Sustainable harvesting of marine resources at lower trophic levels - *Calanus finmarchicus* and species of mesopelagic fish

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The overall background:

• Throughout history sea mammals and species of fish at higher trophic levels have been caught

• The oceans cover almost 70 % of the surface of the earth and account for around 50 % of its biological production. However, only about 3 % of our food comes from the sea

• In the future a larger portion of our food will have to come from marine aquaculture. However:
• Further growth and development in marine aquaculture will require new sources of marine feed, like *Calanus finmarchicus* and mesopelagic species

• Increase in global population
• Economic growth in traditionally poor countries
• Seafood is healthy

• Scarcity of arable land and fresh water resources
• Limited potential for growth in traditional fisheries
• An important, almost untapped source for marine feedstuffs is small, marine species at lower trophic level – mesopelagic fish, krill and zooplankton

• The biomass of species at lower trophic levels is huge, and outnumber the size of the fish stocks many times

• Species at lower trophic levels can be utilized both as feed for farmed fish and terrestrial animals. There are also markets for special products for human consumption, health supplement etc.
• Harvesting marine organisms at lower trophic levels like *Calanus finmarchicus* and mesopelagic fish could contribute to solving some of the great challenges of our time

• In the following: More about *Calanus finmarchicus* and mesopelagic species from the perspective of the Norwegian Directorate of Fisheries:
Calanus

Photo: Cecilie Broms
Institute of Marine Research
• *Calanus finmarchicus* (CF):

- Has been harvested in Norway since 2003 in a small-scale fishery on the basis of one experimental licence

- 513 tonnes were caught in 2015, increased to 660 tonnes in 2016 and 747 tonnes in 2017. In previous years the annual catch was substantially lower

- CF has so far been utilized as raw material for further processing into special products for human consumption and use (mainly for health- and dietary purposes)
• The future:
  – Harvesting on the basis of an experimental licence will continue at least till 2022

• In 2016 the Directorate of Fisheries presented a proposed management plan for CF. The Institute of Marine Research (IMR) delivered the scientific input to the plan

• The proposed management plan has been through a process of public consultation. However, it has as of today not entered into effect
Some key elements of the proposed Norwegian management plan for CF:

• Based on an estimated standing biomass of 33 million tonnes

• A total annual quota of 165 000 tonnes is proposed for the Norwegian Economic Zone in the Norwegian Sea and the Fishery zone around Jan Mayen

• The determination of the quota is based on a conservative and precautionary approach, «inspired» by CCAMLR's methodology for determining the quota of krill in Antarctica
• Ecological challenge in connection with the harvesting of CF:

  – Vital to avoid damages on important parts of the ecosystem, therefore bycatch of eggs, larvae and juveniles of fish shall be kept as low as practically possible
• Other challenges for future harvesting of CF:
  – Detecting harvestable quantities of CF (using various types equipment, e.g. drones)
  
  – Larger and more efficient gears (trawl)
  
  – Right type of vessel (size, processing of catch)
  
  – Systematic and correct sampling of catches
  
  – Sufficient surveillance and control
  
  – Will it be possible to achieve profitable harvesting outside coastal waters?
Mesopelagic species: Include a large number of different species of fish, zooplankton, squid, jellyfish

Lanternfish:
Some characteristics of mesopelagic fish:

- Large resource, both globally and in the North Atlantic
- Small, i.e. 3-6 cm
- Migrates vertically between 200 and 1 000 m depth
- Vertical migration driven by light throughout the day
• Concentrations in «hot spots». Reykjanes Ridge seems to be a «hot spot» in the North-East Atlantic

• Gulf of Oman is probably one global «hot spot»
• Catch in the North Atlantic:

  – No landings are registered from Norwegian vessels

  – Iceland reported more than 73,000 tonnes of silvery lightfish caught in the three year period 2009-2011 (small quantities after 2011)

  – Russia reported more than 13,000 tonnes of glacier lanternfish in 2001 and 2002 (small amounts in other years)
• Norwegian fisheries authorities in cooperation with marine scientists, the fishing industry and funding agencies are currently discussing future fishing possibilities as to mesopelagic species.

• In addition The IMR has launched its Mesopelagic Initiative.

• Some reservations as to future exploitation of mesopelagic fish:
  – The knowledge about the enormous size of the biomass at lower trophic levels is not at all new.
A number of big challenges will have to be overcome before this potential can be realized:

- Various aspects of biological knowledge, including impacts on different parts of the eco-system, e.g. bycatch of commercial species of fish (redfish, argentine, blue whiting)
- Locating «hot spots», the right depths and time periods
- The right type of vessels and equipment/machinery onboard vessels
- The best adapted gear (trawl)
- The best methods for processing and conserving the catch onboard vessels
• Harvesting a resource where knowledge and experience are not sufficiently developed, ("immature" fisheries) presents specific challenges

• A successful approach in Norway concerning "immature" fisheries, has been experimental fishing by commercial vessels
  – Experimental fishing: Gradually more knowledge is acquired by fishermen/companies and public institutions within marine science and fishery management
• For some years the Directorate of Fisheries has issued experimental licences to Norwegian vessels. In 2017 a total number of 50 licences were issued. By May 23rd 2018 the corresponding figure is 5

• With the exception of one Norwegian vessel the activity has been limited thus far. 2-3 more vessels are expected to participate in 2018

• Why so little activity?
  – Norwegian vessels by and large obtain a good operating margin from other fisheries
  – A number of knowledge gaps have to be overcome, and the costs involved are immense
• The need for funding of research and experimental fishing is crucial

• A kind of burdensharing between fishing boat companies/other actors and different financial sources is necessary and called for

• The rationale behind burdensharing as a kind of public-private cooperation could be:
  – Fishing boat companies and others engaging in harvesting and utilization of mesopelagic fish are eligible for financial support
  – In return their obtained results and knowledge have to a large extent to be shared with others
Basic approach of the Norwegian Directorate of Fisheries:

- **Philosophy**: A step-by-step process of gathering new knowledge.

- **Attitude**: Hard work by a number of key actors in various public and private organisations will be necessary.

- **Continue to issue experimental licences to Norwegian fishing vessels**

- **Assist the Ministry of Trade, Industry and Fisheries in its efforts to establish a licencing scheme**
• Observing closely the results from experimental fisheries
• A keen interest in the outcomes from the Mesopelagic Initiative, by IMR and partners

• Success in the medium term:
  – Need to achieve groundbreaking knowledge in a variety of areas
  – Good prospects of a profitable fishery

• Success in a longer time perspective:
  – This new Norwegian fishery will also make a contribution to addressing global challenges such as food safety and high quality food
• If current efforts prove to be successful in the course of some years, The Directorate of Fisheries will start preparing a management plan for harvesting the mesopelagic resource

• Some vital topics in a future management plan:
  
  – Total allowable catch (TAC)?
  
  – One TAC for each stock of mesopelagic species, for instance silvery lightfish? Or
  
  – A TAC for a combination of different stocks, for example covering both glacier lanternfish and silvery lightfish?
– A Norwegian TAC? Or

– A TAC including several coastal states in the North-Atlantic?

– An international approach will require comprehensive international cooperation

– A number of regulatory issues at the national level will have to be examined
Thank you for your attention