3.7. Changes in Observed Depth Distribution

The geometric arguments in Section 3.1 suggest that the efficiency of the trawl should decrease with increasing depth. Under this hypothesis, one would expect a greater fraction of the population to be caught at shallower depths. The loci of population abundance, as measured by a catch-weighted average depth, should be lower in the affected years (2000-2002) than in the base period. The long-term time series of trawl survey data allows the characterization of the seasonal and annual shifts in abundance for each species. Many species have distinct seasonal changes in average depth, coinciding with temperature changes, spawning events, feeding migrations and so forth. The timing of these events is likely to change with environmental conditions and to a lesser extent, with variations in the timing of the NEFSC surveys. The historical pattern of catches can thus serve as a sampling distribution of the catch-weighted average depth. If the warp offset factor caused a severe decline in capture rates at depth, one would expect the mean depth at capture to lie outside the range of historical values.

3.7.1. Catch-Weighted Average Depth

The time series of depth distribution patterns was examined in several different ways. At the aggregate level, the mean and variance of catch-weighted average depths were computed for each species, stock, survey, and year. Both numbers per tow and weight (kg) per tow were used to weight the depth at capture. The stratum area information associated with the survey tows was not incorporated into the estimates. The following estimators were used:

$$\overline{D}_{C,t} = \frac{\sum_{k=1}^{n_t} D_{k,t} C_{k,t}}{\sum_{k=1}^{n_t} C_{k,t}} \qquad (7)$$

where $D_{k,t}$ is the depth of tow k, n_t is the total number of tows in year t, and $C_{k,t}$ is the catch in either numbers or weight in tow k and year t. The variance of the catch-weighted depth was estimated as

$$V(\overline{D}_{C,t}) = \frac{\sum_{k=1}^{n_t} D_{k,t}^2 C_{k,t} - \left(\sum_{k=1}^{n_t} D_{k,t} C_{k,t} \right)^2}{\sum_{k=1}^{n_t} C_{k,t} \left(\sum_{k=1}^{n_t} C_{k,t} - 1 \right)} \qquad (8)$$

The standard error of the $D_{C,t}$ was estimated as

$$SE(\overline{D}_{C,t}) = \frac{\sqrt{V(\overline{D}_{c,t})}}{n_t} \qquad (9)$$

The time series of these values are plotted in Fig. 3.7.1 to 3.7.22 for each species. Lowess smooths were used to identify any apparent trends in average depth. These plots show that in nearly every instance, the average depths in 2000-2002 were within the range of historical variation.

The distribution of average depths before and after 2000 were compared using both parametric and nonparametric statistical tests (Table 3.7.1). Parametric t-tests were used to test whether the mean of the average or mean of the standard deviation of catch-weighted depths during the 2000-2002 period were significantly different from the earlier values. T-tests were computed in two way—with a pooled estimate of a common variance, and with separate variances for each group. Of the 88 tests conducted with each method, 10 (11%) were significant at the 5% level. If the Bonferroni adjustment factor for multiple tests is applied, the Type 1 error rate becomes 0.05/(2*88). At this level of statistical significance, only one of the tests was significant.

The t-test was applied to a pooled set of observations of annual means for all survey types combined. To look at finer scale patterns with respect to each survey (i.e. fall,winter, spring) we used a Kruskall-Wallis test. Under this partitioning of the data, a reliable estimate of the variance for the treatment group was not possible (2-3 observations). Of the 232 tests conducted, 15 (6.5%) were significant at the 5% level. The Bonferroni criterion is quite stringent (0.05/(2*232)) and none of the tests suggested that the catch-weighted average depth during the post treatment period was significantly different from the pre-treatment means.

In summary, there is no compelling evidence of statistically significant changes in the average depth distribution of the 22 stocks examined. Significant tests, when they arose, were usually associated with a difference in the mean of the standard errors of the catch weighted average depth. The low number of statistically significant tests, and the absence of any apparent pattern in the tests suggest that the effects of warp offset factors, if any, are minor.

Analysis of the cumulative frequency distribution of catches with respect to depth may be found in Appendix 2.

3.7.2 Comparisons of Catch Rates at Depth: 1997-1999 vs. 2000-2002

The analyses of gear problem rate, mean-variance relationships and catch weighted average depth all fail to provide evidence of a significant effect of the mismarked cables on trawl performance. No consistent pattern emerges with respect to species groupings (e.g., round groundfish vs. flatfish) or geographical region, especially in the Gulf of Maine. Given its greater average depth one would expect a greater frequency of gear problems since 1999, a tendency to catch less fish in deeper strata, or more variation among tows. None of these features is readily discernible.

In an attempt to conduct more direct tests of potential depth effects on gear performance, it was hypothesized that average catch rates would decline with depth. Moreover, differences in catch rates between a baseline period and the 2000-2002 period should increase with depth. We tested this hypothesis by comparing average catch rates between the pre and post-treatment periods. Average catch rates in both number and weight per tow, were computed for each species, stock and season over 20 m depth intervals. Twenty m depth intervals were used to ensure that sufficient numbers of observations were available to obtain a reliable estimate of the mean. For the spring and winter surveys, we compared catch rates at depth in 2000-2002 with similar quantities for 1997-1999. For the fall survey, we compared 1998-1999 with 2000-2001. This approach ensured that the numbers of observations contributing to each mean would be roughly equal. The general equation for computing these quantities can be expressed as:

$$\overline{C}_{D_k,\tau} = \sum_{D_j \in D_k} \frac{C_{j,\tau}}{n\{D_j \in D_k\}} \quad \forall_j \qquad (10)$$

Where $C_{j,\tau}$= tow j within period τ whose average depth D_j is with the interval of depths defined by D_k. The expression n{.} denotes a counting operator that counts the number of tows within the set. Differences between the "control" and "treatment" periods this experiment were computed on the arithmetic scale, and standardized by the estimated standard deviation of the differences for a given comparison. The standardized difference can be written as

$$Z_k = \frac{\overline{C}_{D_k,\tau=1} - \overline{C}_{D_k,\tau=2}}{\hat{\sigma}} \qquad (11)$$

where τ=1 is the control period and τ=2 denotes the years in the treatment period. A simple regression model of the form

$$Z_k = \alpha + \beta D_k \qquad (12)$$

was used to test for effects of depth. When $\beta \sim 0$, α should equal ~zero. If $\beta > 0$ it implies that the average catch rate in the control period exceeded that in the treatment period and would imply some influence of the warp offset on the catch rates. Conversely, $\beta < 0$ implies that catches in the treatment period exceeded those in the control period.

Equation 12 provides a useful test for trend in catch rates with depth but it is not sufficient to isolate the influence decreasing efficiency with depth. This arises because Eq. 12 is linear and allows for changes in efficiency at shallow depths as well. These post hoc analyses cannot distinguish between true changes in abundance (which would lead to +/- variations) and effects induced by the trawl warp. However, the use of 3 surveys should help to distinguish changes that are real (e.g., all three indices increase with depth) versus artifacts of random variation. Two separate analyses of the standardized difference were conducted. First, plots of Z_k versus depth were constructed for all combinations of 21 species-stock combinations and 3 surveys (Fall, Spring, Winter). For each combination, two response variables (average numbers/tow, average weight/tow) were examined. A linear regression was computed for each combination and response variable to test for statistically significant values of α and β.

Results of the statistical tests are summarized in Table 3.7.1. Of the 112 individual tests conducted, 8 had probability levels less than 0.05. Of these, six had positive and two had negative slopes. The slope was positive for Gulf of Maine cod numbers per tow for both the spring and fall surveys. Similarly, longhorn sculpins had positive slopes for the spring survey regressions. The total number of significant tests is about that expected due to chance alone, but the association of significant tests for Gulf of Maine cod in both the spring and fall surveys merits some attention. The positive trend in the slope of the standardized difference with respect to depth is induced by a few large tows in shallow depth strata during the 2000-2002 interval rather than any general trend toward decreasing average catch rates in deeper strata.

None of the other Gulf of Maine species, notably haddock, pollock, and white hake demonstrated any trend with depth. Moreover, deeper water species, such as redfish and witch flounder did not demonstrate any significant trends of differences with depth. Had the reduced capture rate at depth been a general function of decreasing efficiency, one would have expected some of these comparisons to be significant.

A set of omnibus tests (Table 3.7. 3) in which all species were pooled, suggested no significant slopes for the differences of average numbers or weights per tow or for standardized log ratios of numbers or weights. For the fall survey, the standardized log ratio of numbers and weight in the fall survey was significantly correlated with depth—the slope however, was negative, suggesting higher overall catch rates in the post treatment period.

The second analysis considered the effects of depth on catch differences as a statistical control process. The standardization approach (Eq. 12) ensures that most differences will be between ± 3.5 standard deviations units. Moreover, 80% of the values should lie between ±1.28 SD, and 95% between ±1.96 SD units. Standardization of the differences also allows for pooling across species to permit testing of more general hypotheses. In particular, we examined general tests for gadoid species, flatfish species, species with median depths less than 100 m and those greater than 100 m. If general reductions in catch rates were evident with increasing depth, one would expect a general increase in positive residuals in deeper strata.

Figure 3.7.23 to 3.7.27 suggested no patterns associated with decreased relative efficiency with depth. On the contrary, the plots suggested less than expected variation in the standardized differences as depth increased. This pattern held for gadoid species, flatfish species, shallow versus deep-water species, as well as for all species combined.

A comparison of the observed and expected number of standardized differences suggested that the distribution was leptokurtotic (more peaked) compared to the expected normal distribution with mean zero and unary variance (Table 3.7.4).

In summary, the comparative tests of differences in catch rates versus depth interval did not suggest any significant trend in catch differences with depth. Increases in overall abundance during the 2000-2002 period would potentially cancel out the effects of depth related changes, but one has to postulate an awkward assumption that the increases at depth would have been greater in the deeper waters for 21 species-stocks x 3 surveys. Moreover, the likelihood that such increases would be exactly sufficient to offset the depth related decreases in efficiency, for all of these tests, seems implausible.

3.7.3 Implications of VPA Sensitivity Analyses for Relative Efficiency

Stock assessment models for the GARM investigated the implications of arbitrary increases in the 2000 to 2002 survey indices by factors of 10, 25 and 100%. These potential increases cannot be divorced from their implications for depth relative to efficiency. For example, one cannot simply postulate that the net was 25% less efficient at all fishing depths unless one also postulates that any amount of asymmetry in cable lengths leads to equal degrees of reduced efficiency. This not only denies the fact that increases in asymmetry can reduce efficiency but also asserts that unrealized differences in cable length (i.e., cable still on the winch) influence catch rates at shallower depths.

The 10, 25 and 100% raising factors also do not address the differences in depth distributions among species. By applying the same factors to both deep-water species (eg. Redfish) and shallow-water species (e.g., yellowtail flounder), one implies that the reduction in capture efficiency varies significantly among species.

These implications of these assertions were investigated by substituting Eq. 6 into Eq. 4. to obtain:

$$\sum_j C_{j\,rev} = (1+\delta)\sum_j C_{j,obs} = \sum_j \left(\frac{C_{j,obs}}{1-\left(\frac{0.0134 D_j}{W_{\max}}\right)^{\theta}} \right) \quad (13)$$

Eq. 13 can now be used to find the value of θ necessary to obtain an increase of magnitude δ when integrating over the entire depth range of a species. To illustrate this property, Eq. 13 was solved for hypothetical increases of 10%, 25% and 100% for cod, haddock, and yellowtail flounder for the 2000-2002 spring surveys, and 2000-2001 fall surveys. Model results, summarized in Fig. 3.7.28 to 3.7.30, suggest that efficiency reductions of about 50% would occur at depths of 100 m for cod and haddock if a 100% increase in the survey indices were true. For yellowtail flounder, an increase of 100% in the indices implies a rapid drop in trawl efficiency with decreases of 50% at 50 m. An important aspect of each of the analyses is that the reduction in efficiency is a concave function (i.e., θ >1). This model suggest that sharp declines in efficiency are necessary even when the asymmetry of the trawl is relatively minor.

Eq. 13 predicts the necessary decline in relative efficiency if the δ value is true. Using the data sets described in Section 3.7.2 (Eq. 10) , one can also estimate the magnitude of the expected decline supported by comparison of data in pre and post-warp offset periods. In other words, it is possible to evaluate the potential magnitude of the relative efficiency reduction if the pre- and post –periods are not unduly compromised by large changes in abundance. Results in Fig. 3.7.28-30, labeled as “Actual Data” suggest no reductions for yellowtail flounder or cod at depths less than 300 m. For haddock, (Fig. 3.7.29) the model suggests a reduction of up to 10% at 200m in the fall survey. It is important to note however, that even this magnitude of effect is insufficient to achieve even a 10% increase in the average abundance estimate. These results have important implications for the ascertaining the feasibility of certain raising factors. **On the basis of these analyses, there is no support for even the 10% level of hypothesized increase in survey abundances for cod, haddock or yellowtail flounder.**

3.7.4 Comparisons of Catch-Weighted Depth at Capture

Differences in catch-weighted depth at capture are summarized in Figures 3.7.31 and 3.7.32. Data are organized by species average depths at capture, and are divided for each into pre- and post-warp offset periods. The entire (1963-1999) pre-warp period is included in Figure 3.7.31, and, because of potential time trends of depth at capture, only the period 1997-1999 is included as the pre warp period in Figure 3.7.32. These analyses clearly demonstrate that the average depths of capture are not significantly different pre- and post-warp offset, and that there are no progressive differences between depths at capture among the periods as a function of species depth ranges. Virtually all of the catches of groundfish species included in the GARM updates are made in depths where the offsets were about 9 feet or less.

Table 3.7.1. Summary of statistical tests to evaluate the likelihood that the catch-weighted average depth and variance of catch-weighted depth had changed in response to warp offset factors in 2000 to 2002
Catch weighted average depths are based on either numbers/tow [N] or weight (kg)/tow [W].
Numbers of samples for the tests depends on the number of years and seasons considered.
The number of pre- and post-intervention cases for spring only comparisons is 32 vs 3,
for fall only, 37 vs 2 and for winter only, 8 vs 3.
When all seasons are combined the number of cases for the pre- and post intervention period is 77 vs 8.

					Significance levels for t-test comparisons using alternative variance estimators		Significance levels for Nonparametric
species	**stock**	**season**	**Response Variable**	**Weighting Factor: N=num/tow, W=kg/tow**	***p*: sep var t-test**	***p*: pooled var t-test**	***p*: Kruskal Wallis test**
Haddock	Georges Bank	all	SD	W	0.289862	0.433023	
Haddock	Georges Bank	all	SD	W	0.14826	0.163566	
Haddock	Georges Bank	all	SD	W	0.052296	0.266823	
Haddock	Georges Bank	all	SD	W	0.105207	0.139573	
Haddock	Georges Bank	fall	SD	W			0.798966
Haddock	Georges Bank	fall	SD	W			0.524311
Haddock	Georges Bank	fall	SD	W			0.339541
Haddock	Georges Bank	fall	SD	W			0.279068
Haddock	Georges Bank	spring	SD	W			0.859684
Haddock	Georges Bank	spring	SD	W			0.859684
Haddock	Georges Bank	spring	SD	W			0.723674
Haddock	Georges Bank	spring	SD	W			0.679988
Haddock	Georges Bank	winter	SD	W			0.794003
Haddock	Georges Bank	winter	SD	W			0.29627
Haddock	Georges Bank	winter	SD	W			0.601508
Haddock	Georges Bank	winter	SD	W			0.794003
Cod	Georges Bank	all	SD	W	0.904804	0.90178	
Cod	Georges Bank	all	SD	W	0.640815	0.684401	
Cod	Georges Bank	all	SD	W	0.906653	0.908996	
Cod	Georges Bank	all	SD	W	0.64553	0.706991	
Cod	Georges Bank	fall	SD	W			0.610492
Cod	Georges Bank	fall	SD	W			0.949232
Cod	Georges Bank	fall	SD	W			0.444833
Cod	Georges Bank	fall	SD	W			0.949232
Cod	Georges Bank	spring	SD	W			0.953011
Cod	Georges Bank	spring	SD	W			0.637352
Cod	Georges Bank	spring	SD	W			0.637352
Cod	Georges Bank	spring	SD	W			0.288844
Cod	Georges Bank	winter	SD	W			0.245278
Cod	Georges Bank	winter	SD	W			0.121335
Cod	Georges Bank	winter	SD	W			0.698535
Cod	Georges Bank	winter	SD	W			0.438578
Yellowtail	Georges Bank	all	SD	W	0.996997	0.995838	
Yellowtail	Georges Bank	all	SD	W	0.000071	0.02002	
Yellowtail	Georges Bank	all	SD	W	0.784343	0.709294	
Yellowtail	Georges Bank	all	SD	W	0.00437	0.019447	
Yellowtail	Georges Bank	fall	SD	W			0.048403
Yellowtail	Georges Bank	fall	SD	W			0.226372
Yellowtail	Georges Bank	fall	SD	W			0.085591
Yellowtail	Georges Bank	fall	SD	W			0.074619
Yellowtail	Georges Bank	spring	SD	W			0.813664
Yellowtail	Georges Bank	spring	SD	W			0.025145
Yellowtail	Georges Bank	spring	SD	W			0.595883
Yellowtail	Georges Bank	spring	SD	W			0.015694
Yellowtail	Georges Bank	winter	SD	W			0.414216
Yellowtail	Georges Bank	winter	SD	W			0.153042
Yellowtail	Georges Bank	winter	SD	W			0.540291
Yellowtail	Georges Bank	winter	SD	W			0.414216

Table 3.7.1 (continued).

American Plaice	Georges Bank	all	SD	W	0.437437	0.325598	
American Plaice	Georges Bank	all	SD	W	0.062179	0.000586	
American Plaice	Georges Bank	all	SD	W	0.322863	0.194199	
American Plaice	Georges Bank	all	SD	W	0.06563	0.000953	
American Plaice	Georges Bank	fall	SD	W			0.566616
American Plaice	Georges Bank	fall	SD	W			0.70244
American Plaice	Georges Bank	fall	SD	W			0.70244
American Plaice	Georges Bank	fall	SD	W			0.898669
American Plaice	Georges Bank	spring	SD	W			0.443657
American Plaice	Georges Bank	spring	SD	W			0.0771
American Plaice	Georges Bank	spring	SD	W			0.238593
American Plaice	Georges Bank	spring	SD	W			0.013328
American Plaice	Georges Bank	winter	SD	W			0.305059
American Plaice	Georges Bank	winter	SD	W			0.030368
American Plaice	Georges Bank	winter	SD	W			0.21
American Plaice	Georges Bank	winter	SD	W			0.052705
Witch Flounder	Georges Bank	all	SD	W	0.124172	0.200626	
Witch Flounder	Georges Bank	all	SD	W	0.543153	0.617123	
Witch Flounder	Georges Bank	all	SD	W	0.351447	0.269114	
Witch Flounder	Georges Bank	all	SD	W	0.923525	0.930964	
Witch Flounder	Georges Bank	fall	SD	W			0.444833
Witch Flounder	Georges Bank	fall	SD	W			0.524311
Witch Flounder	Georges Bank	fall	SD	W			0.655814
Witch Flounder	Georges Bank	fall	SD	W			0.566616
Witch Flounder	Georges Bank	spring	SD	W			0.443657
Witch Flounder	Georges Bank	spring	SD	W			0.859684
Witch Flounder	Georges Bank	spring	SD	W			0.215925
Witch Flounder	Georges Bank	spring	SD	W			0.4795
Acadian Redfish	Georges Bank	all	SD	W	0.573568	0.76492	
Acadian Redfish	Georges Bank	all	SD	W	0.010728	0.001963	
Acadian Redfish	Georges Bank	all	SD	W	0.174974	0.584986	
Acadian Redfish	Georges Bank	all	SD	W	0.034491	0.023123	
Acadian Redfish	Georges Bank	fall	SD	W			0.798966
Acadian Redfish	Georges Bank	fall	SD	W			0.111433
Acadian Redfish	Georges Bank	fall	SD	W			0.655814
Acadian Redfish	Georges Bank	fall	SD	W			0.444833
Acadian Redfish	Georges Bank	spring	SD	W			0.516868
Acadian Redfish	Georges Bank	spring	SD	W			0.006717
Acadian Redfish	Georges Bank	spring	SD	W			0.443657
Acadian Redfish	Georges Bank	spring	SD	W			0.015694
White Hake	Georges Bank	all	SD	W	0.172133	0.093167	
White Hake	Georges Bank	all	SD	W	0.658388	0.724624	
White Hake	Georges Bank	all	SD	W	0.333881	0.263352	
White Hake	Georges Bank	all	SD	W	0.001484	0.155635	
White Hake	Georges Bank	fall	SD	W			0.126484
White Hake	Georges Bank	fall	SD	W			0.111433
White Hake	Georges Bank	fall	SD	W			0.444833
White Hake	Georges Bank	fall	SD	W			0.202866
White Hake	Georges Bank	spring	SD	W			0.238593
White Hake	Georges Bank	spring	SD	W			0.637352
White Hake	Georges Bank	spring	SD	W			0.316472
White Hake	Georges Bank	spring	SD	W			0.288844
Pollock	Georges Bank	all	SD	W	0.956284	0.94036	
Pollock	Georges Bank	all	SD	W	0.235266	0.183857	
Pollock	Georges Bank	all	SD	W	0.232096	0.085014	
Pollock	Georges Bank	all	SD	W	0.897456	0.906902	
Pollock	Georges Bank	fall	SD	W			0.848514
Pollock	Georges Bank	fall	SD	W			0.566616
Pollock	Georges Bank	fall	SD	W			0.339541
Pollock	Georges Bank	fall	SD	W			0.750214
Pollock	Georges Bank	spring	SD	W			0.768278
Pollock	Georges Bank	spring	SD	W			0.029239
Pollock	Georges Bank	spring	SD	W			0.03917
Pollock	Georges Bank	spring	SD	W			0.723674

Table 3.7.1 (continued).

