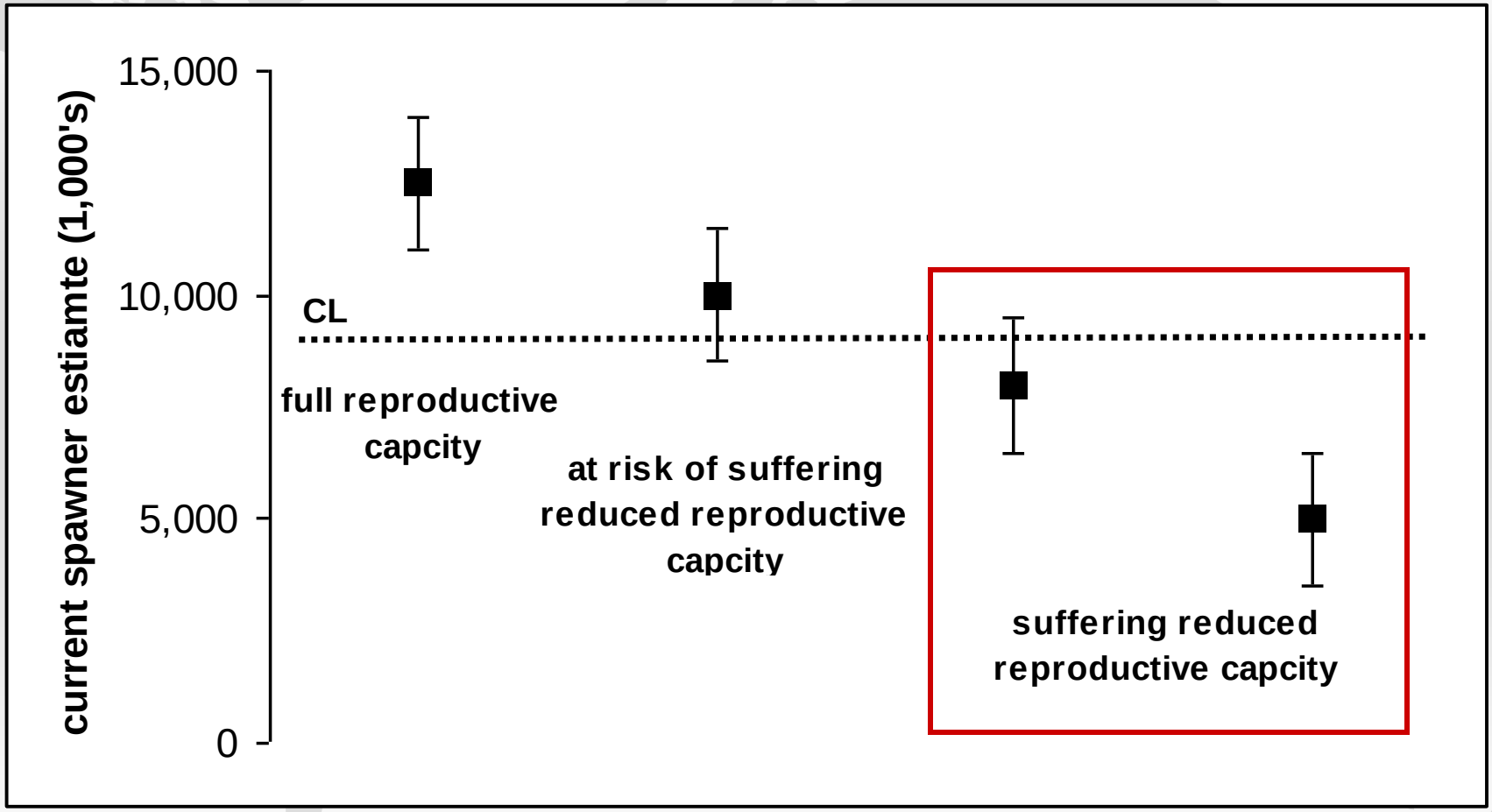
ICES Advice to NASCO 2006

Timothy Sheehan
WGNAS Chair

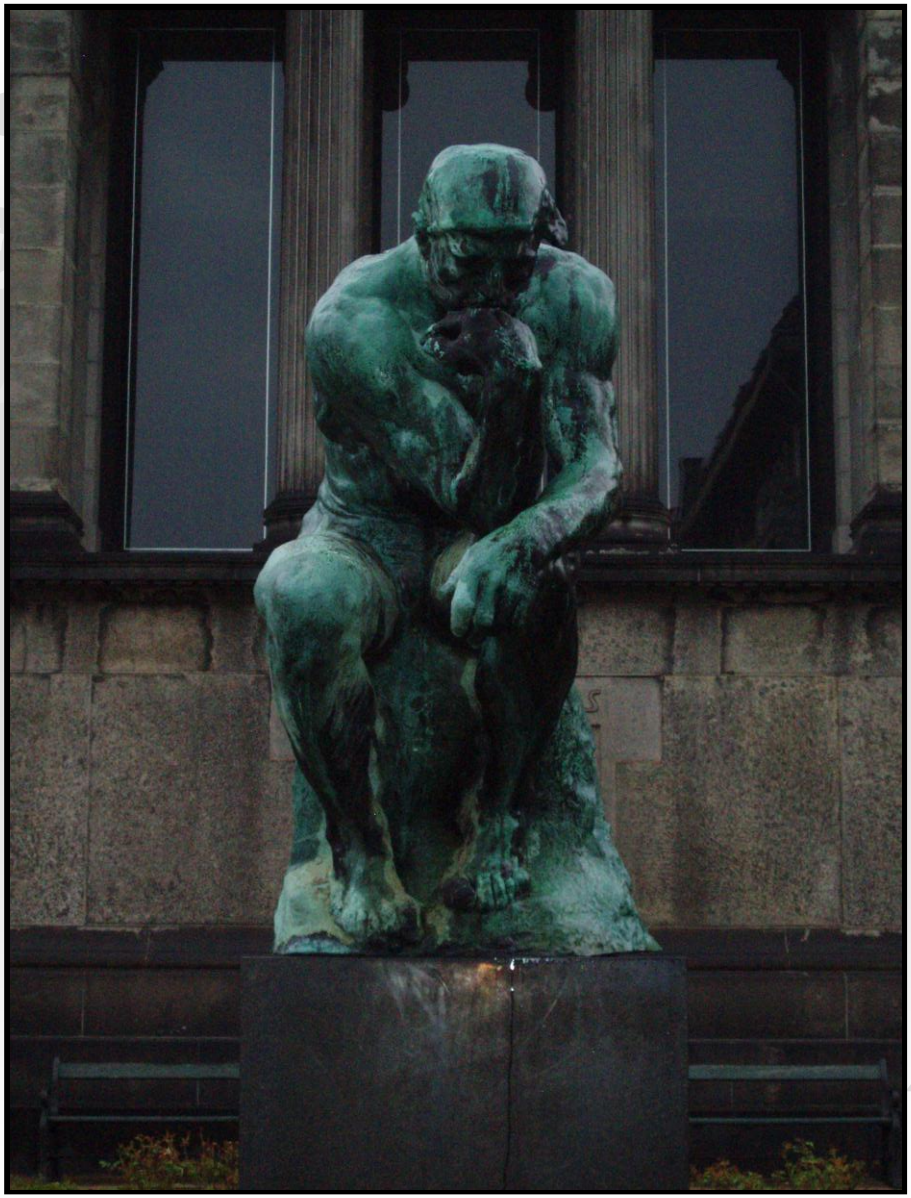
New ICES Terminology



ICES Advice to NASCO 2006

Atlantic salmon in the North Atlantic Area

Timothy Sheehan
WGNAS Chair



Questions posed to ICES, with respect to Atlantic salmon in the North Atlantic Area

1. Overview of 2005 catches, unreported catches, catch and release, and production of farmed and ranched Atlantic salmon

2. Significant developments which might assist with the management of salmon stocks

3. Developments in identifying the origin of Atlantic salmon at finer scale resolution

4. Describe sampling programmes for escaped farmed salmon and the precision and reliability of the identification methods employed

5. An assessment of the minimum information needed to signal a change in the previously provided catch advice

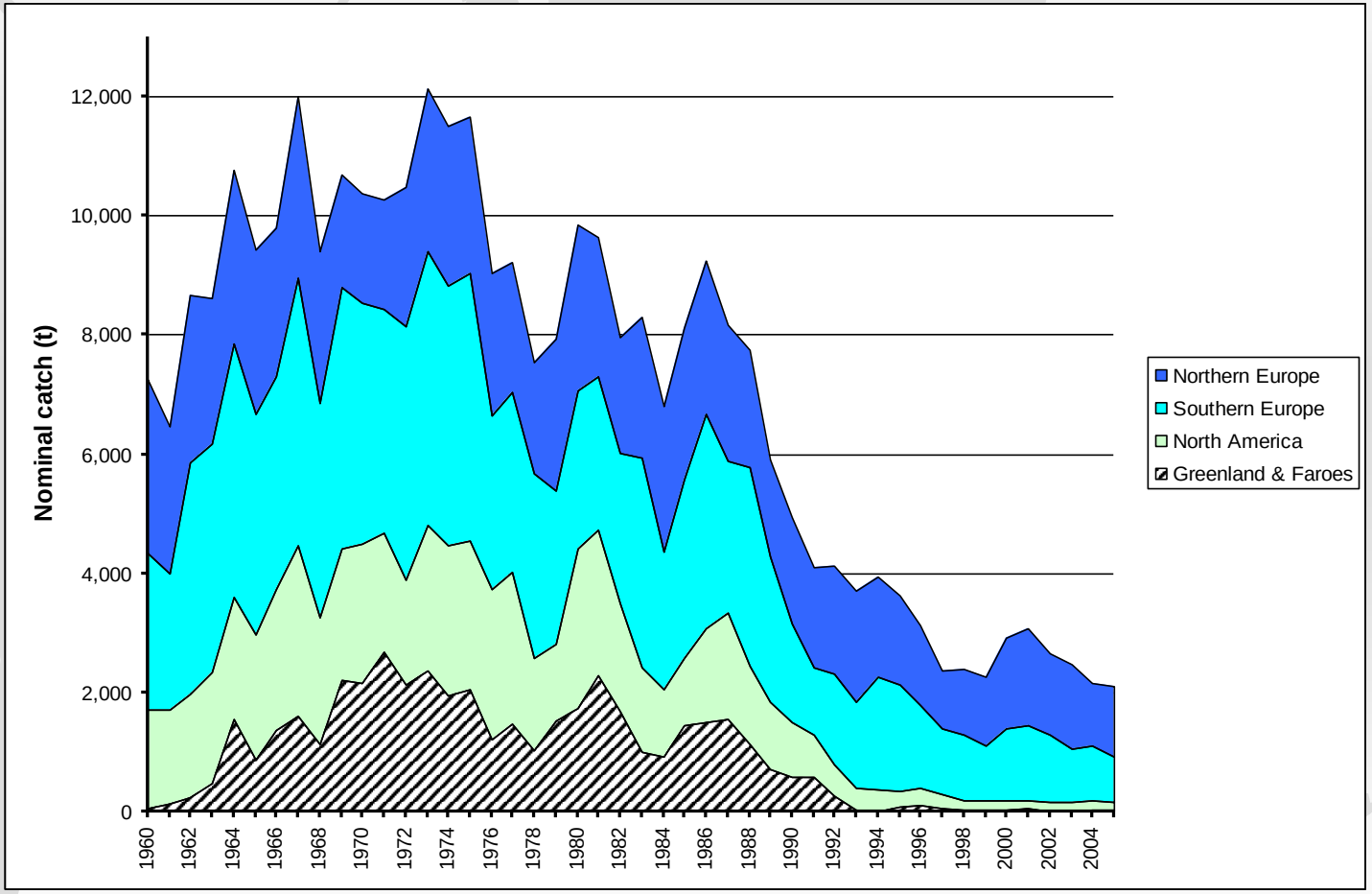
6. Tag release data for 2005

7. Data deficiencies, monitoring needs and research requirements

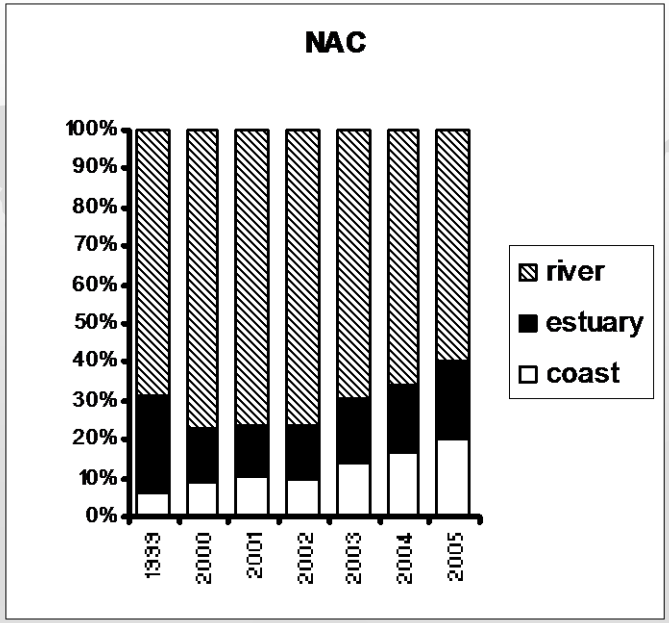
NASCO has requested ICES to provided an overview of 2005 catches, unreported catches, catch and release, and production of farmed and ranched Atlantic salmon

2005 Nominal catches of salmon (fresh round weight)

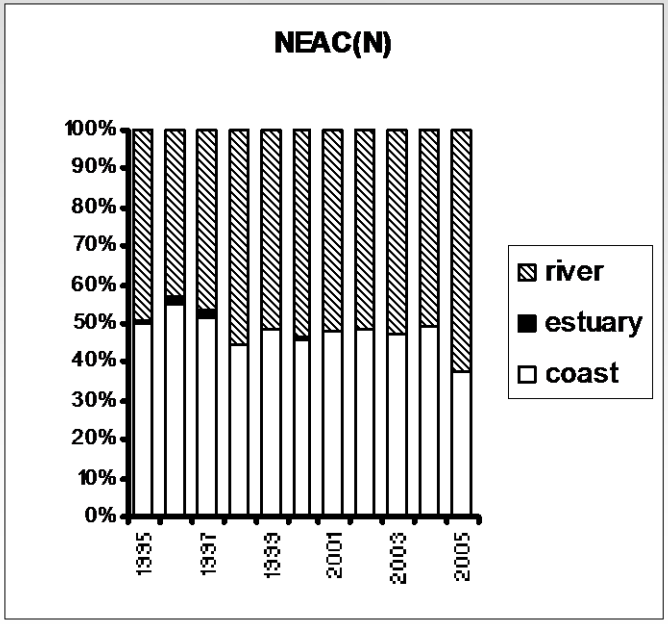
- 2,110 mt – lowest in the time series
- 46 mt lower than 2004
- 500 and 600 mt lower than 5 and 10 yr averages

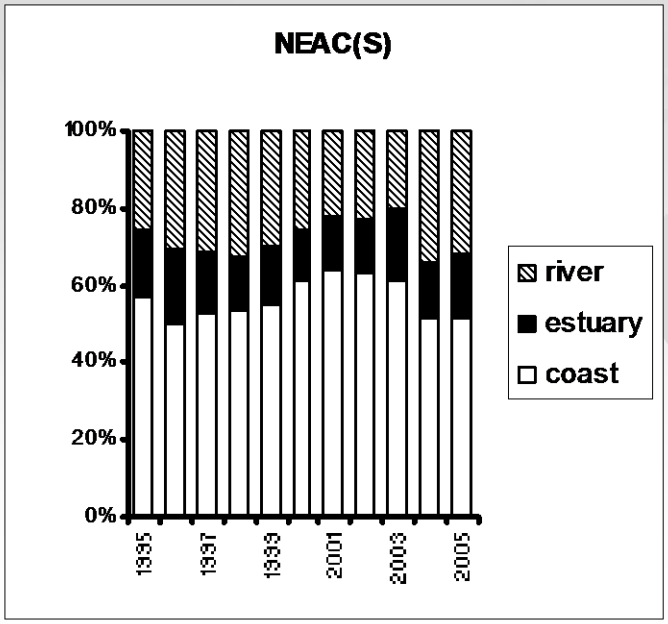


2005 Catches of North Atlantic Salmon



- **Overall** – 47% coastal, 46% river and 7% estuarine
- Increasing % of coastal catch in NAC Commission
- High % of coastal catch in the NEAC Commission
- Contrary to previous ICES advice
- Much country-specific variation





