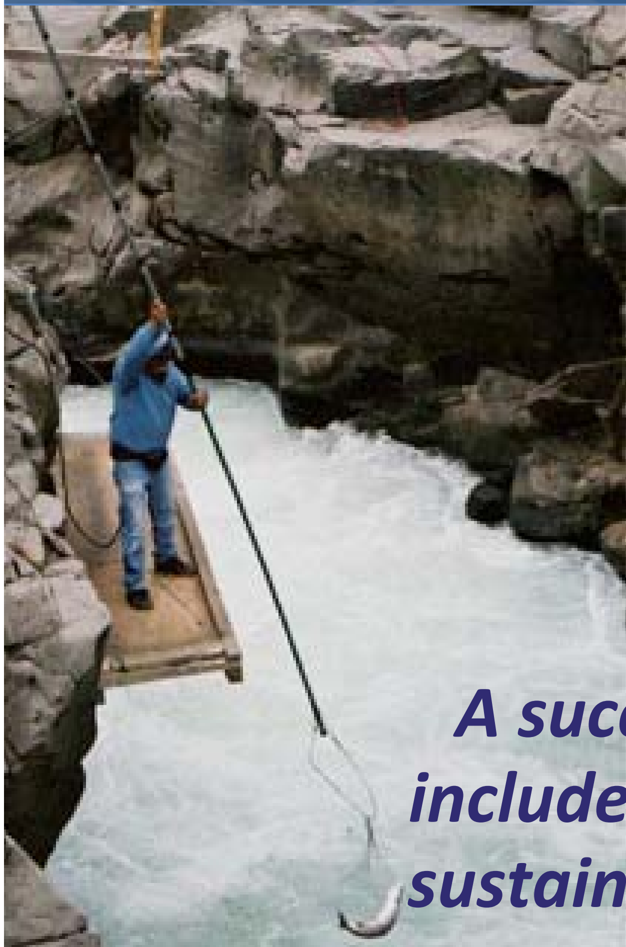

Ecosystem Based Management

A successful treaty review process includes defining an environmentally sustainable operation which includes ecosystem functions

Greg Fuhrer
USGS, Oregon Water Science Center

Eco-Based Impacts

- Anadromous Fish
- Wildlife
- Sedimentation
- Water Quality

- Climate Change
- Estuary
- Resident Fish
- Cultural Resources

Eco-Based Management

Bookends — vs — Alternatives

E1 – Natural Spring Hydrograph

Store and release water from U.S. and Canadian reservoirs to create a more normative spring-peaking hydrograph based on the type of water year, no system flood control, no operation specifically for power

E2 – Reservoirs as Natural Lakes

Generally hold reserves full and *pass inflows* through, no system flood control, no operation specifically for power

E3 – Summer Flows

Store water in Canadian projects during the fall and release to *augment summer flows* in U.S.

E5 – Dry Year Strategy

Store water in Canadian projects during winter/early spring to *augment spring flow* in lowest 20% of water years

Summary of Estuary Findings

Iteration No. 2

- To support Eco-Based Management, a modernized treaty will need to provide just the right amount of additional spring peaking flows, while holding water in reserve for low-flow conditions in summer.
- Estuary is complex, may undergo significant changes post 2024 based on the treaty alternative selected and the specific Eco-system services targeted.
- Most navigation channel reaches will undergo more erosion than at present; shallow water habitats in some reaches will see more deposition.
- Water temperatures are cooler in the Upper Columbia and Snake, but no treaty scenario can bring temperature relief to the Estuary.
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Estuary Work Group Results

<u>Changes to the Treaty: Beneficial or Harmful?</u>

- "Its Complex"...depends on time of year, location, and the Eco-System Service(s) deemed important
- Even though book ends (E1 and E2b) move the estuary toward pre-development flow conditions, today we've a *different estuary* and different *global conditions*

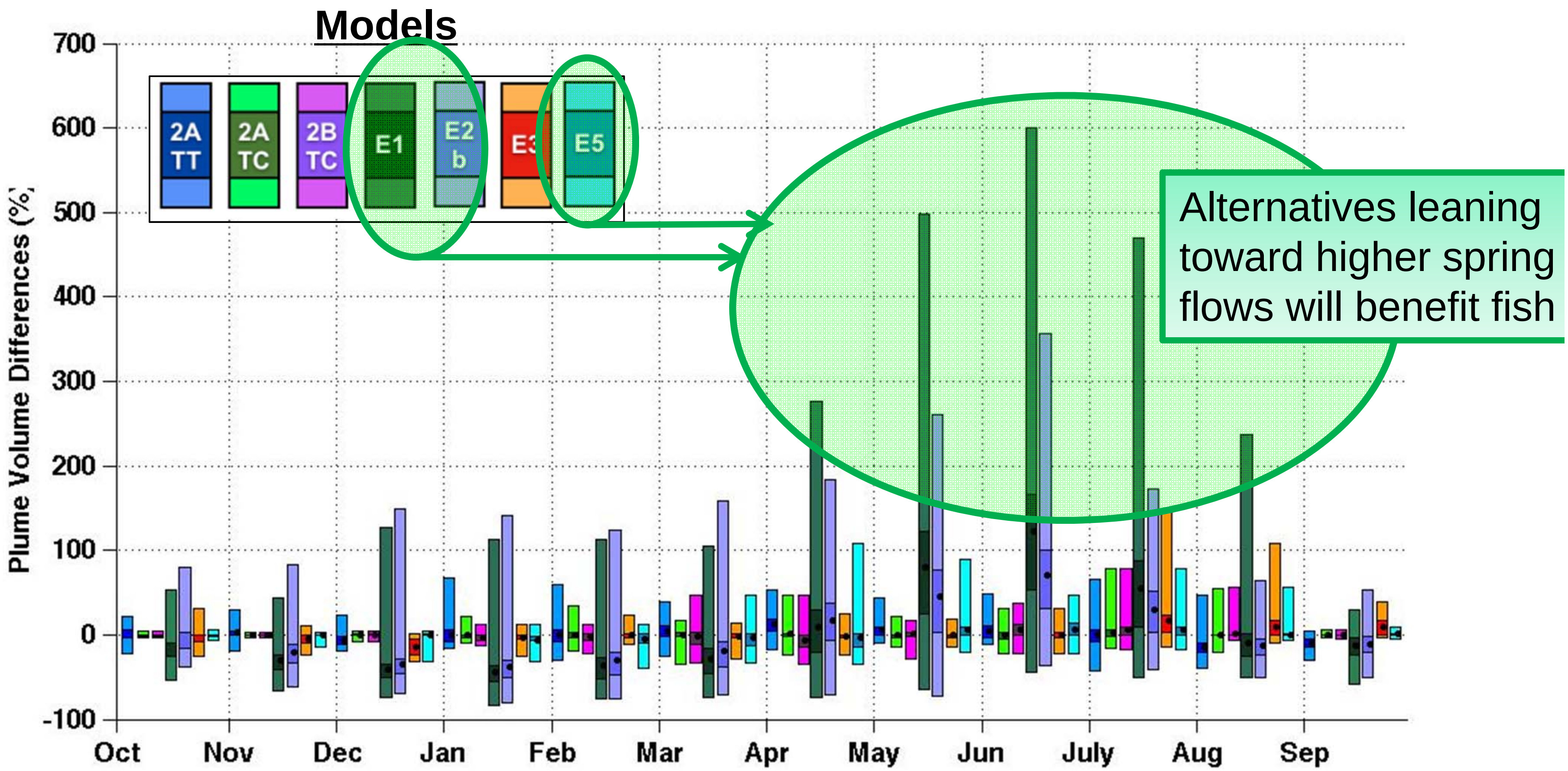
?

