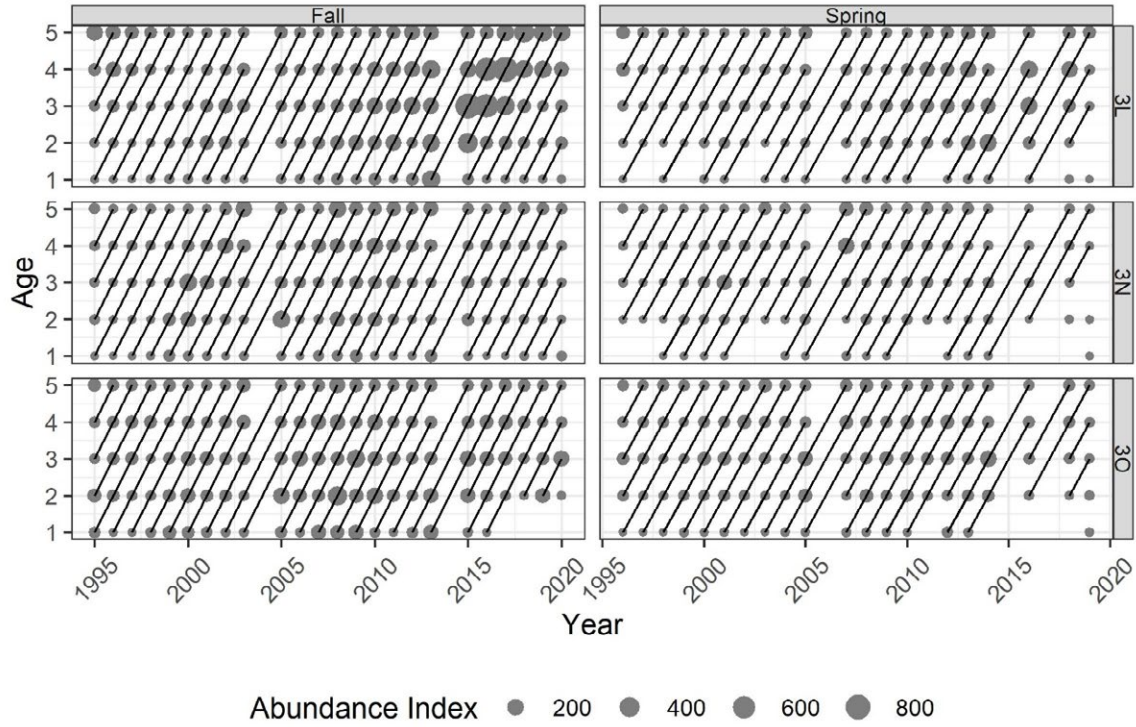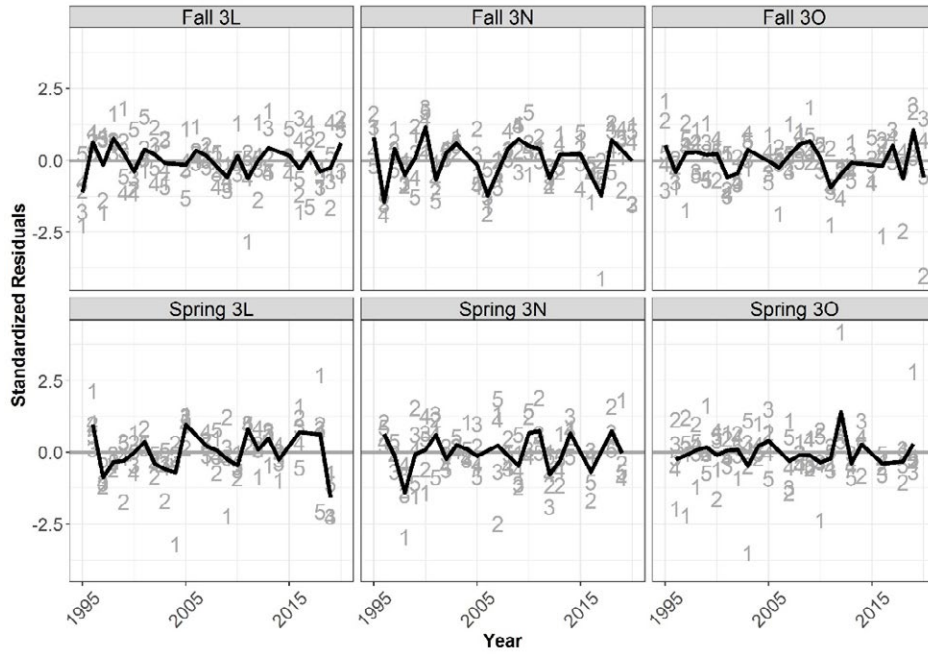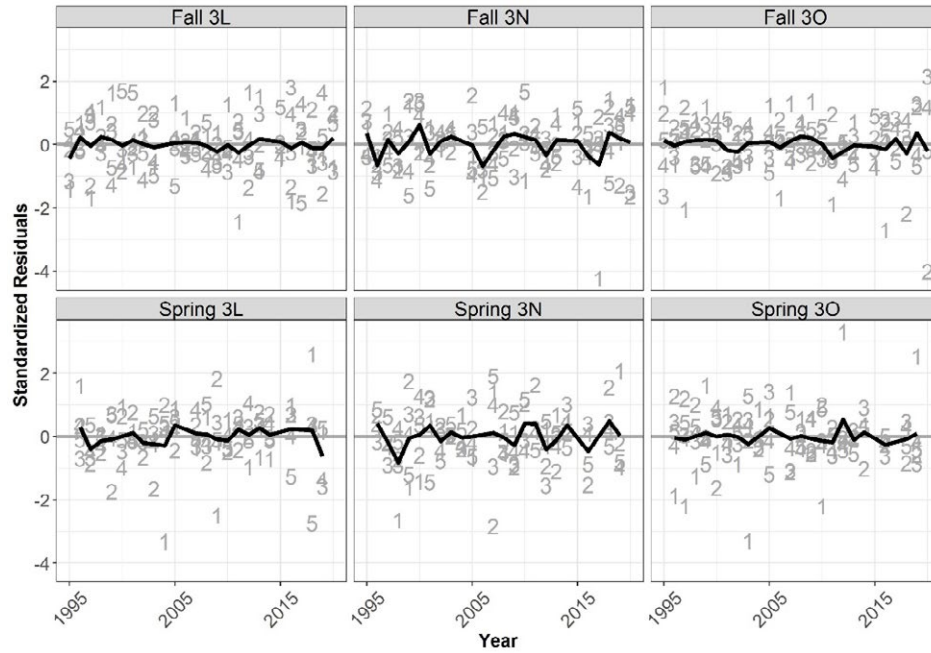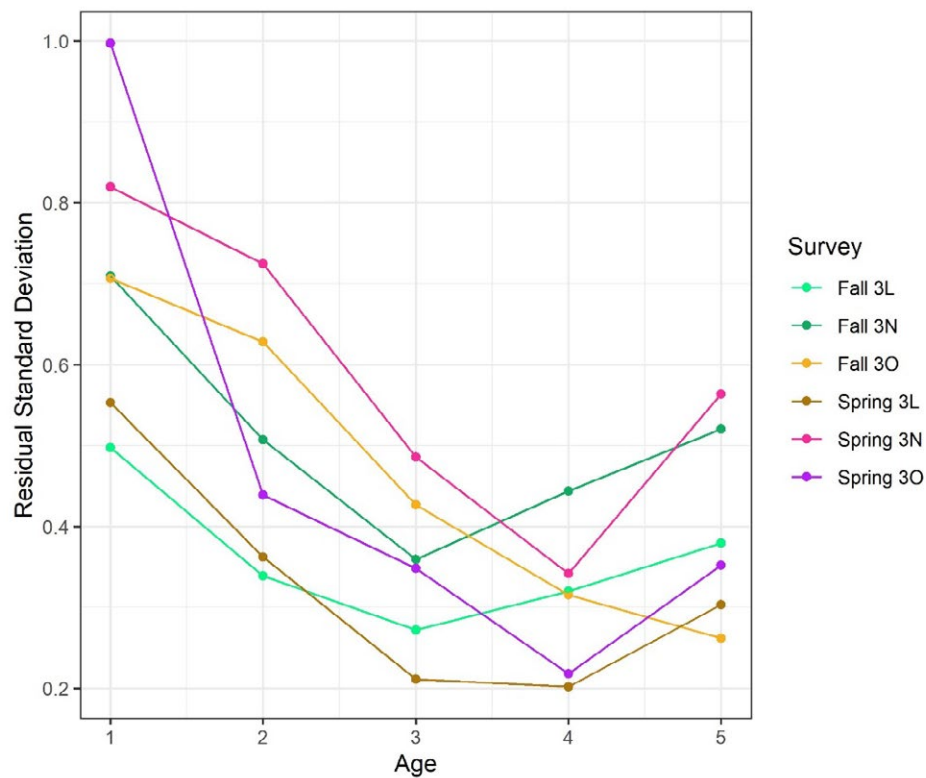# Supplementary Materials

SM. Fig. 1.   Data used in the metapopulation dynamics process model. The figure shows the spatiotemporal coverage of the survey, where diagonal lines connect cohorts and the size of the bubbles are proportional to the value of the abundance index for a given year and age.
