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The language of fishery management advice offered by ICES

by

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Abstract

Since the establishment of the Exclusive Economic Zones in the mid 1970s, several exploited fish stocks in the Northeast Atlantic have been managed by total allowable catch (TAC). The advice on annual levels of TAC, as offered by ICES, has been given on certain assumptions as to what the objectives of the fishery management agencies might be. These objectives have seldom been stated explicitly by fishery management agencies, and the language of the advice has been subject to alternative interpretations. In particular, some terms, e.g. "safe biological limits" have given rise to disputes and doubts about their usefulness and true meaning. In this paper, we discuss the language of ICES' advice, and offer some suggestions on how to improve communication between ICES and the relevant fishery management bodies, NGOs, and the public.

Keywords: Fishery Management, Precautionary Reference Points, Language of Advice

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1. Introduction

Since the establishment of the Exclusive Economic Zones in the mid 1970s, several exploited fish stocks in the Northeast Atlantic have been managed by total allowable catch (TAC). ICES have each year provided advice on the question of how much to fish of various stocks, but the principles upon which the advice has been given has varied. This paper opens with a review of the principles for giving advice during the last 25-30 years. Thereafter the form and language of the current ICES-advice is discussed. Finally we give some suggestion on how to improve communication of the content of the ICES advice.

2. ICES-advice 1976 - 2001

At the Annual Science Conference of ICES in 1992, Frederic M. Serchuk and Richard J.R. Grainger presented their paper *"Development of the basis and form of ICES fisheries management advice"* (Serchuk and Grainger, 1992). The paper gives a good description of how the advisory process related to the level of TAC developed during the period 1976 – 1990. In this section we draw heavily from our interpretation of the paper (and also recommend it for closer examination).

Principles and objectives for giving advice were adopted by the Liaison Committee of ICES in 1976. These principles took their departure on the MSY-concept, but focused on an exploitation level, which was somewhat lower than this ($F_{0.1}$). The application of this principle would identify a need to define an optimal range of spawning stock size as well as to define an agreed minimum biomass level. It was expected that the advantages of such an approach would be: *"……..(a) reduced fluctuations of TACs from year to year; (b) increased catch rates; (c) reduced risks of stock depletion; and (d) increased reliability of scientific advice."* More than anything else, these principles reflect an objective of maximising the physical output/yield from the fishery.

The Advisory Committee on Fishery Management (ACFM), established in 1978, took over the advisory responsibilities from the Liaison Committee. ACFM did not change the principles outlined by the Liaison Committee, but was aware that most stocks were being fished far above $F_{0.1}$ and at unfavourable exploitation patterns. This observation corresponds well with what could be expected when regulating previously (almost) unregulated commercial fisheries, a phenomenon known as "The tragedy of the commons". According to this theory, one should expect higher exploitation rates than MSY-levels for unregulated renewable natural resources; see Gordon (1954) and in more general forms by Hardin (1968). Figure 1 gives the basic relationships.

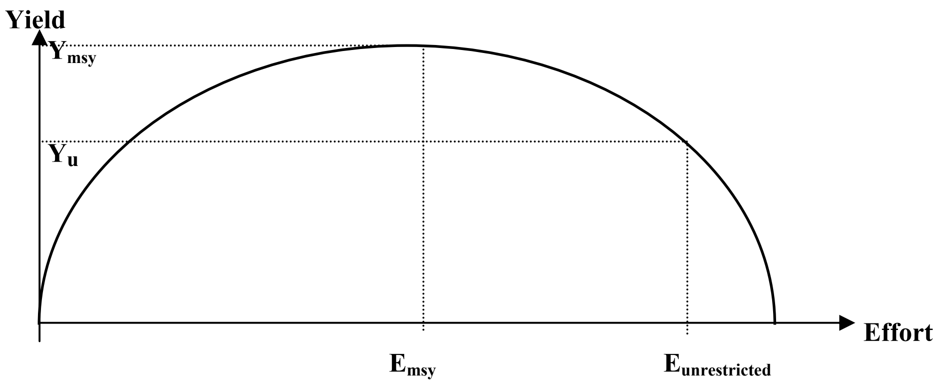

Figure 1 *The figure shows a simplified relationship between effort and yield in a fish stock. The figure shows the potential for higher yield through a reduction of effort from $E_{unrestricted}$ to E_{msy}.*

