FACTORS INFLUENCING FISH DISTRIBUTIONS AND COMMUNITY STRUCTURE IN SHALLOW LAKES WITHIN PRAIRIE AND PRAIRIE-PARKLAND REGIONS OF MINNESOTA, USA[1]

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Fish populations exert strong, but variable, influences on prairie shallow lakes in Minnesota. Consequently, shallow lake managers would benefit from empirical models predicting the distribution of fish populations at landscape scales. We used indirect and direct gradient analysis, classification and regression tree analysis (CART), and simple linear regression to predict fish presence/absence (P/A), species richness, and community composition in 82 shallow lakes. A CART model for fish P/A that included 2 variables, downstream connections to surface waters capable of supporting fish and lake maximum depth, correctly classified 100% and 92% of our training and validation sites, respectively. Fish richness was positively related to both lake size and watershed size in both study areas. Distinct patterns in community composition were also evident, ranging from planktivore-only sites to sites with planktivores, benthivores, and piscivorous fish all present. Community composition varied by study region, and reflected both isolation (lake watershed area, connections to upstream and downstream fish sources) and extinction features (lake size). Negative associations between abundance of soft-rayed minnows (e.g., fathead minnows) and piscivores suggested piscivory was also an important extinction process. Fishless sites were quite rare and tended to be isolated or shallow. Managers interested in minimizing distributions and abundance of fish should focus on protecting shallow, isolated basins, maintaining existing barriers, or breaking up connectivity among basins (e.g., fish screens and velocity barriers) as anthropogenic-induced connectivity (culverts, drainage ditches) repeatedly appeared as an important mechanism supporting persistent fish populations, including detrimental species such as native black bullhead, and invasive common carp. Many of our sites contained only minnows, thus represent candidate sites where piscivore additions could be used to reduce prey fish populations, particularly when combined with installation of fish barriers.

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