Management plan evaluations and the advisory framework

- Issues to be addressed and the ICES approach for development

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Contents

1. Management strategies

ICES should increasingly provide advice which first provides positive long term considerations, then provides short term implications. This is in contrast to what has happened in the last decade which basically can be characterised as advice for immediate crisis management which increasingly has used micromanagement to patch up the resulting problems on the short term. Clients see harvest control rules as an important step in this direction and are requesting ICES for advice in this regard. ICES should however from the outset take a wider perspective in order to maintain the long term basis for the advice. A harvest control rules is one component in a management strategy[1] which describes a procedure for the longer term management of fisheries. A management strategy includes

? A decision (explicit or implicit) on longer term management objectives and performance criteria
? A decision on the relevant knowledge base for tactical management decisions
? Rules for tactical management decisions regarding the fisheries in the current or coming fishing season (harvest control rules)
? A decision on implementation framework (mainly input or output control etc.)

A management strategy thus includes what is called the knowledge system, the decision making system and the implementation system in the WGFS model. The fleet adaptation system and the underlying resource system represents the objects of management and are thus external to the

[1] Other terms used for a ‘management strategy’ (Sainsbury 1998) is ‘management procedures’ (the Butterworth school) or ‘closed loop’ models (Hilborn and Walters school). They are not entirely equivalent. The emphasis here is to evaluate frameworks which strategically defines tactical decisions, thus the term management strategies.

strategy itself but should be incorporated in any management strategy evaluation in terms of achievements of objectives, robustness and risk relative to external factors.

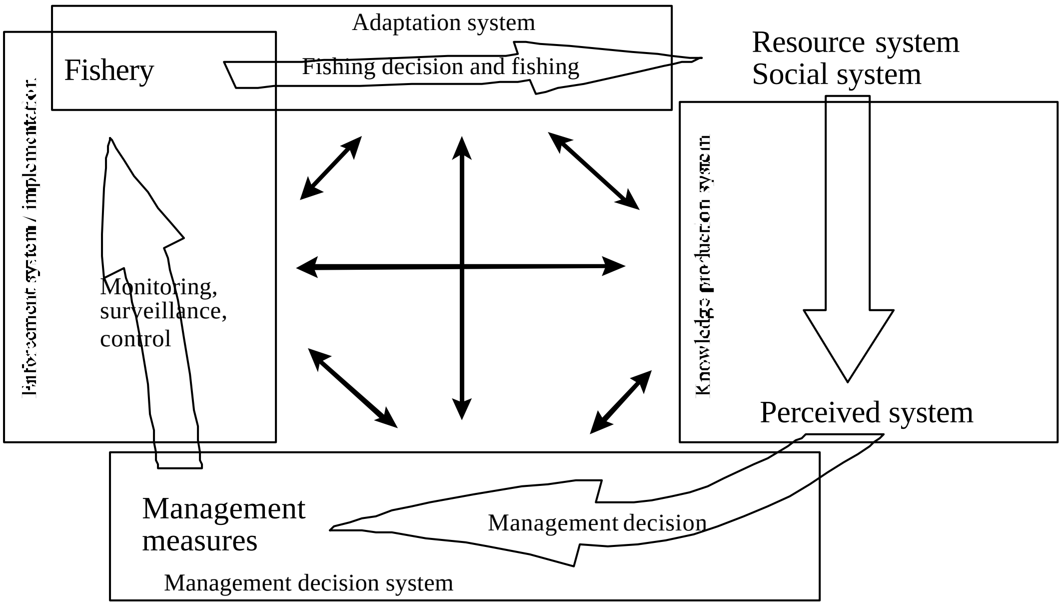


Figure 1. The fisheries system. The management strategy identifies relevant knowledge, decision rules and implementation means (the knowledge production system, the management decision system and the implementation system) while the adaptation of the fleets and the natural changes in the resource system are external constraints. (WGFS 2001)

The knowledge production system should reflect the management strategy. Analytic stock assessments with annual catch forecasts is just one special approach to produce the knowledge base for tactical management decisions within a management strategy based on annual TACs. Other approaches are direct use of survey indices prior to or in the fishing season or catch rates from the early part of the fishing season. In an effort based management strategy other types of knowledge and other frequencies of updates are required and annual catch forecasts may be irrelevant.

