ABSTRACTS


4th International Conference on
Progress in Marine Conservation in Europe 2015
14.–18. September 2015
Stralsund, Germany
BfN HABITAT MARE
active for marine biodiversity
Federal Agency for Nature Conservation
Hosted by the
Federal Agency for Nature Conservation (BfN)
in cooperation with the
German Oceanographic Museum / OZEANEUM
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Deutsches Meeresmuseum Stralsund

4th International Conference on

Progress in Marine Conservation in Europe 2015

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ABSTRACTS

Opening

Marine Biodiversity and Marine Protected Areas

Fishery management in MPAs

Marine Nature Conservation and Fisheries

Monitoring, Mapping & Methods

Opening

Tuesday, 15th September 2015, 9:40h

Progress in marine conservation in Europe – a current overview

Beate Jessel[1], Katrin Wollny-Goerke[2]
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An up-to-date overview is given over some key issues of marine conservation and recently achieved progresses in Europe.

The establishment of representative global MPA networks, in the OSPAR and HELCOM regions, has substantially proceeded, especially in the North East Atlantic and in the Mediterranean. But there is still work to be done regarding the High Seas and some biogeographical regions in the OSPAR and HELCOM maritime area. The further development of assessment criteria as well as legal protection instruments and management plans for these protected areas are the next steps.

Increasing human activities with a variety of associated negative environmental impacts are the biggest problems affecting marine biodiversity. Fishing remains the human activity with the most severe impacts on marine ecosystems. Significant reductions of the present intensive fishing pressure and their adoption to the ecological bearing capacity are urgently needed. Fishery management, especially in marine protected areas, is an important instrument to protect marine biodiversity as well as commercially used fish stocks. More ecosystem-friendly fishing methods and techniques are necessary and need to be field tested. The reform of the European Common Fisheries Policy provides opportunities to move towards more sustainable fisheries in Europe.

The basis for conservation and protection measures in marine nature conservation is the knowledge about the status of ecosystems and its changes, achieved by marine monitoring. We are obliged to monitor various marine biodiversity parameters by numerous European Directives as well as International Conventions and Declarations, e.g. the Habitat and Bird Directives, OSPAR- and Helsinki-Convention and the MSFD. Many monitoring programmes are implemented in European Waters, especially on marine mammals, seabirds and also on benthic habitats. Innovative techniques and monitoring methods have been developed and established within the last years. The current German benthic analyses and comprehensive biotope mapping programme can be considered as one of the most complex benthic monitoring in Europe.

Benthic habitats and benthic species play an increasingly important role in marine nature conservation. The Red Lists serve as necessary instruments showing threat categories and health status of a great number of species and biotopes. In 2014, Germany published the Red List of marine organisms in the North and Baltic Seas. It clarified the extent to which marine species and biodiversity are endangered. But furthermore, it showed that there is a considerable lack of data on about one third of the species that can therefore not be assigned to any threat category.

The presentation briefly touches on the topic of species protection regarding sea birds and harbour porpoises. Increasing human activities in the European Seas and their impacts on the marine environment give cause for concern. The effects of offshore wind farms and their associated activities in the construction and running phase especially on harbour porpoises are severe; the cumulative effects on seabirds are not sufficiently analyzed. Promising research projects provide a lot of reliable and new data. They give hope for future conservation plans and technical mitigation measures for human impacts.

Marine Biodiversity and Marine Protected Areas

Tuesday, 15th September 2015, 10:00h

Global Ocean Process of Identifying Ecologically and Biologically Significant Areas (EBSA) – what now, what next

David Johnson
Director Seascape Consultants Ltd, Coordinator GOBI, Chair ACOPS

Deep-sea and open ocean ecosystems remain under-sampled and under-protected. In recent years Contracting Parties to the Convention on Biological Diversity (CBD) have sought to address this th-rough commitments to bring information together, as part of a scientific and technical process, reli-ant upon expert judgment using agreed criteria. This description of Ecologically or Biologically Sig-nificant Areas (EBSAs) has made rapid progress since 2011, with to date 11 Regional Workshops and 246 EBSA descriptions. The Global Ocean Biodiversity Initiative (GOBI), an international partnership advancing the scientific basis for conserving marine biological diversity, supported financially by the German Federal Agency for Nature Conservation, has played a key role providing guidance and data. Areas where the process remains incomplete include the North-East Atlantic (which is sub-ject to an on-going process) and regions yet to participate (Black Sea/Caspian Sea; South-East Asia; Southern Ocean; and SW Atlantic).

Next steps will require States and competent international organisations to acknowledge EBSA de-scriptions, recognize threats and pressures, and make arrangements to secure protection where needed. Further efforts are needed to secure ecological coherence and well-managed networks. For Area Beyond National Jurisdiction consensus at the UN to negotiate a legally binding agreement to protect biodiversity is a positive move, however, any Implementing Agreement will likely take years to formally adopt. Serious consideration must therefore be given to how to inject the momentum needed to translate scientific findings into protective measures that match political commitments by the end of the decade. The deep and open oceans are home to a major part of the world's biodiver-sity. They support an enormous wealth of productive ecosystems, specialized habitats and individual species. GOBI plans to continue to improve the scientific basis of CBD decisions, UN Resolutions, and other measures through the application of analyses, network design, training and capacity building. Ecological baseline data of this nature is vital to inform area-based management approaches and tools.

Marine Biodiversity and Marine Protected Areas

Tuesday, 15th September 2015, 11:10h

Network of OSPAR and HELCOM MPAs by 2015

Henning von Nordheim
Federal Agency for Nature Conservation (BfN), Unit Marine and Coastal Nature conservation, Germany

The development of the network of MPAs in the OSPAR and HELCOM maritime area can be traced back to different milestones:

- The HELCOM Recommendation 15/5 in 1994 which recommended that the Contracting Parties of the Helsinki Convention take all appropriate measures to establish a system of Coastal and Marine Baltic Sea Protected Areas (BSPA);
- The OSPAR Ministerial Meeting 1998 in Sintra when the OSPAR Ministers agreed to promote the establishing of a network of MPAs in the OSPAR maritime area;
- The world summit on sustainable development in Johannesburg 2002 when the Conference of Parties of the Convention on Biological Diversity agreed to establish a worldwide network of MPAs until 2012;
- The first joint meeting of the HELCOM and OSPAR Commissions in Bremen 2003, when a joint work programme on Marine Protected Areas was agreed (e.g. OSPAR Recommendation 2003/3). This intended network of MPAs in the HELCOM and OSPAR maritime regions should be ecological coherent by 2012 and well-managed by 2016;
- The CBD COP 10 when the Parties confirmed strongly the 10%-Target – i.e. 10% of the world oceans should be protected by a network of MPAs by 2020.

Regarding the OSPAR and HELCOM maritime area in this context, we are on a good way:

By the end of 2014, 5.82% of the OSPAR maritime area was protected, 413 MPAs have been designated. Almost all of these sites are located in territorial waters. Only 10 MPAs are in Areas Beyond National Jurisdiction, covering up to 9% of this important zone. There has been great progress within in the last year. For instance, in 2014, 77 MPAs were added to the OSPAR network, covering about 90,000km . But there are still some gaps, e.g. in the Arctic Waters. Currently new proposals for MPA sites are being developed. There are positive signs regarding the ecological coherence, but there is still a lot of work to do, especially for the management of MPAs. The Group on MPAs within the OSPAR is very engaged in developing criteria for the assessment of ecological coherence and for MPAs being well-managed.

Taking a closer look to the future, there is still a strong need for more MPAs in the High Seas and for more MPAs with a focus on seabird protection.

In the HELCOM maritime area, in 2015 11.9% of the maritime area is already covered by MPAs, encompassing 174 MPAs and by that meeting the CBD target.

Although there is a great progress regarding the number and the size of MPAs, there are also some gaps. There is quite a big difference between biogeographic regions of the Baltic Sea. Not all of them are adequate represented and there is also a lack of MPAs in offshore areas far away from the coastal zone. Additionally, some MPAs are isolated, at a great distance from each other and their connectivity is not satisfactory.

The HELCOM MPAs – the BSPA network – has to be well-managed by 2015 and we must state that at this point, the target has not been achieved.
Within the relevant working groups and in the different countries bordering the Baltic Sea, a lot of work will have to be done to solve these problems within the next years.

Marine Biodiversity and Marine Protected Areas

Tuesday, 15th September 2015, 11:50h

Evaluating Progress towards meeting MPA commitments – experiences from the UK

Hannah Carr
Joint Nature Conservation Committee (JNCC), UK

UK Governments confirmed their commitment towards an ecologically coherent marine protected area (MPA) network in the North-East Atlantic in 2012. To achieve this goal, policy makers, scientists and practitioners face conceptual and practical challenges around the interpretation of 'ecological coherence'. The OSPAR Convention provides a framework for assessment through its network principles, but its application to meet marine policy aspirations faces a number of challenges. Each of the UK's Administrations took forward projects to identify new MPAs to contribute to an ecologically coherent network. MPAs have been designated under both European and domestic legislation and the UK reported a further 61 MPAs to OSPAR in 2014 bringing the UK contribution to a total of 244 OSPAR MPAs. To monitor progress towards meeting their commitments, the UK Governments commissioned the Joint Nature Conservation Committee (JNCC) to produce a catalogue of UK MPAs and their protected features. We will describe how JNCC resolved a series of technical and scientific challenges when bring together information from different legislative and policy processes.

In autumn 2013, the UK Government's Department for Environment, Food and Rural Affairs (Defra) requested JNCC use the evolving UK MPA catalogue to identify any potential "big gaps" in the MPA network in English territorial waters and UK offshore waters around England, Wales and Northern Ireland (known as Secretary of State waters). Defra needed such information for planning future tranches of MPA designations to deliver their contribution to MPA networks in the North-East Atlantic. JNCC used the OSPAR framework to develop practical criteria to assess progress in the developing MPA network. Using elements of the OSPAR network principles of features, representativity, resilience and connectivity, JNCC developed seven benchmark criteria to assess progress towards an ecologically coherent network and thus highlight an 'Big Gaps' in the network. Our approach focussed on fine-scale biogeographic regions to explore options for implementing the OSPAR Commission's guidance on appropriate geographic scales. JNCC assessed areas previously recommended by stakeholders to see how they could contribute to addressing these gaps if designated a MPA, but noting additional areas may still be needed to deliver a coherent network. JNCC repeated the assessment in autumn 2014 to assess further progress following the UK's site designations earlier in the year, and to identify any potential remaining gaps in the network. This 2014 assessment refined the previous methodology with slightly amended criteria to reflect both our practical experience in 2013 and a slightly updated scope of the required assessment.

While these studies have advanced the use of the OSPAR ecological coherence framework and directly informed marine policy, challenges still remain when applying the network concept more broadly. In particular, scientific advisors face the challenge of balancing uncertainties in ecological thresholds, species' occurrences and data limitations while also providing unambiguous conclusions to policy makers under tight timescales. Ongoing work as part of the UK MPA catalogue, particularly storing data on MPA features in a standardised manner within the UK MPA database will help address some of these issues. Nevertheless, further work is needed to develop collective thinking around what an ecologically coherent network looks like, and how can it be described in a practical way to policy makers and stakeholder. The UK is actively engaging in discussions through the OSPAR Commission and the European Commission on the development of this concept and how it can be assessed. We will describe how JNCC tackled some of these challenges and provide our thoughts on how science advisors can explain these difficult concepts to the wider user community.

Tuesday, 15th September 2015, 14:00h

Progress in the implementation of the French strategy for the creation and management of MPAs

Benjamin Ponge, Neil Allioncle
Agence des Aires marines protégées, France

The development of Marine Protected Areas in France is framed by the national strategy established for the 2012-2020 period by the Ministry of Ecology, Sustainable Development and Energy. The presentation deals withthe 2015 assessment regarding the implementation of the strategy (with a focus on French Metropolitan waters only). This assessment aims at enlightening progresses made at mid-term of the strategy. It is of particular importance at national level since it will foster the third national conference for Marine Protected Areas, to be held in October 2015. This national conference occurs every 4 years, the 2015 debate will focus on the governing principles of this strategy, building upon the assessment in order to provide recommendations for the upcoming years.

The assessment is carried out according to these following governing principles for the development and management of the French MPA network, with a particular focus on connectivity::

1. A network that is integrated into a general mechanism for gaining knowledge of and monitoring the marine environment and its uses

In both ways, this part will reflect how MPAs benefit from scientific programmes and how the knowledge of the marine environment increases thanks to the MPAs. This applies as well for the ecological aspects as for the maritime activities.

