Dealing with spatiotemporal dependence in spatial stock assessment models

Francisco Izquierdo[1], *Marta Cousido-Rocha* [1], *Santiago Cerviño*[1] *& Maria Grazia Pennino*[2]

[1]francisco.izqtar@gmail.com, Department of Fisheries, Instituto Español de Oceanografía (IEO-CSIC, C.O. de Vigo)

[2] Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Madrid, C. del Corazón de María, 8, 28002 Madrid, Spain.

Assessing the state of commercial fish stocks is a complex task that requires understanding how species abundance changes over time and space. Spatial stock assessment models can account for the large-scale spatiotemporal dependence of ecological and fishing processes. However, they often fail to consider small-scale spatial correlation unless this is addressed in their input information, such as relative abundance indices. Indices of relative abundance are one of the most important sources of information for stock assessment models, as they are used to calibrate population trends. For many stocks, fishery-independent survey data are not available, so a common practice is to derive abundance indices from fishery-dependent catch per unit effort (CPUE). CPUE indices are known to be influenced by several factors, among which spatiotemporal factors are very relevant, as they affect processes such as species reproduction or feeding patterns. In this study, we used the integrated nested Laplace approximation (INLA) to fit three different CPUE models to simulated lattice data of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean: 1) a model in which spatial dependence was included as a random effect, 2) a model with a spatial Besag component and 3) a model with a spatial Besag component interacting with time through an autoregressive process of order 1. The best CPUE index selected was finally used to calibrate the Stock Synthesis spatial assessment model for the yellowfin tuna stock.

Keywords: CPUE, correlation, INLA, population models, yellowfin