ESTIMATED SIZE-AT-RECRUITMENT OF MALE RED KING CRABS *PARALITHODES CAMTSCHATICUS* INTO THE COMMERCIAL FISHERY OF BRISTOL BAY, ALASKA

By
Donn Tracy

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INTRODUCTION

The size-at-recruitment (or minimum legal retention size) of male red king crabs *Paralithodes camtschaticus* commercially fished in waters of Bristol Bay, Alaska is described as 6.5 inches (165.1mm) in carapace width (CW) in Alaska Department of Fish and Game Commercial Shellfish Fishing Regulations (ADF&G 1997) and 135mm carapace length (CL) in annual population survey results (Otto et al. 1998). The objective of this investigation was to examine a relationship between CL and CW in a subsample of males observed during the 1996 during an ADF&G Bering Sea Test Fishery research survey conducted in 1996, and estimate the true mean CL size-at-recruitment from the subsample data.

METHODS AND PROCEDURES

Carapace lengths and widths for male red king crabs were measured in August 1996. Measurements of CW were taken to the nearest millimeter perpendicular to the medial axis at the point of maximum width; CL was measured from the right eye orbit to the midpoint of the posterior margin. A total of 336 male crabs between 80 and 181mm CL (and 92 to 213mm CW) were randomly selected from pots fished during the research survey. Linear regression using the ordinary least-squares (Neter et al. 1983) was used to fit the linear model

$$CL = \beta_o + \beta_1(CW) + \varepsilon$$

where ε are assumed normally distributed and independent with $E(\varepsilon) = 0$.

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 CL

$$\beta_o + \beta_1(CW) \pm t_{\alpha/n-2} S_{\beta o + \beta 1}$$

where,
β_o = the estimated γ intercept of the linear regression model;
β_1 = the estimated line slope of the linear regression model;
CW = 165.1mm (size-at-recruitment);
$t_{\alpha/n-2}$ = critical value of the t distribution at α and n-2 degrees of freedom, and;
$S_{\beta o + \beta 1}$ = the standard error of the unbiased estimator $\beta_o + \beta_1(CW)$.

RESULTS AND DISCUSSION

Figure 1 shows a strong linear relationship between male red king crab CW and CL with a .98 coefficient of determination (r^2). A residual plot of observed versus predicted carapace length 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 red king crab size-at-recruitment CL

equaled 136.9mm at 165.1mm CW. The application of a 95% CI revealed a true mean size -at-recruitment CL between 136.4mm and 137.4mm. The results of the analysis indicates that very significant relationship of male red king crab CL to CW can be demonstrated, and that the expected mean CL size-at-recruitment is an appropriate value for use in determining the stock component available for commercial harvest.

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.

Otto R. S., J.A. Haaga and R.A. Macintosh. 1998. Report to Industry on the 1997 Eastern Bering Sea Crab Survey. National Marine Fisheries Service, Alaska Fisheries Science Center, Processed Report 98-02, Kodiak.

Table 1. Least Squares regression analysis of carapace length and carapace width in male red king crabs sampled during the 1996 ADF&G Bering Sea Test Fishery research survey.

Regression Statistics	
Correlation coefficient (r)	.99
Coefficient of determination (r^2)	.98
Adjusted r^2	.98
Standard Error	3.7mm
mean carapace length (CL)	121.3mm
mean carapace width (CW)	145.1mm
Sample size (n)	336

Linear model output					
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	7.78	0.93	2.08E-15	5.93	9.60
Carapace width	0.78	0.01	2.40E-282	0.77	0.79

