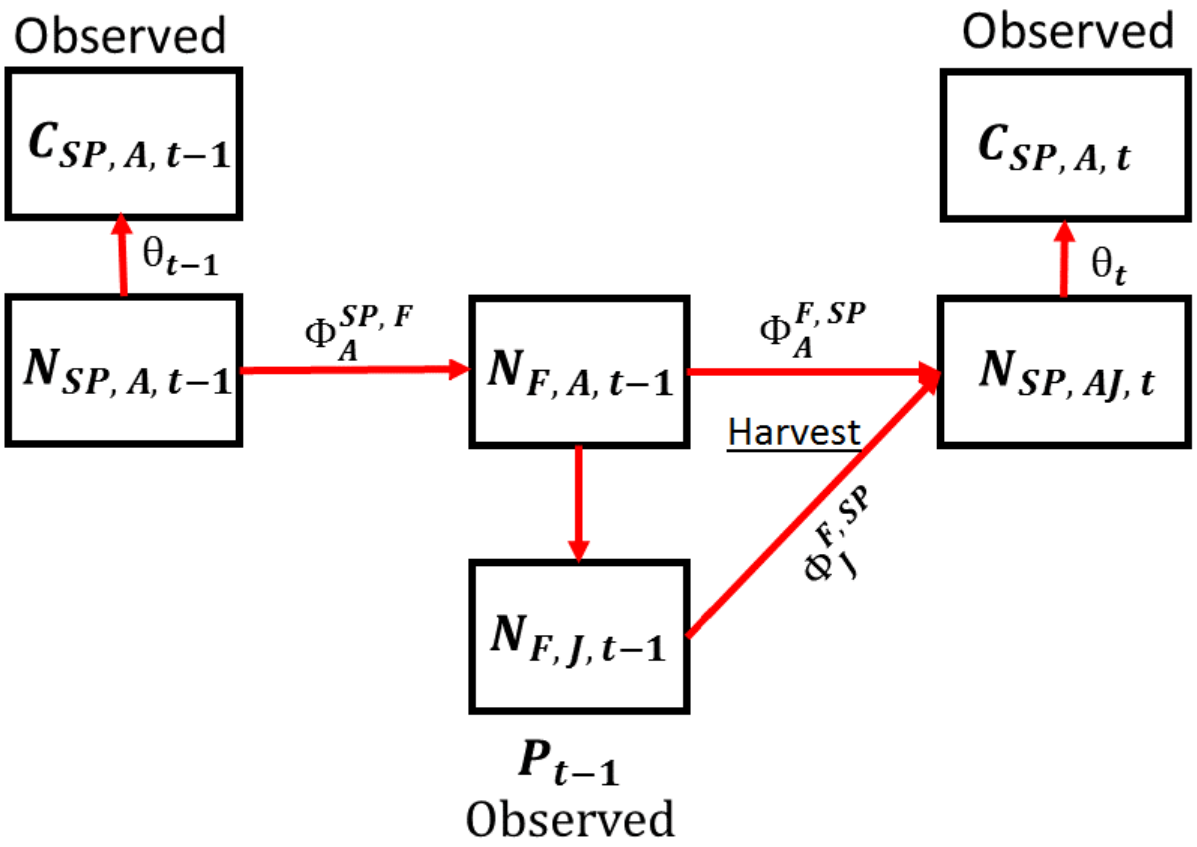

$$P_{t-1} = \frac{N_{F,J,t-1}}{N_{F,A,t-1} + N_{F,J,t-1}}$$

Figure S1: Spring population model that links observed data (spring count, juvenile recruitment, and harvest) and survival parameters to assess the reliability of the annual change in the spring sandhill crane count in the San Luis Valley, CO from one year to the next (1984-1996).

