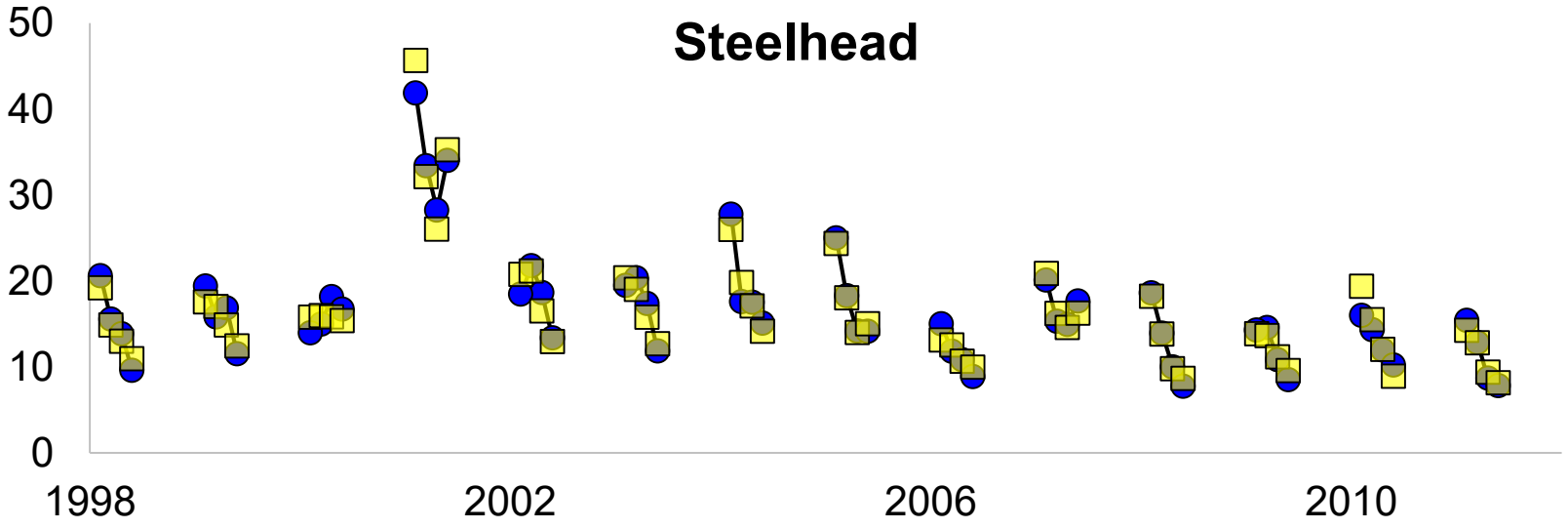
Incorporates spill proportion, flow, and spillway surface passage

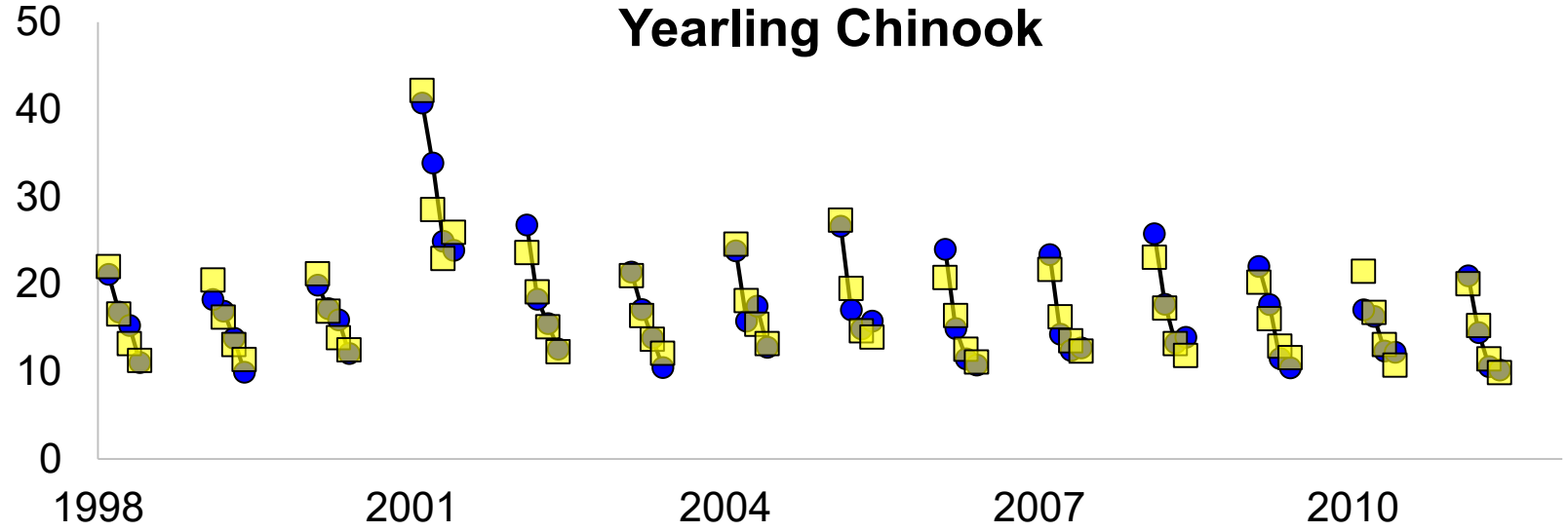
Powerhouse = Turbines + collection/bypass system

Spillway = 1 - Powerhouse

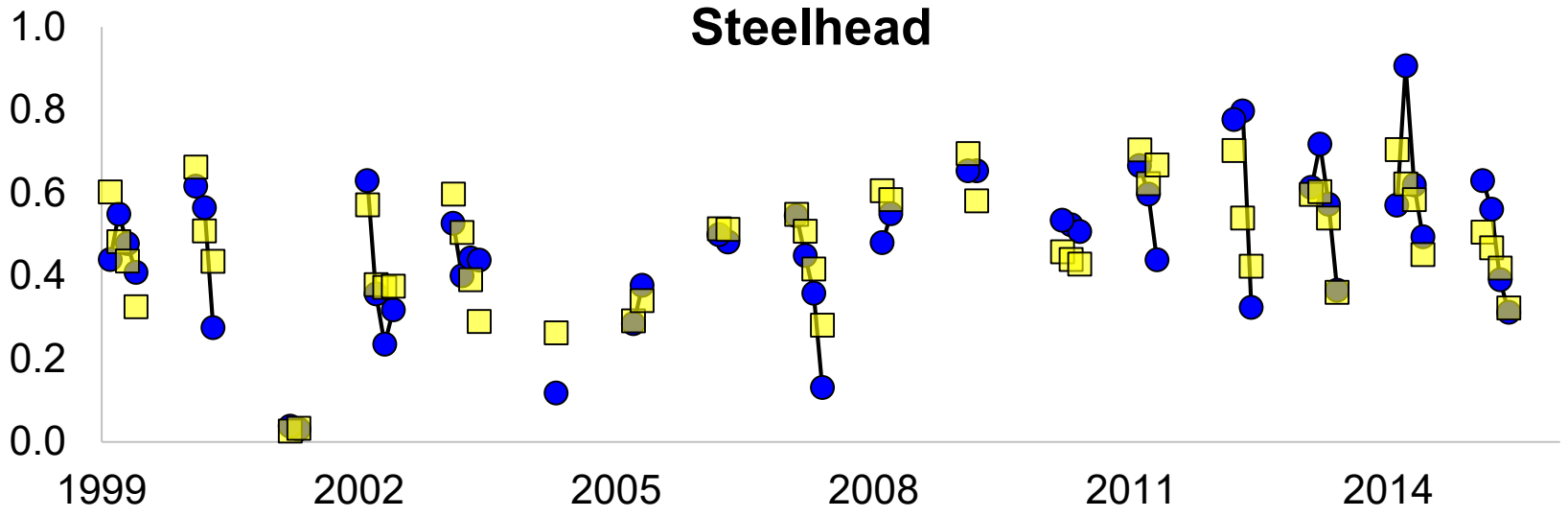


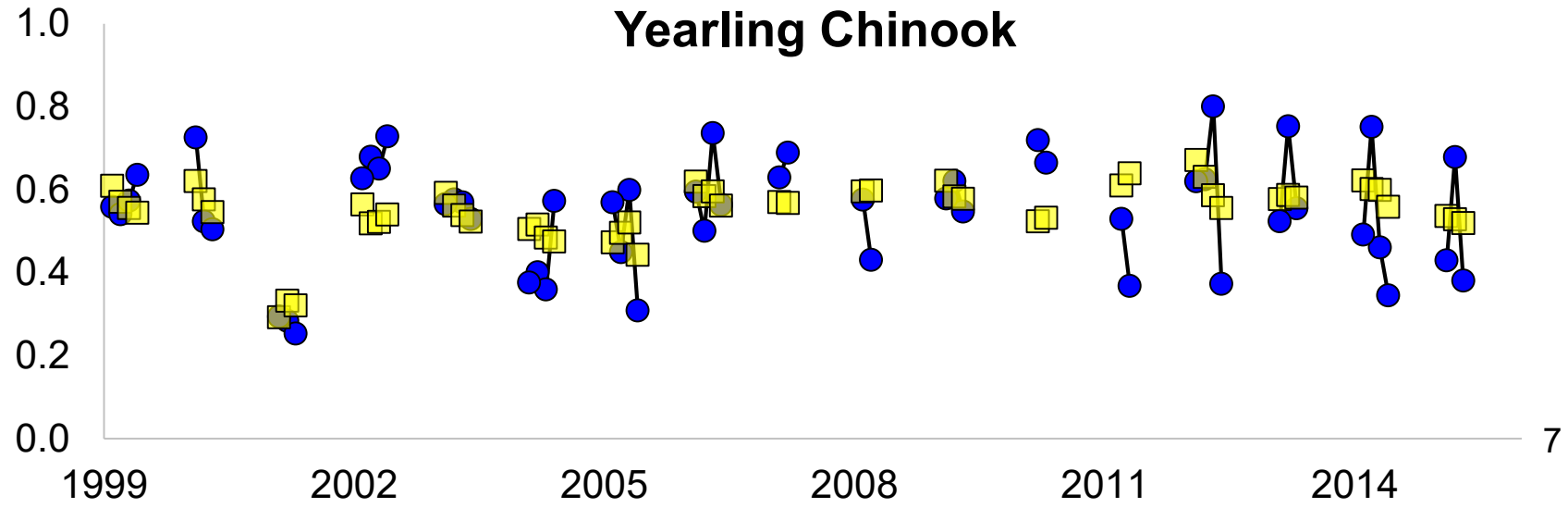
Fish Travel Time (LGR-BON)





Juvenile Survival (LGR-BON)

