

Allometric relationships of Gulf of Mexico red snapper

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Materials and Methods

Length-weight and total length-fork length relationships for red snapper were estimated using Trip Interview Program (TIP) and NMFS Headboat Survey data from 1986 to 2002. Separate relationships were estimated for the East (statistical grid 1-12), and West Gulf of Mexico (statistical grid 13-24), and for the entire Gulf. Total length - Fork length relationship was examined using the linear statistical model:

$$TL = a + b FL \quad (1)$$

where TL and FL correspond to total length and fork length, respectively, and a and b are model parameters. Model parameters of equation (1) were estimated by ordinary least square regression (PROC GLM, SAS Institute). Length-Weight relationships were examined using the following exponential model:

$$W = a L^b \quad (2)$$

where W correspond to weight (whole weight WW or gutted weight GW), L corresponds to length (total length TL or fork length FL), and a and b are model parameters. Model parameters of equation (2) were estimated by nonlinear regression analysis using the least square method (PROC

NLIN, SAS Institute).

For all relationships, a ratio Observed/Predicted values was estimated. Observed values that were not within the range $0.75 < \text{ratio} < 1.25$ were deleted (25% filter) and the regression (linear or non-linear depending on the case) re-run.

Results

All regression results presented were obtained using the 25% filter. Table 1 shows the estimated parameters of the total length - fork length relationship for East, West, and the entire Gulf of Mexico (GOM). Sample size for the East GOM was very small. Note that the sample size for the entire GOM (2,451 red snapper) is much larger than the sum of the observations from the East and West GOM (360 red snapper) because the sample from the entire GOM included all red snapper with both known and unknown fishing location. Ninety percent (2,201 red snapper) of all observations from the entire GOM (2,451) were from the TIP database. Plots of the total length (TL) predicted values for East and West GOM are presented in Figure 1. No statistical differences were observed between TL-FL relationships from East and West GOM. Figure 2 shows the TL-FL observed and predicted values for the entire GOM.

Table 1: Estimated parameters of the Total length - Fork length relationship for East (statistical grids 1-12), West (statistical grids 13-24) and the entire Gulf of Mexico (All). Parameters *a* and *b* correspond to the intercept and slope, respectively, *n* indicates sample size, r^2 is the correlation coefficient, and size-range correspond to the maximum and minimum total length in the samples used to estimate the TL-FL relationships. Units of length are cm.

Parameters					
Area	<i>a</i>	<i>b</i>	<i>n</i>	r^2	size-range (TL)
East	0.984	1.063	4	0.999	45.0 - 78.8
West	0.795	1.056	356	0.990	25.2 - 88.3
All	0.586	1.064	2,451	0.996	45.0 - 78.8

Table 2 presents the estimated parameters of the L-W relationships (equation 2). Parameters

for the East GOM were estimated only using TIP data because no data for that region was available from the Headboat survey. Length-gutted weight relationships were also estimated only using TIP data since the Headboat survey only records whole weight. Figure 3 presents the predicted TL and FL values (from WW and GW) for East and West GOM. Similarly to TL-FL relationship, no significant differences were observed between the different L-W relationships from East and West GOM. Figure 4 shows observed and predicted Length-weight values according to the parameters presented in Table 2. The estimated Length-Weight relationships (Table 2) were compared with the relationships presented by Goodyear (1995) and Schirripa and Legault (1999) (Fig. 5). No statistical differences were observed among all the estimated L-W curves.

Table 2: Estimated parameters of the whole weight - total length (WW-TL), whole weight - fork length (WW-FL), gutted weight - total length (GW-TL) and gutted weight - fork length (GW-FL) for East, West and the entire Gulf of Mexico (All); *a* and *b* correspond to model parameters of equation (2), *n* indicates sample size. Units of length are cm and units of weight are kg.

		Parameters				
	Area	<i>a</i>	<i>b</i>	<i>n</i>	Size-range (W)	Size-range (L)
WW-TL	East	0.000010	3.100	119	0.48 - 7.98	32.1 - 79.5
WW-FL	East	0.000011	3.122	281	0.15 - 12.15	20.5 - 85.5
GW-TL	East	0.000011	3.065	1,239	0.35 - 14.06	30.0 - 101.7
GW-FL	East	0.000019	2.983	2,080	0.45 - 15.42	30.0 - 98.0
WW-TL	West	0.000011	3.074	91,466	0.06 - 16.15	15.2 - 102.0
WW-FL	West	0.000013	3.085	429	0.32 - 18.37	27.5 - 90.0
GW-TL	West	0.000010	3.070	19,097	0.20 - 12.66	24.8 - 95.2
GW-FL	West	0.000011	3.110	16,651	0.27 - 14.29	24.0 - 93.1
WW-TL	All	0.000010	3.076	92,336	0.06 - 16.15	15.2 - 102.0
WW-FL	All	0.000017	3.021	1,382	0.15 - 14.65	20.5 - 97.3
GW-TL	All	0.0000092	3.096	21,853	0.16 - 14.97	24.8 - 101.7
GW-FL	All	0.000014	3.050	33,389	0.18 - 16.33	24.0 - 98.0

