Growth performance and detoxification of mussels cultured in a fjord enhanced by forced upwelling of nutrient rich deep water

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Introduction

•The controlled upwelling of nutrient rich deep water in the Lysefjord (Fig. 1) enables large scale (10-20 km^2) studies on how nutrient availability affect fjord ecosystems

•An increase in primary production and a threefold increase in standing stock of phytoplankton within the area of influence (Fig. 2) were demonstrated in 2004-2005 (Aure *et al.*, 2007)

•In an aquaculture context, the controlled upwelling may enhance the production of seaweed and suspension feeding bivalves but may also promote environmental restoration and detoxification of mussels

Fig 1. The study area: The Lysefjord, South-Western Norway

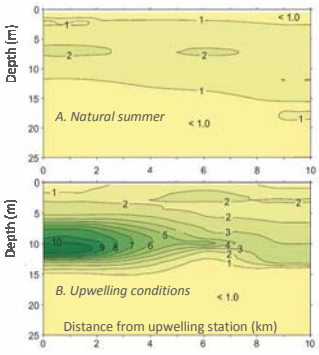

Fig 2. The chlorophyll *a* concentration without (A) and with (B) controlled upwelling , source Aure et al., 2007

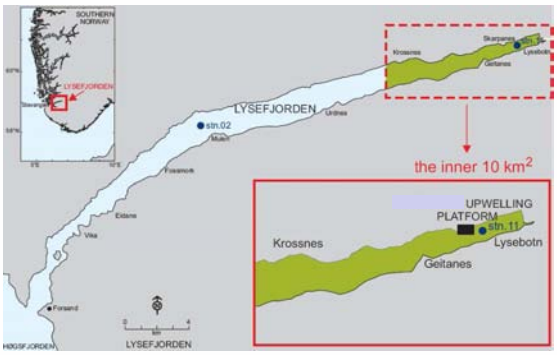

Fig 3. Map of the Lysefjord; the area of influence is indicated in green.

Controlled upwelling

•Freshwater (1-5 m^3 s^{-1}) from a hydropower plant is used to force upwelling of nutrient rich water (Fig. 4)

•The freshwater is discarded below the nutricline and the buoyant freshwater mixes with the nutrient rich water as it ascends into the euphotic zone

•The upwelled nutrient rich water (~15-75 m^{3}s^{-1}) intrudes the layer below the pycnocline and the nutrients are now readily available for primary producers

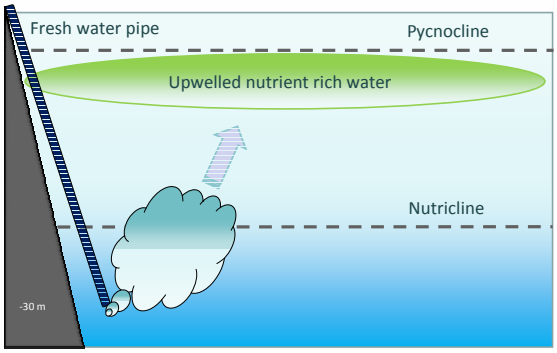

Fig 4. The concept of controlled upwelling of nutrient rich deep water

The GATE project

•The GATE project (2010-2012) (www.imr.no/gate) aims to assess how phytoplankton composition and quantity, enhanced by upwelling, affect tissue growth performance and detoxification in cultured mussels

•The fjord environment, phytoplankton community, mussel feeding physiology and growth, and toxin content are monitored. The DEB model will be applied to explain the variability in mussel growth

•We expect to get new insight and explanation on the contribution from dilution processes (e.g. due to mussel growth) versus active detoxification processes in the uptake-excretion kinetics of toxins by the mussels

Preliminary results

•In 2010 the amount of upwelled water was 10-30 % of the expected volume

•Two years old mussels grew faster within the upwelling plume (Fig 5), while one year old mussels showed similar growth in the fjord (data not shown)

•In 2011, a new upwelling technique is expected to increase the upwelling capacity, resulting in higher primary production in the euphotic zone

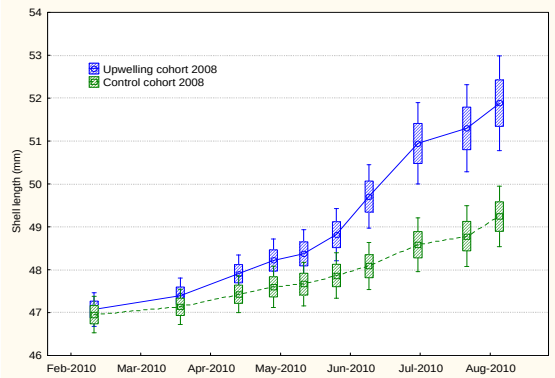

Fig 5. Growth of mussel shell (*Mytilus edulis*) inside and outside the upwelling plume in 2010

Reference

Aure, J., Strand, Ø., Erga, S.R., Strohmeier, T. 2007. Primary production enhancement by artificial upwelling in a western Norwegian fjord. Marine Ecol Prog Ser, 352:39-52