



DIRECTORATE OF FISHERIES

**The 11th Joint Russian-Norwegian
Symposium**

**Ecosystem Dynamics and
Optimal long-term Harvest in
the Barents Sea Fisheries**

Murmansk, 15 – 17 August 2005



Theme Session 2:

Optimal long-term management strategies of commercial stocks in the Barents Sea

Long-term management objectives – with references to cod

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Examples of management objectives

Preservation of sufficient spawning stock to ensure the potential recruitment of strong year classes

Maximum sustainable yield

Maximum economic yield

Job security – stable incomes

Preservation of pattern of settlement in coastal areas

Food security

Stability in the supply of raw material to processing industry and market

Relevant factors when seeking to obtain the objectives

Attitudes towards risk - the precautionary approach

Trade-off between long term and short term consequences

Discount rate

Harvest costs pr kilo – stock size dependency

Demand curve for the relevant specie

Size-dependent prices

Multispecies effects

Major tools to further the objectives

Exploitation pattern (size when fish is caught)

Exploitation rate (level of TAC)

and indirectly:

Exploitation rate of prey and predator species

Relevant factors when seeking the optimum exploitation pattern

Natural mortality

Individual growth

Size-dependent prices

Size-dependent harvesting cost

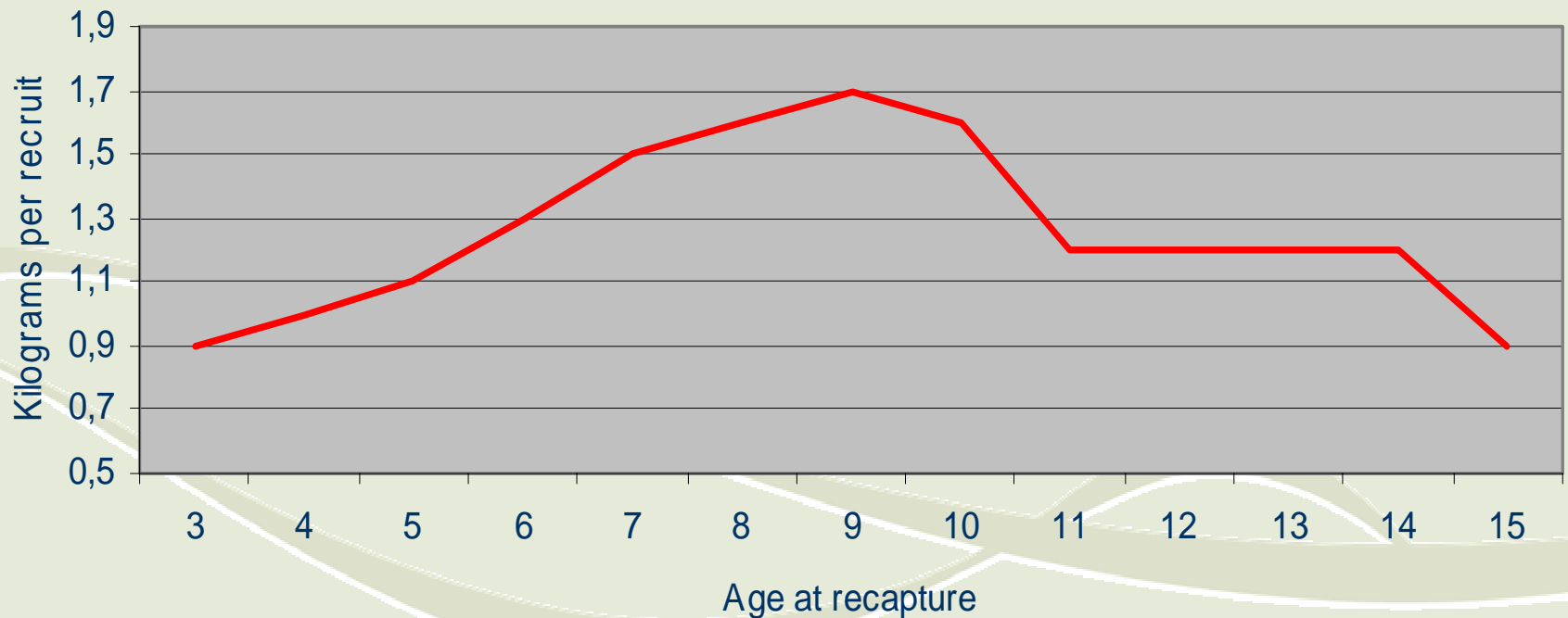


Average age and weight of cod when caught 1950 - 2004

Period	Average age	Average weight
1950 – 1959	5.9	2.13
1960 - 1969	5.3	1.63
1970 – 1979	5.3	1.88
1980 – 1989	5.5	2.23
1990 – 1999	5.7	2.60
2000 - 2004	5.7	2.33

