Context and Comparison: Status of Tailwater Fisheries in the Western United States

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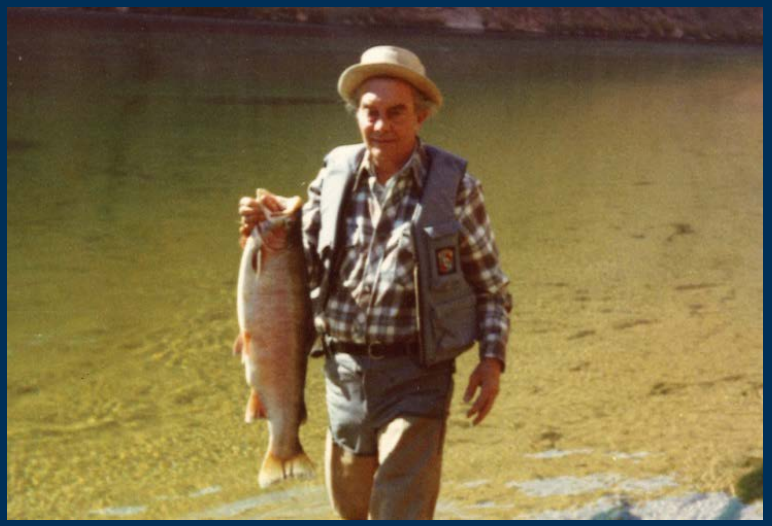
U.S. Department of the Interior
U.S. Geological Survey

Lees Ferry Tailwater, 1970s



Photos: Richard Hepworth, 1977

Photo: Colorado River Conservancy

Hypotheses

- **Changes in dam operations during the stocking era (1990) limit the growth of large rainbow trout**
- **Hydropeaking may be beneficial to adults**
  - **Created fast-growing, high-quality algal assemblage**
  - **Daily surges in invertebrate drift**
  - **Favored larger invertebrate prey (e.g., *Gammarus*)**

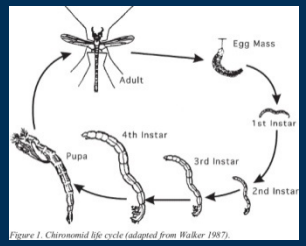
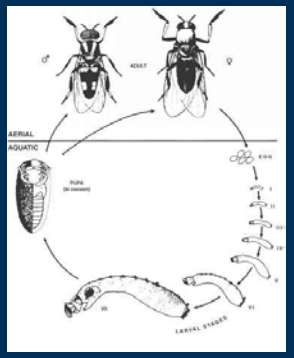


Figure 1. Chironomid life cycle (adapted from Walker 1987).

Midges



Black flies

Glen Canyon Dam

USGS

Why learn from other tailwaters?

- Would be difficult to evaluate hypotheses without changing Glen Canyon dam operations
- Novel flow regimes in other tailwaters to enhance trout fishery, benefit native fish
  - Flaming Gorge- artificial spring floods, temperature modification, summer minimum flows
  - Long history of data collection
- Develop broader understanding of linkages between dam operations and trout growth

USGS

Data Synthesis

- Western tailwaters
  - AZ, NM, CA, NV, CO, UT, WY, MT, ID, OR
- Data obtained from biologists, databases
  - Trout size
  - Discharge
  - Reservoir
  - Water quality
  - Temperature
  - Foodbase
  - Dam size
  - Dam age
  - Latitude/elevation
  - Stocking
  - Whirling disease
  - Brown trout density

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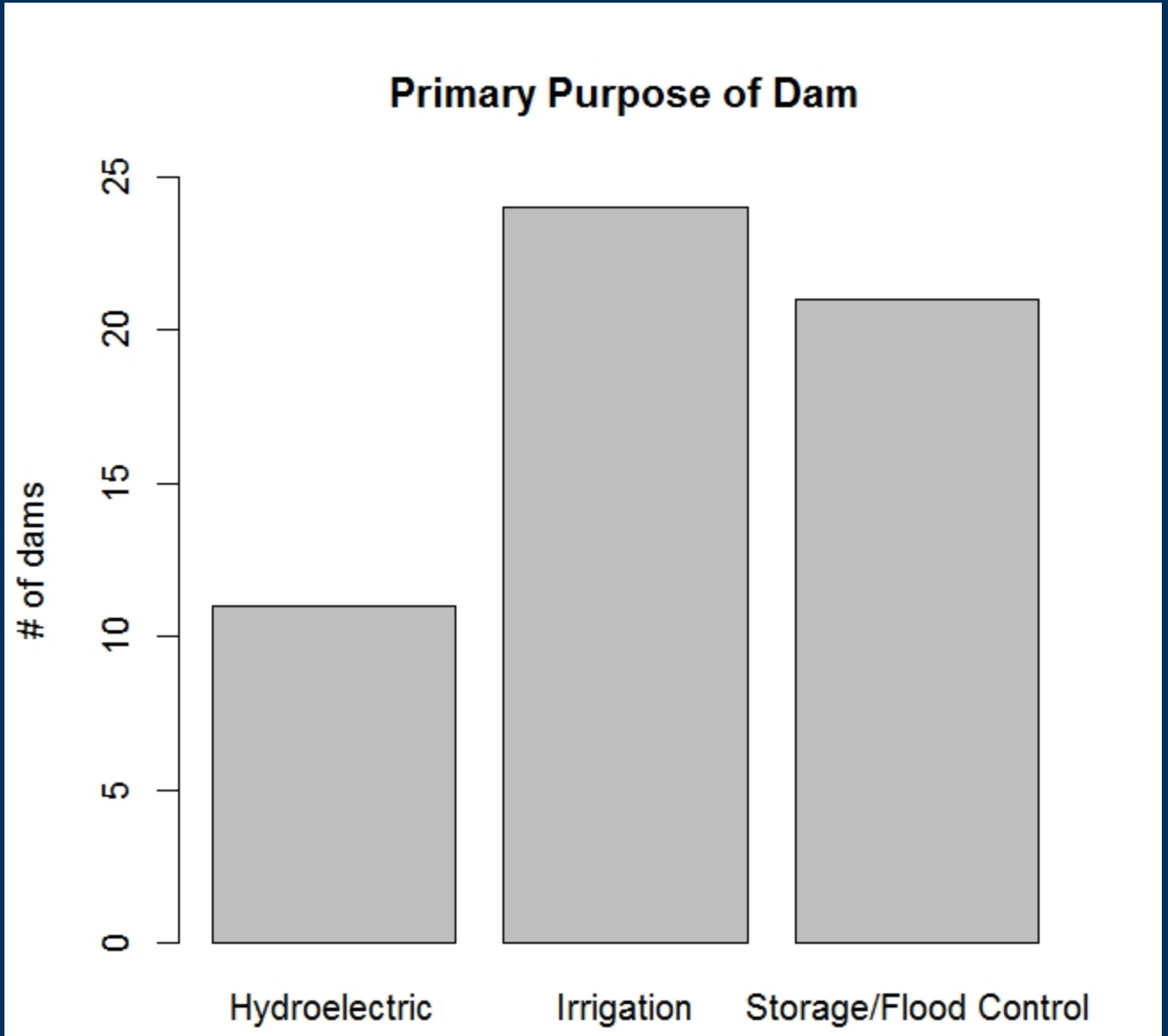
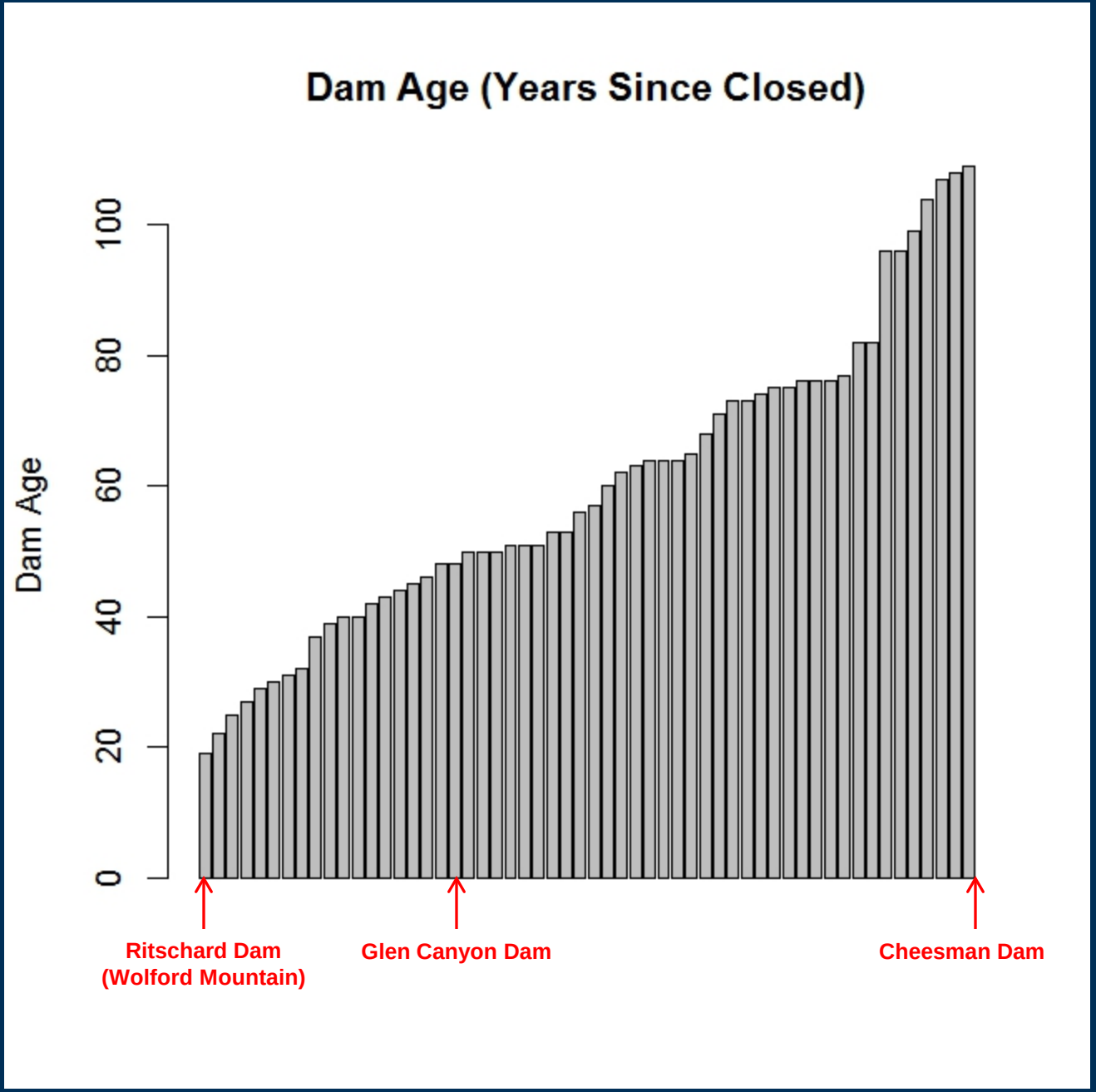


