What is the carrying capacity for fish in the ocean? A meta analysis of population dynamics of North Atlantic cod

Population and community data in one study are usually analyzed in isolation from other data. Here, we introduce statistical methods that allow many data sets to be analyzed simultaneously such that different studies may "borrow strength" from each other. In the simplest case, we simultaneously model 21 Atlantic cod (Gadus morhua) stocks in the North Atlantic assuming that the maximum reproductive rate and the carrying capacity per unit area are random variables. This method uses a nonlinear mixed model and is a natural approach to investigate how carrying capacity varies among populations. We used empirical Bayes techniques to estimate the maximum reproductive rate and carrying capacity of each stock. In all cases, the empirical Bayes estimates were biologically reasonable, whereas a stock by stock analysis occasionally yielded nonsensical parameter estimates (e.g., infinite values). Our analysis showed that the carrying capacity per unit area varied by more than 20-fold among populations and that much of this variation was related to temperature. That is, the carrying capacity per square kilometre declines as temperature increases.

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