Status of Ohio River Crappie Population Vital Rates and Relationships Between Environmental Variables and Year-Class Strength

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Black Crappie (*Pomoxis nigromaculatus*)

White Crappie (*Pomoxis annularis*)

Recruitment

- Variable recruitment
  - Cyclic (Swingle and Swingle 1967)
  - Quasi-cyclic (Allen and Miranda 2001)
- Environmental factors vary
  - Spawning stock CPUE, chlorophyll a, pre-spawn water levels, summer water level, P
  - (Bunnell et al 2006; Sammons et al 2002; Siepker & Michaletz 2013)


nationalgeographic.org


brphycsoc.org

Knowledge Gaps

- Lentic populations well-studied, lotic limited
  - (Sheik et al 1998)
- Clustered, relatively smaller populations

Objectives

- Examine characteristics of Ohio River Smithland pool crappie populations
- Identify environmental variables that may influence recruitment
  - Correlation
  - Least Absolute Shrinkage and Selection Operator (LASSO) Regression
  - Simple Linear Regression

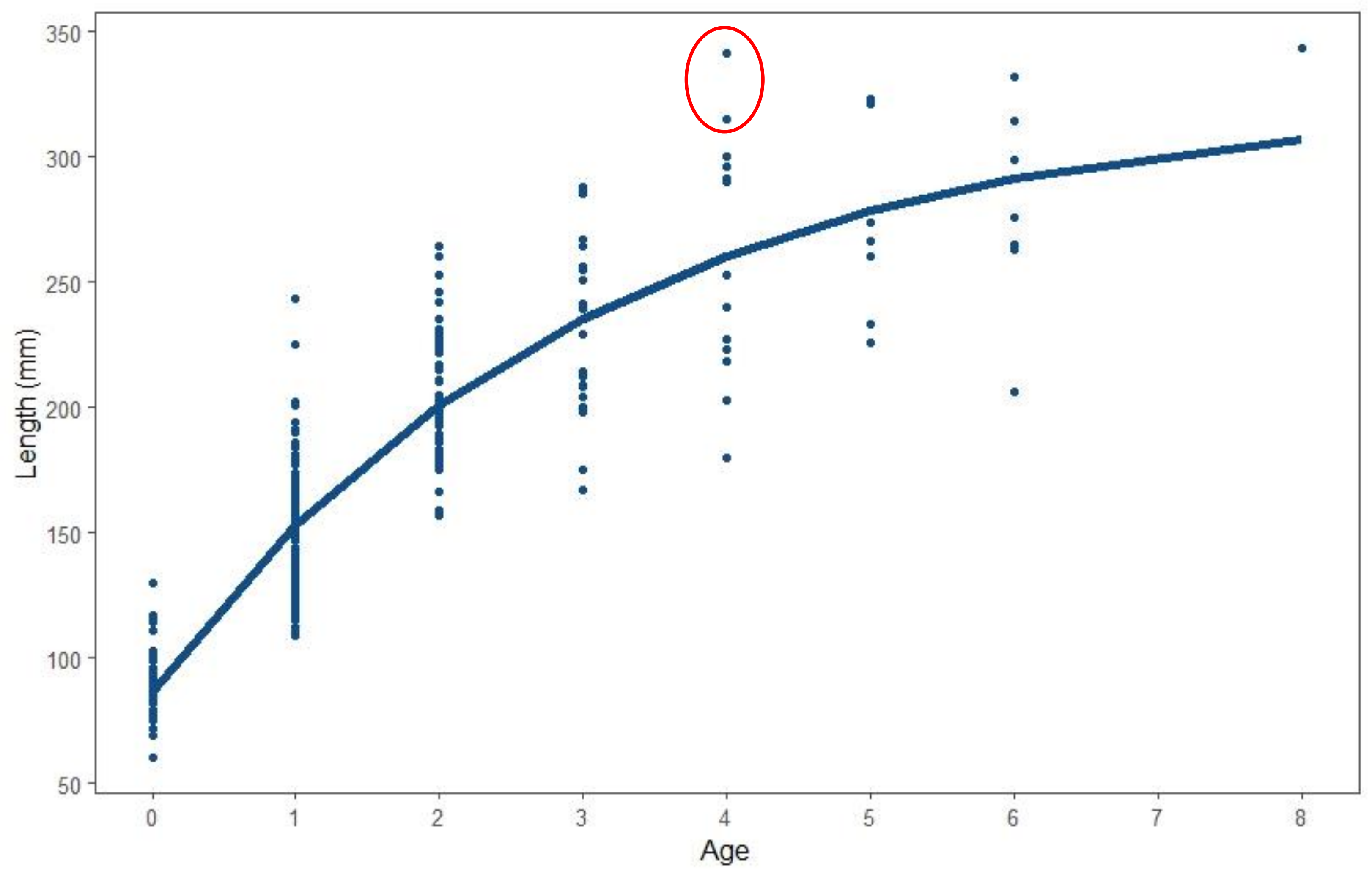
Study Area

Data

- Tributary Crappie Collection
  - Alcorn, Dog, Barren, Bay, Lusk, Big Grand Pierre, Big
    - Black Crappie (BLC): n=256
    - White Crappie (WHC): n=159
- Fall 2020 and Spring/Fall 2021 (Hale 1999)
  - Pulsed DC Electrofishing
  - Fyke Nets
- IDNR contributed crappie from yearly monitoring efforts

