NOAA FISHERIES

NEFSC

Marine and Estuary Update

Timothy Sheehan

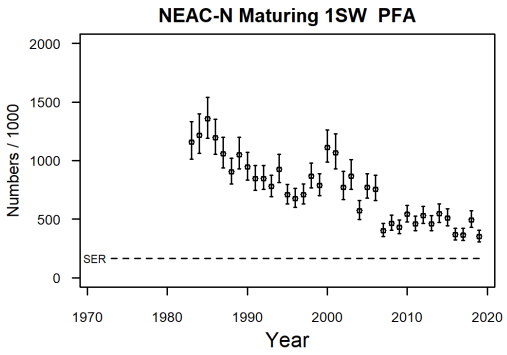
April 15, 2021

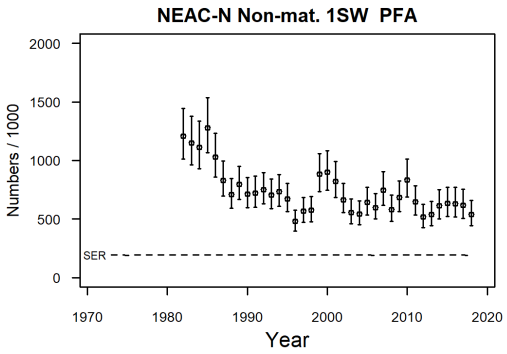
Outline

1. Stock status across the North Atlantic
2. Leading hypothesis on decline (*according to me*)
3. US trends
4. International view on managing salmon in the ocean
5. Local management view

