

REPORT OF ICES ADVISORY COMMITTEE
ON
NORTH ATLANTIC SALMON STOCKS
TO
NORTH ATLANTIC SALMON
CONSERVATION ORGANIZATION
NEAC Area
CNL(11)8

Advice generated by ICES in response to terms of reference from NASCO

- **new format for advice in 2011, standard template adopted by ICES for all stocks and advisory processes**
 - feedback on format is welcome
- **supporting information and details in the report of the ICES Working Group on North Atlantic Salmon available at: http://www.ices.dk/reports/ACOM/2011/WGNAS/wgnas_2011_final.pdf**

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Advice generated by ICES in response to terms of reference from NASCO

10.1.2 With respect to Atlantic salmon in the North-East Atlantic Commission area:

1. describe the key events of the 2010 fisheries
2. review and report on the development of age-specific stock conservation limits
3. describe the status of the stocks and provide annual catch options or alternative management advice for 2012–2014, with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding

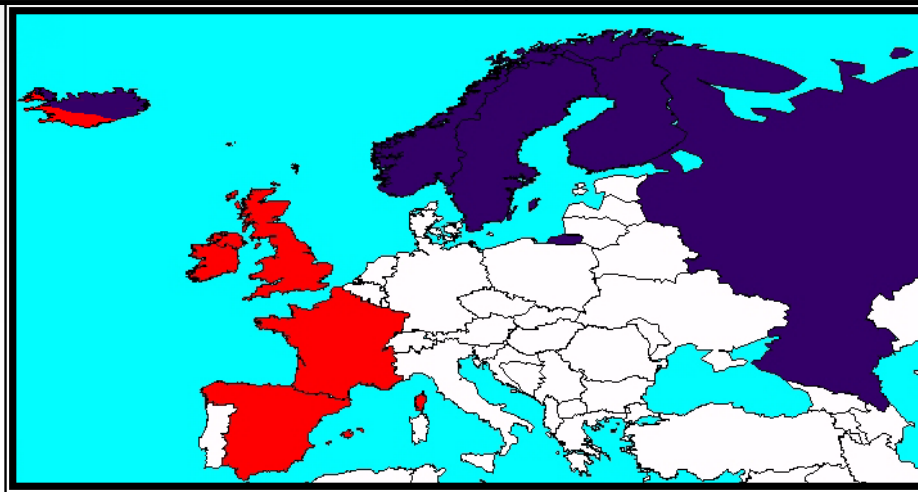
With respect to Atlantic salmon in the North-East Atlantic Commission area:

- ❖ **supplementary request from NASCO received March 9 2011**
“Provide a more detailed evaluation of the choice of appropriate management units to be used in a risk based framework for the provision of catch advice for the Faroese salmon fishery, taking into account relevant biological and management considerations and including, if possible, worked examples of catch advice.”
- 4. further investigate opportunities to develop a framework of indicators or alternative methods that could be used to identify any significant change in previously provided multi-annual management advice**

Composition of NEAC stock complexes

Southern NEAC vs **Northern NEAC**

Southern NEAC	Northern NEAC
Ireland	Finland
France	Norway
UK (England & Wales)	Russia
UK (Northern Ireland)	Sweden
UK (Scotland)	Iceland (north/east regions)
Iceland (south/west regions)	



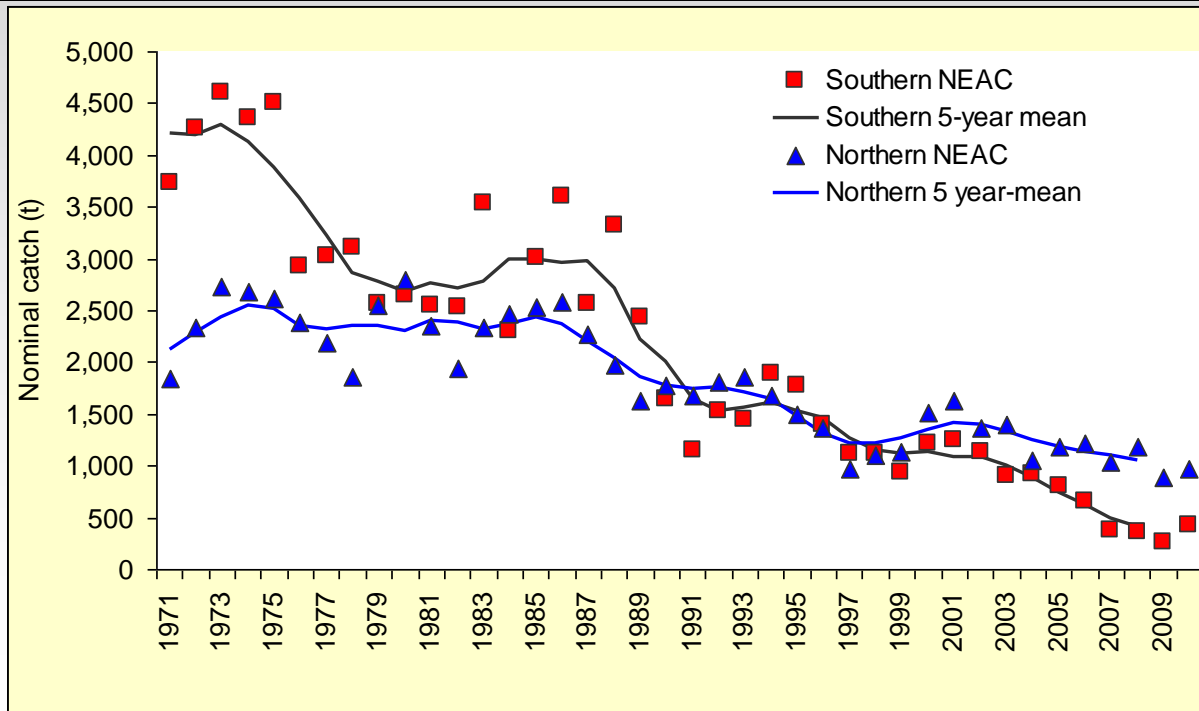
No fishing at Faroes since 2000

Significant events in NEAC homewater fisheries

- **Some measures aimed at reducing exploitation were implemented or extended in 2010**
 - UK (N. Ireland) - net fisheries in the Foyle area closed
 - Norway - active licences in bag and bend nets declined
- **France - new coastal fishery in the southwest began in 2009 and expanded in 2010**
 - catches are unreported but estimated to represent a five-fold increase in coastal fishery catches compared to 2009
- **No significant changes in the types of gear used**
 - number of licensed gear units (effort) generally continued to fall

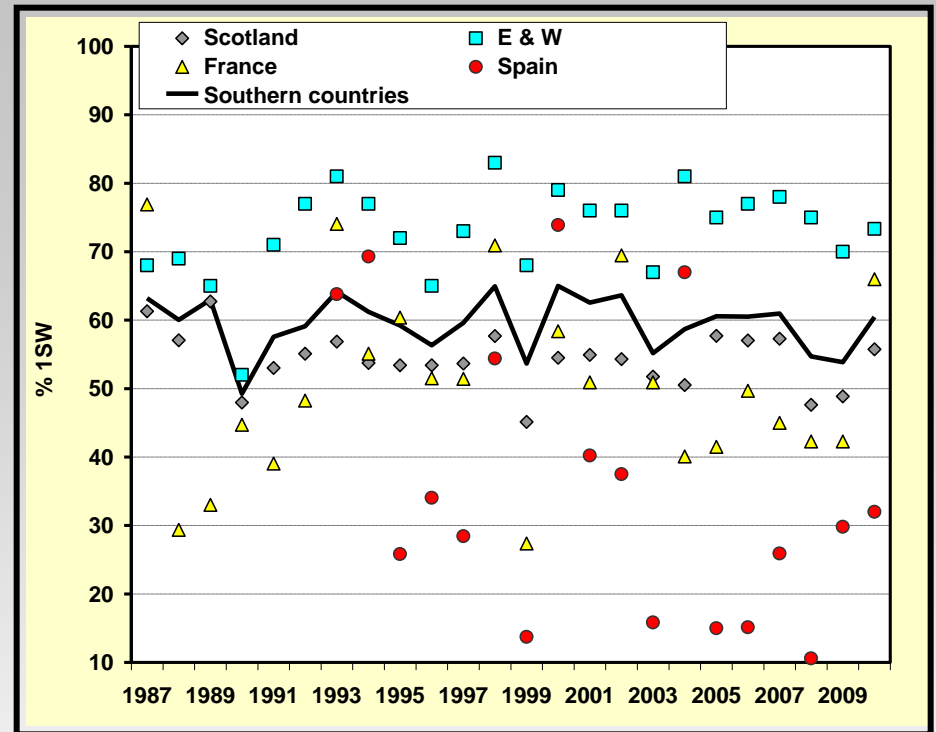
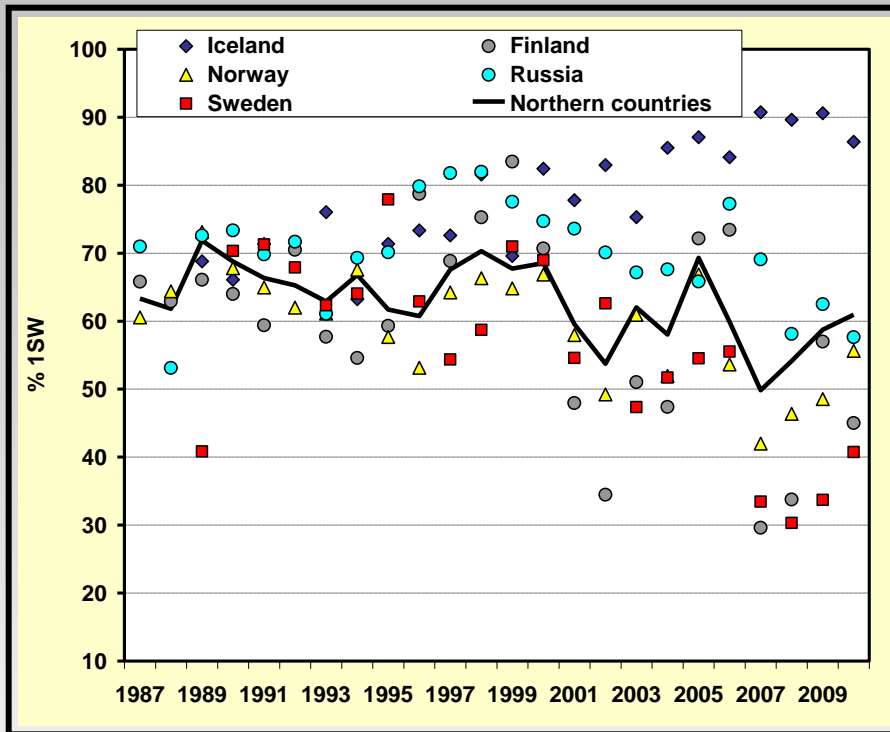
Catches

