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LENGTH-WEIGHT RELATIONSHIPS OF YELLOWTAIL FLOUNDER, BLACKBACK FLOUNDER, AND FLUKE

by

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INTRODUCTION

Fish length-weight information, aside from its biological significance in studies of condition factor, growth, and sexual maturity, is needed in investigations of the population dynamics of exploited species for obtaining removals in numbers of fish and weight yield by size and age groups from length, age, and apparent abundance data. Given in this report are length-weight relationships for the three flounders that are of greatest importance in New England landings: the yellowtail, Limanda ferruginea; the blackback or winter flounder, Pseudopleuronectes americanus; and the fluke or summer flounder, Paralichthys dentatus. Length-weight equations for each calendar quarter and tables of weights at given lengths, calculated by use of the equations, are given. Some information on length-weight differences with sex is provided.

The New England catch of these flounders is taken largely from statistical areas XXII and XXIII. In addition, some yellowtail occasionally are caught in area XXI on Browns and Sable Island Banks. (The statistical areas are described by Rounsefell, 1948.)

METHODS

Flounder weight was considered to be a function of length. The standard length-weight equation used to express this relationship was:

$$W = a L^b$$

in which W = weight, L = length, and a and b are constants. Values for a and b for each species were obtained by computing the logarithmic least squares equation, $\log W = \log a + b \log L$, from a series of lengths in millimeters and weights in grams.

Total lengths of fish from the tip of the snout to the end of the caudal fin were measured to the nearest millimeter. Weights in grams were obtained on spring scales. Fish of under 1,000 grams were weighed on a dietetic platform scale of 1,000 grams capacity and graduated in 2 gram units. Weights were read to the nearest 2 grams. Fish of 1,000 grams and over were weighed on a suspension pan autopsy scale of 6 kilograms capacity and graduated in 10 gram units. Weights were estimated to the nearest 5 grams. The scales frequently were checked with standard weights and readjusted when necessary. Weighing error of the equipment used was approximately 1 percent.

The length-weight samples were obtained from 3 sources: (1) through sampling market fish at the ports of landing; (2) through sampling industrial fish landings at Pt. Judith, Rhode Island; and (3) through sampling at sea with a research vessel. The samples, except for those taken aboard research vessels, were non-random.

Market flounders were sampled at New Bedford, Massachusetts and Pt. Judith, Rhode Island. Fish dealers pack the fish in ice in boxes of 125 pounds following their removal from the vessel. The sampling procedure was to remove the fish from a box and measure and weigh each individual so that no selection of fish by size or sex was made within a box. Fluke and blackback were boxed by market categories, boxes of the larger fish containing fewer individuals than those of smaller categories. Here more boxes of the larger categories than of the small ones were sampled, in proportion to their relative numbers in catches, in order to get a good representation of large fish in the samples. Sex of

some of the yellowtail and blackbacks ~~were~~ was obtained from external examination.[1/]

Samples of yellowtail and blackback in industrial fishery catches were obtained by removing the fish from the conveyer which carried catches from vessel to reduction plant. These flounders were all of pre-market sizes. No intentional selection by size or sex was made. Sex was obtained by internal examination of the gonads. The fish were then measured and weighed as described above.

Research vessel catches of flounders were packed in ice and brought ashore for measurement. Because mesh size of the research trawl was smaller than that of commercial flounder trawls, both pre-market and market size flounders were taken. Sex was determined by internal examination of the gonads. Lengths and weights were obtained as described above.

An attempt was made to obtain samples in all seasons. Since availability of the fish varied with season, it was not practical to obtain samples in all months. However, reasonably good seasonal coverage was achieved (table 1).

Logarithms of lengths and weights used for computing length-weight equations were obtained from a table of 5-place common logarithms, and they were rounded off to 3 decimal places. The sums of

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1/ Sex of maturing and mature yellowtail can usually be determined by holding the fish in front of a strong light source. Ovaries of females show up as dark areas. Sex of mature blackback can usually be determined by rubbing the fingers along the caudal area of the blind side. Mature males are rough to the touch because of the presence of long and numerous ctenii on the scale edges. Females are smooth to the touch because the ctenii are smaller and less numerous than in males.

