Incorporating Chlorophyll-a Levels Into a Model of Gizzard Shad (*Dorosoma cepedianum*) in the Mississippi River

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Introduction

Gizzard Shad, *Dorosoma cepedianum*, are native fish in the United States.

- Consume phytoplankton, zooplankton, and detritus[1]
- Phytoplankton and zooplankton are higher quality food than detritus[2]
- Phytoplankton → Zooplankton → Age-0 Gizzard Shad
- Use chlorophyll-a as an estimate of phytoplankton abundance

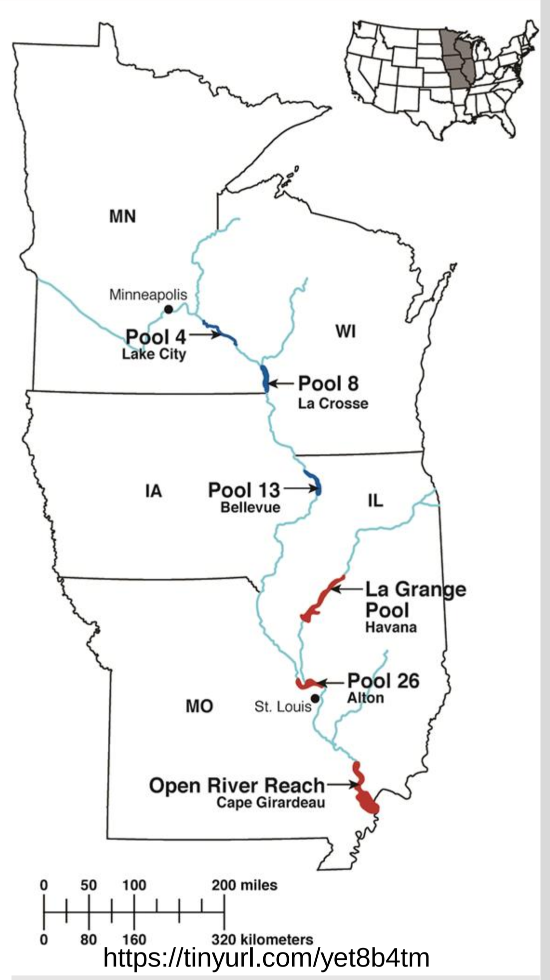


Figure 1: Map of Upper Mississippi River Pools

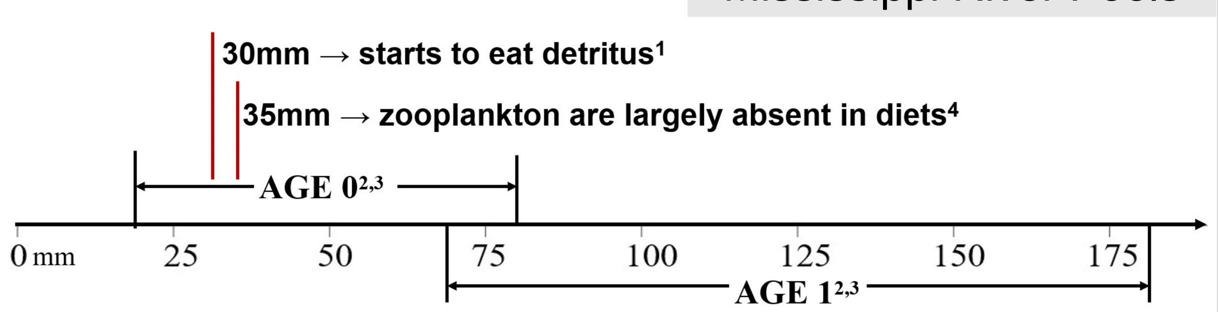


Figure 2: Age-Length Range and Diet

Objectives

1) Incorporate the consumption of phytoplankton at age-0 into a model for gizzard shad.
2) How do chlorophyll-a levels influence the remainder of the fish population?

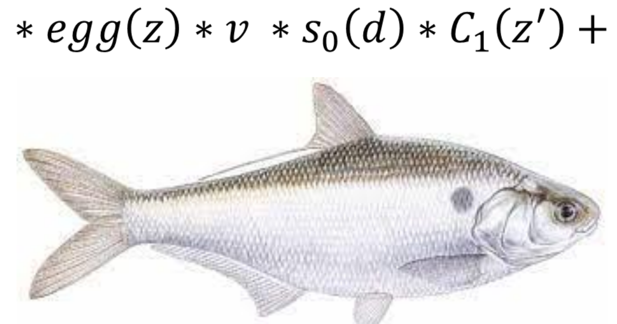
Model Equation

Life-history traits summarize by length dependence

$$n(z',t+1) = \int_L^U K(z',z) * n(z,t)dz$$

With $K(z',z)$ as:

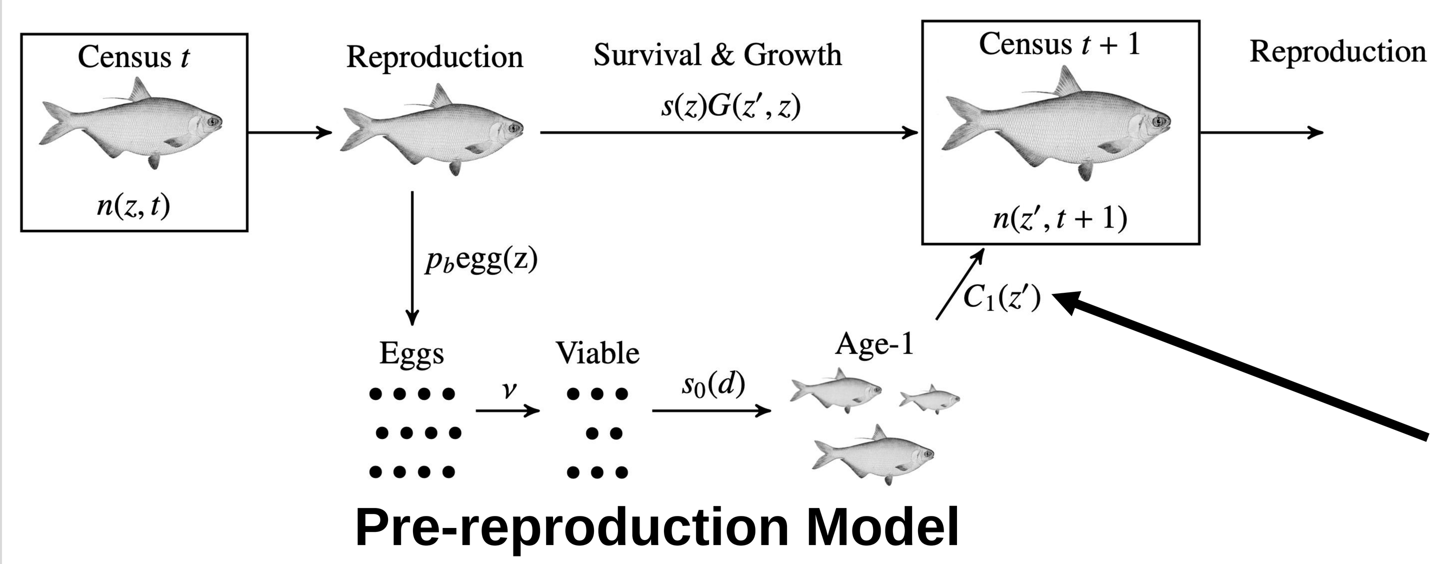
$$K(z',z) = p_b * egg(z) * v * s_0(d) * C_1(z') + S(z) * G(z',z)$$



