Assessment of Ecosystem Function Following Marine Aggregate Dredging

Sand and gravel are routinely dredged from the seabed around the globe to supplement land-based aggregate sources for the construction industry, or as a source of material for beach nourishment and coastal defence. The effects of dredging on the environment are mitigated by government by imposing stringent sets of, usually, site-specific conditions.

Traditionally, biological recovery has been assessed by a return to the same faunal assemblage present at a site prior to disturbance or by comparison of the affected site with a suitable reference site. In recent years, a number of approaches have been developed to characterise the richness and evenness of ecosystem function. These techniques are seen as complementary to the traditional indices that simply capture species diversity – yet, to date, very few studies have used them, especially in the context of the marine environment. This paper identifies a number of functional indices/approaches suitable for use with an existing marine faunal assemblage data set, and compares the results of these techniques against traditional measures of assemblage composition.

A number of indices designed to assess ecosystem function were applied to an existing benthic macrofaunal data set collected following recent marine aggregate extraction activity at the Hastings Shingle Bank (UK). All of the indices tested behaved in a broadly similar fashion following the aggregate extraction event, although some suggested faster rates of functional recovery than others. All indicated that the disturbed area of seabed was capable of full recovery given enough time. It is considered that this outcome may be because the physical nature of the seabed was unlikely to have been permanently altered by dredging for aggregate by the method used. This is not always the case following aggregate extraction and depends on the dredging protocol used (for example, sediment screening). The indices tested (some applied for the first time to benthic macrofaunal data) were considered to be complementary to traditional environmental assessment metrics and each might be used under different circumstances.

Field Testing of Lake Water Chemistry with a Portable and an AUV-based Mass Spectrometer

Natural waters contain dissolved volatile substances of much practical or scientific interest. Many applications demand only little time delay between contacting a water volume and obtaining the requested data. Conventional water sampling and laboratory analysis involve not only delay but also risks of contamination, analyte degradation or unintended volatilisation.

This paper describes environmental applications of an underwater mass spectrometer (MS) and a backpack-portable on-site MS. The underwater MS is deployed aboard an AUV, an advantageous mode of operation in large bodies of water. Such deployment requires that the instrument be waterproof and pressure-resistant, have a suitable interface with its host robot, be able to autonomously handle tasks such as calibration, respond appropriately to malfunctions, and not represent a serious risk to its host in the event of electrical faults or loss of buoyancy.

Both systems were tested in an eutrophic, thermally stratified lake exhibiting steep chemical gradients and significant levels of methane. The systems provided rapid multispecies analysis of dissolved gases, with savings of time of at least a factor of 10 compared to that of conventional analysis. The AUV-mounted MS additionally provided rapid spatial coverage and the capability of performing chemical surveys autonomously.

GIS Techniques for Creating River Terrain Models for Hydrodynamic Modelling and Flood Inundation Mapping

The traditional approach to simulating flow in river channels is through one-dimensional (1D) hydraulic modelling. However, 1D models are unable to accommodate the true physical and hydrodynamic conditions that are critical to understand different river processes. To improve our understanding of river hydrodynamics and processes, the use of 1D hydraulic models in many applications is now being augmented or replaced by 2D and 3D hydrodynamic models. Two- and three-dimensional (2D/3D) hydrodynamic models require the geometric description of river bathymetry and its surrounding area as a continuous surface. Creating surface representations of river systems is a challenging task because of issues associated with interpolating river bathymetry, and then integrating this bathymetry with surrounding topography. The objectives of this paper are to highlight key...
issues associated with creating an integrated river terrain and propose GIS techniques to overcome these issues. The following techniques are presented in this paper: mapping and analysing river channel data in a channel-fitted coordinate system; interpolation of river cross-sections to create a 3D mesh for main channel; and integration of interpolated 3D mesh with surrounding topography. These techniques are applied and cross-validated by using data sets from Brazos River in Texas, Kootenai River in Montana and Strouds Creek in North Carolina. Creation of a 3D mesh for the main channel using a channel-fitted coordinate system and subsequent integration with surrounding topography produces a coherent river terrain model, which can be used for 2D/3D hydrodynamic modelling and flood inundation mapping.

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