A proposed method for assessing the extent of the seabed significantly affected by demersal fishing in the Greater North Sea

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The widespread impact of bottom towed fishing gear on benthic species and communities has long been recognised. The responses to a given intensity of fishing disturbance can be influenced by the extent to which these species and communities are preconditioned to disturbance by natural processes, in particular waves and currents. The advent of vessel monitoring system and models of natural disturbance enable high-resolution and large-scale comparisons of fishing and natural disturbance. Vessel monitoring system data were employed to estimate the trawled area per 12km by 12km grid cell. We then quantified natural disturbance by estimating the number of days in a year the seabed was disturbed by tides and waves. As natural disturbance acts on large spatial scales, we assumed that each natural disturbance event affects whole grid cells. Frequencies could thus be translated into an area of impact, allowing us to compare fishing with natural disturbance. We show how such comparisons can be used to estimate the extent of different seabed substrate types significantly affected by demersal fishing. A measure of the probability that fishing disturbance exceeds natural disturbance provides one metric for identifying areas of significant trawling impact on seabed habitats and might be used to measure progress towards achieving Good Environmental Status for sea-floor integrity within the context of the European Union's Marine Strategy Framework Directive. For more than half the seabed in the English sector of the Greater North Sea, the results suggest that disturbance attributable to demersal fishing exceeds natural disturbance based on data from the years 2006 to 2008. The imbalance between natural and fishing disturbance is greatest in muddy substrates and deep circalittoral habitats.

Lay Summary

All human activities have an impact on the environment, and this is also true for fishing gear that is dragged over the seabed of our continental shelves. However, it is often difficult to assess whether such an impact 'matters' to the environment.

The significance of bottom-fishing impacts depends on the nature of the seabed habitats and the levels of natural seabed disturbance caused by waves and currents.

Ecological theory predicts that animals living on and in the seabed are adapted to the naturally occurring levels of seabed disturbance. Shallow tide-swept and wave-impacted sandy habitats exhibit animal communities that are well adapted to high rates of mortality and natural disturbance. As a consequence, these communities show greater resilience to fishing disturbance as well.

Conversely, deep and stable seabed habitats are often characterised by slow-growing, habitat-modifying species for which bottom fishing can have major and long-term impacts on biomass and diversity.

Whilst these relationships are relatively well understood, it remains a challenge to directly compare seabed disturbance caused by bottom-towed fishing gear with the natural disturbance of the seabed as different metrics are used to measure these.

In a recent study, published in the ICES Journal of Marine Science, Diesing *et al.* describe a methodology that enables such a comparison of fishing and natural disturbance, based on data from the English part of the greater North Sea.

The presented results are particularly relevant as they help identify areas where fishing disturbance is at a level beyond the range of natural background variability.

The proposed methodology might also be used to track progress towards Good Environmental Status of sea-floor integrity (Descriptor 6 of the European Union's Marine Strategy Framework Directive).