Table 1.--Numbers of lengths and weights of the 3 flounder species included in the length-weight studies, by month.

Month	Number of fish		
	Yellowtail flounder	Blackback flounder	Fluke
Jan.	314	46	--
Feb.	--	--	262
Mar.	102	183	203
Apr.	303	373	188
May	60	466	140
June	39	274	675
July	--	61	--
Aug.	34	291	239
Sept.	488	205	161
Oct.	157	59	46
Nov.	111	69	76
Dec.	140	91	63
Total	1748	2118	2053

logarithms used in computations for the 3 flounder species are giv in the appendix Table A-1.

As a check on the accuracy of the length-weight equations for expressing mean weight for a given length, average weights computed for selected lengths were compared with weights computed from the equations by plotting length against weight for both sets of data on logarithmic scale. In all cases the graphs for the 2 sets of data coincided.

YELLOWTAIL FLOUNDER

Royce, Buller, and Premetz (1959) calculated length-weight equations for 1,113 male and female yellowtail lengths and weights obtained from commercial catches in 1943. Through covariance analysis they found significant length-weight differences between calendar quarters and sexes in most cases.

Additional length-weight data for yellowtail are given in the present report to augment those given by Royce, et al., since their sample sizes were small in some cases, and to determine whether or not gross changes in the yellowtail length-weight relationship have occurred between the periods covered. Length-weight equations for male and female yellowtail were calculated for 1,748 lengths and weights collected in 1956-1961. Fish included in the samples were collected in most months (Table 1), and they covered the normal range of sizes caught with commercial gear. The samples came from fishing grounds south of Massachusetts and Rhode Island, except for 249 fish in September 1958 which were from the southeast part of Georges Bank in Subarea XXII-M.

Table 2 gives the length-weight equations in logarithmic for by sex and calendar quarter. The regression coefficients a and b varied with sex, b being consistently higher for females, and with season, b being highest in the second quarter.

Table 3 gives the length distributions of yellowtail samples and the calculated weights at each centimeter of length for each calendar quarter. The calculated weights show more clearly than the equations the seasonal variation in weight for a given length. The weight differences apparently are associated with state of sexual maturity, spawning, and condition of fish, with seasonal weight changes being most pronounced in mature fish. Royce, et al. (1959) have data which show that female yellowtail 32 cm. and longer, and males 30 cm. and longer, are mostly mature. It, therefore, is useful to examine seasonal weight changes for yellowtail under and over 32 cm. separately. For yellowtail under 32 cm. seasonal weight change was small. They were heaviest in the third quarter and of approximately equal weight in the other three quarters. Fish 32 cm. and over were heaviest in the second quarter. This is the spawning season, and peak spawning occurs about mid-May. The higher weight in this quarter, therefore, probably is due to increased gonad weight prior to spawning. Weight decreased in the third quarter, when all yellowtail have spawned, and increased slightly in the fourth quarter.

Yellowtail length-weight curves from Royce, et al. (1959) and from the present study were the same in the first quarter. Small differences occurred in quarters 2, 3, and 4, however, and these are shown in curves of length against calculated weight drawn on logarithmic

Table 2.--Logarithmic length-weight equations for yellowtail flounder by sex and calendar quarter.

Calendar Quarter	Sex	Number of fish	Length - weight equation
1	M	135	$\log W = 3.191 \log L - 5.540$
	F	187	$\log W = 3.445 \log L - 6.161$
	mixed	416	$\log W = 3.380 \log L - 6.003$
2	M	94	$\log W = 3.213 \log L - 5.582$
	F	185	$\log W = 3.431 \log L - 6.099$
	mixed	402	$\log W = 3.451 \log L - 6.169$
3	M	195	$\log W = 2.767 \log L - 4.461$
	F	185	$\log W = 3.048 \log L - 5.164$
	mixed	522	$\log W = 2.937 \log L - 4.884$
4	M	80	$\log W = 2.725 \log L - 4.386$
	F	225	$\log W = 3.273 \log L - 5.753$
	mixed	408	$\log W = 3.164 \log L - 5.473$

Table 3.--Length frequencies of yellowtail flounder used in calculating length - weight equations, and calculated weights in grams at each length, by calendar quarters.

