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# OCCASIONAL PAPERS ON THE LIMNOLOGY OF NEBRASKA

D. B. McCarraher

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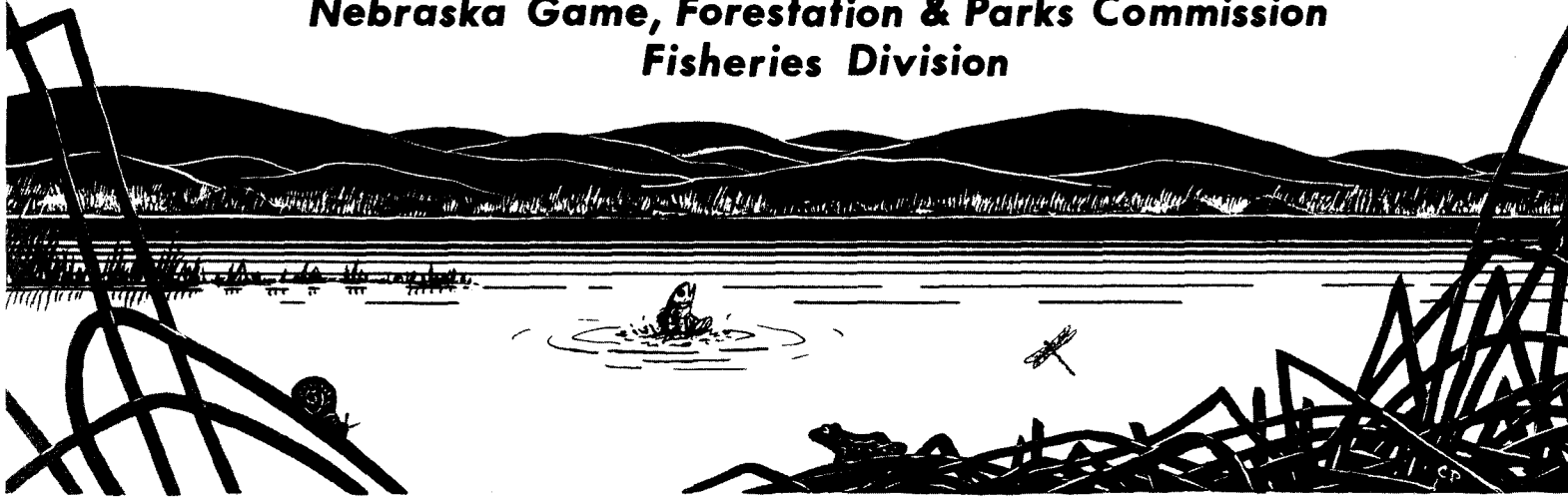
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# Nebraska Game, Forestation & Parks Commission Fisheries Division



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## OCCASIONAL PAPERS ON THE LIMNOLOGY OF NEBRASKA

D. B. McCarraher, Limnologist

Issue No. 2, February, 1967

### HIGHLIGHTS

Nebraska limnological studies got under way throughout the state during 1966. Since this was the first full year of activities, field collections were made at as many sites as possible to accumulate extensive limnological data from which to determine lakes for future studies. A total of 44 reservoirs, natural Sand Hill lakes, rainbasin lakes, and Interstate 80 lakes was sampled. Methodology was perfected throughout the year in order to establish sampling techniques applicable to both natural and impounded waters.

Preliminary data revealed some conspicuous differences in physiochemical and biological characteristics from the geographically different regions of Nebraska. Distributions of properties and qualities, measured quantitatively in time and space, will express biological variations occurring within and between individual lakes. Within the scope of these Occasional Papers, limnology projects throughout Nebraska will be summarized.

### 1966 DATA SUMMARY

1. Water chemical analysis of six reservoirs revealed no significant differences of the major ions in solution. Seasonal chemical variations within reservoirs were related to water levels and formation of thermal stratification. Those impoundments, such as Sherman, Merritt, Harlan, and Medicine Creek, became stratified by early July with corresponding

changes in their vertical chemical profiles. All impoundments reverted again to nearly homothermous conditions and similar chemical conditions by early October.

Of the 22 Interstate 80 borrow-pit lakes examined, 58% exceed 150 ppm total hardness. A maximum reading of 610 ppm hardness (ca and mg) was found in a lake near Elm Creek. These comparatively small lakes are of the calcium-sulfate type suggesting important ion exchange differences compared to the alkaline sandhill waters to the north.

The limnological laboratory located at Hastings College is now equipped to conduct 22 tests for different ions in addition to tests for chemical oxygen demand, turbidity, percent light transmission, and suspended settleable material.

