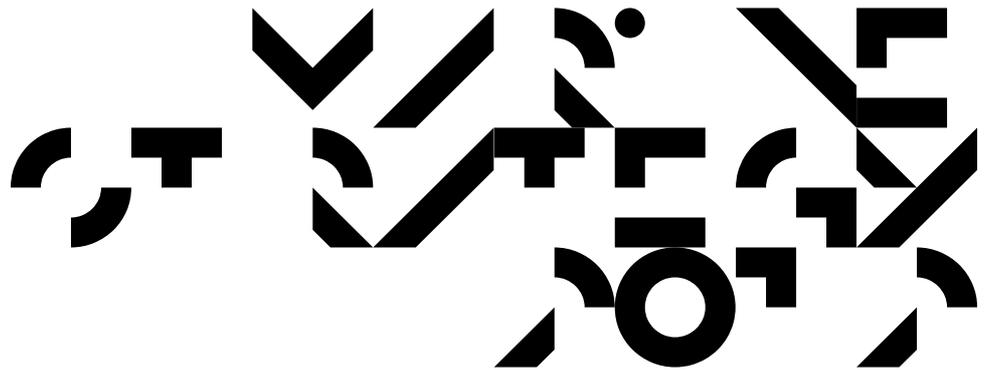


Programme



Research and Ecosystem-Based Management Strategies in Support of the Marine Strategy Framework Directive

14–16 May 2012
Copenhagen
Denmark

Marine Strategy 2012 is organised by:



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Welcome

Welcome to Copenhagen and welcome to **Marine Strategy 2012**, the first European Conference ever on Research and Ecosystem-Based Management Strategies in Support of the Marine Strategy Framework Directive.

The overarching aims of **Marine Strategy 2012** are to take stock of progress in the implementation of the EU Marine Strategy Framework Directive (MSFD) and to consider the next steps with regard to the MSFD implementation process. In particular, we hope to discuss how a good environmental status can be achieved in all European seas.

The target audience ranges from marine scientists over those persons and institutions implementing the MSFD in EU Member States to senior officials and decision makers.

Marine Strategy 2012 presents a mix of key note and invited presentations as well as contributed oral and poster presentations. The presenters are mostly European based. However, we have also invited presentations by non-Europeans in order to gain insight from an “outside” perspective.

We hope you will find the programme of **Marine Strategy 2012** strikes a good balance between science, and potential contributions to evidence-based management and policy-making.

We also hope that you will have fruitful discussions with colleagues and strengthen your contact to scientists and managers from other countries. Such contact is important as the challenges associated with successful implementation of the MSFD do not confine themselves to national marine waters. Only by linking and coordinating efforts at the national level can good marine environmental quality be achieved at the European level.

We hope that you will enjoy **Marine Strategy 2012** and also have a pleasant stay in Copenhagen.

Jesper H. Andersen
Chair of the Organising Committee

Katherine Richardson
Chair of the Scientific Committee

Conference at-a-Glance

Monday 14 May

18:00-18:15	Opening (H. Pilsgaard & K. Nielsen)
18:15-18:45	<i>The challenge of the Marine Strategy Framework Directive</i> (L. De Vrees)
18:45-19:15	<i>"Back to the Future": Past, present and future status of the marine environment</i> (K. Richardson)
19:15-19:45	<i>Eutrophication and oligotrophication in marine waters: Lessons learned from 4 decades of monitoring and assessment in Denmark</i> (J. Carstensen)
20:00-22:00	Get together reception

Tuesday 15 May

08:00-08:30	<i>Promises and challenges of marine ecosystem-based management</i> (M. Fogarty)		
08:30-09:00	<i>MSFD and the "I" word - Integrated ecosystem fisheries surveys, Integrated Ecosystem Assessment and Integrated Fishery/Ecosystem Management</i> (D. Reid)		
09:00-09:30	Coffee/tea		
	MSFD descriptors, criteria and indicators		
09:30-09:40	<i>Introduction</i> (D. Connor, DG ENV)		
09:40-10:00	<i>D 11: 'Underwater Noise': Novel and challenging aspect of Good Environmental Status</i> (M. Tasker)		
10:00-10:20	<i>D 10: 'Marine Litter' within the European Marine Strategy Framework Directive</i> (F. Galgani)		
10:20-10:40	<i>D 8: 'Contaminants and pollution effects'</i> (M. Angelidis)		
10:40-11:00	<i>D 7: 'Permanent alteration of hydrographical conditions': Definition, conceptual understanding and examples</i> (I.S. Hansen)		
11:00-11:20	<i>D 6: A proposal of indicators to evaluate Good Environmental Status for the 'Seafloor Integrity' descriptor</i> (A. Borja)		
11:20-11:40	<i>D 5: Is there life after guidance? Developments on the Marine Strategy Framework Directive 'Eutrophication' descriptor</i> (J. Ferreira)		
11:40-12:00	<i>D 4: Developing the 'Food Web' descriptor: Moving from principles to practice</i> (S. Rogers)		
12:00-12:20	<i>D 3: 'Commercial fish and shellfish'</i> (G. Piet)		
12:20-12:40	<i>D 2: 'Non-indigenous Species' in marine environment: Setting the baseline and defining Good Environmental Status</i> (S. Olenin)		
12:40-13:00	<i>D1: 'Biodiversity': What is it, what did we do with it, and where is it going now?</i> (S. Cochrane)		
13:00-14:30	Poster session		
	Session 1A: MSFD criteria and individual indicators in relation to baseline and GES	Session 2A: GMES/EMOD-NET and other monitoring and modelling activities	Session 3: The MSFD in relation to spatial planning, including protected areas
14:30-14:50	Coppini et al. (615)	Novellino et al. (576)	Carneiro (585)
14:50-15:10	Lynsgaard et al. (621)	Giorgetti et al. (579)	Mohn et al. (580)
15:10-15:30	Wan et al. (573)	Forster et al. (639)	Vinther & Eero (568)
15:30-15:50	Maar et al. (605)	Bahurel et al. (#)	Behrens et al. (640)
15:50-16:10	Howe et al. (606)	Le Quesne (592)	Olesen et al. (636)
16:10-16:40	Coffee/tea		
	Session 1B: (continued)	Session 2B: (continued)	Session 4: Achieving evidence-based management ...
16:40-17:00	Prins et al. (611)	Thomsen (583)	McQuatters-Gollop (567)
17:00-17:20	Solidoro et al. (617)	Markager et al. (537)	Twomey et al. (600)
17:20-17:40	Krause-Jensen et al. (633)	She et al. (635)	Uusitalo et al. (629)
17:40-18:00	Eriksen et al. (628)	Jørgensen et al. (536)	Kalliola (566)
18:00-18:20	Tougaard et al. (570)	Hansen & Fossing (589)	Andrusaitis (638)
19:30-22:00	Conference Dinner		

Wednesday 16 May

08:30-09:00	Understanding and mapping of cumulative pressures: Lessons learned from global and regional assessments (B. Halpern)		
	Session 1C: (continued)	Session 2C: (continued)	Session 5: Linking multiple indicators and pressures for assessment of GES
09:10-09:30	Støttrup et al. (630)	Siguardottir et al. (594)	Borja et al. (587)
09:30-09:50	Uuitsalo et al. (613)	Santos & Siguardottir (595)	Axe et al. (619)
09:50-10:10	Strand et al. (626)	Hansen et al. (574)	Skov et al. (618)
10:10-10:30	Laane et al. (582)	Korpinen et al. (623)	vd Meeren et al. (603)
10:30-10:50	Brander (627)	Stock et al. (590)	Green et al. (578)
10:50-11:10	Møhlenberg & Middelboe (632)	Stelzenmüller et al. (591)	Altvater et al. (#)
11:10-11:30	Coffee/tea		
	Where are we now? And where are we going?		
11:35-11:50	<i>The Water Framework Directive and state of Europe's water</i> (P. Kristensen)		
11:55-12:15	<i>Regional activities to protect the marine environment and the coastal region of the Mediterranean Sea</i> (M. Angelidis)		
12:20-12:40	<i>Current state of the Black Sea and its environment protection</i> (L. Boicenco)		
12:45-13:05	<i>Regional coordination for the implementation of the MSFD in the Baltic Sea by HELCOM</i> (M. Laamanen)		
13:10-13:30	<i>Does MSFD + ICES = Ecosystem-Based Management?</i> (A.C. Brusendorff)		
13:35-13:55	<i>The challenges ahead – from a NGO perspective</i> (G. Seeberg)		
14:00-15:00	Lunch		
15:00-15:45	Conference Summary (J. Carstensen, P. Henriksen, S. Markager)		
15:55-16:00	Closing of Marine Strategy 2012		

Programme

Monday 14 May 2012

Opening Session

Chair: Jesper H. Andersen
Room: 101 + 102, 1st floor

18:00-18:15 Opening of Marine Strategy 2012

H. Piilsgaard

Danish Ministry of the Environment (MoE)

K. Nielsen

Danish Centre for Environment and Energy (DCE), Aarhus University

18:15-18:45 The challenge of the Marine Strategy Framework Directive

L. De Vrees

European Commission, DG Environment, Marine Environment Unit

The Marine Strategy Framework Directive established a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment by the year 2020 at the latest. 2012 is the year in which MS have to provide an initial assessment of the state of their marine waters, determine what is good environmental status for the marine region or subregion and set environmental targets to guide progress towards achieving Good Environmental Status (GES). In 2014 the monitoring programme should be in place and in 2015 the programme of measures should be developed designed to achieve or maintain GES. It is recognized that there is a substantial need to develop additional scientific understanding for assessing GES in a coherent and holistic manner to support the ecosystem-based approach to management. The Commission will make an assessment of the Member State deliverables of 2012 and will inform Member States whether the elements notified are consistent with the Directive and provide guidance on any modification it considers necessary. An important aspect will be the coherence between the neighbouring MS sharing the same region or subregion and across the EU. The presentation will elaborate on possible outcomes of this assessment and how this will guide and deliver inputs to the upcoming monitoring programmes and the research agenda of the years to come, to be implemented in coordination between Member States, Regional Sea Conventions and the EU.

18:45-19:15 “Back to the Future”: Past, present and future status of the marine environment

K. Richardson

Center for Macroecology, Evolution and Climate, Biological Institute and
Leader of Sustainability Science Centre, University of Copenhagen, Denmark

Most of the effort expended on maintaining or restoring environmental quality in marine environments is carried out with the stated aim of protecting nature. Unfortunately, however, there are no recognized criteria for measuring the state of natural ecosystems – either on land or in the sea. Instead, the monitoring and management of natural systems is usually based on a “sector” approach whereby the different anthropogenic stressors acting upon the system are monitored and controlled independently of one another. The underlying assumption with this approach is that reducing the magnitude of the individual stressor will allow reestablishment of the “natural” ecosystem. There are, however, several problems with this approach. Firstly, it is now well documented that, when ecosystems are subject to multiple stressors, they may not return to their “unperturbed” state at the same level of pressure as that where the original “state change” from “good (desired)” quality to “bad

(undesired)” occurred. In addition, however, ecosystems are constantly undergoing change – also in unperturbed systems. Thus, there can be no “ideal” ecosystem to use as a goal in defining the desired state. For convenience, the goal of nature conservation in many systems is often chosen to be a return to an ecosystem comprised of species known to be present historically, i.e. before anthropogenic pressure on the system caused perturbation or state change. As a result of climate change and the dramatic temperature increases being recorded in European ocean areas, however, it seems unlikely that –even if the complete removal of anthropogenic pressures to these systems could be effectuated – that the ecosystems of yesteryear would reestablish themselves. Thus, we have no clear “target” that can help us identify if efforts to establish good environmental quality are successful. Rather than focusing on the presence or absence of individual organisms in ecosystems as being indicative of environmental quality, focus both on land and in the sea is moving towards underpinning the development of resilient ecosystems, i.e. ecosystems capable of withstanding shocks and maintaining both structure and functioning after such shocks. In addition, resilient ecosystems do not require human intervention (i.e. stocking) to be maintained. This talk addresses how this approach might be applied in the management of marine ecosystems in Europe.

19.15-19:45 Eutrophication and oligotrophication in marine waters: Lessons learned from 4 decades of monitoring and assessment in Denmark

J. Carstensen

Aarhus University, Bioscience, Denmark

Nutrient inputs from land increased significantly up to the 1980s, when the deleterious effects of eutrophication were recognised and measures taken to reduce nutrient levels. It was anticipated that the nutrient reductions would lead to oligotrophication and return marine ecosystems to an earlier status. This fundamental tenet, assuming full reversibility of eutrophication, has been challenged recently. Although nutrient concentrations have declined significantly in response to reduced nutrient inputs from both point and diffuse sources, algal blooms are still frequent, benthic vegetation has not recovered and hypoxia is still widespread. This apparent lack of ecosystem predictability is likely caused by changes in other factors such as overfishing and climate change that shift the baselines, and by non-linear ecosystem responses potentially displaying hysteresis and regime shifts. As a consequence, phytoplankton biomass yield to nutrient levels have almost doubled over the last 2–3 decades, coastal waters are still turbid and do not allow for deeper colonisation of benthic vegetation, and nutrient leakage from the sediments remains high because of hypoxia. Hence, loss of important ecosystem services can maintain marine ecosystems in a bad state due to internal feed-back mechanisms, but marine ecosystems have also shown to recover fast once a healthy benthic community is established.

20:00-22:00 Get together reception

Room: Vandrehallen (in front of Kongressalen)

Tuesday 15 May 2012

Plenary Key note presentations

Chair: Bo Riemann

Room: Kongressalen

08:00-08:30 Promises and challenges of marine ecosystem-based management

*M.J. Fogarty**

*Northeast Fisheries Science Center, USA

There is now a global consensus on the need to adopt a more holistic and integrative approach to ocean resource management. Marine Ecosystem-Based Management (mEBM) is designed to provide an integrative framework for the sustainable delivery of ecosystem good and services from coastal and ocean ecosystems. Key characteristics of mEBM are

the importance of understanding and taking into account inter-relationships among the parts of the system; the recognition that humans are an integral part of the ecosystem; and the centrality of spatial considerations - in management - mEBM is fundamentally a place-based approach. Successful implementation of mEBM will depend on effective strategies for ecosystem assessment and the selection of appropriate management tools. These considerations link the development of Integrated Ecosystem Assessments (IEAs) as the analytical framework for evaluating status and trends of marine ecosystems, and Marine Spatial Planning (MSP) as an essential management tool, to the broader dimensions of mEBM. A key consideration in the success of the entire enterprise will rest on the development of approaches to management of complexity at the scientific and institutional levels.

