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
• 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

• CAFF Secretariat
• Arctic scientists
  – Data providers