Analysis of AGFC Historical Crappie Trap-Netting Data

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Introduction

- Important fishery in Arkansas waters
  - AGFC (2017)
    - 26% of anglers listed Crappie as 1st choice
    - Second in popularity to Bass
  - Duda et al. (2000)
    - Most popular fishery with senior anglers (44%)
    - Anglers spent $92.6 million annually angling for Crappie
- Crappie Stock Assessment-Colvin and Vasey (1986)
  - White Crappie in large Missouri reservoirs
  - Population structure indices
- Missouri's method modified to fit Arkansas waterbodies
  - Mixed White and Black Crappie populations-managed as 1
  - Large highland reservoirs-small oxbow lakes

Introduction

- Arkansas Crappie Population Assessment-AGFC (2013)
  - Developed using trap net data from 15 AR lakes
  - Collected during 1989-1993
  - Values assigned for ranges of 5 population structure parameters
  - Overall Assessment Score

- 5 Population Structure Parameters
  - Recruitment: # Age-1+/Net Night
  - Density: # Age-1 or Greater/net night
  - Age Structure: % Age-3 or greater
  - Size Structure: % 250-mm or greater
  - Growth Rate: mm at Age-2+

Methods

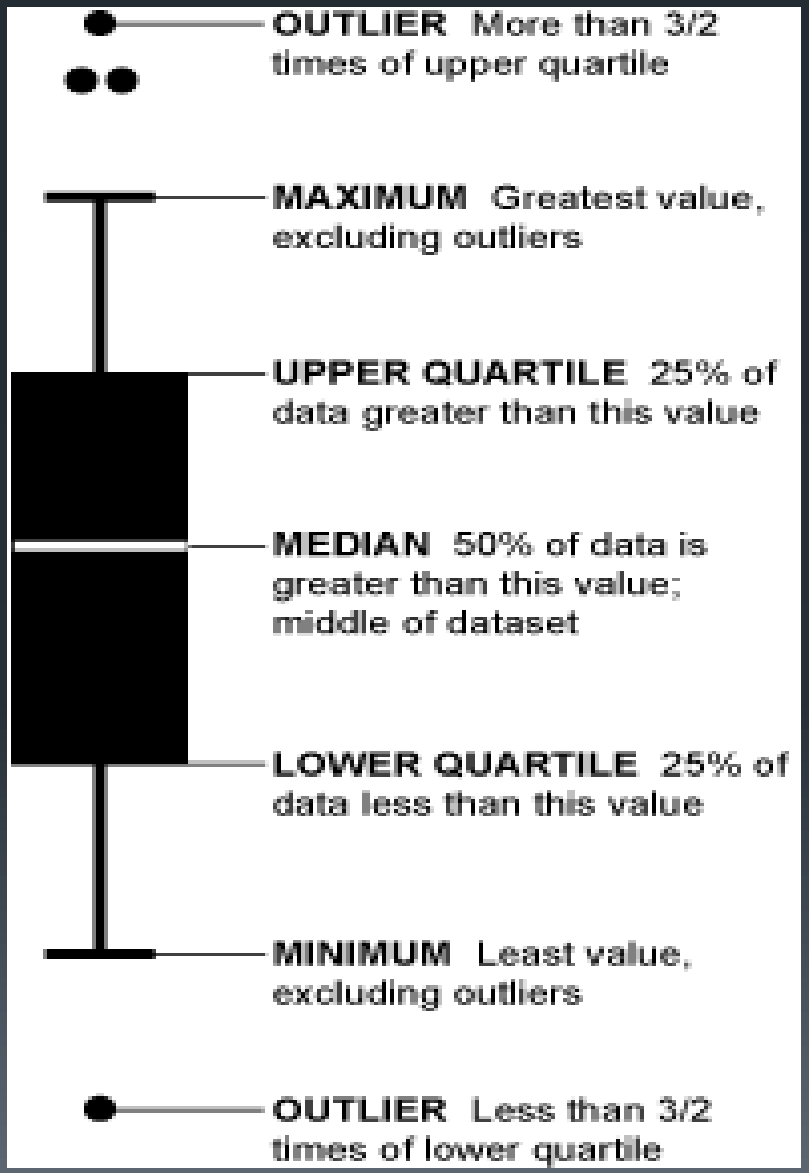
- 6 metrics compiled and summarized across 6 Ecoregions
  - 5 Population Structure Parameters
  - Overall Assessment Score (0-100)
- Test for normal distribution of parameter data
  - Histrograms, boxplots, Shipiro-Wilk Tests
    - Percentages, ratios, skewed, outliers, etc…
  - Normal Distribution: Assessment Score, Growth Rate
- Test for differences in metrics by Ecoregions
  - Non-Normal: K-W test with Dunn pairwise post-hoc test
  - Normal: ANOVA with Tukey HSD pairwise post-hoc test
- Test for differences in parameters by Species
  - Non-Normal: Mann-Whitney test
  - Normal: Welch’s 2-sample t-test