Ocean Pout	Georges Bank	all	SD	W	0.67499	0.58049	
Ocean Pout	Georges Bank	all	SD	W	0.987109	0.987866	
Ocean Pout	Georges Bank	all	SD	W	0.80934	0.758454	
Ocean Pout	Georges Bank	all	SD	W	0.838922	0.872914	
Ocean Pout	Georges Bank	fall	SD	W			0.048403
Ocean Pout	Georges Bank	fall	SD	W			0.161282
Ocean Pout	Georges Bank	fall	SD	W			0.041601
Ocean Pout	Georges Bank	fall	SD	W			0.407824
Ocean Pout	Georges Bank	spring	SD	W			0.140714
Ocean Pout	Georges Bank	spring	SD	W			0.111612
Ocean Pout	Georges Bank	spring	SD	W			0.175326
Ocean Pout	Georges Bank	spring	SD	W			0.08748
Ocean Pout	Georges Bank	winter	SD	W			0.683091
Ocean Pout	Georges Bank	winter	SD	W			0.540291
Ocean Pout	Georges Bank	winter	SD	W			0.307434
Ocean Pout	Georges Bank	winter	SD	W			0.683091
Windowpane	Northern	all	SD	W	0.673309	0.634325	
Windowpane	Northern	all	SD	W	0.114477	0.219954	
Windowpane	Northern	all	SD	W	0.537566	0.437876	
Windowpane	Northern	all	SD	W	0.08611	0.195187	
Windowpane	Northern	fall	SD	W			0.339541
Windowpane	Northern	fall	SD	W			0.339541
Windowpane	Northern	fall	SD	W			0.655814
Windowpane	Northern	fall	SD	W			0.202866
Windowpane	Northern	spring	SD	W			0.194851
Windowpane	Northern	spring	SD	W			0.316472
Windowpane	Northern	spring	SD	W			0.26289
Windowpane	Northern	spring	SD	W			0.859684
Windowpane	Northern	winter	SD	W			0.838256
Windowpane	Northern	winter	SD	W			0.414216
Windowpane	Northern	winter	SD	W			0.683091
Windowpane	Northern	winter	SD	W			0.220671
Halibut	Georges Bank	all	SD	W	0.777323	0.648636	
Halibut	Georges Bank	all	SD	W	0.296723	0.356407	
Halibut	Georges Bank	all	SD	W	0.734529	0.67077	
Halibut	Georges Bank	all	SD	W	0.116645	0.081905	
Halibut	Georges Bank	fall	SD	W			0.898664
Halibut	Georges Bank	fall	SD	W			0.898669
Halibut	Georges Bank	fall	SD	W			1
Halibut	Georges Bank	fall	SD	W			0.949232
Halibut	Georges Bank	spring	SD	W			0.634226
Halibut	Georges Bank	spring	SD	W			0.078983
Halibut	Georges Bank	spring	SD	W			0.906186
Halibut	Georges Bank	spring	SD	W			0.021556
Dogfish	Georges Bank	all	SD	W	0.657296	0.766204	
Dogfish	Georges Bank	all	SD	W	0.268458	0.221025	
Dogfish	Georges Bank	all	SD	W	0.725488	0.800442	
Dogfish	Georges Bank	all	SD	W	0.311377	0.247918	
Dogfish	Georges Bank	fall	SD	W			0.308325
Dogfish	Georges Bank	fall	SD	W			0.161282
Dogfish	Georges Bank	fall	SD	W			0.226372
Dogfish	Georges Bank	fall	SD	W			0.226372
Dogfish	Georges Bank	spring	SD	W			0.175326
Dogfish	Georges Bank	spring	SD	W			0.345779
Dogfish	Georges Bank	spring	SD	W			0.516868
Dogfish	Georges Bank	spring	SD	W			0.376759
Dogfish	Georges Bank	winter	SD	W			0.414216
Dogfish	Georges Bank	winter	SD	W			0.307434
Dogfish	Georges Bank	winter	SD	W			0.307434
Dogfish	Georges Bank	winter	SD	W			0.414216

Table 3.7.1 (continued).

Fourspot Flounder	Georges Bank	all	SD	W	0.468537	0.520394	
Fourspot Flounder	Georges Bank	all	SD	W	0.782591	0.818612	
Fourspot Flounder	Georges Bank	all	SD	W	0.674166	0.73479	
Fourspot Flounder	Georges Bank	all	SD	W	0.636316	0.732836	
Fourspot Flounder	Georges Bank	fall	SD	W			0.610492
Fourspot Flounder	Georges Bank	fall	SD	W			0.111433
Fourspot Flounder	Georges Bank	fall	SD	W			0.750214
Fourspot Flounder	Georges Bank	fall	SD	W			0.70244
Fourspot Flounder	Georges Bank	spring	SD	W			0.03917
Fourspot Flounder	Georges Bank	spring	SD	W			0.09896
Fourspot Flounder	Georges Bank	spring	SD	W			0.033895
Fourspot Flounder	Georges Bank	spring	SD	W			0.09896
Fourspot Flounder	Georges Bank	winter	SD	W			0.066193
Fourspot Flounder	Georges Bank	winter	SD	W			0.066193
Fourspot Flounder	Georges Bank	winter	SD	W			0.066193
Fourspot Flounder	Georges Bank	winter	SD	W			0.066193
Longhorn Sculpin	Georges Bank	all	SD	W	0.180463	0.110084	
Longhorn Sculpin	Georges Bank	all	SD	W	0.353837	0.205575	
Longhorn Sculpin	Georges Bank	all	SD	W	0.140948	0.107944	
Longhorn Sculpin	Georges Bank	all	SD	W	0.209937	0.107135	
Longhorn Sculpin	Georges Bank	fall	SD	W			0.407824
Longhorn Sculpin	Georges Bank	fall	SD	W			0.655814
Longhorn Sculpin	Georges Bank	fall	SD	W			0.483686
Longhorn Sculpin	Georges Bank	fall	SD	W			0.610492
Longhorn Sculpin	Georges Bank	spring	SD	W			0.316472
Longhorn Sculpin	Georges Bank	spring	SD	W			0.4795
Longhorn Sculpin	Georges Bank	spring	SD	W			0.288844
Longhorn Sculpin	Georges Bank	spring	SD	W			0.316472
Longhorn Sculpin	Georges Bank	winter	SD	W			0.220671
Longhorn Sculpin	Georges Bank	winter	SD	W			0.414216
Longhorn Sculpin	Georges Bank	winter	SD	W			0.307434
Longhorn Sculpin	Georges Bank	winter	SD	W			0.414216
Winter Flounder	Georges Bank	all	SD	W	0.483801	0.440467	
Winter Flounder	Georges Bank	all	SD	W	0.363302	0.4133	
Winter Flounder	Georges Bank	all	SD	W	0.468608	0.411567	
Winter Flounder	Georges Bank	all	SD	W	0.302825	0.352209	
Winter Flounder	Georges Bank	fall	SD	W			0.135682
Winter Flounder	Georges Bank	fall	SD	W			0.193759
Winter Flounder	Georges Bank	fall	SD	W			0.135682
Winter Flounder	Georges Bank	fall	SD	W			0.193759
Winter Flounder	Georges Bank	spring	SD	W			0.143235
Winter Flounder	Georges Bank	spring	SD	W			0.305507
Winter Flounder	Georges Bank	spring	SD	W			0.124283
Winter Flounder	Georges Bank	spring	SD	W			0.213399
Winter Flounder	Georges Bank	winter	SD	W			0.10247
Winter Flounder	Georges Bank	winter	SD	W			0.414216
Winter Flounder	Georges Bank	winter	SD	W			0.10247
Winter Flounder	Georges Bank	winter	SD	W			0.414216
Summer Flounder	Georges Bank	all	SD	W	0.605129	0.699592	
Summer Flounder	Georges Bank	all	SD	W	0.820766	0.879866	
Summer Flounder	Georges Bank	all	SD	W	0.699944	0.751436	
Summer Flounder	Georges Bank	all	SD	W	0.473265	0.653004	
Summer Flounder	Georges Bank	fall	SD	W			0.150382
Summer Flounder	Georges Bank	fall	SD	W			0.3268
Summer Flounder	Georges Bank	fall	SD	W			0.191063
Summer Flounder	Georges Bank	fall	SD	W			0.214211
Summer Flounder	Georges Bank	spring	SD	W			0.906186
Summer Flounder	Georges Bank	spring	SD	W			0.4795
Summer Flounder	Georges Bank	spring	SD	W			0.813664
Summer Flounder	Georges Bank	spring	SD	W			0.443657
Summer Flounder	Georges Bank	winter	SD	W			0.21
Summer Flounder	Georges Bank	winter	SD	W			0.73244
Summer Flounder	Georges Bank	winter	SD	W			0.21
Summer Flounder	Georges Bank	winter	SD	W			0.305059

Table 3.7.1 (continued).

Haddock	Gulf of Maine	all	SD	W	0.870036	0.905378	
Haddock	Gulf of Maine	all	SD	W	0.031405	0.058599	
Haddock	Gulf of Maine	all	SD	W	0.132005	0.270298	
Haddock	Gulf of Maine	all	SD	W	0.106911	0.178393	
Haddock	Gulf of Maine	fall	SD	W			1
Haddock	Gulf of Maine	fall	SD	W			0.097832
Haddock	Gulf of Maine	fall	SD	W			0.143073
Haddock	Gulf of Maine	fall	SD	W			0.202866
Haddock	Gulf of Maine	spring	SD	W			0.859684
Haddock	Gulf of Maine	spring	SD	W			0.157299
Haddock	Gulf of Maine	spring	SD	W			0.927432
Haddock	Gulf of Maine	spring	SD	W			0.236415
Cod	Gulf of Maine	all	SD	W	0.530754	0.584534	
Cod	Gulf of Maine	all	SD	W	0.393274	0.450724	
Cod	Gulf of Maine	all	SD	W	0.183749	0.398397	
Cod	Gulf of Maine	all	SD	W	0.047991	0.094618	
Cod	Gulf of Maine	fall	SD	W			1
Cod	Gulf of Maine	fall	SD	W			0.111433
Cod	Gulf of Maine	fall	SD	W			0.524311
Cod	Gulf of Maine	fall	SD	W			0.161282
Cod	Gulf of Maine	spring	SD	W			0.316472
Cod	Gulf of Maine	spring	SD	W			0.953011
Cod	Gulf of Maine	spring	SD	W			0.345779
Cod	Gulf of Maine	spring	SD	W			0.288844
Yellowtail	S. New England	all	SD	W	0.702098	0.801407	
Yellowtail	S. New England	all	SD	W	0.046119	0.031408	
Yellowtail	S. New England	all	SD	W	0.949283	0.957267	
Yellowtail	S. New England	all	SD	W	0.04699	0.045465	
Yellowtail	S. New England	fall	SD	W			0.566616
Yellowtail	S. New England	fall	SD	W			0.226372
Yellowtail	S. New England	fall	SD	W			0.251759
Yellowtail	S. New England	fall	SD	W			0.251759
Yellowtail	S. New England	spring	SD	W			0.859684
Yellowtail	S. New England	spring	SD	W			0.345779
Yellowtail	S. New England	spring	SD	W			0.768278
Yellowtail	S. New England	spring	SD	W			0.26289
Yellowtail	S. New England	winter	SD	W			0.683091
Yellowtail	S. New England	winter	SD	W			0.10247
Yellowtail	S. New England	winter	SD	W			1
Yellowtail	S. New England	winter	SD	W			0.041227
Windowpane	Southern	all	SD	W	0.673705	0.664883	
Windowpane	Southern	all	SD	W	0.769474	0.791003	
Windowpane	Southern	all	SD	W	0.715402	0.71455	
Windowpane	Southern	all	SD	W	0.59928	0.632188	
Windowpane	Southern	fall	SD	W			0.226372
Windowpane	Southern	fall	SD	W			0.566616
Windowpane	Southern	fall	SD	W			0.279068
Windowpane	Southern	fall	SD	W			0.898669
Windowpane	Southern	spring	SD	W			0.953011
Windowpane	Southern	spring	SD	W			0.4795
Windowpane	Southern	spring	SD	W			0.813664
Windowpane	Southern	spring	SD	W			0.637352
Windowpane	Southern	winter	SD	W			0.838256
Windowpane	Southern	winter	SD	W			0.540291
Windowpane	Southern	winter	SD	W			0.838256
Windowpane	Southern	winter	SD	W			0.414216

Table 3.7.1 (continued).

Winter Flounder	S. New England	all	SD	W	0.032823	0.003262	
Winter Flounder	S. New England	all	SD	W	0.125266	0.135732	
Winter Flounder	S. New England	all	SD	W	0.054484	0.009231	
Winter Flounder	S. New England	all	SD	W	0.138046	0.123636	
Winter Flounder	S. New England	fall	SD	W			0.143073
Winter Flounder	S. New England	fall	SD	W			0.339541
Winter Flounder	S. New England	fall	SD	W			0.161282
Winter Flounder	S. New England	fall	SD	W			0.483686
Winter Flounder	S. New England	spring	SD	W			0.26289
Winter Flounder	S. New England	spring	SD	W			0.768278
Winter Flounder	S. New England	spring	SD	W			0.345779
Winter Flounder	S. New England	spring	SD	W			0.516868
Winter Flounder	S. New England	winter	SD	W			0.220671
Winter Flounder	S. New England	winter	SD	W			0.307434
Winter Flounder	S. New England	winter	SD	W			0.10247
Winter Flounder	S. New England	winter	SD	W			0.307434
Yellowtail	Cape Cod	all	SD	W	0.348209	0.247442	
Yellowtail	Cape Cod	all	SD	W	0.499274	0.654831	
Yellowtail	Cape Cod	all	SD	W	0.347324	0.253839	
Yellowtail	Cape Cod	all	SD	W	0.368072	0.562796	
Yellowtail	Cape Cod	fall	SD	W			0.898669
Yellowtail	Cape Cod	fall	SD	W			0.949232
Yellowtail	Cape Cod	fall	SD	W			0.949232
Yellowtail	Cape Cod	fall	SD	W			1
Yellowtail	Cape Cod	spring	SD	W			0.194819
Yellowtail	Cape Cod	spring	SD	W			0.443657
Yellowtail	Cape Cod	spring	SD	W			0.236415
Yellowtail	Cape Cod	spring	SD	W			0.378639
				Total Tests	88	88	232
		Num P levels less than 0.05			0	0	0
	Fraction pf tests with less than 0.05				0.000	0.000	0.000
	Bonferroni P level for multiple tests, each with 5% Type I errors				0.000284091	0.000284091	0.000107759
	Number of tests that with probability levels less than Bonferroni limit				0	0	0

Table 3.7.2. Summary of statistical test of regression model for standardized difference of pre-post treatment catch rates versus depth for numbers per tow, and biomass (kg) per tow. Model type refers to response variable: num/tow= Nd_stan, weight per tow=Wd_stan.

model type	**Species**	**Stock**	**Season**	**Effect: Constant**	**Effect: DepthMid**	**Adj R^2**	**p-value**
Nd_stan	Acadian Redfish	all	fall	0.473255	-0.002754	0	0.573
Wd_stan	Acadian Redfish	1	fall	0.699839	-0.004073	0	0.399
Nd_stan	Acadian Redfish	all	spring	0.203443	-0.001017	0	0.772
Wd_stan	Acadian Redfish	all	spring	0.005724	-0.000029	0	0.994
Nd_stan	American Plaice	all	fall	0.707636	-0.00467	0.063654	0.205
Wd_stan	American Plaice	all	fall	0.709069	-0.004679	0.06428	0.204
Nd_stan	American Plaice	all	spring	-0.379685	0.002109	0	0.456
Wd_stan	American Plaice	all	spring	-0.336627	0.00187	0	0.509
Nd_stan	American Plaice	all	winter	2.350554	-0.019588	0.421454	0.097
Wd_stan	American Plaice	all	winter	2.748405	-0.022903	0.667988	0.029
Nd_stan	cod	GB	fall	-0.113871	0.000949	0	0.875
Wd_stan	Cod	GB	fall	-0.400822	0.00334	0	0.575
Nd_stan	cod	GB	spring	0.00633	-0.000053	0	0.993
Wd_stan	Cod	GB	spring	-0.055814	0.000465	0	0.938
Nd_stan	cod	GB	winter	0.270265	-0.002252	0	0.874
Wd_stan	Cod	GB	winter	-0.739223	0.00616	0	0.660
Nd_stan	cod	GM	fall	-1.586011	0.009231	0.346768	0.033
Wd_stan	Cod	GM	fall	-1.368388	0.007964	0.229734	0.077
Nd_stan	cod	GM	spring	-1.774249	0.008871	0.513467	0.002
Wd_stan	Cod	GM	spring	-0.646247	0.003231	0	0.350
Nd_stan	Dogfish	all	fall	-0.236035	0.001475	0	0.674
Wd_stan	Dogfish	all	fall	-0.018783	0.000117	0	0.973
Nd_stan	Dogfish	all	spring	0.333086	-0.00185	0	0.514
Wd_stan	Dogfish	all	spring	0.348654	-0.001937	0	0.494
Nd_stan	Dogfish	all	winter	0.511442	-0.003086	0.005047	0.322
Wd_stan	Dogfish	all	winter	0.773519	-0.004668	0.118831	0.123
Nd_stan	Fluke	all	fall	-0.22145	0.001845	0	0.680
Wd_stan	Fluke	all	fall	-0.290864	0.002424	0	0.587
Nd_stan	Fluke	all	spring	-0.880215	0.007335	0.207759	0.077
Wd_stan	Fluke	all	spring	-0.960853	0.008007	0.266731	0.049
Nd_stan	Fluke	all	winter	-0.783761	0.009797	0	0.475
Wd_stan	Fluke	all	winter	-0.10594	0.001324	0	0.926
Nd_stan	Fourspot Flounder	all	fall	-0.595604	0.004803	0	0.367
Wd_stan	Fourspot Flounder	all	fall	-0.517414	0.004173	0	0.436
Nd_stan	Fourspot Flounder	all	spring	-0.807506	0.005383	0.10089	0.154
Wd_stan	Fourspot Flounder	all	spring	-0.878435	0.005856	0.136065	0.117
Nd_stan	Fourspot Flounder	all	winter	-0.26492	0.001599	0	0.614
Wd_stan	Fourspot Flounder	all	winter	-0.355459	0.002145	0	0.496
Nd_stan	haddock	GB	fall	-0.084348	0.000588	0	0.887
Wd_stan	Haddock	GB	fall	-0.19594	0.001367	0	0.741
Nd_stan	haddock	GB	spring	-0.41692	0.002396	0	0.413
Wd_stan	Haddock	GB	spring	-0.070542	0.000405	0	0.891
Nd_stan	haddock	GB	winter	-1.413863	0.011782	0	0.382
Wd_stan	Haddock	GB	winter	-1.154848	0.009624	0	0.483
Nd_stan	haddock	GOM	fall	-0.197185	0.001232	0	0.838
Wd_stan	Haddock	GOM	fall	-0.537264	0.003358	0	0.573
Nd_stan	haddock	GOM	spring	-0.115982	0.000725	0	0.904
Wd_stan	Haddock	GOM	spring	-0.513181	0.003207	0	0.591
Nd_stan	Longhorn Sculpin	all	fall	0.568906	-0.004741	0	0.421
Wd_stan	Longhorn Sculpin	all	fall	0.687844	-0.005732	0.010532	0.326
Nd_stan	Longhorn Sculpin	all	spring	-1.668872	0.013907	0.672825	0.002
Wd_stan	Longhorn Sculpin	all	spring	-1.580484	0.013171	0.590553	0.006
Nd_stan	Longhorn Sculpin	all	winter	-1.382063	0.017276	0.272292	0.165
Wd_stan	Longhorn Sculpin	all	winter	-1.354093	0.016926	0.251366	0.177
Nd_stan	Ocean Pout	all	fall	0.629009	-0.004839	0.003345	0.336
Wd_stan	Ocean Pout	all	fall	0.587859	-0.004522	0	0.370
Nd_stan	Ocean Pout	all	spring	-0.288995	0.002223	0	0.665
Wd_stan	Ocean Pout	all	spring	-0.217109	0.00167	0	0.746
Nd_stan	Ocean Pout	all	winter	0.080832	-0.000652	0	0.905
Wd_stan	Ocean Pout	all	winter	0.3447	-0.00278	0	0.608

Table 3.7.2 (continued).

Nd_stan	Pollock	all	fall	0.665613	-0.004392	0.045841	0.235
Wd_stan	Pollock	all	fall	0.49967	-0.003297	0	0.380
Nd_stan	Pollock	all	spring	0.165327	-0.000918	0	0.747
Wd_stan	Pollock	all	spring	0.704614	-0.003915	0.077428	0.155
Nd_stan	White Hake	all	fall	0.74412	-0.00491	0.080002	0.181
Wd_stan	White Hake	all	fall	0.973632	-0.006425	0.201691	0.070
Nd_stan	White Hake	all	spring	1.250393	-0.006947	0.39734	0.005
Wd_stan	White Hake	all	spring	1.299752	-0.007221	0.43508	0.003
Nd_stan	Windowpane	North	fall	0.811478	-0.005796	0.092174	0.176
Wd_stan	Windowpane	North	fall	0.972239	-0.006945	0.175858	0.097
Nd_stan	Windowpane	North	spring	-1.1458	0.007161	0.305566	0.024
Wd_stan	Windowpane	North	spring	-1.178886	0.007368	0.32835	0.019
Nd_stan	Windowpane	North	winter	-2.544398	0.021203	0.536766	0.060
Wd_stan	Windowpane	North	winter	-2.444078	0.020367	0.475948	0.078
Nd_stan	Windowpane	South	fall	-0.472428	0.004395	0	0.502
Wd_stan	Windowpane	South	fall	-0.652119	0.006066	0.007209	0.345
Nd_stan	Windowpane	South	spring	-0.411368	0.002904	0	0.496
Wd_stan	Windowpane	South	spring	-0.134864	0.000952	0	0.825
Nd_stan	Windowpane	South	winter	-0.340323	0.002054	0	0.515
Wd_stan	Windowpane	South	winter	-0.509875	0.003077	0.004506	0.324
Nd_stan	Winter Flounder	GB	fall	1.414214	-0.070711	n/a	n/a
Wd_stan	Winter Flounder	GB	fall	1.414214	-0.070711	n/a	n/a
Nd_stan	Winter Flounder	GB	spring	-1.358549	0.045285	0.640582	0.279
Wd_stan	Winter Flounder	GB	spring	-1.424703	0.04749	0.804248	0.203
Nd_stan	Winter Flounder	GB	winter	0.829594	-0.007392	0.072265	0.243
Wd_stan	Winter Flounder	GB	winter	0.874185	-0.00779	0.096012	0.216
Nd_stan	Winter Flounder	SNE	fall	-0.387029	0.002908	0	0.423
Wd_stan	Winter Flounder	SNE	fall	-0.375643	0.002823	0	0.438
Nd_stan	Winter Flounder	SNE	spring	0.386662	-0.002379	0	0.378
Wd_stan	Winter Flounder	SNE	spring	0.487718	-0.003001	0.023735	0.262
Nd_stan	Winter Flounder	SNE	winter	-0.533972	0.006675	0	0.456
Wd_stan	Winter Flounder	SNE	winter	-1.248604	0.015608	0.241034	0.060
Nd_stan	Witch Flouder	all	fall	0.197154	-0.001301	0	0.733
Wd_stan	Witch Flouder	all	fall	-0.084724	0.000559	0	0.884
Nd_stan	Witch Flouder	all	spring	0.229952	-0.001278	0	0.654
Wd_stan	Witch Flouder	all	spring	0.663112	-0.003684	0.060409	0.183
Nd_stan	Yellowtail	GB	fall	-0.525323	0.005837	0	0.585
Wd_stan	Yellowtail	GB	fall	-0.524222	0.005825	0	0.586
Nd_stan	Yellowtail	GB	spring	-0.266372	0.00333	0	0.814
Wd_stan	Yellowtail	GB	spring	-0.280611	0.003508	0	0.804
Nd_stan	Yellowtail	GB	winter	-2.389447	0.019912	0.443857	0.089
Wd_stan	Yellowtail	GB	winter	-2.266207	0.018885	0.37413	0.116
Nd_stan	Yellowtail	SNE	fall	-0.622878	0.010381	0	0.732
Wd_stan	Yellowtail	SNE	fall	-2.005485	0.033425	0.617214	0.137
Nd_stan	Yellowtail	SNE	spring	-0.787223	0.011246	0	0.557
Wd_stan	Yellowtail	SNE	spring	-1.35803	0.0194	0.168502	0.271
Nd_stan	Yellowtail	SNE	winter	0.387471	-0.005535	0	0.778
Wd_stan	Yellowtail	SNE	winter	-0.132346	0.001891	0	0.924
Nd_stan	Yellowtail	CC	fall	0.694145	-0.013883	0	0.460
Wd_stan	Yellowtail	CC	fall	0.67586	-0.013517	0	0.473
Nd_stan	Yellowtail	CC	spring	0.313874	-0.005231	0	0.710
Wd_stan	Yellowtail	CC	spring	0.228901	-0.003815	0	0.787

Table 3.7.3. Summary of statistical tests of regression model for standardized difference of pre-post treatment catch rates versus deoth for numbers per tow, and biomass (kg) per tow. Model type refers to response variable: num/tow= Nd_stan, weight per tow=Wd_stan. For these analyses, all species are pooled; the depth effect coefficient represents the change in the standardized difference. Positive values imply that the pre-treatment catch rates exceeded the post-treatment catch rates.

