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CALCULATED GROWTH OF WHITE PERCH, *ROCCUS AMERICANUS* (GMELIN) IN THE BAY OF QUINTE, LAKE ONTARIO.

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A study of 868 scales collected from Bay of Quinte included 16 year classes from 1950 to 1965. Each age group of a year class conformed to the growth rate that was typical for the year class to which it belonged. The growth rates of the year classes have decreased from 1950 to 1965 and this change is well exhibited by the first year growth.

INTRODUCTION

A series of papers have been published on the age and growth of white perch in the Bay of Quinte (Sheri and Power, 1968, 1969a, 1969b, 1969c, 1969d, 1972a, 1972b,). It has been established that during colonization of this area from 1957 to 1966, the white perch has tremendously multiplied in its present environment. As the density has increased, the rate of growth has gradually decreased. No relationship could be established between air temperature and rate of growth. Observed length and weight of each age group have decreased with increase in the density of white perch. This paper deals with the effect of density on the calculated growth histories of white perch.

MATERIALS AND METHODS

Details of the collection of the materials and other methods involved in the study have already been published (Sheri and Power 1969b, 1972a,). Scales of only 868 fish from a collection of 4162 were undertaken. The scales were measured at a magnification of 78.5 on a projector designed by Van Oosten (1923) and produced by the Eberback Company, Michigan. Measurements were made along the central axis from the focus to each annulus and to the anterior scale margin.

RESULTS AND DISCUSSION

Calculated Growth Histories of the year Classes.

The 868 white perch scales measured for the calculation of growth

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histories from 1957 to 1966 included 15 year classes from 1951 to 1965 in males, 16 year classes, 1950 to 1965 for females, and also 16 for the sexes combined. The calculated lengths in millimeters at the end of each year of life of males, females and sexes combined of white perch of the Bay of Quinte are given in Tables 1 to 3.

The discrepancies observed among the calculated lengths of different age groups of the same year class can be attributed for the most part to the small number of specimens in the individual age groups. On the whole, it was seen that the difference in the calculated lengths of two fish of the same age group and the same year class was less than the calculated lengths of two fish of same age group but different year classes. The comparison of the growth of various year classes is best shown in this way as within a year class there is a strong tendency for each age group to conform to the growth rate that is typical for the year class to which it belongs. If age group I is comparatively smaller or bigger in any year class, then the other age groups in that year class will show exactly the same growth rate in relation to other year classes.

The great extent to which the growth histories of year classes have changed from 1950 to 1965 is brought out by the data in Table 1 to 3 and Figs. 1 to 3. In this comparison of growth rate of year classes much importance is attached to the first year growth for the following reasons. First, first year growth is rapid and shows maximum increment and any change in growth rate is most marked in the first year growth. Second, growth incurred in other years does not affect the growth of the first year. For males, (Table 1) the calculated length of age group I in year class 1951 was 101.4 mm while in 1965, the last year class in the study period, it was only 72.7 mm. During the 15 year classes of males the growth rate of age group I has steadily changed. In the females, Table 2, from 1950 to 1965 year classes the calculated length of age group I has changed from 88.9 to 72.7 mm. When the sexes were combined, Table 3, the same result was observed, the calculated length changed from 88.9 to 71.7 mm. This gradual decrease is evident in age groups I to IV but after that the pattern in Figs. 1 to 3 is rather variable because the number of fish in the sample gets smaller and smaller.

Tables 4 to 6 give the annual growth increments in mm at the end of each year of life for each year class. The increments in the age groups of various year classes are high for age groups I to III, beyond third year the differences decrease continuously both for males and females and sexes combined. The vertical columns under each age are the mean increments for that age from year to year. An examination of these data in each vertical column indicates whether a particular growth increment is greater or less than the corresponding growth increment for the preceding year class. These increments demonstrate that the amount of growth in a particular year of collection was subject to wide variation from year to year. For example, the increment between first and second year of life for males varied from 51.8 mm in 1952 to 24.8 mm in 1963, for females it ranged from 79.2 mm in 1951 to 27.4 mm in 1964. Similar fluctuations occurred in the growth increments of both sexes in later years of life.

