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Length-weight relationship for lobster (Homarus americanus)
in three areas of the northern Northumberland Strait

by

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ABSTRACT

The length-weight relationship of the American lobster (Homarus americanus) in different areas of the northern Northumberland Strait (district # 8) were calculated and compared. The slopes differ significantly from location to location.

RESUME

La relation taille-poids du homard (Homarus americanus) a été calculée pour différents endroits de la partie septentrionale du Détroit de Northumberland (district # 8). La comparaison des regressions révèle qu'il y a des différences significatives des pentes.

INTRODUCTION :

The length-weight relationship is required for yield per recruit assessments, for converting numbers into weights from size frequency samples obtained from the landings or for condition factor analysis. The length-weight relationship seems to vary from year to year and from location to location. However very little information has been reported in the southern part of the Gulf of St. Lawrence since Wilder's (1953) results.

In 1983 routine sea surveys were organized in the Northumberland Strait in order to obtain data on biological characteristics of exploited lobster stocks in different geographic locations (Miminegash, Richibucto and Shediac). In the present paper length-weight relationships for lobster from these areas is presented as a background for further population dynamics analysis.

MATERIAL AND METHODS :

Data on carapace length (mm) and total body weight (g) of individual lobster were obtained from experimental trap fishing conducted from July to December 1983 in three areas of the Northumberland Strait, lobster fishing district # 8 (Figure 1). Experimental fishing provided data for size-classes smaller than the legal sizes which are not ordinarily represented in commercial landings.

A predictive linear regression was fitted by least squares to each set of paired data for carapace length and total body weight. Only specimens that had lost no appendages were used and no berried females were included. After testing homogeneity of the residual variances, the slopes and the elevations between each area were compared separately for males and for females by ANOVA (Snedecor and Cochran, 1980) which was programmed for HP 9845.

RESULTS :

The relationship is $W = a L^b$ where W is the total body weight, L is the carapace length, a and b are constants. The relationship is derived from the least squares regression of the logarithmic transformation $Y = A \cdot b X$ where $Y = \log_e W$, $A = \log_e L$ (length in mm, weight in g).

Relationships in each location are shown in Figures 2,3, 4,5 and in Table 1. Simultaneous comparison of all regression lines and comparison of regression lines between each location are presented in Table 2. The slopes differ significantly from location to location except between the Miminegash area and the Richibucto area for females, for which the elevations are not significantly different . When the slopes differ significantly it is statistically incorrect to compare the elevations. Comparison of regression equations reveals that the differences are the smallest between the Miminegash area and the Richibucto area for both sexes.

DISCUSSION :

Length-weight relationship varies with biological characteristics such as maturation stages and molting stages. Our observations on maturation reveal that the percentage of berried lobster is very high in the Richibucto area (unpublished data). Wilder (1962) reported that a certain number of commercial size lobsters molt twice a year in Egmont Bay (near the Shediac area), which is not reported in any other area of the Northumberland Strait. Our data for each location were not necessarily collected on the same date and the number of specimens measured and weighed at each sampling date varied from location to location. It is therefore recommended that further detailed investigations such as monthly comparisons of this relationship in regards to biological characteristics (e.g. maturation, molting) in each location should be conducted.

For comparison of regression equations for weight vs. length, a method of ANOVA was used. Results showed that the slopes are significantly different between each location except in one case for females, consequently comparison of the elevations could not be done. In such a case, Conan (1978) suggested a graphical comparison of ellipses of joint confidence limits at given probability levels for slopes and elevations. We also suggest the use of such a method.

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Table 1.

