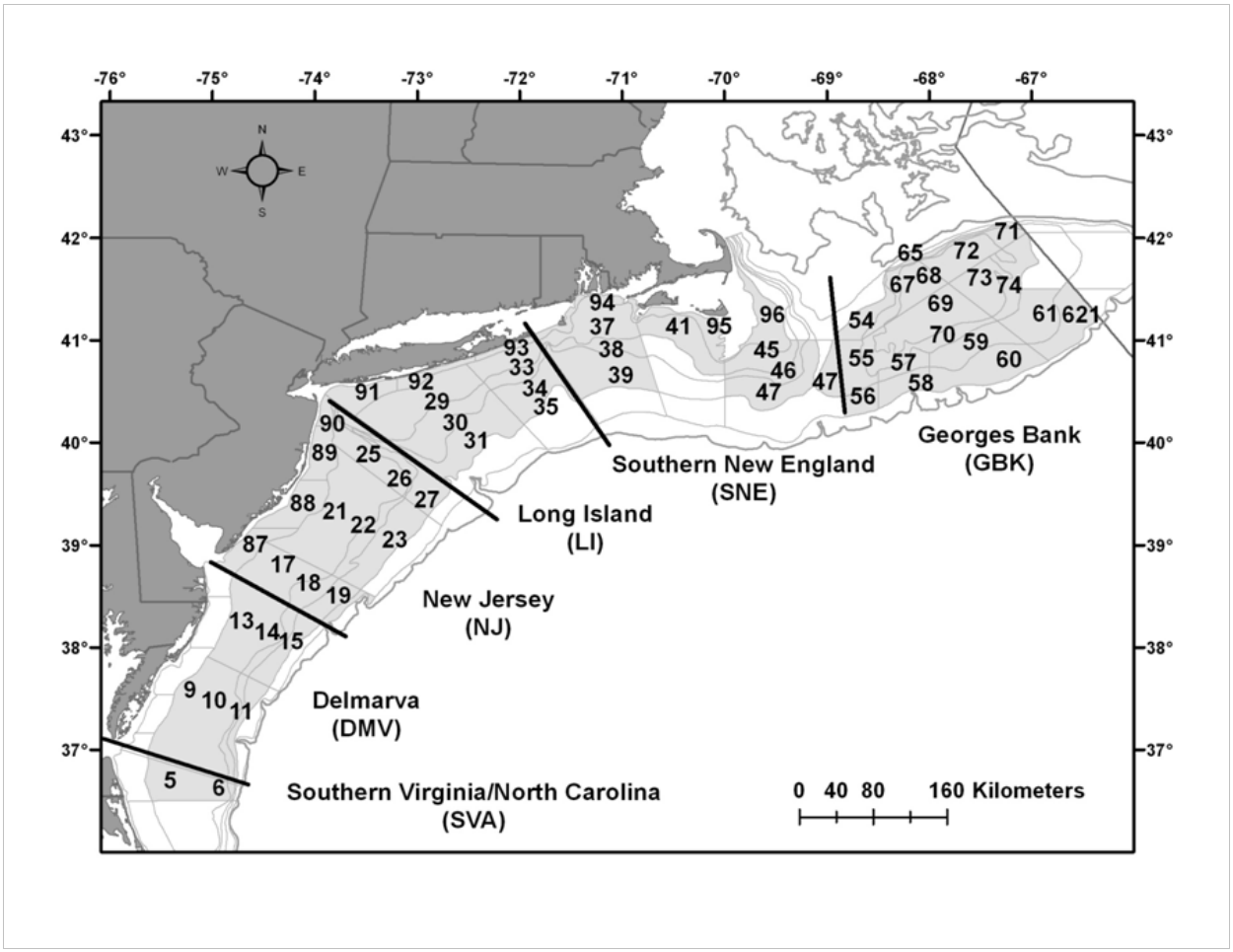


Figure 1. Map of ocean quahog assessment regions, and individual strata used for ocean quahogs.

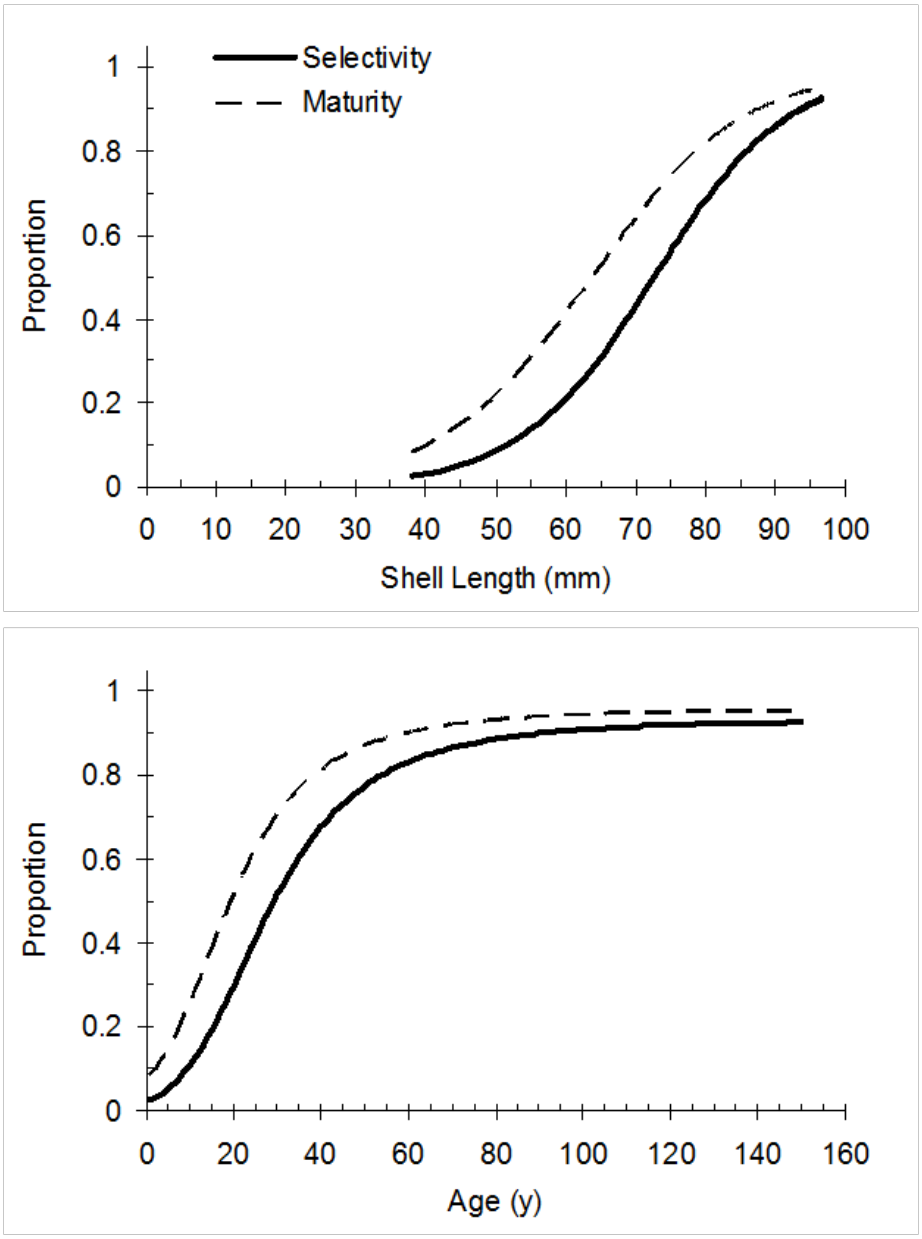


Figure 2. Commercial size-selectivity and maturity by length (top) and by age (bottom) assuming the von Bertalanffy growth curve for ocean quahogs in the exploited area (from Thorarinsdottir and Jacobson, 1995).

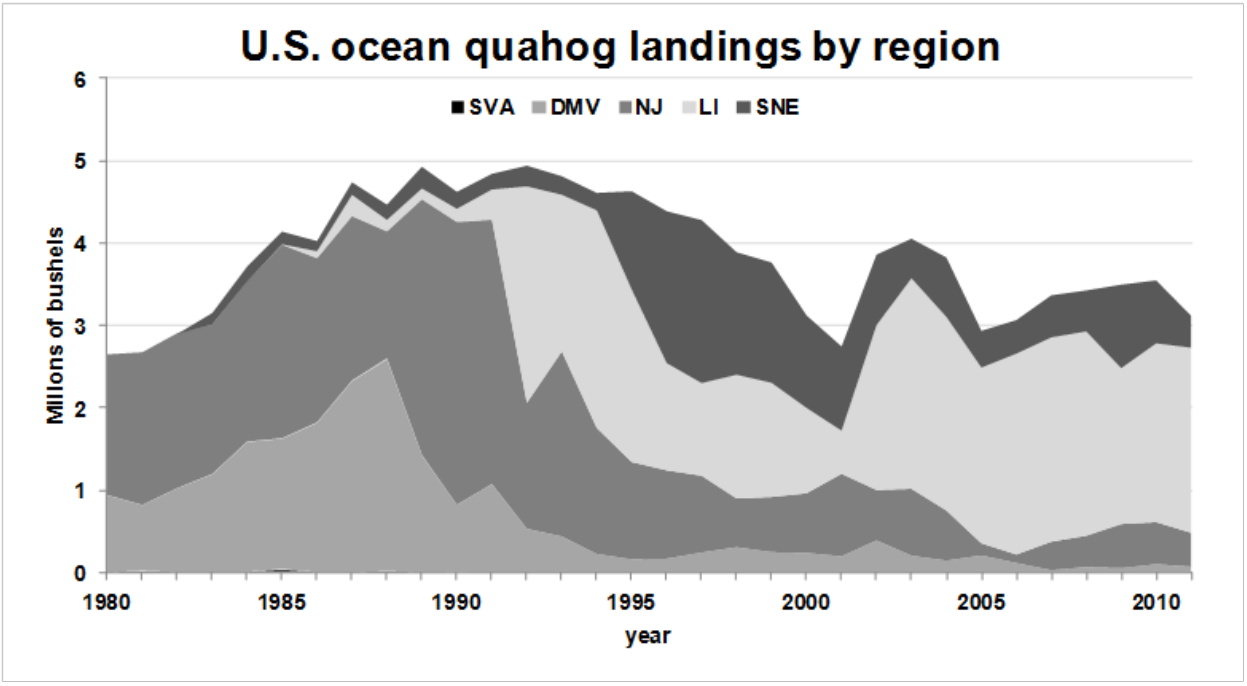


Figure 3. Total ocean quahog landings by region in millions of bushels.

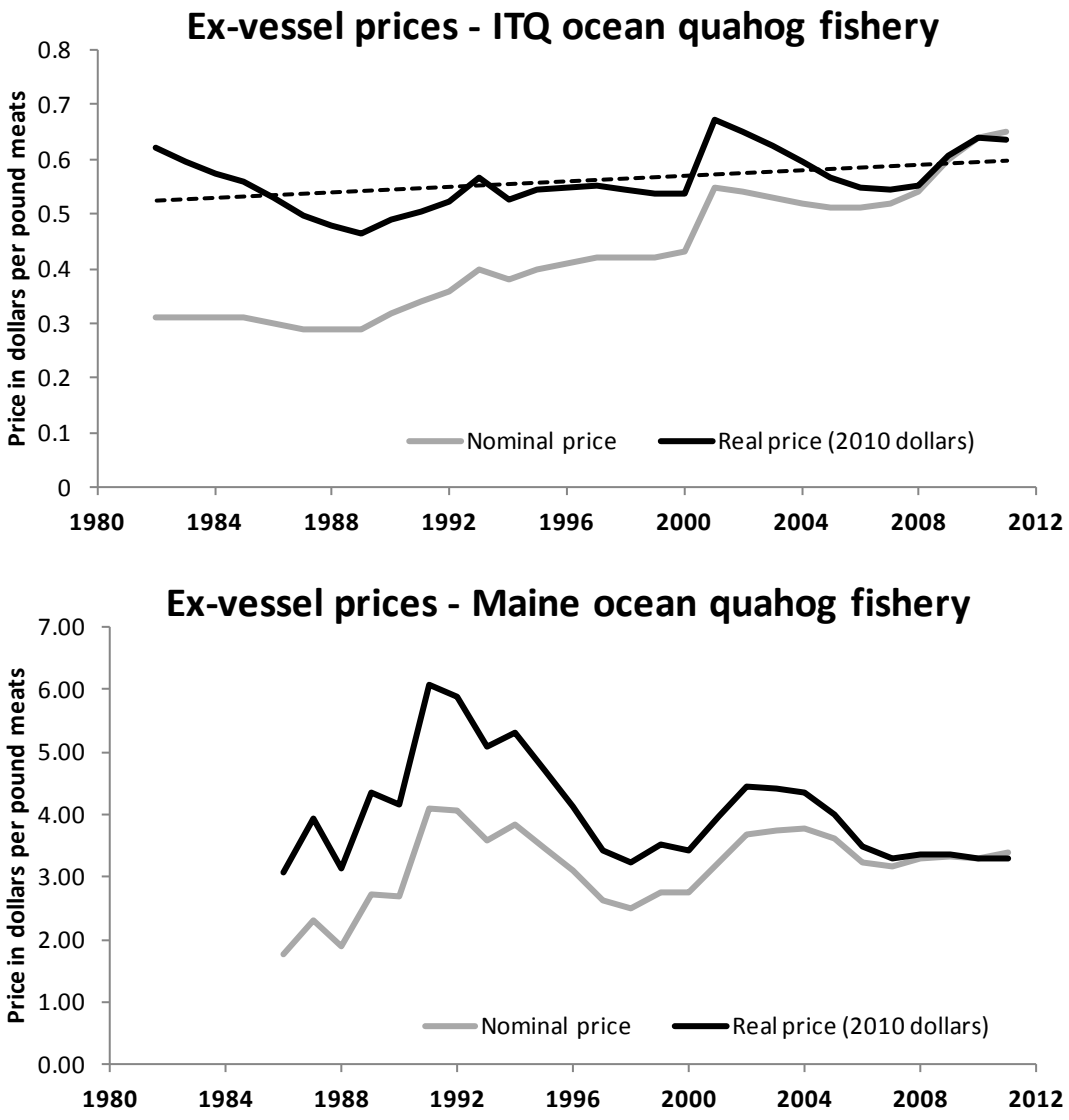


Figure 4. Ocean quahog annual mean ex-vessel price per pound of meats for both the ITQ and Maine fisheries. The gray line shows the actual amount paid (the nominal price) while the black line shows the price adjusted for inflation from the beginning of the time series.

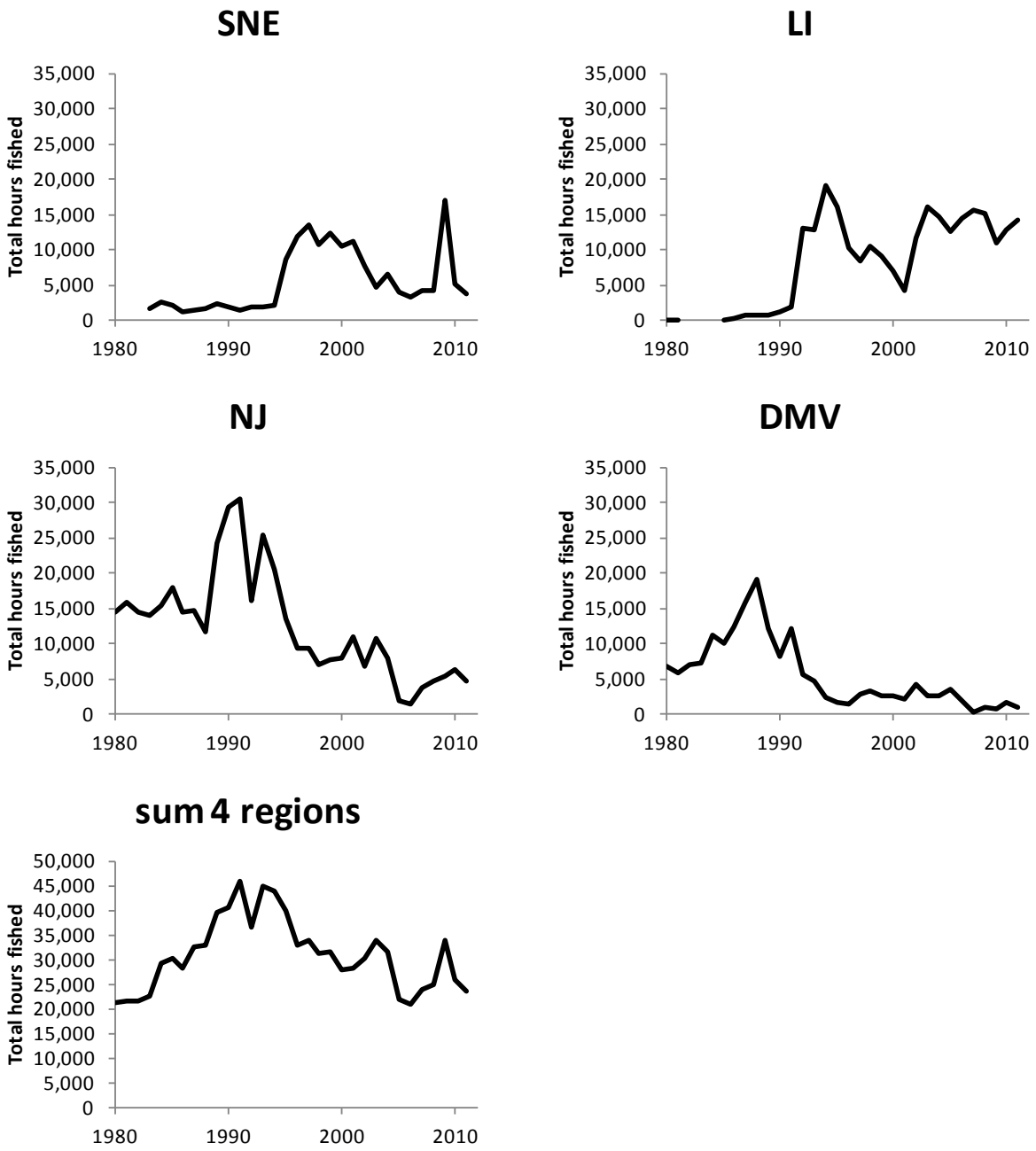


Figure 5. Hours fished by region and year, and sum of hours fished in all four regions.

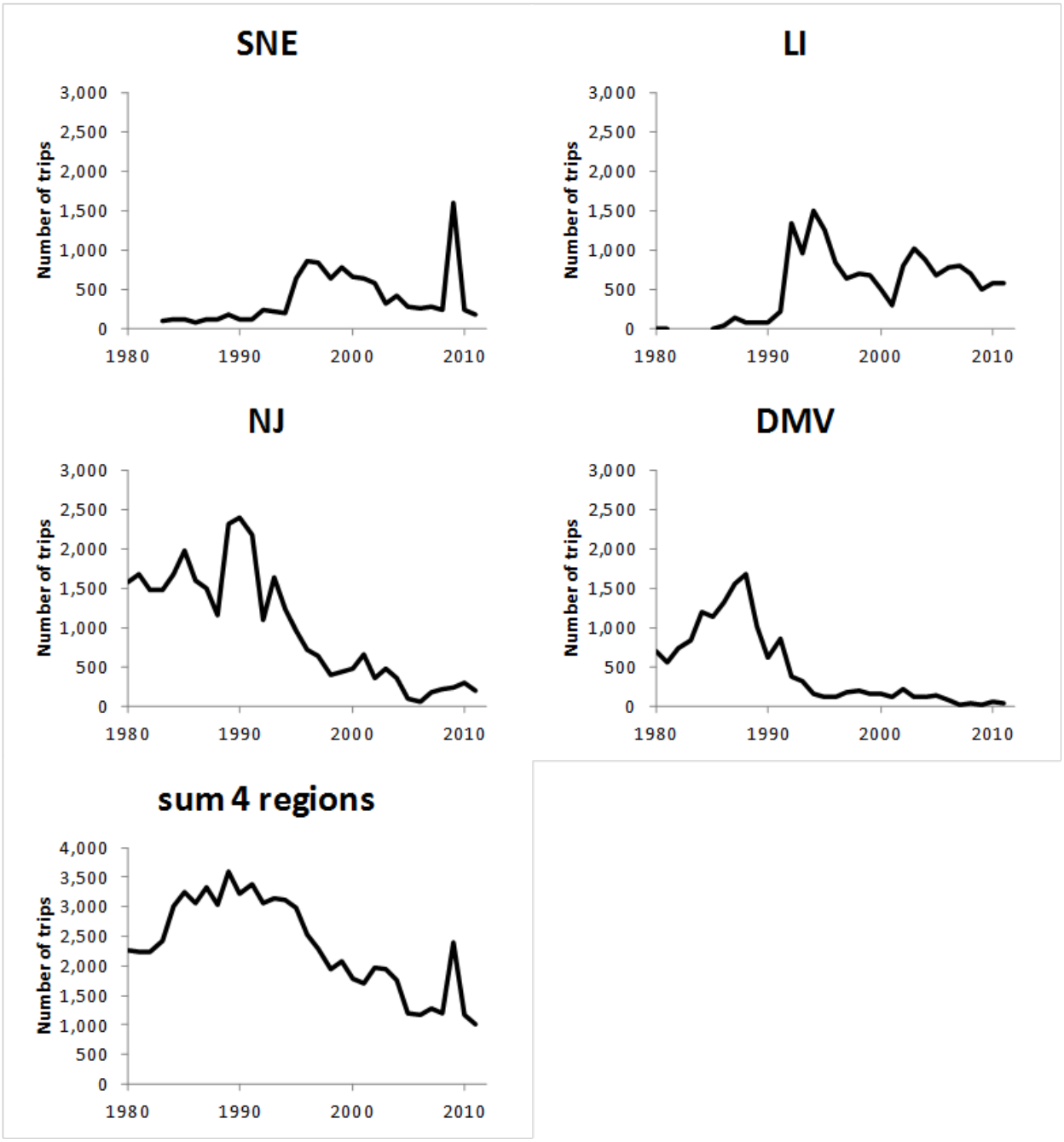


Figure 6. Number of trips by region and year, and the sum of trips from all regions.

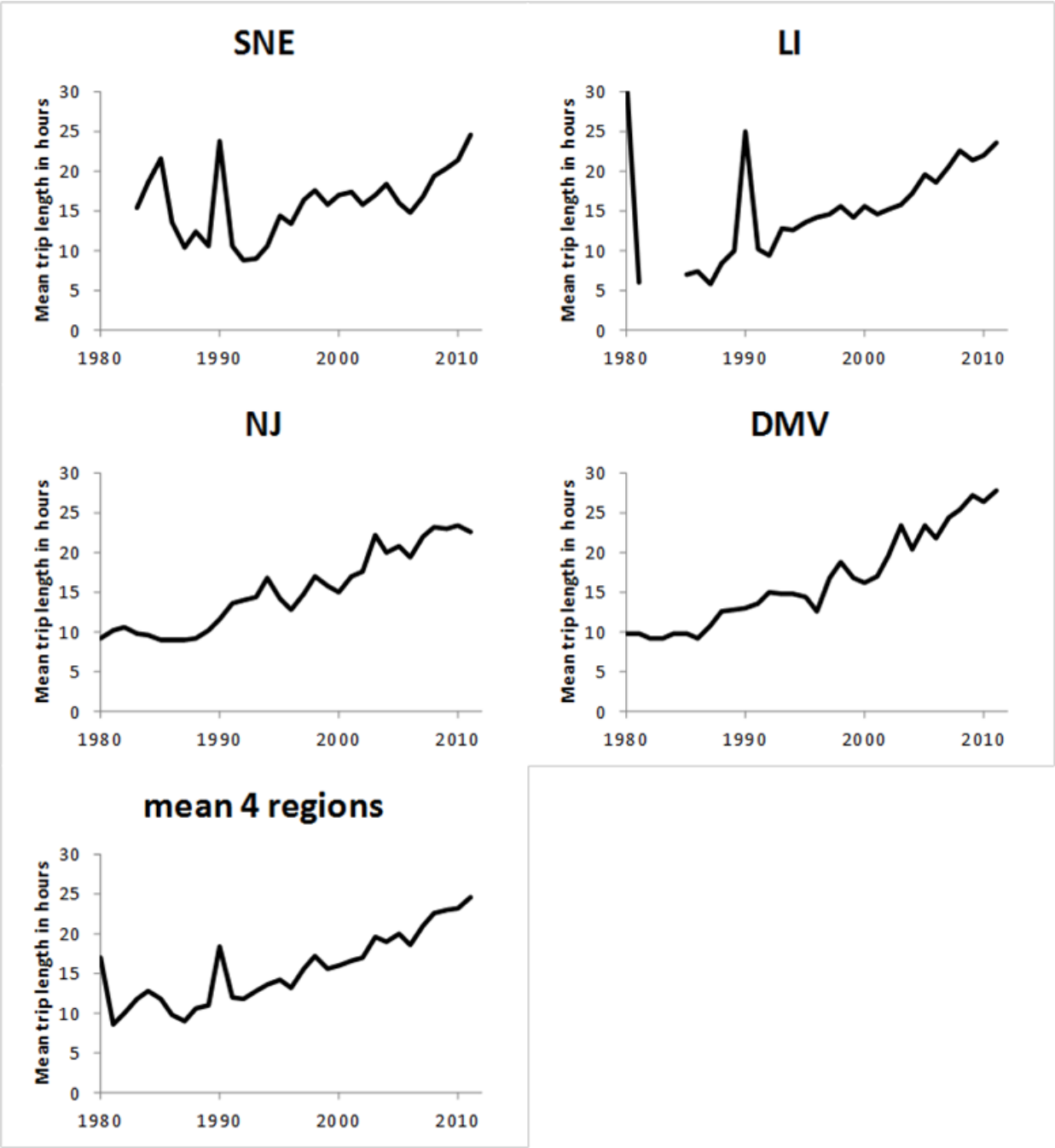


Figure 7. Mean trip length in hours by region and year, and for the four regions combined.

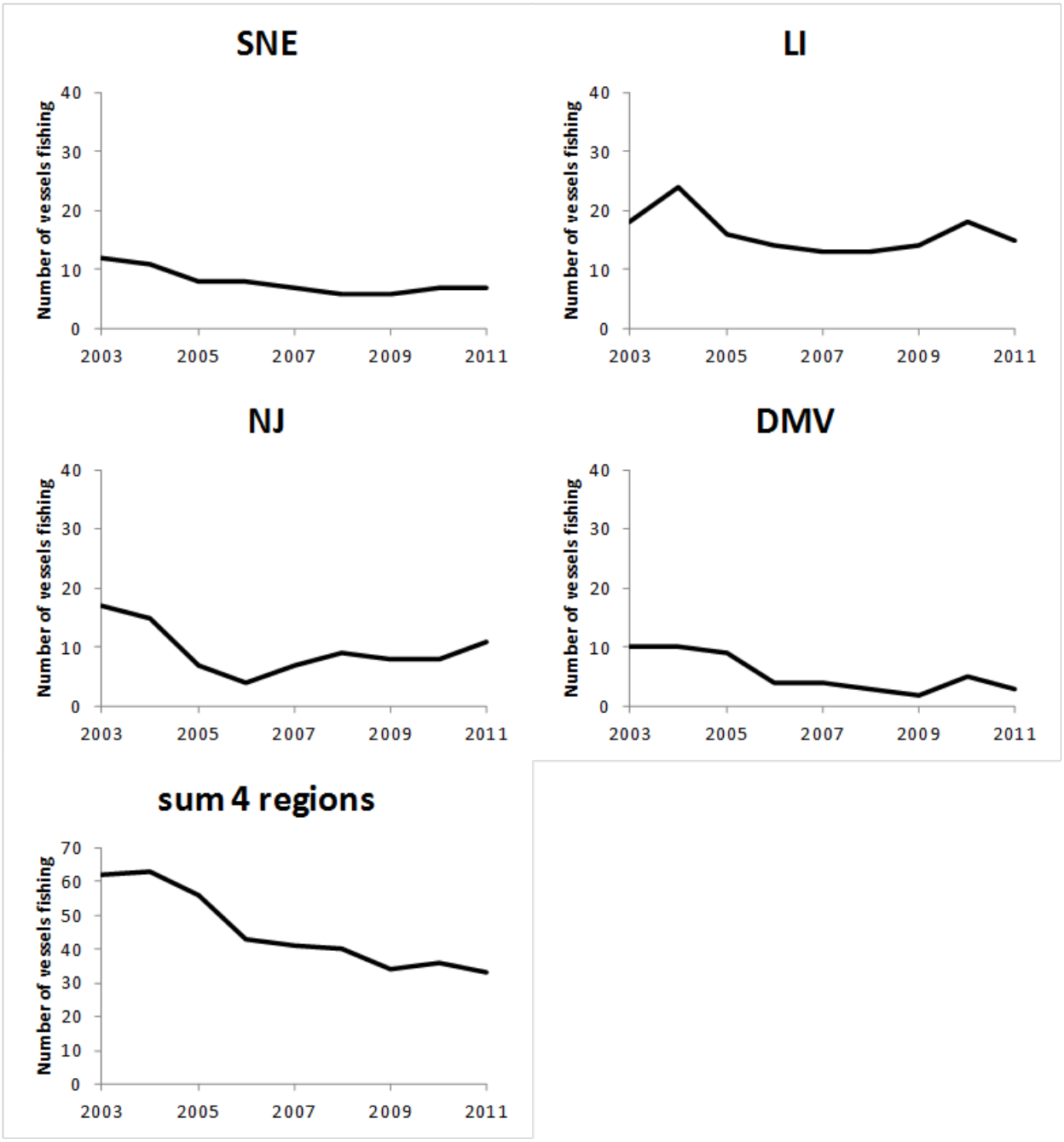


Figure 8. Number of vessels fishing for ocean quahogs by region and year, and the total number of vessels fishing in all four regions combined.

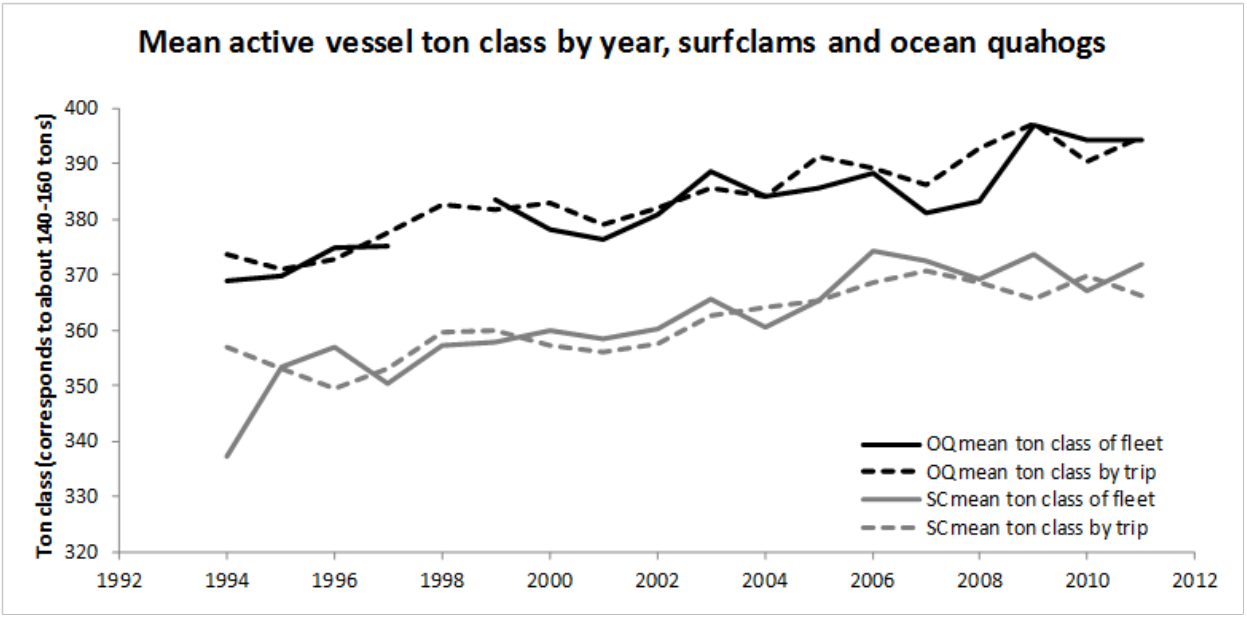


Figure 9. Mean ton class (a number specified by port agents to determine the relative size of a vessel) of the surfclam and ocean quahog fleet from 1994 to 2011. Mean ton class of fleet is the average of all unique vessels that landed greater than 7,500 lbs of meats per trip in a given year. Mean ton class by trip is the mean size of the vessels weighted by the number of trips they made that landed more than 7,500 lbs of meats. The y-axis scale for "ton class" is equivalent to about 140-160 gross tons.

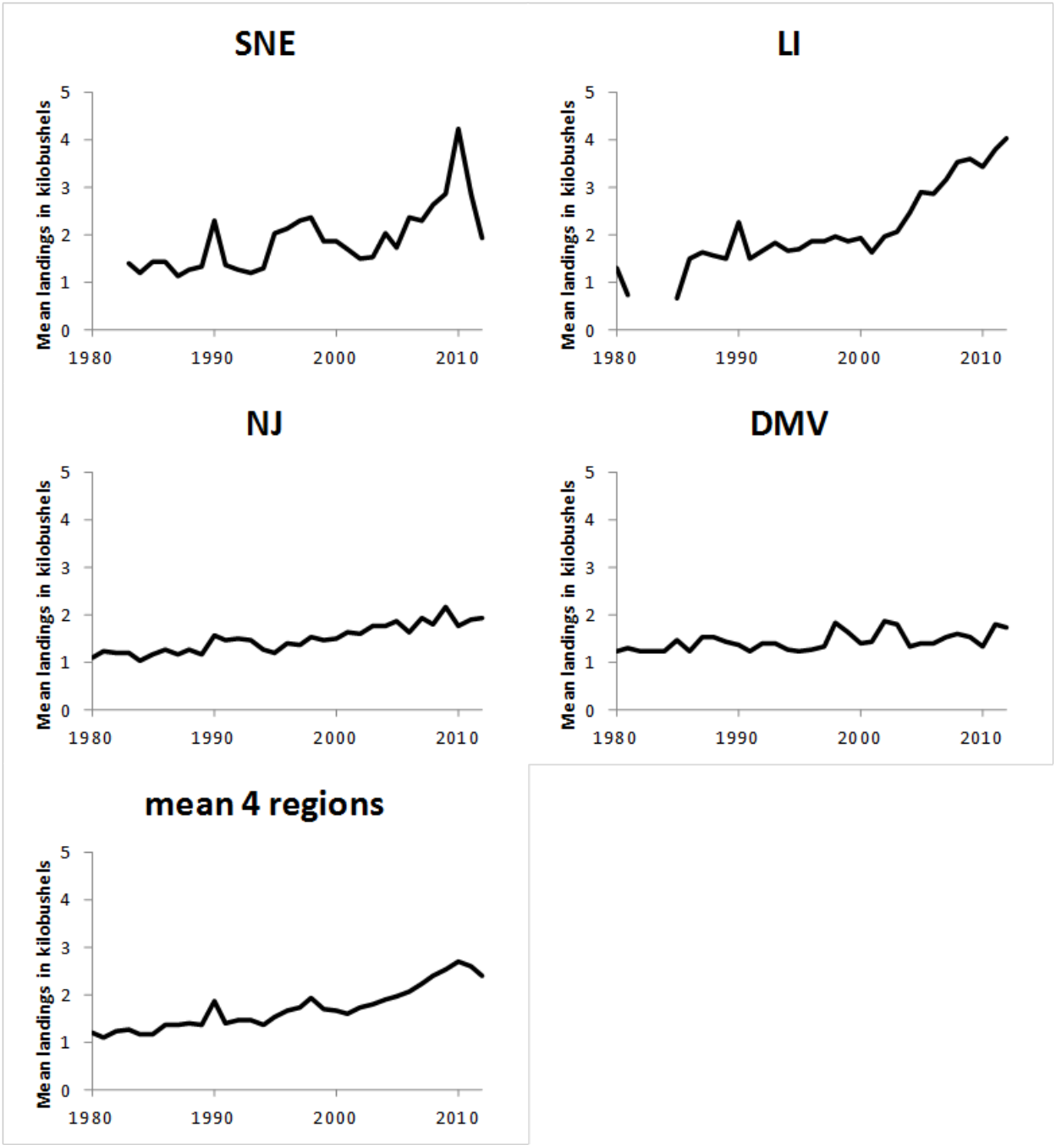


Figure 10. Mean landings per trip in kilobushels by region and year, and for the four regions combined.

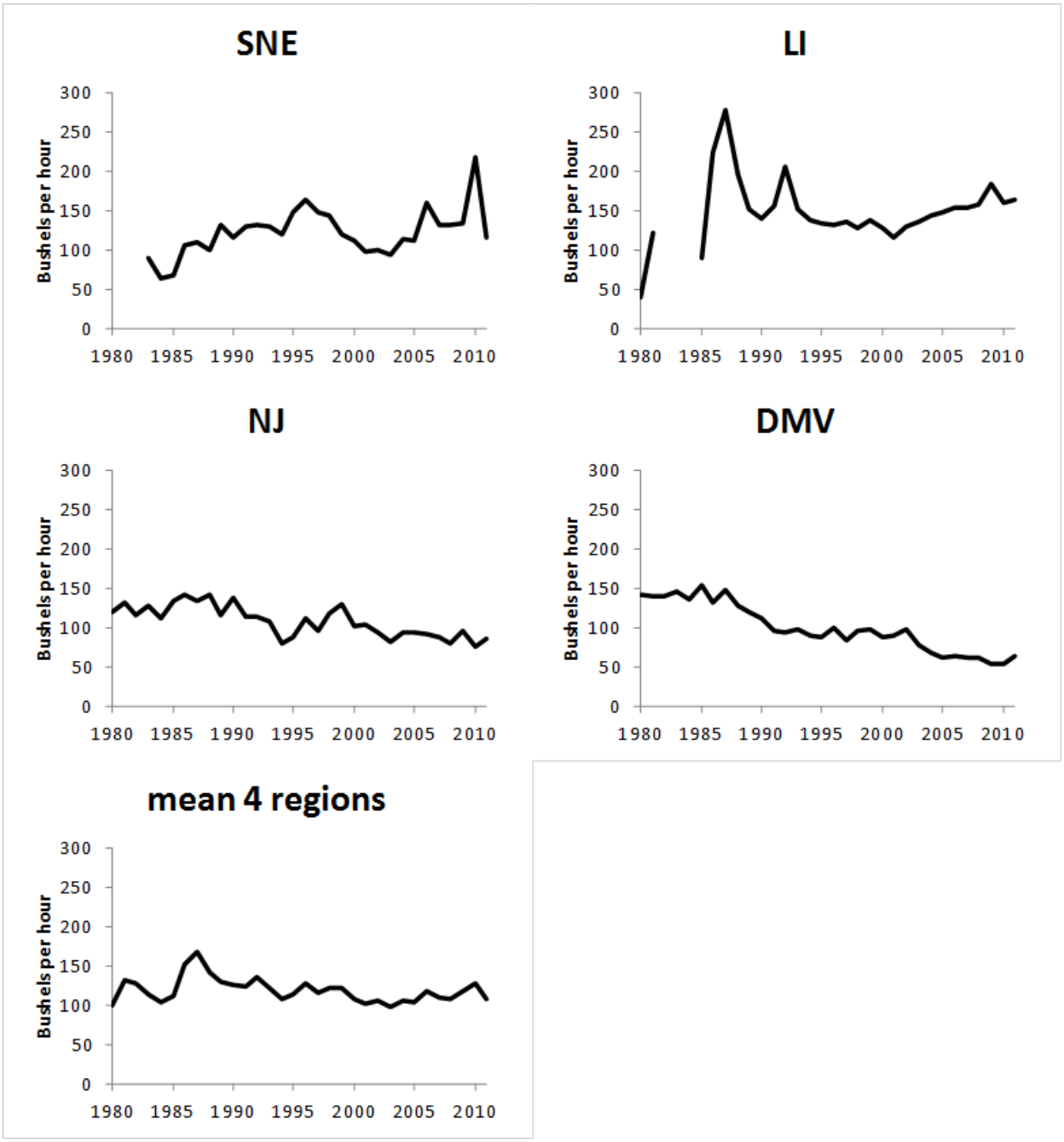


Figure 11. Ocean quahog LPUE (bushels per hour fished) by individual region, and the average of the four regions for each year.