May/June	+	-	Models
▪ Ocean entry conditions for yearlings	■		**2A-TT, <u>E1</u>, <u>E2b</u>, E5**
▪ Habitat opportunity for subyearlings	■	■	**All Models**
July-September			
▪ Estuarine hypoxia and acidification	■	■	**2A-TT, E1, E2b, E3**

?

?

Ocean Entry Conditions



Plume Volume vs Current Condition

(70 water years of record --1929-99)

Estuary Work Group Results

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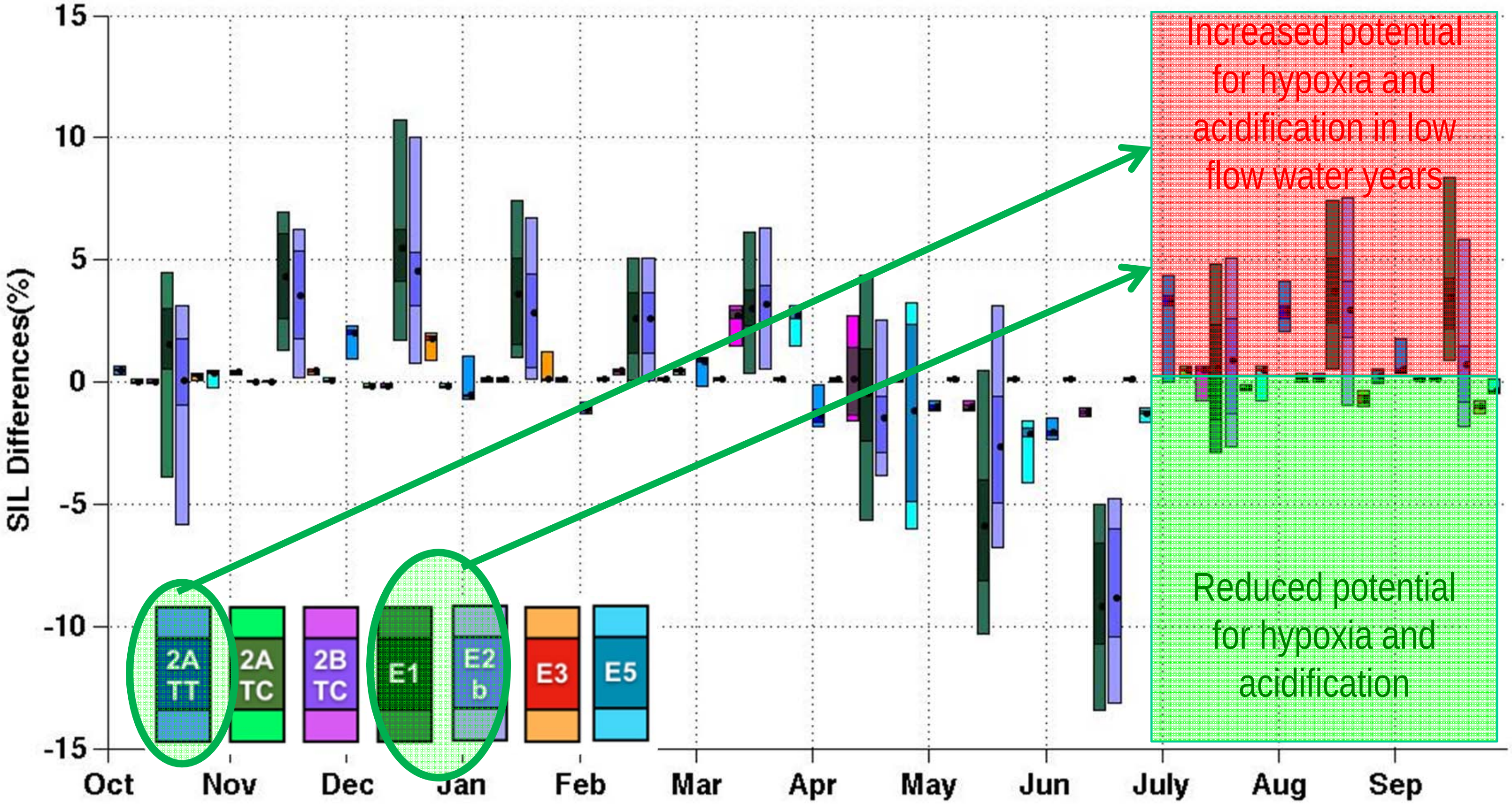
Estuary Hypoxia and Acidification



