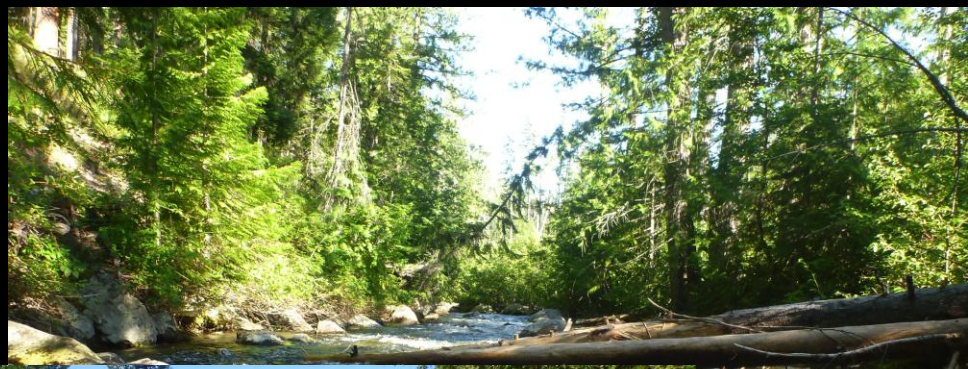
Fish Habitat Modeling

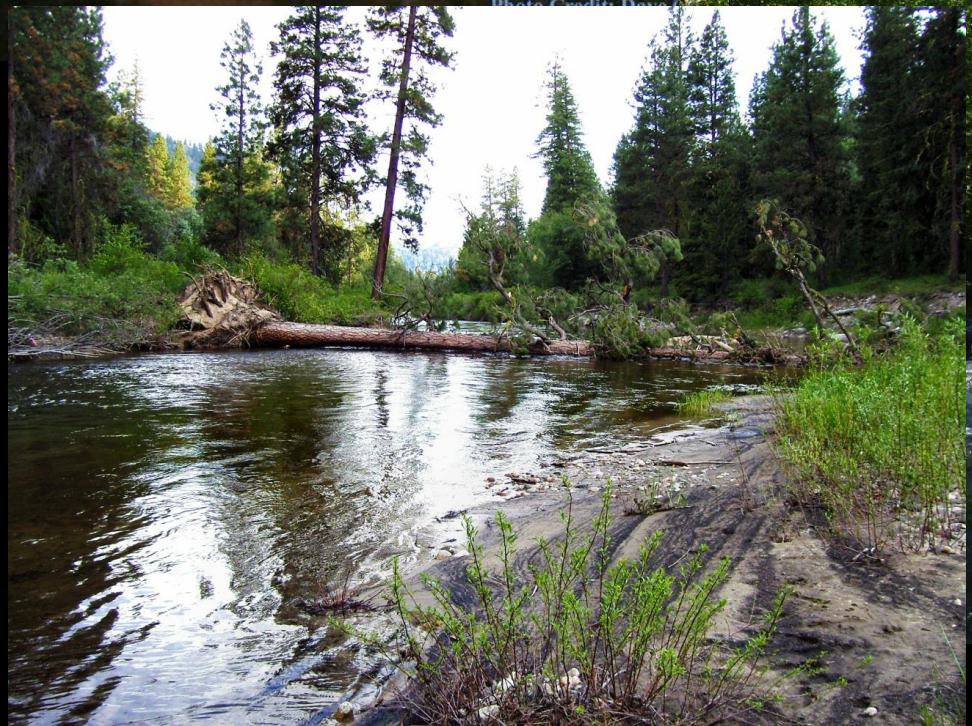
CHaMP Workshop

November 27-29, 2012

Portland, OR

Fish Habitat Modeling





Outline

- Correlative models with 2011 fish/habitat data
- Incorporating other fish
- Hierarchical model
  - Example with fish-only data

State of the Data

- Not enough 2012 fish data CHaMP-wide to analyze yet
- Used 2011 fish data, with 2011 and 2012 habitat data

Habitat Data

- 412 unique sites
- 272 visits in 2011, 219 in 2012
- 9 sub-basins within the Columbia Basin

- Focused on 21 of the numerous CHaMP metrics

Fish Data

- All from 2011
- 271 unique sites, 212 with CHaMP data
- 7 sub-basins within the Columbia Basin
  - Asotin, Entiat, John Day, Lemhi, South Fork Salmon, Upper Grande Ronde & Wenatchee
- Focused analyses on sites with non-zero fish abundance (71 Chinook, 174 steelhead)
- Response was fish / m (based on GRTS)

