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Size of mesh for commercial gill-nets
in Lake Manitoba

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INTRODUCTION

The Game and Fisheries Branch of the Manitoba Department of Mines and Natural Resources referred a problem to the Central Fisheries Research Station of the Fisheries Research Board of Canada in December, 1945. This problem concerned the question of a recommendation as to what sized mesh of gill nets should be legalized for commercial fishing in Lake Manitoba in order to properly manage the fisheries resources of the lake for the best sustained annual yield.

The most suitable mesh would be the one that takes fish of the most suitable size range. The most suitable size range would be one that balances the following factors:

1. In general, fish increase in weight most rapidly during early life, and more and more slowly as they become older. For example, Adamstone showed that in Lake Erie the blue pickerel Stizostedion glaucum, whose market size is about the same as that of the sauger, weigh twice as much when they are four years old as they do when they are three years old, and three times as much when they are five years old as when they are three years old; i. e. they increase in weight 50 per cent. during the fourth year. During the sixth year blue pickerel increase in weight by 19 per cent. and in the seventh by 6 per cent. That is, by leaving a three year old fish in the lake for two years, instead of catching it, the weight taken eventually is tripled. Leaving it still longer increases the weight at a slower rate.

2. But if the fish were left until each individual fish has reached its maximum size, probably only a few fish would be left to be caught. Disease, predators, accidents and sometimes starvation gradually reduce the millions originally spawned in each year class, so that even in virgin lakes there are only a few old fish, and each species has a maximum age.

There will be one size at which the tendency of growth to increase the total weight of fish in a year class is just offset by the tendency of the deaths of individuals to decrease the total weight of fish in a year class. For maximum yield in pounds of fish it would be best to catch the fish at that size.

3. Each fish population has a minimum average size at which fish can be taken if adequate spawning is to be maintained. If this minimum average size is greater than the size which would produce the greatest yield in pounds of fish, then it should be considered to be the proper size at which fish should be taken for maximum sustained yield.

4. The size at which fish are most marketable may be a consideration. Further, the fact that a greater percentage of fillet weight can be taken from small fish than from large fish may be relevant.

It was proposed to make a count, with measurements of length, weight and age, of the fish taken in a considerable number of the nets in present use. Then, it was proposed to catch fish experimentally during the winter season by a series of gill nets of graded mesh sizes. From a study of the scales of these fish

would be obtained the increase of weight with age, to assess factor 1 above. From a consideration of the number of fish of each age taken, and from a study of the fisheries statistics, may be estimated the natural mortality and the fishing mortality. (A tagging programme would greatly assist in making accurate estimates, but it would be too expensive.) These estimates would be used to assess factor 2 above. The size at which fish become mature would be determined from the catch and used to assess factor 3. Information on factor 4 would be obtainable from fishermen and dealers.

When all these factors are considered, the size of fish which is most desirable to catch can be decided. Then, from knowledge of the size range of fish taken by each size of gill net, the most suitable size of legal mesh may be selected.

Catch statistics

Figures for poundage of fish marketed are available from 1912 to 1945, with the exception of the year 1919. These figures are shown in table.1. In the early years the total production was about 3 to 4 million pounds; this was reduced to a low of about 2 million pounds in 1920, rose to $8\frac{1}{2}$ million pounds in 1926, was lower in the early thirties---about 5 million pounds, but rose irregularly to over 9 million pounds in 1941. The catch in 1944 and 1945 was lower, about 4 million pounds.

A consideration of the trend in catch according to species gives additional information:

Whitefish were formerly taken in the amount of about

$\frac{1}{2}$ million pounds, but suffered a very severe decrease after 1930, so that they are now almost commercially extinct.

Pickereel have maintained a fairly constant production level at between about 1 and $2\frac{1}{2}$ million pounds, amounting to slightly over 1 million pounds in each of the last 2 years.

Sauger were not recognized commercially until about 1927, and were not taken in any quantity until after 1930, when the catch rose to over $3\frac{1}{2}$ million pounds in 1941,--probably as the result of the introduction of $3\frac{1}{2}$ " mesh in that year,--and dropped to about 1 million pounds in the last couple of years.

