Should the Delta Smelt Summer Tow-Net Index be Size-Standardized?

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DFG has conducted the summer tow-net survey since 1959 to provide an abundance index for striped bass. The survey also provides abundance estimates for other species, including delta smelt. Unlike other species, the striped bass tow-net abundance indexes are standardized for fish size. The following analysis indicates that size standardization is not an appropriate technique for delta smelt.

About 30 sites in San Pablo Bay and the delta are surveyed over a period of 3-5 days, at 2-week intervals, from June until the average size of striped bass is greater than 38 mm. Total catch per station is multiplied by a weight factor representative of the water volume at each measuring site. The striped bass index is then calculated using the two survey dates bracketing 38 mm. The selected mean length (38 mm, 1.5 inch) is determined by the relationship between abundance and length (Figure 1). The two mean lengths and mid-dates of surveys are interpolated to determine the date at which striped bass reached 38 mm (Turner and Chadwick 1972). Abundance is calculated by regressing the natural log abundance on the day of year for the two surveys and determining the natural log of abundance at the date when striped bass reached 38 mm. Dividing by 1000, a simple scaling factor, yields the index.

The delta smelt abundance index is calculated differently than the striped bass index. Using the first two tow-net surveys only, delta smelt abundance indices are calculated as the product of the total catch at each site and a weighting factor that represents the estimated water volume for the site, divided by 1000. However, variability in timing of delta smelt spawning is a potential source of bias. For that reason, an attempt was made to standardize the size of delta smelt in a way similar to striped bass. The following methods were applied to incorporate selected mean length into an annual summer tow-net abundance index.

Weighted catch of delta smelt for each survey was calculated by multiplying catch at each site by water volume represented by the site, then totaling the various sites. Weighted delta smelt catch was then plotted against mean length (mm) for each survey. The standardized size was determined as the length common to as many of the years as possible. After the selected mean length was found, theoretically the yearly index could be calculated. However, as explained later, the analysis was stopped at this point.

Summer tow-net data for 1973-1994 were used in this analysis. During 1959-1972, delta smelt length was not recorded. Figure 2, Figure 3, and Figure 4 show weighted delta smelt catch versus mean length for each survey. The length of delta smelt most common to all years was 42 mm. Of the 22 years of data analyzed, 16 of the years crossed 42 mm. For years when no lengths crossed 42 mm (1984, 1988, 1989, 1993), the lengths could be extrapolated out to 42 mm, but there would be little confidence in such an extrapolation due to the variability of the data and limited number of data points.

Discussion

As expected, length generally showed an increasing trend over time. However, delta smelt weighted catch was extremely variable and did not have a density-dependent response similar to striped bass (Figure 1). Recent lower levels of striped bass may be more variable than shown in Figure 1. The variability in delta smelt catch could be from a variety of causes, but patchy distribution and response to environmental variation are likely factors. Lack of a density-dependent response in delta smelt would most likely result in interpolation errors; interpolation is necessary to develop a size-standardized index.

Finally, even if size was standardized, Figure 2, Figure 3, and Figure 4 suggest that recalculating the abundance index would not substantially change major abundance trends. Weighted data show that abundance was lower in the 1980s than in previous years, which is also apparent in the current delta smelt summer tow-net indices (Figure 5).

Summary

Results of this analysis suggest that size standardization of the delta smelt index is inappropriate. Abundance estimates prior to 1973 would be "lost", and the procedure is likely to introduce additional error for the other years.

References

Turner, J.L., and H.K. Chadwick. 1972. Distribution and Abundance of Young-of-the-Year Striped Bass, *Morone saxatilis*, in Relation to River Flow in the Sacramento-San Joaquin Estuary. *Trans. Amer. Fish. Soc*. 101(3):442-452.

Department of Water Resources and U.S. Bureau of Reclamation. 1994. *Effects of the Central Valley Project and State Water Project on Delta Smelt and Sacramento Splittail*. Prepared for U.S. Fish and Wildlife Service, Ecological Services, Sacramento Field Office.

