Northwest **Power** and **Conservation** Council

December 4, 2018

MEMORANDUM

TO: **Council Members**

FROM: **Laura Robinson, Program Liaison Coordinator**

SUBJECT: **Presentation by the Columbia River Inter-Tribal Fish Commission on Predation in the Columbia River Basin: Using Salmon Equivalents for Effective Management**

BACKGROUND:

Presenter: Jaime Pinkham, Executive Director
Blaine Parker, Project Lead
Doug Hatch, Senior Fisheries Scientist
Dr. Robert Lessard, Quantitative Fisheries Scientist

Summary: At the December Council meeting, Jaime Pinkham, Blaine Parker, Doug Hatch, and Dr. Robert Lessard will present on the Columbia River Inter-Tribal Fish Commission's (CRITFC) observations of predation in the Basin and how to more effectively manage predators for a population-level benefit. See attachment 1 for an overview of CRITFC's presentation.

Relevance: The 2014 Fish and Wildlife Program identified as one of the seven emerging priorities the need to, "preserve program effectiveness by supporting expanded management of predators."

CRITFC conducts non-lethal hazing of sea lions through a Fish and Wildlife Program-funded project (2008-004-00) and is an active supporting entity of the proposed Endangered Salmon and Fisheries Predation Prevention Act.

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Workplan: Predation presentations in preparation for the Program amendments

Background: This presentation is part of a series of presentations to the Council in preparation for the Program amendments. At the November Council meeting, Tim Dykstra presented on the Army Corps of Engineers' predation management actions on marine mammals and avian predators. Tim's presentation can be found here. At the October Council meeting, Joe Maroney presented to the Council on the Kalispel Tribe's successful suppression of Northern Pike in the Pend Oreille, and representatives from the three Mid-Columbia PUDs provided insights on their predation management efforts. You can access the slides for Joe's presentation here, Douglas PUD's presentation here, Chelan PUD's presentation here, and Grant PUD's presentation here. At the September Council meeting, Dan Roby presented on the long-term avian predation study funded by BPA and the Corps to investigate the impact of avian predators on the survival of juvenile salmonids in the lower Columbia River. The slides for Dan's presentation can be found here.

Attachment 1

Predation in the Columbia River Basin: Using Salmon Equivalents for Effective Management

Authors: Doug Hatch, Dr. Robert Lessard, Jaime Pinkham[1,2], and Blaine L. Parker[2]

[1] Jaime Pinkham is the Executive Director of the Columbia River Inter-Tribal Fish Commission

[2]Presentor

Presentation Overview:

Predation on anadromous fish within the Columbia Basin is ubiquitous and occurs from fresh water rearing through adult life stages. Predation arises from non-native and native fishes, multiple species of birds, and marine mammals. The population level impacts of predation depend on predator abundances, prey abundances, and competition for resources. Management actions to protect anadromous fish can include non-lethal actions such as predator hazing, habitat manipulation, exclusion, and other strategies. Actions can include the lethal removal of predators. Lethal removal of northern pikeminnow has been in place since 1990.

The relative magnitude of survival rates between life stages, and the competitive and predatory relationships predict the relative potential impact of specific predators on the abundance of returning adults. Actions to reduce predation at early life stages may not return 100% dividends due to competitive effects and other externalities in later life stages, whereas reducing predation on adults may translate more directly to a population level benefit. For example, controlling predators to save juveniles early during migration may be futile if those juveniles would later be eaten by birds in the estuary, or would otherwise have been in competition for food.

Costs associated with predator mitigation programs can span a wide range depending upon the species, location, and duration of the program. This presentation focuses on how to more effectively manage predators for a population level benefit. We propose to use a life cycle model to evaluate the relative merits of management actions on predators throughout the system. Using empirically validated models of freshwater production, juvenile outmigration, and adult survival, we will examine the relative benefits of reducing predation impacts at specific life stages. The approach will place predator control actions into a common adult equivalent metric and will contrast benefits under a range of assumptions about the additive and compensatory nature of predation and competitive effects.

Authors Bios:

Doug Hatch: Mr. Hatch is a Senior Fishery Scientist and has lead CRITFC's Sea Lion Monitoring and Non-Lethal Hazing Project since 2005. Mr. Hatch serves on NOAA's Pinniped Fishery Interaction Task Forces for Bonneville Dam and Willamette Falls.

Dr. Robert Lessard: Dr. Lessard has worked on fish and mammal predation, predator prey dynamics, population dynamics, and fisheries stock assessments since 2000. He has worked on fish and wildlife management in Alaska, British Columbia, Alberta, Washington, Oregon, and California. He is currently on the steering committees of the Comparative Survival Studies group (CSS) and the Adaptive Management

Implementation Plan (AMIP), where he has developed life cycle models for the evaluation of alternative recovery strategies of Columbia River salmonids.

Jaime Pinkham: Jaime A. Pinkham (Nez Perce) returned to the northwest as CRITFC's Executive Director in April 2017. Mr. Pinkham was also elected twice to the Nez Perce Tribal Executive Committee and oversaw the Tribe's natural resource programs where he was involved in the salmon restoration, water rights, negotiations, wolf recovery, and land acquisition.

Blaine L. Parker: Mr. Parker has worked for the Columbia River Inter-Tribal since 1991, beginning on the Northern Pikeminnow Predation Project. Mr. Parker now works on white sturgeon, avian predation issues, and invasive species management. He is currently a member for double crested cormorant and Caspian tern Advisory Management Teams.