2005 Catches of North Atlantic Salmon

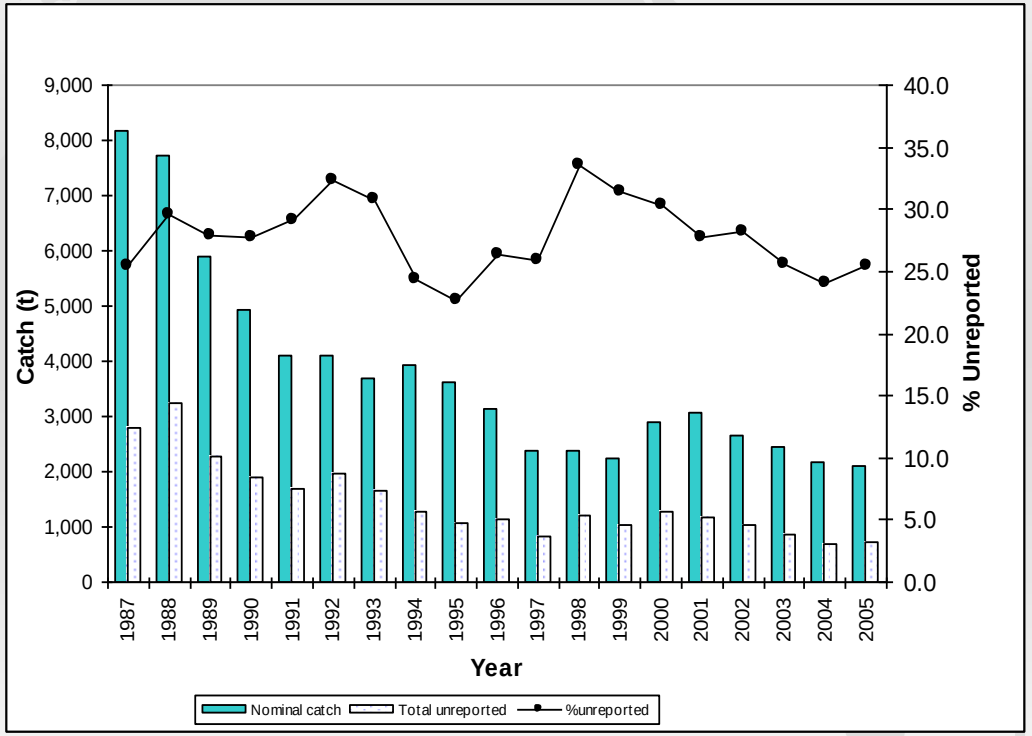
Catch and release

- Not included in nominal catch
- Seven countries report
- Large variations across countries
  - 17% (Iceland) to 87% (Russia)
- Approximately 128,000 in 2005
  - 26,000 less than 2004
- Likely that some mortality occurs

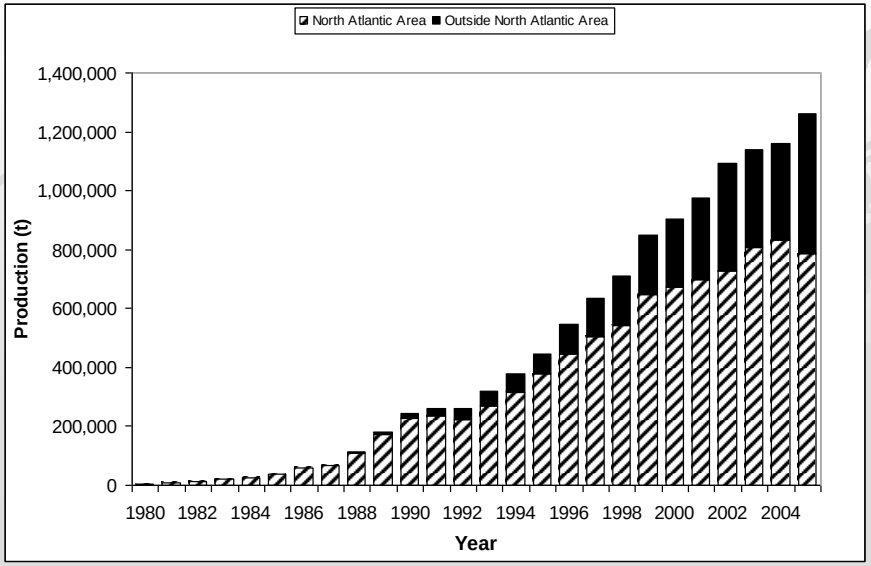
2005 Catches of North Atlantic Salmon

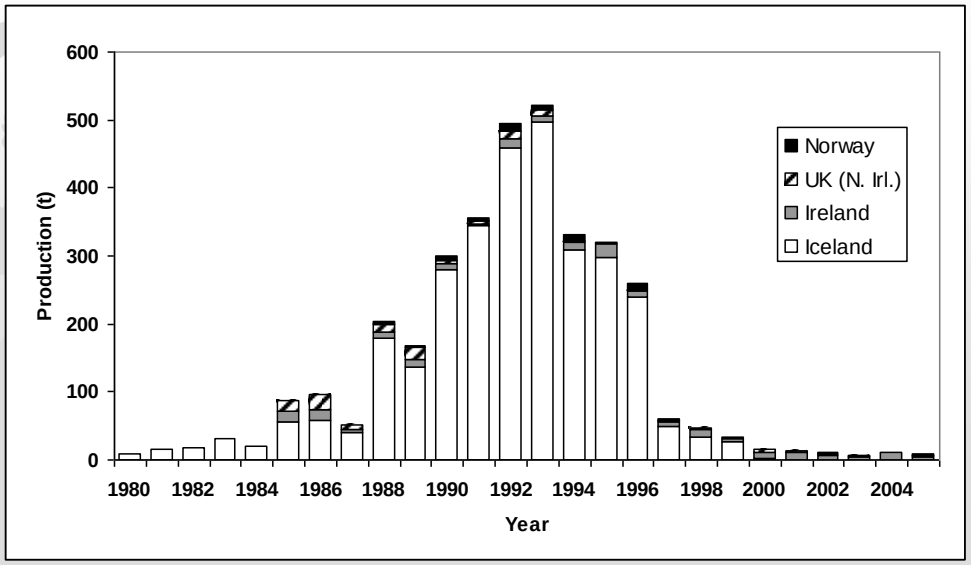
Unreported catches

- 717 mt in 2005 (26% of total catch)
  - 606 mt in NEAC
  - 101 mt in NAC
  - 10 mt WGC
- ~5% increase from 2004
- Downward trend is within recent variation
- Estimates included within assessments
- Continual efforts to reduce unreported catch



2005 Farming and Sea Ranching of Atlantic Salmon





Farmed salmon

- North Atlantic wide ~784,611 mt (2005)
  - Decrease from 2004, but increase over 5 yr mean
- Worldwide ~1,261,638 mt (2005)
  - 9% increase from 2004
  - **~600 times reported nominal catch**

Ranched salmon

- 8 mt (2005) – 33% decrease from 2004

NASCO has asked ICES to report on significant developments which might assist NASCO with the management of salmon stocks including new or emerging threats to, or opportunities for, salmon conservation and management

- Evaluation of options to develop multi-year forecast of PFA_{NA}
- Post-smolt trawling in the Labrador Sea, Fall 2005
- Fatty acid profiles and stock identification
- Preliminary investigations into the deterrence of cormorants to reduce predation on migratory smolts

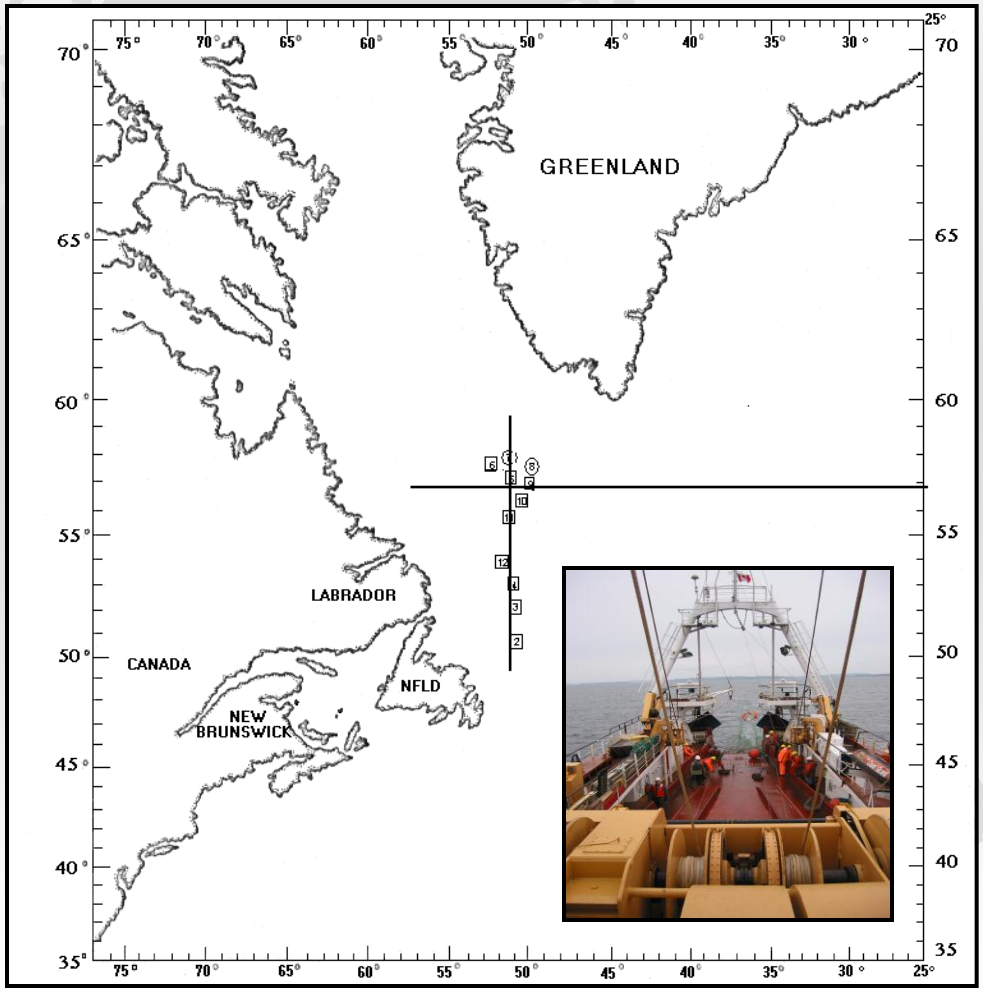
Evaluation of options to develop multi-year forecast of PFA_{NA}

- Catch advice based forecast of 1SW fish at Greenland (PFA_{NA})
- PFA conditional on one of two levels of productivity (phases)
- Phase probability is related to relative change in PFA over a two year period
  - *Is three or four year lag more appropriate?*
- PFA forecasts can be provided for three years
  - *Using two year lag (as done previously) is appropriate*

Post-smolt trawling in the Labrador Sea, Fall 2005

- Combination of PST and gillnets
- 1 postsmolt in 9 trawls
  - caught at night
- 11 adults & 37 post-smolts in gillnets

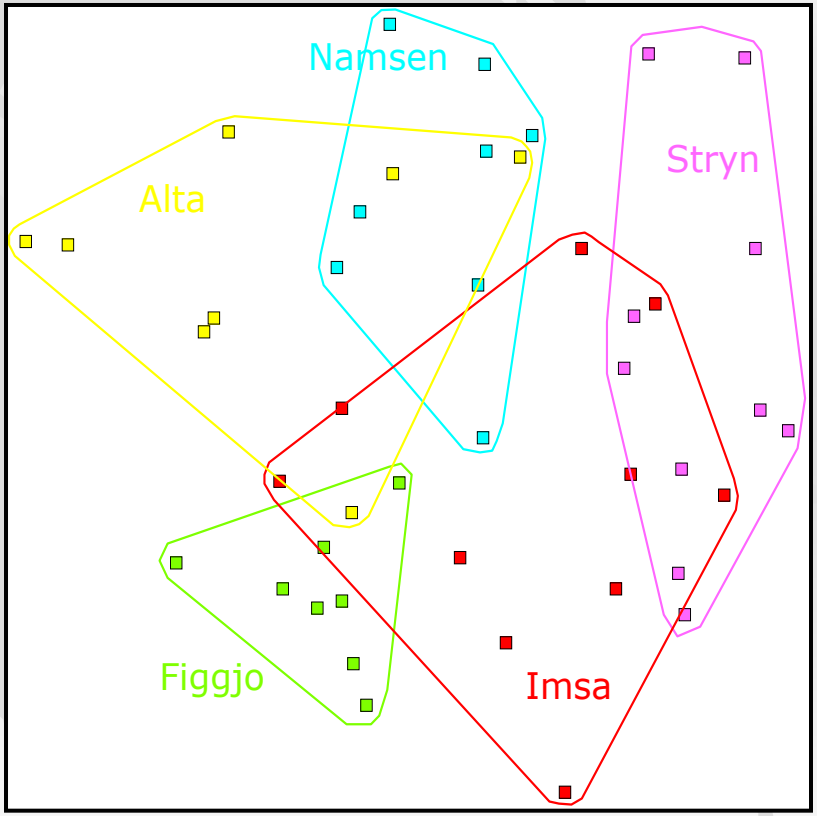
- Trawl was working as other species were caught
- Recommend a bigger/faster ship or pair trawling with smaller vessels
- No viral pathogens detected (90 specimens over 2 yrs)



Fatty acid profiles and stock identification

- Common garden (5 stocks)
- Profiles of 26 fatty acids from 10 fish/stock
- Stock-specific differences evident and suggestive of genetic difference

- Potential for stock identification/discrimination
- Further work suggested
  - different life stages
  - different types of feed
  - wild fish evaluations
  - examine temporal and spatial stability of profiles



Preliminary investigations into the deterrence of cormorants to reduce predation on migratory smolts

- Non-lethal cormorant harassment activities (2 yrs) to reduce predation of smolts (Maine, USA)
- Assess with point counts and ultrasonic telemetry (n=~60/yr)

Preliminary results

- Birds dispersed
- No population level impact
- Individual-specific analysis ongoing

NASCO has asked ICES to report on developments in methods to identify origin of Atlantic salmon at a finer resolution than continent of origin (river stocks, country or stock complexes)

- Numerous ongoing efforts
  - ASAP, SALMAN, FishTrace, Stock Identification of Irish Salmon Stocks
- West Greenland mixed stock fishery
- Spatio-temporal distribution of North American Atlantic salmon populations off West Greenland
- St. Pierre et Miquelon mixed stock fishery

West Greenland mixed stock fishery

- Probabilistic-based Genetic Assignment model (PGA)

- Harvest estimates updated (2003-2004)
  - COO estimates agree with ICES previously reported values
  - majority of NA contribution is Canadian origin