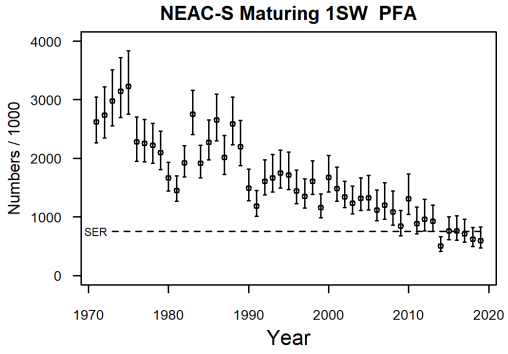
Stock status: North Atlantic-wide

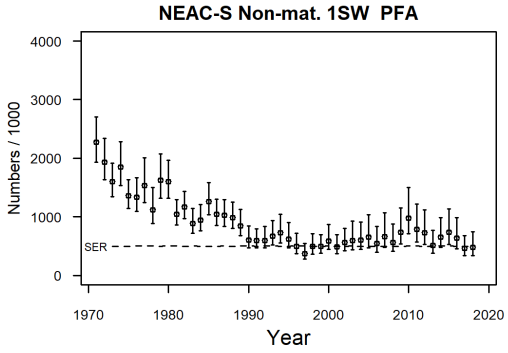
Northern Europe



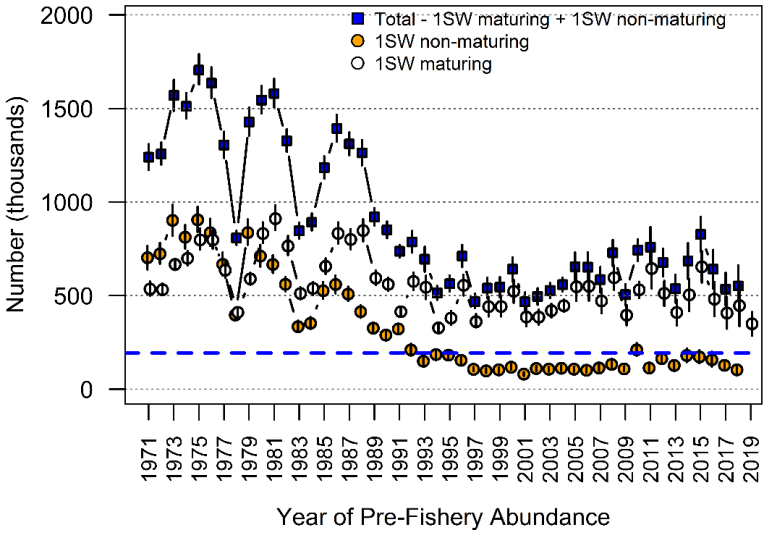


Southern Europe





North America

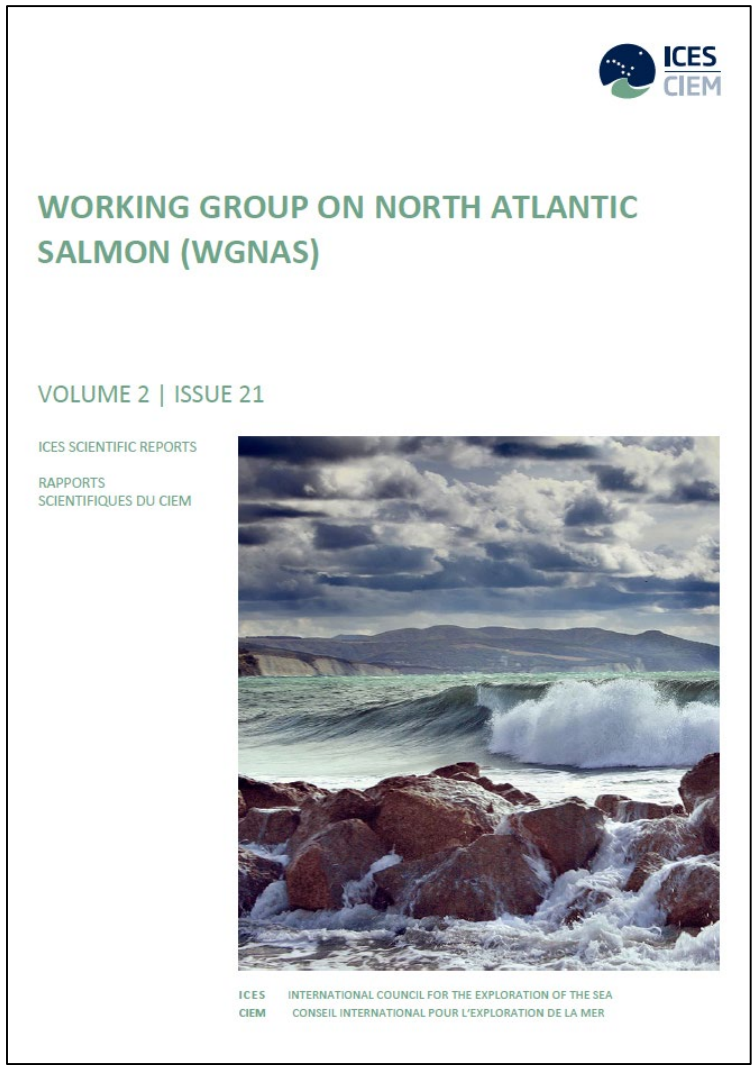


ICES 2020

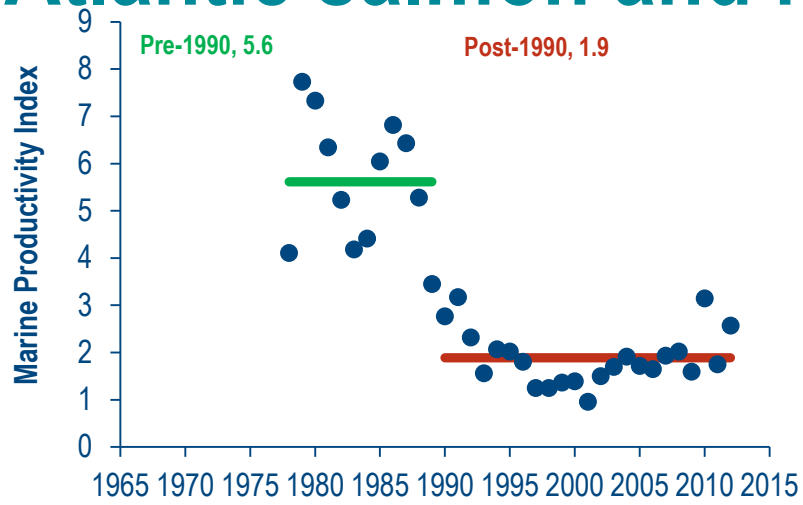
Working Group on North Atlantic Salmon

- "…exploitation rates on Atlantic salmon continue to be among the lowest in the time-series"

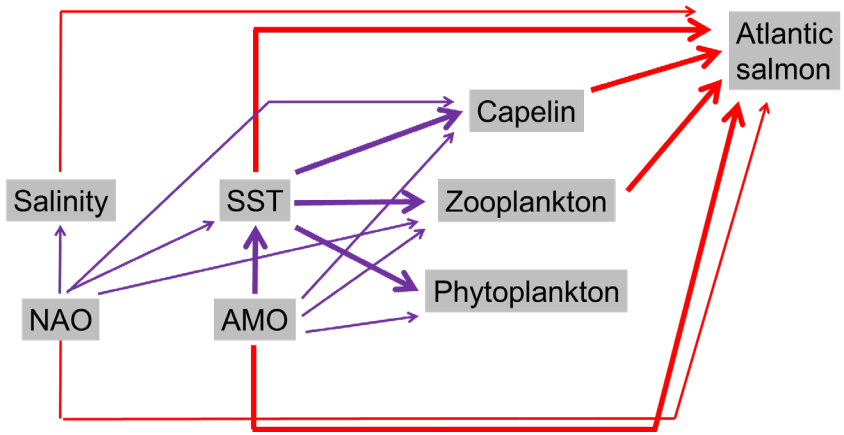
- "…continued low and declining abundance of salmon stocks across North America… strengthens the conclusions that factors acting on survival in the first and second years at sea, at both local and broad ocean scales are constraining abundance…"