2. A network that contributes to the good environmental status of marine ecosystems

In relation with ecological coherence of MPA networks assessments developed at international level (in the OSPAR Commission for instance), this section will deal with the assessment of the MPA network against criteria such as: representativity, replication, adequacy, viability, connectivity.

Although knowledge on connectivity has dramatically increased thanks to the progresses of multiple techniques (genetic analysis, modeling approaches, microchemistry....), this criteria is still under considered in MPAs development.

In order to better integrate connectivity issues within the global marine conservation context, the French MPA agency is working with the research group MarCo (for Marine Connectivity, gathering scientists from the main French research institutes) on a comprehensive overview of connectivity issues from the marine management point of view. Thus, this study will provide guidance and methods to address several key connectivity questions for MPA networks planning or assessment, but also to support management.

Here are few examples of targeted questions:

- From local to regional, how to identify the adequate scale to analyze connectivity between MPAs?
- What are the main approaches and the possible collaborations between scientists and managers to assess connectivity?
- How to assess how much important is connectivity for populations of an MPA (dependency on external input from another MPA or from non protected area)? How to assess the responsibility of an MPA for seeding other MPAs or non protected areas (export of individuals or larvae)?
- How to address the diversity of connectivity patterns of the thousands of species that live in an MPA? How to select relevant surrogate species?

3. A network that contributes to the maintenance or sustainable development of maritime economic activities

Two types of French MPAs (Natural Marine Parks and National Parks) can actively contribute (financially for instance) to the development of human activities, as far as they aim at enhanced sustainability in accordance with the conservation objectives of the MPA. We will present how this integration and support of human activities may help to improve practices while maintaining social and economical values.

4. A network included in the integrated policies for marine environmental management and which contributes to the land-sea coherence of public policy

Beyond the MPA network itself, this principle raises the issue of the integration of the MPAs in other sector-based policies or marine policies. This entails for instance the fact that MPAs are adequately considered in the MSFD or in the planning of the maritime space. The issue of coherence between terrestrial and marine parts is also critical and we will highlight how MPAs are taken into account in the decisions at land.

5. A network that meets multi-scale objectives

The MPA network is implemented to reach goals set at national level, but also to meet the requirements of European directives and other international agreements or targets. We will present here how far the French metropolitan network goes in the achievement of this range of objectives.

These principles are also complemented by operational strategic axes that are part of the assessment such as: strengthening the creation of natural reserves, contributing to the management of fishery resources, pooling the existing conservation tools, encouraging adaptive management, regulation and control, monitoring and assessing management effectiveness, estimating financial costs.

Tuesday, 15th September 2015, 14:20h

Canyon heads in the French Mediterranean Sea – Conservation issues

Pierre Watremez
Agence des Aires marines protégées, France

The numerous submarine canyons cutting across the Mediterranean continental shelf represent key habitats for understanding and managing the biodiversity of coastal areas and the continental shelf. The canyons are extremely frequent in the Mediterranean sea. They are a pathway of transferring matter between the coast and the deep sea. They can represent biodiversity hotspots and recruit areas for many species.

Kwnoledge of these poorly studied habitats is crucial for the implementation of the Barcelona convention, to extend Natura 2000 off-shore network, to define new marine protected areas and to build their management plans.

The MEDSEACAN and CORSEACAN data acquisition campaigns were organized from 2008 to 2010 between Spain and Monaco, and off the western coast of Corsica. These cruises aimed to obtain a reference state of the ecosystems between a depth of 100 and 700 metres, including specific information about the presence and distribution of deep-sea corals and specific biological species (fish, crustaceans, cnidarians), and data about these ecosystems and the impact of human activities in these particularly vulnerable areas.

These campaigns are conducted by the French Marine Protected Areas Agency in partnership with various scientific and were the very first attempt to systematically explore the French Mediterranean deep sea canyons.

The surveying effort was distributed as equally as possible among canyons in order to allow comparisons. The canyon slopes were explored using the same methodology. The description of the environment is based mainly on the acquisition of image data (photos, video) obtained from manned or unmanned submarines. Megafauna species were visually identified based on samples taken during the campaign where possible. The same scientific treated team the data (568 hours of diving video records including 18 hours of HD video, 17600 HD photos, dozens of samples).

We can do general remarks: a) There is a great heterogeneity between the canyons as regards their shape, geology and distance from the coast, b) A brief review of the biodiversity shows some significant differences between the rocky canyons: the canyons in the eastern part show that the presence of hard substrates does not necessarily mean that there is any significant fixed fauna. Many vagile, or even fixed species, were observed in some silted canyons, c) Certain species observed are very rare in the Mediterranean and descriptions were brief. Several of these species are considered to be endangered by the IUCN, d) New occurrences of cold corals were observed.

The anthropogenic impact is easily visible with a clear accumulation of waste (mainly plastic) where the continental shelf is narrow and the canyons are close to large cities such as Marseille and Nice. On the silted canyons in the Gulf of Lion, fishing activity is visible (traces of trawl nets). In canyons with rocky slopes, there are many lost nets and longlines. On the Corsican canyons, the communities are in a good state of preservation instead of continental canyons.

The acquisition of data from these campaigns contributes to scientific research in various disciplines (biology, zoology, ecology, geology, oceanography, etc.). Data compiled in a Geographic Information System is available to scientists and has already been used for several publications.

Data have clarified the boundaries and issues of two marine protected areas. The Lacaze-Duthiers and Cassidaigne canyons are exceptional biodiversity hotspots. In the Lacaze-Duthiers canyon, exu-

berant colonies of Madrepora oculata and Lophelia pertusa were observed, together with numerous vagile and sessile species. The colonies of Lophelia are the largest ever observed in the Mediterranean to date. Biodiversity in the Cassidaigne canyon is heterogeneous, although a highly varied fauna was found in one localized sector - with a diversity of anthozoans observed nowhere else in a single site. These observations fully justify that these sites were specifically protected through new marine protected areas: a) The canyon heads of Lacaze-Duthiers and the two canyons further east have thus been incorporated into the Gulf of Lion marine nature park boundaries, b) A part of the Cassidaigne canyon is included within the Calanques national park.

The results of MEDSEACAN-CORSECAN campains are currently being used by French Museum of Natural History to improve the current typology of deep marine habitats in Mediterranean. The main changes concern bathyal rocky habitats.

Data have contributed to the establishment of the initial assessment of the bathyal benthic ecosystems in French submarine canyons of the Mediterranean for Marine Strategy Framework Directive.

Tuesday, 15th September 2015, 15:00h

Marine Conservation in Portugal - Recent Progress and Perspectives

Antonio Teixeira
DGRM, Ministry for the Sea and Marine Affairs, Portugal

Background

Portugal in world history is acknowledged as a maritime nation which spread across the Ocean. Nature conservation in a modern shape came in 1971 with a marine Reserve on the Salvages, at 160 nautical miles south of Madeira Island. It was contemporary to international debate on Exclusive Economic Zones (EEZ) in the United Nations Convention on the Law of the Sea (UNCLOS).

Following political changes in 1974 a network of protected areas was established under national legislation and Natura 2000 contributed later to expand it further. Outstanding progress was achieved in Madeira and the Azores. Some marine sites became OSPAR MPAs.

Facts and Perspectives

In 2009 Portugal has submitted to the Commission on the limits of the Continental Shelf a claim to the seabed and subsoil beyond 200 nautical miles. According to UNCLOS this brought under Portuguese jurisdiction a substantial marine area in the NE Atlantic, covering more than 3 800 000 km2 on the seafloor.

Portugal has therefore the opportunity (and the international duty according to UNCLOS) to bring sound conservation principles to the management of these areas. There are still many gaps in our global understanding of deep sea ecosystems and a precautionary approach is required to ensure wise use of any living and mineral resources. This makes an excellent case to develop a coherent network of MPAs across the whole marine area under Portuguese jurisdiction. We need a coordinated effort and cooperation with relevant partners worldwide.

So far Portugal has taken important steps to fulfill this purpose. Further measures are scheduled and will follow soon.

National legislation was passed in 2014 to ban the use of fishing trawls and other bottom contacting gear (except for longlines) in most seabed areas under Portuguese jurisdiction. These measures aim to defend seabed integrity and they apply to fishing vessels flying the Portuguese flag. A formal request was forwarded to the EU Commission in order to make the same rules applicable to all fleets under the Common Fisheries Policy (PCP).

Meanwhile Portugal has contributed sites in its territorial waters off western Iberia to be part of the OSPAR network of MPAs. Designation occurred in February 2015 and the combined area of the five new sites is 53 627 km2.

To fulfill commitments at the OSPAR Ministerial Meeting in 2010 Portugal is taking measures to protect the seabed of seamounts Altair and Antialtair, plus a large area on the seafloor of the Mid Atlantic Ridge North of the Azores (MARNA), which are included in the Portuguese claim to the extended Continental Shelf. The superjacent water columns outside the EEZ already are High Seas MPAs, following a collective arrangement invited by Portugal at OSPAR and supported by all other contracting parties.

To help achieving a coherent global network of Oceanic MPAs Portugal has chosen to designate another two big areas offshore, on large seamount complexes within its jurisdiction. Protection in the adjacent High Seas will be addressed at OSPAR.

The Madeira-Tore MPA covers 139 406.53 km2 on the seafloor between Madeira Island and Cape St.

Vincent. Water columns in the EEZ are included (103 006.17 km2). The MPA comprises seamounts Seine, Unicorn, Lion, Dragon, Horseshoe, Josephine, Gago Coutinho, Hirondelle, Ashton, and Tore. The Gorringe Bank is also included and its summit reaches the photic zone in peaks Ormonde, and Gettysburg (-28 m).

The Great Meteor MPA develops around a large underwater archipelago south of the Azores. It covers a total area of 123 238 km2 on the seabed (13 788 km2 in the EEZ). Important features in the MPA include seamounts Great Meteor, Small Meteor, Plateau, Hyères, Irving, Plato, Atlantis, Tyro, and the Cruiser underwater plateau.

Three large MPAs are planned at underwater canyons of Nazaré, Espichel/Comporta, and Cape St. Vincent, to promote cetacean protection in deep water close to the Portuguese mainland.

The new MPAs will be part of the OSPAR network. Attention shall also be paid to the possibility of including parts of them in Natura 2000.

The challenge ahead now is how to ensure adequate management of these big MPAs.

Tuesday, 15th September 2015, 15:20h

Progress in coastal marine conservation in the Azores

Mara Schmiing, Pedro Afonso, M. Santos M, D. Milla
IMAR; University of the Azores, Portugal

Much progress has been made since the first MPAs were designated about three decades ago in the Azores. 17 marine Natura2000 SACs and 2 SICs were designated in the early 2000's, the Azores Marine Park (AMP, a network of offshore MPAs) was created, and nature parks (INPs) were designated until 2011 in each of the nine islands. The AMP and INPs integrate local SACs/SICs and include various MPAs following IUCN classification and objectives. All INPs together protect about 32% of the costal habitat down to 50m, meeting international recommendations of the Convention for Biological Diversity (CBD) or the World Parks Congress (WPC) to protect at least 10-30% of each marine habitat. However, the design and implementation process need an urgent revision: 1) protection varies widely among islands (e.g. 8% - 100% of coastal habitats), 2) protection to the island shelves habitat is substantially smaller (total 13% of habitat from 50 to 200 m) even though these habitats are very important (e.g. by holding Vulnerable Marine Ecosystems deep-water coral and sponge banks), 3) many MPA units are quite small (ca. 1 km2, only 10 of the 34 MPAs larger than 10 km2), 4) only five sites are no-take areas (IUCN category I Nature Reserve), the remaining currently being only partially protected from extractive activities, and 5) enforcement of regulations is often insufficient. In this respect, the Azorean coastal MPA network does not yet ensures that international conservation objectives are met. The fact that management plans for the INPs are in preparation and that novel, critical information is now becoming available from research (e.g. maps of VME, essential fish habitats and critical biodiversity hotspots) create a good opportunity to assess and revise the current network.

Fishery management in MPAs

Tuesday, 15th September 2015, 16:30h

Advice on managing fisheries in MPAs

Mike Quigley, Mark Duffy, Jen Ashworth
Marine Programme Team, Natural England, UK

In English and adjacent UK offshore waters the Government is undertaking a significant project seeking to asses commercial fishing activities against MPA conservation objectives and to apply suitable management measures where needed . MPA advice is provided by Natural England and JNCC, and management put in place by the Inshore Fisheries and Conservation Authorities, the Environment Agency, the Marine Management Organisation or the European Commission. Work initially focussed on Natura 2000 sites but the project now includes Marine Conservation Zones. Representatives from both commercial fishing and the NGOs are engaged through an Implementation Group.

