Revision of SEDAR14-AW-05 Results
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Revised estimates of mutton snapper total mortality rates from length observations

By

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This document provides revised estimates of total mortality for mutton snapper from mean length data in the pot fishery of Puerto Rico. As decided in the SEDAR 14 assessment workshop in St. Thomas, three data points were deemed to be unreliable and a reanalysis analysis of total mortality rates from mean length observations (SEDAR14-AW-05) was recommended. These three records (or interview dates from the NMFS Trip Interview Program) contained an unusually high number of large mutton snapper and were not consistent with the other observations during the time period. In evaluating these data points, Daniel Matos (head of port samplers in Puerto Rico) contacted the local port agent who suggested that, given the number of fish in each sample and the large sizes, these records probably correspond to hook and line catches from the spawning aggregations. The port agent was also confident that he would have remembered if that many large fish had been caught with traps, as it would be a very rare event. As such, the panel agreed to delete those data points from the data set. A total of 53 fish from three interview days were removed from the analysis.

The removal of these three interview day records (one in 2001, and two in 2002) resulted not only in lower mean lengths for the time period but also affected the fit of the weighted model by removing the corresponding large sample numbers. Accordingly, estimates of total mortality for the most recent time period were greater than from the previous analysis. The methodology is identical to that presented in of the original document except for the removal of these points, and for the final estimates, the model was allowed to fit the year of change as a continuous variable rather than explored through a grid search.

To characterize the behavior of the model, results from aggregating data (by year and month) and from fitting the model without weighting by sample size are still presented. In the original analysis these model options reduced the influence of those questionable records in 2001 and 2002 and allowed an evaluation of their impact on final estimates of total mortality. The results of the revised analysis vary little when data are

aggregated by year or month, however considering that there may be a temporal pattern to growth (i.e. seasonal) and sampling was not randomly distributed throughout the year, the analysis on each interview day record should be considered the base case (Figures 6-11). The weighted model should also be considered the base case for the revised analysis as it uses all of the available information from the samples and reduces the impact of outliers (e.g. one record with a single very large fish) on final results. The results from the unweighted analysis are informative, however, in that individual records are representative of only a small segment of the overall population and those with the highest sample numbers will affect final results (see record with 13 fish in 1992, Figure 3, which alters estimated year of change in weighted analysis).

Table 1 summarizes the revised results of the original model which assumes one change in mortality. An additional change in mortality was also explored by adding two extra parameters to the model (z_{three} and the second year of change). Although the objective function was improved slightly, a likelihood ratio test for the additional model complexity was not significant. The results, however, were consistent with that of the simpler model and, in the case of the weighted model, suggest that mortality may have been reduced around 1999 (see Table 2).

All figures that were modified from the original SEDAR14-AW-05 have been included in this document.

Table 1. Revised estimates of total mortality rates for the pot fishery of Puerto Rico.

Mean Lengths computed by:	Function weighted by Sample Size	Estimated First Mortality Rate (Z_{ONE})	Estimated Second Mortality Rate Z_{TWO}	Estimated Year of Change
Year	**No**	**0.457**	**0.969**	**1992.78**
Year	**Yes**	**0.476**	**0.946**	**1992.65**
Month	**No**	**0.434**	**0.848**	**1987.96**
Month	**Yes**	**0.477**	**0.955**	**1993.65**
Interview Day	**No**	**0.392**	**0.845**	**1988.52**
Interview Day	**Yes**	**0.476**	**0.955**	**1993.60**

Table 2. Results of model that includes two changes in mortality and three different total mortality rates. Note that model fit was not improved significantly (through a likelihood ratio test) by the addition of the two new parameters however there is some indication in the weighted model that total mortality may have been reduced around 1999.

Mean Lengths computed by:	Function wieghted by Sample Size	Estimated First Mortality Rate (Z_{ONE})	Estimated Second Mortality Rate ($Z_{TWO)}$	Estimated Third Mortality Rate ($Z_{THREE)}$	Estimated First Year of Change	Estimated Second Year of Change
Year	**No**	**0.47**	**0.00**	**0.98**	**1991.02**	**1992.20**
Year	**Yes**	**0.48**	**1.18**	**0.73**	**1993.21**	**1998.84**
Month	**No**	**0.48**	**0.00**	**0.86**	**1985.54**	**1987.11**
Month	**Yes**	**0.48**	**1.17**	**0.75**	**1993.90**	**1999.30**
Interview Day	**No**	**0.39**	**0.70**	**0.89**	**1987.79**	**1994.50**
Interview Day	**Yes**	**0.48**	**1.17**	**0.76**	**1993.84**	**1999.25**

Figure 1 (revised). Cumulative plot of all individuals in the trap fishery of Puerto Rico (1983– 2006). The estimated length at vulnerability to gear (L_c) is indicated by the red bar.