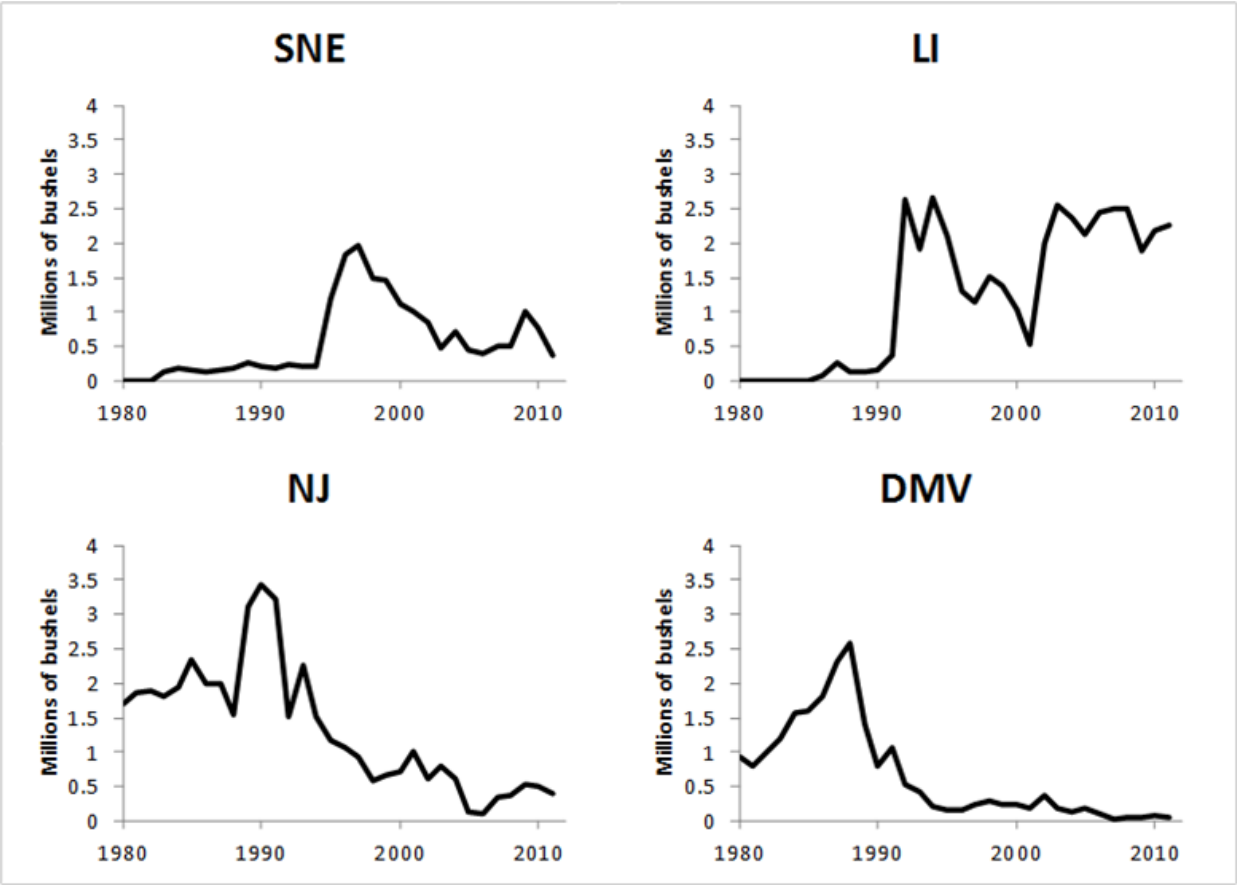


Figure 12. Landings of ocean quahogs in millions of bushels by assessment region.

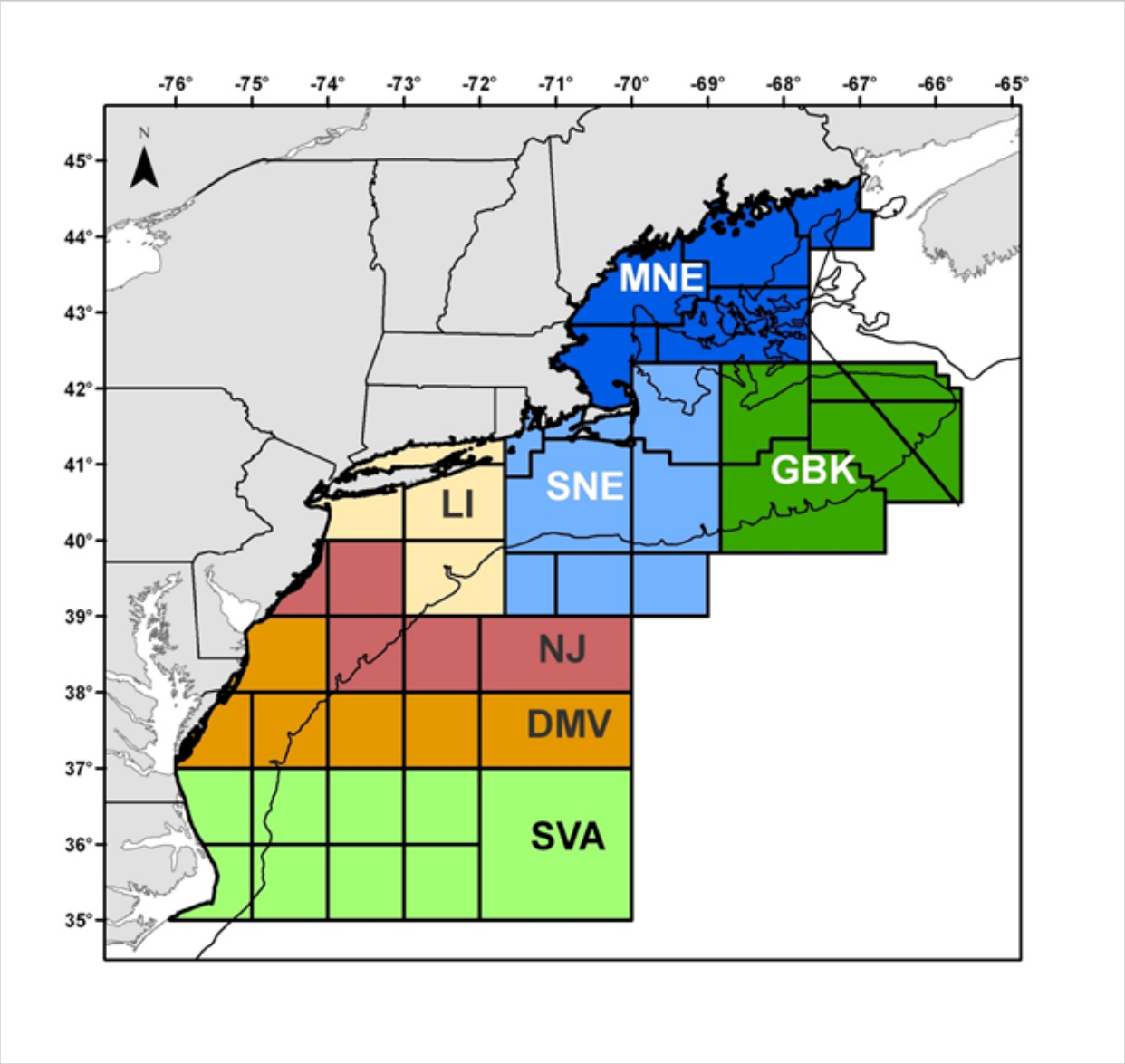


Figure 13. Map showing which statistical areas are used for calculating regional landings.

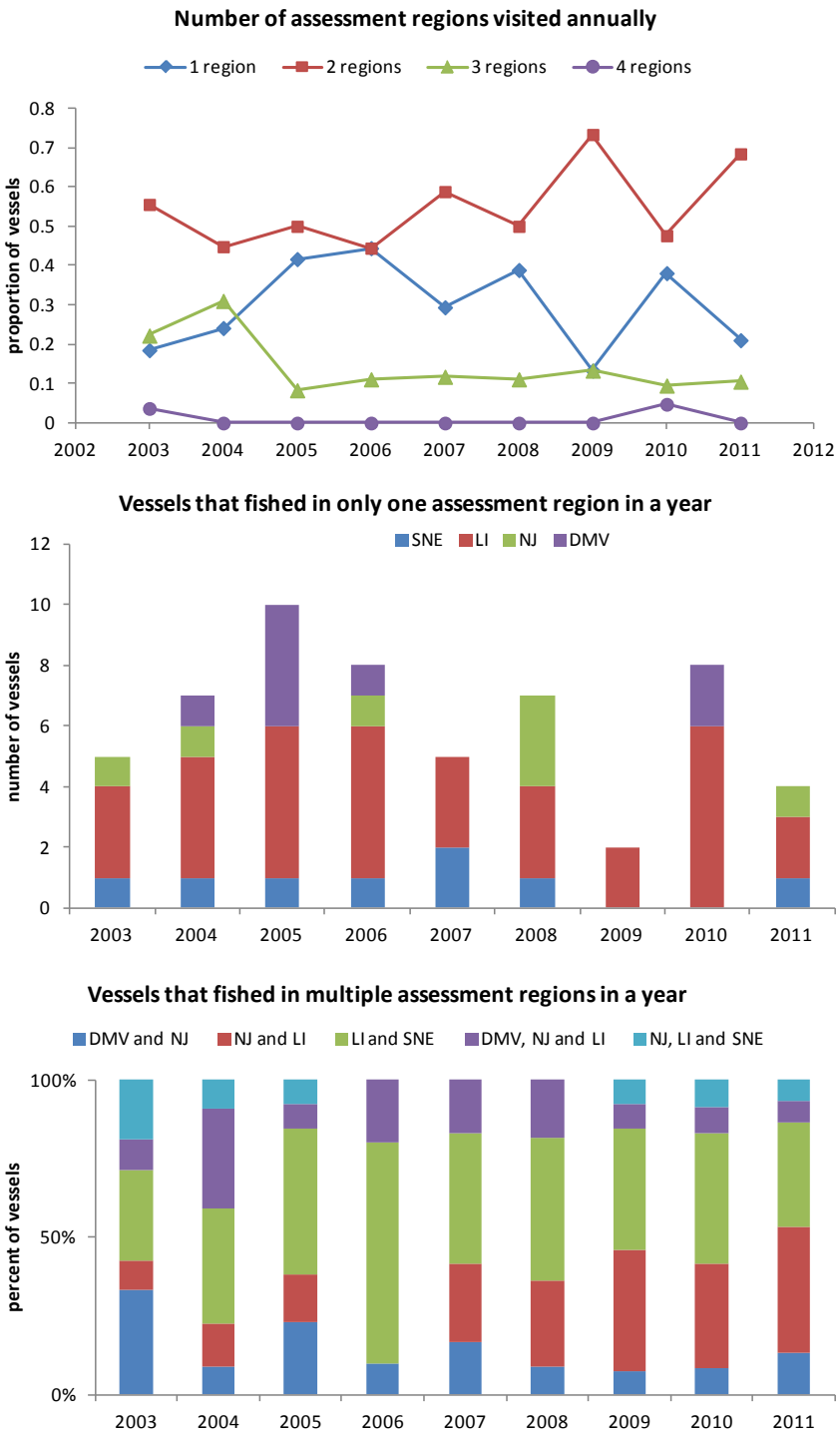


Figure 14. Assessment regions where vessels reported having fished in a given year. Top: Most vessels fish in two assessment regions. Middle: Vessels that fished in only one assessment region were most likely to fish in LI. Bottom: Vessels that fished in two regions have been moving away from LI and SNE and into NJ and LI in the past several years.

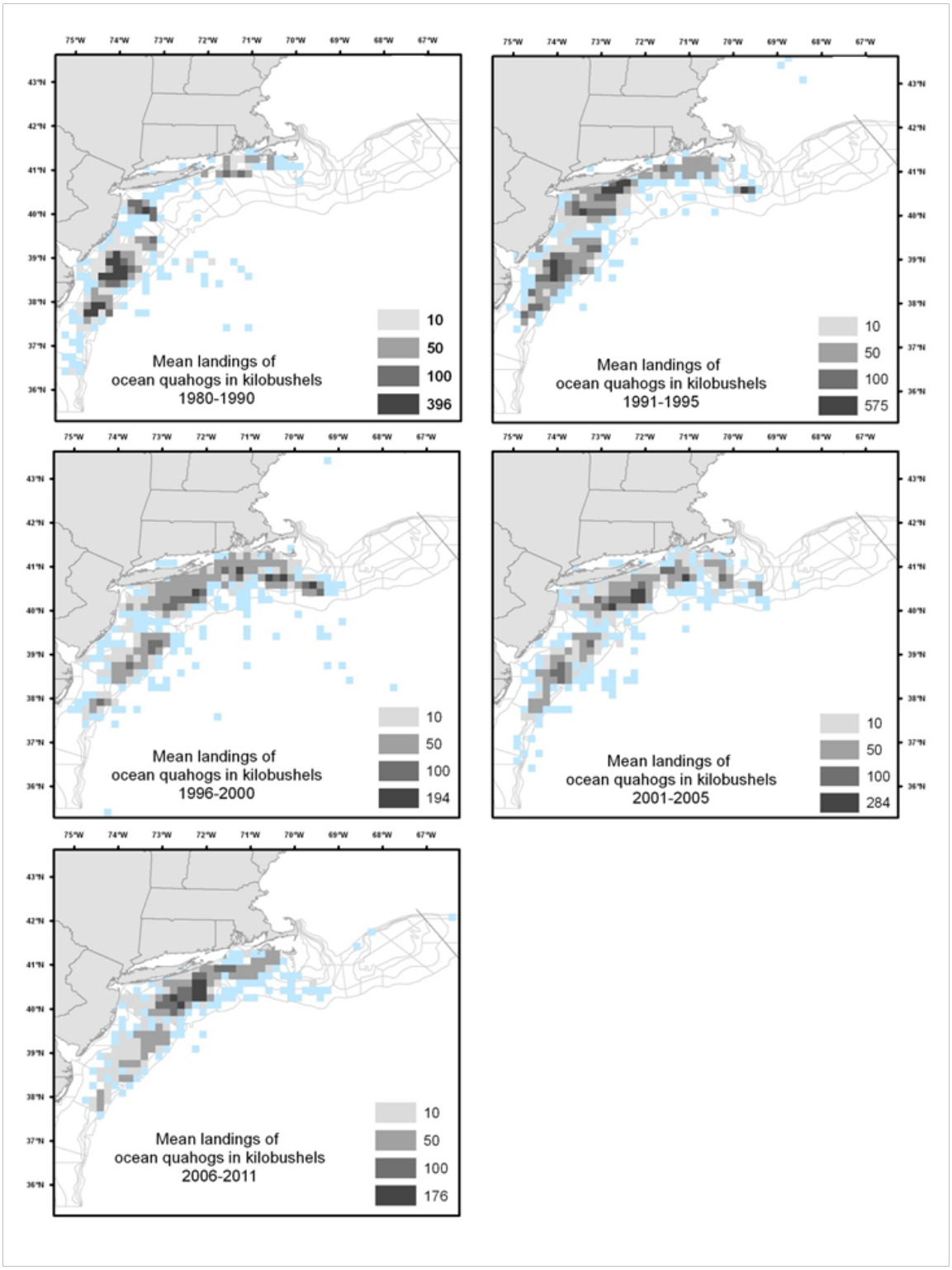


Figure 15. Ocean quahog landings by ten-minute square (TMSQ), the finest scale location for landings reported in logbooks, and time period. TMSQ in light blue had reported landings, but from fewer than three vessels.

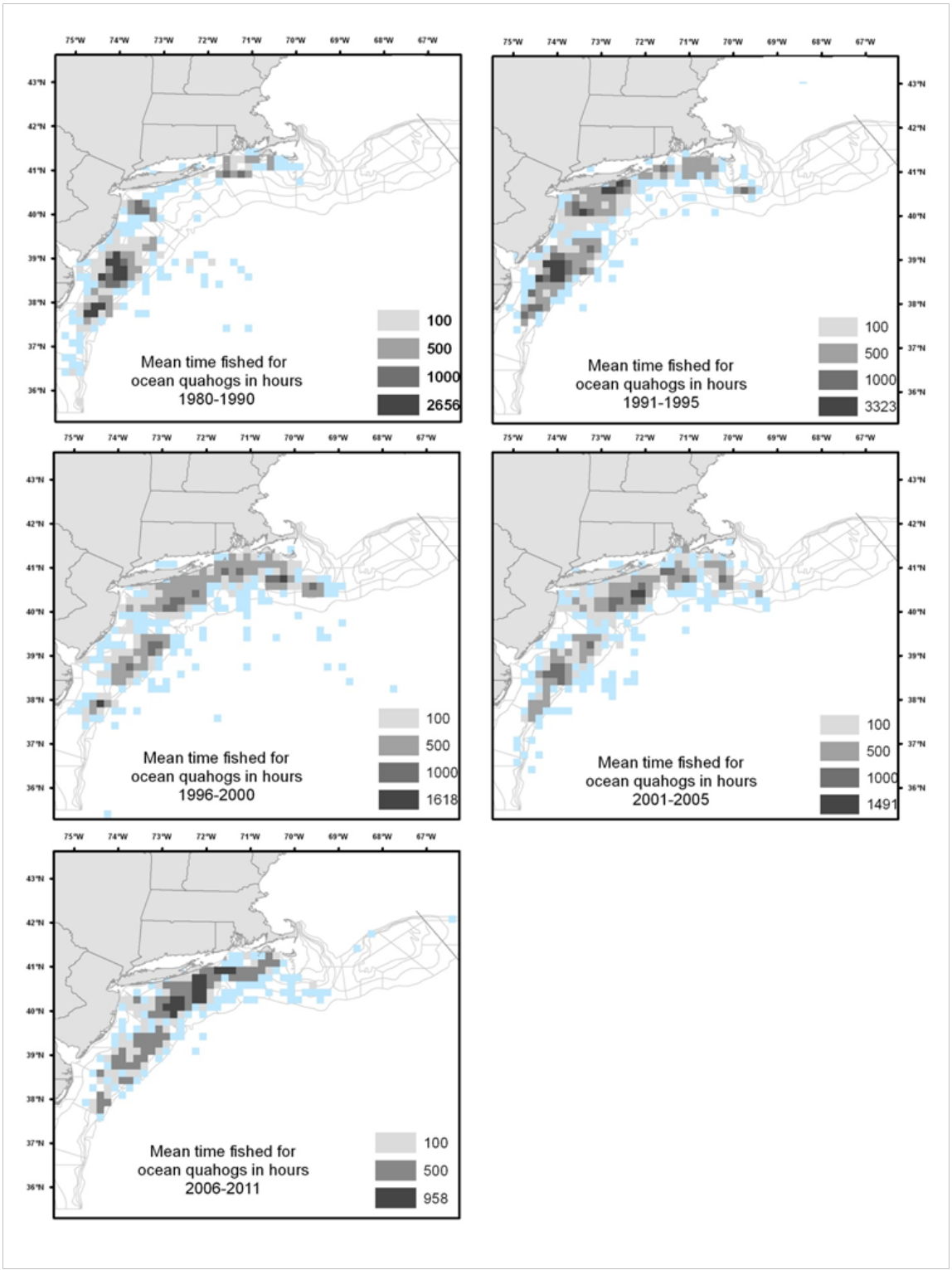


Figure 16. Ocean quahog fishing effort by ten-minute square (TMSQ), the most precise location for fishing activity reported in logbooks, and time period. TMSQ in light blue had reported fishing activity, but from fewer than three vessels.

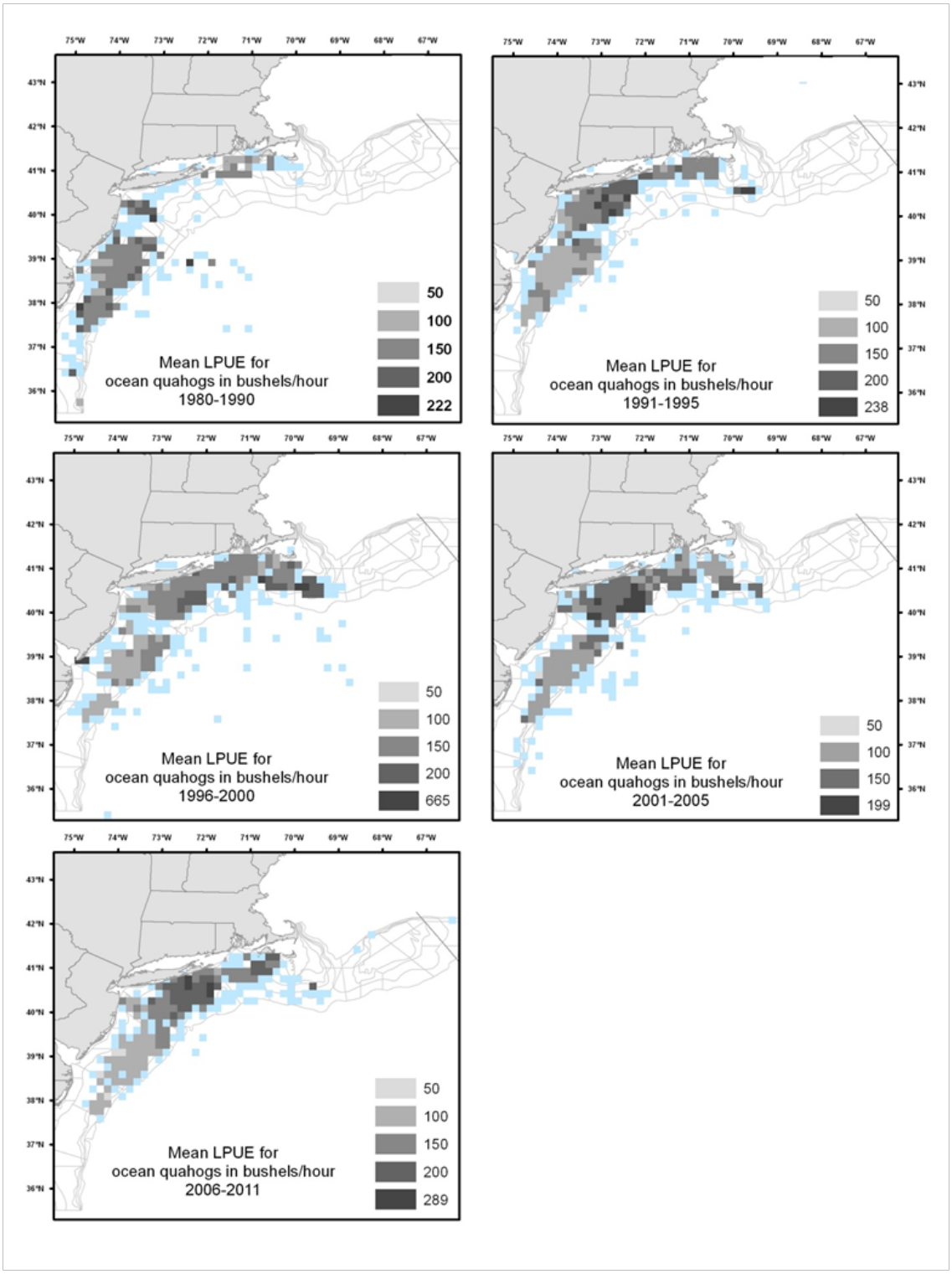


Figure 17. Ocean quahog landings by unit effort by ten-minute square (TMSQ), the most precise location for fishing activity reported in logbooks, and time period. TMSQ in light blue had reported fishing activity, but from fewer than three vessels.

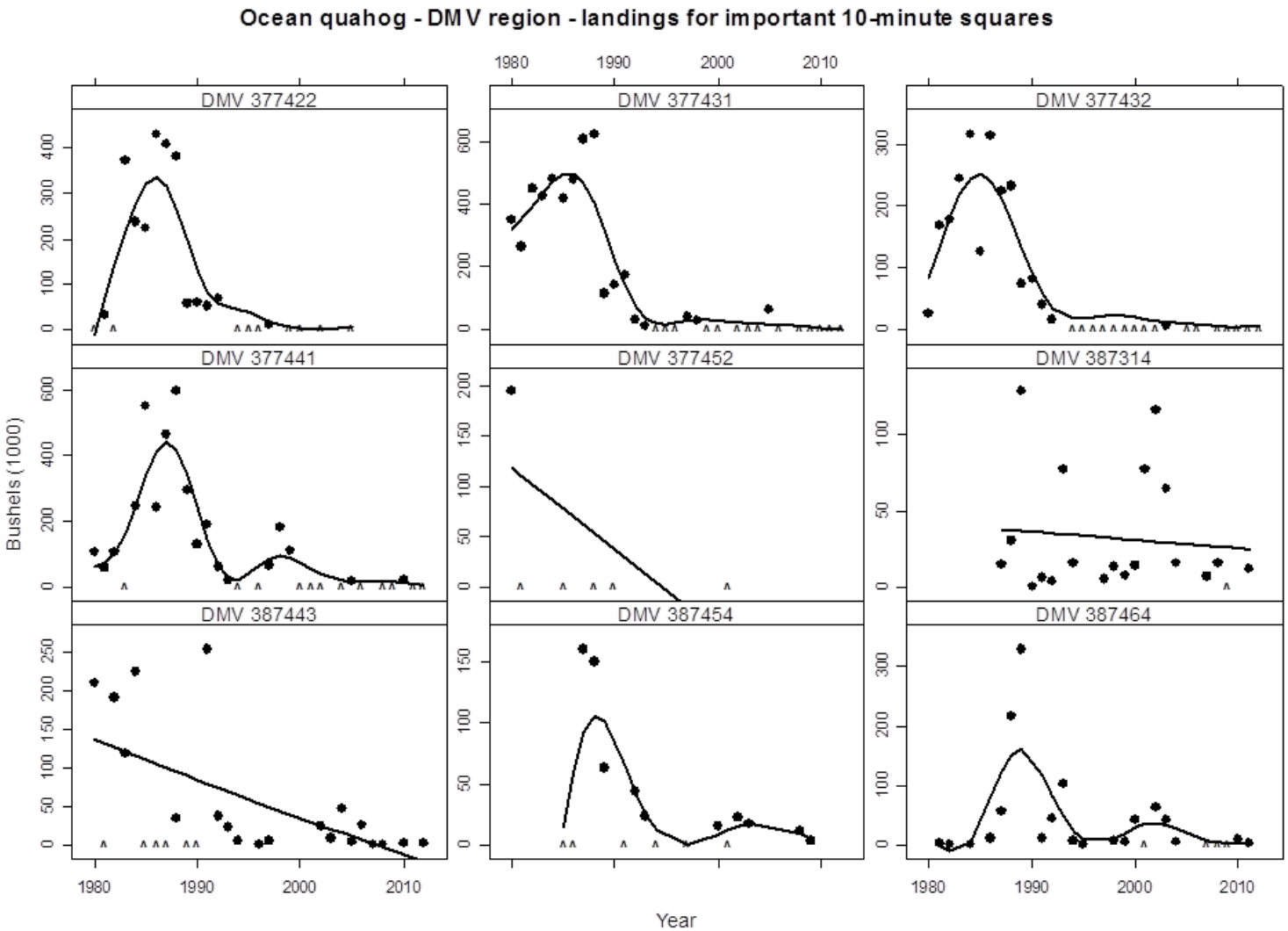


Figure 18A. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the DMV region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

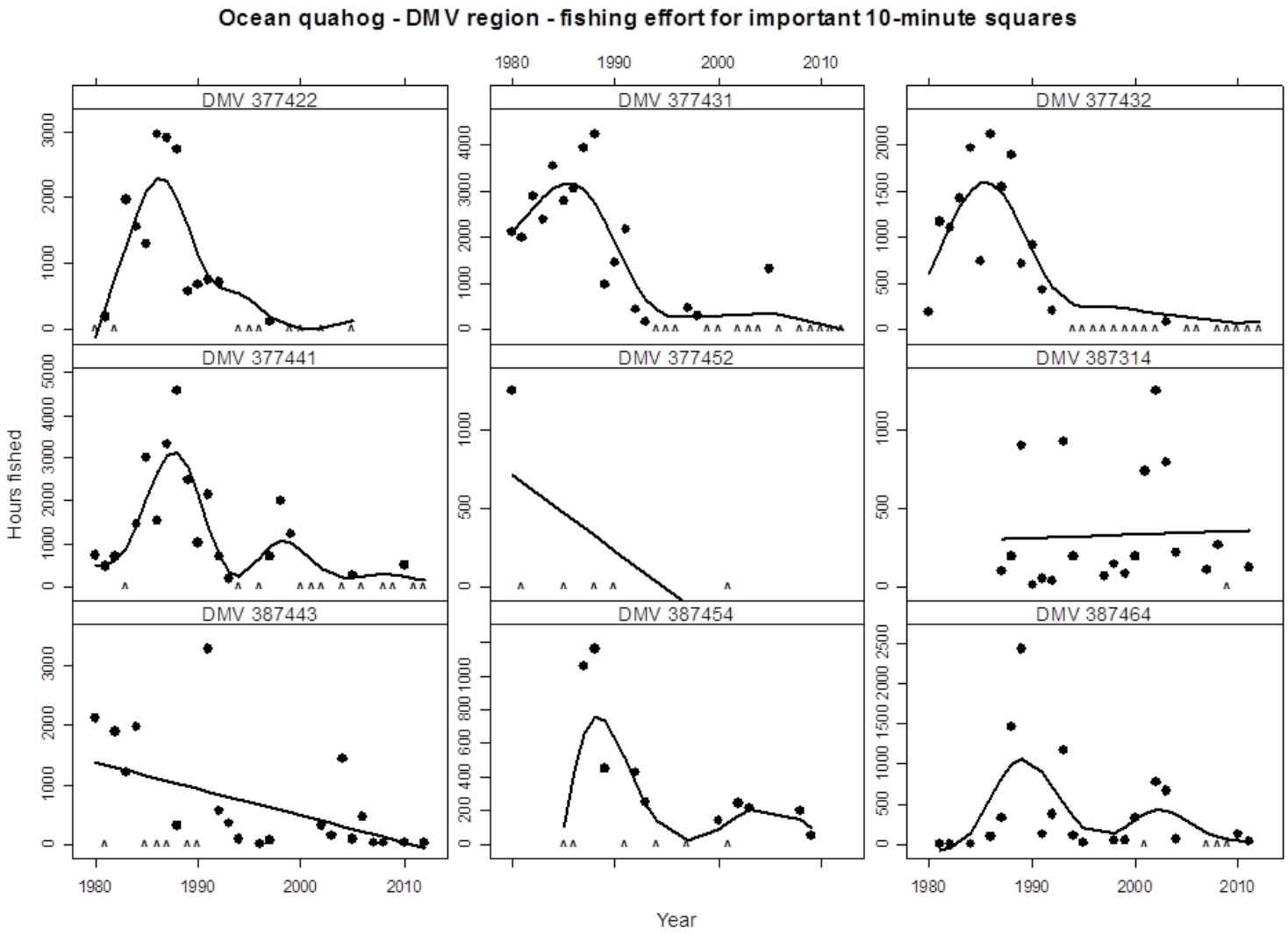


Figure 18A Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the DMV region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

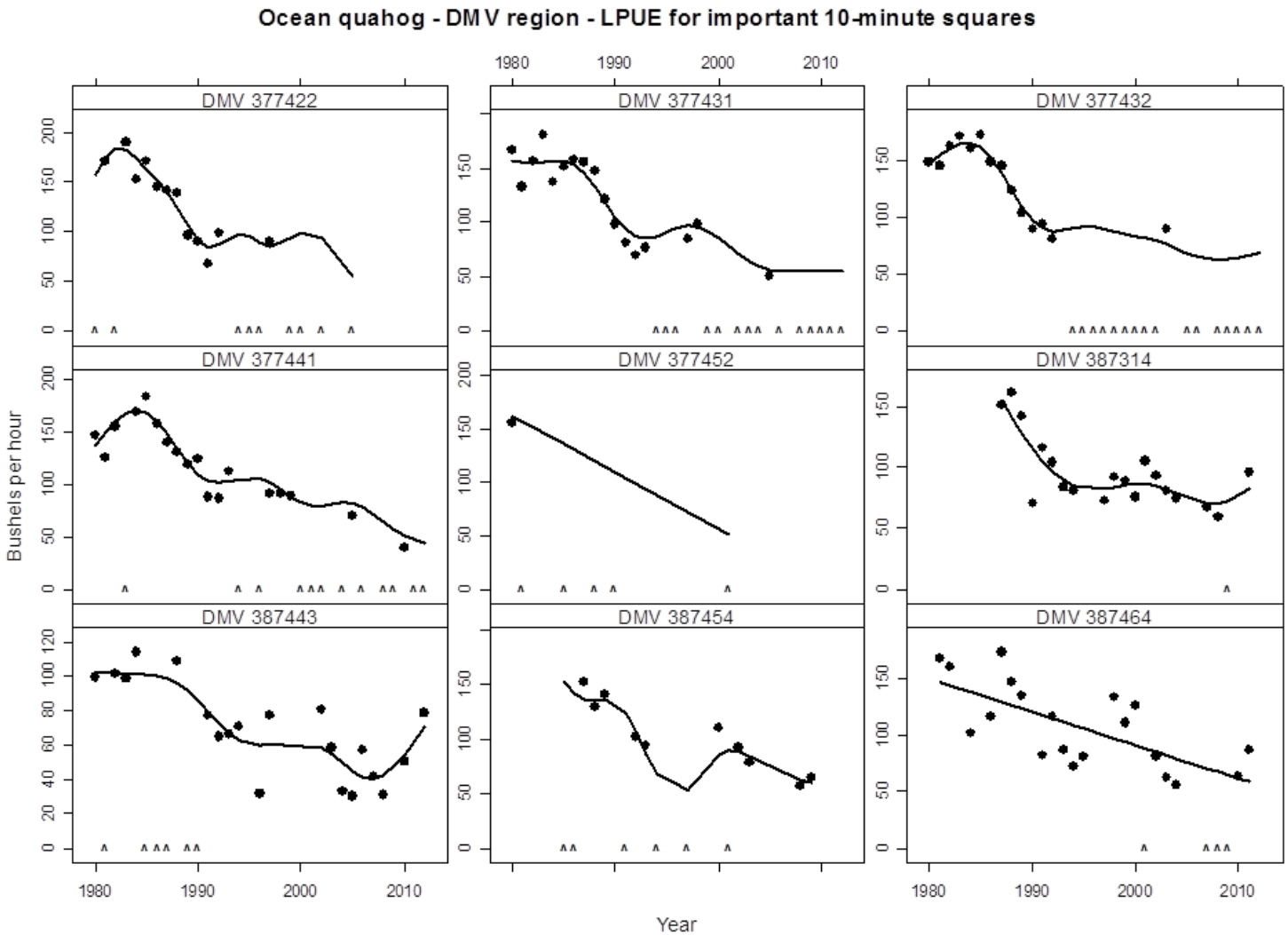


Figure 18A Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the DMV region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

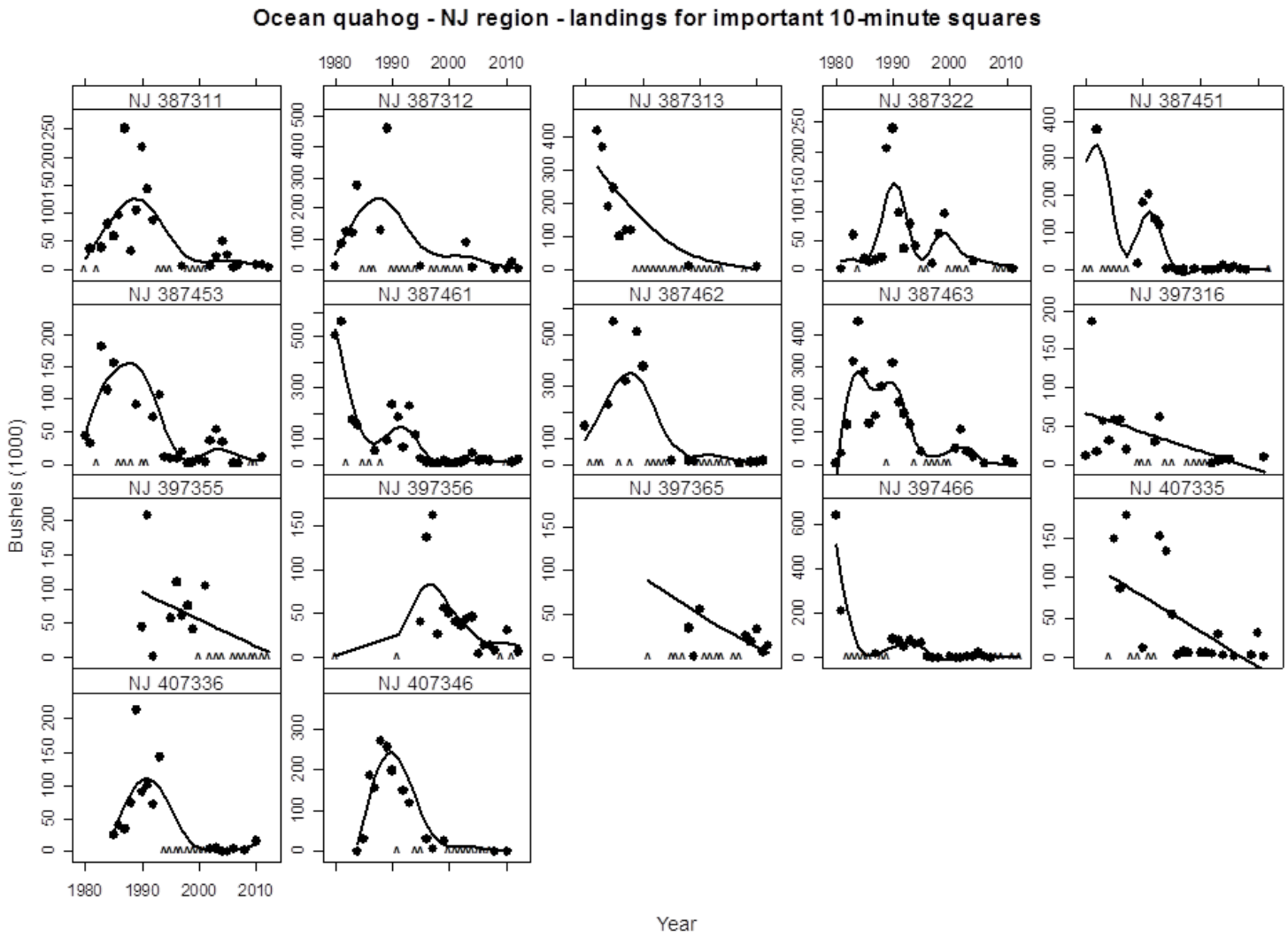


Figure 18B. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the NJ region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

