FILLET WEIGHTS AND LOSS

ON FILLETING OF YELLOW PIKEPERCH FROM SAGINAW BAY

by

LOUIS A. KRUMHOLZ

MICHIGAN DEPARTMENT OF CONSERVATION

MISCELLANEOUS PUBLICATION No. 3

INSTITUTE FOR FISHERIES RESEARCH
ANN ARBOR, MICHIGAN
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FILLET WEIGHTS AND LOSS ON FILLETING OF YELLOW PIKEPERCH, *Stizostedion v. vitreum* (Mitchill), FROM SAGINAW BAY

by

Louis A. Krumholz[1]

Introduction

During past years officers of the Michigan Department of Conservation had difficulty in the enforcement of minimum size regulations established by law for the taking of yellow pikeperch (walleyed pike, yellow pickerel) for commercial purposes. The practice of filleting undersized fish of this species, in order to avoid detection, was apparently growing, and a regulation to provide for a minimum size of yellow pikeperch fillets became necessary. That such a regulation would prove effective was indicated by the fact that the adoption of a law specifying the minimum legal size of fillets of yellow perch, *Perca flavescens* (Mitchill), (Public Act 339, 1939) practically eliminated a similar problem which existed when only the minimum legal total length of the fish was specified. The present investigation was carried out in order to secure information on which to base recommendations to the Michigan Legislature as to the proper minimum legal weight for yellow pikeperch fillets.

Saginaw Bay was chosen as the site for this study since it yields the principal production of yellow pikeperch in Michigan. The main "run" of yellow pikeperch in Saginaw Bay is in the spring (April, May, and June, with the bulk of the catch taken in April) but there is another, though relatively light run in the fall (September, October, and November). In addition to these runs some yellow pikeperch are taken at other times of the year. Statistical records of the commercial fisheries of Saginaw Bay[2] show that during the past 11 years 85.3 per cent of the total yearly catch of yellow pikeperch has been taken during the spring as compared with 10.9 per cent during the fall. The actual production and percentage of the annual catch taken in the spring and fall for each year of the 11-year period 1933–1943 are shown in Table 1. The occurrence of these two distinct runs of yellow pikeperch in Saginaw Bay, one normally including most of the spawning season, made it necessary to obtain data in both fall and spring in order to detect possible seasonal differences in the weights of fillets and in the percentage of loss due to filleting.

With the assistance of Conservation Officer A. J. Neering, fish were obtained from the Bay Port Fish Company and the R. L. Gillingham Fishing Company at Bay Port and from the Geo. Loeffler Fish Company at Sebewaing in November 1942, and from the Bay Port Fish Company and the R. L. Gillingham Fishing Company at Bay Port in May 1943, April 1944, and May 1945. The cooperation of Mr. Neering and of these firms in saving undersized fish and in permitting the use of their facilities for the work is greatly appreciated.

[1]The writer is indebted to Dr. Ralph Hile of the U. S. Fish and Wildlife Service for assistance in gathering data and for a critical examination of the manuscript.

[2]These records are on file in the Great Lakes laboratories of the Fish and Wildlife Service, U. S. Department of the Interior, Ann Arbor, Michigan.

Table 1.—Total annual production (pounds) of yellow pikeperch in Saginaw Bay, 1933-1943, and production (in pounds and percentage of total annual catch) in the spring and fall seasons.

Year	Production in entire year	Production in April, May, and June		Production in September, October, and November	
		Poundage	Percentage of total	Poundage	Percentage of total
1933	1,454,772	1,192,579	82.0	153,125	10.5
1934	1,349,354	1,162,494	86.2	96,300	7.1
1935	1,292,679	1,161,997	89.9	82,369	6.4
1936	1,400,852	1,231,672	87.9	126,140	9.0
1937	1,528,938	1,380,804	90.3	102,223	6.7
1938	1,179,325	1,048,654	88.9	81,823	6.9
1939	1,492,244	1,290,525	86.5	158,101	10.6
1940	1,443,374	1,151,805	79.8	211,969	14.7
1941	1,462,587	1,124,415	76.9	290,381	19.9
1942	2,050,332	1,680,553	82.0	347,269	16.9
1943	1,558,534	1,403,146	90.0	116,666	7.5
Average	1,473,908	1,257,149	85.3	160,579	10.9

The minimum total length provided by law for yellow pikeperch taken commercially is 15½ inches in State of Michigan waters of the Great Lakes other than Lake Erie. To secure a series of weights on either side of this minimum length, fish of from 13 to 17 inches total length were used. These fish were measured to the nearest quarter-inch and each quarter-inch group was handled separately. Messrs. Fred and Floyd Herman of Bay Port were engaged to do the filleting during each of the periods of investigation. These men, both of whom are commercial fishermen, have had considerable experience in dressing and filleting fish.

The numbers of fish employed in this investigation were 239 in the fall (November 12-16) of 1942, 257 in the spring (May 3-4) of 1943, 181 in the spring (April 13) of 1944, and 255 in the spring (April 16, 24) of 1945.

Relationship Between Total Length and Fillet Weight

The present section will be concerned chiefly with the problem of the proper minimum legal weight for yellow pikeperch fillets sold commercially. The subject of the loss of weight in filleting will be treated in the next section.

The number of specimens, the average round weight, and the average fillet weight of fish in each quarter-inch length group in each collection, together with the average round weights and fillet weights for the combined collections are given in Table 2. The minimum, average, and maximum round and fillet weights for fish in each length group in the combined collections are shown in Table 3. A comparison of the round weights and fillet weights according to the total lengths of all fish studied during the investigation is graphically presented in Figure 1. The circles indicate the weighted averages of the round weights and fillet weights, and the vertical lines the extreme ranges of the round and fillet weights of the individuals of each length group for the combined collections. The smooth curves (upper, round weights; lower, fillet weights), fitted to the empirical data by inspection, indicate the general trend of the data.

Table 2.—Round weights (ounces) and fillet weights (ounces) of yellow pikeperch from Saginaw Bay according to length, for each of the four collections and weighted averages for the combined collections. The horizontal ruling in the body of the table separates the legal- and illegal-sized fish.