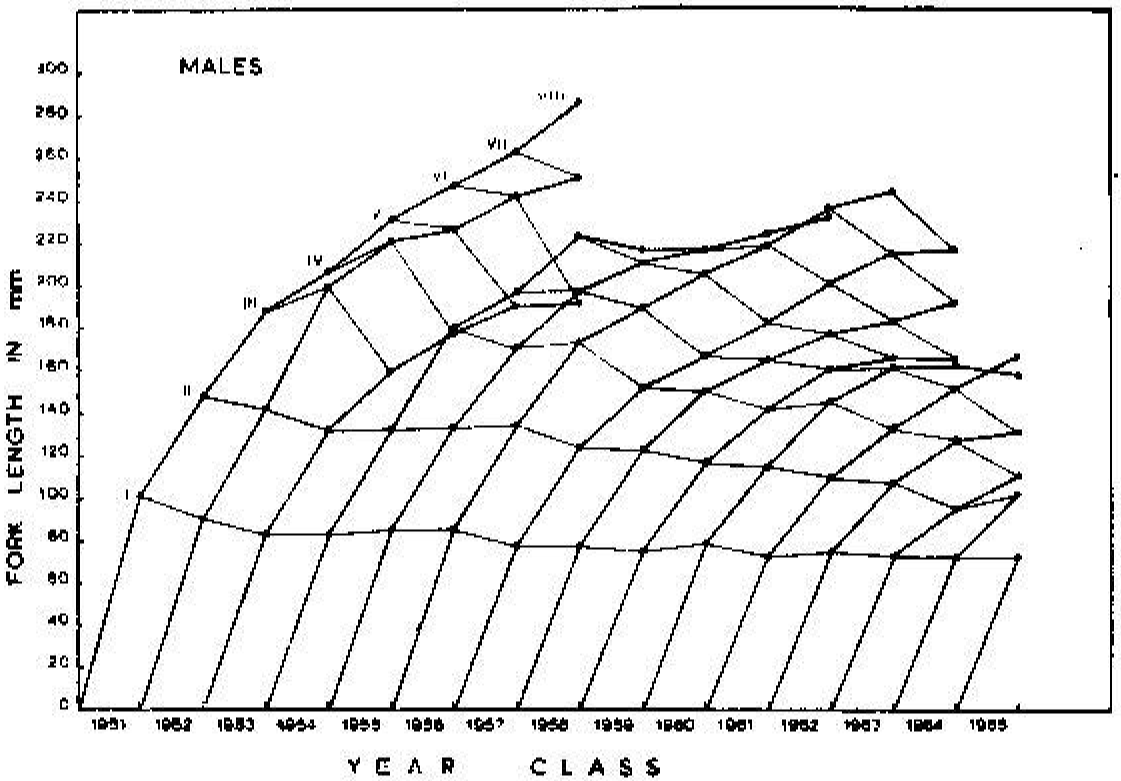

Fig. I Calculated growth histories of year classes of male white perch, *Roccus americanus*, from the Bay of Quinte, Lake Ontario. The calculated lengths of corresponding years of life in different calendar years have been connected with horizontal lines.

The thinner lines in Figs. 1 to 3 connect the calculated lengths for corresponding ages of different year classes. These lines show that when white perch are smaller in age group I in any year class, all the age groups of that year class will be smaller than the preceding and subsequent year

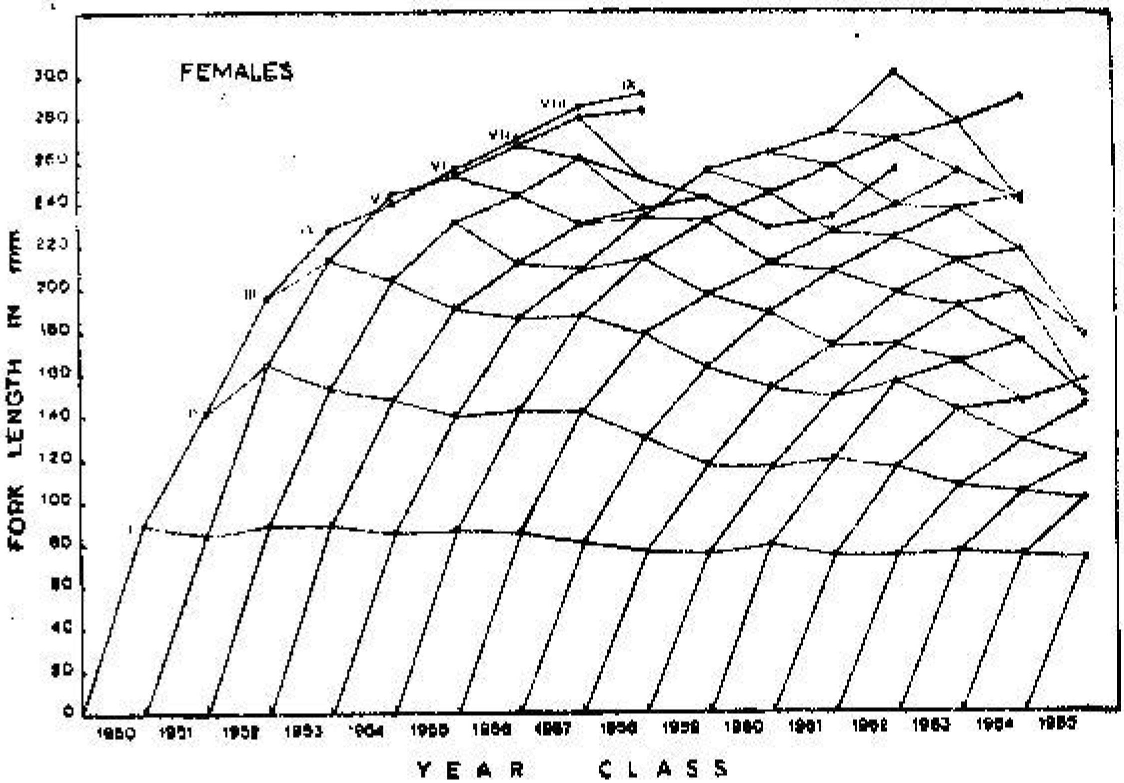

Fig. 2. Calculated growth histories of year classes of female white perch *Roccus americanus*, from the Bay of Quinte, Lake Ontario. The calculated lengths of corresponding years of life in different calendar years have been connected with horizontal lines.

classes. For example, male white perch of 1953 class were smaller at most ages and in year class 1951 males were much larger than the preceding and subsequent year classes.

The regularity with which the calculated lengths of the white perch tend to become smaller for 1950 to 1965 year classes proves without doubt that the changes in the calculated lengths of various year classes are real. These changes cannot be attributed to any other factor, for example, wrong age determination. They are caused by a progressive gradual reduction in the growth rate of white perch in the Bay of Quinte during the period 1950—1965.