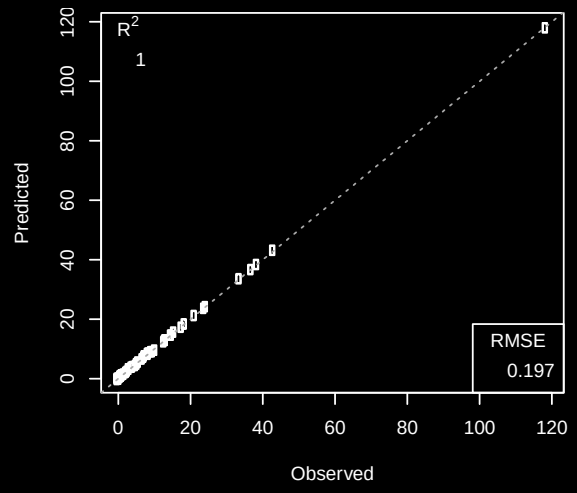
Correlative Models

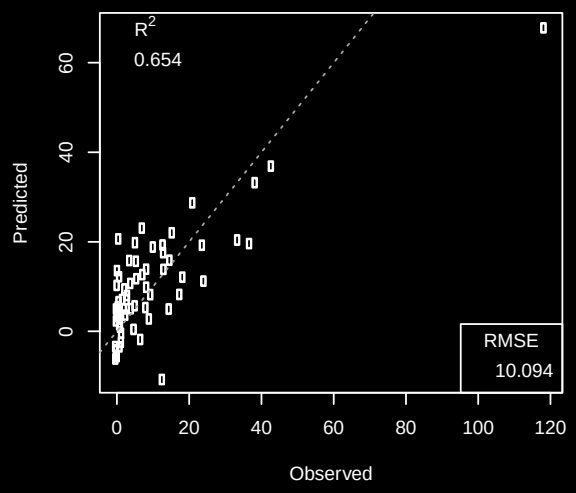
- What habitat metrics are associated with high fish density?
  - What does that association look like?
- No cause & effect
- Some models incorporate:
  - Non-linear effects
  - Habitat metric interactions
  - Simplified list of habitat metrics

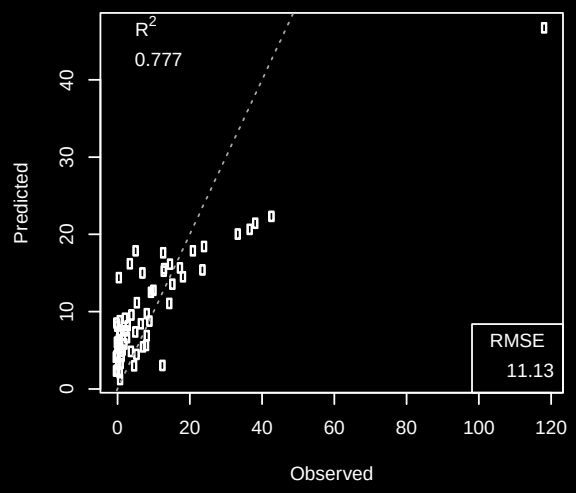
Model List

- Linear
- Log linear
- Poisson GLM
- Quasi-poisson GLM
- Negative Binomial GLM
- Random Forest
- Boosted Regression Tree
- GAM

