

Figures

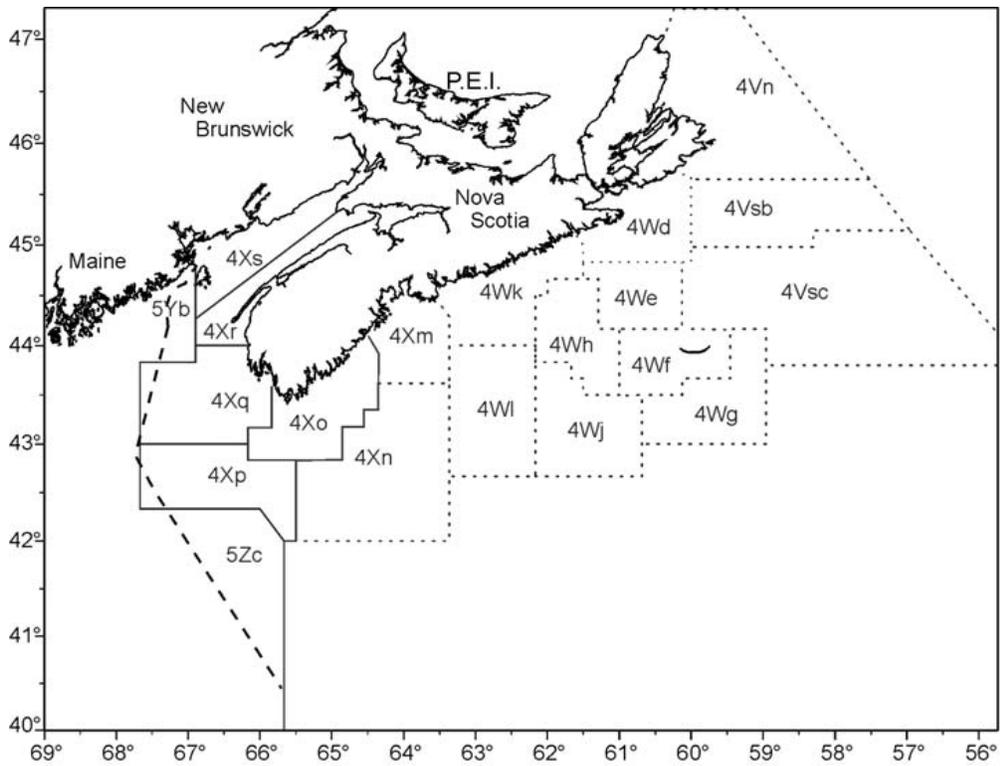
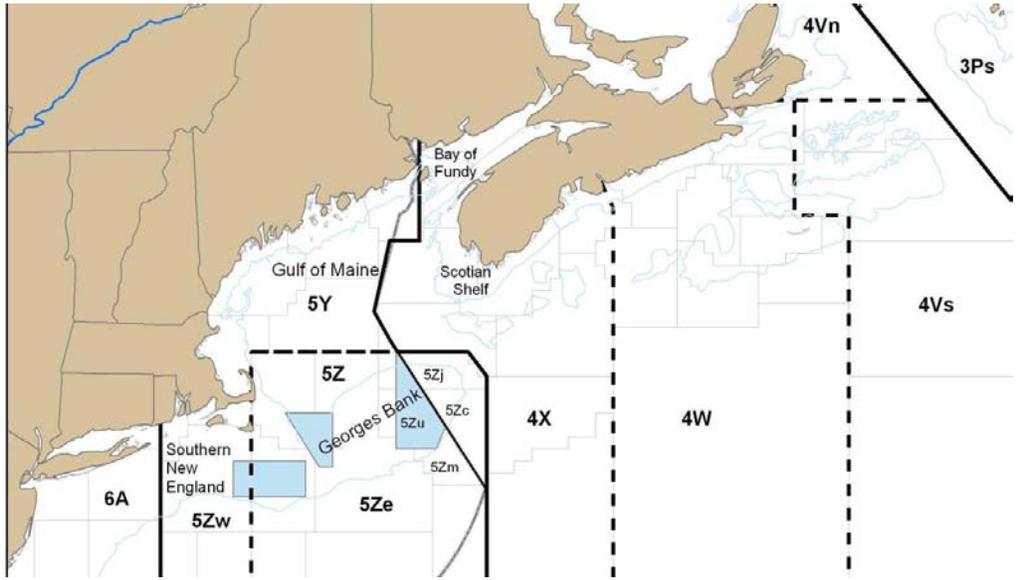


Figure C1. NAFO areas.

Multispecies DAS Permits

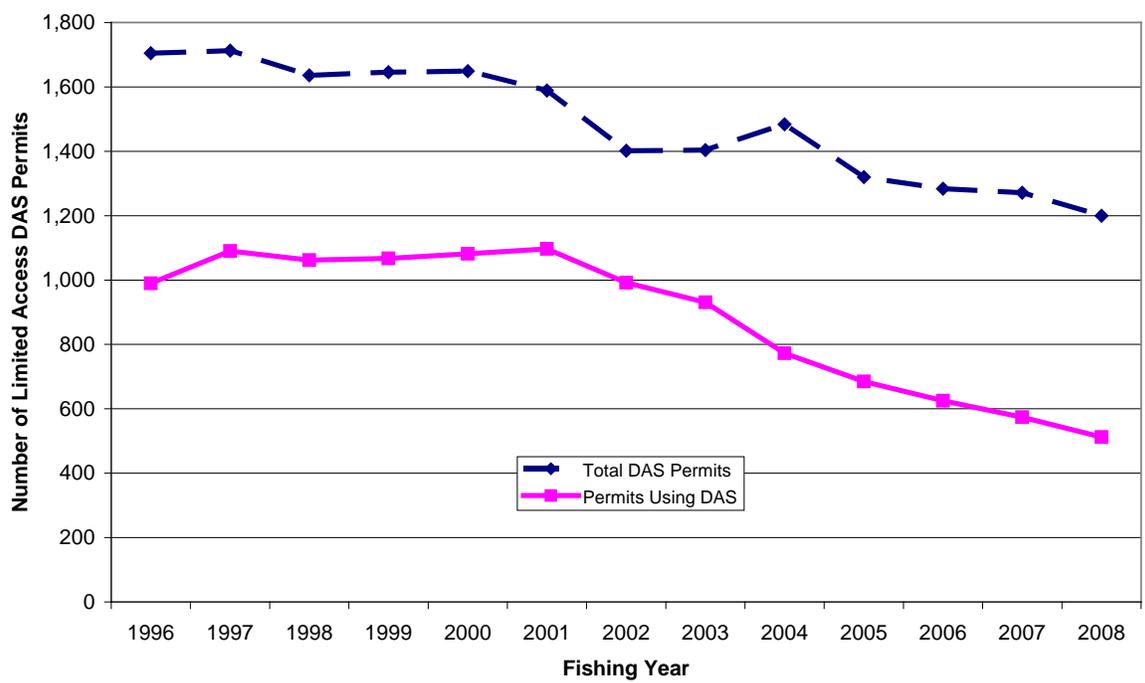


Figure C2. Multispecies DAS permits issued and permits using DAS, 1996 – 2008.

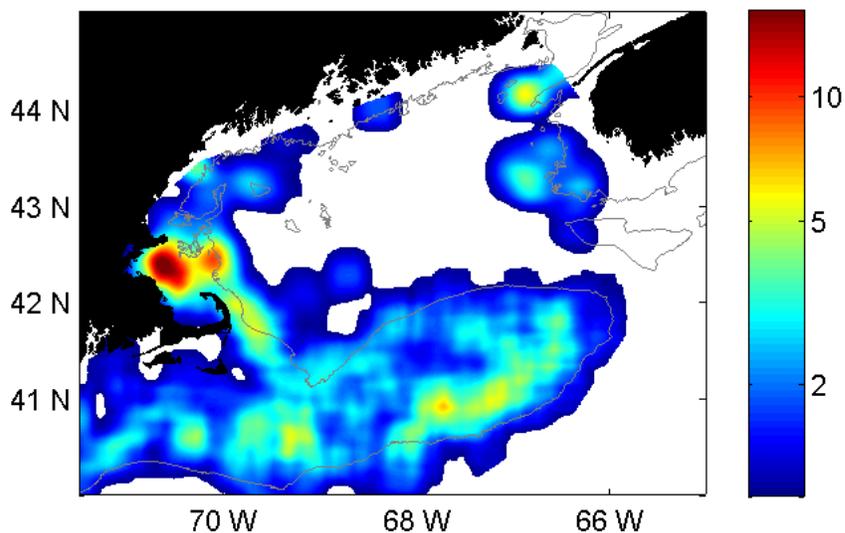
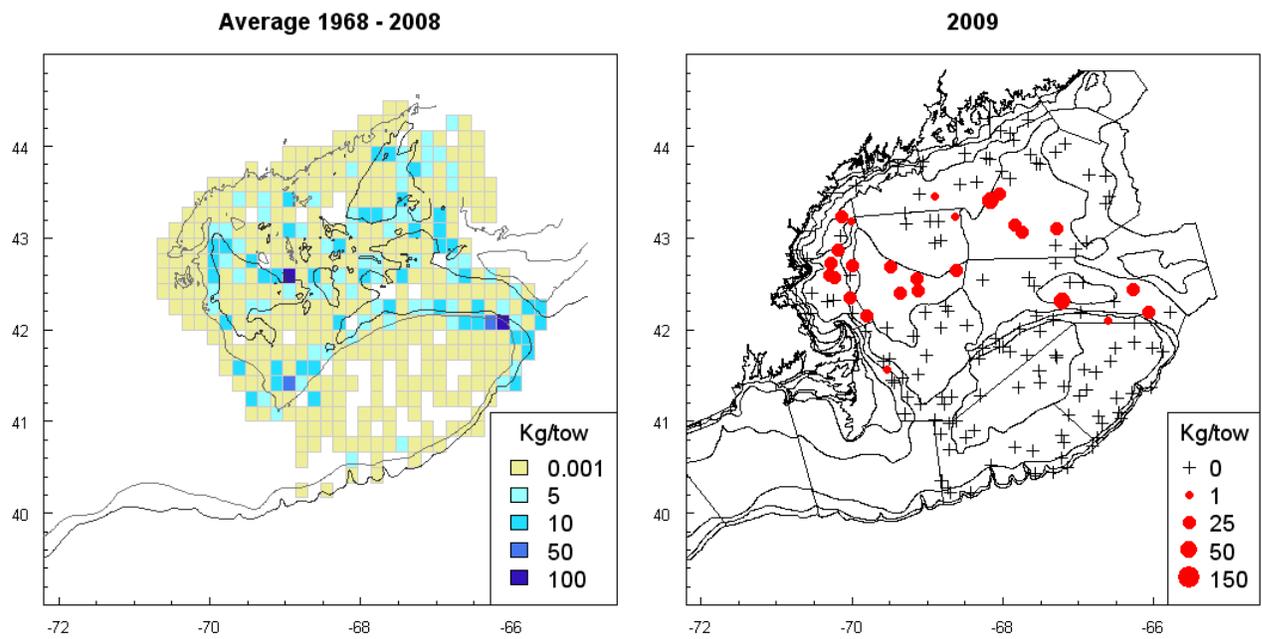
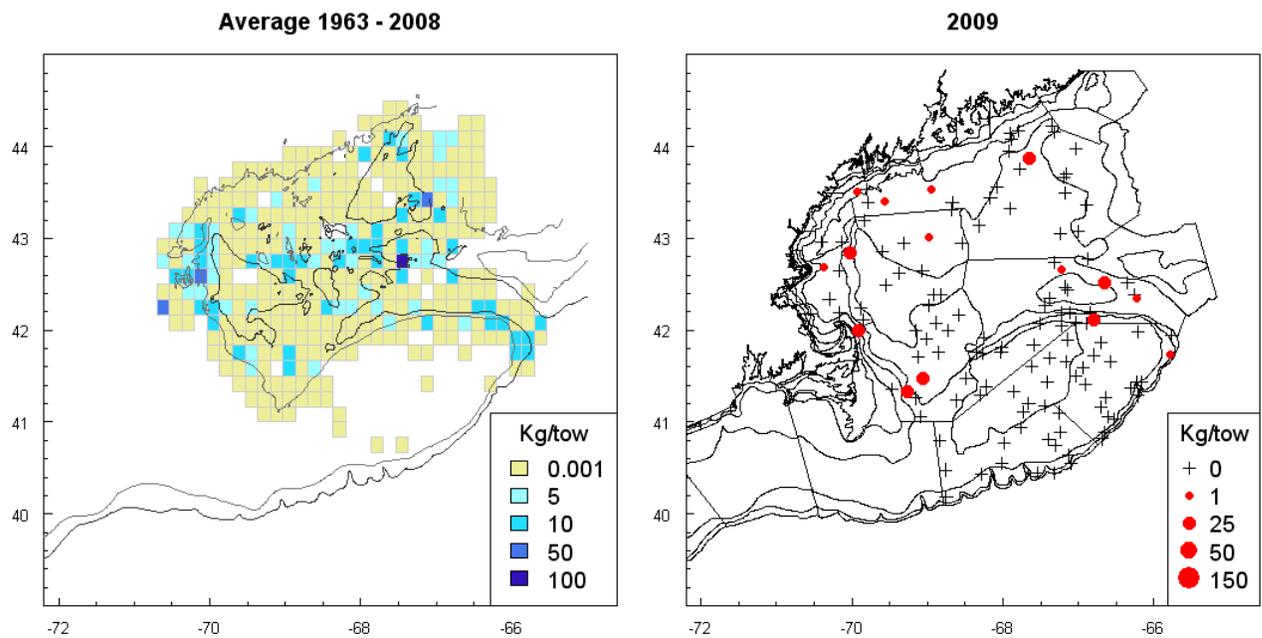


Figure C3. Spatial distribution of pollock larvae from January – March (1978-present).

Pollock in NEFSC Spring Survey

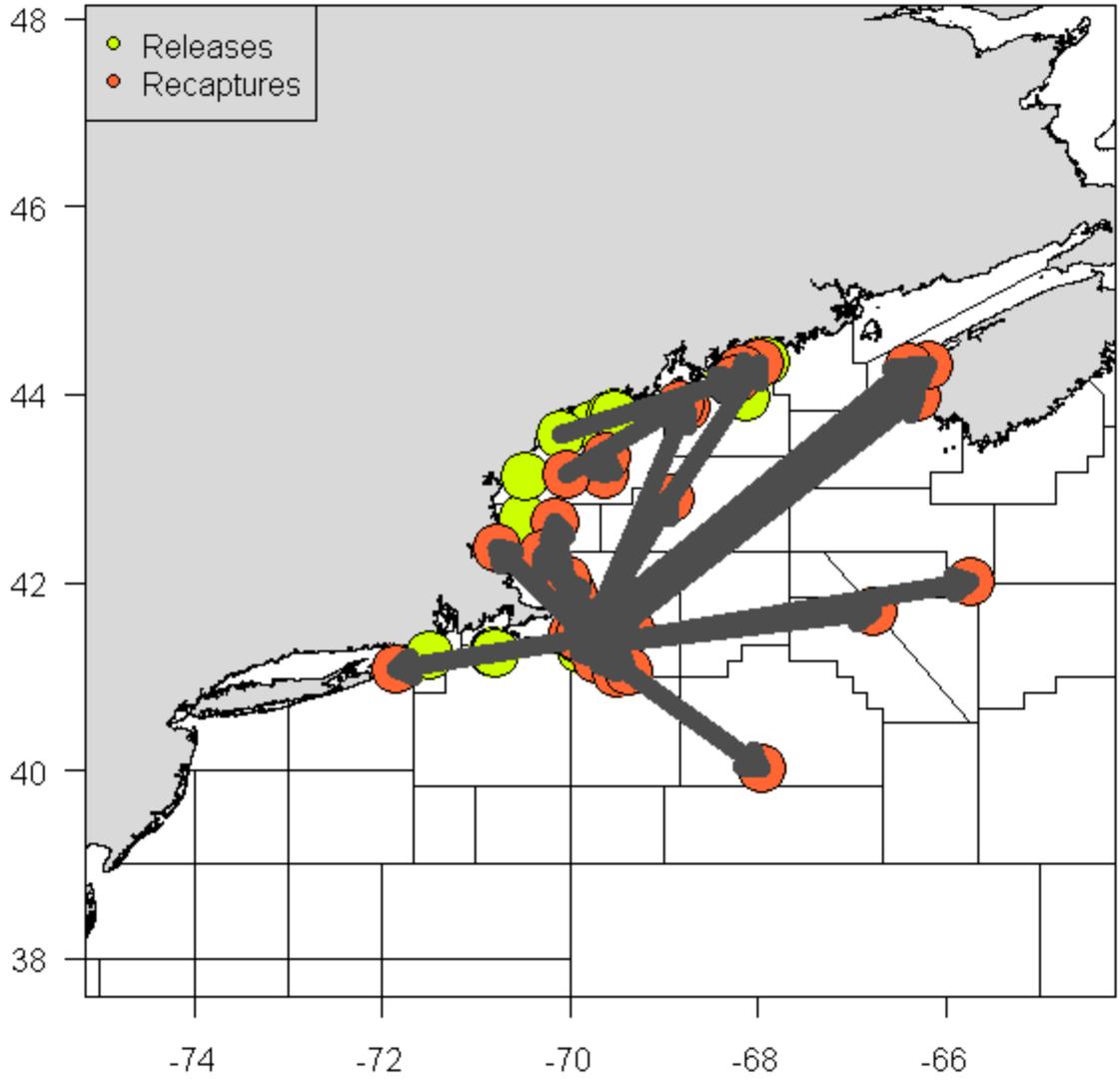


Pollock in NEFSC Fall Survey



C4. NEFSC bottom trawl survey distributions for spring (top) and fall (bottom) and the most recent survey (2009, right panels).

Schroeder Releases and Recaptures of Pollock (1923-1927)



C5. Preliminary analysis of schroeder tag releases and recaptures. The scale of the release and recapture circles is large, as are the connecting arrows, to convey the lack of fine-scale resolution on those locations.

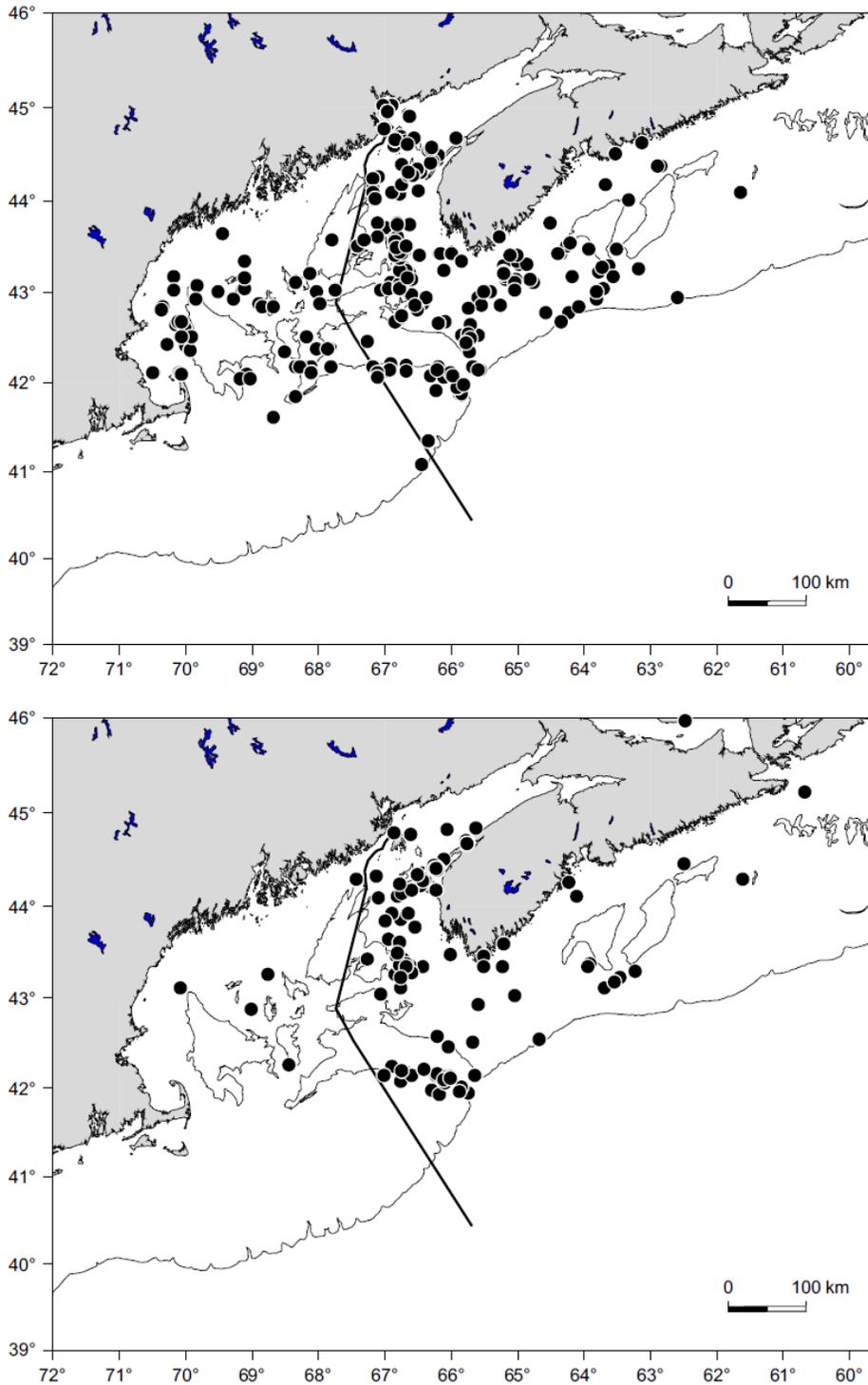


Figure C6a. The location of recaptures of marked pollock released in the eastern side of the Bay of Fundy (statistical Unit Area 4Xr, top panel), and the location of recaptured marked pollock released in the western side of the Bay of Fundy (statistical Unit Area 4Xs, bottom panel). (Figure 10 from Neilson et al. 2006; reprinted with permission from J.D.Neilson).

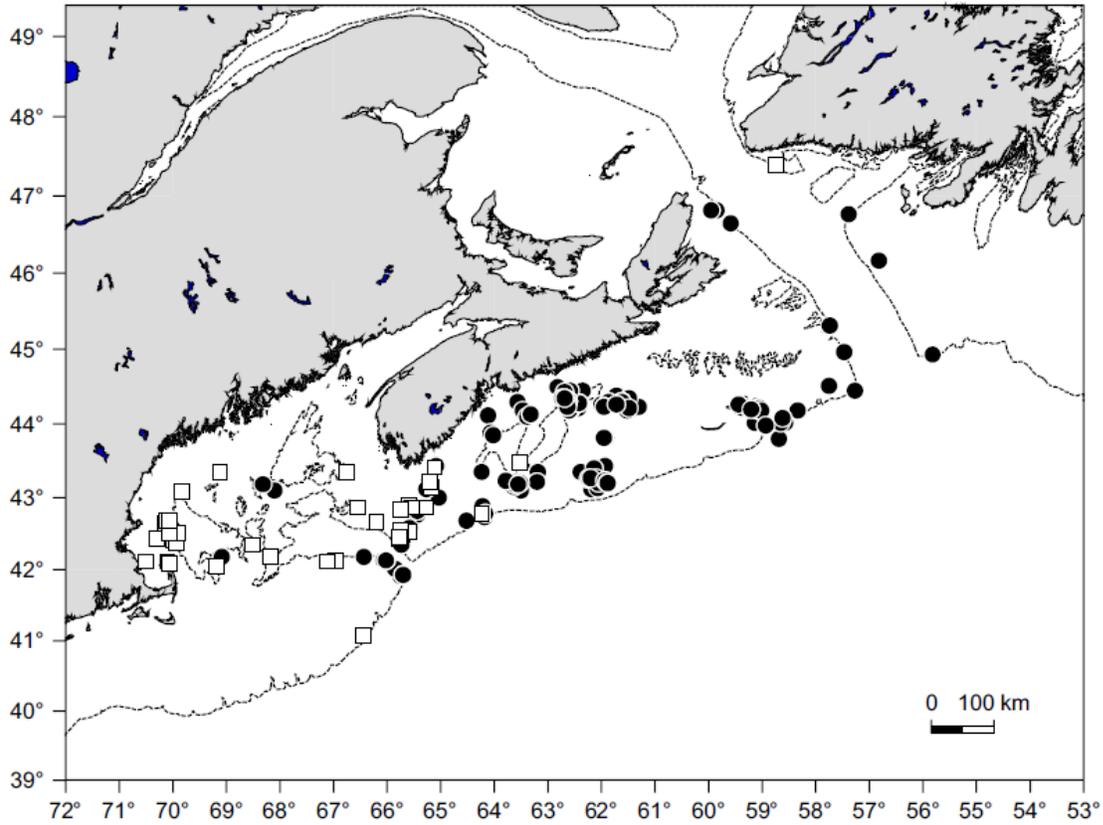
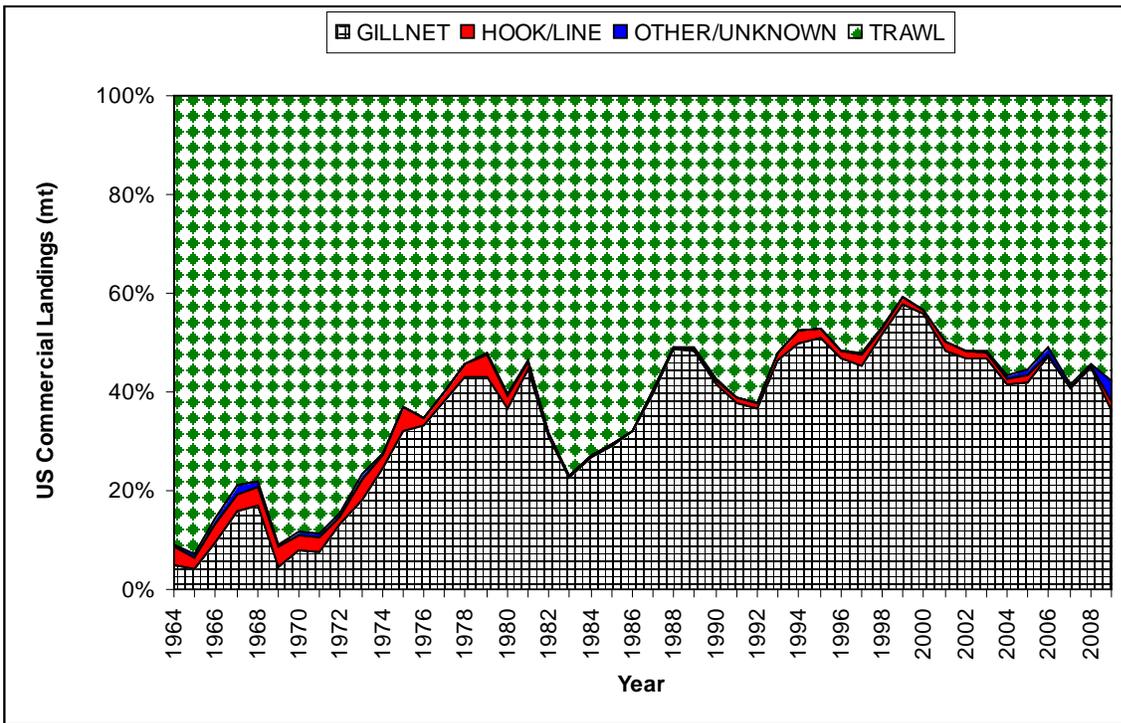
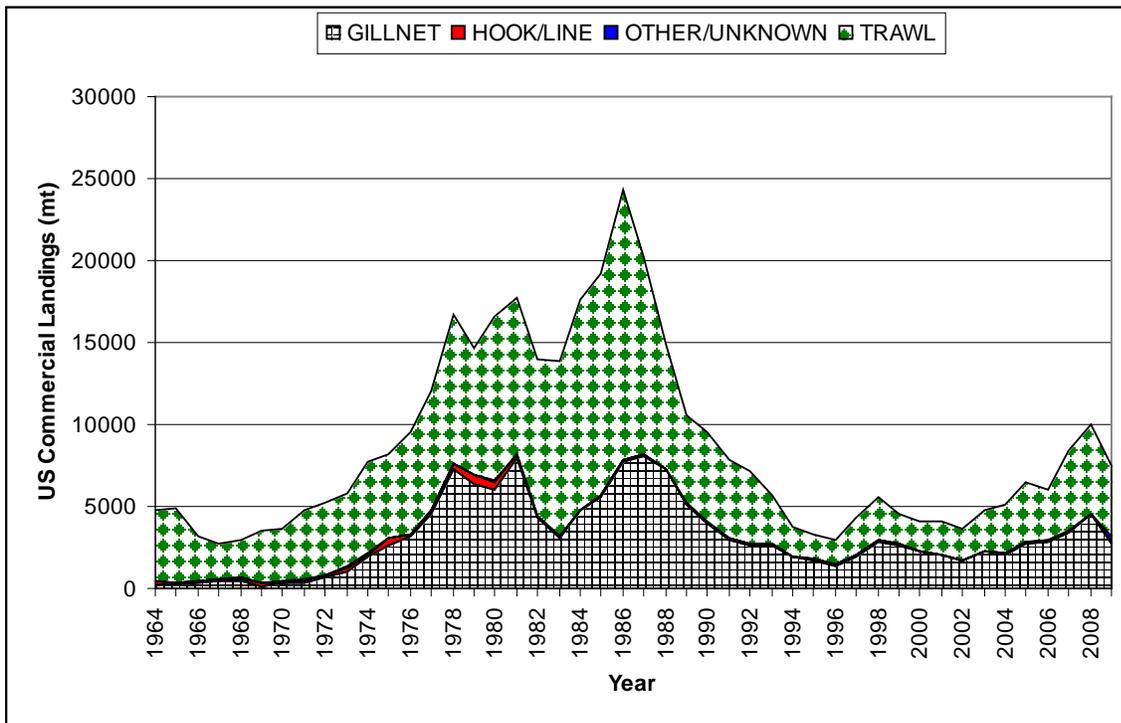
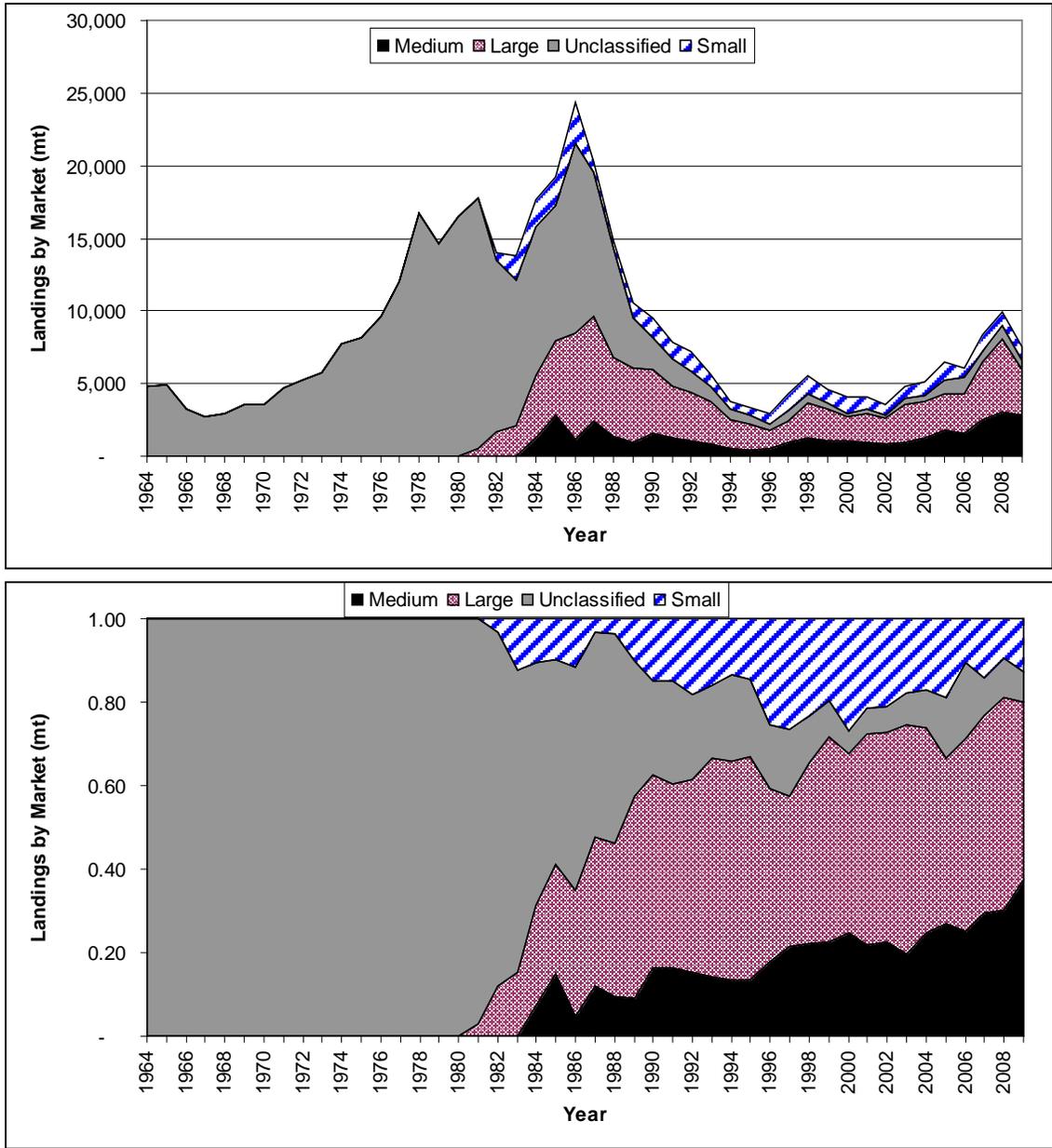


