# Commercial brown, white, and pink shrimp tail size: total size conversions

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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U. S. DEPARTMENT OF COMMERCE
Philip M. Klutznick, Secretary
National Oceanic and Atmospheric Administration
Richard A. Frank, Administrator
National Marine Fisheries Service
Terry L. Leitzell, Assistant Administrator for Fisheries

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

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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 ($p << 0.001$). 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:

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

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

equations presented here relating tail length and total length are more useful since they were fit to greater size ranges of shrimp.

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 ($\bar{X}$) |
|---|---|---|---|---|---|---|---|
| *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 ($p<0.001$)

Table 3. Total Length (X) to Tail Length (Y) (mm)

| 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 ($\bar{X}$) |
|---|---|---|---|---|---|---|---|
| Penaeus setiferus | | | | | | | |
| 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 |
| Penaeus aztecus | | | | | | | |
| 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 |
| Penaeus duorarum | | | | | | | |
| 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 ($p<0.001$)

Table 4. Total Weight (X) to Tail Weight (Y) (gr)

| 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 ($p<0.001$)