Growth in Calculated Length

The calculated lengths of all collections from 1957 to 1966 were combined to determine growth curves in calculated length for white perch in the Bay of Quinte. The growth curves are based on the mean calculated length at the end of each year of life. The use of such data yielded smoother curves, for both sexes, which were representative of the actual data on growth in different years of life. The change in growth rate does raise a question as to the value and significance of such a general growth curve in this population. The presentation of such a curve was based on the assumption that this curve can be taken to represent the course of growth of an individual that was typical of the population as a whole. This curve was derived from the combination of several age groups collected from 1957 to 1966 and their

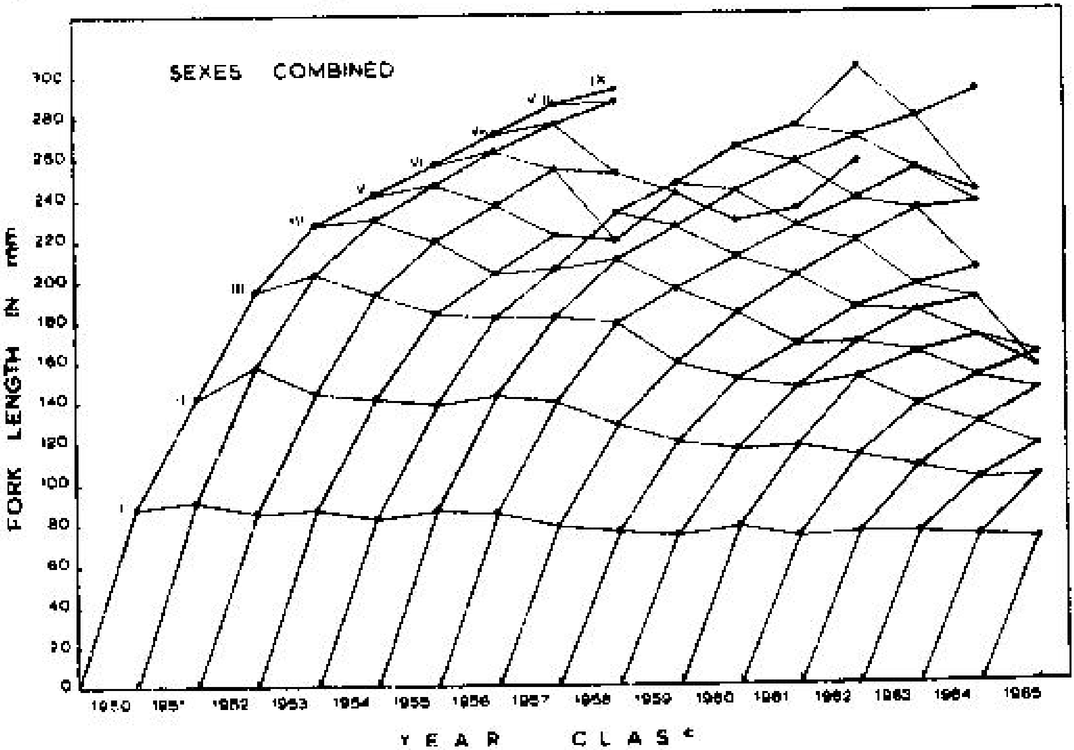

Figure 3. Calculated growth histories of year classes of white perch, *Roccus americanus*, from the Bay of Quinte, Lake Ontario. The calculated lengths of corresponding years of life in different calendar years have been connected with horizontal lines.

TABLE 1 Length at the end of each year of life for male white perch, *Roccus americanus*, by year class in the Bay of Quinte, Lake Ontario (number of fish in parenthesis)

Year	Mean fork length at the end of each year of life (mm)									
	1	2	3	4	5	6	7	8	9	10
1951	101.4 (2)	148.0 (2)	188.6 (2)	207.9 (2)	231.8 (2)	248.5 (2)	264.2 (2)	287.8 (1)		
1952	90.2 (1)	142.0 (1)	200.5 (1)	221.7 (1)	227.7 (1)	242.1 (1)	251.5 (1)			
1953	83.4 (5)	132.0 (5)	160.0 (5)	179.1 (5)	190.8 (5)	192.3 (4)				
1954	83.4 (5)	133.7 (5)	180.9 (5)	197.1 (5)	224.4 (3)	217.3 (2)				
1955	85.5 (21)	134.0 (21)	171.6 (21)	198.3 (17)	211.8 (10)	217.4 (3)	225.1 (2)	234.3 (1)		
1956	85.5 (25)	134.9 (26)	174.8 (23)	190.7 (18)	206.4 (10)	220.8 (7)	237.5 (5)	245.9 (3)		
1957	77.2 (33)	124.1 (36)	152.3 (27)	167.1 (20)	183.4 (13)	202.3 (10)	216.8 (5)	217.1 (2)		
1958	78.2 (38)	123.1 (33)	151.7 (30)	165.3 (23)	178.1 (17)	184.2 (9)	192.7 (6)			
1959	75.3 (36)	117.7 (32)	142.7 (24)	161.3 (16)	166.7 (10)	165.3 (5)				
1960	79.1 (29)	115.2 (22)	144.0 (19)	162.7 (14)	165.6 (9)	159.2 (2)				
1961	73.1 (21)	110.7 (19)	134.1 (14)	153.0 (10)	166.8 (2)					
1962	75.9 (23)	109.6 (18)	128.0 (11)	131.7 (3)						
1963	73.2 (16)	95.3 (12)	110.1 (7)							
1964	72.1 (4)	102.1 (3)								
1965	72.7 (6)									
Grand mean length	78.3	121.0	152.3	173.5	187.8	199.3	221.8	242.0		
Mean increment	78.3	42.7	31.3	21.2	14.4	11.4	22.5	20.2		
Total no. of fish	271	235	189	134	82	45	21	7		

TABLE 2. Length at the end of each year of life for female white perch, *Roccus americanus*, by year class in the Bay of Quinte, Lake Ontario (number of fish in parenthesis)