Predation on salmon in the Columbia River Basin

Jaime Pinkham, Robert Lessard, Doug Hatch, and Blaine Parker

Columbia River Inter-Tribal Fish Commission, Portland, OR

Presentation Outline

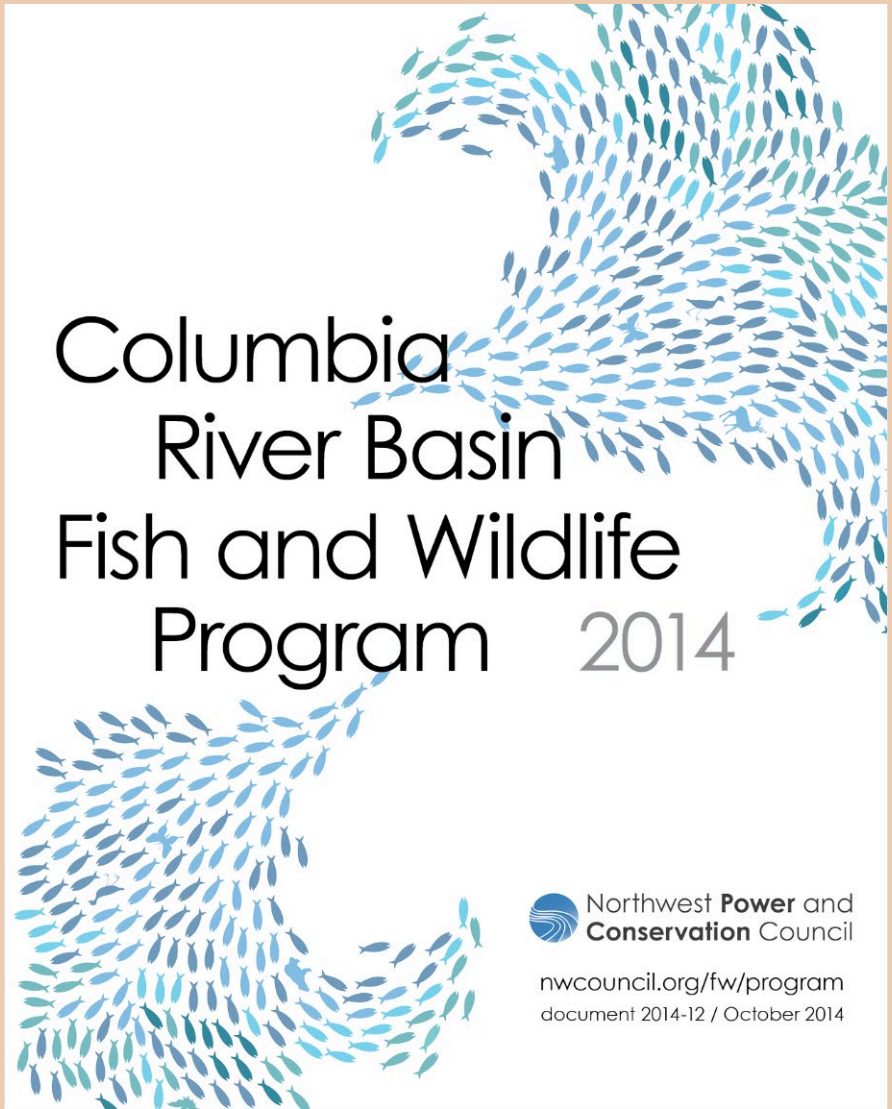
Goals: Summarize predation challenges in the Columbia River and propose steps the Council can take to move forward.

1. Guidance documents
2. Relevant laws and policies
3. Broad predation issues
4. Predation agents
5. Actions that can happen now

1. Guidance Documents

"Active management will keep predators at a level that is more in balance with the environment and reduce losses of Columbia River salmon and other native fish populations."

1. Guidance Documents

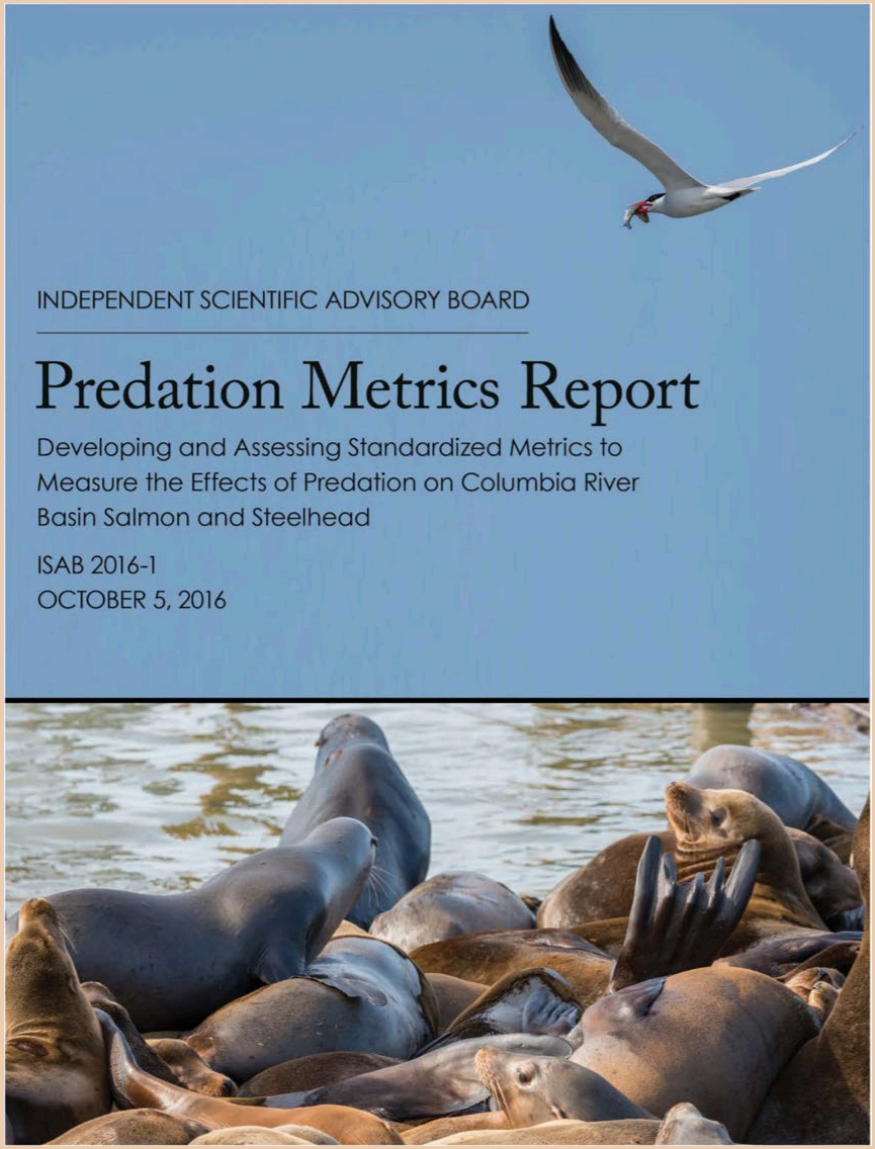


General measures:
The federal action agencies, in cooperation with the Council, state and federal fish and wildlife agencies, tribes, and others, should convene a technical work group to:

(a) determine the effectiveness of predator -management actions; and,

(b) develop a common metric to measure the effects of predation on salmonids, such as salmon adult equivalents, to facilitate comparison and evaluation against other limiting factors.