Acknowledging the distance between $F_{0.1}$ and the realised fishing mortalities, ACFM recommended gradual reductions in fishing mortalities and improvements in exploitation patterns. Such a gradual reduction was assumed to reduce the short-term economic and social hardships to the fishing industry. Although ACFM here modifies its principles by taking into account social and economic considerations, the underlying long-term objective of maximising the physical output from the fishery has not been changed.

Already from these early years of TAC-advice there was a need to have good communication between ICES and its clients. To accommodate for this, ICES Dialogue Meetings were established in 1980 to provide a forum for discussion between scientists, managers and the fishing industry. In light of discussions at two of these meetings, ACFM pointed on the need for management to express their objectives in a clear way. In lack of such objectives, ACFM used objectives based on pure biological considerations. As noted by ACFM: *"These are $F_{0.1}$ and F_{max}, which define a certain level of fishing mortality associated with the optimal use of the growth potential for the existing pattern of exploitation"* (ICES, 1982). Once again, ACFM stress the underlying long-term objective of maximising the physical yield from the fishery.

Presumably, to accommodate the (unknown) objectives of management bodies, ACFM defined different categories of stocks for providing management advice. ACFM proposed catch options for stocks, which are fished at levels not very different from the biological reference points, and clear-cut advice for stocks, which are fished at levels far above the reference points. Obviously, the catch options presented should not bring one stock from the more productive category to the less. To distinguish the two categories of stocks, the term "safe biological limits" was introduced.

Six years later, in 1987, ACFM introduced the additional biological reference points F_{med} and F_{high}, related to fishing mortalities, which probably and doubtfully would give recruitment levels that could sustain a stable stock. At a first glance, the introduction of these latter reference points represented a shift away from an underlying objective of maximising yield, to an objective of securing a certain level of biomass. However, the necessity of a stable stock is indirectly to safeguard productive fish stocks.

The issue of "safe biological limits" was addressed by ACFM in both 1986 and 1987, and the use of the following four parameters should facilitate a classification of stocks as either inside or outside safe biological limits:

- Can a stock size be identified, beneath which recruitment is impaired?
- Is the current stock size lower than what has previously been observed?
- Is there a declining trend of SSB, indicating that it will reach historical low level next year?
- What level of fishing mortality next year would reduce stock to historically low levels the year after?

In 1991, ACFM provided a new form of advice, and defined its own objective to be: *"To provide the advice necessary to maintain viable fisheries within sustainable ecosystems"*. This objective focuses directly on "viable fisheries" a condition, which cannot be realised without productive fish stocks. Furthermore, ACFM signalled that the question of whether or not it would provide clear advice would depend upon the state of the relevant stock. For stocks below "Minimum biological acceptable level

(MBAL)” it would provide clear advice, whereas options would be presented for stocks above this level.

The MBAL reference point was used in the following years as the only reference point for classifying whether or not advice on TAC should be given as options or as specific catch level. It relied solely on the assessment of the level of the spawning stock of fish, and had no implications for the annual level of fishing mortality.

In 1997, ACFM once again changed its principles for giving advice. This time the change was done to incorporate the Precautionary Approach (PA) in the fishery, which had been highlighted by both the Rio Declaration (United Nations, 1992) and the UN Fish Stock Agreement (United Nations, 1995). The background for the various UN resolutions was the perception that many of the important commercial fish species throughout the world were either depleted or at a very low level. ICES established the “Study Group on PA” in 1997 (ICES, 1997). The SG suggested four new reference points – two related to the size of the biomass and two related to the size of the fishing mortality. The reference points related to the biomass were B_{lim} and B_{pa}, where B_{lim} should be the level of biomass beneath which one for several reasons should not come, and B_{pa} should be the level where SSB with a high degree of probability should be above B_{lim}. Correspondingly, reference points for fishing mortality (F_{lim} and F_{pa}) were established.