Length (cm.)	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
9			1					
10								
11								
12			1					
13								
14							1	
15								
16								
17								
18	1							
19								
20			1					
21					1	86	1	75
22	3	82			6	98	2	86
23	5	96	1	96	5	113	9	100
24	7	110	1	111	5	128	20	114
25	11	126	5	128	4	144	13	130
26	34	144	8	146		162	4	147
27	44	164	14	166	3	180		166
28	54	185	14	188	4	201		186
29	29	208	44	212	26	222	2	207
30	15	234	32	239	38	246	7	231
31	12	261	42	267	60	270	12	256
32	13	291	30	299	64	297	28	284
33	21	322	26	332	50	324	41	312
34	31	356	36	367	44	354	40	342
35	28	394	21	407	43	387	23	376
36	28	432	22	448	31	419	27	411
37	18	475	22	493	25	454	25	448
38	9	521	12	543	21	493	13	489
39	11	568	16	592	33	532	28	530
40	10	619	11	647	22	572	23	575
41	10	674	13	704	15	616	28	623
42	7	729	11	763	10	660	20	669
43	4	788	4	825	4	706	24	720
44	3	850	4	894	3	754	9	774
45	1	919	5	970	1	808	5	833
46	5	994	3	1049	2	864	1	897
47		1066		1127	1	919		957
48	1	1145		1210	1	976	1	1023
49	1	1227	2	1300		1038	1	1091
50		1318		1396		1104		1167
Total	416		402		522		408	

scales (fig. 1). The differences probably are due to differences in sample sizes, and in year to year variations in size at maturity, spawning time, and condition factor.[2/] No marked changes between 1943 and 1956-61 are evident. The data from the present study were obtained over a number of years, and they probably provide a better average picture of the length-weight relationship than do the data of Royce, et al. which were collected in a single year.

Table 4 gives the calculated weights for given lengths for male and female yellowtail in each quarter. For fish of 25 and 30 cm. in length, weights were similar for both sexes in all quarters. In larger fish the females were consistently heaviest, and this was due in part at least to differences in gonad weight. Weight for both sexes was greatest in quarter 2, the spawning season.

BLACKBACK FLOUNDER

Lobell (1939) presented a graph of the length-weight relationship of Long Island area blackback of from 15 to 50 cm. Season of collection, size distribution, and number of fish included were unspecified. Berry (1959) calculated a length-weight equation computed from lengths and weights of 107 Rhode Island area blackback from which gonads had been removed before weighing.

In the present study length-weight equations for male and female blackback were calculated for 2,118 lengths and weights collected in 1956-62. The fish were collected in all months except February, but

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2/ Sample sizes in the data of Royce, et al. (1959) for quarters 1-4 were 376, 258, 276, and 203 respectively.