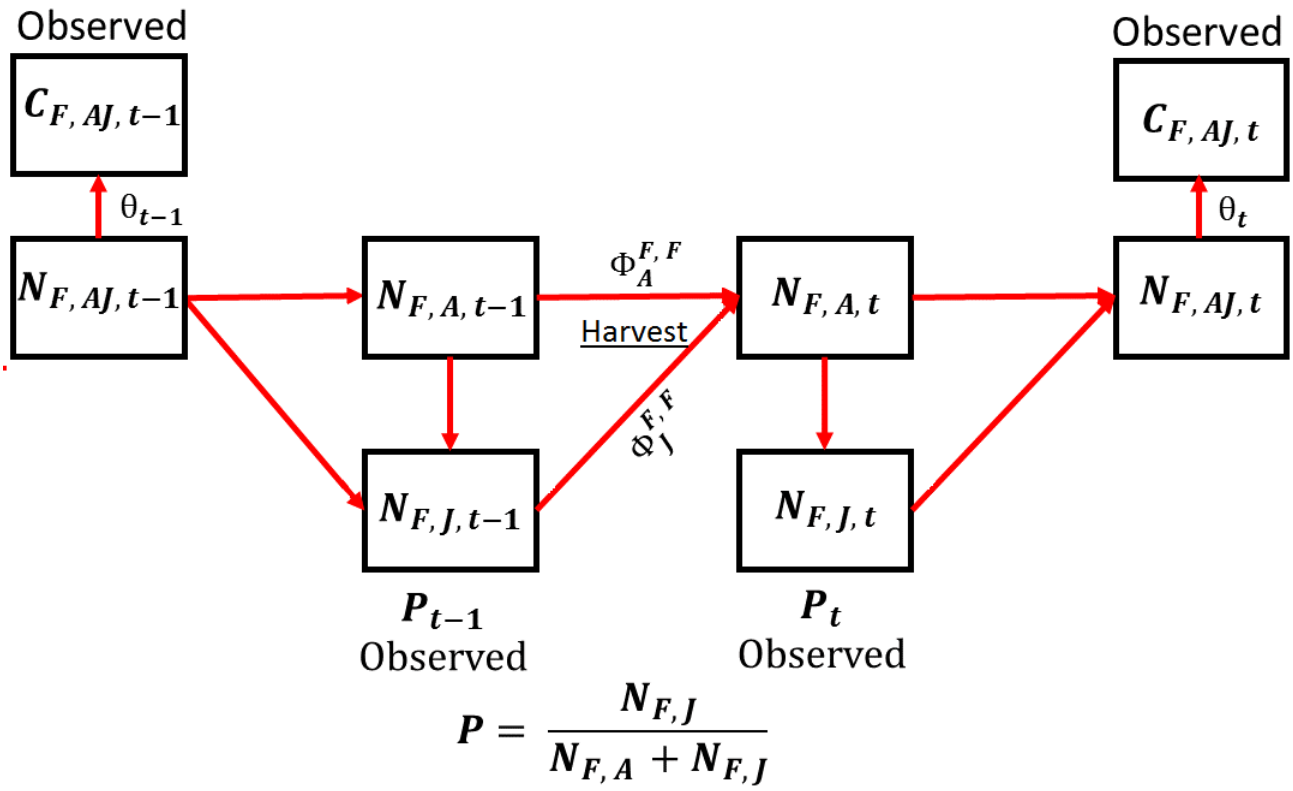

Figure S2: Fall population model that links observed data (fall count, juvenile recruitment, and harvest) and survival parameters to assess the reliability of the annual change in the spring sandhill crane count in the San Luis Valley, CO from one year to the next (1997-2014).

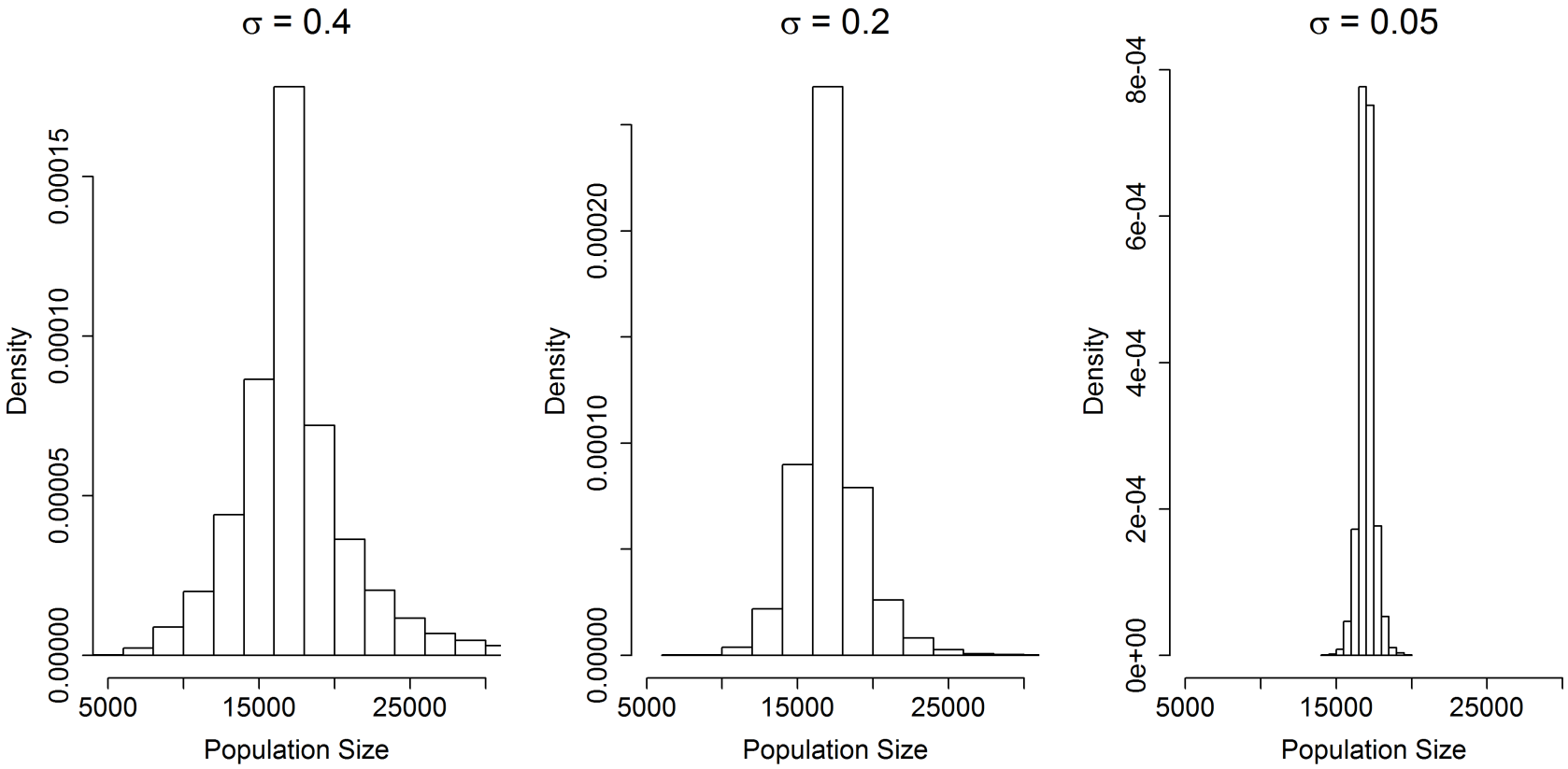

Figure S3: Maximum realized variability due to either the counting or process uncertainty of a population with mean 17,000; σ's pertain to variation on the log-scale of the population.

