Yellow Perch Population Dynamics and Simulation Modeling in the Upper Mississippi River

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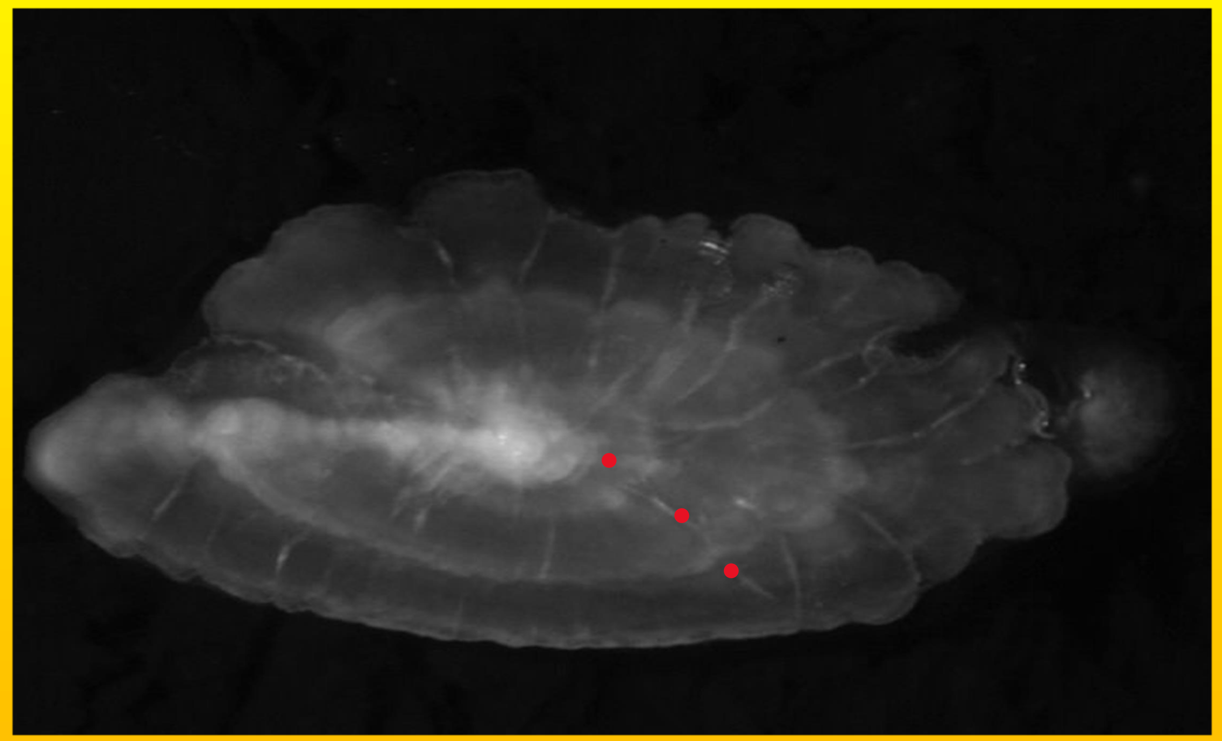
Introduction

The Upper Mississippi River (UMR) supports diverse recreational fisheries. Yellow Perch *Perca flavescens* are found across the UMR and represent an economically and recreationally important species. Throughout the UMR, Yellow Perch are exploited by recreational anglers year-round. Exploited fisheries need proper management to conserve and protect populations. Traditionally, fisheries are managed by quantifying population dynamics (i.e., recruitment, growth, mortality). Few studies have evaluated Yellow Perch population dynamics throughout the UMR. As such, we sought to quantify Yellow Perch population dynamics across three pools in the UMR (i.e. Pool 13, Pool 8, Pool 4).

(Wisconsin DNR)



Methods

Yellow Perch were collected via daytime electrofishing carried out by United States Army Corps of Engineers' Long-Term Resource Monitoring (LTRM) element in Pools 4, 8, 13 of the Mississippi River (Ratcliff et al. 2014). The LTRM uses a stratified random sampling design across all available river habitats (Ratcliff et al. 2014). Fish were transported and processed at Missouri State University. Sagittal otoliths were aged either whole view (<3 yrs) or across a transverse plane (>3yrs) using a low power microscope (Buckmeier and Howells 2003). Natural mortality was estimated using an average of various estimators (e.g., Hoenig method). Weight-length regressions and von Bertalanaffy parameters were used to generate Beverton-Holt yield per recruit models (Ricker 1975). All models were developed using 150mm as minimum vulnerable length as this size likely represents recruitment to the population (e.g., viable member of the population).