Following the emphasis of the PA in the latter part of the 1990s, and the subsequent introduction of the new reference points, ACFM reduced its “option” area to stocks where the SSB were above B_{pa} and the fishing mortality were below F_{pa}. For the remaining stocks, ACFM would give advice in order to get the stock above B_{pa} as soon as possible. In its advice, ACFM deemed management actions outside what was recommended to be “inconsistent with the PA” and to be outside safe biological limits. Later, the language was modified to express if <u>a fish stock</u> was outside safe biological limits ($B < B_{pa}$) or if it was <u>harvested</u> outside safe biological limits ($F > F_{pa}$).

Table 1 shows some key information related to the development of principles and language used in the advisory process.

Year	Ref.point	Principle	Advice	Language
1976	$F_{0.1}$, F_{max}	Max physical yield	Yes	
1978	$F_{0.1}$, F_{max}	Max physical yield, but allowance for a gradual reduction of F towards this level	Yes	
1981	$F_{0.1}$, F_{max}	Max physical yield	Yes for depleted stocks, stocks suffering from recruitment failure and stocks fished in excess of reference points Options for stocks fished at levels not very different from the biological reference points	Safe biological limits
1987	F_{med}, F_{high}	Sustain stable stock	Yes for stocks outside safe biological limits, Options for stocks inside safe biological limits	Safe biological limits
1991	Numerous	Provide advice necessary to maintain viable fisheries within sustainable ecosystems.	Yes for stocks below Minimum Biological Acceptable Level (MBAL). Options for stocks above MBAL	Minimum biological acceptable level/Safe biological limits
1997	B_{lim}, B_{pa} F_{lim}, F_{pa}	Keep stocks above B_{pa}, and fishing mortality below F_{pa}.	Yes for stocks below B_{pa}, and fishing mortality above F_{pa}. Options for stocks above B_{pa}, and fishing mortality below F_{pa}	Safe biological limits referring to harvesting and/or stock

Table 1 *Some key factors in the ICES advice on TACs, 1976 - 2003*

As described above, the generic principle for the advice given by ICES has been to keep fish stocks at levels where their productivity is good and where viable fisheries can be maintained. The words used to characterise whether a stock is in a productive range or outside has been "safe biological limits". This phrase does not give a good description of the state of the stock.

3. The form of ICES-advice in 2002

The form of ICES advice is described at the front page of the ACFM-report as of 2002 (ICES, 2002). Four reference points are used in the process, and they are defined as follows:

"B_{lim}. *The value of B_{lim} is set on the basis of historical data, and chosen such that below it, there is a high risk that recruitment will "be impaired" (seriously decline) and on average be significantly lower than at higher SSB. When information about the dependence of recruitment on SSB is absent or inconclusive, there will be a value of SSB, below which there is no historical record of recruitment. B_{lim} is then set close to this value to minimise the risk of the stock entering an area where stock dynamics is unknown. Below B_{lim} there is a higher risk that the stock could "collapse". The meaning of "collapse" is that the stock has reached a level where it suffers from severely reduced productivity. "Collapse" does not mean that a stock is at high risk of biological extinction, but does mean that recovery to improved status is likely to be slow, and dependent of effective conservation measures."*

"F_{lim}. *The fishing mortality rate should not be higher than an upper limit F_{lim}, which is the fishing mortality that, if maintained, will drive the stock to the biomass limit. "*

To account for the fact that any estimate of biomass or fishing mortality is uncertain, ICES applies a "buffer zone" to establish the reference point for biomass B_{pa} at a higher level than B_{lim}, and F_{pa} at a lower level than F_{lim}.