Nominal Catch (t) in 2010	NEAC	NEAC North	NEAC South
	1401	973	427
	2 nd lowest	3 rd lowest	4 th lowest
From 2009	+21%	+9%	+62%



- Decline in catches has been more important in Southern NEAC

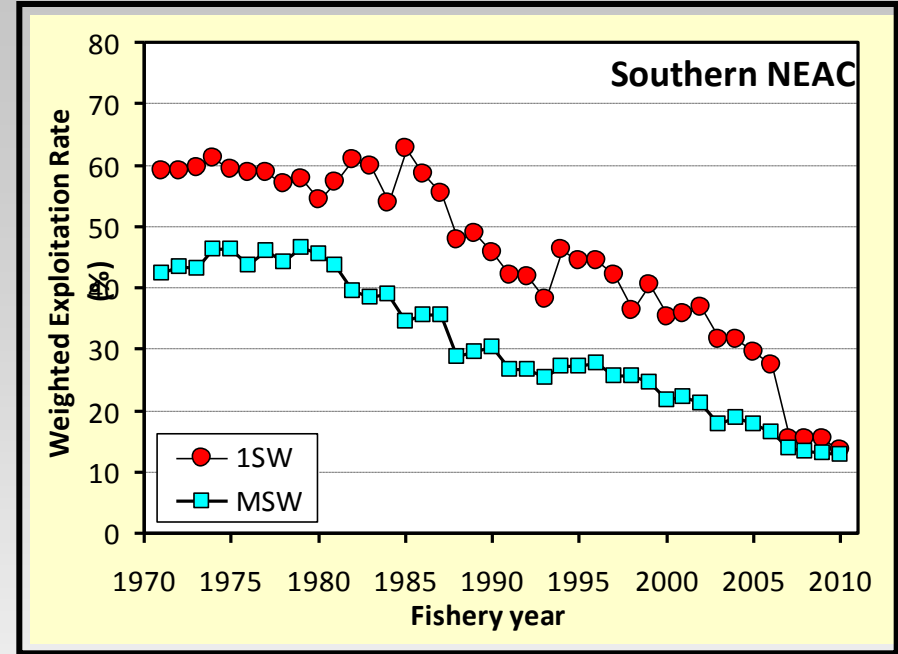
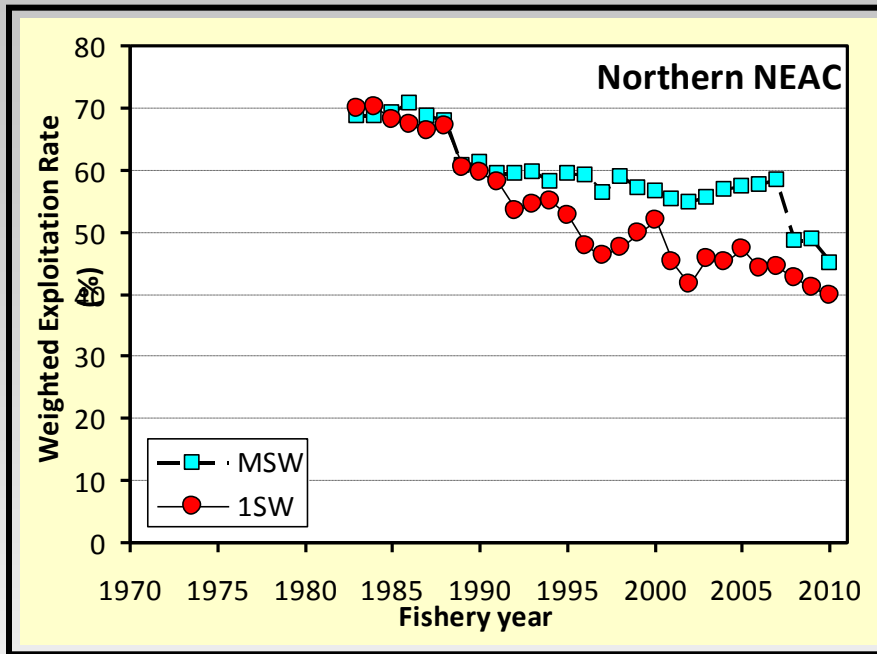
Composition of Catches



- Similar overall percentages of 1SW salmon in the catches in NEAC north and NEAC south (about 60% 1SW)
- Considerable variability among individual countries, particularly in NEAC south and more recently in NEAC north

**Norway: farmed salmon are important composition of catches -
from 8% in rod fisheries to 36% in fjordic fisheries**

Exploitation rates (all fisheries)



- Weighted by national returns
- Exploitation rates on 1SW salmon in Northern and Southern NEAC show general decline over the time series
- Exploitation rates of MSW fish also declined in Northern and Southern NEAC
- Declines in exploitation rates more important in South NEAC

MSY approach and Conservation Limits

Atlantic salmon has characteristics of short-lived fish stocks

- ❖ *mature abundance is sensitive to annual recruitment because there are only a few age groups in the adult spawning stock*

For such fish stocks, the ICES MSY approach is aimed at achieving a target escapement ($MSY B_{escapement}$).

- ❖ *No catch should be allowed unless this escapement can be achieved.*

Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield ($MSY B_{escapement}$).

Development of age-specific stock conservation limits

- River-specific CLs available for France, Ireland, UK(England & Wales), and Norway
- Interim approach has been developed for estimating national CLs for the other countries
- National Stock CLs are not appropriate for homewater fisheries management
 - relatively imprecise
 - do not account for differences in status of individual river stocks

Development of age-specific stock conservation limits

- Corresponding national CLs are summed to develop Northern and Southern NEAC CLs by age group
 - Northern NEAC 1SW spawners – 207 231
 - Northern NEAC MSW spawners – 131 456
 - Southern NEAC 1SW spawners – 624 504
 - Southern NEAC MSW spawners – 258 720
- Stock complex CLs can be used to provide management advice for distant water fisheries