REFERENCES

Goodyear, C. P. 1995. Red snapper in U.S. waters of the Gulf of Mexico. Southeast Fisheries Science Center, Coastal Resource Division MIA-95/96-05, 171 p.

SAS Institute. 1999. SAS/STAT user's guide, version 8. SAS Institute, Inc. Cary, North Carolina.

Schirripa, M. J. and C. M. Legault. 1999. Status of the red snapper in U.S. waters of the Gulf of Mexico: updated through 1998. Southeast Fisheries Science Center, Sustainable Fisheries Division Contribution: SFD-99/00-75, 44 p., 3 appxs.

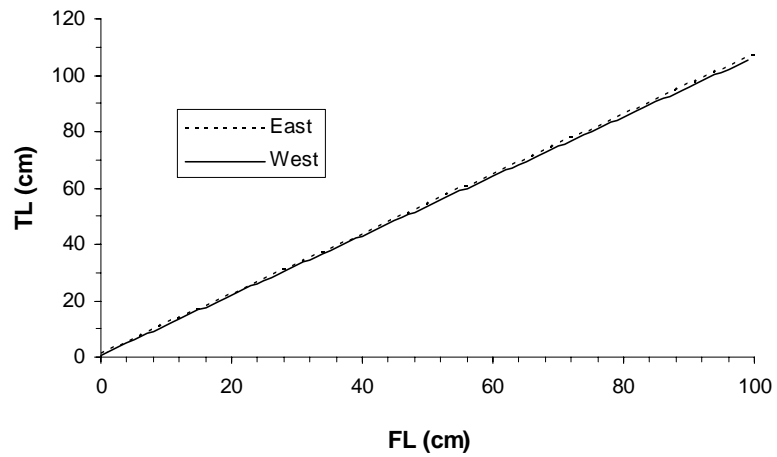


Figure 1: Predicted Total length (TL) for East and West GOM. Parameter values of the TL-FL relationship are presented in Table 1.

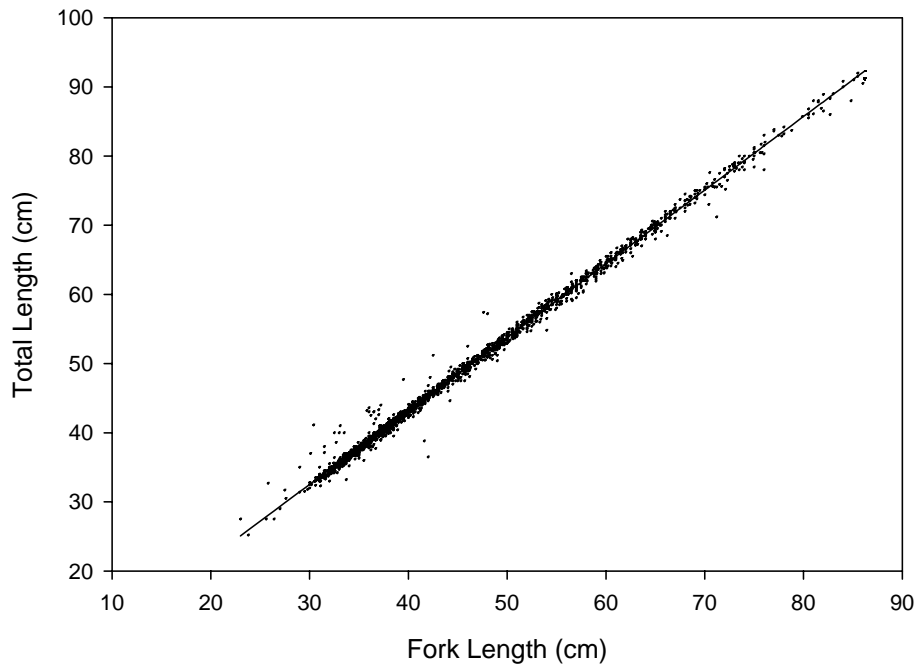


Figure 2: Observed and Predicted TL for the entire GOM. Parameter values of the TL-FL relationship are presented in Table 1.