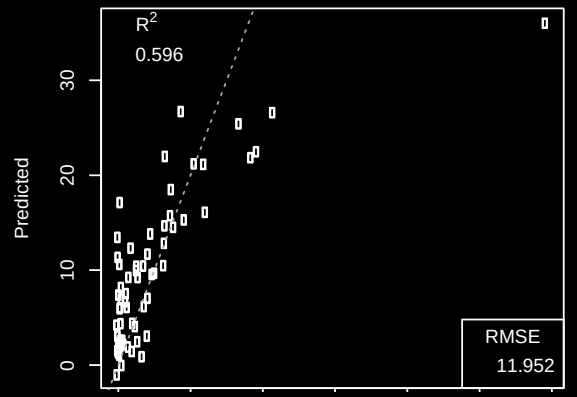
Chinook – Top Models



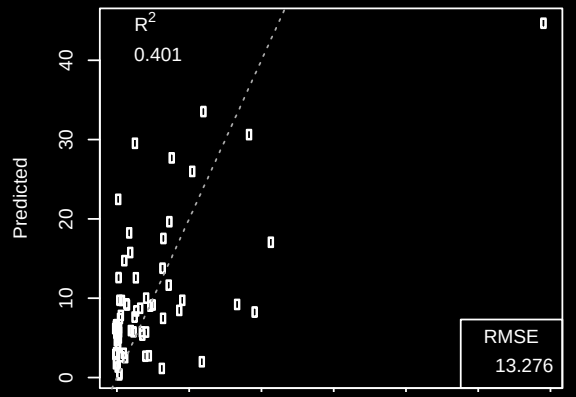




BRT.simp



Pois



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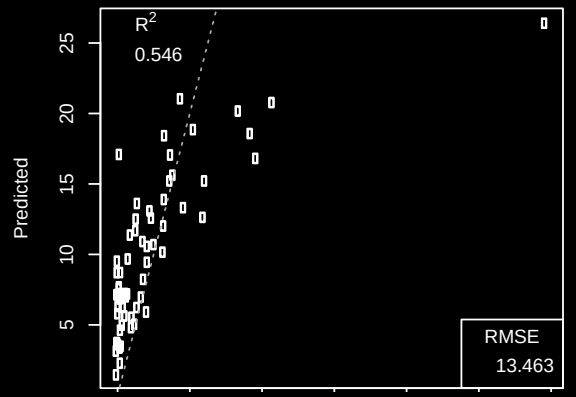
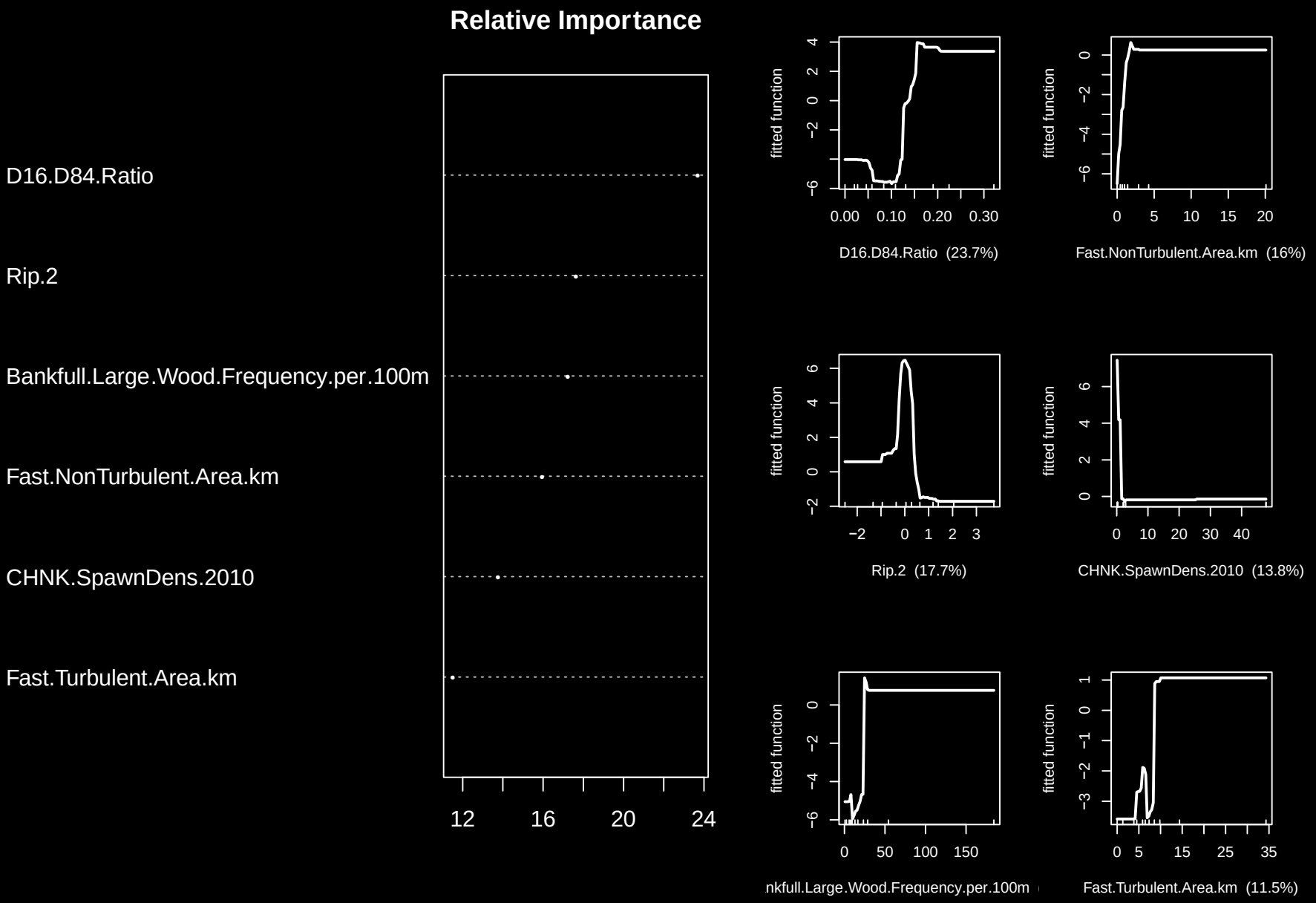
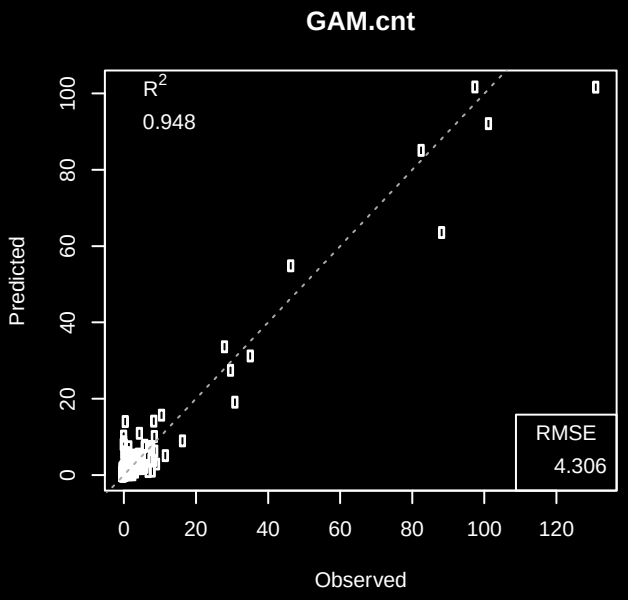
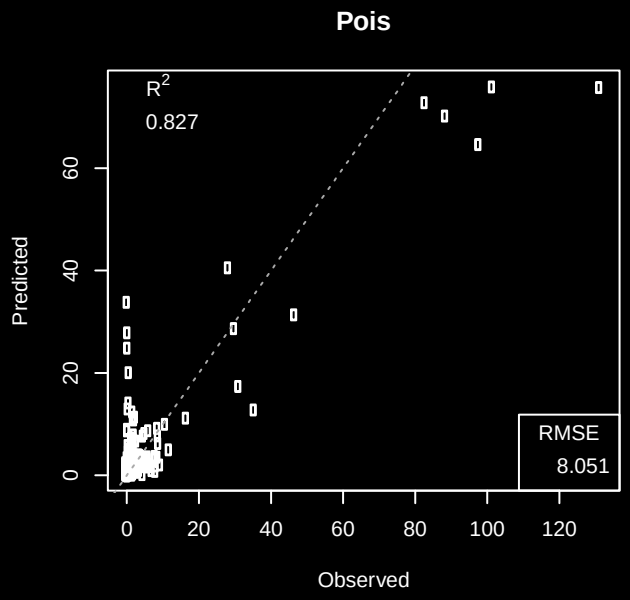