08:30-09:00 MSFD and the "I" word - Integrated ecosystem fisheries surveys, Integrated Ecosystem Assessment and Integrated Fishery/Ecosystem Management

*D. Reid**

*Marine Institute, Ireland

The MSFD presents a number of major challenges to conventional fisheries management. Notably, the need for an integrated approach to the collection of data, its analysis, and use in fisheries management. Fisheries surveys have generally been developed for data collection on the abundance and biology of a few commercial species. In many cases these surveys collect a much wider suite of data, useful for the MSFD. Such programmes often exist as "bolt ons" to the existing surveys, but the potential is much greater. I will explore options for improved data collection and for "designed for purpose" fishery ecosystem surveys to serve the needs of the MSFD and CFP. The MSFD produces a wide range of indicators of pressures and states, but how do we handle these beyond individual pressure/state relationships. Particularly we need to manage fisheries as one key pressure, in an integrated approach with other pressures. This requires an understanding of interactions from multiple pressures, and where fisheries should be placed in a hierarchy of pressures. I will discuss some of the options for this, and the difficulties faced in integration. Finally, there is a need for management approaches that can incorporate ecosystem targets as well as more conventional fish stock based targets. The current TAC and effort management approach is probably inappropriate to also manage large numbers of ecosystem objectives. I will present a new approach to management that is spatially explicit, allows the inclusion of multiple objectives and remains simple at the level of the individual fisherman.

09:00-09:30 Coffee/tea

Plenary MSFD descriptors, criteria and indicators

Chair: Jacob Carstensen
Room: Kongressalen

09:30-09:40 Integration of assessments for the Marine Strategy Framework Directive: the role of the GES criteria and indicators in pressure-state relationships

D. Connor and A. Cheilari*

*European Commission, DG Environment, Marine Environment Unit

The Marine Strategy Framework Directive (2008/EC/56) provides only a broad framework for Member States to undertake assessments on the state of their marine waters and to assess their progress towards achieving or maintaining good environmental status in the marine environment by the year 2020. Annex III of the Directive provides an indicative set of elements (ecosystem characteristics and pressures and impacts) on which to base such assessments, whilst Annex I of the Directive provides a set of eleven GES descriptors which set out in more detail the goals to be achieved. The Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/477/EU) sets out the criteria and indicators to be used in relation to the GES descriptors. The inter-relationships between the Annexes I and III of the Directive, including the roles of the GES criteria and indicators, are further explored in the Commission Staff Working Paper on the Relationship between the initial assessment of marine waters and the

criteria for good environmental status (SEC(2011) 1255 final). The presentation will explore the interrelationships between assessment of environmental state and of the pressures from human activities which may affect the state, linked to the GES descriptors, criteria and indicators. Aspects of integration between descriptors will be examined, as well as possible gaps in the current framework.

09:40-10:00 'Underwater Noise': Novel and challenging aspect of Good Environmental Status

*M. Tasker**

*JNCC, United Kingdom

Descriptor 11 relates to the introduction of energy, including underwater noise, to the marine environment. The European Commission has decided that two types of underwater sound will be addressed initially by indicators of the descriptor – high amplitude (loud), low and mid frequency impulsive sounds and ambient sound within the frequency bands dominated by shipping. There is a limited amount of evidence of the effect of underwater sound on the marine environment, but it is also difficult to study these effects. In particular it is difficult to scale the finding of an effect of behavioural alteration at an individual scale to possible effects at the population or ecosystem scale. It is known that high amplitude (loud), low and mid frequency impulsive sounds can cause behavioural alterations that may be lethal, but the most frequently found effect of such sounds is displacement from habitat. The first of the indicators gives the opportunity to Member States to initially map the occurrence of the sounds and potentially to manage the spatial and temporal occurrence of the activities causing such sounds. The second of the indicators addresses the issue of masking of biologically-important low-frequency sounds by shipping. There is no empirical evidence that such masking is a problem but it is reasonable to surmise that this is the case. Describing current levels of such sounds is challenging. The management of any desired reductions in such sounds will be a long-term process. This work provides a good example of the results of legal requirements meeting the uncertainties of biological science and the complexities of physical science.

10:00-10:20 'Marine Litter' within the European Marine Strategy Framework Directive

F. Galgani, G. Hanke and S. Werner*

*IFREMER, LER/PAC, Bastia, 20600, France

Within the context of the European Marine Strategy Framework Directive (MSFD, 2008/56/EC, European Commission, 2010/477/EU), a Task Group for marine litter (TG 10) recommended that the overriding objective should be a measurable and significant decrease of the total amount of marine litter in comparison with initial baseline values by 2020 using the following indicators: (1) Amount, source and composition of litter washed ashore and/or deposited on coastlines; (2) amount and composition of litter in the water column and accumulation on the sea floor; (3) amount and composition of litter ingested by marine animals; and (4) amount, distribution and composition of microparticles (mainly microplastics). As a follow up to the Commission Decision, the Marine Directors requested the Directorate-General for the Environment (DG ENV) in 2010 to establish a Technical Subgroup under the Working Group on GES (WG GES) to support member states providing scientific and technical background for the implementation of MSFD requirements for D 10 starting with recommendations on monitoring and advise on required future research (<http://publications.jrc.ec.europa.eu/repository/handle/111111111/22826>). Reaching GES may thus be understood as a continuous reduction of inputs with the aim to reduce the total amount of marine litter and prevent further input by 2020. Some examples of monitoring of marine litter and possible targets are presented and discussed in the context of the MSFD. Then, a detailed work program for 2012 and 2013 will be presented to support the implementation of monitoring, focusing on (i) sources, (ii) the understanding of harm and (iii) monitoring strategies.

10:20-10:40 'Contaminants and pollution effects'

*M. Angelidis**

*UNEP/MAP – MED POL

According to Descriptor 8 of the EU MSFD, achievement of Good Environmental Status (GES) in a marine water body requires that "concentrations of contaminants are at levels not giving

rise to pollution effects". For the purpose of implementing Descriptor 8 under the MSFD, three core elements of data assessment were recommended by the MSFD Task Group 8: i) Concentrations of contaminants in water, sediment and biota are below assessment thresholds identified on the basis of toxicological data; ii) Levels of pollution effects are below assessment thresholds representing harm at organism, population, community and ecosystem levels; and iii) Concentrations of contaminants in water, sediment and biota, and the occurrence and severity of pollution effects, should not be increasing. It is proposed that the assessment of achievement of GES should be based upon monitoring programmes covering the concentrations of chemical contaminants and also biological measurements relating to the effects of pollutants on marine organisms in each of the assessment regions. The combination of conventional and newer, effect based, methodologies, with the assessment of environmental concentrations of contaminants provides a powerful and comprehensive approach. As the occurrence of adverse effects at various levels of organisation (organism, population, community, and ecosystem) needs to be avoided, monitoring schemes should also indicate the approaching of critical values as early warning. Monitoring data should be interpreted against the objective described by Descriptor 8 through a series of assessment thresholds, expressed as concentrations of chemical contaminants, or levels of biological response.

10:40-11:00 'Permanent alteration of hydrographical conditions': Definition, conceptual understanding and examples

*I.S. Hansen**

*DHI, Denmark

We are changing the physical marine conditions more and more. It started several hundred years back with small coastal alterations like harbours and coastal reclamations, then came offshore rock extraction from the sea floor, flood dikes, deep water harbours and navigation channels, and now we implement large structures like fixed links across straits, wind farms etc. Many of these pressures in relation to the hydrographical conditions are normally of limited impact extent, but when implemented in narrow straits or at sills with a larger sea area upstream, they may cause more widespread hydrographical effects and in this way affect the ecosystem and biodiversity. The presentation will examine the various types of marine alterations and their potential impact to the hydrographical conditions. Examples of specific projects with potential alterations will be given, discussing the actual pressure, the way it works on the local and regional scale, assessment tools and mitigation measure possibilities. The examples will include the extensive development in offshore wind farms and the fixed links in Belt Sea, forming the transition area of the Baltic Sea.

11:00-11:20 A proposal of indicators to evaluate Good Environmental Status for the 'Seafloor Integrity' descriptor

A. Borja and J. Rice*

*AZTI-Tecnalia, Spain

The Marine Strategy Framework Directive includes 11 Descriptors of "Good Environmental Status" (GES), with "Seafloor Integrity" being one of them. This descriptor is defined as: "Seafloor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected." Expert Task Groups (TG) for several of these Descriptors, would review information on each Descriptor, and provide expert guidance on: (i) A scientific consensus on the interpretation of the terms in the descriptor; (ii) What constitutes GES according to the descriptor, including what are "axes of degradation"; (iii) How to deal with issues of ecological scale; (iv) What are the ecological attributes of Seafloor Integrity; (v) What indicators or classes of indicators for assessing status on the attributes (including reference levels for the indicators and what pressures are linked to them); (vi) How would information on the indicators be rolled up to an overall evaluation of GES for Seafloor Integrity; and (vii) Research and monitoring needs. This contribution will summarize the main conclusions of this TG on all relevant issues. The focus will be shared among the chosen Attributes (Substrate, Bioengineers, Oxygen, Contaminants, Species Composition, Size Composition, Trophodynamics, Life history Traits) and their indicators, how to deal with scale, and how to aggregate results across indicators in assessing GES. The latter issues are important for using indicators, and because the conclusions of TG were influential on the conclusions regarding use of advice from all the descriptors' TGs.

11:20-11:40 Is there life after guidance? Developments on the Marine Strategy Framework Directive 'Eutrophication' descriptor

J.G. Ferreira, J.H. Andersen, A. Borja, S.B. Bricker, J. Camp, M. Cardoso da Silva, E. Garcés, A.-S. Heiskanen, C. Humborg, L. Ignatiades, C. Lancelot, A. Menesguen, P. Tett, N. Hoepffner and U. Claussen

* Centre for Ocean and Environment, DCEA-FCT, Portugal

In early 2011 the authors of this presentation completed a guidance document for MSFD Descriptor 5, Eutrophication. In mid-2011, the science supporting that document was published in the journal *Estuarine, Coastal, and Shelf Science*. In this talk we review the main findings of the guidance document, focussing on the potential assessment methods, spatial and temporal issues, monitoring guidelines and challenges, and the ways in which the recommendations of the guidance task group were translated into the subsequent Commission Decision. We then review actions that have been pursued since the guidance was published. These include: Type 1 actions - scientific and/or application developments relevant to the Eutrophication Descriptor and its assessment; and Type 2 actions - ways in which EU Member States are interpreting and applying the guidance produced. Examples provided for Type 1 include (i) reprocessing the Oxygen Risk Index for Europe, including the most recent satellite data, by the EU's Joint Research Centre; (ii) analysis of a Northern European data set from the HARMONY project on the consequences of the Commission Decision to leave out the 'Benthic Invertebrates' indicator from the secondary (indirect) effects of eutrophication; and (iii) recent results from the OSPAR modelling group about the assessment of transboundary responsibilities in eutrophication of the OSPAR area. For actions of Type 2, we provide an overview of the practical implementation of MSFD Descriptor 5 in EU Member States, with respect to approach and progress, and focus in greater detail on recent proposals for application in the UK, in the context of the guidance provided.

11:40-12:00 Developing the 'Food Web' descriptor: Moving from principles to practice

S. Rogers and S. Malcolm*

* Centre for Environment, Fisheries and Aquaculture Science, UK

Food webs are networks of feeding interactions between consumers and their food. This descriptor of Good Environmental Status addresses the functional aspects of marine food webs, such as rates of energy transfer within the system and levels of productivity in key components. The interactions between species in a food web are complex and constantly changing, and this makes it difficult to identify one condition that represents 'good' status. Changes in species relative abundance in an ecosystem will affect interactions in several parts of a food web, and may have an adverse effect on food web status. There is, however, a significant lack of understanding to assess the ecosystem consequences of such change, or the value that society should attribute to it. GES of food webs will therefore be achieved when the indicators describing the various attributes of the descriptor reach the thresholds set for them. Indicators should ensure that populations of selected food web components occur at levels that are within acceptable ranges that will secure their long-term viability. This talk reviews the principles of food web dynamics and trophic links, and discusses options for making practical progress.

12:00-12:20 Assessment of GES of 'Commercial (shell)fish' in EU waters

*G.J. Piet**

*IMARES, The Netherlands

This presentation shows the outcome of the process undertaken by ICES to provide guidance to support EU Member States (MS) in the implementation of the Marine Strategy Framework Directive (MSFD) Descriptor 3 (commercially exploited fish and shellfish). The approach consists of 5 major steps in the GES assessment process, for which we identify key issues that should be considered: (1) Selection of commercially exploited (shell)fish populations (i.e. which populations are considered relevant for Descriptor 3 in an MSFD sub-region or MS-specific sub-division of the sub-region); (2) Stocks for which primary indicators and reference levels are available (mainly those stocks covered by assessments); (3) Species for which only secondary indicators and no reference levels are available (mainly populations covered by scientific monitoring programs); (4) Interpretation of what GES is; and (5) Assessment of current status in relation to GES. The approach was applied in five case studies covering most of the MSFD (sub)regions, i.e. (1) the Baltic Sea, (2) Mediterranean Sea, (3) North-east

Atlantic Ocean – Bay of Biscay and Iberian Coast, (4) North-east Atlantic Ocean – North Sea and (5) North-east Atlantic Ocean – Celtic Seas. Examples from these case studies will be used to illustrate the outcome of this step-wise approach.

12:20-12:40 ‘Non-indigenous Species’ in marine environment: Setting the baseline and defining Good Environmental Status

*S. Olenin**

*Coastal Research and Planning Institute, Klaipeda University, Lithuania

Descriptor 2 (D2) “Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems” specifically addresses the problem of biological invasion in marine environment. This is a novel aspect of MSFD, because traditionally the environmental status of marine waters has been evaluated without taking into account the adverse effects of invasive alien species (IAS), i.e. biological pollution. The latter is defined as IAS impacts at a level that disturbs environmental quality by effects on: an individual (contamination by parasites or pathogens), a population (by genetic change), a community (by structural shift), a habitat (by modification of living conditions) or an ecosystem (by alteration of energy flow and organic material cycling). Biopollution may pose a serious threat to the environment and human uses of the sea, interacting also with other stressors, such as eutrophication, chemical pollution, habitat destruction or overexploitation. The key term of D2 (“...levels that do not adversely alter the ecosystems”) is defined as “the absence or minimal level of “biological pollution”. A set of indicators proposed for D2 includes: 1) Number of non-indigenous species (NIS) recorded in an area, 2) Ratio between NIS and native species, 3) Abundance and distribution range of NIS, 4) Impacts of IAS on communities, habitats and ecosystem functioning. There are challenging questions, however, which need to be solved: how to define reference conditions in relation to bioinvasion; what is the acceptable level of biopollution; should an ecosystem be assessed as degraded if it contains elevated number of NIS?

12:40-13:00 ‘Biodiversity’: What is it, what did we do with it, and where is it going now?