Model Type	**Difference**	**Season**	**Constant**	**Depthmid**	**Adj. R^2**	**p-value**
Wd stan	Weight	spring	-0.018886	0.000121	0	0.8621
Nd_stan	Number	spring	-0.142906	0.000914	0.002964	0.1879
lnWd_stan	ln W	spring	0.023038	-0.000147	0	0.8322
lnNd_stan	ln N	spring	0.081126	-0.000519	0	0.4553
Wd stan	Weight	fall	0.066983	-0.000492	0	0.5780
Nd_stan	Number	fall	0.075799	-0.000556	0	0.5289
lnWd_stan	ln W	fall	0.358677	-0.002632	0.037413	0.0026
lnNd_stan	ln N	fall	0.416881	-0.003059	0.052196	0.0004
Wd stan	Weight	winter	-0.065415	0.000521	0	0.6700
Nd_stan	Number	winter	-0.064781	0.000515	0	0.6730
lnWd_stan	ln W	winter	-0.085622	0.000681	0	0.5769
lnNd_stan	ln N	winter	0.002906	-0.000023	0	0.9849

Table 3.7.4. Summary of frequencies of standardized residuals of average catch (number/tow) vs Depth for all species combined.

Expected frequencies are based on assumption that standardized residuals are normally distributed.

80%CI				80% CI				
90% CI			90% CI					
95% CI		95% CI						

min Stan Dif	<-1.96	-1.96	-1.645	-1.282	0	1.282	1.645	
max Stan Dif		-1.645	-1.282	0	1.282	1.645	1.96	>1.96

Depth Interval (m)	**<0.025**	**(0.025-0.05)**	**(0.05-0.10)**	**(0.10-0.50)**	**(0.50-0.90)**	**(0.90-0.95)**	**(0.95-0.975)**	**>0.975**	Total
10	0	0	0	5	3	0	0	0	8
30	3	1	0	17	23	0	0	2	46
50	3	0	1	16	18	4	2	1	45
70	4	4	4	16	21	2	2	2	55
90	4	1	2	24	20	1	2	1	55
110	4	0	1	21	23	2	2	0	53
130	0	1	2	17	24	3	2	1	50
150	4	0	2	11	22	1	1	4	45
170	2	0	0	15	24	1	0	1	43
190	1	2	0	17	15	0	0	0	35
210	2	0	0	12	20	1	1	2	38
230	0	0	0	15	17	2	0	0	34
250	0	0	0	5	15	1	0	0	21
270	1	0	0	6	8	0	0	0	15
290	0	0	1	7	13	0	0	0	21
310	0	0	0	4	5	0	0	0	9
330	1	0	1	4	6	0	0	0	12
Total	29	9	14	212	277	18	12	14	585
Percent	0.050	0.015	0.024	0.362	0.474	0.031	0.021	0.024	
Expected%	0.025	0.025	0.05	0.34135	0.34135	0.05	0.025	0.025	
Expected #	14.6	14.6	29.3	199.7	199.7	29.3	14.6	14.6	

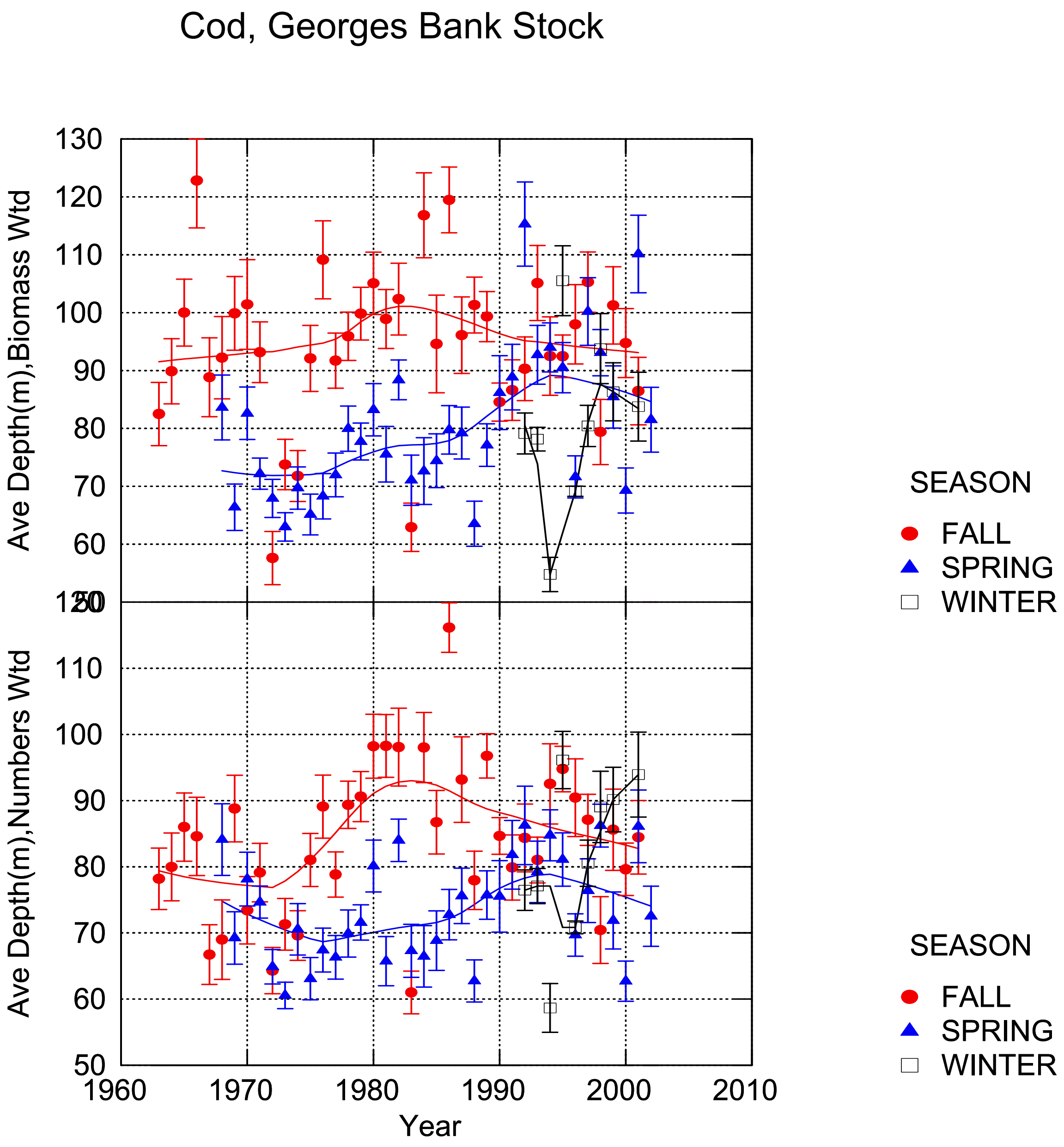


Fig. 3.7.1. Temporal trends in catch weighted average depth for Georges Bank Cod stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

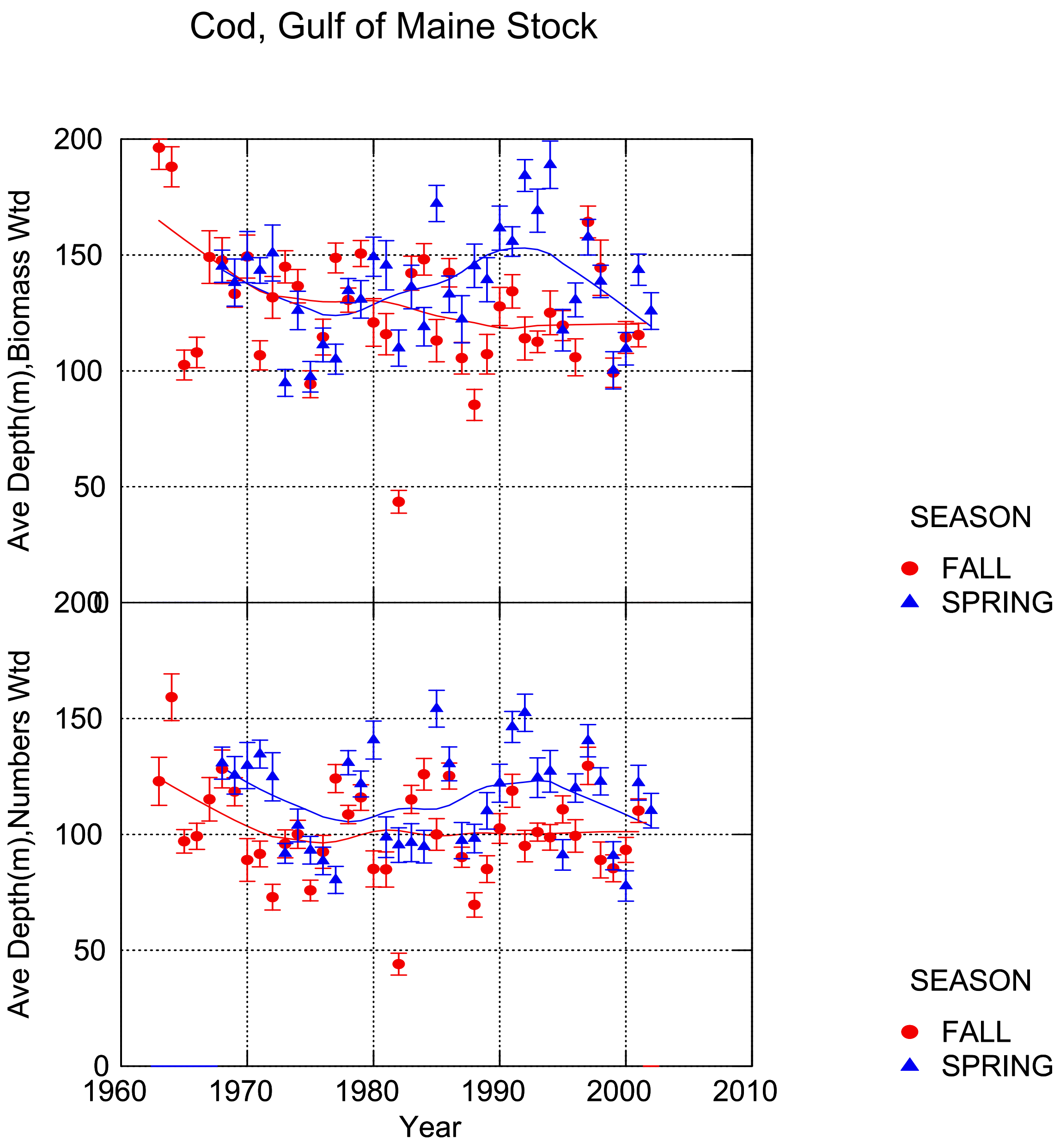


Fig. 3.7. 2. Temporal trends in catch weighted average depth for Gulf of Maine Cod stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

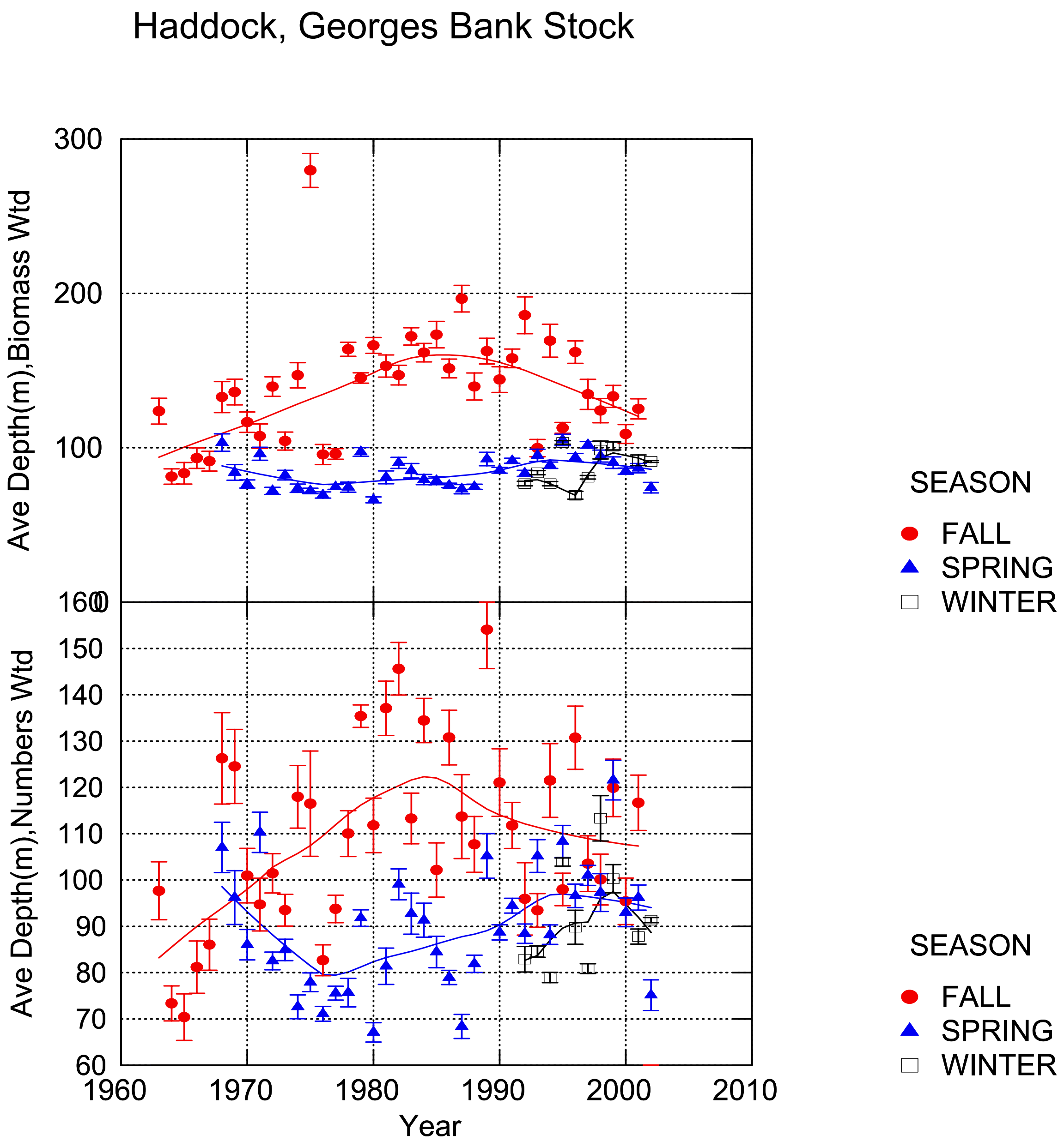


Fig. 3.7.3. Temporal trends in catch weighted average depth for Georges Bank Haddock stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

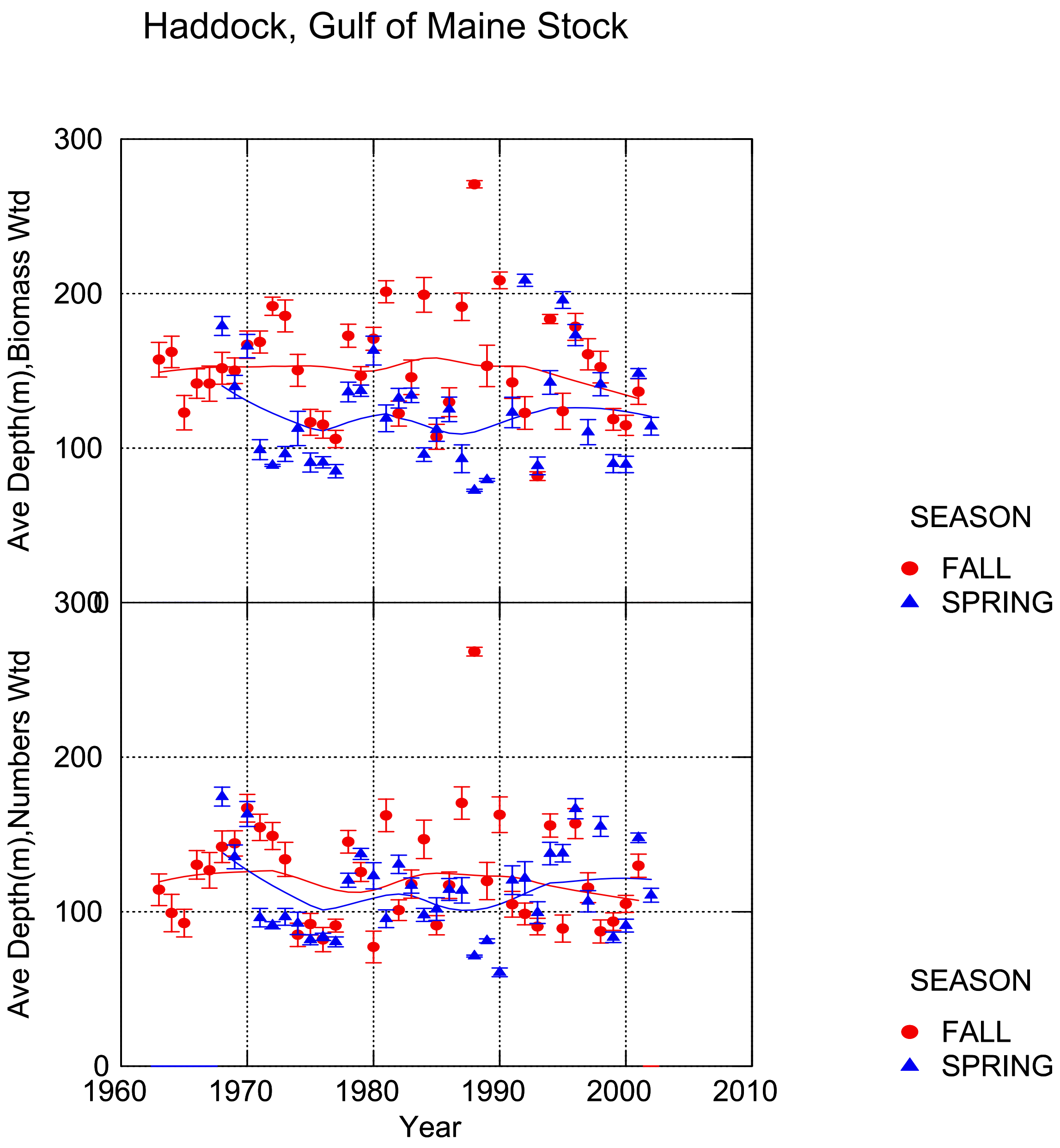


Fig. 3.7.4. Temporal trends in catch weighted average depth for Gulf of Maine Haddock stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

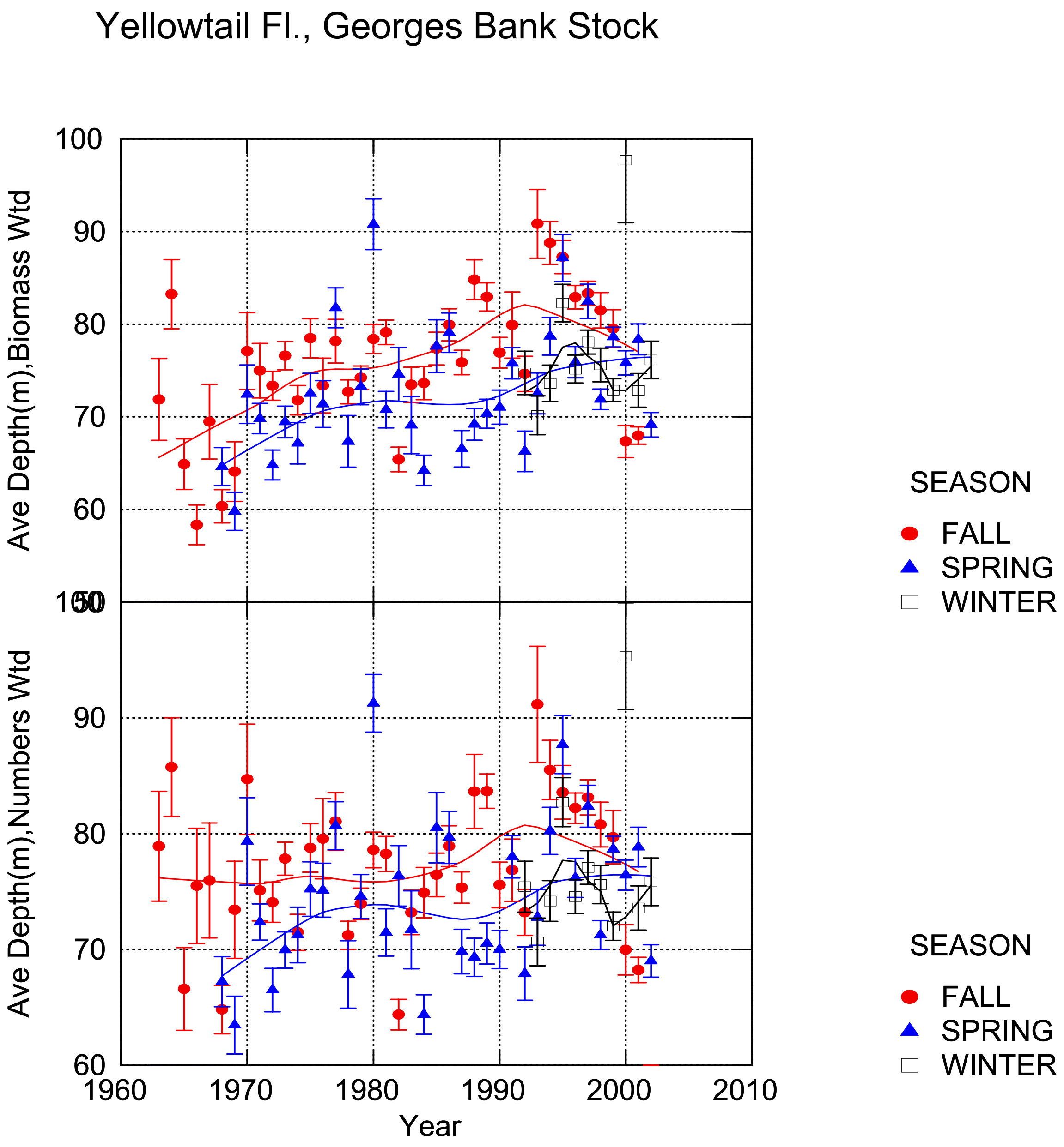


Fig. 3.7.5. Temporal trends in catch weighted average depth for Georges Bank Yellowtail stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