Harvest control rules is the basis for tactical management decisions. There is always a harvest control rule but it is in most cases in the NE Atlantic area not explicit. The present implicit default harvest control rule in Europe is to decide an annual TAC on basis of a two year catch forecast based on the population one year prior to the fishing season. This rule is associated with one limit reference point Blim (Flim does not play a role in the implicit HCR but is just a technical means to get from Blim to Fpa) and two trigger points (Bpa and Fpa).

Even an explicit and agreed HCR is not a full description of the decision making system. Management decisions are more than the harvest control rule. Management decisions will always include a critical evaluation and selection of the specific knowledge used in the current decision and any harvest control rule will be subject to requests for flexibility when politically sensitive issues are at stake.

A harvest control rule is thus the operational result of strategical decisions while the immediate outcomes of the harvest control rule will be subject to modification both before final decisions are taken and through implementation. A harvest control rule is thus the lowest level in a hierarchy within the fisheries management system.

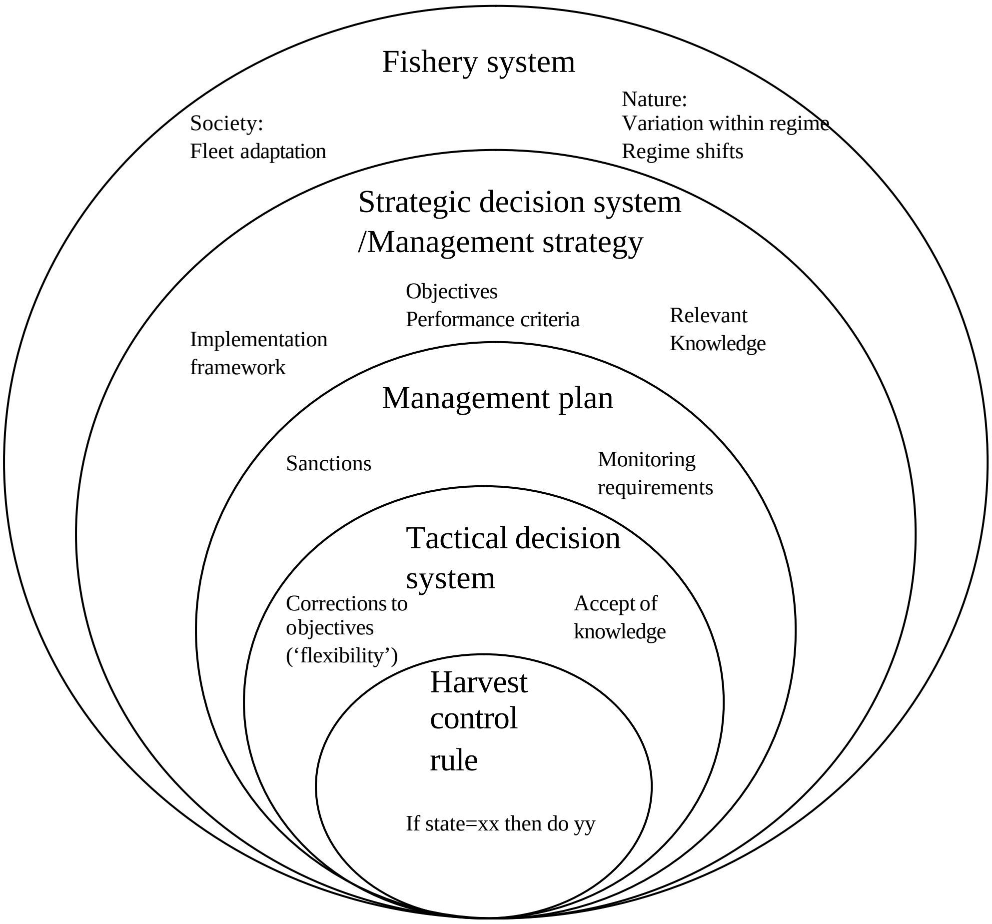


Figure 2. The management strategy onion. The harvest control rule is explicitly or implicitly embedded in a decision hierarchy and is subject to external constraints. The external constraints include the future state of nature and the future behaviour of the fishing fleet which includes adaptations to the management. These external constraints cannot be predicted but management strategies can be evaluated in terms of their robustness to changes in these constraints. Management strategies must include decisions on objectives with associated performance criteria, on the implementation framework (primarily input or output control, to be based on annual predictive updates or multi-year adaptation etc) and on what is considered a relevant knowledge base for decisions (degree of requirements for full-flown analytic assessments, correspondence with fishers perceptions etc). A management strategy may manifest itself as a management plan which includes both the decision rules (harvest control rules or otherwise), sanctions and requirements for monitoring and reporting. Even if decision rules have been formalised in a harvest control rule the practical year-to-year decisions (the tactical decisions within the management strategy) will be much more complex and include at least two elements of interpretation: 1) does the expected outcome of decisions according to the decision rule actually conform to our strategic objectives (calls for flexibility relative to the decision rule to accommodate issues relating to for instance employment or regional economies which may not have been explicitly stated as objectives) ? and 2) do we accept the knowledge base presented to us as a valid and sufficient basis for decisions according to the rule (should other perceptions of the stock which are not included in the advice have weight to increase legitimacy etc) ?.

