



Marine Biodiversity
and Ecosystem
Functioning

network of excellence

Promoting marine values

Featuring
THE BALTIC: Research in a north European sea

including...
Ecological treasures of the southern Baltic

Assessing biodiversity of the Baltic

Threats to Baltic marine values

A special Baltic pull-out

Also:
MarBEF research, progress and events



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COVER IMAGE:

A typical sandy shore in Slowinski National Park, Poland, and (inset) sand goby *Potamoschistus minutus* (© Agnieszka Arciuch).

Dear Readers,

Once again I believe we have collected a wide range of interesting articles to entertain you including an update of the activities within the MarBEF network.

Following the decision to hold the GA in Gdansk in Poland we decided in this issue to head to the Baltic Sea and cover some of the interesting marine research which is being carried out. We continue with our education section for our budding young marine scientists and in this issue they can learn some interesting facts on the Baltic region.

We also feature an original research paper on polychaete community genetics from the Greek lagoons and an interesting article from a PhD study on Irish Reserves where the author talks of using marine reserves as a management tool.

In our next issue we will head south to the Mediterranean region, and so we will particularly welcome your articles on marine research in this area.

Finally, many thanks to all our contributors for taking the time to put together articles and for making this issue a most enjoyable read.

Róisín Nash, Editor



Introduction

Dear Friends and Colleagues,



After the fourth General Assembly of MarBEF in Gdynia and Sopot, we are now over the half life-time of the network. Time for a balance. Obviously, on the whole, things are going very well. The GA clearly showed how much progress had been made in the Core Strategic Programme and especially in the Responsive Mode Projects, which are more and more becoming the places where the action is. We are a very diverse community and that makes the span of our activities so interesting, not only to ourselves, but to the outside world as well. To make good use of this diversity will require some efforts of synthesis between the different projects and we have little over a year to organise that.

When we started MarBEF, biodiversity was still something of a buzzword, now it is understood by the general public, and the message that biodiversity erosion is as big a problem as climate change has clearly reached society. The next step, the conservation of that biodiversity, still needs a lot of support, but there is progress. The legislative process in the European Union has been and will be of tremendous importance for the conservation of biodiversity. After the Bird and Habitat Directives and the Water Framework Directive, we have finally arrived at Europe's last frontier, the open seas and oceans. Although it will take years to get into the implementation stage, the Maritime Policy of the EU is now in the pipeline. MarBEF has formulated an opinion on the Green Paper that the Commission has presented and strongly supports the idea of a common policy that must be based on adequate scientific information.

Of course, MarBEF itself will be a ghost of things past when the Maritime Policy will be a fact. Life after MarBEF and the legacy of MarBEF have become hot topics to consider during the next year, when we will have to come up with a structure that allows durable integration and fulfills our contractual obligations: the European Centre for the Study of Marine Biodiversity and Ecosystem Functioning (EMBEF) that is part of our Consortium Agreement will, in some way or other, have to see the light. It will not be an easy task to construct the correct organisation for this, alone or together with other networks and hopefully with the support of our national authorities.

The rescue, access and archiving of marine biodiversity data is another important legacy of MarBEF, and our contributions to ERMS and EuroBIS are widely visible and of high value. The upgrading of the access to and the use of biodiversity information, coupled with collections and networks of biodiversity observatories, are part of the Life Watch project, which at the origin was a MarBEF initiative, and which will – hopefully – enter a three-year preparation phase soon. This is part of the European Strategy for Research Infrastructures' (ESFRI's) roadmap and an extremely important development for biodiversity research and application, now already supported by fifteen EU member countries.

MarBEF is a network of science and scientists. The flow of scientific information from the network is already impressive, with now over 200 papers, including several in *Science* and *Nature*, bearing the MarBEF stamp. We count on our RMPs to continue to produce state-of-the-art review papers, perspectives and commentaries in *Science* and *Nature*, and we count on our CSP to deliver authoritative reviews on the issues they cover: patterns, processes and socio-economics.

When we go to the final General Assembly in Valencia in November next year, we will prepare not the beginning of the end but the end of the beginning. We will also highlight our scientific achievements and ambitions during the World Conference on Marine Biodiversity that will follow the GA. The preparations for that meeting are going very well and we obtained the support of a number of European and international organisations, including ICES and CIESM, the Census of Marine Life and DIVERSITAS and IOC/UNESCO, to name a few. This must be one of the most important scientific products, and therefore legacies, of the network and is a challenge to our members to present the top in marine biodiversity science.

Carlo Heip
General Coordinator

MarBEF Theme 1: Global Patterns of Marine Biodiversity Across Ecosystems

Progress to date

By Alexandra Kraberg, Fred Buchholz and Doris Schiedek

THE CENTRAL OBJECTIVES of MarBEF are laid out in the Central Strategic Core programme. The Responsive Mode Projects (RMPs) have turned out to be invaluable to follow the MarBEF themes in detail and fill the Network of Excellence with life, organisationally and within many scientific activities. To detect patterns in European biodiversity in temporal and geographical structures, a prerequisite is the accessibility to existing biodiversity data sets of the partners. Here, the RMPs play a key role and, even more importantly, are fora to formulate appropriate hypotheses on the occurrence and changes of pan-European patterns in marine biodiversity.

Long-term data: an important pillar within Theme 1

Nearly all the Theme 1 RMPs are concerned with the collection and analysis of long-term data to detect and study long-term and large-scale changes in different marine ecosystems. Great strides have been made in the area of data acquisition resulting, for instance, in the recovery and compilation of multi-decadal (fish, benthos, plankton) and multi-century-scale (fish) data for analysis of changes in species abundance, distribution and community composition.

Running success stories are:

The MACROBEN database: Owing to the contributions of the different MarBEF partners, this has developed into one of the most comprehensive marine benthic databases available globally. Based on these data, a set of overall hypotheses has been formulated and has already been partly tested with respect to soft-bottom benthic biodiversity patterns and variations across spatial and temporal scales. Large-scale scientific analysis and publication of spatial variations in benthic fauna on a pan-European scale, as well as several detailed studies of Arctic fjords, are in progress.

The MANUELA database: This now has 78 component datasets, containing information on the spatial distribution of nematodes and harpacticoid copepods on a European scale (from Spitzbergen to the Mediterranean Sea).

The work of **DeepSets** has led to the establishment of a series of deep-sea sites equivalent to BIOMARE Long-Term Biodiversity Research/Reference coastal sites. Deep-sea sites for experimental and manipulative studies have also been decided upon. The work of DeepSets'

members has led to the discovery of a large and unprecedented increase in family richness of polychaetes at the European PAP (deep-sea) long-term study site. It has also revealed a large-scale regime shift in the megafaunal (large invertebrate) community and changes in meiofauna dominance and composition, indicating that the abyssal ecosystems respond to environmental perturbations in all size fractions of the benthic community.

Within **MarFish**, new long-term datasets for fish and environmental variables (e.g. regional SST) have been developed. These datasets extend decades, centuries and even millennia back in time, and include periods when main drivers (fishing, climate change and eutrophication) differed greatly from those at the present time.

After compiling long-term data on biodiversity in Arctic fjords, **ArctEco** has started to identify main drivers of variability in biodiversity, which may be reconstructed over decadal or centennial time-scales. A visual impression regarding biodiversity in the Arctic offers the MarBEF photo-gallery photographs of over 600 species from the ATBI site Hornsund and from Kongsfjorden, Svalbard.

Much progress has also been made in RMP **LargeNet**. Six working groups have been set up to investigate a range of questions all centred around evidence for global change-related events in European long-term data sets. These investigations include, among others, shifts in geographic ranges of rocky-shore species on a European scale, regime shifts, shifts in phenology of selected

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Table 1: THEME 1 RMPs (RESPONSIVE MODE PROJECTS)

WP-RMP code and title	Principal Investigator(s)
3-1 Causes and consequences of changing marine biodiversity – a fish and fisheries perspective (MarFish) (www.marbef.org/projects/marfish/index.php)	MacKenzie, Brian
3-2 Biodiversity and ecosystem function under changing climatic conditions – the Arctic as a model system (ArctEco) (www.marbef.org/projects/arcteco/index.php)	Weslawski, Jan Marcin
3-3 Deep-sea & Extreme Environments, Patterns of Species and Ecosystem Time Series (DEEPSETS)	Billet, Dave
3-4 Meiobenthic and Nematode biodiversity: Unravelling Ecological and Latitudinal Aspects (Manuela) (www.marbef.org/projects/manuela/index.php)	Vanaverbeke, Jan
3-5 Web Accessible Taxonomic Expertise in MarBEF: PROviding an e-Platform for the European Taxonomists (PROPE-taxon) (www.medobis.org/prope/index.php)	Arvanitidis, Christos
3-6 Large-scale and long-term Networking on the observation of Global Change and its impact on Marine Biodiversity (LargeNet) (www.marbef.org/projects/largenet/index.php)	Buchholz, Friedrich
3-7 Integration of different methods to study patterns and changes in pelagic biodiversity in the open ocean along the Mid-Atlantic Ridge (MARECO)	Pierrot-Bults, Annelies C. & Piatkowski, Uwe
3-8 European integration of marine microplankton research (MARPLAN) http://www.marbef.org/projects/marplan/index.php	Kooistra, Wiebe H.C.F.
3-9 Modelling key aspects of marine biodiversity	Lambshhead, John

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species, changes in β -diversity along European shores and shifts in thermoclines (check out the MarBEF website for further details). Work is currently focusing on rocky-shore and pelagic zones, as much progress has already been made with the soft-bottom benthos. Data are being actively acquired, with several LargeNet partners already having agreed to make available further data sets. One LargeNet highlight for 2007 will be preparation of a review of the evidence for regime shifts in multiple data sets.

Exchange of people, methods and ideas

Data acquisition and analysis is not the only common activity within Theme 1. The large-scale multi-author analyses carried out in Theme 1 also require a very large skills base and many RMPs are therefore engaged in exchange of methodology including experimental approaches, partly supported through the MarBEF sabbatical programmes. One RMP that is exemplary in this respect is **MarPLAN**, and the examples given below clearly demonstrate that the transfer of skills is only one aspect of these visits. They also result in important, novel scientific insights that in most cases lead to peer-reviewed publications:

Examples:

● Sascha Klöpffer, PhD student of Dr Allan Cembella (AWI-Bremerhaven), visited the SZN in Naples to learn how to make electron micrographs of Adriatic strains belonging to *Chattonella* sp. and *Fibrocapsa*. These unicellular phytoplankton organisms can form potentially toxic blooms in coastal areas, and seem to appear suddenly in regions where they had never been recorded before. *Chattonella* includes three or four widely distributed species whereas *F. japonica*, which is believed to be the only species in its genus, appears to be cosmopolitan. The cells do not have a firm wall and it is therefore difficult to prepare these

organisms for EM observations with their surface ultrastructural details intact. Gandi Forlani and Dr Adriana Zingone trained Sascha in the use of these preservation methods as well as the use of electron microscopy. His work at SZN, combined with molecular phylogenetic results already obtained at the AWI, has shown that both the strains of *Fibrocapsa* and those of *Chattonella* represent new species. Results were presented at the 12th International Conference on Harmful Algae, 4-8 September 2006, in Copenhagen, Denmark.

● Alina Tunin, PhD student in the laboratory of Dr Rodolphe Lemée (LOV), visited SZN to isolate *Ceratium* species from phytoplankton net samples taken in the Gulf of Naples. *Ceratium* is a diverse genus of large phytoplanktonic dinoflagellates with beautiful and often quite bizarre cell-wall architecture. Alina uses these dinoflagellates as biological indicators of environmental change in the NW Mediterranean Sea. She compared species assemblages found presently at the phytoplankton sample stations off Villefranche and off Naples with assemblages reported in old literature. She visited SZN also to retrieve part of that ancient literature. *Ceratium* cells grow slowly and are often difficult to maintain in culture. Therefore, Rodolphe spent two sabbaticals at SBR Roscoff to learn “Single Cell PCR” applied to *Ceratium* phylogeny studies from Dr Nathalie Simon. He isolated numerous cells belonging to various species at Villefranche and he managed to amplify marker regions of several of them at the SBR. The sequences obtained in the lab were compared with sequences obtained from GenBank, and phylogenetic trees were constructed for *Ceratium* systematics and phylogeny.

● As an example of the personal experiences colleagues may undergo when staying in foreign countries for some time, here are the

personal impressions of Alberto Amato, PhD student at SZN-Naples, who spent two months in Dr Allan Cembella’s group at the AWI in Bremerhaven.

“My stay (from the 12th of January to the 13th of March 2007) at the AWI in Bremerhaven was a great experience, not only from a professional, but also from a personal point of view. I integrated with pleasure in a working group of devoted researchers and students from whom I learned a lot of new techniques and had many stimulating discussions. Living in the city centre of Bremerhaven was also a great experience. I had the chance to visit the town, spend time with new friends in the evening and the weekends, talk with them about other things than work alone, see how they lived, what keeps them busy. It showed me that life is good in Germany and that I am happy to work there.”

Another mode to exchange ideas and to communicate is the MarBEF website. Most RMPs have also developed an active web presence and two RMP forums have been established:

- (i) LargeNet (www.marbef.org/modules.php?name=Forums&file=viewforum&f=9)
- (ii) MarPLAN (www.marbef.org/modules.php?name=Forums&file=viewforum&f=11).

MarPLAN also opened a special forum topic for questions related to flow cytometry. These fora are open to all, so please take a look. We encourage you to post questions or discussion points and announcements there. Hundreds or even thousands of people will see them!

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MarBEF Theme 2: Marine Biodiversity and Ecosystem Functioning

RMPs progress report, April 2007

Figure 1. BIOFUSE rocky-shore study site at East Sands in St Andrews, Scotland.

By Rebecca Aspden, Iris Hendricks, David Paterson and Carlos Duarte

The objective of Theme 2 is to generate theory, models and tests of the relationship between marine biodiversity and ecosystem function through the integration of theory, modelling, meta-analysis and experimental tests. The core programme aims to provide a functional dataset with which to compare the activities of marine systems with terrestrial systems. In order to complete this, dataset analysis will consist of a co-ordinated strategy to determine rates of ecosystem functionality from a variety of benthic and pelagic ecosystems.

Theme 2 consists of seven Responsive Mode Projects (RMPs) (Table 1). The overall aim of these RMPs is to determine rates of ecosystem functionality in both benthic and pelagic systems by generating theories, models and experimental tests of the relationship between marine biodiversity and ecosystem function. Details of the meetings and any downloads regarding the RMPs can be obtained from the individual RMP websites (Table 1) and minutes

of the kick-off workshops are placed as deliverables in the download section of the MarBEF webpage (www.marbef.org).

CSP progress

The task and deliverable list of the Theme 2 Core Strategic Programme (CSP) is now complete. The only outstanding deliverables are in the form of workshops, which are currently being organised and will be

completed within Joint Programme of Activities (JPA) IV. The majority of WP4 progress during JPA III has been within the RMP activities.

The training course "Measuring Ecosystem Function: Field and Laboratory Methods" was carried out at the University of St Andrews (5-9 June 2006) with great success (a full report was printed in the MarBEF newsletter, Autumn 2006). Due to the success of the last two courses, funding was successfully applied for in order to carry out the course again during JPA IV (June 2007). The training workshop "Emerging Area Workshop (Theme 2, CSP) – Experimental assessment of the role of marine biodiversity on energy dissipation" was held on 22-26 January 2007 (month 36) at Yerseke. The workshop was organised by Iris Hendriks, IMEDEA (partner nr. 4), and local organisation by Tjeerd Bouma (NIOO-KNAW,

Table 1: THEME 2 RMPs (RESPONSIVE MODE PROJECTS)

<i>WP-RMP code and title</i>	<i>Principal Investigator(s)</i>
4-1 RMP on Genetic Biodiversity (GBIRM) (www.marbef.org/projects/gbirm/index.php)	J.-P. Ferral
4-2 The role of native and/or invasive ecosystem engineers in explaining biodiversity	T. Bouma, P. Herman, T. Ysebaert
4-3 Marine Propagation Along the Coasts of Europe (MARPACE) (www.marbef.org/projects/settlement/index.php)	K. Philippart
4-4 Effects of biodiversity on the functioning and stability of marine ecosystems – European scale comparisons (BIOFUSE) (www.marbef.org/projects/biofuse/index.php)	T. Crowe, L. Benedetti-Cecchi
4-5 Functioning of FOOD Webs across ecosystems of different BIOdiversity level (FOODWEBIO) (www.marbef.org/projects/foodwebio/index.php)	A. Sokolowski
4-6 Microbial diversity and ecosystem functions: concepts, open questions and recommendations for integration of microbes into general ecological frameworks	K. Jürgens, J.M. Gasol
4-7 Role of Secondary Metabolites in Ecosystem Biodiversity (ROSEMEB) (www.marbef.org/projects/rosemeb/index.php)	A. Ianora

CEME). During the workshop, attempts were made to formulate general, allometric 'laws' that could be applied over various factors, predicting turbulent energy dissipation of assemblages, using data available in literature, data from participants (worked up to specific parameters to be used) and experimental data which traditionally will be focused on single species treatments. Apart from the single species treatments measured during the workshop, mixed species treatments were measured and outcomes compared against expected results, validating our hypotheses on effects of (structural) diversity of the assembly on energy dissipation.