Development of age-specific stock conservation limits

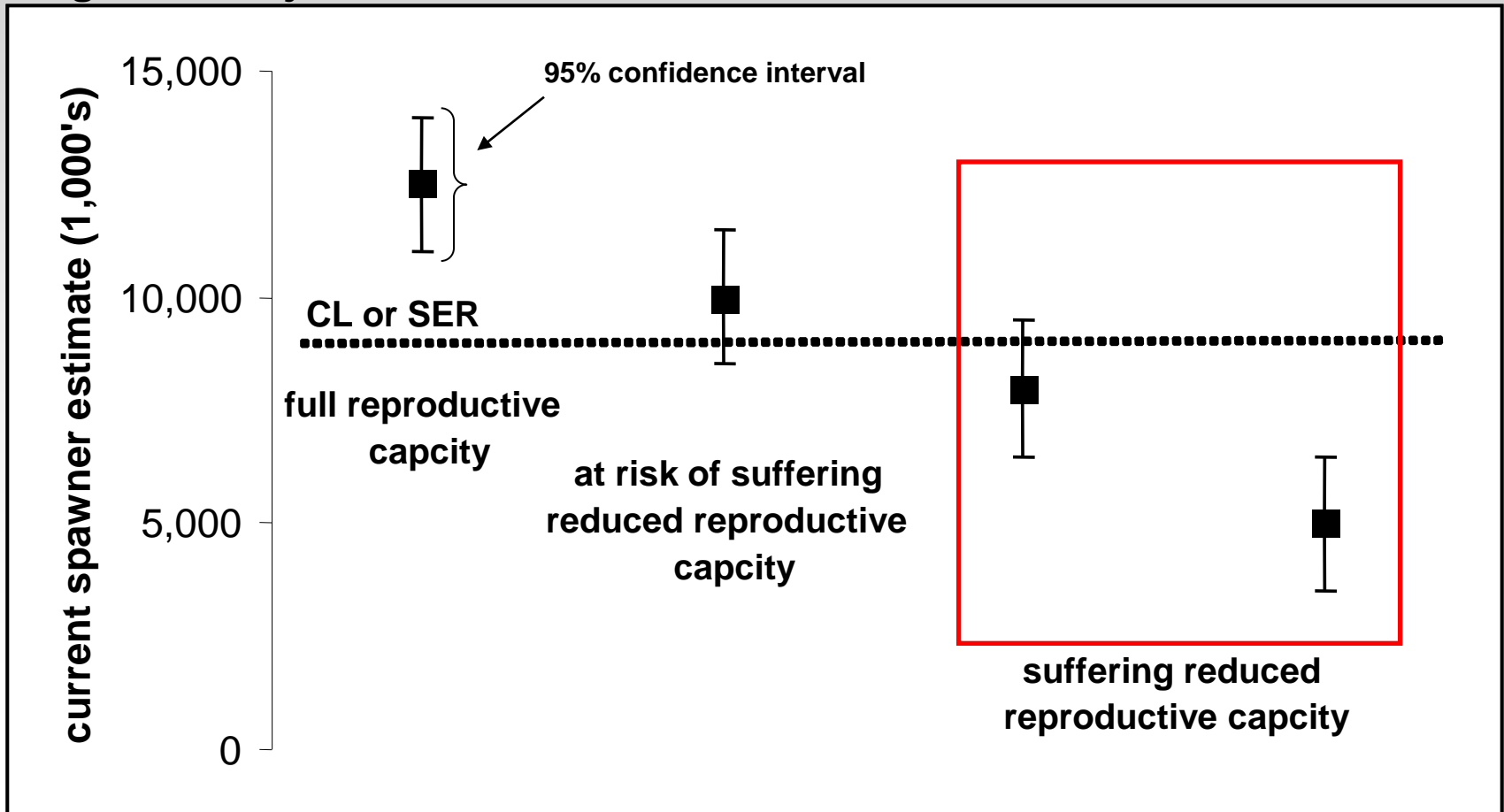
Progress with setting river-specific conservation limits

- For Norway, CLs have been developed for 439 rivers, based on stock recruitment relationships from nine rivers
 - in 2010, attainment of CLs was assessed for 211 rivers
- Work ongoing in UK(Scotland), Iceland, and UK(N. Ireland)

Conservation Limits

- CLs are used to estimate the SER (Spawner Escapement Reserve, the CL increased to take account of natural mortality between the recruitment date (1st Jan) and return to home waters)

For the assessment of status of stocks and advice where there are no specific management objectives:



Status of Stocks

Trends in PFA and Spawners

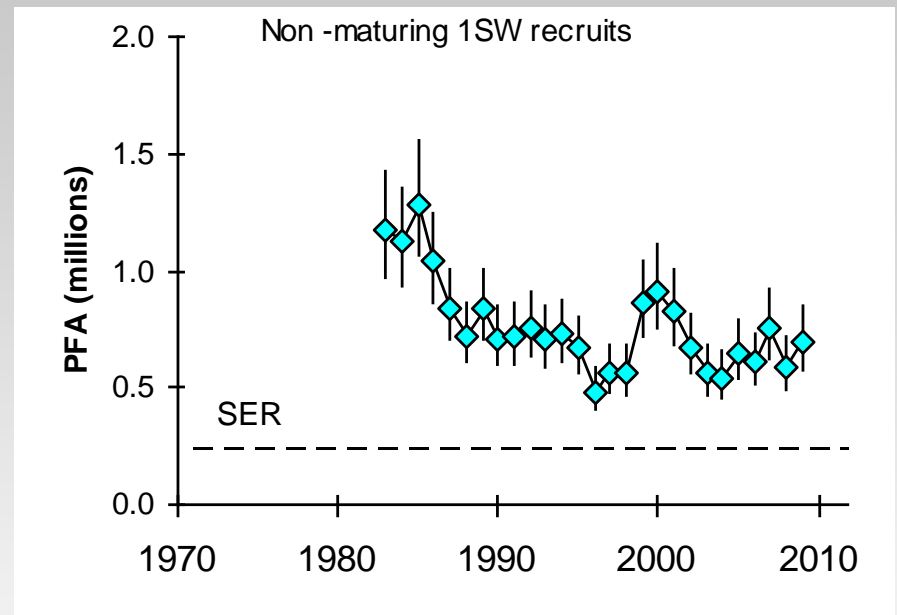
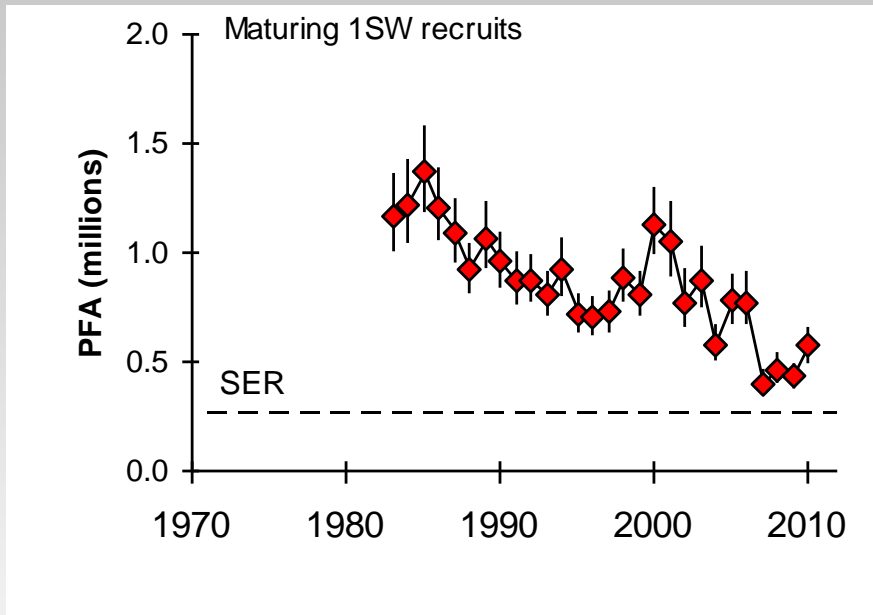
PFA (Pre-Fishery Abundance) :

- ❖ estimated abundance of salmon in the first winter at sea (as of January 1)
- ❖ estimated for 1SW maturing (1SW) and the 1SW non-maturing (MSW)
- ❖ by stock complex (Northern NEAC, Southern NEAC)