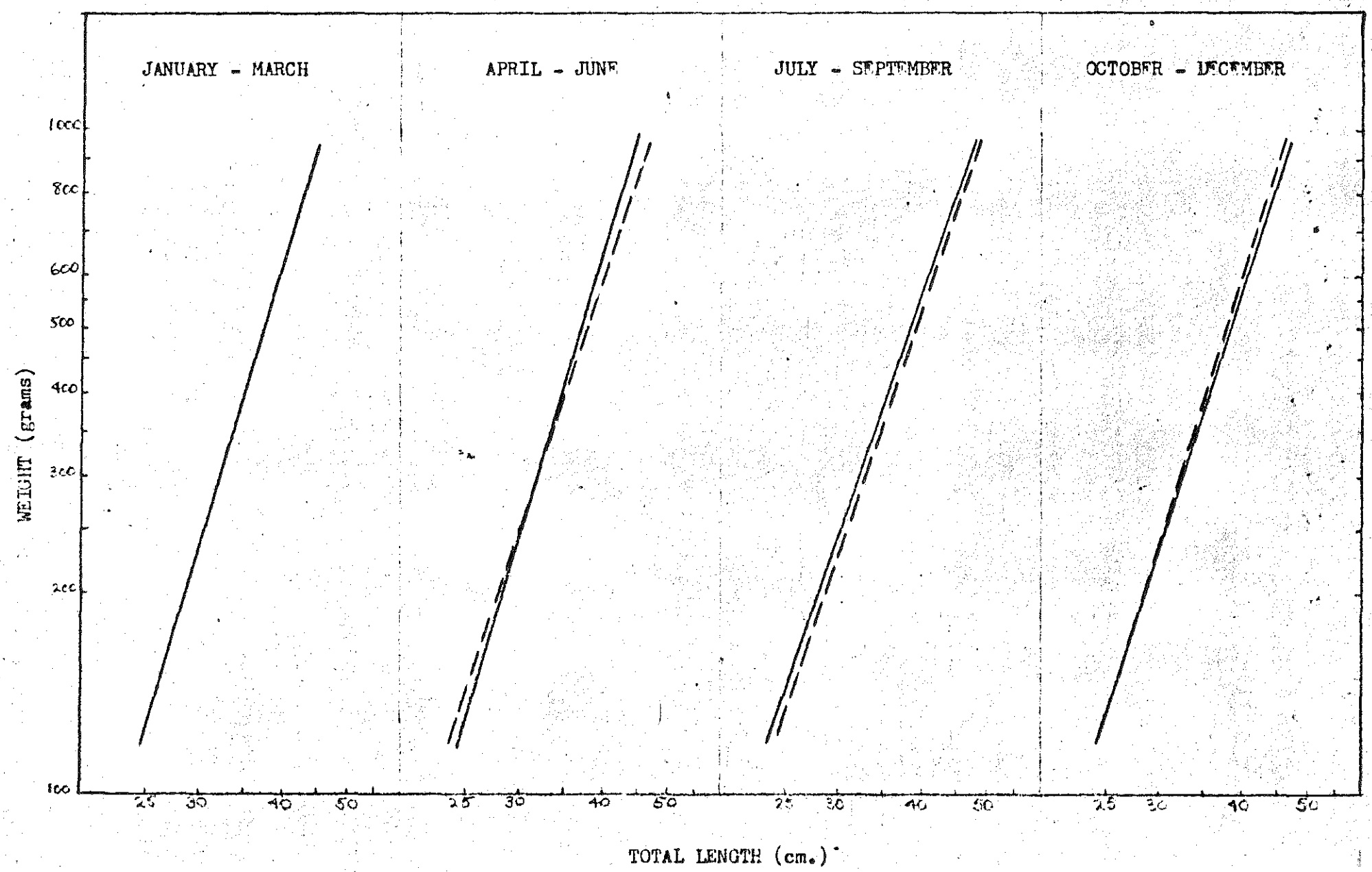

Figure 1. -- The length-weight relationship of yellowtail flounder on logarithmic scale, by calendar quarter. Solid lines: 1956-61 data; dashed lines: 1943 data from Royce, et al. (1959).

Table 4.--Weights of male and female yellowtail flounder at given lengths, by calendar quarter. (Weights are in grams.).

Length (cm.)	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
	males	females	males	females	males	females	males	females
25	129	126			149	140	140	125
30	231	235	238	250	247	243	231	226
35	378	400	390	425	378	389	351	374
40	579	635	600	672	548	584	505	579
45		952		1006		835		850

most of them were obtained in the second and third calendar quarters when the New England catch of this species is greatest (table 1). The samples came from fishing grounds to the south of Massachusetts and Rhode Island, except for 1 May sample which was from the southeast part of Georges Bank. This sample consisted of 92 fish, all of which were of 1,600 grams or over in weight, and they made up many of the fish at the upper end of the size distribution for second quarter samples (table 6). Samples in the first and second quarters covered the normal size range of blackback caught with commercial gear on all grounds. In the third and fourth quarters, however, they were representative only of commercial catches from south of Rhode Island.