	Mean fork length at the end of each year of life (mm)									
Year	1	2	3	4	5	6	7	8	9	10
1950	88.9 (2)	141.4 (2)	195.0 (2)	227.4 (2)	241.3 (2)	255.0 (2)	270.8 (2)	285.9 (2)	292.4 (1)	
1951	84.9 (3)	164.1 (3)	213.7 (3)	243.5 (3)	255.7 (3)	271.9 (3)	282.2 (3)	284.9 (1)		
1952	89.1 (7)	153.0 (7)	204.0 (7)	231.8 (7)	244.6 (7)	261.3 (7)	251.5 (3)			
1953	89 0 (18)	148.3 (18)	190.9 (18)	212.7 (18)	230.4 (18)	237.5 (6)	243.1 (2)	228.1 (1)	233 6 (1)	256.6 (1)
1954	85.9 (32)	140.2 (32)	186.8 (32)	209.9 (32)	234.2 (23)	255.4 (6)	264.5 (2)	274.3 (2)	302.7 (1)	
1955	86.9 (50)	143.6 (50)	187.6 (50)	214.0 (42)	231.0 (34)	245.7 (26)	258.9 (22)	270.4 (14)	278.8 (3)	290.5 (1)
1956	85.8 (65)	142.5 (65)	179.7 (60)	197.9 (46)	211.7 (40)	226.6 (29)	239.2 (17)	255.4 (9)	241.8 (1)	
1957	80 6 (65)	130.7 (61)	163.6 (52)	189.2 (42)	208.4 (34)	224.8 (24)	237.9 (18)	243 2 (6)		
1958	76.3 (48)	117.4 (43)	153.2 (32)	173.0 (26)	197.5 (20)	212.6 (15)	217.1 (6)			
1959	75.6 (49)	116.9 (41)	149.4 (34)	174.1 (29)	191.6 (23)	198.8 (13)	178.8 (3)			
1960	79.2 (39)	120.0 (33)	156.5 (23)	165.1 (15)	175.8 (8)	149.4 (1)				
1961	74.0 (28)	116.5 (23)	143.4 (14)	147.6 (9)	157.7 (3)					
1962	74.8 (29)	106.8 (27)	128.2 (21)	147.3 (11)						
1963	76.8 (23)	104.3 (14)	120.8 (9)							
1964	74.4 (13)	101.7 (10)								
1965	72.7 (4)									
Grand mean length	80.6	128.8	167.7	196.6	214.4	230.2	244.2	262.6	273.5	273.5
Mean increment	80.6	48.2	38.9	24.9	21.9	15.7	14.1	18 3	10.9	0.0
Total no. of fish	475	430	358	283	216	133	79	36	8	2

TABLE 3 Length at the end of each year of life for white perch, *Roccus americanus*, by year class in the Bay of Quinte, Lake Ontario (number of fish in parenthesis)

Year	Mean fork length at the end of each year of life (mm)									
	1	2	3	4	5	6	7	8	9	10
1950	88.9 (2)	141.4 (2)	195.0 (2)	227.4 (2)	241.3 (2)	255.0 (2)	270.8 (2)	285.9 (2)	292.4 (1)	
1951	91.5 (5)	157.7 (5)	203.7 (5)	229.3 (5)	245.1 (5)	262.5 (5)	275.0 (5)	286.4 (2)		
1952	86.0 (11)	144.6 (11)	193.5 (11)	219.9 (11)	235.9 (11)	253.9 (10)	251.5 (4)			
1953	87.3 (36)	141.7 (36)	183.1 (36)	203.0 (36)	221.8 (23)	219.4 (10)	243.1 (2)	228.1 (1)	233.6 (1)	256.6 (1)
1954	83.4 (58)	138.5 (58)	181.9 (58)	205.3 (43)	232.5 (27)	245.9 (8)	264.5 (2)	274.3 (2)	302.7 (1)	
1955	87.6 (91)	142.2 (91)	181.8 (76)	209.5 (59)	226.6 (44)	242.8 (29)	256.1 (24)	268.0 (15)	278.8 (3)	290.5 (1)
1956	85.1 (99)	139.1 (98)	178.3 (83)	195.9 (64)	210.6 (59)	225.5 (36)	238.8 (22)	253.0 (12)	241.8 (1)	
1957	79.2 (113)	128.3 (97)	159.8 (79)	182.1 (62)	201.5 (47)	218.2 (34)	233.3 (23)	236.7 (8)		
1958	76.9 (95)	119.0 (80)	150.9 (66)	167.6 (52)	185.7 (40)	196.7 (27)	204.9 (12)			
1959	74.9 (89)	116.9 (74)	146.1 (59)	168.6 (46)	183.1 (34)	189.5 (18)	178.8 (3)			
1960	78.6 (72)	117.5 (57)	150.3 (44)	163.1 (31)	170.2 (18)	155.9 (3)				
1961	73.4 (61)	112.2 (48)	137.7 (33)	150.4 (19)	161.3 (5)					
1962	75.0 (62)	107.4 (50)	128.1 (33)	144.0 (14)						
1963	75.1 (40)	100.1 (26)	116.1 (16)							
1964	73.0 (19)	10.41 (14)								
1965	71.7 (15)									
Grand mean length	79.6	126.4	162.6	186.2	206.4	221.4	239.5	259.2	273.5	273.5
Mean increment	79.6	46.8	36.1	23.7	20·2	15.0	18.1	19.7	14.2	0.0
Total no. of fish	868	748	602	445	307	183	100	43	8	2

TABLE 4. Mean annual growth increments in millimeters at the end of each year of life for male white perch, *Roccus americanus*, by year class in the Bay of Quinte, Lake Ontario (number of fish in parenthesis)