https://tpwd.texas.gov/huntwild/wild/species/gsh/

Figure 3: *D. cepedianum*

Integral Projection Model



Length dependent parameters
- Egg production: p_b *eggs(z)
- Survival: $s(z)$

Density dependent parameters
- Survival age 0: $s_0(d)$

Chlorophyll-a dependent parameters
- Age-1 length distribution: $C_1(z')$

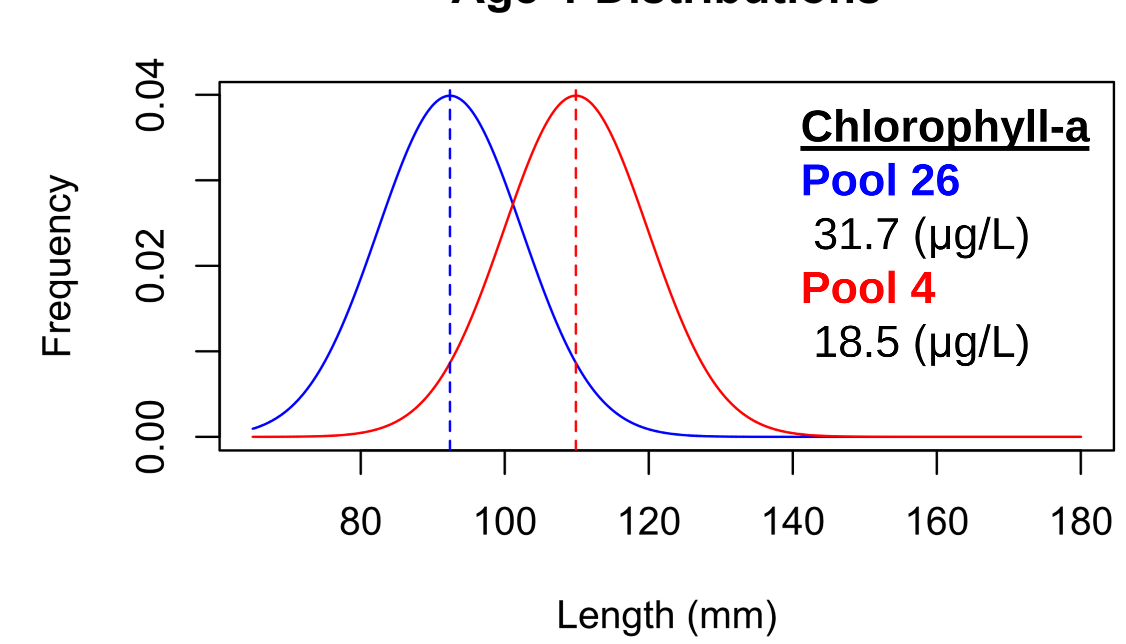
Results

Assuming a linear relationship between mean length of age-1 and chlorophyll-a levels

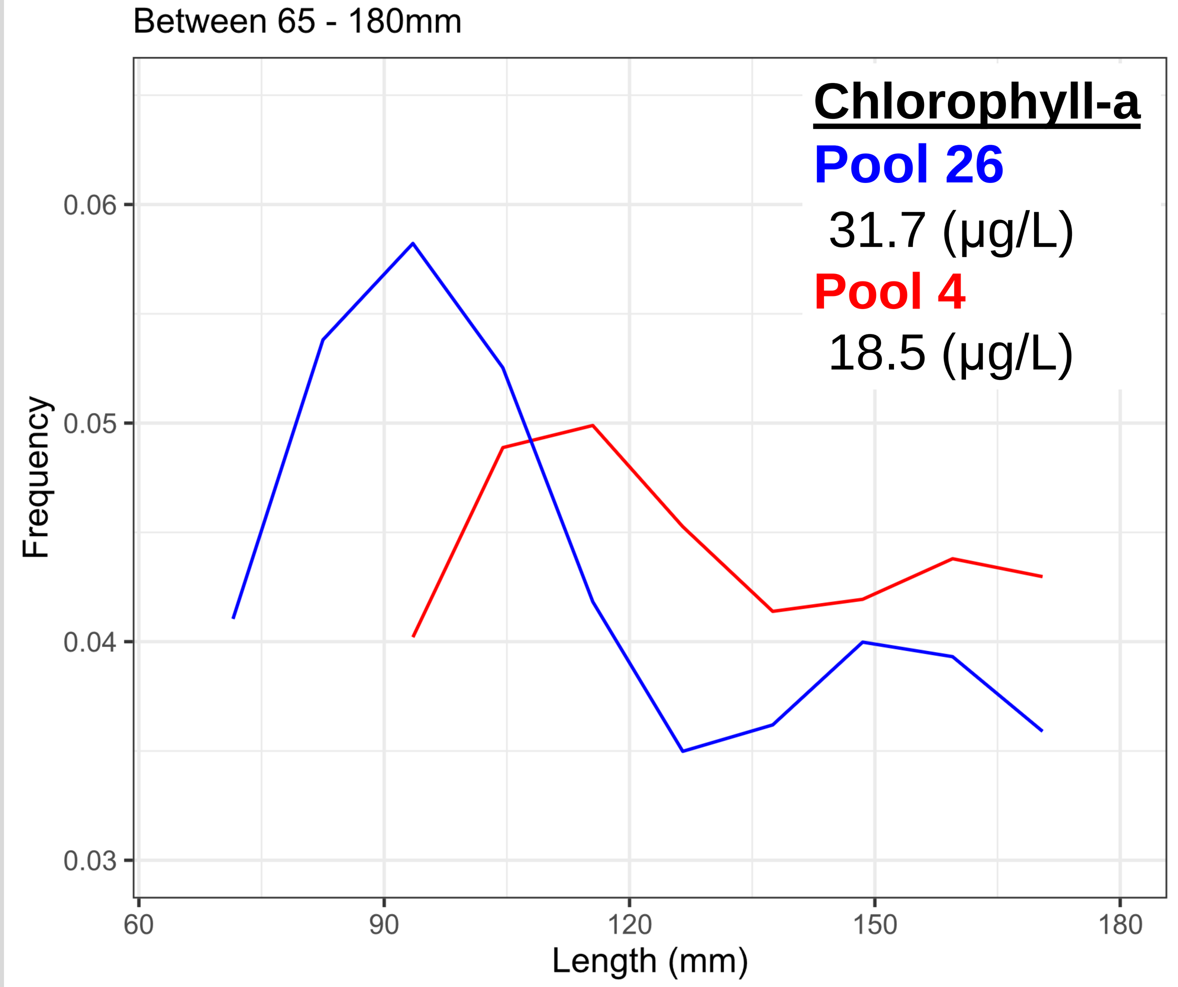
Table 1: Chlorophyll-a levels and mean age-1 length in pools 4 and 26