Salinity Intrusion vs Current Condition

(Low Flow water years of record --1929-99)

Eco-Based Impacts

- Anadromous Fish
- Wildlife
- Water Quality
- *Sedimentation*

- Climate Change
- Estuary
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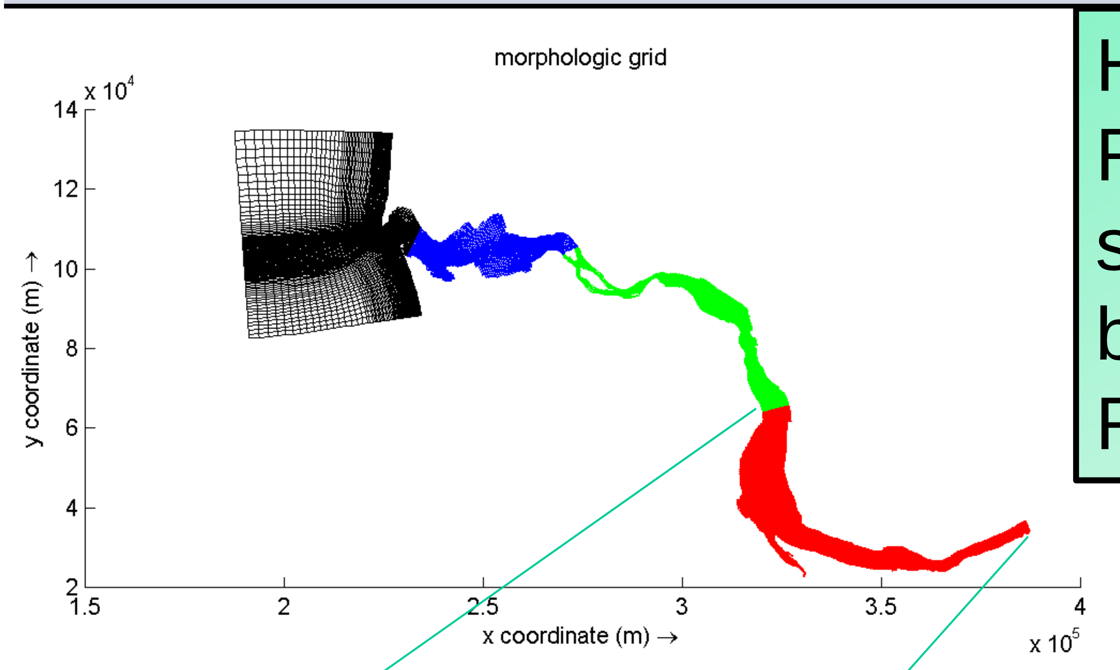
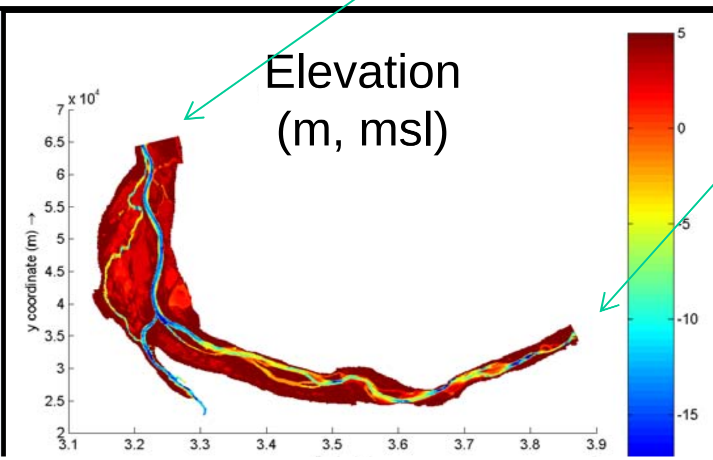
Sediment Transport Modeling



How might the Estuary Respond to future stream flows as shaped by a modern Columbia River Treaty?



Results - Sediment Transport

Comparison of Current Condition (RC-CC) vs CRT Scenarios

HIGH FLOW (1997) July 1 – Aug 30

Scenario	Total Reach								Navigation Channel							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
2A-TC	0.5	0.7	-0.9	0.5	0.4	2.0	-0.8	0.4	0.2	0.4	0.5	0.5	0.4	0.4	0.5	0.5
2A-TT	0.4	0.6	-0.4	0.4	0.5	-1.0	17.8	2.8	0.2	0.3	0.4	0.4	0.5	0.2	0.4	0.5
2B-TC	In-Progress															
2E1 norm hydro	0.6	0.9	4.9	1.1	1.1	-1.0	103	0.1	0.9	1.8	0.8	1.4	1.1	1.0	1.4	0.5
2E2b norm res	0.5	0.8	0.7	0.7	0.8	2.5	0	0.9	0.3	0.4	0.6	0.9	0.7	0.7	0.9	0.6
2E5 dry year	In-Progress															

Alt/Comp **EROSION** is MUCH HIGHER than RC-CC (>=50%)

Alt/Comp **EROSION** is HIGHER than RC-CC (> 30% & <50%)

Alt/Comp **EROSION** is LESS than RC-CC

Alt/Comp **DEPOSITION** is MUCH HIGHER than RC-CC (>=50%)

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+ Alternative/Component MORE erosion/deposition than RC-CC
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2E5 dry year																

The "Bookend" modeling of E1 and E2b show us that reshaping the flows to deliver more peaks in Springtime will result in much higher erosion.

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2E5 dry year																

The "Bookend" modeling of E1 and E2b also show us that reshaping the flows to deliver more peaks in Springtime will result in sediment deposition in some reaches and habitats outside the navigation channel

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Eco-Based Impacts

- Anadromous Fish
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- *Water Quality*

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- Estuary
- Resident Fish
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Results: Temperature Modeling

low flow / hot weather

Columbia - Hanford Reach (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	20.9	23.2	64
2A-TC	21.0	23.2	64
2A-TT*	21.5	24.0	68
2B-TC	20.9	23.2	64

Clearwater at Spalding (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	15.2	19.5	0
2A-TC	15.2	19.5	0
2A-TT	15.2	19.5	0
2B-TC	15.2	19.5	0

*2A-TT has lower summer flows on mainstem than other alternatives.

