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FEDERAL AID IN FISH RESTORATION SECTION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-9-R-5 Name Southwest Montana Fishery Study

Job No. II Title A Limnological Survey of the Three Forks Ponds Before and After the Application of Toxicants.

Period Covered May 1, 1956 - April 30, 1957

Abstract:

A limnological survey has been made on three cold water ponds near Three Forks, Montana. Information was obtained on physical and chemical features, plankton, plant inhabiting and bottom organisms, and fish populations. A different commercial fish toxicant will be applied to each pond in 1957. Follow up studies will be made to determine the effectiveness of these toxicants in killing fish and other aquatic organisms, the periods of toxicity and other effects.

Objectives:

A limnological survey is being conducted on three cold water ponds approximately two miles east of Three Forks, Montana. These ponds are gravel pits which have resulted from construction work by the Chicago, Milwaukee, St. Paul and Pacific Railroad, and the Northern Pacific Railroad. These ponds are similar in area (approximately twenty acres) and lie adjacent to one another. All ponds are known to contain various species of warm water fish.

The limnological study will be carried on for one year and then a different commercial toxicant will be applied to each pond. The investigation will then be carried on for an additional year. The objective is to study the effects of these toxicants on the limnology of cold water ponds and to determine their period of toxicity and effectiveness in killing various species of fish and fish food organisms.

Techniques Used:

For the purpose of obtaining quantitative data on the abundance of fish food organisms present before the application of toxicants; plankton samples, collections of bottom organisms, and collections of plant inhabiting organisms were made. Three plankton stations were located in each pond. One station was located in the approximate center of each pond. A five-gallon sample of water was poured through a plankton of No. 20 silk bolting cloth at each five foot depth interval from the surface to a depth of fifteen feet from April 14, 1956, to November 7, 1956. From November 7, 1956 to the present a five-gallon composite sample was taken from the surface to fifteen feet. Samples were preserved in five percent formalin until the start of the composite samples, and from that time to the present all samples have been preserved in Lugol's preservative.

A plankton station was also located on each end of each pond to allow for horizontal drift of plankters and a five gallon surface sample was taken. Samples were taken at all stations twice monthly during periods of open water and once monthly at the deep station during the period of winter ice-cover.

A one and one-half square foot bottom sample was taken in each pond monthly from June through September 1956 with an Eckman dredge. Samples were separated and preserved in five percent formalin for future analysis. Samples of plant inhabiting organisms were taken with a cylinderical can, 21-inches long and 6-inches in diameter. The can was placed over the desired vegetation; the plants were pulled loose from the bottom; and a section of door screen was placed under the bottom, to serve as a bottom. The apparatus was then lifted from the water and the contents placed in a large washbasin. The material was separated and the organisms were preserved in five percent formalin for later analysis. Approximately one-half pound of plants were collected and separated. After separation, plants were weighed and weights recorded. Samples were collected monthly from July through October. A few specimens of plants were collected, mounted and keyed to species.

Gill net sets were made in order to determine the species of fish present and to obtain scale samples for age and growth.

Gross chemical analyses were taken twice monthly. Analyses were made at the surface and bottom only during periods of turnover and at five-foot depth intervals during periods of stagnation. During open water sampling periods, transparency measurements were taken with a Secchi disc. Nitrate-nitrogen and phosphate-phosphorus analyses were made by the Montana State College Chemistry Department for comparative purposes.

Surface water temperatures were taken daily through the summer months from maximum-minimum thermometer located in each pond. Air temperatures were also taken daily from a maximum-minimum thermometer located in the vicinity of the west pond.

A concrete block was placed in each pond and measurements were taken weekly from the top of the block to the surface of the water.

Findings:

Physical and Chemical Characteristics:

The ice-cover on all ponds broke up at approximately the same time each year. This occurred between March 22 and April 3.

Surface water and air temperatures were taken daily between 8:00 and 9:30 a.m. The rise and fall of water temperatures correlated closely with the rise and fall of air temperatures. The maximum air temperature recorded was 93° F. on July 26, 1956. The minimum air temperature recorded was 54° F. on September 29, 1956. During most of the summer months air temperatures ranged from 74° F. to 88° F. Maximum water temperature recorded was 81°F. in the east pond on July 20 and July 25, 1956. A minimum of 40° F. was also recorded in the east pond, on October 27, 1956. The water temperatures in the east and west ponds ranged in the high sixties and low seventies during June, July, and August, 1956. The temperature range in the middle pond was in the high sixties and low seventies during June and July, but during August temperatures ranged in the high seventies. Temperatures in all ponds were in the low sixties during the month of September.

During the period June 18, 1956 to March 30, 1957, the water level fell 13.5-inches in the west pond, 10.3-inches in the middle pond, and 14.3-inches in the east pond.