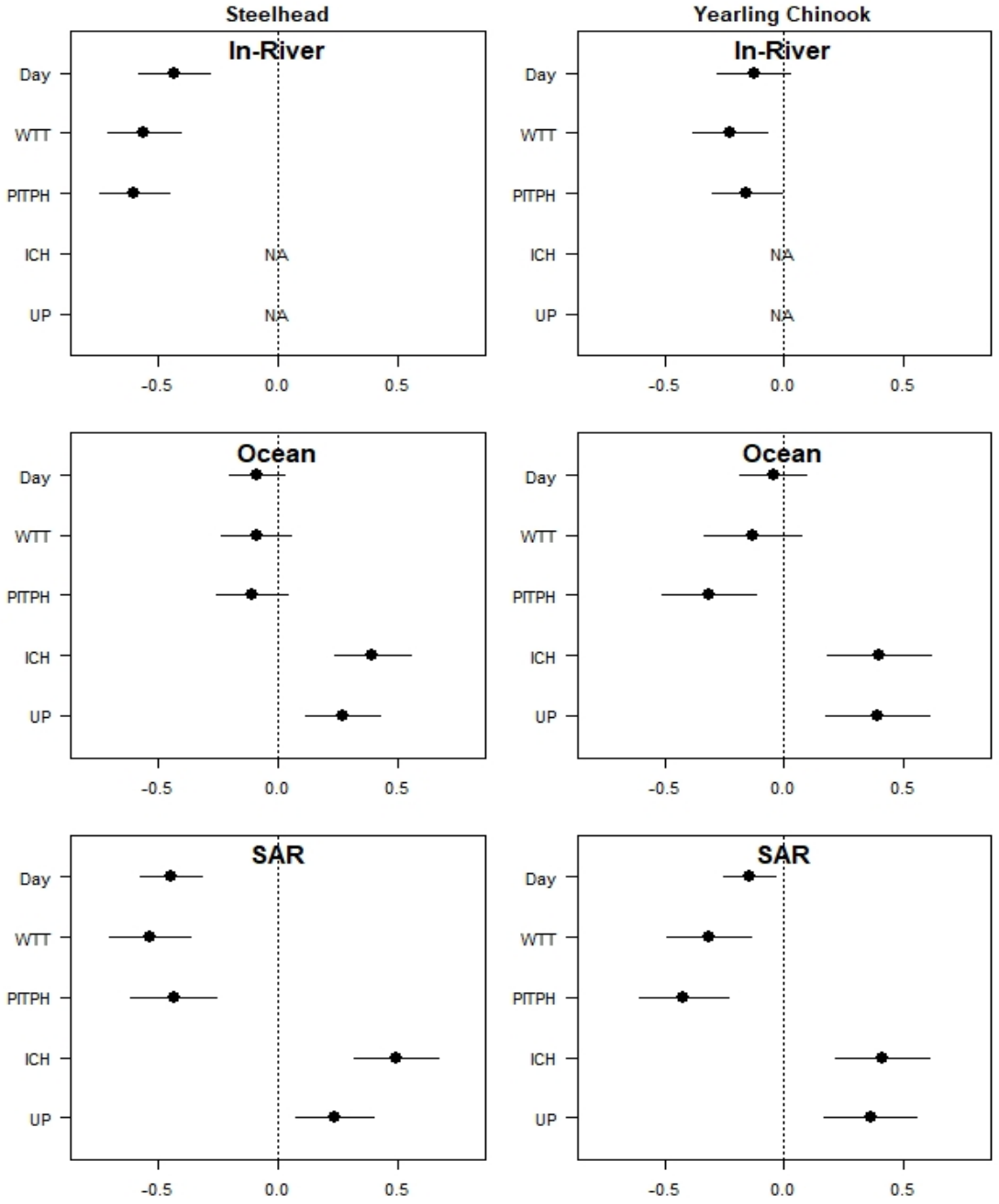




Environmental and Management Factors:

- Seasonality (cohort models)
- PITPH (proportion spill)
- Water transit time (WTT, days)
- Ocean Indices: Upwelling, Forage Biomass

Factors associated with survival at each life stage:



CSS Scenarios Evaluated 2013-2017:

Current dams	Breach LSR dams
BiOp spill	BiOp spill
115%/120%	115%/120%
120%	120%
125%	125%

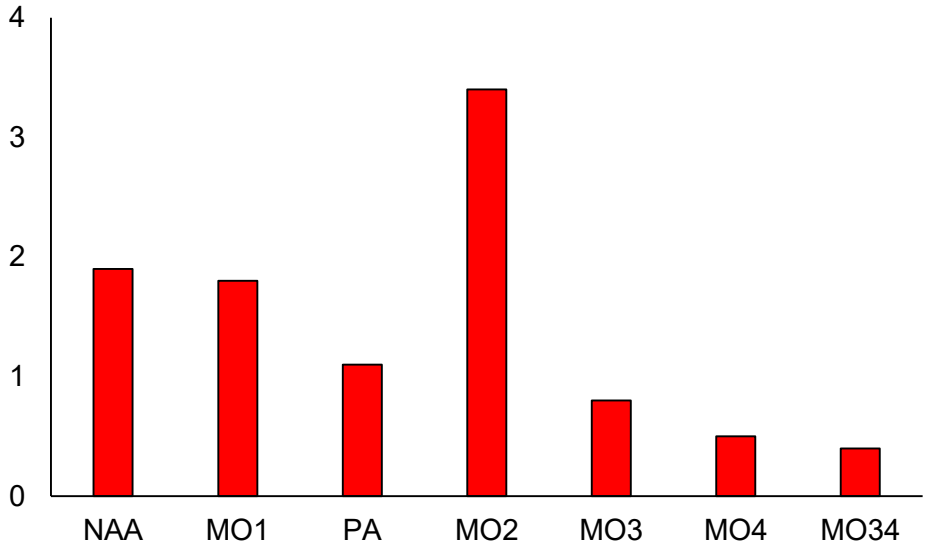
CSS Scenarios Evaluated for CRSO:

	Current dams	Breach LSR dams	
MO2	110%		
NAA	BiOp spill	BiOp spill	
MO1	115%/120%	115%/120%	
PA	120%	120%	MO3
MO4	125%	125%	MO34

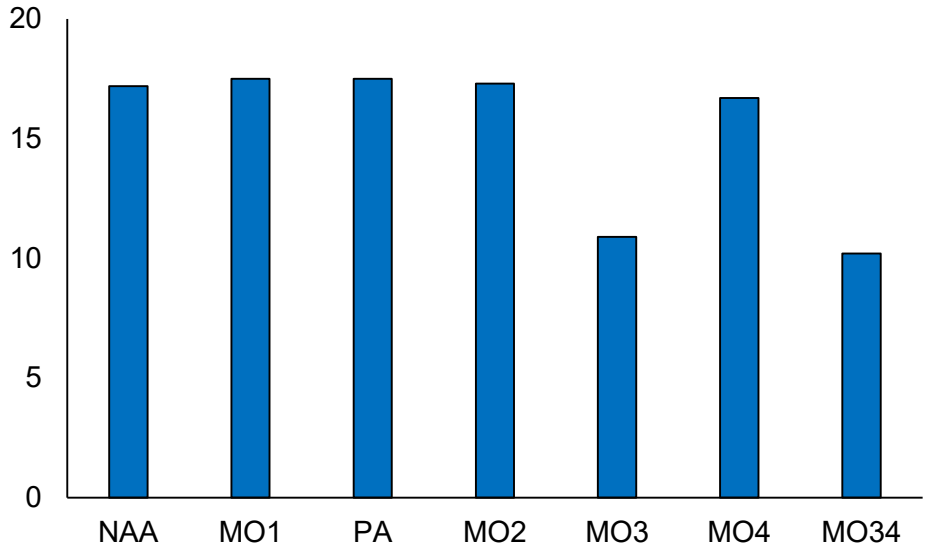
Modeled 80-year water record provided by the Action Agencies

Effects of the Alternatives on freshwater environment

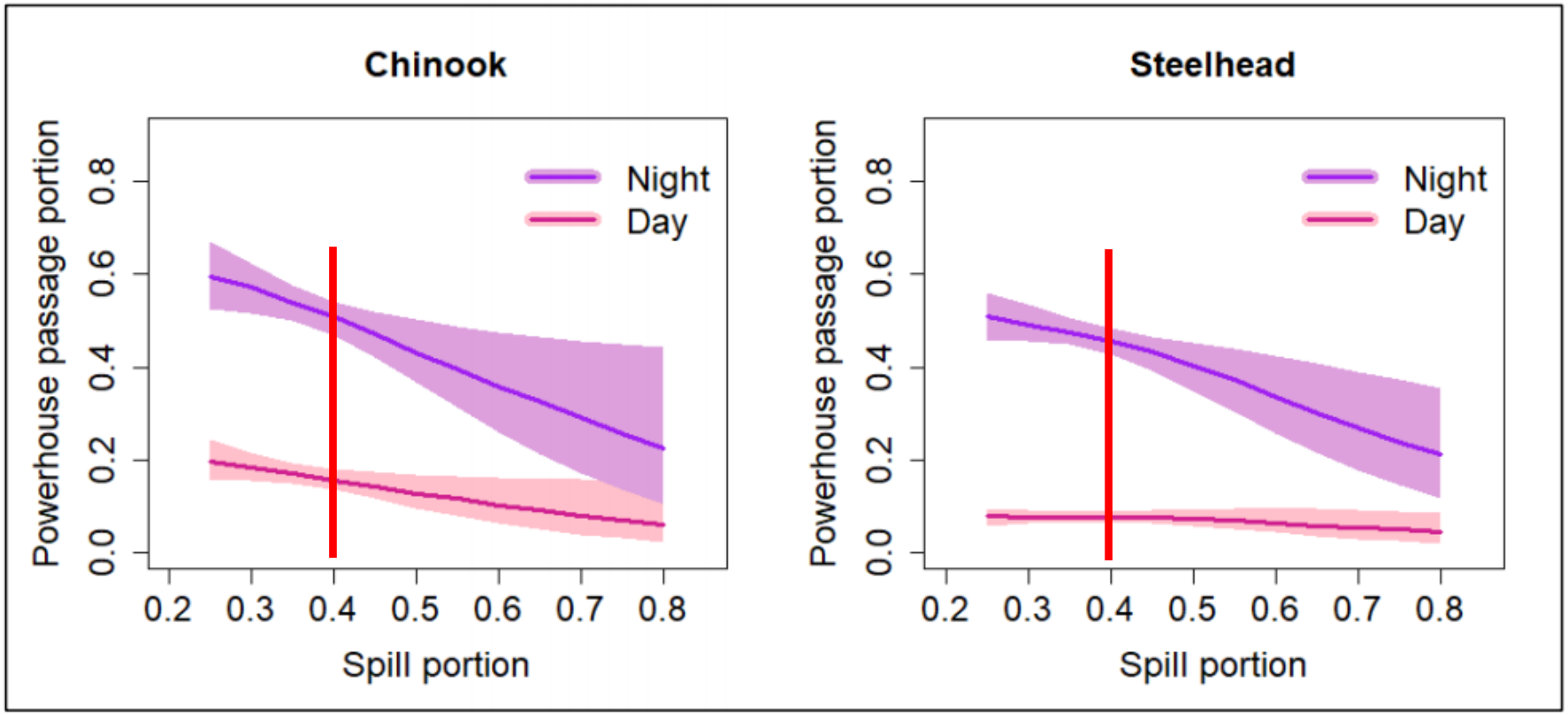
Powerhouse passages



Water Transit Time (days)



