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Theme session U: The Scope and Effectiveness of Stock Recovery Plans in Fisheries Management

The agreed recovery plan in the management of Norwegian spring-spawning herring

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Abstract

In October 2001 the management agency (Coastal States) for Norwegian spring spawning herring agreed to a recovery plan which will become operative if the spawning stock falls below Bpa. The main element in this recovery plan is a linear reduction in the fishing mortality from 0.125 at Bpa to 0.05 at Blim. The paper reviews the process leading to the adoption of the recovery plan, and the performance and consequences of implementing such a plan is also discussed.

Keywords: Recovery strategies, Long-term management plan, Reference points, Medium term simulations, Risk evaluation

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1. Introduction

The spawning stock of the Norwegian spring spawning herring was depleted in the beginning of the 1970s. This stock was rebuild from a depleted state to a target spawning stock level within a time span of about 20 year with an informal rebuilding plan managed by the Norwegian management authorities. After the rebuilding target was reached, the stock resumed its migration into the Norwegian Sea. The migration route now included the EEZs of several nations and the herring also appeared in waters beyond international jurisdiction. The Norwegian spring-spawning herring was thus a prototype of a straddling stock, and the pre-1970 history of the international fishery of this stock showed the obvious necessity of an international management plan. An agreement of such plan was done in several steps, allocation of TAC in 1996, agreement on the exploitation level in 1999 and a recovery plan in 2001. The aim of the present paper is do review the process of how a recovery plan was implemented in the long-term management plan for Norwegian spring-spawning herring.

2. Lifting the stock from a depleted level

The Norwegian spring spawning stock was the basis an important international fishery that gradually expanded throughout the twentieth century, the total catch exceeding 1 million tonnes by 1951 and almost 2 million tonnes by 1966. However, the stock was overexploited and was depleted around 1970 (Dragesund et al 1980). From being a stock that was distributed over large areas in the North Atlantic, the stock was reduced to a small stock in Norwegian coastal waters

It was a general consensus among managers, fishing industry and general public that the stock should be rebuilt. An important fundament in finding a principle for the rebuilding were the first VPA calculations carried out on this stock (Dragesund and Ulltang 1978). The stock/recruitment data from these VPA-calculations seemed to indicate (although there were very few data points in the actual rage) that recruitment seemed to be hampered or reduced if the spawning stock came down to a level of less that 2.5 million t.

The 2.5 million t was chosen as a rebuilding level both by ICES and the Norwegian management authorities. On the basis of this the general ACFM advice in the late 1970s/beginning of 1980s was that no fishery should be carried out before this level was reached or that there were good indications that this level would be reached in the near future. In principle, the Norwegian management authorities accepted this. However, there was also arguments on keeping a fishery due to markets, economic situation for the fishing fleet, keeping the herring fishery expertise in operation etc. The operational management for this stock was therefore not a total ban, but keeping the fishery at a low level as possible. In practice this level was a fishing mortality of maximum 0.05 until the spawning stock reached 2.5 million t and a "normal" fishery could take place. Thus one can say that a low fishing mortality of 0.05 was the main instrument in rebuilding the Norwegian spring-spawning stock from a depleted stock to a target level of 2.5 million t.

3. Achievement of the rebuilding aim

With the recruitment of the strong 1983 year class to the spawning stock spawning stock in the late 1980s, and with the appearance of the commercial concentrations outside the Norwegian EEZ in 1994 the situation changed. The rebuilding aim (or recovery plan) had been successful, although it had taken over 20 years to lift the stock to the target level, but the management regime was no longer adequate. From being a stock under Norwegian jurisdiction, it was now necessary to obtain an international agreement on the management of the stock. A five- party coastal states (EU, Faroe Islands, Iceland, Norway, Russia) meeting was established as a management agency, and the main issues were for discussion were:

- Allocation of the total TAC to the different participants of the fishery
- Agree on a management regime, especially the basis for the total TAC

At the time (1994) the prospects for the stock were very good. Two strong year classes (1991 and 1992) had been detected and assessed in the nursery area in the Barents Sea, and the prognosis for 1995-1996 indicated a near doubling of the spawning stock (from 4 to 7 million t) if a moderate fishing mortality was applied to the stock. On this background it may not seem to be have been necessary to give thought to a recovery plan. It was when applying the medium term simulations, a that time a new tool in assessment analysis, that the first considerations in the ICES Northern Pelagic and Blue Whiting Fisheries Working Group on a recovery plan were made (Bogstad et al 2000).

4. The work of the ICES Northern Pelagic and Blue Whiting Fisheries WG (WGNPBW)

a) The determination of Reference points

These questions were discussed as part of the general process within ICES on the determination of reference points. For Norwegian spring spawning herring a MBAL was chosen as the Blim (in 1991/92 the old rebuilding level had been chosen as MBAL) of 2.5 million tonnes.

