Toward Capturing Model Uncertainty in Bioeconomic Models

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Abstract: A major simplification in bioeconomic models is that the model parameters and functional forms are assumed known. In fisheries, the failure to capture model uncertainty can easily cause overconfidence in model outputs and resultant policy recommendations. Although fisheries modelers regularly assume rather complete knowledge of the systems they study, in reality the biological uncertainty about these systems is often very poorly understood.

Consider recent experience in the red snapper fishery in the Gulf of Mexico. Despite years of scientific effort, a recent assessment made substantial revisions in the populations health. As shown by Smith (Marine Resource Economics, 2008), parameter uncertainty can have dramatic effects in terms of management, especially since learning and management are taking place simultaneously. In recent years, researchers in economics and operations research have focused increasingly on using robust optimization, approaches that can take into account the underlying uncertainty in a system. However, applications in fisheries have been limited (Xepapadeas and Roseta-Palma, 2003; Woodward and Shaw, 2008).

This paper addresses the problem of incorporating parameter uncertainty in a simple stochastic bioeconomic model. Specifically, we explore the differences in policy performance under solutions from a nominal model based on point estimates, a robust alternative that recognizes parameter uncertainty, and a percentile-optimization approach that provides a tuning parameter representing risk aversion. The paper will seek to provide fisheries economists with an introduction to applied tools used to carry out such analysis and argue for the importance of embracing rather than ignoring system uncertainty.