Biology of the Fishes of Ossokmanuan Reservoir, Labrador, 1976

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ABSTRACT

Bruce, W. J., and R. F. Parsons. 1979. Biology of the fishes of Ossokmanuan Reservoir, Labrador, 1976. Fish. Mar. Serv. Tech. Rep. 836: iv + 33 p.

Experimental gillnet sets on the Ossokmanuan Reservoir, Labrador, revealed *Coregonus clupeaformis* and *Catostomus catostomus* were the dominant fish species. Other species present included *Salvelinus namaycush, Esox lucius, Lota lota,* landlocked *Salmo salar, Prosopium cylindraceum* and *Catostomus commersoni. Coregonus clupeaformis* and *Catostomus catostomus* displayed an increase in mean length with increasing mesh size but lake trout and northern pike did not. Catch per unit of effort (kg/100 m of net/24 h) values for lake whitefish varied from 0 to 4.4, while trout values ranged from 0.3 to 16.7. Lake whitefish growth rate was slow and there was considerable overlap of ages for different length intervals; annual mortality rate was 0.4; age at first maturity ranged from 3 to 11 years; fecundity ranged from 967 (16.3 cm) to 20, 963 (46.0 cm). Lake trout growth was slow; age at first maturity was 10 years. Egg counts from 24 fish ranged from 1662 (50.9 cm) to 11,906 (78.8 cm).

Key words: Labrador, lake whitefish, lake trout, gillnet, growth, mortality, maturity, fecundity

RÉSUMÉ

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Les fillets maillants, mis dans le réservoir d'Ossokmanouane, au Labrador, à titre expérimentale, dévoilent le "Corégonus clupeaformis" et le "Catostomus catostomus" comme espèces dominantes. Les autres espèces présentes sont le "Salvélinus namaycush", le "Esox lucius", le "Lota lota", le "Salmo salar" d'eau douce, le "Prosopium cylindraceum" et le "Catostomus commersoni". La longueur moyenne du "Corégonus clupeaformis" et du "Catostomus catostomus" est proportionnelle à la dimension des mailles utilisées, ce qui n'est pas le cas avec le touladi et le grand brochet. Pour la grande corrégone, la prise par unité d'effort (kg/100 m de fillet et pour 24 h) a varié entre 0,0 et 4,4 et pour le touladi entre 0,3 et 16,7. En ce qui concerne le grand corrégone, son rythme de croissances était lent et il y a de considerable chevauchement des âges pour différents intervalles de longueur; son taux de mortalité était de 0,4; la maturité est atteint entre 3 et 11 ans; le nombre d'individus féconds varie entre 967 (16,3 cm) et 20963 (46,0 cm). Quant au touladi, son rythme de croissance est lent et la maturité est atteint qu'après 10 ans. Le nombre d'oeufs recensés chez 24 d'entre eux a été de 1662 (50,9 cm) au minimum et de 11906 (78,8 cm) au maximum.

INTRODUCTION

In 1973, Fisheries and Marine Service initiated a long-term program designed to inventory the fish resources of natural lakes and the Smallwood Reservoir in western Labrador. Investigations of Jacopie Lake (Bruce 1974) and Lobstick and Sandgirt Lakes (Bruce 1975) showed lake whitefish was the most abundant species of the reservoir. This long-term study was then designed to assess the potential for a commercial lake whitefish fishery on Smallwood Reservoir. This assessment will follow the completion of all field work on the Reservoir which is forecast for the summer of 79.

The present study describes the biology of the major fish species of Ossokmanuan Reservoir which is now a part of Smallwood Reservoir. Growth, mortality and fecundity estimates were calculated for lake whitefish. No effort was made to estimate population size. Catch and effort statistics were also kept to compare with similar studies on other lakes of the Reservoir and the Northwest Territories (Bond 1973; Johnson 1976).

STUDY AREA

Gabbro and Ossokmanuan Lakes form what is known collectively as the Ossokmanuan Reservoir. This Reservoir (53°10'-53°90'N and 64°50'-65°90'W) lies on the Labrador Plateau and is now part of the Smallwood Reservoir (Fig. 1).

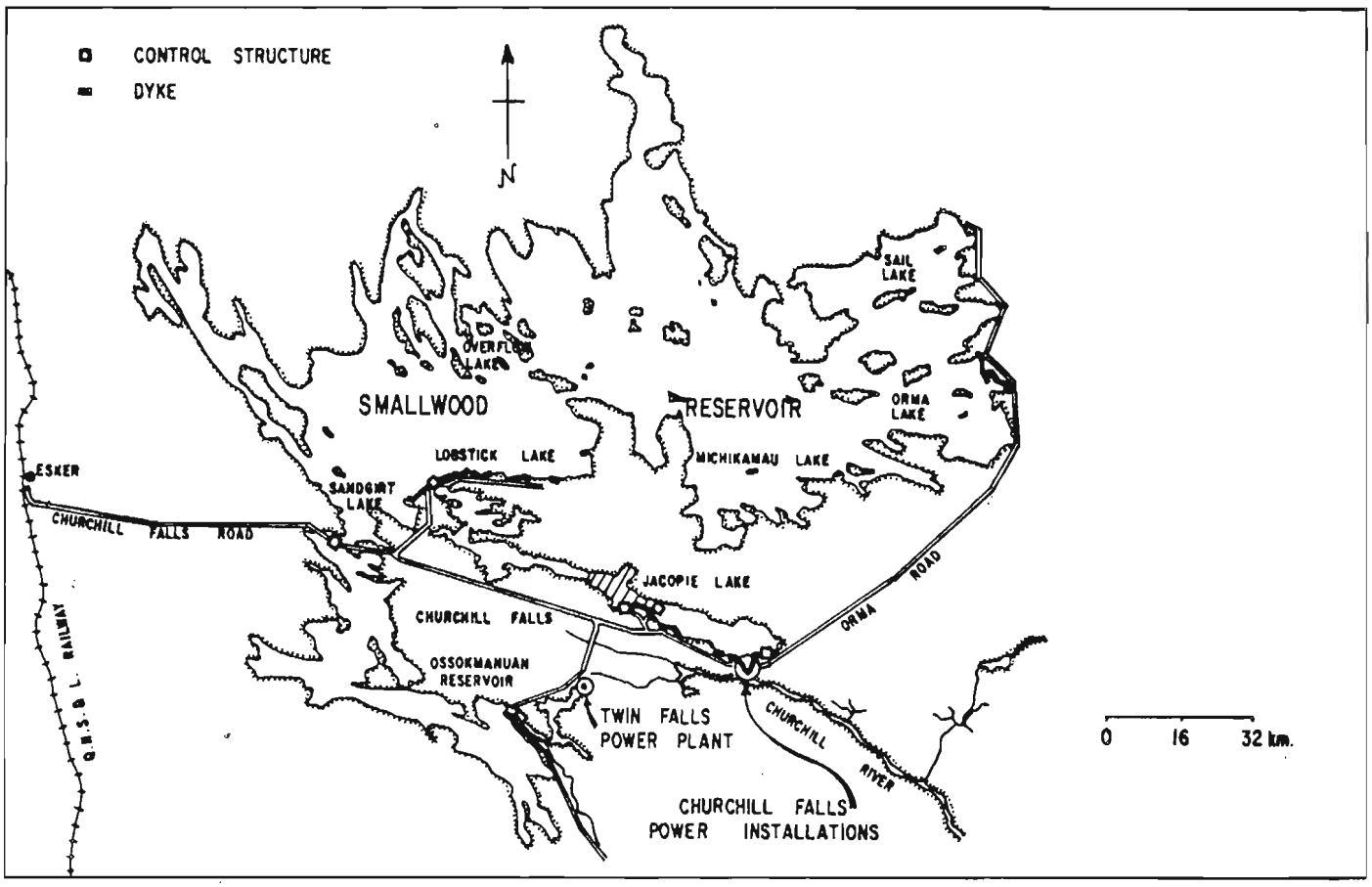
The Ossokmanuan Reservoir was originally formed in 1962 to supply the Twin Falls hydroelectric plant. It has a surface area of 950 km^2 of which about 75% was formerly lake water (Duthie and Ostrofsky 1974).

MATERIALS AND METHODS

Forty-four sets with a gang of gillnets were made in water depths 0-17 m in Ossokmanuan Reservoir between 18 July and 13 August 1976. Each set consisted of five 45.5 m lengths of 3.8, 5.0, 7.6, 10.2 and 12.7 cm stretched mesh multifilament nylon gillnets.

Individual fish of each species was recorded by mesh size to calculate catch per unit of effort (CUE). Fish were measured in the field to the nearest mm and weighed to the closest 0.01 kg. The sex and maturity of each fish was recorded when visible. Stomach samples were taken from a number of each species, preserved in 10% formalin and later analyzed in the laboratory. Invertebrate food organisms were identified according to Pennak (1953) and Ward and Whipple (1959).

C. clupeaformis and *S. salar* were aged by scales taken from the left side of each fish posterior to the dorsal fin, above the lateral line and between the dorsal and adipose fins; *C. catostomus* and *C. commersoni* were aged by scales and pectoral fins at Fish Ageing Facility, Stanley Mission, Saskatchewan; *S. namaycush* and *L. lota* were aged by otoliths and *E. lucius* were aged by left opercula and scales.



