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Dynamic Modeling of the Impact of Chlorine on Aquatic Species in Urban Lake Ecosystem

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Abstract : Urban lakes play an invaluable role in urban water systems such as flood control, water supply, and public recreation. However, over 38% of the urban lakes have suffered from severe eutrophication in China. Chlorine that could remarkably inhibit the growth of phytoplankton in eutrophic, has been widely used in the agricultural, aquaculture and industry in the recent past. However, little information has been reported regarding the effects of chlorine on the lake ecosystem, especially on the main aquatic species.To investigate the ecological response of main aquatic species and system stability to chlorine interference in shallow urban lakes, a mini system dynamic model was developed based on the competition and predation of main aquatic species and total phosphorus circulation. The main species of submerged macrophyte, phytoplankton, zooplankton, benthos, spiroggra and total phosphorus in water and sediment were used as variables in the model,while the interference of chlorine on phytoplankton was represented by an exponential attenuation equation. Furthermore, the eco-exergy expressing the development degree of ecosystem was used to quantify the complexity of the shallow urban lake. The model was validated using the data collected in the Lotus Lake in Guangzhoufrom1 October 2015 to 31 January 2016.The correlation coefficient (R), root mean square error-observations standard deviation ratio (RSR) and index of agreement (IOA) were calculated to evaluate accuracy and reliability of the model.The simulated values showed good qualitative agreement with the measured values of all components. The model results showed that chlorine had a notable inhibitory effect on Microcystis aeruginos□Rachionus plicatilis, Diaphanosoma brachyurum Liévin and Mesocyclops leuckarti (Claus).The outbreak of Spiroggra.spp. inhibited the growth of Vallisneria natans (Lour.) Hara, leading to a gradual decrease of eco-exergy and the breakdown of ecosystem internal equilibria. This study gives important insight into using chlorine to achieve eutrophication control and understand mechanism process.

Keywords : system dynamic model, urban lake, chlorine, eco-exergy
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