*S.K.J. Cochrane**

*Akvaplan NIVA, Norway

Good Environmental Status (GES) for Descriptor 1 requires that “Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions”. Biodiversity components range from prokaryotes (bacteria) and unicellular eukaryotes (phytoplankton) to multi-cellular eukaryotes (invertebrates and fish to marine mammals), and the processes which influence biological systems operate at several levels of organization (genetic, species, community/habitat to ecosystems. Baseline environmental conditions and the range of organisms present vary greatly across the regional seas. Meeting the needs of the Marine Strategy Framework Directive therefore presents an urgent challenge to devise an integrated system to assess this level of biological complexity, at a European scale. The experiences gained during the work of the Task Group for biodiversity will be outlined, together with the criteria and indicators adopted by the Commission Decision (2010). Since then, various influential steps have been taken by the European biodiversity research community; all taking a pragmatic ‘research to tools’ approach will be presented. Developing strategies for integrated assessment of both member state monitoring and reporting, as well as GES itself will be presented.

13:00-14:30 Poster session

Room: Vandrehallen (in front of Kongressalen).

Sandwiches and soft drinks are served.

Abstracts can be found on pages 36 - 39.

Session 1A MSFD criteria and individual indicators seen in relation to setting the baseline and achieving Good Environmental Status

Chair: Frank Thomsen

Room: 101, 1st floor

14:30-14:50 Chl-a trends in European Seas estimated using ocean- colour products

G.Coppini, V.I. Lyubarstev, N. Pinardi, S. Colella and R. Santoleri

*Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Bologna, Italy

Ocean-colour remote-sensing products have been used to estimate Chl-a trends in European seas aiming to develop a new indicator based on ocean-colour data. The new indicator, called CSI023(+), produced from satellite ocean-colour products from the MyOcean Marine Core Service, has been defined and calculated. CSI023(+) is intended to complement the European Environment Agency (EEA) CSI023 indicator for eutrophication, which is based on chlorophyll-a (Chl-a) in-situ observations. Validation of ocean-colour products has been carried out through comparison with observations of the Eionet EEA database, and we believe that such validation should continue in the future, perhaps with a dedicated data-collection exercise. Ocean colour has a much higher spatial and temporal resolution than the in-situ observations. The ocean-colour observations, however, are based on indirect measurements of the optical properties of the ocean, which are transformed to Chl-a using an appropriate algorithm. In our analysis we have used both global and regional (adjusted to specific Mediterranean conditions) ocean-colour products, but the results highlight the fact that regional products produced with regional algorithms are recommended. We propose a methodology for analysing trends comparable to the method EEA uses for its CSI23 indicator. Analysis has revealed the potential of CSI023(+) indicator: large-scale, and in some cases even local-scale, changes appear to be captured by the satellite images even though in general the ocean-colour products underestimate the Chl-a values. Specific analysis has been performed in the Mediterranean and the Black Sea: we defined Chl-a areas and then calculated the CSI023(+) for each of the Chl-a areas.

14:50-15:10 Vertical, horizontal and temporal distribution patterns in primary production

M.M. Lyngsgaard, S. Markager and K. Richardson*

*Center for Macroecology, Evolution and Climate, University of Copenhagen, Denmark

Primary production informs about the organic input and oxygen production in a water body. Both parameters are important in determining the quality of marine waters or the potential for a rich fisheries industry. The concentration of chlorophyll a in the water is often used as an estimate for primary production, however, this measurement can only tell us the 'end product' from a long and complicated process, where a large part of the plant material is recycled. It is, therefore, more accurate and informative to measure the primary production rate in the process of estimating the amount of organic material and oxygen produced. In this study we analysed 1182 coastal water primary production measurements from the time period from 1998 to 2009. We expected primary production to be greatest during the spring bloom period. However, we found a general seasonal variation with the highest production during summer months. Production at this time was highly supported by a deeper primary production from below the pycnocline. This sub-pycnocline primary production accounts for app. 7-29 % of the annual primary production depending on the hydrodynamics in the area. For the specific study area (Baltic Sea transition zone), it accounts for almost half of the oxygen consumption in the waters below the pycnocline. This study shows that when including the sub-pycnocline primary production, not only the annual estimate increases, but also the seasonal variation changes. We therefore strongly suggest that no survey programs are based only on surface primary production measurements.

15:10-15:30 Primary production provided by a 3D ecosystem model covering the North Sea – Baltic Sea as support to the MSFD

M. Maar, S. Markager, E.F. Møller, M.M. Lyngsgaard and P. Henriksen*

*Aarhus University, Bioscience, Denmark

The use of models is essential for the MSFD as a tool that can support monitoring activities, the setup of indicators and make scenarios for reaching the ecological goals in MSFD. However, models are never better than the data for their calibration. In this respect, it is

essential to calibrate and validate the models to rate measurements and not just standing stocks. In Danish waters the primary production is the only rate measured regularly. We have therefore optimized the biogeochemical ERGOM model for primary production using the thousands of primary production measurements available for the Kattegat/Belt Sea area and experimental data. ERGOM was also modified to be valid for both the North Sea – Baltic Sea by adding silicate, modifying zooplankton grazing impact and adjusting light parameterizations and is one of the few models that are validated for both areas. ERGOM is coupled to the 3d circulation model HBM (Hiromb-BOOS model) with a fine two-way nested grid in the Kattegat to Arkona Basin.

15:30-15:50 Monitoring and Modelling Spring Bloom Timing of Phytoplankton in the Baltic Sea

Z. Wan and J. She*

*Danish Meteorological Institute, Denmark

Spring bloom timing is defined as the date when Chlorophyll a concentration reaches its seasonal maximum during spring from March 1 to May 1 for the Baltic basins except the Bothnian Bay where the likely spring bloom is extend from March 1 to June 1. The spring bloom timings are created and compared among the modelled, the satellite derived and the in-situ observed Chlorophyll a. The algorithm to ensemble the bloom timings created from three data sources are discussed. The propagation of spring bloom timing across basins and their interannual variability are investigated.

15:50-16:10 Chlorophyll_a satellite observations in the North Sea and Baltic Sea

Howe, E., Høyer, J.L. and Dobrynin, M.

*Danish Meteorological Institute, Denmark

Within the MarCoast project under GMES satellite products are produced on a daily basis covering the North Sea, inner Danish waters and the Baltic Sea. The resolution is 300 or 1200 meters. Within the Aquamar project, a method has been developed to produce daily interpolated Chlorophyll_a fields for the North Sea and Baltic Sea. Both products are based upon observations from the MERIS sensor and processed with the Case 2R processor. In addition, in situ observations have been obtained from the Danish national monitoring program to validate the products. This region is a very challenging region for satellite ocean colour and for statistical interpolation methods, due to e.g. presence of sharp fronts and occasional high temporal variability. Therefore a large effort have been made to validate the products and develop the OI algorithm for the interpolated Chlorophyll_a field. The satellite products can be a tool for monitoring the open waters for the MSFD. The presentation will focus on the satellite products developed and their possibilities in the MSFD.

Session 2A GMES, EMODNET and other monitoring and modelling activities in support of the MSFD

Chair: Joachim Raben

Room: 102, 1st floor

14:30-14:50 European Marine Observation and DataNetwork (EMODNET) – physical parameters: a support to marine science and operational oceanography

G.M.R. Manzella, A. Novellino, D. Schaap, S. Pouliquen and P. Gorringe*

*ENEA, Italy

In December 2007 the European Parliament and Council adopted a common text for the Marine Strategy Framework Directive which aims to achieve environmentally healthy marine waters by 2020. This Directive includes an initiative for an overarching European Marine Observation and Data Network. During the one-year consultation phase that followed the release of the EU Green Paper on a Future Maritime Policy for the European Union, stakeholders gave an overwhelming positive response. Facilitating access to high quality marine data will resolve difficulties and stimulate an expansion of value-added public and commercial services, lay the foundations for sound governance and reduce uncertainties on human impact on the planet as well as of forecasts relating to the future state of the marine environment. Better and linked marine data will have an immediate impact on the planning

of environmental policy and mitigation measures, and will facilitate impact assessments and scientific work. The objectives of the EMODnet Physics preparatory action is to provide access to archived and near real-time data on physical conditions in Europe's seas and oceans and to determine how well the data meet the needs of users from industry, public authorities and scientists. This implicates that it is also an objective to identify data gaps and arguments why these gaps should be filled in future monitoring. Measurements from fixed stations: wave height, period; temperature, salinity and horizontal velocity of the water column; wind speed and direction; light attenuation; sea level. Measurements from ferryboxes: temperature and salinity of the water column.

14:50-15:10 The EMODNet chemistry lot. An overview on the experience of the three years pilot project

Vinci M., Giorgetti Al., Schaap D., and Charlesworth M.*

*OGS - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Italy

EMODnet Chemistry is focused on the groups of chemicals required for the Marine Strategy Directive monitoring and covers the Greater North Sea, the Black Sea and five spots in the Mediterranean. It is based on SeaDataNet network of NODC's to provide a unified and transparent overview of metadata and a controlled access to a large data collection of multidisciplinary data sets. The activities of the 3 years pilot project were developed to guarantee: (1) common work-flow for metadata compilation, quality check and products generation; (2) common agreement on the management of heterogeneous data for the generation of suitable products: horizontal interpolated maps or time series plots; (3) first version of products validation guidelines. The data availability including the parameters, the matrix measured and the relative products generated was inevitably different in the 3 areas of interest. Several efforts were undertaken to ensure a core of minimum requirements to get consistent and comparable results. The complexity and heterogeneity of the data was a great challenge to manage but the results obtained and the lessons learned are important steps to optimize the workflow and for possible adoption of the Chemistry Lot as an European chemical data harvesting service. In fact, following the proposal for coupling EMODNet infrastructure to WISE-Marine for the MSFD reporting, the inclusion of new requested parameters (as nutrients with O₂, PCO₂ and CHL-a), the generation of new specific products and the experience gained are the key elements for the future development of the Chemistry Lot.

15:10-15:30 Selection and evaluation of GMES MyOcean and MyOcean-2 products for monitoring of marine ecosystem health

R. Forster, T. Silva, J. Foden and D. Mills*

*CEFAS, United Kingdom

An important part of the GMES development process has been the involvement of intermediate-level end users to provide feedback of products and services. In the marine core service, MyOcean, several national agencies are evaluating the suite of products available for monitoring and understanding of water quality. This talk will present findings from an initial screening of user needs and requirements in this sector, followed by discussion of the various products of ecosystem modelling, in situ observations and remote sensing which were available at the close of the first MyOcean project. The presentation will conclude with an overview of the future marine monitoring needs under MSFD in comparison with planned MyOcean-2 products.

15:30-15:50 The GMES Marine Service and the MSFD implementation perspectives

P. Bahurel, M. Bell, J. Johannessen, P.-Y. Le Traon, K. Nittis, N. Pinardi, J. She and A. Podaire*

*Danish Meteorological Institute, Denmark

The European Union GMES Programme defined in 2005 its "Marine Service" (which was considered as one of three "fast tack" services), for delivering short-term forecasts and analyses/re-analyses for the assessment of the physical and biogeochemical state of the oceans and European regional seas, to support the safety of transport and the sustainable exploitation of ocean resources. MyOcean (2009-2012) and MyOcean2 (2012-2014), which involve 60 partners in 29 countries, are a series of EU projects aimed at delivering information and service over the global and European Seas. They represent the main

contribution to the practical implementation of the GMES Marine Service. The MyOcean products (see <http://www.myocean.eu/>) cover all the relevant essential climate variables, both from observational data and numerical ocean models at eddy permitting or resolving scales; MyOcean distributes openly and freely through a single access point about 200 products of different resolution and quality. MyOcean includes functionalities of the GMES Marine Service such as the catalogue, discovery and downloading of the products, the quality control protocols, a user helpdesk, the interfaces between observations and models, and a strategy for the research and development in the future years. Examples of usage of MyOcean information for the implementation of MSFD indicators in the European Seas will be given.

15:50-16:10 Application of the CFP Data Collection Framework ecosystem indicators for GES assessments

*W. Le Quesne**

*CEFAS, United Kingdom

The Data Collection Framework (DCF) specifies fisheries data to be collected by member states and also specifies 9 indicators of the 'ecosystem' effects of fisheries. These include indicators that monitor the impact of fishing on fish biodiversity, fish community structure and sea-floor communities. As fishing is one of the main human activities impacting on the marine environment and as the indicators are calculated with available data they can be readily applied in assessments of GES. This presentation provides an introduction to the DCF ecosystem indicators and shows where specific indicators can be linked to criteria under D1, D4 and D6 for assessments of GES. Recent works have applied the DCF indicators across a range of European waters and demonstrated their utility. However, these works also highlighted limitations and weaknesses with the formal methods specified for calculating the indicators. The availability of targets and reference levels, and potential modifications to calculation methods will be discussed.

Session 3 The MSFD in relation to spatial planning, including protected areas

Chair: Søren Anker Pedersen

Room: Kongressalen

14:30-14:50 Evaluating marine spatial planning in the context of the MSFD

*G. Carneiro**

*Tygelsjö 231, 24791 S Sandby, Sweden

During the last decade there has been a growing interest for marine spatial planning (MSP), and the number of initiatives worldwide has expanded rapidly. In Europe, the Commission and individual states have endorsed MSP as one of the tools for implementing the Marine Strategy Framework Directive (MSFD). For the implementation of MSP, evaluation is generally recognised as an essential step for learning and improvement, and underpins adaptive management strategies. Practical guidance and experience relative to evaluation in MSP are very limited, though. This presentation presents a methodology for evaluating MSP, paying particular attention to the role that MSP is expected to play in the implementation of the MSFD. Drawing explicitly on models for evaluating planning on land, a modular MSP evaluation framework is proposed that encompasses all stages of an MSP intervention. It is structured around four key evaluation moments aligned with the end points of specific policy processes. Namely plan making, plan contents, plan implementation, and plan outcomes and impacts. The importance and usefulness of evaluation for improving MSP in the context of the MSFD is discussed, as are some practical considerations regarding application of the proposed framework.

14:50-15:10 Modelling for Maritime Spatial Planning: Concepts, tools and practical examples from the BaltSeaPlan project

C. Mohn, J. Kotta, K. Dahl, C. Göke, N. Blažauskas, A. Ruskule, R. Aps, M. Fetissov, F. Janssen, C. Lindblad, M. Piotrowski and Z. Wan*

*Aarhus University, Bioscience, Denmark

This study summarizes the most important aspects of integrating modelling into Maritime Spatial Planning (MSP) and Strategic Environmental Assessments (SEA). The results are part of an evaluation carried out in the framework of the EU BaltSeaPlan (BSP) project. The findings are based on a multi-disciplinary assessment carried out by a working group composed of spatial planners, managers and environmental scientists under participation of the BSP community through a number of workshops and group discussions. The overall goal of the study was to identify the most important planning questions and the modelling requirements to adequately address these questions. In addition, the study provides illustrative case studies, e.g. an ecosystem evaluation framework, habitat modelling, and offshore wind site selection modelling.