Status of Ohio River Smithland Pool Crappie Population Vital Rates

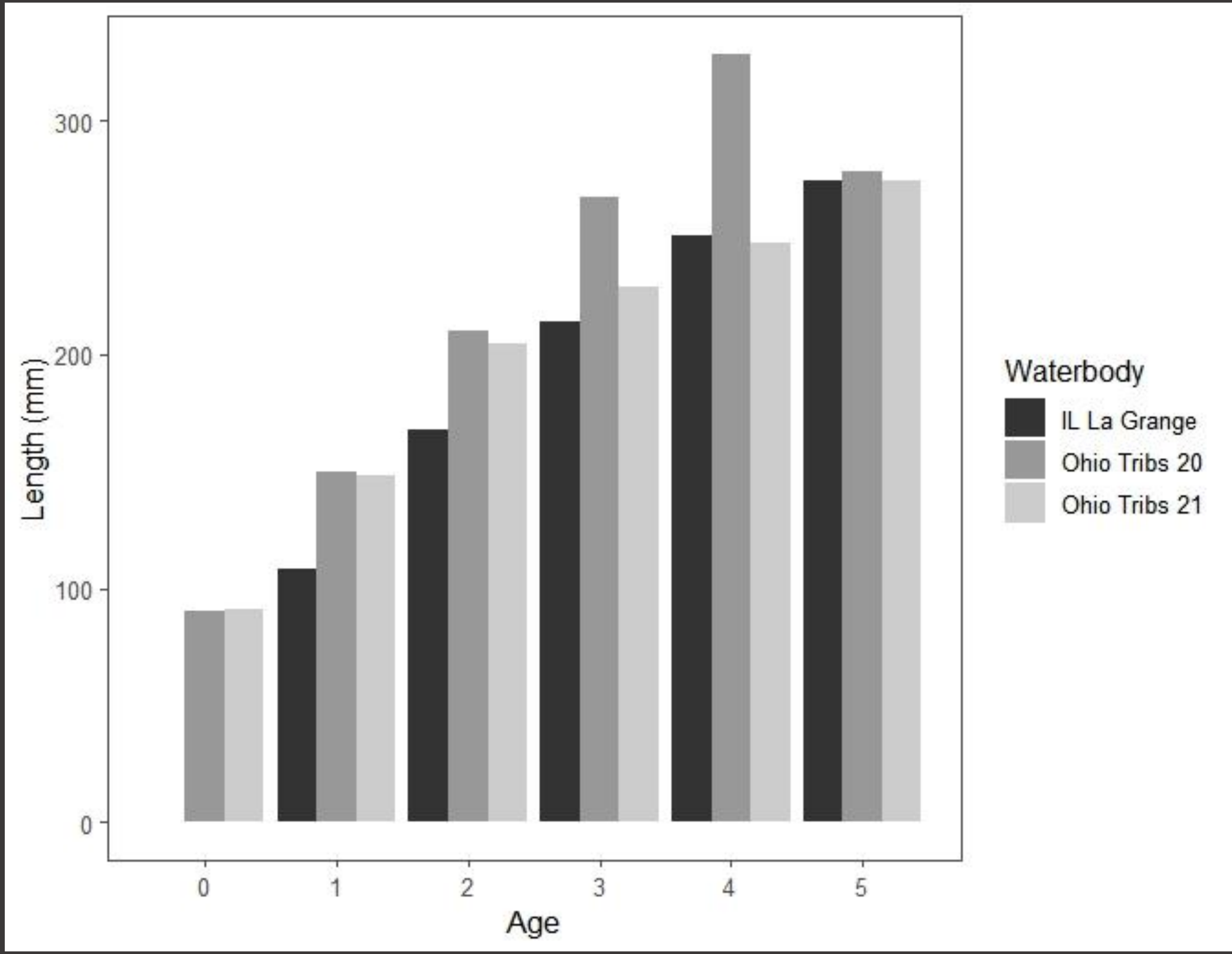
Black Crappie Von Bertalanffy Curve



	L∞ (mm)	K
OHR Total	324.2	0.329
OHR 2020	372.8	0.271
OHR 2021	310.4	0.345
IL 2012-2016	452.0	.154