Major Ecoregions in Arkansas

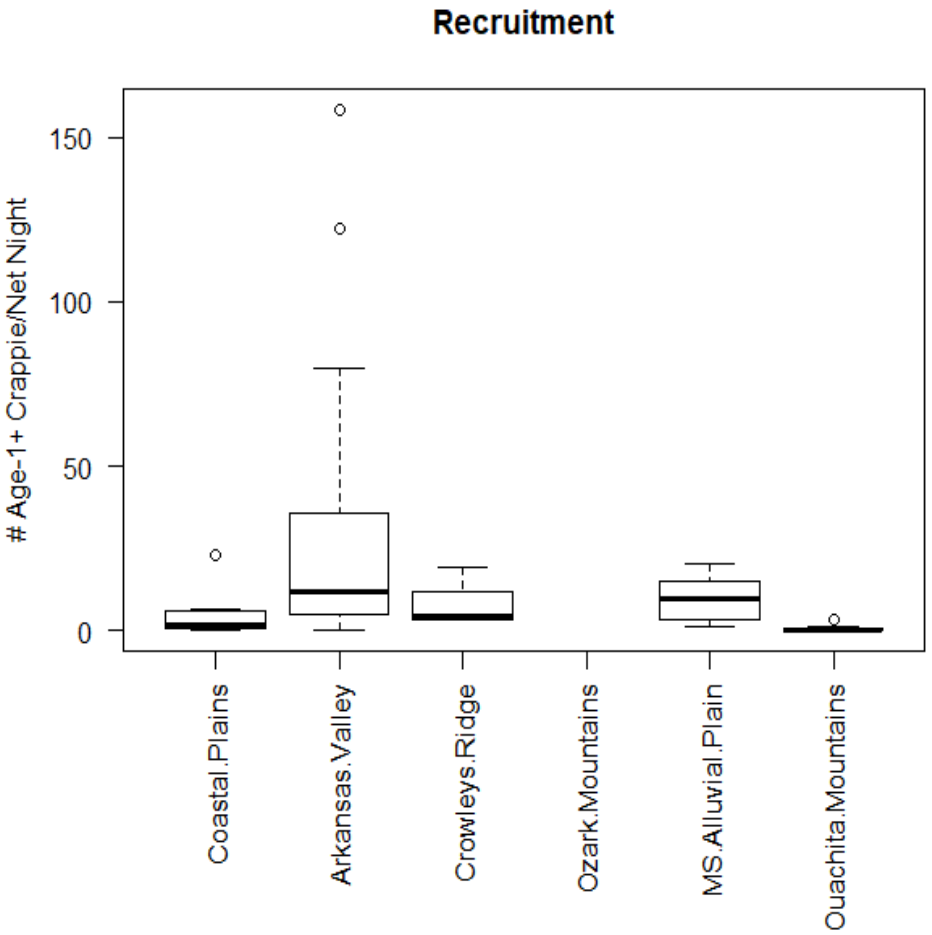
Map courtesy of the Arkansas Natural Heritage Commission

Methods

- Statistical methodology in place
  - Lots of comparisons
  - Can we visualize comparisons?
- Boxplots!
- Boxplot refresher
  - Distribution and shape of datasets
  - Relationships amongst datasets
- Can quickly compare data across multiple categories
- Can quickly determine likely statistical significance