Year	Annual increments for each year of life: 1	2	3	4	5	6	7	8	9	10
1951	101.4 (2)	46.6 (2)	40.6 (2)	19.2 (2)	23.9 (2)	16.7 (2)	15.7 (2)	11.9 (1)		
1952	90.2 (1)	51.8 (1)	58.6 (1)	21.2 (1)	5.9 (1)	14.4 (1)	9.3 (1)			
1953	83.4 (5)	48.6 (5)	28.0 (5)	19.1 (5)	11.7 (5)	16.2 (4)				
1954	83.4 (5)	50.3 (5)	47.2 (5)	16.2 (5)	17.9 (3)	6.7 (2)				
1955	85.5 (21)	48.5 (21)	37.6 (21)	24.7 (17)	15.4 (10)	5.5 (3)	5.1 (2)	11.4 (1)		
1956	85.5 (26)	49.4 (26)	40.4 (23)	14.9 (18)	12.9 (10)	9.9 (7)	13.1 (5)	11.2 (3)		
1957	77.2 (38)	47.0 (36)	28.5 (27)	16.0 (20)	16.0 (13)	10.9 (10)	11.5 (5)	12.0 (2)		
1958	78.2 (38)	44.4 (33)	27.6 (30)	12.6 (23)	14.1 (17)	8.4 (9)	7.1 (6)			
1959	75.3 (36)	41.7 (32)	22.1 (24)	15.3 (16)	11.2 (10)	8.3 (5)				
1960	79.1 (29)	36.6 (22)	27.9 (19)	16.3 (14)	11.8 (9)	8.9 (2)				
1961	73.1 (21)	37.1 (19)	23.3 (14)	15.7 (10)	13.4 (2)					
1962	75.9 (23)	32.5 (18)	27.4 (11)	19.6 (3)						
1963	73.2 (16)	24.8 (12)	22.1 (7)							
1964	72.1 (4)	29.8 (3)								
1965	72.7 (6)									

TABLE 5. Mean annual growth increments in millimeters at the end of each year of life for female white perch, *Roccus americanus*, by year class in the Bay of Quinte, Lake Ontario (number of fish in parenthesis)

Year	Annual increments for each year of life									
	1	2	3	4	5	6	7	8	9	10
1950	89.9 (2)	52.5 (2)	53.6 (2)	32.5 (2)	13.9 (2)	13.7 (2)	15.8 (2)	15.1 (2)	9.5 (1)	
1951	84.1 (3)	79.2 (3)	49.6 (3)	29.8 (3)	12.1 (3)	16.2 (3)	10.3 (3)	10.6 (1)		
1952	89.1 (7)	63.9 (7)	51.1 (7)	27.8 (7)	12.8 (7)	16.7 (7)	12.5 (3)			
1953	89.0 (18)	59.3 (18)	42.6 (18)	21.9 (18)	17.7 (18)	16.1 (6)	12.0 (2)	5.5 (1)	5.5 (1)	22.9 (1)
1954	85.9 (32)	54.3 (32)	46.6 (32)	23.1 (32)	21.1 (23)	14.9 (6)	8.9 (2)	9.8 (2)	12.0 (1)	
1955	86.9 (50)	56.7 (50)	44.0 (50)	25.8 (42)	16.5 (34)	12.6 (26)	12.3 (22)	13.1 (14)	11.2 (3)	11.4 (1)
1956	85.8 (65)	56.7 (65)	37.1 (60)	20.0 (46)	14.4 (40)	13.0 (29)	13.0 (17)	13.4 (9)	6.4 (1)	
1957	80.6 (65)	50.3 (61)	33.3 (52)	22.1 (42)	17.4 (34)	15.2 (24)	11.7 (18)	12.8 (6)		
1958	76.3 (48)	41.3 (43)	34.5 (32)	18.0 (26)	21.3 (20)	19.5 (15)	11.0 (6)			
1959	75.6 (49)	41.9 (41)	31.2 (34)	23.9 (29)	18.4 (23)	11.5 (13)	5.4 (3)			
1960	79.2 (39)	39.8 (33)	34.5 (23)	13.4 (15)	22.1 (8)	12.2 (1)				
1961	74.2 (28)	42.9 (23)	28.2 (14)	14.5 (9)	9.4 (3)					
1962	74.8 (29)	32.2 (27)	23.7 (21)	17.8 (11)						
1963	76.8 (23)	29.6 (14)	22.1 (9)							
1964	74.4 (13)	27.4 (10)								
1965	72.7 (4)									

TABLE 6. Mean annual growth increments in millimeters at the end of each year of life for white perch, *Roccus americanus*, by year class in the Bay Quinte, Lake Ontario (number of fish in parenthesis)

Year	Annual increments for each year of life: 1	2	3	4	5	6	7	8	9	10
1950	89.9 (2)	52.5 (2)	53 6 (2)	32.5 (2)	13.9 (2)	13.7 (2)	15.8 (2)	15.1 (2)	9.5 (1)	
1951	91.5 (5)	66.1 (5)	46.0 (5)	25.6 (5)	16.8 (5)	16.4 (5)	12.5 (5)	11.3 (2)		
1952	86.0 (11)	58.7 (11)	48.8 (11)	26.4 (11)	16.1 (11)	14.4 (10)	11.7 (4)			
1953	87.3 (36)	54.5 (36)	41.4 (36)	19.9 (36)	16.4 (23)	16.1 (10)	12.0 (2)	5.5 (1)	5.5 (1)	22.9 (1)
1954	83.4 (58)	55.1 (58)	43.4 (58)	21.5 (43)	20.6 (27)	12.8 (8)	8.9 (2)	9.8 (2)	12.0 (1)	
1955	87 6 (91)	54.6 (91)	42.0 (76)	25.5 (59)	16.3 (44)	11.8 (29)	11.7 (24)	13.0 (15)	11.2 (3)	11.4 (1)
1956	85.1 (99)	54.0 (98)	38.1 (83)	18 5 (64)	14.1 (50)	12.4 (36)	13.0 (22)	12.8 (12)	6.4 (1)	
1957	79.2 (113)	49.1 (97)	31.7 (79)	20.1 (62)	17.0 (47)	13.9 (34)	11.7 (23)	12.6 (8)		
1958	76.9 (95)	41.8 (80)	30.8 (66)	15.2 (52)	17.6 (40)	14.0 (27)	9.0 (12)			
1959	74.9 (89)	41.6 (74)	27.3 (59)	20.7 (46)	16.5 (34)	10.6 (18)	5.4 (3)			
1960	78.6 (72)	38.4 (57)	31.7 (44)	14.7 (31)	16.7 (18)	10.0 (3)				
1961	73.4 (61)	39.0 (48)	25.8 (33)	15.1 (19)	11.0 (5)					
1962	75.0 (62)	32.2 (50)	25.0 (33)	18.2 (14)						
1963	75.1 (40)	27.4 (26)	22.1 (16)							
1964	73.0 (19)	28.2 (14)								
1965	71.7 (15)									

growth curve was the result of lumping of fast and slow growing fish. The typical individual that this general growth curve is supposed to represent is probably non-existent.

