

ESTIMATED SIZE-AT-RECRUITMENT OF SNOW CRABS *CHIONOECETES OPILIO*
INTO THE EASTERN BERING SEA COMMERCIAL FISHERY

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INTRODUCTION

The size-at-recruitment (or minimum legal retention size) for male snow crabs *Chionoecetes opilio* commercially fished in waters of the Eastern Bering Sea is described as 78.7mm (3.1 inches) in greatest carapace width (GCW) in Alaska Department of Fish and Game Commercial Shellfish Fishing Regulations (ADF&G 1997). The objective of this investigation was to examine the relationship between snow crab “biological” carapace width (CW) and GCW in a subsample of males observed during the 1997 commercial fishery, and estimate the true mean CW size-at-recruitment from the subsample data.

METHODS AND PROCEDURES

Biological and greatest carapace widths for male snow crabs were measured in January through March 1997 by at-sea observers deployed on catcher-processors participating in the commercial fishery. Measurements of GCW were taken to the nearest millimeter perpendicular to the medial axis at the point of maximum width, including any spines at the periphery; CW was measured to the nearest millimeter perpendicular to the medial axis at the point of maximum width, not including peripheral spines. A total of 417 male crabs between 60 and 105mm CW (and 60 to 105mm GCW) were randomly selected from pots fished by two vessels during the commercial fishery. A normal distribution of CW and GCW was assumed and linear regression using the ordinary least-squares fit (e.g., Neter et al. 1983) was used to examine the corresponding relationship between the two variables. The linear model $Y = \beta_0 + \beta_1 X + \varepsilon$ ($E(\varepsilon) = 0$) fit an estimated true regression line and predicted an expected size at recruitment CW.

A probability statement concerning the $100(1-\alpha)\%$ confidence interval (CI) was applied to examine the extent of variability in the linear model at of the expected size-at-recruitment CW

$$\beta_0 + \beta_1 X^* \pm t_{\alpha/n-2} S_{\beta_0 + \beta_1}$$

where,

β_0 = the estimated γ intercept of the linear regression model;

β_1 = the estimated line slope of the linear regression model

X^* = 78.7 GCW (size-at-recruitment);

$t_{\alpha/n-2}$ = critical value of the t distribution at α and $n-2$ degrees of freedom, and;

$S_{\beta_0 + \beta_1}$ = the standard error of the unbiased estimator $\beta_0 + \beta_1 X^*$.

RESULTS AND DISCUSSION

Figure 1 shows an apparent near perfect linear relationship between male snow crab GCW and CW with a 1.00 coefficient of determination (r^2). A residual plot of observed versus predicted biological carapace width also supports application of the linear model (Figure 2). Statistics from the regression analysis are given in Table 1. Based on the model output, the expected male snow crab size-at-recruitment CW equaled 78.6mm at 78.8mm GCW. The application of a 95%CI to the sample data revealed the true mean size-at-recruitment CW within an interval of 78.6mm to 78.7mm. Analysis of the data indicate that a very significant relationship of male snow crab CW to GCW can be demonstrated and that the expected mean size-at-recruitment CW is an appropriate value for use in designating the stock component available for commercial harvest. The data results also appear to show that essentially, any peripheral carapace spines found on snow crabs do not effect a measurable difference between the current standard definitions of biological and legal-size.

LITERATURE CITED

ADF&G (Alaska Department of Fish and Game). Commercial Shellfish Fishing Regulations, 1997-98 edition. Commercial Fisheries Management and Development Division, Juneau.

Neter, J., W. Wasserman and M. H. Kutner. 1983. Applied Linear Regression Models. Richard D. Irwin Inc., Illinois. 537p.

Table 1. Least Squares Regression Analysis of biological carapace width and greatest carapace width in male snow crabs sampled during the 1997 Eastern Bering Sea commercial fishery.

Regression Statistics					
Correlation coefficient (r)					1.00
Coefficient of determination (r^2)					1.00
Adjusted r^2					1.00
Standard Error					.31mm
mean biological carapace width (CW)					83.8mm
mean greatest carapace width (GCW)					83.9mm
Sample size (n)					417
Linear model output					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.33	0.15	0.03	0.03	0.62
Carapace width	1.00	1.78E-03	<0.01	0.99	1.00