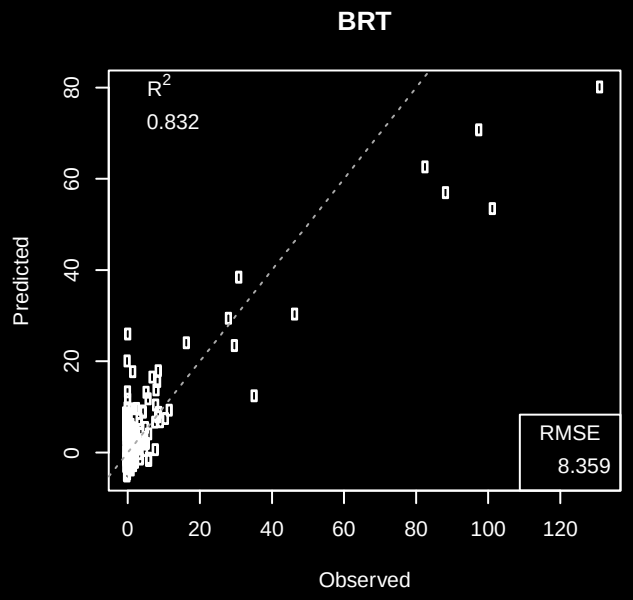
Chinook – Boosted Regression Tree

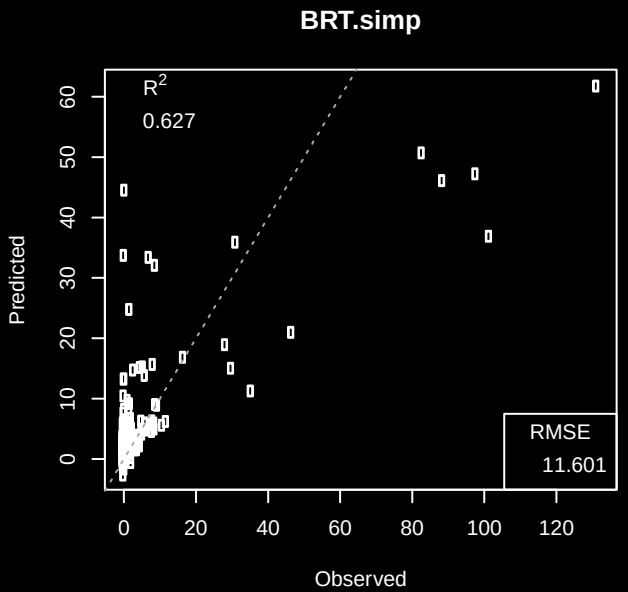


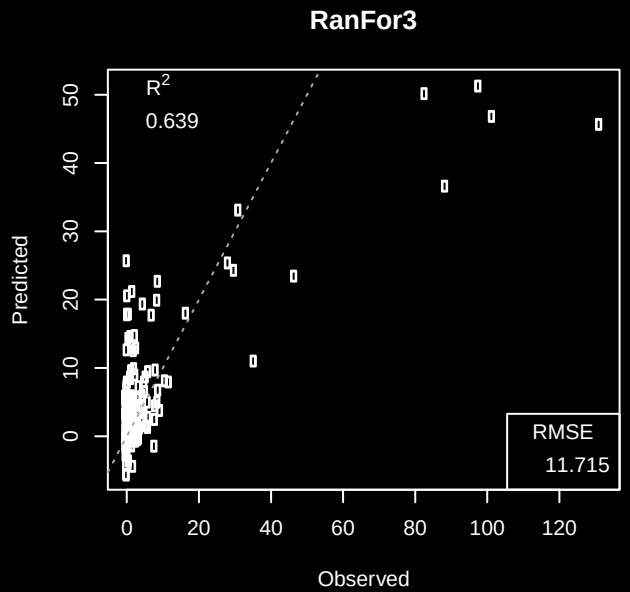
Steelhead – Top Models

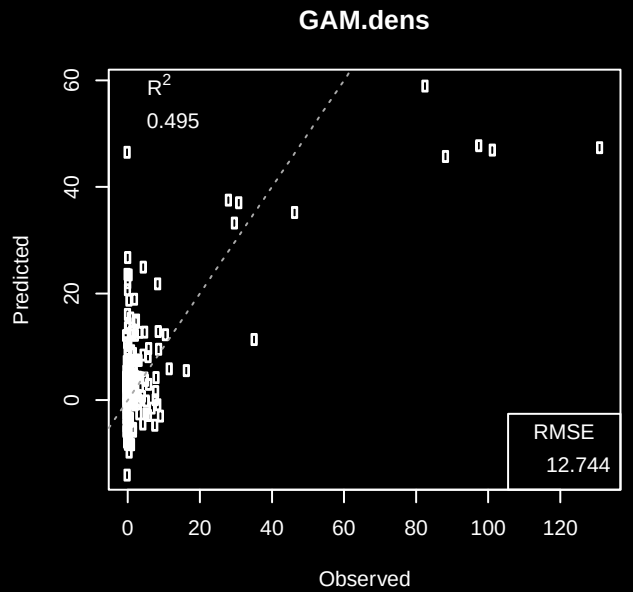




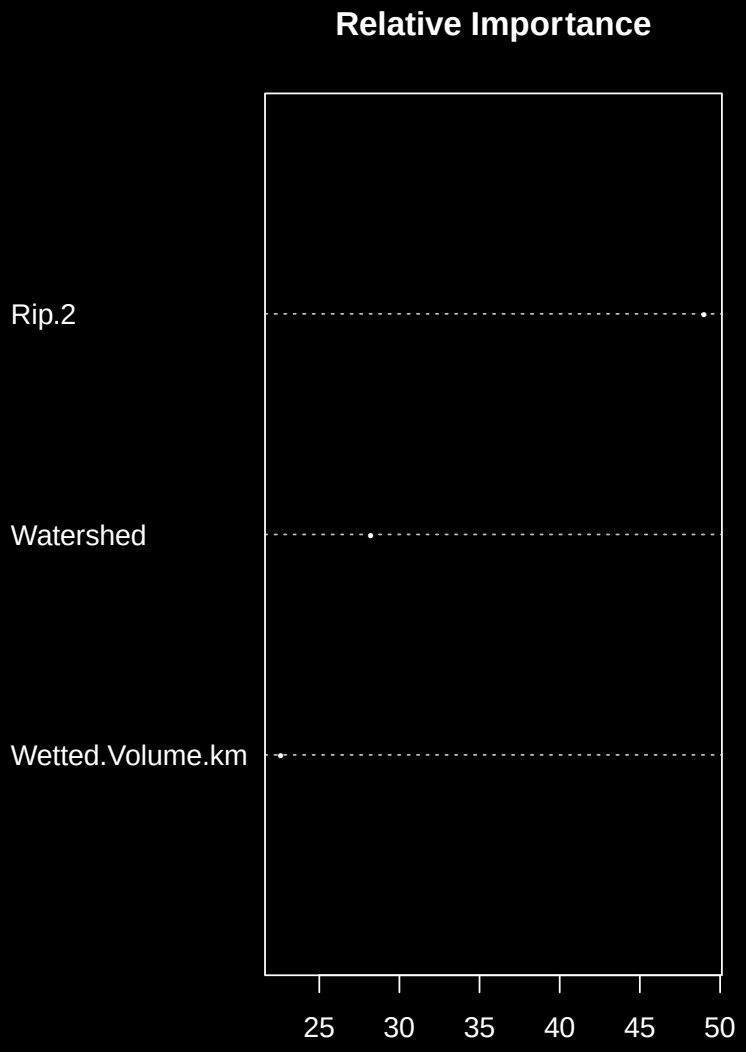


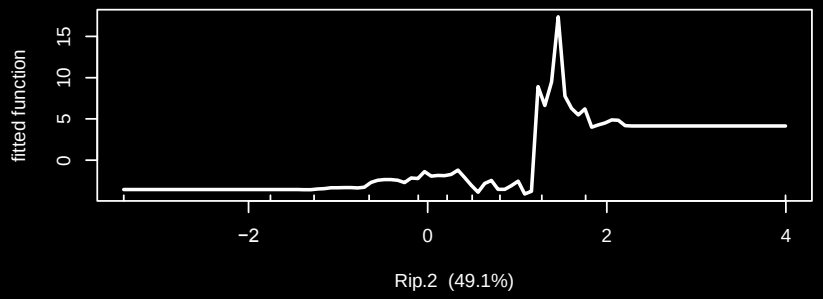