Due to the scale of the task, management has been introduced on a risk prioritised basis i.e. initially bringing in measures where either significant damage was being caused or had potential of occurring and there was supporting evidence for such. Byelaws have already been enacted for high risk features. This paper will focus on an approach currently being explored to address some of the lower risks where the level of evidence is lower. The approach has been termed “adaptive risk management” and here we will consider its application to commercial fishing. This approach has already been taken forward in the terrestrial environment e.g. in nutrient management plans for impacts on SACs.

The intention is to avoid introducing overly precautionary measures yet still maintain sufficient protection for the site’s interest features (and meet Article 6 obligations when for SACs /SPAs). This approach allows progress towards favourable condition but should be accompanied by an appropriately designed monitoring programme that can detect change, and with management measures being reviewed in light of such changes. Adaptive risk management can only be utilised if these qualifying criteria can be met.

Fishery management in MPAs

Tuesday, 15th September 2015, 17:10h

A scientific approach to MPAs as a fishery management tool

Alf Ring Kleiven
Institute of Marine Research, Norway

In 2006, four lobster *(Homarus gammarus)* reserves were implemented along the Norwegian part of coastal Skagerrak in collaboration between fishers, managers and scientists. Based on well documented rapid rebound of lobster within the reserves, the Directorate of Fisheries included reserves as a management tool for lobster in 2013. In parallel, new and larger MPAs, including a no-take zone, have been implemented in order to explore the potential of MPAs as a fishery management tool for cod *(Gadus morhua)* and lobster in coastal Skagerrak. In this talk, we will present how the potential of MPAs as a fishery management tool is explored in collaboration between local stakeholders, municipalities, national management and science. We will present the collaborative implementation process, the on-going research program and some preliminary results 3 years after implementation.

Fishery management in MPAs

Tuesday, 15th September 2015, 17:50h

Impacts of bottom set gillnet anchors on the seafloor and associated flora – potential implications for fisheries management in protected areas

Thomas Kirk Søerensen, Finn Larsen
National Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark, Denmark

In relation to management of fisheries within marine Natura 2000 sites, some European countries are currently leaning towards prohibiting fishing with mobile, bottom contacting fishing gears in areas designated for reefs. In contrast, use of passive gears such as gillnets and traps/creels is likely to be permitted. However, while the exclusion of mobile, bottom contacting fishing gears is based on many years of scientific research on gear impacts on the seafloor and associated flora and fauna, the permission to employ bottom set gillnets in reef areas is based on a relatively uninformed assumption that the physical impacts of gillnets are insignificant. A field study of gillnet anchor impacts was carried out in 2014/2015 in the Sound (Denmark) using stationary underwater video cameras to document and analyze the impacts of gillnet anchors during hauling. Video footage documented physical impacts ranging from zero impact to removal of algae and seagrass, alteration of reef structure and physical disturbance of the seafloor sediment. These observations indicate that while the impact of individual gillnets may be limited, gillnets and their anchors may represent a significant impact in reef areas with high levels of gillnet effort. Results (incl. video footage) of this experiment will be presented and further discussed in the general context of fisheries management in Natura 2000 sites and proposals for mitigation of impacts will be proposed.

Marine Nature Conservation and Fisheries

Wednesday, 16th September 2015, 9:00h

Fisheries management on the international Dogger Bank: a primer for nature conservation in the North Sea

Ton Ijlstra
Nature Conservation Department, Ministry of Economic Affairs, Netherlands

Since 2006 North Sea states have attempted to coordinate their efforts in respect of fisheries management in the marine protected areas (ref. EMPAS, Fimpas). These coordination efforts were mainly geared towards achieving fisheries measures for the Member States' own Natura2000 sites situated within the national jurisdiction. In 2011 the Dogger Bank Steering Group was formed. Its task is to coordinate fisheries measures proposed by Germany, UK, and the Netherlands with the collaboration of Denmark for the Natura2000 sites on the Dogger Bank. Scientific Advice was sought and provided for by ICES. ICES also provided for support in the process of drawing up the submission to the EU. This contribution describes the successive steps Dogger Bank states have taken to get to an agreement an the mutually coordinated and holistic approach they have undertaken in order to reach agreement on a fisheries regime for the international Dogger Bank that safeguards the conservation targets as agreed by these states. It will be shown what are the factors for success and which factors have been decisive in relationship to the support that Dogger Bank states sought from the Stakeholders. The role and contributions of stakeholders have been inventoried. Special attention will be given to the role of the European Commission which attended the meetings of the steering group as an observer. This question is relevant since during the Dogger Bank negotiations the Common Fisheries Policy was revised and a whole new set of rules and procedures entered into force during the work of the Dogger Bank Steering Group. Furthermore the fact that these states intended to submit a joint request to the ECommission for coordinated fisheries measures also raised the question as to whether states were individually acquitted for their legal obligations under the EU regulations and directives if they submit a collective request.

Special attention will also be given to the role of Denmark, which although being a Dogger Bank state does not have a Natura2000 site on the Dogger Bank. Why did Denmark participate?

By showing maps of the Dogger Bank as these were conceived at different stages of the negotiations the positons of states will be illustrated

The Dogger Bank process shows how states and the EC have got on grips with an entirely new situation viz. multilateral cooperation between states to comply with EU obligations in the field of fisheries which fall under the exclusive jurisdiction of the EU.

Marine Nature Conservation and Fisheries

Wednesday, 16th September 2015, 9:40h

Influence of discard ban on transition towards more selective fishing gear

Jurgen Batsleer, J.J. Poos, K. Hamon, H.M.J. Overzee, A.D. Rijnsdorp
IMARES, Institute for Marine Resources and Ecosystem Studies, Netherlands

A large part of demersal fisheries catches constitute of undersized target species. Minimum landing size (MLS) regulations require a fisher to discard this part of the catch, causing additional mortality and hence reducing future yield of a fishery that is already in a fragile economic situation. Discard reduction is high on the agenda of EU fisheries managers wherein modifying current fishing technologies (pulse trawling) are among the possible adaptive strategies of fishers to cope with the changes in management (e.g. discard ban). Given the current situation in which a discard ban and technical modifications are gradually being introduced, this study explores the economic and environmental implications of a discard ban for mixed fisheries with two gear types that differ in their selectivity for the target species. Our hypothesis is that the economic returns resulting from the discard ban are not equal among different fisheries and thus may enhance the transition towards a more selective gear. We will use a Dynamic State Variable Model (DSVM) for testing this hypothesis for a bottom trawl fleet targeting several flatfish species in the North Sea.

Wednesday, 16th September 2015, 10:20h

Can automatic longlines and jigging-machines replace gillnets in bycatch conflict areas? Results of a Baltic Sea research project

Kim Detloff
NABU e.V., Germany

The incidental bycatch of sea birds and marine mammals in Europaen gillnet fisheries is an ongoing conflict in marine Natura 2000 sites and beyond. Žydelis et al. (2009) reviewed 30 studies and estimated that at least 76 000 birds killed by gillnets in the Baltic Sea each year. This annual mortality is thought to have decreased in recent years, driven by the severe decline in seaduck populations (Skov et al., 2011). Bellebaum et al. (2011) estimated a current annual bycatch of 17.550 birds solely on the German Mecklenburg-Vorpommern coast. Not only are sea birds affected. Each year more than one hundred harbour porpoises are washed up on German Baltic coasts, almost 50 per cent are suspected bycatch victims showing net marks on their body surface. The eastern population of the Baltic harbour porpoise is threatened by extinction (IUCN Red List 2014).

The Natura-2000 marine protected areas are designed primarily to protect marine biodiversity and restore favourable conservation status for species and habitats in accordance with the EU Birds and Habitats Directives. In developing an effective fisheries management Germany has taken the lead of an international ICES research project called “Environmentally Sound Fisheries Management in Marine Protected Areas!” (EMPAS). The project was completed in 2008 and worked out concrete management advices for fisheries with gillnets to protect wintering sea birds and harbor porpoises including spatio-temporal closures and the promotion and development of ecologically-sound gear.

In order to replace gillnets in so called “bycatch conflict areas” different alternative fishing techniques could be applied, inter alia different types of baited pots, fish traps, jigging-reels and automatic longline systems. Many of these are already in practice in various fisheries across the world.

NABU coordinated a three-year project commissioned and financed by the Federal Agency for Nature Conservation (BfN) started in December 2012. The project was aiming to test fisheries with an automatic longline system and four jigging machines in order to investigate their application in German waters. Whereas the jigging-reels have been applied sporadically with a focus on winter months, the longline system has been applied for an entire season (June 2014 – May 2015). Different workshops with fishermen, fisheries scientists, authorities and nature conservation experts have been organized to improve collaboration and ensure transparency of project development.

The talk will introduce the project approach, is outlining central developments, main obstacles and progress made and will present first results of test fisheries. The systems tested have been modified during the project period and experiences made are used to feed into other projects on alternative gear types.

Marine Nature Conservation and Fisheries

Wednesday, 16th September 2015, 11:30h

Spatial and seasonal pattern of shrimp fisheries in the German Wadden Sea and adjacent North Sea

Hans-Ulrich Rösner, Dr. Viola Liebich, Helga Kuechly
WWF, Germany

The Wadden Sea and the adjacent North Sea areas comprise the main fishing grounds for brown shrimp (Crangon crangon). Landings of the Dutch, German, Danish, British, Belgian, and French fleet for 2013 totalled 34,685 tons, of which Germany accounted for 36 % (ICES WGCRAN Report 2014). While more than 8 years ago the discussion started whether the brown shrimp fishery would be suitable for an MSC certification, there is no quota under European fishery legislation and only little information on the stock. And although a large proportion of the fishery takes place within Marine Protected Areas (MPAs) such as the Wadden Sea, there is also little information about the quantitative use of such areas. Moreover, e.g. in Germany the need for nature conservation has not resulted in significant regulation of the shrimp fishery.

To contribute to the factual basis for the discussion on the Fisheries and the MPA management we analyzed the spatial and seasonal distribution of the German brown shrimp fishery within the German North Sea waters for the period from 2007 to 2013 and based on VMS (Vessel Monitoring System) satellite data. We present numbers on the actual use of the different sea zones ranging from the exclusive economic zone to the inner waters and also for all MPAs which could potentially be used. We also compared the fishing effort among the different tidal basins within the Wadden Sea National Parks.

It is our intention that the findings contribute to the discussion about a sustainable shrimp fishery which is fully compatible with the protection goals of the MPAs concerned.

Wednesday, 16th September 2015, 12:10h

Gear technology concepts to support sustainable fishery

Daniel Stepputis, Juan Santos, Bernd Mieske
Thuenen-Institute of Baltic Sea Fisheries Rostock, Germany

Most fisheries use highly productive fish stocks. Therefore, fishery can significantly contribute to world food-supply in long-term. However, the basis is an environmental and economic sustainable fishery, which uses natural resources and marine environment in a responsible way. Consequently, there is a rethinking process in the society, fisheries management and – last but not least – in fisheries itself. Additionally, the influence of sustainability and ecological imprint of food production on consumer's decisions will increase. Such developments support a change in fishery and an increasing demand for sustainable, ecosystem adapted and energy-saving fishing gear. The change in European fisheries management – including a stepwise introduction of a landing obligation – will produce further need for action.

Consequently, gear technology research has fundamentally changed over the past 20 years. Historically, the target was to improve fishing efficiency. Nowadays, the research questions include how to develop the fishing process towards improved ecological and economic sustainability (incl. improved energy efficiency, reduced gear impact on the marine environment, reduction of unwanted bycatches).

Current examples for new gear technology concepts, which were developed and/or tested in our working group, will be presented. This concept-toolbox for fisheries contains – amongst others - several tools to obtain multi-species selectivity in mixed fisheries and pulse-trawls for fisheries:

a) Many fisheries around the world are mixed fisheries. Nevertheless, gear developments in the past (e.g. codend-modifications) mostly focused on single species selectivity. A good example is the mixed bottom trawl fishery in the Baltic Sea. Since different species often have different selectivity properties (e.g. flatfish vs. roundfish), it is difficult to optimize selectivity for both types of fish solely within the codend. Consequently, new concepts for multispecies selectivity were developed and tested.

b) New gear concepts are also available for beam trawl fisheries. We will present the results of a long-term test of a shrimp-pulse-trawl-system. This includes comparison of catches (commercial catch, bycatch), energy reduction and potential further improvements.