1. Guidance Documents



The ISAB recommends:

Using and further refining two types of metrics currently in use in the Basin: *Equivalence-factor metrics* (for example, adult equivalents), which can be used to compare the effects of predation on salmon and steelhead at different points in their life cycle.

Change in population growth rate metric (also called *delta-lambda,* Δλ), which can be used to compare how different predation scenarios affect rates of population recovery or decline.

Adjusting the *equivalence-factor metrics* and the *population growth rate metric* (Δλ) to account for assumed or estimated compensation in mortality. **Placing predation mortality in the context of a life-cycle model.**

2. Relevant Laws and Policies

- Treaty Resources
- Acts of Congress in conflict
  - Endangered Species Act
  - Migratory Bird Act
  - Marine Mammal Protection Act
- Non-native invasive species protections

3. Broad Predation Issues

- Small portion of juveniles return as adults to the estuary (5% or less)
- Gauntlet of mortality events during outmigration
- Mitigating mortality at different salmon life stages difficult to quantify directly into adult returns
  - Predation and competition interactions
  - Hydrosystem effects on travel times and passage
- Comparative life stage equivalency may exist for predator control
  - e.g.: Which is better, saving 5 returning adults or saving 100 juveniles?
- What are the discount and savings options? How can we be most strategic in choosing management actions?

Northern Pike Minnow

- Early work suggested predation by Northern Pikeminnow on juvenile salmonids might account for most of the 10-20% mortality experienced in each of 8 Columbia and Snake reservoirs.
- Exploitation at 10%-20% rate could result in a 50% predation reduction from the base period on juvenile salmonids.
- In 2014, exploitation was 11.5% and 163,037 Northern Pike Minnow were harvested.
- How many adult salmon does this save?

Avian

- Double-crested cormorants and Caspian terns on East Sand Island ate a minimum of 23 million salmon and steelhead smolts in 2013.
- In 2018,USFWS and the COE now consider their management efforts for these predators at ESI completed. Avian predator numbers remain substantial and are expanding to new habitats.
- Systemwide losses on specific stocks (i.e. Upper Col. steelhead) from avian predators ranged from 23% to 40%.
- Impacts from gulls, particularly inland, may exceed that of Caspian terns. No management actions are planned for gulls at this time.
- If caspian tern predation on upper Columbia River steelhead was eliminated, the resulting SAR value could exceed 2 fold. (Roby et al. 2018)

Smallmouth Bass and Walleye

- Estimated loss of sub-yearling chinook taken by smallmouth bass from Hells Canyon to Lower Granite Dam 2013-2014 was 835,296 fish. Tiffin and Erhardt (2017 Fall Chinook Symposium, SRFC Summaries, USGS)
- Smallmouth bass consumption of salmonids in the Yakima River between March and June were estimated to average 200,406 fish per year 1998-2001. (Fritts et al. 2004)
- Salmonids represented 13.8% of the walleye and 14.2% of the small mouth bass diet (Zimmerman 1999).
- Smallmouth bass and walleye consumed between 18K to 2M and 170K to 300K juvenile salmonids per year, respectively. Up to 40% of juvenile salmon consumed by a single predator species. (Sanderson et al. 2009)