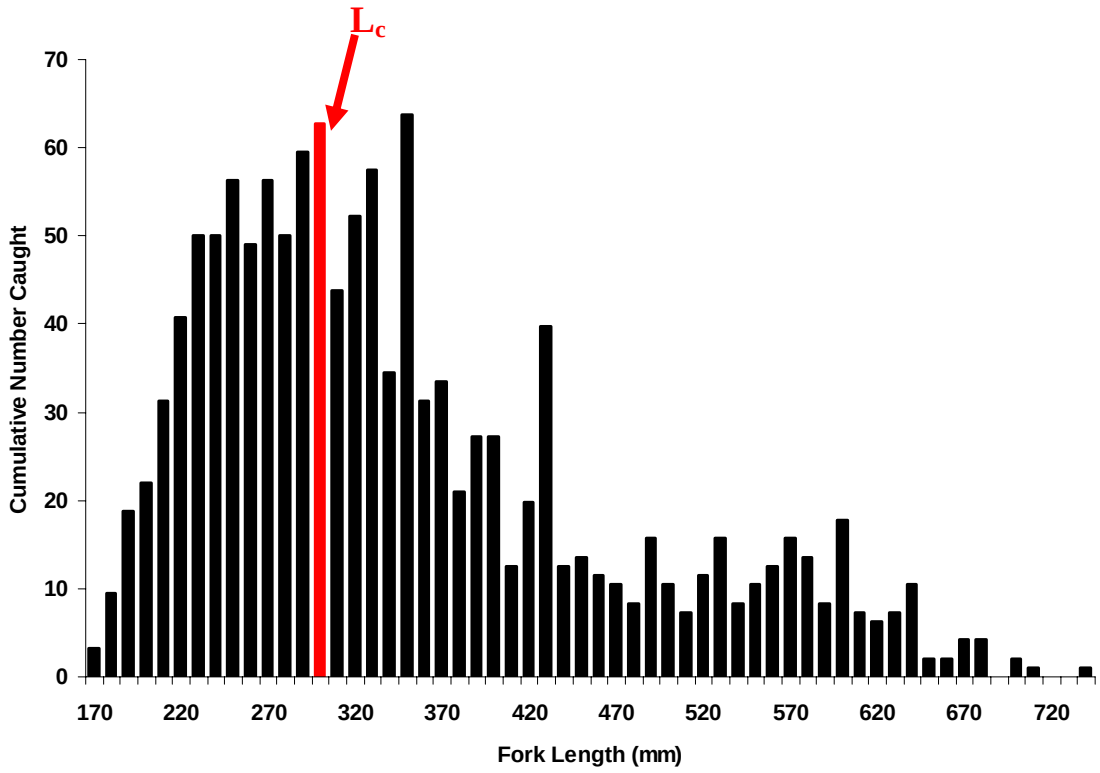

Figure 3 (revised). Mean Length calculated for each interview day. Sample numbers for each interview day have been indicated by both bubble size and number.