15:10-15:30 Quantifying changes in human impact on fish populations in relation to protected areas: example of cod in the Kattegat

M. Eero and M. Vinther

*DTU Aqua, Denmark

Achieving good status of marine ecosystems includes in many cases rebuilding of depleted fish populations. Establishment of protected areas can reduce human pressures on populations or habitats and support their recovery. Relating spatial management measures to the response of an ecosystem component is usually difficult due to other processes acting in parallel on an ecosystem. However, in this paper we demonstrate that a change in human impact on the ecosystem component can be quantified, when highly resolved spatio-temporal data are available. Our example is based on cod in the Kattegat, where closed areas were established in 2009 to protect local cod population. Data from Vessel Monitoring System (VMS) combined with gear selectivity studies and distribution of cod from research surveys were used to quantify a change in fishing impact on cod in recent five years, which include the period when the protected areas were in place. The results show that fishing impact on cod in the Kattegat has decreased in the period from 2007–2011. This is partly because of the intended re-location of fishing effort to areas with lower cod density. Further, the implementation of closed areas created incentives for using selective gears that allow access to part of the areas otherwise closed for fisheries, which significantly contributed to the reduction in fishing impact on cod. This demonstrates that multiple effects have to be considered when assessing the effects of spatial measures on achieving GES and availability of high resolution data, both in time and space, is essential.

15:30-15:50 Precautionary sandeel fishery in Natura 2000 areas on the Dogger Bank (North Sea): a way to comply with MSFD implementation?

J.W. Behrens, P. Tørring, O. Eigaard, G.E. Dinesen, E.M. Pedersen, T.K. Sørensen and H. Mosegaard*

*DTU Aqua, Denmark

EU member states are working measures to protect the marine environment e.g. by appointing areas for the Natura 2000 network. One of these trans-National areas is the North Sea Dogger Bank, the most important fishing ground for sandeel. A Natura 2000 designation could lead to a closure of bottom trawling in major zones of the area with large consequences for the fishery. There are however no scientific data on the impact of the fishery on the seabed at the Dogger Bank. Thus, assuring the best possible data for the decision making process and to investigate whether fishing methods with low impact on the seabed integrity is highly warranted. Supported by The Green Development and Demonstration Programme of the Danish Government (GUDP) a comprehensive project will be carried out (2012–2014) with the main purpose of conducting experimental fishery that reduces the impact of the fishing gear on the seabed, by applying a new type of trawl and floating doors that do not touch the seabed and reduce impact of sweeps considerably. Using side scan sonar and video technology and benthic sampling, we will determine impact of sandeel fisheries on the seabed structure and the inhabiting organisms. Furthermore, to reduce fuel consumption, development of lighter material for production of

the new gear will be in focus, as will evaluation of catchability of the new gear in comparison to the traditional. Here, we present the preliminary data from the first trial voyage evaluating the new pelagic trawl doors, lightweight warps and fuel use.

15:50-16:10 Is the Marine Strategy Directive (MSD) suitable for protecting the benthic communities in the Sound?

M. Olesen, C.D. Pommer and P. Göransson*

*Marine Biological Section, University of Copenhagen, Denmark

The Sound has been spared from bottom trawling since 1932, and should therefore potentially serve as reference for mechanically undisturbed sea area. However, a decline of two major soft bottom types Haploids and Modiolus communities in the northern Sound has been observed. The physical or hydrographic conditions do not seem to have changed. Neither seems the feeding conditions to have altered in recent decades. The remaining causes for the decline may be found in the recruitment conditions and top-down effects. Conditions that is difficult to protect within the frame of the new Marine Strategy Directive.

16:10-16:40 Coffee/tea

Session 1B MSFD criteria and individual indicators seen in relation to setting the baseline and achieving Good Environmental Status (continued)

Chair: Anne Lise Middelboe

Room: 101, 1st floor

16:40-17:00 Developing MSFD indicators – search for the holy grail?

T. Prins, A. Boon, C. Schipper, D. Slijkerman, O. Bos, M. van den Heuvel-Greve and R. Laane

*Deltares, The Netherlands

In the preparation for the implementation of the MSFD in the Netherlands, a desk study was carried out to identify and develop indicators and targets for the 11 MSFD descriptors, based on the criteria set by the Commission decision of 1 September 2010. The Netherlands have an extensive monitoring programme in the North Sea. Data from this monitoring programme are applied in existing indicator-sets for various assessments, like the OSPAR Ecological Quality Objectives or the Water Framework Directive. These existing indicators partly cover the criteria and are related to indicators mentioned in the Commission decision. Besides overlap many gaps were identified as well. In a number of expert workshops an inventory of new indicators was made to fill in the major gaps. Application of criteria for the quality of indicators showed that in many cases knowledge on the performance of indicators in response to human pressures limited the applicability of indicators within the DPSIR approach, and hampered the establishment of quantitative targets. Therefore, a pragmatic approach, focusing on indicators that can easily be developed from available data was necessary in the present phase of implementation. Examples of potential indicators and the limitations and potentials will be presented. The main knowledge gaps will be discussed. Dedicated monitoring and evaluation, preferably coordinated at a (sub)regional scale is suggested as the way forward to improve indicator quality.

17:00-17:20 Assessing ecosystem status and services: conceptual frameworks and numerical models

Solidoro C., Melaku Canu D., Cossarini G., and Libralato S.*

*OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

We discuss potentiality and criticalities of the use of mathematical models in assessing ecosystem state and services. A conceptual framework which extends the DPSIR approach and which might facilitate the identification of causal relationships between multiple stressors and ecosystem response is presented first. Then we discuss the possible uses of different mathematical models in support of monitoring activities and for the development of an integrated and systemic approach to monitoring, with particular reference to the assessment of selected MSD indicators. Data requirements for proper models implementation are discussed too, together with limitations intrinsic in this kind of tools and

recommendation to avoid possible misuses of model derived indications. Presented applications refer mainly to Mediterranean sea study areas and recent or ongoing projects.

17:20-17:40 Diversity of European seagrass indicators. Patterns within and across regions

D. Krause-Jensen, N. Marbà, T. Alcoverro, S. Birk, C.M. Duarte, A. Pedersen, J.M. Neto, S. Orfanidis, J.M. Garmendia, I. Muxika, A. Borja and K. Dencheva*

*Aarhus University, Department of Bioscience, Denmark

Seagrasses are key components of coastal marine ecosystems and many monitoring programs worldwide assess seagrass health and apply seagrasses as indicators of environmental status. This study aims at identifying the diversity and characteristics of seagrass indicators in use within and across European ecoregions in order to provide an overview of seagrass monitoring effort in Europe. Through a compilation we identified 49 seagrass indicators representing 42 monitoring programs and including a total of 51 seagrass metrics used either alone or in various combinations of up to 14 metrics per indicator. The seagrass metrics represented 6 broad categories covering different seagrass organizational levels and spatial scales. The large diversity is particularly striking considering that the pan-European Water Framework Directive sets common demands for the presence and abundance of seagrasses and related disturbance-sensitive species across Europe, and the diversity of indicators reduces the possibility to provide pan-European overviews of the status of seagrass ecosystems. The diversity can be partially justified by differences in species and associated time scales of responses as well as by differences in habitat conditions and associated community types but also seems to be determined by tradition. We encourage an evaluation of seagrass indicators on the basis of their responses to pressures in space and time and their associated uncertainty in order to identify the most suitable indicators for specific European regions.

17:40-18:00 Downstream services in support for MSFD: Combining observation technologies for optimal ecosystem mapping

Erichsen, A.C., Kaas, H., Andersen, J., Uhrenholdt, T. & Closter, R.M.*

*DHI, Denmark

Achieving good environmental status (GES) of EU's marine waters requires detailed knowledge about the current status. Hence, some of the key goals are mapping the current environmental state as well as establishing monitoring programmes to measure progress towards GES. Open water monitoring is traditionally done sampling at a limited number of sites at a frequency of weeks to months, providing time series of different parameters at one or few location in each water body. These data are used for evaluation the overall state of the sea. However, the accuracy of this type of monitoring is debatable, especially with the arrival of new technologies extending the possibilities of exhaustive monitoring programmes, e.g. earth observation, ferry box, continuous buoy measurements and modelling;

Technologies with different advantages and disadvantages, both with respect to quality, frequency, coverage and economics: And, technologies that add valuable knowledge as they increase the temporal and spatial coverage significantly. Question is, however, how they can be applied to help assessing the state of the sea? Through two FP7 projects, Aquamar & CoBiOS, DHI are developing the infrastructure to make use of the different technologies and integrate them into a combined on-line monitoring and information system providing a holistic assessment of the state of the marine environment. Hence, it addresses the past, the present as well as the future through different 'products' presenting 'raw' and aggregated data, and then supports and facilitates the implementation of MSFD. This presentation will discuss advantages and disadvantages related to the different technologies and present the status of integrating these into dynamic models.

18:00-18:20 Underwater noise: Good environmental status for small odontocetes in shallow water poorly captured by low frequency ship noise indicators

*J. Tougaard**

*Aarhus University, Bioscience, Denmark

Over the last decades there has been increasing concern over the effects of the likewise increasing levels of man-made noise in the oceans. While it is trivial to note that increasing noise levels in the ocean can never do anything good to the environment, it is nevertheless very difficult to find consensus on universal exposure limits and define what good

environmental status is with respect to noise. Universal criteria for underwater noise are difficult to establish, due to different sound propagation in different habitats and large differences in susceptibility to noise among different animal groups. A good indicator must thus fulfil at least one of two criteria: either it must be a direct measure of impact itself, or it should at least serve as a proxy for impact, i.e. correlate well with other parts of the noise, which affects the marine environment negatively. Recent measurements of ship noise in the shallow Danish straits show that impact on harbour porpoises are poorly captured by the 63 and 125 Hz ship noise indicators of the MSFD, as porpoises are unlikely to be affected by the noise in this part of the spectrum and energy in those bands turn out to be poor predictors of ship traffic, as the noise at these frequencies propagate very poorly beyond the shipping lane itself. More robust correlations are found at slightly higher frequencies. This calls for additional criteria to be included in assessment of good environmental status, at least for small odontocetes in shallow waters.

Session 2B GMES, EMODNET and other monitoring and modelling activities in support of the MSFD (continued)

Chair: Philip Axe

Room: 102, 1st floor

16:40-17:00 Options for monitoring ambient noise for the Marine Strategy Framework Directive

*Thomsen, F.**

*DHI, Denmark

In many areas, levels of ambient noise have been increasing over the last decades mainly due to increased shipping. Elevated levels of ambient noise could mask biologically relevant signals such as communication calls of marine mammals and fish and could also affect the 'acoustic scene' that fish and marine mammals potentially use for orientation. It has further been suggested that rising levels of ambient noise could induce stress which in turn could affect the health of exposed organisms. Although the problem of increasing ambient noise has been identified as a key issue for the marine environment, little tools for managing the problem from a policy perspective have been available. Continuous low frequency sound has been identified by the EU Marine Strategy Framework Directive (MSFD) as one indicator for measuring good environmental status and member states are asked to provide information on trends in ambient noise levels measured by observation stations. However, baseline information in most regions is not readily available and the methodology for measuring ambient noise is also still in its infancy. It is therefore a challenge to implement the requirements of the indicator. Here, an overview of the technical challenges to implement the ambient noise indicator of the MSFD is given. Appropriate devices will be reviewed and existing studies suitable for providing baseline ambient noise measurements are discussed. Some suggestions for the analysis of the data will also be provided. Finally, further research necessary to implement the ambient noise indicator will be identified.

17:00-17:20 A conceptual model for regime shift in coastal ecosystems during oligotrophication and implications for our work with MSFD

S. Markager, D. Krause-Jensen and J. Carstensen*

*Aarhus University, Bioscience, Denmark

Eutrophication is one of the main descriptors in the MSFD. Over the last decades nutrient loadings to most European marine systems have decreased significantly and we have seen some improvements, primarily reduced nutrient concentrations. Significant improvements in the biological structure and function still remain to be seen. We present a conceptual model for the response of coastal marine ecosystems to reduced nutrient loadings and discuss the implications for implementation of MSFD. We will demonstrate that a number of processes delay or prevent the return of marine ecosystem to good ecological status once they are heavily degraded by eutrophication and important ecosystem services are lost. The implication is that improvements cannot be expected before nutrient loadings have been reduced to levels there might be considerably lower than the loadings where damages to marine ecosystems occurred. Another consequence is that a time delay of maybe 20 to 30

years might be expected from loadings are reduced and until the biological structure is re-established.

17:20-17:40 Modelling as a tool for better understanding and assessing Good Environment Status – a Baltic Sea study

J. She, Z. Wan, L. Jonasson, P. Berg and E. Howe

*Danish Meteorological Institute, Denmark

During last decade physical-biogeochemical models for European regional seas have been significantly advanced, especially for operational oceanography and GMES marine service. However, the potential of using operational models in implementing Marine Strategy Framework Directive (MSFD) has not been widely exploited. Baltic Sea is one of the most comprehensively monitored coastal areas in the world. The current observation-based assessment of the environmental status, however, is still subject to a few major limitations, e.g., uncertainties caused by spatial-temporal gaps of observations, too-long time period of updating assessment, and difficulties in understanding the causes of the changing environmental status etc. This presentation aims to explore what the State-of-the-Art models can offer in understanding and assessing the Good Environment Status by combining physical-biogeochemical laws, accurate external forcing data and marine observations. Examples are given for the Baltic Sea, in using very high resolution models to simulate Major Baltic Sea Inflow, physical ocean reanalysis in decadal scale, rapid and regular environment assessment, the quality of modelling the bottom oxygen depletion, seasonal and interannual variation of nutrient cycle and primary production, using models to explain the relative importance of climate change and human impacts in decadal variability of bottom oxygen. On-going development of next generation models and their future potentials are also introduced.

17:40-18:00 Budgets for total and bioavailable nitrogen in the North Sea-Baltic Sea transition zone

L. Jørgensen, S. Markager and M. Maar*

*Aarhus University, Bioscience, Denmark

Budget calculations show that bioavailability of dissolved organic nitrogen (DON) is a key factor in management of eutrophication in open marine areas as it governs the importance of local loadings versus nitrogen received from adjacent seas and hence if eutrophication is a local or regional problem. Nitrogen is the limiting nutrient in the Belt Sea and the Kattegat. At the same time the area is heavily affected by eutrophication. Hence, a number of abatement measures have been implanted in Denmark, Sweden and Germany in order to reduce the anthropogenic nitrogen loadings. In this context it is essential to know how much of the nitrogen comes from local sources and how much is imported for the adjacent seas. We have therefore made nitrogen budgets for both total nitrogen and bioavailable nitrogen covering the area. Bioavailable nitrogen consists of inorganic N, particulate organic N and the bioavailable fraction of DON. Since DON constitutes by far the largest pool of nitrogen, assessment of the bioavailability of DON becomes the most important parameter in the budget. Hence bioavailability of DON also becomes a key issue for management of coastal areas, as it determines to what extent eutrophication can be managed by local measures or is a more regional problem. The budgets show that direct local loadings with freshwater and atmospheric deposition accounts for 26% of the total TN input but 43% of the bioavailable input for the period 2000–2009. In the 1980s the direct local loadings of bioavailable nitrogen is estimated to be 53%.