In order to keep a low risk that spawning biomass falls below Blim, the estimated spawning biomass should in practice be kept above a higher level (Bpa) that allows for uncertainty in the assessment. When determining this level the discussions in WGNPBW pointed to the fact that this stock had a fatal stock depletion at the end of the 1960s, and together with an overall impression of the retrospective estimates this led to a suggestion of Bpa of 5.0 million t as an appropriate level for this stock (Røttingen 2000). The precautionary fishing mortality was chosen as F=0.15. (ICES 1998a and b), a value that ICES had used for catch recommendations since 1996.

b) The medium term as a basis for long term management plan

Uncertainty in the stock parameters was recognised, and from 1994 the WGNPBW used medium term simulations as a tool for expressing the uncertainty in the assessment and prognoses (the operational instrument was the Excel ad-on program @ RISK). When implementing the simulation techniques the following considerations were made:

- How should one handle simulation runs that came below the Bpa and Blim reference points?
- How should a signal be given to the managers that some additional measurements should be put into force when the SSB came below Bpa in order to slow the reduction towards the Blim?

After discussions in the WGNPBW it was decided to use a linear reduction in F. An important argument for this was partly due the fact that it was technically possible to implement such a rule in the @ RISK program.

The main element in the medium term simulations was to investigate the probability of spawning stock biomass falling below Blim in a medium term period (10 years). The following input was used:

- F=0.15 (i.e. Fpa).
- Linear reduction of F to 0.05 at SSB = 0.05 below 2.5 million tonnes
- F= 0.05 below 2.5 million tonnes (this value of fishing mortality was chosen mainly on basis of the experience from the rebuilding of the depleted stock (Røttingen 2000)).
- In addition, a catch ceiling of 1.5 million tonnes was applied.

This gave the following results as estimated by WGNPBW in 1998-2000:

Starting point for reduction in F	2.5 mill t	5.0 mill t
Probability of falling below 2.5 million t in a 10 year period 1999-2008 (ICES 1998b)	0.38	0.21
Probability of falling below 2.5 million t in a 10 year period 2000-2009 (ICES 1999)	0.38	0.19
Probability of falling below 2.5 million t in a 10-year period 2001-2010 (ICES 2000). (Here F above 5 mill t is reduced to 0.125 according to the management plan decided in 1999)	0.20	0.10

The conclusions were the following:

1. *Continued fishing using the present harvest control rule (i.e. Fpa), gives a high probability of falling below Blim in the medium term (10 years), and*
2. *The probability of SSB falling below 2.5 million tonnes in the coming 10-year period is almost halved when a linear reduction in F at SSB levels below Bpa= 5.0 million tonnes is applied.*

Taking into account the history of this stock including the catastrophic stock collapse, a management objective of avoiding this stock coming below the level of 2.5 million tonnes should be of paramount importance. A reduction of F at spawning stock would significantly reduce the probability to come below Blim, and should be regarded as an important contribution in implementing such an objective to the practical fishery of Norwegian spring-spawning herring. The management authority also appointed a working group of biologist and economist to look at management objectives such as stability, low risk of stock collapse etc, and this working group came to the same conclusions as the WGBPBW regarding the use of a reduction in fishing mortality below the precautionary spawning stock biomass reference point (Anon 1999).

5. The general intentions of a recovery element within the long-term management plan.

The Coastal states agreed to a long time management plan on their meeting in 1999.In item 2) of the plan the maximum fishing mortality was reduced from Fpa (0.15) to 0.125. In item 3) in the agreement considers management action in case the SSB falls below the agreed Bpa of 5 million t. It was stated that if the SSB falls below a reference point of 5 million t (Bpa), the fishing mortality rate of 0.125 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adoptions shall ensure a safe and rapid recovery of the SSB to a level in excess of 5 million t

This expressed a general intention of taking some action if the spawning stock fell below Bpa (5 million t). There was a discussion at the Coastal States meetings in 1999 and 2000 on explicitly stating what type action should be taken. Several felt that a time specific element should be introduced, and the following request was put to ICES in 2000:

“ICES should evaluate the strategies that would ensure a probability in the rage of 50 to 80% of restoring the SSB to above Bpa within 2 to 5 years, in a case where SSB is below Bpa.”

Further, in a request from the Coastal States to ICES for 2001 the following was included: "ICES should particularly continue to evaluate adaptive recovery strategies, including an option with linear reduction in F, in the event SSB falls below Bpa of 5,000,000 tonnes. The strategies should aim at preventing the SSB from falling below Blim with a high probability and ensure the safe recovery of the stock to above Bpa at various time horizons."

