THE AGE AND GROWTH OF THE YELLOW PIKEPERCH *STIZOSTEDION VITREUM VITREUM* (MITCHILL) IN THE GREEN BAY WATERS OF LAKE MICHIGAN

Thesis for the Degree of M. S.
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Robert F. Balch

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This is to certify that the

thesis entitled

"The Age and Growth of the Yellow Pike-perch Stizostedion Vitreum Vitreum (Mitchill) in the Green Bay Waters of Lake Michigan"

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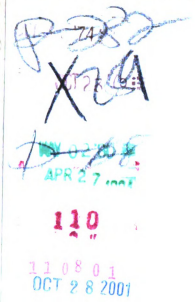

THE AGE AND GROWTH OF THE YELLOW PIKEPERCH *STIZOSTEDION VITREUM VITREUM* (MITCHILL) IN THE GREEN BAY WATERS OF LAKE MICHIGAN

By

ROBERT F. BALCH

A THESIS

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THESIS

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THE AGE AND GROWTH OF THE YELLOW PIKEPERCH, STIZOSTEDION VITREUM VITREUM (MITCHILL), IN THE GREEN BAY WATERS OF LAKE MICHIGAN

BY

ROBERT F. BALCH

INTRODUCTION

This study was initiated during the summer of 1949 while the author was a student at Michigan State College. It was continued during 1950 and 1951 by the author as a research project at the Sturgeon Bay, Wisconsin, headquarters of the Wisconsin Conservation Department. The State of Wisconsin and the U.S. Fish and Wildlife Service, through a co-operative agreement, maintain a research station at Sturgeon Bay, Wisconsin, for investigations of the waters of northern Lake Michigan and Green Bay.

Green Bay is only 118 miles long and 23 miles wide at the maximum. In spite of its small size, this body of water is extremely productive. In 1936-1946, the Wisconsin waters yielded a recorded annual harvest of 6,139,000 pounds. The statistics are not complete for the first seven years of that period. For the same period, Michigan waters of Green Bay yielded 3,353,000 pounds.

The high productivity of the bay is influenced by the shallow character of this body of water and by the higher temperature of the water. Its fisheries are for all practical purposes distinct from those of Lake Michigan.

The fishery of Green Bay is much more intensive than that of the lake. The character of the bay is conducive to greater effort on the part of the operator, since nets can be set at any place in the bay, resulting in less time spent in travel and more time can be spent lifting and setting on the grounds.

The waters of Green Bay are administered by two states. Regulations concerning minimum legal length and fishing gear vary. Michigan, for example requires a 15½ inch minimum size limit, while Wisconsin limits the size of the yellow pikeperch to 15 inches. Wisconsin has made the trap net illegal to operate, while Michigan has not outlawed this type of gear. Many other regulations differ for Wisconsin and Michigan waters of Green Bay.

The yellow pikeperch populations of northern and southern Green Bay act like different populations entirely. Growth rates differ. Factors causing the rise and fall of the populations do not seem to affect both regions in the same way. Fish populations of northern and southern Green Bay are composed of different species.

Southern Green Bay produces large amounts of carp, yellow perch, smelt, catfish, herring and sheepshead. Northern Green Bay produces largely Whitefish, yellow-pikeperch, herring, smelt and yellow perch.

While a large number of investigators have described the growth of the yellow pikeperch, Stizostedion v. vitreum (Mitchill) the recent increase in production in Northern Green Bay waters and the lack of specific information on this particular population has made this study valuable from a fish management standpoint.

ACKNOWLEDGEMENTS

I wish to acknowledge the assistance and advice of Dr. Peter I. Tack of the Department of Zoology, Michigan State College, under whose guidance this study was initiated.

Dr. Ralph Hile, Supervisory Fishery Research Biologist of the U.S. Fish and Wildlife Service, Great Lakes Fishery Investigations contributed three samples of data taken during the spring of 1949, and the spring of 1950. The statistical data for the yellow pikeperch fishery of northern Green Bay was prepared by Dr. Hile. Much valuable advice as to analysis and presentation of data, from Dr. Hile is gratefully acknowledged.

Mr. Leonard Joeris, Fisheries Research Biologist, and Mr. Donald Mraz, Fisheries Technician, of the U.S. Fish and Wildlife Service; and Mr. William Gerl, of the Wisconsin Conservation Department, all aided in the collection of data.

Commercial fishing statistics for the Wisconsin waters of Green Bay were obtained from the Commercial Fisheries section of the Wisconsin Conservation Department at Sturgeon Bay, Wisconsin.

MATERIALS AND METHODS

This investigation of age and growth has been based upon the determinations of ages for 835 yellow pikeperch from northern Green Bay and 33 specimens from southern Green Bay. Samples for growth calculations were restricted to random samples of known sex.

Specimens were obtained largely from wholesale fish dealers in the area. When possible, samples were obtained directly from the fishermen. Unless otherwise noted, all are net run samples. In the case of extremes in size, selection was made for purposes of completeness.

Samples in northern Green Bay were taken in the vicinity of the following localities: Fairport, Round Island, Garden, Ogontz Bay, Wilsey Bay, Escanaba, Ford River, and Cedar River, Michigan; Marinette, Peshtigo

and Suamico, Wisconsin. Figure I shows sampling locations.

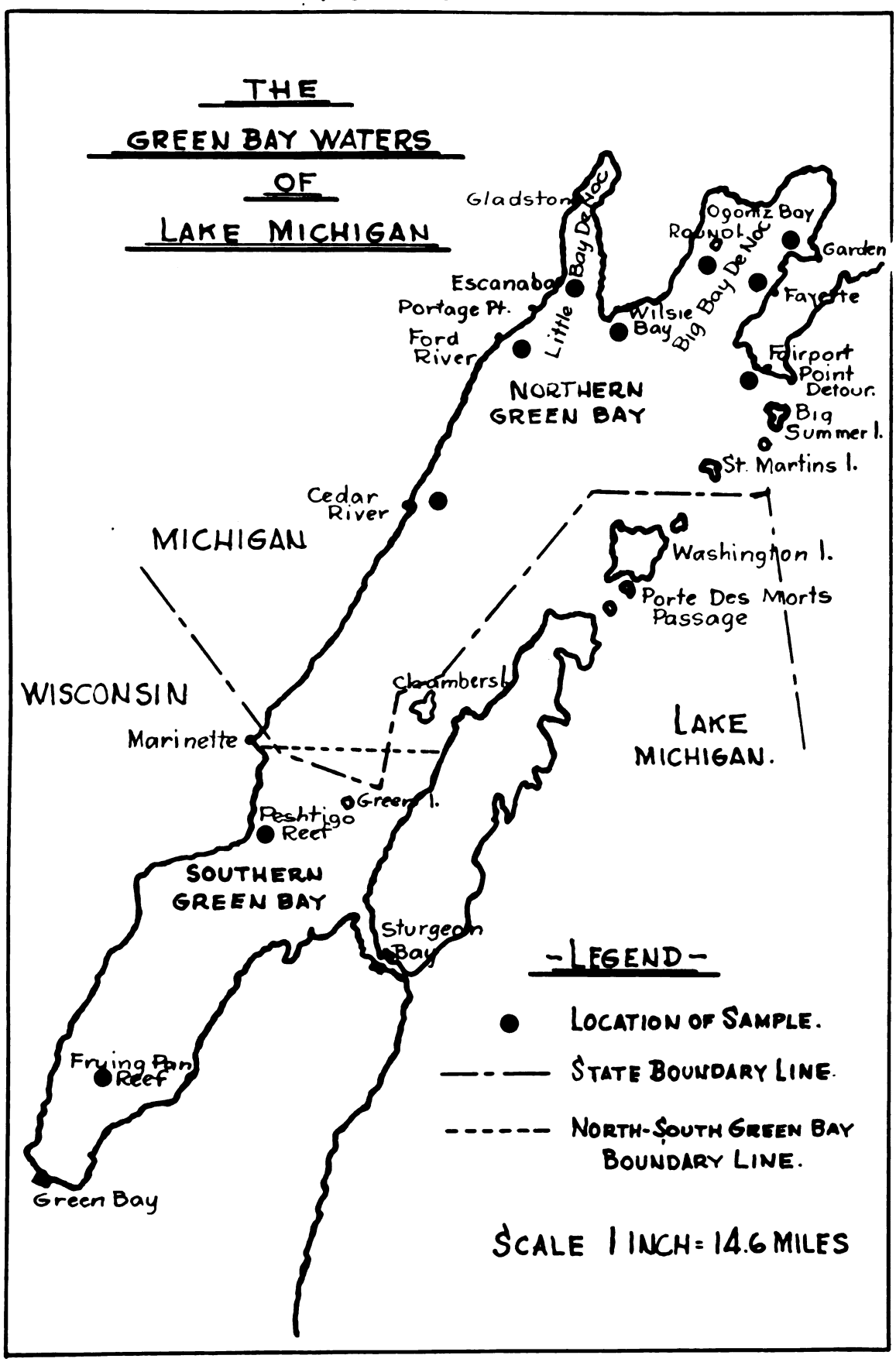
With the exception of the seine, samples were taken from all types of commercial gear used to harvest yellow pikeperch in this area. These include the fyke net, the pound net, the trap net and the gill net. Samples from both large mesh (4½ inch stretched measure) and small mesh (2½ inch stretched measure) gill nets were taken.

Scale samples were taken in the field from all specimens. The scale samples were obtained from the left side of the fish above the lateral line in all cases except one sample taken during the fall of 1949.

These particular scale samples were taken below the lateral line. All scales were taken from the area immediately ventral to the dorsal fin.

With each scale sample a record of the date, location of capture, type of gear, length (total length was taken as the distance from the tip of the snout to the line connecting the tips of the extended caudal fin), weight, sex, and state of maturity was made. In addition standard length was taken for 332 individuals from all length intervals. Standard length was measured from the tip of the snout to, and including, the last caudal vertebrae.

FIGURE 1


THE
GREEN BAY WATERS
OF
LAKE MICHIGAN
Gladstone
Bay De Noc
Ogontz Bay
Round I.
Garden
Escanaba
Big Bay De Noc
Fayette
Portage Pt.
Little
Wilsie Bay
Ford River
Fairport
Point
Detour
NORTHERN
GREEN BAY
Big
Summer I.
St. Martins I.
Cedar
River
MICHIGAN
Washington I.
Porte Des Morts
Passage
Chambers I.
WISCONSIN
LAKE
MICHIGAN.
Marinette
Green I.
Peshtigo
Reef
SOUTHERN
GREEN BAY
Sturgeon
Bay
-LEGEND-
LOCATION OF SAMPLE.
STATE BOUNDARY LINE.
NORTH-SOUTH GREEN BAY
BOUNDARY LINE.
Frying Pan
Reef
Green Bay
SCALE 1 INCH = 14.6 MILES

At least three scales from each fish were mounted on a microscope slide in a gelatin-glycerin medium. The scales were studied by means of a Bausch and Lomb Microprojector. At least two of the three scales in each individual sample were read. The entire collection of scales were read twice, and checked once.

Growth calculations were made by measuring the distance from the annulus to the focus of the scales in the anterior field. Individual calculations were then made with the use of a nomograph as outlined by Hile (1948).

The intercept length used in computations was 50 millimeters. This figure was calculated by Deason (unpublished) in his work with the yellow pikeperch of Lake Erie.

Age was recorded for each individual as the number of years of life actually completed. Thus a fish of eight growing seasons would be designated as age class VII until after the next springs spawning takes place.

The time of annulus formation was not determined for this study. In a sample of 18 specimens made at Cedar River, Michigan, May 18, 1949, none of the scales showed a positive annulus recently formed. The same was true for a sample of nine fish taken May 17, 1950, from the same locality. The next samples were taken on

August 21, 1950, and all specimens showed complete annulus formation. Presumably, the annulus is formed during the month of June.

PRODUCTION OF YELLOW PIKEPERCH IN GREEN BAY

Production figures for both the Michigan and Wisconsin waters of Green Bay are available prior to the year 1929, but are not known to be accurate. Because of this fact, only those statistics compiled since 1929 are used.

Dr. Ralph Hile, in an article printed in the March, 1950, issue of "The Fisherman", described the commercial fishery for yellow pikeperch in Green Bay. In his study of the trends of this fishery in northern Green Bay, he used a base period of 15 years from 1929 to 1943. During this period, the production fluctuated, but within rather narrow limits as compared to the recent increase.