In the ICES areas explicit harvest control rules exist in various variants as *management plans*, *rebuilding plans* or *recovery plans*. While management plans can (and should) include decision rules which aim at recovery in the case decision parameters fall outside trigger points, recovery plans are only temporary until recovery has been achieved. The generic term *management plan* is increasingly being used to cover all such decision rules with their associated agreements regarding for instance documentation, reporting, monitoring and control. If a management plan includes identification of explicit objectives, specifications of data and the specific knowledge (rather than just the parameters) to be used in decisions and of implementation measures it becomes synonymous with a management strategy. However, an evaluation of a management plan must in any case include the full management strategy of which it is a part – the outcomes of a management plan will in all cases be dependent on the quality of knowledge and implementation whether these are internal or external to the plan and an evaluation must include this context. The strategy which the management plan is supposed to implement is generally not explicit but must be interpreted on basis of the longer term policies formulated within the management institution.

A management strategy can only be identified and evaluated on basis of stakeholder choices regarding objectives and acceptable performance in terms of robustness, costs and transparency. It cannot be expected that these choices are made explicitly prior to the process of developing management plans, they will rather be made in an iterative way when options are explored and the expected or realised outcomes become apparent. ICES should contribute to this process by presenting options and evaluations of their expected performance to stakeholders and by monitoring and evaluating the outcomes of existing management strategies.

An evaluation of management strategies must be based on the efficacy of the management strategy in

? Achieving the explicit objectives for management
? Achieving the implicit objectives for management
? Performing according to performance criteria relating to robustness, costs, transparency etc

2. Objectives

Explicit objectives for fisheries management were rarely stated in the past but international agreements and – increasingly – explicit statements from ICES clients are changing this pattern.

The WSSD (2002) declaration, which all ICES member countries have signed up to, states regarding marine management that MSY should be achieved by 2015 and an ecosystem approach implemented by 2010. This implies objectives relating to sustainability, long term yield and maintenance of ecosystem health.

Explicit management objectives are stated by clients and governments in their fisheries and environmental policies but are often very general. The CFP includes objectives regarding an extensive range of social and ecological concerns formulated in broad terms.

The most explicit statement about objectives appears in the MoU between ICES and client commissions which states that maintenance of reproductive capacity while obtaining high long term yields should be an important guideline for advice. High long term yield is here explicitly stated as an objective in its own right.

Implicit management objectives can be read from agreed or proposed management plans. The existing management plans in the ICES area emphasise *sustainability* as the main purpose of the decision rules is to keep the SSB away from Blim. The decision rules basically uses Fpa and Bpa as trigger points to take action to get F and SSB back below and above the trigger points respectively which in practice means that the trigger points are used as targets. The implicit objectives in these cases are thus to keep fishing activity at the highest possible level while (just) maintaining stock reproductivity.

Some management plans also include criteria regarding the acceptable *maximum acceptable annual changes* in TACs which implies that the stability of catch options is an objective in its own right.

A few management plans include decision rules which relate to the *ecosystem services of the stock* in question. The decision rule for capelin is an example where the maintenance of food supply for cod is incorporated as a limit point. Given the WSSD declaration it may be expected that ecosystem services of stocks will receive increased attention in management.

Existing or proposed management plans do not contain reference to other types of parameters beyond stock and yield, which could be equally valid target dimensions. Targets could be formulated as employment, economic contribution to coastal communities and other social or economic dimensions in which case social science inputs would be required before advice could be given. The absence of social and economic explicit targets in management plans is striking given the emphasis on these aspects in policies such as the CFP. The combination of emphasis on social and economic aspects in the CFP and the absence of such parameters in management plans does not mean that such issues are ignored but that they are included informally in tactical decisions and may only be raised indirectly shrouded in critique of the advice or otherwise.