Results

Figure 1: A total of 527 fish were sampled throughout the upper three pools. Lengths of fish ranged from 37mm to 333mm and ages ranged from 1 to 6 years old. Length-Weight Regressions were modeled for each pool using the equation:

$W = aL^b$

where *a* and *b* are coefficients, W = weight, and L = length.

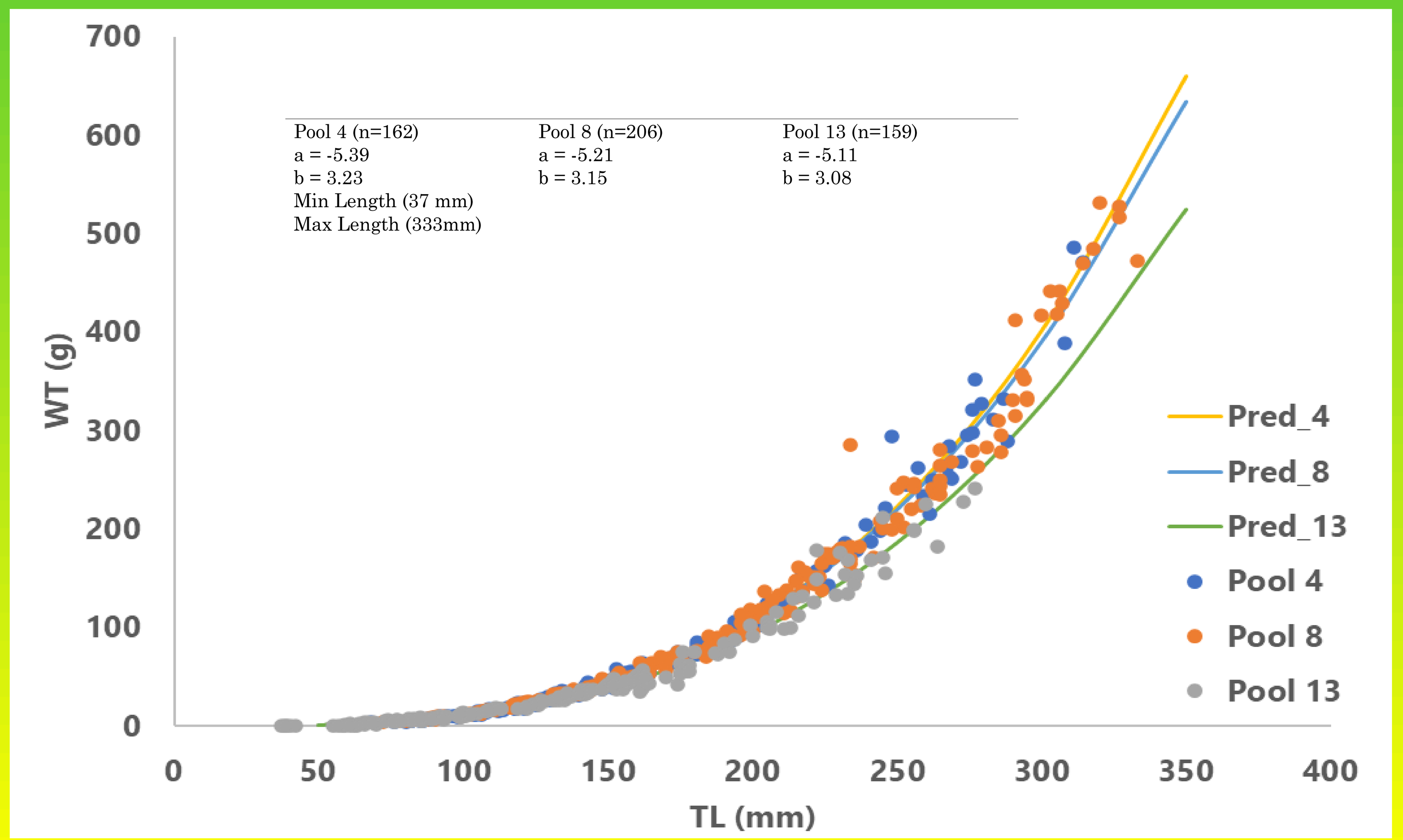
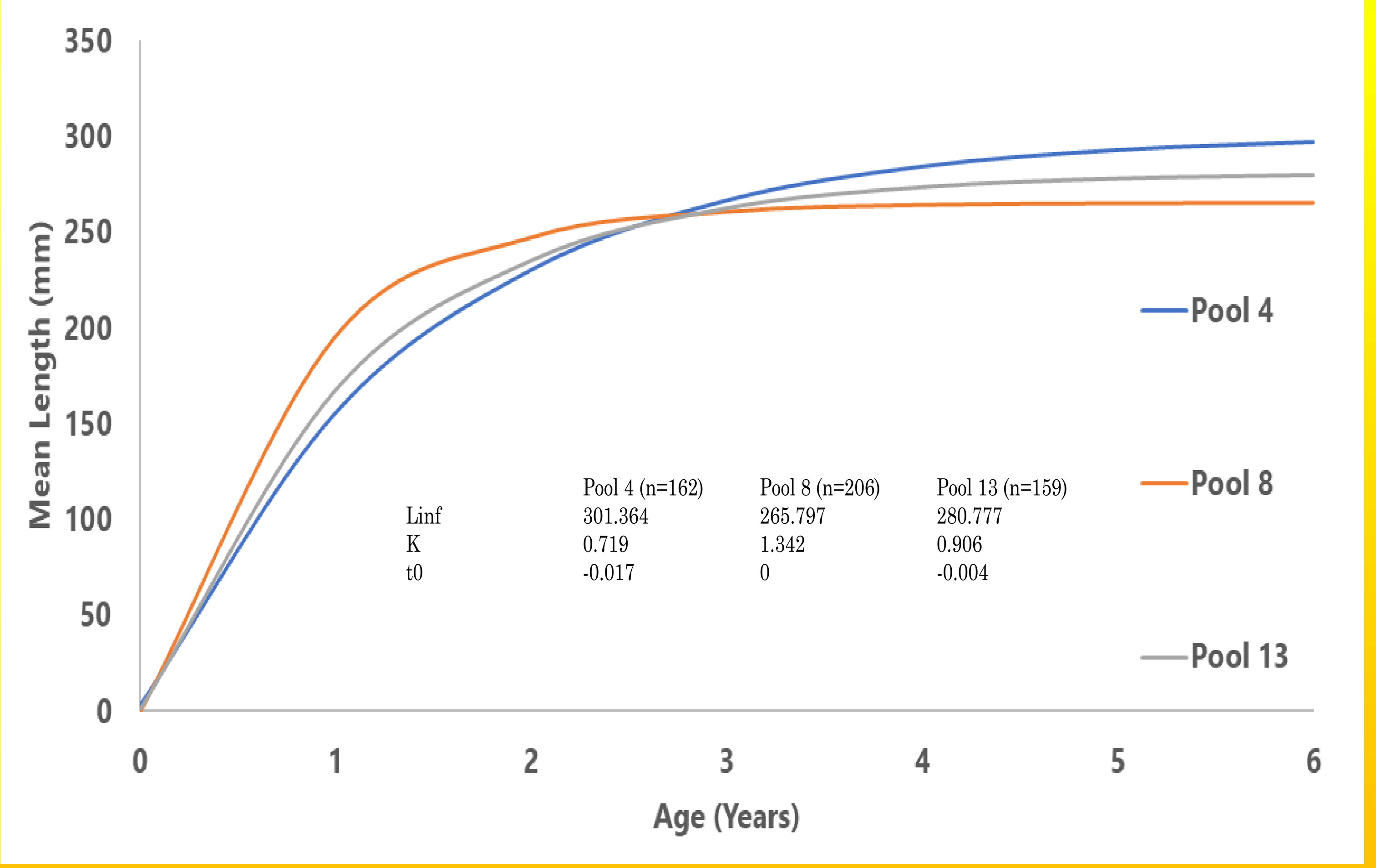


