3.6. Variance vs. Mean Relationships

We hypothesized that potential reductions in gear efficiency owing to asymmetric trawl warps may lead to decreases in average catch rates and increases in variance of estimates. To test this hypothesis, we examined survey data from the NEFSC database for the fall, spring, and winter surveys for the period 1963 to 2002. A database of 28,734 tows for 22 species-stocks was used. Total catch in numbers and total weight per tow were the primary response variables; no age or length information was used. Survey catches were subsequently processed to compute statum means and variances (Section 3.6) as well as catch-weighted average depths (Section 3.7). Where appropriate, defined management-based stocks were treated separately. The species (stocks) were—cod(GB,GOM), haddock(GB, GOM), yellowtail flounder(GB, SNE, CC), American plaice, witch flounder, redfish, pollock, halibut, white hake, winter flounder (GB, SNE), windowpane flounder (Northern, Southern), ocean pout, summer flounder, spiny dogfish, fourspot flounder, and longhorn sculpin. Several non-groundfish species were added to evaluate changes in stocks that are ubiquitous (spiny dogfish), lightly fished (fourspot flounder) or unfished (longhorn sculpin).

Coefficients of variation (CV) for catch in numbers and total weight for each stratum were computed as the ratio of the standard error of the mean divided by the stratum mean. It can be shown that this form of the CV has an upper bound of 1.0 for nonnegative random variables. The upper bound of 1.0 arises when all but one of the observations in a set is zero. The distribution of stratum specific CVs was characterized by a box plot which illustrate the median CV as a horizontal center line, and the interquartile range as lower and upper bounds of a box. Time series of the CVs were plotted for each species, stock and survey in Fig. 3.6.1-3.6.20. Halibut catches were considered too infrequent to permit meaningful estimates of stratum specific variances.

If the underlying pattern of catches in the trawls were adversely affected by the trawl offset one would expect to see an increase in the relative variation of catches in the affected survey years (2000-2002). Visual inspection of the 60 time-series plots revealed no apparent change in the magnitude of the CV during the affected period. The interquartile range of CVs since 2000 agreed well (i.e., overlapped) with the trendless pattern of CVs for each species and survey prior to 2000. The absence of change in either the median CV or the interquartile range of the CVs reaffirms the general principle that variation in catches increases with the mean, that this property holds across all of the species examined, and that the potential effects of the trawl warp offset, if any, are small relative to the usual variation in catches. These properties appear to apply to exploited as well as unexploited stocks.
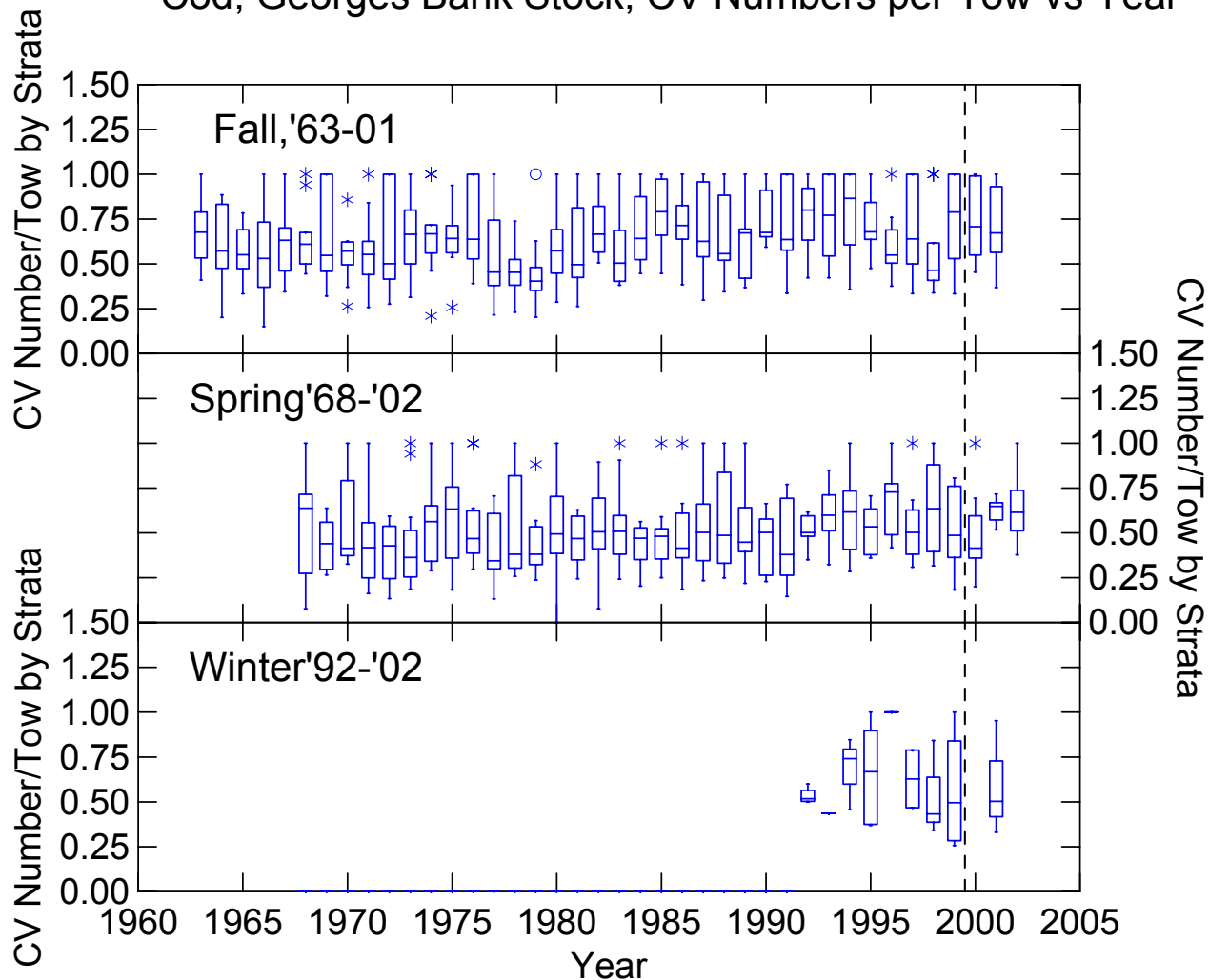
Fig. 3.6.1. Box plots of stratum-specific coefficients of catch (numbers/tow) for Georges Bank stock of cod for fall, spring , and winter NEFSC trawl surveys.
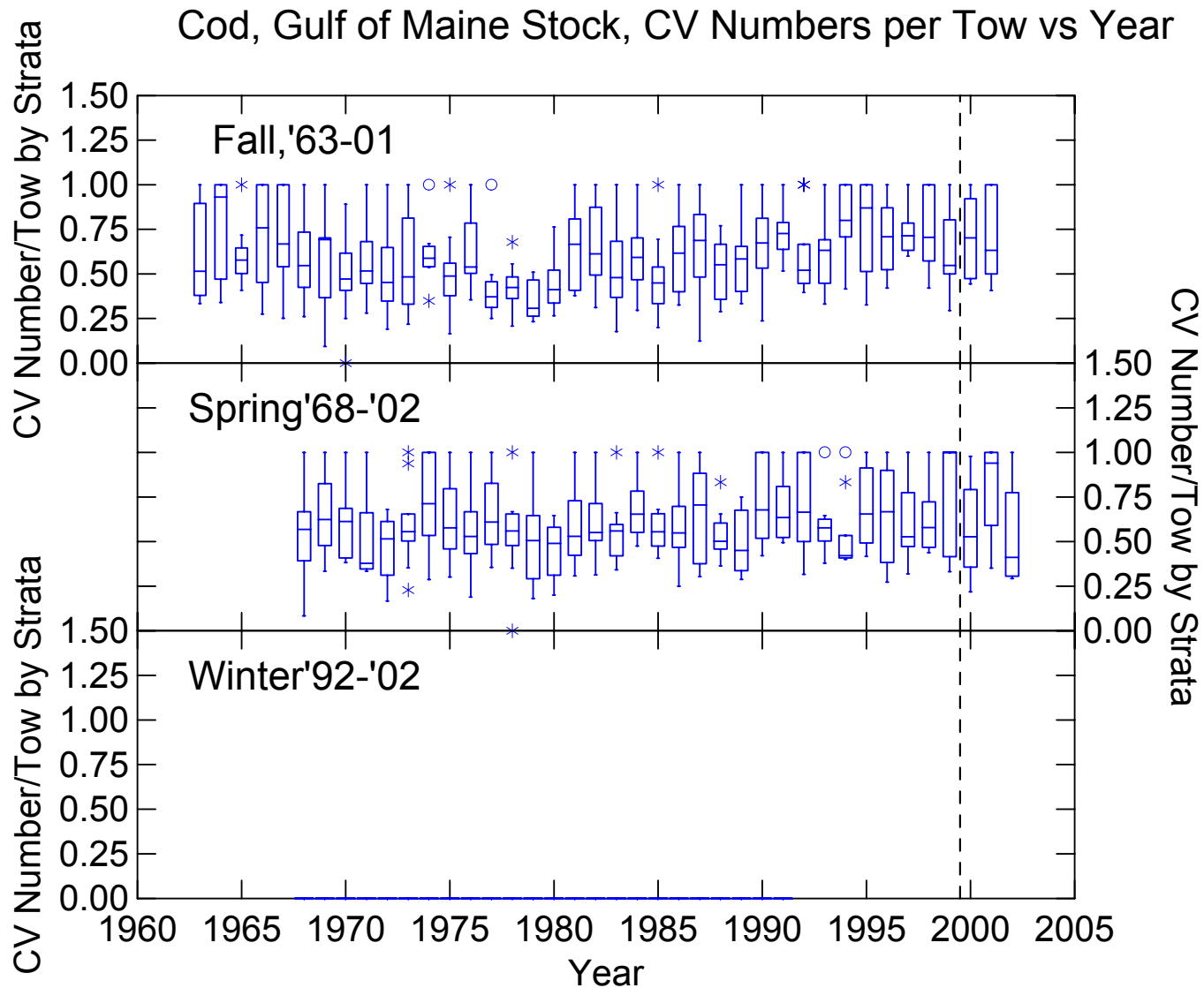
Fig. 3.6.2. Box plots of stratum-specific coefficients of catch (numbers/tow) for Gulf of Maine stock of cod for fall, spring , and winter NEFSC trawl surveys.