Regression equations ($Y = a + bX$) of logarithm of carapace length (mm) vs. logarithm of total body weight (g) for lobsters from the Northumberland Strait

	Miminegash		Richibucto		Shediac	
	Male	Female	Male	Female	Male	Female
a	-7.4611	-6.0876	-6.7779	-6.1542	-5.0787	-4.9730
b	3.0861	2.7589	2.9195	2.7757	2.5055	2.4795
R^2	0.9931	0.9865	0.9908	0.9912	0.9854	0.9875
N	74	109	42	50	68	42
ΣX	309.6090	455,1707	176.2735	208.8250	284.9368	174.8549
ΣX^2	1296.8995	1902.2565	740.3890	872.9857	1194.8371	728.6448
$\Sigma X \cdot Y$	1692.3235	2477.2449	966.7853	1137.9580	1546.5146	937.0907
ΣY^2	2213.3559	3229.5778	1263.9900	1485.2669	2003.1605	1206.2535
ΣY	403.3597	592.2237	229.9546	271.9165	368.5477	224.6794
size range (mm)	53 - 102	54 - 103	54 - 92	53 - 98	55 - 94	55 - 92
weight range (g)	131 - 912	135 - 789	141 - 618	137 - 760	146 - 556	140 - 489

Table 2. Comparison between regression equations of length-weight relationships for lobsters in different areas of the Northumberland Strait

[All data & Male]

ANOVA	All data	M/R/S	M/R	M/S	R/S
Residual variances :					
Two tailed F	1.8767	0.5805	1.2296	1.1239	1.0941
Degrees of freedom	5	2	1	1	1
α	0.8659	0.7481	0.4818	0.6320	0.7709
Significance	-	-	-	-	-
Slopes :					
One tailed F	21.0904	36.8181	4.4116	70.9248	24.6329
Degrees of freedom	5/373	2/178	1/112	1/138	1/106
α	1.4049E-18	4.1549E-02	3.7939E-02	4.2886E-14	2.6612E-06
Significance	+	+	+	+	+
Elevations :	Elevations cannot be compared				

All data : all regression equations of each location for both sexes, M : Miminegash, R : Richibucto, S : Shediac.

[Female]

ANOVA	M/R/S	M/R	M/S	R/S
Residual variances :				
Two tailed F	0.8351	1.2524	1.1122	1.1260
Degrees of freedom	2	1	1	1
α	0.6586	0.3853	0.7180	0.6895
Significance	-	-	-	-
Slopes :				
One tailed F	7.8364	5.3801E-02	12.7455	13.0952
Degrees of freedom	2/195	1/155	1/147	1/88
α	5.3279E-04	0.8169	4.8260E-04	4.9364E-04
Significance	+	-	+	+
Elevations :				
One tailed F	*	0.1399	*	*
Degrees of freedom		1/156		
α				
Significance		-		

