

Henning von Nordheim, Katharina Maschner and  
Katrin Wollny-Goerke (Eds.)

# Progress in Marine Conservation in Europe 2012



3rd International Conference on  
**Progress in Marine  
Conservation in Europe 2012**

18. - 22. June 2012  
Stralsund, Germany

Hosted by the  
**German Federal Agency for Nature Conservation (BfN)**  
in cooperation with the  
**German Oceanographic Museum (DMM)**  
More information on the upcoming conference at: [www.habitatmare.de](http://www.habitatmare.de)



# **Progress in Marine Conservation in Europe 2012**

**Proceedings of the Symposium Stralsund, Germany  
18 - 22 June 2012**

## **Editors**

**Henning von Nordheim  
Katharina Maschner  
Katrin Wollny-Goerke**



**Cover picture:** Conference poster (©Graner / BfN, Gust / BfN, Krause & Hübner / BfN, OZEANEUM Stralsund, Schlorke, Schories / BfN; Layout: von Nordheim, Maschner, Wollny-Goerke)

**Coordination:**

Dr. Henning von Nordheim      Federal Agency for Nature Conservation (BfN)  
Marine and Coastal Nature Conservation  
Isle of Vilm  
18581 Putbus, Germany

**Conference preparation:**

Katharina Maschner      German Oceanographic Museum  
Katharinenberg 14-20  
18439 Stralsund, Germany

Katrin Wollny-Goerke      Kakenhaner Weg 170  
22397 Hamburg, Germany

Further information on the actual status and background of marine protected areas under the Habitats Directive and the Birds Directive of the EU in the German Exclusive Economic Zone (EEZ) can be found on the BfN web page [www.habitatmare.de](http://www.habitatmare.de)

This publication is included in the literature database "**DNL-online**" ([www.dnl-online.de](http://www.dnl-online.de))

BfN-Skripten are not available in book trade but can be downloaded in a pdf version from the internet at: [http://www.bfn.de/0502\\_skripten.html](http://www.bfn.de/0502_skripten.html) or [www.habitatmare.de](http://www.habitatmare.de).

Copies may be requested from the publisher.

Publisher:      Bundesamt für Naturschutz (BfN)  
Federal Agency for Nature Conservation  
Konstantinstraße 110  
53179 Bonn, Germany  
URL: <http://www.bfn.de>

All rights reserved by BfN

The publisher takes no guarantee for correctness, details and completeness of statements and views in this report as well as no guarantee for respecting private rights of third parties.

Views expressed in the papers published in this issue of BfN-Skripten are those of the authors and do not necessarily represent those of the publisher.

No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage and retrieval system without written permission from the copyright owner.

Printed by the printing office of the Federal Ministry of Environment, Nature Conservation and Nuclear Safety.

Printed on 100% recycled paper.

ISBN 978-3-89624-074-3

Bonn, Germany 2013

## Index

Preface.....	V
Acknowledgement.....	VI
Introduction.....	1

## Opening

Beate Jessel: Key Issues of Marine Conservation in Germany and Europe .....	5
Dan Laffoley: Today's global Oceans Stresses, Impacts and Solutions - The State of the Ocean Report.....	15
Henning von Nordheim et al.: Marine Biodiversity and Networks of Marine Protected Areas – Towards a global network of MPAs in Areas beyond national jurisdiction .....	25
Fotios Papoulias: The Implementation of the Natura 2000 Network in European marine areas - Relation to the Marine Strategy Framework Directive .....	39
Dieter Boedeker & Tim Packeiser: Network of MPAs in the Maritime Area of HELCOM and OSPAR by 2012.....	45
Marie Romani: MPAs in the Mediterranean Sea - Coherence and Efficiency .....	65
Jenny Oates & Jon Davies: Progress of the UK's MPAs towards an Ecologically Coherent Network.....	73

## Management and Monitoring of Marine Protected Areas

Jochen Krause & Detlef Czybulka: Towards the Management of MPAs in the German EEZ of the North- and Baltic Sea .....	85
Jens Enemark & Harald Marenic: Wadden Sea World Heritage -- Recent Progress in Protecting and Managing the World's largest Tidal Barrier Island System.....	87

## Management of Anthropogenic Impacts on Marine Ecosystems

Anne Christine Brusendorff: International Council for the Exploration of the Sea (ICES) and Marine Biodiversity .....	105
Karin Lüdemann & Sven Koschinski: Minimizing Underwater Noise from Offshore Wind Farm Construction .....	115
Lindy Weilgart: Alternative Quieter Technologies to Seismic Airguns for Collecting Geophysical Data.....	127
Kim Detloff: Marine Litter: Projects – Threats – Solutions .....	135
Stefan Garthe et al.: Sensitivity of Seabirds to Anthropogenic Activities: a multi-factorial approach ..	147
An Cliquet et al.: Conflicting interests between Offshore Wind Farm Development and the Designation of a Natura 2000 Site: riding a Belgian policy roller coaster? .....	149
Josh Gibson et al.: Great Barrier Reef Region Strategic Assessment .....	167

## Marine Nature Conservation and Fisheries in Europe

Rainer Froese: Towards Sustainable Fisheries in Europe .....	179
Josh Gibson et al.: Role of No-take Marine Reserves in the Protection of Marine Biodiversity .....	183
Joachim Claudet: Ecological and Fisheries Benefits of Marine Protected Areas .....	193
Christian Pusch: Fishery Measures in German Natura 2000-Sites .....	201
Hans Nieuwenhuis: Implementation of Natura 2000 in the Dutch North Sea: Managing Fisheries ...	215
Sara Königson & Sven-Gunnar Lunneryd: Development of alternative Fishing Gear in the Swedish small-scale coastal fisheries .....	217

## Short Notes / Project Reports

Edward Vanden Berghe et al.: The Census of Marine Life, the Ocean Biogeographic Information System, and where do we go from here? Future perspectives .....	229
Philip Weaver & Veerle Huvenne: Seabed Mapping and its Contribution to the Goal of Sustainable Management in the Ocean .....	239
Max Schuster: Mapping of Underwater Noise .....	247
Marc Reichenbach et al.: Optimising the Lighting Equipment on the Mittelplate drilling and Production island in the German Wadden Sea Tidelands .....	249
Lonnie Mikkelsen et al.: Blue Reef - a Danish Reef Restoration Project in a Natura 2000 Site.....	259
Pilar Marin et al.: Identifying and Proposing MPAs in the Baltic Sea and the Mediterranean .....	267

## European Marine Strategy Framework Directive (MSFD)

Britta Kniefkamp et al.: The EU Marine Strategy Framework Directive (MSFD) - State of Implementation in Germany - .....	281
Wim van Urk: The Dutch Approach on the Implementation of the EU – Marine Strategy Framework Directive .....	289
Eduard Interwies & Stefan Görlitz: Economic Aspects of the MSFD: Why and how to estimate the Benefits of Measures? .....	301

## Protection of Marine Endangered Species

Janet Brown & Elizabeth C. Ashton: Restoration of Oysters: a Missing Habitat. ....	311
Vangelis Paravas et al.: Mediterranean Monk Seal Conservation. The Role of Marine Protected Areas and 'Horizontal' Measures for the Preservation of the Species in Greek Seas.....	321
Sarah Fowler: Conservation and Management of Northeast Atlantic Sharks .....	331
Marije Siemensma: Conservation plan for the Harbour Porpoise ( <i>Phocoena phocoena</i> ) in The Netherlands: towards a favourable conservation status .....	333
Jens Koblitz: The Baltic Sea Harbour Porpoise ( <i>Phocoena phocoena</i> ): What do we know and what do we need to know?.....	343
Anders Galatius: Recovery of the Grey Seal ( <i>Halichoerus grypus</i> ) Population in the southern Baltic Sea .....	349

## Preface

The year 2012 is an important year for global marine nature conservation. During the World Summit of Sustainable Development (WSSD) in Johannesburg it was agreed to establish a worldwide representative network of marine protected areas by 2012. Until now, these MPAs cover not more than about 1.5% of the oceans and most of them lie in nearshore or coastal waters. In the OSPAR and HELCOM regions as well as in the German North and Baltic Seas, substantial progress has been achieved. But there is still a lot of work to be done regarding the High Seas and the areas beyond national jurisdiction worldwide.

Furthermore, important milestones were established during the first implementation processes of the European "Marine Strategy Framework Directive" on the way to achieve a good environmental status of the European Seas until 2020.

But human activities which impact the marine environment are still increasing from year to year. Significant reductions e.g. of the present intensive fishing practices are urgently needed. The cumulative and harmful effects of different anthropogenic impacts mean new challenges for research and policy and therefore, a variety of mitigation measures in focus of scientist and institutions.

In June 2012 in Stralsund, Germany, the 3<sup>rd</sup> international conference on "**Progress in Marine Conservation in Europe 2012**" provided again, in the line of two successful conferences in 2006 and 2009, a forum for in-depth discussions on those continuously important and emerging marine nature conservation issues. A wide range of participants such as policy makers, conservation managers, renown scientists and inter- and non-governmental organizations followed the invitation by the German Federal Agency for Nature Conservation (BfN) to take part in the one-week-conference to share latest experiences in marine conservation, to discuss new research results and to get impulses for the future work.

The application of the "ecosystem approach" on different levels in the legislative and political framework on global and regional seas scale will be a necessary step against the loss of biodiversity and ecosystem degradation in our seas. We all have to strengthen our efforts for the protection of species and habitats and for a sustainable and ecologically sound use of our natural marine resources.

This proceedings summarise again many of the high quality speeches held at the conference which paid tribute to progress already made and identifies emerging promising approaches to proceed in marine nature conservation in Europe and beyond.

**Prof. Dr. Beate Jessel,**

President of the German Federal Agency for Nature Conservation (BfN)



## Acknowledgements

The 3<sup>rd</sup> international conference on “**Progress in Marine Conservation in Europe 2012**” and the corresponding proceedings are the result of the joint efforts and help of various speakers and people. Most chapters greatly benefited from the valuable comments of the peer reviewers, whom we would like to thank for all their efforts.

The organisers of the conference would like to sincerely acknowledge the support of many persons on and behind the scene.

The team of the German Oceanographic Museum (DMM) and OZEANEUM GmbH Stralsund, provided again the perfect environment and infrastructure for the conference.

Finally, we are grateful for the support of the German Federal Agency for Nature Conservation (BfN), and especially the colleagues of the section Marine and Coastal Nature Conservation for their help during the conference preparation and realisation as well as for the review process.



## Introduction

The 3rd international conference on „**Progress in Marine Conservation in Europe 2012**“ was held from the 18th - 22nd June 2012 and hosted by the German Federal Agency for Nature Conservation (BfN) in cooperation with the German Oceanographic Museum (DMM). The conference took again place in Stralsund, Germany at the OZEANEUM which is an outstanding enlargement of the German Oceanographic Museum with modern aquaria and exhibitions, thus representing the perfect environment for an international marine conference. The conference was financed by the German Federal Agency for Nature Conservation (BfN) and proved again to be an encouraging event with attendance of more than 200 experts from 20 countries.

A wide range of international experts covered new and emerging issues on progress made in marine nature conservation. In her opening speech the president of the Federal Agency for Nature Conservation, Prof. Beate Jessel warmly welcomed the participants and gave an overview of the German regional, national and international marine conservation obligations, policies and progresses. An excellent key note presentation speech by Dr. Dan Laffoley (World Commission on Protected Areas/IUCN) introduced to the marine conference. During the first and second session speeches focussed on the current status of the implementation of Marine Protected Area networks with regard to the European 2012 marine conservation aims and their respective management and monitoring. Dr. Henning von Nordheim explained the current state of the global network of MPAs and was followed by Mr. Fotios Papoulias, European Commission, who gave an overview on the current Natura2000 status in European Marine Areas. With examples given for the Baltic Sea and North Sea further approaches and strategies towards meeting the challenge of developing and managing MPA networks were presented and discussed.

The third session focussed on the management of anthropogenic impacts on the marine ecosystems and was introduced by the Executive Secretary of ICES Dr. Anne-Christine Brusendorf who focused on the work of the International Council of the Exploration of the Sea (ICES) in respect to the marine biodiversity. Fortunately, also technical improvements can help to reduce anthropogenic impacts. Therefore, new techniques and projects to minimize underwater sound of various sources as well as marine litter were presented by experts in this field. The strategic assessment of planned and potential future development on the Great Barrier Reef Marine Park (GBRMPA) was explained in some details with illustrative examples by Dr. Josh Gibson of GBRMPA.

The fourth session called for new marine management measures and tools with regard to marine nature conservation and fisheries in Europe. The progress reached by employing no-take marine reserves in Australia, the various management proposals developed to reduce fisheries impact in German and Dutch waters as well as Swedish fishing gear projects were explained. Additionally, new techniques and projects help to

improve our understanding of marine biodiversity and ecology such as the Census of Marine Life, the Ocean Biogeographic Information System (OBIS), seabed and underwater noise mapping techniques and a reef restoration project which were presented in the section “short notes/project reports”. The session ended with some conference announcements and presentation of new books (e.g. Threatened Biodiversity in the German North and Baltic Seas/BfN) and films.

The actual status quo and current challenges in the process of implementing the European Marine Strategy Framework Directive (MSFD) were explained during the fifth session. Mrs. Heike Imhoff provided an excellent overview while the national states of implementation and the economic aspects of the MSFD were illustrated by presenters from the Netherlands and Germany.

Finally, the last session covered the protection of marine endangered species. One presentation looked into the potential for restoration of reefs, build by the European oyster (*Ostrea edulis*) while others addressed the protection and status quo of Northeast Atlantic sharks and marine mammals such as grey seals (*Halichoerus grypus*) and harbour porpoises (*Phocoena phocoena*).

These proceedings reflect again the high quality presentations which were discussed during the conference week. We would like to thank all speakers, for their effort to meet the publication deadline and enable the editors to compile this proceeding. Furthermore, the editors would like to clarify that the responsibility, and the contents of these contributions do not necessarily express the opinion of the German Federal Agency for Nature Conservation (BfN). However, all articles underwent a extensive review process by external experts and members of the Marine and Coastal Nature Conservation Unit and were adjusted with the consent of the authors. That said we are confident that these proceedings will offer valuable contributions to the discussion on the protection of marine biodiversity and to the development of a global marine protected areas network.

Henning von Nordheim, Katharina Maschner, Katrin Wollny-Goerke (Eds.)

## Opening

---



# Key Issues of Marine Conservation in Germany and Europe

BEATE JESSEL

President of the Federal Agency for Nature Conservation, Germany

In the line of two successful conferences in 2006 and 2009, the third conference “Progress in Marine Conservation in Europe 2012” comes together again to share experiences in marine conservation, to discuss research results and to get impulses for our future work. And progress in marine conservation *is* still very necessary: human activities which impact our seas are ever increasing from year to year and their cumulative effects mean new challenges for research and policy.

As we assemble here in the middle of the year 2012, I will seize the opportunity to take a look on important marine conservation developments and targets of this year:

- At the Johannesburg World Summit on Sustainable Development in 2002, the contracting parties of the CBD agreed to establish a worldwide network of marine protected areas in the oceans by 2012.
- In 2012, the initial national assessment, the determination of the good environmental status and the definition of environmental targets within the Marine Strategy Framework Directive (MSFD) have to be completed.
- The application of the “ecosystem approach” on different levels in the legislative and political framework on global and regional seas scale will be a necessary step against the loss of biodiversity and ecosystem degradation in our seas.
- In consequence, the implementation of the EU Biodiversity Strategy and therefore the European Parliament resolution of April 2012 play an important role in the current discussion and the forthcoming reforms e.g. the Common Fisheries Policy (by 2013) and an adequate reflection of marine biodiversity conservation issues.

As these are also important topics of this conference let me also reflect some experiences that we had by trying to implement marine conservation in German waters.

## 1 Establishing worldwide and national networks of Marine Protected Areas

Regarding the establishment of a representative worldwide network of Marine Protected Areas by 2012, as one of the results of the COP in 2010 in Nagoya the CBD (Convention on Biological Diversity) endorsed and specified the target. It should encompass at least 10% of the world’s oceans by 2020. Until now, these MPAs cover

not more than about 1.5% of the oceans and most of them lie in nearshore or coastal waters. There are still many threatened marine species, habitats and ecosystems which are not representatively covered by the global network. Completing the network and achieving the coherence and efficiency of MPAs are still great challenges for the future.

To fill the still existing gaps of our knowledge and advance the scientific basis for conserving biological diversity in the deep seas and open oceans, the Global Oceans Biodiversity Initiative (GOBI) was set up. This initiative is very helpful and essential to identify ecologically and biologically significant areas - so called "EBSAs" - in the oceans, with an initial focus on areas beyond national jurisdiction. Our Federal Agency for Nature Conservation (BfN) is able to substantially contribute to the financial basis of this international scientific network.



**Figure 1:** Threatened Habitat in the OSPAR Maritime Area: Sea-pen (left: *Virgularia* sp., Nick Hobgood - Wikimedia commons) and burrowing megafauna communities (right: e.g. with Langoustines (*Nephrops norvegicus*), photo Hans Hillewaert - Wikimedia commons).

But we can also notice progress in certain regions, including the High Seas, in the Mediterranean Sea, and in the OSPAR maritime area e.g. in the Midatlantic Ridge of the Northeast-Atlantic. In 2010, the southern part of the Charlie-Gibbs-Fracture Zone together with five large High Seas MPAs in areas beyond national jurisdiction have been established on and around the Midatlantic Ridge. Important habitats of high ecological value like seamounts and cold water coral reefs as well as threatened species of the deep sea are now protected, especially from destructive impacts due to fisheries and mining.

So we can state that substantial progress in the implementation of marine protected areas (MPAs) in the northern European seas has been achieved, with Germany contributing substantially to the relevant processes on different levels. And even more successful the CBD target is already met by the HELCOM Baltic Sea Protected Area network, where about 10% of the maritime area is now covered by MPAs.

Summing the situation up we can state, that in Europe and worldwide, successful processes are on the way but that to reach the targets, we still have to increase our efforts.

In Germany for instance, the initial steps - the identification, delineation and nomination processes - for MPAs have come to an end. From the coastal waters to the Exclusive Economic Zone (EEZ), Germany nominated approximately 43% of the German marine area of the North Sea and 51% of the Baltic Sea as marine conservation areas. Now the further development of legal protection instruments and management plans for a number of these areas, particularly in the EEZ, are the next steps. Monitoring, management and enforcement of MPAs are the main tasks for the next years. The trilateral Wadden Sea National park and now World Heritage site is an excellent example how to master these challenges in a coastal area.

In the high seas or offshore areas it is much more difficult to install a proper protection regime than in territorial waters since a coastal state has in many cases only limited rights to regulate human activities such as shipping or fisheries. The only way out is to address the concerns and needs together with the appropriate international competent authorities and to find international or even better: global agreements as a necessary basis for effective protection measures.

## **2 Protection of endangered marine species**

One of these international agreements is CITES where we have to intensify our work on the protection of certain species like sharks and on the implementation of CITES in the international community.

For some endangered marine species in European waters, especially those which are protected under the Habitats Directive, we continue in setting up special management or conservation plans. One example is the Harbour porpoise:

When we talk about increasing human activities in our seas and there about highly increasing underwater noise of different sources, we know that Harbour Porpoises – like all whales and dolphins – are seriously affected. They have a very sensitive hearing and are vitally dependent upon it. Some years ago, German scientists were able to identify the acoustic tolerance limit of Harbour Porpoises.



**Figure 2:** Harbour Porpoise (*Phocoena phocoena*) (Sven Gust/BfN).

It was the basis for the threshold of 160 dB (SEL) for acoustic emissions during the pile driving of windmill fundaments. This threshold can only be fulfilled when technical mitigation measures are applied. In a research study, commissioned by the German Federal Agency for Nature Conservation (KOSCHINSKI & LÜDEMANN, 2011), the effectiveness of these technical measures e.g. the big bubble curtain, were analyzed and some promising results will be presented at this conference. Never the less the study also revealed the urgent demand for further reseach and development. I am sure that any development in this topic will be of great interest also for project managers in the wind energy industry.

So steering the necessary extension of offshore wind energy production in marine areas in a nature friendly way is one of our greatest challenges today.

A good example for progress in species protection is the Grey Seal. For many years now, our Agency has been working within HELCOM and its bodies (e.g. the Seal Expert Group) for the comprehensive protection of this seal species throughout the Baltic Sea. On the German Baltic Sea coast the Grey Seal population had totally disappeared. But within the last years, a small population re-established itself and is increasing in the waters around the island of Rügen. Monitoring and protection of Grey Seals in this region is based on cooperation between our Agency for Nature Conservation, the local authorities and the German Oceanographic Museum.

The Grey Seal stocks at the German North Sea coast have increased continuously in the meantime. On Helgoland alone, about 100 pups are born each year. Grey seals

are a good example for the natural dispersal and re-settlement of original habitats of a species as soon as good living conditions like sufficient food and suitable whelping and resting grounds and a public acceptance become available.

Another good example is the Sturgeon, addressed by a “lighthouse” project in our national strategy on biological diversity. Adult Sturgeon live in the open sea and migrate far up the rivers to spawn. They are considered as indicator species for natural dynamics, structural diversity and good water quality of the rivers, and they are also pioneers for better environmental conditions for other threatened migratory fish species. Until now, over 200,000 of young sturgeon have been released mostly in the Odra River or their tributaries but also in the Elbe River in the last years and we all hope to see many of them back in our rivers for spawning some day.



**Figure 3:** Young sturgeon (*Acipenser sturio*) being released (Katrin Wollny-Goerke).

But if we want to address protection of the whole marine biodiversity, there are also highly endangered species in the benthic habitats which play an important role in the food web. Some of them might profit from the status of protection within the Habitat Directive, but others don't.

The European Oyster (*Ostrea edulis*) is an example for such a highly endangered benthic species. Actually, there are no viable populations of the European Oyster in the German Bight left. Due to overfishing in the 19<sup>th</sup> and the first half of the 20<sup>th</sup> century, the populations have collapsed in the North Sea. The recovery of this indigenous species is very slow because of its high demands on good living conditions and of low distribution range. It is considered as a key species in the marine ecosystem of the North Sea: Oysters have a high filtration capacity; they provide a

vast and stable structures and habitat for a lot of other benthic species like sea squirts, boring sponges or worms, but also for young fish.

But species protection can only be successful if the ecosystem approach is consequently applied to all human activities in all the different habitats, the respective species need in their life cycles.

We are looking forward to get some hopefully good news about different marine species within the conference.

In this context our Agency has recently launched a new publication in German and English on threatened biodiversity in the German North and Baltic Sea, in which detailed profiles of threatened and declining marine species and habitats include biological characteristics and sensitivities to human activities (NARBERHAUS et al., 2012). The latter comprise the effects of climate change.

### **3 Human activities in the seas**

In our seas, there is a variety of human activities and their associated specific environmental impacts. And against all better choice, they are ever increasing and they accumulate. We are in the urgent need for mitigating anthropogenic environmental impacts by a proper management of these activities accompanied by continuing research.

Besides fishing and shipping, offshore wind energy is actually the most prominent example for human activities claiming more and more space of our seas. The actual energy concept of the German Government intends to provide Offshore Wind Farms with capacities of 10,000 MW by 2020 and 25,000 MW by 2030 in the North and Baltic Sea – a quite ambitious target. Two years ago the first German offshore wind farm became operational north of the Isle of Borkum in the North Sea, another one the following year in the coastal waters of the German Baltic Sea. Actually (by October 2012), three wind farms are under construction again in the EEZ of the North Sea. 26 additional wind farms encompassing more than 8,875 MW have been approved already in the German EEZ and another 97 (!!) projects in the EEZ have been submitted. The approved and submitted wind farms encompass an area of about 5,250 km<sup>2</sup> in the North Sea and 484 km<sup>2</sup> in the Baltic Sea - these are nearly 17.4% of the entire German EEZ. Let us keep in mind that renewable energies are a necessary requirement if we want to fight climate change successfully. It is our great task as nature conservationists to accompany this development in order to minimise adverse and prevent unnecessary impacts on marine biodiversity.

The generally applied method to fix the foundation of the turbines emits underwater noise intensive enough to injure or even kill marine animals and to stretch out to tens of kilometres forcing for example Harbour porpoises to leave their habitat. Surveys during the construction of various wind farms in the German Bight provided evidence

that there are avoidance reactions of these animals and that they disappear from their habitats. The results further urgently call for due consideration of the need for effective noise mitigation measures like the so-called big bubble curtain or other techniques. When in operation, wind farms and their surrounding environments are avoided by certain sea bird species. This results in a permanent habitat loss. Significant impacts of wind farms on migrating birds due to the risk of collisions and avoidance reactions cannot be excluded.

But offshore wind farms are by far not the only human activity in the EEZ. Large areas are currently licensed under German mining law for the exploration of hydrocarbons or for sediment extraction. For example in the German EEZ of the North Sea, three licensed areas for sand and gravel extraction with an area of 1,300 km<sup>2</sup> are fully located in Natura 2000 sites. Especially near or inside reef areas the long-term effects of aggregate extraction is a major threat and obstacle in achieving a favourable conservation status.

Additionally, gas production platforms, pipelines and cables were installed in the EEZ. The laying procedure of both cables and pipelines leads to mainly temporary disturbance of the seabed habitats and the related species. Particularly operational submarine power cables emit electromagnetic fields and release heat. And as a consequence of the increasing number of offshore wind farms more and more power cables will be needed to bring the offshore energy to the electric mains on land.

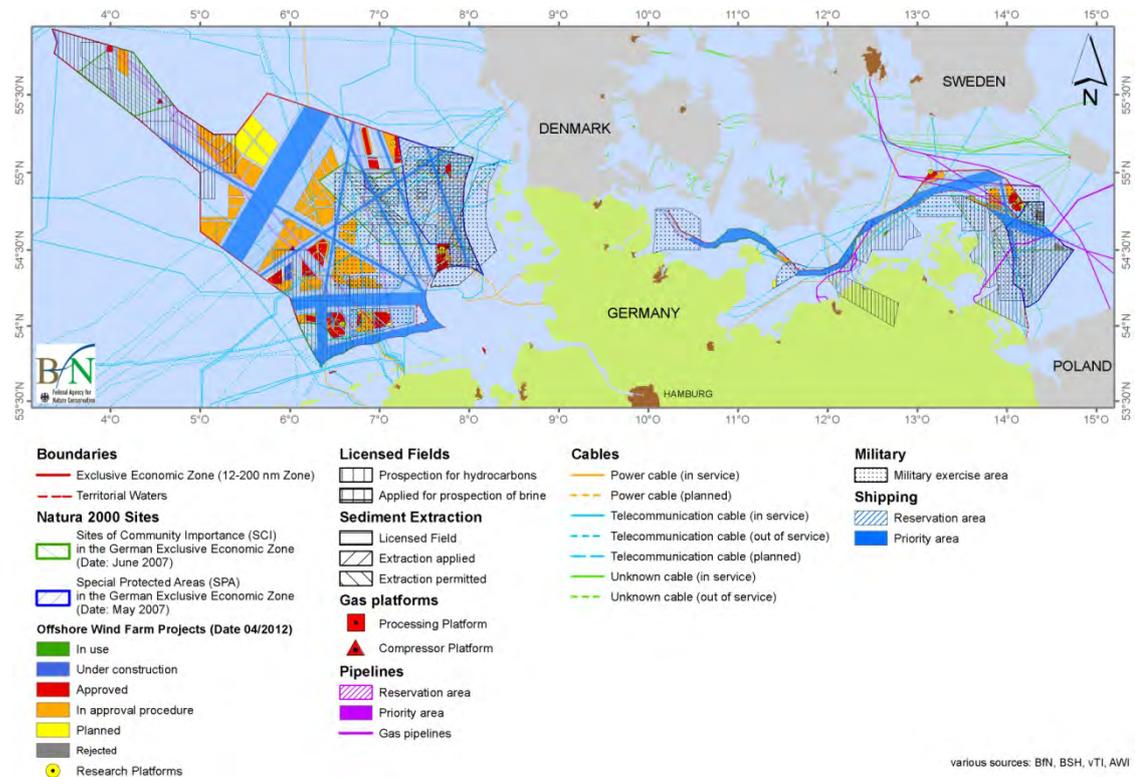


Figure 4: Human Impacts in the German part of the North Sea and Baltic Sea (without Fisheries).

Further activities include military exercises of our navy or shipping. And along with globalisation of trade, shipping activities are increasing from year to year, introducing amongst other impacts more and more noise into our seas and leaving less undisturbed sea surfaces for resting sea birds, especially in the estuaries of our big rivers like Elbe, Rhine or Weser.

These are only some examples and they do not yet include fishing – most probably the spatial activity with the most severe impacts on marine ecosystems. The status of European fish stocks is still dramatic: According to official figures published by the EU Commission, most of the commercially used fish stocks in the Northeast Atlantic are overfished and a high percentage, some 20 percent are outside safe biological limits. The effects of fisheries alone on commercially used fish species are severe. They include reduction of fish stocks, changes in the distributions of size and age, reduction of genetic variability and thus lessening of biological resilience in the face of ecosystem and climate changes.

Let us take a closer look on the situation in German waters: The North Sea is one of the most intensively fished regions worldwide almost not leaving any areas without fishing activities. In consequence, we have to observe – besides overfishing of numerous commercial fish stocks - substantial impacts on habitat types and species protected under the Habitat and Bird Directives.

In an intensive research project (“Environmentally Sound Fisheries Management in Marine Protected Areas”, named EMPAS, see PUSCH & PEDERSEN, 2010) the main conflict areas have been identified, as most of you know:

- (1) impacts of mobile bottom-contacting fishing gears on reef and sandbank habitats,
- (2) bycatch of seabirds in static gears, especially bottom set gillnets,
- (3) bycatch of Harbour porpoise in static gears

On the basis of the advices from the International Council for the Exploration of the Sea (ICES), a joint working group of our Agency and the Johann Heinrich von Thünen Institute has identified specific management recommendations, for fisheries management in Natura 2000 sites in the German EEZ. However the ongoing reform of the European Common Fisheries Policy is a great chance to move forward to sustainable fisheries within Europe. In this reform process, European member states have to strengthen their efforts to:

- reduce the overcapacity of the commercial fleet to reach an equilibrium between fleet capacity and fish stocks
- reduce the by-catch of target and non-target species (e.g. marine mammals, seabirds etc), by improving the selectivity of fishing gear.
- implement efficient management measures in Marine Protected Areas (especially Natura 2000-sites).

Furthermore, member states are obliged to harmonize fishing activities with the targets of reaching the “Good Environmental Status” until 2020 in line with the Marine Strategy Framework Directive. And there is no doubt that with the current fishing intensity, the targets of the MSFD cannot be fulfilled. Significant reductions of the fishing effort are urgently needed for the recovery of exhausted fish stocks, protected habitats and endangered species.

#### **4 Implementation of the Marine Strategy Framework Initiative**

Now having mentioned the Marine Strategy Framework Directive, this instrument is indeed - after many good but sectoral approaches - an integrative framework. The MSFD gives the EU-Member States a unique, challenging and complex task to achieve and maintain a good environmental status of the European Seas by 2020. Each Member State has to develop jointly with its neighbors marine strategies that are based on the ecosystem approach. The national strategies have to be established on profound knowledge of the respective European marine region and require a number of work intensive preparatory steps.

These include an (initial) assessment of the actual status of the national marine waters addressing essential features and characteristics, predominant pressures and impacts as well as economic and social aspects. The second step is the definition of how the good status of the marine waters looks like. The result of the comparison of the actual and desired status does then lead to the establishment of environmental targets. These shall lead to measures necessary to achieve a good environmental status.

The initial assessment of the MSFD shows that our parts of the North and Baltic Seas despite all efforts in the past do not yet show a good environmental status.

For reducing the impact of the existing and growing human activities we need a twofold strategy: On the one hand we have to assess and act on the level of specific human activities, plans and projects when they negatively affect the marine environment: here, the German Federal Agency for Nature Conservation is for example involved in the development of threshold values for noise and habitat loss and to develop and promote appropriate mitigation measures. And on the other hand the cumulative impacts of all human activities have to be monitored and assessed and adaptive management measures have to be implemented, also in the frame of the MSFD requirements to reduce these effects on the ecosystem.

More information about our Agency’s activities and involvement in marine conservation can be found in our BfN-brochure “Active for marine nature conservation” that is also available as a pdf file ([www.bfn.de/habitatmare/de/downloads-publikationen](http://www.bfn.de/habitatmare/de/downloads-publikationen)).

Finally, I hope that this conference will bring us a lot of examples of best practice, new ideas and fruitful dialogues for an ongoing progress in marine nature conservation!

## 5 References

Koschinski, S. & Lüdemann K. (2011): Stand der Entwicklung schallminimierender Maßnahmen beim Bau von Offshore-Windenergieanlagen.- Studie im Auftrag vom Bundesamt für Naturschutz (BfN), Juli 2011, 83 pp. (<http://www.bfn.de/habitatmare/en/publikationen-studie-schallmindernde-massnahmen.php>)

Narberhaus, I., Krause, J. & Bernitt, U. / Eds. (2012): Threatened Biodiversity in the German North and Baltic Seas. Sensitivities towards Human Activities and the Effects of Climate Change.- German Federal Agency for Nature Conservation (BfN), Naturschutz und biologische Vielfalt, Vol. 117, Bonn-Bad Godesberg, 674 pp.

Pusch, C. & Pedersen, S.A. (2010): Environmentally Sound Fisheries Management in Marine Protected Areas (EMPAS) in Germany.- German Federal Agency for Nature Conservation (BfN), Naturschutz und biologische Vielfalt, Vol. 92, 301 pp.

## **Today's global Oceans Stresses, Impacts and Solutions - The State of the Ocean Report**

DAN LAFFOLEY

Marine Vice Chair, IUCN's World Commission on Protected Areas, United Kingdom

### **Opening keynote speech**

Thank you Henning for that kind introduction. Good morning ladies and gentlemen. Henning asked me some time ago if I would come and give this opening keynote, and having been here before there was little need for a decision. So it is nice to be back.

Today I will talk about the state of the ocean report. This is something we developed as a result of joining up with the International Programme on the State of the Ocean – we met in 2011 and again this year. Hence, the state of the ocean name to our workshop outputs. But more about that in a moment.

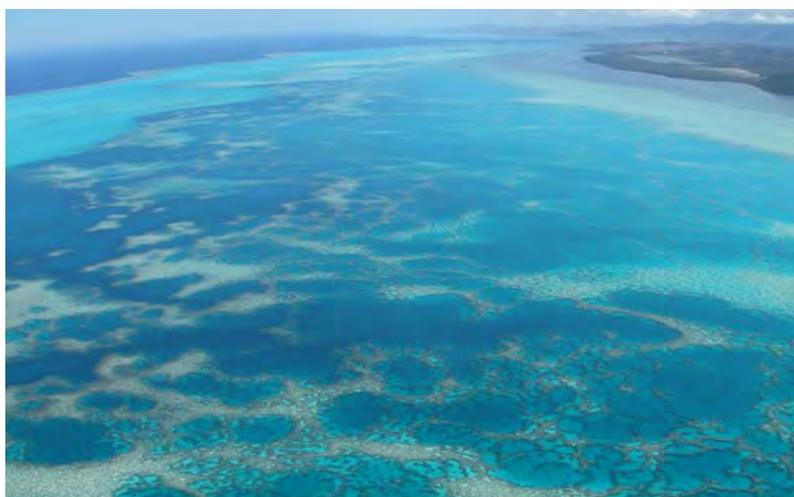
So this presentation is about the state of the ocean – a reflection on where we have come from, the current situation that has resulted, and some thoughts on where we might go from here to address the problems that have arisen. And it is amazing to think it is really just 40 or 50 years ago that the view of our blue planet became etched as an image in our minds. In those years since then many things have changed. The ocean world we viewed from afar from those early Apollo missions has become a digital ocean that we can view from any desktop computers. The Indian Ocean – the world's warmest ocean. The Pacific Ocean – its surface dotted by small island states. The Atlantic ocean with its characteristic erratic zip-faster-like mid-Atlantic ridge. And the Arctic Ocean – the world's most climate compromised ocean.

So what have we learnt in these intervening years, what values do we attach to the ocean, what is its state, and what opportunities are there to build a healthier future for the ocean and ourselves. And with just a little help from Google this brings us to today's location and our meeting this morning.



**Figure 1:** We live on the blue planet – the ocean shapes our daily lives, whether from the air we breathe, the water we drink, the weather we experience or the resources it provides to feed and support us (Google).

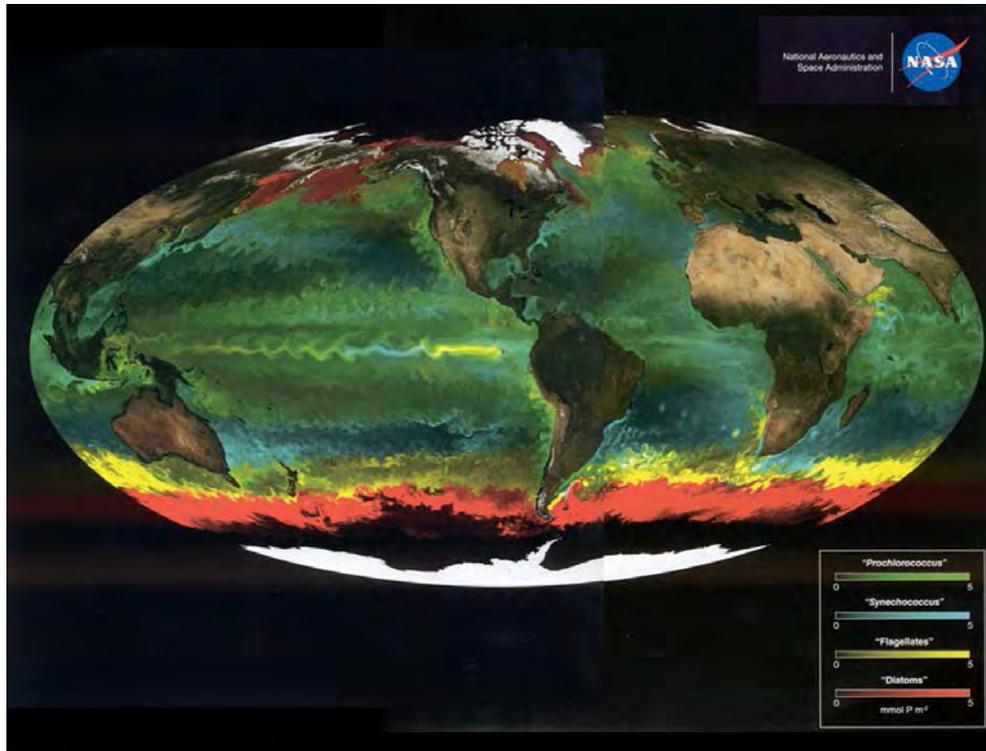
In terms of values, we recognised the ocean as a place of great beauty. This is the western side of New Caledonia with these amazing blue honeycomb reefs – not a person in sight. These reefs are also World Heritage status now like where we are today, inscribed just a couple of years ago.



**Figure 2:** We can often get drawn into detailed cases for why protecting the ocean matters – but at the simplest level is it a place of amazing beauty and inspiration that warrants much better protection. The beautiful coral reefs of New Caledonia received World Heritage Status in 2008 (Dan Laffoley/IUCN).

We know the ocean as something of great significance. For some time we had recognised that the ocean absorbs about 26% of the carbon dioxide we throw out from our activities each year. It was not until the late 80's however, that we realised the oxygen-giving properties. *Prochlorococcus*, shown here in light green, was discovered in the western Sargasso Sea and is the world's most abundant photosynthetically

active organism. So it is not some species of tree or variety of grass that is the most abundant oxygen-giving life form. We owe that to the ocean, so remember every second or third breaths you take comes from the sea.



**Figure 3:** In the late 1980s it was discovered that the most abundant photosynthetic organisms on the planet are not some species of grass or variety of tree but minute bacteria called *Prochlorococcus* that float in surface waters (NASA).

We know the ocean as a place of great discovery. Only two people alive today have been to the deepest part of the ocean – the Marianas Trench – Don Walsh and just a few months ago, James Cameron. There are more people alive today who have stood on the surface of the moon. It is amazing that it was not until the late 1970s that we discovered hot water communities around deep ocean ridges – powered by chemistry and not the sun - a completely new type of ecosystem on Earth.

We value it as a place of enjoyment – many hundreds of millions of people visiting the seaside every year for holidays. It is a place of great economic importance. The bulk of goods go by sea – so it underpins wealth, trade and therefore global financial markets. And it is a place we are dependent on for food. Millions if not billions look to it for a supply of protein in the form of fish. It is all these things and many more.

What we do know now though is that it is also a changed ocean in those intervening 40 or 50 years - change building of centuries of use and change reflected throughout that period. This map produced by Ben Halpern and colleagues a few years back in

Science gave a stark picture of just how much we have changed the blue heart of the planet. There are few places unaffected in the global ocean - so few in fact that organisations such as National Geographic actually have an expedition programme to seek out those last natural places – and they struggle to find them given the pervasive impacts of, for example, plastic pollution and fishing.

This map provided a backdrop to our work with the International Programme on the State of the Ocean. In 2011 and again this year we did something different that attracted worldwide press attention. Seldom do we pause to look across ocean impacts – many of you will have attended fisheries events, or meeting on pollution or water quality. We rarely look at the synergistic effects across all such areas. So we took leaders in their fields and gave them a few days away from the pressures of their day jobs to explore this issue. The result was a stark view on the state of today's ocean. I will tell you a little about this now but we also said in reporting these problems that there is still time to act to recover the situation – so the end of my keynote will look at some of the things we are doing 'outside' the box to restore ocean health and support for the ocean.

As I mentioned we did this to worldwide press coverage – nearly 1500 media stories, not just written media but TV and radio, and even coverage across Russia and China. So what were we saying?

In essence much of our concern relates to carbon – rate of movement and volume of carbon being moved. This slide shows the atmospheric levels of carbon dioxide over the past 20,000 years. Every year I need to add a little to reflect the latest higher figure for increased carbon dioxide levels. As you can see the peak on the right – some call it the anthropocene – reflects our impact in the recent past. Perhaps more alarming – and making this graph more real – is to put your birthday in carbon dioxide concentrations on the graph. Now some of you might have noticed, especially many of you who know me that I'm not as young as I use to be! Put my birthday concentration on the graph and it is roughly just a third of the way up the anthropocene – so the changes we see in concentrations are very recent, very quick and very large compared to the last 20,000 years, and even before that.

So what is the consequence of all this? Well some is well known and some less so. Melting sea ice. The challenge of warming and the vicious circle of the ice albedo effect – warming, thinning ice, open water, darker coloured water absorbing more of the sun's energy, resulting in thinner ice forming in winter and so on. Warming is also affecting the Antarctic, particularly the Antarctic Peninsula. The effect in Antarctica may be as much to do with changes in wind patterns altering current and causing warming, as it is to do with direct heating effects from the sun. What is perhaps less well known is the warming of the southern ocean. Very small changes but we now are seeing them throughout the full 4000m depth of the southern ocean.

Warming seas are bringing other problems – such as the release of methane hydrates as the methane bubbles off to the surface. In the Arctic this is now being observed at an increasing scale. In fact more recent observations than these by NASA show spikes of methane in the air as planes with detectors fly across breaks in the ice covering the Arctic Ocean.

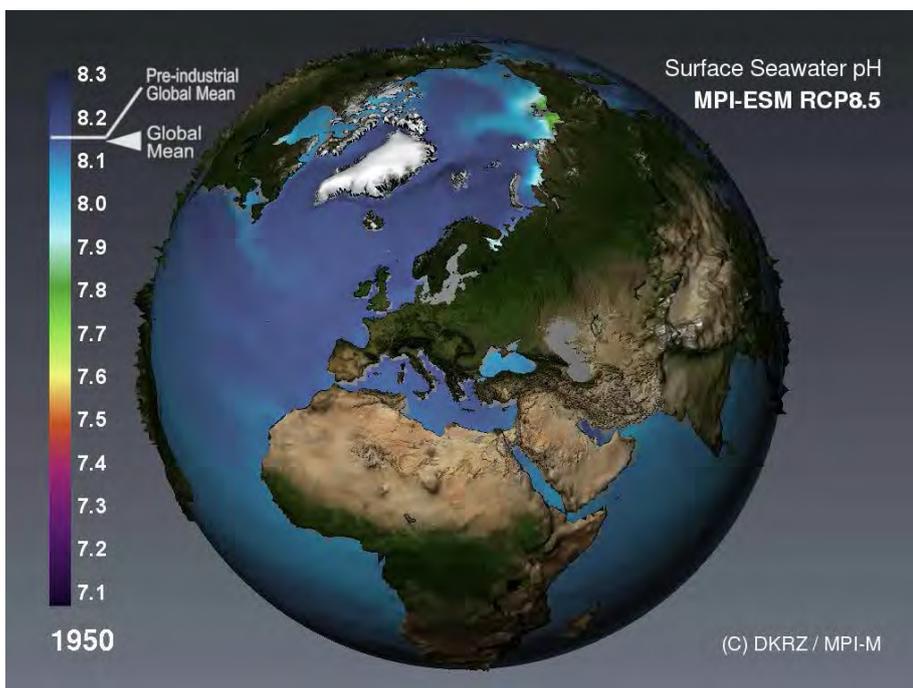
I mentioned changing wind patterns and these are affecting the plight of species. Take the iconic albatross – they are actually benefitting at the moment as changed patterns result in better feeding and breeding. Ultimately though if wind speeds increase too much they might not so well, so there will be winners and losers – and it might be difficult to map out what species will do well and which won't as their circumstances change with time and changing conditions.

We predict now that many species won't be able to adapt – some, such as species of fish for example, will 'run out of ocean' as they try to move pole-ward to keep in good habitat and run up against continent edges. As species move, we also predict that new species will invade, and that this will become especially prevalent in higher latitudes and especially polar waters.

It is not just species that are being affected but also gross marine ecosystem scale changes. Dead zones – areas with too little oxygen to support life – have dramatically increased. Just 50 perhaps in the 1960s have expanded to around 500 in 2010. We know this is reversible as it reflects the intimate linkages between land management and the coastal zone and indeed around 60 have recovered in the same period. Away from the coast we see oxygen sags now occurring in open ocean waters. To quote Robert Diaz: 'as the American Lung Foundation says when you can't breathe nothing else matters'. Indeed we have seen the habitat for the iconic Marlin, a species of great economic and recreational value, shrink by perhaps 15% since the 1960s and this may collapse to just 50% of the previous area by 2050. In essence the area of good water for this species is being squeezed into a smaller space as oxygen minima in the ocean start to shallow.

Alongside oxygen levels are the contaminants in the ocean. Many of us will be familiar with the legacy contaminants – PCBs etc. The good news is we have controlled emissions for many but the bad news is that they are often still present in the environment, in species such as cetaceans – and now appear to have spread even further afield in the ocean. Alongside these known contaminants are a new breed fed by our modern lifestyles. Flame retardants and things like artificial musks – from all those body sprays we use – that are now also accumulating in the ocean. So we need to wake up to these new challenges and keep ever vigilant as to their effects and ecosystem impacts.

And then there is the matter of ocean acidification – the other problem alongside climate change. As we have put ever more carbon dioxide into the atmosphere so it has been reacting with the ocean driving it towards more acidic conditions. The changes you see you might think are small but the pH scale is a log scale, just like the Richter scale for earthquakes – in the last 250 years the ocean has become 30 times more acidic and if we don't change our behaviour it is being predicted to increase to 120 times by 2060. This is not theory – we can already measure this trend in pH in the open ocean. Why does this matter? – well most marine life we depend on need carbonate to build their shells or skeletons – more acidic conditions will make this increasingly harder to do.



**Figure 4:** Until 10 years ago a less well known consequence of rising levels of carbon dioxide in the air was the effect on the ocean now called ocean acidification. As the ocean absorbs more and more carbon dioxide it is causing a shift in the ocean pH towards more acidic conditions and a commensurate reduction on concentrations of the form of calcium carbonate that marine animals build their shells and skeletons with (Max Planck Institute for Meteorology (courtesy Dr. Tatiana Ilyina)/German Climate Computing Center [www.dkrz.de](http://www.dkrz.de) (courtesy Dr. Michael Böttinger).

The most serious observation we made concerned how major impacts interact. When you look back on the history of the Earth at the last major extinction events – they all have been accompanied by a characteristic signature – climate change, ocean acidification and anoxia. What matters is the scale and rate of change. What we now see present in our ocean echos the signatures from previous extinction events that resulted in major losses of species. What is perhaps more worrying is that when you look at the last event – the PETM – and the rate that carbon was moved in the system – our activities are now moving carbon perhaps 30 times faster. We see this reflected

in a pickup of the background species extinction rate, so all the warning signs are there that we should take heed of.

So what can we do about this? Well we look to Rio + 20 happening this week. Major ocean issues are at stake in those discussions. For example roughly half our world – the open ocean beyond the jurisdiction of any country – the High Seas – still lacks an effective conservation, management and protection framework. What we need is a new treaty – an Implementing Agreement under the UN Law of the Sea – to give that protection. On the one hand Brazil wants the ocean as one of four outcomes – so we really could see Rio as a summit for the seas. On the other hand stands the USA and a handful of countries who are actively opposing completion of the world conservation framework. Time will tell and we should know which way this went by the coming weekend.

So alongside high politics and big new plans what else should we be doing to improve the situation for the ocean? Well first up we should be giving it better protection – a much higher level of protection than we currently do. We know what to do and we know high levels of protection – where we stop taking from the ocean – really work. Massive effects happen which restore ecosystems and the benefits we derive. It just makes sense to do this and not to continually deplete the real 'world bank' because we all know where that gets us. There are new and very real reasons why higher protection is needed. The amount of carbon some coastal habitats contain is very high so protection of them can stem the losses of that carbon back into the atmosphere that might and probably will occur as we damage and destroy these valuable resources.

We also need to increase the scale of protection. Countries have agreed to 10% protected areas by 2020 and yet we have only achieved about 1.6%, of which just a minor fraction is properly protected as I have just described. In 2006 Greenpeace gave us a view of what 40% protection in MPAs might look like – and indeed people are now thinking that big – thinking seriously about the need for scale-up. So instead of the Serengeti let us think of places like the Sargasso Sea. To do this we need to bring together the best knowledge and the best minds to identify ecologically and biologically significant areas in the open ocean - EBSAs. GOBI, the global ocean biodiversity initiative, is a key way. We are doing this under the auspices of the Convention on Biological Diversity. We have already had three EBSA workshops with another two on the way and EBSAs are now moving through the CBD process. Madam President, Henning, we are very grateful for your support, your agency's support and that of Germany in making this possible – your support is literally making a world of difference.

Alongside this work we also need to reach out much more to people. I do feel that in past decades people with their busy lives have become more disconnected with nature and the ocean. So we need to look for innovative ways to bring that connection back.

Alongside persuading more people to simply visit the sea and the seaside to see what is at stake, we need to use new technology so people 'find' the ocean more often in their daily computerised and digital lives. A few years back, working with the legendary ocean explorer Sylvia Earle, I helped champion the new version of Google Earth with a 3D ocean on it. In 2009 we launched this new version and just a few months ago more than 1 billion people now have access to this system.

Whilst this gives access to a fair proportion of the planet I think we must go further. Around this year or next access to digital information moves from desktops to hand-held devices – industry data tells us that. So why not put the ocean onto your mobile phone. So with a sweep of a finger in the palm of your hand you can dive into the ocean. I'm not just saying this – we are doing this. I am delighted to say just a few weeks ago on world ocean day we developed for and launched with UNESCO a new APP to explore all the marine world heritage sites – these jewels in the crown of ocean conservation. I hope this will be the start of many 'MPApps' to open up the wonders of the ocean and the needs and value of its protection to new large audiences worldwide.

Finally we are also looking beyond this to build new exciting partnerships to champion the ocean and its protection and management. In 2009 Sylvia Earle was given the TED prize. TED stands for technology, entertainment and design and is a USA based initiative where those three worlds collide. Each year one to three people are awarded the TED prize - \$100,000 but more importantly a wish to change the world, which the TED community then helps to make come true. Sylvia got the TED Prize and we have been working closely with her on it. One of the partnerships that have emerged through this is with the America's Cup. They are embracing the idea of ocean conservation to become 'more than just a sport'. They want to awaken, inspire and engage and whole new generation to care and act for the ocean.

One of the very latest outputs is a film produced by Puma Creative just a week or so ago. This will be shown at America's Cup events to engage a very large and wide audience in the need to care for the ocean. I am delighted today to play you this film by kind permission of the filmmaker, Yann Arthus Bertrand, and Puma Creative, in partnership with IUCN and the America's Cup Healthy Ocean Project.

So what ARE you waiting for!

Thank you very much

## **Marine Biodiversity and Networks of Marine Protected Areas**

---



# Marine Biodiversity and Networks of Marine Protected Areas - Towards a global network of MPAs in Areas Beyond National Jurisdiction

HENNING VON NORDHEIM<sup>1</sup> & KATRIN WOLLNY-GOERKE<sup>2</sup>

<sup>1</sup> German Federal Agency for Nature Conservation (BfN), Isle of Vilm, Germany

<sup>2</sup> Kakenhaner Weg 170, 22397 Hamburg

## 1 Introduction – global marine biodiversity conservation

It is known that the oceans and its deep seas cover more than two thirds of the global surface area. They play an important regulating role in the Earth's climate and are home to a major part of the world's biodiversity, containing some of the most productive ecosystems, vast natural resources, unique habitats, and globally rare species, many not even discovered. Various pressures resulting from intensified human uses, climate change and ocean acidification threaten to undermine these ecosystems' biodiversity, balance and resilience. As the open oceans and deep seas are mostly areas beyond national jurisdictions, international cooperation and coordination is fundamental for their conservation. The implementation of marine protected areas (MPAs) is widely considered as one of the most effective and pragmatic measures for the protection of marine ecosystems despite a number of open legal and governance questions (THIEL, 2003; AGARDY & STAUB, 2006; IUCN-WCPA, 2008; MORA et al., 2006; PARKS et al., 2006; GJERDE, 2012; BAN et al., 2013).