Status of Stocks

Trends in PFA and Spawners

Northern NEAC

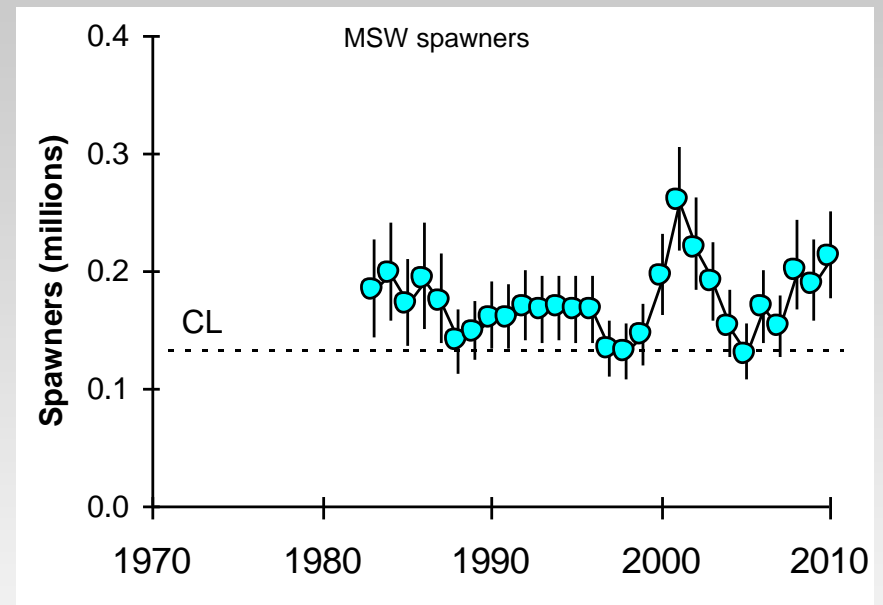
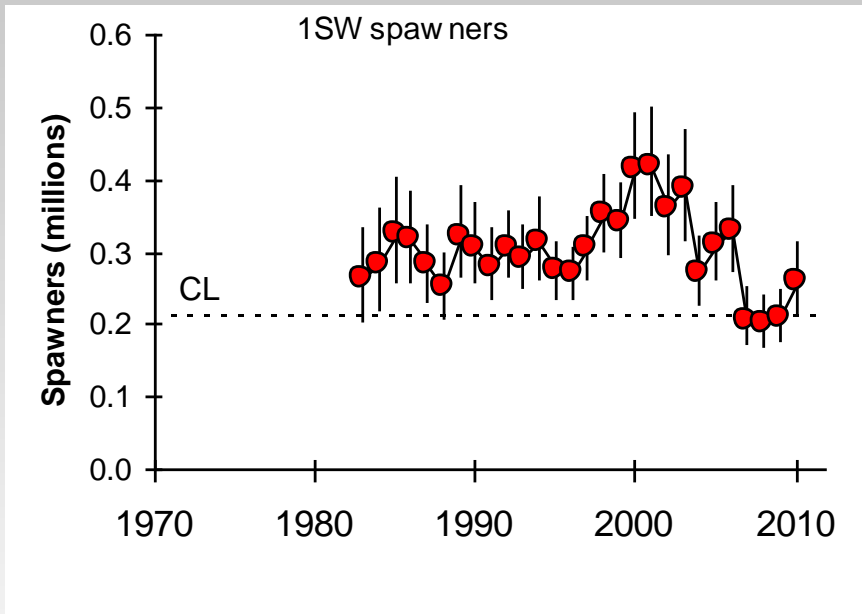


- General decline interrupted by a short period of increased recruitment from 1998 to 2003
- Both age components have been at full reproductive capacity prior to the commencement of distant water fisheries
- Patterns are broadly consistent with the general decline in marine survival of 1SW and 2SW salmon in most monitored stocks

Status of Stocks

Trends in PFA and Spawners

Northern NEAC

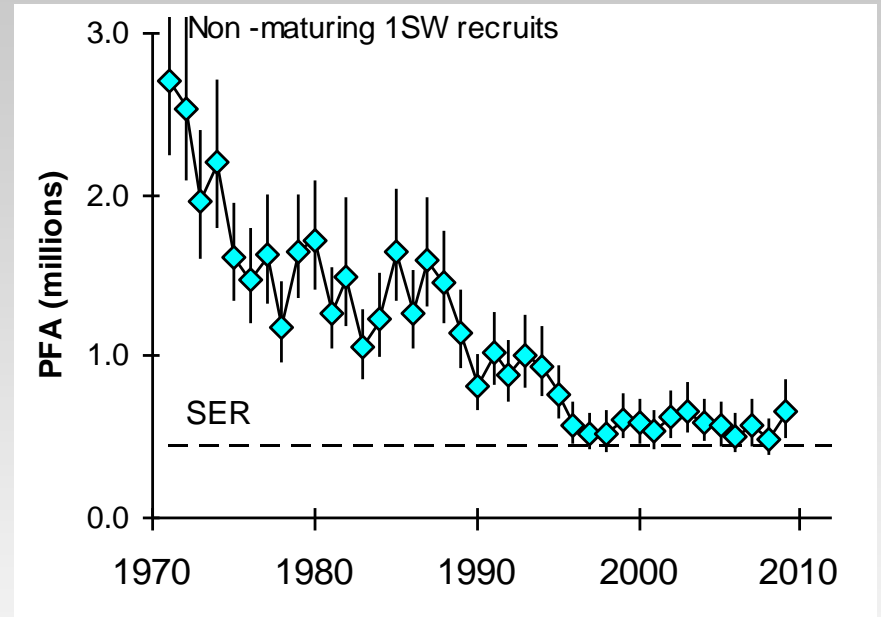
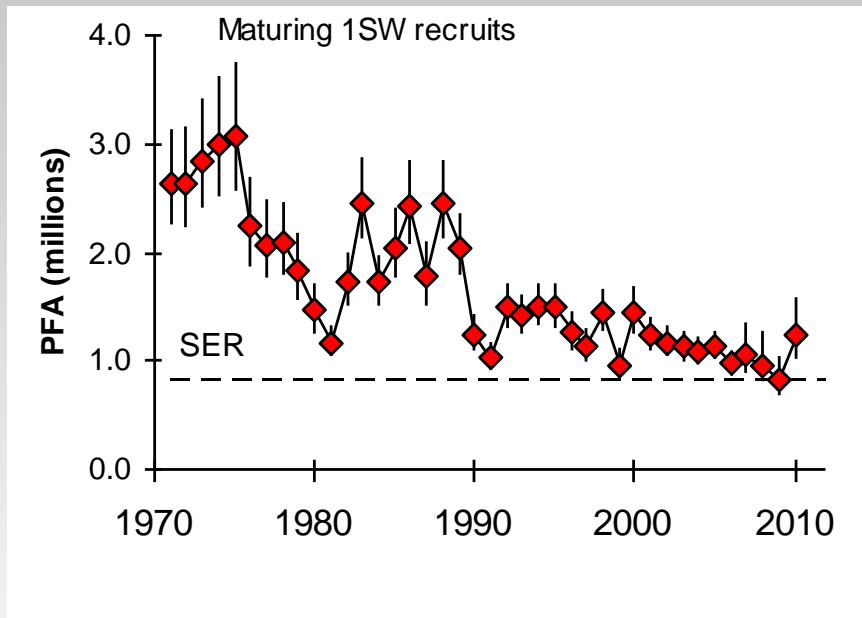


- 1SW and MSW spawners have been at full reproductive capacity or at risk of reduced reproductive capacity over most of the time series
- over 2007 to 2009, 1SW spawner suffering reduced reproductive capacity

Status of Stocks

Trends in PFA and Spawners

Southern NEAC

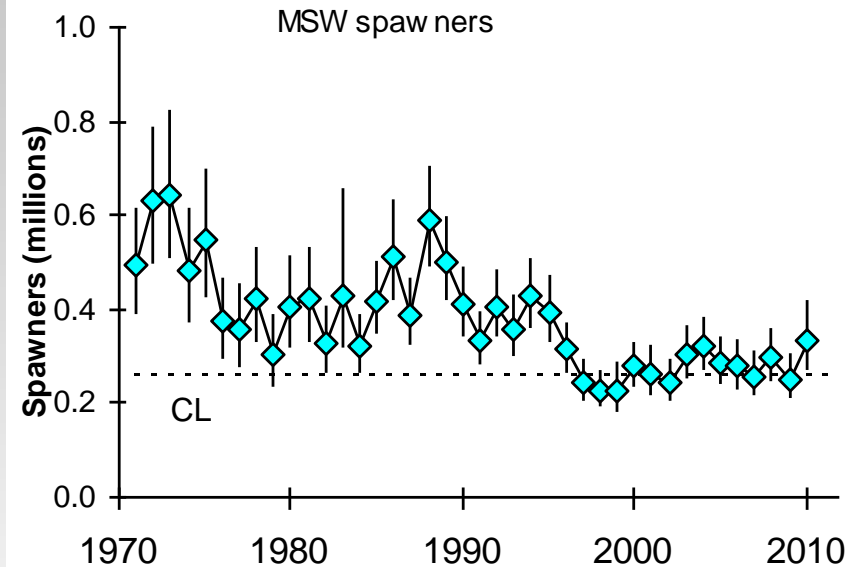
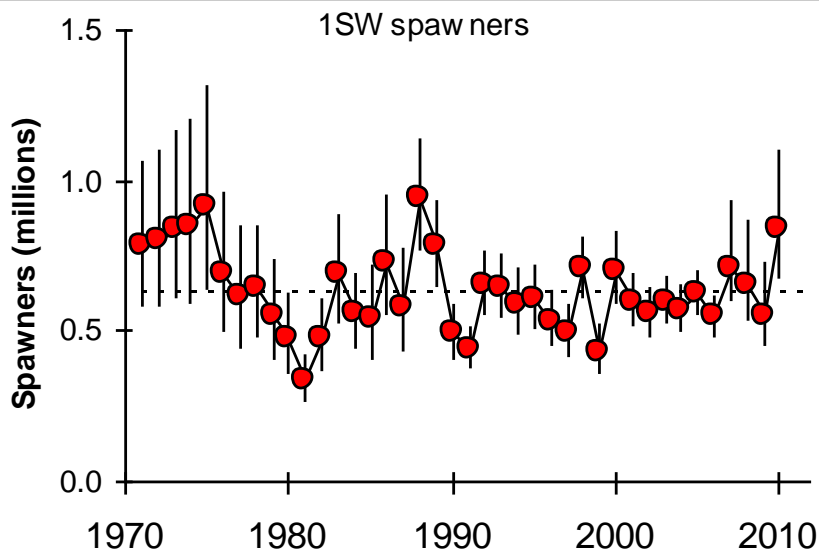


