The Weight-Length Ratio of Georges Bank Sea Scallops

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Laboratory Reference 65-9
13 May 1965

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In the fishery for sea scallops (Placopecten magellanicus, Gmelin) on Georges Bank (ICNAF Division 5Z), only the adductor muscle, called the meat, is retained. The shell and viscera are discarded at sea. This paper reports the results of measuring the shells and weighing the meats of several thousand scallops collected from all the fishing grounds on Georges Bank in all seasons of the year over a five-year period. Regression equations are given for males and females, all seasons and areas combined; and, sexes combined, for four areas and three seasons. The data have then been further combined to give equations for each area all seasons combined, each season for all areas combined, and finally all seasons and all areas combined.

This document is a condensation of a paper by Haynes, to be published soon, which gives the basic data, details the analysis, and covers areas other than Georges Bank.

Differences between sexes

Data were available for 3319 males and 3002 females. Pooling all data, regardless of season or area, the regression equations are:

Males: $\log_e W = 2.996 \log_e L - 10.0234$

Females: $\log_e W = 3.003 \log_e L - 10.0529$

Analysis of covariance showed that the differences were non-significant, so the sexes were combined in all further analyses.

Differences among seasons and areas

Sea scallops on Georges Bank usually spawn around the end of September. The gonads remain flaccid during October and start to ripen in November. Gametogensis is usually complete by the end of March and the gonads then remain full and plump until the next September.

To see if the reproductive cycle affects the weight-length ratio, the collections were separated into three seasons: October, spent; November - March, ripening; and April - September, ripe. To see if different geographic areas had different weight-length ratios, the seasonal collections were further separated into four groups representing different fishing grounds (Fig. 1). The data were then put through an IBM 7090 computer to calculate the parameters of the regression equations.

The intercepts (a) and the slopes (b) of the regression equations and the calculated mean weight of a 110 mm scallop (w) are shown below for the three seasons and the four fishing grounds, as well as seasons combined by grounds, grounds combined by seasons, and all seasons and grounds combined.

Season		October Spent	Nov.-Mar. Ripening	Apr.-Sept. Ripe	All seasons combined
Ground					
Northern Edge	a	-10.0411	-11.6013	-11.0038	-11.1555
	b	2.773	3.110	2.994	3.0218
	w	19.9 gm	20.6	21.5	21.1
Eastern Part	a	no	-10.9373	-10.9093	-10.7396
	b	samples	2.966	2.981	2.940
	w		20.2	22.3	21.7
Southeast Part	a	no	-11.8185	-12.0647	-10.5746
	b	samples	3.118	3.230	2.878
	w		17.1	22.6	19.2
South Channel	a	-11.0103	-10.6864	-10.5486	-11.5934
	b	2.937	2.880	2.090	3.094
	w	16.4	17.3	22.8	19.1
All grounds combined	a	-10.2516	-11.7472	-10.9926	-10.8421
	b	2.785	3.131	2.995	2.949
	w	17.1	19.5	21.9	20.5

It is apparent that there is a seasonal variation in the average weight of meat obtained from a scallop of a given size. It is lowest just after spawning, highest during the ripe phase, and intermediate during gametogenesis. The value of 17.1 grams for a 110 mm. scallop in October, all grounds combined, is only 78 percent of the 21.9 grams obtained during the April - September period. The reproductive cycle, of course, may not be the cause of the seasonal variation in the weight-length ratio; there may be other uninvestigated causes.

Analysis of covariance showed that the seasonal differences exhibited in each area were significant at the 1 percent level, but that in all cases the differences between areas within each season were non-significant, even at the 5 percent level.

Variation from the mean weight at length

We have calculated the limits within which 95 percent of the individual weight values are expected to fall for the regressions for each season, all grounds combined, and that for all seasons and grounds combined. No account has been taken of the effects on the limits of any errors made in measuring or weighing the individual scallops. The 95 percent confidence belts about the regression line are usually somewhat wider at lengths greater or smaller than the mean length. Within the span of 80 - 145 mm, however, the differences in the width of the confidence belts are so slight that they can be neglected. The limits are:

October	$\log_e W_1 \pm 0.6377$
November - March	$\log_e W_1 \pm 0.3883$
April - September	$\log_e W_1 \pm 0.3845$
Seasons combined	$\log_e W_1 \pm 0.4414$

Using the regression equation calculated by pooling all the data without regard to area or season we have tabulated the mean weight of meats for scallops between 80 and 145 mm. long at 5 mm. intervals, and the limits between which 95 percent of the weights can be expected to fall.

Shell Length (mm)	Meat Weight (gm) Lower Limit	Mean	Upper Limit
80	5.1	8.0	12.5
85	6.1	9.6	14.9
90	7.2	11.5	17.7
95	8.5	13.3	20.6
100	9.7	15.4	23.7
105	11.4	17.9	25.3
110	13.3	20.5	31.7
115	15.0	23.6	36.2
120	17.9	26.5	41.4
125	19.1	30.0	46.4
130	21.5	33.6	52.2
135	23.6	37.0	57.3
140	26.9	41.6	64.7
145	29.8	46.5	72.0

Regression of length on weight

Pooling all the Georges Bank data regardless of season or ground, we have also calculated the regression of length on weight, and the limits within which 95 percent of the points fall. The equation is:

$$\log_e L = 0.2856 \log_e W + 3.8245$$

As reported previously for the regressions of weight on length, the limits at the smaller and larger weights are not appreciably greater than at the mean weight. For practical purposes within the span of 10 - 35 gm, 95 percent of the logarithms of the lengths can be expected to fall within $\pm$ 0.1357.

