

## Coastal water darkening and the competition between fish and jellyfish

Coastal waters in Northern Europe are becoming darker (Kahru et al. 2022, Opdal et al. 2023), a process commonly referred to as “coastal water darkening” (Aksnes et al. 2009). The underlying causes are many, but several point towards increased vegetation on land (Opdal et al. 2023). With more vegetation comes more organic matter (humic substances) that in turn leach into freshwater lakes and rivers, causing a gradual freshwater browning (Kritzberg et al. 2020). Ultimately, these waters drain to the coast, with consequences for the coastal water light attenuation. From previous theoretical (Haraldsson et al. 2012) and field (Aksnes 2007, Aksnes et al. 2009) studies we know that increased light attenuation, and hence reduced visibility, gives a competitive advantage to tactile predators as opposed to visual predators – or to jellyfish as opposed to fish (Figure, Eiane et al. 1999).

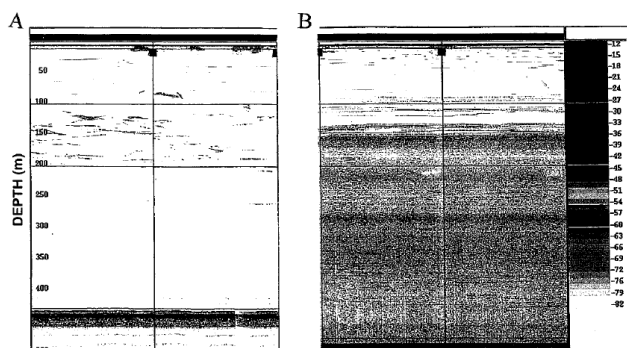


Fig. 1. Echograms (38 kHz) from (A) Lurefjorden at 10:47–11:02 (GMT) on 9 January 1996, and (B) Masfjorden at 10:40–10:55 on 7 January 1996. In Masfjorden trawling has shown that the upper pronounced sound-scattering layer (130–170 m) is dominated by the mesopelagic fish *M. muelleri*. The layers below 200 m consist mainly of the mesopelagic fish, *B. glaciale*, some krill (*M. norvegica*), prawns (*Sergestes arcticus* and *Pasiphaea multidentata*), and blue whiting (*Micro-mesistius poutassou*). In Lurefjorden trawling has given catches totally dominated by *P. periphylla*, although some krill (*M. norvegica*) and some whiting (*Merlangius merlangus*) are encountered. Color code refers to volume backscattering strength (dB).

**Methods:** In this master thesis we will investigate how long terms historic changes in the light attenuation may have altered the relationship between jellyfish and fish in western Norwegian fjords. The approach is largely theoretical, and will be based on the “killing the winner” model framework as coined by Thingstad et al (2010) for microbial competition. This framework has been successfully used to model energy flux through phytoplankton, zooplankton, jellyfish and fish in the Baltic Sea (Haraldsson et al. 2012), the Black Sea (Olsen 2016), and even the global ocean (Schnedler-Meyer et al.). A space-for-time approach may be used to parameterize the model, using Masfjorden and Lurefjorden as examples of cases of contrasting dominance between fish and jellyfish, respectively (see figure).

**Research environment:** The master project will be part of the research project “Plankton size and planktivore competition along the Norwegian coast and fjords: ecological implications of warmer and darker waters (PELAGIC)”, lead by [Johanna M. Aarflot](#) at the Institute of Marine Research, Bergen. [Anders F. Opdal](#) at the Theoretical Ecology Group (UiB) is leading the work-package that the master thesis will be part of.

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