6. Response from ICES/ACFM

The recovery element was a part of the agenda for ACFM in May 2001. They stated (ICES 2002) on the two types of adaptive recovery strategies have been investigated:

a) *Restoring SSB to above Bpa within a time constraint*
A harvest control rule aiming at restoring the SSB to above Bpa within a time constraint (strategies that would ensure a probability of 50 to 80% of restoring the SSB to above Bpa within 2 to 5 years) was evaluated in 2000. ACFM and WGNPBW made the following comment: "ICES regarded this as a request within the process of evolving management strategies to rebuild SSB within a time constraint to levels above Bpa after it has fallen below that level. The request was regarded as relevant but it was pointed out that this type of general rebuilding approach might not be useful as a rule for stocks that show a highly variable recruitment, including the stock of Norwegian spring-spawning herring. There may be situations when the SSB is fairly low but strong year classes are expected to recruit to the spawning stock in the near future. On the other hand there may be situations when SSB is expected to decline in the short and medium term levels below Bpa since no strong year class has been observed among the recruiting year classes. In the latter case it may not be possible to restore the SSB to levels above Bpa within 2 to 5 years even if the fishery is stopped"

b) Linear reduction in F
"This type of harvest control rule has been evaluated several times by WGNPBW. Different reduction rates in F have been considered, and the general conclusions from WGNPBW and ACFM based on these evaluations can be summed up as follows: "Medium-term simulation indicates that the probability of SSB falling below Blim is almost halved when A reduction in F at SSB levels below Bpa = 5.0 million t is applied. An example of such a reduction would be to reduce F linearly to 0.05 as the SSB falls from 5.0 million t to 2.5 million t." (ACFM 1999).

The ICES Study Group on the Precautionary Approach to Fisheries Management (SGPAF) has listed other advantages in applying a linear reduction in F in a harvest control rule in case SSB is falling below Bpa: "The fishery continues at a reduced level after the threshold is crossed, resulting in a continuity of yield; rather than open or close fisheries Depending on the stock's position relative to Blim. At the same time, more stringent conservation measures are applied as the stock worsens; errors in the estimation of SSB become less critical; additional time and flexibility is obtained to evaluate whether the stock is in a transition phase from one stationary state to another; short-term changes in Biomass levels imply only small changes in F rather than permanent or large-scale changes in fishing operations; and small changes in F may be less contentious and more easily accepted than large ones". Further, NAFO has in many cases illustrated a linear reduction in fishing mortality in its precautionary framework..

The stock of Norwegian spring spawning herring has a highly dynamic recruitment; the development depending on the occurrence of strong year classes, and the action taken if the

SSB approaches Bpa will depend on the prospects of the recruitment of such year classes. This element should be regarded as important when considering a suitable harvest control rule. A linear reduction adapts the exploitation rate to the abundance of the spawning stock, and is by the WGNPBW regarded as an appropriate strategy which significantly lowers the risk for the spawning stock to come below Blim, and in this type of harvest control rule will in addition have some practical elements such as the continuation of fisheries even if the Bpa is crossed."

7. The adoption of a recovery strategy in the long-term management plan.

The conclusion after evaluating two different types of recovery strategies, was that ICES came out in "favor" of a linear reduction in the fishing mortality below Bpa as the more appropriate for the Norwegian spring spawning herring with its dynamic recruitment properties. This response from ICES was discussed Coastal States meeting in autumn 2001. The result was that the recovery item in the present long- term management plan was changed from a general statement to an explicit form. At present it reads as follows:

"Should the SSB fall below a reference point of 5,000,000 (Bpa), the fishing mortality rate, referred to under paragraph 2 (i.e. 0.125), shall be adapted in the light of scientific estimates of the conditions then prevailing to ensure a safe and rapid recovery of the SSB to a level in excess of 5,000,000 tonnes. The basis for such adoption should be at least a linear reduction in the fishing mortality rate from 0.125 at Bpa (5,000,000 tonnes to 0.05 at Blim (2,500,000 tonnes)"

8. Discussion and summary

Thus we at present have for this stock a harvest control rule that says explicitly how the advice from ICES should be based if the spawning stock estimate comes below the precautionary biomass level. A schematic presentation of the recovery plan is given in Fig 1.

This is a recovery plan in the sense that it aims to:

- Lowering the probability of the spawning stock to reach the limit biomass reference point.
- Restoring the spawning stock to level above Bpa as soon as possible.

