

# RESTORATION OF CARRYING CAPACITY OF MUSSEL FARMING IN FJORDS BY USE OF ARTIFICIAL UPWELLING

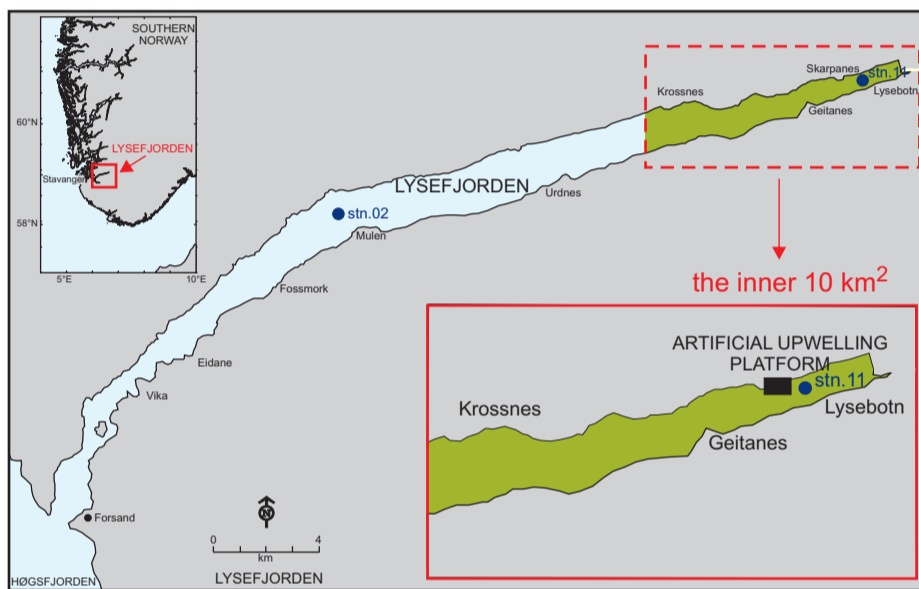
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HYDROPOWER PLANT OPERATIONS MAY REDUCE FRESHWATER DISCHARGE TO FJORDS DURING SUMMER, CAUSING LOWER PRIMARY PRODUCTION.

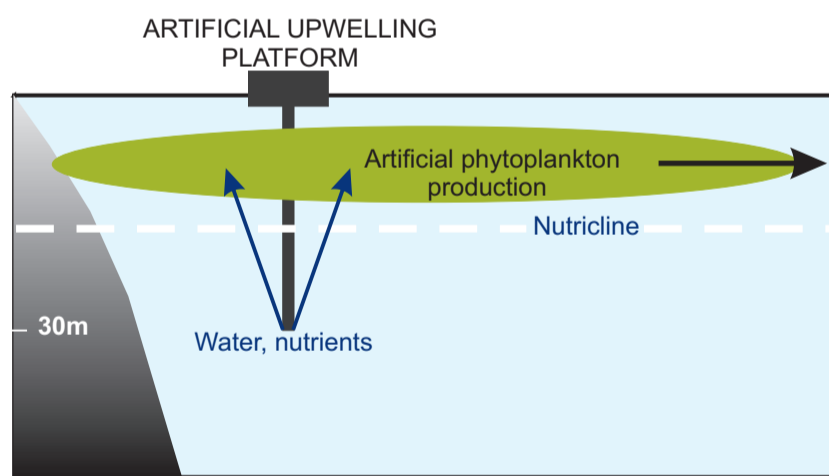
THE LYSEFJORD, IN SOUTH – WESTERN NORWAY, HAS BEEN RESTORED IN TERMS OF PRIMARY PRODUCTION BY THE USE OF ARTIFICIAL UPWELLING. THIS ABOUT TRIPLED THE PRIMARY PRODUCTION AND STIMULATED DIATOM GROWTH IN A LIMITED PART OF THE FJORD.

ARTIFICIAL UPWELLING MAY THEN HAVE GREAT POTENTIAL FOR INCREASING THE CARRYING CAPACITY OF MUSSELS IN FJORDS.