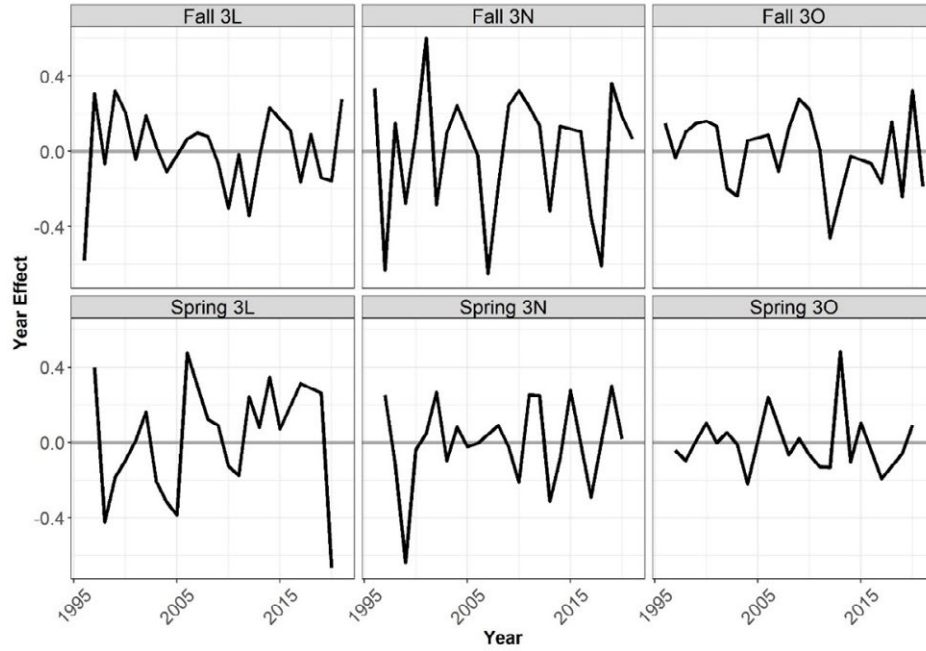

SM. Fig. 2.   Standardized residuals by survey for model M4. Black lines indicate the mean across ages in a given year, while grey lines indicate zero. Numbers represent the age-class for each residual.
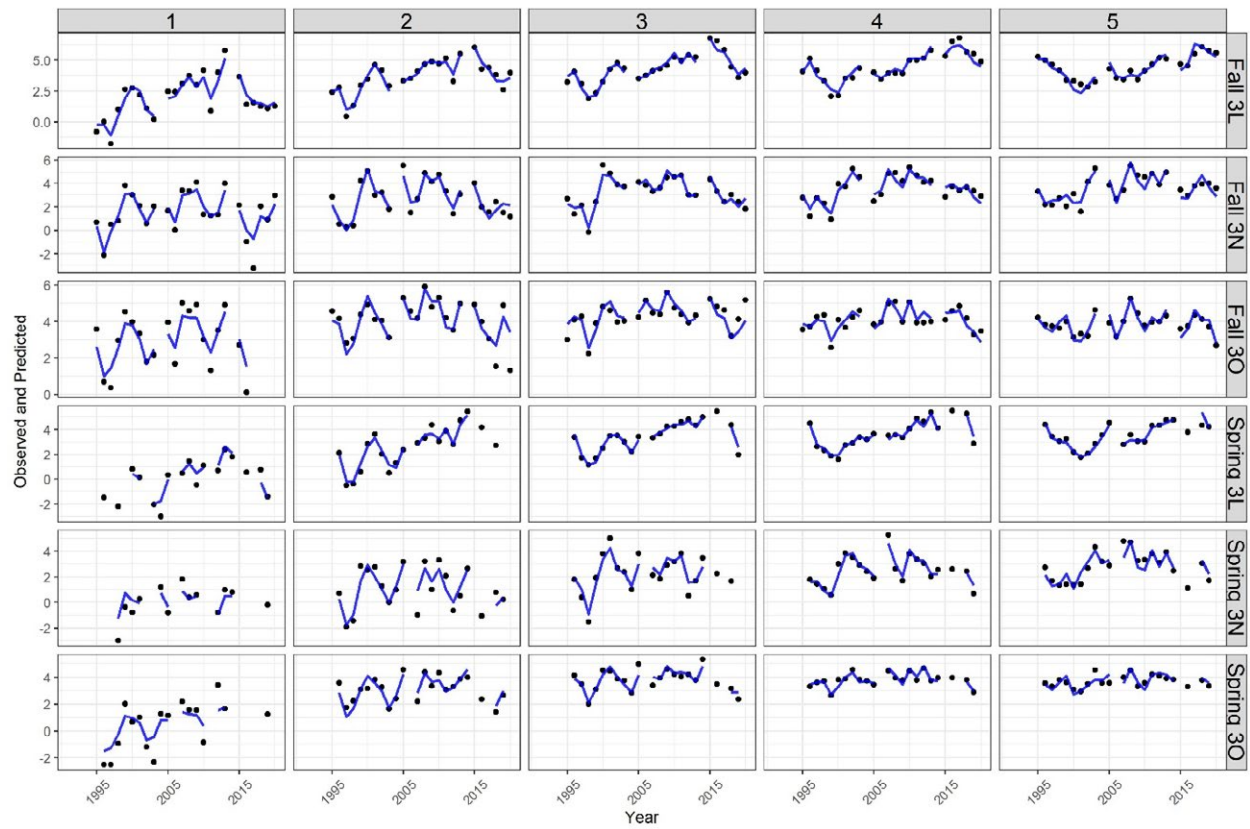
SM. Fig. 3. Standardized residuals by survey for model M5. Black lines indicate the mean across ages in a given year, while grey lines indicate zero. Numbers represent the age-class for each residual.