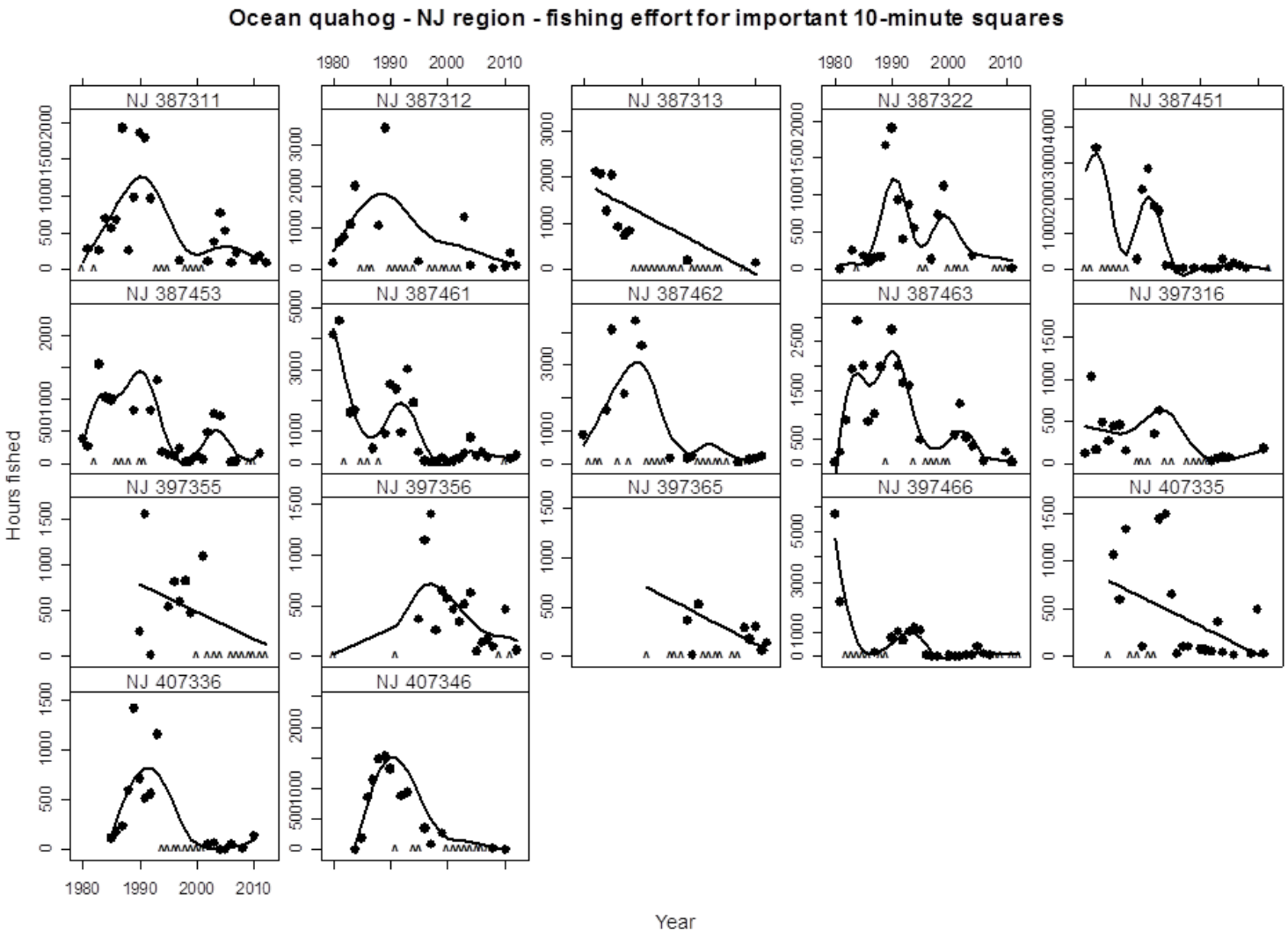


Figure 18B Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the NJ region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

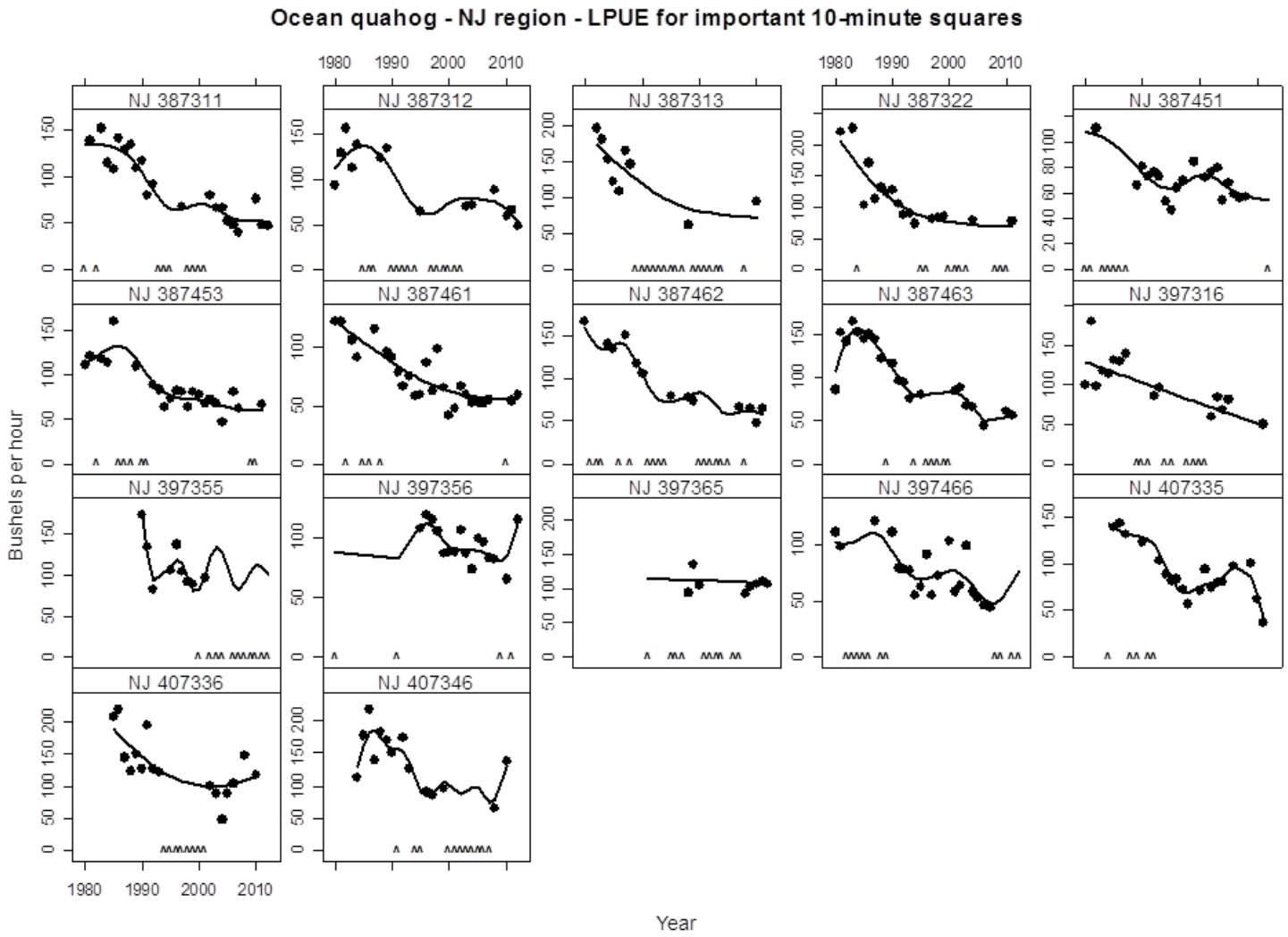


Figure 18B Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the NJ region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

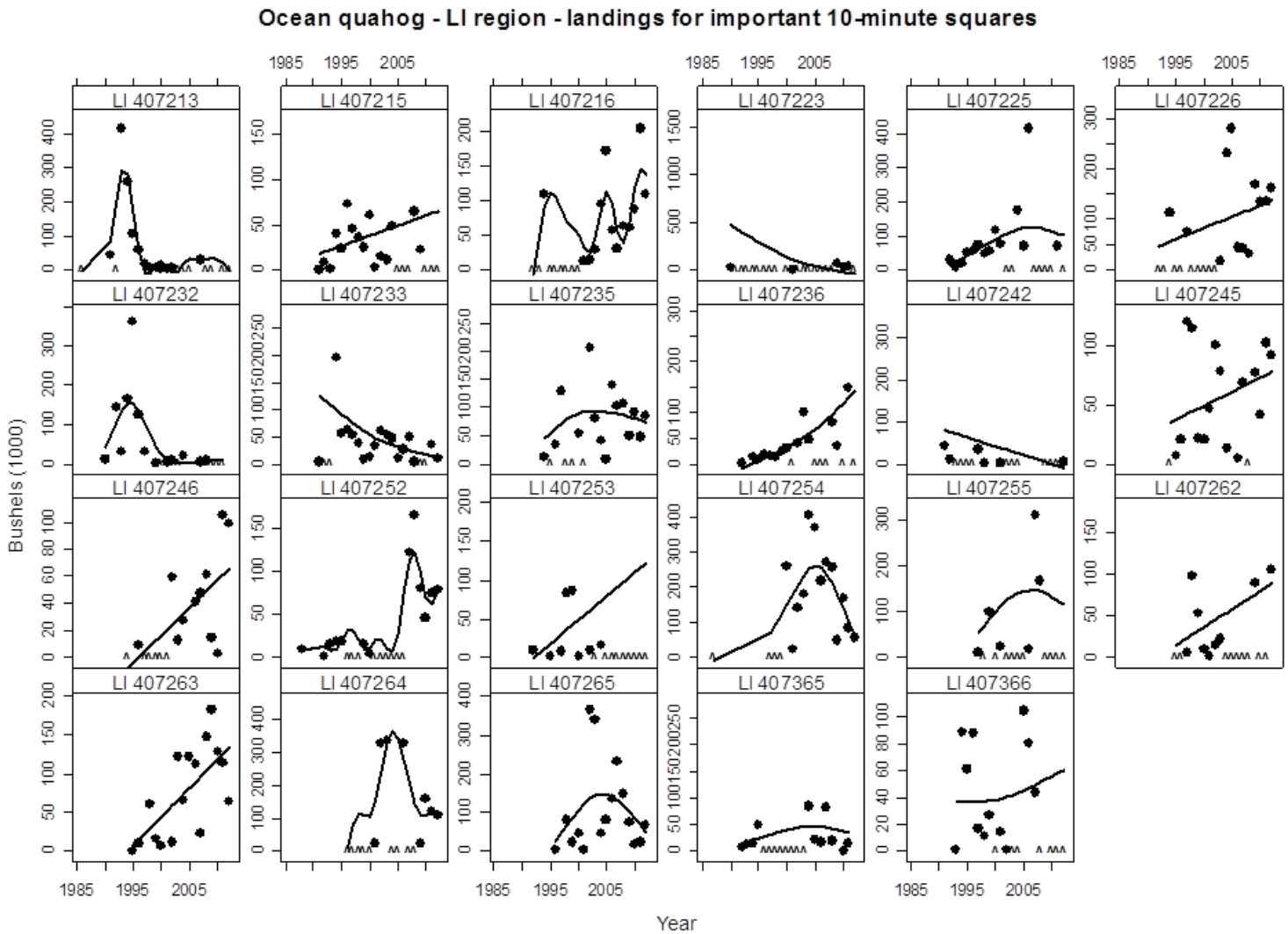


Figure 18C. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the LI region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

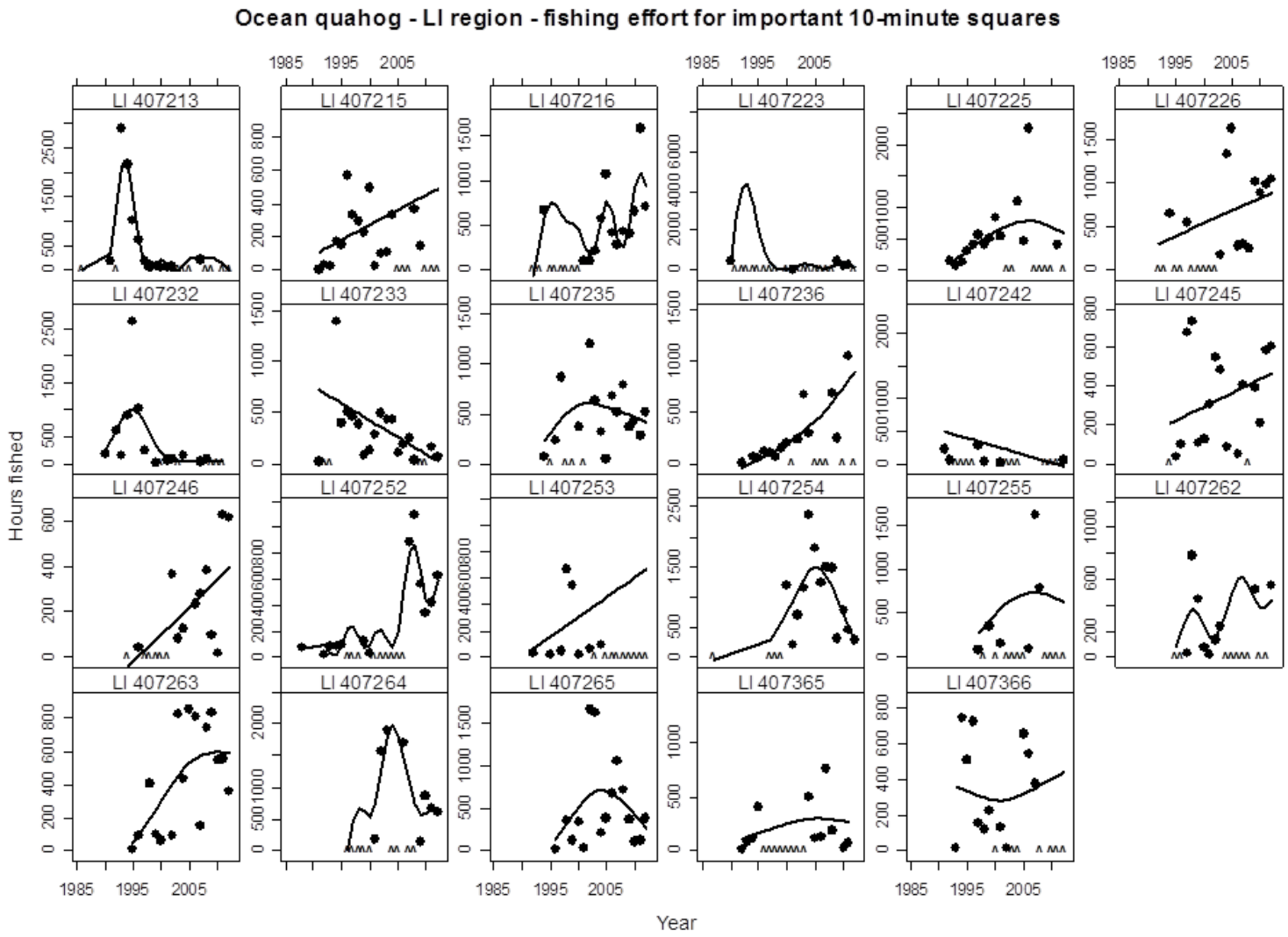


Figure 18C Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the LI region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

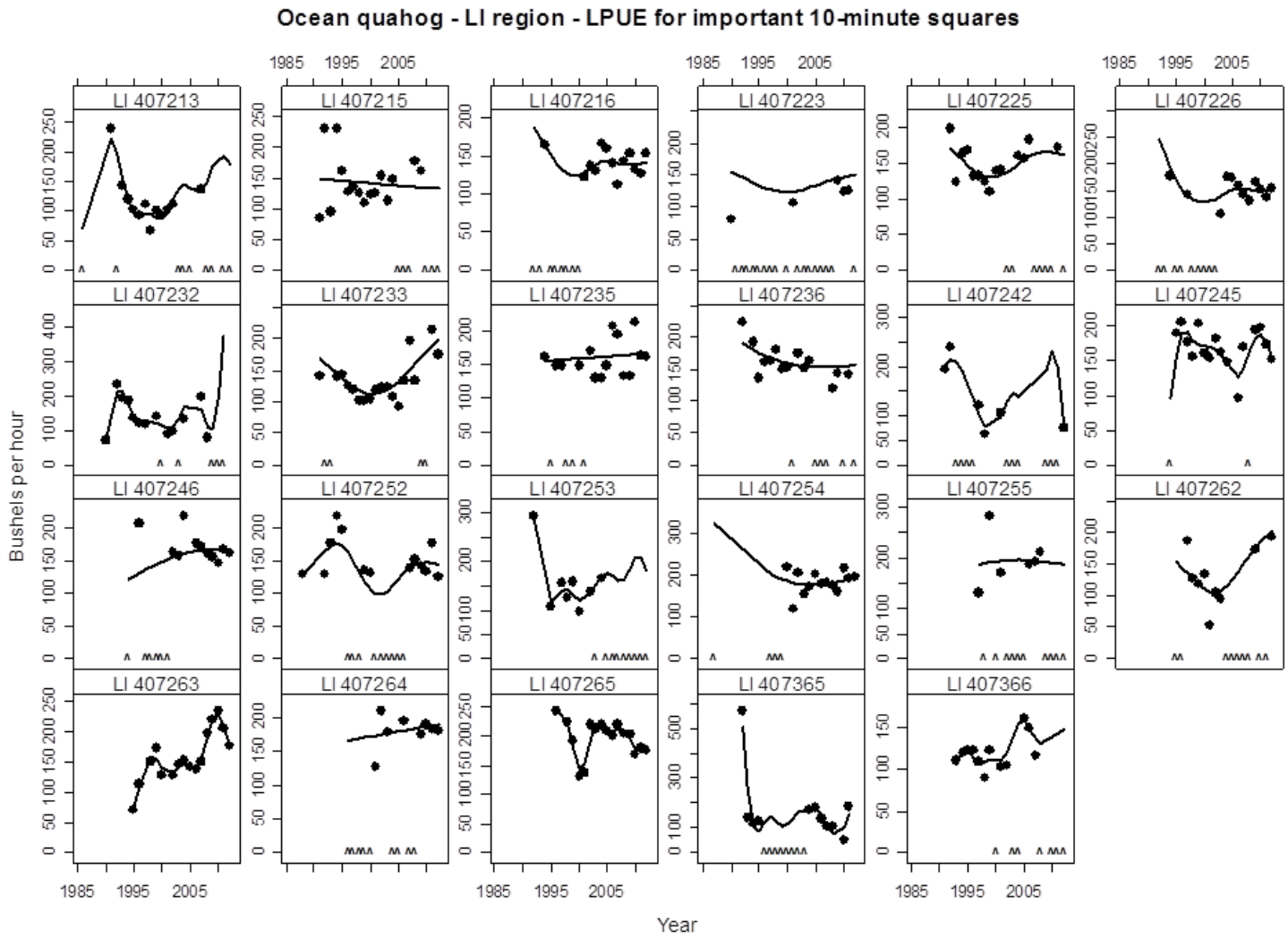


Figure 18C Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the LI region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

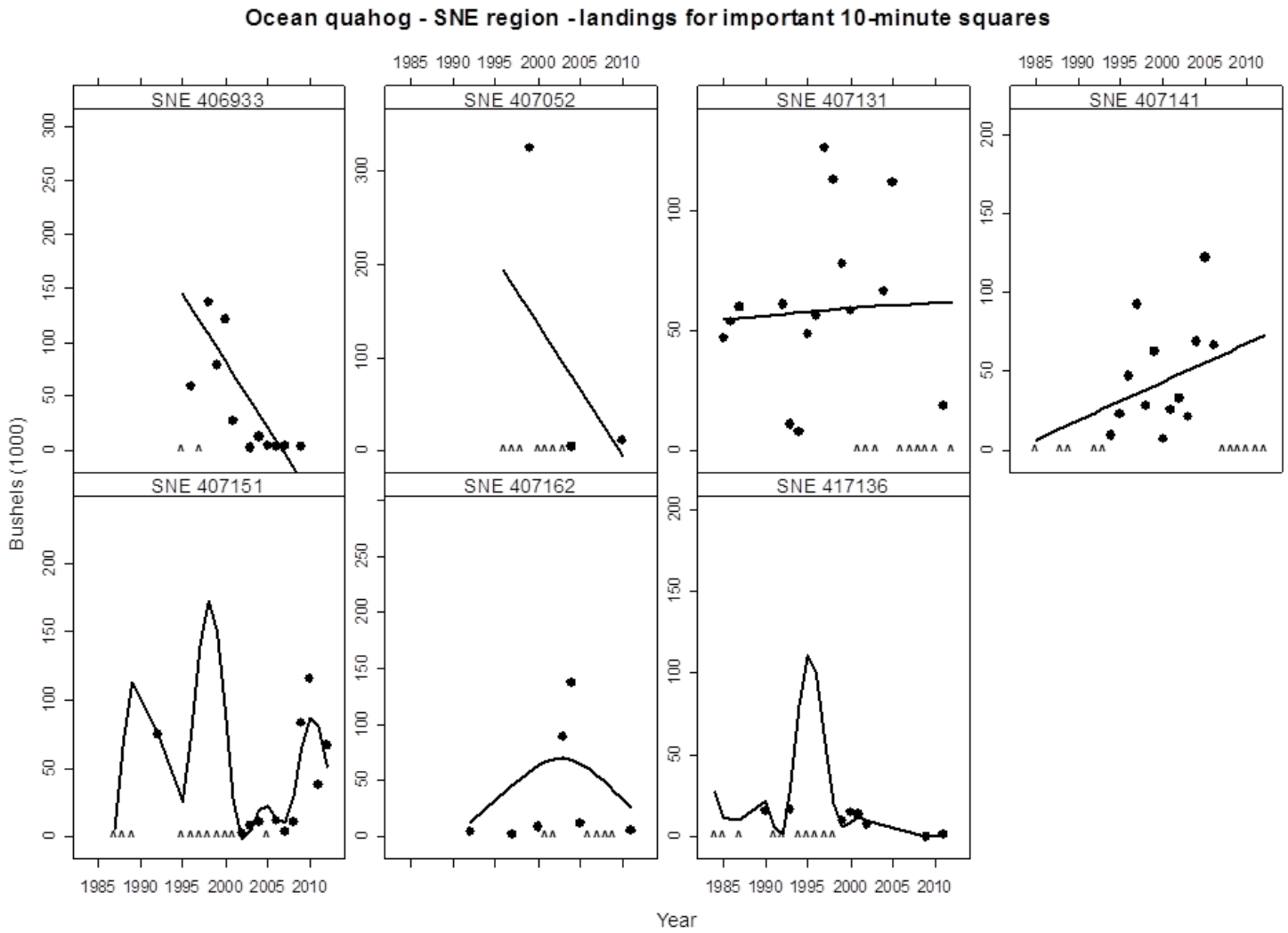


Figure 18D. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the SNE region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

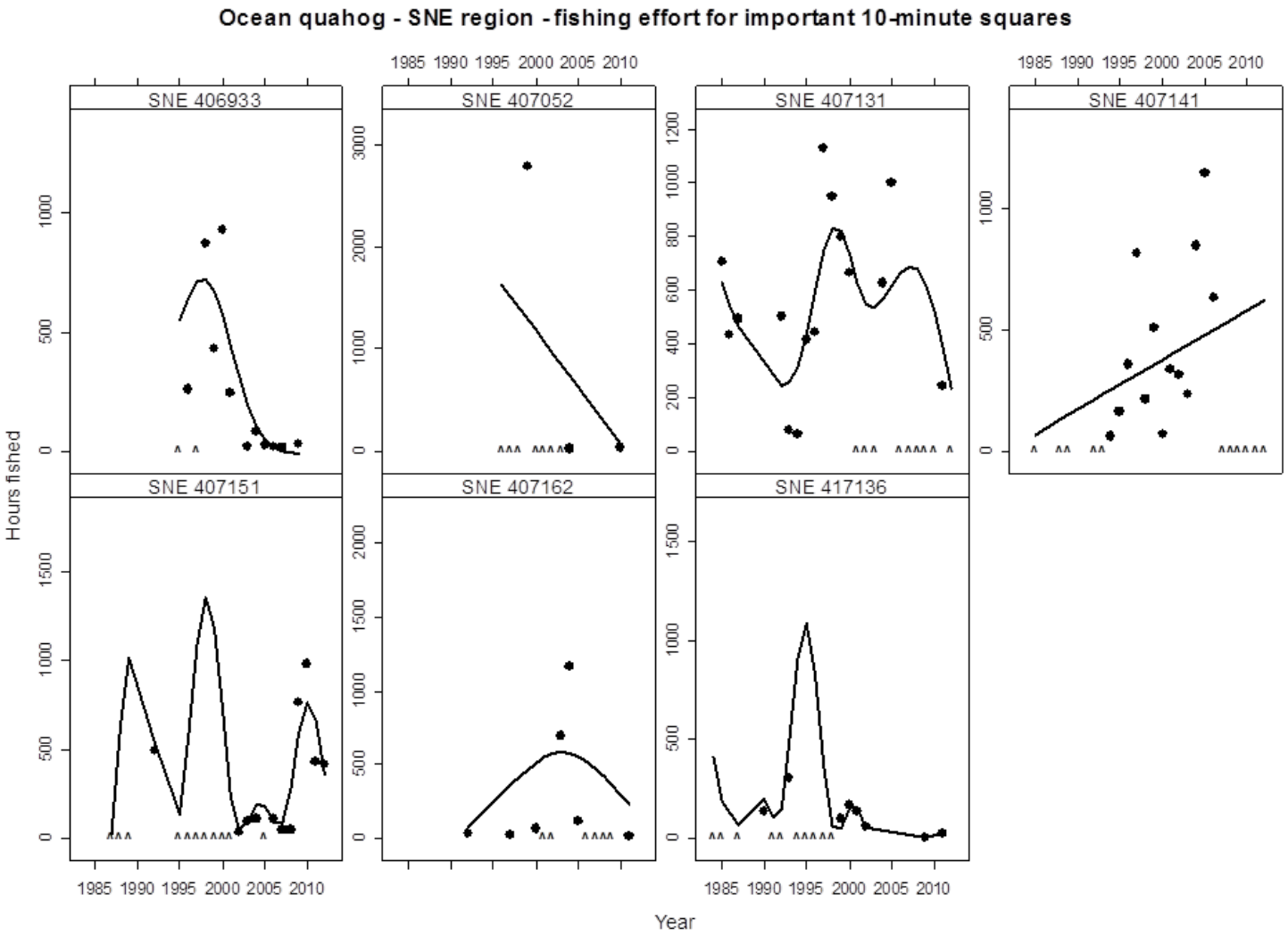


Figure 18D Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the SNE region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

Ocean quahog - SNE region - LPUE for important 10-minute squares

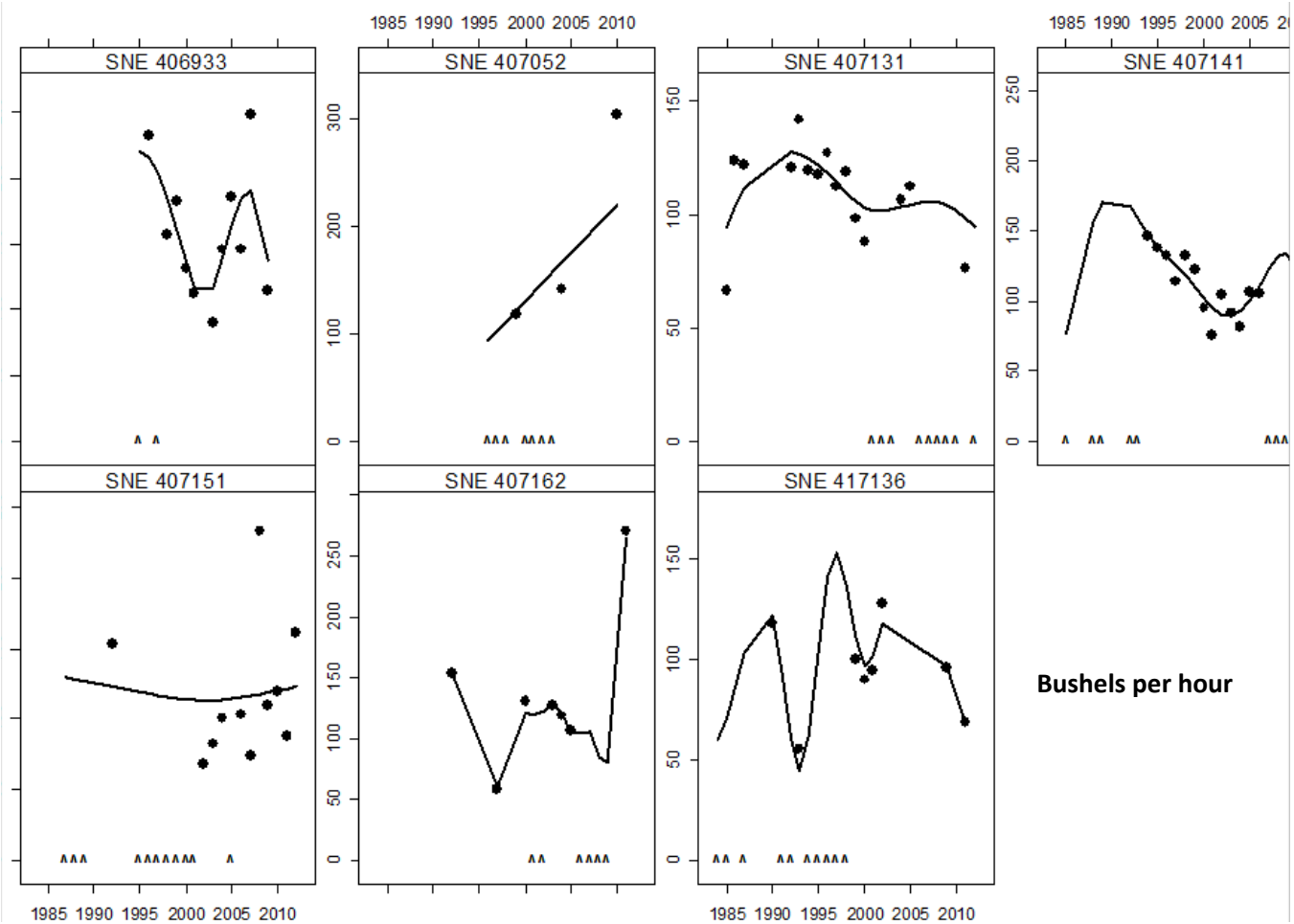


Figure 18D Cont'd. Plots of landings from important TMSQ (landings of 100,000+ bushels in one year during the time series) in the SNE region, 1980-2011. Plots are sorted N to S then E to W. The caret marks at zero represent years where less than three vessels fished in the area, so the data point is not shown. The line is a smoother to show trend, fit to all data including those not plotted.

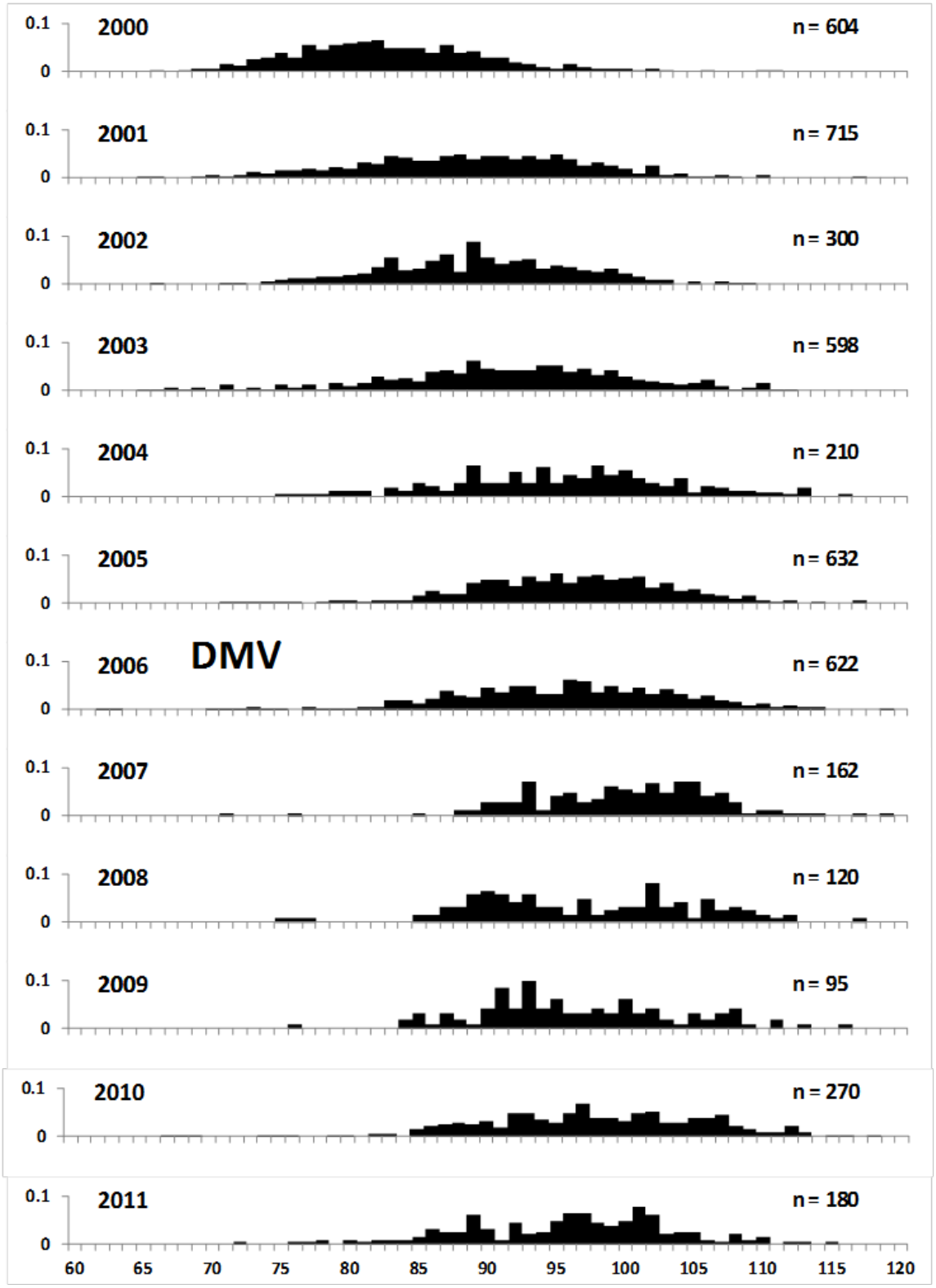


Figure 19A. Length composition of port samples by year from the Delmarva region.

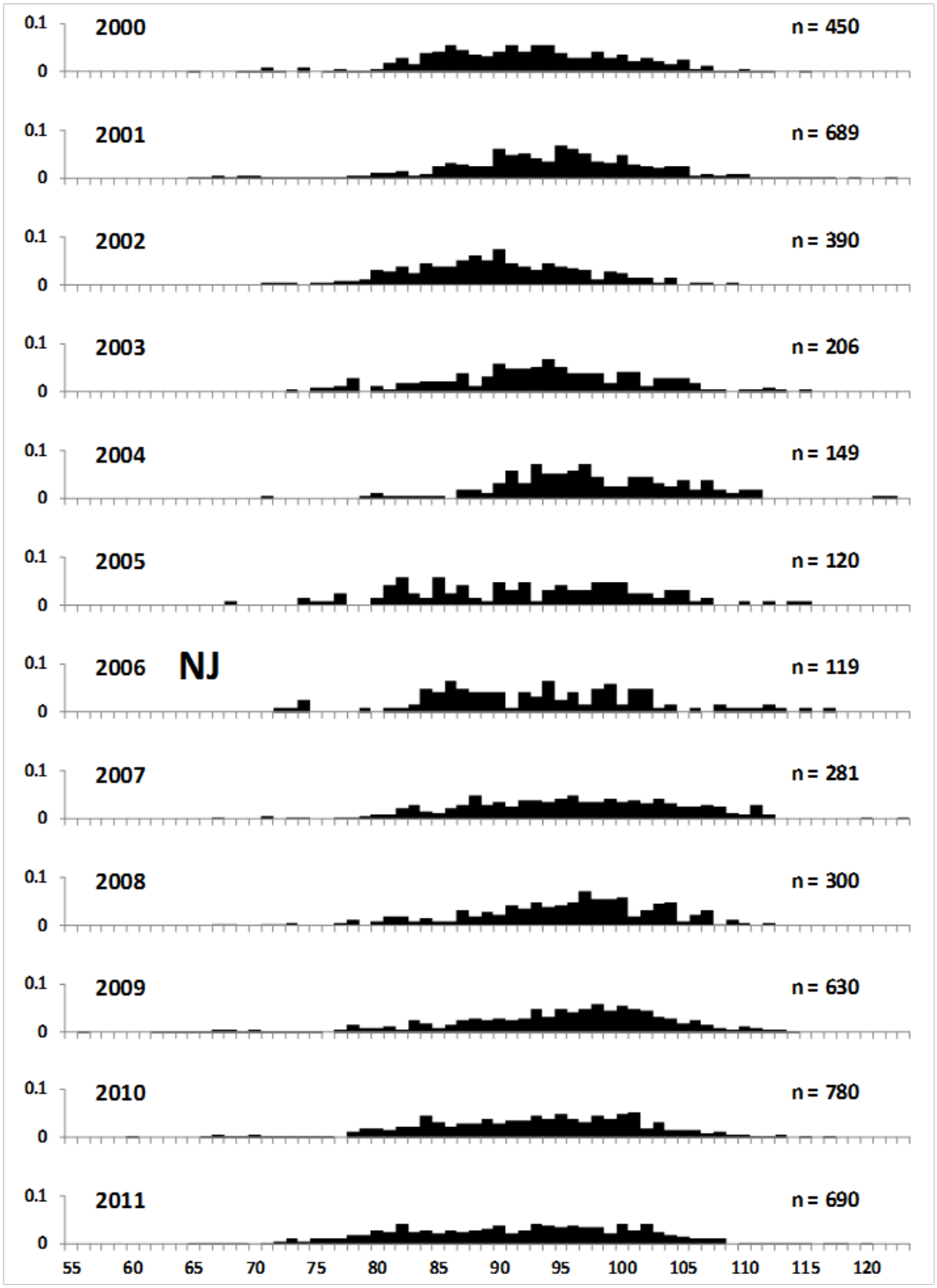


Figure 19B. Length composition of port samples by year from the New Jersey region.

