

**A likelihood method for determining joint time in multiple variables:  
application to deep-water species**

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A new method for simultaneously comparing time trends in multiple variables, such as ecosystem indicators or indices of population abundance is presented. The method allows to determine the evidence in the data for a given joint time trend scenario, e.g. whether population trends are the same in different areas. The time trends are defined in qualitative terms as increasing, stable or decreasing. Generalised additive models fitted under monotonicity constraints are used to calculate the likelihood of a given time trend for each variable. The likelihood of a joint time trend is then the product of likelihoods for the set of variables. The method is demonstrated for the case of exploited deep-water species. The questions investigated are: Did population time trends in different areas change in the same direction, i.e. is there a single underlying stock? Did different species in the same area changed in the same direction indicating a fisheries effect? Application of the method shows that for blue ling there is no strong evidence for nor against the hypothesis of similar population time trends in five investigated areas. In contrast, for grenadier the evidence in favour of similar (decreasing) time trends in all areas was strong, while for black scabbardfish population abundance indices in different areas were different. There was no evidence for common trends across species in each area. A second illustrative example for the method uses time trends in abundance and length indicators to identify population process changes.

Keywords: likelihood principle, abundance indices, time series.

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