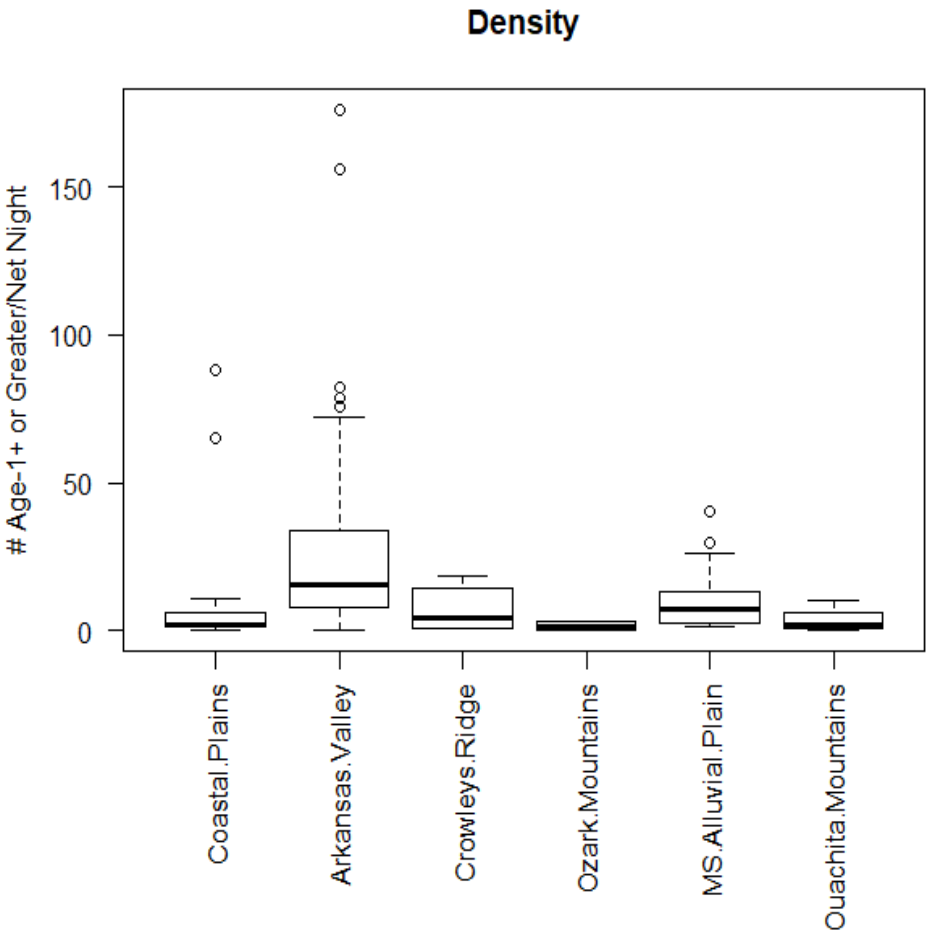


Recruitment by Ecoregion



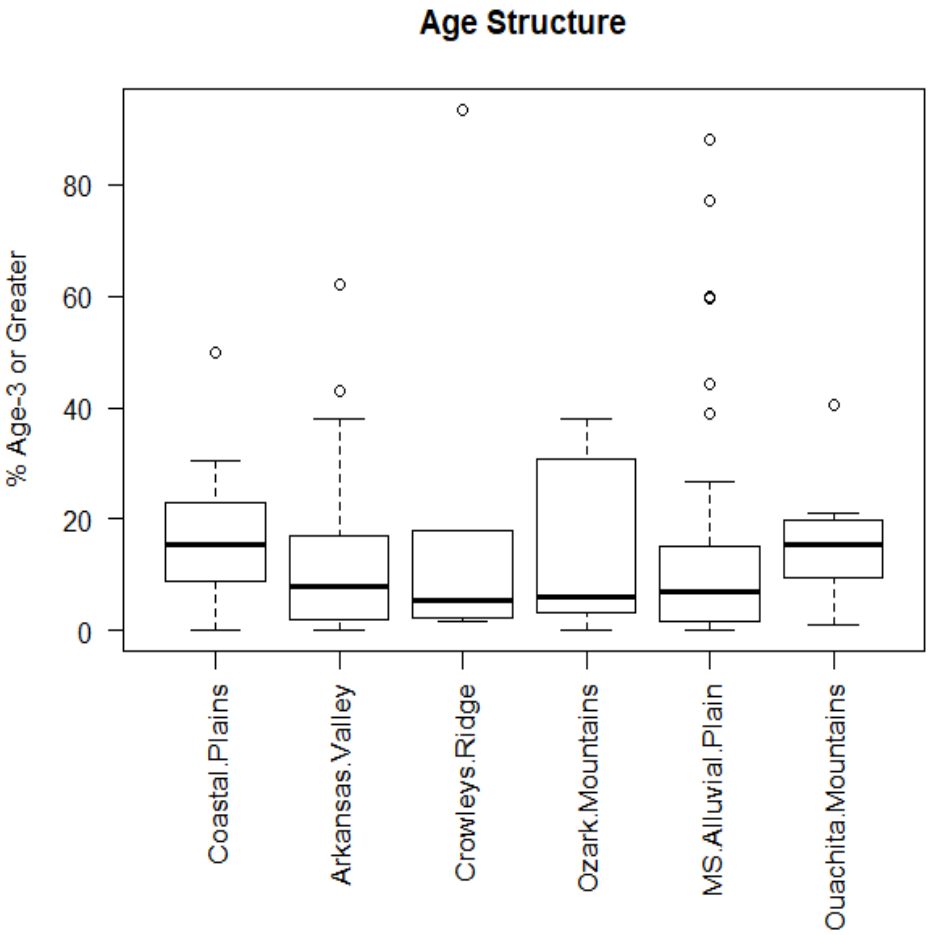
- KW test: $p < 0.001$
  - Highly significant differences between ecoregions detected
- Arkansas Valley~Coastal Plains
- Arkansas Valley~Ouachita Mountains
- Crowley's Ridge~Ouachita Mountains
- MS Alluvial Plain~Ouachita Mountains

Density by Ecoregion



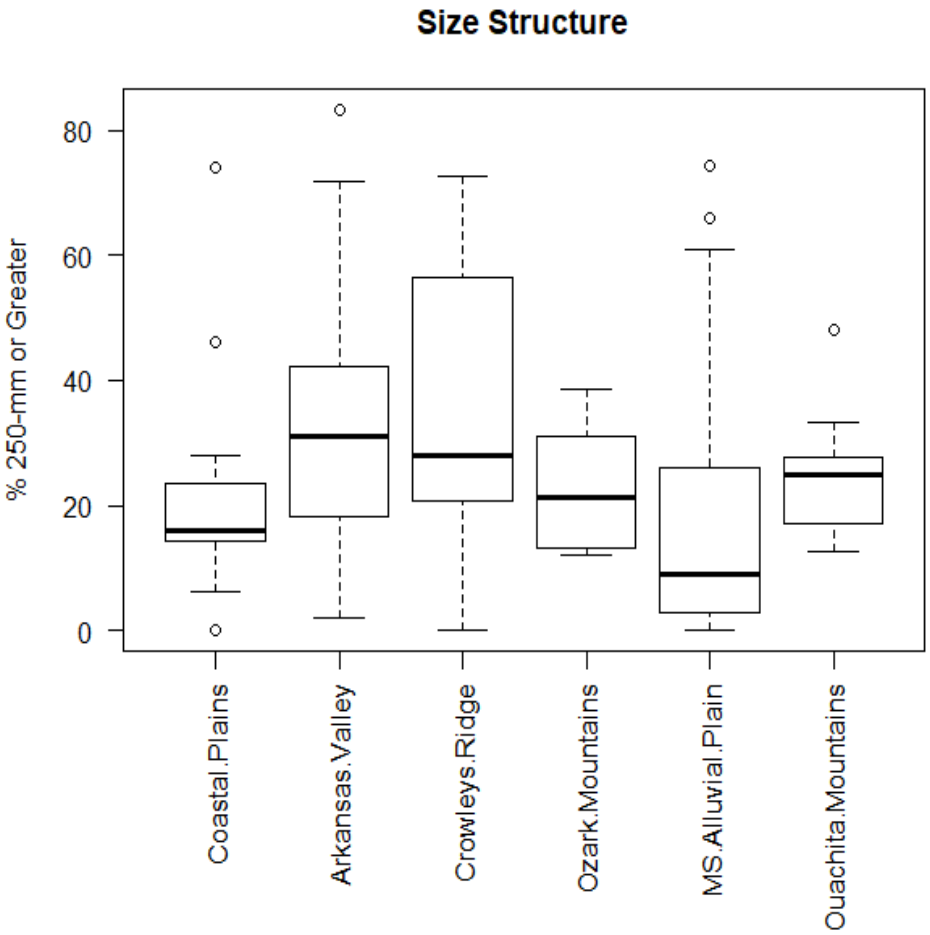
- KW test: p = 0.0015
  - Significant differences between ecoregions detected
- AR Valley~Ozark Mountains
- AR Valley~Coastal Plains
- AR Valley~Ouachita Mountains

