Do wetland lakes exhibit alternative stable states? Submersed aquatic vegetation and chlorophyll in western boreal shallow lakes

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ABSTRACT: Shallow lakes often exhibit alternative vegetative states, one a clear-water state dominated by submersed aquatic vegetation (SAV) and the other a turbid state dominated by pelagic phytoplankton. We determined the nutrient and vegetation status of 148 wetland lakes in boreal Alberta, Canada. The lakes were very shallow (mean depth, 1.3 m), rich in phosphorus (123 μg total P L^{-1}), and relatively low in available nitrogen (18 μg L^{-1} $NH_4^+ + NO_3^-$), and 62% of them exhibited alternative states. The results of principal components analysis suggested that these lakes could be divided into four categories: (1) phytoplankton-dominated lakes (25%) with higher concentrations of chlorophyll a (>20 μg L^{-1}), are more turbid, and have low densities of SAV; (2) SAV-dominated lakes (37%), with high densities of submersed aquatic plants (>25% cover), are clearer, and have lower phytoplankton concentrations; (3) high SAV and high phytoplankton lakes (12%), with dense populations of both SAV and phytoplankton; and (4) low SAV and low phytoplankton lakes (26%), with low densities of both SAV and phytoplankton. The phytoplankton-dominated lakes are usually found in hypereutrophic conditions (mean = 205 μg TP L^{-1}), whereas the SAV-dominated lakes primarily exist in eutrophic and mesotrophic conditions (mean = 82 μg total P L^{-1}) and have lower available N (11 μg L^{-1} $NH_4^+ + NO_3^-$). Because most of these lakes lack fish, we expect that nutrient status, depth, and invertebrate predators are probably the most important determinants of vegetative structure and alternative states.

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