Total length (inches)	Weight of fish in round (ounces)					Weight of fillet (ounces)				
	Nov. 12-16, 1942	May 3-4, 1943	April 13, 1944	April 16, 24, 1945	Average	Nov. 12-16, 1942	May 3-4, 1943	April 13, 1944	April 16, 24, 1945	Average
13	12.0	12.0	11.0	13.1	12.9	5.7	5.7	4.5	5.6	5.6
	(2)	(2)	(1)	(30)	(35)					
13¼	11.8	12.0	12.2	13.3	12.9	6.2	5.8	5.3	5.7	5.7
	(5)	(4)	(3)	(30)	(42)					
13½	13.9	12.7	13.7	14.0	13.7	6.8	6.4	6.0	6.2	6.2
	(6)	(8)	(19)	(30)	(63)					
13¾	13.7	13.8	14.3	15.0	14.5	7.1	6.7	6.4	6.4	6.5
	(7)	(12)	(21)	(30)	(70)					
14	13.4	13.9	15.0	15.8	14.9	7.0	6.9	6.7	6.9	6.8
	(11)	(16)	(36)	(30)	(93)					
14¼	15.0	14.7	15.4	16.3	15.5	7.4	7.3	6.9	7.2	7.2
	(17)	(18)	(32)	(30)	(97)					
14½	15.5	15.9	16.3	17.6	16.3	7.8	7.6	7.3	7.8	7.6
	(22)	(26)	(38)	(24)	(110)					
14¾	16.9	16.3	17.1	18.3	16.9	8.6	8.0	7.6	8.0	8.1
	(21)	(24)	(14)	(10)	(69)					
15	17.6	17.3	17.9	19.7	17.7	8.6	8.2	7.9	8.6	8.3
	(19)	(27)	(13)	(6)	(65)					
15¼	18.8	17.7	18.8	.....	18.3	9.3	8.6	8.4	.....	8.9
	(19)	(19)	(3)	.....	(41)					
15½	20.3	19.3	19.0	22.3	20.0	10.3	9.3	8.4	9.7	9.7
	(16)	(18)	(1)	(3)	(38)					
15¾	21.7	19.8	.....	22.9	21.4	10.8	9.7	.....	10.3	10.4
	(20)	(10)	.....	(6)	(36)					
16	22.5	21.2	.....	23.2	22.1	11.5	10.6	.....	10.2	11.0
	(17)	(13)	.....	(6)	(36)					
16¼	23.0	21.8	.....	23.3	22.6	11.4	10.9	.....	10.2	11.0
	(17)	(15)	.....	(6)	(38)					
16½	24.8	23.1	.....	24.7	24.1	12.7	11.5	.....	10.9	12.0
	(18)	(15)	.....	(6)	(39)					
16¾	25.9	24.5	.....	27.2	25.4	13.1	11.9	.....	12.1	12.4
	(11)	(15)	.....	(5)	(31)					
17	26.5	24.8	.....	27.5	25.7	13.2	12.5	.....	12.7	12.8
	(11)	(15)	.....	(3)	(29)					

Table 3.—Numbers of yellow pikeperch from Saginaw Bay in each quarter-inch length group and minimum, average, and maximum round weights and fillet weights in the combined collections, 1942-45. The horizontal ruling in the body of the table separates the legal- and illegal-sized fish.

Total length (inches)	Number of fish	Weight of fish in round (ounces)			Weight of fillet (ounces)		
		Minimum	Average	Maximum	Minimum	Average	Maximum
13.....	35	11.0	12.9	14.5	4.5	5.6	6.7
13¼....	42	10.5	12.9	14.5	4.8	5.7	7.1
13½....	63	11.5	13.7	18.0	4.6	6.2	7.7
13¾....	70	12.0	14.5	17.0	5.3	6.5	7.7
14.....	93	11.5	14.9	17.0	5.3	6.8	8.3
14¼....	97	12.8	15.5	18.5	6.1	7.2	8.5
14½....	110	12.5	16.3	19.5	6.3	7.6	8.9
14¾....	69	14.8	16.9	20.0	6.6	8.1	9.7
15.....	65	15.0	17.7	21.5	6.5	8.3	9.6
15¼....	41	16.0	18.3	24.5	7.3	8.9	11.7
15½....	38	17.0	20.0	25.0	8.2	9.7	12.2
15¾....	36	17.0	21.4	24.0	8.4	10.4	12.2
16.....	36	18.0	22.1	25.0	9.4	11.0	13.6
16¼....	38	18.5	22.6	26.8	8.9	11.0	13.0
16½....	39	21.0	24.1	27.5	9.2	12.0	14.1
16¾....	31	22.5	25.4	31.5	10.4	12.4	14.3
17.....	29	22.5	25.7	28.0	11.5	12.8	14.1

Two features of the data of Tables 2 and 3 have important bearing on the problem of the proper minimum legal weight for yellow pikeperch fillets. The first is the substantially greater weight of fillets from fish captured in the fall as compared with those from fish taken in the spring. The average fillet from a yellow pikeperch of minimum legal length (15½ inches) with an average round weight of 20.3 ounces, taken during the fall of 1942 weighed 10.3 ounces. The average fillet from a 15½-inch yellow pikeperch, with an average round weight of 19.7 ounces, taken during the spring run (combined collections 1943-45) weighed 9.3 ounces. The difference between these two weights is sufficiently great to suggest the possible desirability of separate weight limits for different seasons. From the enforcement standpoint, however, different limits in different seasons would be impractical because of the difficulty in establishing the time of capture of fish from which frozen fillets were prepared once those fillets were removed from storage. Since a single minimum legal weight for fillets must be recommended, greater consideration should be given to the data collected in the spring than in the fall as the bulk of the annual yield from Saginaw Bay (85.3 per cent) is produced in the former period and only a relatively small part (10.9 per cent) of the annual catch is taken during the fall. The average of the two fillet weights mentioned above, with each weighted according to the percentage of the total annual yield in the season for which the weight was determined, is 9.4 ounces.

The second feature of the data of Tables 2 and 3 pertinent to the problem of the proper legal weight for yellow pikeperch fillets is the variation of the fillet weight for fish of the same length group. The difference in weight between the heaviest and lightest fillet from fish in any one length group ranged from 2.2 ounces (13 inches) to 4.4 ounces (15¼ inches). Similar variations occurred in the round weights of yellow pikeperch[3]. Because of the variability of the weight

[3]The heaviest fillets did not necessarily come from the heaviest fish of a length group nor the lightest fillet from the lightest fish. In the field procedure the individual fillets were not identified with the individual fish.

