Improving the communication and transparency of stock assessment using interactive visualization tools

Paul M Regular, Gregory J Robertson, etc.?

Fisheries and Oceans Canada, Northwest Atlantic Fisheries Center, 80 East White Hills, St. John’s, Newfoundland and Labrador, A1C 5X1, Canada

# Introduction

A primary role of stock assessment is to provide fisheries managers with the information needed to adequately manage a fishery. Stock assessment involves the use of various sources of data and statistical methods to determine the status of one or more fish stocks and to make quantitative predictions of the consequences of different management choices (Hilborn and Walters 1992). A wide array data may be collected for an assessment and, formally, an assessment often reduces to algorithms that convert these data to advice for fisheries managers. In some cases, particularly for commercially valuable species, this means that hundreds or thousands of historical data points from the monitoring program of a stock gets reduced into a single policy value, such as a recommended catch quota (Maunder, Schnute, and Ianelli 2009).

The datasets used in stock assessments are constantly growing. This growth in data either stems from the continuation of long-term monitoring efforts or from the addition of new monitoring programs. As such, stock assessment biologists often have to manage large volumes of data from a variaty of sources. For instance, time series of reported landings and catch-at-age are “fishery-dependent” data that are frequently used in stock assessments. These data are often analyzed in conjunction with data from “fishery-independent” surveys that track changes in abundance and, in many cases, also monitor trends in biological factors such as age composition, growth rates, sex ratios and maturation stages. For some data-rich stocks, mark and recapture studies are also caried out to estimate movement, migration, growth rate, natural mortality, and discard mortality. All of the abovementioned datasets are multidimensional and as the volume and viriaty of these data increases, it becomes more difficult to be aware of the details of each dataset and to synthesize the results.

Synthesizing data from multiple sources presents a key challenge to stock assessment. Analyses of different data sources were traditionally carried out independently and the summaries or parameters from these analyses were used in the assessment model. This approach, however, is less than ideal because information may be lost and uncertinty may be unaccounted for when we “do statistics on the statistics” (Link 1999; Maunder and Punt 2013).

… Advances in software have greatly facilitated the analysis of all available data, in as raw a form as appropriate, in a single integrated analysis (Maunder and Punt 2013). …

“We are in an age of data‐intensive science and big data, and ecologists must develop the capabilities to deal with their data.” (Hampton et al. 2013)

# References

Hampton, Stephanie E, Carly A Strasser, Joshua J Tewksbury, Wendy K Gram, Amber E Budden, Archer L Batcheller, Clifford S Duke, and John H Porter. 2013. “Big Data and the Future of Ecology.” *Frontiers in Ecology and the Environment* 11 (3). Wiley Online Library: 156–62.

Hilborn, Ray, and Carl J Walters. 1992. *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty*. Chapman; Hall.

Link, William A. 1999. “Modeling Pattern in Collections of Parameters.” *The Journal of Wildlife Management*. JSTOR, 1017–27.

Maunder, Mark N, and André E Punt. 2013. “A Review of Integrated Analysis in Fisheries Stock Assessment.” *Fisheries Research* 142. Elsevier: 61–74.

Maunder, Mark N, Jon T Schnute, and James N Ianelli. 2009. “Computers in Fisheries Population Dynamics.” In *Computers in Fisheries Research*, 337–72. Springer.