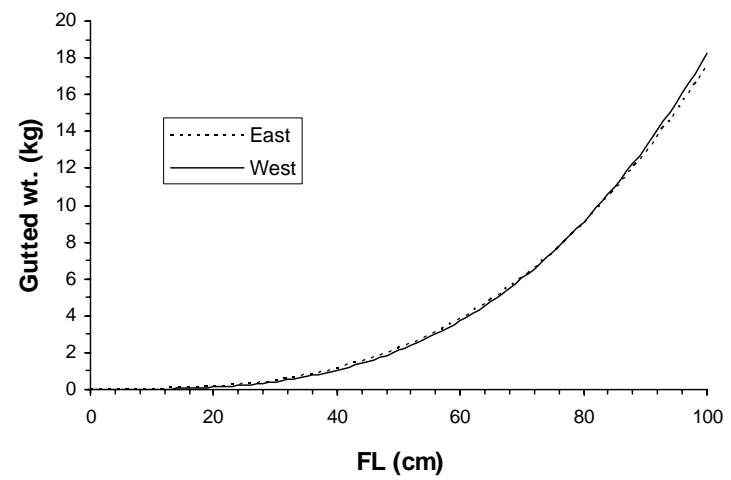
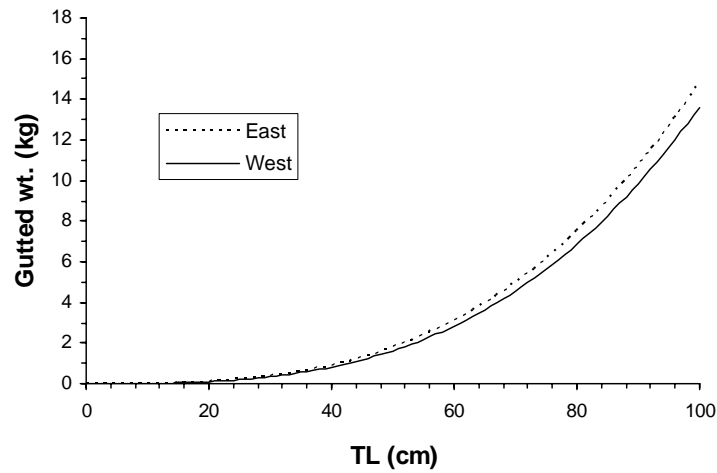
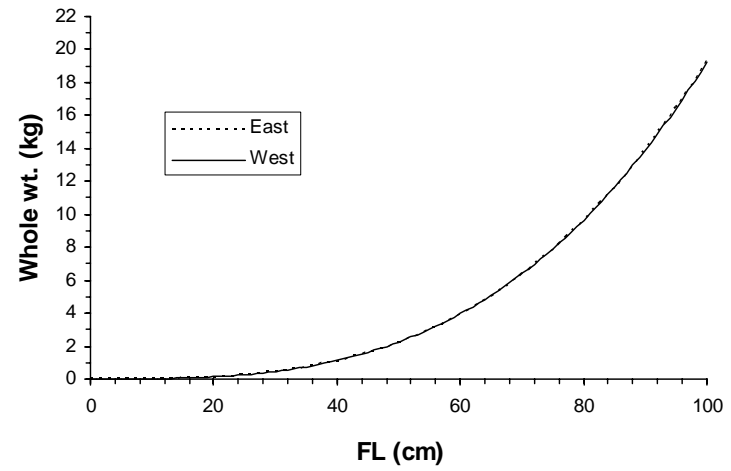
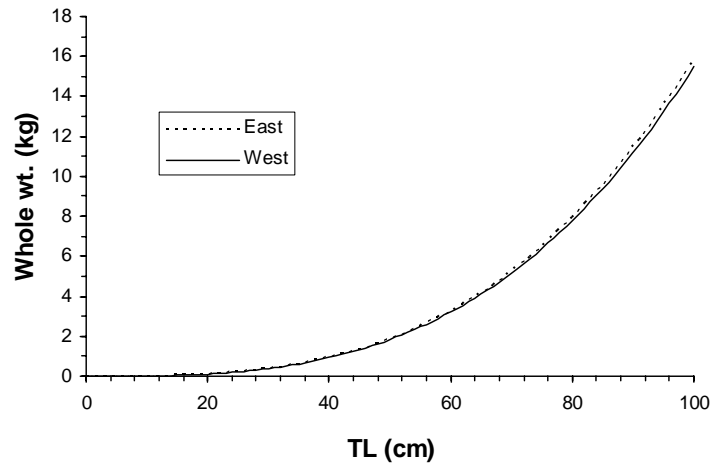
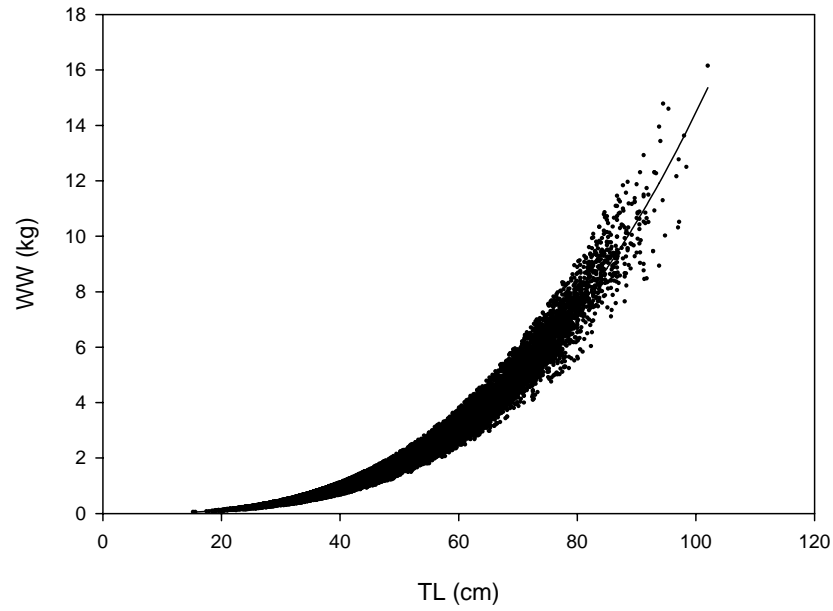