Atlantic salmon and NW Atlantic regime shift



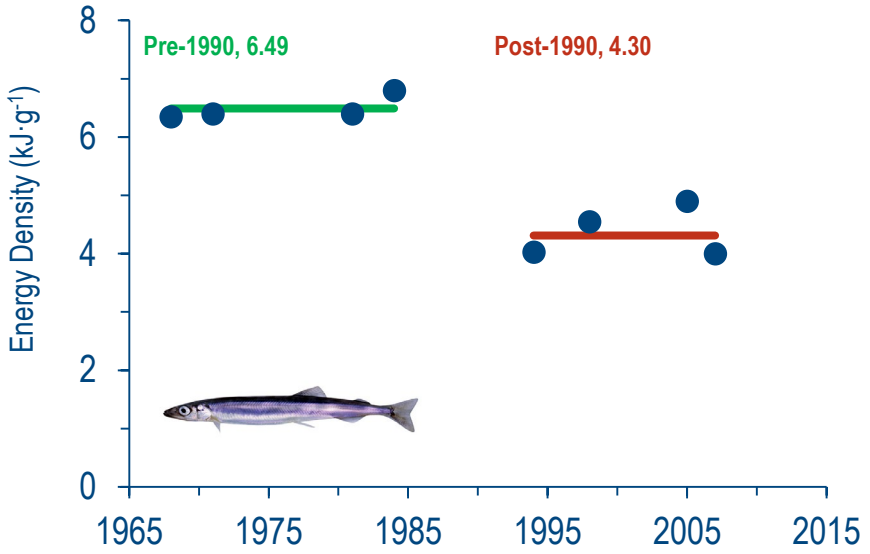
- Chaput *et al.* 2012
  - 1990 NW Atlantic regime-shift in marine productivity
    - Relative number of marine fish per spawner

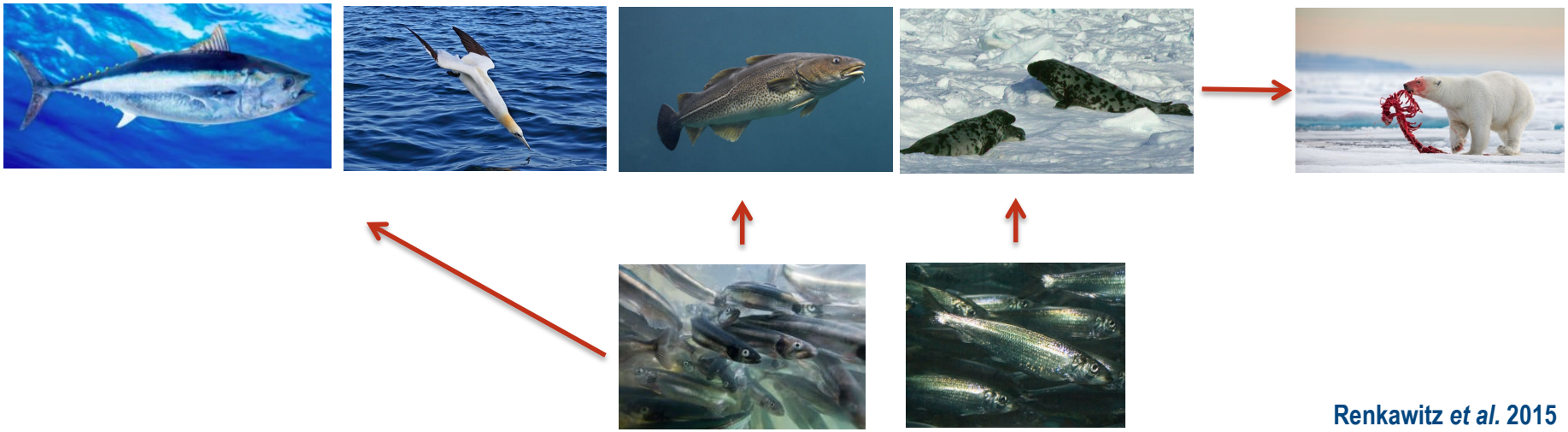


- Mills *et al.* 2013
  - Coherent declines in productivity across N. America
  - Increasing SST influenced timing of phytoplankton bloom
  - Phytoplankton influenced zooplankton composition
  - Zooplankton influenced capelin length and distribution
  - All parameters influence Atlantic salmon marine productivity directly or indirectly