In Table I-A, it may be seen that the greatest production during this period occurred in 1934, when 108,247 pounds of yellow pikeperch were taken commercially in the Michigan waters of Green Bay. During this same period, (Table I-B) Wisconsin's greatest production occurred in 1930, when Commercial fishermen reported an annual catch of 21,710 pounds.

Table I-A

PRODUCTION OF YELLOW PIKE-PERCH
STIZOSTEDION VITREUM VITREUM (MITCHILL)
IN THE STATE OF MICHIGAN WATERS OF GREEN BAY
(DISTRICT M-1) 1929-1949

Year	Production
1929	26,963
1930	27,446
1931	41,469
1932	85,059
1933	108,110
1934	108,247
1935	57,371
1936	73,748
1937	59,345
1938	38,023
1939	30,177
1940	27,629
1941	25,987
1942	16,121
1943	36,215
1944	42,968
1945	20,712
1946	71,798
1947	261,627
1948	571,696
1949	1,063,016 *

* Tentative figure
--Dr. Ralph Hile, U. S. Fish & Wildlife Service,
Ann Arbor, Michigan

Table I-B

FLUCTUATIONS IN THE PRODUCTION OF YELLOW PIKE-PERCH STIZOSTEDION VITREUM VITREUM (MITCHILL) IN THE STATE OF WISCONSIN WATERS OF GREEN BAY 1929-1949

Year	Production
1929	18,367
1930	21,710
1931	4,687
1932	3,365
1933	4,200
1934	4,000
1935	2,600
1936	1,364
1937	25
1938	15
1939	7,396
1940	3,769
1941	-------
1942	-------
1943	46
1944	200
1945	117,209
1946	119,906
1947	72,644
1948	35,697
1949	40,891

Note: 1929-1945 figures represent production for Green Bay and Lake Michigan.

--1929-1935 figures from U. S. Bureau of Fisheries
--1936-1949 figures from Wisconsin Commercial Fishing Reports, Sturgeon Bay, Wisconsin.

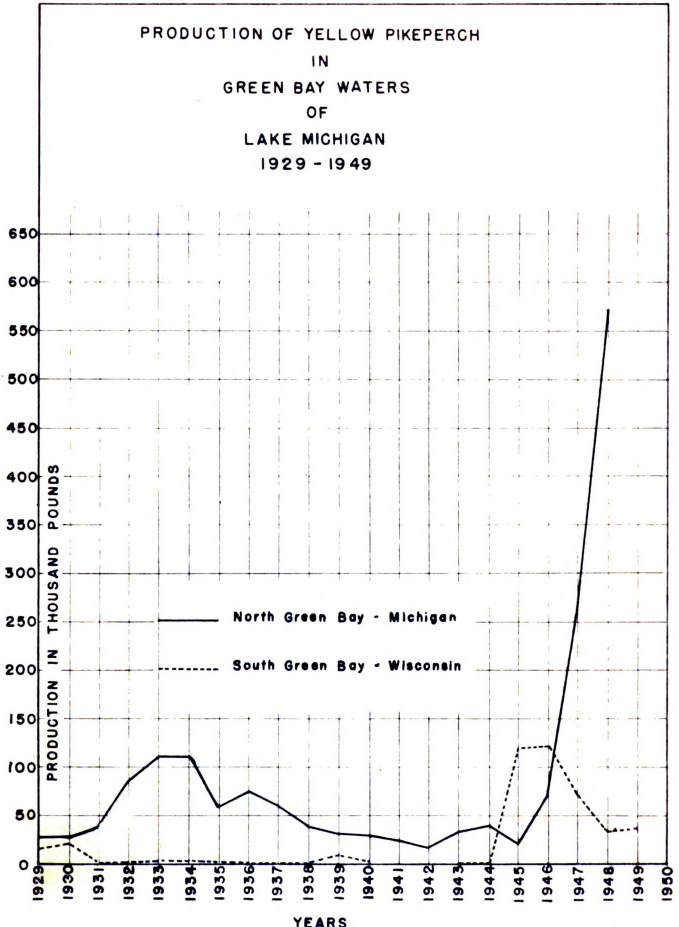
Table II

FLUCTUATIONS IN THE PRODUCTION AND ABUNDANCE OF YELLOW PIKE-PERCH STIZOSTEDION VITREUM VITREUM (MITCHILL) AND IN THE FISHING INTENSITY FOR THE SPECIES IN THE STATE OF MICHIGAN WATERS OF GREEN BAY 1929-1948
(Production in Thousands of Pounds-Abundance and Fishing Intensity as Percentages of the 1929-1948 Mean)

Year	Production	Abundance	Fishing Intensity	Per cent of Production
1929	27	54	104	53
1930	27	57	98	53
1931	41	83	102	81
1932	85	121	144	167
1933	108	198	111	213
1934	108	171	129	213
1935	57	106	108	112
1936	74	115	127	146
1937	59	105	112	116
1938	38	57	132	75
1939	30	54	112	59
1940	28	86	64	55
1941	26	108	48	51
1942	16	66	48	31
1943	36	119	61	71
Average	51	100	100	
1944	43	152	56	85
1945	21	89	47	41
1946	72	136	105	142
1947	262	220	236	516
1948	572	282	403	1126

--Dr. Ralph Hile, U. S. Fish & Wildlife Service,
Ann Arbor, Michigan

FIGURE 2


PRODUCTION OF YELLOW PIKEPERCH
IN
GREEN BAY WATERS
OF
LAKE MICHIGAN
1929 - 1949
650
600
550
500
450
400
350
300
250
200
150
100
50
0
PRODUCTION IN THOUSAND POUNDS
North Green Bay - Michigan
South Green Bay - Wisconsin
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
YEARS

The smallest annual production for the 1929-1943 period occurred in Michigan waters in 1942, when 16,121 pounds were produced. In Wisconsin, however, the yellow pikeperch was removed from the commercial list and for the period of 1941 and 1942, there was no commercial fishing for this species reported.

Because there has not been the great fluctuation in production of yellow pikeperch in Wisconsin and because of the incomplete statistics, no detailed analysis of the production has been made. It may be seen, however, from the graph on production for both Michigan and Wisconsin (Fig.2), that Wisconsin's yellow pikeperch fishery is not nearly as great as that in Michigan. Furthermore, the factors that caused the tremendous increase in the yellow pikeperch population in northern Green Bay are evidently lacking or insignificant in southern Green Bay.

The present abundance of yellow pikeperch in northern Green Bay is not a normal situation. It is obvious from past catch statistics that Green Bay does not produce yellow pikeperch normally in the quantities that have occurred since 1946. After consulting Table II, it can be seen that the catch in 1948 was 1126 percent of the production average over the 1929-1943 base period.

There is, however, more to the picture than production alone. One must consider effort as well as production when considering the relative abundance of a fish population. If the level of abundance of a certain fish population remains constant, the production may be increased or decreased by the fishing intensity. In other words, a man can fish more gear and lift more often to produce a higher yield inspite of the fact that the number of fish available remains constant.

To evaluate this change of fishing intensity or effort, scientists have devised an index called the unit of effort. This value actually is the average catch per net per lift. Thus the variable of changing fishing intensity is eliminated.

It may be seen from Table II that the fishing intensity in 1948 was 403 percent of the 1929-1943 average. It is obvious, therefore, that the production of Green Bay is due in some part to greatly increased fishing pressure.

In Table II, there will be found a column entitled "Abundance". These statistics supplied by Dr. Ralph Hile represent percentages of the catch per unit of effort related to the average catch per unit of effort for the 1929-1943 period. Thus, the index of abundance eliminates the variable, fishing intensity, and gives as accurate an index as possible of the actual abundance

of the population.

In Table II, there may be found a column headed "Percent of Production". These figures are percentages computed using the 1929-1943 average as a basis and assigning that value 100. Thus it may be seen that some years, prior to 1943, were better than average (an index of abundance of over 100) and for some the production did not equal the average figure.

In 1948, in spite of the fact that the fishing intensity was 403 percent of the 1929-1943 mean, the index of abundance was 282 percent of the average for the base period.

Fishermen in northern Green Bay in 1948 were fishing four times as intensively as they did during the base period and were taking about eleven times as many fish as they did during this period.

From these facts, therefor, it is evident that the increased yield of the Green Bay waters of Lake Michigan is due primarily to two causes. The first is the greatly increased number of available yellow pike-perch, and the second is the increased fishing pressure or effort directed toward the capture of these fish.

SEASONAL FLUCTUATION

Table III presents data on the monthly trends of yellow pikeperch production in Michigan waters. There is a fluctuation evident in the production during the different seasons of the year. The period of greatest productivity occurs in the spring. During the months of May and June, roughly 50 percent of the annual catch is made. Yield decreases during the warm summer months, presumably because of rising water temperatures. During the months of September and October, another heavy catch is taken. The winter months are periods of low yield because of curtailed operations due to cold weather. While the ice cover permits a rather intensive gill net fishery, trap, fyke, and pound nets are fished with some difficulty. It will be noted below that these types of gear produce the bulk of the catch.

CATCH BY GEAR

It may be seen in Table V that the catch by gear varies widely. Fyke and hoop nets during the 1929-1943 base period caught 50.2 percent of the average annual yield.

TABLE III

MONTHLY TRENDS IN THE YELLOW PIKE FISHERY IN THE STATE OF MICHIGAN WATERS OF GREEN BAY
DISTRICT M-1, 1929-1943

Month	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
January	217	68	229			514	55	864	1,650	442
February	237	22	229		22	162	100	476	1,717	208
March	263	145		405		21	22	100	602	155
April	927	1,673	2,193	2,927	91			99		
May	3,114	6,396	9,586	25,956	38,969	36,328	16,843	11,056	16,808	12,139
June	3,045	5,180	8,953	14,497	35,918	45,757	20,151	17,817	13,738	9,963
July	3,165	3,017	3,337	5,345	2,676	5,529	5,915	5,964	4,761	2,489
August	2,542	2,945	3,724	3,935	2,488	2,702	1,804	26,106	3,251	2,086
September	4,470	4,992	6,807	15,172	16,425	11,894	8,115	5,285	9,676	5,869
October	4,239	2,190	4,745	13,757	9,824	4,801	3,245	3,864	4,690	3,374
November	4,617	479	1,583	2,378	1,401	457	591	1,087	1,926	1,127
December	127	340	85	687	306	72	554	1,050	651	203
Total	26,965	27,446	41,469	85,059	108,110	108,247	57,371	73,748	59,345	38,025

Month	1939	1940	1941	1942	1943	Total	Average	Per Cent
January	348	1,000	630	254	140	6,589	439	0.8
February	176	578	531	217	222	4,897	326	0.6
March	252	1,795	464	747	185	5,152	342	0.7
April			9			7,919	528	1.0
May	6,649	6,570	3,280	1,828	10,946	206,457	13,764	27.1
June	7,016	5,079	5,054	2,160	6,161	200,484	13,366	26.3
July	3,825	3,622	1,094	1,579	2,358	54,674	3,645	7.2
August	2,411	456	474	1,614	3,117	59,654	3,977	7.8
September	5,242	4,295	10,474	3,590	7,094	119,398	7,960	15.7
October	4,080	3,288	3,659	3,391	4,149	73,492	4,899	9.7
November	141	602	65	665	1,594	18,713	1,248	2.5
December	39	349	53	96	299	4,701	313	0.6
Total	30,177	27,629	25,987	16,121	36,215	761,910	50,794	100.0

TABLE III - Continued

MONTHLY TRENDS IN THE YELLOW PIKE FISHERY IN THE STATE OF MICHIGAN WATERS OF GREEN BAY
DISTRICT M-1, 1944-1949

Month	1944	1945	1946	1947	1948	1949
January	899	299	448	9,308	44,361	116,051
February	410	332	766	5,831	30,537	66,155
March	492	492	2,170	9,321	43,010	110,714
April			118	276	217	84
May	10,398	2,616	2,913	27,467	69,727	88,932
June	14,957	7,582	6,263	61,093	125,688	133,585
July	2,380	2,915	2,481	20,968	29,509	47,474
August	2,899	238	3,765	16,120	33,595	37,774
September	4,776	2,443	14,387	28,959	39,890	128,379
October	4,772	2,156	21,490	40,451	77,045	156,154
November	925	1,243	14,219	14,606	32,598	95,889
December	60	396	2,778	27,227	45,519	81,825
Total	42,968	20,712	71,798	261,627	571,696	1,063,016

Pound nets produced the next greatest amount or 24.9 percent of the average annual catch. Shallow trap nets produced 20.2 percent and large mesh gill nets produced 3.6 percent. In Wisconsin waters, the trap net is considered as an illegal type of fishing gear. From Table IV, the gear producing the greatest percentage of the catch in Wisconsin waters was the fyke and drop net with 74.1 percent of the total catch for the period of 1944 through 1949. Seines followed with 11.9 percent. Pound nets produced 6.6 percent, and large mesh gill nets (4½" up) produced 6.4 percent of the catch. Small mesh gill net (2 3/8" and up to 2 3/4") produced approximately 1 percent of the total catch.