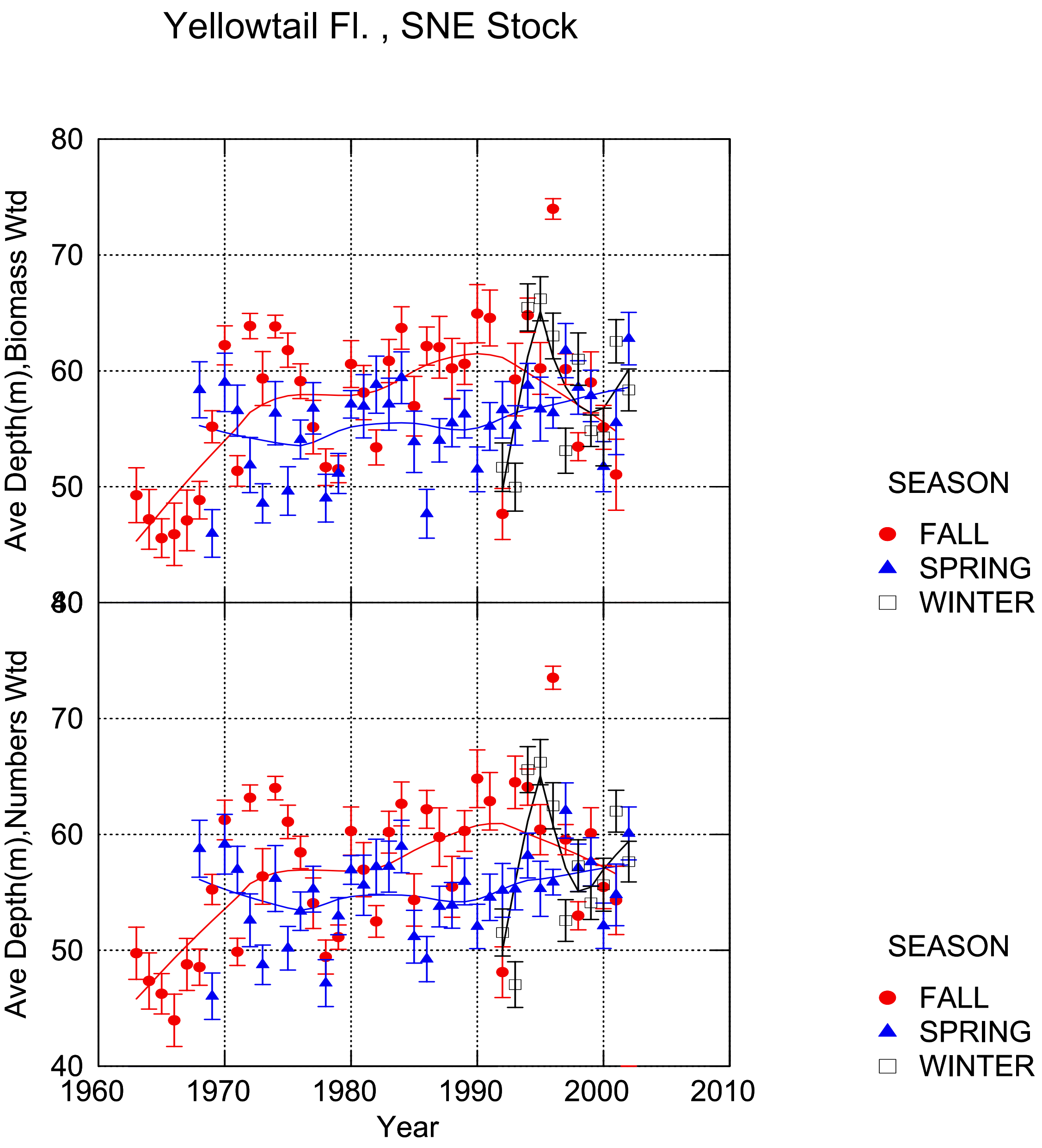


Fig. 3.7.6. Temporal trends in catch weighted average depth for Southern New England Yellowtail stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

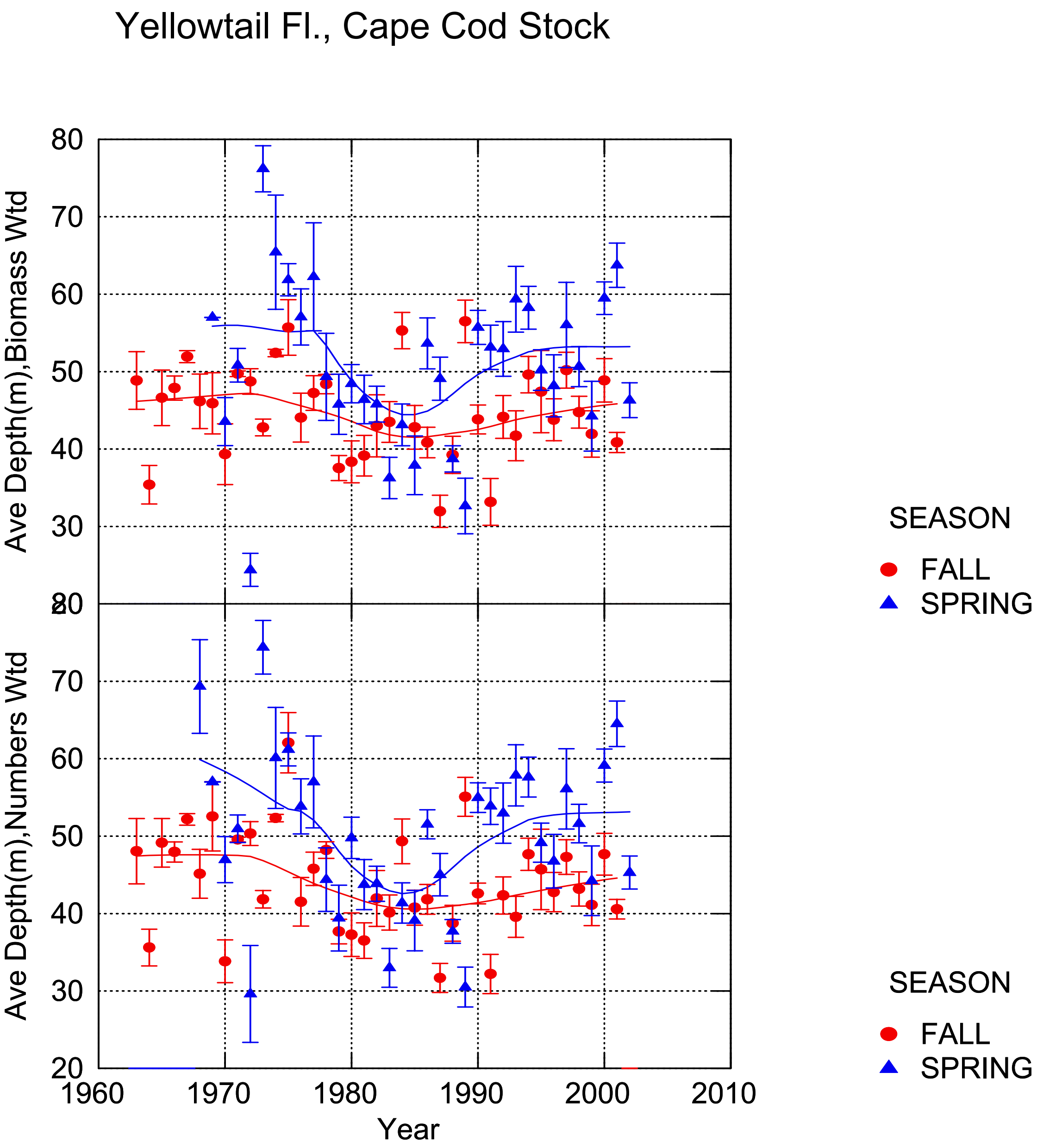


Fig. 3.7.7. Temporal trends in catch weighted average depth for Cape Cod Yellowtail Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

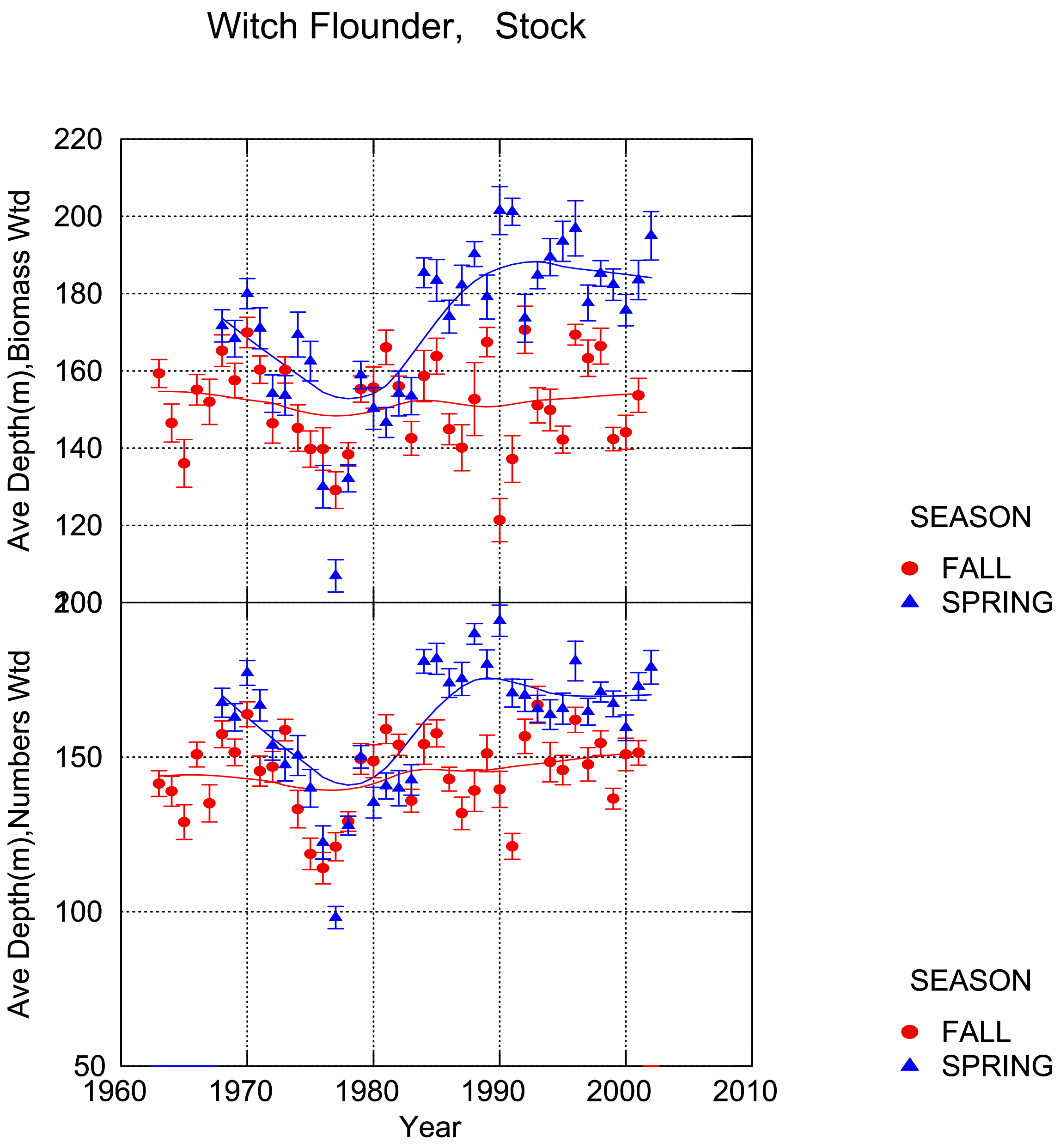


Fig. 3.7.8. Temporal trends in catch weighted average depth for Witch Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

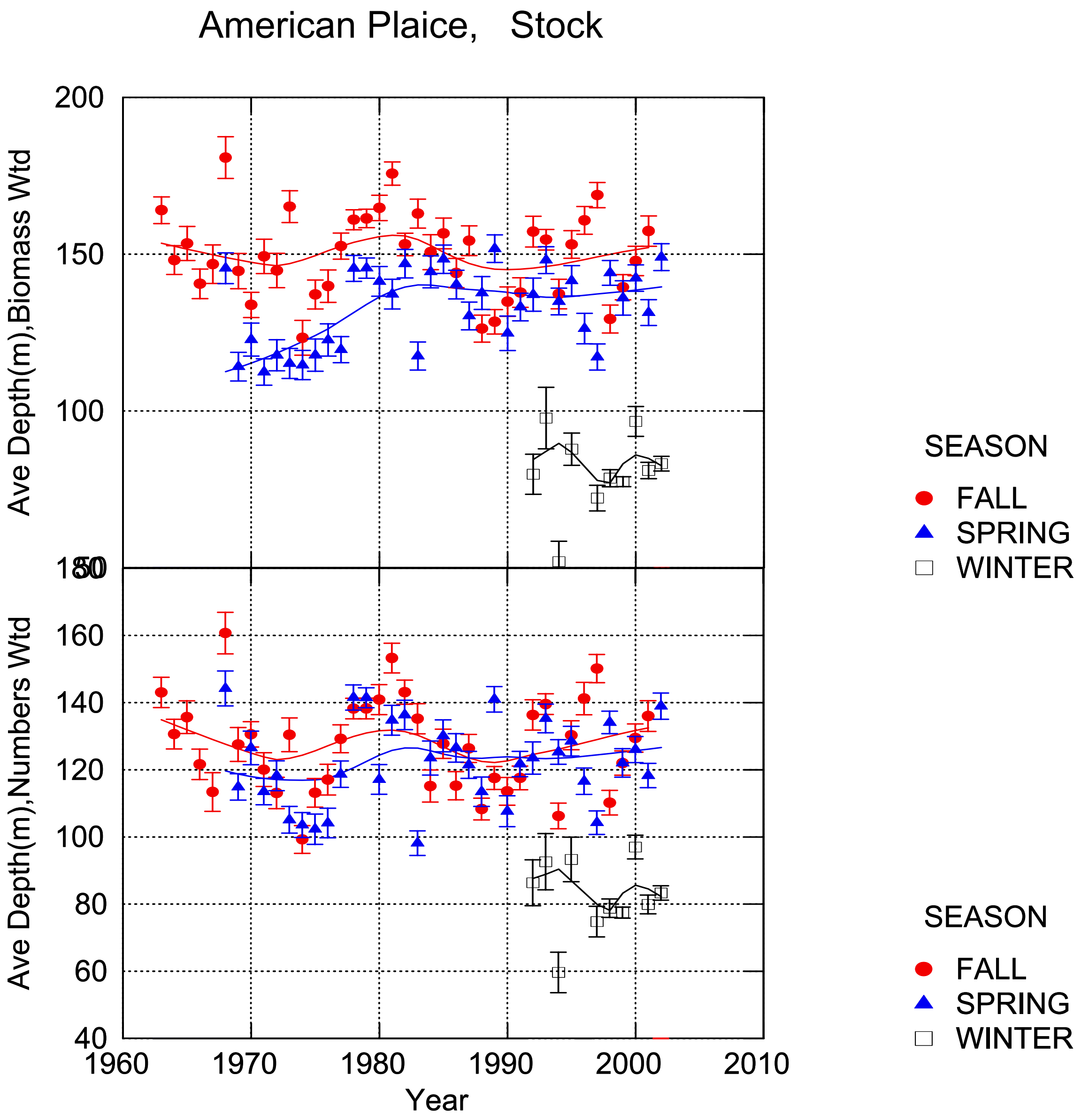


Fig. 3.7.9. Temporal trends in catch weighted average depth for American Plaice stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

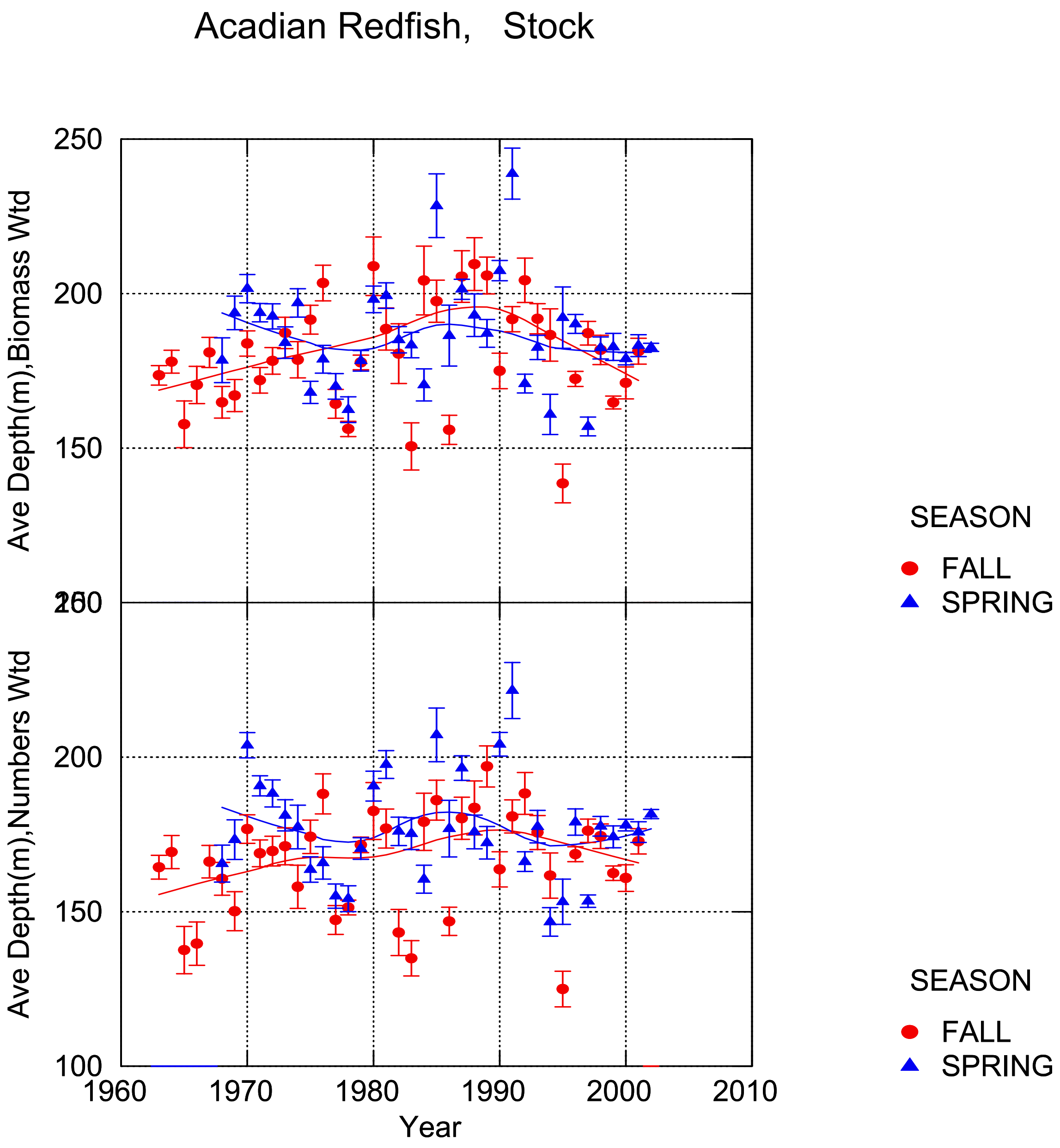


Fig. 3.7.10. Temporal trends in catch weighted average depth for Acadian Redfish stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

