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**SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL
CHARACTERISTICS OF WASHBURN LAKE**

Department of Fish and Wildlife Resources

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SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL

CHARACTERISTICS OF WASHBURN LAKE

By

Peter W. Pfeiffer

Senior Fishery Biologist

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ABSTRACT

Physical, chemical, and biological studies were conducted at Washburn Lake from 1962 through 1965.

A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was usually evident by early May when the thermocline extended from 7 to 11 feet. Fall overturn was complete by mid-October.

Mean monthly dissolved oxygen profiles show this characteristic to be present in amounts adequate for fish survival (2.6 ppm) to a depth of 10 feet during all months. It became void in the lower depths from July through September. Annual maximum, mean, and minimum values are given for total alkalinity and total phosphates.

Population studies indicated a relatively stable fish population. A low standing crop of 68 pounds per acre was recorded in 1962, and by 1965 this had dropped to 53 pounds per acre.

*The fertilization studies showed no substantial increase in the production of the lake during the first three years of fertilization. This was related to the dense growth of weeds (mainly *Najas quadalupensis* (Spreng) Morong), which utilized the nutrients that were intended for plankton production.*

INTRODUCTION

Washburn Lake is a 26-acre impoundment located in Ohio County in the Western Coalfield Physiographic Region of the state. It was purchased by the Department in 1950 and opened to public fishing that same year. This report includes the results of the studies conducted on the lake from 1962 through 1964. The physical and chemical studies, fish population studies, and fertilization studies were conducted each year. The aquatic vegetation studies were conducted only in 1964. The stocking record was as follows:

<u>DATE</u>	<u>SPECIES</u>	<u>SIZE</u>	<u>NUMBER</u>
10/25/45	Largemouth bass		800
7/18/46	Bluegill	Adult	800
3/25/47	Bluegill	Adult	1,200
10/9/62	Channel catfish	3 - 4"	500
4/10/63	Channel catfish	4 - 5"	400
9/1/64	Channel catfish	4"	250
7/2/65	Largemouth bass	3"	2,500
10/11/66	Channel catfish	3 - 7"	600

METHODS

Physical

The basic outline of the bathymetric map, presented in Figure 1, was made from an aerial photograph provided by the Division of Photogrammetry of the Highway Department. The depths and contour intervals were determined using a Raytheon Recording Fathometer.

Temperature profiles were recorded monthly with a Tele-thermometer, near the dam, at the point of greatest depth. Temperatures were taken in one-foot decrements and recorded at every 0.5° F. change.

Chemical

Dissolved oxygen profiles were determined monthly using the modified Winkler method. Samples for this characteristic were collected every five feet to a depth of 20 feet, and then every 10 feet to the bottom.

Total alkalinity and total phosphate determinations were made from monthly samples collected as described above. All sampling was done near the dam at the point of greatest depth. The values used in this report are an average of the results obtained from samples collected at the surface, middle, and near-bottom.

Biological

Population studies were conducted each year in pre-selected cove areas. These areas were measured to the nearest tenth of an acre by the plane table method. At approximately 7:00 a.m. a block net measuring 300' x 20' x 1" (bar measure) was placed across the mouth of the cove to be sampled. Emulsifiable rotenone (Chem-Fish Regular) was applied with a venturi-type bailer at the rate of 1 ppm (0.05 ppm actual rotenone). All fish that surfaced in the sample area within 60 hours were picked up, sorted to species, counted, placed in inch groups, and weighed.

Washburn Lake was fertilized each year from 1963 through 1965 with an inorganic fertilizer (20-20-5) at the rate of 40 pounds per acre per application. Eight applications were made in the lake each year beginning in April and continuing through September. Double applications were made in April and May. The fertilizer was placed in the lake at two different sites (in water one to three feet deep). Water temperatures and Secchi disc readings were taken once a week by the conservation officer. Because of purchasing difficulties, in 1962, the fertilization program was discontinued after two applications.

Aquatic vegetation studies were conducted in 1964 to identify and preserve aquatic plants from the lake and its watershed. On May 17, 1965, the heavy and profuse growth of *Najas quadalupensis* (Spreng.) and Morong, and *Najas minor* Allioni, interspersed with *Potamogeton crispus* L. and *Potamogeton vaseyi* Robbins, were treated with liquid sodium arsenite. The herbicide was applied at the rate of 4 ppm with a venturi-type boat bailer.

