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THE TWENTIETH ANNUAL REPORT ON THE RIFLE RIVER RECREATION AREA, OGEMAW COUNTY, 1964[1]

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The Rifle River Recreation Area, site of the Rifle River Research Station, is a 4,318-acre tract of wooded land in northeastern Ogemaw County. Six lakes, several ponds, and 9.5 miles of trout streams are within its fenced boundary. Free permits are given to visitors at the entrance which they return upon leaving. Pertinent information on fish and game taken from the Area is recorded at the checking station.

Total attendance at this Area in 1964 amounted to 38,284 people, which exceeds the record total for 1963. Approximately 35 thousand (35,014) daily use permits were issued, of which 24,320 (69.4%) were for sightseeing, 6,420 (18.4%) for fishing, 4,167 (11.9%) for hunting, and 107 (0.3%) for trapping. Seven hundred and forty-one camps were established at the campground on Devoe Lake. Campers who fished or hunted on the Area were required to conform to the Area rules for the daily reporting of fishing and hunting activities.

As in previous annual reports, the major portion of this report concerns fisheries research. This section, which immediately follows,

* Institute for Fisheries Research Report No. 1714.

1 Contribution from Dingell-Johnson Project F-27-R-3, Work Plan No. 6, Michigan.

will provide Job Completion reports that are required annually for Federal Aid (Dingell-Johnson) projects, as well as furnish a continuing record of the work done at the station for the information of the Department of Conservation. A section at the end deals with hunting and trapping done on the Area in 1964.

Job No. 1.--Station correspondence, record keeping, and library maintenance

Records were maintained for the various research projects, station activities, and personnel. Station and personal library systems were kept current.

Job No. 2.--Construction and maintenance of equipment

Trap nets and other fishing gear were kept in repair. An inner lining of 1/2-inch mesh seine material was sewn into the bag of two trap nets for the purpose of retaining small fish. These nets proved to be effective for bluegills as small as 2.0 inches in Jewett Lake and yearling perch 3.0-5.0 inches long in Grebe Lake. On the other hand, fewer large fish were caught. The average catch of the latter in the modified nets was 8.3 fish per overnight set; 41.5 for the unmodified nets.

Job No. 3.--Study of relationship between trout populations, exploitation rates and fishing pressure

This job is divided into two segments: (1) stream creel census and (2) trout population studies.

(1) Stream creel census

A total of 2,880 fishermen spent 6,621.5 hours on the six trout streams in the Area in 1964 (Table 1). The 9.5 miles of streams in the Area have a surface area of about 34 acres. Fishing pressure amounted to 195.3 hours per acre and the average fishing trip lasted 2.3 hours.

Ninety per cent of the fishing was done by male anglers--76% by licensed males and 14% by unlicensed minor males; wives constituted 6.2%, unlicensed minor females 2.3%, and licensed females 1.3%.

Anglers caught 1,418 fish or 41.8 fish per acre. Nearly 93% of the catch was trout--1,293 wild trout and 25 hatchery trout. Of the wild trout, 1,251 were brown and 42 brook trout, which were caught at the rate of 38.1 fish per acre.

Of the 2,880 fishermen, about 16% were successful in catching at least one wild trout. About 85% of the Area fishing trips were made on the Rifle River, and 15% of them were successful. The poorest success occurred on Houghton Creek (7.8%) and the best percentage of success (49.3%) occurred on Vaughn Creek, one of the smaller streams.

Angling quality for all fish caught on Area streams was 0.17 fish per hour per angler; 0.15 for wild trout. The angling quality for

Table 1.--A summary of angling on the trout streams of the Rifle River Recreation Area in 1964

Stream	Area (acres)	Number of anglers	Hours of fishing	Number of fish caught			
				Hatchery-reared trout	Native fish		Total
					Wild trout	Others	
Rifle River	22.8	2,461	5,796.0	3	1,036	91	1,127
Gamble Creek	5.9	206	338.5	21	80	8	88
Houghton Creek	0.9	90	165.5	-	14	-	14
Vaughn Creek	0.9	73	254.0	1	150	-	150
Diversion	0.8	43	57.5	-	9	1	10
Oyster Creek	2.6	7	10.0	-	4	-	4
Totals	33.9	2,880	6,621.5	25	1,293	100	1,393

wild trout varied from 0.07 for Houghton Creek to 0.46 fish per hour per angler for Vaughn Creek.

Rifle River.--In 2,461 trips, fishermen spent 5,796 hours on the river. This is equivalent to about 254 hours per acre, a fishing intensity nearly identical to that of 1963. Of the 1,036 wild trout harvested, 1,025 were brown and 11 were brook trout (Table 2). The catch of wild trout was 45.4 fish per acre, which represented a 61.6% increase over the previous year when the yield was 28.1 fish per acre.

Approximately 15% of the fishermen were successful in catching at least one wild trout compared to 11% in 1963. Angling quality for wild trout was 0.13 fish per hour per angler in 1964 and represented a significant improvement over 1963 (0.08).

As in the past, 2- and 3-year-old brown trout were predominant in the catch (91.1%) from the river. The main difference in the age composition from the previous year was the greater contribution of 2-year-old brown trout to the 1964 catch.

As in 1963, hatchery trout were not stocked in the Area portion of the river in 1964. As a result, their contribution to the catch in 1964 (and 1963) was insignificant. Only three hatchery trout were caught in 1964. One came from a 1964 planting in Devoe Lake, and two presumably were from plantings in the Rifle River below the Area.

