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Mapping indirect habitat loss: about awareness, implementation realities and prevention

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Marine ecosystems are affected by many drivers and pressures, both natural and anthropogenic. Pressures are classified as sealing (i.e., placement of structures), abrasion (e.g., scraping by demersal trawling), removal (e.g., aggregate extraction, navigational dredging), and deposition (e.g., dredged material disposal). Assessment of direct physical disturbance and loss is based typically on spatial data of human activities. However, the full extent of the pressures, and particularly indirect habitat losses in the near and far field are much more difficult to assess. It relates to the intensity, frequency and persistence of an activity that may lead to irreversible habitat loss. Assessing habitat loss is a mandatory criterium of seafloor integrity, an important descriptor of Good Environmental Status as defined by the European Marine Strategy Framework Directive (MSFD; 2008/56/EC). New thresholds are now proposed, e.g., restricting loss to a maximum of 2 % per broad habitat type (BHT). Hitherto, this is related mostly to sealed loss; for indirect loss there are yet no commonly agreed approaches.

For the MSFD implementation, Belgium put forward an indicator on the areal extent of EUNIS level 2 habitats and gravel beds. In view of applying thresholds of habitat change substantial improvements are needed on the knowledge of the main substrate types in the Belgian part of the North Sea (BPNS) (mud, sand, and coarse sediments per biological zone). For the BPNS, this categorization complies with the definition of the BHTs *sensu* the Commission Decision EU 2017/848. Dedicated seabed mapping and monitoring is set-up at high spatial and temporal resolution, underpinned by information on geology and sediment dynamics. A new reference seabed substrate map has been developed building on high-resolution acoustic data over the entire BPNS and is further valorised via EMODnet Geology and Seabed Habitats. Pilot change assessments are made from a risk perspective with focus on (1) 'sandification' (mud to sand; gravel to sand), with relevance to the burial of sensitive receptors; and (2) 'muddification' (e.g., sand to mud), with relevance to changes in biogeochemistry.

Steps are taken to assess the cumulative impact of activities and how this may lead to indirect loss. However, the dynamical nature of shelf environments, fragmented knowledge on substrate variability (geology-related), but also the process of map making, and chosen scale, complicates applying thresholds of change. Notwithstanding the environmental and operational constraints, most important is to prevent irreversible loss, requiring systematic integration of data and knowledge.