Physical Characteristics

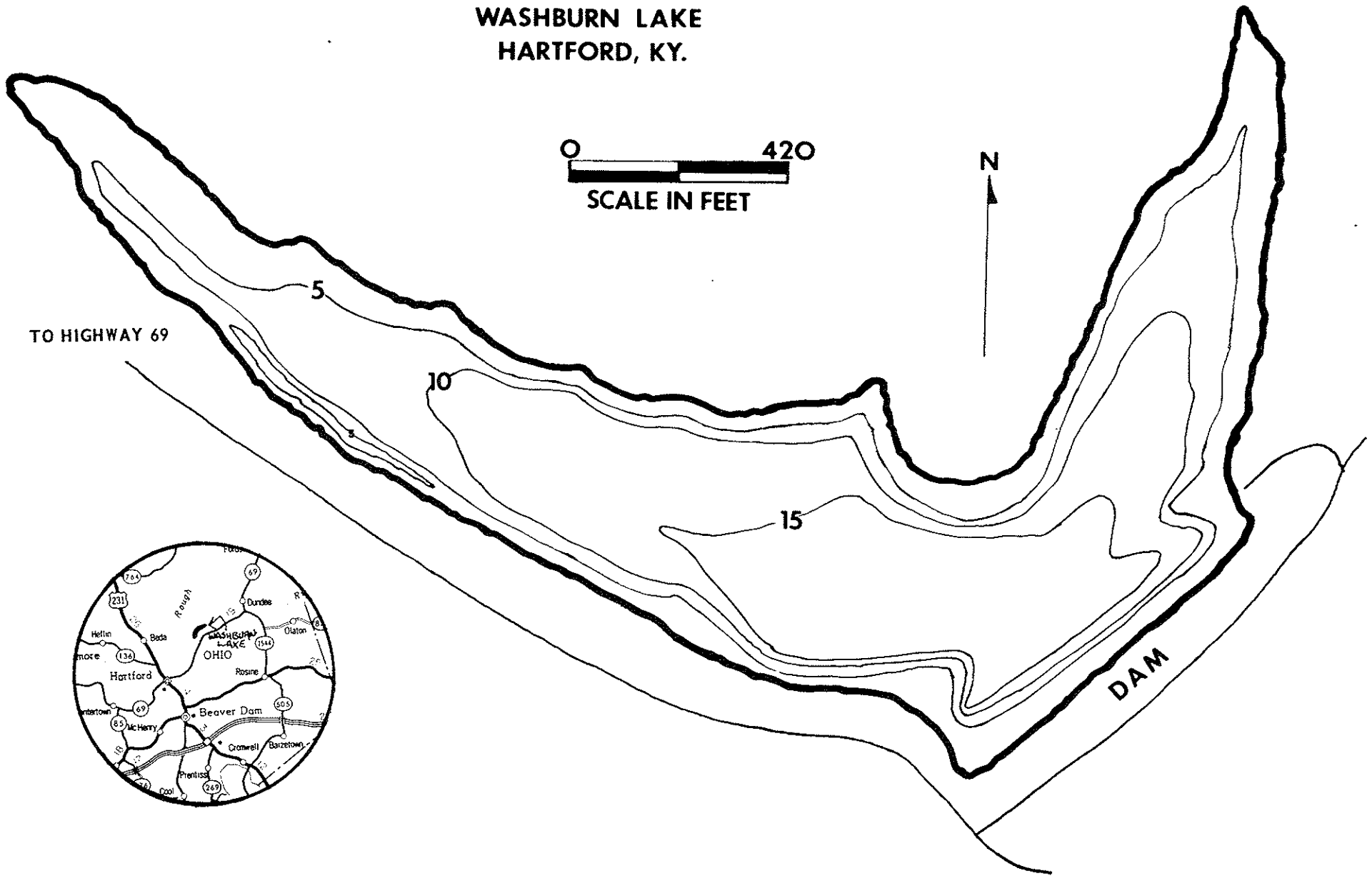
A bathymetric map of Washburn Lake is presented in Figure 1. The lake has a maximum depth of 19 feet, a mean depth of 8.4 feet, 1.1 miles of shoreline, and a total volume of 218 acre feet. Table 1 gives the volume in gallons and cubic feet and the percent volume for each five foot contour.

Table 1. Percent volume of Washburn Lake for each five-foot contour in gallons and cubic feet.

Depth	Volume		Percent volume
	Gallons	Cubic feet	
0 - 5'	34,967,504	4,674,800	49.1
5' - 10'	23,356,300	3,122,500	32.8
10' - 15'	12,849,144	1,717,800	18.1

FIGURE 1.