Monitoring, Mapping & Methods

Wednesday, 16th September 2015, 12:50h

Short Note: Global fishing impact / fishery watch

Lasse Gustavsson
Senior Vice President and Executive Director of Oceana in Europe, Sweden

Global Fishing Watch is the result of a collaboration among Google, Oceana and SkyTruth to map and measure fishing activity worldwide. Global Fishing Watch is made possible by the availability of data from the Automatic Identification System (AIS), used by more than 100,000 vessels worldwide. The system analyzes these data to identify behavior consistent with fishing, and gives citizens everywhere in the world the information they need to examine that behavior in the context of global fishery management rules and ensure that the government agencies responsible for managing commercial fishing fleets are accountable for delivering a healthy, diverse and maximally productive ocean.

The Global Fishing Watch prototype demonstrates a system unlike any existing AIS fishery tracking service because it will be: free, global in scale, easy to use, and available to anyone in the world with an internet connection.

Illegal, unreported and unregulated fishing is one of the greatest threats to the long-term economic and environmental sustainability of global ocean fisheries. Activities like fishing in restricted areas, ignoring quotas, catching prohibited species or failing to accurately report catches now account for an estimated 11-26 million tons of fish caught each year and $10-23 billion in economic losses for countries and local communities.

The long-term health of our oceans depends on action by governments, fishery management organizations, citizens and the fishing industry itself. Governments must set and enforce scientifically based limits, and set policies to protect the ecosystems on which fishing depends. Fishing companies must follow those rules, and citizens must hold government and the industry accountable. Global Fishing Watch is designed to empower all stakeholders so that together they may work to restore fishery abundance, especially to governments with limited resources to monitor the extent and nature of fishing in their national or local waters. They will be able to enforce fishing restrictions such as trawling bans and no-take zones or use this system to assess the character of the vessels to help enforce areas set aside for small-scale or local fishermen. In addition, it will allow governments requiring AIS to track and assess the behavior of vessels registered in their countries. This tool could enhance the ability of countries to block imports of fish from vessels flagged in countries that fail to enforce fishery laws.

Global Fishing Watch analyzes AIS data to create a complete and continuous track of a vessel's movements including speed, accelerations and decelerations, changes in direction, and proximities to other vessels and landmarks like ports and boundaries of marine protected areas. The system is based on openness, from the original data itself to the final web portal, which will be free to the public and available to anyone who wishes to use it.

By helping to manage fisheries more sustainably, Global Fishing Watch will help bring back fishery abundance, protecting and enhancing the livelihoods of the hundreds of millions of people around the world who depend on ocean fisheries for food and income.

Wednesday, 16th September 2015, 13:10h

Short Note: Satellite Tracking to Create Transparency in Fishing

Alfred Schumm
WWF Smart Fishing Global Initiative, Germany

Good systems to monitor global fishing activities and track fish catches are fundamental to create transparency at sea and stop illegal fishing. Fortunately, the technology exists today to make monitoring fisheries and tracking catches possible.

Technologies such as the Automatic Identification System (AIS), Vessel Monitoring System (VMS) or Global System for Mobile Communication (GSM) can be of great help to create transparency. AIS is an open communication tool widely used in commercial shipping to help ships avoid collisions. It can be captured by satellite and provides information about GPS location, speed, direction of travel and ship identity. VMS is a fishery management system which allows selected groups to track and monitor the activities of fishing vessels. GSM based systems are vessel tracking systems which can track small scale fishery vessels and have a low power consumption.

WWF and its partner navama, the Munich based technology company, have been actively promoting a new, affordable way to use satellite data to monitor fishing operations, known as the Automatic Identification System. Our aim is to make fishing operations more transparent and to ensure that the seafood reaching markets is fully traceable to legal sources.

To achieve this we have developed **four tools** based on Vessel Monitoring technologies:

We visualize routes of fishing vessels, and cooperate with fisheries who want to make their operations transparent and register on our new website www.transparentsea.org. They can show their customers that they are committed to legal and responsible fishing and demonstrate that they respect boundaries of sensitive areas and no take zones and use responsible fishing practices.

We also developed a new web based fishery track data analysis platform for fisheries experts called **seeOcean explorer** - an analysis tool for marine geographic information and AIS/VMS/GSM tracks. It enables access to a big AIS satellite database with data about global AIS coverage, individual shared fishery tracks, marine protected areas, wind and waves, track patterns, ports, and economic data which can be combined and visualized to provide a holistic view of fishing operations. It can be used by governments, supply chain representatives, fishermen and scientists to monitor and visualize fishing activities worldwide.

The **smartTrack** is a vessel tracking system for artisanal fisheries based on vendor independent hardware solutions.

Finally, **SEEyourFISH** is a European economic interest group working towards value increase of sustainable certification processes and seafood labels in joint effort by WWF, navama and LuxSpace, the technology and space company.

All these tools contribute to improve collaboration on transparency between fisheries, NGOs, administration, the seafood industry and science.

WWF urges national governments, Regional Fisheries Management Organisations as well as states flagging fishing vessels operating on the high seas to promote transparency at sea and adopt mandatory installation of the AIS system on all commercial fishing vessels under their flag or fishing in their national waters in addition to monitoring, control and surveillance (MCS) measures currently used such as VMS systems.

Thursday, 17th September 2015, 9:00h

Progress in marine biotope mapping in Germany

Roland Pesch[3], Claudia Propp[4], Alexander Bartholomä[5], Kolja Beisiege[11], Dieter Boedeker[7], Alexander Darr[1], Dario Fiorentino[2], , Christian Hass[7], Peter Holler[5], Maria Lambers-Huesmann[4], Peter Richter[6], Svenja Papenmeier[7], Bastian Schuchardt[3], Klaus Schwarzer[6], Franz Tauber[1], Manfred Zeiler[4]; Michael Zettler[1]

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[6] Christian-Albrechts-Universität zu Kiel, Institut für Geowissenschaften
[7] Federal Agency for Nature Conservation (BfN), Germany

All authors were involved in the first phase of the Project Biotope Mapping in the German EEZ of the North and the Baltic Sea funded by the Federal Agency of Nature Conservation and carried out between 2012 and 2014. Kolja Beisiegel, Alexander Darr and Michael Zettler thereby dealt with the benthic biological investigations in the Baltic Sea, Dario Fiorentino, Roland Pesch and Bastian Schuchardt addressed the empirical works in the North Sea. All named scientists were responsible for the development of biotope maps applying expert based classification systems as well as GIS- and statistical mapping tools on biotic and abiotic geodata. Manfred Zeiler and Claudia Propp coordinated the full coverage sediment mapping by means of hydroacuostical methods and ground truthing (grab and video sampling). The empirical field work was performed by the Federal Maritime and Hydrographic Agency of Germany, the Alfred Wegener Institute (AWI Sylt), the Senckenberg am Meer (Wilhelmshaven), the Institute of Geosciences of the Christian Albrechts University (Kiel) and the Institute for Balitc Sea Research.

Detailed knowledge on the distribution and the characteristics of benthic biotopes and biotope complexes are major prerequisits for their assessment and monitoring as implemented in the Federal Nature Conservation Act and the Habitats Directive as well as the Marines Strategy Framework Directive of the EU. While large-scale homogeneous soft-bottoms are satisfactorily covered by existing broad-scaled sediment maps (scale 1 : 100.000 – 200.000), the mapping of more heterogeneous areas, exhibiting small scale change of various sediment types or a mixture of soft and hard bottoms, need a more sophisticated approach such as hydroacoustic techniques (e.g. side-scan-sonar). A requirement for the assessment of the status of benthic biotopes is a better understanding of the direct linkage of the substrate to its associated macrobenthic community.

The underlying mapping methodologies and results were worked out within the project Biotope Mapping in the German EEZ of the North and the Baltic Sea funded by the Federal Agency for Nature Conservation and the respective institutes involved. The project is based on the concept of stepwise production of biotope maps of the German parts of the North and Baltic seas. These are based on existing and newly collected benthos and sediment data as well as on further geodata relevant to assess the spatial heterogeneity of the abiotic and biotic conditions at the ocean floor. The data are structured and classified according to international, expert-based classification systems. Furthermore, predictive modelling techniques are applied to map the spatial distribution of benthic species and communities.

The project is structured in different phases with the overall goal to produce high resolution biotope maps for the Exclusive Economic Zones of the German North and Baltic seas. In the first phase of the project low resolution, but full coverage biotope maps were calculated using a large amount of geodata that was structured in an ArcGIS Registry Biotope Mapping. The full coverage biotope mapping in the North Sea EEZ relied on classification rules of a modified version of the European Nature Information Systems (EUNIS) – EUNIS+, for the Baltic Sea the Underwater Biotope and Habitat

Classification System (HUB) of HELCOM was applied. Each of these classification system is structured into six hierarchical levels of which the upper three levels contain abiotic and the lower three levels contain the biotic classification criteria. The latter three levels consider threatened biotopes such as those defined by the Federal Nature Conservation Act. All biotope maps are based on predictive modelling techniques where biological variables of interest are investigated regarding their statistical associations to the abiotic conditions at the sea floor. These associations were quantified in terms of decision rules and then applied on full coverage information on abiotic variables.

Within the first phase of the project the investigations concentrated on the eight Natura 2000 sites in the EEZ. The same holds true for the sediment mapping performed by hydroacoustical methods. Based on a new guideline for the sediment mapping data collection and interpretation is performed in a manner producing a consistent layer of defined sediment classes. Their benefit is a much more reliable information on the heterogeneity of the seabed which supports understanding the benthic diversity and identify boulder fields hosting geogenic reefs.

Along with other biological data, a large amount of data is available to produce EUNIS+ and HUB biotope maps within the protected areas at the end of the project. The presentation at hand will introduce a mapping design accounting for the high resolution data available, representativity criteria, downscaling of abiotic descriptors and predictive modelling techniques. First coverage maps will be presented for one example area each in the North and the Baltic seas emphasizing threatened biotopes that should be handled with care and excluded from economic use in the future. The talk will therefore give an insight into the remaining work to come until the end of the project in the next decade.

Thursday, 17th September 2015, 9:20h

Investigation and classification of reefs in the German Baltic Sea (biotope mapping)

Alexander Darr, Kolja Beisiegel, Michael L. Zettler
Leibniz Institute for Baltic Sea Research Warnemünde (IOW), Germany

Within the project Biotope Mapping in the German EEZ funded by the Federal Agency for Nature Conservation, high resolution maps of benthic habitats and biotopes in the North and Baltic Sea are produced. While subtidal, low-relief terrains with homogenous soft-bottoms are satisfactorily covered by existing sediment maps and can directly be linked with their associated infauna communities by predictive modeling, hard-bottom biotopes are difficult to map and classify. Representing anomalies within vast sand and mud flats, they often occur patchy and vary in size from two to hundreds of square meter. Hard-bottom habitats are either biogenic concretions (e.g. mussel beds) or of geogenic origin (e.g. boulder fields). If these structures are topographically distinct from the surrounding seafloor and host a specific community that depends on the hard substrate rather than the nearby sediment, they can be classified as reefs or reef complexes.

Reefs are often home to a variety of species and functional groups not found elsewhere. Hosting a diverse, exclusively epibenthic community with motile and attached, colonial and individual species, they generally make a significant contribution to benthic production and play an important role for marine food webs. Erect biota (e.g. kelp) additionally enhances the three-dimensional habitat complexity, alters the physical and biogeochemical micro-scale environment and thus affecting the distribution of smaller-sized bottom fauna as well as mobile megafauna. Despite the brackish environment, also the Baltic reefs provide a habitat for many marine invertebrates, serve as nursery ground for fish and offer food for marine mammals and birds. Isolated hard structures such as glacial boulders provide refuges and stepping stones for sessile organisms. Due to their ecological value, reefs are generally protected in German waters (EU Habitat directive). However, little is known about the community structure and functionality of Baltic reefs, especially in offshore areas, and a coherent classification is lacking.

The object of the present study is to develop adequate mapping techniques for hard-bottom biotopes and to describe the diversity and functionality of reef habitats and their associated communities in the German Baltic EEZ. Based on high resolution sediment maps, providing more detailed information on the heterogeneity of the seafloor and the location of hard substrates, biological investigations were conducted. Following methods and results refer to a case study carried out on hard substrates in the Fehmarnbelt area.

Drop-frame photography and towed video platforms were deployed to give an overview of both the overall structure and distribution of epibenthic reef communities and the small scale heterogeneity. Macro- and megazoobenthic species as well as marine macrophytes were identified, species coverage was calculated and distribution range was annotated during the surveys. These information were used to set up a station network for quantitative investigations by scuba diving along depth gradients. A modified Kautsky frame was used to sample the epibenthic communities, allowing the determination of biomass and diversity. Finally, sedimentological and biological data were combined to classify hard-bottom biotopes following the HELCOM Biotope and Habitat Classification System (HUB). The resulting maps are important tools both for the scientific community to understand the functioning of marine ecosystems as well as for nature conservation, e.g. for the implementation of MPA management plans, for the development of monitoring concepts and the red list classification of biotopes.

