



# Marine Fishes Expert Network: Findings and recommendations from the Circumpolar Biodiversity Monitoring Program's State of the Arctic Marine Biodiversity Report



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# Outline

- Background
- Current level of monitoring across the Arctic
- Focal Ecosystem Components
  - Status and trends
- Drivers of observed trends
- Knowledge and monitoring gaps

# Background

- Arctic marine fish communities are changing
  - Elevated ocean temperatures
  - Altered stratification
  - Altered wave action
  - Reduced availability of ice habitats
- Northward expansion of bordering species
  - Competitive and predator-prey interactions
- Anthropogenic threats to Arctic marine fishes
  - Increased accessibility because of reduced sea ice concentration, extent and changes in the timing of melt and onset
  - Fishing, petrochemical and mineral exploration and extraction, transportation and tourism
  - Increased noise, erosion and pollution

# Background

- 633 marine fishes recorded in the Arctic Ocean and adjacent seas (ABA2013)
- Approximately 10% harvested commercially and assessed
  - Less known about other 90%
- Large areas of the Arctic have never been surveyed for marine fish biodiversity
- Monitoring programs occur in relatively restricted areas
  - Frequently focus on commercial fisheries
- Short-term biodiversity surveys occur sporadically
  - Generally unsuited for monitoring

# Monitoring

- Distributions and abundance data derived from various groups
- Governmental programs
  - Longer time series
  - Good consistency in methods and equipment
  - Function for ongoing monitoring
- Academic programs
  - Short time series
  - Methods can vary considerably among studies



# Monitoring

- Industry-related programs
  - Normally conducted by consulting companies
  - Time frames are usually short (< 5 years)
  - Methods are often standardized
  - Legal difficulties in identifying and accessing these databases
- Surveys can be combined, but problematic for robust biodiversity monitoring



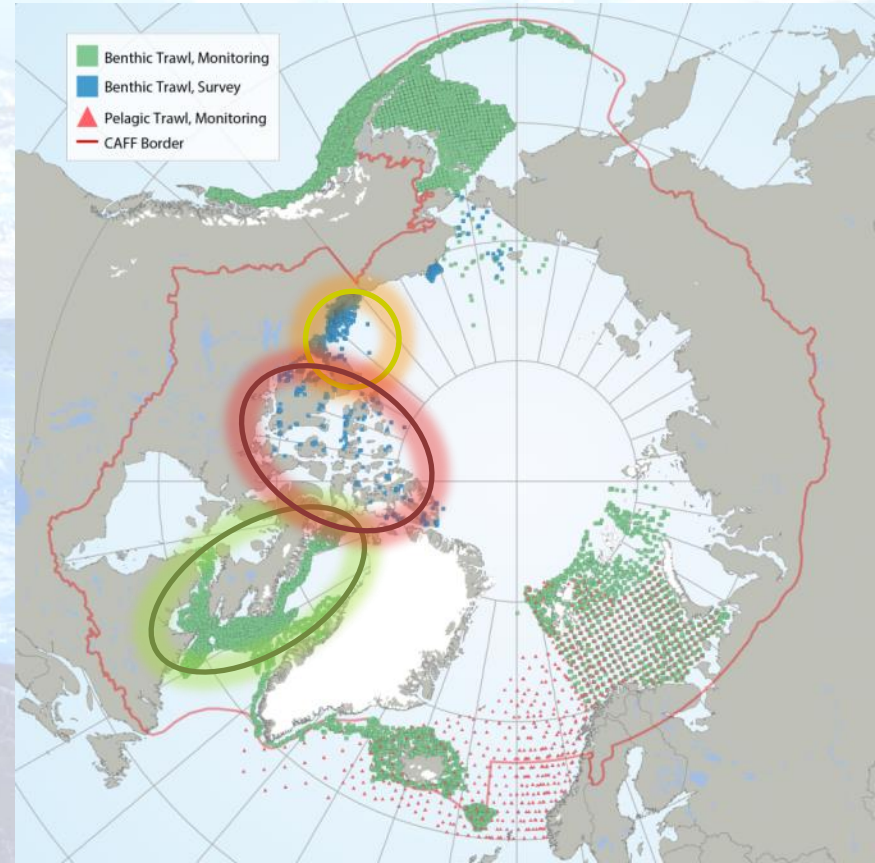
# Monitoring

- Marine fish biodiversity surveys needed throughout the Arctic
- Short duration surveys can provide information on marine distributions and abundance patterns
- Long-term programs needed to monitor changes in biodiversity



