

**CERES** 

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# **CERES storyline - mussels in the North Sea**

#### What do we expect under climate change?

Blue mussel (*Mytilus edulis*) is a ubiquitous species present along the North Sea Coast in the intertidal and subtidal areas. The main physical factor influencing its distribution is temperature which affects both adult and larvae survivals. Other external pressures for mussel aquaculture development in the coastal zone include pollution, biotoxins, invasive species, water quality and competition with other activities. Along the North Sea Coast, mussels are both fished at a commercial size for food consumption and as juveniles (seeds) for bottom culture. Mussel seeds are also caught directly on spat collectors for both onbottom and long-line cultures.

Blue mussel culture is currently dependent on natural recruitment and environmental factors such as food supply, temperature and salinity. Our goal in CERES is to determine and predict the changes in Blue mussel productivity (and resulting socio-economic effects) from direct and indirect climate-driven environmental factors on physical, biochemical and biological components. Climate change is expected to affect the health and growth performance of farmed mussels directly via physiological responses, immunobiological performance and acclimation to the new environmental conditions and indirectly via potential pressure from Harmful Algal Blooms (HABs), jellyfish outbreaks, invasive species and diseases. The expectation is that the southern boundary where *M. edulis* can be cultured may shift Northwards and conditions for the Mediterranean mussel (*Mytilus galloprovinciallis*), that already occurs in the North Sea area in low percentages, may become more favourable.

### How vulnerable are mussles?

Mussels are taking nutrients directly from the water column and do not require feeding, thus production is dependent on the environmental conditions. Bivalves are sensitive to climate change induced variabilities in temperature and salinity which affect behaviour, physiological rates and immune system. Recent Blue mussels mass mortalities in Europe potentially are linked to multi-factor stress and could jeopardize the mussel industry.

### What is the economic value of this species?

Mussel, both blue mussel (*Mytilus edulis*) and Mediterranean mussel (*Mytilus galloprovinciallis*), is the first aquaculture species produced in the EU with around 470 thousand tons produced in 2014 for a value of around 372 million euros.







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Within the North Sea area (Denmark, Germany, Netherlands, UK, Norway and Sweden) only *M. edulis* is produced. In 2013 production was 90 thousand tons. Although the production has declined since the 90s, new values have been added to the mussel market with the development of organic products and labeling. In 2012, blue mussels represented 8% of the weight and 4% of the value of the cultivated seafood in Europe .

## What are the challenges?

Some parameter values and functional response curves for climate change driven environmental conditions (e.g. extreme temperature, low oxygen concentration) on blue mussel are not described adequately in the literature and require new experiments to improve production models under climate-driven changes. Other experiments regarding indirect factors such as toxic algae impact on mussel productivity and mortality are missing. Regarding indirect pressure from HABs, pathogens and jellyfish bloom, early warning techniques are not developed to take preventive actions to protect cultured mussels



## What is the working program in CERES?

Multi-stressor laboratory experiments (e.g. temperature vs food concentration vs oxygen saturation) will be conducted on blue mussels as well as the impact of indirect effects of toxic algae on mussel productivity.

For modelling two approaches are used to predict the mussel productivity under various climate change scenarios.

- Direct effect of climate change models for productivity and connectivity, including physiological models and population models at farm and local scale
- Indirect effects of climate change models for mitigation and early warning (Harmful Algal Bloom occurrence)

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