18:00-18:20 The Danish marine monitoring program 2011–2015

J.W. Hansen and H. Fossing*

*Aarhus University, Bioscience, Denmark

The Danish monitoring program 2011–2015 documents the status and development of the marine environment comprising a description of the relationship between nutrient supply (nitrogen and phosphorous) and secondary biological effects and further elucidates the link between release, concentration, and effect of hazardous substances. Additionally, oxygen depletion in Danish marine waters has special focus owing to both public and political awareness and as a proxy for nutrient enrichment. Through monitoring activities a comprehensive database has been established over decades and gained knowledge has

formed the scientifically basis for management and environmental policy of Danish marine areas. The Danish monitoring program is organized to meet both national and international obligations and is to a greater extent than previously aligned with demands of the international environmental legislation focusing on the Water Framework Directive, the Habitats Directive, the Shellfish Water Directive, the Marine Strategy Framework Directive and various international conventions (in particular OSPAR and HELCOM). This presentation outlines purpose, scope and elements of the Danish marine monitoring program i.e. selected parameters, sampling frequencies and number and location of stations. Further, necessary adjustments to fulfil the monitoring requirements of the Marine Strategy Framework Directive are discussed.

Session 4 Achieving evidence-based management of marine areas

Chair: Yvonne Walther

Room: Kongressalen

16:40-17:00 Challenges for managing our seas in a climate of macroecological change

*A. McQuatters-Gollop**

*SAHFOS, United Kingdom

Unprecedented basin-scale ecological changes are occurring in our seas. As temperatures warm ocean pH is lowering, sea ice is decreasing, and marine stratification and nutrient regimes are changing. These unparalleled changes present new challenges to managing our seas as we are only just beginning to understand the ecological manifestations of these climate alterations. The Marine Strategy Framework Directive requires all European Member States to achieve Good Environmental Status (GES) in their seas by 2020 which means that management toward GES will take place against a background of climate-driven macroecological change. Each Member State must develop indicators and targets to monitor towards GES; however, in order to set targets for achieving GES an understanding of large-scale ecological change in the marine ecosystem is first necessary. At the base of the marine food-web, plankton are tightly linked to their environment and offer insight into pelagic responses to change in the marine system. Much of our knowledge of macro-ecological change in the North Atlantic is a result of research using data gathered by the Continuous Plankton Recorder (CPR) survey, a near-surface plankton monitoring program which has been towing in the North Atlantic since 1931. Indicators developed using CPR data have revealed information about shifts in primary production, alterations to plankton community composition and diversity, biogeographical range shifts, links between plankton and higher trophic levels (including fish), ocean acidification, and jellyfish dynamics. Decision makers will need to consider these issues when developing pelagic targets and indicators for achievement of GES in European Seas.

17:00-17:20 Multi-sector and participatory marine management in regional seas: A case study from the Celtic Sea

Twomey, S.; O'Mahony, C., Dodds, L., and Roxburgh, T.*

*University College Cork, Ireland

Large marine areas and regional seas present a challenge in terms of management. They are often bordered by numerous maritime jurisdictions; with multi-use and multi-sector environments; involving varying governance arrangements; and generation of sufficient levels of data to best inform decision-makers. Marine management at the regional scale involves a range of mechanisms and approaches to ensure all relevant stakeholders have an opportunity to engage in the process; and these approaches can differ in their legal and regulatory conditions. At present, no such comparable structures exist at the transnational level for the ecosystem-based management of the Celtic Sea. Against this backdrop, a participative process, involving representatives from differing sectors of activity in the Celtic Sea spanning four Member States, was established for the purpose of identifying realistic and meaningful management principles in line with the goals of the Marine Strategy Framework Directive.

17:20-17:40 Analysis of initial assessments in Finland, Estonia and Latvia

*L. Uusitalo, J.-M. Leppänen, J. Aigars, G. Martin and A.S. Heiskanen**

*Finnish Environment Institute SYKE, Finland

Within INTERREG IV A project GES-REG, the Initial assessments of Latvia, Estonia and Finland are analyzed for coherence of approaches, data sources, and the assessment procedures and methods of pressures and human impacts. The project will provide an overview of data and approaches used in initial assessments, including state, pressures, human impact, gaps in knowledge and needs for capacity building. Furthermore, a data sheet of existing indicators, reference conditions and environmental targets will be produced. In this talk we will present the framework and first results of this assessment and harmonization exercise.

17:40-18:00 Academia responding to the challenge of MSP

*R. Kalliola**

*University of Turku, Finland

The more importantly marine and coastal areas are becoming targeted by the means of integrative and strategic spatial planning, highlighting good environmental status and sustainable societal progress, the greater becomes the pressure for the academia to respond. Measures such as the Marine Strategy Framework Directive or the principle of ecosystem-based management cannot be implemented properly unless their knowledge-basis is sufficient. Reliable research-based knowledge and professionalism are needed to cope with many new types of challenges. In this contribution, experiences from some initial steps at the university level are highlighted. Emphasis is on the needs to appreciate the importance of local geographical settings, in absolute and relative gaps of confirmed information and in the means of communication among experts producing information and those in need of it. Additionally, this presentation focuses the need to train professionals. Experiences will be shared from a recent university course held in Turku during with title Marine and Coastal Spatial Planning, including students from different scientific and professional backgrounds.

18.00-18:20 MSFD in focus of the macro-regional marine research programme: the case of the BONUS strategic research agenda 2011–2017

*A. Andrusaitis**

*BONUS Programme, Finland

The BONUS SRA is a result of almost two years of consultations with the stakeholders and scientific community through various platforms: BONUS forum, series of national workshops in all Baltic Sea countries and the BONUS strategic orientation workshop. As the EU member states must complete the initial assessment of the current environmental status and the environmental impact of human activities on their respective marine regions, and establish criteria for determining of the associated indicators in 2012, it came as no surprise that the message from the stakeholders was equivocal: "Research support to implementing of the EU MSFD must become the key issue of the BONUS SRA". Thus the new scientific knowledge that is needed for development and interpretation of indicators for each of the eleven GES descriptors became enshrined into the expected outcomes of almost every of the nineteen research themes of the BONUS SRA. In this paper we examine several nontrivial generic issues that were lively discussed during development of the BONUS SRA. These include e.g.: (1) synchronizing the research with the main MSFD milestones; (2) linking the sea basin to its drainage and coupling the implementation of MSFD with implementation of WFD; (3) integrating credible societal and economic science; (4) applying the known DPSIR framework as a tool revealing the true knowledge needs. We believe that the BONUS pioneering experience would be useful in the context of the current development of marine research agendas for the other European marine regions, in particular the Black Sea, the Mediterranean and the European Atlantic sea basin.

19:30-22:00 CONFERENCE DINNER

Plenary **Key note presentation**

Chair: Katherine Richardson

Room: Kongressalen

08:30-09:00 Understanding and mapping of cumulative pressures: Lessons learned from global and regional assessments

B. Halpern

University of California Santa Barbara, National Center for Ecological Analysis and Synthesis, United States

Marine resource management strategies and practices increasingly are moving towards ecosystem-based management and marine spatial planning, both of which focus on assessing the cumulative impact of human activities and on including human needs into assessment efforts. Two recent projects offer scientific advances, practical tools, and key lessons learned for how to operationalize and achieve these two goals: cumulative impact mapping and the Ocean Health Index. In this presentation I will briefly discuss key results and lessons learned from these two projects and how the tools can be applied to national, regional, and global scale assessments, in turn supporting implementation of evidence-based management.

Session 1C: Linking multiple indicators and pressures in the assessment of Good Environmental Status (continued)

Chair: Jun She

Room: 101, 1st floor

09:10-09:30 The Systems Approach Framework for integrated evidence-based management of marine areas

J. G. Støttrup and G.E. Dinesen*

*DTU Aqua, Denmark

The Systems Approach Framework (SAF) is a methodology aimed at integrated assessments of complex systems to improve sustainable development of coastal systems. The SAF was developed by the EU project SPICOSA (Science and Policy Integration for Coastal Systems Assessment). The aim of the SAF is to provide a scientific approach to extract relevant information and structure the process for integrated assessments. It includes the human dimension into the definition of the system, thus providing a higher level of information to society for its governance. It addresses two major challenges: that of exploring potential management options through simulations of complex systems and that of incorporating the social and cultural dimensions for a more effective science-policy interface. The SAF provides prognostic tools for decision making at higher informed levels that may facilitate proactive planning involving stakeholder deliberations, in contrast to retroactive action. The SAF provides the potential to evaluate changes occurring in natural systems and identification of remedial policy options through integrated Ecological-Social-Economic assessments. By including social, cultural and economic dimensions in the assessment, it recognizes the role that public preferences and social norms play in the dynamics between anthropogenic and natural systems. The SAF does not include the dynamics of policy making, but attempts to strengthen the science-policy interface by improving the quality of information and its dissemination.

09:30-09:50 Testing cost-efficient monitoring methods for higher spatial resolution for macrozoobenthos and zooplankton

*L. Uusitalo, H. Nygård, M. Lehtiniemi, S. Tasala, J.A. Fernandes and A.S. Heiskanen**

*SYKE, Finland

Sediment profiles mirror the quality of the sedimentary habitat and encompass information on the benthic functional biodiversity: the redox potential discontinuity (RPD) depth reflects the functionality of the macrozoobenthos and successional stage of the community. Sediment profile imagery is a rapid and cost-efficient methodology for biomonitoring purposes, covering large areas and reducing laborious laboratory work. The method has been used e.g. on the west coast of Sweden, where a Benthic Habitat Quality (BHQ) index has also been developed. The applicability of this concept will be tested in the northern Baltic Sea by relating RPD depth in sediment cores to the macrozoobenthic community structure and function. Zooplankton has a crucial role in the pelagic food web dynamics: it transfers energy from primary production to a form useable by fish. Zooplankton sample analysis is very labour-intensive, which restricts the spatial resolution that can be attained. Recent advances in image analysis and automatic classification of zooplankton taxa show promising results for quickly and cost-efficiently analyzing large amounts of zooplankton samples. This methodology will be tested both on net sample data and samples collected using Continuous Plankton Recorder (CPR) system. This presentation outlines the plans to test and develop monitoring tools that can complement traditional monitoring to achieve higher spatial resolution without increased costs.

09:50-10:10 Indicators of pollution effects in the Baltic Sea

Jakob Strand, Doris Schiedek, Katja Broeg, Ulrike Kammann, Thomas Lang, Brita Sundelin, Janina Baršienė, Henryka Dabrowska, Maija Balode, Lars Förlin, and Kari Lehtonen*

*Aarhus University, Bioscience, Denmark

In the Baltic Sea region, recent progress has been made within the framework of the BONUS+ projects BEAST and BALCOFISH, for addressing Descriptor 8 in the EU MSFD with the main aim "concentrations of contaminants are at levels not giving rise to pollution effects" in the marine environment. In an anthropogenically affected ecosystem such as the Baltic Sea, combined effects of contaminants are to be expected since in most cases no single-source or single-compound pollution but a mixture of contaminants is acting. Therefore there is a need for an integrated monitoring strategy based on both measurements of environmental levels of specific contaminants as well as biological effects of single substances or mixtures as also recommended by the Task Group established to address Descriptor 8. Otherwise, it will not be possible to assess if the presence of contaminants in the marine environment and their biological effects, i.e. "sub-lethal effects" and impact on "healthy wildlife", are kept within acceptable limits. A set of core and candidate indicators for biological effects in marine organisms, for which Background Assessment Criteria (BAC) and Environmental Assessment Criteria (EAC) have been established as quantitative targets for addressing Good Environmental Status (GES), has been proposed and also included in the HELCOM CORESET recommendations on indicators for impact of hazardous substances in the Baltic Sea. These indicators can be used for deriving health indices for single indicator species of mussels, amphipods or fish, or as integrative measures for the general status of pollution effects in a particular area.

10:10-10:30 From ostrich policy to evidence based management strategies of the chemical status of marine areas

Remi W.P.M. Laane, Diana Slijkerman, Dick Vethaak and Theo Prins*

*Deltares, The Netherlands

Policymakers and managers differ in philosophy and approach to achieving healthy coastal and marine ecosystems from scientists. In this contribution we will discuss the evolution of the scientific assessment of the chemical status in the aquatic environment and the growing rift between the political intention (precautionary principle – forbid) and the scientific developments (adaptive and evidence based management - possibilities) in the context of the pitfalls and practicalities confronting the current Marine Strategy Framework Directive (MSFD). The conclusion is that policymakers and water managers should move with time and take on board new techniques and scientific developments that scientists use to assess chemical status and apply new scientific developments. These new techniques, such as

biological effect tools (biomarkers and bioassays) and Effect Directed Analysis (EDA), are cheaper than the classic approaches of checking whether concentrations of priority compounds comply with permissible thresholds. Additionally, these new techniques give more insight into the real impact and risk of the total chemical pressure. The way ahead to realistically and cost effectively unravel the field-relevant risk of individual and mixtures of chemical compounds is adaptive management based on evidence-based science. Environmental science is faced with a choice between ostrich policy of ignoring new scientific developments and uncertainties or opting to become evidence based science and quantify uncertainties.

10:30-10:50 Moving towards conservation and production objectives in marine ecosystems

*K. Brander**

* DTU Aqua, Denmark

The objectives for management of marine ecosystems include conservation (or even restoration), high sustainable yields from fisheries and equitable distribution of the benefits. We seek to achieve these at a time of rapid environmental change. In the limit, the objectives are incompatible and some compromises and trade-offs are inevitable. This is also true in terrestrial systems, where human impact has been greater. The role that science can play in devising technical measures, regulations (such as the MSFD) and alternative means of production and protection will be explored, as will the role that science plays in evaluating and explaining possible scenarios and trade-offs. However the complexity of the social-ecological interactions, the limits of our predictive ability and the differences in outlook and values between all the human actors (fishing enterprises, conservation groups, communities, governance at local, regional, national and international levels) lead us to expect that the process of achieving acceptable trade-offs and outcomes will be a continuing one that requires adaptive co-management. The implications of this for the science agenda will be considered, using examples from different parts of the world and taking account of what has been learned in terrestrial systems.

10:50-11:10 Beyond criteria – How do we identify the important threats affecting marine ecosystems?