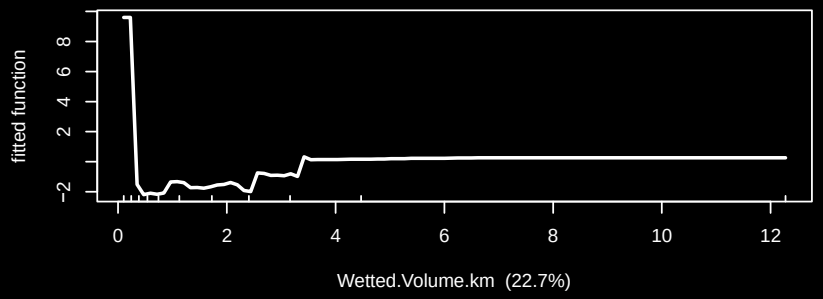




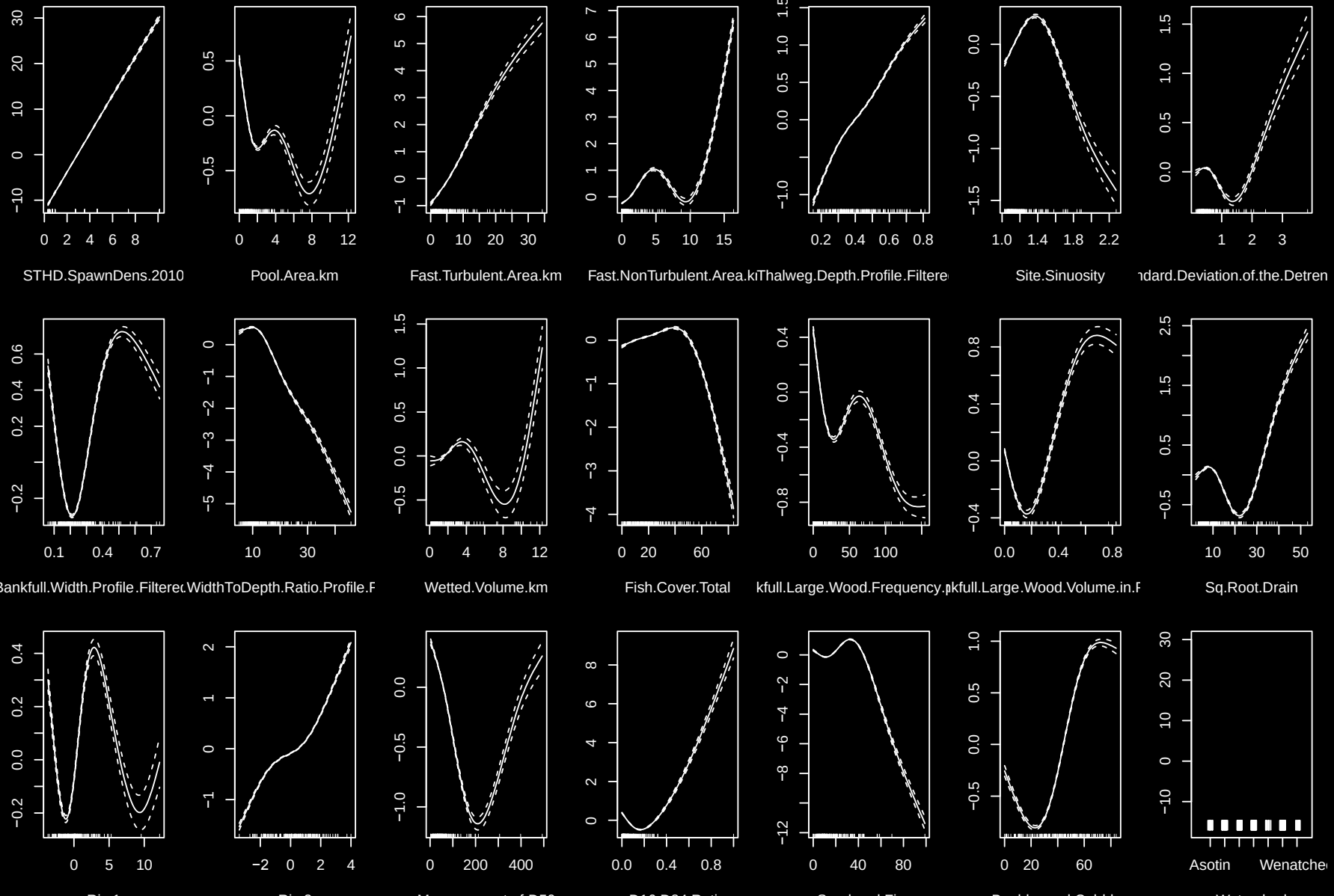
Steelhead– Boosted Regression Tree







Steelhead – GAM



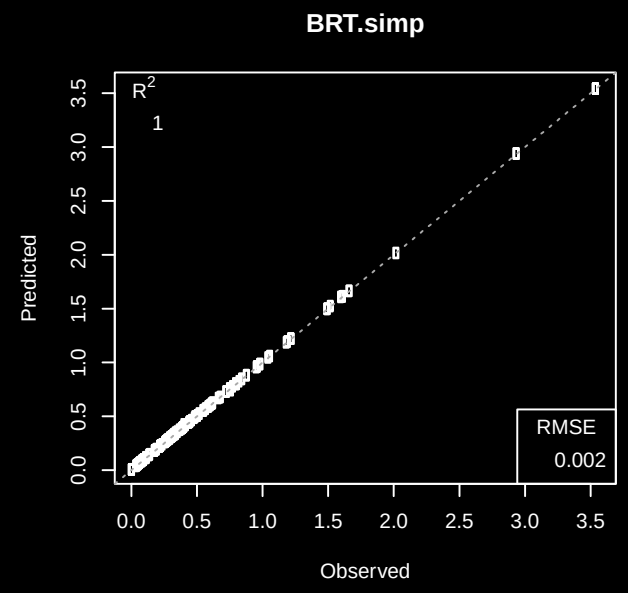
Moving beyond the single-species paradigm

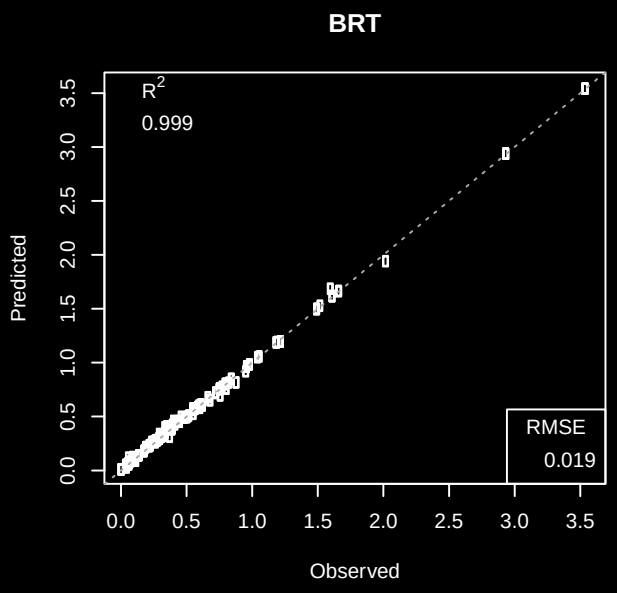
WHAT ABOUT OTHER FISH?