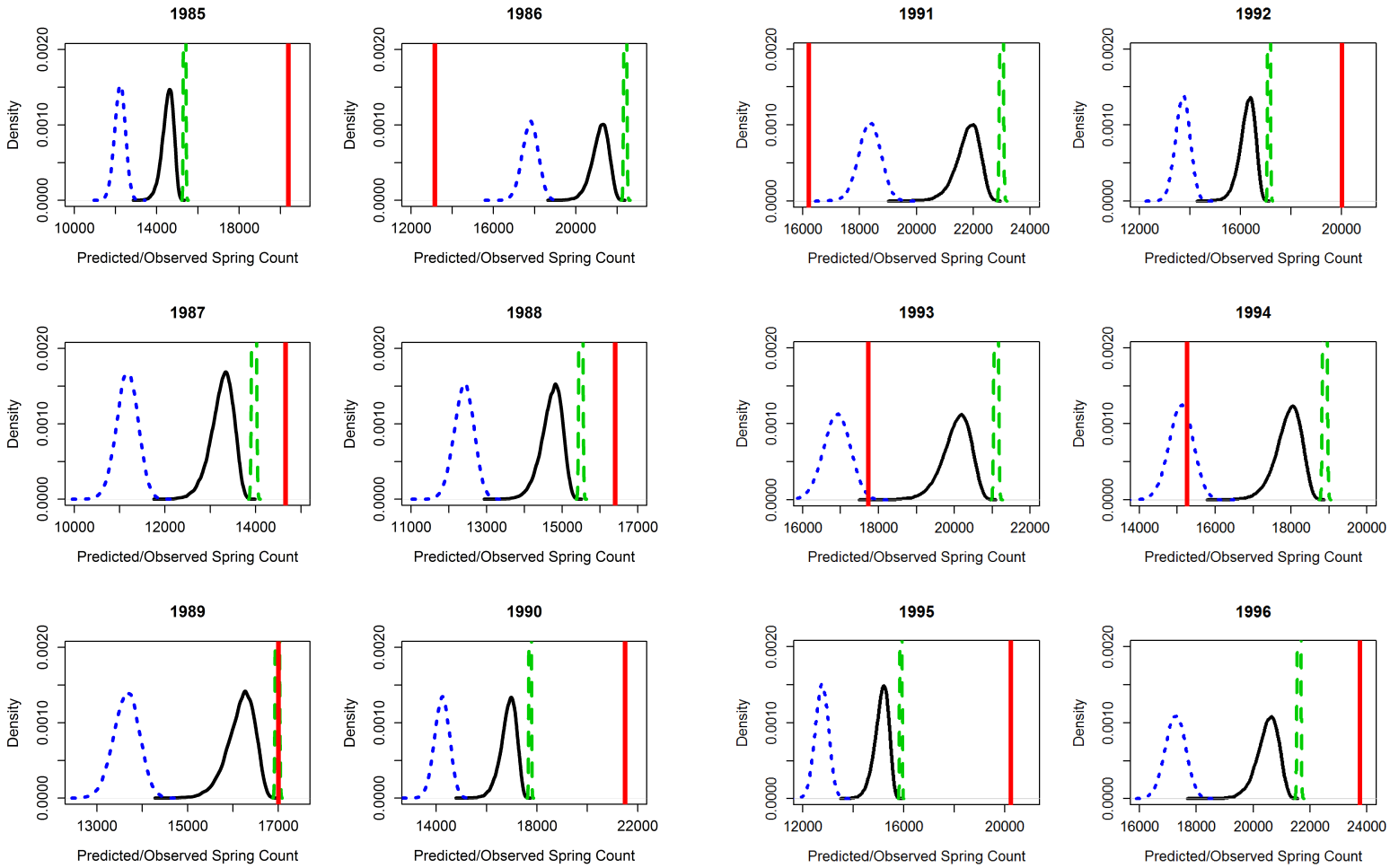

Figure S4: Comparing predicted spring counts (low (dashed), realistic (solid), high (dashed)) in year $t+1$ based off of the count and observed juvenile recruitment in year t with the observed count in year $t+1$ (solid vertical line).