Table 7 and Figs. 4 and 5 have been derived from a combination of subsamples for different years. Information presented on decrease of growth rate in 1950 to 1965 year classes and the data on the percentage deviation in the annual growth and the decrease in mean length and weight are enough to prove that white perch taken in different years from 1957 to 1966 will have different growth curves based on the calculated lengths. The present growth curves based on combined data are indicative of a general growth curve in the Bay during 10 years of study.

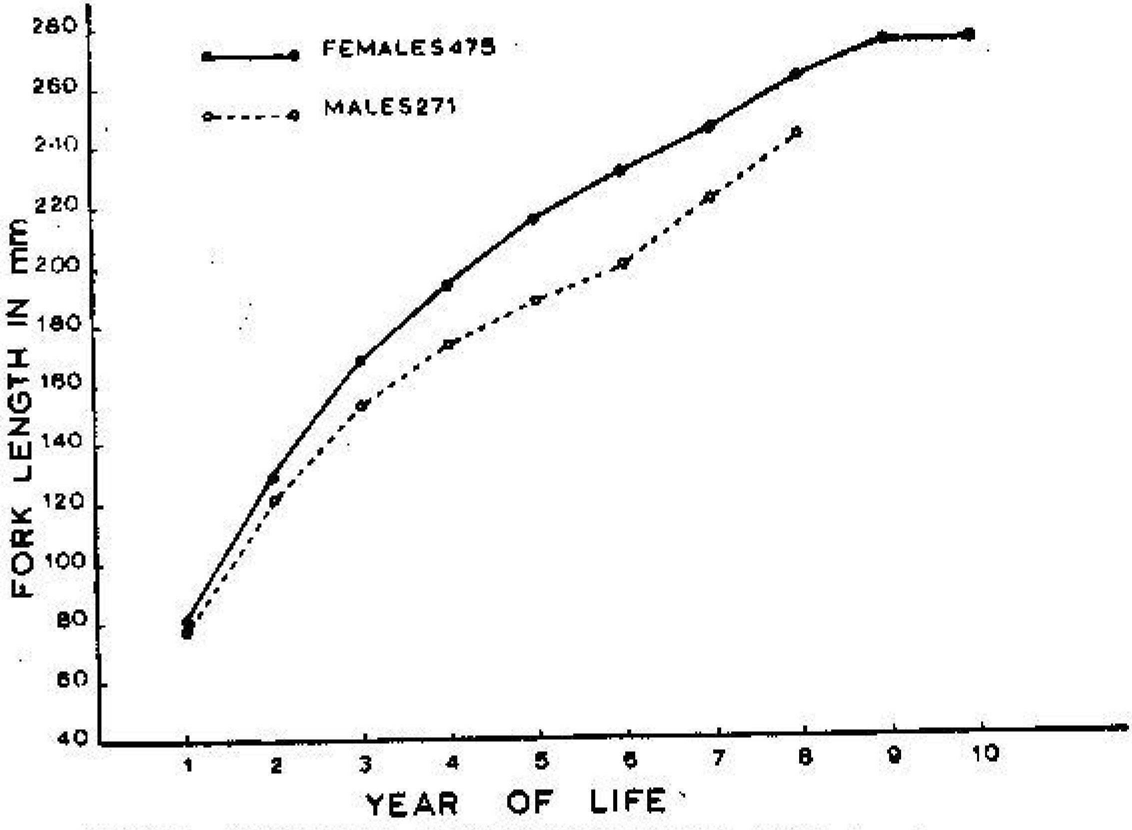

Figure 4. Grand average calculated length of white perch, *Roccus americanus*, at the end of each year of life from the Bay of Quinte Lake Ontario.

Figure 4 shows that the growth curves for both sexes have the same general form. The females, however, grow at a distinctly higher rate. The divergence is clear from the first and second years of life but in the third year it is more pronounced. Comparing the lengths of males and females at the end of different years of life, the faster growth of the females becomes more apparent. For example, females at the end of four years of life were 4.7 mm larger than the males at the end of the fifth year. At the end of seven years of life the length of females was 2.2 mm above the length of eight year old males. In fact, at all ages beyond fourth year females were consistently larger than males that were one year older.

