Appendix K: Statistical Analyses with Composite Samples

Weighted Average
The number of fish in each sample is its "weight". A sample from one fish would have w = 1.

$$\text{Weighted average} = \dot{x}w = \frac{\sum w_i \times x_i}{\sum w_i}$$

Where: $\dot{x}w$ = weighted average
w_i = number of fish in sample "i"
x_i = concentration of mercury in sample "i"

The weighted average can be calculated using Excel with the formulas SUMPRODUCT and SUM. Code is as follows:

$$\text{WtAvg} = SUMPRODUCT\ (x_i, w_i)\ /\ SUM\ (w_i)$$

Standard Deviation of the Weighted Average
The standard deviation of the weighted average is the square root of the variance of the weighted average:

$$Variance_{WtAvg} = \frac{N * \sum w_i (x_i - \dot{x}w)^2}{(N-1) * \sum w_i}$$

$$Standard\ Deviation_{WtAvg} = \sqrt{(Variance_{WtAvg})}$$

Where: N = total number of samples in the data set; composites count as 1

The COUNT function can be used to determine N: $N = COUNT(x_i)$

The standard deviation of the weighted average ($Stdev_{wt}$) can be calculated using Excel with the formulas SUMPRODUCT, SUM, and SQRT. Assume data are arranged in columns (arrays).

It helps to create a new column with a portion of the variance formula for each data point:

$$= (x_i - WtAvg)^2$$

Remaining code is as follows:

$$Variance = \frac{N}{N-1} * \frac{SUMPRODUCT\ (x_i * (x_i - WtAvg)^2)}{SUM\ (w_i)}$$

$$= \frac{N}{N-1} * \frac{SUMPRODUCT\ (array\ of\ x_i * array\ of\ (x_i - WtAvg)^2)}{SUM\ (array\ of\ w_i)}$$

Therefore, $Wt\ Stdev = SQRT\ (Variance)$