Tullibee increased in marketings after 1923, to the extent of nearly 3 million pounds in 1926 and 1927, decreasing to slightly over 1 million pounds until 1943, and with a marked decrease the last two years.

Perch were taken in rather small quantities until early in the 1930's reached a maximum production of over $1\frac{1}{2}$ million pounds in 1941, and declined to 3 or 4 hundred thousand pounds in 1944 and 1945.

Pike or jackfish were marketed in amounts of over 1 million pounds 30 years ago, and the catch of this species has since been partly a reflection of the market price. Catches of between $\frac{1}{2}$ and $1\frac{1}{2}$ million pounds were made from 1936 to 1943, dropping in the two years following.

Suckers or mullets were not marketed to any appreciable degree until 1924, increased to 400,000 pounds with better prices towards 1930, dropped off again, and then were sold in the amount

of about $\frac{1}{2}$ million pounds in 1944 and 1945. Marketing of both pike and suckers in part follow the price, i. e. they were likely taken in larger amounts but not sold or reported in years of low demand for the species.

Intensity of fishing

A rough measure of the intensity of fishing is available in the figures of the number of gill nets in use each year. There were only 3-4,000 nets reported for 10 years after 1911, but this increased rapidly to 23,000 in 1927, dropped to 16,000 by 1935, and increased to over 29,000 in 1943. While there is some relationship between poundage taken and the number of nets in use, the total catch is not always a reflection of the number of nets in use. As will be shown below probably most of the catchable fish are caught during the first part of the fishing season, so that adding more nets only decreases the time necessary to take off the "crop" without appreciably increasing the total catch. The price of fish also affects the number of nets put into operation.

Over about 35 years, the average catch of fish per gill net has been just under 300 pounds per year. The average annual catch per net for the last 5 years has been just under 250 pounds.

Ecological

A lake is not a static body of water, but is always moving towards its ultimate destination of becoming filled up with sediments and the products of its own metabolism. A "new" lake is a sterile, rocky basin filled with cold, clear water. An

"old" lake is muddy and shallow, eventually becoming a marsh, and then land. This progression is usually slow, but can be accelerated by land use practices in the watershed which tend to denude and loosen the soil and allow it to be carried into the lake by tributary streams.

The progression of dominant fishes from a new lake to an old lake shows a change from trout to whitefish to pickerel to sauger, perch, and suckers. Trout need cold, clear water in order to thrive, and as a lake becomes more mature the other fishes become dominant as the water becomes warmer, shallower, and more turbid.

Lake Manitoba is filling up, particularly in the southern portion, with an accumulation of soft mud in the lake basin. Also, the water level has dropped, so that present surface level is lower than formerly. It is doubtful if there are depths of water of 20 feet anywhere in the lake, and great areas of it are 16 to 18 feet in depth. The north part has a harder bottom, perhaps owing to the rockier nature of the country and some flow from the Waterhen River to the Fairford River.

It is considered that the lake is now no longer suitable to the production of large quantities of whitefish, even if this species was given a chance to "come back" by the use of only large gill nets. It is also believed that the progress of sedimentation in the south end is gradually eliminating much of the remaining hard bottom favoured by pickerel, but that the soft bottom can be

utilized by sauger and perch. The hard bottoms of the north end can still produce pickerel. Therefore, it is suggested that the southern portion of Lake Manitoba be recognized and managed as a sauger lake, and the northern portion as a pickerel lake.

Gill nets suitable for sauger operations in the south end would take many immature pickerel, but would take a satisfactory harvest of perch and tullibee as well as sauger. Gill nets suitable for pickerel operations in the north end would allow many mature saugers to live beyond the best size for harvesting, thus adding to the annual seeding of the south end with young sauger.

By way of comparison, it may be pointed out that another large lake in central Canada is now undergoing noticeable ecological changes. In Lesser Slave Lake, Alberta, the commercial fishermen used to take lake trout, but now none are available. The quota of 400,000 pounds of whitefish once was caught with ease, but now is not obtained in some years. In recent times, pickerel have increased to constitute a considerable proportion of the total catch. Thus, Lesser Slave Lake is probably changing, but is at an earlier stage in the succession than is Lake Manitoba.

