December 1957

THE FISHERY OF AN ALKALINE SANDHILL LAKE, NEBRASKA

D. B. McCarraher

THE FISHERY OF AN ALKALINE SANDHILL LAKE, NEBRASKA

by

D. B. McCarraher

Melvin O. Steen, Director

Nebraska Game, Forestation and Parks Commission

Glen R. Foster
Chief of Fisheries Division

Orty E. Orr
Fisheries Project Leader

INTRODUCTION

The sandhill region of Nebraska is a plains regions that has been excessively modified by the force of wind. It is an area of partially changed environment through wind action, an area of dune sandhills, sandy basins and valleys, exposed ground water lakes and marshes, and possessing little surface runoff.

General Physical, Chemical and Biological Characteristics of Sandhill Lakes

For the most part, sandhill lakes are considered alkaline eutrophic; some, however, are so extremely alkaline that fish populations do not exist. The alkaline compounds found in these lakes are mostly of the sulphate type. The lakes are shallow with regular bottoms and usually have an east-west axis. Sandhill lakes are formed by a high ground water table in dune depressions and in closed valley drainages. The alkalinity of these lakes may also be regarded as the key to the climatic and physiographic conditions that were responsible for their development. It is obvious that these conditions continue to affect the life in the lakes as well as through the concentration of salts.

From a review of available literature, it appears that very little attention has been directed toward the physiographic and biological aspects of alkaline 'sloughs' and lakes in the United States. Research of saline lakes has been comprehensively covered by workers in the Canadian provinces of Saskatchewan and Manitoba. Wyoming now has a project in progress to test the effects of the salinity of natural waters on various species of trout.

Big Alkali Lake -- Its Fishery

Big Alkali Lake is the fourth largest natural lake in Nebraska. When full, this body of water contains 850 surface acres with a maximum

depth of 11.0 feet. The mean depth is 6.5 feet.

This lake is considered moderately alkaline, maintaining a yearly mean pH value of 9.0. Total solids vary directly with annual precipitation and ground water levels. During years of low water levels, total solids ranged between 5,000 to 19,000 ppm., while more recently a total solids range of 900 to 4,500 ppm. has been recorded. Total alkalinity, recorded only for the past three years fluctuated between 320 to 800 ppm.; the mean for the three year period being 665 ppm.

Submergent vegetation in Big Alkali is restricted to several species of Potamogeton and scattered beds of Chara. Hardstem bullrush, Scirpus americanus, and saltgrass, Distichlis stricts, grow along the shore of the lake.

The present fishery of Big Alkali consists of the following species: largemouth bass, northern black bullhead, black crappie, northern pike, grass pike, yellow perch, carp, golden shiner, bluegill, green sunfish, fathead minnow, walleye and the channel catfish.

It is estimated that Big Alkali is now producing a standing crop of between 350 to 450 pounds of fish per acre. Of this total poundage, the black bullhead and yellow perch comprise approximately 60% by weight per acre.

Northern pike growth rates are good in this lake with fish obtaining 16.3 inches by the first winter.[1] Reproduction of this species is directly proportional to the total amount of drainage entering the lake each spring. With the advent of a good springtime runoff, the pike are able to ascend into several square miles of submerged meadows for spawning.

Yearly reproduction of all resident species is evident during years of normal water alkalinity. Periods of increased alkalinity appears to

[1] Table I

Average Total Length in Inches of Several Big Alkali Fishes at End of Each Year[1]

Year	1	2	3	4	5	6
Northern Pike	16.3	25.7	28.1	33.4	35.0	....
Black Crappie	4.6	9.2	10.4	12.3	13.5	14.9
Largemouth Bass	5.4	9.5	13.8	15.2	16.8	....
Yellow Perch	3.6	5.8	6.5	7.7	9.8	11.3

[1] Mean length at time of annulus formation

preclude successful spawning of most species. Records from the 1930's indicated that the black bullhead and fathead minnow survived low water levels and high alkalinities while the perch, bass, crappie and bluegill disappeared.

The walleye was introduced in the spring of 1957 as fingerlings and have promise of contributing greatly to the future sport fishery. By November of this year, walleyes were caught having a total length of 8.5 inches.

Growth of the yellow perch is not considered good when compared to growth in other sandhill lakes. Numerically, the 6.0 - 8.0 inch size perch group dominates the fish population structure of the lake.

During 1930's, when water levels were receding, the water assumed a light gray color. The color of the fish was also affected by the alkali, the perch and bass being of light color and having white fins.