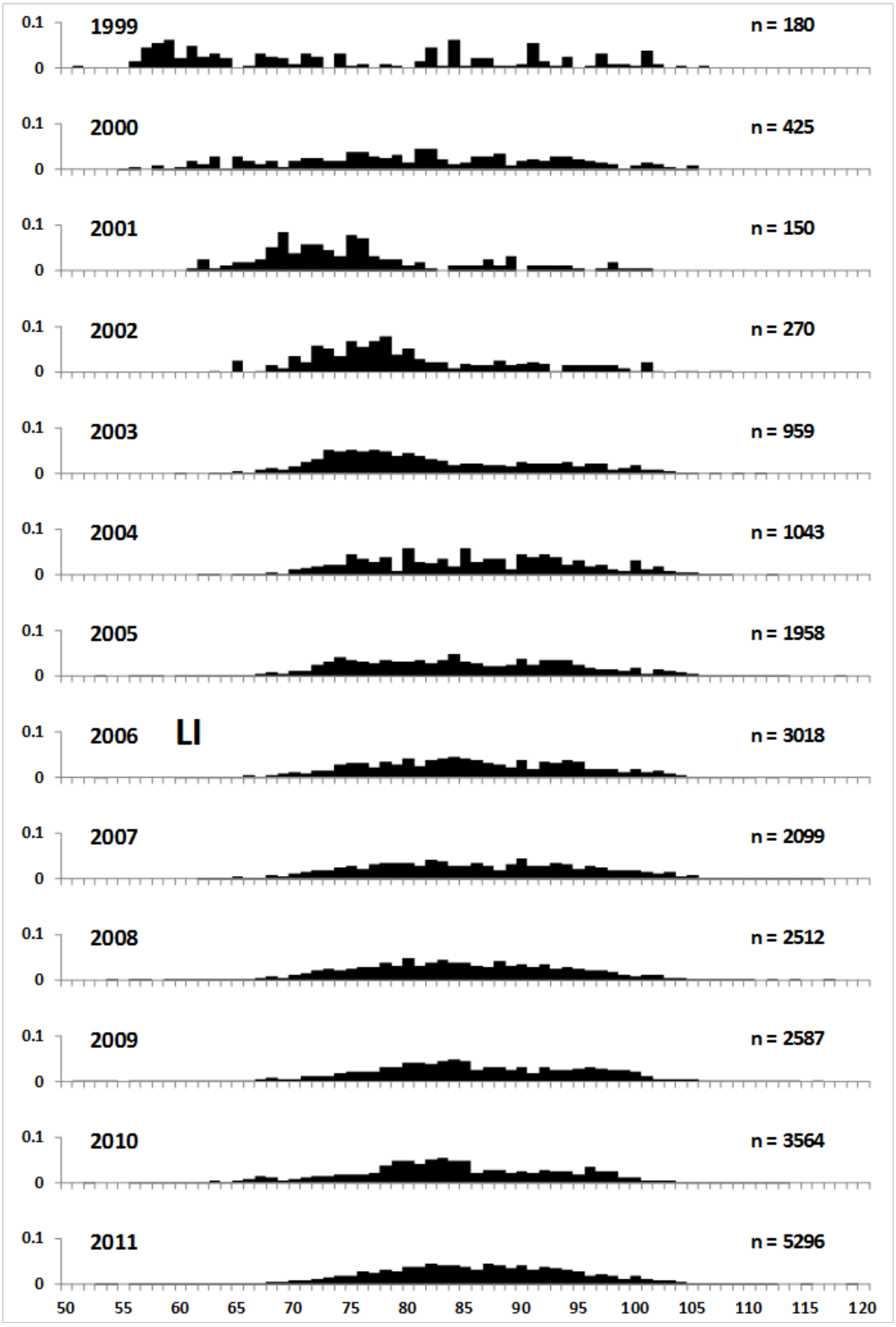


Figure 19C. Length composition of port samples by year from the Long Island region.

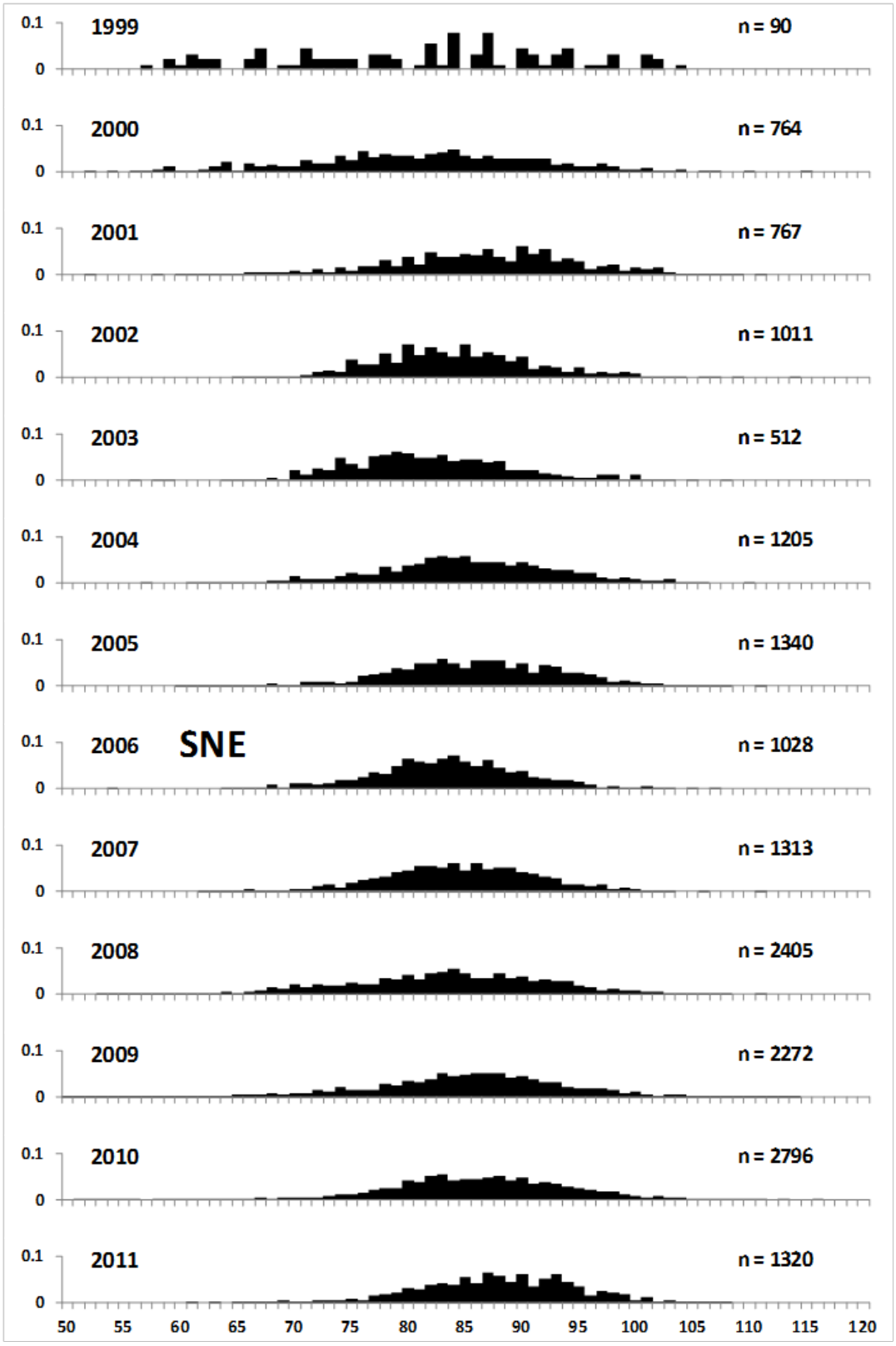


Figure 19D. Length composition of port samples by year from the southern New England region.

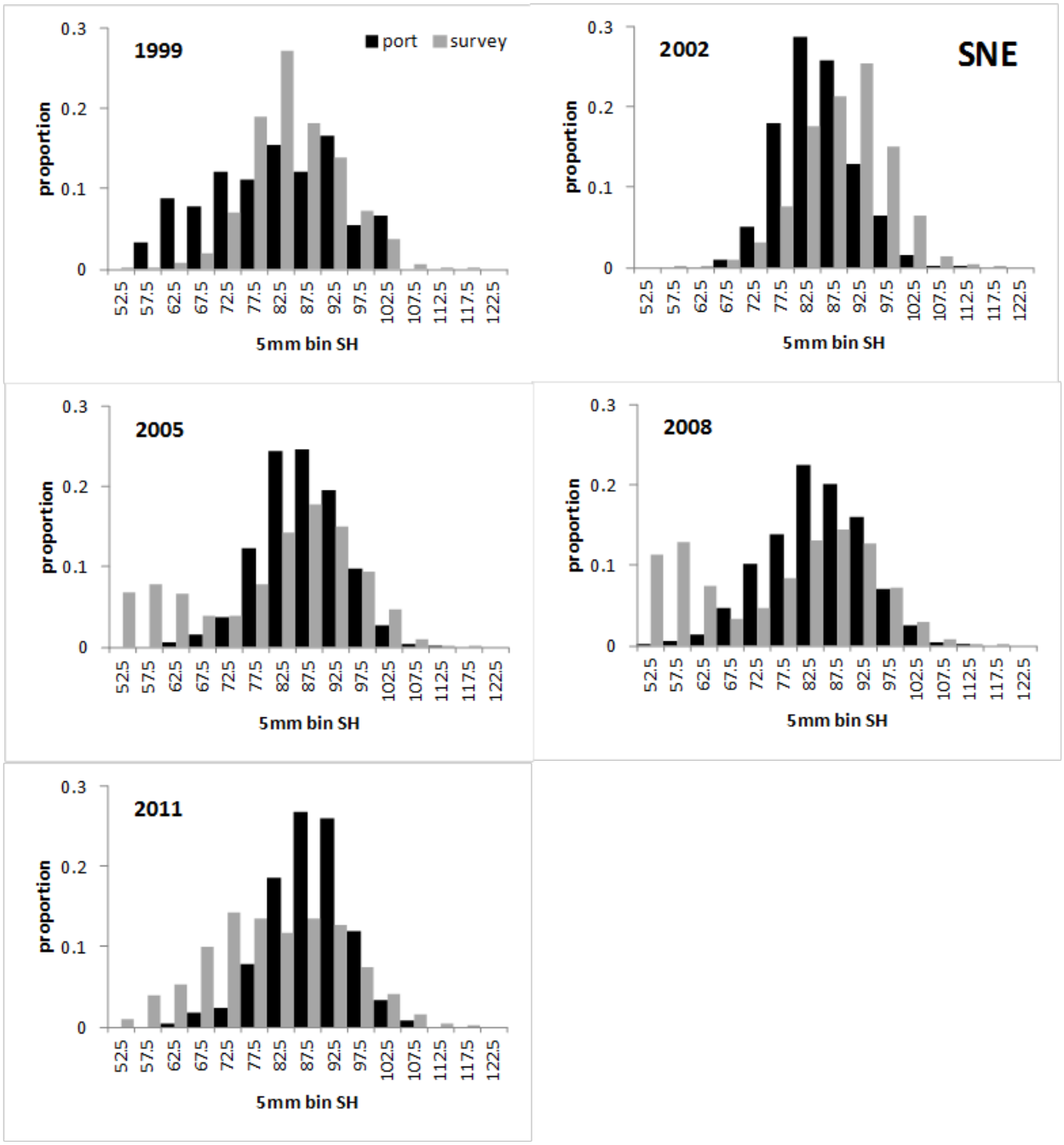


Figure 20A. Port sample length frequencies from the SNE region plotted with survey length frequencies from the same region and year.

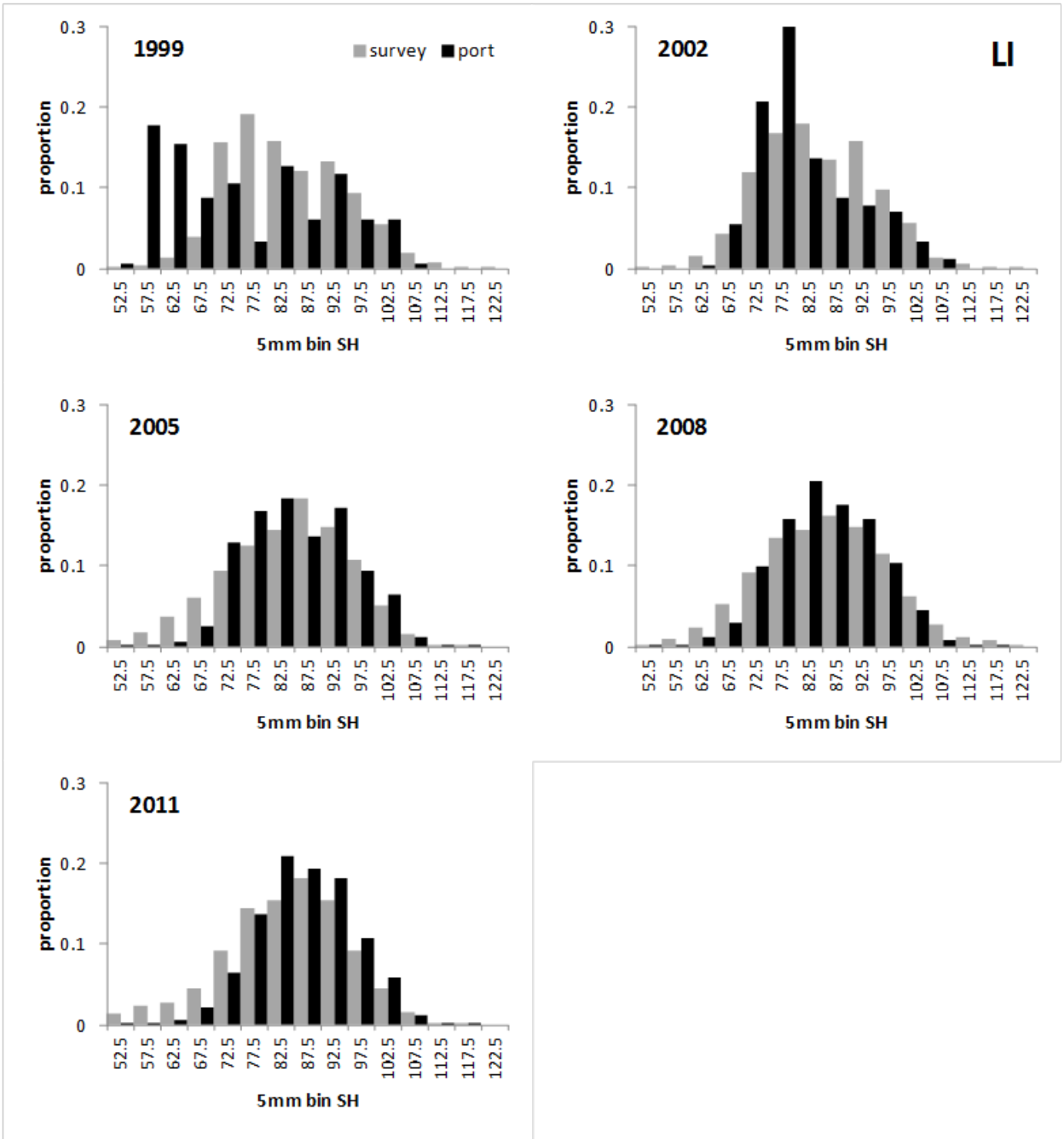


Figure 20B. Port sample length frequencies from the LI region plotted with survey length frequencies from the same region and year.

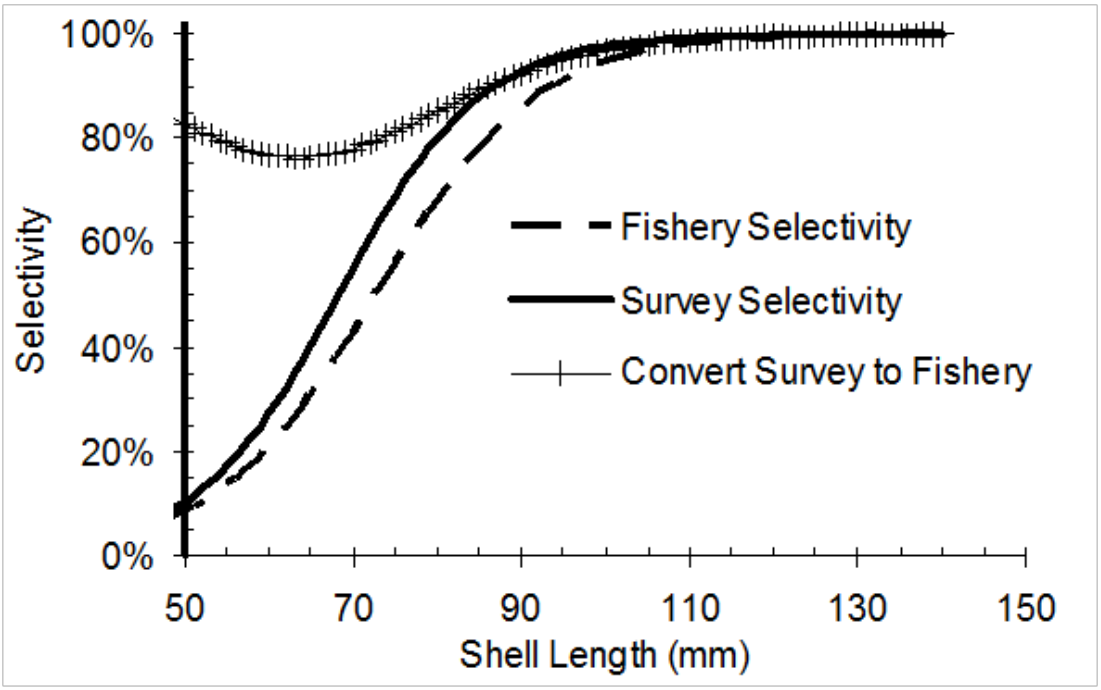


Figure 21. Fishery and survey selectivity curves for ocean quahog from NEFSC (2007a). The ratio of the fishery and survey selectivity curves, which can be used to convert survey abundance at size directly to fishable abundance at size, is also shown.

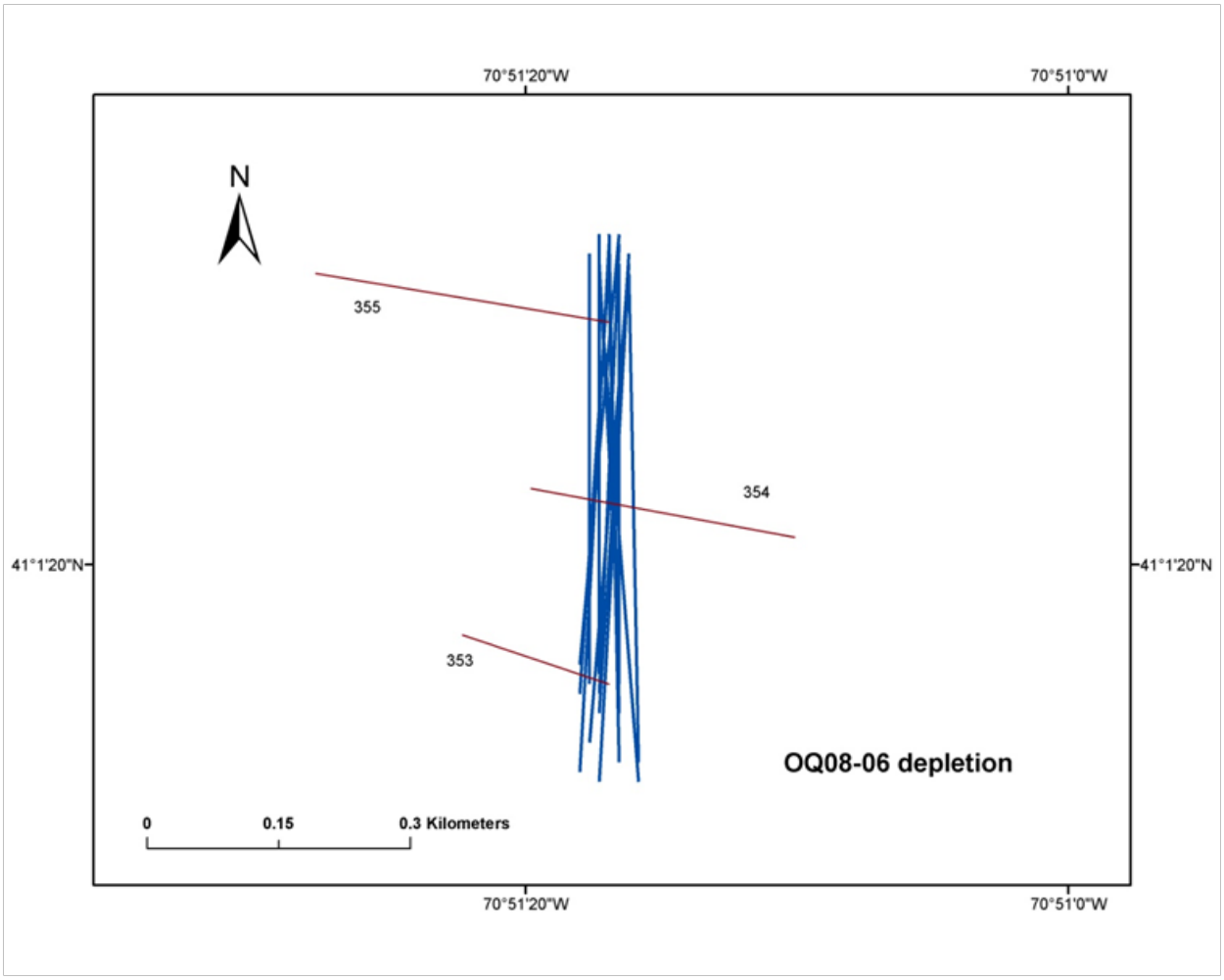


Figure 22. Map of an ocean quahog depletion experiment site from 2008. The start and stop locations are correct, but the tow paths were not straight lines. The map was made to look at the relationship of the setup tows (red lines) to the depletion tows (blue lines).

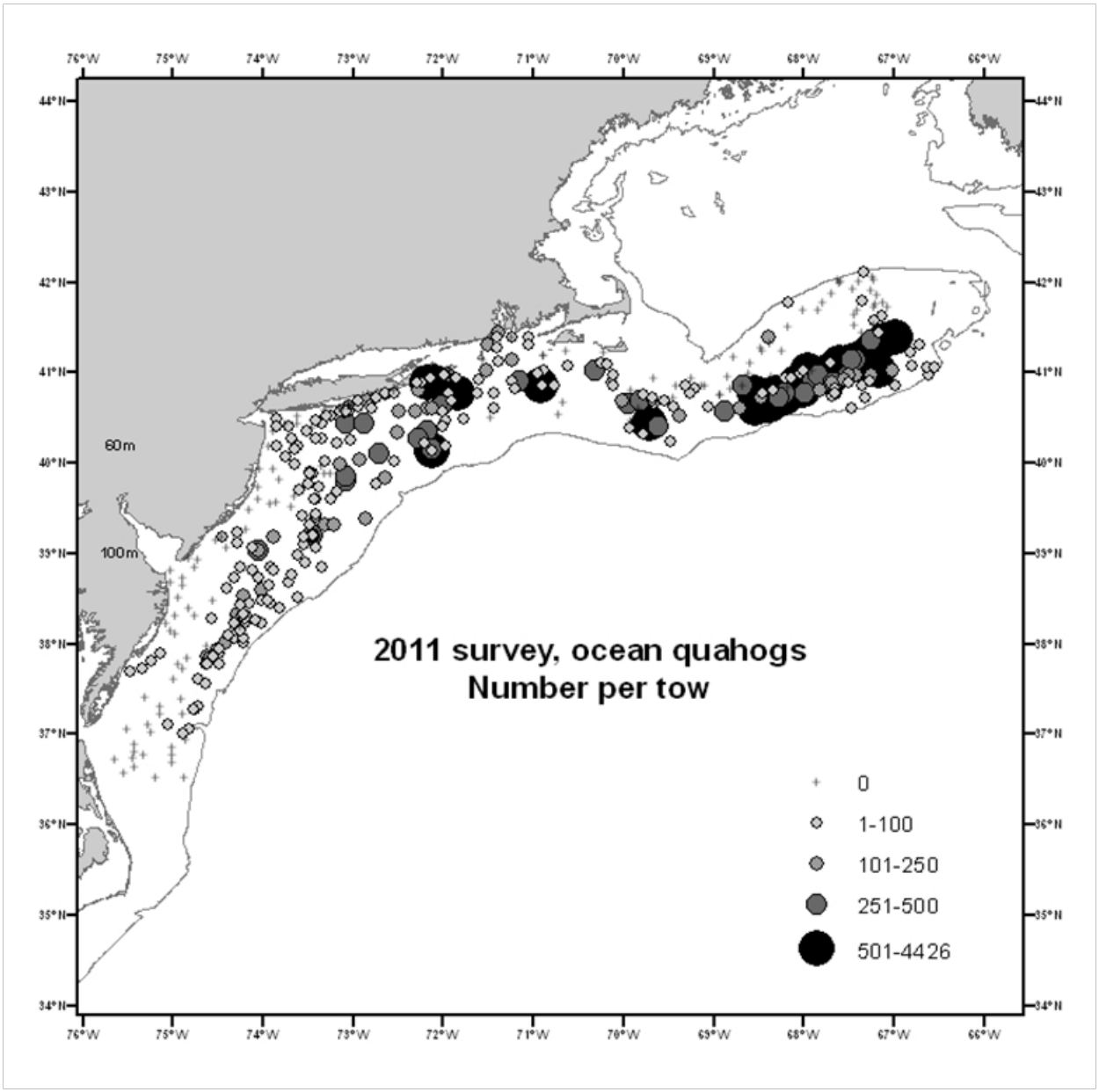


Figure 23. The number of ocean quahogs caught at each 2011 survey station. The small crosses are stations where no ocean quahogs were caught.

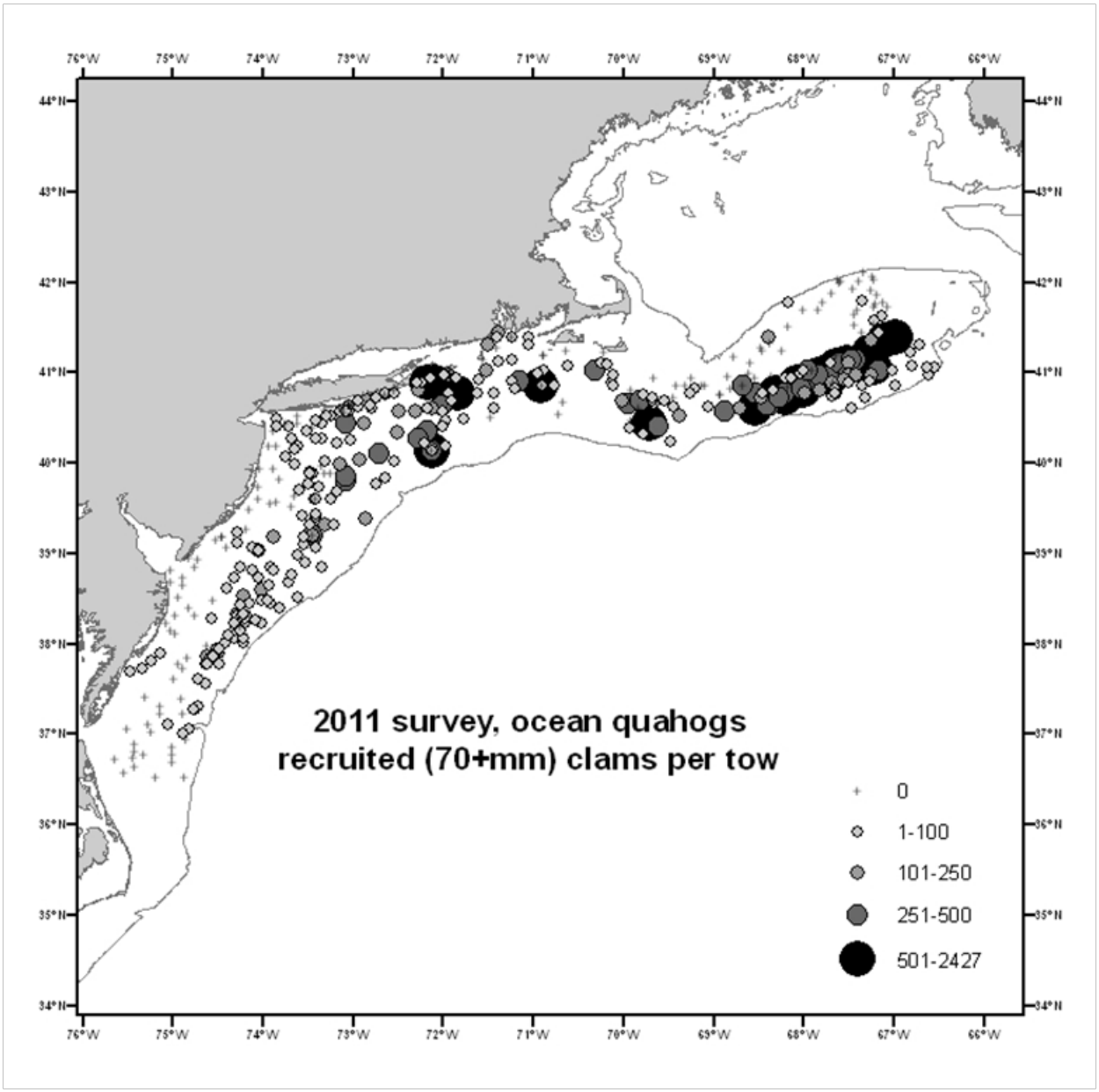


Figure 24. The number of ocean quahogs at least 70mm in shell length caught at each 2011 survey station. The small crosses are stations where no ocean quahogs larger than 69mm were caught.

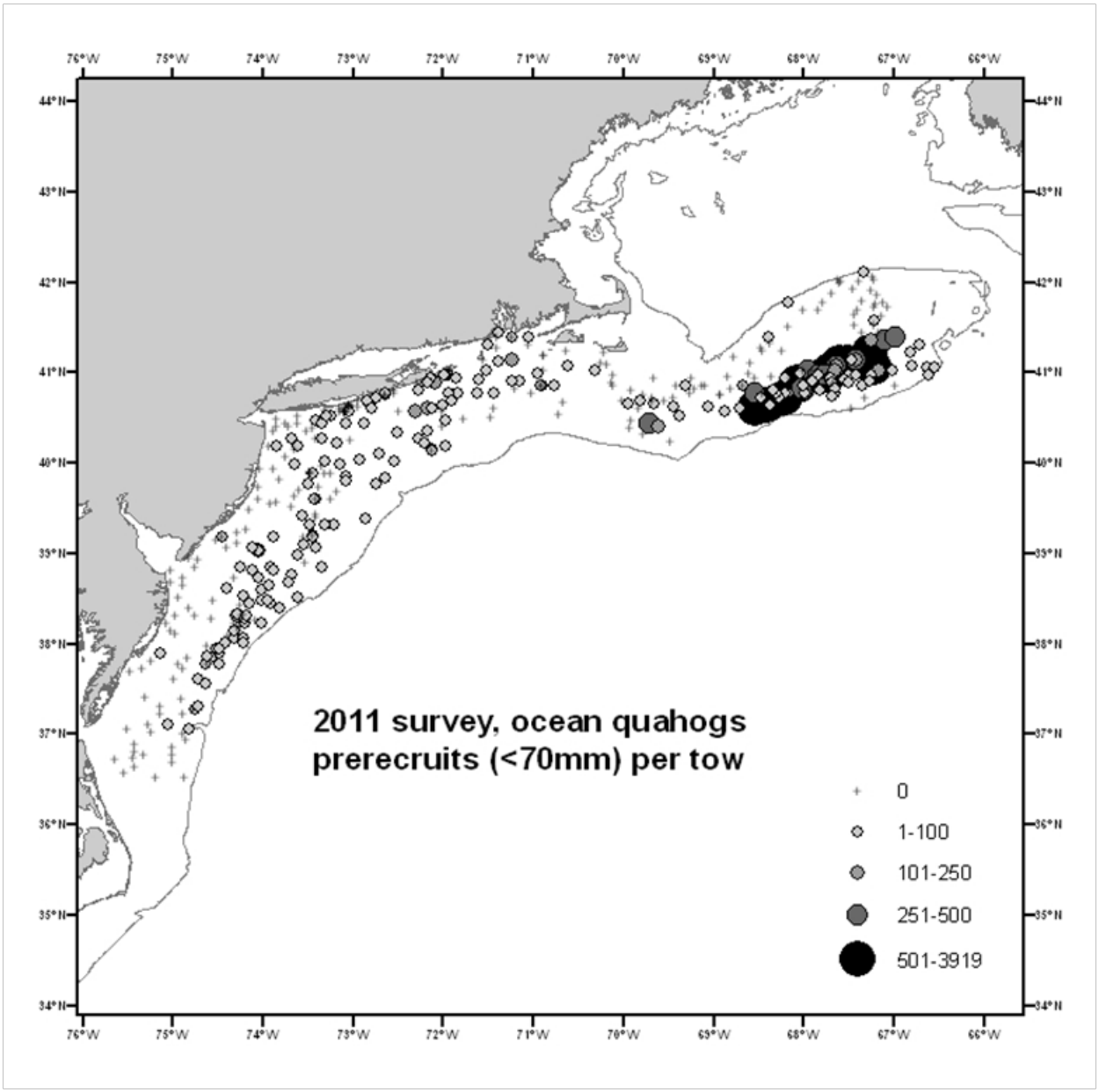


Figure 25. The number of ocean quahogs less than 70mm in shell length caught at each 2011 survey station. The small crosses are stations where no ocean quahogs less than 70mm were caught.

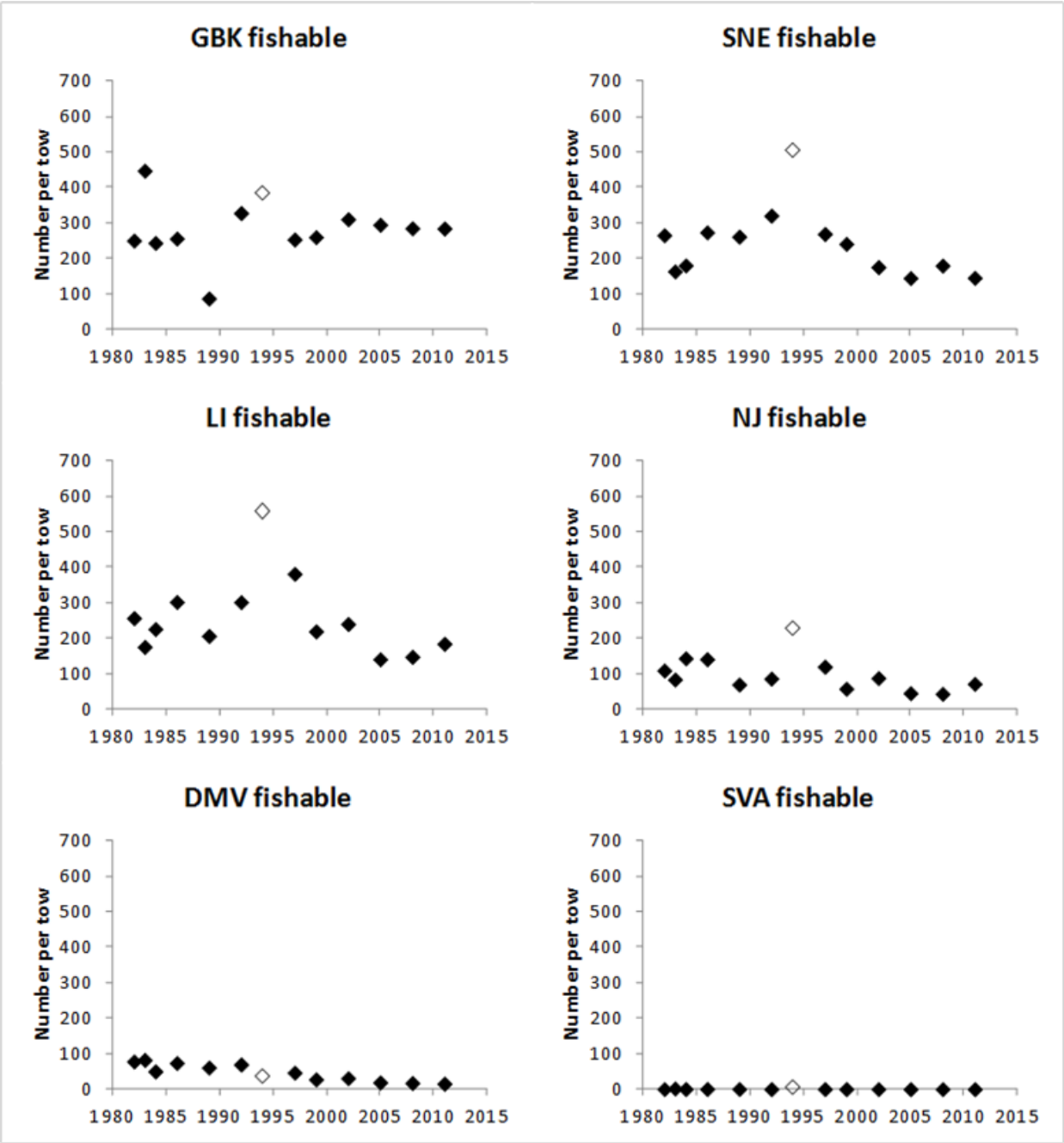


Figure 26. Number per tow of ocean quahogs that would be available to the fishery (number per tow X fishery selectivity curve) from the NEFSC clam survey. The 1994 survey, when increased voltage to the dredge resulted in more than standard fishing power, is indicated by the open diamond.