Figure 3: Predicted Total Weight (WW) and Gutted Weight (GW) from Total Length (TL) and Fork Length (FL) for East and West GOM. Parameter values of the different relationships are presented in Table 2.

a)



b)

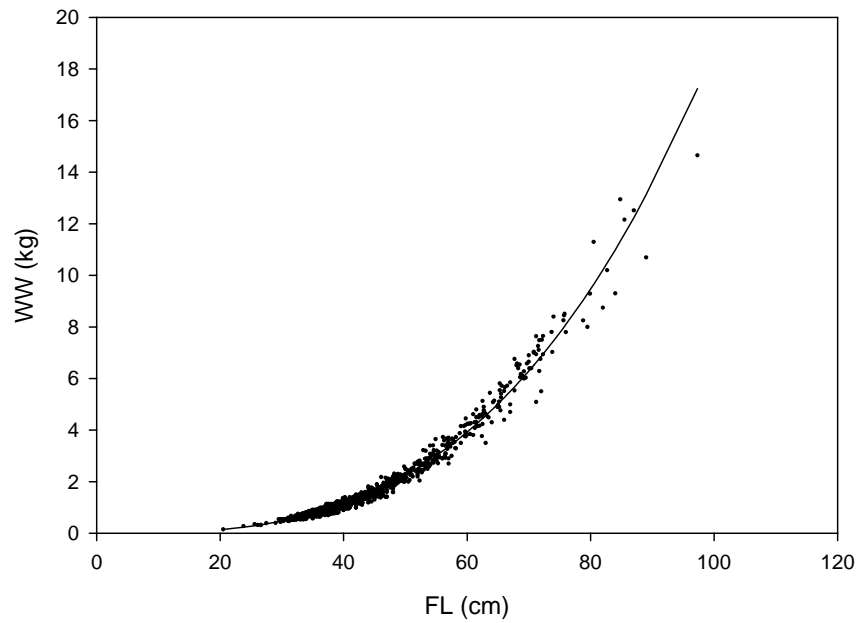
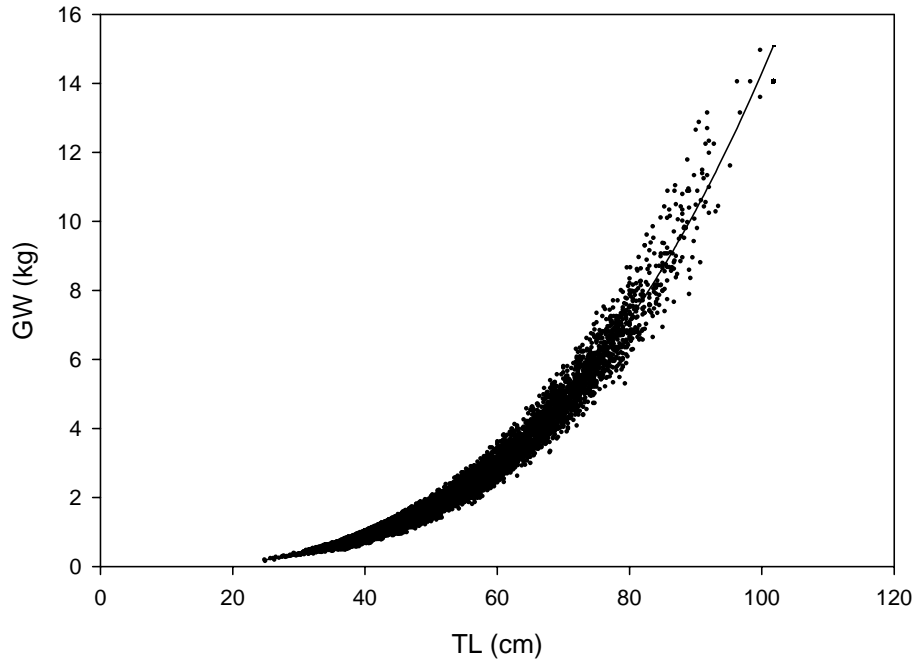