35/56 dams capable of hydroelectric generation

USGS



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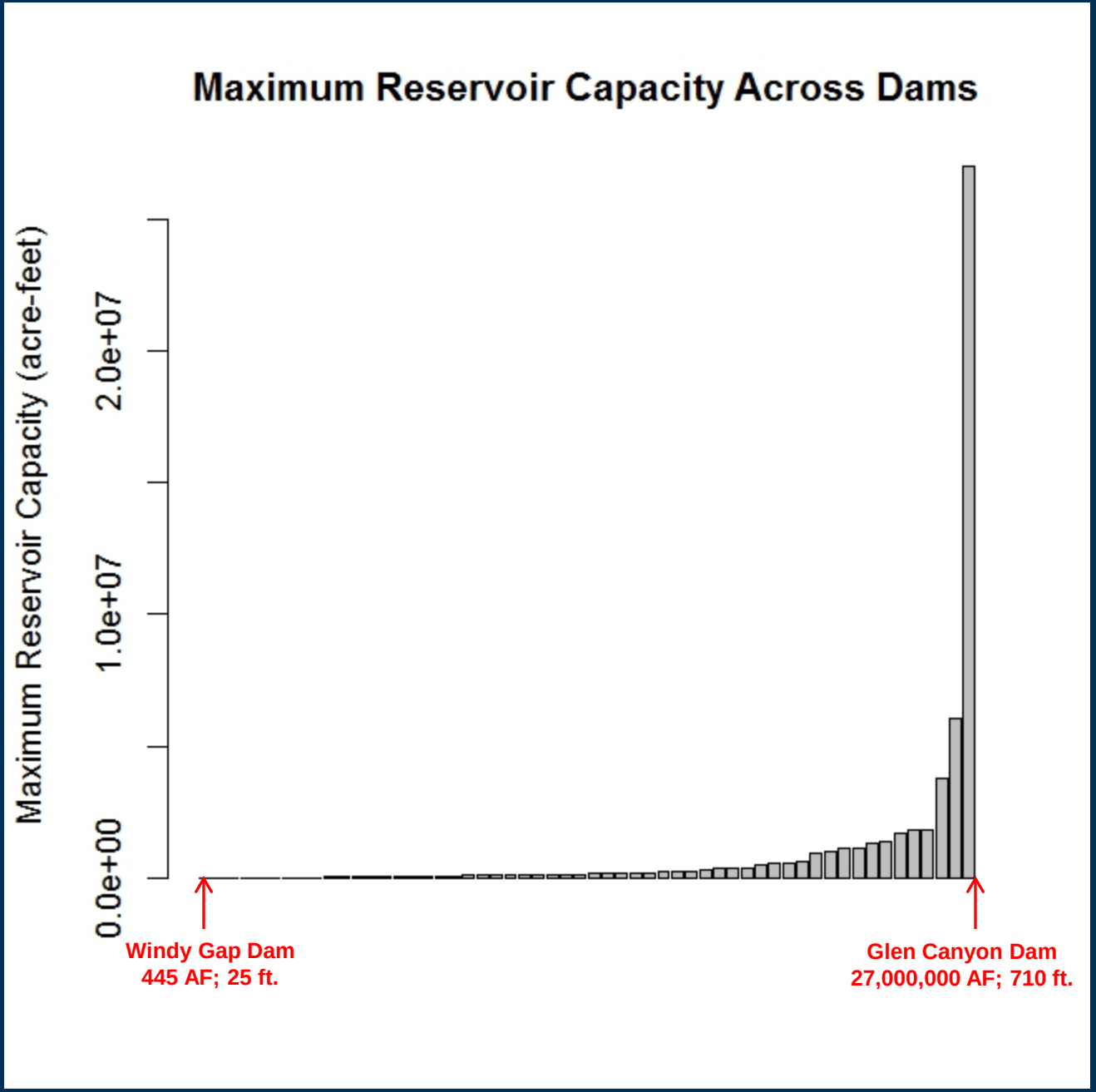
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite


Maximum Reservoir Capacity Across Dams
Maximum Reservoir Capacity (acre-feet)
0.0e+00
1.0e+07
2.0e+07
Windy Gap Dam
445 AF; 25 ft.
Glen Canyon Dam
27,000,000 AF; 710 ft.