Table 5 gives the blackback length-weight equations in logarithmic form by sex and calendar quarter. The regression coefficients a and b varied with quarter, but differences were small. The calculated weights for each quarter at each centimeter of length (table 6) show the seasonal variations in weight for a given length. Information from Saila, Matthiessen, and Perlmutter (1961) indicate that blackback mature at age 3, or at average lengths of 27 cm. for males and 31 cm. for females. Since state of maturity affects weight, it is useful to consider the data of table 6 in two parts: immature blackback of approximately 29 cm. and under in length, and mature blackback of approximately 30 cm. and over in length. For fish of 29 cm. and under, weight increased from the first to the third quarter (when they reached their peak weight), and then decreased very slightly in the fourth quarter. Of the fish that were considered to be mature, those of 30-35 cm. showed a pattern similar to that of the immature, while those of over 35 cm. dropped in weight from quarter 1 to quarter 2, increased to a peak weight in quarter 3,

Table 5.--Logarithmic length-weight equations for blackback flounder, by sex and calendar quarter.

Calendar Quarter	Sex	Number of fish	Length-weight equation
1	M	52	$\log W = 3.070 \log L - 5.115$
	F	150	$\log W = 3.199 \log L - 5.405$
	mixed	229	$\log W = 3.211 \log L - 5.440$
2	M	168	$\log W = 2.913 \log L - 4.705$
	F	435	$\log W = 2.978 \log L - 4.845$
	mixed	1113	$\log W = 3.070 \log L - 5.084$
3	M	132	$\log W = 3.071 \log L - 5.064$
	F	275	$\log W = 3.120 \log L - 5.178$
	mixed	557	$\log W = 3.134 \log L - 5.208$
4	M	41	$\log W = 3.211 \log L - 5.415$
	F	178	$\log W = 3.107 \log L - 5.152$
	mixed	219	$\log W = 3.136 \log L - 5.226$

Table 6.--Length frequencies of blackback flounder used in calculating length-weight equations, and calculated weights in grams at each length, by calendar quarters.

Length (cm.)	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
12			1					
13	4	22	3	25				
14	2	28	4	32				
15	2	35	5	39	1	41		
16	2	43	6	48		50		
17	5	52	7	58	3	60		
18	11	63	13	69	6	72		
19	8	75	22	82	10	86		
20	12	89	18	95	14	101		
21	7	104	27	111	26	117		
22	12	120	20	128	34	135		
23	14	139	21	147	36	156		
24	10	159	29	167	28	178	1	173
25	4	182	11	190	39	203	1	197
26	4	206	12	214	37	230	2	223
27	6	232	15	239	33	257	3	250
28	12	261	28	268	29	289	7	280
29	4	292	37	298	18	322	7	313
30	8	326	50	331	20	359	2	348
31	8	362	51	365	24	397	5	385
32	9	401	59	403	25	439	11	427
33	13	441	68	442	23	482	11	468
34	10	486	43	485	31	529	22	514
35	4	535	24	532	21	582	26	565
36	9	584	53	579	28	633	29	617
37	7	639	32	630	20	691	24	671
38	8	698	30	686	18	754	12	733
39	5	758	31	740	9	816	13	792
40		822	21	801	9	884	10	859
41	3	890	29	866	8	956	15	929
42	3	958	21	930	3	1027	4	1000
43	1	1032	13	997	3	1106	8	1074
44	4	1114	12	1071		1188		1154
45	1	1199	5	1150		1275	4	1242
46		1291	8	1232	1	1375	1	1334
47		1379	11	1314				1422
48	3	1475	17	1402			1	1521
49	8	1576	25	1492				
50	1	1681	22	1591				
51	1	1798	25	1697				

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Table 6.--(Continued).

Length (cm.)	Quarter 1 Number	Quarter 1 Weight	Quarter 2 Number	Quarter 2 Weight	Quarter 3 Number	Quarter 3 Weight	Quarter 4 Number	Quarter 4 Weight
52	1	1909	24	1793				
53	1	2026	30	1900				
54	2	2146	22	2008				
55			20	2126				
56			23	2247				
57			8	2381				
58			17	2498				
59			8	2647				
60			9	2777				
61			6	2921				
62			3	3067				
63			4	3226				
64			2	3385				
65				3561				
66			5	3738				
67			3	3904				
Total Number	229		1113		557		219	

and decreased slightly in quarter 4.