In addition to trout, four other species of fish were caught in the Rifle River. Eighty-seven of the 91 fish in this category were white suckers.

Table 2.--Number of fish of different species caught in six streams of the Rifle River Recreation Area in 1964

Kind of fish	Stream						Total number of fish	Percentage of total catch
	Rifle River	Gamble Creek	Houghton Creek	Vaughn Creek	Diversion	Oyster Creek		
Brown trout								
Native	1,025	68	13	132	9	4	1,251	88.2
Hatchery	1	2	-	1	-	-	4	tr [a]
Rainbow trout								
Hatchery	2	19	-	-	-	-	21	1.5
Brook trout								
Native	11	12	1	18	-	-	42	3.0
White sucker	87	-	-	-	1	-	88	6.2
Carp	2	-	-	-	-	-	2	tr
Northern pike	1	-	-	-	-	-	1	tr
Bluegill	1	-	-	-	-	-	1	tr
Yellow perch	-	5	-	-	-	-	5	tr
Pumpkinseed	-	3	-	-	-	-	3	tr
Total	1,130	109	14	151	10	4	1,418	-
Percentage of total Area catch	79.7	7.7	0.9	10.6	0.7	tr	-	-

[a] tr = less than 0.5%.

Gamble Creek. --Although this stream ranks second to the Rifle River in length and surface area, it is not fished intensively. Fishing pressure amounted to 57.4 hours per acre in 1964 as compared to 254.2 for the Rifle River. Fishing pressure on Gamble Creek was up slightly (9.5%) over that of 1963. The catch of wild trout in 1964 consisted of 68 brown and 12 brook trout, or 13.6 trout per acre, a 60% increase over 1963. Three-year-old fish comprised 56% of the catch of wild brown trout (Table 3). Seventeen per cent of the anglers were successful in catching at least one wild trout. Angling quality equalled 0.21 fish per hour per angler.

Approximately 20% of all the trout caught were of hatchery origin--19 rainbow and 2 brown trout. The rainbow trout came from a spring planting of 1,000 legal-length fish in Devoe Lake in 1964. The brown trout came from fingerling plantings in Gamble Creek in 1960 and 1961.

Houghton Creek. --Ninety fishermen spent 165.5 hours on the one-quarter mile of stream within the Area, and they caught 13 wild brown trout and 1 brook trout. Pressure and catch were down slightly from 1963 when 105 anglers harvested 25 wild brown trout and 2 hatchery trout. Angling quality amounted to 0.07 fish per hour per angler, the poorest of any Area stream in 1964.

Vaughn Creek. --Fewer anglers (73) fished this stream in 1964 than in 1963 (87) but the average trip lasted 3.5 hours in 1964, compared to 2.2 hours in 1963. Consequently, total effort was about 31% greater

Table 3.--Number (N) and percentage (P) of native brown trout of different age groups caught in streams of the Rifle River Recreation Area in 1964

Age group	Stream											
	Rifle River		Gamble Cr.		Houghton Cr.		Vaughn Cr.		Diversion		Oyster Cr.	
	N	P	N	P	N	P	N	P	N	P	N	P
I	14	1.7	-	-	-	-	1	0.8	-	-	-	-
II	535	62.7	11	18.6	7	53.8	45	37.2	5	62.5	1	25.0
III	242	28.4	33	56.0	4	30.8	55	45.5	3	37.5	3	75.0
IV	53	6.2	12	20.3	2	15.4	19	15.7	-	-	-	-
V	8	0.9	3	5.1	-	-	1	0.8	-	-	-	-
VI	1	0.1	-	-	-	-	-	-	-	-	-	-
Totals	853		59		13		121		8		4	
Total catch[a]	1,025		68		13		132		9		4	

[a] Includes fish for which age was not determined.

in 1964. Fishermen caught 150 wild trout (132 brown and 18 brook), an increase of 183% over the previous year, but nearly identical to the catch of 1962. Only one hatchery trout was caught in 1964. The largest portion of the catch of wild brown trout in 1964 consisted of 3-year-old fish (45.5%); these and 2-year-olds comprised nearly 83% of the total. Of the 16 brook trout that were aged, 11 were 2 years old and 5 were 3 years old. Almost half of the fishermen were successful in catching at least one wild trout, whereas only 18% were successful in 1963. The catch per hour per angler for wild trout was 0.46 fish (Table 4), a marked improvement over 1963 when it was 0.18.

Diversion. --As in 1962 and 1963, angling pressure in 1964 was light and the catch small. Forty-three anglers fished 57.5 hours here in 1964 and caught nine wild trout. Angling quality was 0.21 fish per hour per angler.

Oyster Creek. --This stream contributes very little to the trout fishery of the Area. Seven anglers fished here 10 hours and caught four wild brown trout.

All Streams. --In general, there was very little difference in angling pressure on the Area streams between 1964 and 1963. The number of anglers and hours fished in 1964 increased 2.3% and 0.6%, respectively, over that of 1963.

