

SUMMING UP

R.I.C.C. Francis

*Fisheries Research Centre
Ministry of Agriculture and Fisheries
Box 297 Wellington New Zealand*

I'd like to say how much I have enjoyed listening to the papers and discussions over the last two days. It is heartening to see the extent and diversity of the uses of fisheries models in Australia. I've perhaps enjoyed the discussions a little less because it seemed to me that speakers were sometimes at cross purposes. It appeared that different speakers were using the same term to mean different things. Because mathematicians are rather fussy about their definitions this set me to thinking about what we mean by a model.

Defining Models and their Roles

In very general terms a model may be thought of as a simplified representation of reality. It may be expressed in a number of forms: as a set of equations, a computer program, or simply a diagram (this last approach would be possible, for instance, with the model underlying Tony Koslow's trophodynamic study). However, on reflection, it's probably more important to describe what we intend to do with our models, rather than what we mean by a model. I can think of four quite separate roles for models.

A major role of models in fisheries research is as a means of drawing inferences about reality. We make a model, input some observations (e.g. catches, biological parameters, catch rates), and draw out certain inferences (e.g. current biomass or exploitation rate). This is the main

way that the models described in Kay Allen's retrospective summary are used. Another role that was highlighted by a number of speakers (e.g. Rick Fletcher, Tony Koslow) was to suggest hypotheses, and thus direct research. We make models and modify them until they mirror our observations. The structure of the model then suggests hypotheses that we may test with our research. A third role for models is in helping design sampling strategies. For example Dave Smith described how Kevin Sullivan used simulation modelling to determine the sorts of age and length samples necessary to obtain a given level of precision from virtual population analyses.

A fourth role for models was described by Tony Smith. This is the evaluation of management strategies. Here models are used to answer "What if?" questions. For example, we might ask, "If we managed a certain fishery using a constant fishing mortality policy, how much are the catches likely to fluctuate from year to year, and what would be the probability of the biomass falling below a given threshold?" I like this sort of modelling because it is used outside the hurly-burly of the annual TAC-setting process and the conflicts that arise there. Thus fishing industry representatives can join with scientists in less heated, more objective, discussions.

I think there was some confusion in our earlier discussion about the value of ecosystem models because we were not always specific about what we meant by an ecosystem model,

and what role we saw for these models. In my comments I was referring to the type of model that attempts to describe how environmental variables, and population sizes for each of a number of different aquatic species, vary and interact with each other. I support Tony Smith's suggestion that this type of model is "not irrelevant but impractical". What I mean by this is that, as a direct tool in the management of fisheries (role one, above), they are impractical; but they are not irrelevant because they may be useful in hypothesis formulation (role two).

I'm bemused by the suggestion that modelling has been captured by some elite group. I see modelling as a collaborative process. We need biologists to keep us in touch with reality, mathematicians to steer us away from technical difficulties, and fishery managers to make sure that we are addressing the right questions. All I can say is, if you believe yourself to be excluded from some "elite group" who are doing the modelling, then do something about it. Your skills are needed.

Communication

I agree wholeheartedly with Phillip Sluczanski's plea that we make more effort in communicating the results of our modelling. It doesn't matter how brilliant your model is, or how well it is able to predict, if you cannot communicate this information effectively to the managers and the industry then your efforts are wasted. However, that said, I have to confess that I'm a little uneasy about some modellers' concentration on fancy graphical output. I would not want to find fishery modellers grouped with advertising agencies and the writers of company annual reports. The aim of these people is to convince, rather than inform. Let us beware of the shoddy model that is given the aura of veracity and respectability by means of a glossy presentation.