Age Structure by Ecoregion



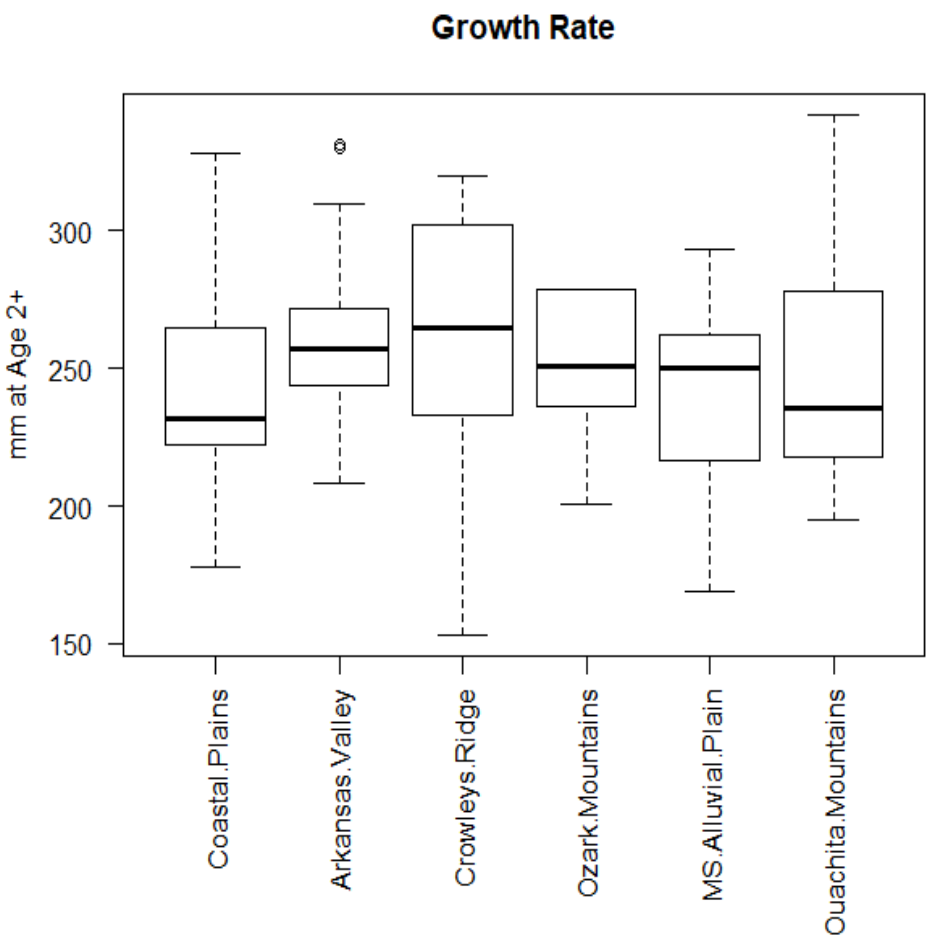
- KW Test: p = 0.553
  - No significant differences between ecoregions detected

