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# Highlights

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Same data different story: guidelines for data weighting in a multispecies statistical catch-at-age stock assessment framework

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# Abstract

Multispecies stock assessment frameworks that use standard statistical tools and are fit to the same data as their single-species counterparts are rapidly developing and may signify the path of least resistance towards an ecosystem approach to fisheries management. Nevertheless, the transition from a single-species to a multispecies framework faces many obstacles including but not limited to: (a) increased data requirements, (b) increased uncertainty, (c) decreased transparency, and (d) the inability to generate traditional management reference points. Monte Carlo simulations were used to quantify the effect of changing pre-specified weightings of compositional data on parameter estimates within a multispecies statistical catch-at-age stock assessment framework. The multispecies model was fit to diet-compositions, which are often numerous and highly variable, as well as traditional length- and age-compositions. Weighting of diet-compositions, used to calculate relationships between predators and their prey, can magnify changes in parameter estimates compared to outcomes from weighting traditional length- and age-compositions. Adjusting weights had the largest impact on estimates of recruitment. Results should be of interest to both stock assessment scientists and fisheries managers given that biased estimates of recruitment can lead to ill-informed management reference points.

# Keywords

data weighting; multispecies; stock assessment

# Introduction

Information from several data sets is often used to draw inferences about parameters which characterize the biology of commercially harvested species. For example, catch, effort, age- or length-compositions, and indices of abundance are common sources of data used as input for integrated statistical catch-at-age stock assessment frameworks (e.g., Fournier and Archibald, 1982; Deriso et al., 1985; Methot and Wetzel, 2013). Integrated analysis (IA), combining more than one source of information into a single analysis, facilitates the inclusion of all available information and the propagation of uncertainty into model results.

IA alleviates some problems but introduces questions regarding variance estimation, model misspecification, and how to appropriately weight each data set (Stefansson, 2003; Francis, 2011; Maunder and Punt, 2013). If data sets are consistent, weighting factors, sampling standard deviations or effective sample sizes, should have little effect on model results (citation). When data sets are contradictory, the estimation process may be disproportionately influenced by one data source over another because doing so leads to a lower likelihood function and not necessarily because one data set is more ‘correct’ than the other (citation).

Methods (McAllister and Ianelli, 1997).

The effects are not limited to complicated models and can be found in simple single-species models (e.g., differentially weighting survey age groups led to changes in abundance trends (Stefansson, 1998)). However, as the number of species included in the stock assessment model increases, the number of data sets tends to increase in a non-linear fashion, thus increasing the probability for contradictory parameter estimates should one data set be believed to be more ‘correct’ than another.

Mandates for the implementation of ecosystem based fisheries management (EBFM) are increasing and consequently the parameterization of multispecies models is also increasing. Therefore, performance metrics of statistically based objective methods that facilitate the inclusion of all data sets are needed. Monte Carlo simulations were used to investigate the effect of differential weightings among data sets in a statistical catch-at-age multispecies stock assessment framework (Kinzey and Punt, 2009). To increase the applicability of results to management, simulations were based on available data from three commercial fish species in the Aleutian Islands, Alaska: walleye Pollock (*Theragra chalcogramma*), Atka mackeral (*Pleurogrammus monopterygius*), and Pacific cod (*Gadus microcephalus*).

# Methods

Models were fit to diet data as well as data typically used in single-species stock assessments.

# Results

Results go here …

# Discussion

Discussion goes here …

Appropriateness of multinomial (citation).

# Acknowledgements

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# Tables

# Figures