Scope of Pinniped Predation

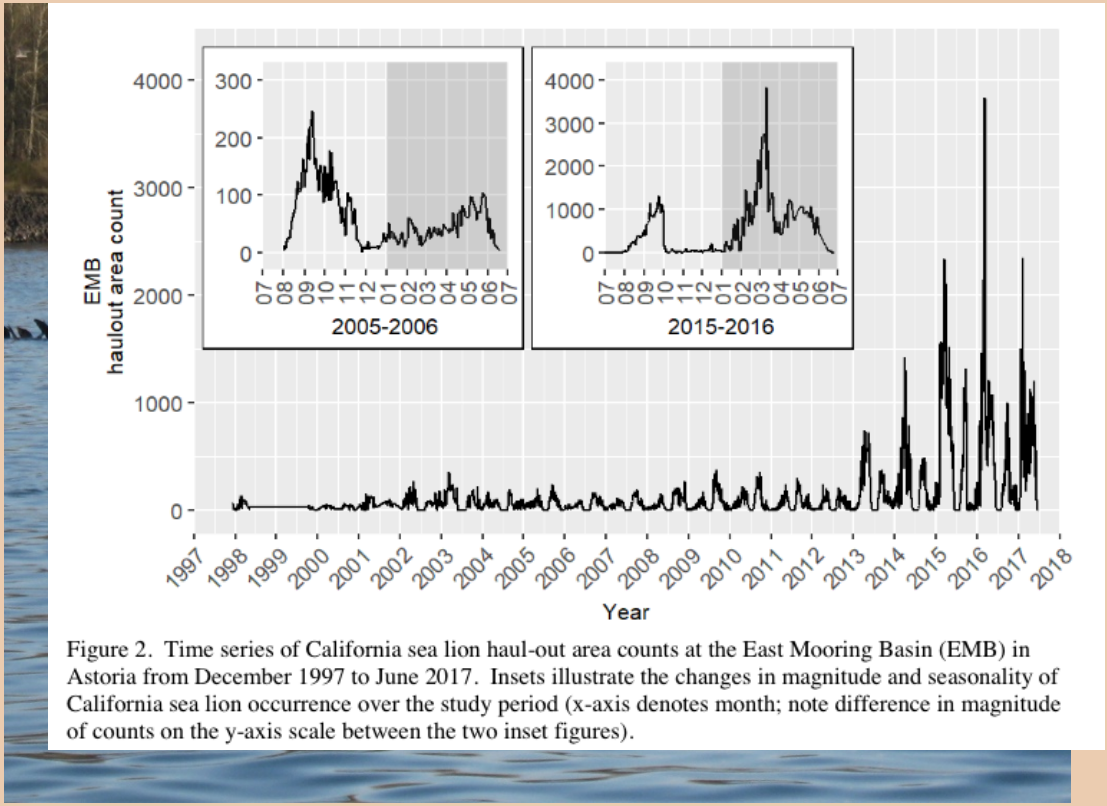
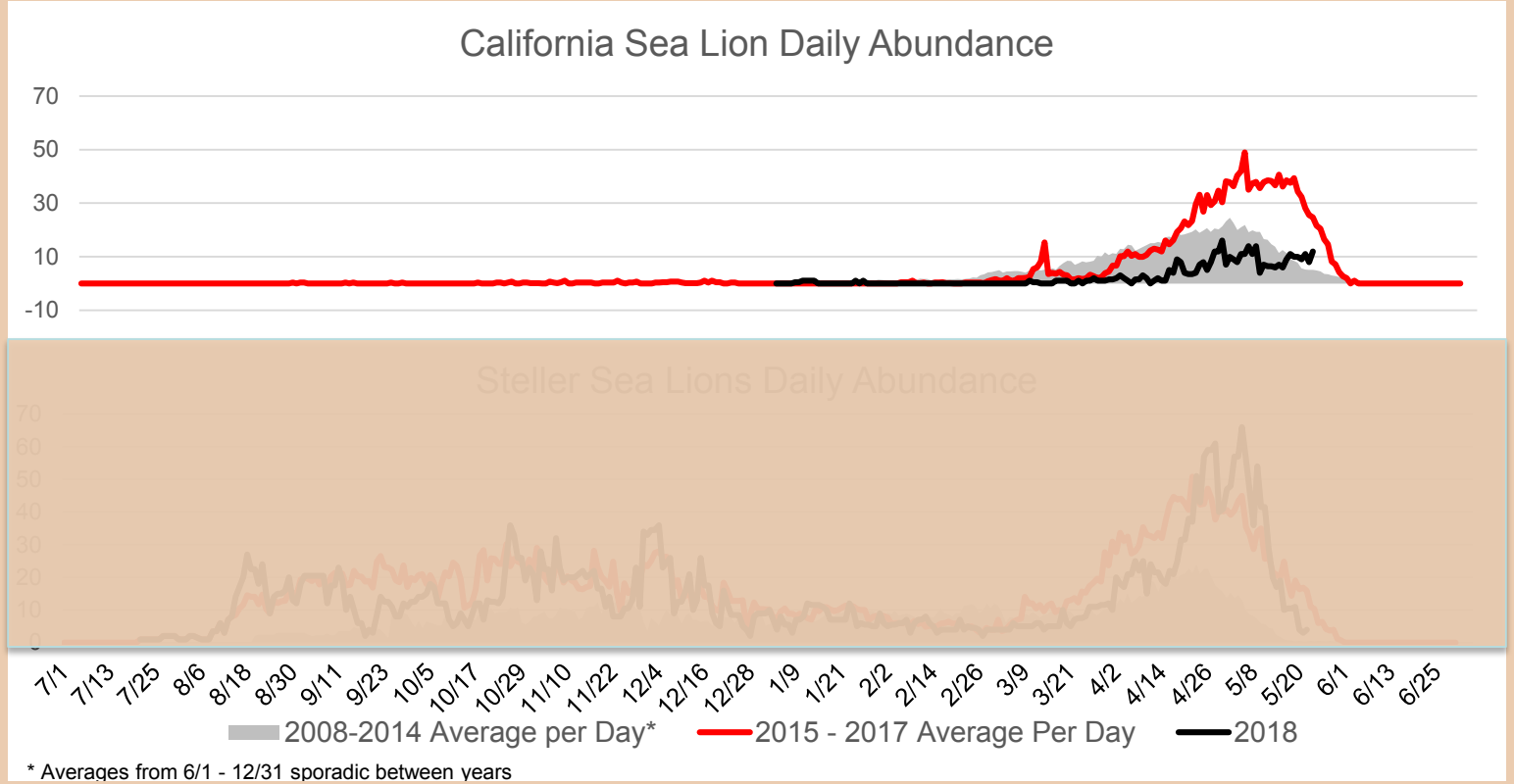


Figure 2. Time series of California sea lion haul-out area counts at the East Mooring Basin (EMB) in Astoria from December 1997 to June 2017. Insets illustrate the changes in magnitude and seasonality of California sea lion occurrence over the study period (x-axis denotes month; note difference in magnitude of counts on the y-axis scale between the two inset figures).