RETURN PER UNIT OF EFFORT

This calculated value, perhaps more than any other, assists the fishery biologist in examining catch statistics for it is in itself, an index of abundance. Levels of abundance are reflected in its fluctuation for it eliminates the variable fishing intensity. Production may remain constant in a declining fishery, but the return per unit of effort accurately records the condition of the fish population.

The yield in pounds divided by the amount of gear used, yields an average weight value per net per lift. The length of time the net is in use is disregarded. Unit of effort values are calculated on the basis of one net and one lifting of that net, in the case of fyke, trap and pound nets, and on the basis of 1,000 lineal feet in the case of gill nets and seines.

Table VI and VII show unit of effort calculations for Michigan and Wisconsin waters of Green Bay. It is interesting to note in Michigan's production (Table VI) that the fyke net not only produces the largest amount of yellow pikeperch, but also the greatest return per unit of effort. For the period of 1929-1943, fyke nets produced 1.7 times the amount of fish that the pound nets produced per lift and 4.2 times the amount that trap nets produced. However, the same does not hold true for the yellow pikeperch fishery of southern Green Bay. Here the seine, a gear not important in northern Green Bay waters, produces the greatest return per unit of effort. Gill nets are second in importance, pound nets third and fyke nets are last, inspite of the fact that they produce the largest percentage of the total yield. This may be explained by the nature of the fishery in southern Green Bay.

The major fish produced in southern Green Bay are the yellow perch Perca flavescens, the lake herring Leucichthys artedi and the carp Cyprinus carpio. The major type of gear fished during the open water season is the fyke or drop net. These nets are essentially fished for perch and, incidental to their operation, catch the bulk of the yellow pikeperch produced annually. The seine is used principally for the capture of carp and, while not used extensively, it does result in a high return of yellow pikeperch per unit of effort.

The pound net in southern Green Bay produces lake herring to a large extent, but some yellow perch, yellow pikeperch, white fish Coregonus clupeaformis, smelt Osmerus mordax, are also taken incidental to the catch of herring.

It is significant that the total poundage of yellow pikeperch produced by the use of seines is not large, while the total produced by fyke nets is very large. The fishery for yellow pikeperch in southern Green Bay is directed toward other species and yellow pikeperch are taken incidental to the catch.

The yellow pikeperch fishery in northern Green Bay is directed toward the capture of this species and yellow perch, carp, and other species are incidental. The gear set in northern Green Bay is designed to fish for yellow pikeperch alone.

TABLE IV

MONTHLY TRENDS, BY GEAR AND UNIT OF EFFORT CALCULATIONS, OF THE YELLOW PIKEPERCH FISHERY IN THE WISCONSIN WATERS OF GREEN BAY 1944-1945
AREA-M-1

1944

Month	Gill 4½		Fyke-Drop		Pound		Seine		Total
	Lbs.	Effort	Lbs.	Effort	Lbs.	Effort	Lbs.	Effort	
January									
February	8	2.							8
March									
April									
May							9	1.5	9
June									
July			4	1.3					4
August							8	1.1	8
September									
October			2	2.					2
November									
December	169	11.3							169
Total	177	9.3	6	1.5			17	1.3	404

1945

January	184	14.2							184
February	222	7.7							234
March	171	34.2							176
April							66	66.0	68
May							451	56.4	451
June	1,354	24.2	19,944	3.9	52	2.2	5,534	16.8	26,888
July	3,707	42.6	6,589	1.5	505	9.7	1,989	22.9	12,898
August	4,399	17.1	9,221	1.8	97	3.3	470	15.7	14,523
September	2,297	37.0	21,264	3.6	240	5.1	198	14.1	24,366
October	382	10.9	29,130	5.5	410	6.1	4	4.0	29,966
November	17	8.5	6,097	5.4	11	3.7	719	14.4	7,023
December	1,147	7.9	338	3.3					1,547
Total	13,880	20.1	92,583	3.4	1,315	5.9	9,431	18.1	118,428

Note: No yellow pikeperch caught from 1929-1943
Total catch for Gill 2½ has been included in total catch, but deleted from unit of effort calculations since the catch is small.

TABLE IV - Continued

MONTHLY TRENDS, BY GEAR AND UNIT OF EFFORT CALCULATIONS, OF THE YELLOW PIKEPERCH FISHERY IN THE WISCONSIN WATERS OF GREEN BAY 1946-1947
AREA -M-1

1946

Month	Gill 4½		Fyke-Drop		Pound		Seine		Total
	Lbs.	Effort	Lbs.	Effort	Lbs.	Effort	Lbs.	Effort	
January	34	28.2							34
February	24	2.0							24
March			154	38.5					154
April									
May							223	13.1	223
June	2,354	33.6	29,776	5.7	728	6.2	10,000	33.9	42,858
July	1,411	15.7	12,905	3.2	511	4.0	5,536	33.6	20,363
August	305	21.8	19,414	4.4	1,071	16.7	316	11.7	21,112
September	2	.2	16,035	3.2	2,172	11.0	33	5.5	18,320
October			12,231	3.7	1,239	6.9			13,499
November			2,887	5.8	142	2.3	53	10.6	3,088
December	100	33.3	200	2.8			50	16.7	362
Total	4,230	20.0	93,602	4.1	5,863	7.8	16,211	31.2	120,037

1947

January									
February									
March									
April			36	1.5					36
May	7	.4					56	8.0	63
June	1,298	17.8	17,910	4.8	1,068	5.4	13,717	61.5	34,340
July	28	7.0	8,502	3.1	367	7.1	801	25.8	9,701
August			9,743	3.4	1,220	19.4	142	10.9	11,140
September	416	9.7	3,891	1.5	1,049	9.2	120	12.0	5,572
October	799	13.1	10,077	3.2	1,024	4.6			11,902
November			273	1.0	69	2.3			402
December	31	1.9							31
Total	2,579	12.1	50,432	3.3	4,797	7.1	14,836	52.2	73,187

Note: Total catch for Gill 2½ has been included in total catch, but deleted from unit of effort calculations since the catch is small.

TABLE IV - Continued

MONTHLY TRENDS, BY GEAR AND UNIT OF EFFORT CALCULATIONS, OF THE YELLOW PIKEPERCH FISHERY IN THE WISCONSIN WATERS OF GREEN BAY 1948-1949
AREA-M-1

1948

Month	Gill 4½		Fyke-Drop		Pound		Seine		Total
	Lbs.	Effort	Lbs.	Effort	Lbs.	Effort	Lbs.	Effort	
January	7	.5							7
February									
March									
April			30	1.3					30
May							24	4.8	24
June	237	9.1	8,328	4.3	1,674	7.0	2,626	41.0	13,049
July	204	15.7	8,409	4.0	28	2.3	489	16.9	9,130
August			5,181	3.6	1,057	21.6			6,244
September	805	57.5	1,979	1.4	1,151	5.6			4,020
October			1,467	.9	459	3.0			1,931
November	410	9.1	701	3.0	105	4.0			1,216
December			126	5.7					126
Total	1,663	15.0	26,221	3.0	4,474	6.5	3,139	32.0	35,777

1949

January									
February	9	.9							9
March	3	1.5							3
April	7	1.8							7
May							38	2.7	38
June	803	14.9	8,393	3.7	2,275	8.4	2,329	49.6	13,897
July	65	10.8	2,298	1.8	165	4.2	499	19.2	3,027
August	124	10.3	3,392	1.5	652	9.4	38	7.6	4,451
September	624	24.0	5,171	2.0	4,256	19.8			10,051
October	161	80.1	6,049	2.6	1,742	10.0	78	39.0	8,035
November	89	9.9	654	1.7	158	3.9			901
December	797	3.6			22	7.3			819
Total	2,682	7.6	25,957	2.3	9,270	10.3	2,982	31.7	41,238

Note: Total catch for Gill 2½ has been included in total catch, but deleted from unit of effort calculations since the catch is small.

TABLE V

CATCH BY GEAR IN THE YELLOW PIKE FISHERY IN THE STATE OF MICHIGAN WATERS OF GREEN BAY
DISTRICT M-1, 1929-1949

Year	Gill 3½	Gill 4½	Pound	Deep Trap	Shallow Trap	Fyke And Hoop	Set Hooks	Troll	Gear Unknown	Total
1929	1,086	4,951	7,171		7,244	6,557			22	26,965
1930	186	3,258	6,294	10	5,036	12,646			16	27,446
1931	145	2,086	13,876	206	5,379	19,545			234	41,469
1932	461	1,086	29,586	1,205	7,929	44,768			26	85,059
1933	12	406	36,687	894	17,538	52,546			27	108,110
1934	4	373	25,916	3,441	17,259	61,182			92	108,247
1935	124	904	17,818		11,026	27,200			299	57,371
1936	6	2,627	29,089		16,694	25,332				73,748
1937	2	3,724	10,038		17,351	28,230				59,345
1938	46	333	3,630		9,272	24,742				38,023
1939	9	530	2,986		5,805	20,857				30,177
1940	2	3,398	2,145		7,628	14,456				27,629
1941	16	1,409	1,016		9,949	15,597				25,987
1942	11	1,537	605		3,857	10,111				16,121
1943	43	603	2,949		12,149	20,471				36,215
Total	2,105	27,195	189,806	5,754	154,096	382,258			716	761,910
Average	140	1,813	12,654	384	10,273	25,482			48	50,794
Per cent	0.3	3.6	24.9	0.8	20.2	50.2			0.0	100.0
1944	25	726	4,678		17,322	20,217				42,968
1945	9	1,564	5,063		11,744	4,332				20,712
1946	737	5,546	7,946		49,625	7,944				71,798
1947	470	47,636	41,253		148,159	23,528	12	569		261,627
1948	302	168,356	124,357		228,829	29,668		20,224		571,696
1949	82	435,703	160,635		421,375	33,356		11,868		1,063,016

Table VI

AVERAGE CATCH (POUNDS) OF YELLOW PIKE-PERCH
STIZOSTEDION VITREUM VITREUM (MITCHILL) PER LIFT
OF ONE NET IN THE STATE OF MICHIGAN WATERS OF GREEN BAY
1929-1948

Year	Gear		
	Pound Net	Shallow Trap Net	Fyke Net
1929	10.8	3.7	15.4
1930	7.4	4.6	20.2
1931	11.0	10.2	27.3
1932	19.5	9.8	37.0
1933	33.3	19.2	56.6
1934	31.8	8.6	59.3
1935	35.3	5.4	31.0
1936	61.6	7.1	20.1
1937	19.8	9.6	30.2
1938	7.8	4.0	23.1
1939	7.7	2.4	22.7
1940	9.8	7.5	28.1
1941	9.0	10.9	32.1
1942	9.3	4.4	23.4
1943	10.9	7.3	54.0
Average	19.0	7.6	32.0
1944	12.5	13.3	58.3
1945	5.7	16.6	19.8
1946	7.5	20.6	23.4
1947	16.8	30.2	47.5
1948	27.6	40.1	66.4

--Dr. Ralph Hile, U. S. Fish & Wildlife Service,
Ann Arbor, Michigan

Table VII

FLUCTUATIONS IN THE PRODUCTION AND ABUNDANCE OF YELLOW PIKE-PERCH STIZOSTEDION VITREUM VITREUM (MITCHILL) IN THE STATE OF WISCONSIN WATERS OF GREEN BAY (DISTRICT M-1) 1943-1949

(Pounds Per Unit of Effort)

Year	Gear				Total Production in Pounds
	Gill Net	Pound Net	Fyke-Drop Net	Seine	
1943			3.3	2.4	46
1944	9.3		1.5	1.3	200
1945	20.1	5.9	3.4	18.1	117,209
1946	20.0	7.8	4.1	31.2	119,906
1947	12.1	7.1	3.3	52.2	72,644
1948	15.0	6.5	3.0	32.0	35,697
1949	7.6	10.3	2.3	31.7	40,891

Unit of effort defined as harvest/amount of gear.
--Wisconsin Commercial Fishing Reports,
Sturgeon Bay, Wisconsin

AGE AND YEAR CLASS COMPOSITION OF THE CATCH

The following discussion of the age and year class composition of the commercial catch is based on observations made on random samples from commercial gear. It will be noted, however, that two samples from small-mesh gill nets, a gear not fished for walleyes, are included in Table VIII. Because of the small size of the southern Green Bay collections, no tabulation was made of the age class composition of that particular population.