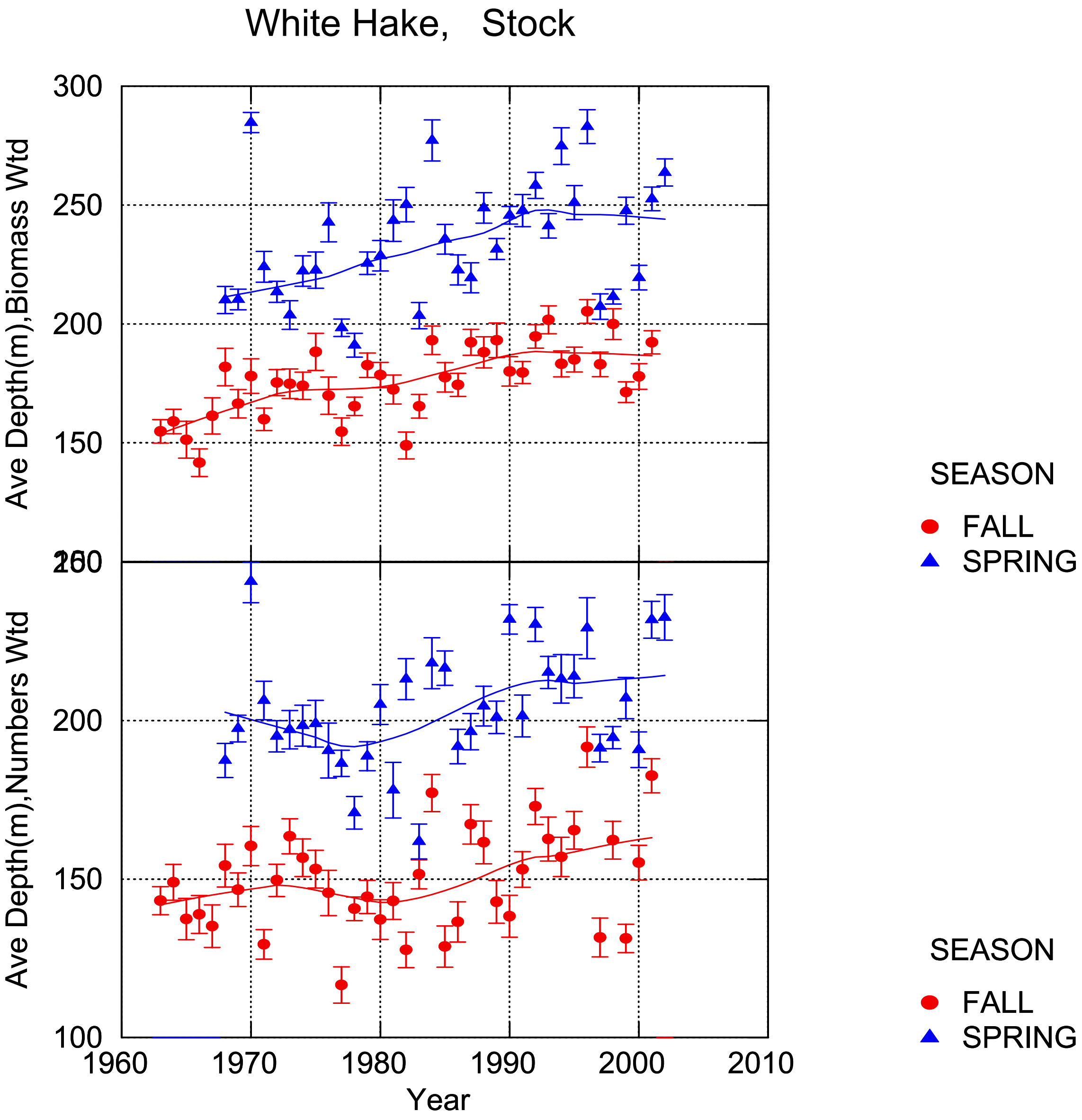


Fig. 3.7.11. Temporal trends in catch weighted average depth for White Hake stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

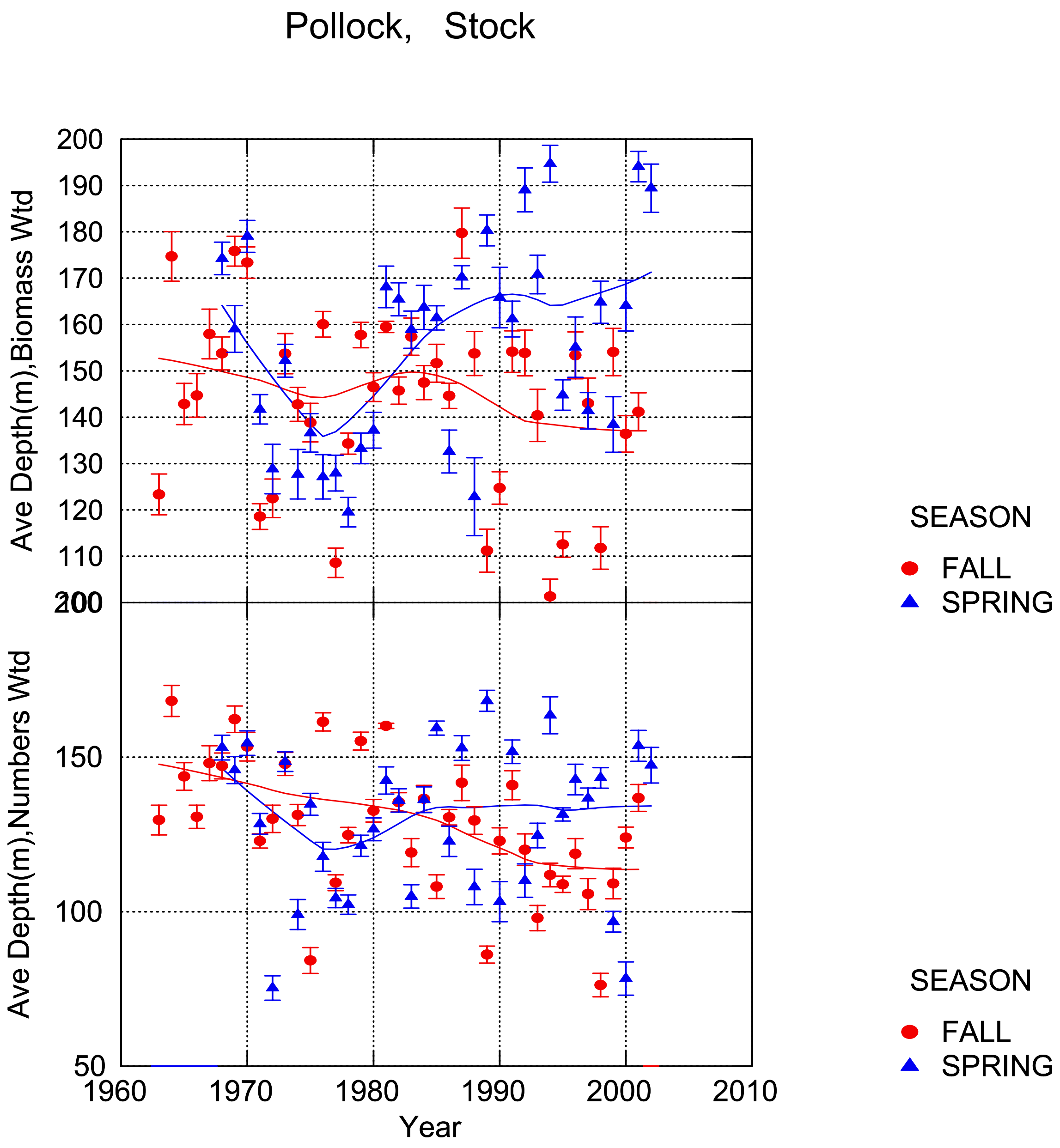


Fig. 3.7.12. Temporal trends in catch weighted average depth for Pollock stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

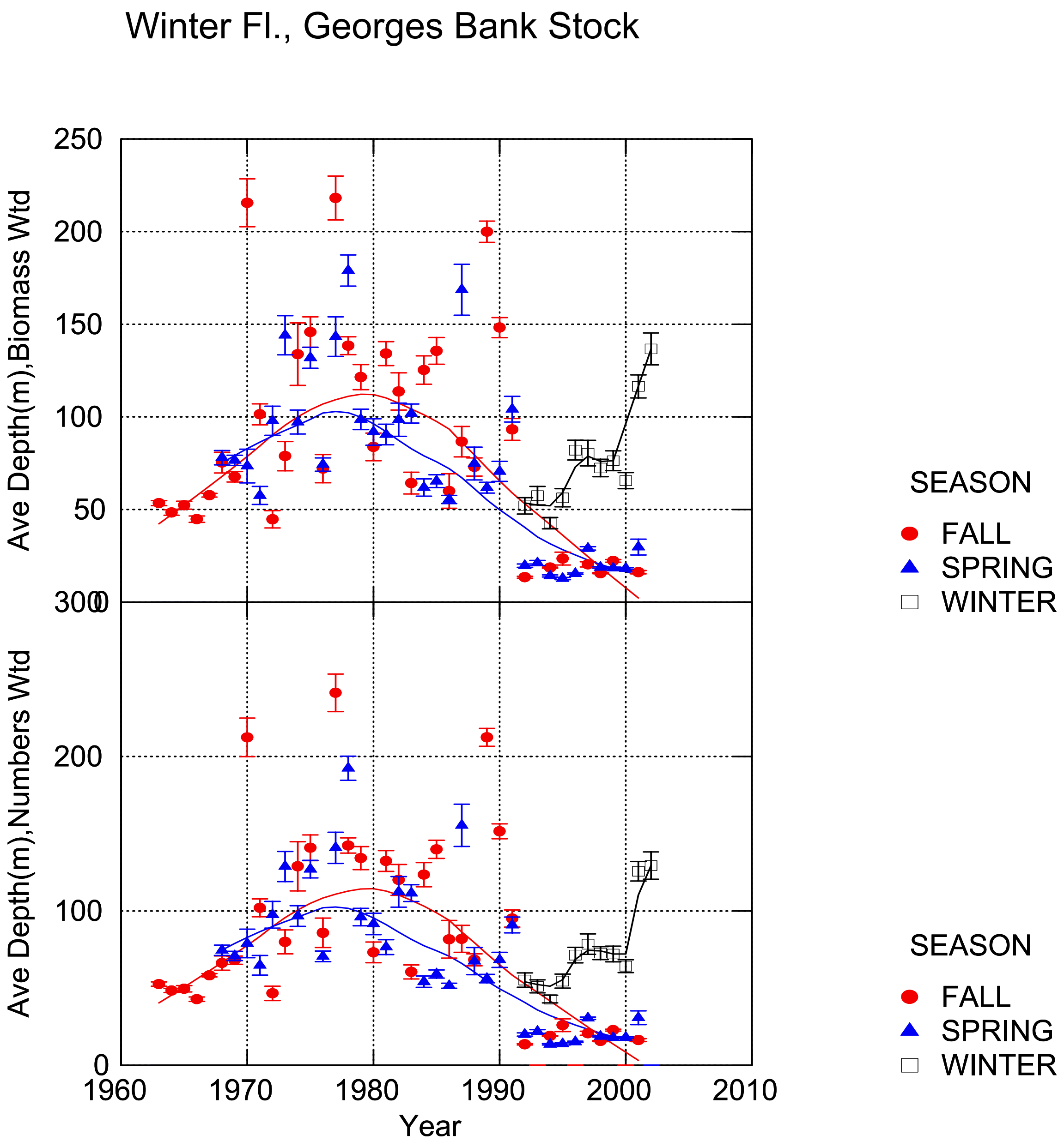


Fig. 3.7.13. Temporal trends in catch weighted average depth for Georges Bank Winter Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

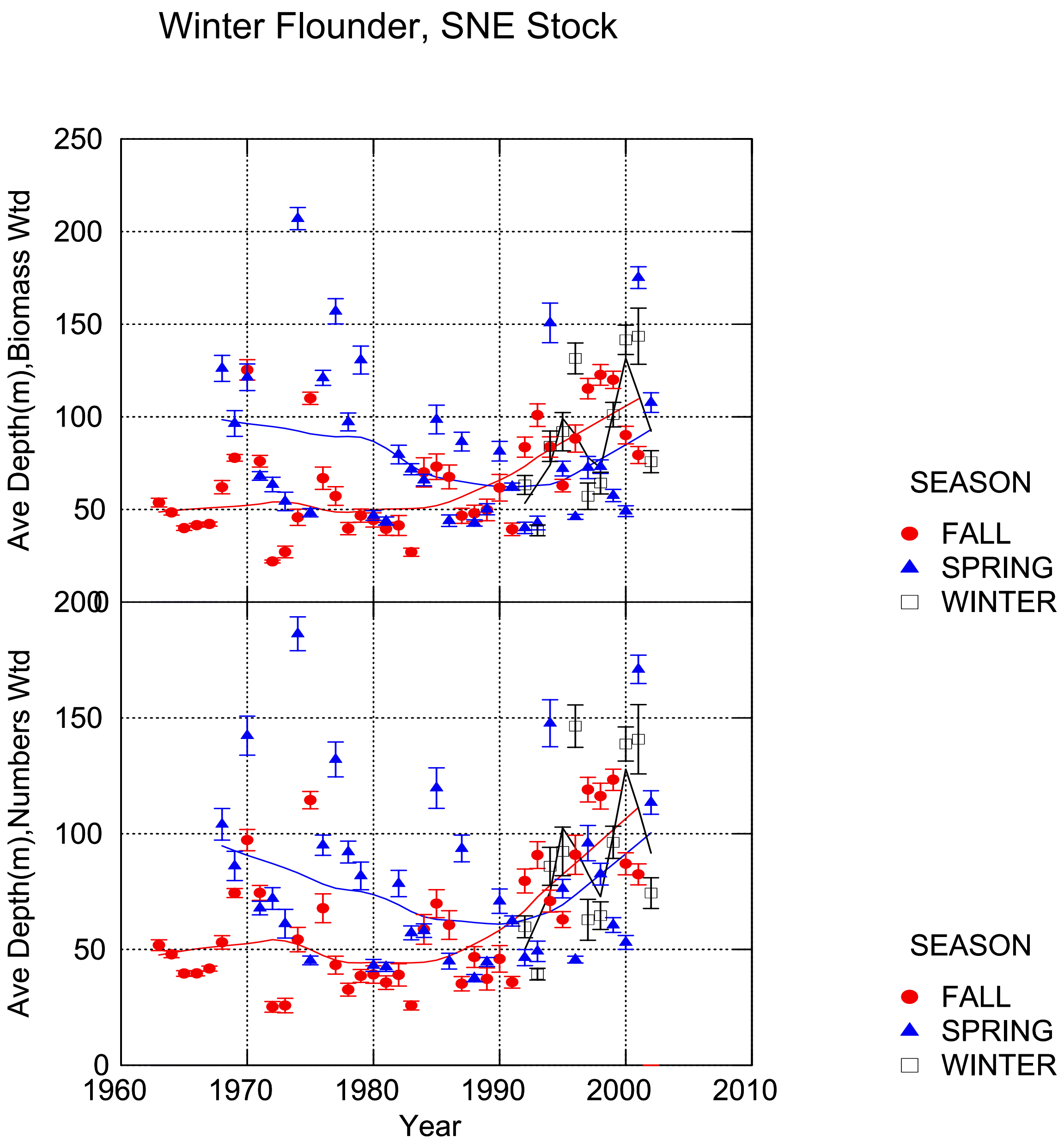


Fig. 3.7.14. Temporal trends in catch weighted average depth for Southern New England Winter Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

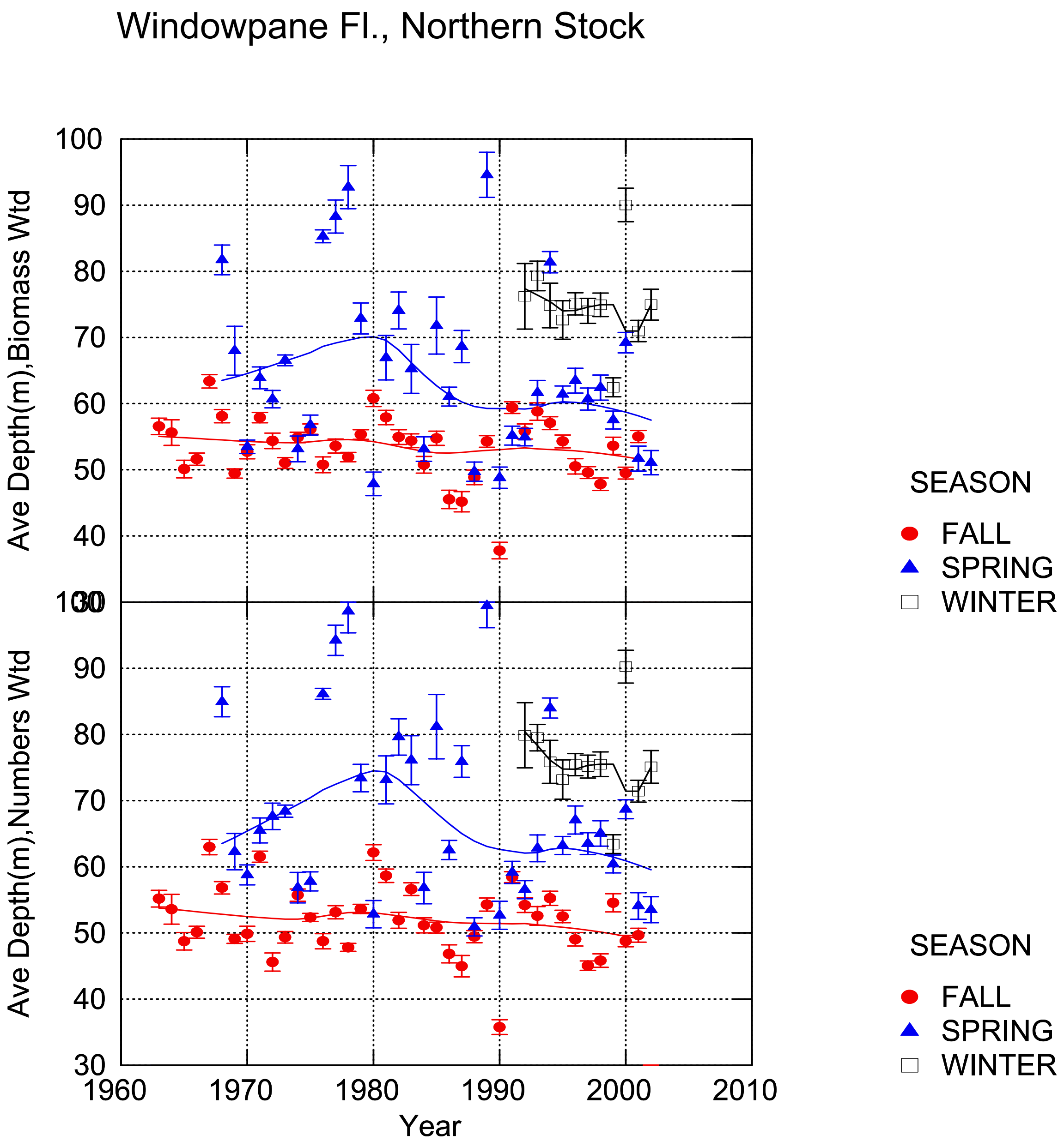


Fig. 3.7.15. Temporal trends in catch weighted average depth for Northern Windowpane Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

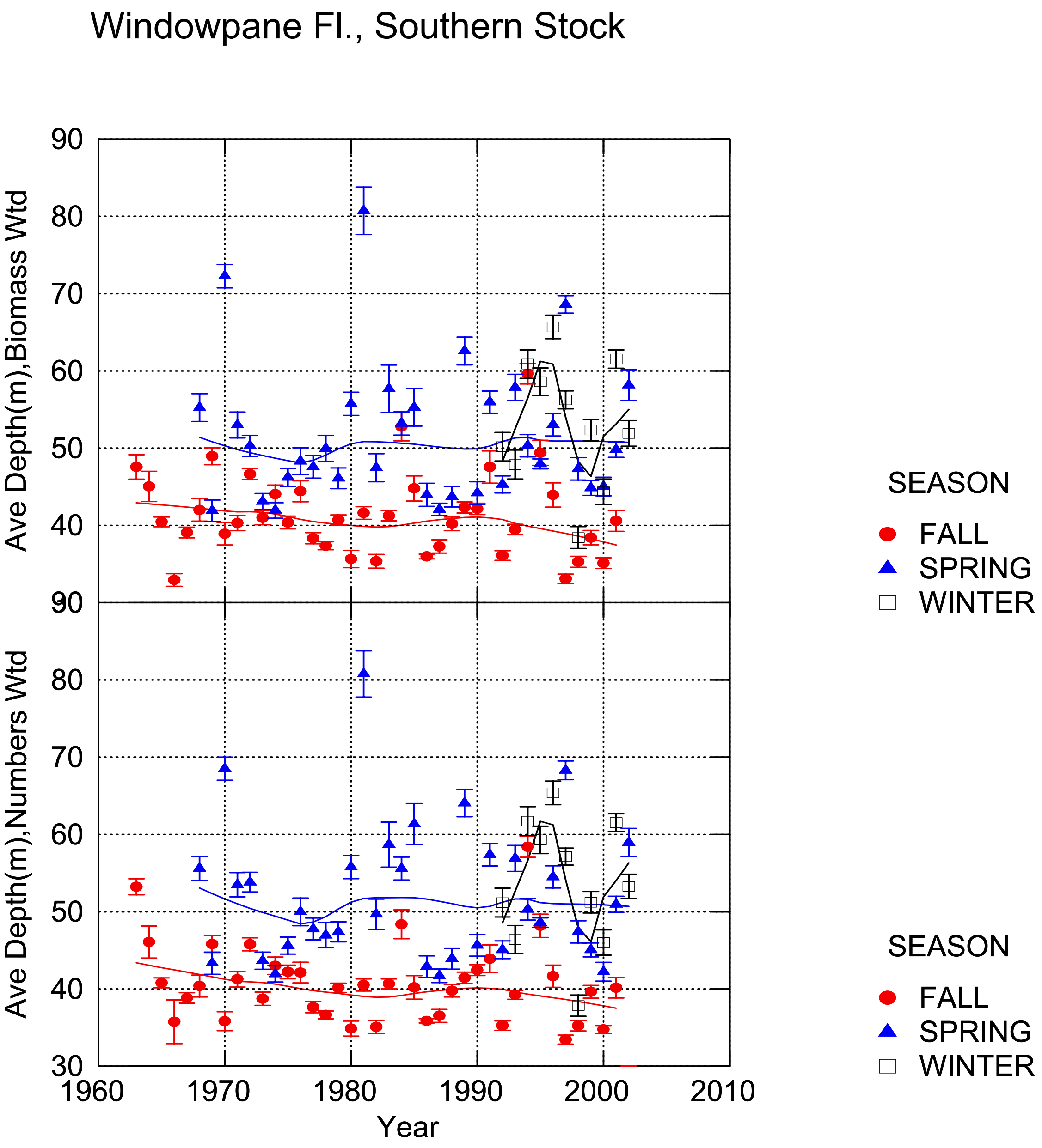


Fig. 3.7.16. Temporal trends in catch weighted average depth for Windowpane Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

