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Rationalising seabed sediment classification to promote consistency in biotope classification and improve accuracy in predictive biotope mapping

Bryony Pearce, Ceri James, Roger Coggan, Caroline Chambers, Jacqueline Hill and David Tappin

Abstract

The relationship between the distribution of benthic marine fauna and different aspects of the physical environment has been a key topic of research for many years. The nature of seabed sediments, in particular, their grain size composition, has been identified as one of the main drivers determining benthic community composition. Sediment maps are therefore a primary determinant in producing reliable predictive biotope maps of the marine environment.

A number of classification schemes have been developed over the last decade as a means of standardising the way in which the marine environment is categorised. The most widely used scheme in Europe being the European Nature Information System, more commonly referred to as 'EUNIS'. Recent attempts to apply this scheme to a series of regional level mapping projects have identified a number of issues and inconsistencies within the classification scheme, including, but not limited to, the way in which sediment deposits are categorised. Four main sediment divisions have been adopted by the EUNIS scheme (Level 3); coarse sediments, sands and muddy sands, muds and sandy muds, and mixed sediments. These divisions were initially thought to reflect major changes in the composition of marine communities, particularly related to the amount of silt or clay in the sediment. However, there was no practical guidance supplied with the original EUNIS scheme on to how these sediment categories should be applied to empirical or modelled sediment data, leading to inconsistent sediment categorisations.

The Folk sediment classification (1954) is used universally for sediment mapping because the categories can be assigned to both modern and historic particle size analysis (PSA) datasets. Consistent classifications are critical as mapping efforts may cross international boundaries and data collection, analysis and classifications may vary dramatically. However, there is generally a degree of consistency with regards to PSA data.

Amalgamation of the Folk categories to reflect the substrate types in the EUNIS classification scheme was recently developed during the UKSeaMap project (Connor et al, 2006) and was adopted by the Mapping European Seabed Habitats (MESH) project (Figure 1). The simplicity and consistency achieved by this method resulted in its adoption by many broad-scale mapping projects in Europe. However, empirical evidence shows this new categorisation results in a poor match between modelled and observed biotopes; primarily because the boundaries between classes have not been defined because of any known effect on benthic community distribution.

