Ocean acidification harms cod larvae more than previously thought

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Decreasing pH values in the seawater harm cod larvae more than previously thought. Credit: Catriona Clemmesen/GEOMAR (CC BY 4.0)

Next to rising temperatures and dwindling oxygen concentrations, acidification is one of the major threats to marine life due to the

changing global climate. Carbon dioxide concentrations in the atmosphere are rising and the ocean therefore takes up increasing amounts of CO_2 from the atmosphere, as well. The reaction of carbon dioxide with the water forms carbonic acid, the pH is lowered—the ocean becomes more acidic.

To what extent and how ocean acidification affects the marine ecosystem as a whole is incredibly hard to predict, but evidence is accumulating that some species are affected adversely. One such species is the Atlantic cod. A new scientific study, just published in *Global Change Biology* by scientists from the GEOMAR Helmholtz Centre for Ocean Research Kiel with colleagues from France and Norway, concurs with previously published studies showing that high carbon dioxide concentrations damage this species, particularly affecting eggs and larvae .

A previous study by these scientists demonstrated that due to ocean acidification, fewer cod larvae survive, which means fewer individuals mature and reproduce. Dr. Martina Stiasny from GEOMAR, first author of this study, says, "So far, we liked to believe that at least the larvae that survived would be able to deal with these conditions and could have allowed the species to adapt across generations." The results of the new study defeat this hope.

The researchers found that even the surviving larvae have significant organ damage and developmental delays. "The development of the gills is especially worrying. Compared to the body size, they are underdeveloped," explains Dr. Catriona Clemmesen, corresponding author of the study and leader of the larval ecology group at GEOMAR. Gills, like the lungs in humans, are an extremely important organ, which not only regulates the oxygen uptake, but in fish is also responsible for adjusting the internal pH. Underdeveloped gills are therefore likely to affect the individuals negatively throughout their development and

following life stages.

Another paper, published last year in *Scientific Reports*, showed that the acclimation of the parental generation to high carbon dioxide concentrations only yields a benefit to the offspring if prey concentrations are very high. "These ideal situations are very unlikely to be encountered by the larvae in nature," says Dr. Clemmesen. In more realistic food conditions, exposing the parental generation to acidification led to an even worse health status of the larvae.

"Our results are of particular importance, since the Atlantic cod is one of the most important commercial fish species worldwide. It therefore not only supports a large fishing industry but is furthermore an important source of protein for many people," says Dr. Stiasny. "Dwindling populations would have far-reaching consequences, not only for the environment and marine ecosystems, but also for the fishermen, the industry and human nutrition."

More information: Martina H. Stiasny et al, Divergent responses of Atlantic cod to ocean acidification and food limitation, *Global Change Biology* (2018). DOI: 10.1111/gcb.14554

M. H. Stiasny et al. Effects of parental acclimation and energy limitation in response to high CO_2 exposure in Atlantic cod, *Scientific Reports* (2018). DOI: 10.1038/s41598-018-26711-y

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