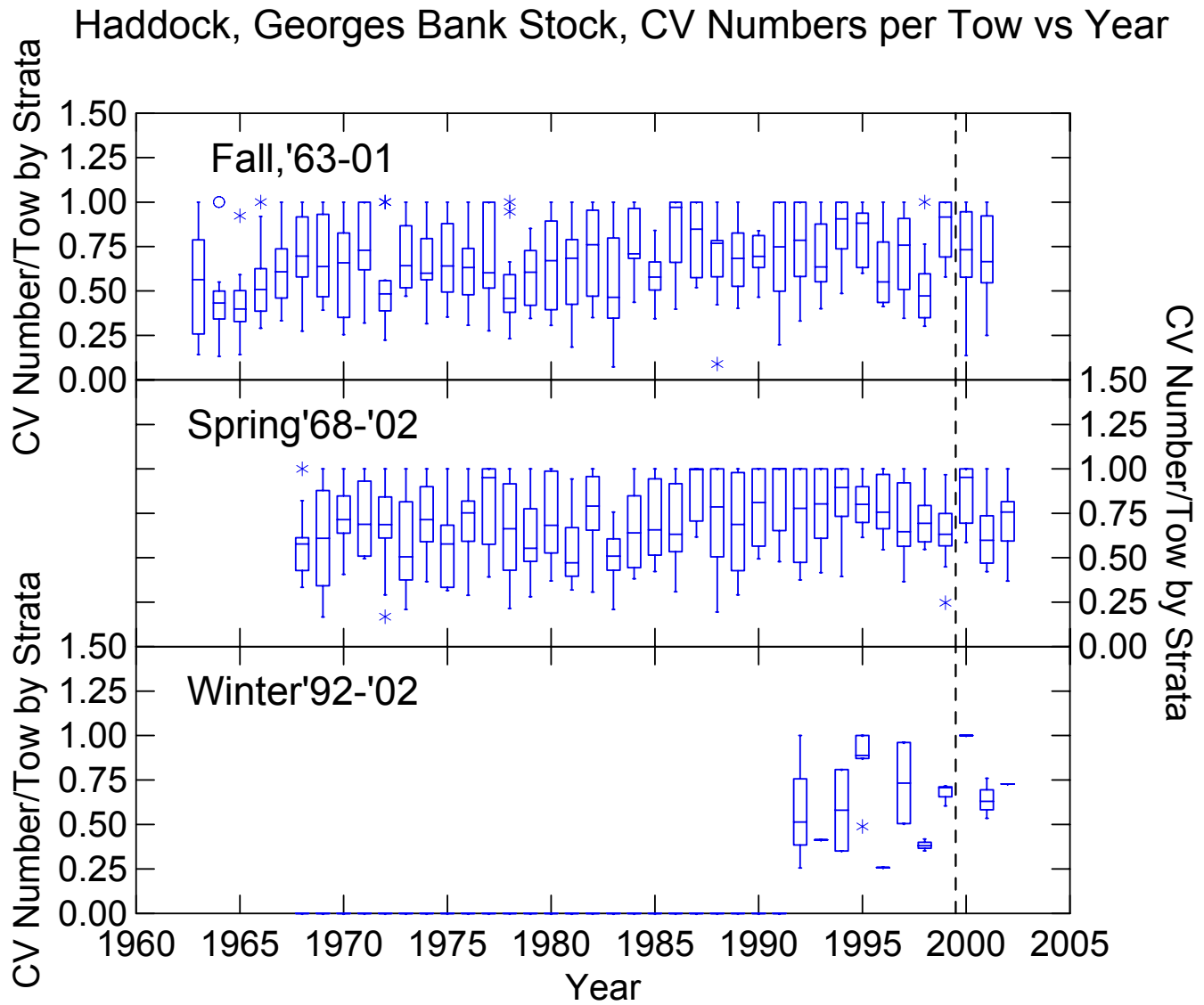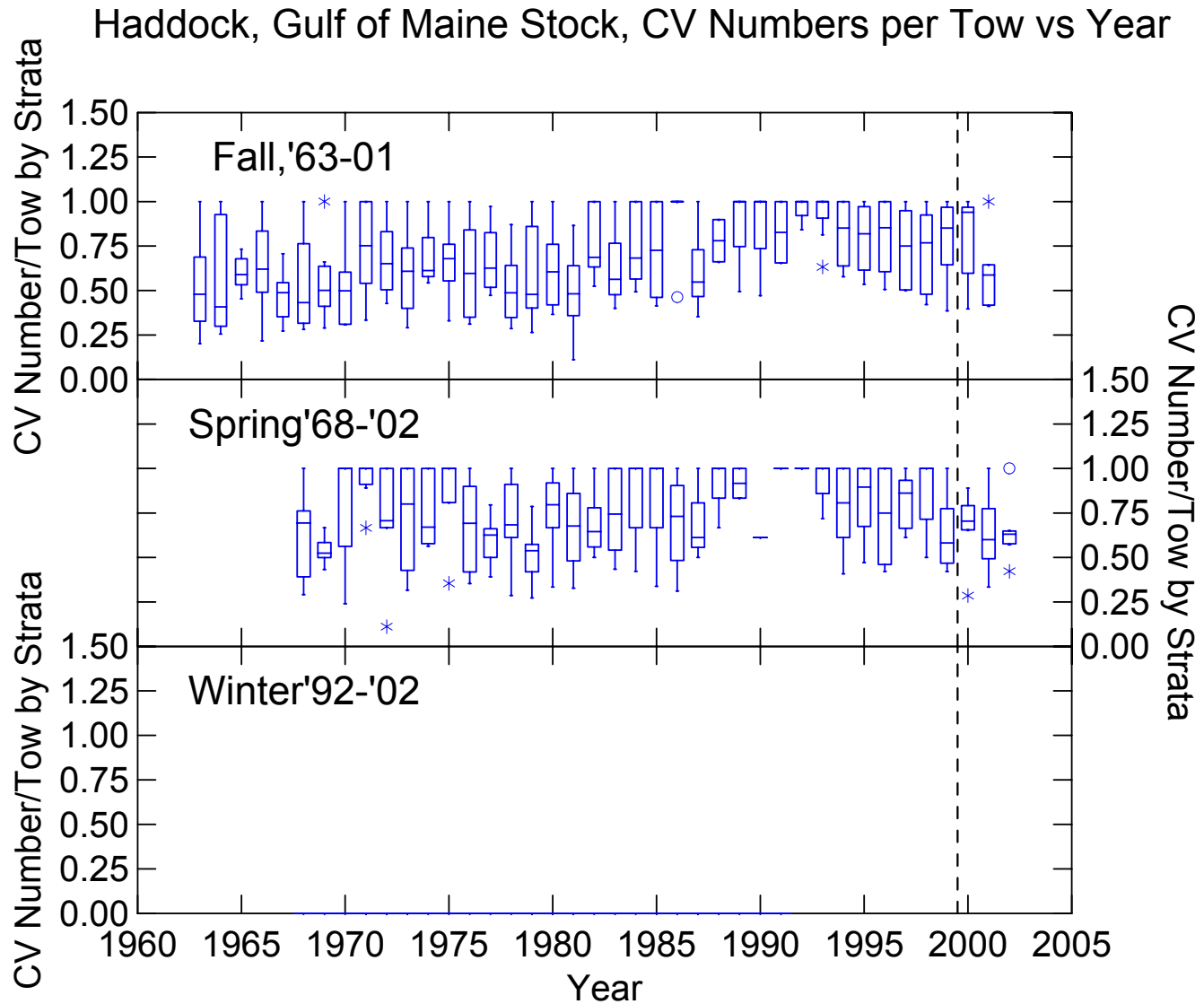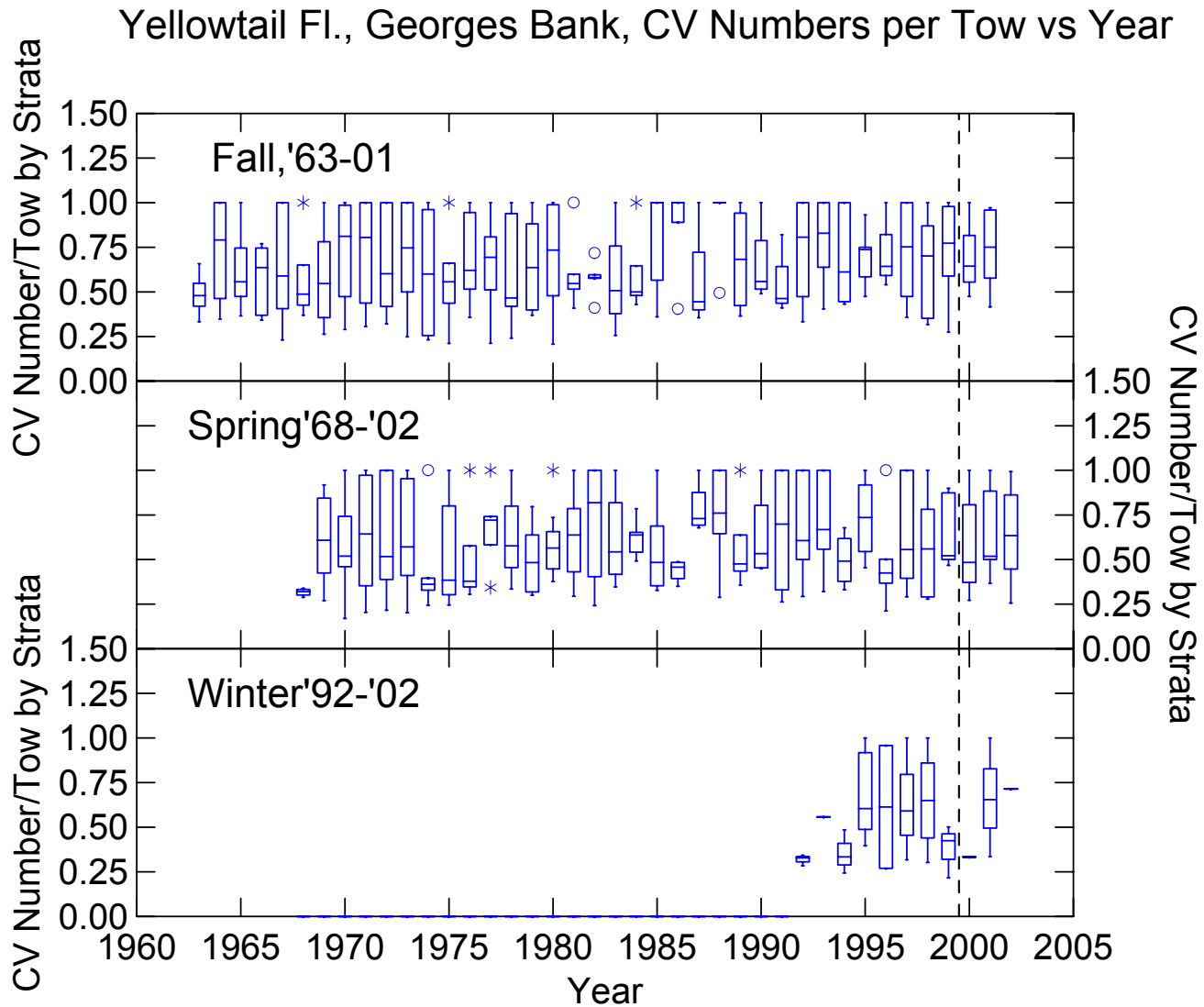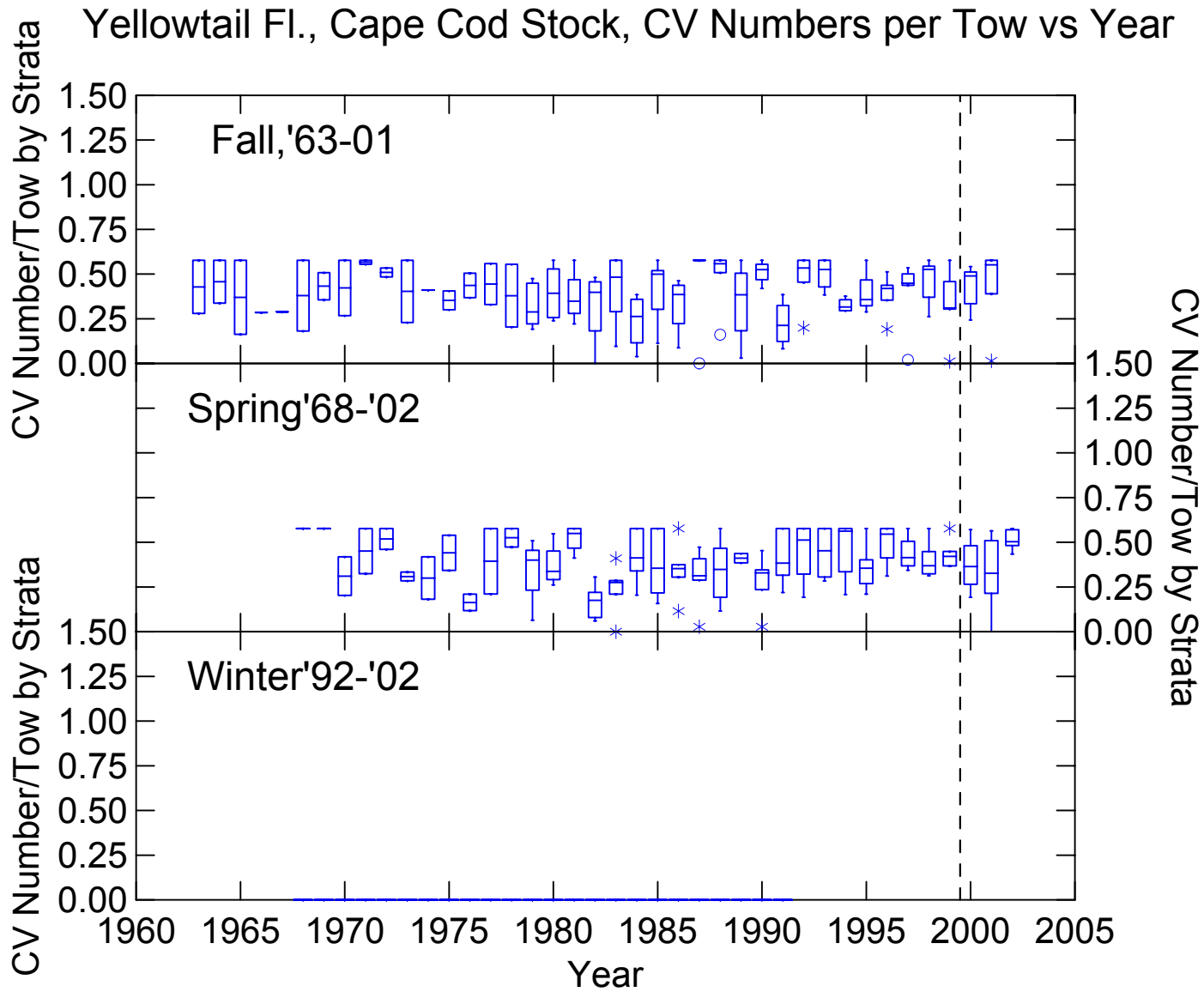
Fig. 3.6.3. Box plots of stratum-specific coefficients of catch (numbers/tow) for Georges Bank stock of haddock for fall, spring, and winter NEFSC trawl surveys.