Size Structure by Ecoregion



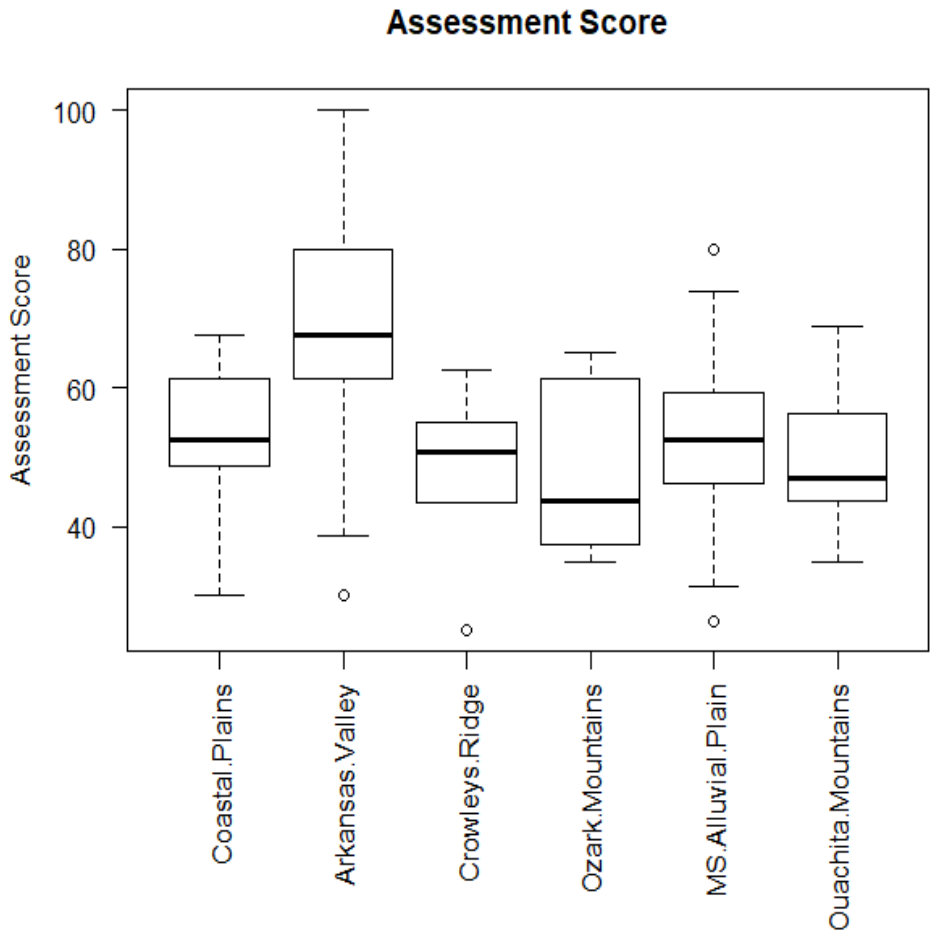
- KW Test: p = 0.005
  - Significant differences between ecoregions detected
- AR Valley~MS Alluvial Plain