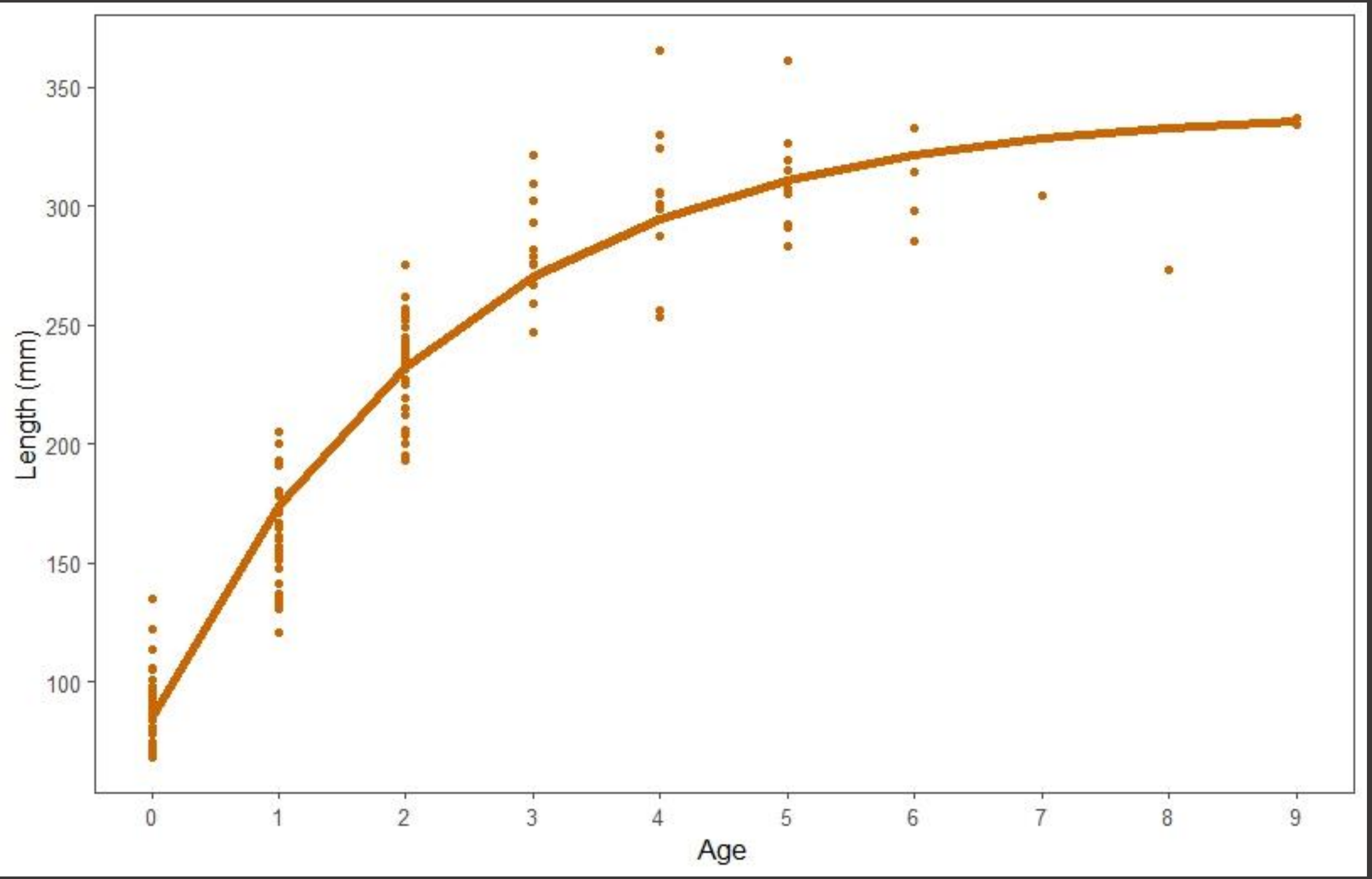
(Solomon et al 2019)

