

ESTIMATED SIZE-AT-RECRUITMENT FOR TANNER CRABS  
*CHIONOECETES BAIRDI* INTO THE EASTERN BERING SEA  
COMMERCIAL FISHERY

by  
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## TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES .....	i
LIST OF FIGURES.....	i
INTRODUCTION.....	1
PROCEDURE AND METHODS.....	1
RESULTS AND DISCUSSION.....	1
LITERATURE CITED .....	3
TABLES .....	4
FIGURES.....	5

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Least Squares Regression Analysis of biological carapace width versus greatest carapace width in male Tanner crabs sampled during the 1996 AF&G Bering Sea Test Fishery research survey .....	4

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Observed and predicted biological carapace width correlated to greatest carapace width in Tanner crab males sampled during the 1996 ADF&G Bering Sea Test Fishery research survey .....	5
2. Predicted versus observed biological carapace width of Tanner crab males sampled 1996 ADF&G Bering Sea Test Fishery research survey .....	5

## INTRODUCTION

The size-at-recruitment (or minimum legal retention size) for male Tanner crabs *Chionocetes bairdi* commercially fished in waters of the Eastern Bering Sea is described as 139.7mm (5.5 inches) in greatest carapace width (GCW) in Alaska Department of Fish and Game Commercial Shellfish Fishing Regulations (ADF&G 1997) and 138mm biological or “scientific” carapace width (CW) in annual population survey results (Otto et al. 1998). The objective of this investigation was to examine a relationship between CW and GCW in a subsample of males observed during a 1996 Alaska Department of Fish and Game (ADF&G) research survey, and estimate the true mean CW size-at-recruitment from the subsample data.

## METHODS AND PROCEDURES

Biological and greatest carapace widths for male Tanner crabs were measured in August 1996. Measurements of GCW were taken to the nearest millimeter perpendicular to the medial axis at the point of maximum width, including spines at the periphery; CW was measured to the nearest millimeter perpendicular to the medial axis at the point of maximum width, not including spines at the periphery. A total of 155 male crabs between 99 and 172mm CW (and 99 to 173mm GCW) were randomly selected from pots fished by a chartered vessel during the research survey. A normal distribution of CW and GCW was assumed and linear regression using the ordinary least-squares fit (Neter et al. 1983) was used to examine the corresponding relationship between the two variables. The linear model  $Y = \beta_0 + \beta_1 X + \epsilon$  ( $E(\epsilon) = 0$ ) 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,

$\beta_0$  = the estimated  $\gamma$  intercept of the linear regression model;

$\beta_1$  = the estimated line slope of the linear regression model

$X^*$  = 139.7 GCW (size-at-recruitment);

$t_{\alpha/n-2}$  = critical value of the  $t$  distribution at  $\alpha$  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 a complete linear relationship between male Tanner 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 Tanner crab size-at-recruitment CW equaled 139.3mm at 139.7mm GCW. Using a 95%CI, an interval of 139.2mm to 139.5mm surrounded the true mean size-at-recruitment CL. The results of the analysis of relationship of male Tanner crab CW to GCW differs statistically from the conclusions of Otto and others inferring a mean biological size-at-recruitment of 138mm CW for this species. However, the current analysis has biological relevance to the previous findings and in that context is generally supportive of them.

## 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. McIntosh. 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 biological carapace width and greatest carapace width in male Tanner crabs sampled during the 1996 Bering Sea Test Fishery research survey.

Regression Statistics					
Correlation coefficient ( <i>r</i> )					1.00
Coefficient of determination ( <i>r</i> <sup>2</sup> )					1.00
Adjusted <i>r</i> <sup>2</sup>					1.00
Standard Error					0.8mm
mean biological carapace width (CW)					141.5mm
mean greatest carapace width (GCW)					141.9mm
Sample size ( <i>n</i> )					155
Linear model output					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-0.26	0.63	0.68	-1.50	0.98
Carapace width	1.00	0.004	2.00E-195	0.99	1.01

