

Improving the EBFM Toolbox with an Alternative Open Source Mass Balance Model

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Introduction:

As ecosystem-based fisheries management moves from the theoretical stage towards implementation the need for flexible tools will increase. The popular Ecopath with Ecosim (EwE) ecosystem modelling software is one of those flexible tools. Developed to be an open source software package, EwE allows universal access to the code which can be redistributed and subsequently improved by any interested users. However, a major draw-back to modifying the EwE code is the Microsoft Visual Basic platform upon which it is built. Many ecologists do not have the skills necessary to modify the code to tailor the model to their needs. We introduce a complementary product to EwE built on a more familiar software platform, R. R is a rapidly growing open source statistical language that is familiar to many ecologists. Once fully developed, the new R package, called Rpath, will allow users to fully customize their models to meet their needs.

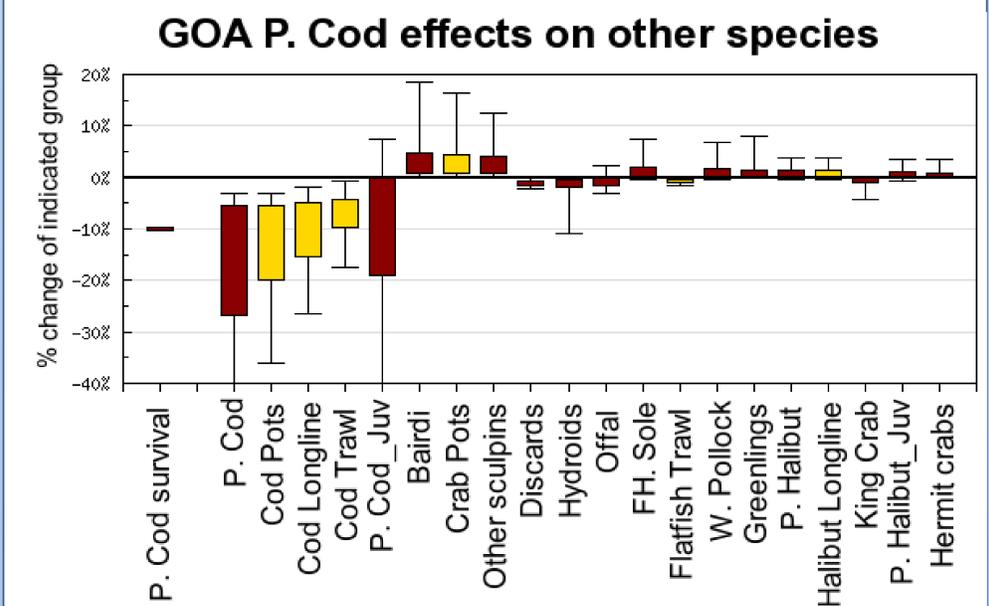
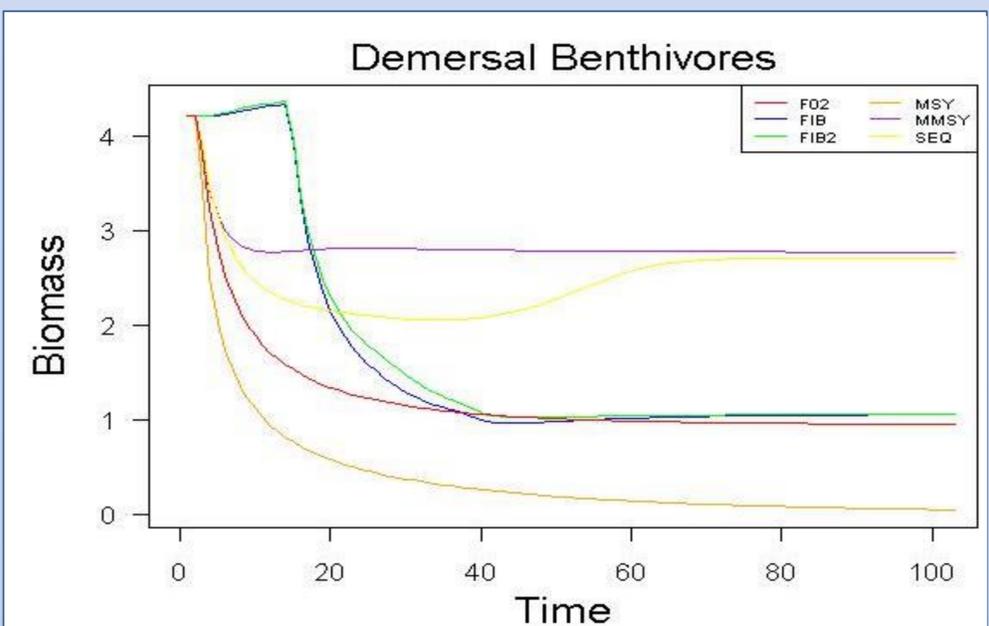
Advantages and Disadvantages of implementing EwE in R

Advantages	Disadvantages
Greater flexibility/customization	No GUI interface
Leverage existing R packages	Knowledge of R required
Community development	
Cross-platform software	



Methods:

Rpath applies the process equations originally described by Polovina (1984) and further developed by Walters et al. (1997). Originally developed by Aydin et al. (2007), the code is being refined to leverage several existing R packages such as data.table, Rcpp, and Shiny. The goal is to have a package served through the Comprehensive R Archive Network (CRAN) by the end of 2015. The base version of Rpath will have the functions Rpath and Rsim, which will function similar to Ecopath and Ecosim. We also expect further development of add-ons from other users. An example would be the Ecosense routine developed by Aydin et al. (2007) which uses a Bayesian framework to address uncertainty in input parameters.



Top: Typical line output from Ecopath with Ecosim software for several different fishing scenarios.

Bottom: Example output from Rpath showing the effect of a 10% reduction in Pacific cod survival on other species in the Gulf of Alaska (GOA) food web model using the Ecosense routines. Reprinted from Aydin et al. 2007.

Conclusions:

We expect that programming the mass balance equations used by EwE in R will unlock the potential of open source by allowing users to collaborate and develop add-ons using a programming language that is more familiar to most ecologists. Rpath has the added advantage of allowing fully customizable outputs of publication quality without switching between software packages. Together, this complement to EwE can communicate a more complete picture of the state of our knowledge of ecosystem dynamics. Further development of this flexible tool that integrates statistical analysis and visualization tools in one package will be extremely useful in bridging the gap from theory to practice for ecosystem based management.