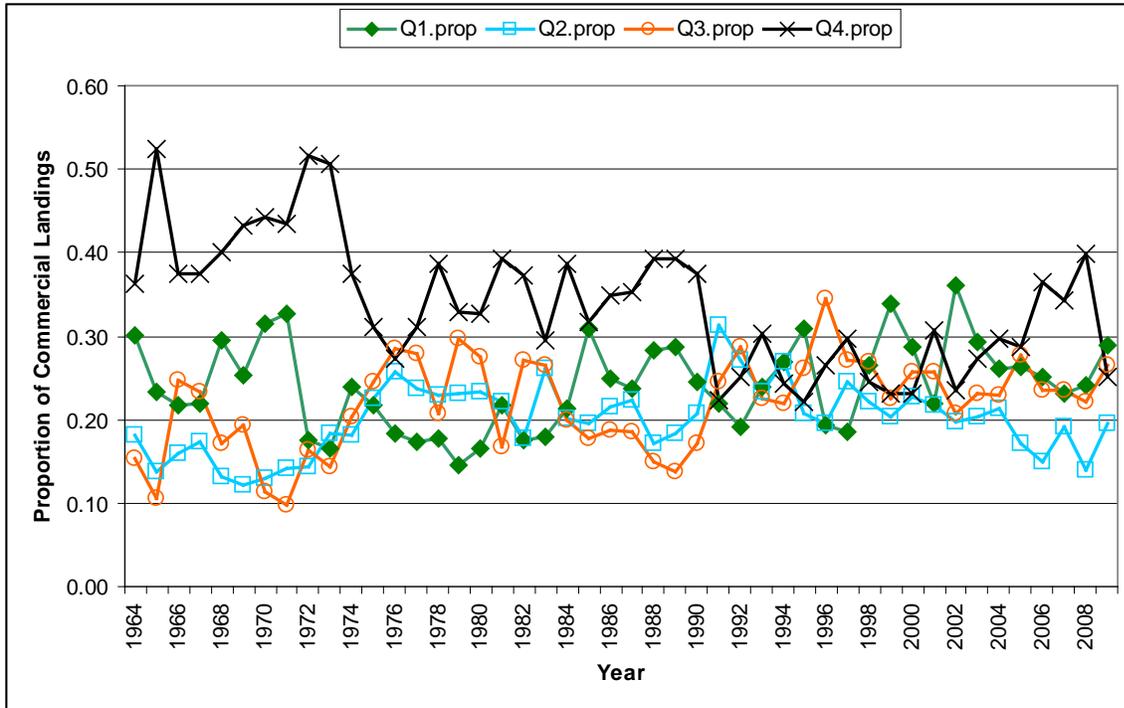
Figure C6b. Locations of recaptures of presumed spawners (>50 cm; recaptures made from November to February). Locations marked by an open square signify fish that were released near the western extremity of the management unit (4Xs; see Figure C1), and those locations marked with a filled circle signify fish that were released near the eastern extremity of the management unit (4Wd). (Figure 12 from Neilson et al. 2006; reprinted with permission from J.D.Neilson).



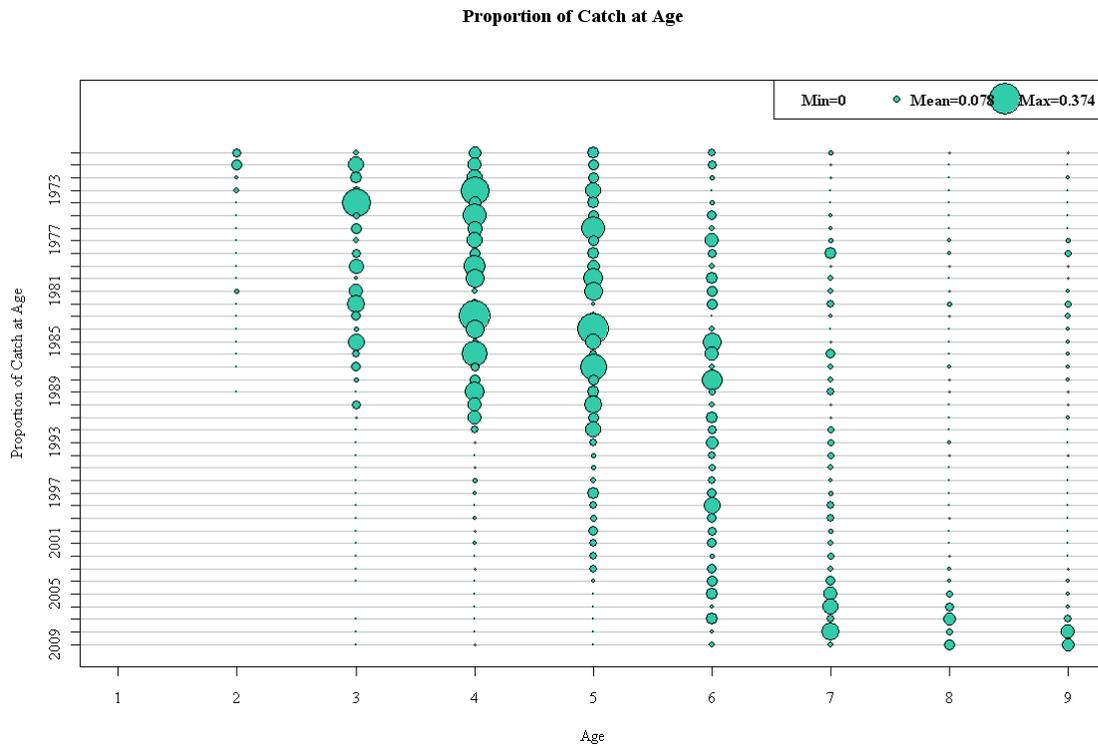
C7. US Commercial landings of pollock (mt) by gear.



C8. US commercial landings of pollock (mt) by market category.



C9. US commercial landings of pollock by quarter.



C10. Total commercial landings at age of pollock expressed as a proportion of total annual landings.

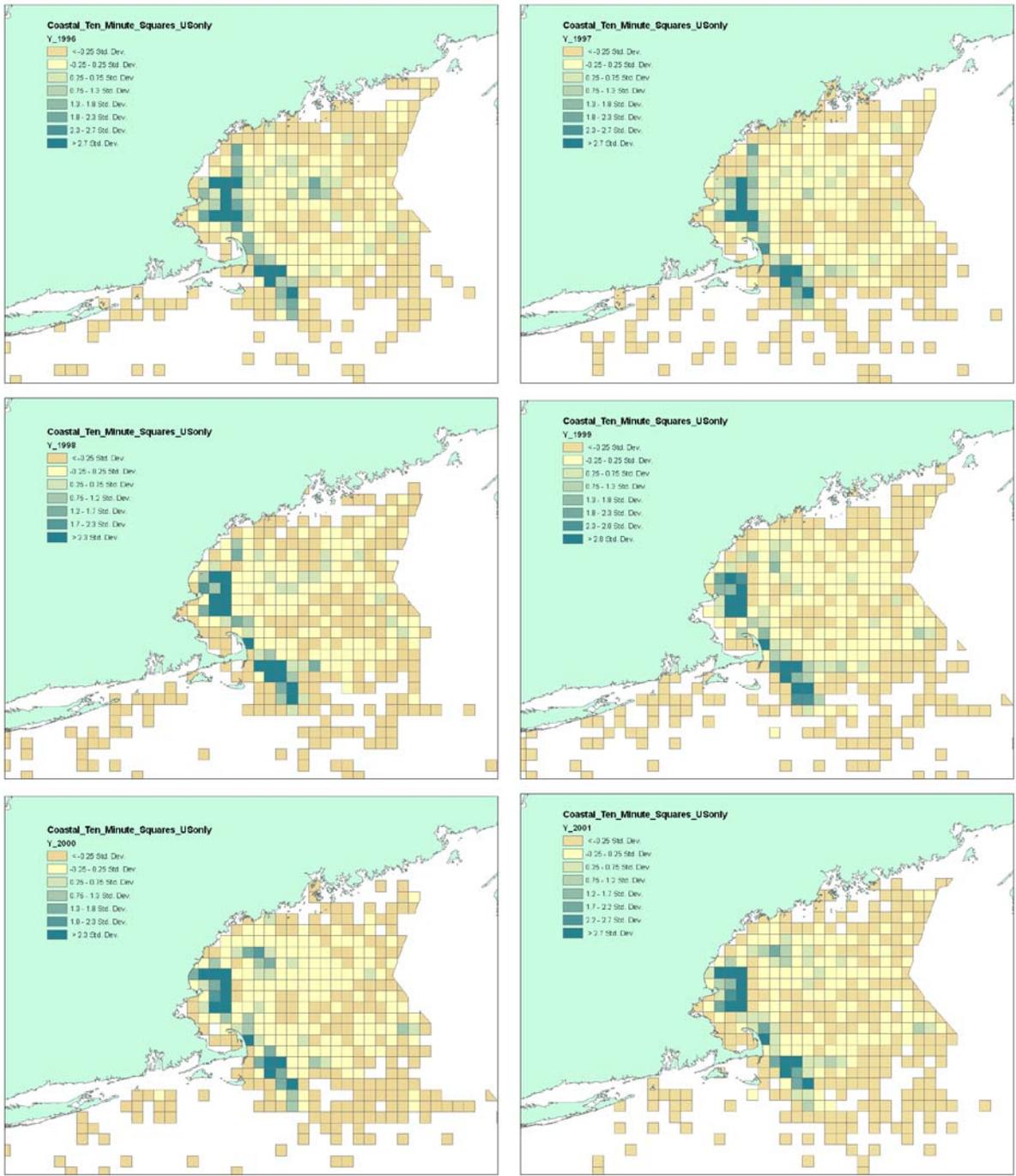


Figure C11. Sum of Trips Landing Pollock by VTR Area, 1996-2008 (Standard Deviation)

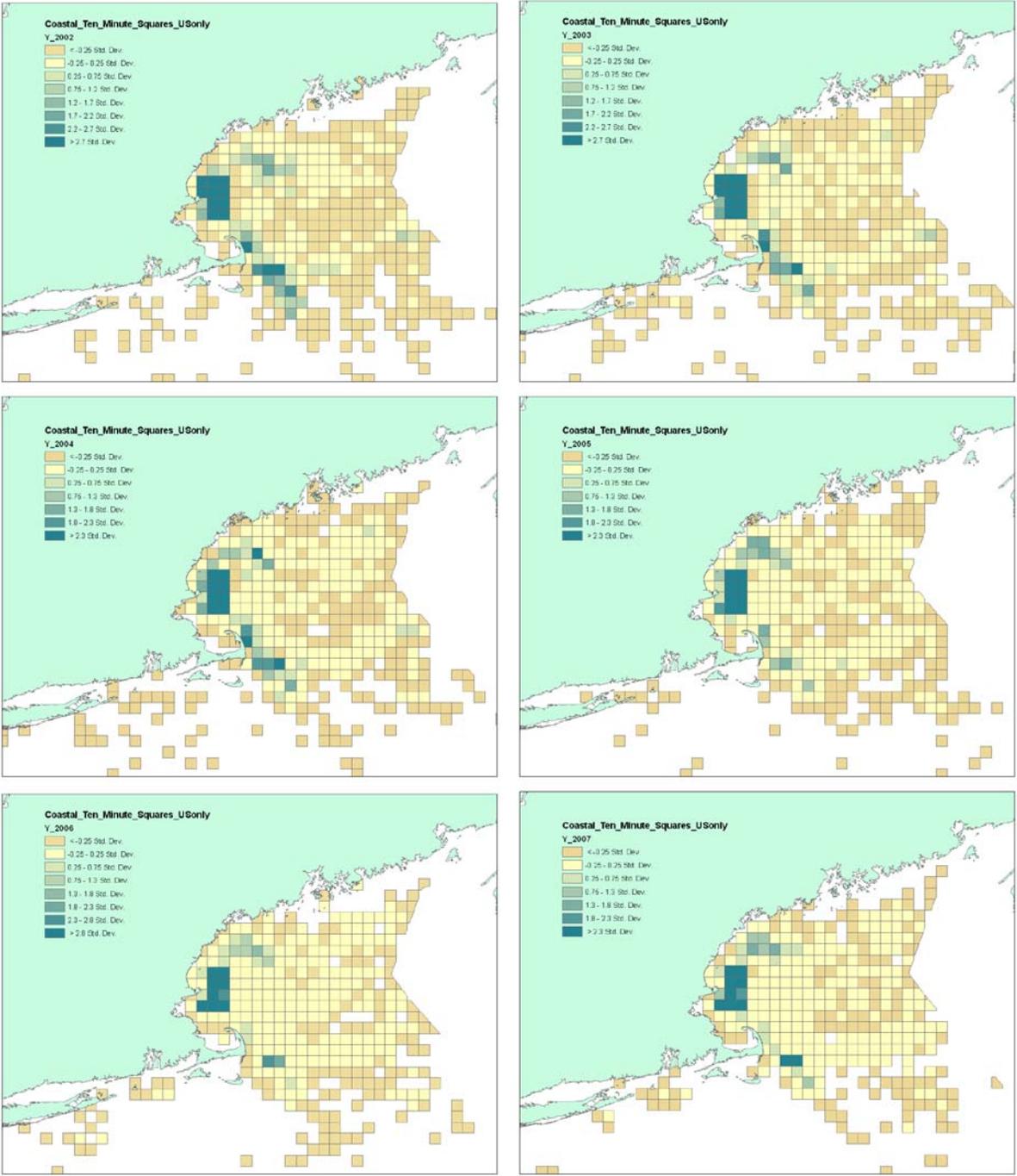


Figure C11. (cont.)

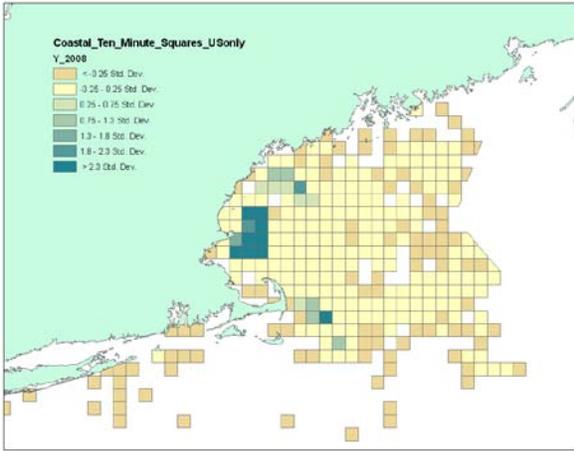


Figure C11. (cont)

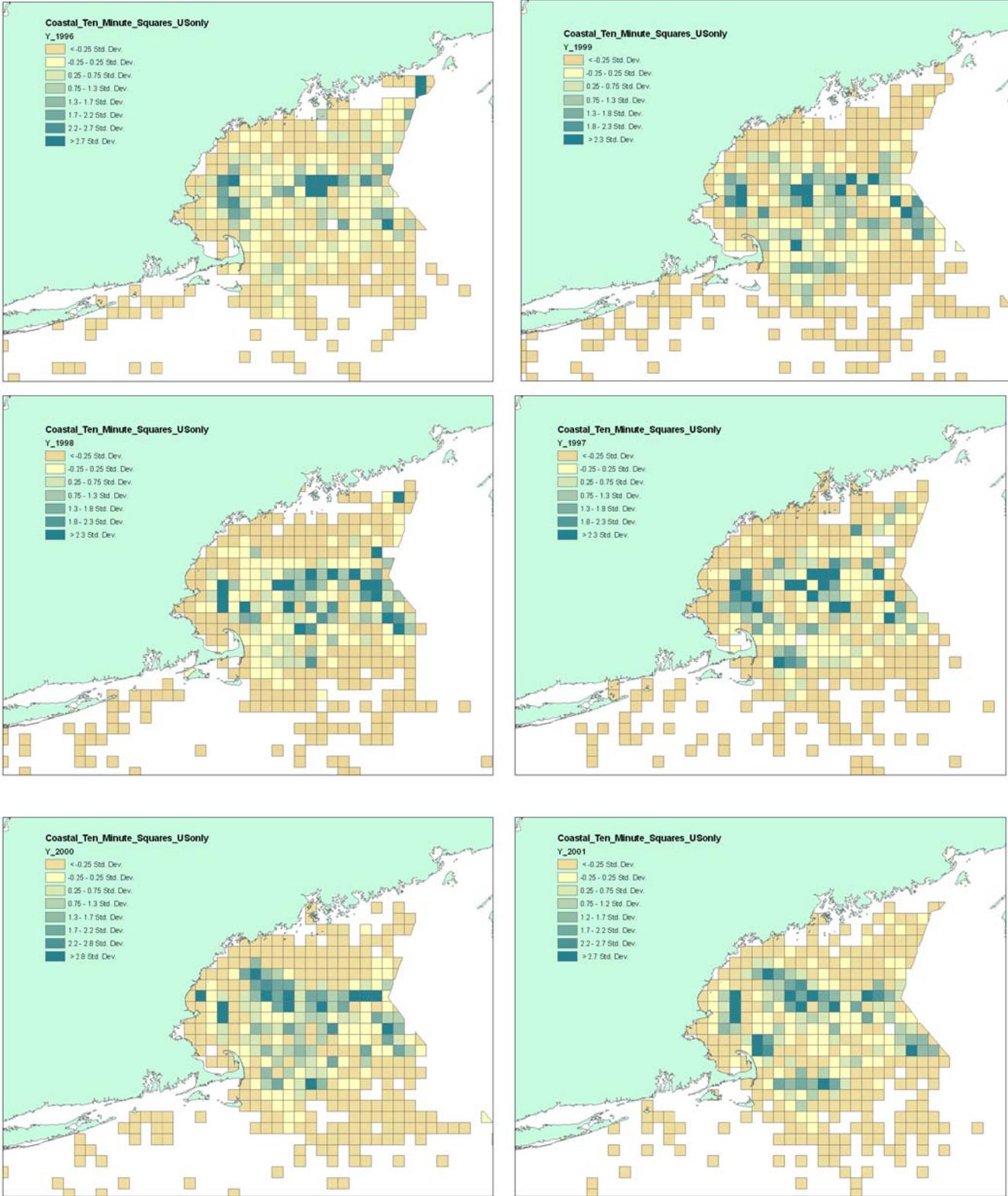


Figure C12. Pollock landed by VTR area, 1996-2008 (Standard Deviation).

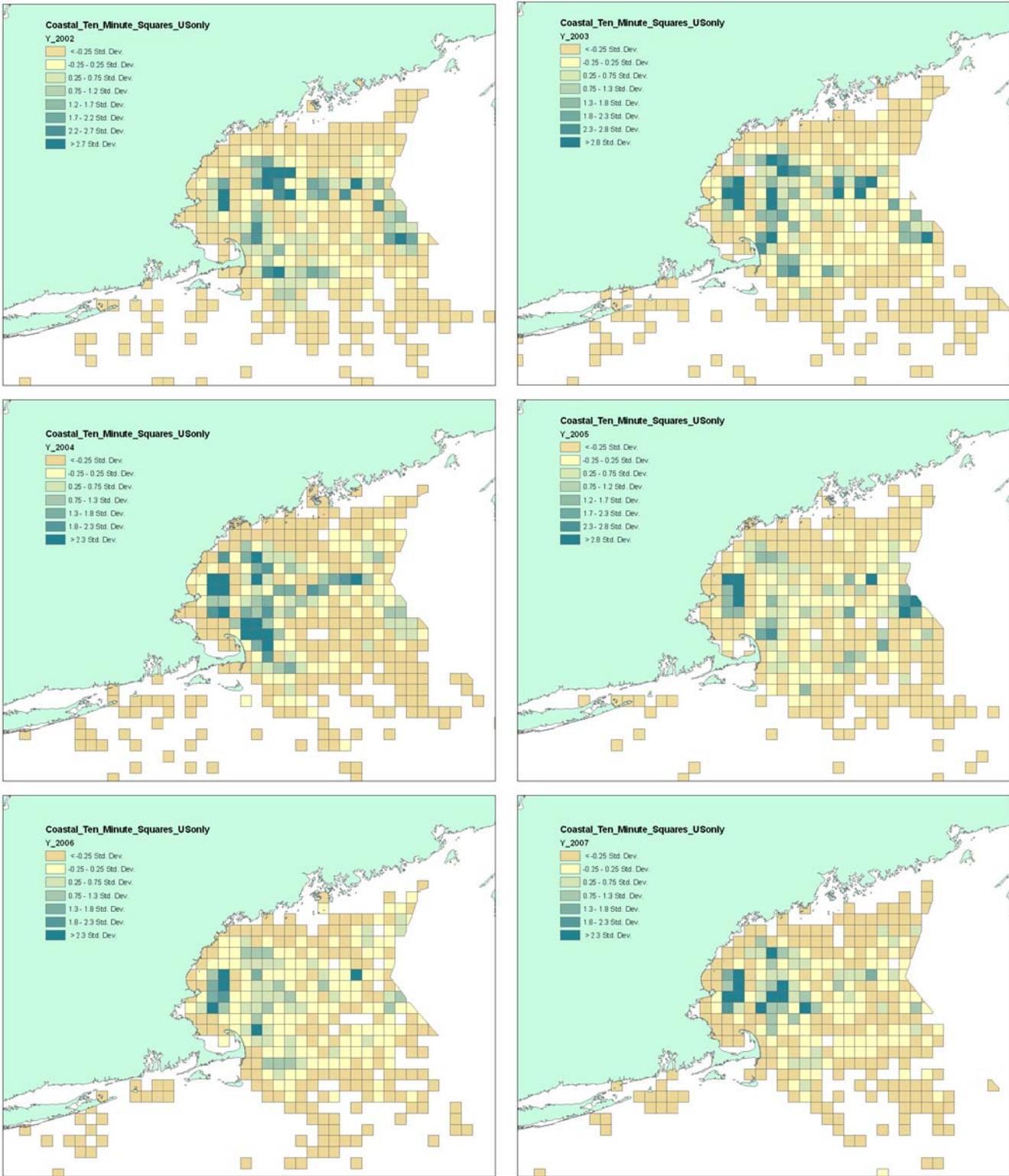


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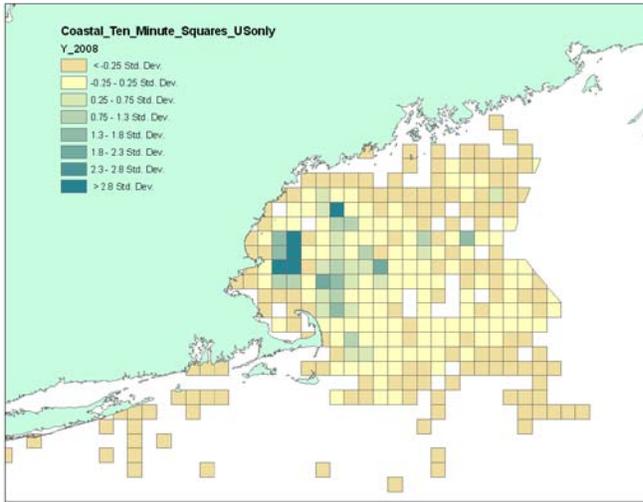
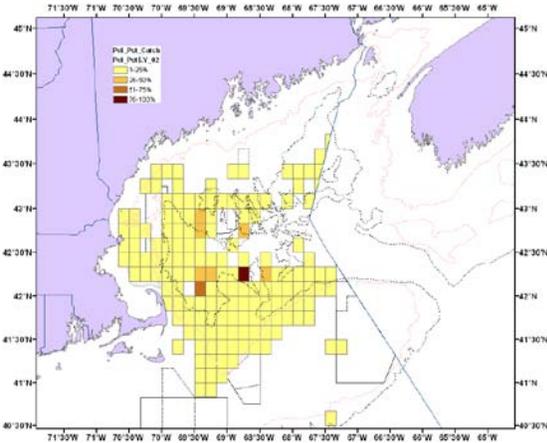
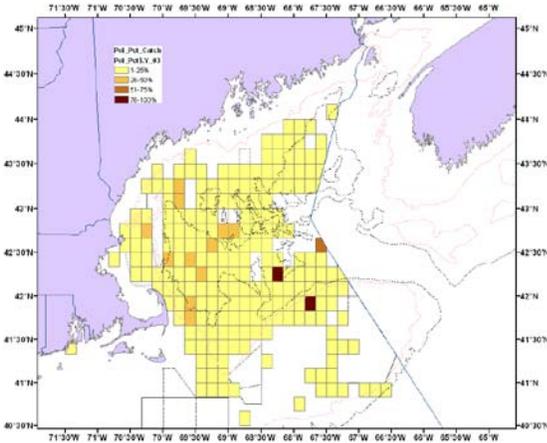


Figure C12. (cont.)

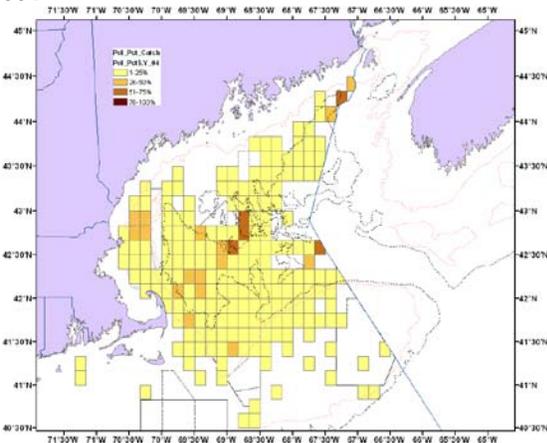
2002



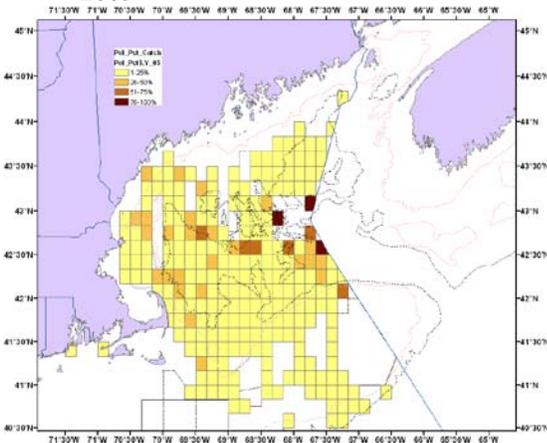
2003



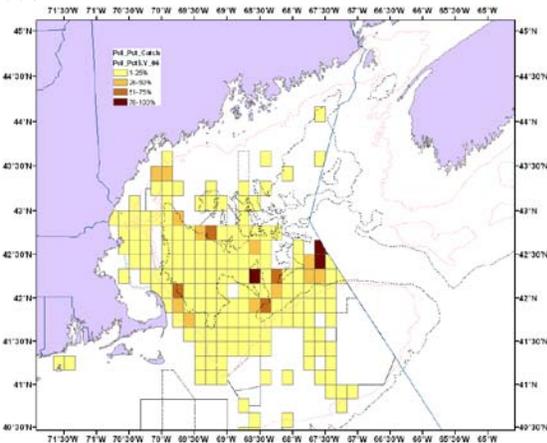
2004



2005



2006



2007

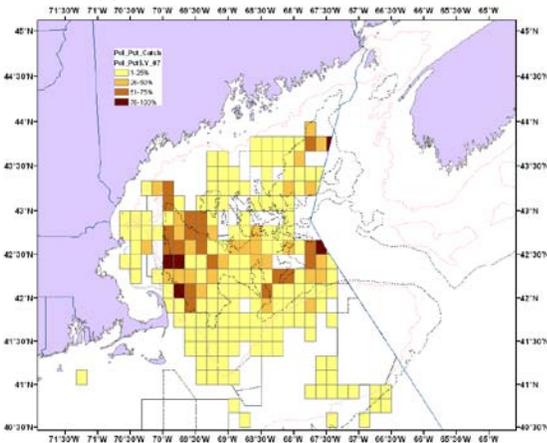
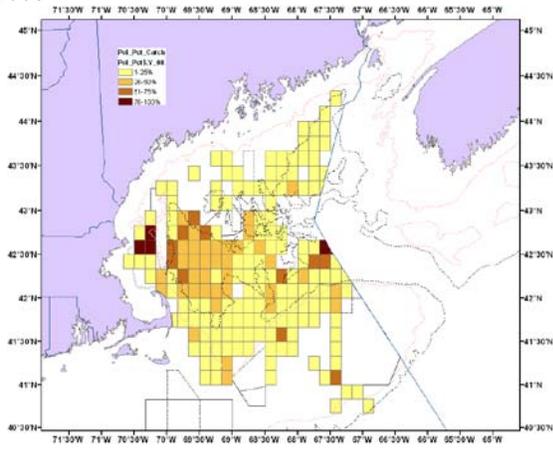


Figure C13. Pollock as a percent of the observed trawl catch in a ten-minute square, 2002-2009.