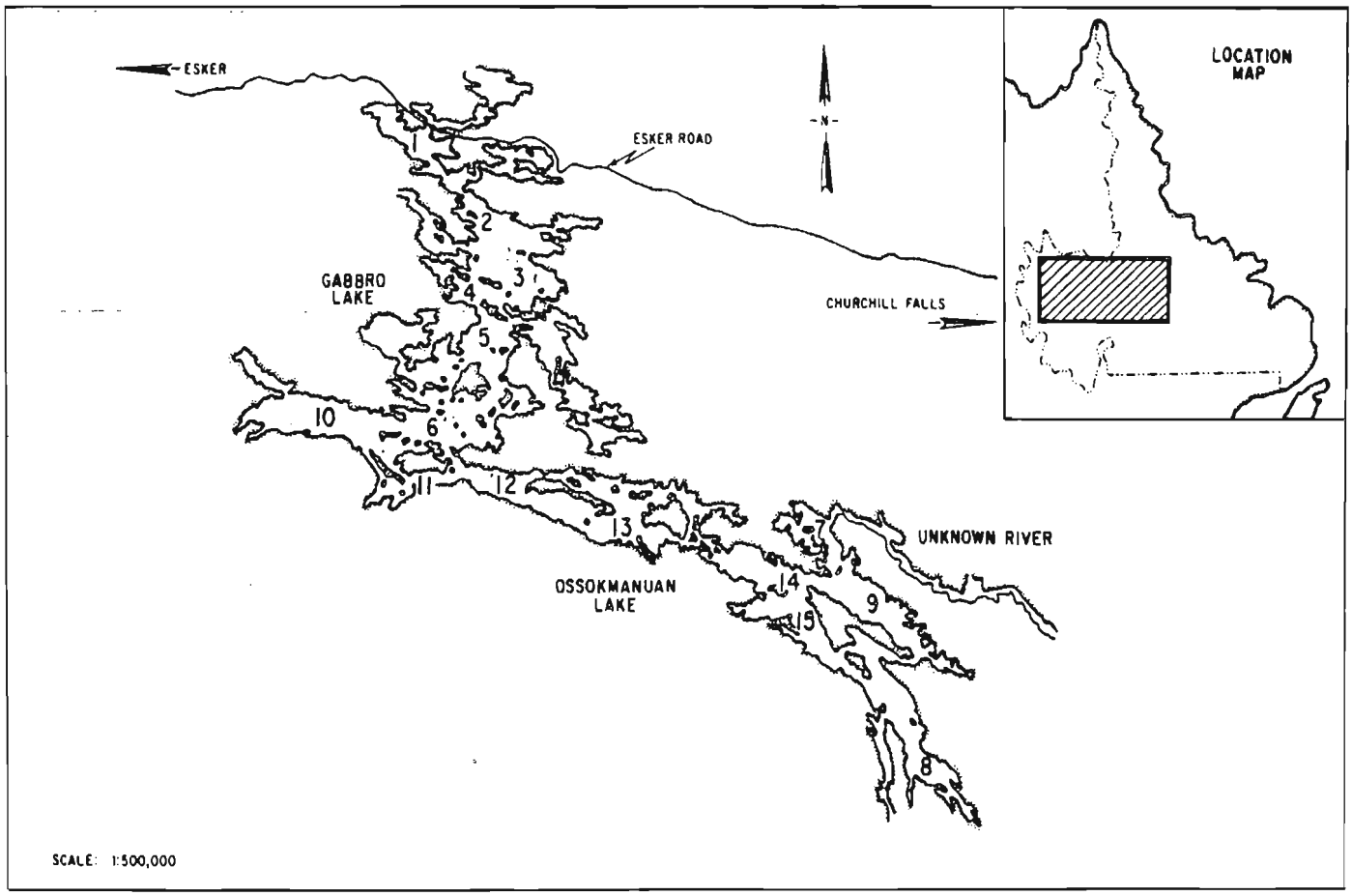


Fig. 1. Smallwood Reservoir and Ossokmanuan Reservoir (netting sites).

An attempt was made to fit the age and growth data for each species to a von Bertalanffy growth curve (Ricker 1958) but a good fit was found only for lake trout. As a consequence empirical age and growth data only was presented for the remaining most abundant species.

Analysis of covariance was used to determine significant differences between the length-weight regressions of the sexes for each species.

Annual mortality rates (A) were calculated from catch curves as described by Ricker (1958).

RESULTS

TEST NETTING

Species composition

Total catch was 1,663, fish weighing 1078.6 kg (Table 1). Lake whitefish was the most abundant species in terms of numbers (44.0%) but due to their small overall size accounted for only 10.8% of the catch by weight. Lake trout, comprising only 15.8% by number, made up 58.0% of the catch by weight. Northern pike and longnose sucker accounted for approximately 27.0% of the catch by weight with landlocked salmon, round whitefish, common sucker and burbot acconting for 4.4% by weight.

Table 1. Number and weight of each species taken from Ossokmanuan Reservoir, 1976.

Species	Number	Percent	Weight(kg)	Percent
Lake whitefish (*Coregonus clupeaformis*)	719	44.0	116.5	10.8
Longnose sucker (*Catostomus catostomus*)	526	32.2	137.6	12.8
Lake trout (*Salvelinus namaycush*)	259	15.8	625.0	57.9
Northern pike (*Esox lucius*)	96	5.9	151.7	14.1
Landlocked salmon (*Salmo salar*)	6	0.4	8.1	0.8
Round whitefish (*Prosopium cylindraceum*)	3	0.2	0.5	-
Common sucker (*Catostomus commersoni*)	3	0.2	2.6	0.2
Burbot (*Lota lota*)	21	1.3	36.6	3.4
Totals	1633		1078.6	

Catch per unit of effort

The catch per unit of effort (CUE) for all species combined ranged from 2.5 kg/100 m of gillnets/24 h (Station 14), to 24.1 kg/100 m of gillnet/24 h (Station 9) (Table 2). The mean CUE for the 15 stations for all species combined was 8.7 kg/100 m of gillnet/24 h. A comparison was made of the CUE values for bottom and surface sets for the five most abundant species (Table 3). Bottom sets for all stations combined gave a CUE of 16.2

kg/100 m of net/24 h as compared to 1.0 kg/100 m of net/24 h for surface sets. Bottom nets caught 90.6% of the lake whitefish and lake trout in terms of weight. The CUE values for lake whitefish for all stations ranged from 0 kg to 4.4 kg, while the lake trout values ranged from 0 kg (Station 7) to 16.7 kg/100 m of net/24 h (Station 9) (Table 2). The three largest mesh sizes (7.6, 10.2, 12.7 cm) combined yielded CUE values of 1.0 kg and 5.2 kg/100 m of net/24 h for lake whitefish and lake trout, respectively.

Table 2. Catch per unit of effort for species combined, lake whitefish, and lake trout at each station in Ossokmanuan Reservoir, 1976.

Station Number	Amount of fish (kg)	m of net	CUE 100 m/24 h (kg)	Lake Whitefish	Lake Trout
1	99.5	910	10.9	4.4	4.1
2	68.0	455	14.9	2.3	7.2
3	94.7	910	10.3	0.3	7.5
4	61.9	910	6.8	0.1	4.6
5	102.6	910	11.3	0.2	8.6
6	58.1	910	6.4	0.1	4.8
7	37.4	910	4.1	1.5	0.3
8*	-	-	-	-	-
9	109.5	455	24.1	0.1	16.7
10	39.1	455	8.6	1.2	5.5
11	24.4	455	5.4	0	4.0
12	48.8	910	5.4	0.1	2.9
13	80.7	910	8.9	2.0	4.9
14	11.4	455	2.5	0.4	0
15	30.5	455	6.7	1.0	3.7
Total	866.6	10,010	9.0	1.0	5.3

* Inclement weather conditions prevented accurate estimates from being made for Station No. 8.

Table 3. Comparison of catches (kg) for bottom and surface gillnets used in experimental sampling, 1976.

Species	Bottom set		Surface set		Total	
	wt	CUE	wt	CUE	wt	CUE
Lake whitefish	92.5	1.9	9.6	0.2	102.1	2.1
Lake trout	493.1	9.9	17.6	0.4	510.7	10.3
Northern pike	65.6	1.3	18.9	0.4	84.5	1.7
Longnose sucker	139.1	2.6	2.1	-	141.2	2.6
Burbot	26.8	0.5	-	-	26.8	0.5
Total	817.1	16.2	48.2	1.0	865.3	17.2

Size of fish by mesh size

Mean fork lengths and mean weights for all fish species taken by each mesh size are given in Table 4. Lake whitefish and longnose sucker displayed an increase in mean fork length with increasing mesh size. The mean size of lake trout seems to have little relationship to the mesh size. There was only an 8.8 cm difference between the smallest (7.6 cm mesh) and largest (12.7 cm mesh) mean fork lengths. Large fish were taken by all mesh sizes but the small fish (<30 cm) were taken only in the smaller meshes. Northern pike, like the other piscivorous species, burbot, landlocked salmon and lake trout, did not show any relationship between mean length and mesh size. Presence of large prominent teeth, which tangle easily in the smaller meshes, appear to cause this. Comparing the mean length of the 7.6, 10.2 and 12.7 cm meshes for these species, there appears to be a selectivity of these meshes for larger fish.

LENGTH AND AGE DISTRIBUTIONS

LAKE WHITEFISH

The length distribution for lake whitefish (Fig. 2) is peaked for all meshes combined and individual meshes except the 5.0 cm mesh. The modal sizes range from 16.0-16.9 cm (3.8 mesh and all meshes combined) to 46.0-46.9 cm (12.7 cm mesh). Lakes in the Northwest Territories had modes ranging from 42.6 to 54.9 cm with the majority peaking at 50 cm (Johnson 1976). The bulk of fish (77.8%) were between 14.0 and 19.9 cm with the 3.8 cm mesh catching 99.5% of the fish in this interval. Only 15.6% of the sample exceeded 30 cm and 84.8% of these fish were taken in the three largest meshes. The largest fish taken measured 52.0 cm.

