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LIMNOLOGY OF CARBONATE - BICARBONATE
LAKES IN NEBRASKA

by

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A B S T R A C T

The relation between chemical, physical and biological indices was examined in 1,640 sandhill lakes during the years of 1954 to 1963. Sandhill lakes are formed by either (1) wind deflation basins and closed drainages or (2) exposed ground water table basins. Topography of the 20,000 square mile sandhill region is primarily stabilized dune sand interspersed with wet meadows and pine - cedar - oak river drainage systems. Two-thirds of the area is dune sandhills and one-third occupied by basins, valleys and lakes.

All of the lakes are comparatively shallow, the deepest lake being Blue Lake with 13.8 feet. The average depth of the 1,640 lakes is around 3.2 feet. The lakes have a combined area of 65,800 surface acres ranging in size from 10 to 2,300 acres. Permanent natural lakes less than 10 acres were not included in the survey but number about 850. Average rainfall is less than 18.0 inches a year.

The lakes are for the most part alkaline eutrophic of the sodium carbonate-bicarbonate group. Several lakes, high in potassium salts, could be called alkaline dystrophic. Sodium hydroxide lakes are scattered throughout the region. Thermal stratification does not exist. Solar evaporation losses are high - from three to five feet of water annually.

Most of the lakes have between 150 to 65,000 p.p.m. total dissolved solids but one unnamed lake has 448,000 p.p.m. Dissolved salt content varies from 0.01 to 44 percent. The carbonate present in 88 percent of the original water samples,

mainly bicarbonate, exceeds sulfates and the latter exceeds chlorides. The pH as a factor is real and ranges between 7.8 and 10.8 with an average value of 9.4. Most of the waters are highly buffered and reveal no significant seasonal differences in pH.

Many of the small alkaline lakes are comparatively simple ecosystems with high euryhaline species in the higher alkali waters. There is a distinct drop in the variety and abundance of submergent aquatic plants when the degree of alkalinity approaches 600 p.p.m. and a second marked reduction around 800 p.p.m. Sago pondweed, Potamogeton pectinatus, is the predominant plant in 60 percent of the lakes. Phyllopod shrimp are seasonally abundant in the smaller, fluctuating water level lakes and occur in alkaline sites up to pH 10.5. Gastropods are abundant in the less alkali lakes but disappear in the higher bicarbonate and carbonate lakes.

Twenty species of warmwater fish are found in the sandhill lakes. All species, except the fathead minnow, Pimephales promelas and the Sacramento perch, Archoplites interruptus, disappear from lakes with bicarbonate values exceeding 900 p.p.m. The fathead minnow has been recorded from bicarbonate waters up to 1,500 p.p.m. The Centrarchidae fishes appear to be the least resistant to bicarbonate-carbonate alkalinity whereas northern pike, Esox lucius, have been introduced into borderline lakes with some success. At the present time 58 percent of the sandhill lakes support fish life, mostly the black bullhead, Ictalurus melas; 9 percent are borderline and 33 percent are nonsupporting lakes. Carbonate alkalinity is to a great extent the explanation for the wide difference in the biology of the lakes so geographically close together and so uniform in all other physiographic conditions.

As yet, information about the fauna and flora of high carbonate-bicarbonate environments is still too fragmentary to permit a complete and final classification of such waters on an ecological basis.

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