Growth Rate by Ecoregion



- ANOVA: p = 0.165
  - No significant differences between ecoregions detected

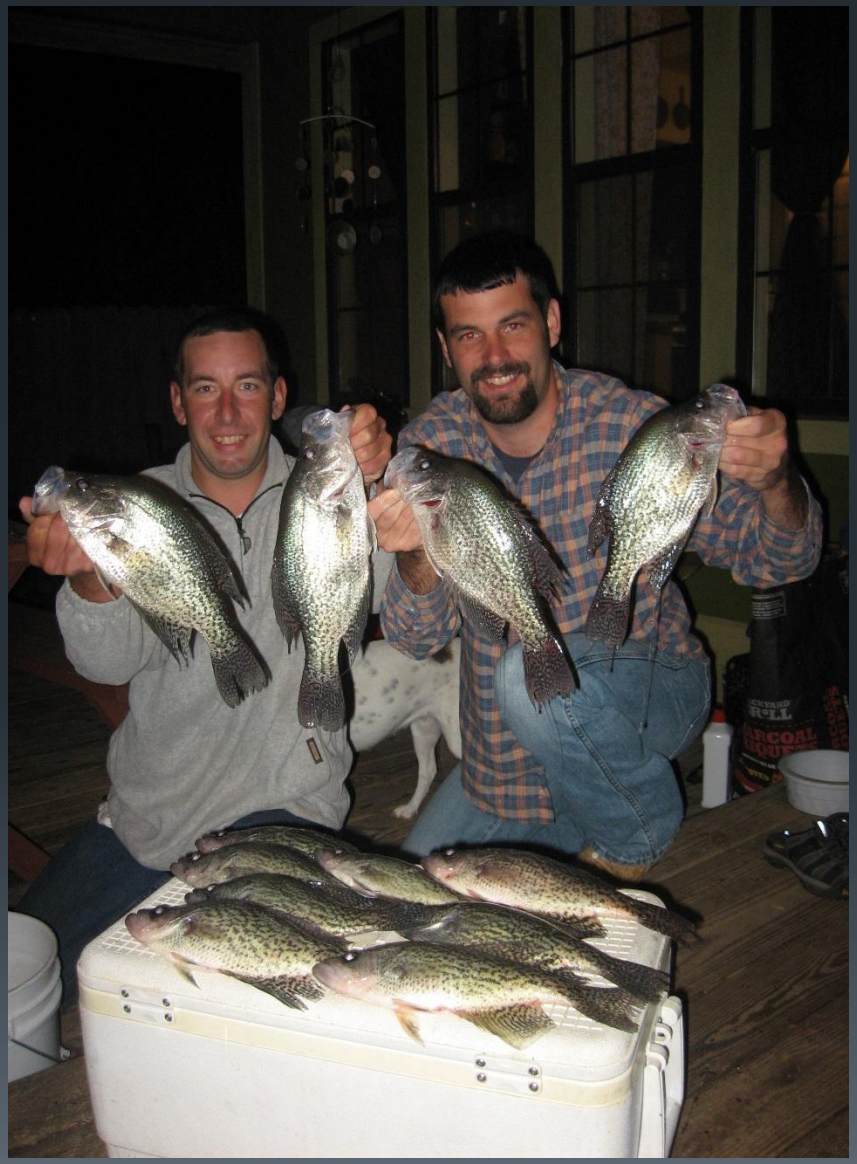
Assessment Score by Ecoregion



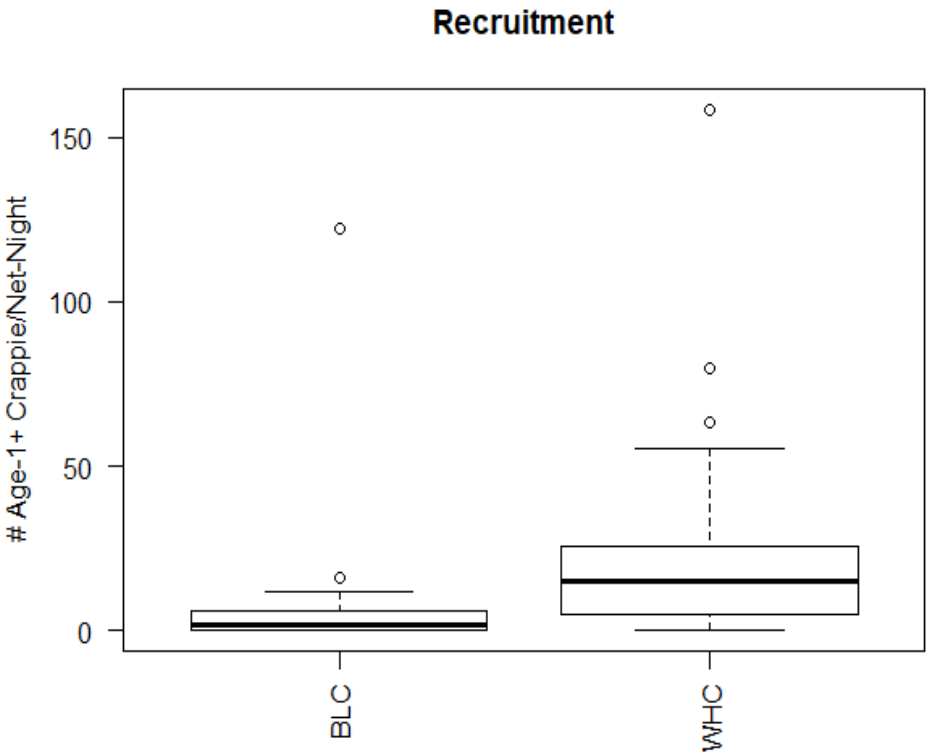
- ANOVA: $p < 0.001$
  - Highly significant differences between ecoregions detected
- AR-Valley~All other ecoregions

Breather and Shift Gears

- Done with Ecoregion Analysis
- Lots of boxplots
- Some significant differences
  - Arkansas Valley
  - Density/Recruitment
- Lets look at BLC v WHC
  - Species dominance by lake
- Differences in Assessment Score parameters by species?