# Monitoring: Canada

- Surveys primarily designed to support stock assessments
- Beaufort Sea programs but no ongoing monitoring





# Monitoring: Greenland

- Waters off northeast Greenland are regularly monitored by The Arctic University of Norway
- Greenland Institute of Natural Resources conducts annual multi-species bottom trawl surveys in Baffin Bay, Davis Strait, Denmark Strait and in inshore waters of West Greenland



# Monitoring: Iceland

- Primarily to assess commercial stocks
- Fish communities in deep waters (<1,500 m) and mid-waters poorly known
- Irregular and single-year surveys have examined marine fishes outside the core area



# Monitoring: Norway

- Joint monitoring in the Norwegian Sea by Norway, Greenland, the Faroe Islands and Iceland
- Main Barents Sea monitoring by Norway and Russia



# Monitoring: Russia

- The Russian–American Long-Term Census of the Arctic
  - Multidisciplinary surveys in 2004, 2009 and 2012
  - Explore under-studied waters



# Monitoring: United States

- Recent NOAA surveys in the Arctic
  - U.S. Beaufort Sea in 2008
  - U.S. Chukchi Sea in 2007 and 2012
- NOAA has sponsored studies of voucher specimens and genetic studies
- The University of Alaska Fairbanks has recently conducted fisheries research in the eastern Chukchi Sea and western Beaufort Sea



# Monitoring

- Exploitation history needs to be considered when interpreting trends in monitoring data
  - Do historical data represent unexploited or altered states?
  - Incorporation of Traditional Knowledge (TK) and fishers' knowledge in study planning, analyses and decision making can be beneficial for placing surveys and results in context



# Checklists and Identification Guides

- Up-to-date checklists and guides are essential tools for monitoring biodiversity
  - Marine Fishes of the Arctic Region (Mecklenburg et al. 2018)

# FECs

- Selection
  - Listed in the Marine Biodiversity Monitoring Plan
  - Draw attention to a few species that are of particular ecological, subsistence or commercial importance throughout the Arctic
  - Examples of current changes among marine fishes



# FECs

- Polar Cod (*Boreogadus saida*)
  - Close linkage with sea ice, widely dispersed forage fish
- Capelin (*Mallotus* spp.)
  - Commercially harvested, range expanding, widely dispersed forage fish
- Greenland Halibut (*Reinhardtius hippoglossoides*)
  - Commercially harvested, fisheries expanding



# FEC: Polar Cod

- Key ecological species in the Arctic Ocean
- Uses ice as a refuge from predation and spawning habitat
  - Antifreeze agents in its blood
- One-year-old fish follow sea ice drift





# FEC: Polar Cod

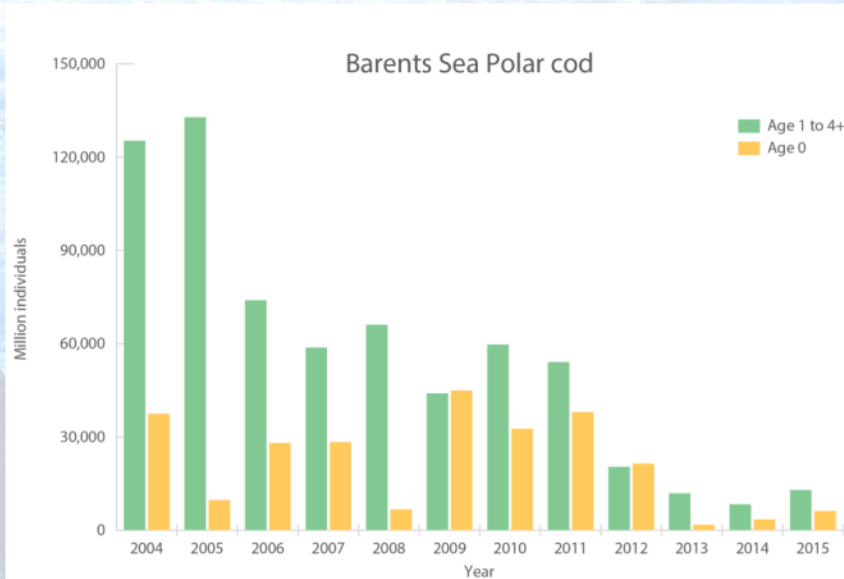
- Suitable indicator species for monitoring Arctic marine fish communities and food webs
- However, few monitoring time series exist, except in the Barents Sea