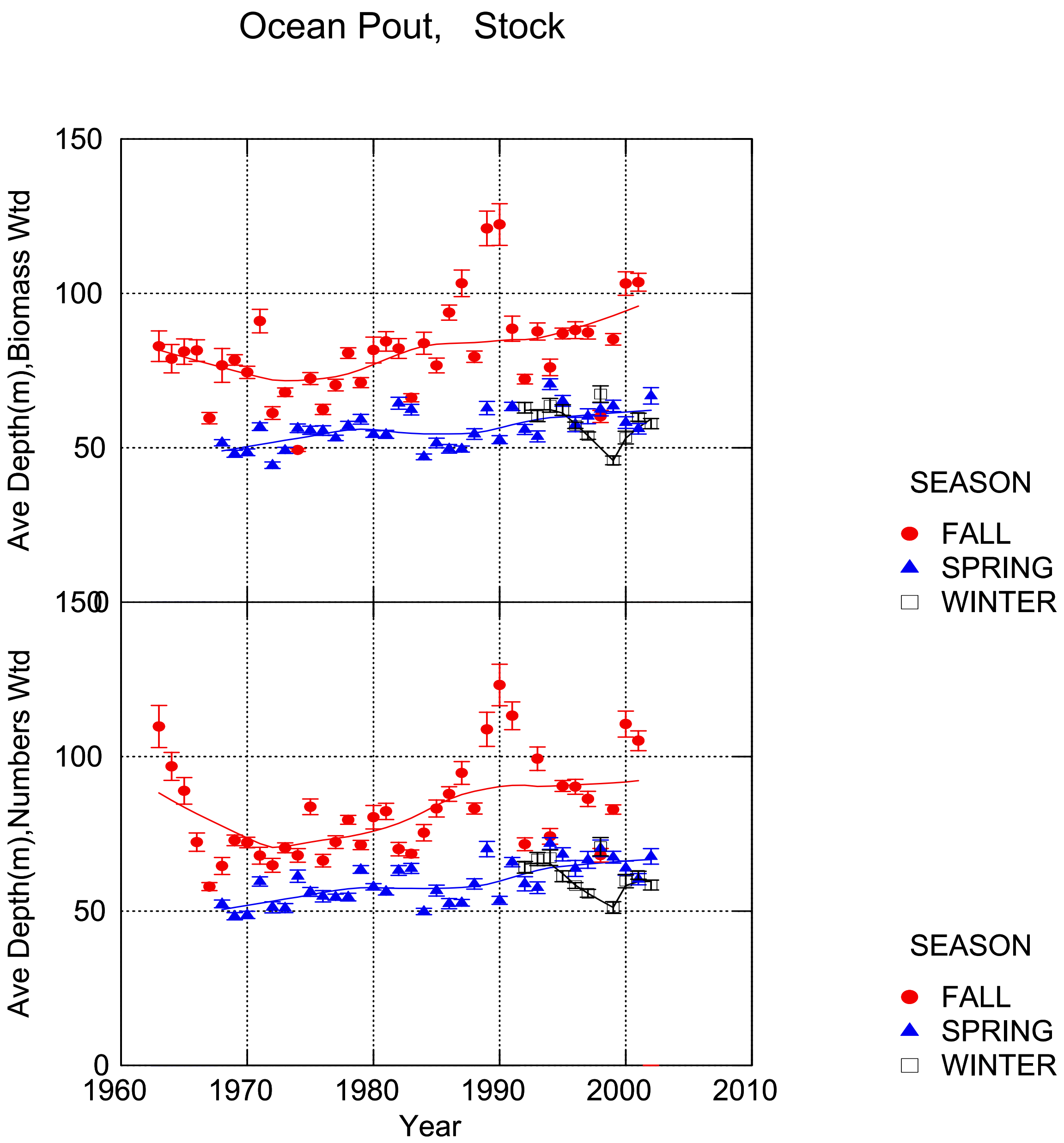


Fig. 3.7.17. Temporal trends in catch weighted average depth for Ocean Pout stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

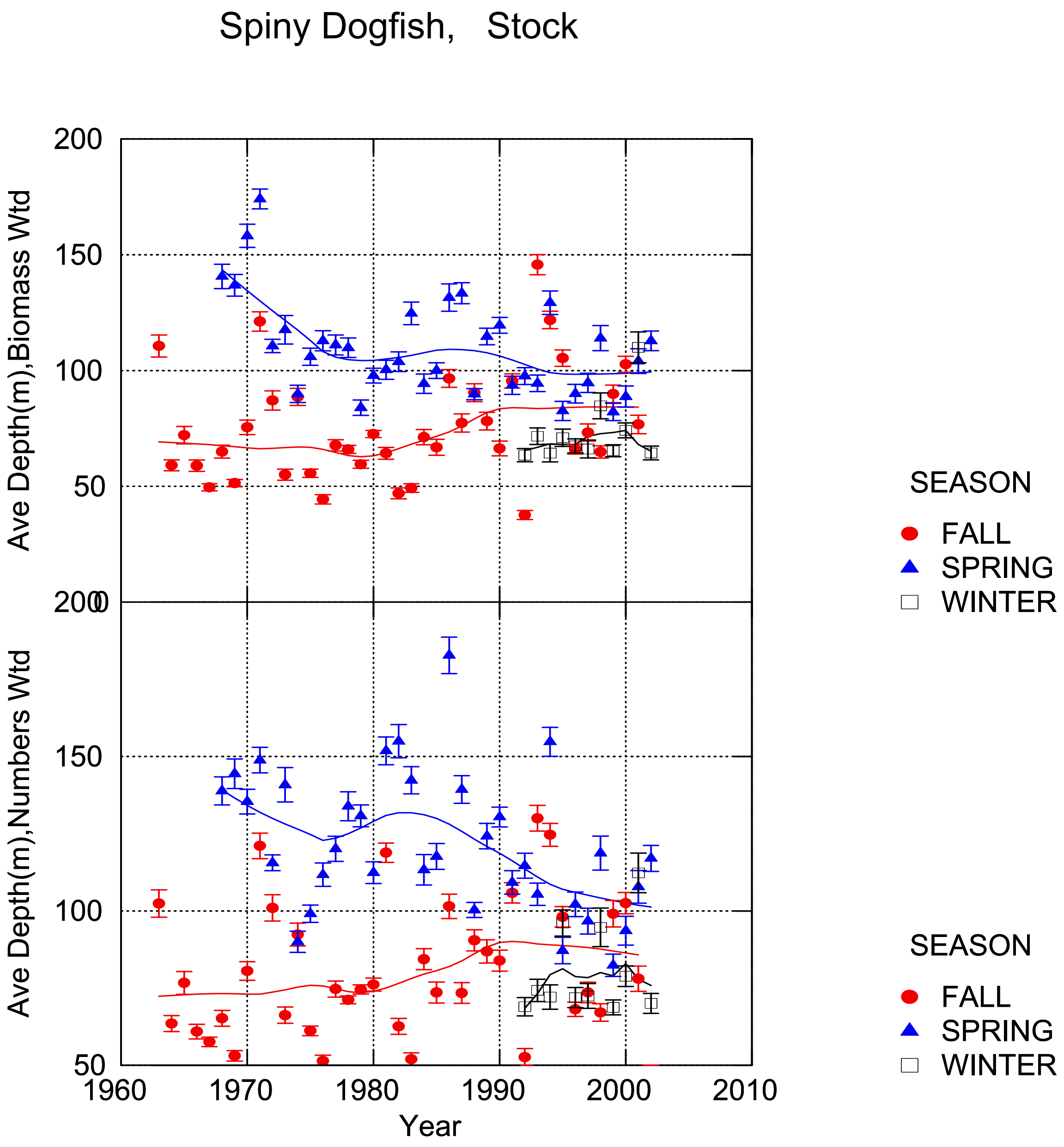


Fig. 3.7.18. Temporal trends in catch weighted average depth for Spiny Dogfish stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

Summer Flounder,   Stock

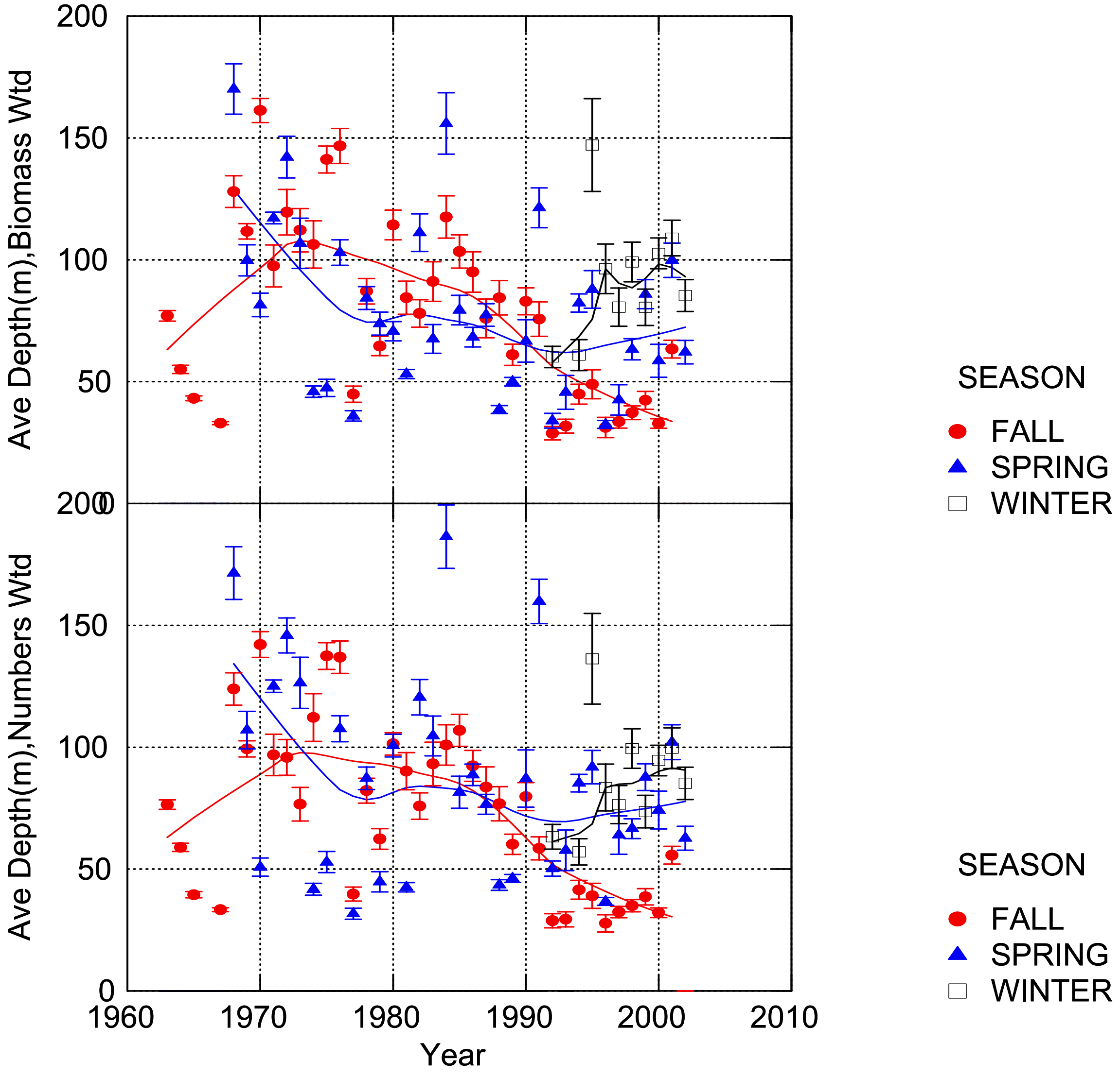


Fig. 3.7.19. Temporal trends in catch weighted average depth for Summer Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

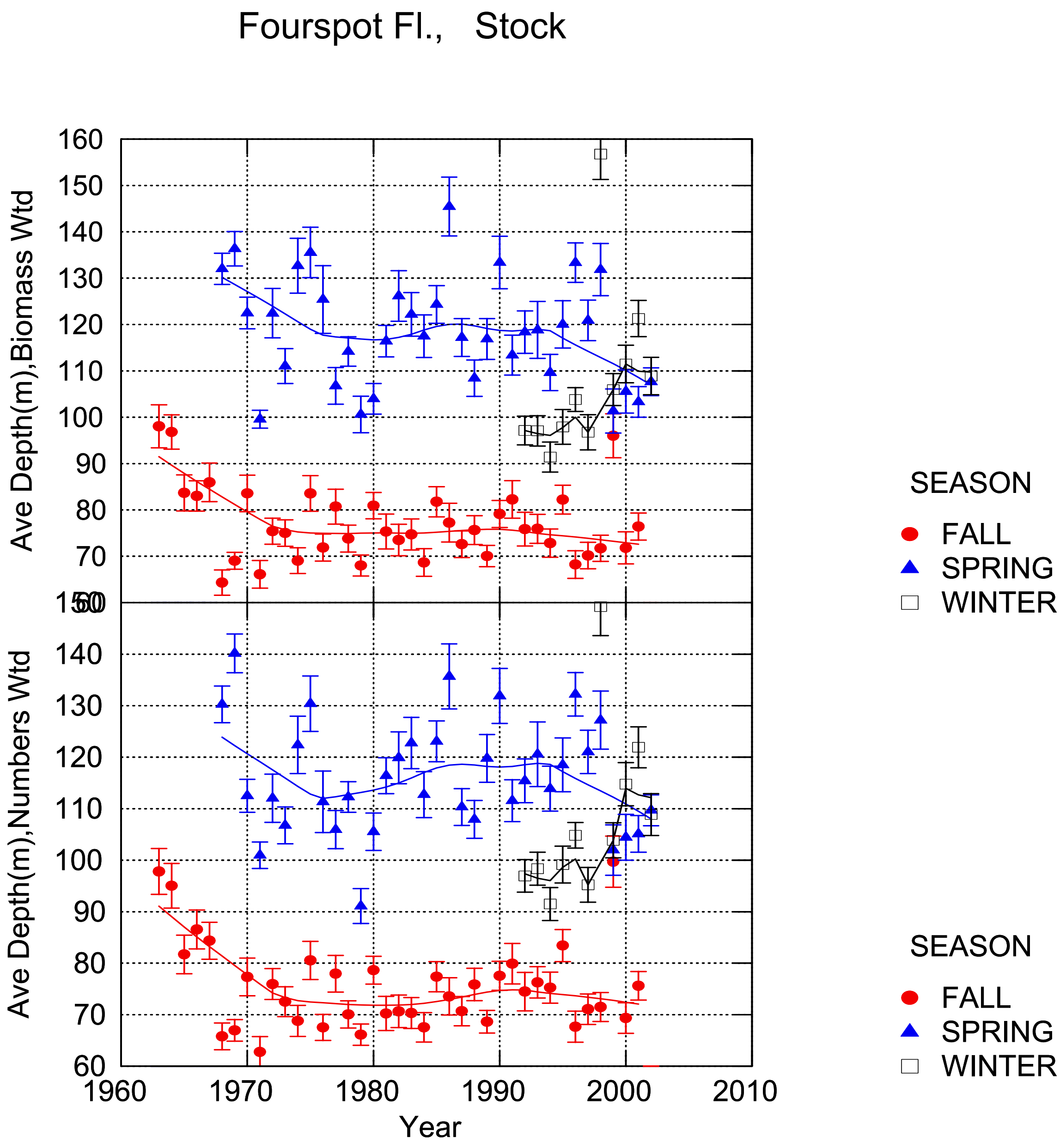


Fig. 3.7.20. Temporal trends in catch weighted average depth for Fourspot Flounder stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

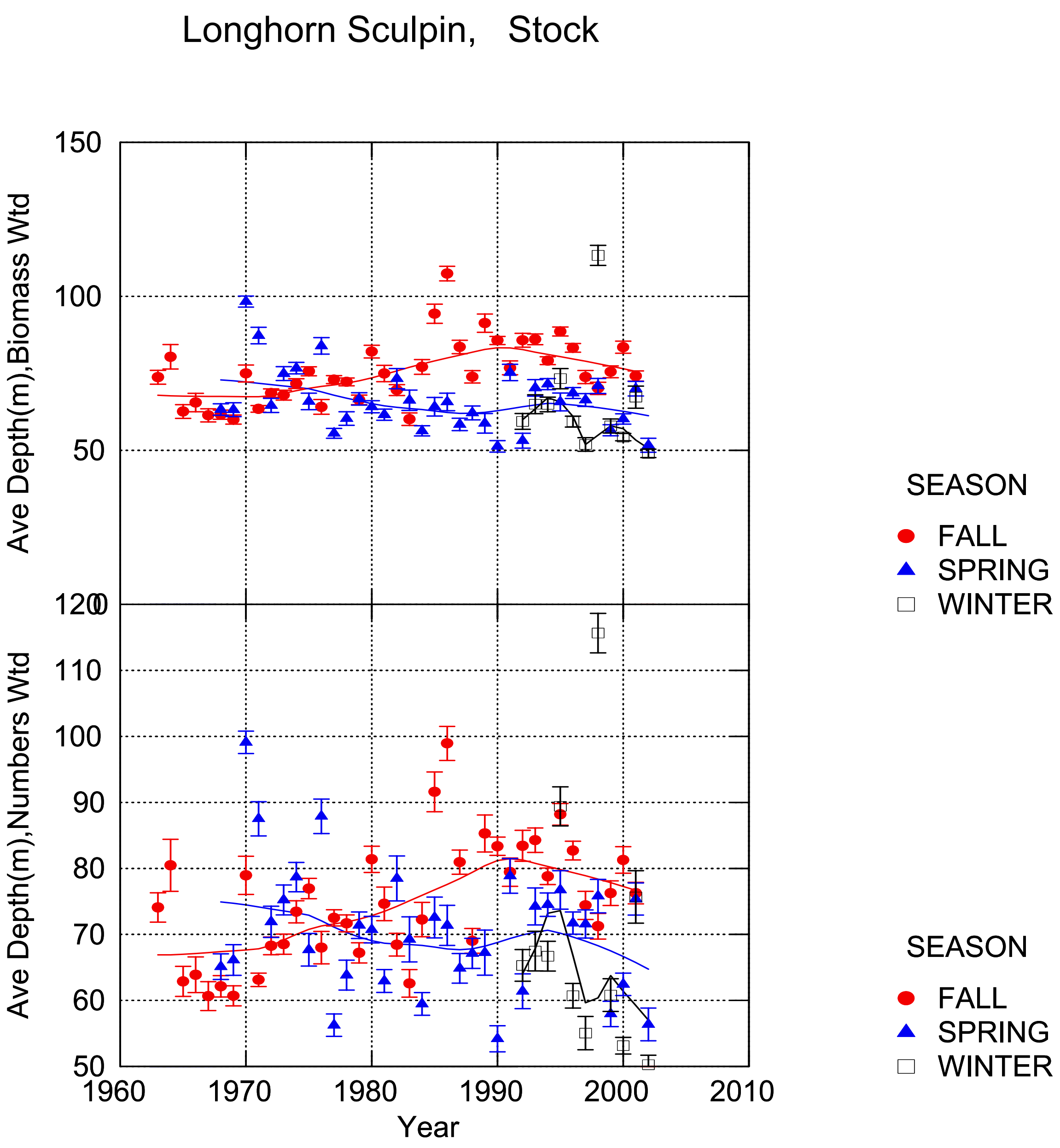


Fig. 3.7. 21. Temporal trends in catch weighted average depth for Longhorn Sculpin stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

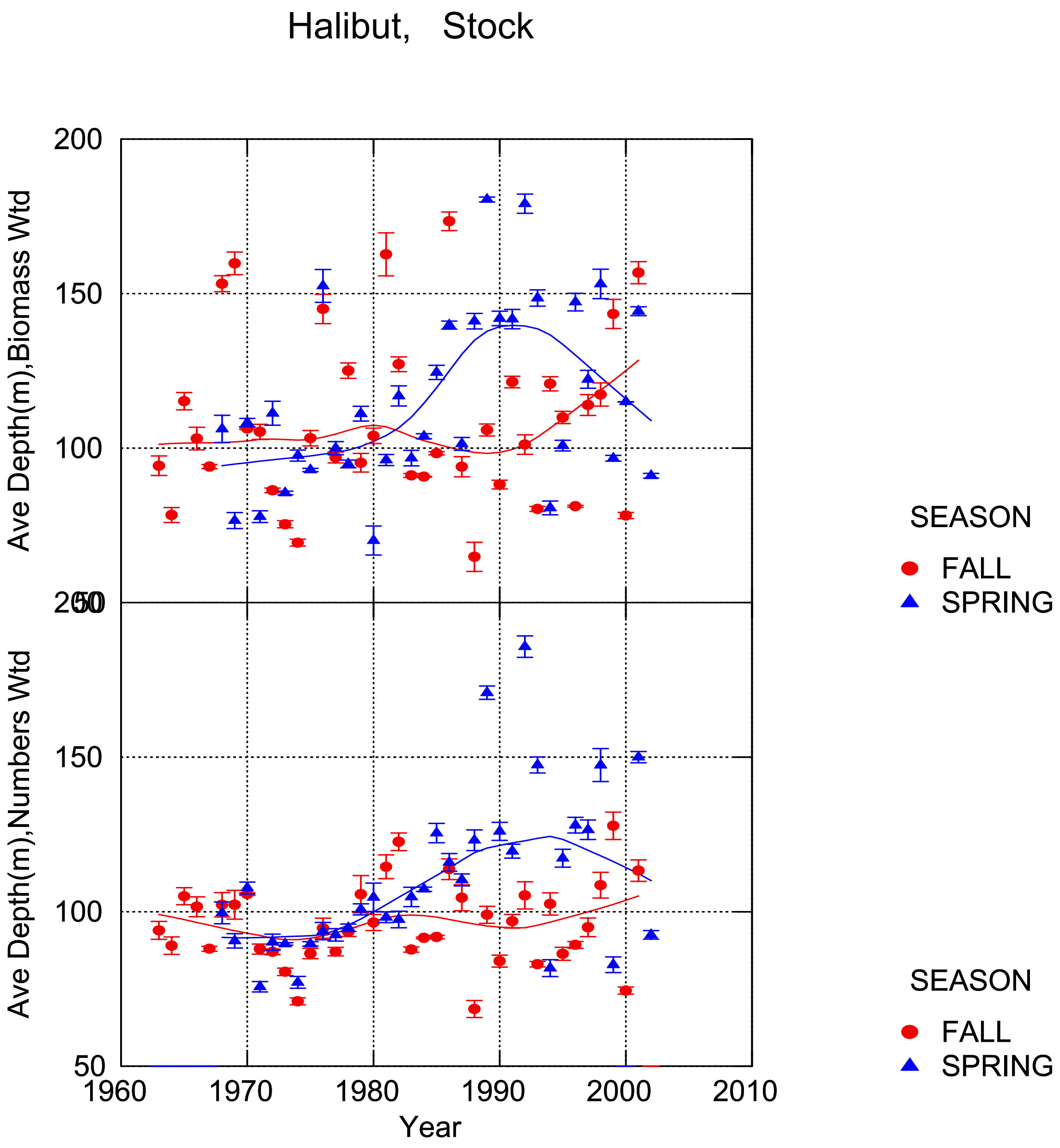


Fig. 3.7.22. Temporal trends in catch weighted average depth for Halibut stock for fall, winter and spring surveys. Top panel- biomass (kg/tow) weighted average depth; bottom panel- numbers (#/tow) weighted average depth. Error bars represent ± 1 SD. Lines are Lowess smooths with tension=0.5.