Results: Temperature Modeling

low flow / hot weather

Snake below Ice Harbor (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	20.9	22.8	67
2A-TC	20.9	22.8	67
2A-TT	21.0	22.9	68
2B-TC	20.9	22.8	67

Columbia below Bonneville (1941/1998)

Alternative	Mean WT (Jul-Aug) °C	Max Daily WT °C	Duration WT above 20 °C days
RC-CC	22.4	24.5	84
2A-TC	22.4	24.6	83
2A-TT	22.6	25.0	84
2B-TC	22.4	24.7	85

Eco-Based Impacts

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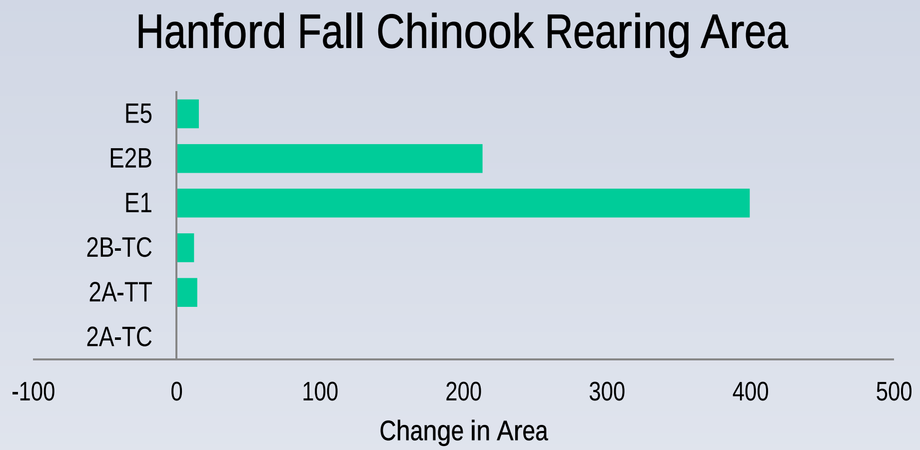
Fall Chinook Rearing Habitat
Sturgeon Spawning Habitat

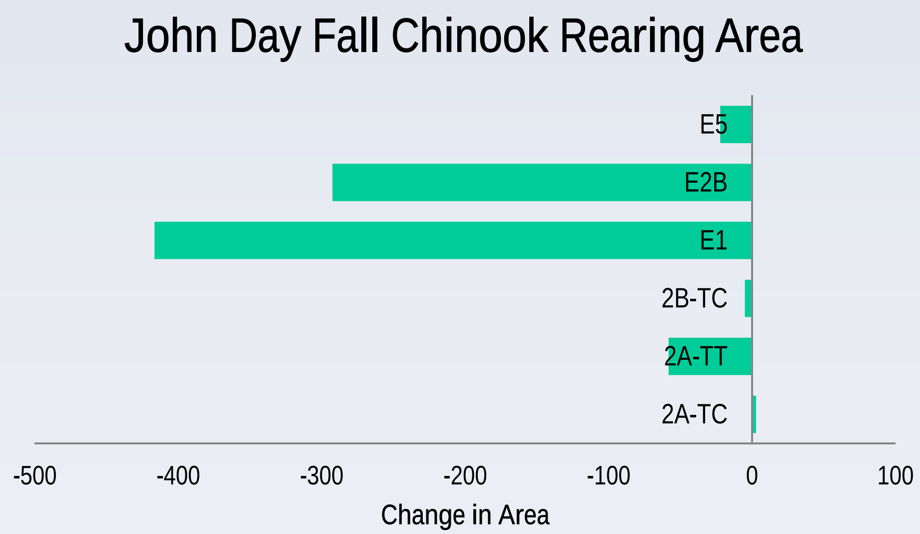
Fall Chinook migrate as sub-yearlings and use shallow, low velocity habitats to feed in spring/summer.

Sturgeon spawn in fast moving water of various depths and are particularly successful spawning in areas below Bonneville Dam