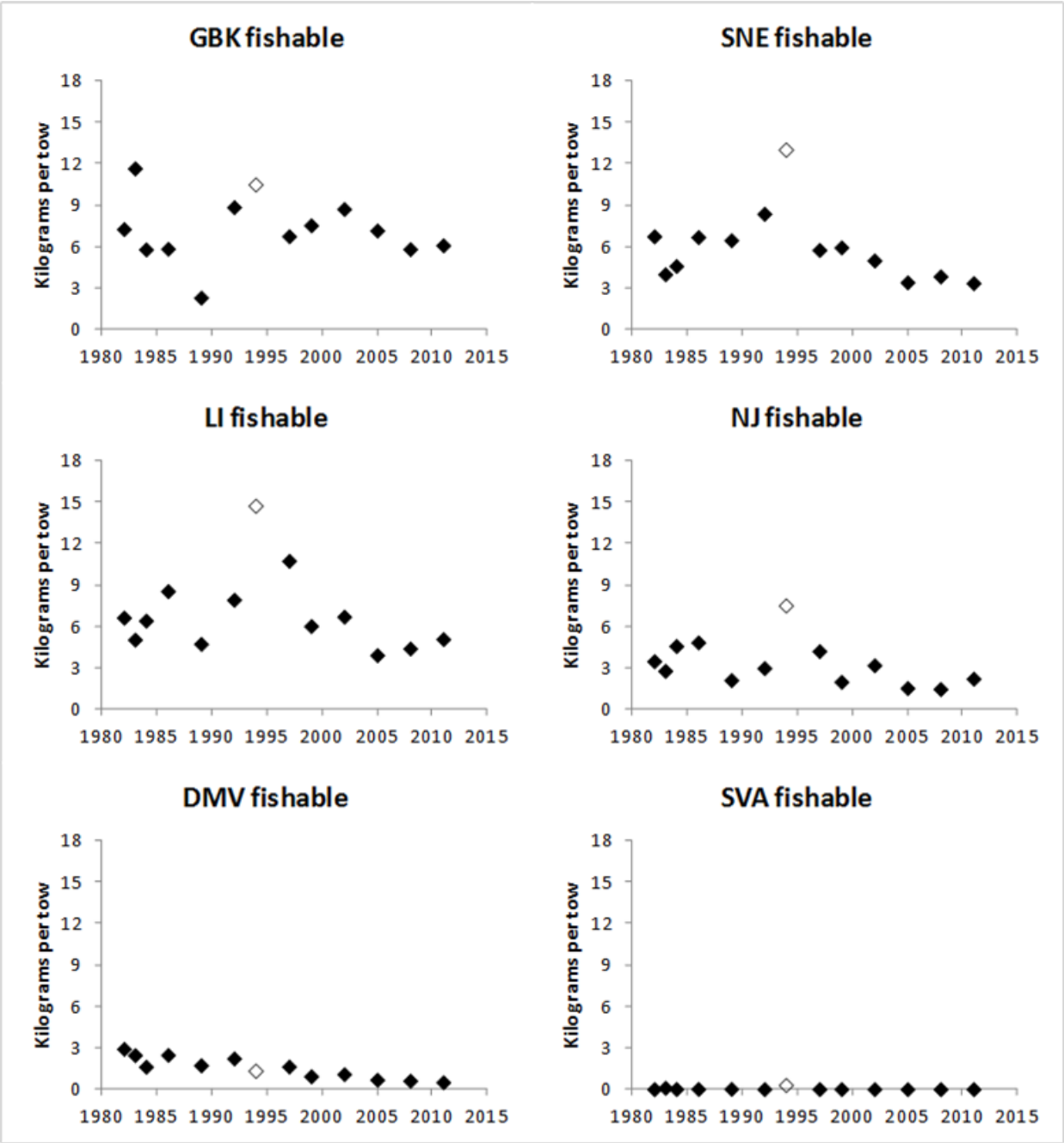


Figure 27. Kilograms per tow of ocean quahogs that would be available to the fishery (number per tow X fishery selectivity curve) from the NEFSC clam survey. The 1994 survey, when increased voltage to the dredge resulted in more than standard fishing power, is indicated by the open diamond.

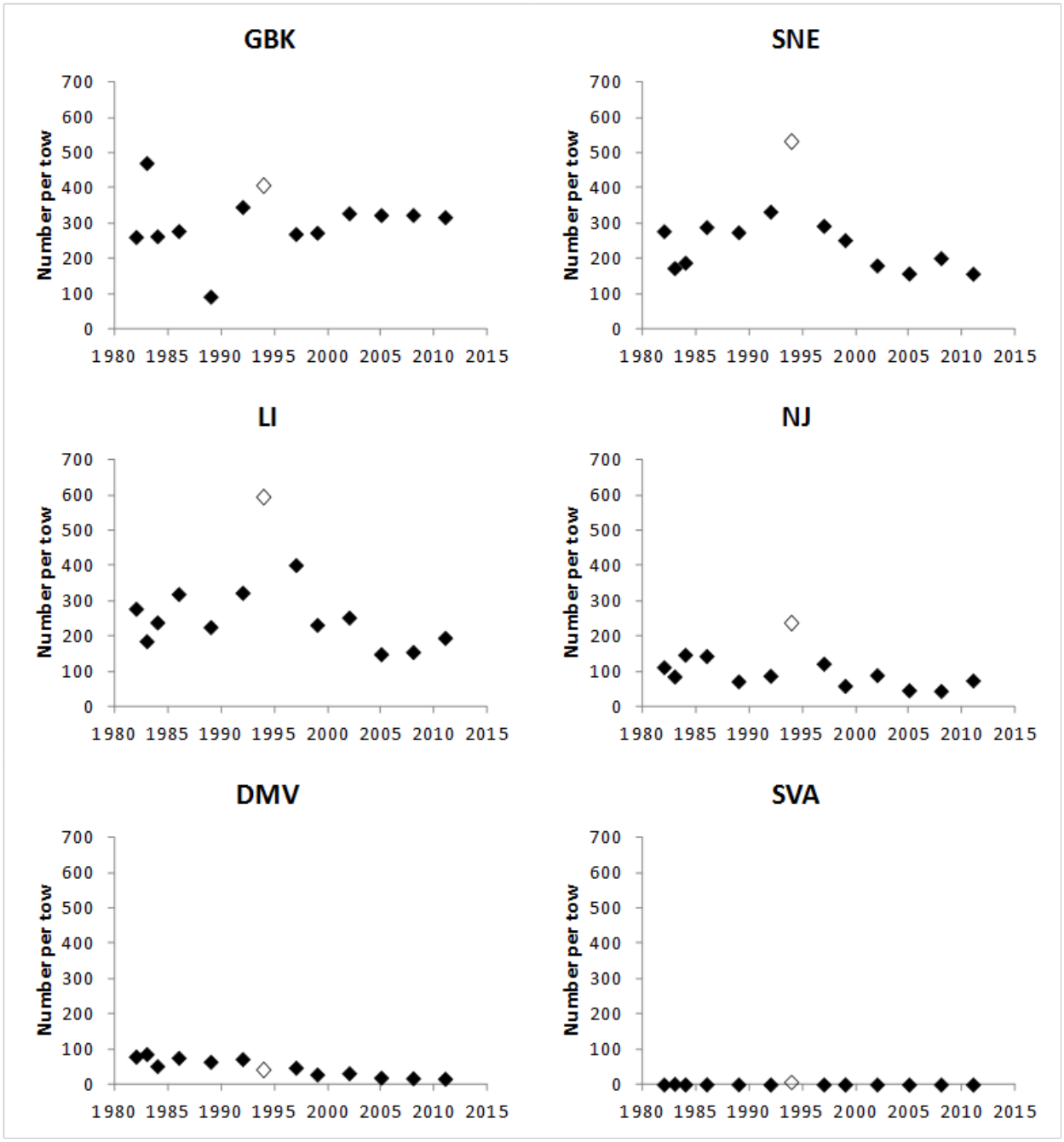


Figure 28. Number per tow of ocean quahogs greater than 50 mm SL from the NEFSC clam survey by region. The 1994 survey, when increased voltage to the dredge resulted in more than standard fishing power, is indicated by the open diamond.

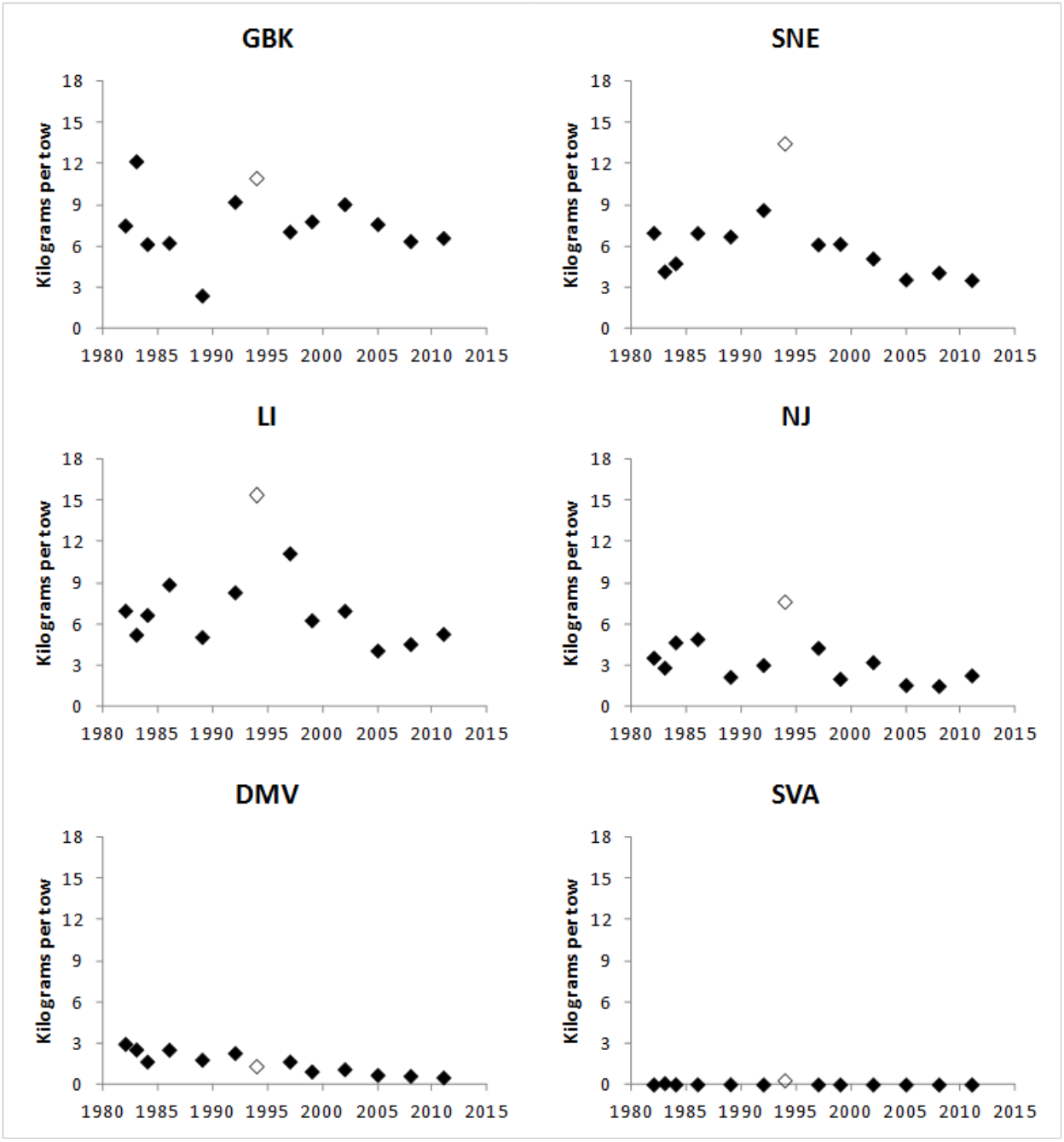


Figure 29. Kilograms per tow of ocean quahogs greater than 50 mm SL from the NEFSC clam survey by region. The 1994 survey, when increased voltage to the dredge resulted in more than standard fishing power, is indicated by the open diamond.

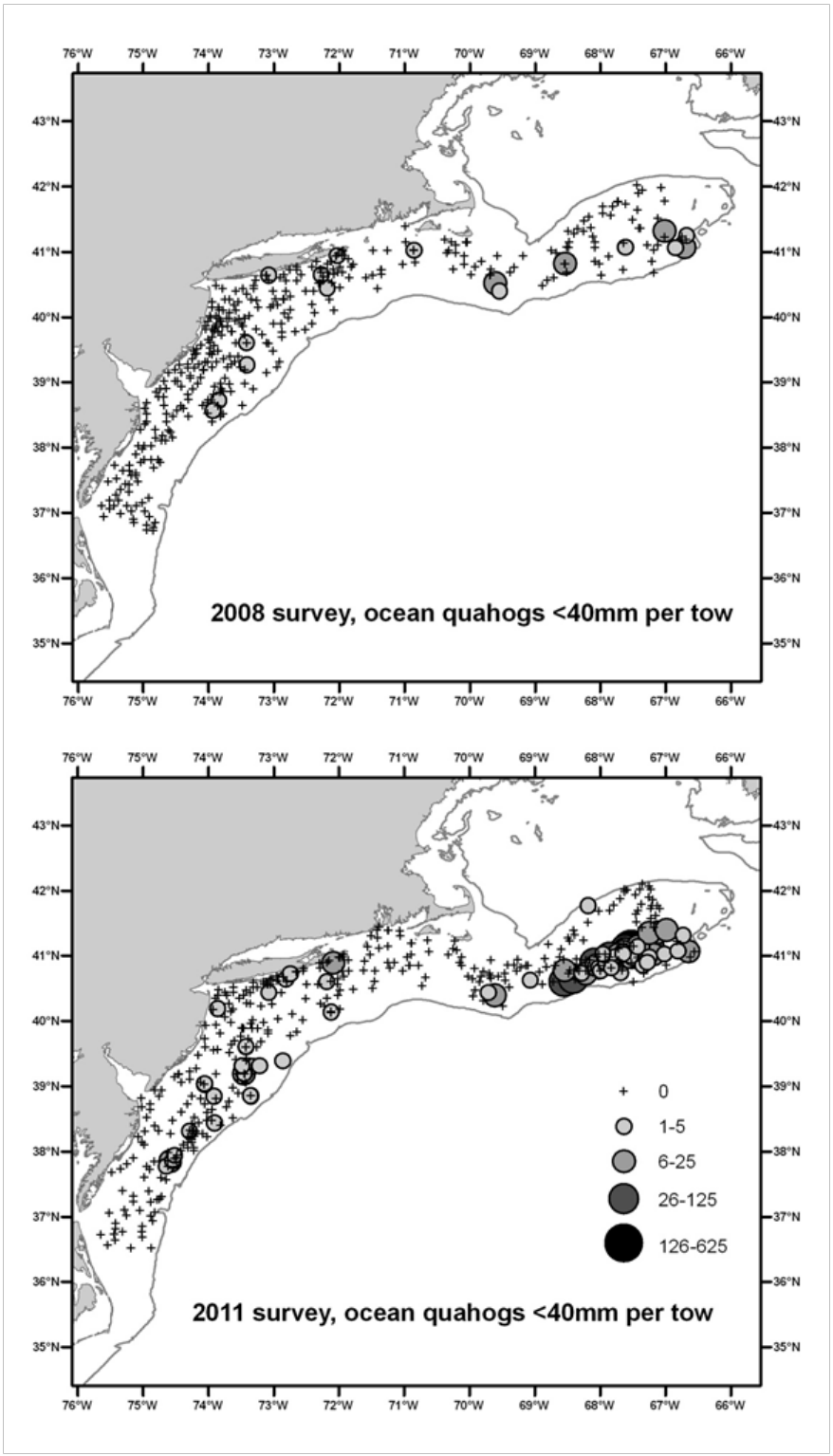


Figure 30. Survey catches of ocean quahogs less than 40mm SL from the 2008 survey (top) and the 2011 survey (bottom), illustrating a recruitment event on GBK where the ocean quahogs are growing large enough to be selected by the survey dredge.

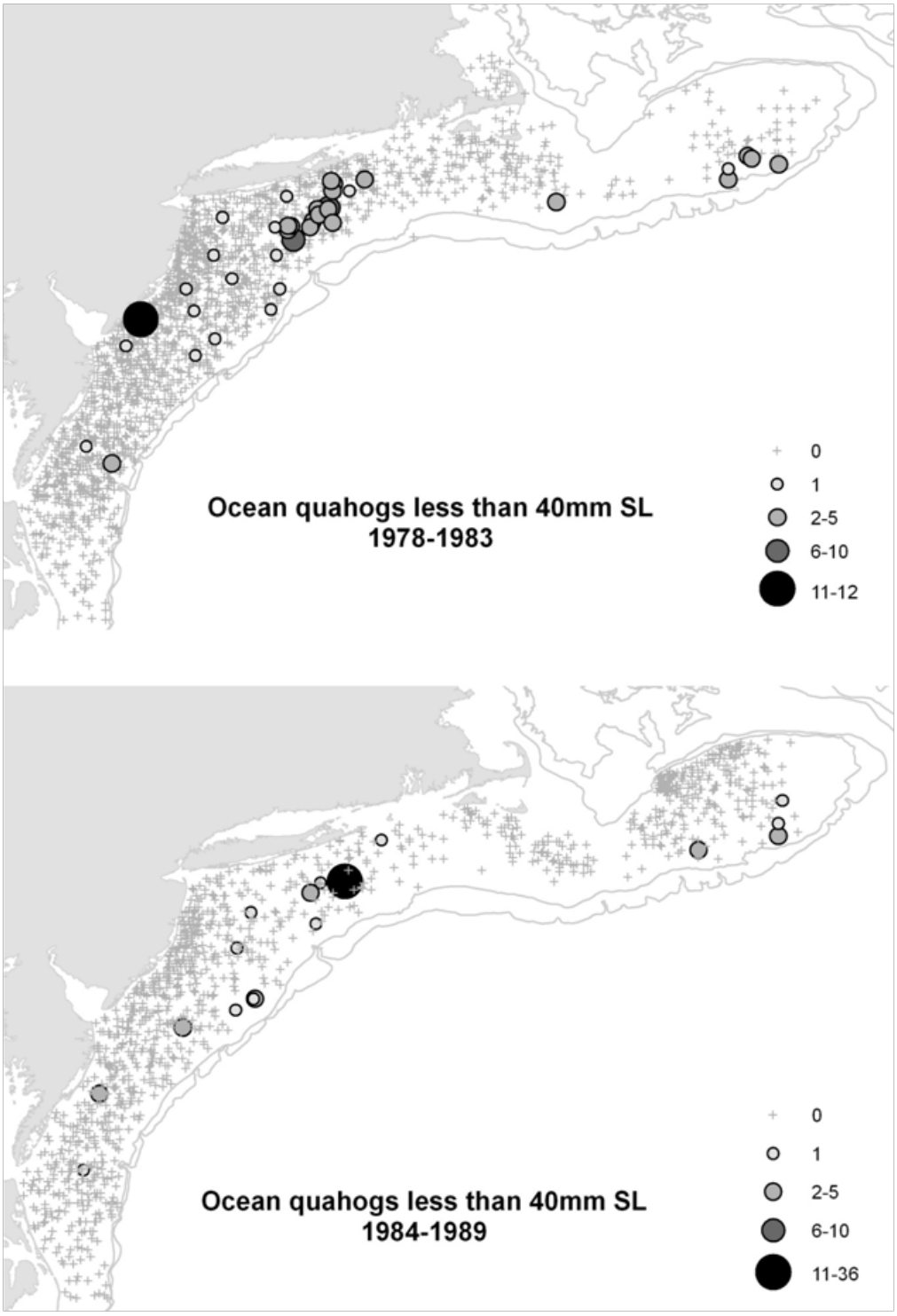


Figure 31A. Number per tow of ocean quahogs less than 40mm shell length from all surveys from 1978 to 1983 combined (top) and from all surveys 1984 to 1989 combined (bottom).

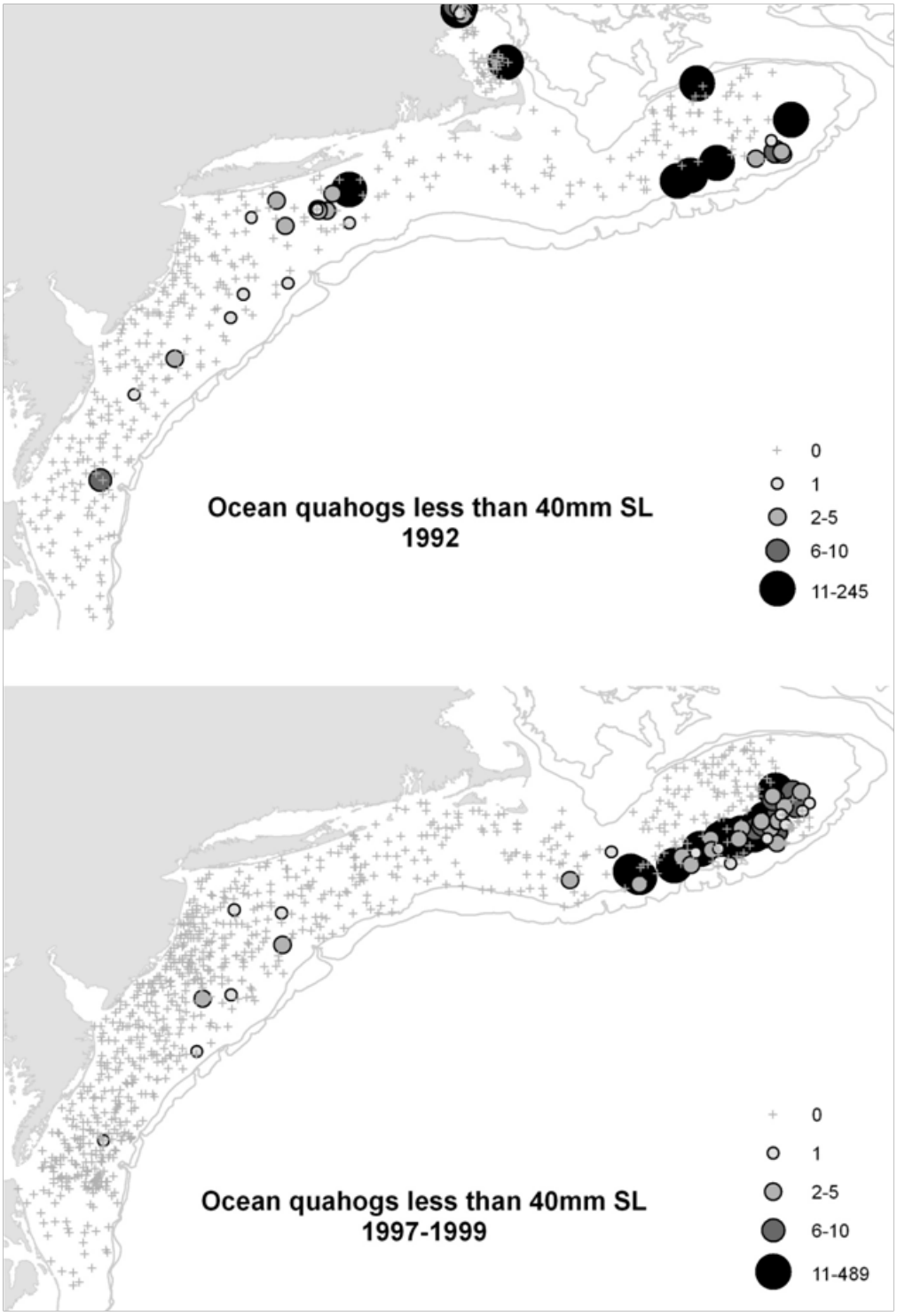


Figure 31B. Number per tow of ocean quahogs less than 40mm shell length from the 1992 survey (top) and from the 1997 and 1999 surveys combined (bottom).

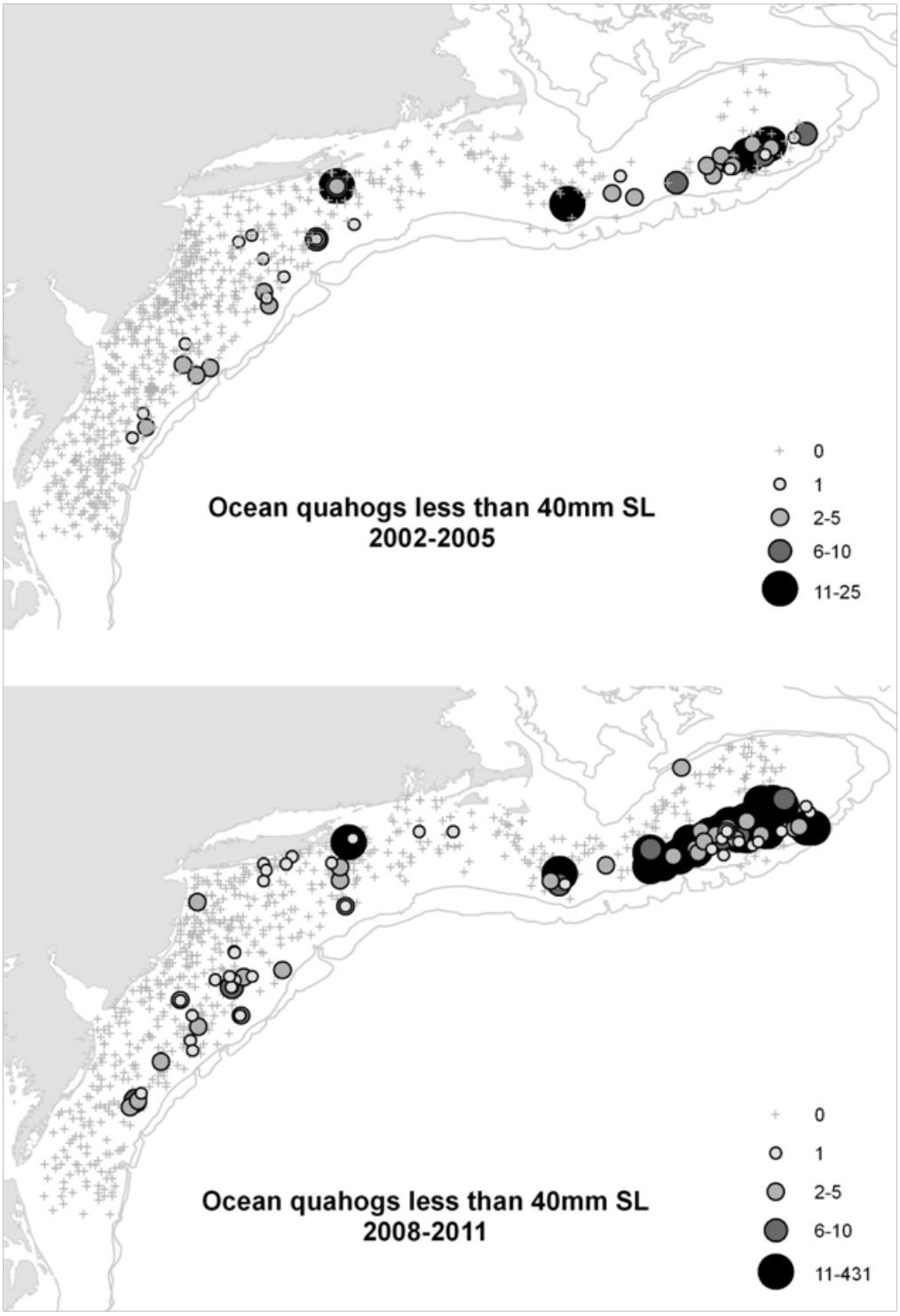


Figure 31C. Number per tow of ocean quahogs less than 40mm shell length from the 2002 and 2005 surveys combined (top) and from the 2008 and 2011 surveys combined (bottom).

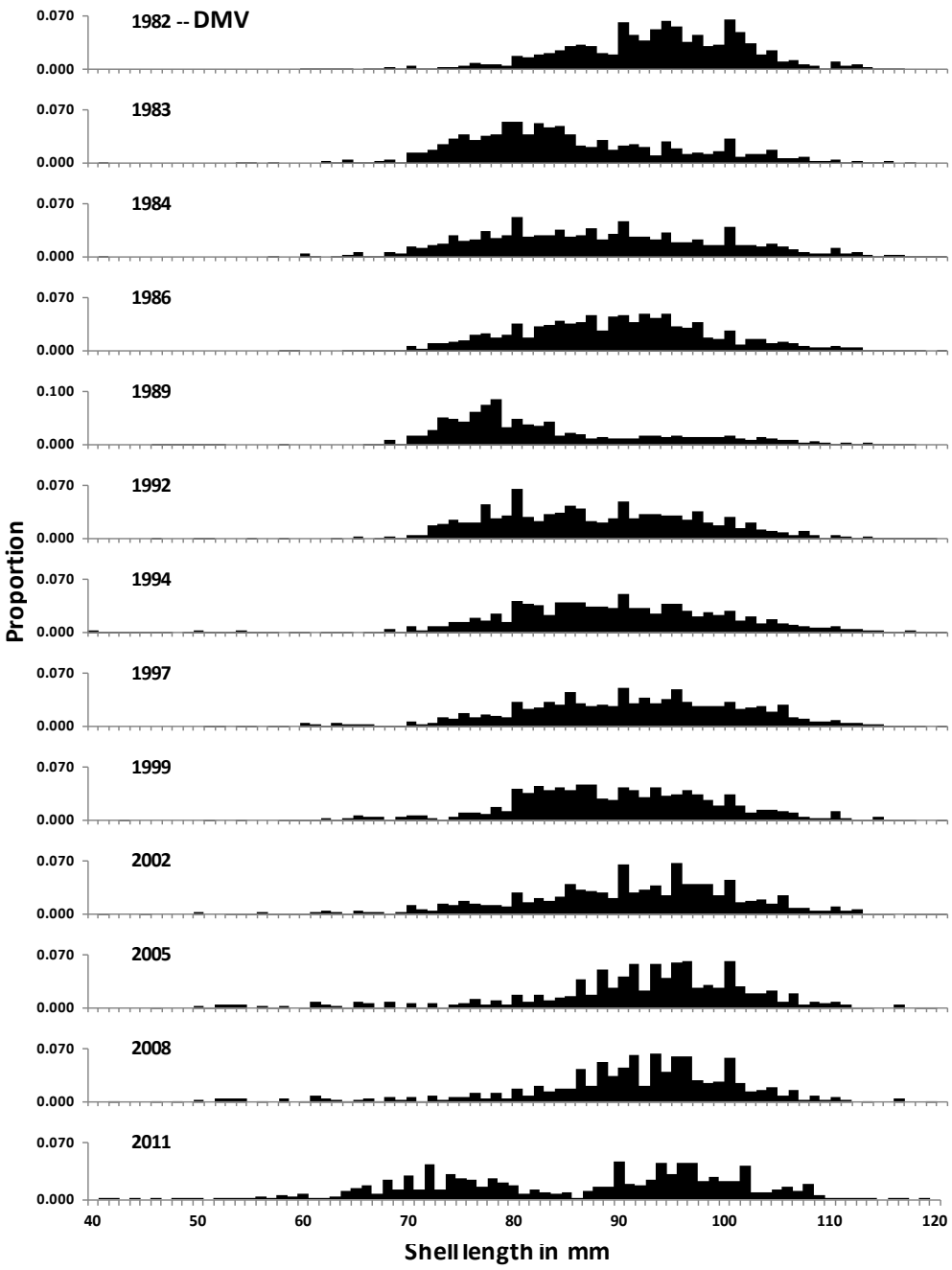


Figure 32A. Survey length frequencies for the DMV region. Mean proportion per tow (vertical axis) by shell length class (horizontal axis).

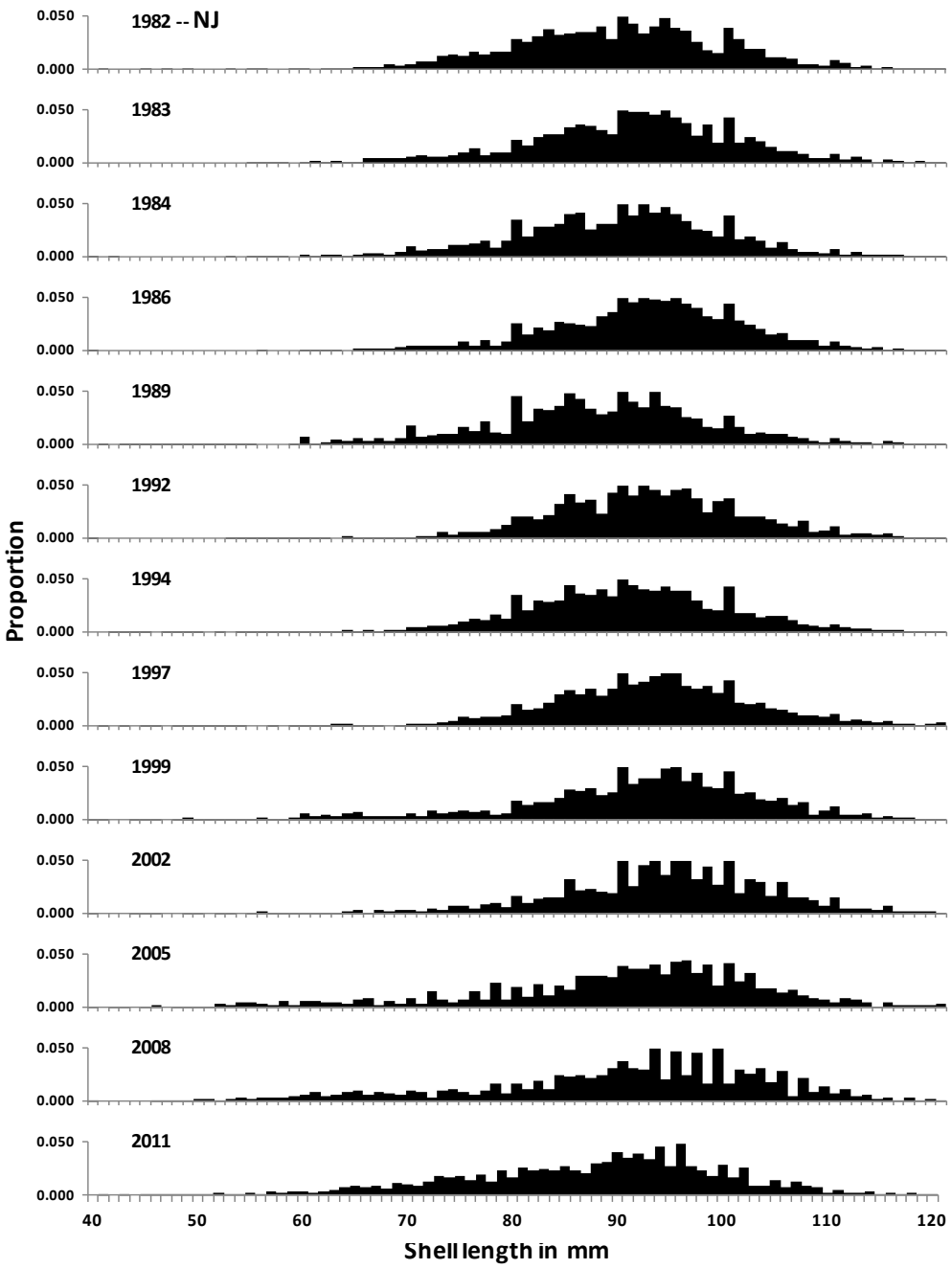


Figure 32B. Survey length frequencies for the NJ region. Mean proportion per tow by shell length class.

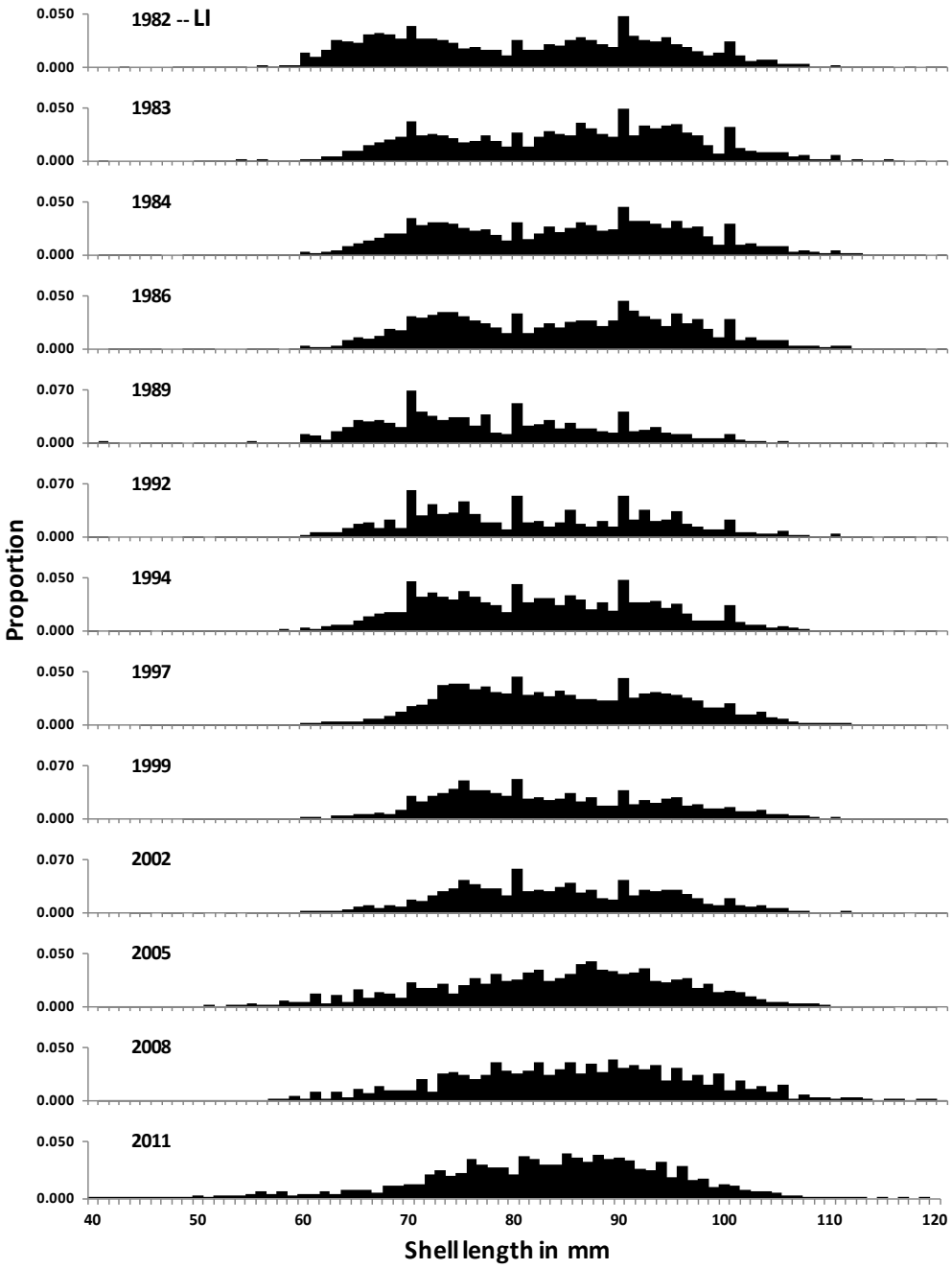


Figure 32C. Survey length frequencies for the LI region. Mean proportion per tow by shell length class.