2. The biological phase of study during the first year was directed towards zooplankton, benthos and algal taxonomy, and distribution. We are directly concerned with discovering what the factors are in determining their presence or absence and abundance in Nebraska aquatic environments.

Sampling of zooplankton populations throughout the year revealed 11 genera and 25 species present from 21 reservoirs and lakes. Diaptomus sicilis, Diaptomus siciloides, Daphnia pulex, Daphnia longispina and Cyclops vernalis occurred in 72% of the one minute oblique plankton tows. The plankters were collected by a Miller high-speed sampler with a four-inch aperture and number 10 straining net and bucket. The net was towed at a constant speed of 5 m.p.h.

Red Willow, Pawnee, and Johnson Reservoirs indicated the greatest abundance of zooplankton on a seasonal basis. These preliminary collection data suggest highest densities occur during October through December and again during late February through March.

Plankton volumes were determined by a mercury immersion method designed by Yentsch and Hebard of the Woods Hole Oceanographic Institution.

Benthos sampling started during September and continued until middle December. A total of 182 bottom samples were taken from nine lakes and reservoirs. These limited benthic data produced 18 genera with Chironomus, Chroborus and Pentaneura comprising 83% by number of the total sample. The lakes showing the greatest fall bottom fauna production in order of decreasing numbers were: Bluestem, I-80 #219, Pawnee, and Red Willow. Sherman Reservoir was the least productive for total volume of benthos and species composition. The benthos was collected by means of a 100 cu. in. (1600 cc) orange peel dredge.

Random algae collections from 20 lakes produced 73 different genera of which Navicula, Synedra, Oedogonium, Anabaena, Spirogyra, Cymbella and Gomphonema were most frequently encountered.

The finding of Pectodictyon cubicum in South Twin Lake, Cherry County, and in I-80 #264.5 lake is the third and fourth record of this species in North America. Previous localities were in Ohio and Indiana.

We are currently interested in both planktonic and non-planktonic algae in relation to water quality. Distribution trends already point to a decreasing number of algae found in conjunction with increasing alkalinity values. Concentrated efforts will be made in 1967 to obtain algal samples from the hydroxide-carbonate lakes in Sheridan and Garden counties.

3. The arrival of limnological gear and a research boat gave impetus to the studies in 1966. A 17-foot Boston Whaler was modified and equipped with a stern boom and an oceanographic winch. A transmissometer system was adapted for boat mounting and provides in situ light transmission readings at depths to 150 feet. Vertical dissolved oxygen, specific conductance, and temperature values are obtained from boat-mounted deck-readout units. The Whaler has proved to be a versatile vessel adaptable to small inter-state lakes and large impoundments alike.

Consultant service and part-time assistance was furnished by the following:

#### Invertebrate Limnology

Dennis C. Aylward, Hastings College Biology Department, M.S.,  
Ph.D. candidate.

Gilbert L. Adrian, Hastings College Biology Department, M.S.  
Steve Robinson, Hastings College student assistant.

#### Algae Taxonomy and Ecology

Wendell V. Showalter, chairman, Hastings College Biology  
Department, Ph.D.

Ronald Hoham, Ph.D. candidate, University of Washington.

#### Chemical Limnology

Harold Thaut, Jr., Hastings College student assistant.

Richard Frueling, Hastings College student assistant.

Rick Penny, Hastings College student assistant.

#### Physical Limnology and Gear Technology

Carl R. Throckmorton, Hastings College Physics Department, M.A.

A limnological paper entitled the "Effects of Main Stem Impoundments and Channelization upon Missouri River Invertebrates" is being prepared for publication by Larry Morris of the fisheries research division and Ralph Langemeier of the fisheries management division. They found that channelization has reduced both the size and variety of aquatic habitats by destroying important invertebrate producing areas. Average standing crops of benthos per acre were similar in both the unchannelized and channelized section of the river but the benthic area had been reduced by 67 percent by channelization. They also reported little similarity between the organisms found in the drift and those found in the benthos.

#### NEWS AND VIEWS

A shipment of desert pupfish, Cyprinodon macularius, and southwest plains killifish, Fundulus zebrinus, arrived from the New Mexico Game and Fish Department during the Fall of 1966. Bioassay tests were started to find out whether these species could survive in alkaline-type waters typical of many of the Nebraska Sand Hill lakes. Although the fish are able to survive in chloride-sulfate waters up to 52,00 ppm total solids they perished when alkalinities approached 1,300 ppm and carbonate alkalinity exceeded 620 ppm.