Results: Fall Chinook Rearing Modeling

Comparison of Current Condition (RC-CC) vs CRT Scenarios





Results: Sturgeon Spawning Modeling

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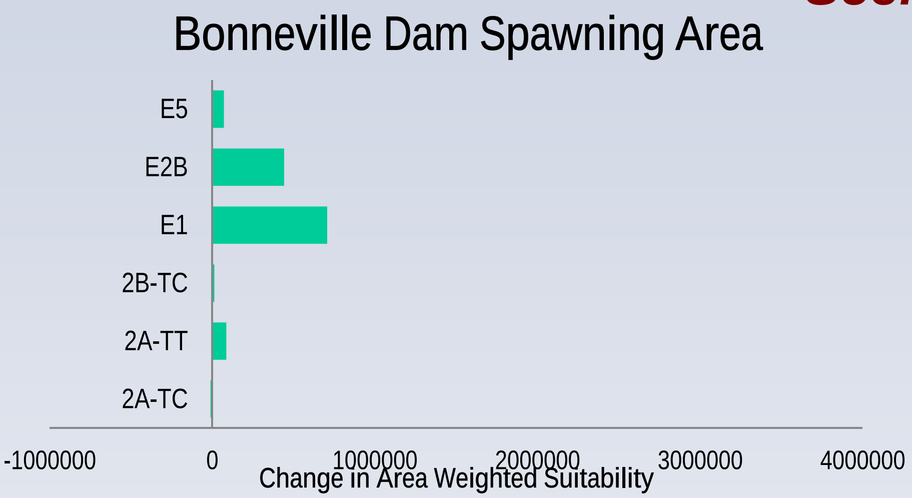
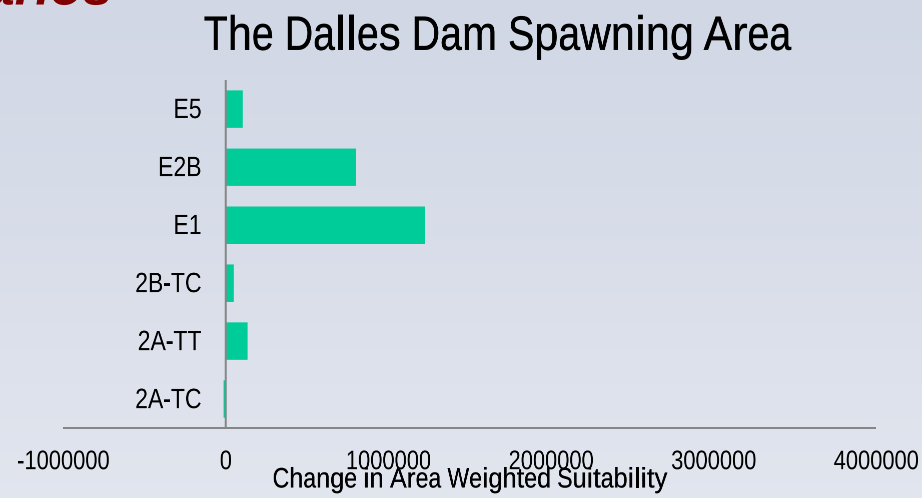
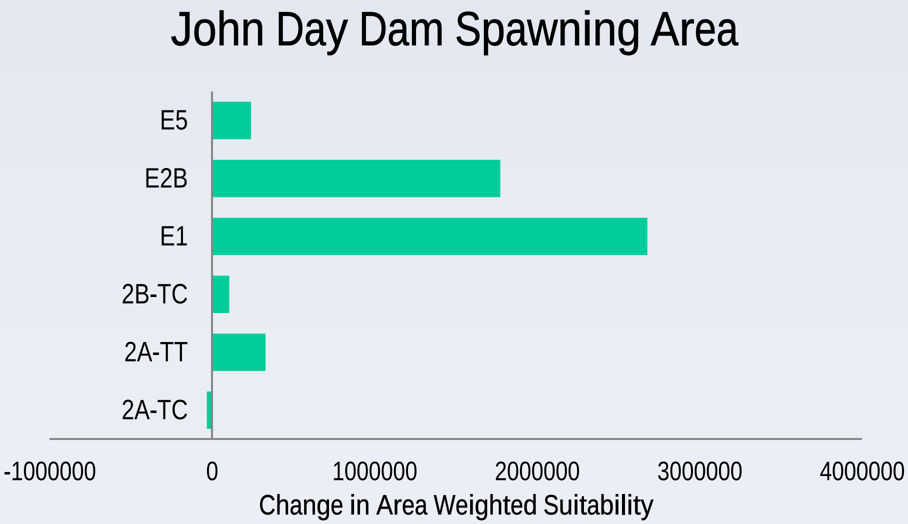
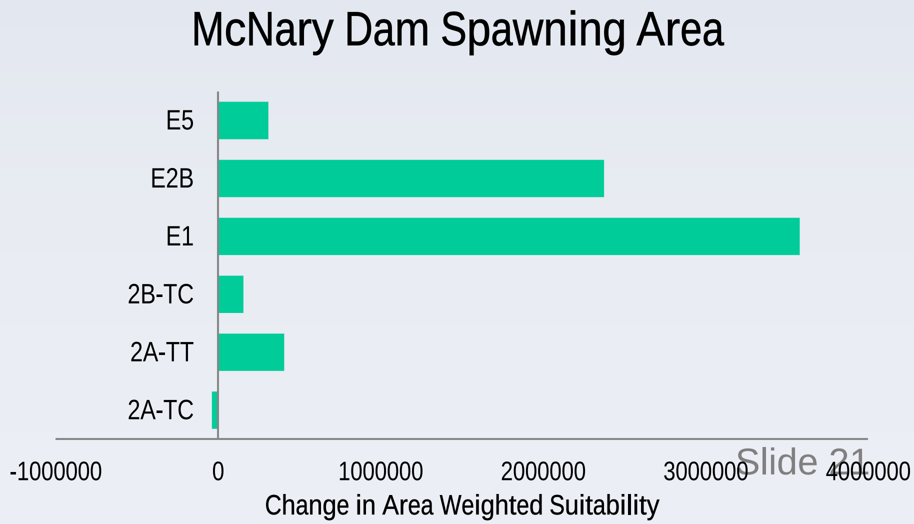