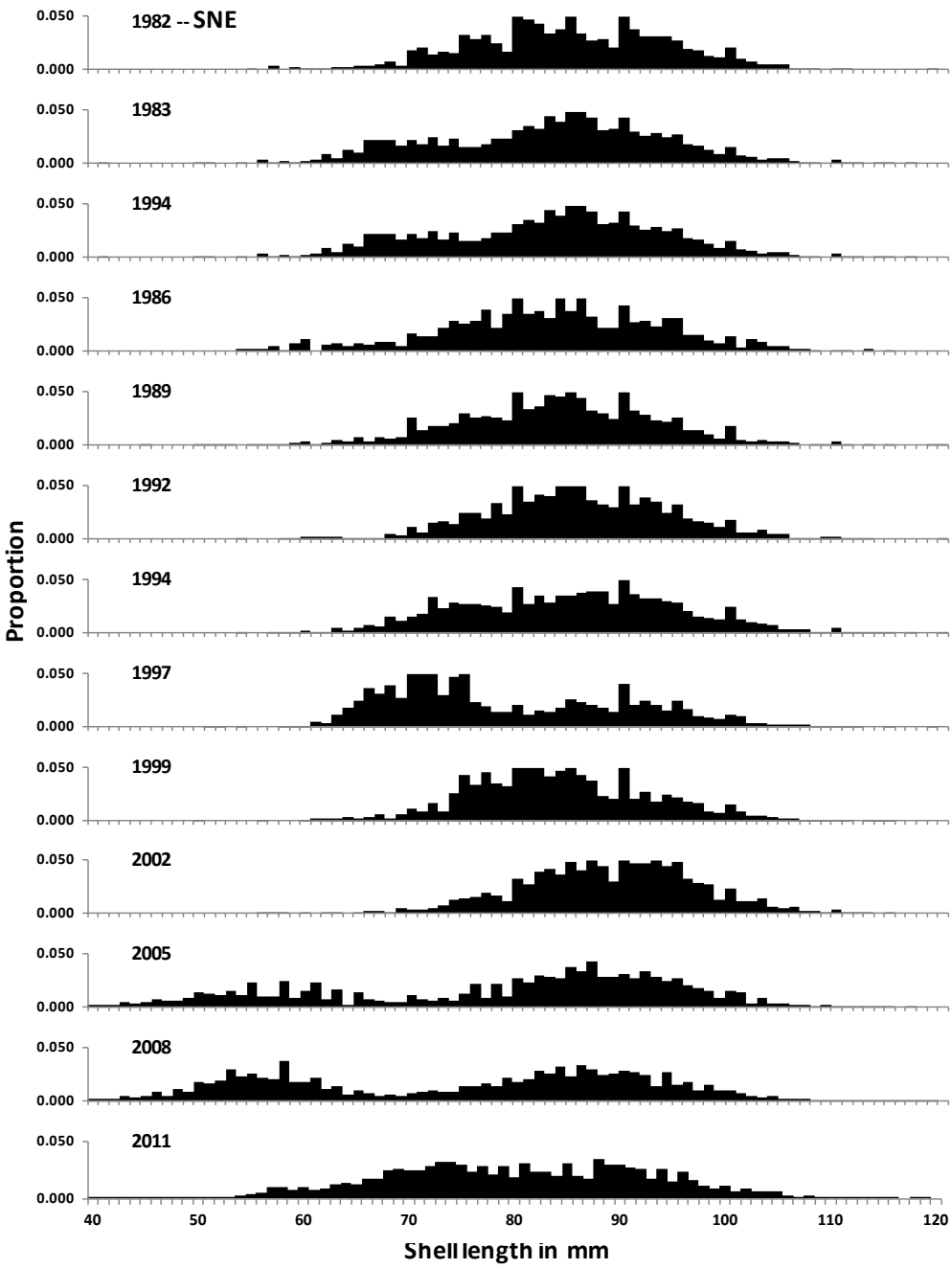


Figure 32D. Survey length frequencies for the SNE region. Mean proportion per tow by shell length class.

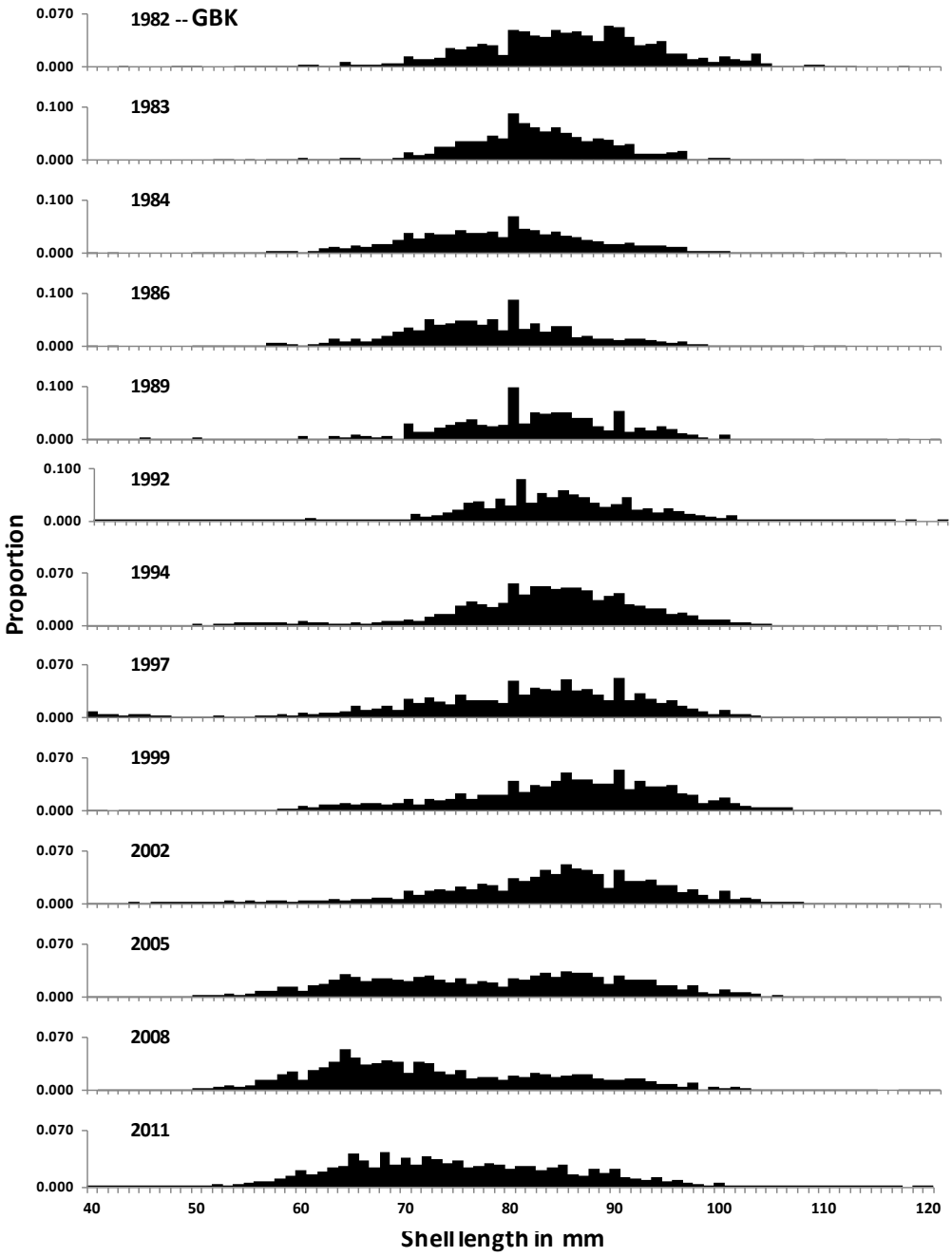


Figure 32E. Survey length frequencies for the GBK region. Mean proportion per tow by shell length class.

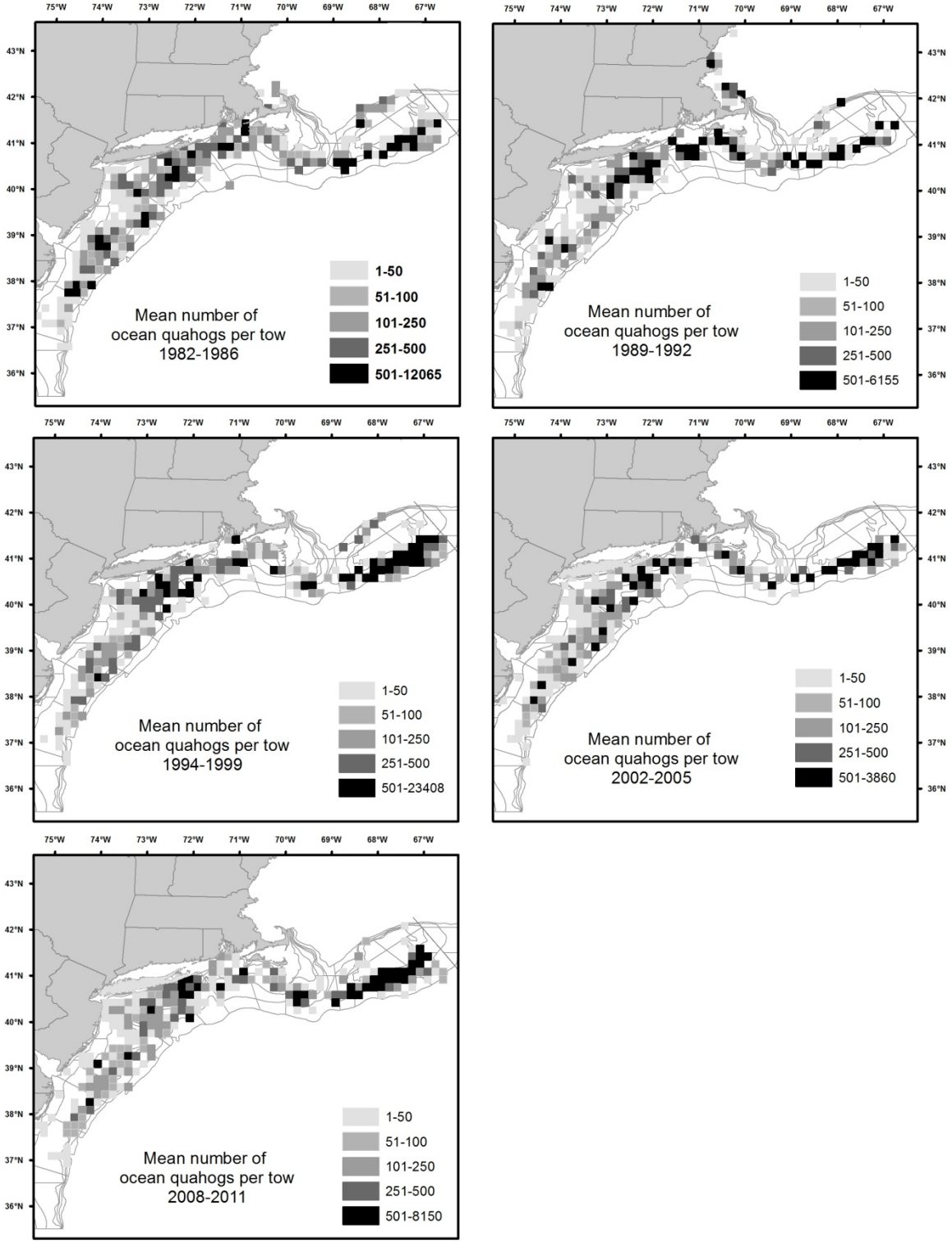


Figure 33. Mean number of ocean quahogs of all sizes caught per survey tow in any given TMSQ during the time period.

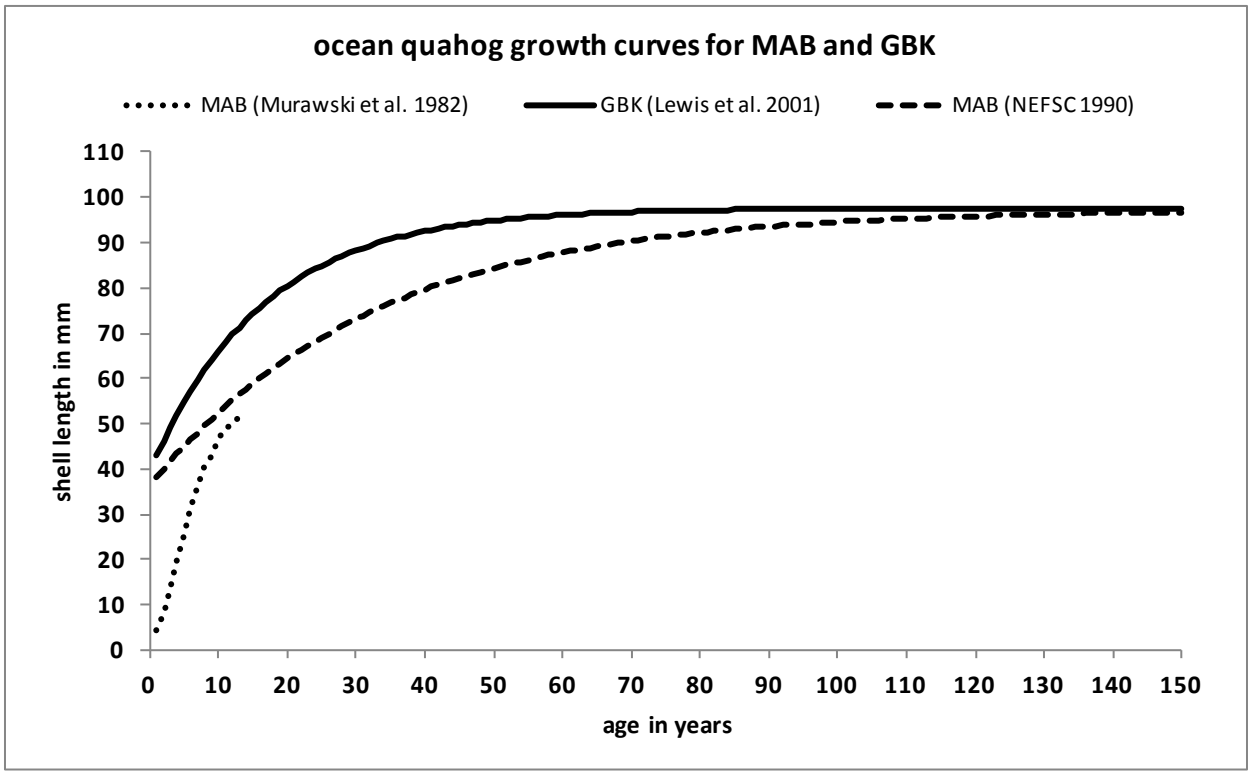


Figure 34. Growth curves (size at age) used in the KLAMZ model for ocean quahogs from the MAB (dashed line), and GBK (solid line). The dotted line is for small ocean quahogs from the MAB and is not used in the model, but may be a more realistic depiction of size of the youngest ocean quahogs.

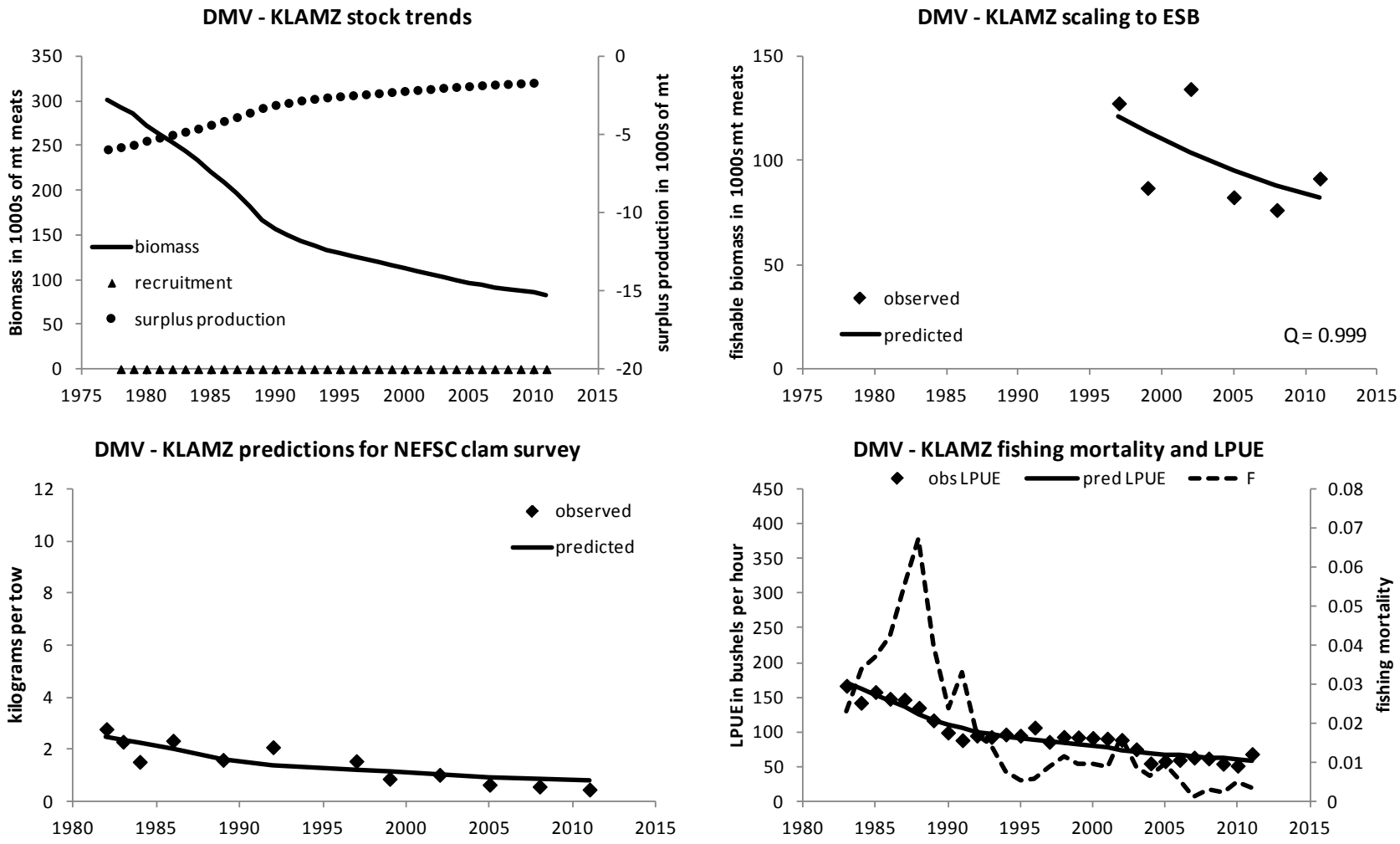


Figure 35. KLAMZ model results for the DMV region.

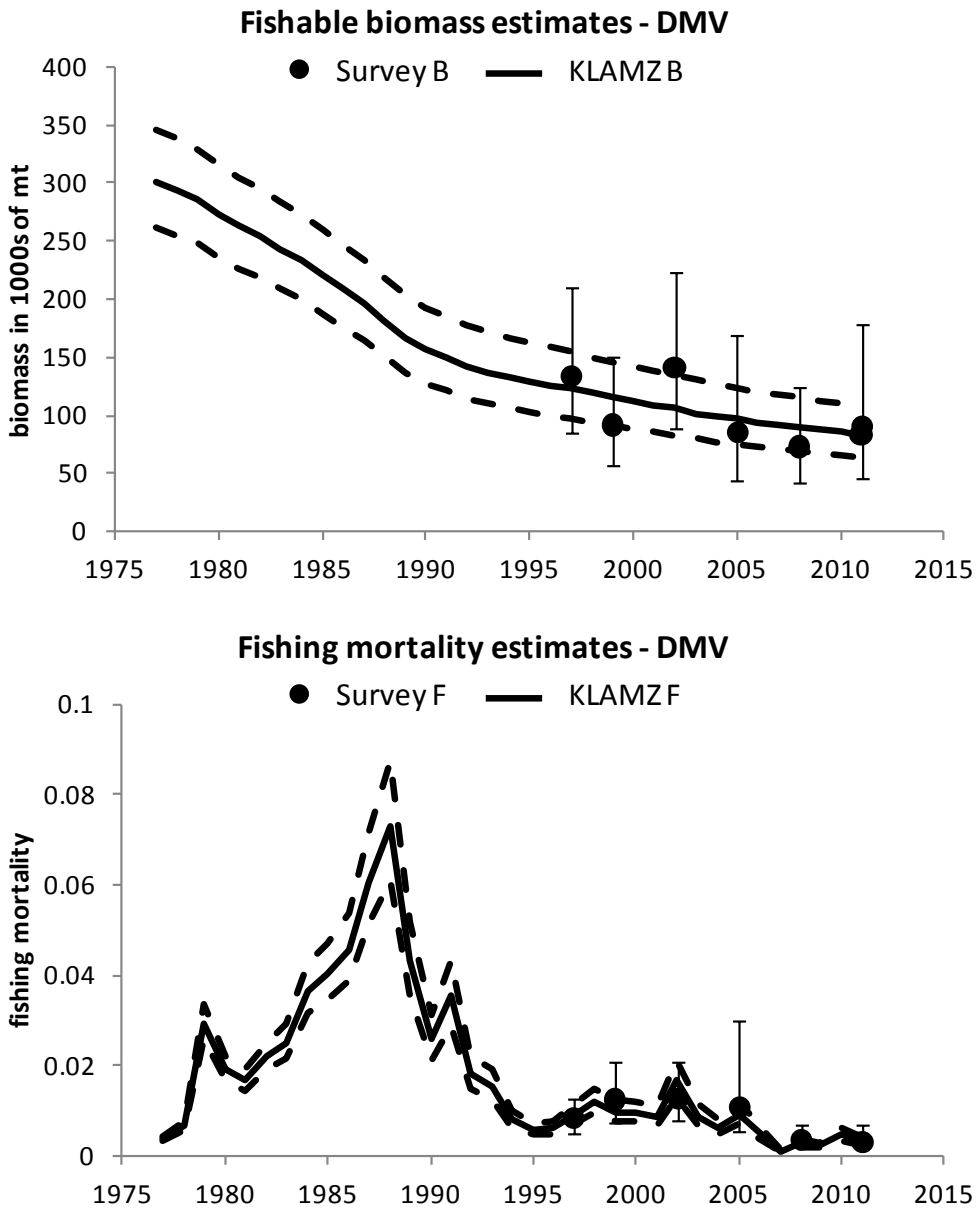


Figure 36. KLAMZ biomass and fishing mortality estimates and survey biomass and fishing mortality estimates for the DMV region with 80% confidence intervals. Survey biomass is the efficiency-corrected swept-area biomass (ESB). Survey fishing mortality is calculated by dividing catch (reported landings plus 5% incidental mortality) by ESB.

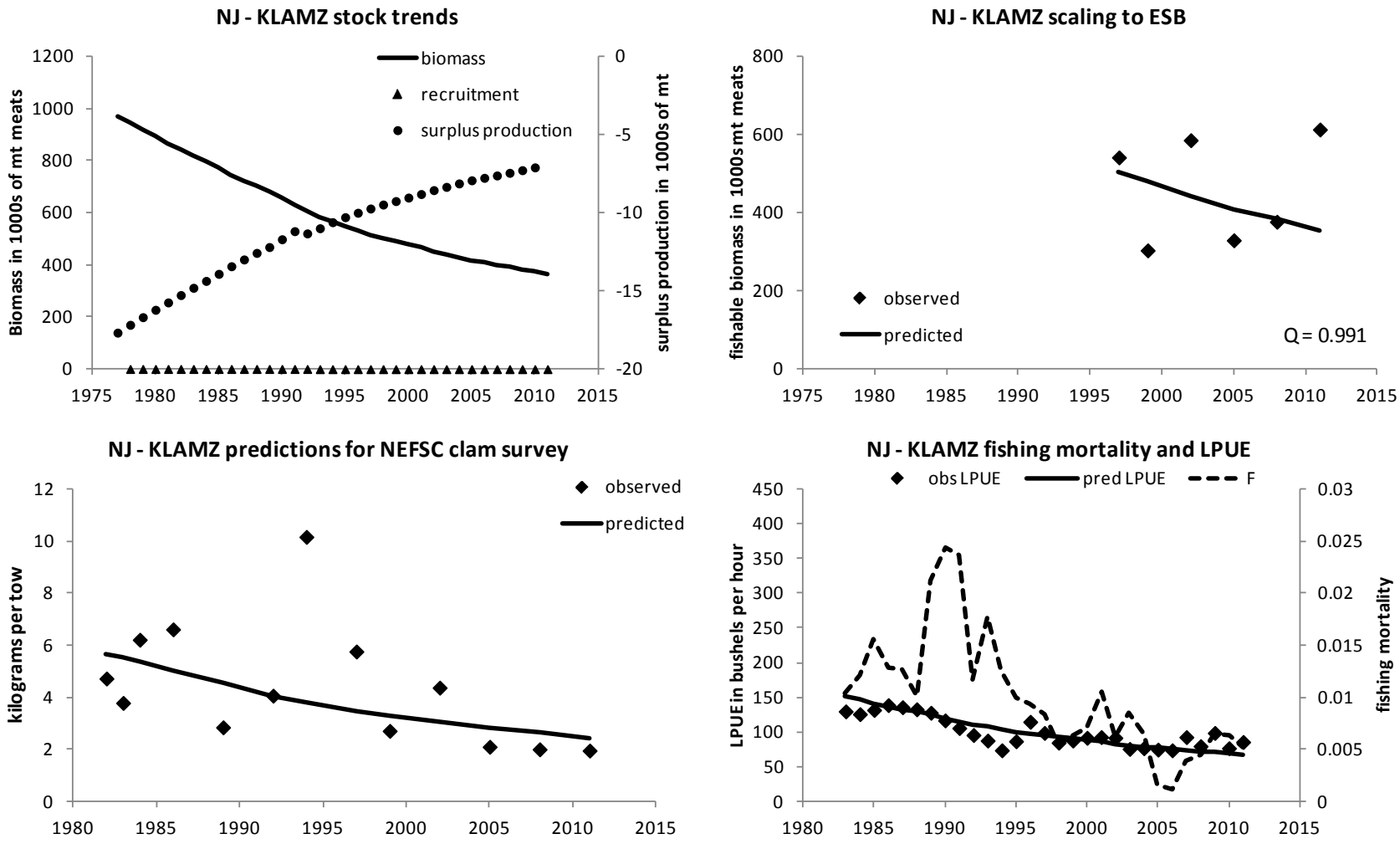


Figure 37. KLAMZ model results for the NJ region.

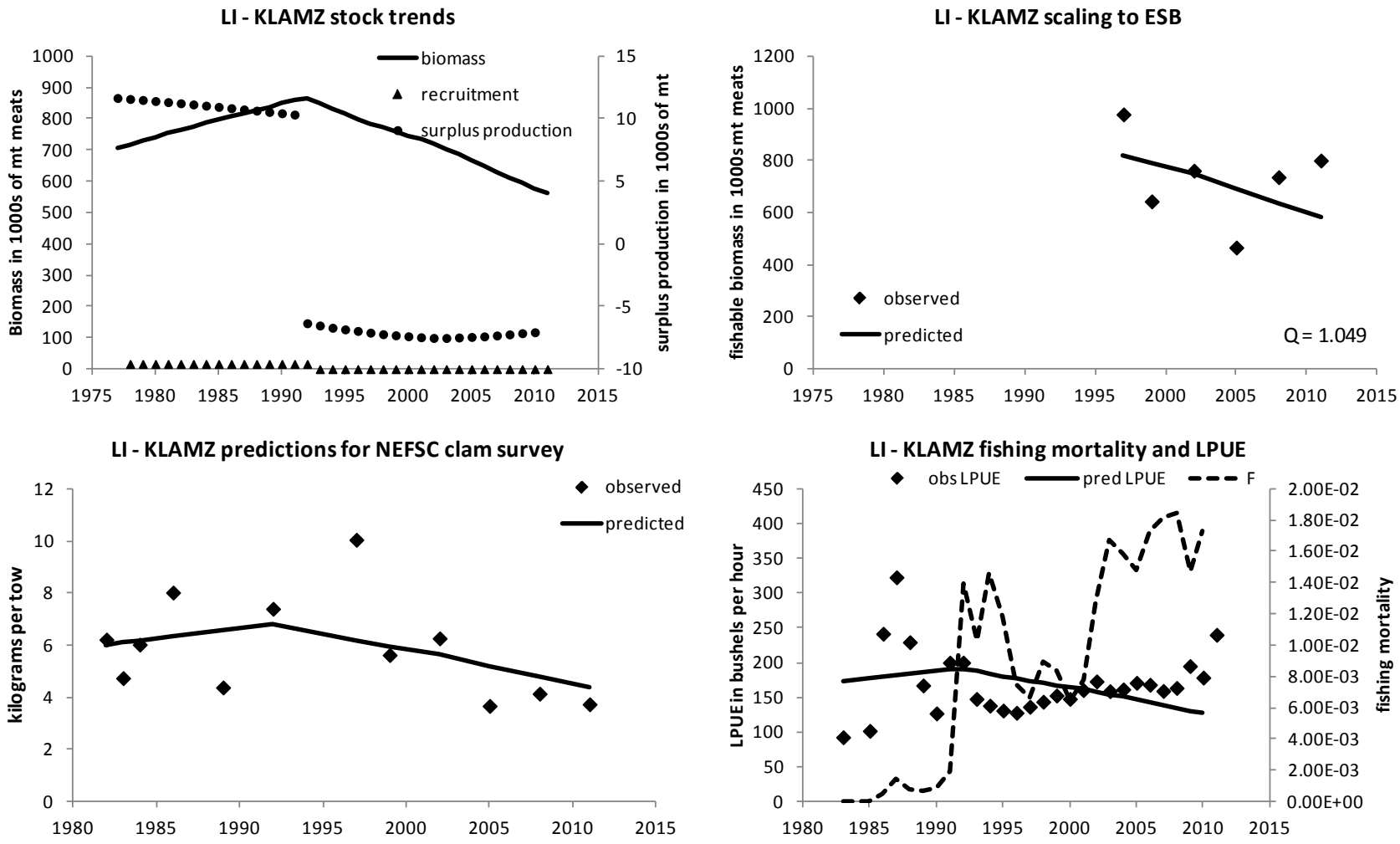


Figure 38. KLAMZ model results for the LI region.

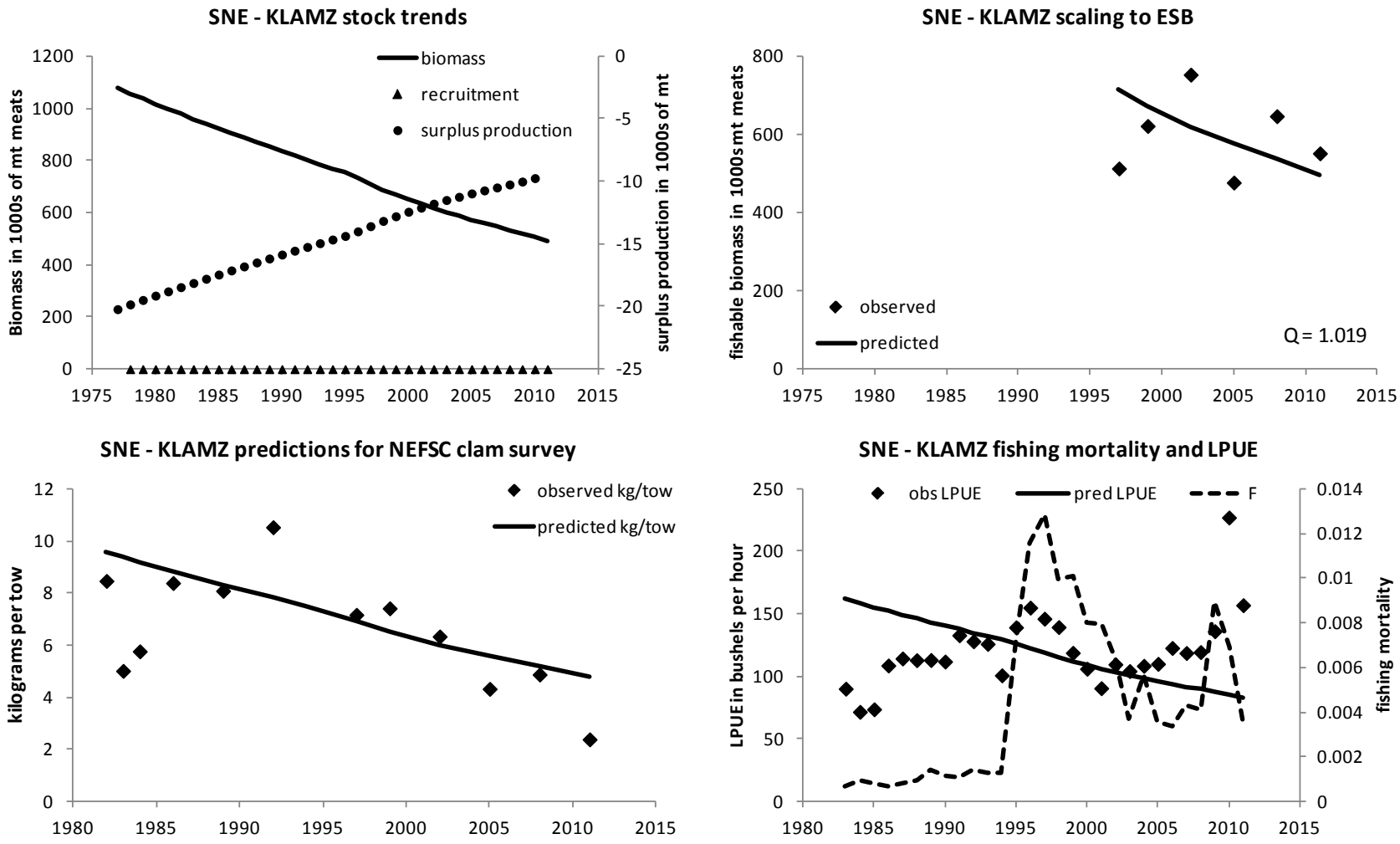


Figure 39. KLAMZ model results for the SNE region.

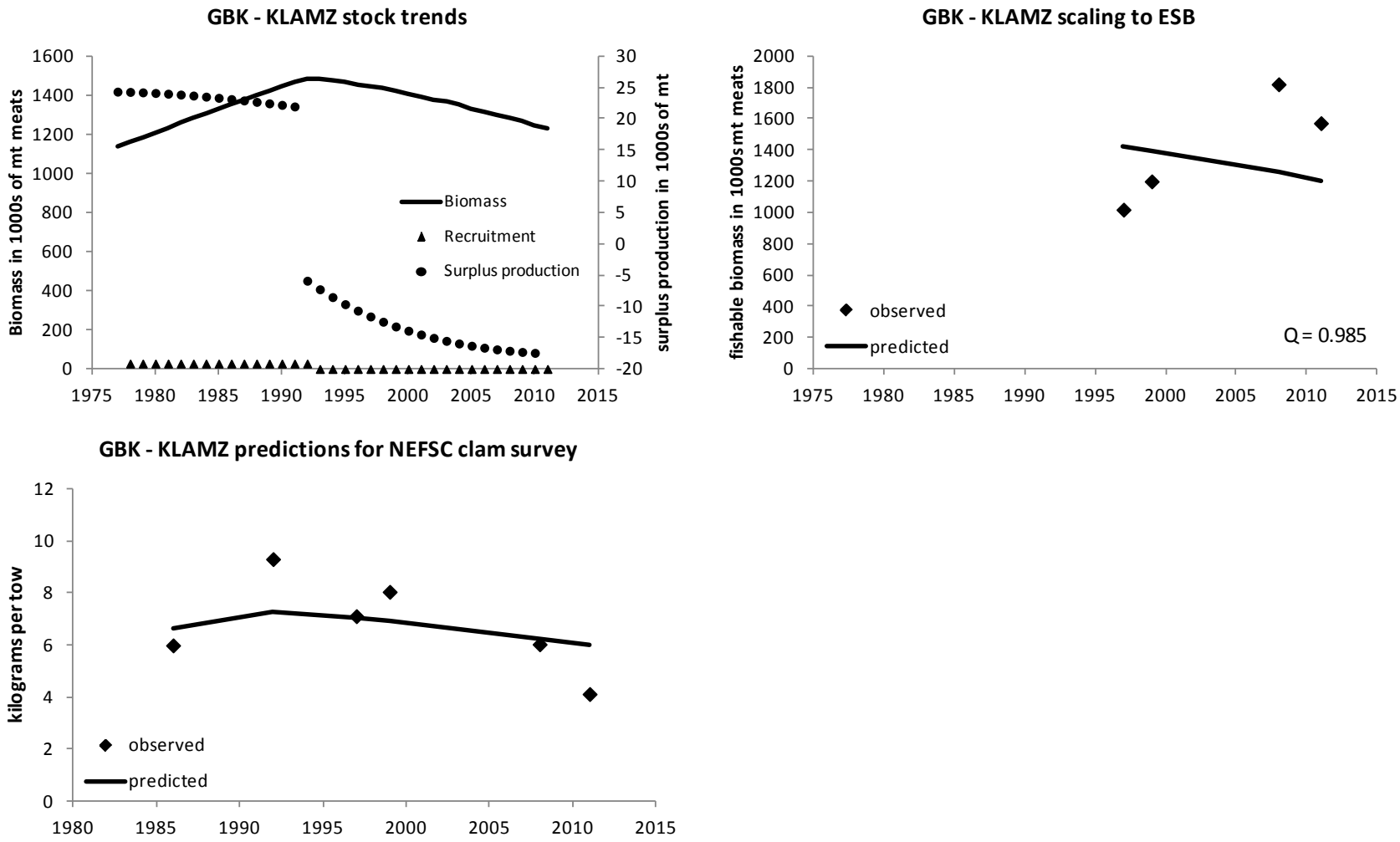


Figure 40. KLAMZ model results for the GBK region.

