

A Transparent Precautionary Approach to Harvest Control Rules

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What is Wrong with Current Harvest Control Rules?

- Harvest control rules cannot be effective unless they are ecologically and economically sustainable, and they must be acceptable to all stakeholders (fishermen, administration, environmentalist groups, etc).
- Stakeholders often disagree on how much precaution is necessary when following a Precautionary Approach. Even when there is agreement on stock assessments, there is seldom agreement on how much risk is associated with each harvest strategy and how much risk is acceptable.
- There is a lot of uncertainty in the assessment process, especially when environmental factors are taken into account, and yet current procedures treat all indicator values as if they were precise figures.

An Alternative “Fuzzy” Approach

- We have tried to separate the technical aspects of stock assessment from more controversial issues of health and resilience of stocks, especially in light of the growing uncertainty associated with climate change and other environmental concerns. Uncertainty is an unavoidable aspect of fisheries management – without it we would not need a Precautionary Principle.
- The concept of the “health of a stock” is appreciated by almost everyone, although it is poorly defined and it seems impossible to reach agreement on what it means. Even so, it can be a useful focal point for stock management. In the absence of any precise definition it can be treated as a fuzzy quantity, one defined in linguistic rather than numerical terms.
- A typical fuzzy rule for stock management is:
 - IF the stock is healthy**
 - THEN set a high TAC and fish it hard**
 - ELSE leave it alone and let it recover**
 - END IF**
- We propose to implement this rule by defining a variable **H** representing the health of a stock which lies between 0 and 1. If **H=1** the stock is fully able to withstand fishing pressure and the allowed yield **Y(H=1)** can be calculated by standard assessment techniques (e.g., the TAC). Otherwise the allowed yield is **Y(H)=H×Y(H=1)=H×TAC**.

What is H?

- The variable **H** is related to risk (**RISK=1-H**) and it is clear that stakeholders will seldom agree on how much risk is acceptable. The fishing industry often argues that stocks are healthy and can be fished with little risk even while ENGOs claim that they are on the brink of extinction. There can be no consensus on a precise definition of “healthy stock”.
- Reliance on esoteric assessment techniques that few stakeholders understand leads to a lack of confidence and distrust of technical experts.
- More common ground can be achieved by formulating assessments in terms of fuzzy rules expressed in common language, such as
 - IF spawning stock biomass is high**
 - AND IF there are lots of mature spawners**
 - AND IF conditions are favourable for recruitment**
 - THEN stock is healthy (i.e., H=1)**
 - END IF**
- These fuzzy rules can include important factors which are hard to quantify, such as
 - IF compliance is good ...**

Why Go Fuzzy?

- Fuzzy rules are easily expressed in common language which can be understood by all stakeholders and makes the assessment and management process more transparent.
- The precision implied by current assessment techniques is misleading and does not adequately reflect the degree of uncertainty that is present. We are dealing with a system that is inherently fuzzy and should not pretend otherwise.
- Some important factors are difficult to quantify and thus can better be represented in fuzzy linguistic terms than by numbers.
- A fundamental principle of fuzzy logic is that precision and significance are incompatible. This is clearly the case in fisheries science, where it is becoming more and more evident that by focussing just on “scientific” data we are arousing the anger of stakeholders who want to know why we are ignoring the issues that they consider important. Fuzzy logic lets us take all factors into account – if they can be quantified, fine, but even if we don’t have all the numbers, we can still use all the knowledge available.