Fig. 3.6.4. Box plots of stratum-specific coefficients of catch (numbers/tow) for Gulf of Maine stock of haddock for fall, spring , and winter NEFSC trawl surveys.

Fig. 3.6.5. Box plots of stratum-specific coefficients of catch (numbers/tow) for Georges Bank stock of yellowtail flounder for fall, spring , and winter NEFSC trawl surveys.
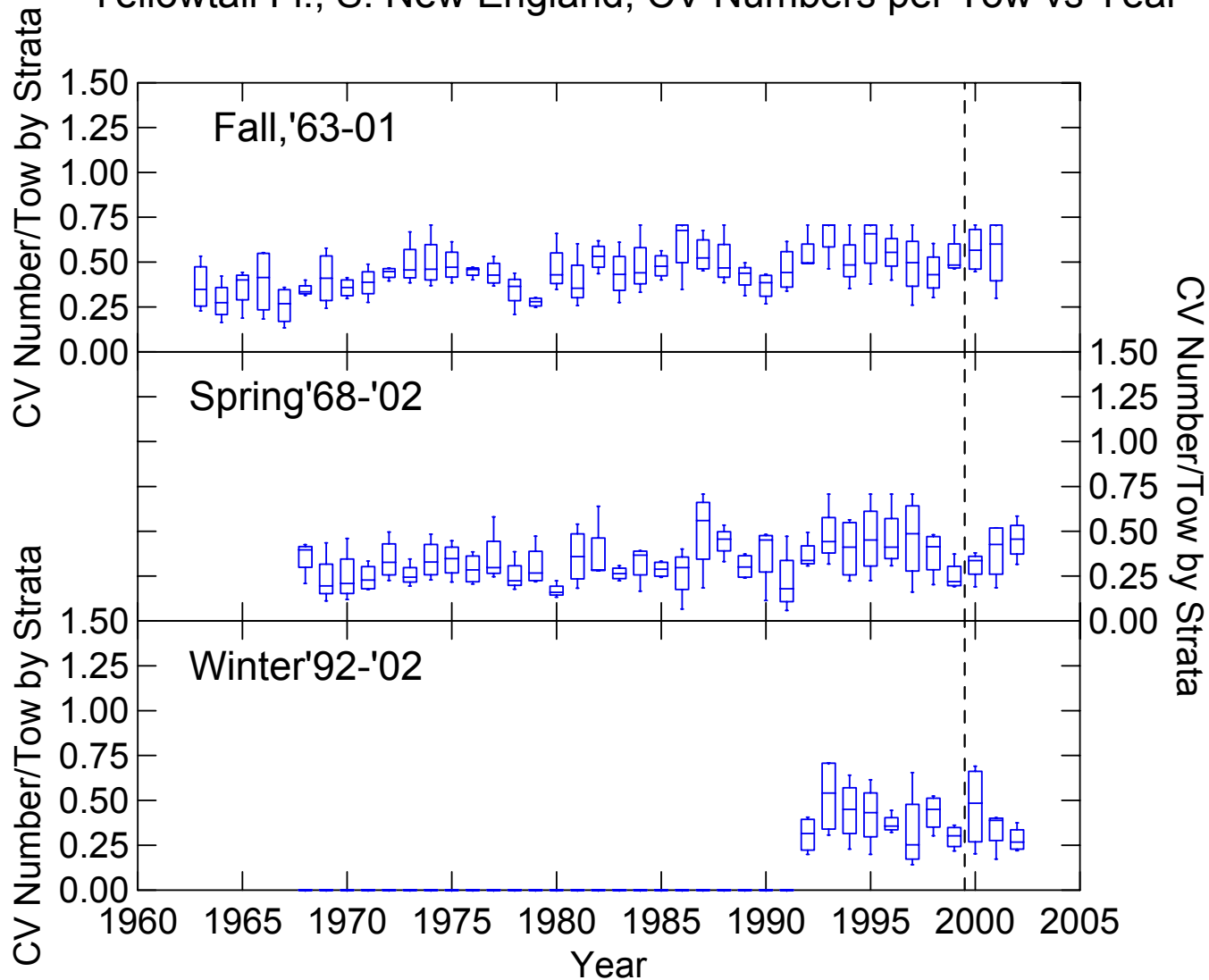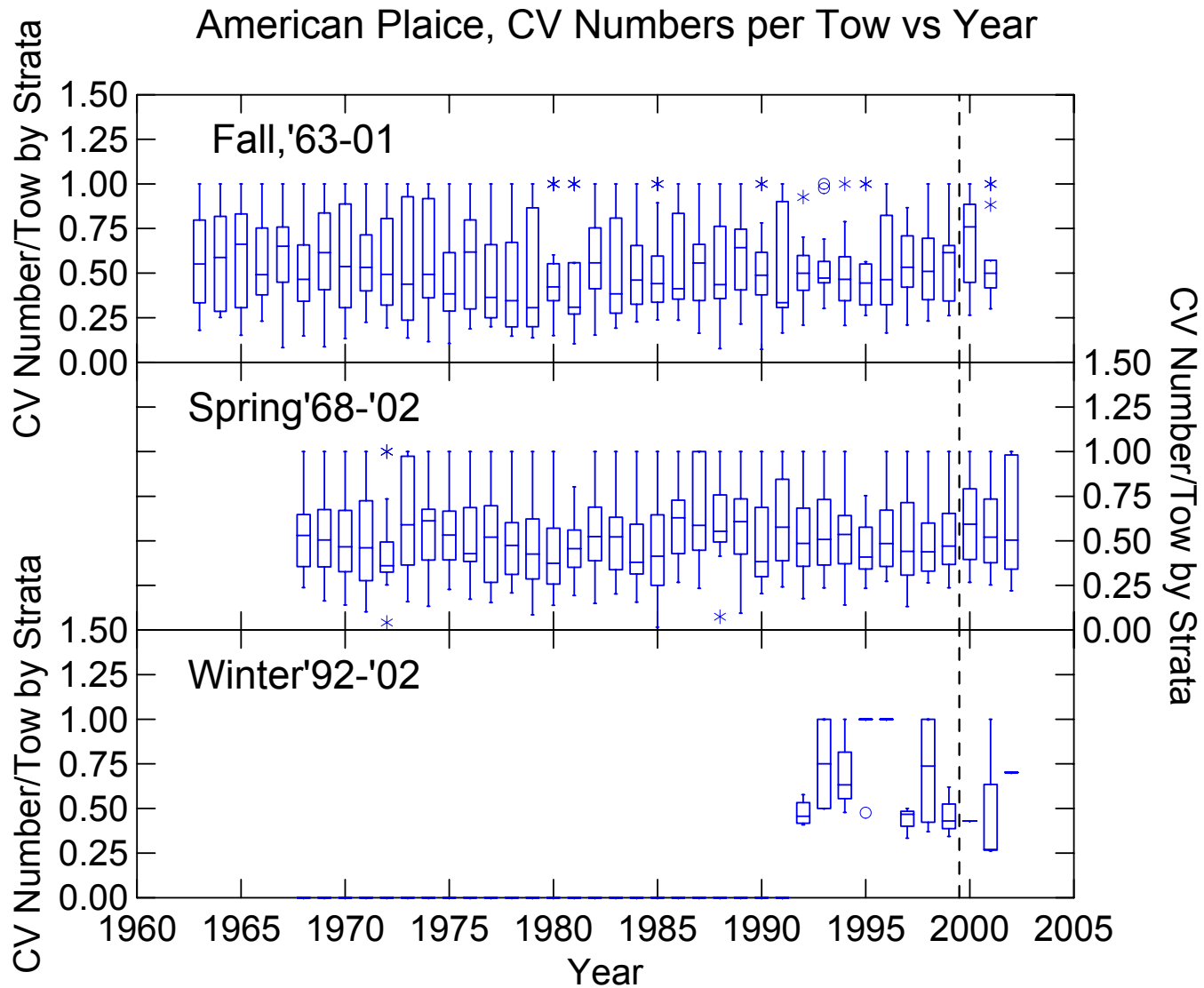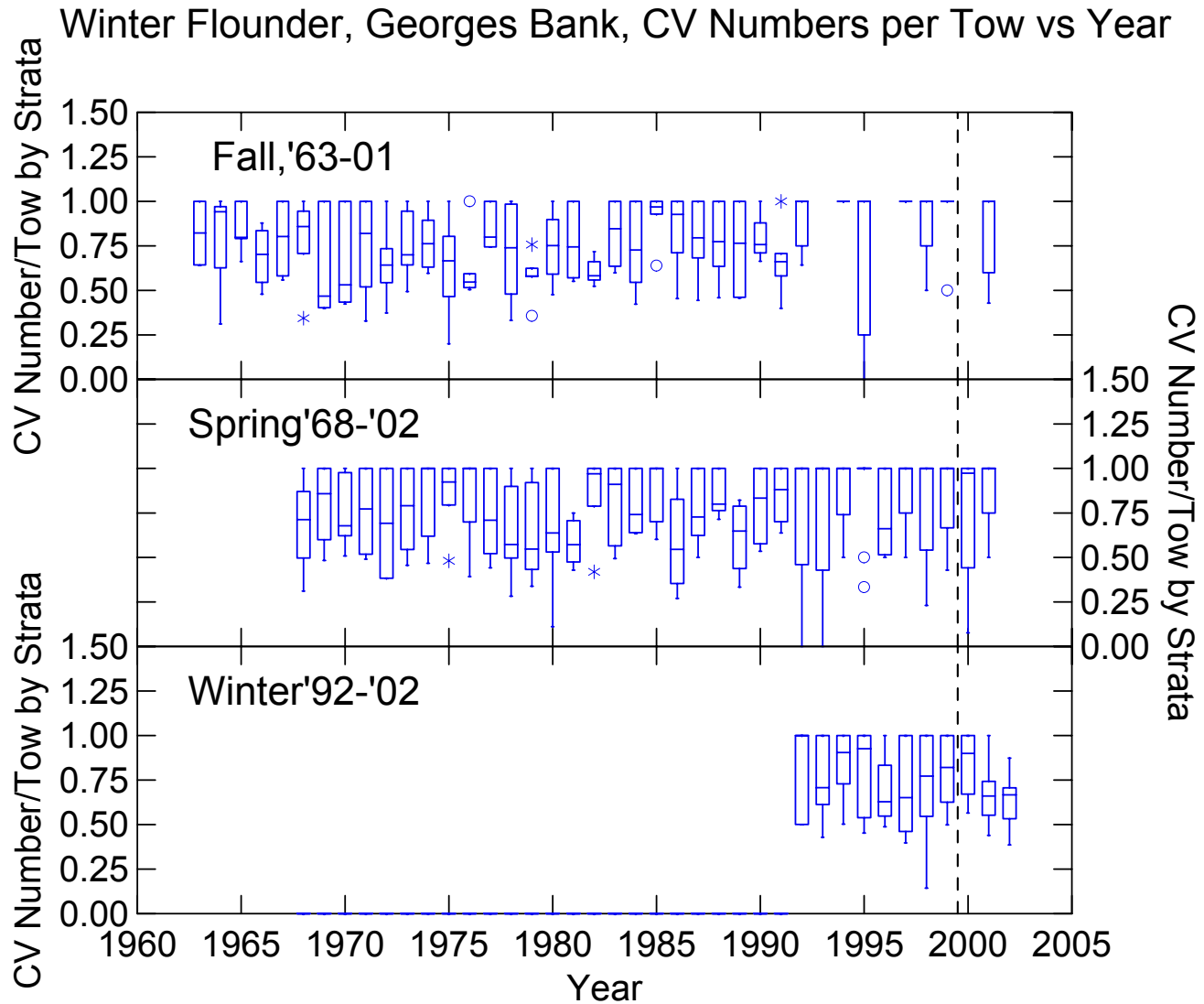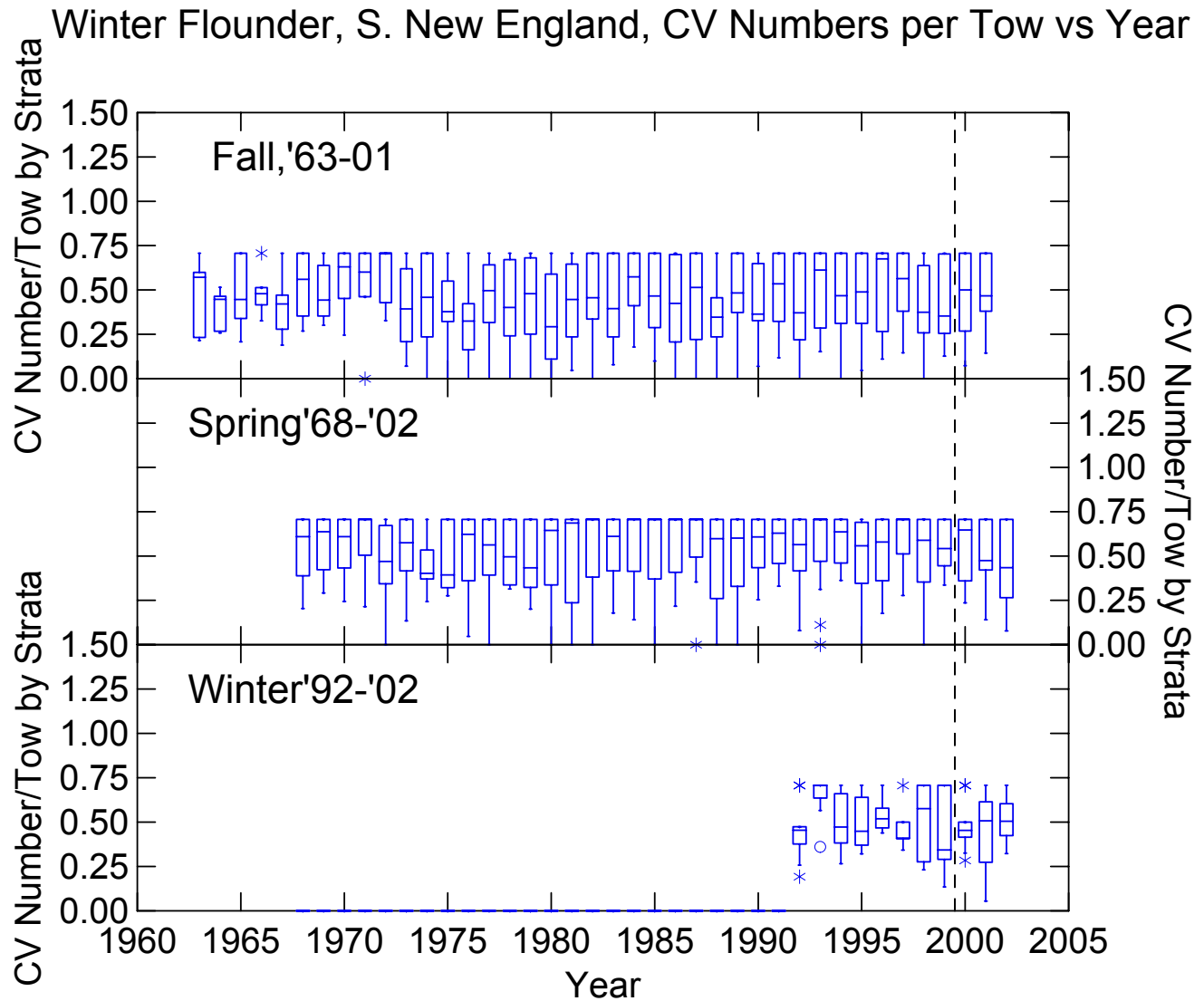
Fig. 3.6.6. Box plots of stratum-specific coefficients of catch (numbers/tow) for Southern New England stock
of yellowtail flounder for fall, spring , and winter NEFSC trawl surveys.