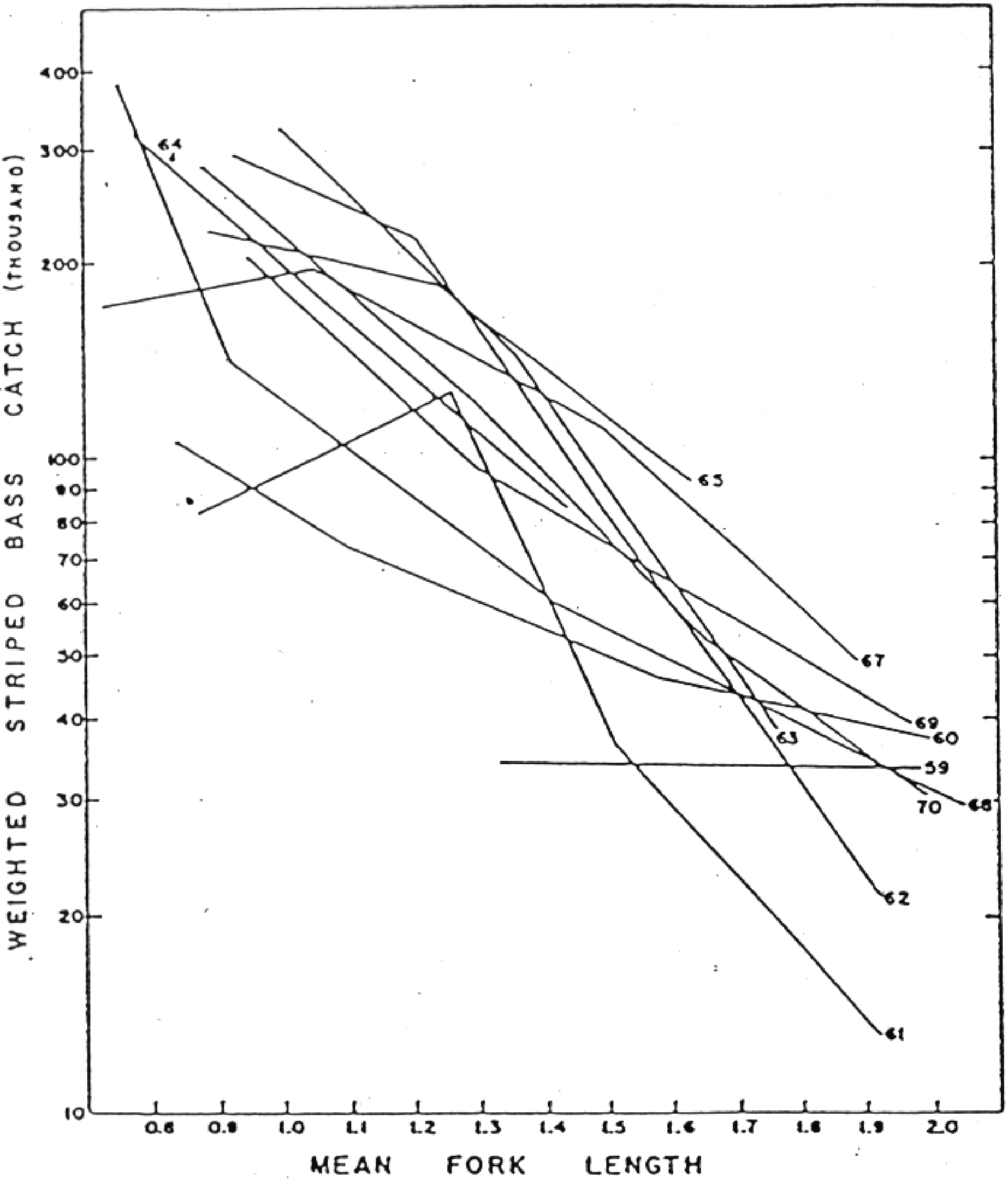

Figure 1
Relationship between Weighted Number and Mean Length (inches) of Young Striped Bass Population for 11 Year Classes
Numbers of figure designate years.
Source: Turner and Chadwick (1972)

