Integrated modeling of condition and sexual maturity of witch flounder in Atlantic Canada

Changes in the environment or population dynamics can often be reflected in the variability of life-history traits such as fish condition, mortality, growth, or sexual maturity. Reliable estimation of the spatiotemporal variation in these traits is important to understand population dynamics and provide better information for assessment and management, such as biomass or spawning stock biomass. Despite its importance, the variability in life-history traits is often overlooked. We used generalized mixed models with temporal (AR1) and spatial (Gaussian Markov Random Fields) correlation to estimate length-weight relationships, condition, and sexual maturity of witch flounder in the Newfoundland shelf in the Atlantic of Canada. We tested several specifications of the models, with or without the temporal, spatial, or spatiotemporal structure, and selected the best model based on AIC and BIC. We found significant spatiotemporal variation in these traits. We integrated the estimation and described the relationship between fish condition and sexual maturity. We then used cluster analysis to identify common trends in the spatiotemporal variability of the traits, and we found areas where the variation is similar. Traditionally, the witch flounder in in the Newfoundland shelf is managed as if condition and maturity are constant and homogeneous in the whole region. Our results highlight the importance of considering the spatiotemporal variation of condition and maturity to obtain a more accurate and realistic biomass estimation. We also discuss the mechanism that drives maturity changes based on the condition of the fish. Our estimates of life-history traits are precise and will contribute to the further development of improved biomass indices. This will benefit our understanding of the status of the population.