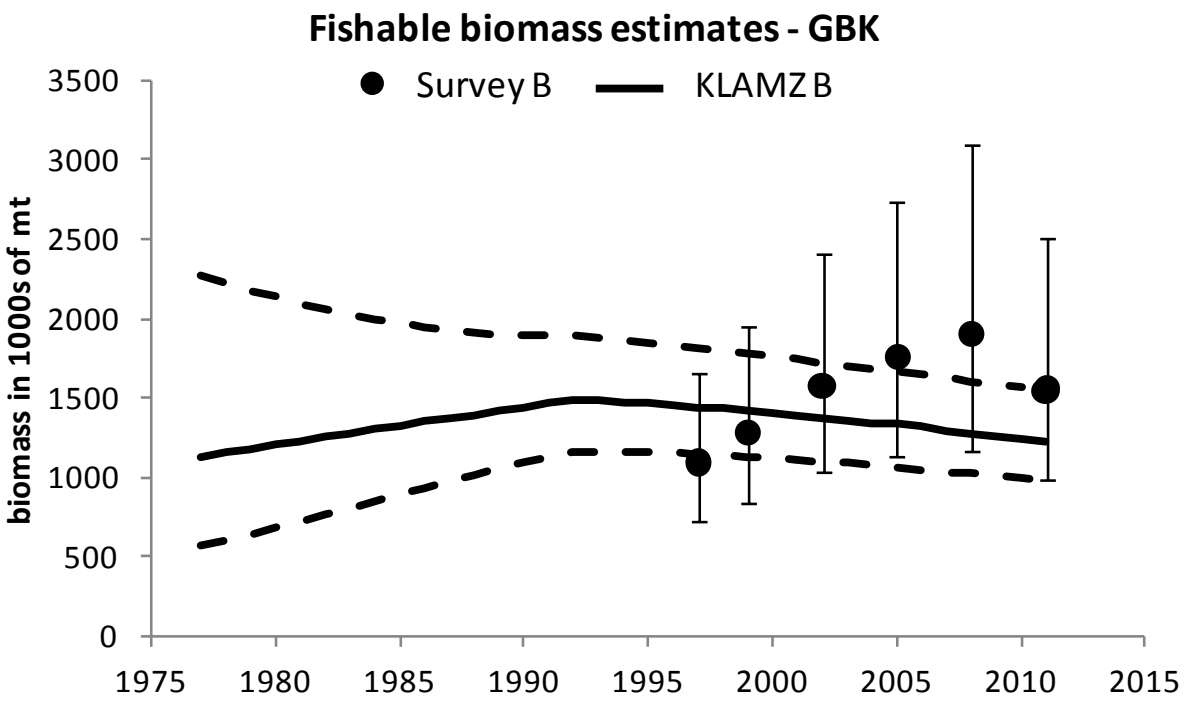
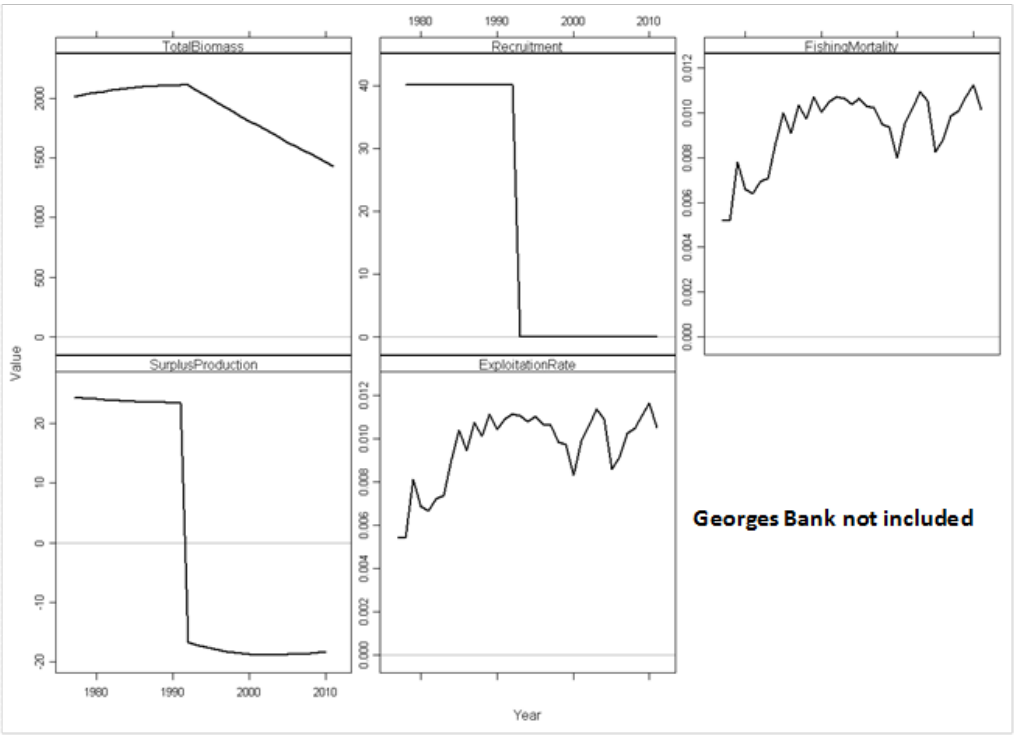


Figure 41. KLAMZ biomass estimates and survey biomass estimates for the GBK region with 80% confidence intervals.



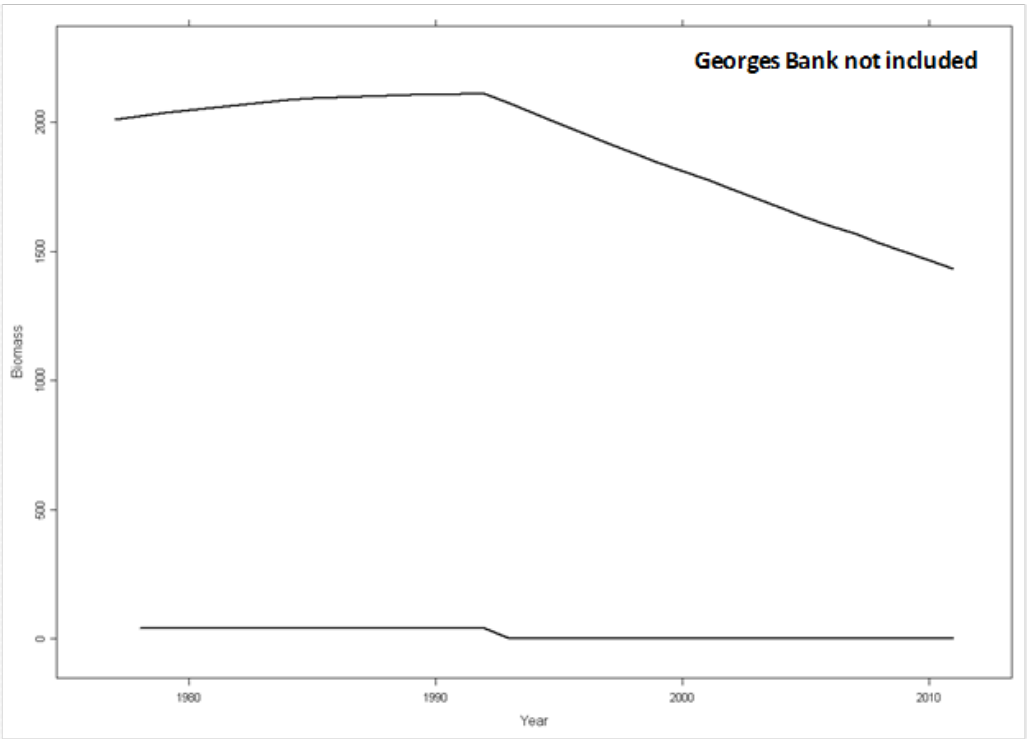


Figure 42. KLAMZ model population dynamics time series variables (above) and total and recruit biomass (below) for the exploited regions DMV, NJ, LI and SNE combined.

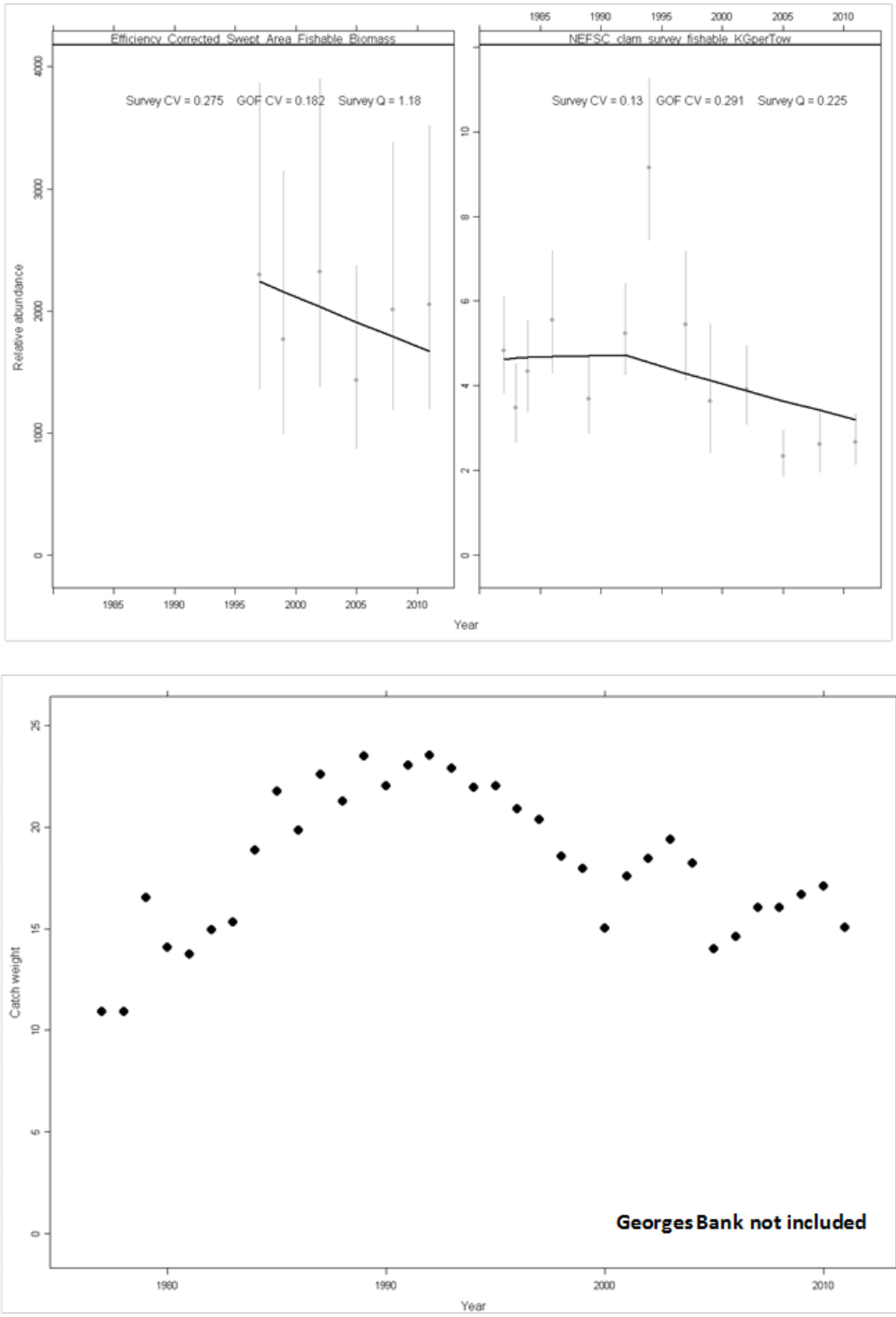
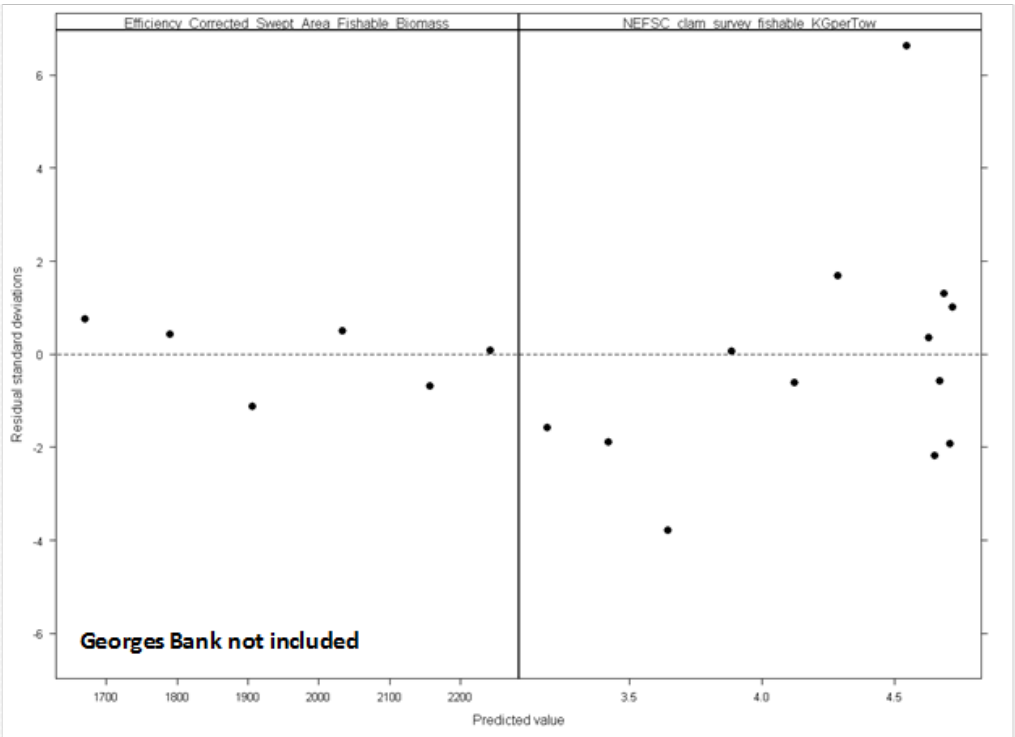


Figure 43. KLAMZ model results for the exploited regions DMV, NJ, LI and SNE combined. Survey observations, 95% confidence interval and fitted values (above) and observed catch data used in the model (below).



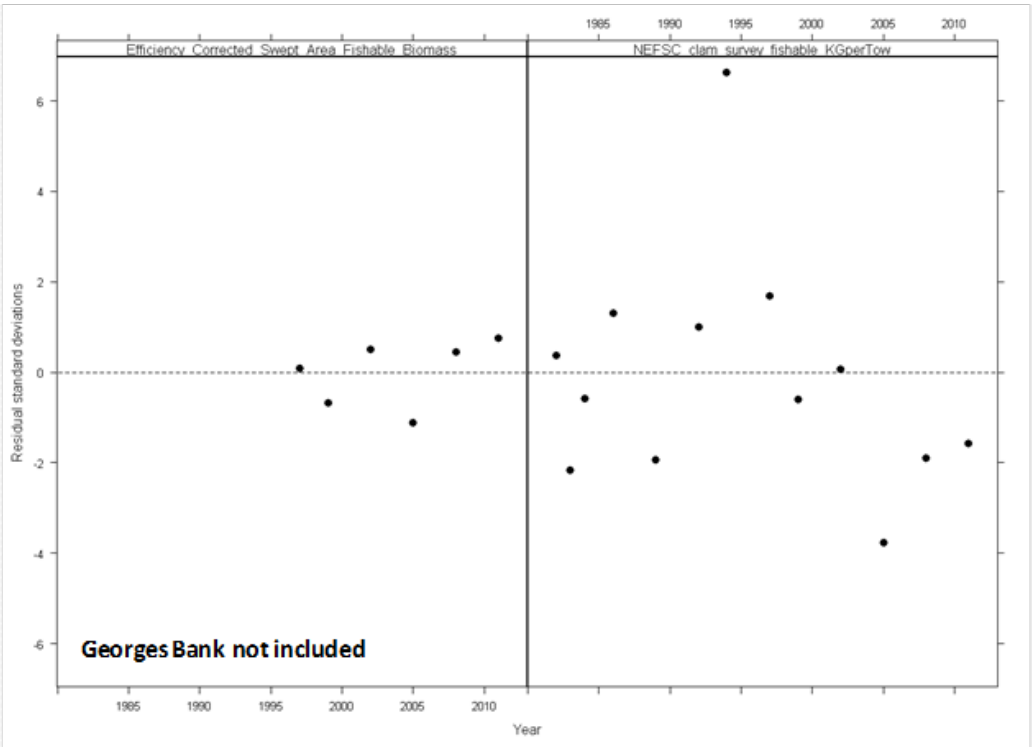


Figure 44. KLAMZ model diagnostics for the exploited regions DMV, NJ, LI and SNE combined. Standardized residuals vs. predicted values for survey data (above) and standardized residuals vs. year for survey data (below).

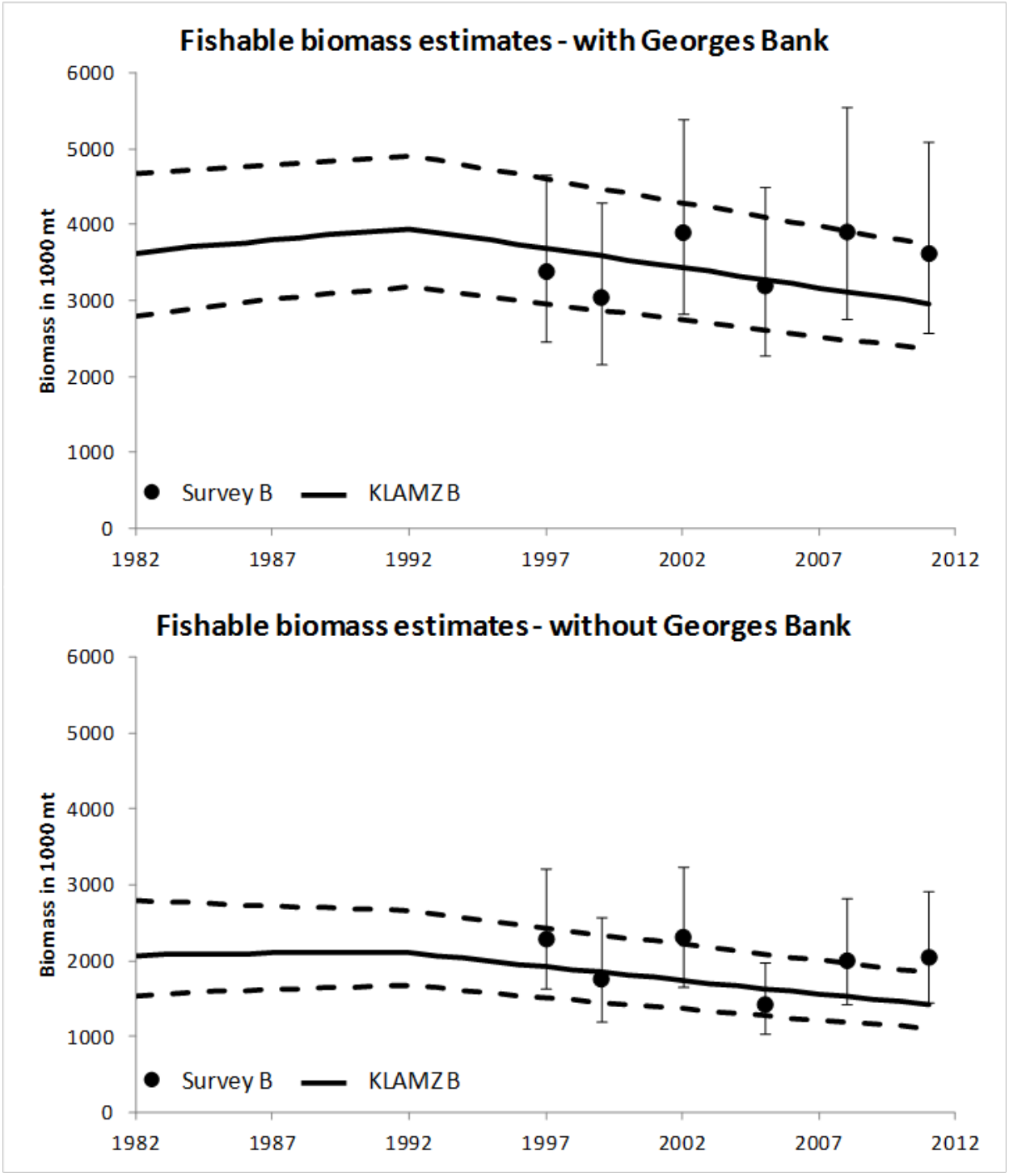


Figure 45. KLAMZ model estimates of fishable biomass for the entire stock (top) and the exploited regions (bottom).

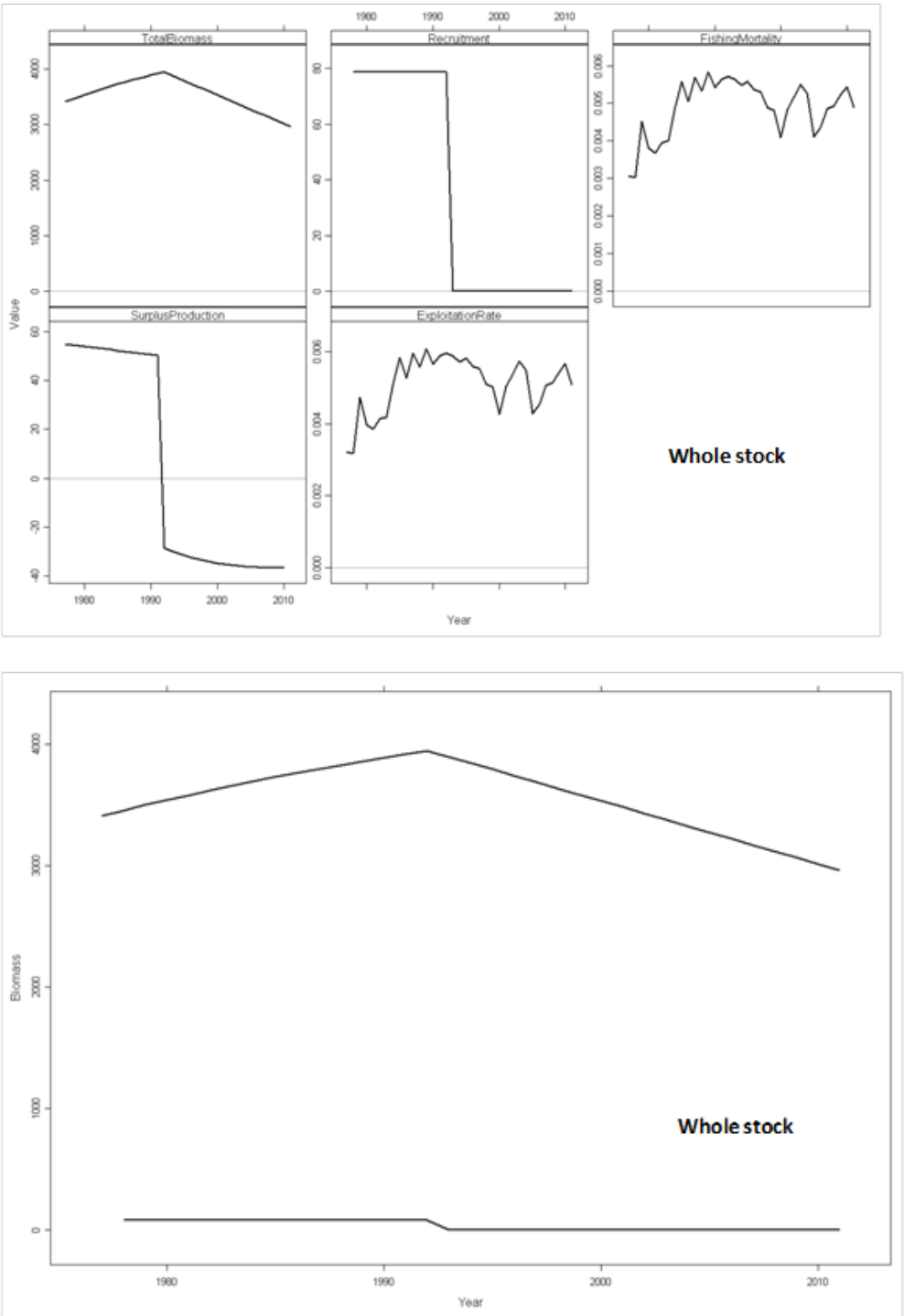


Figure 46. KLAMZ model population dynamics time series variables for the whole stock model (above) and total and recruit biomass (below) from the whole stock model.

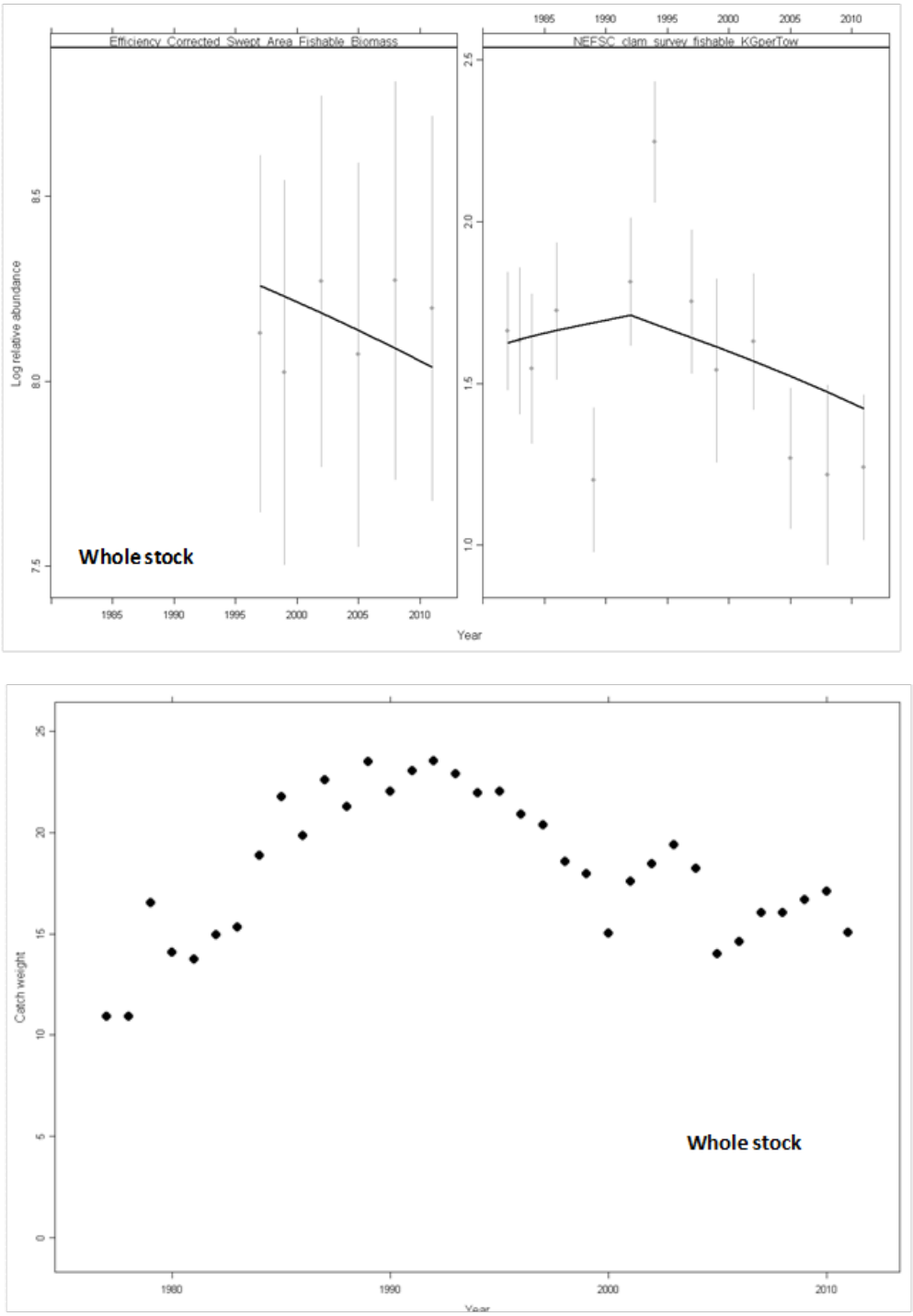
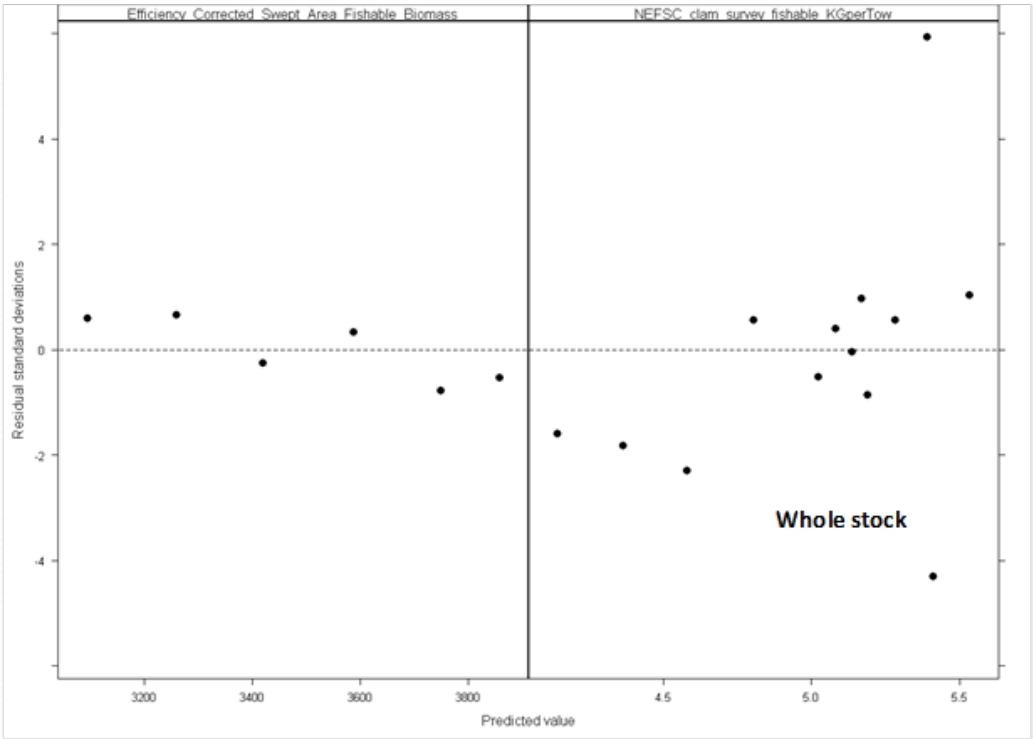


Figure 47. KLAMZ model results for the whole stock. Survey observations, 95% confidence interval and fitted values (above) and observed catch data used in the model (below).



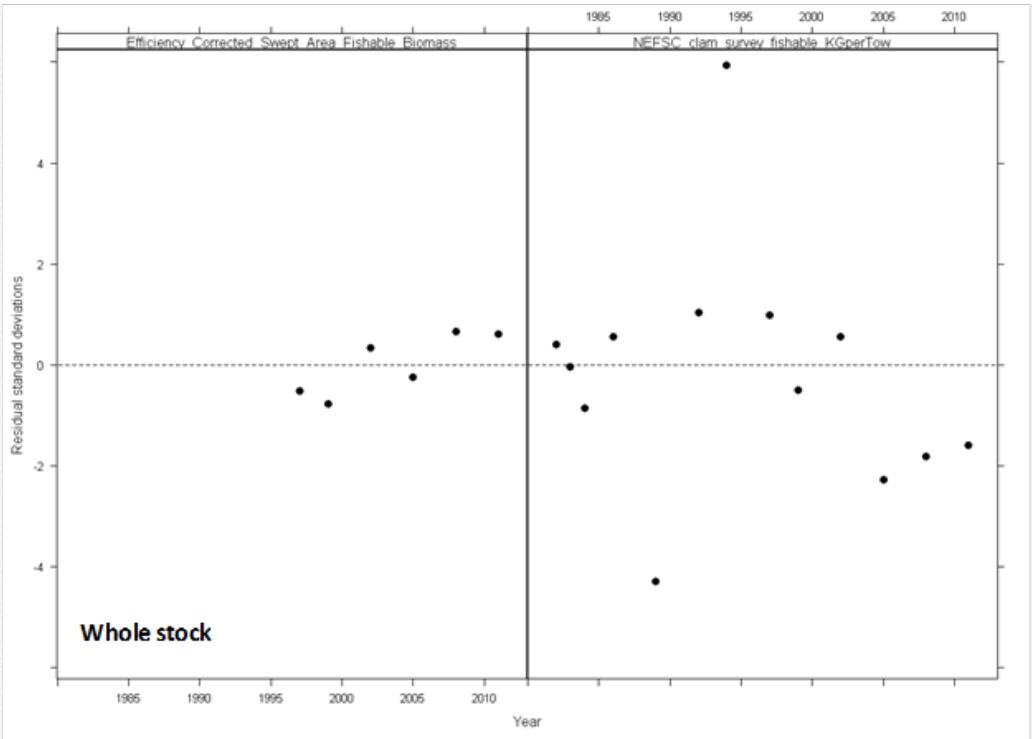


Figure 48. KLAMZ model diagnostics for the whole stock model. Standardized residuals vs. predicted values for survey data (above) and standardized residuals vs. year for survey data (below).

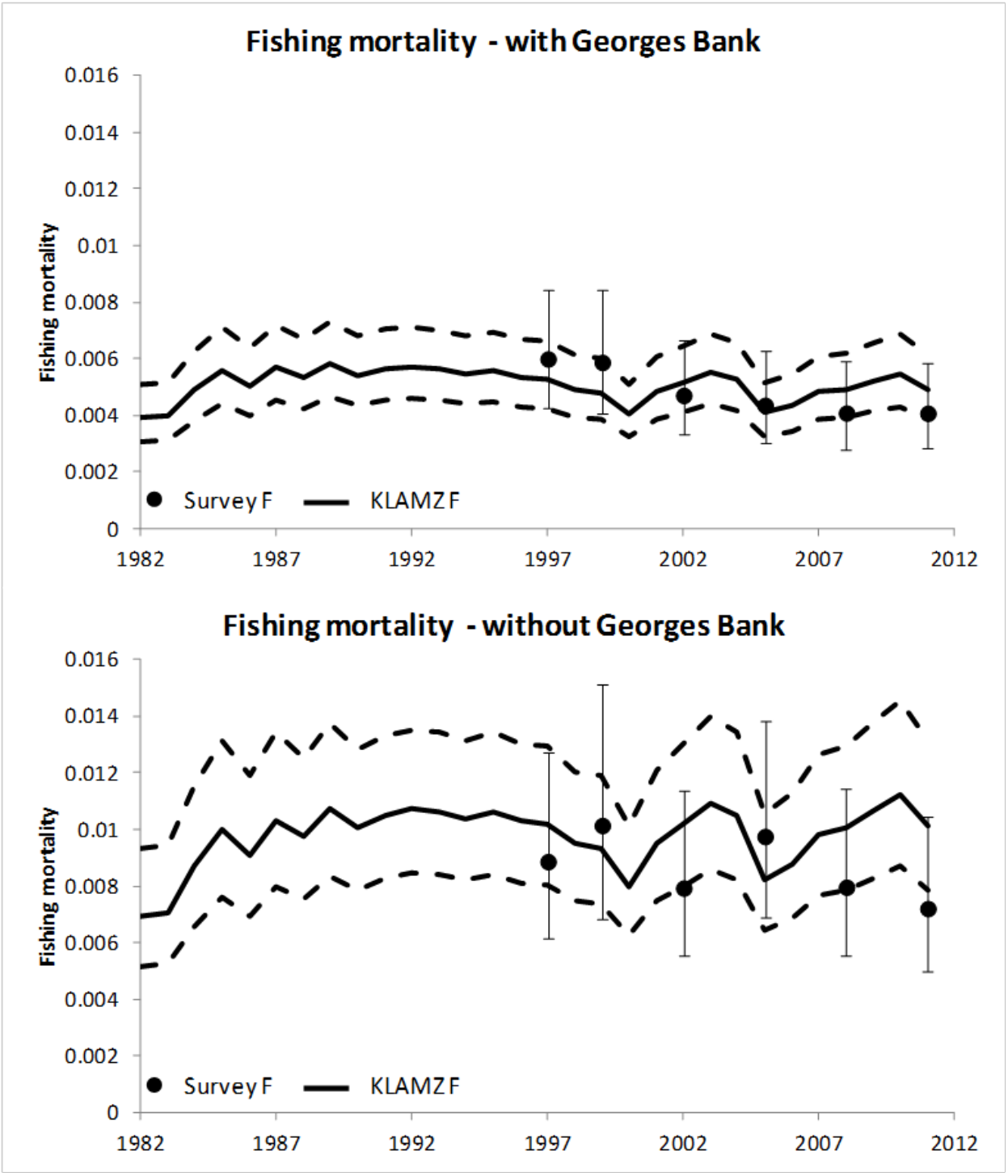
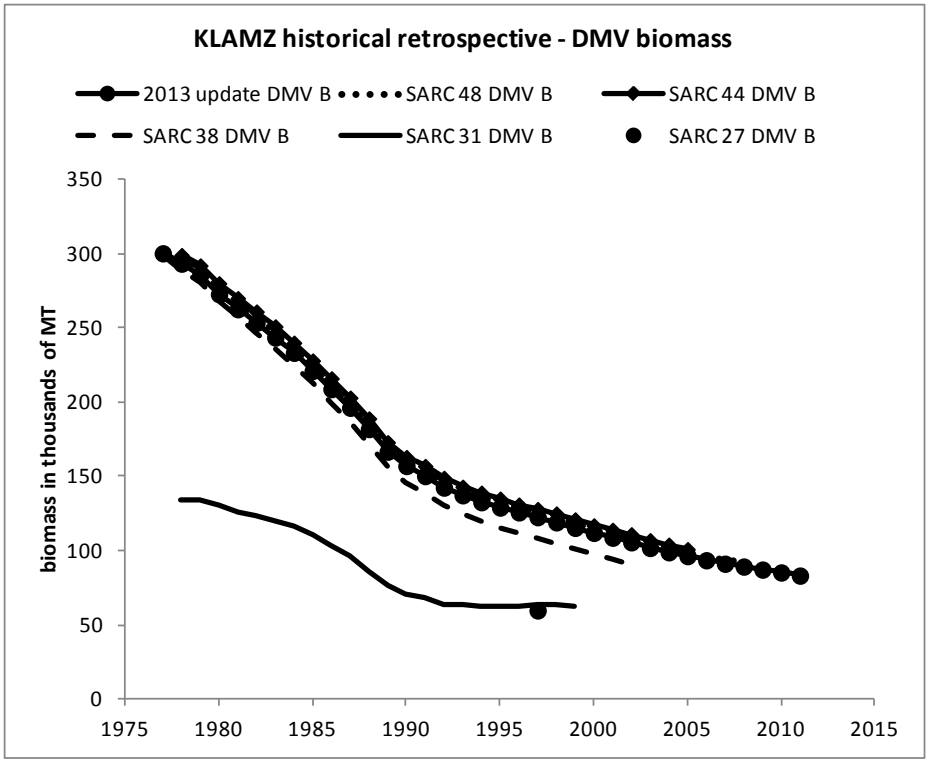


Figure 49. KLAMZ estimates of fishing mortality for the entire stock (top) and the exploited regions (bottom).