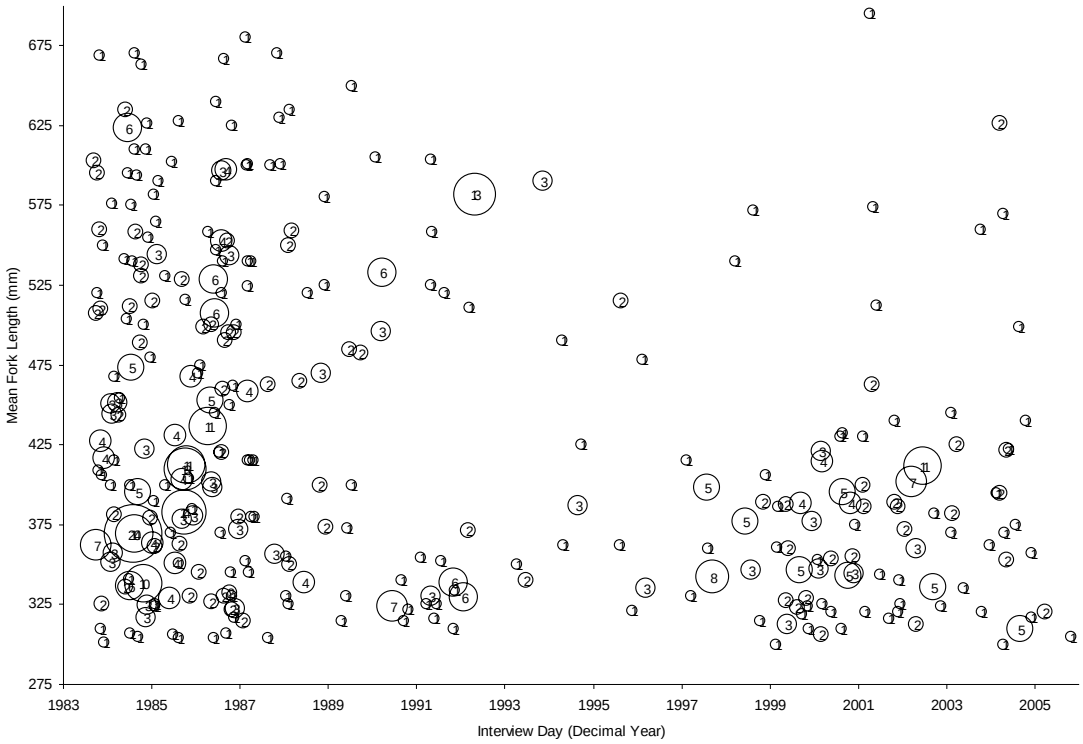

Figure 4 (revised). Mean Length calculated by month. Sample numbers for each month have been indicated by both bubble size and number.

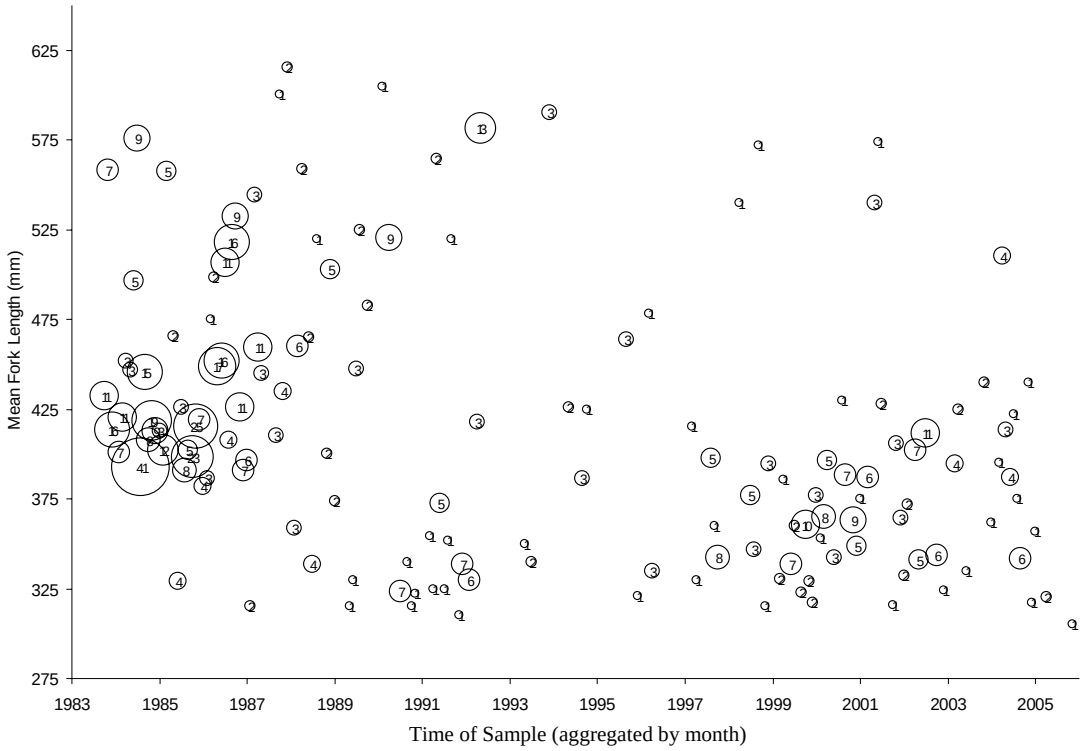

Figure 5 (revised). Mean Length calculated by year. Sample numbers for each year have been indicated by both bubble size and number. Note that means in 2001 and 2002 are extremely high due solely to two samples (see Figure 5).