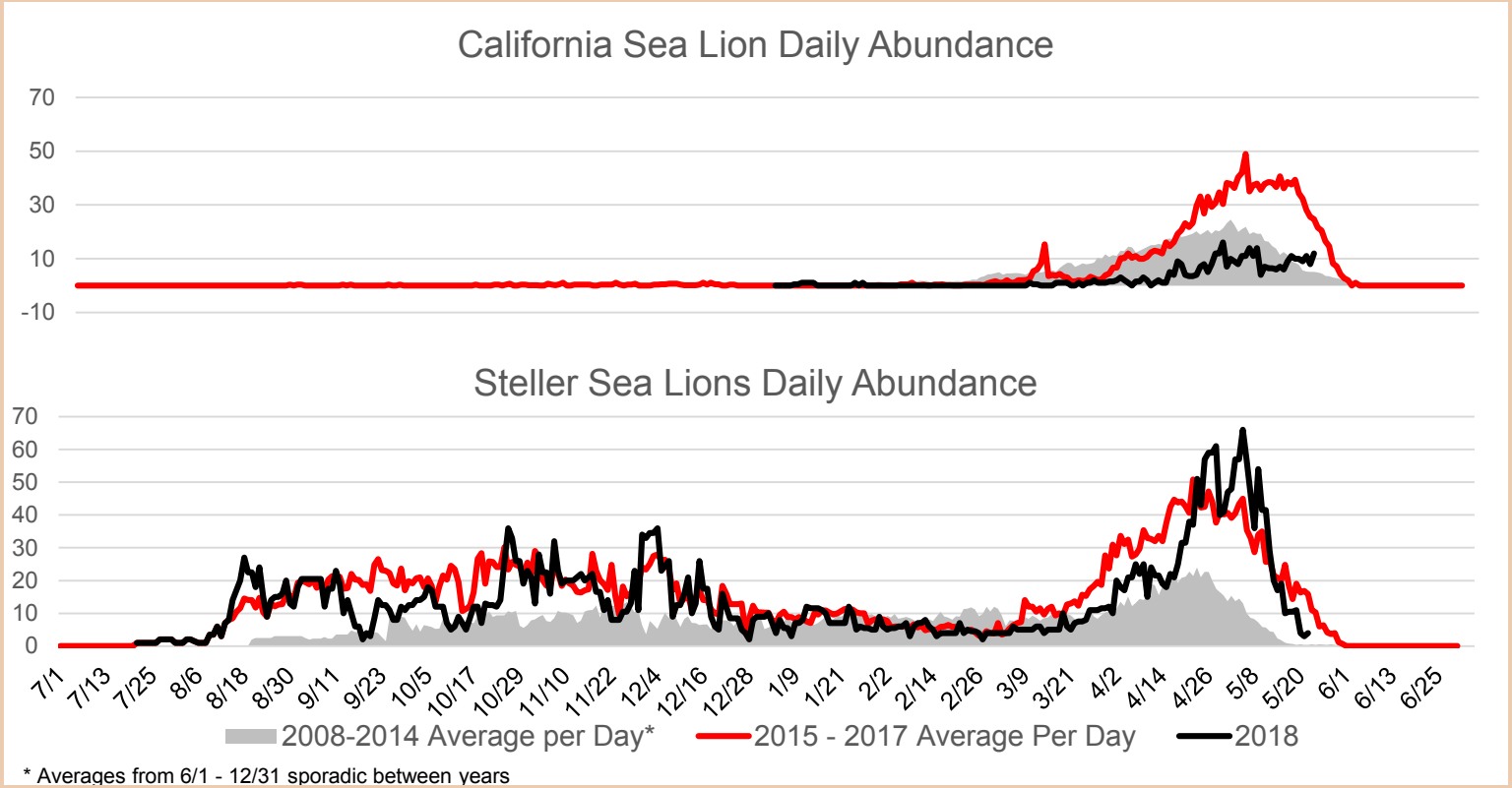
Bonneville Pinniped Abundance



From Kyle Tidwell, USACE

- Annual adult loss of Spring Chinook Salmon – 35,000 to 100,000 in the lower Columbia River (Rub et al. 2018).

Bonneville Pinniped Abundance



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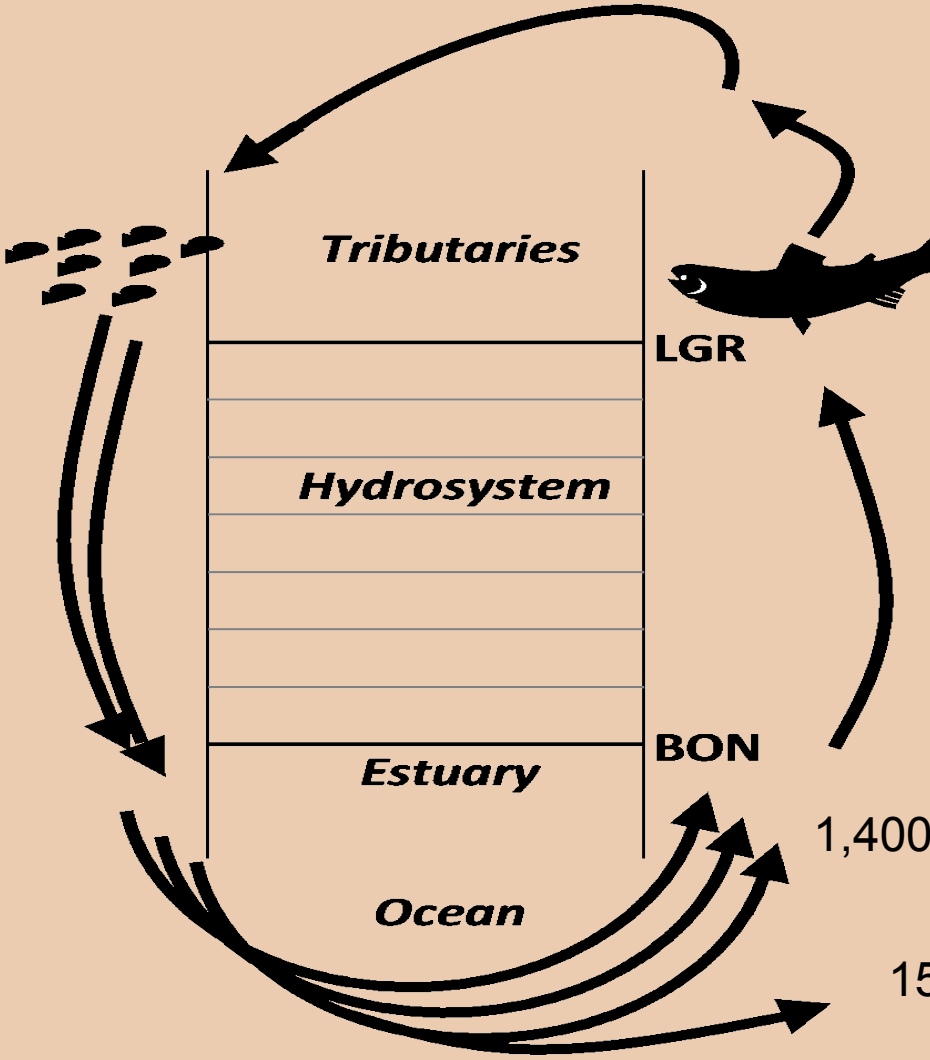
- Annual adult loss of Spring Chinook Salmon – 35,000 to 100,000 in the lower Columbia River (Rub et al. 2018).