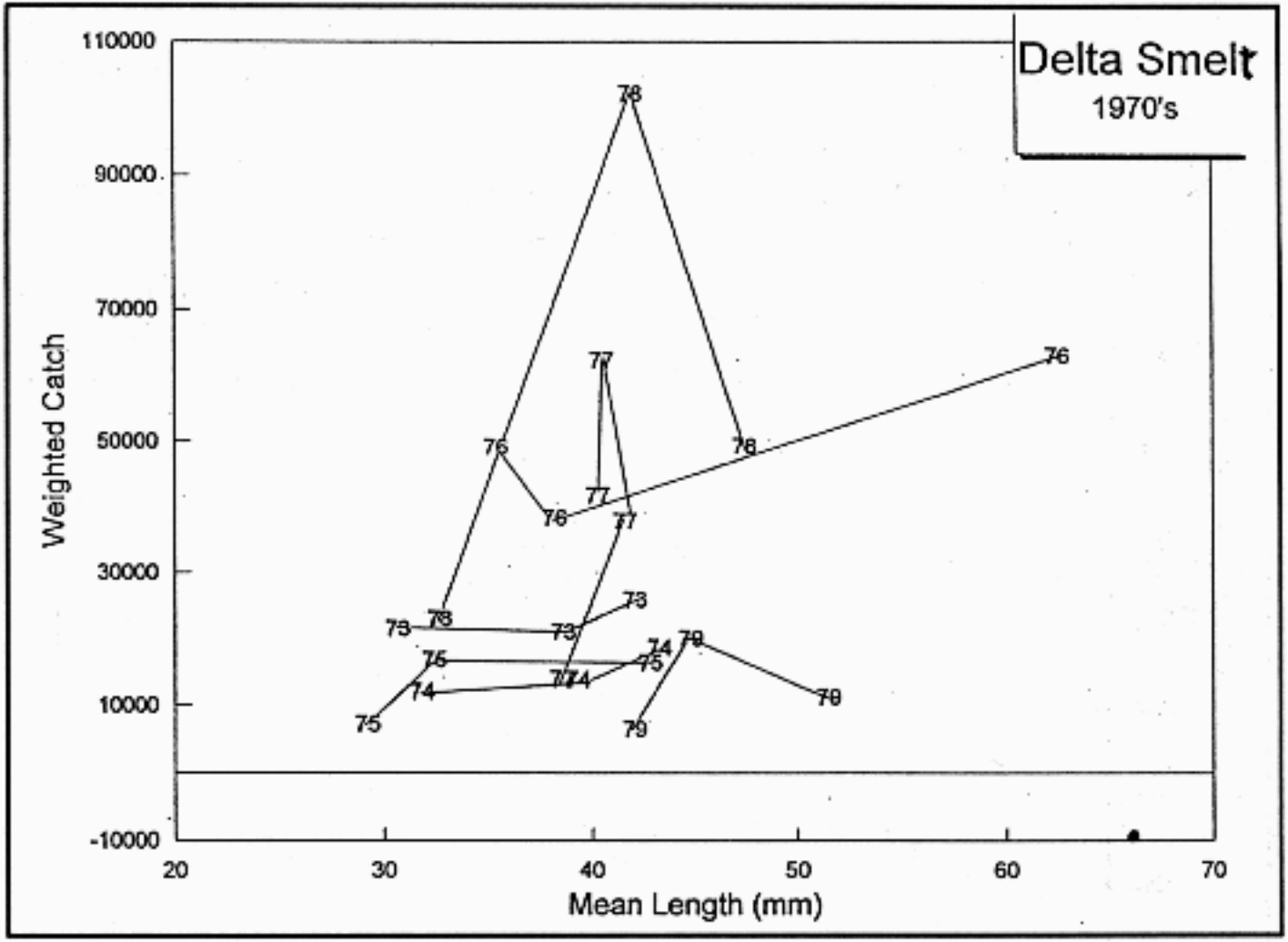

Figure 2
Relationship between Weighted Number and Mean Length (mm) of Delta Smelt Collected in the Tow-Net Survey During the 1970s