Changing forage base quality

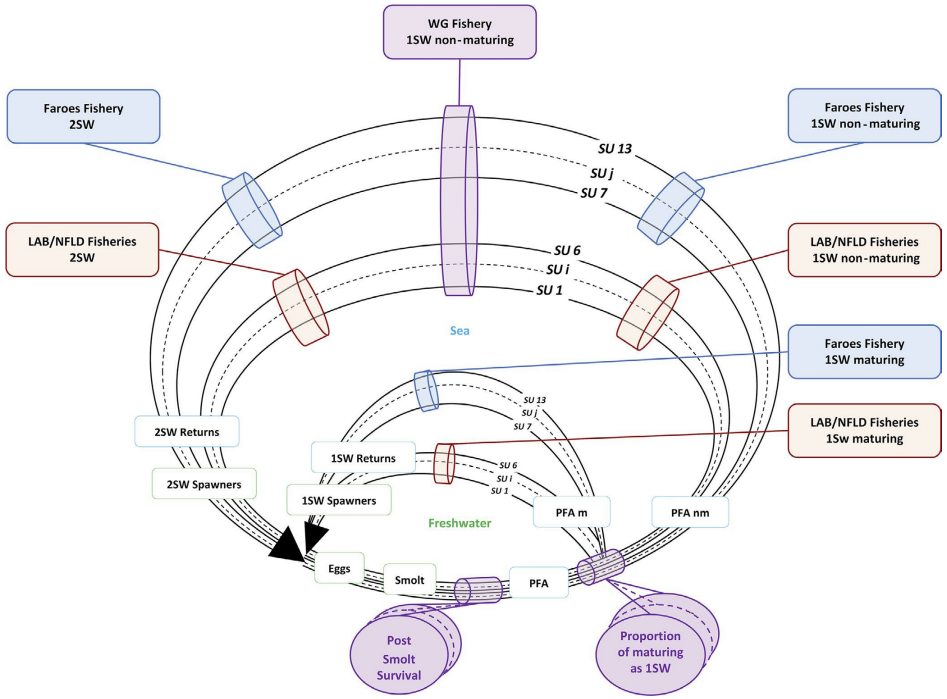
- Direct/indirect impacts from changing energy density of forage base
  - Across NW Atl., NE Atl., Pacific, southern ocean, Great Lakes, etc.
  - Atl. salmon, Atl. bluefin tuna, various seabirds, various seals, polar bears, southern Right whales, alewife…
  - Capelin, Atl. herring, sprat, sandlance, euphausiid, copepod, etc.

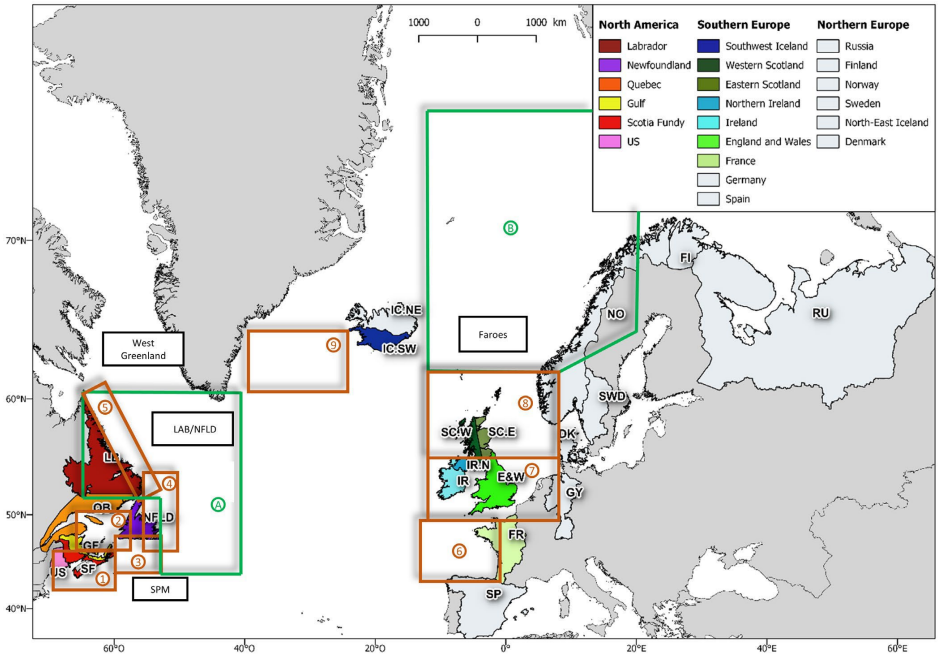




Renkawitz *et al.* 2015

Local versus global drivers?