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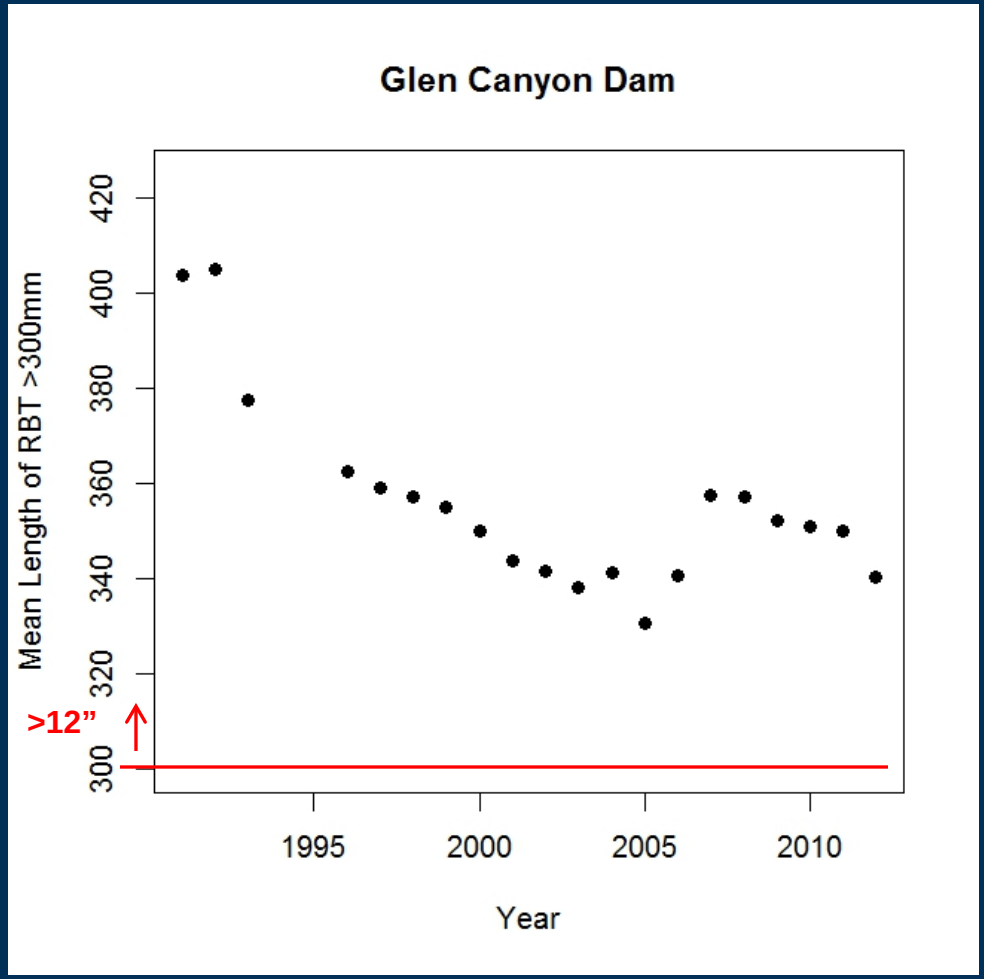
Response Metric: Length >300mm



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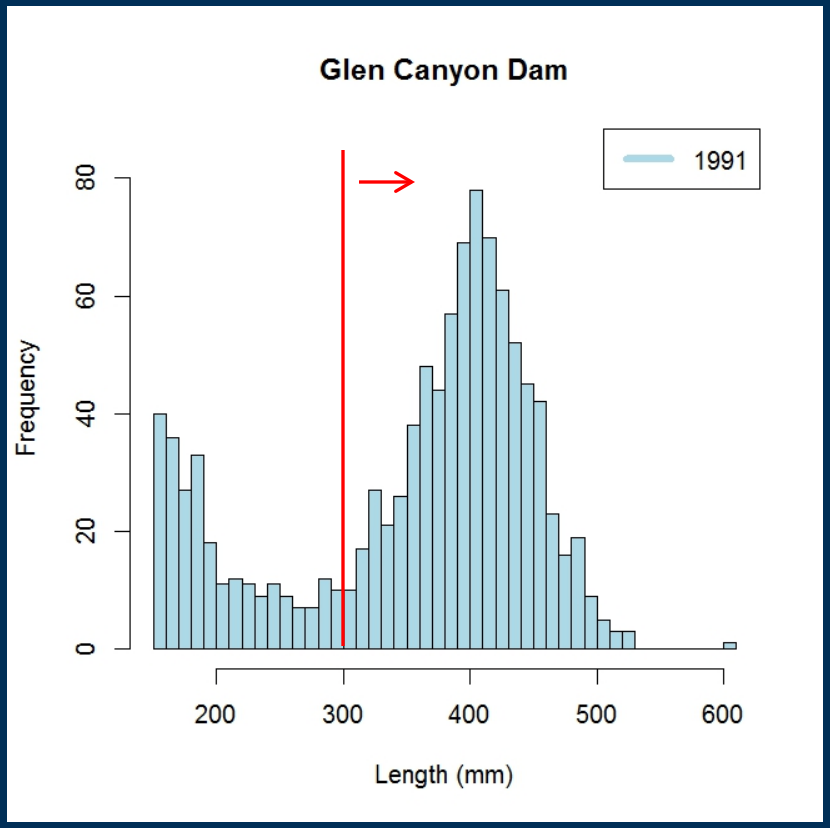
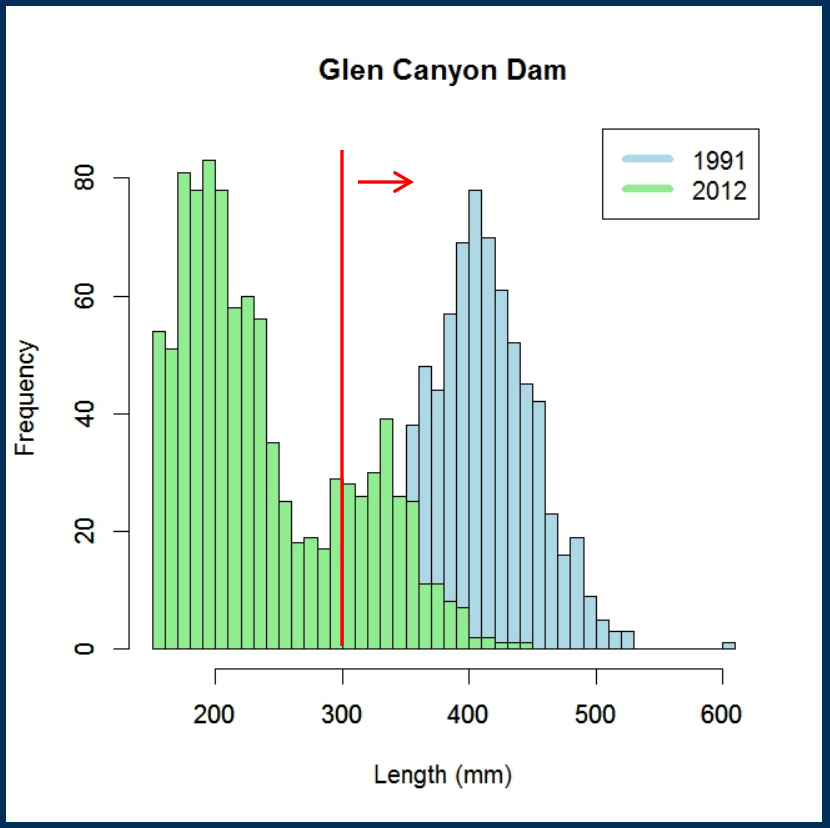
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Response Metric: Catch/mile >300mm