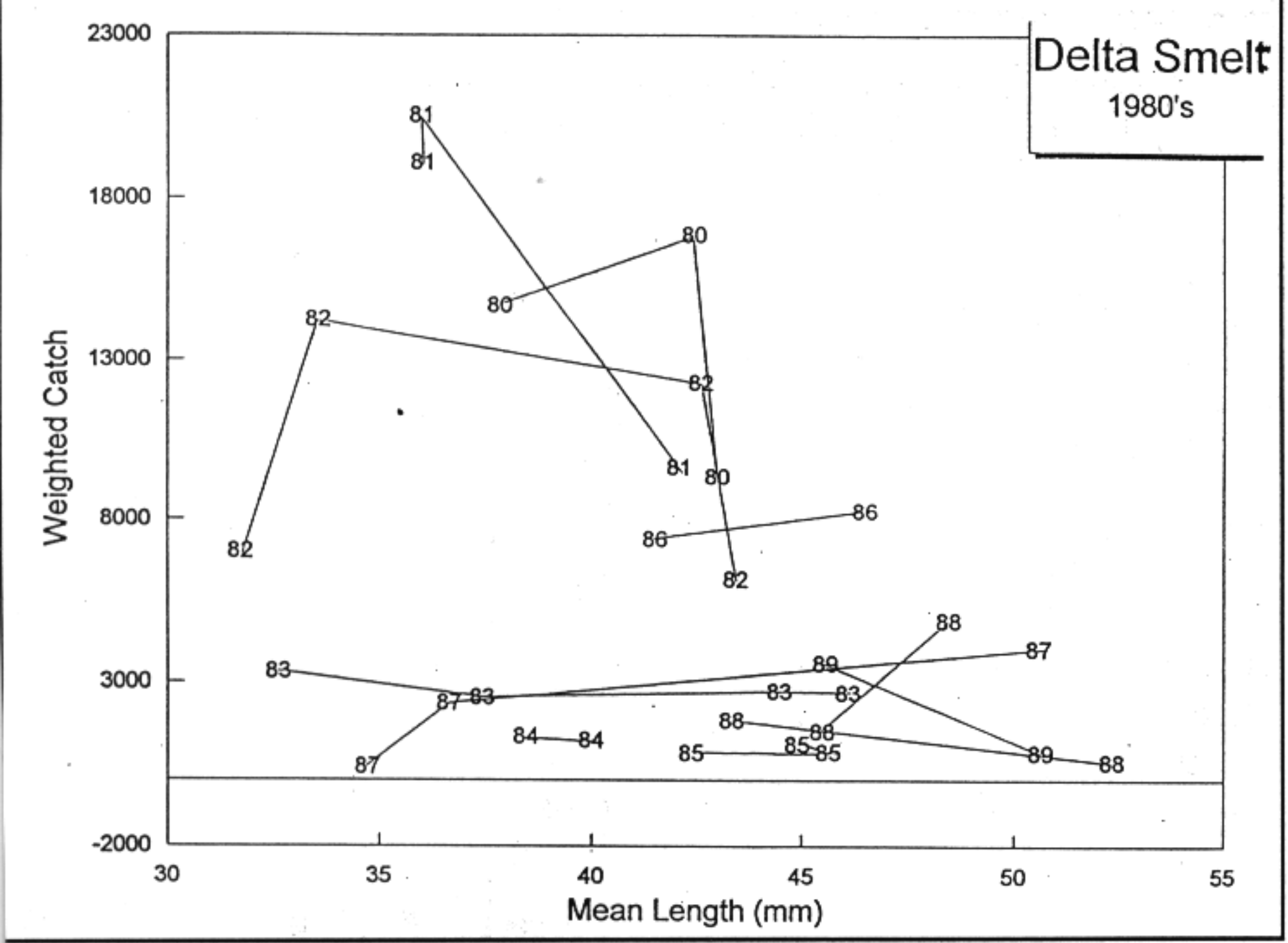

Figure 3
Relationship between Weighted Number and Mean Length (mm) of Delta Smelt Collected in the Tow-Net Survey During the 1980s