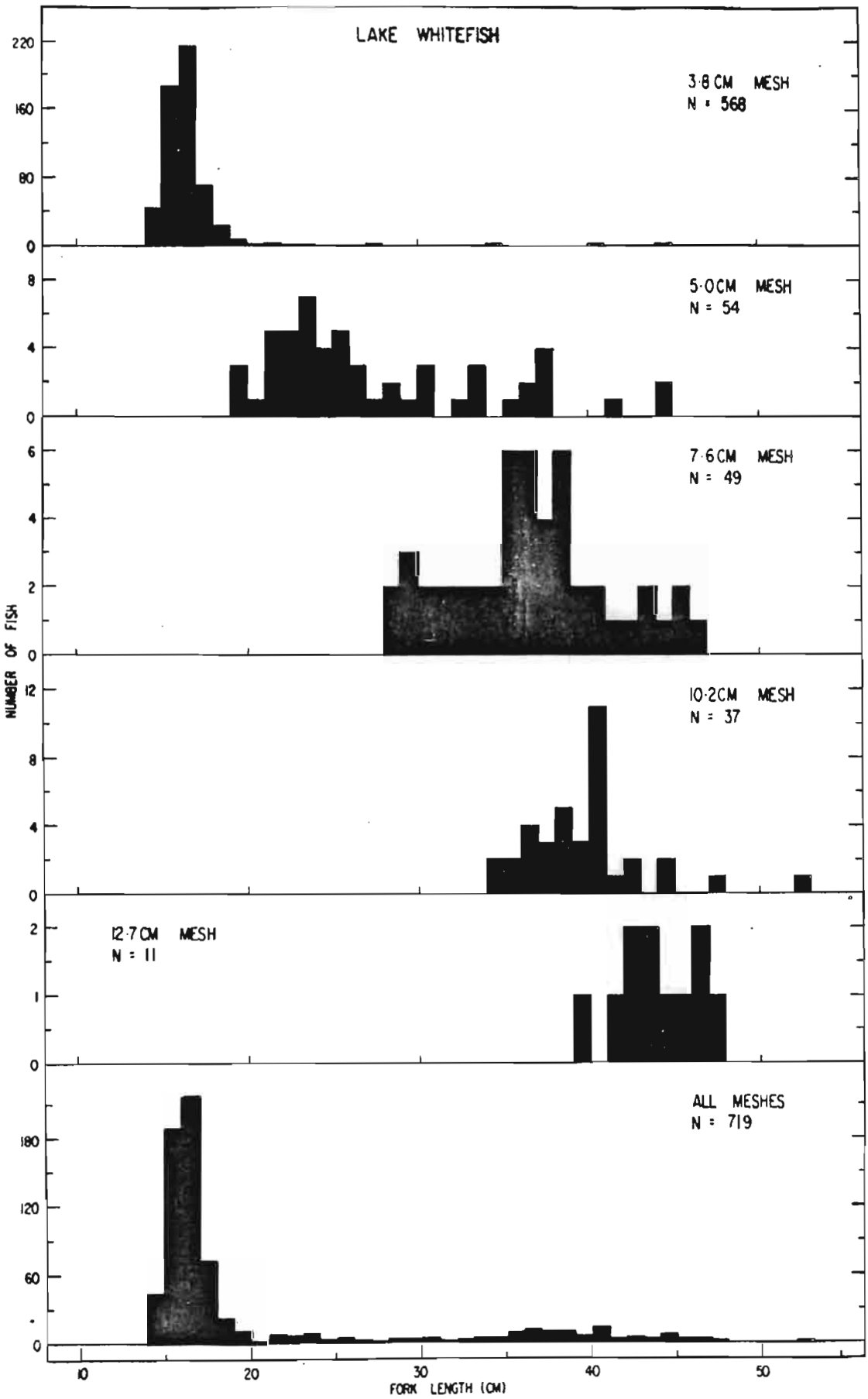


Fig. 2. Fork length frequency distribution for lake whitefish, Ossokmanuan Reservoir, 1976.

Table 4. Mean fork lengths and mean whole weights for fish captured in different mesh sizes at Ossokmanuan Reservoir, 1976

Species	Mesh size (cm) 3.8 No.	Mean fork lt. (cm)	Mean weight (kg)	5.0 No.	Mean fork lt. (cm)	Mean weight (kg)	7.6 No.	Mean fork lt. (cm)	Mean weight (kg)	10.2 No.	Mean fork lt. (cm)	Mean weight (kg)	12.7 No.	Mean fork lt. (cm)	Mean weight (kg)
Lake whitefish	568	16.3	0.05	54	27.6	0.29	49	36.6	0.64	37	39.6	0.78	11	43.8	1.08
Longnose sucker	161	18.2	0.08	234	23.8	0.17	113	34.5	0.54	12	44.4	1.21	6	48.0	1.57
Lake trout	58	55.6	2.29	57	55.7	2.29	54	54.5	2.09	43	58.4	2.43	47	63.3	3.12
Northern pike	10	67.1	2.06	11	57.8	1.38	45	55.4	1.32	25	63.6	1.77	5	70.9	2.41
Burbot	1	55.6	1.20	1	30.8	0.13	2	59.8	1.61	6	64.8	1.62	11	67.3	2.06
Landlocked salmon	-	-	-	2	26.8	0.22	1	36.4	0.63	1	56.0	2.05	2	57.6	2.52
Round whitefish	-	-	-	3	24.8	0.16	-	-	-	-	-	-	-	-	-
Common sucker	1	29.9	0.39	1	29.9	0.39	-	-	-	1	49.3	2.10	-	-	-

The age distribution (Fig. 3) is bimodal with peaks between 2-3 and 9-year-old classes. Johnson (1976) reported the modal age to lie between 12.7, 17.0 and 18.9 years for three unexploited lakes in the Northwest Territories. Approximately 71.0% of the sample was comprised of 2+ and 3+ year olds. These two age groups were comprised of both mature and immature individuals of both sexes. Most of these fish were taken in the 3.8 and 5.0 cm meshes (Table 5). The low number of 5-, 6- and 7-year olds may reflect gillnet selectivity.

Table 5. Age frequency (percent) distribution of lake whitefish by mesh size from test netting Ossokmanuan Reservoir, 1976.

Age (years)	Mesh size (cm) 3.8	5.0	7.6	10.2	12.7	Total
1+	100.0	-	-	-	-	3
2+	100.0	-	-	-	-	196
3+	93.6	6.4	-	-	-	219
4+	62.2	37.8	-	-	-	37
5+	13.3	53.3	33.4	-	-	15
6+	14.3	71.4	14.3	-	-	7
7+	-	18.8	43.7	37.4	-	16
8+	-	4.6	59.1	31.7	4.6	22
9+	8.8	14.8	38.2	29.4	8.8	34
10+	-	10.5	26.3	42.1	21.1	19
11+	-	8.3	16.7	41.7	33.3	12
12+	-	-	100.0	-	-	1
13+	-	-	-	100.0	-	-
						*582

* 137 small fish of similar size were not aged.