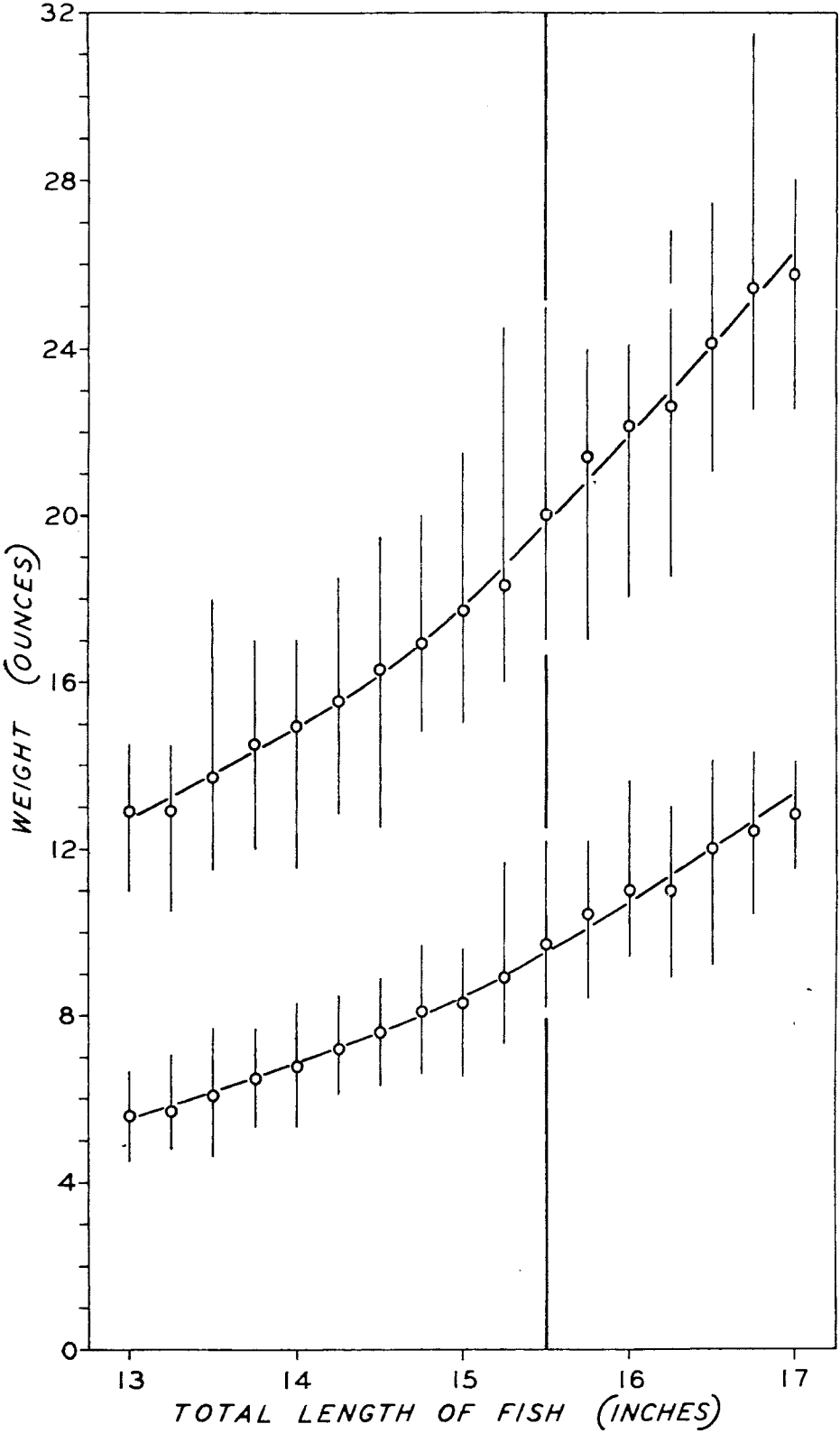

Figure 1. Round weight (curve at right) and fillet weight (curve at left) of Saginaw Bay yellow pikeperch over the length range 13-17 inches. The curves were fitted by inspection to the averages (shown by the circles) for the quarter-inch intervals of length. The vertical lines passing through the averages indicate the ranges of weight. The heavy vertical ruling at 15½ inches separates under-sized and legal-sized fish.

of fillets from fish of the same length group, it is obvious that with any minimum legal weight of fillet that reasonably could be considered some yellow pikeperch below legal length will produce legal-sized fillets and some fish at or above legal length will yield undersized fillets. Assuming the average fillet weight of 9.4 ounces for fish 15½ inches in length to be proper, it may be seen from the data in Table 3 that no fish of a lesser total length than 14¾ inches furnished fillets of this size and that no fish of a greater total length than 16½ inches yielded undersized fillets. The percentage of undersized fish (14¾-15¼ inches inclusive) producing legal-sized fillets and the percentage of legal-sized fish (15½-16½ inches inclusive) producing undersized fillets at various assumed fillet weights in each of the four collections and for the combined collections are given in Table 4. The figures in parentheses indicate for undersized fish the total number of each length at which some individuals produced legal-sized fillets and the number of fish in that group which yielded such fillets; for the legal-size fish the figures in parentheses show total number of each length at which some individuals provided undersized fillets and the number which yielded those fillets.

The data from the combined spring and fall collections would indicate that a fillet weight of 9.25 ounces would be suitable inasmuch as it would allow the filleting of approximately 11 per cent of the undersized fish whereas the same percentage of legal-sized fish would yield undersized fillets. However, data from preceding years gathered by the U. S. Fish and Wildlife Service showed that the yellow pikeperch taken during the springs of 1943-1945 were somewhat heavier than were fish of similar lengths taken from Saginaw Bay in the spring of either 1929 or 1930; and presumably these latter fish would yield lighter fillets. Thus a lesser fillet weight than 9.25 ounces would seem more suitable. Furthermore, the weighted averages of the numbers of undersized fish providing legal-sized fillets and legal-sized fish yielding undersized fillets, obtained by considering the spring-run fish as 85.3 per cent of the total annual production and the fish caught in the fall as 10.9 per cent of that figure, suggest that a weight of 9.0 ounces is a more suitable fillet weight than that of 9.25 ounces. When all pertinent information is considered the samples employed in this investigation indicate that a fillet weight of 9.0 ounces is reasonable.

A minimum fillet weight of 9.0 ounces would be more practical than one involving a fraction of an ounce. A further argument for the 9-ounce as against a higher weight limit for yellow pikeperch fillets lies in the fact that processors may find it necessary to provide a margin to cover possible loss of weight of fillets after dressing, particularly for those processed for freezing and storage. Inasmuch as the weight limit, to be effective, has to be specified as applicable to fillets at the time of any inspection regardless of their previous history, some leeway must be given to cover these losses of weight after filleting. The 9-ounce limit should provide a fully adequate allowance for these losses.

Loss of Weight Due to Filleting

The percentage loss of weight of yellow pikeperch from Saginaw Bay at filleting did not vary widely either with season or size of fish (Table 5). Such variations as did occur were consistent in that the percentage loss in weight was higher for undersized than for legal-sized fish in all collections where adequate samples were taken and was greater in spring-caught fish (April, May) than in fish taken during the fall (November). Furthermore, fish caught in April suffer a greater loss at filleting than those taken in May. From the

Table 4.—Percentages of undersized yellow pikeperch providing legal-sized fillets and percentages of legal-sized fish producing undersized fillets, at various fillet weights, Saginaw Bay. Data are given for the individual collections and for all collections combined. The figures in parentheses indicate the number of fish handled in each group (at left) and those fish which provided either legal-sized or undersized fillets (at right).

Assumed fillet weight (ounces)	Item	November 1942	May 1943	April 1944	April 1945	Combined collections	Weighted average*
9.0	Percentage of undersized fish producing legal-sized fillets	39.7 (58-23)	10.0 (70-7)	3.3 (30-1)	0.0 (16-0)	17.8 (174-31)	10.6
	Percentage of legal-sized fish producing undersized fillets	3.4 (88-3)	14.1 (71-10)	100.0 (1-1)	0.0 (27-0)	7.5 (187-14)	10.2
9.25	Percentage of undersized fish producing legal-sized fillets	22.4 (58-13)	7.1 (70-5)	3.3 (30-1)	0.0 (16-0)	10.9 (174-19)	7.1
	Percentage of legal-sized fish producing undersized fillets	5.7 (88-5)	16.9 (71-12)	100.0 (1-1)	7.4 (27-2)	10.7 (187-20)	14.1
9.4	Percentage of undersized fish producing legal-sized fillets	17.2 (58-10)	5.7 (70-4)	3.3 (30-1)	0.0 (16-0)	8.6 (174-15)	5.8
	Percentage of legal-sized fish producing undersized fillets	6.8 (88-6)	21.1 (71-15)	100.0 (1-1)	11.1 (27-3)	13.4 (187-25)	17.8
9.5	Percentage of undersized fish producing legal-sized fillets	17.2 (58-10)	4.3 (70-3)	3.3 (30-1)	0.0 (16-0)	8.0 (174-14)	5.0
	Percentage of legal-sized fish producing undersized fillets	6.8 (88-6)	23.9 (71-17)	100.0 (1-1)	11.1 (27-3)	14.4 (187-27)	19.6

*See text for method of weighting in determining these averages.

data given in Table 5 it may be stated that in filleting yellow pikeperch from Saginaw Bay there is a 50-55 per cent loss in weight at filleting.

No records are available of other experimental studies on the filleting of yellow pikeperch. Statements, not accompanied by data, in the typewritten report of the Red Lakes Fisheries Association (Minnesota) for 1938 and in the Great Lakes Fishermen for April 1937 gave the loss of weight of yellow pikeperch due to filleting as 58 and 60 per cent respectively (the latter figure referred to spring-run fish from Saginaw Bay). Both of these percentages are above those determined in the present study.