Developing a common metric to evaluate predation

"At first glance, developing a metric to evaluate the consequences of predation on salmonid populations might seem straightforward. Predators take individuals from a population and cause a corresponding decline in salmonid abundance. However, it can be misleading to assume that mortality at each life stage accumulates additively over the salmonid life cycle if other factors *compensate* for this mortality." ISAB 2016-1

"The ISAB considers compensatory mortality the most important uncertainty to address when developing a predation metric. Compensatory mortality occurs when predation mortality at one life stage is offset to some degree by decreased mortality at the same or subsequent life stages. For example, a predator might eat injured or weak fish that would have died before reaching adulthood; therefore, controlling this predator would not result in more adult fish." ISAB 2016-1

Adult Equivalent (AE) Analysis



100,000 smolts

20,000 predation loss

30,000 other mortality

50,000 or 70,000 ?

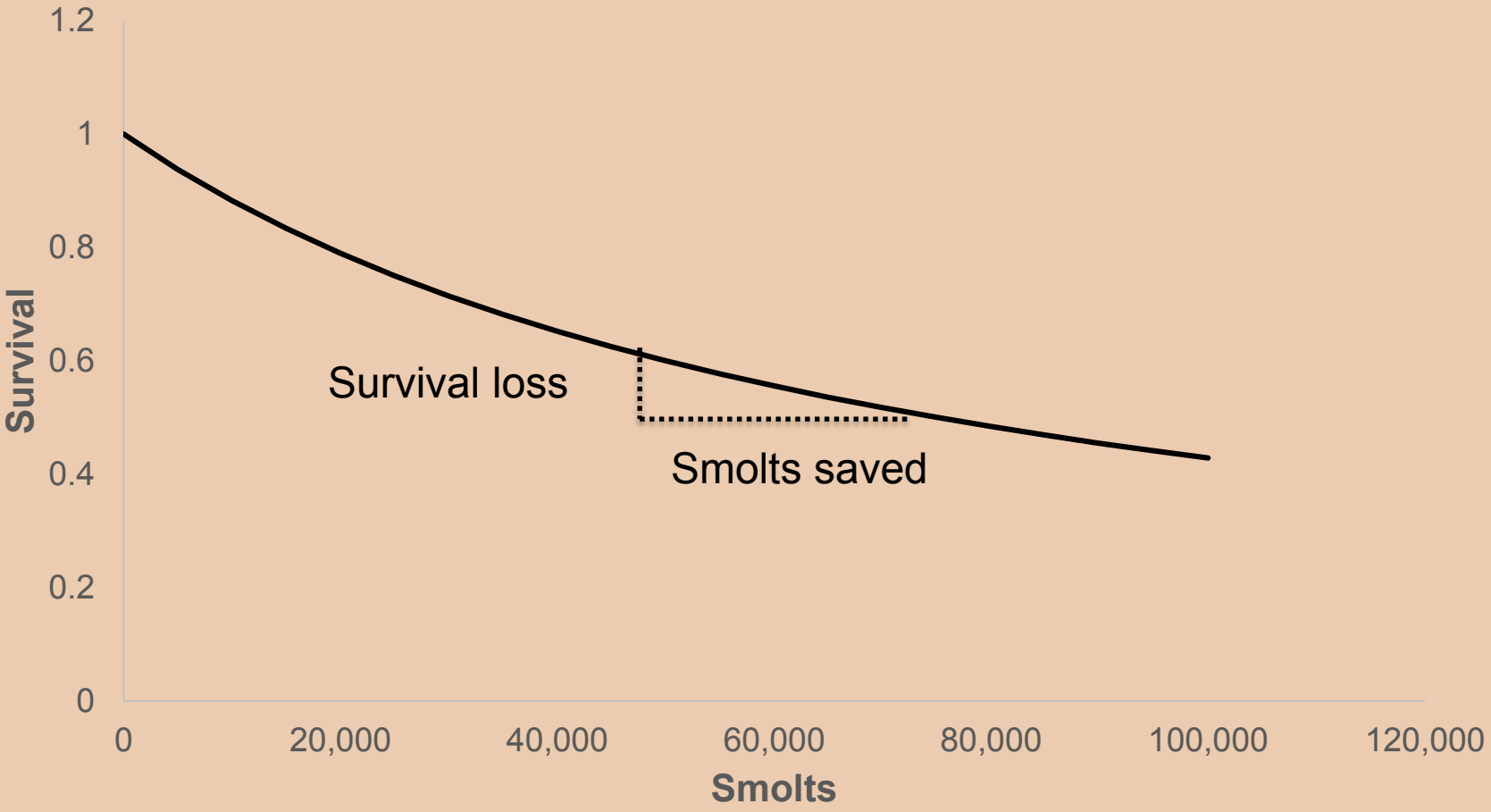
1,250 spawners

150 harvest

1,400 past BON

150 sea lion predation

Survival post predation



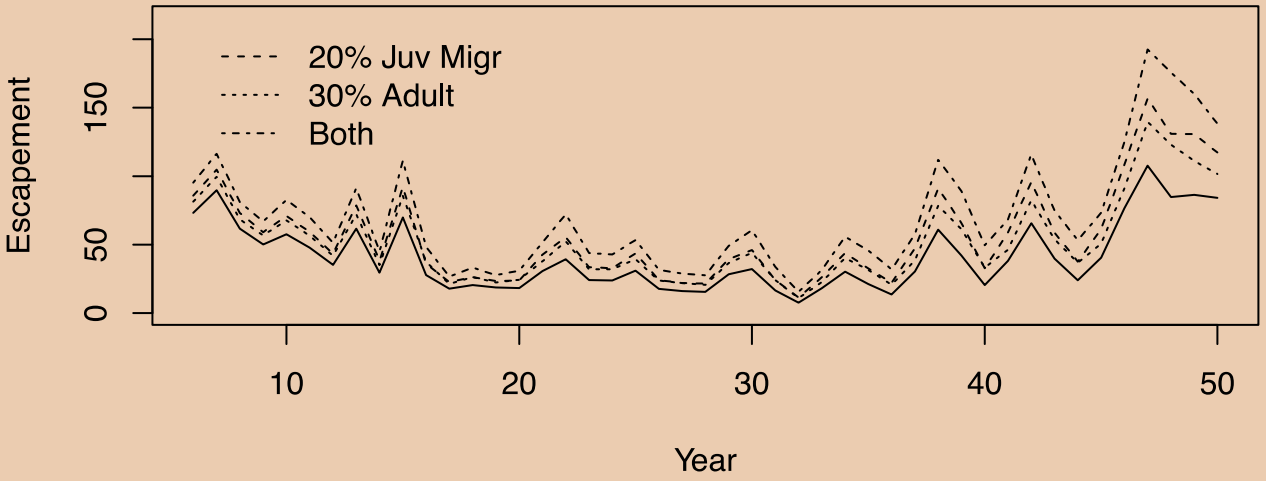
Adult Equivalent Benefits

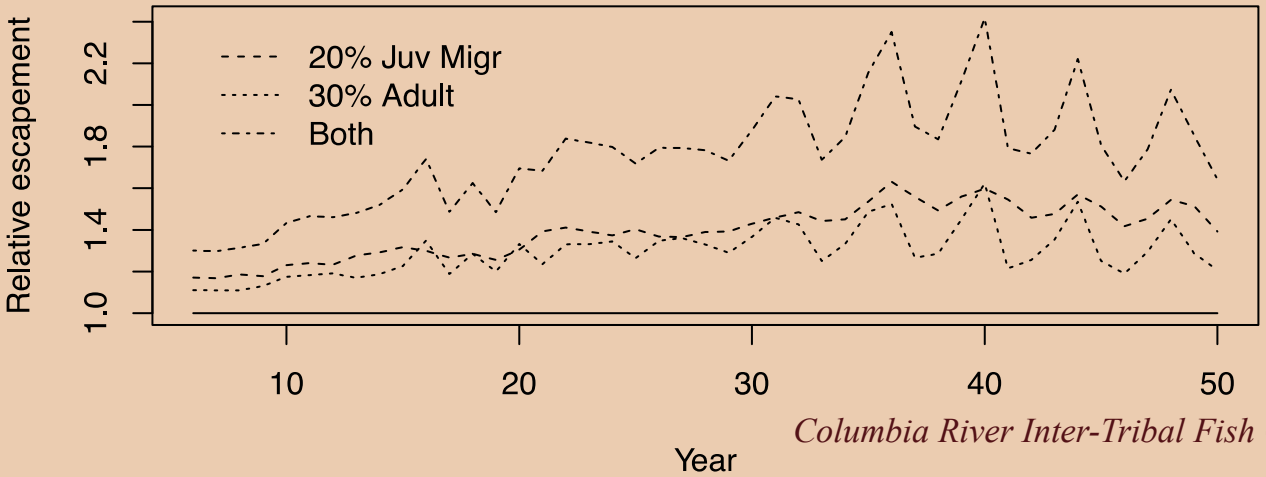
	No control	Additive	Compensatory
Post predation smolts	50,000	70,000	70,000
Survival	0.62	0.62	0.47
Estuary	30,800	43,400	32,900
Ocean survival	0.050	0.050	0.050
Adults	1,540	2,170	1,645
Adult benefit		630	105

AE analysis using life cycle model

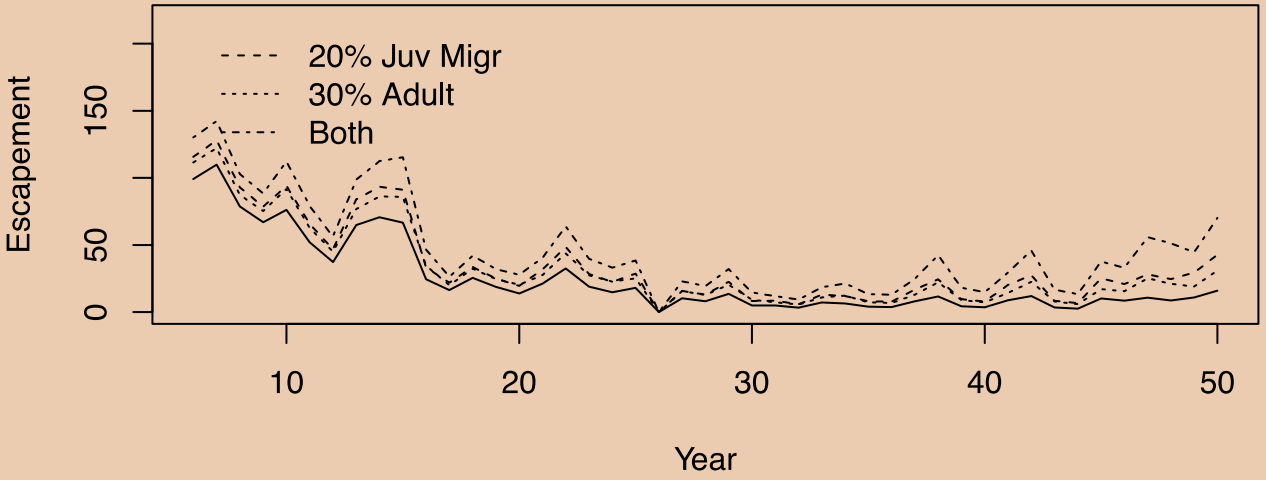
- Adult Equivalent analysis can be performed using life cycle model
- Complete SR and UC models available (CSS and NOAA)
- SARs available for many tag groups (BON,MCN,LGR)
- Need to recast model estimates using total juvenile abundances
  - Compensation on a scale larger than a single population
  - No density dependence estimated in mainstem and ocean
  - Need to estimate degree of compensation
- Compare actions at different predation reduction levels at different stages

