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Science for Environment Policy

Environmental DNA survey technique for deepwater fish can complement trawl surveys

A survey of deepwater fisheries off the coast of Greenland which used traces of fish DNA has produced similar results to trawl surveys and fishing catches. The 'environmental DNA' (eDNA) technique can therefore complement trawl data, the researchers say. It may be particularly useful for surveying large species — which can often avoid bottom trawls — or cryptic species[1] in inaccessible ocean areas.

Monitoring deepwater fish communities is necessary to assess the impacts of climate change and intensive fishing. However, it is difficult due to the remoteness of deepwater habitats, which are expensive to survey. Bottom trawling is also not possible in certain areas due to steep slopes or deepwater coral cover. However, many species is only being monitored through invasive bottom trawling. As a result, many fish species and ocean regions are little studied.

Environmental DNA is a new method of monitoring wild species by detecting traces of DNA in the environment. It is non-invasive, more efficient and easier to standardise across study areas and surveying staff than traditional survey methods. However, the technique has been little used in deepwater or to assess the abundance of fish communities.

This study extracted and analysed eDNA from 21 seawater samples collected from depths of 188–918 metres (m) in the Davis Strait off the southwest coast of Greenland. The eDNA underwent a process known as polymerase chain reaction (PCR), which amplifies limited pieces of DNA to produce thousands to millions of copies — enough for analysis — and then sequencing.

DNA from fish species detected in the samples were then compared with catch data from annual bottom trawl surveys in the same locations.

A total of 26 families of fish were found from both trawl data and eDNA, with a further three families only found from the eDNA tests and two families only recorded from trawl data. Commercial fish species in Greenland were the most commonly found species from both eDNA and trawl surveys.

The abundance of fish, in terms of both the total biomass and total number of individual fish caught, suggested the eDNA samples matched well with the abundance of fish detected by the trawling surveys. This was true for important commercial fish species caught in large numbers including the Greenland halibut (*Reinhardtius hippoglossoides*) and rockfishes (*Sebastes* spp.).

The researchers say the study demonstrates that eDNA sampling can be used to complement deepwater trawling surveys and commercial fish stock data. An advantage of eDNA is that it can provide information on non-commercial species, including species rarely caught by trawling methods, such as large species. For example, Greenland shark (*Somniosus microcephalus*) had the second highest abundance of eDNA detected, but only one individual was caught in trawl surveys, as this species can normally avoid trawl nets.

Continued on next page.

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Source: Thomsen, P.F., Møller, P.R., Egelyng Sigsaard, E., Wilhelm Knudsen, S., Jørgensen, O.A., Willerslev, E. (2016). Environmental DNA from Seawater Samples Correlate with Trawl Catches of Subarctic, Deepwater Fishes. *PLOS one*, 11: e0165252. DOI:10.1371/journal.pone.0165252. This study is free to view at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0165252

Contact:
pfthomsen@snm.ku.dk;
ewillerslev@snm.ku.dk

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1. Species that appear identical, but which are genetically quite distinct.

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The study is one of the first to demonstrate that eDNA has the potential to not only to assess the presence of different fish families, but also their abundance. This information is necessary to monitor fish stocks, which may not be accurately recorded by official reporting of global catches.

The researchers emphasise that further work is needed to develop the technique. A major shortcoming of this study is that the DNA analysis used cannot discriminate between some common species including Atlantic cod and polar cod. Environmental DNA detection can depend on a number of factors, such as cell shedding rates of different species, degradation of eDNA, microbial activity, salinity and temperature. Despite these shortcomings, the researchers say the technology can support efforts to monitor fisheries and the impacts of climate change, such as the northward expansion of certain species as the oceans become warmer.

Source: Thomsen, P.F., Møller, P.R., Egelyng Sigsaard, E., Wilhelm Knudsen, S., Jørgensen, O.A., Willerslev, E. (2016). Environmental DNA from Seawater Samples Correlate with Trawl Catches of Subarctic, Deepwater Fishes. *PLOS one,* 11: e0165252. DOI:10.1371/journal.pone.0165252. This study is free to view at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0165252

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