M : Miminegash, R : Richibucto, S : Shediac, * : elevations cannot be compared

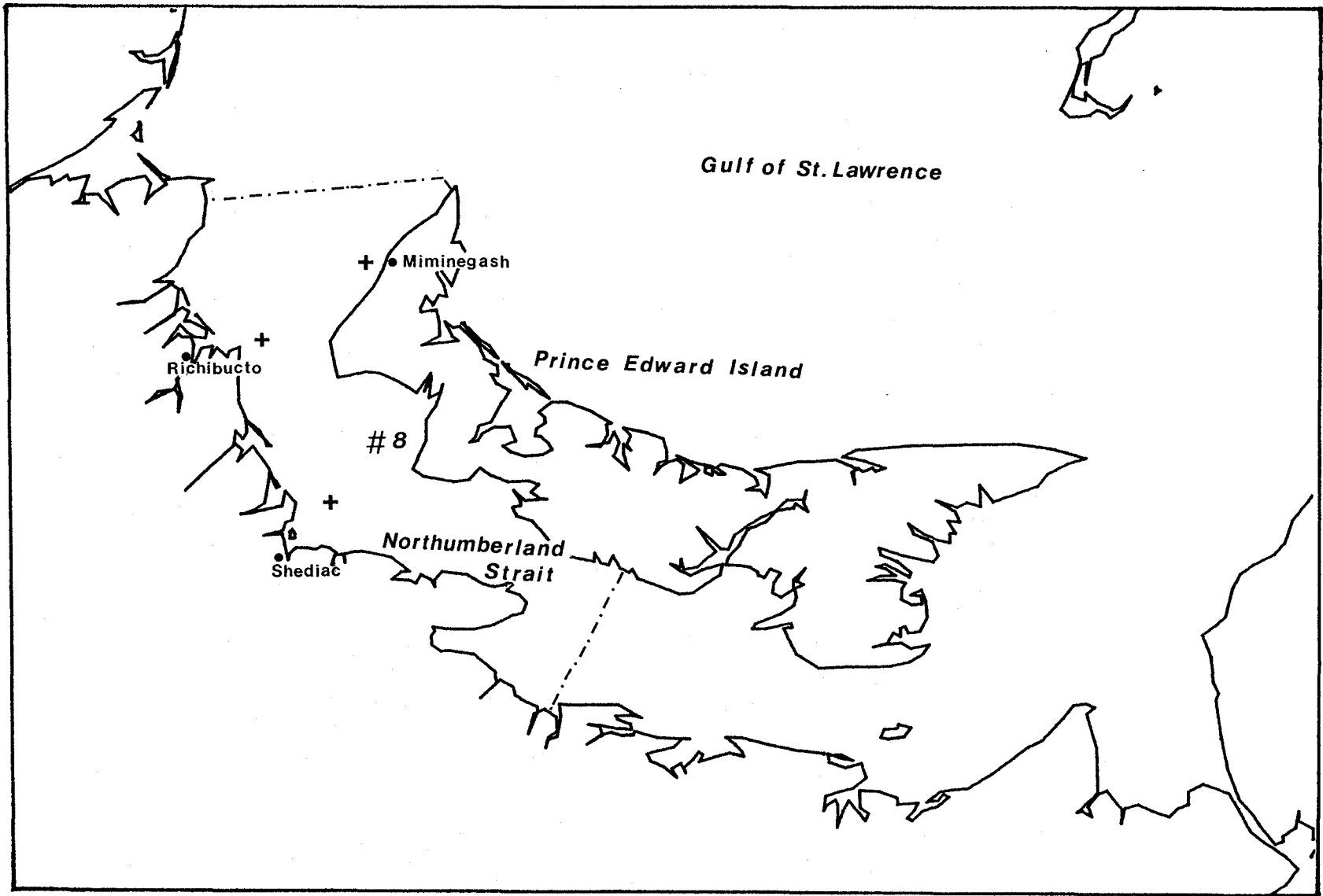


Figure 1. Geographical location of sampling sites (+) in the Northumberland Strait Lobster fishing district # 8 enclosed by dashed lines (-.-.-)