PA: Flex-spill can impact powerhouse passage, depending on timing

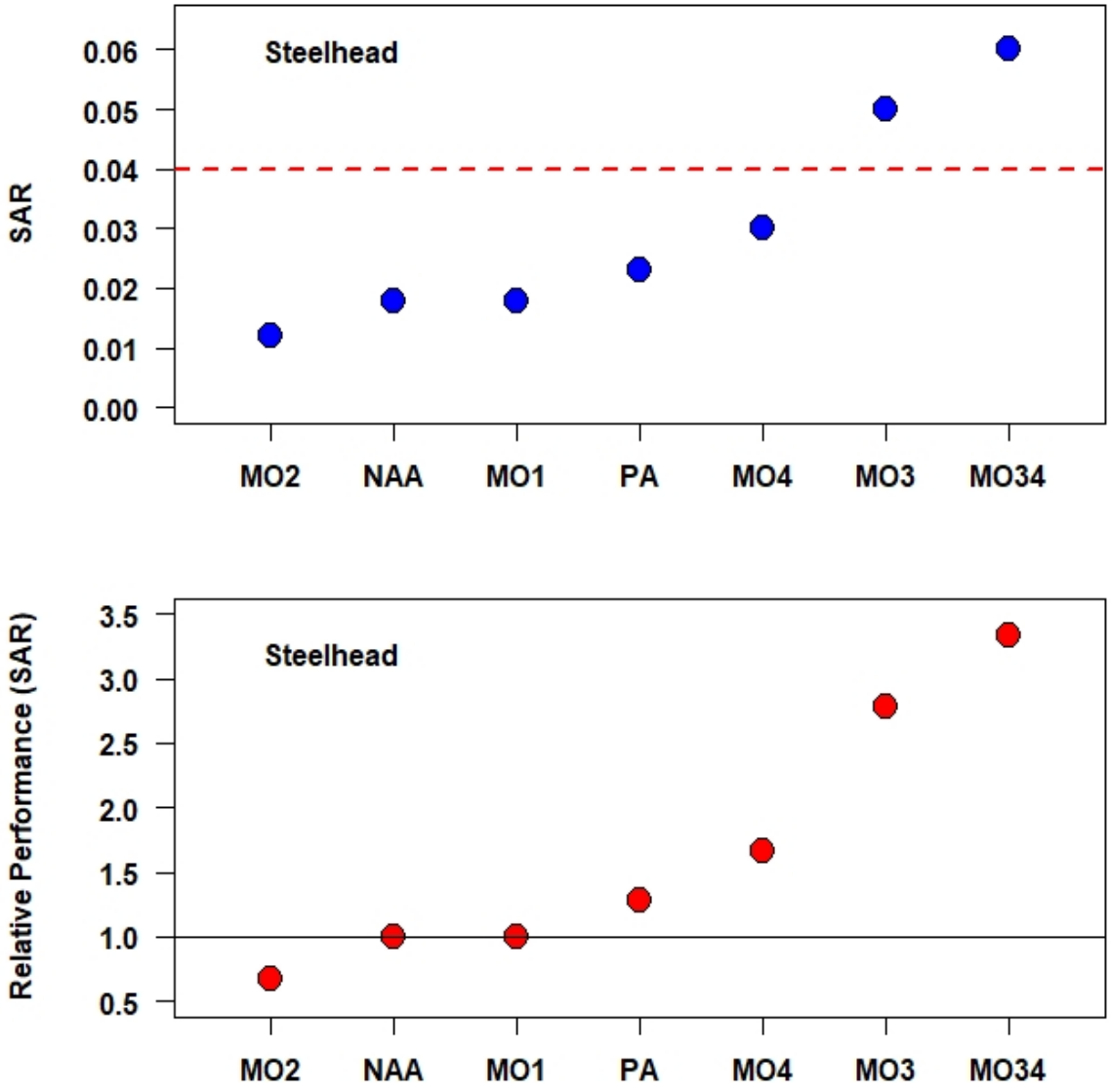


Results

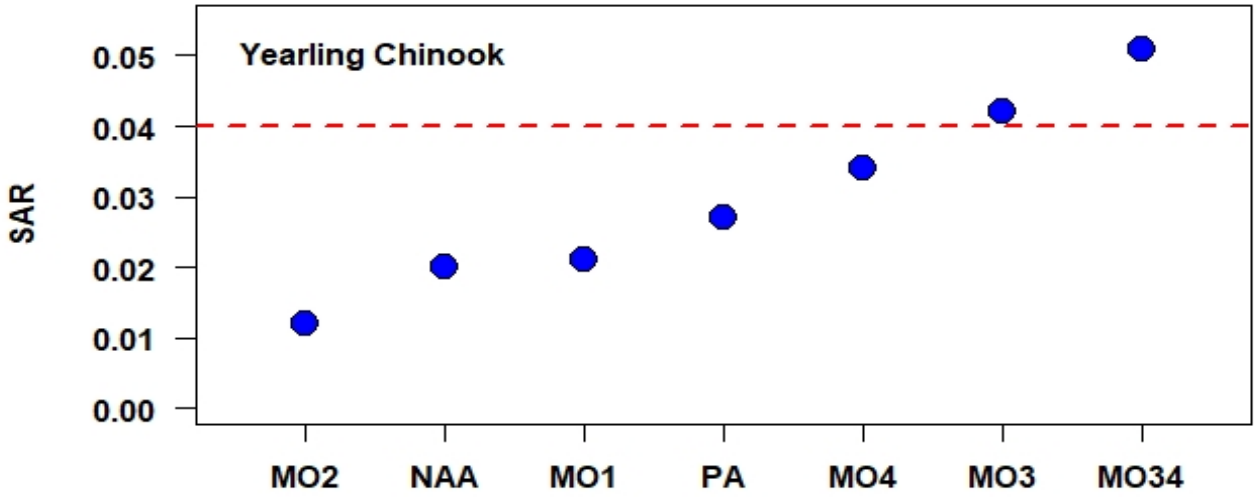
Summarized means of each biological performance metric, by each alternative

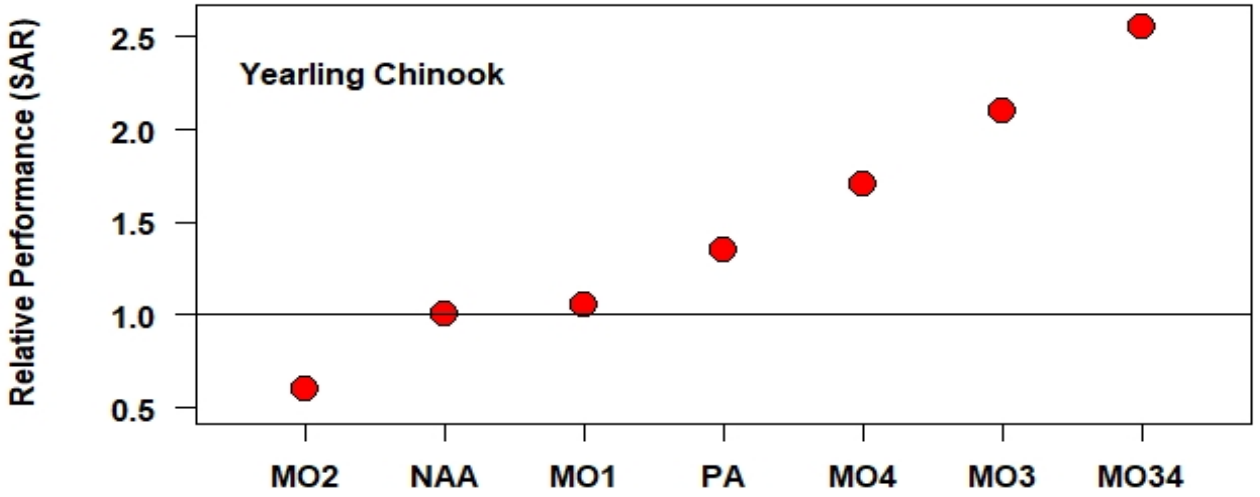
Summarized performance relative to NAA (e.g. MO1/NAA)

Results: steelhead SARs



Results: yearling Chinook SARs

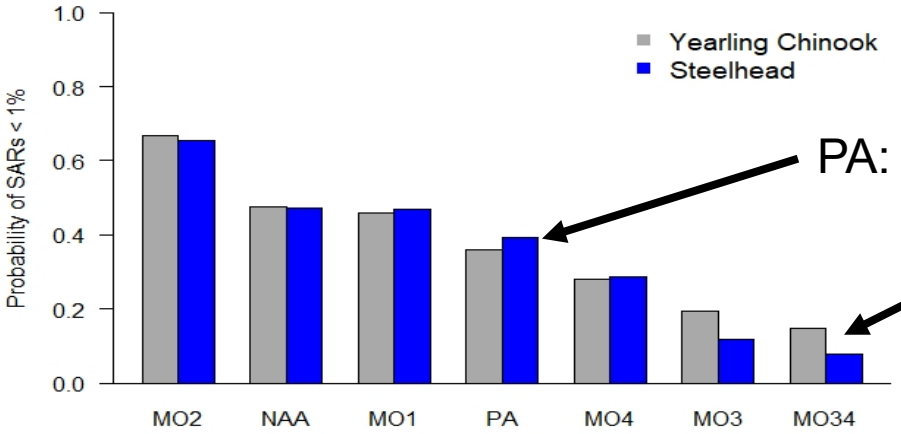




Quantifying risks and desired outcomes

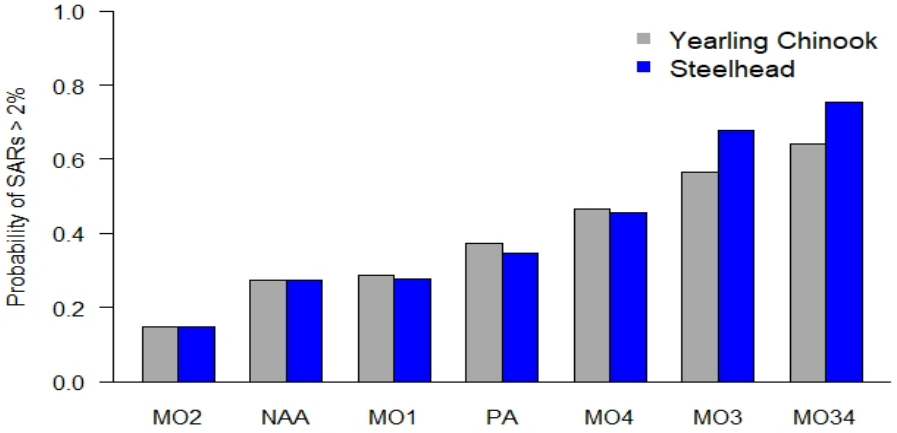
SARs < 1% associated with population declines

SARs > 2% associated with population increases (also NPCC minimum SAR goal)



PA: 36-39% of SARs < 1%

MO34: 8-15% of SARs < 1%



Conclusions

- MO2 consistently resulted in poor biological performance

- MO3 and MO4 consistently demonstrated the greatest improvements in biological performance relative to the NAA

- MO3 and MO4 were the only two alternatives that may be capable of achieving the NPCC average SAR goal of 4% (MO3 above, MO4 near, both ranges overlap 4%)

- CSS alternative MO34 outperformed the federal alternatives

- PA results may be overly optimistic:
  - Flex spill allows decreased spill during night
  - High-capacity turbines
  - Allows drafts below flood control