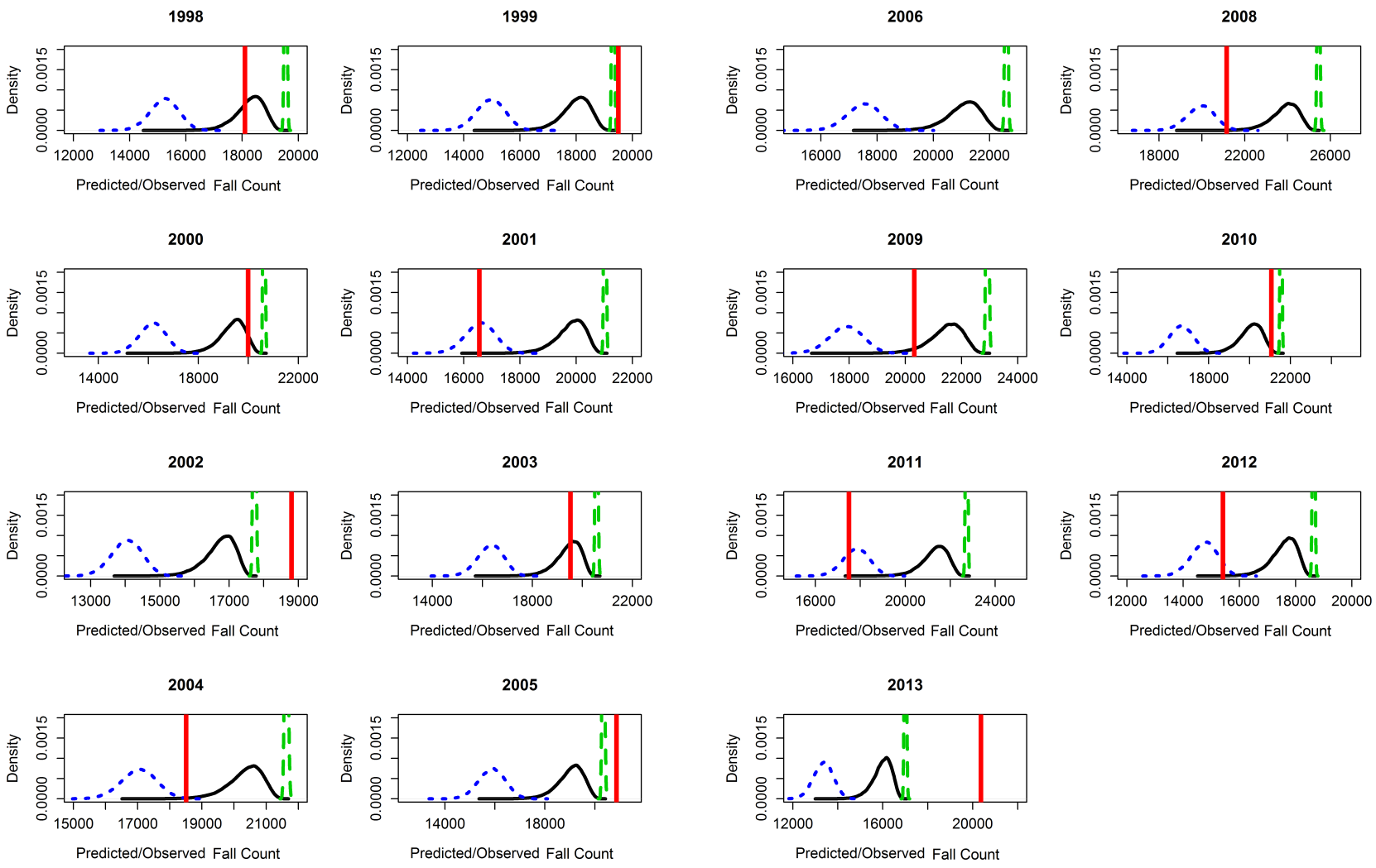

Figure S5: Comparing predicted fall counts (low (dashed), realistic (solid), high (dashed)) in year $t+1$ based off of the count in year t and observed juvenile recruitment in year $t+1$ with the observed count in year $t+1$ (solid vertical line). There was no count in 2006; thus, no vertical line in that plot and no prediction for 2007.

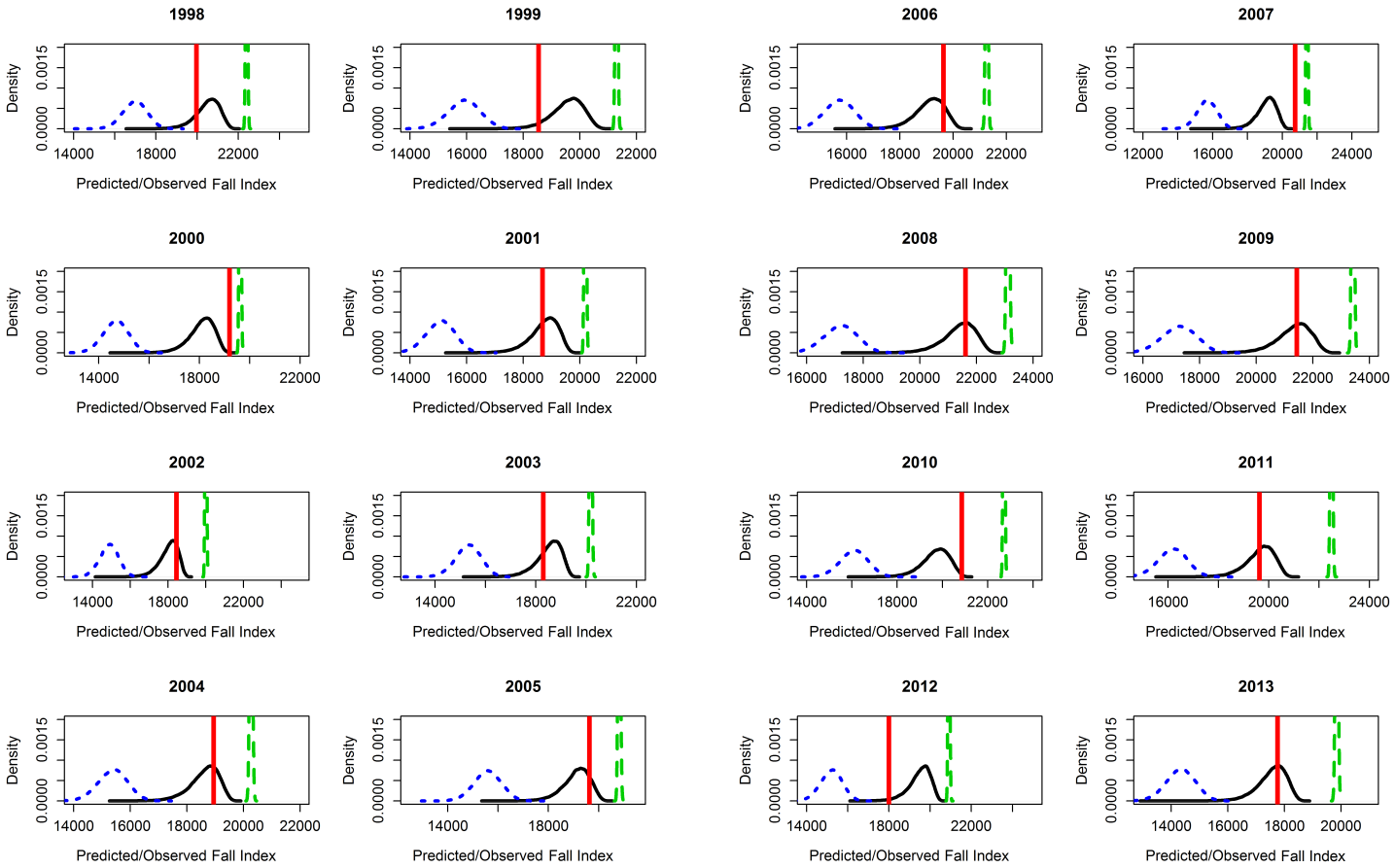

Figure S6: Comparing predicted fall indices (low (dotted), realistic (solid), high (dashed)) in year t with the observed population index in year t (solid vertical line).

