

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)

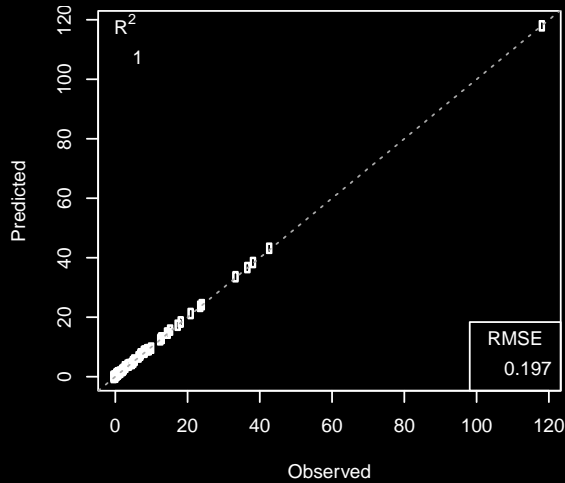
Correlative Models

- 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

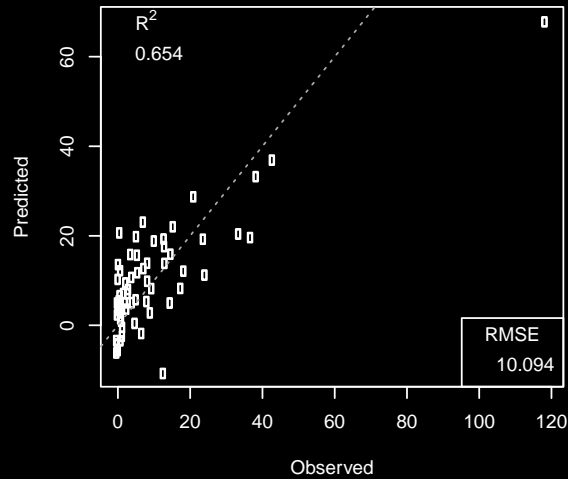
Model List

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

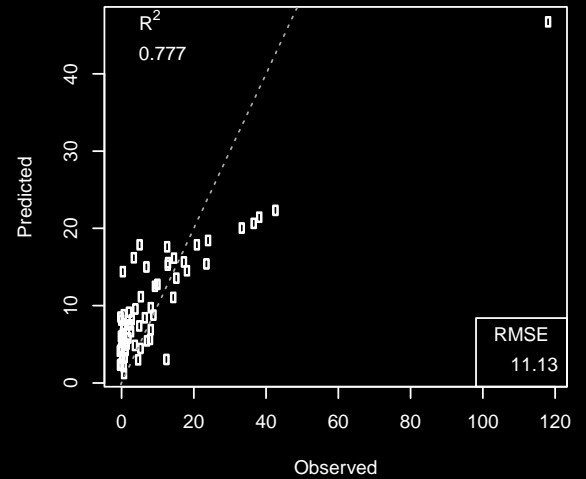
Chinook – Top Models



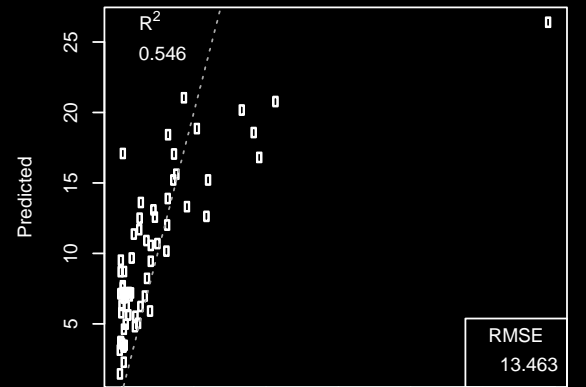
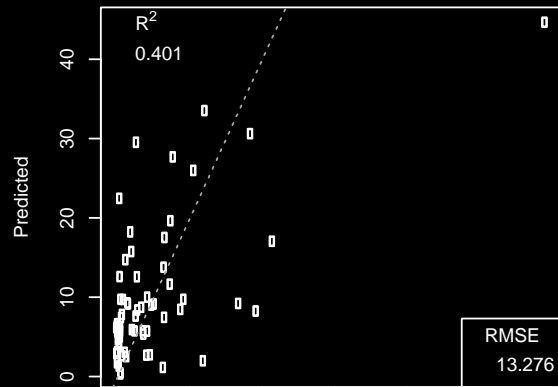
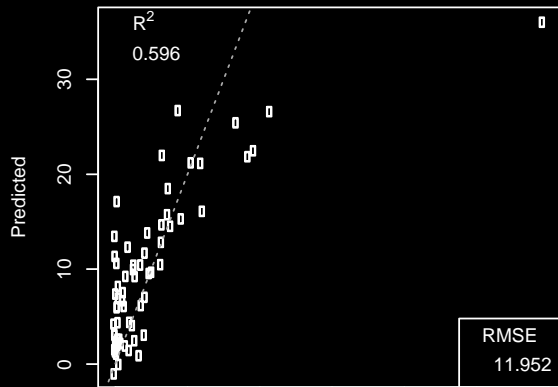
BRT.simp