- Maturing 1SW stock at full reproductive capacity over most of the series
 - in 2008: at risk of suffering reduced reproductive capacity
 - in 2009, suffering reduced reproductive capacity
- Non-maturing 1SW stock at full reproductive capacity before 1996
 - at risk of suffering reduced reproductive capacity in 10 of 14 years between 1996 and 2010

Status of Stocks

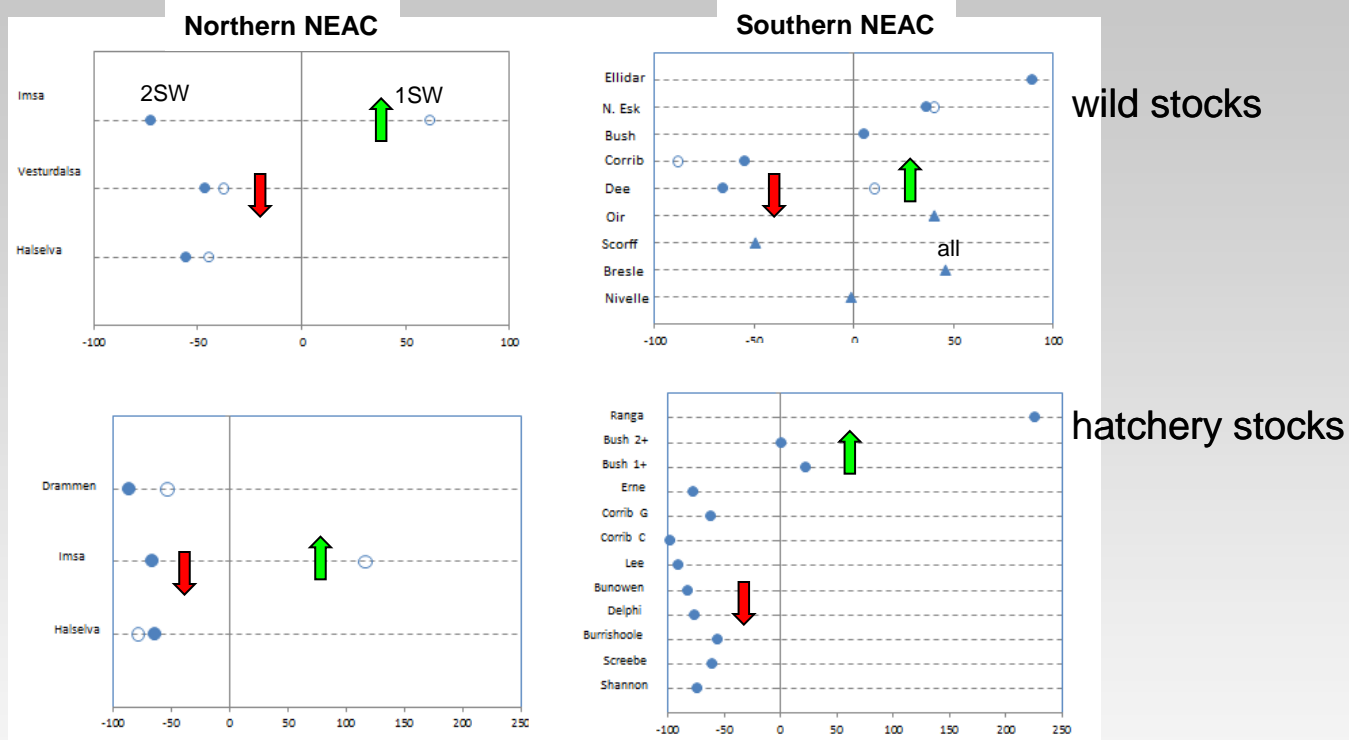
Trends in PFA and Spawners

Southern NEAC



- declining trends in 1SW and MSW spawners
- 1SW mid-point and lower bound of spawners have fluctuated around the CL for most of the time series
 - in 2010, is at full reproductive capacity
- MSW mid-point and the lower bound close to or below CL since 1997
 - in 2010, is at full reproductive capacity

Overall declining trend in Northern and Southern NEAC



- Overall decline in marine survival for Northern NEAC, in both wild and hatchery smolts (left panels)
- Southern NEAC, hatchery smolt survivals decreased but wild smolt survival indices more variable (right panels)
- Returns are strongly influenced by factors in the marine environment

Overview of Status of Stocks

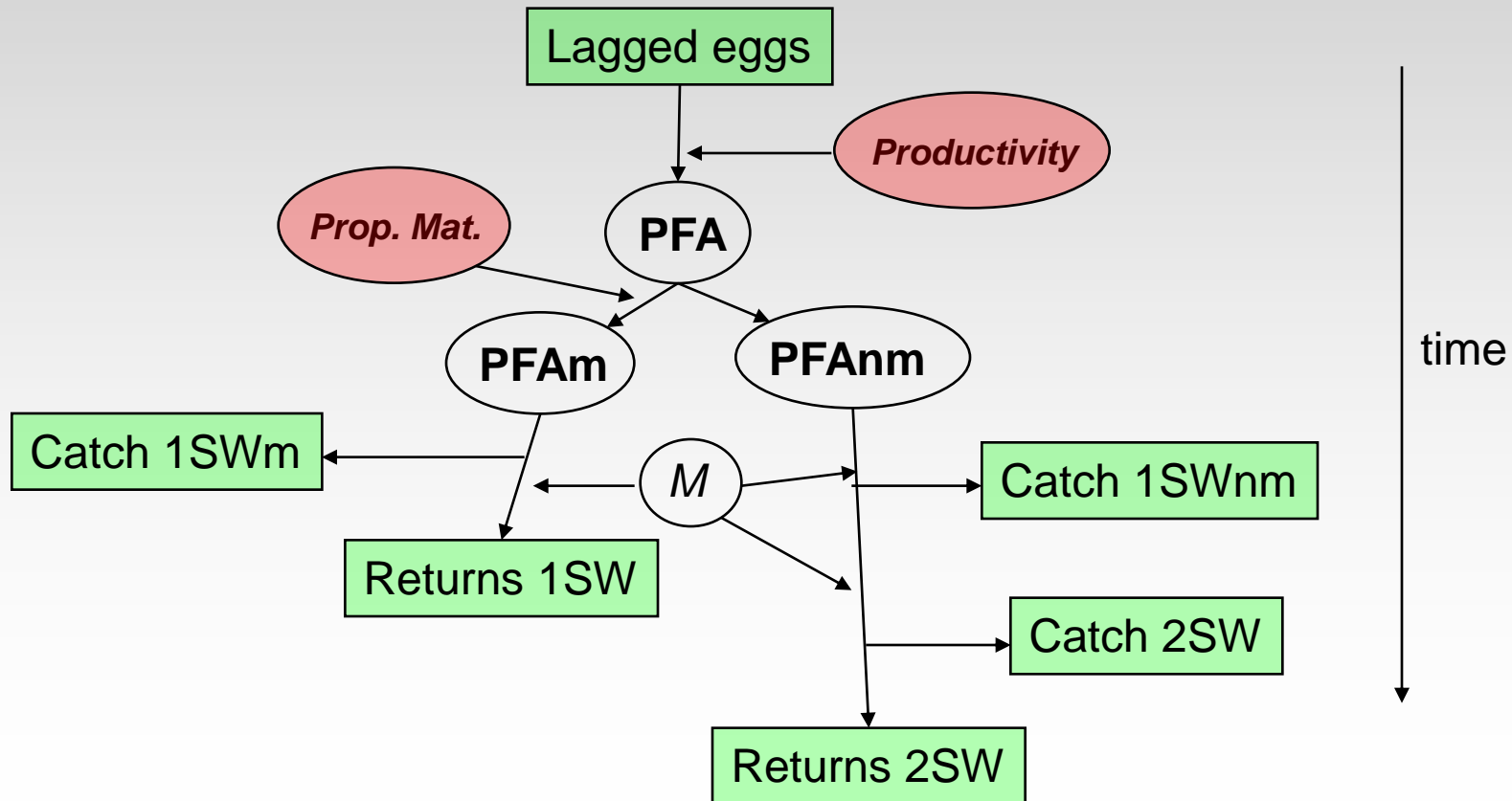
- **Despite management measures aimed at reducing exploitation in recent years there has been little improvement in the status of stocks**
- **This is mainly as a consequence of continuing poor survival in the marine environment**

ICES was asked to provide catch options or alternative management advice for 2012–2014, with an assessment of risks relative to the objective of exceeding stock conservation limits

- Fishing should only take place on maturing 1SW and non-maturing 1SW salmon from rivers where stocks have been shown to be at full reproductive capacity
- Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status
- Conservation would be best achieved if fisheries target stocks that are at full reproductive capacity. Fisheries in estuaries and especially rivers are more likely to meet this requirement.