Progress during the winter 1945-46

A study of the fishery was initiated December 17, 1945 when the three authors began to examine catches made by fishermen on Lake Manitoba. They recorded the lengths, weights and in some cases sex of the fish, and took scale samples from them for age determination. The catch from each net was tabulated separately,

and the size of the mesh, location, number of nights fished, and other pertinent information was recorded. Shortly after, officers of the Manitoba Department of Mines and Natural Resources were instructed in collecting this data, and they continued to do so for the remainder of the fishing season in a highly satisfactory manner.

In addition the fisheries officers operated some nets smaller than the legal $3\frac{1}{2}$ " mesh and sent the fish which were caught to the Central Fisheries Research laboratory where the sex, length, and weight were recorded and a scale sample was taken.

Although the samples of fish examined from fishermen's nets were taken haphazardously, we feel that they represent the commercial catch reasonably well. Further we see no reason to doubt that the fish caught in the small meshed nets are representative of the small fish in the lake. Only pickerel, saugers, perch and tullibee were measured.

Analysis of the data

In the preliminary analysis the catches made north of a line east and west through Duck Island were treated separately from catches made south of that line. Since the fish populations in the two areas appeared to differ in average size and in abundance this separation of the two areas has been maintained.

The length from the tip of the snout to the fork of the tail of each fish was originally recorded to the nearest quarter of an inch. Because these intervals seemed too small, one inch

has been used as the unit. For example, all the fish recorded as 10", 10 $\frac{1}{4}$ ", 10 $\frac{1}{2}$ ", and 10 $\frac{3}{4}$ " have been put into one group 10" to 10 $\frac{3}{4}$ ". Actually this group includes all fish whose exact length falls between 9-7/8" and 10-7/8".

The fish were weighed on a spring balance and the weight was recorded to the nearest ounce. Scales were taken from between the dorsal fin and the lateral line. No scales have been read to date.

The sex and state of maturity was determined by examining the gonads. Pickerel, perch and saugers which appeared to be about to spawn, and tullibee which appeared to have just spawned, were recorded as mature. The rest were regarded as immature.

The stretch measure of the mesh in which the fish were caught was originally measured to the nearest sixteenth of an inch. In this analysis the nets have been grouped to the nearest quarter of an inch. Catches from nets which were recorded half way between two quarters were divided equally between them. For example, half the catches recorded as taken in 3-3/8" mesh would be put into the 3 $\frac{1}{4}$ " mesh group and half into the 3 $\frac{1}{2}$ " mesh group.

Sizes of fish (See tables 2 to 9 inclusive and figure 1)

The average size of each of the 4 species--pickerel, saugers, perch and tullibee--was greater in the north end than in the south end, in all sizes of mesh from which the samples were adequate. This indicates that the average size of the fish in the north end is greater than that in the south end.

The average size of saugers was practically the same,

whether $2\frac{3}{4}$ " , 3" , $3\frac{1}{4}$ " or $3\frac{1}{2}$ " mesh nets were used. That is, saugers probably reach a maximum average size of about 13" (16 oz.) in the south end and 14" (18 oz.) in the north end. Pickerel increased in average weight from about 12" (13 oz.) in $2\frac{1}{2}$ " mesh to about 17" (40 oz.) in $4\frac{1}{2}$ " mesh; perch from about 6" ($2\frac{1}{2}$ "oz.) in $1\frac{1}{2}$ " mesh to $11\frac{1}{2}$ " (14 oz.) in $3\frac{3}{4}$ " mesh; tullibee from about $8\frac{1}{2}$ " (6oz.) in 2" mesh to $10\frac{1}{2}$ " (10 oz.) in $3\frac{1}{2}$ " mesh.

Availability -- (See tables 10 to 13)

The availability--as measured by catch per unit effort--of each species tended to decrease with time for all sizes of mesh commonly used by the fishermen. That is, the numbers of fish of the sizes which were exploited decreased appreciably during the winter. An exception to this is the pickerel in the south end of the lake. This tendency was not present in the case of mesh sizes not commonly used by the fishermen.