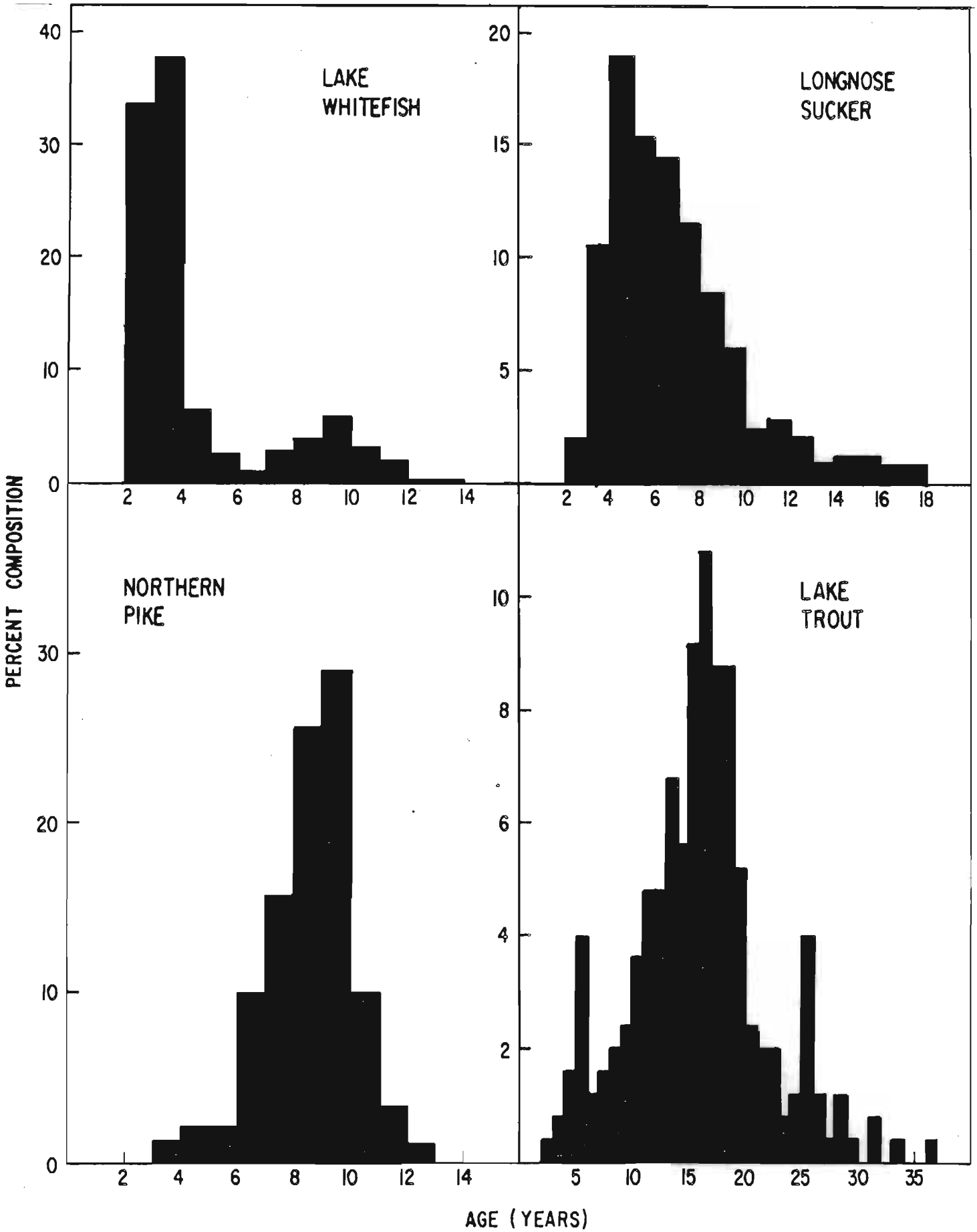


Fig. 3. Age-frequency distribution for lake whitefish, longnose sucker, northern pike and lake trout, Ossokmanuan Reservoir, 1976.

LAKE TROUT

The fork length distribution for lake trout was unimodal for all meshes combined but showed variations from normality in some of the individual meshes (Fig. 4). The modal size (62.0-63.9 cm) was constant for the 3.8, 5.0, 12.7 cm meshes and for all meshes combined. Johnson (1976) reported lake trout modes randing from 48.6 to 78.9 cm for three unexploited lakes in the Northwest Territories. Approximately 74.0% of the sample was between 50.0 and 69.9 cm in length and the largest fish was 91.4 cm. Only 10.4% of the sample was less than 40.0 cm indicating the inefficiency of the smaller meshes to catch small fish.

The age distribution (Fig. 3) was unimodal with the mode occurring at 17 years. Modal ages ranged from 11.8 years to 18 years in lakes sampled in the Northwest Territories (Johnson 1976). Almost 41.0% of the sample was older than the modal age, with 37+ years being the oldest age reported. The youngest age groups, 3+ and 4+ years, were taken only in the 3.8 cm mesh. The 5+, 6+ and 7+ year olds were taken in the 3.8, 5.0 and 7.6 cm meshes. None of the 8-10+ year olds were taken in either the smallest (3.8 cm) or largest (12.7 cm) meshes (Table 6). Most of the older fish (12 years and older) taken in the 3.8 cm mesh were tangled by the teeth.

NORTHERN PIKE

The fork length distribution for all meshes combined has modes occurring in the 50.0-50.9 and 65.0-65.9 cm length intervals (Fig. 5). Pike of Beaverlodge Lake, Northwest Territories had a modal value between 70.0 and 75.0 cm (Johnson 1976). No fish smaller than 40.0 cm were taken in this study indicating either the fish were not in the areas sampled or the gear used did not select for them. Approximately 55.0% were larger than 60.0 cm and the largest fish taken was 80.3 cm.

The age distribution is unimodal with the modal age being 10 years (Fig. 3) with approximately 28% of the sample in this age-class. The 9+ age group comprised 27.0% of the sample with 4+ and 13+ being the youngest and oldest ages recorded, respectively. The younger fish (4+, 5+ and 6+ year olds) were all caught in the 5.0 and 7.6 cm meshes with the older fish being taken in the 7.6, 10.2 and 12.7 cm meshes (Table 7).

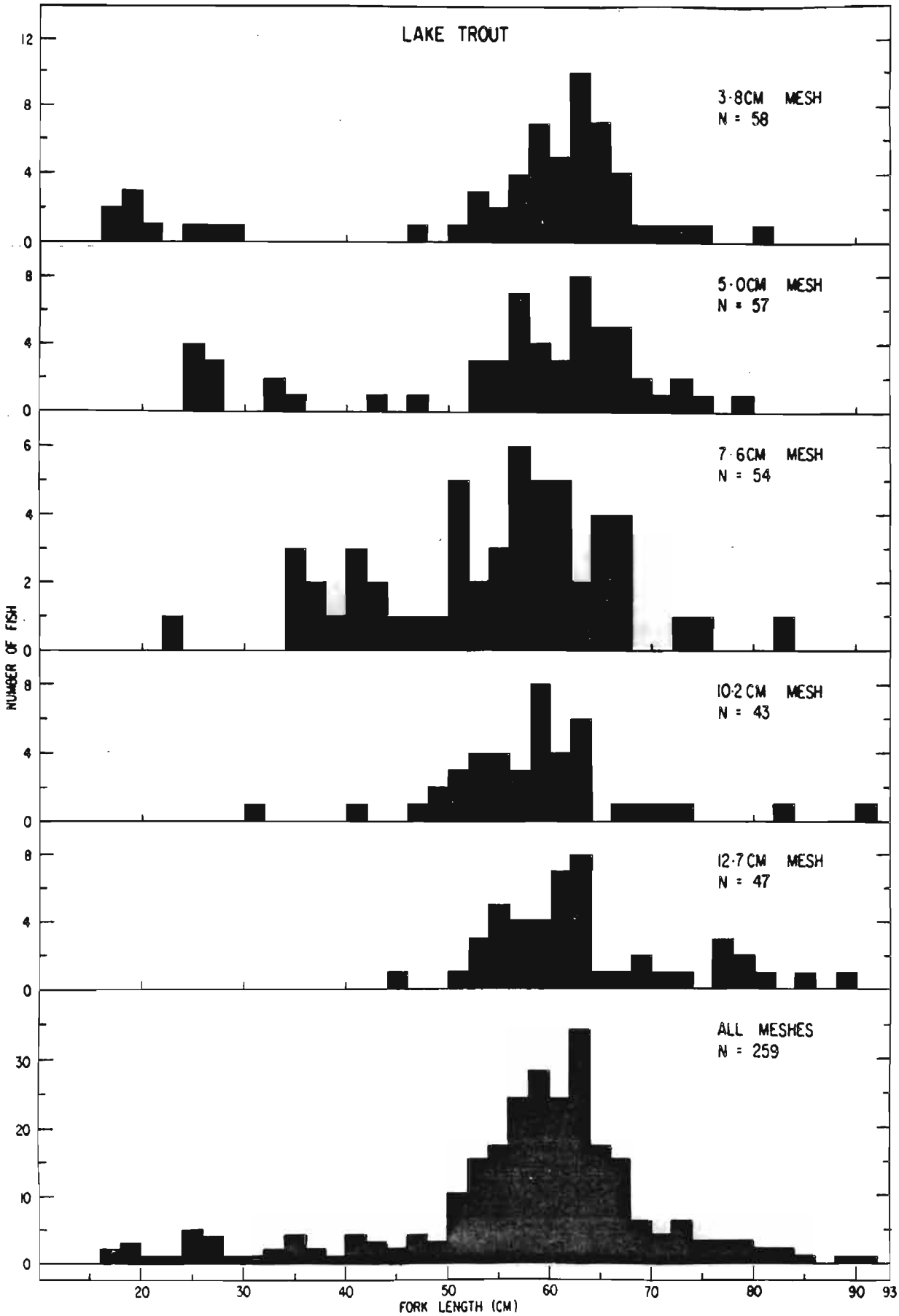


Fig. 4. Fork length frequency distribution for lake trout, Ossokmanuan Reservoir, 1976.