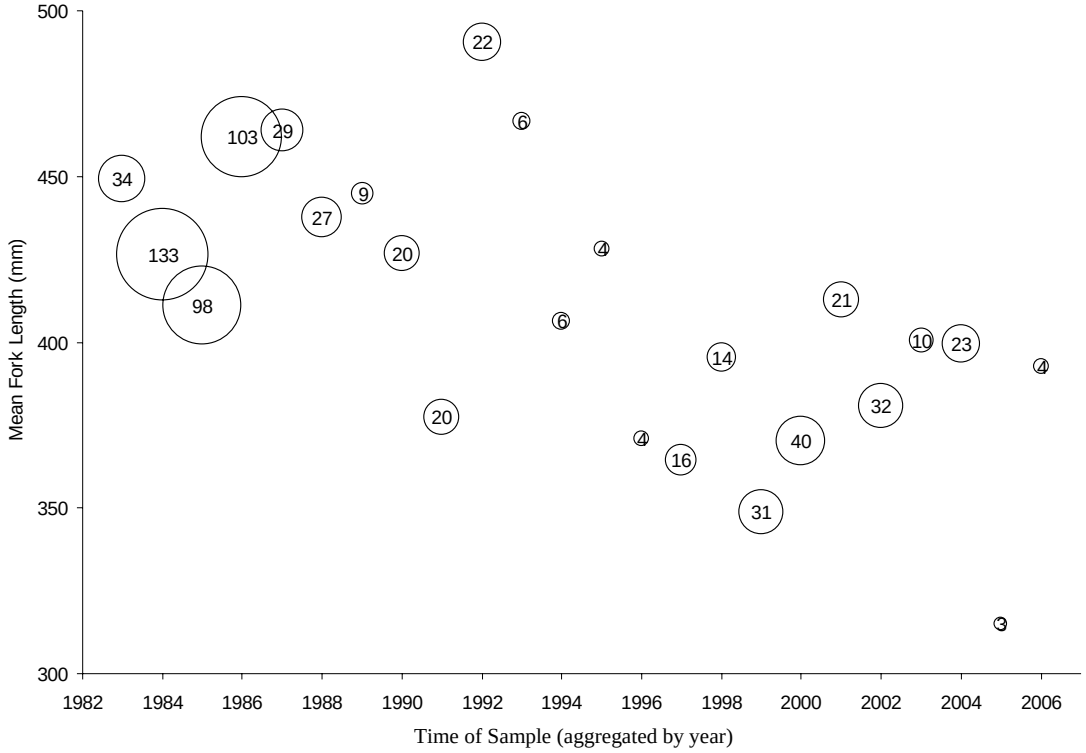

Figure 6 (revised). Results of grid search over all years of change in Z. Likelihood function is weighted by the sample size from each interview day. The function is maximized (indicated by the red dashed box) when the year of mortality change is 1994 and Z_{one} = 0.48 yr^{-1} and Z_{two} = 0.97 yr^{-1}. Note that the objective function is similarly maximized when the year of change is 1993 which would have a corresponding Z_{two} of 0.93 yr^{-1}. Final results estimated year of change to be 1993.6 (see Figure 7 revised).