Møhlenberg F. and A.L. Middelboe*

*DHI, Denmark

Based on numerical indices (MSFD descriptors) most marine ecosystems within the Danish marine waters may not be able to meet good environmental status (GES) today or in 2020. The “usual suspect”, i.e. nutrient loads from Danish land will be of minor importance, compared to nutrient inputs from adjacent water bodies. Instead, the advancing climate effects (including species invasions, acidification, hydrographic features) and physical alterations of the sea floor are and will constitute important obstacles for achieving GES in the Danish marine ecosystems. Historical records show that marine species including commercial fish move with the changes in the climate. For that reason, we cannot control invasion of “non-indigenous” species totally. Acidification affects calcification and may decimate shelled organisms in brackish waters with low buffer capacity. Sedimentary records from the central Baltic Sea have demonstrated that the climate has a major effect on hydrography, Baltic Sea-North Sea exchange and anoxia in the bottom water in the central Baltic. Physical habitats constitute ‘the template for ecology’ (Southwood, 1977), and if habitats are disturbed continuously or ultimately destroyed, species can be lost and recolonize only if pressures are released or habitats are restored. Repeated bottom trawling leads to levelling of the sea floor, reducing 3-dimensional habitats to species-poorer 2-dimensional planes. Given the large area affected complete restoration of heavily trawled seabed is impossible. Instead, we may adopt the concept “ecological potential” from the WFD for those habitats that are permanently modified, and strive to achieve GES within the constraint set by the present ‘template for ecology’.

Session 2C: GMES; EMODNET and other monitoring and modelling activities in support of the MSFD (continued)

Chair: Thomas Kirk Sørensen
Room: Kongressalen

09:10-09:30 Seagrass Management, Conservation and Policy in Europe

*R. Sigurdardottir**

*Wetland Institute, Agricultural University of Iceland, Iceland

Seagrass ecosystems rank with rainforests and mangroves in their many ecosystem services. Yet seagrass habitats are declining worldwide at unprecedented rate as a consequence of both anthropogenic and natural pressures, which suggests a global crisis in their management. The project, "Seagrass Productivity: from genes to ecosystem management (COST ES0906)" formed a European-wide research coordination network that integrates expertise in physiological ecology, ecological genomics and conservation-resource management to form a basis for seagrass management in Europe. The aim of the project was to form a database and provide guidelines to promote a more effective conservation-resource seagrass management which can be used to develop more effective seagrass policy in Europe. A survey was made to gather information on country-specific seagrass management. The survey assessed the ecological and conservation status of seagrasses in Europe, and the major threats to seagrass habitats. The survey identifies some of the most important seagrass habitats in Europe, assesses how well seagrass distribution is mapped in each country and identifies the agencies involved in seagrass management and the conservation plans and policies in place. The survey furthermore collects information on monitoring programs of seagrass habitats and results of seagrass restoration efforts. Based on the survey, public, policy and resource manager awareness on seagrasses and seagrass habitats differ greatly in Europe, which gives indication on where efforts are needed.

09:30-09.50 European seagrass network: "Seagrass productivity, from genes to ecosystem management"

Santos, R. and Sigurdardottir, R.*

*Center of Marine Sciences, University of Algarve, Portugal

The European research action "Seagrass productivity, from genes to ecosystem management" (COST Action ES0906) started in 2010. This network involves 19 European countries, two Universities from Australia, and 126 experts in physiological ecology, ecological genomics and conservation/resource management. Its aim is to provide the scientific basis for preserving the goods and services arising from the productivity of European seagrass ecosystems under anthropogenic pressure and to develop comprehensive best practices for integrated seagrass habitat management. The network is organized into four working groups (WG1) Ecophysiology: drivers of seagrass plant productivity, vulnerability and resilience to anthropogenic driven change, (WG2) Genetics: understand genetic seagrass responses to environmental stressors, (WG3) Scientists-Managers Interface and (WG4) Innovative approaches to seagrass monitoring and management in Europe. The WGs will coordinate research and management actions to address the following questions: 1) How is the productivity of seagrass meadows along European coastlines affected by anthropogenic disturbances that alter the light, temperature and pH environment and, how does this affect their capacity to adapt while still providing ecological services and function? and 2) how can we implement a scientifically-based management system across Europe that will provide both baseline and predictive information to help to prevent seagrass decline? This Action is unique for Europe, consolidating existing knowledge and coordinating research efforts, but will also be assembled in a way so as to link directly with local managers and other seagrass monitoring and research programs. It will constitute Europe's significant contribution to global efforts towards understanding and preserving the important seagrass habitats.

09:50-10:10 Towards a prototype Decision Support Tool for ballast water risk management

F.T. Hansen, T. Uhrenholdt and J.H. Andersen*

*DHI, Denmark

Non-indigenous species introduced to marine areas through the release of ballast water may exhibit a threat to European marine ecosystems. Non-indigenous species are explicitly mentioned in the Marine Strategy Framework Directive as a qualitative descriptor of Good Environmental Status and therefore methodologies are needed for understanding, quantifying and mapping the vulnerability of marine waters towards the potential impact of introductions. This risk of a marine area receiving non-indigenous species varies between localities due to numerous factors affecting the probability of survival of individual organisms and subsequently successfully establishing of sustainable populations. One important factor is the connectivity of marine areas, i.e. the likelihood that an organism once released from ballast water in one area ends up in another area. For small organisms (e.g. planktonic species, pelagic larvae of benthic invertebrates or juvenile fish) connectivity is primarily determined by the sea currents and secondarily by species specific life histories and motional behaviour. We have developed a prototype methodology for mapping the connectivity of marine areas of the North Sea region and the western Baltic Sea based on numerical modelling integrating classical 3D hydro-dynamical modelling and agent-based modelling. Dividing the North Sea region into areas of 25x25 kilometres in size, a connectivity index of each area has been calculated to produce a series of ballast water vulnerability maps indicating areas where introduced organisms are more likely than others to spread to other areas. We argue that the methodology applied here may be very suitable for other application of relevance to the MSFD.

10:10-10:30 Assessing cumulative pressures and impacts in a regional scale: HELCOM Baltic Sea Impact Index

S. Korpinen, L. Meski, J.H. Andersen and M. Laamanen*

*HELCOM, Finland

The European countries are facing a new era in the field of marine environmental assessments as the Marine Strategy Framework Directive (MSFD) requires not only assessments of status but also of anthropogenic pressures and impacts. To address the new standards, the traditional approach of identifying hot spots needs to be replaced by spatial high-resolution maps associated with estimated impacts on key ecosystem components. The Baltic Sea Marine Environment Protection Commission (HELCOM) took a first step towards an initial regional assessment of anthropogenic pressures in the Initial Holistic Assessment of the Baltic Sea by producing the Baltic Sea Pressure Index (BSPI) and the Baltic Sea Impact Index (BSII). The BSPI visualizes cumulative anthropogenic pressures in the Baltic Sea scale, whereas the BSII consists of potential impacts of anthropogenic pressures on key ecosystem components. In addition to the spatial overview, the tools give a simple ranking of predominant pressures, thus providing a linkage to the management of human activities. The ranking has been made both on the scale of the entire sea region and 14 sub-basins. The HELCOM BSPI has been validated against the status of macrozoobenthic communities in some Baltic sub-basins and the results have suggested that more specific selection of pressures is needed in order to assess anthropogenic impacts on benthic habitats. Such an adaptation of the tool has already been tested to assess the sea-floor integrity under the MSFD qualitative descriptor 6. Similar pressure and impact estimates can be produced for any biotope or species once the pressure-impact relationships have been identified.

10:30-10:50 Mapping cumulative human impacts in the eastern North Sea

*Stock, A. *, J.H. Andersen, S. Heinänen, M. Mannerla, M. Vinther and J. Reker*

*DHI, Denmark

Marine ecosystems are influenced by multiple anthropogenic stressors such as fishing, pollution and non-native species. The EU Marine Strategy Framework Directive (MSFD) explicitly requires an assessment of the cumulative effects of such stressors. Methods for mapping cumulative human impacts on marine ecosystems have only recently been developed. The aims of our study were: 1) to develop a map of cumulative human impacts for the Danish, Swedish, Norwegian and German parts of the Greater North Sea; 2) to adjust the existing methods for mapping cumulative human impacts to fit the requirements of the

MSFD; and 3) to deepen the understanding of how errors in expert judgment affect the resulting cumulative human impact maps by means of Monte Carlo simulations. We combined existing data sets on the spatial distribution of 33 anthropogenic stressors (linked to the MSFD pressures) and 28 key habitats and marine species (linked to the MSFD environmental characteristics). The relationships between these data were established based on an online expert survey. The resulting cumulative human impact index predicted the highest impacts in the German Bight, along the Danish west coast and in the Kattegat. In contrast, the predicted impacts for much of the Norwegian EEZ and areas far offshore were lower. The Monte Carlo simulations confirmed earlier findings that mapping cumulative impacts is generally "robust", but also showed that specific combinations of errors can seriously change local and regional patterns. We finally present ways to manage such uncertainties, including a new software tool for cumulative impact mapping.

10:50-11:10 MESMA: An integrated tool box to support an ecosystem based spatial management of marine areas

Stelzenmüller, V., Stamford, T., Vassilopoulou, V., Kastanevakis, S., Vincx, M., Vanaverbeke, J., Rabaut, M., van Dalfsen, J., Cronin, K., Sutton, G., Essid, M., Jones, P.J.S., Qiu, W. and van Hoof, L.
*vTI Institute of Sea Fisheries, Germany

The implementation of the MSFD requires the operationalization of an ecosystem based management of marine areas recognizing combined effects of human pressures on coastal and offshore waters. Marine spatial planning (MSP) manages human activities to resolve potential conflicts over maritime space while balancing multiple objectives such as sustainable use and marine conservation. Hence place based management measures can contribute to the achievement of MSFD objectives. Thus the monitoring and evaluation of the effectiveness of spatially managed areas (SMAs) in coastal and offshore waters where MSP is implemented, under development, or considered requires practical approaches. The EU funded project MESMA develops and tests an integrated and transparent tool box to support an ecosystem based spatial management. Its central component is a flexible framework guiding through an indicator based assessment of SMA effectiveness by means of structured practical tasks and analysis. The framework describes an iterative process comprising the key elements of scoping, performance measures, assessment, evaluation and adjustment. Methods and technical tools, including a geoportal, are being developed to support its application. The MESMA framework and associated methods are tested in nine case studies, being at different stages of MSP implementation, and spanning the various geographical regions of the European marine waters. A parallel governance analysis is also conducted in the different case studies. Here we exemplify first results from the framework applications in the case studies, reflect on the integration of the framework assessment with the parallel governance research analysis, and highlight practical links to a MSFD related assessment.

Session 5: Linking multiple indicators and pressures in the assessment of Good Environmental Status

Chair: Mette Blæsbjerg
Room: 102, 1st floor

09:10-09:30 Towards the implementation of the European Marine Strategy Framework Directive: a methodological approach and research for the assessment of environmental status in the Southeastern Bay of Biscay

Ángel Borja, Javier Franco, Iñaki Quincoces and Marina Santurtún*
*AZTI-Tecnalia, Spain

The Marine Strategy Framework Directive (MSFD), by applying an ecosystem-based approach to the management of human activities, demands the assessment of the environmental status (ES) in the European Seas. In order to do this, a set of 11 qualitative descriptors were established and, for each one, the European Commission proposed an extensive set of criteria and indicators. The assessment of ES implies a huge effort for data compilation and processing, development of approaches and methodologies and integration of results in a comprehensive way. In this contribution we present the approach developed in the Exclusive Economic Zone of the south-eastern Bay of Biscay, for the assessment of the ES. Some projects aiming to increase the information and knowledge of

the different qualitative descriptors in this area will be presented. The investigations have been undertaken during the past 25–30 years, monitoring coastal and offshore marine waters within the framework of European, national and regional projects. A synthesis of methods used and the components sampled, which have included human pressures, oceanographic conditions, pollutants, phyto- and zooplankton, benthos, fishes, cetaceans and seabirds, will be presented. In addition, a recent proposal for an integrated environmental status assessment will be presented. The strengths and weaknesses of the methods, as well as the main scientific gaps and challenges will be discussed.

09:30-09:50 Assessment and classification of eutrophication status in the Eastern North Sea

Axe, P. et al.*

*SMHI, Sweden

This contribution describes the first eutrophication assessment of the eastern North Sea using a harmonized quantitative assessment tool, so as to describe recent environmental status in response to nutrient loading pressures. The assessment tool HEAT (Andersen et al., 2010) was developed in accordance with the EU Water Framework Directive (Anon., 2000) and as a result, it is expected that this assessment meets the requirements of the EU Marine Strategy Framework Directive (MSFD; Anon., 2008) for consistent status classification of coastal waters under the two directives, as well as illustrating cooperation between countries bordering a common marine sub-region. The harmonized approach allows status changes between acceptable (non-problem area) and unacceptable (problem area) to be more precisely mapped: in previous applications of the OSPAR Comprehensive Procedure (OSPAR Comp; OSPAR Commission 2005) eutrophication status was presented as single values covering large assessment units (often national Exclusive Economic Zones) with no indication of status gradients within these regions. The present assessment resolves status variation within and across these assessment units. The eutrophication assessment highlighted limitations of some eutrophication indicators, differences in assumptions about eutrophication status between countries and also between the OSPAR COMP, Water Framework Directive and Marine Strategy approaches.

09:50-10:10 Towards harmonised assessment and classification of "biodiversity status" in the North Sea eco-region

Skov, H., J.H. Andersen, M. Vinther, G. v. d. Meeren and P.O. Moksnes*

*DHI, Denmark

As one of the milestones in the HARMONY-project a demonstration of the application of the integrative indicator based biodiversity assessment tool (BEAT) was undertaken for the Greater North Sea sub-region across a range of coastal and offshore areas. The first version of the BEAT tool was applied in the Baltic Sea, and was only to a limited extent including indicators and data reflecting the status of fish, seabirds and marine mammal populations. The BEAT assessment for the Greater North Sea included these components as well as assessments of benthic communities, marine landscapes and supporting features, and provided a promising first step towards widening the spectrum of available marine biodiversity indicators within EU offshore areas and developing a fully integrative indicator-based assessment matrix on biodiversity under the GES framework. The strengths of the BEAT approach include the flexibility of the size of assessment units as well as the potential to compare ecologically widely different areas with each other through the assessed status. The main weaknesses are the inherent assumption that the overall status of biodiversity can be defined by fixed values of a set of indicators, the lack of a rigorous statistical approach and a balanced representation of different ecosystem components/food web categories.