Forecast Model

- Combined sea age models for southern NEAC and northern NEAC
- Maturing PFA (PFAm) and the non maturing PFA (PFAnm) are modeled together simultaneously



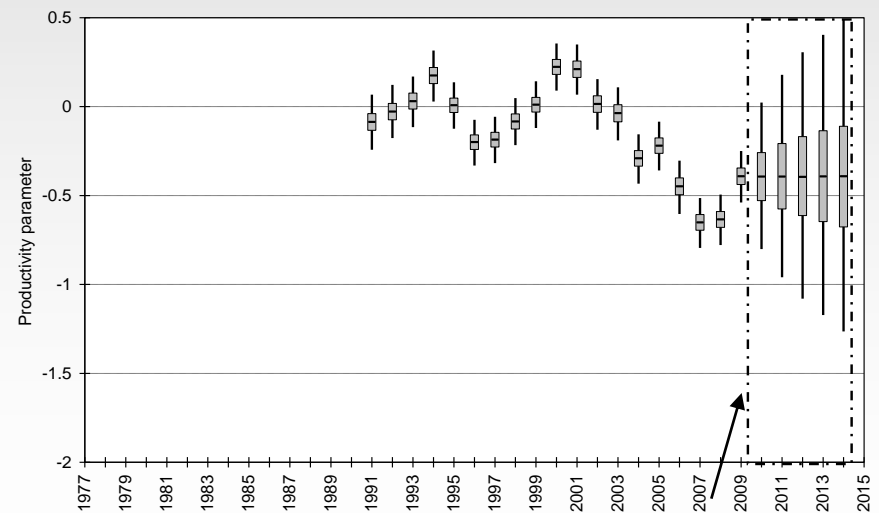
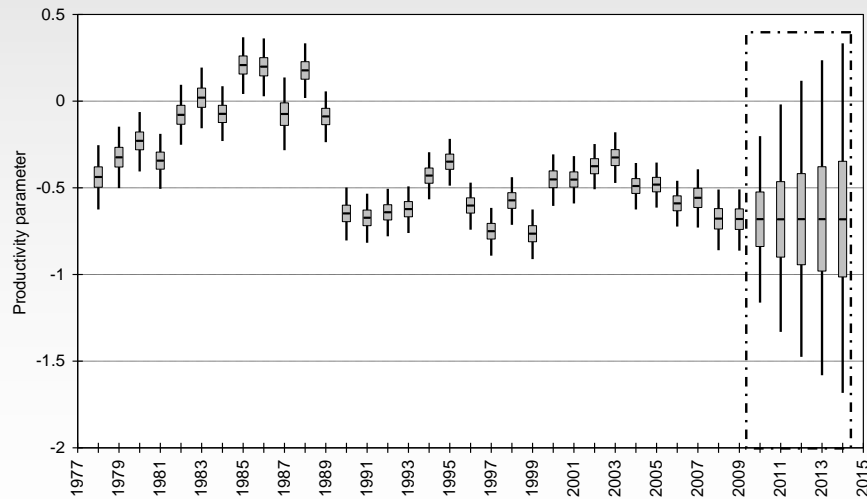
Southern NEAC

- productivity peaked in 1985 and 1986
- sharp drop in the productivity during 1989 to 1991 and the values post-1991 are all lower than during the previous time period
- productivity expected to remain low

Northern NEAC

- sharp drop in the productivity during 2002 to 2007
- productivity increased in 2009
- productivity expected to remain at a low level

productivity



forecast

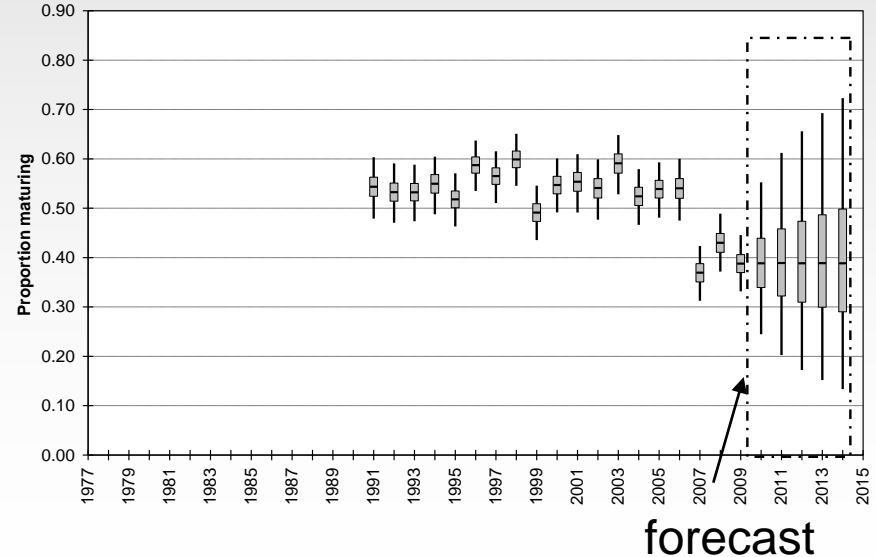
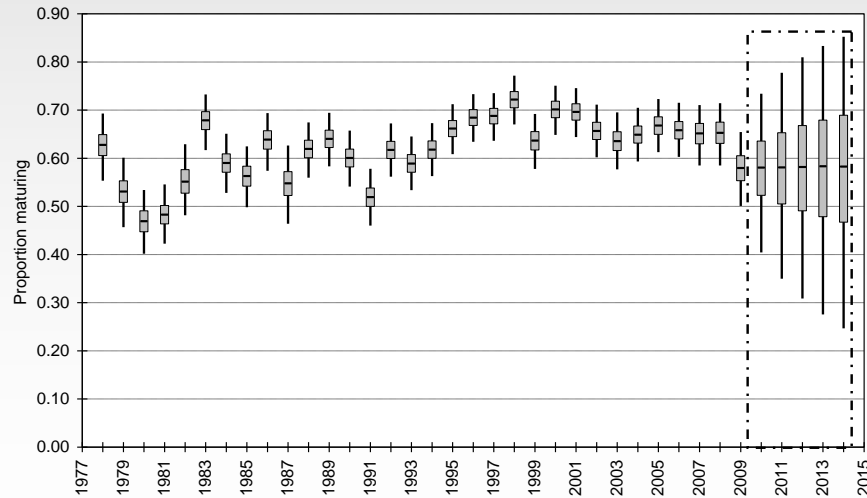
Southern NEAC

- proportion maturing averaged about 0.6 with the lowest proportion in 1980 and the highest proportion in 1998
- increasing trend in the proportion maturing
- but a drop for 2009

Northern NEAC

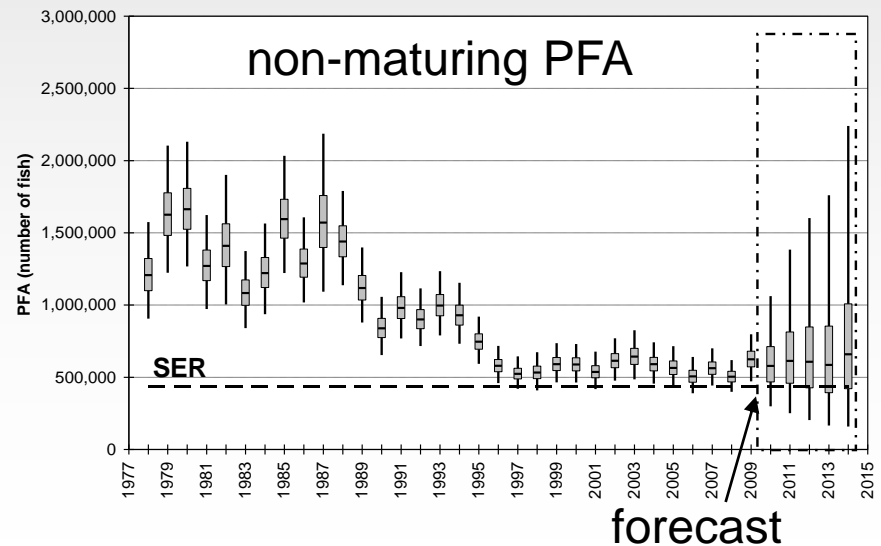
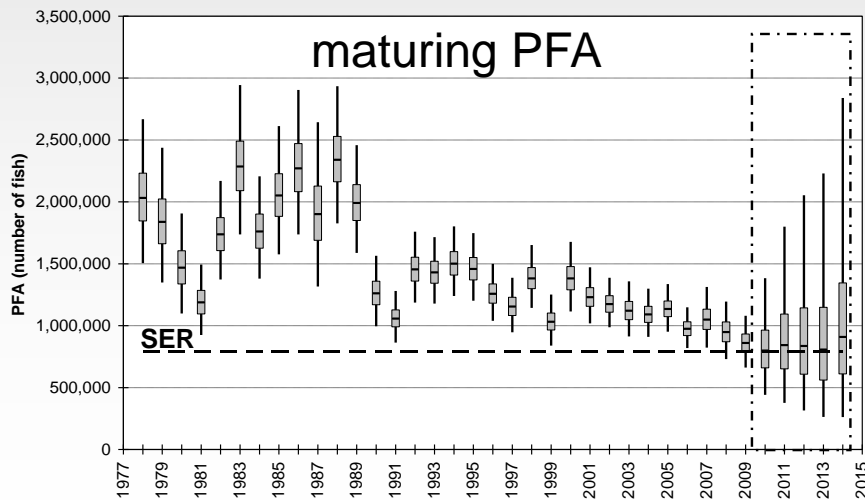
- proportion maturing varied around 0.55 until 2007
- in 2007, abrupt drop in the proportion maturing and remaining at about 0.4 since
- proportion maturing in forecast is about 0.38