The yield of wild trout in 1964 (1,293) was about 67% greater than that in 1963 and is the highest on record since 1959. The increase in 1964 is attributed largely to the greater catch of 2-year-old brown

Table 4.--A summary of angling quality for native trout on the trout streams of the Rifle River Recreation Area in 1964

Stream	Trout caught per acre of stream	Catch per hour per angler	Percentage fishermen successful
Rifle River	45.4	0.13	15.1
Gamble Creek	13.6	0.21	17.0
Houghton Creek	15.6	0.07	7.8
Vaughn Creek	166.6	0.46	49.3
Diversion	11.2	0.21	11.6
Oyster Creek	1.5	0.31	42.8
Average	38.1	0.15	15.8

trout in the Rifle River and, to a lesser extent, of 2- and 3-year-old brown trout in Vaughn Creek. The 1964 yield amounted to 38.1 trout per acre. Relatively few yearling brown trout were caught. Two-year-old trout made up the largest portion of the catch in the Rifle River whereas 3-year-olds comprised the greater part of the catch in Vaughn Creek and Gamble Creek. Angling quality was 0.15 trout per hour per angler in 1964, a marked improvement over the 0.08 in 1963.

Area streams were not stocked with trout in 1963 and 1964. Their contribution to the total trout catch was less than 2% in 1964; approximately 4% in 1963.

Whirlpool. --A few hundred feet below Devoe Lake dam is a shallow, 0.6-acre pond which is broadly connected to the Rifle River. Carp and northern pike inhabit the pond, along with other species of fish, and provide some fishing interest. In 364.5 hours of angling here in 1964, 184 fishermen caught 24 carp, 7 white suckers, and 6 northern pike.

(2) Trout population studies

The Petersen mark-and-recapture method was used to estimate populations of native brown trout in portions of certain streams in the Area. Estimates were obtained before and after the fishing season in 1964 for Section D of Gamble Creek (Mallard Pond to north boundary of the Area) and three segments of the Rifle River--Section B (Devoe Lake bridge to mouth of Houghton Creek), Section A (mouth of Houghton Creek

to 'Big Pines'), and Section J ('Big Pines' to terminal loop at the south end of the Rifle River Road). The post-season studies also included an estimate for Houghton Creek in the Area. Estimates were obtained for Section D of Gamble Creek and Section B of the Rifle River in the spring of 1965. Estimates for the latter section were of dubious value because of the exceptionally poor recovery of marked fish. High water levels in the spring of 1965 precluded pre-season estimates for Houghton Creek and Sections A and J of the Rifle River.

As in the past, there was little exploitation of brown trout in Section D of Gamble Creek during 1964. The 1964 pre-season estimate was 973 brown trout, including 331 of legal size. Anglers' exploitation of the legal size trout (Age II-V) amounted to 8.2% compared to 10.2% in 1963. The distribution of the brown trout (legal size) by age groups is shown in the table below.

	Age-group			
	II	III	IV	V
1964 spring estimate	77	180	60	14
1964 catch	6	15	5	1
1964 fall estimate	179	78	11	0
Exploitation (%)	7.8	8.3	8.3	7.1

Between April and September of 1964 the percentage of all trout lost from mortalities and migration out of Section D for each age group (except Age 0) was: I, 41.2%; II, 8%; III, 55.1%; IV, 81.7%; V, 100%.

The smallest turnover in the population occurred among Age-II fish. Yearlings had the greatest numerical loss, followed by Age-III fish.

Over-winter total mortality between September, 1964 and April, 1965 for each year class was: 1964--12%; 1963--22.4%; 1962--53.5%; 1961--36.2%; 1960--90.9%. The 1964 year class showed an unusually small loss. Conceivably, recruitment into Section D occurred in early spring from upstream and masked mortality. Age-II fish (1962 year class) were the most stable segment of the population in 1964 but showed a rather large over-winter loss.

The 1964 pre-season estimate of legal-length brown trout in Section B of the Rifle River was 26.2 fish per acre. Anglers harvested 3.2 trout per acre. The post-season estimate was 36.2 trout per acre. Based on the 1964 pre-season estimate of Age-II and older fish of legal size, the exploitation rate was 12.4%. Percentage of exploitation by age groups was: II (18.6), III (5.6), IV and V (none).

Recruitment of brown trout, mostly from migrants, in Section B of the Rifle River occurred between the spring and fall of 1964 as shown below:

	Age group						
	0	I	II	III	IV	V	IX
Spring estimate	-	6	78	36	7	2	1
Angler catch	-	-	11	2	-	-	-
Fall estimate	44	68	125	16	1	-	-

The fall estimate was 117% greater than the spring estimate (minus the anglers' catch). This recruitment occurred among age groups 0, I, and II.

The brown trout population in Sections A and J of the Rifle River, as in Section B, is maintained by immigration because reproduction in the river is negligible. This recruitment is demonstrated in the table below:

	Age group							
	0	I	II	III	IV	V	VI	VII
Section A								
Spring estimate	-	141	739	197	39	3	1	-
Angler catch	-	14	343	154	32	8	-	-
Fall estimate	250	575	659	62	8	3	-	-
Section J								
Spring estimate	-	35	366	252	59	17	5	3
Angler catch	-	1	307	127	25	-	1	-
Fall estimate	13	221	346	39	5	-	-	-

The fall estimate for Section A exceeded the spring estimate (minus the catch by anglers) by about 174%. The greatest influx of trout occurred among age groups 0-III. Recruitment into Section J was somewhat smaller than for upstream Section A. The fall estimate was approximately 126% greater than the spring estimate, less the anglers' catch. Recruitment involved age groups 0-III.