Thursday, 17th September 2015, 10:00h

Short Note: Conceptual ecological models in benthic habitats monitoring

Joe Turner, Hayley Hinchen, E. Verling
Joint Nature Conservation Committee, Marine Ecosystems Team, Peterborough, UK

Conceptual ecological models (CEMs) are visual representations of a target system (e.g. ecosystem, habitat, protected site) which summarise complex ecological interactions. They facilitate the selection of monitoring indicators by identifying key biological components, environmental drivers and aspects sensitive to human pressures. Although CEMs are recognised as an important step in terrestrial monitoring programmes, they are rarely used in the marine environment due to greater ecosystem complexity and a lack of information for many habitat types. However, with increased legislative demands to monitor and assess benthic habitat condition, the need to develop CEMs has never been greater. As part of the UK Marine Biodiversity Monitoring R&D Programme, the Joint Nature Conservation Committee (JNCC) has developed a methodology for creating habitat CEMs. This is based on a thorough literature review and incorporates knowledge gap analysis, confidence assessment and peer-review stages. A hierarchical set of models is produced which includes a general model to represent the entire habitat and various sub-models which investigate constituent biotopes or biological communities in more detail. The models describe environmental drivers at global, regional and local scales and how these drivers influence the biological assemblage groups. Faunal interactions, ecosystem functions and feedback systems are also expressed. Ecosystem complexity is captured by displaying the impact and magnitude of each interaction and the degree of natural variability for each model component. The species and ecological groups included within the models relate to sensitivity assessments, highlighting aspects of the habitat important for monitoring both natural variation and human-induced change. The models are used as a qualitative tool to identify potential relevant indicators and inform recommendations for future research. The greater understanding of habitat ecology provided by the models will aid subsequent data interpretation and models may be used as a communication tool among partners when developing management options.

Thursday, 17th September 2015, 10:20h

Short Note: Managing long-term and large-scale data on marine biodiversity

Heiko Kalies[1], Mirko Hauswirth[2], Peter Hübner[2], Torsten Lehmann[1], Timothy Coppack[3], Alexander Walkowski[4], Thomas Wojaczek[4]

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The Federal Agency for Nature Conservation (BfN) has implemented long-term and large-scale monitoring schemes to document the state of the marine biodiversity in the Exclusive Economic Zone (EEZ) of the German North and Baltic Sea. Ship- and aircraft-based grid surveys are carried out routinely to map seabirds and marine mammals, as well as benthic organisms and their habitats. In addition, the frequency distribution of harbour porpoises is tracked passively through networks of acoustic porpoise detectors. Besides new technological developments at detection level (e.g., the use of digital aerial imagery for surveying seabirds and marine mammals), the design and optimization of complex database applications is becoming ever more important as data volumes continuously increase. BfN has recently implemented a state-of-the-art data management system to increase the efficiency of the reporting process and to keep up-to-date with the increasing demand to archive large data sets. These technical solutions, which include a variety of modern standard software components, were purpose-designed to match the data processing environment at BfN. This workflow embraces the generation and storage of raw and processed data, taking quality assurance (QA) measures at all levels into account. At raw data level, data quality depends strongly on the consistency of the applied methods, for which standard operating procedures (SOP) provide the formal framework. The revision of these guidelines is carried out on a regular basis by research partners from all relevant disciplines and by independent auditors from the Federal Environment Agency (UBA). At geo-data level, purpose-assembled data services can be used to visualize spatio-temporal variation in the occurrence of focal species and communities. To facilitate the visualization of time series data, a time-slider function module was embedded. The geo-data base is designed to enable an efficient export of data for further analyses through interested parties as well as the import of data from providers outside BfN. The overall aim is to make marine environmental data comprehensive, transparent and accessible to a wide public, including governmental authorities and non-governmental organisations.

Thursday, 17th September 2015, 11:10h

Short Note: UFOs in the North Sea - High tech for a modern and innovative monitoring of fish and other marine organisms

Joachim Gröger
University of Rostock, Germany

Based on an idea and concept of Joachim Gröger of the Thünen Institute of Sea Fisheries (TI-SF, Hamburg), research on an innovative, intelligent Underwater Fish Observatory (UFO) for the North Sea has been initiated and subsequently undertaken as part of an innovation support project. The UFO idea arose when he was working as a Professor of Fisheries Oceanography at the University of Massachusetts (USA), where he also began to practically explore the feasibilities. An UFO pre-prototype is currently being developed under his guidance in Kiel, in cooperation with a consortium of four partners from industry and research. UFO is designed not only to automatically detect fish stocks in an intelligent and non-invasive manner, but at the same time also to extensively and continuously monitor the ambient environmental conditions, being aimed at sustainably managing fish stocks as well as entire marine ecosystems.

In the first stage, UFO is conceptualized as a stationary system. It is innovative in the sense that for the first time highly sensitive opto-acoustical system components are combined, calibrated and synchronized with other sensors, collectively providing a continuous and synoptical stream of blended acoustico-stereo-optical fish images plus synchronically taken environmental information. When contrasting this with the conventional situation, the integrated UFO approach is similar to generating highly resolved video sequences instead of only snapshots. Hence, the UFO data stream allows quantitative statements, for instance, about the size of fish populations as well as of the state of ecosystems which is completely in line with the Marine Strategy Framework of the EU. Continously monitoring UFO arrays may be installed, for instance, in sensitive key areas such as Marine Protected Areas (MPAs) – e.g. in the German wadden sea – or windparks or areas where research vessels have no access to. In a later stage, also a mobile version in terms of an autonomous underwater vehicle (AUV) being based on the same concept (again an idea of Gröger brought from the US) will be developed to complement the static systems in areas where fishing is not prohibited.

It should be noted that because of its open design UFO does not only allow to detect fish but, may be adapted to also or selectively detect other organisms such as whales, seals, squid, jelly fish, allowing to continuously monitor all of these species. In cases where individual identification is essential and possible a real micro-census based on meristic and/or morphometric properties may be performed using intelligent algorithms of pattern recognition.

The funding of the project by the Innovation Support Fund of the Federal German Ministry of Food and Agriculture is 4 Mio EUR for 2.5 years. The project executing organisation is PT-BLE. The project started in July 2013 and will end in December 2015.

Thursday, 17th September 2015, 11:30h

Short Note: Porpoise Alerting Device (PAL): synthetic harbour porpoise *(Phocoena phocoena)* communication signals influence behaviour and reduce bycatch

Boris Culik[1], Christian von Dorrien[2], Vailett Müller[3], Matthias Conrad[4, 5]

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The novel and programmable Porpoise Alarm (PAL, patd.) electronically synthesizes life-like harbour porpoise communication signals based on those described for captive animals. Our aim is to develop new methods to a) mitigate by-catch of harbour porpoises in gillnet fisheries and b) to focus porpoise echolocation in order to enhance their detection.

In the Little Belt, Denmark, we employed PAL (SL 158 db ± 1 dB p-p re 1 µPa @ 1 m; centroid frequency 133 kHz ± 8,5kHz) to synthesize three aggressive click train types termed „A“, „F3“ and „M1“ to naive, free-living harbour porpoises. Via theodolite tracking (372 h of total visual effort spread over 10 expeditions) we found that depending on signal type, porpoises either avoid or become attracted to PAL. Signal type „A“ and „F3“ are slight deterrents, porpoises increasing minimum range by 23 to 32 m, respectively, whereas „M1“ attracts porpoises, reducing range by - 29 m. As determined via archival acoustic detectors (AAD), signal „A“ led to a significant reduction of echolocation (click rate - 59%) whereas both signals „F3“ and „M1“ led to an increase (by + 10 and 68 %, respectively).

The fisheries version „PALfi“ produces 3 synthetic porpoise-like aggressive signals „F3“ per Minute. Each upsweep chirp has a duration of 1.3 s and consist of 700 clicks (SL 151db ± 2dB p-p re 1µPa at 1 m; centre frequency 133 kHz ± 0,5kHz). PALfi are attached to the headrope of gillnets and spaced 200 m apart. We deployed and re-deployed PALfi in German and Danish gillnet fisheries in the Baltic and North Sea, total effort was approx. 900 Net km days. 14 porpoise by-catch events were reported during the 14 month field test: 12 in control but only 2 in PAL nets (p= 0.006, binominal test). This shows that PALfi is an efficient by-catch mitigation device.

We also propose that detection probability and -radius of Autonomous Acoustic Detectors (AAD) could be improved by emitting signal „M1“ to focus porpoise echolocation signals on the AAD. The signal may also be useful in luring animals away from hazards. Both may be helpful for conservation measures prior to the onset of harmful acoustic activities such as pile-driving, seismic exploration or ammunition clearance.

Thursday, 17th September 2015, 11:50h

Short Note: Using high-resolution aerial imagery to assess populations of wintering waterbirds

Timothy Coppack, Axel Schulz, Alexander Weidauer
Institute of Applied Ecology (IfAÖ GmbH), Germany

Waterbird and seabird species inhabit spatially and temporally heterogeneous environments across a wide range of scales. They are highly reactive to changes in climate, food availability and anthropogenic influences, and thus represent important indicators for assessing the state of the marine environment. The Baltic Sea with its many Special Protection Areas (SPAs) holds large numbers of moulting and wintering sea ducks, such as Common Scoters, Scaup and Long-tailed Ducks. Current population estimates for these species are often confounded by inadequate survey designs, distance-related observer bias and maladapted models that assume an even distribution of individuals. Aerial surveys represent snapshots of populations, but do not by themselves identify changes in population density and size, unless site-specific occupancy rates, migration rates among sites and detection probabilities are known. Digital aerial imaging opens up new possibilities and prospects for quantifying these sources of variation, thereby solving major problems with conventional, observer-biased survey methods. Through confining digital sampling effort to areas within functional ecological boundaries (rather than monitoring an unadjusted, random proportion of sites) survey times and costs could be reduced, while the statistical power and biological meaning of the resulting data would increase. A mosaic of simultaneously surveyed habitat patches would then add up to basic population estimates that are ecologically defined and that account for short-term among-site fluctuations. We review recent experimental surveys based on high-resolution digital vertical imagery (flight altitude ca. 420 m, ground sample distance 2 cm) of various species-rich areas in the German Baltic Sea (Bay of Wismar, Orderbank Plateau, Pomeranian Bay) in order to assess local population densities of key waterbird species. Through comparing the results of these trials with long-term observational data and with near simultaneous ship-based estimates we evaluate the potential of digital aerial surveys for calibrating the backlog of existing data and for continuing large-scale monitoring schemes beyond administrative boundaries.

Ecosystem services

Thursday, 17th September 2015, 12:10h

Marine ecosystem services assessment to support marine management, from theory to practice

Diane Vaschalde
French Agency for Marine Protected Areas, France; MPA managers and scientific partners to be associated

While economic valuation of ecosystem services (ES) is widely acknowledged as a tool to support decision-making processes, studies have also shown that there exists a literature blindspot on the use of economic valuation. The VALMER project seeks to bridge this gap between theory and practice by looking at how ecosystem services assessment (ESA) can support marine management and planning. Natural scientists, economists and managers from various institutions undertook ecosystem services assessments in six pilot sites over the two sides of the Channel. The objectives of this communication are to i/go beyond the economic valuation by presenting broader ESAs, ii/share results of the operational ESAs, and iii/discuss issues and perspectives of ESAs from a management perspective.

Framing ESA according to management needs and expectations

ESAs were shaped according to the site management contexts and the marine issues at stake. To this effect, an innovative approach was implemented: the triage process. The triage consists in an analytic framework which aims at defining the scope of the ESA in relation with its purposes, while taking under consideration the main policy issues related to ES in the area. It ensures operational perspectives by supporting the processes of identification, selection and assessment of ES.

Integrated ESA into practice: Two contrasted experiences

In the Golfe normand-breton (GNB) pilot site, the objective of the ESA was to provide an initial diagnosis of marine ES in a context of a creation-process of a potential marine natural park. Substantial work was carried out in order to analyze the links between the habitats, ecological functions and ES of the GNB. Various tools and methodologies were then developed in order to characterize the current state of some of the marine ES: an ecosystem-based activity accounting; a mapping approach to ES intensity; and a characterization of the provision of fish by subtidal sandy and muddy habitats through historic and economic analysis. In parallel, a participative scenario-building exercise was undertaken so as to co-construct possible futures about the level of two ES (fish provisioning from open-seas and recreational activities at the foreshore) in relation with general economic trends and the state of marine waters.