These various objectives are not of similar character. Some (maintenance of stock reproductivity and ecosystem services) are boundaries or limits to management but may not identify targets within the boundary area on their own. Others (high long term yield) identify targets within the boundary area. This has implications when objectives are translated into management decision parameters in a harvest control rule.

In summary for the NE Atlantic areas governments and commissions explicitly or implicitly identify the following objectives:

? Sustainability (limit objectives):
  o Long term sustainability in terms of maintenance of stock productivity
  o Maintenance of ecosystem services associated with the stock
? Societal benefits:
  o High long term yield (a target objective)
  o Maximal interannual changes in catch opportunities (a limit objective)

An evaluation of objective achievement must be based on some criteria relating to how well objectives have been achieved. The achievement of objectives is not an either-or issue and may only be evaluated on a relative basis when comparing two management plan options. In a world of uncertainty the *acceptable risk* that objectives are not met is an integral part of the objectives and should be decided outside the scientific advisory process. The level of acceptable risk is never stated explicitly. Instead implicit accept of specific levels has been sought by presenting proposals to decision makers. It seems in this way to have been agreed that the maximum acceptable risk of the SSB falling below the limit for maintained reproductive capacity is in the range of 5-10%. Higher levels of risks may be acceptable regarding objectives relating to targets than what is accepted in relation to limits. However, the risks associated with all objectives will in most cases not be quantifiable

3. Performance criteria

Management strategies are evaluated against their efficacy in achieving objectives within acceptable probability (or risk) and in relation to performance criteria which are not themselves part of objectives but will serve as important discriminators when choices are made between alternative management strategies.

It is not stated in policy documents which properties are deemed desirable by stakeholders or clients for ICES advice. However, the following performance parameters seem to recur in various discussions and documents:

- Robustness: the management strategy must be robust to the major types of uncertainty (including bias) involved in the strategy. These are uncertainty associated with data, model uncertainty, implementation uncertainty and uncertainty about the future state of nature. A special aspect of robustness is the ability of a harvest control rule to lead to timely and sufficient decisions in specific, critical situations
- Cost efficiency: There must be a reasonable relation between the benefits to society from a fishery and the costs involved in managing it including data production, assessment, decision making and implementation.
- Transparency and legitimacy: management strategies cannot be implemented in an open society if they are not considered legitimate by stakeholders and citizens. Management strategies which rely on counterintuitive models or models for which even the basic properties cannot be communicated or which rely on assessments which are not documented and open to public scrutiny have little scope of being considered legitimate.

These performance criteria can to some extent be evaluated from a technical (natural science) perspective but elements of all would require inputs from social sciences for evaluation. This relates especially to costs and legitimacy.

3.1. Robustness

Robustness is the ability of a management strategy to absorb uncertainty and error by reducing its impact on the outcomes in terms of objectives.

Uncertainties

The main uncertainties to be included in management procedure evaluations are

- Data uncertainty
- Model uncertainty
- Implementation uncertainty (including uncertainty about fleet adaptations)
- Uncertainty about future state of nature

Robustness is evaluated measurement of performance in relation to objectives such as the frequency of the sustainability criterion not being met (for instance if true SSB falls below Blim more than the accepted risk frequency).

Robustness evaluation should include both variance and bias in relation to both data, models and implementation. Robustness in relation to uncertainty regarding the future state of nature including regime shifts should be tested with special focus on the sensitivity to changes in productivity at low stock sizes.

Bias is known to be a major problem and it is generally known in which way it works – both in assessments, decisions and implementation.

Evaluating robustness: predictive modelling or sensitivity test?

Robustness can be evaluated through two approaches. One is by modelling the sources of uncertainty and bias and thereby estimating uncertainties under specific assessment, decision and implementation regimes. The other is by sensitivity tests for a range of error levels, where the choice of the relevant error range may be informed by historical data.

Data uncertainty may in some cases be estimated directly while robustness to model, implementation and state of nature uncertainty may only be evaluated through sensitivity analysis.

Ability to lead to adequate decisions in critical situations: Crash capture

It is relevant to evaluate robustness in relation to specific critical situations where poor performance of the management strategy may lead to longer term, possibly irreversible changes. Cases like the collapse of the Newfoundland cod stocks have demonstrated that delays in detection and reaction to rapid decreases in stock sizes as may be the result of a range of very low yearclasses can be fatal by leading to stock collapses which may prove impossible to reverse. It should therefore be an element of an evaluation of a management strategy to investigate its ability to identify such rapid downward changes early and that the harvest control rule will result in sufficient and sufficiently early action to reverse the trend before it has developed beyond reversal.