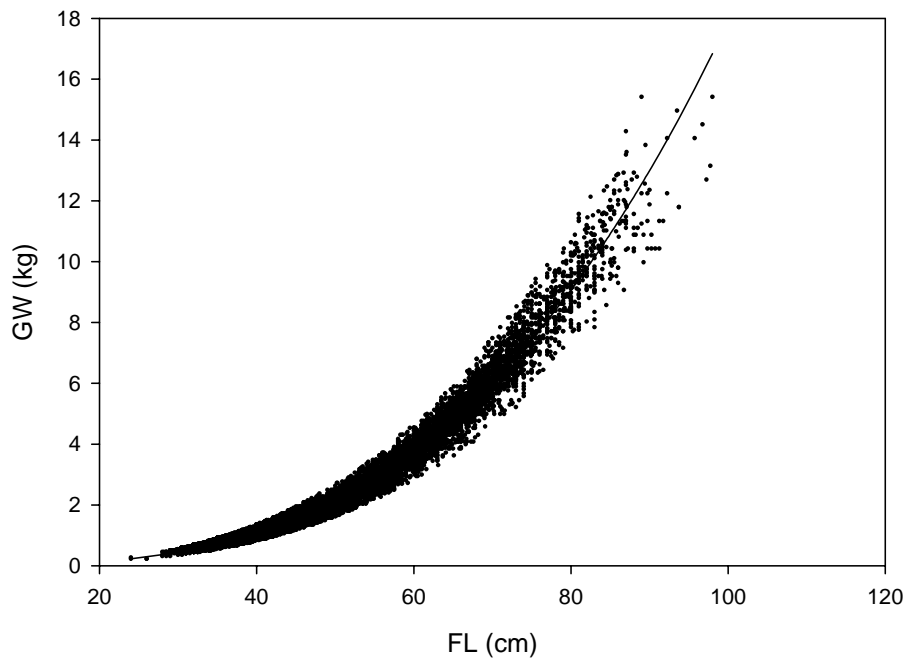
Figure 4: observed and predicted red snapper a) Whole weight-total length, b) whole weight-fork length, c) gutted weight - total length and d) gutted weight-fork length for the entire Gulf of Mexico. Parameter values of the four relationships are presented in Table 2.