Fig. 3.6.7. Box plots of stratum-specific coefficients of catch (numbers/tow) for Cape Cod stock
of yellowtail flounder for fall, spring , and winter NEFSC trawl surveys.

Fig. 3.6.8. Box plots of stratum-specific coefficients of catch (numbers/tow) for American plaice for fall, spring , and winter NEFSC trawl surveys.

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Fig. 3.6.9. Box plots of stratum-specific coefficients of catch (numbers/tow) for Georges Bank stock of winter flounder for fall, spring , and winter NEFSC trawl surveys.
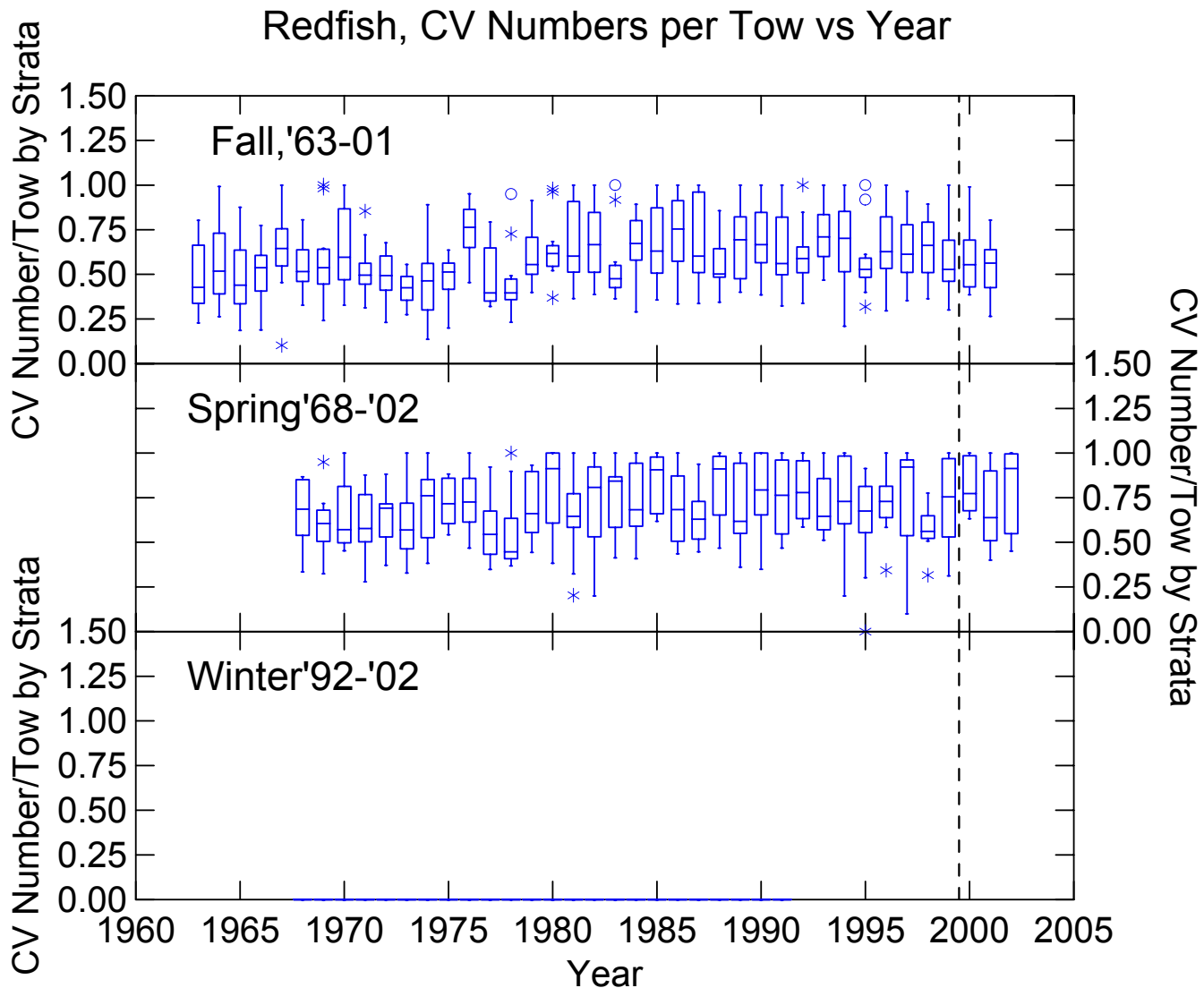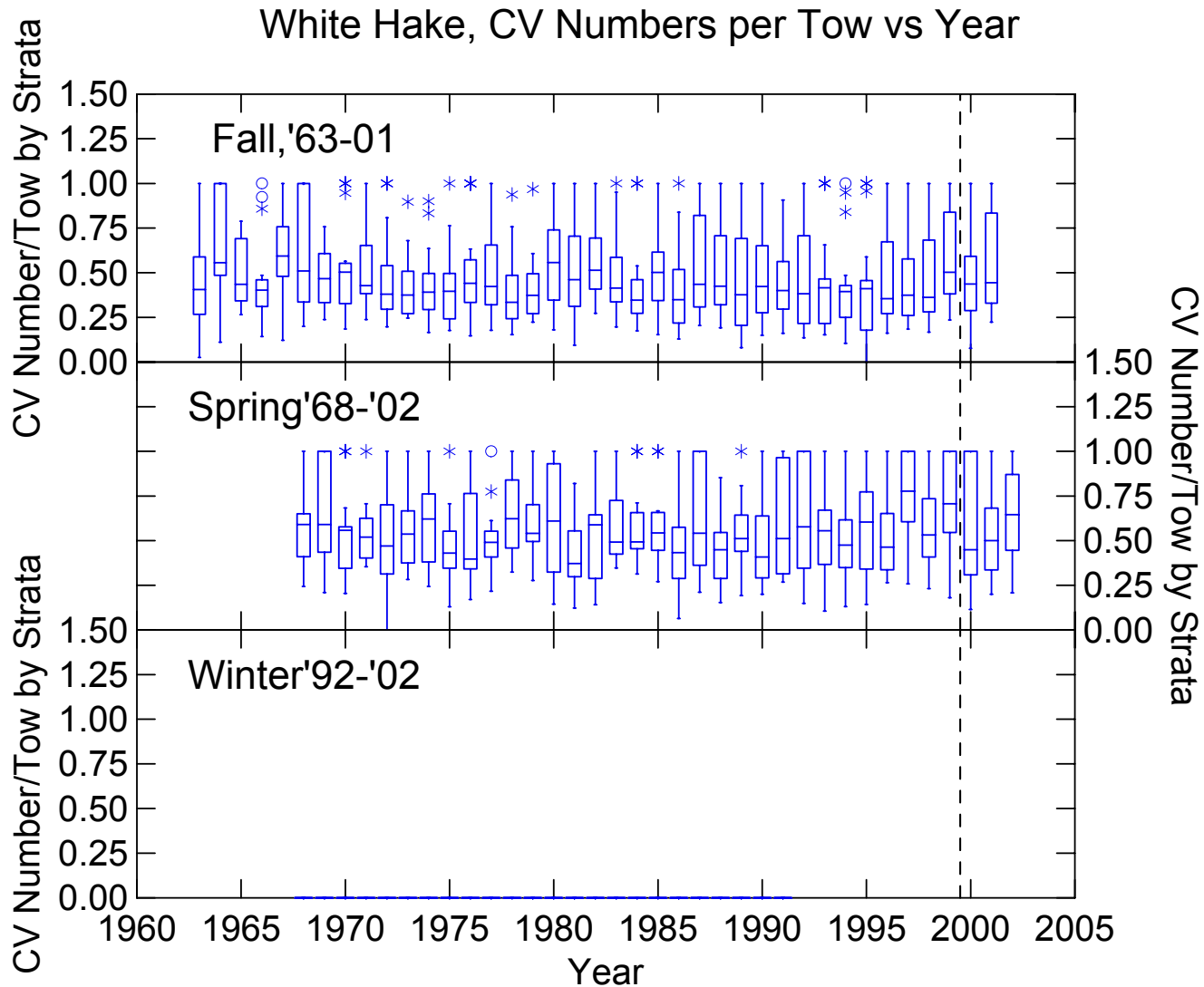
Fig. 3.6.10. Box plots of stratum-specific coefficients of catch (numbers/tow) for Southern New England stock of winter flounder for fall, spring, and winter NEFSC trawl surveys.

Fig. 3.6.11. Box plots of stratum-specific coefficients of catch (numbers/tow) for Acadian redfish for fall, spring, and winter NEFSC trawl surveys.