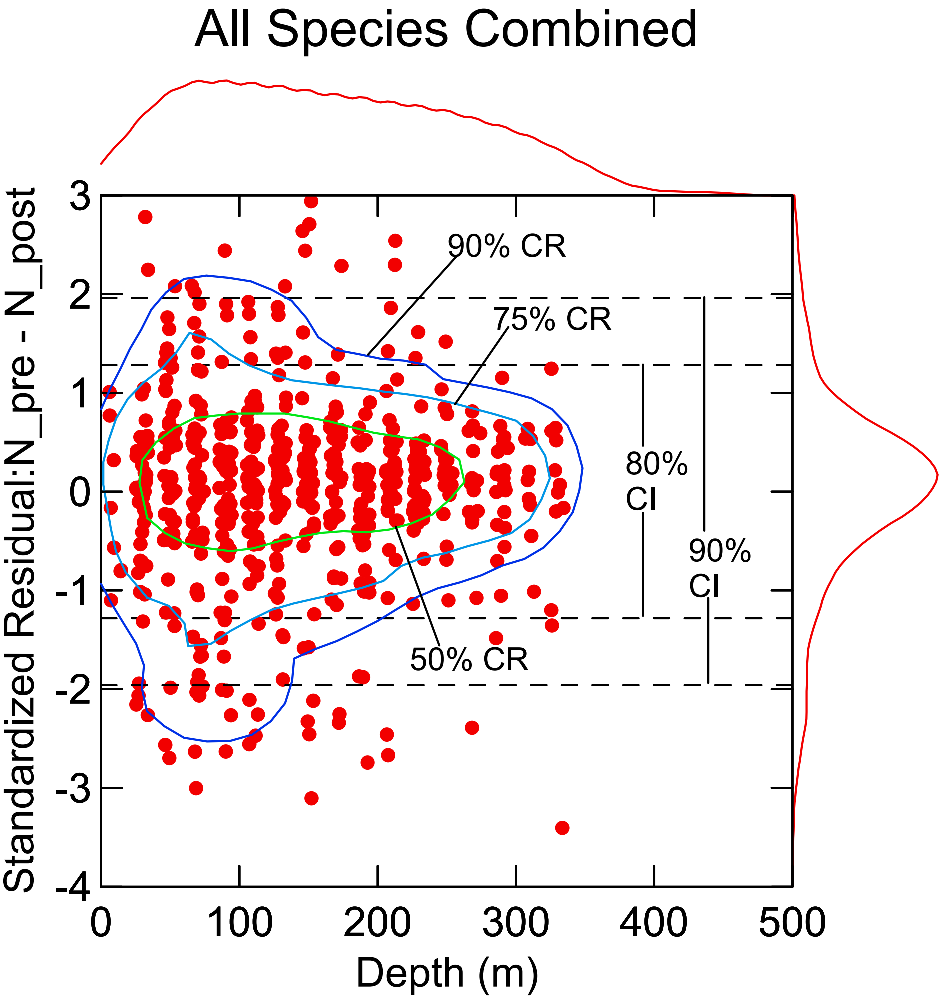


Fig. 3.7.23. Distribution of standardized difference in catch rates(numbers/tow) vs depth interval for all species combined. Each point represents a separate species, stock and survey combination for difference in number per tow in the 2year period (1998-99) vs 2000-2001 for the fall survey, and 3 yr period (1997-99) vs 2000-02 for the spring and winter surveys. Approximate confidence intervals for the standardized differences are denoted by dashed lines. The 50, 75 and 95% confidence regions are approximated by an Epanechnikov kernel. Marginal kernel distribution of the distribution of differences are described by the right-hand border. The top border is the kernel of differences by depth category.

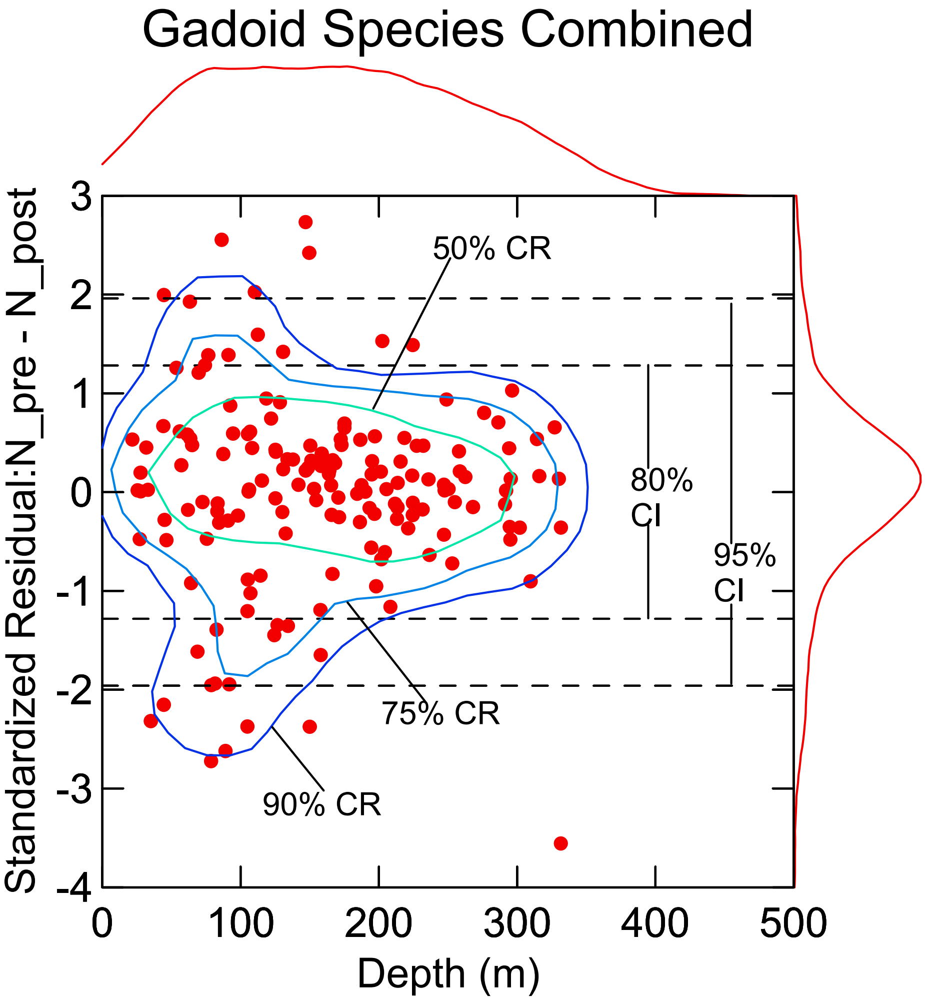


Fig. 3.7.24. Distribution of standardized difference in catch rates(numbers/tow) vs depth interval for gadoid species (GB cod, GOM cod, GB haddock, GOM haddock, white hake, and pollock. Each point represents a separate species, stock and survey combination for difference in number per tow in the 2year period (1998-99) vs 2000-2001 for the fall survey, and 3 yr period (1997-99) vs 2000-02 for the spring and winter surveys. Approximate confidence intervals for the standardized differences are denoted by dashed lines. The 50, 75 and 95% confidence regions are approximated by an Epanechnikov kernel. Marginal kernel distribution of the distribution of differences are described by the right-hand border. The top border is the kernel of differences by depth category.

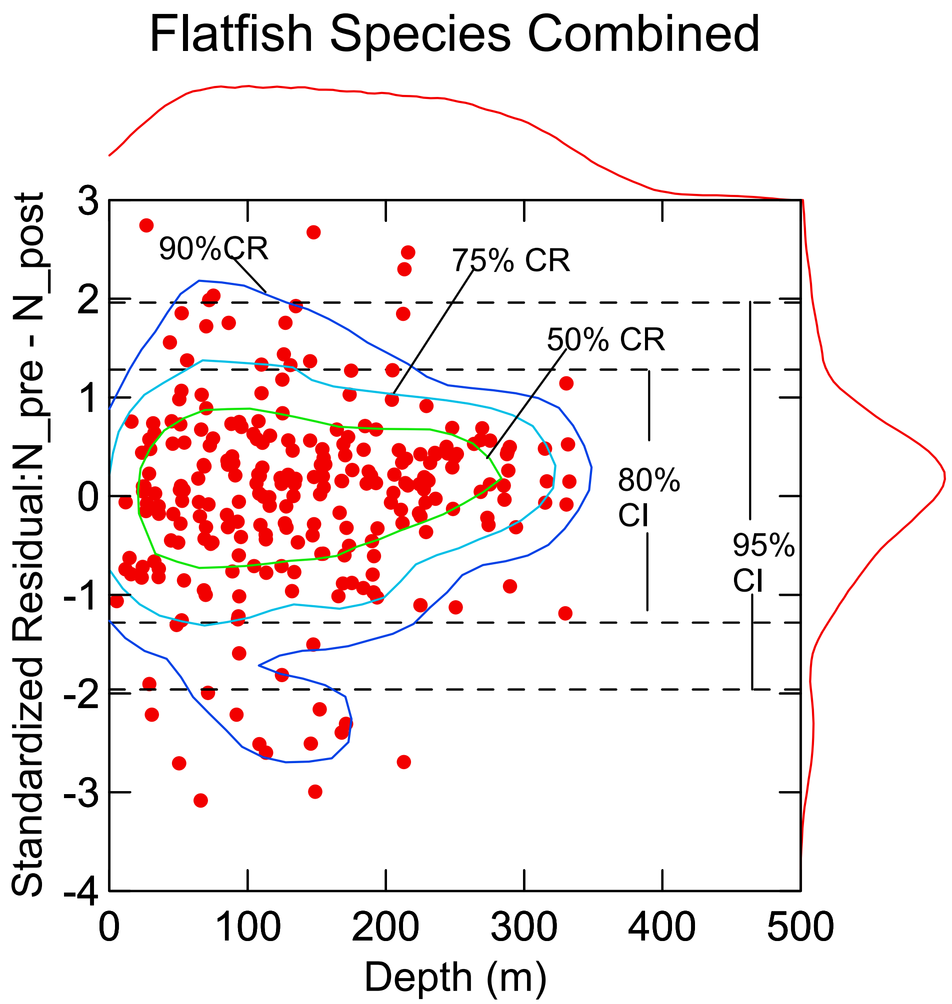


Fig. 3.7.25. Distribution of standardized difference in catch rates(numbers/tow) vs depth interval for flatfish species (GB yellowtail, SNE yellowtail, Cape Cod yellowtail, American plaice, witch flounder, windowpane (Northern and Southern), GB winter flounder SNE winter flounder, summer flounder, and fourspot flounder. Each point represents a separate species, stock and survey combination for difference in number per tow in the 2year period (1998-99) vs 2000-2001 for the fall survey, and 3 yr period (1997-99) vs 2000-02 for the spring and winter surveys. Approximate confidence intervals for the standardized differences are denoted by dashed lines. The 50, 75 and 95% confidence regions are approximated by an Epanechnikov kernel. Marginal kernel distribution of the distribution of differences are described by the right-hand border. The top border is the kernel of differences by depth category.

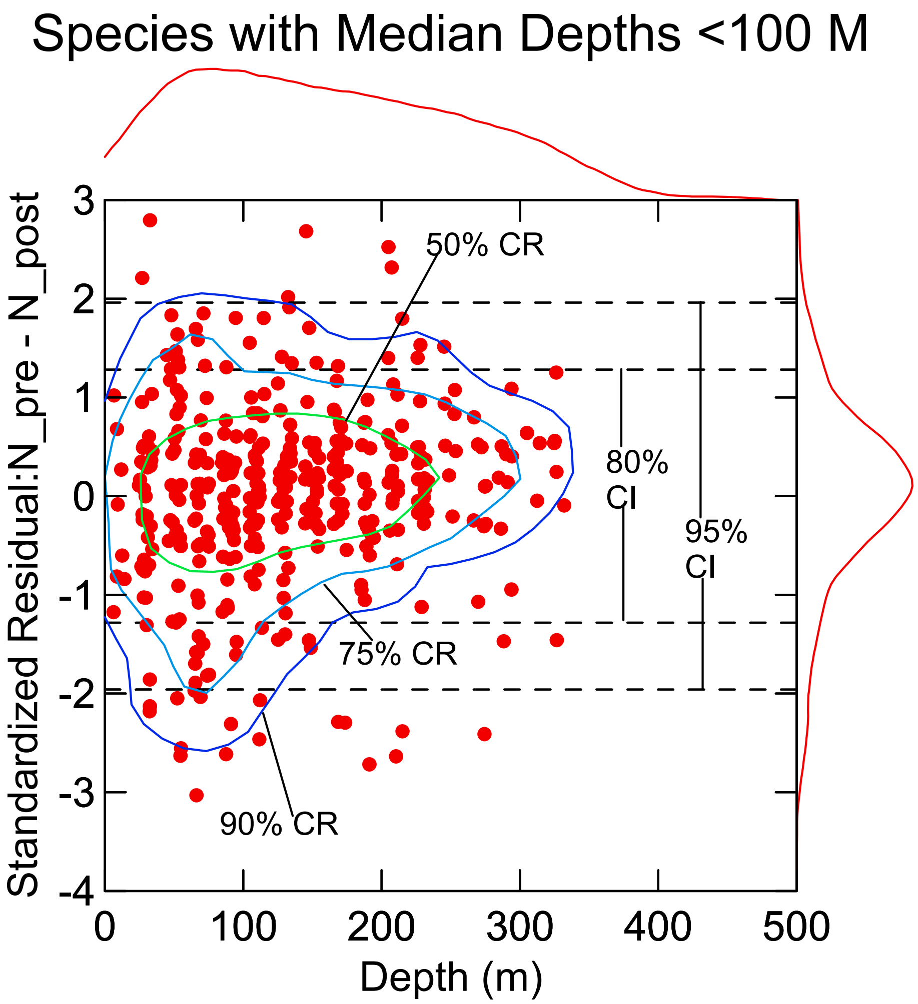


Fig. 3.7.26. Distribution of standardized difference in catch rates(numbers/tow) vs depth interval for flatfish species (GB yellowtail, SNE yellowtail, Cape Cod yellowtail, windowpane flounder (Northern and Southern), GB winter flounder, GB cod, GOM cod, SNE winter flounder, summer flounder, fourspot flounder, ocean pout, longhorn sculpin, spiny dogfish. Each point represents a separate species, stock and survey combination for difference in number per tow in the 2year period (1998-99) vs 2000-2001 for the fall survey, and 3 yr period (1997-99) vs 2000-02 for the spring and winter surveys. Approximate confidence intervals for the standardized differences are denoted by dashed lines. The 50, 75 and 95% confidence regions are approximated by an Epanechnikov kernel. Marginal kernel distribution of the distribution of differences are described by the right-hand border. The top border is the kernel of differences by depth category.

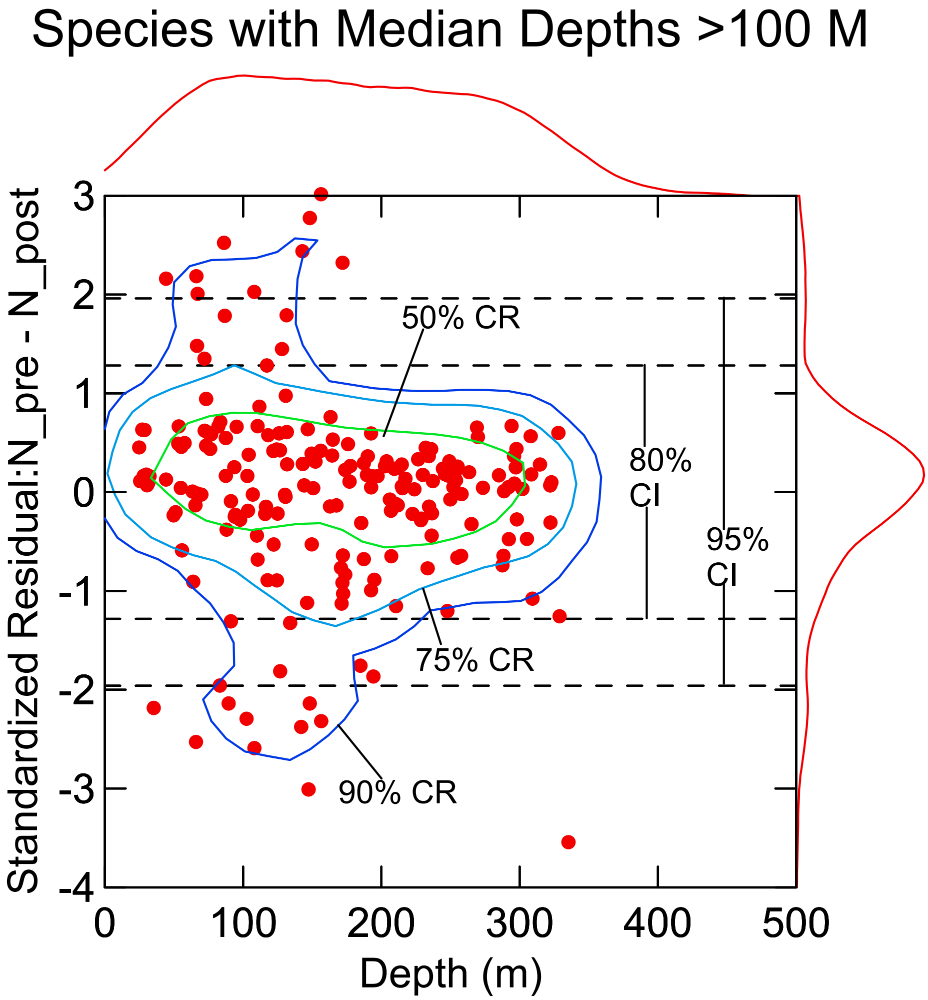
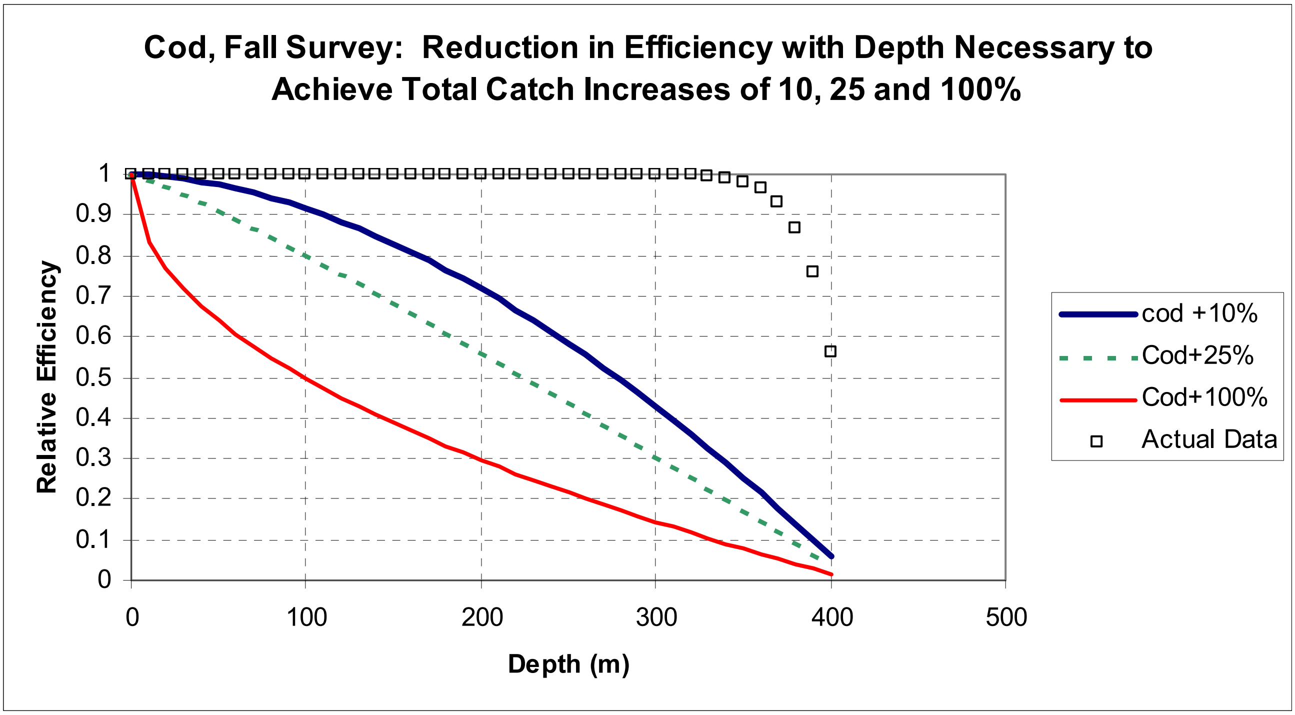


Fig. 3.7.27. Distribution of standardized difference in catch rates(numbers/tow) vs depth interval for flatfish species (GB haddock, GOM haddock, white hake, pollock, American plaice, witch flounder, and Acadian redfish. Each point represents a separate species, stock and survey combination for difference in number per tow in the 2year period (1998-99) vs 2000-2001 for the fall survey, and 3 yr period (1997-99) vs 2000-02 for the spring and winter surveys. Approximate confidence intervals for the standardized differences are denoted by dashed lines. The 50, 75 and 95% confidence regions are approximated by an Epanechnikov kernel. Marginal kernel distribution of the distribution of differences are described by the right-hand border. The top border is the kernel of differences by depth category.



