On the Suggestion that a Traffic Light-based Management System be Considered for the South African Squid Resource

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Abstract

The suggestion made by Sauer (2008) that a Traffic Light-based management approach be considered for the South African squid resource is critically examined. Such an approach does not appear to have a defensible scientific basis (though this is not to exclude some desirable aspects of the approach, such as pre-specified decision rules, that are common to other management approaches). Suggestions are made for taking some of Sauer's proposals forward in a modified way.

Background

The current intended management strategy for the South African squid population is one of constant effort. The specific target effort level recommended is the output of an OMP-development-like process: a Bayesian assessment of the resource developed from catch, CPUE and research survey data provides the basis to project forward under alternative possible fixed levels of effort, with the target level recommended chosen on the basis of anticipated performance statistics for both catch and CPUE.

However, recently serious questions have arisen about the reliability of inputs of past CPUE and particularly past catches to these computations as a result of reporting problems. Consequently further refinements of effort target level computations have been placed on hold until these data can be corrected to the extent possible. In the meantime, management actions have sought to move the fishery towards a situation where the existing target effort level could not be exceeded.

Given this situation of data uncertainty, Sauer (2008 – SWG-04-08-SQ1) has recently suggested that a "Traffic Light" approach form the basis of scientific recommendations for the management of the squid resource. In particular, Sauer contends that: "This [Traffic Light] management framework was originally designed for data limited invertebrate fisheries and is based on identifying reliable indicators, with minimal use of modelling to define reference points."

Commentary

It is first important to clarify which features of Sauer's suggestion are specific to the "Traffic Light" approach alone, and which are more generic. Two features in the latter category are:

1) pre-specified decision rules to provide management recommendations; and
2) the indication that such rules should be simple, linked directly to monitoring data related to the resource ("indicators"), and of a nature that is readily understood by and credible to stakeholders.

The first of these feature is certainly completely in common with, for example, the OMP approach, while the second reflects a frequently deliberately intended property of the class of OMPs that are termed "empirical" (i.e. ones that convert monitoring data directly into management recommendations without an intervening and possibly complex population model based assessment process) (see, for example, Rademeyer *et al.*, 2007).

What is specific to the Traffic Light approach is the manner of selection of reference points, or put more specifically the values of the parameters of the decision rules ("cut-offs") which determine when management recommendations change (such as in the example provided in Sauer (2008)). Although Sauer does not provide any details of this process, the likely intention would seem to be that these values are to be determined by discussion (amongst "experts"), with the resultant set of decision rules perhaps captured within an "expert system" framework.

This contrasts with an OMP (or even traditional assessment) process, where such choices are made based upon predictions of (and trade-offs between) future catches and resource trends under some population dynamics models (termed "Operating Models" in an OMP testing context) for the resource which account for how the population is impacted by harvesting.

Concerns associated with the Traffic Light approach relate particularly to the seemingly rather arbitrary manner in which the parameter values for the decision rules are to be selected. The aim of fisheries management is to move resources towards states at which high catches and catch rates can continue to be achieved without any substantial risk of depletion towards a low abundance level at which future resource productivity might be impaired. Standard inputs to the population models used traditionally (e.g. research survey estimates of abundance) relate directly to the key quantities of interest, resource abundance or recruitment level. When other indices such as CPUE are used, this is where there is a reasonable expectation of a simple relationship. Furthermore some combination of standard population dynamics approaches applied to the resource in question (direct estimation) and the cumulative results from many studies of different resources over time (proxies provided by analogy) contribute towards identification of appropriate values for target reference points (such as the spawning biomass corresponding to MSY). These provide a ready and straightforward basis for the simulation testing of decision rules based on input data such as surveys and CPUE for attainment of a target reference point that is reliable and robust to associated uncertainties.