**WASHBURN LAKE
HARTFORD, KY.**



Temperature

The values given in Table 2 are a monthly average of temperatures taken once a month for four years (1962 - 1965). Stratification usually became evident during early May when the thermocline extended from 7 to 11 feet. It attained its maximum thickness by the end of May when it extended from 9 to 14 feet. It maintained this position until mid-August after which it began to disappear. This early disappearance was related to the shallowness of the lake as mixing occurred very readily and early. Inverse stratification was not observed (although I'm sure it occurred). A homothermic condition was recorded in January.

Chemical Characteristics

Oxygen

The mean monthly oxygen profiles are presented in Table 2. Dissolved oxygen was present in amounts above 2.6 ppm to a depth of 10 feet during all sampling. During July, August, and September dissolved oxygen became a limiting factor (for fish) in depths below 10 feet. Mean surface concentrations fluctuated from a high of 10.9 ppm in February to a low of 6.5 in September.

Alkalinity

Total alkalinity expressed as ppm CaCO_3 , varied from month to month as high as 71 ppm (1964), Table 3. Annual mean concentrations did not significantly vary from 1962 to 1964.

Phosphates

Mean total phosphate concentrations fluctuated widely from month to month in Washburn Lake, Table 3. Annual mean values ranged from a low of 0.07 ppm in 1962 to a high of 0.15 ppm in 1964.

Table 3. Mean temperatures and dissolved oxygen concentrations (ppm) for Washburn Lake.

Depth in Feet	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F	D.O.-°F
0	10.7-40°	10.9-44°	9.0-47°	9.4-64°	8.3-78°	11.6-82°	7.7-85°	8.3-82°	6.5-77°	8.5-65°	7.8-53°	10.7-45°
5	10.5-40°	11.2-43°	9.1-46°	9.4-62°	8.4-76°	11.1-78°	7.5-84°	8.3-80°	5.8-76°	7.8-64°	7.8-53°	9.8-45°
10	10.3-40°	10.3-44°	8.7-46°	8.5-54°	8.2-65°	7.3-69°	2.8-77°	4.0-77°	2.6-75°	7.1-63°	6.8-53°	10.1-45°
15	7.7-40°	10.2-44°	8.4-46°	4.2-50°	4.4-55°	2.8-59°	0.4-63°	0.6-65°	0.0-65°	5.8-62°	6.6-53°	10.1-44°

Thermocline -----

Oxygen Depletion Zone _____

Table 3. The annual maximum, mean and minimum values for alkalinity and total phosphates in Washburn Lake from 1962 through 1964. Values expressed as ppm.

	1962	1963	1964
Alkalinity	69.0	79.0	117.0
	59.2	65.6	66.0
	46.0	57.0	36.0
Total phosphate	0.18	0.29	0.36
	0.07	0.08	0.15
	0.01	0.00	0.02

Biological Characteristics

Aquatic Vegetation Studies

In 1964, four aquatic plant species were collected, identified, and preserved from Washburn Lake -- the vasey pondweed *Potamogeton vaseyi* Robbins, the curly pondweed *Potamogeton crispus* L., and the naiads *Najas minor* Allioni and *Najas quadrelupensis* (Spreng.) Morong.

On May 17, 1965 the obnoxious pondweeds (described above) covering 50% of the lake's surface were treated with sodium arsenite (40% solution of sodium arsenite containing 4 pounds of arsenic trioxide (As₂O₃) per gallon) at the rate of 4 ppm. No apparent effect was observed after 48 hours. One week later the plants had almost completely disappeared. The lake was checked again on June 14, and it was estimated that the weeds had been reduced by 80%. This was followed with monthly applications of fertilizer (20-20-5) from June to September. The plankton blooms that resulted prevented any further growth of the plants during 1965.

Fish Population Studies

In 1962, the cove population studies conducted at Washburn Lake yielded an average standing crop of 68 pounds per acre. This weight was composed of 82% panfishes, 16% game fish, and 2% commercial fish, Table 4. The largemouth