CSS Life Cycle Predictions Using CRSO 80 Year Water Record

Robert B Lessard, CRITFC
June 16, 2020

Outline

2017 CSS life cycle model

\+ CRSO-EIS 80 year water record

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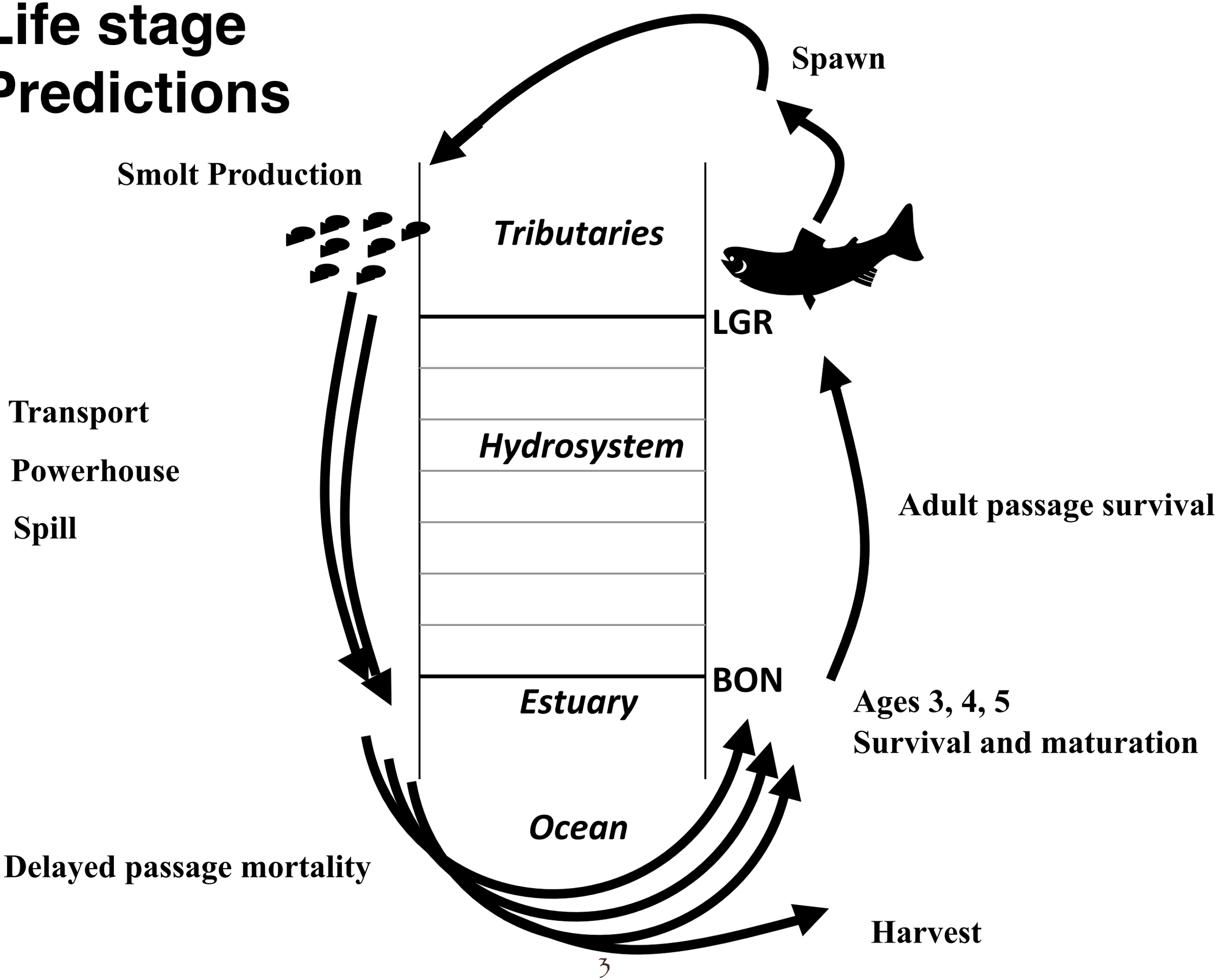
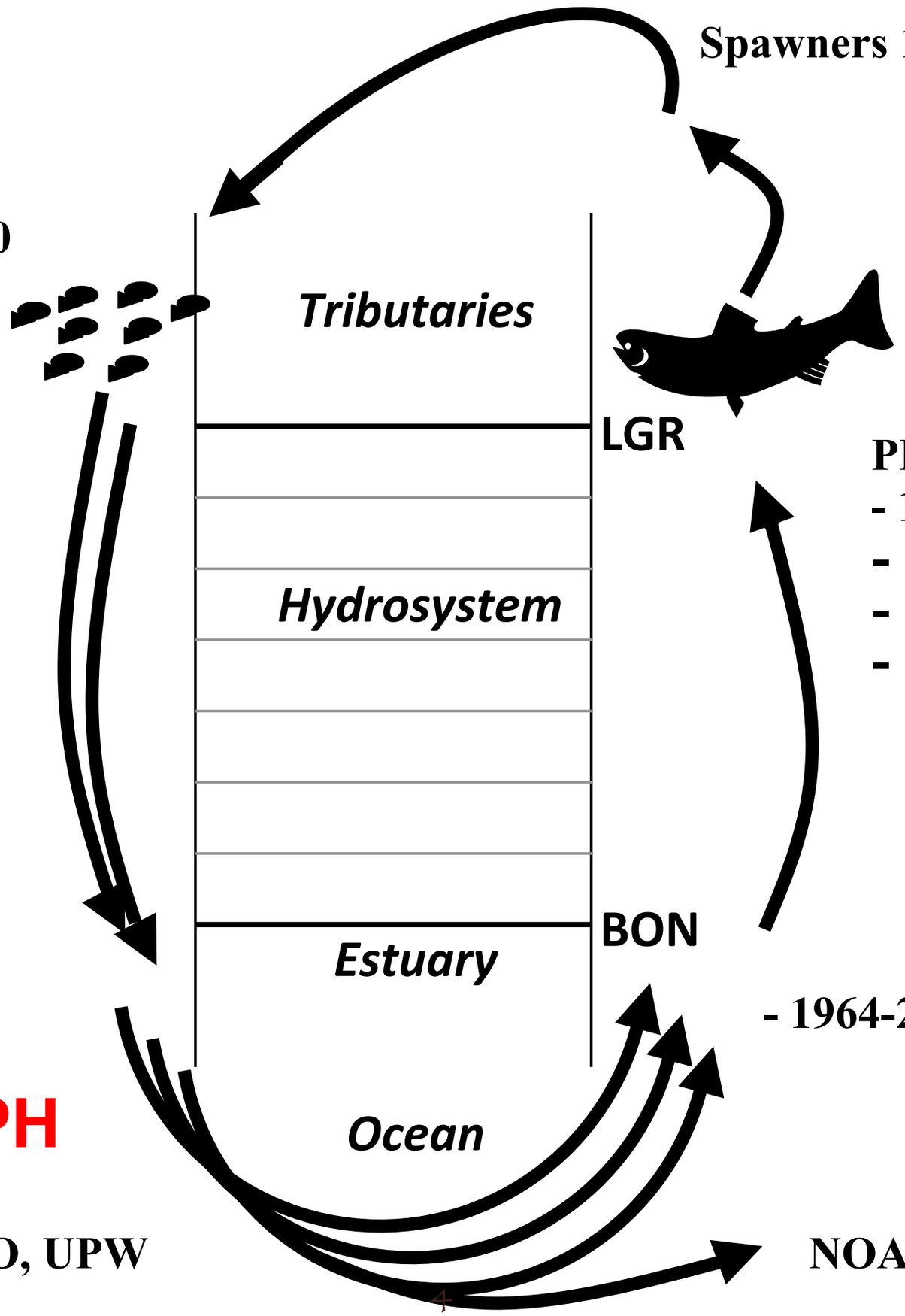
80 years of SAR & Abundance trends