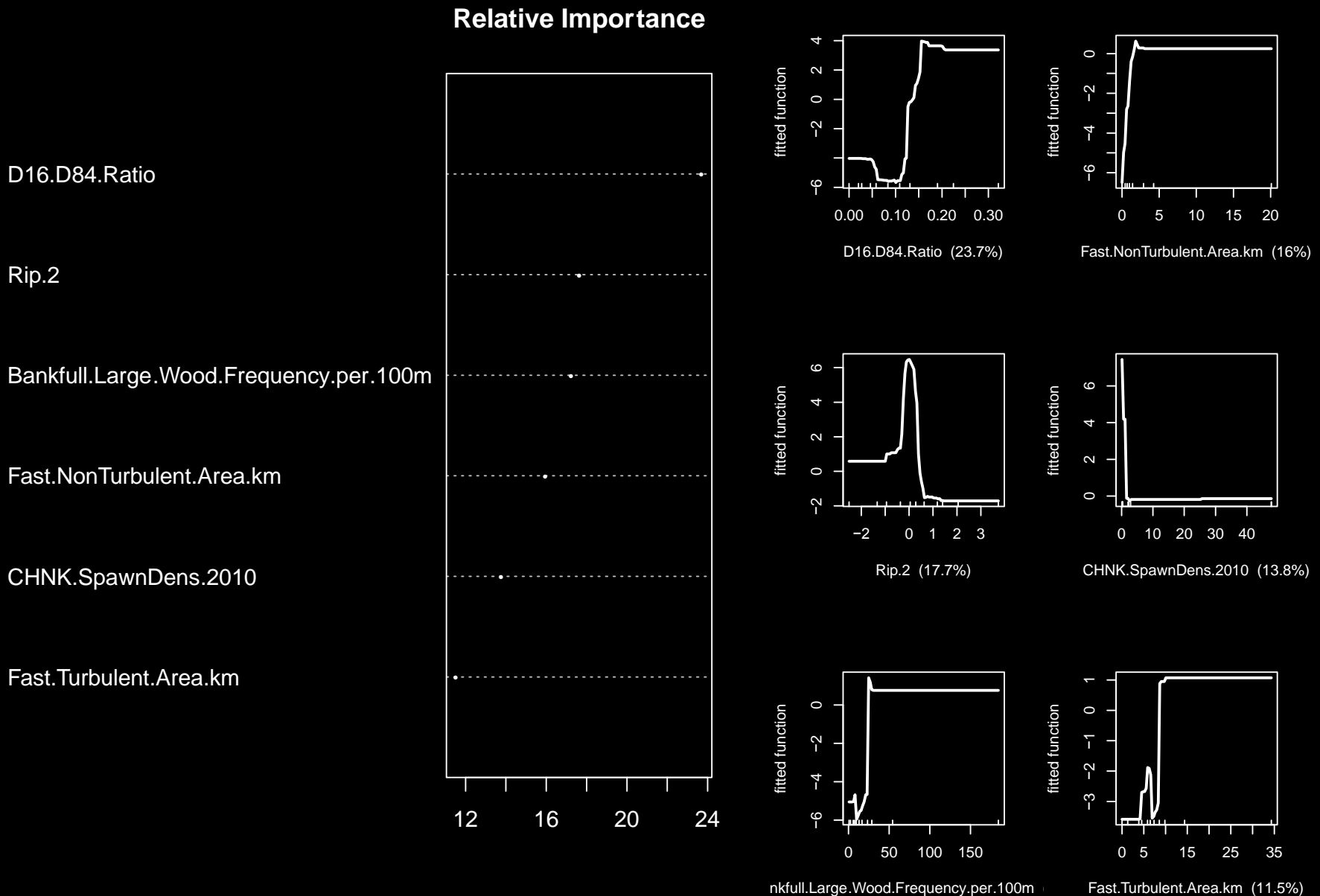
Pois



BRT

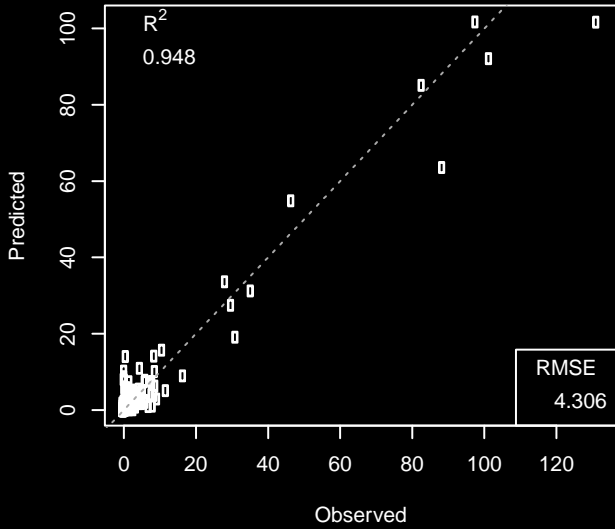


Chinook – Boosted Regression Tree

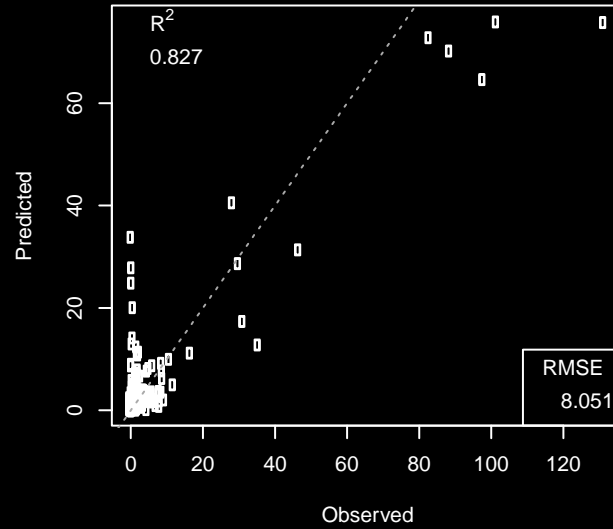


Steelhead – Top Models

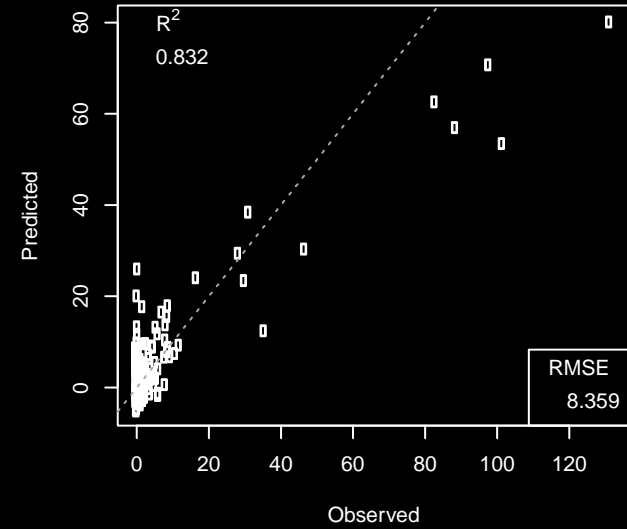
GAM.cnt