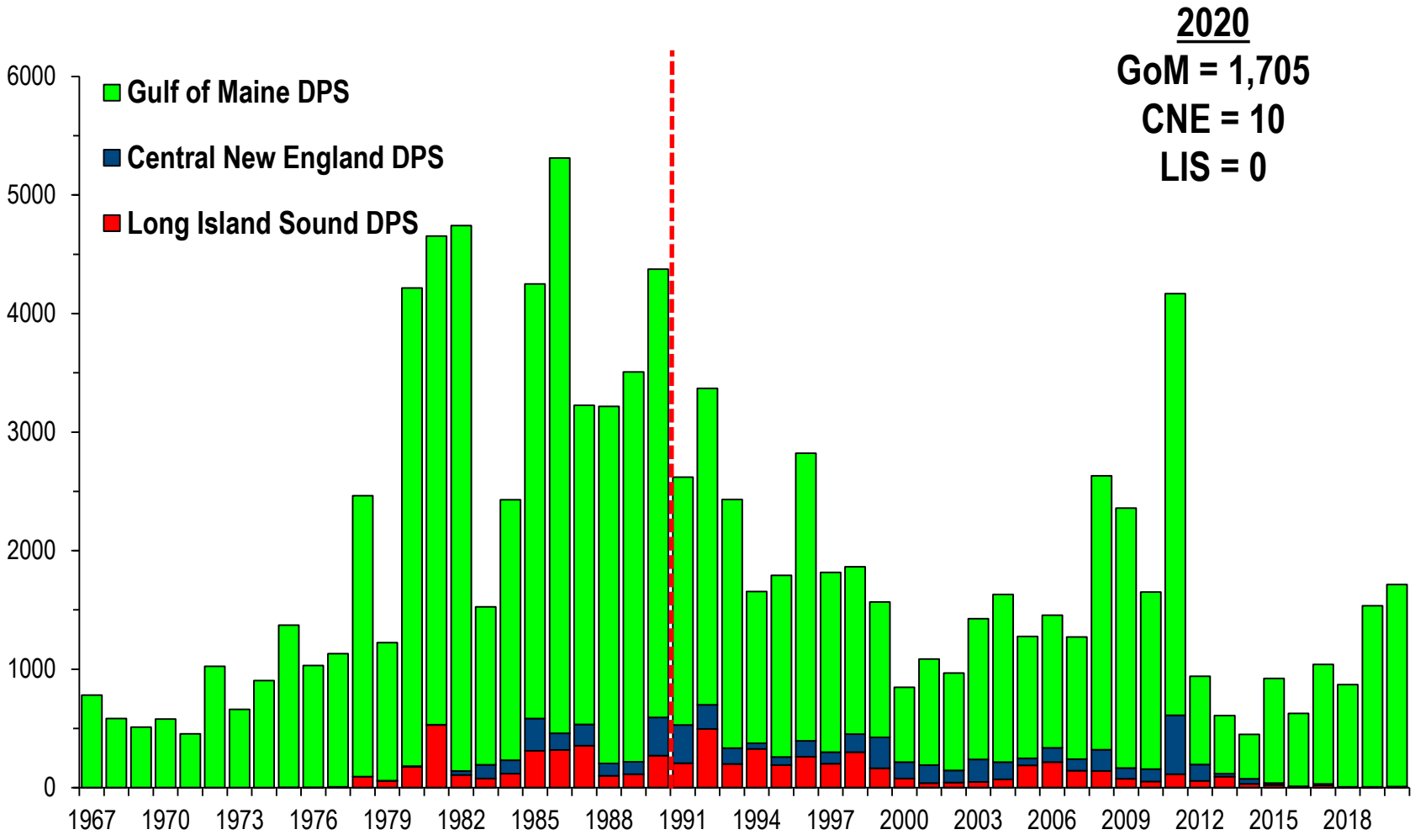




"The findings support the hypothesis of a response of salmon populations to large climate-induced changes in the North Atlantic simultaneously impacting populations from distant continental habitats."

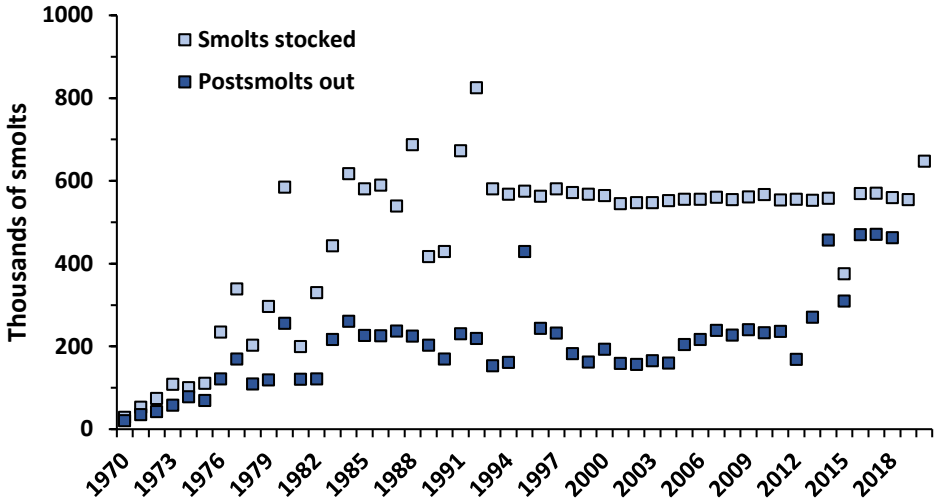
Olmos *et al.* 2019

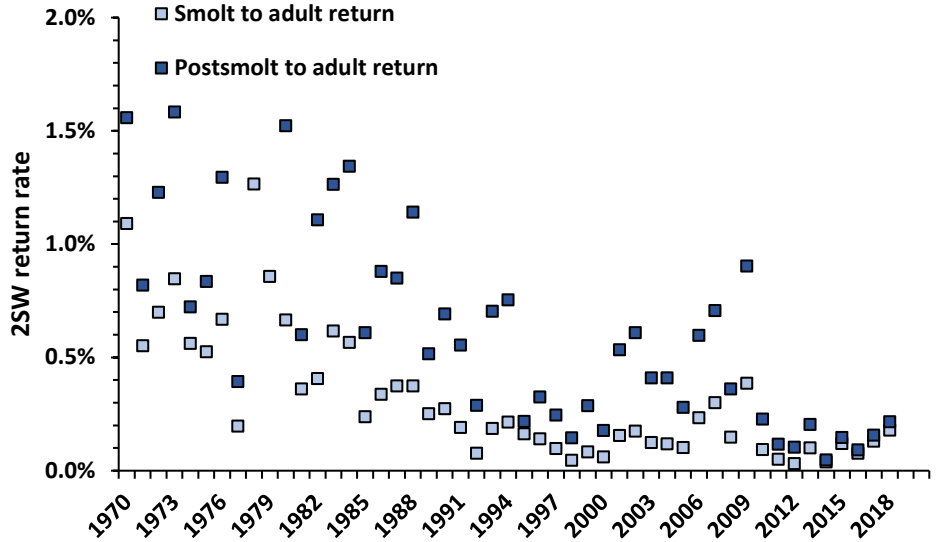
US adult returns (USASAC 2021)