ICES further states: *When an assessment shows that the spawning biomass is below B_{pa} , ICES regards the stock as being "outside safe biological limits", regardless of the fishing mortality rate, and ICES will provide advice to increase spawning biomass above B_{pa}, …… When an assessment shows that the stock is above B_{pa} but that the fishing mortality is above F_{pa}, the stock is "harvested outside safe biological limits".* …..

From the definitions of the reference points, given by ICES, it is quite clear that the major concern for a management body from not following the advice given by ICES is that the productivity of the fish stock is not utilised. As such, the definitions given above fits very well with principles upon which ICES have given advice for the last 25-30 years. By managing a depleted fish stock without the aim of bringing it above B_{pa}, ICES tells that productivity gains are lost. The principle underpinning this argument can be traced back from the time when ICES started to give advice, and is mostly an argument of reaping a good physical yield from the fishery. It can be argued that the change from an advisory system building on the MSY concept via the MBAL concept to the PA-reference points has a less sharp focus on the maximisation of yield. It is still reflecting the underlying principle of avoiding stock sizes where the productivity of the stock is poor – mainly due to poor recruitment. However, the language to characterize this fails to pass on the message.

4. Language used by the United Nations and the FAO

Is the term "safe biological limit" used by the United Nations or the FAO?

The UN Fish Stock Agreement

In the UN Fish Stock Agreement (United Nations, 1995), the concept is used. Annex II, point 2, has the following wording: *"……… Limit reference points set boundaries* *which are intended to constrain harvesting within safe biological limits within which the stocks can produce maximum sustainable yield. ……"*

The concept is here qualified to be the area *"within which the stocks can produce maximum sustainable yield."*

<u>The FAO Code of Conduct</u>
In the FAO Code of Conduct, the term "safe biological limits" has not been used. Under Article 7.2, labelled Management Objectives, it says: *"Recognizing that long-term sustainable use of fisheries resources is the overriding objective of conservation and management, States and ....., should, inter alia, adopt appropriate measures,….., which are designed to maintain or restore stocks at levels capable of producing maximum sustainable yield, as qualified by relevant environmental and economic factors ...*"

The Code does not use the term "safe biological limits" to characterise whether or not the stock is managed to achieve such a goal, but use the words *"levels capable of producing MSY, ...".*

Whereas the Code does not use the term, the UNFSA does. In both text it is however, clear what the objective of management should be – to keep the fish stocks at productive levels.

5. Problems of communicating the message

We have already stated that the phrase "safe biological limits" fail to pass on the message, which it is meant to convey. Experience from conducting fishery management and explaining the ICES-advice to fishermen, NGOs and the general public tells us that the content of the term "safe biological limits" can be interpreted in several ways. In an article in the Norwegian newspaper "Fiskaren" last spring, the Secretary General of the Norwegian Ministry of Fisheries pointed on the fact that the term "outside safe biological limits" is interpreted by NGO's as a stock threatened by extinction (Fiskaren, 2003).

An example of how one NGO interpret the stock of Northeast Arctic cod is the following:

"The FAO has estimated that 75% of the fish stocks in the world are either fully exploited, overexploited or in crisis. ICES characterise the cod in the Barents Sea to be outside safe biological limits. The Norwegian Government has, during the forthcoming fishery negotiations an excellent opportunity to show the world how to manage fish resources in a sustainable manner. If not- the cod stock may decline as the herring did. Such historical ignorance cannot be accepted.[1]"

In this statement, Greenpeace compares the management of the Northeast Arctic cod in 2002 with the management of the Norwegian Spring Spawning Herring in the late 1960s, when the stock was nearly extinct. The history of this stock is seen by the

[1] Freely translated from a statement in Norwegian given on: www.greenpeace.org/norway_no

public in Norway as a prototype of a stock depletion due to bad management, including lack of appropriate advice and failure to obtain international agreements.

As a response to this kind of interpretation, the head of Center for Marine Resources at the Institute of Marine Research in Norway wrote an article in one of the largest newspaper in Norway (Bjordal, 2002) to explain the difference between concepts like "outside safe biological limits" and "stock extinction".