The data indicate that until 1950, very few fish younger than those spawned in 1943 appeared in the lifts. Of 120 fish sampled in the fall of 1949 at Garden, Michigan, 80.8 percent were of the 1943 year class. Of 80 fish taken from trap nets in the spring of 1949, in Ogontz Bay, Delta county, Michigan, by Mr. Stanley Lievense of the Michigan Department of Conservation, 92.5 percent were of the 1943 year class, and 6.2 percent were of the 1944 year class. During the spring of 1950, younger fish began to show up in the catches. Of 58 fish sampled from the trap net catches in Ogontz Bay by Dr. Ralph Hile on May 17, 1950, 79.3 percent were of the 1943 year class and 17.3 percent were from the 1944 year class. As the season progressed, reports came in that smaller fish were becoming more numerous. Reports of smaller fish from Roy Jensen, a fish dealer in

Escanaba and Buck Lavallie of Garden, were verified by a trap net sample taken from the vicinity of Ford River in Little Bay De Noc on August 21, 1950. This sample had 50 percent 1943 year class fish, 12.5 percent 1944 year class fish, 6.2 percent of 1945 year class fish, 15.8 percent fish spawned in 1946, 12.5 percent from 1947, and 3.0 percent from 1948.

From another sample taken on the same day with the same type of gear from the vicinity of Escanaba, 50.0 percent were 1943 year class fish, 3.8 percent were from the 1946 spawning, and 46.2 percent were hatched in 1948.

Many expressed concern during the fall of 1949, and the spring of 1950, that the yellow pikeperch fishery would return to its former production level when the 1943 year class passed through the fishery. It is evident that succeeding year classes were not as successful as that of 1943. However, fishermen contacted at Fairport, Michigan, report large numbers of small yellow pikeperch appearing in small mesh gill nets set for perch in that vicinity. On October 4 and 5, 1950, small yellow pikeperch were taken from these gill nets. These fish on both occasions were 100 percent of the 1949 year class. Upon questioning Norbert Casey and Nestor Seaman, both of Fairport, reported that in 1944, similar catches of yellow pikeperch were made in small mesh nets. They added, however that the 1950 catches were lighter than those of 1944.

On February 1, 1951, Roy Jensen of Escanaba sent a selected sample of small yellow pikeperch to the Sturgeon Bay headquarters. The sample had been taken from the Escanaba area where they were mixed with pound net smelt. Only 12 fish were received, but these were 100 percent young of the year.

From the summary of Table VIII, it can be noted that in 1949, the 1943 year class dominated the catch with 85.1 percent of the total catch. The 1944 year class contributed 10.5 percent of the total production.

In 1950, however, 73.6 percent of the catch was made up of the 1943 year class, 7.9 percent of the 1944 year class and 6.2 percent of the 1947 year class.

Table VIII is also summarized by gear. In both 1949, and 1950, pound nets took fish only of the 1943 year class or older fish. This probably is due to two factors. These nets have 4 1/2" to 6" mesh netting in the backs and will allow many of the smaller fish to escape. As a rule, they are set in more than 60 feet of water. It may also be noted that in 1950, the trap nets caught more of the younger fish than they did in 1949. This may be due to the fact that there were more fish of the year classes following 1943, in 1950 than there were in 1949. The large mesh gill nets took roughly the same age class composition in both years.

TABLE VIII

A SUMMARY OF YELLOW PIKEPERCH SAMPLES IN NORTHERN GREEN BAY MICHIGAN WATERS
SHOWING YEAR CLASS COMPOSITION OF THE CATCH BY GEAR

(All samples are net run unless otherwise noted--Data taken 1949-1951)

Location	Gear	Date	Number of Specimens	Year Spawned										
				1939	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
				Percentage of Sample										
Fairport	2½ Gill	10-4-50	62										100.0[4]	
Round Is.	2-5/8 Gill	10-5-50	30										100.0[4]	
Escanaba	3" Trap	10-5-50	111							0.9	20.8	67.5	10.8[5]	
Escanaba	Pound Net	2-1-51	12											100.0
Escanaba	4½ Gill	3-23-49	29				93.1	6.9						
Garden	4½ Gill	9-15-49	120				80.8	15.8	2.6	0.8				
Ogontz Bay	Trap	4-11-49	80				92.5	6.2	1.3					
Cedar River	Deep Pound	5-18-49	18	5.5	11.1	16.7	66.7							
Ogontz Bay	3" Trap	5-17-50	58				79.3	17.3		1.7	1.7			
Cedar River	Deep Pound	5-17-50	9				100.0							
Ford River	3" Trap	8-21-50	32				50.0	12.5	6.2	15.8	12.5	3.0		
Escanaba	3" Trap	8-21-50	26				50.0			3.8		46.2		
Fairport	4½ Gill	8-23-50	15			6.7	53.3	6.7	13.3		13.3		6.7	
Fairport	4½ Gill	8-24-50	21				95.2						4.8	
Wilsey Bay	4½ Gill	8-24-50	55				94.5	5.5						
Garden	4½ Gill	10-5-50	29				93.3		3.4				3.3	
Wilsey Bay	3" Trap	10-4-50	35				51.4	11.4		2.9	31.4	2.9		
Garden	Fyke	10-5-50	27			3.7	59.3				3.7		33.3	
Round Is.	4½ Gill	2-1-51	45				75.5	13.4	4.4		6.7			
			Summary											
1949 Samples	4½ Gill		149				83.3	14.1	2.0	0.6				
	Trap		80				92.5	6.2	1.3					
	Deep Pound		18	5.5	11.1	16.7	66.7							
			247	0.4	0.8	1.2	85.1	10.5	1.6	0.4				
1950 1951 Samples	2½ Gill[3]		92										100.0	
	4½ Gill		165			0.6	85.4	6.1	3.7		3.0	0.6	0.6	
	Trap		178			0.5	61.4	10.1	1.0	4.5	9.6	7.9	5.0	
	Deep Pound[2]		9				100.0							
			352	—	—	0.6	73.6	7.9	2.3	2.3	6.2	4.3	2.8	

Note: 1--includes fyke nets, excludes selected sample of sublegal fish. 2--excludes selected sample from smelt net. 3--excluded in grand average. 4--nets set for perch, entire lift of pike, 4 boxes of nets. 5--illegal segment only (below 15½")

A 4 1/2" mesh gill net rarely catches a yellow pikeperch smaller than 15 inches, a fish probably four years old.

Indications are that following 1943, conditions prevented another large year class from entering the fishery. 1944 was a more successful year than the succeeding two years. Undoubtedly, the presence of a large number of predacious fish in a body of water results in a minimum survival rate. It would appear from the limited data, that the 1947 year class was stronger than the two years preceding it. However, escapement of fish spawned in 1947, and sampled in 1950, would be high due to the size of the commercial gear. Large mesh gill net and pound nets with 4 1/2" backs would allow a large number of three-year-old (12.5") fish to escape.

THE 1943 YEAR CLASS

The great increase in the yellow pikeperch in northern Green Bay was caused by a very successful spawning season during the spring of 1943. The exact reason for the spawning success in 1943 is not definitely known. In his article, Hile (1950) writes as follows:

"The reason for the phenomenal hatch of walleyes in Green Bay in 1943, must be given as 'unknown'. Many hold that the recent great abundance was made possible by the mortality that all but wiped out the population

of smelt in the late winter of 1942-1943. Certainly, the timing is suggestive and the explanation is made even more attractive by the fact that the lake herring and the whitefish enjoyed similar increases. **********. We cannot ignore the possibility that the increase in all three species was not associated at all with the decline of the smelt but rather arose from peculiarly favorable weather conditions.******** In support of the latter interpretation I may cite the fact that Minnesota scientists report an exceptional 1943 hatch of walleyes in Mille Lacs where smelt could not have been a factor."

It is interesting to note, when examining catch statistics, that Michigan fishermen in 1942, produced only 16,121 pounds of yellow pikeperch. This figure will give some idea of the size of the population in northern Green Bay at the time of the spawning of the 1943 year class. The production of yellow pikeperch in 1942, was the lowest on reliable record. These fish, in 1943, spawned so successfully, and the fry survived so well, that the largest production on record resulted.

The population levels of the yellow pikeperch were so high in 1948 and 1949, that sportsmen took out

commercial fishing licenses and fished with hook and line. In 1948, 20,224 pounds were produced in this manner with a return per unit of effort of 60 pounds per man per day. In 1949, the total production from commercial sport trolling was 11,868 pounds and a return per man-day of 35 pounds. In 1950, few fish were caught in this manner and immediately speculation arose to the effect that the yellow pikeperch had disappeared. It is interesting to note, however, that commercial production kept increasing. The fact that there are fewer, but larger fish present now than there were in 1948, may be the answer to this paradox.

That the 1943 year class has added tremendously to the fishery of northern Green Bay, is obvious. 1949 and 1950 samples indicate that by far the greatest percentage of the catch was made up of 1943 year class fish. Data indicates that 85.1 percent of the 1949 catch was made up of this year class. This amounts to 883,366 pounds. During 1950, 73.6 percent of the total catch was made up of the 1943 year class. The final figure for the 1950 production is not available, but the state of Michigan has issued an estimate of the yellow pikeperch production of all of Lake Michigan waters as 1,298,412 pounds. An assumption of 1,250,000 pounds

for the 1950 Green Bay production results in at least 920,000 pounds of the total catch made up of the fish spawned in 1943.

It can be seen from the above data that, inspite of the reduction in percentage of occurrence of the 1943 year class individuals in the total catch, a greater production in pounds has resulted. This trend will continue as long as the annual growth in weight of fish spawned in 1943 exceeds the weight of this year class removed from Green Bay waters. When exploitation and natural mortality of this year class reduce the population composition below the point where growth in weight makes up the difference in production, the value of the 1943 year class to the fishery will decline. Unless the decline is balanced by the entrance into the fishery of another year class, total production will then decline.

GROWTH OF THE YELLOW PIKEPERCH IN GREEN BAY

Tables IX and X present growth data for the yellow pikeperch in northern and southern Green Bay. Although the southern Green Bay sample is inadequate for a detailed study of the growth characteristics of the yellow pikeperch population, it does indicate that the growth rate in southern Green Bay is more rapid than that found for the same species in northern Green Bay.

TABLE IX

CALCULATED TOTAL LENGTHS (INCHES) OF THE NORTHERN GREEN BAY YELLOW PIKEPERCH TAKEN BY ALL MAJOR TYPES OF GEAR 1949-1951

Year Class	Sex	Number Of Specimens	Calculated Length At End Of Year Of Life									
			I	II	III	IV	V	VI	VII	VIII	IX	X
X	M	1	6.5	9.8	15.0	17.9	20.4	22.4	25.6	24.8	25.8	26.8
IX	F	1	7.5	12.6	16.6	19.2	20.6	22.5	23.9	27.2	27.9	
VIII	F	5	7.7	12.0	16.1	19.4	21.6	23.4	25.2	26.7		
VII	M	107	6.8	10.0	12.5	15.0	17.2	18.5	19.6			
	F	161	6.8	10.0	12.8	15.4	17.8	19.7	21.0			
VI	M	106	6.4	9.8	12.5	15.1	17.2	18.6				
	F	131	6.5	10.1	13.0	15.9	18.3	19.9				
V	M	18	6.1	9.5	12.7	15.4	17.7					
	F	16	6.4	9.6	12.9	15.7	18.2					
IV	M	16	6.3	9.7	14.0	15.5						
	F	3	7.1	10.6	13.4	15.8						
III	M	46	6.2	9.6	13.8							
	F	14	6.3	10.5	13.9							
II	M	44	6.7	11.2								
	F	41	6.8	11.3								
I	M	52	7.1									
	F	70	7.2									
0*	M	7	5.1									
	F	5	5.6									
GRAND AVERAGE												
Males			6.6	10.1	12.8	15.1	17.2	18.6	19.7	24.8	25.8	26.8
Number of Specimens			390	338	294	248	252	214	108	1	1	1
Annual Increment			6.6	3.5	2.7	2.3	2.1	1.4	1.1	5.1	1.0	1.0
Females			6.7	10.2	12.9	15.7	18.1	19.8	21.1	26.8	27.9	
Number of Specimens			442	372	331	317	314	298	167	6	1	
Annual Increment			6.7	3.5	2.7	2.8	2.4	1.7	1.3	5.7	1.1	

* Young of the year taken on February 9, 1951, not included in grand average.