Figure 4 (continued)

c)



d)



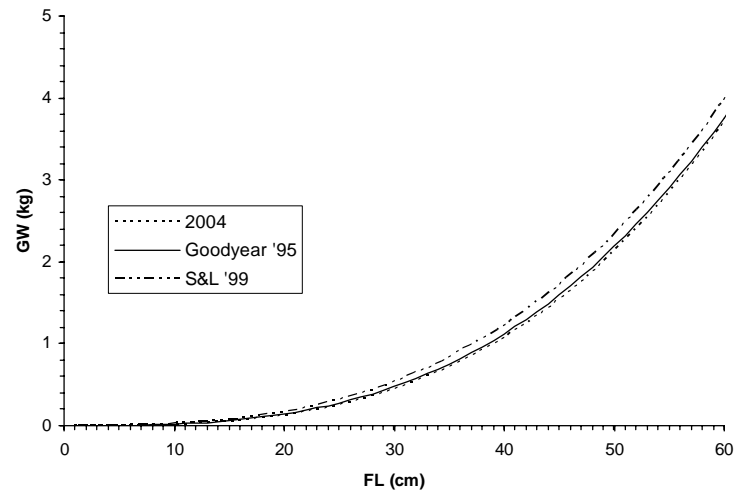
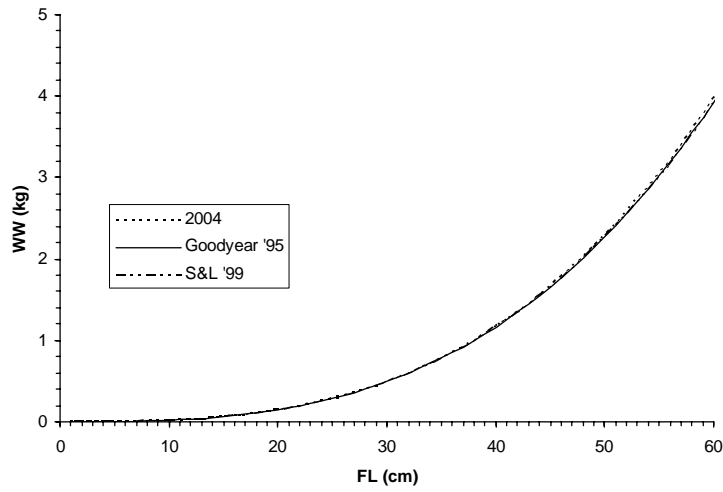
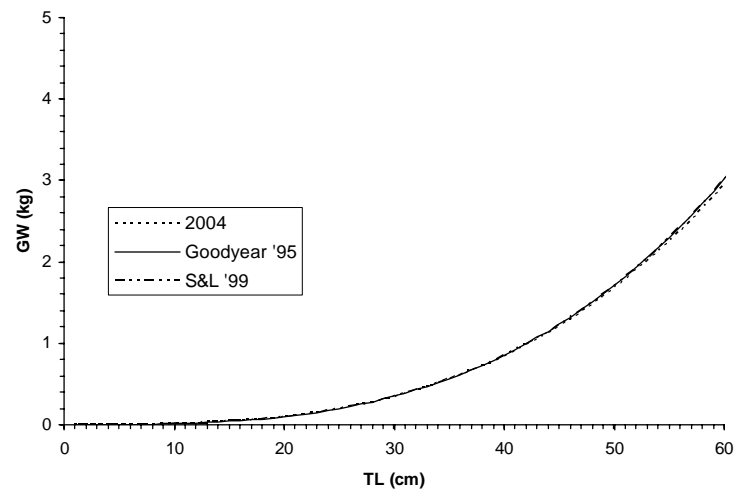
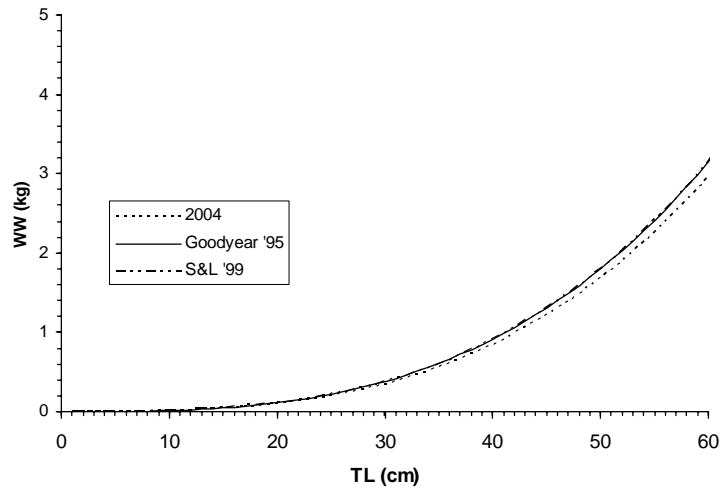


Figure 5: Predicted Total weight (WW) and Gutted weight (GW) from Total length (TL) and Fork length (FL) by Goodyear (1995), Schirripa and Legault (1999) and the present document.