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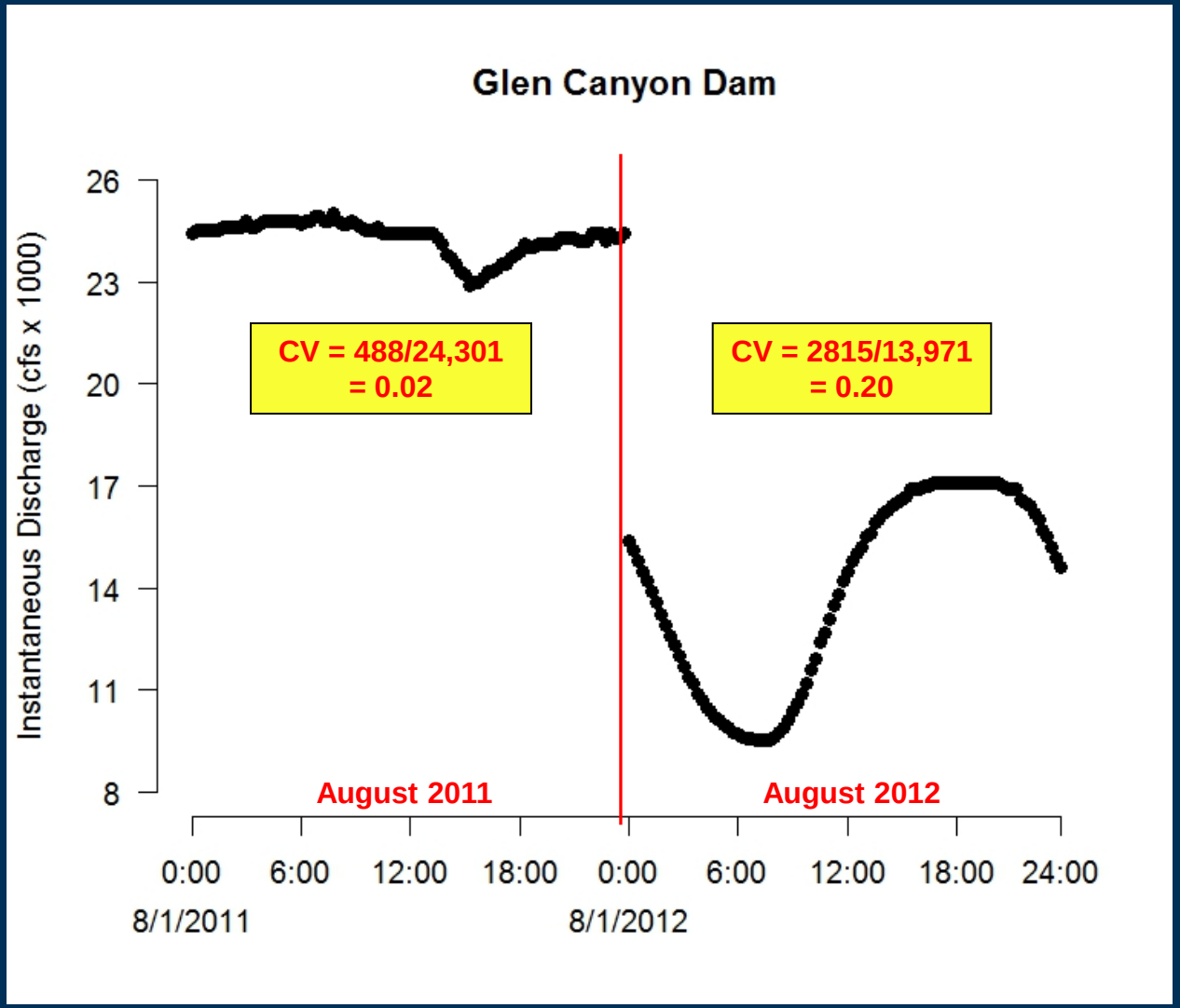
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Explanatory Metric: Hydropeaking

Coefficient of Variation
Ratio of the standard deviation to the mean

CV= σ/μ

CV is high when the range of discharges within a day is large



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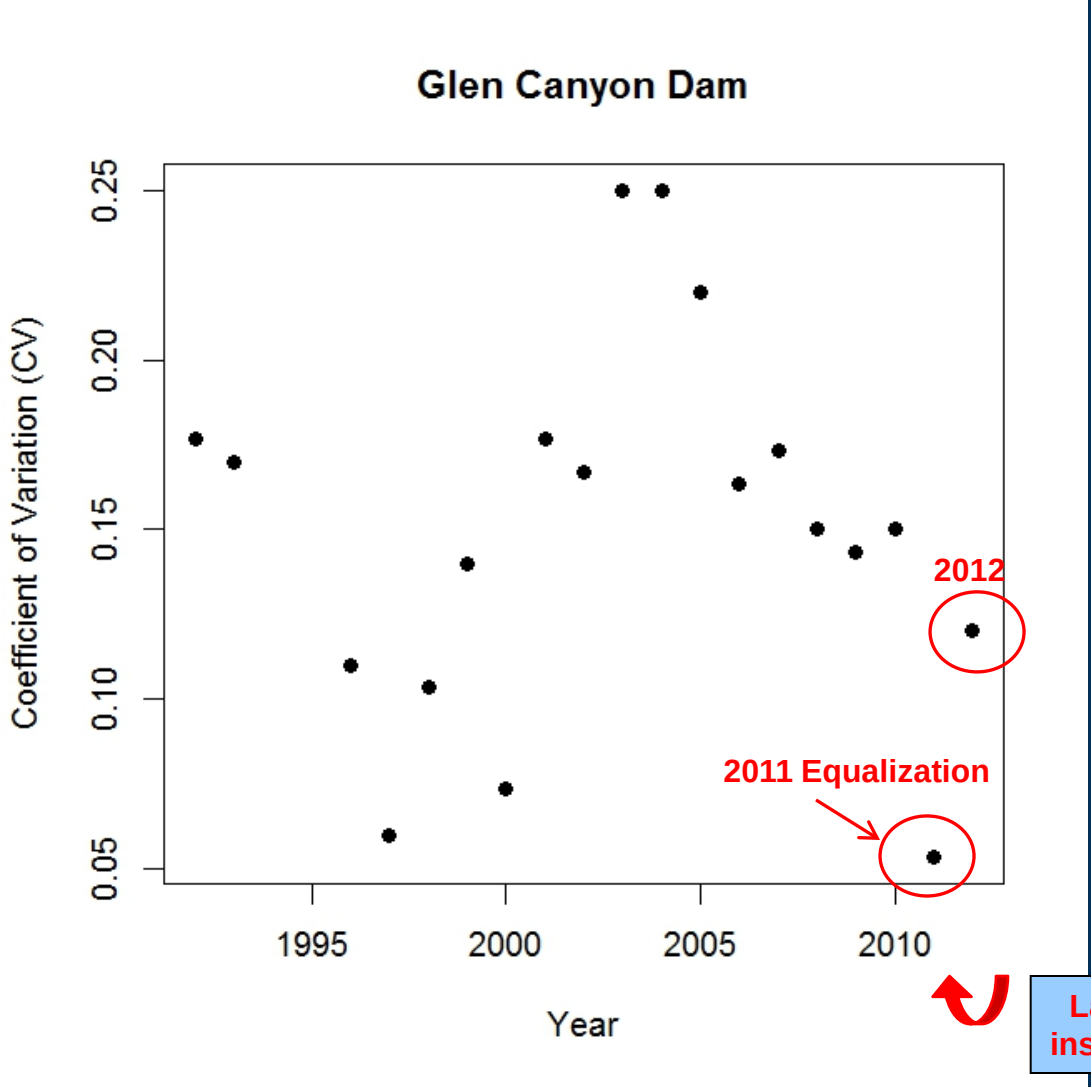
Hydropeaking Across Years



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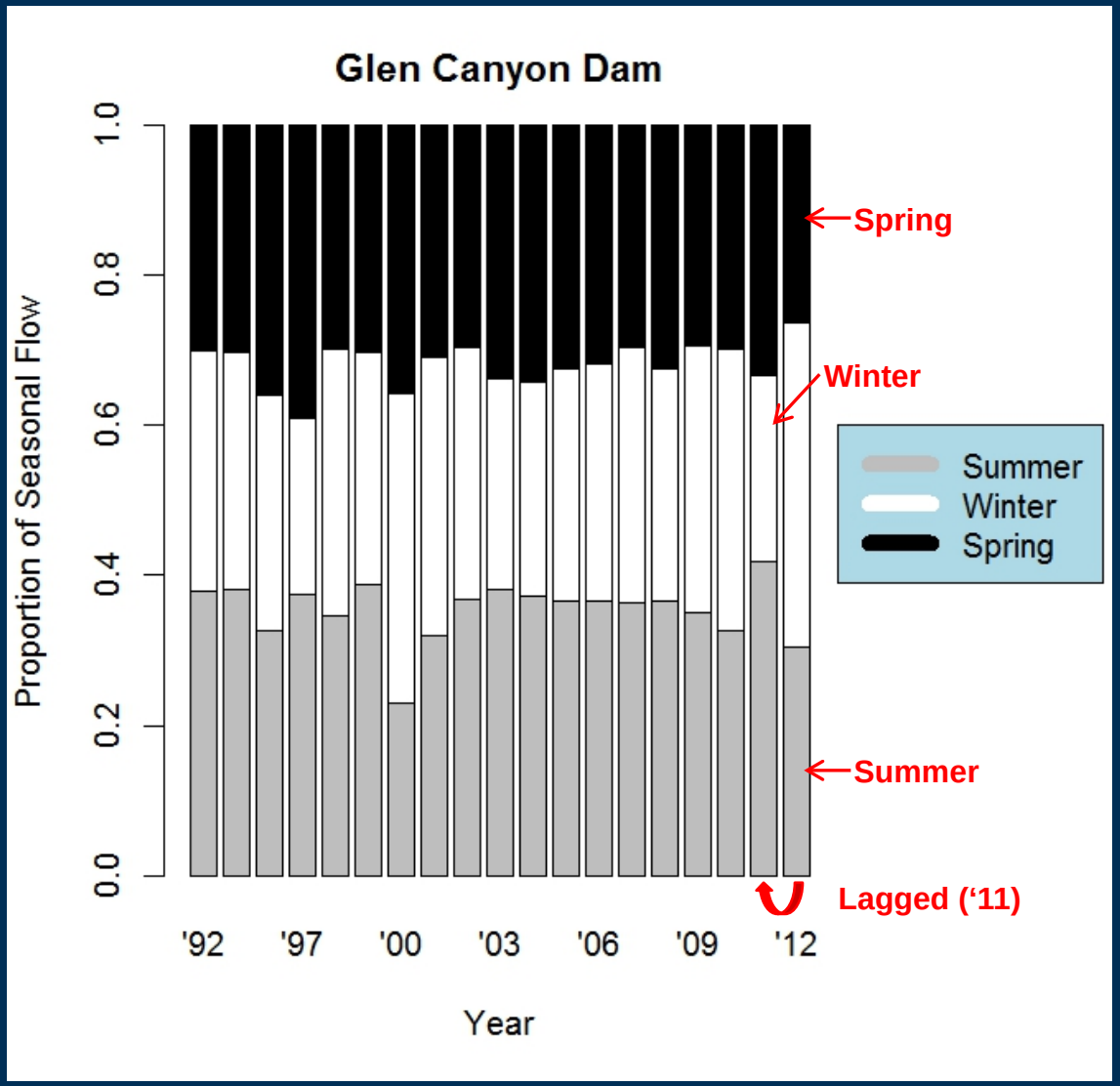
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Explanatory Metric: Seasonal Discharge