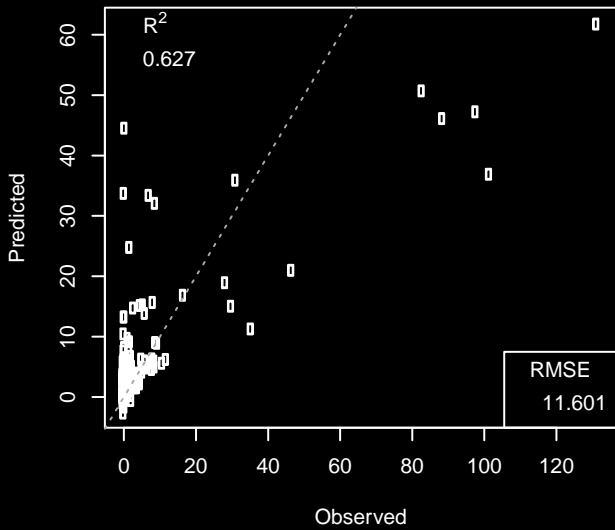
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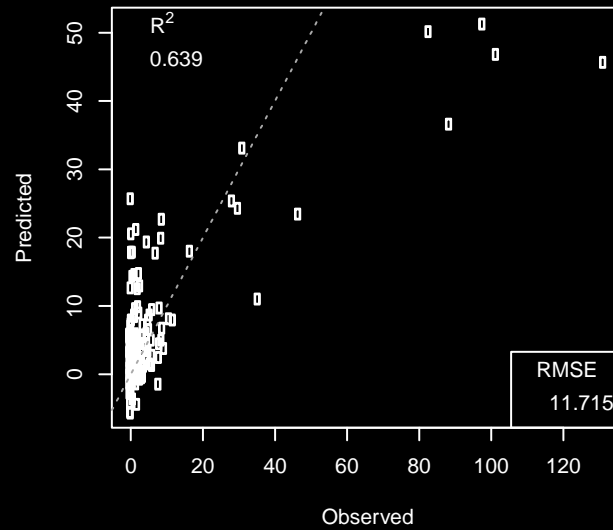
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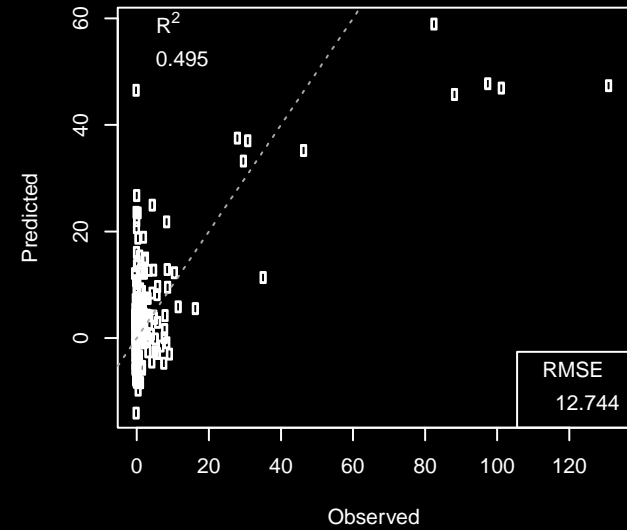
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RanFor3