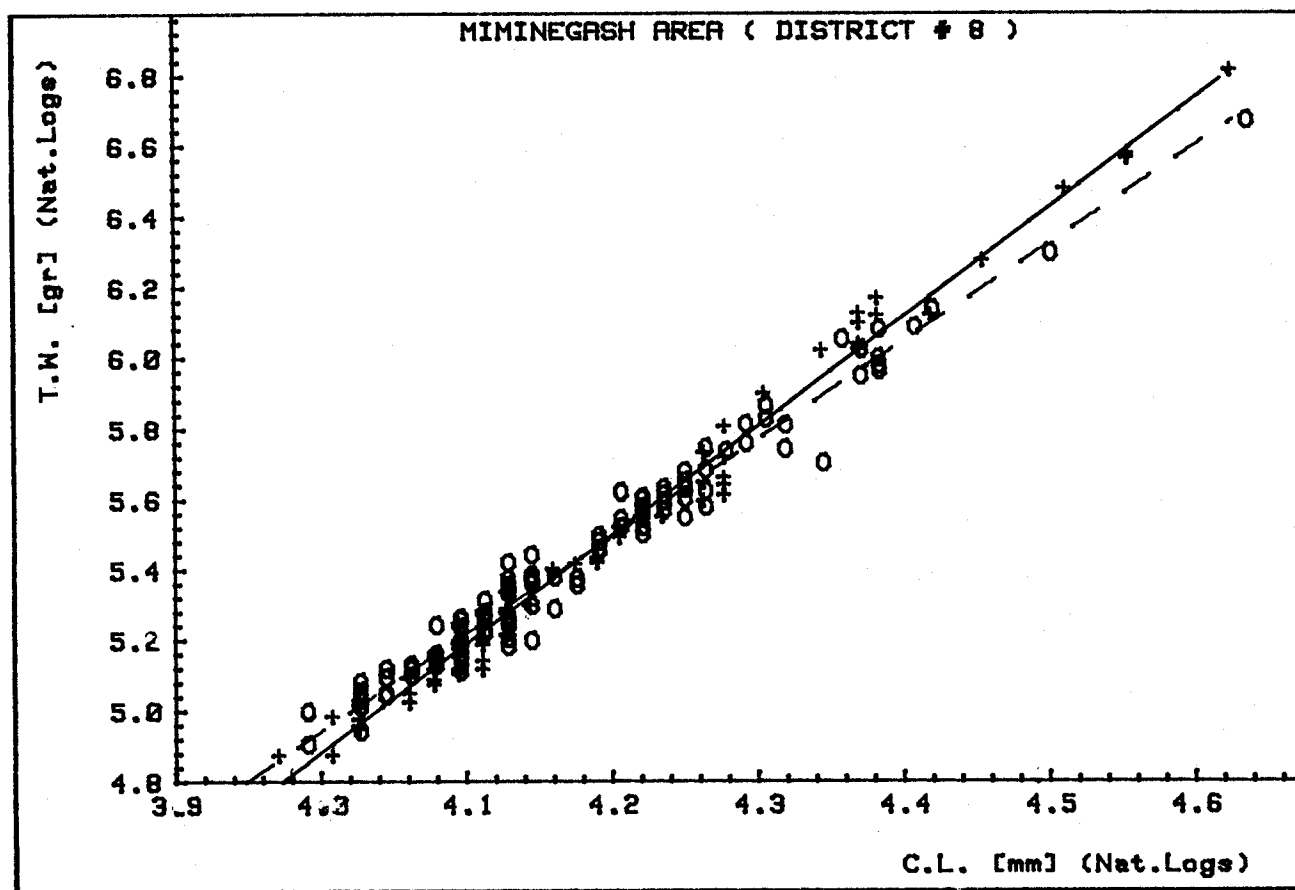


Figure 2. Length-weight relationships for male (+) and for female (o) lobsters in the Miminegash area.
 (T.W. : total weight, C.L. : carapace length)