Short term proposal:

? Evaluate robustness to data error on basis of variance and bias estimates from historical assessments.

? Evaluate model robustness as sensitivity analysis.

? Evaluate implementation robustness as sensitivity analysis with emphasis on bias.

? Evaluate state of nature robustness as sensitivity analysis regarding S/R parameters with special focus on sensitivity to changes in productivity at low stock sizes.

? Evaluate performance in respect of reacting sufficiently and sufficiently early in cases of sequences of very low recruitment

3.2. Cost efficiency

Formal evaluation of cost efficiency would imply costing data gathering, assessments, decisions and implementation against the benefits of objective achievements. This is not formally doable without extensive economic data.

Short term proposal for ICES: include semi-quantitative accounts of data requirements, requirements for model complexity and frequency of updates and requirements for monitoring, control and surveillance. The outcomes of the EASE project will contribute to this.

In the longer term – associate with economists to include more formal approaches to cost efficiency evaluation.

3.3. Transparency

Transparency relates to 1) whether the methods used are understandable to stake holders and 2) whether the process by which decisions are reached (including the data collection and stock assessments) is open to public scrutiny. The first aspect can be illuminated (but not evaluated fully) in terms of model complexity. An evaluation of transparency and legitimacy require a social science input and ICES should team up with social scientists to evaluate the properties of and requirements to various management procedures in terms of transparency.

4. Evaluation of harvest control rules

4.1. The predictive/adaptive balance

The first decision to be made regarding a management strategy is whether it is primarily predictive or adaptive on the tactical level.

Management strategies which can assume a high level of existing knowledge and insignificant external change can rely on predictive tactics. If the time series are long and cover a variety of exploitation rates which are sufficient to provide good information about S/R dynamics and if regime shifts are not expected management tactics can rely on predictions with annual (supposedly minor) adaptations to deviations in outcomes as is currently the practice in most management regimes in the NE Atlantic. This approach can be termed passive adaptation.

However, there are several reasons why passive adaptivity is not sufficient for many cases in the NE Atlantic:

- Stocks for which data series are short or only one state is known. The historical data are thus insufficient to understand whether the known stock history represent a depleted state or early phases of exploitation. The stock dynamics may only be known if a range of exploitation regimes have been observed and target and limit reference points can thus not be identified. Examples are southern hake and western Channel sole.

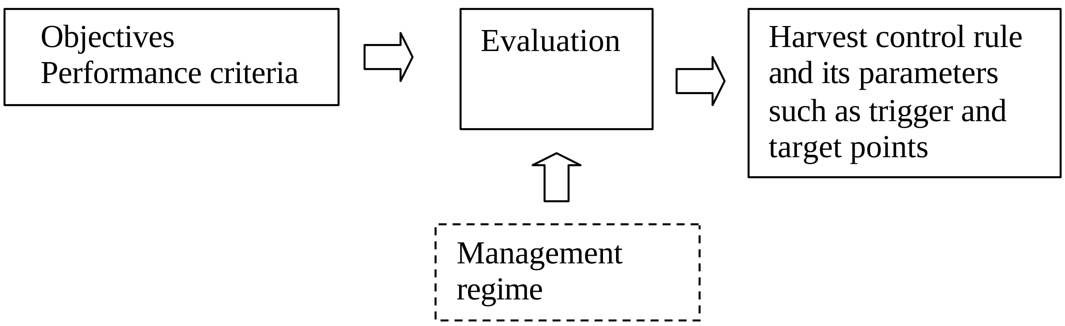
– Target reference points for stocks where biological interactions are important or only low productivity has been seen. Examples are North Sea roundfish
– Cases where regime shifts may be apparent. Examples are North Sea cod where the indications of a more northerly distribution may indicate a new productive regime for this stock.
– Stocks where we are uncertain about present state or stock dynamics.

In such cases active adaptation is required whereby the stock dynamics is explored through an evaluation of outcomes of management which deliberately probes varying exploitation levels to assemble experience about stock dynamics which may be used to identify limit, target and trigger reference points in the future. This can be achieved by (dependent on the situation) gradually increasing or decreasing the fishing mortality and monitor the outcomes. It will in general not be acceptable to identify limit reference points ‘coming from above’ by adaptive increase of fishing mortality while identification ‘coming from below’ through gradual exploratory reduction of fishing mortality is relevant for some stocks such as southern hake and some sole stocks.