Within the global political frame, the necessity of marine biodiversity conservation got more and more on the political agenda after the Rio-conference in 1992, also on the UN-level, especially within the United Nations General Assembly (UNGA). Addressing closer the "impact-side", the United Nations Convention on the Law of the Sea (UNCLOS) entered into force in 1994. Often described as the constitution for the oceans, UNCLOS is the most important source of international law governing human activity in the seas and oceans, but it also creates an obligation for states to protect and preserve the marine environment (e.g. UNCLOS Article 192). Thus, it provides a legal framework also for nature conservation agreements both for the high seas (beyond territorial waters and EEZs) and for coastal waters and EEZs. Therefore it is of key importance for the process of the implementation of marine protected area networks, also in Europe. Since 2000, the UNGA is supported by the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (UNICPOLOS), which deals – among others – with aspects of the conservation of marine biodiversity and the implementation of MPA networks. The chances of this process to enhance marine conservation were analysed in a ground-breaking workshop in 2001 on Isle of Vilm, Germany (THIEL AND KOSLOW, 2001). In addition in

2005, an Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine Biological diversity Beyond areas of National Jurisdiction (BBNJ) was established. Furthermore, the necessity of marine biodiversity conservation is more and more emphasized in different UNGA Resolutions.

Probably the most important basis for the conservation also of marine biodiversity became within the last years the Convention on Biological Diversity (CBD) of 1992. The CBD's main decision-making body, the Conference of the Parties (COP), have agreed on two key strategy targets in recent years. The first target is a significant reduction in the rate of biodiversity loss by 2010, including marine biodiversity. Secondly, at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, global leaders agreed to establish a comprehensive and representative worldwide network of MPAs by 2012 and start to improve the status of oceans biodiversity (Johannesburg Plan of Implementation 2002). The World Summit of 2002 can therefore be considered as the basic reference point for all global programs, activities and initiatives concerning marine biodiversity conservation for states, international organisations, institutions and NGOs (VON NORDHEIM, PACKEISER & DURUSSEL, 2011).

In the line with this successful World Summit, further meetings of the COP of CBD specified more and more the development and implementation of MPA networks in coastal areas, exclusive economical zones (EEZs) and above all the "high seas". In 2008, the COP 9 agreed upon a system and the application of scientific criteria for the selection of ecologically and biologically significant marine areas (so-called EBSAs) in the high seas (CBD Decision IX/20) (Fig. 3). In 2010, the COP 10 specified the process on the identification of EBSAs and confirmed strongly the "10%-target": the worldwide representative network of marine protected areas in the oceans should encompass at least 10% of the world's oceans. In the meantime, the target year to fulfil this goal has been shifted from originally 2012 to 2020 (CBD Decision X/2).

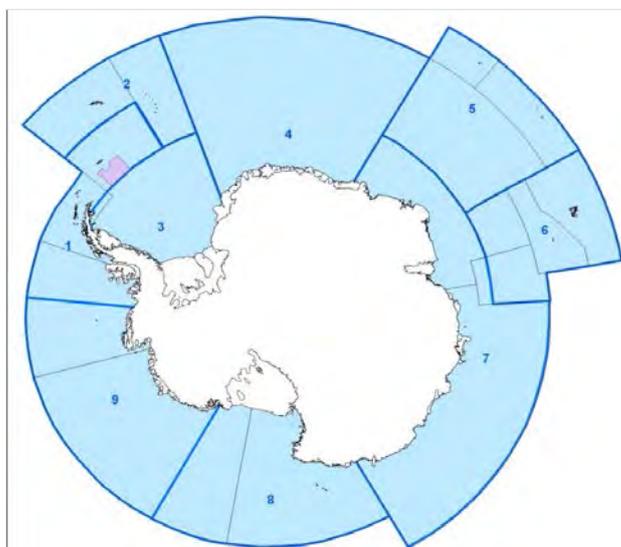
Until now, only a fraction of the 191 Contracting Parties of the CBD has implemented MPAs in more or less 10% of their national or territorial marine waters and therefore reached the 10%-target. On the contrary, a lot of states established less than 1% of their waters as MPAs. Most of these protected areas lay within territorial waters, near to the coast. Just a few states – including Germany for about 31 % of its EEZ – have implemented MPAs also in their EEZ (SPALDING et al., 2010; VON NORDHEIM, PACKEISER & DURUSSEL, 2011). There are only a handful of states who declared some very large MPAs within their EEZ, e.g. Great Britain the Chagos MPA in the British Overseas Territory in the Indian Ocean. The Chagos MPA is at the moment the largest comprehensive MPA worldwide, encompassing 540,000km<sup>2</sup>.

## 2 Different Initiatives in Areas beyond national jurisdiction

For the protection of sensible marine areas beyond national jurisdiction (ABNJ), international cooperation has improved. In the past years, different initiatives were established, in particular within the framework of regional Conventions for the protection of the sea. Often, these processes are supported by international NGOs. The implementation processes of MPAs sometimes lead to politically and legally complex areas. Such areas like the International Seabed Authority (ISA) - “Areas of Particular Environmental Interest” or other areas with restrictions to certain human uses like fisheries closures due to regulations by the Regional Fisheries Management Organisations (RFMOs) would be supplementary components for a better protection of the high seas. In the following, an up-date overview about the ongoing development, identification and establishment of the most important and largest EBSAs and high seas MPA networks is given.

### 2.1. Antarctic Region - Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)

As far as Spalding et al. 2010 referred to in their study, the only MPAs beyond national jurisdiction were 38 sites around Antarctica (p. 34). Most of them are small, nearshore sites declared under the Antarctic Treaty. Only one - the South Orkney Islands Southern Shelf MPA - encompasses a large area of 94,000 km<sup>2</sup> and extends across large areas of open oceans, in the high seas, including the front systems “Antarctic convergence” and “Weddell front”. This MPA was globally the first large MPA in ABNJ. It was adopted in 2009 by CCAMLR and entered into force in May 2010. One of the most remarkable management measures is that there are no fisheries activities at all. Further important initiatives to protect high seas areas are conducted by CCMLAR for the Antarctic region and were presented as proposals in Brest 2011 (Figure 1):



#### The Planning areas:

1. western Antarctic peninsula  
+ southern Scotia ridge,
2. northern Scotia ridge<sup>2</sup>,
3. Weddell sea,
4. Bouvet-Maud<sup>2</sup>,
5. Del Cano-Crozet<sup>2</sup>,
6. Kerguelen Plateau<sup>2</sup>,
7. eastern Antarctica,
8. Ross sea region,
9. Amundsen-Bellingshausen.

<sup>2</sup>area north of 60°S

**Figure 1:** CCAMLR-Proposals Brest 2011 (Source: Workshop on Marine Protected Areas, Meeting Report, 2011)

The 2012 meeting of the CCMLAR-parties could not yet agree on further MPAs and thus missed to implement these proposals and to establish a network of MPAs around the Antarctic continent so far.

## **2.2. Barcelona Convention**

In the frame of the Barcelona Convention and its “Barcelona Protocol”, Italy, France and Monaco established in 1999 the Pelagos Sanctuary in international waters of the north western Mediterranean Sea. It entered into force in 2002 and is implemented as a Specially Protected Area of Mediterranean Interest (SPAMI) of the United Nations Environmental Programme (UNEP). The MPA encompasses nearly 87,500 km<sup>2</sup> with about 53% in ABNJ. Therefore, it is considered as one of the first MPAs which include high seas parts. The Pelagos Sanctuary with its high levels of primary production is significantly important for whales and dolphins. Even if management measures are still complicated and limited due to ongoing fisheries or shipping, the Pelagos Sanctuary is confirmed as successful.

The contracting states of the Barcelona Convention started several initiatives in recent years to establish a network of MPAs in the Mediterranean Sea. Most of these MPAs lay in coastal waters, new proposals include now also ABNJ (see 2.5). Please look for further information to ROMANI or MARIN in this volume. For the EBSAs see 2.5.

## **2.3. OSPAR Convention**

It was a remarkable success that on the OSPAR Ministerial Meeting in Bergen 2010 six MPAs in ABNJ of the North East Atlantic have been designated. The Contracting Parties agreed – as a result of long-term scientific research, legal evaluation and political negotiations – on the protection of ecologically and biologically significant deep sea habitats along the Mid-Atlantic Ridge. These MPAs (together with a seventh MPA “Rainbow”) encompassed about 286,000 km<sup>2</sup>; the biggest one is the so-called “Charlie Gibbs Fracture Zone” (see BOEDEKER & PACKEISER in this volume). In the meantime in 2012 OSPAR has added another ABNJ MPA “Charlie Gibbs North“ with additional 180,000 km<sup>2</sup>. Added up, an area of nearly 480,500 km<sup>2</sup> <sup>2</sup> in 9 ABNJ-sites is now under protection. At water depths between 700 and 4,500m, seamounts, cold water corals, colonies of sponges and deep sea communities with numerous threatened species are found. These sensitive habitats some of which with rich colonisation, the deep sea fish communities and marine mammals like whales are in the urgent need for special protection.

Taking the high ecological importance of the region into account, the North-East Atlantic Fisheries Commission (NEAFC) established – one year before the designation of the MPAs by OSPAR – Closed Areas for Bottom Fisheries. In some zones of the Mid-Atlantic Ridge, the NEAFC implemented temporary area closures where fishing activities by vessels flying the flags of NEAFC Contracting Parties or cooperating Non-Contracting Parties, with fishing gear which is likely to contact the seafloor during the

normal course of fishing operations, are prohibited. For the area around the MPA “Charlie-Gibbs-Fracture Zone”, the fisheries closure in 2012 is nearly as large as the MPA itself.

Based on an UNGA Resolution of 2007, the NEAFC also established a Move-on Rule in this region of the North-East Atlantic in 2008. A Move-on Rule means that the vessel has to move on when vulnerable marine ecosystems (VME) are encountered during fishing operations. These regulations are under review, concerning the definition what would constitute an encounter with a VME, e.g. which provisions has the captain of the vessel to make or which threshold levels for the amount of key indicators are to be set.

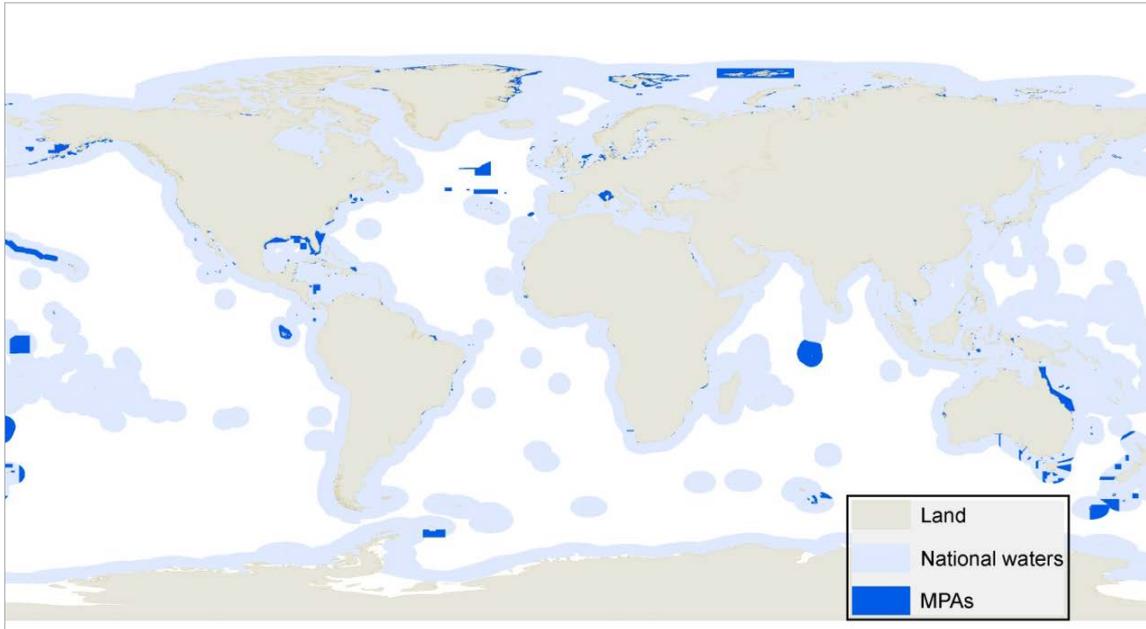
The NEAFC regulations form an important part of the protection scheme of the MPAs in this ABNJ. See also chapter 3.

#### **2.4. The status of identifying the network of high seas MPAs**

Even if there have been joint efforts for the protection of marine biodiversity within the last years, we could state that reaching the 10%-target is still at a distant prospect. The designated MPAs updates are unevenly distributed along the different biogeographic marine regions and, additionally, lay mostly in coastal waters, in the territorial seas or the EEZs i.e. in areas under national jurisdiction. The various species, habitats and ecosystems are not representatively covered by the actual global MPA network and many of them are under pressure due to destructive human impacts. Especially the deep and open sea habitats with their vulnerable communities, areas which are of high importance for the life cycle of e.g. marine mammals and reptiles or areas with rare and endangered species or with high biological productivity have to be taken more into consideration. Despite all efforts, we are far away from a consistent network, the distribution of MPAs looks more or less like a patchwork or a mosaic. And there are still far too many gaps in the areas beyond national jurisdiction (Figure 2).

Therefore, the main future task is to intensify the identification and designation of ecologically and biologically significant areas (EBSAs) in the high seas and – in a third step – to implement them as MPAs and to mitigate negative human activities.

Due to the results of the international worldwide Census of Marine Life (CoML) 2000 – 2010, we fortunately could intensify the knowledge about our oceans. Scientific information about the diversity, distribution and abundance of thousands of marine species have been collected and worked up in an immense database, the Ocean Biographic Information System (OBIS). It is a great chance to use these data also for the identification of sensible marine areas within the CBD framework.



**Figure 2:** Worldwide „Network“ of Marine Protected Areas? Source: Data.iucn.org/dbtw-wpd/edocs/2010-053.pdf, modified and supplemented by Federal Agency for Nature Conservation (BfN).

## 2.5. The CBD-EBSAs process

At the COP 9 in Bonn 2008, the Contracting Parties of the CBD agreed upon a list of scientific criteria for identifying EBSAs (Figure 3).

These criteria are based on existing (regional) criteria already applied by international organisations e.g. like those of the HELCOM Baltic Sea Protected Areas (BSPAs), the OSPAR MPAs or of the SPAMIs in the Mediterranean (see also DRUEL, 2012).

### **CBD Scientific Criteria for identifying Ecologically and Biologically Significant Areas (EBSAs)**

1. Uniqueness or Rarity
2. Special importance for life history stages of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, Fragility, Sensitivity, or Slow recovery
5. Biological Productivity
6. Biological Diversity
7. Naturalness

**Figure 3:** Scientific criteria for EBSAs (CBD COP 9, Decision IX/20).

In Nagoya 2010 (COP 10), the Contracting Parties took a decision on marine and coastal biodiversity: the process to describe marine areas meeting the EBSA criteria was set out through regional workshops. They requested the CBD Secretariat to

establish a CBD repository and an information sharing mechanism. Furthermore, they agreed that marine areas meeting the EBSA criteria as described by regional workshops will be screened by the CBD Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) and, as applicable, endorsed by a subsequent COP. The information on EBSAs endorsed by the CBD COP will then be made available for the UNGA and relevant competent authorities.

COP 10 also noted that the application of EBSAs scientific criteria is a scientific and technical exercise. It may require enhanced conservation and management measures, including MPAs and impact assessments, to protect areas which meet the criteria. The conservation and management measures are a matter of states and competent intergovernmental organizations.

After CBD COP 10 three regional workshops were conducted to identify EBSAs in different regions and additional three were planned until the end of 2012. The first regional workshop took place in Hyères in France in September 2011, concerning the OSPAR region. The workshop was jointly organized by OSPAR, NEAFC and the CBD-Secretariat. 10 possible EBSAs were described which all lay in ABNJ (Figure 4). These EBSAs undergo currently a scientific review process.

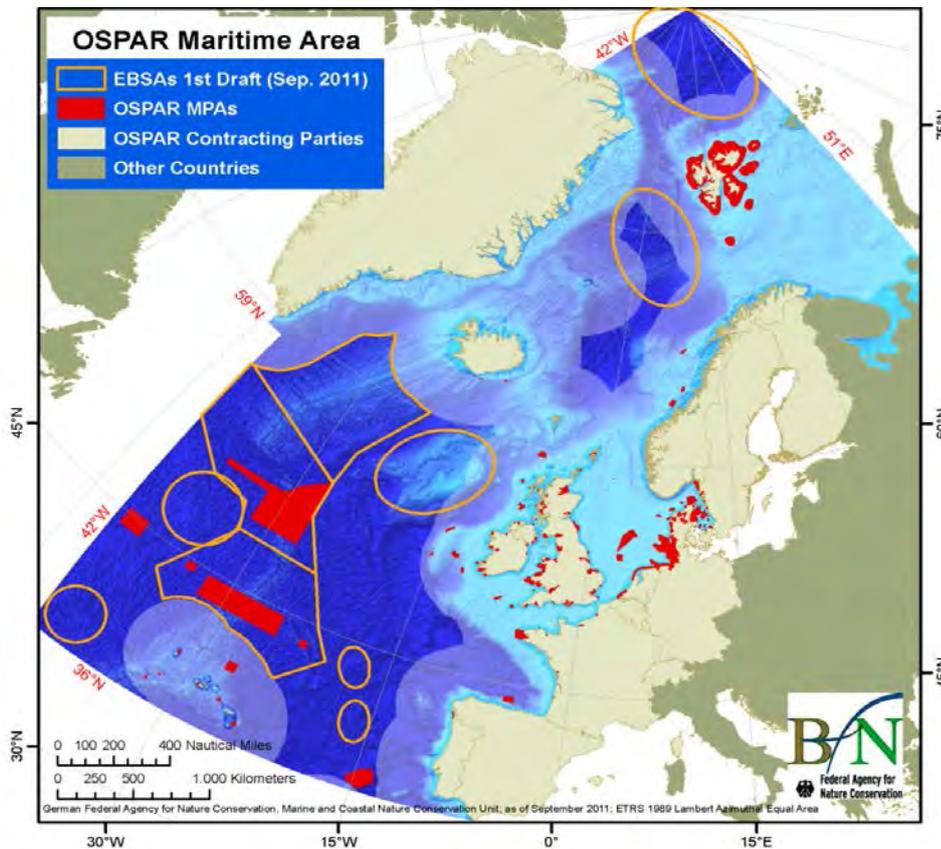
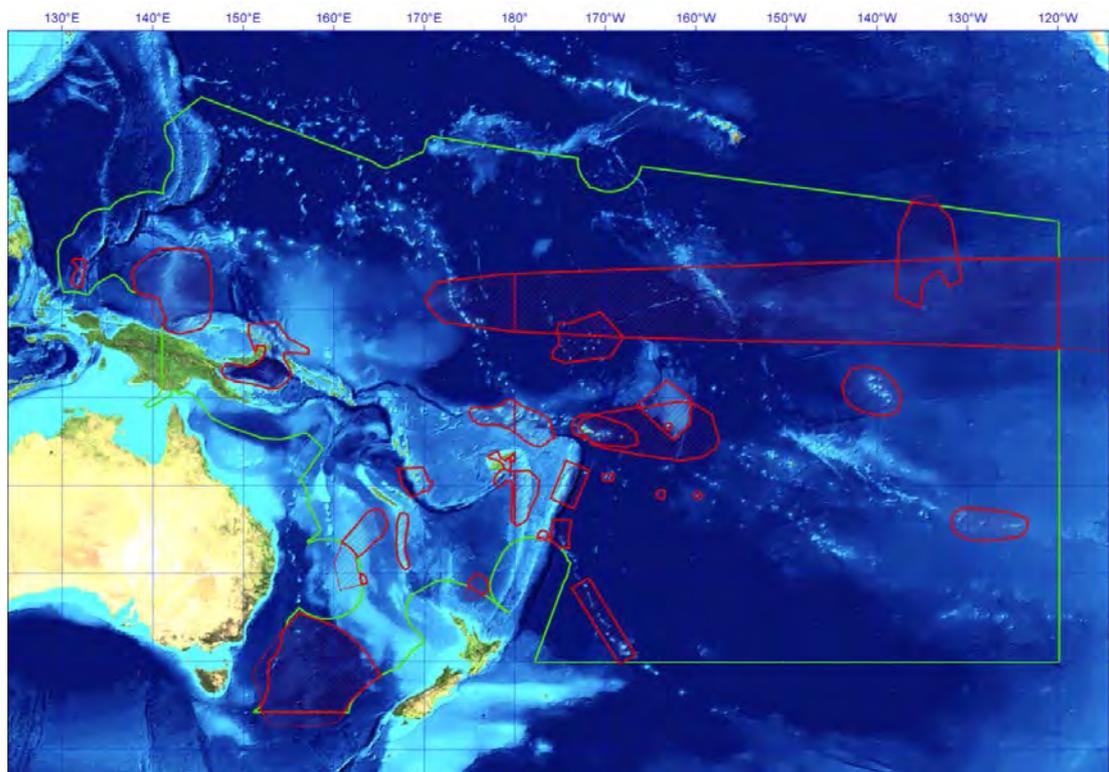


Figure 4: Potential EBSAs in the OSPAR region (North-East Atlantic).

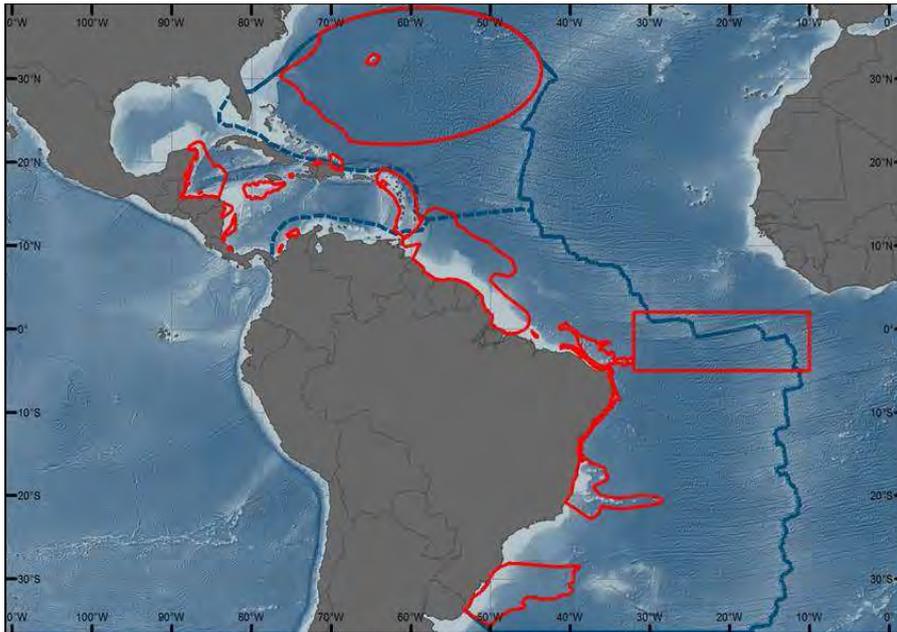
The second regional workshop on the Western South Pacific took place in November 2011 in Nadi, Fiji.



**Figure 5:** EBSAs in the Western South Pacific (Source: document UNEP/CBD/SBSTTA/16/INF/6).

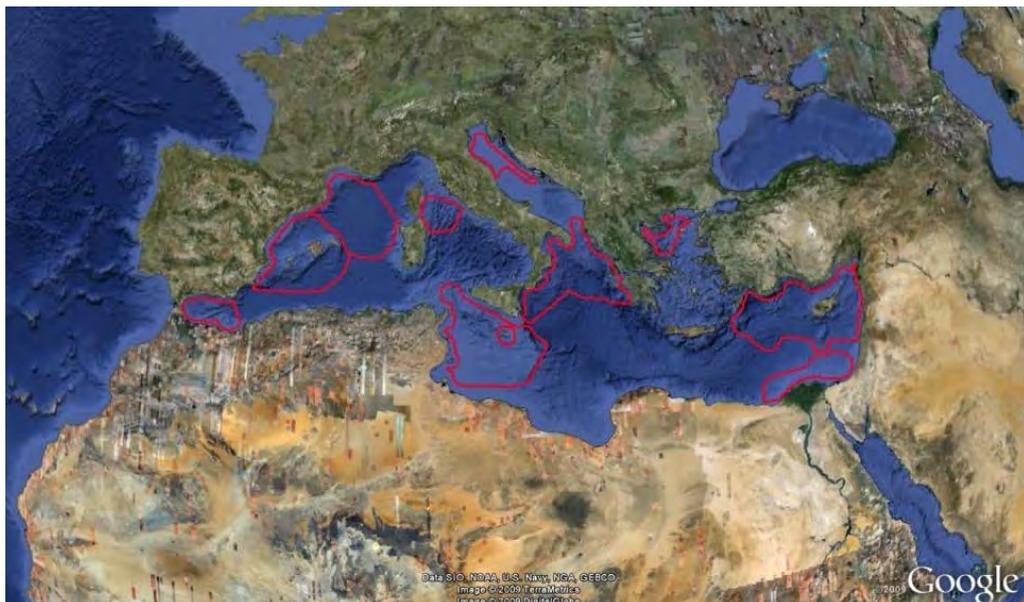
This workshop was jointly organized by the CBD Secretariat, the Secretariat of the Pacific Regional Environment Program, the Government of Australia/Commonwealth Scientific and Industrial Research Organization (CSIRO). They agreed on 26 areas within and beyond national jurisdiction which meet the EBSA criteria (Figure 5). These EBSAs were reviewed at the SBSTTA 16 and forwarded to and endorsed by the CBD COP 11 in India.

The third regional workshop concerned the Wider Caribbean and Western-Mid Atlantic and took place in Recife, Brazil in February / March 2012. It was jointly organized by the CBD Secretariat and the United Nations Environment Program – Caribbean Environment Program (UNEP-CEP). 22 Areas within and beyond national jurisdiction have been identified which meet the EBSA criteria (Figure 6). They have been reviewed at SBSTTA 16 and were also forwarded to and endorsed by the CBD COP 11.



**Figure 6:** Areas proposed to meet the EBSA Criteria in the Wider Caribbean and Western-Mid Atlantic (Source: document UNEP/CBD/SBSTTA/16/INF/7).

There was still no specific regional CBD-workshop on EBSAs in the Mediterranean Sea. In the last years, a long-term endeavor could be confirmed on the identification of “Specially Protected Areas of Mediterranean Importance (SPAMIs)” (Figure 7). The Contracting Parties of the Barcelona Convention agreed to report 10 of these areas as meeting the EBSA criteria to the CBD. They were reviewed at SBSTTA 16 and were also forwarded to be endorsed by CBD COP 11.



**Figure 7:** Potential EBSAs in the Mediterranean Sea (Source: document UNEP/CBD/SBSTTA/16/INF/8).

The regional workshop of the Southern Indian Ocean took place at the end of July / beginning of August 2012, where 40 areas meeting the EBSA criteria were identified. But the workshop also noticed that the limited information concerning the regions off eastern Africa prevented the description of EBSAs for this area (DRUEL, 2012). The regional workshop of the Eastern Tropical and Temperate Pacific was held at the end of August 2012, the participants agreed upon 21 EBSAs. These two workshops were organized after the last meeting of SBSTTA and therefore have not yet been reviewed, and were not endorsed by COP 11.

For the other marine regions, e.g. the North Pacific, Arctic, North West Atlantic, Red Sea and Gulf of Aden and others, regional workshops are planned or foreseen within the next two years. The objective is to achieve a near-global coverage by the end of 2014 for the next COP of CBD.

## **2.6. The Global Oceans Biodiversity Initiative**

These mentioned EBSAs-activities are strongly complemented by the Global Ocean Biodiversity Initiative (GOBI), supported by the German Federal Agency for Nature Conservation (BfN) with core funding (VON NORDHEIM et al., 2011; <http://www.gobi.org>).

GOBI is a multi-partner project aiming to help identify EBSAs within (if countries wish so) and beyond areas of national jurisdiction based on the CBD scientific criteria. The objectives of this project are 1. to maintain a scientific collaboration process to assist states and relevant regional and global organisations with the best available scientific data and methods; 2. to provide illustrations and initial guidance on how the EBSA criteria can be interpreted and 3. to apply; as well as to develop selected regional analyses.

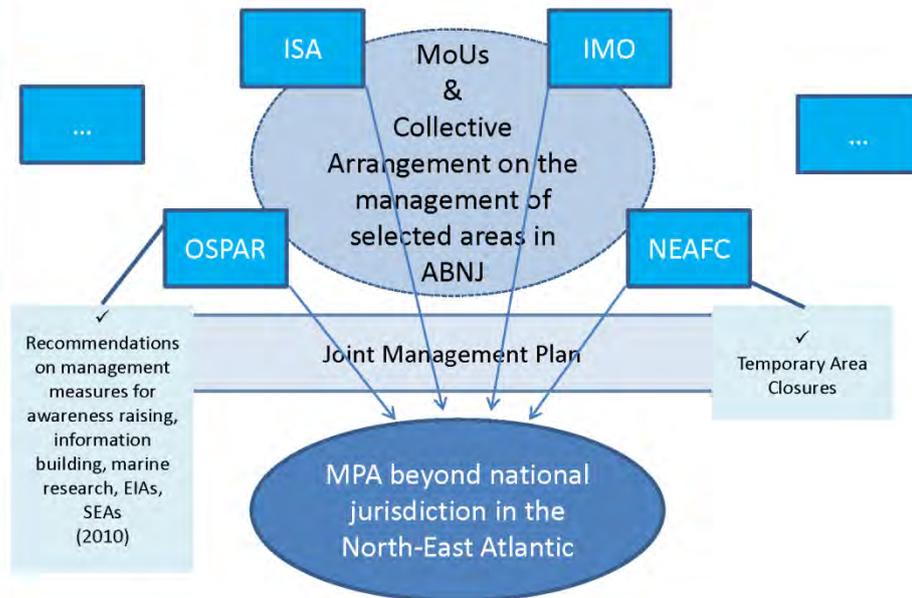
GOBI has so far supported all relevant regional workshops with scientific advice and input (see also <http://www.gobi.org/>).

## **3 Future Management and Governance**

Based on EBSAs or similar scientific identification processes future networks of MPAs in the ABNJ can only be established and managed in consultation and cooperation with the UN and main competent international organisations relating to human use of the oceans, including the International Maritime Organisation (IMO), the International Seabed Authority (ISA), the UN Food and Agriculture Organisation (FAO) and Regional Fisheries Management Organisations (RFMOs), in consistence with the Convention on the Law of the Sea (UNCLOS).

The process of protecting MPAs in ABNJ in the North East Atlantic within the last years has developed a concept for a possible shared joint management of the OSPAR MPAs.

## Concept for a shared Management of OSPAR MPAs beyond national jurisdiction



**Figure 8:** A concept for a shared management of OSPAR MPAs beyond national jurisdiction.

In this concept the Memorandums of understanding (MoU), recommendations or agreed arrangements are key tools of developing and establishing a joint management for areas beyond national jurisdiction (ABNJ) between states and international organizations. (see also [www.charlie-gibbs.org](http://www.charlie-gibbs.org))

In the future, the role of the EBSAs, as scientific experts assessments, their endorsement by the CBD and their worldwide acceptance will gain more and more importance on the global level. In this process, there is great variety of needs for cooperation and complementary work between states, intergovernmental organizations, global organizations mentioned above, regional commissions, parties of the CBD and the UN.

The UNGA and its Biological diversity Beyond areas of National Jurisdiction (BBNJ) Working Group have a key position for the global political implementation of marine protected areas beyond national jurisdiction. Considering the EBSA process, the UNGA could adopt the relevant mechanism that would allow for true and comprehensive conservation and protection of marine biodiversity in the global oceans.

### **Acknowledgements:**

We wish to thank Hjalmar Thiel for critically reading the MS, his valuable comments and his constant efforts for protecting marine biodiversity particularly in the “High Seas”.

## **4 References**

Agardy, T. & Staub, F. (2006): Marine Protected Areas and MPA Networks. Educational Module. Network of Conservation Educators and Practitioners (NCEP). 48 pp.

Ardron, J., Dunn, D., Corrigan, C., Gjerde, K., Halpin, P., Rice, J., Vanden Berghe, E. & Vierros, M. (2009): Defining ecologically or biologically significant areas in the open oceans and deep seas: Analysis, tools, resources and illustrations. A Report of the Global Ocean Biodiversity Initiative (GOBI). Ottawa, Canada. 29 September–2 October 2009. 111pp.

Ausubel, J. H., Crist, D. T. & Waggoner, P. E. / Ed. (2010): First Census of Marine Life - Highlights of a Decade of Discovery. Census of Marine Life International Secretariat. Consortium for Ocean Leadership. Washington, DC. USA. 64 pp.

Ban, N. C., Bax, N. J., Gjerde, K. M. et al. (2013): „Systematic conservation planning: a better recipe for managing the high seas for biodiversity conservation and sustainable use“. *Cons. Letters* 2013: 1-14.

CBD - Convention on Biological Diversity, 1992 - CDB Decision IX/20 and CDB Decision X/2

Dudley, N. / Ed. (2008): Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN. 86pp.

Druel, Elisabeth (2012): Ecologically or Biologically Significant Marine Areas (EBSAs): the identification process under the Convention on Biological Diversity (CB) and possible ways forward. Working Paper No. 17 / 12, IDDRI, Paris, 24 pp.

Gjerde, K. M. (2012): “Challenges to Protecting the Marine Environment beyond National Jurisdiction” *Int. J. Mar. Coast. Law* 27: 839-847.

IUCN-WCPA (2008): Establishing Marine Protected Area Networks – Making it Happen. IUCN-WDPA, NOAA and The Nature Conservancy. Washington, DC.. 118 pp.

Mora, C., Andrefouet, S., Costello, M. J., Kranenburg, C., Rollo, A., Veron, J., Gaston, K. J. & Myers, R. A. (2006): Coral reefs and the global network of marine protected areas. *Science* Vol. 312: 1750-1751.

Notarbartolo di Sciara, G., Agardy, T., Hyrenbach, D., Scovazzi, T. & Van Klaveren, P. (2008): The Pelagos Sanctuary for Mediterranean marine mammals. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18: 367-391.

OSPAR (2010): 2009/2010 Status Report on the OSPAR Network of Marine Protected Areas. OSPAR Commission. Biodiversity Series. Publication Number 2010-493. 62pp.

Parks, J. E., Pomeroy, R. S. & Philibotte, J. (2006): Experiences and Lessons Learned from Evaluating the Management Effectiveness of Marine Protected Areas in Southeast Asia and the Pacific Islands. CBD/IUCN International Workshop for Better Management of Protected Areas. Jeyu Island, Korea. October 24-27, 2006.

Spalding, M., Wood, L., Fitzgerald, C. & Gjerde, K. (2010): The 10% Target: Where do we stand? In: Toropova, C.; Meliane, I.; Laffoley, D.; Matthews, E. and Spalding, M. (Eds.): *Global Ocean Protection: Present Status and Future Possibilities*. IUCN. Gland Switzerland: 25-40.

Thiel, H. & Koslow, A. (Eds) (2001): Managing Risk to Biodiversity and the Environment on the High Sea, Including Tools such as Marine Protected Areas – Scientific Requirements and Legal Aspects. BfN-Skripten 43. 216 pp.

Thiel, H. (2003): Approaches to the Establishment of Protected Areas on the High Seas. In: Kirchner, A. (ed.): *International Maritime Environmental Law*: 169-192.

UNCLOS – United Nations Convention on the Law of the Sea, 1994

UNEP/CBD/SBSSTA/16/INF/6 (2011): – Report of the Western South Pacific Regional Workshop to facilitate the description of ecologically or biologically significant marine areas.

UNEP/CBD/SBSSTA/16/INF/7 (2012): – Report of the Wider Caribbean and Western Mid-Atlantic Regional Workshop to facilitate the description of ecologically or biologically significant marine areas.

UNEP/CBD/SBSTTA/16/INF/8 (2012): – Synthesis Report on the Work carried out regarding the description of EBSAs in the Mediterranean.

Von Nordheim, H., Packeiser, T. & Durussel, C. (2011): Auf dem Weg zu einem weltweiten Netzwerk von Meeresschutzgebieten. In: *Natur und Landschaft*, Heft 09/10-2011, Themenheft Meeresnaturschutz: 382-387.

Workshop on Marine Protected Areas (2011): Meeting Report of the CCAMLR-Workshop in Brest, France, 29 August to 2 September 2011. See [www.ccamlr.org](http://www.ccamlr.org)

WSSD World Summit of Sustainable Development: Johannesburg-Plan of Implementation, 2002

**Links:**

<http://www.gobi.org>

<http://www.charlie-gibbs.org>



# The Implementation of the Natura 2000 Network in European Marine Areas - Relation to the Marine Strategy Framework Directive

FOTIOS PAPOULIAS

European Commission, Brussels

## 1 The EU marine policy – the Marine Strategy Framework Directive – Establishing MPAs

The EU marine conservation policy is to be considered as part of the broader EU Biodiversity policy as well as within the Marine Strategy Framework Directive (MSFD). A key contribution in that context is made by implementing the Birds and Habitats directives, and the Natura 2000 network, in the marine environment.

These instruments respond also to commitments at the international level concerning the establishment of a **Network of Marine Protected Areas** (the EU Council Conclusions on the 9th Conference of the Parties to the Convention on Biological Diversity (CBD) stated that "*The EU WILL STRIVE FOR the establishment of a global representative network of marine protected areas by 2012 within and beyond areas of national jurisdiction inter alia through the full and timely implementation of Natura 2000 in marine areas and the establishment and management of protected areas networks in the context of the Regional Marine Conventions*) and the **2020 Global target** agreed at CBD COP10 (stating that "*By 2020, at least 17 % of terrestrial and inland water, and 10 % of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.*").

Under the EU Biodiversity Strategy to 2020 'Our life insurance, our natural capital' Target 1 – Nature conservation is of primary importance for marine conservation as, with a view to measurable improvements in conservation status, it calls for the completion of the establishment of the Natura 2000, including in the marine, the adequate management and financing of the areas and an improved knowledge base. Equally relevant are Target 3 addressing the sustainable use of marine resources (with a focus on sustainable fisheries and on the MSFD), and Target 2 concerning the maintenance and restoration of ecosystems and their services.

## New EU biodiversity strategy to 2020 « Our life insurance, our natural capital »

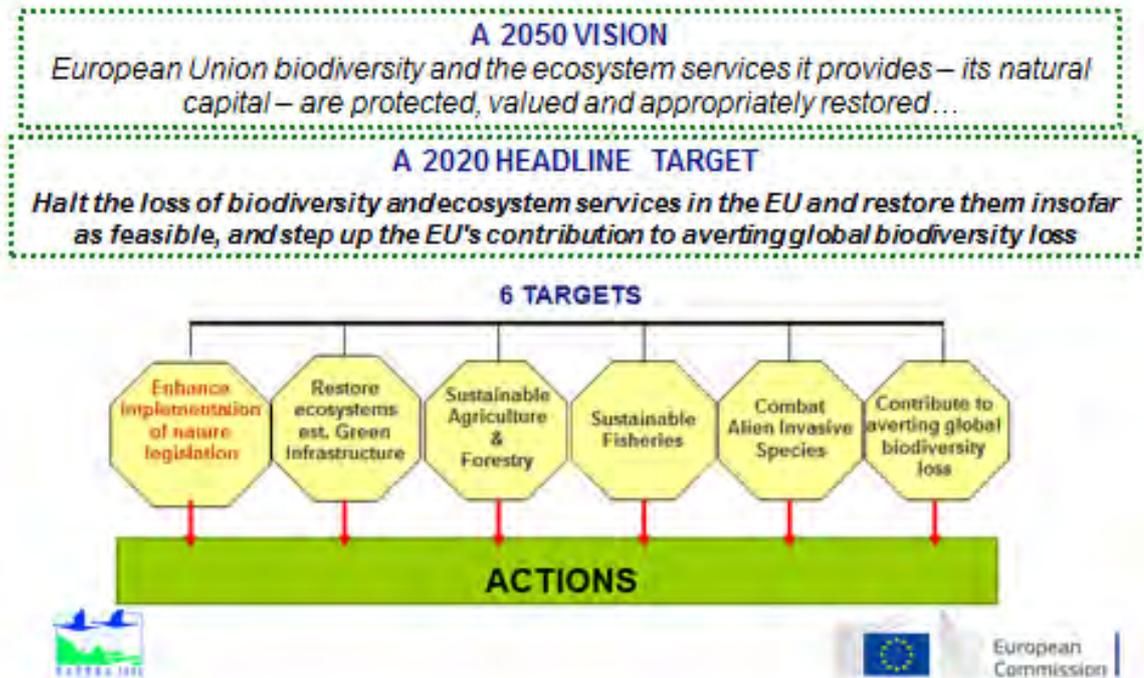


Figure 1: EU biodiversity strategy to 2020.

The Marine Strategy Framework Directive (MSFD) is the environmental pillar of the EU's Integrated Maritime Policy, by requiring Member States to *'take the **necessary measures** to achieve or maintain **good environmental status (GES)** in the marine environment by the year 2020 at the latest.'* The directive provides a **framework**: a structure and a timeline, but no details, which are developed within a common implementation strategy. As regards Marine Protected Areas in particular, the MSFD calls, in its Article 13, the Member States to present, as part of their programmes of measures, spatial protection measures contributing to coherent and representative **networks of marine protected areas** adequately covering the diversity of the constituent ecosystems, such as Special Areas of Conservation under the Habitats Directive, Special Protection Areas under the Birds Directive, and other MPAs agreed by the EU or MSs under international or regional agreements (namely the Regional Sea Conventions).

## 2 Natura 2000 in the marine environment

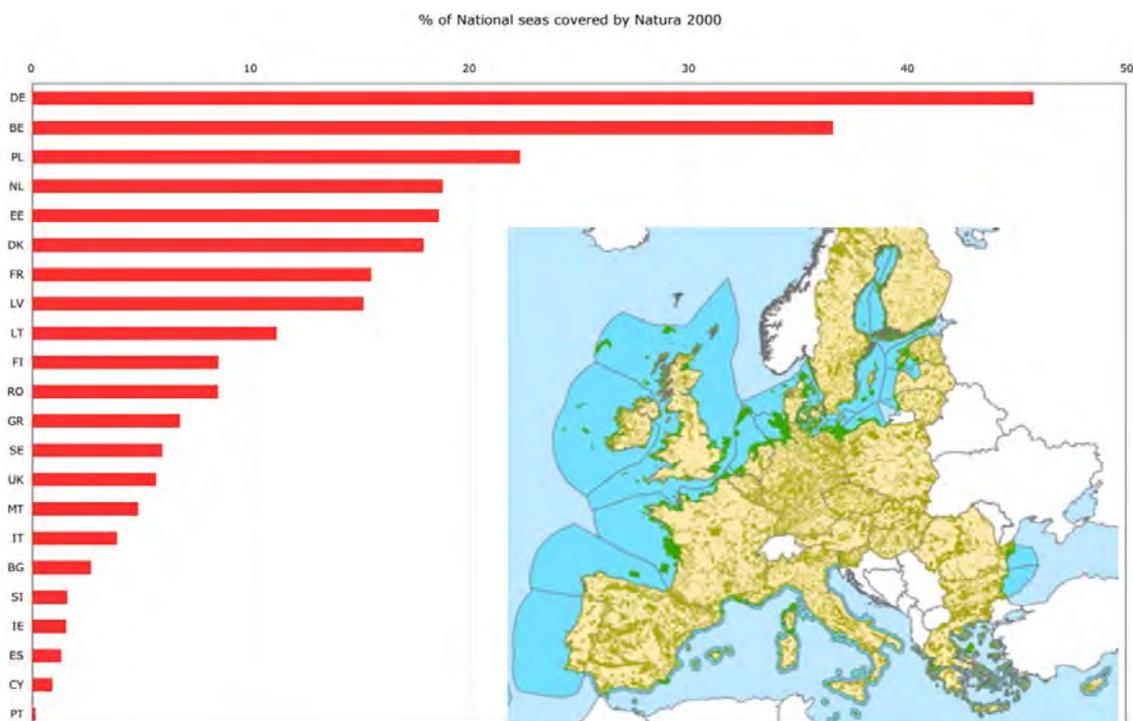
The implementation of the Natura 2000 network in the marine environment has for some years remained out of focus, also due to legal or technical uncertainties. Following legal clarifications (specifying that the Birds and Habitats directives apply to

all marine waters where Member States exercise sovereign rights), technical guidelines and political commitments, work has been accelerated over the recent years with the aim to achieve significant progress in site designations by 2012 and implement measures, including for fisheries, so that the conservation status of marine features is stabilised and improved by 2020.

The need for action is reinforced by the results from monitoring the conservation status of key habitat types (e.g. reefs, sandbanks, posidonia beds) and species (e.g. harbour porpoise, seals and sea turtles) across the marine biogeographical regions, revealing either an unfavourable status of these features or large gaps in knowledge of our marine ecosystems.

There are multiple threats to marine biodiversity, e.g. resulting from unsustainable fisheries, pollution, unsustainable tourism, climate change or activities like shipping, oil/gas/mineral extraction, plastic debris. A well planned and managed network of marine Natura 2000 areas should therefore afford adequate protection to important marine ecosystems, enhance important economic services they deliver, improve the conservation status of most threatened marine species, and contribute to sustainable use of marine resources.

As of today, out of a total of 26.406 Natura 2000 sites, 2.341 sites with a marine component have been designated either as Sites of Community Importance under the Habitats Directive (or as Special Protection Areas under the Birds Directive, covering 217.464 km<sup>2</sup> (i.e. slightly more than 4 %) of territorial and EEZ waters. However most marine N2000 sites are coastal or within the first 12 nm (i.e. in territorial waters); only 81 sites extend offshore (i.e. beyond territorial waters) and only 53 are entirely located within the EEZ. Furthermore, the conclusions from the marine biogeographical seminars, where the sufficiency of marine SCIs is assessed, show that most marine habitats and species are still insufficiently represented in the network. This means that, despite significant progress during recent years, more than 90% of European seas and oceans are not covered yet and considerable efforts are still required to build a representative network of sites, especially offshore, and make it work.



**Figure 2:** Natura 2000 sites in national seas.

This action is supported by a number of guidelines that have been issued by the Commission (and available at

[http://ec.europa.eu/environment/nature/natura2000/marine/index\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm)), such as:

*"Guidelines for the establishment of Natura 2000 in the marine" (including an update of Marine Habitat types definitions); "Fisheries measures for marine Natura 2000 sites: A consistent approach to requests for fisheries management measures under the Common Fisheries Policy"; as well as sectoral guidance related to Natura 2000 implementation that is also relevant to marine (wind-energy, mineral extraction, ports & estuaries).*

### 3 Current activities/priorities – promoting synergies

Current efforts focus on ensuring sufficient site designations at marine biogeographical level and promoting the sound management of the areas, including tackling fishing pressure. In addition to Member States' efforts, securing effective integration in other policies and adequate financing are of crucial importance. In that regard, the on-going reform of the Common Fisheries Policy and the associated new fisheries fund offer significant opportunities for strengthening the ecosystem-based approach in managing marine resources and supporting the protection, restoration and monitoring of Marine Protected Areas. Furthermore, beyond site protection, species protection measures

are also required to tackle issues like by-catch; in that regard species action plans, if correctly established and applied, constitute an effective means of implementation.

Clearly effective conservation of marine areas depends a lot on implementing suitable **fisheries measures**. Area closures or restrictions to certain types of fishing gear have already been taken in certain cases. With a view to facilitating the tasks of Member States, the Commission issued in 2008 guidelines on introducing requests for fisheries management measures under the CFP. Currently several Member States have undertaken work to prepare fisheries measures (e.g. EMPAS project for marine N2000 sites in German EEZ, FIMPAS for sites in the Dutch EEZ, a joint proposal for the Doggerbank, measures for NL coastal sites, fisheries measures considered by Spain in the context of the INDEMARES LIFE project). The Commission is actively monitoring and supporting such initiatives, esp. cooperation among Member States. Furthermore, it engaged in the preparation of a common methodology to assess impact of fisheries on marine N2000.

The LIFE programme has been instrumental to support relevant projects, e.g. to designate marine sites under N2000, to develop monitoring systems (a challenging and expensive task), to reduce by-catches, to raise awareness and develop sustainable management of marine areas.

The proposals for the **reform of the CFP** contain provisions *inter alia* to promote the management of marine protected areas. Thus, the new proposed CFP Regulation provides under Art. 12 "Compliance with obligations under Union environmental legislation" for measures to comply with obligations for Natura 2000 sites and MPAs, while the new proposed European Maritime and Fisheries Fund allows, under Art. 38 "Protection and restoration of marine biodiversity and ecosystems in the framework of sustainable fishing activities", for financing to support the management, restoration and monitoring of NATURA 2000 sites, in accordance with prioritised action frameworks established pursuant to Council Directive 92/43/EEC, and under Art. 52 and 54, for investments to substantially reduce the impact of aquaculture on the environment and aquaculture methods compatible with specific environmental needs and subject to specific management requirements.

Furthermore, by-catch is addressed in the proposed CFP Regulation (Art 14 stipulates that "*Technical measures frameworks to ensure the protection of marine biological resources and the reduction of the impact of fishing activities on fish stocks and on marine eco-systems shall be established. Technical measures frameworks shall:...(c) reduce catches of unwanted marine organisms;*") and the new proposed EMFF (under "Sustainable development of fisheries", Article 36 on "Limiting the impact of fishing on the marine environment" stipulates: "*1. In order to reduce the impact of fishing on the marine environment, foster the elimination of discards and facilitate the transition to exploitation of living marine biological resources that restores and maintains*

*populations of harvested species above levels which can produce the MSY, the EMFF may support investments in equipment: (a) improving size selectivity or species selectivity of fishing gear; (b) reducing unwanted catches of commercial stocks or other by-catches....").*

With a view to promoting more effective implementation of respective legal provisions there is a need to identify and enhance the **links between the Birds and Habitats Directives and the MSFD**. To that effect the Commission has produced a Frequently Asked Questions document, to identify and clarify interactions, synergies, differences and potential areas for greater coordination between these instruments. The issues addressed are: Relationship between Good Environmental Status & Favourable Conservation Status; Application at a regional level. Synergies as regards the key measures (Protected Areas, More general conservation measures, Integrated Policy & Planning, BHD objectives to support MSFD targets and indicators); Monitoring requirements; How can the assessments of Conservation Status under HD assist with the assessments under MSFD; Socio-economic considerations.

More broadly, it is recognised that EU policies and legislation on water (WFD), marine (MSFD), nature/biodiversity (Birds/Habitats directives, EU biodiversity strategy 2020) are closely interlinked in terms of objectives, provisions, reporting/information flow and there is therefore a need for **closer cooperation and enhanced synergies in implementation**. Following discussions of Member States' Nature and Marine Directors, the priority areas for cooperation include: Designation and management of MPAs; Integrated approach in implementation of EU legislation, incl. coherent interpretation of definitions; Joint efforts on EU fisheries issues, incl. common methodologies, involving relevant national experts and bodies; Streamlining/harmonising monitoring and reporting.

In order to put these principles into practice, a number of **joint activities** are being considered or implemented. The areas concerned include: FAQ documents (e.g. links between WFD&Birds/Hab dir. and between MSFD&Birds/Hab dir., and a possible consolidated policy paper on links among all areas); relevant sector-specific guidance (e.g. ports&estuaries, inland waterways); fisheries issues (e.g. development of a common methodology for assessing impact of fisheries on marine N2000 areas, support to MS coordinated efforts, implementation of MSFD Descriptor 3 on fisheries linked to Target 4 of Biodiversity Strategy and to CFP); MPA designation/management (e.g. link-up Natura 2000 with other MPAs under MSFD/regional conventions, stronger cooperation between respective expert groups); streamlining of reporting / information flow (avoid duplications of reported data, synchronise reporting cycles, integrate existing information flows and status assessments); streamlining developments in ecosystem-based approaches and services (e.g. the ecosystem-based approach an objective under EU Biodiversity Strategy Target 2, embedded in MSFD, relevant to water management / RBMPs under WFD).

# Network of MPAs in the Maritime Area of HELCOM and OSPAR by 2012

DIETER BOEDEKER<sup>1</sup> AND TIM PACKEISER<sup>2</sup>

<sup>1</sup>Federal Agency for Nature Conservation, Germany

<sup>2</sup>World Wide Fund for Nature, Germany

## 1 Introduction

The idea for establishing well-managed networks of marine protected areas (MPAs) is relatively young. Only in 1988, the 17<sup>th</sup> Session of the General Assembly of IUCN recognised the need for a coordinated MPA network approach. Other high-level conferences such as the World Congress on national parks and protected areas, held in Caracas, Venezuela in 1992 called for the establishment of a global network of MPAs. However, it lasted another ten years before the United Nations World Summit on Sustainable Development (UN WSSD; 2002; Johannesburg, South Africa), agreed upon the first concrete target, *i.e.* to establish representative networks of MPAs, consistent with international law and based on scientific information, until 2012. Two years later, the 7<sup>th</sup> Conference of the Parties to the CBD (CBD COP 7; 2004; Kuala Lumpur, Malaysia) reconfirmed this target and adopted the objective to establish and maintain by 2012 comprehensive, effectively managed, and ecologically representative national and regional systems of marine protected areas, which should cover at least 10 % of the world's oceans (HELCOM, 2010a). Having noted the limited progress in this regard, the CBD COP 10 (2010; Nagoya, Japan) postponed the target to have at least 10 % of coastal and marine areas protected until 2020.