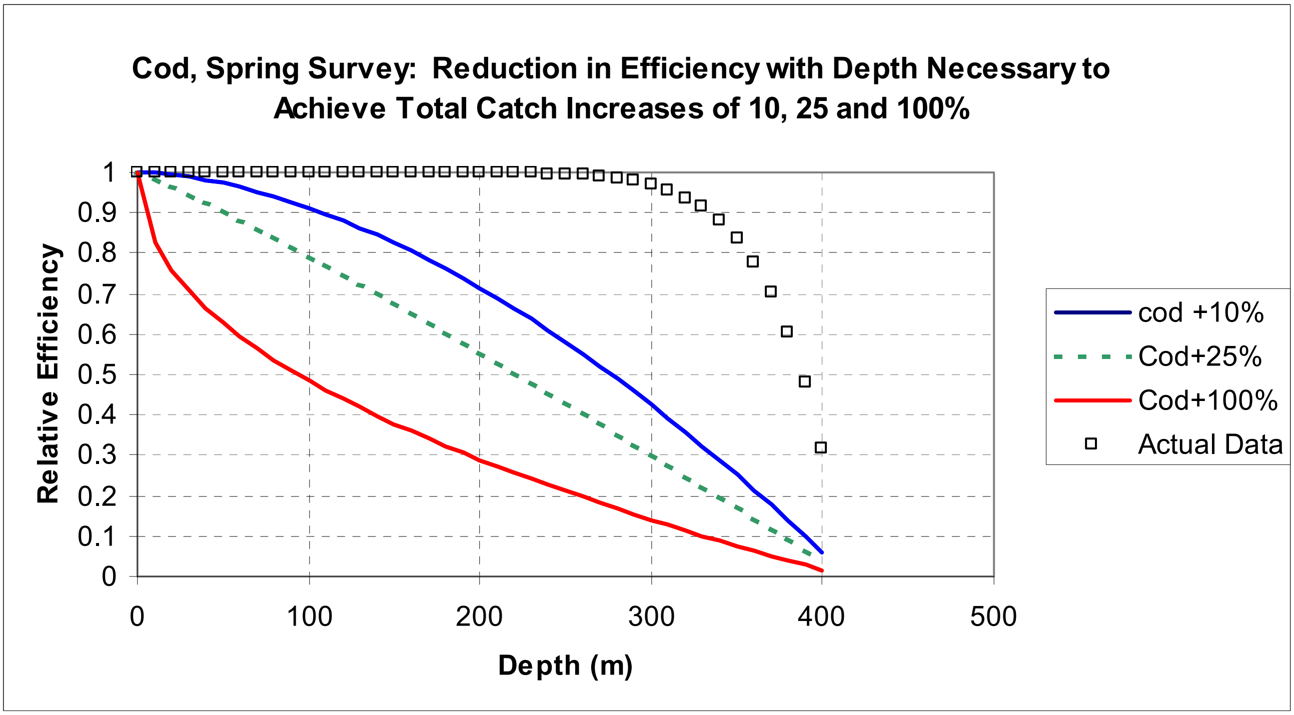
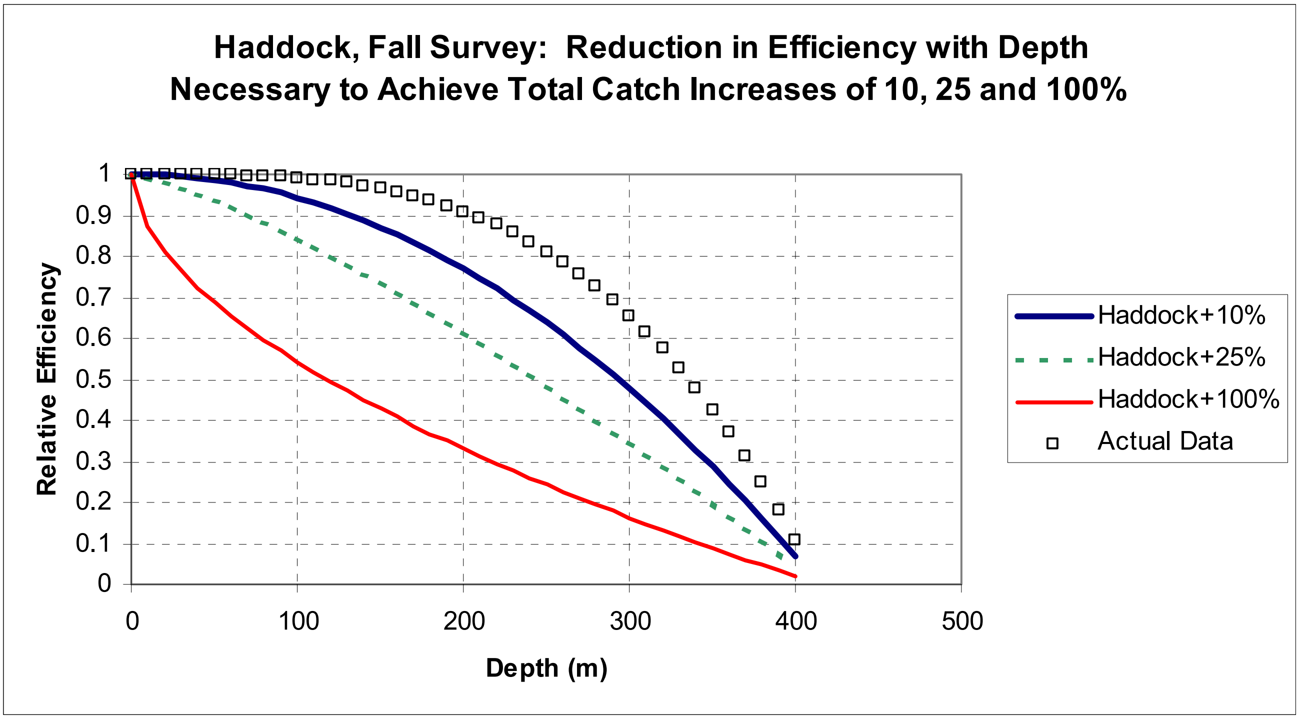


Fig. 3.7.28. Predicted reductions in relative efficiency of capture for cod in fall and spring surveys given hypothesized increases in overall abundance of 10, 25, and 100%. Relative efficiency predictions are based on fit of Eq. 13 to observed survey catches at depth for the 2000-2002 spring survey data and 2000-01 fall survey data. “Actual data” plots refer to nonlinear least squares estimates based on comparisons of between pre and post-trawl warp asymmetry periods.



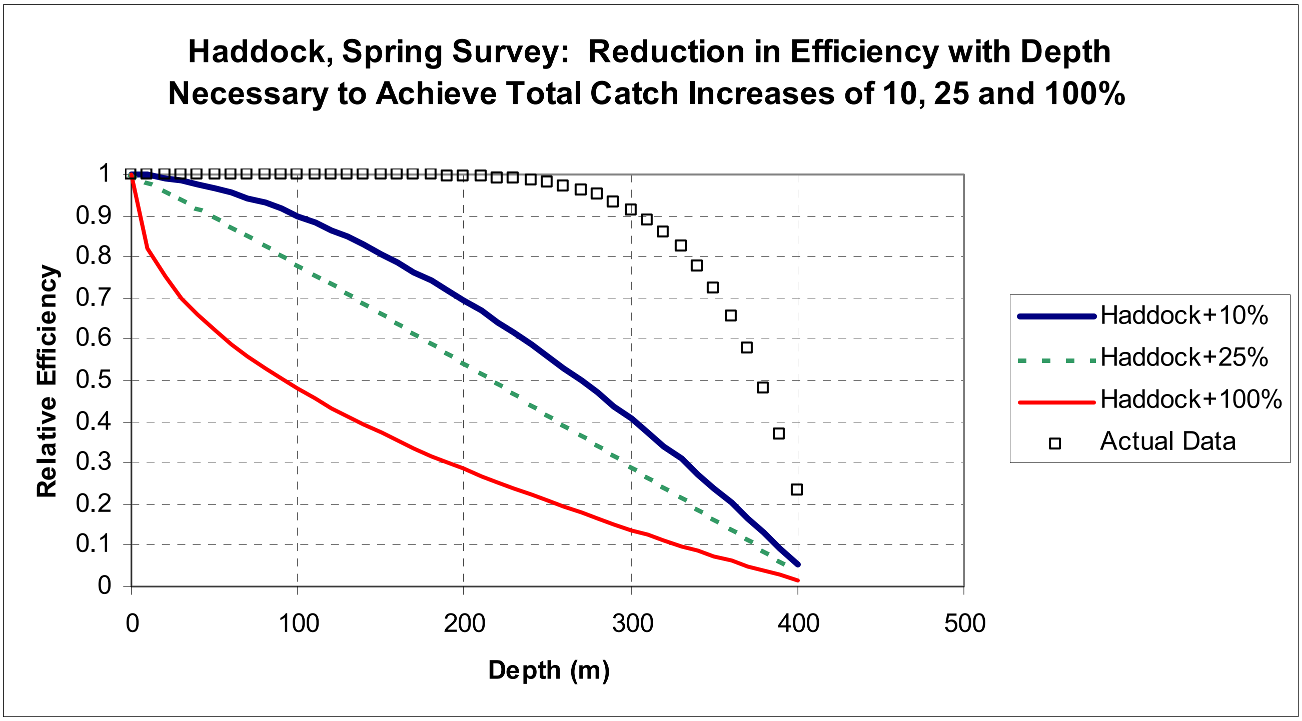
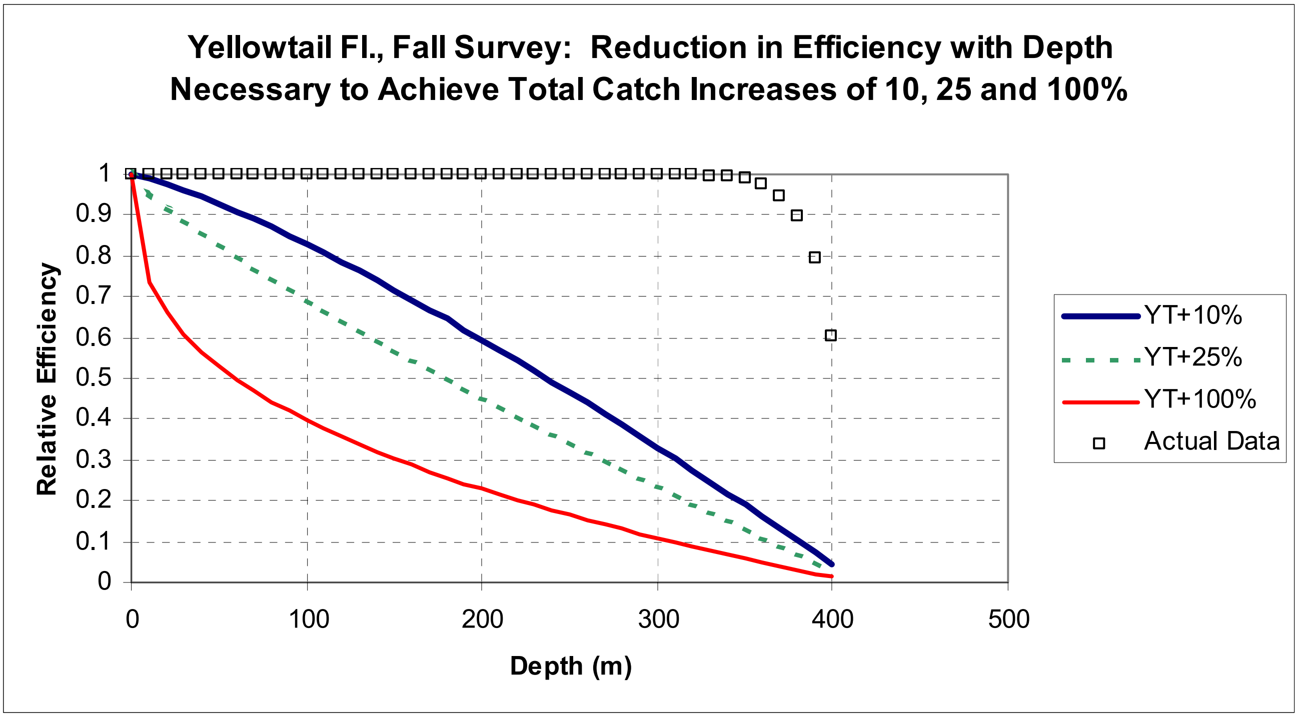


Fig. 3.7.29. Predicted reductions in relative efficiency of capture for haddock in fall and spring surveys given hypothesized increases in overall abundance of 10, 25, and 100%. Relative efficiency predictions are based on fit of Eq. 13 to observed survey catches at depth for the 2000-2002 spring survey data and 2000-01 fall survey data. “Actual data” plots refer to nonlinear least squares estimates based on comparisons of between pre and post-trawl warp asymmetry periods.



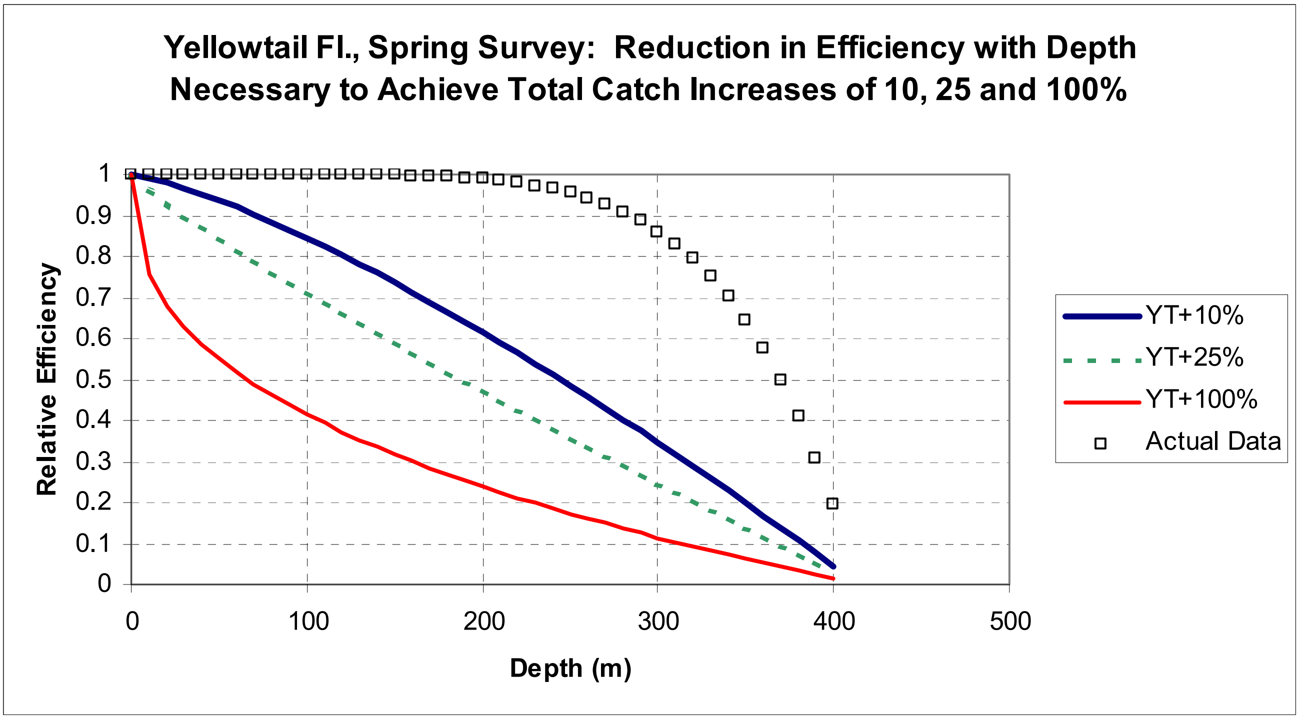


Fig. 3.7.30. Predicted reductions in relative efficiency of capture for yellowtail flounder in fall and spring surveys given hypothesized increases in overall abundance of 10, 25, and 100%. Relative efficiency predictions are based on fit of Eq. 13 to observed survey catches at depth for the 2000-2002 spring survey data and 2000-01 fall survey data. “Actual data” plots refer to nonlinear least squares estimates based on comparisons of between pre and post-trawl warp asymmetry periods.

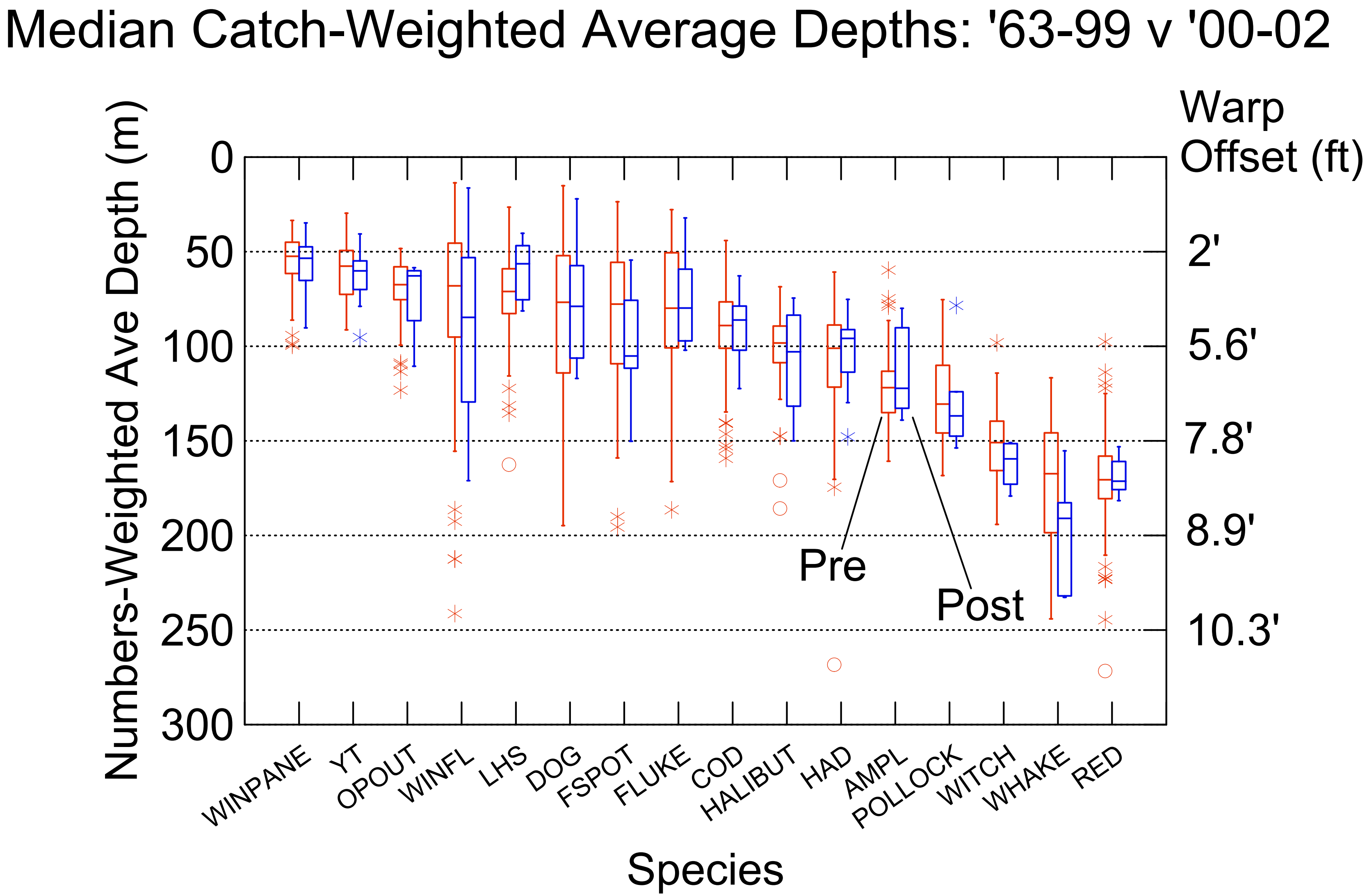


Figure 3.7.31. Catch weighted average depths at capture for 16 species of groundfish taken in NEFSC bottom trawl surveys. Data are presented for pre- and post trawl warp offset periods. The pre-warp period includes all data from 1963 onward until 1999.

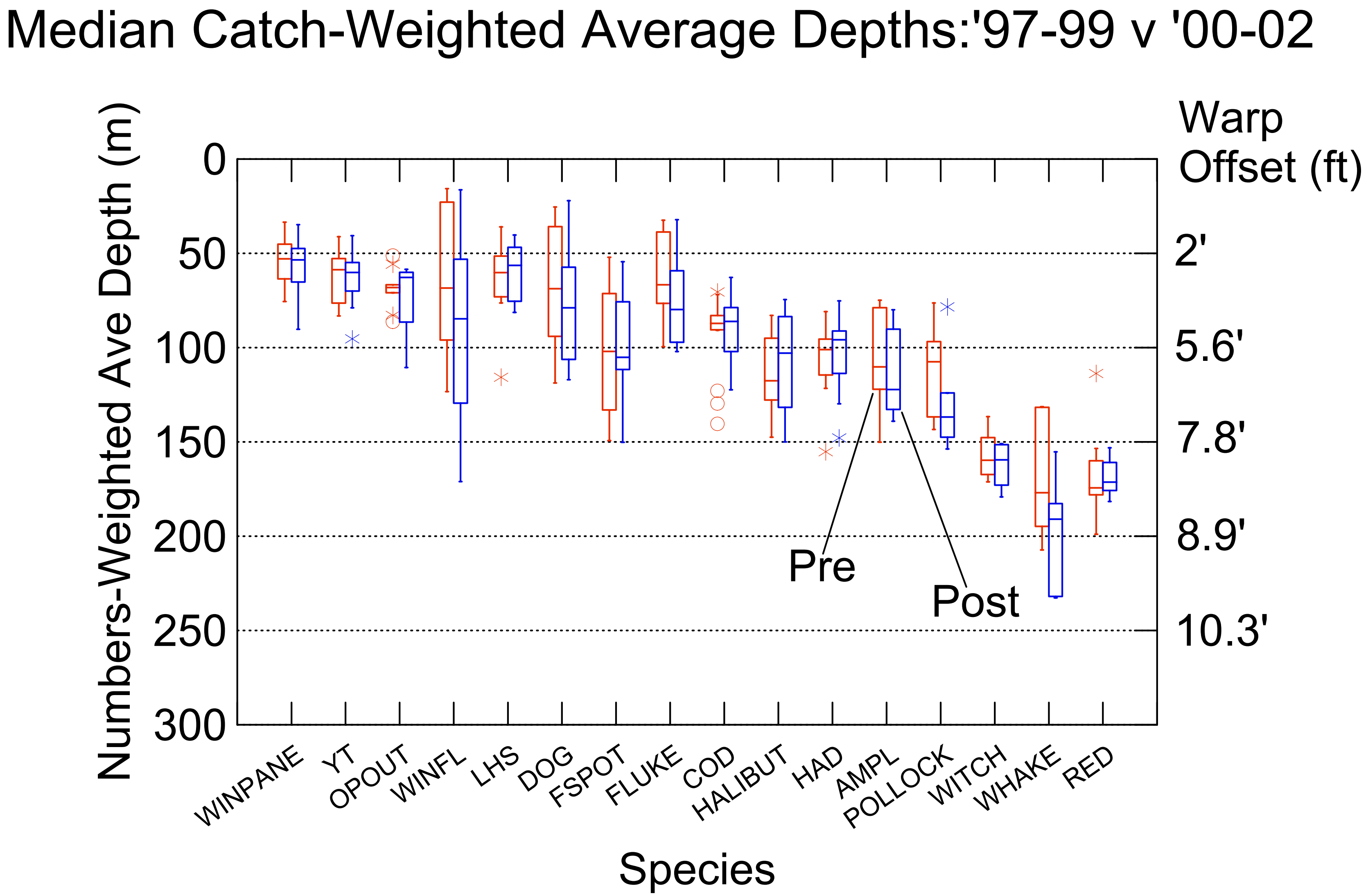


Figure 3.7.32. Catch weighted average depths at capture for 16 species of groundfish taken in NEFSC bottom trawl surveys. Data are presented for pre- and post trawl warp offset periods. The pre-warp period includes all data from 1997-1999.