The Iroise marine Natural Park is a well-established marine protected area, with governance bodies and a management plan in place. The exploitation of two kelp species raises peculiar management issues. The aim of the ESA was to better understand the socio-ecological system of kelp fields in order to inform the design of management options. The provisioning, supporting and cultural services delivered by kelp fields of the Molène archipelago were specifically studied. A dynamic spatial simulation model that encompasses a kelp population model sensitive to environmental conditions, an economic model describing kelp harvesting and a module assessing kelp habitat's ecological functions and providing ES indicators was developed. By being sensitive to factors of change (e.g. management rules, economic factors, climate change), this dynamic model will enable the MPA managers to test the impacts of contrasted scenarios on the level of ES provided by kelp forests.

Issues and perspectives of ESA from a management perspective

Among the encountered difficulties during the ESA are the diversity of definitions on ecological functions and services, the lack of knowledge about the links between functions and services, and the lack and/or accessibility of data. From a marine management perspective, first results drawn

from the implementation of the VALMER project in the two study sites briefly described above show that ESAs allow to better understand a socio-ecological system at the scale of a (proposed) marine protected area, to develop a common culture about marine ES with stakeholders, and to inform the design of management measures. The final workshop on the lessons learned from ESA organized in February 2015, as well as the final project conference in March 2015 will feed and complement these preliminary analyses.

The VALMER project was selected under the European cross-border cooperation programme INTERREG IV A France (Channel) – England, co-funded by the ERDF.

Thursday, 17th September 2015, 13:50h

Assessing maintenance costs of marine ecosystems in the context of the MSFD

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The MSFD represents the environmental component of the European integrated marine approach (2008/56/EC) and establishes a legislative framework for community action in the area of marine environmental policy. The aim is in the end to design a program of environmental measures to achieve a good environmental status (GES) by 2020. The MSFD is founded on an initial assessment of the current environmental status of national marine waters and a socio-economic analysis of human activities in these waters (carried out in 2012). The socio-economic initial assessment includes an analysis of the costs of degradation of the marine environment.

There are two ways of assessing the costs of environmental degradation: as the costs associated with the loss of benefits resulting from the degradation of natural capital, and as the maintenance costs required to compensate for the actual or potential degradation of natural capital. The first of these methods is based on the Total Economic Value (TEV) of benefits forgone because of the depletion of ecosystem services delivered by marine biodiversity. The second method is based on the costs required to maintain a good state of marine biodiversity, one which makes it possible to deliver ecosystem services. This communication gives an illustration of this second approach.

In a first step, the communication details the major reasons why it seems not feasible to estimate the TEV of marine ecosystems. These reasons are, inter alia: the lack of data on interactions between biological entities, ecological functions, ecosystem services production, and changes in well-being; the high level of uncertainty regarding some of the values based on support services or cultural services; the controversies around the benefit-transfer method for extrapolating local values to a regional or national scale; the controversies around the stated preferences analysis for capturing non-use, indirect use, and non-market use values; ethical issues regarding the commensurability and monetisation of nature; the limits of the TEV to give a relevant information when the analysis is used in a policy frame where some strong sustainability goals are fixed.

In the context of the MSFD, it is inappropriate to provide a judgment on marine ecosystems based on their TEV. TEV is obtained from individual aggregated preferences, and the consecutive decisions use should target the maximum of welfare, a normative principle which is different from the one adopted within the MSFD, namely the 'good ecological status' (GES). On the other hand, it might seem meaningful to know the current maintenance costs devoted to marine environmental ecosystem management, considering the gap between the present situation and the GES goal. Indeed, to achieve the GES will require improving and complementing existing marine environmental management measures, which will generate additional costs. From this perspective, the maintenance cost approach will also provide the basis for a future cost-effectiveness analysis of the complex management system which will result from the Programme of Measures recommended by the MSFD

In a second step, the communication details how these maintenance costs have been calculated in the initial assessment of the Marine Strategy Framework Directive (MSFD) in France. The maintenance costs were then divided into three categories: 1) Costs of monitoring and information: aimed at improving information and coordination levels relative to conservation of the marine environment; 2) Costs of preventing or avoiding environmental degradation: costs of specific investment in preventing and avoiding environmental impact. 3) Costs of environmental restoration and remediation: costs of environmental restoration and remediation after destruction or an ecological accident. The estimation addresses nine problem areas corresponding to nine sources of environ-

mental degradation from non-native invasive species to oil spills.

The results give a total figure for these degradation costs (around 2 billion Euros). A significant proportion of these costs (1247 million euros) was related to preventing marine water degradation by microbial pathogens, and took the form of enforcement of water quality standards. The second highest was the chemical compounds category, with costs associated with prevention of chemical pollution amounting to 347 million euros. In both cases, the main goal is protection of human health, which explains the size of this expenditure. Next come the costs associated with loss of biodiversity and decrease of fish stocks, 148 and 133 million euros respectively. The high costs associated with fishing are due to the increasing erosion of fish stocks and the need for more sustainable management of these stocks (67% of costs). The costs linked to biodiversity loss are mainly related to monitoring and reporting (52% of costs), which indicate substantial interest in these issues and a serious lack of scientific data. There are three problems for which the costs of environmental degradation are much lower: eutrophication (47.4 million euros), oil pollution (47.3 million euros), and degradation of exploited resources related to aquaculture (30 million euros).

Finally, the results are compared with those of other Member States who have taken similar approaches in the context of the MSFD. One key conclusion is that it is not really possible to make meaningful comparisons at this stage, since the methods of data collection and the nature of the costs are very different. The need to develop such assessments in a standardised way is emphasized.

Thursday, 17th September 2015, 14:30h

Developing MSFD benthic indicators to assess the status of marine biodiversity

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To determine the health of our marine environment, indicator-driven assessments can be used to inform reporting requirements under multiple policy instruments. At the European marine level, these policy instruments are implemented due to the Marine Strategy Framework Directive (MSFD), the Habitats Directive and the Regional Seas Conventions (RSCs).

Generally, indicators are designed to describe and assess the status of marine ecosystems as well as the impact of anthropogenic activities on the marine environment. Outputs from indicator-driven assessments will subsequently be used to support ongoing development of management measures to protect marine biodiversity.

For all EU Member States regional coherency and coordination when measuring the state of the marine environment is obligatory to achieve under Article 12 MSFD. Therefore, the RSCs responsible for the protection of the NE-Atlantic and the Baltic Sea intend to develop these indicators as similarly as possible across them (as stated in a joint meeting of ICG COBAM and CORESET II in Gothenburg, 2014). Thus, a benthic case study is presented here to demonstrate how indicators are being developed to directly support the implementation of the MSFD.

The indicator called “Extent of physical damage to seafloor habitats” has been developed and tested within the OSPAR framework by the UK and Germany and it has made considerable progress in the last year. This is an OSPAR common indicator for the Greater North Sea, Celtic Seas, and Bay of Biscay/Iberian peninsula regions. It has been proposed as candidate indicator, subject to further testing, for the Arctic region and Wider Atlantic region. It is an indicator to address the level of disturbance of the marine seafloor under existing anthropogenic pressures.

The indicator is being designed to assess predominant as well as special marine habitat types and is regarded as particularly useful to target larger sea areas with relatively low effort. The overall aspiration is to design an indicator that will help evaluate to what extent the integrity of the seafloor and associated ecology is being damaged by anthropogenic activity using a combination of sensitivity assessments and exposure to pressures.

The indicator will build upon two types of underlining information: i) the distribution and sensitivity of habitat components and ii) the distribution and intensity of human activities and pressures that cause physical damage, such as mobile bottom gear fisheries. The indicator method is based on a series of analytical steps to combine the distribution and intensity of physical damage pressures with the distribution and range of habitat sensitivities using a GIS spatial analysis model. The final output of this model is a ‘Physical Damage Index’ for each benthic habitat or geographical area.

The development and testing of this indicator is being done alongside benthic condition indicators, in particular the Condition of Habitat Community indicator (Multimetric index) (BH2) and the Condition of Typical Species (BH1). It is envisaged these two indicators will be used to calibrate and ground-truth BH3 outputs and methods, and in particular to calibrate the pressure/impacts matrices being used within the models underpinning BH3. The overall aspirations of the OSPAR and HELCOM benthic expert groups is to develop complementary benthic indicators which can be eventually integrated to obtain an holistic assessment of seabed habitats

In parallel to this process a very similar indicator is being developed under the HELCOM CORESET II project. The ambition of Germany and the UK is to utilise the same indicator for both RSCs and therefore meeting requirements for regional coordination under the MSFD.

Marine Strategy Framework Directive

Thursday, 17th September 2015, 15:10h

Healthy oceans by 2020 in the context of the MSFD – an NGO perspective

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Healthy oceans are rich and diverse ecosystems with a wide range of connected communities. However, human activities have altered this habitat considerably for decades e.g. by exploiting marine resources and discharging large amounts of toxic substances and nutrients into the seas. Some of the main pressures in the North Sea and the Baltic Sea are eutrophication, destruction of habitats, overfishing, contaminants and marine litter. The cumulative effect of all these pressures is still largely unknown as is the effect of climate change as another threat to the marine environment.

With the Marine Strategy Framework Directive (MSFD) the EU has created a legally binding framework aimed at the protection of the marine environment. Its objective is to achieve a Good Environmental Status (GES) in all European Waters by 2020 at the latest. Unfortunately the EU is still very far from enjoying healthy oceans and seas. “Meeting this objective by 2020, in less than seven years, implies renewed and intensified efforts and rapid and important change in the way Member States, the European Commission, Regional Seas Conventions and other relevant organisations work together” (Article 12 report of the EU Commission, Feb 2014)

The MSFD has now entered a crucial phase: this year Member States are developing their programmes of measures (PoMs). By the end of 2015 all PoMs should be completed and should enter into operation by the end of 2016.

Environmental NGOs started at an early phase to develop their own views on essential measures that should be undertaken to obtain GES in our seas. Based on a joint NGO paper at EU level, German NGOs compiled a document introducing a detailed analysis of the threats to the marine environment and the crucial measures that will have to be put into effect without delay.

Protection of endangered species and habitats

Thursday, 17th September 2015, 16:10h

HELCOM Red List of Species and Habitats

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The **Red List of Baltic Sea species in danger of becoming extinct and the Red List of Baltic Sea underwater biotopes, habitats and biotope complexes** were published in 2013 and are an important support to the efforts to protect the Baltic Sea environment.

The HELCOM Red List of Baltic Sea Species is the first regional threat assessment for the Baltic Sea that covers all macroscopic species of marine mammals, fish, birds, macrophytes (aquatic plants), and benthic invertebrates. For the first time, this regional assessment was carried out using internationally agreed and globally applied criteria of the International Union for Conservation of Nature (IUCN).

In the Red List assessment of species, almost 2800 species were considered and about 1750 were evaluated according to the IUCN Red List criteria. In all, 4% of those were regarded as threatened (Critically Endangered (CR), Endangered (EN) or Vulnerable (VU)) which means that they are in danger of becoming extinct in the Baltic Sea. The assessment results also indicated that all the threatened species are under pressure from human activities and that none of them seem to be under pressure from a single specific human activity; each species rather faces a multitude of pressures.

The HELCOM Red List of Baltic Sea underwater biotopes was made for 209 biotopes of which 59 were red-listed. Data availability was relatively poor for many biotopes, and long time series were generally not available. Therefore the threat assessment was largely based on expert judgement. Of the assessed biotopes, 8% were regarded as threatened while 73% were classified as Least Concerned (LC) and were not seen to be at actual risk of collapse. However, 8 out of the 10 assessed biotope complexes are according to different threat classes in danger of collapsing.

The Red List assessment results for underwater biotopes indicate that many of the threatened biotopes occur in the deep areas of the Baltic Sea. The most important pressure is eutrophication, indirectly causing oxygen depletion in the deeper areas. Many of the deep biotopes occurring on soft sediments have also declined due to destructive fishing methods such as bottom trawling. Furthermore, many of the red-listed biotopes occur in the southwestern Baltic Sea due to the salinity restricted distribution of the species that are characteristic of the biotope.

Implication of the red list

The results of the Red List assessment naturally gave cause for major concern among HELCOM Contracting parties. In fact, the goal of the Baltic Sea Action Plan to “achieve a favourable conservation status of all species by 2021” cannot be achieved with species being red listed. As a consequence, the 2013 HELCOM Copenhagen Ministerial Declaration stated that conservation plans for species at risk of extinction should be established. Therefore HELCOM is currently developing a HELCOM Recommendation for the conservation of such species as a response of the Contracting Parties. This recommendation will include specific protection and conservation advises such as:

- actions needed to mitigate identified threats (pressures and/or impacts) as specified in the red list
- specification of respective conservation needs
- consideration whether any sites justify selection as new or expanded MPAs
- development of guiding documents on conservation, recovery or action plans and/or related management measures for individual or groups of HELCOM red listed species and their habitats

- regular reviews of the progress of respective programmes and measures.