Table 4. Average weight and number of fish per acre taken from Washburn Lake during 1962 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Grass pickerel	0-4	-	-	5-9	1	0.06	10	-	-	1	0.06	0.01	0.09
Largemouth bass	0-4	14	0.17	5-9	15	2.68	10	18	7.72	47	10.57	0.37	15.66
TOTAL		14	0.17		16	2.74		18	7.72	48	10.63	0.38	15.75
<u>PANFISHES</u>													
Bluegill	0-2	8,496	33.09	3-5	365	7.44	6	31	5.29	8,892	45.82	69.65	67.90
Warmouth	0-2	2,923	1.70	3-5	838	6.15	6	12	1.61	3,773	9.46	29.55	14.02
TOTAL		11,419	34.79		1,203	13.59		43	6.90	12,665	55.28	99.20	81.92
<u>COMMERCIAL FISH</u>													
Redhorse	0-4	-	-	5-11	-	-	12	1	0.75	1	0.75	0.01	1.11
Bullhead	0-4	20	0.22	5-8	2	0.34	9	1	0.13	23	0.69	0.18	1.02
TOTAL		20	0.22		2	0.34		2	0.88	24	1.44	0.19	2.13
<u>FORAGE FISH</u>													
<u>ABOVE FORAGE SIZE</u>													
Misc. cyprinids	0-3	21	0.04	4-7	1	0.01	8	-	-	22	0.05	0.17	0.08
Topminnows	0-3	5	0.04	4-7	-	-	8	-	-	5	0.04	0.04	0.06
Pirate perch	0-3	2	0.03	4-7	1	0.01	8	-	-	3	0.04	0.02	0.06
TOTAL		28	0.11		2	0.02		-	-	30	0.13	0.23	0.20
GRAND TOTAL		11,481	35.29		1,223	16.69		63	15.50	12,767	67.48	100.00	100.00
% OF TOTAL		89.93	52.30		9.58	24.73		0.49	22.97	100.00	100.00		

Table 5. Average weight and number of fish per acre taken from Washburn Lake during 1963 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Grass pickerel	0-4	1	0.01	5-9	1	0.01	10	1	0.29	3	0.31	0.01	0.31
Largemouth bass	0-4	156	1.26	5-9	26	4.62	10	17	9.70	199	15.58	1.01	15.14
White crappie	0-4	4	0.03	5-7	4	0.26	8	4	1.32	12	1.61	0.06	1.56
TOTAL		161	1.30		31	4.89		22	11.31	214	17.50	1.08	17.01
<u>PANFISHES</u>													
Bluegill	0-2	18,186	47.38	3-5	780	13.20	6	56	12.86	19,022	73.44	96.22	71.38
Longear sunfish	0-2	-	-	3-5	1	0.01	6	-	-	1	0.01	0.01	0.01
Warmouth	0-2	105	0.67	3-5	381	8.65	6	9	0.94	495	10.26	2.50	9.97
TOTAL		18,291	48.05		1,162	21.86		65	13.80	19,518	83.71	98.73	81.36
<u>COMMERCIAL FISH</u>													
Bullhead	0-4	18	0.09	5-8	13	1.27	9	1	0.15	32	1.51	0.16	1.46
TOTAL		18	0.09		13	1.27		1	0.15	32	1.51	0.16	1.46
<u>FORAGE FISH</u>													
							<u>ABOVE FORAGE SIZE</u>						
Misc. cyprinids	0-3	-	-	4-7	3	0.14	8	-	-	3	0.14	0.01	0.14
Topminnows	0-3	2	0.01	4-7	-	-	8	-	-	2	0.01	0.01	0.01
Darters	0-3	-	-	4-7	1	0.02	8	-	-	1	0.02	0.01	0.02
TOTAL		2	0.01		4	0.16		-	-	6	0.17	0.03	0.17
GRAND TOTAL		18,472	49.45		1,210	28.18		88	25.16	19,770	102.89	100.00	100.00
% OF TOTAL		93.43	48.06		6.12	27.39		0.45	24.55	100.00	100.00		

Table 6. Average weight and number of fish per acre taken from Washburn Lake during 1964 (3 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Largemouth bass	0-4	58	tr.	5-9	45	4.36	10	13	7.18	116	11.54	1.07	17.11
White crappie	0-4	1	tr.	5-7	1	tr.	8	-	-	2	tr.	tr.	tr.
TOTAL		59	tr.		46	4.36		13	7.18	118	11.54	1.07	17.11
<u>PANFISHES</u>													
Bluegill	0-2	9701	26.10	3-5	798	13.79	6	29	6.52	10,528	46.41	95.20	68.81
Warmouth	0-2	118	0.64	3-5	252	6.31	6	15	1.87	385	8.82	3.50	13.08
TOTAL		9819	26.74		1050	20.10		44	8.39	10,913	55.23	98.80	81.88
<u>COMMERCIAL FISH</u>													
Bullhead	0-4	4	tr.	5-8	5	0.68	9	-	-	9	0.68	0.08	1.01
TOTAL		4	tr.		5	0.68		9	-	9	0.68	0.08	1.01
<u>FORAGE FISH</u>													
Topminnows	0-3	5	tr.	4-7	-	-	8	-	-	5	tr.	0.05	tr.
TOTAL		5	tr.		-	-		-	-	5	tr.	0.05	tr.
GRAND TOTAL		9887	26.74		1101	25.14		57	15.57	11,045	67.45	100.00	100.00
% OF TOTAL		89.52	39.54		9.97	37.27		0.52	23.08	100.00	100.00		

Table 7. Average weight and number of fish per acre taken from Washburn Lake during 1965 (2 studies).