TABLE X

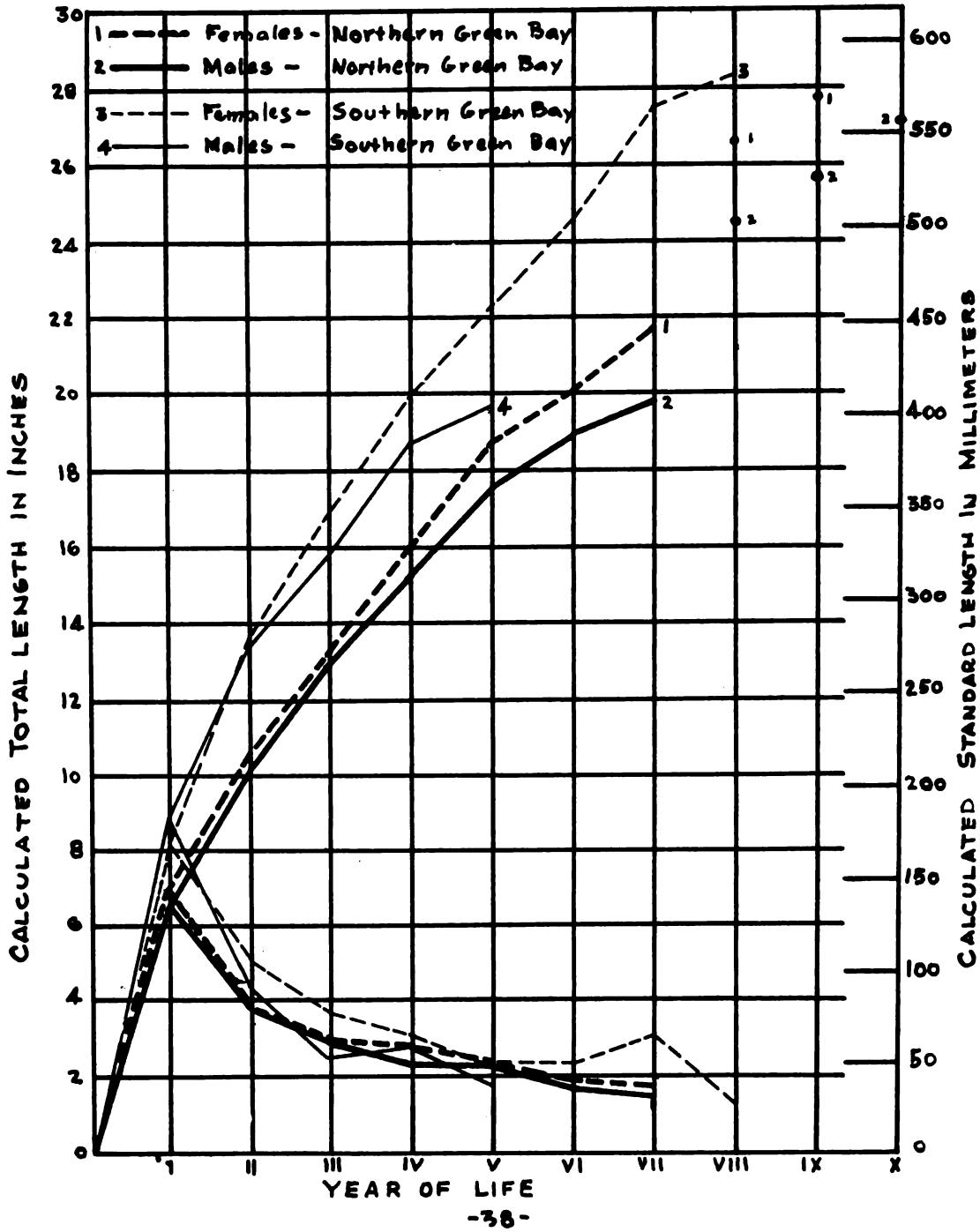
AVERAGE LENGTH AND WEIGHT AT CAPTURE OF YELLOW PIKEPERCH FROM SOUTHERN GREEN BAY AND THE AVERAGE CALCULATED LENGTH ATTAINED BY THE AGE GROUPS AT THE END OF EACH YEAR OF LIFE

Sex	Number of Fish	Weight in Pounds	Total Length Inches	Calculated Total Length in Inches at End of Year of Life							
				1	2	3	4	5	6	7	8
Female	1	8.19	28.0	9.3	13.3	17.7	21.1	25.2	25.6	27.2	28.0
Female	3	4.69	23.9	8.0	13.5	16.7	20.0	22.4	23.9		
Male	1	2.69	19.4	9.5	13.5	16.7	18.5	19.4			
Female	3	3.06	21.1	8.5	12.5	16.2	18.8	21.1			
Male	8	1.21	15.5	8.5	12.8	15.5					
Female	3	2.78	16.3	8.7	13.5	16.7					
Male	4	0.72	13.2	8.1	13.1						
Female	1	0.94	13.6	7.9	13.6						
Male	6	0.38	12.4	9.4							
Female	3	0.18	8.6	8.6							
GRAND AVERAGE											
Males				8.9	13.1	15.7	18.5	19.4			
Average Annual Increment				8.9	4.2	2.6	2.8	0.9			
Number of Fish				19	13	9	1	1			
Females				8.5	13.2	16.6	19.7	22.0	24.3	27.2	28.0
Average Annual Increment				8.5	4.7	3.4	3.1	2.3	2.3	2.9	0.8
Number of Fish				14	11	10	7	7	4	1	1

FIGURE 3

CALCULATED GROWTH IN LENGTH AND THE ANNUL INCREMENT OF THE YELLOW PIKEPERCH IN GREEN BAY.

The Sexes and Location of Capture are shown Separately.



Calculations show that, on the average, the yellow pikeperch in southern Green Bay grows 25 percent faster than in northern Green Bay. Age Class I is 32 percent larger, and Age Class VIII is 10 percent larger with the difference in length between northern and southern Green Bay becoming smaller as the fish become older.

The following table will serve to illustrate the point:

A COMPARISON OF TOTAL LENGTHS (BY INCHES) OF THE YELLOW PIKEPERCH IN NORTHERN AND SOUTHERN GREEN BAY

	AGE CLASS							
	I	II	III	IV	V	VI	VII	VIII
S. Green Bay	8.7	13.2	16.1	19.1	20.7	24.3	27.2	28.0
N. Green Bay	6.6	10.2	12.8	15.4	17.6	19.2	20.4	25.8
% Difference A over B	32	30	26	24	18	27	33	10

Figure 3 compares the growth characteristics from northern and southern Green Bay, by sex.

In southern Green Bay after the second year of life, the female yellow pikeperch begins to exhibit a more rapid rate of growth than does the male. This growth characteristic is not apparant in northern Green Bay until the fish have reached their third growing season. While detailed observations on the age of sexual maturity

in southern Green Bay are lacking, data from northern Green Bay indicate that 93.1 percent of three-year-old males are immature and in the case of females, 100 percent are immature (Table XXI). Sexual maturity is attained by 22.3 percent of the fish between their third and fourth year of life.

Tables IX through XIV, inclusive, present growth data for yellow pikeperch from both northern and southern Green Bay. Table IX presents data for northern Green Bay from all types of gear. Age Class 0 is included in this tabulation for the sake of completeness, but because these fish were selected for their small size they have not been included in the grand average.

Figure 3 and Tables IX and X present detailed growth data for Green Bay. As has been mentioned, growth rates differ rather widely. The growth rate as illustrated graphically by Figure 2 does not differ greatly in character from those computed for the yellow pikeperch in other waters. Growth of the females exceeds that of the males. This is, of course, the usual finding for this species. Growth rates are more rapid during the first years of life. As the fish becomes older, the rate of growth declines gradually untill during the last years of life growth rates are very slow. Figure 3 also shows growth increments.

It is interesting to examine data from individuals older than those spawned in 1943. With the exception of three specimens, all individuals examined were selected for their large size and so cannot be considered with the growth data.

It does appear, however, that the general growth rate in northern Green Bay before the entrance of the 1943 year class was somewhat more rapid than it is at present. It seems logical that the increase in numbers of fish since the 1943 year class could reduce the available food supply from a previously high level and so also reduce the rate of growth of the present population.

The almost complete reduction of the smelt from Green Bay in 1942, may also have affected the rate of growth of the Green Bay yellow pikeperch. Certainly, this fish is important in the diet of this species. Further work is necessary to confirm the supposition that there actually has been a reduction in growth rates of the yellow pikeperch following the entrance of the 1943 year class.

Figure 3 shows growth data for fish spawned before 1943. These data are plotted only as points since the author does not feel justified in establishing growth rates for these age classes based on such a limited sampling.

Table X presents combined data from various types of fishing gear for southern Green Bay.

Table XI through XIV inclusive presents growth data by types of fishing gear for 1949 and 1950.

It may be seen in comparing these tables that between 1949 and 1950, there was no significant variation in growth rate. Neither does there appear to be a significance in growth rate calculations due to net selectivity. Variations in calculations are rather small, considering the size of the sample, between fish taken in gill nets and in trap nets.

In northern Green Bay, regulations limit the minimum size of the commercial catch to 15 1/2 inches in total length. Generally, fish of this size are in their fourth year of life. Because of variation, however, three-year-old individuals may attain the legal minimum. Especially slow growing individuals may not reach 15 1/2 inches until they are five years old.

In southern Green Bay, Wisconsin's regulations limit the minimum size of yellow pikeperch taken commercially to 15 inches. Because of the more rapid rate of growth in southern Green Bay, the fish enter the fishery in their second and third years of life.

Table XV presents a tabulation of length frequency distribution of all fish examined. Specimens from 4 to

TABLE XI

GROWTH OF THE YELLOW PIKEPERCH IN NORTHERN GREEN BAY
SAMPLES WERE TAKEN BY 4½" GILL (NET RUN) IN 1949

Year Class	Sex	Year Spawned	Number Of Specimens	Calculated Length At End Of Year Of Life					
				I	II	III	IV	V	VI
VI	M	1943	54	6.4	9.8	12.4	14.8	16.9	18.4
VI	F	1943	70	6.5	9.8	12.5	15.3	17.6	19.5
V	M	1944	8	6.3	9.8	12.8	15.4	17.4	
V	F	1944	13	6.2	9.7	12.7	15.5	17.8	
IV	M	1945	2	6.7	9.7	12.9	15.8		
IV	F	1945	1	6.4	9.1	14.2	16.6		
III	M	1946	1	6.2	10.1	12.4			
III	F	1946	0						
			GRAND AVERAGE						
Males				6.4	9.8	12.5	14.9	17.0	18.4
Annual Increment				6.4	3.4	2.7	2.4	2.1	1.4
Females				6.4	9.7	12.4	15.3	17.7	19.5
Annual Increment				6.4	3.3	2.7	2.9	2.4	1.8

TABLE XII

GROWTH OF THE YELLOW PIKEPERCH IN NORTHERN GREEN BAY

Samples Were Taken By 4½" Gill Net. All Samples Are Net Run And Represent Either The Entire Catch Or A Random Sample Of The Total Lift. All Samples Were Taken In 1950.

Year Class	Sex	Year Spawned	Number Of Specimens	Calculated Length (Inches) At End Of Year Of Life							
				I	II	III	IV	V	VI	VII	VIII
VIII	F	1942	1	8.5	12.3	16.2	18.8	20.4	21.8	23.1	24.0
VIII	F	1942	2*	7.6	12.0	16.3	19.9	22.5	23.9	25.9	27.9
VII	M	1943	75	6.7	9.9	12.3	14.7	16.7	18.1	18.9	
VII	F	1943	67	6.7	9.8	12.4	15.1	17.5	19.5	20.9	
VI	M	1944	7	6.2	9.4	11.8	14.5	16.6	18.2		
VI	F	1944	3	7.0	10.3	13.1	15.9	18.3	20.1		
V	M	1945	2	5.8	8.8	12.8	16.0	18.2			
V	F	1945	3	7.9	10.2	13.7	16.9	19.6			
IV	M	1946	0								
IV	F	1946	0								
III	M	1947	4	7.0	11.2	15.2					
III	F	1947	1	6.3	11.5	15.9					
II	M	1948	0								
II	F	1948	0								
I	M	1949	1	7.6							
I	F	1949	2	6.9							
GRAND AVERAGE											
Male				6.6	9.8	12.4	14.7	16.8	18.1	18.9	
Annual Increment				6.6	3.2	2.6	2.3	2.1	1.3	0.8	
Female				6.7	9.9	12.6	15.2	17.7	19.5	21.0	24.0
Annual Increment				6.7	3.2	2.7	2.6	2.5	1.8	1.5	3.0

* Two specimens selected for their large size and deleted from sample grand average.