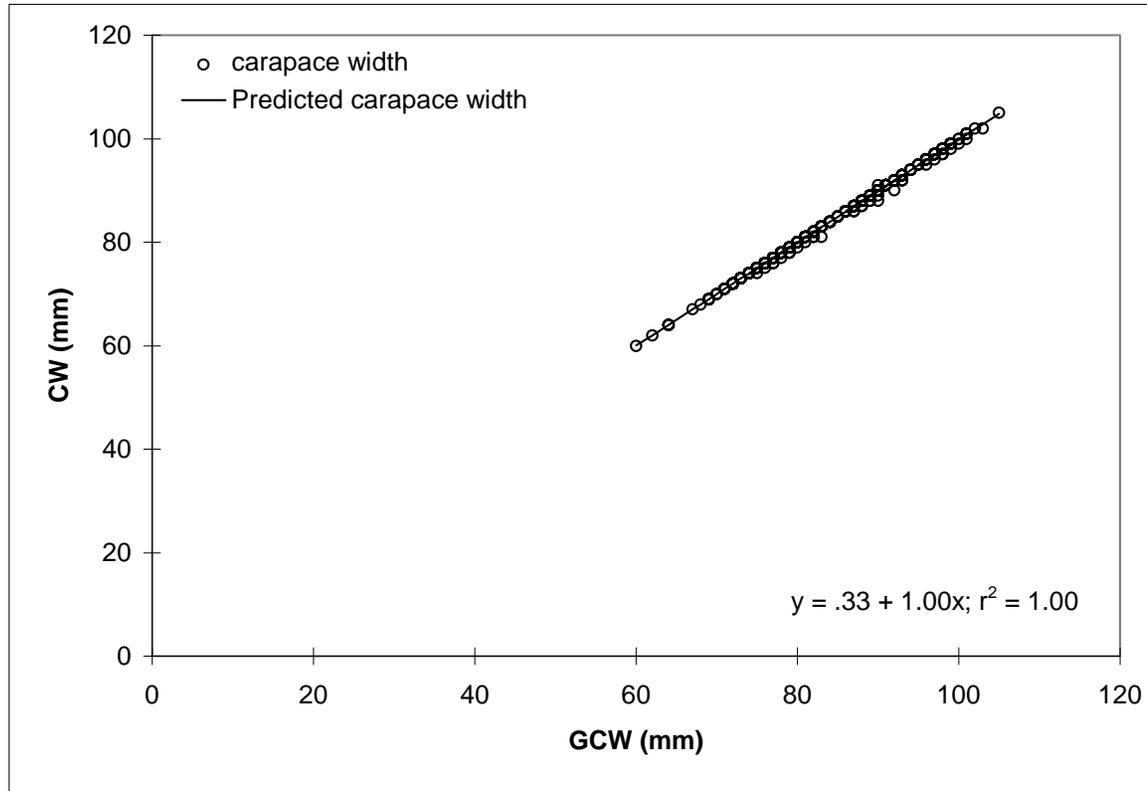


Figure 1. Observed and predicted biological carapace width correlated to greatest carapace width in snow crab males sampled during the 1997 Eastern Bering Sea commercial fishery.

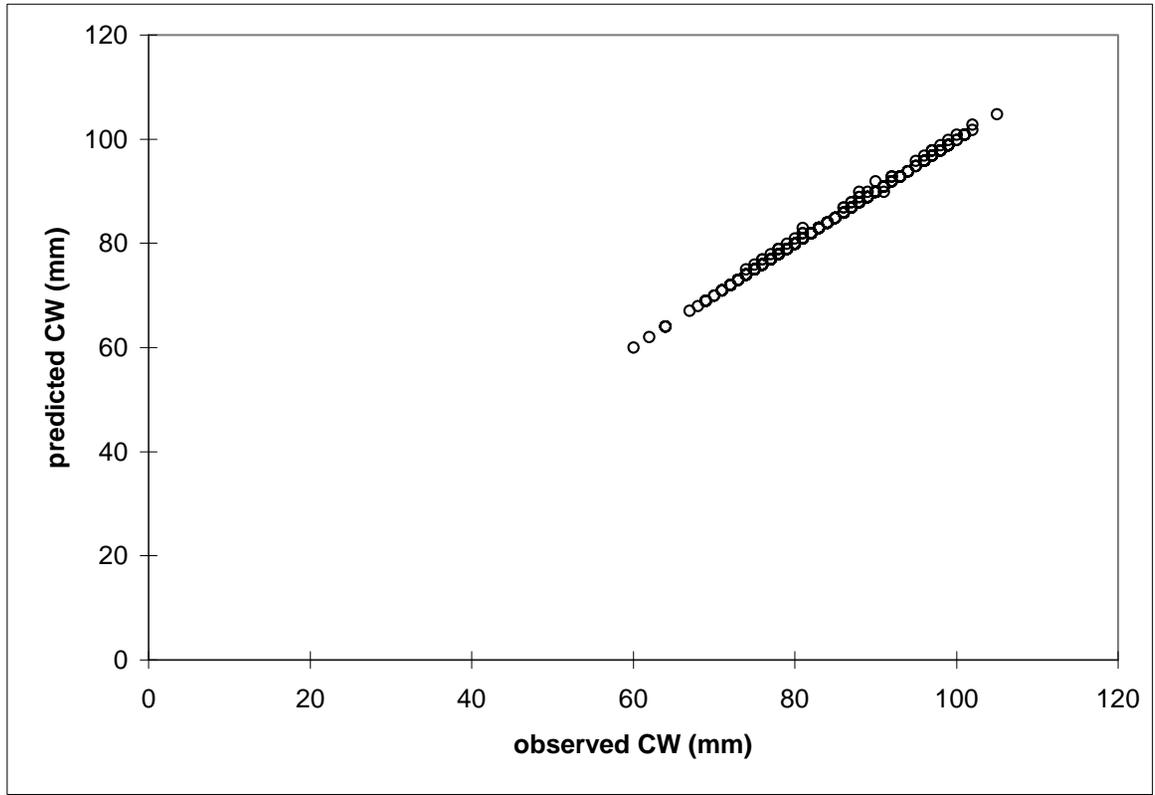


Figure 2. Predicted versus observed biological carapace width of snow crab males sampled during the 1997 Eastern Bering Sea commercial fishery.

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