SPECIES	FINGERLING SIZE			INTERMEDIATE SIZE			HARVESTABLE SIZE			TOTAL		% OF TOTAL	
	Range	No.	Wt.	Range	No.	Wt.	Min. in.	No.	Wt.	No.	Wt.	No.	Wt.
<u>GAME FISH</u>													
Largemouth bass	0-4	35	0.49	5-9	30	4.09	10	16	8.19	81	12.77	1.66	24.01
Black crappie	0-4	8	0.10	5-7	1	0.05	8	-	-	9	0.15	0.17	0.28
White crappie	0-4	17	0.21	5-7	tr.	0.02	8	1	0.32	18	0.55	0.37	1.03
TOTAL		60	0.80		31	4.16		17	8.51	108	13.47	2.20	25.32
<u>PANFISHES</u>													
Bluegill	0-2	4290	8.24	3-5	354	10.33	6	63	15.26	4707	33.83	95.15	63.60
Warmouth	0-2	20	0.09		94	3.18	6	5	0.79	119	4.06	2.40	7.64
TOTAL		4310	8.33		448	13.51		68	16.05	4826	37.89	97.55	71.24
<u>COMMERCIAL FISH</u>													
Bullhead	0-4	3	0.02	5-8	tr.	0.07	9	1	0.40	4	0.49	0.09	0.92
TOTAL		3	0.02		tr.	0.07		1	0.40	4	0.49	0.09	0.92
<u>ABOVE FORAGE SIZE</u>													
<u>FORAGE FISH</u>													
Golden shiners	0-3	-	-	4-7	1	0.15	8	5	1.18	6	1.33	0.12	2.50
Topminnows	0-3	2	0.01	4-7	-	-	8	-	-	2	0.01	0.04	0.02
TOTAL		2	0.01		1	0.15		5	1.18	8	1.34	0.16	2.52
GRAND TOTAL		4375	9.16		480	17.89		91	26.14	4946	53.19	100.00	100.00
% OF TOTAL		88.45	17.22		9.72	33.63		1.83	49.15	100.00	100.00		

bass reproduced lightly while the bluegill reproduced heavily. An F/C ratio of 5.3 and an A_t value of 30.0 was calculated for the population.

The studies conducted in 1963 revealed an increase in the standing crop of 35 pounds per acre over 1962. This increased weight was accounted for by fingerling- and intermediate-size bluegill. Ample reproduction of both bluegill and largemouth bass was found. An unchanged F/C ratio indicated a proportional increase in the standing crop of the piscivorous and non-piscivorous species. The A_t value dropped 34% to 19 and can be related to the increase in the intermediate and fingerling groups. White crappie, longear sunfish, and pirate perch were taken in the studies for the first time, Table 5.

In 1964, the standing crop dropped back to the level recorded in 1962 (68 pounds per acre), Table 6. Due to an over-abundant growth of aquatic plants a new study area had to be selected which had not been sampled in previous years, and in part may have been responsible for the decrease of 36 pounds per acre in the standing crop. Fingerling fish accounted for the largest part of the decrease, due to a greatly reduced spawn in 1964. The spawn of both piscivorous and non-piscivorous species during 1964 was moderate, however the carryover to the intermediate group was not indicated, reflecting either very heavy predation or very poor growth. The proportional characteristics (F/C, A_t) of the lake remained about the same as recorded in 1963.

In 1965, (final year of work on Washburn) the lake was supporting a standing crop of 53 pounds per acre, Table 7. The total number of fish present in the lake had dropped more than 50% while the total weight dropped only 19% (excluding the fingerling group). This along with an improved A_t value (41) seemed to indicate a definite improvement in the quality of the fishery.

Fertilization Studies

Figure 2 shows a comparison of the standing crop and the weight of harvestable fish (A_t), from 1962 to 1965. No population study data were available previous to fertilization.

During each of the four years the lake was fertilized approximately 40% of its surface area was covered with obnoxious aquatic plants. Consequently the added nutrients were growing plants which provided myriads of hiding places for the small fishes (which consequently took them out of the food fish chain) instead of affecting the growth of plankton that was needed not only to increase the productivity of the lake, but also to shade out the growth of the obnoxious weeds. In 1965 these plants were eradicated with sodium arsenite and an improvement in the fishery was noted.

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Figure 2. Standing Crop, and Weight of Harvestable Fish in Washburn Lake From 1962-1965.