2000			90% Confidence Interval	
Continent of Origin	Estimate	Percent	lower	upper
NA total	7,731	66.0%	7,657	7,808
E total	3,983	34.0%	3,906	4,057
Country of Origin				
CAN total	7,685	99.4%	7,527	7,793
USA total	46	0.6%	0	192
2001				
NA total	10,766	64.6%	10,673	10,859
E total	5,893	35.4%	5,798	5,985
CAN total	10,402	96.6%	10,046	10,691
USA total	364	3.4%	89	710
2002				
NA total	4,782	70.0%	4,728	4,837
E total	2,054	30.0%	1,999	2,107
CAN total	4,737	99.1%	4,631	4,817
USA total	45	0.9%	0	141
2003				
NA total	4,714	64.2%	4,657	4,771
E total	2,634	35.8%	2,577	2,691
CAN total	4,652	98.7%	4,561	4,732
USA total	62	1.3%	5	132
2004				
NA total	6,197	73.0%	6,138	6,257
E total	2,286	27.0%	2,226	2,345
CAN total	6,184	99.8%	6,111	6,251
USA total	12	0.2%	0	64

Spatio-temporal distribution of North American Atlantic salmon populations off West Greenland

- New project
- Current NA reference datasets to be updated
  - to date, 70 rivers have been sampled from Québec, the Maritimes and Maine
- Partition past 10 years of West Greenland harvest to finer scales
- Evaluate impacts of fishing by estimating contribution of base populations to harvest

St. Pierre et Miquelon mixed stock fishery

- PGA applied to 134 genetic samples from 2004 harvest of 2.8 mt
- All NA origin
  - ~2% USA origin

2004			90% Confidence Interval	
Continent of Origin	Estimate	Percent	lower	upper
NA total	1,235	100.0%	1,235	1,235
EUR total	0	0%	0	0
Country of Origin				
CAN total	1,212	98.1%	1,158	1,235
USA total	23	1.9%	0	77

NASCO has requested ICES to describe sampling programmes for escaped farmed salmon and the precision and reliability of the identification methods employed

- Techniques for identifying escaped farmed salmon
- Sampling programmes in different countries
- Behavior of escaped farmed salmon

Techniques for identifying escaped farmed salmon

- **Morphology**
  - farmed salmon commonly have external defects on the fins and elsewhere, which can be used to distinguish them from wild fish
    - defects of the fin tissue , fin ray defects, gill cover shortening, undershot jaw, heavy pigmentation
  - up to 100% accuracy
- **Scale and otolith pattern recognition**
  - smolt size, smolt age, fresh water to salt water transition, sea-winter band, summer checks, replacement scales
  - 80% accuracy or greater
- **Biochemical and physiological markers**
  - vaccination, pigmentation, trace elements/stable isotopes, genetic markers
  - unknown accuracy
- **Large scale marking**
  - cwt, fin clipping
  - up to 100% accuracy

Summary

- Range of options with varying levels of accuracy
- Regardless, more emphasis should be placed on
  - physical means to prevent escapes
  - restrict access to spawning populations (e.g. in-river trapping facilities)
  - screening and rapid identification of potential farmed fish

Sampling programmes in different countries

- NAC
  - only occurs if weirs/traps installed
  - rarely marked/tagged so distinguishing characteristics used
- NEAC
  - Finland & Norway (River Teno)
    - scale samples from fisheries
    - <0.5% occurrence in most years
      - Late season occurrence a concern
  - Norway
    - scale samples and morphological assessment from fishermen
    - occurrence in reported Norwegian salmon estimated between 30,000 and 60,000 annually
  - Iceland
    - 10% of fish are cwt
    - no systematic screening
  - UK (Scotland)
    - sampling programmes in some fisheries (examination of scale patterns)
    - reported catch partitioned by morphometric assessment by fishermen
  - UK (England & Wales)
    - study initiated in 2003 and extended to 2004 to examine occurrence of escaped farmed salmon
  - UK (N. Ireland)
    - some catches examined by morphometric assessment and scale reading
  - Ireland
    - some catches examined by morphometric assessment

Behavior of escaped farmed salmon

Two studies presented (acoustic tags and external tags) which simulated the escape of farmed salmon:

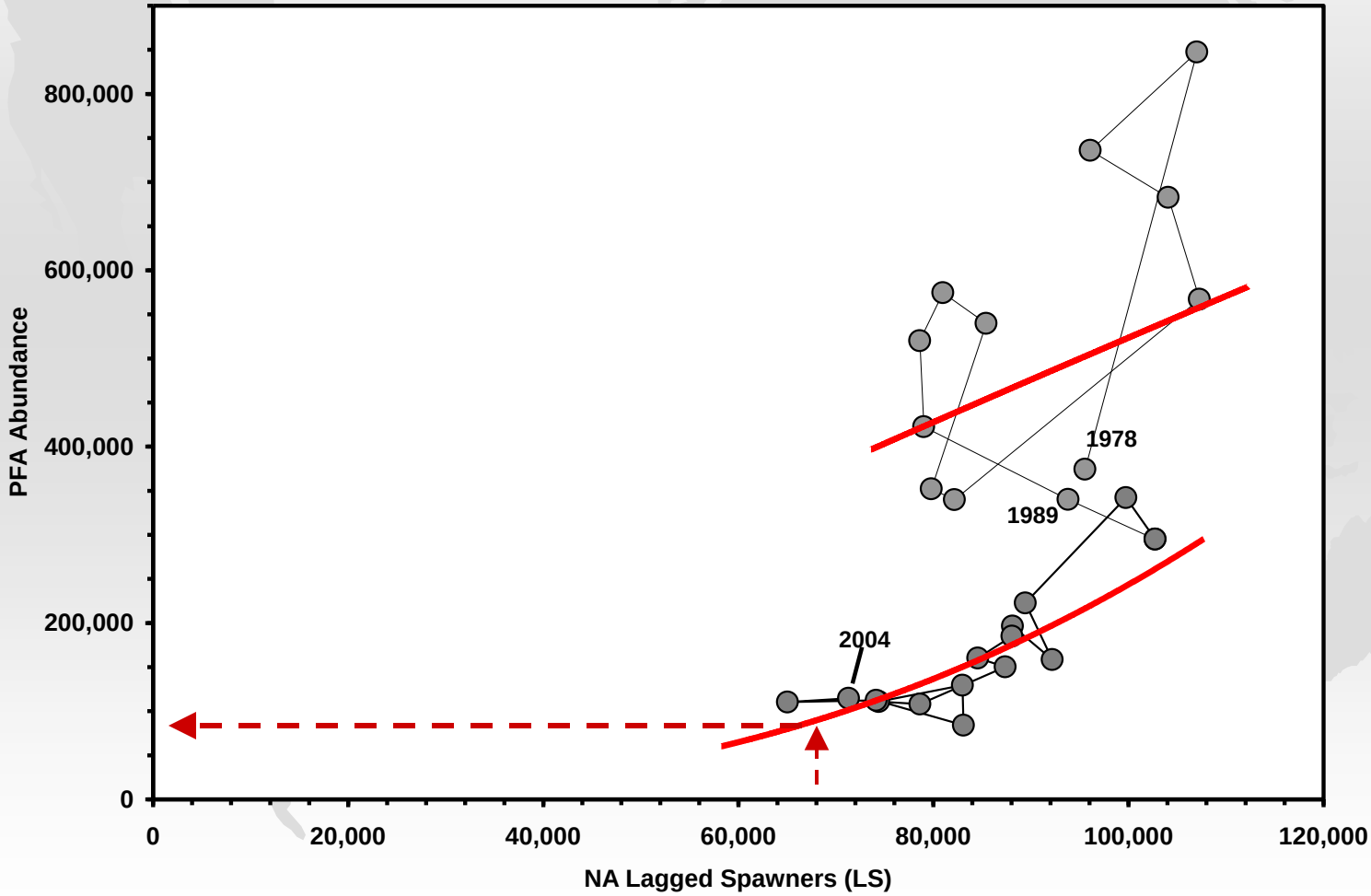
Combined results/conclusions:

1. Wild salmon home with high precision
2. Hatchery smolts returned to release river
3. Hatchery smolts released from a marine site returned to the same geographical area and entered rivers in this area to spawn.
4. Marine site released farmed postsmolts survive poorly and stray over great distances
5. Escaped large farmed salmon appear homeless and move with the prevailing current
   - survival may improve if escape close to maturity
6. Survival/migratory patterns are dependent on the time of escape and on life stage at escape

NASCO has asked ICES to provide an assessment of the minimum information needed which would signal a significant change in the previously provided catch advice for each Commission area

ICES considers it highly unlikely that the catch options provided for each Commission area will change during the next three years.

- Management advice/catch options are determined via PFA estimates
- PFA is estimated from Lagged Spawner (Eggs) relationship



- Lagged Spawners (and PFA) are set for 2006-2008 (NAC and NEAC)
- An increase in spawning escapement would only affect PFA (and LS) 3-7 years in the future (*in the example below*)

		Smolt Age Proportions					
		0.2	0.4	0.2	0.1	0.1	Lagged
Year	Spawners	Age 1	Age 2	Age 3	Age 4	Age 5	Spawners
1999	63343						
2000	63702						
2001	76467						
2002	43914	12668.6					
2003	67103	12740.4	25337.2				
2004	64121	15293.4	25480.8	12668.6			
2005	67804	8782.8	30586.8	12740.4	6334.3		
2006		13420.6	17565.6	15293.4	6370.2	6334.3 ▶	58984.1
2007		12824.2	26841.2	8782.8	7646.7	6370.2 ▶	62465.1
2008		13560.8	25648.4	13420.6	4391.4	7646.7 ▶	64667.9
2009			27121.6	12824.2	6710.3	4391.4	
2010				13560.8	6412.1	6710.3	
2011					6780.4	6412.1	
2012						6780.4	

Other things to consider

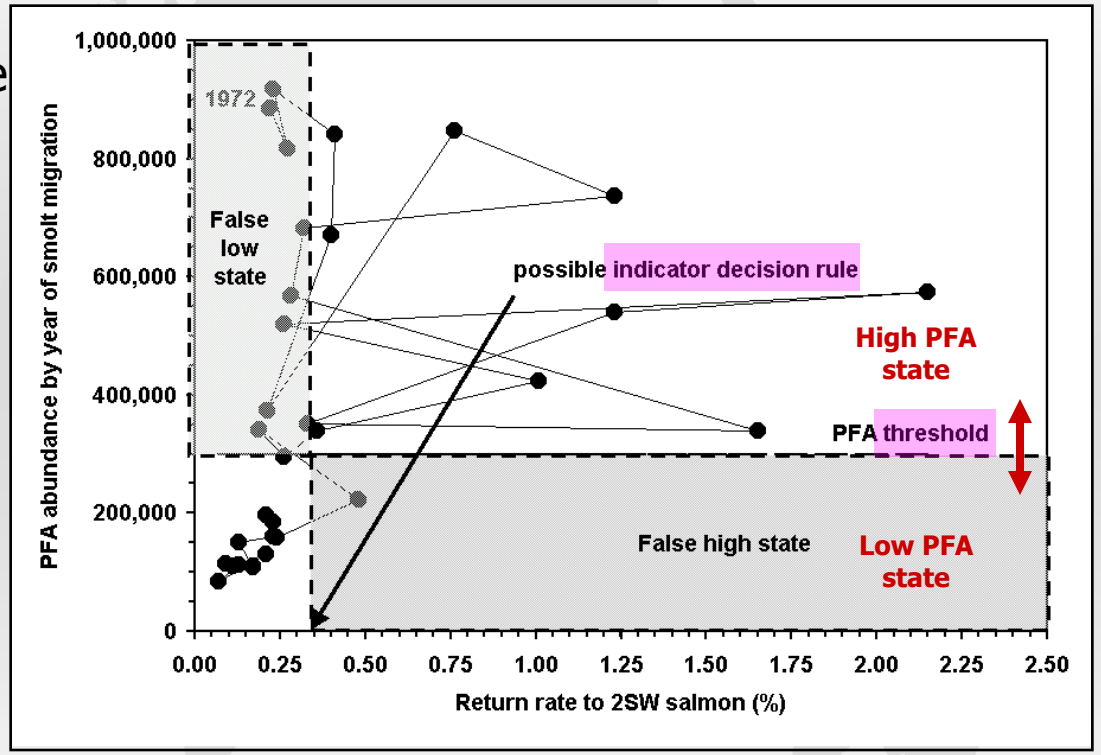
- The Precautionary Approach requires all stocks above Conservation Limits
  - 1 year of high PFA is not sustained recovery

- Compliance Rules may need to be developed
  - UK (England and Wales) – probability of exceeding CL in 4 out of 5 years
    - >95% - complies within that year
    - <5% - fails to comply within that year
    - all else – uncertain stock status
  - additional information must also be considered
    - above CL doesn't mean no management needed
    - below CL (temporarily) doesn't mean there is a problem
    - dynamics of population(s) must also be assessed

- Significant change in productivity would likely be identified by the various monitoring programs (changes in adult returns, marine survival, CPUE…)
  - ICES reviewed possible indicators of these changes and how they could be applied.

NASCO has asked ICES to provide an assessment of the minimum information needed which would signal a significant change in the previously provided catch advice for each Commission area

- False high state - PFA is in a high state when it is in a low state
  - may threaten conservation if fisheries were to proceed
- False low state - PFA is low when in fact it is in a high state
  - results in foregone harvest but would not threaten the resource
- Precautionary management would minimize false high relative to false low

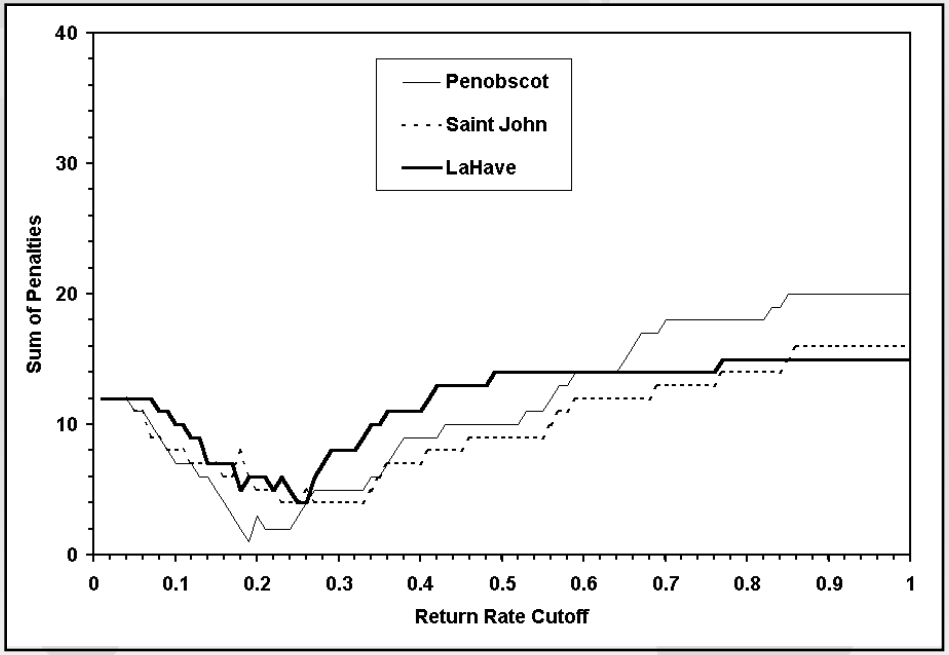


Can use past observations to determine appropriate decision rule with appropriate weightings for both errors types

What is the appropriate indicator decision rule?