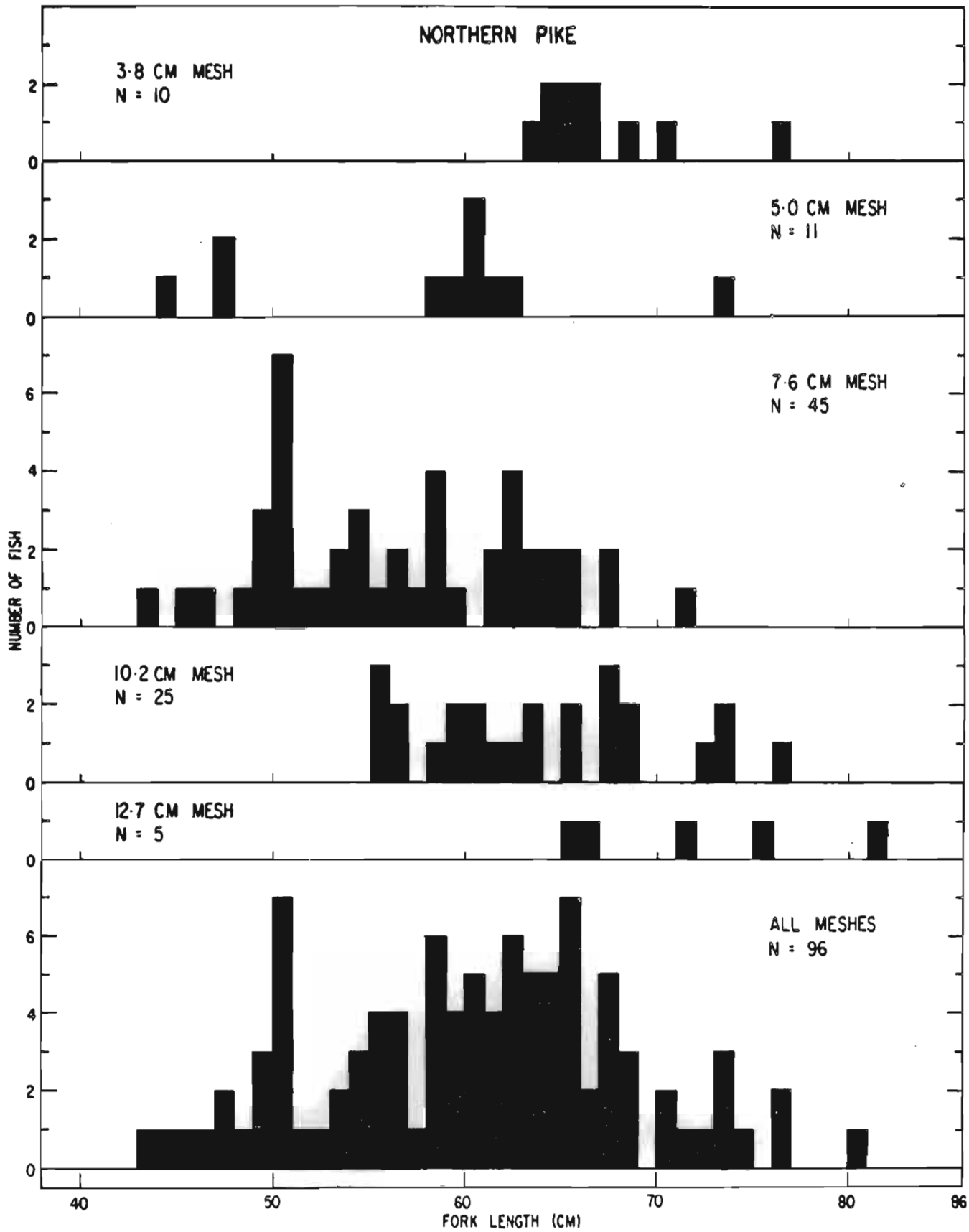


Fig. 5. Fork length frequency distribution for northern pike, Ossokmanuan Reservoir, 1976.

Table 6. Age frequency (percent) distribution of lake trout by mesh size from test netting at Ossokmanuan Reservoir, 1976.

Age (years)	Mesh size (cm) 3.8	5.0	7.6	10.2	12.7	Total
3+	100.0	-	-	-	-	1
4+	100.0	-	-	-	-	2
5+	75.0	25.0	-	-	-	4
6+	20.0	60.0	20.0	-	-	10
7+	33.3	33.3	33.4	-	-	3
8+	-	25.0	25.0	50.0	-	4
9+	-	-	80.0	20.0	-	5
10+	-	50.0	33.3	16.7	-	6
11+	-	-	44.4	33.3	22.3	9
12+	9.1	9.1	45.5	27.2	9.1	12
13+	8.3	16.7	33.3	16.7	25.0	12
14+	23.5	5.9	11.8	23.5	35.3	17
15+	14.3	21.4	21.4	28.6	14.3	14
16+	34.8	4.4	26.1	21.7	13.0	23
17+	33.3	33.3	14.8	7.4	11.2	27
18+	31.8	22.7	22.7	9.2	13.6	22
19+	18.2	27.3	13.6	22.7	18.2	22
20+	30.8	15.4	-	15.4	38.4	13
21+	33.3	-	16.7	16.7	33.3	6
22+	40.0	60.0	-	-	-	5
23+	-	20.0	20.0	40.0	20.0	5
24+	50.0	-	50.0	-	-	2
25+	33.3	-	-	-	66.7	3
26+	20.0	50.0	-	20.0	10.0	10
27+	-	33.3	-	-	66.7	3
28+	-	-	-	-	100.0	1
29+	33.3	33.3	-	-	33.4	3
30+	100.0	-	-	-	-	1
32+	-	-	-	-	100.0	2
34+	-	-	-	-	100.0	1
37+	-	-	-	-	100.0	1

* 10 otoliths could not be read with any degree of certainty.

Table 7. Age frequency (percent) distribution of northern pike by mesh size from test netting at Ossokmanuan Reservoir, 1976

Age (years)	Mesh size (cm) 3.8	5.0	7.6	10.2	12.7	Total
4+	-	100.0	-	-	-	1
5+	-	-	100.0	-	-	2
6+	-	-	100.0	-	-	2
7+	-	11.1	77.8	11.1	-	9
8+	7.1	7.1	78.7	7.1	-	14
9+	4.3	17.4	34.8	43.5	-	23
10+	15.4	11.5	26.9	38.5	7.7	26
11+	33.4	-	22.2	22.2	22.2	9
12+	-	-	66.7	-	33.3	3
13+	-	100.0	-	-	-	1
						*96

* Scales from 6 fish were all regenerate

LONGNOSE SUCKER

The length distributions were unimodal for the 3.8, 5.0 and 7.6 cm meshes. The length distribution for all meshes combined had modes corresponding to the modal ranges of the individual meshes (Fig. 6). These modes ranged from 16.0-17.9 (3.8 cm mesh) to 50.0-50.9 cm (12.7 cm mesh). Nearly 63% of the sample measured less than 24.9 cm and the largest fish samples was 54.6 cm.

The age distribution for longnose suckers (Fig. 3) has a modal age of 5 years. This age group accounted for 19% of the sample with 87% lying between the 3+ and 10+ age group. The oldest age recorded was 19+ years and less that 6% of the sample was older than 14 years. Age distribution by mesh size (Table 8) shows the 3+ to 6+ age groups were all taken in the 3.8 and 5.0 cm meshes. The 9+ and 11+ age groups were primarily taken in the 7.6 cm mesh with the oldest fish being taken in the three largest meshes.

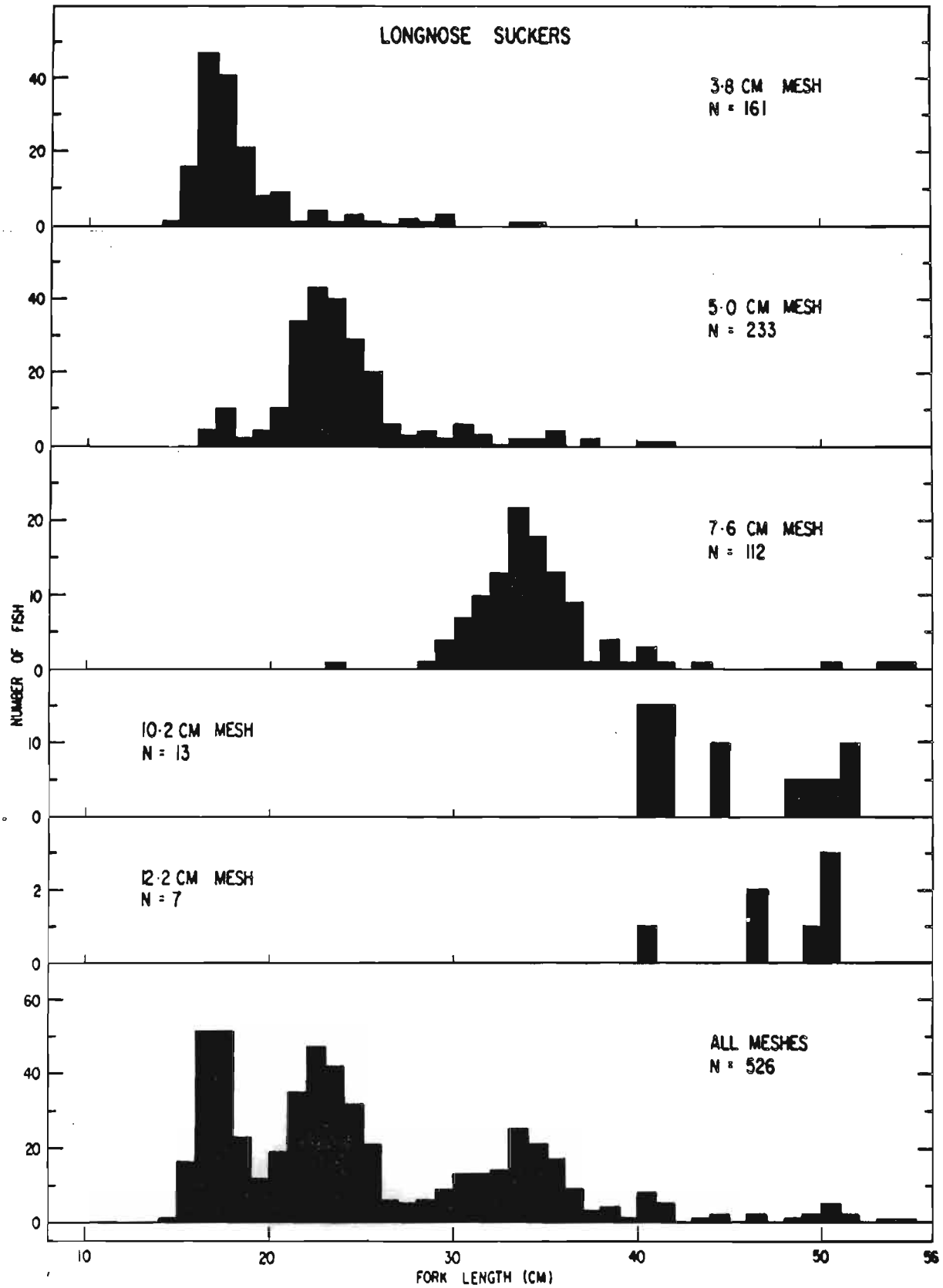


Fig. 6. Fork length frequency distribution for longnose sucker, Ossokmanuan Reservoir, 1976.

