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THEME SECTION

Large-scale studies of the European benthos: the MacroBen database

Idea and Coordination: **Paul J. Somerfield, Christos Arvanitidis, Edward Vanden Berghe**

CONTENTS

MarBEF, databases, and the legacy of John Gray

P. J. Somerfield[1,*], C. Arvanitidis, E. Vanden Berghe, P. van Avesaath, H. Hummel, C. H. R. Heip

[1]**Plymouth Marine Laboratory, Prospect Place, West Hoe, Plymouth PL1 3DH, UK**

ABSTRACT: Within the European Network of Excellence (NoE) on Marine Biodiversity and Ecosystem Functioning (MarBEF), marine biodiversity scientists from across Europe have been brought together to focus on 3 broad themes. Theme 1 describes large-scale (and long-term) distribution patterns of marine biodiversity, Theme 2 examines the consequences of changes in marine biodiversity for the functioning of marine ecosystems, and Theme 3 explores and disseminates the socio-economic consequences of changes in marine biodiversity and biodiversity-mediated processes. Within MarBEF Theme 1, a large collaborative effort has produced an integrated database of species occurrence information (MacroBen), which contains data of quantitative samples of soft-sediment benthic infauna collected in European continental waters, from the Arctic to the Black Sea. Papers in this Theme Section describe initial studies based on the database. The late Prof. John S. Gray led activities within MarBEF Theme 1 for the first 2.5 yr, during which time the majority of the work described in this Theme Section was set in motion, and he continued to be involved in the work until his untimely death. We dedicate this body of work to his memory.

KEY WORDS: Marine biodiversity · Macrobenthos · Large-scale patterns · Science integration · MacroBen

*Email: pjso@pml.ac.uk

Addresses for all authors are given in the Electronic Appendix at www.int-res.com/articles/suppl/m382p221_app.pdf

INTRODUCTION

In early 2003, a group of scientists from across Europe put a proposal to the European Commission to set up a network of institutes with expertise in different aspects of marine biodiversity research, under the then new Framework Programme VI instrument of a Network of Excellence (NoE). The proposal was accepted, and the NoE, entitled Marine Biodiversity and Ecosystem Functioning (MarBEF), began operating in 2004. An inaugural meeting took place in Bruges in March of that year. Institutes from Norway, Sweden, Finland, Lithuania, Poland, Germany, Denmark, the Netherlands, Belgium, France, the United Kingdom, Ireland, Portugal, Spain, Italy, Slovenia and Greece were represented. The framework of activities and provisional timetables for 5 yr of operation had been laid out in the original proposal document, but this was the first chance for members of the network to meet together to plan the practicalities of delivering the proposed programme.

A wide range of activities was included in MarBEF with the aim of integrating marine biodiversity research within Europe (see www.MarBEF.org). Although the primary goal of a NoE had to be integration rather than research, a programme of collaborative research was included in MarBEF as a means to promote integration. The proposed science was grouped into 3 themes. Broadly, Theme 1 addresses large-scale and long-term patterns in marine biodiversity, Theme 2 brings together researchers to examine relationships between biodiversity and ecosystem functioning, and Theme 3 explores and describes the socio-economic consequences of changes in marine biodiversity and biodiversity-mediated processes. The delivery mechanism for research within these core themes was workshop-based, with researchers coming together to discuss and undertake activities. In addition to the 3 scientific themes, several integrating activities shared by these themes were included in MarBEF's programme of activities, including data management.

Although the science proposed within Theme 1 had several elements, a major thrust was to use MarBEF's data management infrastructure and geographical spread of people and institutions to combine, integrate and analyse existing data to address large-scale patterns in species occurrence and community structure. A major motivation of this work was to attempt to address the mismatch in spatial scales between the scales of sampling (e.g. grabs with an area of 0.1 m^2, collected m or km apart) and the scales at which marine management and policy decisions are implemented (e.g. regional seas). In this Theme Section we describe initial scientific outcomes from MarBEF Theme 1.

MARBEF THEME 1

MarBEF had the ideal person to chair Theme 1 in Prof. John S. Gray (Fig. 1) of Oslo University, who agreed to take on the role for 2.5 yr. The well-attended Theme 1 'kick-off' meeting was held in Oslo in June 2004, at which MarBEF scientists discussed the practicalities of delivering the planned science programme. Friendships were forged and reforged, ideas were aired, shared and discussed, and all those involved left with work to do. An initial aim was to collect and make available existing data from samples collected in European waters. Data from across Europe were provided to the data management team, checked, organised, and added to a database. In parallel, ideas were formulated concerning analyses that could be carried out using the database. Within Theme 1, the decision was taken to focus initially on soft-sediment macrobenthos. Working with the data management team, scientists began to develop a subset (MacroBen) of the main MarBEF database, described by Vanden Berghe et al. (2009, this Theme Section). The second Theme 1 meeting was held in Oslo in March 2005, at which various analyses were discussed and trialed, and the teams that would collaborate to deliver them were formed. Discussions held during the second MarBEF General Assembly meeting in Porto during March 2005, led to the Declaration of Mutual Understanding (DMU) for data sharing within MarBEF Theme 1 (available from www.medobis.org/MarbefDMU.doc). Work continued through the summer of 2005, leading up to the highly successful workshop held in Crete in October 2005 at which an analysis and publication plan, which marked the genesis of this Theme Section, was agreed upon.