The "Impacts of top predator removal on marine ecosystem function" workshop is now being run by the Sea Mammal Research Unit (University of St Andrews) and is scheduled to occur in month 45.

Dr Alexandra Kraberg and Dr Doris Schiedek are in the process of organising the metrics workshop, with the assistance of Rebecca Aspden and David Paterson.

Cross-theme RMP integration occurred between Themes 1, 2 and 3, in the form of two workshops during the First European Congress of Conservation Biology, organised by Professor D M Paterson, Professor J Gray and Dr I Sousa Pinto. A further activity will be organised within JPA IV.

RMP progress

All seven of the RMPs within Theme 2 are currently well under way, and are addressing the deliverables and milestones outlined for JPA IV. Most are now beyond the organisation stage of their work and, through various different methods, including theory, meta-analysis, laboratory and field-based experimentation, and modelling, all the objectives of the RMPs are currently being met.

The first **GBIRM** sampling trip was completed in October within the framework of the RMP MANUELA ("Meiobenthic and nematodes biodiversity: unravelling ecological and latitudinal aspects"). Three other trips are planned for JPA IV.

A **MarENGIN** meta-database has been set up to provide detailed information on available data relevant to the RMP: the ecosystem engineering species, study area(s), sampling and experimental designs, types of observations/measurements on the ecosystem engineering species, on biological (biodiversity) components and on abiotic (physical, chemical) attributes. A number of scientific papers acknowledging MarBEF have been published in relation to this RMP.

The **MarSETTLE** protocols for benthic and pelagic sample collection have been finalised by the NIOZ and disseminated amongst partners. Standardised "recruitment boxes" for



Marine Biological Station at Roscoff.

pelagic sampling and standardised "recruitment panels" have been sent out to all partners for deployment. Benthic and pelagic sampling started on December 15, 2006.

A successful workshop for High School Biology Teachers was organised in January 2006 by Katja Philippart (NIOZ) and Arjan Gittenberger (NHM). This outreach was communicated with EcoServe for possible incorporation in general MarBEF outreach activities.

A **BIOFUSE** workshop (32 participants) was held in January 2007 in the Marine Biological Station, Roscoff. The person responsible for each element of the RMP presented a progress report and preliminary results. Plans were made for the coming year. The next workshop will be held in Pisa in January 2007.

Nineteen of the 28 existing datasets have been collated and meta-analyses are well underway with seven proposed hypotheses already tested. The sampling of the biodiversity on rocky shores around Europe is going very well. Simple experiments have been set up in three habitats (rocky shores, soft sediments and sea grasses). The experimental work on rocky shores is nearing completion. Measurements of community respiration and photosynthesis are being undertaken by members of the Roscoff team who are travelling among institutions with their benthic incubation chamber. In August 2006, measurements were completed at six of the nine participating institutions.

With an end date now scheduled in the summer/autumn of 2007 it is anticipated that results will be collated and basic analyses undertaken prior to the Pisa meeting in January 2008. The experimental aspect of the soft sediment experiments has been completed and data analysis is now underway. The experiment in sea grass was successful at only one participating institution and the experiment will be re-run to a new protocol in May 2007.

Members of BIOFUSE have been involved in the **MoBIDiC** initiative (involving school children in sampling marine biodiversity). Plans have been made for a survey of awareness of marine biodiversity issues among undergraduates of different disciplines in different

countries. A questionnaire has been developed at ConISMA in collaboration with a social scientist. It will be circulated by BIOFUSE participants to students at their universities. A number of scientific papers acknowledging MarBEF have been published in relation to this RMP.

Current progress of **FOODWEBIO** RMP includes collection of data on stable isotopes in different components of ecosystem, and data necessary for Network Analysis (such as standing stocks of auto- and heterotrophic species, rates of their basic physiological processes and their diets) from different European coastal systems. Data is being gathered through a questionnaire that lists single parameters and variables required for each methodological approach. The data will be stored in one database per approach. The project was disseminated to students, scientists and the public at large during several events in 2006, including: the Fifth International Conference on Applications of Stable Isotope Techniques to Ecological Studies, Queens University, Belfast, Northern Ireland, and a Summer School on "Diversity of Coastal Habitats", Wadden Sea Station Sylt, Alfred-Wegener Institute for Polar and Marine Research, Sylt, List, Germany.

Future work within the **MarMICRO** RMP includes the creation of a website, and a conceptual paper, summarising the current understanding, differences between the research communities and gaps of knowledge.

ROSEMEB members have produced a list of published scientific papers, relevant to the general field of marine chemical ecology, in order to provide general reading for interested scientists, to offer a starting point for potential researchers in chemical ecology and to present supporting evidence from different models on the role of secondary metabolites in marine systems. This list of publications can be found on their website (www.marbef.org/projects/rosemeb/index.php). A poster was presented last July at the meeting of the Italian Association of Limnology and Oceanography (AIOL) in Naples and is currently visible to visitors at the Stazione Zoologica of Naples, Italy. The exchange of samples between institutes is ongoing. A series of short sabbaticals have been taken by members of ROSEMEB, and a new member, Klaipeda University, Coastal Research and Planning Institute, was added to the list of participating institutes of ROSEMEB.

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MarBEF Theme 2: Marine Biodiversity and Ecosystem Functioning

Experimental assessment of the role of marine biodiversity in energy dissipation

Emerging Area Workshop (CSP), Yerseke, The Netherlands, 22-26 January 2007

By Iris Hendriks

The idea behind this workshop, held at NIOO-KNAW, CEME, Yerseke, The Netherlands, in January, was to look at structural diversity of benthic organisms and their effects on water flow in general and turbulent kinetic energy specifically. The main question posed was: "Is there an additive effect of (structural) biodiversity?"



Workshop participants. Back row (left to right): Gareth, Nick, Ed, Tjeerd, Andrew. Front row: Jennifer, Iris (holding bivalve shell for the experiment), Tom, Luca.

The oceans contain thousands of species that are able to form structures that interact with flow fields. These species profit by these altered flow fields by increased food supply to the bed, and increased larval supply or shelter for their siblings, and they provide habitat complexity through their physical structures.

Organisms that change the abiotic environment, resulting in modification, maintenance or destruction of habitats, are called physical ecosystem engineers (Jones *et al.* 1994), whose physical effects might outlast their own lifespan (Hastings *et al.* 2007). Well-known examples are coastal vegetation (Bouma *et al.* 2005), seagrasses (Koch *et al.* 2006), coral reefs (Foster *et al.* 2007), polychaetes (Volkenborn & Reise 2007) and molluscs (Gutierrez *et al.* 2003). These structures vary widely in flexibility, protrusion, roughness and size. By altering the environment, ecosystem engineers create patches with organism assemblages that differ from the surrounding, unmodified habitats (Wright *et al.* 2006).

Only a handful of these species have been brought into experimental facilities where their (structural) effects on flow can be investigated under controlled conditions. There is, therefore, little hope that a comprehensive understanding of the role of benthic communities on flow parameters like turbulent energy dissipation (TKE) may emerge from experiments encompassing these organisms. The alternative approach followed by this

workshop involved generating a theoretical framework on what particular traits affect turbulent energy dissipation, and in what way – after which we submitted these hypotheses to experimental tests across a range of species (plant (mimics), bivalves, a tube-building polychaete), alone and in assemblages, encompassing a broad range of physical structures. To simplify the experiment, we chose surface exposed to flow as a potential crude predictor of structural effects on energy dissipation and bulk flow. This experimental part of the workshop took place in the NIOO flume, an annular flume with benthic module in the test section and a capacity of 10 m³ of seawater placed in an acclimatised room.

To evaluate species-specific (structural) effects on turbulent energy dissipation and bulk flow over assemblages, we built a database of data available in literature, existing data from participants (worked up to specific parameters) and experimental data from tests (single species and mixed treatments) run during the workshop in the NIOO flume. Analysis of the data is in progress.

List of participants

Andrew Folkard, University of Lancaster, UK
Ed Morris, Universidad de Cádiz, España
Gareth Johnson, School of Ocean Sciences, University of Wales, Bangor, UK
Iris Hendriks, IMEDEA, Spain
Jennifer Verduin, Murdoch University, Australia
Luca van Duren, RIKZ, The Netherlands
Nick Pope, Plymouth Marine Laboratory, UK

Tjeerd Bouma, Netherlands Institute of Ecology (NIOO), The Netherlands
Tom Ysebaert, Netherlands Institute of Ecology (NIOO), The Netherlands

Acknowledgments

Organisation by Iris Hendriks, IMEDEA; local organisation by Tjeerd Bouma (NIOO-KNAW, CEME). The organisers are grateful to Carlo Heip (the coordinator of MarBEF and institute director of NIOO-KNAW, CEME) for making the workshop possible and to Carlos Duarte (MarBEF Theme 2 leader) for ideas, input and support.

We would also like to thank all participants for their enthusiasm and involvement in the workshop and, in particular, Edward Morris for helping during the preparation phase, and Luca van Duren for technical support during the preparation of the NIOO flume.

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MarBEF Theme 2: Marine Biodiversity and Ecosystem Functioning

ROSEMEB activities and achievements in 2006-2007

By Adriana Ianora

Plants and animals in the sea produce a variety of secondary metabolites that are crucial for the survival of the producing organisms. Such compounds can affect feeding and reproductive patterns (see Fig. 1, from Ianora *et al.* 2004), act as defenses against predators and pathogens, and promote evolution and maintenance of biodiversity through resource and habitat partitioning. The science which considers these types of chemical interactions is termed chemical ecology.

Chemical ecology is one of the youngest and fastest growing sub-disciplines of the ecological sciences. **ROSEMEB** is the first coordinated effort to better integrate research within this field in Europe. Our aim is to develop and apply novel and ecologically relevant methodologies to studies of allelopathy, anti-predation, anti-fouling, anti-microbial, and other possible functions of secondary metabolites, to better understand the diversity and function of these natural products and what environmental factors trigger increased production of these compounds.

Recent achievements by our group include the publication of a position paper (Ianora *et al.* 2006) which was the outcome of the kick-off meeting convened in November 2005 at the

Benthos Laboratory of the Stazione Zoologica Anton Dohrn in Ischia, Italy. The essay focuses on a few key topics in this field, such as bacterial quorum sensing and the defensive and protective functions of sponge-associated bacterial interactions, which have indicated the microbial origin of many of these natural products. Another emerging topic considered is the potential role of secondary metabolites and allelopathy in controlling microalgal biology, species successions during bloom development, competition and communication within the phytoplankton, and defence against predation by zooplankton. Theories concerning the circumstances under which organisms defend themselves chemically are discussed, and selected examples are given also of interactions between marine benthic invertebrates, especially sponges, molluscs and

cnidarians that are mediated by specific secondary metabolites.

Last year, we organised a training course on bioassay methods in marine chemical ecology, held from 9-14 September at the Tjärno Marine Biological Laboratory, Strömstad, Sweden. The overall aim of the course was to teach some of the basic principles and protocols to monitor the responses of marine organisms to secondary metabolites and the role that these compounds play in mediating ecological interactions at sea. An article on the course appeared in *MarBEF Newsletter* No 5. Lecture topics focused on the ecological effects of secondary metabolite production in heterotrophic bacteria, phyto- and zooplankton, benthic macrophytes and invertebrates. The course included theoretical presentations in the morning sessions and illustrations of theory and small practical experiments in the laboratory in the afternoon sessions. A total of 18 students from Sweden, Italy, Germany, UK, Spain, Ireland, Philippines and Mexico attended the course, most of whom were PhD or post-doc students from other MarBEF institutions. The teaching staff consisted of 15 researchers mainly from the MarBEF community, two invited lecturers from the UK and Sweden, and two invited lecturers

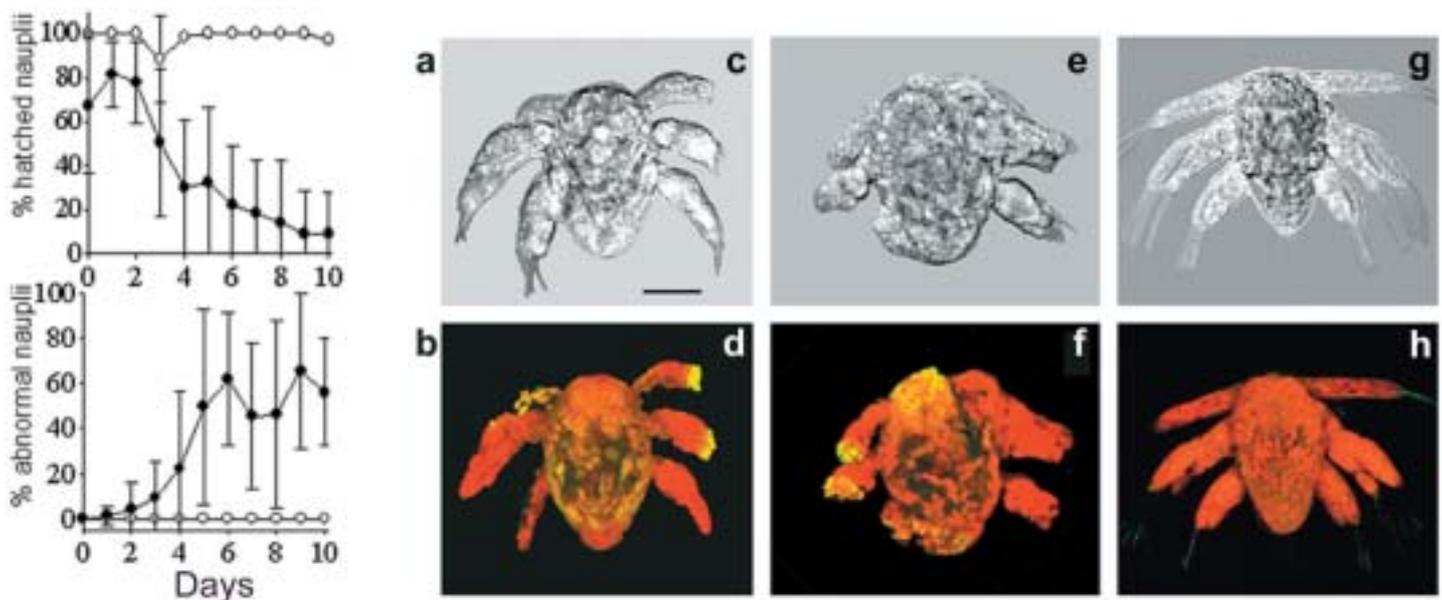


Figure 1. Effects of diet on offspring fitness in the copepod *Calanus helgolandicus*. After 10 d of feeding, the viability of eggs spawned by females that were fed the diatom *Skeletonema costatum* (SKE) dropped to <20% compared to > 95% with the control dinoflagellate *Prorocentrum minimum* (PRO) (a). After 5 d of feeding on SKE, 45-65% of the hatched nauplii were abnormal (b). Such nauplii had deformed limbs (c) that were positive for TUNEL staining specific for apoptosis (d). After 9 d of feeding on SKE, the degree of teratogenesis increased and nauplii were strongly deformed (e,f). Nauplii generated from females fed the control PRO diet appeared normal (g) and stained negatively with TUNEL (h), indicating that nuclei were not apoptotic. Scale bar = 90 μ m. (From Ianora *et al.*, 2004.)

from the US. The course was very successful and will now be followed by another training course on chemical isolation methods which will be organised in Pozzuoli (Naples), Italy, in September 2007 and which will precede the V European Conference on Marine Natural Products to be held in Ischia from 16-21 September. Further information on this course will soon be made available through our web page and that of the Conference, <http://www.ecmnp.org/introduction.php>.

This new course will teach some of the techniques currently employed to fractionate and purify biologically active compounds and will complement the first course on bioassay methods to test the biological activity of natural products. Both courses are intended to bring together current methods of chemical ecology so as to render them more understandable and accessible to researchers and students initiating in this field of research.

A list of relevant publications on chemical ecology was constructed last year for the ROSEMEB web page. The list has several aims,

from providing general reading to interested scientists to offering a starting point for potential researchers in chemical ecology. Included in the list are general books on chemical ecology or on natural products derived from marine organisms, as well as review articles and key publications on chemical ecology spanning several groups of marine organisms as well as articles on selected groups of marine organism (bacteria, phytoplankton, zooplankton, benthic), listed as general (review or large focus) or advanced (more specific research articles).

Future activities for ROSEMEB will include the organisation of a workshop on the chemical ecology of plankton which will explore the function of infochemicals in mediating interactions in the phytoplankton, the noxious effects that these compounds often have on zooplankton grazers, the possible transfer of toxic compounds through aquatic food webs and the development of future research strategies to enhance our understanding of chemical interactions in the plankton. This workshop will be held in August 2008 at Klaipeda University

Coastal Research and the Planning Institute in Lithuania and will be open also to non-MarBEF members.

A workshop on the chemical ecology of benthos is also in the planning for late 2008 to study how natural products drive complex predator-prey and competitive interactions, settlement cues and potential infection by microorganisms.