TABLE XIII

CALCULATED TOTAL LENGTHS (INCHES) OF THE NORTHERN GREEN BAY YELLOW PIKEPERCH TAKEN BY TRAP NETS (NET RUN) 1949

Year Class	Sex	Year Spawned	Number Of Specimens	Calculated Length At End Of Year Of Life					
				I	II	III	IV	V	VI
VI	M	1943	34	6.6	9.8	12.7	15.3	17.5	18.9
VI	F	1943	39	6.6	10.5	13.6	16.6	19.3	21.4
V	M	1944	5	5.9	9.7	12.7	15.6	18.0	
V	F	1944	0						
IV	M	1945	1	6.5	10.0	15.4	17.0		

GRAND TOTALS

Males	6.5	9.8	12.8	15.4	17.5	18.9
Number of Specimens	40	40	40	40	39	34
Annual Increment	6.5	3.3	3.0	2.6	2.1	1.4
Females	6.6	10.5	13.6	16.6	19.3	21.4
Number of Specimens	39	39	39	39	39	39
Annual Increment	6.6	3.9	3.1	3.0	2.7	2.1

TABLE XIV

CALCULATED TOTAL LENGTHS (INCHES) OF THE NORTHERN GREEN BAY YELLOW PIKEPERCH TAKEN BY TRAP NETS (NET RUN) DURING 1950

Year Class	Sex	Year Spawned	Number Of Specimens	Calculated Length At End Of Year Of Life						
				I	II	III	IV	V	VI	VII
VII	M	1943	33	7.0	10.2	12.6	14.9	17.0	18.5	19.5
VII	F	1943	60	7.0	10.2	12.9	15.6	18.0	20.0	21.5
VI	M	1944	9	6.4	9.9	12.7	15.3	17.2	18.6	
VI	F	1944	9	6.2	9.2	11.8	14.7	17.2	19.2	
V	M	1945	3	6.3	9.1	12.4	16.7	17.8		
V	F	1945	0							
IV	M	1946	5	6.0	9.5	13.1	15.5			
IV	F	1946	2	7.4	10.5	13.1	15.5			
III	M	1947	23	6.1	10.1	14.0				
III	F	1947	5	6.4	10.2	13.9				
II	M	1948	2	6.6	11.5					
II	F	1948	0							
GRAND TOTALS										
Males				6.6	10.1	13.1	15.1	17.1	18.5	19.5
Number of Specimens				75	75	73	50	45	42	33
Annual Increment				6.6	3.5	3.0	2.0	2.0	1.4	1.0
Females				6.8	10.1	12.8	15.5	17.9	19.9	21.5
Number of Specimens				76	76	76	71	69	69	60
Annual Increment				6.8	3.3	2.7	2.7	2.4	2.0	1.6

6 inches in total length in Age Class 0 have been included for completeness. They were selected for their size. Fish taken by all types of gear are represented in this tabulation.

Those fish that appear in the 9-11 inch classes were taken largely by small meshed gill net set for perch or herring.

It should be noted that the large number of specimens appearing in the 18-22 inch length intervals is due largely to two causes. First, the gear used to obtain these specimens was selective for fish above the legal minimum; and second, the presence of the dominant 1943 year class creates a disproportionate number of fish of this size.

There is a large variation in size between individuals of the same age. It may be seen in Table XV that fish from Age Class VII range from 16.5 inches to 27.9 inches in total length. Fish 16.5 to 16.9 inches in total length ranged from Age Class III to Age Class VII.

The theoretical distribution of the length frequencies is, in this case, unbalanced. Instead of a large number of small individuals gradually decreasing, as the length increases, to a point where age, fishing pressure and natural mortalities reduce the population

Table XV

LENGTH-FREQUENCY OF 835 YELLOW PIKEPERCH FROM NORTHERN GREEN BAY DURING THE YEARS 1949 - 1950

(The Sexes Are Combined)

Total Length (Inches)	Age Group 0	I	II	III	IV	V	VI	VII	VIII	IX	Totals
4.5 - 4.9	4										4
5.0 - 5.4	3										3
5.5 - 5.9	6										6
6.0 - 6.4											
6.5 - 6.9											
7.0 - 7.4											
7.5 - 7.9											
8.0 - 8.4											
8.5 - 8.9											
9.0 - 9.4		3									3
9.5 - 9.9		5									5
10.0 - 10.4		23									23
10.5 - 10.9		46									46
11.0 - 11.4		36									36
11.5 - 11.9		6	1								7
12.0 - 12.4		1	4								5
12.5 - 12.9			8								8
13.0 - 13.4			19	1							20
13.5 - 13.9			26	2							28
14.0 - 14.4			20	6	1						27
14.5 - 14.9			8	7							15
15.0 - 15.4				27							27
15.5 - 15.9				3							3
16.0 - 16.4				6	2						8
16.5 - 16.9				4	2	1	3	1			11
17.0 - 17.4				4	2	2	3				11
17.5 - 17.9				1	2	3	9	3			18
18.0 - 18.4						4	14	6			24
18.5 - 18.9					1	9	27	11			48
19.0 - 19.4					1	1	24	16			42
19.5 - 19.9						2	35	31			68
20.0 - 20.4						6	35	25			66
20.5 - 20.9						4	29	40			73
21.0 - 21.4						2	16	27			45
21.5 - 21.9							14	27			41
22.0 - 22.4							10	25			35
22.5 - 22.9							9	20			29
23.0 - 23.4							3	15			18
23.5 - 23.9							2	6			8
24.0 - 24.4							2	5			7
24.5 - 24.9								3			3
25.0 - 25.4							1	2	1		4
25.5 - 25.9								2			2
26.0 - 26.4								1			1
26.5 - 26.9									1		1
27.0 - 27.4								1			1
27.5 - 27.9								1			1
28.0 - 28.4									1		1
28.5 - 28.9									1		1
29.0 - 29.4									1		1
29.5 - 29.9											
30.0 - 30.4										1	1
Total	13	122	86	61	11	34	256	266	5	1	835

to zero, there are fewer small fish, a large number of them between 18 and 22 inches, and practically none beyond this point.

The selective action of fishing gear, both for very small and very large individuals, must be recognized. Large individuals are not usually taken in gill nets, but pound nets and trap nets will take them readily. It is felt that this factor is negligible in the case of extremely large individuals. In the case of small fish, however, the error is quite large. Only from about 15 inches and up does Table XII represent a true picture of the present length frequency distribution.

Length-weight relationships of the yellow pikeperch have been calculated for northern Green Bay only. There are no data to indicate whether or not fish of comparable lengths are different in weight in northern and southern Green Bay. Tables XVI and XVII present lengths, weights, theoretical weights and condition factors expressed in both English and metric systems. The sexes are kept separate. At no time was sampling made during the time when the fish were in a spawning or near spawning condition.

The condition factor or coefficient of condition has been widely used by fishery biologists to serve as a measure of the "degree of well being" of fishes (Hile 1936). For purposes of comparison, both the metric coefficient (K) and the English coefficient (C) were computed. Alignment charts similar to those published by Carlander (1950) were used to compute both C and K. These values, however, were spot checked to compare the graphical method of computation with the arithmetic.

The condition factor generally increases with an increase in size. The increase appears gradual and does not show any abrupt changes at the time of sexual maturity for either sex.

In general, female specimens averaged somewhat heavier than males of similar size. Accordingly, the condition factor reflects this trend.

The formulae describing the length-weight relationships for northern Green Bay were computed according to the proceedure set forth by Beckman (1948). The computations were made separately by sex since length weight relationships show sexual differentiation. The equation $W = cL^n$ is a general formula describing growth in weight for any fish.

TABLE XVI

VALUES OF LENGTH, ACTUAL WEIGHT, THEORETICAL WEIGHT, AND CONDITION FACTOR EXPRESSED IN ENGLISH AND METRIC SYSTEMS BY ONE-HALF INCH LENGTH INTERVALS FOR MALE YELLOW PIKEPERCH IN NORTHERN GREEN BAY 1949-1950

Total Length Inches	Total Length Millimeters	Actual Weight Pounds	Actual Weight Grams	Calculated Weight Pounds	Calculated Weight Grams	Condition Factor C	Condition Factor K	Number Of Specimens
4.75	121	0.04	18	0.05	23	37	1.08	4
5.25	133	0.04	18	0.07	30	28	0.76	8
5.75	146	0.06	27	0.09	39	31	0.87	1
6.25	159							
6.75	171							
7.25	184							
7.75	197							
8.25	210							
8.75	222							
9.25	235	0.23	104	0.31	141	29	0.80	8
9.75	248	0.33	150	0.35	159	33	0.98	3
10.25	260	0.37	169	.41	184	34	0.96	10
10.75	273	0.39	175	.46	210	31	1.00	15
11.25	286	0.46	209	.52	238	32	0.89	20
11.75	298	0.45	204	.59	267	28	0.77	3
12.25	311	0.56	254	.66	300	30	0.84	2
12.75	324							
13.25	337	0.78	354	.82	372	33	0.92	11
13.75	349	0.86	390	.90	409	32	0.92	18
14.25	362	0.97	440	1.00	452	33	0.93	15
14.75	374	1.07	485	1.07	494	33	0.91	9
15.25	387	1.40	635	1.19	541	41	1.10	20
15.75	400	1.42	644	1.31	593	34	1.01	2

TABLE XVI - Continued

VALUES OF LENGTH AND WEIGHT FOR MALE YELLOW PIKEPERCH 1949-1950 (Continued)

Total Length Inches	Total Length Millimeters	Actual Weight Pounds	Actual Weight Grams	Calculated Weight Pounds	Calculated Weight Grams	Condition Factor C	Condition Factor K	Number Of Specimens
16.25	415	1.44	653	1.43	647	34	0.93	8
16.75	425	1.58	717	1.54	699	34	0.94	9
17.25	438	1.91	866	1.67	758	37	1.06	9
17.75	451	1.97	894	1.81	821	30	0.92	16
18.25	464	2.16	980	1.95	886	35	0.99	22
18.75	476	2.28	1034	2.09	950	34	0.96	37
19.25	489	2.54	1152	2.25	1022	35	0.98	37
19.75	502	2.78	1261	2.42	1097	36	1.00	39
20.25	514	2.91	1320	2.54	1150	35	0.97	35
20.75	527	3.36	1524	2.77	1255	42	1.04	23
21.25	540	3.45	1565	2.95	1337	36	0.99	12
21.75	552	3.50	1588	3.13	1419	34	1.10	11
22.25	565	4.58	2077	3.34	1514	44	1.15	2
22.75	579	4.56	2068	3.56	1616	39	1.06	2
23.25	591							
23.75	603							
24.25	616	5.56	2522	4.21	1911	39	1.08	1
24.75	629							
25.25	641							
25.75	654							
26.25	667							
26.75	679	6.19	2807	5.48	2486	32	0.90	1

TABLE XVII

VALUES OF LENGTH, ACTUAL WEIGHT, THEORETICAL WEIGHT, AND CONDITION FACTOR EXPRESSED IN ENGLISH AND METRIC SYSTEMS BY ONE-HALF INCH LENGTH INTERVALS FOR FEMALE YELLOW PIKEPERCH IN NORTHERN GREEN BAY 1949-1960

Total Length Inches	Total Length Millimeters	Actual Weight Pounds	Actual Weight Grams	Calculated Weight Pounds	Calculated Weight Grams	Condition Factor C	Condition Factor K	Number Of Specimens
5.25	133	0.04	18	0.05	24	28	0.76	1
5.75	146	0.06	27	0.07	32	31	0.87	4
6.25	159							
6.75	171							
7.25	184							
7.75	197							
8.25	210							
8.75	222							
9.25	235	0.25	113	0.29	133	31	0.87	1
9.75	248	0.32	145	0.34	152	34	0.95	2
10.25	260	0.35	159	.38	174	32	0.92	14
10.75	273	0.40	181	.44	201	32	0.90	31
11.25	286	0.45	204	.51	230	31	0.87	19
11.75	298	0.50	227	.57	259	30	0.86	5
12.25	311	0.54	245	.65	294	31	0.81	3
12.75	324	0.76	345	.73	331	36	1.01	9
13.25	337	0.77	349	.82	372	33	0.91	14
13.75	349	0.86	390	.91	412	33	0.92	9
14.25	362	0.95	431	1.01	458	33	0.90	12
14.75	374	1.06	481	1.11	504	33	0.92	6
15.25	387	1.20	544	1.23	557	33	0.94	8
15.75	400	1.28	581	1.35	614	33	0.91	1
16.25	413							
16.75	425	1.64	735	1.62	735	35	0.98	2
17.25	438	1.75	794	1.75	795	34	0.95	2
17.75	451	2.06	934	1.92	871	36	1.02	2
18.25	464	1.92	885	2.09	946	30	0.85	2
18.75	476	2.40	1089	2.25	1020	36	1.01	10
19.25	489	2.71	1229	2.43	1102	37	1.06	6
19.75	502	2.84	1288	2.63	1192	37	1.01	28
20.25	514	2.89	1311	2.88	1278	35	0.97	34
20.75	527	3.36	1524	3.05	1374	37	1.05	45
21.25	540	3.35	1520	3.25	1475	35	0.96	38
21.75	552	3.79	1719	3.47	1573	37	1.02	31