The DMU was also finalized at the Crete workshop, but difficulties of working in large multi-partner pro-

John Gray (1945–2007)

jects, and with large-scale sharing of data and resources, became manifest. Overcoming these required hard work and a detailed strategy to contact and engage those who could provide data (managers, stewards) both inside and outside MarBEF. The DMU lays out (1) the principles upon which the rules for sharing data within Theme 1 are based, and (2) the rights and obligations of the contracted parties, i.e. between the leader of the data management team (who acts for the MarBEF consortium), and the data providers. There are 3 main principles: (1) data custodians have formal agreements in place before sharing data; (2) the resulting database is open only to people sharing data within MarBEF Theme 1; and (3) scientists whose data are used should be involved in the creative process of hypothesis generation and testing. The data policy is assumed to be successful as almost of those contacted agreed to share their datasets in the context of the Theme 1 activities. All data providers wishing to access and analyse the database must first sign up to the DMU. Each of them can then exploit the dataset as a whole in order to test their own hypotheses. Studies involving only single datasets can only be undertaken after negotiations between the respective data providers. One of the consequences of the DMU (and the agreements explicit within it) is that data providers are, unless they state otherwise, included as authors on papers that use their data. This makes clear the scope of the collaborations involved in putting together and analysing the data. The results of each study in this Theme Section were communicated to the relevant data providers, who had the opportunity to add analyses or text or decline their right to co-authorship.

Professor Gray's term as chair of Theme 1 came to an end in 2006, following the MarBEF General Assembly meeting in Lecce in May. For many people in MarBEF, this was the last time that they saw him. Although further smaller workshops were held to develop specific aspects of the work, overall progress slowed as resources within MarBEF were focused on a series of Responsive Mode Programmes. It is to the credit of a small number of committed individuals, including Prof. Gray, who worked hard to maintain progress, that this work progressed to the stage where a series of manuscripts were in preparation in 2007.

PRELIMINARY OUTPUTS FROM THE MACROBEN DATABASE

Data sharing and integration were central to the work described in this Theme Section. Datasets and their associated metadata were sent to the Flanders Marine Institute where they were converted into a common format and integrated into the MacroBen database. The datasets, the processes applied to them, and the resultant database are described by Vanden Berghe et al. (2009).

Renaud et al. (2009, this Theme Section) use samples from the database to describe large-scale patterns in benthic soft-sediment infaunal assemblages on European continental shelves, ranging from the high Arctic to the Black Sea. Escaravage et al. (2009, this Theme Section) analyse relationships between species accumulation and area. Both Renaud et al. (2009) and Escaravage et al. (2009) conclude that processes associated with local pelagic production are important determinants of infaunal community structure and that there are no strong differences between different regions in the way in which communities are structured. Coastal seas and oceans are partitioned according to different schemes for a range of purposes, e.g. science, management, politics, or simply convenience. The extent to which different schemes reflect genuine differences in the benthos is examined by Arvanitidis et al. (2009, this Theme Section) who conclude that a scheme based on regional differences in pelagic productivity reflects biogoegraphic differences in benthic infaunal assemblages.

The usefulness of a large-scale database such as MacroBen for addressing ecological questions is demonstrated by the next 2 papers. Somerfield et al. (2009, this Theme Section) examine whether local macroinfaunal communities may be assembled at random from regional species pools at a range of spatial scales, concluding that this is not the case and that regional processes probably influence community assembly. Different processes determine the assembly of whole communities and of the polychaete component of those communities. Polychaete assemblages, on the local scale, appear to be a randomly assembled subset from the regional species pool. The large scale of the MacroBen database allowed Webb et al. (2009, this Theme Section) to apply techniques from the field of macroecology to marine benthic data for the first time. They show that there are important similarities and differences between macroecological patterns on land and on the seabed.

Finally, Grémare et al. (2009, this Theme Section) use the large-scale taxonomic and geographic coverage of the database to assess how 2 different indices proposed for monitoring the implementation of the European Water Framework Directive compare when the data used to calculate them come from different parts of the European coast.