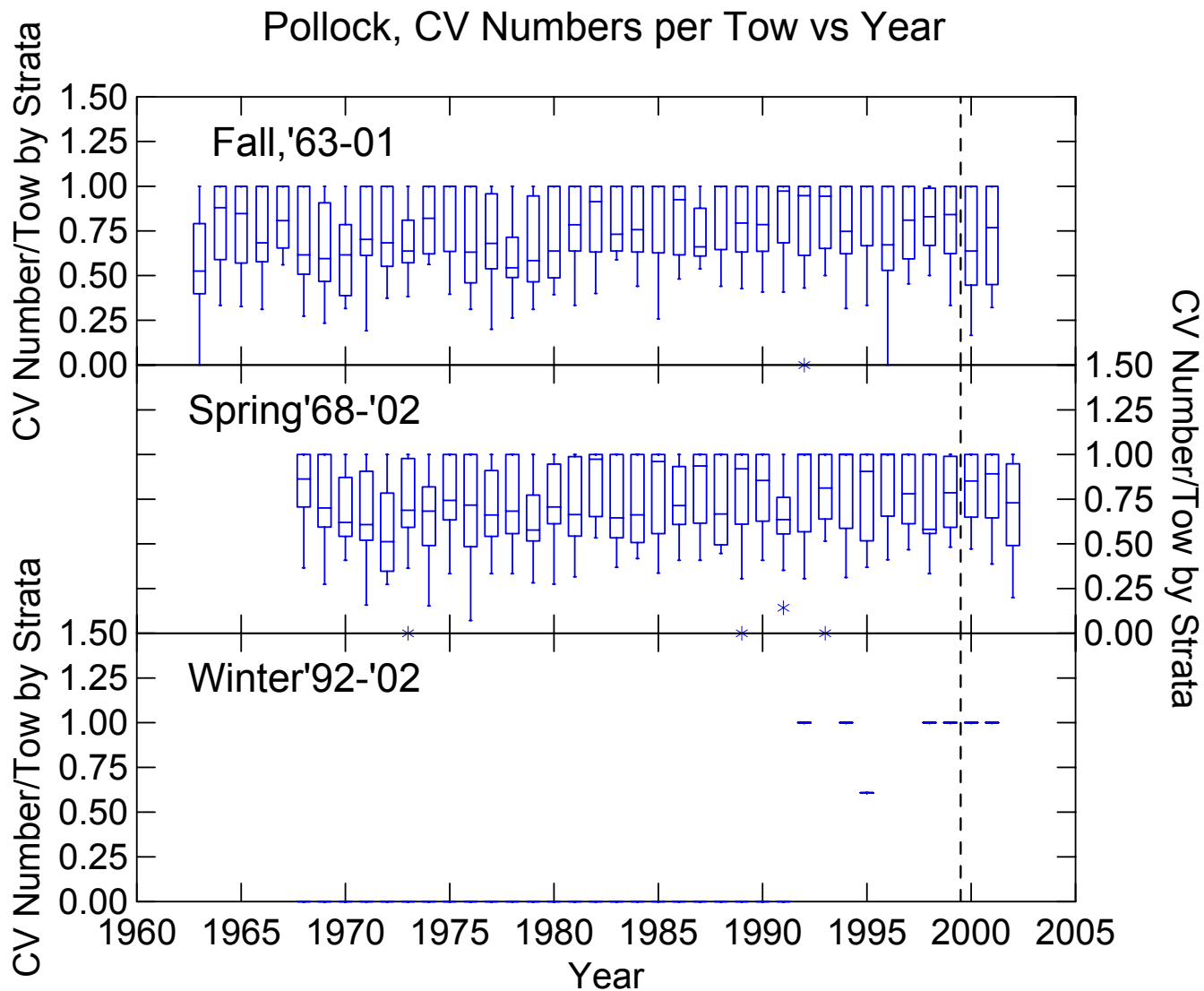
Fig. 3.6.12. Box plots of stratum-specific coefficients of catch (numbers/tow) for white hake for fall, spring , and winter NEFSC trawl surveys.

Fig. 3.6.13. Box plots of stratum-specific coefficients of catch (numbers/tow) for pollock
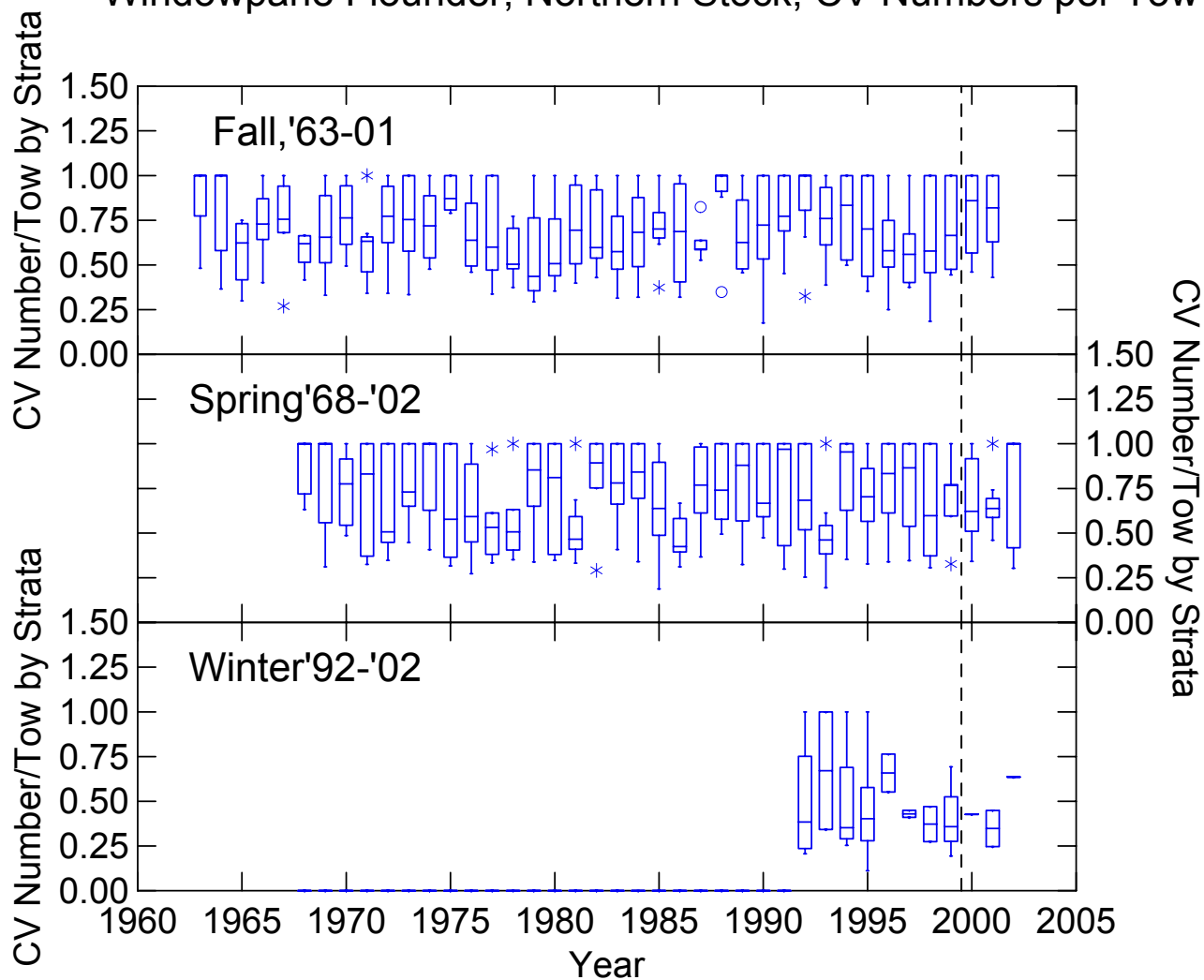for fall, spring , and winter NEFSC trawl surveys.

Fig. 3.6.14. Box plots of stratum-specific coefficients of catch (numbers/tow) for northern stock of windowpane flounder for fall, spring , and winter NEFSC trawl surveys.
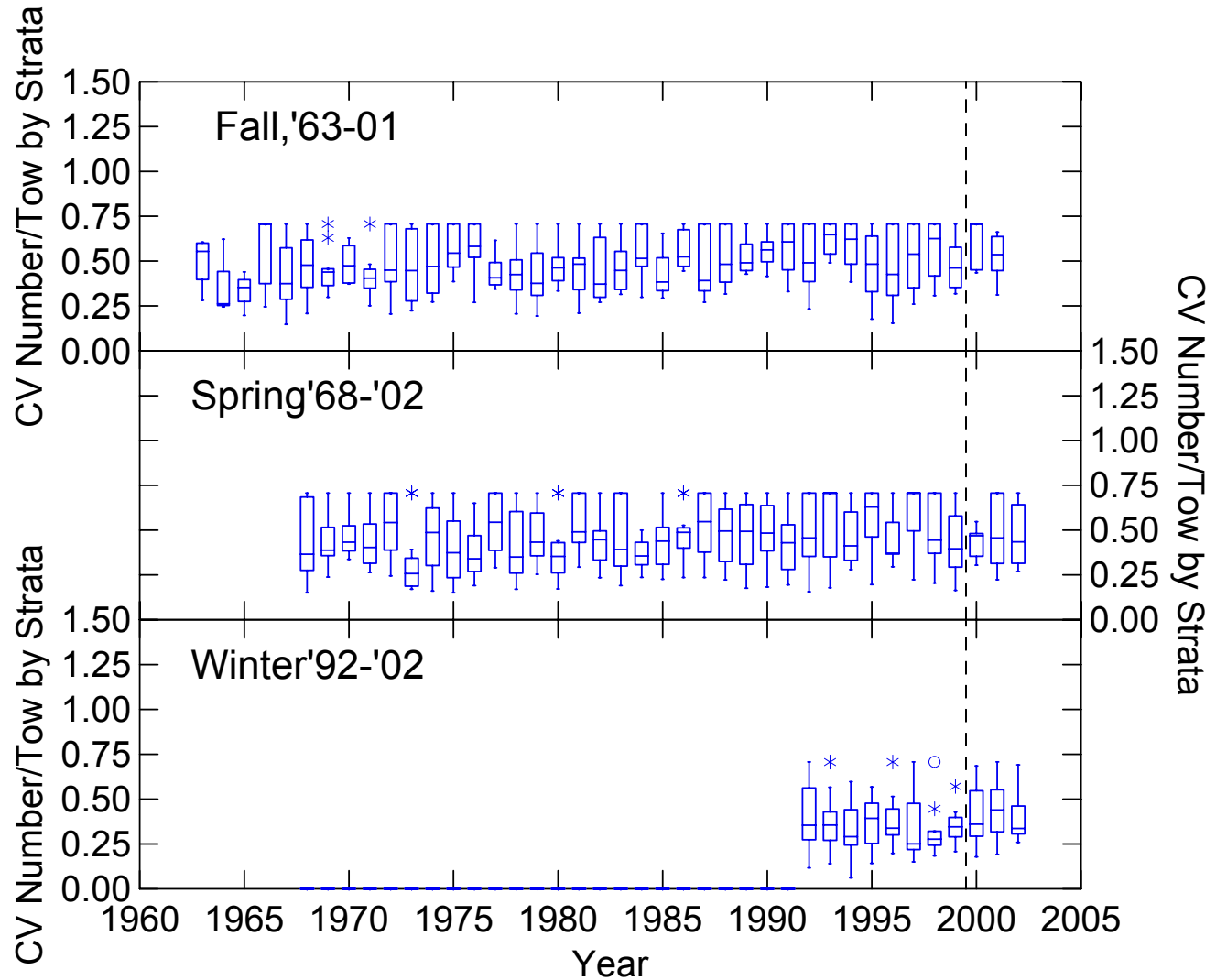
Fig. 3.6.15. Box plots of stratum-specific coefficients of catch (numbers/tow) for southern stock of windowpane flounder for fall, spring, and winter NEFSC trawl surveys.