BLC Mean Length at Age



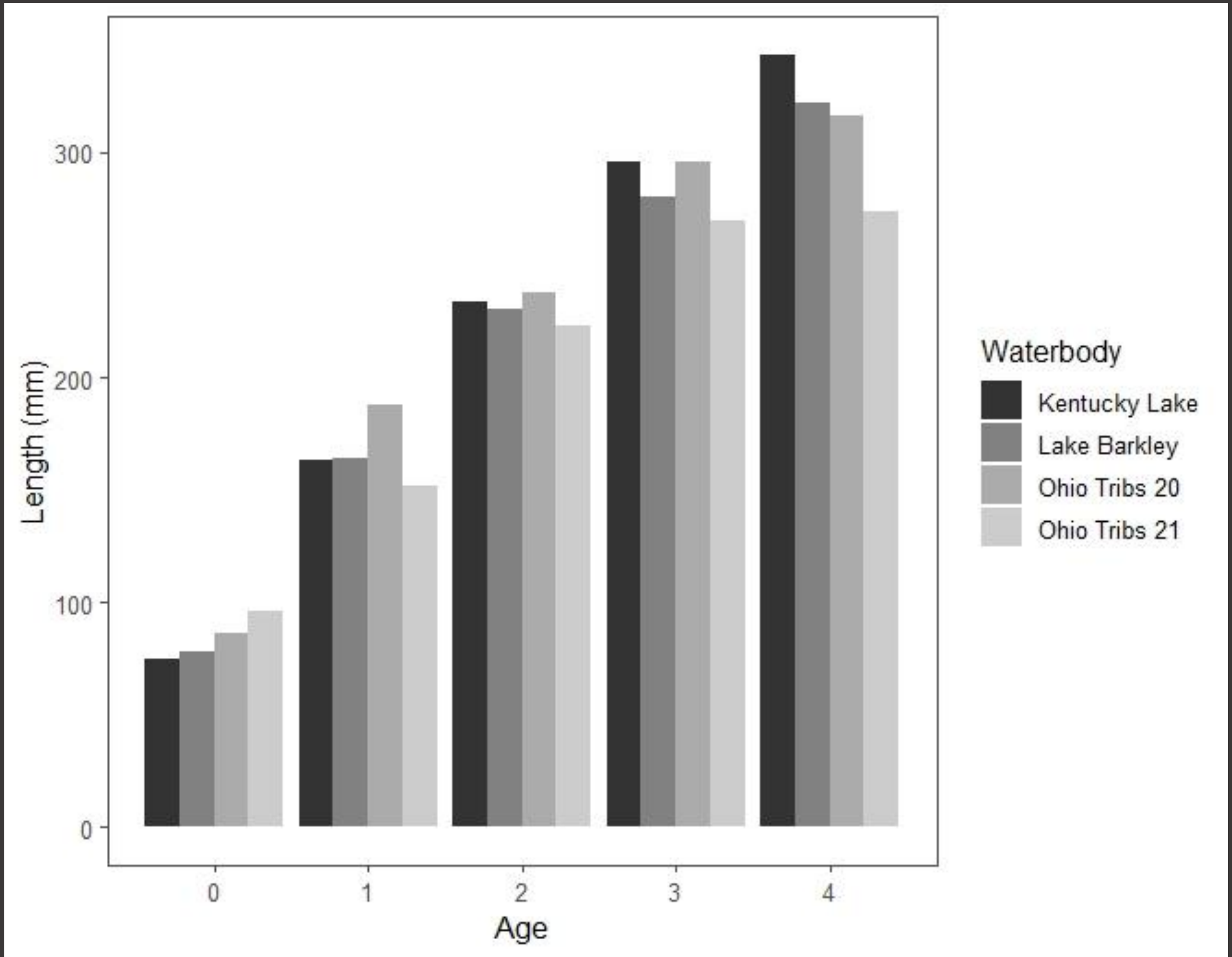
Smith et al 2007

White Crappie Von Bertalanffy Curve



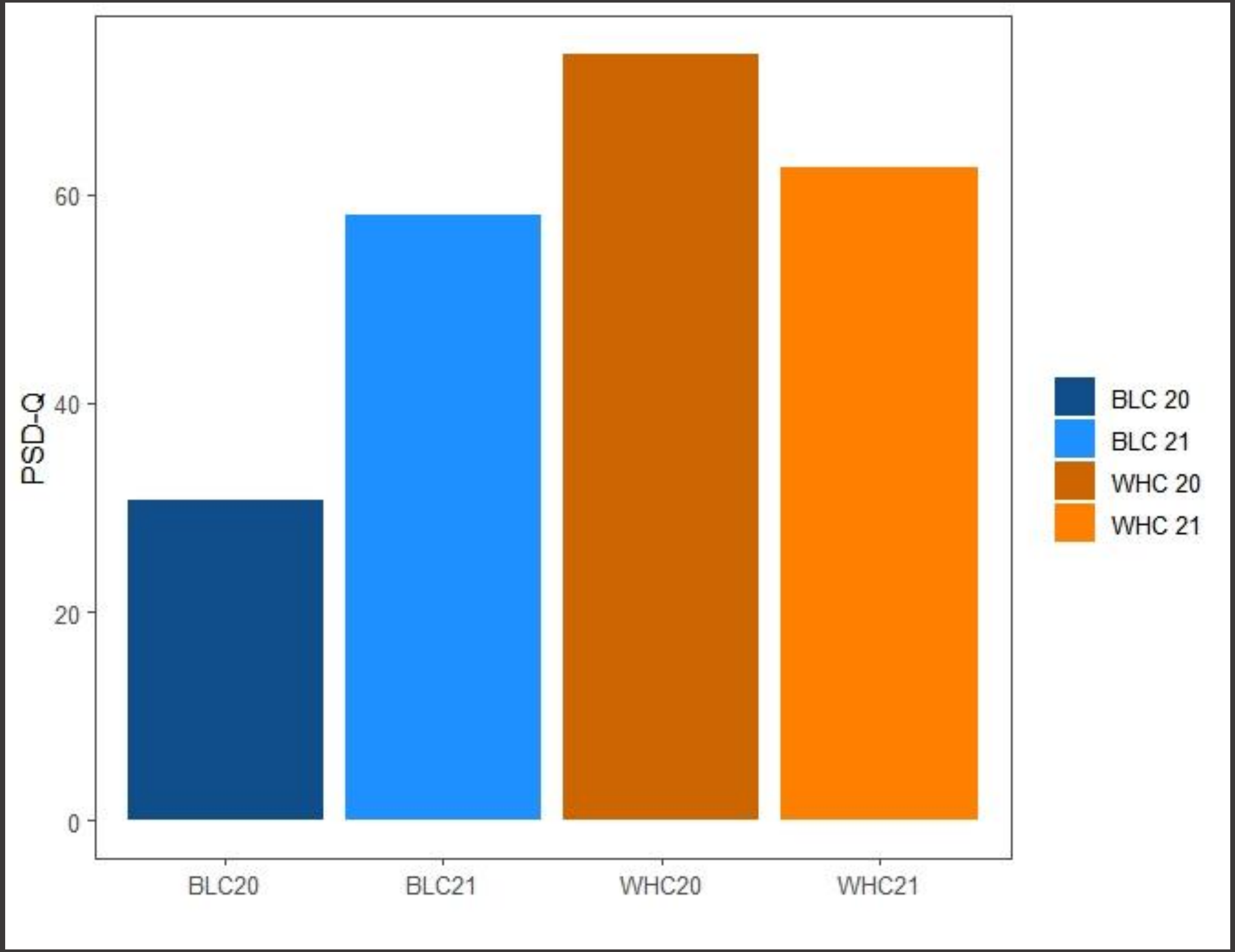
	L∞ (mm)	K
OHR Total	341.3	0.426
OHR 2020	345.6	0.460
OHR 2021	337.0	0.357

