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Editorial

Recovery of Bioenergetics Parameters From Field Growth Data

Bioenergetics modeling is becoming increasingly important in fisheries studies. Given growth data, bioenergetics models are used to back calculate probable food consumption rates, and such rates are critical for predictions about the impact of fisheries on food web (predator-prey) interactions and ecosystem function. Given parameters for variation in growth rate with body size, food availability, and temperature, bioenergetics models are used to predict changes in growth that may accompany changes in temperature regimes with climate change.

Bioenergetics parameter values needed for such calculations have typically been estimated from laboratory data, and there has been much suspicion about whether laboratory measurements are good predictors of parameter values exhibited by fish under field conditions. There is a clear need for methods to estimate parameter values in so far as possible directly from field data.

This supplement introduces and provides examples of one approach for estimating at least some key bioenergetics parameters for size and temperature dependence of feeding and metabolic rates, directly from field data on growth from tagging studies and size at age. The approach is based on generating predicted growth patterns from a compressed version of the well-known Wisconsin bioenergetics model, and estimating parameters of the compressed model using maximum likelihood methods. The likelihood framework helps to evaluate which bioenergetics parameters cannot be estimated directly from the field data, because of confounding of effects or inadequate contrast in field conditions, so as to allow development of models that make only minimum required use of laboratory data.

The approach has been used on data from a wide variety of North American freshwater fish species, mainly as part of graduate research programs by colleagues at the Universities of British Columbia and Florida. The six case study papers in this supplement demonstrate that the approach gives reasonable parameter estimates, sometimes even avoiding known tendency to upward bias in feeding rate estimates from detailed bioenergetics models. These papers also demonstrate that the approach can help provide insights about bioenergetic consequences of factors ranging from ontogenetic habitat shifts to spatial variation in prey size distributions. None of the case studies provides an unequivocal demonstration that bioenergetics parameters can be estimated from field data without using any laboratory information, particularly about effects of temperature on metabolism and maximum feeding rate. But they do offer promise that severe departures from laboratory based assumptions, particularly about relationships involving variation in feeding rate with body size and temperature, can be detected in field tagging and growth data.

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