The availability of saugers was markedly less in $3\frac{3}{4}$ " and larger meshes than in $3\frac{1}{4}$ " and smaller meshes. The availabilities of perch and tullibeets in $3\frac{1}{2}$ " and larger were markedly less than in $3\frac{1}{4}$ " mesh and smaller. There was little difference in availability of pickerel from the smallest to the largest mesh sizes.

This increases the probability of the hypothesis mentioned above, that saugers reach a maximum average size which is the average size taken by $3\frac{1}{2}$ " mesh. From this it appears too that perch and tullibee also tend to reach a maximum average size, namely the average size taken by $3\frac{1}{4}$ " mesh. Pickerel, on the other hand, reach

no such maximum within the size ranges for which there are adequate data.

The availability of all 4 species was appreciably less in the north part than in the south part of the lake.

Probably these populations of pickerel, sauger, perch and tullibee follow the general rule that a body of water will support either a few large fish or a number of small fish. So, in the south part of the lake the availability is greater and the average size smaller than in the north part.

Maturity - (See tables 14 and 15)

Almost all of the perch and saugers taken in meshes of $2\frac{1}{2}$ " or greater were mature. Twenty-nine per cent of the tullibee taken in $2\frac{1}{2}$ " mesh, 44 per cent of those taken in 3" mesh, and 95 per cent of those taken in $3\frac{1}{2}$ " mesh were mature. The data on the size of pickerel at maturity are scanty but it indicates that about 30 per cent of the pickerel taken in $3\frac{1}{4}$ " mesh, and about 50 per cent of those taken in $3\frac{1}{2}$ " mesh and over are mature. Our limited data indicate that no mesh size could be fished which would not take about 50 per cent immature pickerel from the population now present.

A consideration of some methods which might be used to increase the value of the Lake Manitoba fishery

1. Increase in size of mesh

Suppose the minimum legal mesh size were increased to, say $3\frac{3}{4}$ ". This would probably result in a more profitable pickerel

fishery. However, consideration of the data at hand, suggests that the increase in value of the pickerel fishery would not nearly compensate for the anticipated loss of practically all of the saugers, perch and tullibees now taken in $3\frac{1}{4}$ " mesh nets.

2. Shorter season

Unless the season were shortened considerably such action would not appreciably increase the escapement, since the data on changes in availability suggest that most of the fish of catchable size are taken long before the end of the present season.

3. Fewer nets per fisherman

Suppose each fisherman was restricted to one-third of his present yardage. Then he could, and probably would, lift more often than he does at present. Suppose he lifts every four days whereas previously he had lifted every twelve days. From our knowledge of the effect of the number of nights fished on the resulting catch in other places, we would expect two-thirds as many fish after four days as would be after twelve days. So by lifting three times as often the fisherman could catch two-thirds of the fish he originally caught with three times the yardage. That is, if a reduction in yardage were to result in more frequent lifts then the reduction must be quite drastic to allow an appreciably greater escapement.

4. A quota

This is a direct approach to the objective aimed at more indirectly by the other three suggestions, namely, an increase in the escapement. Before a quota is applied however, careful consider-

ation should be given to the possibility that a greater escapement would: not necessarily result in more young fish being produced, which is the only reason for allowing a greater escapement. We again call attention to the fact that almost all saugers and perch taken are mature, which suggests the possibility that as many of these species are produced now as the lake can carry.

If the number of fishermen were decreased sufficiently the effect would be the same as if a quota were applied.

5. Decrease in mesh size

It is possible, especially in the south part of the lake, that if the legal mesh size were 3" and 2 $\frac{1}{2}$ " that the total sustained monetary yield of the fishery would be greater. The pickerel would probably become almost extinct but the increased weight of saugers and perch caught might more than compensate for the loss in pickerel. Such a decrease in mesh size cannot be recommended until further data have been gathered, but the possibility should be kept in mind.

Recommendations

1. Pending a completion of our study, we recommend that the legal mesh size remain unchanged.

2. During the winter of 1946-47 we suggest that the following data be gathered:

(a) More complete information on the change in catch per unit effort throughout the season. We propose to have selected fishermen keep a daily or weekly record of the number of nets lifted, and the number of fish caught. It is essential that these

fishermen be interested volunteers, who will remain interested for the whole season.