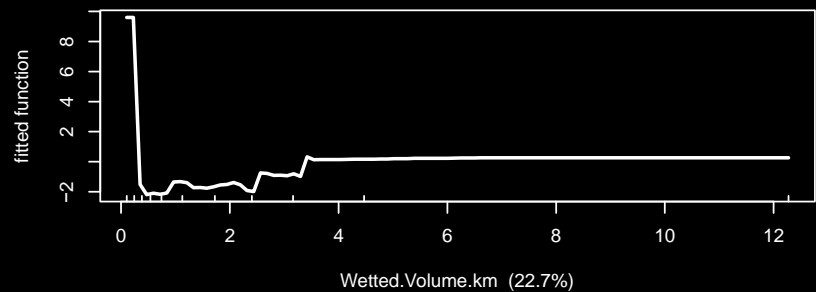
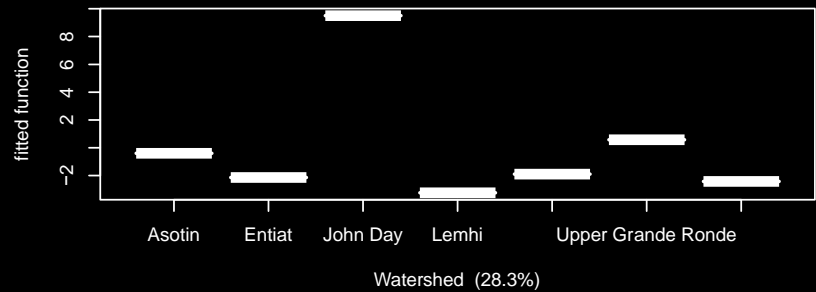
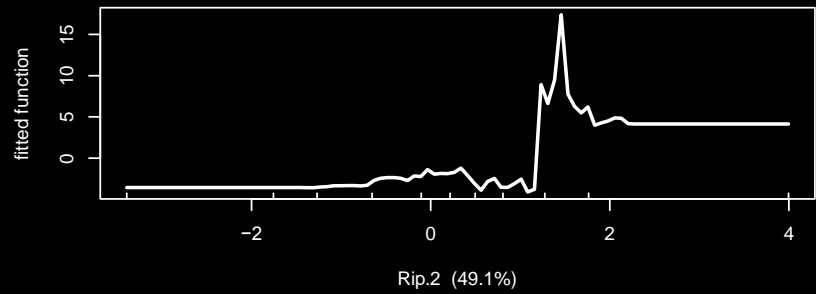
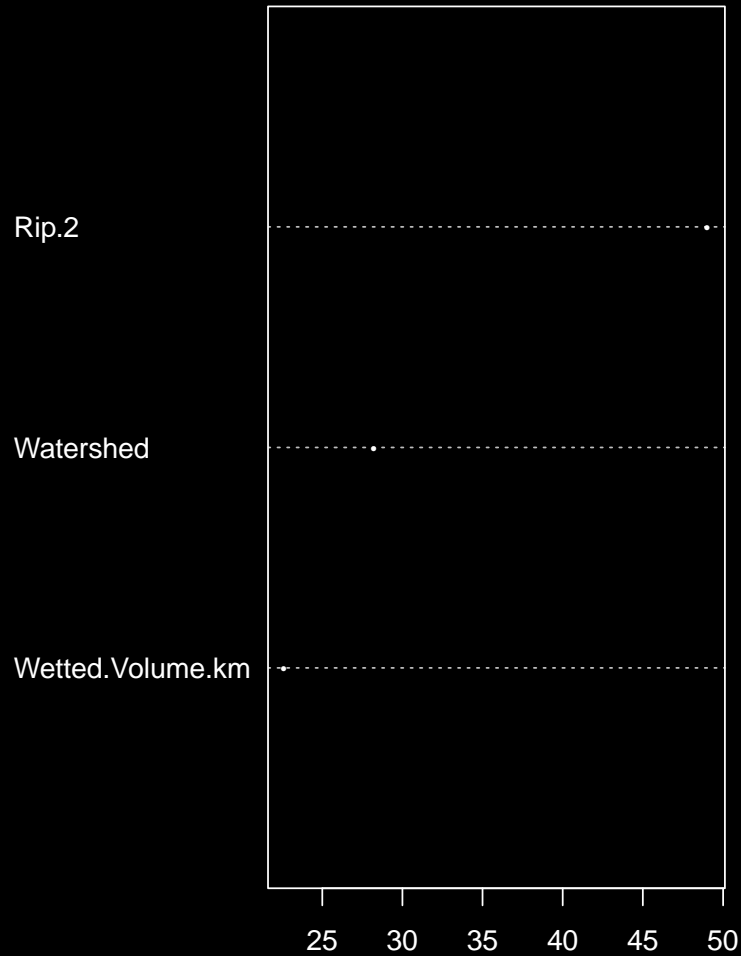