There appears to be a true correlation between cattle utilization of winter range, which drains into the lake, and the total standing crop of fish pounds produced per acre. In Big Alkali, where surface run-off releases organic matter from several square miles of winter pasture, the total pounds of fish produced per surface acre is approximately twice that of nearby sandhill lakes without surface drainage.

The sum harvest of the game fish in Big Alkali is dependent upon

two primary conditions: (1) season and (2) standing alkalinity of the lake.

At this time the winter fishery is composed almost entirely of perch and northern pike. The perch catch for a two month period during the winter of 1955-56 amounted to 4.9 perch per hour effort. The perch catch for a two month period during the summer of 1957 was .7 perch per hour effort. The bullhead catch for this same summer season was 1.2 fish per hour. The bass harvest is primarily concentrated during the spring months following the disappearance of the ice cover. Although there is present a sizable crappie fishery in Big Alkali, the yearly total yield of this species is nil. The fall and early winter of 1956 revealed numerous dead crappies, 8 to 15 inches in length along the shores of the lake. We imagine that this die-off was partially related to the sudden rise in dissolved salts content. Some old age mortality was also represented with this crappie die-off.

The winter of 1956-57 found ice fishing success on the lake to be almost non-existent. Also during this period an above normal zooplankton bloom prevailed. Plankton populations of 10,000 organisms per liter of lake water were recorded. An unusual event occurred during the spring of 1956-57 at which time northern pike trapped from Big Alkali failed to produce mature - ripe eggs. All eggs were translucent and "glassy" in appearance. During 1957, natural reproduction failed to materialize Big Alkali for the first time since spawning pike were introduced into the lake in 1951. This egg production failure cannot be attributed to the weather because in a nearby lake, pike successfully spawned. There is some indication to believe that the sudden increase in the lakes alkalinity during the fall and winter of 1956-57 produced a physiological effect on the developing ova of the pike. The total alkalinity over a four month period increased from 350 to 800 ppm. with a suggested marked

increase in total solids for the same period.

The rough fish population of which the carp is dominant, has been increasing numerically within the lakes fish population structure. Carp spawning runs into the drainage flow are normally follows the pike run by four to six weeks. The effect of an expanding carp population in Big Alkali has to date exhibited no significant depressing action in regard to game fish growth rates, availability of bottom organisms, and submergent vegetation abundance.

Special Problems Affecting Alkaline Lake Fisheries

Many of the lakes in the sandhills of Nebraska have no permanent inflow or outflow and under the influence of a semi-arid climate, periodically develop a high degree of alkalinity.

The effects of high alkalinity on the life of these lakes is of immediate economic importance in restricting their fishery potential. During the drought years of the 1930's when Big Alkali Lake was greatly reduced in water volume only the fathead minnow managed to tolerate the increased alkalinity. ~~were the largemouth bass, blu-gill, and black crappie.~~ We also suspect that the black bullhead was the last of the game fish to disappear from the lake. Rawson (1944) while discussing saline lakes in Saskatchewan, suggests a tolerance limit of 15,000 ppm. total solids for the survival of freshwater species.

It is our intention to manage an alkaline lake, such as Big Alkali, for a pike - walleye - perch association. The present bullhead fishery, important to many Nebraska fishermen, appears to be perennial, thus requiring little attention.

Of interest to this group might be the interim results of an abortive attempt to establish a rainbow trout fishery in a small alkaline sandhill lake during 1957. Punch-Bowl Lake, a lake of 30 surface acres, was stocked with 10,000 rainbow trout fingerlings averaging 2.2 inches during

February. By May these trout were found to be 5.0 inches. On June 28 a gill-net catch in this lake provided rainbows 7.0 to 8.0 inches. From this date until November intensive gill-netting has resulted in negative catches of trout.

The mean pH values recorded over a 10 month period was 9.8, while the total alkalinity range was 315 to 460 ppm.

It is expected that in the future studies will continue to explore the possibilities of introducing trout into selected alkaline sandhill lakes and to perhaps determine the feasibility of producing a strain of salt-tolerant trout.

To conclude, present evidence points out that many chemical, physical, and biological problems remain which, when investigated, could throw additional light on the basic productivity of alkaline lakes. The end result from such inquiries should be of practical concern to the fisheries field.

Literature Cited

Rawson, D. S. and J. E. Moore

1944. The saline lakes of Saskatchewan. Canadian Jour. of Research. D., Vol. 22, pp. 141-201.

Presented At The

Nineteenth Annual Midwest Wildlife Conference

Milwaukee, Wisconsin

December 10, 1957