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MarBEF Training & Integration Training courses

By Róisín Nash and Jens Harder

Each year, a number of specialised training courses are organised by MarBEF members to help prepare a new generation of professional marine ecosystem scientists for Europe. This year was no exception, with a very high number of members applying to host training courses. Each application is assessed by the Steering Committee and a training management group under our Spreading of Excellence programme. Training courses being supported by MarBEF later in 2007 include:-

1. Methods for the study of Meiofauna, Wilhelmshaven (Germany)

This training course will give an introduction to the methods and techniques commonly used for the study of meiofauna communities. Going through every step from sampling and processing of the samples to the identification of organisms and interpretation of the data. *Wilhelmshaven, Autumn 2007*

2. Tidal flat ecology: field experiments as a tool for marine research, Sylt (Germany)

An introduction to the history of experimental benthic research and theory. Statistical aspects of experimental set-ups (e.g. randomisation, replication, blocking) will be treated and students introduced to the potential of multifactorial approaches. An overview on common univariate and multivariate statistical analysis will be provided. *Sylt, September 2007*

3. Identification of marine macrozooplankton and micronekton, Bergen (Norway)

This course will consist of introductory lectures by specialists on the groups, followed by extensive hands-on training sessions in the laboratory. The emphasis will be on species identification based on morphological and anatomical characters, and the sample material will be drawn from the northern mid-Atlantic

(MAR-ECO collection at the Bergen Museum). *Bergen, June 2007*

4. Plankton bloom dynamics – an integrative approach using genomics and other molecular tools. A Marine Genomics Europe summer course co-organised with MarBEF, Barcelona (Spain)

This unique summer course will address key issues for the molecular study of plankton bloom dynamics, such as the physical and chemical factors determining the development and decline of blooms, the diversity of the organisms involved, the genes expressed and the subsequent changes in the functioning of the pelagic ecosystem. *Barcelona, June 2007*

5. MarBEF Summer School on Diversity and Functioning of Coastal Habitats, Sylt (Germany)

The topic of this advanced study course is a comparison of coastal ecosystems: soft-bottom systems in the Baltic Sea (Gulf of Gdansk/Puck Lagoon; Mecklenburg Bight) versus Wadden Sea habitats versus hard-bottom communities of Helgoland, with some perspectives to polar and tropical regions. Aspects of the influence of global change on diversity and the functioning of coastal ecosystems will be addressed. *Sylt, July 2007*

6. Physiological and genetic diversity of marine organisms in European coastal systems, Hel (Poland)

The Marine Biology Summer School (MBSS 2007) is a nine-day self-contained programme of intensive study on various aspects of marine biodiversity, primarily the diversity in ecophysiological performance of individuals and population genetics of benthic organisms from various European coastal regions. *Hel, July 2007*

7. Assessing ecosystem function, St Andrew's (UK)

This course will last five days (residential) and introduce aspects of biodiversity measurement, the concept of ecosystem function and how this can be measured. It will include a field study of a relevant system followed by analysis and data integration. *St Andrew's, June 2007*

Some of the above training courses have already taken place. Please watch the website for more information on the MarBEF training courses and when they are taking place (www.marbef.org/training/index.php).

Participant fees for course, travel and subsistence from MarBEF member institutions may be paid by the MarBEF travel budget of the individual institutions.

Short-term sabbaticals

A reminder that the next two calls for short-term sabbaticals are 30 June and 3 September, 2007. See guidelines for sabbaticals within MarBEF at www.marbef.org/modules.php?name=Rules.

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MarBEF Theme 2: Marine Biodiversity and Ecosystem Functioning

National Science Week Open Day at the University of St Andrews, Scotland

Figure 1. The Sediment Ecology Research Unit display on National Science Day.

By **Rebecca Aspden, Paddy Pomeroy and David Paterson**

The University of St Andrews held a science open day on the 10th of March, as part of National Science Week in the UK, in order to inform the public of the important research the university was carrying out in collaboration with MarBEF. The Sediment Ecology Research Group and the Sea Mammal Research Group both provided displays in order to raise awareness and engage public enthusiasm in science. The aim was to raise the profile of marine and coastal biodiversity issues by informing the public of MarBEF's role within the science community.

Both displays were a huge success, with in excess of 650 members of the public attending. The target audience for the event was families and so most features were aimed at providing an opportunity for people of all ages to take part.

The Sediment Ecology Research Group created a stand titled "Mud, Glorious Mud" (Figure 1). The aim of the display was to explain the importance of our local coastal systems, in particular estuarine systems and how mankind benefits from them.

As well as containing various posters regarding MarBEF, estuarine environments, and marine biodiversity, the display provided a hands-on approach comprised of three sections, and the visitors were encouraged to carry out all three in order. The first part of the display involved sieving through small quantities of fresh estuarine mud, in order to collect the benthic macrofauna from within it. Once the macrofauna had been collected from the sieves and placed into petri dishes, the visitors were encouraged to examine the specimens through a binocular microscope (Figure 2).

Judging from the gasps of excitement (mainly from the children) and horror (mainly from the parents!), most participants were surprised at what they had found. The roles, functions and importance of each of the specimens were explained to the participants to give a broader understanding of our estuarine systems.



Figure 2. Most visitors were excited to see what they could find in local estuarine sediments.

Once finished at the microscopes, participants were directed to the computers which were linked to the MarBEF web pages in order for people to browse the site and for the children to navigate and use the educational pages (Figure 3). The Kids Pages proved to be a huge success with the children, and it was hard to encourage people to move on to allow others to use the facilities. Most parents at the open day said they would definitely encourage their children to visit the site again. The parents who were home-schooling their children were especially happy with the site, and stated it would be a fantastic resource.

As well as providing computers linked to the website, flyers were handed out advertising the "draw a picture, design a mascot, take a photo" competition as advertised on the website.

The display was a massive success and we have since received a huge amount of feedback regarding the popularity of it, and the request for further educational visits of this kind to local schools, etc, which we intend to follow up by carrying out school visits and providing displays and presentations at local aquariums.

The Sea Mammal Research Unit's display covered three main topics: "How many seals or whales are there?" "What do we know about structure within populations?" and "How do diving animals manage their oxygen and energy demands?" (Figure 4). Animals that spend much of their lives underwater aren't easy to count, let alone study in their wild state, and the display offered an overview of the survey methods used to observe and count seals, dolphins and whales.



Figure 3. Most parents thought the website was a great resource and would definitely use it in the future. The jigsaws were a firm favourite with the kids!

A critical part of understanding populations is knowing how individuals group together. The display demonstrated how breeding colonies of seals have different levels of organisation and how this gives the opportunity to find out how social living arises. At a more fundamental level, the display showed how we are beginning

to understand how seals achieve their remarkable diving abilities by using oxygen-sparing mechanisms during diving bouts. Finally, the ever-popular examples of fin and minke whale baleen plates were on show, letting visitors see and feel the specialised mouthparts that filter-feeding whales use to strain food from the sea.

The open day was a great success and the hard work that all visitors put in certainly paid off during the day. Most visitors left happy after having many questions answered regarding the importance of our coastlines, and what activities they could do in order to help conserve the associated species and habitats.

The opportunity to be involved in the open day has highlighted the importance for future outreach activities of this kind to occur more often, and as a result we will definitely be spreading the word of MarBEF far and wide in the future!



Figure 4. The Sea Mammal Research Unit display on National Science Day.

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MarBEF Theme 3: Socio-economics

Training course on 'Valuation Methodologies for Marine Environments'

By Tomaz Dentinho

The training course on Valuation Methodologies for Marine Environments took place in Faro, Portugal, from the 11th to the 14th of April 2007. The operational objective of the course was to prepare the students to collect and treat the data on economic, socio-cultural and biological valuation of marine biodiversity from the various case studies proposed within Theme 3 RMP. The long-term objective of the course was to address the growing demand for interdisciplinary valuation experts related to marine environments.

The programme of the Training Course included plenary sessions on Introductory Decision Support Systems, Data Treatment and Regulation Issues; and parallel sessions on Economic, Socio-Cultural and Biological valuations of marine biodiversity. In the end there was an excursion to Sagres, the more southwestern part of Europe, from where the sailors of Henry the Navigator departed in the beginning of the 15th century.

On the last day, the remaining 25 students that could go on the field trip were asked to appraise the degree of accomplishment of the various objectives of the training course, ranking the achievement from 1 to 5.

From Table 1 it is clear that there was a good environment for cross-disciplinary communication amongst the students, lecturers and across the MarBEF community (D) and, for most of the students, the course provided a good opportunity for cross-disciplinary training, research and outreach (A) and was good for stimulating discussion among various end-users (E). Although responding fairly positively, some students did not feel any connection with Theme 3 of MarBEF (B) and it appears that it would be necessary to do more to stimulate the creation of interdisciplinary teams (C).



Training course participants on excursion to Sagres in southwestern Portugal.

The Training Course was organised by the Department of Oceanography and Fisheries of the University of the Azores with the strong support of the Faculty of Water and Marine Sciences of the University of the Algarve. Furthermore, many other institutions contributed with lecturing: Plymouth Marine Laboratory, University of Roskilde, University of Wageningen, University of Ghent, University of Gdansk, University of Hull, University of the Algarve and University of the Azores.

The training course involved 33 students from Alaska, Belgium, Denmark, Greece, Germany, Italy, Netherlands, Norway, Poland, Portugal, United Kingdom and New York, and 10 lecturers from most of the institutions that participate in Theme 3. Students were accommodated close to the sea, 6km from Algarve University, in Hotel Aeromar. Lecturers were accommodated in Hotel Mónaco, Montenegro, 4km from the sea and 2km from Algarve University.

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Table 1. Appraisal regarding the objectives of the training course

Training course input	1	2	3	4	5	Median
A Provide an opportunity for cross disciplinary joint training, research and outreach	0	2	2	9	12	4
B Enable students to collect and analyse data that could support Theme 3 research. Data will be made available in MarBEF databases.	1	0	8	12	4	4
C Stimulate the creation of teams with the right mix of skills, expertise and resources to undertake interdisciplinary research on marine ecosystems.	0	1	3	11	10	4
D Promote cross-disciplinary communication amongst the students, students and lecturers, across the MarBEF community.	0	0	4	6	15	5
E Stimulate discussions among various end users	0	1	4	8	12	4

Table 1: THEME 3 RMP (RESPONSIVE MODE PROJECT)

WP-RMP code and title
2-1 Development of decision support systems (www.marbef.org/projects)

Principal Investigators
Poul Holm and Melanie Austen

MarBEF Communications & Outreach

A lot done, more to do...

By **Róisín Nash**

This year's General Assembly was held in Sopot in Poland and due to the success of last year's assembly it too was held as a conference-style science meeting with a theme entitled "The value of biodiversity observatories and monitoring for science and society." This meeting was again a large success, much of which can be attributed to the local organisers and the 'tight ship' which each session chairperson ran to keep to schedule.

The General Assembly gave only a glimpse of the amount of research work being carried out in all corners of Europe between MarBEF partners. What was particularly encouraging for the future was the interaction across both Research Themes and RMPs.

Progress and presentations

Where have we been since we last took pen to paper? We've travelled from the warm shores of the Mediterranean to the Arctic waters of Norway, promoting the MarBEF network and spreading the research results that are arising from the Arctic Frontiers conference, the MESH (Mapping European Seabed Habitats) conference, and to the Baltic Sea and European Marine Strategy Conference.

These engagements also included attending workshops run by other EU projects, including AQUA-TNET, and giving presentations on MarBEF for PROBIOPRISE (PRO-BIODiversity for small medium enterPRISEs) and EDIT (European Distributed Institute of Taxonomy). Watch out for further joint activities between MarBEF and EDIT on the website www.marbef.org including a number of outreach events.

New-look Outreach pages

We will soon be launching our new-look

outreach pages. Here we now direct interesting articles and press releases on marine science topics from around the world for you to read. We also have included a special events page dedicated to educational outreach events in your area, so if you have a local outreach event you want advertised, please drop me a line or register on the website and enter the details, selecting the outreach events box only, and your event will appear on the outreach web pages and be circulated with the web news. It was encouraging to hear at the GA about all the outreach events that different MarBEF members are running from their institutes – keep up the good work!

Education

We are working hard to provide you with free downloadable marine biodiversity education material. These will be available on the new education pages shortly, so keep an eye on the web news for the launch. These pages will include activities under three themes (Marine Biology, Marine Ecology and Marine Awareness) with teachers' notes available for each activity. Here you will also find additional material such as posters and presentations on a number of different marine topics.

Keep your eye out for a number of MarBEF characters which will present themselves in the

tales from the seashore to the depths of the ocean. If you would be willing to translate these pages into your own language I would appreciate it if you would drop me a line at outreach@marbef.org and we can make this material more widely available.

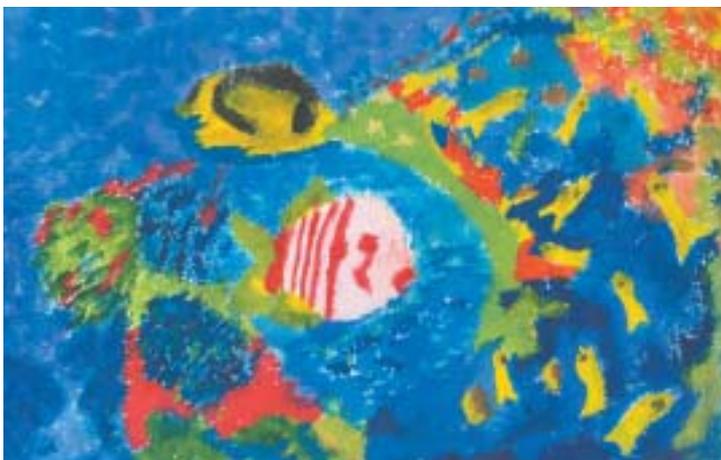
The Intertidal Ecology Skills Training (InterEST) pilot programme for secondary schools was started in 2007 in Dublin. InterEST is a marine education and outreach project that is based on the successful MoBIDiC programme (Sousa-Pinto & Vieira, (2006). (See "MoBIDiC – school at the beach!" *MarBEF Newsletter 5*: 29-30). Two MarBEF partners are involved (EcoServe and UCD) along with Marine Dimensions. MoBIDiC and 'The Shore Thing' – an educational initiative by MarLIN (Marine Life Information Network) which runs a similar intertidal survey around the coast of England – are looking at forming educational links and examining their monitoring protocols for compatibility.

Competition winners

We recently announced the winners of the MarBEF drawing competition – you can see some of the results both on this page and in the Baltic pullout. We had numerous entries from around Europe and we hope to put together a calendar containing as many of the entries as is possible. So watch out for its release on the outreach pages. Two of the winning entries are shown on the Baltic pullout. Also highly recommended were Eva Gielen (5), Belgium, Ala Janiszewska (11), Poland (both shown below), Carlos Finlay (8), UK, Marcin Golombek (10), Poland, and Ralcewicz Dominika (11), Poland.

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"Animals in Ocean" by Ala Janiszewska (11) (runner-up) from Poland: "There are fish Zuzi and Klazi. Zuzi is red and white and very big. Kazi is yellow and black and is also big."



"A plankton-eating whale" by Eva Gielen (5) (runner-up), Belgium. "The whale swims around catching plankton (yellow, red, pink dots). Above is a yellow sea mouse, but she is not afraid because the whale won't eat her."

MarBEF Quality Assurance

BEQUALM: National Marine Biological Analytical Quality Control Scheme

By Keith Cooper

QA schemes aim to provide a source of external quality assurance, thus helping to ensure the quality of data generated by laboratories engaged in common scientific programmes. Examples of such schemes include the German 'Quality Assurance Panel of the German Marine Monitoring Programme (QA GMMP)' and the United Kingdom's 'National Marine Biological Analytical Quality Control Scheme (NMBAQC).' These national schemes were principally designed to ensure the quality of data generated through national monitoring programmes.



The increasing number of environmental assessments crossing national boundaries (e.g. OSPAR assessments, Water Framework Directive, MarBEF) highlights a need for wider participation in such schemes. Recognising this, the European Union funded a project to develop a quality assurance scheme for marine biological effects monitoring techniques, which would eventually become self-funding. This project, known as the 'Biological Effects Quality Assurance in Monitoring Programmes,' or BEQUALM, began in November 1998.

Under the EU-funded phase, QA/QC procedures were developed by expert laboratories for three components: Whole Organism, Biomarkers and Community Analysis. The research programme was completed in April 2002, and in September 2004 the BEQUALM self-funded scheme was

launched. Recognising the potential for duplication of effort, BEQUALM approached the NMBAQC to deliver the community analysis component of its QA scheme.

The Community Analysis component is made up of five distinct sub-components, each run by separate NMBAQC Scheme contractors. These include:

1. Benthic invertebrates (including sediment particle size analysis)
2. Phytoplankton
3. Epifauna
4. Macroalgae
5. Fish

Each component meets the aim of the scheme, namely to maintain and improve the quality of data, through a variety of modules. These

modules include training exercises, workshops, checking exercises and sharing of information.

As the scheme is self-funding, the running costs for each sub-component, or modules within a sub-component, need to be covered by the participants. For the benthic invertebrate sub-component, fees are estimated according to the level of participation during the previous year. Any surplus funds are put back into the scheme and used for the production of taxonomic keys, literature lists, and to subsidise workshops for the benefit of scheme members.