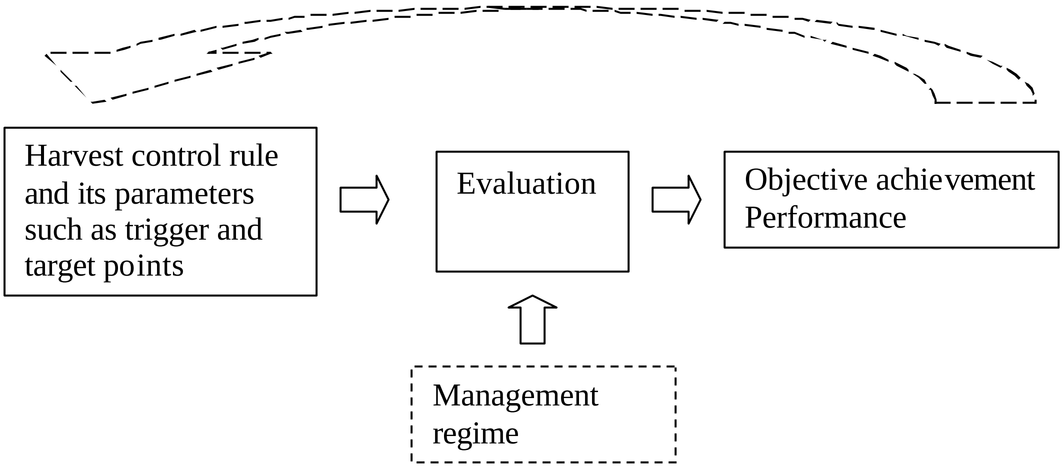
Evaluations of the choice of the predictive/adaptive balance within a management strategy must involve the full process of underlying system-assessment-decision-implementation and cannot focus on the harvest control rules only. Given the uncertainties in most estimates in limit reference points in NE Atlantic assessments all management strategies should have an important active adaptation element.

4.2. Objectives and performance criteria as design inputs

Candidates for harvest control rules are presently evaluated on basis of their expected achievement of objectives and how they perform. Ideally one would go the other way round, and specify criteria for objective achievement and performance (and the uncertainty structure) and then estimate appropriate HCR parameters such as trigger and target reference points which would be expected to lead to performance according to the desired performance standards.



Whereas with the present evaluation tools this is done in the opposite sequence or at best iteratively:



4.3. HCR parameters

Harvest control rules are generally formulated as decision rules delimited on basis of limit, trigger and target parameters supplemented by conditions regarding acceptable interannual change etc.

Limits: Conservation or ecosystem limits

Objectives regarding maintenance of reproductive capacity or ecosystem services from the stock define exploitation limits. These are fundamentally related to stock size, either spawning stock for reproductive capacity and total stock or (in practice) a size range of the stock for ecosystem services. If stock size is difficult to measure proxies including relative values may be used. In some cases stock estimates may be so uncertain that fishing mortality based reference points which are consistent with the biomass reference points may be preferable, but these would be derived from stock considerations.

Targets: production of benefits

Targets relate to objectives to produce benefits and may have any dimension dependent on the objective. If the main objective is high long term yield targets may be expressed in fishing mortality but units in direct societal benefits such as economic or social benefits may be used – in which case social science is required to evaluate both the HCR and the present status during implementation.

Trigger points: signposts for decisions to achieve objectives and performance criteria

Trigger points are generally introduced as safeguards to ensure sufficient and timely action when there is risk that the stock may be moving towards the limit reference point. Trigger points are selected on basis of an evaluation of expected objective achievement and performance. A HCR may have one or more trigger points in stock, fishing mortality or both dimensions and trigger points may have other dimensions such as catch.

Pa reference points are only the a priori relevant trigger points in the special case of a HCR where the annual quota is decided on basis of a two year prognosis of catch on basis of stock size one year before the fishing season. In this case it is the uncertainty in the stock estimate at the beginning of the forecast period which identifies the relevant trigger point relative to the limit point. For other HCRs pa reference points may not even be relevant.

The estimation of HCR parameter candidates

Limit reference points relate to stock productivity and ecosystem dynamics. These reference points are thus considered properties of nature and may be estimated independently of the management strategy including the associated harvest control rules. The introduction of formalised management plans do thus not imply new approaches or methodologies for limit reference point estimation.