WHC Mean Length at Age



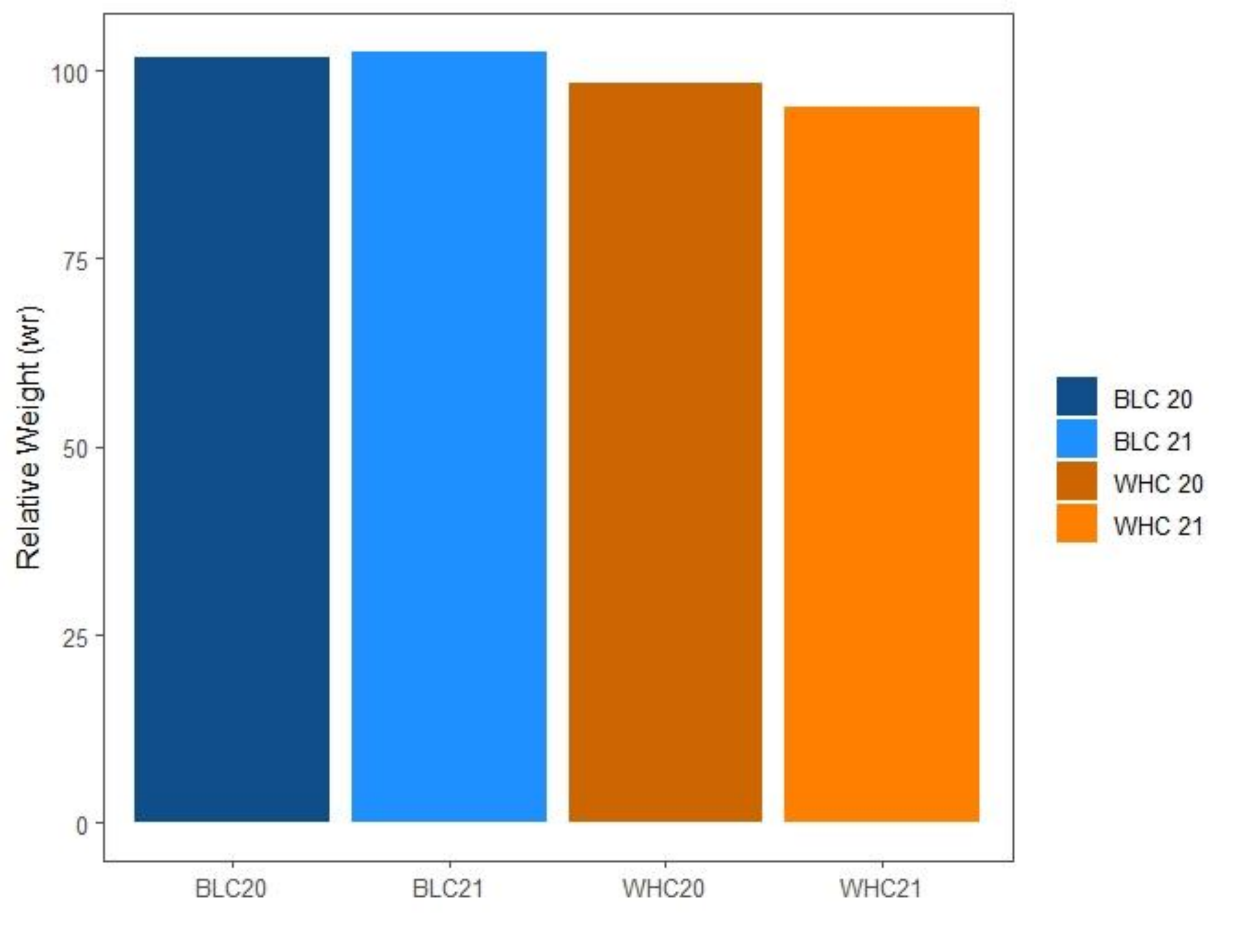
Parrish et al 1986

Proportional Size Distribution (PSD)



(Gabelhouse 1984)

Relative Weight (W_r)



(Neumann and Murphy 1991)