Using the equation and limits given above, we have calculated the mean length and upper and lower 95 percent limits on length for weights between 10 and 35 gm at intervals of 2.5 gm.

	Shell Length (mm)		
Weight (gm)	Lower Limit	Mean	Upper Limit
10.0	77.2	88.4	101.3
12.5	82.3	94.2	107.9
15.0	86.7	99.3	114.1
17.5	90.6	103.7	118.8
20.0	94.1	107.8	123.5
22.5	97.3	111.5	127.7
25.0	100.3	114.9	131.6
27.5	103.1	118.0	135.2
30.0	105.7	121.0	138.6
32.5	108.1	123.8	141.8
35.0	110.4	126.5	144.9

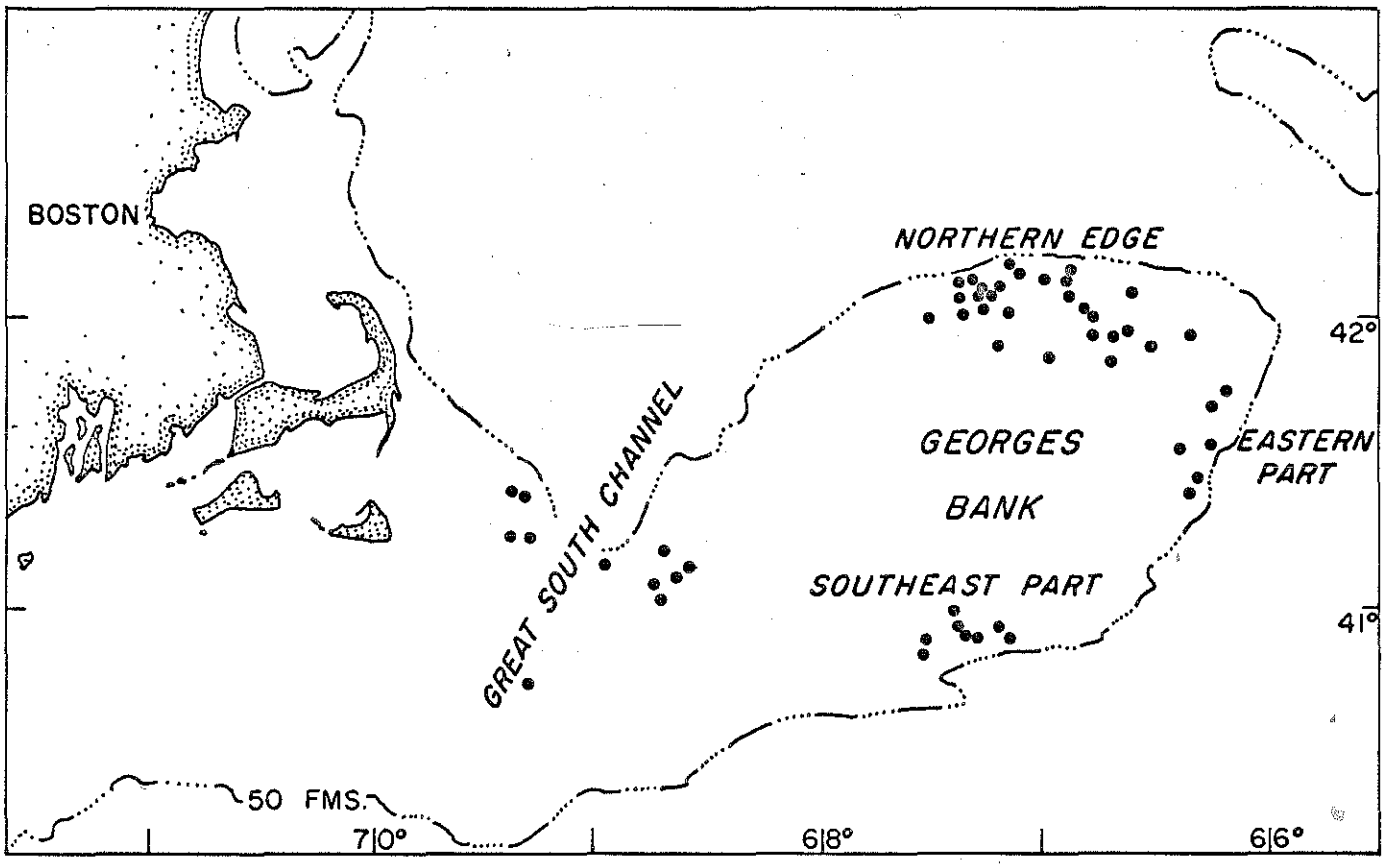

Figure 1. --The sea scallop fishing grounds of Subarea 5Z showing the location of the samples.