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Simulating larval connectivity between offshore structures, wrecks and hard substrate in the North Sea

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Offshore oil structures have been present in the North Sea for several decades. Currently, large numbers of renewable marine energy generating devices (so far mainly wind turbines) are being installed. Together, these man-made structures form artificial hard substrates within otherwise mostly sandy and muddy habitats. As they get colonised by sedentary marine organisms associated with hard substrates, they have the potential to play an important role in the marine ecosystem and proliferation of species. To elucidate the functioning of offshore structures as a network for the proliferation of sedentary organisms, model simulations were carried out with the three-dimensional hydrodynamics model GETM (General Estuarine Transport Model) and the particle tracking model GITM (General Individuals Transport Model). Particles with life-history characteristics (spawning and settling times, stage-varying vertical migration behaviour) representing larvae of 8 species were released from 670 15x15 km sectors known to contain offshore structures, wrecks and/or natural hard substrate. Potential connectivity between these sectors was traced during the settling stages of the larvae. The simulations were repeated for individual years between 2001 and 2010. Sectors were identified based on their relative dominance in providing or receiving roles. The results indicated distinct patterns of connectivity related to the circulation patterns in the North Sea, with substantial differences between species, and a certain level of inter-annual variability. The results are discussed in the context of decommissioning strategies for oil and gas infrastructures.