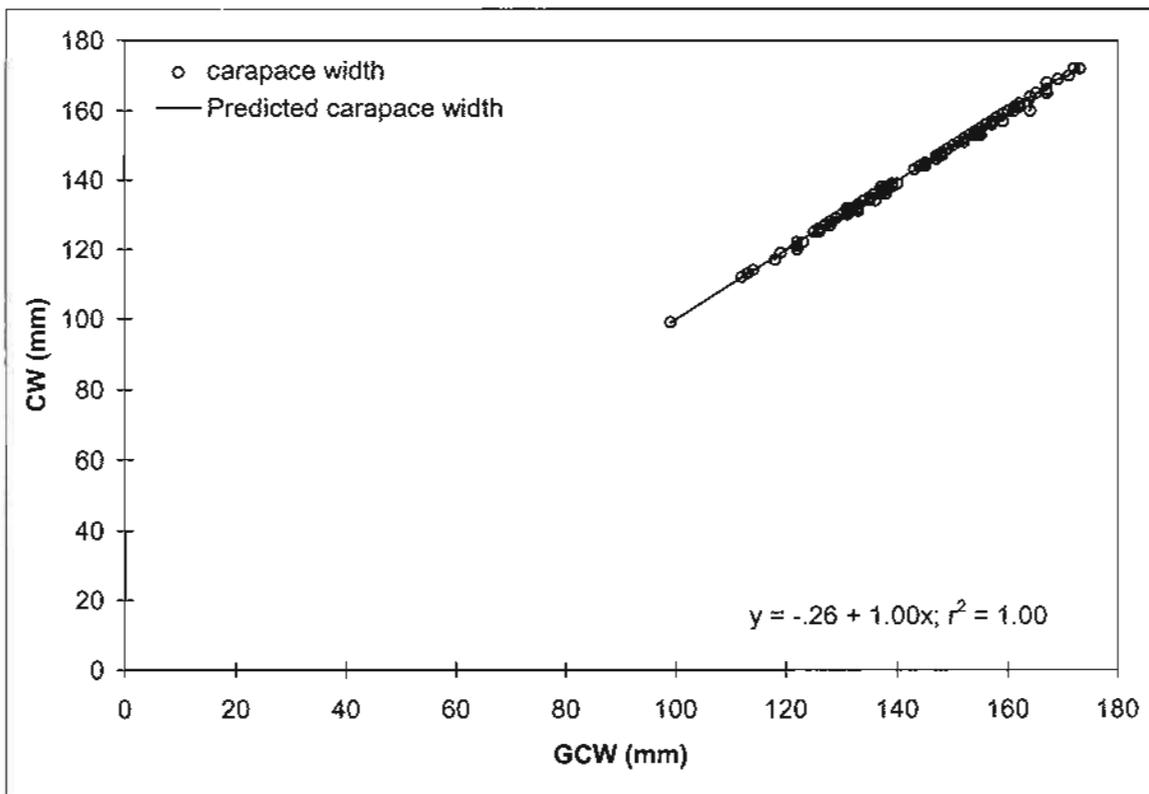


Figure 1. Observed and predicted biological carapace width correlated to greatest carapace width in Tanner crab males sampled during the 1996 Bering Sea Test Fishery research survey.

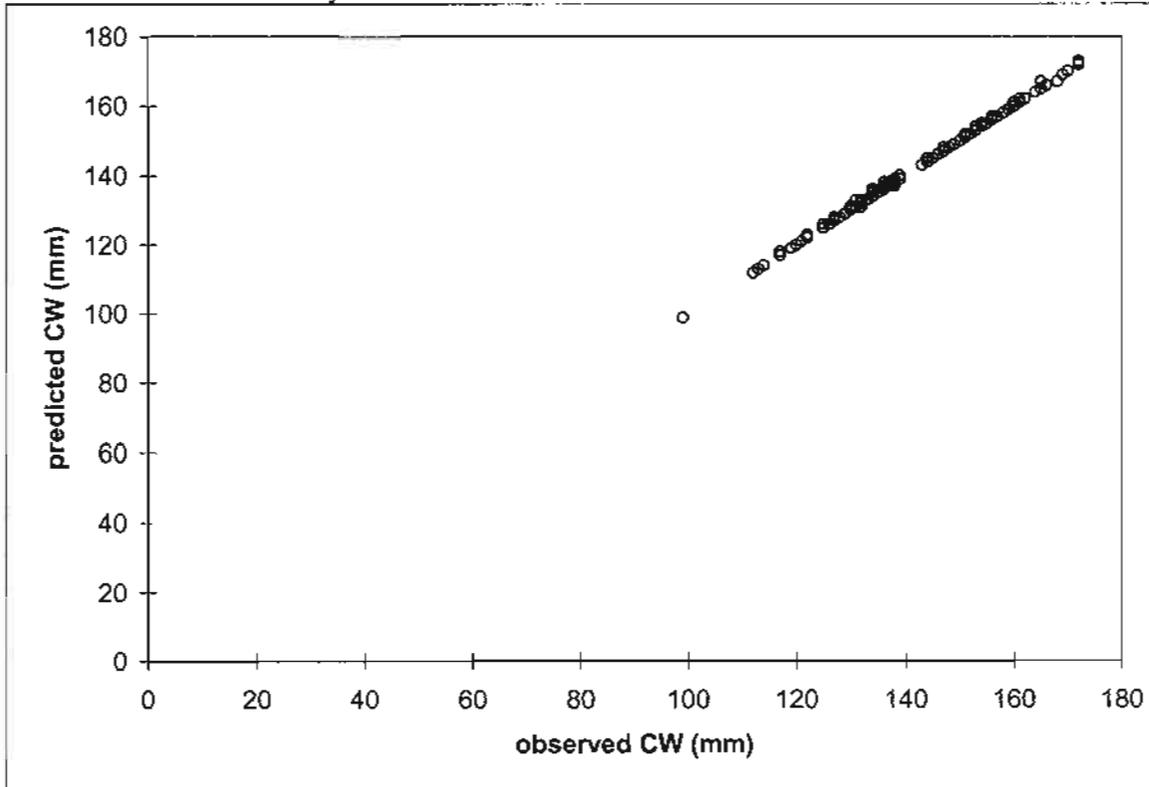


Figure 2. Predicted versus observed carapace width of Tanner crab males sampled during the 1996 Bering Sea Test Fishery research survey.

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