The adoption of this recovery plan is a result of a process of several years of work, deliberations and interplay of the WGNPBW, ACFM, the Coastal States Management agency and of scientist and economists working on this field. As the spawning stock of Norwegian spring spawning has been above the Bpa level since 1996 (for 2003 the spawning stock is estimated to approximately 6 million tones), the effect of this recovery plan has not been put to test. However, theoretically it has been estimated that the probability of SSB falling below 2.5 million tonnes (Blim) in the coming 10-year period is almost halved if the plan is implemented. It was probably easer to obtain a final agreement of the recovery plan when the stock was above the precautionary reference point, and the effects, that is, a stronger reduction in catches than a corresponding decrease in stock estimates, did not immediately had to be put into force.

The plan can of course be developed further. At the time one felt it natural to regard the Bpa as the trigger point, but can for instance another value of the trigger point improve the recovery plan?

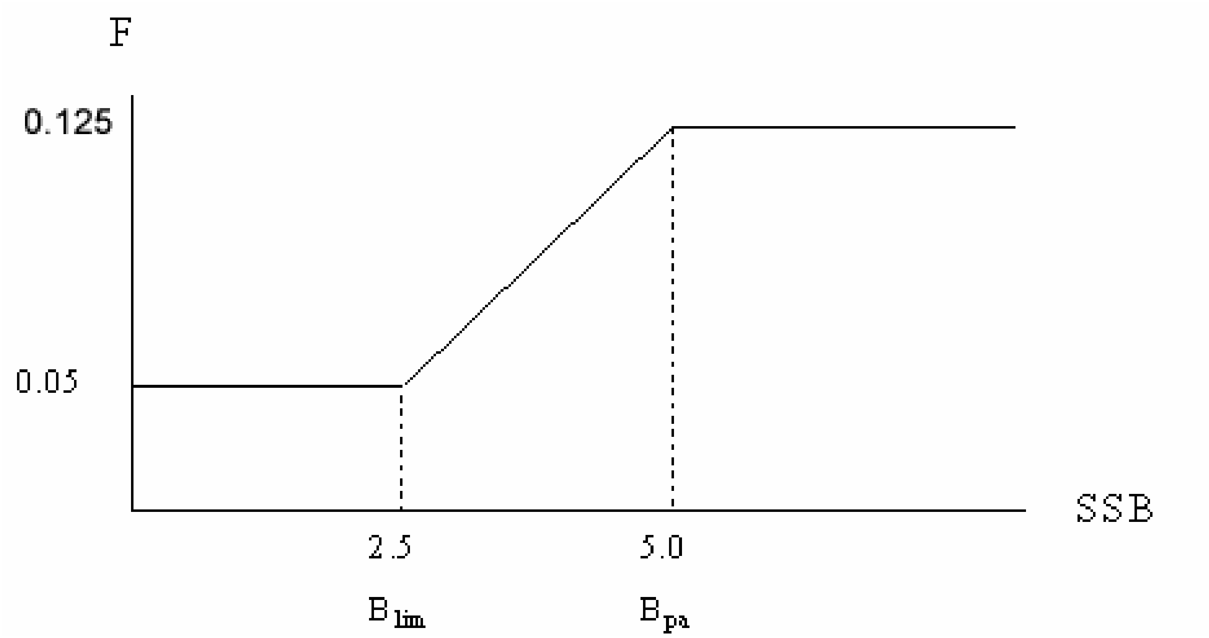

Fig 1 Schematic view of the recovery plan for Norwegian spring- spawning herring

9. References

Anon 1999. Report of the Working Group to study appropriate harvest strategies for medium and long-term management of Norwegian spring spawning herring. September 1999.11pp.

Bogstad, B, Røttingen, I, Sandberg, P and Tjelmeland, S 2000. The use of Medium-Term forecasts in advice and management decisions for the stock of Norwegian spring spawning herring (Clupea harengus L.). ICES CM 2000/V:01

Dragesund, O and Ulltang, Ø 1978. Stock size fluctuations and rate of exploitation of the Norwegian spring spawning herring, 1950-1974. *FiskDir.Skr.Ser.HavUnders., 16*: 315-337.

Dragesund, O, Hamre, J and Ulltang, Ø 1980. Biology and population dynamics of the Norwegian spring spawning herring. *Rapp.P.-v.Reun.Cos.int.Explor.Mer 177*: 43-71

ICES 1998a. Report of the Sturdy Group on the Precautionary Approach to Fisheries Management. ICES CM 1998/ACFM 10.

ICES 1998b: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, ICES CM 1998/ACFM :18

ICES 1999: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, ICES CM 1999/ACFM :18

ICES 2000: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, ICES CM 2000/ACFM :16

ICES 2002. Report of the ICES Advisory Committee on Fishery Management, 2001. ICES Cooperative Research report 255.

Røttingen, I. 2000. A review of the process leading to the establishment of limit and precautionary reference points for Norwegian spring-spawning herring ICES CM 2000/X:08.