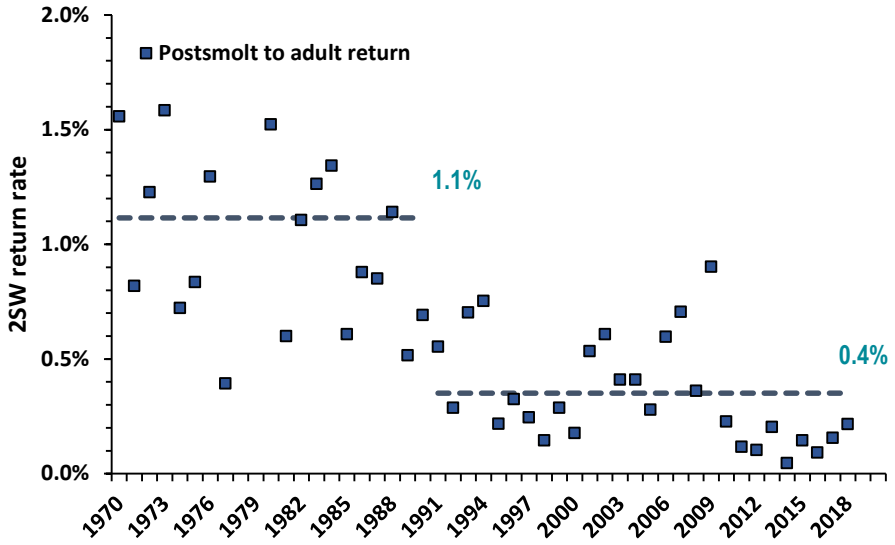


USASAC 2021

US regime-shift

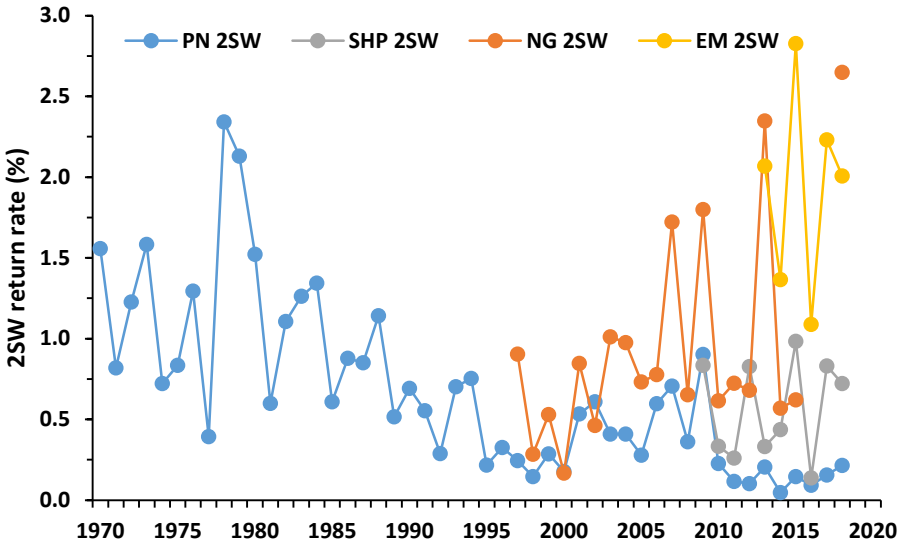


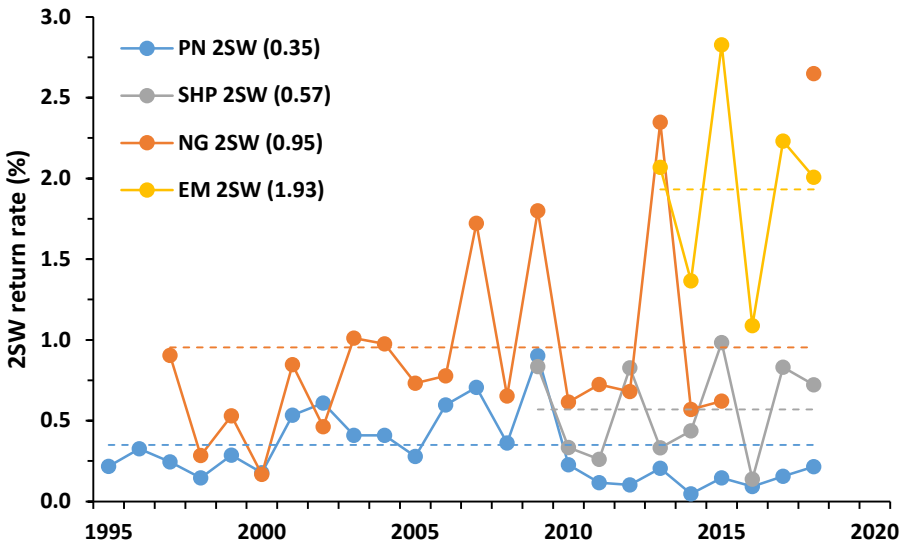




Stevens *et al.* 2019; USASAC 2021

Variable US marine return rates





USASAC 2021

https://www.toonpool.com/cartoons/Now%20what_202222

NASCO symposium (Agency/Org. advice)