The two regional seas conventions for the North-East Atlantic (OSPAR Convention) and for the Baltic Sea (Helsinki Convention) acted as pioneers with regard to the implementation of this objective. In 2003, they both decided at the high level segment of their first joint Commission meeting (in Bremen, Germany), to establish a coherent network of well-managed marine protected areas by 2010 (hereafter referred to as the 2010 target) and adopted a Joint Work Programme (JWP) for the OSPAR and HELCOM convention areas (Box 1). At the same meeting, governments of the signatory states adopted a ministerial declaration<sup>1</sup> in which they sought to combine efforts with the European Union in order to realize a coherent network of MPAs in the North-East Atlantic and the Baltic Sea: *"We reaffirm our commitments to establish a network of well-managed marine protected areas. [...] Working with the European*

---

<sup>1</sup> <http://www.helcom.fi/stc/files/MinisterialDeclarations/HelcomOsparMinDecl2003.pdf>

*Community, we shall have identified the first set of such areas by 2006, and shall then establish what gaps remain and complete by 2010 a joint network of well-managed marine protected areas that, together with the NATURA 2000 network, is ecologically coherent.”*

**Box 1:** Joint Work Programme (JWP) for the OSPAR and HELCOM convention areas.

### **Joint HELCOM/OSPAR Work Programme on Marine Protected Areas**

The Baltic Marine Environment Protection Commission (the Helsinki Commission – HELCOM) and the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) jointly adopt the following work programme on the creation of a network of marine protected areas:

1. The purpose of the work programme is to ensure that by 2010 there is an ecologically coherent network of well managed marine protected areas for the maritime areas of both HELCOM and OSPAR (“the network”).
2. To these ends, HELCOM and OSPAR will:
  - a. develop coordinated approaches to
    - i. compile and evaluate proposals for the components of HELCOM and OSPAR networks of marine protected areas, and
    - ii. identify and address any gaps to be filled in order to achieve the network, which reflect the needs for protection of species and habitats identified by HELCOM and OSPAR as threatened, declining or in need of protection;
  - b. develop and implement a strategy for achieving dialogue with relevant stakeholders on the management and conservation of marine protected areas, using (where possible) existing national and international forums;
  - c. in order to ensure the ecological coherence of the network, develop common theoretical and practical aspects of what would constitute an ecologically coherent network of marine protected areas;
  - d. develop, by 2005, a common proposal, taking into account the work done by HELCOM and OSPAR as well as work by the European Community, for a programme aimed at enhancing the protection of species and habitats in European marine waters, in order to produce suggestions for consideration by the European Commission for amendments to the annexes to the Habitats and Birds Directives;
  - e. consider how Baltic Sea Protected Areas and components of the OSPAR Network of marine protected areas in the waters under the jurisdiction of EU Member States, together with the NATURA 2000 network, can constitute a coherent network of marine protected areas;
  - f. by 2006, evaluate whether the Baltic Sea Protected Areas and the components of the OSPAR

Network of marine protected areas that have been identified by that date are sufficient to constitute the joint network, and take steps to identify and fill any gaps that are identified;

g. by 2010, evaluate whether the aim of establishing the network has been achieved, take steps to fill any shortfalls and to maintain and develop the network thereafter and periodically evaluate whether the aims of the network continue to be met;

h. develop practical guidance for the application of HELCOM and OSPAR management guidelines, including appropriate means to enlist the help of other authorities which are competent for some necessary action, in order to achieve a common standard of good management across the network;

i. develop guidance on, and make arrangements for, the assessment of how effectively the management of HELCOM and OSPAR marine protected areas is achieving the aims of protection;

j. consider how to take into account other relevant HELCOM and OSPAR initiatives, such as that on the identification and compilation of lists of habitats and species in particular need of protection, and those on marine habitat classification and mapping;

k. as appropriate, identify and assist where collaboration with other international forums (such as the Convention on Biological Diversity, and the Berne, Bonn and Ramsar Conventions) may be required, for the implementation and management of HELCOM and OSPAR marine protected areas;

l. explore the possibilities for collaboration with the Barcelona Convention and the Bucharest Convention and in the framework of the Arctic Council in this field.

3. To facilitate this joint work, the relevant HELCOM nature conservation working group and the OSPAR intersessional correspondence group on marine protected areas may hold joint meetings, in accordance with arrangements agreed by HELCOM and OSPAR. Where possible, these groups will also work in cooperation with the European Commission and any relevant informal advisory groups that the European Commission establishes.

In the following the progress of HELCOM and OSPAR regarding the implementation of the JWP is described.

## **2 History and status of the HELCOM Baltic Sea Protected Areas Network (BSPA)**

HELCOM started as early as 1994 to establish a system of marine and coastal Baltic Sea Protected Areas (HELCOM Recommendation 15/5). All Contracting States to the Helsinki Convention contributed by identifying and nominating an initial suite of 62 sites. With Recommendation 15/5, Contracting States committed themselves to include additional BSPAs, particularly offshore sites outside their Territorial Waters (HELCOM, 2009).

In order to implement Recommendation 15/5, the HELCOM Working Group on Nature Conservation and Biodiversity commissioned WWF to compile a comprehensive overview of all existing coastal and marine protected areas (not only BSPAs) in the Baltic Sea area (HELCOM, 1996). The study showed that a wide range of coastal terrestrial and nearshore marine protected areas already existed in all Baltic Sea states, which to a large extent were not BSPAs. Additionally, the assessment showed that there was a Baltic Sea-wide lack of offshore protected sites. Another expert opinion proposed 24 ecologically significant offshore sites as potential protected areas (HÄGERHÄLL & SKOV, 1998), but only some of them were subsequently designated as BSPAs after the HELCOM Baltic Sea Action Plan (BSAP, 2007) had committed Contracting States again to implement Recommendation 15/5 and the JWP (HELCOM, 2010b).

### **2.1. History: implementation of the JWP by HELCOM**

Between 2003 and 2010 several steps for the implementation of the JWP were conducted by HELCOM:

1. The Guidelines for Designating Marine and Coastal Baltic Sea Protected Areas (BSPA) and Proposed Protection Categories were revised and harmonized with respective OSPAR guidelines and the EU Habitats and Birds Directives.
2. Based on the work conducted jointly by HELCOM and Germany, HELCOM and OSPAR commonly developed practical guidance for establishing management plans for BSPAs and OSPAR MPAs (HELCOM, 2006). The guidance specifies that where Natura 2000 sites are reported as BSPAs, EU Member States may manage them according to the legally binding requirements of the EU Habitats and/or Birds Directives (HELCOM, 2009) and that no further obligations are required.
3. The HELCOM secretariat established a GIS-supported public BSPA data base which provides also a password-protected tool for nomination of new BSPAs by HELCOM Contracting States.
4. Based on work conducted by OPSAR, HELCOM agreed on common criteria for the assessment of the ecological coherence of the BSPA network (Box 2; HELCOM, 2010b).

**Box 2:** Requirements for the ecological coherence of the BSPA-Network.

**A BSPA should fulfill the following requirements in order to be ecologically coherent:**

1. It should give particular protection to the species, natural habitats and nature types to conserve biological and genetic diversity;

2. It should protect ecological processes and ensure ecological function;
3. It shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range;
4. The network should protect areas with:
  - a. Threatened and declining species and habitats
  - b. Important species and habitats
  - c. Ecological significance
    - A high proportion of habitats of migratory species
    - Important feeding, breeding, moulting, wintering or resting sites
    - Important nursery, juvenile or spawning areas
    - A high natural biological productivity of the species or features being represented
  - d. High natural biodiversity
  - e. Rare, unique, or representative geological or geomorphological structures or processes.
  - f. High sensitivity
5. Representativity
6. Replication of features. Replication refers to the occurrence of the same features in different sites: species, habitats and biotopes.
7. Connectivity, i.e. the movement of items (nutrient, pollution etc.) and/or species (waterborne larvae, migrating birds etc.) between sites by using "blue corridors".

5. In 2006, HELCOM conducted the first assessment on the implementation of the JWP. Another assessment was undertaken within the EU funded InterregIII B-project "BALANCE" regarding the ecological coherence of BSPAs. Both evaluations concluded that at that time the network was neither complete nor ecologically coherent (HELCOM 2007; BALANCE 2008).

## **2.2 Status of the BSPA Network as of February 2010**

HELCOM published its last comprehensive report on the status of BSPAs in 2010 (HELCOM, 2010b).

### **2.2.1. Number and Size of BSPAs**

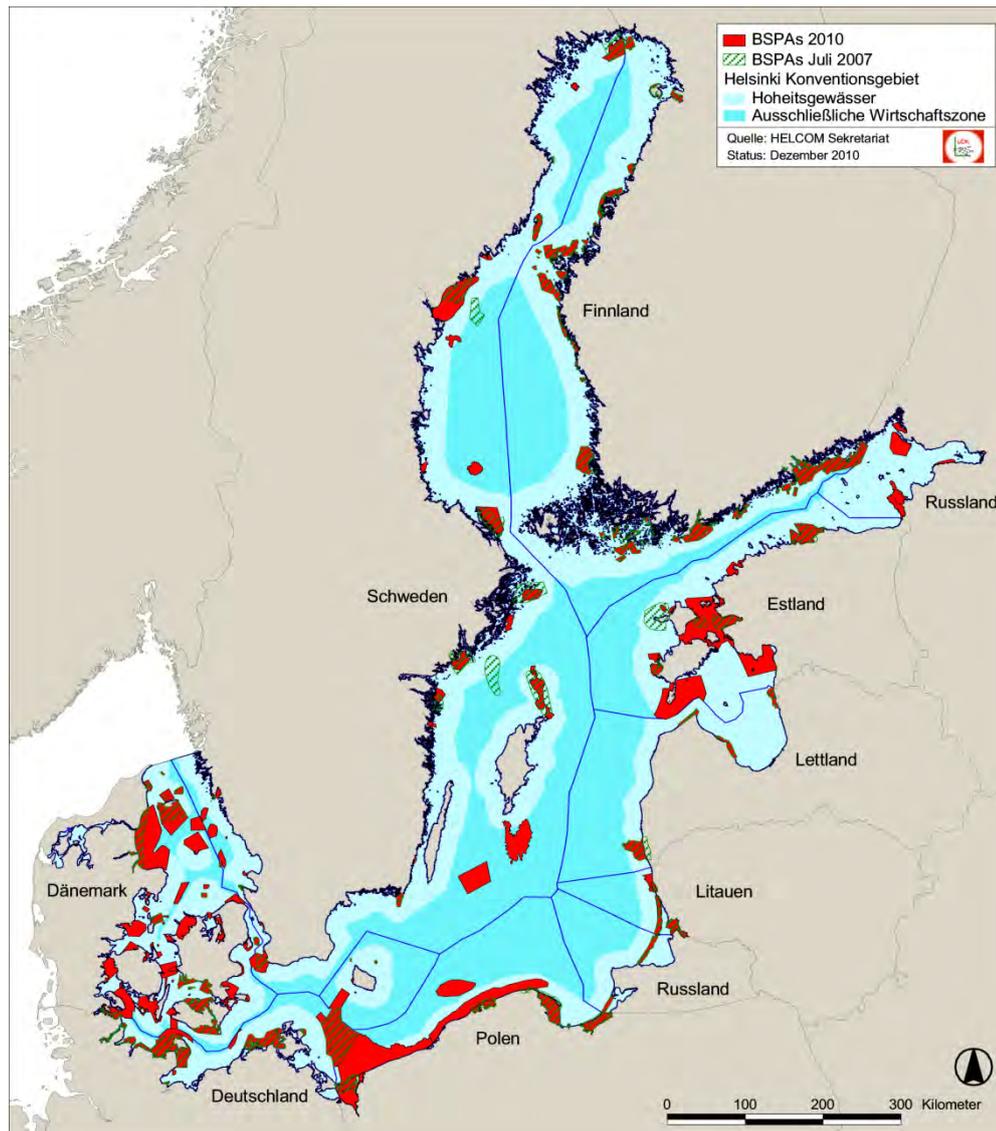
An important result of HELCOM's 2010 comprehensive assessment (HELCOM, 2010b) was that by the end of February 2010 159 BSPAs had officially been designated by the nine Baltic Sea nations. This amounts to a marine area of 42,823 km<sup>2</sup> (48,784 km<sup>2</sup> including terrestrial parts) (Table. 1), which is considerably more than before the assessment started. In total, over 10.3 % of the HELCOM marine area was covered by BSPAs in Feb. 2010, compared to only 7% in 2009, 5.5% in 2008, and

3.9% in 2004. Nevertheless, many BSPAs still lacked a proper management and protection regime. In addition, the quantity of BSPAs and the proportion of protected marine areas varied considerably between the Contracting States. While some presented a suite of BSPAs covering between 20 and nearly 30 % of their marine area, other Contracting States designated only between 3 % and 7 % of their respective Baltic Sea area (HELCOM, 2010a). Only four Contracting States had by February 2010 fulfilled the target of 10% protection (Table 1, Figure 1). Figure 1 shows also that in some cases BSPAs that were already proposed in 2007 by some Baltic Sea nations are for unknown reasons no more fully or partly included in the 2010 suite.

**Table 1:** Number and size of designated BSPAs in all Contracting States and for the entire Convention Area as of Feb. 2010. Area calculations are based on the ETRS\_1989\_LAEA Projection (HELCOM, 2010b).

	No. of BSPAs	Total Area of BSPAs [km <sup>2</sup> ]	Marine fraction of BSPAs [km <sup>2</sup> ]		Marine Area [km <sup>2</sup> ]			Protected Marine Area [%]			Protected Marine Area [km <sup>2</sup> ]	
			Sum	(%)	TW	EEZ	Total	TW	EEZ	Total	TW	EEZ
Denmark	67*	10.976	10.008	(91,2)	32.280	13.098	45.378	27,6	8,3	22,1	8.920	1.088
Estonia	7	7.237	5.980	(82,6)	24.728	11.593	36.320	24,0	0,4	16,5	5.937	43
Finland	22	6.100	5.512	(90,3)	51.809	28.962	80.771	10,6	0,0	6,8	5.509	2
Germany	12	4.866	4.561	(93,7)	10.806	4.529	15.335	19,4	54,5	29,7	2.092	2.469
Latvia	4	949	863	(91,)	12.625	16.126	28.751	6,7	0,1	3,0	840	24
Lithuania	4	761	363	(47,7)	2.274	4.238	6.512	15,9	0,0	5,6	363	0
Poland	9	7.939	7.175	(90,4)	10.076	19.494	29.570	54,6	8,6	24,3	5.507	1.668
Russia	6	1.572	1.089	(69,2)	16.533	7.369	23.901	6,6	0,0	4,6	1.089	0
Sweden	28	8.383	7.273	(86,8)	76.055	71.352	147.407	5,9	3,9	4,9	4.523	2.749
<b>Baltic Sea</b>												
Feb. 2010	159	48.784	42.823	(87,8)	237.186	176.760	413.946	14,7	4,6	10,3	34.779	8.044
Dec. 2008	104	34.009	29.058	(85,4)	237.186	176.760	413.946	10,0	3,1	7,0	23.661	5.397
2008	89	27.405	22.569	(82,4)	/	/	413.946	/	/	5,5	/	/
2004	78	27.020	16.022	(59,3)	/	/	413.946	/	/	3,9	/	/

\* one BSPA terrestrial only



**Figure 1:** Comparison between HELCOM BSPAs designated in 2010 and such proposed in 2007 (von NORDHEIM ET AL., 2011; data source HELCOM Sekretariat/University of Vechta).

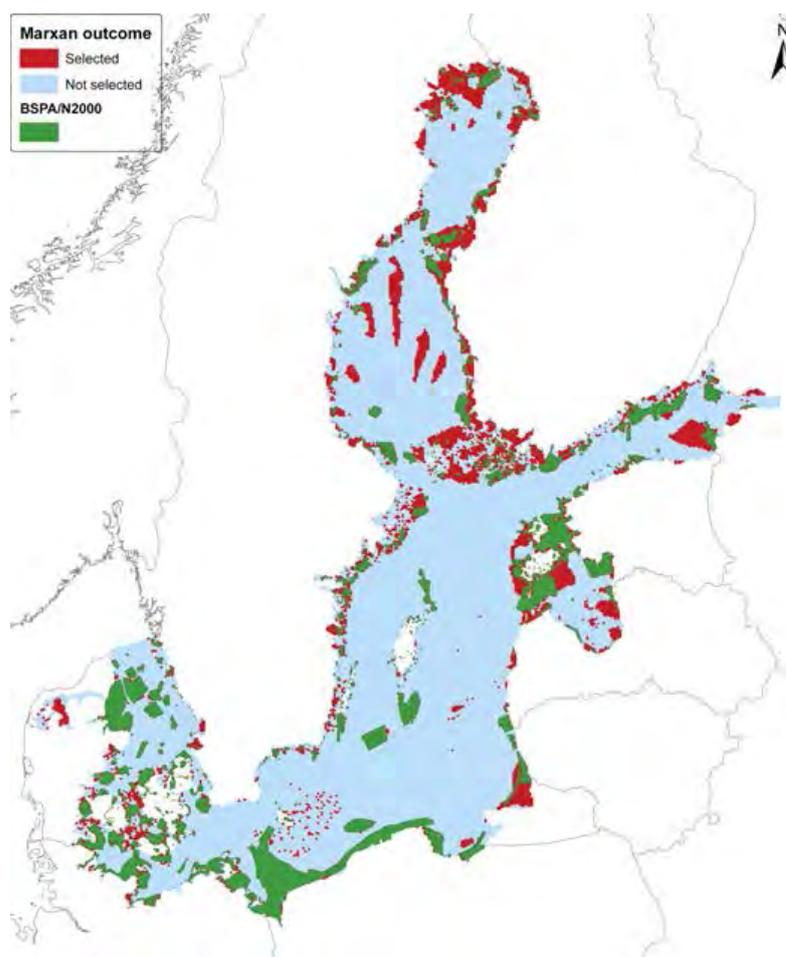
### 2.2.2. Assessment of the ecological coherence of the network

Assessing the ecological coherence of a MPA network remains a new approach and therefore challenging. Although the term was used in the JWP, no operational definition existed. The HELCOM requirements are listed in Box 2. In practice, these criteria take into account MPA size and shape, coverage of species and their habitats, biotope types and landscapes, locations of the MPAs across biogeographic borders, natural variation of species and biotope types within landscape types and the dispersal distance of individual species at different scales. Although the HELCOM GIS data base could be used for the assessment, information was not complete and therefore not appropriate for a highly significant assessment of the network in 2010. However, the results indicate that if the aim is to provide more comprehensive protection to the

entire range of biodiversity in the basin, the network of BSPAs should be expanded to at least twice its size, in particular with additional offshore sites. This was in line with the results of the Balance project (HELCOM, 2010a).

### **2.2.3. Selection tool for new BSPAs**

A coherent network of BSPAs must ensure that the whole range of the marine biodiversity over the entire Baltic marine area is comprehensively covered and that the responsibility for the network is as far as possible and necessary equitably shared among all countries (HELCOM, 2010a). This is in line with the principle HELCOM aims. A systematic selection process under different preconditions with the software tool "MARXAN", as carried out by HELCOM, has the advantage that the outcome remains intersubjectively revisable and cost-efficient. This ensures on the one hand a good transparency and defensibility of the process, and means on the other hand that a number of social and economic objectives can be considered besides ecological aspects. It is for example cost-efficient, if existing major shipping routes be locked into the system for not being chosen as newly proposed sites. A great advantage of this tool is that it provides different options for discussion according to the preconditions fed in. Last not least, such a regional approach ensures that the responsibility for the network is equitably shared among the Baltic basins (HELCOM, 2010b). This means according to the HELCOM Ministerial Declaration from Moscow (2010) that, when scientifically justified, at least 10% of all sub-basins of the Baltic Sea area be protected by the network. HELCOM (2010b) provides a comprehensive documentation of the MARXAN approach for the Baltic Sea area. Figure 2 shows as example the outcome for complementary sites with the preconditions: minimum 12% sub-basinal coverage, minimum 17% of the Baltic Sea area protected, while existing BSPAs and Natura 2000 sites are included. As a matter of fact, non of the Contracting States has designated any of these proposals as new BSPA as yet.



**Figure 2:** Example for a MARXAN outcome showing selected complementary sites with minimum 12% sub-basinal coverage, minimum 17% of the Baltic Sea area protected, while existing BSPAs and Natura 2000 sites are included (HELCOM, 2010b).

#### 2.2.4. Further needs towards an ecologically coherent BSPA-network

Germany acted within the HELCOM framework as lead country for BSPAs and was therein supported by the HELCOM secretariat. They presented the 2010 assessment to the HELCOM Ministerial Meeting 2010 in Moscow. The ministers acknowledged in their declaration what had been reached so far, in particular that in the year of biological diversity HELCOM had reached the 10% target of the CBD, but were aware:

- “that despite the designation of many new BSPAs, an ecologically coherent network has not been reached so far;
- that not all relevant Natura-2000 sites and only few offshore sites beyond territorial waters were designated as BSPAs; and
- that a number of important species, habitats, marine landscapes and ecological processes are thus still not receiving sufficient spatial protection...”

In order to fill the gaps the ministers agreed at the Ministerial meeting in 2010:

- “to secure the establishment of a network of BSPAs that fulfills the criteria of ecological coherence (representativeness, replication, adequacy and connectivity) and thereby contributes to the protection of the entire ecosystem;
- that where appropriate, the Contracting States identify additional BSPAs at the latest by the end of 2011 taking into account respective proposals for potential BSPAs to be elaborated by HELCOM HABITAT and using the information provided by the actual assessment of HELCOM, including the results of the site-selection analysis, and to designate the identified sites finally at HELCOM HABITAT 14/2012; in doing so, to focus on:
- the needs for providing protection to species and habitats identified in HELCOM as being threatened or declining, and for the EU Member States taking into account the obligations stemming from the Birds and Habitats Directives and their Annexes as well as the EU Marine Strategy Framework Directive, and especially;
- including off-shore areas also in the Exclusive Economic Zone with the aim that BSPAs not only cover a total of at least 10% of the Baltic Sea Area as a whole, but also when scientifically justified, at least 10% of all its sub-basins, following the COP 7 10%-decisions;
- to develop and apply by 2015, management plans and/or measures for already existing BSPAs; and that every new BSPA designation should within five years be followed by the establishment of a management plan and/or measures...”

So far (June 2012) no additional BSPAs were designated by the HELCOM states, but some new designations are under preparation (Minutes of HELCOM HABITAT 14, 2012: [www.helcom.fi](http://www.helcom.fi)).

### **3 History and status of the OSPAR network of MPAs in the North-East Atlantic**

#### **3.1. History**

Following the Joint HELCOM-OSPAR Ministerial Meeting in 2003 and the subsequent adoption of OSPAR Recommendation 2003/3 setting out the goal to establish an ecologically coherent network of well-managed MPAs by 2010 (OSPAR, 2003a), OSPAR Contracting Parties enhanced their cooperation in the North-East Atlantic.

#### **The aims of the OSPAR MPA Network have been set out as**

- *to protect, conserve and restore species, habitats and ecological processes which have been adversely affected by human activities;*
- *to prevent degradation of, and damage to, species, habitats and ecological processes, following the precautionary principle; and*

- *to protect and conserve areas that best represent the range of species, habitats and ecological processes in the maritime area.*

With a view to support and harmonize the respective national efforts and activities, a series of technical and methodological guidelines and guidance documents has been developed and agreed upon by the OSPAR Commission. These include a biogeographic classification of the OSPAR maritime area (DINTER, 2001), a list of threatened and /or declining species and habitats in the North-East Atlantic (OSPAR, 2008a), guidelines and criteria for the identification and selection of MPAs (OSPAR, 2003b), guidance on developing an ecologically coherent network of MPAs (OSPAR, 2006), as well as guidelines for the management of MPAs (OSPAR, 2003c).

Elaboration of these guiding documents has been the responsibility of the OSPAR Intersessional Correspondence Group on Marine Protected Areas (OSPAR ICG-MPA), convened and chaired by the German Federal Agency for Nature Conservation (BfN). This group, consisting of experts nominated by representatives of Contracting Parties as well as Non-Government Organizations and scientific institutions, in addition supports the identification of MPAs, in particular in areas beyond the jurisdiction of Contracting Parties, and monitors overall progress in the North-East Atlantic.

Furthermore, an OSPAR MPA database has been established and is being maintained by BfN, holding available information on those MPAs reported to or collectively agreed by the OSPAR Commission and thereby providing the basis for the annual progress reports on the establishment of the OSPAR Network of MPAs prepared by BfN and published by the OSPAR Commission (*latest published report*: OSPAR, 2012).

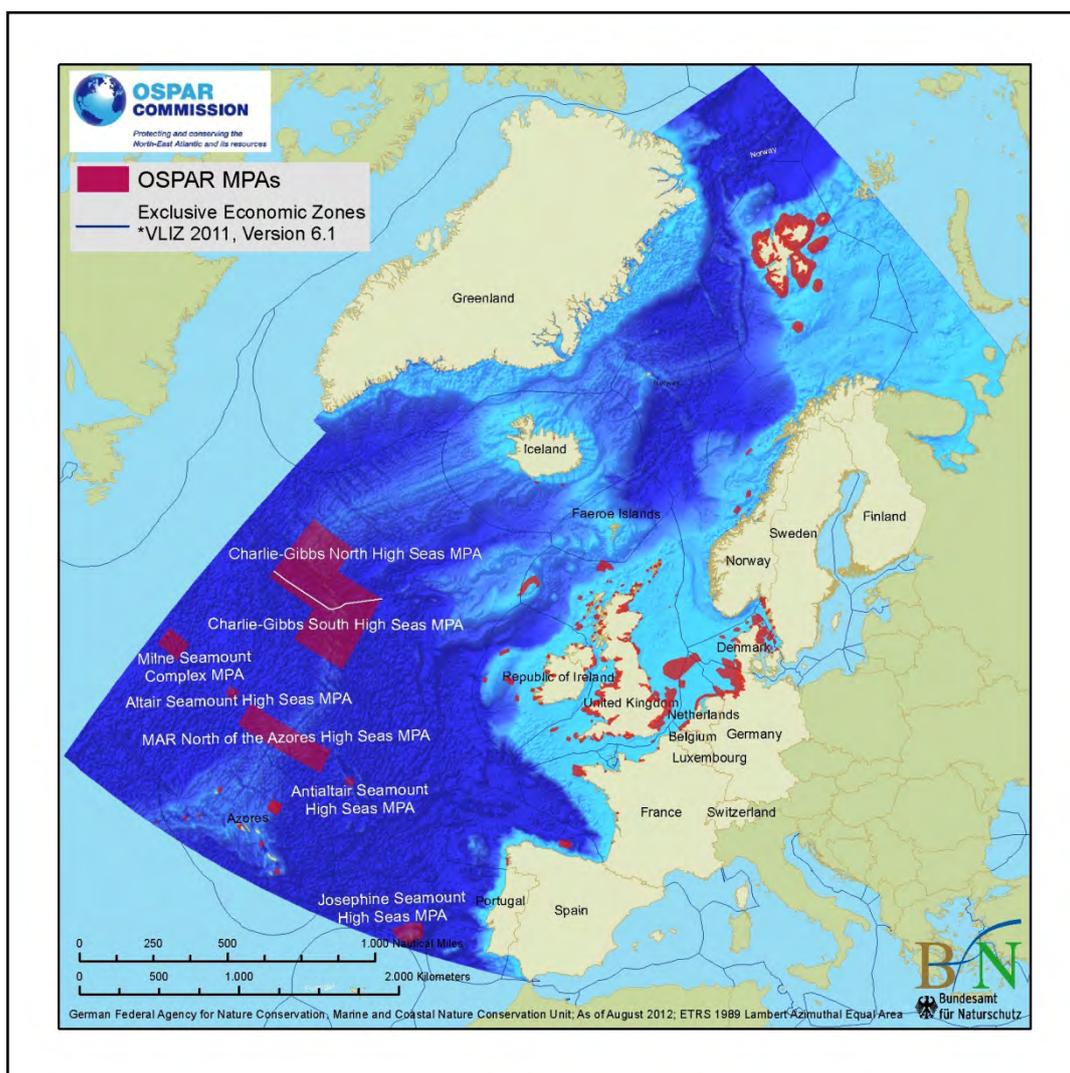
In 2010, the Ministerial Meeting of the OSPAR Commission (Bergen, Norway) evaluated progress with regards to the agreed target. OSPAR Contracting Parties and observer organizations identified significant gaps with regards to the overall coverage, representativity and connectivity of the MPA Network in the North-East Atlantic and therefore agreed upon revised targets for its completion as a key element of work within the North-East Atlantic Environment Strategy (OSPAR, 2010):

- *to fill OSPAR MPA network gaps and ensure its ecological coherence by 2012; and*
- *to ensure adequate management of OSPAR MPAs reported by 2010 until 2015.*

### **3.2. Status of the OSPAR Network of MPAs by 2012**

The OSPAR Network of MPAs as of 31 July 2012 comprises a total of 283 sites, including 276 MPAs situated within national waters of Contracting Parties. Furthermore, four MPAs have been established under split jurisdiction with the seabed

under a submission by Portugal to the UN CLCS<sup>2</sup> for an extended continental shelf while the water column remains High Seas. Two MPAs have been designated entirely in Areas beyond National Jurisdiction (ABNJ), and one MPA protecting the High Seas above the northern part of the Charlie-Gibbs Fracture Zone where the seabed is subject to a submission by Iceland to the UN CLCS for an extended continental shelf. Collectively, these sites cover 654,898 km<sup>2</sup> or 4.83% of the OSPAR maritime area in the North-East Atlantic (see Figure 3 for a graphic illustration of the OSPAR Network of MPAs in 2012).



**Figure 3:** OSPAR Network of Marine Protected Areas (as of 31 July 2012)<sup>3</sup>.

<sup>2</sup> United Nations Commission on the Limits of the Continental Shelf

<sup>3</sup> For the purpose of visibility, OSPAR Marine Protected Areas within the boundaries of Exclusive Economic Zones have in this map been slightly increased. A number of the smaller sites otherwise would not be visible in this illustration showing the entire OSPAR maritime area.

### 3.2.1. MPAs in national waters of OSPAR Contracting Parties

OSPAR Contracting Parties (CPs) have in the period 2005–2012 nominated a total of 276 MPAs and collectively agreed on seven MPAs in Areas beyond National Jurisdiction/in the High Seas for inclusion in the OSPAR Network of MPAs. The contributions by CPs regarding number of MPAs nominated, MPA coverage and distribution in their respective national waters (territorial waters plus exclusive economic zone) differ substantially. Table 2 indicates the number of sites per CP and associated area subject to MPAs. As can be inferred from Table 2, there is no direct relationship between the number of MPAs nominated and the total area protected as the sizes of MPAs vary substantially.

**Table 2:** OSPAR Marine Protected Areas (as of 31 July 2012).

OSPAR Contracting Party	OSPAR MPAs	MPA coverage in Territorial Waters	MPA coverage in Exclusive Economic Zones	MPA coverage in High Seas	MPA coverage - Total
Belgium	0	0	0		0
Denmark	34	6,960	5,511		12,472
France	9	3,598	0		3,598
Germany	6	8,968	7,916		16,884
Iceland	7	10	69		79
Ireland	19	1,593	2,543		4,136
Netherlands	5	2,434	5,886		8,320
Norway	8	78,492	2,092		80,583
Portugal	8	1,022	4,679		5,700
Spain	2	85	2,398		2,483
Sweden	8	1,046	211		1,257
United	170	26,330	27,286		53,616
High	7			464,770	464,770
<b>Total</b>	<b>282</b>	<b>130,538</b>	<b>58,590</b>	<b>464,770</b>	<b>654,898</b>

Amongst OSPAR Contracting Parties, Norway hosts the largest area subject to MPAs (>80,000 km<sup>2</sup>) with a high absolute and relative coverage of its territorial waters by OSPAR MPAs. However, due to the extensive area of its national waters, the overall relative coverage of OSPAR MPAs is at 3.9%. While the United Kingdom (UK) has nominated by far the most OSPAR MPAs, the overall proportion of their national

waters protected is at 7%. In Germany, due to the comparatively smaller marine area under its jurisdiction, OSPAR MPAs represent about 40% of its national waters. Denmark and The Netherlands show a relative MPA coverage of about 17%<sup>4</sup> and 13%, respectively, in their national waters. Sweden has 9.7% of its national waters covered by MPAs. Coverage of national waters by OSPAR MPAs in France, Ireland, Spain and Portugal remains at 1.5%, 1%, 0.8% and 0.7%, respectively. The proportion of Icelandic national waters covered by OSPAR MPAs remains minimal, due to the extensive marine areas and the comparatively small sizes of their MPAs. No MPAs have so far been nominated by Belgium.

There has been an overall tendency by Contracting Parties to designate and nominate MPAs in nearshore areas. Of the 276 MPAs within national jurisdiction, the majority, *i.e.* 215 sites, have been designated in Contracting Parties' territorial waters. While 24 sites are situated crossing the borders between territorial waters and Exclusive Economic Zones, 36 sites are situated entirely in the EEZ. One site has been designated by Portugal on its extended continental shelf already in 2006.

As illustrated above, there continues to be an imbalance regarding the overall distribution of OSPAR MPAs across the OSPAR maritime area, with a tendency towards nearshore sites. At the same time it should be noted that thereby about 16% (130,538 km<sup>2</sup>) of the territorial waters of OSPAR Contracting Parties are subject to Marine Protected Areas. This seemingly good overall coverage of coastal waters is a result mainly of extensive MPAs designated in OSPAR Regions II (Greater North Sea) and III (Celtic Seas) and around the Svalbard archipelago in Region I (Arctic Waters).

However, MPA coverage of coastal waters in the remaining OSPAR (Sub-) Regions is substantially lower.

The lower overall MPA coverage in the North-East Atlantic (4.83%) is explained by the relatively small proportion of the Exclusive Economic Zones protected (58,590 km<sup>2</sup>, corresponding to 0.89% of all EEZ in the OSPAR maritime area) and, in general, the extensive areas in OSPAR Regions I (Arctic Waters), IV (Bay of Biscay and Iberian Coast) and V (Wider Atlantic), including ABNJ, that are not subject to OSPAR MPAs.

---

<sup>4</sup> Area calculations only consider national waters adjacent to mainland Denmark, excluding the marine areas of Greenland and the Faeroe Islands.

### 3.2.2. MPAs across OSPAR Regions

As in Contracting Parties' national waters, the distribution of OSPAR MPAs across the OSPAR Regions is likewise imbalanced, as can be inferred from Table 3.

**Table 3:** Coverage of OSPAR Regions by OSPAR MPAs (as of 31 July 2012).

OSPAR Region		Area	Total area	Proportion covered by OSPAR MPAs
I	Arctic Waters	5.529.716	81.024	1,47%
II	Greater North Sea	766.624	72.340	9,44%
III	Celtic Seas	366.459	18.223	4,97%
IV	Bay of Biscay and Iberian Coast	539.153	2.511	0,47%
V	Wider Atlantic	6.346.159	479.800	7,56%
OSPAR maritime area		13.548.111	654.898	4,83%

It is worth noting that coverage of the Greater North Sea (Region II) by the OSPAR Network of MPAs has almost reached the target as agreed by the Convention on Biological Diversity (CBD) to have at least 10% of the ocean protected by marine protected areas. Coverage of the Wider Atlantic (Region V) and the Celtic Seas (Region III) by the OSPAR Network of MPAs is comparatively good. Coverage of Arctic Waters (Region I) and the Bay of Biscay (Region IV) by the MPA Network remains rather low.

### 3.2.3. OSPAR MPAs in Areas beyond National Jurisdiction

The OSPAR maritime area encompasses extensive areas in the Wider Atlantic (OSPAR Region V) and the Arctic Waters (OSPAR Region I) that are beyond the jurisdiction of coastal states. These areas, covering approximately 40% of the OSPAR maritime area, host extensive open-ocean and deep-sea areas between the Svalbard archipelago and Iceland, and along the Mid-Atlantic Ridge (MAR) between Iceland and Portugal Azores with abyssal plains to the east and west of the Ridge (see Figure 10).

The 2003 Ministerial Commitment to establish an ecologically coherent network of well-managed MPAs included a clear remit to identify and designate MPAs in these areas, usually referred to as ABNJ. Designation of a Marine Protected Area in an ABNJ in the North-East Atlantic requires collective agreement and action by the OSPAR Commission. Any proposal for an OSPAR MPA in ABNJ prepared by either a Contracting Party or a Non-Governmental Organisation (NGO) needs to be considered by all Contracting Parties.

Over the years, a number of proposals to designate OSPAR MPAs in ABNJ have been elaborated taking into account data and information collated within the frame of international research programmes in the North-East Atlantic (e.g. Mar-Eco, Eco-Mar). These proposals have originally been prepared by WWF (for the *Charlie-Gibbs Fracture Zone/Mid-Atlantic Ridge*) and the University of York<sup>5</sup>, subsequently reviewed by the International Council for the Exploration of the Sea (ICES) in 2008 (ICES Advice, 2008 Book 1), and gradually finalized by the relevant OSPAR bodies, namely the Intersessional Correspondence Group on Marine Protected Areas (ICG-MPA), the Working Group on Marine Protected Areas, Species and Habitats (MASH) and the Biodiversity Committee (BDC).

Following collation and review of scientific information and data, preparation of legal feasibility studies and consultations amongst Contracting Parties, six proposals have been presented to the OSPAR Ministerial Meeting 2010 (Bergen/Norway) and – after complex negotiations – finally adopted. These areas collectively represented the first network of MPAs in the High Seas.

In 2012, another proposal has finally been agreed upon by the OSPAR Commission, establishing the northern area of the Charlie-Gibbs Fracture Zone on the Mid-Atlantic Ridge as a pelagic MPA in ABNJ.

Today, these seven OSPAR MPAs (see Figure 3), collectively, cover about 8.57% of the Area beyond National Jurisdiction in the North-East Atlantic.

#### **3.2.4. Ecological Coherence of the OSPAR Network of MPAs**

A comprehensive analysis of the ecological coherence of the OSPAR Network of Marine Protected Areas is currently not possible due to the persistent lack of ecological data, particularly on the distribution of species populations and habitats in the North-East Atlantic. In the absence of such data, only basic approaches can be conducted that allow for an assessment to what extent the elements of ecological coherence have *not* been addressed in the Network of MPAs rather than to determine if they have appropriately been addressed.

For the time being, only coarse assessments of the spatial arrangement of the MPA Network can be applied (OSPAR, 2008b). Results of initial spatial tests (OSPAR, 2012) suggest that the OSPAR Network of MPAs currently is unlikely to be ecologically coherent as the distribution of OSPAR MPAs across OSPAR Regions and biogeographic regions and provinces in the North-East Atlantic remains uneven with

---

<sup>5</sup> The University of York has elaborated these proposals under a contract (2008-2010) provided by the German Federal Agency for Nature Conservation (BfN).

the majority of sites situated generally in coastal waters, particularly in the Greater North Sea and the Celtic Seas. If the MPA Network is generally not well-distributed in space, then it is very likely not *connected* and/or *representative*, and probably not *replicated* and/or *adequate*.

However, it might be inferred from the spatial arrangement of OSPAR MPAs particularly in the Greater North Sea, but to some extent also in the Celtic Seas and around the Azores archipelago, as well as in ABNJ/in the High Seas of the Wider Atlantic, that the Network in these areas shows first signs of ecological coherence with regards to representativity, adequacy, replication and connectivity. In these areas, a substantial proportion (adequacy) has been set aside for protection and the range of biogeographic provinces is covered (representativity) by a large number of sites (replication) that are relatively close to each other (connectivity).

This coarse evaluation conducted by OSPAR has to be seen as a first basic step in a multi-staged assessment procedure to evaluate the ecological coherence of the OSPAR Network of MPAs. More sophisticated tests are currently being developed and tested on a trial basis in the Channel by the OSPAR ICG-MPA. Large-scale implementation of more detailed assessments will, however, only be possible if substantive ecological data is available.

#### **4 Conclusions**

Both OSPAR and HELCOM have over the last years made significant progress on developing networks of marine protected areas in the North-East Atlantic and the Baltic Sea, respectively. While the network of Baltic Sea Protected Areas (BSPAs) today covers about 10.3 % of the HELCOM Convention area, the network of OSPAR MPAs encompasses 4.83 % of the OSPAR maritime area. When comparing these figures, one needs to take into account that the OSPAR maritime area is approximately 30 times the size of the Baltic Sea and that about 40 % of the North-East Atlantic is beyond the jurisdiction of coastal States, posing a complex challenge on the OSPAR Commission with regards to establishing MPAs in these areas.

Despite the substantial coverage of the MPA networks of about 48,800 km<sup>2</sup> in the Baltic Sea and about 655,000 km<sup>2</sup> in the North-East Atlantic, the common target agreed on in 2003, *i.e.* to establish an ecologically coherent network of well-managed MPAs, has not yet been reached.

A comprehensive assessment of these networks with regards to their ecological coherence currently remains impracticable. This is mainly due to the insufficient availability of data and information, in particular on the occurrence and distribution of threatened or declining species and habitats as well as on the extent to which these are effectively protected by MPAs, the fundamental shortcomings are yet apparent.

The extent and proportion of the diverse biogeographic regions within both the HELCOM and OSPAR Convention areas covered by marine protected areas still shows significant variation and cannot be considered to be adequate throughout both regional seas. The uneven distribution of BSPAs and OSPAR MPAs accounts for an inadequate representation of the various biogeographic regions, leaving in particular offshore areas largely without spatial protection. Furthermore, the extensive spatial distances between individual sites in some regions apparently impair their connectivity.

With a view to make further progress towards achieving the common target, the respective expert groups of OSPAR and HELCOM recommend:

- to improve monitoring and data collation with regards to the occurrence and distribution of species and habitats in the North-East Atlantic and the Baltic Sea;
- EU Member States not to limit their identification of protected areas only to nominating Natura 2000 sites, but rather to identify further sites on the basis of the more comprehensive selection criteria agreed on by OSPAR and HELCOM;
- to systematically identify and establish further MPAs/BSPAs in offshore areas (*i.e.* Exclusive Economic Zones) and those biogeographic regions which are still underrepresented in the respective networks; and
- to enhance efforts towards developing and implementing specific and effective management measures for the existing MPAs/BSPAs taking into account the guidelines agreed on by OSPAR and HELCOM.

## 5 References

BALANCE (2008): Ecological coherence and principles for MPA assessment, selection and design. BALANCE Technical Summary Report PART 3/4.

Dinter, W. P. (2001): Biogeography of the OSPAR Maritime Area. A Synopsis and Synthesis of Biogeographical Distribution Patterns described for the North-East Atlantic. Federal Agency for Nature Conservation. Bonn, Germany. pp167.

Hägerhäll, B. & Skov, H. (1998): Proposal for offshore Baltic Sea Protected Areas (BSPAs). Expert-Report to HELCOM EC-NATURE (unpublished).

HELCOM (2010a): Towards an ecologically coherent network of well-managed Marine Protected Areas - Implementation report on the status and ecological coherence of the HELCOM BSPA network. Executive Summary. Balt. Sea Environ. Proc. No. 124A – Helsinki (Helsinki Commission)

HELCOM (2010b): Towards an ecologically coherent network of well-managed Marine Protected Areas - Implementation report on the status and ecological coherence of the HELCOM BSPA network. Balt. Sea Environ. Proc. No. 124B – Helsinki (Helsinki Commission).

HELCOM (2009): Biodiversity in the Baltic Sea – An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea. Balt. Sea Environ. Proc. No. 116B–Helsinki (Helsinki Commission).

HELCOM (2007): Assessment on the ecological coherence of the network of Baltic Sea Protected Areas. HELCOM 28/2007 Doc. 3/13(Helsinki Commission).

HELCOM (2006): Planning and management of Baltic Sea Protected Areas: guidelines and tools. – Balt. Sea Environ. Proc. 105 – Helsinki (Helsinki Commission).

HELCOM (1996): Coastal and marine protected areas in the Baltic Sea region. Balt. Sea Environ. Proc. 63 – Helsinki (Helsinki Commission).

OSPAR (2003a): OSPAR Recommendation 2003/3 on a Network of Marine Protected Areas.[http://www.ospar.org/content/content.asp?menu=00180302000011\\_000000\\_000000](http://www.ospar.org/content/content.asp?menu=00180302000011_000000_000000).

OSPAR (2003b): Guidelines for the Identification and Selection of Marine Protected Areas in the OSPAR Maritime Area. Reference Number: 2003-17.

OSPAR (2003c): Guidelines for the Management of Marine Protected Areas in the OSPAR Maritime Area. Reference Number: 2003-18.

OSPAR (2006): Guidance on Developing an Ecologically Coherent Network of OSPAR Marine Protected Areas. Reference Number: 2006-3.

OSPAR (2008a): OSPAR List of Threatened and/or declining Species and Habitats. Reference Number: 2008-6.

OSPAR (2008b): Background document on three initial spatial tests used for assessing the ecological coherence of the OSPAR MPA Network. Biodiversity Series. Publication Number 360/2008.

OSPAR (2010): The North-East Atlantic Environment Strategy. Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic 2010–2020. OSPAR Agreement 2010-3.

OSPAR (2012): 2011 Status Report on the OSPAR Network of Marine Protected Areas. Biodiversity Series. OSPAR Publication Number: 577/2012.

Von Nordheim, H., Boedeker, D., Packeiser, T. & Ranft, S. (2011): Netzwerke von Meeresschutzgebieten im Nordostatlantik und in der Ostsee – Ziele für 2010 erreicht? – Natur u. Landschaft 86 (9/10): 388-396.



# MPAs in the Mediterranean Sea - Coherence and Efficiency

MARIE ROMANI

Mediterranean Protected Areas Network, France

## 1 The Mediterranean Sea, a hot spot of biodiversity yet bearing important threats

The Mediterranean is a semi-enclosed sea whose waters bathe the coasts of twenty one countries of a region that has been for centuries the cradle of great civilizations. Its geological and human history has given the Mediterranean region its richness in terms of biodiversity but also in terms of social, cultural and political diversity. Known as one of the planet's hotspots for marine biodiversity, the Mediterranean Sea hosts habitats, species and assemblages of particular ecological importance.

Although there are still significant gaps still information and reliable data about the biodiversity of many Mediterranean zones, a recent scientific assessment coordinated by the Regional Activity Center for Specially Protected Areas (RAC/SPA) led to the identification of 10 areas that conform to the criteria 6<sup>1</sup> set under the Convention on Biological Diversity (CBD) for Ecologically or Biologically Significant Areas (EBSAs). Today, the region is under heavy pressure from various human activities. Coastal development and urbanisation are one of the main threats. 450 million people live in riparian states, 40% of whom live on the coast. This contributes to degraded landscapes, soil erosion, increased waste discharges into the sea, loss of natural habitats, a higher pressure on endangered species.

Standing as the world's most important tourism destination, the Mediterranean region attracts about 30% of international tourism which, while generating benefits to the countries' economy, also generates significant added negative impacts on the marine environment through uncontrolled coastal zone development, increased use of water resources and production of solid wastes and sewage. Maritime transport is an important activity affecting the Mediterranean marine environment with about 30% of the international shipping trade as well as about 25% of maritime oil transport transiting through the Mediterranean Sea.

---

<sup>1</sup> Uniqueness or rarity, Special importance for life history of species, Importance for threatened, endangered or declining species and/or habitats, Vulnerability, fragility, sensitivity, slow recovery, Biological productivity, Biological diversity, Naturalness (CBD Decision IX/20, Annex 1):

Fishing is another important activity in the Mediterranean in terms of employment, incomes and food security. The uncontrolled rise in fishing effort registered over the last decades in many Mediterranean countries has led to the decline of many fish stocks. According to recent evaluations made within the framework of the General Fisheries Commission for the Mediterranean (GFCM), 90% of the assessed fish stocks were exploited beyond the limits of overfishing.

## **2 Main International/Mediterranean/European instruments to address these challenges**

It is obvious that one of the challenges for Mediterranean States in the coming years is to combine their efforts to reverse the degradation trends in the marine environment and ensure the long term conservation of biodiversity. This needs a multi-sector governance approach using the most appropriate tools, in accordance with the globally and regionally agreed targets for the conservation and sustainable use of natural resources.

In this context, Mediterranean countries have embarked, since 1975, through the Barcelona Convention and its related Protocols, on a series of cooperation, coordination and mutual assistance processes aimed at protecting the Mediterranean, conserving its biological diversity and combating pollution. One of the Convention's Protocols focusses on the conservation of biodiversity, in particular through the development of MPAs. In 2008, determined to revitalize their collaborative efforts, the Parties to the Barcelona Convention sparked off a process that led, in 2012, to a noted high level of commitment and ownership by the riparian States regarding the application of the ecosystem approach to the management of the Mediterranean marine environment. An important effort has been made to ensure a good level of streamlining and harmonisation with the European Union's Marine Strategy Framework Directive (MSFD).

As members of the European Union, 7 Mediterranean countries <sup>72</sup> are also committed to the provisions of the European Directives applicable to the preservation and sustainable use of the marine environment. The MSFD is the most recent of them. It aims to achieve by 2020 a Good Ecological Status for the marine environment in European waters by following an integrated process which, , on a national scale, involves initial assessments, descriptors, indicators, measures and monitoring programmes. For European Union Countries, the Common Fisheries Policy (CFP) is another binding instrument that involves measures and rules for the sustainable management of European fisheries. Started in 1983, the CFP is being reformed to

---

<sup>2</sup> Cyprus, France, Greece, Italy, Malta, Slovenia and Spain. Croatia will join European Union in 2013.

reverse the decline of the European fish stocks and mitigate the adverse impact of fishing on the marine environment. The new CFP is expected to enter into force in 2013. It includes provisions for setting up a network of protected marine areas which will reconcile conservation of the environment and sustainable fishing practices. There are other agreements applicable to the Mediterranean Sea which promote MPAs among the tools required to achieve their objectives. The ACCOBAMS<sup>8</sup> agreement makes provisions for setting up of MPAs in areas identified as habitats for cetaceans and/or which provide important food resources for them.

However, considering that ACCOBAMS<sup>3</sup> is not a treaty that is specifically directed at MPA legal requirements, the Parties to this Agreement agreed that developing protected areas for cetaceans should be undertaken within the framework of other existing appropriate instruments, in particular the Specially Protected Areas/Biological Diversity (SPA/BD) Protocol of the Barcelona Convention.

The General Fisheries Commission for the Mediterranean (GFCM), one of the regional fishery management organisations (RFMOs) created under the auspices of the Food and Agriculture Organization (FAO), recommends establishing fishing reserves and Fisheries Restricted Areas (FRAs) as tools for the management of fisheries and for the preservation of the marine environment, including in areas beyond the States' jurisdiction. To date four FRAs have been established by the GFCM.

The Mediterranean Science Commission (CIESM) has grown from its original eight founding countries to 22 Member States today. These support a network of several thousand marine researchers, applying the latest scientific tools to better understand, monitor and protect a fast-changing, highly impacted Mediterranean Sea.

### **3 The Mediterranean MPA network: current state and challenges**

Initial results stemming out of the 2012 Status assessment of the Mediterranean MPAs network are presented below.

#### **1.1. The CBD target of 10% protection of Mediterranean waters has not yet been achieved**

The total number of Mediterranean MPAs and their surface area is today more accurate as they are now geo-referenced, but information on their actual protection level is still limited and many documents consider many sites are "paper MPAs" without any effective management structure. As such, the analysis took into account

---

<sup>3</sup> Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area

the area covered by the MPAs under legal protection rather than protected surface area actually and effectively managed.

In 2012, the Mediterranean Sea's<sup>4</sup> 9 2.5 million km<sup>2</sup> is covered by:

- 4.56% of MPAs from all statuses (677 sites) and 1.08% when excluding the Pelagos Sanctuary (87 500 km<sup>2</sup>), which alone represents 3.48%;
- 5.26% including the 4 fisheries restriction areas on the high seas created by the GFCM (17 677 km<sup>2</sup>; 1.78% excluding the Pelagos Sanctuary).
- Finally, the bottom trawling exclusion zone, which includes the benthic zones at less than depths of -1000m (GFCM regulation adopted by European legislation in 2006) covers 58% of the Mediterranean Sea (1 455 411 km<sup>2</sup>) in spatial projection.

**1.2. There is still an imbalance in the geographical distribution of MPAs between the southern, eastern and northern areas of the Mediterranean and MPAs are still mainly coastal.**

83% of MPAs are located in the northern part of the Mediterranean (North-West and North-East) with 66% in the European Union member countries<sup>5</sup>, highlighting the lack of MPAs on the southern and eastern shores. Yet, progress has been made in these areas since 2008 and several countries in the South and East indicate that they have some being planned: Algeria (6 MPAs planned), Israel (8 MPAs planned), Lebanon (4 MPAs planned), and Libya (3 MPAs planned), and Tunisia (3 MPAs planned);

This regional disparity is more pronounced if one considers Natura 2000 sites at sea in the EU member countries, because 96% of the Mediterranean MPAs are in the north of the basin; Italy, France and Spain hold 52.8% of the total MPAs with a national status; Greece and Italy have 67% of all Natura 2000 sites at sea and France 47% of the total surface area. The 12 nautical mile zone (territorial waters<sup>10</sup>), under national legal jurisdiction, has an 8.5% protection, with the Pelagos Sanctuary contributing a large area (6.1%). The open sea area, usually beyond the 12 nautical miles, represents 74% of the Mediterranean's surface area and has a 2.7% protection, 2.6% of which is Pelagos. One must note, however, that there are many initiatives for creating MPAs in the open sea.