2008



2009

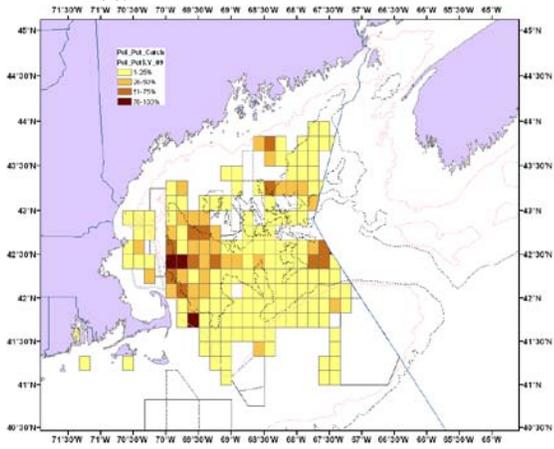
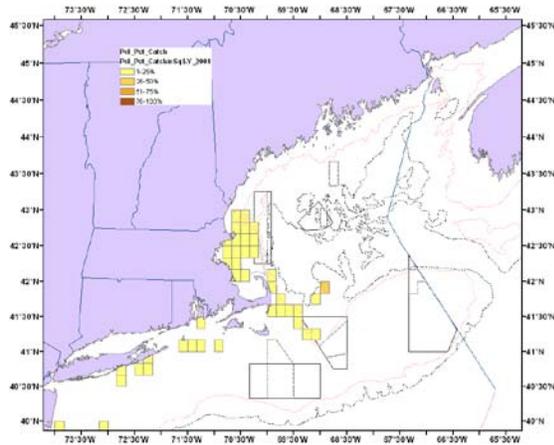
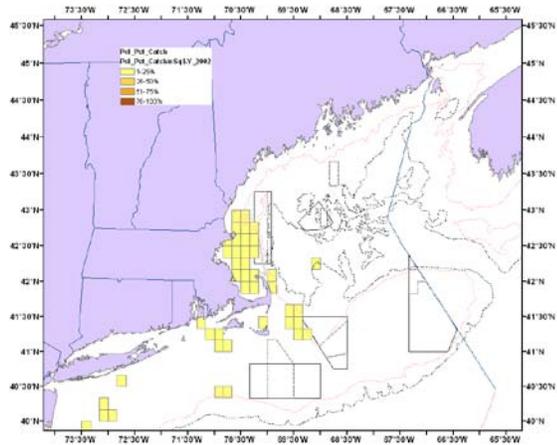


Figure C13. (cont.)

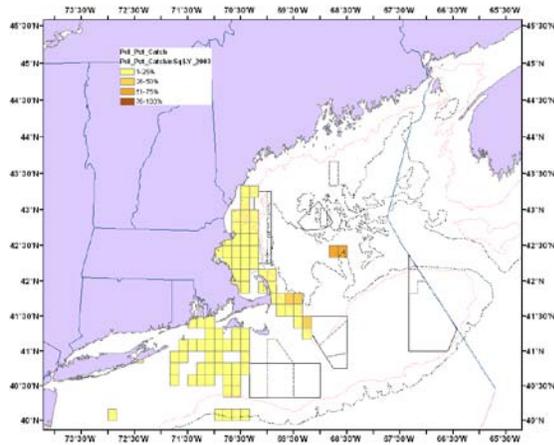
2001



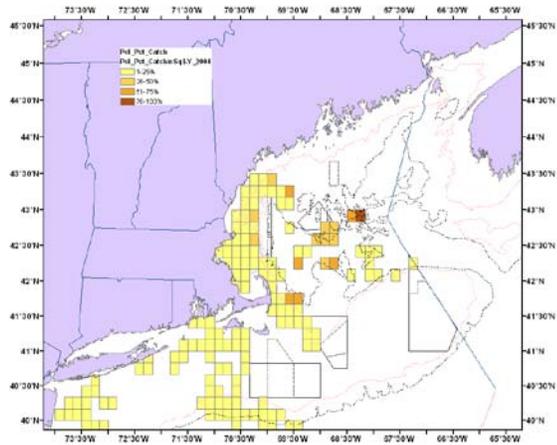
2002



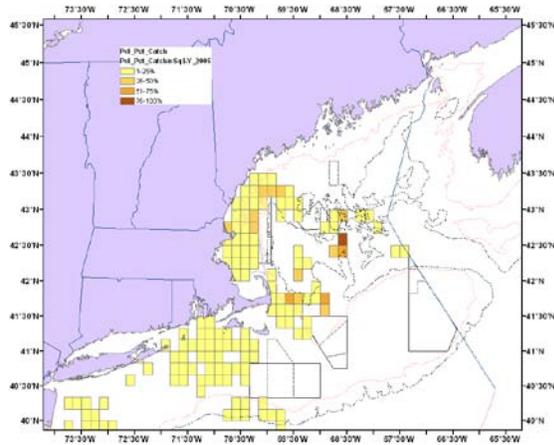
2003



2004



2005



2006

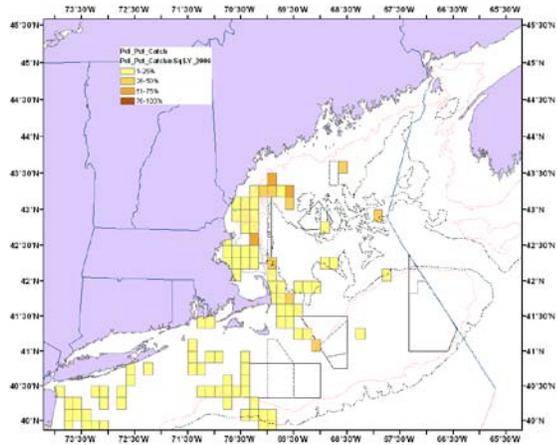
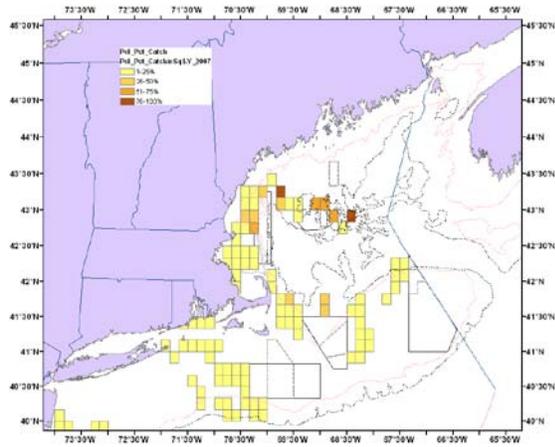
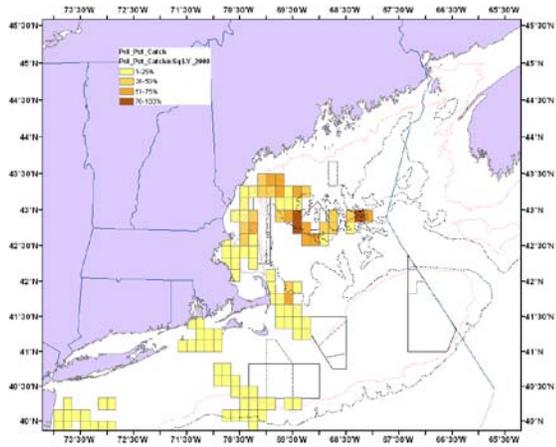


Figure C14. Pollock as percent of sink gillnet catch, 2001 – 2009.

2007



2008



2009

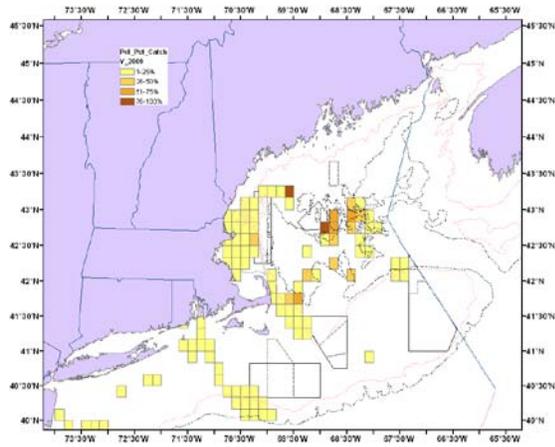
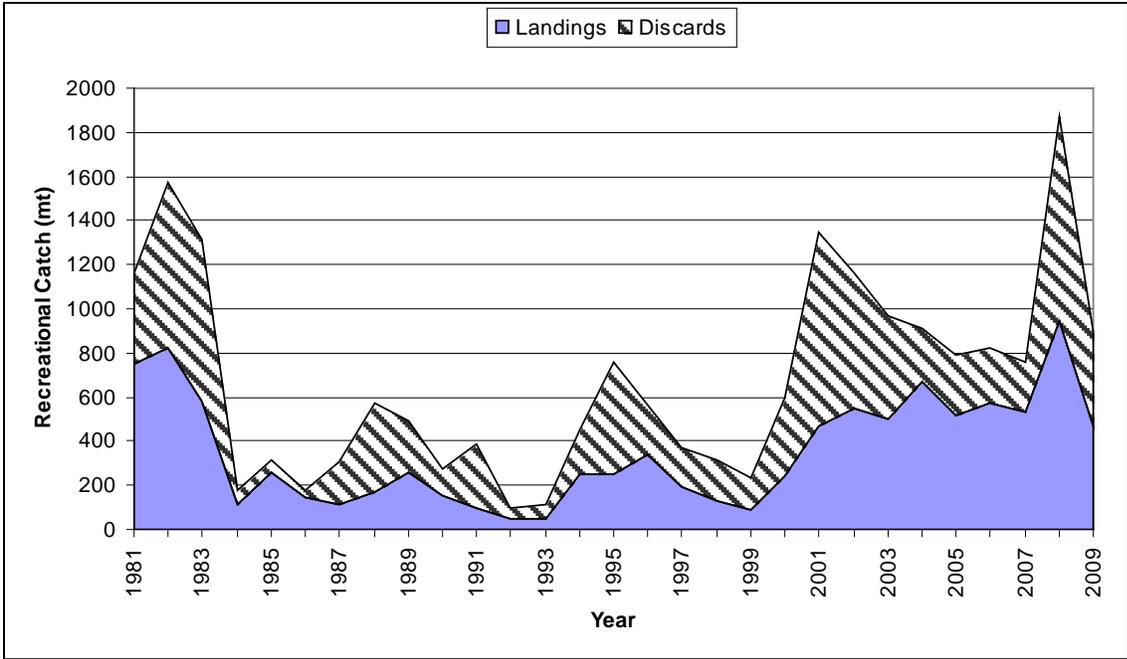
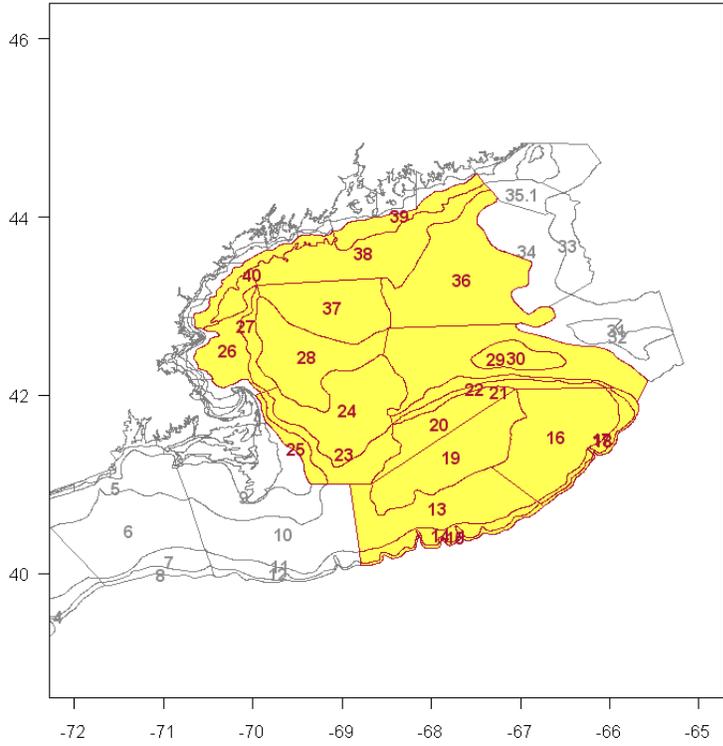


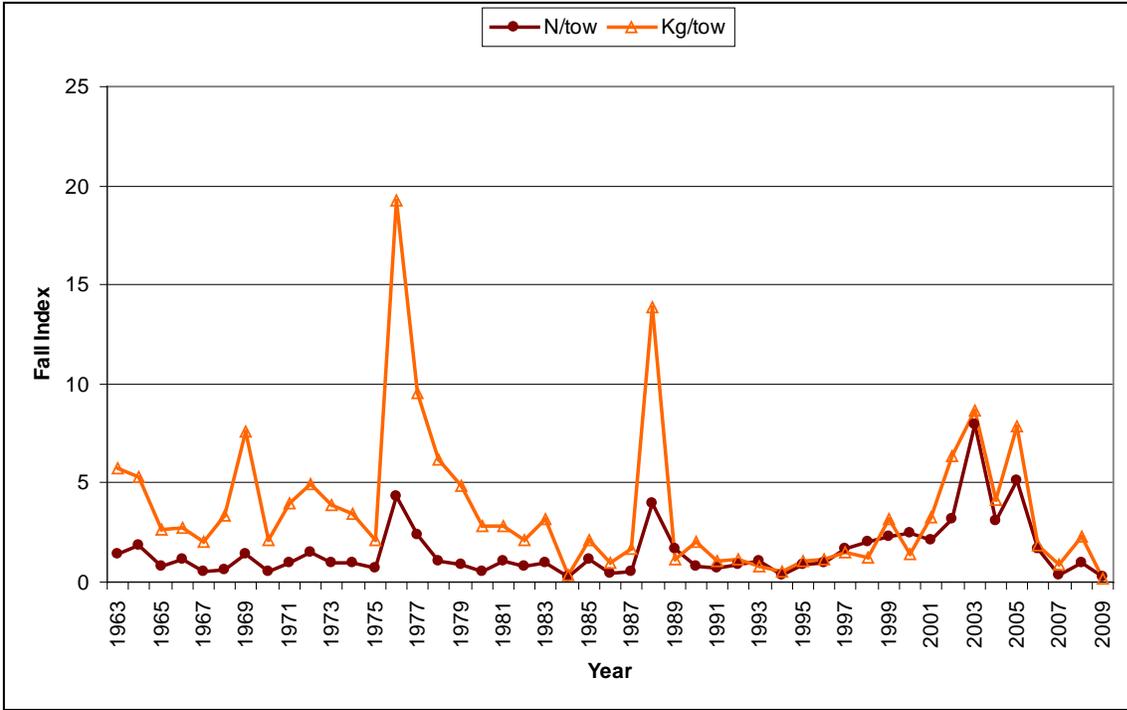
Figure C14. (cont.)



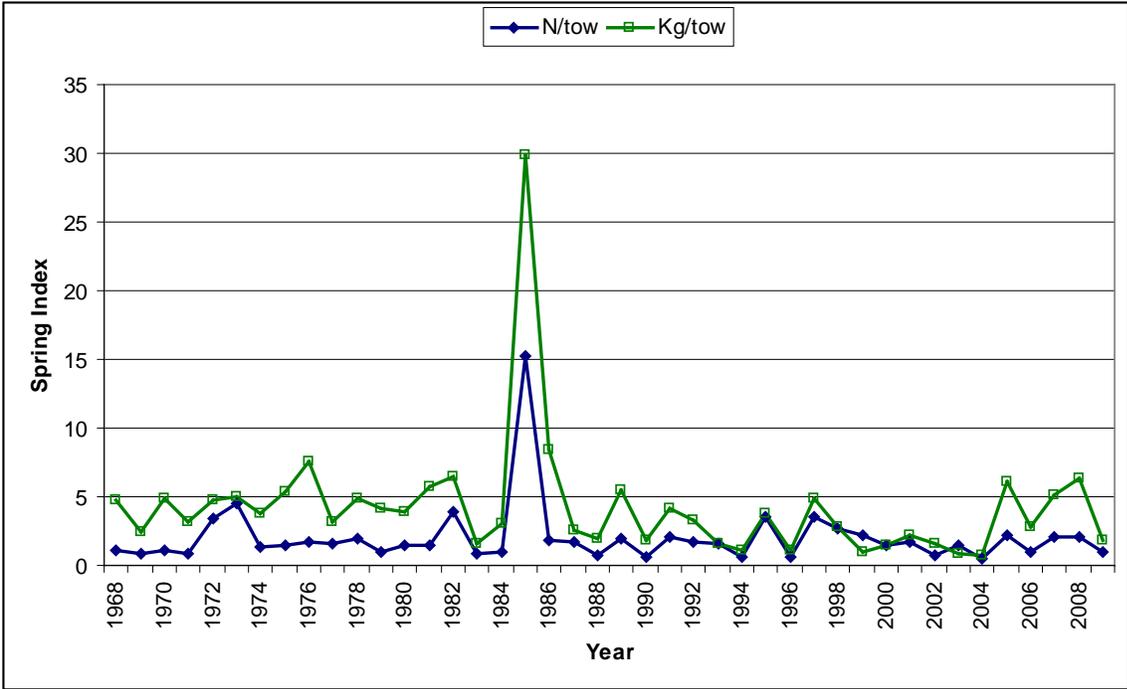
C15. US recreational catch (mt) of pollock.



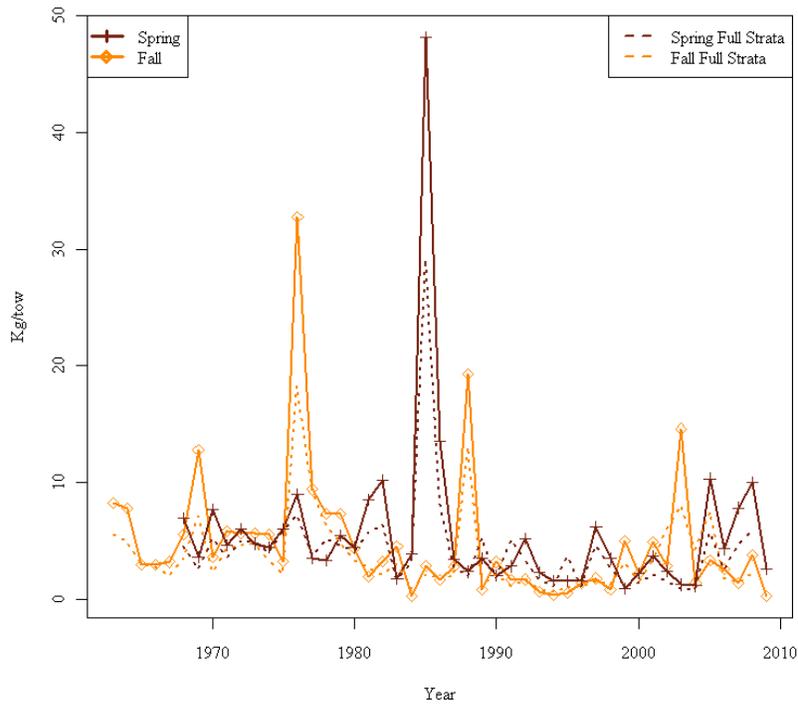
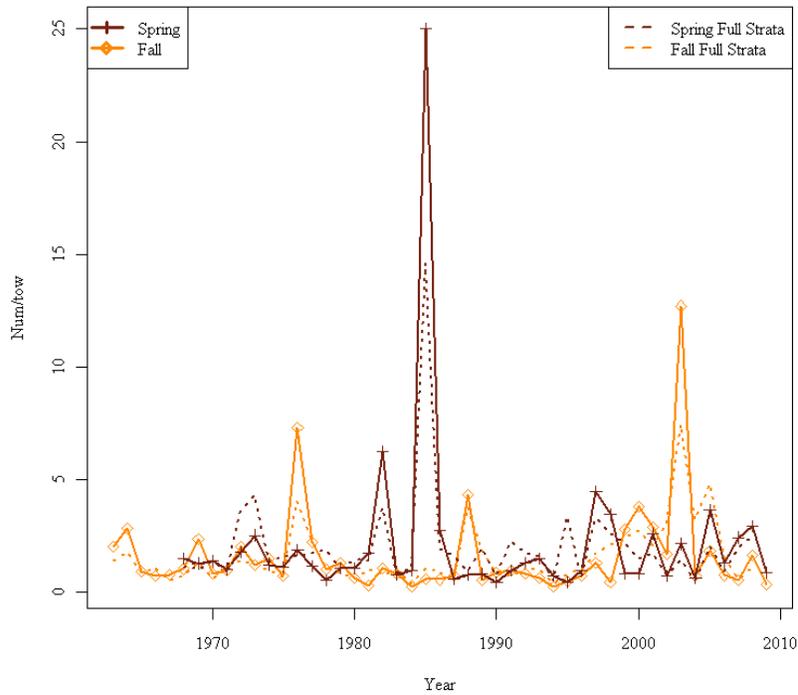
C16. NEFSC bottom trawl survey strata used to represent the pollock stock.



C17. NEFSC bottom trawl fall survey index.



C18. NEFSC bottom trawl spring survey index.



C19. Comparison of NEFSC spring and fall bottom trawl survey indices for Pollock in strata (13-30, 36-40) versus pollock in the deep strata (23-24, 27-30, 36-38).

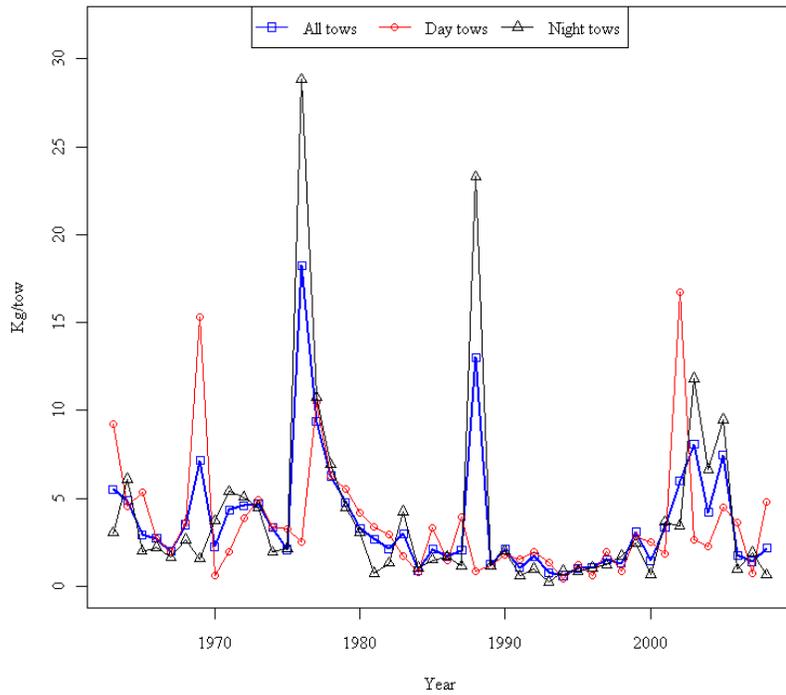
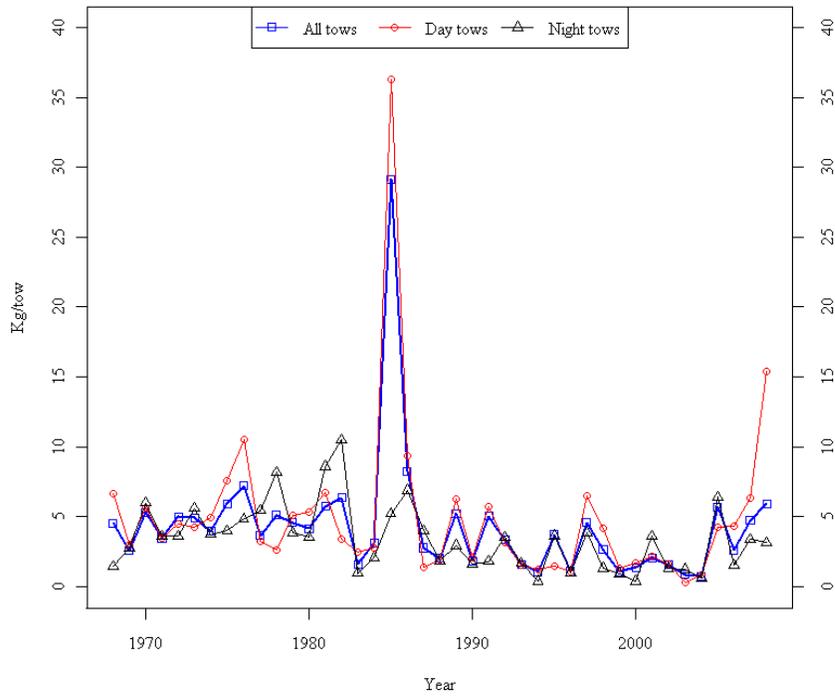


Figure C20. Comparison of NEFSC bottom trawl survey indices for Pollock in the spring (top) or fall (bottom). In blue is the index using all tows, while daylight tows are plotted in red and night tows are plotted in black.

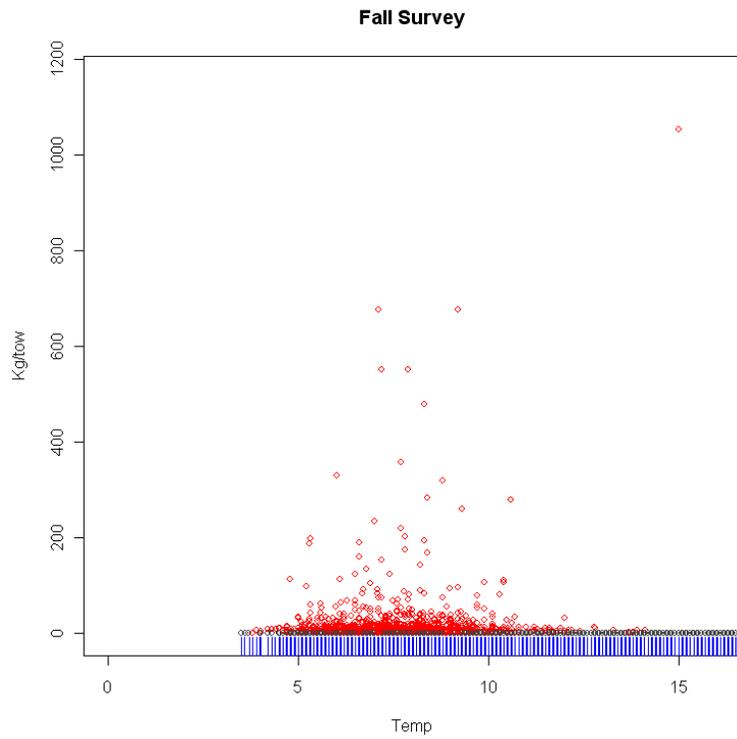
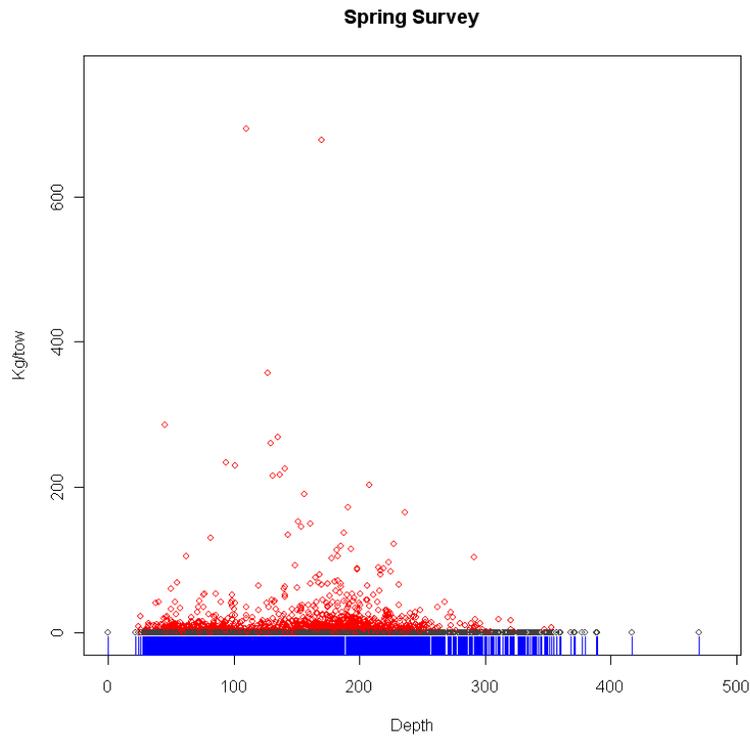


Figure C21. Plot of bottom temperature on a given tow and the corresponding kg/tow of Pollock. Red circles are nonzero, black circles are zero tows, and the blue vertical lines are a ‘rug plot’ to indicate the number of observations at a given temperature.

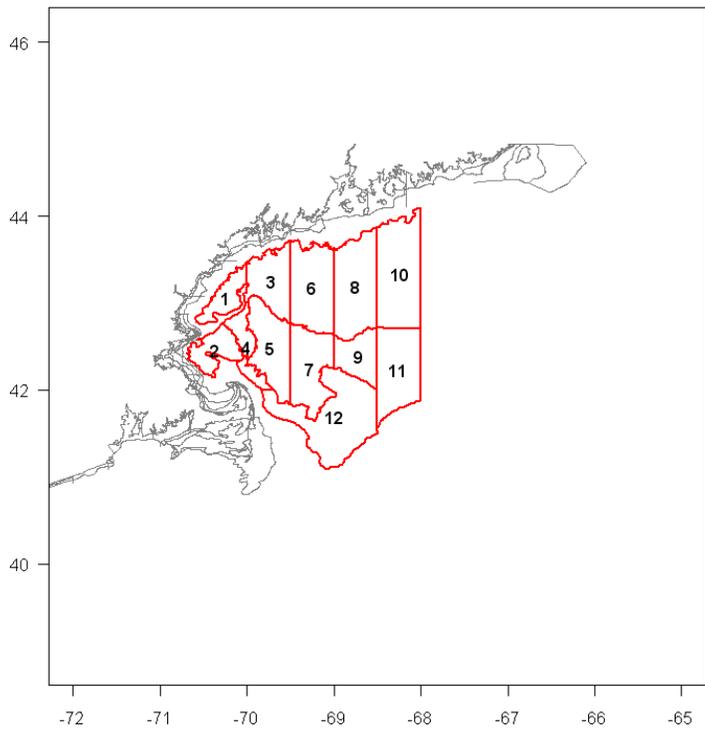


Figure C22. NEFSC summer survey strata in the Gulf of Maine.