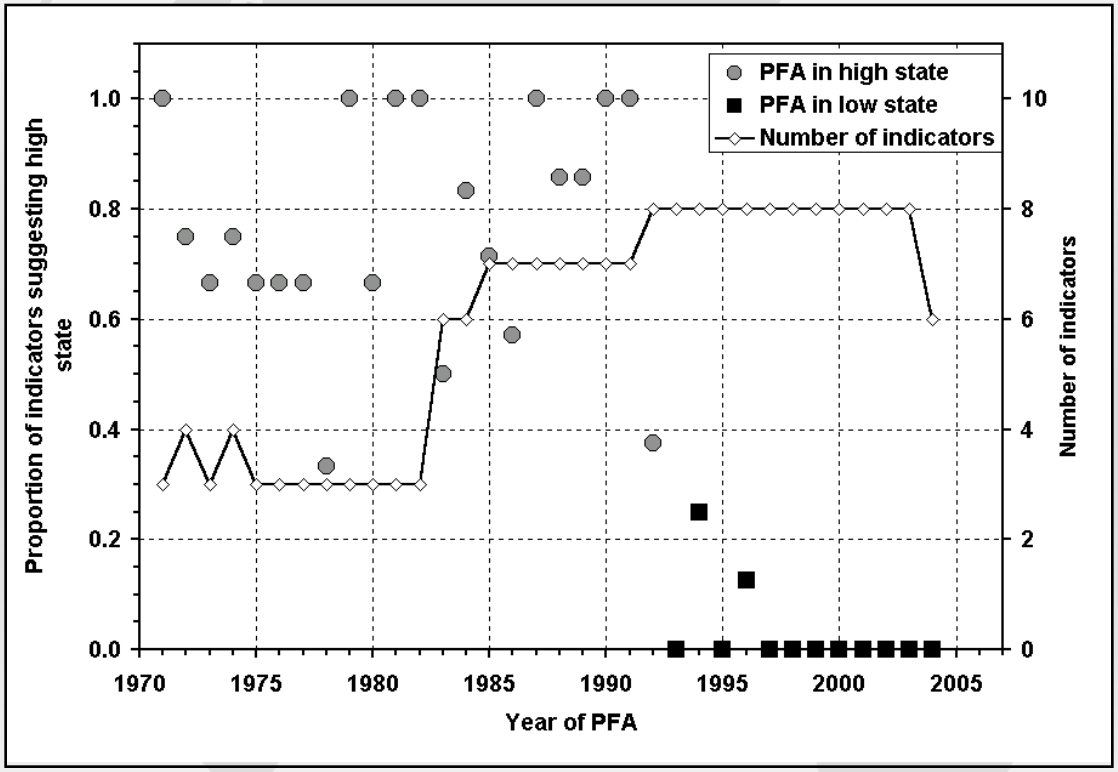
- Equal penalty for false highs and false lows

- 0.25% return rate minimizes the sum of incorrect assignments



Can combine multiple rivers with river-specific indicators

- 2SW/large salmon for 8 rivers
- Proportion exceeding decision rules are highly variable
- However, when returns to 50% of indicator rivers exceeded the river-specific decision rules - PFA abundance was generally above the threshold



Assigning the state of PFA abundance for the years 1971 to 2004 using the returns of large/2SW salmon simultaneously for three to eight monitored rivers in North America

NASCO has asked ICES to provide an assessment of the minimum information needed which would signal a significant change in the previously provided catch advice for each Commission area

Conclusions and suggested approaches

- Southern NEAC MSW stock complex indicators can be explored
- Further development/analyses is needed
- Continuation and possible expansion of population monitoring programs required

- Return rates of smolts would be better indicators of PFA state
  - they are corrected for smolt output - returns are not
  - assumes that smolt production is comparable over time

- There are no data on the movement from a low state to a high state

- High state should be describe as providing a high probability of meeting the CLs (e.g. 75% probability level used for catch options)

Compilation of tag releases and finclip data by ICES member countries in 2005

- 5.64 million salmon were marked in 2005
  - an increase from the 4.95 million fish marked in 2004
  - adipose clip most common, microtags (cwt) next most
  - passive integrated transponder (PIT) releases increasing
- Some marking of farmed salmon in Iceland and USA (cwt, genetic marking, and fin clips)

Analysis of historic tagging data

- Research on salmon at sea is resource intensive and expensive
- Available North Atlantic-wide tag recovery datasets may help focus salmon at sea research
  - minimally 8,000 salmon recovered at Greenland and Norwegian Sea/Faroes
    - 7,000 tagged as smolts and 800 as adults
  - various states of analyses/reporting

ICES recommends a workshop on the development and use of old tagging information from oceanic areas

NASCO has requested ICES to identify relevant data deficiencies, monitoring needs and research requirements taking into account NASCO's international Atlantic salmon research board's inventory of on-going research relating to salmon mortality in the sea

Recommendations for the North Atlantic Area Commission

- ICES recommends that **NASCO considers supporting the development of collaborative efforts to genetically characterize salmon stocks** across the North Atlantic and the development or continuation of genetic sampling programmes for all mixed stock fisheries and populations contributing to mixed-stock fisheries.
- ICES recommends that **NASCO encourage all Parties to support the continuation of current monitoring programmes** across the North Atlantic and encourage the development of opportunities for initiating new monitoring programmes.
- ICES recommends that a **workshop be organized to assemble and analyze historical tagging information** to investigate trends in migration and marine distribution of Atlantic salmon at sea.

Recommendations for the North East Atlantic Commission

- ICES recommends that **non-catch mortality in relation to bycatch** of Atlantic salmon at sea be evaluated.

Recommendations for the North American Commission

- No recommendations from the North American Commission area.

Recommendations for the West Greenland Commission

- ICES recommends that the Home Rule Government of Greenland provides **information on the extent of fishing activity by all license holders**. Furthermore, it would be helpful if reports filled out by fishers offered the option to report date of catch and number of fishing nets.
- ICES recommends that a **broad geographic sampling program** be undertaken (multiple NAFO divisions) to more accurately estimate continent of origin in the mixed-stock fishery.
- ICES recommends that the Home Rule Government of Greenland **improves the estimates of the annual catches** of salmon taken for private sales and local consumption in Greenland.

River Drammen, Norway

Courtesy of Lars Petter Hansen

ICES Advice to NASCO 2006

North-East Atlantic Commission

Timothy Sheehan
WGNAS Chair

Questions posed to ICES, with respect to Atlantic salmon in the North-East Atlantic Commission Area

1. Describe 2005 fisheries and the status of the stocks

2. Any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

3. Further develop the age-specific stock conservation limits where possible based upon individual river stocks

4. Provide annual catch options or alternative management advice for 2006-2008

5. Update and further refine estimates of by-catch of salmon in pelagic fisheries (including non-catch fishing mortality) with an assessment of impacts on returns to homewaters

NASCO has requested ICES to describe the key events of the 2005 fisheries and the status of the stocks

Fishing at Faroe

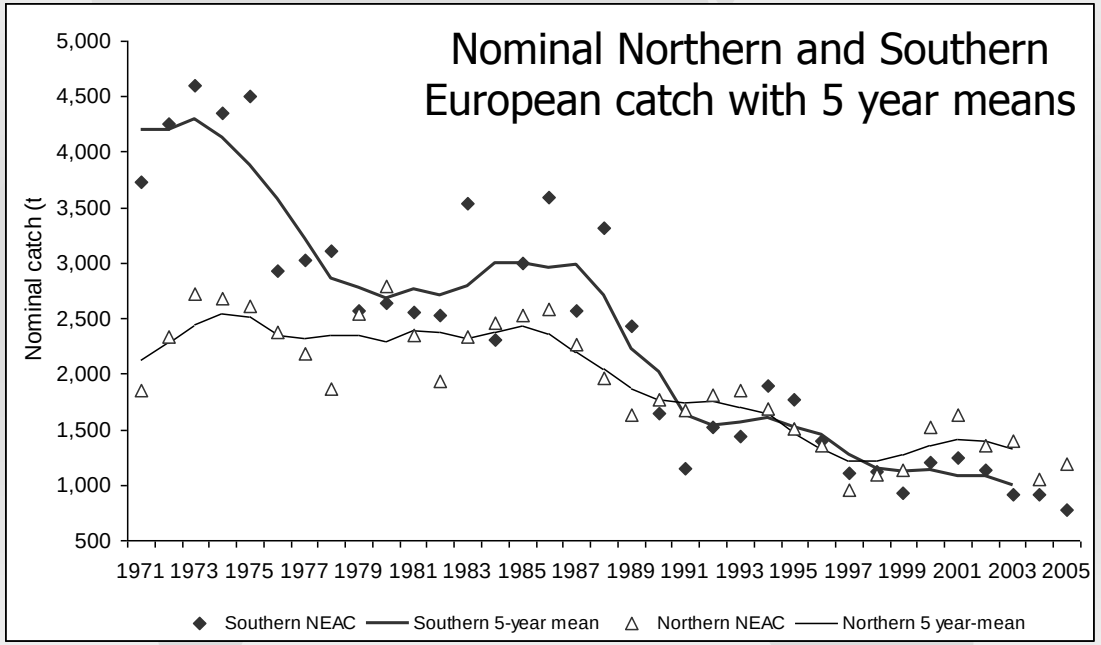
- no fishing in 2004/2005 or 2005/2006 to date

Significant events in NEAC homewater fisheries in 2005

- UK (England & Wales) – accelerated phase out of drift net fishery
- Ireland – continued TAC reductions
- Norway – bag net buyouts

Gear and effort

- no significant changes
- continued downward trend in effort (except for rod fisheries)



Catches

- NEAC total 1,964 mt – similar to 2004 (1977 mt)
- Continued downward trend (since 1980's) for both Northern and Southern NEAC
  - due to changes in various management measures and decreasing stock size

2005 Fisheries

Catch per unit effort (CPUE)

- General decrease over the time series

Age composition of catches

- Slightly over 60% of the Northern and Southern harvests were 1SW
- Consistent with 5 and 10 year means

Farmed and ranched salmon in catches

- Remains low in most countries (<2% of catch) and similar to recent years
  - Norway is still the exception

2005 Fisheries

National origin of catches

- Irish fisheries - 51 tags non Irish tags were recovered in 2005 and added to the time series (1985-2005)
  - UK (N. Ireland) (28)
  - UK (England & Wales) (10)
  - Spain (7)
  - Germany (5)
  - Denmark (1)

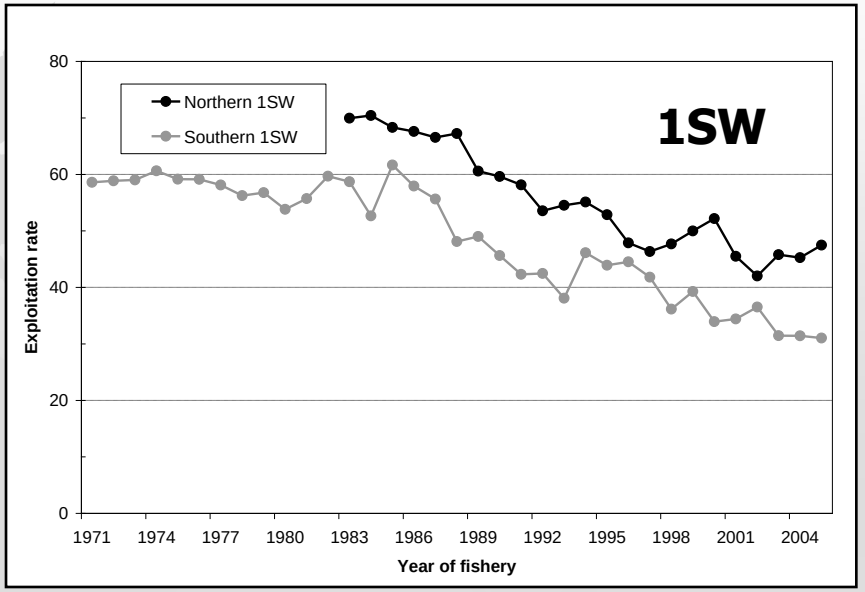
- Time series analysis indicated that highest recapture rates are for:
  - UK (N. Ireland), UK (Scotland), Denmark, France, UK (England and Wales), Spain, Germany, and Norway respectively

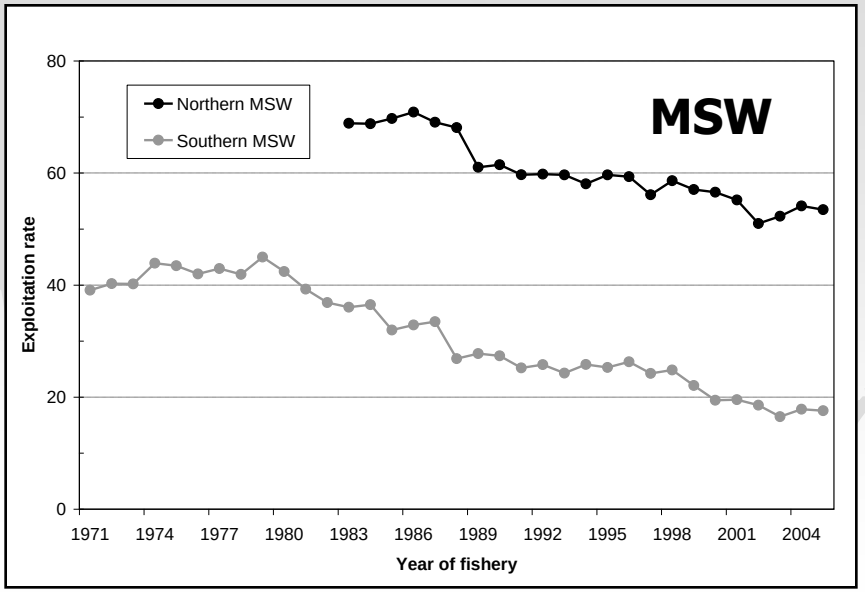
- ICES notes that exploitation rates vary considerably from year to year
  - may be high for some stocks in some years and negligible in other years
  - even low levels may impede recovery for stock below their CL

2005 Fisheries

- Exploitation rates have decreased over the time period and are amongst lowest in time series

- Exploitation rates on Northern stocks are generally higher than on Southern stocks
  - considerably higher for MSW





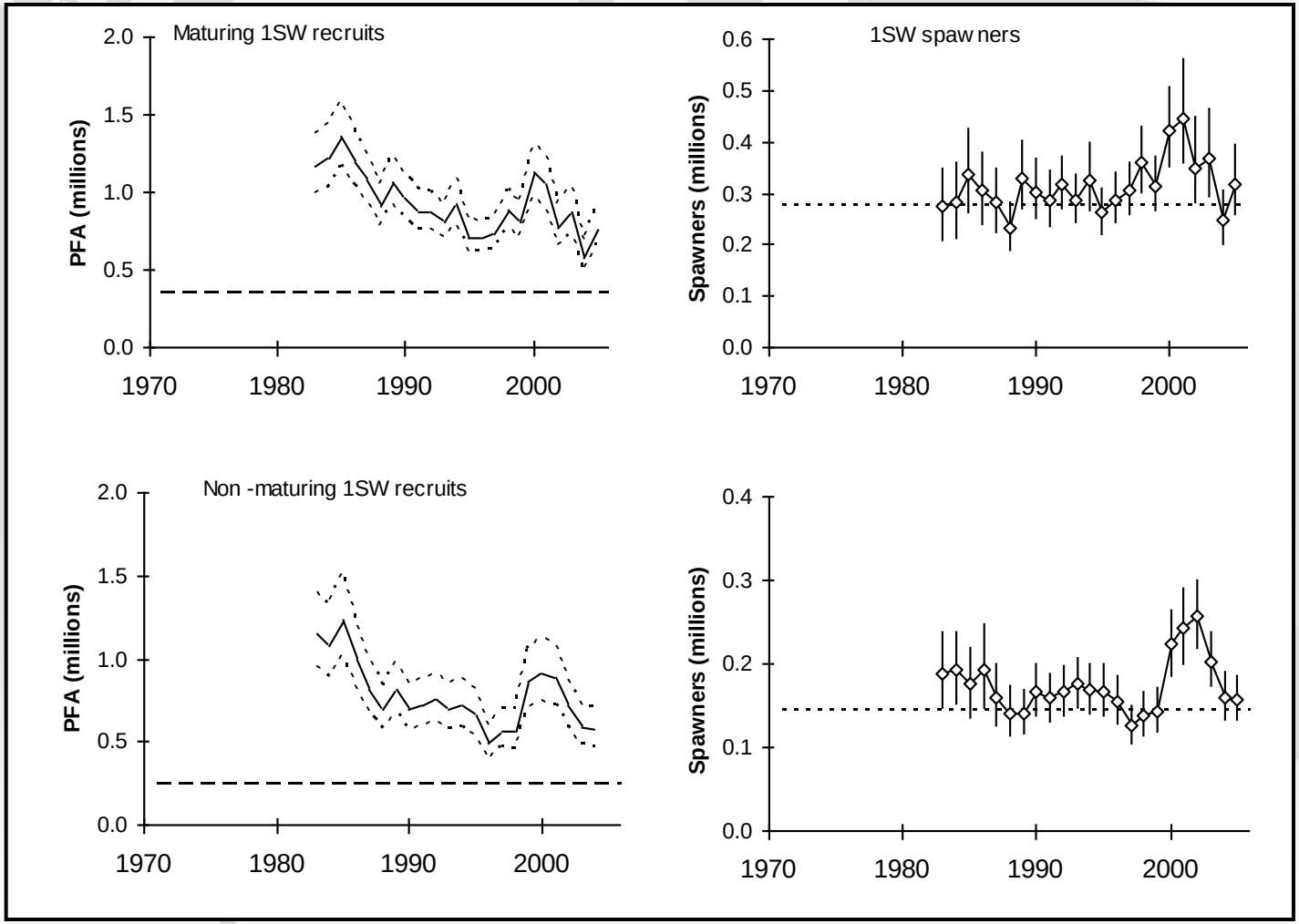
Status of the stocks

Northern European 1SW and MSW stock complexes were above their conservation limits in 2005. However, these stocks are considered to be **at risk of suffering reduced reproductive capacity**