Table 5.—Percentage loss in weight on filleting yellow pikeperch according to length for each of four collections and weighted averages for the combined collections and for all illegal- and legal-sized fish, Saginaw Bay, November 1942, May 1943, April 1944, and April 1945. The horizontal ruling in the body of the table separates the legal- and illegal-sized fish.

Total length (inches)	Nov. 12-16, 1942	May 3-4, 1943	April 13, 1944	April 16, 24, 1945	Weighed average
13	52.5	52.5	59.1	57.3	56.8
	(2)	(2)	(1)	(30)	(35)
13¼	47.5	51.7	56.6	57.1	55.4
	(5)	(4)	(3)	(30)	(42)
13½	51.1	49.6	56.2	55.7	54.6
	(6)	(8)	(19)	(30)	(63)
13¾	48.2	51.4	55.2	57.3	54.7
	(7)	(12)	(21)	(30)	(70)
14	47.8	50.4	55.3	56.3	53.9
	(11)	(16)	(36)	(30)	(93)
14¼	50.7	50.3	55.2	55.8	53.7
	(17)	(18)	(32)	(30)	(97)
14½	49.7	52.2	55.2	55.7	53.5
	(22)	(26)	(38)	(24)	(110)
14¾	49.1	50.9	55.6	56.3	52.1
	(21)	(24)	(14)	(10)	(69)
15	51.1	52.6	55.9	56.3	53.2
	(19)	(27)	(13)	(6)	(65)
15¼	50.5	51.4	55.3	.....	51.3
	(19)	(19)	(3)	.....	(41)
15½	49.3	51.8	55.8	56.5	51.2
	(16)	(18)	(1)	(3)	(38)
15¾	50.2	51.0	.....	55.0	51.2
	(20)	(10)	.....	(6)	(36)
16	48.9	50.0	.....	56.0	50.5
	(17)	(13)	.....	(6)	(36)
16¼	50.4	50.0	.....	56.2	51.2
	(17)	(15)	.....	(6)	(38)
16½	48.8	50.2	.....	55.9	50.4
	(18)	(15)	.....	(6)	(39)
16¾	49.4	51.4	.....	55.5	51.4
	(11)	(15)	.....	(5)	(31)
17	50.2	49.6	.....	53.8	50.3
	(11)	(15)	.....	(3)	(29)
Average Illegal	49.8	51.4	55.5	56.5	53.8
	(129)	(156)	(180)	(220)	(685)
Average Legal	49.6	50.6	55.8	55.6	50.9
	(110)	(101)	(1)	(35)	(247)

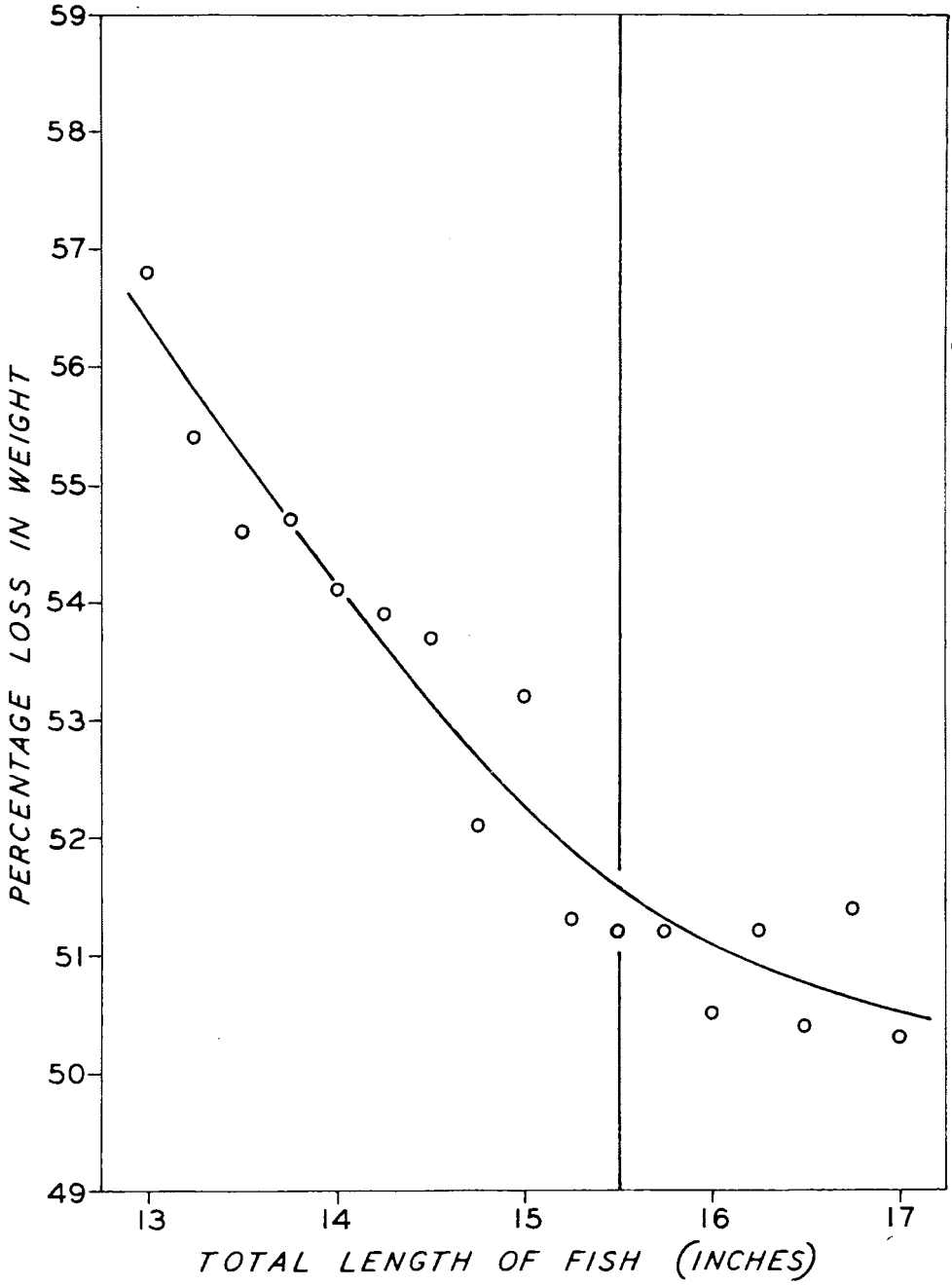

Figure 2. Percentage loss in weight due to filleting of Saginaw Bay yellow pikeperch over the length range 13-17 inches. The curve was fitted by inspection to the averages (shown by the circles) for each quarter-inch length group. The vertical ruling at 15½ inches separates the undersized and legal-sized fish.

Commercial fishermen interviewed at Bay Port during this investigation believe that yellow pikeperch from Saginaw Bay lose approximately 50 per cent of the round weight in filleting in the fall and 60 per cent in the spring. The former estimate agrees closely with the findings in this study, but the latter estimate is higher. The greatest loss on filleting may be expected among ripe females, and yellow pikeperch of that sex are seldom mature at lengths (17 inches or less) employed in this study.

As a result of this investigation the commercial fishing law of 1929 (P. A. 84, 1929) was amended in 1945 to prohibit the possession or marketing of yellow pikeperch fillets of a less weight than 9 ounces.