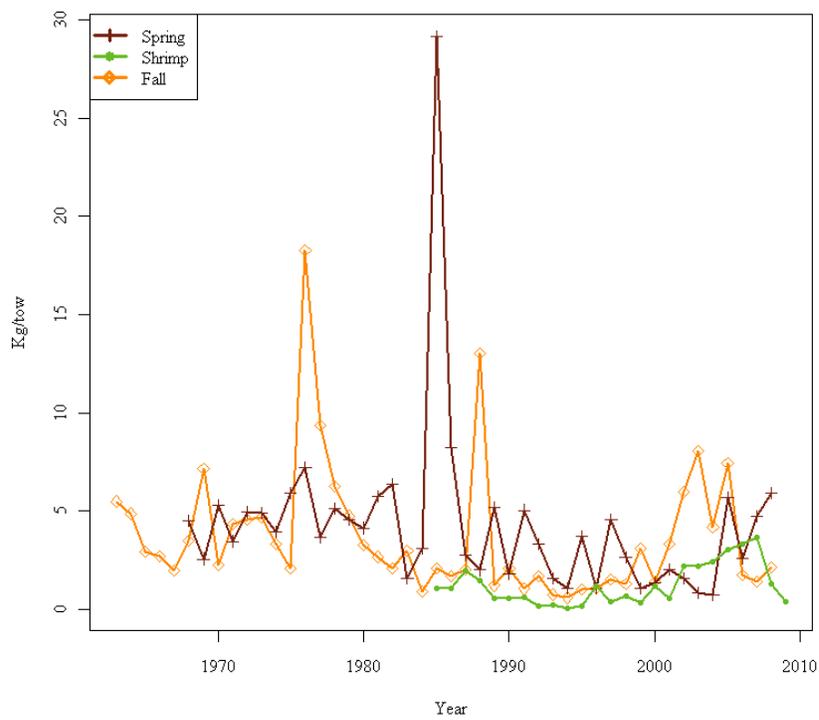
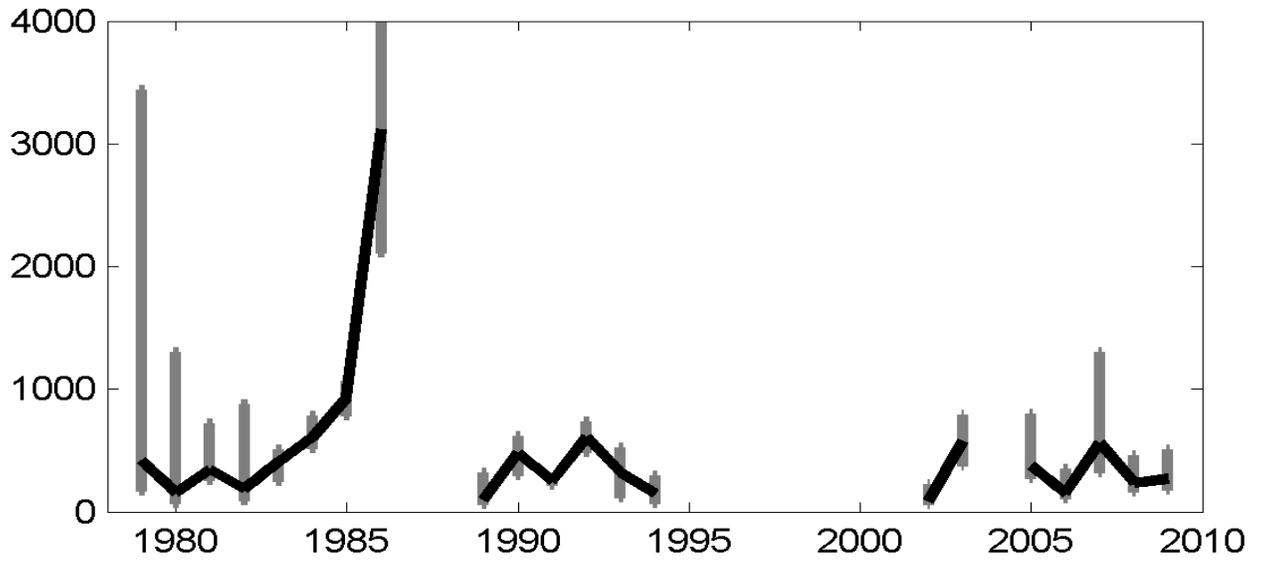


Figure C23. NEFSC fall, spring and summer survey indices for pollock.



C24. Larval index for pollock from ichthyoplankton data, which could be used as an index of spawning biomass. Units are number per 10m².

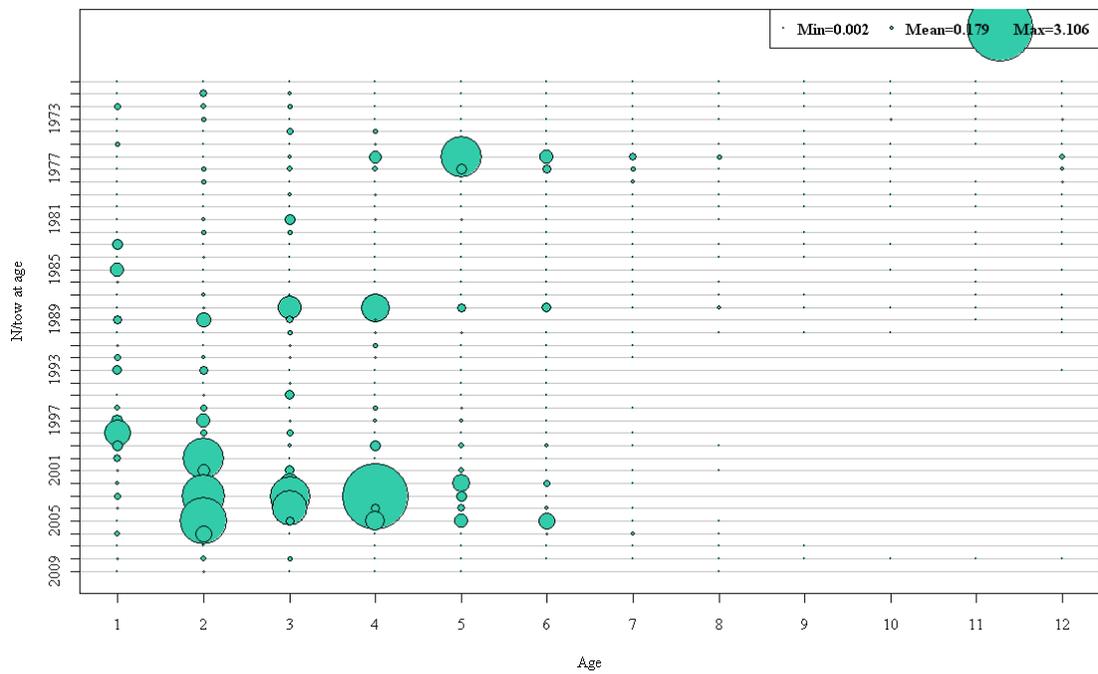
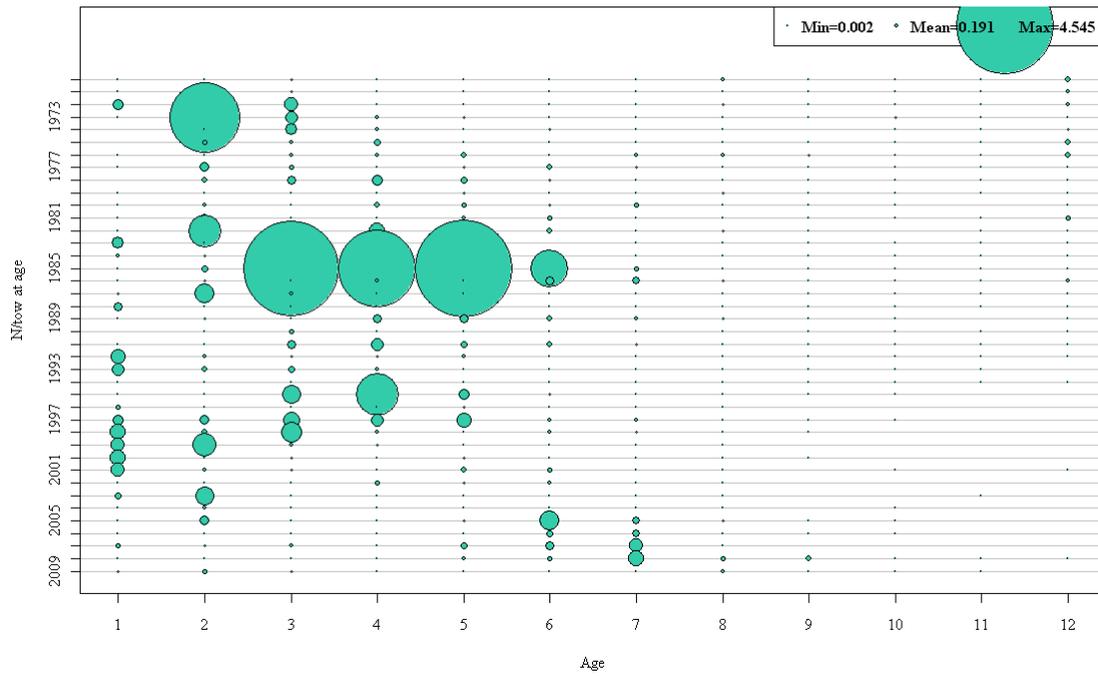


Figure C25. Survey age structure in the NEFSC spring (top) and the NEFSC fall (bottom).

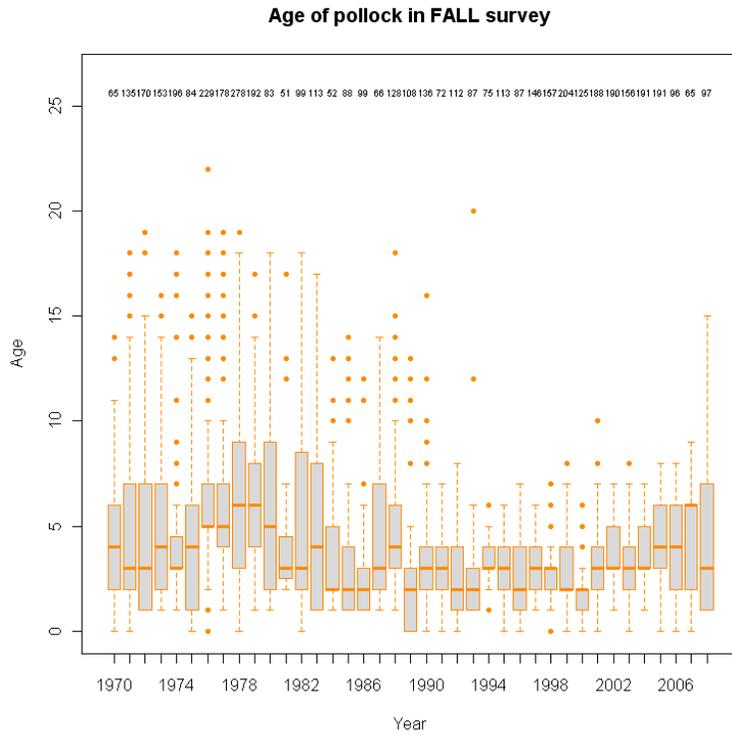
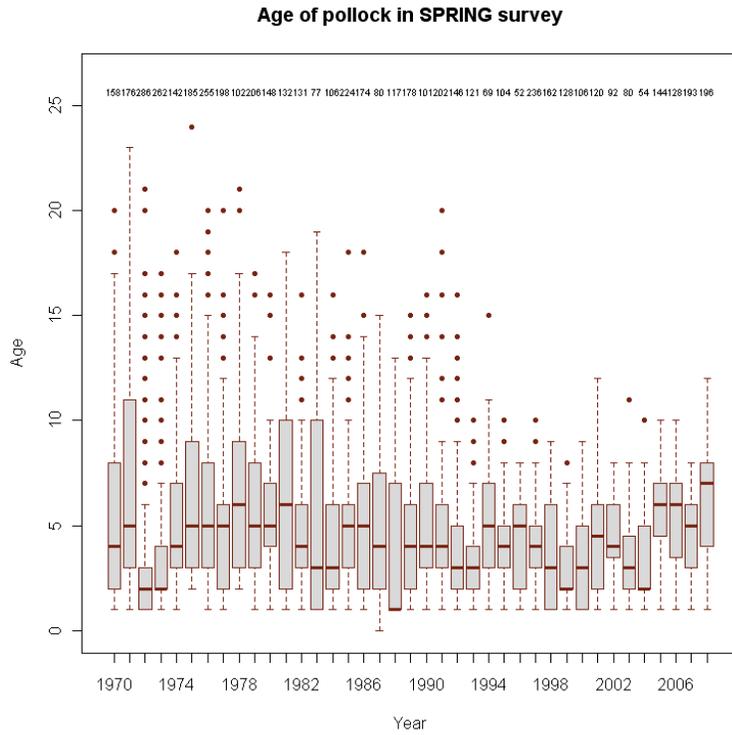
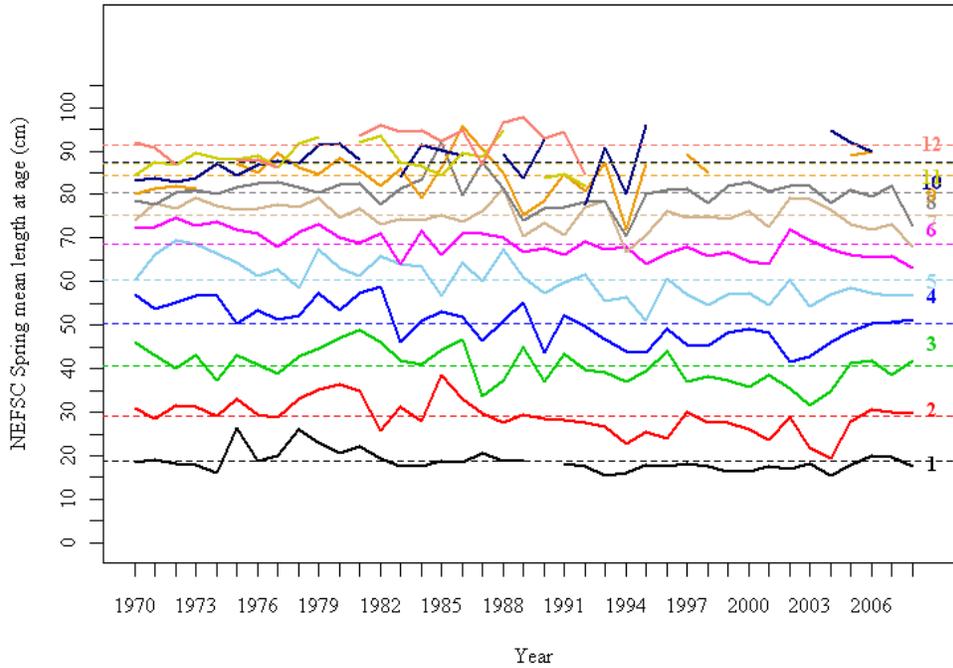


Figure C26. Annual box-plot of NEFSC bottom trawl spring and fall survey age structure.

Spring Survey Mean Length at age



Fall Survey Mean Length at age

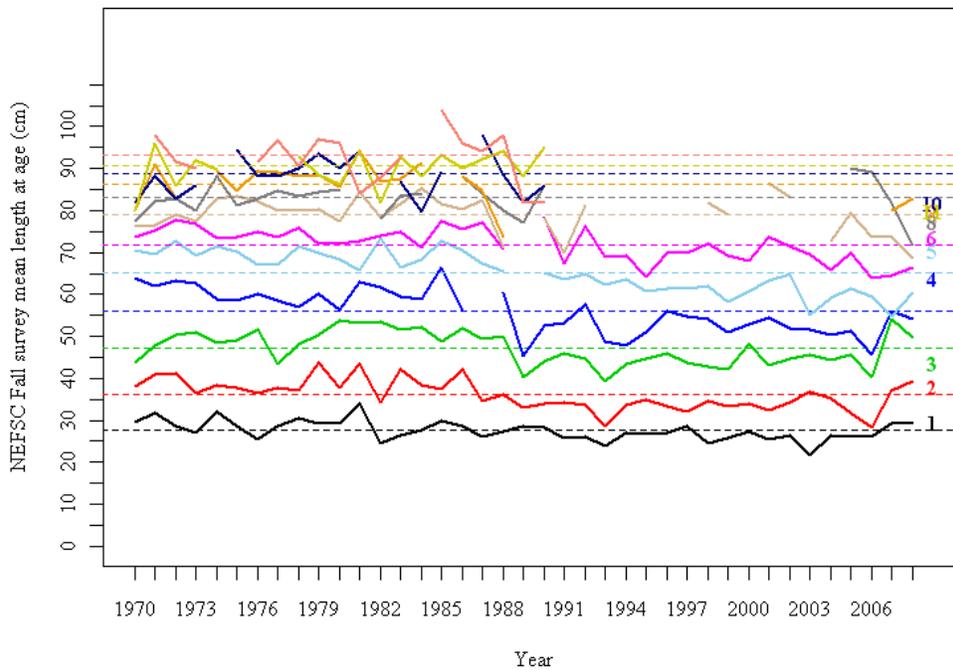


Figure C27. Mean size at age (cm) of pollock from length samples in the NEFSC bottom trawl spring and fall surveys. For each age, the time series mean length is plotted with a dashed line in the same color as the mean length trend.

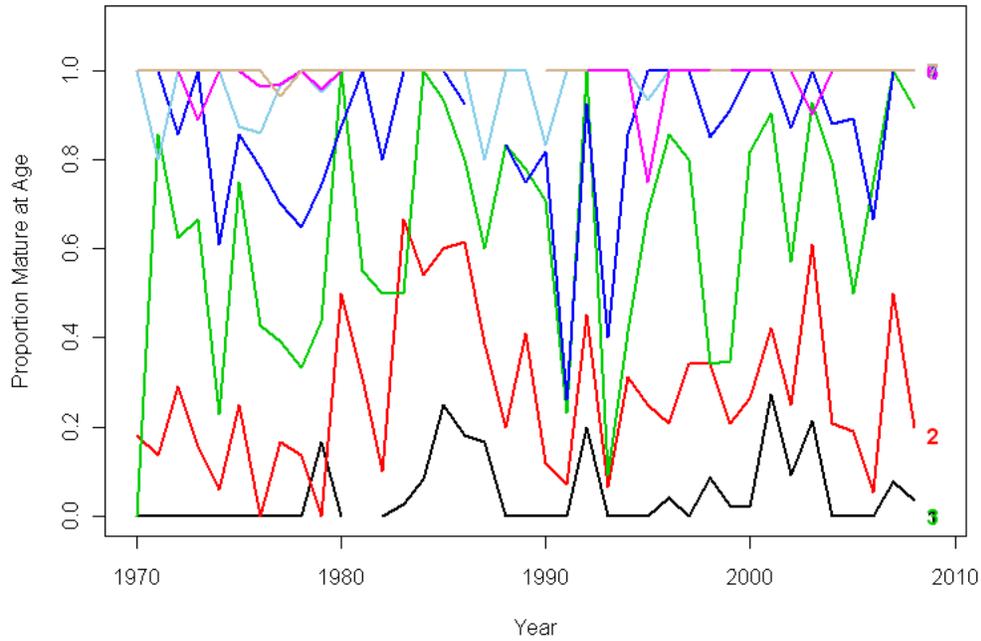


Figure C28. Pollock maturity at age by year from samples in the NEFSC fall bottom trawl survey.

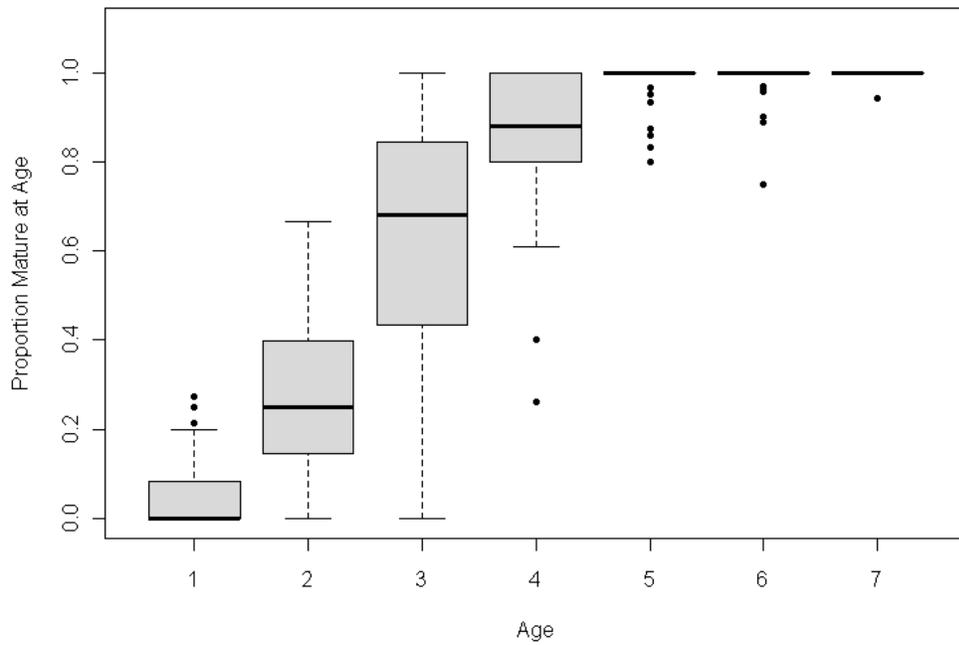


Figure C29. Pollock maturity at age, pooled across all years, from samples in the NEFSC fall bottom trawl survey.

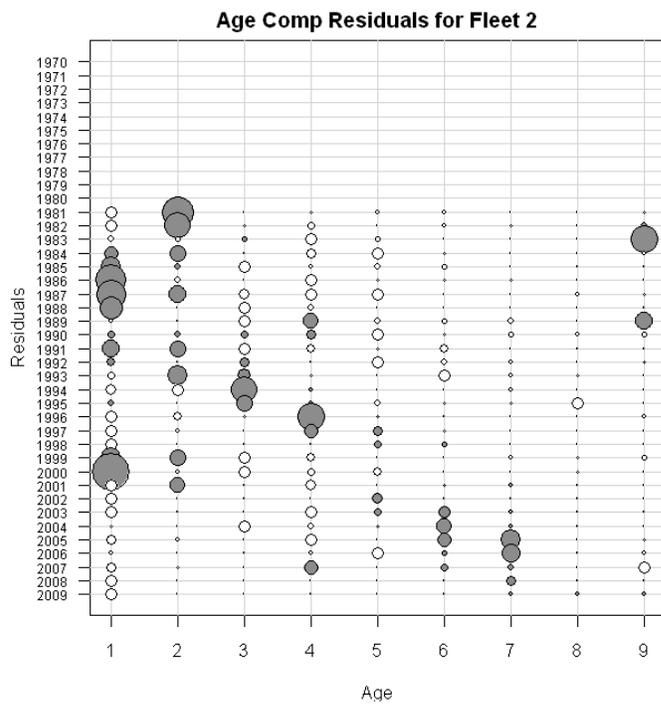
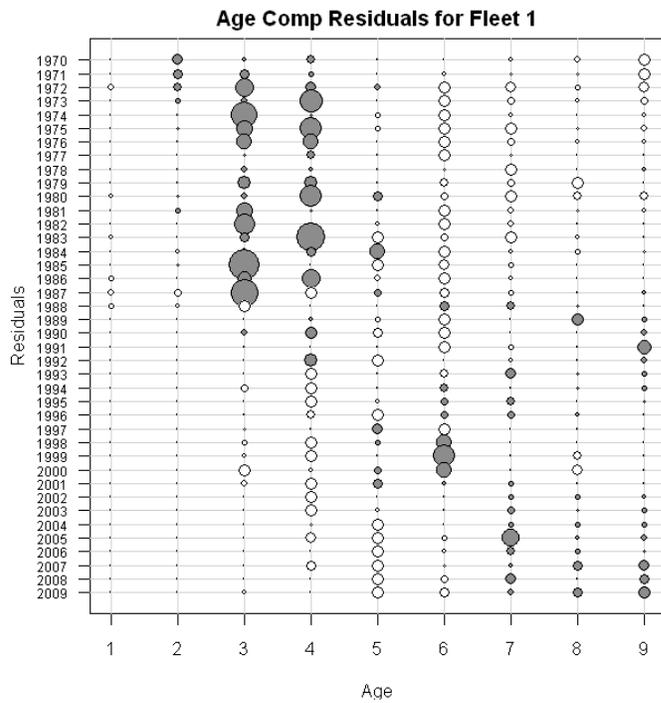


Figure C30. Residuals (predicted-observed) for age composition in the commercial (Fleet 1) and recreational (Fleet 2) fishery when only 1 selectivity block is used for each fleet in the ASAP base model. This was an exploratory model, and the residual pattern supports the addition of more selectivity blocks.

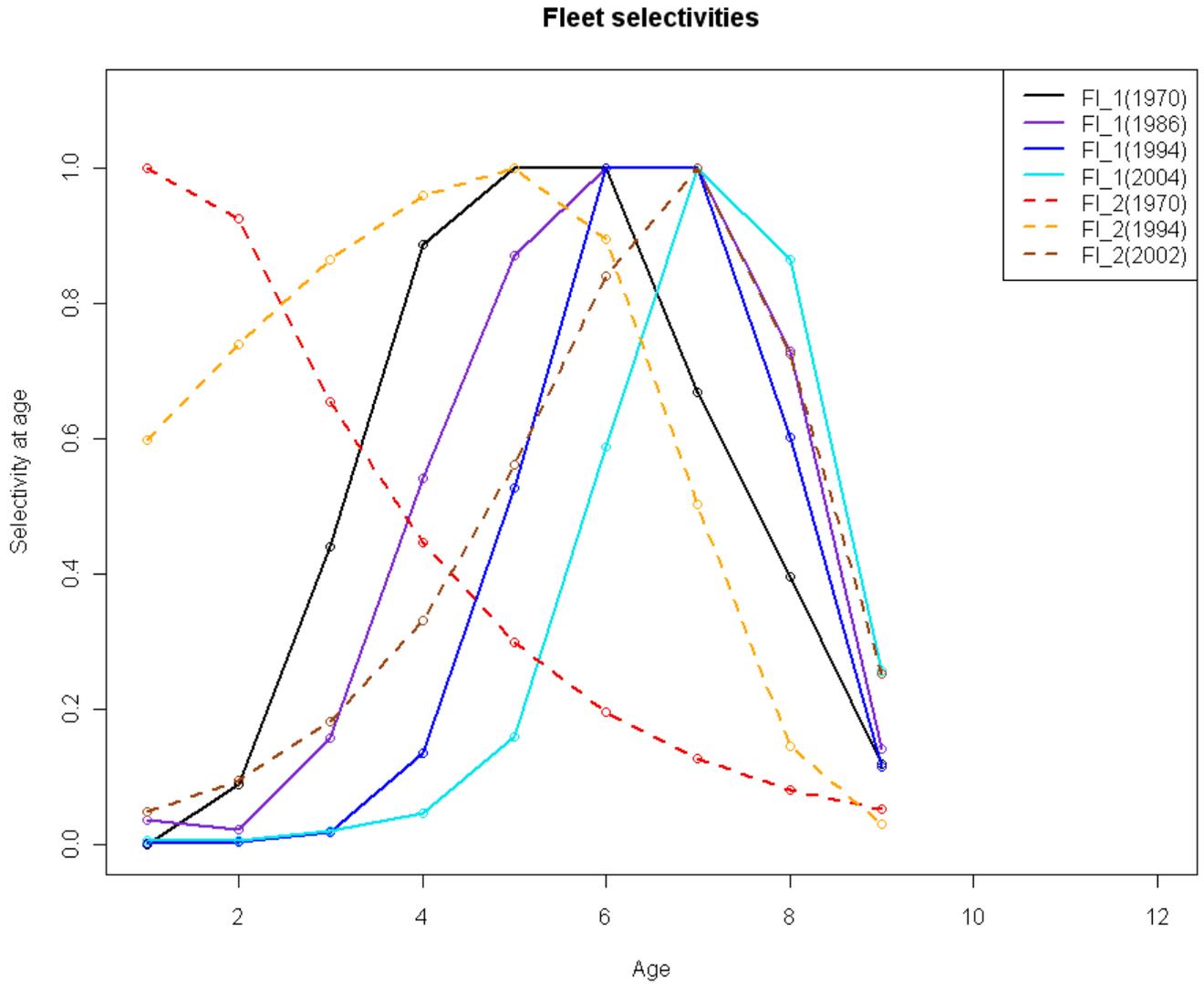


Figure C31. Selectivity blocks estimated for each fleet in the ASAP base model (solid lines for commercial, dashed lines for recreational). The legend identifies either the commercial (FL_1) or recreational (FL_2) fleet, and in parentheses are the first years that each new selectivity vector was used.

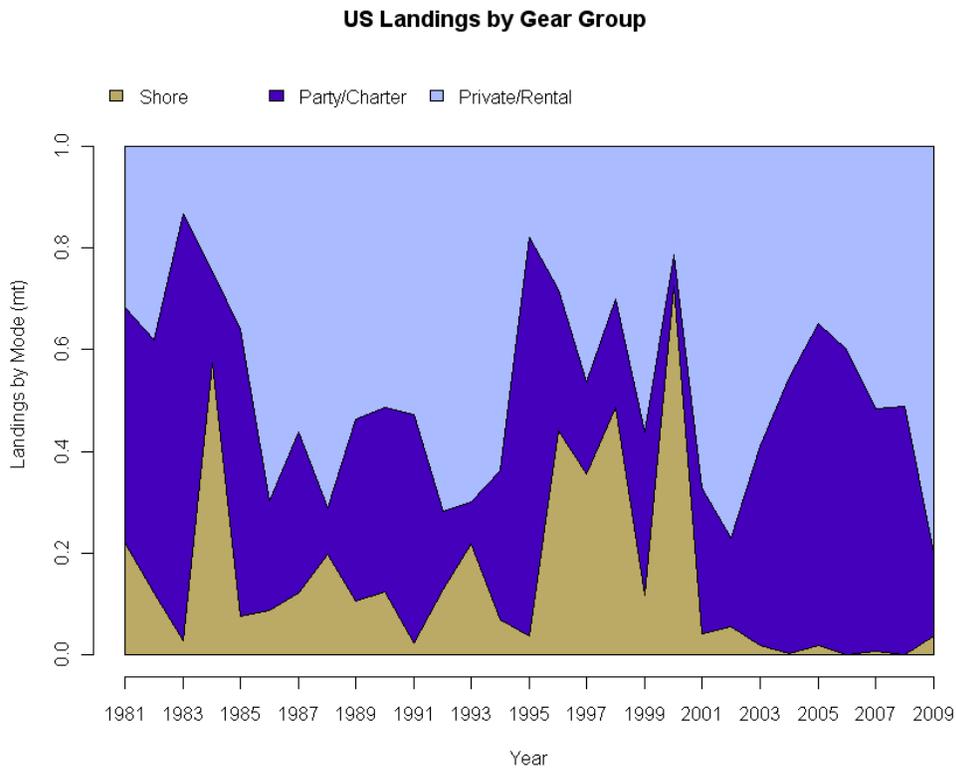


Figure C32. Proportional composition of recreational landings by mode.

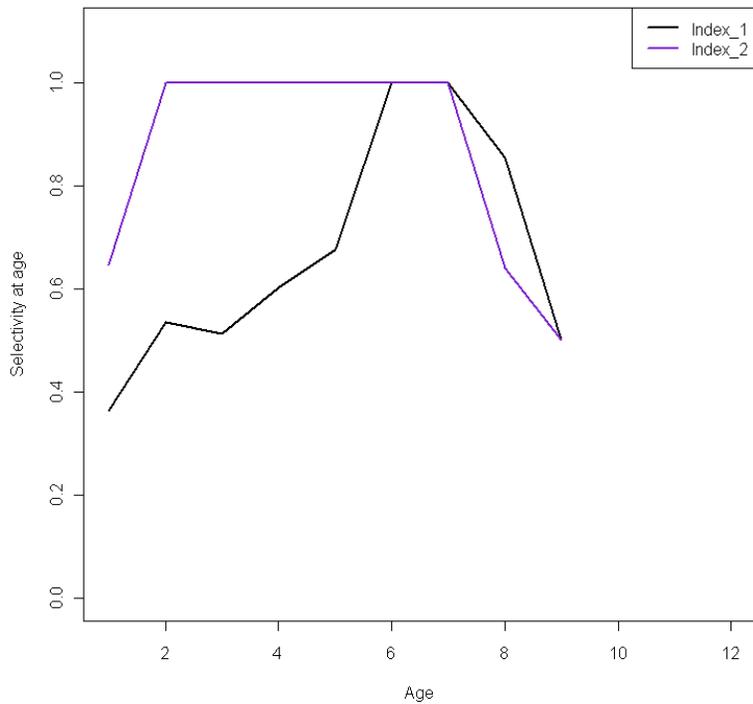


Figure C33. Selectivity at age for the NEFSC spring (Index_1) and fall (Index_2) surveys from the ASAP base model.