Southern European 1SW and MSW stock complexes were below their conservation limits in 2005. These stocks are considered to be **suffering reduced reproductive capacity**

Status of the stocks

Northern NEAC



1SW

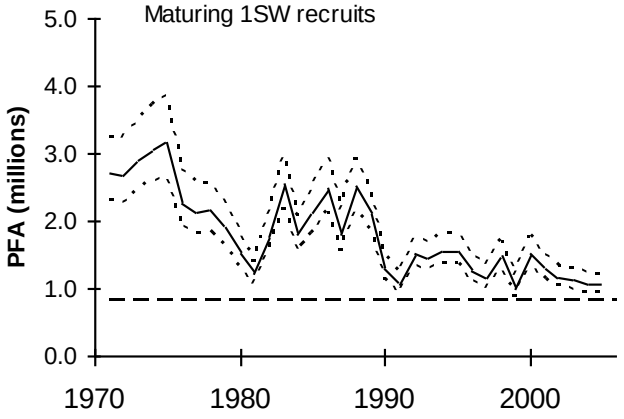
MSW

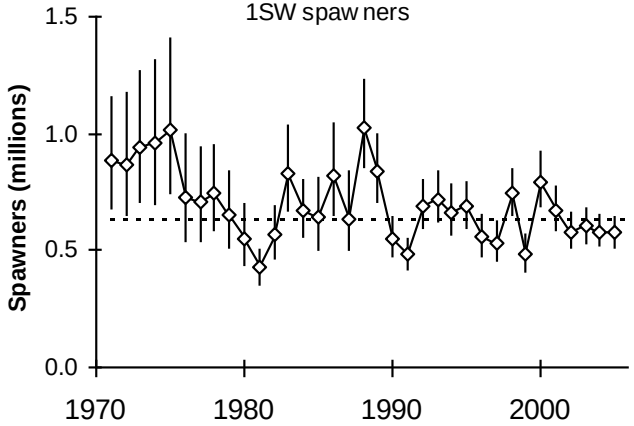
Estimated PFA vs SER

Estimated spawners vs CL

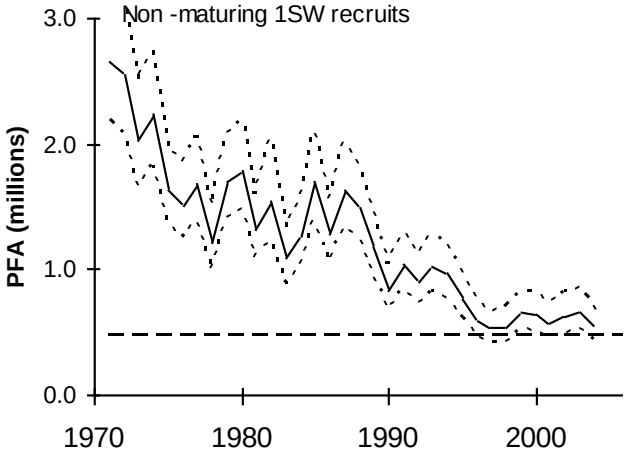
Status of the stocks

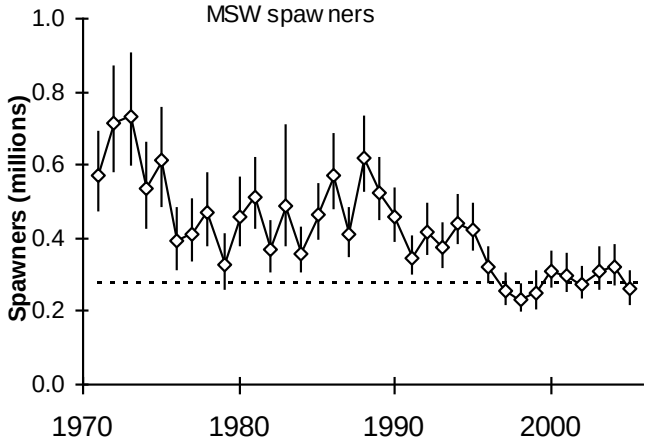
Southern NEAC





1SW





MSW

Estimated PFA vs SER

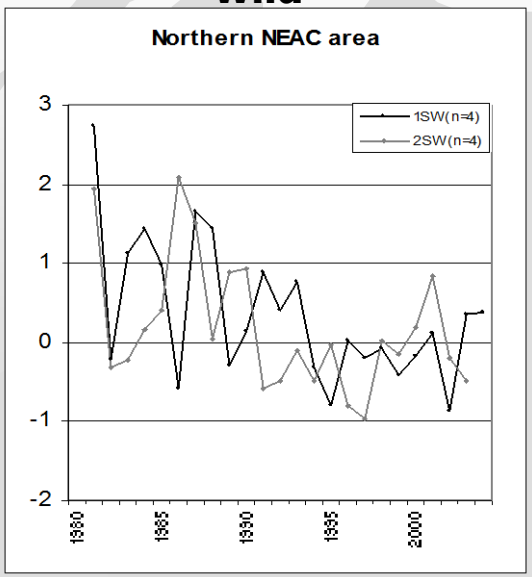
Estimated spawners vs CL

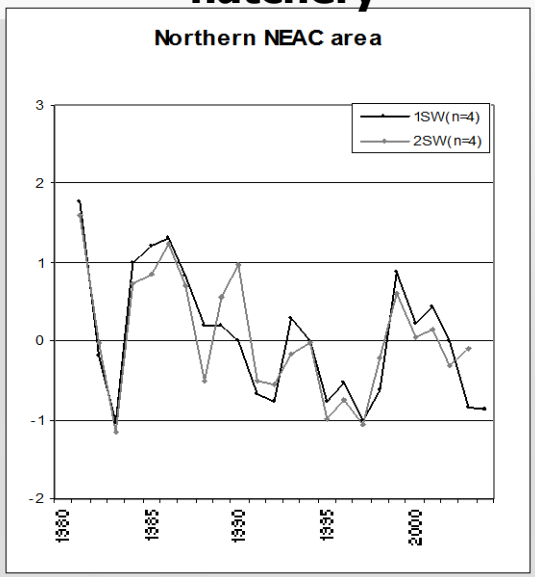
Status of the stocks

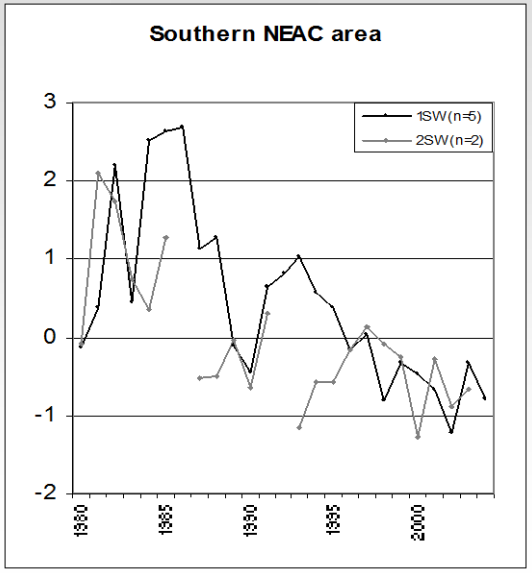
Survival indices for NEAC stocks

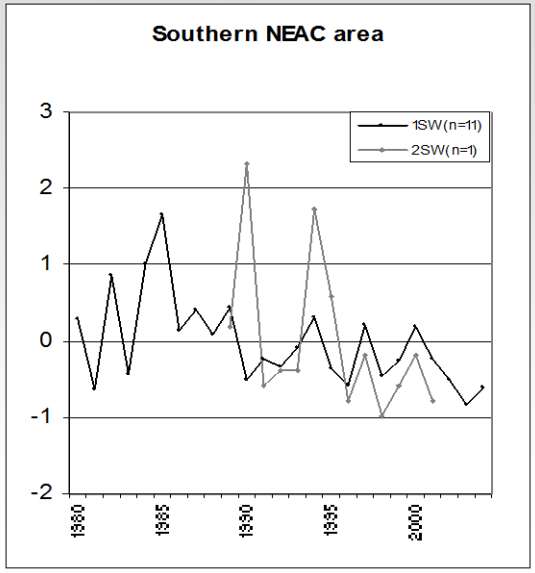
- Standardized time series indices
- General decline over past 20 years
  - most significant for wild Southern smolts
  - wild stock more variable than hatchery
- Results are consistent with return and spawner data
- Suggestive that returns are strongly influenced by factors in the marine environment

wild | **hatchery**









NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

- All EU countries have been provided a specific conservation objective arising from the “Habitats Directive”
  - Council Directive 92/43/EEC (on the conservation of natural habitats and of wild flora and fauna)

"If a species is included under this Directive, it requires measures to be taken by individual member states to maintain or restore them to favorable conservation status in their natural range”

- Reports detailing conservation status are required every 6 years, starting in 2007

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

- National and local objectives were reported by individual countries
  - countries not represented haven’t reported on recent management measures implemented by their countries

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

France

- Objective – reduce MSW exploitation and increase CL compliance
- Measure – closures of some fisheries (1994, Loire-Allier), TAC introductions for some fisheries (1996, Brittany and Lower Normandy), and various management measures enacted for other fisheries (1999 and 2003, Adour-Gaves basin)
- Outcome -
  - no enhancement detected in some cases (Loire-Allier)
  - reduced harvests in some cases possibly resulting in increased escapement (Brittany and Lower Normandy)
  - increased exploitation with lapse of measures, current regulations unable to reduce exploitation (Adour-Gaves basin)

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

Germany

- Objective – reintroduction of some extinct stocks whose habitat was deemed suitable
- Measure – juvenile stocking in North Sea rivers
- Outcome -
  - 200-500 adult returns annually, < 1% return rate

- Objective – establish free migration routes for salmon and other anadromous fishes
- Measure – Rheine programm 2020 started
- Outcome -
  - assessment in progress

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

Ireland

- Objective – reduce exploitation and increase freshwater returns
- Measure – annual TAC reduction since 2002, reduction in bag limits
- Outcome -
  - wild exploitation rate reduced from 62% (pre-2002) to 46% (post-2002)
  - hatchery exploitation rate reduced from 82% (pre-2002) to 69% (post-2002)
  - exploitation of UK stocks reduced by 50%

- Objective – maintain stocks at favorable conservation status
- Measure – annual TAC reduction since 2002, reduction in bag limits
- Outcome -
  - stocks meeting CL (10)
  - stock above 50% of CL (8)
  - stock below 50% of CL (6)
  - stock of uncertain status (2)

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

Russia

- Objective – reduce fishing effort and enhance catch and release
- Measure - several management changes including prohibition of some important in-river fisheries
- Outcome -
  - commercial catch reduced by 55% (2001-2005 vs. 1996-2000)
  - catch and release increased 50% in last 5 years

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

UK (England and Wales)

- Objective – safeguard MSW stock component
- Measure – measures introduced in 1999
- Outcome -
  - increase of spring salmon abundance by 1/3 on some rivers

- Objective – meet CLs for 4 out of 5 years
- Measure – phase outs, closures, and reductions of mixed-stock fisheries
- Outcome -
  - large coastal catch reductions and rod catch increase

- Objective – meet River Lune management targets
- Measure – net and rod exploitation rate reductions (50% and 25%)
- Outcome -
  - increases in spawning escapement and juvenile production

- Objective – Maintain stocks at favorable conservation status
- Measure – Targeted actions to address specific issues
- Outcome -
  - stocks meeting CL (2)

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

UK (Scotland)

- Objective – improve early MSW status
- Measure – delay of net fishing season
- Outcome -
  - 80% reduction in MSW early season net fishery catch relative to previous 5 year mean

- Objective – improve early MSW status
- Measure – delay of net fishing season and catch and release only
- Outcome -
  - indications of increased escapement

NASCO has requested ICES to further develop the age-specific stock conservation limits where possible based upon individual river stocks

Most NEAC countries don't have river-specific CLs

- Only France, Ireland, and UK (England & Wales) do to date

Updates only are provided

<u>Ireland</u>

- Modification made to CLs to account for uncertainty in meeting river-specific CLs simultaneously in each District

<u>UK (England & Wales)</u>

- CL for one river revised
  - re-evaluation of the accessible wetted area
  - inclusion of river-specific data on fry and parr densities

<u>UK (Scotland)</u>

- begun to develop a procedure for setting river-specific CLs based on useable wetted area model using GIS

Relevant factors to be considered in management

- ICES considers that management should be based on assessments of the status of individual stocks
- Fisheries on mixed stocks, either in coastal waters or in distant waters pose particular difficulties for management, as they cannot target only those stocks that are within precautionary limits
- Conservation would best be achieved if fisheries can be targeted at stocks that have been shown to be at full reproductive capacity
- Fisheries in estuaries and rivers are more likely to fulfill this requirement
- Based on previously defined stock groupings
  - Faroes fishery should be based on all NEAC stock complexes
  - West Greenland fishery should be based on Southern NEAC MSW stock complex

NASCO has requested ICES to provide annual catch options or alternative management advice for 2006-2008

- ICES emphasizes that national stock CLs are not appropriate for management of homewater fisheries
  - relative imprecision of national CLs
  - overlook status of individual rivers or sub-river populations
- Regardless, ICES agrees that these groupings can provide general management advice for distant water fisheries

Reference points for management advice

- Spawner reserve - # of PFA salmon required for subsequent returns (accounting for natural mortality) to achieve region-specific CLs

- CL - # of spawners required to achieve MSY
  - number of spawners required to fully seed the wetted area of the river
  - pseudo stock-recruitment observations
  - adult-to-adult stock and recruitment relationship

- CLs are limit reference points (S_{lim}) and should be avoided with high probability

Northern European 1SW stock complex

Considering the stock complex is
at risk of suffering reduced reproductive capacity

- Decrease overall exploitation to consistently meet CL
- Inclusion of farmed fish may overestimate stock status
- Management should be based on status of individual river or sub-river stocks
- Fisheries on maturing 1SW salmon should **only be on river stocks shown to be at full reproductive capacity**

Northern European MSW stock complex

Considering the stock complex is
at risk of suffering reduced reproductive capacity