Miscellaneous Publication No. 3

Original: Fish Division
cc: Education-Game
Dr. Krumholz

July 23, 1945

REPORT NO. 1013

FILLET WEIGHTS AND LOSS ON FILLETING OF YELLOW PIKEPERCH, *Stizostedion v. vitreum* (Mitchill), FROM SAGINAW BAY

by

Louis A. Krumholz[1]

Introduction

During past years officers of the Michigan Department of Conservation had difficulty in the enforcement of minimum size regulations established by law for the taking of yellow pikeperch (walleyed pike, yellow pickerel) for commercial purposes. The practice of filleting undersized fish of this species, in order to avoid detection, was apparently growing, and a regulation to provide for a minimum size of yellow pikeperch fillets became necessary. That such a regulation would prove effective was indicated by the fact that the adoption of a law specifying the minimum legal size of fillets of yellow perch, *Perca flavescens* (Mitchill), (Public Act 339, 1939) practically eliminated a similar problem which existed when only the minimum legal total length of the fish was specified. The present investigation was carried out in order to secure information on which to base recommendations to the Michigan Legislature as to the proper minimum legal

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weight for yellow pikeperch fillets.

Saginaw Bay was chosen as the site for this study since it yields the principal production of yellow pikeperch in Michigan. The main "run" of yellow pikeperch in Saginaw Bay is in the spring (April, May, and June, with the bulk of the catch taken in April) but there is another, though relatively light run in the fall (September, October, and November). In addition to these runs some yellow pikeperch are taken at other times of the year. Statistical records of the commercial fisheries of Saginaw Bay [2] show that during the past 11 years 85.3 per cent of the total yearly catch of yellow pikeperch has been taken during the spring as compared with 10.9 per cent during the fall. The actual production and percentage of the annual catch taken in the spring and fall for each year of the 11-year period 1933-1943 are shown in Table 1. The occurrence of these two distinct runs of yellow pikeperch in Saginaw Bay, one normally including most of the spawning season, made it necessary to obtain data in both fall and spring in order to detect possible seasonal differences in the weights of fillets and in the percentage of loss due to filleting.

With the assistance of Conservation Officer A. J. Neering, fish were obtained from the Bay Port Fish Company and the R. L. Gillingham Fishing Company at Bay Port and from the Geo. Loeffler Fish Company at Sebewaing in November 1942, and from the Bay Port Fish Company and the R. L. Gillingham Fishing Company at Bay Port in May 1943, April 1944, and May 1945. The cooperation of Mr. Neering and of these firms in saving undersized fish and in permitting the use of their facilities for the work is greatly appreciated.

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[2] These records are on file in the Great Lakes laboratories of the Fish and Wildlife Service, U. S. Department of the Interior, Ann Arbor, Michigan.

Table 1.—Total annual production (pounds) of yellow pikeperch in Saginaw Bay, 1933-1943, and production (in pounds and percentage of total annual catch) in the spring and fall seasons

Year	Production in entire year	Production in April, May, and June		Production in September, October, and November	
		Poundage	Percentage of total	Poundage	Percentage of total
1933	1,454,772	1,192,579	82.0	153,125	10.5
1934	1,349,354	1,162,494	86.2	96,300	7.1
1935	1,292,679	1,161,997	89.9	82,369	6.4
1936	1,400,852	1,231,672	87.9	126,140	9.0
1937	1,528,938	1,380,804	90.3	102,223	6.7
1938	1,179,325	1,048,654	88.9	81,823	6.9
1939	1,492,244	1,290,525	86.5	158,101	10.6
1940	1,443,374	1,151,805	79.8	211,969	14.7
1941	1,462,587	1,124,415	76.9	290,381	19.9
1942	2,050,332	1,680,553	82.0	347,269	16.9
1943	1,558,534	1,403,146	90.0	116,666	7.5
Average	1,473,908	1,257,149	85.3	160,579	10.9

The minimum total length provided by law for yellow pikeperch taken commercially is 15 1/2 inches in State of Michigan waters of the Great Lakes other than Lake Erie. To secure a series of weights on either side of this minimum length, fish of from 13 to 17 inches total length were used. These fish were measured to the nearest quarter inch and each quarter-inch group was handled separately. Messrs. Fred and Floyd Herman of Bay Port were engaged to do the filleting during each of the periods of investigation. These men, both of whom are commercial fishermen, have had considerable experience in dressing and filleting fish.

The numbers of fish employed in this investigation were 239 in the fall (November 12-16) of 1942, 257 in the spring (May 3-4) of 1943, 181 in the spring (April 13) of 1944, and 255 in the spring (April 16, 24) of 1945.

Relationship Between Total Length and Fillet Weight

The present section will be concerned chiefly with the problem of the proper minimum legal weight for yellow pikeperch fillets sold commercially. The subject of the loss of weight in filleting will be treated in the next section.

The number of specimens, the average round weight, and the average fillet weight of fish in each quarter-inch length group in each collection, together with the average round weights and fillet weights for the combined collections are given in Table 2. The minimum, average, and maximum round and fillet weights for fish in each length group in the combined collections are shown in Table 3. A comparison of the round weights and fillet weights according to the total lengths of all fish studied during the investigation is graphically presented in Figure 1. The circles

Table 2.—Round weights (ounces) and fillet weights (ounces) of yellow pikeperch from Saginaw Bay according to length, for each of the four collections and weighted averages for the combined collections. The horizontal ruling in the body of the table separates the legal- and illegal-sized fish.

Total length (inches)	Weight of fish in round (ounces)					Weight of fillet (ounces)				
	Nov. 12-16, 1942	May 3-4, 1943	April 13, 1944	April 16, 24, 1945	Average	Nov. 12-16, 1942	May 3-4, 1943	April 13, 1944	April 16-24, 1945	Average
13	12.0 (2)	12.0 (2)	11.0 (1)	13.1 (30)	12.9 (35)	5.7	5.7	4.5	5.6	5.6
13 1/4	11.8 (5)	12.0 (4)	12.2 (3)	13.3 (30)	12.9 (42)	6.2	5.8	5.3	5.7	5.7
13 1/2	13.9 (6)	12.7 (8)	13.7 (19)	14.0 (30)	13.7 (63)	6.8	6.4	6.0	6.2	6.2
13 3/4	13.7 (7)	13.8 (12)	14.3 (21)	15.0 (30)	14.5 (70)	7.1	6.7	6.4	6.4	6.5
14	13.4 (11)	13.9 (16)	15.0 (36)	15.8 (30)	14.9 (93)	7.0	6.9	6.7	6.9	6.8
14 1/4	15.0 (17)	14.7 (18)	15.4 (32)	16.3 (30)	15.5 (97)	7.4	7.3	6.9	7.2	7.2
14 1/2	15.5 (22)	15.9 (26)	16.3 (38)	17.6 (24)	16.3 (110)	7.8	7.6	7.3	7.8	7.6
14 3/4	16.9 (21)	16.3 (24)	17.1 (14)	18.3 (10)	16.9 (69)	8.6	8.0	7.6	8.0	8.1
15	17.6 (19)	17.3 (27)	17.9 (13)	19.7 (6)	17.7 (65)	8.6	8.2	7.9	8.6	8.3
15 1/4	18.8 (19)	17.7 (19)	18.8 (3)	... ...	18.3 (41)	9.3	8.6	8.4	...	8.9
15 1/2	20.3 (16)	19.3 (18)	19.0 (1)	22.3 (3)	20.0 (38)	10.3	9.3	8.4	9.7	9.7
15 3/4	21.7 (20)	19.8 (10)	... ...	22.9 (6)	21.4 (36)	10.8	9.7	...	10.3	10.4
16	22.5 (17)	21.2 (13)	... ...	23.2 (6)	22.1 (36)	11.5	10.6	...	10.2	11.0
16 1/4	23.0 (17)	21.8 (15)	... ...	23.3 (6)	22.6 (38)	11.4	10.9	...	10.2	11.0
16 1/2	24.8 (18)	23.1 (15)	... ...	24.7 (6)	24.1 (39)	12.7	11.5	...	10.9	12.0
16 3/4	25.9 (11)	24.5 (15)	... ...	27.2 (5)	25.4 (31)	13.1	11.9	...	12.1	12.4
17	26.5 (11)	24.8 (15)	... ...	27.5 (3)	25.7 (29)	13.2	12.5	...	12.7	12.8

Table 3.--Numbers of yellow pikeperch from Saginaw Bay in each quarter-inch length group and minimum, average, and maximum round weights and fillet weights in the combined collections, 1942-45. The horizontal ruling in the body of the table separates the legal- and illegal-sized fish.