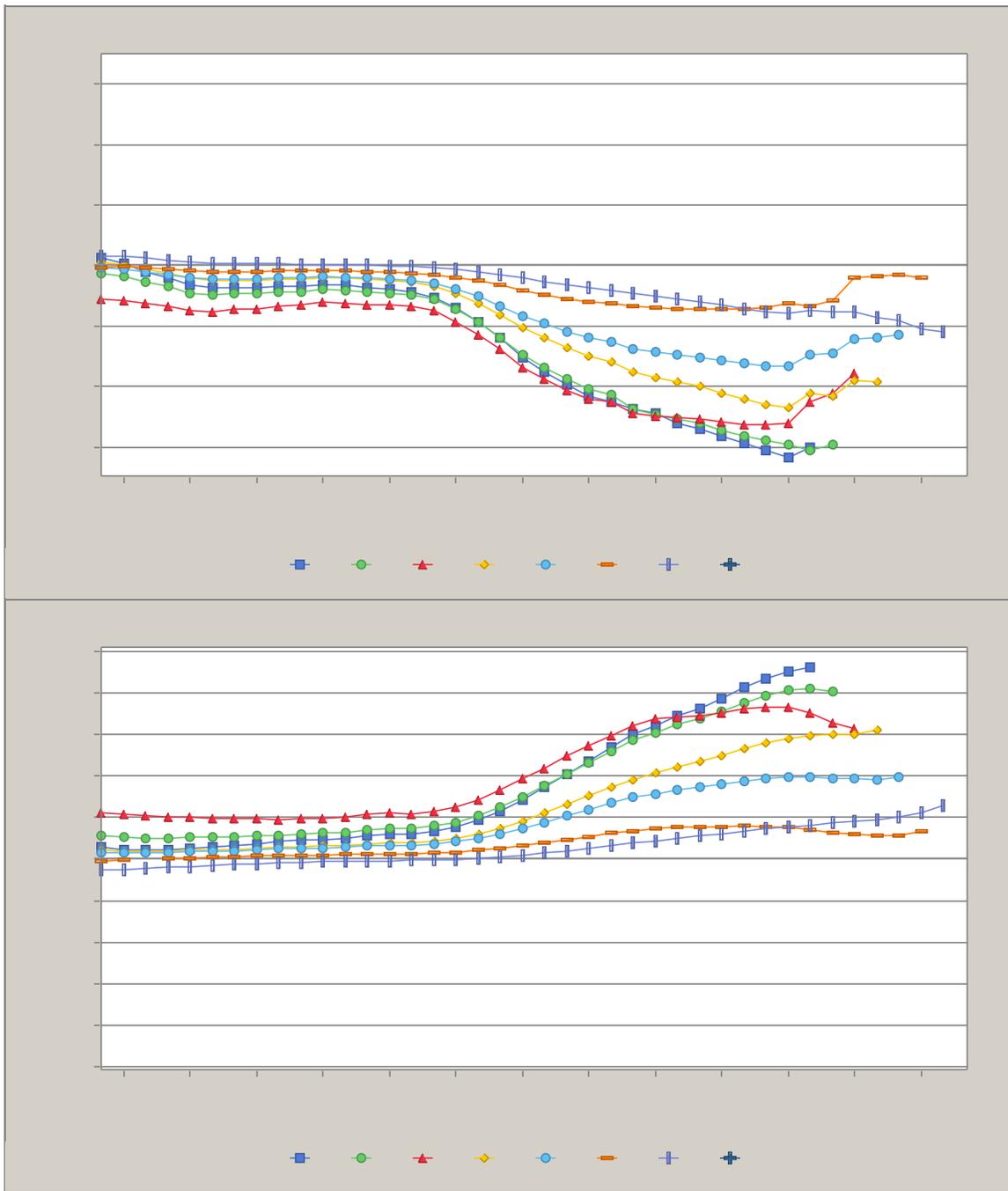


Figure C34. Retrospective analysis for the ASAP base model for years 2002-2008.

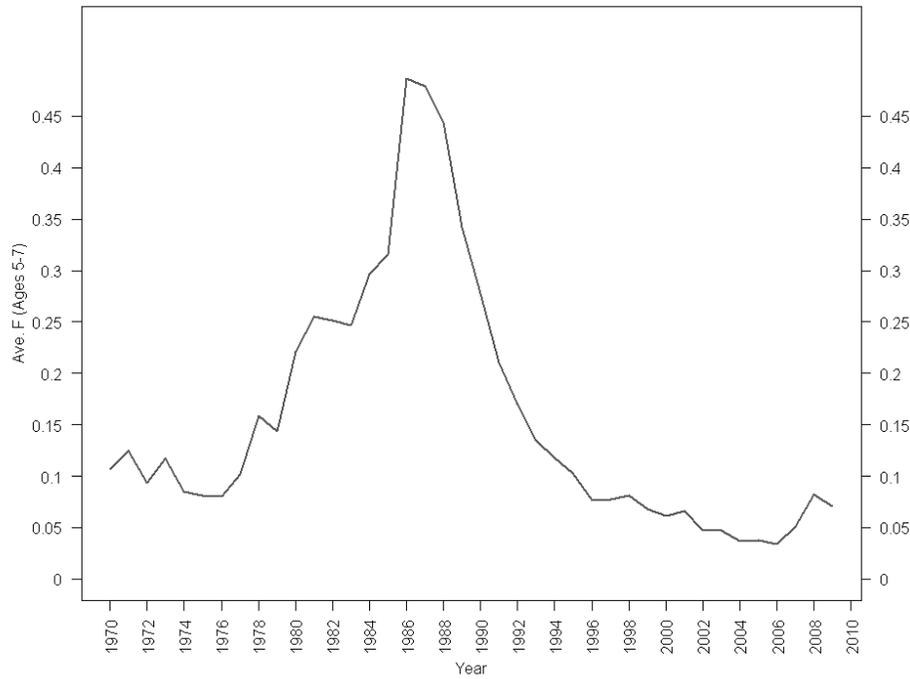
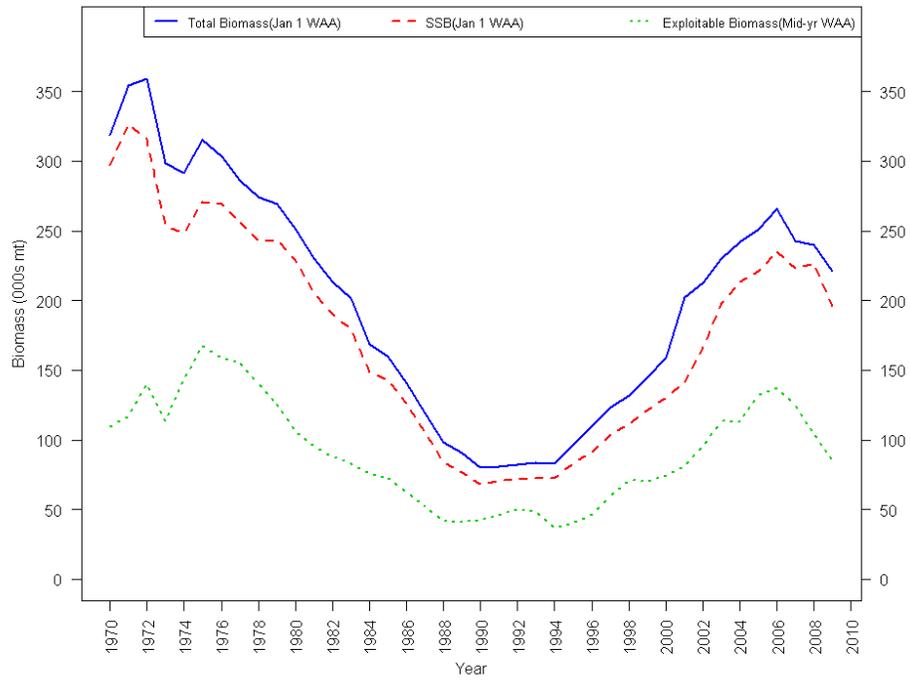


Figure C35. Annual estimates biomass (mt) and F_{5-7} from the ASAP base model.

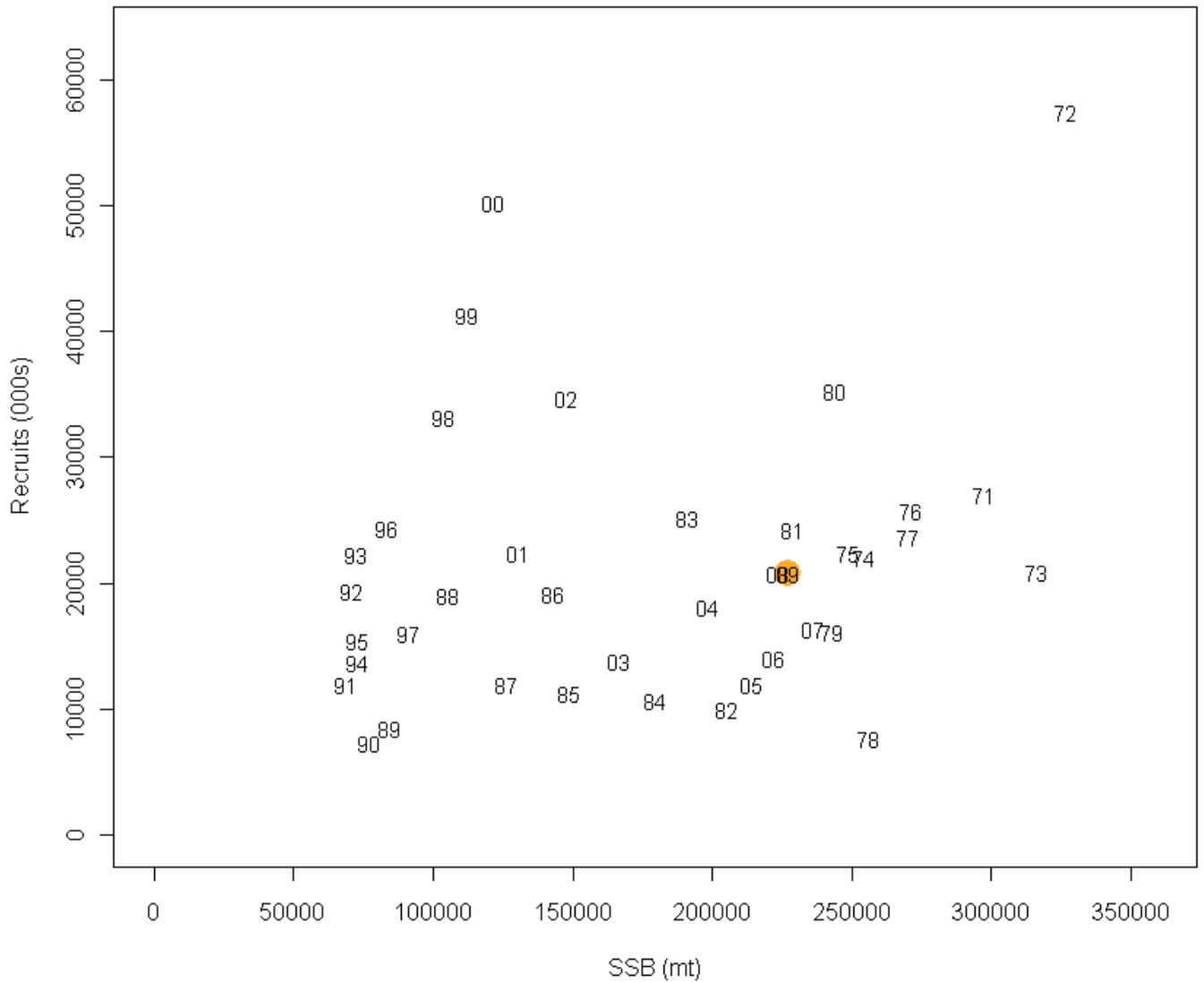


Figure C36. Scatterplot of ASAP estimates of spawning stock biomass (SSB, mt) versus recruitment at age 1 (thousands of fish). The symbol for each observation is the last two digits of the year (e.g. '09' is the model estimate of age 1 recruitment in year 2009). The most recent recruitment estimate for 2009 is highlighted by a filled orange circle.

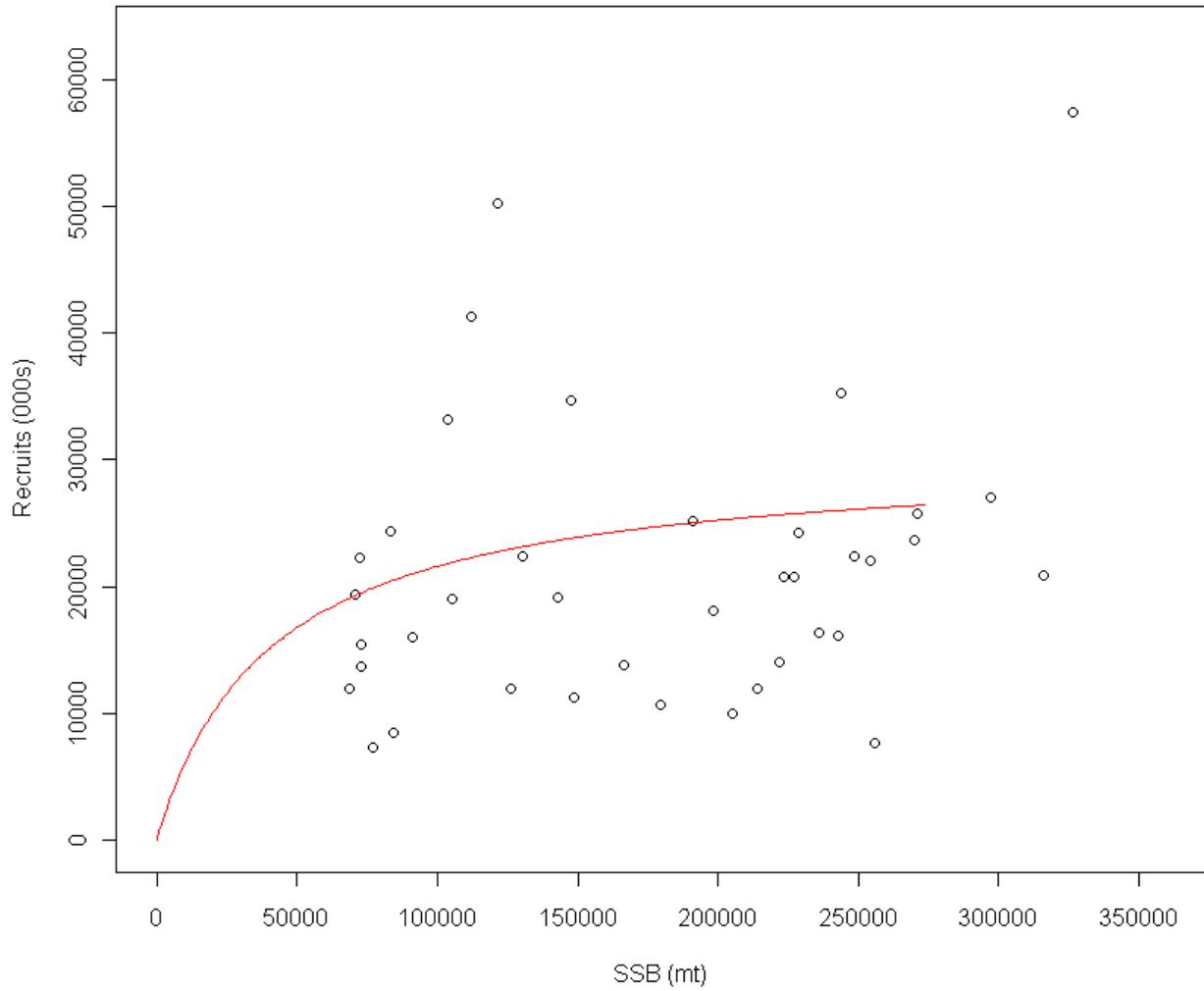


Figure C37. ASAP base model of the predicted stock recruit relationship (solid red line) and the estimated spawning stock biomass (SSB mt) and age 1 recruits (in thousands of fish).

Fleet 1

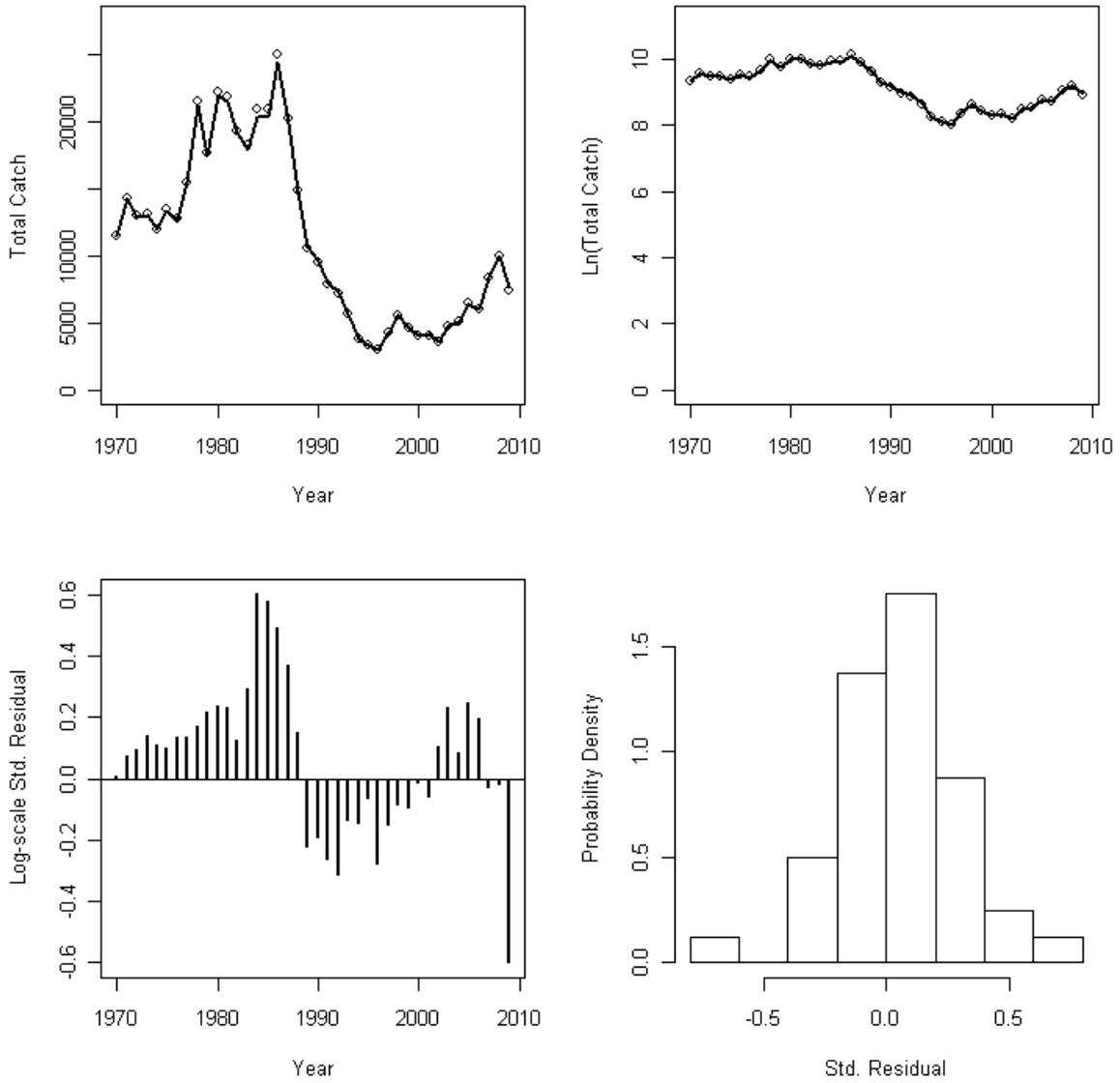


Figure C38. ASAP base model fit to commercial landings.

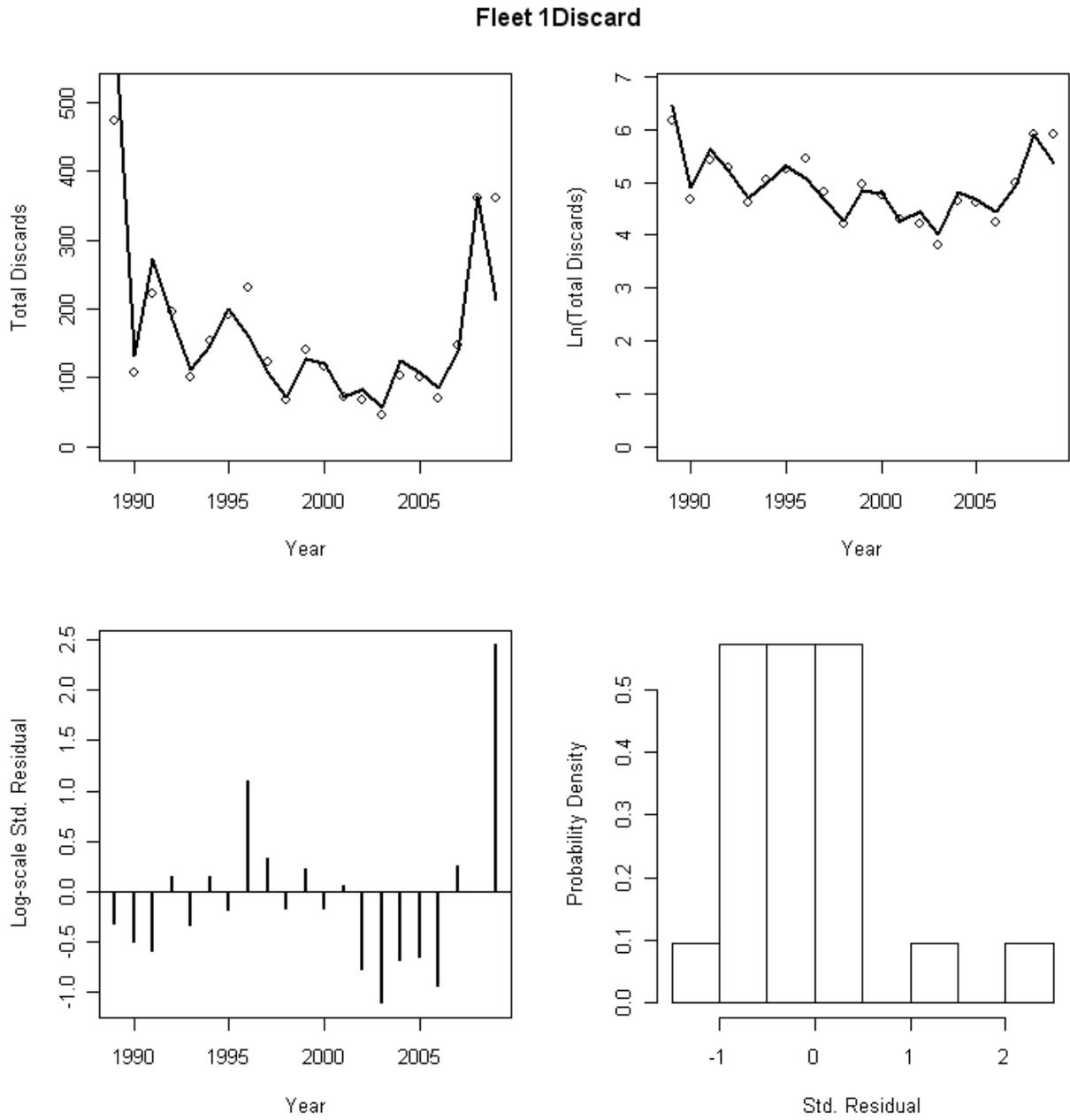


Figure C39. ASAP base model fit to commercial discards.

Age Comp Residuals for Fleet 1

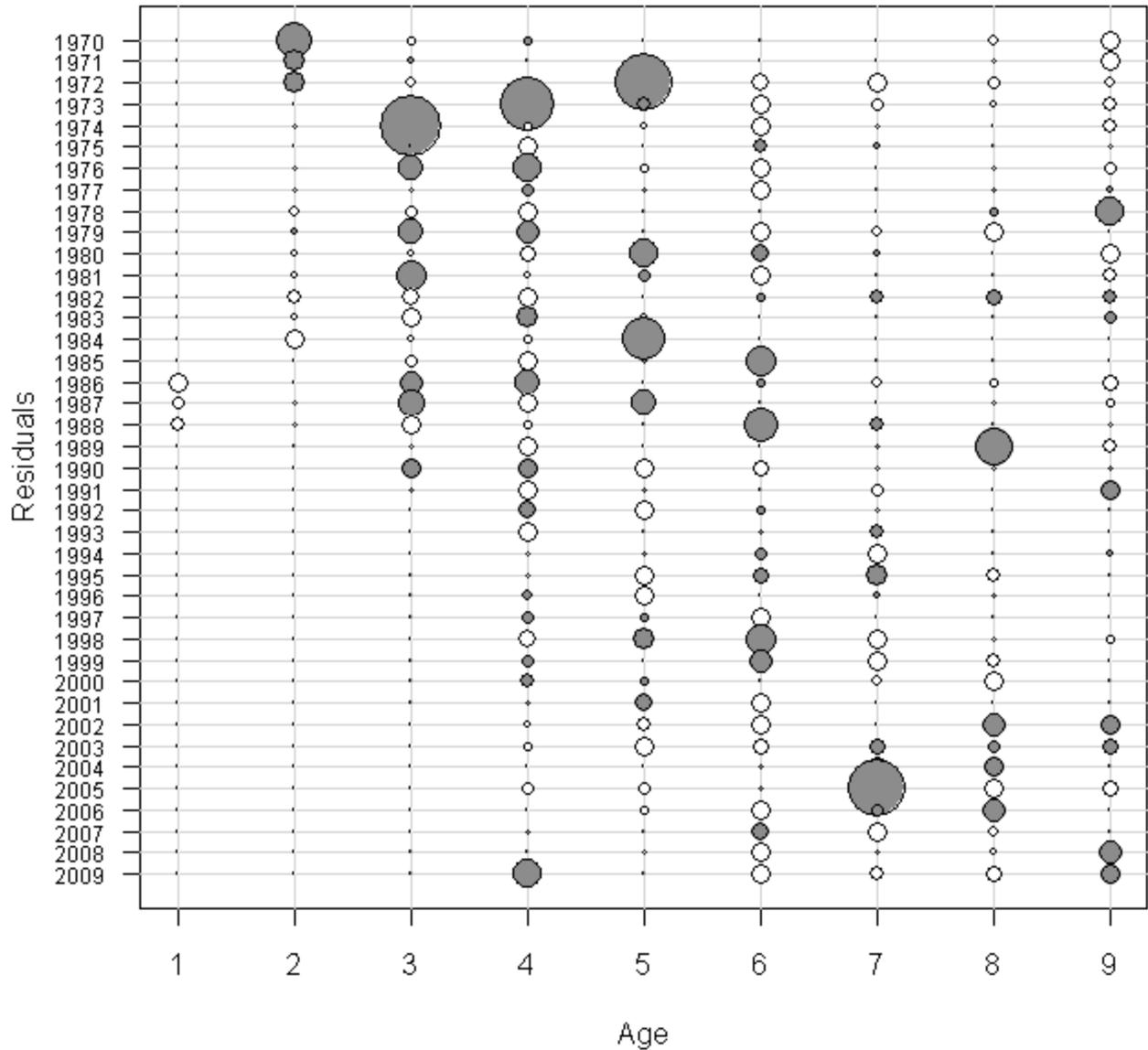


Figure C40. ASAP base model residuals for commercial catch age composition. Open circles are positive residuals, filled circles are negative residuals, calculated as (Predicted-Observed).

Fleet 1

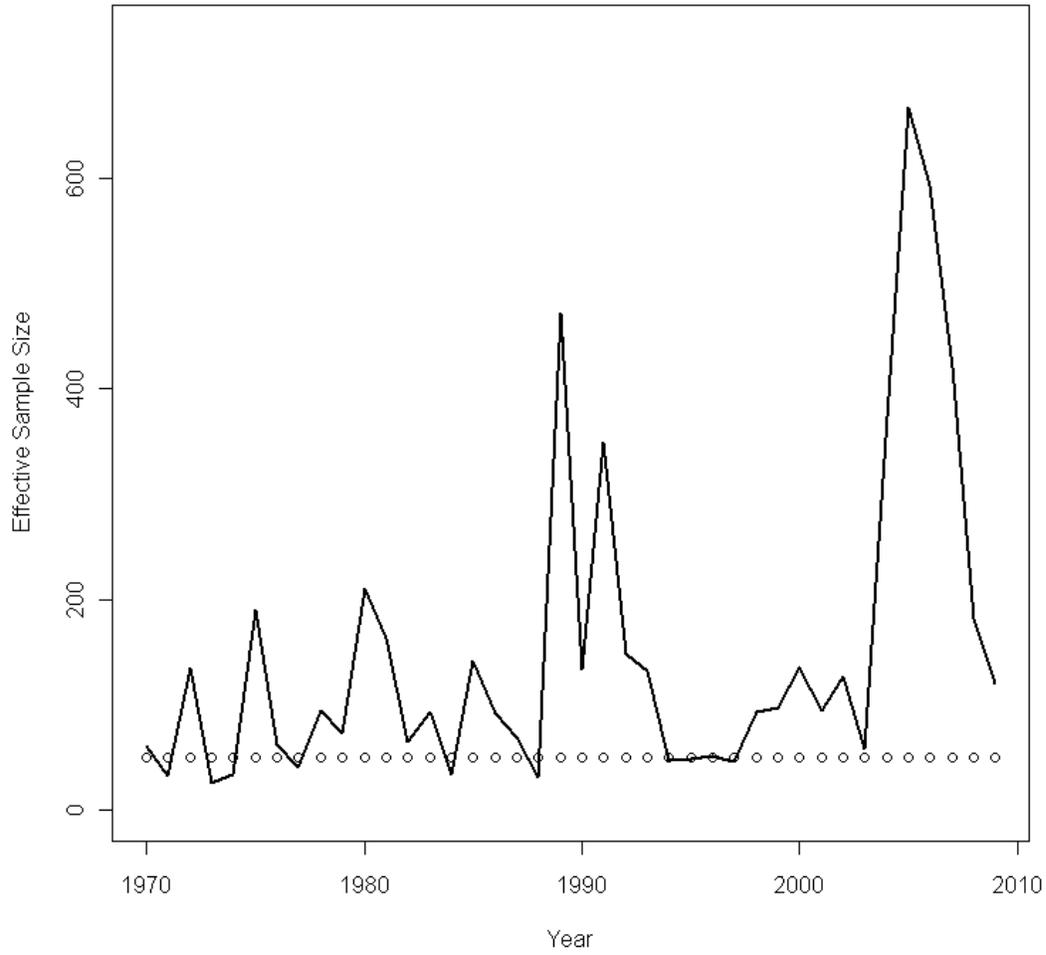


Figure C41. ASAP base model comparison of input effective sample size versus the model estimated effective sample size for the commercial fleet.