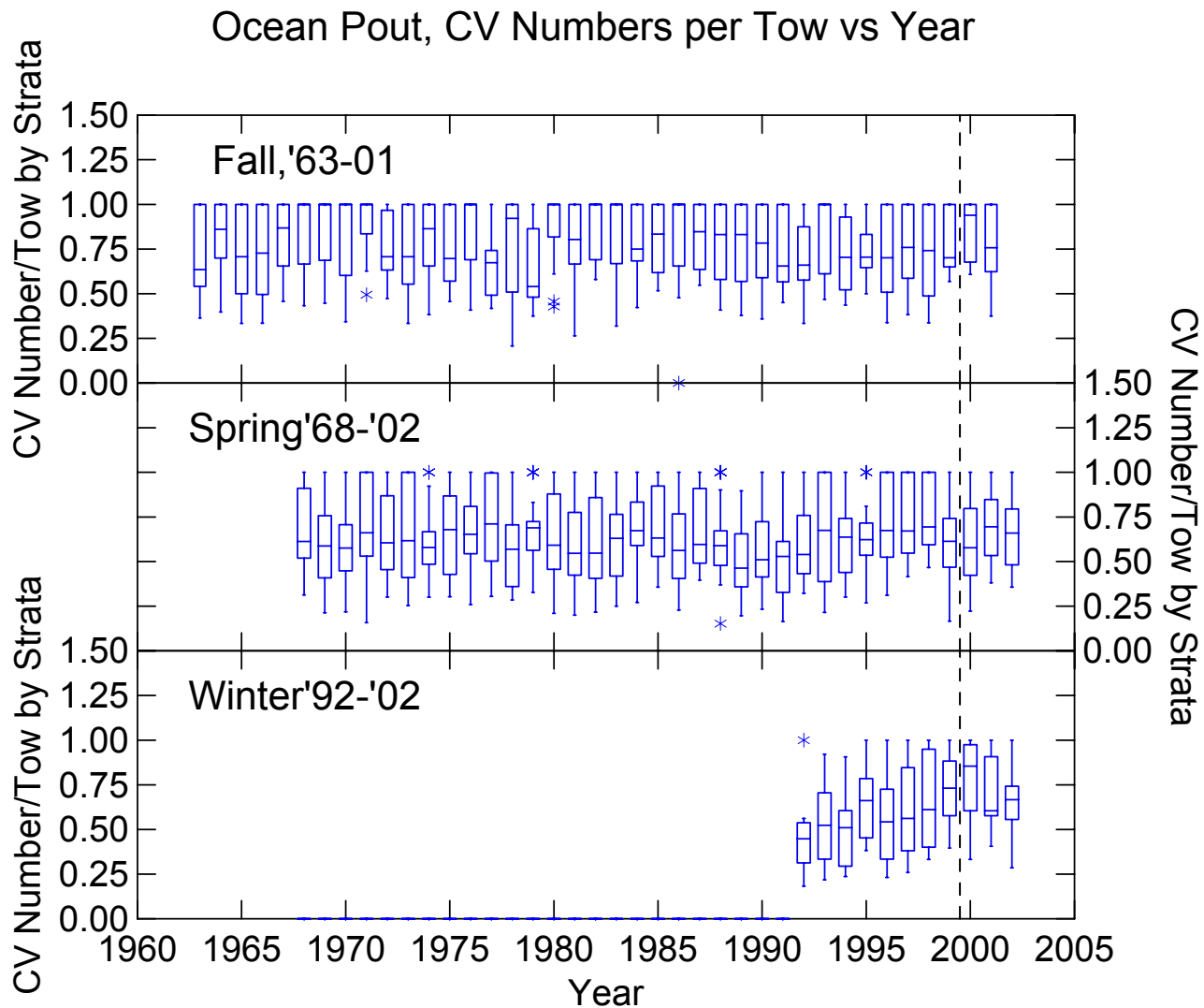
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Fig. 3.6.16. Box plots of stratum-specific coefficients of catch (numbers/tow) for ocean pout for fall, spring , and winter NEFSC trawl surveys.
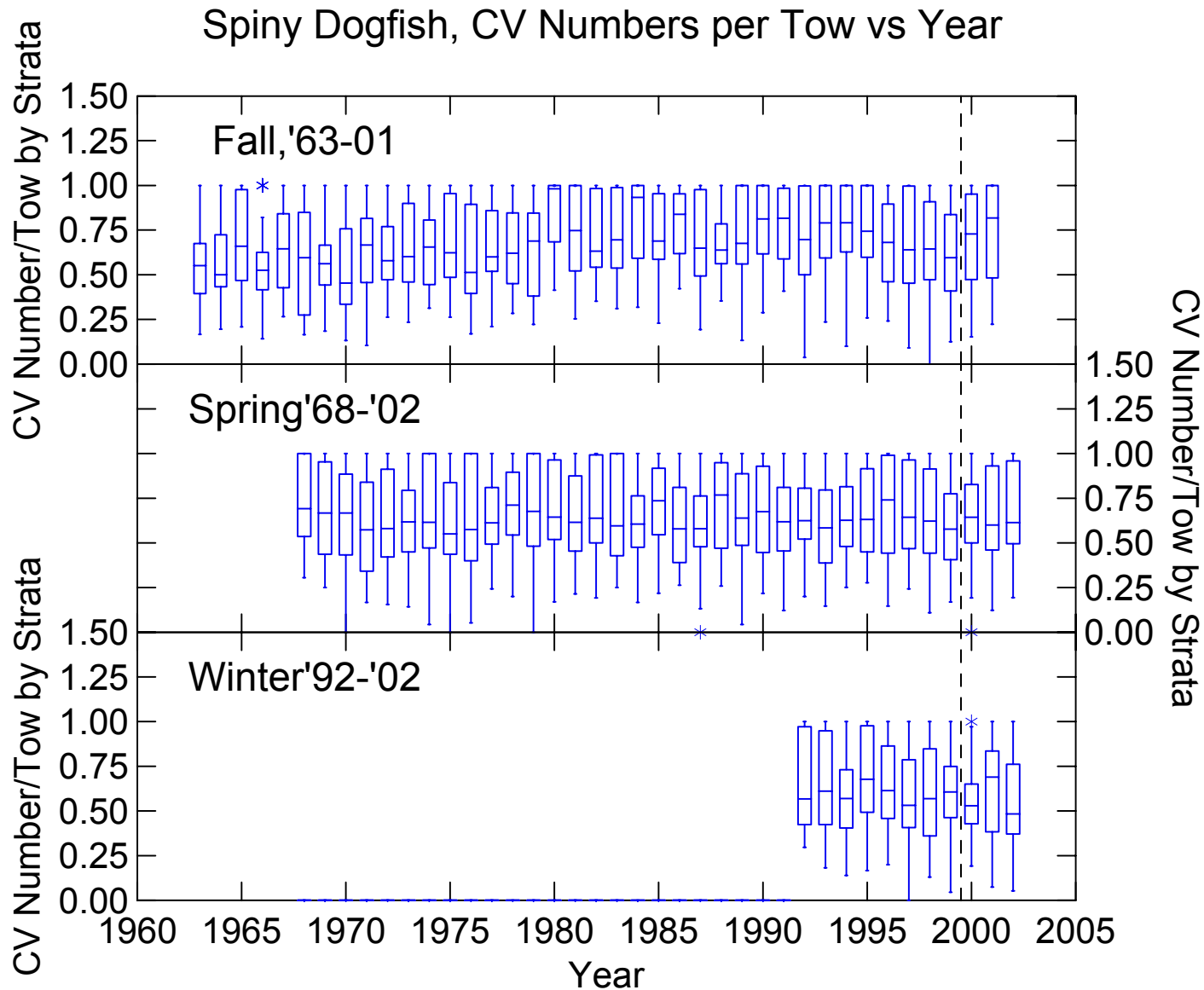
Fig. 3.6.17. Box plots of stratum-specific coefficients of catch (numbers/tow) for spiny dogfish
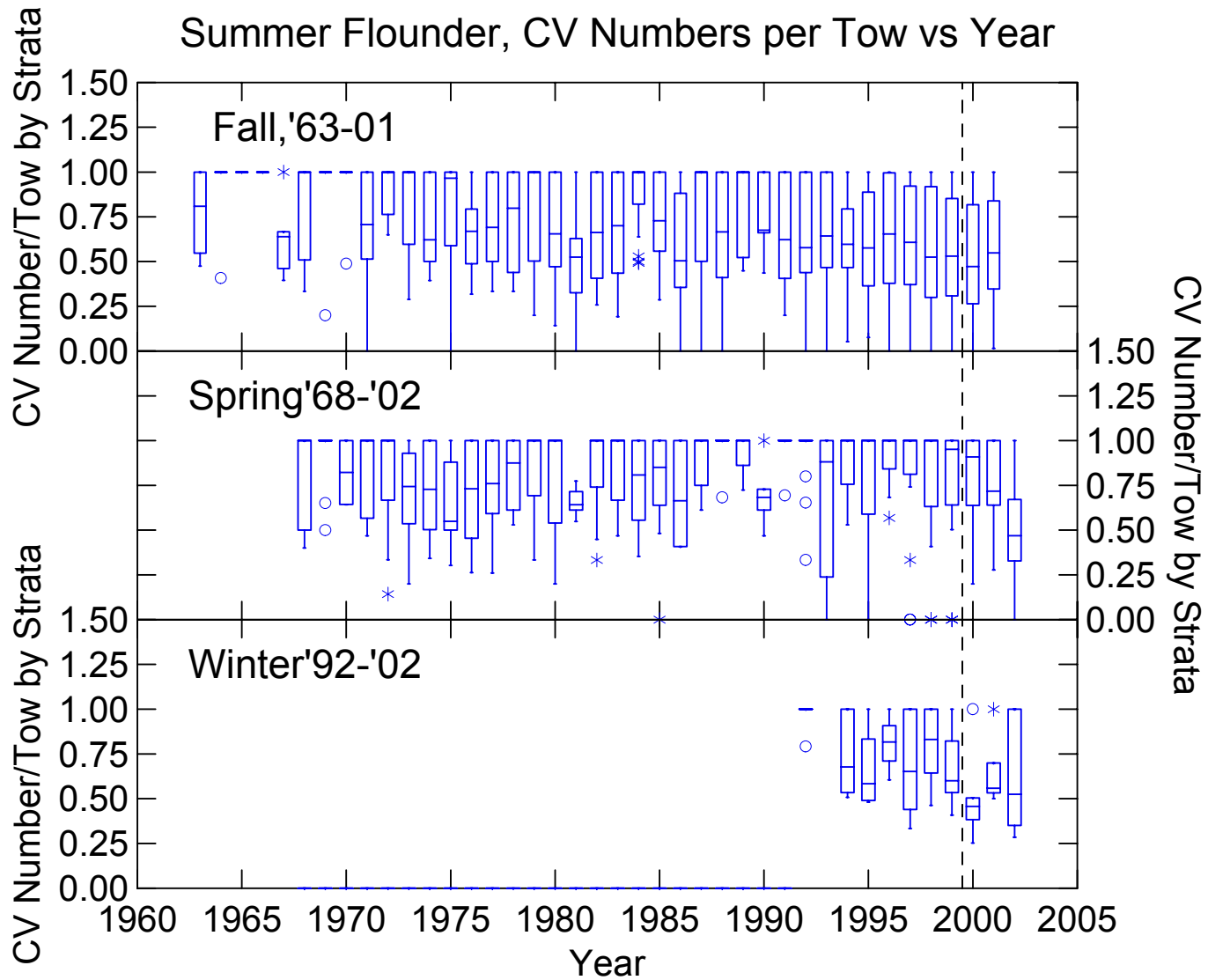for fall, spring , and winter NEFSC trawl surveys.