As *target reference points* relate to societal objectives they may in principle similarly be decided independently of the management plan. However, the translation of a societal objective into a technical reference point will in practice include an evaluation of the properties of various management plan candidates in achieving objectives given a specific target reference point. The achievement of long term high yield will not only be dependent on the definition of a target fishing mortality which from classical considerations would have this property but will also depend on how trigger reference points are defined and which decision rules are set up. Simulations is thus an important tool to estimate target reference points as an integral part of the evaluation of management plan candidates. However, such estimates of target reference points must start off from an identification of the objectives underlying the target.

There are many situations in the ICES area where important biological interactions would change stock productivity when they rebuild to larger sizes than is currently the case and where target reference points relating to yield therefore cannot be estimated in advance through simulations or otherwise. This is also the case where the stock history does not include periods of high stock productivity. In these cases candidates for target reference points can only be estimated adaptively on basis of monitoring stock productivity changes as the stock rebuilds.

Target reference points should therefore be identified in relation to the specific management plan and the approach will be adaptive estimation either on basis of simulation experiments or through real implementation.

Trigger reference points are technical signposts for changes in decision regime. They do not have relevance outside the specific harvest control rule. The value of trigger points have pervasive effect on the performance of a harvest control rule and should therefore be estimated as an integral part of an evaluation of harvest control rule candidates. The present pa reference points are in effect trigger points in the context of a specific harvest control rule and do not have independent meaning outside this HCR.

The procedure for estimation of candidates for HCR parameters would thus be that limit points are estimated on basis of the properties of the stock and the ecosystem and that candidate target and trigger points are estimated on basis of simulations which have 1) objectives, 2) the uncertainty structure and 3) desired performance standard as inputs. Estimating target and trigger reference points this way would result in HCRs which would neither under- nor overperform while a procedure which uses candidate HCR parameters as inputs and performance as output would ensure against underperformance but not necessarily against overperformance.

With existing simulation software the procedure is the other way round, the performance of candidate HCRs is simulated with an uncertainty structure as input and if performance is deemed acceptable the candidate HCR is accepted even if it may be overperforming. However, there are costs to overperformance. If a HCR is extremely robust to implementation and assessment error this will almost certainly indicate that the decision rules are too conservative and there will be relative losses in terms of foregone yield.

Updating HCR parameters

Limit reference points should be modified when the understanding of the natural system changes. Trigger and target HCR parameters depend on the uncertainty structure and the desired performance and should therefore be changed when either changes. Another reason for estimating the harvest control rule trigger and target points as an output rather than an intput is that a procedure and criteria thereby are identified for changing the values. If the uncertainty structure changes due to better data or increased implementation uncertainty trigger points should be changed accordingly. The same applies if the perceptions about required performance change.

If trigger and target reference points are identified generically/conceptually rather than numerically in harvest control rules and if the values have been estimated on basis of the uncertainty structure updating should be reasonably straightforward if it is a part of the management strategy that such updates can take place and the process for updates has been agreed.

4.4. HCR variants

Variants of relevance for investigation are, based on the preferences implicit in existing management plans:

1) Present default HCR – TAC regime with two year catch prognosis based on stock one year prior to fishing seas. This variant should serve as a comparative reference for new proposals.

2) Three step decision rule with biomass and/or F trigger points based on information on recent stock and predictions: 1) Low catch below limit point (including zero catch option if stock dynamics unknown), 2) recovery regime between limit and trigger point and 3) restoration to target and maintenance around target above trigger point.

3) Decision rule on basis of generalized parameters and in-year information. Generalised parameters: fishing mortality which the stock can sustain. In-year information: surveys or early catch rates. Such rules are presently used for short lived stocks like anchovy and capelin but could also be applied to longer lived stocks.

4) the above including limits on interannual TAC variation

5) the above but with different management regimes. If TAC regimes are used as default for the above include effort regulation – as supplement to TACs or as main implementation modality.

6) It may be relevant to compare harvest control rules above with a simple approach where the TAC or effort is kept constant for several years

The evaluations of these HCR candidates should in principle have objectives, uncertainty structure, desired performance standards and limit reference points as input and trigger and target reference points as output together with information on extent of objective achievement. A HCR candidate would in this case be a certain structure of the decision rule while the trigger and target parameters of the rule would be an output of the evaluation.

4.5. Criteria for evaluations

Management plans cannot be evaluated in an absolute sense as many aspects of uncertainty and bias cannot be estimated or will remain unpredictable. Management plan evaluations will therefore involve 1) relative objective achievement and performance where a base rule is used as reference and 2) sensitivity tests where the robustness of the management plan to uncertainties is analysed.