Fleet 2

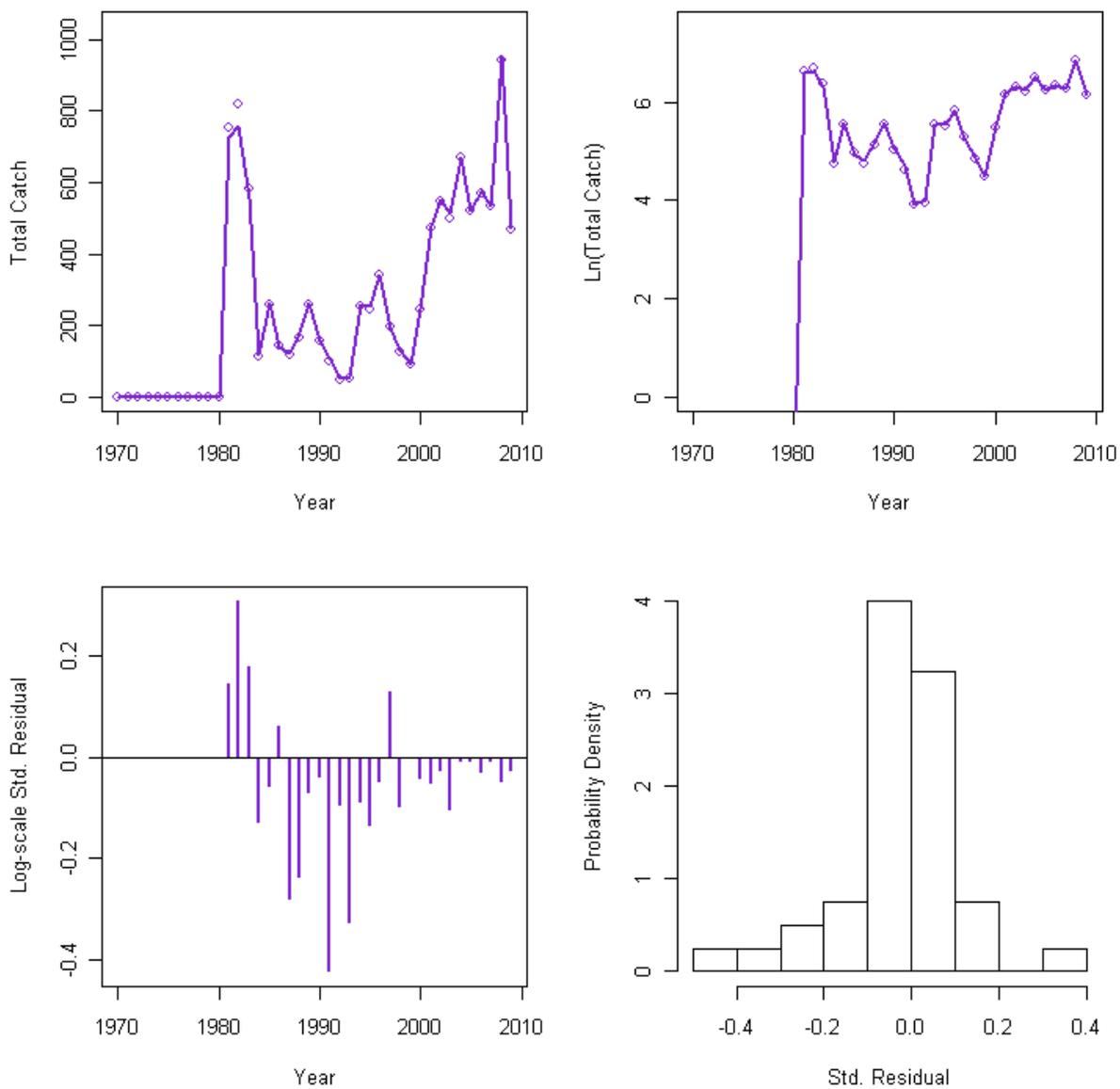


Figure C42. ASAP base model fit to recreational landings.

Fleet 2Discard

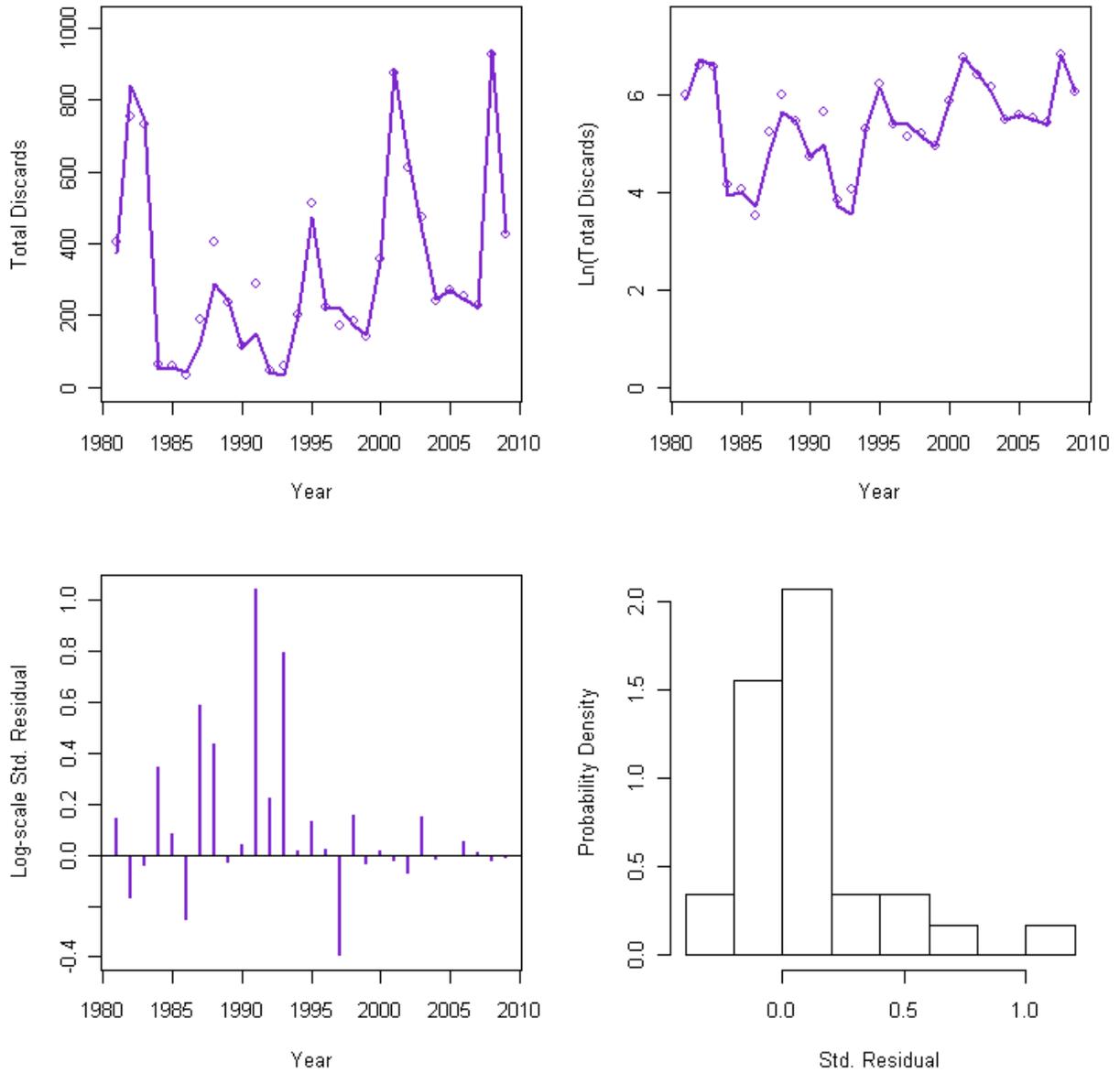


Figure C43. ASAP base model fit to recreational discards.

Age Comp Residuals for Fleet 2

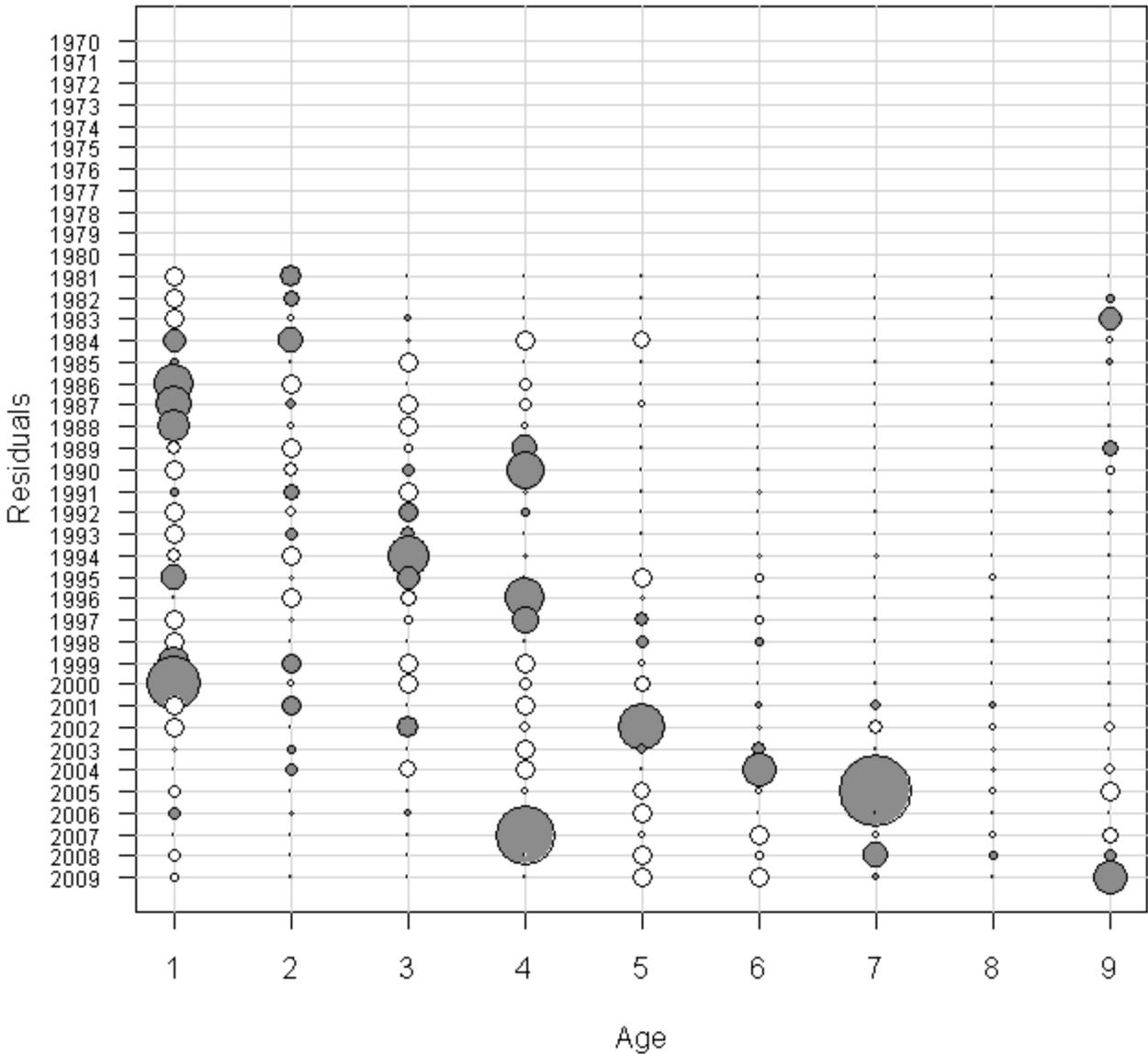


Figure C44. ASAP base model residuals for recreational catch age composition. Open circles are positive residuals, filled circles are negative residuals, calculated as (Predicted-Observed).

Fleet 2

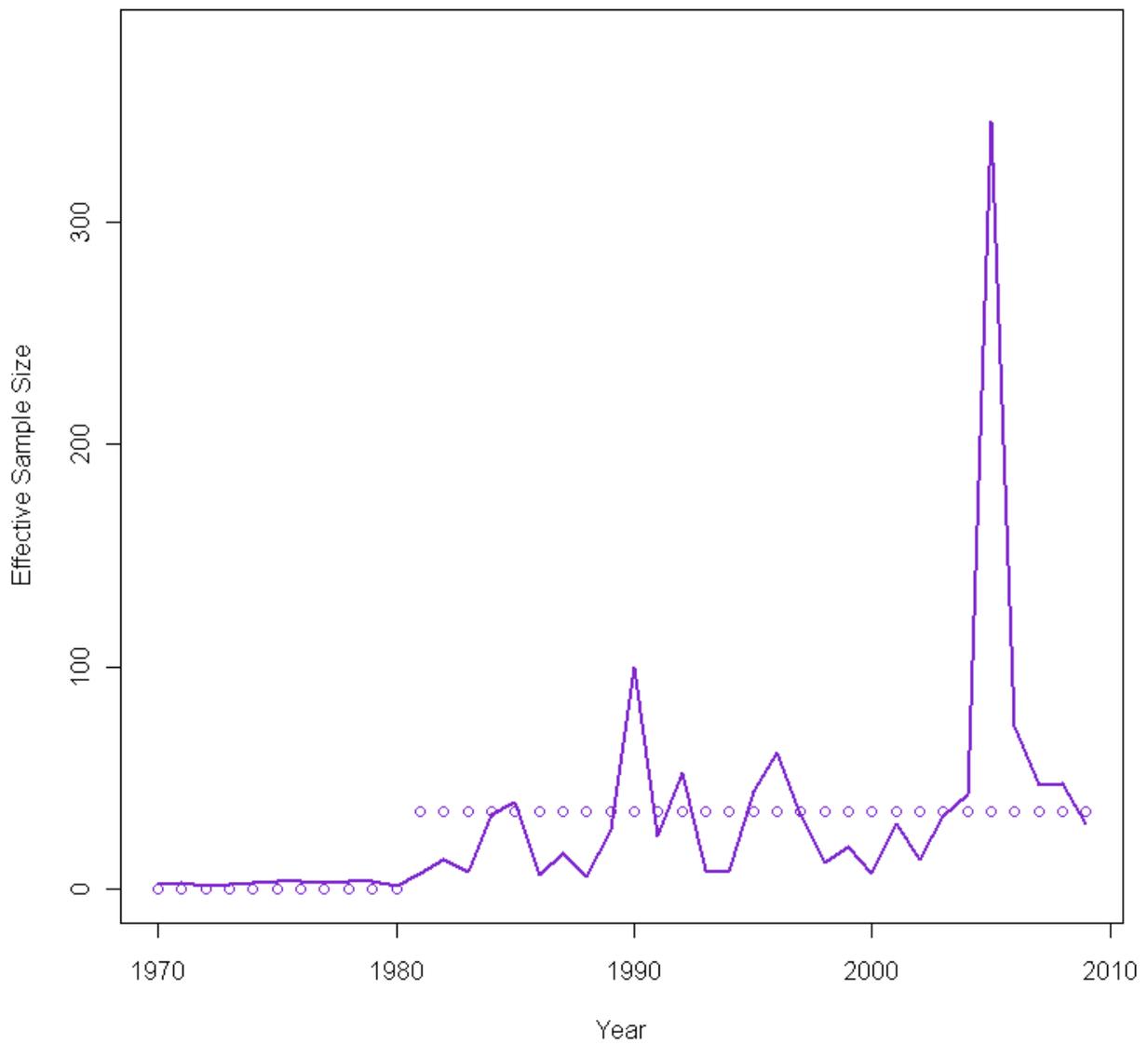


Figure C45. ASAP base model comparison of input effective sample size versus the model estimated effective sample size for the recreational fleet.

Index 1

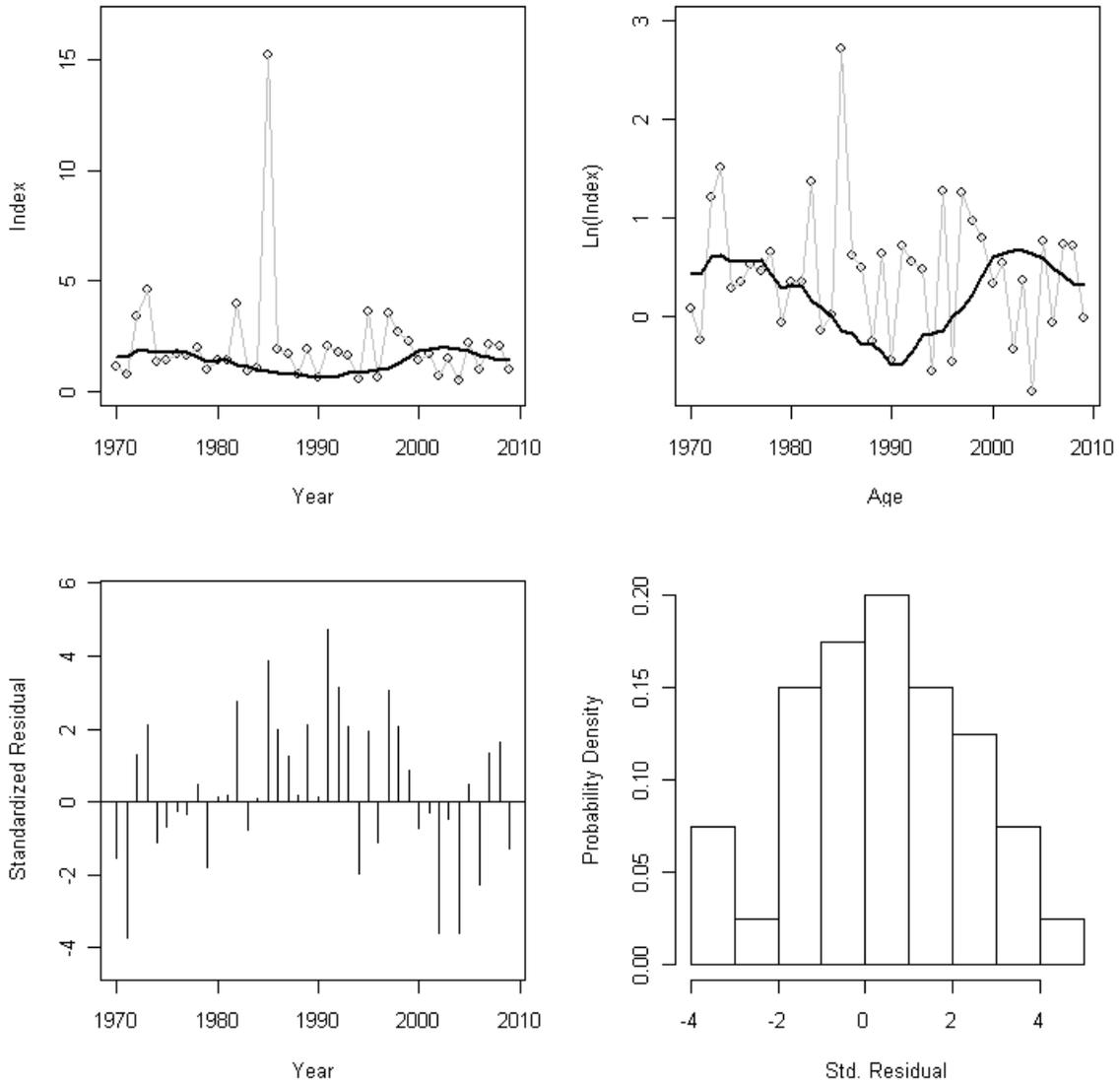


Figure C46. ASAP base model fit to the NEFSC spring index.

Age Comp Residuals for Index 1

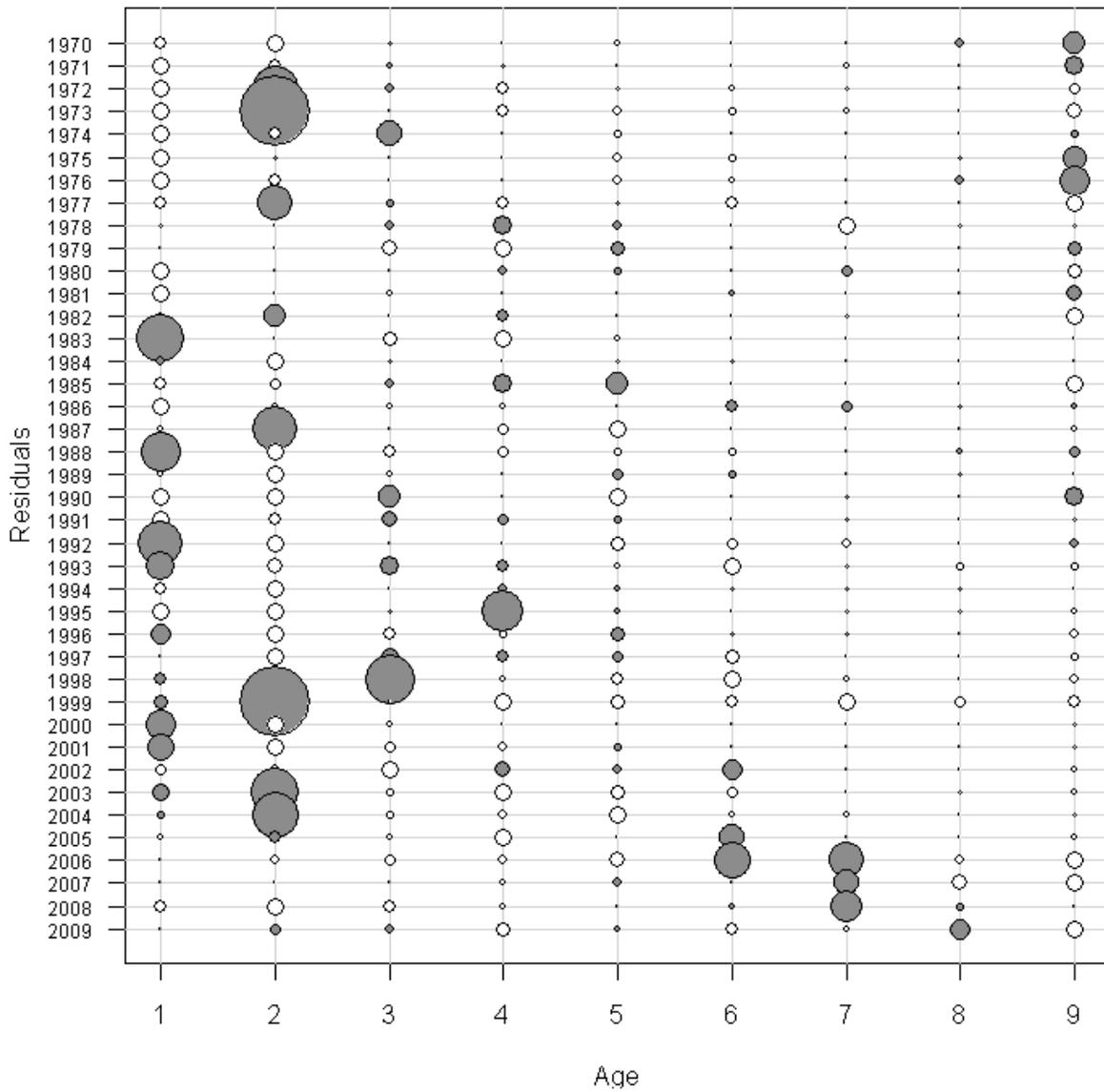


Figure C47. ASAP base model residuals for NEFSC spring index age composition. Open circles are positive residuals, filled circles are negative residuals, calculated as (Predicted-Observed).

Index 1

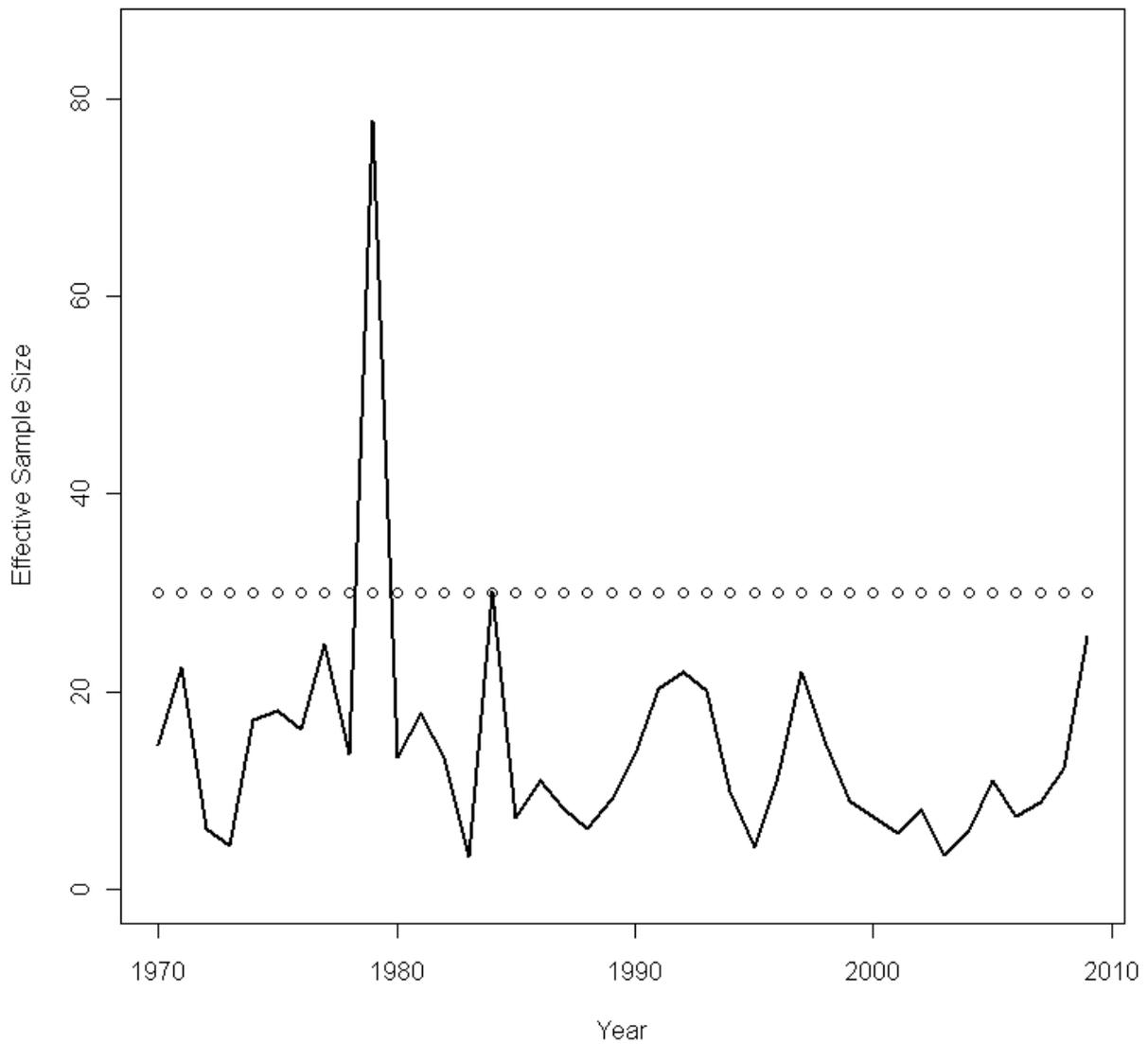


Figure C48. ASAP base model comparison of input effective sample size versus the model estimated effective sample size for the NEFSC spring index.

Index 2

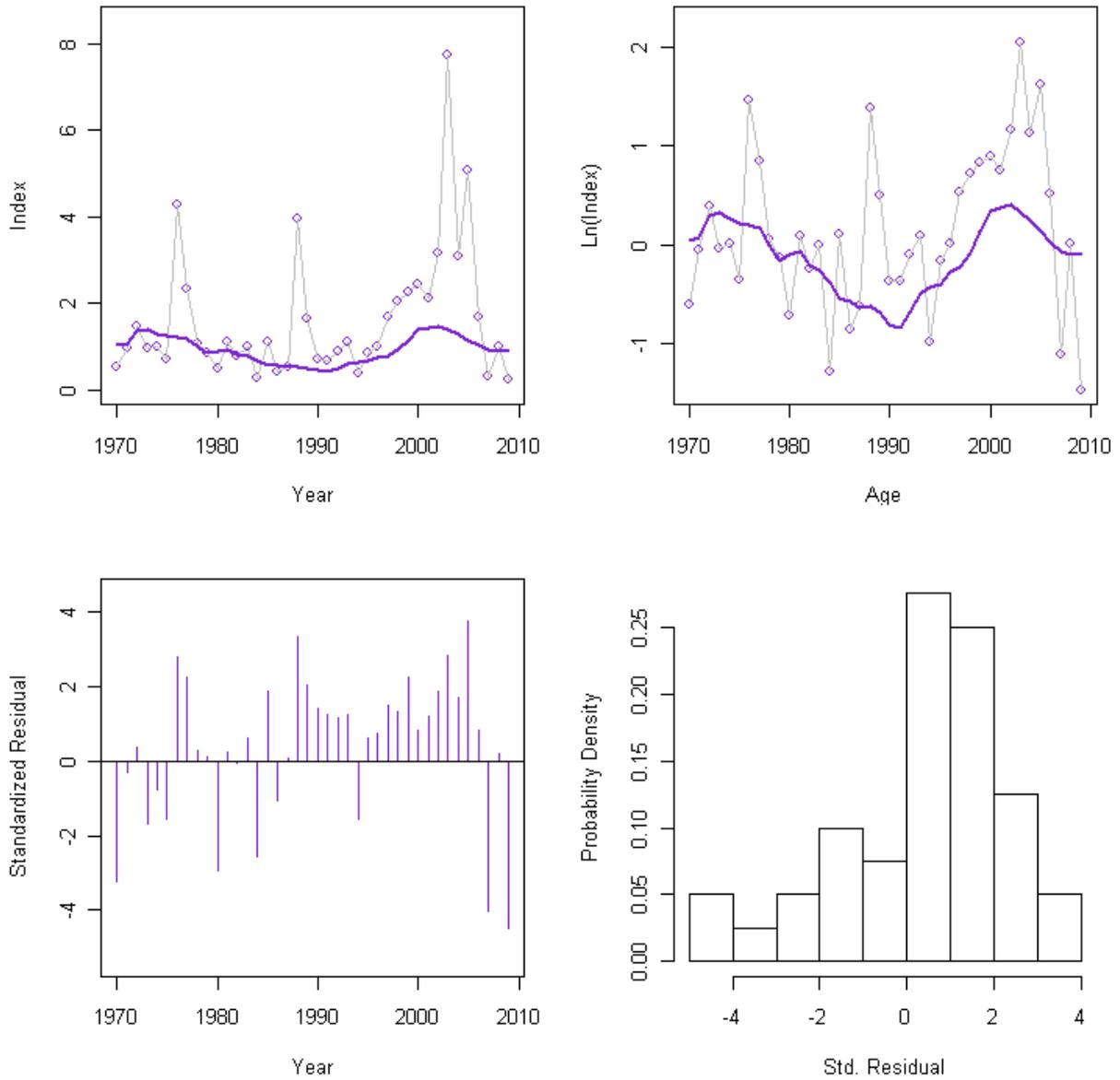


Figure C49. ASAP base model fit to the NEFSC fall index.

