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COMMERCIAL BROWN, WHITE AND PINK SHRIMP TAIL SIZE: TOTAL SIZE CONVERSIONS

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U.S. DEPARTMENT OF COMMERCE
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Equations for converting tail length to total length and tail weight to total weight and vice versa were obtained for white, brown and pink shrimp (*Penaeus setiferus*, *Penaeus aztecus* and *Penaeus duorarum*, respectively), using linear regression analyses. This model, with no variable transformations, produced the best fits to the data i.e. explained the greatest variation in the dependent variable (Y) by variation in the independent variable (X). The available data consisted of measurements taken on shrimp samples obtained during shrimp tagging studies conducted by SEFC, Galveston Laboratory during 1979 and the latter part of 1978.

Data obtained over one or more days during a tagging trip were treated as a single sample. Data were plotted separately for males and females and outliers identified by visual inspection were deleted. Fits were obtained for males and females of each sample in order to identify any significant heterogeneity between sexes or among samples. All regressions were significant ($p \ll 0.001$). Residuals of fits were examined in each case statistically by two methods as well as visually. The first method applied a run's test against the residuals (+,-) ranked by X to identify consistent bias in lack of fit. The second method tested for a significant regression of the absolute deviation of $(Y-\hat{Y})$ on X, which would indicate that the variance was not constant and that a weighted least squares analysis was appropriate. Non-significance of these tests ($p > 0.05$) indicated satisfactory residuals. Residuals were inspected visually when these tests were of borderline significance.

Regression equations were compared using analysis of covariance. Although significant differences in some cases were observed, no consistent trends in differences between males and females or among samples were apparent, and thus, these differences were not considered meaningful. Hence conversion equations were obtained for males and females of each species pooled over samples. Although analysis of covariance showed equations of males and females comprising each pair differed significantly in slope ($p < 0.001$), in practice, the differences in predicted values fall within the range of measurement error, i.e. maximum differences in estimated values for males and females lay within ranges of standard errors of the estimates. Thus, conversion equations obtained by pooling males and females are provided for each species for general use.

Conversion equations for males and females and pooled males and females of each species are given in Tables 1-4. Also tabulated are sample statistics necessary to calculate the standard error of a predicted Y value for a given X ($S.E._Y$), using the following formula:

$$S.E._Y = SQRT\ (EMS\ (1 + 1/N + (X-\overline{X})^2 /SSX)$$

Equations for converting tail length to total length and vice versa in white, brown and pink shrimp have also been reported by Fontaine and Neal (1968, Fish. Bull. 67(1): 125-126). Their estimates lie within the range of variation observed within this study over the coincident portions of the size ranges of the data sets. The studies do differ, however, in ranges of shrimp sizes and sample sizes. The ranges of shrimp size utilized here were generally greater and included smaller sizes of shrimp. Sample sizes used here were also greater. Hence, the

Table 1. Tail Length (X) to Total Length (Y) Conversions (mm)

Shrimp species/sex	Range in Tail Length	Sample Size (N)	Regression Equations	% Explained Variability	Error Mean Square (EMS)	Sum of Squares of X (SSX)	Mean of X ($\overline{X}$)
Penaeus setiferus							
Males	35 - 106	1417	$Y = 0.079 + 1.672X$	98.1	8.968	236632.1	69.1
Females	30 - 112	1847	$Y = -1.938 + 1.713X$	98.7	9.960	470630.2	67.9
Sexes Combined	30 - 112	3264	$Y = -1.277 + 1.699X^*$	98.5	9.796	708481.3	68.4
Penaeus aztecus							
Males	22 - 109	4652	$Y = 1.591 + 1.643X$	97.6	11.361	789624.3	60.4
Females	29 - 138	5482	$Y = -0.138 + 1.684X$	98.8	12.068	1836565.1	61.2
Sexes Combined	22 - 138	10134	$Y = 0.242 + 1.672X^*$	98.4	11.954	2627784.0	60.8
Penaeus duorarum							
Males	37 - 100	1035	$Y = 7.202 + 1.549X$	96.1	11.651	121862.5	68.0
Females	35 - 114	996	$Y = 1.843 + 1.643X$	95.8	22.647	189208.6	70.3
Sexes Combined	35 - 114	2031	$Y = 3.582 + 1.610X^*$	95.8	17.647	313742.0	69.1

*equations obtained for males and females, respectively, differed significantly in slope ($p<0.001$)

Table 2. Tail Weight (X) to Total Weight (Y) Conversions (gr)