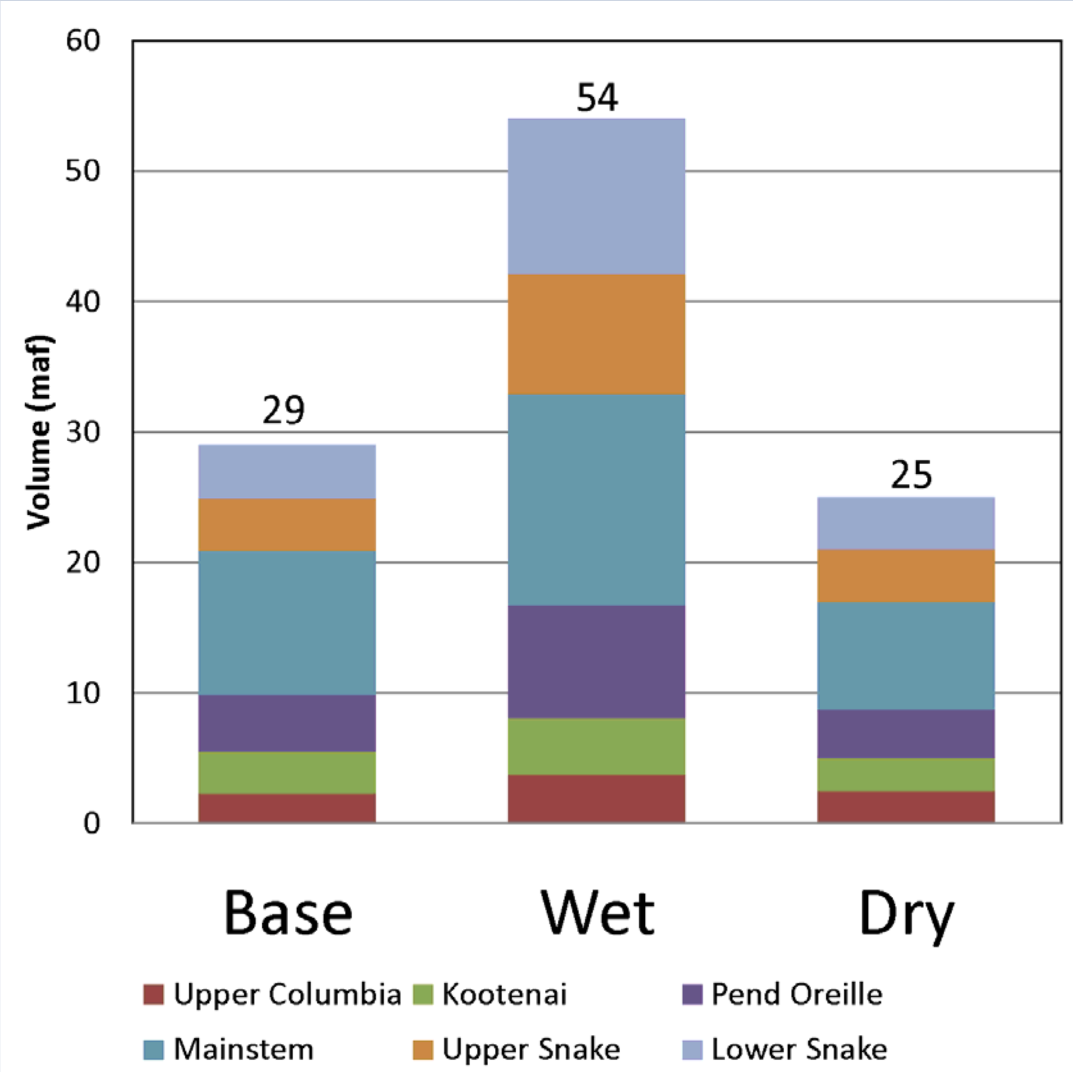






Results: Climate Change Models

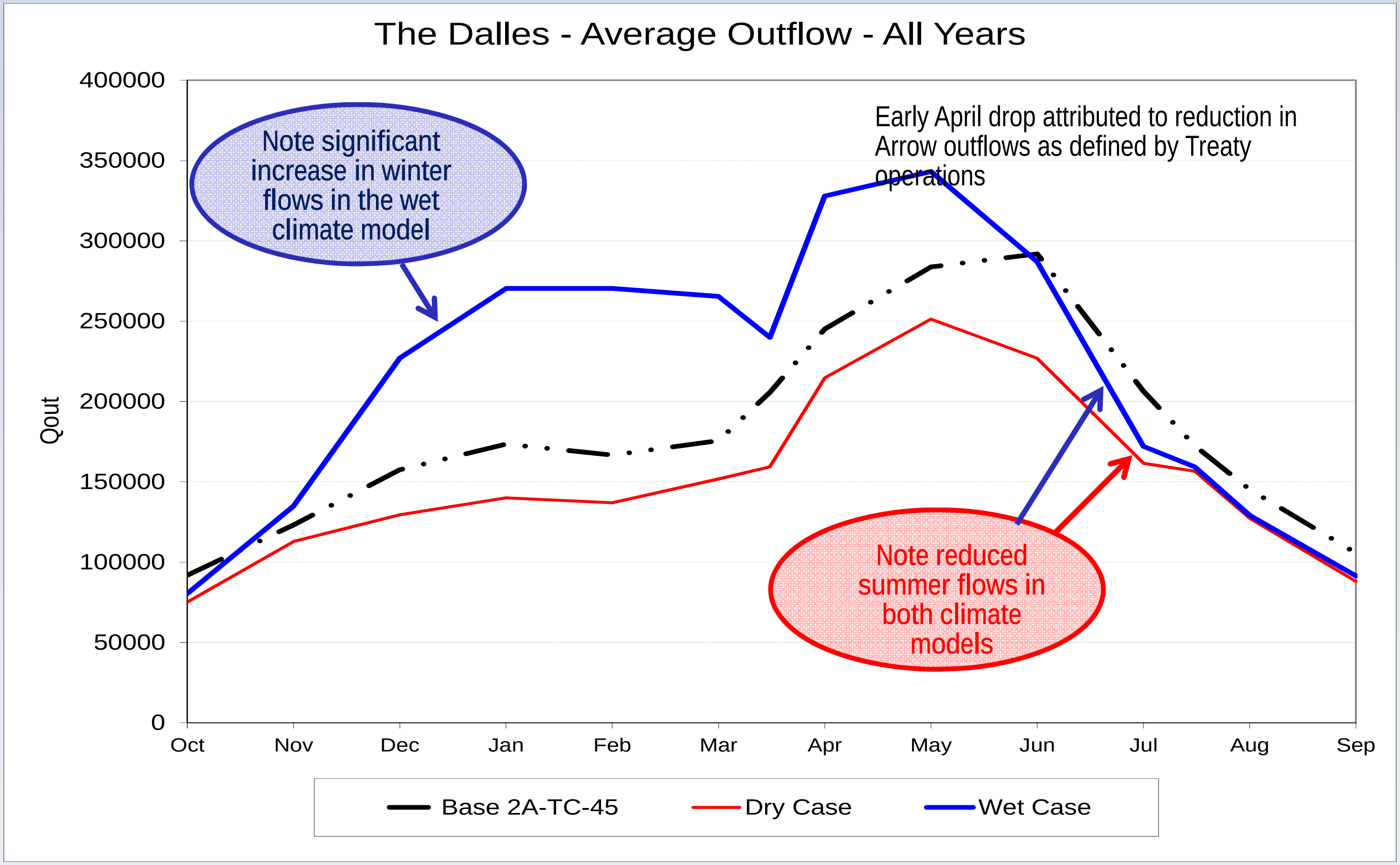
Wettest Winters, Volume Distribution



- Largest 7 years represents the top 10% of the datasets
- Wet has 86% more volume than the Base
- Storm volume comes from locations downstream of most major reservoir space
- During peak of winter rain events typically ~50% of volume comes from the Snake