Fig. 3.6.18. Box plots of stratum-specific coefficients of catch (numbers/tow) for summer flounder for fall, spring , and winter NEFSC trawl surveys.
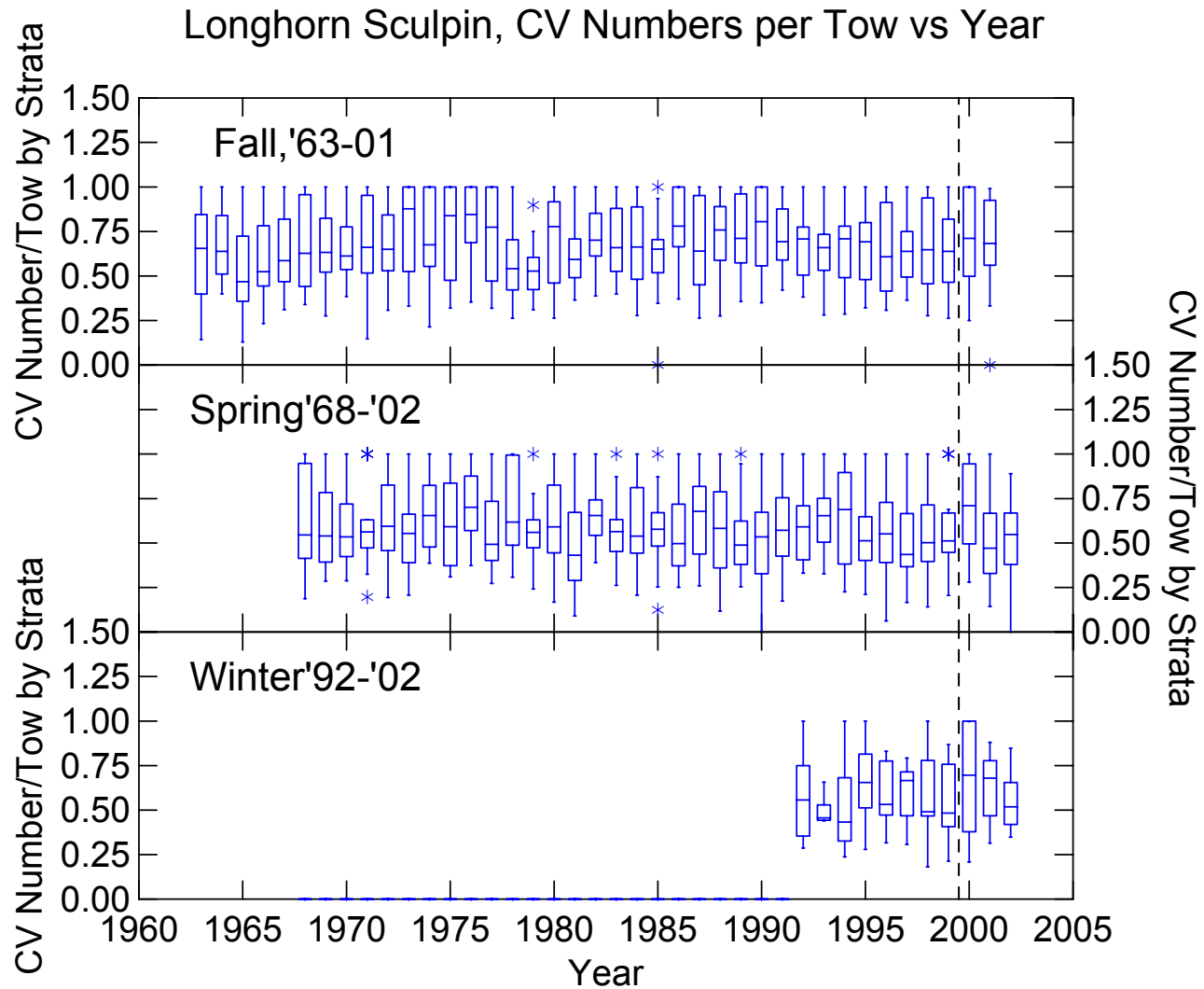
Fig. 3.6.19. Box plots of stratum-specific coefficients of catch (numbers/tow) for longhorn sculpins for fall, spring , and winter NEFSC trawl surveys.
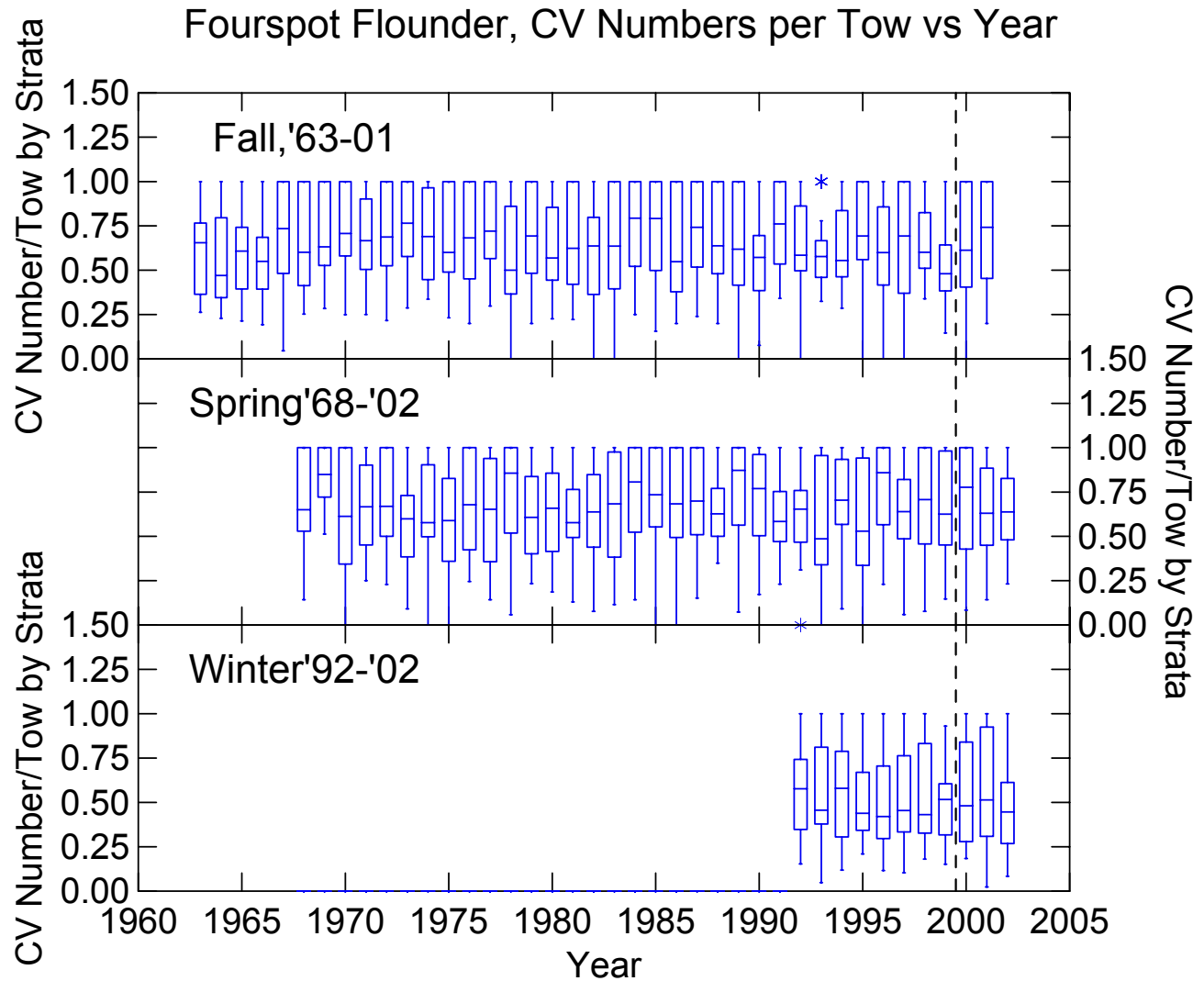
Fig. 3.6.20. Box plots of stratum-specific coefficients of catch (numbers/tow) for fourspot flounders
for fall, spring , and winter NEFSC trawl surveys.