Approximately 1,000 (996-1,000) fingerling brown trout (Age 0) were planted in Section D of Gamble Creek in the fall of 1959, 1960, and 1961. Fall estimates of these populations were made annually until their extinction. Maximum survival was to the fifth year of life (Age IV). The greatest numerical loss of fish occurred during the first year after planting. First year loss for the three plantings averaged 87.3% (unweighted). In subsequent years the annual total mortality was: I-II, 88.2%; II-III, 74.7%; III-IV, 72.2%. Most of the trout reached legal size (7.0 inches) in their third year (Age II). Average annual increments of growth for the first 4 years of stream life were 2.6, 2.2, 2.0, and 1.1 inches, respectively.

Fishing pressure on Gamble Creek ranged between 45.8 and 62.4 hours per acre during the years these fish were of legal size. Anglers recovered between 0.5% and 1.5% of the three plantings. That some of these trout moved out of the stream was snown by captures in Houghton Creek, Rifle River, and Vaughn Creek.

Job No. 4.--Fish production and its utilization in small warm-water lakes

There are two segments to Job No. 4: (1) creel census statistics and (2) calculations of production and maximum sustained yield.

(1) Creel census statistics

A virtually complete record of fishing activity on the individual lakes and ponds was kept again in 1964 in order to have a record of fishing

pressure and exploitation. In 10,617 hours of fishing, anglers caught 5,078 fish (1,291.1 pounds) from 6 of the Area lakes (Table 5). On the average, 24% of the anglers caught and kept at least one fish, and the average catch per hour was 0.48. Yellow perch comprised 55.5% of the catch, bluegills 19.2%, and black crappies 6.0%. None of the other 11 kinds of fish comprised as much as 5.0% of the catch. Only two fish (bluegills) were caught in Jewett Lake; none in South Pond. Both of these small lakes contain experimental plantings of bluegills (see Job No. 8).

Devoe Lake.--In 2,028 trips, anglers fished 5,955 hours and caught 2,850 fish (576.8 pounds). This harvest amounted to only 4.4 pounds per acre, despite the fact it was the largest catch from any Area lake (Table 5). Yellow perch (mean length, 6.9 inches) accounted for three-fourths of the total catch that included 13 kinds of fish (Table 6). The average length of the bluegills and crappies was 6.5 and 9.3 inches, respectively.

One thousand legal-size rainbow trout, from which the left pelvic fin was removed, were planted in Devoe Lake April 15, 1964. Only 149 of these fish (14.9%) and 1 rainbow from the 1963 planting were caught during the year. During the past 5 years the proportion of spring-planted trout caught has ranged between 8% and 21%.

Fifty-eight per cent of the trout caught were captured in May by trolling with worm and spinner. Forty-two per cent of the anglers still-fished with worms and caught 56% of the fish--mostly perch. Only 15 fish

Table 5.--The fishing pressure, yield, and fishing quality on the lakes in the Rifle River Recreation Area in 1964

Lake	Fishing pressure				Yield				Fishing quality	
	Number of fishing trips	Trips per acre	Hours of fishing	Hours per acre	Number of fish	Fish per acre	Pounds of fish	Pounds per acre	Catch per hour	Percentage fishermen successful
Devoe	2,028	15.6	5,955	45.8	2,850	21.9	576.8	4.4	0.48	23
Grebe	620	8.6	1,599	22.1	696	9.6	263.1	3.6	0.44	25
Grousehaven	576	6.1	1,594	16.8	243	2.6	88.4	0.9	0.15	11
Lodge	329	19.6	855	50.9	692	41.2	161.6	9.6	0.81	33
Scaup	196	33.8	573	98.8	595	102.6	200.2	34.5	1.03	61
Jewett	14	1.1	23	1.8	2	0.2	1.0	0.1	0.08	7
South Pond	16	12.3	18	13.8	0	-	-	-	-	0
Total or average	3,779	-	10,617	-	5,078	-	1,291.1	-	0.48	24

Table 6.--Species composition by number (N) and weight (W) in pounds of the catch from five lakes on the Rifle River Recreation Area in 1964

Species	Lake										Area totals
	Devoe		Grebe		Grousehaven		Lodge		Scaup		
	N	W	N	W	N	W	N	W	N	W	N
Yellow perch	2,129	255.0	500	69.0	151	16.3	27	2.9	11	2.1	2,818
Bluegill	250	46.7	-	-	18	4.1	322	36.7	385	76.5	975
Rock bass	97	19.6	-	-	35	4.6	8	1.7	1	0.4	141
Black crappie	117	51.0	163	108.6	7	2.6	15	3.3	10	2.7	312
Rainbow trout	150	71.3	-	-	-	-	-	-	-	-	150
Northern pike	15	61.5	33	85.5	4	29.2	7	28.2	31	63.2	90
Largemouth bass	27	24.1	-	-	6	5.5	54	47.7	24	25.3	111
Smallmouth bass	18	18.3	-	-	15	22.0	-	-	-	-	33
Pumpkinseed	27	4.3	-	-	3	0.6	31	3.6	63	11.2	124
Bullheads	-	-	-	-	-	-	219	35.7	31	8.3	250
Brown trout	10	18.1	-	-	-	-	-	-	-	-	10
Sucker	7	6.7	-	-	2	2.9	-	-	-	-	9
Bluegill x Pumpkinseed	1	0.2	-	-	2	0.6	9	1.8	39	10.5	51
Longear sunfish	2	0.1	-	-	-	-	-	-	-	-	2
Totals	2,850	576.9	696	263.1	243	88.4	692	161.6	595	200.2	5,076

were caught by casting with artificial lures in 386 hours of effort. Sea lamprey scars were observed on two brown trout and two rainbows.