The spawning season for blackback normally runs from January to April, and a large number of fish in the first quarter collections were heavy with ripening gonads. This probably accounted for the difference in relative weight of mature and immature fish in the first quarter.

The length-weight curve given by Lobell (1938) coincided closely with that for the second quarter in the present study. Because gonads were removed in the blackback included in Berry's (1959) samples, no comparison of his data with that presented here was possible.

Weights of male and female blackback for given lengths are presented in table 7. In quarters 2 and 3, sample sizes were adequate for comparison (table 5). For fish of 35 cm. and over in these quarters the females were consistently heavier than males. This may be due largely to differences in gonad weight, since gonads of mature females are heavier than those of males of comparable size and state of sexual development.

FLUKE

Hildebrand and Schroeder (1928) presented average weight data for 118 Chesapeake Bay fluke of from 19-50 cm., caught in both summer and winter. Neville (1944) presented a table of average weights for Long Island area fluke of 11-25 inches (28-64 cm.) in length. Sizes and numbers of fish included in samples and the length-weight equation were unspecified. Season was unspecified also, but since fluke are found in the Long Island area only from late spring to early fall, this presumably was the period covered.

Table 7.--Weights of male and female blackback flounder at given lengths, by calendar quarter. (Weights are in grams.).

Length	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
(cm.)	Males	Females	Males	Females	Males	Females	Males	Females
20	89	90	99	102	100	100	- -	- -
25	176	184	190	198	199	201	- -	- -
30	308	330	324	339	349	354	346	350
35	- -	540	508	538	561	574	567	564
40	- -	829	749	801	844	870	- -	854
45	- -	1207	- -	1137	- -	1255	- -	1232

In the present study length-weight equations for fluke were calculated for 2,175 lengths and weights collected in 1956-62. Fish included were collected in most months (table 1), although only 185 fish were represented in the last calendar quarter, when the fluke catch is small. The normal size range of the commercial catch was covered in all quarters except the last (table 9). Winter samples were from the winter fishing grounds in 50-75 fathoms of water in the area from Hudson Canyon to Hydrographer Canyon. Summer samples were from inshore grounds off Rhode Island and southern Massachusetts.

Fluke apparently spawn in the fall at the time of migration from inshore to offshore grounds, although the time of spawning is not precisely known. Availability is low at this time, and no fish heavy with spawn were represented in any of the length-weight samples. Some of the fluke included in samples for the last quarter were from inshore grounds, while some were caught offshore, where catches that we have examined have consisted of spawned out fish.

Table 8 gives the length-weight equations in logarithmic form by calendar quarter and, for the second quarter only, by sex. The length distributions of fluke samples and calculated weights at each centimeter of length for each quarter are given in table 9. These data show that there was little difference in weight in the first three quarters. In the fourth quarter large fluke of over 55 cm. were lighter than in the first three quarters. Because of the small number of fish represented in fourth quarter samples, however, the apparent weight difference may have stemmed from sampling error.

The Chesapeake Bay length-weight data from Hildebrand and Schroeder (1928) agreed closely with that of the second and third quarters in the present study. A comparison of the Long Island fluke length-weight

Table 8.--Logarithmic length-weight equations for fluke, by sex and calendar quarter.

Calendar Quarter	Sex	Number of fish	Length-weight equation
1	mixed	465	$\log W = 3.358 \log L - 5.943$
2	M	163	$\log W = 3.190 \log L - 5.507$
	F	183	$\log W = 3.320 \log L - 5.852$
	mixed	1003	$\log W = 3.302 \log L - 5.799$
3	mixed	400	$\log W = 3.343 \log L - 5.894$
4	mixed	185	$\log W = 3.109 \log L - 5.271$

Table 9.--Length frequencies of fluke used in calculating length-weight equations, and calculated weights in grams at each length, by calendar quarters.