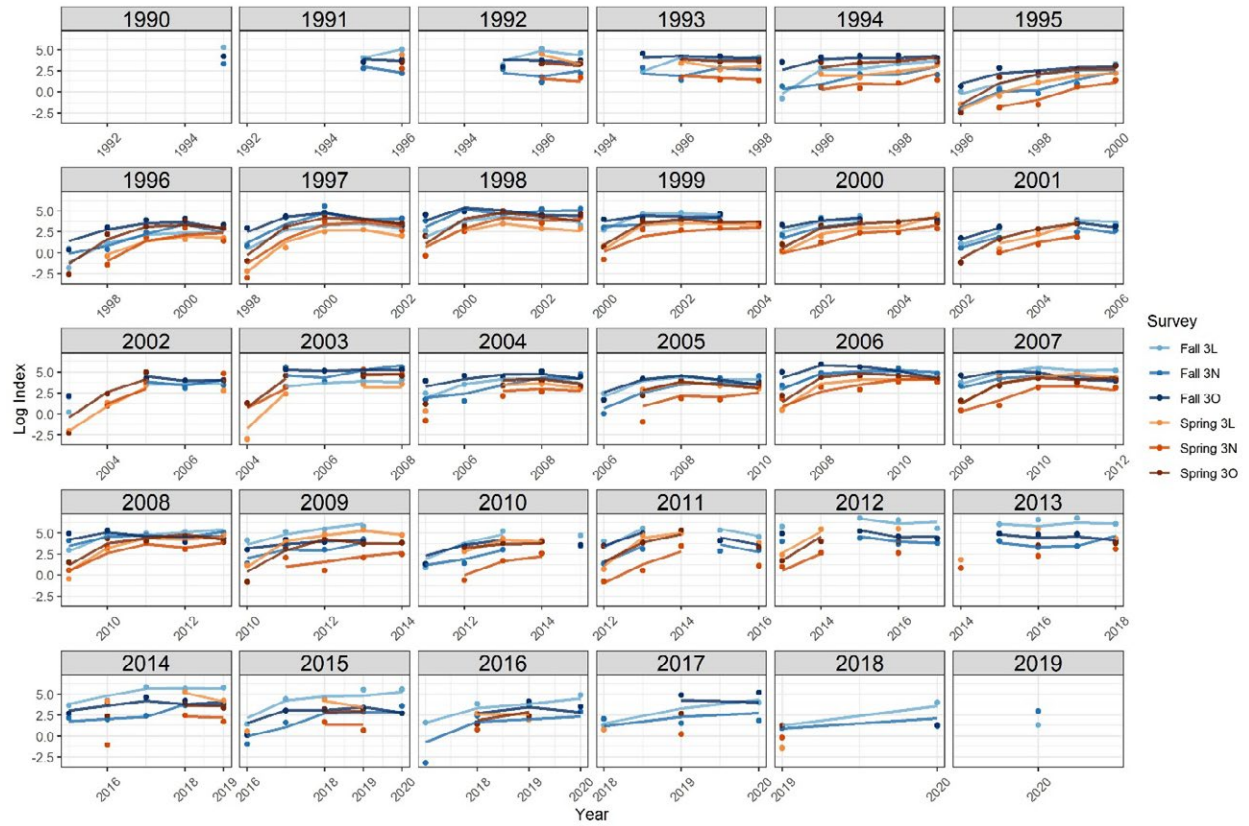

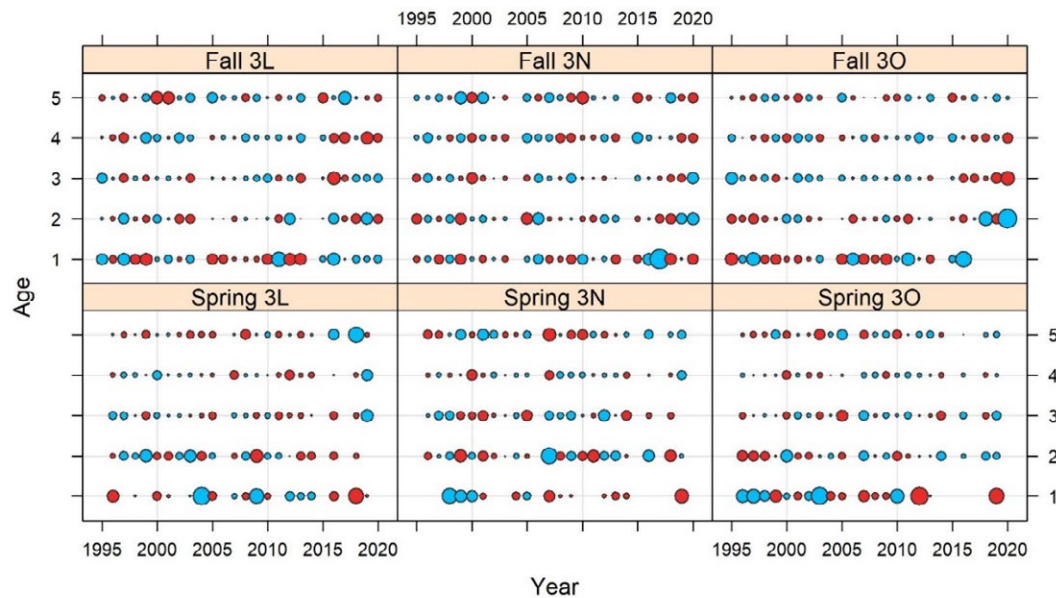SM. Fig. 4. Residual standard deviations by age and survey from model M5.