# FEC: Polar Cod

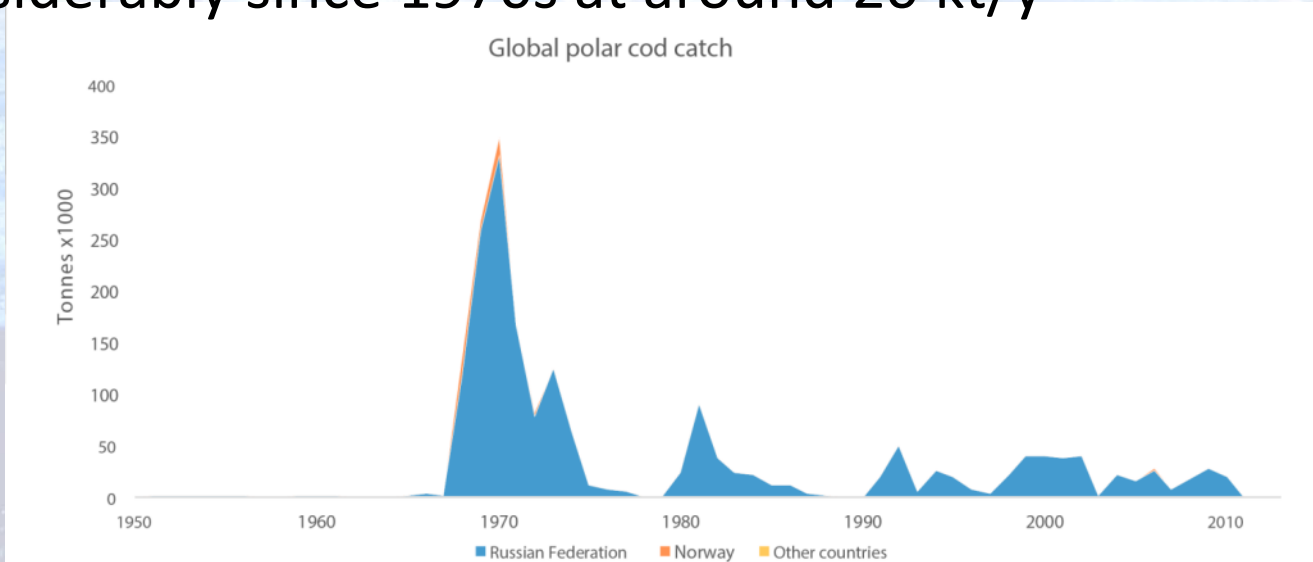
- Declines in Barents Sea since 2004
  - Recruitment failure, Atlantic cod immigration, increased predation pressure
  - 0-group index for 2013-2015 was < 10% of the average from 1980-2012 (4360 million individuals)
- 2016 survey showed notable increase in biomass, primarily because of a high catch of age one fish





# FEC: Polar Cod

- Only true Arctic species that has sustained commercial fisheries
- Fisheries expanded rapidly in late 1960s; fluctuated considerably since 1970s at around 20 kt/y





# FEC: Capelin

- Capelin transfers energy between oceanic habitats and nearshore spawning grounds
- Several life history characteristics make capelin a relevant indicator of climate variability
  - Broad physiological limits
  - Potential for fast population growth
  - Thermal constraints on the timing of spawning