Length (cm.)	Jan. - Mar. Number	Jan. - Mar. Weight	Apr. - June Number	Apr. - June Weight	July - Sept. Number	July - Sept. Weight	Oct. - Dec. Number	Oct. - Dec. Weight
27			1	169				
28			4	191				
29			8	214	3	217		
30			21	240	6	244		
31			28	266	5	271		
32			44	297	7	302	2	329
33	3	325	73	327	8	334	1	360
34	5	359	76	361	11	369	4	396
35	7	398	80	399	15	407	5	434
36	4	436	74	437	23	447	8	474
37	9	478	80	479	13	490	10	516
38	18	526	86	524	26	538	5	562
39	14	571	66	570	17	586	8	608
40	15	623	47	620	20	636	9	659
41	29	677	33	674	30	693	8	712
42	19	732	38	727	25	749	3	765
43	27	792	21	785	30	808	8	822
44	16	854	16	846	21	874	4	882
45	19	923	17	913	16	943	4	948
46	17	997	15	985	15	1018	7	1018
47	14	1069	12	1056	8	1091	19	1086
48	4	1147	9	1132	13	1169	12	1158
49	9	1229	12	1210	6	1255	11	1235
50	12	1317	13	1296	2	1345	11	1317
51	17	1411	13	1389	5	1441	12	1405
52	21	1502	12	1475	1	1533	12	1488
53	15	1598	8	1569	2	1628		1576
54	17	1701	4	1666	1	1733	2	1670
55	15	1810	7	1769	5	1843	2	1769
56	13	1926	6	1882	5	1957	1	1874
57	8	2049	4	1998	4	2083	2	1980
58	17	2161	6	2107	12	2201	1	2083
59	5	2299	6	2242	2	2337	1	2206
60	3	2425	10	2364	4	2470		2321
61	5	2563	3	2493	5	2604	5	2436
62	9	2708	6	2628	1	2752	3	2563
63	8	2855	4	2771	2	2902		2696
64	3	3011	11	2921	3	3059		2836
65	5	3182	2	3081	4	3222		2983
66	2	3362	4	3256	2	3409		3130
67	5	3521	6	3401	5	3570	1	3271

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Table 9.--(Continued).

Length (cm.)	Jan. - Mar. Number	Jan. - Mar. Weight	Apr. - June Number	Apr. - June Weight	July - Sept. Number	July - Sept. Weight	Oct. - Dec. Number	Oct. - Dec. Weight
68	5	3687	3	3561		3738		3416
69	6	3886	3	3755	5	3950	1	3586
70	5	4080	2	3932	3	4137		3746
71	12	4272		4118	1	4332		3914
72	7	4473	2	4312		4536	2	4080
73	2	4684	2	4515	1	4749		
74	2	4905	1	4716	1	4973		
75	2	5136		4938		5208		
76	1	5378		5171		5453		
77	5	5592	1	5378	2	5669	1	
78	1	5855	2	5617	2	5937		
79	2	6131		5882	2	6216		
80		6377	1	6118				
81	1	6630						
82	2	6943						
83	2	7221						
84	1	7508						
Total	465		1003		400		185	

data from Neville (1944) with that for July-September for southern New England (table 9) suggested that among fluke over 45 cm. in length, the southern New England fish were heavier. Lack of data on sizes and numbers of fluke included in Neville's study, however, make this comparison of questionable value.

Length-weight relationships for separated male and female fluke were obtained for one inshore sample of 346 fish taken in June aboard a research vessel. Most of the fish were small, with only 1 male and 16 females being over 45 cm. in length. Length-weight equations based on these limited data (table 8) indicated that weight for a given length for fluke of 50 cm. and over was highest for females, but that it was similar for both sexes for smaller fish.

LITERATURE CITED

Berry, R. J.

1959. Critical growth studies of the winter flounder, Pseudopleuronectes americanus (Walbaum), in Rhode Island waters. M. S. thesis, University of Rhode Island, Kingston. 52 pp.

Hildebrand, Samuel F., and Wm. C. Schroeder.