- Decrease overall exploitation to consistently meet CL
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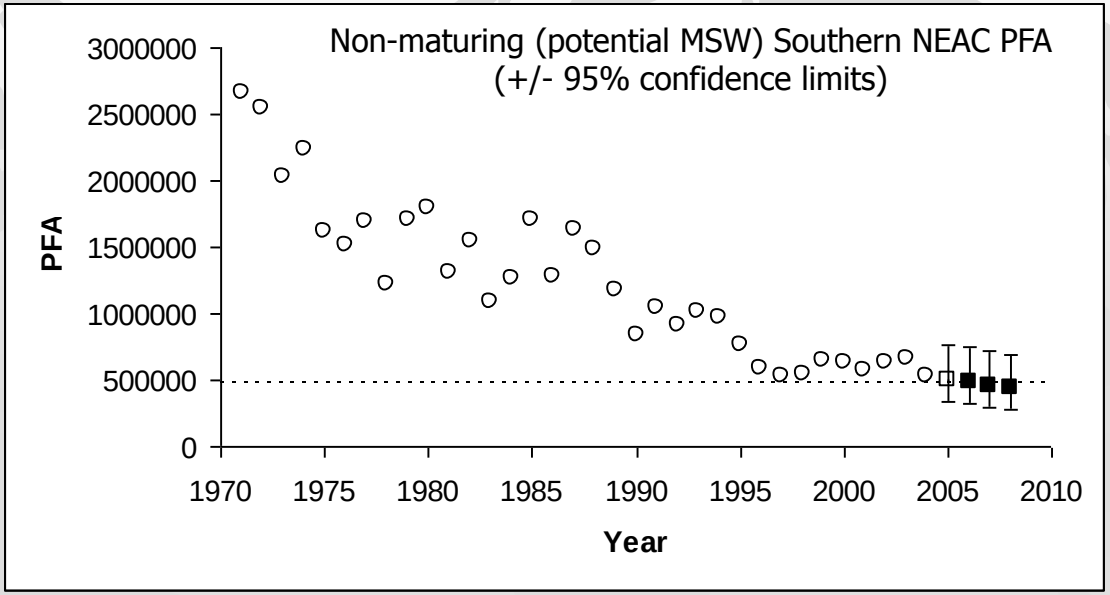
Southern European 1SW stock complex

Considering the stock complex is
suffering reduced reproductive capacity

- Reduction in exploitation is required to increase probability of meeting CL
- Mixed-stock fisheries pose particular threats given the different status of individual stock
- Fisheries on maturing 1SW salmon should **only be on river stocks shown to be at full reproductive capacity**

Southern European MSW stock complex Pre-Fishery Abundance Forecasts, 2006-2008



- Multi-year projections only available for Southern NEAC MSW stock complex
- PFA is number of 1SW recruits on 1st January in the first sea winter (stock status)
- Basis for catch advice for 2006-2008 Faroes and West Greenland fisheries
- 2005 PFA forecast updated from 505,000 to 486,000
  - 2006-2008 estimates - 489,000, 461,000, and 440,000

Southern European MSW stock complex

Considering the stock complex is
suffering reduced reproductive capacity

- Reduction in exploitation is required to increase probability of meeting CL
- Mixed-stock fisheries pose particular threats given the different status of individual stock
- There is < 75% probability of the 2006-2008 PFA being above the SER, therefore no fishing at West Greenland
- The 2006-2008 PFA forecast midpoints are below the SER, therefore no fishing at the Faroes
- Fisheries on maturing MSW salmon should **only be on river stocks shown to be at full reproductive capacity**

NASCO has requested ICES to update and further refine estimates of by-catch of salmon in pelagic fisheries (including non-catch fishing mortality) with an assessment of impacts on returns to homewaters

- SGBYSAL did not meet in 2006
- New information reported directly to Working Group
  - Russian Pelagic Fish Survey and Russian Commercial Screening Program
    - results suggest that Russian vessels using traditional pelagic trawl design and rigging are unlikely to catch significant numbers of salmon post smolts or adult salmon
  - Iceland questionnaire
    - estimated low level of salmon bycatch in 2005 by Icelandic fleet (5110 salmon)
      - <0.001% of total Icelandic commercial catch
  - Faroese herring fisheries
    - no salmon bycatch reported
  - Germany
    - only country to respond to SGBYSAL disaggregated data request

Conclusion

- **SGBYSAL 2005 conclusions still valid**
  - **low impacts of salmon bycatches on PFA or returns to homewaters**

River Teno, Finland

Courtesy of Jaakko Erkinaro

ICES Advice to NASCO 2006

North American Commission

Timothy Sheehan
WGNAS Chair

Questions posed to ICES, with respect to Atlantic salmon in the North American Commission Area

1. Describe the 2005 fisheries and the status of the stocks

2. Any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

3. Update age-specific stock conservation limits based on new information as available

4. Provide annual catch options or alternative management advice for 2006-2008

NASCO has requested ICES to describe key events of the 2005 fisheries and the status of the stocks

Gear and effort

- Canada
  - no commercial harvest
  - 3 user groups:
    - aboriginal peoples' food fisheries
    - residents fishing for food in Labrador
    - recreational fishers
- St. Pierre et Miquelon
  - gillnet fishery
- USA
  - no recreational or commercial fisheries

2005 Fisheries

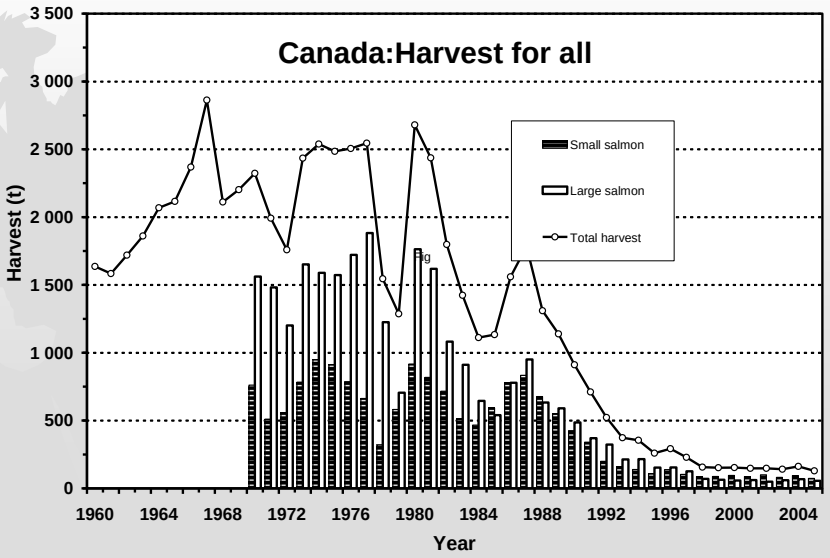
Catches in 2005

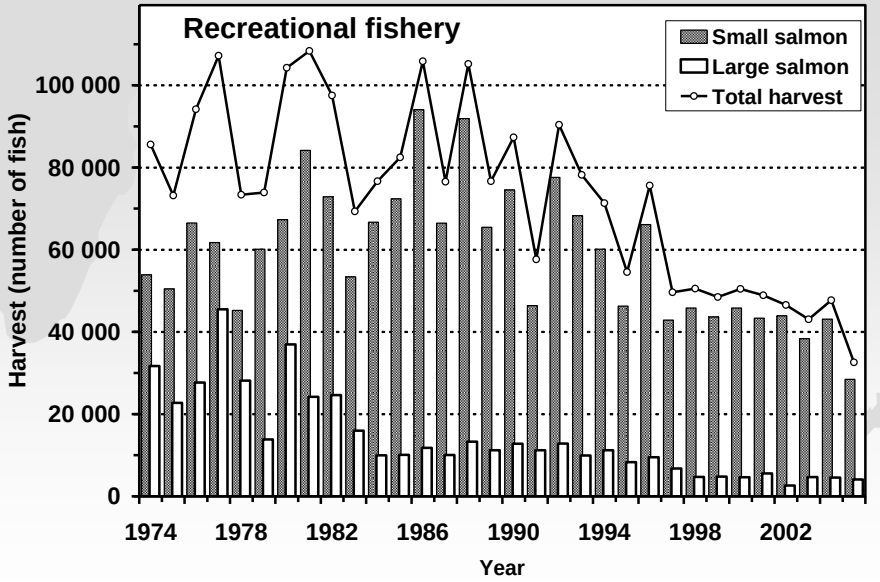
- Total NAC harvest (129 mt) decreased by 20%
  - 41 709 small salmon (23% decrease)
  - 10 949 large salmon (15% decrease)
  - USA 0 mt
- Unreported (101 mt)
- Saint-Pierre and Miquelon (3.3 mt)
  - among largest catch on record (18% increase)

2005 Fisheries

Catches in 2005

- Aboriginal peoples' food fisheries
  - harvests in 2005 (56.4 mt) decreased 7 % but increase of 14 % over 5-yr average
- Residents fishing for food in Labrador
  - 2.6 mt (80% small salmon)
- Recreational fishers
  - 32 585 fish, ~31% below 2004 and 5-yr mean





2005 Fisheries

Origin and composition of catches

- No reports of tagged fish captured in 2005 Aboriginal Peoples' and resident food fisheries
- Saint-Pierre and Miquelon 2004 harvest was 100% NA origin of which 98% originated in Canada and 2% originated in the USA

Exploitation rates

- No directed exploitation by commercial fisheries
- Little other data reported

Status of the stocks

In 2005, the midpoint of the spawner estimates for six geographic areas indicated that all areas except Newfoundland were below their conservation limit for 2SW salmon and **are suffering reduced reproductive capacity**. **Newfoundland was at risk of suffering reduced reproductive capacity.**

Status of stocks

Estimates of total adult abundance by geographic area (1SW)

Labrador

- 129% increase – highest in time series

Newfoundland

- 25% increase and 33% over 5-yr mean

Québec

- 32% decrease and 16% under 5-yr mean

Gulf

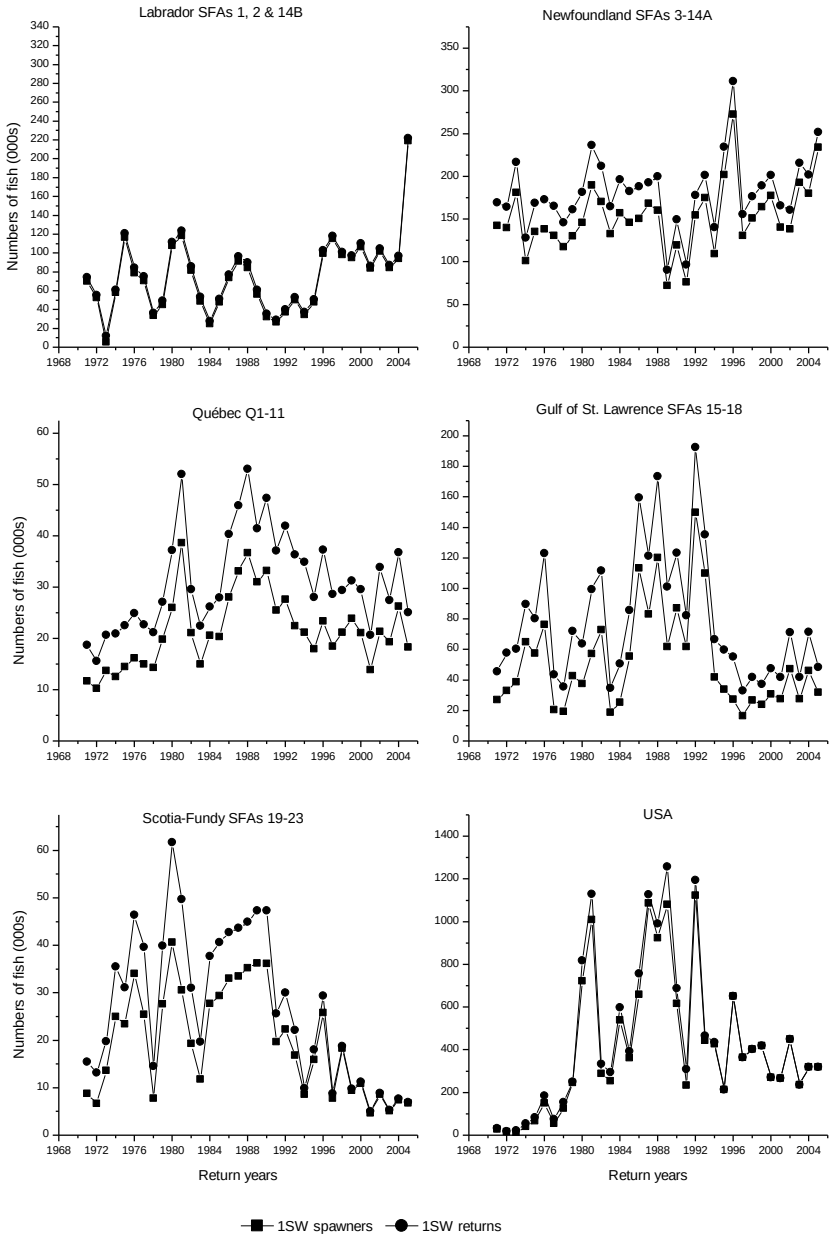
- 32% decrease

Scotia Fundy

- 10% decrease and 3rd lowest

USA

- Similar to 2004 and over 5-yr mean



Status of stocks

Estimates of total adult abundance by geographic area (2SW)