GAM.dens

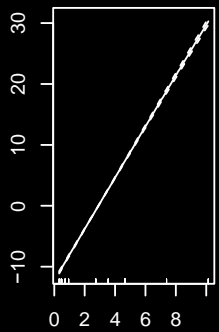


Steelhead– Boosted Regression Tree

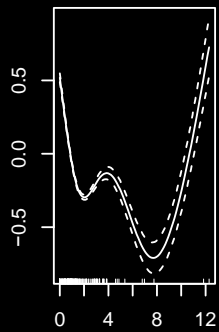
Relative Importance



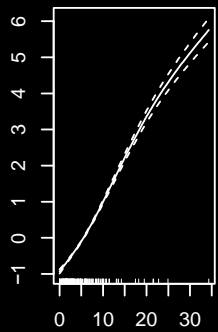
Steelhead – GAM



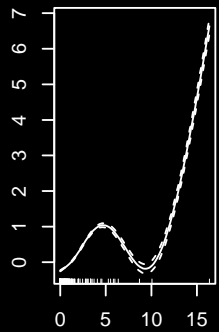
STHD.SpawnDens.2010



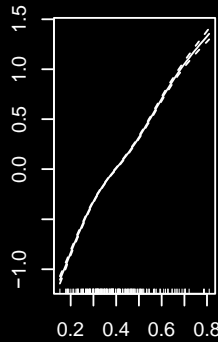
Pool.Area.km



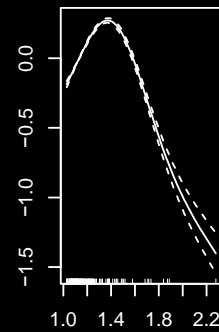
Fast.Turbulent.Area.km



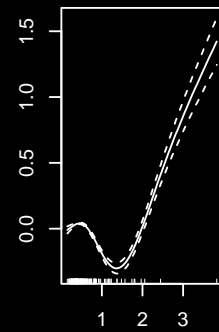
Fast.NonTurbulent.Area.kiThalweg.Depth.Profile.Filtere



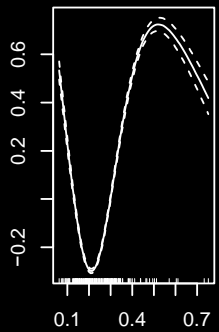
Site.Sinuosity



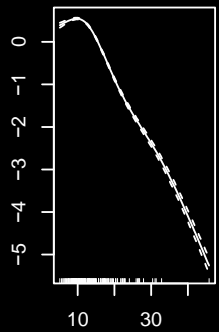
Standard.Deviation.of.the.Detren



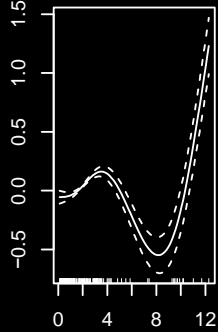
Rip.1



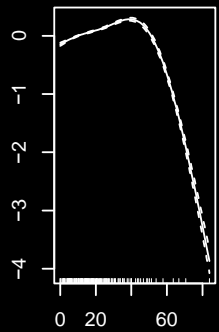
Bankfull.Width.Profile.Filtere



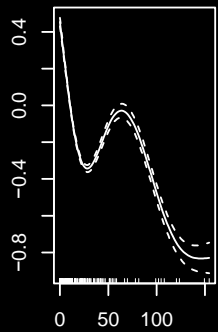
Rip.2



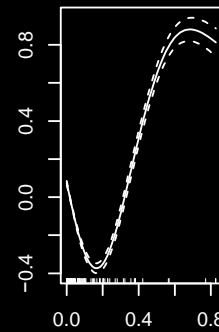
Wetted.Volume.km



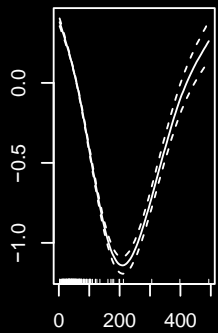
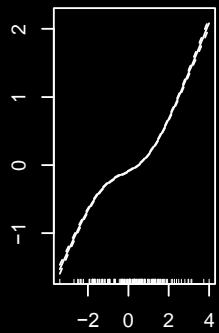
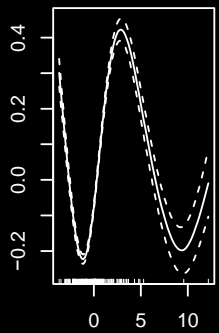
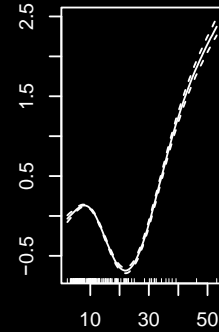
Fish.Cover.Total



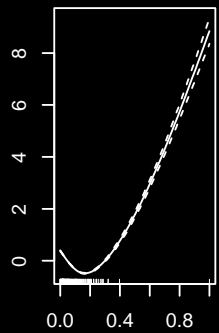
kfull.Large.Wood.Frequency.pkfull.Large.Wood.Volume.in.F