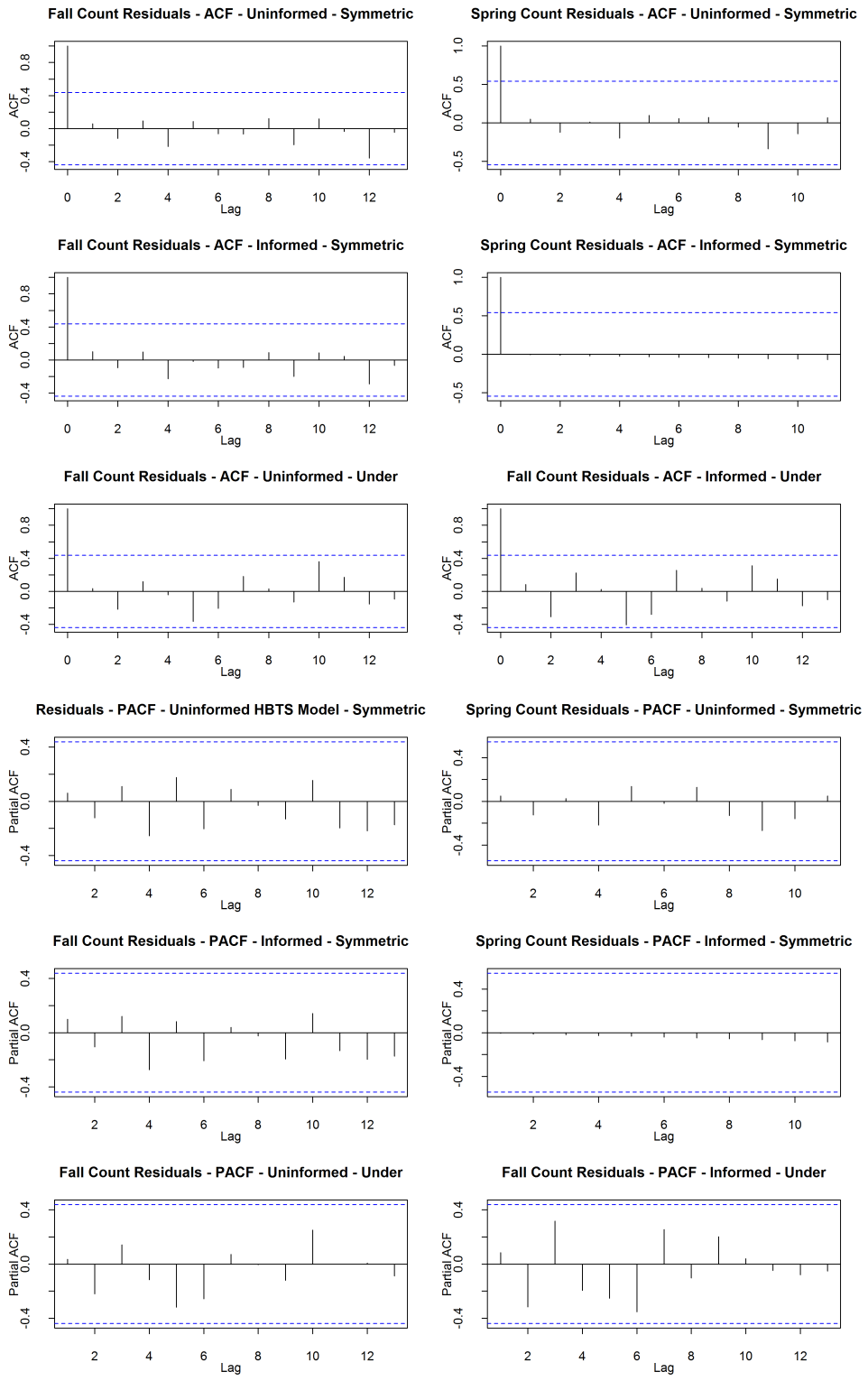

Figure S7: Autocorrelation function (ACF) and partial autocorrelation function (PACF) of Pearson residuals from hierarchical Bayesian time series model predictions of fall and spring observed counts, where variance parameters were informative or relatively uninformative, and the observational process was either symmetric around the true population process or strictly under-counting.