Mortality Estimates and Comparison

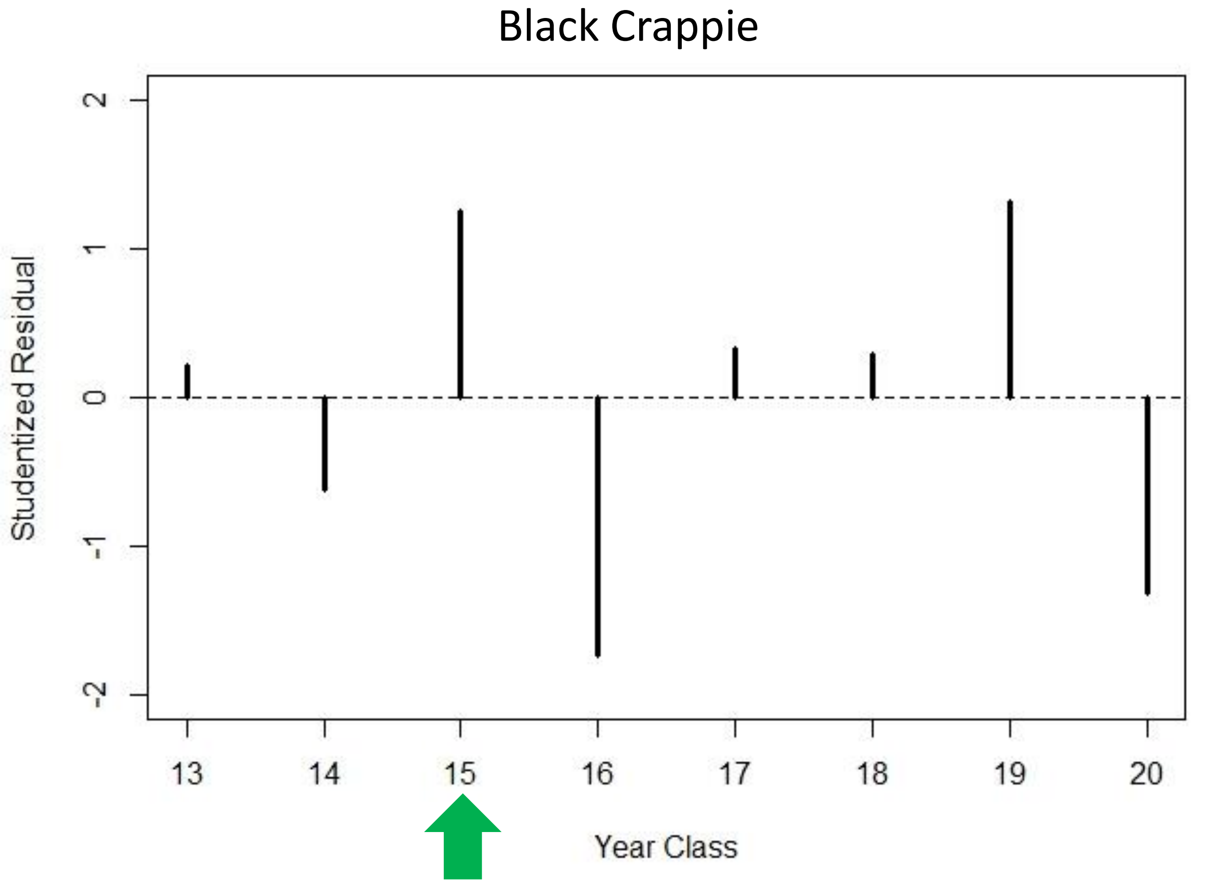
OHR BLC EF 20	OHR BLC EF 21	Nebraska Sand Hills Lakes BLC (Paukert et al 2001)
0.78	0.49	0.39 (0.11-0.71)

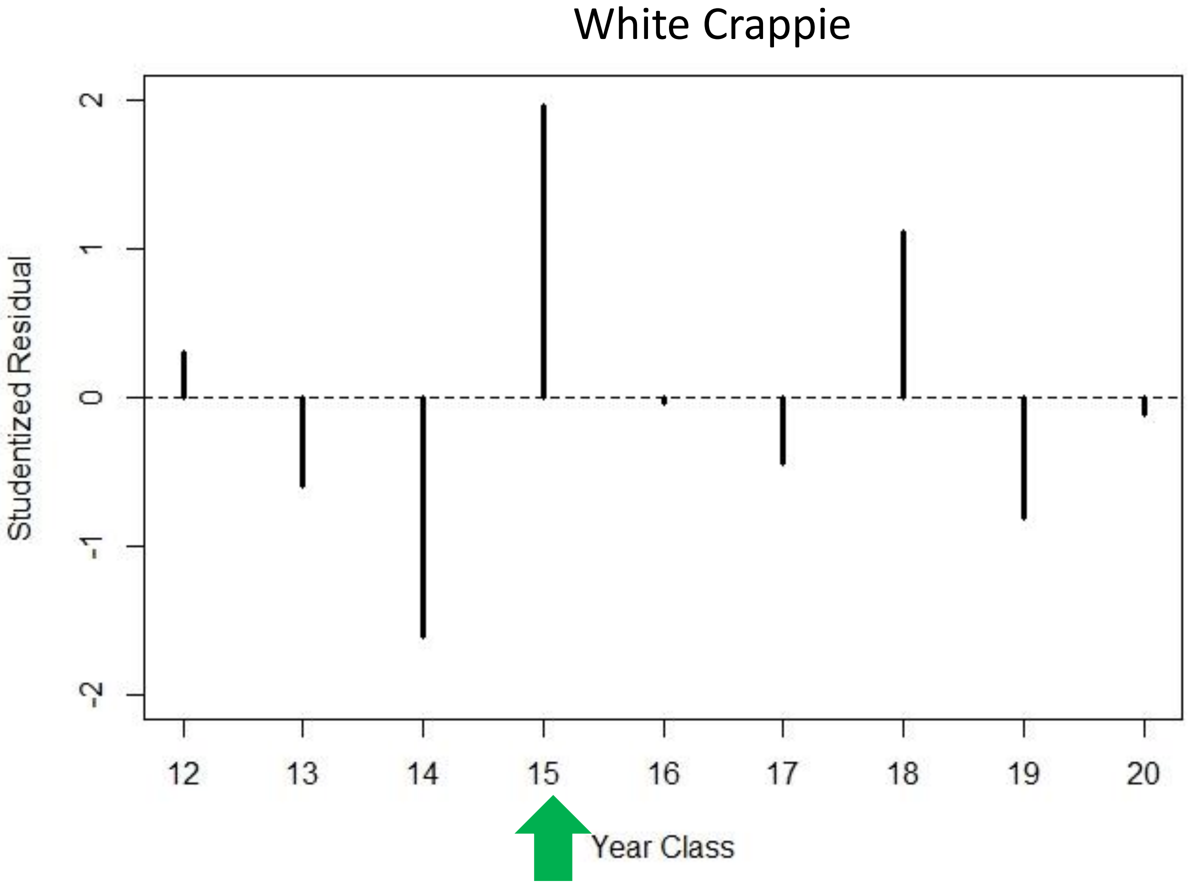
OHR WHC EF 20	OHR WHC EF 21	Lake McMurtry, OK WHC (Stewart et al 2015)
0.53	0.40	0.39-0.51