Table 8. Age frequency (percent) distribution of longnose sucker by mesh size from test netting Ossokmanuan Reservoir, 1976.

Age (years)	Mesh size (cm) 3.8	5.0	7.6	10.2	12.7	Total
3+	90.0	10.0	-	-	-	10
4+	87.5	12.5	-	-	-	48
5+	69.0	31.0	-	-	-	87
6+	25.7	74.3	-	-	-	70
7+	6.0	89.6	4.4	-	-	67
8+	9.6	61.5	28.9	-	-	52
9+	2.6	31.6	65.8	-	-	38
10+	3.7	22.2	74.1	-	-	27
11+	-	45.5	54.5	-	-	11
12+	-	7.7	84.6	7.7	-	13
13+	-	10.0	80.0	10.0	-	10
14+	-	-	50.0	50.0	-	4
15+	-	20.0	60.0	20.0	-	5
16+	-	-	-	80.0	20.0	5
17+	-	-	25.0	25.0	50.0	4
18+	-	-	25.0	50.0	25.0	4
19+	-	-	66.7	-	33.3	3
						*458

* 68 small fish of similar size were not aged

AGE AND GROWTH

Lake whitefish

Empirical lengths and weights for each age-group are presented in Table 9. There was a considerable degree of overlap of age groups for different length intervals.

Table 9. Summary of empirical age and growth data for lake whitefish from Gabbro and Ossokmanuan Lakes, 1976.

Age (years)	Number of fish	Mean fork length (cm)	Range (cm)	Mean weight (kg)	Range (kg)
1+	3	15.3	15.0-15.7	0.03	-
2+	196	16.0	14.0-18.0	0.05	0.02-0.08
3+	219	16.5	14.0-24.6	0.05	0.03-0.15
4+	37	20.5	16.2-30.2	0.10	0.04-0.30
5+	15	26.2	16.2-30.7	0.23	0.11-0.36
6+	7	28.9	21.8-33.1	0.29	0.09-0.42
7+	16	35.0	30.0-38.0	0.53	0.32-0.73
8+	22	36.4	31.7-40.0	0.60	0.37-0.85
9+	34	38.9	32.3-44.3	0.74	0.45-1.15
10+	19	42.0	37.3-46.4	0.94	0.60-1.30
11+	12	43.6	38.1-47.7	1.05	0.67-1.41
12+	1	43.1	-	1.02	-
13+	1	52.0	-	1.65	-

Lake trout

Mean empirical fork length and weight for each age group (Table 10) were used in describing the von Bertalanffy equation.

$$l_t = L_\infty (1-e^{-k(t-t_o)})$$

Table 10. Summary of empirical age and growth data for lake trout from Ossokmanuan Reservoir, 1976.

Age	Number of fish	Mean fork length (cm)	Range (kg)	Mean weight (kg)	Range (kg)
3+	1	17.9			
3+	1	17.9	-	0.10	-
4+	2	17.9	16.7-19.0	0.05	0.03-0.07
5+	4	17.3	18.8-25.1	0.11	0.05-0.16
6+	10	26.8	19.7-36.5	0.21	0.07-0.48
7+	3	31.7	27.1-35.5	0.35	0.20-0.50
8+	4	37.4	26.1-50.2	0.65	0.18-1.34
9+	5	41.3	35.3-50.7	0.83	0.47-1.39
10+	6	44.8	34.9-59.8	1.16	0.43-2.39
11+	9	48.5	39.0-57.9	1.40	0.60-2.53
12+	12	51.9	44.9-61.5	1.61	0.92-2.83
13+	12	52.8	46.0-63.0	1.73	0.95-2.58
14+	17	57.8	50.0-72.0	2.18	1.56-3.30
15+	14	58.6	50.0-66.5	2.22	1.46-3.05
16+	23	60.1	52.2-72.4	2.43	1.65-4.75
17+	27	61.1	52.7-70.6	2.30	1.54-4.55
18+	22	63.2	54.2-80.3	2.92	1.75-6.15
19+	22	63.9	52.3-91.4	3.25	1.71-10.17
20+	13	67.4	53.2-85.7	3.84	1.51-7.24
21+	6	67.0	60.0-82.8	3.22	2.25-4.00
22+	5	63.8	54.3-71.2	2.75	1.77-3.68
23+	5	63.6	57.0-69.9	3.20	1.80-6.32
24+	2	63.0	62.8-63.1	2.60	2.50-2.69
25+	3	64.2	60.4-68.1	2.60	2.17-3.28
26+	10	66.5	60.0-75.5	3.34	2.36-5.02
27+	3	70.0	63.3-78.5	4.41	2.13-6.68
28+	1	55.8	-	1.73	-
29+	3	69.3	6.20-78.8	3.93	2.42-5.82
30+	1	59.5	-	2.10	2.42-5.82
Z					
32+	2	76.0	64.0-88.0	5.98	3.43-8.53
Z					
34+	1	59.2	-	2.02	-
Z					
37+	1	62.5	-	2.52	-

where l_t is the length at age t (in years), L_∞ is the theoretical maximum length, K is constant expressing the rate of change in the length increments with respect to t, and t_o is the hypothetical age at zero length. The parameters for the von Bertalanffy growth equation and their standard errors are as follows:

Parameter	Final estimate	Standard error	Confidence limits		
			1.96 x SE	Lower limit	Upper limit
k	0.13	0.02	0.02	0.11	0.16
t_o	2.27	0.37	0.72	1.54	2.99
L	70.30	1.53	3.00	67.32	73.32

Northern pike

Both scales and opercula bones were used in aging northern pike. The empirical age-length relationships calculated by each aging method are presented in Appendices 3a, and b. The growth curve calculated from the scale ages was consistently slower than that calculated from the opercular bone ages. Additional work is being done to determine the best method to age Northern pike in Labrador lakes (Bruce, Wheeler, unpublished data).

Longnose sucker

Longnose suckers were aged using scales and fin rays (Appendices 4a and b). Analysis of covariance test showed there was no significant difference between the slopes ($F_{1,176} = 1.56$, $p = 0.211$) or the intercepts ($F_{1,176} = 2.92$, $p = 0.085$) of both lines. The scales were therefore used throughout this study.

Burbot

Twenty-one burbot were taken in the gillnets ranging in ages from 5+ to 17+ years as determined from otoliths. The lengths and weights for each age-group is given in Table 11.

Length-weight relationships, annual mortality rates and sex ratio for these species described above are given in Table 12.

Table 11. Empirical fork lengths and whole weights of burbot by age-groups.

5+		6+		9+		10+		11+		12+		14+		15+		16+		17+	
L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)	L (cm)	W (kg)
30.8	0.136	64.4	1.36	47.5	0.63	67.0	2.01	63.6	1.85	65.7	1.95	72.5	2.46	68.6	2.24	72.0	2.58	70.1	2.10
				65.4	1.77	61.7	1.77	63.0	1.42	66.4	2.03	63.0	1.71	72.5	2.18	68.8	1.73	55.6	1.20
						54.4	0.98	70.6	2.56							71.0	2.35		

Table 12. Length-weight, annual mortality (A) and sex ratio of most abundant fish species of Ossokmanuan Reservoir, 1976.

Species	Length/Weight	A	Sex Ratio % Males
Lake whitefish	$W = 7.54 \times 10^{-6} L^{3.13}$	0.41	43
Lake trout	$W = 6.45 \times 10^{-6} L^{3.13}$	-	56
Northern pike	$W = 2.07 \times 10^{-5} L^{2.73}$	0.66	46
Longnose sucker	$W = 1.65 \times 10^{-5} L^{2.93}$ (M)	0.27	34
	$W = 5.42 \times 10^{-5} L^{3.22}$ (F)		
Burbot	$W = 1.34 \times 10^{-5} L^{3.37}$	-	29

AGE AT FIRST MATURITY

Lake whitefish

Approximately 60% of the 2+ year-old fish were mature, with 69.6% and 54% of the males and females being mature, respectively. Of the 3+ year olds, 77% of the fish were mature, with 81% of the males and 75% of the females being mature. Fifty-one percent of the 4+ year-old fish were mature, with 51% and 67% of the males and females respectively, being mature. In the older age groups it is not certain whether many fish were actually sexually immature or if they just were not ripening for spawning that particular fall. Alternate spawning has been observed for lake trout, northern pike, longnose and common suckers, in the Smallwood Reservoir (personal observations). In the case of the 9+ and 10+ age-groups, it is felt alternate-year spawning is taking place. However, no eggs from the previous year's spawning was found in any of the female body cavities.

Lake trout

None of the fish younger than 9+ years of age were sexually mature. It is not certain what the true age of first maturity is, as a good percentage of the ovaries of older fish, although sexually mature, were not in a ripening condition. This suggests that at least some members of the population are alternate spawners. Additional evidence for this was the presence of unshed eggs from the previous year in the abdominal cavity of some fish.

Northern pike

The one 4+ male pike was immature. Of the two female 5+ year old fish, one was mature. All other fish were sexually mature except one 7+ male.

Longnose sucker

Of the 110 fish which were sexed, 6+ was the youngest age recorded and all fish of this age and older were sexually mature. This age-group was comprised of members from both sexes.