Yield per recruit of cod as a function of age

Yield per recruit at various ages of recapture



Measures to improve the exploitation pattern

Improve existing exploitation pattern by gradually increasing the allowed spacing between bars in sorting grids from 55 mm to, let say, 80 mm

Continue research to improve selectivity in fishing gears

Continue biological and economic research to more precisely determine the optimal exploitation pattern for cod

Further improve technical regulations when scientific information and advice so indicate

Management strategy for cod as agreed by the Commission in 2003

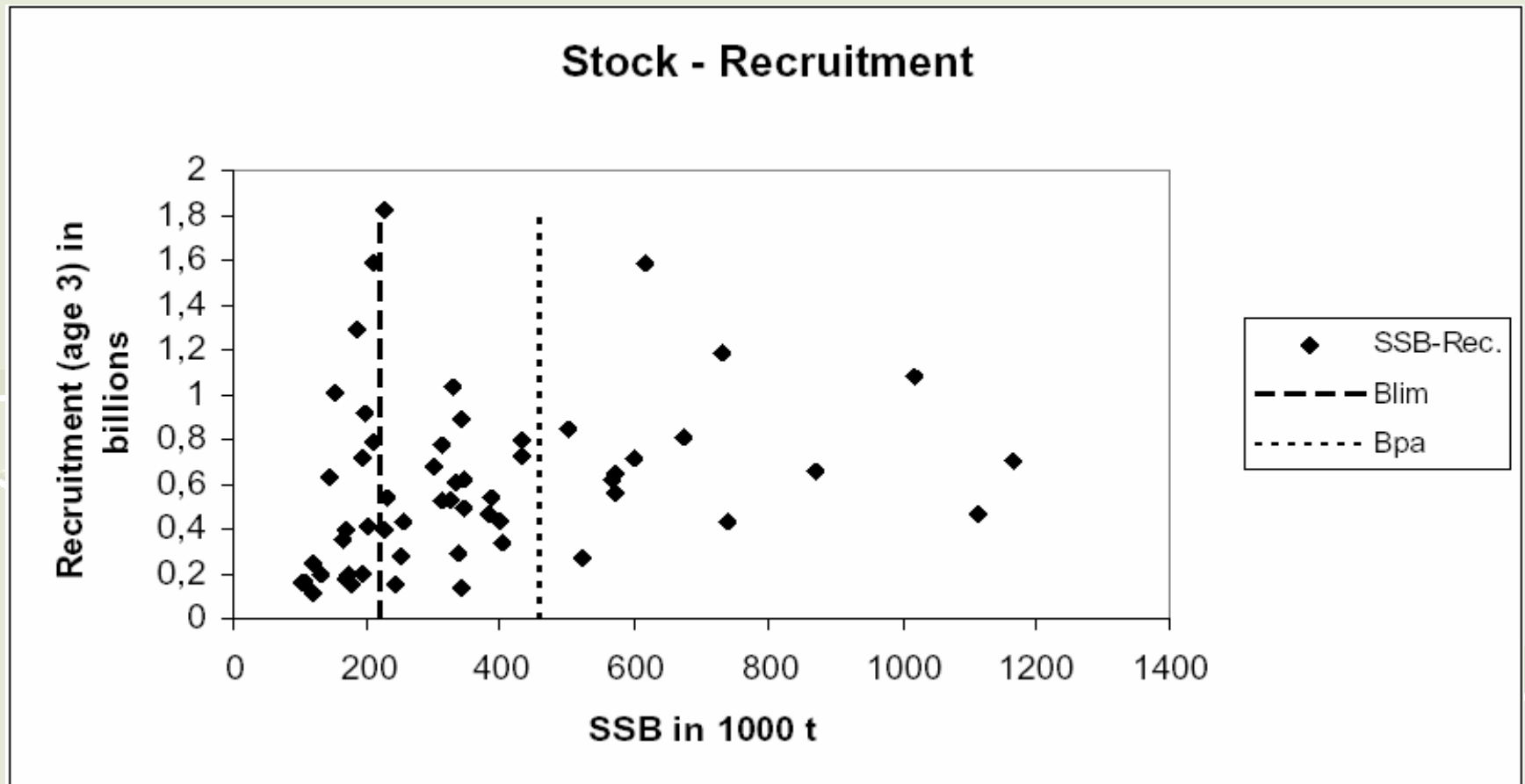
Keep SSB at a safe, reproductive level – above B_{pa}