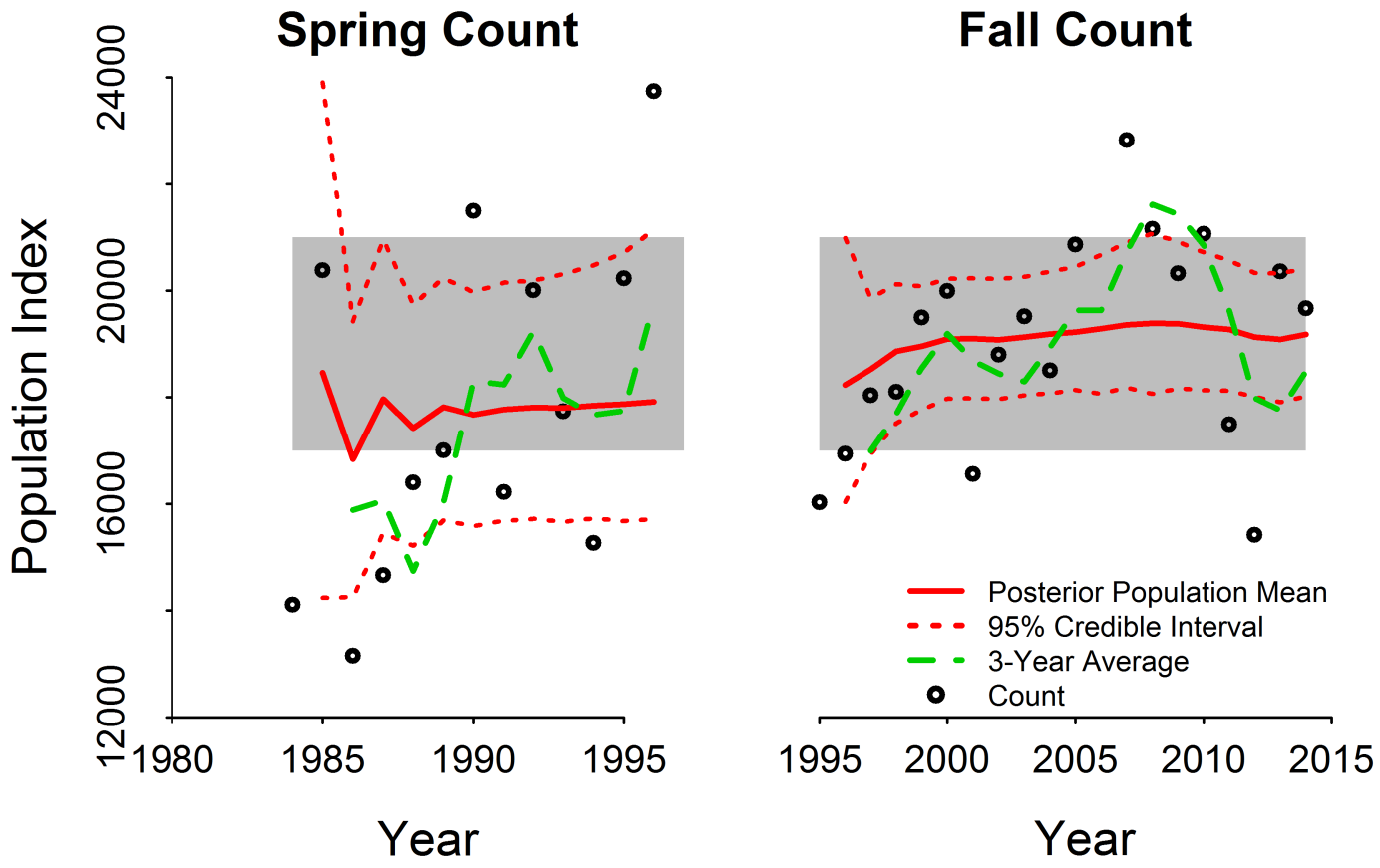

Figure S8: Predicted population mean with 95% credible intervals, observed fall and spring counts, and population indices (3-Year Average) of the Rocky Mountain Population (RMP) of sandhill cranes. The grey area indicates the population objective. Prior probability distributions on σ_C and σ_N are defined using a uniform distribution with lower bounds of zero and informative upper bounds: Spring Counts uses of 0.4 and 0.05, respectively, Fall Counts uses 0.2 and 0.05, respectively.

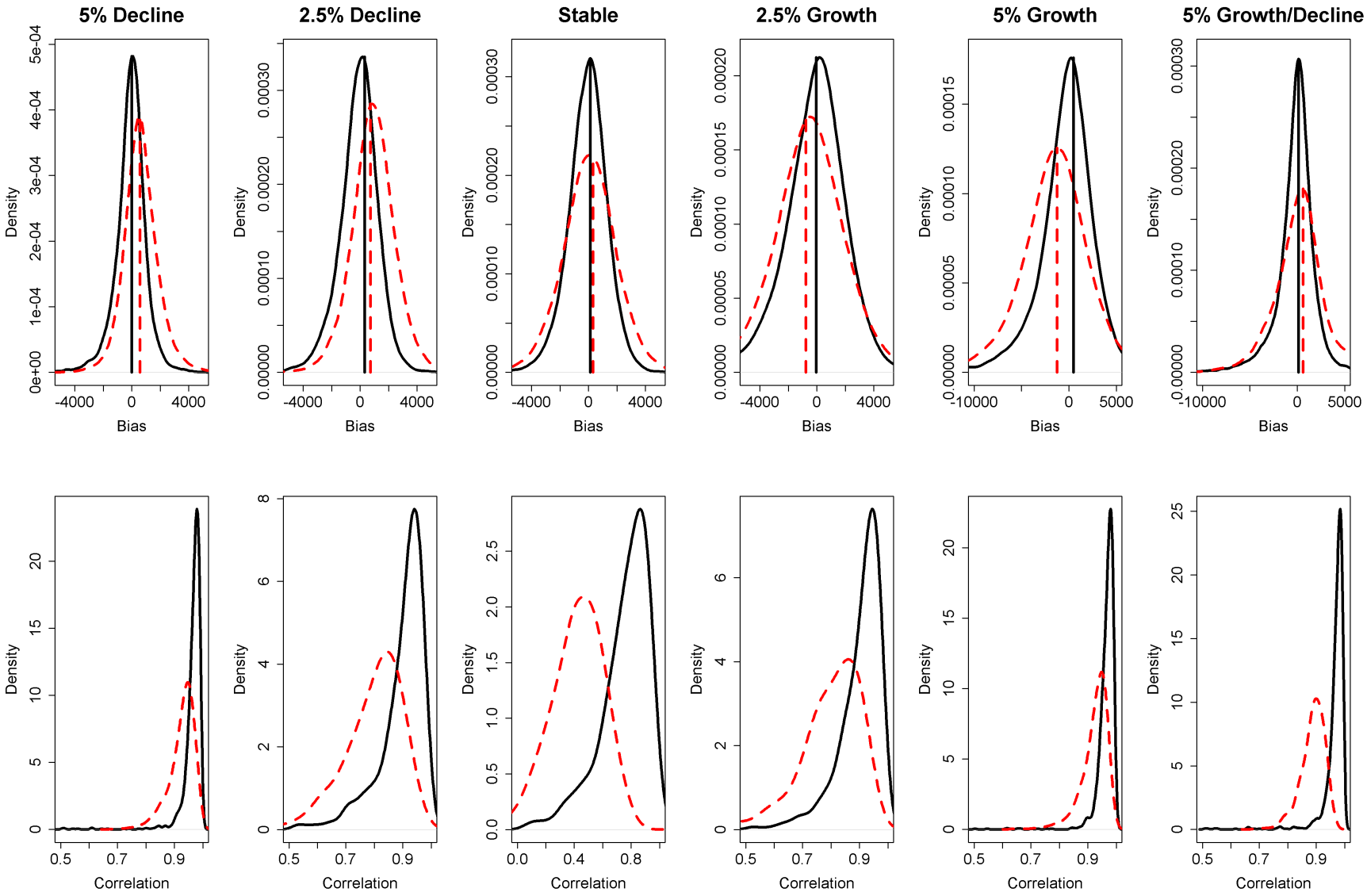

Figure S9: Empirical distributions of annual bias and correlation of the mean predicted population from a hierarchical Bayesian time-series model (solid lines) that considers counts to be symmetric around the true population and using the moving three-year average estimator (dashed lines) for different scenarios of population growth, stability, decline, or combination over a 20 year period. Note, axes are not consistent