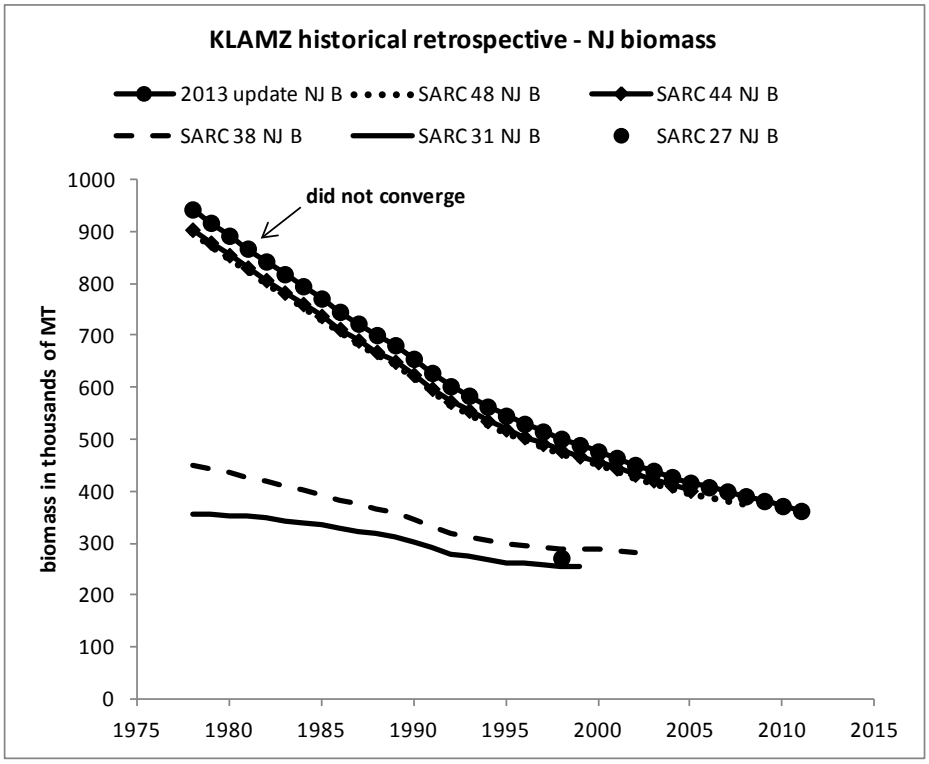
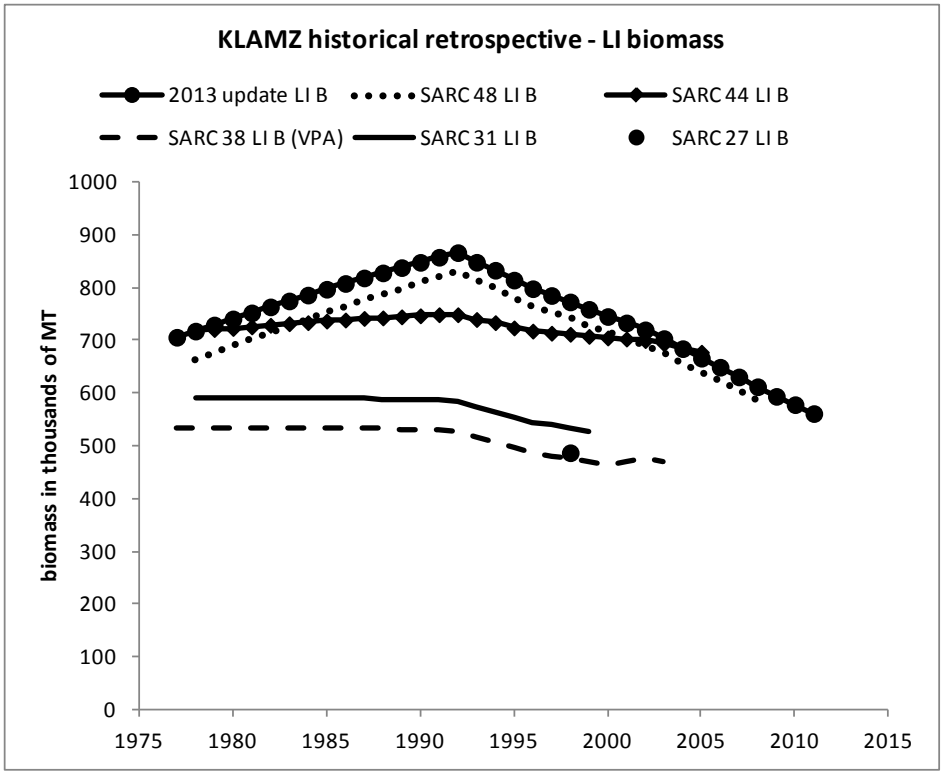


Figure 50. KLAMZ results for total biomass in the DMV (top) and NJ regions with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009.



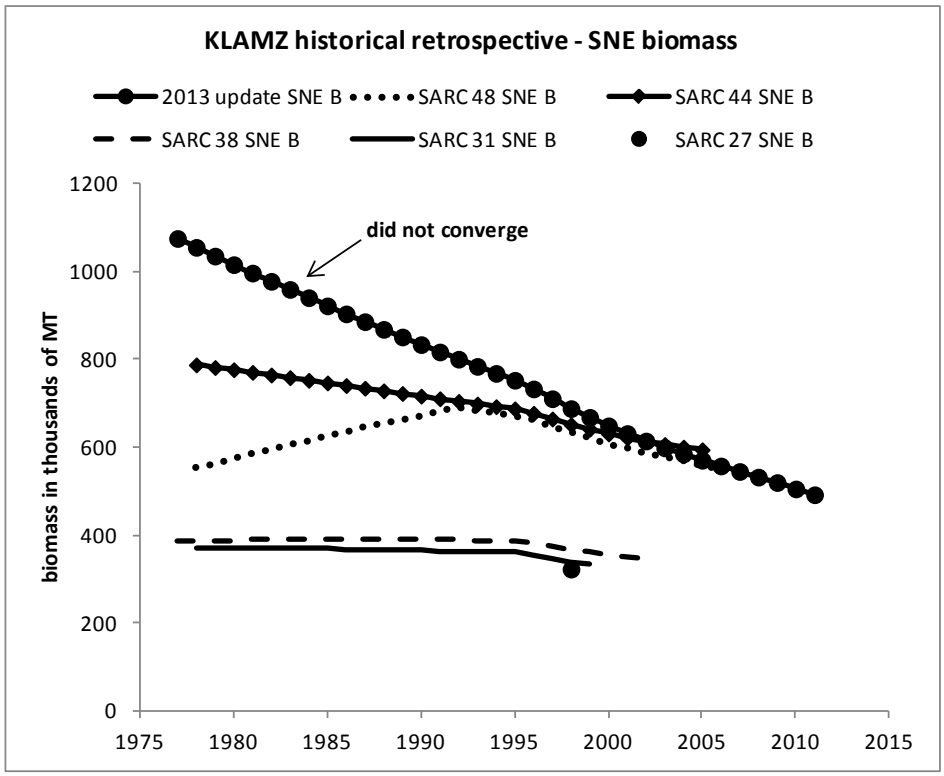
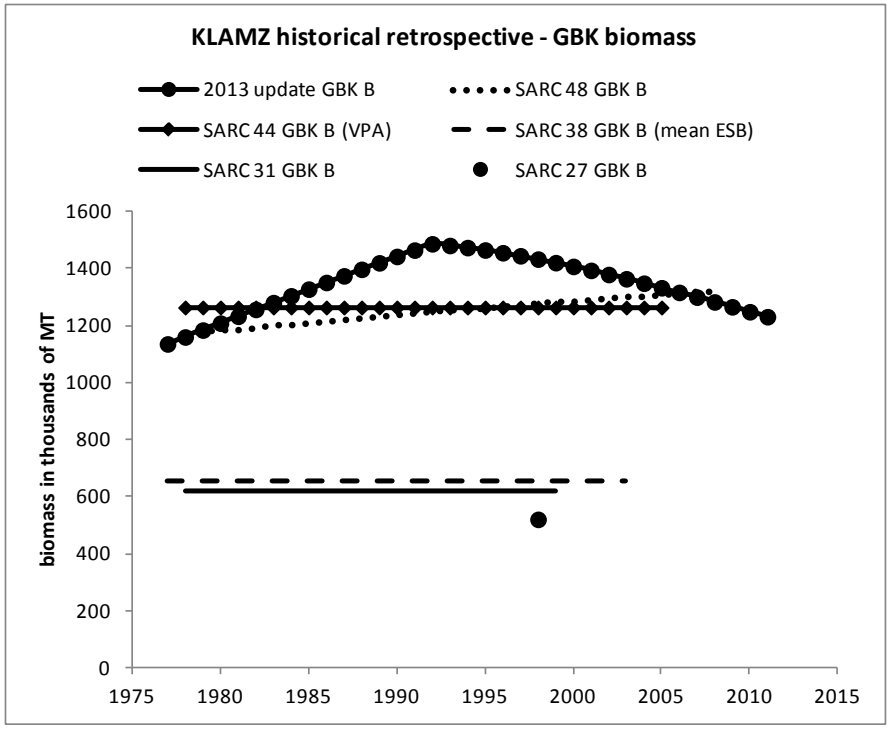


Figure 51. KLAMZ results for total biomass in the LI (top) and SNE regions with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009.



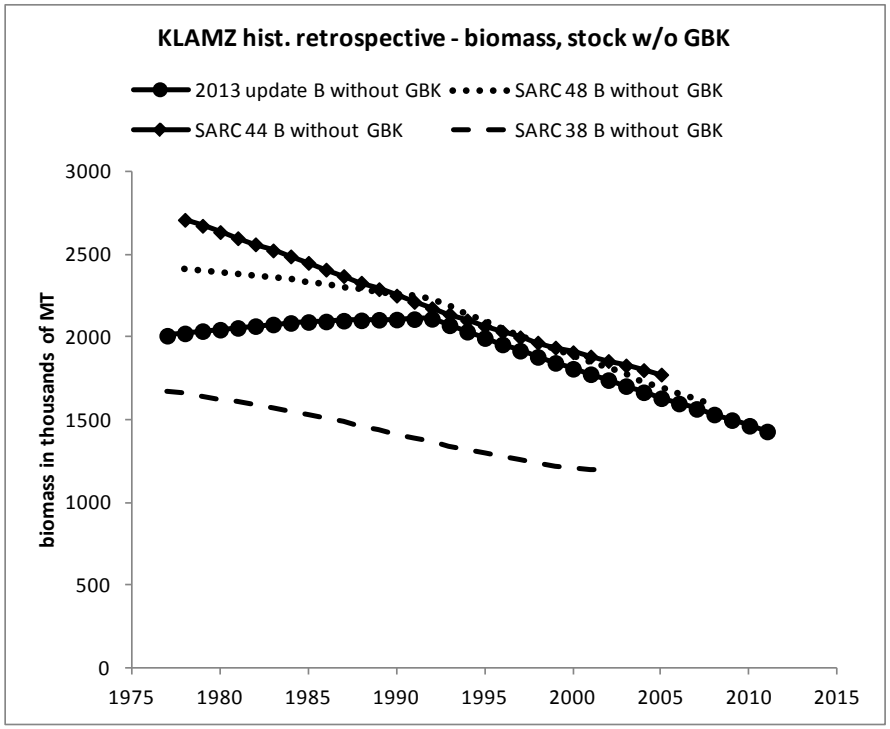


Figure 52. KLAMZ results for total biomass in the GBK region (top) and the whole stock minus GBK with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009. Exploited area was not modeled for SARC 27.

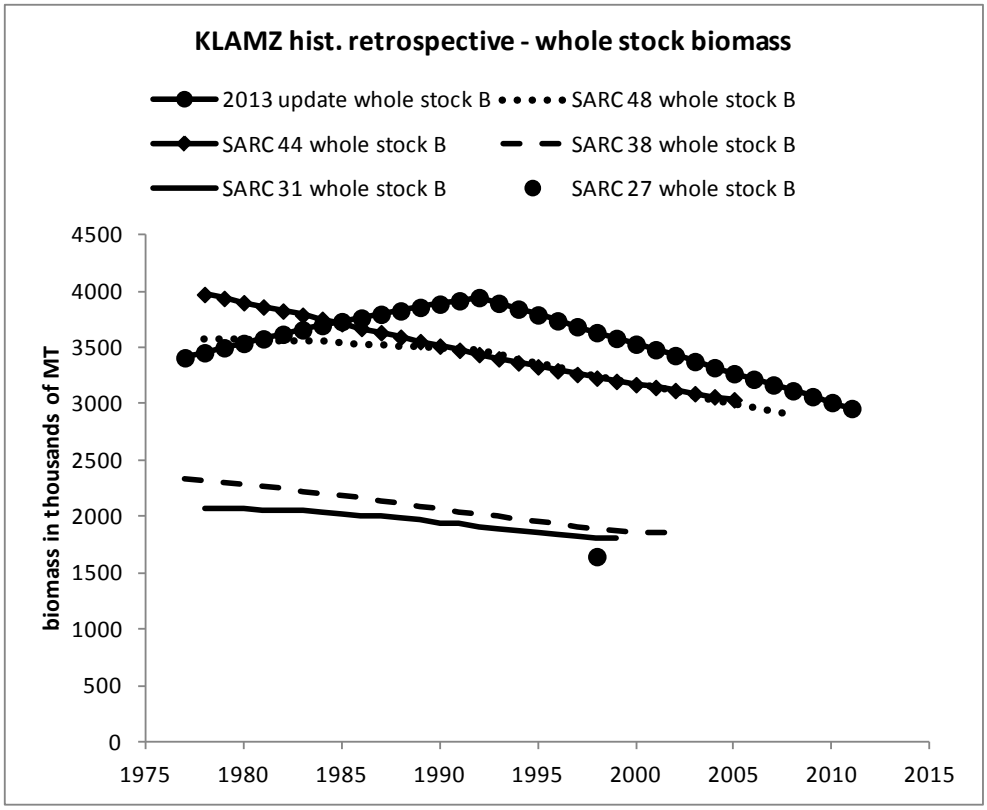
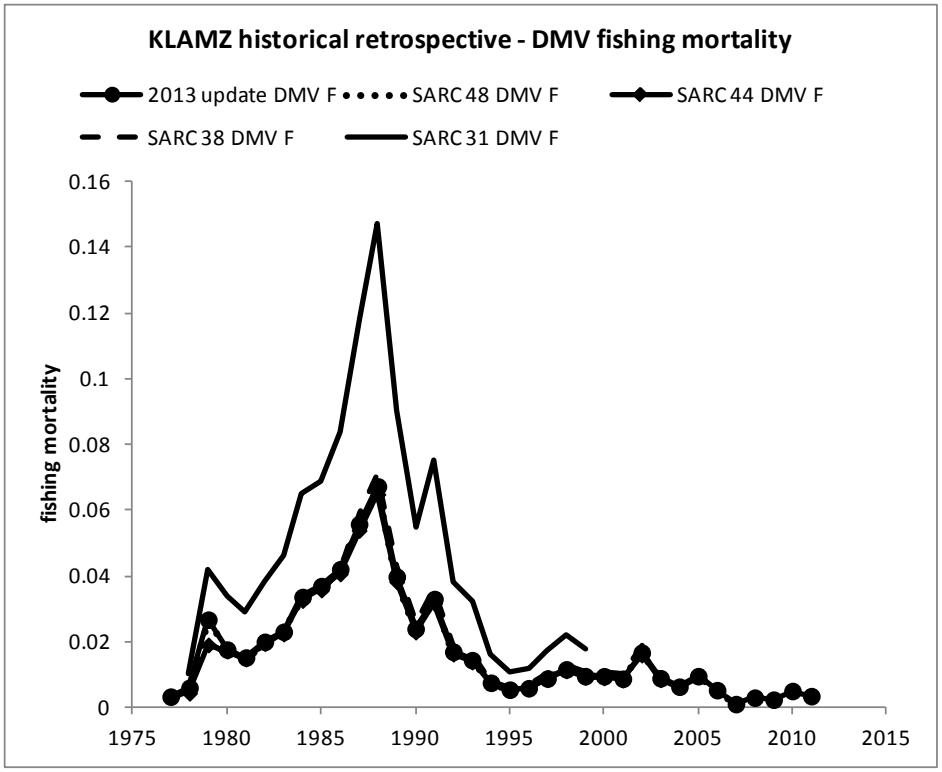


Figure 53. KLAMZ results for the whole ocean quahog stock with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009.



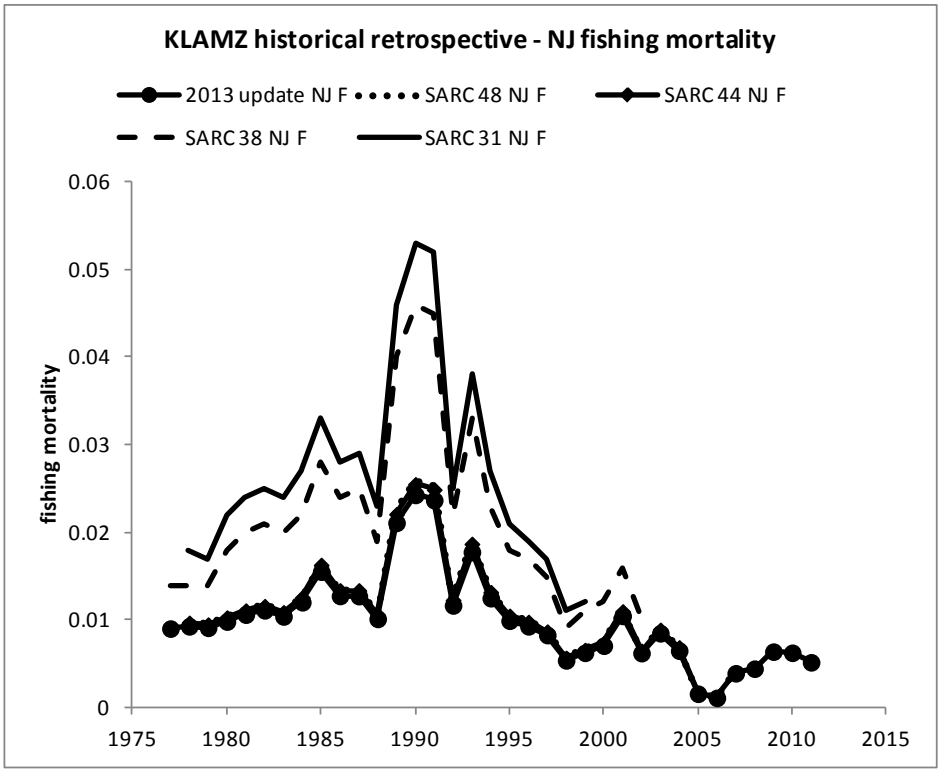
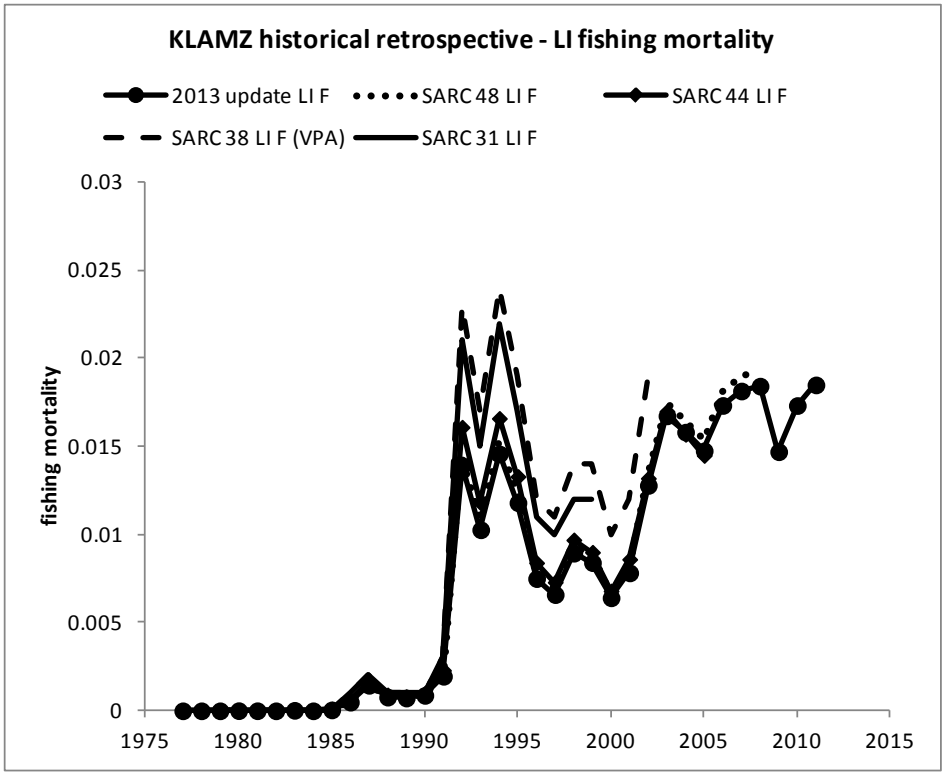


Figure 54. KLAMZ results for fishing mortality in the DMV (top) and NJ regions with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009.



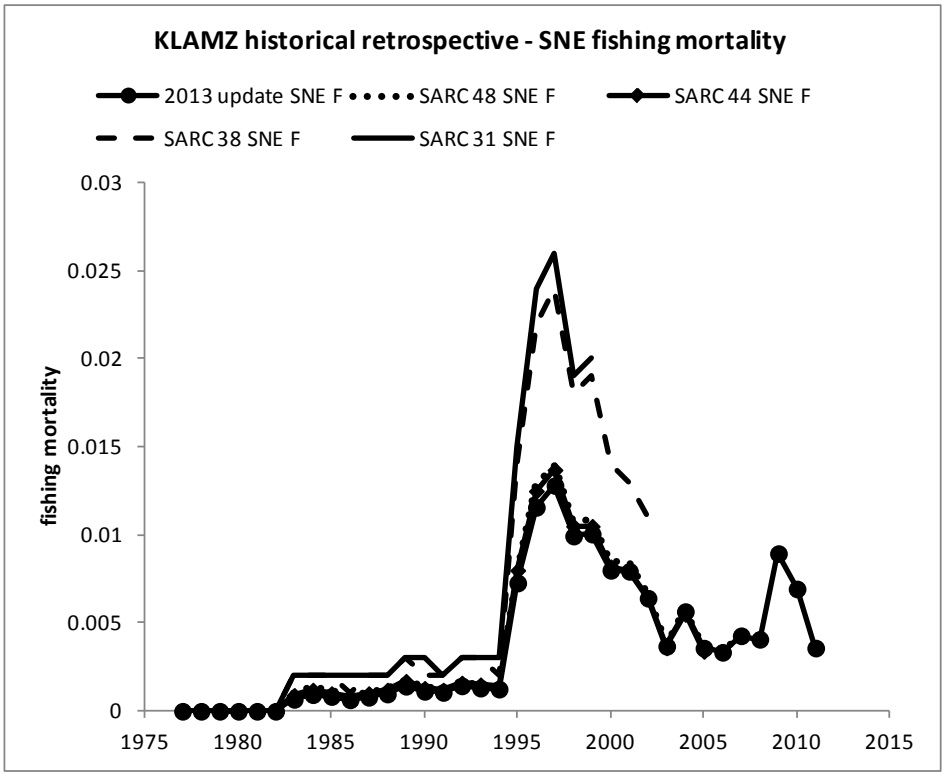
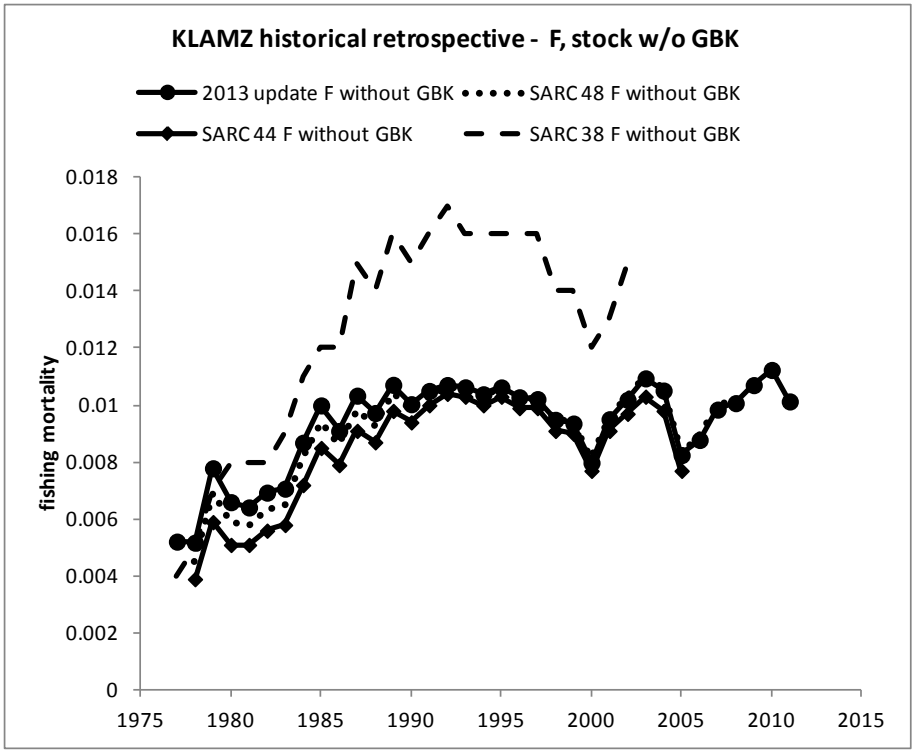


Figure 55. KLAMZ results for fishing mortality in the LI (top) and SNE regions with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009.



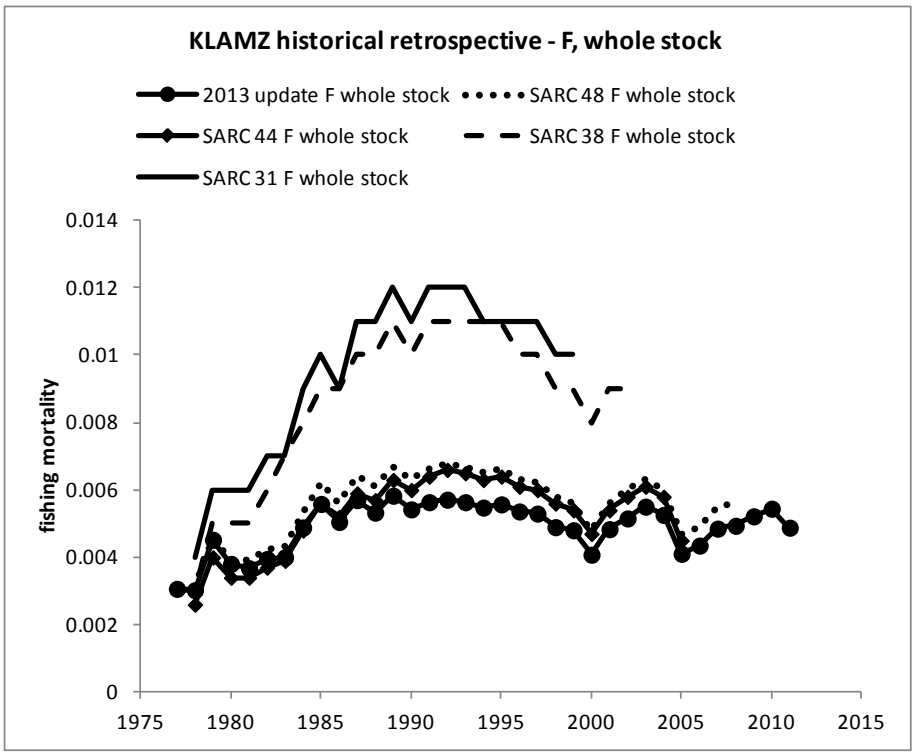


Figure 56. KLAMZ results for fishing mortality for the whole stock minus GBK (top) and the whole ocean quahog stock with KLAMZ results from past assessments for comparison. SARC 27 was in 1998, SARC 31 was in 2000, SARC 38 was in 2004, SARC 44 was in 2007 and SARC 48 was in 2009.

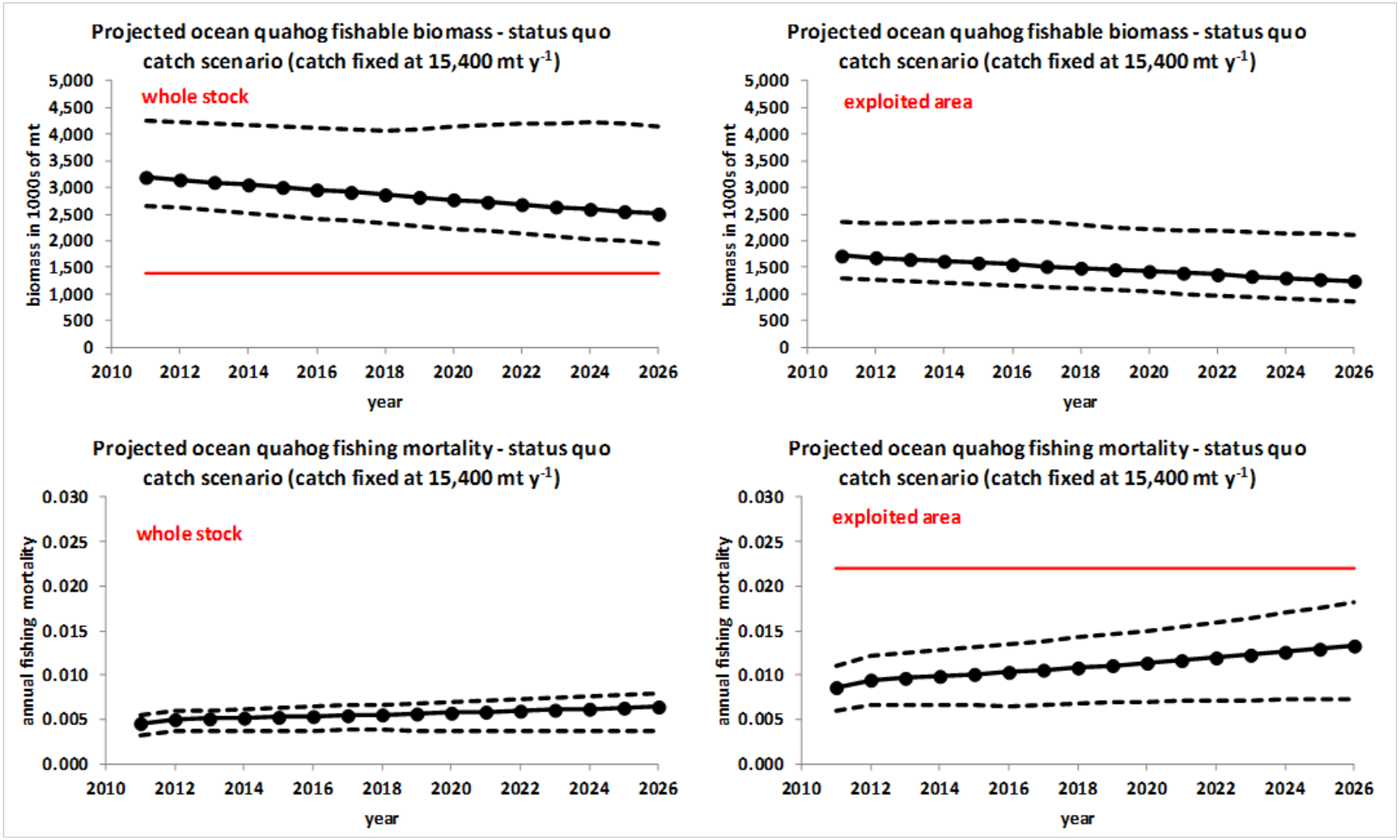


Figure 57A. Biomass and fishing mortality results from 15-year projections for the whole ocean quahog stock (left side) and the exploited area only (right side) under the "status quo" scenario (15,400 mt, the mean annual catch during 2006 to 2011). The center line is the mean of the bootstrap estimates, the dashed lines are 95% confidence intervals, and the red lines are biomass or fishing mortality thresholds.

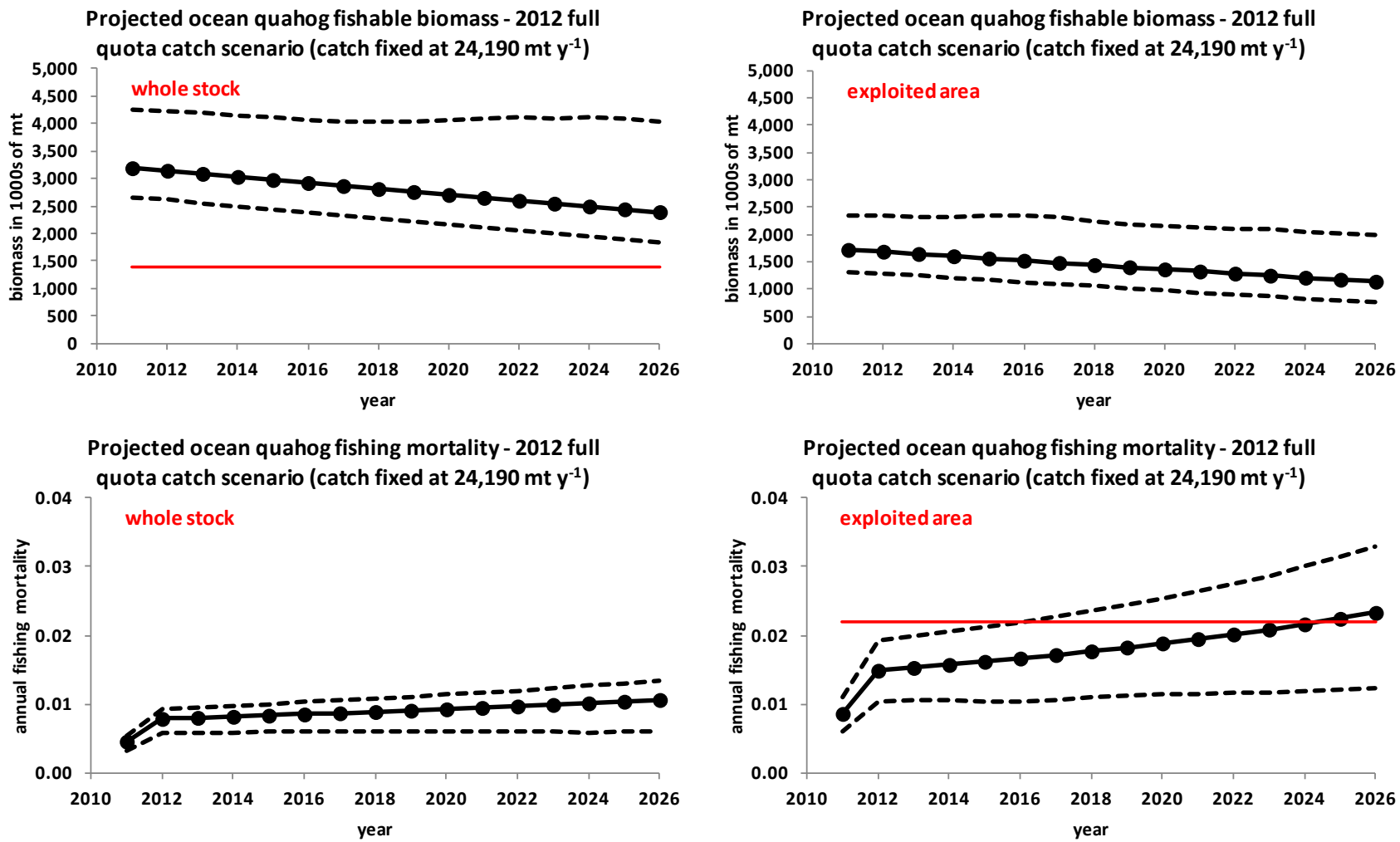


Figure 57B. Biomass and fishing mortality results from 15-year projections for the whole ocean quahog stock (left side) and the exploited area only (right side) with the catch fixed at the current quota of 24,190 mt. The center line is the mean of the bootstrap estimates, the dashed lines are 95% confidence intervals, and the red lines are the biomass or fishing mortality thresholds.

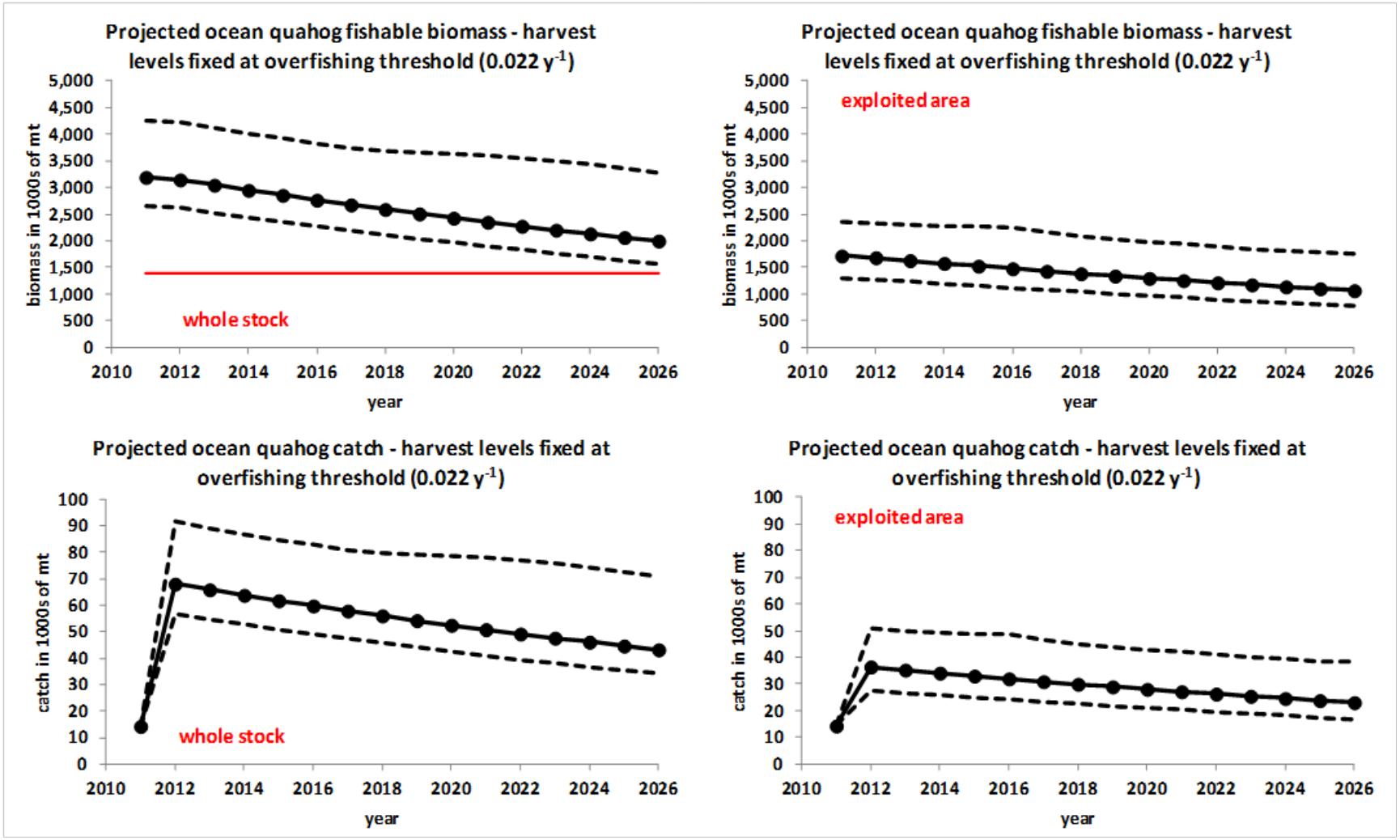


Figure 57C. Biomass and catch results from 15-year projections for the whole ocean quahog stock (left side) and the exploited area only (right side) with fishing mortality fixed at the overfishing threshold of $F = 0.022y^{-1}$. The center line is the mean of the bootstrap estimates, the dashed lines are 95% confidence intervals and the red line is the biomass threshold. Probabilities of overfishing are not shown as they are 50% in each year when fishing is at the OFL level.