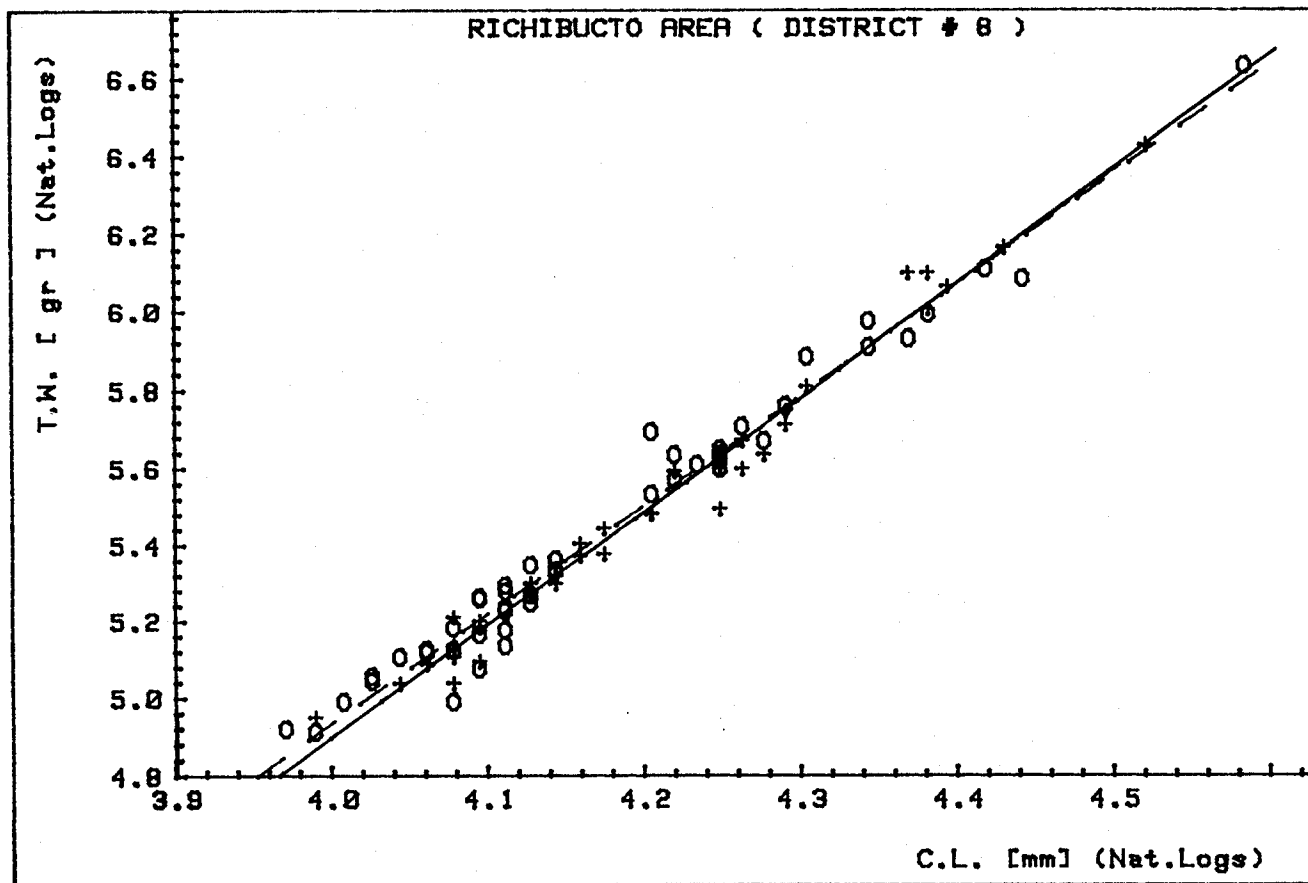


Figure 3. Length-weight relationships for male (+) and for female (o) lobsters in the Richibucto area.
 (T.W. : total weight, C.L. : carapace length)