Age Comp Residuals for Index 2

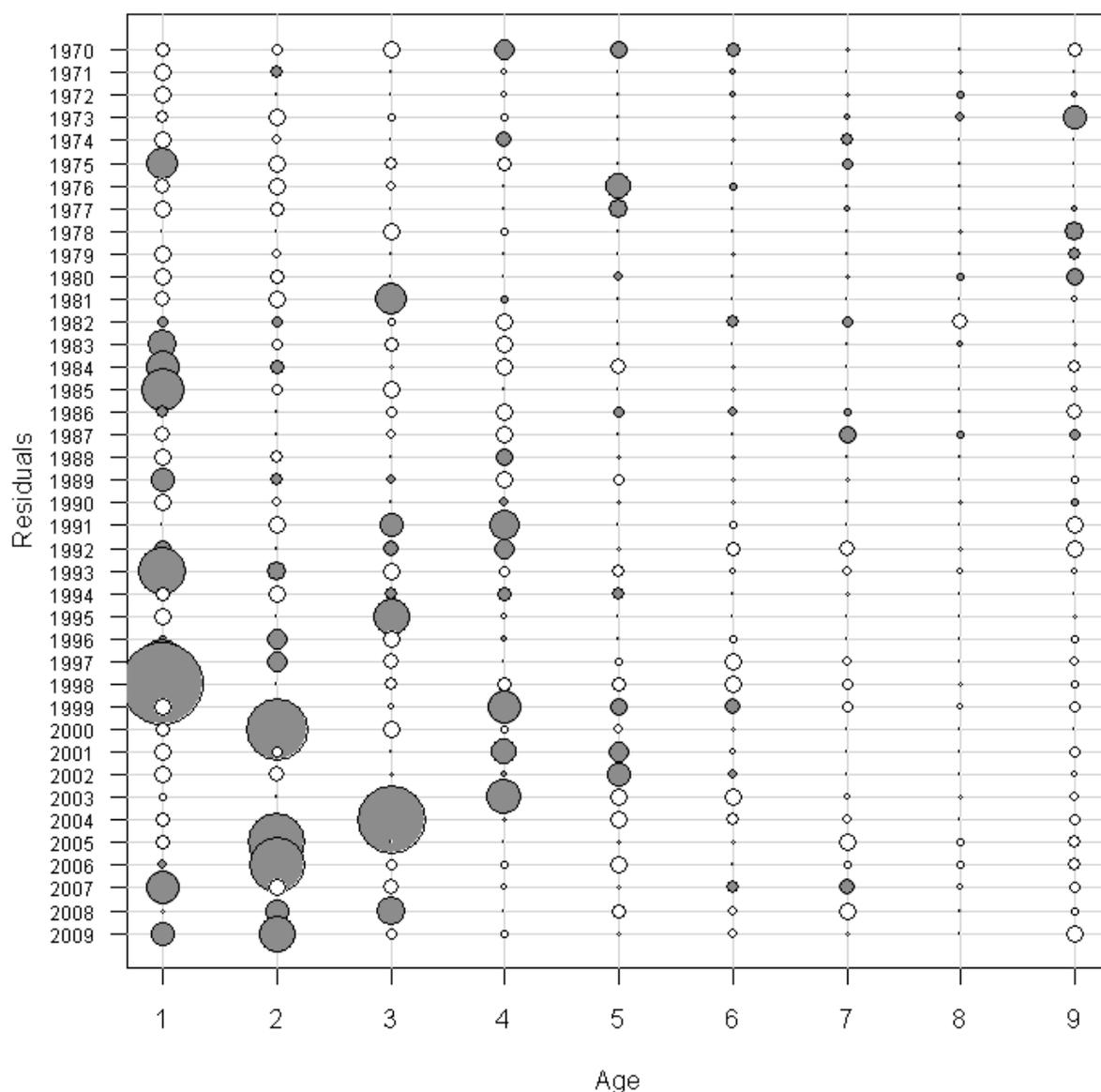


Figure C50. ASAP base model residuals for NEFSC fall index age composition. Open circles are positive residuals, filled circles are negative residuals, calculated as (Predicted-Observed).

Index 2

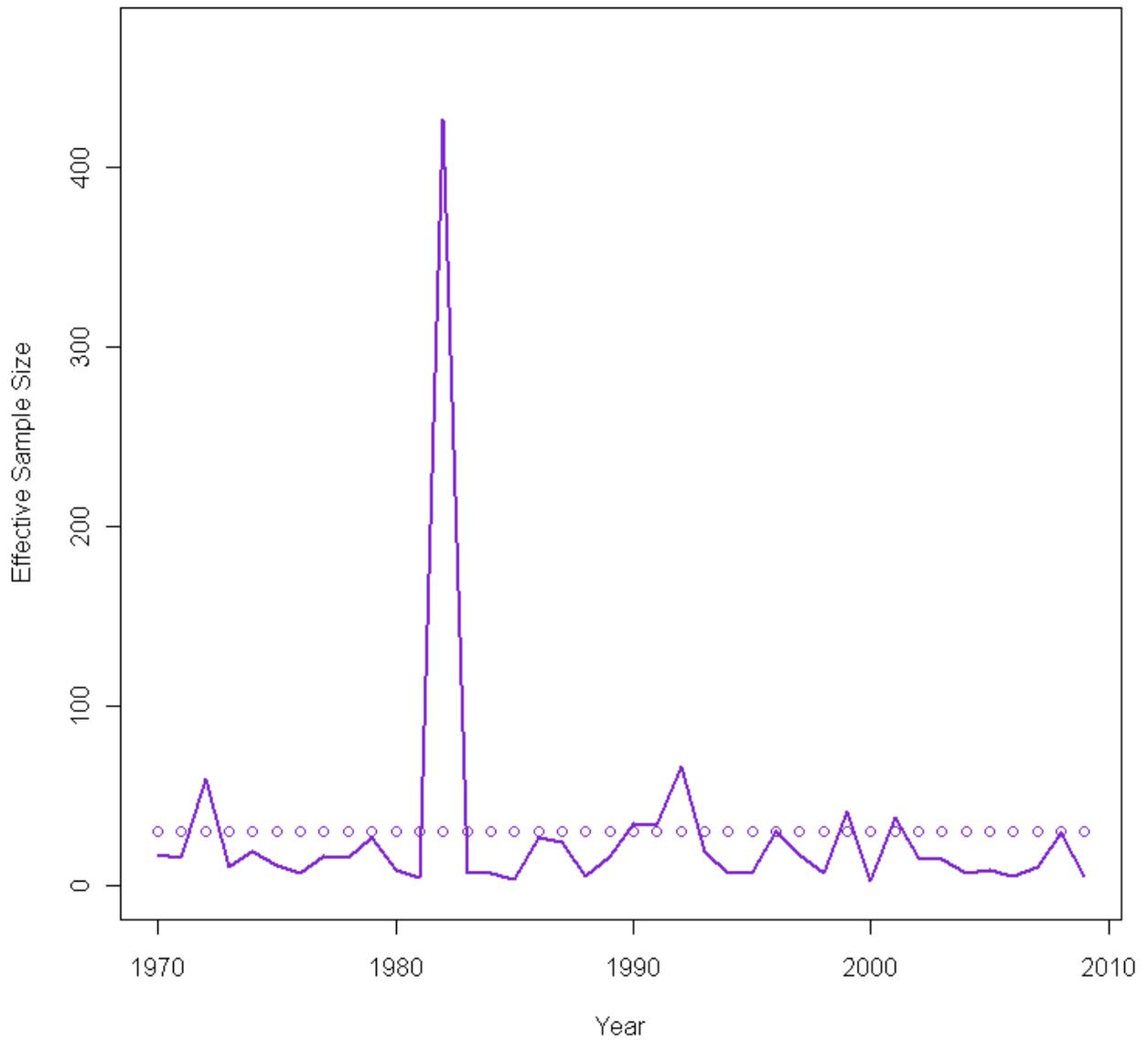


Figure C51. ASAP base model comparison of input effective sample size versus the model estimated effective sample size for the NEFSC fall index.

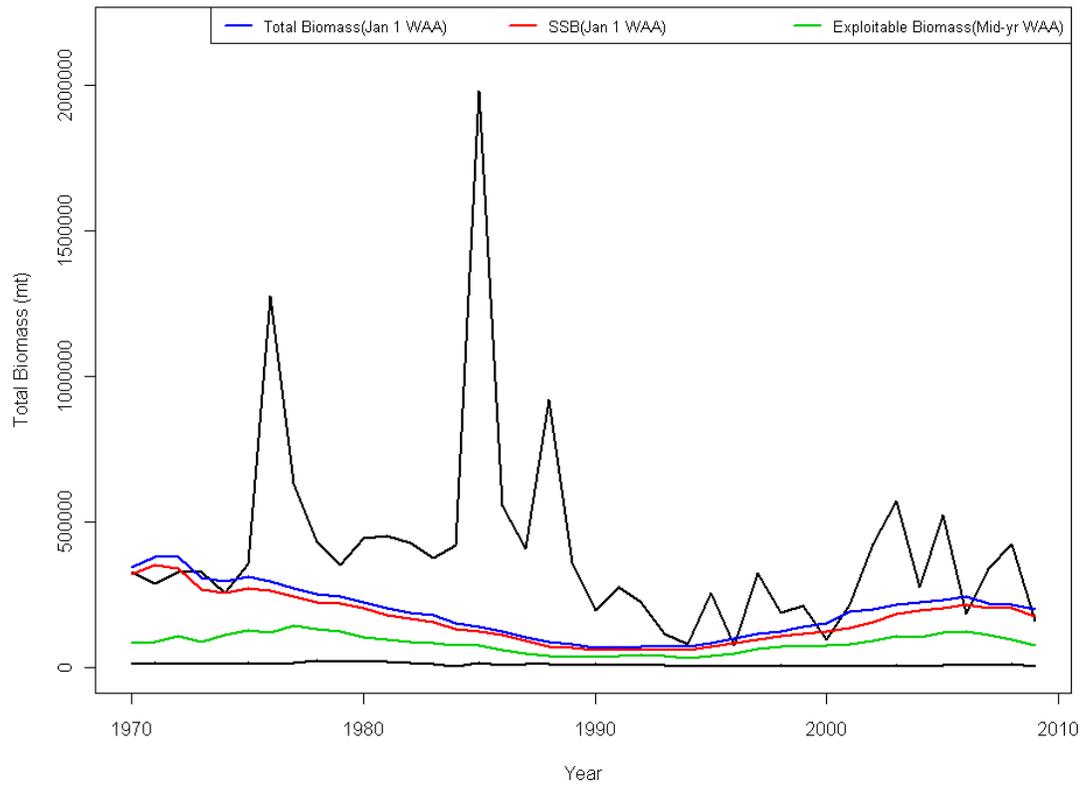


Figure C52. A proposed envelope of reasonable biomass is bounded by the solid black lines, while the ASAP base model estimated biomass of 3 quantities is plotted.

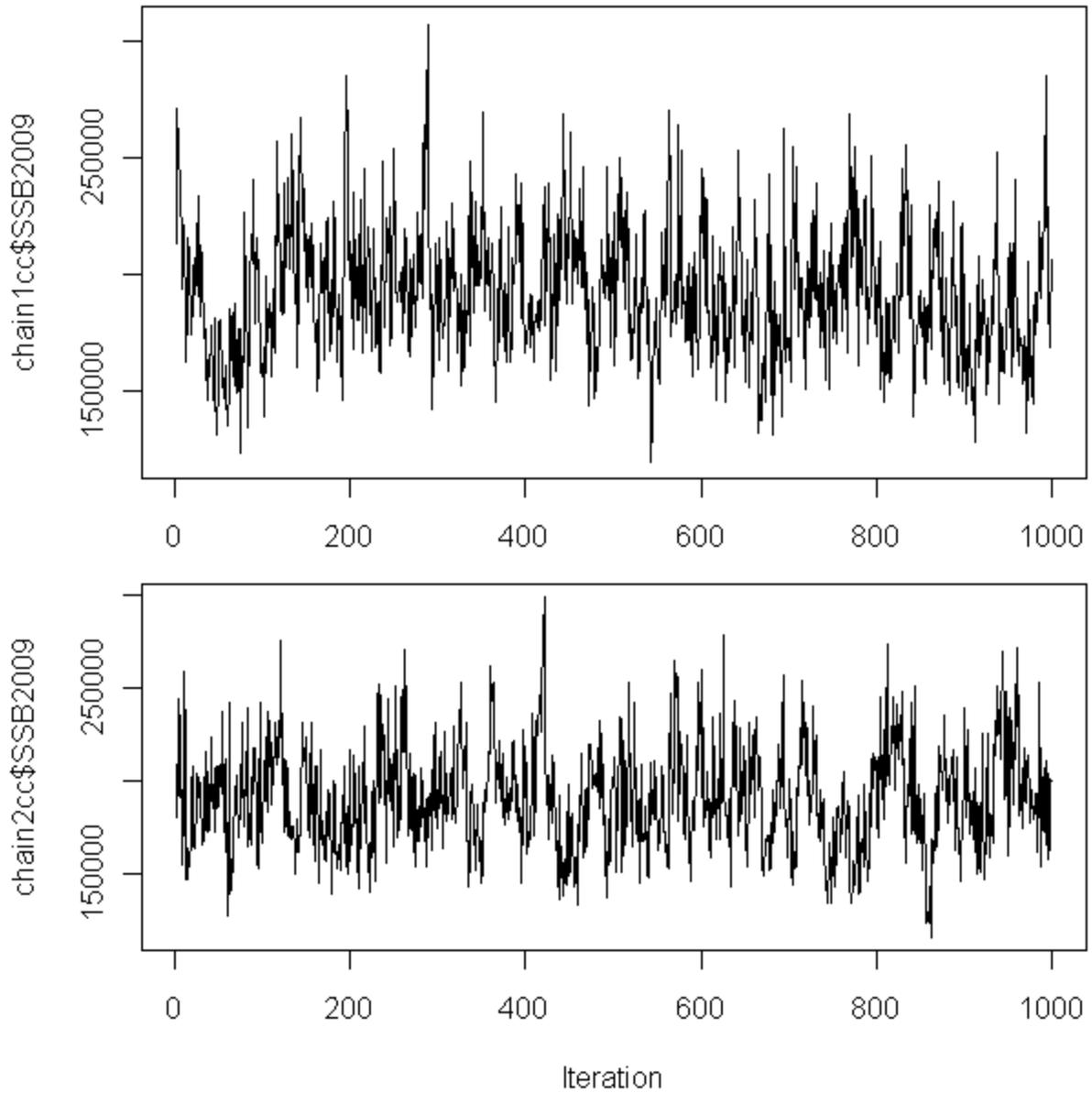


Figure C53. Trace of two MCMC chains for SSB2009, showing good mixing (ASAP base model). Each chain had initial length of 10 million; the first 5 million were dropped for burn-in, and the remaining 5 million were thinned at a rate of one out of every 5,000th. The final chain length was 1000 saved draws.

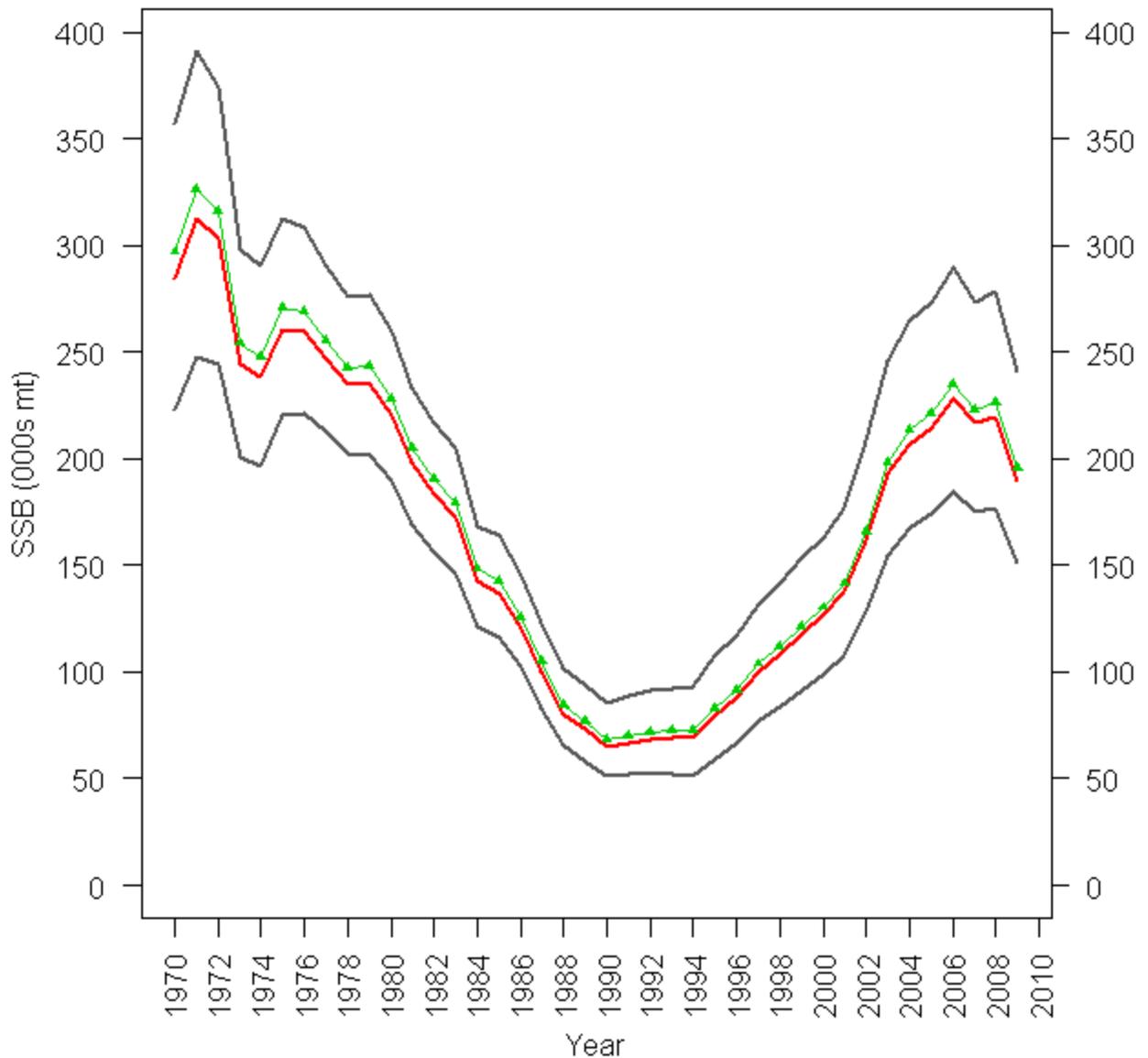


Figure C54. A 90% probability interval for pollock spawning stock biomass (SSB) in thousands of mt is plotted for the entire time series. The median value is in red, while the 5th and 95th percentiles are in dark grey. The point estimate from the base model (joint posterior modes) is shown in the thin green lined with filled triangles. (ASAP base model)

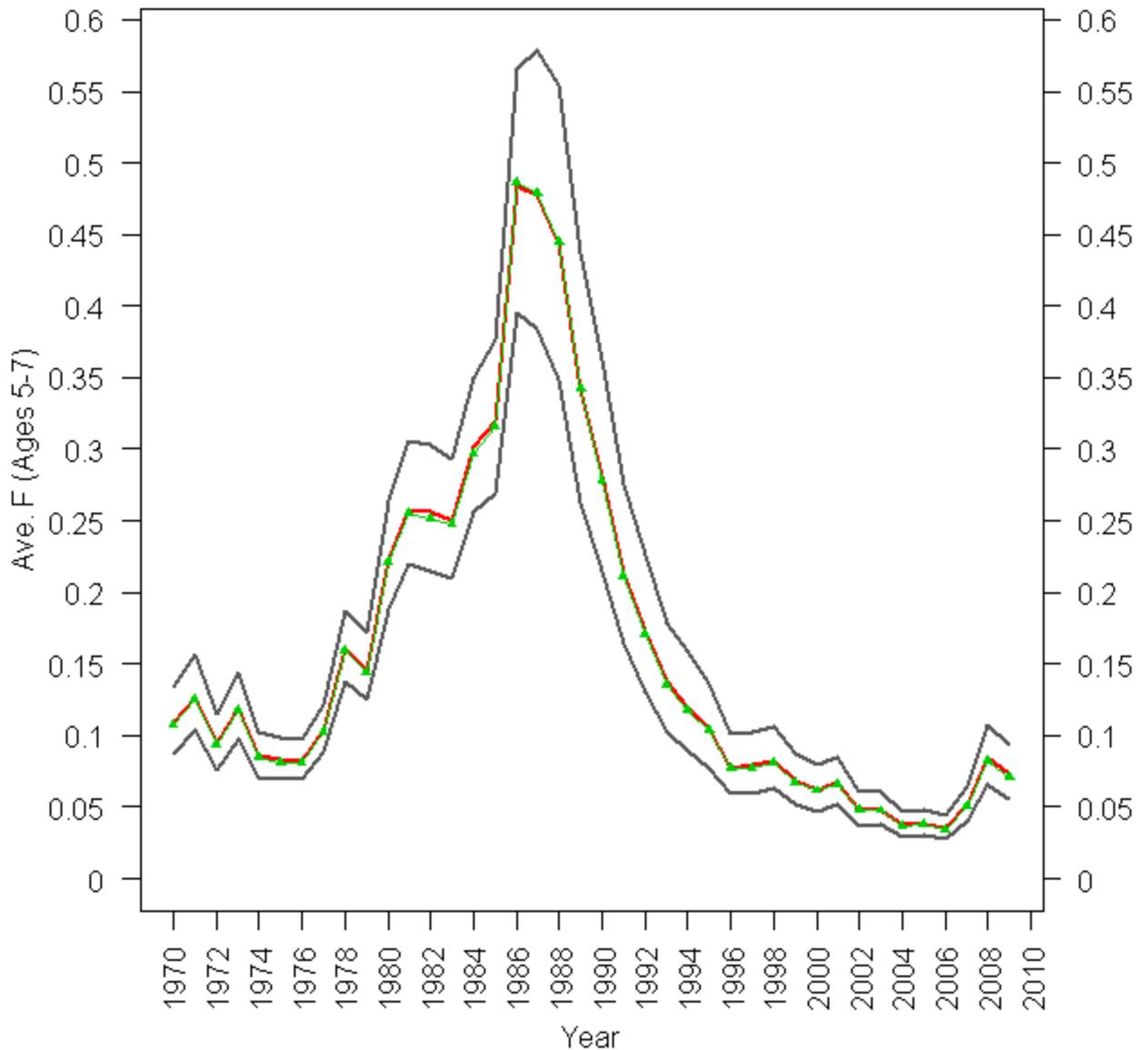


Figure C55. A 90% probability interval for the average F on ages 5-7 (F_{5-7}) for pollock is plotted for the entire time series. The median value is in red, while the 5th and 95th percentiles are in dark grey. The point estimate from the base model (joint posterior modes) is shown in the thin green lined with filled triangles. (ASAP base model)

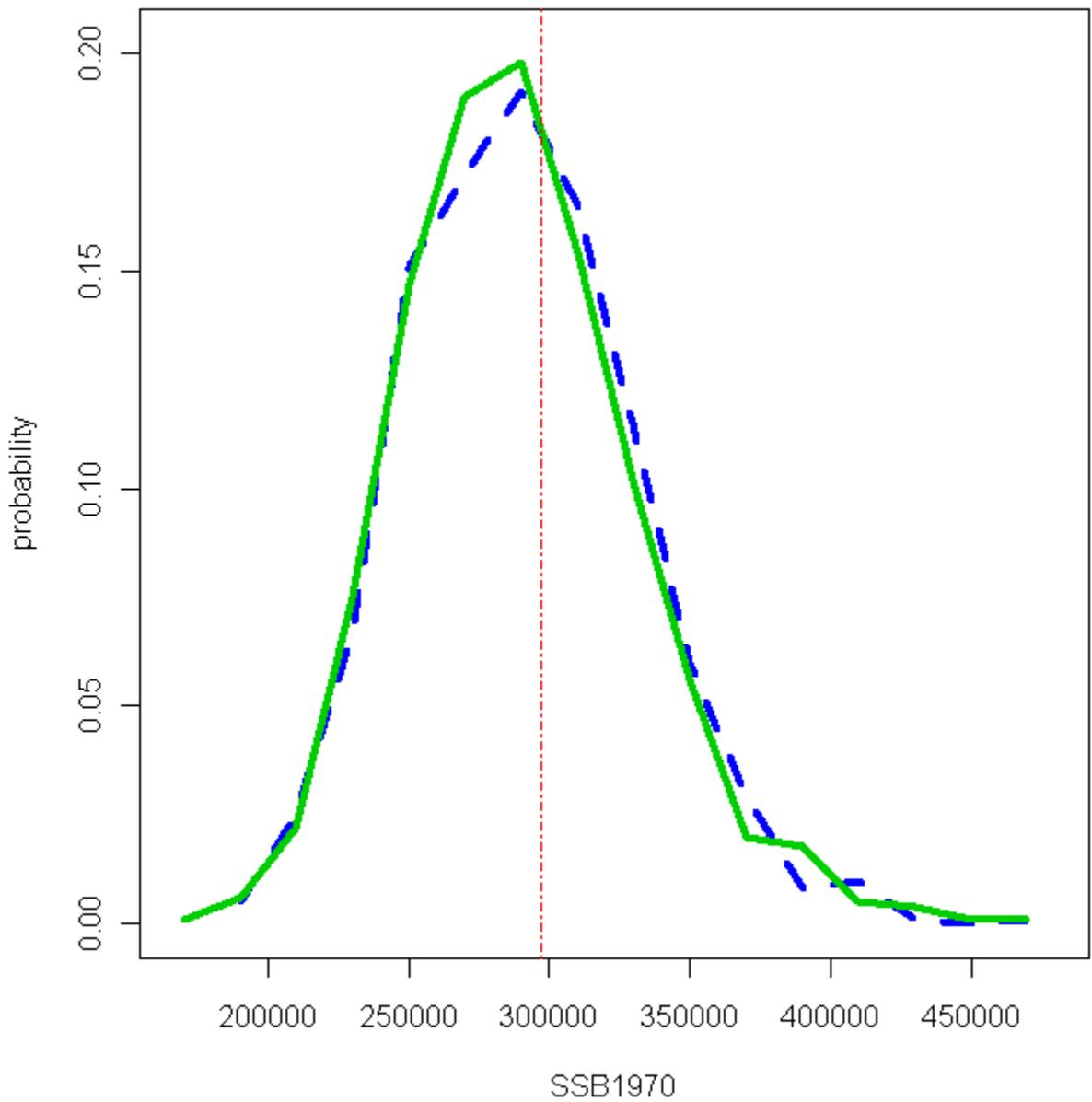


Figure C56a. Posterior distribution for spawning stock biomass (SSB) in 1970 (the first model year) for two MCMC chains (dotted blue and solid green lines). The vertical dashed red line indicates the point estimate. (ASAP base model)

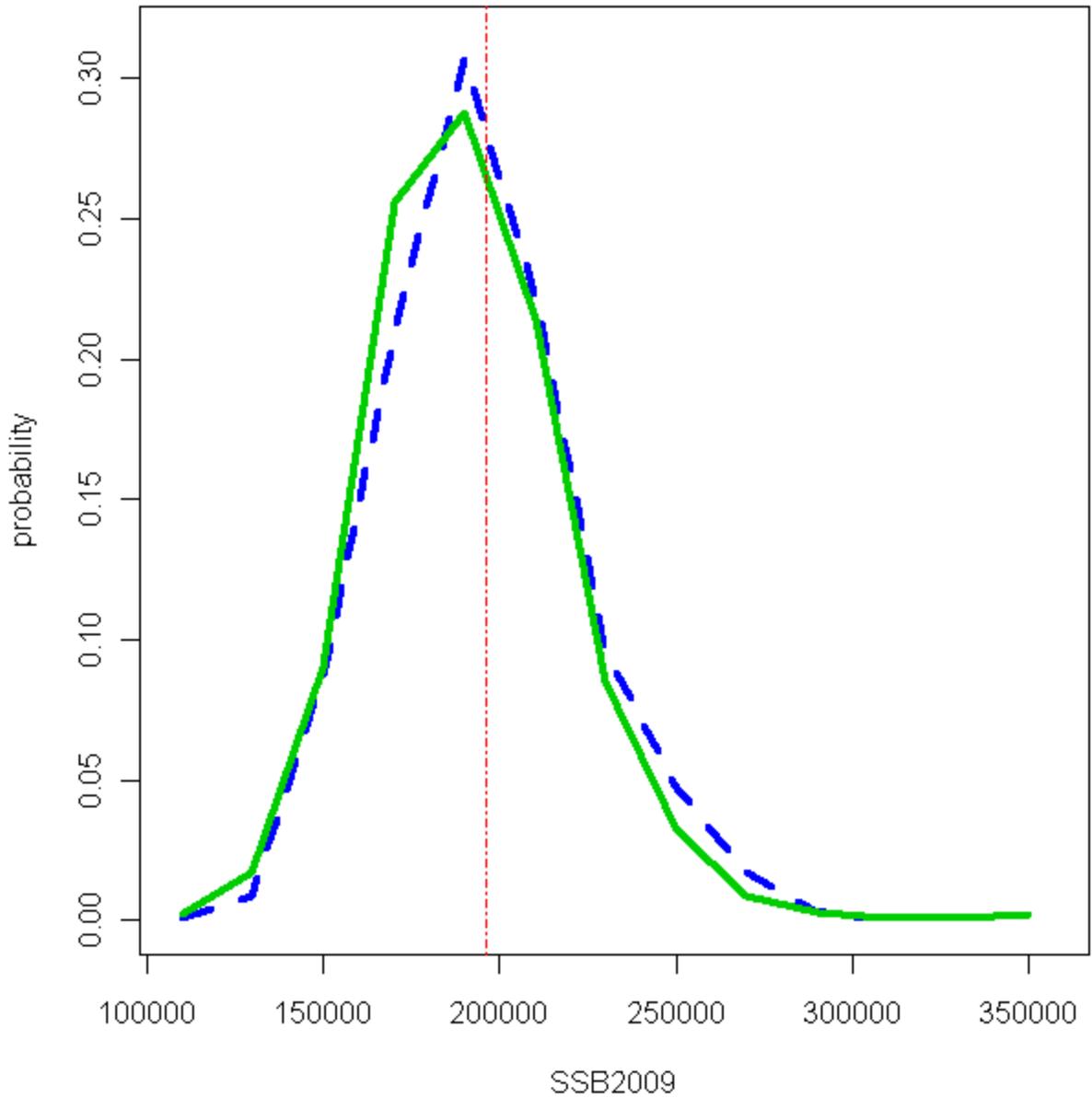


Figure C56b. Posterior distribution for spawning stock biomass (SSB) in 2009 for two MCMC chains (dotted blue and solid green lines). The vertical dashed red line indicates the point estimate. (ASAP base model)