(b) A larger series of measurements on pickerel including scales samples, and examination of their gonads to increase our knowledge of the size at which they mature.

(c) Measurements and scales from limited samples of the other species for comparison with the fish considered in the present report.

3. Consideration should be given to separate treatment for the north and south ends of the lake in view of the apparent difference in fish populations.

June 12, 1946
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Table 1. Catch statistics in hundred weight for Lake Manitoba, 1912 to 1945 inclusive.

Year	Total catch	White-fish	Pick-erel	Sauger	Tullibee	Perch	Pike	Suckers	No. gill nets
1912	32,186	2,587	7,908				12,860		4,720
1913	30,936	1,780	7,850			36	11,520		1,840
1914	10,300	100	800						
1915	40,600	3,000	15,300		4,300				
1916	25,400	2,200	4,400		1,000				
1917	39,415	2,620	12,450		3,591	300	16,790	1,164	4,680
1918	39,415	2,620	12,450		3,591				
1919	-----	-----	-----	-----	-----	-----	-----	-----	-----
1920	18,115	530	5,630		5,650	500	5,000	805	3,040
1921	19,226	776	9,000		5,800	270	3,020	360	3,135
1922	19,600	770	12,000		2,700	300	3,400	-----	-----
1923	25,205	780	15,400		3,900	325	4,800	450	9,390
1924	48,558	990	18,321		19,742	530	7,400	1,575	12,386
1925	51,587	1,170	16,742		19,535	640	9,694	3,806	16,272
1926	85,256	1,365	27,626		29,306	4,436	18,045	4,478	22,920
1927	77,858	1,894	26,106	209	28,459	162	17,316	2,254	23,000
1928	57,300	1,800	22,500	1,100	14,500	250	4,600	-----	-----
1929	56,625	1,558	11,330	1,070	19,366	335	18,741	4,225	20,960
1930	36,584	1,576	12,043	265	9,060	281	9,245	4,114	18,016
1931	32,000	1,950	11,600	900	7,900	900	2,200	-----	-----
1932	45,000	350	15,700	1,700	16,500	800	2,300	-----	-----
1933	48,696	365	20,325	2,400	11,016	4,131	9,415	1,044	21,330
1934	50,350	270	20,281	7,008	13,710	4,745	2,925	1,410	16,175
1935	42,816	238	16,885	5,721	10,508	3,783	3,266	2,415	16,000
1936	68,888	92	22,561	10,601	18,425	7,293	7,093	2,823	16,350
1937	61,061	17	20,020	18,337	5,365	5,963	9,032	2,327	27,217
1938	58,602	27	10,404	17,276	6,614	5,189	15,338	3,704	23,190
1939	72,830	5	20,530	19,608	16,181	7,147	7,876	1,483	25,830
1940	56,267	29	14,853	18,280	7,591	7,950	5,725	1,810	21,960
1941	93,863	6	17,884	38,178	12,065	15,980	8,297	1,430	24,690
1942	89,755	80	21,694	37,506	13,348	9,516	4,810	2,801	28,530
1943	57,740	313	14,350	15,920	11,665	5,381	5,131	4,974	29,070
1944	37,201	34	11,604	9,353	1,553	2,958	4,386	7,309	23,460
1945	40,777	6	11,670	10,113	3,756	4,251	3,805	7,172	25,470

Table 2. Size distribution of pickerel catches in the south end of Lake Manitoba as determined by samples taken during the winter of 1945-1946.

Length in inches	Mesh size									
	2"	2½"	3"	3½"	3¾"	4"	4½"	4¾"	5"	5½"
8-8½	1									
9-9½	0		3							
10-10½	0	2	19	3		1				
11-11½	1	5	57	15		10	1		1	
12-12½		1	19	13	2	14	7		0	
13-13½		1	8	8	12	14	34	1	1	
14-14½		11	3	3	2	7	47	15	5	1
15-15½		1	7	6	6	10	27	36	4	
16-16½			5	1	1	3	11	54	3	
17-17½				1	1	1	2	27	1	1
18-18½					2	2	0	14	0	1
19-19½					1	0	0	4	2	0
20-20½						2		4		0
21-21½								3		1
22-22½								1		

Table 3. Size distribution of pickerel catches in the north end of Lake Manitoba as determined by samples taken during the winter of 1945-1946.