1928. Fishes of Chesapeake Bay. U. S. Department of Commerce, Bulletin of the U. S. Bureau of Fisheries, vol. 43, 366 pp.

Lobell, Milton J.

1939. A biological survey of the salt waters of Long Island, 1938. Report on certain fishes. Winter Flounder (Pseudopleuronectes americanus). 28th Ann. Rept. New York State Conserv. Dept., Suppl., Pt. I: 63-96.

Neville, Wm. C.

1944. A report on the study of summer flounder. Biological report prepared for the Annual Meeting of the Atlantic States Marine Fisheries Commission, Sept. 28-29, 1944. 9 pp. (mimeo.)

Rounsefell, Geo. A.

1948. Development of fishery statistics in the North Atlantic. U. S. Department of the Interior, Fish and Wildlife Service, Spec. Sci. Rept. No. 47, 27 pp.

Royce, Wm., F., R. J. Buller, and E. D. Premetz.

1959. Decline of the yellowtail flounder (Limanda ferruginea) off New England. U. S. Department of the Interior, Fish and Wildlife Service, Fishery Bull. 146, 59: 165-267.

Saila, Saul B., Geo. C. Matthiessen, and Alfred Perlmutter.

1961. Winter flounder (blackback) Pseudopleuronectes americanus (Walbaum). Biological report prepared for the Annual Meeting of the Atlantic States Marine Fisheries Commission, Oct. 25-27, 1961. 4 pp. (mimeo.).

Table A-1.--Sums of log L, log L^2, log W, and (log L) (log W) for male and female yellowtail flounder, blackback flounder and fluke, by calendar quarter.

Quarter	Sex[1/]	N	Σ log L	Σ log L^2	Σ log W	Σ log L log W
YELLOWTAIL FLOUNDER						
Jan. - Mar.	M	135	334.845	831.041	320.447	796.455
	F	187	471.353	1189.224	471.976	1193.558
	mixed	416	1038.208	2593.261	1012.230	2533.696
Apr. - June	M	94	235.055	587.925	230.278	576.312
	F	185	470.965	1199.612	487.571	1243.467
	mixed	402	1012.043	2549.851	1013.572	2558.635
July - Sept.	M	195	487.011	1216.816	477.471	1193.891
	F	185	471.988	1204.798	483.102	1234.425
	mixed	522	1318.671	3332.920	1323.330	3347.996
Oct. - Dec.	M	80	198.647	493.746	190.363	474.018
	F	225	573.222	1461.652	582.157	1487.327
	mixed	408	1036.828	2637.255	1047.290	2669.079
BLACKBACK FLOUNDER						
Jan. - Mar.	M	52	125.773	304.824	120.177	292.562
	F	150	373.001	930.183	382.683	960.069
	mixed	229	559.524	1371.895	550.624	1360.739
Apr. - June	M	168	412.756	1016.549	411.855	1019.036
	F	435	1085.934	2715.236	1125.993	2823.763
	mixed	1113	2832.216	7230.553	3037.464	7801.489
July - Sept.	M	132	315.774	756.333	301.296	723.624
	F	275	677.399	1671.441	689.142	1705.355
	mixed	557	1363.986	3344.900	1374.068	3380.003
Oct. - Dec.	M	41	103.684	262.370	110.928	281.056
	F	178	454.959	1163.273	496.509	1270.360
	mixed	219	558.643	1425.643	607.437	1551.416

1/ Data for males and females for which length-weight relationships were computed separately is included in the "mixed" category in the table.

Table A-1.--(Continued)

Quarter	Sex	N	Σ log L	Σ log L^2	Σ log W	Σ log Llog W
FLUKE						
Jan. - Mar.	mixed	465	1254.871	3390.419	1447.613	3919.924
Apr. - June	M	163	414.028	1051.898	423.232	1075.818
	F	183	473.338	1224.796	500.349	1295.786
	mixed	1003	2602.990	6762.664	2778.483	7235.081
Jul. - Sept.	mixed	400	1055.234	2787.137	1170.015	3097.765
Oct. - Dec.	mixed	185	491.758	1308.159	553.638	1474.738