Grousehaven Lake.--As usual, angling success in this marl lake was the poorest of any lake on the Area. Two hundred and forty-three fish were caught in 1,594 hours of fishing (Table 5). Perch dominated the catch of 10 species (Table 6), and their average length was 7.2 inches. Anglers who still-fished with worms caught 83% of the fish.

Grebe Lake.--In 620 trips, anglers fished 1,599 hours and caught 696 fish that weighed 263.1 pounds (Table 5). Twenty-five per cent of them caught at least one fish. Grebe Lake contains only three species of game fish. Perch (average length, 7.0 inches) comprised 72% of the catch. The mean length of the crappies was 10.4 inches, and that of pike, 23.3 inches. Ninety-six per cent of the perch were 2 years old, whereas 3-year-olds (83%) dominated in the crappie catch. Age groups II and IV each made up one-third of the pike catch.

Many fish were marked in the spring of 1964 for a population estimate. The percentage of marked perch and crappies recovered by anglers (shown below) is equivalent to the estimated exploitation rate. For pike, the proportion of fish marked in the fall of 1963 that were subsequently caught in 1964 suggests the harvest rate. Ice fishermen accounted for half of the total catch of pike.

Species	Minimum length (inches)	Number marked	Number of marked fish caught	Percentage of recovery
Crappie	7.0	1,085	74	6.8
Perch	7.0	224	13	5.8
Pike	20.0	59	13	22.0

Lodge Lake.--One-third of the anglers on Lodge Lake succeeded in catching at least one fish. In 855 hours of angling they caught 692 fish (161.6 pounds) (Table 5). Bluegills and bullheads comprised 78% of the catch (Table 6) of nine species. The average length of the bluegills was 5.7 inches. More largemouth bass (54) were caught here than from any other Area lake, and this catch slightly exceeded the 1963 high yield (52). Still-fishing with worms accounted for 70% of the total catch.

Scaup Lake.--This small lake (5.8 acres) showed the best fishing quality of the six lakes and also produced the highest yield (34.5 pounds per acre). Bluegills comprised 65% of the catch of nine species; average length was 6.5 inches. The 1964 statistics show a marked change from those of 1963 when only 20 anglers caught 12 fish here. Winter oxygen depletion frequently occurs in Scaup Lake but this has not happened since the winter of 1961-62.

(2) Calculation of production and sustained yields

This segment involves the preparation of a manuscript on bluegill production and sustained yield with data collected between 1957 and 1962 from Jewett and Lodge lakes. A brief summary was included in the report for the preceding year (Research and Development Report No. 19). The first draft was rewritten and shortened but the paper has not been completed.

Job No. 5.--Study of systematic errors associated with multiple census population estimates

A total of 24 population estimates have been made for the lakes at this station during the past 8 years, 3 of which were made during this fiscal year. No work was done this year on analysis of these data to find systematic errors.

Job No. 6.--Evaluation of watershed and stream improvement practices.

A final report on this job is being edited.

Job No. 7.--Study of lakes subject to extreme oxygen depletion

During the winter of 1964-65, periodic checks were made on five of the Area lakes to determine the oxygen content of the water at various depths. The purpose of this sampling was to obtain estimates of the mean daily amount of oxygen consumption--especially during the fore part of the winter when the oxygen supply sometimes declines to critical levels. Such quantitative data could be useful for the development of methods to overcome winterkill of fish. The work plan virtually duplicated that reported for the winter of 1963-64. Data on weather conditions and snow depth also were recorded. Grebe and Lodge lakes were sampled nine times between December 4, 1964 and April 8, 1965. The other

lakes were sampled four to seven times. The first samples were taken as soon as it was safe to walk on the ice. The elapsed time between freeze-up and the first sampling was 12 days for 4 lakes and 19 days for Grebe Lake.

Oxygen depletion was detected only in Devils Washbasin. The winter of 1964-65, like that of the previous year, was relatively mild. Total snowfall between December 1 and March 31 amounted to 58.4 inches, as compared with 32.4 inches in 1963-64. Despite the 62% increase in snowfall, less oxygen was consumed in 1964-65 (Table 7). The mean daily consumption ranged from 0.08 to 0.34 pound per acre-foot of water, whereas in 1963-64 the range was 0.26 to 0.98 pound. These data were computed for the period between the first sampling date and the date when the least amount of oxygen was found just beneath the ice.

Other aspects of this job entailed observation on the survival capabilities of the special population established in Grebe Lake and a fall population estimate of Lodge Lake. In Grebe Lake, pike, perch, and black crappies were planted several years ago to test their ability to survive low oxygen tension. No critical oxygen level developed in the upper stratum in the winter of 1964-65. The lowest oxygen determination at the 5-foot depth was 5.5 ppm on February 1. The fall population in Lodge Lake was estimated because if a winterkill had occurred an idea of the magnitude of the mortality could be obtained by estimating the number of survivors in the spring and determining the difference. However, no winterkill occurred, although the oxygen declined to 2.2 ppm at the 5-foot depth on February 24.