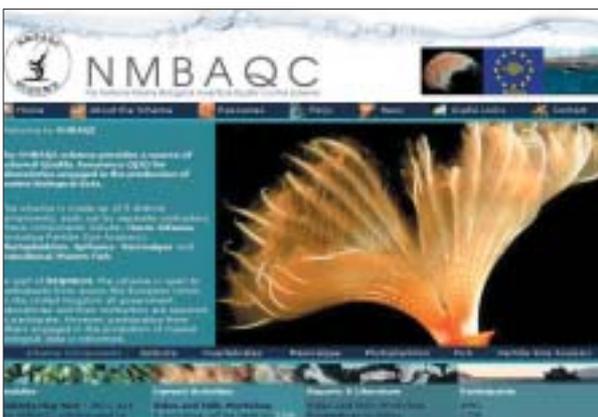
As part of BEQUALM, the NMBAQC Scheme is open to participants from across the European Union. It should be stressed that the scheme is not a laboratory accreditation scheme but aims to facilitate improvements in the quality of sample collection and processing.

Further information about BEQUALM and the NMBAQC can be found on their respective websites, or by contacting the individuals below.

Website: new site currently under construction
Contact: Myles O'Reilly, contract manager (Myles.OReilly@Sepa.org.uk)

Website: <http://www.bequalm.org/>
Contact: Yvonne Allen (yvonne.allen@cefas.co.uk)

One of the aims of the MarBEF QA work package is to provide a description of the QA schemes that exist in Europe with relevance to work carried out under MarBEF (see <http://www.marbef.org/qa/schemes.php>). It is hoped that access to this information will encourage participation from within the MarBEF community. If you are involved in BEQUALM or other QA schemes, please register this involvement on the MarBEF QA Scheme Register (<http://www.marbef.org/qa/schemes.php>). In doing so you will be helping to demonstrate MarBEF's commitment to the production of high quality data.



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Progress towards European marine biodiversity data integration

By Ward Appeltans, Leen Vandepitte, Bart Vanhoorne, Francisco Hernandez and Jan Mees

We have recently undergone a change in leadership in the data integration work package. Edward Vanden Berghe, who was leading this WP, has taken up a new position as executive director of OBIS, in New Jersey. From now on, Ward Appeltans will take over from him and will coordinate the MarBEF data and information management activities at VLIZ.

Edward has done an excellent job and in several ways has paved the path towards a European approach to marine biodiversity data management and integration. At VLIZ we will continue building on this road, and hope we can do our part in further strengthening this network of collaborative research and partnerships. We experience a very positive attitude and many scientists are willing to share their knowledge, including basic data, with others, and in return also benefit from data exchange practices. In addition, only recently, new technologies in informatics are making this possible. Europe has a wide spectrum of marine institutions, universities, marine stations and museums, of which 92 are now partners in MarBEF.

The way so many different partners from so many different countries are working together and forming this network is certainly unique and is setting a trend towards a more global approach to marine biodiversity science. Data integration and dissemination are some of the fruitful products of these networks, and for this good data management practices are essential. MarBEF recognises this and is making good progress. The amount of data integrated and effectively used is increasing. The Responsive Mode Project on data archaeology allows for rescuing data and making them available in a digital format suitable to share with a much larger public.

Europe now has two unique and large integrated databases, one on soft-bottom macrobenthos and one on meiobenthos (read more in the article on the new MANUELA database). The subproject LargeNet will do a similar job on hard-bottom macrobenthos and pelagic biota. The benefits of these kinds of integrative projects are enormous. The

analyses that are going to be done on these databases with such an extensive geographical, temporal and taxonomical scale will undoubtedly bring several new insights, which were impossible to obtain on an individual basis.

We strongly support MarBEF's philosophy of open access to data within a partnership approach and sincere thanks to many partners who have contributed a lot of data, which is now freely available through the European node of the Ocean Biogeographic Information System (EurOBIS). With 3.5 million records from 47 data providers, EurOBIS serves one-third of all species distribution records in the world and hopefully in the future several more datasets will be added. Also interesting is that EurOBIS integrates data from a variety of data sources, from large-scale monitoring surveys to time-series of a single location, from observational data to museum collections. EurOBIS is making good progress and is already an important source to data discovery. We are aware that this is just a tiny bit of the top of the iceberg, and we will have a lot more work just to get the data, currently at risk of being lost forever, integrated and made publicly available, as soon as possible.

Another big challenge is to control data quality. We rely very much on the data providers, but there are a number of things we can do, such as to link the taxonomic names with the European Register of Marine Species (ERMS). There is now also an online tool where you can do this exercise yourself (called taxon match) and check the geographical positions and other parameters related to the taxon. Extensive metadata, the information on the datasets, describing the accuracy of the data, the protocols applied and the people involved,

will be extremely important. The more data available, the more difficult it will be to find the right data that fits your needs and satisfies your standards.

It is heartwarming to see how many people are actually making use of the systems. Every month there are over 10,000 visitors (nearly half a million hits) on the MarBEF website. The taxonomic register ERMS comes up as one of the most visited pages and we have nearly 100 people visiting EurOBIS every day and many are effectively downloading the data. It is also encouraging to see that the mobility portal, a system that matches CVs and vacancies, is a success and the MarBEF calendar of events is serving details on many meetings, not only those organized by MarBEF. The MarBEF Open Archive (MOA), an initiative we started only one year ago, already includes over 250 scientific papers, fully downloadable in PDF format. MOA is now also indexed by Google Scholar, which increases our visibility. The weekly news bulletin (MarBEF web news) is a way to advertise the latest news from MarBEF, including related topics by a simple weekly email. The mailing list of this e-bulletin includes over 1,500 subscribers, and thereby has become a service that is now appreciated by a large community of scientists, students, policy-makers and many others interested in marine sciences.

Time is moving on quickly and, as we said, there is still a lot of work left to be done. Our team will do its best and hopefully we can be of service to everyone. If you need any assistance or have data you want to contribute, archive and share, please let us know, so that we can plan this and deal with it appropriately.

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MANUELA: Developing an integrated database on meiofauna to perform joint analyses

By Leen Vandepitte

MANUELA – one of the nine Theme 1 RMPs – is cruising ahead. As all delivered meiofaunal datasets have recently been integrated into one single database, an enthusiastic crew of meiofaunal researchers has started their joint analysis. Here, we present you with an overview of the integrated database from the data manager's point of view.

VLIZ – as the data management team within MarBEF – has once again taken on the challenge to compose an integrated database. With the expertise built up during the compilation of the soft-bottom macrobenthos database (MACROBEN), we now concentrated on developing an integrated database to capture the meiofaunal information collected within the framework of the MANUELA RMP (Meiobenthic and Nematode biodiversity – Unravelling Ecological and Latitudinal Aspects). Data collection for the MANUELA project started in December 2005 and ended in February 2007. During this period, twelve institutes delivered a total of 86 datasets, mainly consisting of nematode and copepod related data (Figure 1). MANUELA has not only been actively involved in the process of data integration, but it has also taken on a small role in data rescue, as some of the delivered datasets only existed as paper versions and thus needed digitising before their integration.

All this fragmented information has been integrated into a central database. The scientists involved in the MANUELA project have performed a preliminary analysis on this integrated database in January 2007, giving them the opportunity to get familiar with the content and to indicate possible shortcomings. After dealing with their remarks, the integrated

database was released to the MANUELA scientific community in early April 2007. These meiofaunal researchers now face the challenge of performing a joint analysis on this database. A first insight from the scientific point of view will be presented in the next issue of this newsletter.

The MANUELA database contains a grand total of 140,431 distribution records, representing some 1,850 unique taxa. Table 1 provides a short numerical overview of the content of this database. Sampling locations vary from the intertidal to the deep sea and this both in marine and brackish environments. Although there is a strong focus on the European waters (e.g. North Sea and Mediterranean), samples taken in the Arctic and Antarctic regions as well as samples from the African and Australian coasts are included, giving the whole a somewhat global scope (with the exception of North and South America).

One of the deliverables of the MANUELA project to MarBEF was to make sure that all European nematode species names present in the integrated database were also present in the European Register of Marine Species (ERMS) (Figure 2). During this update in September 2006, 333 nematode taxa were added to ERMS, bringing the nematode taxa

Table 1. Database overview

Data-providing institutes	12
Datasets	86
Stations	1,448
Samples	5 638
Distribution records	140,431
Biometrics	38,362
Unique taxa	1,864
Sampling methods	29
Abiotic readings	21,325
Nematode taxa new for ERMS	333
Distribution records delivered to EurOBIS	38,132

within ERMS to a grand total of 2,173 (as of 13th September 2006).

In November 2006, another deliverable for MANUELA was met: information on the distribution of meiofaunal taxa within the MANUELA database was transferred to the European node of OBIS for 35 of the received datasets. A total of 38,132 distributions were added to EurOBIS. For 25 of these 35 datasets, not only the distribution information was made available, but also the individual taxon counts per location. For a number of other datasets, data providers have asked us to temporarily withhold the information from EurOBIS, as the data are still being processed for publication. In this light, and the fact that we have received a number of datasets later than November 2006, a second call to deliver data to EurOBIS will be launched to our data providers in November 2007, giving everyone the opportunity to still make their distribution data widely available through EurOBIS.



Figure 2. Copepods *Oithona similis* and *Oithona atlantica* (© Slawomir, Kwasniewski). From the MarBEF species gallery (www.marbef.org/modules.php?name=Photogallery&album=411&pic=9048 (copepoda).

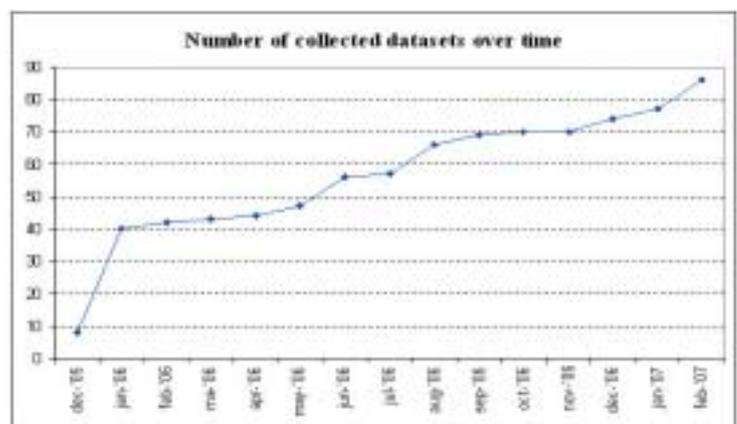


Figure 1. Number of collected databases over time.

Leen Vandepitte

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The Baltic



Baltic seasons are divided into short, moist, moderately warm summers and long, cold and dry winters.



Which biome does the Baltic belong to?

The Baltic Sea falls into two biomes: Temperate Deciduous Forest and the Boreal or Taiga Forest.

The Temperate Deciduous Forest biome is characterised by well-defined seasons with a distinct winter. The Boreal or Taiga biome is the largest terrestrial biome on Earth.

Where is it?

The Baltic Sea is located in northern Europe, bounded by the Scandinavian peninsula, the islands of Denmark and mainland Europe. It comprises the Gulf of Bothnia, the Aland Sea, the Gulf of Finland, the Gulf of Riga, the Kattegat and Skagerrak. The Skagerrak links the Baltic with the North Sea and the Atlantic Ocean.

The Baltic is artificially linked to the White Sea (in the Russian Arctic) by the White Sea Canal, via the Gulf of Finland. It is linked to the North Sea by the Kiel Canal. It has a mean depth of 60m and covers 415,266 square kilometres. Its catchment area of 1.7 million km² is four times as large as the sea itself.

Nine countries share the Baltic Sea coastline: Sweden and Finland to the north, Russia, Estonia, Latvia and Lithuania to the east, Poland in the south, and Germany and Denmark in the west. Other countries in the catchment area are Belarus, the Czech Republic, Norway, the Slovak Republic and the Ukraine.

Biomes

Biomes are the world's major communities, sorted according to their main vegetation and characterised by adaptations of creatures to that particular environment – Aquatic, Grasslands, Deserts, Forests and Tundra.

What is the weather like?

The weather is typically **continental**, i.e. cold and frosty in winter but hot in the short, northern summer. It also depends on the behaviour of the Azores 'high.' When the regular high pressure over the Azores extends as far north as the Baltic, then long and fairly settled periods of weather can occur.



What lives there?

The Baltic Sea has a very unique ecosystem. Compared to other ecosystems, relatively few animals and plants live there. It is almost an enclosed sea, fed by many rivers, and its water is very brackish, approaching freshwater in places. The low salinity of the Baltic, particularly in the north and east, means more freshwater species occur in those areas than marine species.

Despite the limited biodiversity, there is a unique mix of marine and freshwater animals which are adapted to the brackish conditions. There are also a few true **brackish-water species**.

Interesting Baltic facts

The best quality **black caviare** is taken from a fish called the **sturgeon** which is caught during the winter months in the estuaries of rivers flowing into the Baltic. Caviare is the mass of eggs found inside the female fish; it is not unlike frogspawn.

The Baltic is a very busy **shipping** area. Every year, over 500 million tonnes of cargo are shipped across the Baltic and more than 50 passenger **ferries** ply routes between Baltic ports.

The **salt content** of the Baltic Sea is very low because of the number of rivers flowing into it and the narrow opening to the North Sea. The salt content is around 20 PSU (Practical Salinity Units) in the Kattegat and as low as 1–2 PSU in the Bothnian Bay in the north, compared to about 35 PSU in the world's oceans.

Baltic seabirds



Herring gull
(*Larus argentatus*)

The north and south of the Baltic are very different when it comes to nesting birds. The birds in the northern part of the Baltic are evenly spread across the large chain of islands (archipelago) found there, but in the south of the Baltic the bird colonies are densely packed into a few locations.

The most common Baltic seabirds are the cormorant, eider, herring gull, black-headed gull, great black-backed gull and common gull.

Threats to the Baltic



Human activities

The catchment area of the Baltic is home to 85 million people. Because of its semi-enclosed nature, the sea is highly sensitive to human activities and their environmental impacts.

Nearly all of the Baltic's top predators, including marine mammals and birds, are affected by **fishing activity, pollution** and **habitat destruction**.



The overfishing of Baltic cod is a serious problem. Cod populations have fallen dramatically in the last 100 years



Oilspill at sea

Oilspills

Because of the high level of shipping activity in the Baltic, accidental and intentional oilspills are becoming more frequent. Oilspills contaminate the surface water, smothering marine plants and animals. Many chemicals in crude oil are toxic and can have serious cumulative effects as they build up in ecosystems. A large oilspill in the Baltic would be devastating because of the weak currents and gentle wave action, which would not help natural dispersal.

Slow water exchange with the North Sea means that the effect of any oilspill lasts longer. The Baltic is a brackish sea with very low temperatures, so any oil spilled takes a long time to degrade and, as a result, affects more wildlife.



Pollution

The Baltic is one of the most heavily polluted seas in the world. Among the chemical contaminants are PCBs (polychlorinated biphenyls); these are long-lasting pollutants that can impair the reproductive ability of sea animals.



Enriched water with algal bed

Eutrophication

The Baltic Sea is particularly vulnerable to eutrophication (i.e. water enrichment with loss of oxygen) as it is semi-enclosed and it drains an area of land four times larger than the sea itself. Eutrophication has caused large-scale replacement of sea grasses (important for fish nurseries) with beds of algae, particularly along densely populated shores. Associated toxic blooms of algae cause major losses to fisheries.

The deepest waters have low levels of oxygen, and this is only improved by heavy storms that mix the waters, or by pulses of oxygenated seawater from the North Sea.

Shipping brings exotic species

As ships arrive in the Baltic from other parts of the world, they bring new species of animals with them in their ballast water (water to keep ships more stable in the water). These new species can be aggressive and stronger than the native species and can quickly outnumber them, making their survival impossible.

Inland waterways that lead to the Black and Caspian Seas have helped some exotic invaders find their way to the Baltic. Once they have established a foothold, they can spread at rates of up to 480 kilometres a year.

Non-native species can seriously disrupt ecosystems. Fishermen in the Gulf of Riga and Gulf of Finland remember the sudden arrival of an exotic water flea in 1992. These tiny animals soon started to clog up the gills of fish and fishing nets, leading to serious economic losses. The flea quickly spread to Stockholm and Gotland.



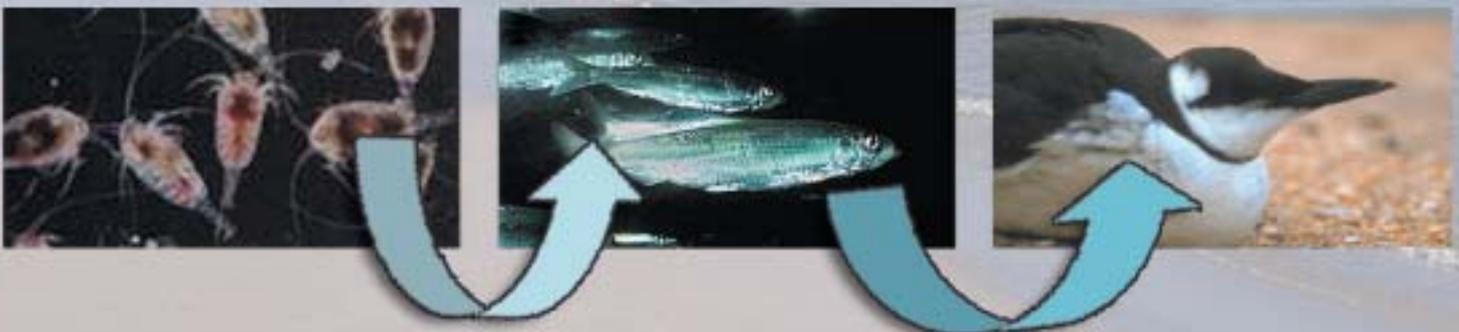
Water flea (*Cercopagis pengoi*)

A simple foodchain in the Baltic

Neritic copepods
(*Acartia tonsa*)

Baltic herring
(*Clupea harengus membras*)

Guillemot
(*Uria aalge*)



How PCB pollutants move up the food chain

PCBs are absorbed by phytoplankton, which are then eaten by zooplankton. The fish that feed on zooplankton accumulate these persistent chemicals, and the seals, dolphins and porpoises that feed on the fish have the highest PCB concentrations of all. People in the Baltic region are advised to limit their consumption of Baltic herring and salmon – fish that can accumulate high concentrations of these hazardous substances in their fatty tissue.