# FEC: Capelin

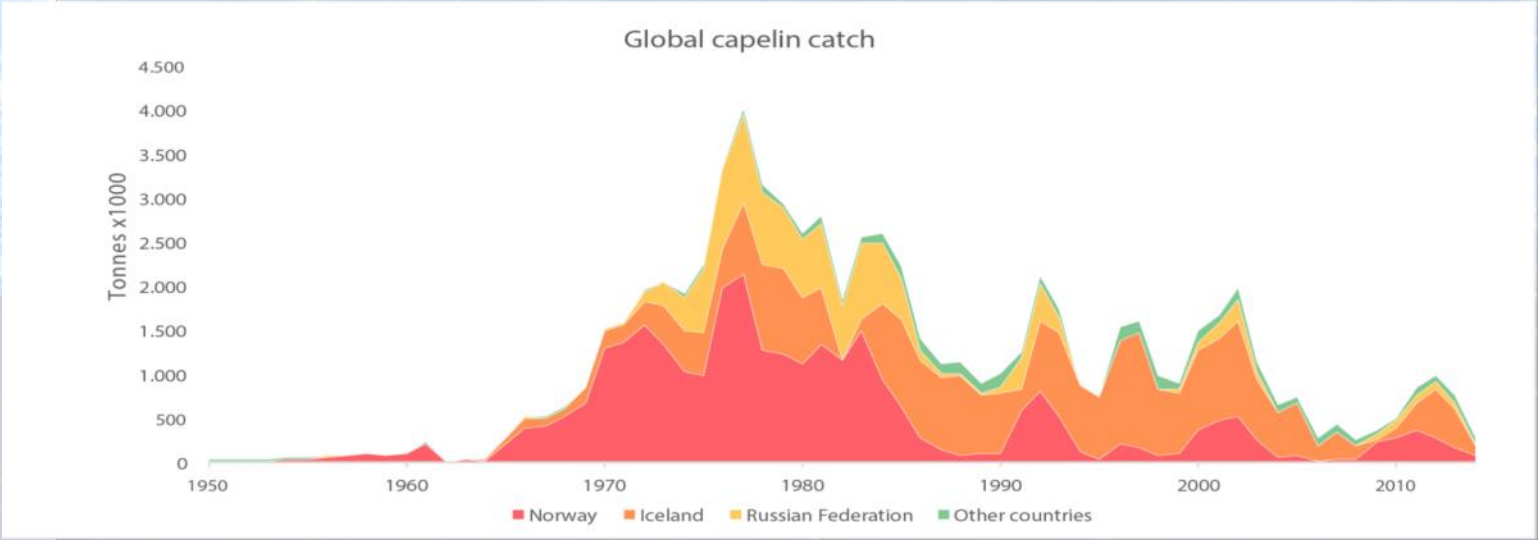
- Increasing trends in abundance and distribution of capelin in Arctic waters
- Commercially exploited in Arctic and sub-Arctic regions
- All major stocks recently exhibited northerly range displacements associated with periods of warmer water temperature and reduced sea ice extent





# FEC: Capelin

- One of the most fished fish species in the world







# FEC: Greenland Halibut

- Top predator, feeding on polar cod, capelin and other forage species
- Highly mobile
  - Baffin Bay to the Grand Banks and western Iceland





# FEC: Greenland Halibut

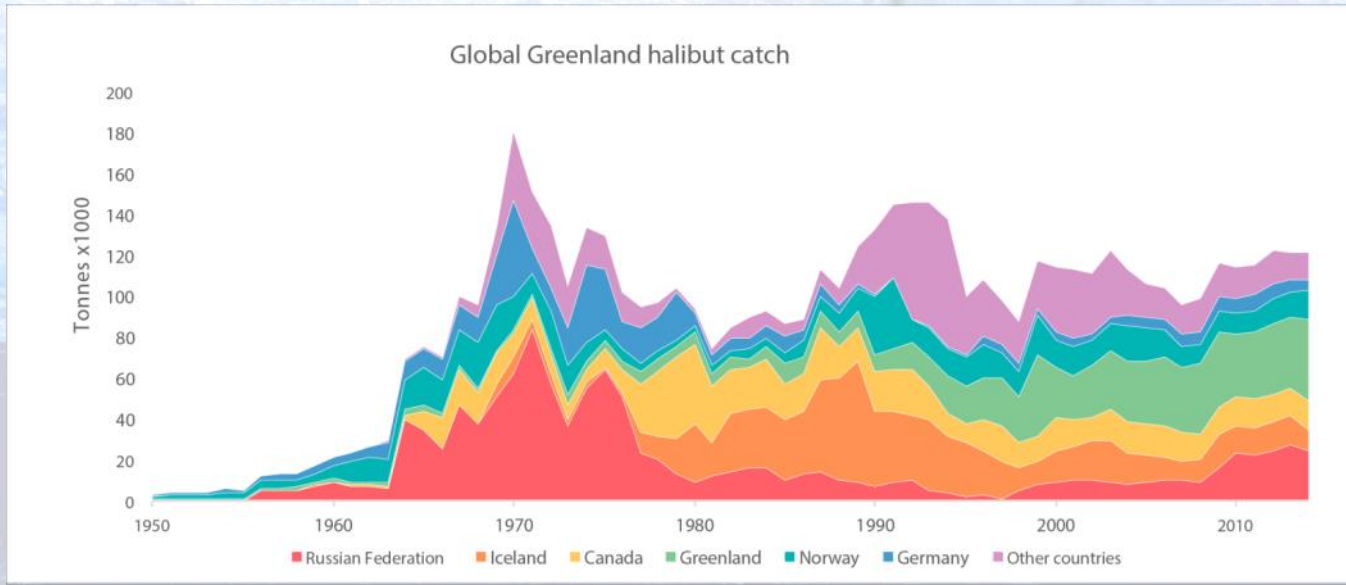
- Commercial fisheries in Norway and Russian since the 17th Century
- Old records did not always distinguish Greenland halibut from Atlantic halibut and were sometimes classified with “various pleuronectiformes”