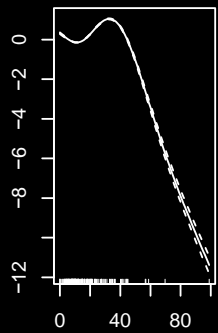
Sq.Root.Drain



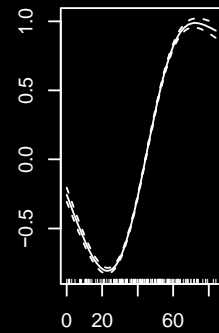
Measurement.of.D50



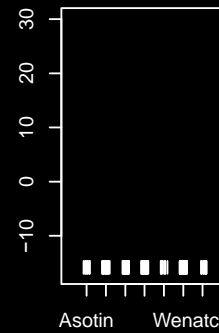
D16.D84.Ratio



Sand.and.Fines



Boulder.and.Cobbles



Watershed

Asotin Wenatche

Moving beyond the single-species paradigm

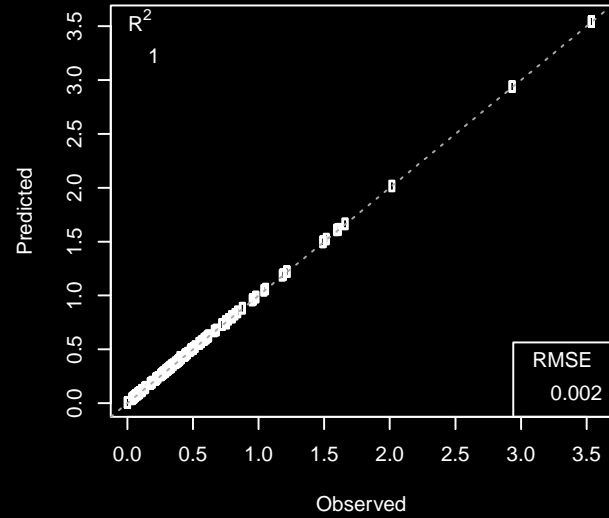
WHAT ABOUT OTHER FISH?

Similar Correlative Models

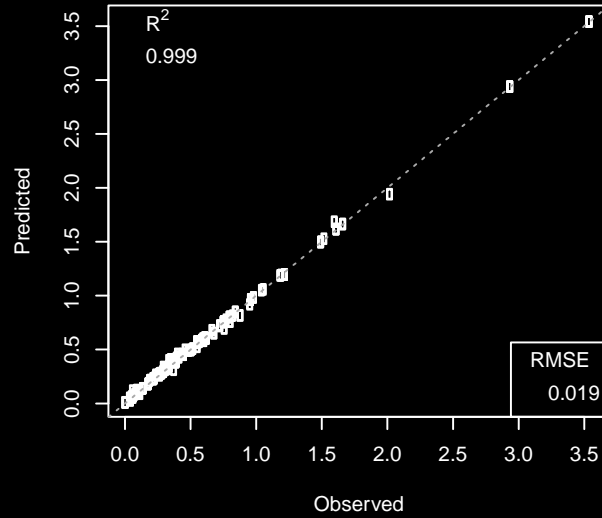
- 4 possible “target” fish
 - Chinook, steelhead, Chinook & steelhead, all salmonids
- Incorporate density of non-target fish as covariate
- Used 4 years of data from Salmon sub-basin
 - Close to 240 observations

Predicting Density of All Salmonids

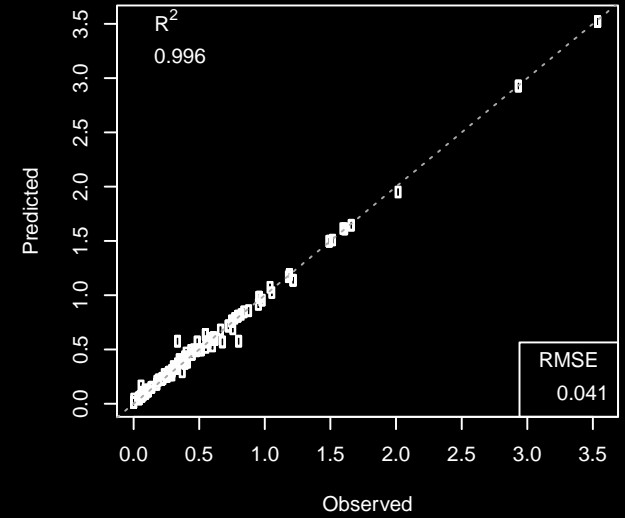
BRT.simp



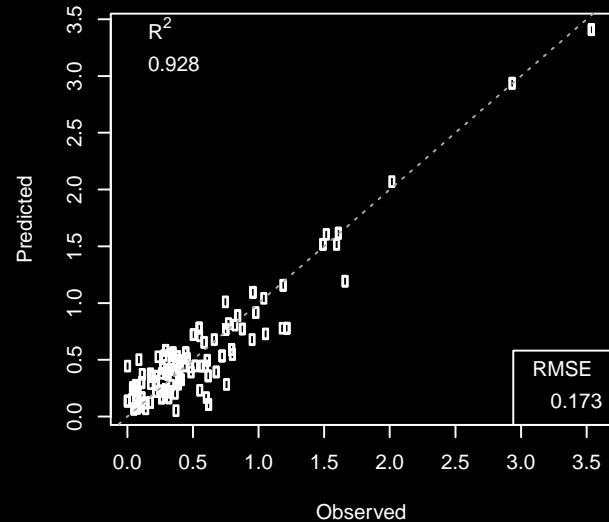
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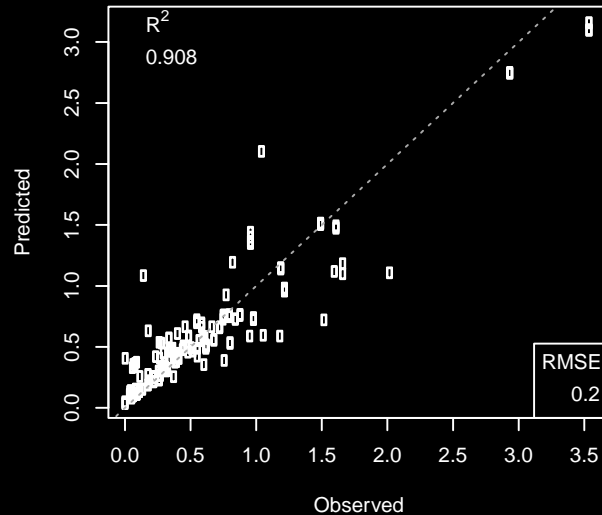
RanFor3