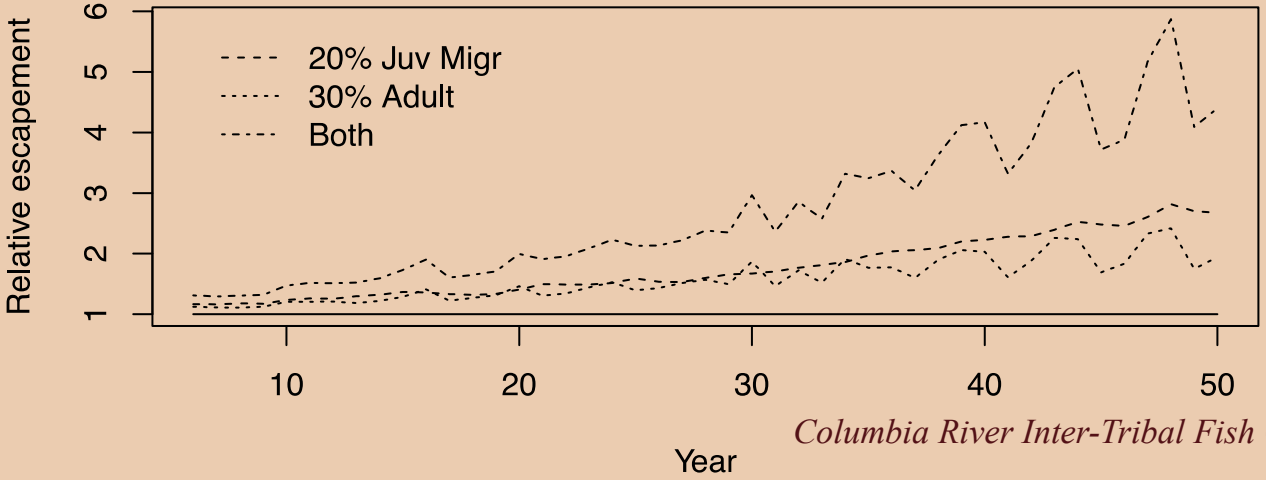
Interacting populations



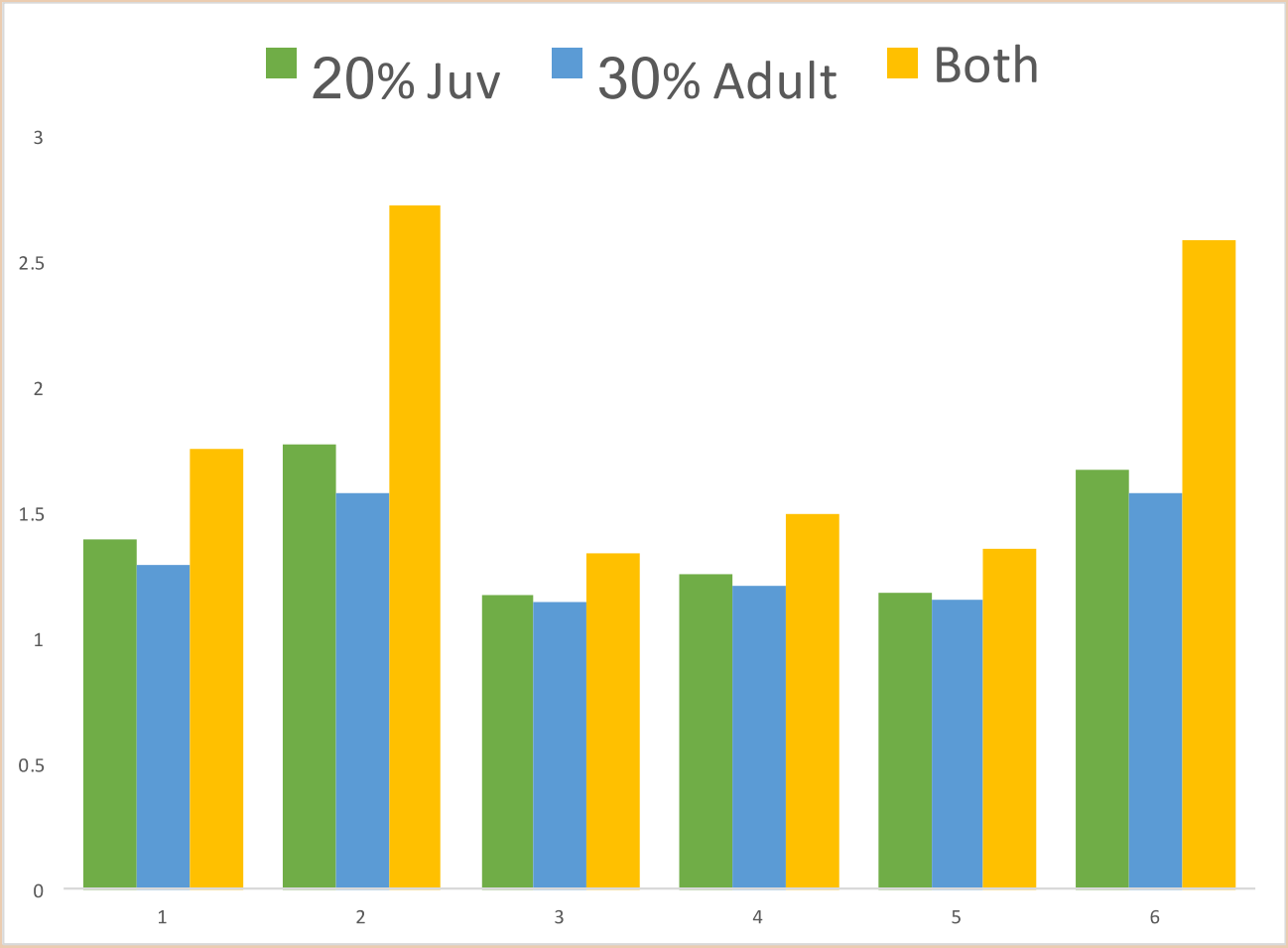


AE analysis using life cycle model





AE analysis using life cycle model



AE analysis using life cycle model

- Predator control/mitigation needs to be quantified
  - Amount of predation mortality eliminated
  - Amount of predator control needed
  - Degree of compensation detected
- If compensation is density mediated, magnitude of compensation needs to be estimated, and total abundance of outmigration needed
- Need to consider population abundances relative to tributary capacities

4. Actions We Can Do Now

1. *Develop a common metric for predation assessments and place in context with a life-cycle model.*
2. *Support legislative changes to the Migratory Bird Act and Marine Mammal Protection Act.*
3. *Review regulations and if appropriate roll back protections for non-native fish in salmon bearing waters.*
4. *Fund sea lion removal and effectiveness monitoring efforts*
5. *Expand temporal coverage of Rub et al. to monitor all fish runs and evaluate impacts resulting from sea lions downstream of Bonneville Dam.*

4. Actions We Can Do Now

6. *Implement a common metric approach with life cycle model integration and vet the model within the region. Phase 1.*
7. *Perform analysis of benefits from various predator control programs. Phase 2.*

Photo credit Sara Thompson

Questions?