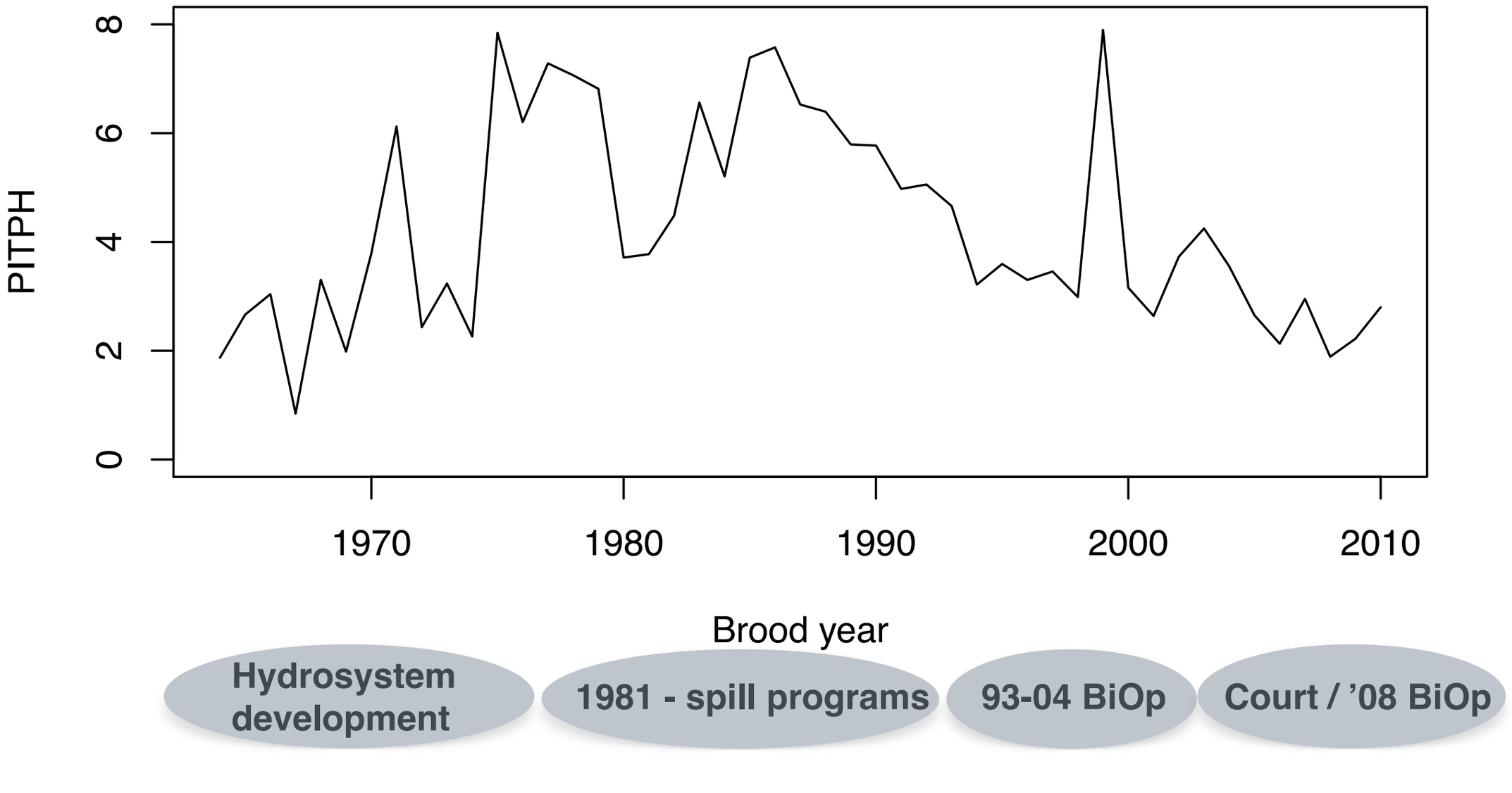
Life stage Predictions



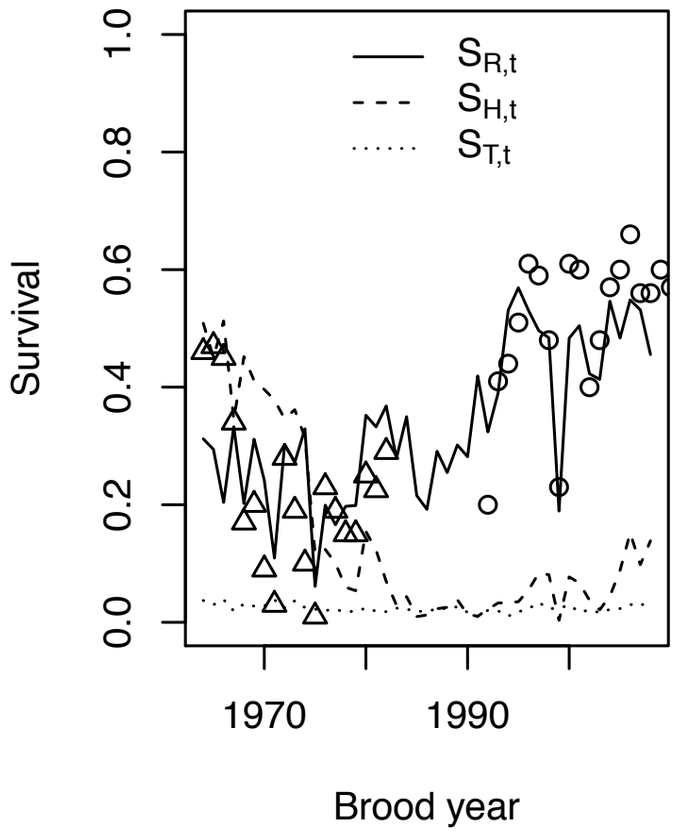
Life stage Data

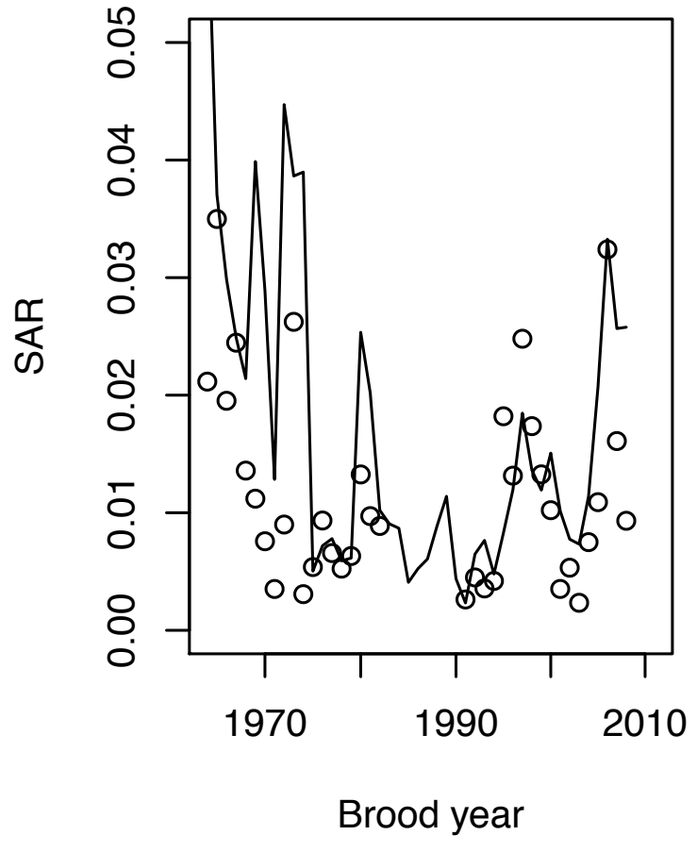


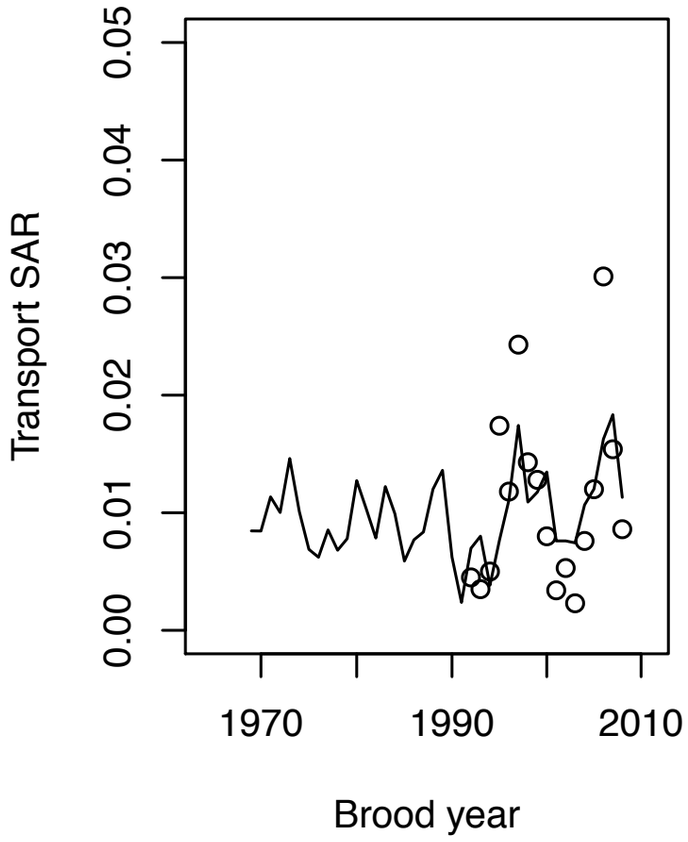
Powerhouse Passage

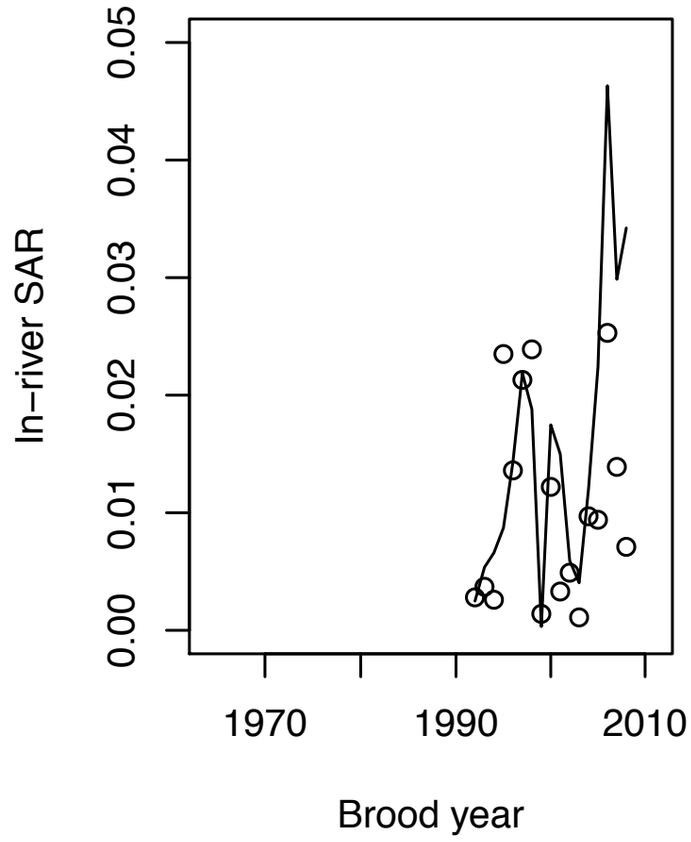


Survival


Survival
0.0
0.2
0.4
0.6
0.8
1.0
$S_{R,t}$
$S_{H,t}$
$S_{T,t}$
1970
1990
Brood year

