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FITTING PREDATOR–PREY MODELS TO TIME SERIES WITH OBSERVATION ERRORS[1]

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Abstract. Fits of nonlinear difference equations to time series with observation errors were examined by stochastic simulation and analysis of plankton time series from two lakes. Even modest observation errors (e.g., coefficient of variation among replicate samples $\approx 10\%$) cause errors in model identification and bias in parameter estimates. The latter problem can be corrected by estimation techniques that account for observation error, but model identification is difficult unless the state variables are manipulated. Without manipulation, statistical criteria tend to favor linear models, even when data are simulated by nonlinear processes. Methods that account for observation error produced satisfactory fits to time series of edible algae from two lakes over 7 yr. In Paul Lake, which has not been manipulated, the best fitting model included linear growth, a linear functional response for grazing loss, and an autoregressive moving average model for the errors. In manipulated Tuesday Lake, the best fitting model included linear growth and a nonlinear functional response. Experimental manipulations, or other substantial perturbations, may be essential for detection of nonlinearities in ecological interactions.

Key words: difference equations; ecosystem experiments; error in variables; lakes; plankton; predator–prey models; time series.