---

<sup>4</sup> The surface area taken into account for this report is 2 513 270 km<sup>2</sup>

<sup>5</sup> Some countries have a 6 n.m. territorial waters limit (Turkey and Greece for example). It was decided for the purposes of this study and to circumvent the jurisdiction problems of this enclosed sea to take 12 nautical miles for all the countries.

### **1.3. Representativeness is highly variable depending on the species and habitats**

Located in the western part of the Mediterranean, offshore France, Spain and Italy, the ecoregions of the Agerio-Provencal Basin and Tyrrhenian Sea appear best protected, with 12.5% of their surface included in MPAs with a management structure. However, the Pelagos sanctuary contributes 90% or more to representing these two ecoregions. Less than 1% of the surface area of the 6 other ecoregions are included in MPAs with a management structure, aside for the Aegean Sea (with a notable 3%). The *posidonia* meadows is reported in 69% of the MPAs in the sample group (not reported in Lebanon, Morocco - and Slovenia) and 52% of MPAs for coralligenous (not reported in Greece, Lebanon, Libya, Malta, Morocco). All other iconic habitats are only reported in less than 35% of MPAs. Less than 10% of MPAs mention deep-water corals, which seems logical given that MPAs in the Mediterranean are mainly coastal. No MPA mentions the presence of the abyssal floor.

The species most frequently mentioned are the great fan mussel, *posidonia*, the bottlenose dolphin, the loggerhead turtle and the grouper. A number of responses indicated the presence of species considered rare, which would need a further more detailed investigation to see if this is due to a real protective effect or the occasional sightings of individuals (for mammals and top marine predators); thus MPAs indicate the presence of endangered species such as the date mussels (60%), 10% reported the presence of monk seals and 6% the white shark, which seems particularly high and will require further enquiry.

In the Mediterranean, there is a wide variety of sizes in the marine part of the MPA, the smallest covers 0.003 km<sup>2</sup> (Akhziv National Park in Israel) and the largest (aside the 87 500 km<sup>2</sup> Pelagos sanctuary) covers about 4 000 km<sup>2</sup> (the Gulf of Lion Marine Nature Park in France). But 66% of MPAs cover less than 50 km<sup>2</sup>. With regards to the age of MPAs 61% is older than 10 years which is considered a minimum for a given MPA to access some sort of maturity; and 35% is even older than 20 years, a fact which could bring out some interesting points concerning management effectiveness upon assessment.

### **1.4. MPA management must become more effective**

The part of all MPAs that have a management structure is of only 42%. Across the panel of 80 surveyed MPAs, over half (56%) still don't have a management plan. 67% of MPAs who already have a management plan have already evaluated it. Most of the MPAs (76%) are governed by the government whether at a local, regional or national level, with only 11% having shared governance in co-management or joint

collaboration<sup>6</sup>. Only three MPAs reported being directly managed by local communities, but more than 60% of MPAs declared that local stakeholders were involved in the planning and management, and nearly half of the MPAs have developed a charter of good conduct with users (fishermen, divers ...). As for the involvement of scientists in management, half of the MPAs have no scientific committee. MPAs are strongly taken into account in policy local planning (91% of MPAs). Half of the MPAs have a good cooperation with other Mediterranean MPAs, indicating that the human network for exchanging experiences (particularly MedPAN) works quite well.

The ability to rely on an ecological baseline (habitat change, species populations, or functionality of the MPA) or socio-economic status (MPA visitor numbers, MPA-induced benefits for the population ...) and ensuring regular monitoring of parameters and corresponding indicators is essential to give support to management decisions and adapt them regularly. Many MPAs have indicated a baseline on habitats and species (70% of MPAs) even if it is not always complete, and a socio-economic baseline (56% - against 48% in 2008), with respect to regular monitoring this is provided in 80% of MPAs surveyed (against 39% in 2008) and three-quarters of them also provide specific studies on different relevant MPA topics. The managers and their teams are involved in about 30% of monitoring alongside scientists.

On human resources management, 84% of MPAs reported having permanent staff, the most often supplemented by seasonal and temporary staff, which is quite important even if it is difficult to know what kind of staff they are (in administrative offices or technical staff actually assigned to MPA management in the field). Ten MPAs (12%) however indicated having no full-time/permanent staff (including five with no staff at all). Enforcement is recognized critical elements to ensure the good management of MPAs. If only a quarter of the MPAs reported having sworn-in personnel, most of them rely on partners for surveillance such as coast guards, marine police, armed forces or the police. MPAs are fairly well equipped in boats (surveillance and research), with only 12% indicating none and 30% having more than 2 boats. They are quite well equipped in GIS equipment too (more than 3/4 of the MPAs), this is a significant improvement on 2008. In contrast, signs of demarcation at sea showing the

---

<sup>6</sup> In the "collaborative" management, decision-making and responsibility is assigned to an organization, but it is required by law or by political decision to inform or consult other stakeholders. Participation in collaborative management can be enhanced by giving bodies which are composed of various stakeholders the responsibility of developing technical proposals for the regulation and management of the protected area, which will then be subject to the final approval of the decision-making body. In "joint" management, various stakeholders sit on a management body that has the authority and responsibility for decision-making. Decisions may or may not require a consensus.

boundaries of the MPAs are rare (11% of MPAs), as well as diving equipment, thus MPAs are generally poorly equipped.

Financial resources are essential for good management, but very few MPAs gave information on their operating budgets or investment and among those who responded their budgets differ vastly with 7 MPAs whose operating budget is between 20 000 and 100 000 €/km<sup>2</sup>, 8 between 10 000 and 20 000 €/km<sup>2</sup>, and 15 MPAs between 1 and 10,000 €/km<sup>2</sup>. Funding is mainly from government (89% of MPAs); few MPAs get funding from NGOs and international donors, while 36% of MPAs are self-financed, which is still too little to ensure the sustainability of MPAs who have no other resources, including some countries in the South or the North-East. The commitment of the private sector is currently low (only eight MPAs mentioned it).

#### **4 MedPAN contribution to challenges on Mediterranean MPAs**

Since 1990, the MedPAN network has brought together the managers of Mediterranean MPAs and has supported them in their management activities. Activities were temporarily ceased between 1996 and 2004, due to lack of funding. In 2004, the MedPAN network was revived by the Port-Cros National Park and WWF France that coordinated an Interreg IIC project with 23 partners in the Mediterranean.

After the first Mediterranean MPA Conference in 2007; MPA managers decided then to create a long-term organization with an independent governance to coordinate the network. In 2008, MedPAN became a legally independent association (established under the French law) with international governance and a permanent Secretariat was established in Hyeres.

Currently, the MedPAN organization has 9 founding members, 31 members (MPA managers), 24 partners (activities related to MPA) in 18 Mediterranean countries. MedPAN is organized through a Board of Directors, a General Assembly, a Scientific Committee, an Advisory Committee and several expert committees. MedPAN aims to promote the establishment, the operation and sustainability of the network of MPAs contributing to the Convention on Biological Diversity, to the Barcelona Convention and to different European policies on marine issues.

The MedPAN network's mission is to promote, through a partnership approach, the sustainability and operation of a network of marine protected areas in the Mediterranean which are ecologically representative, connected and effectively managed to help reduce the current rate of marine biodiversity loss. MedPAN developed a 2013-2017 strategy with 3 main axis:

- Being a network for knowledge, information, anticipation and synthesis

- Reinforce the vitality of the network, interactivity between members and building their capacity for an effective management of MPAs with stakeholders
- Reinforce the MedPAN network's sustainability, prominence, governance and resources.

Main activities implemented include: MPA database (MAPAMED) and Status Report of the network, call for small projects, trainings and exchange visits and workshops, link with scientist on monitoring and information-watch, communication through website and e-newsletter, representation of the MPA network in priorities political arena. MedPAN and its partners, the Regional Activity Centre for Specially Protected Areas (RAC/SPA), the General Directorate of Natural Assets Protection (Turkey) and the United Nations Development Programme (UNDP) in Turkey, also organize the 2012 Forum of Marine Protected Areas (MPAs) in the Mediterranean being held from November 25th to 28th, 2012 in Antalya, Turkey.

This Forum will serve as a platform to review the progress of the Mediterranean MPA network developed over the last years, and establish a common roadmap for 2020 in order to meet marine conservation challenges in the region. It will also provide an opportunity to:

- Bring together the representatives of the national agencies for the environment, fisheries, tourism and economy in the Mediterranean countries; managers of marine protected areas; scientists; regional and international partners; and local economic actors to share experiences and knowledge,
- Articulate a common vision among the Mediterranean MPA community through constructive dialogue and engagement and,
- Help demonstrate the economic, social and cultural importance of MPAs.

Given the current economic crisis and political upheaval, the preservation of the natural, cultural and social features of the Mediterranean region will only be possible if all riparian countries and stakeholders are committed to pursuing a common vision to strengthen the marine protected areas network for the benefit of our Mediterranean communities especially those living in fragile and vulnerable eco-systems.

## 5 References

Gabrié C., Meola, B., Webster, C. (2012): Status of the Network of Marine Protected Areas in the Mediterranean. MedPAN & RAC/SPA. Ed.: MedPAN Collection.

[www.medpan.org](http://www.medpan.org)

[www.mapamed.org](http://www.mapamed.org)

[www.medmpaforum2012.org](http://www.medmpaforum2012.org)

# Progress of the UK's MPAs Towards an Ecologically Coherent Network

JENNY OATES AND JON DAVIES

Joint Nature Conservation Committee, United Kingdom

## 1 Summary

The Joint Nature Conservation Committee (JNCC) provides scientific advice to the UK Government and Devolved Administrations (Northern Ireland, Scotland and Wales) on nature conservation issues. JNCC has been working together with the other statutory nature conservation agencies to identify a suite of Marine Protected Areas (MPAs) in the UK which will contribute towards an ecologically coherent network. JNCC is responsible for the identification of MPAs in UK offshore waters, and also works with the other nature conservation agencies to develop guidance and identify MPAs. In the UK the network of marine Special Areas of Conservation (SACs) for habitats and species is almost complete, and work is ongoing to complete the network of marine Special Protection Areas (SPAs) for birds. However, the lists of marine habitats and species of European importance for which SACs and SPAs are selected do not represent the full range of habitats and species in UK waters, which means that there are significant gaps in the existing network of MPAs. This paper outlines the progress of recent projects towards identifying new national MPAs to contribute towards an ecologically coherent network, demonstrating how each project is underpinned by common network design principles drawn from OSPAR guidance on developing ecologically coherent MPA networks.

## 2 Ecological coherence and ecologically coherent networks

It is important to clarify what is understood by the terms 'ecological coherence' and 'ecologically coherent networks'. These terms refer to the concept that a network of MPAs can provide more benefits than an individual protected area could on its own. Ecological coherence is a developing scientific concept which refers to a spectrum of different ecological factors that each has a currently undefined endpoint. However, there is a working understanding from OSPAR of what is required for an ecologically coherent network of MPAs (Section 4); a network can be considered to be ecologically coherent if it meets these network design principles.

### 3 UK's MPA network commitments

Along with other countries worldwide, the UK is working towards meeting various international commitments to establish a network of marine protected areas (Table 1).

**Table 1:** Policy commitments to establishing a network of MPAs.

<b>Policy Driver</b>	<b>Target</b>
OSPAR Convention for the Protection of the marine environment of the North-East Atlantic (1992)	Establish an ecologically coherent network of MPAs in the north-east Atlantic by 2012 and ensure it is well-managed by 2016 (OSPAR 2010)
World Summit on Sustainable Development (WSSD) (2002)	Establish representative networks of MPAs by 2012
Convention on Biological Diversity (CBD) (1993)	Establish representative networks of MPAs globally by 2012  Conserve 10% of coastal and marine areas through systems of protected areas and other area-based conservation measures by 2020 (Aichi Biodiversity Target number 11, CBD 2010)
EU Birds Directive (2009) and EU Habitats Directive (1992)	A coherent European ecological network of sites shall be set up under the title Natura 2000.
EU Marine Strategy Framework Directive (MSFD) (European Union 2008)	Establish coherent and representative networks of MPAs that will contribute to achieving Good Environmental Status of Europe's seas

Responsibilities for nature conservation in the UK have been devolved so that Scottish Government, Welsh Government and the Northern Ireland Assembly are responsible within their respective regions. However all the Administrations are working towards the same goal with respect to MPAs. The international targets outlined in Table 1 have been translated into national MPA commitments in the UK Marine Policy Statement (HM GOVERNMENT, NORTHERN IRELAND EXECUTIVE, SCOTTISH GOVERNMENT AND WELSH ASSEMBLY GOVERNMENT, 2011). This document states that 'The UK

Administrations are committed to substantially completing an ecologically coherent network of MPAs by 2012 as part of a broad based approach to nature conservation’.

#### **4 OSPAR network design principles**

The identification of new MPAs in the UK is underpinned by common network design principles drawn from OSPAR guidance on developing ecologically coherent MPA networks (OSPAR, 2006). These network design principles are grouped into the following themes:

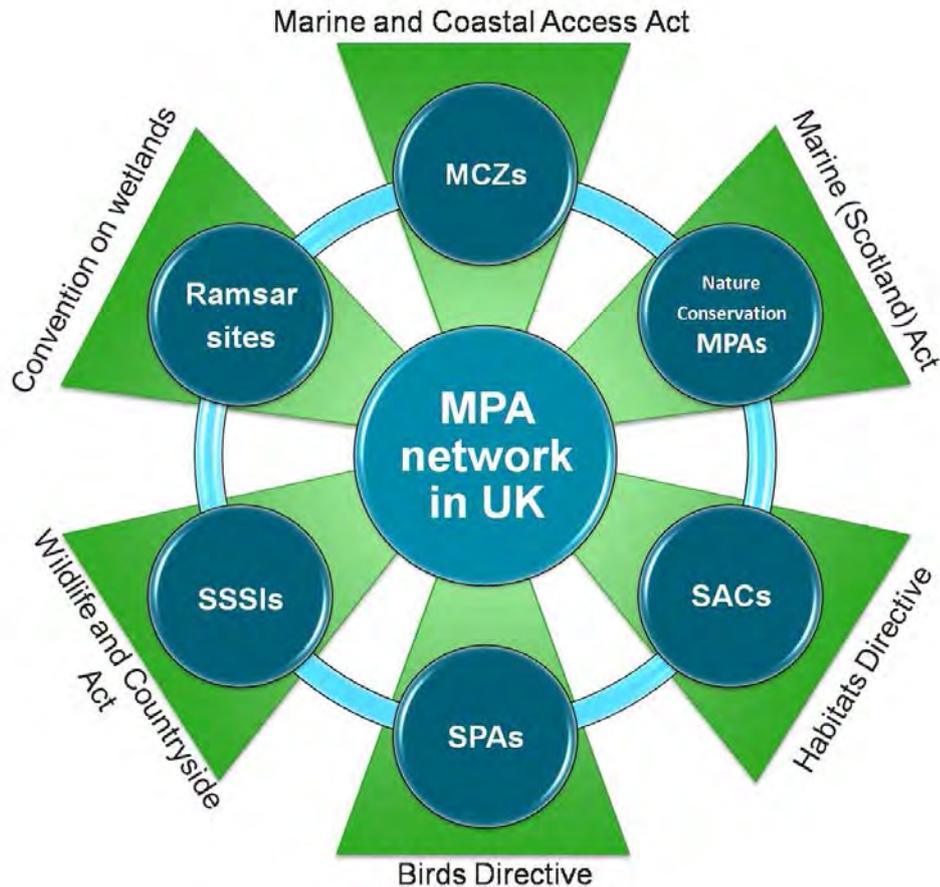
- Features- MPA networks should represent the range of marine habitats, species and ecological processes present in an area
- Representativity- The network should reflect biogeographic variation by representing the range of features in each biogeographic area
- Connectivity- The network should be well connected, for example by ensuring that the network is well distributed in space
- Resilience- Where possible, habitats, species and ecological processes should be replicated in separate MPAs in each biogeographic area, and each site should be large enough to maintain the integrity of the feature for which it is selected
- Management- sites within a network should be managed to ensure the protection of the features for which they were selected and to support the functioning of an ecologically coherent network

#### **5 Components of the UK MPA network**

There are a number of types of site under different legislation which will contribute to the network of MPAs in the UK (Figure 1). Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) with marine components are designated under European legislation: the EC Habitats and Birds Directive respectively. These sites protect species and habitats of European importance. Sites of Special Scientific Interest (SSSIs) designated under the Wildlife and Countryside Act 1981 and the Nature Conservation (Scotland) Act 2004, and Ramsar sites designated under the 1971 Convention of Wetlands of International Importance, protect marine features close to the coast.

New national MPAs can be designated under the UK Marine and Coastal Access Act (2009) and the Marine (Scotland) Act 2010 which are called Marine Conservation Zones (MCZs) and Nature Conservation MPAs respectively. New legislation is currently progressing through the Northern Ireland Assembly that contains provisions for the designation of Marine Conservation Zones in Northern Ireland’s territorial waters. These new national MPAs will be used to plug the gaps in the UK MPA

network by representing the full range of marine habitats and species, helping the UK to achieve its target for contributing towards an ecologically coherent network of MPAs.



**Figure 1:** Components of the UK MPA network.

## 6 Natura 2000 (SACs and SPAs)

SACs and SPAs are part of a European network of protected areas which are terrestrial as well as marine. The network of marine SACs for habitats and species in UK waters is almost complete, and work is ongoing to complete the network of marine SPAs (Figure 2). Since the lists of marine habitats and species of European importance for which SACs and SPAs are selected do not represent the full range of habitats and species in UK waters, this means that there are significant gaps in the existing network of MPAs.

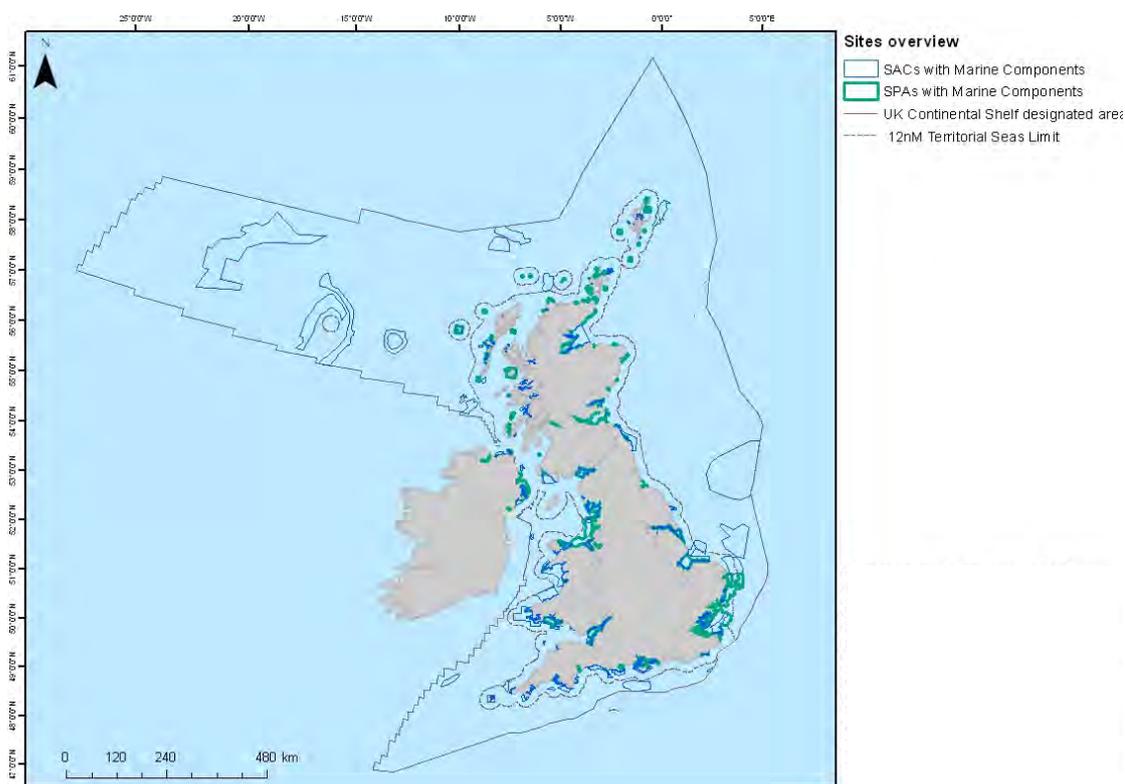


Figure 2: Marine Natura 2000 network in UK waters (October 2012).

## 7 UK MPA projects

The UK Administrations have established projects to identify new MPAs which will fill the gaps in the existing MPA network by representing the full range of marine habitats and species in the UK, and protecting rare and threatened habitats and species (e.g. features from the OSPAR List of Threatened and/or Declining Species and Habitats). JNCC has been working in partnership with Natural England on the identification of MPAs through the Marine Conservation Zone project in English territorial waters and UK offshore waters adjacent to England, Wales and Northern Ireland. JNCC is also involved in the Steering Group and Technical Advisory Group for the Marine Conservation Zone Project Wales covering Welsh territorial waters. JNCC also work in partnership with Marine Scotland and Scottish Natural Heritage on the Scottish MPA project to identify Nature Conservation MPAs in Scottish territorial waters and UK offshore waters adjacent to Scotland.

Together with existing MPAs, the new MPAs which are being identified by these projects in the UK will contribute towards the UK Administrations' policy aim of contributing towards an ecologically coherent network. It will also enable the UK to meet international commitments regarding the creation of coherent and representative networks of MPAs (including the OSPAR Convention, Convention on Biological Diversity and EC Marine Strategy Framework Directive).

The selection of new MPAs is supported by detailed sets of guidance:

- Marine Conservation Zone Project: Ecological Network Guidance (NATURAL ENGLAND AND JNCC, 2010)
- Marine Protected Areas in Scotland's Seas: Guidelines on the selection of MPAs and the development of the MPA network (MARINE SCOTLAND, SNH AND JNCC, 2011)
- Marine Conservation Zone Project- Wales: Site selection guidance for highly protected Marine Conservation Zones (WELSH ASSEMBLY GOVERNMENT, 2011)

Each of these sets of guidance uses the OSPAR MPA network design principles (OSPAR, 2006) set in their respective regional context, and outlines how additional MPAs should be identified to work with existing MPAs to create an ecologically coherent network.

## **8 Marine Conservation Zone Project**

Four regional projects were established to recommend MCZs to the Government. The regional projects worked with sea users and interest groups who identified and then recommended MCZs within their regions. The recommended MCZs contain broadscale habitats, habitats and species of conservation importance, and geological and geomorphological features of interest as specified in the Ecological Network Guidance (NATURAL ENGLAND AND JNCC, 2010). In September 2011, each regional project submitted their final recommendations, which were then reviewed by an independent Science Advisory Panel. JNCC and Natural England provided their formal advice on the recommendations to Government in July 2012 (JNCC AND NATURAL ENGLAND, 2012). Following the submission of this advice to Government, a public consultation on all recommended sites will start at the end of 2012, and the first MCZs should be designated in 2013.

## **9 Scottish MPA Project**

The Scottish MPA Project to identify MPAs in Scottish waters is led by Marine Scotland in partnership with Scottish Natural Heritage (SNH), JNCC and others. . JNCC and SNH are leading the work to identify potential areas for Nature Conservation MPAs using the Scottish MPA selection guidelines (MARINE SCOTLAND, SNH AND JNCC, 2011). Throughout this process there has been significant stakeholder engagement through workshops and other meetings. In November 2012, JNCC and SNH will advise Marine Scotland on a possible suite of Nature Conservation MPAs to make a contribution to an ecologically coherent network. Scottish Ministers expect to consult the public on a set of nature conservation MPAs in 2013.

## 10 Marine Conservation Zone Project Wales

Welsh territorial waters are covered by the Marine Conservation Zone Project Wales. Given that a significant proportion of Welsh inshore waters is already protected by some form of designation, Welsh Government, in collaboration with the Countryside Council for Wales, used the site selection guidance (WELSH ASSEMBLY GOVERNMENT, 2011) to identify a small number of potential sites for highly protected Marine Conservation Zones. The first consultation on potential site options for highly protected Marine Conservation Zones in Wales finished in July 2012. Welsh Government will decide on the next steps in autumn 2012.

## 11 Is the MPA network ecologically coherent?

Through the work that has already been carried out and ongoing work to identify new national MPAs, the UK is making significant progress towards the goal of contributing towards an ecologically coherent network of MPAs. A key current issue is how to determine for reporting purposes, whether the UK's MPAs are making an adequate contribution towards an ecologically coherent network. Consideration of this issue needs to be underpinned by biogeographic principles but must also respect the devolved responsibilities which correspond to administrative areas of UK waters. JNCC is currently providing advice to UK Administrations about how they could complete their assessment and appropriate methodology that could be used, in line with international best practise.

At the OSPAR level, various methodologies have been developed for assessing whether the network of MPAs is ecologically coherent. The OSPAR three initial spatial tests (OSPAR, 2008b) address whether the network is spatially well distributed, how well the network represents each of the biogeographic regions, and how well the species and habitats on the OSPAR threatened and/or declining list are represented. Currently, the full application of the three initial tests is limited by the availability of data on the distribution of habitats and species in the OSPAR area. It is important to recognise that these tests will not give a definitive answer to the question of whether the OSPAR MPA network is ecologically coherent. These tests are only a rough indicator for when an ecologically coherent network has not been achieved but do not indicate that it has been achieved. These tests will be used for reporting at the OSPAR level in 2012, but with a view to moving towards other more detailed methodology in future as the network progresses towards being ecologically coherent.

JNCC is working with Agence des aires marine protégées (French MPA agency) to trial a simplified version of the OSPAR matrix approach (OSPAR, 2008b) to assessing ecological coherence in the Channel area. The matrix approach would provide a more sophisticated assessment than the three initial tests, and would enable more specific

identification of potential gaps in the network. However this approach would still be limited by the level of ecological data available. The simplified version of the matrix allows understanding of five of the OSPAR elements of an ecologically coherent network (Features, Representativity, Replication, Resilience, and Connectivity), by cross-tabulating species and habitats against the number of MPAs in each biogeographic region (Figure 3). The range of features in an area that are protected in MPAs gives an indication of representativity; the presence of multiple sites for each feature gives an indication of replication and resilience; and if MPAs protect areas that are important for different life cycle stages of species (e.g. feeding and breeding areas) this indicates that the network has good connectivity.

The trial of the matrix approach is likely to focus on species and habitats listed on the OSPAR List of Threatened and/or Declining Species and Habitats, but will also consider the practicality of using modelled data from EUSeaMap<sup>1</sup> to assess which broadscale habitats are protected within MPAs in the Channel. The trial will include a consideration of how success criteria could be used to evaluate Adequacy/Viability in the future, and the limitations associated with such a step. The work will also aim to make some suggestions on suitable success criteria for wider consideration by OSPAR. A progress report including results from the trial will be completed in 2012 which will consider the feasibility of moving towards using the matrix approach for reporting at the scale of the whole OSPAR area in future.

Species and habitats	Number and type of sites	Total number of MPAs
Species x	4W	4
Species y	2F 1B	3
Species z	1W	1
Habitat x	4	4
Habitat y	1	1
Habitat z	2	2

**Figure 3:** Example of simplified matrix approach. In the 'Number and type of sites' column, the coding indicates the number of sites that contain wintering (W), important feeding (F) or breeding (B) areas.

<sup>1</sup> EUSeaMap webpage: <http://jncc.defra.gov.uk/page-5020>

## 12 Conclusion

The national MPA projects in the UK are making good progress towards identifying MPAs to represent the full range of marine species and habitats in the UK, working towards the policy aims of contributing towards an ecologically coherent network. The OSPAR three initial tests are a useful method of determining whether MPA networks are not ecologically coherent, however the main constraint to assessing whether MPA networks are ecologically coherent is the limited data which are available on the distribution of habitats and species. JNCC are contributing towards work to develop methodologies which should enable more detailed assessments as more data become available and scientific understanding develops.

## 13 References

HM Government, Northern Ireland Executive, Scottish Government and Welsh Assembly Government, (2011): UK Marine Policy Statement.

JNCC and Natural England (2012): 'JNCC and Natural England's advice on recommended Marine Conservation Zones'. <http://jncc.defra.gov.uk/page-6228>

Marine Scotland, Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC) (2011): Marine Protected Areas in Scotland's Seas. Guidelines on the selection of MPAs and development of the MPA network.

Natural England and the Joint Nature Conservation Committee (2010): The Marine Conservation Zone Project: Ecological Network Guidance. Sheffield and Peterborough, UK: Natural England and JNCC. [http://jncc.defra.gov.uk/pdf/100608\\_ENG\\_v10.pdf](http://jncc.defra.gov.uk/pdf/100608_ENG_v10.pdf)

OSPAR (2008a): Background Document on three initial spatial tests used for assessing the ecological coherence of the OSPAR MPA Network

OSPAR (2008b): A matrix approach to assessing the ecological coherence of the OSPAR MPA Network. OSPAR Convention for the Protection of the Marine Environment of the Northeast Atlantic, Meeting of the Working Group on Marine Protected Areas, Species and Habitats, 21-24 October 2008, Baiona, Spain. Meeting Document MASH 08/5/6-E,

OSPAR (2006): Guidance on developing an ecologically coherent network of OSPAR marine protected areas. (Reference number 2006-3).

Welsh Assembly Government, 2011. Marine Conservation Zone Project- Wales. Site selection guidance for Highly Protected Marine Conservation Zones.

<http://wales.gov.uk/docs/desh/publications/110321marinesiteselectionen.pdf>

<http://archive.defra.gov.uk/environment/marine/documents/interim2/marine-policy-statement.pdf>

[http://www.ospar.org/documents/DBASE/DECRECS/Agreements/06-03e\\_Guidance%20ecol%20coherence%20MPA%20network.doc](http://www.ospar.org/documents/DBASE/DECRECS/Agreements/06-03e_Guidance%20ecol%20coherence%20MPA%20network.doc)

[http://jncc.defra.gov.uk/pdf/0506\\_UK\\_OSPARMPAsEcoCoherenceAssessmt.pdf](http://jncc.defra.gov.uk/pdf/0506_UK_OSPARMPAsEcoCoherenceAssessmt.pdf)

[http://www.ospar.org/documents/dbase/publications/p00360\\_3\\_initial\\_tests OSPAR\\_MPA\\_network%20.pdf](http://www.ospar.org/documents/dbase/publications/p00360_3_initial_tests OSPAR_MPA_network%20.pdf)

<http://www.scotland.gov.uk/Resource/Doc/295194/0114024.pdf>

## **Management and Monitoring of Marine Protected Areas**

---



## **Towards the Management of MPAs in the German EEZ of the North- and Baltic Sea**

JOCHEN KRAUSE<sup>1</sup> AND DETLEF CZYBULKA<sup>2</sup>

<sup>1</sup>Federal Agency for Nature Conservation, Germany

<sup>2</sup>University of Rostock, Germany

### **Abstract**

Germany identified and nominated ten Natura 2000 sites across the German EEZ in the North Sea and the Baltic Sea to the European Commission on 25 May 2004. According to European legislation (Art. 4(4) Habitat Directive) Member States have to designate their Natura 2000 site as a special area of conservation as soon as possible and within six years at the latest and shall establish appropriate management plans (Art. 6(1) Habitats Directive) in due time. The German Natura 2000 sites in the EEZ were accepted by the European Commission in November 2007 and therefore Germany is looking forward to reach this obligation with the given six year time period. In Germany the Federal Agency for Nature Conservation together with the Federal Environmental Ministry are responsible for this task. They are supported in this process by legal advisers and marine ecologists of the University of Rostock and other marine research institutions as external subcontractors.

To develop effective ordinances and management plans for these sites a number of substantial questions have to be answered, such as:

- Which are the species (animals and plants) and habitats to be protected,
- What are the conservation objectives for the selected species and habitats as well as for the site itself
- What are the specific sensitivities of the species and habitats in the designated areas
- What are the appropriate measures to avoid deterioration of natural habitats and of habitats of species
- What are the contents of an appropriate assessment to estimate the effect on the conservation objectives by human activities, especially for plans or projects
- What are management measures within the national and the European jurisdictional framework and which have to be developed according to the law of the European Union, regional environmental law (Helsinki and OSPAR-Conventions) and to the United Nations Law of the Sea (UNCLOS).

Additionally, the Marine Strategy Framework directive (MSFD) from 2008 introduces as a new component the ecosystem approach as a guideline for measures to reach good environmental status of all of the European Seas. This strongly supports the development of a network of well managed MPAs. The MSFD requirements will be integrated in the here developed management plans. For offshore MPAs in Europe these questions are of general importance to all Member States and we will introduce in our talk first ideas and guidance we have developed so far.

# Wadden Sea World Heritage -- Recent Progress in Protecting and Managing the World's largest Tidal Barrier Island System<sup>1</sup>

JENS ENEMARK AND HARALD MARENCIC

Common Wadden Sea Secretariat, Germany

## 1 Wadden Sea – A Shared Tidal Area

The Wadden Sea is located along the southern North Sea coast of The Netherlands, Germany and Denmark from Den Helder in the west to Blåvandshuk in the north. The Wadden Sea Area, as delimited in the context of the Dutch-German-Danish Wadden Sea Cooperation, covers an area of almost 15,000 km<sup>2</sup> including the barrier islands and the offshore area which ecologically belongs to the Wadden Sea.

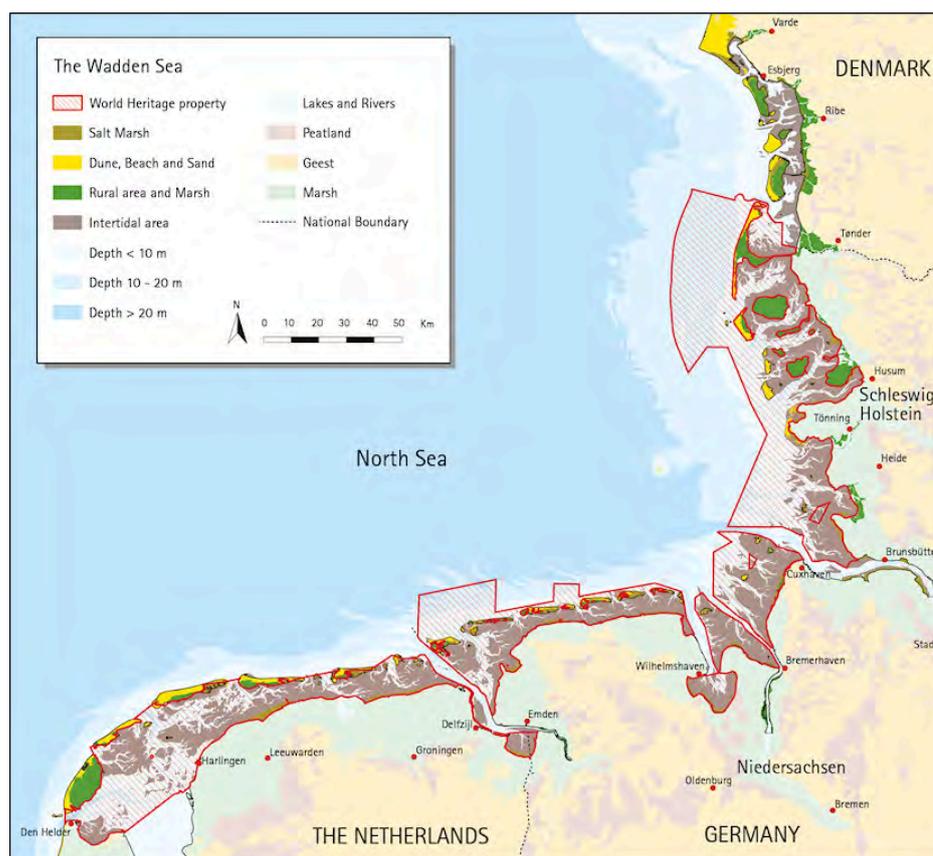


Figure 1: Map of the Wadden Sea Area and World Heritage.

<sup>1</sup> This article is an adaptation of the article „Weltnaturerbe Wattenmeer stärkt länderübergreifenden Naturschutz und nachhaltige Entwicklung“, written for the magazine „Natur und Landschaft“, Themenheft: „Naturschutz in Europa – neue Entwicklungen und Herausforderungen“

The Wadden Sea is the world's largest tidal barrier island system and a relatively young system. Sediment supply from the sea has sufficiently balanced a slow sea-level rise in the last 8,000 years to maintain a coastal configuration of a seaward sandy barrier, extensive tidal flats and episodically flooded marshes. The Wadden Sea is unique in that it consists of vast (4,700 km<sup>2</sup>) bare sand and mud flats, emerging twice daily at low tide. Oceanic waters dominate river influence, and dynamic sandy shoals and dune islands provide a partial shelter against waves and winds of a rough sea. In the course of a year, the Wadden Sea is visited by an unparalleled 10-12 million birds for foraging and resting on their East Atlantic flyway. Food provision in the form of tidal flat fauna is 10-20 times higher than in adjacent deeper waters. When the tide is in, the flats serve as a rich nursery for shrimp and fish.

The Wadden Sea constitutes a gigantic biological filter between land and sea. This filter is primarily composed of extensive beds of molluscan suspension feeders which filter the local tidal volume about twice a month, of sediment kept permeable by bioturbating lugworms, and of marsh vegetation which functions as a filter during episodic storm surges when waters are loaded with re-suspended fine particles. An impressive number of about 10,000 species of plants, fungi and animals thrive in the Wadden Sea. After a long phase of overexploitation, protection measures have triggered spectacular recoveries in breeding birds and seals.

Large-scale land claims have ceased and the Wadden Sea is today highly rated for its serene beauty.

## **2 Protection and Conservation**

Some 11,000 km<sup>2</sup> is subject to strict nature protection under the respective Nature Conservation Acts of the countries, comprising in Germany the Wadden Sea National Parks and in the Netherlands and Denmark the Wadden Sea Nature Reserves since the 1980s. Furthermore the large majority of the Wadden Sea Area has been designated as a Natura 2000 site under the Birds and the Habitats Directives, as well as parts of the relevant river basin districts under the Water Framework Directive, Wetlands of International Importance according to the Ramsar Convention, and as a Particularly Sensitive Sea Area (PSSA) by the International Maritime Organization (IMO). And finally, as the jewel in the crown, the Dutch-German Wadden Sea was inscribed on the exclusive World Heritage List in 2009. It is expected that the Danish part will follow soon.

Since 1978 the governments of the three Wadden Sea States have cooperated on the protection of the Wadden Sea. At the 1982 Ministerial meeting in Copenhagen the Joint Declaration of the Protection of the Wadden Sea was adopted as the formal basis of the Trilateral Wadden Sea Cooperation. The Joint Declaration is a

Memorandum of Intent in which the three governments declare their intention to cooperate to protect and conserve the Wadden Sea as an ecological entity and to use their legal instruments and other rules and regulations for a more effective coordinated protection of the area. 5 years later the Common Wadden Sea Secretariat was established to support and facilitate the Trilateral Cooperation. The secretariat is located in Wilhelmshaven, Germany and celebrates its 25<sup>th</sup> anniversary this year.

The initiative to protect the Wadden Sea and initiate the cooperation between the three countries was a response to significant threats to the Wadden Sea which had developed since the 1950s in conjunction with the appreciation of the global uniqueness of the Wadden Sea as an irreplaceable natural heritage. Main threats to the Wadden Sea were plans for large scale embankments for agricultural and industrial purposes, increased land based pollution and impacts from tourism and other uses. As a result of the initiative of scientists and nature conservation organizations and after a broad debate in the region it was decided to protect the Wadden Sea comprehensively based on an ecosystem approach. The Wadden Sea Conservation Area now constitutes one of the largest, if not the largest, coherent nature protection site in the European Union.

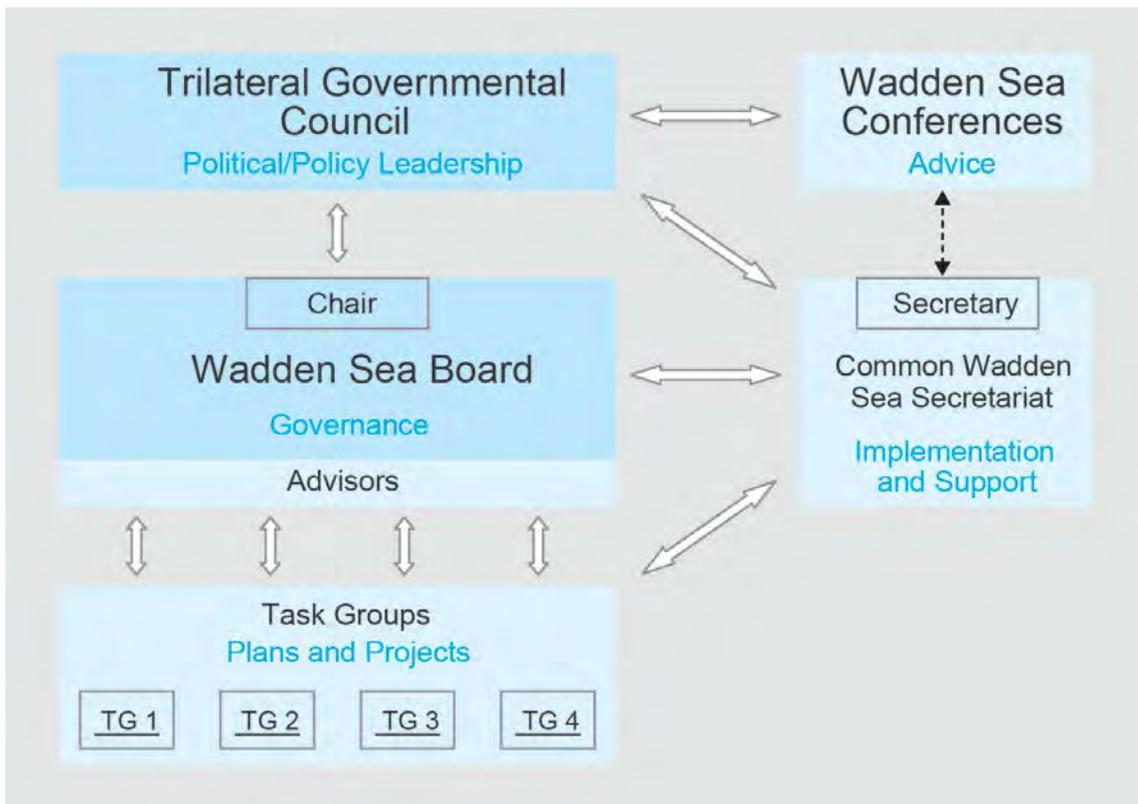
### **3 Wadden Sea Cooperation**

At the 2010 Wadden Sea Ministerial Conference the Joint Declaration was refreshed to integrate and codify the key policy and management decisions which had been adopted at consecutive ministerial conferences. As stipulated in the Joint Declaration, the guiding principle of the cooperation is “[t]o achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way”. Furthermore the Joint Declaration also defines the objectives of the Cooperation which are to achieve, a.o., a natural ecosystem with its functions and characteristic biodiversity, its adaptability to climate change and to other impacts, and to obtain public support for the protection of the Wadden Sea.

In conjunction with the adoption of the 2010 Joint Declaration the organizational structure of the cooperation was modernized and streamlined to make the governance of the Cooperation more effective. This resulted in the establishment of a Wadden Sea Board (WSB) to replace the previous meetings of Senior Officials and Policy officers from the three countries. The WSB consists of 12 members. 4 from each of the countries, 4 advisors representing e.g. the WWF Germany and the Dutch Wadden Society, and an independent chair, appointed by the country which has the presidency between the tri-annual ministerial meetings. The Board is the governing body of the Cooperation and prepares, adopts and implements the Strategy of the cooperation, oversees the operational and advisory bodies, and secures relations with key

stakeholders. Tasks groups are established by the Board to prepare and undertake specific tasks, plans or projects.

The meetings of the responsible ministers at the tri-annual conferences in the Ministerial Council remain the politically responsible body for the Cooperation. It establishes and oversees the Cooperation; gives political leadership, assures international policy development, harmonisation and decision-making between the three governments.



**Figure 2:** Organizational chart Wadden Sea Cooperation.

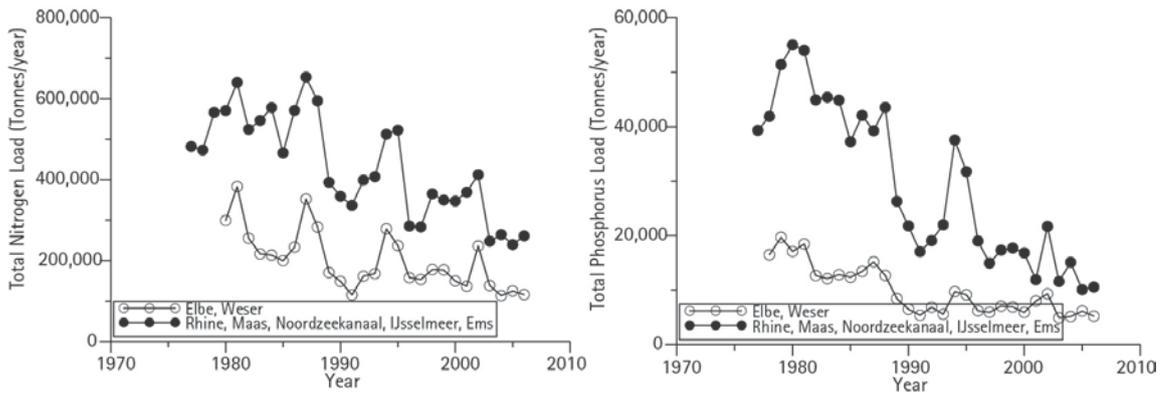
Key documents of the Cooperation are the Wadden Sea Plan (WSP) and the Trilateral Monitoring and Assessment Programme (TMAP). In conjunction with the adoption of Wadden Sea Area and the Conservation Area at the 1994 Wadden Sea Conference in Leeuwarden, it was agreed to protect and conserve all habitats that belong to a natural and dynamic Wadden Sea ecosystem. For each of those habitats, ecological targets were adopted together with targets for birds, landscape and culture, and water and sediment. These have been implemented in the context of a management plan, the WSP, which was adopted at the 1997 Stade Conference. The WSP was also updated and revised at the 2010 Wadden Sea Conference, in particular with regard to the relevant European directives and include now also targets for fish and policies and management related to realize those.

The aim of the TMAP is to scientifically assess the Wadden Sea in its entirety including an assessment of the implementation of the targets of the WSP. The TMAP conjunction with the common monitoring guidelines and the trilateral data handling system provides a firm scientific and technical basis for the Cooperation making it possible to monitor and assess data on a harmonized basis. The results are published regularly in Quality Status Reports (QSR) of which the latest one was issued in 2009, and in thematic reports such as reports on migratory and breeding birds.

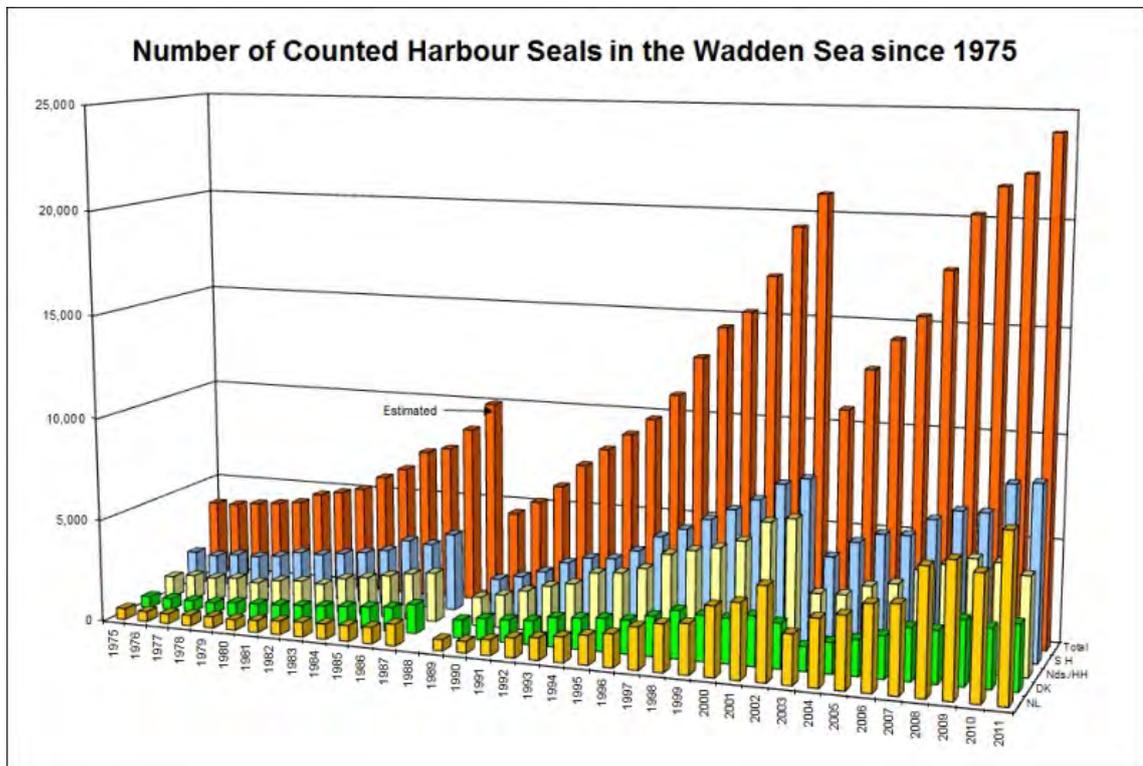
#### **4 Quality Status. Recent Progress**

The 2009 QSR encompasses 30 thematic reports covering all habitats in conjunction with the ecological targets including topical trend analyses. It provides an excellent overview of the progress which has been made and the future challenges in terms of protection and management.

There have been positive developments with regard to the reduction of pollution: increase in size of the area of natural salt marshes, extension of sea grass in certain areas, and an increase of harbour and grey seals. The migratory and breeding bird populations show different trends. As regards migratory birds: 14 bird species out of 34 of all counted, such as Oystercatchers, Avocets, and Kentish plovers, have reduced in quantity significantly, while 20 species such as Eurasian Spoonbill, Bar-tailed Godwit, Sanderling and Grey Plover showed an increase in their population. Particularly species that breed and winter in North, Central or Western Europe seem to be influenced by the conditions in North-West Europe, which has a negative impact on the trends. Some bird species, especially those that breed in the Arctic or in northern Europe, arrive at the Wadden Sea later in spring as 20 years ago, which can possibly be attributed to climate change. In last decades the distribution of birds in the Wadden Sea region seems to depend on environmental changes. For many species, that feed on mudflats, in the last 21 years the trend in Denmark and the Netherlands has remained stable, while the numbers in Schleswig-Holstein and Lower Saxony show a negative trend. Here the correlation between trend and sediment composition, which has changed in the last 20 years due to the climate change, has been established.



**Figure 3:** Major riverine Nitrogen and Phosphorous loads to the southern (Rhine, Meuse, Ems) and to the central and northern Wadden Sea (Weser, Elbe) (in: MARENIC & DE VLAS, 2009).

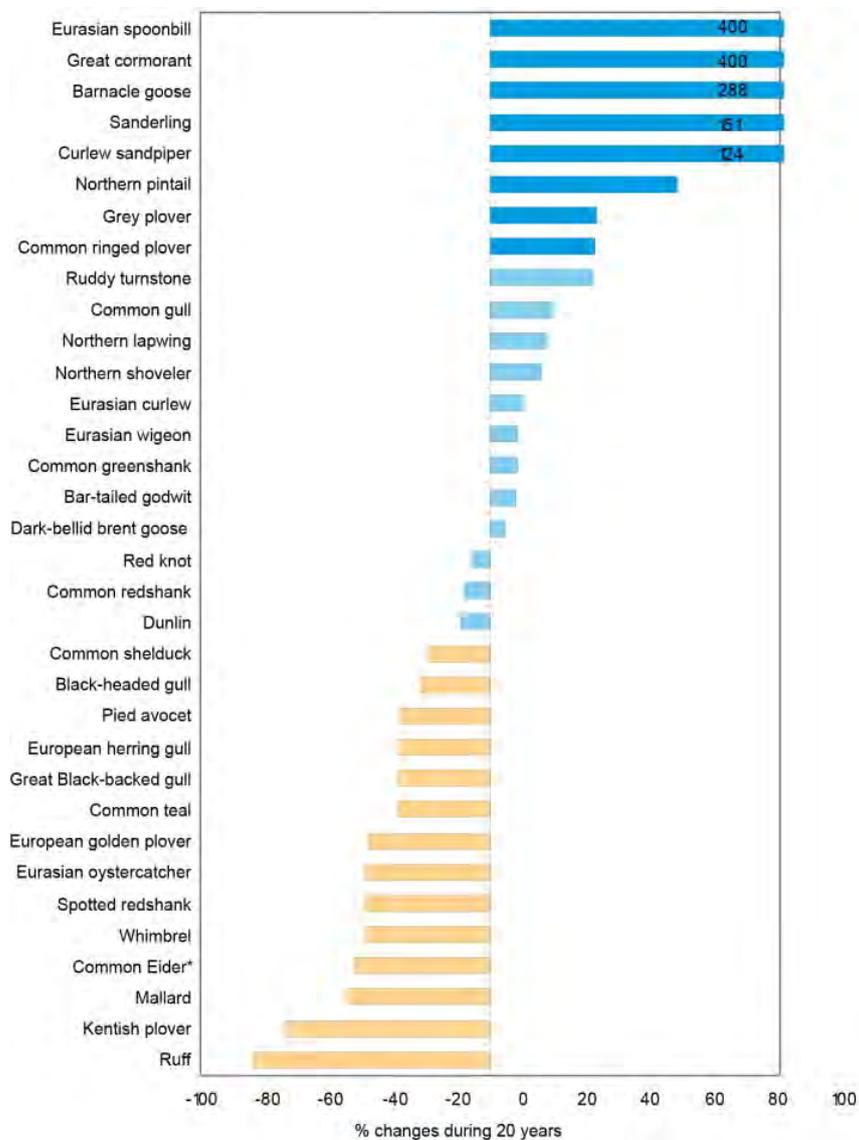


**Figure 4:** Number of counted harbour seals in the Wadden Sea since 1975 (NL: The Netherlands, DK: Denmark, Nds/HH: Niedersachsen/Hamburg, SH: Schleswig-Holstein, Total: entire Wadden Sea).

