Habitat impacts by beam and pulse trawling in the southern North Sea

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The passage of a bottom trawl causes incision into the seabed sediments. This trawl penetration is followed by sediment reworking, mixing and mobilisation. Trawl penetration depth has also been associated with benthic mortality rates, and is suggested as a cost-effective alternative to estimate benthic habitat impacts. We will present two field experiments to study the seabed disturbance caused by commercial tickler-chain trawls and commercial pulse trawls using a combination of observational and modelling approaches. Both experiments compared flatfish-directed bottom trawls where mechanical disturbance using tickler chains was replaced by electrical disturbance using electrodes. One field trial took place in a shallow coastal-zone area (Voordelta) using a 4 m beam with trawl shoes to open net (Depestele *et al.*, 2016). The second field trial was located in the deeper offshore area of the Frisian Front, and compared 12 m trawls which were kept open by a wing-shaped foil instead of the conventional cylindrical beam with two trawl shoes ('SumWing' trawl versus 'PulseWing' trawl).

Numerical modelling has shown in both studies that the gear components of tickler-chain trawls penetrated deeper into the seabed in contrast to pulse trawls, whereas there was no difference in the quantity of sediment mobilised in the wake of these two gears. Bathymetrical measurements using a multi-beam echo sounder (MBES) confirmed that the relic tickler-chain trawl tracks were consistently deeper than after the passage of a pulse trawl. In addition, the Sediment Profile Imaging (SPI) analysis in the Frisian Front study has shown that beam trawls homogenised the sediment deeper, flattened the seabed topography more and removed the oxidised layer more than pulse trawls do. Particle size analysis using box corer samples suggested that pulse trawling only caused coarsening of the top layers (winnowing effect), while tickler-chain trawls also injected finer particles into the deeper sediment layers. SPI analysis showed that the reduced pulse trawling impacts allowed a faster re-establishment of the oxidised layer and micro-topography in contrast to tickler-chain trawling. The lower impact of the pulse trawl is mainly due to the replacement of tickler chains by electrodes. Since the mortality rate imposed by a bottom trawl is proportional to the penetration depth of the gear, we infer that the mortality rate imposed by mechanical disturbance of the pulse trawl is reduced by a similar proportion.

Further work comparing the mechanical, electrical, chemical and biological effects of gears on varying substrates, habitats and hydrographic conditions and associated effects on seabed status and functions will build a more integrated view of gear effects on the seabed overall.

Reference

Depestele, J., Ivanović, A., Degrendele, K., Esmaeili, M., Polet, H., Roche, M., Summerbell, K., Teal, L. R., Vanelslander, B., and O'Neill, F. G. Measuring and assessing the physical impact of beam trawling. ICES Journal of Marine Science, 73: i15–i26.

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