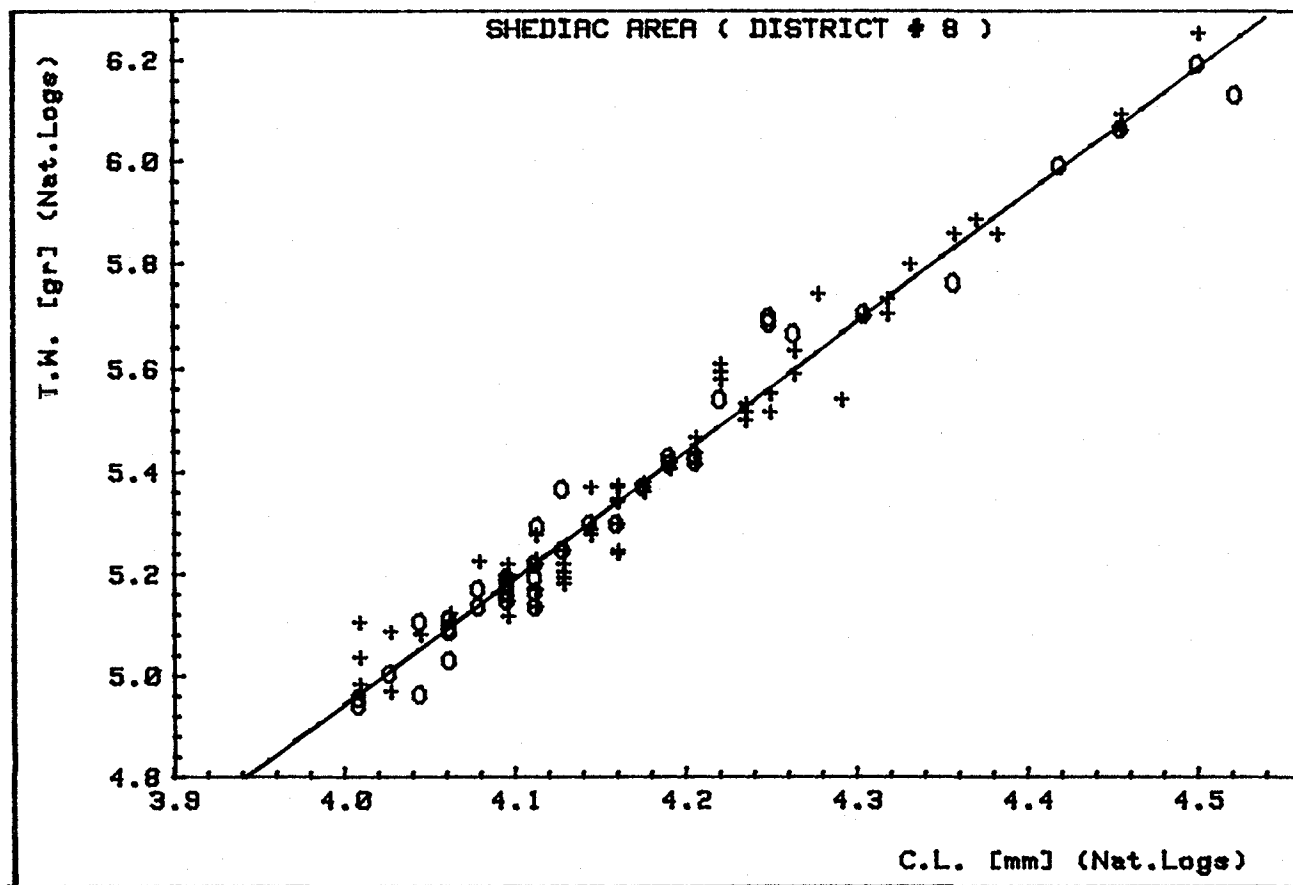


Figure 4. Length-weight relationships for male (+) and for female (o) lobsters in the Shediac area.
 (T.W. : total weight, C.L. : carapace length)