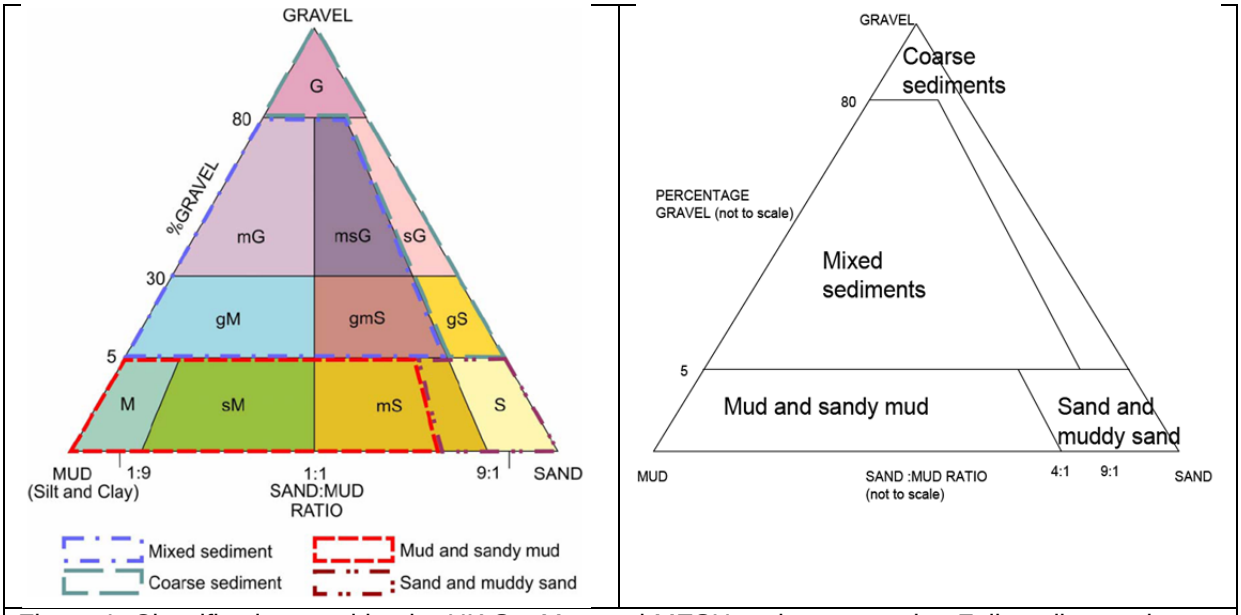

Figure 1. Classification used by the UK SeaMap and MESH projects to assign Folk sediment classes to the four broader sediment classes used in the EUNIS habitat classification scheme

Many of the difficulties in using the Folk category amalgamation developed for the UKSeaMap and MESH projects have arisen because the scheme counter-intuitively places some sand habitats into the coarse sediment category. Although a small number of species have very specific sediment preferences driven, for example, by their burrowing or tube building behaviours, most do not and hence the composition of benthic communities can be very similar, if not identical, in coarse, medium and fine sand deposits. The practicality of differentiating between different types of sand deposits can also be problematic where a detailed analysis is not practical, as in the case of assigning EUNIS biotope classes to images of the seabed, when sand may be interpreted as anything from coarse to fine sand depending on the interpreter, the position of the camera relative to the seabed as well as the level of visibility.

Another major issue with the current Folk to EUNIS conversion is that the divisions between ‘mud’ and ‘sandy mud’ and between ‘sand’ and ‘muddy sand’ have not been defined. These finer divisions in sediments are introduced at Level 4 (broad level biotopes) and therefore any model which does not include this split is limited to a purely physical description of the habitat (Level 3). During the course of two regional seabed mapping projects in the UK, we investigated alternative ways of amalgamating the Folk categories and propose a refined classification that better reflects the relationship between sediment classes and species distributions, and which improves habitat modelling using the EUNIS classification scheme (Figures 2 and 3) .

