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Editorial

Multi-model inference and model selection in Mexican Fisheries

Stelios Katsanevakis

Water Resources Unit, Institute for Environment and Sustainability, European Commission - Joint Research Centre, Ispra, Italy

The information-theoretic approach to data treatment is an integrated process of a priori specification of a set of candidate models (based on the science of the problem), model selection based on the principle of parsimony, and the estimation of parameters and their precision. The principle of parsimony implies the selection of a model with the smallest possible number of parameters for adequate representation of the data, *i.e.* a trade-off between model fit (likelihood) and model complexity. Model selection based on information theory is a relatively new paradigm in biological sciences and is quite different from the classical methods based on null hypothesis testing (Burnham and Anderson 2002, Katsanevakis 2006, Beninger *et al*. 2012).

The information theory method frees the researcher from the limiting concept that the proper approximating model is somehow 'given'. It is not assumed that truth is included in the set of candidate models and the issue is not which model is true, but rather which model, when fitted to the data, is the one which best represents the finite information contained in the data. The concept of a 'true' model seems to be of little utility in marine biology and fisheries science, as biological systems are quite complex. Individual heterogeneity, unknown interactions, and many small effects define the behavior of such systems. In the information theoretic approach, 'information' about the biological system under study is assumed to exist in the data, and the goal is to express this information in a coherent and compact way. Since larger data sets usually contain more information, they may support more complicated models.

When the data support evidence of more than one model, model-averaging the predicted response variable across models is advantageous in reaching a robust inference that is not conditional on a single model. Rather than estimating parameters from only the 'best' model, parameter estimation can be made from several or even all the models considered. This procedure is termed multi-model inference and has several theoretical and practical advantages (Burnham and Anderson 2002). When a single model is 'picked' in some way, independent of the data, and used to approximate the data as a basis for inference, both the uncertainty associated with model selection and the benefits of selecting a parsimonious model are ignored. This strategy incurs substantial costs in terms of reliable inferences, because uncertainty in model selection is assumed to be zero, and thus precision is likely overestimated (Katsanevakis 2006).

One of the earliest uses of the information theory approach in fisheries science was in a series of papers on growth and allometry in marine fish and invertebrates (Katsanevakis 2006, Katsanevakis *et al*. 2007, Katsanevakis and Maravelias 2008). This approach has since been applied to growth studies of many other fish and invertebrate species (*e.g*. Lin and Tzeng 2009, Griffiths *et al*. 2010, Cerdenares-Ladrón de Guevara *et al*. 2011, Mercier *et al*. 2011, Cruz-Vásquez *et al*. 2012, Wells *et al.* 2013), and also to other areas of fisheries science, such as investigations of the effect of exploitation pattern on the status of fish stocks (Vasilakopoulos *et al*. 2011), investigations of stock-recruitment relationships of fish (Galindo-Cortes *et al*. 2010), and studies of fish escape behavior in trawls (Krag *et al*. 2014).

The information theory approach has been widely applied in Mexican fisheries in the last

few years (*e.g*. Cerdenares-Ladrón de Guevara *et al*. 2011, Cruz-Vásquez *et al*. 2012). This Special Issue on "Multi-model inference and model selection in Mexican Fisheries" provides the state of the art on this topic in Mexico. It includes studies investigating size at sexual maturity (of the shark *Rhizoprionodon terraenovae*, the thread herring *Opisthonema libertate*, and the rocky oyster *Striostrea prismatica*), and growth (of the cuatete *Occidentarius platypogon*, the gulf corvina *Cynoscion othonopterus*, the silky shark *Carcharhinus falciformis*, juvenile blue crabs *Callinectes arcuatus*, and Cortes Geoduck *Panopea globosa*). This Special Issue is an important collection of best practice examples in fisheries science, promoting the shift from the single-model approach to the more robust and less restricted by strict assumptions approach of multi-model inference. I hope that this issue of *Ciencia Pesquera* will generate additional interest on the information theoretic approach to investigation and data analysis in fisheries science.

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