Total length (inches)	Number of fish	Weight of fish in round (ounces)			Weight of fillet (ounces)		
		Minimum	Average	Maximum	Minimum	Average	Maximum
13	35	11.0	12.9	14.5	4.5	5.6	6.7
13 1/4	42	10.5	12.9	14.5	4.8	5.7	7.1
13 1/2	63	11.5	13.7	18.0	4.6	6.2	7.7
13 3/4	70	12.0	14.5	17.0	5.3	6.5	7.7
14	93	11.5	14.9	17.0	5.3	6.8	8.3
14 1/4	97	12.8	15.5	18.5	6.1	7.2	8.5
14 1/2	110	12.5	16.3	19.5	6.3	7.6	8.9
14 3/4	69	14.8	16.9	20.0	6.6	8.1	9.7
15	65	15.0	17.7	21.5	6.5	8.3	9.6
15 1/4	41	16.0	18.3	24.5	7.3	8.9	11.7
15 1/2	38	17.0	20.0	25.0	8.2	9.7	12.2
15 3/4	36	17.0	21.4	24.0	8.4	10.4	12.2
16	36	18.0	22.1	25.0	9.4	11.0	13.6
16 1/4	38	18.5	22.6	26.8	8.9	11.0	13.0
16 1/2	39	21.0	24.1	27.5	9.2	12.0	14.1
16 3/4	31	22.5	25.4	31.5	10.4	12.4	14.3
17	29	22.5	25.7	28.0	11.5	12.8	14.1

Figure 1. Round weight (upper curve) and fillet weight (lower curve) of Saginaw Bay yellow pikeperch over the length range 13-17 inches. The curves were fitted by inspection to the averages (shown by the circles) for the quarter-inch intervals of length. The vertical lines passing through the averages indicate the ranges of weight. The heavy vertical ruling at 15 1/2 inches separates undersized and legal-sized fish.

Figure 1

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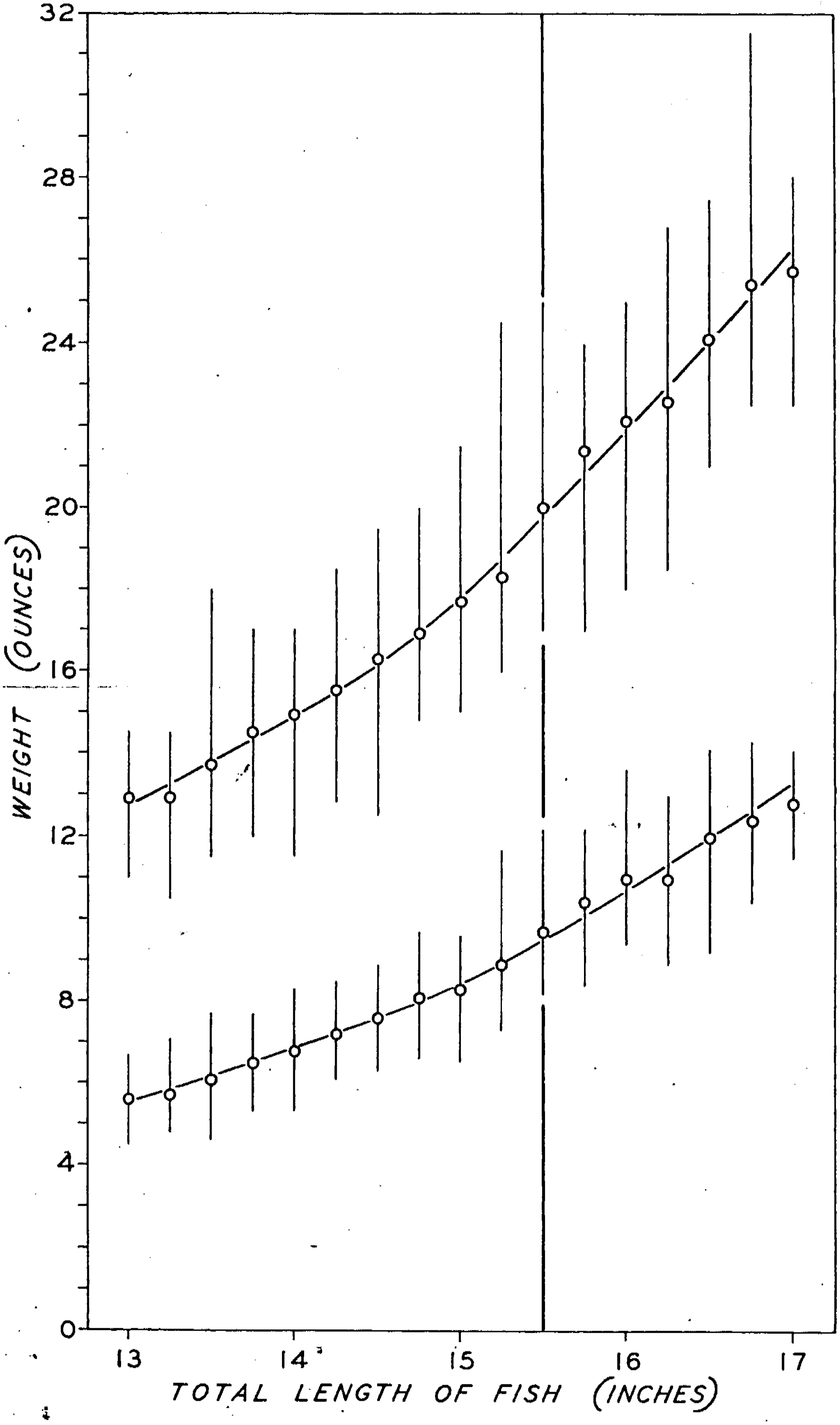

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indicate the weighted averages of the round weights and fillet weights, and the vertical lines the extreme ranges of the round and fillet weights of the individuals of each length group for the combined collections. The smooth curves (upper, round weights; lower, fillet weights), fitted to the empirical data by inspection, indicate the general trend of the data.

Two features of the data of Tables 2 and 3 have important bearing on the problem of the proper minimum legal weight for yellow pikeperch fillets. The first is the substantially greater weight of fillets from fish captured in the fall as compared with those from fish taken in the spring. The average fillet from a yellow pikeperch of minimum legal length (15 1/2inches) with an average round weight of 20.3 ounces, taken during the fall of 1942 weighed 10.3 ounces. The average fillet from a 15 1/2-inch yellow pikeperch, with an average round weight of 19.7 ounces, taken during the spring run (combined collections 1943-45) weighed 9.3 ounces. The difference between these two weights is sufficiently great to suggest the possible desirability of separate weight limits for different seasons. From the enforcement standpoint, however, different limits in different seasons would be impractical because of the difficulty in establishing the time of capture of fish from which frozen fillets were prepared once those fillets were removed from storage. Since a single minimum legal weight for fillets must be recommended, greater consideration should be given to the data collected in the spring than in the fall as the bulk of the annual yield from Saginaw Bay (85.3 per cent) is produced in the former period and only a relatively small part (10.9 per cent) of the annual catch is taken during the fall. The average of the two fillet weights mentioned above, with each weighted according to the percentage of the total annual yield in the season for which the weight was determined, is 9.4 ounces.