Length in inches	Mesh size									
	3"	3½"	3¾"	4"	4½"	4¾"	5"	5½"	6"	
10-10½		3								
11-11½		2								
12-12½		35	1							
13-13½		55	5	2						
14-14½		84	19	16	1		1			
15-15½	1	27	8	23	6	17	1			
16-16½	1	10	4	27	8	13	3			
17-17½		4	2	2	4	15	8			
18-18½		1	0	1	3	8	3			
19-19½		1	1	1	2	2	2			1
20-20½		2		1	0	4	0	2	1	
21-21½		1			1		1			1
22-22½							0			
23-23½							0			1
24-24½							0			
25-25½							0			
26-26½							1			

Table 4. Size distribution of sauger catches in the south end of Lake Manitoba as determined by samples taken during the winter 1945-1946.

Length in inches	Mesh size								
	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"
8-8½				2					
9-9½			1	0					
10-10½	1	3	1	2	3				
11-11½	3	16	2	33	29				
12-12½	14	45	26	168	53				
13-13½	6	41	26	206	33	3			
14-14½		16	2	59	5	1		1	
15-15½		2		6	1	1		3	
16-16½				1				1	1
17-17½				2					

Table 5. Size distribution of sauger catches in the north end of Lake Manitoba as determined by samples taken during the winter of 1945-1946.

Length in inches	Mesh size		
	3¼"	3½"	3¾"
11-11½	1		
12-12½	18	2	
13-13½	85	8	1
14-14½	60	17	1
15-15½	10	2	2
16-16½	4		
17-17½	4		

Table 6. Size distribution of perch catches in the south end of Lake Manitoba as determined by samples taken during the winter of 1945-1946.

Length in inches	Mesh size									
	1½"	2"	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4½"
4-4½	8									
5-5½	2	1		1	1					1
6-6½	6	10		1	0					
7-7½	3	11	14	10	1			1	1	
8-8½			58	72	44	3	1			
9-9½			12	62	63	36	3	1		
10-10½			3	11	3	59	8		1	
11-11½				1	1	25	1	1		
12-12½					1	0				
13-13½						1				

Table 10. The relationship of average catch of pickerel per lift to date and to mesh size in Lake Manitoba as determined from samples taken during the winter 1945-1946.

Dates	Mesh size											
	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"	4¾"	5"	5¼"
Dec.17-Dec.30				4							3	
Dec.31-Jan.13		18 ^x		2	3	4		2				
Jan.14-Jan.27	0.3 ^x	7 ^x	4 ^x	3	5	5		3				
Jan.28-Feb.10	2. x	10 ^x	8 ^x					6				
Feb.11-Feb.24	2. x	3	3 ^x									
Feb.25-Mar.6				5								

North end

Dec.17-Dec.30				5	2 ^x			2 ^x	2 ^x			
Dec.31-Jan.13			1 ^x	0.1	3			1	0.8			1 ^x
Jan.14-Jan.27				0.4	0.3	0.9	1	0.7				
Jan.28-Feb.10	-											
Feb.11-Feb.24						0.5	0.7	0.8				1 ^x
Feb.24-Mar.6	-											

x Sample inadequately small.

Table 11. The relationship of average catch of saugers per lift to date and to mesh size in Lake Manitoba as determined from samples taken during the winter of 1945-1946.

Dates	Mesh size									
	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"	
Dec.17-Dec.30				35						
Dec.31-Jan.13		22 ^x		12	3	2		0.3		
Jan.14-Jan.27	0.3	8	2	14	12	2	1	0		
Jan.28-Feb.10	2 ^x	10 ^x	8 ^x					0.9		
Feb.11-Feb.24	10 ^x	1 ^x	8 ^x		0		0.8			
Feb.25-Mar.6				7						

North end

Dec.17-Dec.30				3	2 ^x			0 ^x	1 ^x	
Dec.31-Jan.13			0 ^x	0.2	2			0	0	
Jan.14-Jan.27				0.4	0	0.02	0	0		
Jan.28-Feb.10	-									
Feb.11-Feb.24					0	0.06	0	0		
Feb.25-Mar.6	-									

x Sample inadequately small.