TABLE XVII - Continued

VALUES OF LENGTH AND WEIGHT FOR FEMALE YELLOW PIKEPERCH 1949-1950 (Continued)

Total Length Inches	Total Length Millimeters	Actual Weight Pounds	Actual Weight Grams	Calculated Weight Pounds	Calculated Weight Grams	Condition Factor C	Condition Factor K	Number Of Specimens
22.25	565	4.03	1828	3.71	1684	37	1.03	32
22.75	579	4.33	1964	3.99	1810	37	1.03	26
23.25	591	4.74	2150	4.24	1921	38		17
23.75	603	5.43	2461	4.49	2037	40	1.04	8
24.25	516	5.21	2363	4.78	2169	37	1.01	7
24.75	629	5.02	2277	5.08	2306	33	0.91	2
25.25	641	6.77	3071	5.37	2437	42	1.16	3
25.75	654	5.88	2667	5.70	2584	35	0.96	3
26.25	667							
26.75	679	7.68	3484	6.36	2884	40	1.11	2
27.25	692	7.38	3347	6.72	3047	37	1.01	1
27.75	705	5.50	2495	7.09	3218	26	0.74	1
28.25	718	8.19	3715	7.48	3394	36	1.00	1
28.75	730	7.94	3602	7.86	3563	34	0.93	1
29.25	741	9.81	4450	8.21	3722	39	1.09	1
29.75	756							
30.25	768	9.06	4110	9.11	4134	33	0.91	1

The formula describing the growth in weight of the male yellow pikeperch in northern Green Bay is as follows:

$$W = 1.9210 \times 10^{-5} L^{2.7118}$$

The formula describing the growth in weight for female fish is as follows:

$$W = 6.6450 \times 10^{-5} L^{2.9247}$$

Where W = weight in grams

L = standard length in millimeters

c = constant

n = constant

Figure 4 presents curves for these equations. The more rapid rate of growth in length of the female fish, as previously noted, holds true for growth in weight also. In comparing Figures 3 and 4, it may be seen that the length growth differential of female fish becomes apparent at approximately 13 inches (Figure 3). At that same length, female fish also begin to increase their weight at a more rapid rate (Figure 4). Generally, then it may be said that beginning at the time of sexual maturity growth differentials in length and in weight becomes apparent between the sexes with females showing greater growth in length and weight.

Table XVIII presents data on the calculated growth in weight of the specimens from northern Green Bay.

The annual weight increment calculations are of interest in that they show an increase each year until a maximum increment occurs during the fifth year of life. From that time the increments decrease annually.

Table XIX presents factors for conversion between total length and standard length in both English and metric systems. These factors agree within reason with published data for yellow pikeperch in other bodies of water.

SEXUAL DETERMINATION

The following criteria were used for sex determination. Certain of these details were reported by Dr. Paul Eschmeyer and are based on his observations of the yellow pikeperch of Lake Gegebic, Michigan. (Eschmeyer 1950)

In the case of mature fish of either sex, the gonads show either eggs or the characteristic greyish-white color of the testis from September until the time of spawning. Mature female fish show residual eggs immediately after spawning until the ovaries develop for the following season. Sex determination of mature males depends on comparison of the size and color of the testis. The testis has an opaque color and is smaller in size than the ovary. The ovary may have a

TABLE XVIII

THE CALCULATED GROWTH IN WEIGHT OF THE YELLOW PIKEPERCH IN NORTHERN GREEN BAY
(Empirical Weights Correspond To Calculated Lengths From All Types Of Gear)

Sex	Calculated Weight In Pounds At End Of Year Of Life									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Males	.13	.40	.75	1.16	1.64	2.03	2.39	4.48	4.97	5.30
Annual Increment	.13	.27	.35	.41	.48	.39	.36	2.09	.49	.33
Females	.09	.36	.75	1.34	2.03	2.65	3.18	6.17	7.21	
Annual Increment	.09	.27	.39	.59	.69	.62	.53	2.99	1.04	
Unweighted	.11	.38	.75	1.25	1.84	2.34	2.80	5.32	6.09	
Mean	.11	.27	.37	.50	.59	.50	.46	2.54	.77	

FIGURE 4.

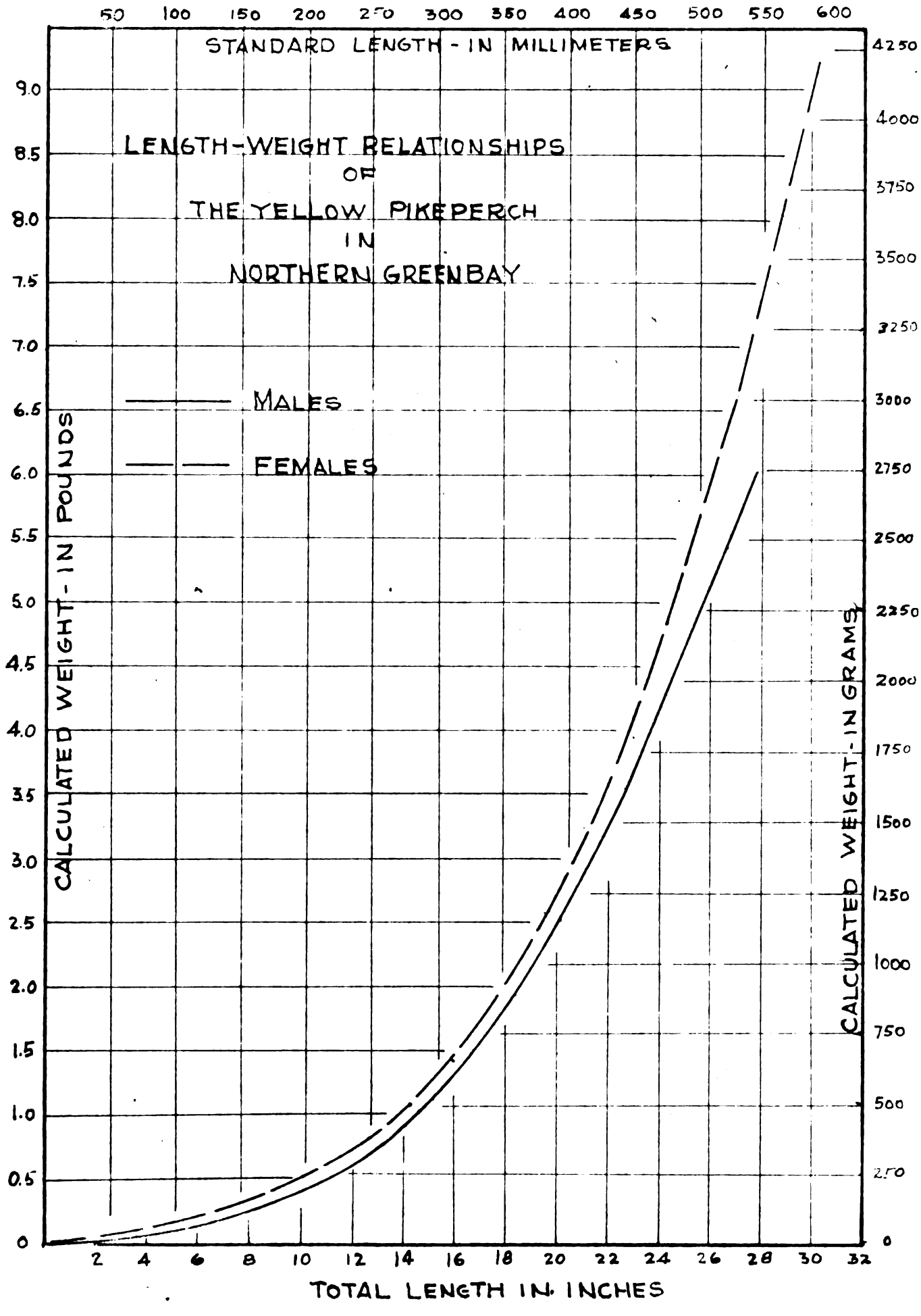

STANDARD LENGTH - IN MILLIMETERS
50 100 150 200 250 300 350 400 450 500 550 600
LENGTH-WEIGHT RELATIONSHIPS
OF
THE YELLOW PIKEPERCH
IN
NORTHERN GREENBAY
MALES
FEMALES
CALCULATED WEIGHT - IN POUNDS
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0
CALCULATED WEIGHT - IN GRAMS
0 250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000 3250 3500 3750 4000 4250
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
TOTAL LENGTH IN INCHES

Table XIX

FACTORS FOR CONVERSION BETWEEN TOTAL (T.L.) AND STANDARD (S.L.) LENGTHS OF GREEN BAY YELLOW PIKEPERCH

(The Data Are Based On Fish Taken In 1950 Collections From Different Ports And From All Major Types Of Fishing Gear)

Total Length (Inches)	Number of Fish	Conversion Factor			
		T.L. to S.L. No Change of Units	S.L. to T.L. No Change of Units	T.L. (In.) to S.L. (mm)	S.L. (mm) to T.L. (In.)
Below 9.9	27	1.2019	0.8320	21.1328	30.5283
10.0 - 11.4	99	1.1902	0.8402	21.3411	30.2311
11.5 - 22.4	186	1.1799	0.8475	21.5265	29.9695
Above 22.5	20	1.1650	0.8583	21.8008	29.591

pinkish color.

In immature fish, the size and shape of the gonads is of some use in determining sex. In fish of the same size, the ovary is wider. The testis also tapers toward the anterior portion and over much of its length while the ovary tapers more abruptly.

Internally, the ovary exhibits folds when cut in cross section, while the testis appears homogeneous.

The dorsal blood vessel of the testis lies in a groove, while the blood vessel of the ovary lies on the surface. Cross veination may also be seen on the ovary while generally, it is lacking or inconspicuous on the testis.

In extremely small individuals (young of the year) the ovary may exhibit two dark lines along its length while the testes appear as thread-like organs devoid of pigmentation.

SEXUAL MATURITY

Only those females showing eggs forming in the ovary were considered mature. Males were considered mature if the testis showed the characteristic whiteish color, during the fall, winter and early spring. During late spring and summer, maturity determinations are difficult. The testis, however, increases noticeably in size when maturity occurs.

Table XX contains data taken from samples made in northern Green Bay. About one half of the male yellow pikeperch are mature by the time they reach 15 1/2 inches. None of the females examined were mature at the 15 1/2 inch legal minimum length. Males mature at a smaller size than do females. 100 percent of the males were mature by the time they were 19 inches in total length. The females were not all mature until they had reached a total length of 21 inches. Table XVI gives the length interval and the percentage of maturity by sexes for northern Green Bay.

GROWTH IN OTHER WATERS

Many authors have described the growth rates of the yellow pikeperch Stizostedion vitreum vitreum (Mitchill) in various bodies of water. Generally, it may be said that the population for every body of water described differs in growth rate from every other. It can be seen from Figure 5 that growth rates vary greatly from that of Lake Abitibi, Ontario, Hart (1928) to that of Norris Reservoir, Tennessee, Stroud (1948).

The Green Bay yellow pikeperch is one of the fastest growing fish studied to date. Stroud (1949) reports the growth rates from Norris Reservoir, Tennessee, as being more rapid. The only other reported data available indicate that the yellow pikeperch of Bass Lake, Wisconsin, Schloemer and Lorch (1942), grows more rapidly than does the same species in Green Bay.

Table XXI compares published data with that computed for northern and southern Green Bay. Figure 5 presents this data graphically.