6. Do better terms exist?

The confusion among the fishermen, NGOs and the public with regard to the content of the term "safe biological limit" calls for improvement of the term or the general understanding of it. We see two possibilities for doing this:

1. One approach would be to leave the term as it is, and use more effort to define and explain its content. The term has been in use by ICES since 1981, and it may cause more misunderstanding to try to substitute it for another term. An additional argument for sticking with the term is that it is used in the UN fish stock agreement of 1995.
2. Another approach would be to search for an alternative wording. For a substitute to be valuable, it must be able to target the problem at hand, by referring to efficiency, productivity or yield of the fish stock. Such a substitute should indicate that the stock is in a state where its productivity is either good or bad, or that the fishing mortality is at a level, which will move the stock into a more or less productive range. Following this line of thought, a possible substitute is "within or outside ***a sound productivity range***".

Following the second approach above, an ICES statement could be rephrased as: *When an assessment shows that the spawning biomass is below B_{pa}, ICES regards the stock as being "**outside a sound productivity range**", regardless of the fishing mortality rate, and ICES will provide advice to increase spawning biomass above B_{pa}. …… When an assessment shows that the stock is above B_{pa} but that the fishing mortality is above F_{pa}, the stock is "**harvested outside a sound productivity range**".*

7. The time perspective of the advice

The time perspective of today's advice offered by ICES is one year. Its clients, the various management bodies, are in a position to establish annual TACs, and the advice reflects this by providing a stock estimate and a short-term prognosis regarding catch and stock development. However, a proper decision on TAC-level should also take into account the dynamics of the stock, inter alia, is it in a period of strong growth or in a period of strong decline?

To illustrate the assessment of a fish stock, a diagram of SSB versus F is often used. An example of such a diagram is shown in Figure 2.

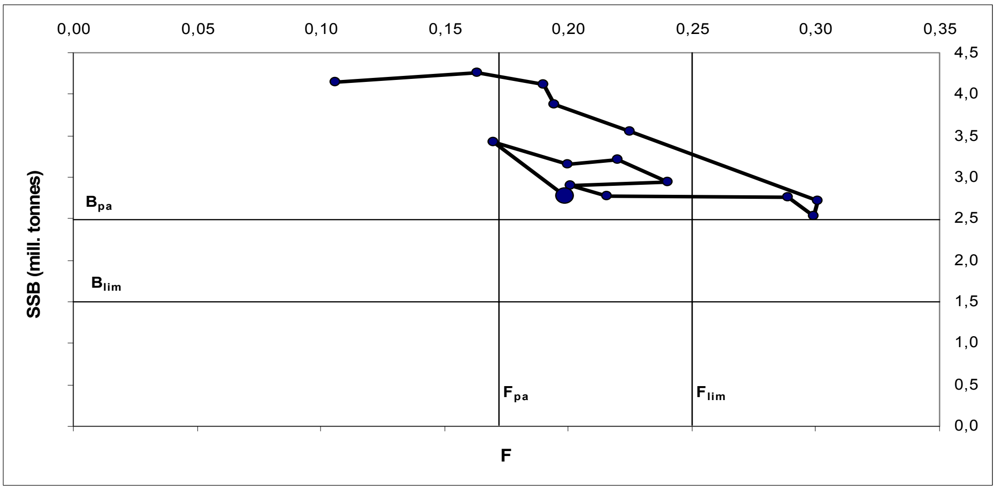

Figure 2. *Graphical presentation of the fishing mortality and the spawning stock biomass of a theoretical fish stock.*

The historic values of SSB and F are plotted with straight lines between the points, illustrating the history of the stock, where the end point is the current stock assessment with respect to SSB and F. The PA and limit reference points divide the diagram into 9 different zones, where the regions between the limit points and PA-points are buffer zones to accomplish for uncertainty of the assessment. It should be emphasized that this uncertainty and buffer zones are only relevant for the current assessment, not for the historic values[2].