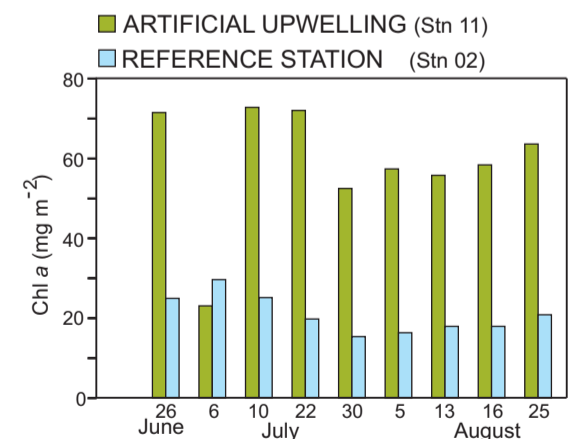
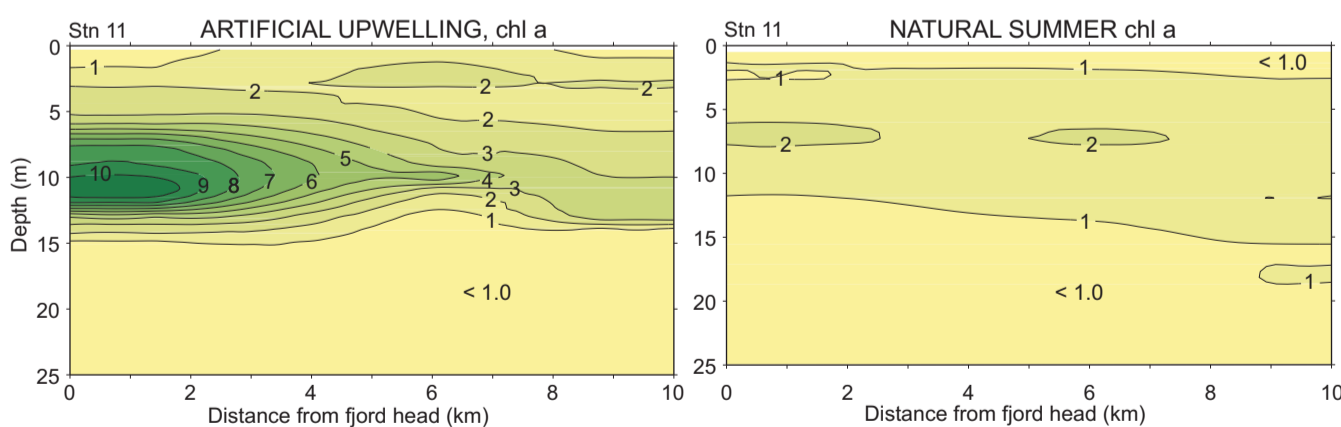


Many fjords are affected by reduced freshwater discharge during summer due to hydropower plants. The supply of nutrients and related primary production may be substantially reduced.

An example is the Lysefjord, located on southwest coast of Norway (area = 44 km<sup>2</sup>, sill depth = 15m, maximum depth = 450 m). Hydropower plants established in 1935 and 1952 have caused a reduction of 35 - 40 % in freshwater input and related fresh water nutrient supply to the fjord during the summer period.

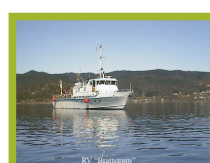
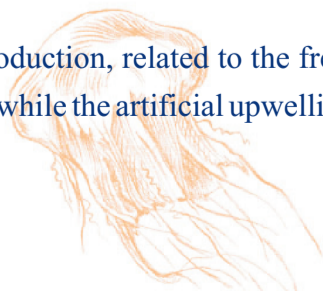


A large-scale artificial upwelling experiment was carried out near the head of the Lysefjord, pumping brackish surface water down to 30 m depth. The entrainment of deeper water into the buoyant brackish plume resulted in a transport of nutrients to the upper layer (450 kg d<sup>-1</sup> nitrate, 760 kg d<sup>-1</sup> silicate and 70 kg d<sup>-1</sup> phosphate), thus providing nutrients for phytoplankton growth.



The artificial upwelling restored the decreased supply of nutrients and primary production in the summer period caused by hydropower plants.

The primary production, related to the fresh water discharge, included the entire fjord, while the artificial upwelling was limited to the inner 10 km<sup>2</sup>.



As a consequence phytoplankton biomass and concentrations below the brackish layer, expressed as chlorophyll a, approximately tripled inside this area and in addition stimulated diatom growth. This would increase the carrying capacity of seston feeding shellfish and could form the basis of more predictable mussel cultivation in fjords.