Issues of concern remain the decrease in natural blue mussel beds, the increase in marine neobiota and the lack of dynamic developments of terrestrial habitats such as dunes. Furthermore, the information on the sublittoral habitats and the exchange processes between the Wadden Sea and the adjacent offshore and the sediment is incomplete.

The QSR synthesis report outlines the most important protection and management challenges for the coming years, in particular:

- Elaboration of strategies for climate adaptation and enhanced sea level rise e.g. through the restoration of salt marshes
- Maintenance and restoration of natural dynamics in particular with regard to geomorphological processes, habitats and with regard to migratory species such as fish, marine mammals and birds
- Reduction of the external impacts such as the input of nutrients and pollutants, impacts from shipping and invasive species
- Enhancement of international cooperation also with sites connected to the Wadden Sea along the East Atlantic Flyway for migratory birds



**Figure 5:** Changes in numbers of 34 migratory waterbird species in the Wadden Sea during 20 years (1987/88 – 2996/07). Dark blue columns indicate species with significant increasing numbers, light blue indicate species with stable numbers and orange columns indicate species with significant decreasing numbers. \* Data for Common Eiders are from 1992/93 – 2006/07).

## 5 Wadden Sea World Heritage - Opportunities and Perspectives

As indicated above, the Dutch-German Wadden Sea Conservation Area was inscribed on the World Heritage List in 2009. It is expected that the Danish part will follow shortly. The inscription on the prestigious World Heritage List is a recognition of the outstanding universal value of the Wadden Sea and the progress which has been made in sustainably protecting and managing it for more than a generation.

In order to be inscribed on the World Heritage List a site must meet the requirements with regard to Outstanding Universal Value in terms of its natural values, integrity and protection and management. As outlined above it is the world's largest tidal barrier islands system with little riverine influence. It constitutes a gigantic biological filter between land and sea and food provision in the form of tidal flat fauna, which is 10-20 times higher than in adjacent deeper waters. 10 to 12 million migratory birds pass through the area on their journey from arctic areas to mainly West Africa and back again. It is an area which has largely maintained its natural state and where natural processes largely proceed in a natural way. Furthermore the Wadden Sea is as outlined above subject to a comprehensive protection and management scheme that aims to conserve the area for current and future generations.

On the inscription of a property on the World Heritage List, the World Heritage Committee adopts a Statement of Outstanding Universal Value which is the basis for the future protection and management of the property. The Statement of Outstanding Universal Value for the Wadden Sea in addition to listing the criteria under which it has been inscribed determines e.g. that ".....the continued priority for the protection and conservation of the Wadden Sea is an important feature of the planning and regulation of use..... Key threats requiring on-going attention include fisheries activities, harbours, industrial facilities and maritime traffic, residential and tourism development and climate change." Furthermore, the Statement stipulates that the ecosystem approach needs to be continued for an effective management of the property. In addition to this overall guidance the World Heritage requested Denmark to nominate its part of the Wadden Sea for the List, they requested the development of a sustainable tourism strategy, as well as a monitoring programme for alien species and finally asked for a flyway programme for migratory species relevant for the Wadden Sea.

The inscription of the Wadden Sea on the World Heritage List is a major success. It is a global recognition of the outstanding universal value of the Wadden Sea and the efforts of the governments, non-governmental organizations, scientists and the inhabitants of the area to protect its values and use its resources in a sustainable way. In the spirit of the World Heritage Convention, the Wadden Sea World Heritage is now protected and managed on behalf of the World community. The inscription does not introduce new rules and regulations but it underpins the common responsibility for protection and management of the property on a level that concerns governments,

organizations and inhabitants. In this sense the inscription reinforces conservation efforts on a national and international level and opens up for new perspectives in terms of regional sustainable development and collaboration opportunities.

As a result of the inscription on the List and in order to use its potentials a Wadden Sea World Heritage Communication and Marketing Programme for the period 2010-13 was adopted by the Wadden Sea Board. The programme sets out the following objectives:

- Safeguard the protection, management and awareness of the property
- Strengthen the common responsibility for the site and support regional sustainable development
- To promote, support and benefit from national and international cooperation and awareness on World Heritage

Based on the objectives the following four work priority themes have been identified:

- Nature Conservation/International Cooperation
- Information and Awareness
- Environmental Education and Cooperation Information Centres
- Tourism and Recreation

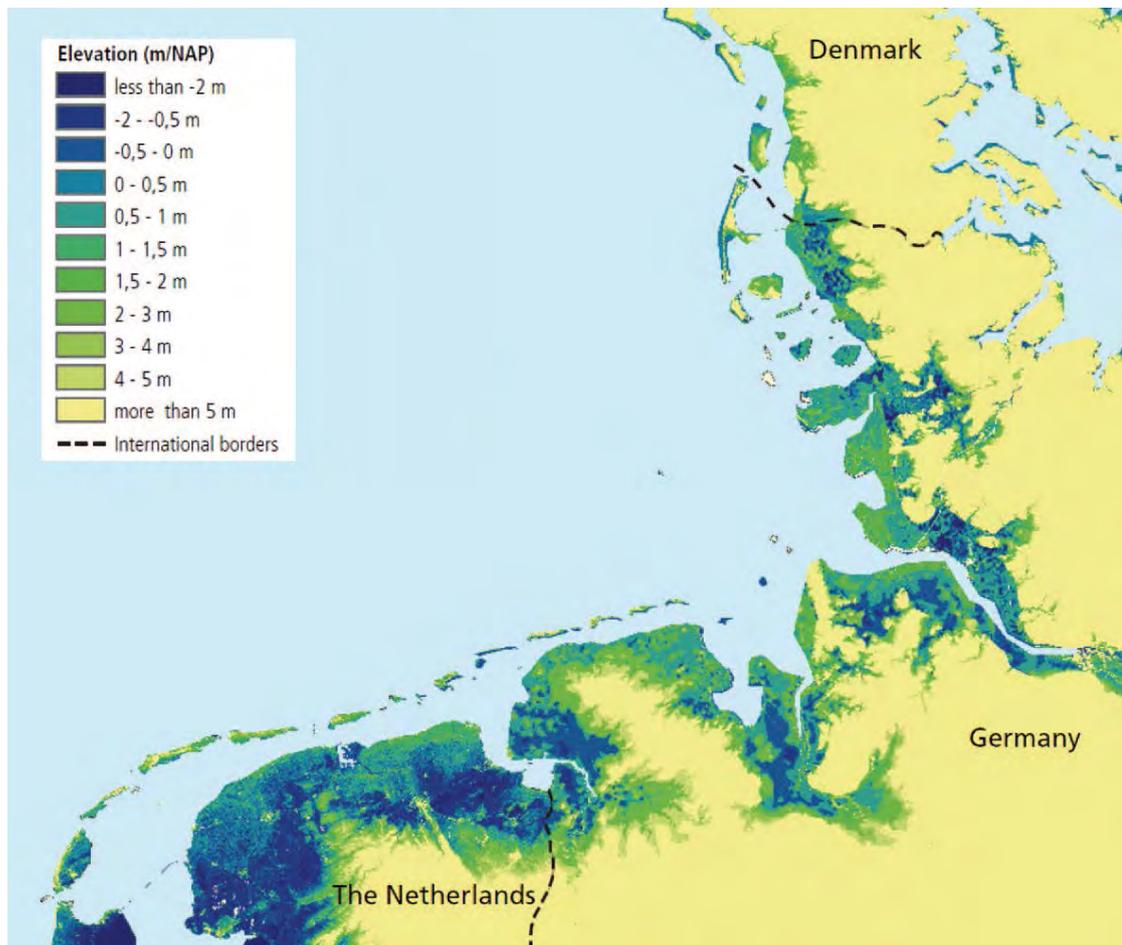
### **5.1 Nature Conservation and International Cooperation**

As indicated above the conservation task remains at the core of the efforts to protect and manage the Wadden Sea World Heritage. This must ensure that its values are maintained and, where necessary, enhanced in the future. It is basically a reinforcement of the national protection schemes and of the Trilateral Cooperation in terms of the Wadden Sea Plan, the TMAP and other central tasks.

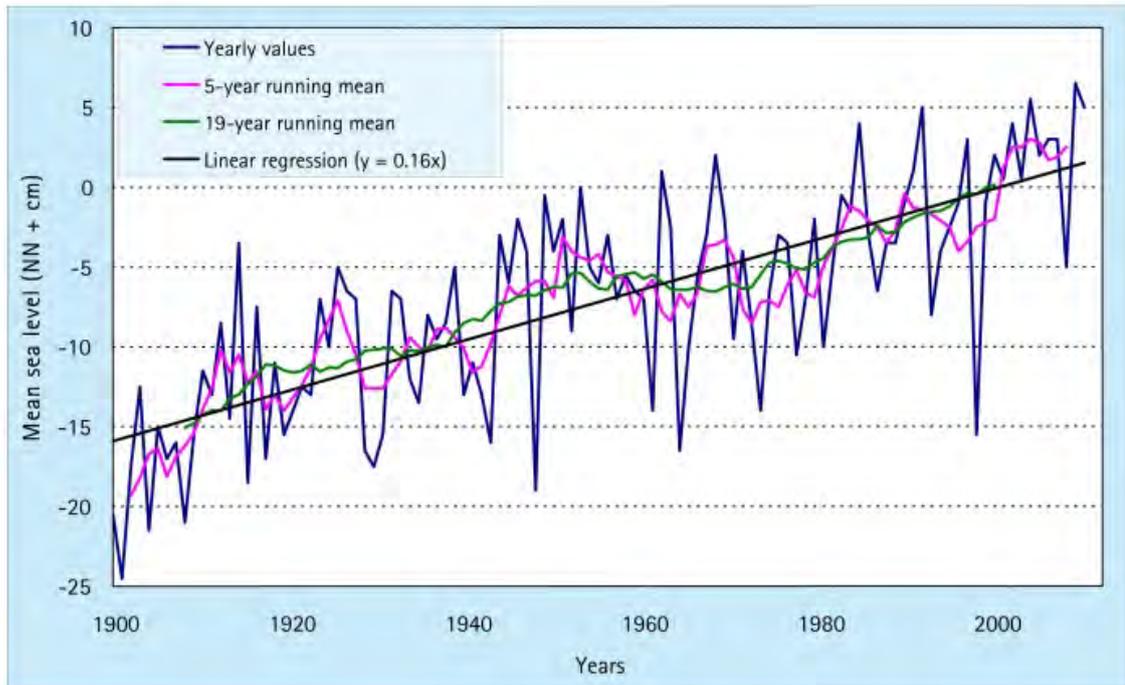
As indicated above, the World Heritage Committee in the context of the Statement of Outstanding Universal Value decided to request the State Parties “..... to implement a strict monitoring programme to control invasive species associated with ballast waters and aquaculture in the property“. In implementing the decision which was incorporated in the 2010 Ministerial Council Declaration (the Sylt Declaration) in the sense that an alien species strategy should be developed, an inventory was made with the aim to collect state of the art information on, in particular, ballast water, aqua culture, and biofouling related to introductions of alien species in the international Wadden Sea. An

observation of the report is that once an invasive alien species has been introduced into the Wadden Sea and exists with a self-sustaining population, the perspective for eradication and control measures is limited. In case new alien species are detected in a confined area, the area should be isolated and eradication undertaken. On the basis of the inventory a draft alien species strategy has been elaborated which will shortly be discussed between the partners with a view to an approval of the strategy.

A further issue of concern in this context is the impact of climate change. Enhanced water temperatures may further the invasion and settlement of non-native species such as the pacific oyster, but the Wadden Sea Region is a flooding risk area which will be subject to further risk with regard to an enhanced sea level rise. The normal sea level rise is about 20-25 cm per century with which the Wadden Sea is able to cope. The normal sea level rise is actually precondition for the survival of the Wadden Sea as a sediment transport system.



**Figure 6:** Wadden Sea region low-lying areas (CPSL, 2010).



**Figure 7:** Development of mean tidal half water level (= approximately Mean Sea Level) at Norderney (CPSL, 2010).

So far an accelerated sea level rise has not been observed but can be assumed following the assessment of the IPCC. The Coastal Protection and Sea Level Rise Expert Group (CPSL) earlier looked into various sea level rise scenarios and impacts on the Wadden Sea and costs for coastal protection. For the most realistic scenario (25 cm of sea-level rise in 50 years) changes in the Wadden Sea ecosystem (morphology and biology) are expected not to be substantial and costs for coastal defence might increase by 5 to 15%. For the “worst-case” scenario (50 cm of sea-level rise in 50 years), the capacity of the system to balance changes might become exhausted and the Wadden Sea tidal basins might start to evolve into tidal lagoons. These morphological changes will substantially influence the biology and the costs for coastal defence might double.

There are a number of strategies to respond to enhanced sea level rise such as reinforcing the sea dikes and creating additional flooding area. One of the most effective ones is to adapt to the sea level rise by creating e.g. wash-overs on the islands to increase the natural sedimentation on the islands. An additional positive effect is that this also helps to establish a higher biodiversity and a more resilient system. Other strategies include realignment of the coastal defence and sediment nourishment of the coast in particular on the islands to ensure that the system has sufficient sediment to “grow” with the enhanced sea level rise.

Another request from the World Heritage Committee was to strengthen the cooperation on management and research activities with States Parties on the African Eurasian Flyways. This was a recognition of the key role of the property for migratory birds migrating along, in particular, the East Atlantic Flyway and the responsibility of the states for protection and good cooperation with other states along the flyway. As a first step an extensive inventory was made of past and on-going activities in the field of management, monitoring and international cooperation including an overview of the relevant international conventions and agreements and current initiatives. At an international workshop in March 2011 with participation of renowned international experts, it was recommended to develop a clear vision with regard to the flyway management and the role of the Wadden Sea states in this context. It was further recommended to start projects with regard to monitoring bird species in West Africa and capacity building activities in close cooperation with the relevant international organizations such as Wetlands International and the African Eurasian Waterbird Agreement (AEWA) and organizations in West Africa.



**Figure 8:** The Wadden Sea is the turntable of bird migration of the African-Eurasian Flyway.

Two projects have been developed under what is now known as the Wadden Sea Flyway Initiative. The projects, which run from 2012 to 2014, are funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Dutch Ministry of Economic Affairs, Agriculture and Innovation. The aims of the Initiative are to support the conservation of migratory waterbirds in the

region, to obtain more detailed monitoring data and to develop a long-term perspective for the cooperation of the Wadden Sea with countries along the whole flyway.

The Initiative works in close collaboration with other migratory bird conservation projects and initiatives in West Africa, most notably AEWA and the Conservation of Migratory Birds (CMB) project of Birdlife International and Wetlands International. Both projects are coordinated via the CWSS. A steering committee with participation of experts from the governments and the international organizations provides advice on the implementation of the projects and reviews their results, and on the basis hereof also delivers an outline for the vision and the follow up, to be adopted at the next Wadden Sea Ministerial Council Meeting in February 2014.

The inscription on the List also includes an obligation to participate in the relevant activities of the Convention and to bring in experiences, information etc. that can support the world community in protecting its natural treasures. This is done in particular through the UNESCO marine programme in which the World Heritage marine sites participate. The cooperation with tidal areas in West Africa and Korea is intended to be further extended in this context.

A central issue of the Statement of Outstanding Universal Value is to maintain and enhance maritime safety, in particular offshore the Wadden Sea World Heritage, which constitutes one of the busiest shipping areas in the world with ships also serving the major ports of Hamburg and Bremerhaven. With the opening of the new Wilhelmshaven container harbour shortly it can be anticipated that the intensity will also increase in the context of the overall anticipated increase of maritime traffic.

The Wadden Sea was declared a Particularly Sensitive Sea Area (PSSA) by the IMO in 2002. A PSSA is an area that needs special protection through action by the IMO because of its significance for recognized ecological or socio-economic or scientific reasons, and which may be vulnerable to damage by international maritime activities. The PSSA aims to maintain and where necessary enhance maritime safety. As a result of an evaluation of the Wadden Sea PSSA in 2009 the Governments agreed to develop a vision on the Wadden Sea PSSA with regard to the future maritime safety and prevention of pollution stemming from shipping. The vision is currently under development by a trilateral task group and in cooperation with the stakeholders.

## **5.2 Broaden Stakeholder Involvement**

The World Heritage Committee, on the inscription of the Wadden Sea on the List, decided to request the states to develop a sustainable tourism strategy. The IUCN and the Committee were concerned that the designation would attract more tourists to the area which would negatively impact on the sites natural value.

Tourism is one of the most important economic activities in the Wadden Sea region generating income and work for thousands of inhabitants. Though it is unlikely that the World Heritage designation will attract substantially more tourists in the short and mid term, the World Heritage designation will undoubtedly enhance the tourist destination, and the tourism industry is therefore keen to use the designation in their marketing of the area. This is not in principle contrary to the interests of nature conservation but opens up new possibilities for strengthening the cooperation between the sectors.

A start has been made with the development of the required tourism strategy. The project PROWAD – “Protect and Prosper – Sustainable Tourism in the Wadden Sea” - has been granted co-financing under the EU North Sea Interreg IVB programme and includes as partners national, regional and local governments, and tourism and nature conservation organizations from the region. The central elements of the strategy are to further a quality tourism that supports and promotes the World Heritage values and creates and further extends partnerships between governments, the industry and relevant organizations, also across boundaries. Information on the project as it progresses can be found at [www.prowad.org](http://www.prowad.org). A closer cooperation has also already developed at the regional level, resulting in qualification initiatives of tourism entrepreneurs and making available additional information.

Already in 2010-11, a successful joint campaign was initiated with the partners to communicate the Wadden Sea World Heritage. The campaign “There is a place where heaven and earth share the same stage” invited inhabitants and visitors to tell their personal story about the Wadden Sea and thereby demonstrate their affection for the World Heritage. Almost 300 stories were collected in the whole region and they are oral heritage of the Wadden Sea. Furthermore, the International Wadden Sea School (IWSS) has developed educational material and offers for schools and young people to promote the awareness of the global importance of the area and to develop a joint responsibility among the young generation for its conservation.

Finally it should be mentioned that the information about the World Heritage has been intensified. The dense net of information centres plays a central role in disseminating the information. With the support of the project financing of the German government, information columns have been and will further be placed in the region to inform about the designation and thereby making the Wadden Sea World Heritage visible.



**Figure 9:** Outdoor and indoor columns placed along the coast which inform about protection and nature experiences of the Wadden Sea World Heritage.

## 6 Outlook

The protection of the Wadden Sea has continued to make progress in recent years as documented in the 2009 Quality Status Report and other assessment papers. A key aspect is the intimate relationship between the policy and management, as outlined in the Wadden Sea Plan, and the monitoring and assessment of the TMAP, which delivers a basis for analysing where policies and management are successful and where there are issues of concern which need to be addressed.

Progress continues with regard to reducing the pollution of the Wadden Sea and in the protection of most of the habitats such as salt marshes. The increase in the number of harbour seals has been spectacular and is the result of the establishment of a coherent net of seal reserves to reduce disturbance and reduction of the input of hazardous substance to the marine environment which has improved the health status of the population. The issues of concern and the future challenges are for the most part clear. It concerns climate change including the possible associated sea level rise, alien species, maritime safety and last but not least fisheries. New strategies are currently under development to address these challenges. The inscription of the Dutch–German Wadden Sea and within shortly also the Danish part on the prestigious

World Heritage List has accentuated this. The designation has reinforced nature conservation and international cooperation.

It has further put emphasis on the common responsibility of stakeholders and the inhabitants for the protection of the Wadden Sea. The recognition of the efforts made to conserve the area for more than a generation already, created pride and identification with the Wadden Sea. Undoubtedly, the Wadden Sea World Heritage has the potential to develop as a catalyst for sustainable regional development, making the region fit for the future. Pride and identification with marine conservation is as essential as for other conservation efforts. The Wadden Sea is in the unique position of having obtained the prestigious World Heritage brand and is in that sense in an exceptional position. The use of the brand to communicate and reinforce the values of the area is however something which can also be applied to other marine areas. Identification with the marine environment and pride of what has been done in terms of conservation is also an important dimension in conservation and management efforts.

## 7 References

CPSL (2010): CPSL Third Report. The role of spatial planning and sediment in coastal risk management. Wadden Sea Ecosystem No. 28. Common Wadden Sea Secretariat, Trilateral Working Group on Coastal Protection and Sea Level Rise (CPSL), Wilhelmshaven, Germany.

CWSS (2010): Sylt Declaration. Ministerial Declaration of the Eleventh Trilateral Governmental Conference on the Protection of the Wadden Sea, Westerland/Sylt 2010.

Laursen, K., Blew, J., Eskildsen, K., Günther, K., Hälterlein, B., Kleefstra, R., Lüerßen, G., Potel, P., Schrader, S. (2011): Migratory Waterbirds in the Wadden Sea 1987- 2008. Trend, Phenology, Distribution and Climate Aspects. Wadden Sea Ecosystem No. 30. Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Marencic, H. & de Vlas, J. (2009): Quality Status Report 2009. Wadden Sea Ecosystem 25. Trilateral Monitoring and Assessment Group, Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Reise, K., Baptist, M., Burbridge, P., Dankers, N., Fischer, L., Flemming, B., Oost, A.P., Smit, C. (2010): The Wadden Sea – A Universally Outstanding Tidal Wetland. Wadden Sea Ecosystem No. 29. Common Wadden Sea Secretariat, Wilhelmshaven, Germany, pp. 7-24.

Wolff, W. J., Bakker, J. P., Laursen, K., Reise, K. (2010): The Wadden Sea Quality Status Report - Synthesis Report 2010. Wadden Sea Ecosystem No. 29. Common Wadden Sea Secretariat, Wilhelmshaven, Germany, pp. 25-74.

WSP (1997): Erklärung von Stade. Trilateraler Wattenmeerplan. Ministererklärung der Achten Trilateralen Regierungskonferenz zum Schutz des Wattenmeeres, Stade 1997.

## **Management of Anthropogenic Impacts on Marine Ecosystems**

---



## **International Council for the Exploration of the Sea (ICES) and Marine Biodiversity**

ANNE CHRISTINE BRUSENDORFF

ICES General Secretary, Denmark

Through the development of the Ecosystem Approach concept (ICES, 2005) the work programme of the International Council for the Exploration of the Sea (ICES) is supporting marine biodiversity conservation at the international, regional, and sub-regional levels. At the international level ICES has been working with the European Union, other relevant intergovernmental organizations, and Member States to provide scientific support for the development and implementation of the EU Marine Strategy Framework Directive (MSFD; 2008/56/EC), the habitats directive (92/43/EEC) and the protection of vulnerable marine ecosystems in international waters. Existing ICES Services such as the Data Centre, Training Programme, communication, and scientific networks, including the provision of advice to competent authorities and international organizations, continue to address biodiversity issues and inform the marine policy process.

ICES is an intergovernmental organization whose main objective is to increase the scientific knowledge of the marine environment and its living resources, and to use this knowledge to provide advice to competent authorities. ICES Science and Advice considers both how human activities affect marine ecosystems and how ecosystems affect human activities. In this way, ICES ensures that best available science is accessible for decision-makers to make informed choices on the sustainable use and management of the marine environment.

To achieve its objectives of increasing the scientific knowledge of the marine environment, ICES prioritizes, organizes, delivers, and disseminates research needed to fill gaps in marine knowledge related to issues of ecological, political, societal, and economic importance at the pan-Atlantic and global levels.

The main ICES deliverables are scientific publications, scientific information and policy supporting advice requested by member countries and international organizations and commissions such as the Oslo Paris Commission (OSPAR), the Helsinki Commission - Baltic Marine Environment Protection Commission (HELCOM), the North East Atlantic Fisheries Commission (NEAFC), the North Atlantic Salmon Conservation Organization (NASCO), Northwest Atlantic Fisheries Organization (NAFO), and the European Commission (EC). Importantly, specific processes have been put in place to ensure that these products are unbiased, non-political in nature, and based on the best available science.

## **1 ICES – and fisheries**

ICES is known for delivering its annual fisheries advice to the European Commission and other competent authorities, forming the basis for annual decisions regarding fishing opportunities for nearly all commercial fisheries in the northeast Atlantic. The ICES approach to fisheries advice integrates international policy guidelines regarding the precautionary approach, the maximum sustainable yield, and the ecosystem approach into a single advisory framework. The aim is to inform policies for high long-term yields while maintaining productive fish stocks within healthy marine ecosystems.

The precautionary approach framework was adopted by ICES in 1997. Since 2010, the basis for ICES advice has been complemented by the maximum sustainable yield (MSY) concept. The current evolution of ICES advice includes a transition process to attain full implementation of the MSY approach by 2015. The ecosystem approach in the advice is being implemented in an incremental way as scientific knowledge becomes available. ICES continues to work proactively to develop the science basis for integrated assessments regarding Northeast Atlantic marine ecosystems and future frameworks for integrated advice. ICES provides advice on more than 200 fish stocks annually. For the main commercial fish stocks ICES has time-series of detailed population developments that stretch back many decades and for some more than half a century. These data are the back bone of ICES fish stocks assessments and scientific advice.

It is an important quality of scientific evidence to inform policy to ensure that there is transparency about the evidence available, and that the evidence available is fully used. Societal choice should be based on the best available evidence, even when such evidence is incomplete, with proper precautionary safeguards taken when facing incomplete knowledge. In 2012 ICES developed and implemented, for the first time, quantitative advice on so-called “data-limited” fish stocks, such as flounder, brill, and pollack. The process to define a method for providing this kind of advice began in 2011 and of the 84 data-limited stocks ICES considered in spring 2012, quantitative advice was produced for 68 of these stocks. This represents a six-fold increase in quantitative advice provided for data-limited stocks compared to 2010. This new approach supports the move towards sustainable fisheries.

## **2 ICES – and environment**

ICES advice on human interactions with marine ecosystems and fisheries interactions is only one part of the advisory system. Every year ICES provides advice to governments and intergovernmental commissions on a wide range of ecosystem issues to support environmental policy. There is a global commitment to reduce biodiversity loss at regional and national levels and the ICES community is well placed

to provide advice on many facets of this. The structure of the ICES Science Programme (with numerous expert groups e.g. on biodiversity; integrated assessments, and monitoring of ecosystem health) represents an important component of ICES work to support biodiversity policy. This broad research topic includes: continuing reception and collection of qualitative and quantitative data from a wide variety of sources to provide a more complete picture of long-term changes; working to develop knowledge on climate change processes and responses at individual and population levels; understanding the implications of changes in hydrography and climate; populations of marine organisms including assessments of exploited fish populations; and invasion of alien species on the diversity (and structure and function) of marine ecosystems; and assessing the role of species diversity in resilience and regime shifts. ICES science contributes to understanding functionality as well as other properties of biodiversity and ecosystem services, and how anthropogenic pressures affect such properties and identify what rates of impact are sustainable. The knowledge generated under the ICES Science and Advisory Programmes are transferred into objectives for decision makers who are able to contribute to marine biodiversity conservation. A recent pan-European challenge of this kind is the transfer of biodiversity knowledge into policy by providing the best possible support to client commissions and Member States in their implementation of the Marine Strategy Framework Directive.

ICES science priorities are described in the *ICES Science Plan*. The scientific knowledge generates advances in the state of the art and allows to initiate further studies and cooperation links with other scientific/technology development organizations from marine and maritime science fields. It also helps to support the ICES Advisory Programme respond to specific requests from competent authorities on the state of marine ecosystems including fish stocks. ICES advice is responsive and constantly evolving to accommodate the demands of important legal frameworks such as the global commitments outlined in the Johannesburg Plan of Implementation adopted by the World Summit on Sustainable Development, regional commitments such as the Regional Seas Conventions, the European Union's Common Fisheries Policy, MSFD, and relevant legislation at national level.

### **3 Examples of recent ICES advice in the area of biodiversity include:**

Advice provided to OSPAR regarding Ecological Quality Objective (EcoQO) generally and seabird populations in OSPAR regions, specifically. The EcoQOs are indicators developed by OSPAR towards application of the ecosystem approach to the management of human activities in the marine environment. ICES has been an important collaborator in the development of these tools by reviewing and making recommendations of the draft EcoQOs through its advisory system. ICES has also responded to requests from OSPAR to provide advice on the quality of the scientific

evidence to support the nomination of species to the OSPAR list of threatened or endangered species. Thereby ensuring a transparent and reliable listing process for North Atlantic species to the OSPAR list.

The three projects: Environmentally Sound Fisheries Management in Protected Areas (EMPAS), Fisheries Measures in Protected Areas (FIMPAS), and the forthcoming Managing Fisheries in Baltic Marine Protected Areas (BALTFIMPA). Beginning with EMPAS in 2006, ICES has worked to coordinate, facilitate, and peer-review various components of these projects which focus(ed) on analysing to what extent specific fishing activities significantly threaten attainment of the conservation objectives of NATURA 2000 sites, as well as suggesting what management measures would reduce these conflicts and assessing their effectiveness.

The 2006 United Nations General Assembly Resolution 61/105 called “upon States to take action immediately, individually and through regional fisheries management organizations and arrangements, and consistent with the precautionary approach and ecosystem approaches, to sustainably manage fish stocks and protect vulnerable marine ecosystems (VMEs), including seamounts, hydrothermal vents and cold water corals, from destructive fishing practices, recognizing the immense importance and value of deep-sea ecosystems and the biodiversity they contain”.

Since 2005 ICES has been providing NEAFC with advice on VMEs. In 2007, ICES received a standing request from NEAFC to provide all available information on the distribution of vulnerable habitats and fisheries activities in the vicinity of such habitats within the NEAFC Convention Area. Over time ICES has recommended the closure of several areas for fisheries impacts and updated the closure boundaries based on new data. This is facilitated by the continual updating of the ICES VME database and distribution maps for the North Atlantic. Both the source and quality of the data are evaluated in the advisory process.

#### **4 The Ecosystem Approach**

The international community has progressively agreed on the application of the ecosystem approach since 2000, under the Convention on Biological Diversity, and in 2002, in the World Summit on Sustainable Development. Other international fora and organisations have also promoted the ecosystem approach, such as FAO, UNEP, UNDP, and GEF. At the regional and subregional levels, a number of mechanisms provide for development and implementation of the ecosystem approach in a coordinated manner, including the Regional Seas Programmes, the Regional Fisheries and Management Organisations, and the Large Marine Ecosystem projects.

In order to improve and maintain the environmental conditions of marine waters in Europe, the EU adopted the MSFD in June 2008 (as the environmental pillar of the

integrated EU Maritime Policy). The main objective of the Directive is to achieve “Good Environmental Status in all European Marine Waters by 2020”. Article 3 of the Directive defines Good Environmental Status (GES) as “the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations”.

ICES is contributing to the scientific underpinning of these developments by initiatives regarding integrated surveys and monitoring, programmes of measures and review of methodologies to assess Good Environmental Status (GES):

## **5 Integrated Surveys and Monitoring**

ICES is supporting MSFD implementation both in short and longer term time perspectives. After Member States have presented and notified their initial assessments with environmental targets and associated indicators by the second half of 2012, monitoring programmes will also need to be established. Work is already ongoing to tailor existing monitoring programmes to the needs of the regulation in the Regional Seas Commissions, such as the MORE project in HELCOM (Revision of the HELCOM monitoring programmes (2012 - 2013)) and the OSPAR “KISS project” that aims to aid progress towards meeting the demands of eutrophication monitoring and assessment programmes by supporting regional cooperation through the development of tools and approaches that ensure best use of data streams, and identifying needs for improvement in observation capacity. Similar activities are being carried out by the Black and Mediterranean regional seas conventions (the Black Sea Commission and the Contracting Parties to the Mediterranean Action Plan and the Barcelona Convention).

Concurrently with the development of the MSFD the EU has, (since 2001) provided funding to national authorities to support the collection of both economic and biological data under the Data Collection Framework (DCF) Regulation (199/2008/EC). The current DCF will run until 2013, providing € 50 million a year to support national programmes. The majority of this money is spent on Fisheries Research Vessel Surveys. The next phase of the DCF will run from 2014 to 2020 and is currently being finalized by the European Commission, EU Parliament, and Member States. As this new framework is developed it is important to consider the opportunities available for achieving resource efficiencies, as well as ensuring that the data collected is fit for purpose. Research vessel surveys should be considered “platforms of opportunity”. Careful planning and coordination of these surveys could ensure that surveys are able to gather the data needed for both the MSFD and the DCF. The data collected would

then be able to inform the evaluation of biodiversity and fish community health, as well as feed into the assessment of good environmental status.

Such concerted data collection will not only ensure efficient use of precious and scarce resources, but will also support a closer integration of the scientific basis for environment and fisheries policies as foreseen in the Commission's proposal for a reform of the Common Fisheries Policy.

Some development of integrated surveys has already taken place and future extension of this approach can be based on existing experiences. ICES is currently coordinating fisheries surveys in the Northeast Atlantic and the Baltic Sea. Some of the ICES coordinated surveys already perform multipurpose sampling, a programme which has evolved over time. The result of this process is that the surveys are no longer specifically designed for a clearly defined fishery-related objective, but address a more complex portfolio of questions. Revisiting the surveys in relation to frequency, international coordination, and design (incl. parameters) would be a timely exercise in order to free capacity for sampling benefitting the ecosystem approach needs and thus also serving MSFD goals.

The importance of "integration between fisheries and environmental surveys" is a strategic issue to be addressed in the development and coordination of monitoring programmes under the MSFD, and a strategic monitoring initiative between ICES, interested Member States, and the Regional Seas Commissions is being considered. Such a strategic monitoring initiative would draw on existing ICES and regional seas commission's competencies as well as current work in publishing guidelines, technical standards, and coordination of fisheries/environmental surveys and methods.

ICES is currently developing a white paper that outlines the caveats and the benefits of integrating traditional fish stock surveys with environmental monitoring into ecosystem surveys, and outlines the current ICES niches such as technical standards, monitoring techniques, survey design, and training. The paper also provides a detailed description of the benefits to be obtained from an integrated approach. The benefits that can be realized by standardizing and automatization of procedures to analyse data are also included. Furthermore, the aim is to develop concrete proposals for integrated survey/monitoring demonstration projects, possibly with transnational elements. ICES is aware that the financing of integrated surveys may require contributions from the budgets supporting the various policies served by such integration. This question is beyond ICES competence and the white paper will thus provide a technical decision base for a move in this direction, should those responsible for the relevant budgets desire to do so.

## **6 Programmes of Measures**

ICES has the potential to assist Member States with the development of their programmes of measures – having in mind also that the fisheries management under the Common Fisheries Policy will impact on the potential of member states to achieve GES, and for this reason the need to ensure consistency between management measures, and established targets under the CFP and the MSFD.

The ICES community is strong in relation to modelling, which is not only related to fisheries assessments and management strategy evaluation (MSE), but also related to ecosystem modelling, integrated ecosystem assessments, risk assessments and development of risk based decision support tools. The ICES MSE tools can therefore be used to simulate management measures and to review proposed measures. ICES is also aiming to provide a modelling “toolbox” to member states, specific to the implementation of the MSFD, to help in relation to state-pressure-impact assessments and for evaluation of management measures, related indicators, and associated risks.

## **7 Review of Methodologies to Assess GES**

ICES also has the potential to contribute to the review of methodologies used for assessing GES – understood in a broad sense as methodological standards for sampling, analysis, monitoring and assessment as well as indicators and criteria.

Coordinated data collection would not only provide resource efficiencies, but would also ensure a consistent approach to the DCF that requires member states to evaluate the effects of fishing on the ecosystems with a number of specified indicators – and the MSFD that compels the same member states to define similar descriptors needed to measure progress towards achieving or maintaining good environmental status.

In addition, this would be a very tangible and real input to advance European uptake of the ecosystem approach by incorporating environmental considerations into the activities carried out under the revised Common Fisheries Policy.

Currently, the Common Fisheries Policy lacks clear policy objectives regarding how to deal with impacts of fishing on the wider fish community and benthic habitats. As a consequence there are also no agreed targets or limits in relation to the Data Collection Framework indicators. If these specific targets are to be developed under the MSFD, then there will also need to be instruments developed to translate these back into management measures under the CFP.

Close regional coordination is required among member states to develop and harmonize regional targets, indicators, and management measures that help member states achieve GES for fisheries related descriptors and to ensure that the impact of

fishing activities on the marine ecosystem are mitigated. This regional approach should not only cover the requirements of managing the impact of fishing under the MSFD, but also under the "Birds Directive" (2009/147/EC), the "Habitats Directive" (92/43/EEC), and other international agreements.

Considering that the upcoming Article 12 assessment reports provide Member States an opportunity to overcome difficulties and ensure coherence towards implementation, and the Commission Decision (2010/447/EU) on "Criteria and methodological standards" to be used by the Member States there is a possibility that the Decision may need to be revised. Also having in mind that the aim of the Decision is to ensure consistency and to allow for comparison between marine regions or sub regions on the extent to which GES is being achieved.

## **8 Conclusion**

ICES is in the process of creating the science and advisory frameworks necessary to further support the application of the ecosystem approach by evidence – and thereby enhance the protection of biodiversity and marine conservation and in doing so specifically contribute to the implementation of the Marine Strategy Framework Directive; working together with relevant organizations and Member States. Existing ICES Services (Data Centre, Training Programme, communication and expert networks), including experience providing advice to competent authorities and international organizations, are already dealing with biodiversity related issues and informing the MSFD implementation process - and may be expanded to meet further specific MSFD requests.

ICES hosts substantial international long-term dataseries on marine living resources and the marine environment required for defining targets and setting thresholds for MSFD indicators. ICES is also in a position to synthesize approaches that integrate across indicators and aims to make outputs and recommendations increasingly tailored to the objectives and requirements of the Directive.

Moreover, ICES has established and sponsors a training programme for marine scientists. Course topics range from traditional fisheries assessments, via specific statistical tools for marine ecology, to integrated ecosystem assessments and integrated survey methods. In addition, ICES offers training for marine and fisheries decision makers and policy advisers on how to make best use of scientific advice in policy planning and decision-making. More specific MSFD courses are also under preparation.

The time seems ripe to achieve an integration between environmental and fisheries issues, and thus in a very tangible way achieve an ecosystem approach. ICES will continue to work together with Member States, marine intergovernmental

organizations (such as HELCOM and OSPAR, the BSC, and MED Action plan), industry, academia, and other stakeholders to achieve ecosystem-based management that enables effective conservation and protection of marine biodiversity.

## 9 References

Auster, P. J., Gjerde, K., Heupel, E., Watling, L., Grehan, A. & Rogers, A.D. (2011): Definition and detection of vulnerable marine ecosystems on the high seas: problems with the “move-on” rule. – *ICES Journal of Marine Science*, 68: 254–264.

ICES (2005): Guidance on the Application of the Ecosystem Approach to Management of Human Activities in the European Marine Environment. ICES Cooperative Research Report no. 273

ICES (2009): ICES Science Plan, 2009–2013. 15 pp

ICES (2011): Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Books 1 - 11. 1685 pp

ICES (2012): Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 1.



# Minimizing Underwater Noise from Offshore Wind Farm Construction

KARIN LÜDEMANN<sup>1</sup> AND SVEN KOSCHINSKI<sup>2</sup>

<sup>1</sup>Wissenschaftsbüro Hamburg, Germany

<sup>2</sup>Meereszoologie, Germany

## 1 Summary

The German noise exposure criteria of 160 dB (SEL) and 190 dB (peak-to-peak) at 750 m for impact pile driving which is valid in the German exclusive economic zone (EEZ) can only be met by applying noise mitigation measures. A broadband noise mitigation of up to some 20 dB (SEL), depending on pile diameter, hammer and ground properties, is needed. Noise reduction can be achieved by technical mitigation measures (bubble curtains, pile sleeves, cofferdams, hydro sound dampers). Alternative foundation concepts work either with less noisy techniques to deploy the piles (vibratory pile driving, bucket foundations, foundation drilling), or anchoring without piles (gravity based foundations, floating wind turbines). Avoidance of noise emissions is preferable to the mitigation of construction noise.

## 2 Introduction

The German government has decided on the construction of offshore wind farms in the North Sea and Baltic Sea with a capacity of up to 25.000 MW until 2030 (BMU, 2002). The foundations most commonly used for wind turbines are monopiles, jackets and tripods or tripiles. For the installation, large steel piles have to be driven in the ground, mostly by impact pile driving. This technique is of special concern for the marine environment as it generates very high broad-band noise levels with source levels of up to 200 dB (SEL) and 243 dB (peak) (ITAP, 2008). Major energy falls in the low frequency range below 500 Hz (ELMER et al., 2007a,b).

Underwater noise may negatively impact marine mammals, fish and other organisms. The possible effects include immediate or delayed death for fish swimming very close to the sound source, and for all organisms severe injury, temporary or permanent threshold shifts (TTS/PTS), masking of biological relevant signals, disturbance (behavioural avoidance reactions) and physiological responses (stress) (MADSEN et al., 2006, POPPER & HASTINGS, 2009).

In Germany, dual noise exposure criteria have been defined for the process of approving for offshore wind farms in order to avoid injury of harbour porpoises (TTS). During pile driving sound immissions must not exceed 160 dB (SEL) or 190 dB (peak-

to-peak) at a distance of 750 m from the source (UMWELTBUNDESAMT, 2011; BSH, 2012).

During the installation of the offshore wind farm (OWF) “alpha ventus”, noise levels of up to 174 dB (SEL) were measured at 750 m distance from the pile. Deep foundations required up to 8.700 impulses for each of the rather small piles (2,6 m) (ITAP, 2010). Sound immissions of pile driving increase with pile diameter (ITAP, 2008) and thus large monopiles are a special challenge with respect to noise mitigation.

Noise exposure criteria can be met either by mitigation of pile driving noise, or by the application of alternative foundation concepts which produce less noise. A variety of concepts exist. This paper focuses on sound mitigation techniques suitable for offshore conditions in the North Sea and Baltic Sea.

### **3 Mitigation of Pile Driving Noise**

#### **3.1 Technical Measures**

Technical mitigation measures use the physical principles of reflection, absorption, scattering and dissipation. Different applications have become available recently.

##### **3.1.1 Bubble Curtains**

A bubble curtain consists of a ring of perforated pipes encircling the pile. Gas bubbles produced by compressed air form a curtain around the pile. The pipe can be either positioned as a large ring at the sea floor (“Big Bubble Curtain”, BBC), or in various arrangements of vertical pipes arranged close to the pile (“Layered Bubble Curtain”, LBC, or “Small Bubble Curtain”, SBC). The curtain may also be confined by casings. However, experiences with “Confined Bubble Curtains”, though demonstrating a high mitigation potential, currently only exist for bridge construction works in shallow waters close to the shore (CALTRANS, 2003).

Bubble curtains have been applied as an effective noise mitigation technique in several experimental and practical setups (WÜRSING et al., 2000; CALTRANS, 2003; VAGLE, 2003; PETRIE, 2005; GRIEBMANN et al., 2009; ITAP, 2010). Under offshore conditions in the German North Sea, the effectiveness of the BBC has been proven during the construction of the research platform “FINO 3” (GRIEBMANN et al., 2009) and at the OWF “Borkum West II” (BIOCONSULT-SH et al., 2012; BELLMANN, 2012). The LBC has been tested at the first German OFW “alpha ventus” (GRIEBMANN et al., 2010; ITAP, 2010) and at “BARD OFT1” (KUMBARTZKY, 2012; VERFUSS, 2012). The noise mitigation potential for both concepts has been demonstrated to be in the order of 12 dB (SEL) and 14 dB (Peak) (Table 1).

However, problems encountered during experimental use have to be solved in order to enable the large scale economical use of bubble curtains. E.g. the LBC applied at “alpha ventus” used only a pre-installed lower part of the tube-system. An additional mobile upper system could not be installed due to bad weather (ITAP, 2010). Thus, the tidal current drifted the bubbles away, resulting in sound leakages that greatly reduced the effectiveness. An improved concept of flexible attachment of perforated vertical pipes to the piling frame was tested at “BARD OFT 1” and resulted in sound mitigation of up to 14 dB (SEL) (Table1) (KUMBARTZKY, 2012).

During the installation of the commercial OFT “Borkum West II” a BBC was successfully employed at 31 out of 40 turbines (MENTRUP, 2012). Moreover, experiments were performed with a double bubble curtain. Preliminary results revealed noise mitigation levels of up to 18 dB (SEL) and 16 dB (peak) when the distance between both pipe half-rings was large enough to form two separate curtains (BELLMANN, 2012). Bubble curtains are currently offered by the German companies Hydrotechnik Lübeck and Bernhard Weyres Offshore. Their application is planned in several OWFs.

### 3.1.2 Pile Sleeves

A simple pile sleeve consist of a steel pipe around the pile reflecting a part of the noise back inside. More complex systems use additional layers containing air (foam, composites) making use of the difference of impedance between water and thus absorption, scattering and dissipation effects (ELMER et al., 2007a; NEHLS et al., 2007).

The **Noise Mitigation System** (NMS) developed by IHC Merwede consists of a double-wall pile sleeve with an air filled inner compartment. A bubble curtain between the NMS and the pile provides an additional noise barrier. A special guiding system keeps the pile and the NMS concentric. In an experimental set-up in shallow water, a damping rate of 20-27 dB in 1/3 octave bands between 150 Hz and 8 kHz was achieved (no broadband mitigation given) (Bob Jung, IHC Hydrohammer BV, pers. comm.). The NMS 6900 will be deployed at the OWF “Riffgat” in summer 2012 (IHC MERWEDE, 2012).

The **BEKA-Shells** (Bernhard Weyres Offshore) are a combined system based on the principle of a pile sleeve. Two acoustically uncoupled double layered half-shells of steel, filled with a sound absorbing composite material are separated by 10 cm. From the inside, the inner shell is coated with a noise absorbing material. Two bubble curtains are produced between sleeves and between inner sleeve and pile. An additional shield pressed into the ground is supposed to mitigate the sound propagation via the seismic pathway. Due to the combination of several principles the design is very promising. Sound measurements from a representative site are not available yet.

Although technically feasible, the concept of a **Casing of Fire Hoses** with several layers of hoses fixed to frames has not resulted in the development of a commercial application.

### 3.1.3 Cofferdams

Cofferdams are comparable to pile sleeves, but in contrast to them the space between pile and surrounding cofferdam is completely dewatered. Hence pile driving takes place in air and not in water thus uncoupling the propagation of sound from the surrounding water. Modeling results predicted a noise reduction of about 20 dB for a dewatered cofferdam which was considered to be the most effective mitigation technique of underwater pile driving noise (Applied Physical Sciences 2010). In shallow water, sheet pile walls are often used as cofferdams (CALTRANS, 2009), but this is not feasible in deeper water where steel piles are used.

A pilot test with a **Dewatered Cofferdam** was performed in Aarhus Bight in December 2011 by Siemens and TenneT with acoustic measurements performed by Rambøll (Kurt Thomsen, Lo-Noise Aps, pers. comm.). Impact pile driving was performed in water depth of about 14 m on a pile of 2,13 m diameter. A comparison of noise immissions with and without cofferdam revealed an average broadband mitigation of 22 dB (SEL) and 18 dB (peak). Best results were achieved for frequencies above 500 Hz. The system is also applicable for jacket foundations. Cofferdams will be deployed for pile driving at the converter platforms BorWin2 in 2012 and HelWin in 2013.

A particular case of a cofferdam is the principle of **Pile-in-Pipe Piling** which is currently developed by the Hamburg-based company Overdick GmbH & Co KG (E. Overdick, pers. comm.). In this case, four cofferdams are permanently fixed to the legs of the four-legged jacket (“quadjack”). The cofferdams are not reusable as they remain with the foundation and serve as a protective pipe. The piles reach beyond sea level, hence piling occurs only above sea level and the cofferdam acts as a noise barrier over the whole water depth.

### 3.1.4 Hydro Sound Damper

An innovative noise reducing method is a system of hydro sound dampers (HSD), small gas filled elastic balloons and robust PE-foam elements fixed to nets or frames placed around the pile as developed by the German company OffNoise Solutions. The underlying principle is identical to that of a bubble curtain with the exception that the frequencies at which the maximum damping efficiency is achieved are adjustable by variations in the balloon size. By this, the system allows for the damping of specific frequencies, e.g. in relation to the affected species susceptibilities. In laboratory experiments a broadband reduction of 20-22 dB (SEL) and 19 dB (peak) was achieved

(ELMER, 2010). In summer 2012, the HSD will be tested at the OFT “London Array” (K.H. Elmer, OffNoise Solutions, pers. comm.).

## **3.2 Alternative Foundation Concepts**

### **3.2.1 Vibratory Pile Driving**

Steel piles may be driven into the ground by vibratory pile driving. Rotating weights of the pile driver induce a vibrating movement that makes the pile penetrate into the ground. In a direct comparison, sound levels during vibratory pile driving were about 15-20 dB lower than with impact pile driving (ELMER et al., 2007a; ITAP, 2010). At the OFW “alpha ventus” a high frequency tonal component went with the regular operational noise (ITAP, 2010).

Currently vibratory pile driving is only applied in combination with impact pile driving as it is assumed that the final stability under load can only be achieved by impact pile driving. However, even if only a part of the penetration was achieved by vibratory pile driving, the number of impact strikes would be reduced which in terms would reduce the impact zones for marine organisms. This is based on the fact that the harmful effect of impulsive sound increases with the number of impulses as the sound energy accumulates in the ear of the organisms (CARLSON et al., 2007; SOUTHALL et al., 2007).

### **3.2.2 Gravity Base Foundations**

Concrete gravity base foundations are large box girders whose stability is achieved by the self-weight of the structure, supplemented by additional ballast. Foundations are shipped to the offshore location where they are settled out. Ground preparation works are required to ensure the upright positioning of the structure. In case the foundation is designed such that it reaches out beyond sea level it possibly reduces the operational noise of the turbine as the steel mast is decoupled from the surrounding water (ELMER et al., 2007a).

Gravity base foundations are already installed in several OWFs in water depths of up to 20 m, e.g. “Nysted” and “Middelgrunden” in Denmark, “Lillgrund” in Sweden and “Thornton Bank” in Belgium. For greater water depths there is virtually no experience. Furthermore the cost factor has to be considered as for concrete gravity base foundation the costs rise with increasing water depth (RAGHEB, 2010). The application of gravity base foundations is planned for about 10 locations in the test-field “Albatros” in a depth of about 40 m.

### 3.2.3 Bucket Foundations

A bucket foundation is a large downward opening steel caisson (“turned bucket”). The bucket is lowered onto the seabed and penetration into the ground is achieved by suction pressure that exhausts the water from the inside of the caisson. The founding process is reversible by pumping water back into the bucket. The overall stability of the foundation is ensured by a combination of sediment pressure on the skirt and the vertical bearing capacity of the bucket (IBSEN & NIELSEN, 2007). Hence water depth is an important factor for the dimension of a bucket foundation.

Bucket foundations are widely-used for a variety of oil- and gas-platforms. One application is the Mobile Application Platform (MOAB) with multiple buckets. The MOAB is hauled swimming to its offshore location or transported there on a super-barge (OVERDICK, 2012a). This system is planned for the converter platform at the OWF “Global Tech 1” (OVERDICK, 2012b).

A prototype of a bucket foundation for a wind turbine Vestas V90 was installed on a land reclamation area at Frederikshavn (Denmark) in 2002 (IBSEN et al., 2005). The welded steel structure of the single bucket (diameter 12 m, height 6 m, total weight 135 t) consists of a tubular centre column connected to a steel bucket through flange-reinforced stiffeners (IBSEN et al., 2005). The installation of a 5 MW turbine at Wilhelmshaven, Germany, using a bucket foundation, failed however. The installation barge collided with the bucket and initiated buckling of the structure (IBSEN & NIELSEN, 2007; LEBLANC BAKMAR, 2009).

### 3.2.4 Foundation Drilling

Foundation drilling is a common technology for hard substrates like bedrock or layers of mudstone or limestone. Currently drilling is developed as a foundation engineering for a wider range of sediments. The concepts differ e.g. in their drilling concepts. The Dutch company Ballast Nedam uses a full face excavator machine where the diameter of the drill hole for a concrete monopile is determined by the size of the drilling head (VAN DE BRUG, 2009). In contrast the German partnership between Herrenkecht and Hochtief Solutions uses a partial face excavator machine for offshore foundation drilling (OFD). A hydraulic controlled beam with rotary grinder rotates horizontally both inside and under the pile in both directions by 190°, thus creating a circular drilling hole with a variable diameter of 4,5-10 m. The excavated material is pumped out of the pile and the solid material is separated in order to be filled back into the monopile after the drilling procedure is finished (AHRENS & WIEGAND, 2009; HERRENKNECHT AG, 2009).

Acoustic measurements have been conducted for the OFD-technique in a water-filled underground shaft in Naples. The operational noise of a vertical shaft machine (VSM) with a diameter of about 5 m emitted sound with a broadband source level of about

161 dB re 1  $\mu$ Pa. Maximum energy was emitted in the low-frequency range below 200 Hz. Converted to a distance of 750 m the sound emissions of the VSM correspond to a broadband value of 117 dB re 1  $\mu$ Pa which is more than 40 dB below the allowed threshold value (AHRENS & WIEGAND, 2009; HERRENKNECHT AG, 2009). In a current project the development and construction of a prototype is planned for 2013 together with a scientific research programme (PETERS, 2012).