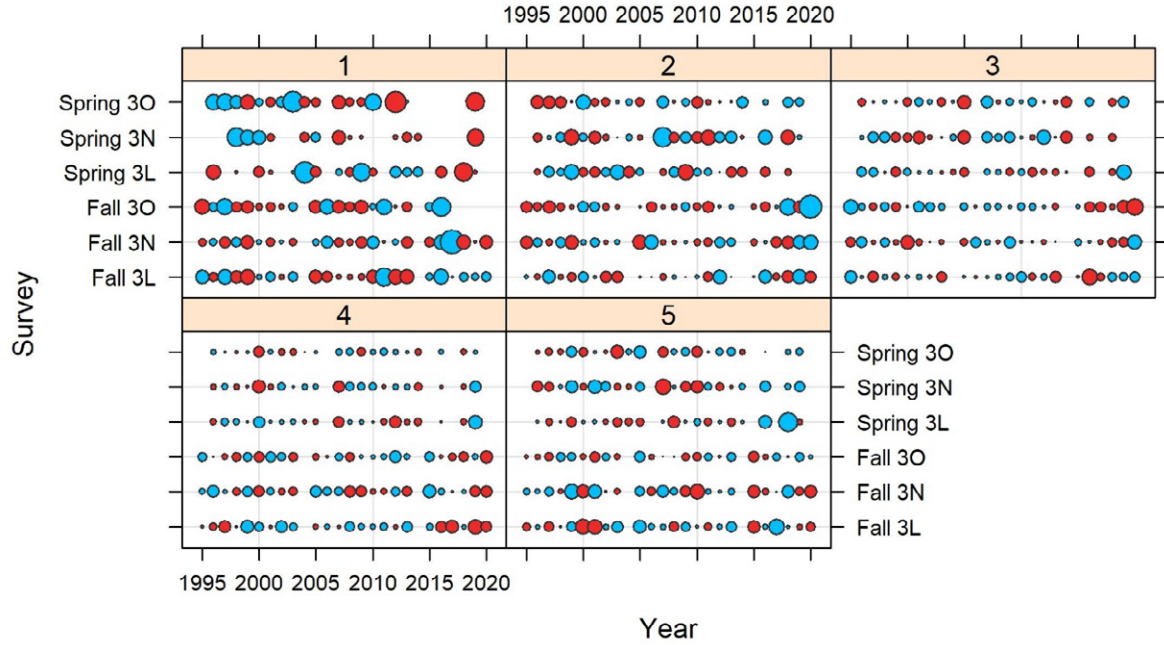SM. Fig. 5.   Time-series of survey year-effects estimated for each survey in M5.

SM. Fig. 6.   Log-transformed observed and predicted survey trends over time for each survey and age in M5. Black points represent the observed data while blue lines indicate model predictions.
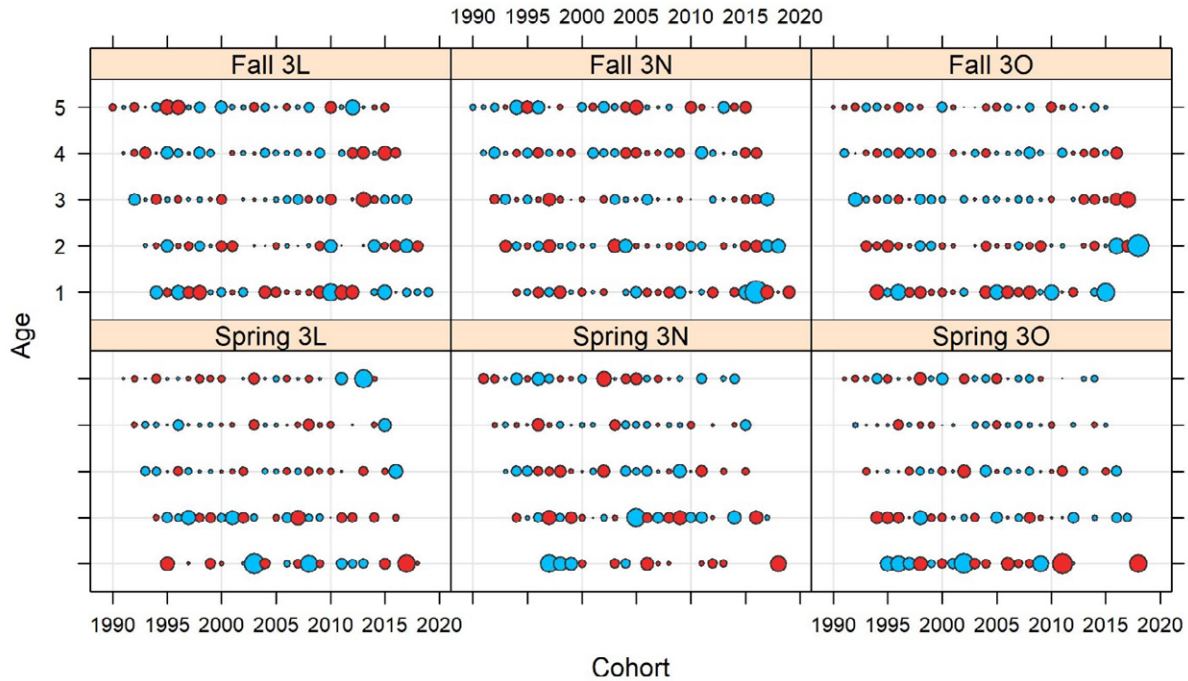
SM. Fig. 7   Log-transformed observed and predicted survey trends by cohort for each survey in M5. Points represent the observed data while the lines indicate model predictions.