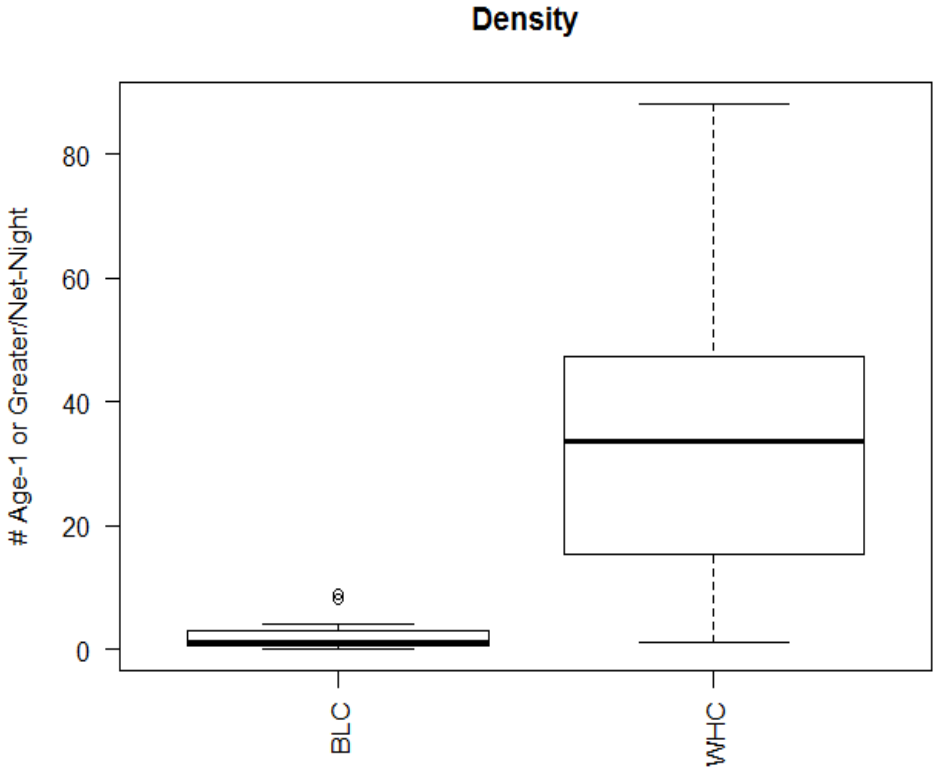


Recruitment: BLC v WHC



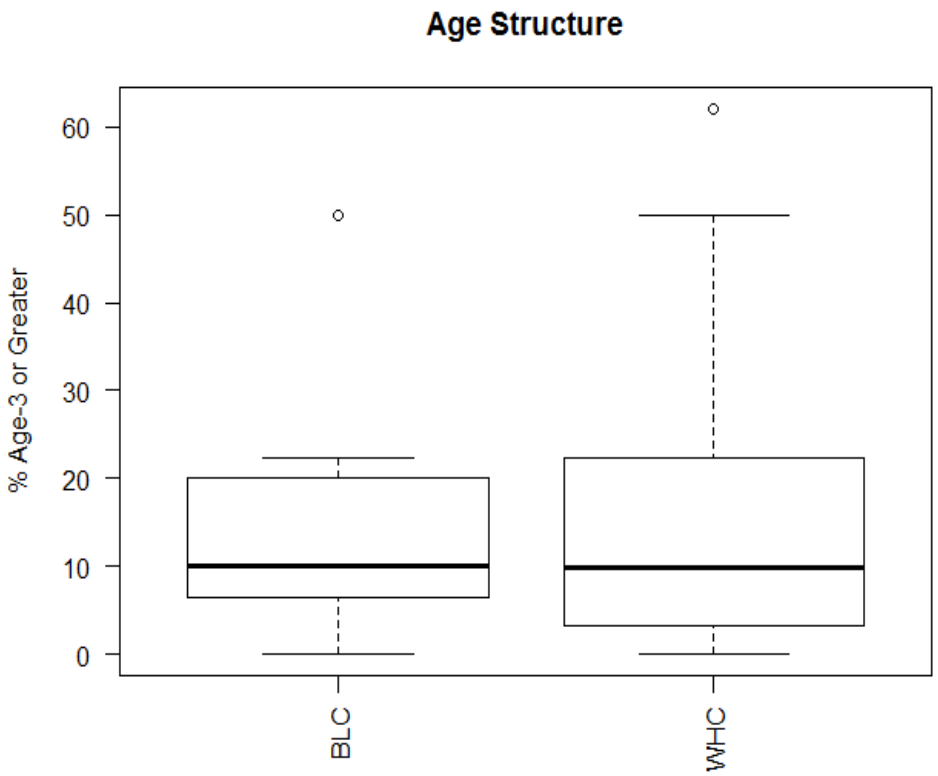
- Mann-Whitney test: $p < 0.001$
  - Highly significant difference detected

Density: BLC v WHC



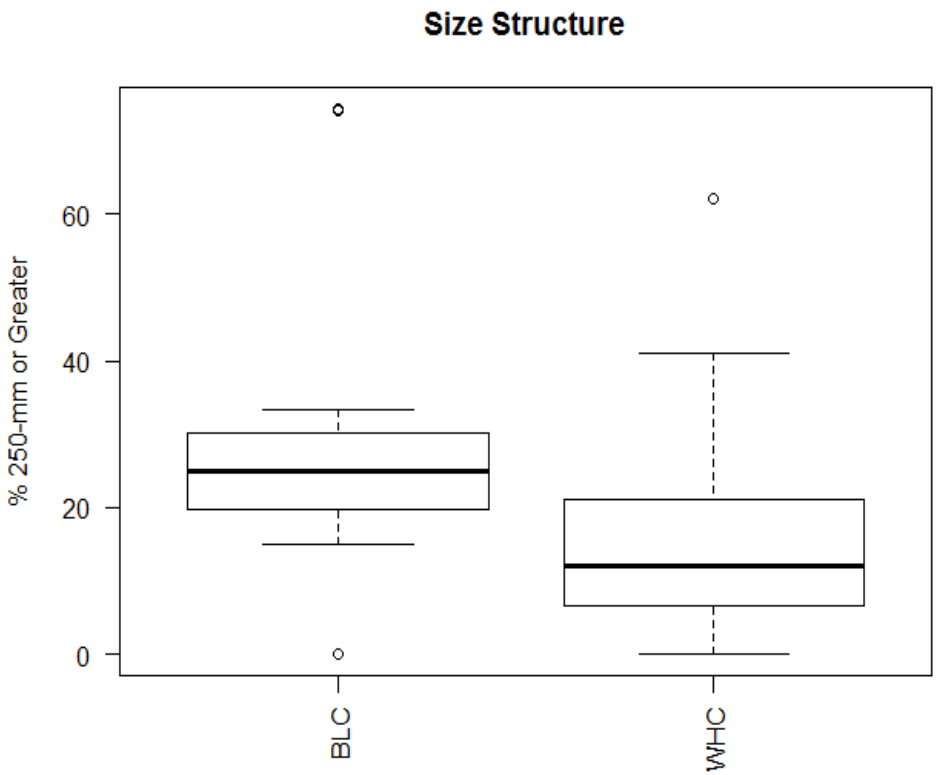
- Mann-Whitney test: $p < 0.001$
  - Highly significant difference detected