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L. H. (Hank) Dawson, fisheries manager at Norfolk, completed his M.S. degree requirements at the University of Nebraska. Hank's thesis was entitled: Watershed Management and Insect Production in Two Streams in Northeast Nebraska. Also his paper on the occurrence of fresh-water sponges (Spongillidae) in Nebraska was published in the Trans. of the Kansas Academy of Science, Vol. 69 (1): 96-98.

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Monte L. Madsen, fisheries manager at North Platte, is currently involved in fisheries limnology studies with the striped bass, Roccus saxatilis. This highly rated, marine transplanted, game fish has been successfully reared at the North Platte Hatchery and initial releases made in Lake McConaughy. In conjunction with these and future releases we anticipate a complete limnological survey of the 35,000 acre reservoir.

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Special limnology studies in Holmes Lake, part of the Salt Valley Watershed District in eastern Nebraska, started during the Fall of 1966. Fish survival and growth in this impoundment has been less than reported from the other Salt Valley lakes. Preliminary data points to extreme turbidity caused by particles less than one micron in diameter, consisting of montmorillonite, mica, kaolinite, and chlorite particles as being directly

responsible for the poor biological environment of the site. Suspended sediment decreased from 0.69 ml. per liter during the fall to 0.08 ml. per liter (under ice cover) by January. Obviously, the chemical nature of the sediment is an important factor and will receive special study in the future.

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Primary production studies using the  $C^{14}$  method will start during the Spring of 1967. Comparative photosynthetic rates will be measured in stratified and non-stratified I-80 lakes and several south central Nebraska reservoirs.

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A Northern Great Plains Limnology Seminar was held on the Hastings College campus January 25, 1967. About 38 fisheries biologists, limnologists, and college personnel attended from four states.

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Hastings College biology students, Steve Robinson and Fred McCurdy, have recently completed a mid-winter limnology survey of the upper end of Lake Hastings. This is the area of the lake where water temperatures remain above 55 degrees F. during the winter months and where the Nebraska Fisheries Division released the fish, Tilapia mossambica, last winter.

The Spring of 1966 found few temporary water pools in south-central Nebraska and consequently the hatch of phyllopod shrimp was poor. Several specimens of Streptocephalus texanus were collected from a turbid pool north of Hastings. Good hatches of Branchinecta lindahli, B. campestris and Artemia salina were again located in numerous alkaline Sand Hill ponds and lakes. Thousands of these permanent and temporary mineral water lakes annually produce some of the highest density populations of fairy shrimp in North America.

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Ronald W. Hoham, Ph.D. candidate at the University of Washington and a former Omaha resident, is presently compiling a taxonomic list of Nebraska algae. This project is being sponsored by the Nebraska Game Commission's Office of Limnology. Ron has just completed his M.S. degree in phycology under Dr. G. W. Prescott at Michigan State University.

\*\*\* \*\*

Marine amphipoda, Carinogammarus mucronatus, from the Salton Sea in California were successfully propagated in the limnology laboratory. Aquaria experiments with Sand Hill lake water containing 800-1,400 ppm potassium and sodium carbonate alkalinity indicated no survival above these levels. A shipment of the amphipods was sent to Richard Gregory, Colorado Game and

Fish Department, Ft. Collins, Colorado, for experimentation in the saline waters of Newell Lake. The lake with a total solids content of about 15,000 ppm does not presently contain amphipoda. The chloride-sulfate water of Newell Lake shows promise of providing suitable habitat for this marine amphipod.

A partial kill of rainbow trout, Salmo gairdneri, took place in Merritt Reservoir, Cherry County. Dick Peckham, fishery manager at Bassett, reported that irrigation drawdown of the lake level coupled with prolonged 95 -105 F. air temperatures during July caused the trout mortality. The 2,800-acre stratified impoundment, Nebraska's only trout-managed reservoir, failed to maintain the normal cool water temperatures and the oxygenated zone essential for trout survival.

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Robert A. McDonald, fisheries biologist at North Platte is currently engaged in the first complete chemical limnology of the 20 State fish rearing ponds in the Parks, Nebraska area. Chemical analyses are being determined at the Hastings Limnology Laboratory. The taxonomy and distribution of algae in the ponds will also be studied during the project period.

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Hackberry Lake, a natural Sand Hill lake in Garden County, is currently under investigation to determine the reason for the poor survival and growth of fishes in the lake. Evaluation of organic and inorganic suspended matter promises to hold the key for a direct solution of the problem. The study was requested by the Bureau of Sport Fisheries and Wildlife, Fisheries Management Services.

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In order to broaden the scope of coverage we request items of aquatic interest from Nebraska colleges and universities. Knowledge of student and faculty research projects also would be especially welcomed for inclusion in issue Number 3 of the Occasional Papers.

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