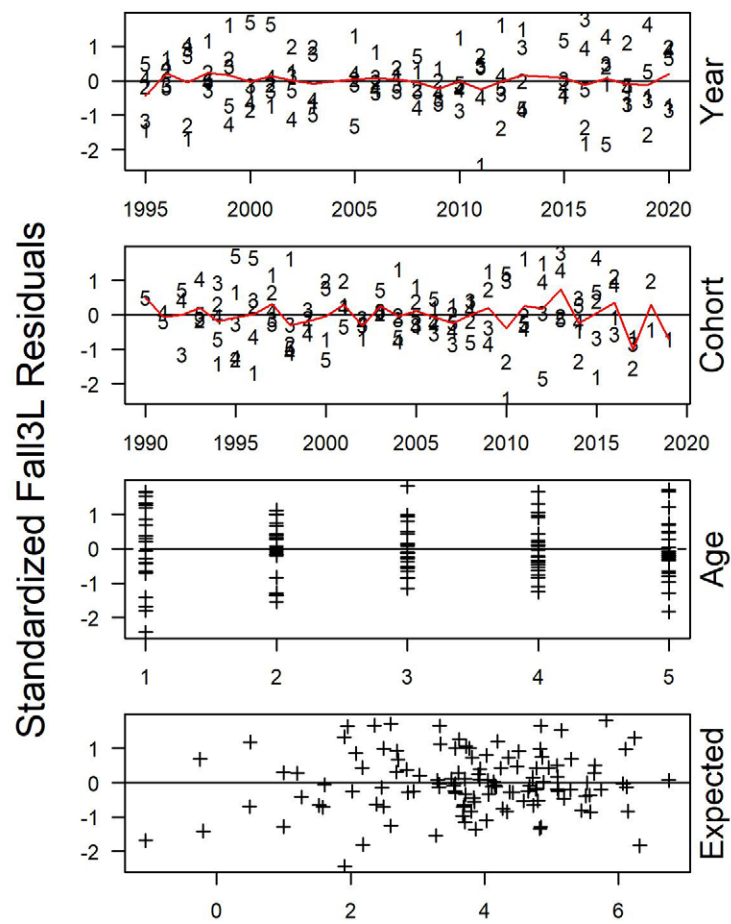

SM Fig. 8.   Standardized residual bubble plot for each survey across ages and years from model M5. Symbol sizes are scaled and values greater than average are shown as blue circles, average values are shown as small dots, and less than average values are shown as red circles.
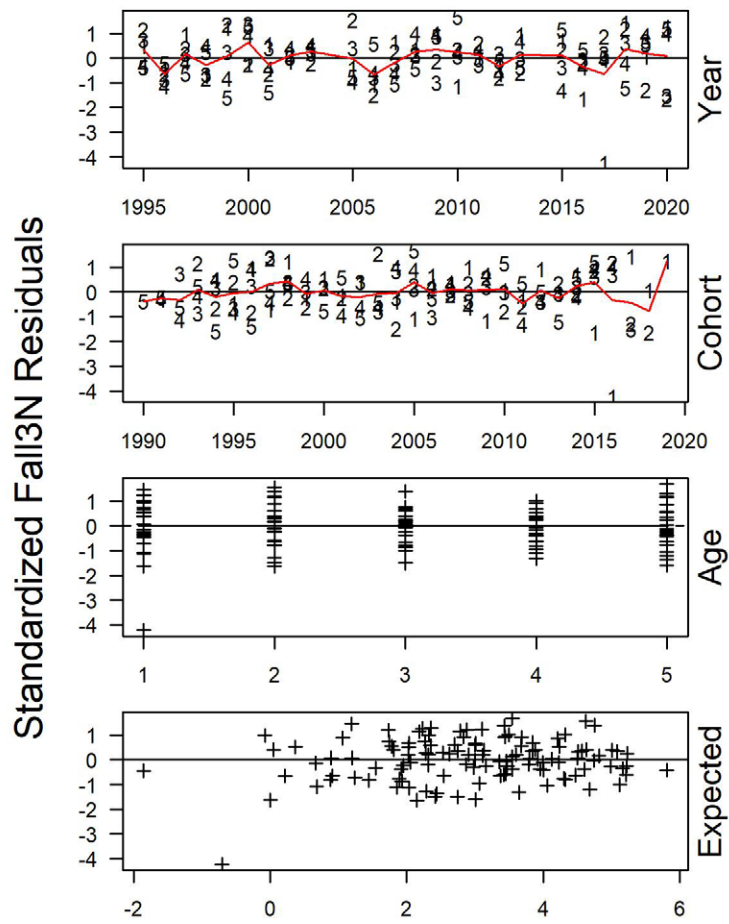
SM. Fig. 9. Standardized residual bubble plot for each age across ages and cohorts from model M5. Symbol sizes are scaled and values greater than average are shown as blue circles, average values are shown as small dots, and less than average values are shown as red circles.