Labrador

- 14% increase but below 5-yr mean

Newfoundland

- 24% increase and > 5-yr mean

Québec

- Similar to 2004 and 5-yr mean

Gulf

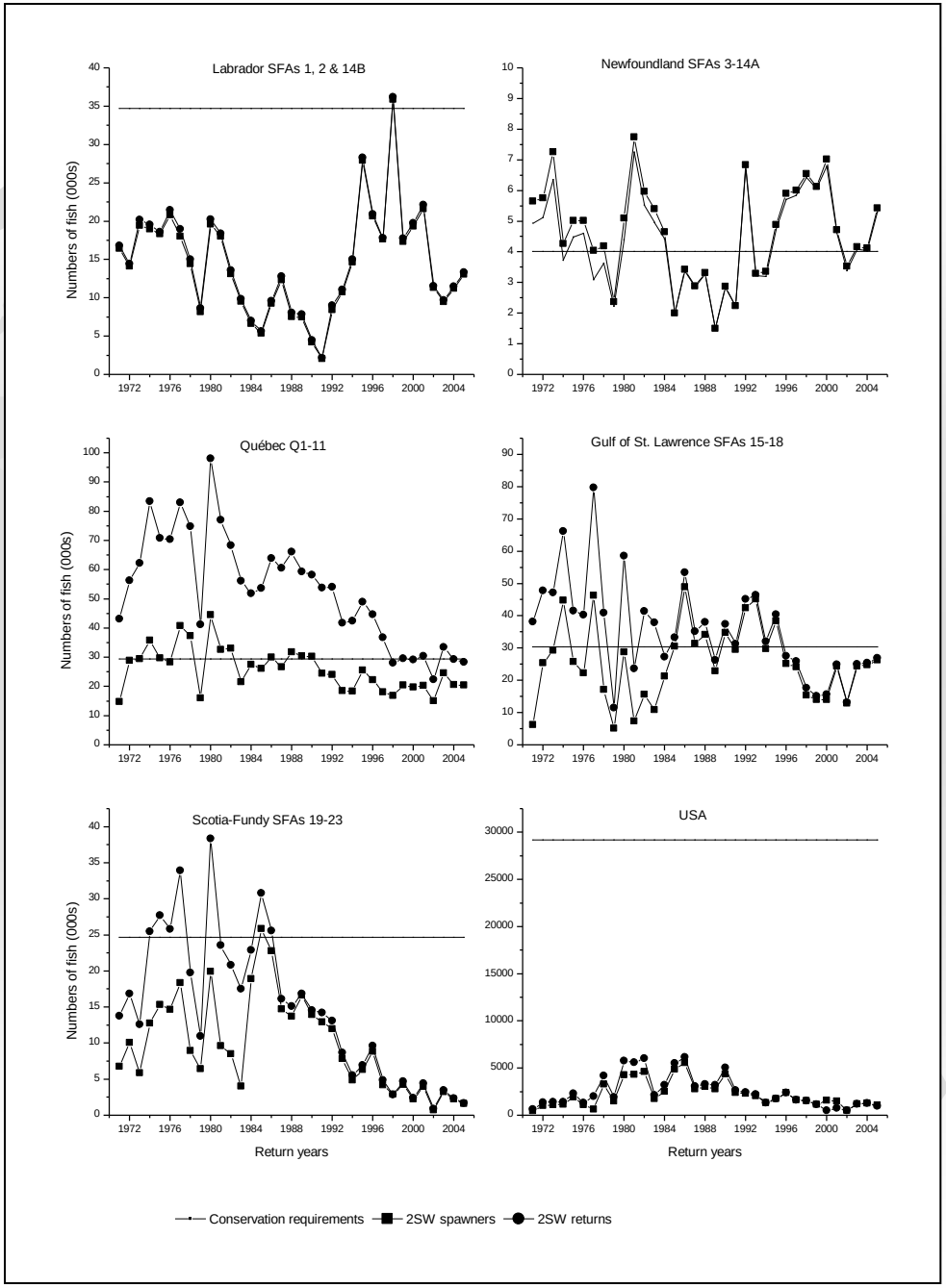
- Similar to 2004

Scotia Fundy

- 28% decrease and among lowest

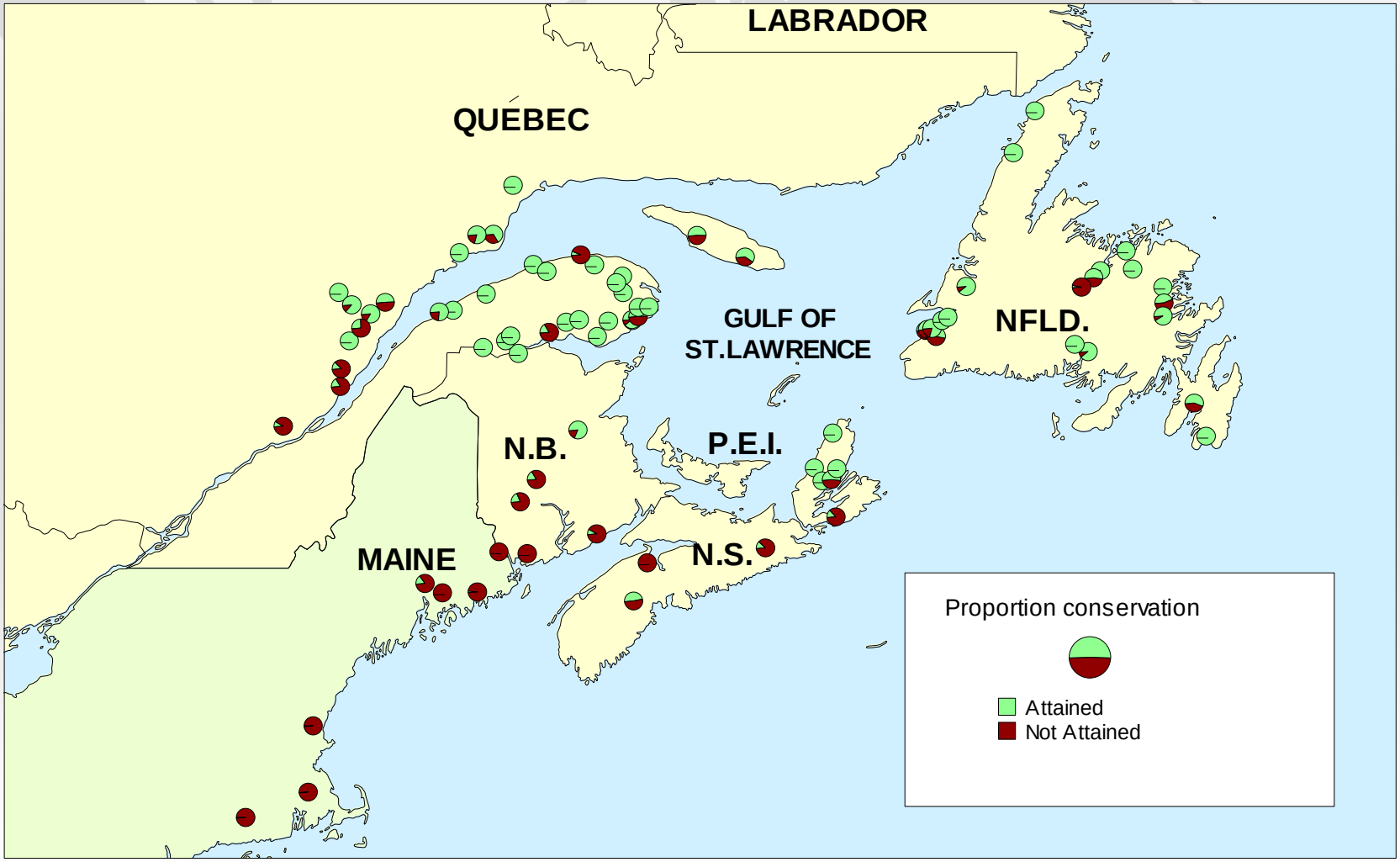
USA

- Decreased but increase over 5-yr mean



Status of the stocks

Egg depositions (all sea-ages) exceeded or equalled the river-specific CLs
42% of assessed river (34 of 81)

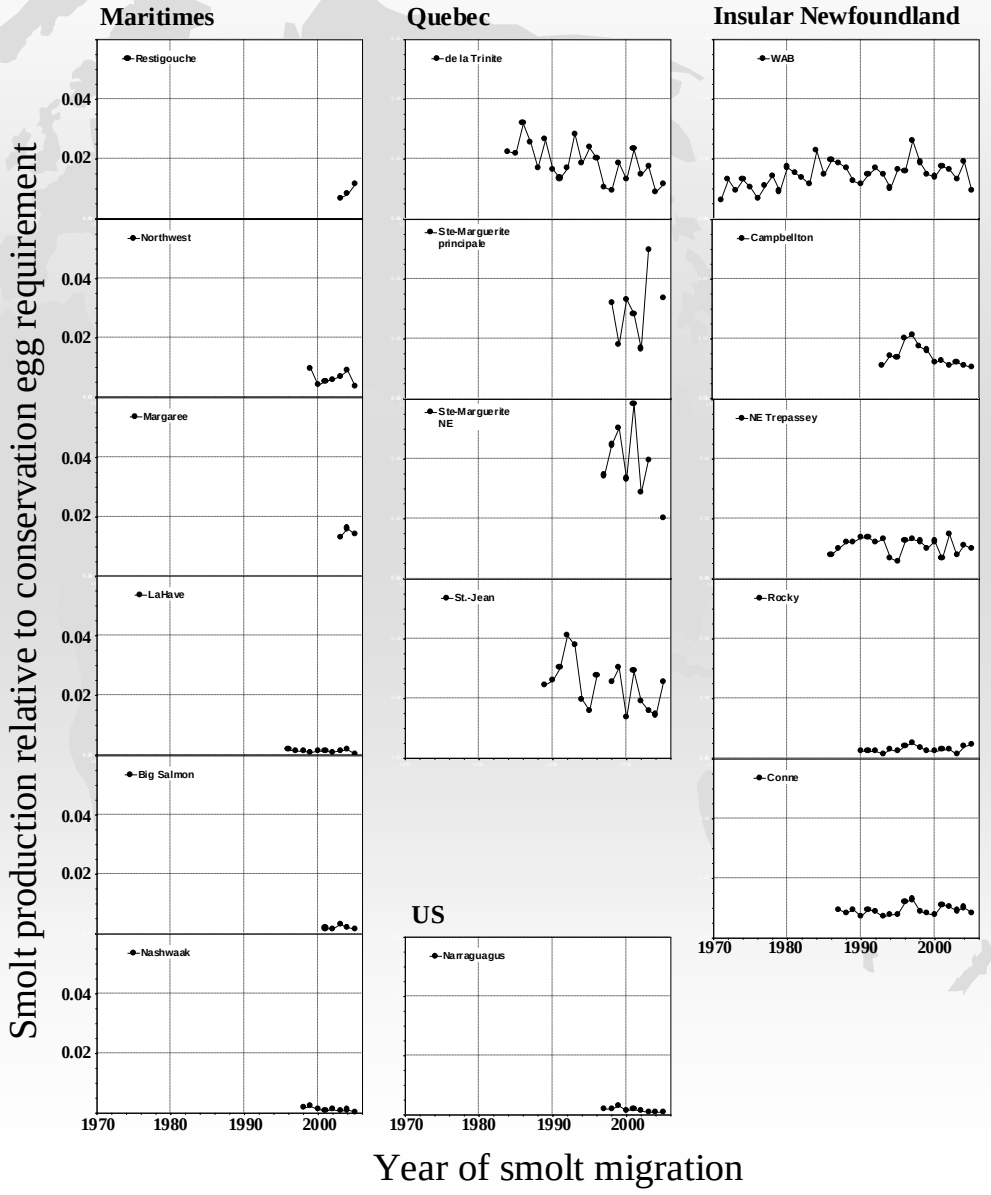


Status of the stocks

Smolt and juvenile abundance

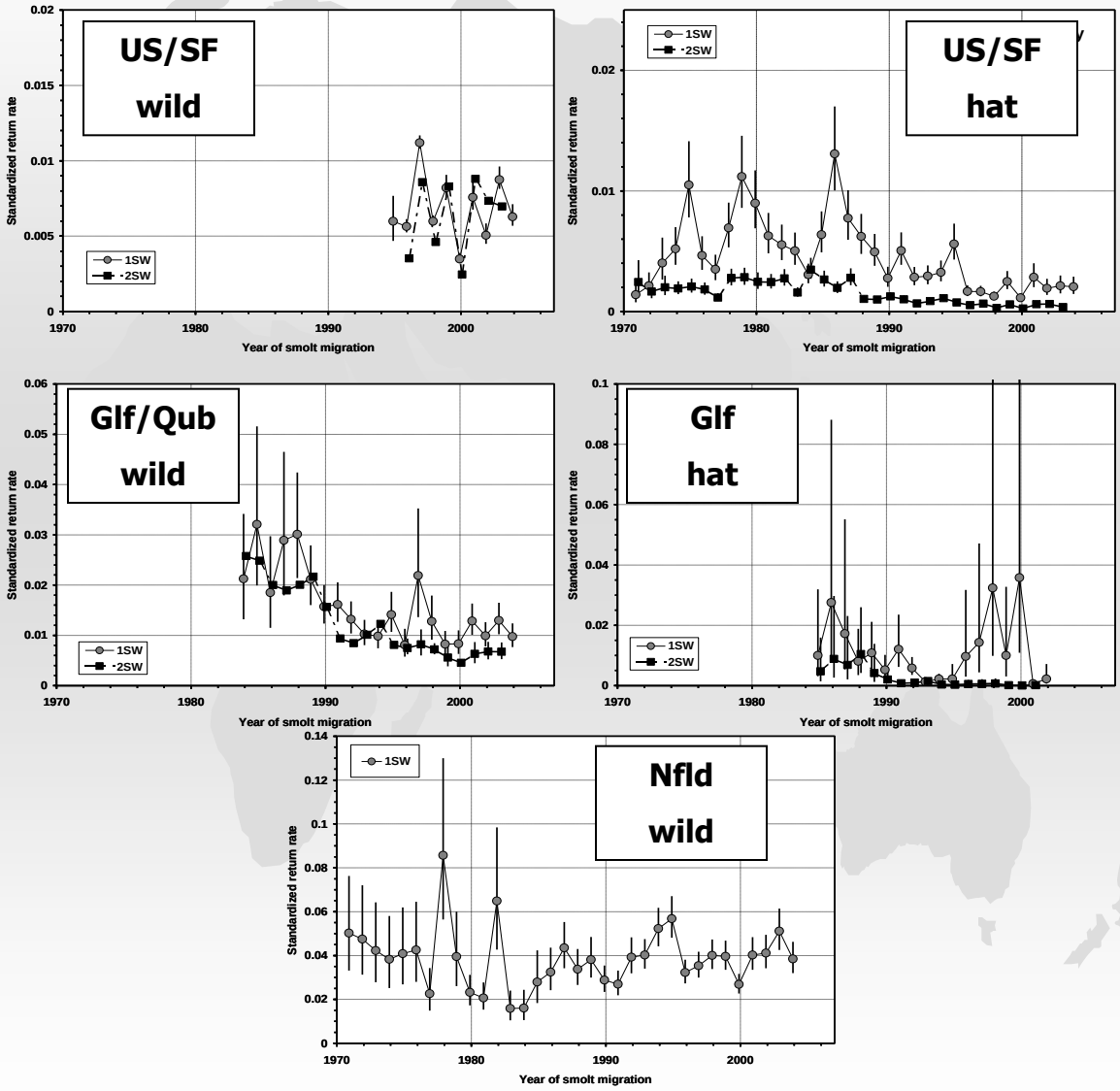
- Canadian smolt production decreased in 8 of 13 monitored rivers
- USA smolt production remains critically low

- Juvenile production remains variable



Status of the stocks

- Survival is low compared to historical levels, especially in the south
- 1SW return rates in MSW salmon stocks (Maritimes, Québec, USA) are lower than those in predominantly 1SW salmon stocks of Newfoundland
- Return rates of wild stocks exceed those of hatchery stocks
- Survival did not increase after commercial closures (1992, 1997/98, …)



NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved.