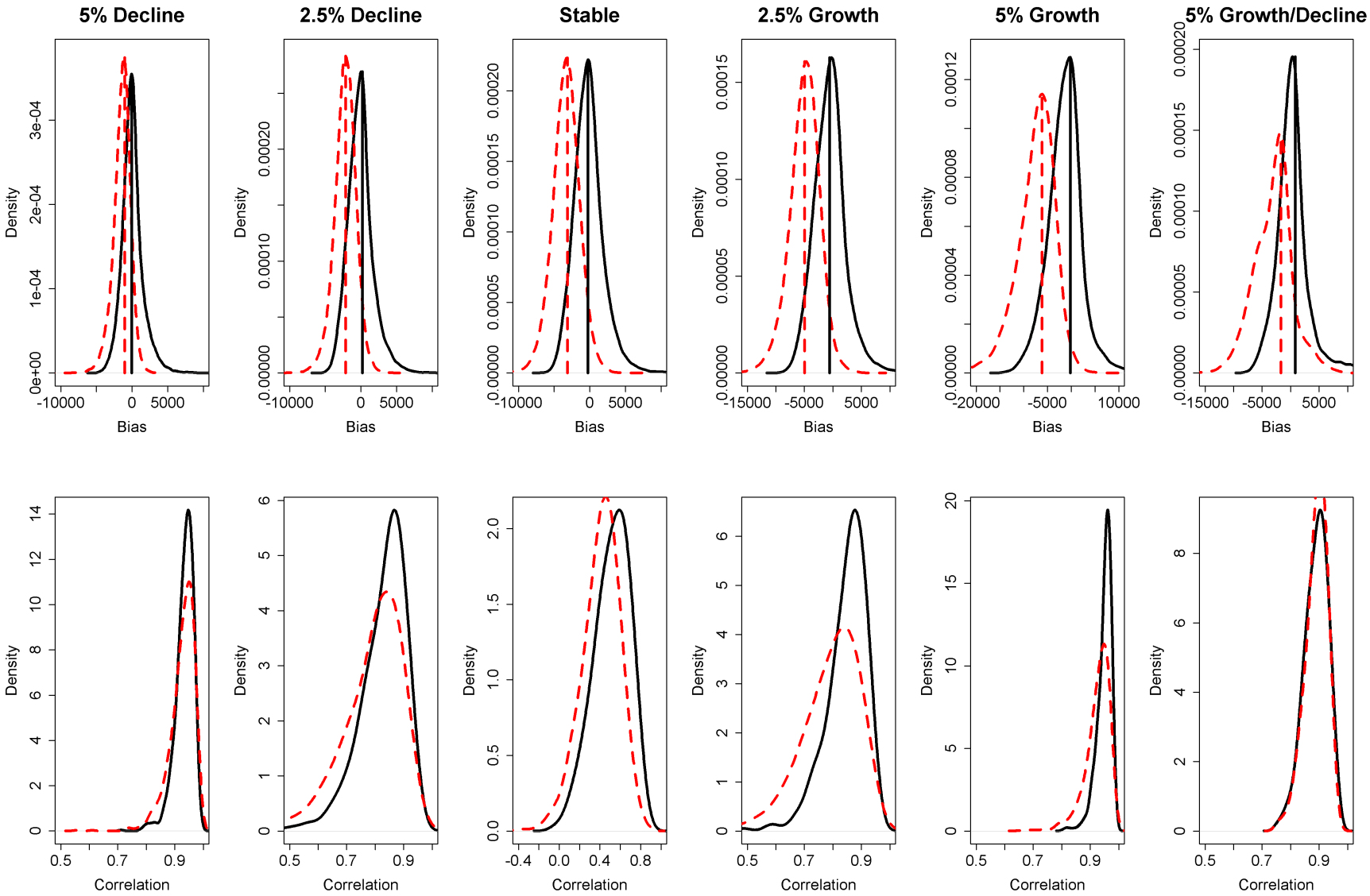

Figure S10: Empirical distributions of annual bias and correlation of the mean predicted population from a hierarchical Bayesian time-series model (solid lines) that considers observations as only under-counting and using the moving three-year average estimator (dashed lines) for different scenarios of population growth, stability, decline, or combination over a 20 year period. Note, the x-axis in the third plot on the bottom row has a different range. Note, axes are not consistent

