Title
Modeling time-varying growth using a generalized von Bertalanffy model with application to bloater (*Coregonus hoyi*) growth dynamics in Lake Michigan

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Abstract
A concurrent increase in lakewide abundance and decrease in size-at-age of bloater (*Coregnus hoyi*) in Lake Michigan have suggested density-dependent growth regulation. We investigated these temporal patterns by fitting a dynamic von Bertalanffy model and length-weight relationship with time-varying parameters to mean length- and weight-at-ages (ages 1-7) from annual surveys (1965-1999). We modeled yearling length, asymptotic size ($L_\infty$), and the parameters of a power relationship between mean weight and mean length ($\alpha$ and $\beta$) as changing slowly over time using a random walk model. The Brody growth coefficient ($k$) was modeled as a linear function $L_\infty$ and $k$, indicated that under conditions supporting larger asymptotic lengths, individuals approach the asymptote more rapidly. We explored the relationship between year-specific growth parameters and indices of lakewide bloater abundance found evidence of density-dependent growth. However, in the most recent years $L_\infty$ and yearling length have remained low in Lake Michigan despite bloater abundances, suggesting the occurrence of a fundamental shift in the food web.

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