Three seal species breed in the Baltic Sea area Harbour Seal, Grey Seal and Ringed Seal

Harbour Seal *Phoca vitulina*

The harbour seal is the most widely distributed pinniped (animal with winged feet or finned feet) in the world. It is found in temperate and subarctic coastal areas on both sides of the North Atlantic and North Pacific Oceans. In 1998, it was found that there were only 580 harbour seals left in the Baltic Sea.



Harbour seals

Grey Seal *Halichoerus grypus*

At the start of the 20th century there were a reported 10,000 grey seals in the Baltic Sea, but through hunting and pollution the numbers had fallen to 7,500 by the year 2000. In 1988, the hunting of grey seals was banned in the Baltic by signatories to the Helsinki Convention, but there is mounting pressure, particularly from Finland and Sweden, to lift the ban on the hunting of seals. The Baltic grey seal is quite distinct from its East Atlantic grey seal cousins and is listed as endangered on the IUCN Red List.



Ringed seal

Ringed Seal *Phoca hispida*

Ringed seals have ring-shaped marks on their coat, hence the name. At the start of the 20th century there were about 200,000 Baltic ringed seals, but today there are only about 5,500. The population crash was due to pollution and hunting. They are found most abundantly in the Bothnian Bay area.

Harbour Porpoise: special sea mammal

The harbour porpoise *Phocaena phocaena* is the only resident cetacean (i.e. whale or dolphin) species breeding in Baltic waters.

Harbour porpoises are small and dark with a short dorsal fin, so they can be difficult to spot. They are usually seen alone or in pods of three or four. They are great hunters and regularly dive to depths of 60 metres to locate their prey by sonar.

There are two different populations of harbour porpoise in the Baltic. One lives where the

Baltic Sea enters the North Sea, while the other lives within the Baltic Sea itself. Unfortunately, historical records suggest that the Baltic Sea population has fallen from around 20,000 to 600 in the last 100 years. It is classified as 'vulnerable or endangered.'



Harbour porpoise

Baltic fish

Both freshwater and marine fish are found in the Baltic. Herring, sprat and cod are the most abundant species in the open waters, while both marine and freshwater fish including salmon and eel are found around the coasts. About 100,000 tonnes of Baltic Riigen herring are caught annually.

Aquaculture or fish farming is an important activity on the rivers, lakes and coasts of the Baltic countries. Most fish farms grow salmon and trout.

Many birds are moving north in the Baltic and the avocet and the sandwich tern have nested there recently for the first time. Is this a sign of global warming?

Is the Baltic Sea in trouble?

Vulnerable

The Baltic Sea is an unusually sensitive sea area. Due to the slow exchange of water, harmful substances remain in the sea for many years. The cold winters and long periods when ice covers the sea also slow the physical, chemical and biological breakdown of toxic and harmful substances, including oil, heavy metals and PCBs.

The food webs of the Baltic are simple compared to oceans and are therefore more vulnerable to environmental change. In food chains that are short, changes at one end may easily spread through the entire chain (a cascading effect) and have an unpredictable impact, particularly on the top species.

Because of the limited influx of oxygenated waters from the North Sea, the bottom of the Baltic Sea is relatively stagnant. Organic material sinks from the surface and is broken down on the sea bottom.

When pollutants are added to the mix from river inflows, the seawater becomes eutrophic, giving rise to algal blooms. When the algae die and sink to the bottom, they start to decompose.

The decomposition uses up any oxygen present. This means that there are often anoxic (no oxygen) conditions, which leads to the formation of poisonous hydrogen sulfide. The anoxic areas can be one-third of the entire sea area. As a result, the diversity of benthic (sea-bottom) animals is very low, and animals that feed on benthic fauna are disappearing.

Because of the bioaccumulation of toxic compounds in fish, white-tailed eagles (which feed mainly on fish) experienced breeding difficulties in the 1970s. It is also suspected that bioaccumulation caused similar problems in seals and salmon. However, protective measures have now been put in place and things are improving.



White-tailed eagle

Marine Biodiversity Competition winner



Above: "Sea Life." This painting by Carlos Finlay (8) from Great Britain won a runner-up award in our Marine Biodiversity Competition.

Left: This painting by Ralcewicz (11) from Poland won first prize in our Marine Biodiversity Competition. Said Ralcewicz: "In my painting, everything is moving and lively."

Baltic Marine WordSearch

Find the words listed below. Words can go horizontally, vertically or diagonally in all eight directions.

- Brackish
- Pinniped
- Riigen herring
- Northern Europe
- Eutrophication
- Harbour porpoise
- Seal
- Anoxic
- Guillemot
- Alien species
- Ballast water
- Phytoplankton
- Baltic salmon
- White-tailed sea eagle



W	T	T	Z	V	D	K	Z	L	N	G	U	I	L	L	E	M	O	T	M
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O	R	A	N	C	Q	T	T	A	M	O	E	S	L	N	G	N	N	X	T
P	E	R	H	M	E	L	R	H	U	L	D	C	N	W	A	Z	H	O	W
H	V	B	N	G	L	G	C	R	E	E	A	I	I	R	M	J	N	N	A
I	I	X	A	K	L	T	P	A	L	R	P	S	O	E	L	M	Z	A	T
C	D	T	C	E	O	O	K	I	V	T	N	M	C	Y	S	G	Z	D	E
A	O	H	E	I	R	T	A	V	R	I	R	E	L	I	R	K	D	P	R
T	I	J	L	P	Z	T	B	C	T	C	A	P	U	L	T	J	K	M	T
I	B	M	O	L	E	K	N	C	C	G	X	R	X	R	H	L	A	E	S
O	R	I	N	T	N	P	B	K	P	V	T	L	E	L	O	L	A	H	D
N	S	F	I	N	O	T	K	N	A	L	P	O	T	Y	H	P	K	B	K
E	Y	H	M	E	T	S	Y	S	O	C	E	N	F	T	N	Y	E	G	Q
M	W	Y	H	V	M	D	E	I	F	I	T	A	R	T	S	G	M	K	Y



MarBEF on the move!
 The MarBEF Newsletter, even read by bears in Poland!
 Send your pictures of where the MarBEF Newsletter has been to:
outreach@marbef.org

Watch out for our next issue to see where we will head to in our next pull-out.

This fact sheet will soon be made available on our website:
www.marbef.org/outreach
 If there is anything you would like to see on our website or in our next issue, please e-mail us at:
outreach@marbef.org



To Hel and back, with MarBEF! Participants at the General Assembly in Hel, Poland, in May.

Values of, and threats to, marine and coastal habitats in the southern Baltic

– Redłowo area as a case study

By Tomasz Zarzycki, Urszula Janas and Hanna Łądkowska

Despite many regulations and recommendations, maritime authorities in Poland decided to build a coastal defence system in one of the most vulnerable areas along the Polish coastal zone – the marine area in Gdynia Redłowo. The submerged breakwaters (4,000 m²) are directly affecting a wide range of values, including economic, social and cultural, which arise from both the naturalness and uniqueness of the site.

Gdynia Redłowo area: site description

The case study area is located within the Gulf of Gdańsk coastline (the Polish part of the Baltic Sea) (Figure 1). The terrestrial part of the area contains natural and semi-natural beech forest and oak forest. The coastline is characterised by the cliff slopes and high plateau of the partially active cliffs. The shape of the cliffs as well as of the sandy and rocky beaches is created by natural land-sea interactions. Surrounding waters and seabed provide a unique environment for many fish and macrobenthic communities. The specific mosaic of habitats such as rocky bottoms, sandy beds, *Zostera* meadows and communities of red seaweed *Furcellaria lumbricalis* calls for urgent protection measures.

Legal status

Poland has a number of Acts, Laws and Regulations, etc. which take account of the protection of rare species and unique habitats and provide rules for the establishment and management of terrestrial protected areas (national parks, landscape parks, reserves, etc).

The terrestrial component of the area, including the cliffs and beaches, is a national nature reserve called “Kępa Redłowska.” The reserve is protected for a number of natural processes that occur there. Both the marine and terrestrial component were under consideration for the HELCOM Baltic Sea Protected Area conservation status until 2005. This marine area is also designated as an SPA (Special Protection Area, NATURA 2000) “Zatoka Pucka” (PLB 220005).

Values of Redłowo area

This area is a unique site in the southern part of the Baltic Sea with a wide range of values:

- economic (fishing grounds)
- cultural (scenic landscape, inspiration for artists)
- cognitive (education, research)
- geological (natural geological processes)
- biological (details below).

Biodiversity

The marine area is a site with a high natural biodiversity:

- Plants: 20 taxa, including two very important and protected species: eelgrass *Zostera marina* and the red seaweed *Furcellaria lumbricalis* (Kruk-Dowgiałło & Opióła 2001, Chrobak 2004, authors unpublished);
- Benthic invertebrates: 36 taxon, including the sponge *Ephydatia fluviatilis* (Osowiecki & Żmudziński, 2000, own studies);
- Fish: 15 species, including protected (six species) as well as commercial fish (e.g. garpike fish *Belona belona*, herring *Clupea harengus*) (Brodecki & Żmudziński, 1997, authors unpublished);

- Diving birds: 16 species, including protected species goldeneye *Bucephala clangula*, black-throated diver *Gavia arctica*, red-throated diver *Gavia stellata*, great crested grebe *Podiceps cristatus* (Osowiecki & Żmudziński, 2000, Meissner pers. com.).

Importance of habitats

There are two very important species which are called “habitat building species”: eelgrass *Z. marina* and red seaweed *F. lumbricalis* (Figure 2). The former species inhabits sandy sediment at depths between 2-4 metres, whereas the latter is found at depths below 3m. The species provide the following functions in the area:

- Rhizomes and roots of *Z. marina* stabilise the sediment and thus reduce coastal erosion;
- The beds are used as refuge, nursery and as feeding grounds by fish, including commercial and protected species, and sea-birds.

Other species strictly protected by Polish law which were observed in the case study area in years from 2002 to present include the sand goby *Potamoschistus minutus*, two-spotted goby *Coryphopterus flavescens*, river lamprey *Lamperta fluviatilis*, fifteen-spined stickleback *Spinachia spinachia*, deep-snouted pipefish *Syngnathus typhle* and straightnose pipefish *Nerophis ophidion* (Figure 2).

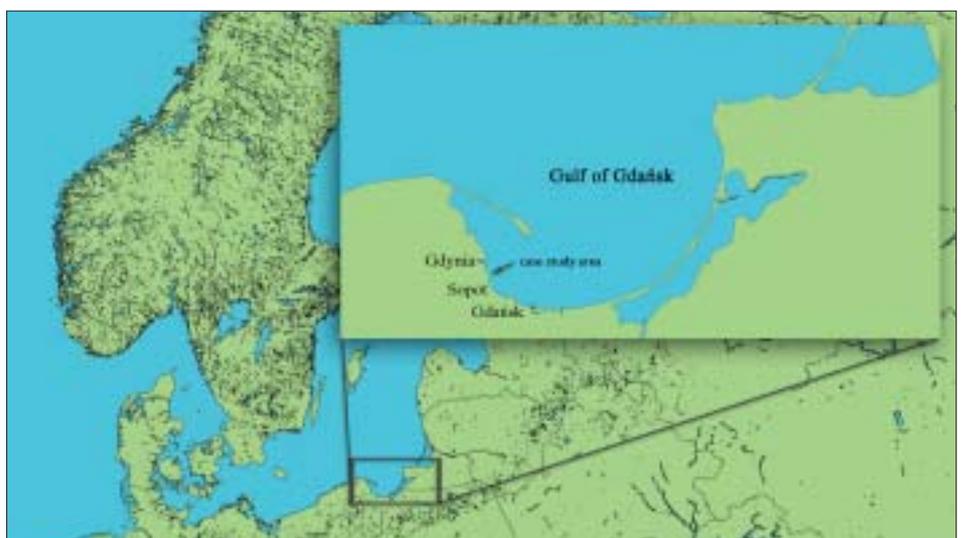


Figure 1. The case study area is located within the Gulf of Gdańsk, in the Polish part of the Baltic Sea.



Figure 2. Clockwise from top left: protected species observed in the Redłowo area: eelgrass *Zostera marina*, red seaweed *Furcellaria lumbricalis*, two-spotted goby *Coryphopterus flavescens*, deep-snouted pipefish *Syngnathus typhle*, straightnose pipefish *Nerophis ophidion*, sand goby *Potamoschistus minutus*.

Threats

Despite the high value of the area, the coastal defence system was constructed to 'protect' a small part of the coastline in 2006. Underwater construction works caused damage in the most valuable area of *Zostera* meadows. Other negative changes are also expected in the future:

- Increase of abrasion intensity, especially in the most active part of the cliff.
- Disturbance of natural dynamic equilibrium between land and sea can cause changes in the habitat and consequently in the biotope. Most threatened species are the rare and protected species which are very sensitive to changes in the environment.
- It has already been observed that artificial substrates (breakwaters) are mainly inhabited by non-native species (round goby *Neogobius melanostomus*, rockpool prawn *Palaemon elegans* and white-fingered mud crab *Rhithropanopeus harrisi*).

Conclusions

Along the Polish coastal zone there are only a few areas with as many important values to maintain. The coastal habitats in the southern Baltic have a unique value from a social,

economical and educational point of view and as an example of the high marine biodiversity present despite of the low salinity level. The Redłowo area is also popular as a study site for comparative analysis, and several educational initiatives welcome international students and marine professionals. This area is also a popular activity destination from a leisure and tourism perspective. It is important to consider all activities that could potentially cause changes to the environment, during the planning period. Experts in several disciplines should be involved in the Environmental Impact Assessment (EIA) procedures. The challenge is to minimise negative effects of human activities on the natural processes and marine biodiversity in the area.

Acknowledgments

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Shallow sandy sublittoral: the ecological treasure of the southern Baltic Sea

By J.M. Węśławski, Lech Kotwicki, Józef Wiktor, Agnieszka Tatarek and Katarzyna Grzelak

Few areas look less promising for biodiversity research than an extensive, almost flat, sandy bottom, swept with open sea swell and strong longshore current. Highly mobile, coarse sand grains offer no place for hiding out and host no macroscopic vegetation. Almost 1,500 kilometres of such coastline runs along the southern Baltic Sea from Germany, Poland, Russia, Lithuania and Latvia.

The shallow sea shelf (the area up to 20m in depth) offers enough light at the seabed to provide development of microphytobenthos – able primary producers (up to 50g C/m²/year), dominated by diatoms (Figure 1). As many as 180 microphytobenthic species occur in the shallow sandy bottom of the sea, where larger taxa dominate when compared to similar but more sheltered localities (e.g. Sylt in the North Sea) and more often broken frustules are found in the sediment samples. These observations tell us about the dynamic character of the biotope.

Ciliates are abundant micrograzers and microcarnivores. No less than 48 species were recognised in the upper 2cm of sediment layer. At least 200 species of metazoan meiofauna, with nematodes as a leading taxon (Figure 2), attain 1g ww biomass per m² and densities of 1,000 individuals per 10cm².

Baltic macrofauna inhabiting shallow sands do not exceed 12 species, with a strong predominance of *Bathyporeia pilosa*, a minute detritivorous amphipod attaining densities of 25,000 ind./m².

All that rich life relies on the water that percolates through the sand, loaded with organic particles and chemical compounds. Altogether, the permeable sandy bottom forms an active, biocatalytical filter that is able to metabolise up to 40kg wet weight of organic matter per m² per year. Considering the area of 20,000km² of Southern Baltic sea-shelf found within the euphotic zone, the service provided by mobile sands in self-cleaning the water ranges from 400 to 800 thousand tonnes of organic suspensions burned into H₂O and CO₂ (Figure 3).

For more information, see the COSA web page at <http://www.cosa.org>.

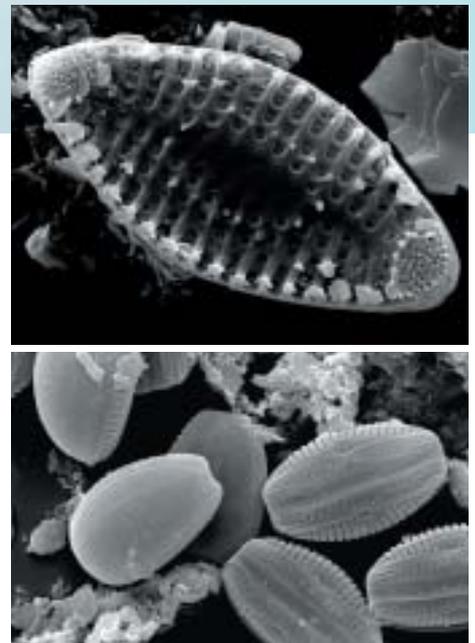


Figure 1. Microphytobenthic diatoms viewed under a scanning microscope.