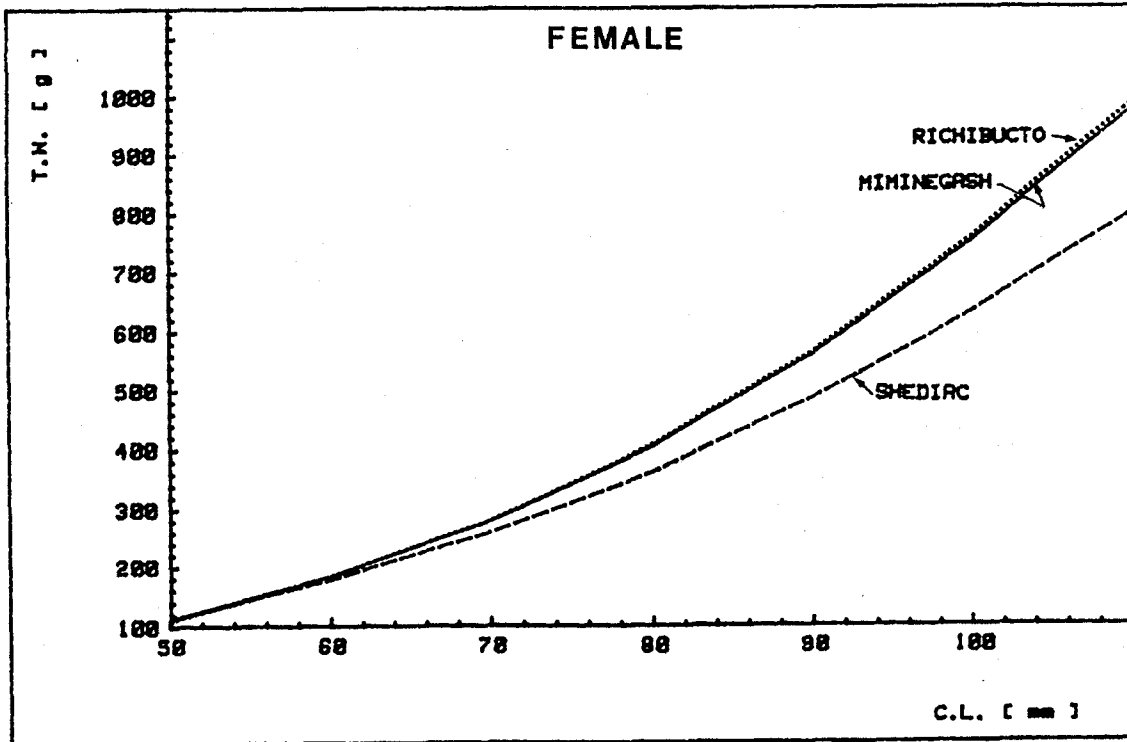
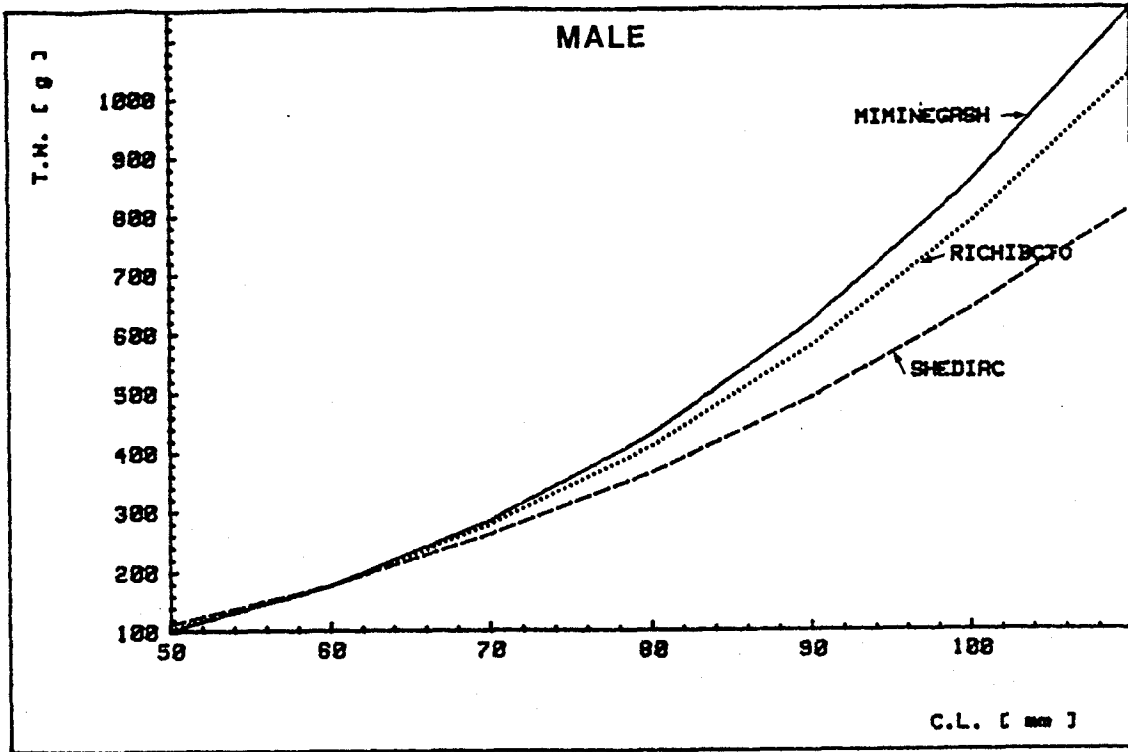


Figure 5. Length-weight relationships (arithmetic scales) for lobsters in three different areas of Northumberland Strait. (T.W. : total weight, C.L. : carapace length)