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What causes cod stock collapse: climate-induced environmental change or fishing?

- For the first time, a digital model has shown that both fishing and climate-induced environmental change are responsible for the collapse of cod stocks in the North Sea.
- Taking into consideration these two factors together is crucial for the sustainable management of fish stocks.

Using a new digital model, an international team led by researchers from the oceanology and geosciences laboratory (LOG) (CNRS/Université de Lille/Université du Littoral Côte d'Opale) has shown how fishing and climate affect cod stocks in the North Sea. . Their study indicates that the influence of climate-induced environmental change (CIEC) has increased considerably and is expected to continue. Published in *Communications Biology* on 09 November 2022, these results suggest that dynamically adjusting fishing quotas in response to CIEC would delay the collapse of cod stocks by almost 20 years and increase accumulated catches by almost 30%.

Studying the effects of fishing and climate-induced environmental change (CIEC) on fish stocks separately is difficult because estimates of environmental impact are generally not made for pre-fishing periods. Similarly, the effects of fishing cannot be estimated without considering environmental fluctuations given that the climate is constantly changing.

A research team led by scientists from the oceanology and geosciences laboratory (LOG) (CNRS/Université de Lille/Université du Littoral Côte d'Opale) has developed a new digital model that finally sheds light on this issue. Their FishClim model combines environmental factors determined by climate (temperature, bathymetry and the availability of food) with the influence of fishing intensity. FishClim is operational and faithfully models trends in North Sea cod stocks between 1963 and today and can be used to test various future scenarios.

Results show that the effects of climate and fishing are closely intertwined and interact by inducing synergies or antagonisms, depending on the period. Their respective influences on cod stocks have fluctuated, however. From 1963 to 2019, 55% of stocks were affected by fishing and 45% by the environmental regime (i.e., the average temperature during a given period). The influence of climate change has increased considerably, to 64%. According to FishClim, this percentage is expected to increase further in the future.

The research also demonstrates that if the current environmental regime persists or worsens, many cod stocks in the central and southern North Sea will disappear, independently of fishing quotas. However, FishClim shows that the fishing of stocks could be extended 20 years longer than expected, with a 30% increase in accumulated catches, if fish stock management is adapted to the predicted CIEC.

Results show that fish stocks should no longer be managed without considering the effects of climate change on species. The research team plans to continue its work by configuring FishClim to study other fish species and extend its studies of cod to the entire Atlantic Ocean.





Fishing boats in the port of Boulogne-sur-mer
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Bibliography

Addressing the dichotomy of fishing and climate in fishery management with the FishClim model. Grégory Beaugrand, Alexis Balembois, Loïck Kléparski, and Richard R Kirby. *Nature Communications Biology*, 9 November 2022. DOI:10.1038/s42003-022-04100-6

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