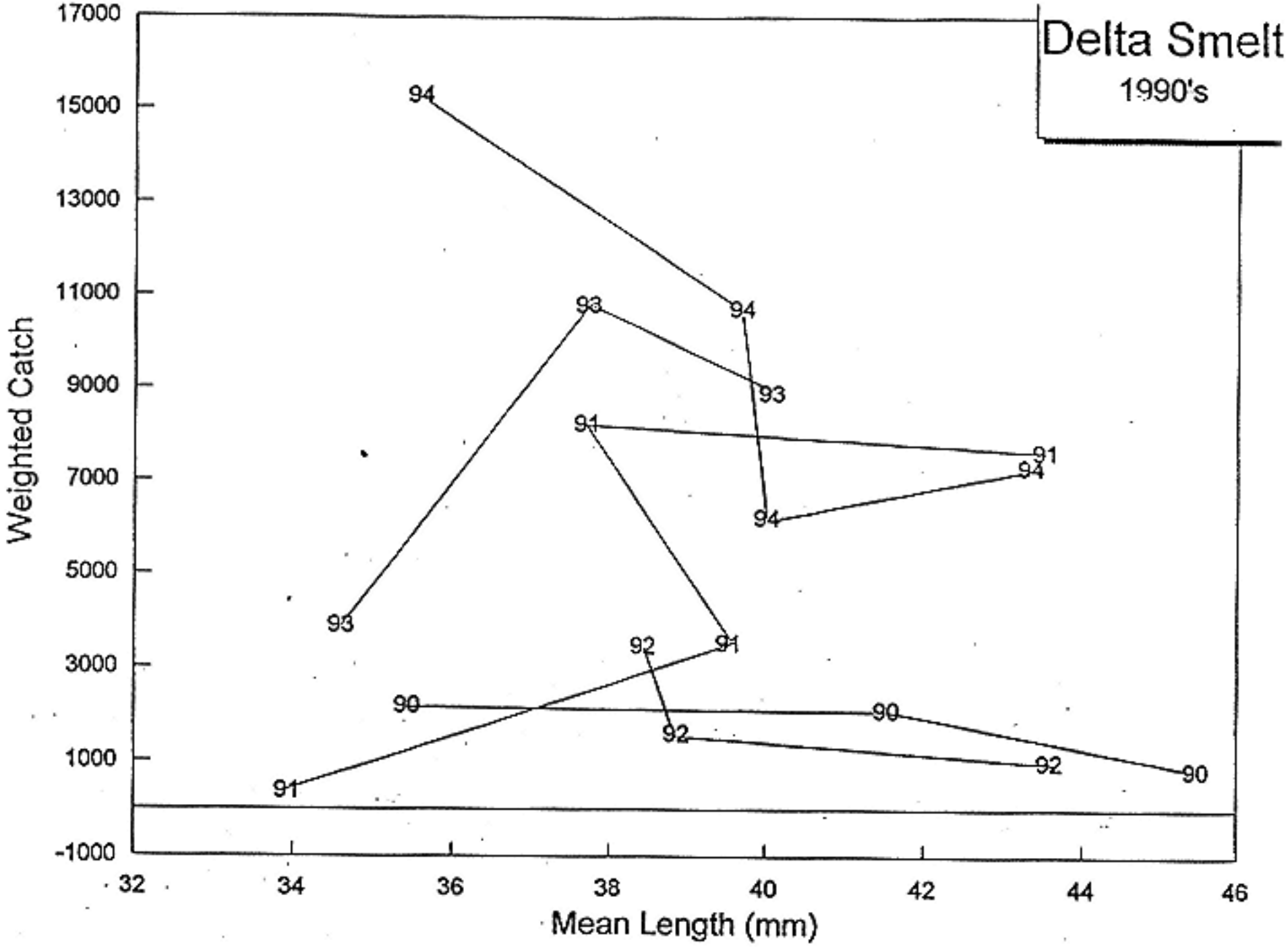

Figure 4
Relationship between Weighted Number and Mean Length (mm) of Delta Smelt Collected in the Tow-Net Survey During the 1990s