Table 12. The relationship of average catch of perch per lift to date and to mesh size in Lake Manitoba as determined from samples taken during the winter of 1945-1946.

Dates	Mesh size							
	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"
<u>South end</u>								
Dec.17-Dec.30				11				0
Dec.31-Jan.13				3	2	0		0.8
Jan.14-Jan.27	6	5 ^x		8	4	0.1		0
Jan.28-Feb.10	11 ^x	15 ^x	5	14 ^x				0
Feb.11-Feb.24	13 ^x	10 ^x	16 ^x					0
Feb.25-Mar.6				6				
<u>North end</u>								
Dec.17-Dec.30				2	1 ^x			0 ^x
Dec.31-Jan.13			0 ^x	0.4	0.2			0
Jan.14-Jan.27				0.2	0.2	0.05	0	0
Jan.28-Feb.10	-							
Feb.11-Feb.24					0.7	0.2	0	0.2
Feb.25-Mar.6	-							

x Samples inadequately small.

Table 13. The relationship of average catch of tullibee per lift to date and to mesh size in Lake Manitoba as determined from samples taken during the winter of 1945-1946.

Date	Mesh size							
	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"
<u>South end</u>								
Dec.17-Dec.30				15				
Dec.31-Jan.13				1	0.2	0		0
Jan.14-Jan.27	9	26 ^x		8	0	0		0
Jan.28-Feb.10	26 ^x	28 ^x	10	23 ^x				0
Feb.11-Feb.24	3 ^x	4 ^x	10 ^x					
Feb.25-Mar.6				0.5				
<u>North end</u>								
Dec.17-Dec.30				3	0.5 ^x			0.7 ^x
Dec.31-Jan.13			0 ^x	0.3	0.5			0
Jan.14-Jan.27				0.1	0.1	0	0	0
Jan.28-Feb.10	-							
Feb.11-Feb.24	-					0	0.2	0
Feb.25-Mar.6	-							

x Sample inadequately small.

Table. 14. The relationship of sex and state of maturity to size of fish as determined from the examination of gonads of samples of four species of fish from Lake Manitoba during the winter of 1945-1946.

Length in inches	<u>Perch</u>				<u>Tullibee</u>				<u>Sauger</u>				<u>Pickereel</u>			
	Immature		Mature		Immature		Mature		Immature		Mature		Immature		Mature	
	M	F	M	F	M	F	M	F	M & F	M	F	M & F	M	F		
4-4 $\frac{1}{2}$	0	5	5	0												
5-5 $\frac{1}{2}$	0	6	4	2												
6-6 $\frac{1}{2}$	0	0	4	12	1	1	0	0								
7-7 $\frac{1}{2}$	0	0	12	28	36	23	0	2								
8-8 $\frac{1}{2}$	0	1	21	151	111	115	23	88				1	0	0		
9-9 $\frac{1}{2}$	0	0	20	112	17	25	21	92	0	1	0	3	0	0		
10-10 $\frac{1}{2}$	0	1	0	28	0	0	4	4	1	4	0	26	0	0		
11-11 $\frac{1}{2}$	0	0	0	2					1	17	2	83	0	0		
12-12 $\frac{1}{2}$	0	0	0	1					2	82	23	34	2	0		
13-13 $\frac{1}{2}$	0	0	0	1					1	42	84	20	6	1		
14-14 $\frac{1}{2}$									0	8	33	8	6	0		
15-15 $\frac{1}{2}$									0	3	5	10	13	1		
16-16 $\frac{1}{2}$									0	0	1	5	3	1		
17-17 $\frac{1}{2}$									0	0	1	0	0	0		
18-18 $\frac{1}{2}$									0	0	1	0	1	0		
19-19 $\frac{1}{2}$												0	0	0		
20-20 $\frac{1}{2}$												0	0	1		

Figure 1. The average size of fish caught related to mesh size.