Recruitment and Related Variables

Recruitment

$p = 0.11$





Environmental Variables

Pre-Spawn (Jan-Mar) Spawn (Apr-May) Post-Spawn (June-Sep) Fall (Oct-Dec)

OHR Discharge OHR Stage Lusk Creek Discharge Lusk Creek Stage Air Temp (Water Temp Proxy) Precipitation

Predator CPUE (lagged 1 year)

Total of 25 potential correlates/regressors

(Maceina & Stimpert 1998)

Correlations

Black Crappie

Variable	r	p
Ohio River Discharge Post-Spawn	0.90	0.0025
Ohio River Stage Post-Spawn	0.88	0.0042

White Crappie

Variable	r	p
Fall Air Temperature	0.70	0.034

LASSO Regression

- Shrinkage Method
- Utilizes a tuning parameter (λ)
  - As λ increases, model variance increases, bias decreases
- Cross validation methods to choose the proper value for lambda
  - Minimize cross validation test error

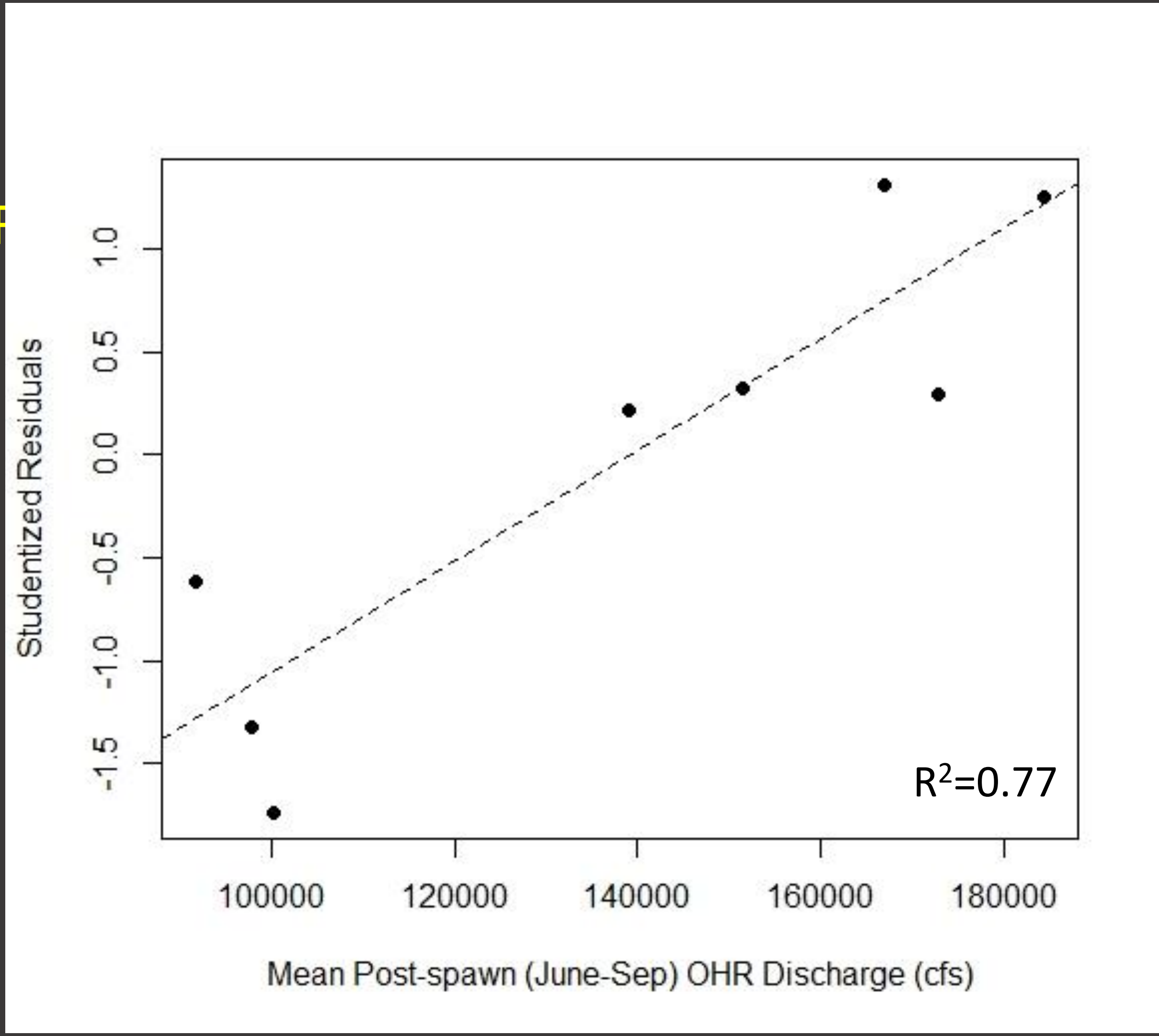
$$\sum_{i=1}^{n}\left(y_i - \beta_0 - \sum_{j=1}^{p}\beta_j x_{ij}\right)^2 + \lambda\sum_{j=1}^{p}|\beta_j| = \text{RSS} + \lambda\sum_{j=1}^{p}|\beta_j|$$