HCR variants should be evaluated in relation to

- Criteria relating to objective achievement:

  - Sustainability:
    - the frequency of the true biomass undershooting the limit reference point
    - the average SSB
    - ability to capture crash with sufficient action and timely for reversal

  - Societal objectives if this is formulated as high long term yield:
    - average yield
    - variation in yield including interannual variation
    - forgone yield (relative to base or comparative HCR variants)
    - trajectory of yield in recovery situations (short term losses)

- Criteria relating to performance:
  - Robustness to
    - Data uncertainty/parameter estimates: annual stock estimates, annual fishing mortality estimates, changes in biological parameters etc
    - Model error as sensitivity to different model assumptions, especially recruitment model
    - Implementation error – as sensitivity to changes in nonreporting and discard practices. Constant nonreporting and discard practices is assumed to be absorbed into the stock history and be reflected in the assumed S/R model
    - Uncertainty on future state of nature. The effects of possible regime shifts etc. This may in practice be tested as sensitivity to model error and biological parameter estimates

- Cost efficiency. This is a task for economists but can initially – lacking economic data – only be evaluated qualitatively on basis of complexity of models, data requirements and implementation requirements
- Transparency and legitimacy. This is a social science task. Complex or counterintuitive models are assumed to contribute to the alienation of stakeholders to the knowledge which is used as the basis for decisions under the HCR.

4.6. Mixed fisheries

Harvest control rules for stocks taken in mixed fisheries should be developed in concert and each stock rule should include an extra decision rule regarding possible limitations due to other stocks taken in the fishery being in a critical condition.

Harvest control rules for such stocks should in principle be evaluated in one procedure where the technical coupling in the fisheries enters as a new parameter with associated uncertainty. When single-stock software is used for evaluation the interaction can only be added post-evaluation as extra (unevaluated) clauses in the HCR for each species. Such clauses may be considered to lean to the more precautionary side since extra conditions are added on decision rules. However, there may be a cost to this in foregone yield if such rules are invoked when they would actually not be needed. There may on the other hand be an underestimate of risk if the harvest control rule for the most critical stock does not consider the effects of a possible increase in discards when other fisheries in which it is taken as bycatch proceed.

5. The precautionary approach

The precautionary approach in a management plan context focuses on the achievement of sustainability objectives. The core is the robustness of the management plan in terms of

? The true population not undershooting the limit reference point (or only undershooting with an acceptable low frequency),

? ability to take sufficient action to enable the stock to recover once it is below the limit reference point and

? ability to capture a crash situation such as a series of very low recruitments with sufficient action and timely enough to prevent an irreversible stock crash

The core of an evaluation relative to the precautionary approach is thus the limit reference point and the behaviour of the decision rule when the true population is around and below the limit reference point.

One of the main functions of trigger points is to ensure sufficient and timely action when there is risk that the stock may move towards the limit reference point. The risk for the stock approaching the limit point is entirely dependent on the management plan and the trigger level will thus also be dependent on the management plan. The present pa reference points will thus be replaced conceptually and numerically as relevant to the management strategy.

6. ICES plan for contributing to management strategies

ICES will continue to develop its capacity for producing advice regarding management plans. This will be done in two respects: 1) increase ability to evaluate management plan proposals by better and more complete inclusion of uncertainty structures, by use of evaluations which consider all elements of the management framework and by improved evaluations in relation to performance criteria and 2) by proactively presenting candidates for management plans to clients including candidates for decision rules and their parameters including target reference points. This will depend on external development of the evaluation tools but ICES is responsible for encouragement and guidance to of such development and for timely use of new tools as they become available.

This will take place through the following activities:

? Develop conceptual basis for advice on HCRs (this document expanded and included in guidance on form of advice)

? Establish SG to provide tools for WGs to produce evaluated proposals for HCRs in 2005.

? Advice in 2005 to include evaluations of candidate HCRs including target reference points.

? From 2005 forward: modify advisory framework to link to management strategy framework: from pa reference points to management strategies.

The change to advice on a larger variety of management plans represents some immediate problems. The present pa framework is perceived outside ICES (and to some extent inside as well) as universally applicable independently of management regimes. The form of advice and the state of the stock classification as it is presently constructed implies this as well. It will represent an important communication challenge to explain an evaluation of proposed management plans which does not refer to the present pa reference points.