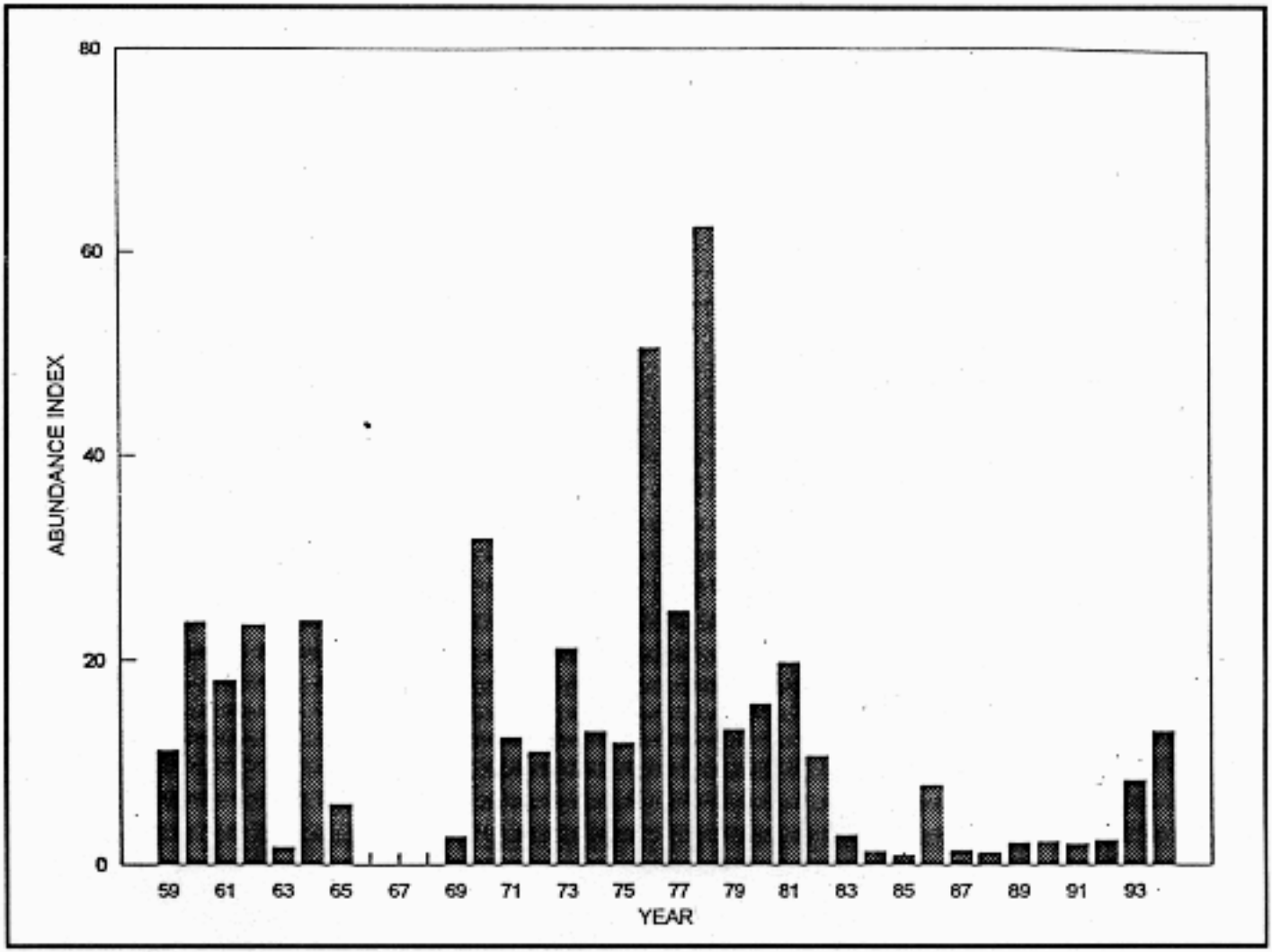

Figure 5
Delta Smelt Summer Tow-Net Index, 1959-1994