### **3.2.5 Floating Wind Turbines**

Various concepts exist for floating wind turbines (for an extensive review see KOSCHINSKI & LÜDEMANN, 2011). The basic principle is to anchor a floating construction either ballast stabilized, or as a Tension Leg Platform, or with a catenary mooring system. For oil- and gas-platforms in water depths of several hundred meters, floating systems are state of the art. Most of the systems developed for wind turbines are considered for greater water depths like the Norwegian coast where deep-foundations are impossible or too expensive. For offshore wind farms in the North Sea and Baltic Sea, the concept of a ballast-stabilized platform is considered best suitable.

In 2011, the “WindFloat”-system of Principal Power Inc. has been installed off the Portuguese coast as a prototype of a floating system equipped with a Vestas V80-turbine. The foundation is fitted with patented water entrapment plates at the base of each column. The anchors are pre-laid drag embedded (Principal Power Inc. 2012). The construction and installation of a pilot Swimming Offshore Foundation (SOF) in the Baltic Sea is planned by Gicon for 2013/2014 (GROSSMANN & DAHLHAUS, 2012).

## **4 Summarizing Conclusions**

In summary, there is a general consensus on the demand on noise mitigation for the construction of offshore wind farms. Recent experiences with various noise mitigation techniques have shown that a reduction of broadband levels by about 10-20 dB (SEL) is possible. These findings are also in line with results of numerical simulations (APPLIED PHYSICAL SCIENCES, 2010).

Bubble curtains have been applied as an effective noise mitigation technique in several experimental and practical setups as well as under offshore conditions in the North Sea. With a noise mitigation potential of 12 dB (SEL) and 14 dB (Peak) they are suitable e.g. for piles whose diameter does not exceed a critical size (jackets and tripods/tripiles), and at locations without neighboring sensitive or protected areas. Bubble curtains are ready for use and the application is planned at some German OWFs.

For cases that require even higher mitigation potentials (e.g. large monopiles), more complex methods or a combination of several techniques are needed. Pile sleeves and

cofferdams have been shown to account for noise reductions in the order of 20 dB. The application of cofferdams and pile sleeves is planned at some German commercial offshore projects.

Hydro sound dampers are characterized by a low weight of the system and the possibility to adjust the damping frequency. They can be easily adapted to different applications. HSDs will be tested in summer 2012 in an offshore situation during the construction of a British OWF.

Gravity base foundations are state of the art at water depths of up to 20 m in the Baltic Sea. In the near future, their application is planned in a test field at greater water depth. Bucket foundations are widely-used for oil- and gas-platforms. The application for wind turbines requires more development work. The application of bucket foundation is planned for the converter platforms in a German OWF. The technical feasibility of the offshore foundation drilling concept has been proven. In a current project the construction of a prototype is planned for 2013. Concepts for floating turbines are currently being developed. A prototype has been installed off Portugal in 2011. The installation of a pilot project in the Baltic Sea is planned for 2013/2014.

Technical noise mitigation measures and alternative foundations concepts are rather new techniques and as such their development is still under way. The recent past has seen major improvements and currently, several research and development project exist to further improve the systems` performance and applicability. Results have shown that technically, the existing noise exposure criteria can already be met in many planned projects if a suitable mitigation technology is chosen.

**Table 1:** Key facts of studies on Big (BBC), Layered (LBC), and Small (SBC) Bubble Curtains.

Project	Reference	Concept	Water depth	Pile diameter	Blow energy	Mitigation (dB <sub>SEL</sub> / dB <sub>PEAK</sub> )	Best effect
FINO-3 (2008)	GRIEßMANN et al. 2009	BBC	23	2,7-4,7 m	800 kJ	12 / 14	1 kHz < f < 3 kHz
alpha ventus (2009)	GRIEßMANN et al. 2010 ITAP 2010	LBC	30	2,4-2,6	max. 500 kJ	12 / 14*	f > 300 Hz
BARD Offshore 1 (2011)	VERFUSS 2012, BELLMANN 2012	SBC	40	n/a	n/a	14 / 19	n/a
Borkum West II (2011/2012)	BIOCONSULT-SH et al. 2012	BBC	26-33	2,5	n/a	12 / 11**	f > 50 Hz

\* Only in flow direction; no effect in the opposite direction

\*\* Tube with hole diameter 1,5 mm and 0,3 m distance between holes; 4 compressors

## 5 References

Ahrens, C. & Wiegand, J. (2009): Foundation of Offshore Wind Power Plants – an introduction of the Vertical Shaft Machine as an economic and ecologic alternative.

<http://search.informit.com.au/fullText;dn=848024769051558;res=IELENG> (15.06.2012)

Applied Physical Sciences (2010): Mitigation of Underwater Pile Driving Noise During Offshore Construction. Final Report. Report Nr. M09PC00019-8.

[www.boemre.gov/tarprojects/634/M09PC00019-8PileDrivingFinalRpt.pdf](http://www.boemre.gov/tarprojects/634/M09PC00019-8PileDrivingFinalRpt.pdf) (15.06.2012)

Bellmann, M. (2012): Die technische Entwicklung von Schallminderungstechnologien: Stand der Forschung. Presentation „Minimierung von Unterwasserschall bei der Gründung von Offshore-Windenergieanlagen: Anforderungen und Möglichkeiten“, IHK Rostock, 28. März 2012.

[http://www.offshorestiftung.com/60005/Uploaded/Offshore\\_Stiftung|2012\\_03\\_28\\_HRO\\_SOW\\_Schallschutz\\_2\\_Bellmann.pdf](http://www.offshorestiftung.com/60005/Uploaded/Offshore_Stiftung|2012_03_28_HRO_SOW_Schallschutz_2_Bellmann.pdf) (15.06.2012)

Bioconsult-SH, ITAP & Hydrotechnik Lübeck (2012): Projekt: HYDROSCHALL OFF BW II. Entwicklung und Erprobung des „Großen Blasenschleiers“ zur Minderung der Hydroschallemissionen bei Offshore-Rammarbeiten. Förderkennzeichen 0325309A/B/C. Akustische Messungen bei den Rammungen in Forschungsphase 1 im Offshore-Windpark Borkum West II. 23. April 2012.

<http://www.hydroschall.de/wp-content/uploads/2012/05/Kurzbericht-Schallminderung20120425.pdf> (15.06.2012)

BMU, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2002): Strategie der Bundesregierung zur Windenergienutzung auf See, im Rahmen der Nachhaltigkeitsstrategie der Bundesregierung.

[http://www.erneuerbareenergien.de/files/pdfs/allgemein/application/pdf/windenergie\\_strategie\\_br\\_020100.pdf](http://www.erneuerbareenergien.de/files/pdfs/allgemein/application/pdf/windenergie_strategie_br_020100.pdf) (15.06.2012)

BSH – Bundesamt für Seeschifffahrt und Hydrographie (2012): Leitsätze für die Anwendung der Eingriffsregelungen innerhalb der ausschließlichen Wirtschaftszone und auf dem Festlandsockel im Rahmen von § 58 Abs. 1 Satz 2 BNatSchG.

[http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/Grundlagen/Leitsaetze\\_Eingriffsregelung.pdf](http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/Grundlagen/Leitsaetze_Eingriffsregelung.pdf) (15.06.2012)

CALTRANS (2003): Underwater sound pressures associated with the restrike of the pile installation demonstration project piles. Report prepared by Illingworth & Rodkin, Inc. for State of California, Department of Transportation.

[http://biomitigation.org/reports/files/Hydroacoustic\\_Report\\_for\\_PIDP\\_Restrike\\_0\\_1263.pdf](http://biomitigation.org/reports/files/Hydroacoustic_Report_for_PIDP_Restrike_0_1263.pdf) (15.06.2012)

CALTRANS (2009): Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (Final). Prepared by ICF Jones & Stokes and Illingworth & Rodkin. [http://www.dot.ca.gov/hq/env/bio/files/Guidance\\_Manual\\_2\\_09.pdf](http://www.dot.ca.gov/hq/env/bio/files/Guidance_Manual_2_09.pdf) (15.06.2012)

Carlson, T., Hastings, M. & Popper, A.N. (2007): MEMORANDUM. Update on Recommendations for Revised Interim Sound Exposure Criteria for Fish during Pile Driving Activities. 8 pp. [http://www.dot.ca.gov/hq/env/bio/files/ct-arlington\\_memo\\_12-21-07.pdf](http://www.dot.ca.gov/hq/env/bio/files/ct-arlington_memo_12-21-07.pdf)

Elmer, K.H. (2010): Pile Driving Noise Using New Hydro Sound Dampers. ECS 2010 Workshop: Pile driving in offshore windfarms Effects on harbour porpoises, mitigation measures and standards, 21 March 2010, Stralsund.  
[www.bsh.de/de/Das\\_BSH/Veranstaltungen/Cetacean\\_Society/Elmer.pdf](http://www.bsh.de/de/Das_BSH/Veranstaltungen/Cetacean_Society/Elmer.pdf) (15.06.2012)

Elmer, K.-H., Betke, K. & Neumann, T. (2007a): Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch die Schallimmission von Offshore-Windenergieanlagen: SCHALL2. - Project 0329947 final report. The German Federal Environment Ministry.

Elmer, K.-H., Betke, K. & Neumann, T. (2007b): Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch die Schallimmission von Offshore-Windenergieanlagen: Untersuchung von Schallminderungsmaßnahmen an FINO 2. - Project 0329947 A final report. The German Federal Environment Ministry.

Grießmann, T., Rustemeier, J. & Rolfe, R. (2009): Forschungsplattform FINO 3 - Einsatz des großen Blasenschleiers. Präsentation beim BSH Meeresumweltsymposiums 2009. [http://www.bsh.de/de/Das\\_BSH/Veranstaltungen/MUS/2009/Dokumente/Griessmann\\_P.pdf](http://www.bsh.de/de/Das_BSH/Veranstaltungen/MUS/2009/Dokumente/Griessmann_P.pdf) (15.06.2012)

Grießmann, T., Rustemeier, J. & Rolfes, R. (2010): Research on mitigation measures at alpha ventus. 24. Conference of the European Cetacean Society. Pile driving in offshore windfarms. Stralsund, 21 March 2010.  
[http://www.bsh.de/de/Das\\_BSH/Veranstaltungen/Cetacean\\_Society/Griessmann.pdf](http://www.bsh.de/de/Das_BSH/Veranstaltungen/Cetacean_Society/Griessmann.pdf) (15.06.2012)

Grossmann, J. & Dahlhaus, F. (2012): Innovative Gründungslösungen im On- und Offshore Windenergiebereich. 3. Windenergieabend, Stuttgart, 23.02.2012. <http://www.wind-energy-network.de/downloads/vortraege-3-wind-energy-abend/Hr-Prof-Grossmann-GICON-040312.pdf>

Herrenknecht AG (2009): Machbarkeitsstudie zum Einsatz der Vertical Shaft Sinking Machine (VSM) im Bereich der Errichtung von Offshore-WEA. FKZ 0325064. Fachlicher Schlussbericht nach 8.2 NKBF 98. 20 pp.

Ibsen, L.B. & Nielsen, S.B. (2007): Case Study: Implementation of the Bucket Foundation Concept. [http://vbn.aau.dk/files/13793610/Case\\_Study](http://vbn.aau.dk/files/13793610/Case_Study) (15.06.2012)

Ibsen, L.B., Liingaard, S. & Nielsen, S.A. (2005): Bucket Foundation, a status. Proceedings of the Copenhagen Offshore Wind 2005.  
[http://wind.nrel.gov/public/SeaCon/Proceedings/Copenhagen.Offshore.Wind.2005/documents/papers/Future\\_innovative\\_solutions/L.B.Ibsen\\_Bucket\\_Foundation\\_a\\_status.pdf](http://wind.nrel.gov/public/SeaCon/Proceedings/Copenhagen.Offshore.Wind.2005/documents/papers/Future_innovative_solutions/L.B.Ibsen_Bucket_Foundation_a_status.pdf) (15.06.2012)

ICH Merwede (2012):

<http://www.ihcmerwede.com/about-ihc-merwede/news/newsmessage/article/ihc-offshore-systems-provides-worlds-biggest-noise-mitigation-system-to-protect-sea-life/> (15.06.2012)

ITAP - Institut für technische und angewandte Physik (2008): Prognose des Unterwassergeräusches beim Bau und beim Betrieb des Offshore-Windparks Borkum-West („alpha ventus“) und Messung des Hintergrundgeräusches im Planungsgebiet. 42 pp. [http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/StUK3/Fachgutachten\\_Basisaufnahme\\_av/schallgutachten-itap-15okt2008.pdf](http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/StUK3/Fachgutachten_Basisaufnahme_av/schallgutachten-itap-15okt2008.pdf) (15.06.2012)

ITAP (2010): Messungen von Unterwasserschall beim Bau der Windenergieanlagen im Offshore-Testfeld „alpha ventus“. Abschlussbericht zum Monitoring nach StUK 3 in der Bauphase. [http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/StUK3/Fachgutachten\\_Bauphase\\_av/Schallbericht\\_Bauphase\\_2009.pdf](http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/StUK3/Fachgutachten_Bauphase_av/Schallbericht_Bauphase_2009.pdf) (15.06.2012)

Koschinski, S. & Lüdemann, K. (2011): Stand der Entwicklung schallminimierender Maßnahmen beim Bau von Offshore-Windenergieanlagen. Studie im Auftrag vom Bundesamt für Naturschutz (BfN). Juli 2011. 81 pp. [http://www.bfn.de/habitatmare/de/downloads/berichte/BfN-Studie\\_Bauschallminderung\\_Juli-2011.pdf](http://www.bfn.de/habitatmare/de/downloads/berichte/BfN-Studie_Bauschallminderung_Juli-2011.pdf) (15.06.2012)

Kumbartzky, G. (2012): The BARD Group. Small Bubble Curtain / OFT 1 and 2. Symposium "Minimierung von Unterwasserschall bei der Gründung von Offshore - Windenergieanlagen. March 2012". [http://www.offshorestiftung.com/60005/Uploaded/Offshore\\_Stiftung|2012\\_03\\_28\\_HRO\\_SOW\\_Schallschutz\\_41\\_Kumbartzky.pdf](http://www.offshorestiftung.com/60005/Uploaded/Offshore_Stiftung|2012_03_28_HRO_SOW_Schallschutz_41_Kumbartzky.pdf)

LeBlanc Bakmar, C. (2009): The Monopod Bucket Foundation: Recent Experience and Challenges Ahead. Hamburg Offshore Wind, 12. May 2009. [http://www.gl-group.com/pdf/No12\\_Bakmar.pdf](http://www.gl-group.com/pdf/No12_Bakmar.pdf) (15.06.2012)

Madsen, P.T., Wahlberg, M., Tougaard, J., Lucke, K. & Tyack, P. (2006): Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Mar. Ecol. Progr. Ser. Vol. 309: 279-295.

Mentrup, K. (2012): Schallschutz Trianel Windkraftwerk Borkum. Fachtagung "Minimierung von Unterwasserschall bei der Gründung von Offshore-Windenergieanlagen: Anforderungen und Möglichkeiten" IHK Rostock, 28. März 2012. [http://www.offshorestiftung.com/60005/Uploaded/Offshore\\_Stiftung|2012\\_03\\_28\\_HRO\\_SOW\\_Schallschutz\\_42\\_Mentrup.pdf](http://www.offshorestiftung.com/60005/Uploaded/Offshore_Stiftung|2012_03_28_HRO_SOW_Schallschutz_42_Mentrup.pdf)

Nehls, G., Betke, K. Eckelmann, S. & Ros, M. (2007): Assessment and costs of potential engineering solutions for the mitigation of the impacts of underwater noise arising from the construction of offshore windfarms. - BioConsult SH report, Husum, Germany. On behalf of COWRIE Ltd.

Overdick (2012a): <http://www.overdick.com/projects/offshore-oil-and-gas> (15.06.2012)

Overdick (2012b): <http://www.overdick.com/projects/offshore-wind/#moab-dc-substation-north-sea-a> (15.06.2012)

Peters, M. (2012): Offshore Bohren. Einsatz der Offshore Foundation Drilling Machine (OFD®) im Bereich der Errichtung von Offshore-Windenergieanlagen. 3. Windenergieabend, Stuttgart, 23.02.2012. <http://www.wind-energy-network.de/downloads/vortraege-3-wind-energy-abend/Hr-Dr-Peters-Herrenknecht-230212.pdf> (15.06.2012)

Petrie, F.S. (2005): Washington State Ferries' Experience with Bubble Curtains: Purpose, Hardware, and Use. 2005 Summer Meeting/Conference of the Transportation Research Board ADC40 (A1F04) Noise & Vibration Committee

Popper, A.N. & Hastings, M.C. (2009): Review paper - The effects of anthropogenic sources of sound on fishes. *J. Fish Biol.* Vol. 75: 455-489.

Principle Power Inc. (2012): <http://principlepowerinc.com/products/windfloat.html> (15.06.2012)

Ragheb, M. (2010): Offshore Wind Farms Siting. <https://netfiles.uiuc.edu/mragheb/www/NPRE%20475%20Wind%20Power%20Systems/Offshore%20Wind%20Farms%20Siting.pdf> (15.06.2012)

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, T.E. Gentry, R.E. Jr. Greene, C.R., Kastak, D., Ketten, D., Miller, J.H., Nachtigall, P.E., Richardson, J.W., Thomas, J.A. & Tyack, P.L. (2007): Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. - *Aquatic Mammals* 33(4): 411-521.

Umweltbundesamt (2011): Empfehlung von Lärmschutzwerten bei der Errichtung von Offshore-Windenergieanlagen (OWEA). Umweltbundesamt Dessau, Germany, 6 pp. <http://www.umweltdaten.de/publikationen/fpdf-l/4118.pdf> (15.06.2012)

Vagle, S. (2003): On the Impact of Underwater Pile-Driving Noise on Marine Life. Institute of Ocean Sciences, DFO/Pacific, Ocean Science and Productivity Division.

Van de Brug, E. (2009): Drilled Concrete Monopile. [http://www.bsh.de/de/Das\\_BSH/Veranstaltungen/Cetacean\\_Society/van\\_de\\_Brug.pdf](http://www.bsh.de/de/Das_BSH/Veranstaltungen/Cetacean_Society/van_de_Brug.pdf)

Verfuß, T. (2012): Noise Mitigation Measures & Low-noise Foundation Concepts – State of the Art. International Symposium "Towards an Environmentally Sound Offshore Wind Energy Deployment" Stralsund, 25.01.2012.

[http://www.bfn.de/fileadmin/MDB/documents/themen/erneuerbareenergien/Tgng\\_offshore2012/6\\_1\\_verfuss.pdf](http://www.bfn.de/fileadmin/MDB/documents/themen/erneuerbareenergien/Tgng_offshore2012/6_1_verfuss.pdf) (15.06.2012)

Würsig, B., Greene, C.R. & Jefferson, T.A. (2000): Development of an air bubble curtain to reduce underwater noise of percussive piling. *Mar. Environ. Res.* Vol. 49: 79-93.

## Alternative Quieter Technologies to Seismic Airguns for Collecting Geophysical Data

LINDY WEILGART

Department of Biology, Dalhousie University, Canada and Okeanos Foundation, Germany

Undersea noise pollution is a growing problem for marine life, with shipping, seismic surveys, and naval sonar being the main sources of noise. The most straightforward and effective mitigation is to: 1) spatially or temporally separate the noise sources from biologically rich areas or concentrations of sensitive species; and 2) quiet the noise sources, through, e.g. technological modifications or quieter alternatives. Here, I explore some possible technological alternatives to seismic airgun surveys, used by the industry to find oil and gas deposits under the sea floor or by academic geophysical researchers, to study geological features of the ocean bottom.

Seismic airgun surveys generate sharp onset (high rise time), loud, intense broadband impulses. These can raise ambient background noise levels 10-30 dB (especially in the very low frequencies of around 20 Hz) over areas covering 35,000-70,000 sq. km. for months at a time (CLARK & GAGNON, 2006). Singing humpback or fin whales often stop vocalizing within an hour or less of the survey's start, staying quiet for weeks at a time, resuming only once the survey ends. Exposing a large portion of the population to such noise for several weeks, i.e. having 250 male fin whales collectively not singing during this time, or alternatively, leaving an area of high food resource value (CLARK & GAGNON, 2006), is likely to be biologically significant. Castellote et al. (2012) also found that fin whales changed their songs and moved away from a seismic airgun array for 2-3 weeks after the 10-day seismic survey ended. In over a decade of recordings, bottom-mounted hydrophones detected airguns 4,000 km away, and surveys were heard 80-95% of the days per month, throughout the year, in some areas (NIEUKIRK et al., 2012). Seismic surveys obliterated any biological sounds at times, forming a ubiquitous, dominant part of the background noise.

Since most marine animals rely on sound for their vital life functions, such as communication, mating, prey and predator detection, orientation, and sensing their surroundings, it is not surprising that impacts from airgun surveys on marine species from mammals to fish are well-documented (e.g. GORDON et al., 2004; WEILGART, 2007). These can range from hearing or organ damage, displacement from important feeding or mating areas, reductions in fisheries catch rates, masking or obscuring of sounds, through to behavioral effects (e.g. WEILGART, 2007).

While the energy from airgun impulses is mostly concentrated in the lower frequencies, there is still substantial energy in the tens of kiloHertz (kHz), which explains why cetaceans with higher frequency sensitivities react to the noise (GOOLD & FISH, 1998).

Geophysicists and the oil and gas industry do not make use of, nor even record, any energy over ca. 100 Hz, however. This energy therefore needlessly impacts marine life, especially animals with mid- or high-frequency hearing. As a result, Bolt Technology Corporation and WesternGeco have attempted to design an airgun, the E-source airgun, which reduces the output of high-frequency energy while optimizing it in the seismic band of interest, in order to minimize the effects on marine animals. This approach may be too piecemeal and not comprehensive enough, however, as other potentially damaging characteristics of airgun pulses remain.

Likely a better, more far-reaching and thorough alternative is marine vibroseis (MV). MV uses signals of drastically lower peak pressure than airguns. High peak pressure is a characteristic of sound thought to be harmful to organisms. Most airgun arrays have an effective source level of 255 dB (0-p) in the downward direction, compared with a MV array of about 223 dB rms (Bird 2003)—a difference of 32 dB. Since the decibel scale is logarithmic, this is more than a 1,000-fold difference in intensity. Peak pressure can be lower with MV at any given distance because the same geophysically useful energy in an airgun pulse is spread over a longer duration, i.e. whatever energy is lost in pressure can be compensated for in the time domain. This means that a 10-ms airgun pulse can be lengthened, by a factor of 100, to a 1-s MV signal, so that it can be 100 times quieter, resulting in about a 10,000-fold reduction in the presumed area of impact in the near field (WEILGART, 2010, 2012). A MV survey is estimated to only expose roughly 1-20% of whales and dolphins to high noise levels when compared to those exposed to an airgun survey, based on models (LGL & MAI, 2011). Mitigation would be easier, as mitigation radii would be substantially smaller.

MV, as a non-impulsive seismic source, does not have the rapid rise time (sounds quickly increasing in loudness) of airguns. Rapid rise time, along with high peak pressure, is considered to be injurious to tissues. According to Southall et al. (2007), for cetaceans, a non-pulse sound such as MV would have to be about 12-17 dB louder than an impulse such as airguns produce, to cause the same injury, because of the rapid rise time of an impulse. Thus, the MV technology has a higher likelihood of being more benign toward marine life, with a lower potential to cause hearing damage (WEILGART, 2010, 2012).

As mentioned previously, airguns produce wasteful energy in the form of geophysically unwanted higher frequencies (> 100 Hz). MV signals can suppress these frequencies while still producing satisfactory geophysical results. A future MV system is expected to operate between 5-10 Hz to 90-100 Hz, with higher frequencies, such as harmonics, being minimized (LGL & MAI, 2011). This substantially reduces the biological effects in species not sensitive to low-frequency sounds (most odontocetes).

MV is considered to be a controlled source, which means it has well-controlled spectral properties. This allows for the necessary seismic information to be extracted using

lower levels of energy, e.g. through improved signal processing (LGL & MAI, 2011), again reducing environmental impact.

MV can be used over a broader range of depths than airguns can, in deep water, shallow water, and transition zones. The MV sound source can also be operated substantially deeper in the water column than airguns. MV has been demonstrated to operate at a source depth of at least 100 m depth (LGL & MAI, 2011) vs. the typical 3-12 m source depth for airguns, but could theoretically operate at 0-1,000 m source depth (WEILGART, 2010). The operating depth can be more easily adjusted in MV than airguns, and this can further reduce exposure to key species. For instance, by operating at deeper depths, exposures near the water's surface, where most animals are, are minimized. In shallow water, a MV source would generate a considerably lower peak pressure on the sea floor than airguns, to the benefit of bottom-dwelling marine life (LGL & MAI, 2011).

Finally, MV can use either frequency-modulated (FM) sweeps or frequency-coded signals (pseudo-random noise, PRN) as output (LGL & MAI, 2011). This makes it more flexible than airguns which are limited to impulses. Both signal types have their advantages: PRN allows use of specially coded patterns to facilitate signal processing, enabling a lower source level; FM sweeps, because they are narrowband, may reduce masking effects (LGL & MAI, 2011).

In summary, MV can lower the environmental impact, compared with airguns by:

1. lowering peak pressure levels by increasing the signal's duration, keeping the energy input into the sea floor equivalent, but reducing mitigation radii and exposing only a fraction of animals to high sound levels;
2. eliminating the rapid rise time, which can be biologically damaging;
3. strongly suppressing the unwanted, high-frequency components of the MV signal;
4. having well-controlled spectral properties, so lower levels of energy can be used;
5. operating at deeper depths, reducing the potential for exposing animals nearer the water surface; and
6. being more flexible, using either FM or PRN signals.

The greatest drawback of MV compared with airguns is the greater potential for masking, since the MV signal is of longer duration (seconds vs. tens of milliseconds for an airgun pulse), and MV will likely have a higher duty cycle (percentage of time it is "on"). Some estimates of MV signal duration range from 5-12 s (LGL & MAI, 2011). This would impact mainly low-frequency hearing specialists such as baleen whales and some fish. Slight masking effects could extend to a few tens of kilometers from

the MV source. As previously mentioned, narrow-band FM sweeps might ameliorate the potential for masking somewhat.

Airgun pulses are also not always as short in duration as they appear, if heard over larger distances from the source. Reverberation and multi-paths "stretch" the signal from its original 10 ms to sometimes seconds, at long ranges. Sometimes, noise levels do not have a chance to return to ambient in the 10 s between airgun shots, since there is still reverberation from the previous shot (WEILGART, 2010). MV signals can also be lengthened or stretched in time with increasing distance from the source, but such stretching would be proportionally less than for airgun pulses, since MV signals are longer in duration initially, close to the source (LGL & MAI, 2011).

Preliminary research indicates that MV does not cause obvious injury to fish and shrimp (LGL & MAI, 2011). More studies on the most important ecosystem components need to be undertaken, however, to show more definitively whether MV is indeed more environmentally benign than airguns. If MV does have a lower impact overall, options for the MV signals (PRN vs. FM sweeps) should be tested to determine which would be best tolerated by the most species.

In general, however, MV surveys would be expected to cause less of an impact (behavioral, physiological, auditory) than airgun surveys in all habitats and environments regardless of water depth or environmental conditions (LGL & MAI, 2011). Also, "...tests and limited operational use have demonstrated that, at least in some situations, the MV is a satisfactory energy source from a geophysical perspective..." (SMITH & JENKERSON, 1998). Airguns have some geophysical disadvantages as well, in addition to being more limited in which depths they can be used in. Airguns can become unreliable because of the wear and tear caused by the high pressures they use to operate (LGL & MAI, 2011).

As oil and gas exploration extends into ever more sensitive habitat such as the Arctic, MV may have a competitive advantage over airguns, especially if government regulators demand that the least potentially harmful technology be chosen. In fact, national laws often require that an analysis of alternatives be undertaken, to ensure the environment is not needlessly subjected to negative impacts. If MV is shown to be better tolerated by marine life, mitigation measures for MV may be less restrictive than for airguns, and MV surveys may be allowed in situations where airgun surveys are not.

Currently, MV is arguably the most likely technology to eventually replace airguns. Seismic surveys on land used to be accomplished using dynamite, until this became socially and environmentally unacceptable. Explosions were replaced with Vibroseis on land. A commercial electrical MV system, developed in 2008, could be available as early as 2014. It is being commercialized by Geokinetics, which has a license from

PGS to use it for shallow water applications. Some mechanical design issues remain, causing unwanted harmonics, however (Rune TENGHAMN, pers. comm.).

The Global Petroleum Research Institute (GPRI), Department of Petroleum Engineering at Texas A&M University, has a Joint Venture with ExxonMobil, Shell, Total, and Statoil as partners, to investigate alternatives to airguns, mainly MV, for certain seismic surveys. They hope to improve seismic imaging in shallow waters.

Stephen Chelminski, the inventor of the airgun and primary founder of Bolt Technology Corporation, manufacturer of most airguns, and the inventor and designer of almost all of the products the company has made, has also developed a design for a MV prototype. His "seavibe" is 53 cm in diameter, 3.5-6 m in length, fully stream-lined, and towable at any speed. It is pressure-balanced, so it can run on the bottom or be towed at any depth. The signal can be either pulse-coded or a swept signal or even a mix, without any high frequencies (5-100 Hz or can range from 2 to 200 Hz). The signal emitted by the source is dictated by the program controlling it, so the same construction will work and mimic (within its mechanical constraints), all input signals, so it could conceivably switch between the two signal types. The signal can be any duration, and the duration can be changed real-time. It is very reliable, and takes much less horsepower (only 20-50 hp) to tow than airguns. More than 50% of the power to compress air for an airgun array is lost as heat, so overall airguns are only about 5% efficient. The input power to the "seavibe" can be 150 kW or more, and might be close to 80% efficient. Seavibes can be used as arrays, and the design is modular, so one can add length to add power. Seismic surveys could be undertaken with 1-4 units. Chelminski believes MV to be more benign than the airguns he invented. He states, "Though airguns have been an improvement over high explosives to the well-being of marine life, I would very much like to see a more benign sound source such as the MV come into use." (Stephen Chelminski, pers. comm.).

Deep Towed Acoustic Geophysical Systems (DTAGS) is also a controlled source, like MV, being developed at the Naval Research Laboratory, Stennis Space Center. The sound source is towed at depth and is insensitive to changes in depth. It produces nearly identical signals at the sea surface to full ocean depth (6000 m). Almost any kind of waveform can be used as output, at almost any sound level under 200 dB (WEILGART, 2010). By keeping the source close to the target of interest, deep water sources such as DTAGS can achieve commercially useful sound pressure levels in the sea floor while keeping sound levels in the ocean to a minimum, especially in the shallower parts of the water column where sensitive marine life is concentrated (WEILGART, 2010). DTAGS was tested in the Gulf of Mexico in the summer of 2011, and will undergo another trial off Oregon in September 2012. Though the frequency range of DTAGS is currently 200-4,000 Hz, it may be extended down to about 100 Hz (Warren Wood, pers. comm.).

Finally, the U.S.'s Bureau of Ocean Energy Management (BOEM), which manages the exploration and development of the U.S.'s offshore energy resources, intends to hold a workshop on airgun alternatives in early 2013. Alternatives to technologies associated with renewable energy, such as pile driving, will also be discussed.

While there is currently no commercial technology available to replace seismic airguns, with a combination of sufficient regulatory pressure and funding, this could change quickly. We owe it to the marine environment, especially sensitive areas such as the Arctic, to do our utmost to keep impacts from seismic surveys to an absolute minimum.

## References

- Bird, J. (2003): The marine vibrator. Industrial Vehicles International. The Leading Edge, April.
- Castellote, M., Clark, C.W. & Lammers, M.O. (2012): Acoustic and behavioural changes by fin whales (*Balaenoptera physalus*) in response to shipping and airgun noise. Biological Conservation 147: 115-122.
- Clark, C. W. & Gagnon, G.C. (2006): Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales. International Whaling Commission Scientific Committee document SC/58/E9.
- Gould, J. C. & Fish, P.J. (1998): Broadband spectra of seismic survey air-gun emissions, with reference to dolphin auditory thresholds. Journal of the Acoustical Society of America 103: 2177–2184.
- Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. & Thompson, D. (2004): A review of the effects of seismic surveys on marine mammals. Marine Technology Science Journal (Winter 2003/2004), 37(4): 16-34.
- LGL & MAI. (2011): Environmental Assessment of Marine Vibroseis. LGL Rep. TA4604-1; JIP contract 22 07-12. Rep. from LGL Ltd., environ. res. assoc., King City, Ont., Canada, and Marine Acoustics Inc., Arlington, VA, U.S.A., for Joint Industry Programme, E&P Sound and Marine Life, Intern. Assoc. of Oil & Gas Producers, London, U.K. 207 p.
- Nieukirk, S. L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P. & Goslin, J. (2012): Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009. Journal of the Acoustical Society of America 131(2): 1102–1112.
- Smith, J.G. & Jenkerson, M.R. (1998): Acquiring and processing marine vibrator data in the transition zone. Society for Exploratory Geophysicists. Expanded Abstracts. 4 p.
- Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Jr. Greene, C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thoma, J.A. & Tyack, P.L. (2007): Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33(4), i-iv: 411-522.

Weilgart, L. S. (2007): The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology* 85: 1091-1116.

Weilgart, L. / Ed. (2010): Report of the Workshop on Alternative Technologies to Seismic Airgun Surveys for Oil and Gas Exploration and their Potential for Reducing Impacts on Marine Mammals. Monterey, CA, USA, 31 August-1 Sept. 2009. Okeanos - Foundation for the Sea. Available from: <http://www.okeanos-stiftung.org/assets/Uploads/Airgun.pdf>

Weilgart, L. (2012): Are there technological alternatives to air guns for oil and gas exploration to reduce potential noise impacts on cetaceans? In: Popper, A. N.; and Hawkins, A. (Eds.). *The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology* 730: 605-607, New York: Springer Press.



# Marine Litter: Projects – Threats – Solutions

KIM CORNELIUS DETLOFF

Nature and Biodiversity Conservation Union, Germany

## 1 Introduction

Marine Litter constitutes a global concern and causes serious environmental and economic problems (GALGANI et al., 2010, BARNES et al., 2009). Far from being a recent marine conservation issue it has been underestimated or lost sight of for far too long. Marine litter occurs along densely populated coastlines, as well as in remote areas far away from obvious sources of waste. Marine debris accounts for hundreds of thousands of deaths among marine animals each year across all species groups, including marine mammals, sea birds, marine turtles, fishes and invertebrates. The very slow rate of degradation of most litter items, primarily plastics, together with the growing quantity of debris disposed accidentally or even deliberately, is leading to a gradual rise in marine litter items found at sea, in the water column, on the sea floor, and on shore. Like many other environmental problems affecting marine ecosystems, marine littering does not stop at national borders. Global currents distribute marine debris across the world's oceans. As a consequence, potential solutions have to be considered at a national, regional or even global level. Our knowledge about the ecological and socio-economical effects of litter in the marine environment is still limited. However, what we understand so far is alarming and demands immediate action. There is not much time to prevent the degradation of our oceans into a lifeless soup of plastics.



**Figure 1:** Marine Litter has become a global concern (Greenpeace / G. Parsons).

## 2 Facts, Figures & Trends

We still have no reliable data on the total amount of marine litter in the seas. A study by the US Academy of Science estimated that already in 1997 up to 6.4 million tons of debris were entering our oceans every year. Presumably, current numbers are even higher because this study considered predominantly sea-based sources and suffered from a fundamental lack of data regarding land-based input. Others estimate that some eight million litter items enter the world's oceans every day. There are very few quantitative evaluations on a national or regional level. Some data are outlined in a United Nations Environment Programme (UNEP) report from 2009. More than 20,000 tons of debris are dumped in the North Sea each year. The highest levels of beached litter were found in the Greater North Sea Region during the OSPAR Pilot Beach Litter Monitoring Project with 600-1,400 items every 100 m of beach surveyed (OSPAR, 2009). The highest amounts in the data of the Baltic Sea were between 700 and 1,200 pieces per 100 m of coastline, which is similar to the levels found on the beaches of the northern North Sea (UNEP, 2009).

Approximately 75 percent of all debris is made up of plastics. UNEP (2006) estimates that up to 18,000 pieces of plastic are floating on every square kilometer of water surface. What we can see at the ocean's surface is therefore just the very tip of the iceberg. According to figures from the North Sea, as well as from the waters around Australia, it has been estimated that up to 70 percent of the marine litter that enters the sea ends up on the seabed. The time an item takes to sink to the ocean floor depends on its size and density. About 15 percent float while another 15 percent will eventually be washed ashore.

## 3 Ecologic Consequences

### 3.1. Macroplastics

The harmful effects of marine litter are as diverse as they are dramatic. Each year up to one million sea birds and 100,000 marine mammals die due to entanglement, ingestion, internal injury or poisoning. The US Marine Mammal Commission lists about 136 species affected by entanglement in lost fishing gear alone, which causes limited mobility, suffocation or mortality (UNEP, 2009). According to Macfadyen et al. (2009) more than 260 marine species are reported to have either become entangled in or have ingested marine debris. About 40 percent of cetacean species, one third of the world's sea birds, all marine turtles, many fishes and invertebrates have reportedly ingested marine litter because of misidentifying it as natural prey or food. As a result they are affected by internal injuries or suffer starvation due to a blocked digestive tract. Other harmful effects are more subtle. These include the steady absorption of toxic components contained in plastics, such as Bisphenol A (BPA) and Phthalates,

and environmental persistent organic pollutants (POPs). Latest studies have shown that plastic particles can attract and hold hydrophobic elements such as DDT or PCBs in concentrations that are 100,000 to one million times higher than background levels (RIOS et al., 2010, TEUTEN et al., 2007). That means that POPs do accumulate in marine food chains on many different trophic levels.



**Figure 2:** Marine turtles can often be found entangled in lost fishing gear (M.E.E.R. e.V. / F. Ritter).

Although scientific research on adverse effects of litter on marine ecosystems and species has increased significantly in the recent past, we continue to lack regional and standardized data and scientific information. We have not fully explored the seasonal and regional fluctuation of litter items, the transportation processes, and how marine debris is distributed through vertical and horizontal currents, wind and other forces. We are also still investigating the complex and in parts variable degradation processes. We already know about the long life of plastic products, which can extend to several hundreds of years, for some time now. However, we recently discovered that degradation through salt water, sun light and mechanical forces begins very soon after an item enters the ocean. Furthermore, the environmental consequences of marine litter are still poorly understood. Similarly, while there is plenty of evidence and countless examples of harm to individuals, information about potential population effects is very limited.

### **3.2.1 Microplastics**

Scientists and conservationists are particularly concerned about the adverse effects of microplastics in the marine food web. Initially, the term microplastic was used for truly

microscopic particles in the region of 20 micrometers. Today, the definition has been broadened to include all particles smaller than 5 mm (ARTHUR et al., 2009). Microplastics have been found in the gastrointestinal tracts of sea birds (VAN FRANEKER, 2008), in planktivorous fishes (DAVISON & ASCH, 2011), in the circulation systems of blue mussels (BROWNE et al., 2008), and recently in scats of grey seals (LIEBEZEIT, unpublished). We do have direct input of micro particles into the marine environment as preproduction pellets getting lost during transportation, as additives in cleaning products (peelings) or as synthetic fibers from textiles. A recent study showed that waste water from washing machines is heavily contaminated with synthetic fibers, which cannot be excluded by current filter techniques and can enter the oceans via sewage systems (ARTHUR et al., 2009). There is also an indirect source through the degradation of larger items. According to the US environmental activist Charles Moore from the Algalita Foundation, there are areas in the Great Pacific Garbage Patch where the ratio of Plastics to Plankton is six to one, which results in dramatic consequences for the marine ecosystem (MOORE et al., 2001).



**Figure 3:** Many sea birds do ingest marine litter due to misidentification of natural prey (Marine Photobank / S. Siegel).

## 4 Legislation, Initiatives and Activities

### 4.1 Global and Regional Agreements

During past few years, the scientific, political and public interest in marine litter effects has steadily increased. On an international level, the initiatives of the United Nation's Environmental Programme (UNEP) are particularly noteworthy. UNEP published several reports, including the "Analytical Overview" 2005 and the "Global Challenge" in

2009. The UNEP Global Programme of Action (GPA) developed a “Global Initiative on Marine Litter”, including awareness campaigns, scientific assessments, monitoring and cleanup activities. Together with the US National Oceanic and Atmospheric Administration (NOAA), UNEP organized the 5<sup>th</sup> International Marine Debris Conference in Honolulu (Hawaii) in March 2011. The final outcome of this one week conference, attended by more than 440 participants representing 38 countries, was the Honolulu Declaration: a global strategy which aims to provide a strategic framework for coordinated action plans to prevent and manage marine debris (UNEP/NOAA, 2011). UNEP is also closely collaborating with regional multinational environmental agreements, in particular the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention). In addition to several scientific reports, OSPAR established a standardized beach litter monitoring scheme for its area of responsibility. Under this scheme, litter items are collected, quantified and about 120 litter items are differentiated. The aim of this approach is to gather valuable information about the quantity, composition and source of marine litter in the area (OSPAR, 2009). The only available quantitative data on the environmental impact of marine litter stems from the OSPAR’s Ecological Quality Objective-System (EcoQOs). Dead fulmars are examined for plastic particles in their stomachs. In the North Sea area 94 percent of all birds investigated contained plastic, with an average of 34 particles per bird (OSPAR, 2010; FLEET et al., 2009). The Convention also established an Intersessional Correspondence Group on Marine Litter compiling and discussing the latest scientific knowledge and developments. OSPAR also adopted a Recommendation in 2010, which calls on Member States to support national initiatives for the collection of litter.

HELCOM, the Commission of the Helsinki Convention launched a report in 2007, which summarizes available regional data that tend to stem from different NGO activities (HELCOM/UNEP, 2007). According to this assessment, marine litter appears not to be the Baltic Sea’s major problem. However, more information is needed. As a consequence, HELCOM adopted a Recommendation in 2008, calling on Member States to increase their monitoring, survey and research activities.

#### **4.2 EU-Legislation: The Marine Strategy Framework Directive**

The latest EU environmental legislation, the Marine Strategy Framework Directive (MSFD), seems to be of fundamental importance in addressing the problem of marine litter in European waters. It was adopted in 2008 and aims at meeting or maintaining a good environmental status by 2020 at the latest. To achieve these objectives, Member States are required to develop marine strategies that serve as action plans and employ an ecosystem-based approach to the management of human activities. For the very first time, an EU-Directive addresses the problem of marine litter directly, and Member States are obliged to introduce measures to ensure that “Properties and quantities of

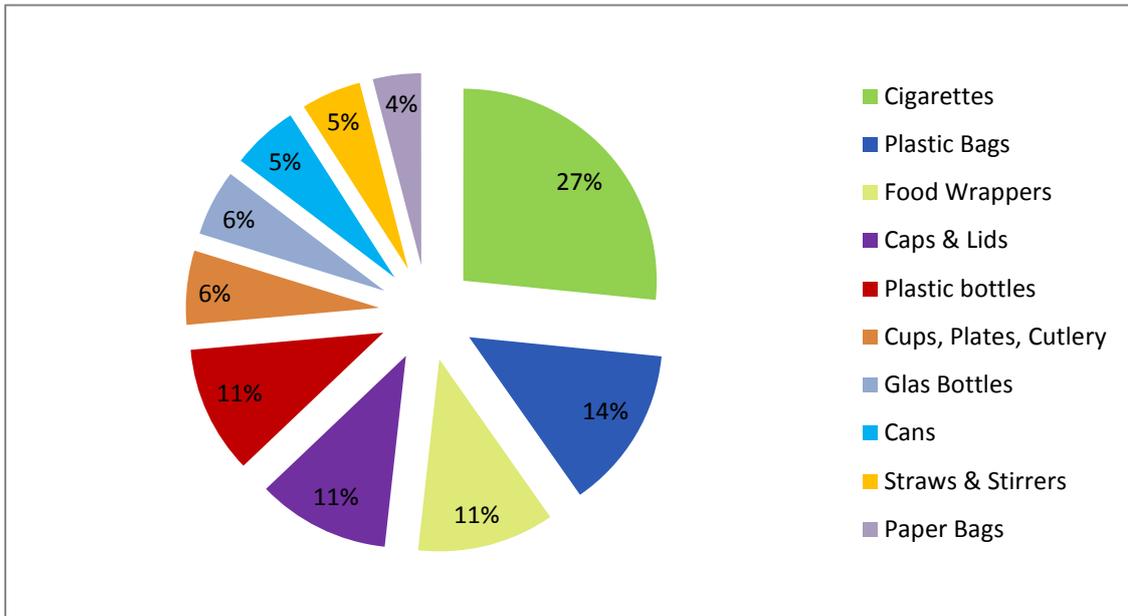
marine litter do not cause harm to the coastal and marine environment". The MSFD is following an ambitious time schedule with milestones in 2012, 2015 and 2020. Marine Litter is one of 11 indicators that characterize the environmental status of the marine ecosystems. As a follow up to the Commission's Decision on Criteria and Methodological Standards on Good Environmental Status (GES) of marine waters (Commission Decision 2010/477/EU), the Marine Directors requested the Directorate-General for the Environment (DG ENV) in 2010 to establish a technical subgroup under the Working Group on GES (WG GES) in relation to the MSFD for further development of Descriptor 10 (Marine Litter). The group's mandate as specified by the DG ENV, IFREMER and the Joint Research Center(JRC) included a review of current data and knowledge on marine litter, the consideration of standards and surveying, the development of impact indicators and environmental targets, as well as the recommendation of proposals for future research priorities. The group consists of 42 members, representing 14 countries. The 2011 report is available at: <http://publications.jrc.ec.europa.eu/repository/handle/111111111/22826>.

In 2012 the group was asked to continue with its work in order to support Member States in implementing the MSFD, with a particular focus on identifying and collaboratively addressing common knowledge gaps, develop and promote common standardized monitoring and assessment protocols, and the sharing of best practice.

### **4.3 NGO Initiatives**

#### **4.3.1 Cleanup Activities**

Several national and international non-governmental organizations (NGOs) have identified marine litter as one of their work priorities in the field of marine conservation. One of the most famous initiatives is the International Coastal Cleanup Day (ICC) initiated by the US organization Ocean Conservancy. Since 1986, the ICC has become the world's largest volunteer effort in the service of ocean health. In the course of 25 years, nearly nine million volunteers from 152 countries and locations have collected 145 million US pounds of trash from the shores of lakes, rivers and the ocean – the equivalent of 65,000 tons. The Nature and Biodiversity Conservation Union (NABU), the German partner of BirdLife International, joined this initiative by conducting cleanup operations at the German Baltic Sea coast since 2010. Volunteers recorded all litter items found, thus providing a clear picture of the items impacting wildlife. Looking at the ICC top ten statistics, we can see that waste products thrown away by tourists represent the majority of beach litter. Cigarettes and filters account for some 27 percent of all items, followed by cups, plates, knives, forks and spoons, food wrappers and plastic bottles at 14 percent,



**Figure 4:** “The Top Ten” 25 years International Coastal Cleanup Day (ICC).



**Figure 5:** NABU cleanup operation on the island of Fehmarn (Baltic Sea) 2010 (NABU / K. Detloff).

#### 4.4 Fishing for Litter

Fishermen too contribute to marine litter, for example through the ghost-net problem. At the same time, they suffer as a result of contaminated hauls and damaged gear caused by plastics or other litter items that have been accidentally or deliberately discharged at sea. To address the problem of marine littering, fishermen, communities and other partners have joined up in so called fishing for litter projects. The idea behind different schemes is as straight forward as it is effective. Fishermen accidentally fish for litter in the course of normal fishing operations, particularly during

bottom trawls. In the past, these items were routinely thrown back into the sea due to a shortage of space or other logistical problems on-board, as well as the fact that payment was necessary to dispose of collected trash in many harbours. Now, fishing for litter projects are putting things right by providing fishermen with large bags and organizing containers for disposal free of charge.

The organization KIMO (Local Authorities International Environmental Organisation) has been running Fishing for Litter schemes since 2003. About 400 vessels from Scotland, England, Belgium, the Netherlands and Sweden have joined the campaign so far. In 2011 NABU launched the first Baltic fishing for litter initiative in the very North of Germany. Today, three Baltic Sea harbours and one from the German North Sea involving more than 30 fishermen from federal states of Schleswig-Holstein, Mecklenburg-Vorpommern and Lower Saxony have joined the NABU-project; further harbours are lined up to join. The fishing for litter scheme is following a three pronged approach, which includes the local collection and cleaning of marine litter, an intensive campaign to raise awareness amongst different stakeholders including fishermen, local communities, and waste disposal industries. These activities are complemented by the collection of data on the quantity of marine waste and its composition. Beginning in 2012, NABU and its partners analyzed the first consignment of collected litter items, amounting to a total of 700 kilograms. The sample was made up primarily of metal items such as old oil barrels, cans, and tins with remnants of paint and lacquer. Plastics accounted for about 23 percent. This differs from the information provided by KIMO about the Atlantic and North Sea, where plastics accounted for up to 50 percent. NABU suggests that most of the litter on the sea floor originates from commercial shipping operations. This is indicated by the large proportion of industrial waste such as oilskins, cables and fishing equipment in addition to different types of barrels and cans. It seems to be too early for a final conclusion. More litter items need to be assessed, which is why our project partners decided to continue and extend the project to facilitate the collection of reliable data on the waste pollution on the sea floor of the Baltic Sea.



Figure 6: NABU's fishing for litter initiative in Burgstaaken / Fehmarn (NABU / A. Hentschel).

## 5 Solutions

### 5.1 Land based Solutions: Reduce, Reuse & Recycle

Several national and international reports indicate that up to 80 percent of all marine litter originates from land-based sources such as tourists, beach activities, sewage, rivers and fly tipping. With this in mind we recognize that cleanup operations or fishing for litter initiatives are important but have a limited effect, at least on a global level. Waste prevention and the conservation of natural resources are the clear priority. If marine littering is to be addressed properly, a fundamental social rethink of our consumerist culture is required. Otherwise we are simply getting lost in treating the symptoms. With respect to products made from plastics, sustainability must meet the "3Rs-philosophy": Reduce, Reuse and Recycle. Future product designs have to be developed in line with the "cradle to cradle-principle" (BRAUNGART, 2002).

Products must be repairable and be designed for the long-term. One-way, throw away products should be eliminated and scientists should increase research into environmentally-sound, sustainable materials with reduced environmental persistence. Furthermore, politicians and the whole society must agree on these new requirements with regard to new plastic products. Products that cannot be reused should be fully recycled. Effective, regional waste collection and recycling schemes are an essential prerequisite for such changes. To date, national recycling rates in the EU reach an average of 25 percent. There is therefore plenty of scope for improvements. Multi-cycle systems have to be promoted and encouraged. In addition, the production and use of vast amount of transport packaging have to be reduced or completely avoided. Product sharing is another new innovative approach by which People can share e. g.

cars, tools, lawn-mowers, or other products to preserve valuable resources and to avoid preventable waste.

## **5.2 Legislation, Enforcement and Awareness**

It is widely accepted that there is no need for special new legislation. However, we do need effective enforcement of and compliance with existing laws, as well as selected improvements. On land, the Recycling Management and Waste Law allows us to agree ambitious recycling quotes. But industrial lobbying and a lack of political will get in the way of appropriate and effective decision making. The MARPOL Agreement has prohibited the discharge of plastics from ships into the sea for decades (IMO, 2011). But legislative loopholes and a lack of enforcement render it more or less ineffective. The EU Directive on Port Reception Facilities from the year 2000 led to a heterogeneous system of waste management in European harbours, particularly with respect to local management plans, fee systems and infrastructure. The area-wide adoption of the HELCOM “no special fee system” might be helpful in harmonizing and improving the situation. Last but not least, there is crucial need for effective public awareness campaigns. The public has to be informed that litter poses a fundamental threat to marine ecosystems and their biodiversity.

In some cases more dramatic measures seem to be required to effect the necessary social changes. Bans alone are no solution. However, sometimes they can point the way. Bans on single-use plastic bags are already in place in many countries and communities, including China, France, Italy, the Northern Territories in Australia, and the cities of Toronto and Vancouver in Canada. A consultation by the European Commission in 2011 showed that 70 percent of the public supports such a ban. However, a decision is still outstanding. As a result of millions of cigarettes on beaches and in oceans, several communities introduced no smoking areas on beaches and in parks (e.g., Ontario, New York City or Sydney).

Marine litter is a global problem. Its causes and environmental impacts are complex and not fully understood. Land-based processes play an essential role in reducing its adverse effects. On the up side, there are opportunities to engage with this issue on multiple levels to address it. Policies have to set the framework, while environmental and waste legislation has to be implemented effectively, adopted and improved. Authorities have to be responsible for effective enforcement and controls and counteract abuse and illegal dumping. Industries have to move towards conserving natural resources and develop and provide long-lived, repairable and environmentally-friendly products. The behavior of individuals can complement these efforts through personal social engagement and responsibility and by choosing sustainable consumption.

## 6 References

Arthur, C., Baker, J. & Bamford, H. (2009): Proceedings of the international research workshop on the occurrence, effects and fate of microplastic marine debris. September 9-11, 2008: NOAA Technical Memorandum NOS-OR&R30.

Barnes, D. K. A., Galgani, F., Thompson, R.C. & Barlaz, M. (2009): Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B*, 1985-1998.

Braungart, M. & McDonough, W. (2002): *Cradle to Cradle. Remaking the way we make things.* North Point Press.