Results: Climate Change Models

Comparison of Treaty Continues (2A-TC) to 2040's climate



Summary of Estuary Findings

Iteration No. 2

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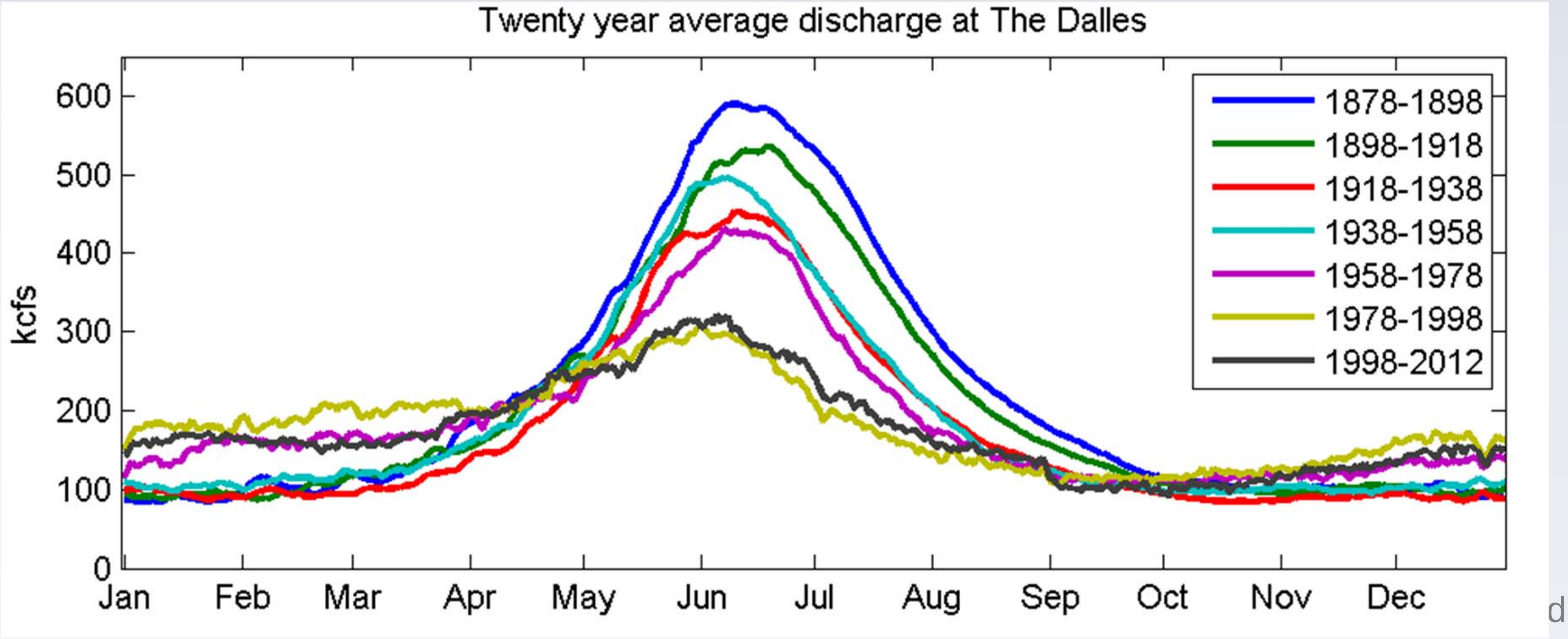
Acknowlegements

- Estuary Work Group: Antonio Baptista (OHSU), Guy Gelfenbaum and Krista Jones (USGS), Rod Mortiz (USACE), Mojgan Rostaminia and Charles Seaton (OHSU)
- Water Quality Work Group: Temperature Team --Scott English, Geoffrey Walters, Jim Crain and Mike Schneider (USACE)
- Anadromous Fish & Resident Fish Work Groups: Fall Chinook and Sturgeon Habitat Team –Jim Hatten and Mike Parsley (USGS)
- Climate Change Work Group: –Kristian Mickelson (USACE) and Brian Kuepper (BPA)

Historical discharges

- River discharges have drastically changed over the last ~1.5 centuries
- The number, duration, and magnitude of springtime peak flows have decreased and winter flows have increased