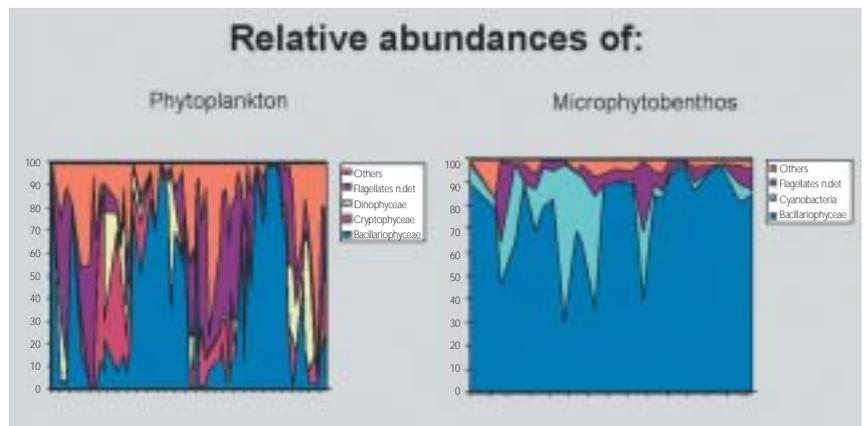


Figure 2. Meiofauna of the shallow sandy sublittoral – taxa percent share in biomass and abundance.

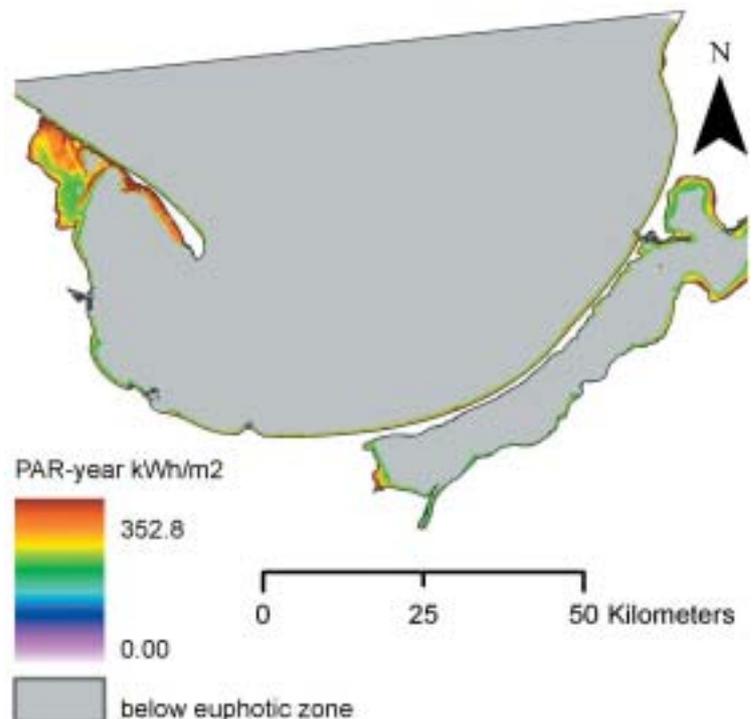


Figure 3. Sandy seabed within the euphotic zone (shaded), Bay of Gdańsk, with surroundings.

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Daily sea surface temperatures from the late 1800s to the early 2000s: implications for biodiversity in the Baltic Sea

By Brian R. MacKenzie and Doris Schiedek

Ocean temperatures in most parts of the world are increasing and are expected to continue to rise during the 21st century. This trend will also occur in the Baltic Sea (BACC, 2007). A challenge to ecologists and marine resource managers around the Baltic and elsewhere is to understand and predict how these changes will affect species and ecosystems.

Some insight into how biota might respond to future temperature variations can be obtained by comparing responses to past temperature fluctuations, and by comparing past temperature fluctuations with those expected to occur in the 21st century. These types of comparative analyses require long time series of both biological variables and temperature.

In this study, we have compiled and analysed long time series of daily measurements of sea surface temperature. We have chosen sea surface temperature because a vast number of marine species occupy the surface layer during some stage in their life-histories, and are either directly (e.g. via physiological effects on key rates such as growth or development) or indirectly (e.g. via the timing of interactions with prey, predators and competitors) affected by variations in temperature.

Our analyses are based on two data sources:

1. Monitoring programmes which were established in the mid-late 1800s to record oceanographic and meteorological observations in coastal areas. These programmes typically were associated with meteorological, zoological or fisheries institutes operated by governments or universities and were established to provide information to assist the shipping and fishing industries. Measurements were performed daily from light-vessels (Fig. 1) and harbour monitoring stations by professional staff using calibrated, standardised thermometers. This dedicated work has resulted in rich data material collected using consistent methodology and allows us to assess the level of historical temperature variability (e.g. absolute



Figure 1. A Danish lightship on which oceanographic and meteorological measurements were recorded daily since the 1880s until the mid-late 1900s. This particular vessel was anchored near Gedser Reef, Denmark, in the western Baltic Sea until 1970 and is now moored in Nyhavn, central Copenhagen. Photo: Brian MacKenzie

2. Opportunistic or ship-of-opportunity data collected by merchant and research vessels and which are subsequently compiled into large databases (ICES and the Hadley Centre for Climate Change and Prediction, UK). These data can be used to calculate spatially averaged time series for large offshore areas in regional seas, such as the Baltic Sea. The spatial and temporal coverage of these databases is, however, not uniform, and generally deteriorates farther back in time. Nevertheless, the data are sufficient to support the results based on the monitoring data.

Using these two data sources we studied long-

term variability in sea surface temperatures, not only in the Baltic but also in the North Sea at four coastal sites (Marsdiep, Netherlands; Torungen, Norway; Skagens Reef, Denmark; and Christiansø, Denmark) and in several large offshore areas. All time series began during 1861-1880 and continue until at least 2001.

Most time series document a warm period in the mid-1900s and that warming has occurred during the last 10-15 years in nearly all sites and during all seasons of the year (Fig. 2). In addition to this warm period, the coastal monitoring time series indicate that there was another warm period in the mid-late 1800s (ca. 1861-mid 1880s); temperature during this period was almost as high as the present period.

Moreover, by employing four of the world's longest calibrated daily time series we could show that surface temperature trends in the

Baltic and North Seas in the early 2000s exceeded those at any time since instrumented daily measurements began in 1880 and 1861 (MacKenzie and Schiedek 2007b).

We also found significant differences in the seasonal pattern of warming. Summer temperatures since 1985 have risen 2-5 times faster than those in other seasons. In addition, temperatures in summer since 1985 have increased at nearly triple the global warming rate which is expected to occur during the 21st century (Kerr, 2004).

These analyses indicate that temperatures have increased since the mid-1980s. However, biota also respond to extreme temperatures: changes in extreme temperatures could determine whether species can complete life-histories in existing or new habitats, and thereby lead to changes in geographic distribution and local biodiversity. We found that the frequency of extremely warm winters, summers and years has significantly increased in recent decades, and conversely that the frequency of extremely cold winters, summers and years has declined (Fig. 3). If these changes continue they will have major impacts on biota and the timing of life-history events in the Baltic and North Seas.

The recent warm period is therefore unique in the past 120-140 years. How are these temperatures affecting the biology of the Baltic Sea? Some of the consequences are beginning to be evident: the abundance of warm-adapted species such as the clupeid fish, sprat, *Sprattus sprattus* (MacKenzie & Köster, 2004) and copepods *Temora longicornis* and *Acartia* spp. (Möllmann *et al.*, 2003) have increased during the last 10-15 years, and the abundance of herring in northern parts of the Baltic has also increased in the same time period (ICES, 2006). Similar shifts in distributions of species towards colder waters have been reported for the North Sea and many other waters (Beaugrand *et al.*, 2002; Brander *et al.*, 2003; Hawkins *et al.*, 2003; ACIA, 2004). These observations suggest that temperatures are now beyond the optima for many species, and may be exceeding the ability of local species to adapt.

Rising temperature, however, is not the only factor which will affect life in the Baltic Sea if climate change continues. One of the other changes in northern European climate is an expected increase in precipitation, which due to runoff to the Baltic Sea, will likely lead to a decrease in its already lower salinity (BACC, 2007). This will have a direct impact on the distribution and acclimation capacity of native biota. The combination of higher temperature and lower salinity will probably reduce the

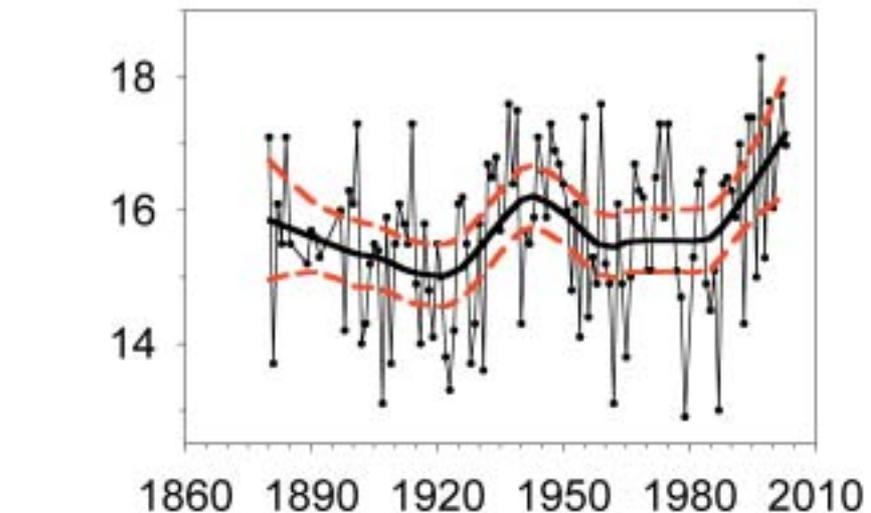


Figure 2. Interannual variability in summer (July-August-September) sea surface temperature measured at Christiansø, Denmark (southern Baltic Sea, near Bornholm). Thin line with dots: observations; thick solid line: the statistically significant nonlinear regression fit, as identified by General Additive Modelling (GAM); red dashed line: 95% confidence limits for the fitted GAM. Similar patterns are evident for all four seasons and annually-averaged data for 11 sites and regions in the Baltic-North Sea area (MacKenzie & Schiedek, 2007b).

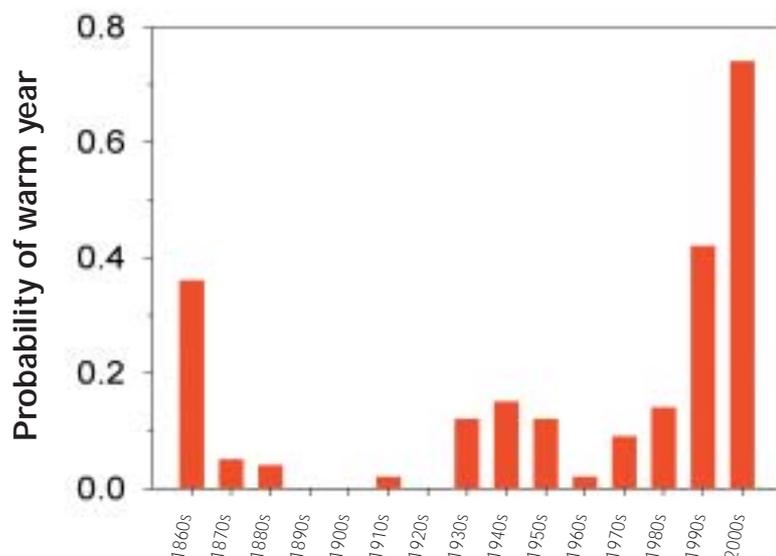


Figure 3. Inter-decadal probability in the frequency of extremely warm years in the Baltic-North Sea region since the 1860s. A warm year is defined as a year when SST is in the upper 10th percentile of the frequency distribution for the whole time period. See MacKenzie and Schiedek (2007b) for plots for winter and summer data, and for the frequency of extremely cold winters, summers and years.

general fitness of marine species and may favour freshwater species and the invasion of non-native species. Those marine species presently in the Baltic Sea may have to alter their spatial distributions to minimise salinity stress (i. e. move southwards and westwards; MacKenzie *et al.*, 2007). These considerations demonstrate that predictions of the future biodiversity of the Baltic Sea under climate change will have to consider not only the consequences of increased temperature, but also the consequences of and interactions involving a decrease in salinity.

The expected changes in abiotic conditions therefore will challenge stakeholders (e.g. scientists, policy-makers, the fishing industry) responsible for managing, exploiting and conserving species and ecosystems in the Baltic Sea.

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Application of benthic indices to assess biodiversity in the southern Baltic Sea

What do they tell us about the 'ecological status' in a brackish water system?

By Doris Schiedek and Michael L. Zettler

Benthic invertebrates are often used as bioindicators to detect and monitor environmental changes because of their rapid responses to natural and/or anthropogenic-caused stress. Benthic organisms are usually long-living and sessile and thus unable to avoid unfavourable conditions. In this way, they integrate water and sediment quality conditions over time and their presence or absence indicates temporal as well as spatial disturbances.

In the Baltic Sea salinity has a major impact on benthic communities and distribution of species. In this enclosed, non-tidal ecosystem salinity gradients are particularly pronounced in the transition zone from the North Sea ranging from the euryhaline Skagerrak and Kattegat to the brackish Baltic proper. As a consequence, the number of marine species is significantly decreased or has been displaced by limnic species (Figure 1). In this respect, a lower benthic diversity reflects the missing ability of marine species to tolerate salinities below 10 psu rather than any anthropogenic impact.

One of the main aims of the Water Framework Directive is to maintain or reach a 'good ecological status' for all European waters by 2015. In order to reach this aim the environmental status of marine and coastal waters has to be assessed. This has encouraged the design of specific biotic indices to evaluate the response of benthic communities to human-induced changes in water quality and to

separate impacted sites from undisturbed (reference) sites. Meanwhile a great variety of these biological indicators have been developed. However, many of them are based on species richness and on the presence/absence of dominant species.

What does this mean for an ecosystem such as the Baltic and the assessment of its ecological status? In order to answer this question, we

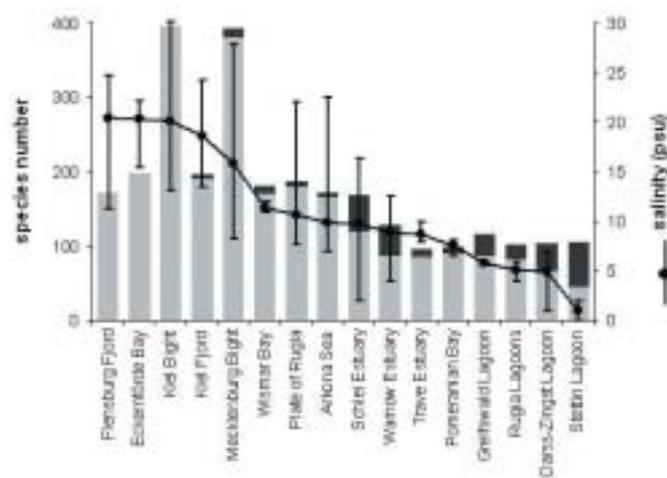


Figure 1. Total number of macrozoobenthic species in different parts of the southern Baltic Sea and mean salinities (\pm maximum and minimum). The percentage of limnic species is indicated by dark gray colour.

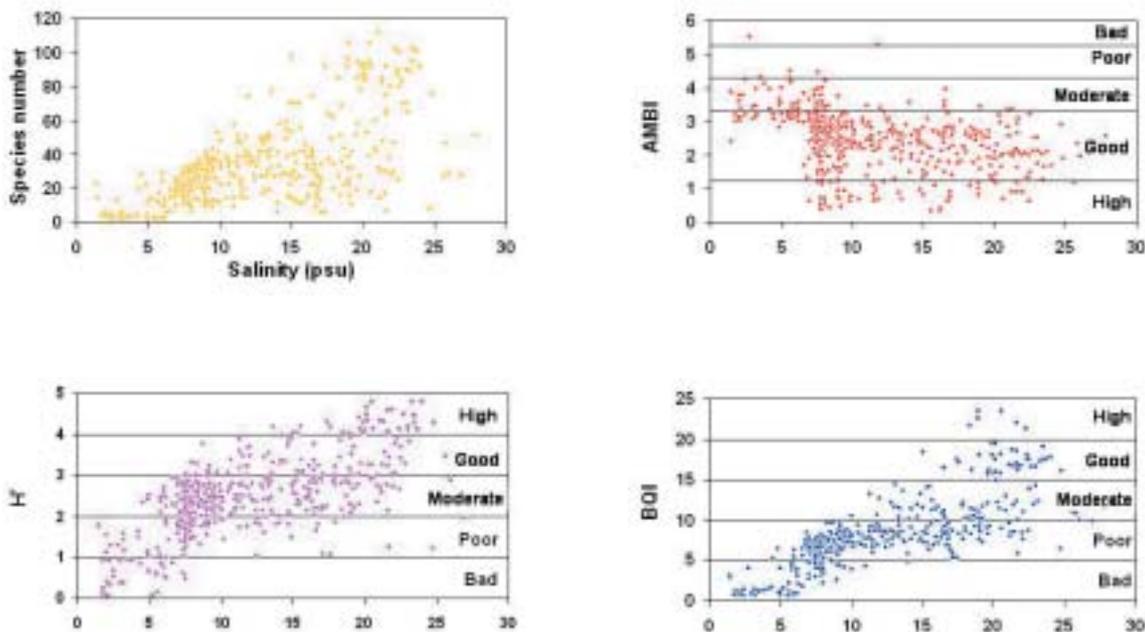


Figure 2. Clockwise from top left: Relationships between salinity and species number and three biotic indices in the southern Baltic Sea. The EcoQ status is indicated by the categories ranging from “Bad” to “High.”

compared three common biotic indices, the traditional Shannon Wiener Index (H') and the more recently published AMBI (AZTI Marine Biotic Index) and BQI (Benthic Quality Index), along a salinity gradient in the southern Baltic Sea. Benthic diversity was estimated at 625 stations sampled during the past 10 years, and salinity ranged from 1.5–27.8 psu.

