

How fish species suffer as a result of warmer waters

January 4 2007



The eelpout (*Zoarces viviparus*). Credit: Alfred Wegener Institute

Ongoing global climate change causes changes in the species composition of marine ecosystems, especially in shallow coastal oceans. This applies also to fish populations. Previous studies demonstrating a link between global warming and declining fish stocks were based entirely on statistical data. However, in order to estimate future changes, it is essential to develop a deeper understanding of the effect of water temperature on the biology of organisms under question.

A new investigation, just published in the scientific journal *Science*, reveals that a warming induced deficiency in oxygen uptake and supply to tissues is the key factor limiting the stock size of a fish species under

heat stress.

Scientists of the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven investigated the relationship between seasonal water temperature and population density using eelpout (*Zoarces viviparus*), a fish species from the Southern North Sea.

The goal of the study was to identify those physiological processes exhibiting the most immediate response to warming in the field. Comparing ecological field data with laboratory investigations of the eelpout's physiology, the authors were able, for the first time, to demonstrate a direct link between temperature dependent oxygen limitation experienced by the eelpouts and warming induced changes in their population density.

During evolution, animals have specialised on environmental conditions and are often very limited in their tolerance to environmental change. In this context, fish species from the North Sea which experience large seasonal temperature fluctuations, are more tolerant to higher temperatures and display wider thermal windows than, for instance, fishes from polar regions living at constant low temperatures. The latter are able to grow and reproduce only within a very limited thermal tolerance window.

Investigations at the Alfred Wegener Institute show the key importance of oxygen uptake and distribution – through respiration and blood circulation – in setting the animals' thermal tolerance range, in that these processes are optimised to only a limited temperature window. With increasing temperature, the organism's oxygen supply is the first to deteriorate, followed by other biochemical stress responses. Finally, oxygen supply fails entirely, leaving the organism to perish. These results represent a significant step forward towards understanding the mechanisms involved in climate-induced alterations in marine

ecosystems.

The paper 'Climate change affects marine fishes through the oxygen limitation of thermal tolerance' is published on January 5, 2007 in the scientific journal *Science*.

Source: Alfred Wegener Institute for Polar and Marine Research

Citation: How fish species suffer as a result of warmer waters (2007, January 4) retrieved 26 April 2024 from <https://phys.org/news/2007-01-fish-species-result-warmer.html>

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