1. Promote strong, healthy, and resilient populations of local wild salmonids (protect genetic integrity, enhanced water quality and habitat protection);

2. Broaden management approach from harvest/stocking to ecosystem protection;

3. Prevent AQ escape and sea lice impacts;

4. Stocking principles:
   - Last resort after all other conservation efforts;
   - Minimize negative effects and maintain genetic integrity;
   - Use local/wild broodfish, stock early life stages, minimizing time in captivity…; and
   - Tag to enable evaluation;

5. Invasive species management:
   - Discourage introduction and eradicated where possible; and
   - Healthy salmon populations may mitigate potential impacts;

6. Ensure the highest number of wild smolts in the best condition leave from rivers and near-coastal areas to the ocean;

7. Work to understand the magnitude and causes of marine mortality;

8. Continued exchange of science/management related information; and

9. Human dimensions are a critical element of the conservation process

NASCO 2020

A further peer reviewed exploration

- Many fw/est threats are known and management options are available
- Global scale of climate change and altered ocean ecosystems is difficult to address

- Conditions in fw and sw are projected to deteriorate
- Global response is needed, which is beyond the scope of fisheries management

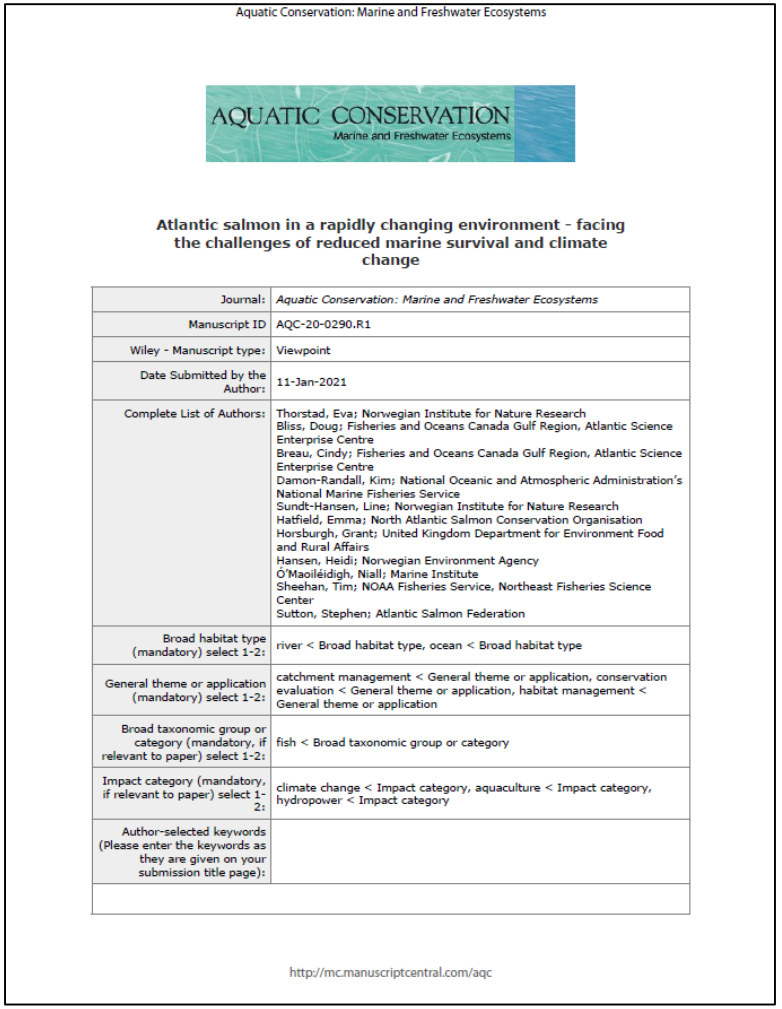
- In the interim, climate perspectives must be incorporated into salmon management
  - Holistic view working across sectors, governments and borders to reduce human pressures

- Can't presently counteract poor marine survival, therefore emphasis should be on fw
  - Strong, healthy, and resilient wild populations is the optimal approach to reduce CC impacts
  - Optimize productivity by ensuring the highest number of wild smolts in the best condition enter the ocean.
  - Improving/maintaining habitat quality, connectivity, freshwater ecological function, water quality, etc. are front-line defenses

- Maintain genetic integrity/diversity (of wild populations)
  - Eliminate escaped farmed salmon, poorly planned stocking and reduce impacts of low abundance

- Lack of evidence for compensatory marine mortality -> increasing smolt output increases adult returns

- A focus on human dimension is needed, since most threats are the result of human activities
  - Improved communication of scientific and management perspectives