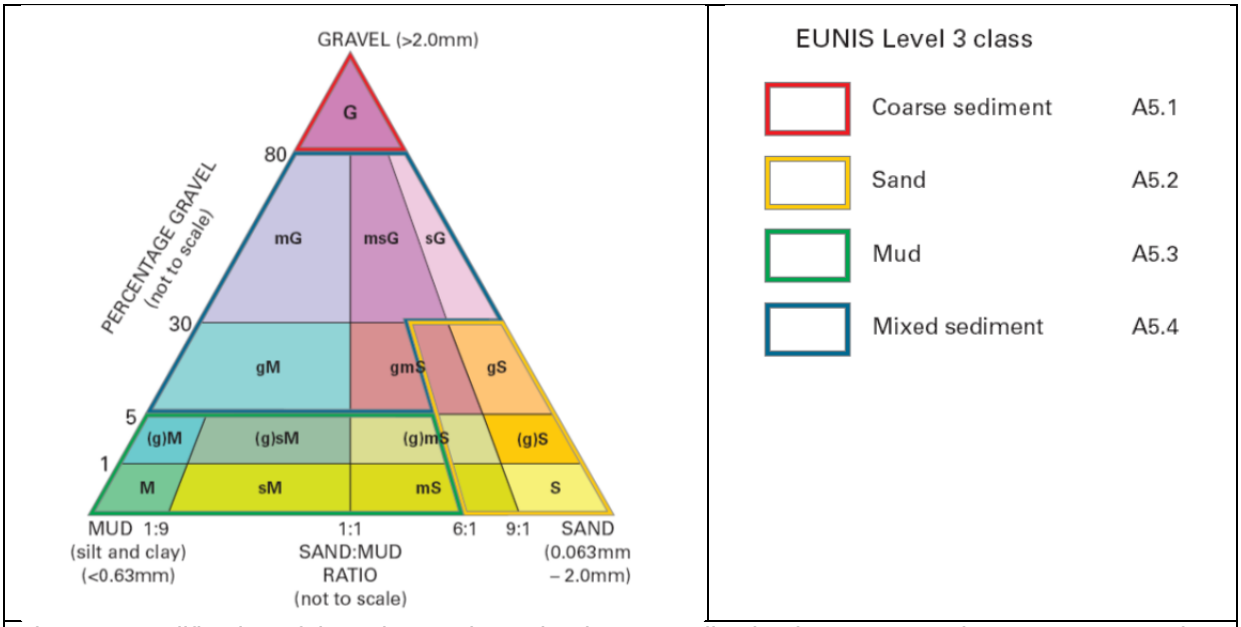

Figure 2. Modification of the schema shown in Figure 1, adjusting how EUNIS classes are mapped to the Folk trigon, in an attempt to improve matching between modelled EUNIS habitat maps and ground-truth observations of benthic communities (from James et al., 2010)

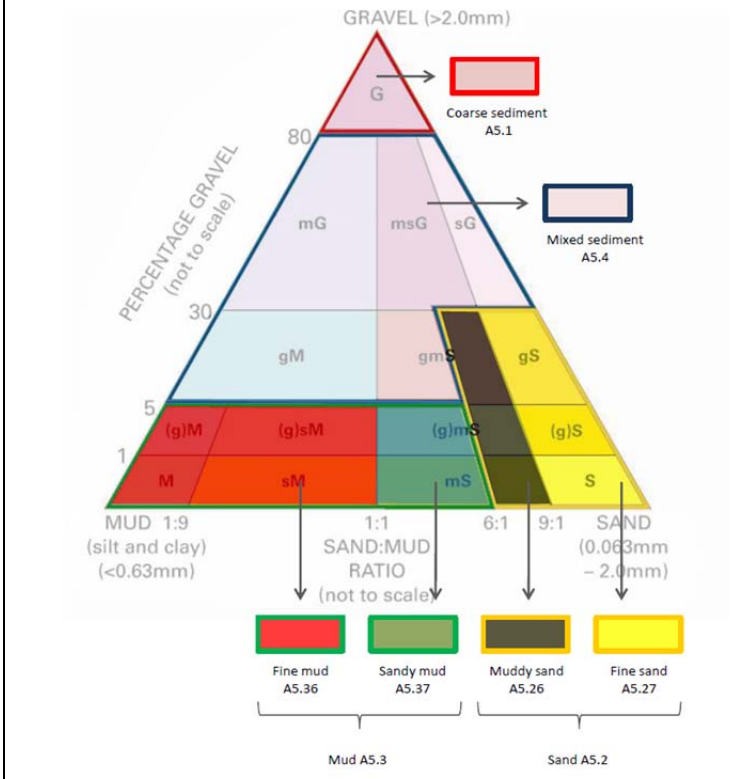

Figure 3. Modification of the schema shown in Figure 2, further dividing the Sand and Mud categories to allow for biotope modelling beyond EUNIS Level 3 (from Tappin et al., 2011)

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Bryony Pearce, Marine Ecological Surveys Ltd, 24a Monmouth Place, Bath, BA1 2AY, UK Tel: +44 (0)1225-442211. Fax: +44 (0)1225-444411. email: bryony@seasurvey.co.uk

Ceri James, British Geological Survey, Nicker Hill, Keyworth, Nottingham NG12 5GG, UK Tel: +44 (0)1159-363467. Fax: +44 (0)1159-363437. email: jwcj@bgs.ac.uk

Roger Coggan, Cefas, Pakefield Road, Lowestoft NR33 7PB, UK. Tel: +44 (0)1502-524532. Fax: +44 (0)1502-513865. email: roger.coggan@cefas.co.uk

Caroline Chambers, Marine Ecological Surveys Ltd, 24a Monmouth Place, Bath, BA1 2AY, UK Tel: +44 (0)1225-442211. Fax: +44 (0)1225-444411. email: caroline@seasurvey.co.uk

Jacqueline Hill, Marine Ecological Surveys Ltd, 24a Monmouth Place, Bath, BA1 2AY, UK Tel: +44 (0)1225-442211. Fax: +44 (0)1225-444411. email: jackie@seasurvey.co.uk

David Tappin, British Geological Survey, Murchison House, West Mains Road, Edinburgh, EH9 3LA, UK Tel: +44 (0)131-6671000. Fax: +44 (0)131-6682683. email: drta@bgs.ac.uk