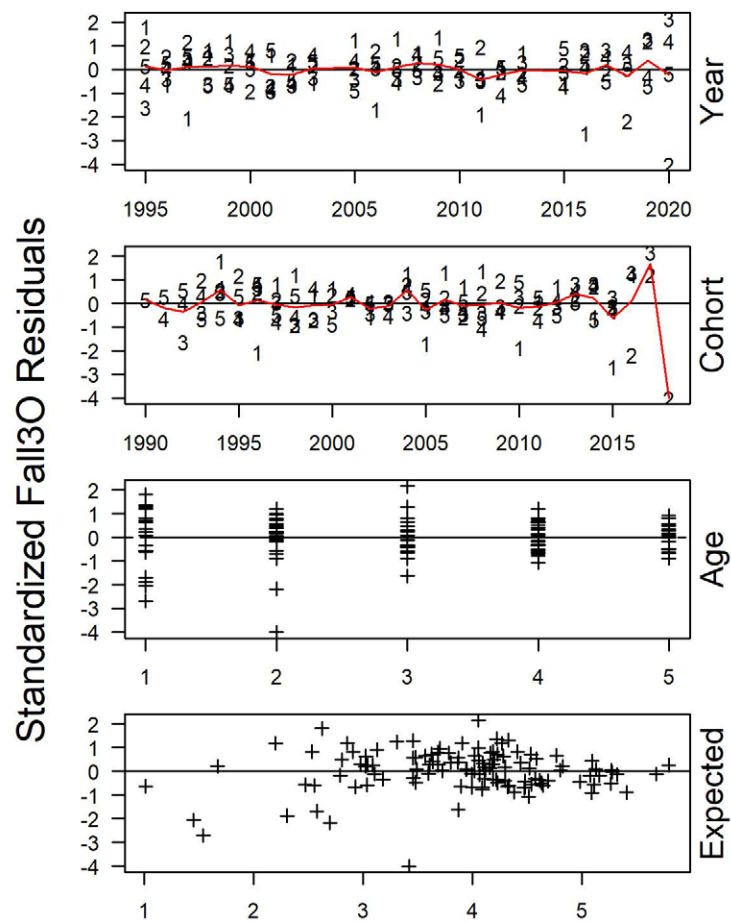

SM. Fig. 10. Standardized residual bubble plot for each age across surveys and years from model M5. Symbol sizes are scaled and values greater than average are shown as blue circles, average values are shown as small dots, and less than average values are shown as red circles.
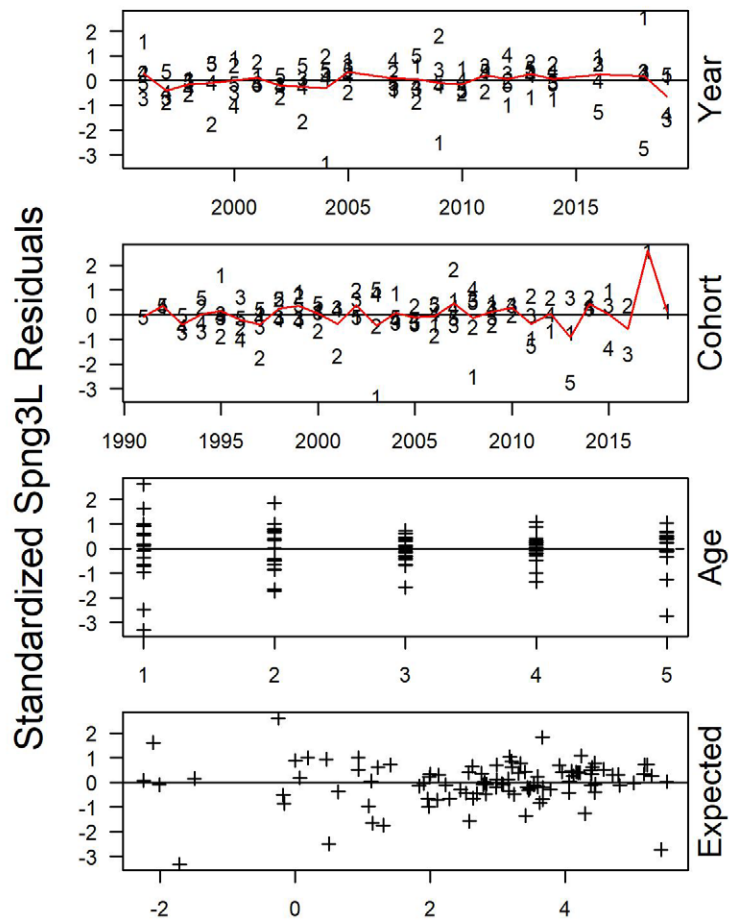
SM. Fig. 11. Standardized residual panel plot for the Fall 3L survey from model M5. Numbers represent age, black lines indicate zero, and red lines indicate means.

SM. Fig. 12. Standardized residual panel plot for the Fall 3N survey from model M5. Numbers represent age, black lines indicate zero, and red lines indicate means.