It must be stressed that these papers are only first steps. New data may be added to the database, as there are large gaps in the geographic coverage, and even in areas where coverage is relatively good there are large distances between individual samples in both

space and time. Using the database as it is, there are many new questions that can be addressed, and the data provide new ways to address existing questions over a range of geographic scales. Linking the occurrence information in MacroBen to information about the species, such as functional traits (Bremner 2008), physiology, or information about the species' tolerances to chemicals, pollution, temperature, or climate change would allow whole new analyses aimed at understanding large-scale changes (e.g. Somerfield et al. 2008), and assessment of existing analyses at larger spatial scales (e.g. Grémare et al. 2009). Effort is already being made within MarBEF to integrate and synthesise time-series data, and a similar database to MacroBen for meiofauna (Vandepitte et al. 2009) is currently being analysed (e.g. Schratzberger et al. 2009).

PROFESSOR JOHN STUART GRAY

John Gray's terminal illness was diagnosed in 2006, and the MarBEF General Assembly in Poland in 2007 took place without him. Although John no longer attended meetings, he was active in MarBEF until the very end. It was with great sadness that we heard of his passing on 21 October 2007, aged only 66. His life and work have been covered in this journal (Warwick et al. 2008a) and elsewhere (Richardson et al. 2008, Warwick et al. 2008b). We present in this Theme Section a body of work that exemplifies John's belief that data always have value above and beyond the reasons for which the data were originally collected. Criticism has been levelled against John for being more a user of other people's data rather than a collector of original data, but we share his view that data represent information that can never be re-gathered. To make the best use of datasets (once the original purpose for the data collection is completed), it benefits everyone if the information is made available widely. The data collector benefits from the exposure of the original collection effort (and receives citations if the work was good enough to be published), and questions can be addressed that could never be addressed by new sampling programmes, no matter how much money is made available for conducting them. John believed in the approach adopted by MarBEF, and worked hard to make it a success. We acknowledge his contribution, are thankful for it, and dedicate the work presented here to his memory.

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LITERATURE CITED

Arvanitidis C, Somerfield PJ, Rumohr H, Faulwetter S and others (2009) Biological geography of the European seas: results from the MacroBen database. Mar Ecol Prog Ser 382:265–278

Bremner J (2008) Species' traits and ecological functioning in marine conservation and management. J Exp Mar Biol Ecol 366:37–47

Escaravage V, Herman PMJ, Merckx B, Włodarska-Kowalczuk M and others (2009) Distribution patterns of macrofaunal species diversity in subtidal soft sediments: biodiversity–productivity relationships from the MacroBen database. Mar Ecol Prog Ser 382:253–264

Grémare A, Labrune C, Vanden Berghe E, Amouroux JM and others (2009) Comparison of the performances of two biotic indices based on the MacroBen database. Mar Ecol Prog Ser 382:297–311

Renaud PE, Webb TJ, Bjørgesæter A, Karakassis I and others (2009) Continental-scale patterns in benthic invertebrate diversity: insights from the MacroBen database. Mar Ecol Prog Ser 382:239–252

Richardson B, Wu R, Shin P, Lam P and others (2008) A tribute to John Stuart Gray (1941–2007). Mar Pollut Bull 56: 1–4

Schratzberger M, Lampadariou N, Somerfield PJ, Vandepitte L, Vanden Berghe E (2009) The impact of seabed disturbance on nematode communities: linking field and laboratory observations. Mar Biol 156:709–724

Somerfield PJ, Clarke KR, Warwick RM, Dulvy NK (2008) Average functional distinctness as a measure of the composition of assemblages. ICES J Mar Sci 65:1462–1468

Somerfield PJ, Arvanitidis C, Faulwetter S, Chatzigeorgiou G and others (2009) Assessing evidence for random assembly of marine benthic communities from regional species pools. Mar Ecol Prog Ser 382:279–286

Vanden Berghe E, Claus S, Appeltans W, Faulwetter S and others (2009) MacroBen integrated database on benthic invertebrates of European continental shelves: a tool for large-scale analysis across Europe. Mar Ecol Prog Ser 382: 225–238

Vandepitte L, Vanaverbeke J, Vanhoorne B, Hernandez F and others (2009) The MANUELA database: an integrated database on meiobenthos from European marine waters. Meiofauna Mar 17:35–60

Warwick R, Field J, Heip C, Stebbing T (2008a) In memoriam John Stuart Gray. Mar Ecol Prog Ser 354:1

Warwick R, Stebbing T, Field J, Heip C (2008b) Prof. John Stuart Gray (1941–2007) Obituary. J Exp Mar Biol Ecol 366:1–5

Webb TJ, Aleffi IF, Amouroux JM, Bachelet G and others (2009) Macroecology of the European soft sediment benthos: insights from the MacroBen database. Mar Ecol Prog Ser 382:287–296