Arrange for the high long-term yield from the stock

Aim at reducing year to year variation in TAC

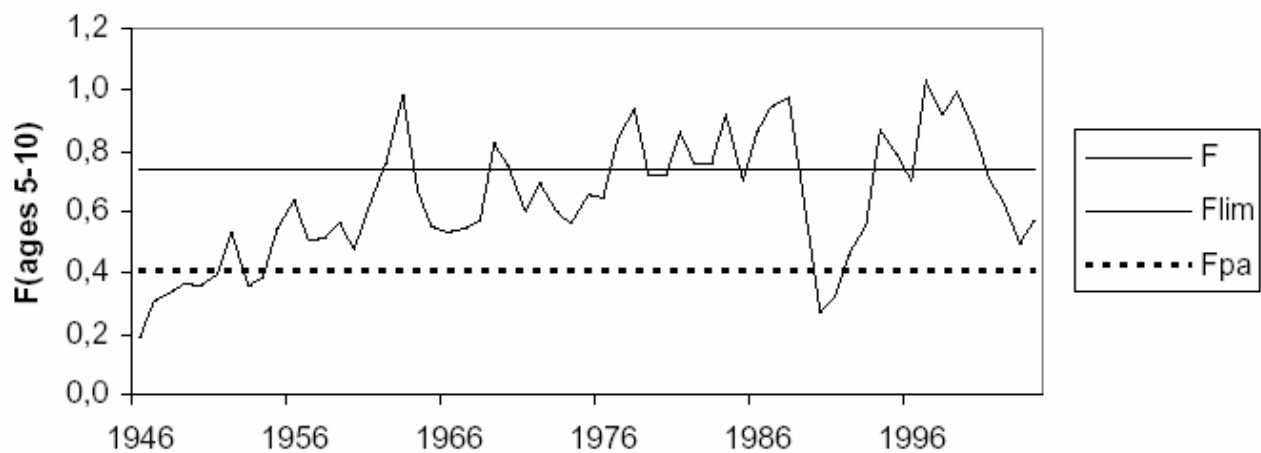
Annually update and utilise all available scientific information on stock development when calculating next years TAC

Relationship between SSB and recruitment for cod 1946-2005

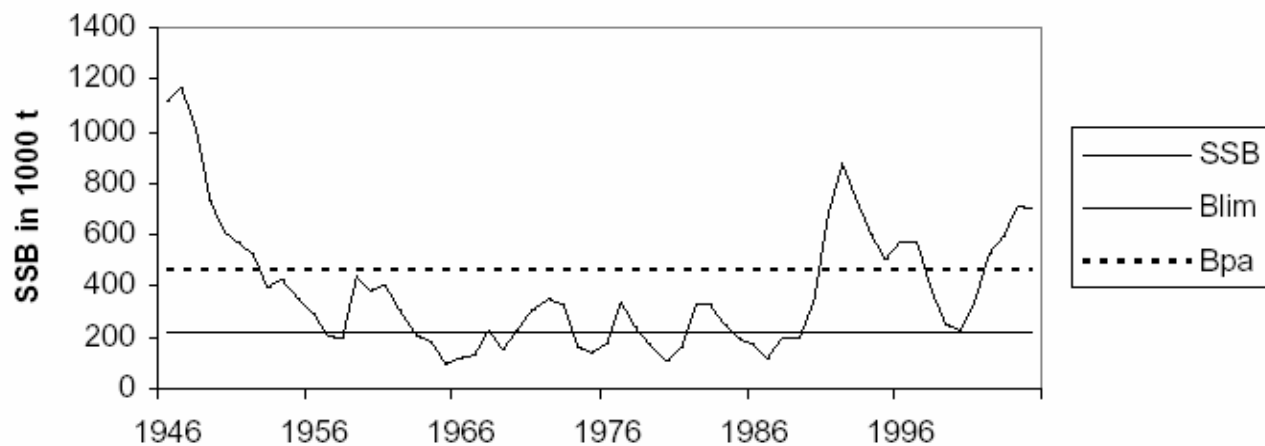




Fishing Mortality



Spawning Stock Biomass



Harvest control rule (HCR) for cod as amended by the Commission in 2004

Calculate average TAC-level for the coming three years based on F_{pa} . TAC for next year is set to this value.

The following year, repeat the calculation of TAC-level for the next three years based on updated information on stock development. The TAC should not, however, be changed with more than $\pm 10\%$ from last year.

If SSB falls below B_{pa} , TAC should be based on a fishing mortality that is reduced linearly from F_{pa} at $SSB=B_{pa}$, to $F=0$ when $SSB=0$. When SSB is below B_{pa} , the $\pm 10\%$ rule shall not apply.

Suggestions for future improvements in the HCR for cod

Replace F_{pa} with a target fishing mortality (typically F_{msy} or F_{mey}), when calculating next years TAC

Establishing such a target fishing mortality, ecosystem factors like stock-size dependent growth and multispecies effects should be taken into consideration