Other monitoring data (indicators) can also be considered as the basis for decision rules (e.g. mean fish length, environmental measures such as temperature, etc.), but they need to be simulation tested in the same way as are survey and CPUE data for OMPs based on those inputs before they can be considered as of sufficient reliability to be considered as scientifically defensibility. The difficulty that arises is that the relationships between such indicators and actual resource abundance or recruitment are typically much less clear than for, say, a research survey estimate of abundance. There is thus very likely a wide range of relationships between the indicator and the underlying resource abundance or recruitment level that has to be considered in the simulation testing process. Confirming robustness of a decision rule across such a range is consequently likely to necessitate a choice that is relatively conservative in terms of anticipated catch levels to ensure that risks are suitably constrained. [Note in this context the flaw in the quotation from Sauer (2008) given at the end of the Background section above: scientifically defensible determination of reference points for such indicators is certainly not compatible with “minimal use of modelling” – instead this needs to be yet more intensive.]

Assertions that this simulation-testing approach can be reliably replaced by, say, an “expert system” developed purely on the basis of discussions of a more qualitative than quantitative nature are very questionable. If “experts” claim to be able to specify quantitative relationships between indicators and abundance or recruitment, why then cannot those relationships be confirmed by quantitative evaluation? And if they were so confirmed, surely they would already be included in the quantitative assessment process. The possibility that scientists are able, through some human pattern recognition ability, to provide a multi-factor relationship which standard statistical estimation approaches fail to identify cannot be excluded. But the poor success of the nearly all environment-recruitment relationships that have been claimed once these were used in predictive mode (Myers, 1998) argues against the likelihood that “experts” with such abilities do indeed exist (indeed, have any such claimed relationships ever been subsequently verified?).

A further difficulty with the Traffic Light system in the form illustrated by Sauer (2008) is the discontinuous nature of the decision rule examples provided. Certainly for fisheries which are not (potentially) data poor, as in the case of this squid population, decision rules should be continuous functions of their inputs:

a) for smoother change to enhance industrial stability, and

b) more importantly to avert the inevitable wrangling if a future value of an indicator turns out to be close to a cut-off value, so that minor changes in the data summarised by the indicator can lead to major differences in management recommendations.

What do Aspects specific to the Traffic Light approach have to offer?

The Traffic Light approach does provide a convenient simple visual manner of summarising information related to resource status for presentation to stakeholders, particularly when comparing across a large number of populations. However care must be taken in such representations not to select, amongst a set of indicators, a large group which would be expected to behave in a highly correlated manner; otherwise the visual impression given by the Traffic Light plot will tend to bias lay reviewers towards the action suggested by the result for that indicator group.

For data poor fisheries without the information needed to fit conventional population models (past catches and abundance measures or indices), decision rules based on other indicators do have a role to play. But the only basis to formulate the indicator-resource relationships needed for testing purposes in such cases would be other similar populations for which such relationships had been established. The range of such relationships is likely to be wide, and with no basis to determine where within that range the relationship for the population under consideration might lie, a rule that is robust in terms of depletion risk across such possibilities will necessarily involve a relatively low level of utilisation. This data poor situation is however hopefully not the scenario that applies to the South African squid resource.

Where to next?

Application of the Traffic Light approach in the form suggested by Sauer (2008) as a basis for management of the squid resource does not appear to have a defensible scientific basis (though this is not to exclude aspects of the approach, such as pre-specified decision rules, that are common to other management approaches).

However there could be merit is modifying the objectives of some of the workshops which Sauer (2008) suggests for identification of indicators and specification of reference/cut-off points. While the normal stock assessment refinement process would address indicators such as survey abundances and CPUE which are in standard use for fitting population models to facilitate prediction, in other areas not to date contributing to that process it could be beneficial to:

i) identify potentially useful monitoring data (indicators);

ii) clearly specify the hypothesis describing the quantitative manner in which such an indicator is assumed to be related to underlying population variables such as abundance or recruitment;

iii) determine what past data are available for the indicator, and specify how those might be used to test the hypothesis, and in particular to quantify the variance about the relationship assumed (this being a key input required for the simulation testing process).

References

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