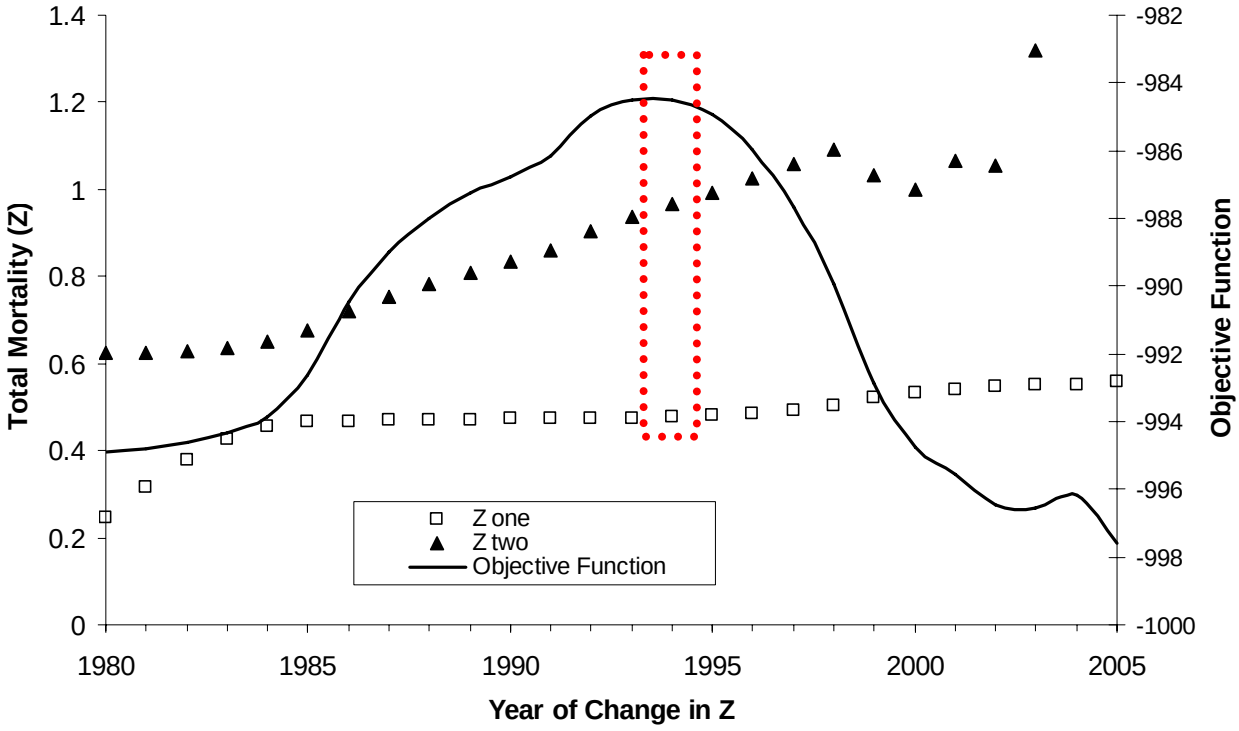

Figure 7 (revised). Observed and predicted mean lengths for weighted fit of interview day. Year of mortality change is 1993.6 with $Z_{one} = 0.48$ yr^{-1} and $Z_{two} = 0.96$ yr^{-1}.

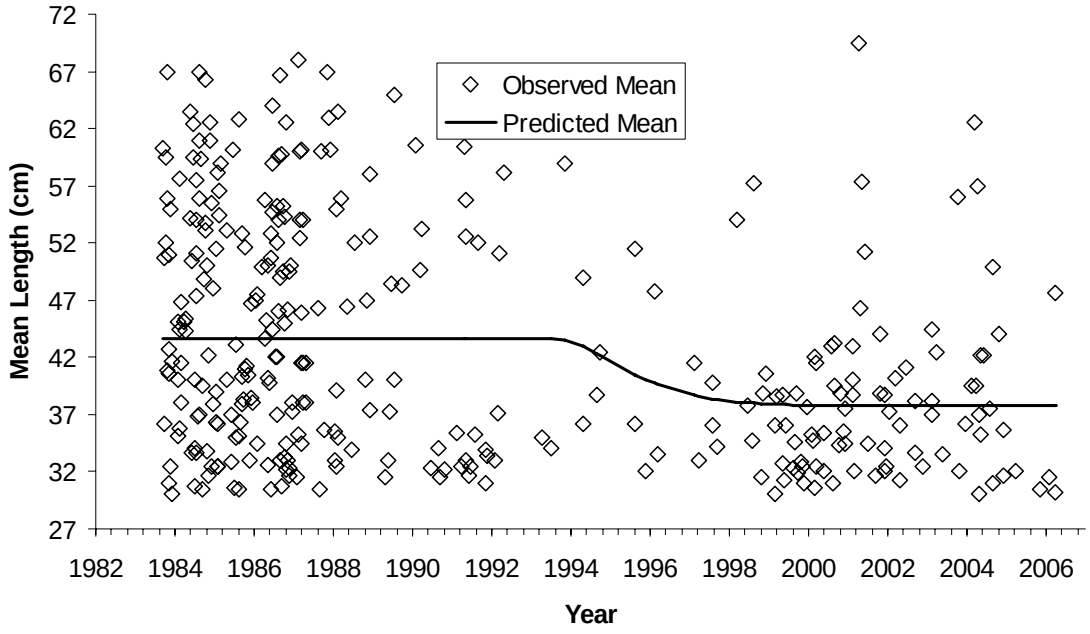

Figure 8 (revised). Residuals of observed and predicted mean lengths for weighted fit by interview day.