Secchi disc readings were taken twice monthly during periods of open winter. Transparency in the west pond at all times coincided with the bottom, 15 to 18 feet. Transparency in the east and middle ponds was at all times less than six-feet. Low transparencies in the east and middle ponds probably coincided with phytoplankton production or with the activities of carp or suckers, which were present in the ponds.

The three ponds differed from each other in total alkalinity and in pH. A comparison of total alkalinity and pH is presented in Table 1. This difference was most pronounced during the winter months, December through March. Dissolved oxygen content was, in general, five ppm. or better in all ponds throughout the year at depths down to ten feet. During periods of summer and winter stagnation, dissolved oxygen content at times fell as low as 1.0 ppm. at a depth of 15 feet. Carbon dioxide content was, in general low in all ponds throughout the year, except during the period of winter stagnation, when total alkalinity increased and pH decreased in the water at the fifteen-foot depth level. At this time CO_2 content rose to as much as 32 ppm. at this water level. Phenolpthalein alkalinity was present during periods of open water in slight amounts at depths above five feet, except during October and November, when it was present at all depths in much larger quantities.

Table 1. Comparison of total alkalinity and pH in the three ponds.

	West			Middle			East		
Date	Depth	M.O.	pH	Depth	M.O.	pH	Depth	M.O.	pH
April	0'	210.2	-	0'	210.0	-	0'	190.3	-
14,15,16	10'	180.3	-	15'	227.0	-	5'	192.0	-
April 28									
May 1 & 6	0'	220.0	-	0'	207.0	-	0'	205.0	-
May 15	0'	206.0	-	0'	226.0	-	0'	212.0	-
May 29	0'	172.0	8.1	0'	215.0	8.6	0'	200.0	8.2
June 14	0'	151.0	8.5	0'	217.0	8.5	0'	190.0	8.3
& 15	15'	142.0	-	15'	215.0	-	5'	190.0	-
June 27	0'	152.0	8.2	0'	210.0	8.6	0'	172.0	8.4
& 28	15'	162.0	-	15'	235.0	-	-	-	-
July 13	0'	150.0	8.0	0'	200.0	8.2	0'	165.0	8.4
& 14	15'	167.0	-	15'	225.0	-	-	-	-
July 25	0'	147.0	8.3	0'	197.0	8.8	0'	163.0	8.7
& 26	15'	198.0	-	15'	237.0	-	8.5'	195.0	-
Aug. 9	0'	162.0	8.3	0'	193.0	8.7	0'	165.0	8.4
	15'	172.0	-	15'	207.0	-	5'	180.0	-
Aug. 22	0'	190.0	8.2	0'	191.0	8.8	0'	165.0	8.3
& 25	15'	182.0	-	15'	200.0	-	5'	166.0	-
Sept. 6	0'	205.0	8.0	0'	197.0	8.2	0'	178.0	8.5
& 7	15'	205.0	-	15'	160.0	-	5'	181.0	-
Sept. 20	0'	212.0	7.5	0'	180.0	8.8	0'	180.0	8.2
& 22	15'	202.0	-	15'	192.0	-	5'	180.0	-
Oct. 6	0'	231.0	8.5	0'	202.0	8.6	0'	182.0	8.3
& 9	15'	172.0	-	15'	195.0	-	5'	182.0	-
Oct. 20	0'	232.0	8.2	0'	200.0	8.5	-	-	-
	15'	240.0	-	15'	194.0	-	-	-	-

Table 1. (Cont.)

Date	West			Middle			East		
	Depth	M.O.	Ph	Depth	M.O.	pH	Depth	M.O.	pH
Nov. 7	0'	230.0	8.2	0'	200.0	8.5	0'	167.0	8.6
& 8	15'	235.0	-	15'	200.0	-	-	-	-
Dec. 13	0'	235.0	8.2	0'	205.0	8.4	0'	187.0	8.2
	15'	250.0	-	13'	205.0	-	6'	195.0	-
Dec. 31	0'	253.0	-	0'	219.0	-	5'	205.0	-
	12'	274.0	-	13'	226.0	-	-	-	-
Jan. 14	0'	252.0	8.3	0'	222.0	8.3	6'	225.0	8.0
	15'	266.0	-	15'	225.0	-	-	-	-
Jan. 30	0'	240.0	8.0	0'	237.0	8.0	6'	245.0	7.7
	15'	317.0	7.4	15'	227.0	7.3	-	-	-
Feb. 13	0'	282.0	7.6	0'	241.0	8.1	6'	255.0	7.7
	15'	321.0	7.4	15'	245.0	7.9	-	-	-
March 1	0'	135.0	7.8	0'	26.0	8.7	0'	105.0	7.4
March 18	0'	162.0	7.9	0'	170.0	8.2	7'	230.0	-
	15'	330.0	7.3	12'	245.0	8.0	-	-	-

Nitrate-nitrogen was present in all ponds on the two sampling dates. Phosphate-phosphorus was present only in the west pond on the two dates. These analyses are presented in table 2.

