

RANDOMIZED INTERVENTION ANALYSIS AND THE INTERPRETATION OF WHOLE-ECOSYSTEM EXPERIMENTS¹

STEPHEN R. CARPENTER, THOMAS M. FROST, DENNIS HEISEY, AND
TIMOTHY K. KRATZ

Center for Limnology, University of Wisconsin, Madison, Wisconsin 53706 USA

Abstract. Randomized intervention analysis (RIA) is used to detect changes in a manipulated ecosystem relative to an undisturbed reference system. It requires paired time series of data from both ecosystems before and after manipulation. RIA is not affected by non-normal errors in data. Monte Carlo simulation indicated that, even when serial autocorrelation was substantial, the true P value (i.e., from nonautocorrelated data) was $<.05$ when the P value from autocorrelated data was $<.01$. We applied RIA to data from 12 lakes (3 manipulated and 9 reference ecosystems) over 3 yr. RIA consistently indicated changes after major manipulations and only rarely indicated changes in ecosystems that were not manipulated. Less than 3% of the data sets we analyzed had equivocal results because of serial autocorrelation. RIA appears to be a reliable method for determining whether a nonrandom change has occurred in a manipulated ecosystem. Ecological arguments must be combined with statistical evidence to determine whether the changes demonstrated by RIA can be attributed to a specific ecosystem manipulation.

Key words: ecosystem; experiment; intervention analysis; lake; manipulation; randomization tests; replication; statistics.