We found a significant positive relation between species number, H' , BQI and salinity resulting in ecological quality (EcoQ) status of “Bad”, “Poor” or “Moderate” in areas with a salinity value below 10 psu (Figure 2). In areas where salinity was above 20 psu EcoQ status was usually “Good” or “High”. The AMBI was less dependent on salinity but appears to partly overestimate the EcoQ status. The greatest advantage of the AMBI, the discrete species list with its categorisation from very sensitive (Group I) to first-order opportunistic (Group V) species, seems to be a disadvantage in this gradient system. Particularly when dominant species are not classified accordingly, it may result in inappropriate assessment of the EcoQ (Zettler *et al.*, 2007).

The comparison of the three indices demonstrates that in the southern Baltic Sea the “ecological status” based on macrozoobenthic communities as indicator greatly depends on the biotic index chosen. Presently none of them seem to be adjusted

for application in this ecosystem. Even in areas where the potential maximum species diversity will be reached, the H' and BQI never showed the same or similar values as in more saline coastal waters. The positive relationship between these two indices and salinity (with increasing salinity, species number increased as well) is not surprising since both of these indices account for species richness and dominance.

Application of these benthic indices in brackish systems such as the Baltic probably requires adjusting the range when defining EcoQ values. Otherwise, a high ecological quality (EcoQ) as requested by the European Water Framework Directive will never be observed. We also see the need for user-friendly assessment tools to fulfil the main objective of the WFD. However, the risk for a drastic reduction of the initial environmental information when using a single biotic index still needs further consideration. In our opinion, a suitable approach could be to combine all three biotic indices. The recent published Multivariate-AMBI (Muxika *et al.*, 2007) which includes species richness, Shannon Wiener index and AMBI is an important step in this direction.

Acknowledgments

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MARDEM: Marine Reserve Design & Monitoring

A multidisciplinary study of marine reserves in Ireland

By Olwyen Mullholand

Increased technology and fishing capacity has led to many of the world's fisheries being largely overfished. Dredging, wetland drainage, pollution and ocean mining destroy fish habitats and contribute to the depletion of valuable marine species (NRC 2003). Concern about the sustainability of living marine resources has stimulated interest in the use of marine reserves as a management tool.



Sampling in Strangford Lough marine reserve.

Reserve designation priorities include fisheries stock enhancement, conservation of habitats and the protection of target species of particular interest for their rarity, cultural value or emotional appeal (Palumbi 2001). Marine reserves designated to preserve biodiversity are the focus of this study (Figure 1). Ways these reserves can be designed include: (1) to preserve the typical habitats and species of an area or (2) to protect biodiversity hotspots (i.e. areas with an accumulation of species or with large numbers of rare, threatened or endemic species).

However, despite the increased popularity of marine reserves as a management tool, few reserves appear to have been designated with an understanding of how they affect biological processes or how reserves can be used to meet biological goals more effectively (Halpern 2003). In fact, many reserves appear to have been designated due to historical, aesthetic or practical factors and designation in such an ad-hoc fashion (Sutur 1998) may not be the most effective way to meet fishery or conservation objectives.

Progress on the design and monitoring of marine reserves requires knowledge about how reserves function. A key issue is how marine reserves relate to the surrounding habitat. Reserves do not exist in isolation and a

network of reserves must provide some degree of 'insurance' for disturbances such as oil spills or climate-related effects (Allison *et al* 1998). Knowledge of such linkage is essential for designing of such networks. Direct measurements of mean larval dispersal are needed to understand connectivity in a reserve system, but such measurements are extremely difficult (Palumbi 2003). If there is linkage between reserve and non-reserve areas, there should be a degree of synchrony in the dynamics of populations in reserves and surrounding areas. If there is synchrony, it is important to characterise the scale at which it breaks down. A first attempt at defining the relevant scales of synchrony has been published recently for sites around Shetland (Burrows *et al* 2002).

A clearer understanding of the species that reserves are aimed at protecting is also essential. Marine species differ in their life-history strategies. Some are direct developers while others have a free-living planktonic phase, which varies greatly from species to species. Such life-history strategies directly affect recruitment and influence the geographical range of species, the genetic structure of populations and distribution on a small spatial scale. This feature of life history has the potential to provide a useful indicator of the scale of inputs in the marine



Figure 1. Locations of study marine reserves.

environment. If numbers of direct developers are reduced, this suggests a local impact at the site. If numbers of pelagic developers are reduced, this suggests a more widespread impact. Preliminary evidence for such patterns have been found in the Isle of Man (Johnson *et al* 2001), but further work is needed.

A reserve might be designated to provide a source of individuals to surrounding communities; however, local hydrodynamics might cause it to act as a sink, receiving larvae but not exporting them (Allison *et al* 1998.). These dispersal patterns are not well understood for many species or in many areas. Coastlines are not linear and there may be a variety of consequences to designating reserves in bays or on the open coast (Archambault & Bourget 1999). For example, given the importance of hydrodynamics in larval flows, it is likely that coastal configuration (enclosed embayments versus open coasts) will play a large part in determining patterns of linkage between populations.

The Higher Education Authority of Ireland (HEA) has funded a cross-border collaborative where groups from University College Dublin (UCD), University College Cork (UCC) and Queens University Belfast (QUB) unite in a multidisciplinary partnership to answer the following questions about marine reserves.

A multi-disciplinary approach is being taken, with a PhD student from each university working on the following themes:



Lough Hyne, Co Cork.



The Rapids, Lough Hyne, Co Cork.

QUB: Genetic diversity and comparative population structure inside and outside marine reserves.

UCC: Exchange of larvae between marine reserves and other areas.

UCD: Spatio-temporal patterns of biodiversity inside and outside marine reserves.

The MARDEM project addresses the following questions:

- 1 Do reserves act as a source of larvae or adults or are they areas with low extinction rates such that species accumulate locally?
- 2 Are the dynamics of reserve and non-reserve areas in synchrony? (And over what scale does synchrony persist?)
- 3 How does coastline configuration affect population stability?
- 4 How do the population dynamics of species with different life-history strategies differ inside and outside reserves?

Molluscs were used as a model group in this study, given their tractability for sampling and relative ease in identification. Moreover, Smith (2005) advocated molluscs as useful, general surrogates for overall species richness in marine conservation studies.

Ireland is currently building a network of marine reserves in response to EU legislation. However, some of the Irish reserves were designated when information was not available to facilitate decisions in relation to optimal location, number, size and distance between reserves to create functioning networks of reserves. Two of these reserves, Strangford Lough and Lough Hyne, are the focal reserves in the MARDEM study.

Strangford Lough, a large (150km²) shallow sea lough on the east coast of County Down (Northern Ireland), its northern tip some 15km from central Belfast, was designated Northern Ireland's first marine reserve. This semi-

enclosed marine lake sea is separated from the Irish Sea by the Ards peninsula to the east and is bounded to the south by the Lecale coast. A long channel (8km x 0.5km) known as the Strangford Narrows connects the Lough to the open sea. The currents in the Narrows are extremely strong and fast, up to 8 knots (4m/s). The Lough has a long history of scientific research and extensive surveys have shown that the Lough has an exceptional diversity of marine habitats, supporting over 2,000 marine species, including some typical of the Arctic, others of southern distribution.

Lough Hyne is a small (0.8x0.6km), deep, semi-enclosed marine lake, located in west Cork (Republic of Ireland), 5km west of Skibbereen and 80km from Cork city. Established in 1981, this marine reserve was one of the first designated in Europe.

The lough is connected to the Atlantic Ocean by a narrow, shallow channel referred to as the Rapids. As a result of the Rapids, the tidal range in the lough is reduced to about 1m at Spring tides compared with 3.5m at springs in the adjoining open sea (Kitching & Ebling 1967, Kitching 1987). Consequently, the vertical zonation of the intertidal communities is confined to a narrow band. Tidal inflow lasts for 4 hours, and outflow into the sea lasts about 8.5 hours (Holland 1991).

Sampling took place from 2004 to 2005 and a full complement of results is expected in early 2007. It is hoped the multidisciplinary approach adopted by the MARDEM project will provide a broader picture of the functioning of marine reserves.

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Polychaete community genetics from the northwestern Greek lagoons sampling

Preliminary results

By K Vasileiadou, E Sarropoulou, K Tsigenopoulos, S Reizopoulou, A Nikolaidou, S Orfanidis, M Simboura, G Kotoulas, C Arvanitidis

All ecosystem components are interrelated; the adoption of a common approach in the study of ecosystems is essential. Community genetics, an approach combining ecology and genetics, takes into account the fact that evolution is influenced by ecological interactions and that the gene of environment interactions provides the key to species diversity (Collins, 2003). The importance of genetic diversity is that, by its means, organisms become capable of adaptation to their environment and play their functional roles in the communities and ecosystems (Solbrig, 1991).

In this study, invertebrates from Greek lagoons were collected in order to compare the patterns of intraspecific genetic diversity for several species to patterns of community diversity, and to investigate the underlying environmental variables which affect them. Environmental gradients are interesting cases to look at, because of the impact of external forcing in shaping intraspecific patterns of diversity, as well as genetical patterns, which affect the whole community structure. Such comparisons may reveal the limits of adaptive plasticity of a given gene pool across an environmental gradient, highlighting the advantages of speciation (disruption of a gene pool), when some thresholds of environmental conditions are crossed. Such a comparison and understanding may allow predictions of response of single species and of communities to systematic environmental changes.

The highest possible resolution within species genetic diversity at a given DNA region or gene derives from comparison at the sequence level. Comparisons between individuals are summarised into a resemblance matrix, which includes distances between sequences. A phylogenetic tree is then produced based on these distances.

Such a combined study has been carried out in three Greek lagoons: Logarou and the Tsoukalio–Rodia system. Lagoons are located in Amvrakikos Gulf, Ionian Sea (western Greece), with all three characterised by a wide range of temperature and salinity (euryhaline and eurythermic) and separated from the sea by sand barriers with narrow openings allowing limited water exchange. Rodia is an internal lagoon, not directly connected to the sea but linked through the coastal lagoon, Tsoukalio. The salinity regime of Rodia is significantly affected by freshwater inputs that cause a marked seasonal reduction of salinity.

The research was carried out by the Institute of Marine Biology and Genetics and the Institute of Oceanography of the Hellenic Centre for Marine Research.

Currently, the genetic analysis has been restricted to species of the Polychaete family *Nephtyidae*, the most abundant, and for this reason, offers the possibility of estimating both abundance and allele distribution

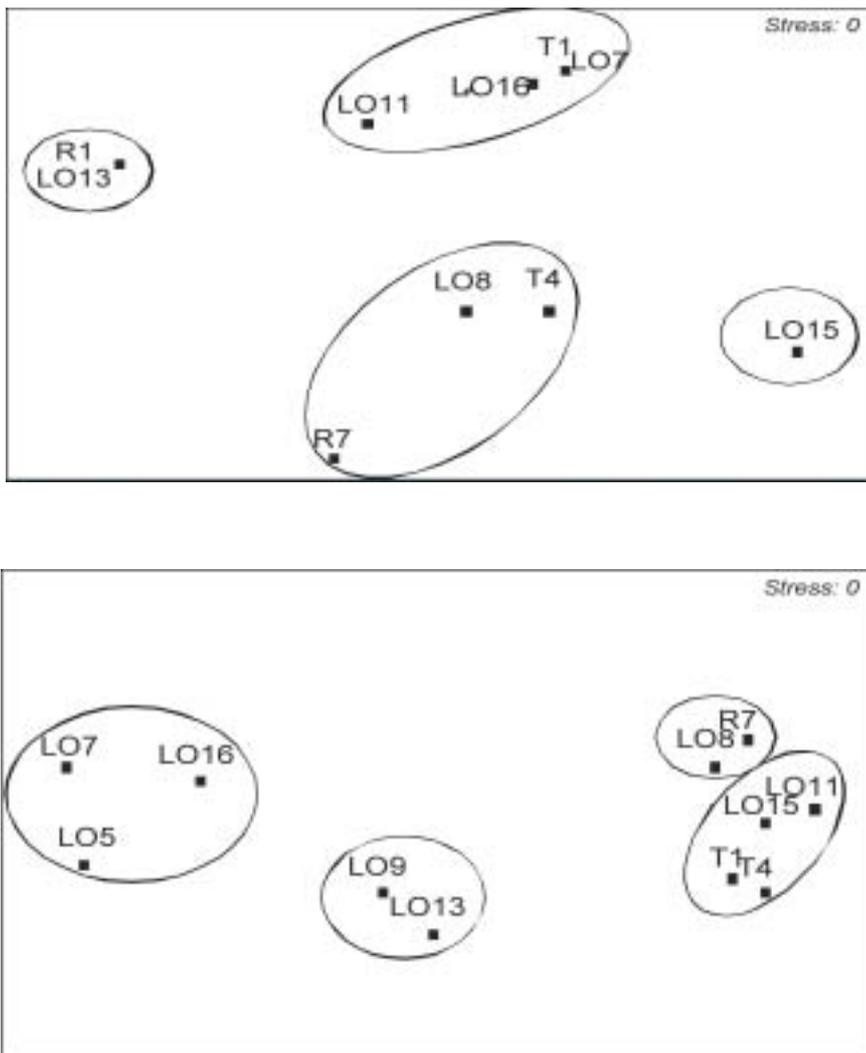


Figure 1a, 1b. Multi-dimensional scaling from 16S data (Figure 1a, top) and from COI data (Figure 1b, bottom). LO: stations from Logarou lagoon; R: stations from Rodia lagoon, T: stations from Tsoukalio lagoon.

patterns across the environmental gradient. So far, existing results come from a single species, *Nephtys hombergii* Savigny, 1818, one of the most abundant species in the study area.

The 16S and COI genes from mitochondrial DNA were chosen for the genetic part of the study. Mitochondrial DNA has a relatively high mutation rate (Rand, 1994; Page & Holmes, 1998; Brown *et al.*, 1979) and is considered to be a neutral marker (William *et al.*, 1995). Neutral markers are in general considered not to be influenced by natural selection and a lack of recombination (see Rokas *et al.*, 2003, for some exceptions). These attributes indicate that mtDNA is a very useful tool in population studies.

The sequences that arose were basically aligned visually, using the BIOEdit software in order to assess the variable sites directly. Alignment results for 16S showed three types of haplotypes, while results for COI showed two types (Figure 1a, 1b). A triangular similarity matrix was produced, comprising the number of each haplotype per station, after which the matrix was inserted to PRIMERv6 software, where-upon the non-metric multi-dimensional scaling analysis was performed.

The resulting MDS plots, which depict the relative abundance of each haplotype, show different patterns for the two genes. Four groups of stations can be identified in the plot deriving from sequences of 16S (Figure 1a): the first group includes only station LO15 from

Logarou lagoon; the two stations from Tsoukalia lagoon are separated into two groups, one with station R7 from Rodia and LO8 from Logarou clustered together with LO7, LO11 and LO16 from Logarou; the last group includes stations LO1, LO6 from Logarou and R1 from Rodia lagoon.

Multi-dimensional scaling plots deriving from the COI data show stations clustered in four groups (Figure 1b). Stations from Tsoukalia lagoon are grouped together with stations LO11 and LO15 from Logarou lagoon. Another group is formed with stations R7 from Rodia lagoon and LO8 from Logarou. Stations LO9 and LO13 are clustered in the third group. The fourth group contains stations LO5, LO7 and LO16 from Logarou.

Currently, it is not possible to compare genetic patterns with those deriving from species-by-station since the genetic data are based on a single species: *Nephtys hombergii*. However, these preliminary results tentatively show a possible way of data analysis and interpretation from an ecological point of view. Genetic data from more species are expected in the near future, the patterns of which will be combined with those of species abundance and with those of the environmental variables. Clearly, more analytical methods must be applied to test for hypotheses of adaptive evolution, co-evolution or sorting of preadapted lineages by incorporating phylogenetic information (Cavender-Bares & Wilczek 2003).

Acknowledgments

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FEATURES

Marine Institutes & Associations

Research at the littoral station of Aguda in northern Portugal

By Mike Weber

Praia da Aguda, a small fishing village on the northern Portuguese Atlantic coast, located 9km south of the River Douro estuary, is known for its "artisanal" fishery, based on methods handed down from generation to generation. Around 1870, fishermen from two villages nearby, Afurada and Espinho, settled here to build the first wooden shelters and to fish mainly swim-crabs or "pilado" (*Polybius henslowi*) which they sold to the local farmers for fertilisation. The fields became more productive, and the fishery developed with increasing demand.