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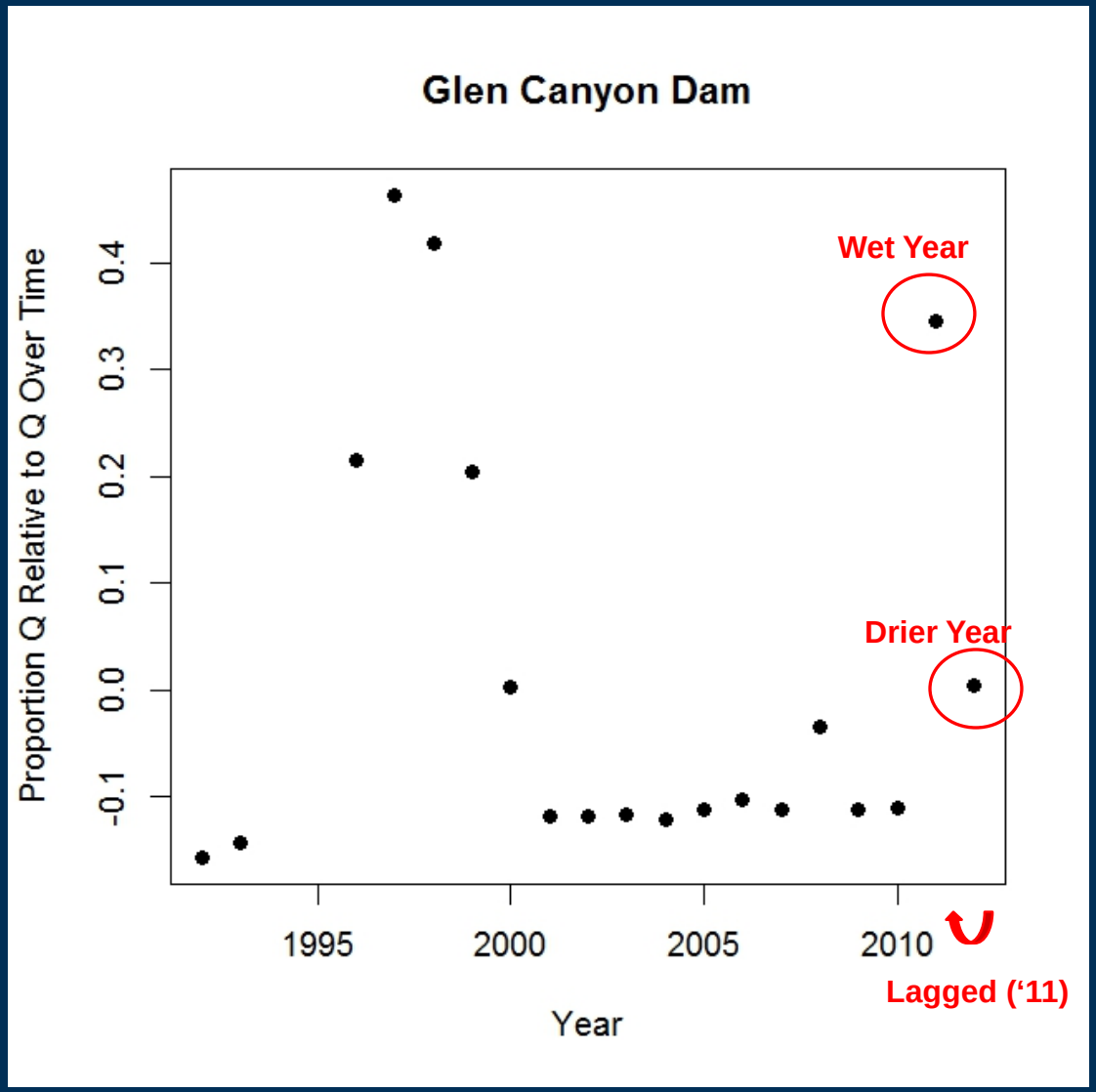
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Explanatory Metric: Annual Proportion Q



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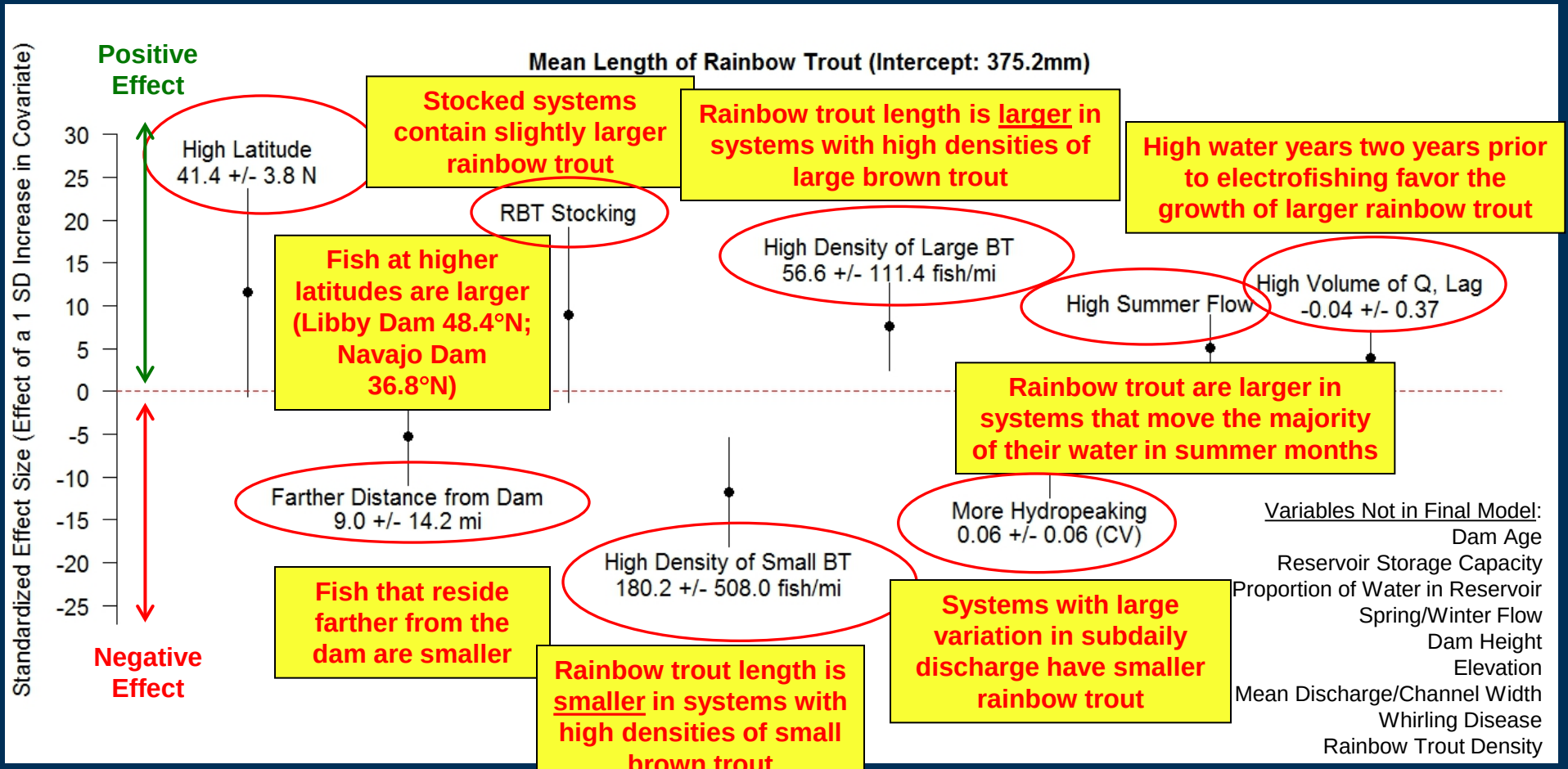
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Results: Mean RBT Length >300mm