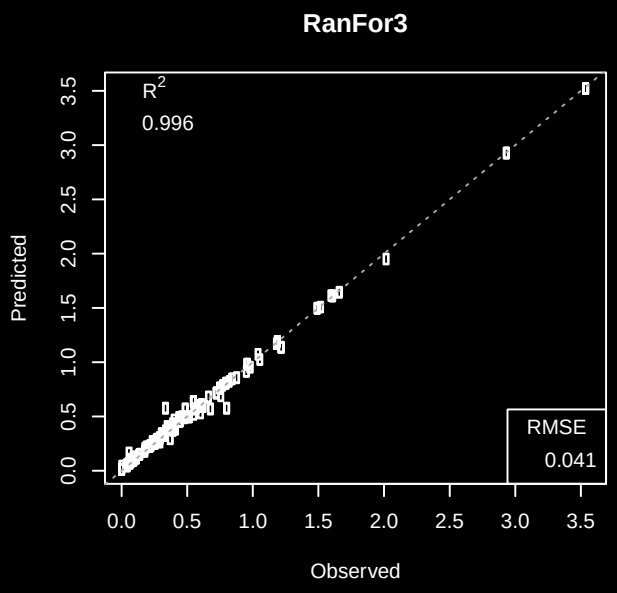
Similar Correlative Models

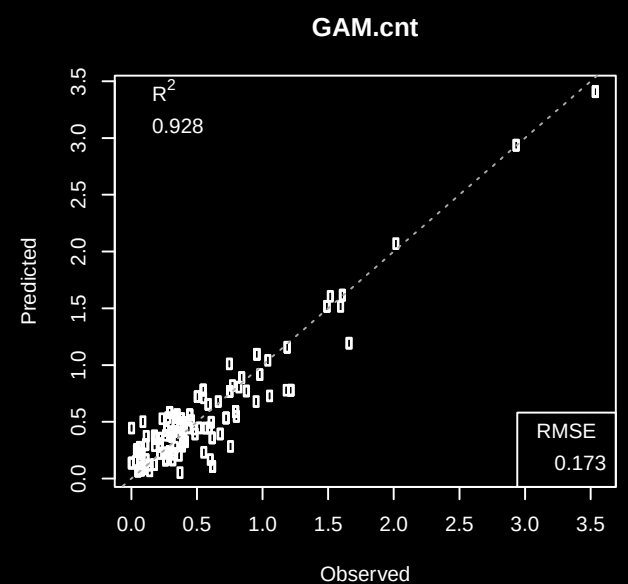
- 4 possible “target” fish
  - Chinook, steelhead, Chinook & steelhead, all salmonids
- Incorporate density of non-target fish as covariate
- Used 4 years of data from Salmon sub-basin
  - Close to 240 observations

