

# DISCUSSION OF SESSION 2

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## Recorded by J.S. Andrews

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Questions were first addressed to individual panellists, and then followed by more general discussion. There was no discussion immediately following the first panel presentation, by *Des Lord*, nor after *Tony Koslow's* contribution.

Tony Smith made the comment to *Nic Bax* that the multispecies approach to modelling is more relevant in places like the North Sea, where information and resources have historically been available. The knowledge-base which has accumulated must be an advantage.

Nic Bax pointed out that while this is so, one does not have to start by modelling the whole system. A modular approach to multispecies models is often better.

Peter Doherty agreed with the assertion that mortality can be non-linear and variable. Over ten years he has looked at damselfish recruitment on several different coral reef systems. After ten years these populations were sacrificed and the mortality curves examined. These mortality curves were non-linear and highly variable from one reef to another.

Rod Treble mentioned that from his tagging studies with limpets, it seemed like smaller animals were dying at a much faster rate than larger animals. Nic Bax agreed that in general, smaller animals are subjected to greater predation than larger animals of the same species. Modellers have predicted this result from consideration of size distributions of both predators and prey.

Derek Staples asked the final panellist, *Tony Smith*, whether a generalised model could be constructed for the purpose of say, describing the Jervis Bay system, and then adapted for other purposes. Tony Smith replied that the general framework of this model was written with the pretext for developing a more general capability in this area.

Tania Birch questioned the usefulness of the Jervis Bay model for monitoring the effectiveness of an aquatic reserve management plan due to be implemented in the Bay. Tony Smith replied that while this could be possible it would depend on the details of the management plan. While it was noted that this particular model had no components related to fish fauna, John Glaister was interested in the oceanic water circulation patterns which were incorporated. Although regarded as reasonably crude, the modelling of water circulation seems to mimic the observed patterns in this case.

To open the general discussion of Session 2, the question of using variable mortality in Virtual Population Analyses (VPAs) was raised by David Smith. Nic Bax pointed out that this approach has been used in the North Sea and in the Bering Sea with pollock, where an MSVPA was used to estimate natural mortality, and this parameter estimate was then fed into a more simple VPA model. Kay Allen also noted that age-dependent natural mortality was used with an Australian gemfish VPA.

Evidence for variation in mortality with year class strength may be important for some fish stocks. Rob Day noted that if this occurs, it may confound any stock recruitment relationship which would otherwise be detected in the data. Nic Bax pointed out that in many cases recruitment indices are derived from the VPA which is run with the variable rate of natural mortality and so, unless recruitment indices are derived from surveys (ie independently), it is difficult to test the hypothesis that natural mortality changes with year class strength.

Terry Walker suggested that there may, in the case particularly of longer lived animals, be merit in considering a "U" shaped mortality function. With seals for example, natural mortality declines after weaning then increases as animals reach sexual maturity and begin to defend territories, fight for mates etc. Nic Bax suggested that this idea has fallen out of favour for heavily fished populations where the chances of senescent mortality or even multiple spawning before capture are small.

Tony Smith observed that one of the strengths of fisheries research was that specific models have been fitted to data in a quantitative and statistically valid manner. This is almost impossible to do for large scale complex models with large numbers of parameters. Des Lord agreed that while you may match the physics, the chemistry and flow rates, his experience suggests that the real difficulty is in matching forecasts for biological change. In the case of the Perth Coastal Waters Study, the bulk of the long range forecasts have been matched with laboratory-derived data rather than with field information. With three outfalls operating however, it is possible to compare the environmental response at different levels of exposure. Effectively a monitoring program has been derived from the model (augmented by field information) and the results of 3 - 5 years monitoring will be fed back into the model. The model is then progressed to the next stage.

Doug Ferrell was interested in time scales and error structure with modelling and Tony

Smith noted that propagation of error is a reality in any forward simulation at short time steps over a long period of time.

With regard to modelling the fish or the ecosystem, Karen Edyvane felt that this should be determined by clearly defined management objectives. More difficult is determining the scale of resolution required and whether the focus should be on multispecies interactions or on single species with habitat interactions. Karen Edyvane enquired about integrating fish models with ecosystem models generally. It was proposed by Tony Smith that the adaptive or experimental management approach allows scientists to look at actual responses of large systems at large spatial scales with some degree of replication. In this way it is possible to learn from managing stocks in a particular way without the morass of process-based uncertainties.

It was noted that in defence of a process-based approach, it is dependent on defining management objectives and therefore tends to be more relevant to management problems. This is particularly relevant during times of funding restraint. It may, however be debated that there are some management issues which require very complex (multispecies or ecosystem) modelling. Whether or not these interactions influence the sustainability of fisheries, or whether multispecies interactions are more or less important than large scale environmental changes are open to speculation. The important point is that so long as the possibility of longer term changes is built into the models, understanding the processes underlying the change may not be critical. Rather the system can be modelled as a time series problem.

The question of model complexity was discussed. Sandy Morison observed that the range went from complex single species models to simplified ecosystem models. It was noted that simple single species models can be just as accurate at predicting stock responses as more complex ones.

Phillip Sluczanowski responded to this with the comment that the appropriate level of reso-

lution was dependent on the question you were trying to answer. If for example the objective includes between-week effects, then interspecies interactions are unlikely to be within the scope of the study. Alternatively, if you are concerned about a number of variables and how they relate to each other, then there will be the "curse of dimensionality". This may be avoided by coming back to very simple models.

Nic Bax warned that models are not static but should be changed or made redundant when they outlive their usefulness. It is possible for example to improve a model as more information comes from other areas. Jeremy Prince suggested that better use might be made of the research expertise in Australian universities to improve the empirical basis for developing more complex and realistic models.

The effects of fisheries on ecosystems may be an appropriate area of study for the future,

given that they are likely to have a substantial effect on the system they belong to. Mike Moran suggested that if, through bad wastewater management, seagrasses were reduced to 20% of their natural level, or penguins were reduced to 20% of their natural level, there would be a public outcry. But we think we have succeeded if we maintain an exploited fish stock at 20% of its virgin biomass.

Patrick Coutin was interested to learn about the use of ecopath-type models in Australia. These models look at the higher predators to monitor fish stocks or look at the particular aquatic environment. No one knew of such approaches being used in Australia, but Rob Day noted that in South Africa the penguins are reportedly used to monitor the anchovy fishery on the West Coast.