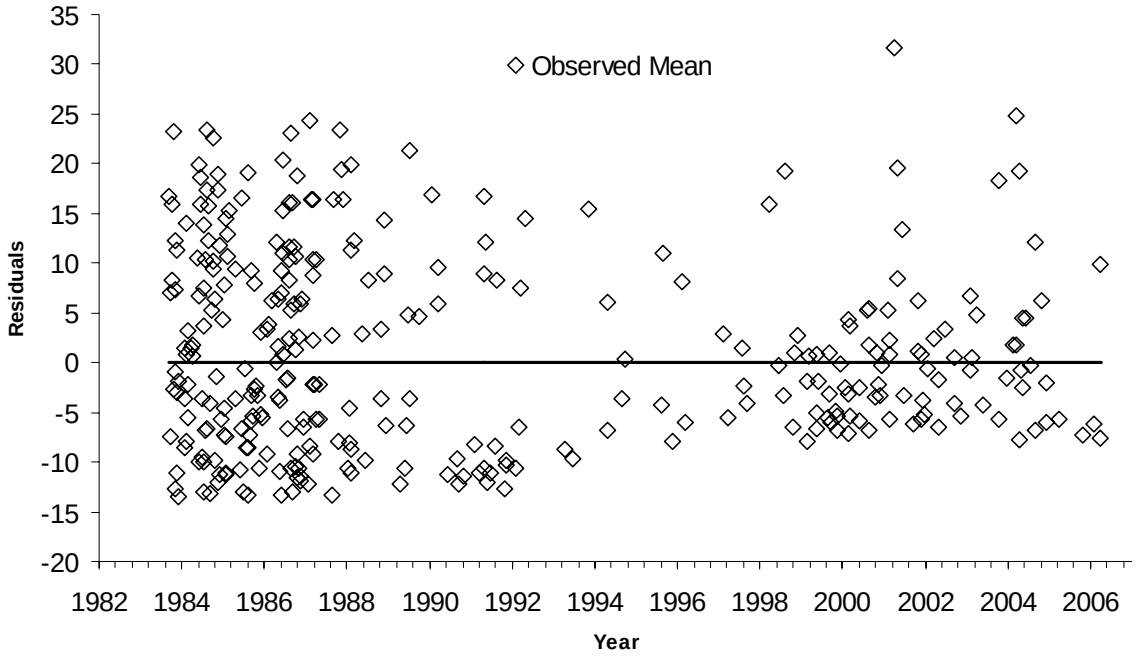

Figure 9 (revised). Results of grid search over all years of change in Z. Likelihood function is not weighted by the sample size. The function is maximized (indicated by the red dashed box) when the year of mortality change is 1988 and Z_{one} = 0.39 yr^{-1} and Z_{two} = 0.85 yr^{-1}. Note that a specific year of change in fishing mortality is more clearly indicated in this case versus the weighted analysis.