proportion maturing



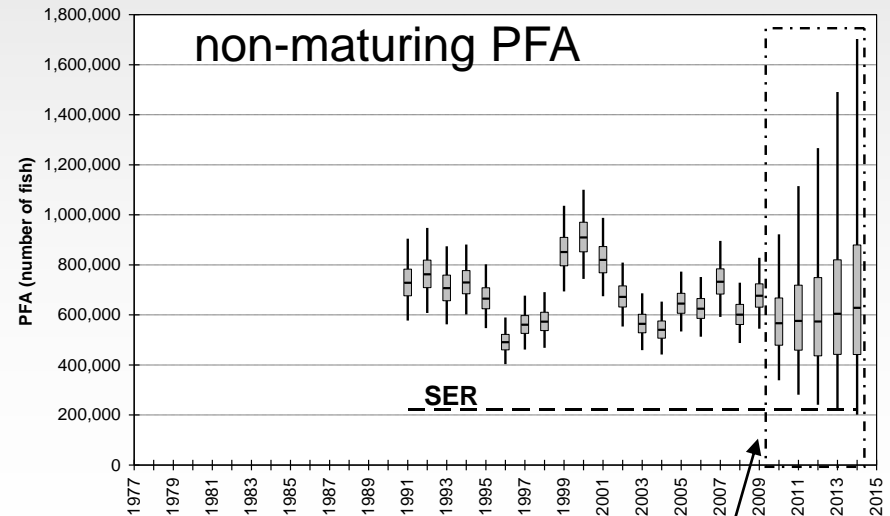
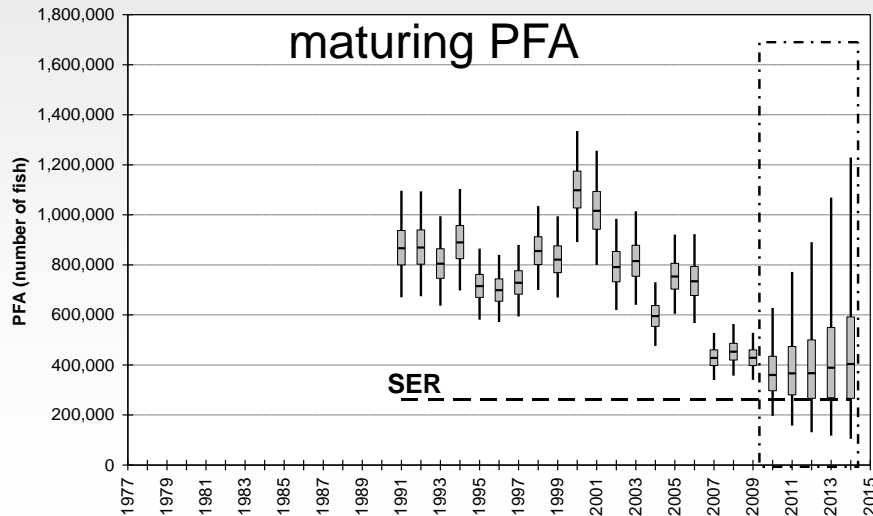
Southern NEAC

- Total PFA (maturing 1SW and non-maturing 1SW) ranged from 3 to 4 million fish between 1978 and 1989, declined rapidly to just over 2 million fish in 1990, and fell to its lowest level of just over one million fish in 2008
- 25th percentiles of the posterior distributions of the forecasts are below the SER for both the maturing (2010- 2014) and non-maturing (2013-2014) age components
- Probabilities that the PFAs will be above or equal to SERs in 2010 to 2014 range from 0.51 to 0.81



Northern NEAC

- Total PFA abundance was estimated at about 2 million fish in 2000 with the lowest value of the series in 2008 at over 1 million fish
- Lower bound of the 95% confidence has fallen below the 1SW maturing SER for 2010 to 2014
- Lower bounds of 95% confidence interval for non-maturing salmon remain above SER in 2010 to 2012, slip below SER in 2013 and 2014
- Probabilities PFAs will be above or equal to SERs in 2010 to 2014 from 0.76 to 0.99



forecast

Probability of attaining stock and age complex specific SER

Probability that PFAs will be greater than or equal to the complex and age specific SERs

Southern NEAC		Maturing	Non-maturing
	SER	793 900	437 525
Year		p	p
2010		0.508	0.810
2011		0.562	0.782
2012		0.543	0.734
2013		0.512	0.688
2014		0.589	0.732
Northern NEAC		Maturing	Non-maturing
	SER	261 359	222 225
Year		p	p
2010		0.862	0.999
2011		0.800	0.994
2012		0.761	0.982
2013		0.765	0.974
2014		0.760	0.965

Given the current and forecast abundances

Prior to commencement of distant water fisheries		
	1SW maturing (1SW)	1SW non-maturing (MSW)
Northern NEAC	<u>2011 – 2014:</u> <u>at risk</u> of suffering reduced reproductive capacity	<u>2011-2012:</u> at full reproductive capacity <u>2013-2014:</u> <u>at risk</u> of suffering reduced reproductive capacity
Southern NEAC	<u>2011 – 2014:</u> <u>at risk</u> of suffering reduced reproductive capacity	<u>2011 – 2014:</u> <u>at risk</u> of suffering reduced reproductive capacity

“Provide a more detailed evaluation of the choice of appropriate management units to be used in a risk based framework for the provision of catch advice for the Faroese salmon fishery, taking into account relevant biological and management considerations and including, if possible, worked examples of catch advice.”

- ICES (2010) described the procedure for conducting a risk assessment and noted that the following three issues would require decisions by managers before full catch advice could be provided:
 - the choice of management units for NEAC stocks;
 - the specification of management objectives;
 - the share arrangement for the Faroes fishery.
- NEA Commission discussed the questions at 2010 annual meeting of NASCO and during inter-sessional discussions but did not reach any conclusion
- NASCO therefore submitted the additional question to ICES in March 2011

10.1.12.1 Faroes fishing season

- Faroes fishery historically operated between October/November and May/June, but the historical TACs applied to a calendar year
- Two different cohorts of salmon of each age class (e.g. two cohorts of 1SW salmon, etc) are exploited during a calendar year
- ICES could continue to provide catch advice on the basis of calendar year TAC options, but this would add another level of uncertainty to the advice
- ICES recommends that NASCO should manage any fishery on the basis of fishing seasons operating from October to June, and catch advice would be provided on this basis

10.1.12.2 Choice of management units

- ICES (2010) noted that basing an assessment of stock status on the large stock complex units presently used greatly increases the risks to individual river stocks
- There is a conflict between the desire to define the NEAC management units at the jurisdiction level or below, and the restrictions of the data which limit the definition of management units between jurisdictions and stock complexes
- Main problem with allocating catch to management units relates to the difficulty of estimating the contribution to the fishery of the management units for which there are limited tag recoveries (e.g. UK (Northern Ireland), France, Finland)
- A possible compromise that could partly resolve this problem is to amalgamate geographically neighbouring units

10.1.12.3 Management objectives

- NASCO has not provided management objectives for the Faroes fishery
- Implications of basing the risk framework on overall abundance objectives for management units comprising large numbers of river stocks
 - For management units at the jurisdiction level, some of these would be comprised of over one hundred river stocks
 - Thus it would still be possible for large numbers of river stocks to be below CL while the management unit as a whole was meeting its management objective
- ICES recommends an additional management objective based on the status of individual stocks in management units
 - For example, an agreed percentage of the assessed river stocks must be meeting specified management objectives before a TAC is allocated to the high seas fishery

10.1.12.4 Sharing agreement

- ‘Sharing Agreement’ establishes the proportion of any harvestable surplus within the NEAC area that could be made available to the Faroes fishery through the TAC
- For any TAC option being evaluated for the Faroes, it is assumed that the total harvest would be the TAC divided by the Faroes share
- NASCO has not provided a share allocation, but one Party had proposed a baseline period of 1984–1988.
 - The share allocations based on this period would be 8.4% Faroes, 5.2% West Greenland and 86.4% all NEAC homewater fisheries
- In the absence of an agreed share allocation, a value of 8% for the Faroes fishery has been used in the worked example.