The second feature of the data of Tables 2 and 3 pertinent to the problem of the proper legal weight for yellow pikeperch fillets is the variation of the fillet weight for fish of the same length group. The difference in weight between the heaviest and lightest fillet from fish in any one length group ranged from 2.2 ounces (13 inches) to 4.4 ounces (15 1/4 inches). Similar variations occurred in the round weights of yellow pikeperch.[3] Because of the variability of the weight of fillets from fish of the same length group, it is obvious that with any minimum legal weight of fillet that reasonably could be considered some yellow pikeperch below legal length will produce legal-sized fillets and some fish at or above legal length will yield undersized fillets. Assuming the average fillet weight of 9.4 ounces for fish 15 1/2 inches in length to be proper, it may be seen from the data in Table 3 that no fish of a lesser total length than 14 3/4 inches furnished fillets of this size and that no fish of a greater total length than 16 1/2 inches yielded undersized fillets. The percentage of undersized fish (14 3/4 - 15 1/4 inches inclusive) producing legal-sized fillets and the percentage of legal-sized fish (15 1/2 - 16 1/2 inches inclusive) producing undersized fillets at various assumed fillet weights in each of the four collections and for the combined collections are given in Table 4. The figures in parentheses indicate for undersized fish the total number of each length at which some individuals produced legal-sized fillets and the number of fish in that group which yielded such fillets; for the legal-size fish the figures in parentheses show total number of each length at which some individuals provided undersized fillets and the number which yielded those fillets.

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[3] The heaviest fillets did not necessarily come from the heaviest fish of a length group nor the lightest fillet from the lightest fish. In the field procedure the individual fillets were not identified with the individual fish.

Table 4.--Percentages of undersized yellow pikeperch providing legal-sized fillets and percentages of legal-sized fish producing undersized fillets, at various fillet weights, Saginaw Bay. Data are given for the individual collections and for all collections combined. The figures in parentheses indicate the number of fish handled in each group (at left) and those fish which provided either legal-sized or undersized fillets (at right).

Assumed fillet weight (ounces)	Item	Nov. 1942	May 1943	April 1944	April 1945	Combined collections	Weighted average [*]
9.0	Percentage of undersized fish producing legal-sized fillets	39.7 (58-23)	10.0 (70-7)	3.3 (30-1)	0.0 (16-0)	17.8 (174-31)	10.6
	Percentage of legal-sized fish producing undersized fillets	3.4 (88-3)	14.1 (71-10)	100.0 (1-1)	0.0 (27-0)	7.5 (187-14)	10.2
9.25	Percentage of undersized fish producing legal-sized fillets	22.4 (58-13)	7.1 (70-5)	3.3 (30-1)	0.0 (16-0)	10.9 (174-19)	7.1
	Percentage of legal-sized fish producing undersized fillets	5.7 (88-5)	16.9 (71-12)	100.0 (1-1)	7.4 (27-2)	10.7 (187-20)	14.1
9.4	Percentage of undersized fish producing legal-sized fillets	17.2 (58-10)	5.7 (70-4)	3.3 (30-1)	0.0 (16-0)	8.6 (174-15)	5.8
	Percentage of legal-sized fish producing undersized fillets	6.8 (88-6)	21.1 (71-15)	100.0 (1-1)	11.1 (27-3)	13.4 (187-25)	17.8
9.5	Percentage of undersized fish producing legal-sized fillets	17.2 (58-10)	4.3 (70-3)	3.3 (30-1)	0.0 (16-0)	8.0 (174-14)	5.0
	Percentage of legal-sized fish producing undersized fillets	6.8 (88-6)	23.9 (71-17)	100.0 (1-1)	11.1 (27-3)	14.4 (187-27)	19.6

[*] See text for method of weighting in determing these averages.

The data from the combined spring and fall collections would indicate that a fillet weight of 9.25 ounces would be suitable inasmuch as it would allow the filleting of approximately 11 percent of the undersized fish whereas the same percentage of legal-sized fish would yield undersized fillets. However, data from preceding years gathered by the U. S. Fish and Wildlife Service showed that the yellow pikeperch taken during the springs of 1943-1945 were somewhat heavier than were fish of similar lengths taken from Saginaw Bay in the spring of either 1929 or 1930; and presumably these latter fish would yield lighter fillets. Thus a lesser fillet weight than 9.25 ounces would seem more suitable. Furthermore, the weighted averages of the numbers of undersized fish providing legal-sized fillets and legal-sized fish yielding undersized fillets, obtained by considering the spring-run fish as 85.3 per cent of the total annual production and the fish caught in the fall as 10.9 per cent of that figure, suggest that a weight of 9.0 ounces is a more suitable fillet weight than that of 9.25 ounces. When all pertinent information is considered the samples employed in this investigation indicate that a fillet weight of 9.0 ounces is reasonable.

A minimum fillet weight of 9.0 ounces would be more practical than one involving a fraction of an ounce. A further argument for the 9-ounce as against a higher weight limit for yellow pikeperch fillets lies in the fact that processors may find it necessary to provide a margin to cover possible loss of weight of fillets after dressing, particularly for those processed for freezing and storage. Inasmuch as the weight limit, to be effective, has to be specified as applicable to fillets at the time of any inspection regardless of their previous history, some leeway must be given to cover these losses of weight after filleting. The 9-ounce limit should provide a fully adequate allowance for these losses.

Loss of Weight Due to Filleting

The percentage loss of weight of yellow pikeperch from Saginaw Bay at filleting did not vary widely either with season or size of fish (Table 5). Such variations as did occur were consistent in that the percentage loss in weight was higher for undersized than for legal-sized fish in all collections where adequate samples were taken and was greater in spring-caught fish (April, May) than in fish taken during the fall (November). Furthermore, fish caught in April suffer a greater loss at filleting than those taken in May. From the data given in Table 5 it may be stated that in filleting yellow pikeperch from Saginaw Bay there is a 50-55 per cent loss in weight at filleting.

No records are available of other experimental studies on the filleting of yellow pikeperch. Statements, not accompanied by data, in the typewritten report of the Red Lakes Fisheries Association (Minnesota) for 1938 and in the Great Lakes Fishermen for April 1937 gave the loss of weight of yellow pikeperch due to filleting as 58 and 60 per cent respectively (the latter figure referred to spring-run fish from Saginaw Bay). Both of these percentages are above those determined in the present study.