Figure 2. – Growth was modeled using the von Bertalanaffy equation as

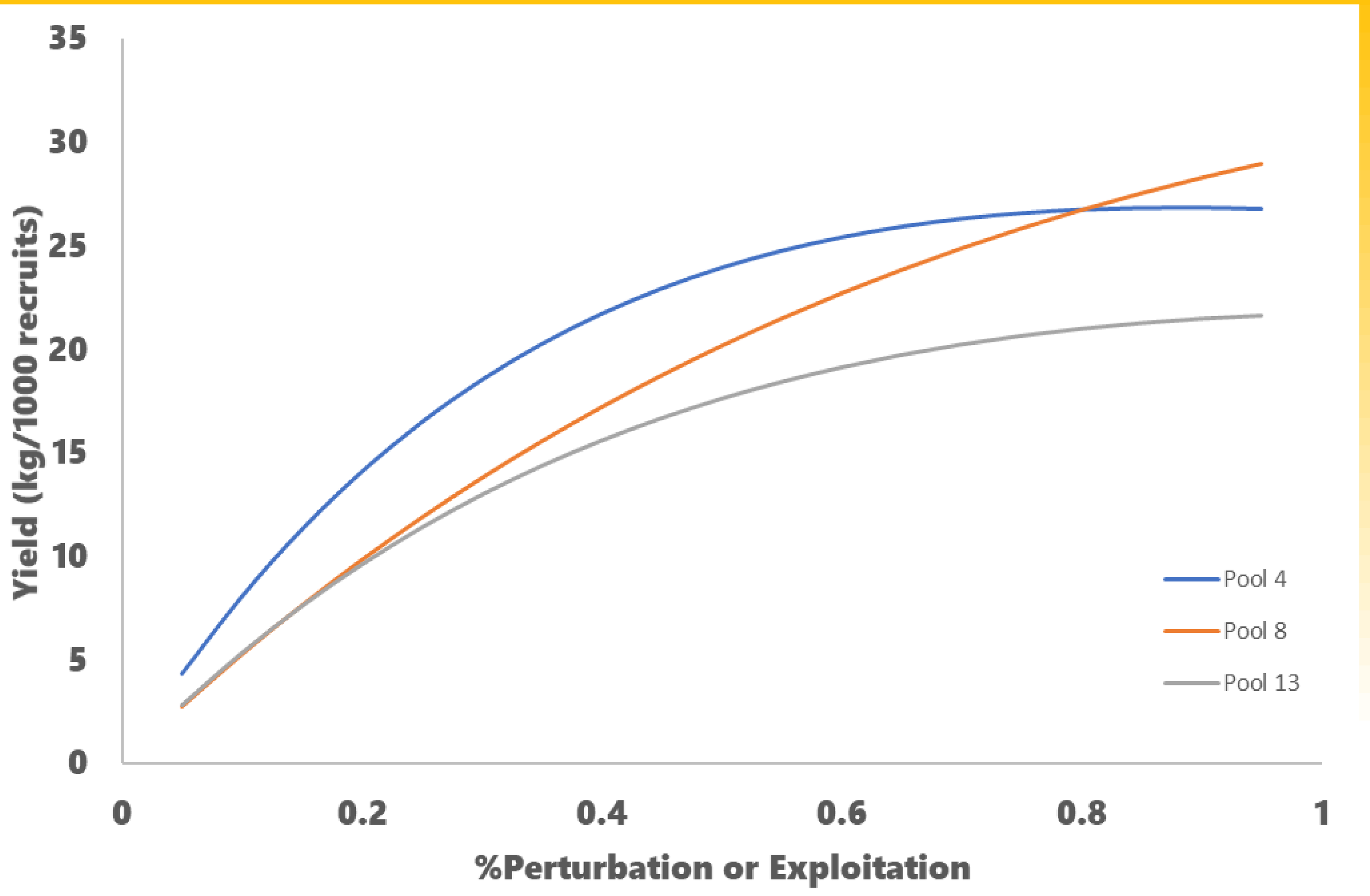
$$L_T = L_\infty\left(1 - e^{-k(t-t_0)}\right)$$

Where, L_∞ = maximum theoretical length that can be obtained, k = Brody growth coefficient, t = time or age in years, and t_0 = is the time in years when length would theoretically equal zero.



	Pool 4 (n=162)	Pool 8 (n=206)	Pool 13 (n=159)
Linf	301.364	265.797	280.777
K	0.719	1.342	0.906
t0	-0.017	0	-0.004

Beverton-Holt yield per recruit models developed using weight-length (Figure 1) and von Bertalanaffy (Figure 2) parameters. Natural mortality estimations varied across pools 4, 8, and 13 and was estimated at 56%, 70%, and 61%, respectively. Maximum age was held constant at 6 years for all models.



Discussion

Yellow Perch in the UMR grew relatively quickly and exhibited relatively high natural mortality rates. Fish exhibiting these characteristics (i.e., live fast and die young) are generally more resilient to exploitation or other perturbations (e.g., habitat modification). Our yield models suggests UMR Yellow Perch growth potential would not decrease (i.e., growth overfishing) across all levels of perturbations or exploitation. Upper Mississippi River Yellow Perch appear to be relatively resilient to exploitation or other perturbations. Our results provide insights into regulating Yellow Perch harvest throughout the UMR. Further, our results provide a biological benchmark for future comparisons. Population dynamics often directly reflect various abiotic and biotic changes to the river ecosystem. Yellow Perch exhibit characteristics of a good bio-indicator (e.g., relatively short regeneration time). As a fast-growing, short-lived, resilient species, demographic changes can inform abiotic and biotic changes to the UMR.

References

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