Application of Bayesian belief networks to marine ecosystem services assessment to support management

Olivia Langmead[*1]

[1]Marine Institute Plymouth University – Marine Institute Plymouth University Drake Circus Plymouth Devon PL4 8AA, United Kingdom

Abstract

Ecosystem services are becoming increasing important in informing decisions in natural resource management, planning and biodiversity conservation. However, applications for their consideration in the management of UK coastal and marine systems are not well developed. In this study a Bayesian belief network (BBN) modelling framework linked with a geospatial database was applied to local scale case studies to incorporate spatial information on: 1) seabed habitats; 2) the intensity of human activities giving rise to pressures on the seabed; and 3) the existing configuration of spatial management (marine protected areas plus any sectoral measures such as fisheries restrictions, harbour authority regulations). These data were processed into gridded layers that were used for model input. Information on the relationship between pressures, subtidal sediments and their capacity to provide ecosystem services was used to construct conditional probability tables to underpin causal relationships within the socio-ecological models. Linkages in the models that represented 1) the impact of human activities on seabed habitats were conditioned using detailed information on the likely sensitivity seabed habitats groups to specific pressures; and 2) the potential seabed habitats to provide ecosystem services were conditioned using matrices that link ecosystem services to marine features. Model output comprised two types of information: the potential for the seabed to deliver ecosystem services based solely on the particular habitat type (i.e. in a pristine world without human activities) and the likely actual provision of services which took into account the impact of human activities and their pressures on the seabed and any likely impairment in ecosystem service provision. This information was used to construct maps to show the likely potential and actual provision of different ecosystem services across the marine landscape. This method allowed visualisation of the spatial configuration of provision of ecosystem services of different types, and enabled identification of areas with high service provision within the context of human activities and management. Such information is important because it can ensure that management measures or interventions, such as Marine Protected Areas, target important areas for ecosystem service provision, and that trade-offs between activities and management interventions that may affect marine ecosystem service provision are made explicit and considered by decision makers. This BBN framework approach is a novel way to combine many types of information, together with their underlying uncertainties, and combined with a geospatial database, enabled mapping of ecosystem services across a landscape, which can be readily communicated with managers and stakeholders.

[*]Speaker