	Pool 4	Pool 26
Chlorophyll-a level	18.5 (µg/L)	31.7 (µg/L)
Mean Age-1 Length	109.88 mm	92.39 mm

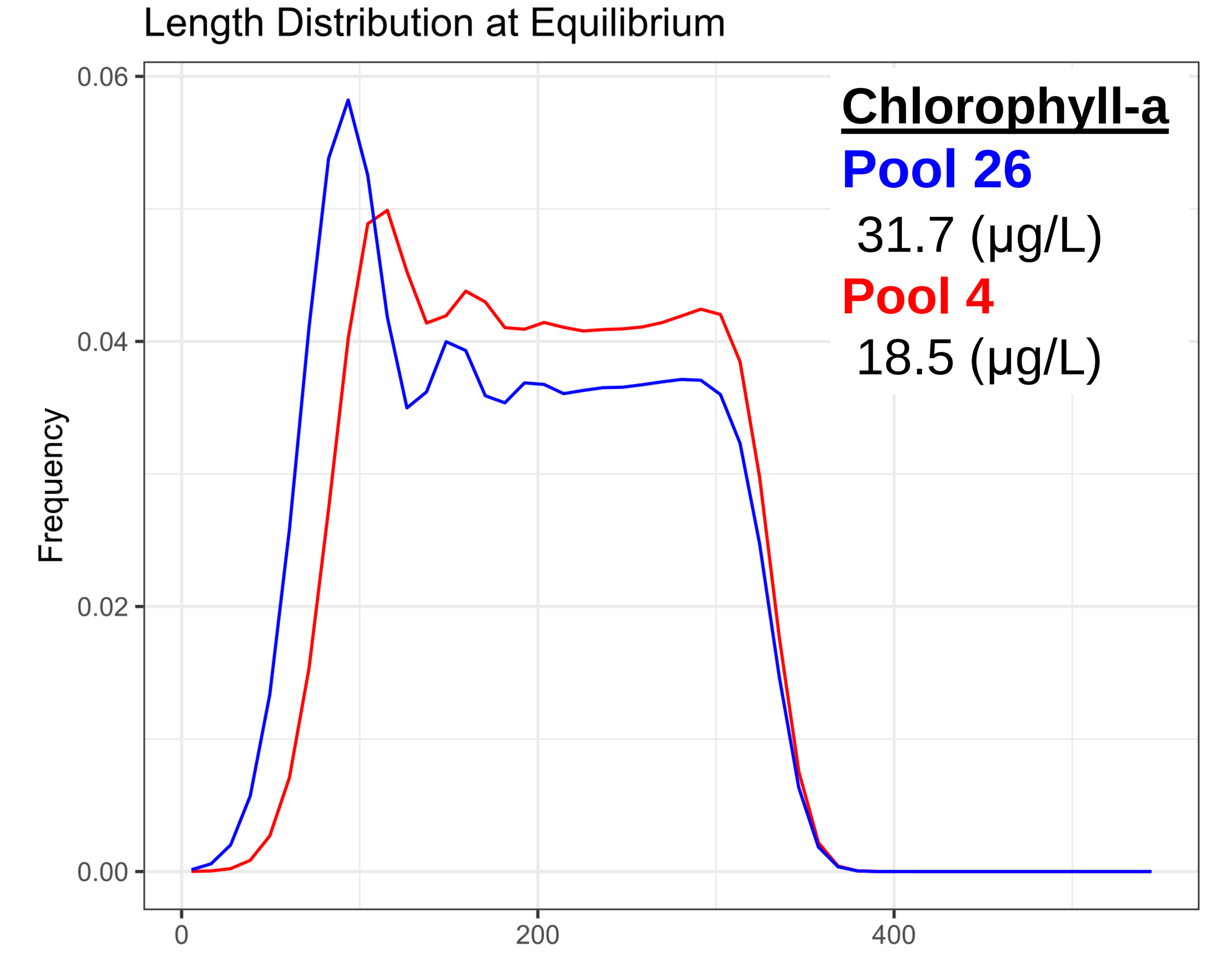
Age-1 Distributions



Length Distribution at Equilibrium
Between 65 - 180mm

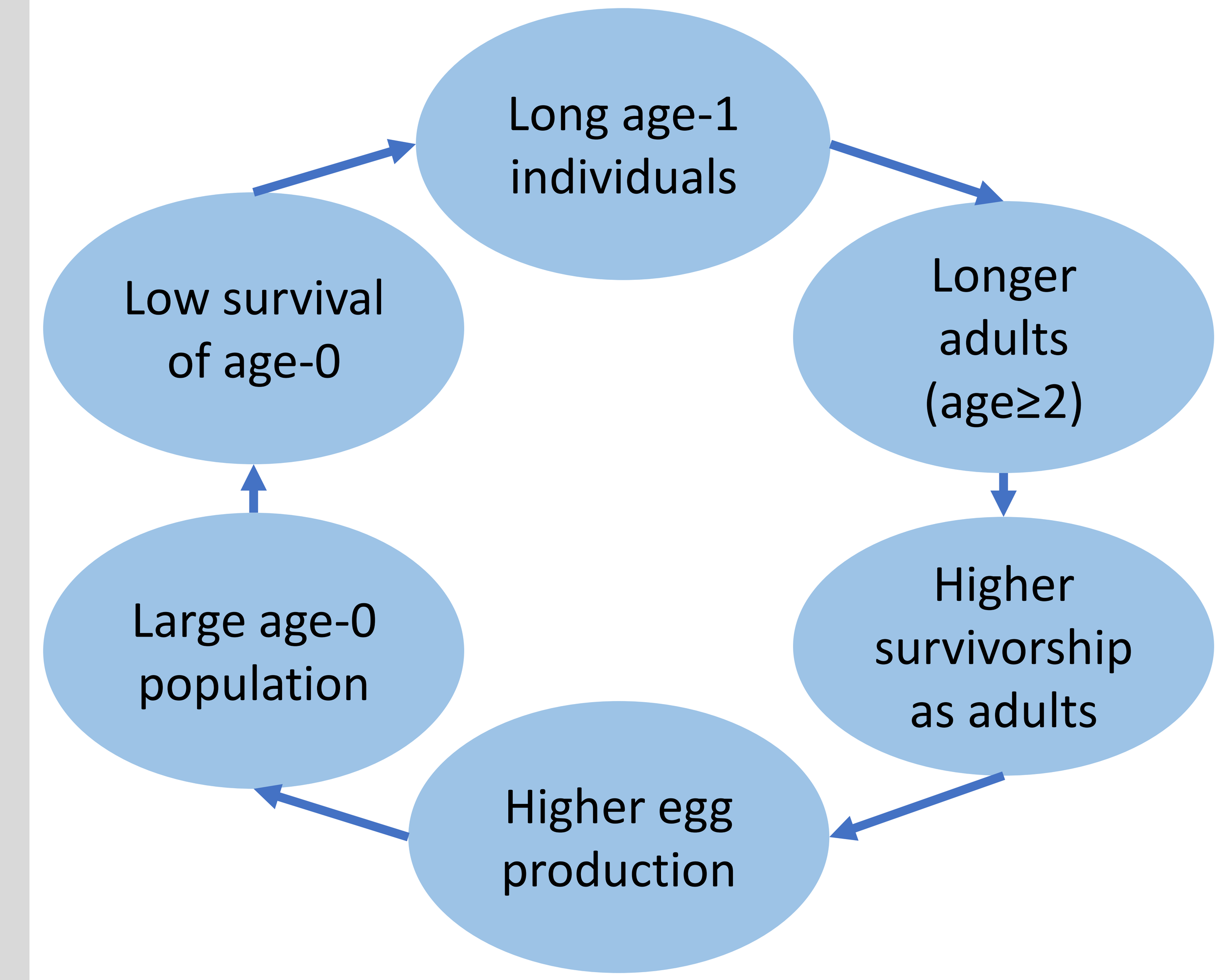


Length Distribution at Equilibrium



Discussion

Chlorophyll-a levels are inversely associated with age-1 mean
In a low chlorophyll-a pool:



- Trade-off between length and density of age-1
- Pools with low chlorophyll-a levels may imply higher competition
- Patchy distribution of zooplankton may explain age-0 length distribution patterns

Future work should employ statistical methods to compare models across pools in Upper Mississippi River and other locations!

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