Tables XXII and XXIII present unpublished data from Dr. Ralph Hile on the Saginaw Bay yellow pikeperch. This material was not included in Table XXI because it presents growth data in more detail than is possible in Table XXI, and because for purposes of comparison,

Table XX

SEXUAL MATURITY OF YELLOW PIKEPERCH
IN NORTHERN GREEN BAY

Total Length Inches	Number Of Specimens	Number Of Immature Fish	Number Of Mature Fish	Percentage Of Maturity
Males				
4.0 - 12.9	74	74	0	0.0
13.0 - 13.9	29	27	2	6.9
14.0 - 14.9	24	17	7	29.2
15.0 - 15.9	22	12	10	45.5
16.0 - 16.9	16	2	14	87.5
17.0 - 17.9	30	3	22	88.0
18.0 - 18.9	59	0	59	100.0*
Females				
4.0 - 16.9	122	122	0	0.0
17.0 - 17.9	4	2	2	50.0
18.0 - 18.9	12	1	11	83.3
19.0 - 19.9	35	2	33	94.3
20.0 - 20.9	139	0	139	100.0

*One male yellow pikeperch 21.9" total length appeared to be immature

TABLE XXI

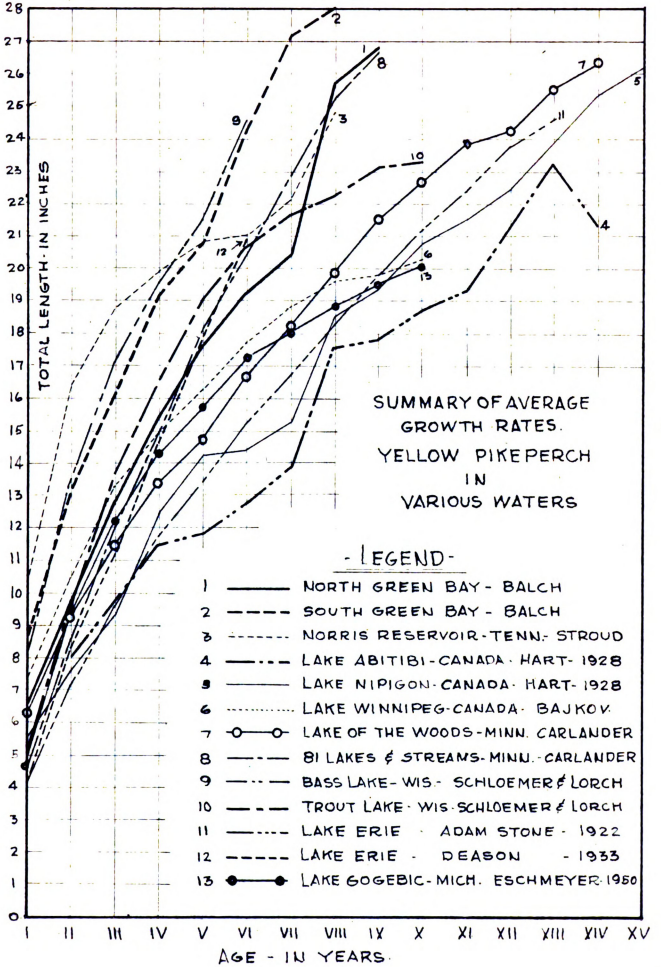
SUMMARY OF GROWTH

THE GROWTH (APPROXIMATE TOTAL LENGTH IN INCHES) OF THE YELLOW PIKEPERCH IN VARIOUS BODIES OF WATER. WHERE TOTAL LENGTH IS NOT USED CONVERSION FACTORS FROM ORIGINAL WORK ARE USED TO YIELD HOMOGENEOUS DATA. THIS TABLE IS TAKEN LARGELY FROM STROUD'S WORK ON THE NORRIS RESERVOIR WALLEYED PIKE

	Average Length At End Of Year Of Life														
Water And Source	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
North Green Bay Balch	6.6	10.2	12.8	15.4	17.6	19.2	20.4	25.8	26.8						
South Green Bay Balch	8.7	13.2	16.1	19.1	20.7	24.3	27.2	28.0							
Norris Reservoir Stroud	10.3	16.4	18.7	19.9	20.8	21.0	22.1	24.8							
Lake Abitibi Hart-1928*		8.0		11.5	11.8	12.8	15.9	17.6	17.8	18.7	19.4		23.2	21.4	
Lake Nipigon Hart-1928	5.6	7.7	9.4	12.5	14.2	14.4	15.3	18.5	19.4	20.8	21.5	23.5		24.4	26.1
Lake Winnipeg Bajkov**	7.3	10.5	13.2	15.0	16.4	17.8	18.9	19.6	19.8	20.2					
Lake Of The Woods-Carlander*	6.4	9.3	11.5	13.4	14.8	16.7	18.2	19.9	21.6	22.7	23.9	24.3	25.6	26.4	
81 Minn. Lakes & Streams-1939 Carlander	4.6	8.6	12.0	15.0	18.1	20.5	22.9	25.2	26.7						
Bass Lake Wis. Schloemer & Lorch***	8.4	13.5	17.1	19.6	21.5	24.5									
Trout Lake Wis. Schloemer & Lorch	5.3	9.7	13.7	16.6	19.0	20.7	21.7	22.3	23.1	23.3					
Lake Erie Adam Stone-1922 ****	4.1	7.1	9.6	11.7	13.5	15.2	16.8	18.3	19.8	21.1	22.4	23.8	24.6		
Lake Erie Deason-1933*	4.1	8.3	11.3	14.9	18.0	20.9									

* Standard length given by authors. Total length estimated as 1.159 Standard Length (Carlander-1945)
** Original figures assumed to be standard length. Total length equals 1.159 Standard Length.
*** Standard length given by authors. Total length estimated as 1.184 Standard Length.
**** Original figures reported as total length in centimeters.

FIGURE 5.


TOTAL LENGTH IN INCHES
AGE - IN YEARS
I II III IV V VI VII VIII IX X XI XII XIII XIV XV
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
SUMMARY OF AVERAGE GROWTH RATES.
YELLOW PIKEPERCH
IN
VARIOUS WATERS
- LEGEND -
1 NORTH GREEN BAY - BALCH
2 SOUTH GREEN BAY - BALCH
3 NORRIS RESERVOIR - TENN.- STROUD
4 LAKE ABITIBI - CANADA - HART - 1928
5 LAKE NIPIGON - CANADA - HART - 1928
6 LAKE WINNIPEG - CANADA - BAJKOV
7 LAKE OF THE WOODS - MINN. CARLANDER
8 81 LAKES & STREAMS - MINN. - CARLANDER
9 BASS LAKE - WIS - SCHLOEMER & LORCH
10 TROUT LAKE - WIS - SCHLOEMER & LORCH
11 LAKE ERIE - ADAM STONE - 1922
12 LAKE ERIE - DEASON - 1933
13 LAKE GOGEBIC - MICH. ESCHMEYER 1950

Saginaw Bay, more than any other body of water, closely resembles Green Bay in physical and biological characters.

Until the fifth year of life in the case of male yellow pikeperch, Saginaw Bay and northern Green Bay growth characteristics are similar. In the case of females, growth rates are very close until the sixth year. After this time, the growth rates in Saginaw Bay for both sexes slow up more rapidly than in the case of northern Green Bay. As a result, the older fish in northern Green Bay are longer than in Saginaw Bay. Comparisons are made upon the growth rates computed since 1930.

Tables XVIII and XXIII contain data on the weights of yellow pikeperch from Saginaw Bay and Green Bay.

A marked difference is apparent between the weights of northern Green Bay and Saginaw Bay yellow pikeperch of comparable age. Saginaw Bay specimens average heavier than the northern Green Bay fish of the same age all through life. It should be stated that the size of the sample in northern Green Bay of fish older than Age Class VII is small and is influenced by a large percentage of larger than average fish.

Table XXII

COMPARISON OF LENGTHS (INCHES) AT DIFFERENT AGES OF YELLOW PIKEPERCH CAUGHT IN SAGINAW BAY IN 1926-1930 AND 1943

Age in Years	Males		Females	
	1926-1930	1943	1926-1930	1943
1	6.7	6.4	6.9	6.4
2	10.7	12.0	10.9	12.0
3	13.4	15.8	13.8	16.3
4	15.3	18.1	16.0	18.9
5	16.6	19.5	17.8	21.3
6	17.6	20.6	19.3	22.9
7	18.3	21.4	20.3	24.3
8	18.9	21.9	21.0	25.4
9	19.5	22.7	21.7	26.3
10	20.0	23.3	22.3	27.3
11			22.9	27.9
12			23.5	28.8
13			24.0	29.5

Table XXIII

COMPARISON OF WEIGHTS (POUNDS) AT DIFFERENT AGES OF YELLOW PIKEPERCH CAUGHT IN SAGINAW BAY IN 1926-1930 AND 1943

Age in Years	Males		Females	
	1926-1930	1943	1926-1930	1943
1	0.09	0.08	0.10	0.08
2	0.37	0.52	0.39	0.52
3	0.71	1.18	0.81	1.29
4	1.06	1.76	1.26	2.04
5	1.36	2.25	1.74	2.96
6	1.61	2.69	2.21	3.73
7	1.83	3.05	2.60	4.55
8	2.05	3.35	2.94	5.18
9	2.25	3.69	3.29	5.77
10	2.45	4.00	3.62	6.41
11			3.91	6.86
12			4.23	7.53
13			4.50	8.14

Growth rates in waters located in a comparable geographical location do not show the rapid growth of the Green Bay population. Yellow pikeperch from Canadian Lakes described by Hart (1928) and Bajkov (1930), the Minnesota Lakes and streams as described by Eddy and Carlander (1939), Lake Erie, Adamstone (1922) and Deason (1933), Lake Gogebic, Michigan, Eschmeyer (1950), and work done on northern Wisconsin lakes (Schloemer and Lorch, 1942) all have growth rates somewhat slower than that of Green Bay.

SUMMARY

Although the yellow pikeperch Stizostedion vitreum vitreum (Mitchill) of Green Bay is not the most important commercial species, either in pounds produced or in value, it does rank among the most important species in northern Green Bay. Northern Green Bay produces the bulk of the yellow pikeperch taken from Lake Michigan waters.

The yellow pikeperch populations of northern and southern Green Bay are apparently discrete populations. Factors causing fluctuations in numbers do not seem to affect both regions in the same way. Growth rates differ rather widely. Physical and biological characteristics are quite different in northern and southern Green Bay.

The recent production of yellow pikeperch in northern Green Bay has been greatly affected by the presence of a dominant year class spawned in 1943. Samples taken in 1949 indicate that 85.1 percent of the commercial harvest was made up of the 1943 year class. In 1950, 73.6 percent of the estimated annual production was made up of this year class. A combination of increased fishing pressure (403 percent of the 1929-1943 average) and increased abundance (282 percent of the 1929-1943 average) have resulted in an increased harvest (1126 percent

of the 1929-1943 average).

The period of greatest production occurs during the months of May and June when approximately 50 percent of the annual catch is made. September and October are also periods of increased yield when about 25 percent of the annual production is taken.

The fyke net produces the largest amount of yellow pikeperch as well as the highest return per unit of effort in northern Green Bay. In southern Green Bay, the seine produces the largest return per unit of effort, but the least production of the commercial gear operated. The fyke net in southern Green Bay produces the greatest percentage of the annual harvest but has the lowest return per unit of effort.

Growth rates were computed for northern and southern Green Bay. Growth rates in length and weight of female yellow pikeperch are more rapid than those of the males. Growth rates (sexes combined) in southern Green Bay exceed those found in northern Green Bay by approximately 25 percent.

For female yellow pikeperch in northern Green Bay, the formula describing the growth in weight is as follows:

$$W = 6.6450 \times 10^{-5} L^{2.9247}$$

For males it is:

$$W = 1.9210 \times 10^{-5} L^{2.7118}$$

Weight increments increase annually until the sixth year of life and then decrease gradually.

Sex determination, though easily determined in the case of adults, requires close examination in the case of immature fish. The size of the gonades, the ovary being larger, as well as the cross veination of the ovary, aid in determining sex. A transverse section of the gonad reveals the ovary to be hollow with folds, while the testis is solid.

Sexual maturity for male yellow pikeperch occurs in 45.5 percent of the specimens studied at 15 inches (total length). In the case of females, none were found mature at 15 inches. Fifty percent were mature by the time they had reached 18.9 inches. Females were 100 percent mature at 20.9 inches.

The Green Bay yellow Pikeperch population is one of the most rapidly growing populations on record. Growth rates in Norris Reservoir, Tennessee, and possibly Bass Lake, Wisconsin, are the only known populations that exceed the rate of growth in Green Bay.

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