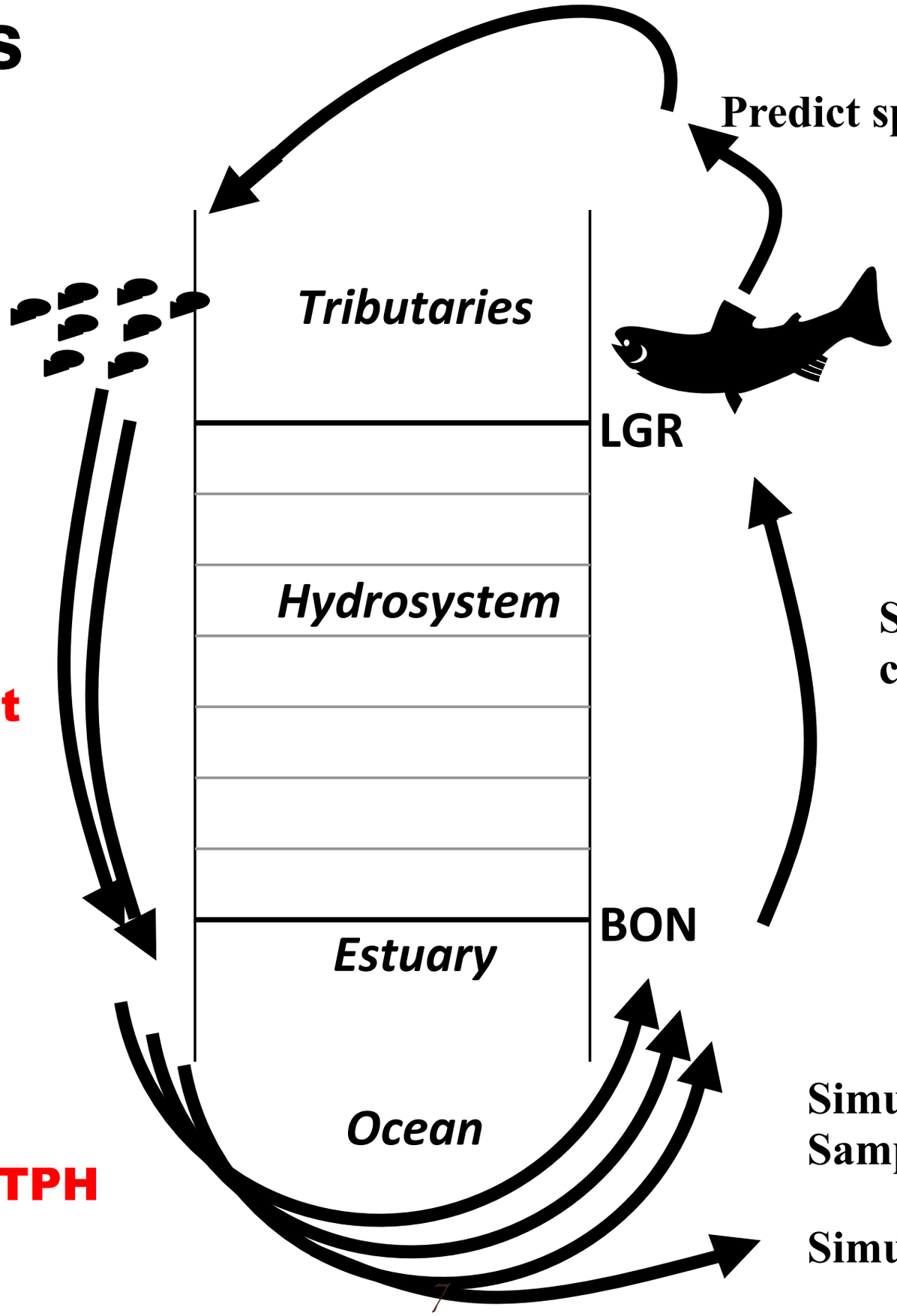

SAR
0.00
0.01
0.02
0.03
0.04
0.05
1970
1990
2010
Brood year


Transport SAR
0.00
0.01
0.02
0.03
0.04
0.05
1970
1990
2010
Brood year


In−river SAR
0.00
0.01
0.02
0.03
0.04
0.05
1970
1990
2010
Brood year

Simulations

** Start spawners 2008-2010



In river

- **CRSO PITPH**
- **CRSO WTT**
- **CRSO Transport**

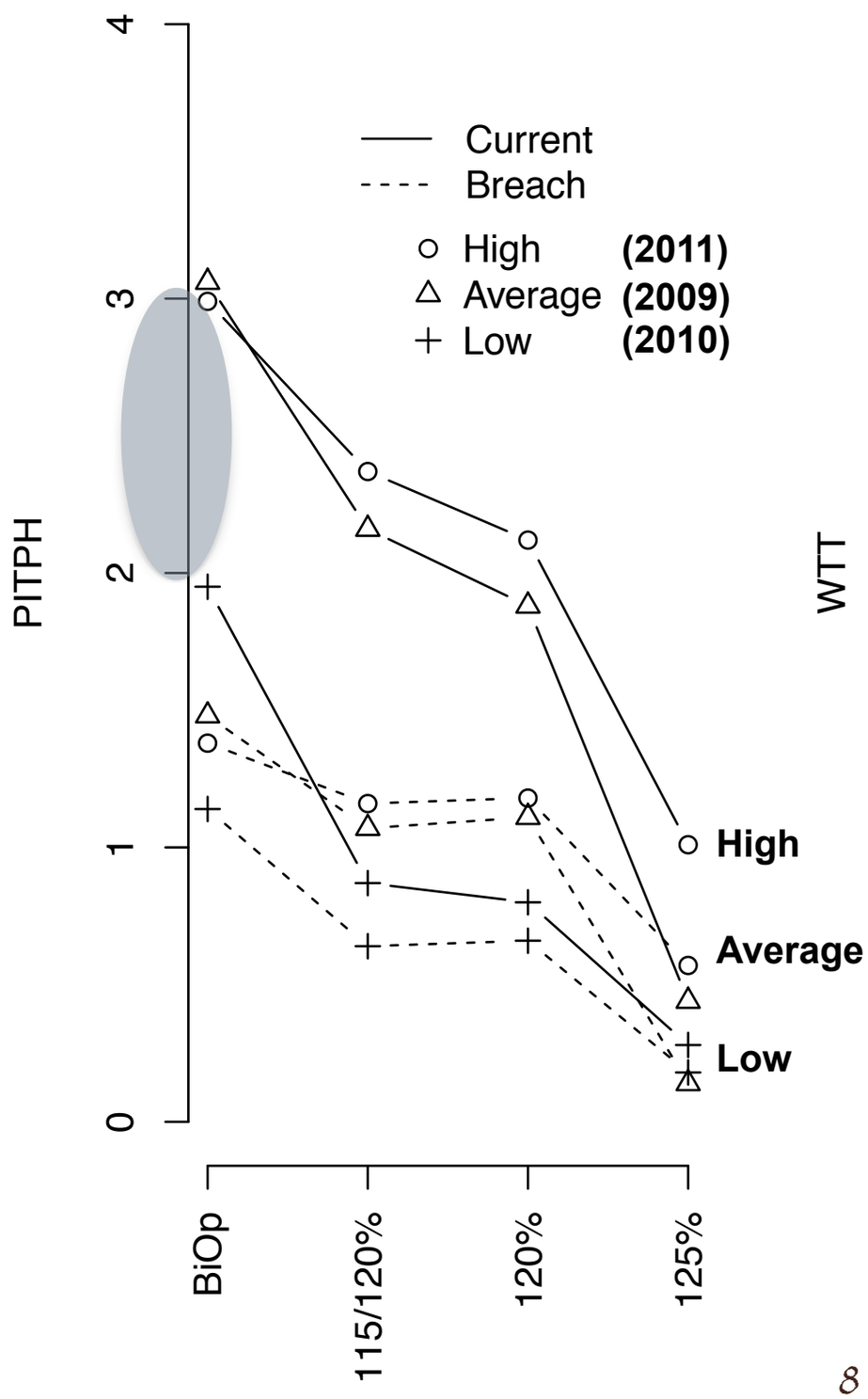
CRSO PITPH

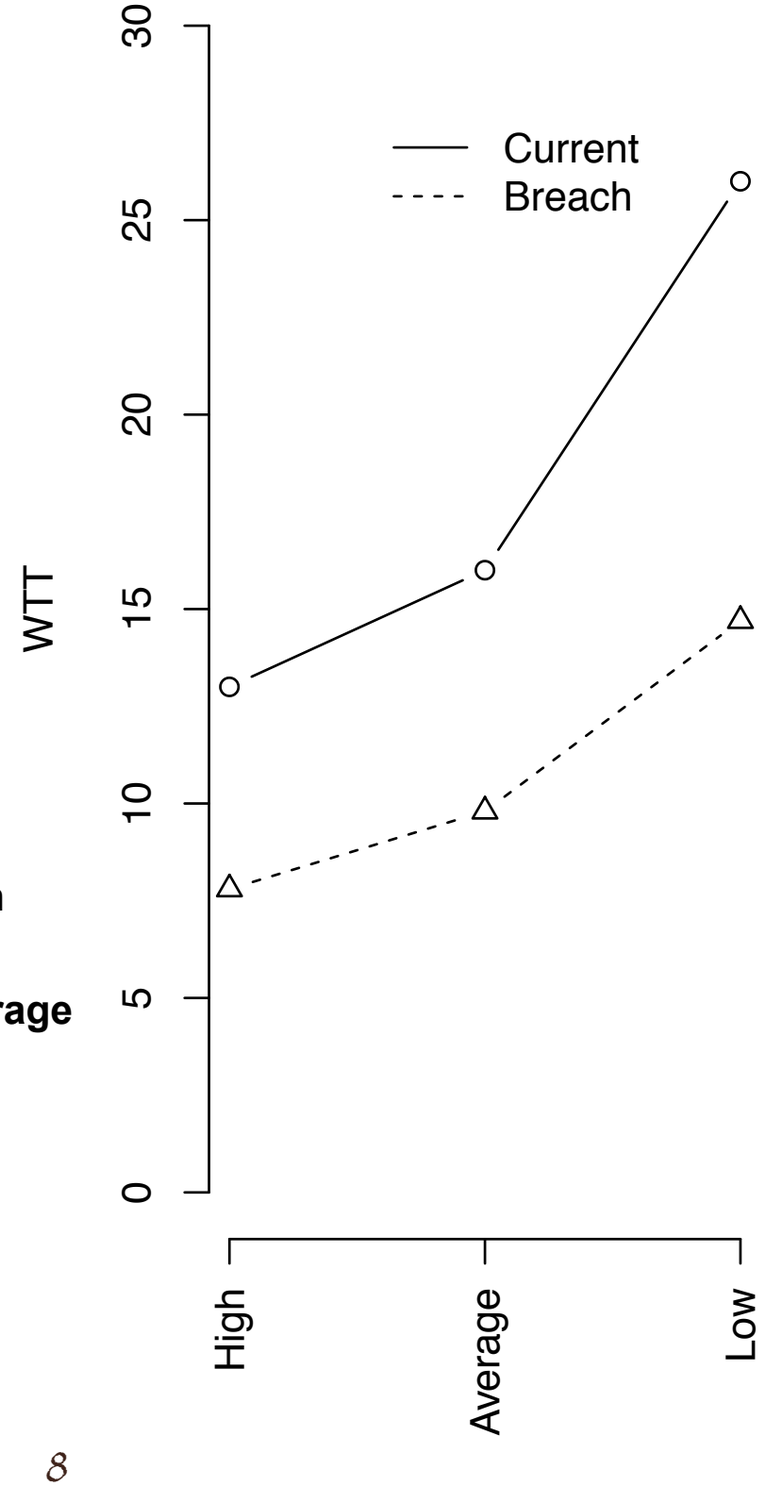
Sample historical conversion rates

Simulate PDO
Sample UPW

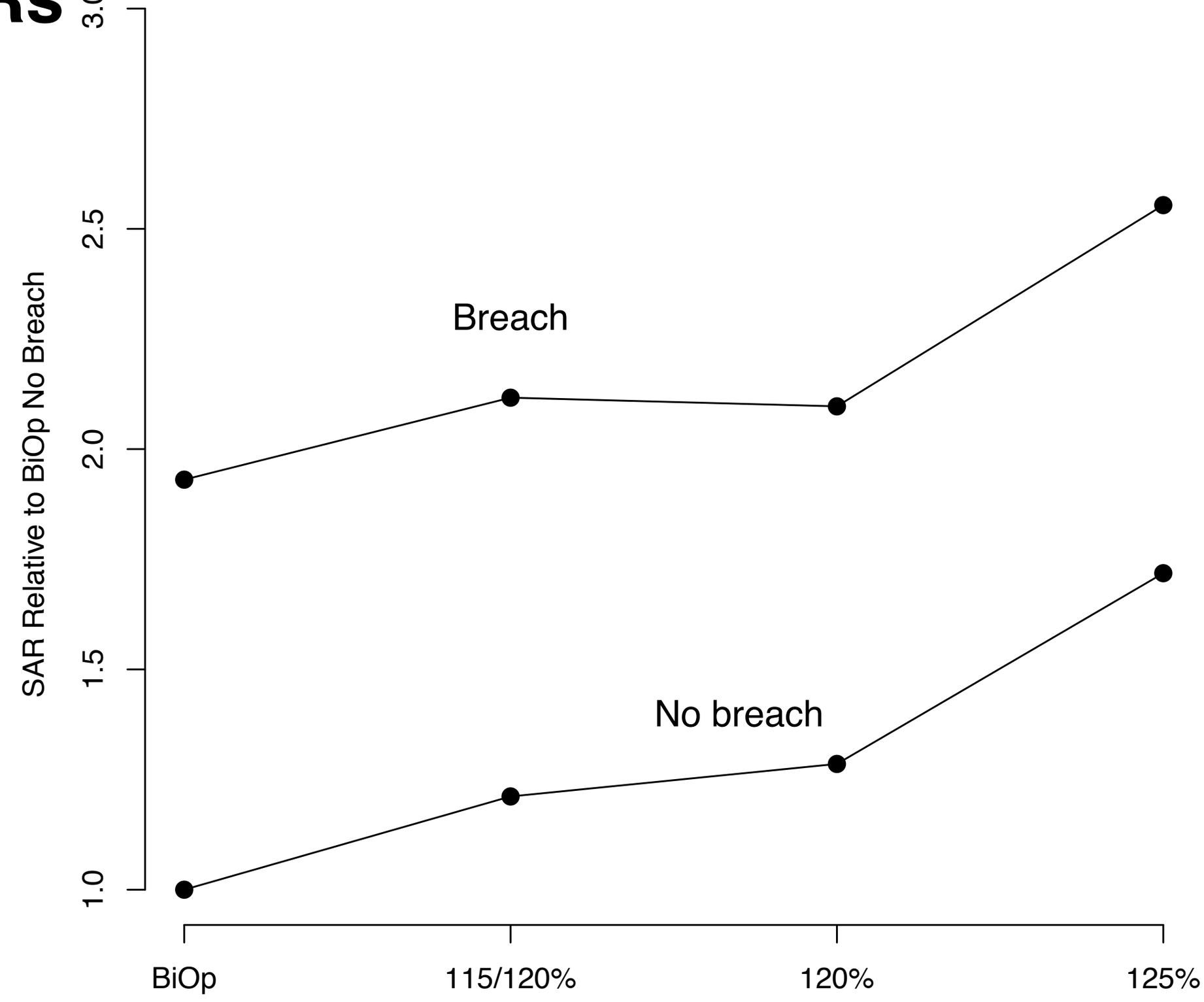
Simulate harvest

CSS 2017 Scenarios



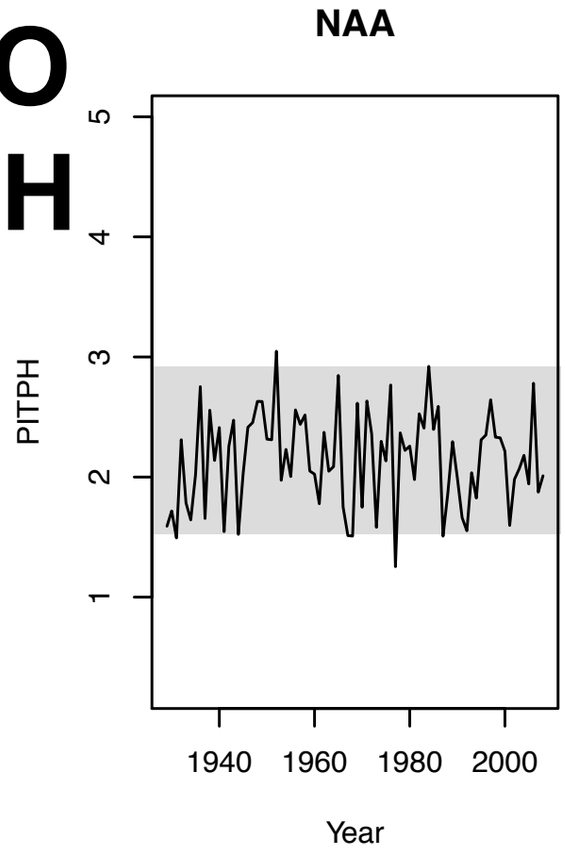


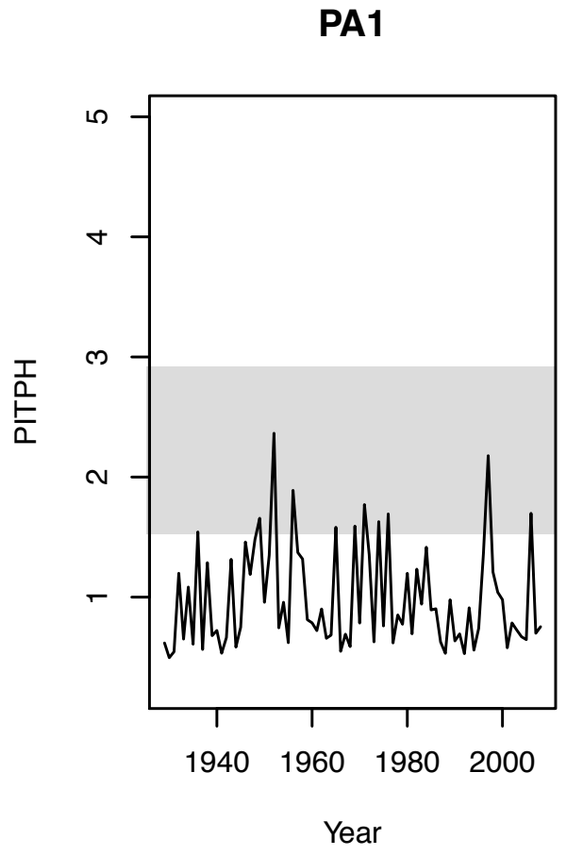
CSS SARs

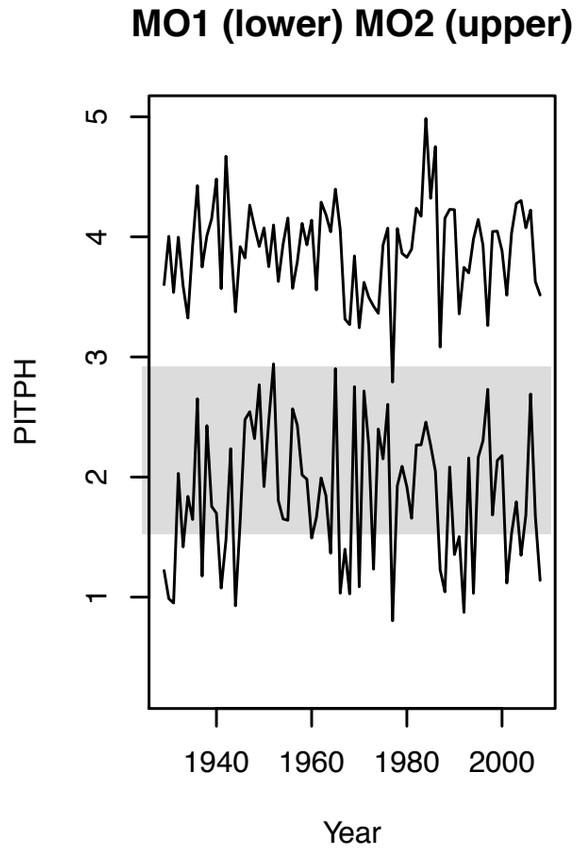

SAR Relative to BiOp No Breach
3.0
2.5
2.0
1.5
1.0
Breach
No breach
BiOp
115/120%
120%
125%