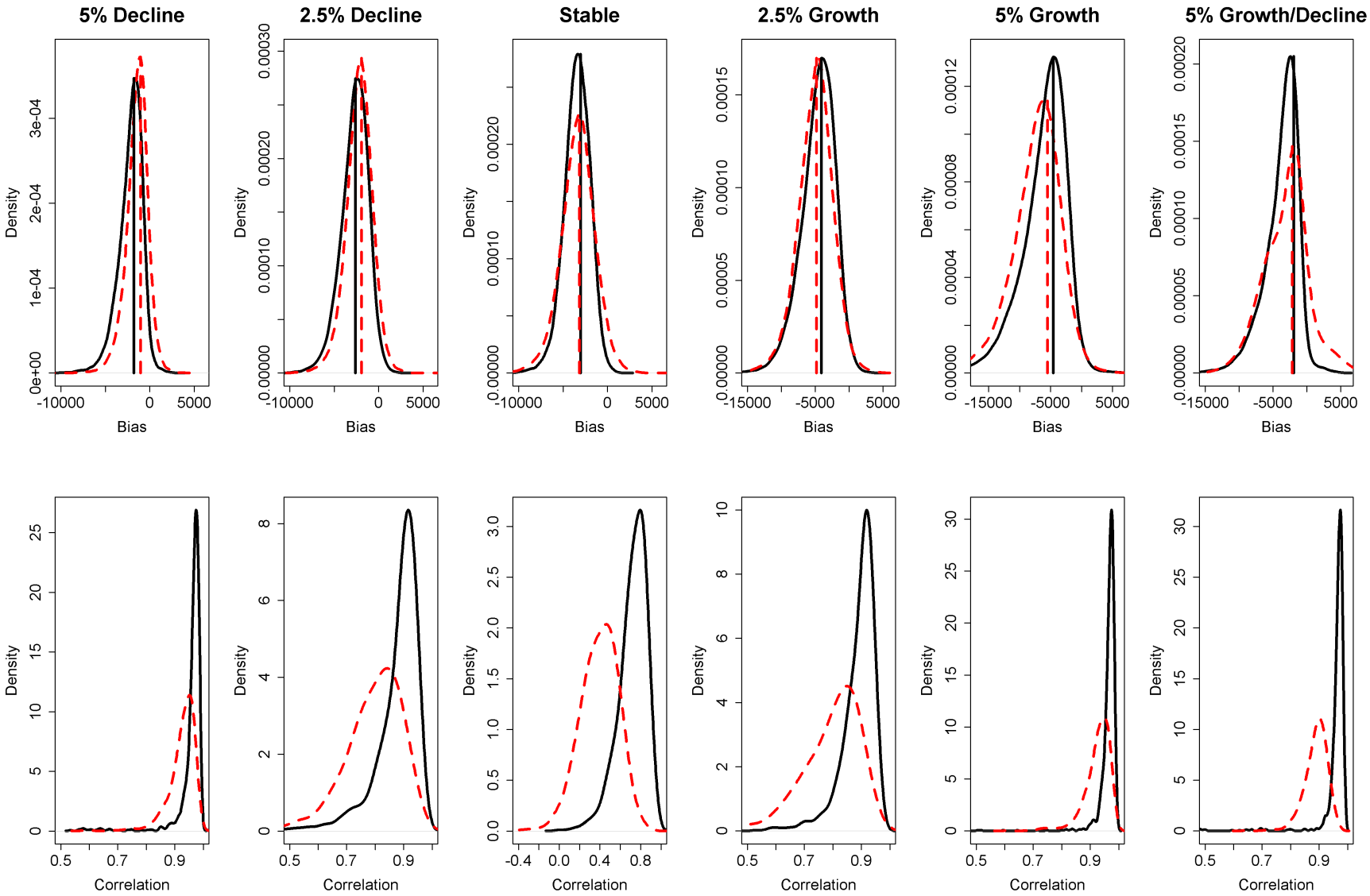

Figure S11: Empirical distributions of annual bias and correlation of the mean predicted population from a hierarchical Bayesian time-series model (solid lines) that considers observations as symmetric around the true population and using the moving three-year average estimator (dashed lines) for different scenarios of population growth, stability, decline, or combination over a 20 year period. The true observational process is equal probability of under-detection between 0.7 and 0.95. Note, axes are not

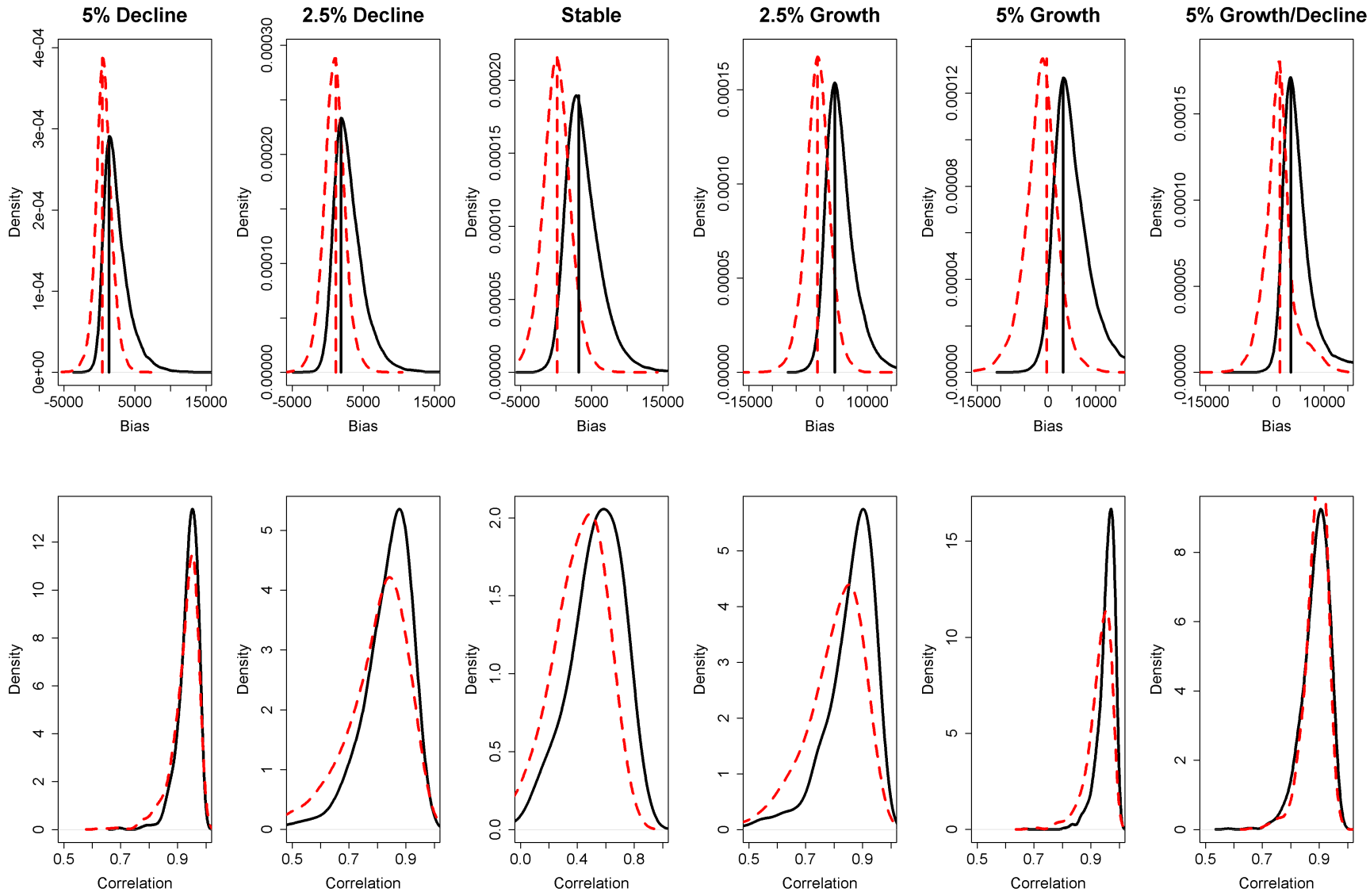

Figure S12: Empirical distributions of annual bias and correlation of the mean predicted population from a hierarchical Bayesian time-series model (solid lines) that considers observations to be under-detections of the true population and using the moving three-year average estimator (dashed lines) for different scenarios of population growth, stability, decline, or combination over a 20 year period. The true observational process allow for both under- and over-counting the true population. Note, axes are