10.1.12.5 Evaluation of catch options

- Process for assessing each catch option within the risk framework is described

10.1.12.6 Input data for the risk framework

- Some of the data (e.g. mean ages and weights, discard rates, etc.) apply to the catch that might occur at the Faroes if a TAC was allocated
- In most cases the only data available to estimate these parameters comes from sampling programmes conducted in commercial and research fisheries in Faroese waters in the 1980s and 1990s

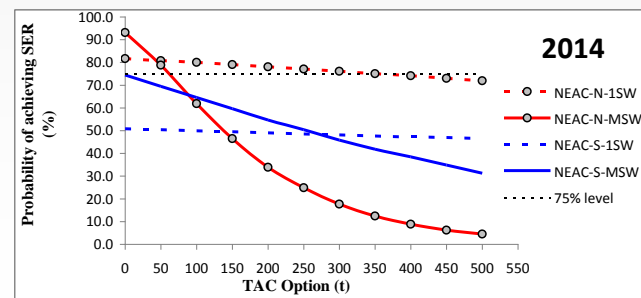
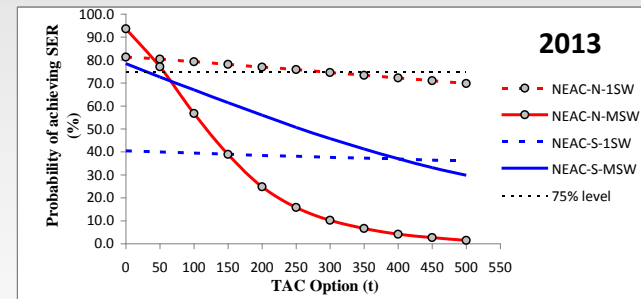
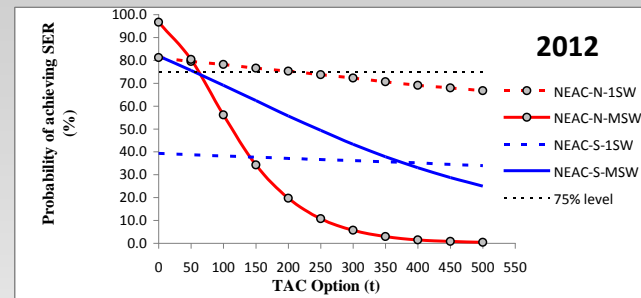
10.1.12.7 Worked example of the risk framework

- Example of the risk framework for the Northern and Southern NEAC stock complexes using the PFA forecasts derived from the Bayesian model
- Results are an example only

10.1.12.7 Worked example of the risk framework

- Probability of the stock complexes in Northern and Southern NEAC areas achieving their SERs (the overall abundance objective) for different catch options in the Faroes fishery (from 0 to 500 t) in 2012 to 2014 (Figs 10.1.2.1, 10.1.12.2; Tables 10.1.12.4, 10.1.12.5)

- assumes that the same TAC is applied and is taken in each of the three years
- no TAC options that will permit all stock complexes to have a greater than 75% probability of achieving their SERs in any year from 2012–2014
- flatness of the curves in the catch options figures is a function of the uncertainty in the estimates and the level of exploitation on the stocks in the Faroes fishery
- more uncertain data and lower exploitation rates generate flatter curves

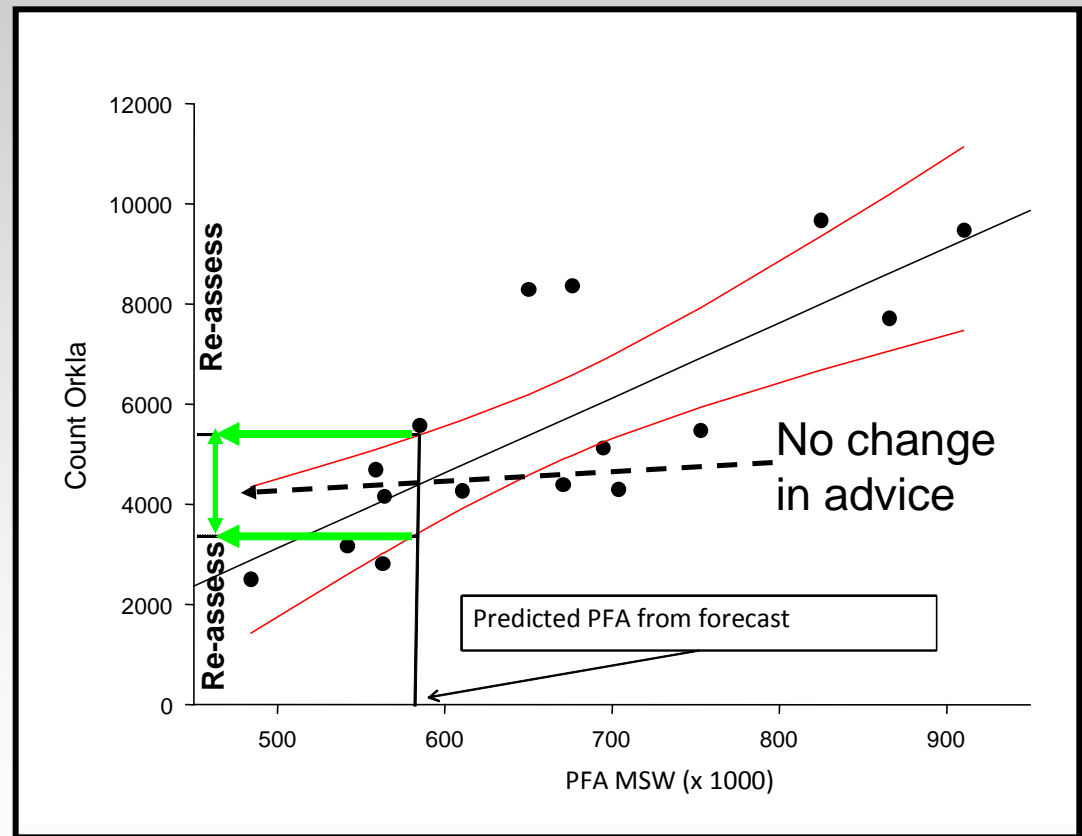


10.1.11 Further investigate opportunities to develop a framework of indicators or alternative methods that could be used to identify any significant change in previously provided multi-annual management advice

- In 2009 the ICES Working Group updated the NEAC data sets previously examined in the FrameWork of Indicators (FWI) exercise
- These still did not satisfy the criteria for inclusion in the FWI as defined for West Greenland, and as being informative of a significant change
- A different approach to that applied in respect of the Greenland fishery was explored

10.1.11 Framework of indicators

- Status of stocks would be re-evaluated if the FWI suggests that the PFA estimates are deviating substantially from the median values of the forecast
- Values of indicator (counts) are plotted against the PFA (median)
- Regression line is shown with 95% confidence limits
- Based on forecast PFA in the year in question (2012 for ex.), the values of the indicator corresponding to the upper and lower 95% confidence interval are estimated
- If the realized indicator value falls outside these limits, a reassessment is suggested by this indicator



10.1.11 Framework of indicators

- To be included in the FWIs an indicator must fulfil two criteria:
 - must be reliable predictor of the relevant PFA (r^2 from the regression larger than 0.20),
 - value of the indicator (or a preliminary value) must be available for the inclusion in the FWI evaluation by mid-January.
- Of 38 indicators evaluated, 28 (74%) were assessed to be relevant predictors of PFA
- Of retained indicators eight were from Northern NEAC and 20 from Southern NEAC
- A spreadsheet for FWIs for each of the stock complexes was developed and tested

10.1.11 Framework of indicators

- Until alternative management units are agreed, ICES recommends that the indicators be regressed against the stock complexes to which they belong
 - for example, MSW indicators from Norway should be regressed against PFA MSW for Northern NEAC
- Any indication that there has been a change in PFA from the forecast median value would trigger an assessment.
- If too few indicators are available to run the FWI by the agreed time, this would automatically trigger an assessment for the coming year
- ICES recommends that this procedure be developed further and that new possible indicators be brought forward for the next assessment in 2012, for submission to NASCO

Recommendations

See general recommendations (10.1.13)

- Further work be undertaken to check the appropriateness of the various data inputs used in the catch advice framework for the Faroes fishery, including seeking original data sets from the sampling programmes of the fishery in the historical time period
- Preliminary proposal for a Framework of Indicators for the NEAC stock complexes was developed in 2011. ICES recommends that until alternative management units are agreed by NASCO, this procedure be developed further and that new possible indicators be brought forward to ICES for the next assessment in 2012
- In support of the management objective from NASCO to ensure that individual river stocks meet their conservation limits, ICES recommends that additional monitoring data or analyses of existing monitoring data (catches, juvenile surveys, short-term count data), be considered to augment the river specific data used to develop the stock status and to improve management advice in NAC and NEAC areas

Acknowledgements

Members (24) of participating countries (14) to Working Group on North Atlantic Salmon, March 22-31, 2011

- NEAC subgroup chair: Julian MacLean (UK(Scotland))**
- Several new members to WG in 2011 who worked on the alternative FWI for NEAC**