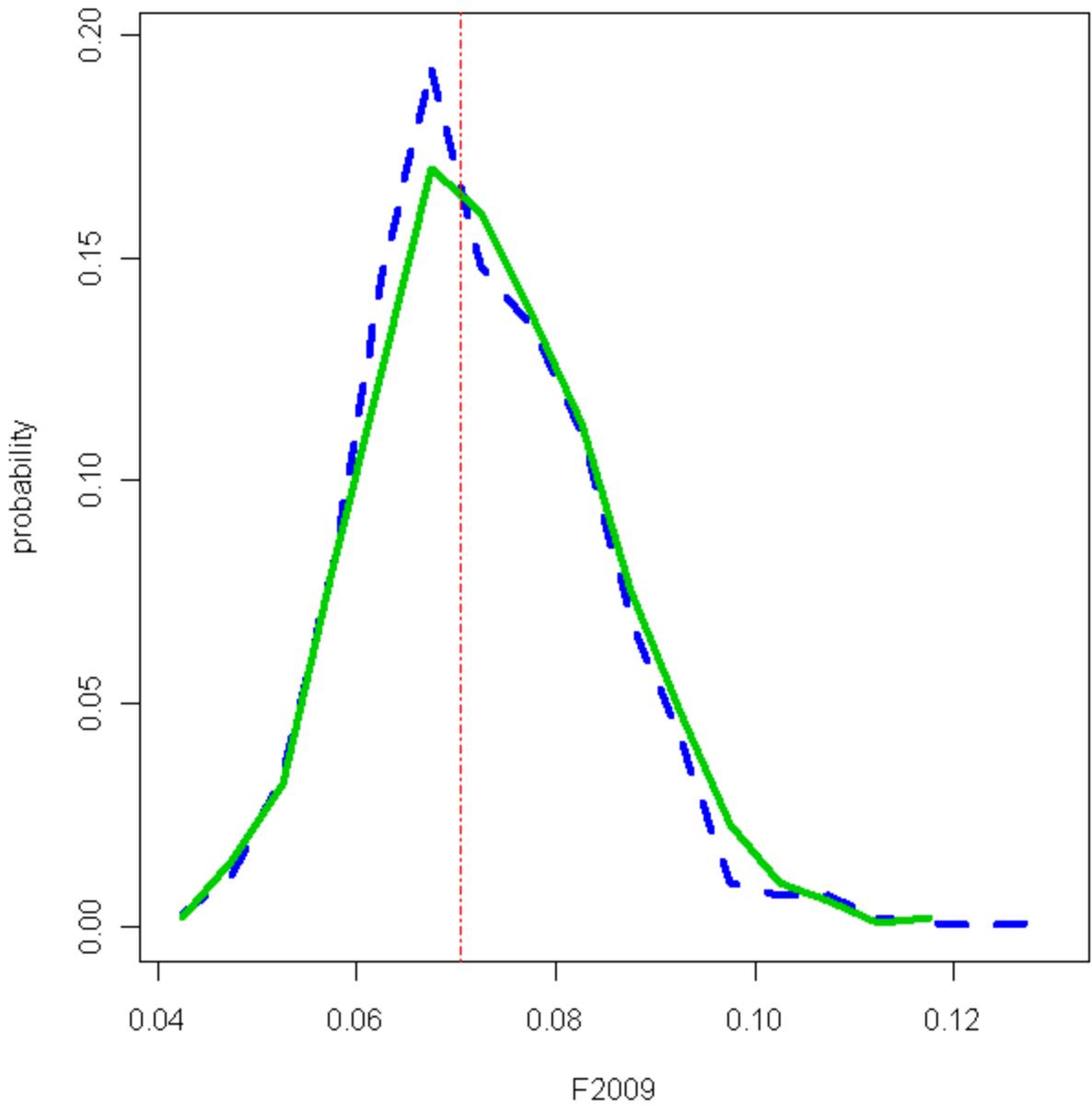


Figure C57. Posterior distribution for the average F on ages 5-7 (F_{5-7}) in 2009 for two MCMC chains (dotted blue and solid green lines). The vertical dashed red line indicates the point estimate. (ASAP base model)

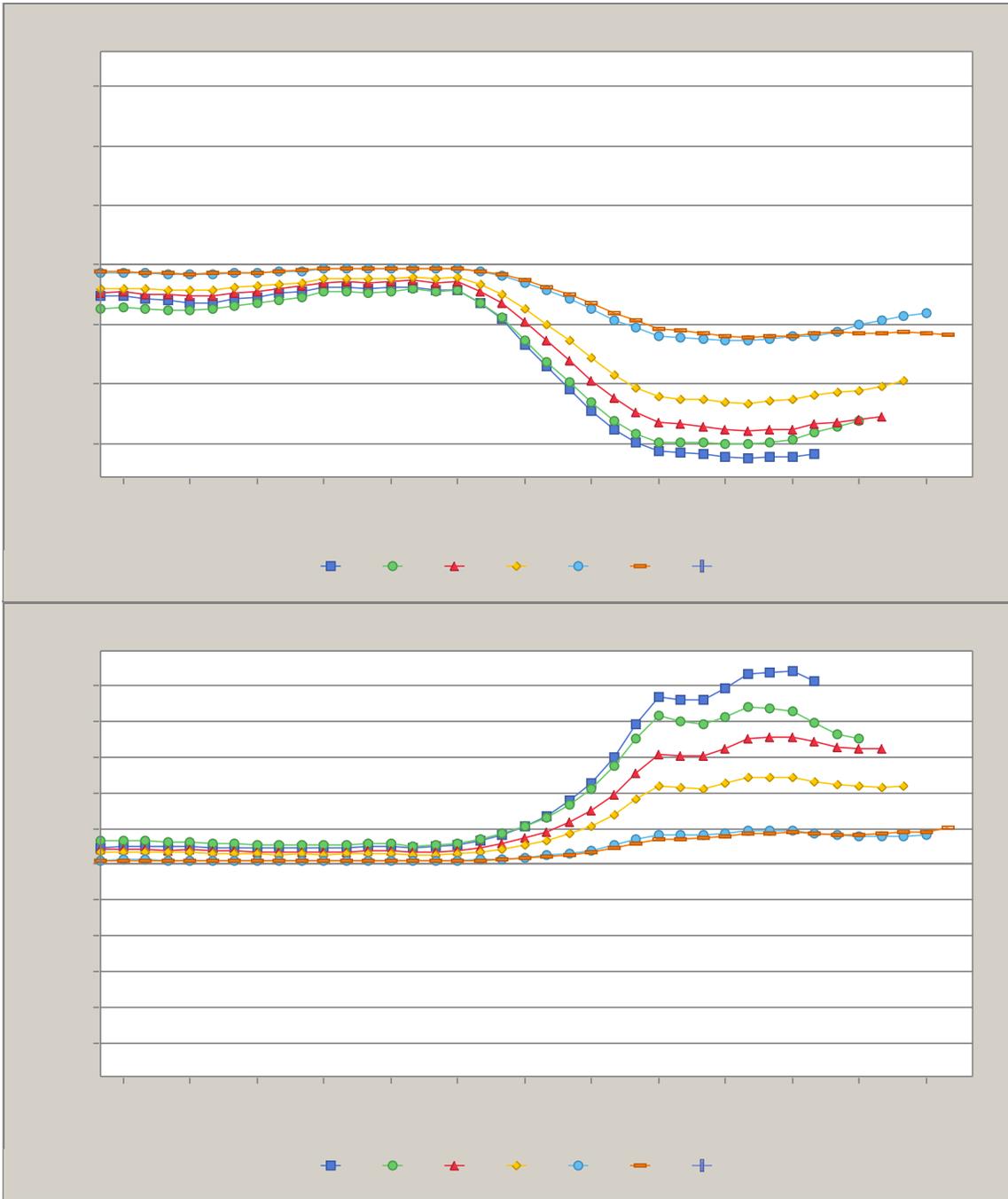


Figure C58. Retrospective analysis for years 2002-2008 for the ASAP sensitivity model with selectivity at ages 6-9+ fixed at 1.0. Relative bias for F (top) and SSB (bottom) are displayed for 2002 and 2004-2008; the model did not successfully run for year 2003.

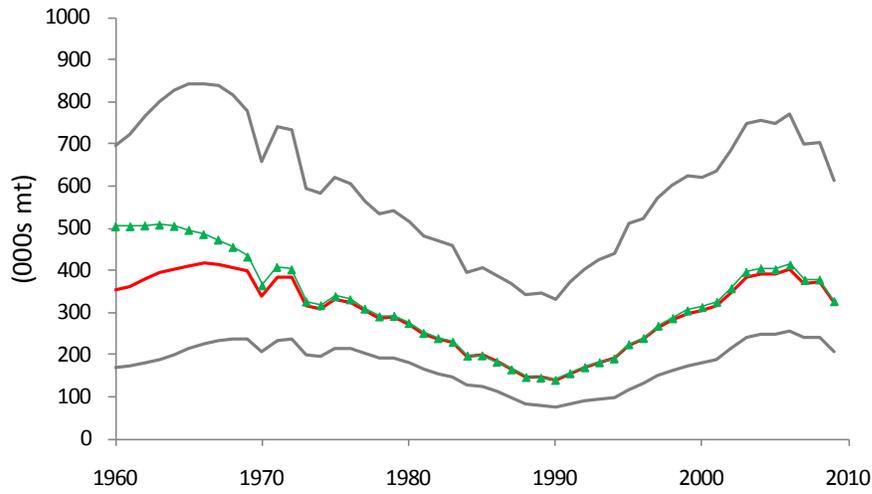


Figure C59. A 90% probability interval for spawning stock biomass (SSB) in thousands of mt is plotted for the entire time series. The median value is in red, while the 5th and 95th percentiles are in dark grey. The point estimate from the base model (joint posterior modes) is shown in the thin green lined with filled triangles. (model SCAA2)

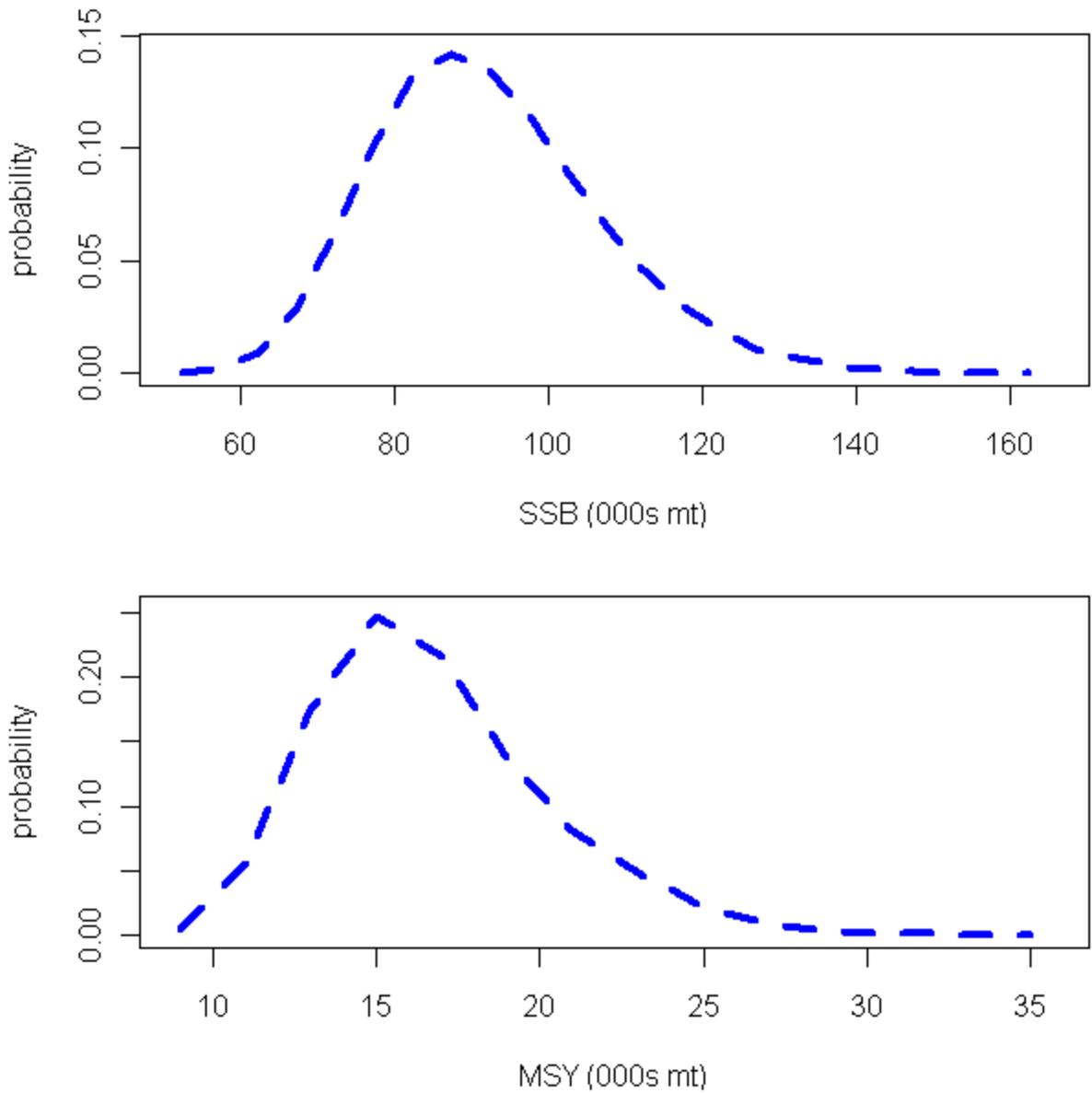


Figure C60. Distributions of SSB_{MSY} and MSY based on stochastic projections at F40%. The median estimates are 91,000 mt for SSB_{MSY} and 16,200 mt for MSY , based on projections that used F40% as a proxy for F_{MSY} . (ASAP base model)

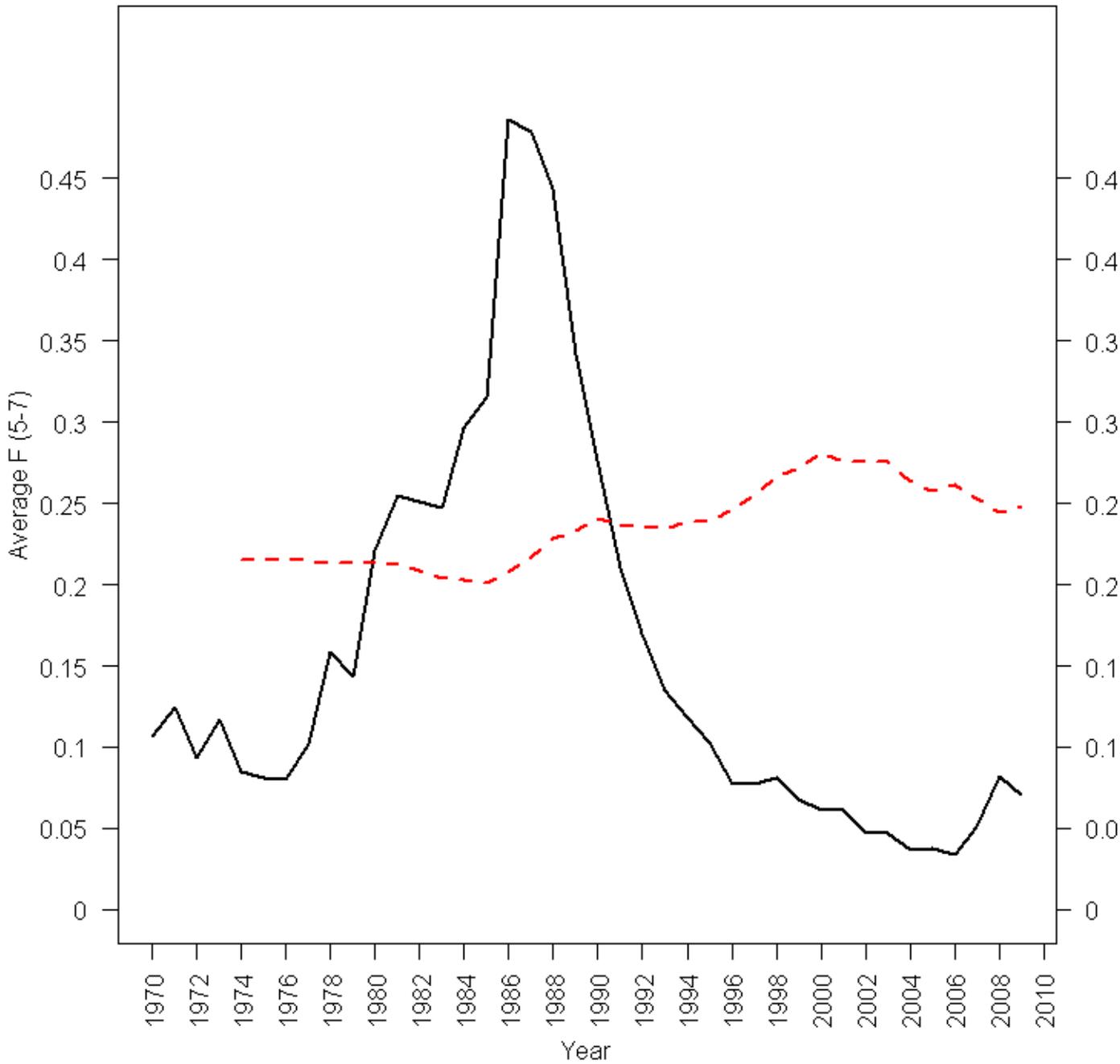


Figure C61. ASAP base model estimated time series of $F_{5.7}$ (solid line). The dashed red line is the corresponding $F_{40\%}$ on ages 5-7 calculated for years 1974-2009 with a 5 year moving average of weights at age, selectivity at age, and maturity at age. The $F_{40\%}$ in 1974 used years (1970-1974) while the final $F_{40\%}$ used years (2005-2009). (ASAP base model)

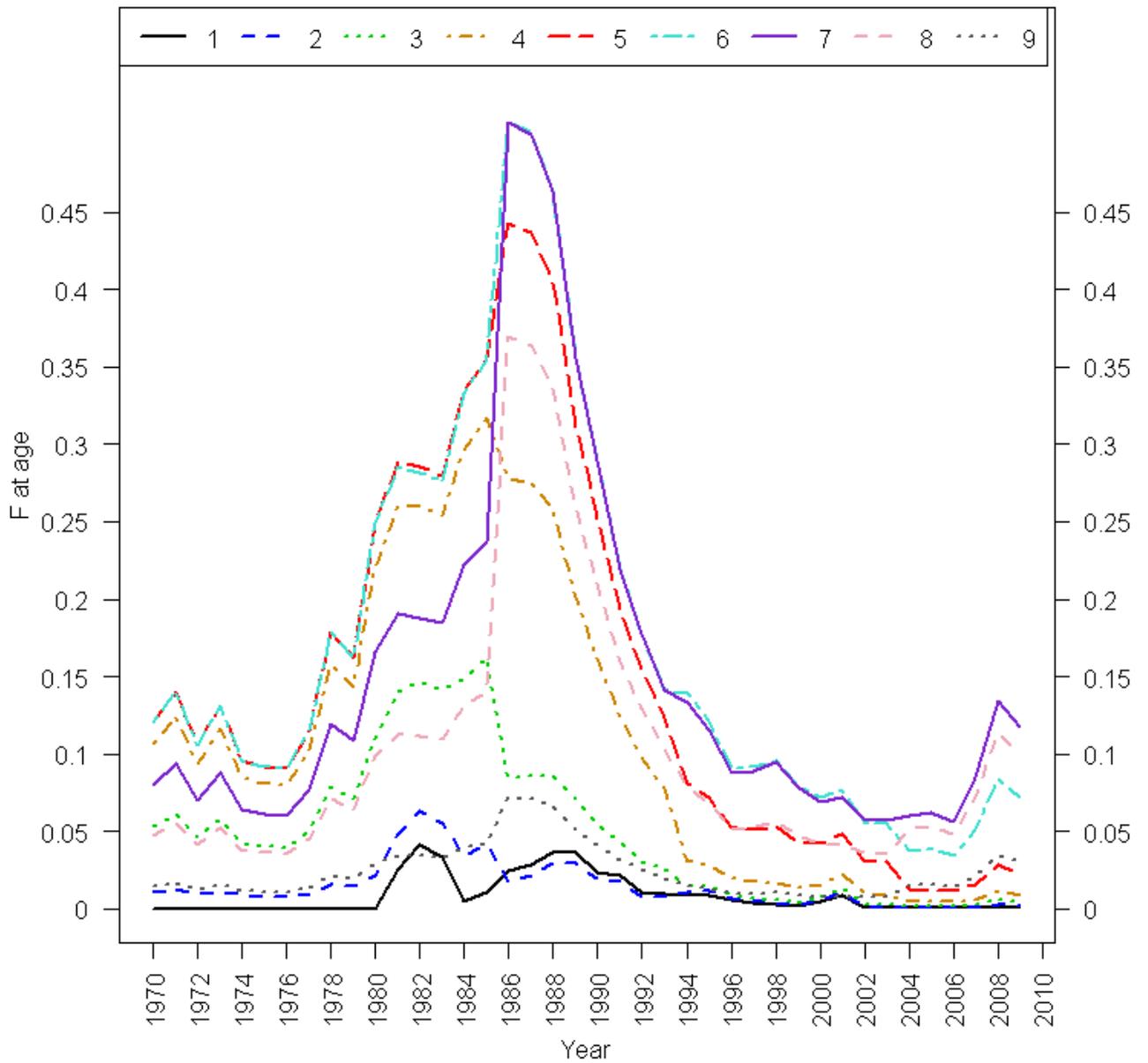


Figure C62. ASAP base model estimate of fishing mortality at age.

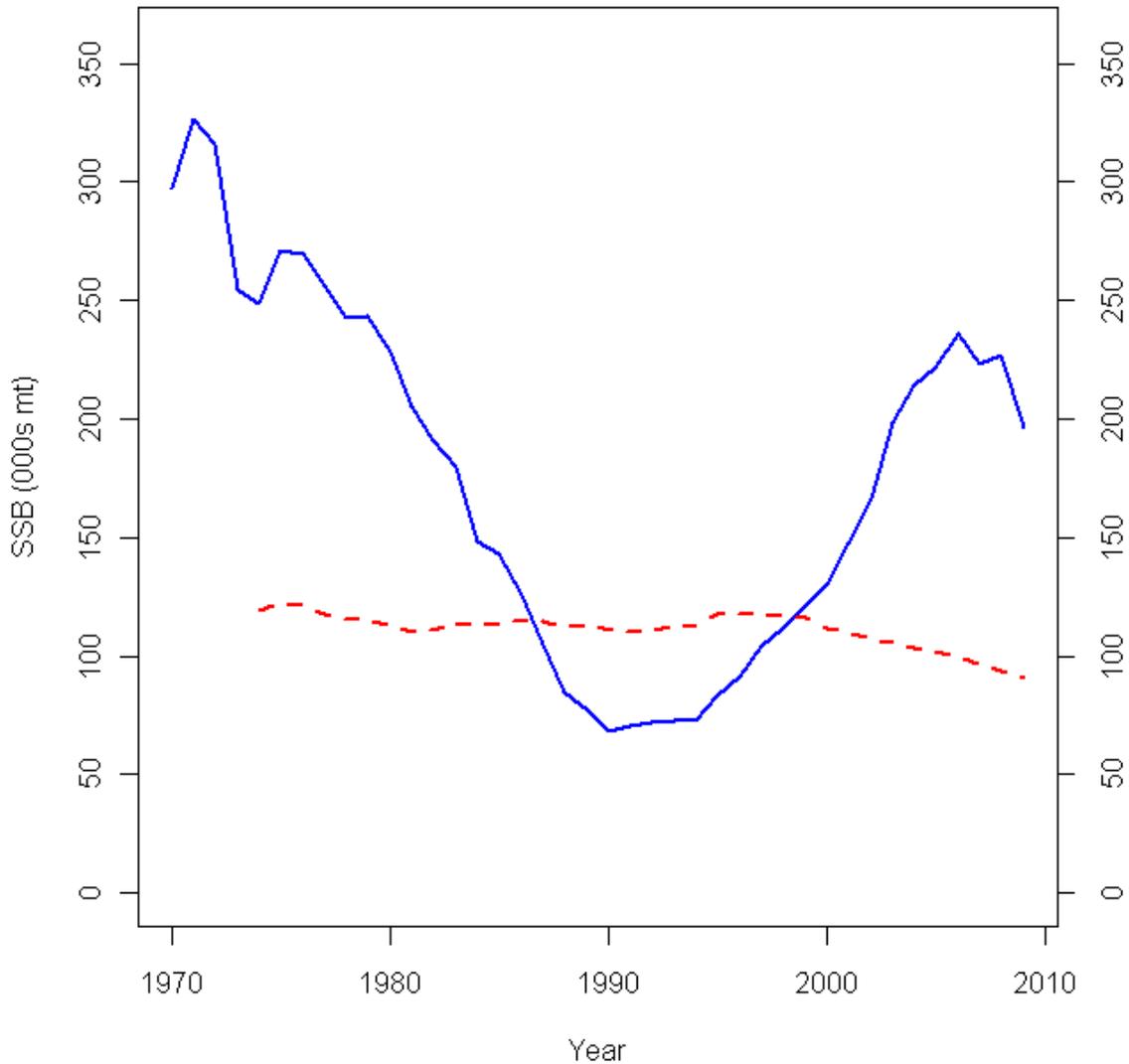


Figure C63. ASAP base model estimated time series of SSB (solid line). The dashed red line is the corresponding SSB_{MSY} proxy as calculated from stochastic projections at year-specific $F_{40\%}$ with a 5 year moving average of weights at age, selectivity at age, and maturity at age. SSB_{MSY} in 1974 used years (1970-1974) while the final SSB_{MSY} used years (2005-2009). (ASAP base model)

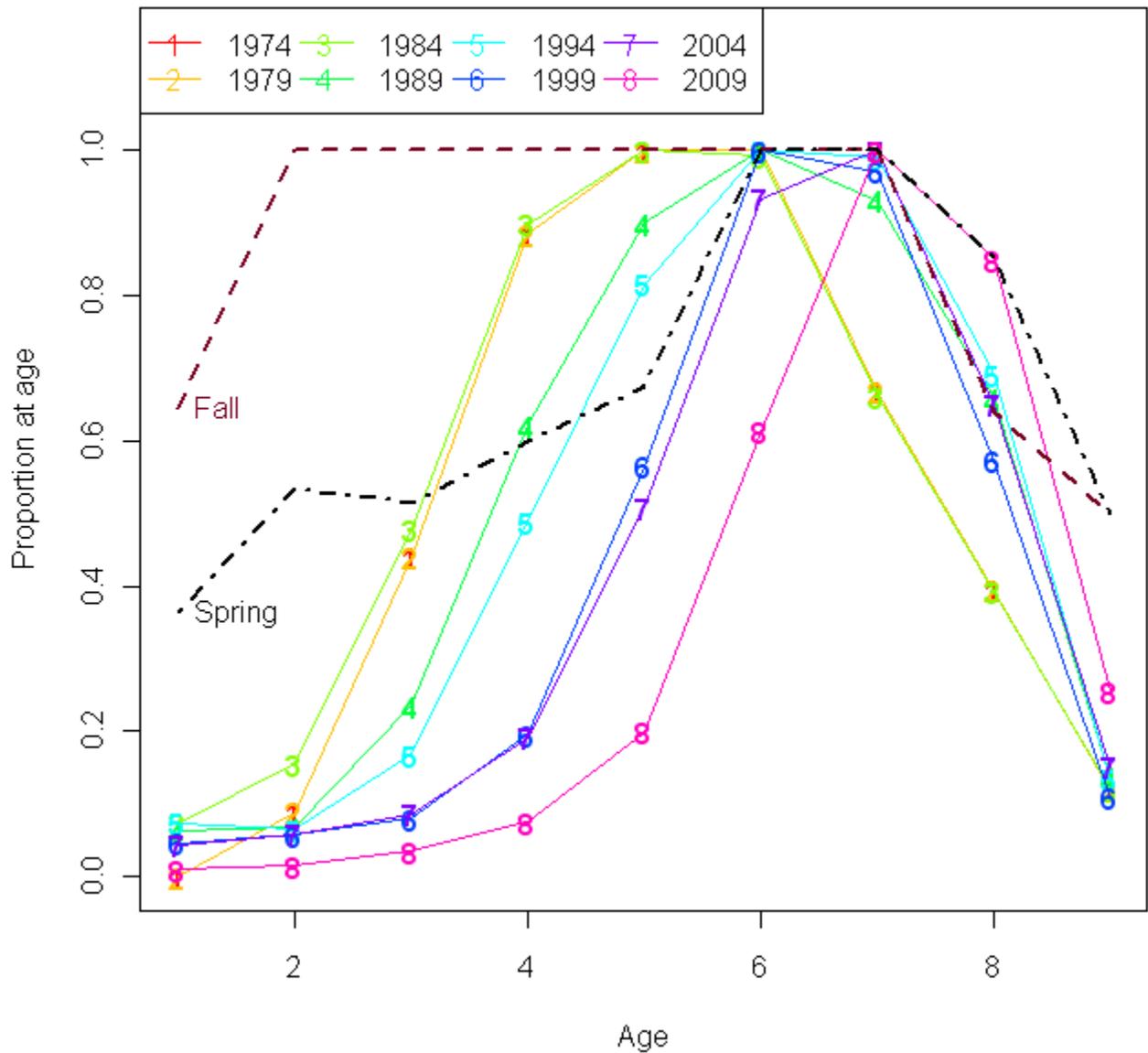


Figure C64. ASAP base model estimates for NEFSC Fall and Spring index selectivities (dashed, and dot-dash, respectively) compared to 5-year average fleet selectivities. Average selectivity at age for the 1st 5-year period includes estimates from 1970-1974 (line with '1' for point symbols) while the last 5-year average includes estimates from 2005-2009 (line with '8' for point symbols).

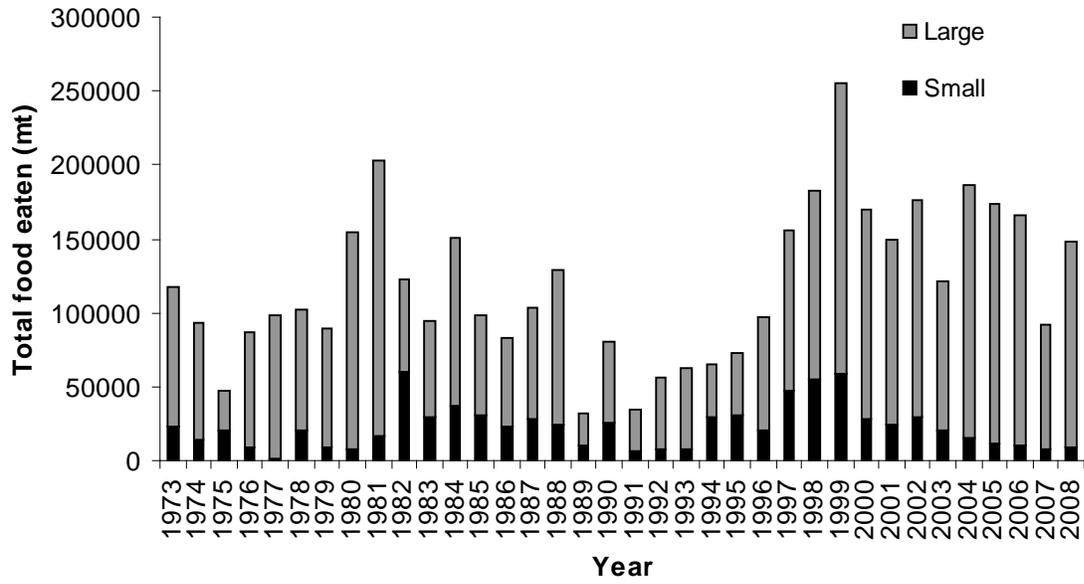


Figure C65. Total amount of food consumed by pollock.