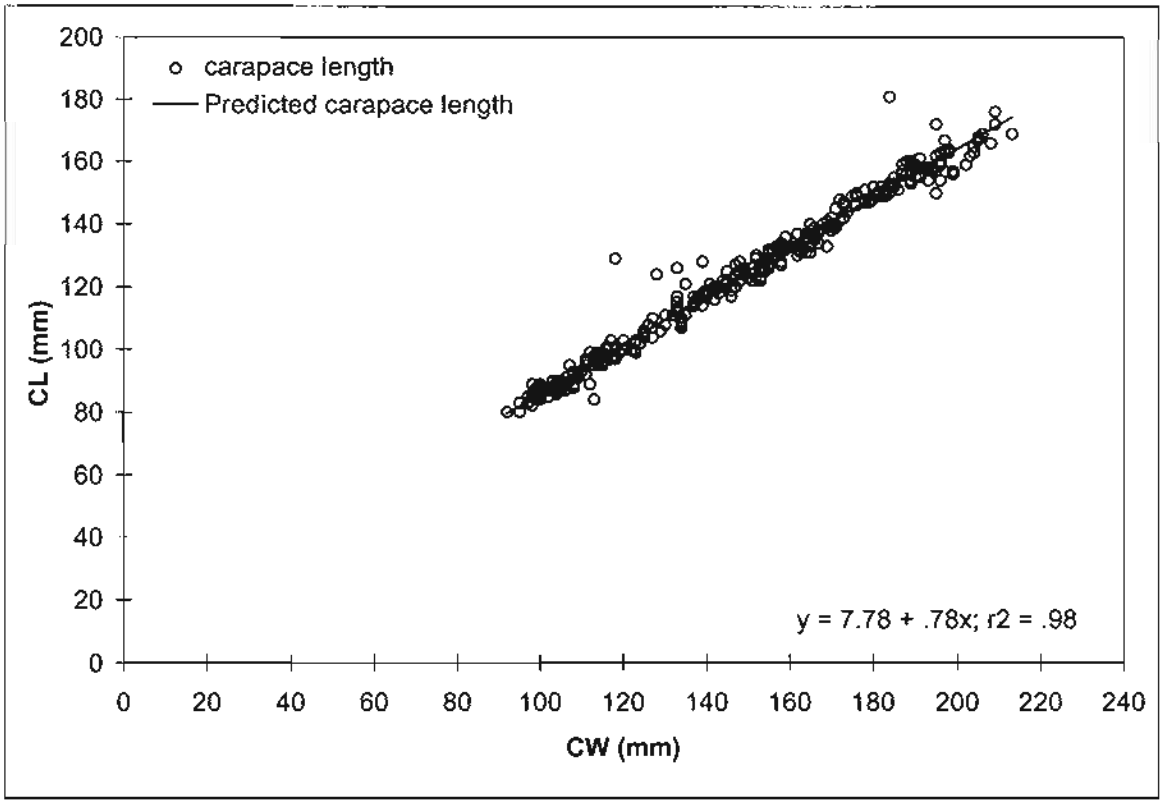

Figure 1. Observer and predicted carapace length correlated to carapace width in red king crab males sampled during the 1996 ADF&G Bering Sea Test Fishery research survey.

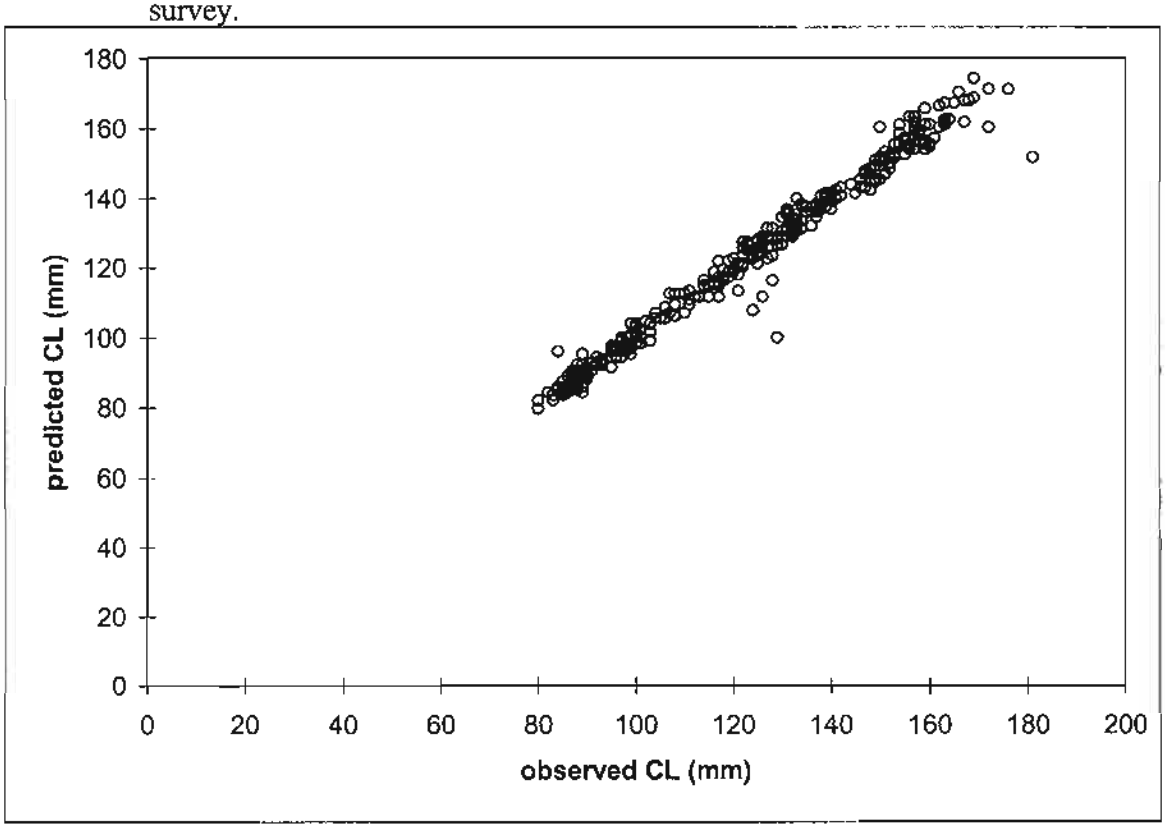

Figure 2. Predicted versus observed carapace length of red king crab males sampled during the 1996 ADF&G Bering Sea Test Fishery research survey.