

PRINCIPLES AND GUIDELINES FOR THE USE OF INDICATORS IN FORMULATING MANAGEMENT RECOMMENDATIONS FOR COMMERCIAL FISHERIES

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INTRODUCTION

Recent discussions in joint meetings of the EAF and Pelagic Working Groups have included suggestions that results from time series of indicators (in particular ones related to natural predators of pelagic fish) be taken into account in formulating management recommendations for commercial fisheries. These recommendations could potentially relate, *inter alia*, to TAC proposals or time/area closures. Specific suggestions have been of the form of using indicator information to invoke “exceptional circumstances” under which, for example, scientific recommendations for a TAC could be changed from the output provided by the OMP for the species under consideration.

For stakeholders to have confidence in the outcome from such a process, it would seem important that first some principles and guidelines for that process be set out and agreed. This paper intends a contribution to such an exercise. It is separated into three sections: general overarching aspects, more specific considerations, and appropriate features of management responses.

GENERAL

- For the purposes of this document, “indicators” are time series of measures of the fish (hereafter termed “the target fish population”) or fishery for which management recommendations are under consideration, or of dependent or related species or other ecosystem components.
- There is a role for the consideration of indicators in formulating management recommendations for the target fish (beyond the incorporation of some of such indicators in quantitative assessments that may have been carried out towards this end).

- A role for indicators is specifically recognised in the formal provisions (in prep.) for “Procedures for deviating from OMP output for a TAC, and for initiating an OMP review”.
- Indicators are/involve models of the relationship between the quantity measured and the target fish population in the same way that standard quantitative fisheries assessments are/involve models of such relationships. They are therefore desirably subject to the same level of quantitative scrutiny and diagnostic checking as are such assessments.
- If an indicator is not already used in fitting quantitative assessment models, this is likely because the relationship between the indicator and the target fish population is not as established or reasonably presumed as, for example, would be that between the abundance of the target fish population and the results of research surveys specifically designed to measure that abundance with minimal and time-invariant bias. For that reason, modification of the recommendations that would otherwise follow from such assessments (or OMPs developed therefrom) should be considered only if contrary evidence suggested by indicators is extremely strong.

SPECIFIC

- The manner in which an indicator is being taken to relate to the target fish population must be clearly stated. This must include specification of whether the linkage has been empirically demonstrated, or is rather argued to be reasonably assumed based on general ecological understanding.
- Such specifications need to clarify whether the relationship is “unique”, or measures of the indicator are expected to be correlated with other indices. For indices of predators of the target fish population, this could concern correlations between indices for the same predator (e.g. seabird laying rate and fledging success rate), or between different predators (e.g. penguins and gannets).
- An index is a measurement of some quantity, and is therefore potentially subject to both measurement bias and variance; efforts need to be made to quantify these for better informed interpretation of the values of the index, and greater assurance that it is representative.
- Factors other than abundance or local density of the target fish population that may impact the value of an index need to be specified, and attempts made to adjust quantitatively for them (e.g. in the same way as GLM techniques are used to standardise CPUE as an index of target fish population abundance to adjust for the bias that might be introduced were such co-variates to be ignored).

- Thresholds as a basis for consideration of management action need to be developed and justified for indicators. These thresholds may refer to a minimally desired level, or to a recent negative trend in indicator values. Their specification must take measurement errors into account (i.e. appreciate that an index exceeding a threshold does not necessarily mean that the underlying population has exceeded that threshold, and *vice versa*); this process may be a component of that suggested below for the development of associated decision rules. Correlations between past values of different indicators should be examined to determine the extent to which they provide independent evidence.
- If management action may be suggested on the basis of an indicator value(s), reasonable evidence or arguments must be presented to justify an expectation that such action will positively affect future values of the indicator(s) (e.g. if the abundance of a seabird population is declining towards a minimally desired level, and a TAC reduction for the target fish population is proposed in response, analyses must be presented which support the contention that such a reduction will have the desired effect (which the analyses should attempt to quantify) on the seabird population trend).

MANAGEMENT RESPONSE

- Indicators may be used for the purpose of “warning”, as well as of instituting “action” in the form of some limitation on the fishery in question. Responses to indicators exceeding “warning” thresholds may involve bringing forward a planned in depth assessment, or commissioning additional research (including either or both of further data collection and further analyses).
- Ideally the response to an indicator exceeding an action threshold should be in the form of a pre-agreed decision rule.
- Such decision rules should be based on anticipated responses to such actions indicated in simulation tests involving dynamic models of the populations concerned, and taking account of uncertainties/error levels in both the dynamics and in indicator measurements.
- Where actions are “quantitative” (e.g. a reduction in the TAC that would otherwise have applied), the decision rule should reflect a continuous or near-continuous relationship to the indicator, so that small changes in data do not lead to large changes in recommended management responses in circumstances where an indicator is close to its action threshold level.
- Decision rules may be based on weighted combinations of indicators to improve precision and hence reduce the frequency of false alarms or inappropriate lack of response as a consequence of measurement variance. However, care must be

taken to ensure that such weighting is used only provided the indicators combined continue to show statistically compatible trends. Should this not be the case, this would constitute strong evidence that at least one of the indicators concerned was not related to the target fish population in the manner presumed, so that a review of such presumptions should be conducted before any management action might be recommended.

- Where appropriate and feasible, quantitative comparisons of the differential impact on populations of changes in values of different indicators for that population should be developed. For example, a measure of low reproductive success for a longish-lived predator for one year is of much less concern than indications of unusually low adult survival or population decline, and the comparative impacts of changes to different demographic parameters can readily be quantified by means of simple population models.
- When management action is instituted in response to an indicator exceeding an action threshold, consideration should be given to putting in place or expanding existing monitoring activities. This is to attempt to determine whether the action is achieving the desired effect and to assist in assessing whether the action needs to be modified.