PRELIMINARY STUDIES ON THE LIMNOLOGY OF FOUR PONDS IN SOUTHERN OKLAHOMA

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This study was made to give some information regarding the chemical quality and the basic fertility of the water in four ponds in southern Oklahoma, to provide a backlog of data for future reference, and to furnish information to be correlated with the results of a proposed fish population study of the same ponds. The fish population study has not been made but data collected in this study indicate some of the factors which should be considered in a complete pond management program.

The four ponds included in the study are located on the Caddo Ranch, 5 miles north of Ardmore. All were free of turbidity due to suspended soil particles. Pond No. 3 is a fairly shallow pond with the exception of the main channel which passes through the west side of the pond. It has a surface area of about 25 acres and is located in such a manner that the overflow from the Ardmore Club Lake will enter it. The club lake has a drainage area of some 2500 acres, mostly grassland. The watershed which drains directly into this pond is largely improved pasture. At the time this study was made, submerged vegetation, dominated by *Najas* and *Ceratophyllum*, covered the bottom of most of Pond No. 3.

Pond No. 4, covering a surface area of about 4 acres, collects the drainage from an improved grassland watershed and had been fertilized with inorganic fertilizer in the summers of 1948 and 1949. Information regarding the amount and time of application is not available. Since this pond is considerably deeper than No. 3, the submerged vegetation did not extend over as large a portion of the bottom. A heavy plankton bloom, predominantly *Melosira granulata*, present at the beginning of this study continued until well into the winter.

Pond No. 7 has a surface area of about 6 acres and a maximum depth of 20 feet. This pond lies immediately below the dam of No. 4 and collects its water from very similar watershed. The overflow of No. 4 passes into a much smaller pond which in turn spills into No. 7. On August 18, 1949, 300 pounds of inorganic fertilizer, composed of 25 pounds of ammonium nitrate to 100 pounds of 5-10-5, was added to this pond. Much of the shallower portions of the pond had an abundance of submerged vegetation including *Chara*, *Najas*, *Potamogeton*, and *Ceratophyllum*.

Pond No. 9, about 10 acres in area, is a fairly deep pond located on much higher ground than the other three ponds. To this pond also was added approximately 300 pounds of the same fertilizer as was used on Pond No. 7 and on the same date. Some submerged vegetation, to a large extent composed of *Najas*, *Ceratophyllum*, and *Chara*, was present in more shallow places and plankton production, limited largely to phyto-plankton, was dominated by *Pediastrum simplex* which was not found in large numbers in other ponds.

Two stations were selected on each pond and two 250-ml. glass-stoppered sample bottles were filled weekly for a period of 15 weeks (September 28, 1949 to February 9, 1950) on each station. The free CO_2 was tested for in the field immediately after collecting the sample. As soon as it was filled, one bottle had the dissolved O_2 set in it. The other sample was taken into the laboratory for *p*H measurement and alkalinity determination.

Plankton was collected by drawing a bolting-cloth plankton net, 10.2 cm. in diameter, through a measured horizontal haul (8 feet) and the bucket emptied and rinsed into a 15-ml. graduated centrifuge tube. From 0.5 to 1.0 - ml formalin was added to each tube to preserve the plankters. The tubes were stoppered securely and taken to the laboratory where, after 24 hours settling, the total volume was determined.

The Rideal-Stewart modification of the Winkler method was followed in determination of the dissolved oxygen content (6). *p*H was measured electrometrically in the laboratory with a Beckman Model H *p*H meter. Phenolphthalein and methyl orange alkalinities were determined in the laboratory by following the procedure outline by Welch (7).

At different times during this period of investigation it was found that the use of the different amounts of phenolphthalein indicator in the tests for free CO_2 and normal carbonate alkalinity as outlined in the standard procedure (1) had a definite effect on the results. To avoid the confusion of these tests indicating neither free CO_2 nor normal carbonate alkalinity, the same amounts of indicator were used in the analyses for both after November 2, 1949.

Results and Discussion

The low, high, and average conditions of the factors studied are listed in Table I.

These data furnish information regarding the chemical quality and plankton content covering a period of some four months—October through January—when the metabolic rate of plants and animals would be expected to be decreasing. This is confirmed by the decrease in the amount of plankton. For example, Pond No. 4 had a plankton content of 130 cc. per cubic meter during the first part of October. This decreased as the fall progressed into winter until it had reached a low of 4.5 cc. per cubic meter during the latter part of January.

A sharp drop in *p*H, followed by a rise after which a general downward trend resumed, occurred at all stations on October 26.

TABLE I

	Pond No. 3			Pond No. 4		
	LOW	HIGH	AVE.	LOW	HIGH	AVE.
*p*H	7.4	8.8	7.8	7.5	8.2	7.8
O_2 (ppm)	5.6	12.3	8.2	3.3	11.8	8.0
CO_3 (ppm)	0	20.8	10.8	0	18.2	8.4
HCO_3 (ppm)	64.7	115.5	89.7	77.0	101.1	90.6
Plankton (*)	2.5	6.5	4.5	4.5	133.8	50.3
Temp. (° F.)	44.6	76.0	59.1	45.0	76.0	61.0
	Pond No. 7			**Pond No. 9**		
	LOW	HIGH	AVE.	LOW	HIGH	AVE.
*p*H	7.7	8.5	8.0	7.6	8.2	7.9
O_2 (ppm)	4.8	12.4	8.1	4.8	12.6	8.2
CO_3 (ppm)	5.6	24.6	16.4	0	20.6	9.8
HCO_3 (ppm)	84.0	116.6	102.8	67.6	119.0	100.1
Plankton (*)	3.5	17.0	8.6	2.5	22.6	7.8
Temp. (° F.)	44.6	76.0	59.1	44.1	76.0	59.9

* cc. per C. M.

There was the expected relationship between the bicarbonate-carbonate ratio and *p*H. Although Ellis, Westfall, and Ellis (2) noted that at concentrations of between 45 and 200 ppm, the carbonates and bicarbonates have little direct effect on fish, the total alkalinity of these ponds is such that they can be classed as hardwater ponds and they should be fairly productive (3).

Only a trace of free CO_2 was found at any of the stations. At no time checked did either of the stations on Pond No. 7 indicate a trace of free CO_2. Table No. 2 lists results of additional analyses of some of the elements in the ponds.

These analyses were made with a Model DU spectrophotometer and a Beckman flame unit by the methods of Snyder (5). Further studies should be made to determine if the relatively high values for magnesium and sodium in Pond No. 7 have any significant effect on the free CO_2 content.

Moyle (4) states that because of the influences exerted on it by the life processes of plants and animals, the determination of CO_2 is of little value as a comparative index of productivity of ponds. Since high concentrations of CO_2 are in themselves toxic to fish and are usually accompanied by low values

TABLE II

POND NO.	STA. NO.	MG (ppm)	CA (ppm)	NA (ppm)	K (ppm)
3	1	11	24	22.9	2.0
3	2	10	24	15.9	2.4
4	1	15	30	22.0	3.0
4	2	13	29	19.1	1.9
7	1	27	27	45.5	1.1
7	2	25	27	53.8	1.7
9	1	12	33	12.2	1.2
9	2	10	33	15.5	2.1

Mg, Ca, Na, and K concentrations in ponds checked.

for dissolved oxygen (6), the absence of CO_2 plus the relatively high dissolved oxygen content indicate an environmental suitability for the production of fish.

These data indicate that each pond, no matter how closely located to other ponds, presents individual problems. A limnological study helps form a complete picture of the individual pond and its needs.

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