Table 7.--Estimated mean daily amounts of oxygen consumption beneath the ice for five lakes on the Rifle River Recreation Area during the period of oxygen decline

Lake	Winter	Period of decline (days)[a]	Oxygen consumption per day		
			Pounds	Pound per acre-foot	Mg/l
Lodge	1963-64	42	40.2	0.53	0.59
	1964-65	82	25.7	0.34	0.51
Grebe	1963-64	44	154.0	0.98	0.68
	1964-65	75	52.0	0.20	0.25
Jewett	1963-64	52	35.5	0.38	0.21
	1964-65	103	7.8	0.08	0.09
South Pond	1963-64	64	2.95	0.29	0.28
	1964-65	103	0.86	0.08	0.16
Devils Wash-basin	1963-64	78	2.6	0.26	0.28
	1964-65	103	2.2	0.22	0.22

[a] Number of days between first sampling date and date of lowest oxygen value at water surface.

Estimates of the fall population in Lodge Lake are shown in Table 8. These estimates were computed from data acquired by trap netting between October 6 and November 2. Nets were moved periodically between randomly chosen, numbered sites. DeLury's modification of the Schumacher method was used for the calculations. Bluegills comprised 79% of the population of 10 species.

Job No. 8.--Development and management
of bluegill populations in warm-water lakes

The original intent was to utilize South Pond as well as Jewett Lake for this research, and the Belmont Ponds near the Hastings Research Station were to be involved in a similar investigation (see also Work Plan No. 3, Job No. 10). However, in the spring of 1965 it was discovered that South Pond was contaminated with other species for the second time. Thus, after two attempts to establish a bluegill-only population here, it was decided to abandon this site. Its proximity to Devoe Lake and the danger of interconnection at a time of high water, plus the establishment of a public campground near by, influenced this decision.

An estimate of the population in Jewett Lake was made from trapping data accumulated between May 4 and June 16, 1965 (Table 9). Four trap nets were fished from May 4 to June 2 for adult fish. Between 16 and 20 small hardware-cloth traps were fished from May 25 to June 16 for small fish (less than 4.0 inches). A trap net with an inner lining of

Table 8.--The estimated population of fish in Lodge Lake, October 1964

Species	Inch group [a]	Population estimate [b]	Confidence limits (P = 0.95)
Bluegill	4.0- 4.9	12,635	10,310-16,390
	5.0- 5.9	12,015	10,990-13,330
	6.0- 6.9	505	430- 615
	7.0- 7.9	19	11- 71
Pumpkinseed [c]	4.0- 4.9	1,485	1,200- 1,935
	5.0- 5.9	395	345- 460
Black bullhead	6.0- 7.9	2,540	2,320- 2,820
	8.0- 8.9	2	2- 2
Brown bullhead	5.0- 6.9	120	100- 150
	7.0- 8.9	67	60- 78
	9.0-11.9	14	14- 14
Rock bass	5.0- 5.9	205	155- 295
	6.0- 6.9	63	54- 75
Perch	6.0- 6.9	1,465	400- ?
	7.0- 8.9	39	27- 68
Black crappie	6.0- 9.9	360	250- 655
Northern pike	16.0-29.9	38	24- 92
White sucker	12.0-17.9	88	55- 250
Total estimate		32,055	

[a] Other fish marked for which no estimates could be made included: Bluegill (3"), 250; pumpkinseed (3"), 13; (6"), 6; rock bass (4"), 10; largemouth bass (< 10"), 55; (> 10"), 12.

[b] Values over 100 rounded to the nearest unit of 5.

[c] Bluegill x Pumpkinseed hybrids included. They probably comprised less than 10% of the total "pumpkinseed" estimate.

Table 9. --The estimated bluegill population of Jewett Lake, May-June, 1965

Source	Inch group	Estimate[a]	Confidence limits (P = 0.95)
1963 planting	8.0-9.9	14	13- 15
1963 year class	2.0-3.9	35,370	31,650-40,080
1963 year class	4.0-5.9	225	170- 330
1964 planting	5.0-8.9	230	215- 245

[a] Values over 100 rounded to the nearest unit of 5.

1/2-inch mesh (see Job No. 2) also was especially effective for small bluegills. A total of 7,265 bluegills in the 2- and 3-inch groups were marked.

The 1964 spring estimates showed that only 16 adults had survived the initial stocking of 150 bluegills in 1963, and the 1965 estimates substantiated this result. Two of these bluegills were caught by anglers in 1964. An undetected residue of toxaphene is believed to have caused heavy mortality, which probably occurred before the fall of 1963 because only 13 of these fish were captured in nets set in October that year. In May 1965 there were 230 survivors of the 1964 planting of 307 additional adult bluegills. The 1964 estimate of the 1963 year class was 22,827 (20,367-25,974); the length of these fish ranged from 1.7 to 2.9 inches. That this year class was underestimated (smaller fish no doubt avoided or escaped the traps) is borne out by the larger estimate (35,595) in 1965. No yearlings (1964 year class) were caught in 1965.