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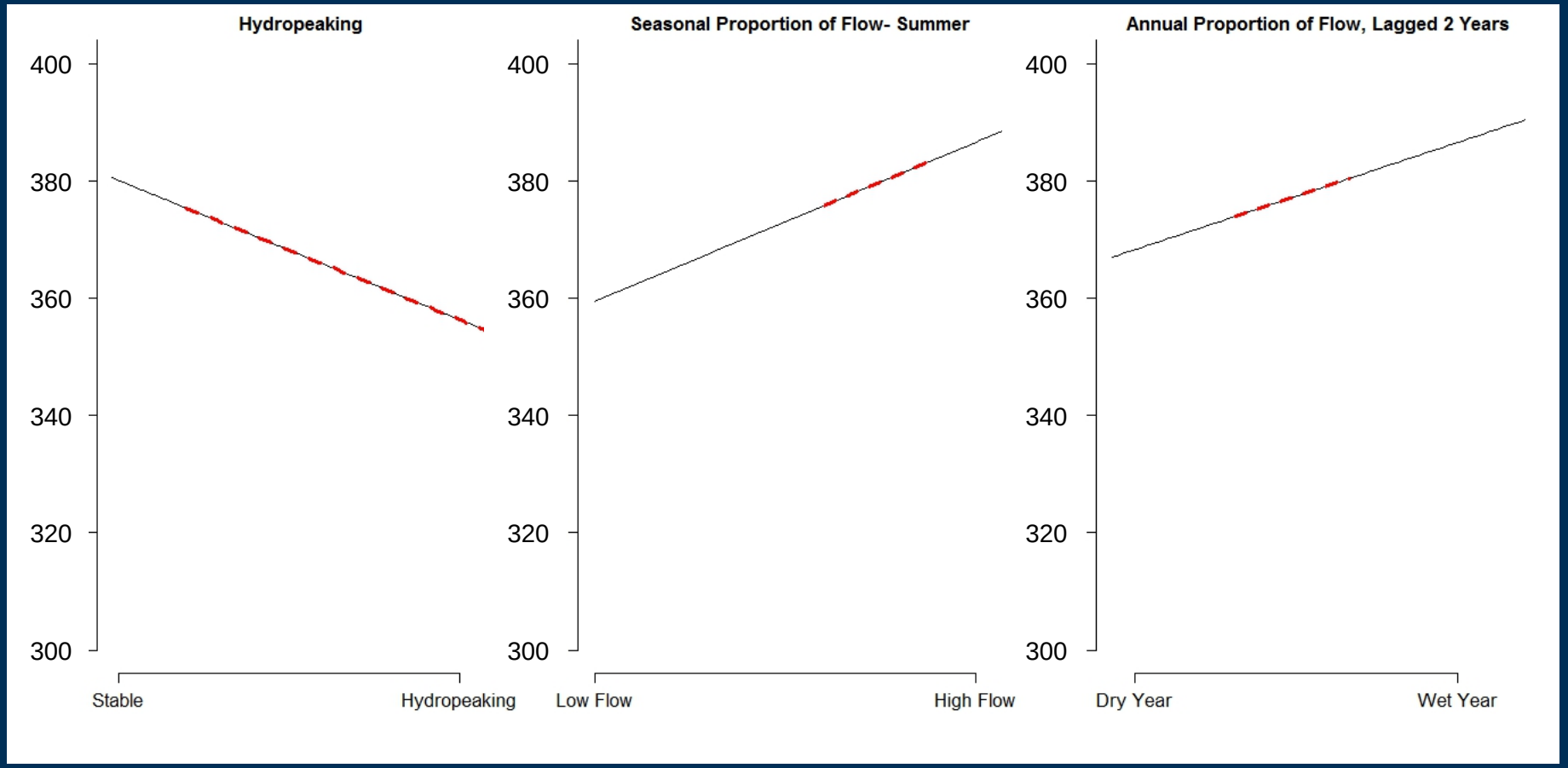
Results (TL): Discharge metrics



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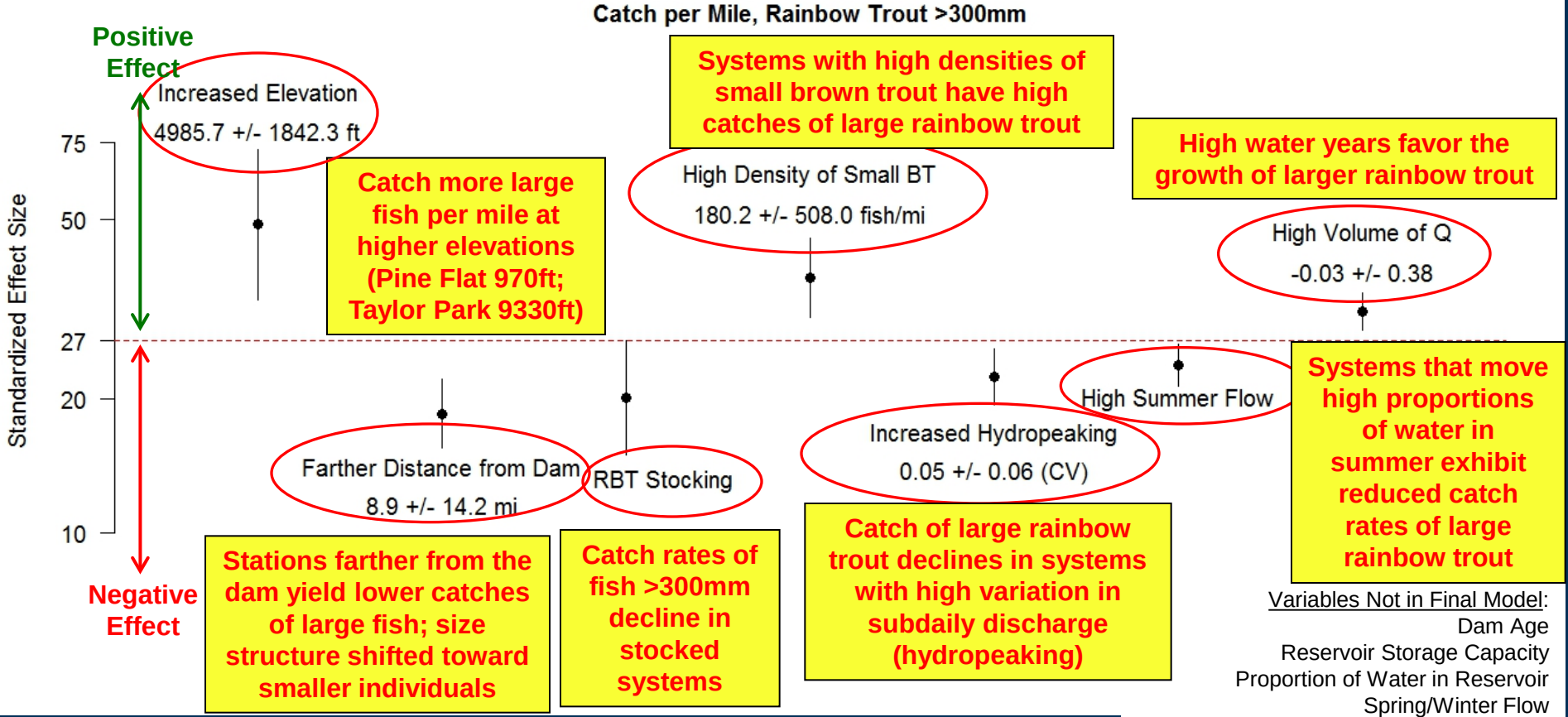
Rainbow trout size declines in systems that hydropeak, but increases in systems with high annual and summer discharge relative to other years and seasons

Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Results: Catch/mile, RBT >300mm

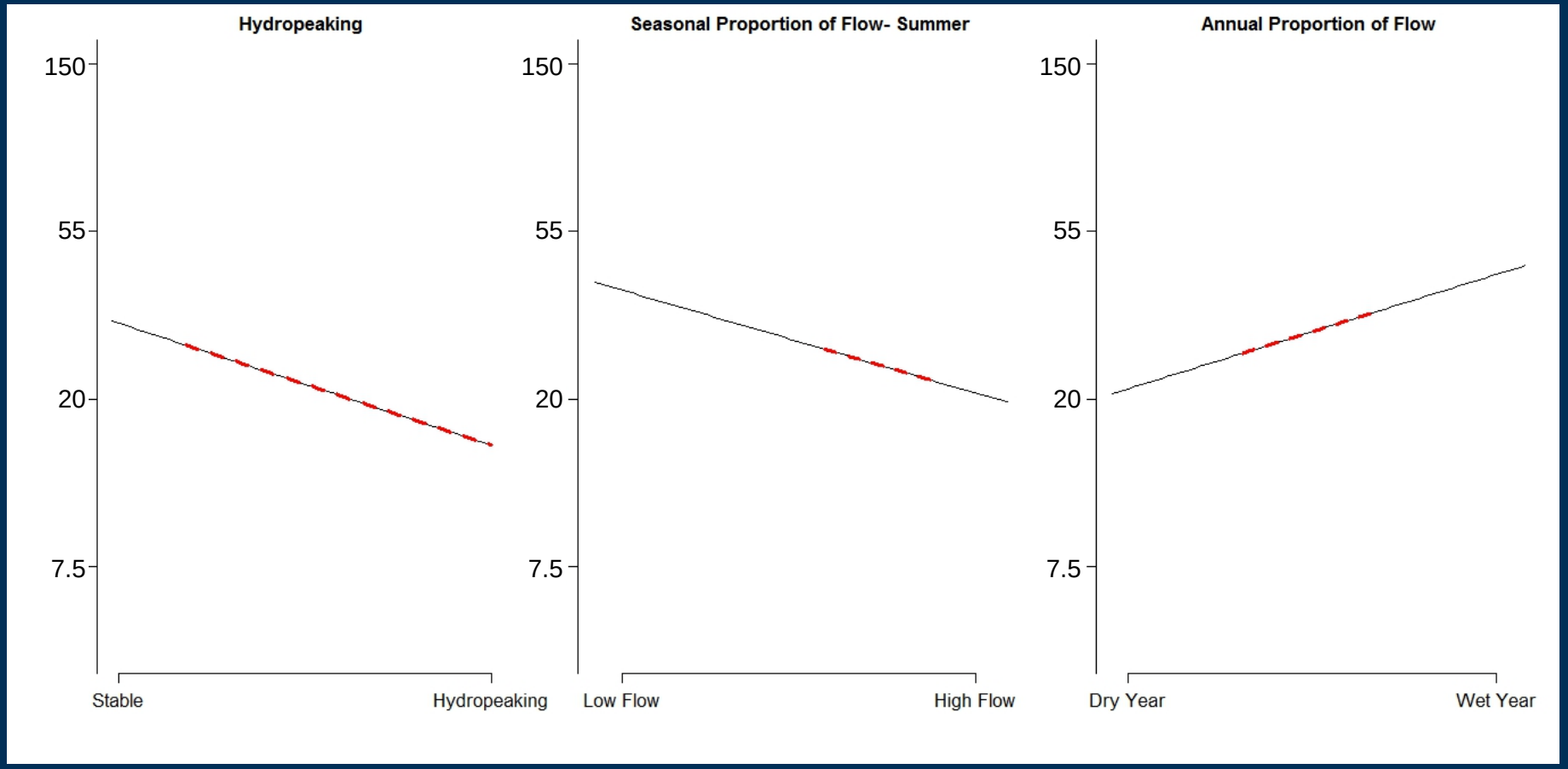


Variables Not in Final Model:
Dam Age
Reservoir Storage Capacity
Proportion of Water in Reservoir
Spring/Winter Flow
Dam Height
Latitude
Mean Discharge/Channel Width
Whirling Disease
Density of Large Brown Trout

USGS

Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Results (CPUE): Discharge metrics

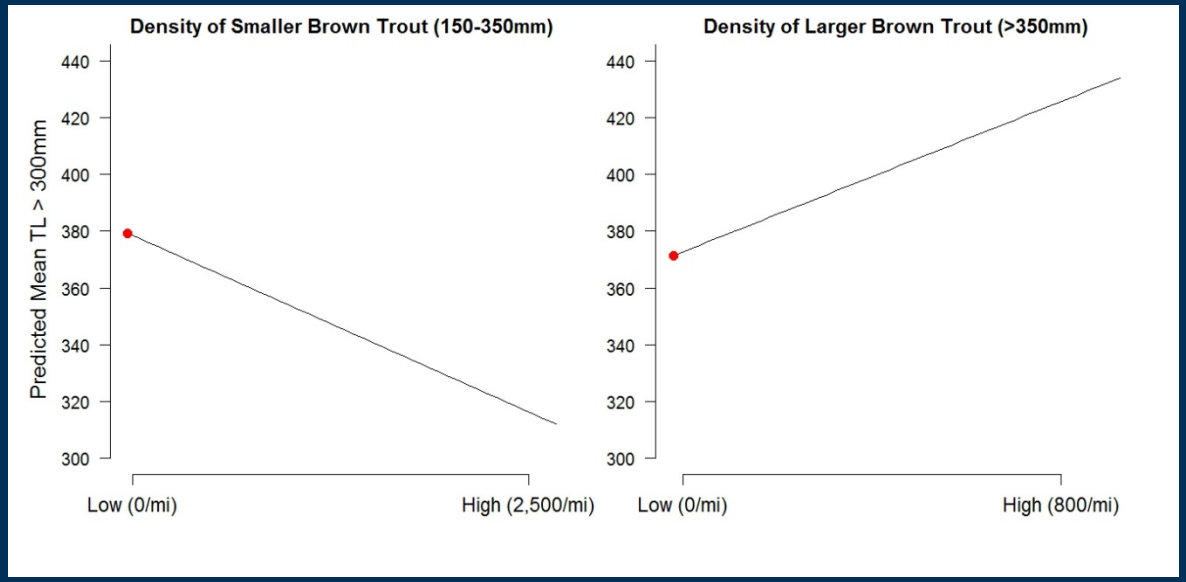


USGS

Tailwaters that hydropeak may support fewer large fish.
High flows in summer two years prior to capture increases the size of trout in the 300+ length class; however, catch declines

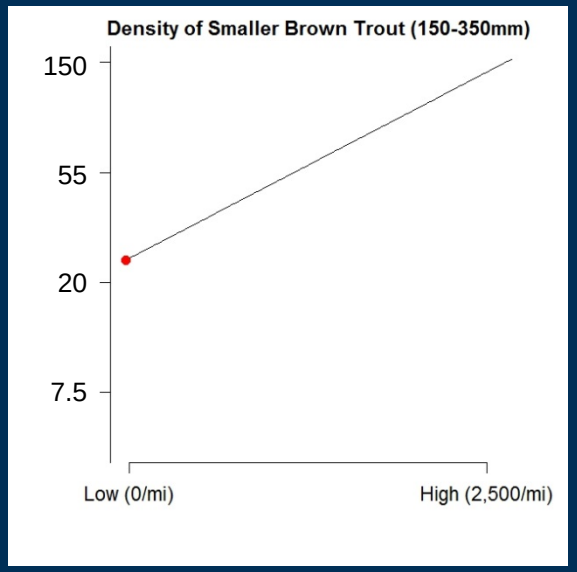
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Results: Brown Trout Density



Density, competition, and/or predation?