Browne, M. A., Dissanayake, A., Galloway, T.S., Lowe, D.M. & Thompson, R.C. (2008): Ingested microscopic plastic translocates to the circulatory system of the mussel, *Mytilus edulis* (L.) *Environmental Science & Technology* 42: 5026-5031.

Davison, P. & Asch, R.G. (2011): Plastic ingestion by mesopelagic fishes in the North Pacific Subtropical Gyre. *Marine Ecology Progress Series* Vol. 432: 173-180.

Fleet, D., van Franeker, J., Dagevos, J. & Hougee, M. (2009): Marine Litter. Thematic Report No. 3.8. In: Marencic, H. and Vlas, J. de (Eds). *Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.*

Galgani, F., Fleet, D., Van Franeker, J., Katsavenakis, S., Maes, T., Mouat, J., Oosterbaan, L., Poitou, I., Hanke, G., Thompson, R., Amato, E., Birkun, A. & Janssen, C. (2010): Marine Strategy Framework Directive Task Group 10 Report Marine litter, JRC Scientific and technical report, ICES/JRC/IFREMER Joint Report (no 31210 – 2009/2010), Editor: N. Zampoukas, 57 pp.

HELCOM/UNEP (2007): *Assessment of the Marine Litter problem in the Baltic region and priorities for response.* HELCOM.

IMO (2011): *International Convention for the Preservation of Pollution from ships.*

Macfadyen, G., Huntington, T. & Cappell, R. (2009): Abandoned, lost or otherwise discarded fishing gear. *UNEP Regional Seas Reports and Studies* 185, *FAO Fisheries and Aquaculture Technical Paper* 523.

Moore, C. J., Moore, S.L., Leecaster, M.K. & Weisberg, S.B. (2001): A comparison of Plastic and Plankton in the North Pacific Central Gyre. *Marine Pollution Bulletin*, Vol. 42: 1297-1300.

OSPAR (2009): *Marine litter in the North-East Atlantic Region: Assessment and priorities for response.* London, United Kingdom, 127 pp.

OSPAR (2010): *Quality Status Report 2010.* OSPAR Commission. London. 176 pp.

Rios, L.M., Jones, P.R., Moore, C. & Narayana, U.V. (2010): Quantitation of persistent organic pollutants adsorbed on plastic debris from the Northern Pacific Gyre's eastern garbage patch, DOI: 10.1039.

Teuten, E.L., Rowland, S.J., Galloway, T.S. & Thompson, R.C. (2007): Potential for plastics to transport hydrophobic contaminants. *Environmental Science and Technology* 41: 7759-7764.

UNEP/NOAA (2011): The Honolulu Strategy: A Global Framework for Prevention and Management of Marine Debris. Draft September 2011.

UNEP (2006): Ecosystems and biodiversity in deep waters and high seas. UNEP Regional Seas Reports and Studies No. 178. Switzerland: UNEP/IUCN.

UNEP (2005): Marine litter – an analytic overview. United Nations Environmental Programme. 58 pages.

UNEP (2009): Marine Litter: Global challenge. ISBN 978-92-807-3029-6. 234 pages.

Van Franeker, J.A. & SNS Fulmar Study Group (2008): Fulmar Litter EcoQO Monitoring in the North Sea - results to 2006 Wageningen IMARES Report No. C033/08, IMARES, Texel, 53 pp.

## **Sensitivity of Seabirds to Anthropogenic Activities: a multi-factorial approach**

STEFAN GARTHE, ANNA-MARIE JESS, BETTINA MENDEL, PHILIPP SCHWEMMER, NICOLE SONNTAG

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

### **Abstract**

Seabirds are affected by various anthropogenic activities both on land and at sea. While some human pressures are ongoing since decades (e.g. fisheries), others have only recently been developed (e.g. generation of renewable energy). Assessments of possible impacts of current human pressures often lack solid scientific data as time scales for research and for economic development mostly do not fit. This is further complicated by the fact that different species tend to respond differently to most of the human pressures.

Based on long-term research, we have developed a suite of indices describing the sensitivity of seabirds to certain human pressures. Each of the 27 seabird species occurring in the offshore waters of the German North and Baltic Seas was scored for various factors (with regard to species biology, ecology and conservation) which are grouped into the following indices: wind farm, set net, ship traffic, oil pollution and use of discards from fishing vessels. These indices serve two main purposes: (1) identifying the most and the least sensitive species as to each human pressure, (2) mapping the most and the least sensitive sea areas when combining species sensitivity indices with data on seabird abundance. Such information is of high relevance for assessments, management and conservation measures.



# Conflicting Interests between Offshore Wind Farm Development and the Designation of a Natura 2000 Site: riding a Belgian policy roller coaster?

AN CLIQUET, HENDRIK SCHOUKENS AND FRANK MAES

Department of Public International Law, Ghent University, Belgium

## 1 Introduction

Belgium has a coastline of 65 km and a territorial sea and continental shelf of 3,600km<sup>2</sup>, thus making it the smallest maritime area in North-West Europe. The Belgian marine environment is intensively used by different actors, competing with each other for limited space. Activities include recreation and tourism, shipping, fisheries, dredging, military activities, laying of cables and pipelines and mineral extraction (MAES et al., 2005; DOUVERE et al., 2007). Almost all activities are regulated by law (SOMERS & MAES, 2001). In the Belgian marine areas several Annex I habitat types<sup>1</sup> occur: sandbanks which are slightly covered by sea water all the time (habitat type 1110), mudflats and sandflats not covered by seawater at low tide (habitat type 1140) and reefs (habitat type 1170) (RABAUT & CLIQUET, 2011; CLIQUET et al., 2008a). Taking into account the European policy aim to increase the share of renewable energy to 20% of Europe's total energy production in 2020 and the rapid growth of wind energy the past years, it was clear that wind farms and their associated infrastructure would pose new challenges for the designation and conservation of marine protected areas in the Belgian part of the North Sea. The numerous judicial proceedings surrounding the proposed construction of a wind farm on the 'Vlakte van de Raan', an ecologically valuable complex of sandbanks that runs in a line off the Belgian coast at the town of Knokke-Heist, provide a clear illustration of this. Although allowed in 2002, the construction of the wind farm was prevented due to the withdrawal of the previously issued permits. In 2005, 19 km<sup>2</sup> of the Belgian part of the Vlakte van de Raan was finally designated as a Natura 2000 site by the Belgian federal government, while the Dutch government, on its turn, decided to designate 190 km<sup>2</sup> as a Natura 2000 site. However, in 2008 the decision to designate the Belgian area was annulled by the Belgian Council of State, whereas the owner of the permits, in the meantime, had introduced a liability action against the Belgian state claiming compensation for the damages suffered due to this, supposedly negligent, change of policy by the Belgian government.

---

<sup>1</sup> Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, Official Journal L 206, 22 July 1992.

This paper will analyze in more detail the above mentioned case of the Vlakte van de Raan, and touch on legal, social and scientific issues. First, the legal regime for marine protected areas in Belgium and the legal regime for offshore windmill parks will be briefly described (part 2). The process of designation of both the Natura 2000 sites and the zones for offshore windmills will be presented in part 3. The main part of this article will be aimed at analyzing the legal challenges arising out of the troublesome designation of the Vlakte van de Raan as a protected area. Turning from the judicial decisions which were issued with respect to this case (part 4), the remaining policy options for the Belgian federal government in this respect will be presented (part 5). In this respect, also the possible liability issues, which are linked to the designation of the area as a protected area, will be discussed (parts 6).

## **2 Legal regimes in Belgium for marine protected areas and offshore windmill parks**

### **2.1 Legal regime for marine protected areas**

The legal basis for the designation and management of Natura 2000 sites in the Belgian marine environment is the federal Act on the protection of the marine environment (Act of 20 January 1999, amended by Act of 17 September 2005)<sup>2</sup>. This Act enables the designation of marine protected areas (MPAs) in Belgian marine waters, including the territorial sea and the exclusive economic zone. Five types of MPAs have been distinguished in the Act: integral marine reserves, specific marine reserves, Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), closed zones and buffer zones (CLIQUET & MAES, 1998; CLIQUET et al., 2008b). Only the SPAs/SACs are relevant for the focus of this paper. Concerning the conservation of the SPAs/SACs (i.e. the 'Natura 2000 sites') the Act on the marine environment (as amended in 2005) provides that, by Royal Decree, activities can be forbidden within the sites, except for certain activities mentioned in the Act (such as fishing, dredging etc.)<sup>3</sup>. The reasoning from the federal government behind this legal provision is that some of these activities belong to Flemish competences and thus cannot be regulated by the federal government, which is responsible for marine nature conservation. This complicates the establishment of conservation objectives and management measures and might impede the favourable conservation status of the habitats and species for which the sites have been designated. Although no specific conservation objectives have been set for these sites, several conservation measures were already included in the legislation (see below at part 3) (CLIQUET et al., 2008a).

---

<sup>2</sup> Act of 20 January 1999 on the protection of the marine environment, Belgian Official Journal 12 March 1999; amended by Act of 17 September 2005, Belgian Official Journal 13 October 2005.

<sup>3</sup> Article 8, § 3 Act on the protection of the marine environment.

## 2.2 Legal regime for offshore windmill parks

The administrative procedure to obtain a permit to build and run an offshore wind energy park in Belgian marine waters consists of two stages and is part of the exclusive authority of the federal government. First, one has to obtain a 'domain concession' from the Minister responsible for Energy. Without prejudice to the provisions of the Act on the protection of the marine environment, the Minister - on the proposition of the Commission for Regulation of Electricity and Gas (CREG) - can grant a domain concession for building and running a unit for the production of electricity from water, wind or currents, in the marine areas under Belgian jurisdiction according to international law<sup>4</sup>. The concession is granted for a fixed period, with a 20 year maximum. A prolongation is possible, but the total duration of the concession cannot exceed 30 years. Secondly, the Minister for the of Environment, after an evaluation of the environmental impact, decides whether or not an authorization and permit for the construction and exploitation of the park, can be granted. The legal basis is the Act on the protection of the marine environment: industrial activities in marine areas require a prior authorization and permit<sup>5</sup>. The application for the environmental permit is made to the Minister and sent to the Management Unit of the North Sea Mathematical Models and the Scheldt estuary (MUMM). The application has to be accompanied by an environmental impact assessment<sup>6</sup>.

Before an environmental permit can be granted there is an environmental impact procedure. According to the Act on the protection of the marine environment, every activity in marine areas that is subject to prior authorization and permit (except certain activities such as fisheries) has to pass through an environmental impact procedure, both prior to the granting of the permit and afterwards. The purpose of the environmental impact procedure is to assess the effects of the proposed activities on the marine environment<sup>7</sup> (CLIQUET, 2003a; CLIQUET, 2003b).

---

<sup>4</sup> Article 6, § 1 Act of 29 April 1999 on the Organization Of The Electricity Market, Belgian Official Journal 11 May 1999; Procedure set out by Royal Decree of 20 December 2000, Belgian Official Journal 30 December 2000, as amended.

<sup>5</sup> Article 25, § 1, (v), Act on the Protection Of The Marine Environment; Procedure set out by Royal Decree of 20 December 2000, Belgian Official Journal 25 January 2001 (replaced by Royal Decree of 7 September 2003, Belgian Official Journal 17 September 2003).

<sup>6</sup> Article 13, § 1, 5° Royal Decree of 7 September 2003.

<sup>7</sup> Article 28, § 1 Act on the Protection of The Marine Environment.

### **3 Two parallel processes: designation of marine protected areas and designation of zones for offshore windmill parks**

#### **3.1 Windmills intertwined with protected areas (2000-2002)**

After the Act on the protection of the marine environment was approved in parliament in 1999, the first attempts were made to designate marine protected areas, including several Natura 2000 sites. The process can be described as a predominantly top-down approach. The attempts failed because of protests alongside the Belgian coast by different user groups, such as fishermen and local communities (see BOGAERT et al., 2008; BOGAERT et al., 2009). In the same period another policy process started, aimed at developing offshore wind farm parks. This process can also be described as mainly a top-down approach as there was no strategic planning framework present to identify the most interesting locations for wind energy development in the Belgian part of the North Sea. The Ministers responsible for the marine environment linked this dossier to the MPAs dossier. Rather rapidly, this linking appeared to be disastrous in terms of political strategy. The first proposals for the establishment of wind turbine parks in the North Sea brought about yet more consternation among local agents, the local population, and politicians, especially because of the expected eyesore on the horizon. After the adoption of Royal Decree of 20 December 2000 setting out the procedure for obtaining a 'concession' for building and running wind farm parks, two applications were filed. The first project, named 'Seanergy', aimed at the construction of a wind farm located in the nearshore zone on the Vlakte van de Raan and was initiated by nv Electrabel and nv Ondernemingen Jan De Nul. A second project, initiated by C-Power, provided for the development of a wind farm, just off the coast, at the height of the coastal town of De Haan.

The (federal) Minister for Energy organized several information meetings at the coast about the proposed offshore wind energy parks. Although this was certainly a good initiative, there was some criticism, as the decisions for the concession of the wind energy parks were given shortly after these information rounds, respectively in March and June 2002<sup>8</sup>. This left a feeling that these information rounds were only a formality and that the views of the public were not seriously considered. There were several negative reactions in the media. Also a parliamentary hearing was organized<sup>9</sup>. Several groups and experts were asked to give their views on offshore wind energy parks. The end conclusion of the debate was that wind energy parks in the nearshore environment are not favorable (because of interaction with other users and because of possible negative effects on the marine environment). The construction of a pilot project in the nearshore environment was considered useless if future wind energy

---

<sup>8</sup> Ministerial Decree of 26 February 2002 ('C-Power'), Belgian Official Journal 28 March 2002; Ministerial Decree of 27 March 2002 ('Seanergy'), Belgian Official Journal 11 May 2002.

<sup>9</sup> Parliamentary Commission for the environment, hearing of 12 June 2002.

parks were to be situated further offshore. Nevertheless, the building and environmental permit for Seanergy was granted by the Minister of the Environment in 2003<sup>10</sup> (CLIQUET, 2003a). The construction of 50 windmills with a nominal power of 2 MW was allowed in the nearshore zone on the Vlakte van de Raan. However, no permit was obtained for the C-Power project alongside the more western part of the Belgian coast.

### **3.2 Judicial proceedings against the concessions and permits for a wind farm on the Vlakte van de Raan (2003-2005): NIMBY at sea?**

Various agents (local inhabitants and authorities, action groups, etc.) searched for legal means to thwart the planned wind turbine parks in the sea off the Belgian coast. The wind farm development caused polarization, with the federal Minister for the Environment as supporter and an amalgam of opponents, among whom was now also a part of the environmental movement (BOGAERT et al., 2009). Several groups (such as coastal communities in Belgium and the Netherlands) filed numerous complaints against the concession and building permit for Seanergy at the Belgian Council of State. In 2003 they obtained a first success when the Council of State decided to suspend the permits granted for the building and exploitation of the wind farm on the Vlakte van de Raan<sup>11</sup>. The Council of State provisionally decided that the Royal Decree of 20 December 2000, which sets out the procedure for obtaining the required environmental and building permits, had to be declared illegal on procedural grounds. Thus the obtained permits, which were rooted in the mentioned Royal Decree, had to be declared illegal. However, these procedural grounds were not upheld in the final decision of the Council of State on the legality of the obtained building and environmental permit. In its decision of 30 June 2005<sup>12</sup>, the so-called 'Soete-decision', the Council also rejected the other, more substantial, claims against the construction of a wind farm on the Vlakte van de Raan. Yet this decision only was limited to the claims from a local inhabitant (Soete) and the municipality of Knokke. The claims from the other opponents were still pending.

In its decision of 30 June 2005 the Council of State had to deal with two interesting judicial arguments (SCHOUKENS, 2008).

The first question pertained to the lack of protection of the Vlakte van de Raan in 2005. As already mentioned above (see introduction), the Vlakte van de Raan is claimed to possess high ecological value. It was argued that the permit was illegal given the fact that this site should already have been designated as a Natura 2000 site by the

---

<sup>10</sup> Ministerial Decree of 25 June 2002 (environmental permit 'Seanergy'); Ministerial Decree 25 June 2002 (building permit 'Seanergy').

<sup>11</sup> Decision Belgian Council of State 25 March 2003, no. 117.482.

<sup>12</sup> Decision Belgian Council of State 30 June 2005, no. 147.047.

Belgian authorities. At first sight, this appeared to be a convincing argument. Indeed, according to the settled case law of the Court of Justice, Member States must designate the most suitable areas of their territory as a Natura 2000 site (SPA/SAC). The classification of those areas remains subject only to certain ornithological and ecological criteria determined by the Birds<sup>13</sup> and Habitats Directive<sup>14</sup>. Economic considerations can, in this respect, not be taken into account<sup>15</sup>. Taking into account the high number of protected species and habitats present on the Vlakte van de Raan, it therefore could be argued that the site qualified as an SPA/SAC. However, in the case at hand, the Council of State decided that the Birds Directive was to be interpreted in such a way that an authority is not obliged to designate every site where birds listed in Annex I of the Birds Directive are present, but only the most suitable in number and size. The same interpretation was upheld within the framework of article 4 of the Habitats Directive. In short: only the most suitable sites of the Belgian part of the North Sea had to be designated as an SPA/SAC, according to the Belgian Council of State. No proof was presented before the Council of State that the Belgian part of the Vlakte van de Raan qualified as such.

A second line of argumentation was linked to the potential negative impact of the proposed wind energy developments on nature and wildlife present on the Vlakte van de Raan, especially the expected disturbance of birds and marine mammals. The Council of State, however, equally rejected the alleged violation of the precautionary principle, as enshrined in article 4, § 1 and § 3 of the Act on the protection of the marine environment. The Council found no reasons to doubt the outcome of the environmental impact assessment that had been carried out before granting the permit for the construction of the wind farm. Whilst acknowledging that insufficient knowledge was available to assess the potential impact on the birds present in the area, the Council refused to see this deficiency as a sufficient reason to annul the contested permits. It is hard to reconcile this decision of the Council of State with the strict interpretation of the Court of Justice of the precautionary principle in the Cackle fisheries case of 2004<sup>16</sup>. In this case the Court of Justice stressed that an assessment must allow the elimination of all reasonable doubts regarding presence or absence of significant impact<sup>17</sup>. The Court also stressed that a project may only be granted authorization on the condition that the competent authorities are convinced that it will

---

<sup>13</sup> Directive 2009/147/EC of the European Parliament and the Council of 30 November 2009 on the conservation of wild birds, Official Journal L 20, 26 January 2010.

<sup>14</sup> See inter alia: Case 355/90, *Commission v Spain* (1993), par. 26.

<sup>15</sup> Case 44/95, *Regina t. Secretary of State for the Environment* (1996), par. 27 (Birds Directive); Case 371/98, *First Corporate Shipping*, pars. 22-25 (Habitats Directive).

<sup>16</sup> Case 127/02, *Landelijke Vereniging tot Behoud van de Waddenzee, Nederlandse Vereniging tot Bescherming van Vogels v Staatssecretaris van Landbouw, Natuurbeheer en Visserij* (2002).

<sup>17</sup> Case 127/02, *Landelijke Vereniging tot Behoud van de Waddenzee, Nederlandse Vereniging tot Bescherming van Vogels v Staatssecretaris van Landbouw, Natuurbeheer en Visserij* (2002), par. 53.

not adversely affect the integrity of the site concerned (*'in dubio pro natura'*)<sup>18</sup>. The lenient approach of the Belgian Council of State can perhaps be explained while taking into account the fact that, in a first phase, only a small part of the proposed wind farm would be constructed. Afterwards, during the next stage of the project, the results of the ongoing monitoring, should be taken into account and, if necessary, lead to a modification of the project. The Council clearly took this specific element into account when upholding the validity of the contested permits. It is however interesting to point out that the same Council of State, in its more recent case law, took a more restrictive view on the application of monitoring in order to avoid a strict approach of the precautionary principle<sup>19</sup>.

### **3.3 A shift in policy: the withdrawal of the permits and the first steps towards marine spatial planning (2003-2005)**

Although several procedures were still pending, the dismissal by the Council of State of the claims of Soete and the municipality of Knokke against the building permit, seemed to indicate that there existed no legal grounds any longer to protest against the arrival of a wind farm on the Vlakte van de Raan. Yet this implied no definite 'go ahead' for the proposed wind farm as, in the meantime, a shift in policy had occurred. In 2003, the new Belgian Minister for the North Sea initiated a more strategic approach to the (potential) conflicting spatial claims for the Belgian part of the North Sea (PLASMAN, 2008), which led to the adoption of a 'Master plan for the North Sea'<sup>20</sup>. Although this Master plan is not legally binding, as, until now, there are no provisions in the Act on the protection of the marine environment which describe the judicial effects of this Master plan, it can be seen as one of the first examples of marine spatial planning within the EU. The Master plan consisted of two phases: in the first phase the zones for the 'hard' economic activities were designated: sand and gravel extraction and wind turbine parks in the sea<sup>21</sup>. In both cases the demarcation was now based on consultation rounds with stakeholders and on the basis of socio-economic and ecological studies. For the offshore windmill parks a zone further seawards was designated for offshore windmills (on the Thornton-bank). The Vlakte van de Raan was not included. In order to avoid further developments that would go against the new policy objectives for the Belgian part of the North Sea, an intervention was needed as to the previously granted permit for the construction of a wind farm on the Vlakte van de Raan. Therefore, the Minister decided to withdraw the environmental and building permit for the construction of the wind farm on the Vlakte van de Raan. In the

---

<sup>18</sup> Case 127/02, Landelijke Vereniging tot Behoud van de Waddenzee, Nederlandse Vereniging tot Bescherming van Vogels v Staatssecretaris van Landbouw, Natuurbeheer en Visserij (2002), par. 56.

<sup>19</sup> Decision Belgian Council of State 13 August 2010, no. 206.911.

<sup>20</sup> See map in Plasman 2008, 813.

<sup>21</sup> Royal Decree of 17 May 2004, Belgian Official Journal 29 June 2004, amended by Royal Decree of 3 February 2011, Belgian Official Journal 17 February 2011.

Ministerial Decree of 25 July 2005 explicit referral was made to the fact that in one of the, at the moment, still pending judicial procedures, it had been argued that the existence of a strategic planning framework was indispensable before granting permits for wind farm construction. As this framework was not present yet when granting the permits for the proposed wind farm on the Vlakte van de Raan, the validity of the permits could be questioned. In the view of legal certainty and taking into account the recent shift of policy, the permits were withdrawn.

In the second phase of the Master plan, marine protected areas were designated. This was done after a process of bilateral consultation with all actors concerned, including fishermen, recreational water sports representatives, coastal mayors, civil servants of several departments (transport, fisheries, economics and environment), scientists and civil society (the environmental movement). In 2005 three Special Protection Areas (SPA) were designated under the Birds Directive and two Special Areas of Conservation (SAC) under the Habitats Directive<sup>22</sup>. The three SPAs were designated along the coast, with surface areas of 110.01 km<sup>2</sup>, 144.8 km<sup>2</sup> and 50.95 km<sup>2</sup> respectively. Another two areas for the protection of habitats (SACs) were established: 'Trapegeer-Stroombank' (SAC 1), parallel along the West coast with a surface area of 181 km<sup>2</sup> and 'Vlakte van de Raan' (SAC 2) at the East coast with a surface area of 19.17 km<sup>2</sup>. These two SACs have the necessary surface and distance from each other (28 km) to be considered biologically linked (RABAUT ET AL., 2008).

The Royal Decree that designated the sites contained some protection measures. Within the SPAs and SACs, the following activities are prohibited: all building activities, industrial activities and activities of commercial and advertising enterprises. In the SAC, the dumping of dredged material and inert materials of natural origin is also forbidden. In SPA 1 and SPA 2, common tern, sandwich tern, little gull and great crested grebe are protected. During winter, helicopter flights at altitudes of less than 500 ft, the passage of high speed vessels and offshore water sports are forbidden. The Minister of Environment can consult with the Minister of Defense on the planning of military firing exercises and other military activities. Furthermore, an appropriate assessment has to be designed of all new plans and projects that are likely to have a significant effect on the site in view of the site's conservation objectives. A new plan or project can only be allowed if it does not adversely affect the integrity of the site concerned. In case of a negative assessment, the plan or project can only be allowed under certain strict conditions as provided in the Royal Decree (which implements Article 6, § 3 and § 4 of the Habitats Directive).

---

<sup>22</sup> Royal Decree of 14 October 2005, Belgian Official Journal 31 October 2005.

#### **4 The difficult outcome of the judicial procedure against the designation of a Natura 2000 site**

After the designation as SAC of the Vlakte van de Raan, nv Electrabel, nv Ondernemingen Jan de Nul and the nv Electrabel Seanergy, the corporations that wanted to construct a wind farm on the Vlakte van de Raan, contested this decision before the Belgian Council of State. Although the necessary permits for the construction of the proposed wind farm had been withdrawn in 2005, both companies still possessed the required interest for the suspension and/or annulment for the designation as they had, in the meantime, also attacked the validity of the latter decision before the Council of State. While rejecting the request for suspension, the Council of State, in February 2008, decided to declare the decision on the designation of the Vlakte van de Raan as an SAC void<sup>23</sup>. At first glance, this outcome seemed logical. Already in its decision of 2005, on the validity of the building and environmental permit for the construction of the proposed wind park, the Council had stressed that there did not exist a legal obligation to designate the area in question as an SAC. Yet the Council of State stressed that the fact that it had already decided that there existed no clear obligation to designate the area as a protected site, did, as such, not imply that it was totally forbidden for the Belgian competent authority to protect the site in the framework of the Habitats Directive. However, such a designation could only be based on sound ecological criteria, which had to be applied to the specific area at hand. According to the Council of State such a specific assessment was not present in the case of the designation of the Vlakte van de Raan. In its reasoning, the Belgian federal government only made referral to the so called 'Development Sketch 2010 for the Scheldt Estuarium', a policy framework which had been agreed upon, in the context of deepening of the Westerscheldt, between the Flemish and Dutch government. As the Council of State already mentioned in its decision in 2005, this document could not be considered to be specific enough to underpin the designation of the Vlakte van de Raan. In contrast with the reasoning which had been used to underpin the designation of the other sites in the Belgian marine waters, the decision lacked specific ecological information to support the designation of the Vlakte van de Raan. Also the referral which was made to a Dutch ecological survey of the Vlakte van de Raan could not help to save the day for the Vlakte van de Raan (CLIQUET, 2008; SCHOUKENS, 2008). The Council of State rightfully pointed out that the scope of this Dutch study was essentially limited to the Dutch part of the Vlakte van de Raan. And even if one would take into account the content of this study, then it would have been logical to designate a larger part of the Vlakte van de Raan as an SAC. Yet the Belgian government decided to designate only a small portion (approx. 20 km<sup>2</sup>). All in all, the decision of the Council of State is a clear illustration of the strict supervision of this instance of the sound motivation of government decisions.

---

<sup>23</sup> Decision Belgian Council of State, 1 February 2008, no 179.254.

## 5 How to avoid a possible conflict between European obligations and Belgian case law?

As such, the annulment of the decision to designate a protected area due to an erroneous reasoning is not that problematic. In the context of a mere national protected site, the competent authority then would retain the discretionary power to designate the area again as a protected site, if desirable. However, here the federal government is confronted with a much stricter European framework, as this site was in the meantime included in the list of Sites of Community Importance (SCI) in 2008<sup>24</sup>. Indeed, this last decision had not been attacked by the *nv Electrabel*, *nv Ondernemingen Jan de Nul* and the *nv Electrabel Seanergy*. Possible annulment proceedings against the decision of the European Commission of 2008 would in any event have been declared inadmissible by the Court of Justice. In the *Salhstedt*-decision of 2008 the Court of Justice decided that natural or legal persons who own land within the Sites of Community Importance adopted by the contested decision are not individually concerned by a decision of the European Commission to enlist an area as an SCI<sup>25</sup>.

Once a selected SCI has been adopted by the European Commission, the Member State concerned has to designate that site as an SAC and establish priorities and take measures for the conservation of the site<sup>26</sup>. This is the last step in the designation process, included in article 4 of the Habitats Directive. In this case things are even more complicated as the annulment does not concern the designation of the Commission to adopt the site as an SCI but the national decision to propose the area as an SCI, *i.e.* the first step in the designation process. Until now, the Belgian government has not adopted a clear approach to the *Vlakte van de Raan*, taking into account the annulment decision of the Council of State. The policy plan for the MPAs of 2009 does not mention the redesignation of the *Vlakte van de Raan* as an SAC. However, the policy plan mentions that research will be conducted to establish a list with proposed SCIs (CLIQUET et al., 2008a). In 2009 a scientific report was written on the designation of additional SACs in the marine environment (DEGRAER et al., 2009). Two proposals were made in this document: an extension of the existing SAC *Trapegeer-Stroombank* and the designation of the *Vlakte van de Raan*. In this report a clear scientific rationale was given for the designation of the site, be it with different coordinates, which partly overlaps with the previously designated *Vlakte van de Raan*. The policy summary by the federal government of this scientific report only dealt with the first area (*Trapegeer-Stroombank*). Political priority for designating additional sites

---

<sup>24</sup> Commission Decision of 12 December 2008 adopting, pursuant to Council Directive 92/43/EEC, a second updated list of sites of Community importance for the Atlantic biogeographical region, Official Journal L 43, 13 February 2009.

<sup>25</sup> Case 362/06 P, *Markku Sahlstedt and Others* (2009), pars. 32-34.

<sup>26</sup> Article 4, § 5 of the Habitats Directive.

is clearly given to the extension of the Trapegeer-Stroombank. However, as the Vlakte van de Raan is included in the list of Sites of Community Importance, the federal government has to specifically plan in order to avoid a possible infringement procedure by the European Commission. Hereafter the three possible policy options will be briefly presented, assessing both their possible advantages and drawbacks.

### **5.1 Option 1: Decision not to designate the Vlakte van de Raan as a Special Area of Conservation**

First it has to be assessed whether the federal government could still decide not to designate the area as an SAC, taking into account the earlier decision of the European Commission to enlist the Vlakte van de Raan as an SCI. Although not completely excluded, such an approach would probably give rise to serious legal objections. In its judgment in the Stadt Papenburg-case the European Court of Justice stressed that article 4, § 2 of the Habitats Directive must be interpreted as not allowing a Member State to refuse to agree on grounds other than environmental protection to the inclusion of one or more sites enlisted as an SCI<sup>27</sup>. More specifically the Court stated that if Member States were allowed to refuse to give their agreement on grounds other than environmental objectives, the objective of the Habitats Directive (setting up a Natura 2000 Network), would be put in danger<sup>28</sup>. As such, it is therefore impermissible to invoke economic, social and cultural grounds and regional and local characteristics, in order to refuse to designate an enlisted site as an SAC. Hence, it seems very difficult to argue, from a legal point of view, that the annulment decision of the Council of State would, as such, be a sufficient ground to underpin a refusal to designate the Vlakte van de Raan as an SAC again. The fact that the federal government has not sufficiently motivated or justified the initial decision to select the Vlakte van de Raan as an SCI, does not preclude the autonomous assessment of the European Commission when adopting the list of sites selected as SCI. In fact, the European Commission shall establish, in agreement with each Member State, a list of SCIs, on the basis of the (ecological) criteria set out in Annex III to the Habitats Directive. In any event, the short reasoning provided in the (national) decision to select the Vlakte van de Raan as an SCI did not preclude the European Commission from accepting the ecological importance of the site. The ecological importance of the site is, as such, also not contradicted in the above mentioned scientific report of 2009. Thus, it remains doubtful whether an ecological reasoning could be presented not to designate the Vlakte van de Raan as an SAC again.

---

<sup>27</sup> Case 226/08, Stadt Papenburg v Bundesrepublik Deutschland (2010), par. 33.

<sup>28</sup> Case 226/08, Stadt Papenburg v Bundesrepublik Deutschland (2010), par. 31.

## 5.2 Option 2: Withdrawal of the site from the Community list with Sites of Community Importance

The Belgian State could in 2009, theoretically, have asked for the annulment of the decision of the European Commission on the ground of a possible shortcoming in the material accuracy of the statement of reasons. It could be argued that the updated list of sites selected as SCIs for the Atlantic biogeographical region was, at least for the Vlakte van de Raan, not based on the best available information present. The deadline for instituting annulment proceedings against the decision of the Commission of 12 December 2008, that was published on 13 February 2009, expired in April 2009<sup>29</sup>. However, the possible success of such an action would, in any event, have been very doubtful. Although the admissibility of an action for annulment by Belgium probably could not be questioned, as Member States are, in contrast to individual applications, privileged applicants that do not have to prove that they have specific interest in bringing proceedings, it remains questionable whether a Member State could successfully ask for the annulment of a decision of the Commission, with referral to its own shortcomings. This could be seen as contrary to the well-known principle '*nemo auditur propriam turpitudinem allegans*'<sup>30</sup>. It could be argued that the Belgian State is indeed partially responsible for a possible erroneous reasoning to enlist the Belgian part of the Vlakte van de Raan as an SCI, making it less evident for it to request the annulment of the Commission Decision of 12 December 2008.

In any event, no annulment proceedings were initiated against the decision of the European Commission, leaving a possible withdrawal of the site from the list with SCIs as the last option in this respect. Yet it remains rather doubtful that the European Commission would, on request of the Belgian state, withdraw the Vlakte van de Raan from the list of SCIs. By doing this, the European Commission would set a precedent, which could undermine the establishment of the European Natura 2000 Network, especially when the reason for withdrawal would find its origins in negligent behavior of a Member State when selecting a site. Probably the European Commission would only be willing to withdraw the Vlakte van de Raan from the list when this site does not fulfill the criteria from the Habitats Directive for the designation of sites. However such a conclusion does not follow from the decision of the Belgian Council of State of February 2008. Moreover, a new scientific study acknowledges the ecological importance of the Belgian part of the Vlakte van de Raan.

On the same grounds, it remains highly questionable whether article 9 of the Habitats Directive, which allows for a declassification where this is warranted by natural

---

<sup>29</sup> According to Article 263 (ex Article 230) of the Treaty on the Functioning of the European Union annulment proceedings "*shall be instituted within two months of the publication of the measure, or its notification to the plaintiff, or, in the absence thereof, of the day on which it came to the knowledge of the latter, as the case may be*".

<sup>30</sup> 'None shall invoke their own turpitude'.

developments<sup>31</sup>, could be invoked. Also, the Court of Justice already pointed out that a Member State may not reduce the surface area of an SPA or alter its boundaries unless the areas excluded from the SPA are no longer the most suitable territories for the conservation of species of wild birds within the meaning of Article 4(1) of the Birds Directive<sup>32</sup>. As in this case such a situation cannot be established, this option is also very unlikely. In sum: a withdrawal of the Vlakte van de Raan from the list of Sites of Community Importance seems very improbable and thus should not be taken into account as a realistic policy option.

### 5.3 Option 3: restart the designation process for the Vlakte van de Raan

The third and, in our opinion, only feasible option is to give full effect to the decision of the Belgian Council of State without contravening the Habitats Directive, which would be to restart the designation process for the Vlakte van de Raan from the very beginning. The annulment of the SAC designation by the Belgian Council of State results in the removal of its legally protected status in the Belgian legal order from the date on which it came into force. The parties to the proceedings have been brought in the situation which they were in before the SAC designation entered into force. As the annulled decision was the first step of the three stage-designation procedure in article 4 of the Habitats Directive, the Belgian government cannot simply suffice by designating the area as an SAC (third stage) again. In order to prevent a new successful judicial complaint against this designation, a solid (scientific) reasoning for selecting the site as being eligible again for identification as an SCI should be provided. Based on the scientific information that is now available, this should not be too troublesome. A problem still arises though as to the coordinates of the site. The site that has been proposed in the scientific report (DEGRAER et al., 2009) overlaps only partly with the first designation. As far as the newer part is concerned, this poses no legal problems, as this can be considered as an extension of the existing site. However, a part of the old designated site is no longer included in the new proposal of the scientific report. It remains doubtful whether the Commission would accept a partial declassification of an SCI, included in the Community list. The federal government has also take into account the specific deadline to designate the site as an SAC. According to article 4, § 4 of the Habitats Directive this designation has to take place as soon as possible or, at least, within a period of 6 years after designation of a site on the Community list. As this was done in 2008, the deadline for final designation is 2014, at least for the part that was already included in the list of Sites of Community

---

<sup>31</sup> Article 9 of the Habitats Directive: “*The Commission, acting in accordance with the procedure laid down in Article 21, shall periodically review the contribution of Natura 2000 towards achievement of the objectives set out in Article 2 and 3. In this context, a special area of conservation may be considered for declassification where this is warranted by natural developments noted as a result of the surveillance provided for in Article 11.*”

<sup>32</sup> Case 191/05, Commission v Portugal (2006), pars. 9-16.

Importance. In case the site is extended, it is advisable to also designate this site at the national level within the same period in order to prevent two designation decisions about largely the same area.

## **6 State liability issues: the devil is in the detail!**

As regards the protected status of the Vlakte van de Raan, it has been demonstrated that most problems can be solved by restarting the designation process and ensure that the area is designated as an SAC at the latest by 2014. However already in 2003, after the suspension by the Council of State of the building and environmental permit for the proposed wind farm on the Vlakte van de Raan, the holders of these permits, nv Electrabel, nv Ondernemingen Jan de Nul and the nv Electrabel Seanergy, introduced an action for damages against the Belgian state at the Court of First Instance in Brussels. Under Belgian law, public authorities are subject to the same rules as any other legal subject regarding non-contractual liability, unless a specific legal provision contains a partial or full exemption from liability. In its so-called Flandria judgment of 5 November 1920<sup>33</sup>, the Court of Cassation held that an act of a public authority, notwithstanding its administrative nature, could constitute 'negligence' in the sense of the Civil code provisions on tort liability. Thus, the provisions of the Civil code, in particular Articles 1382 to 1386 of the Belgian Civil Code, will equally apply: a public authority will be held to compensate persons who have suffered damages that have been caused by the fault or negligence of the public authority. The questions then arises to what extent the actions of the Belgian state with respect to the protection of the Vlakte van de Raan and the proposed wind farm can be considered 'negligent'. Normally, the annulment of a public decision by the Council of State is sufficient to prove that the concerned public authority made a fault or was negligent as required by article 1382 of the Belgian Civil Code. If then a causal link can established between this fault or negligence and the damages suffered by the claimant, the public authority will be required to compensate these damages.

Notwithstanding the above mentioned decisions of the Council of State with respect to the proposed wind farm and the designation of the Vlakte van de Raan as a protected area, the final outcome of the action for damages which has been introduced by the holders of the permits against the Belgian state is hard to predict. After the suspension of the building and environmental permit in 2003 by the Council of State it looked for a while very probable that the introduced action for damages would succeed. In its decision of 2003 the Council of State stated that the Royal Decree of 20 December 2000, which sets out the procedure for obtaining the required environmental and

---

<sup>33</sup> Cass. 5 November 1920, Pasicrisie, 1920, I, p. 193. See also Cass. 7 March 1963, Pasicrisie, 1963, I, p. 744.

building permits, had to be declared illegal on procedural grounds<sup>34</sup>. More specifically, it was adjudged that the Belgian government wrongfully had refused to make the draft of this Decree subject to a full-fledged advise to the legislative branch of the Council of State. If the Council of State would have confirmed this view in its decision on the request for annulment, the Court of First Instance of Brussels could have easily concluded that the erroneous adoption of the Royal Decree amounted to negligent governance. However, as mentioned before, the Council of State finally rejected these procedural and the other, more substantive, objections to the permits for the wind farm in its final decision of June 2005, thereby making the successful outcome of the, in the meantime, initiated action for damages less evident (see above, 3.2.). With the withdrawal of the permits in 2005 and the annulment of the designation of the Vlakte van de Raan as protected site in 2008, the outlook of the liability case changed again, although not necessarily to the detriment of the Belgian State as the (contested) decision to withdraw the permits was finally declared legal by the Council of State in 2009<sup>35</sup>. In the latter decision the Council of State stated that a public authority is allowed to withdraw a permit if an annulment procedure is still pending before the Council of State and referral is made to the illegality grounds invoked in the latter procedure. As mentioned above, the Minister referred explicitly to the fact that in one of the, at the moment, still pending judicial procedures, it had been argued that the existence of a strategic planning framework was indispensable before granting permits for wind farm-construction. The Council of State seemed to approve this point of view in its decision of 28 May 2009. It acknowledged the necessity of having a marine planning framework present before granting the permits for the proposed wind farm on the Vlakte van de Raan. The establishment of the above mentioned (see above, 3.3.) Master plan for the North Sea during 2003 and 2004 was considered a further proof of the fact that the Minister had sufficient grounds to withdraw the contested permits. The Council also rejected the view that the annulment of the designation of the Vlakte van de Raan as a protected area in 2008 should be seen as a proof of the failure of the marine spatial planning framework, which had been initiated in 2004. Hence it can be expected that the latter decision of the Council of State will be invoked by the counselors of the Belgian state in order to support the view that it had acted as a '*bonus pater familias*', whereas the former holders of the permits will argue that the shift of policy with respect to wind farm development on the Vlakte van de Raan should still be seen as government negligence. Until now, no verdict has been issued about the action for damages, not even in first instance. Therefore, it remains to be seen to what extent the Court of First Instance of Brussels will rely on the earlier decisions of the Council of State in this respect.

---

<sup>34</sup> Decision Belgian Council of State 25 March 2003, no. 117.482.

<sup>35</sup> Decision Belgian Council of State 28 May 2009, no. 193.599.

## 7 Conclusion

Given the European policy aim to increase the share of renewable energy to 20% of Europe's total energy production in 2020 and the rapid growth of offshore wind energy in Europe the past years, it is clear that offshore wind farms and their associated infrastructure pose new challenges for the designation and conservation of marine protected areas. The numerous judicial proceedings surrounding the proposed construction of a wind farm on the Vlakte van de Raan, illustrate the potential pitfalls and delays when wind farm development is initiated without having a strategic planning framework ready yet. The decisions of the Belgian Council of State with respect to the previously issued permits for the proposed wind farm on the Vlakte van de Raan and the subsequent designation of the area as an SAC, serves in the first place as an illustration of the possible contradictions which could arise between wind farm development and biodiversity protection. Yet in its decision of 28 May 2009 the Council of State clearly acknowledged, although in an indirect way, the importance of marine spatial planning in order to identify the most appropriate locations for offshore wind energy. In its recent Guidance on wind energy development and Natura 2000 the European Commission moreover rightly observed that marine spatial planning provides a mechanism for stakeholder involvement, which is particularly important as multiple organizations have competences and/or roles in the planning and management of activities in the marine environment (COMMISSION, 2010).

By acknowledging the reasoning behind the withdrawal of the previously issued permits, the Council of State also made a successful outcome of the damage claim initiated against the Belgian state less probable. The Master plan for the North Sea, which has been established during the years 2003 and 2004, made a more strategic approach to wind farm development in the Belgian part of the North Sea possible. It is a first step towards a legally binding framework with respect to marine spatial planning. In the second half of 2012 the Law on the protection of the marine environment probably will be modified in order to allow the adoption of a legally binding marine strategic and spatial plan for the Belgian part of the North Sea. In the meantime it is clear that in the coming years offshore wind energy development will be further focused on the Thornton bank, further offshore. In any event, the approval of the validity of the withdrawal of the above mentioned permits excluded the option of any offshore wind energy development on the Vlakte van de Raan in the short term. Lastly, in order to avoid a possible infringement procedure by the European Commission, the Belgian government will have to designate the Vlakte van de Raan again before 2014. By then also the necessary conservation objectives and measures for this protected site, together with the other parts of the marine Natura 2000 Network in the Belgian part of the North Sea, will have to be established. In sum: there is clearly no lack of further challenges for the conservation of biodiversity in the Belgian marine waters during the coming years.

## 8 References

- Bogaert, D., Cliquet, A. & Maes, F. (2009): Designation of marine protected areas in Belgium: legal and ecological success? *Marine Policy*, pp. 878–886.
- Bogaert, D., Cliquet, A., De Waen, D. & Maes, F. (2008): The designation of Marine Protected Areas in Belgium. An Analysis of the Decision Making Process. In: Bogaert D. and Maes F. (eds.): *Who Rules the Coast. Policy Processes in Belgian MPAs and Beach Spatial Planning*. Antwerpen: Maklu, pp. 57-105.
- Cliquet, A. (2003a): Planning procedures for offshore wind farms in Belgium. Relation to nature conservation. In: Petersen H. and Neumann F. (eds.), *Workshop Report. Offshore Wind Farms and Designated Areas, Topical Expert Workshop, Institute of Infrastructure, Environment and Innovation, Brussels, 14 and 15 January 2003*, pp. 8-9.
- Cliquet, A. (2003b): Infrastructuurwerken en natuurbehoud: de casus van de offshore windmolenparken in België. In: Neumann, F. & Woldendorp, H. (eds.), *Praktijkboek habitattoets. Praktische leidraad voor de toepassing van natuurbeschermingswetgeving bij projecten in Nederland en Vlaanderen*, SDU Uitgevers, Den Haag, pp. 121-135.
- Cliquet, A. (2008): De aanwijzing en het beheer van de Natura 2000-gebieden in Vlaanderen en het Belgisch deel van de Noordzee (2008). In: Teasing N. (ed.), *Wie beschermt het natuurbeschermingsrecht?*, Boom Juridische Uitgevers, Den Haag, pp. 36-37.
- Cliquet, A., Bogaert, D. & Maes, F. (2008a): Implementation of Natura 2000 in the marine environment. A Belgian case study, *Proceedings Littoral 2008. A changing coast: challenge for the environmental policies*, Venetië, 25-28 November 2008.
- Cliquet, A., Bogaert, D. & Maes, F. (2008b): The legal framework for marine protected areas in Belgium. In: Bogaert D. and Maes F. (eds.): *Who Rules the Coast. Policy Processes in Belgian MPAs and Beach Spatial Planning*, Antwerpen, Maklu, 2008, pp. 21-56.
- Cliquet, A. & Maes, F. (1998): The new Belgian law on the protection of the marine environment. *Journal of International Wildlife Law and Policy*, pp.395-402.
- Degraer, S., Braeckman, U., Haelters, J., Hostens, K., Jacques, T., Kerckhof, F., Merckx, B., Rabaut, M., Stienen, E., Van Hoey, G., Van Lancker, V. & Vincx, M. (2009): Studie betreffende het opstellen van een lijst van potentiële Habitatrictlijngebieden in het Belgische deel van de Noordzee, Eindrapport in opdracht van de Federale Overheidsdienst Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu, Directoraat-generaal Leefmilieu Brussel, pp. 79-83.
- Douvere, F., Maes, F., Vanhulle, A. & Schrijvers, J. (2007): The role of marine spatial planning in sea use management. The Belgian case, *Marine Policy* 31 (2): 182-191.
- European Commission (2010): *Wind energy developments and Natura 2000*, pp. 47-48.
- Maes, F., Schrijvers, J. & Vanhulle, A. (red.) (2005): *A flood of space. Towards a spatial structure plan for the sustainable management of the North Sea*, Brussels, Belgian Science Policy, 204 p.
- Plasman, C. (2008): Implementing marine spatial planning: A policy perspective, *Marine Policy* 32 (5): 811-815.

Rabaut, M. & Cliquet, A. (2011): The dynamics of the marine environment versus the rigid interpretation of nature conservation law. In: Riley, A.T. (ed.): *Advances in Environmental Research*, Ed. by Series 3: 191-210.

Rabaut, M., Degraer, S., Schrijvers, J., Derous, S., Maes, F., Bogaert, D., Vincx, M. & Cliquet, A. (2008): Ecological and Legal Analysis of the 'MPA-process' in Temperate Continental Shelf Areas. The Belgian Part of the North Sea as Case Study, *Aquatic Conservation: Marine and Freshwater Ecosystems* 19: 596-608.

Schoukens, H. (2008): Het beschermingsregime voor Natura 2000-gebieden in Vlaanderen. In: Teesing N. (ed.), *Wie beschermt het natuurbeschermingsrecht?*, Boom Juridische Uitgevers, Den Haag, pp. 82-98.

Somers, E. & Maes, F. (2001): The law applicable on the continental shelf and in the exclusive economic zone: The Belgian perspective, *Ocean Yearbook* 25 249-276.

# Great Barrier Reef Region Strategic Assessment

JOSH GIBSON, JON DAY, KIRSTIN DOBBS, FERGUS MOLLOY

Great Barrier Reef Marine Park Authority, Australia

## 1 Introduction

In February 2012 the Australian and Queensland Governments committed to undertaking a comprehensive strategic assessment of the Great Barrier Reef World Heritage Area. Strategic assessments are landscape scale assessments which allow us to look at the impacts of multiple activities on values and the effectiveness of management arrangements to protect values. The comprehensive strategic assessment of the Great Barrier Reef World Heritage Area represents the largest and most complex strategic assessment undertaken in Australia.

### 1.1 Background

The Great Barrier Reef is the largest coral reef ecosystem in the world, spanning a length of 2,300km along the coast of Queensland (Figure 1). It comprises over 2,900 individual reefs and its diverse range of habitats and extraordinary biodiversity make the Great Barrier Reef one of the richest and most complex natural ecosystems found on earth.

Since the early 1980s areas of the Great Barrier Reef have been progressively included in the Australian Government's Great Barrier Reef Marine Park (Marine Park), which today covers 344,400km<sup>2</sup>. In 1981 the Great Barrier Reef was inscribed on the World Heritage list in recognition of its Outstanding Universal Value, meeting all four natural criteria. The Marine Park incorporates approximately 99% of the World Heritage Area, but does not include most islands, port areas and some inland waters of the State of Queensland.

The Great Barrier Reef supports a wide range of uses, including Indigenous cultural use, tourism, fishing, ports, shipping, defence training activities, recreation and scientific research. The Marine Park and World Heritage Area have, since their inception, provided for sustainable use, consistent with the overriding object to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region.



Figure 1: Great Barrier Reef Region.

## 1.2 Management

Management of the Great Barrier Reef involves a number of agencies. The Great Barrier Reef Marine Park Authority (GBRMPA) is the primary Federal Government agency responsible for the planning and management of the Marine Park. GBRMPA is also responsible for assisting the Australian Government to meet its international responsibilities in relation to the environment and protection of world heritage. Various Queensland Government agencies are involved in the management of the Great Barrier Reef and adjoining lands and tidal waters. Joint management arrangements between the Australian and Queensland Governments are formalised and guided by agreements between the Prime Minister of Australia and the Premier of the State of Queensland<sup>1</sup>.

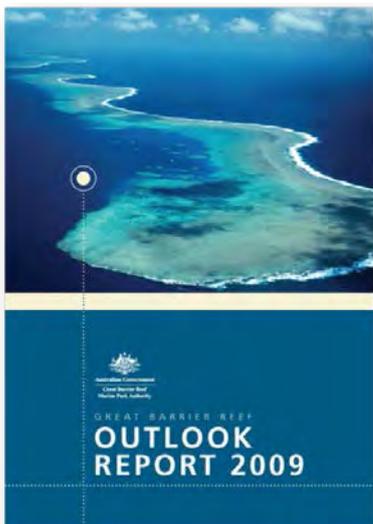
A combination of tools and approaches are used in the management of the Great Barrier Reef Region (Table 1). Legislative instruments include zoning plans, plans of management; species recovery plans, permits and enforcement provisions. Non-legislative tools which guide management intent include strategies, policies, position statements and guidelines. Decision-making is underpinned by the best available

<sup>1</sup> Great Barrier Reef Intergovernmental Agreement  
[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0003/3189/gbr-agreement-2009.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0003/3189/gbr-agreement-2009.pdf)

research, scientific data and information, and GBRMPA works closely with research and scientific institutes to identify and prioritise its research information needs for management (GBRMPA, 2009a). GBRMPA encourages community engagement in the protection and management of the Great Barrier Reef. This includes partnerships with Traditional Owners in the management of marine resources<sup>2</sup>, and partnership and stewardship programs, including education programs, with industry sectors, local government and regional communities. GBRMPA's Reef Guardian Program<sup>3</sup> provides a platform for it to work closely with those who use and rely on the Reef or its catchment for their business or recreation to help build a healthy Reef. GBRMPA adopts an adaptive, ecosystem-based management approach to the management of the Great Barrier Reef. The condition and trend of biodiversity values which underpin the health and resilience of the Great Barrier Reef, key risks and management effectiveness are constantly reviewed and updated in response to new and emerging issues. A comprehensive report on the Outlook of the Great Barrier Reef is compiled every five years (GBRMPA, 2009b).

### 1.3 Key Risks

In 2009, GBRMPA identified, through its *Great Barrier Reef Outlook Report* (Figure 2), that the Great Barrier Reef ecosystem is at a crossroad and decisions Australia makes now are likely to determine its long-term future. Climate change, declining water quality from catchment runoff, coastal development and remaining impacts from fishing were identified as the biggest risks to the future of the Reef.



Since this 2009 report, some of the identified risks to the Reef have increased. These include increases in shipping activity as a result of port expansions; population growth as a result of expanding urban and industrial activities along the Great Barrier Reef coast; intensification and changes in land use within the Great Barrier Reef catchment; and extreme weather events including flooding and cyclones.

