Objectives

The overall aim of EcoSTAR is to understand how the introduction or removal of man-made structures (MMS) will affect the North Sea ecosystem. This will be delivered through five linked work packages (WPs) with the following objectives:

WP 1 will investigate the role of MMS as drivers of distribution for top predators (seals and cetaceans) in the context of environmental drivers. Through this, we will:

1) Quantify the association between the North Sea distribution of top predators (seals and cetaceans) and MMS
2) Predict the spatio-temporal distribution of top predators across the North Sea to inform WPs 2,3 & 5

WP 2 will investigate the frequency and nature of interactions between top predators (seals and harbour porpoise) and MMS. Through this, we will:

1) Quantify population level-use of MMS by structure type and age.
2) Quantify the relative benefits and/or costs of foraging at structures and, where data allow, define this in terms of activity budget & body condition.

WP 3 will estimate the multi-species functional responses (MSFR) of top predators (seals and harbour porpoise). Through this, we will:

1) Generate spatio-temporal prey abundance and combine with marine mammal tracking data (WPs 1 and 2) and diet information to estimate how top predators exploit foraging resources around MMS.
2) The fitted MSFR will provide estimates of preference and potentially of switching (changes in preference as a consequence of changing prey availability). These will inform the parameterisation of the food web model (WP 5) and enable model runs for different scenarios to be carried out, to explore the relationship between MMS and predator populations in the context of different regimes of fishing and environmental change.

WP 4 will investigate changes within the benthic fauna, in the structure (diversity and biomass), and function (traits and productivity) in response to the introduction of different types of MMS at a range of different locations. Through this, we will:

1) Use updated data from the INSITE interactive data portal to describe the benthic biomass (biomass-profile) and trait structure (functional diversity) for a range of MMS types with respect to their environmental background.
2) Build on these pattern descriptions (commonalities and differences) to inform on our predictive abilities regarding MMS effects on seabed functioning.
3) Link to the wider food webs by integrating previous findings to an Ecospace model parameterised in WP5 by first, conducting habitat preference modelling of benthic functional groups using environmental drivers and, second, improving MMS context-dependent local change in the benthos near and at MMS.

WP 5 will integrate new data and information acquired through WPs 1-4 and refine a spatial food web model (North Sea Ecospace). This will allow predictions of changes in the biomass of functional groups as a result of changes in hard habitat through the introduction or removal of MMS. Through this, we will:

1) Review the inputs used by the INSITE 1 Ecospace model and update where necessary.
2) Update top predator groups plus consumption and production rates for benthic taxa and top predators (from WPs 1-4). Use estimated spatial distribution (from WP 1 and

2) to drive the movement of predators in the model using the 'habitat based foraging' module in Ecospace. Finally, compare Ecospace predictions to the fitted MSFRs (from WP3) to validate the outputs.

3) Implement a novel approach to model local production at MMS (through "biomass emitters") and allow one-way coupling to the North Sea wide Ecospace model.

4) Run potential scenarios of management (in terms of MMS addition and removal, MPA designation and fisheries) and natural change (e.g. climate scenarios) to assess their relative impact on the North Sea food web structure (biomass of groups) as a result of change in functioning (i.e. consumption and production rates).