Shrimp species/sex	Range in Total Weight	Sample Size (N)	Regression Equation	% Explained Variability	Error Mean Square (EMS)	Sum of Squares of X (SSX)	Mean of X ($\bar{X}$)
Penaeus setiferus							
Males	.9 - 29.0	1433	Y = -.0878 + 1.574X	99.6	17.85	2863463.4	7.9
Females	.6 - 38.3	1855	Y = -.1192 + 1.596X	99.7	21.91	6389127.7	8.0
Sexes Combined	.6 - 38.3	3288	Y = -.1286 + 1.590X*	99.7	20.89	9255135.2	8.0
Penaeus aztecus							
Males	.6 - 32.9	4698	Y = .0624 + 1.546X	99.5	17.37	6720361.5	5.8
Females	.4 - 59.0	5575	Y = -.1965 + 1.616X	99.6	57.46	31737796.3	7.4
Sexes Combined	.4 - 59.0	10273	Y = -.1953 + 1.606X*	99.9	42.52	39113583.5	6.7
Penaeus duorarum							
Males	.7 - 24.8	1112	Y = .3067 + 1.511X	99.1	28.85	1459380.5	8.2
Females	.4 - 41.4	1062	Y = -.1639 + 1.606X	99.3	63.98	3542758.7	9.9
Sexes Combined	.4 - 41.4	2174	Y = -.1290 + 1.585X*	99.1	53.28	5157359.6	9.0

*equations obtained for males and females, respectively, differed significantly in slope ($p<0.001$)

Shrimp species/sex	Range in Total Length	Sample Size (N)	Regression Equation	% Explained Variability	Error Mean Square (EMS)	Sum of Squares X (SSX)	Mean of X ($\bar{X}$)
<u>Penaeus</u> <u>setiferus</u>							
Males	51 - 177	1417	Y = 1.254 + 0.586X	98.1	3.147	674231.1	115.6
Females	51 - 194	1847	Y = 2.006 + 0.576X	98.7	3.345	1401197.6	114.4
Sexes Combined	51 - 194	3264	Y = 1.792 + 0.579X*	98.5	3.341	2076623.9	114.9
<u>Penaeus</u> <u>aztecus</u>							
Males	40 - 191	4652	Y = 0.517 + 0.594X	97.6	4.105	2185219.6	100.9
Females	45 - 229	5482	Y = 0.847 + 0.586X	98.7	4.329	5272202.9	102.9
Sexes Combined	40 - 229	10134	Y = 0.845 + .588X*	98.3	4.276	7467987.6	102.0
<u>Penaeus</u> <u>duorarum</u>							
Males	62 - 165	1035	Y =-1.777 + .620X	96.1	4.662	304584.1	112.6
Females	62 - 239	996	Y = 1.893 + .583X	95.8	8.034	533360.5	117.4
Sexes Combined	62 - 239	2031	Y = 0.784 + .595X*	95.8	6.518	849565.9	114.9

*equations obtained for males and females, respectively, differed significantly in slope ($p<0.001$)

Shrimp species/sex	Range in Total Weight	Sample Size (N)	Regression Equations	% Explained Variability	Error Mean Square (EMS)	Sum of Squares of X (SSX)	Mean of X ($\bar{X}$)
Penaeus setiferus							
Males	1.2 - 47.4	1433	Y = .0839 + 0.633X	99.6	7.175	7122188.1	12.3
Females	.9 - 61.3	1855	Y = .0946 + 0.625X	99.7	8.578	16321326.4	12.7
Sexes Combined	.9 - 61.3	3288	Y = .1041 + 0.627X*	99.7	8.258	23458165.5	12.5
Penaeus aztecus							
Males	1.0 - 53.5	4698	Y =-.0106 + 0.643X	99.5	7.225	16150716.2	9.1
Females	.7 - 96.9	5476	Y = .1497 + 0.616X	99.6	22.336	78530037.0	11.4
Sexes Combined	.7 - 96.9	10174	Y = .1480 + 0.620X*	99.5	16.548	96079922.0	10.4
Penaeus duorarum							
Males	1.8 - 38.1	1112	Y =-.1226 + 0.655X	99.1	12.506	3366346.8	12.7
Females	1.8 - 64.9	1062	Y = .1745 + 0.618X	99.3	24.620	9206116.6	15.7
Sexes Combined	1.8 64.9	2174	Y = .1611 + 0.625X*	99.1	21.058	13069043.9	14.2

* equations obtained for males and females, respectively, differed significantly in slope ($p<0.001$)