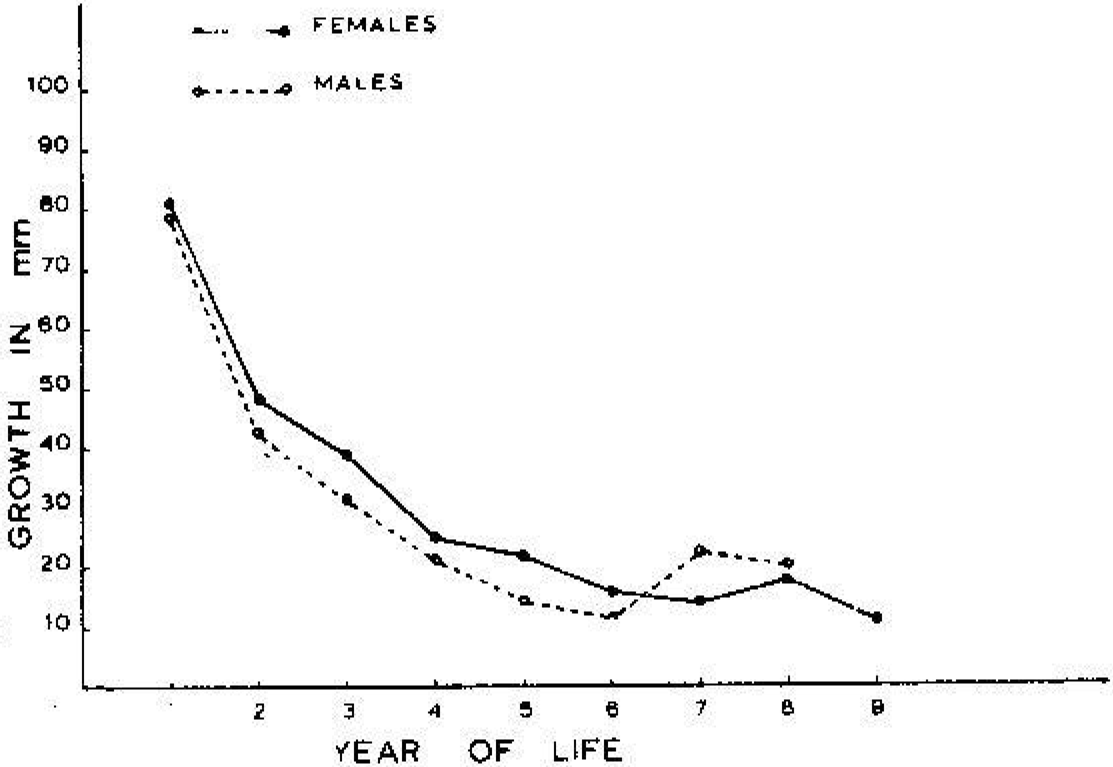

Figure 5. Calculated increments of the growth in length of the white perch, *Roccus americanus,* in each year of life, from the Bay of Quinte, Lake Ontario.

In Table 7 the ratios of the increments of sexes and the differences between the increments show the relative and actual advantages of the growth of females over males in the different years of life except at seven and eight years, where males show better increments. The greatest, actual and relative advantages in the difference between increments occurred for males in the seventh year which was 8.4 mm (Fig. 5). The greatest relative and actual advantages in the growth of the females were in the fifth year of life when the length increment of the females was 1.52 times that of the males and the difference between increments was 7.5 times.

In both males and females the growth in the first year was greater than in any other year of life- The length increment in males decreased from the first to the sixth year of life while in females the growth increment decreased from the first to the seventh year of life. In males there was a sharp increase in the length increment in the seventh year of life while such an increase was observed in the eighth year of life in the females. Males after seven years and females after eight years of life showed an improvement in growth. In females there wss no length increment between the ninth and tenth years (only two specimens) and only females were represented beyond the eighth year.

The rate of growth as expressed by the annual percentage $\left(\frac{100 \triangle L}{L}\right)$ increase (Table 7) declined continuously from the second to the sixth year of life in males after which it increased. In females it decreased continuously from the second to the seventh year, showed an increase in the eighth year and again decreased in the ninth year of life. This decrease was rapid in the earlier years of life.

Percentage Deviation from the Mean Annual Growth Increment.

The description of the calculated growth histories of the year classes did show that a change in growth rate had occurred but it did not give any account of the rate of annual fluctuation in the growth of white perch in the Bay of Quinte. Hile (1941) reported a method to study these year to year fluctuations. Chadwick (1966) wrote an age and growth programme, Univac 1107, Fortran IV, for this method. This programme was modified to run on IBM 360/75. This programme made it possible to perform detailed study of the growth data and to work out percentage deviations in the growth rate from year to year. Details of this method are given by Hile (1941) so it will not be discussed here. This procedure consisted of the determination of the percentage change in the growth in each year in comparison with the growth of fish in corresponding years of life in the preceding year. The percentage deviations in the growth rate of males, females, and sexes combined of white perch from 1957 to 1965 show the same trend. These trends correspond closely in spite of the fact that these percentages were derived from males and females with different growth rates. These means of the percentage deviations in Table 8 have been used to describe the annual fluctuations in the growth of white perch. The growth of the male white perch in 1957 was 10.7% more than the average, it increased to 12.0 in 1958 but in later years until 1965, it continuously decreased, except that it was below average in 1961, but in

1962 it was slightly more than the average. In 1965, the growth of male white perch was 10.2% below average which is a very significant decrease. The growth of female white perch also recorded a very drastic decrease. In 1957, the growth stood at 16.3% above average, while in 1965 it decreased to 23.7% below average. In between these years the percentage of growth decreased irregularly in a pattern similar to that described for the males. The data based on sexes combined shows exactly the same pattern (Fig. 6). The growth of the white perch was 15 7% above the average in 1957, while in 1965 it was 19 9 percent below the average. The fish in which sex was not determined were very few so the same pattern of growth was not observed.

