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Modelling structural dynamical changes in a Danish shallow lake

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Abstract

Biomanipulation and diversion of nutrients can affect not only the eutrophication level, but also the trophic structure and species composition of the phytoplankton society in lakes. Existing models often fail to describe the reactions of the ecosystem when such qualitative changes are involved. For this purpose structural dynamic models are needed. This paper presents the first attempt to model the qualitative changes that have been observed to occur in a Danish shallow lake as a result of biomanipulation. A structural dynamic model was developed that included nine species or types of algae normally observed in Danish shallow lakes. The high flow ratio of the lake was assumed to justify that summer conditions would represent a steady state of the system. The parameters of the model were calibrated until the model gave adequate results. The available mathematical tools normally used for calibration were found to give unsatisfactory results. The calibration therefore had to be carried out by running the model repetitively, adjusting parameters until it was able to perform according to the changes actually observed in the lake chosen for this case study. The use of parameters from literature to

observed in the lake chosen for this case study. The use of parameters from literature to characterize the different types of algae is shown to have a great impact on this phase of model development. The calibration was found to be very time consuming, mainly due to uncertainties connected to the input parameters. The importance and uncertainty of the parameters chosen indicate that we may probably have to choose new strategies for similar modelling approaches in the future, such as the application of goal functions. The implementations would allow parameters to vary during simulations in order to simulate ecosystem properties, such as adaptational processes and buffering capacities which are features possessed by natural ecosystems.

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Keywords

Eutrophication; Lake; Species composition; Trophic structure

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