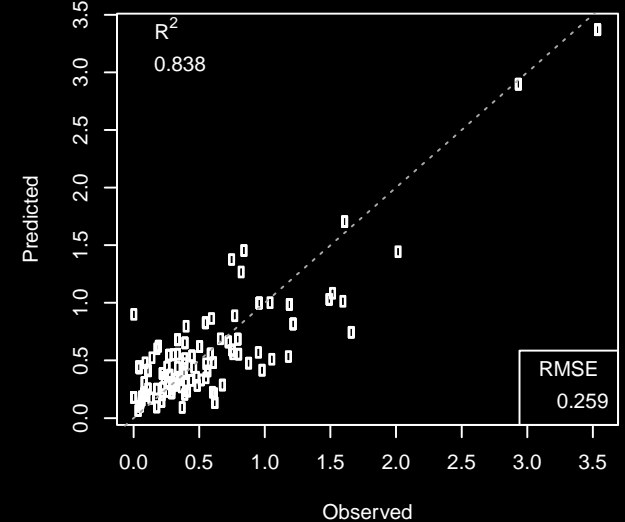
GAM.cnt



RanFor1.simp



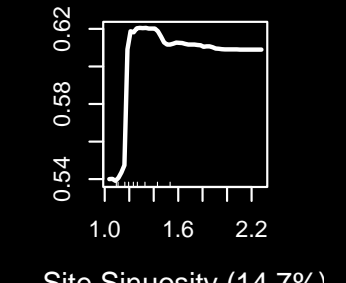
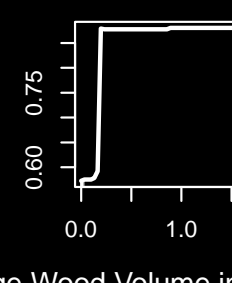
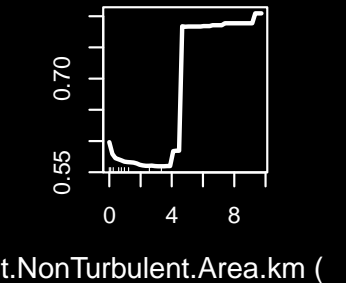
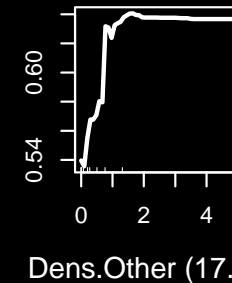
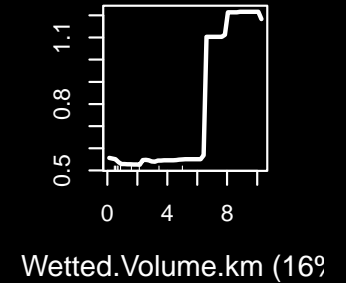
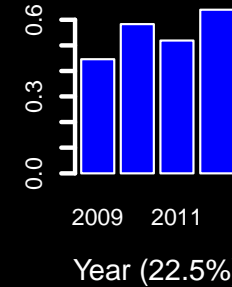
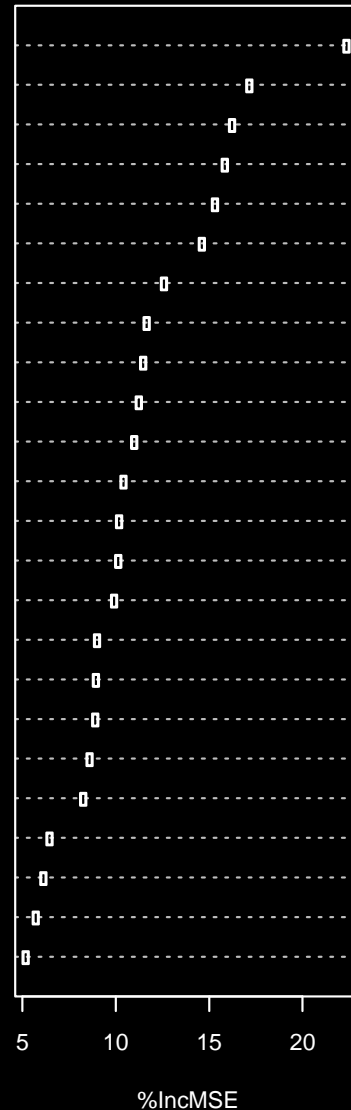
Pois



