Summing the parts: Improving population estimates using a state-space multispecies production model

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# Introduction

# Methods

## Model formulation

Trends in fish populations have frequently been described using biomass dynamic models of the form

where is biomass at the start of year , is the catch through year , and changes in biomass due to growth, recruitment, and natural mortality are captured via the production function ([1](#ref-polacheck1993)). An early and influential form for the production function was based on the logistic equation,

where is the maximum per-capita rate of change, and is the carrying capacity ([2](#ref-schaefer1954)). That is, a populations’ intrinsic ability to grow () is limited by the size of the current population relative to the maximum biomass the system can support ().

Combining equations (1) and (2) results in the Schaefer production model and, by applying a state-space framework (sensu [3](#ref-meyer1999)), the stochastic form of this population process may be informed by survey data with observation error. Specifically,

where represents process error, represents observation error, is an index of relative abundance in year from survey , and is the time-invariant catchability coefficient for survey .

# Results

# Discussion

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# References

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# Figures