A weak point with this kind of illustration is that the current assessment does not "tell the whole story". There is normally additional information that is highly relevant for management of the fish stock, e.g. what recruitment that can be expected in the near future. With some notable exceptions, fish living in temperate areas normally enter into the spawning stock at an age of at least 2-3 years. If the number of offspring is monitored annually, that means that something is known about the recruitment two-three years into the future. Obviously, in such situations the current SSB and F is not the only relevant information for setting a TAC for next year. If the incoming year classes indicate that recruitment will be rich, it is less urgent to reduce F in case it is above F_{pa} than in a situation where one can foresee a couple of years with poor recruitment. An alternative way of illustrating the current situation graphically is shown in Figure 3.

[2] The historic values of SSB and F are normally taken from sequential population analysis models (like VPA) or other models where the values are less uncertain the further back in history one goes. Consequently, historic values should be compared to limit reference points only.

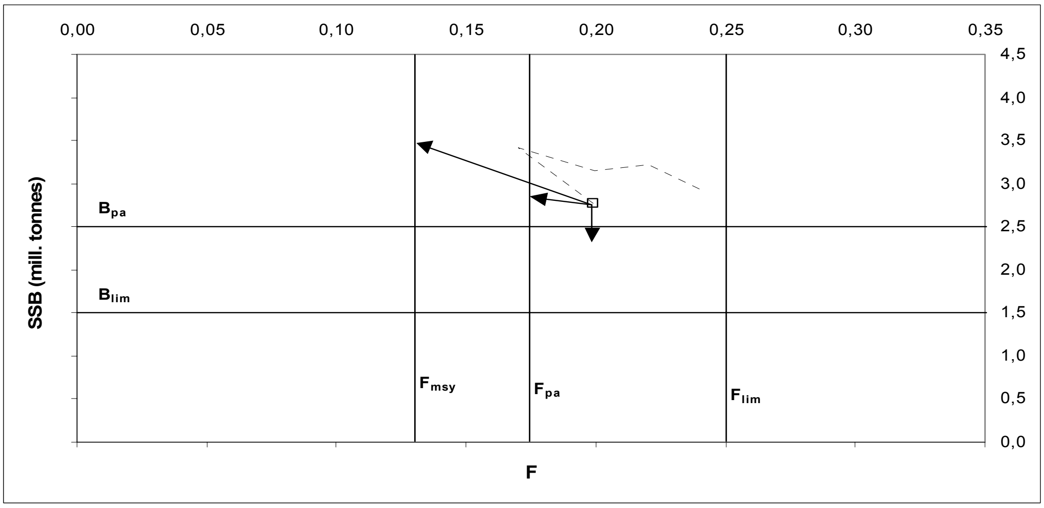

Figure 3. *Graphical presentation of the spawning stock biomass and the fishing mortality and the future position of these because of various management measures.*

In this case, only the last few years of the history are shown, to avoid the problem that the regions of the plot are only relevant for the current or last couple of years. To show the more important aspect of the future, a short-term prognosis for SSB and F is entered. These prognoses take the form of vectors, one for each of several possible scenarios for future exploitation, growth and recruitment. The number of scenarios should probably be restricted to two or three, not to overload the plot. In Figure 2, two scenarios are given; one assuming status quo F the coming three years (this vector will always point in the vertical direction, either upwards, in case of good recruitment and/or growth, downwards, in case of poor expectancies of these parameters. The other scenario is for reduced F to for instance F_{msy} (if the present F is above this value) or increased F to this value, if presently below. Other reference points than F_{msy} could be used, but preferably, this point should represent an F value that should be targeted ($F_{0.1}$, F_{msy} or other points chosen by managers). In this way, the vectors would tell the managers how much could be gained in form of increased yield by decreasing or increasing the exploitation rate toward a target value.