Approximately 50% of the 1963 year class (18,000 fish under 5.0 inches) were removed from the lake during June 17-25, 1965. These fish were captured with dip nets after being stunned with electricity. The electrofishing equipment consisted of a 3-phase a-c generator, a specially constructed power output control unit, and a boom shocker boat. An average output of 3 amps in fairly soft water (specific resistance = 9,200 ohms at 80 F), at temperatures between 65-77 F, effectively narcotized the fish. These fish were captured in 24 hours of actual

"shocking" time. Collecting at night was about twice as effective as daytime collecting. The number of fish removed was estimated from the total weights after several samples of 100 fish were weighed. The effects of this thinning operation will be measured in terms of growth, survival, and reproduction rates. It is interesting to note that about 225 bluegills of the large 1963 brood grew twice as fast as the other 35, 370 fish.

Job No. 9.--Preparation of a report on the movement of fish in Area streams and connecting lakes

No work was done on the report during this segment.

Job No. 10.--Development of electronic fishing gear

Development of new electrical fishing gear, with respect to this job, depends entirely on the time available to a retired electronics engineer who has volunteered his services. Our role is that of testing and applying the models that Mr. C. H. Harris designs and builds. Due to other committments, and especially the development of telemetry for the game research staff, only limited progress was made on electro-fishing devices. However, Mr. Harris did devise a battery-operated stream-type shocker that is more effective than the capacitor-discharge

unit built in 1963-64. The output of this device, which is equipped with an inverter, is a pulsed direct current that produces a square wave with an 8% duty cycle and a pulse duration of one millisecond. This unit is more versatile than the other in that it is limited less by resistance in the water--an important consideration. It stores no energy, and turns itself on and off independently of the electrode system. Twenty-four volts (from two automobile batteries) are required to increase the voltage so that the ampere ratio is lower, thereby facilitating the switching of current due to varied resistances encountered in water. This "inverter" unit is heavier than the capacitor-discharge device because it requires a sophisticated transformer. The bottleneck that delays acquisition of a finished product is finding a manufacturer willing and able to design and build the specialized transformer. Two trials of the new unit in Gamble Creek in April 1965 demonstrated that it can be very effective in small streams.

Several trials were made on Grebe Lake in July 1965 with two different arrays of electrodes hung from a boom in front of the boat. The power source was a Kohler 3-phase, 2,500-watt a-c generator which also can produce direct current. For this generator, Mr. Harris built a 3-phase rectifier and control unit which permitted a choice and the regulation of power output. It is important to be able to control the voltage in order to regulate the current output to the electrodes, the maximum of this equipment being 7.5 amps (a-c) or 9 amps (d-c). The number of watts needed depends, of course, on the water resistance. The specific resistance

of Grebe Lake water at 80 F amounted to 4,200 ohms, and that of softer Jewett Lake was 9,000 ohms.

The more effective array was that of five electrodes hung from two booms crisscrossed in the center (X-shaped), one electrode suspended from the center and one from each extremity. Alternating current was more effective than direct current. Results on Grebe Lake illustrated the effectiveness of this gear for collecting small fish. When the night trials were conducted on Grebe Lake, 10 hardware-cloth traps were fished for 3 nights in the same areas where the shocking was done. The total catch by traps was 10 yearling perch (2.5-5.5 inches) and one 5.2-inch pike. In 50 minutes of shocking, two people picked up 76 young-of-the-year perch, 78 yearling perch, 4 fingerling black crappies, and numerous golden shiners.

This equipment was used successfully for the removal of small bluegills from Jewett Lake in June 1965 (see Job No. 8). Three amps was the maximum output used for the soft water of Jewett Lake. The small fish were also successfully narcotized by two amps, but were stunned only momentarily by one amp. In contrast, outputs of five and six amps were used in Grebe Lake for various sizes of perch, pike, and crappies.

A major problem associated with collecting with shockers in lakes--that of drawing fish up from water deeper than about 4 feet--remains unsolved. Possibly a physiological barrier is involved which cannot be overcome. The solution to sampling at greater depths may very well lie in the use of electrified trawls.

Job No. 11.--Experimental management of a warm-water fishery for maximum equilibrium yield

A rather intensive study of population dynamics in Grebe Lake has been underway since 1962. The previous work on this lake was summarized in the annual report on the first segment of Work Plan No. 6, under Jobs 5 and 6, and under Jobs 4 and 5 in the annual report on the second segment. During the third segment, Job No. 11 was established to cover all of the work pertaining to the population dynamics of this lake except for creel census information (Job No. 4).

A spring population estimate was made in 1965 for the fourth consecutive year, in April 1965. Trapping activities were started on April 26--2 weeks later than in 1964 because the lake stayed frozen until the 23rd. Seventy numbered trap sites were established previously around the perimeter of the lake and the open-water sites were located on a map of the lake. Traps were moved as frequently as possible to randomly selected sites during the period of April 27-May 18. Eight trap nets were fished the first week, but only six were used thereafter. Two of the nets were equipped with an inner lining of 1/2-inch mesh. Twenty small hardware-cloth traps were used for young-of-the-year perch. Estimates of the perch, pike, and crappie populations were made by inch groups by using the DeLury modification of the Schumacher method. Confidence limits at the 95% level were computed for each

estimate. These estimates were then converted to year class abundance, based on the ratio of age groups determined for the inch groups from a series of scale samples. Estimates also were made of the sex composition of the population.