Table 2. Nitrate-nitrogen and Phosphate-phosphorus analyses

Pond	Date	Nitrate-nitrogen ppm.	Phosphate-phosphorus ppm.
West	June 20	0.20	0.05
	Nov. 7	0.17	1.00
Middle	June 20	0.07	0.20
	Nov. 7	0.21	0.00
East	June 20	0.13	0.45
	Nov. 7	0.05	0.00

Biological Characteristics:

One hundred and seventy three plankton samples have been collected, 60 in the west pond, 59 in the middle pond, and 54 in the east pond. Four bottom and four plant inhabiting organism samples were collected in each pond. Plankton organisms are being analyzed with reference to numbers of organisms per gallon of water. Bottom organisms will be analyzed with reference to volume and weight of each species of organism per square foot of bottom. Plant inhabiting organisms will be analyzed with reference to weight of each species of organism per pound of plant. Plankters have been identified and two samples have been counted. Bottom and plant organisms have been separated but no counts have been made.

Plant specimens collected during the summer have been identified as follows: Great bullrush (Scirpus validus), Chara spp., and cattail (Typha spp.) were common to all ponds. Water milfoil (Myriophyllum exalbescens), widgeon grass (Ruppia maritima), sago pondweed (Potamegeton pectinatus) were common to the middle and east ponds. Spike rush (Eleocharis palustris) and white-water crowfoot (Ranunculus circinatus) were found only in the middle pond.

Twelve gill-net sets were made as follows: three in the west pond, six in the middle pond, and three in the east pond. Species of fish present in each pond were: largemouth bass (Micropterus salmoides),Common bluegill (Lepomis machrochirus) , and yellow perch in all ponds; black crappie (Pomoxis nigro-maculatus) and suckers (Unidentified) were present in the east and middle ponds; northern brown bullheads (Ameiurus nebulosis) were present only in the middle pond; and carp (Cyprinus carpio) was present only in the east pond. All fish caught and observed were small indicating possible slow growth.

Recommendations:

Gross chemical analysis should be continued throughout the remainder of the study to detect any changes brought about by the application of toxicants. One water sample should be analyzed following the application of toxicants in order to detect any change in nitrate-nitrogen and phosphate-phosphorus content. Bottom organism and plant inhabiting organism sampling periods should be changed. One sample should be taken in the early spring, one immediately before and one immediately after application of toxicants, and one in the late fall, instead of taking monthly samples during the spring, summer and fall, as has been the case. Turbidity samples should be taken twice monthly during the remainder of the study and correlated with Secchi disc readings. Plankton sampling should be continued as before during the remainder of the study.

It is recommended that rehabilitation take place July 8 through July 13, a period of six days. Commercial toxicants to be applied are: Pro-nox Fish to the west pond; Chem-fish special to the middle pond; and Toxaphene to the east pond. Toxicity tests with live trout should be conducted daily to determine the period of toxicity. The effectiveness of the toxicants in killing fish will be determined by daily gill net sets. These sets will be continued until either fish are caught or until it is reasonable that all fish have been killed.

Summary:

1. Ice-cover left all ponds between March 22 and April 3.

2. During the summer, air temperatures ranged from 74° F. to 88°F. and water temperatures ranged from the low sixties to the high seventies.

3. Between June 18, 1956 and March 30, 1957, the water level dropped 13.5 inches in the west pond, 10.3 inches in the middle pond, and 14.3 inches in the east pond.

4. Secchi disc transparency coincided with the bottom in the west pond and was less than six feet at all times in the middle and east ponds.

5. Dissolved oxygen content, phenolpthalein alkalinity, and carbon dioxide content are discussed. Total alkalinity, pH, and nitrate-nitrogen and phosphate-phosphorus analyses are presented in tables one and two.

6. One-hundred and seventy three plankton samples were collected. Organisms have been identified and two samples have been counted.

7. Four bottom samples and four samples of plant inhabiting organisms were collected in each pond during the summer. These samples have been sorted but have not been identified nor counted.

8. The aquatic plants found in the ponds were great bullrush, Chara, cattail, water milfoil, widgeon grass, sago pondweed, spike rush, and white-water crowfoot.

9. Largemouth bass, common bluefill, yellow perch, black crappie, suckers, carp, and northern brown bullhead were the fish present. All fish were small indicating possible slow growth.

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