8. Long-term considerations

The PA reference points are presently used by ICES in a one-year perspective. More and more fish stocks are now managed through multi-annual management plans. Such management plans may imply temporary higher or lower fishing mortality than the F_{pa} used by ICES. When such management plans exists, and are approved by ICES as being in accordance with the Precautionary Approach, it is important that the characterisation of the stock or the fishery is done in the time perspective of the plan.

9. Discussion and concluding remarks

It is of prime importance that an organisation like ICES, offering advice on resource management to governments and other management bodies, uses terms and concepts that on the one hand are useful for the scientific community and on the other hand are useful for the managers. Concerning the latter, it is of high importance that the terms and concepts are not easily misunderstood by fishermen, NGOs or the public. In our opinion, the term "safe biological limit" is often misunderstood. Consequently, it should either be defined and explained more carefully or, preferably, exchanged with a term like ***"sound productivity range"***.

In addition, the advice could be improved in other ways. Figure 2 shows three regions for classifying the fish stock and the fishing mortality. The stock, for example, can be classified to be above B_{pa}, between B_{pa} and B_{lim} or below B_{lim}. In the advice given by ICES, the stock is classified to be outside safe biological limits if it assessed to be below B_{pa}. This is the same classification as when it is below B_{lim}. However, there is a wide discrepancy between a stock, which is assessed to be just below B_{pa} and another assessed to be just below B_{lim}. The wording used in the advice could take account of this. Following our suggestion for the words ***"sound productivity range"*** for a stock assessed to be in the range between B_{pa} and B_{lim}, the wording could be that the stock ***"is assessed to be at risk of being outside sound productivity ranges"***. However, when a stock is assessed to be below B_{lim}, the wording ***"assessed to be outside sound productivity range"*** seems to be the adequate description. However, if it is driven far below B_{lim} a stronger wording could be appropriate.

The similar kind of wording could be used to describe the level of fishing mortality.

A third point of relevance is that one should pay more attention to what may happen in the short to medium term, given various management actions. Today's advice is often too focused on the situation next year, which classifies the stock and the fishing mortality. As illustrated by Figure 3, it is of importance in which direction the TAC next year moves F and SSB.

Finally, the most important development within fish stock management will be to develop harvest control rules or management strategies. When such management plans are evaluated by ICES, and found to be in accordance with the Precautionary Approach, there will be less need to give an annual characterisation of the state of the fish stock and the fishing mortality. The F_{pa} and B_{pa} will, to some extent become redundant if it can be demonstrated that the Management plan implies a low risk of attaining the limit reference point. It is thus misleading to look at one single year and to characterize the stock or the fishery (fishing mortality) as "outside safe biological limits" if the agreed long term management plan is followed and is in accordance with the Precautionary Approach.

References

Bjordal, 2002. Er torsken utryddingstruet? [Will the cod become extinct?]. Article in Norwegian in the Norwegian newspaper Dagbladet. 3 May, 2002.

FAO, 1995. FAO Code of Conduct for Responsible Fisheries. Food and Agriculture Organisation of the United Nations, Rome

Fiskaren, 2003. Newspaper article 25 April, 2003, page 4.

Gordon, 1954. The Economic Theory of a Common-Property Resource: The Fishery. Journal of Political Economy. 62, pp 124-142.

Hardin, 1968. The tragedy of the commons. Science 162, 1243-1247.

ICES, 1997. Report of the Study Group on Precautionary Approach to Fisheries Management. ICES C.M. 1997/Assess:7

ICES, 2002. The Form of ICES Advice. ICES Cooperative Research Report no 255 (2002).

Serchuk, F.M. and Grainger, J.R. 1992. Development of the basis and form of ICES Fisheries Management Advice; Historical background (1976 – 1990) and the new form of ACFM Advice (1991 - ?). ICES CM 1992/Assess:20.

United Nations, 1992. Report of the United Nations Conference on Environment and Development. Resolutions Adopted by the Conference. A/CONF.151/26/Rev.1, vol.1. United Nations, 3-14 June 1992, Rio de Janeiro.

United Nations, 1995. Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. New York, 1995.