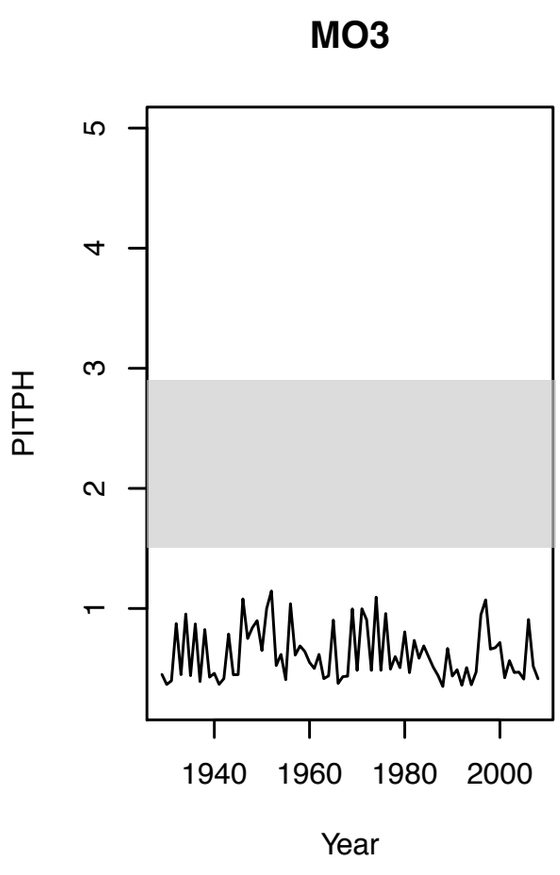
CRSO
PITPH

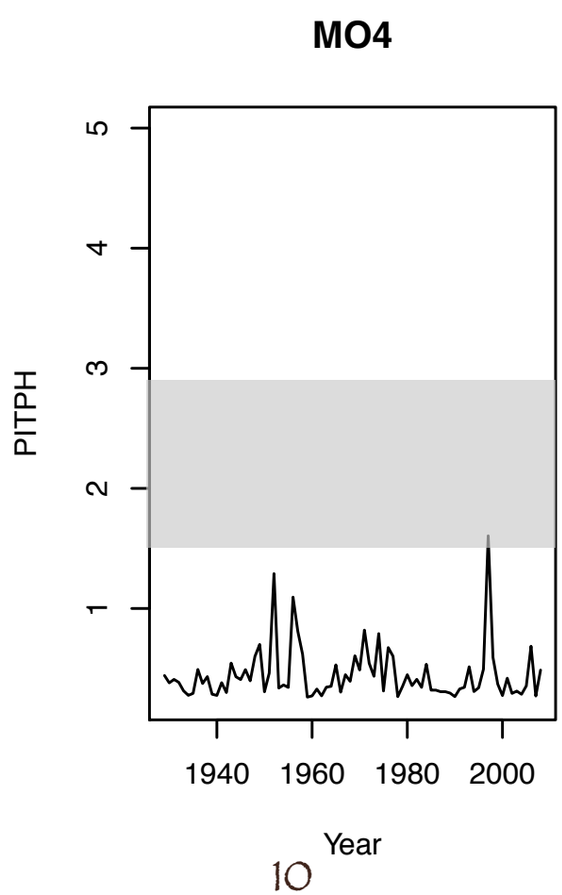
High
Average
Low

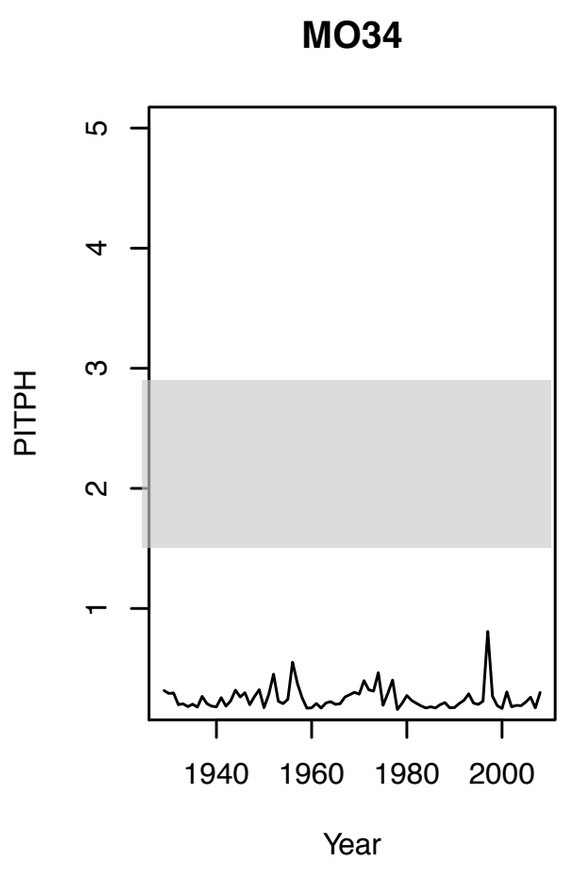




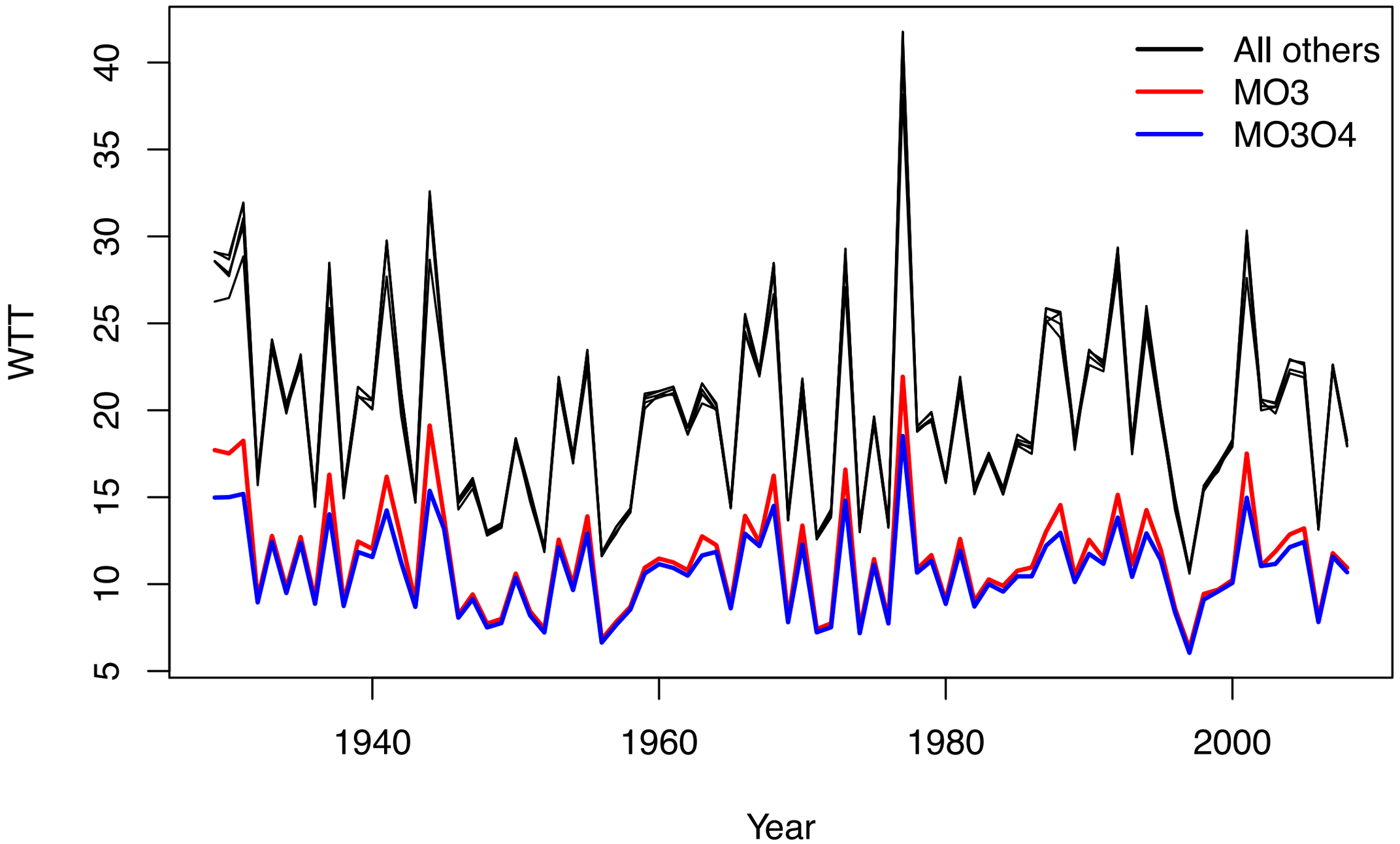








CRSO
WTT

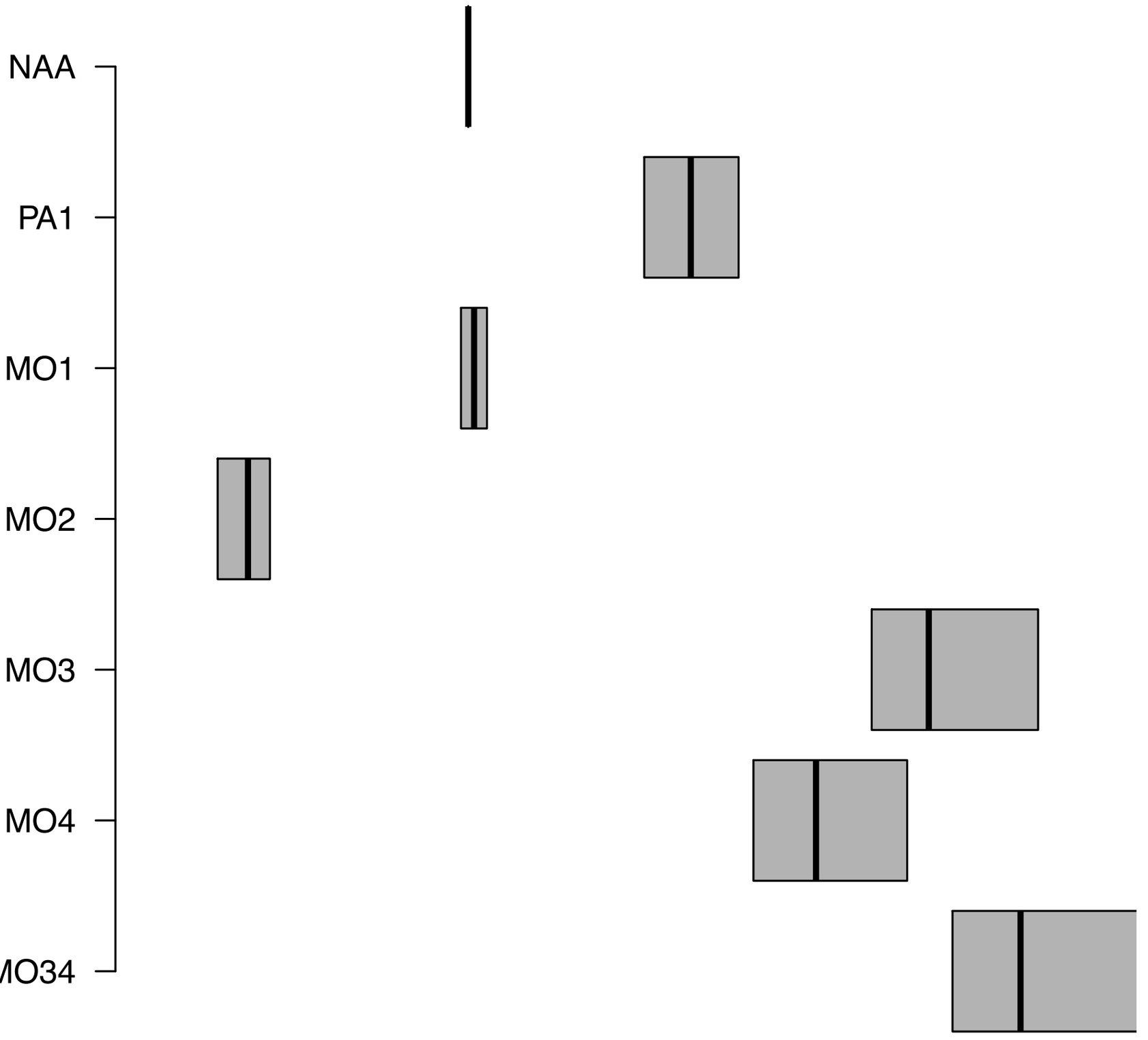

All others
MO3
MO3O4
WTT
5
10
15
20
25
30
35
40
1940
1960
1980
2000
Year

CRSO
SARs

SAR relative to NAA

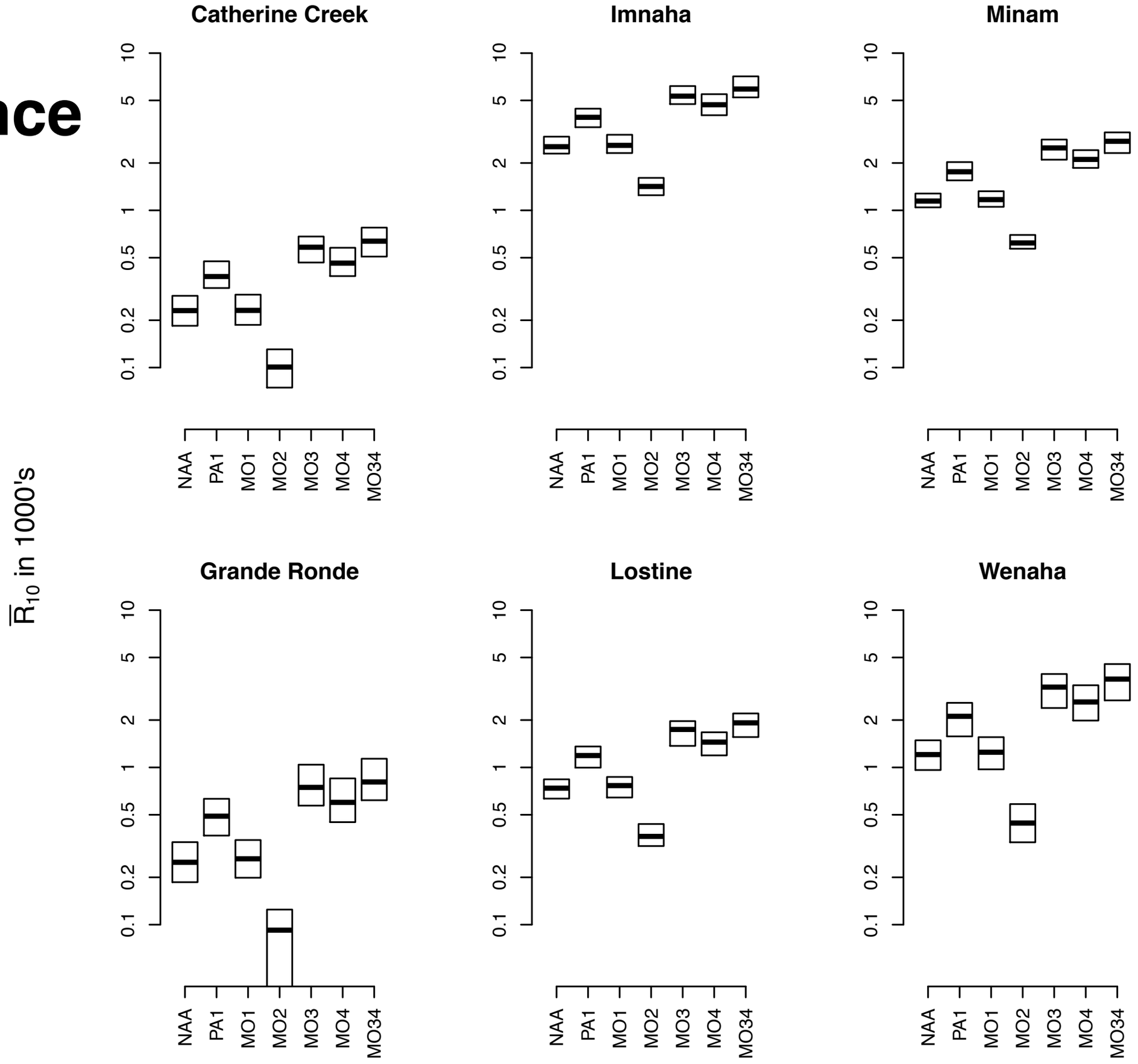
0.5 1.0 1.5 2.0

NAA
PA1
MO1
MO2
MO3
MO4
MO34

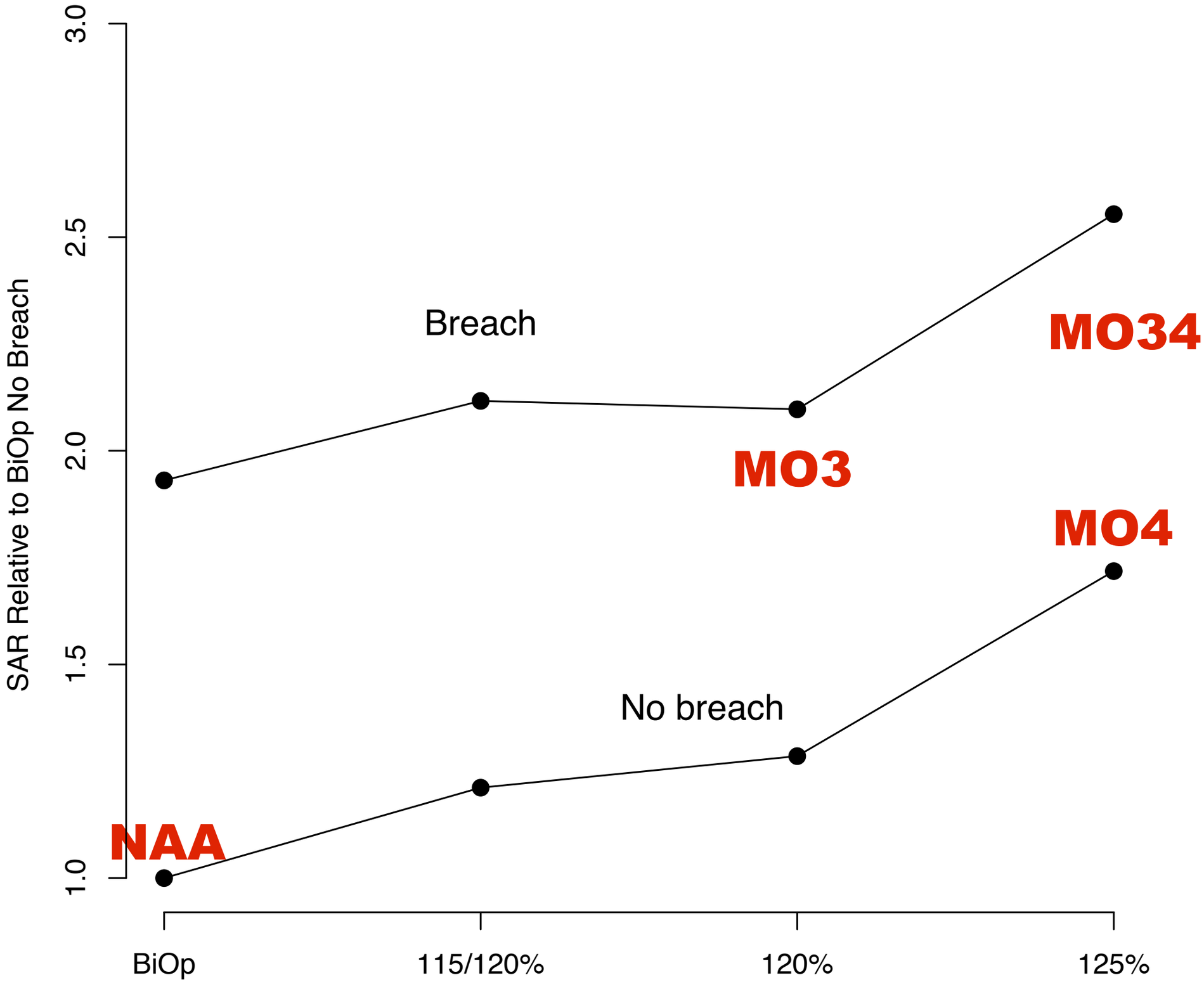


12

CRSO Abundance



CRSO v. CSS


SAR Relative to BiOp No Breach
3.0
2.5
2.0
1.5
1.0
Breach
MO3
MO34
MO4
No breach
NAA
BiOp
115/120%
120%
125%

Relative performance

1. CRSO MO34 ~ CSS Breach/125%
2. CRSO MO3 ~ CSS Breach/120%
3. CRSO MO4 ~ CSS no Breach/125%

Conclusions

- Results conform with the broader weight of evidence showing the effect of Passage.
- Higher % spill predicts higher life cycle survival rates and abundances.
- Breach together with 125% TDG spill predicts highest survival and abundance.