

Predator-Prey Model for Largemouth Bass and Channel Catfish

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Introduction

Largemouth Bass and Channel Catfish are among the most common sport fish in Texas. We model these fish via differential equations and evolve this model to try to solve some unanswered questions about the interactions of these species.

Assumptions

- Similar Sizes of Fish
- Constant Water Level
- $\frac{1}{2}$ Acre Pond ~ 15 ft depth
- Ample Amount of Insects
- No Predators
- Natural Mortality
- Quality of Water is Sufficient

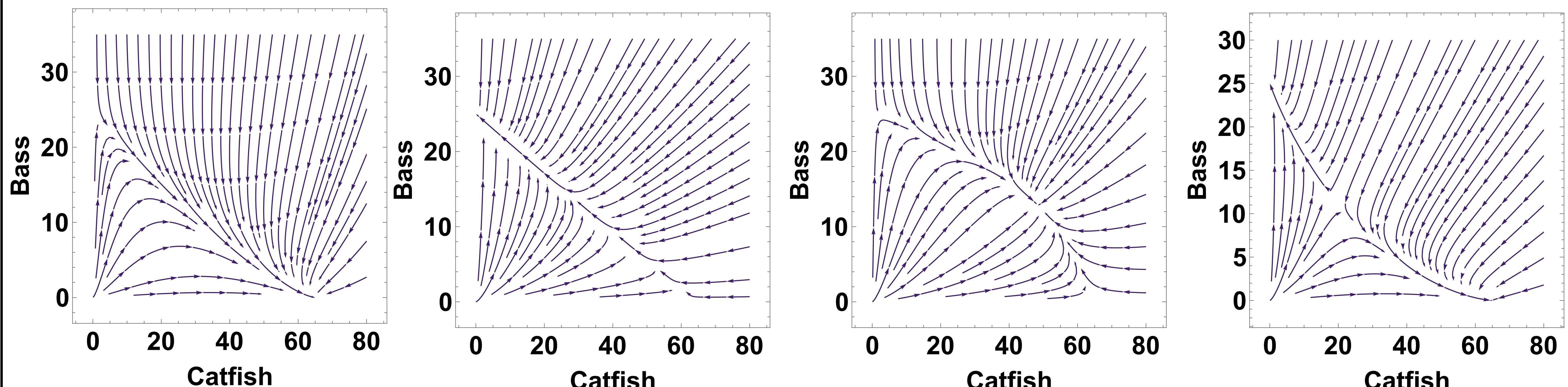
Lotka-Volterra Competition

$$\text{Catfish}' = Cg_1 \left(1 - \frac{C}{k_1}\right) - f_1 CB$$

$$\text{Bass}' = Bg_2 \left(1 - \frac{B}{k_2}\right) - f_2 CB$$

Variable	Description	Parameter
g_i	Annual growth of fish	$\approx .7\text{lbs Bass per year}$ $\approx .5\text{lbs Catfish per year}$
k_i	Carrying Capacity ~ Biomass	$\approx 25\text{lbs Bass}$ $\approx 65\text{lbs Catfish}$
f_i	Competition Factor	Varies

Situation Direction Fields



Equilibrium

(C , B)	Stability Conditions
(0 , 0)	Never
(k_1 , 0)	$f_2 > \frac{g_2}{k_1}$
(0 , k_2)	$f_1 > \frac{g_1}{k_2}$
$\left(\frac{g_2 k_1 (g_1 - f_1 k_2)}{g_1 g_2 - f_1 f_2 k_1 k_2}, \frac{g_1 (g_2 - f_2 k_1) k_2}{g_1 g_2 - f_1 f_2 k_1 k_2} \right)$	$0 < f_2 \leq \frac{g_1}{k_1} \& (0 < f_1 < \frac{g_1}{k_2} f_1 > \frac{g_1 + g_2 - f_2 k_1}{k_2})$ $> \frac{g_1 g_2}{f_2 k_1 k_2} \& \frac{g_1}{k_1} < f_2 < \frac{g_2}{k_1} \&$ $(0 < f_1 < \frac{g_1}{k_2} f_1 > \frac{g_1 + g_2 - f_2 k_1}{k_2})$

Conclusions

- If competition is within these specific intervals the species will co-exist
- Further research concluded that for a $\frac{1}{2}$ -acre pond, one should expect similar results
- Many variables impact these species that are not included in this model.



Largemouth Bass (*Micropterus salmoides*)

Future Works

- Include optimal feeding rates in relation to deadly loss of oxygen levels.
- Water quality effects on growth and competition
- Implement tournament and/or production harvest rates



Channel Catfish (*Ictalurus punctatus*)