10:10-10:30 Assessing the state of biodiversity in marine ecosystems. Two different approaches discussed: the Norwegian Nature Index and BEAT 2.0

Gro I. van der Meeren, J.H. Andersen, G. Certain and C. Murray*

*IMR, Norway

The Marine Strategy Framework Directive (MSFD) "aims at achieving or maintaining a good environmental status" of the sea and implementation of the MSFD necessitates assessment of the current environmental status. Norway, not being an EU Member State, has not implemented the MSFD. Still, Norway has since 2002, prepared and implemented and

implemented integrated management plans for the Norwegian EEZ. The environmental status of the Barents Sea and the Norwegian Sea have been monitored and reported since 2006 and 2009, respectively. The Norwegian parts of the North Sea and Skagerrak will have similar management plans implemented by 2013. The environmental status of an ecosystem can be assessed using a set of ecologically relevant indicators. In order to do this, good monitoring data is essential. Such data is available for commercial fisheries and pollution, but less adequate data is available for non-commercial species and habitats. The HARMONY tools are indicator-based tools for marine assessments in regard to eutrophication, biodiversity status, chemical status and ecological status. They build on the tools developed for HELCOM's thematic and holistic assessments (HOLAS) of the Baltic Sea. The tool used in assessing biodiversity is known as BEAT 2.0. The Norwegian Nature Index aims to provide an overview of the state of biodiversity within and across major ecosystems, marine as well as freshwater and terrestrial, based on standardized and integrated information and data. This presentation discusses the similarities and differences of the two models for integration of data in biodiversity indicators. We will discuss the two concepts NI and BEAT 2.0, and the purposes for which they were intended.

10:30-10:50 CHASE assessment of the North Sea – a pilot study

N. Green, T. Høgåsen, J.H. Andersen and M.M. Larsen

*NIVA, Norway

In this pilot study, hazardous substances in the North Sea were assessed and classified using the HELCOM Chemical Substances Status Assessment Tool (CHASE). The study was based on monitoring by Belgium, Denmark, France, Germany, the Netherlands, Norway, Sweden and the United Kingdom. Together, 1350 locations (1155 for sediment and 195 for biota) were used resulting in 966 matrices sampled in the open-sea and 506 in coastal areas. CHASE is a multi-metric indicator-based tool developed for the HELCOM integrated thematic assessment of hazardous substances in the Baltic Sea. CHASE produces an integrated assessment and classification of "hazardous substances status". This can be in particular advantageous for use in remedial action plan and, in particular, for the science-based evaluation of whether the North Sea is undisturbed by hazardous substances.

10:50-11:10 A review of current practice in integrated ecosystem assessments and summary of best practice recommendations using four case studies

S. Altvater, K. McGlade, E. von Sperber and F. Stuke*

*Ecologic Institute Berlin, Germany

The aim of this study is to provide the German Federal Agency for Nature Protection a comprehensive overview of the up to date knowledge regarding integrated ecosystem assessments (IEAs). In addition to the literature survey, a number of key experts were interviewed to provide supplementary input on the background and implementation of IEA approaches worldwide. The present analysis has shown that many interesting approaches for the assessment of the environmental status of marine ecosystems exist worldwide. Whilst none of the approaches examined fulfil the requirements of the MSFD fully, certain aspects and the experience gained during their development and implementation can serve as useful input in developing an assessment approach in the MSFD context. The compilation of IEAs began by looking at some of the more well-known assessments currently in existence at a regional scale in Europe: these included the Report of the Regional Ecosystem Study Group of the North Sea (REGNS), the Oslo-Paris Conventions for the protection of the north-east Atlantic (OSPAR) and the Helsinki Commission for the protection of the Baltic marine environment (HELCOM). The UK Charting Process provided an example of a northern European approach to IEA at national level. During these evaluations, international examples of IEAs came to light, such as those in North America: assessments for the Eastern Scotian Shelf in Canada and for Puget Sound and the California Current in the USA. An integrated assessment covering the Great Barrier Reef in Australia was also analysed, as was the Ocean Health Index, an attempt at an integrated assessment on a global scale. As well as the more fully integrated assessments which took both biological and anthropogenic factors into account, two thematic assessments were also examined: the Ecological Risk Assessment for the Effects of Fishing (ERAFF); focused on fisheries in Australia and Assessment of Estuarine Trophic Status (ASSETS); an approach from the USA on eutrophication. This presentation provides an overview of the evaluation of four of the 12 examined approaches chosen for case study, namely the approaches of Canada, USA and Australia. The assessment approaches chosen are presented and the overall findings gained

from the analysis are summarised. Additionally, the information provided in the interviews with experts - either directly involved in one of the case study approaches or general experts - are presented. Based on this information the case studies are evaluated and 'best practice' examples are identified. All of this leads into the identification of requirements for an integrated ecosystem assessment.

11:10-11:30 Coffee/tea

Plenary **Where are we now? And where are we going?**

Chair: Jesper H. Andersen
Room: Kongressalen

11:30-11:50 **The Water Framework Directive and state of Europe's water**

*Kristensen, P.**

*European Environment Agency, Denmark

Europe's waters are affected by several pressures including water pollution, water scarcity, floods; and by major modifications affecting morphology and water flow. To maintain and improve the essential functions of our water ecosystems, we need to manage them well. This can only succeed if we adopt the integrated approach introduced in the Water Framework Directive (WFD). Europe has via the WFD strong water legislation in place and the challenge now is to see how it works in practice. Current reporting under the WFD shows that a substantial proportion of Europe's waters are at risk of not achieving the aim of 'good status' by 2015. In 2010, EU Member States reported their 170 River Basin Management Plans. The plans contains much information and results on the ecological and chemical status of water bodies and the pressures affecting them. EEA and its Topic Centre are for the moment finalizing reports illustrating the status and pressures affecting Europe's waters. Throughout the EU, more than 100 000 surface water bodies have been reported, the majority being river water bodies. In total, the status and pressures affecting more than 280 000 km² transitional and coastal waters have been reported. Overall, more than half (55 %) of the surface water bodies in Europe are in less than good ecological status or potential. The worst water category is transitional waters, where 68% of the water bodies are in less than good ecological status or potential. In coastal waters, the situation is somewhat better with 49% of water bodies in less than good ecological status or potential. The reason why transitional waters are so much worse than coastal waters are due to their proximity to pollution sources from land based sources including loading from the upstream river basins. Moreover, transitional waters are exposed to extensive hydromorphological pressures caused by land reclamation, flood protection, as well as large harbours causing altered habitats in these water bodies.

11:55-12:15 **Current state of the Black Sea and its environment protection**

L. Boicenco, Ç. Polat-Beken and V. Velikova*

*National Institute for Marine Research and Development, Romania

Presently, there is a regional acknowledgement that the Black Sea (BS) state visibly improved compared to the early 1990s. However, while offering a certain amount of resilience, the BS ecosystems (especially coastal) stay fragile and require robust protection. Four priority environment concerns remain in the focus of activities aimed at the BS recovery: eutrophication, chemical pollution (including oil), biodiversity change and the collapse of fishery. Undoubtedly, the level of BS eutrophication shows decreasing trend, however, it is not yet stable. Chemical pollution is mostly of local concern except for petroleum hydrocarbons. Species extinction and introduction of non-natives have clear relevance to the regime shifts in the BS ecosystem functioning observed. The major current threats for the living resources appear to be the illegal fishing and the use of destructive harvest techniques. De-coupling between the shelf and deep sea regions of the sea in response to anthropogenic pressure and climate change has been recently claimed. The present BS ecosystem functions with a low ecotrophic efficiency, which results in a state characterized as intermediate in between the healthy pristine and the eutrophic (1970s-1980s) ones. Most of the environmental problems of the BS are of transboundary character and as such cannot be efficiently regulated by individual states. A new regional BS Strategic Action Plan for the implementation of the Bucharest Convention was adopted by the BS States in 2009. The Plan recognizes the ecosystem approach as a key management strategy. Meanwhile, the

European Union (EU) 2007 enlargement brought the EU to the shores of the BS and the coastal BS countries have acknowledged the need for convergence between the regional legal/policy framework with relevant EU acquis. They have also recognized the increasing commitment of the EU to the protection of the BS (Sofia Declaration, 2009). Recently, the European Commission supported a new initiative of Bulgaria, Romania and Turkey aimed at facilitating the MSFD implementation. This initiative is a policy/science interface project which summons Ministries of Environment and scientific institutions to work together in building knowledge-based BS environment protection management.

12:20-12:40 Regional activities to protect the marine environment and the coastal region of the Mediterranean Sea

*M. Angelidis**

*UNEP/MAP – MED POL

The MSFD calls for a coherent approach within a marine sub-region covering EU Member States, particularly promoting the cooperation with the Regional Conventions in the implementation of all necessary steps for the achievement of Good Environmental Status GES. The Barcelona Convention and its seven Protocols represent a political and legal framework for the protection of the marine environment and the coastal areas of the Mediterranean region. All 21 countries bordering the Mediterranean Sea, as well as the European Union, are Parties to the Convention and to several Protocols. The Contracting Parties have already recognized the need to better protect the ecosystems at both regional and sub-regional levels by progressively applying the ecosystem approach to the management of human activities (ECAP) that may affect the Mediterranean marine and coastal environment. Following the definition of an ecological Vision for the Mediterranean and the setting of common Mediterranean strategic goals by the Parties, an initial integrated assessment has been completed in 2011. The assessment presents the region as a conglomerate of linked coastal and marine ecosystems, with many shared resources, species and common approaches to both environmental monitoring and management. Furthermore, in line with the agreed road map for the gradual implementation of the ECAP, countries have agreed on 11 Ecological Objectives, with operational objectives and indicators and are working on the definition of GES and the setting of targets to achieve it. A new integrated monitoring programme, which will generate data relevant to the agreed indicators, is under preparation.

12:45-13:05 Regional coordination for the implementation of the MSFD in the Baltic Sea by HELCOM

*M. Laamanen**

*HELCOM Secretariat, Finland

Regional seas are central units in the implementation of the MSFD. By the declaration of the ministerial meeting held in 2010, Helsinki Commission, HELCOM, was established as the platform for regional coordination of the national implementation activities in the Baltic Sea region. The regional action programme, HELCOM Baltic Sea Action Plan (BSAP) adopted in 2007, already offered for great synergies since it has the same goal as the MSFD: to reach a Baltic Sea with good environmental status by year 2020/2021. In 2010, a specific body, now called HELCOM Group of the Implementation of the Ecosystem Approach (GEAR) was established to allow for MSFD implementation related information exchange and coordination between the countries. In addition, a number of projects have been initiated to support the implementation of the BSAP and MSFD: the CORESET project for development of core indicators with good environmental boundaries, TARGREV project for the review of eutrophication status targets and the MORE project for the revision of HELCOM's monitoring programmes. Although the numerous measures included in the BSAP are already being implemented in the Contracting Parties, the GEAR group will next look into the coordination and cooperation needed on the MSFD programmes of measures. In doing so, it will consider the measures in the whole Baltic Sea basin. A regional roof report of the MSFD related reporting by the member states in 2012 is also under development.

13:10-13:30 Does MSFD + ICES = Ecosystem-Based Management?

*A.C. Brusendorff**
ICES, Denmark

ICES has traditionally been perceived as a conventional “fisheries organization” – with a major focus placed on the advisory function for providing scientific background information to support decision-making on catch quotas for fish stocks. This is not the whole truth. The scientific and ecosystem approach in ICES is developing and fisheries advice now builds upon the MSY framework and ecosystem considerations, and work continues to develop assessments that deal with multispecies and mixed fisheries, i.e. more ecosystem considerations. But ICES also has a much wider expertise and experience, which is of direct relevance for MSFD implementation. ICES Focal points in relation to MSFD are: (1) our Data Centre; (2) our scientific expert groups; and (3) our transparent system for Advice drafting. All of which is embedded within a major scientific network across Europe and the Pan-Atlantic, and is driven by needs of marine management authorities in the 20 ICES member countries, international organizations and commissions, such as HELCOM, OSPAR, NEAFC, NASCO, and the EU. Recently ICES issued guidance to member states on the implementation of Descriptor 3 (commercially exploited fish and shellfish). This guidance document revealed the broad and integrated ICES work on fish, with biodiversity, marine food webs and sea-floor integrity. This process also showed ICES capability and readiness to support the MSFD implementation. A potential and willingness that extends to many other aspects of the MSFD, such as integrated ecosystem surveys, interregional cooperation, concept development, review, as well as development and evaluation of new methodologies.

13:35-13:55 The challenges ahead

*G. Seeberg**
*WWF Denmark

The marine environment is under pressure by a multitude of human activities, such as fishing, agricultural run-off, shipping, pollution with hazardous substances, and many more. The sea is getting exceedingly and the variety of maritime activities is projected to expand substantially. To protect biodiversity and habitats and to ensure sustainable exploitation, we have to start managing and planning our use of the sea in a better way. The obligation to protect the marine environment is set out in environmental legislation, such as the Marine Strategy Framework Directive. This has led to a focus on developing scientific indicators, and while there is a clear need for improving the scientific basis, this must not become an excuse not to take the necessary steps. We need to make the move from science, to regulation and to results. One of the main drivers for the current decline in ocean health is the lack of coherent and comprehensive legal and policy frameworks affecting natural resource management. There has been insufficient interest and will – from politicians to industry and the public - to take the necessary steps. Furthermore, the regulation of most maritime activities has happened independently and in a reactive and somewhat ad hoc manner, most often triggered by arising conflicts. The result has been a patchwork of rules and regulations, with insufficient environmental consideration, which has led to unsustainable resource use, pollution and habitat destruction. Until we have adequate and effectively enforced governance arrangements, there is little prospect for sustainable management of ocean users and marine resource use. Governments must take part in developing and implementing common ecosystem based goals for our seas, including goals for all sectors that fit with the capacity of the ecosystem. There is also an urgent need for creating the appropriate governance and management frameworks, with national, regional and international governance structures that can ensure that maritime policies are sustainable, integrated and synergistic.

14:00-15:00 Lunch

15:00-15:45 Conference Summary

J. Carstensen, P. Henriksen* and S. Markager**
*Aarhus University, Bioscience, Denmark

The results presented along the Marine Strategy 2012 conference will be summarised and presented in an overview, produced during the meeting, to synthesize and integrate these results into a coherent and comprehensive view of our progress in understanding marine

ecosystems, the research challenges still pending, and the management options to maintain or, where needed, to improve the environmental status of European seas. This conference summary will be collated from materials and ideas presented along the conference, as well as from thoughts and ideas raised during the question periods and debates following the presentations, as well as casual conversations during the conference, which represent one of the core, if informal, components of scientific meetings. With the science in hand, with more complexities to be discovered, our challenges might become more social and economic in nature.