A complementary HELCOM Recommendation on biotopes, habitats and biotope complexes is also planned. HELCOM has agreed to make the Red List assessments of Baltic Sea species, habitats and biotopes a regular activity with the next planned assessment in 2019 which will enable the tracking of long-term trends and the effectiveness of the implementation of recommendations to protect and conserve Baltic Sea biodiversity.

Protection of endangered species and habitats

Thursday, 17th September 2015, 16:50h

What do population trends of seabirds tell us about the ecological conditions in the North Sea?

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Research and Technology Centre (FTZ), University of Kiel, Büsum, Germany

Among marine organisms seabirds are comparatively easy to census both on land and at sea. While counts in breeding colonies often go back in time to the early 20th century, systematic counts of birds at sea commenced many decades later. In the North Sea, ship-based census data from monitoring and research programmes are stored in the European Seabirds at Sea (ESAS) Database, managed by the Joint Nature Conservation Committee (JNCC).

For this talk, data from the ESAS Database, covering the period 1980 to 2010, were analysed. The focus was particularly on the common pelagic (offshore) species. Because survey effort was not homogeneous over space and time, analyses are based on seabird abundances in ten discrete spatial units, covering major parts of the North Sea. Data were aggregated over 3-year-periods and analysed with the widely used software TRIM (Pannekoek & van Strien 2005).

Significant increases of numbers at sea during the 30-year-period were found for Northern Gannet (both during the breeding and non-breeding seasons), Great Skua (breeding season), Lesser Black-backed Gull (breeding season), Common Guillemot (breeding season) and Atlantic Puffin (breeding season), significant decreases for Northern Fulmar (breeding season), Herring Gull (season non-breeding) and Great Black-backed Gull (both during the breeding and non-breeding seasons).

The observed trends are striking. Both direct and indirect effects of fisheries appear to have the strongest effects on the trends of the common offshore seabird species. On one side, the availability of discards and offal from fishing vessels has recently decreased, especially in winter and in the central North Sea. On the other hand, overfishing of large predatory fish has led to increases in small pelagic fish that are the preferred prey of various seabird species. Recent increases in water temperature due to climate changes and alterations in the food web do not seem to have negatively affected the investigated species at the temporal scale of this study but may be a strong (negative) force in the future.

Overall, changes in seabird numbers and biology are suitable and early indicators of changes in the marine environment.

Protection of endangered species and habitats

Thursday, 17th September 2015, 17:30h

Population trends and anthropogenic threats to long-tailed ducks in the Baltic Sea

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The long-tailed duck Clangula hyemalis is a globally threatened species. The largest of the four recognized populations is the West Siberian / North European population. Birds belonging to the WS/NE population breed in northern Russia and northern Scandinavia and overwinter mainly in the Baltic Sea. Two Baltic wide surveys have shown that this population has decreased very rapidly from approx. 4.3 million birds in 1992-93 to approx. 1.5 million birds in 2007-2009. A further decline also after 2009 can be assumed as the mean proportion of juveniles in the wintering population has been low since 2009. Because of the rapid decline the long-tailed duck has been classified as globally vulnerable on the IUCN red list. An International Single Species Action Plan for the long-tailed duck has also recently been developed by specialists under the auspices of AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds).

The decline of the population can most likely be explained by a combination of factors affecting both the productivity at the Arctic breeding grounds and the adult mortality in wintering areas. Four important present and future anthropogenic threats affecting the wintering birds have been recognised, namely, operational oil spills, by-catches in fishery, hunting and exploitation of offshore banks. Hunting mortality is fairly well known and can be regulated if agreements are reached. Mortality due to oil spills and by-catches have decreased but is still high. Displacement of wintering long-tailed ducks from good feeding areas might be an important additional factor in future if planned large scale wind farms will be established at core wintering sites, i.e. at offshore banks.

Today, the most intensively used shipping routes in the Baltic Proper are crossing or are situated very close to three important marine Natura 2000 sites, i.e. the Hoburgs bank, the Northern Midsjö bank and Salvorev. Recurrent operational oil spills from ships within or close to sensitive areas along the main shipping routes in the central Baltic Sea have killed tens of thousands of long-tailed ducks each year during the past 20 years. Such effects can be avoided by seasonal modifications of shipping routes, i.e. by dynamic route planning where ships to a greater extent than today are assigned individual routes based on the traffic situation, weather and sensitive marine areas. Marine spatial planning is a tool to ensure that sensitive and protected marine areas in the Baltic Sea remain healthy. A marine spatial planning process is urgently needed to resolve conflicts between shipping, energy production, fishery and the protection of sensitive habitat and threatened species.

Protection of endangered species and habitats

Thursday, 17th September 2015, 18:10h

Feasibility of the restoration of the European flat oyster in the German Bight – opportunities and perspectives

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Institute of Applied Ecology (IFAOE), Germany

Up to the second half of the 19th century the European flat oyster *(Ostrea edulis)* was once widely distributed in the Wadden Sea and in deeper areas of the German Bight. During long periods of time oyster beds had developed mainly on sandy sediments. As a result of in particular improved fishing methods and lack of resource saving management stocks declined dramatically and were practically extinct in the German North Sea in the early 20th century.

The biogenic oyster reefs are habitats with a high biological diversity and play an important role as biological hot spot in marine communities. Because of the important role of Ostrea edulis beds in marine ecology they are included in the OSPAR list of threatened and/or declining species and are in the focus of the Federal Agency for Nature Conservation (BfN).

In the light of this a study was funded by BfN in order to assess whether a reintroduction of the native oyster in the German North might be feasible. At first the historical distribution of the European flat oyster in the German Bight and the factors that led to the extinction of oyster reefs were investigated. In addition abiotic factors like temperature and substrate, biotic factors like disease and pests as well as genetic aspects were highlighted. Furthermore the condition of present populations of Ostrea edulis and efforts for the restoration of stocks were considered.

As a result of the study it was concluded that a reintroduction of the native oyster in the German Bight might be feasible. The main findings that support this conclusion are the genetic similarity of the European populations of Ostrea edulis, the availability of disease free oysters from a Danish and a Swedish hatchery together with oysters from a natural population in the Danish Limfjord. To have a reasonable chance of success it is crucial to offer suitable substrate (cultch) and to fully protect the restoration site from fishing activity just to name only two preconditions. Before starting a large-scale reintroduction project it is recommended to perform a pilot-scale transfer of oysters at selected sites in order to examine their performance with respect to growth, reproduction and diseases.

A long-running monitoring will be necessary once a large-scale oyster transplantation would be realized. A reintroduction of Ostrea edulis and the restoration of reefs definitely is a long-term commitment.

Protection of endangered species and habitats

Friday, 18th September 2015, 9:00h

Identification of high risk areas for porpoise bycatch by use of data from remote electronic monitoring and satellite telemetry

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Incidental catch of harbour porpoises *(Phocoena phocoena)* is an issue of major concern for fisheries management and harbour porpoise conservation. With the aim of identifying areas of potential high risk for porpoise bycatch, we analyzed high resolution spatial and temporal data on porpoise density and fishing effort data from the Danish Skagerrak Sea, including areas designated under the EC Habitats Directive (Natura 2000) for harbour porpoise protection. From May 2010 to April 2011 four commercial gillnet vessels were equipped with Remote Electronic Monitoring (REM). The REM system recorded time, position and CCTV (Closed-circuit television) footage of all net hauls. The REM data were used to identify fishing grounds, quantify fishing effort and document bycatches of harbour porpoises. Movement data from 53 harbour porpoises equipped with satellite transmitters from 1997-2012 were used to model porpoise density. A simple model was set up for investigating the relationship between the response (number of porpoises caught) and porpoise density and fishing effort described by net soak time, net length and target species. The results showed that a model including both porpoise density and effort data predicts bycatch better compared to models including only one factor. We therefore conclude that the inclusion of porpoise telemetry data allows for better prediction of areas of high porpoise bycatch than when using the fishing effort data alone. The final model can thus be used as a tool to identity areas of porpoise bycatch risk and hereby support the management of both fisheries and porpoises in accordance with the Habitats Directive.

Protection of endangered species and habitats

Friday, 18th September 2015, 9:40h

Effects of vessel noise on harbour porpoise *(Phocoena phocoena)* foraging activity

Danuta Maria Wisniewska[1], Mark Johnson[2], Jonas Teilmann[1], Lee Miller[3], Ursula Siebert[4], Anders Galatius[1], Rune Dietz[1] and Peter Teglberg Madsen[1]
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While cetacean auditory systems have evolved to cope with underwater noise from natural sources, there is a growing concern that anthropogenic noise may disrupt the behaviour, impair the hearing or compromise the general health of cetaceans. Little is known about the noise free-ranging animals are exposed to and how individuals react to specific noise sources.

We deployed archival multi-sensor DTAG3 tags on ten wild harbour porpoises to study noise exposure and behaviour in the highly trafficked Danish Straits. The suction-cup attached tags provided continuous recordings for up to 24 hours, while logging stereo sound (500kHz), triaxial magnetometry, acceleration and depth (250-625Hz).

The movement and noise exposure of the animals in relation to ships were estimated using sensors on the tag and attaepts have been made to relate the noise exposure to the AIS positioning system carried by larger vessels. The porpoises were exposed to low-to-moderate vessel noise for up to 16-73% of the recordings from different animals, with occasional high levels extending for >1 hour.

Received noise levels were analysed in 1-min segments in the 16 and 50 kHz third-octave-bands and correlated with the occurrence of buzzes indicative of foraging. The animals foraging activity constitute more than 50% of the dive time for most animals and context-dependent reactions to noise including cessation of foraging and echolocation, logging at the surface, or sustained energetic fluking was observed. No clear general difference in noise level was seen between minutes with and without foraging activity.

The effect on foraging activity from ship noise exposure, suggests strong implications for foraging efficiency, energy expenditure and stress impacts.

Friday, 18th September 2015, 10:20h

Short Note: Genome-wide Single Nucleotide Polymorphism (SNP) analysis of harbor porpoise *(Phocoena phocoena)* improves population resolution in North and Baltic Seas

Ralph Tiedemann[1], Ljerka Lah, Daronja Trense, Porvaldur Gunnlaugsson, Christina Lockyer, Ursula Siebert, Harald Benke, Anna Roos, Iwona Pawliczka, Krzysztof Skóra, Santiago Lens Lourido, Bayram Öztürk, Ayaka Öztürk, Per Berggren, Gísli Víkingsson
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In a pilot study, we investigated the population differentiation of harbor porpoises from the populations in the Baltic Sea and adjacent waters, in comparison to European Atlantic shelf waters (Iceland, Spain) and the Black Sea. We tested a population genomics approach using 1,801 Single Nucleotide Polymorphisms (SNPs) and compared the population resolution to those using more traditional molecular markers (microsatellites, mitochondrial DNA). We observed a distinct separation of the North Sea/Skagerrak population from the other Baltic Sea populations and identified splits between porpoise populations in the southern Kattegat, the Belt Sea, and the inner Baltic Sea. The improved resolution of harbor porpoise population assignments for the Baltic are important for conservation management of this endangered cetacean in threatened habitats, particularly in the Baltic Sea proper. We also show that genome-wide SNPs outperform microsatellite markers both regarding population delimitation and population assignment of single specimens. We demonstrate the utility of the approach on a relatively small sample set, and suggest an upscaled analysis including a more comprehensive sampling from North and Baltic Seas. Such a comprehensive spatially and seasonally explicit study on porpoises of different age and gender has the ability to provide detailed information on the population status and relatedness among individual porpoises and may hence contribute to the identification of reproduction areas, close kin associations, and seasonal migration.

Protection of endangered species and habitats

Friday, 18th September 2015, 10:40h

Short Note: Distribution of Harbour Porpoises in the Baltic Sea - SAMBAH-Results

Mats Amundin
Project Coordinator SAMBAH, Kolmården Wildlife Park, Sweden

SAMBAH (Static Acoustic Monitoring of the Baltic Harbor porpoise, www.sambah.org) aims at contributing to the conservation of the harbour porpoise population in the Baltic Sea. The project started in January 2010 and ends in September 2015. All EU member states around the Baltic Sea are involved in the project. It is funded by the EU LIFE+ program and various national sources; the German part was completely funded by the Federal Agency for Nature Conservation.