One of our aims in improving our communication skills is to overcome fishers' inherent

distrust of scientists and their models. Another way in which this aim will be achieved is by fishers hiring their own modellers. This has happened to an increasing extent in New Zealand over the last few years and has had several beneficial effects. It has raised the fishing industry's consciousness about modelling and stock assessment matters, increased their willingness to believe in the value of this sort of information, and improved the quality of the work of government scientists. I think you can judge how much industry accepts models and their output by the way in which they use the advice from their scientific consultants. The modelling is accepted when the advice is used to participate more usefully in scientific forums; it is rejected when the advice is used selectively as a bludgeon in political forums.

Case Studies

I have been involved in assessing a fishery for which there has been a great deal of conflict with industry. Thus, I was particularly pleased to hear a number of apparent success stories amongst the case studies presented here. Cases where the models seem to fit and have even influenced management.

Model Inadequacies

There have been a number of references to inadequacies in our data and models. It is easy to become depressed by the extent of some of these problems. My advice is to be concerned, but not neurotically so. When scientists from other disciplines look at what we do in fisheries science - in particular the science that supports fisheries management - a common response is that the questions we are trying to address are unanswerable with the data we have available. Strictly speaking that may be so.

However, this view overlooks the pragmatic necessity to offer the best advice available

so that our fisheries can be managed as rationally as possible. Given the value of many of our fisheries, and the serious consequences of a fishery collapse, it would often be irresponsible to refuse to offer advice because our models, or data, were imperfect.

Are Some Models Too Complex?

Some speakers warned about the dangers of making models too complex. The danger here is, I think, with the modeller, rather than the model. The model is too complex when the modeller is lacking in either the skills or the time to develop a good understanding of what drives the model, and to communicate that understanding effectively. On this topic I would warn against confusing computational intensity with complexity. Many modelling exercises (particularly stochastic simulations) require astronomical numbers of calculations but are fundamentally reasonably simple. This is a situation where computers liberate us to “think the unthinkable” (Efron 1979) - to carry out what would have been an unthinkable number of computations in pre-computer days. What is done may not be particularly complicated, it’s just that it is done many, many times.

Other Comments

I’d like to finish by offering some brief reactions to various comments that have been made during the Workshop.

Iain Suthers asked “Why the obsession with stock-recruit relationships?”. I think the answer is that, in managing fisheries, it is a high risk assumption to ignore the possibility of such a relationship.

On the question of the desirability of including economics into our models I used to think this was important. However, I now suspect that, in many fisheries, the degree of heterogeneity amongst the economic situations and motivations of the various participants may be so great that useful economic modelling is not feasible. For example, the economic effect of a reduction in TAC for a particular fishery will depend strongly on the debt load and extent of diversification of each fishing company. Certainly, if economic modelling is to be useful it must be carried out with the full cooperation of the fishing industry.

I think Norm Hall’s “modellers’ toolbox” is a great idea. We have something like this in New Zealand (Anon. 1993) and I see three values in it. First, it is educational - making all parties in the stock assessment aware of the tools available. Second, it sets standards: where rules of thumb need to be applied there is some consistency in their application to different fisheries. Third, it is part of our duty to document what we do in our stock assessments.

Terry Walker spoke of the importance of data maintenance and Jim Penn commented that it was difficult to obtain a data time series of really useful length because the time required was longer than that typically spent on a project by any one scientist. I think both of these comments show how important it is to take the responsibility for gathering and maintaining certain basic data sets out of the hands of individuals and put it into the hands of our institutions.

I have said enough. To conclude, I note that Geoff Gordon advocated that biologists should get into matrices; someone else suggested (somewhat accidentally) that we would all like to get into motherhood; my message is - if you’re not already into it, get into modelling!

References

- Anon. (1993). Guide to biological reference points for the 1993 fisheries assessment meetings. In 'Report from the Fishery Assessment Plenary, May 1993: stock assessments and yield estimates.' (J.H. Annala, comp.) pp 13-21. (Unpublished report held in the MAF Fisheries Greta Point library).
- Efron, B. (1979). Computers and the theory of statistics: thinking the unthinkable. *Society for Industrial and Applied Mathematics Review* 21, 460-480.