Age Structure: BLC v WHC



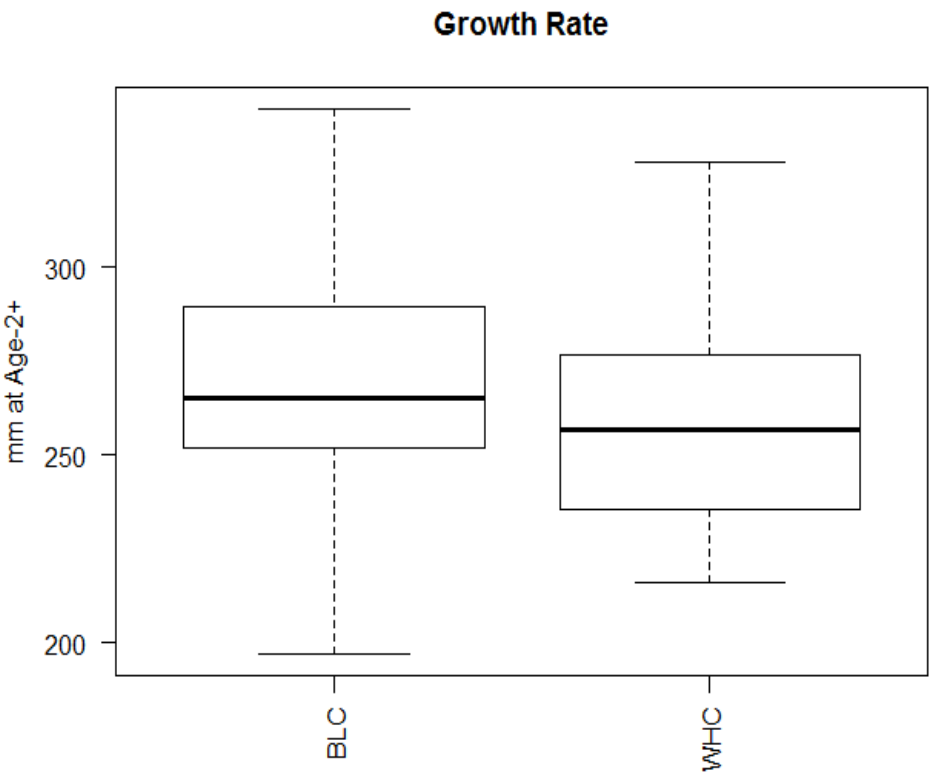
- Mann-Whitney test: p = 1.0
  - No significant difference detected

Size Structure: BLC v WHC



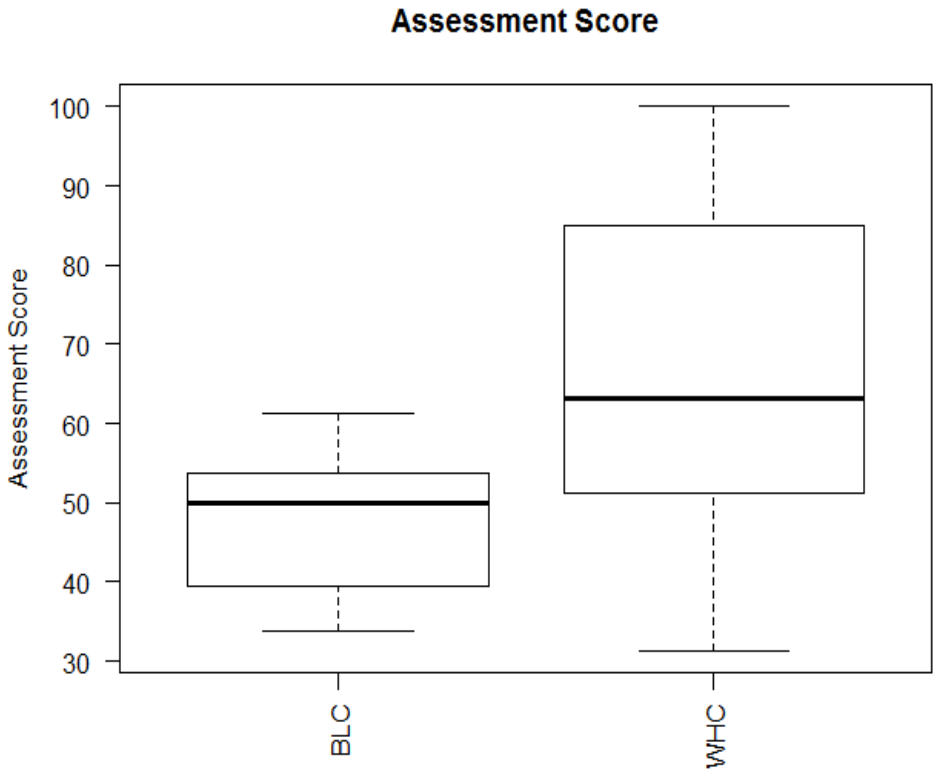
- Mann-Whitney test: p=0.005
  - Significant difference detected

Growth Rate: BLC v WHC



- Welch t-test: p=0.463
  - No significant difference detected

Assessment Score: BLC v WHC



- Welch t-test: $p < 0.001$
  - Highly significant difference detected

Discussion

- Significant differences clustered around Density, Recruitment and Assessment Score
  - Same trends in Ecoregion and BLC v WHC analysis
  - Focus on BLC v WHC Assessment Score
  - Boxplot differences obvious in data range and median values
- What could be driving this?
  - Assessment Score calculations weighted
  - Favor Growth Rate, Age Structure, Size Structure
- BLC values for these parameters
  - Similar to or better than WHC in boxplots
  - Size Structure significantly different
    - Value favors BLC
- Density and Recruitment
  - Boxplots show large differences
  - Highly statistically significant

Discussion

- Are Density and Recruitment valued too highly?
  - Problem: Vagaries of netting CPUE
  - Already given less weight in Assessment Score calculation
    - Effect can still multiply throughout score calculation
    - Unintended effects on Assessment Score calculation
- May skew score + for WHC lakes and – for BLC lakes
  - BLC/WHC similar in other Assessment Score parameters
    - 12 WHC-dominant lakes scored 60-100 on Assessment Score
    - 1 BLC-dominant lake > 60 on Assessment Score
- Arkansas Crappie Population Assessment
  - Growth Rate, Size Structure, Age Structure
    - Sufficient to describe population structure/dynamics?
    - Density/Recruitment by proxy
      - Catch Curve residuals
- Place even less importance on CPUE data?

Questions?