FECUNDITY

Lake whitefish

Eggs counts of 10 large lake whitefish (37.0-46.2 cm) ranged from 6554 to 20,963. These fish were between 7+ and 11+ years old (Table 13). The mean fork length was 41.8 cm with a mean count of 14,726 eggs. The relationship between fecundity and length was expressed by the equation: log F = 2.2863 log L +2.7590, or, in the arithmetic transformation,

$$F = 574.12\ L^{2.2863}$$

where F = fecundity, L = fork length in cm. The correlation coefficient for this relation ($r = 0.52$) was not significantly different from zero ($p > 0.05$).

The mean egg count for thirty-nine pairs of small whitefish (14.5-18.7 cm) ovaries was 1784 eggs with a range of 967-3095 (Table 14). Apart from one 4+ year-old, there was almost an equal number of 2+ and 3+ year olds. The equation describing the relationship between fecundity and fish length was:

$$\log F = 3.2773 \log L + 0.1712$$

or expressed exponentially

$$F = 1.48\ L^{3.2773}$$

where F = fecundity and L = fork length in cm. The correlation coefficient for the relation (r = 0.64) was significantly different from zero ($p < .001$).

Table 13. Fork length, age, and egg count of 10 large lake whitefish from Ossokmanuan Reservoir, 1976.

Fork length (cm)	Age (years)	No. of eggs
40.8	9+	6654
38.9	9+	9852
37.0	7+	10376
38.5	9+	14399
44.5	10+	14886
45.7	10+	15976
40.3	10+	16785
46.2	10+	17817
40.5	9+	19652
46.0	11+	20963
$\bar{X}$ 41.8		14726
SD 3.4		4572

Table 14. Fork length, age, and egg count of 39 small lake whitefish from Ossokmanuan Reservoir, 1976.

Fork length (cm)	Age (years)	No. of eggs
16.2	3+	1513
16.3	3V[1]	2035
16.3	3+	967
17.1	3+	1547
15.4	3+	1194
17.5	3+	2556
16.2	4V	1473
17.2	3+	1949
17.0	3+	1378
15.0	2+	1834
18.0	3+	3095
15.6	3+	1568
16.2	3+	1739
15.5	3+	1553
17.3	3+	2682
15.5	-	1596
16.4	3+	1326
18.1	2+	1945
15.2	2+	1018
16.3	2+	2128
16.5	2+	1286
16.2	2+	1261
17.5	2+	2343
18.7	3+	2728
18.0	2+	2433
16.2	3+	1120
17.0	2+	2325
16.0	2+	1554
16.5	3+	1237
17.0	2+	1671
16.4	2+	2188
16.7	2+	1669
18.3	2+	2376
16.7	2+	1282
18.0	2+	2086
14.5	2+	1224
16.5	2+	2327
17.1	2+	1483
16.8	2+	1887
$\bar{X}$ 16.6		1784
SD 0.95		526

[1]V = Virtual, meaning the annulus is being laid down on the edge of the scale.

Lake trout

The absolute egg counts from 24 pairs of ovaries of fish ranging in length 50.9-85.7 cm varied from 1662 (50.9 cm) to 11,906 (78.8 cm). The mean fork length was 66.4 cm and the mean egg count was 4635 eggs. These fish ranged in age from 13+ to 27+ years (Table 15). The relationship between fecundity and fork length was expressed by the equation: log F = 3.2154 log L +0.0056 or in the arithmetic form: $F = 1.01, L^{3.2154}$ where F = fecundity, L = fork length (cm). The correlation coefficient for this relation ($r = 0.89$) was significantly different from zero ($p < .001$).

Table 15. Fork length, age and egg count of 24 lake trout from Ossokmanuan Reservoir, 1976.

Fork length (cm)	Age (years)	No. of eggs
50.9	14+	1662
52.5	15+	3191
55.7	14+	2928
57.8	17+	3433
58.5	13+	2876
60.0	21+	3327
60.7	15+	3191
62.5	19+	2665
62.5	26+	3322
63.0	18+	3306
63.0	26+	3077
63.1	24+	2670
65.7	16+	4670
66.0	17+	5688
67.2	17+	2827
69.0	26+	4670
69.2	22+	4831
69.9	23+	6646
75.5	26+	4931
76.5	21+	4558
78.5	27+	7528
78.8	-	11906
81.8	20+	6697
85.7	20+	10641
$\bar{X}$ 66.4		4635
SD 9.2		26

FOOD

Lake whitefish are plankton feeders when small and depend on benthic invertebrates as they grow larger. Lake trout, northern pike and burbot are fish eaters relying primarily on lake whitefish (Table 16).

Table 16. Stomachs contents (percentages of frequency of occurrence) of fish species from Ossokmanuan Reservoir, 1976 (sample size in parentheses).

Food item	Lake whitefish (large) (65)	Lake whitefish (small) (75)	Lake trout (75)	Northern pike (72)	Longnose sucker (32)	Burbot (21)
Ephemeroptera (larvae)	3.6	7.0	-	3.0	-	-
Trichoptera (larvae)	41.0	27.0	-	-	37.5	-
Odonata (nymph)	-	-	-	6.0	-	-
Diptera (larvae)	10.9	14.2	-	-	87.5	-
Diptera (pupae)	29.9	41.4	-	-	28.1	-
Ceratopogonidae	10.9	21.4	-	-	-	-
Hemiptera	-	1.4	-	-	-	-
Coleoptera	5.5	2.8	-	-	-	-
Plecoptera	1.8	5.7	-	-	-	-
Hymenoptera	3.6	4.3	-	-	-	-
Pelecypoda	65.5	30.0	-	-	68.8	-
Gastropoda	25.5	5.7	-	-	3.1	-
Hydracarina	56.4	20.0	-	-	21.9	-
Copepoda	23.6	-	-	-	-	-
Cladocera	34.6	64.3	-	-	-	-
Castostomus sp.	-	-	1.7	3.0	-	-
Coregonus sp.	-	-	49.0	39.0	-	8.3
Lota lota	-	-	-	3.0	-	8.3
Gasterosteus sp.	-	-	-	-	-	-
Cottus sp.	-	-	1.7	-	-	-
Fish remains	-	-	40.0	27.0	-	16.7
Unidentifiable insect remains	27.2	20.0	12.0	-	12.5	-
Invertebrate eggs	3.6	11.4	-	-	3.1	-
Detritus	20.0	1.4	1.7	-	9.4	-
Empty	10.0	5.0	23.0	54.0	2.0	9.0

OTHER SPECIES

Ouananiche

Six ouananiche ranging in ages from 4+ to 9+ (ages determined from scales) were collected during the course of this study and length, weight, age and sex are given in Table 17.

Table 17. Fork length, weight, age and sex of ouananiche collected at Ossokmanuan Reservoir, 1976.

Length (cm)	Weight (kg)	Age (years)	Sex
56.0	2.05	7+	M
26.8	0.22	4+	F
26.8	0.22	4+	F
63.7	3.03	9+	F
51.4	2.00	7+	M
36.4	0.63	4+	F

Round whitefish

The length, weight, age (by scales) and sex of the three round whitefish taken in this study are presented in Table 18.

Table 18. Fork length, weight, age and sex of round whitefish collected at Ossokmanuan Reservoir, 1976.

Length (cm)	Weight (kg)	Age (years)	Sex
24.2	0.16	5+	F
26.6	0.19	6+	M
23.7	0.12	5+	F

Common sucker

There were also three common suckers taken in this study whcse length, weight, age (by scales) and sex data are given in Table 19.

Table 19. Fork length, weight, age and sex of common suckers collected at Ossokmanuan Reservoir, 1976.

Length (cm)	Weight (kg)	Age (years)	Sex
29.9	0.39	7+	-
16.7	0.06	4+	-
49.3	2.10	10+	F

SUMMARY

Experimental gillnet catches at Ossokmanuan Reservoir in 1976 were comprised chiefly of lake whitefish, which consisted 44% of the catch by number and 10.8% by weight. Similar gillnetting experiments in 1974 of Lobstick and Sandgirt Lakes, Smallwood Reservoir, showed lake whitefish constituting 57.6% of the catch by number and 50.6% by weight (Bruce 1975). Approximately 79% of whitefish in 1976 were taken in the 3.8 cm mesh while only 27.1% of the 1974 whitefish were taken in the same mesh. In this study, the 3.8 cm mesh contained mature and immature males and females (2+ and 3+ year olds) a phenomenon not witnessed in the 1974 study. In the 1974 study, lake trout comprised 10.9% of the catch by number and 35.2% by weight as compared to 15.8% by number and 57.9% by weight for this study.

The great difference in the weight composition of whitefish is reflected in the catch per unit of effort value for both studies. The CUE value for lake whitefish in 1976 for the 7.6, 10.2, 12.7 cm meshes combined was 1.0 kg/100 m of net/24 h compared to 11.2 kg/100 m of net/24 h in the 1974 study. The CUE value in 1976 for lake trout in the same three meshes was 5.2 kg compared to 4.8 kg/100 m of net/24 h in the 1974 study. Bond (1973) gave values of 19.5 kg for lake whitefish and 3.6 kg for lake trout for a commercial fishery in the Northwest Territories using 14.0 and 15.9 cm mesh gillnets. Johnson (1976) reported 81 kg of trout and whitefish/100 m of net/24 h were obtained in the most favourable regions of Great Bear Lake while Lac La Marte gave catches of 79 kg/100 m of net/24 h. The CUE values for Labrador reservoirs are considerably less than Northwest Terrirories, maybe indicating the standing crop of fishes in Labrador reservoirs is somewhat lower than lakes in the Northwest Territories.

Lake whitefish mean length increased with increasing mesh size, unlike lake trout and other piscivorous species, emplying length maybe a good criterion in determining the mesh sizes to be used in a commercial fishery for lake whitefish. The younger age classes for both lake whitefish and lake trout were taken in the 3.8, 5.9 and 7.6 cm meshes suggesting the 7.6 cm mesh should be the minimal mesh used in any fishery thereby protecting the immature and recruiting fish.