All Salmonids – Random Forest Model

Relative Importance

Year
 Dens.Other
 Bankfull.Large.Wood.Volume.in.Pools.km
 Wetted.Volume.km
 Fast.NonTurbulent.Area.km
 Site.Sinuosity
 Rip.1
 Bankfull.Large.Wood.Frequency.per.100m
 Pool.Area.km
 Measurement.of.D50
 Bankfull.Width.Profile.Filtered.CV
 Fast.Turbulent.Area.km
 Site.Measurement.of.Conductivity
 Boulder.and.Cobbles
 Fish.Cover.Total
 D16.D84.Ratio
 Bankfull.WidthToDepth.Ratio.Profile.Filtered.Mean
 Rip.2
 Stream.Power
 SubBasin
 Sq.Root.Drain
 Thalweg.Depth.Profile.Filtered.CV
 Sand.and.Fines
 Standard.Deviation.of.the.Detrended.DEM



How to best incorporate

MULTIPLE SPATIAL SCALES

Hierarchical Model

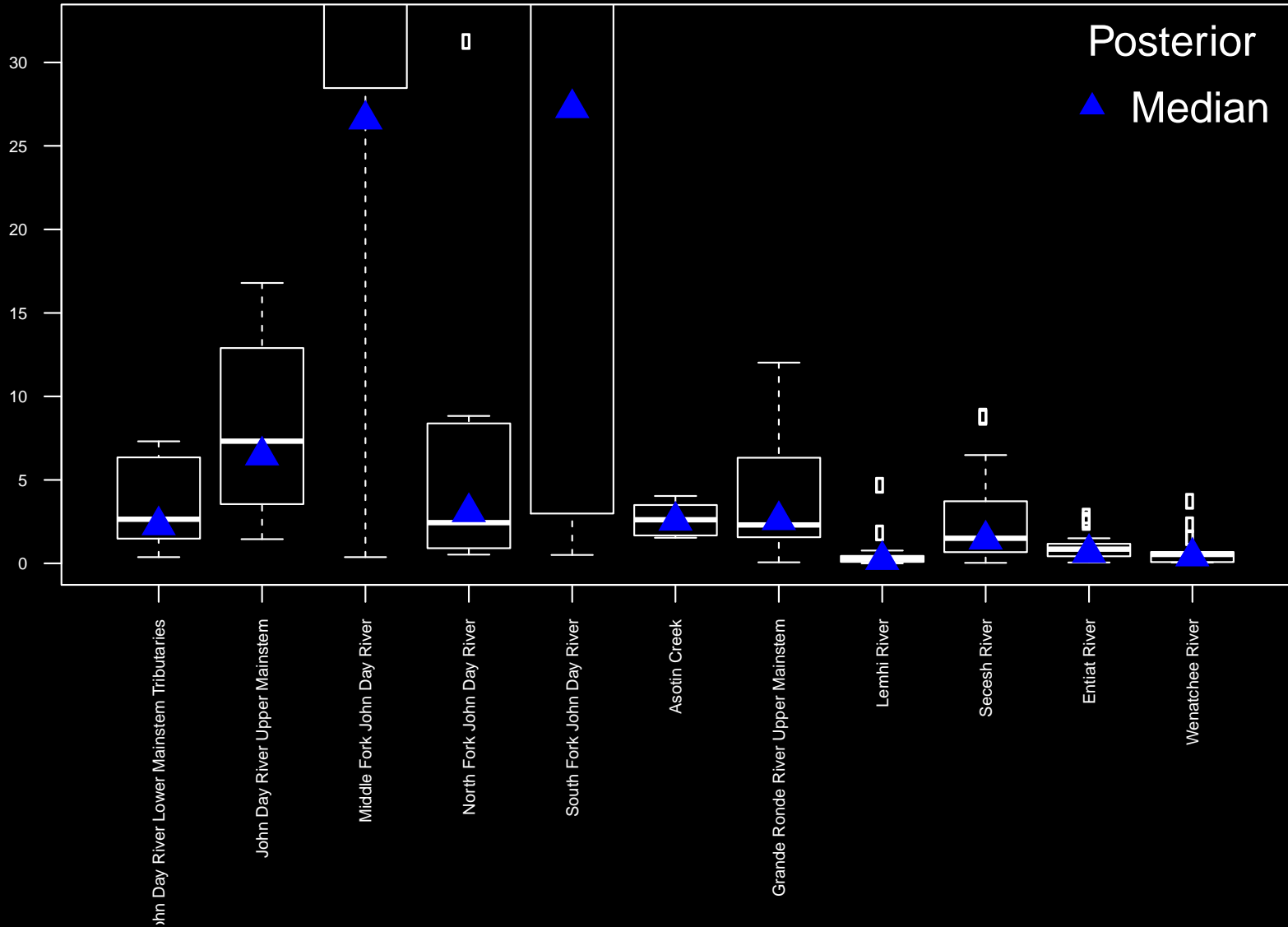
$$Z_j \sim N(\mu, \sigma)$$

$$\mu = X\beta$$

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

Preliminary Posterior Results

Steelhead Density



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?

