

# Science for Environment Policy

## Ocean acidification puts Norwegian fishing industry at risk

**Fishing in most of Norway's counties is at 'moderate' to 'high' risk from ocean acidification, concludes a new study.** The researchers reached this conclusion with the use of an integrated risk-assessment method that accounts for environmental, economic and social factors within the 19 counties. They call for immediate action to protect the fishing industry against the effects of ocean acidification.

**Ocean acidification is one of many challenges faced by Europe's fishing industry.** It is a consequence of increased uptake of atmospheric CO<sub>2</sub> by the oceans, which act as a carbon sink. The CO<sub>2</sub> lowers seawater's pH and this increasing acidity can have potentially severe negative impacts on [marine creatures](#), including commercially important species.

Previous research has explored acidification's effects on molluscs and crustaceans, such as mussels and crabs, which struggle to build shells following ocean acidification. Less research has been conducted into fish, but evidence suggests that ocean acidification can damage their reproductive abilities, larval organs and shape. It may also indirectly affect fish by removing species further down the food chain.

It, therefore, seems likely that ocean acidification will affect the fishing industry, but there is a lack of research exploring the socio-economic impacts of this environmental threat. This study assessed the potential effects of acidification on Norway's fishing industry, testing out a new risk-assessment method. Norway is the world's second largest exporter of fish and fish products, and is partly surrounded by high-latitude oceans, which are highly sensitive to acidification.

The risk-assessment method is a modified version of a risk-assessment framework introduced in the IPCC's [Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation](#). This modified version considers risk to be a sum of 'hazard', 'exposure' and 'vulnerability'. The researchers used it to rank Norway's counties, in relation to one another, according to their vulnerability to the socio-economic impacts of ocean acidification. It integrates environmental, economic and social information to develop an overall risk score for each county.

The researchers considered 'hazard' in terms of the threat level of acidification to the three seas around Norway (the Barents, Norwegian and North Seas). The Barents Sea is considered most at threat of acidification, in part because high-latitude oceans have less saline waters. 'Exposure' was considered in terms of the potential effects on different groups of species, which were categorised as 'potentially affected crustaceans', 'potentially affected fish' and 'unaffected fish'. Aquaculture was excluded from the assessment, as water chemistry can be controlled to some extent on many fish farms.

'Vulnerability' was assessed in terms of a fisher's ability to cope with the adverse effects of acidification. For instance, those living in a county with higher personal income and levels of education (which increases the likelihood of finding a new job) were judged to be less vulnerable.

Counties were then scored for vulnerability based on which seas they border (if any), what kind of fish they catch, and the socio-economic characteristics of their workforce.

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1. Mathis, J.T., Cooley, S.R., Lucey, N., Colt, S., Ekstrom, J., Hurst, T., *et al.* (2015). Ocean acidification risk assessment for Alaska's fishery sector. *Progress in Oceanography*, 136: 71–91. DOI: 10.1016/j.pocean.2014.07.001

Results of the assessment indicate that 13 of the 19 counties are either at 'moderate' or 'high' risk, in relation to other counties. The northernmost counties of Finnmark and Troms are among the most vulnerable as they fish in the Barents Sea for vulnerable species and have a high number of fishers who may be less able to adapt to environmental changes.

Although these findings are concerning, the researchers comment that Norway's risk is relatively low in an international context, as it has a high standard of living relative to developing countries, which are at much higher risk. They also stress that there is some uncertainty in their results, due to gaps in data. For example, they comment that more detailed data on pH and carbon saturation levels in seawater would give a better picture of the potential impacts on each of the three Seas. Nonetheless, they say their results show that immediate action is needed to prepare Norway's fishing industry for acidification in order to prevent negative effects on the country's economy and citizens. They also say their risk-assessment method could be applied to other regions<sup>1</sup>.