BLC LASSO Regression

- Optimum λ obtained through cross validation: 0.927
- Final Model:
  - **Studentized Residuals = -0.236 + 0.00000147(Ohio Discharge Post-Spawn)**
  - MSE=1.20
- Eliminated all variables but Ohio River Discharge Post Spawn

BLC Simple Linear Regression

- Model:
  - Studentized R... Post Spawn)
    - $F_{1,6} = 24.65$
    - $p = 0.003$

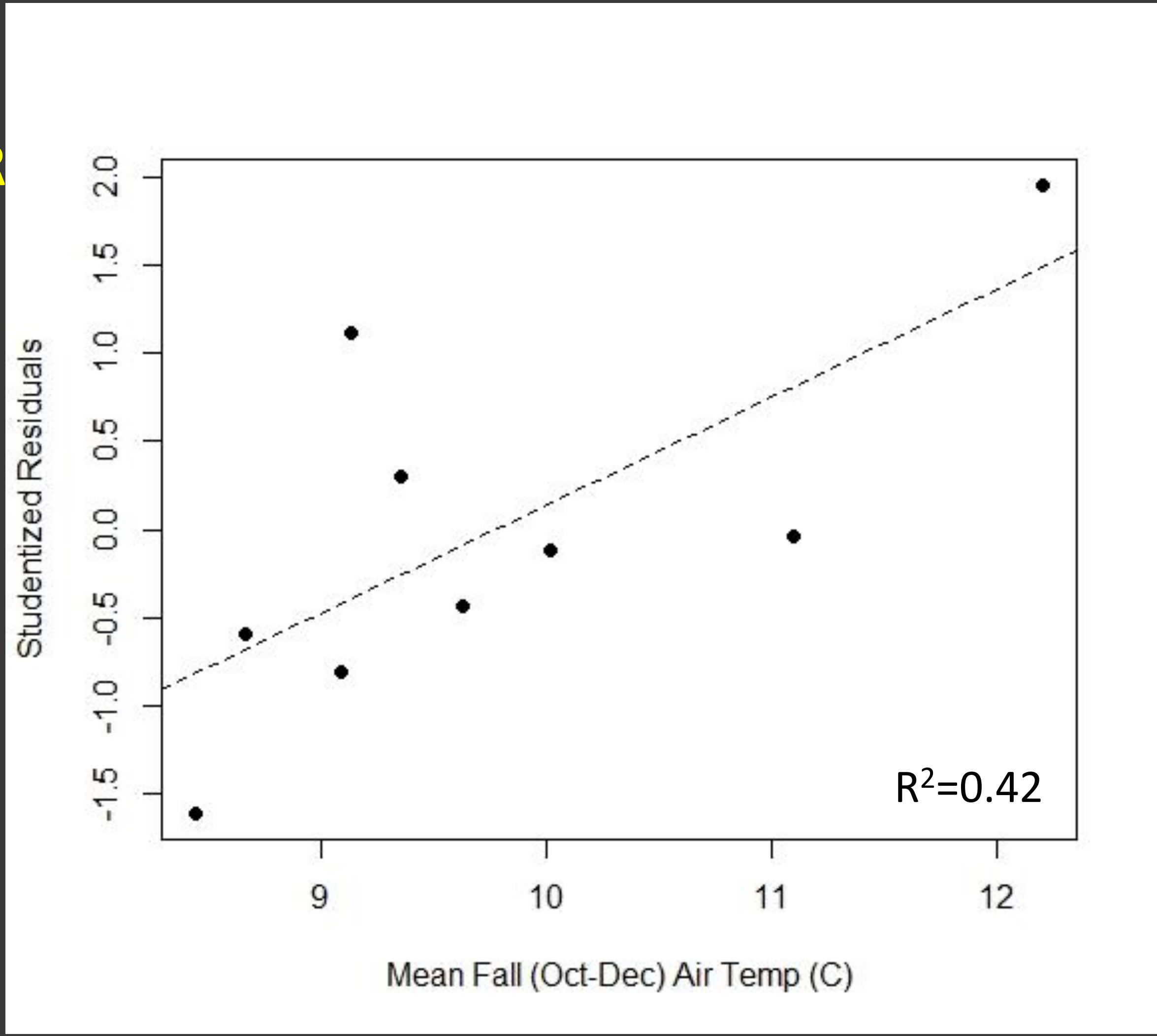


WHC LASSO Regression

- Optimum λ obtained through cross validation: 0.661
- Final Model:
  - **Studentized Residuals = --0.408 + 0.0391(Fall Air Temperature)**
  - MSE=1.74
- Eliminated all variables but Fall Air Temperature

WHC Simple Linear Regression

- Model:
  - Studentized R
  - t Spawn)
    - $F_{1,7} = 6.903$
    - $p = 0.034$



Discussion

- BLC: Ohio River Discharge Post Spawn
  - Strong Ohio River influence on tributaries
  - Flood control vs “natural” flooding pattern

- WHC: Fall Air Temperature
  - Increased growth opportunity
    - Scheller et al 1999

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Questions

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