Accounting for temporal and individual variation in the estimation of Von Bertalanffy growth curves

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Abstract

Growth and growth limitation are important indicators of density dependence and environmental limitation of populations. Estimating individual growth trajectories is therefore an important aspect of understanding and predicting the life history and dynamics of a population. Variation in individual growth trajectories arises due to variation in the environmental factors limiting individual growth. This environmental limitation can vary over time, between cohorts and between individuals within a cohort. For a complete and accurate understanding of individual growth in a population, it is important to include all these sources of variation. So far, statistical models only accounted for a subset of these factors or required an extensive growth history of individuals. Here we present a novel model describing the growth curves of cohorts in a population. This model is derived from a stochastic form of the Von Bertalanffy growth equation describing individual growth. The model is specifically tailored for use on length-at-age data in which the growth trajectory of an individual is unknown and every individual is only measured once. The presented method can also be used if growth limitation differs strongly between age or length classes. We demonstrate the use of the model for length-at-age data of North Sea plaice (Pleuronectes platessa) from the last thirty years. Fitting this model to length-at-age data can provide new insights in the dynamics of the environmental factors limiting individual growth and provides a useful tool for ecological research and management.

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