The recoveries of fish marked in previous years were recorded, and ovaries were collected from perch and crappies. All black bullheads captured were removed from the lake. This removal amounted to 1,100 pounds or approximately 10,600 fish. A plan to remove 50% of the pike to improve growth was not carried out when it was discovered there was a large population of yearling perch in the lake. Table 10 shows the basic population estimates and their confidence limits. Estimates on abundance of year classes are presented in Table 11.

Scale samples taken from trap net catches in October 1964 supplemented those taken during the spring netting period in 1965. Growth computations (annual, seasonal, and instantaneous) have been completed to date. Length-weight relationships have also been computed for the three species, but mortality rates have not been worked out. Additional information on the population in the form of food habits of perch and crappies (see Job No. 12) and egg production data is being acquired. The incidence of tapeworm infestation has been recorded for pike found dead in the net leads. Maximum equilibrium yield calculations are to be made using these population data and adjustments will be made in the population to see if Ricker's method of calculation can be used for predictable results. Periodic collections were made in the summer of 1965.

Table 10.--Grebe Lake population estimates, April-May, 1965 [a]

Yellow perch		Black crappie		Northern pike	
Inch group	Estimate	Inch group	Estimate	Inch group	Estimate
3.0- 3.9	44,875 (33,330-68,490)	7.0- 8.9	1,285 (1,200-1,380)	14.0-16.9	1,460 (980-2,875)
4.0- 5.9	12,640 (6,280- ?)	9.0- 9.9	225 (210-250)	17.0-18.9	255 (220- 300)
6.0- 7.9	6,540 (4,405-12,660)	10.0-12.9	1,045 (1,010-1,085)	19.0-19.9	180 (160- 215)
8.0-10.9	245 (185- 360)			20.0-21.9	290 (250- 340)
11.0-11.9	27 (22- 36)			22.0 and over	155 (135- 185)
12.0-12.9	16 (?)				

[a] Values over 100 rounded to the nearest unit of 5; 95% confidence limits in parentheses.

Table 11.--Estimated abundance of year classes in Grebe Lake, April-May, 1965 [a]

Species	Year class					Original stock	Totals
	1964	1963	1962	1961	1960		
Yellow perch	44, 875	12, 640	6, 730	90	-	10	64, 345
Black crappie	?	?	1, 400	1, 160	-	1	2, 560
Northern pike	?	1, 565	670	50	34	3	2, 320
Total							69, 225

[a] Values over 100 rounded to the nearest unit of 5.

Job No. 12.--Bottom fauna populations in the lakes at the Rifle River Research Station and their utilization by certain species of fish

In previous annual reports this work was reported under Job. No. 4. This year it seemed appropriate to place the work on bottom fauna and stomach analyses under one job (No. 12) since one aspect of this job is to compare the benthos crop with its utilization by fish, particularly in the intensively studied lakes.

Sampling of bottom fauna this year was confined to 20 samples taken in Scaup Lake in December 1964. The number of samples collected within each 5-foot contour interval was apportioned according to the ratio of the area of the interval to the total area of the lake. This sampling was done as part of a program to compare standing crops among Area lakes and before it was decided that research activity will continue on only three Area lakes after 1965. These samples, and those collected from Jewett and Grebe lakes in 1963, were processed in 1965. "Processing" included sorting the organisms, identification to a major taxonomic group, counting, and volumetric measurements.

Stomachs from 81 bluegills collected in 1962 and 1963 from Jewett Lake were examined. Stomachs collected from Grebe Lake fish in 1962 and 1964 totaled 38 crappies, 59 perch, and 44 bullheads. More were obtained in 1965 but have not been examined. Several dead pike in the leads and nets were examined in the field.

Hunting and trapping

Statistics on hunting and trapping done in 1964 are presented in Table 12. Data compiled by Richard J. Moran of the Game Division indicate the small game season was almost identical to that of 1963 with respect to hunting pressure and the kill of ruffed grouse and woodcock, but the squirrel and duck kills increased considerably.

Deer hunting results were summarized by Louis C. Ruch in Game Section Report No. 2466. Hunting pressure was somewhat lower than in 1963, although a record number of permits (670) was issued on opening day. There was an 18% decline in the legal buck kill from the previous year. A total of 33 legal bucks was taken. Total kill for the Area in 1964 was 125 deer. This figure includes 117 legal animals during the rifle season, 6 unclaimed deer found in the woods during the season, and 2 shot by archers. The oldest buck was 3 1/2 years old--a 10-pointer which weighed 147 pounds. Eighty per cent of the deer killed were shot during the first 3 days.

Twelve trappers used the 107 daily trapping permits issued in 1964. Their total take consisted of 28 muskrats, 19 beavers, and 1 otter.

INSTITUTE FOR FISHERIES RESEARCH

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Report approved by G. P. Cooper

Typed by M. S. McClure

Table 12.--Summary of hunting and trapping statistics for the Rifle River Recreation Area, 1964

Season and game species	Number of permits	Hunting hours or trap nights	Number of animals harvested
HUNTING			
Small Game	851	2,765	-
Ruffed grouse	-	-	101
Woodcock	-	-	87
Waterfowl	-	-	51
Squirrel	-	-	61
Snowshoe hare	-	-	6
Raccoon	-	-	4
Cottontail	-	-	4
Deer			
Gun [a]	2,727	12,183	117
Archery	495	1,850	2
TRAPPING	107	1,001	-
Beaver	-	-	19
Muskrat	-	-	28
Otter	-	-	1

[a] In addition to the kill shown, six unclaimed deer were found.