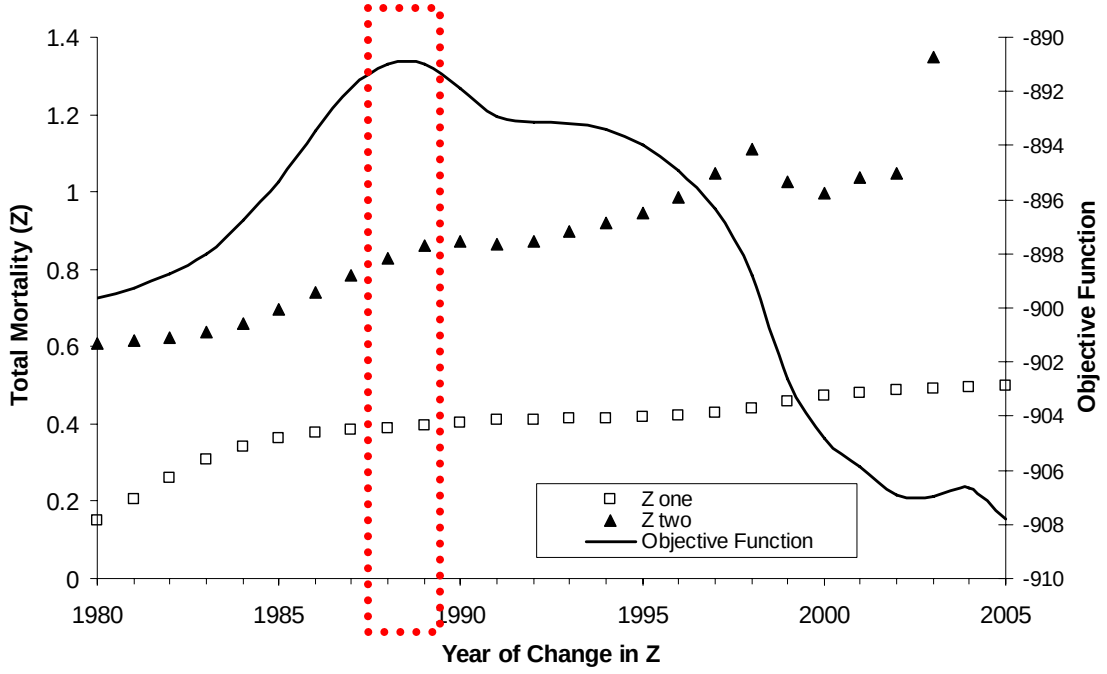

Figure 10 (revised). Observed and predicted mean lengths for non weighted fit by interview day from best model fit of year of mortality change = 1988.5, Z_{one} = 0.39 yr^{-1} and Z_{two} = 0.85 yr^{-1}.

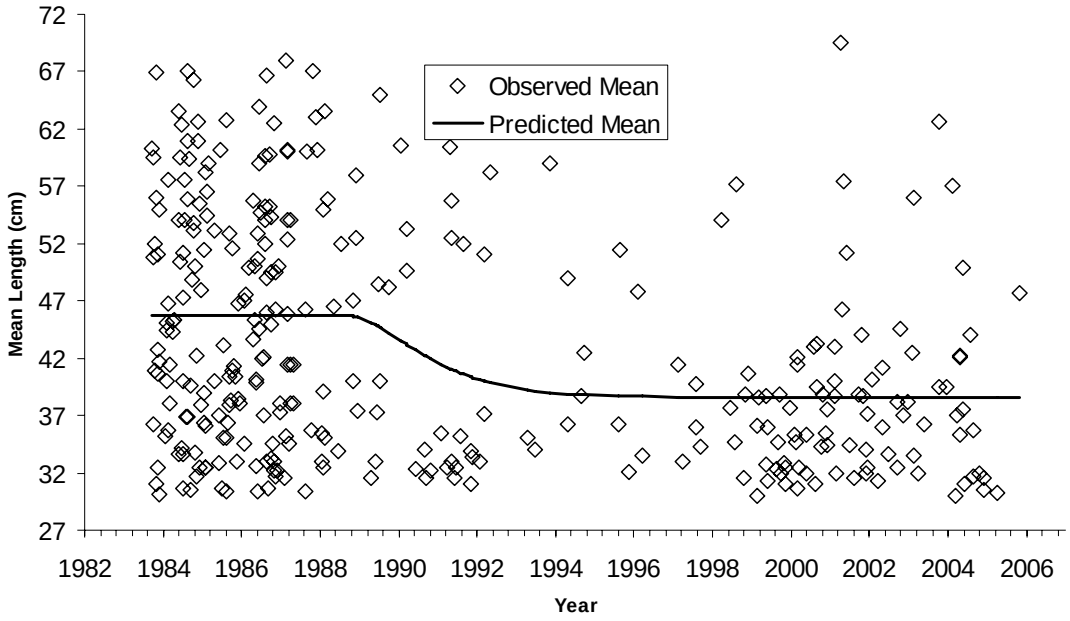

Figure 11 (revised). Residuals of observed and predicted mean lengths for non weighted fit by interview day.