# Granger causality: a tool to explain causal links between ecosystem components?

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**Abstract**

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The concept of Granger causality, born in econometrics, is tied to time series modelling. A time series y is said to Granger-cause x if inclusion of y in an autoregressive model for x improves prediction. This practical notion of causality is not often used in ecology, despite more and more widespread use of multivariate autoregressive models that have strong ties to Granger causality. Sugihara and colleagues [Science, 338(6106), 496-500] showed, using coupled dynamic population models, that Granger causality may not always be the appropriate criterion for a number of ecological systems and that ecologists should favour more complex mathematical frameworks to infer causality between different components of an ecosystem. We revisit this question using a simulation approach. Autoregressive models are fitted to the outputs of stochastic predator-prey and competition models submitted to environmental variability, which allows us to evaluate in which scenarios causality is recovered (i.e., competition or predation between species). Granger causality seems to provide meaningful answers in a number of cases, and thus might help to pinpoint likely interaction networks using long-term monitoring data. We further explore the relationship between Granger causality and current autoregressive modelling of food webs and competitive networks in ecology.

**Keywords:** population dynamics, statistics, autoregressive models, interactions, climate

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