Aquatic Conservation: Marine and Freshwater Ecosystems

AQUATIC CONSERVATION
Marine and Freshwater Ecosystems

Atlantic salmon in a rapidly changing environment - facing the challenges of reduced marine survival and climate change

Journal:	*Aquatic Conservation: Marine and Freshwater Ecosystems*
Manuscript ID	AQC-20-0290.R1
Wiley - Manuscript type:	Viewpoint
Date Submitted by the Author:	11-Jan-2021
Complete List of Authors:	Thorstad, Eva; Norwegian Institute for Nature Research Bliss, Doug; Fisheries and Oceans Canada Gulf Region, Atlantic Science Enterprise Centre Breau, Cindy; Fisheries and Oceans Canada Gulf Region, Atlantic Science Enterprise Centre Damon-Randall, Kim; National Oceanic and Atmospheric Administration's National Marine Fisheries Service Sundt-Hansen, Line; Norwegian Institute for Nature Research Hatfield, Emma; North Atlantic Salmon Conservation Organisation Horsburgh, Grant; United Kingdom Department for Environment Food and Rural Affairs Hansen, Heidi; Norwegian Environment Agency Ó'Maoiléidigh, Niall; Marine Institute Sheehan, Tim; NOAA Fisheries Service, Northeast Fisheries Science Center Sutton, Stephen; Atlantic Salmon Federation
Broad habitat type (mandatory) select 1-2:	river < Broad habitat type, ocean < Broad habitat type
General theme or application (mandatory) select 1-2:	catchment management < General theme or application, conservation evaluation < General theme or application, habitat management < General theme or application
Broad taxonomic group or category (mandatory, if relevant to paper) select 1-2:	fish < Broad taxonomic group or category
Impact category (mandatory, if relevant to paper) select 1-2:	climate change < Impact category, aquaculture < Impact category, hydropower < Impact category
Author-selected keywords (Please enter the keywords as they are given on your submission title page):	

http://mc.manuscriptcentral.com/aqc

Thorstad *et al. in press*

What can be done locally?

- Due diligence on aquaculture monitoring

- **Grow** more smolts that survive better
  - Habitat improvements

- **Make** more smolts that survive better
  - Close the hatchery-wild marine performance gap
  - Utilize vacant habitat
    - Develop additional capacity
    - Develop better release schemes
  - Develop a comprehensive climate-adaptive spatiotemporal management plan
  - Habitat improvements

Citations

- ICES. 2020. Working Group on North Atlantic Salmon (WGNAS). ICES Scientific Reports. 2:21. 358 pp. http://doi.org/10.17895/ices.pub.5973.
- Chaput, G. (2012). Overview of the status of Atlantic salmon (*Salmo salar*) in the North Atlantic and trends in marine mortality. ICES Journal of Marine Science, 69(9): 1538–1548.
- Mills, K.E., Pershing, A., Sheehan, T.F. and Mountain, D. 2013. Climate and ecosystem linkages explain widespread declines in North American Atlantic salmon populations. Global Change Biology. 19: 3046-3061.
- Renkawitz, M.D., Sheehan, T.F., Dixon, H. J. and Nygaard, R. 2015. Changing trophic structure and energy flow in the Northwest Atlantic: implications for Atlantic salmon feeding at West Greenland. Marine Ecology Progress Series. 538: 197–211.
- Olmos, M., Payne, M.R., Nevoux, M., Prévost, E., Chaput, G., Du Pontavice, H., Guitton, J., Sheehan, T.F., Mills, K. and Rivot, E. 2020. Spatial synchrony in the response of a long range migratory species (*Salmo salar*) to climate change in the North Atlantic Ocean. Global Change Biology.26: 1319-1337.
- USASAC. 2021. Annual Report of the U.S. Atlantic salmon Assessment Committee, Report No. 33-2020 Activities [online]. United States Atlantic salmon Assessment Committee (virtual). https://www.fisheries.noaa.gov/resource/document/atlantic-salmon-assessments.
- Stevens, J.R., Sheehan, T.F., and Kocik, J.F. 2019. Modeling the impacts of dams and stocking practices on an endangered Atlantic Salmon population in the Penobscot River, Maine, USA. Canadian Journal of Fisheries and Aquatic Science. 76(10):1795-1807.
- NASCO. 2020. Managing the Atlantic Salmon in a Rapidly Changing Environment – Management Challenges and Possible Responses. E.B. Thorstad, D. Bliss, K. Damon-Randall, H. Hanson, G. Horsburgh, N. Ó Maoiléidigh, S.G. Sutton, V. Newton and E. M. C. Hatfield (Eds.). Report of the IYS Symposium held in Tromsø, Norway, 3 – 4 June 2019. 176 pp.
- Thorstad, E.B., Bliss, D., Breau, C., Damon-Randall, K., Sundt-Hansen, L.E., Hatfield, E.M.C., Horsburgh, G., Hansen, H., Ó Maoiléidigh, N., Sheehan, T. and Sutton, S.G. *in press*. Atlantic salmon in a rapidly changing environment - facing the challenges of reduced marine survival and climate change. Aquatic Conservation: Marine and Freshwater Ecosystems.