ABSTRACT

The aim of the PhD research was to contribute to improving fisheries management. The overall purpose was to select applicable modeling techniques, develop models and simulate the dynamics of fisheries management with the aim of comparing different management strategies by looking at their impact on selected indicators. The indicators are biological, economic or social. The main contribution of the research is the introduction of methods which have either not previously been applied in fisheries management or to a limited extent. The research is very interdisciplinary as it combines modelling & simulation methods from engineering with fisheries science which is multidisciplinary and builds on ecology, economics and sociology. This poster presents three models which were a part of the PhD research: a hybrid system dynamics-discrete event simulation model, a system dynamics model and a model from a new simulation method inspired by agent flocking.

1 INTRODUCTION

There is a general consensus that the global problem in fisheries can be summed up to too many boats chasing too few fish (Fulton, Smith, Smith, & van Putten, 2011). Overfishing, where so much fish is caught that the stock cannot sustain its population, has certainly been a consequence of this overcapacity (Pauly et al., 2002). Simulation models can help develop an understanding of a system and are used to explore the impact of both endogenous and exogenous changes in the system. Figure 1 shows how simulation models can be used to evaluate the impact of management policies on different things in either the biophysical or human components of fisheries.

Figure 1: Fisheries are a combination of a biophysical and a human system. Models can be used to assess the impact of management policies or other factors on the performance of the system.

2 THE MODELS

2.1 A hybrid simulation model to assess the impact of policy changes in the Icelandic cod fishery.

A hybrid simulation framework was developed that consists of a SD model that describes the population dynamics of Icelandic cod and a discrete event (DE) model that simulates fishing trips. A special focus was put on tracking environmental impact and the framework makes it possible to combine life cycle assessment (LCA) data with the SD-DE model. The main contribution of the study is a hybrid SD-DE simulation framework which incorporates LCA data. The study shows that this type of hybrid modelling is feasible.
is a powerful tool to model fisheries systems and can provide a holistic overview but also a more detailed view of a fishery where needed.

2.2 A system dynamics model for analyzing and managing the lumpsucker fishery in Iceland.

The Icelandic lumpsucker fishery is a small-scale fishery which has seen many changes in recent years. The fishery was analyzed using System Dynamics (SD). The purpose of the system analysis was to understand the economic, social and environmental impacts of changing specific schemes in the management of the fishery. The main contribution is a new SD model in the context of a specific fishery, but the SD approach has not been used much in analyzing fisheries systems. The study shows that SD can offer a new way of looking at human-environment systems as they account for complexity and explore the drivers of the system instead of viewing it as linear.

2.3 A new approach to simulating fisheries data for policy making

A new simulation approach, based on Schruben and Singham (2010) which can be useful in resource management was further developed and applied. It is fundamentally different from the most commonly used parametric methods which require fitting mathematical models to available data based on statistical assumptions. This methods relates most to bootstrapping or trace driven simulation as it uses agent flocking to simulate time series. That means that the output from such simulations are simulated time series that are based on real data but two parameters control how closely we want the simulations to follow it. The use of the simulation algorithm is demonstrated through an example where an optimal harvest rate to calculate yearly total allowable catch for Icelandic cod was explored.

3 CONCLUSIONS

The models from the research are all for fisheries in Icelandic waters. They benefit from good management and data availability. They all have in common a very simple biological model. The rationale for a simple bio-model has been underlined by Moxnes (2005) who stated that policies are not very sensitive to the choice of biological model. It is therefore interesting to introduce new methods to fisheries modelers who have been developing and applying very complex biological models in the last years.

ACKNOWLEDGEMENTS

This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 613571.

REFERENCES