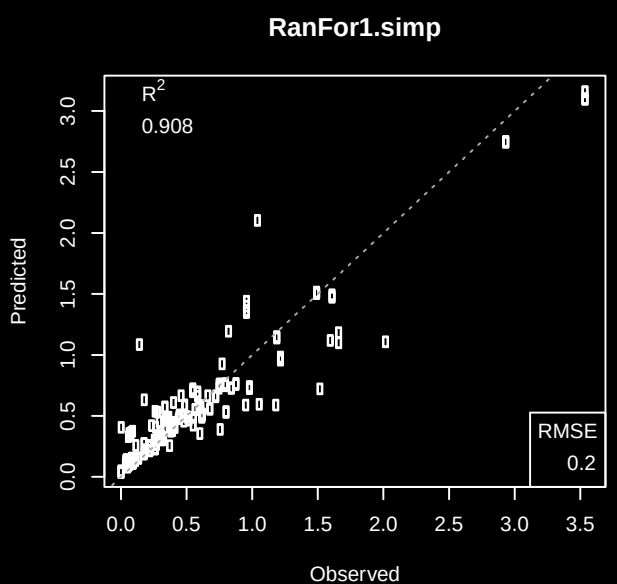
Predicting Density of All Salmonids

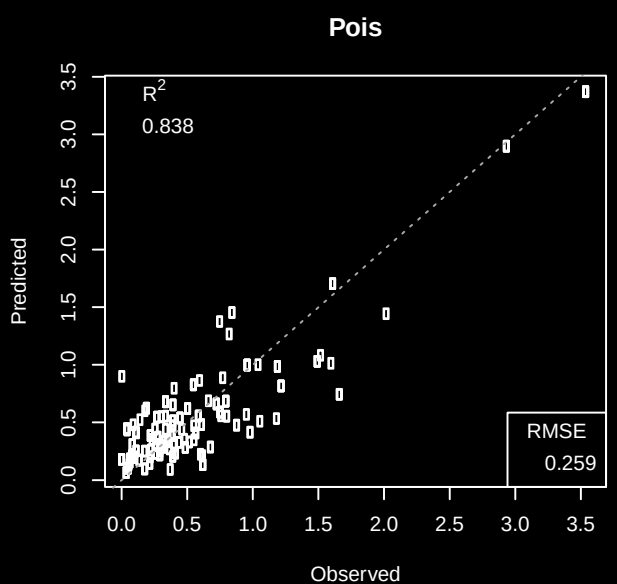




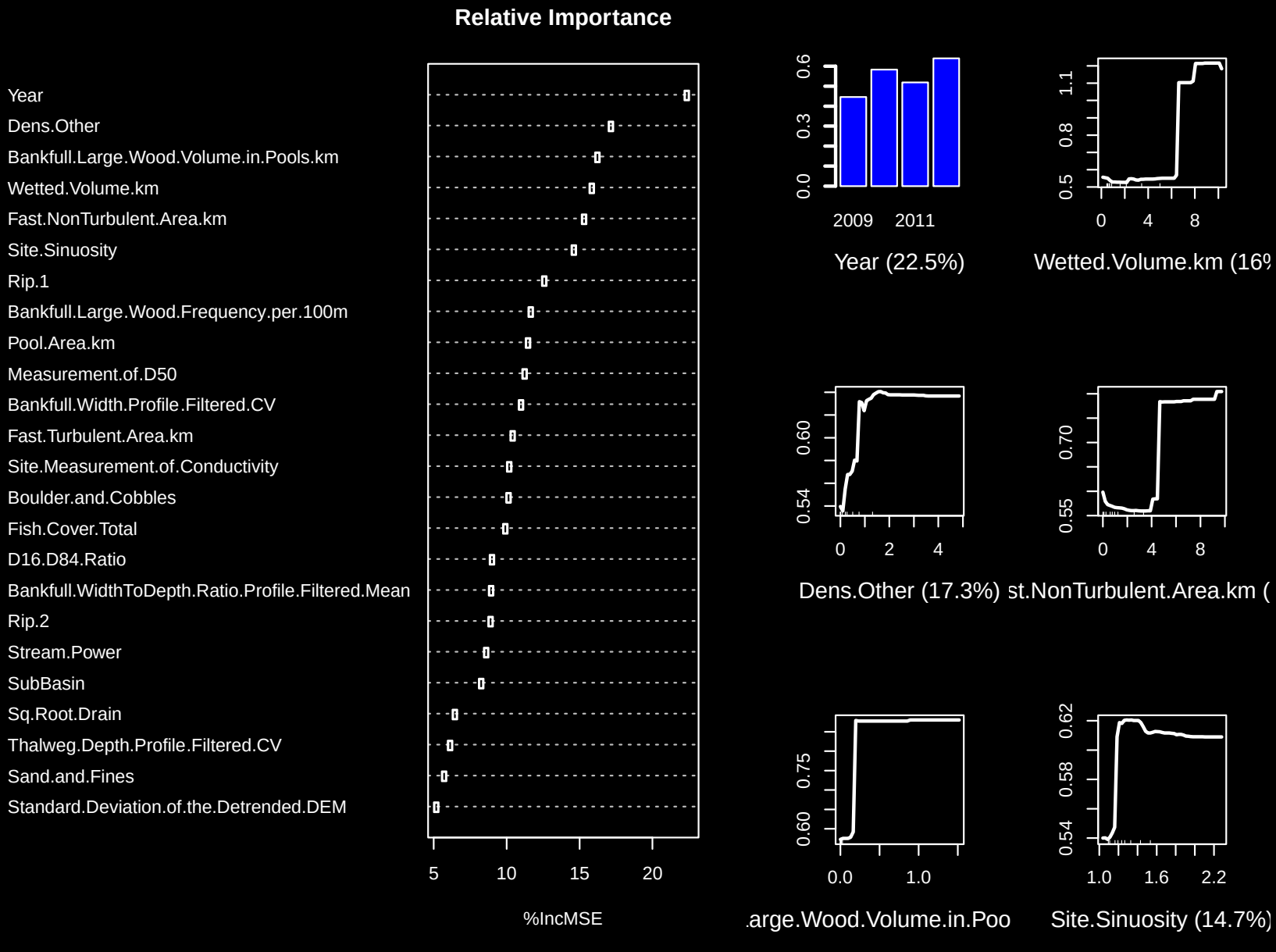








All Salmonids – Random Forest Model



How to best incorporate

MULTIPLE SPATIAL SCALES

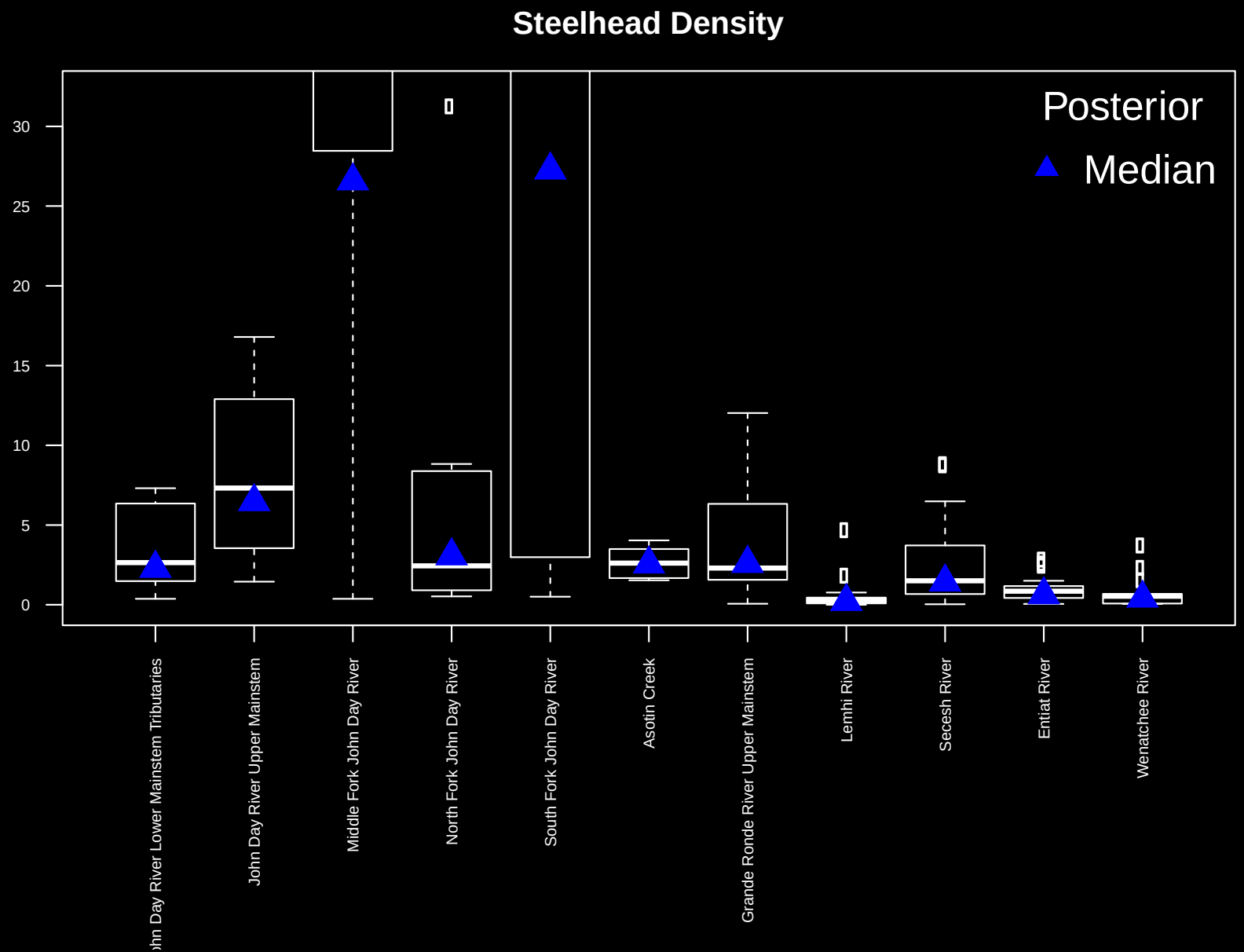
Hierarchical Model

$$Z_j \sim N(\mu, \sigma)$$

$$\mu = X\beta$$

$$Y_{i(j)} \sim N(Z_j, \tau)$$

Preliminary Posterior Results



Future Projects

- Finalize these analyses
- Structural equation models
  - Allows for causation hypotheses, more realistic biological interactions
- Focus on growth as a response to habitat


Questions?