Comparison of mean empirical length at age data for lake whitefish from the two years' catches reveals the Lobstick and Sandgirt population are larger in all age-groups except one (13+ age group). However, there was only one fish in this group for the 1976 sampling as compared with 10 in the 1974 investigation. Whitefish in Ossokmanuan Reservoir and Lobstick and Sandgirt Lakes grow at a moderate rate in comparison with Northwest Territory populations (Healy 1975).

Annual mortality of 0.41 (between ages 9-12+) is a little lower than the average mortality (0.49) of unexploited northern populations (Healy 1975). The mortality estimate for Lobstick and Sandgirt Lakes was 0.32 and lies within the 0.20 to 0.80 mortality range for unexploited populations (Healy 1975).

The whitefish at Ossokmanuan Reservoir showed a very low age at maturity (3 years) and together with whitefish of Clear Lake, Maine (Fenderson 1964) are the only population with the majority mature before age 6 (Healy 1975). The size at maturity (14-24 cm) is the lowest record for any unexploited whitefish population. Fenderson (1964) used this early age at maturity as one criterion in describing two sympatric populations, normal and dwarf, in Clear Lake. Kennedy (1943) described a similar situation in Lake Opeongo, Ontario, and it is possible the same situation may exist in the Ossokmanuan Reservoir.

Lake trout growth, in terms of length and weight, was slow compared with other unexploited population (Healy 1978). It appears slower than Lobstick and Sandgirt lake trout, but direct comparisons cannot be made since this study used otoliths while scales were used in the 1974 study. Healy (1978) gave a good review on the effects of different ageing methods in calculating other population parameters.

Age-structure data would not lend itself to any meaningful calculation of mortality. Lobstick and Sandgirt lake trout mortality was 42.3%. Healy (1978) reported a range of 10-37% mortality for 15 unexploited population in the Territories.

Growth rate of northern pike (using scales) is comparable to that published for four northern Canadian lakes (Miller and Kennedy 1948). The slope (2.7318) of the length-weight relationship is lower than that (3.17) of more northern Canadian lakes.

Growth of longnose sucker is slower than Great Slave Lake sucker population (Harris 1962) with 19 years being the oldest age recorded in both populations. The annual mortality rate of 27% is considerably less than the 55% reported for Great Slave Lake fish.

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Appendix 1. Number and weight (kg) of each species caught by mesh size at Ossokmanuan Reservoir, 1976.

Species	Mesh size (cm) 3.8 No.	3.8 Wt. (kg)	5.0 No.	5.0 Wt (kg)	7.6 No.	7.6 Wt (kg)	10.2 No.	10.2 Wt (kg)	12.7 No.	12.7 Wt (kg)	Total No.	Total Wt (kg)
Lake whitefish	568	29.8	54	15.6	49	28.9	37	29.1	11	13.1	719	116.5
Longnose sucker	161	12.9	234	39.8	113	61.0	12	14.5	6	9.4	526	137.6
Lake trout	58	133.0	57	132.9	54	112.9	43	99.8	47	146.4	259	625.0
Northern pike	10	20.6	11	15.2	45	59.5	25	44.3	5	12.1	96	151.7
Burbot	1	1.2	1	0.1	2	3.2	6	15.9	11	16.2	21	36.6
Ouananiche (Landlocked salmon)	-	-	2	0.4	1	0.6	1	2.1	2	5.0	6	8.1
Round whitefish	-	-	3	0.5	-	-	-	-	-	-	3	0.5
Common sucker	1	0.1	1	0.4	-	-	1	2.1	-	-	3	2.6
Total	799	197.6	363	204.9	264	266.1	125	207.8	82	202.2	1633	1078.6
Percent	48.9	18.3	22.2	19.0	16.2	24.7	7.7	19.3	5.0	18.7		

Appendix 2. Percent number and weight (kg) of each species caught by mesh size at Ossokmanuan Reservoir, 1976.

Species	Mesh size (cm) 3.8 % No.	3.8 % Wt.	5.0 % No.	5.0 % Wt.	7.6 % No.	7.6 % Wt.	10.2 % No.	10.2 % Wt.	12.7 % No.	12.7 % Wt.
Lake whitefish	79.0	25.6	7.5	13.4	6.8	24.8	5.1	24.9	1.5	11.4
Longnose sucker	30.6	9.4	44.5	28.9	21.5	44.4	2.3	10.5	1.1	6.8
Lake trout	22.4	21.3	22.0	21.3	20.8	18.0	16.6	16.0	18.2	23.4
Northern pike	10.4	13.6	11.5	10.0	46.9	39.2	26.0	29.2	5.2	8.0
Burbot	4.8	3.8	4.8	0.3	9.5	8.7	28.5	43.4	52.4	44.3
Ouananiche (Landlocked salmon)	-	-	33.3	4.9	16.7	7.5	16.7	25.9	33.3	61.7
Round whitefish	-	-	100.0	100.0	-	-	-	-	-	-
Common sucker	33.3	3.9	33.3	15.4	-	-	33.4	80.7	-	-

Appendix 3a. Summary of empirical age and growth data for northern pike from Ossokmanuan Reservoir, 1976 (using scales).

Age	Number of fish	Mean fork length (cm)	Range (cm)	Mean weight (kg)	Range (kg)
5+	2	45.1	43.7-46.4	0.61	0.53-0.68
6+	2	50.8	50.0-51.5	0.97	0.95-0.98
7+	10	50.5	47.6-58.1	0.94	0.72-1.43
8+	13	56.2	47.5-65.8	1.32	0.71-1.95
9+	24	60.9	50.6-68.3	1.53	0.94-2.10
10+	25	64.1	54.5-76.4	1.86	1.31-2.86
11+	9	68.7	61.0-76.0	2.29	1.58-2.91
12+	3	71.7	63.4-80.3	2.23	1.78-2.53
13+	1	73.9	-	2.54	-

Appendix 3b. Summary of empirical age and growth data for northern pike from Ossokmanuan Reservoir, 1976 (using opercular bones.

Age	Number of fish	Mean fork length (cm)	Range (cm)	Mean weight (kg)	Range (kg)
4+	5	47.1	44.1-50.8	0.74	0.53-0.99
5+	14	51.5	45.5-56.5	0.98	0.72-1.35
6+	8	53.2	47.5-62.5	1.14	0.71-1.83
7+	21	60.3	50.6-67.5	1.54	0.94-2.20
8+	25	62.3	56.5-72.5	1.68	1.31-2.50
9+	12	68.1	62.2-76.0	2.18	1.67-2.83
10+	8	69.0	60.8-76.4	2.14	1.52-2.86
11+	1	74.1	-	2.91	-
12+	1	80.3	-	2.38	-

Appendix 4a. Summary of empirical age and growth data for longnose sucker from Ossokmanuan Reservoir, 1976 (using scales).

Age	Number of fish	Mean fork length (cm)	Range (cm)	Mean weight (kg)	Range (kg)
4+	6	15.8	15.1-16 7	0.04	0.03-0.05
5+	10	18.1	16.0-20.5	0.07	0.03-0.11
6+	5	20.3	18.9-23.0	0.09	0.98-0.13
7+	12	23.2	20.2-25.5	0.15	0.10-0.20
8+	10	26.2	22.2-30.6	0.22	0.13-0.37
9+	6	28.4	24.2-31.8	0.28	0.18-0.38
10+	6	31.2	27.2-33.3	0.39	0.27-0.48
11+	5	32.7	30.5-34.5	0.42	0.32-0.54
12+	5	34.0	29.7-37.0	0.49	0.35-0.64
13+	10	37.7	34.7-40.5	0.67	0.55-0.88
14+	4	42.5	38.2-44.5	1.00	0.65-1.19
15+	5	42.1	40.1-48.2	0.98	0.73-1.58
16+	5	42.9	40.5-49.4	1.11	0.86-1.78
17+	4	48.1	40.8-51.7	1.60	0.80-2.17
18+	4	50.5	50.0-51.3	1.89	1.80-2.00
19+	3	51.3	46.3-54.6	1.85	1.38-2.10

Appendix 4b. Summary of empirical age and growth for longnose sucker from Ossokmanuan Reservoir, 1976 (using fin rays).

Age	Number of fish	Mean fork length (cm)	Range (cm)	Mean weight (kg)	Range (kg)
3+	3	18.2	17.0-19.2	0.07	0.06-0.09
4+	6	17.9	15.8-19.6	0.06	0.05-0.10
5+	1	20.5	-	0.11	-
6+	8	24.6	21.1-30.3	0.18	0.09-0.34
7+	5	22.1	18.9-24.0	0.14	0.08-0.18
8+	8	29.6	22.8-44.2	0.38	0.14-1.19
9+	10	33.4	25.8-50.0	0.56	0.18-1.81
10+	6	30.0	23.0-36.0	0.42	0.13-0.60
11+	12	37.5	28.0-49.4	0.78	0.25-1.78
12+	10	38.3	29.7-50.6	0.86	0.36-2.00
13+	6	36.9	30.5-41.6	0.63	0.34-0.88
14+	9	38.1	31.5-49.1	0.72	0.37-1.43
15+	2	44.7	38.0-51.3	1.23	0.65-1.80
16+	1	37.0	-	0.64	-
17+	2	47.7	40.8-54.6	1.45	0.80-2.10
18+	1	51.7	-	1.98	-
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21+	1	53.1	-	2.06	-