The harbour porpoise is one of the smallest toothed whales and it has a wide distribution in temperate waters in the northern hemisphere. In the Baltic region, there are three harbour porpoise sub-populations; (1) in the northern North Sea, Skagerrak and Kattegat, (2) in the southern Kattegat, Belt Seas and Western Baltic, and (3) in the Baltic Proper and north-northeast thereof. The latter is very small and has been drastically reduced during the last half of the 20th century, and is now classified as critically endangered by the IUCN. The species is listed in Annexes 2 and 4 of the EC Habitats Directive as well as in the national red lists of several EU Member States.

Due to the very low population density in the Baltic, traditional survey methods have not yielded enough data for robust abundance estimates. Hence a new survey methodology was called for. SAMBAH built on previous Static Acoustic Monitoring (SAM) studies, and combined their methods with point transect methodology. SAM relies on logging the high frequency click trains produced by harbour porpoises for echolocation and communication. These echolocation click trains were recorded by acoustic data loggers called C-PODs. In total, C-PODs were deployed at 304 locations in waters 5-80 m deep, within the project area stretching from south and east of the Darss and Limhamn ridges in the south-west, to latitude 60°20'N in the north. The C-PODs were kept in operation for two years and then followed two years of statistical analyses. The SAMBAH project has so far reached a preliminary population abundance estimate for porpoises in the Baltic Sea Proper which is approximately 500 porpoises. New auxiliary data are now being analyzed in order to confirm this number and to minimize the confidence interval.

Based on spatial modeling, preliminary maps showing the distribution of porpoises in time and space have also been produced. These show a clear spatial separation during May-October between a porpoise concentration on the offshore banks in the Baltic Proper and the relatively high population density in the south-western Baltic. Porpoises give birth, mate and nurse their calves during this period, and thus these offshore banks seem to be an important breeding area for the critically endangered Baltic porpoise sub-population.

The SAMBAH results are expected to contribute to improved conservation status of the Baltic harbour porpoise, since a population estimate in combination with known distribution in space and time opens up for dedicated conservation actions that will make a difference. Being the largest ever SAM study of any animal, the developed methodologies offer new possibilities for assessing population densities, abundance and distribution using passive acoustics.

Friday, 18th September 2015, 11:30h

Quieting Technologies for Offshore Pile Driving

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Impulsive noise from pile driving in offshore wind farms or at oil and gas installations has the potential to harm marine animals or to deteriorate neighbouring marine protected areas. The ever-increasing diameters of driven monopiles require increasingly effective noise mitigation techniques in order to meet threshold levels or conservation objectives.

Noise can be reduced directly at the source (primary noise mitigation) or during radiation through the water (secondary noise mitigation). So far, mostly secondary noise mitigation has been applied on construction sites in the German EEZ by using various setups of bubble curtains or an isolation casing around the driven pile.

The most tested offshore technology for secondary noise mitigation is the bubble curtain. Shielding tubes such as isolation casings (with water and bubbles between isolation casing and pile) or cofferdams (with an air gap between cofferdam and pile), can scatter and absorb noise or reduce the coupling of noise to the water. The theoretical noise reduction of these secondary methods is limited to some 20 dB as noise also radiates through the sea floor. An approach under development (prototype tested at the offshore wind farm Amrumbank West) is the use of Hydro Sound Dampers which are gas filled elastic balloons or foam fixed to nets held around the pile by a frame. The attenuation frequencies can be adjusted by the size of balloons or foam pellets. This offers a methodology for selectively reducing noise at frequencies of biological significance (e. g., within the hearing range of an animal in order to reduce disturbance) or at frequencies of maximum energy in pile strikes to optimise for the amount of noise reduction.

The only primary noise mitigation method currently applied is the reduction of blow energy in order to meet obligations if secondary noise mitigation measures alone are not sufficient. This however results in an unwanted higher number of pile strikes and the noise reduction is limited to only a few decibels. A novel method to reduce noise at the source offers the potential for a more effective noise reduction by combining primary and secondary noise mitigation. BLUE Piling by the Dutch company FISTUCA BV instead of a hydraulic hammer uses a hammer with a large water column inside to generate the driving force in two steps. Sea water inside a steel tube closed at the bottom is pushed upwards by igniting a gas mixture in a combustion chamber at the bottom. The pressure increase by the flue gases lifts the water column and generates a downward force at the same time. A second downward force pulse is produced when the water falls down again. The gradual force build-up increases the pulse duration by a factor of 20, thus reducing the amplitude of noise emissions.

In addition to noise mitigation methods, several alternative foundation types exist or are under development. With these, wind turbines can be founded without impact pile driving and therefore less underwater noise generation is expected. Progress has been made e. g., in bucket foundations by the installation of a prototype three-legged jacket on buckets in the offshore wind farm Borkum Riffgrund.

Friday, 18th September 2015, 11:50h

Measuring pile-driving noise and related potential effects on porpoises with special emphasis on the construction of the OWF Butendiek

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The erection of offshore wind farms (OWFs) has moved on from first installations of a few turbines as pilot projects towards the regular use of pile driving procedures throughout the North Sea for building foundations for a multitude of wind farm projects. Porpoises Phocoena phocoena have been shown to be displaced up to distances of 20 km around ongoing pile driving due to the impulsive noise emissions. Such displacement is one of the strongest behavioral reactions of animals towards sound. Others include change of behavior (e.g. interruption of feeding behavior, communication, changes in movement pattern or speed) or increase of respiration and heart rate, stress in general and may lead in their totality to a decreased fitness of the population. Whether this is true for offshore wind farms and porpoises remains unknown and depends on how much pile driving is being conducted, what other (noise) effects contribute and if porpoises are disturbed in high density areas during 'biologically important behaviors for a relevant period of time.

A monitoring of harbor porpoise and noise levels was conducted in 2013 for a two months period during the construction of three OWFs in close vicinity of 'Sylt Outer Reef' – an area, amongst others, designated a Natura 2000 site due to high abundance of porpoises in the breeding period. The monitoring was continued in 2014 when the OWF Butendiek - the only one permitted in a Natura 2000 site - was constructed. These building processes were monitored using stationary acoustic monitoring for echolocation clicks with CPODs (Porpoise detectors, www.chelonia.co.uk) as well as noise monitoring with AMARs (Autonomous Multichannel Acoustic Recorders, www.jasco.com) and DSG-Oceans (www.loggerhead.com). Aim was set at quantifying behavioral reactions of harbor porpoises in larger distances in terms of displacement.

Preliminary results indicate that noise levels throughout Sylt Outer Reef were highly variable. Depending on geographic location of the measuring device noise levels were elevated in 2013 or 2014, but a contribution of anthropogenic (ship) noise in the 50 to 100 Hz range is likely and increased noise levels in this band by ~15 dB. Analysis of the porpoise registration rates and echolocation behavior is currently being conducted. First results will be presented at the conference. One conclusion of the found noise levels is, however, that an effective noise mitigation already reduced impulsive noise around the OWF Butendiek to a great extent.

Anthropogenic impacts on marine biodiversity

Friday, 18th September 2015, 12:30h

Continuous underwater noise from activity in offshore wind farms: potential for environmental protection

Max Schuster
DW Ship Consult, Germany

The Maritime Strategy Framework Directive obliges all European countries to achieve a „good environmental status“ of the seas until the year 2020. In the meanwhile the development of the environmental status shall be continuously monitored by means of indicators. One of these is underwater noise which has become an important issue in connection with erection of offshore wind farms.

In 2012 and 2013 the Federal Agency for Nature Conservation has funded an acoustic baseline evaluation for the Natura2000 protected areas in the Baltic Sea and North Sea. These investigations revealed that ambient noise levels are dominated by contribution from industrial activity during large periods of time. Especially the erection of offshore wind farms comes along with distinctly increased noise levels.

Particularly during pile driving operations extremely high sound pressure is radiated at a level that may damage the auditory system of marine mammals in hundreds of meters radius. The disturbing effect may range way beyond 20 km . Therefore an underwater noise protection value has been assigned based on the sensitivity of the harbor porpoise’s auditory system. Since this value must not be exceeded during construction works in German waters it has stimulated the design of additional noise reduction technologies for pile driving operations. An example for a very efficient system has been applied during construction works of wind farm Butendiek.

During 2014 and 2015 additional long-term underwater noise measurements have been carried out in the protected area “Sylter Außenriff” to determine the contribution of anthropogenic activity in the construction sites “Butendiek” and “Amrumbank West”. During this period of time some of the measurement locations have been chosen identically with measurements in the previous year when construction works were carried out in four other adjacent wind farms. The resulting data set allows comparison of ambient noise levels during construction works with rather quiet periods before start of installation.

One of the conclusions is that even with efficient noise reduction the highest noise levels originate from pile driving operations. However, these sounds are generated only during a small fraction of time while other noise sources such as support vessels are continuously active. The result is that median noise levels are much higher than before start of construction. The given presentation highlights and quantifies the acoustic pressure on the environment due to noise from continuous sources that are not covered by the mandatory noise protection value. This implies conclusions for the environmental status: Which noise sources are dominant? How can the noise contribution be reduced by means of reasonable effort? What are the consequences for the marine environment?

Anthropogenic impacts on marine biodiversity

Friday, 18th September 2015, 13:10h

Short Note: Whales and ship strikes – how to mitigate a problem with many unknowns

Fabian Ritter
IWC und MEER e.V., Germany

This talk will provide an introduction to the issue of ships colliding with cetaceans and ask, why do whales get hit by vessels?‘ and ‚how can collisions be avoided?‘. Current research and kowledge gaps will be identified and the role of different stakeholders will be highlighted, as well as several examples of hot spots for ship strikes. An overview of the mitigating actions that are currently in place or are being discussed will be provided. This includes technological solutions and tools, operational measures, legal provisions and educational approaches. The talk will also discuss the important role of reporting and highlight the IWC‘s global ship strike database.

Poster Abstracts

Poster, Venue: in/near Conference Room

Current understanding of marine benthos diversity in and around Korean tidal flats

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Comprehensive reviews of microphytobenthos (MPBs) and macrofaunal studies have been conducted along the coasts of Korea, supporting the biodiversity of Korean tidal flats. The internationally recognized topics related to the tidal flat MPBs appeared to be assemblages, dynamics, production, and food web etc. The brief summary from the several representative works (selected based on citations) related with each topic was provided as for comparison, if applicable. Although great scientific gap of about half a century between Korea and the European countries were historically evidenced, a recent scientific advancement during the last decade would be noteworthy. The study of floral assemblages was found to be steady issue in Korea, with documentation of >400 MPBs species (ca. 10 new species) from tidal flats. Future research direction was also carefully discussed by comparative analysis between worldwide versus Korean studies in various aspects. In the meantime most updated checklist of Korean marine benthic invertebrates of 624 species belonging to ten phyla has been compiled from 72 references during the last 40 years. The phylum Annelida was the most diverse taxon (n=248) followed by Mollusca (n=196) and Arthropoda (n=135). While annelids prevailed in the subtidal area compared into intertidal, mollusk and arthropod species prevailed in the intertidal. Among 17 regions across the west coast of Korea, the Incheon exhibited the largest number of macrobenthic animals (n=272) followed by the Jeonjupo where 173 species have been reported over the past 30 years. More than half of all species compiled are reported from one region only while certain opportunistic polychaetes e.g. Heteromastus filiformis widely distributed across the coast. Overall the future studies of marine benthos in Korea by broadening target species and regions would be promising to support unique biodiversity in tidal flats.

Poster Abstracts

Poster, Venue: in/near Conference Room

Green algal diversity in coastal area of Korea

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Green algal species namely Chlorophyta are autotrophic organisms with chloroplasts inhabiting primarily in the aquatic environments. They belong to the Virifipalntae (green lineage) having many common taxonomic feature co-sharing with terrestrial angiosperms. While approximately five thousand species from fourteen classes of Chlorophyta has been reported worldwide, 123 Chlorophyta species has been known to the science from coastal areas of Korean peninsula; the number is most comparable to that from Australia (n=127). Of note, the number of the species has doubled from the early records of half a century ago (n=61). One of the obstacles in the study of this taxonomic group is the delineation of species boundaries due to the high plasticity of morphological characteristics as well as highly simplified structures without clear diagnostic features, altogether making the vary taxonomic group being notorious with extreme difficulties in species identification. Accordingly various new approaches and/or methodologies are being tested and applied. The most promising one would be the combination of detailed observation of morphological traits with sophisticated molecular tools such as phylogenetic analysis, barcoding, which have also been applied to the understanding of biodiversity of Koran green algae. In the present study, we aimed to

1. address the current understanding of overall diversity of green algae in Korea,
2. introduce some of the successful application of combined approaches of morphological and molecular studies, and finally
3. to suggest the future prospects of green algal studies in Korea.