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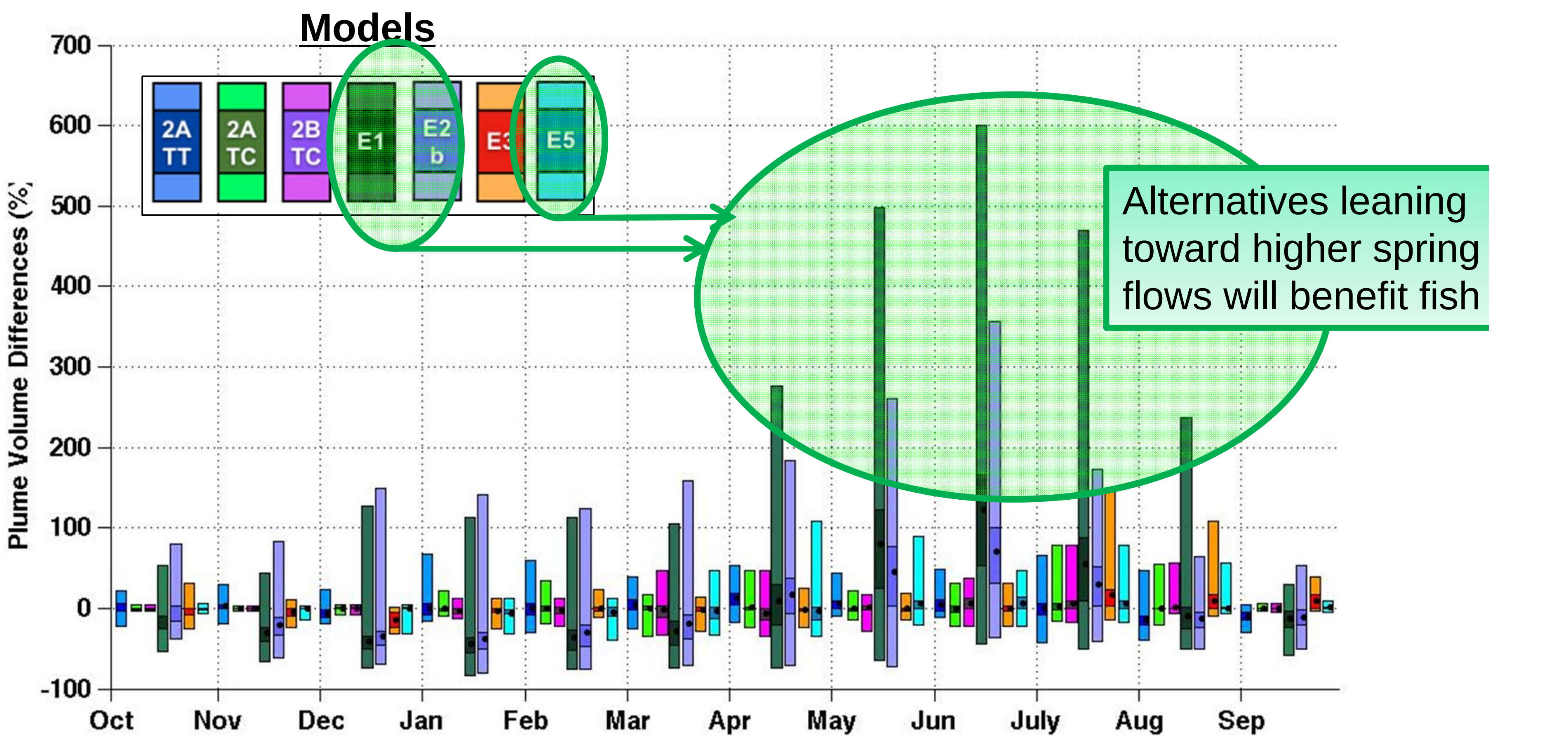

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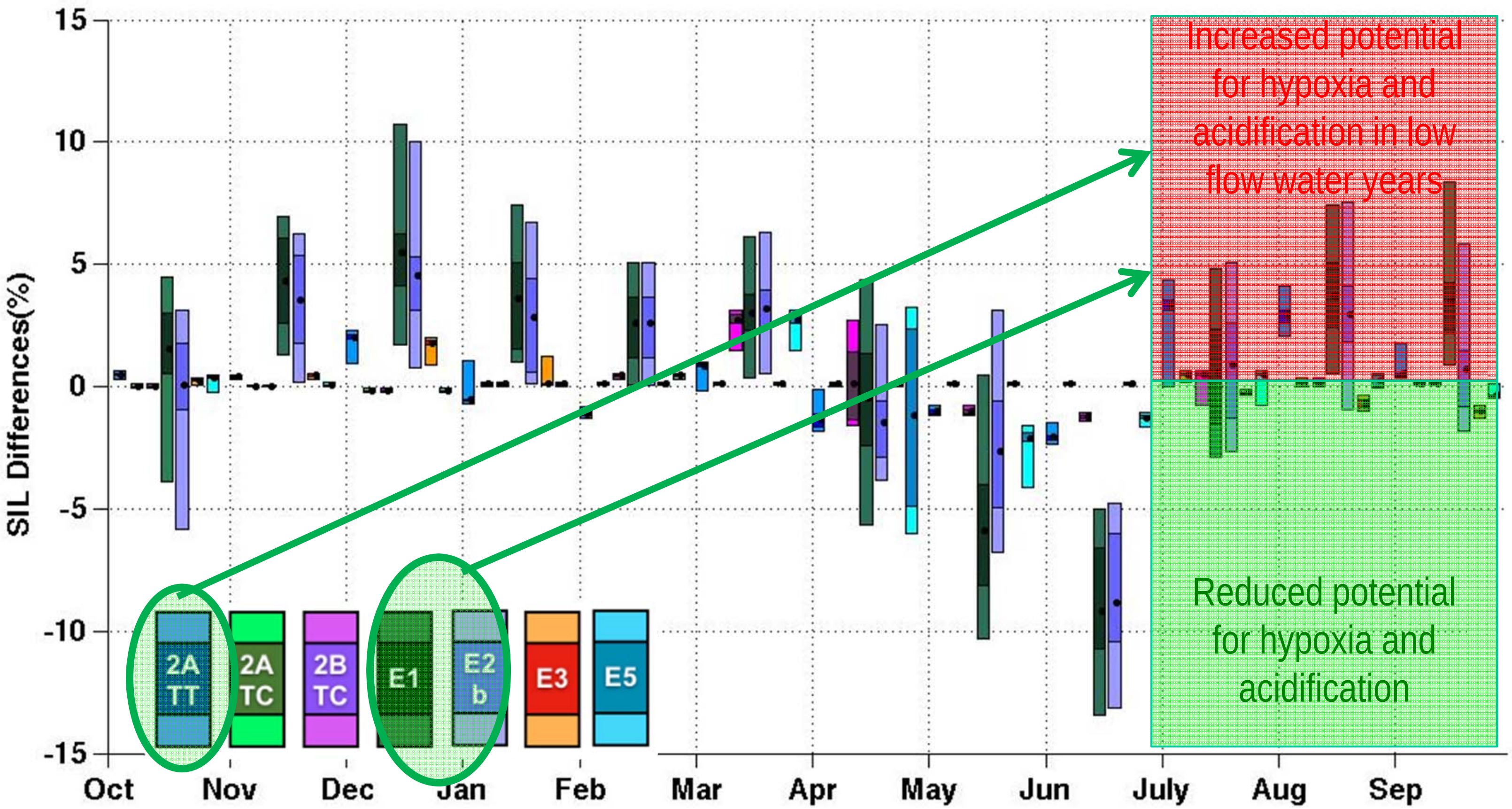

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