Rainbow trout size declines with high densities of small brown trout. However, size increases with high densities of large brown trout. Catch of large rainbow trout increases in systems with brown trout.



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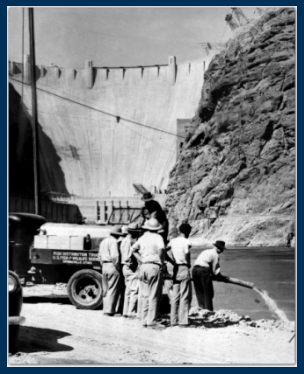
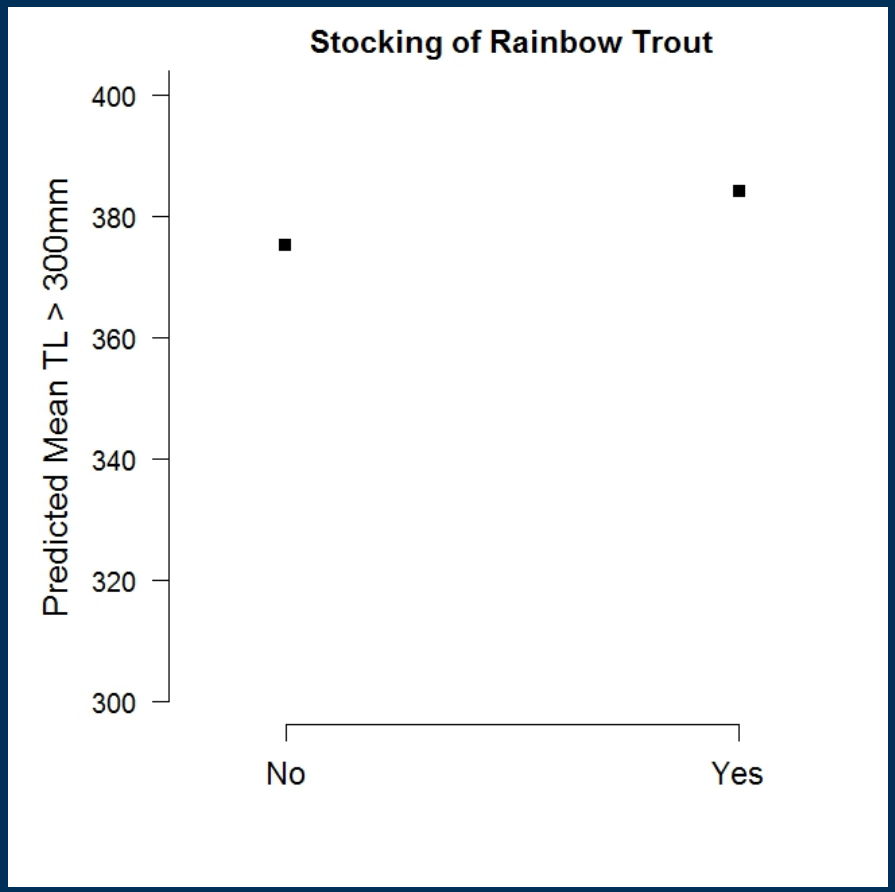
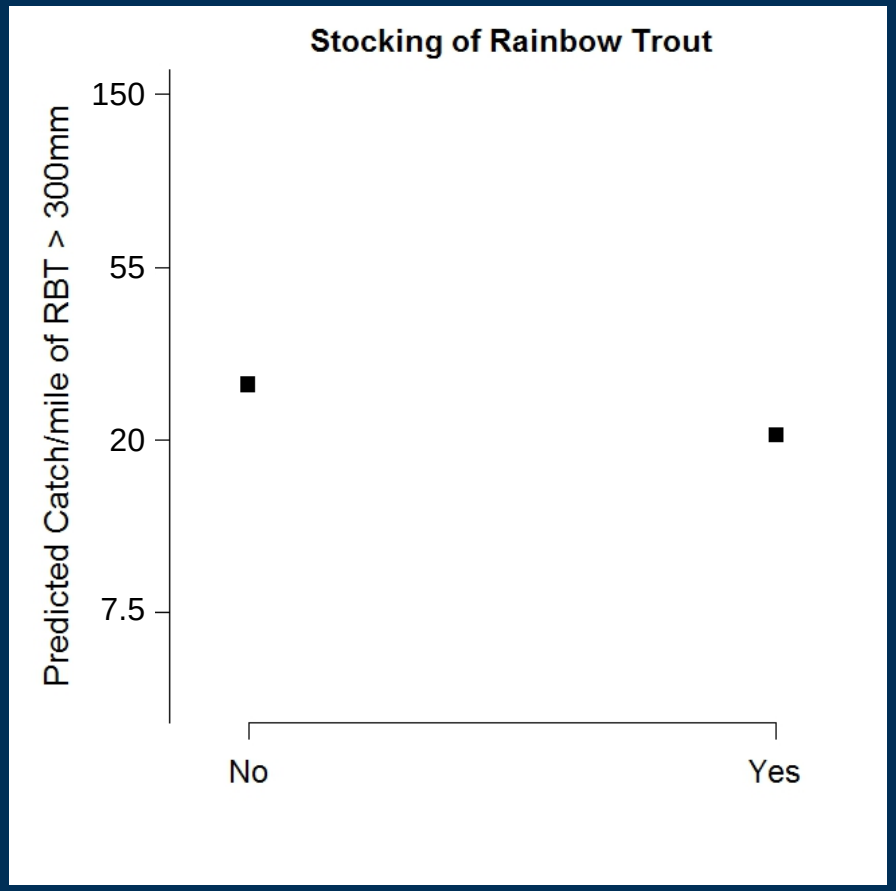
Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Results: Stocking



Bigger fish, but smaller catch of large fish





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Preliminary Data; Dibble, Yackulic, Kennedy, and Budy 2014; Do Not Cite

Next Steps

- Repeat models using other fish metrics (condition factor, weight)
- Repeat models using data from other salmonids (e.g., brown, cutthroat) and native species
- PATH analysis to discern mechanisms behind patterns we see in GLMM analysis

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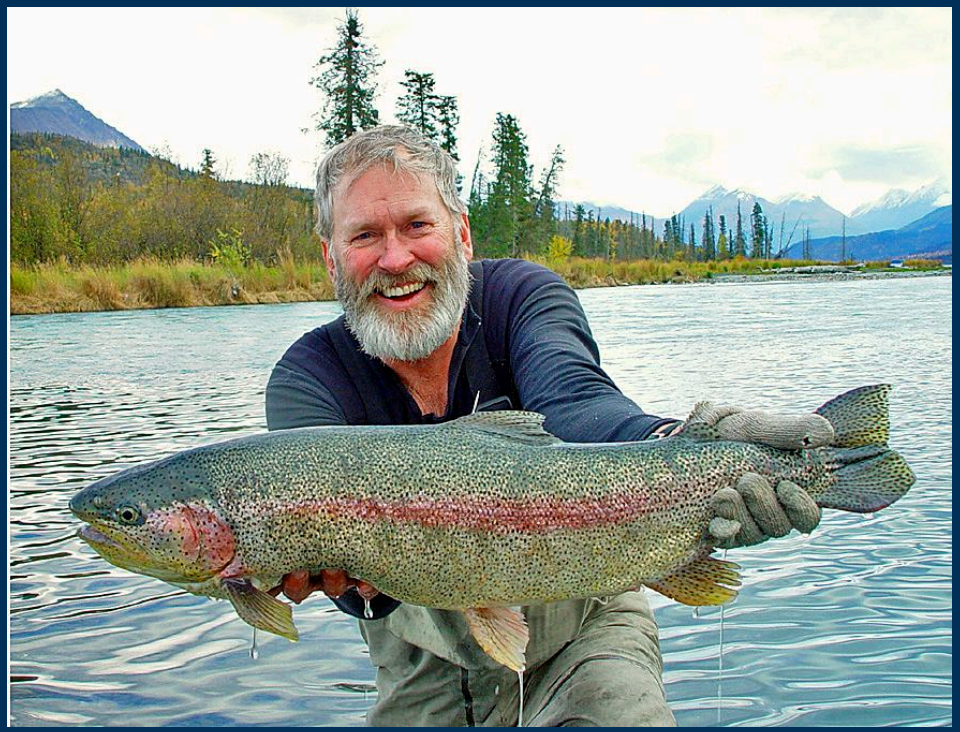
Questions?



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