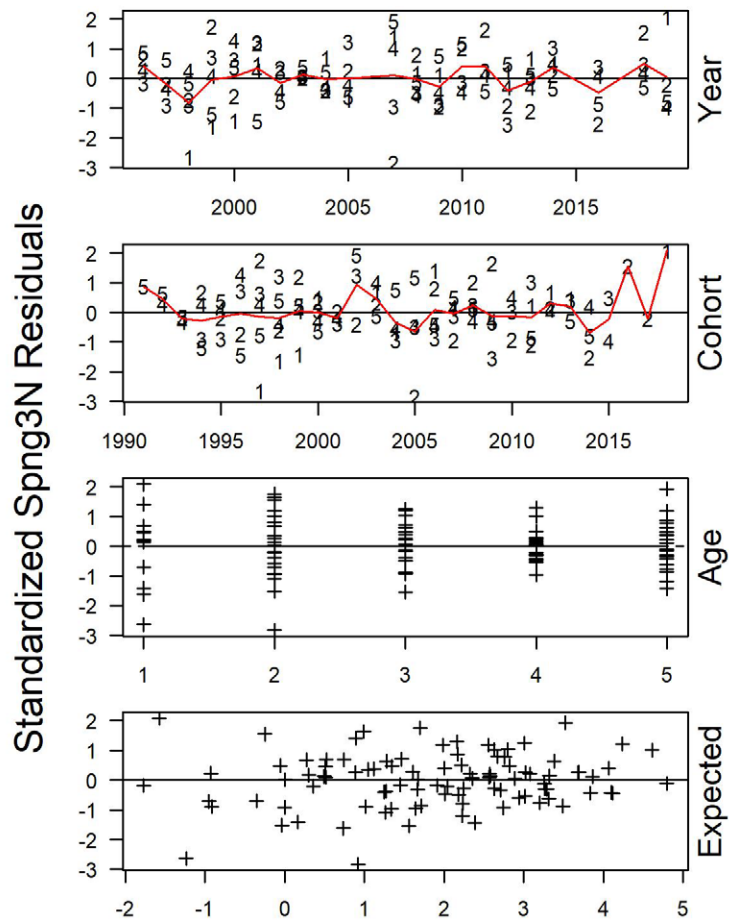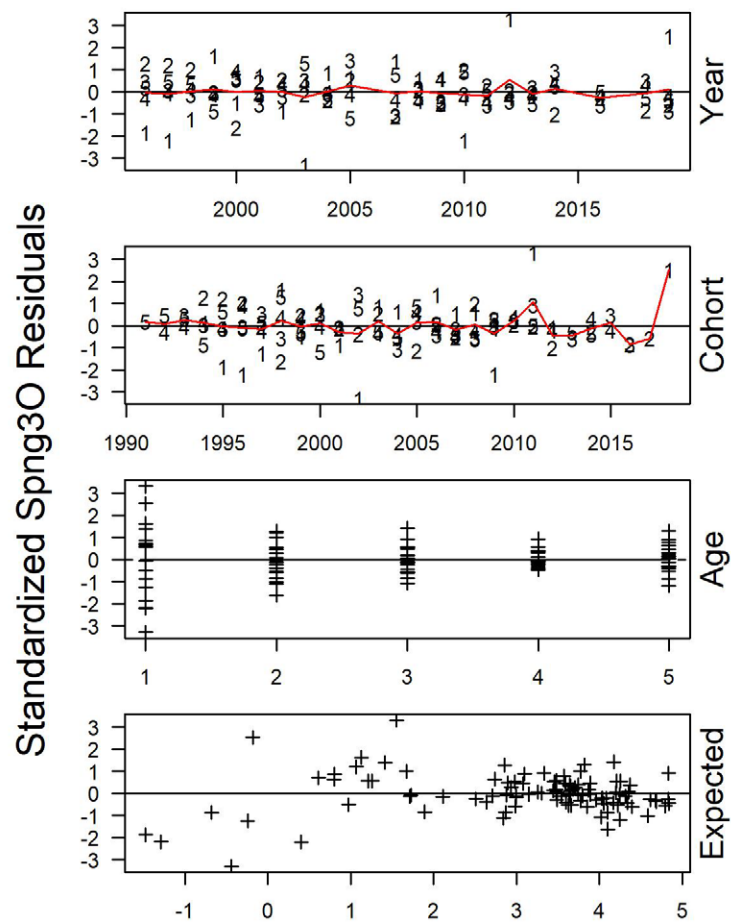
SM. Fig. 13. Standardized residual panel plot for the Fall 3O survey from model M5. Numbers represent age, black lines indicate zero, and red lines indicate means.

SM. Fig. 14. Standardized residual panel plot for the Spring 3L survey from model M5. Numbers represent age, black lines indicate zero, and red lines indicate means.

SM. Fig. 15. Standardized residual panel plot for the Spring 3N survey from model M5. Numbers represent age, black lines indicate zero, and red lines indicate means.

SM. Fig. 16. Standardized residual panel plot for the Spring 3O survey from model M5. Numbers represent age, black lines indicate zero, and red lines indicate means.