15:55-16:00 Closing of Marine Strategy 2012

*K. Richardson**

Center for Macroecology, Evolution and Climate, Biological Institute and
Leader of Sustainability Science Centre, University of Copenhagen, Denmark

Posters

Phytoplankton diversity response to nitrogen inputs and water motion

Mohamed Adjou, Jørgen Bendtsen and Katherine Richardson

The bulk phytoplankton biomass response to nutrient inputs is commonly addressed, when parameters for implementing the Water Framework Directive (WFD) boundary are suggested (e.g. Danish coastal waters). The response of phytoplankton diversity to nutrient inputs is, however, usually not addressed due to a lack of diversity data and of developed semi-theoretical methodologies (modelling tools). Here, we present an empirical mechanistic model for analyzing the potential impact of nutrient inputs, transport advection and mixing on phytoplankton diversity. Phytoplankton species in the model are defined by their growth kinetics within 5 functional groups. Mortality is determined from selective grazing and natural loss. The model sensitivity was analyzed in relation to changes in nutrient input and transports of biomasses and related to realistic values of new production and ocean currents, respectively. Model solutions show a hump-shaped behaviour of the phytoplankton's diversity vs. bulk biomass, where low nitrogen inputs (oligotrophic conditions) are associated with low diversity, medium to relatively high nitrogen inputs (mesotrophic–eutrophic conditions) are characterized by a relatively high diversity whereas heavy nutrient (nitrogen) inputs (i.e. eutrophication case) dramatically decrease diversity. The results of the model are in general accordance with observed patterns of phytoplankton diversity. In a sensitivity study, we show that contributions of phytoplankton biomasses from advective marine transports or turbulent mixing (water motion) increase diversity in the model significantly. The model results are discussed under future potential threats (i.e. nitrogen inputs, global warming engendered stratification, anthropogenic coastal water confinement) to suggest some indicative guidelines for Good Environmental Status (GES).

Improving the evaluation of marine ecosystems environmental status

Margit Eero and Henn Ojaveer

Assessments of the environmental status of marine ecosystems are increasingly needed to inform management decisions, regulate human pressures and meet policy objectives. Ecosystem assessments however have a number of methodological challenges including the selection of appropriate indicators and definition of reference conditions corresponding to “good” or “bad” status of the ecosystem. Furthermore, combination of individual indicators to an overall ecosystem status involves a number of methodological choices. Currently ecosystem assessments usually focus on the outcome of the evaluation and corresponding management actions, with less attention paid to the evaluation procedure itself. However, the methodological choices made during the evaluation process can, in some cases, be highly influential to the overall result of the evaluation. Here the case study of the Baltic Sea is used to address some of these methodological challenges in order to improve the transparency of the assessment procedure and help to set priorities for future work. The results are presented in the form of a Fact Sheet of the European FP7 project Marine Ecosystem Evolution in a Changing Environment (MEECE).

When were the good ol' times good ? A Large Fish Indicator applicable to historical data for the German Bight 1902–1932

Heino O. Fock, Matthias Kloppmann, Wolfgang N. Probst

Historical data from 1902–1908, 1919–1923, and 1930–1932 from the German Bight were acquired to reveal the performance of a Large-Fish-Indicator (LFI2) based on the number of species per haul with specimens larger than 40 cm. Conditions before 1914 were characterized by a high LFI2 > 2 declining sharply immediately after 1919 resuming lower levels after 1923 resembling contemporary conditions as shown for ICES IBTS quarter 3 and pooled regional surveys.

Measuring MSFD Descriptor 10 microparticle indicator in the marine environment - how hard can it be?

Heather A. Leslie and A. Dick Vethaak

Initial pioneering studies have detected microplastics in the marine environment – in surface waters, continuous plankton recorder samples (10 m depth), in marine sediments and in field collected marine organisms. Micro-particles, especially microplastics are one of the four indicators to be assessed and potentially monitored within MSFD Descriptor 10 Marine Litter, but as indicator, microplastics require further development. Microplastics are commonly defined as synthetic polymer particles “less than 5 mm” but can often be much smaller than 5 mm; evidence exists that the hazards posed by plastic particles in the ultra fine range (low μm to nm particles) may also be significant. Seafood safety is therefore also dependent on ensuring that ultrafine synthetic polymer particles are not present in edible seafood tissues. Most detection of microplastics has been on a visual basis under the microscope, with staff manually separating the microplastics from nonplastic microdebris collected in nets, sieves or in gut contents of biota. We will briefly compare analytical methods for analysis of microplastics in environmental samples, including biota. What are the real size limits of the plastic particles we are measuring with the current approaches to sampling and analysis? Which size categories are potential threats to marine organisms and are we measuring or missing these size categories with current approaches? What are the quality control issues that should be addressed for microplastics sampling and analysis? These questions will be addressed and recommendations given for future research and development in this emerging field of study.

Implementation of the Marine Strategy Framework Directive in Italy: towards the definition of assessment areas and GES for Descriptor 5 (Eutrophication)

Erika Magaletti, Franco Giovanardi, Marina Amori, Simone Russo

Eutrophication-related phenomena represent a major threat to the health and functioning of marine ecosystems. The assessment of eutrophication in marine waters is therefore explicitly required by the EU Marine Strategy Framework Directive (Descriptor 5). A proposal for the definition of assessment areas which results from the analysis of pressures (e.g. freshwater inputs) and selected impacts (e.g. Chl 'a' concentrations) in each of the three sub-regions that are present in Italian marine waters will be presented. Furthermore, an indication on which indicators are likely to be used and on how they will be aggregated to assess GES for the descriptor 5 will be provided, with special emphasis on the links to Directive 2000/60/EC.

Cumulative impact mapping of the Western Mediterranean Sea

Megan S. Nowell, François Morisseau, Françoise Breton

The main objective of the Pegaso Project is to build on existing capacities and develop common novel approaches to support integrated policies for the coastal, marine and maritime realms of the Mediterranean and Black Sea Basins within an ecosystem based approach. Understanding where multiple pressures are occurring, their principal source and how they impact marine and coastal ecosystems is essential to support these strategies and is a requirement of the Marine Strategy Framework Directive (MSFD). At present, an integrated qualitative and quantitative understanding of the relationship between pressures and impacts in the marine environment is far from being achieved. In 2007, Halpern et al. provided a way to predict ecosystem response to pressures using expert knowledge. Using this methodology and its developments in more recent studies, a cumulative impact map is being created by Pegaso for the Western Mediterranean Sea (Spain, France, Italy, Morocco, and Algeria). Not only will this approach be consistent and comparable across all marine regions and sub-regions, but it will also enhance the cross-boundary cooperation between EU and non-EU countries. This study will provide a framework to extend the capacity of implementing the cumulative impact index methodology to the rest of the Mediterranean and Black Sea as necessary datasets become available. The cumulative impact map will be an integrative component of the Pegaso toolbox which includes tools such as ecosystem accounts, indicators, scenarios, participatory methods and economic valuation. Together, this toolbox will support end-users in governance and decision making for the coastal zone of the Mediterranean and Black Sea Basins.

Descriptor 2 of the Marine Strategy Framework Directive: ten suggestions to move forward

Henn Ojaveer, Sergej Olenin, Dan Minchin, Ana Amorim, Joao Canning-Clode, Paula Chainho, Gordon Copp, Bella Galil, Stephan Gollasch, Anders Jelmert, Stefan Kacan, Francis Kerckhof, Ian Laing, Maiju Lehtiniemi, Tracy McCollin, Cynthia McKenzie, Josip Mikus, Laurence Miossec, Anna Occhipinti, Marijana Pecarevic, Judith Pederson, Gemma Quilez-Badia, Andrea Sneekes, Lauri Urho, Jeroen Wijsman, Argyro Zenetos

EC Decision (2010/477/EU) defines the two criteria for assessing progress towards good environmental status relevant to descriptor 2 "Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem": (1) Abundance and state characterisation of non-indigenous species (NIS), in particular invasive species; and (2) Environmental impact of invasive non-indigenous species. The following ten generic points should be considered when addressing this descriptor:

- 1) Availability of taxonomic expertise is critical to address MSFD D2 criteria and indicators;
- 2) Evaluation of the numbers of NIS, their spread and impact need to be standardized;
- 3) Evaluation of the newly arrived NIS may start with selected well studied taxonomic groups;
- 4) Ratio of NIS/NS (native species) in a region or habitat is to be calculated and evaluated based on contemporary reliable data;
- 5) Ratios (NIS/NS) and NIS impacts may vary with habitat, region, and presence of other drivers, and so could be independent of NIS management actions;
- 6) NIS with lesser recognized impact may be evaluated separately;
- 7) NIS inventories should be accompanied by pathways and vectors analyses;
- 8) Selected areas (hot-spots) could be used in monitoring to improve cost-effectiveness;
- 9) Management options should be agreed by neighboring countries because of the risk of secondary spread of NIS, as appropriate;
- 10) NIS with known impact(s) are to be managed as is practicable and on the basis of this the success of managements effort should be evaluated.

PERSEUS - Policy (MSFD) - oriented marine Environmental Research in Southern EUropean Seas)

N. Streftaris, E. Papathanassiou and N. Bellou

PERSEUS (Policy-oriented marine Environmental Research in Southern EUropean Seas) FP7 Project aims to identify and predict the combined effects of human and natural pressures on the Mediterranean and Black Seas, assess their impact on the marine ecosystems and, using the objectives and principles of the Marine Strategy Framework Directive, to design an effective and innovative governance framework based on sound scientific knowledge. Well-coordinated scientific research and socio-economic analysis will be applied at basin, subregional and coastal scale whereby short term data gaps will be identified and consequently addressed through targeted actions based on the MSFD descriptors and indicators. Existing observational systems will be upgraded and extended and new tools will be developed, by way of combining monitoring and modelling "Ecosystem End to End" capabilities. This will allow to evaluate the current environmental status by explicitly tackling the MFSD descriptors and to develop an overall strategy for monitoring the SES, in compliance with the MSFD. The acquired knowledge along with the analysis of the countries' initial assessments will be used to implement the MSFD principles and objectives and promote them across the SES with emphasis on non-EU countries. A state-of-the-art methodology will ensure coherence and consistency throughout the SES towards achieving the required 'Good Environmental Status' (GES). In view of reaching this GES, a scenario-based framework for future implementation of adaptive policies and management schemes will be developed. Appropriate environmental state scenarios will help the definition and ranking of a feasible adaptation policy framework through an extensive participatory approach (stakeholder platforms).

A modelling approach to assess the performance of size-based indicators of fish population structure

Wolfgang Nikolaus Probst, Vanessa Stelzenmüller, Gerd Kraus

Several size-based indicators have been proposed to assess the status of population structure of commercially exploited fish species within descriptor 3 of the Marine Strategy Framework Directive (MSFD). The general perception of a 'healthy' size-structure is usually related to high abundances of large (and old) individuals. The performance of the proposed MSFD size-based indicators in capturing the abundance of large fish within a population, however, has not been evaluated. We show that the interpretation of size-based population indicator time-series can be counterintuitive because the simultaneous influences of recruitment and fishing on the size-structure of a population are not easily separated. Several relative size-based indicators such as the 95% percentile of the length distribution (L95) may lead to ambiguous interpretations if the processes influencing the size structure of a population are not fully understood. Using a cod-like model population we test the performance of several size-based indicators in relation to dynamic recruitment and fishing mortality. The model results suggest that many size-based indicators are more closely related to population size than to fishing pressure. Thus potential GES target levels for size-based indicators should not be set in relation to fishing pressure but to the status of population abundance as exemplary demonstrated for North Sea cod.

Describing distributional range and patterns of *Posidonia oceanica* (L.) Delile meadows: a methodological approach

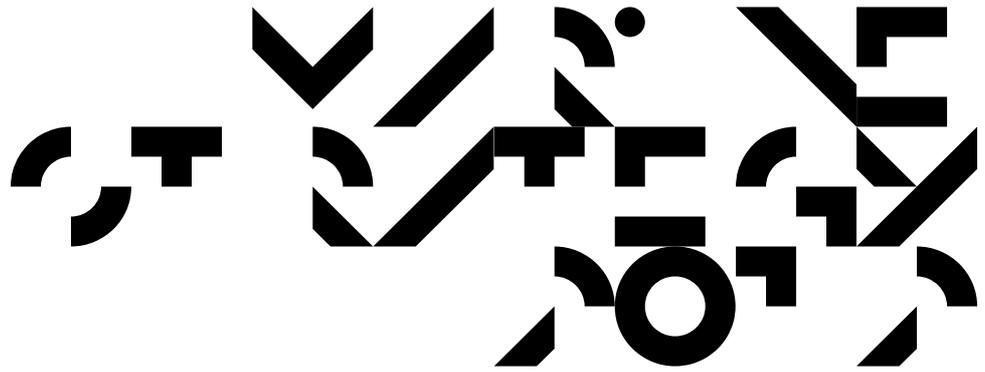
Rende S.F., Bacci T., Gennaro P., Penna M., Trabucco B., Cicero A.

Distribution and extent of the habitat within assessment areas are the main topics in describing characteristics of the predominant or special habitat in the MSFD 2008/56/EC. The extension of one of Italian assessment areas selected in the Western Mediterranean sub-region is from Southern Latium to Punta Campanella (SW Mediterranean Sea); within this area, the study habitat is the *Posidonia oceanica* meadow between Monte Circeo and Gaeta. Maps of the meadow obtained by SSS surveys were shaped in 2005 and 1990. A theoretical reconstruction of the meadow was elaborated from 1990 data and it is considered as a base-line (reference condition). Biological data have been related to information on human induced pressures (CORINE Land Cover 1975–2006). Data were analyzed by means of GIS geo-processing techniques in order to evaluate temporal trend in the range and patterns indicators as required by the MSFD first assessment. Indices such as "total patch area", "level of fragmentation" and "depth of the lower and upper limits" have been studied from a landscape perspective. Results showed a general fragmentation of the distributional pattern, a reduction of the covered area and a shift of meadow limits from the reference period to nowadays, quantifiable by values of indices used.

Evaluating the Baltic Sea Action Plan with the help of a newly developed Assessment tool (MESMA): Experiences and lessons learned

Weber Smit A., Carlström J., Piwowarczyk J., Holen S. N., Rabaut M., Stelzenmüller V., Vega Fernández T., Wijkmark N., Backer H.

This paper provides the first results from the pilot application of a new generic and flexible methodological framework tool (MESMA FW) for monitoring and evaluation of spatially managed marine areas. The MESMA FW addresses the demand for a practical tool for integrating monitoring, evaluation and implementation of Spatially Managed Areas in coastal and offshore waters. It has integrated the lessons learned from existing frameworks (Integrated Environmental Assessment and Marine Spatial Planning) and aims to provide guidance for assessing and achieving good environmental status in line with the EU Marine Strategy Framework Directive (MSFD). This paper shows how the MESMA FW has been applied on the international and cross-sectoral Baltic Sea Management Plan.



Research and Ecosystem-Based Management Strategies in Support of the Marine Strategy Framework Directive

14–16 May 2012
Copenhagen
Denmark

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