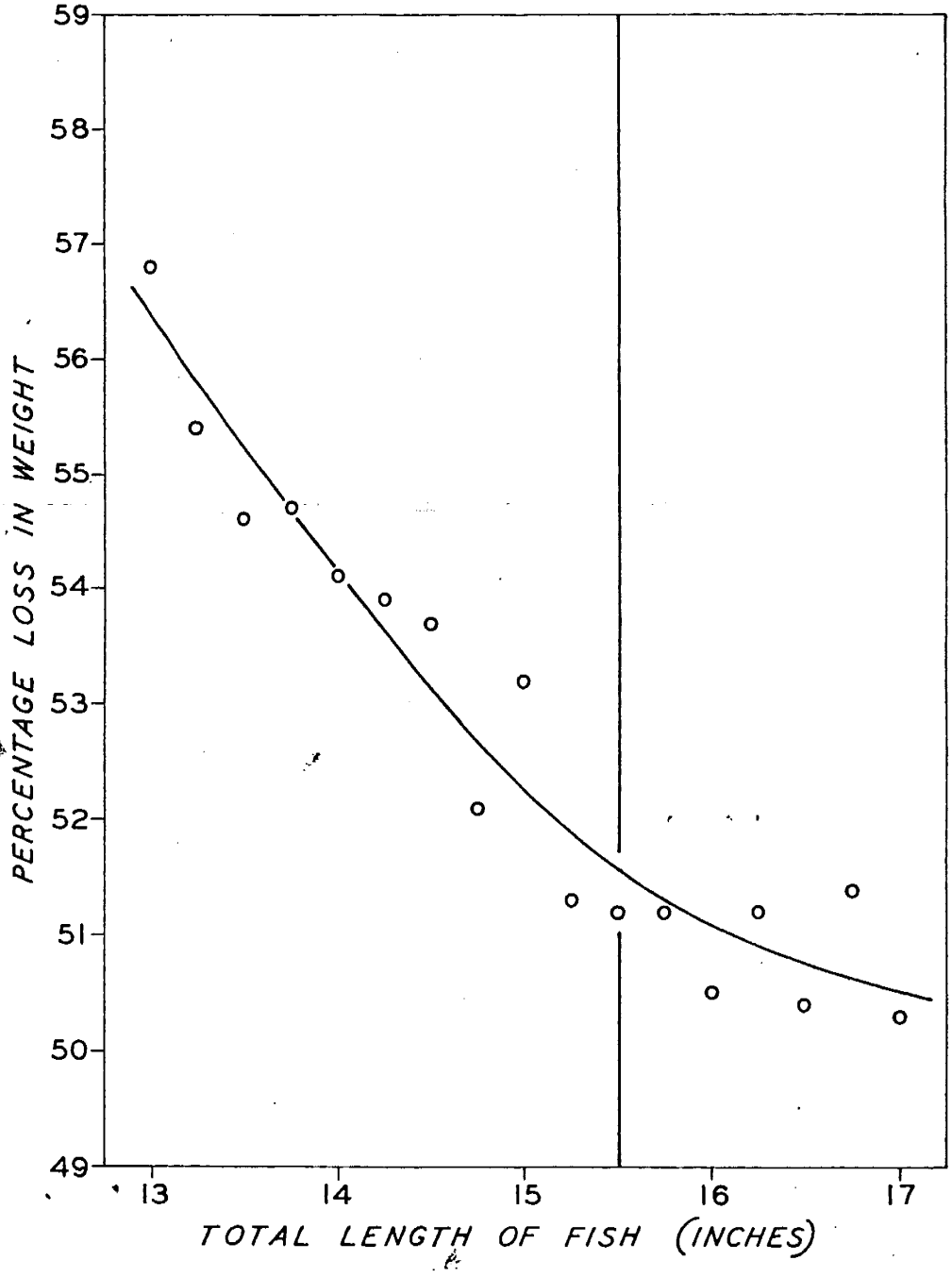
Commercial fishermen interviewed at Bay Port during this investigation believe that yellow pikeperch from Saginaw Bay lose approximately 50 per cent of the round weight in filleting in the fall and 60 per cent in the spring. The former estimate agrees closely with the findings in this study, but the latter estimate is higher. The greatest loss on filleting may be expected among ripe females, and yellow pikeperch of that sex are seldom mature at lengths (17 inches or less) employed in this study.

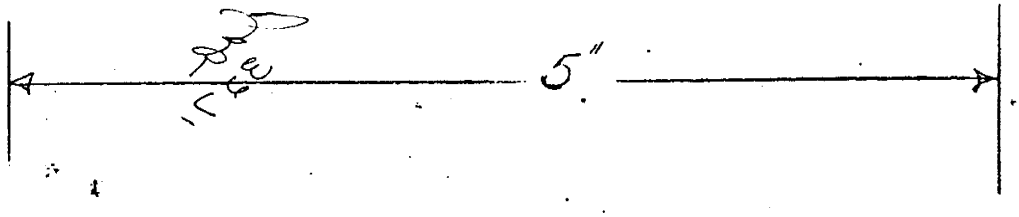
Table 5.--Percentage loss in weight on filleting yellow pikeperch according to length for each of four collections and weighted averages for the combined collections and for all illegal- and legal-sized fish, Saginaw Bay, November 1942, May 1943, April 1944, and April 1945. The horizontal ruling in the body of the table separates the legal- and illegal-sized fish.

Total length (inches)	Nov. 12-16, 1942	May 3-4, 1943	April 13, 1944	April 16, 24, 1945	Weighted average
13	52.5	52.5	59.1	57.3	56.8
	(2)	(2)	(1)	(30)	(35)
13 1/4	47.5	51.7	56.6	57.1	55.4
	(5)	(4)	(3)	(30)	(42)
13 1/2	51.1	49.6	56.2	55.7	54.6
	(6)	(8)	(19)	(30)	(63)
13 3/4	48.2	51.4	55.2	57.3	54.7
	(7)	(12)	(21)	(30)	(70)
14	47.8	50.4	55.3	56.3	53.9
	(11)	(16)	(36)	(30)	(93)
14 1/4	50.7	50.3	55.2	55.8	53.7
	(17)	(18)	(32)	(30)	(97)
14 1/2	49.7	52.2	55.2	55.7	53.5
	(22)	(26)	(38)	(24)	(110)
14 3/4	49.1	50.9	55.6	56.3	52.1
	(21)	(24)	(14)	(10)	(69)
15	51.1	52.6	55.9	56.3	53.2
	(19)	(27)	(13)	(6)	(65)
15 1/4	50.5	51.4	55.3	...	51.3
	(19)	(19)	(3)	...	(41)
15 1/2	49.3	51.8	55.8	56.5	51.2
	(16)	(18)	(1)	(3)	(38)
15 3/4	50.2	51.0	...	55.0	51.2
	(20)	(10)	...	(6)	(36)
16	48.9	50.0	...	56.0	50.5
	(17)	(13)	...	(6)	(36)
16 1/4	50.4	50.0	...	56.2	51.2
	(17)	(15)	...	(6)	(38)
16 1/2	48.8	50.2	...	55.9	50.4
	(18)	(15)	...	(6)	(39)
16 3/4	49.4	51.4	...	55.5	51.4
	(11)	(15)	...	(5)	(31)
17	50.2	49.6	...	53.8	50.3
	(11)	(15)	...	(3)	(29)
Illegal Average	49.8	51.4	55.5	56.5	53.8
	(129)	(156)	(180)	(220)	(685)
Legal	49.6	50.6	55.8	55.6	50.9
	(110)	(101)	(1)	(35)	(247)

Figure 2. Percentage loss in weight due to filleting of Saginaw Bay yellow pikeperch over the length range 13-17 inches. The curve was fitted by inspection to the averages (shown by the circles) for each quarter-inch length group. The vertical ruling at 15 1/2 inches separates the undersized and legal-sized fish.

Figure 2





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As a result of this investigation the commercial fishing law of 1929 (P. A. 84, 1929) was amended in 1945 to prohibit the possession or marketing of yellow pikeperch fillets of a less weight than 9 ounces.

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