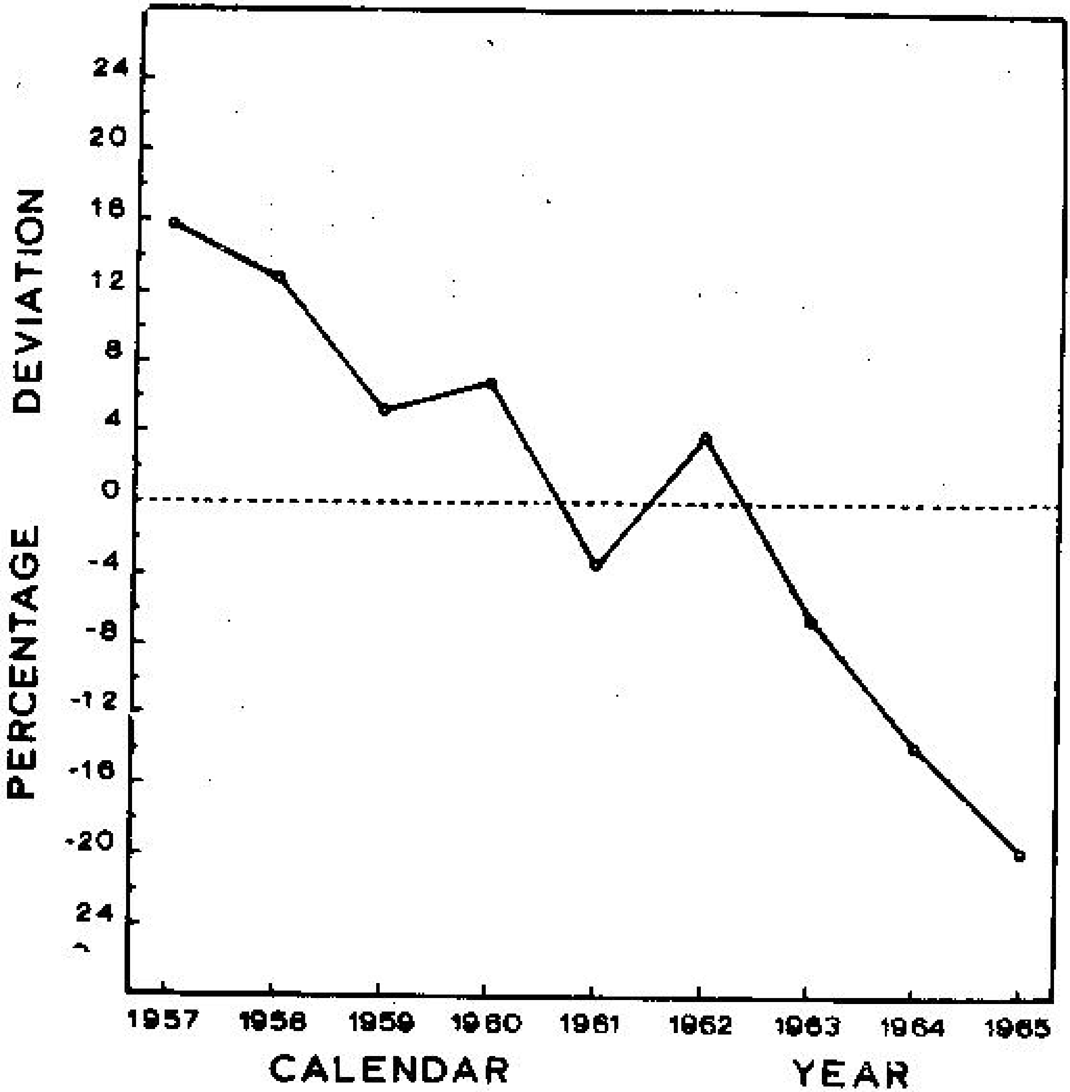

Figure 6. Annual percentage deviation of the growth of white perch, *Roccus americanus*, from the average for the period 1957-1965 from the Bay of Quinte, Lake Ontario.

TABLE 7. Average calculated length at end of each year of life, annual increment of growth in length, and annual percentage increase in length of white perch *Roccus americanus*, in the Bay of Quinte, Lake Ontario, 1957-1966

Males					Females					Ratio of increments of sexes	Difference between increments of sexes
No. of fish	Year of life	Length in mm	ΔL	$\frac{100\,\Delta L}{L}$	No. of fish	Year of life	Length im mm	ΔL	$\frac{100\,\Delta L}{L}$		
—	-	—	—	—	2	10	273.5	0.0	—	—	—
—	-	—	—	—	8	9	273.5	10.9	4.1	—	—
7	8	242.0	20.2	9.1	36	8	262.6	18.3	7.5	1.10	-1.9
21	7	221.8	22.5	11.3	79	7	244.2	14.1	6.1	1.59	-8.4
45	6	199.3	11.4	6.1	123	6	230.2	15.7	7.3	1.38	4.3
82	5	187.9	14.4	8.3	216	5	214.5	21.9	11.4	1.52	7.5
134	4	173.5	21.2	13.9	283	4	192.6	24.9	14.8	1.17	3.7
189	3	152.3	31.3	25.9	358	3	167.7	38.9	30.2	1.24	7.6
235	2	121.0	42.7	54.5	430	2	128.8	48.2	59.8	1.13	5.5
271	1	78.3	78.3	—	475	1	80.6	80.6	—	1.03	2.3

TABLE 8. Percentage deviation from the mean annual growth increment of white perch, *Roccus americanus*, in the Bay of Quinte, Lake Ontario. (number of year in parenthesis)

Year	Males	Females	Sex unknown	Sexes Combined
1957	+10.7 (1)	+16.3 (1)	+ 5.6 (1)	+15.7 (1)
1958	+12.0 (1)	+10.8 (1)	+ 1.9 (1)	+12.7 (1)
1959	+ 7.4 (2)	+ 2.9 (2)	—14.9 (1)	+ 5.1 (2)
1960	+ 7.7 (3)	+ 6.4 (3)	— 8.4 (2)	+ 6.8 (3)
1961	— 5.3 (4)	— 2.3 (4)	— 3.3 (3)	— 3.5 (4)
1962	+ 0.6 (5)	+ 6.8 (5)	+ 8.0 (4)	+ 3.7 (5)
1963	— 8.8 (6)	— 5.2 (6)	+ 5.9 (5)	— 6.7 (6)
1964	—14.1 (7)	—12.2 (7)	— 0.4 (3)	—13.9 (7)
1965	—10.2 (6)	—23.4 (7)	+ 5.5 (1)	—19.9 (7)

In both the sexes split and the sexes combined the pattern of decrease in the percentage of growth rate is the same which speaks for the accuracy of the method. In males, females and sexes combined a total change of 20.9, 39.7 and 35.6% of the average was recorded. This clearly indicates that apparent population explosion is a strong factor determining the calculated rate of growth.

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