The littoral station of Aguda.

On Aguda Beach, the littoral station of Aguda, or "ELA," directed by the Foundation ELA of the Municipality of Vila Nova de Gaia, was inaugurated in July 1999. The building houses three areas: a fishery museum, an aquarium, and a department for education and research. Various programmes, projects, and services have been developed to:



Honeycomb worm (*Sabellaria alveolata*) reefs at Aguda Beach.

- increase public sensitivity to the littoral;
- provide a direct contact with the sea to educational institutions;
- promote environmental education for all age groups;
- participate in university courses;
- study the biological processes in the littoral;
- support the local fishery with research projects.

The fishery museum displays ancient and modern equipment of small-scale fisheries from all over the world with special reference to Aguda's community. The exhibition is based on a collection of unique items, gathered in five continents over the past 30 years: hooks, artificial baits, fishing spears, harpoons, traps, fyke-nets, pots and nets.

The aquarium is dedicated to the local marine and freshwater fauna, particularly the marine fish of commercial interest to Aguda's fishery, common invertebrates and macroalgae. More than 1,000 specimens of almost 60 species inhabit 15 aquarium tanks of volumes up to 6,700 litres, representing the characteristic biotopes of the area. The display starts with the life of the intertidal zone and then enters the sublittoral, descending down into a kelp habitat. With increasing depth, and diving through the rocky zone of Aguda's sea, the exhibit finally reaches a sandbank where an artificial reef is located, giving shelter to bigger species of fish. Ascending again, the display returns to land and ends in a small freshwater creek crossing the dunes.

The education and research department promotes environmental education and develops research projects in marine ecology, aquaculture and fishery. A natural conservation programme involves the protection of local sand coral reefs (*Sabellaria alveolata*) through information and education of the public, and the rehabilitation and reintegration of marine turtles (*Caretta caretta*).

The rocky intertidal area of Aguda Beach presents an ideal training ground for environmental education. Pedagogical services are available for all age classes and on all levels: "Marine Fairytales" for children aged 3-5; "Sea Classes" (ages 6-12); "A Night on the Bottom of the Sea" (ages 6-12); "Environmental Education in the Littoral" – a pioneer programme which started in 1997, involving until today over 9,000 students – and "Nature's Beach Walk" for secondary school students (ages 10 and over), associations and the general public; "Science Alive in Summer" and "ELA's Guided Tours" for schools and the general public; "Marine Ecology and Fishery Technology" for undergraduate students of the Institute of Biomedical Sciences-ICBAS of the University of Porto; "Coastal Ecology and Artificial Reefs" for graduate students of the Masters of Science Course of Marine Sciences and Resources of ICBAS.

The station's concept constitutes an unprecedented project in Portugal and has already created an important impact on the educational and cultural development of the council's area. ELA has also served as an example for a similar project, the Aqua-Museum of the River Minho ("Aquamuseu do Rio Minho") in Vila Nova de Cerveira, on the northern Portuguese-

Spanish border. Further-more, ELA might be the guideline for a new aquarium in Horta, on the Azorean island of Faial.

Temporary exhibitions about aquarium photography, paintings, newspaper reports of the project's history, scientific posters, local hand-made crafts, and the presentation of new books published by ELA's staff, have increased public interest considerably.

The station is open to the public daily from 10:00am to 6:00pm, all year round (closed on Monday to Friday from 12:30pm to 2:00pm) and has been visited by more than 200,000 people since opening in 1999.

Recent research projects are concerned with the colonisation and succession of the marine fauna and flora on Aguda's new breakwater, and its impact on mussel patches (*Mytilus galloprovincialis*) and the associated fauna of sand coral reefs (*Sabellaria alveolata*). A long-term project deals with the cultivation and restocking of the European lobster (*Homarus gammarus*) at Aguda Beach.

Aguda's intertidal zone is characterised by rocky platforms, numerous tide pools and a great variety of microhabitats such as channels, crevices and holes, constituting an important ecosystem with a highly diverse marine fauna and flora. The upper eulittoral is colonised by barnacles (*Chthamalus* spp.) and limpets (*Patella* spp.), and the mid-eulittoral is dominated by the blue mussel (*Mytilus galloprovincialis*). The lower eulittoral is covered with colonies of the honeycomb worm (*Sabellaria alveolata*) and in the sublittoral fringe are growing large kelps (*Saccorhiza polyschides*, *Laminaria ochroleuca*).

Before the construction of the breakwater, Aguda Beach was completely exposed and unprotected with regard to wind and wave. The construction started with an access road, built perpendicular to the beach, which was removed after finalisation in 2002. Shortly after the beginning, an important variation of sediments took place on the beach. Owing to the interruption of the long-shore drift in a north-south direction, heavy erosion occurred on the south side and accumulation of sand on the north side of the breakwater under construction.

Several impacts were predicted among them the formation of sandbanks owing to wave diffraction and a decrease of wave height in the central part of the beach. Based on these predictions, a Differential Global Positioning System was applied to detect a possible long-term volumetric variation of the sediments. Monthly measurements were carried out since October 2000 by the Department of Geology of the Faculty of Sciences of the University of Porto. Until now, sand accumulations have never stopped and two-thirds of the northern part of the formerly detached breakwater are now completely covered with sediments.



Environmental education at Aguda Beach.

The ecological impact of the breakwater on the adjacent shore has been studied before, during, and after its construction. Monitoring focused on mussel patches (*Mytilus galloprovincialis*) which provide favourable conditions for the occurrence of other marine species, constituting a characteristic associated fauna. Statistical methods were applied to detect biological variations in the mussel patches through the spatial confrontation of the supposed zone of impact in relation to two control areas at the north and the south side of the breakwater, and through the temporal confrontation between before and after the impact. Forty-three species of macroinvertebrates were found in the mussel patches in three random and destructive samples, taken before and during the construction. According to statistical analysis, no significant temporal differences were detected but only natural fluctuations of the diversity within the mussel patches and of the biomass of the mussels.

After construction, the ecological impact of the breakwater on the faunal diversity was analysed again and the results were analysed



Tubes of the honeycomb worm (*Sabellaria alveolata*).

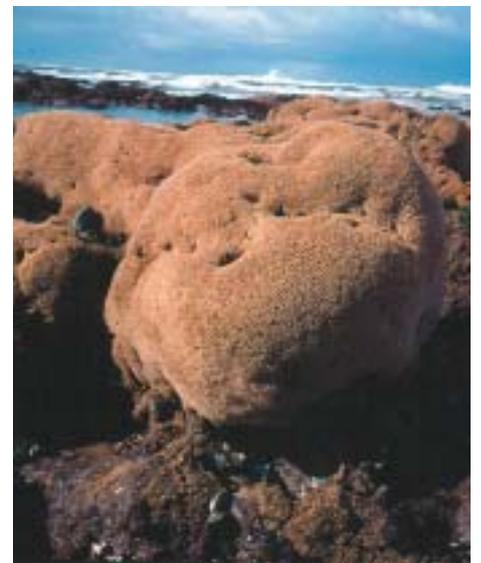
using statistical analysis. According to these, a short-time impact of the breakwater could not be detected.

At Aguda Beach, the sedentary polychaete *Sabellaria alveolata* builds honeycomb-like colonies in the lower eulittoral and the sublittoral fringe. In an advanced phase, these colonies can grow into authentic "reefs" up to a height of 0.5 metres. The irregular structures, full of cavities and crevices, are known to form an ideal substrate for hiding, feeding and reproduction of other marine animals. In order to identify the associated fauna, samples were taken monthly during one year at three sites which were exposed to different hydrodynamic activity. The first lateral site faced the sea and was exposed to the waves, the second lateral site faced the shore and was protected from wave agitation, and the horizontal site was located on top of the 'reef.' The associated fauna of the colonies included 143 species, among them 50 crustaceans, 46 polychaetes, 31 molluscs, 9 pycnogonids and 2 echinoderms.

Statistical analysis revealed significant faunal differences between the sampling sites. Higher concentrations of species and specimens were found at the exposed site, whereas lesser numbers were obtained at the protected and the horizontal site, which were less affected by wave and tidal erosion, and covered by colonies of a more compact structure with fewer cavities and crevices. In comparison with other European *Sabellaria* colonies, which grow on rocky substrate in similar conditions, the numbers of associated species and specimens were greatly superior at Aguda's beach.

The extension of the sand coral reefs at Aguda Beach has been drastically reduced since the construction of the breakwater. Two complementary statistical methods were applied to detect whether the coastal defence structure had a significant impact on the associated fauna. Samples were compared,

which had been taken randomly in space and time from the potentially impacted site and three control sites on beaches nearby. Multivariate methods were used in an attempt to understand the differences and/or the similarities between the sampling sites. The data of four sampling months at four beaches, involving six replicated samples at each beach, led to the identification of 121 associated species, among them 31 gastropods, 19 bivalves, 41 crustaceans, 15 polychaetes and 2 echinoderms. The results indicated that only a few polychaetes and some crustaceans have suffered short-term changes in their diversity, probably caused by the construction of the breakwater. A modification of the local hydrodynamic regime, which is recognised to be a limiting factor for the survival and development of the honeycomb worm, might also have affected some of the associated species. The applied statistical methods suggested changes in the faunal community



Honeycomb worm (*Sabellaria alveolata*) reefs.

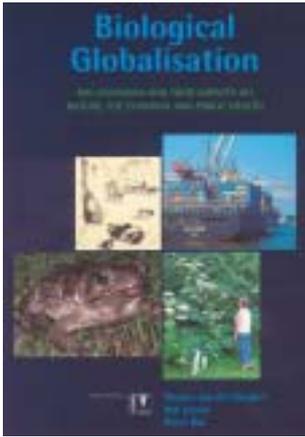
and, despite the data showing that the breakwater impact has not yet reached many other species, the effect could become more pronounced in the long run.

Future studies are planned concerning the submerged reefs of the honeycomb worm in the sublittoral of Aguda Beach.

Mike Weber

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By Bert Hoeksema



Biological Globalisation
Bio-invasions and their impacts on nature, the economy and public health

By Wouter van der Weijden, Rob Leewis and Pieter Bol
 KNNV Publishing, Utrecht,
 The Netherlands (February 2007)
 Price: €49.95
 ISBN: 978-90-5011-243-7

The book *Biological Globalisation* deals with global issues, many of which are related to the sea. It was written by three authors; two biologists and a medical epidemiologist. One author is a marine biologist with a major interest in marine invasive species. Although the authors have chosen for an integrative approach, which is obvious considering the book's title, it is easy to find specific examples dealing with marine species introductions. Almost 100 pages are dedicated to thematic boxes which give this publication the resemblance of an encyclopedian reference book. This makes the book very accessible, attractive to browse and easy to read. Examples of marine invaders include deliberately introduced species, ballast water, shellfish trade, released aquarium organisms, swamping species, follow-up invasions by a natural enemy, damage to fisheries, the Suez Canal, and fouling of ship hulls. Some species that receive special attention because of economic damage or swamping are the Japanese oyster (*Crassostrea gigas*), the American jack-knife clam (*Ensis directus*), the shipworm *Teredo navalis*, the ctenophores *Mnemiopsis leydei* and *Beroe ovata*, the European green crab *Carcinus maenas*, the Chinese mitten crab *Eriocheir sinensis*, the copepod oyster parasite *Mytilicola*

intestinalis, the Japanese wireweed *Sargassum muticum*, and the green alga *Caulerpa taxifolia*. Biological globalisation is increasing rapidly due to growing long-distance traffic and trade. Climate change is also a relevant driving factor. Since the authors are Dutch and the book was published by the Royal Dutch Society for Natural History (KNNV) it is not surprising that many cases are explained with examples from the Netherlands and the Dutch maritime history. Nevertheless, the issues at stake are still seen from a global perspective. They contribute documentation that helps to support the chapter dedicated to 'lessons learned and actions needed'. The book is not only aimed at professional biologists and naturalists, who may find the elaborate examples very useful, but also at people working for governments who can use the presented information as a basis for policy making.

The book has 224 pages, which contain 132 colour illustrations (including 8 maps), 12 tables, 87 boxes and 7 appendices.

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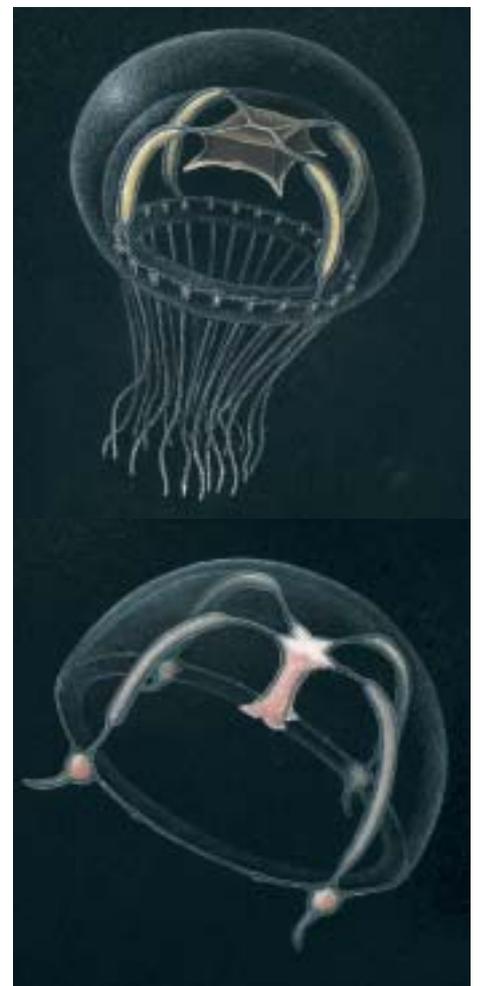
Francesc Pagés



Francesc Pagés in Fujiyama, Japan.

Francesc Pagés, a research scientist at the Institut de Ciències del Mar (CSIC) in Barcelona, Spain, died on 5th of May, 2007. Francesc, who got his PhD from the University of Barcelona in 1990, soon became one of the most active young scientists studying marine plankton, visiting almost all of the world oceans in search of new jellyfish species. He was a good colleague and mentor for his students, a superb researcher, and one of very few taxonomists with a very deep knowledge of all aspects of gelatinous zooplankton. He was such a charming, helpful man and will be sadly missed for his good company as well as for his very great expertise. Science has lost a great enthusiast in jellyplankton diversity research.

Right (from top): drawings of *Medusa* species by Jordi Corbera: *Teclaia recincolae*, *Barcino foixensis*. (From Gili, J.M., J. Bouillon, F. Pagès, A. Palanques & P. Puig (1999). Submarine canyons as habitats of prolific plankton populations: three new deep-sea *Hydroidomedusae* in the western Mediterranean. *Zool. J. Linn. Soc.* **125**: 313-329.)



MarBEF Events Calendar (July 2007–November 2007)

(MarBEF-supported events*)

<i>Date</i>	<i>Title</i>	<i>Location</i>	<i>Event Type</i>
JULY 2007			
2-13th	IPY International Summer School on Sea Ice	Svalbard, Norway	Course
4-6th	Change in Aquatic Ecosystems: Natural & Human Influences	Plymouth, UK	Course*
8-16th	MarBEF/MBSS2007 training course on physiological and genetic diversity of marine organisms in European coastal systems	Gdansk, Poland	Course*
15-20th	World Congress of Malacology	Antwerp, Belgium	Meeting
17-27th	MarBEF Summer School on Diversity and Functioning of Coastal Habitats	Sylt, Germany	Course*
23-27th	4th European Phycological Congress	Oviedo, Spain	Meeting*
23-3rd (Aug)	Summer School: Advanced Training for Women in Scientific Research	Krems, Austria	Course*
29-3rd (Aug)	13th International Meiofauna Conference	Brazil	Meeting*
AUGUST 2007			
27-31st	42nd European Marine Biology Symposium (EMBS42)	Kiel, Germany	Meeting*
SEPTEMBER 2007			
1-13th	ALTER-Net Summer School 2007 Trends in Biodiversity: European Ecosystems and Policy	Peyresq, France	Course
8-14th	MarBEF training course in tidal flat ecology: Field experiments as a tool for marine research	Sylt, Germany	Course*
9-15th	BA Festival of Science	York, UK	Meeting
16-20th	5th European Conference on Marine Natural Products (V ECMNP)	Ischia, Italy	Meeting*
17-21st	2007 ICES Annual Science Conference	Helsinki, Finland	Meeting*
25-28th	European Symposium on Marine Protected Areas	Murcia, Spain	Meeting
OCTOBER 2007			
2-4th	Ocean Biodiversity Informatics 2007	Nova Scotia, Canada	Meeting
8-12th	Chapman Conference on Long Time-Series Observations in Coastal Ecosystems: Comparative Analyses of Phytoplankton Dynamics on Regional to Global Scales	Rovinj, Croatia	Workshop*
15-20th	MANUELA Workshop: Sampling and Laboratory Techniques in Meibenthology	Wilhelmshaven, Germany	Workshop*
NOVEMBER 2007			
12-16th	10th International Conference on Shellfish Restoration (ICSR)	Vlissingen, Netherlands	Meeting
20-23rd	ICES Symposium: Environmental Indicators: Utility in Meeting Regulatory Needs	London, UK	Meeting

For further information on these events, or if you are hosting an event and would like to see it advertised on the MarBEF website, please go to <http://www.marbef.org/modules.php?name=Calendar>.



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