- No significant NAC management measures introduced in recent years

NASCO has requested ICES to update age-specific conservation limits based on new information as available

- No changes to conservation limits in 2005

Canada	123 349
USA	29 199
Combined	**152 548**

Relevant factors to be considered in management

- ICES considers that management should be based on assessments of the status of individual stocks
- Fisheries on mixed stocks, either in coastal waters or in distant waters pose particular difficulties for management, as they cannot target only those stocks that are within precautionary limits
- Conservation would best be achieved if fisheries can be targeted at stocks that have been shown to be at full reproductive capacity
- Fisheries in estuaries and rivers are more likely to fulfill this requirement

Management advice

- River-specific management of catch is required to meet river-specific biological conservation limits
- Where river-specific conservation limits are not being exceeded, there is no scope for harvest
- Where river-specific conservation limits are being exceeded, there are no biological reasons to restrict harvest of the surplus

Reference points for management advice

- Spawner reserve - # of PFA salmon required for subsequent returns (accounting for natural mortality) to achieve region-specific CLs

- CL - # of spawners required to achieve MSY
  - number of spawners required to fully seed the wetted area of the river
  - pseudo stock-recruitment observations
  - adult-to-adult stock and recruitment relationship

- CLs are limit reference points (S_{lim}) and should be avoided with high probability

Management advice

- Catch options only provided for the non-maturing 1SW and maturing 2SW components
  - maturing 1SW component is not fished outside home waters and is managed in home waters
- Four years of catch options are possible
- Revised 2006 forecast of maturing 2SW due to updated 2005 PFA plus 2005 harvests (Greenland and Labrador)
- 2007 - 2009 options are based on 2006-2008 PFA forecasts

NASCO has requested ICES to provide annual catch options or alternative management advice for 2006-2008

Catch options for 2006 fisheries on 2SW maturing salmon

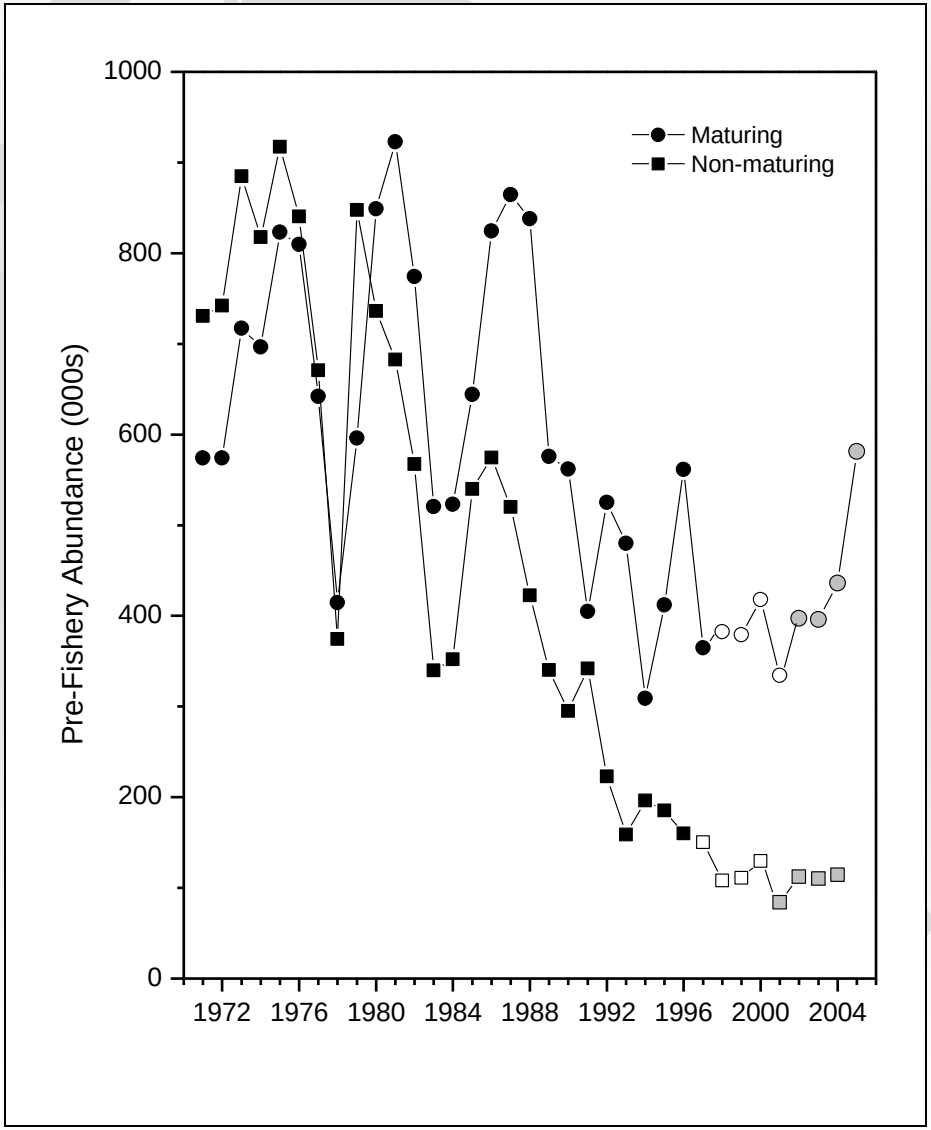
- 2005 PFA (updated) is available to homewaters in 2006
- 2005 PFA (126 000) expressed as 2SW equivalents minus Greenland/Labrador removals and natural mortality equals 87 346 returning fish
  - substantially lower than the 2SW CL of 152 548
- **No catch options** at probability levels of 75% for the composite North American fisheries in 2006
- No biological reasons to restrict harvest on rivers where spawning requirements are being achieved

Comparison with previous assessment and advice

- Revised 2005 PFA (126 000) is ~ 5% higher than previous forecast (120 400) due mainly to
  - slight input value changes
  - parameter values changes (additional PFA and LS values)

Pre-fisheries abundance

- North American Run-Reconstruction Model
  - Unchanged in 2006
- 2004 non-maturing (2SW) PFA estimate 114 578
  - 6th lowest in time series
- 2005 maturing (1SW) PFA estimate 581 362
  - 33% increase



Catch options for 2007-2009 fisheries on 2SW maturing salmon

- Catch options from 2006-2008 PFA would apply to 2007-2009 homewater fisheries
  - median 2006 PFA_{NA} - 119 000
  - median 2007 PFA_{NA} - 114 000
  - median 2008 PFA_{NA} - 120 000
- Accounting for potential Greenland/Labrador removals, natural mortality, and surplus allocation
- **No catch options** for composite North American fisheries for 2007-2009
- No biological reasons to restrict harvest on rivers where spawning requirements are being achieved

St John's Harbor Newfoundland, Canada

Courtesy of Dave Reddin

ICES Advice to NASCO 2006

West Greenland Commission

Timothy Sheehan
WGNAS Chair

Questions posed to ICES, with respect to Atlantic salmon in the West Greenland Commission Area

1. Describe the 2005 fisheries and the status of the stocks

2. Any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

3. Provide annual catch options or alternative management advice for 2006-2008

NASCO has requested ICES to describe the events of the 2005 fishery and status of the stocks

- In 2005, NASCO agreed to restrict the fishery *"to that amount used for internal subsistence consumption in Greenland, which in the past has been estimated at 20t"*

- Greenlandic authorities set commercial quota to nil
  - landings to fish plants, sale to shops and for export were forbidden
  - all catches to be reported to fishery office daily

- Season allowed 01 Aug - 31 Oct

Events of the 2005 fishery

Catch and effort in 2005

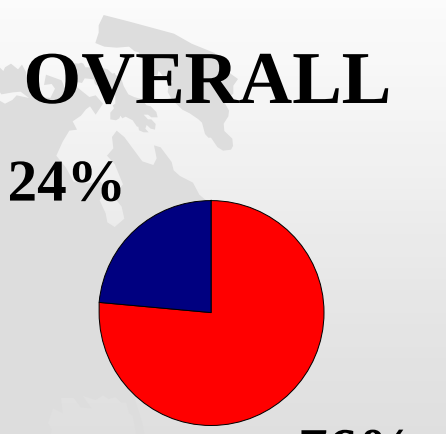
- 13.8 mt reported
- 145 reports received (169 in 2004)
- Only 29 of 185 licenses holders reported landings
- Approximately 50 non-license holders reported landings
- Continued increase in reported landings in north
- Low reported landings in 1st weeks of season
- Some landings reported without week (assigned proportionally)
- Estimated unreported catch of 10 mt

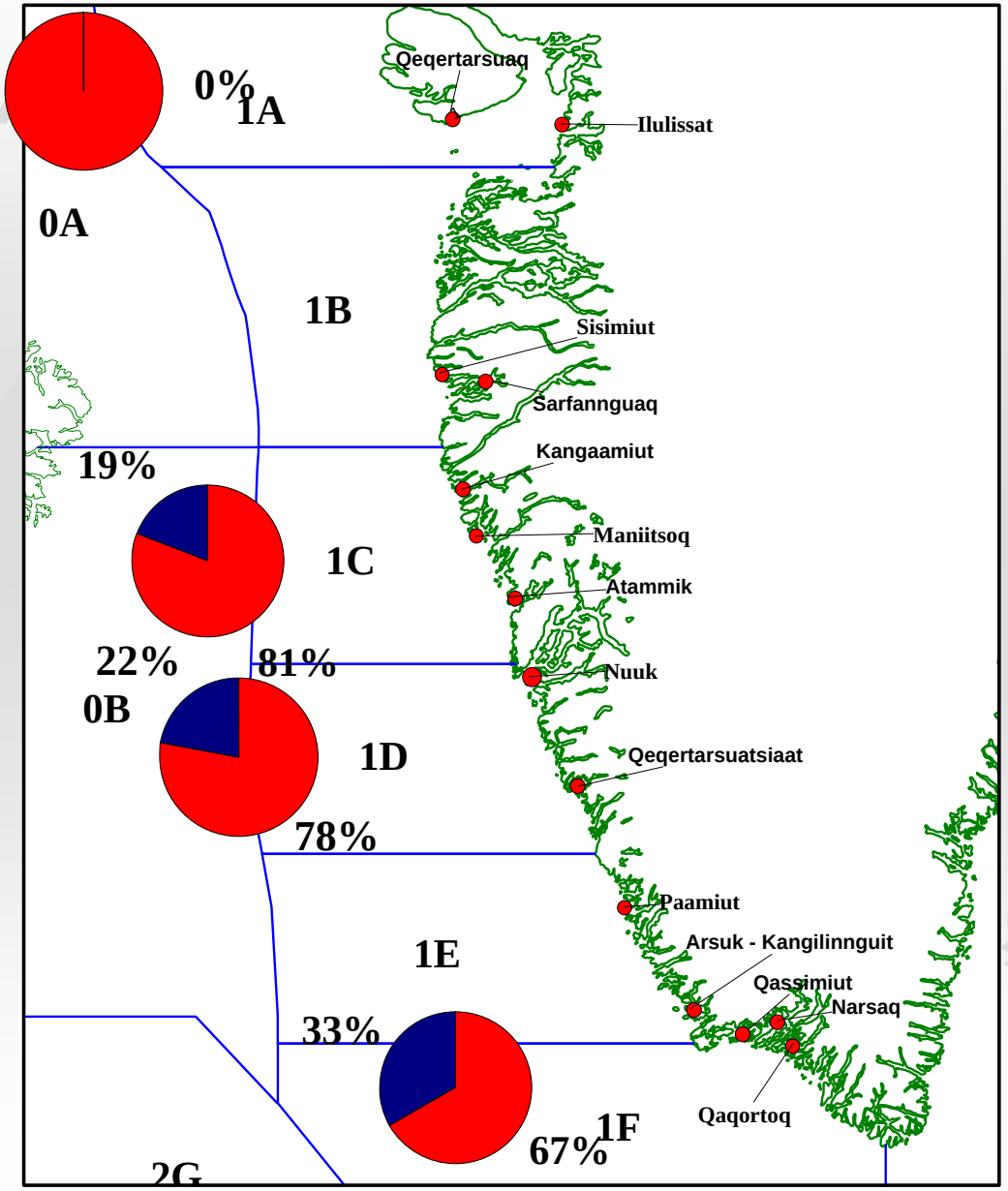
Events of the 2005 fishery

Biological characteristics of the catches

- 854 inspected, 767 sampled (fl, wt, scales, tissue, disease, tags…) from 4 divisions
- More salmon sampled than reported in Nuuk
  - total landings were adjusted for assessment calculations
  - increase of ~ 2 mt

Events of the 2005 fishery





Applying these %s to adjusted catch (15.8 mt) results in:

- 12.1 mt NA origin (3700 fish)
- 3.7 mt EUR origin (1200 fish)

Events of the 2005 fishery

River Age

Continent of Origin	1	2	3	4	5	6
North American	2.7%	21.4%	36.3%	30.5%	8.5%	0.5%
European	19.2%	60.5%	15.0%	5.4%	-	-

Sea Age

Continent of Origin	1SW	2SW	Previous Spawners
North American	92.4%	1.2%	6.4%
European	96.7%	1.1%	2.2%

Status of stocks

ICES considers the stock complex at West Greenland to be below S_{lim} and thus **suffering reduced reproductive capacity**

Status of stocks

Newfoundland
- At risk of suffering reduced reproductive capacity (132% of 2SW CL)

Labrador
- Suffering reduced reproductive capacity (38% of 2SW CL)

Québec
- Suffering reduced reproductive capacity (70% of 2SW CL)

Gulf of St. Lawrence
- Suffering reduced reproductive capacity (86% of 2SW CL)

Scotia-Fundy
- Suffering reduced reproductive capacity (6% of 2SW CL)

USA
- Suffering reduced reproductive capacity (4% of 2SW CL)

Southern European MSW stock complex
- Suffering reduced reproductive capacity (94% of 2SW CL)

NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

West Greenland

- Objective – reduce exploitation
- Measure – restricting the fishery to internal subsistence consumption only (estimated at 20 tons)
- Outcome -
  - fishery caught no more than the negotiated amount

- Objective – 75% of meeting CLs or increasing returns for contributing stock complexes
- Measure – restricting the fishery to internal subsistence consumption only (estimated at 20 tons)
- Outcome -
  - has not been meet

NASCO has requested ICES to provide a detailed explanation and critical examination of any changes to the models used to provide catch options

Pre-Fishery Abundance forecast

- Models used to estimate PFA of non-maturing 1SW salmon for North America was the same as used in 2004 and 2005
- Models used to estimate PFA of non-maturing 1SW salmon from the Southern European stock group was the same as used in previous years

Overall approach:

- The Lagged Spawner variable is an index of the 2SW parental stock of the PFA
  - sum of the lagged spawner estimates for the six North American regions
- Historical relationship between the LS and PFA may be used to forecast future PFA
- Regress natural log transformed PFA and LS and use Monte Carlo resampling to derive a probability density function of PFA forecast
  - phase change incorporated in PFA/LS ratio
  - models include two without phase shifts, plus five models with phase shifts with eight possible break years (1986 to 1993) for each model
  - AIC criterion used to select the appropriate model in each simulation (10 000 total)
- Uncertainty in the input data and model selection accounted for

Risk Assessment of Catch Options

- Developed for each stock complex (NAC and NEAC) in parallel and then combined
- Primary inputs are:
  - PFA forecast for the year of the fishery
  - harvest level being considered (mt of salmon)
  - CLs

Overall approach:

1) identify the sources of uncertainty
2) describe the precision or imprecision of the assessment
3) define a management strategy
4) evaluate the probability of an event (i.e. being below CLs)) resulting from the fishery action

Prefishery abundance forecast for 2006 - 2008

North American stock complex

- Median 2006 PFA_{NA} (119 000)
- Median 2007 PFA_{NA} (114 000)
- Median 2008 PFA_{NA} (120 000)

- Two temporal phases of salmon production in the Northwest Atlantic previously described
- 2007-2008 based on the same model used in 2006
- Assumed same low phase probability

Southern European MSW stock complex

- Median 2006 PFA (489 000)
- Median 2007 PFA (461 000)
- Median 2008 PFA (440 000)

- 2007-2008 based on the same model used in 2006

Comparison with previous assessment and advice

- Catch option haven't changed since 2003
- Current model has provided stable comparisons of PFA_{NA} (predications versus updates)
- 2005 PFA_{NA} update increased from 120 400 to 126 000
- 2005 Southern NEAC MSW PFA increased from 486 000 to 505 000

Management objectives

Precautionary management plan (75% probability) of simultaneously achieving three management objectives:

1. Meeting the 2SW CLs simultaneously in four northern regions of North America (Labrador, Newfoundland, Quebec, and Gulf of St Lawrence)

2. Achieving return increases (> 10% and 25%) for Scotia-Fundy and USA relative to 1992-1996 period

3. Meeting the CL for the Southern NEAC MSW complex

Reference points for management advice

- Spawner reserve - # of PFA salmon required at West Greenland for subsequent returns (accounting for natural mortality) to achieve region-specific CLs
- CL - # of spawners required to achieve MSY
  - number of spawners required to fully seed the wetted area of the river
  - pseudo stock-recruitment observations
  - adult-to-adult stock and recruitment relationship
- CLs are limit reference points (S_{lim}) and should be avoided with high probability
- CLs limited to 2SW (all North American complexes) and MSW (Southern European complex)
  - >90% of harvest is 1SW non-maturing salmon
- 75% risk level for catch advice

NASCO has requested ICES to provide annual catch options or alternative management advice for 2006-2008

None of the stated management objectives would allow a fishery at West Greenland to take place in 2006, 2007, or 2008

- In the absence of marine fishing mortality (2006-2008)
  - ~3% probability of meeting CL in 4 northern NA regions
  - <1% probability of 10% increase to 2 southern NA regions
  - <70% probability of meeting the southern NEAC MSW CL
- In addition, the probability of increased returns to North American compared to 2001-2005
  - 2007, 65%
  - 2008, 61%
  - 2009, 66%

Mountain Sermitsiaq Nuuk, Greenland

Courtesy of Jessica Pruden