# FEC: Greenland Halibut

- One of the most valuable fishes in the Arctic
  - Two and a half times more valuable than Atlantic cod, by weight

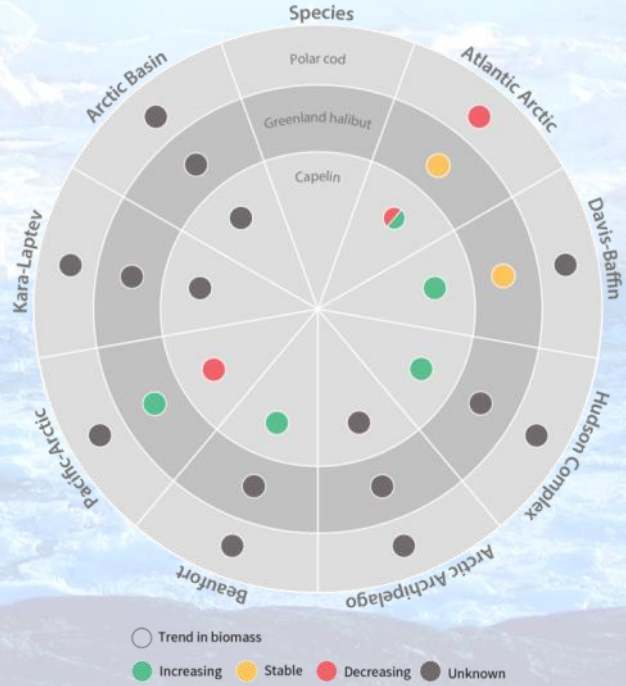




# FEC: Greenland Halibut

- Demonstrates interest and energy related to expanding Arctic commercial fisheries
- Fishing seasons and areas heavily dictated by sea ice conditions
- Reductions in sea ice extent, duration and thickness provide opportunities for fishery expansion

# Trends in Fishes Across Arctic Marine Areas



# Drivers

- Most drivers affecting marine fishes in the Arctic are linked, directly or indirectly, to climate change
- Northward expansion of boreal species
  - Boreal species are shifting northwards at a faster rate than Arctic species are retreating
- Changes in sea ice, water temperature, stratification

# Knowledge and Monitoring Gaps

- Baseline assessments remain limited
- Short-term data collections provide occurrence data
  - Quantitative assessments and monitoring remain the exception instead of the norm
- Regular biodiversity monitoring programs are needed throughout the Arctic, not only in areas that support commercial fisheries
- Taxonomic uncertainties need to be resolved
- Seabed mapping is limited in Arctic waters
- Existing charts require updating

# Conclusions and Key Findings

- TK holders have a considerable wealth of information regarding marine fish FECs
- Unfished areas have been poorly surveyed
  - Little is known about effects on non-commercial marine fishes in the Arctic
- Ice conditions affect both species distributions and the ability to monitor Arctic marine fish biodiversity



# Conclusions and Key Findings

- Range expansions (northward) pose unknown consequences for resident species and inter-specific interactions (predator-prey, competitive)
- The main commercial marine fishes in the Arctic, Greenland halibut and capelin, do not yet seem to be adversely affected by climate change although their distributions are changing
- Polar cod is being affected by multiple stressors

# Thank You

A photograph of a fishing boat deck. Two workers in orange overalls and white hard hats are visible on the deck, handling fishing equipment. The deck is cluttered with green fishing nets, black floats, and other gear. The ocean is visible in the background, with white foam from the boat's wake. The text 'Thank You' is overlaid in the upper center.

- CAFF Secretariat
- Arctic scientists
  - Data providers