**Figure 2:** Great Barrier Reef Outlook Report.

<sup>2</sup> Traditional Use of Marine Resources Agreements  
<http://www.gbrmpa.gov.au/our-partners/traditional-owners/traditional-use-of-marine-resources-agreements>

<sup>3</sup> Reef Guardians Program  
<http://www.gbrmpa.gov.au/our-partners/reef-guardians>

**Table 1:** List of management tools and their purpose.

<b>Management tool</b>	<b>Purpose</b>
<b>Act and Regulations</b>	The <i>Great Barrier Reef Marine Park Act 1975</i> and <i>Great Barrier Reef Marine Park Regulations 1983</i> govern the protection and management of the Great Barrier Reef Marine Park. They provide for the zoning plan and plans of management, and govern permit decisions. They include offence and penalty provisions (e.g. prohibition of mining).
<b>Zoning Plan</b>	Provides spatial control of use (predominantly extractive activities) and, to a lesser extent, access within the Great Barrier Reef Marine Park. Establishes the need for permits for some uses in the Marine Park, such as tourism, infrastructure and research. There are complementary arrangements in adjacent areas under Queensland jurisdiction.
<b>Management plans</b>	Set out specific arrangements for areas, species, ecological communities or activities (e.g. Cairns Area and Whitsundays Plans of Management). They complement zoning and permit arrangements. Some components are legally binding.
<b>Permits</b>	Facilitate opportunities for use of the Great Barrier Reef Marine Park. Permits are issued for marine tourism, research, harvest fisheries, dredging and infrastructure (e.g. jetties and marinas) and include detailed environmental impact assessment. Matched in adjacent areas of Queensland jurisdiction, generally through the provision of a joint permit. Fisheries licences are issued by the Queensland Government.
<b>Traditional Use of Marine Resources Agreements</b>	Formal agreements describing how Traditional Owner groups work with Australian and Queensland governments to manage traditional use activities in sea country.
<b>Strategic Assessments</b>	Strategic assessments are broad landscape-scale environmental assessments of a policy, plan or program under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> . They differ from the usual project-by-project impact assessments which focus on specific development activity.
<b>Compliance</b>	Activities that encourage adherence with legal requirements, both through education and enforcement. Includes both formal (e.g. Field Management Program jointly undertaken with the Queensland Government) and informal (e.g. Eyes and Ears Incident Reporting Program) activities.

<b>Management tool</b>	<b>Purpose</b>
<b>Policy documents</b>	<p>Specific arrangements that guide decision makers and the public. These include: strategies which outline a long-term approach to managing an issue (e.g. Recreation Management Strategy)</p> <p>policies which provide a statement of principles to guide decision-making (e.g. Environmental Impact Management Policy);</p> <p>site management arrangements which are localised plans for use of sites with significant values and/or use issues (e.g. Clump Point Site Plan);</p> <p>position statements which outline GBRMPA's position on an issue where it has a strong interest but no direct regulatory control (e.g. Position Statement on Indigenous participation in tourism)</p> <p>Guidelines which detail recommended practice in support of a policy or position statement (e.g. Guidelines on coral transplantation).</p>
<b>Site infrastructure</b>	<p>On-ground infrastructure installed to better protect the values of individual sites (e.g. reef protection markers, public moorings, signs). Implemented and maintained by the GBRMPA and the Queensland Government through the Field Management Program.</p>
<b>Partnerships</b>	<p>Formal arrangements, often executed through a memorandum of understanding (MOU) or an agreement, to enable a partnership approach to management of the Marine Park (e.g. Intergovernmental Agreement with the Queensland Government, Reef Advisory Committees, Local Marine Advisory Committees, MOU with a government agency, partnership with Ecotourism Australia).</p>
<b>Education &amp; community awareness</b>	<p>Programs to inform and motivate members of the community about the Great Barrier Reef and its protection and management, including ways they can contribute (e.g. Reef HQ, GBRMPA website, information sheets, zoning maps).</p>
<b>Stewardship and best practice</b>	<p>Voluntary arrangements with stakeholders that provide the opportunity for contributions to protection and management (e.g. Reef Guardian Programs, Provision Reef Stewardship Action Plan, best environmental practices).</p>
<b>Research and monitoring</b>	<p>Undertaken or commissioned by GBRMPA to better inform decisions on protection and management of the Great Barrier Reef (e.g. Reef Health Indicator Surveys, Eye on the Reef monitoring, Climate Change research programs).</p>

## 2 Strategic Assessment

The latest adaptive management measure to ensure the ongoing protection of the Great Barrier Reef is the February 2012 formal agreement<sup>4</sup> between the Federal Environment Minister and GBRMPA to undertake a strategic environmental assessment of the Great Barrier Reef Region. The strategic assessment is one of several actions being carried out in response to concerns raised by the World Heritage Committee<sup>5</sup> about the increasing pressure of urban and industrial development along the Queensland coastline.

The strategic assessment is being carried out under Australia's Federal *Environment Protection and Biodiversity Conservation Act 1999* and will examine the effectiveness of the GBRMPA's management arrangements to protect and conserve values which underpin the Great Barrier Reef's World Heritage listing and Marine Park declaration.

Recognising that many of the major pressures on the Great Barrier Reef ecosystem occur outside the marine environment, a second parallel strategic assessment is being carried out by the State of Queensland. This assessment will examine the effectiveness of arrangements under the Queensland coastal management, planning and development framework to ensure that development occurs sustainably and does not impact unacceptably on the Great Barrier Reef World Heritage Area.

GBRMPA and the Queensland Government are working together to analyse impacts at the marine-coastal interface from activities such as coastal development and shipping, and on water quality and island management.

The decision to undertake two, complementary strategic assessments recognises the need for an integrated ecosystem based approach to management of land and marine environments with the capacity to impact on Great Barrier Reef health and resilience.

### 2.1 Process

Strategic assessments enable a 'big picture' approach to environment, biodiversity and heritage protection that provide certainty in the long-term, by determining where sustainable development can occur, the type of development that will be allowed and

---

<sup>4</sup> Strategic Assessment Agreement between the Minister for Sustainability, Environment, Water, Population and Communities and the GBRMPA  
[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0008/26909/s146-gbr-strategic-assessment-gbrmpa.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0008/26909/s146-gbr-strategic-assessment-gbrmpa.pdf)

<sup>5</sup> World Heritage Committee Decision 36COM 7B.8, Great Barrier Reef (Australia) (N 154) 2012.  
<http://whc.unesco.org/en/decisions/4657/>

the conditions under which development may proceed. They differ from the usual project-by-project impact assessments which focus on a specific development activity.

The strategic assessment process is a collaborative one between the Australian Government and the strategic assessment partners, in this instance GBRMPA and the Queensland Government, and includes two formal rounds of public consultation (DSWEPAC, 2012).

The comprehensive strategic assessment is the largest and most complex strategic assessment undertaken in Australia. It will include both a broad examination of the Great Barrier Reef Region and more focussed studies of specific locations and issues.

Terms of Reference<sup>6</sup> for the strategic assessments were approved by the Federal Environment Minister on 30 August 2012 and these set out the requirements for the assessment. Key steps include:

1. **Identifying and describing values to be protected:** This includes ecological, social, cultural and economic values that underpin matters of national environmental significance. Values are wide-ranging, and may differ between industry, community and individuals. Capturing these differences and mapping and describing these values is the first step of the strategic assessment process.
2. **Identifying and analysing impacts and pressures to the values:** It is important to understand how different impacts and pressures impact on values in order to assess the effectiveness of management. Impacts may include climate change, extreme weather, and coastal development.
3. **Assessing management effectiveness:** The strategic assessment will examine how current management arrangements protect values. Demonstration cases will be used as examples to examine management effectiveness, such as looking at the management of a particular region or species. This will also help to show how policy and legislative processes are practically applied.
4. **Recommending improvements to management arrangements:** Recommendations will be made based on the findings of the strategic assessment, and may include recommendations to modify GBRMPA's management arrangements or recommended improvements to related local state or national government programs or policies.

---

<sup>6</sup> Great Barrier Reef Region Strategic Assessment Terms of Reference

[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0010/26866/Great-Barrier-Reef-Region-Strategic-Assessment-Terms-of-Reference.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0010/26866/Great-Barrier-Reef-Region-Strategic-Assessment-Terms-of-Reference.pdf)

## 2.2 Outputs

The strategic assessment will collectively look at planned future development and decision-making processes to protect environmental values and guide Great Barrier Reef management for the next 25 years. It will deliver two reports:

### 1. A Strategic assessment report

- describing values to be protected
- identifying and describing impacts
- assessing management effectiveness
- describing projected condition of values
- recommending improvements to management.

The strategic assessment will use methods consistent with, and build upon approaches employed in, the *Great Barrier Reef Outlook Report* (GBRMPA, 2009b), the *Climate Change Action Plan* (GBRMPA, 2007), the draft *Great Barrier Reef Biodiversity Conservation Strategy* (GBRMPA, 2012a), the *Informing the Outlook for Great Barrier Reef Coastal Ecosystems* Technical Report (GBRMPA, 2012b) and supporting Vulnerability Assessments<sup>7</sup>

GBRMPA will also commission independent expertise to assess the effectiveness of its existing management arrangements and a peer review of the Strategic Assessment Report.

### 2. A Program report

- describing existing management arrangements
- recommending modifications for improvement
- outlining forward commitments (25 year timeframe)

Outcomes of the strategic assessment, including recommendations for future management will be presented to the Federal Environment Minister for consideration. Endorsement is subject to the Minister being satisfied that the management arrangements described in the Program Report adequately identify and address impacts on values and addresses the terms of reference for the strategic assessment. Once endorsed management actions can be implemented and will subject to ongoing adaptive management, monitoring, review and reporting.

---

<sup>7</sup> Great Barrier Reef Marine Park Authority Vulnerability Assessments

<http://www.gbrmpa.gov.au/about-the-reef/biodiversity/draft-biodiversity-conservation-strategy/vulnerability-assessments>

### 2.3 Outcomes

The strategic assessment will improve our understanding of the multiple or 'combined' impacts on the Great Barrier Reef values arising from pressures such as coastal development, existing use, climate change and extreme weather events. It will:

- assess the ability for existing management arrangements to predict, monitor and report on multiple impacts and make recommendations for ways to improve our current management approach.
- ensure that the management tools used by GBRMPA are most effectively tackling the range of past, present and likely future impacts associated with coastal development and protecting Reef values.
- provide greater certainty on where sustainable development may occur, the types of activities allowed and the conditions under which activities may proceed.
- set the strategic direction for Great Barrier Reef management for the next 25 years.

### 2.4 Timeframes

It is anticipated that draft strategic assessment and program reports will be finalised for public comment in early-mid 2013 and finalised in the later part of 2013.

## 3 Further information

Further information on the strategic assessment, including progress updates may be obtained at [www.gbrmpa.gov.au](http://www.gbrmpa.gov.au).

### Acknowledgements

The authors would like to thank BfN for the opportunity to present at the 3<sup>rd</sup> International Conference in Progress in Marine Conservation in Europe and participate in the BfN-GBRMPA exchange program.

## 4 References

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012): A Guide to Undertaking Strategic Assessments, *Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia

<http://www.environment.gov.au/epbc/publications/pubs/strategic-assessment-guide.pdf>

Great Barrier Reef Marine Park Authority (2007): Great Barrier Reef Climate Change Action Plan 2007 – 2011, Great Barrier Reef Marine Park Authority, Townsville

[http://www.gbrmpa.gov.au/\\_\\_\\_data/assets/pdf\\_file/0020/4493/climate-change-action-plan-2007-2012.pdf](http://www.gbrmpa.gov.au/___data/assets/pdf_file/0020/4493/climate-change-action-plan-2007-2012.pdf)

Great Barrier Reef Marine Park Authority (2009a): Scientific Information Needs for the Management of the Great Barrier Reef Marine Park 2009-2014, Great Barrier Reef Marine Park Authority, Townsville

[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0019/3376/GBRMPA\\_Scientific\\_Information\\_Needs.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0019/3376/GBRMPA_Scientific_Information_Needs.pdf)

Great Barrier Reef Marine Park Authority (2009b): Great Barrier Reef Outlook Report 2009, Great Barrier Reef Marine Park Authority, Townsville

[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0018/3843/OutlookReport\\_Full.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0018/3843/OutlookReport_Full.pdf)

Great Barrier Reef Marine Park Authority (2012a): Draft Great Barrier Reef Biodiversity Conservation Strategy 2012, Great Barrier Reef Marine Park Authority, Townsville

[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0020/21728/gbrmpa-BioStrategy-DRAFT-Aug-2012.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0020/21728/gbrmpa-BioStrategy-DRAFT-Aug-2012.pdf)

Great Barrier Reef Marine Park Authority (2012b): Informing the outlook for Great Barrier Reef coastal ecosystems, Great Barrier Reef Marine Park Authority, Townsville

[http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0006/28257/Informing-the-Outlook-for-Great-Barrier-Reef-coastal-ecosystems.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0006/28257/Informing-the-Outlook-for-Great-Barrier-Reef-coastal-ecosystems.pdf)

## **Marine Nature Conservation and Fisheries in Europe**

---



# Towards Sustainable Fisheries in Europe

RAINER FROESE

GEOMAR, Germany

## Abstract

Global catches stagnate at about 80 million tonnes since the late 1980s while global fishing effort is increasing. This means that global fish stocks are declining in abundance. These trends are even more pronounced in European waters. Many European stocks are still overfished with stock sizes near the border to compromised reproduction. For most stocks, Europe will not be able to fulfill international obligations to rebuild stocks to sizes that can produce the maximum sustainable yield. Under reasonable management, catches in Europe could be up to 60% higher than currently, from healthy stocks with highly profitable fisheries. Latest news from the reform process of the Common Fisheries Policy of Europe are not encouraging: a reasonable reform proposal by the European Commission is weakened by resistance in the Council of Agriculture Ministers. The role of the International Council for the Exploration of the Seas (ICES) in the reform process is discussed.

## 1 Status of global fish stocks

In its recent report on the status of global fisheries (FAO, 2010), the Food and Agriculture Organization of the United Nations proposed that the stagnation of global catches at around 80 million tonnes since the late 1980s is a reassuring sign of stability. Pauly and Froese (2012) disagree and point out that during that period the global fishing effort, i.e., the time, gears, diesel, and person days spent on fishing, have increased significantly. Stagnating catches with increasing effort means that the abundance of the fish in the water is decreasing: therefore global fish stocks must be shrinking.

In a separate study, Froese et al. (2012) show that the number of overfished and collapsed stocks continues to rise globally, with 24% of about 2000 analyzed stocks providing less than 10% of the catches they previously supported. This result stands in stark contrast to the analysis performed by FAO on about 400 fully assessed stocks which present 80% of the world catches. Based on these resilient stocks which have withstood high fishing pressure for decades, FAO considers only 3% of the global stocks as collapsed.

## **2 Status of European Stocks**

An analysis of European stocks shows that they have been even more systematically overexploited than global stocks: in European waters, 32% of the stocks (e.g. eel, dog fish, salmon, North Sea cod) are considered as collapsed (FROESE et al., 2012). This was caused by excessive fishing pressure of 2-3 times the international reference point agreed in the Law of the Sea (UNCLOS, 1982) and the United Nations Fish Stock Agreement (UNFSA, 1995). As a result, European fish stocks were fished down to a size where successful reproduction may be compromised. Keeping stocks at exactly this lowest level of safe biological limits was the core element of the European Common Fisheries Policy until recently (FROESE & PROELSS, 2010).

## **3 A Proposal for Future European Harvest Control Rules**

A group of international experts (FROESE et al., 2011) has proposed broadly applicable harvest control rules for European fisheries. These rules for sustainable and profitable fisheries were based on 1) economic optimization of fisheries, 2) honoring international agreements, 3) true implementation of the precautionary principle, 4) learning from international experiences, 5) the ecosystem-approach to fisheries management, and 6) recognition of the biology of European fish stocks. The authors showed that if these rules were applied, catches could increase by 63%. Froese and Quaas (2011) use the example of the recovering eastern Baltic cod (*Gadus morhua*) to show that rebuilding stocks make good economic sense. If the above harvest control rules were applied to this stock, profits of fishers would increase 4-fold in less than 10 years. Similarly, if the rules had been applied to the collapsed North Sea cod stock in 2003, and consequently the fishery had been closed for three subsequent years as requested by ICES, the stock would likely have recovered to 8 times its current size, and profits of fishers would have increased more than 10 fold. Instead, the stock remains far outside of safe biological levels in 2011 (FROESE & QUAAS, 2012).

## **4 Seafood Labels to the Rescue**

Seafood labels promise products from healthy stocks and sustainable fisheries. Froese and Proelss (2012) put that claim to a test. They examined all stocks certified by the Friend of the Sea (FoS) and the Marine Stewardship Council (MSC) in April 2011. They found that 19% (FoS) to 31% (MSC) of certified stocks were overfished (MSC prefers to call that 'depleted' instead of 'overfished') and suffered from ongoing overfishing. But 61% (MSC) to 81% (FoS) of the stocks with data were large enough and moderately exploited, which was better than the corresponding 15% in uncertified stocks. Therefore, buying certified seafood still makes sense.

## 5 News from the CFP Reform

Europe is currently in the process of reforming its failed Common Fisheries Policy. Towards that end, the European Commission (under Commissioner Maria Damanaki) has presented an ambitious reform proposal. In response, the Council of Agriculture Ministers has now decided upon its 'compromise' position and the European Parliament will present its position in October. The 'compromise' of the Council postpones sustainable fishing for stocks without reference points (the majority) until 2020. Lots of loopholes for continued overfishing were introduced, e.g. for not 'significant' species in mixed fisheries, for which the MSY-concept shall not apply. Also, the broadly agreed reduction of discards shall be introduced in a much delayed and highly bureaucratic manner. Subsidies for fisheries, which are one of the main drivers of overfishing, shall continue. With such politics, fish and fishers in Europe will remain endangered species.

## 6 Role of ICES in the CFP Reform Process

ICES has traditionally refused any responsibility for the status of European fish stocks. In practice, this refusal has contributed to continued overfishing. For example, the Law of the Sea of 1982 established the binding commitment for its parties (including the EU and all European member states) to rebuild stocks to a size (*B<sub>msy</sub>*) that can produce the maximum sustainable yield (*MSY*). However, to date ICES refuses to provide (easily obtained) estimates of *B<sub>msy</sub>* and *MSY*, thus depriving politicians and the public of these internationally agreed reference points for sustainable management. More recently, ICES has presented a multispecies management plan (ICES, 2012) for the Baltic. This plan presents as only example of multispecies management the continued overfishing for Baltic sprat and herring and extreme overfishing of cod. This example is incompatible with binding international and European law. Moreover, it is ignorant of widely agreed scientific principles of ecosystem-based fisheries management, where the mortality caused by humans may not exceed the mortality caused by other, natural predators (CURY et al., 2011, PIKITCH et al., 2012). In general, ICES advice and reference points often favor high fishing pressure, with proposed sustainable fishing pressure (*F<sub>msy</sub>*) exceeding rates of natural adult mortality by 50% on average.

## 7 Graphs

The graphs supporting the points made in this paper are available from the respective presentation which can be downloaded from [www.fishbase.de/rfroese](http://www.fishbase.de/rfroese) under the 'Oral presentations' section.

## 8 References

- Cury, P. et al. (2011): Global seabird response to forage fish depletion – one-third for the birds. *Science* 334: 1703-1706.
- FAO (2010): The state of the world fisheries and aquaculture. Rome: Food and Agriculture Organization of the United Nations.
- Froese, R. & Proelss, A. (2010): Rebuilding fish stocks no later than 2015: will Europe meet the deadline? *Fish and Fisheries* 11: 194-202.
- Froese, R., Branch, T.A., Proelss, A., Quaas, M., Sainsbury, K. & Zimmermann, C. (2011): Generic harvest control rules for European fisheries. *Fish and Fisheries* 12:340-351.
- Froese, R. & Quaas, M. (2011): Three options for rebuilding the cod stock in the eastern Baltic Sea. *Marine Ecology Progress Series* 434: 197-2011.
- Froese, R. & Quaas, M. (2012): Mismanagement of the North Sea cod by the Council of the European Union Ocean & Coastal Management. DOI 10.1016/j.ocecoaman.2012.04.005.
- Froese, R. & Proelss, A. (2012): Evaluation and legal assessment of certified seafood. *Marine Policy*, doi:10.1016/j.marpol.2012.03.017.
- Froese, R., Zeller, D., Kleisner, K. & Pauly, D. (2012): What catch data can tell us about the status of global fisheries. *Marine Biology* 159: 1283-1292.
- ICES (2012): Multispecies considerations for the central Baltic stocks: cod in Subdivisions 25–32, herring in Subdivisions 25–29 and 32, and sprat in Subdivisions 22–32. Retrieved from [http://www.ices.dk/committe/acom/comwork/report/2012/2012/Baltic\\_multispecies\\_advice.pdf](http://www.ices.dk/committe/acom/comwork/report/2012/2012/Baltic_multispecies_advice.pdf) in June 2012.
- Pauly, D. & Froese, R. (2012): Comment's on FAO's state of fisheries and aquaculture, or 'SOFIA 2010'. *Marine Policy* 36: 746-752.
- Pikitch, E. et al. (2012): Little fish, big impact. Managing a crucial link in ocean food webs. Lenfest Ocean Program. Washington, DC. 108 pp.
- UNCLOS (1982): United Nations Convention on the Law of the Sea. 1833 UNTS 3. Retrieved from [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/unclos\\_e.pdf](http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf) in April 2011.
- UNFSA (1995): Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982, relating to the conservation and management of straddling fish stocks and highly migratory fish stocks. 2167 UNTS 88. Retrieved from: [http://www.un.org/Depts/los/convention\\_agreements/texts/fish\\_stocks\\_agreement/CONF164\\_37.htm](http://www.un.org/Depts/los/convention_agreements/texts/fish_stocks_agreement/CONF164_37.htm) in April 2011.

# Role of No-take Marine Reserves in the Protection of Marine Biodiversity

JOSH GIBSON, DARREN CAMERON, JON DAY, KIRSTIN DOBBS, LAURENCE MCCOOK, MARK READ, RANDALL OWENS, DAVID WACHENFELD

Great Barrier Reef Marine Park Authority, Australia

## 1 Introduction

The 2003 Zoning Plan for the Great Barrier Reef Marine Park provides a valuable case study for examining the process and effects of implementing a large scale zoning network, including a representative system of marine reserves. The development and implementation of this Zoning Plan resulted in a seven-fold increase in the area of no-take zones across the Great Barrier Reef. The combination of best practice implementation and a carefully targeted monitoring program provides a valuable opportunity to explore the potential benefits and role that no-take zones play in the protection of marine biodiversity and ecosystem health.

### 1.1. Background

The Great Barrier Reef comprises the world's largest system of coral reefs, together with islands, inter-reefal lagoons, seagrasses, mangroves and open waters. It is an area of extraordinary biodiversity, with 70 distinct bioregions, each with its own distinct plant and animal assemblages and physical features. Almost all of the Great Barrier Reef ecosystem is included within the Federal Great Barrier Reef Marine Park (Marine Park), which extends over 2,300km along the coast of Queensland and covers approximately 344, 000km<sup>2</sup>. The Marine Park is complemented by the Great Barrier Reef Coast Marine Park in adjacent Queensland (State) waters. In 1981 the Great Barrier Reef was inscribed on the World Heritage list in recognition of its Outstanding Universal Value. Since its inception, the Great Barrier Reef Marine Park has been managed as a multiple use Marine Park. It supports a wide range of commercial and non-commercial uses, consistent with the protection of its environment, biodiversity and heritage values. The *Great Barrier Reef Marine Park Zoning Plan 2003* is the primary management instrument for the protection and management of the area's biodiversity, heritage and use values. In the mid-1990s concerns were raised that the levels of protection provided by the zoning at the time were inadequate to protect the range of biodiversity that existed in the Marine Park. Less than 5% of the Marine Park was in 'no-take' zones, these areas were largely confined to coral reefs or the remote far north

of the Marine Park and the protection for many habitat types in no-take reserves was minimal.

## 2 Zoning Process

Between 1999 and 2003, the Great Barrier Reef Marine Park Authority (GBRMPA) undertook a systematic planning and consultation program, known as the 'Representative Areas Program', to develop a new Zoning Plan for the Marine Park. The primary aim of the Representative Areas Program was to better protect the range of biodiversity in the Great Barrier Reef, in part by increasing the extent of no-take areas and ensuring they included representative examples of all the different habitat types. In addition to protecting biodiversity, the program also aimed to maximise the benefits and minimise the negative impacts on the existing users of the Marine Park. The Representative Areas Program and subsequent re-zoning of the Marine Park involved several stages or phases. The process has been documented in a number of publications, including Day et al. (2000), Day et al. (2003) and Fernandes et al. (2005). Additionally GBRMPA has produced a series of Technical Information Sheets<sup>1</sup> on the Representative Areas Program background and planning process.

### 2.1. Planning and collation of scientific information phase

This initial phase involved the collation of existing biophysical datasets that identified 70 different habitat types or 'bioregions' (30 reef bioregions and 40 non-reef bioregions) across the Great Barrier Reef (KERRIGAN et al., 2010). A series of 'Operating Principles'<sup>2</sup> were developed to guide the development of the Zoning Plan. This work was guided by two independent Scientific Steering Committees — one focusing on biophysical principles, the second focussing on socio-economic and management feasibility principles — along with advice from a range of experts and stakeholders.

### 2.2. First phase of community participation:

Public consultation occurred throughout the re-zoning process and included two formal periods of public input. The first phase of community participation focussed on ensuring the public were aware of pressures on the Great Barrier Reef and why a new Zoning Plan was needed. This stage of community participation included providing blank maps of defined areas in the Marine Park linked to a questionnaire. People were asked to

---

<sup>1</sup> Great Barrier Reef Representative Area Program Technical Information Sheets [http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0010/6211/tech\\_sheet\\_05.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0010/6211/tech_sheet_05.pdf)

<sup>2</sup> Biophysical operational principles for the Representative Areas Program [http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0011/6212/tech\\_sheet\\_06.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0011/6212/tech_sheet_06.pdf)

Social, economic, cultural and management feasibility operational principles for the Representative Areas Program [http://www.gbrmpa.gov.au/\\_\\_data/assets/pdf\\_file/0012/6213/tech\\_sheet\\_07.pdf](http://www.gbrmpa.gov.au/__data/assets/pdf_file/0012/6213/tech_sheet_07.pdf)

mark areas that were of interest to them on the blank maps and to record corresponding information on the questionnaire. A total of 10,190 written submissions were received.

### **2.3. Development of a Draft Zoning Plan**

This phase involved the analysis of scientific data collected in the planning and collation phase and information provided in public submissions. The analytical approaches comprised marine reserve design software, including Marxan adapted for use in the Representative Areas Program, and a suite of GIS-based spatial analysis tools (LEWIS et al., 2003). This analysis helped to inform the selection of areas to be considered for inclusion in new no-take zones with the aim to maximise the protection of biodiversity while minimising negative social, economic or cultural impacts on Marine Park users and stakeholders.

### **2.4. Second phase of community participation**

The second consultation phase focused on community comment on the Draft Zoning Plan. A more focussed questionnaire prompted people to identify the draft zones they did not support and requested them to provide alternative options and to state their reasons. The questionnaire also prompted people to nominate those proposed zones they did support with reasons why and to make comment on the draft zoning provisions. Over 21,500 submissions were received by the close of the community participation phase.

### **2.5. Further development and approval of the Final Zoning Plan**

The Draft Zoning Plan was subsequently revised to incorporate community input, including social, economic, cultural and practical dimensions, while still meeting most of the operational principles, including the minimum levels of biodiversity protection. The final Zoning Plan was markedly different to the Draft Zoning Plan, although in some locations, particularly the inshore coastal areas, there was limited scope for modification of proposed zones. This was due to the need to maintain a minimum 20 per cent of each bioregion within a highly protected zone type and sometimes conflicting stakeholder uses and values.

The *Great Barrier Reef Marine Park Zoning Plan 2003* took effect on 1 July 2004. Key outcomes included:

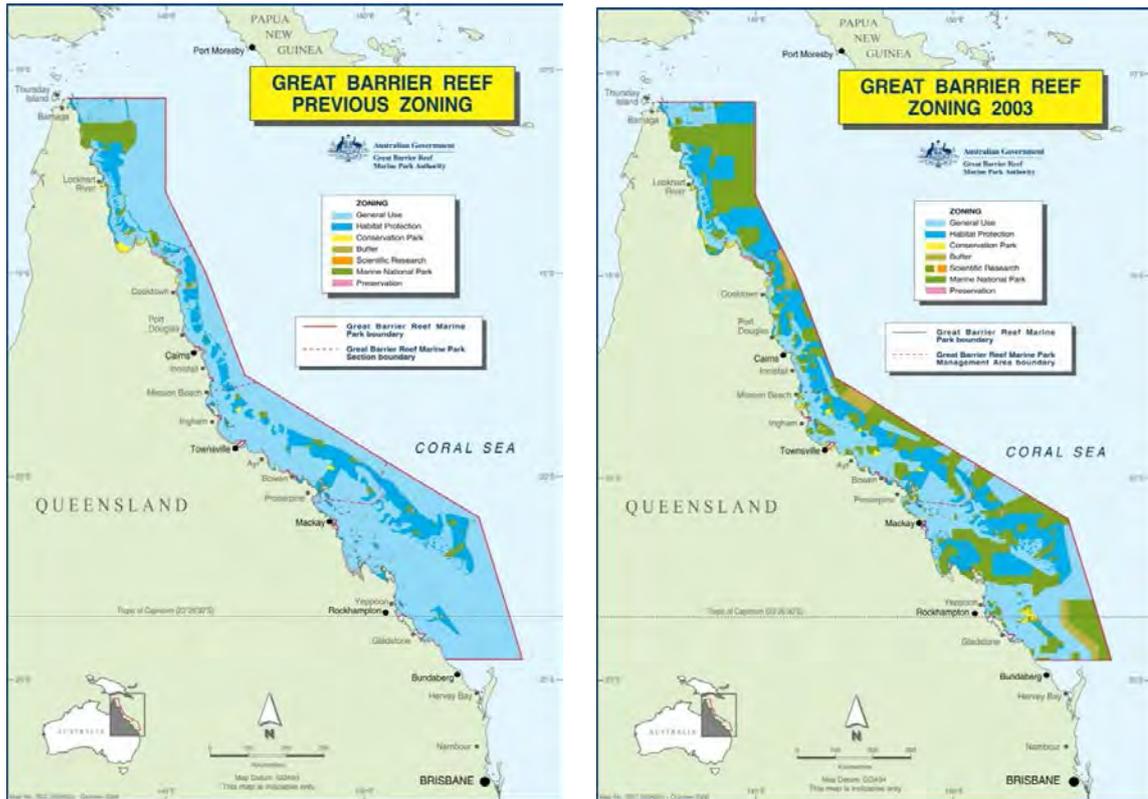
- A minimum of 20 per cent of each of the Great Barrier Reef's 70 bioregions was included within a highly protected zone type.

- The area of no-take zones increased from 4.6% to 33.3% of the Marine Park and the area where trawling was permitted was reduced from 78% to 34% (Table 1).
- Continuation of policies restricting large scale fishing anywhere in the Marine Park including multiple hook fishing, using more than six hooks and purse seining.
- High priority nesting and foraging areas for marine turtles and dugongs were provided with increased levels of protection (DOBBS et al., 2007; DOBBS et al., 2008).
- The importance of connectivity between habitats was recognised by ensuring examples of habitats, both across and along the continental shelf, were included in no-take zones (Figure 1).
- Amalgamating all previous five sections of the Marine Park as well as 28 new coastal sections into one Zoning Plan covering the entire area with standardised names and objectives for zones.

In November 2004, the Queensland Government mirrored the final zoning in most of the adjoining State waters, so there was complementary zoning for virtually all the State and Federal waters within the Great Barrier Reef World Heritage Area.

**Table 1:** Spatial zoning with the Great Barrier Reef Marine Park.

<b>GBRMPA Zone</b>	<b>Activities</b>	<b>Equivalent IUCN category</b>	<b>% prior to 2003 Zoning Plan</b>	<b>% area in 2003 Zoning Plan</b>
<b>General Use</b>	All reasonable uses: trawling and large mesh gill netting allowed.	VI	77.9%	33.8%
<b>Habitat Protection</b>	Trawling prohibited, large mesh gill netting allowed.	VI	15.2%	28.2%
<b>Conservation Park</b>	Gill netting and trawling prohibited; limited fishing and collecting allowed.	IV	0.6%	1.5%
<b>Buffer</b>	Where fishing is limited to trolling for pelagic fish only.	IV	0.1%	2.9%
<b>Scientific Research</b>	Extractive use prohibited without the GBRMPA's permission except some types of Scientific Research.	Ia	0.01%	0.05%
<b>Marine National Park (No-take zone)</b>	Extractive use prohibited without the GBRMPA's permission.	II	4.6%	33.3%
<b>Preservation (No-entry zone)</b>	Access prohibited without the GBRMPA's permission.	Ia	0.1%	0.2%
Commonwealth Islands	Extractive use prohibited without the GBRMPA's permission in waters surrounding the islands.	II	—	—



**Figure 1:** Maps showing differences in the area of 'no-take' or 'green' zones in the previous Zoning Plan compared to the *Great Barrier Reef Marine Park Zoning Plan 2003*.

## 2.6. Implementation and enforcement of the Zoning Plan

Since the 2003 Zoning Plan came into effect on 1 July 2004, GBRMPA and the Queensland Government have implemented a comprehensive and ongoing communication, education and compliance campaign. The campaign has seen more than one million free zoning maps distributed by GBRMPA, the establishment of signs with zoning information at major boat ramps and 200 community access points to information on Marine Park zoning along the Great Barrier Reef coast.

Enforcement of the Zoning Plan occurs through a joint field management program operated by GBRMPA, the Queensland National Parks and Wildlife Service, and a range of Federal and State government partners<sup>3</sup>. While GBRMPA continues to view education as the most effective strategy to encourage compliance, it recognises that strategically directed enforcement action, infringement notices and prosecution provide critical deterrence. The joint field management program operates regular boat and aircraft patrols in the Marine Park, checking on activities and monitoring ecological conditions.

<sup>3</sup> Representative Areas Program – Education, Surveillance and Enforcement  
<http://www.gbrmpa.gov.au/zoning-permits-and-plans/rap/education,-surveillance-and-enforcement>

### 3 Monitoring the effects of Zoning

As part of the re-zoning process a major research program investigating the ecological effects of the 2003 Zoning Plan was established<sup>4</sup>. This was a collaborative program involving scientists from research institutes and universities and protected area managers.

While it will take many years to realise the full effects of the re-zoning, early indications are positive.

Using visual surveys of abundance and size of target fish, Russ et al. (2008) found a rapid and sustained recovery of coral trout populations (*Plectropomus spp*) with up to a two-fold increase in the number and size of fish on no-take reefs within two years of the implementation of the new Zoning Plan. This pattern was found to hold across inshore and offshore reefs and over a wide spread area.

Sweatman (2008) found that the outbreaks of coral-eating crown of thorns starfish appeared less frequent on no-take reefs, resulting in higher levels of coral cover. These findings are especially important for Great Barrier Reef health and resilience as corals form the very foundation of the reef.

A post re-zoning survey of the Great Barrier Reef Region seabed covering 1,380 sites over an area of 200,000km<sup>2</sup> found the protection of seabed biodiversity had substantially increased as a result of the zoning process (PITCHER et al., 2007). This study showed that the use of physical data in the re-zoning process was a good proxy for seabed biodiversity with a minimum of 20 per cent of the predicted biomass for 840 species and 20 per cent of the area for nine seabed habitat types protected in no trawling zones post re-zoning.

In 2010, McCook et al. undertook a comprehensive synthesis of available data on the effectiveness of the new Zoning Plan and concluded there was clear, widespread evidence for the long term benefits of no-take zones. In addition to the biodiversity benefits highlighted above, the review examined the effect of the re-zoning on fishers, tourism values and management effort. It found that while increases in the no-take zones affected some fishing activities, preliminary economic data suggested considerable net benefits, in terms of protecting environmental and tourism values. It also found that relative to the revenue generated by the Great Barrier Reef, expenditure on protection was minor and that the expanded network of zones provided

---

<sup>4</sup>Monitoring the ecological effects of the 2004 zoning of the Great Barrier Reef <http://www.gbrmpa.gov.au/zoning-permits-and-plans/rap/monitoring-the-ecological-effects-of-the-2004-rezoning-of-the-great-barrier-reef-marine-park>

a critical and cost-effective contribution to enhancing the resilience of the Great Barrier Reef.

More recently, a key study has suggested that the benefits of no-take reserves extend well beyond the boundaries of individual zones, making important contributions to both ecosystem and fisheries sustainability in the broader region, including fished areas (HARRISON et al., 2012). Using genetic parentage analysis to track larval dispersal of two exploited species of reef fish between fished and no-take reefs, the study found that in a 1,000 km<sup>2</sup> study area populations in no-take zones exported 84 per cent of coral trout (*Plectropomus maculatus*) and 55 per cent of stripey snapper (*Lutjanus carponotatus*) offspring to fished reefs. The remainder of fish recruited back to their 'home' zone or to other no-take zones in the region. The study estimated that no-take zones, which accounted for 28 per cent of the local reef area, produced 50 per cent of all juveniles recruited to no-take and fished zones with 30km. This study also highlighted the importance of 'connectivity' principles in the design of no-take networks and the need to consider dispersal distances between fished areas and no-take marine reserves. It also showed that while the re-zoning was not implemented for fisheries management purposes the combination of more and bigger fish in no-take zones combined with their dispersal to other areas, has delivered benefits to fish populations targeted by commercial and recreational fishers.

#### **4 Outcomes and lessons learnt**

The representative system of reserves established by the *Great Barrier Reef Marine Park Zoning Plan 2003* provides a robust foundation for the protection of biodiversity and makes an important contribution to ecosystem resilience. Key learning's from the Representative Areas Program include:

- Objectives and operational principles need to be clear, well communicated and established up front
- Early and ongoing engagement with stakeholders is central to building a collective understanding of issues and subsequent support of the process and its outcomes (GRANEK et al., 2008)
- The process needs to be transparent and consider all the different stakeholder views
- Decisions need to be based on the best available science and information
- Despite imperfect knowledge, clear planning and operational principles can deliver good outcomes

- Effective research, monitoring and reporting programs, prioritised to provide information for decision-making are critical to effective ongoing adaptive management of marine resources
- No-take reserves do not function as stand-alone units but are dynamically interconnected to other areas and this consideration is paramount to realising the full benefits they can deliver.

Finally, it is important to acknowledge that no-take zones are just one component of the zoning network and zoning is but one component of GBRMPA's overall ecosystem based management approach (DAY, 2011).

Great Barrier Reef health and resilience relies on an integrated package of management measures to sustain biodiversity and heritage values and to support ecologically sustainable use. The vulnerability of marine ecosystems to climate change, coastal development, fishing and catchment runoff continues to underpin the need for integrated management actions which address threats within and external to the Great Barrier Reef.

## 5 Further information

Further information on the Representative Areas Program and re-zoning process may be obtained at [www.gbrmpa.gov.au](http://www.gbrmpa.gov.au).

### Acknowledgements

The authors would like to thank BfN for the opportunity to present the paper '*Role of No-Take Reserves in the Protection of Marine Biodiversity*' at the 3<sup>rd</sup> International Conference on Progress in Marine Conservation in Europe and to participate in the BfN-GBRMPA exchange program.

We would also like to acknowledge the many scientists, protected areas managers and local communities who played such important roles in the re-zoning process and whose contributions are fundamental to the ongoing protection and conservation of the Great Barrier Reef.

## 6 References

Day, J., Fernandes, L., Lewis, A., De'ath, G., Slegers, S., Barnett, B., Kerrigan, B., Breen, D., Innes, J., Oliver, J.K., Ward, T. & Lowe, D. (2000): The Representative Areas Program - Protecting the Biodiversity of the Great Barrier Reef World Heritage Area, in Proceedings 9th International Coral Reef Symposium.

Day, J.C., Fernandes, L., Lewis, A. & Innes, J. (2003): RAP – An ecosystem level approach to biodiversity protection planning, International Tropical Marine Ecosystem Management Symposium (ITMEMS) Proceedings Manilla, Philippines, March 2003.

Day, J.C. (2011): Protecting Australia's Great Barrier Reef. *Solutions* Jan-Feb 2011, Vol 2(1): 56-66.

Dobbs, K., Fernandes, L., Slegers, S., Jago, B., Thompson, L., Hall, J., Day, J., Cameron, D., Tanzer, J., Macdonald, F., Marsh, H. & Coles, R. (2008): Incorporating dugong habitats into the marine protected area design for the Great Barrier Reef Marine Park, Queensland Australia, *Ocean and Coastal Management*, 51(4): 368-375.

Dobbs, K., Fernandes, L., Slegers, S., Jago, B., Thompson, L., Hall, J., Day, J., Cameron, D., Tanzer, J., Macdonald, F. & Limpus, C. (2007): Incorporating marine turtle habitats into the marine protected areas design for the Great Barrier Reef Marine Park, Australia, *Pacific Conservation Biology*, 13(3): 293-302.

Fernandes, L., Day, J., Lewis, A., Slegers, S., Kerrigan, B., Breen, D., Cameron, D., Jago, B., Hall, J. & Lowe, D. (2005): Establishing representative no-take areas in the Great Barrier Reef: large scale implementation of theory on Marine Protected Areas, *Conservation Biology* 19(6): 1733-1744.

Granek, E.F., Madin, E.M.P., Brown, M.A., Figueira, W., Cameron, D.S., Hogan, Z., Kristlanson, G., de Villiers, P., Williams, J.E., Post, J., Zahn, S. & Arlinghaus, R. (2008): Engaging recreational fishers in management and conservation: global case studies, *Conservation Biology* 22(5): 1125-1134.

Harrison, H.B., Williamson, R.D.E., Almany, G.R., Thorrold, S.R., Russ, G.R., Feldheim, K.A., van Herwerden, L., Planes, S., Srinivasan, M., Berumen, M.L. & Jones, G.P. (2012): Larval export from marine reserves and the recruitment benefit for fish and fisheries, *Current Biology* 22(11): 1023-1028.

Kerrigan, B., Breen, D., De'ath, G., Day, J., Fernandes, L., Tobin, R. & Dobbs, K. (2010): Classifying the biodiversity of the Great Barrier Reef: technical report on the classification phase of the Representative Areas Program: Report to the Great Barrier Reef Marine Park Authority, Great Barrier Reef Marine Park Authority, Townsville

Lewis, A., Slegers, S., Lowe, D., Muller, L., Fernandes, L., Day, J. (2003): Use of Spatial Analysis and GIS techniques to Re-Zone the Great Barrier Reef Marine Park. Coastal GIS Workshop, July 7-8 2003, University of Wollongong, Australia.

McCook, L.J., Ayling, T., Cappo, M., Choat, J.H., Evans, R.D., DeFreitas, D.M., Heupel, M., Hughes, T.P., Jones, G.P., Mapstone, B., Marsh, H., Mills, M., Molloy, F.J., Pitcher, C.R., Pressey, R.L., Russ, G.R., Sutton, S., Sweatman, H., Tobin, R., Wachenfeld, D.R & Williamson, D. (2010): Adaptive management of the Great Barrier Reef: a globally significant demonstration of the benefits of networks of marine reserves, *Proceedings of the National Academy of Science, USA* 107(43): 18278-18285.

Pitcher R., Venables B., Browne M., Doherty P, De'ath G. (2007): Indicators of Protection Levels for Seabed Habitats, Species and Assemblages on the Continental Shelf of the Great

Barrier Reef World Heritage Area. A report to the Marine and Tropical Sciences Research Facility.

Russ, G.R., Cheal, A.J., Dolman, A.M., Emslie, M.J., Evans, R.D., Miller, I.R., Sweatman, H., Williamson, D.H. ( 2008): Rapid increase in fish numbers follows creation of world's largest marine reserve network. *Current Biology*, Vol 18: (12) R514 –R515.

Sweatman, H. (2008): No-take reserves protect coral reefs from predatory starfish, *Current Biology* 18(14): R598-R599.

# Ecological and Fisheries Benefits of Marine Protected Areas

JOACHIM CLAUDET

National Center for Scientific Research, France

## 1 Introduction

MPAs are a specific type of management zone and one component of the larger suite of ocean zoning possibilities encompassed by marine spatial planning. MPAs may be strictly no-take, such as marine reserves, or they may be complete no-access zones, where neither extractive nor non-extractive uses are allowed. Other MPAs may receive partial protection, allowing restricted uses such as traditional/artisanal fisheries or scuba-diving. Most MPAs include another layer of complexity by combining different levels of protection within a spatially-zoned management scheme. Zones may be dedicated to strict conservation, act as a buffer zone that can be used for research, education or traditional uses, and/or allow non-consumptive uses and limited consumptive uses, providing space-related incentives to users (AGARDY et al., 2003). MPA zoning can thus allow coexistence of different resource users but must be established according to the management goals of the MPA (CLAUDET & PELLETIER, 2004). All of these regulatory means must be combined with the establishment of conspicuous borders (with or without access fees) to reduce possible impacts of incidental intrusions, public information about uses permitted in different zones, and voluntary and participatory involvement of local communities and diverse users who contribute to the process (CHRISTIE, 2004). Compliance with spatial zoning regulations such as within an MPA depends on whether the users understand the regulations designed to ensure the orderly and sustainable use of marine resources. If compliance is good, additional management costs to ensure the zoning enforcement will be reduced.

## 2 Direct and Indirect Ecological Effects of Protection

The anticipated ecological effects of protection can be synthesized as follows: Following the cessation of fishing activities, fishing mortality is immediately eliminated and targeted individuals can live longer. On the short-term, habitat quality is improved and fish densities and sizes are increased, leading in turn to increases in individual and spawning biomasses. On the medium- to long-term, the pre-harvested population structure in age and size should be re-established and the spawning activities increased, leading to several indirect ecological or fisheries-related effects. Because

fishing has historically targeted the higher trophic levels of marine food webs, many of the species that should show the greatest increases within MPAs are upper trophic level predators. Consequently, the simplest and most commonly described indirect effect of marine reserves involves a trophic cascade, which are classically defined as the indirect effects of apical species in the food web (e.g. carnivores) on basal species (e.g. primary producers) mediated by intermediate consumers (e.g. herbivores).

The observed direct ecological effects of full protection have been synthesized in several meta-analyses (CÔTÉ et al., 2001; MICHELI et al., 2004; CLAUDET et al., 2008; LESTER et al., 2009). From these studies, it has been shown that reserves often lead to significant increases of fish density, size, biomass and richness, mainly of commercial species.

Indirect effects of full protection can be described through increased abundance and size of predators within marine reserves that reduce the density of prey species. For example, in many temperate and tropical regions, predation rates on benthic invertebrates (especially sea urchins) are higher within marine reserves hosting more abundant and larger predators (fish or large invertebrates such as lobsters) than in fished areas, which often reflects into lower prey population density into reserves (BABCOCK et al., 2010). The reestablishment of lost-predatory interactions (GUIDETTI & SALA, 2007) or the maintenance of interactions unaffected by fisheries (MUMBY et al., 2006) within marine reserves can respectively help to reverse or avoid negative regime shifts due to trophic cascades induced by fishing.

Partial protection provided by multiple use MPAs or by buffer zones surrounding no-take zones may most of the time confer benefits that are lower than in marine reserves (LESTER & HALPERN, 2008), if not inexistent (DI FRANCO et al., 2009).

Average magnitudes of direct or indirect ecological effects of MPAs may be poor predictors for any single MPA as the response to protection may greatly vary, from local to regional and global scales. At a local scale, the highest source of variation in the direct response to protection is driven by multi-scale differences in habitat (GARCÍA-CHARTON et al., 2004), leading to different pools of species assemblages within and/or outside the MPAs. Locally, indirect effects of protection are mainly driven by the presence of size or habitat refuges for prey species, predator prey preferences, predatory efficiency, the availability of alternative prey and size-mediated predator-prey relationships (SHEARS et al., 2008).

At a regional scale, the heterogeneity in the ecological response to protection among MPAs can be attributed, in part, to socio-cultural factors. It has clearly been demonstrated that enforcement and compliance are fundamental aspects of effective MPAs (GUIDETTI et al., 2008). The social acceptance of the MPA by local human

communities is a key factor for enforcement and ecological success of the MPAs (CHRISTIE, 2004).

Ecological effects of protection, especially those that increase with commercial fish density, typically require time to accrue (CLAUDET et al., 2008; MOLLOY et al., 2009). In some cases, those changes can be rapid ( $\pm 3$  yr, e.g. CLAUDET ET AL., 2006), but in many cases (e.g. for long-lived, slow-growing fishes, like groupers) the effects may take many years to accumulate (BABCOCK et al., 2010). Indirect effects on densities (e.g. trophic cascades from top predators) or changes in species composition may require even greater time to accrue (BABCOCK et al., 2010). These time lags arise for two reasons: (1) indirect effects can take many years to occur (because they involve the response of intermediate species); and (2) they involve non-linearities (e.g. hysteresis and thresholds), which can lead to situations where large changes in one variable are needed before demonstrable changes in another can be seen. Therefore, reserves need to have been in place for sufficient periods to allow predators to reach these critical densities or size to mediate indirect effects. Critical densities between lower trophic levels and behavioral modifications of prey species can further delay cascading indirect effects. In New Zealand, low numbers of urchins are required to maintain urchin barrens habitats and it took  $\sim 15$  years to reduce urchins below a threshold density to allow macroalgal habitats to recover (SHEARS & BABCOCK, 2003). Furthermore, a switch in behavior where urchins became more cryptic in the presence of predators meant that urchins were able to persist at relatively high densities for an extended period despite high predator densities. Consequently, understanding how trophic interactions between species or trophic levels depends on density, size and behavior is key to predicting the magnitude and timing of the indirect effects of marine reserves.

The effectiveness of MPAs is also linked to their design (CLAUDET et al., 2008). Although small reserves can be effective, increasing the size of a reserve increases the ratio of commercial fish density within the reserve relative to outside, whereas the size of the partially protected buffer zone has the opposite effect.

The life history and ecological traits of the protected species can also influence the effectiveness of MPAs (MICHELI et al., 2004; MOLLOY et al., 2009; CLAUDET et al., 2010). For example, Claudet et al. (2010) showed that, contrary to previous theoretical findings, mobile species with wide home ranges benefited from protection. The effect of protection was at least as strong for mobile species as it was for sedentary ones. This was indirectly illustrated by Lester et al. (2009), who showed that temperate marine reserves, where most benthic-pelagic species tend to be more mobile than in tropical environments, performed as well as or better than marine reserves in the tropics.

Finally, the ecological effectiveness of MPAs can depend on human activities that occur outside the MPA, even when they are prohibited within the MPA. For example, overfishing of the spawning stock biomass in the surrounding fishing grounds may limit adult immigration or larval dispersal into the MPA, leading to smaller effects when stocks are more severely overfished (e.g. LLORET et al., 2008). Stressors occurring outside the MPAs also can introduce a bias in the assessment of MPAs effectiveness, as many conclusions drawn about the effectiveness of an MPA depend on the state of the populations in these control locations. When looking only at relative differences between control and protected locations, one MPA could appear more effective than another simply because its surrounding fishing grounds are more intensively fished. Quantifying the actual fishing pressure occurring outside an MPA, the potential spillover across MPA boundaries (see below), as well as human behavior in control areas (e.g. displacement effects, STELZENMÜLLER et al., 2008) is therefore essential for an appropriate assessment of MPA effectiveness (CLAUDET & GUIDETTI, 2010).

### **3 Fisheries Effects of Protection**

Fisheries effects of protection can only take place if an export of fish individuals occur over the boundaries of the MPA ("spillover"; MCCLANAHAN & MANGI, 2000), and/or if eggs and larvae are exported from the MPA outwards (PLANES et al., 2000). The spillover of adult biomass can be due to random movement, density-dependent out-migration, directed movements (daily or seasonal migrations), and ontogenic habitat shifts (GRÜSS et al., 2011). By contrast the outflux of eggs and larvae will depend on currents, tides, frontal dynamics, but also larval duration and swimming capabilities (PLANES et al., 2000). Optimal MPA benefits to fisheries are expected for species with intermediate dispersal characteristics. From a bio-economic standpoint, the relative economic return from harvesting fish across space is a fundamental driver of the potential opposition to MPA creation (SANCHIRICO, 2011).

In ecologically effective MPAs with permeable boundaries, spillover can induce increases in Catch Per Unit of Effort (CPUE) of target species in surrounding fisheries grounds (GOÑI et al., 2011). These increases constitute a yield surplus and fishers' catch per unit effort tends to be higher, although often more variable due to seasonal processes underlying spillover (MCCLANAHAN & KAUNDA-ARARA, 1996; GOÑI et al., 2006). Spillover can also induce increase in total catch, catch per unit of area, species mean size in catch and species diversity in catch (GOÑI et al., 2011). These increases in turn can lead to increases in fishing effort along the MPA boundaries. In spite of this, empirical estimates of net transfer are scarce and lead to low evidenced net benefits from spillover to local fishery catches (i.e. accounting for the loss of fishing area due to the MPA) (e.g. 10% per year for lobster; GOÑI, 2010).

Although only a few MPAs have been deliberately located on soft bottoms and generally consist of towed gear exclusion zones, they include most of the MPAs specifically designed for fisheries management objectives. The primary goal of existing soft bottom gear exclusion MPAs is rebuilding the biomass of exploited fish assemblages or of particular fish or shellfish species. Therefore studies evaluate their performance on those grounds rather than focusing on effects on fisheries outside their boundaries. Most soft bottom MPAs succeed in doing so (GOÑI et al., 2011). Furthermore, since towed gears affect whole assemblages, positive responses on other exploited species have also been documented. Gear exclusion MPAs are also a useful tool for resolving conflicts among artisanal and industrial fisheries in coastal areas.

Similarly to ecological effects inside MPA borders, fisheries effects of MPAs cannot be generalized easily. In particular, spillover is species- and habitat-specific and not all target species CPUE can increase near MPA boundaries (GOÑI et al., 2011). The nature of density-dependence relative to the timing of the dispersal process is also a critical component in determining when, where, and whether MPAs are part of an optimal fishery policy (SANCHIRICO, 2011). Finally, the consideration of non-fishery values can dramatically affect the optimality of MPAs for fisheries management. If MPAs represent the preferences of society for conservation, then the debate surrounding MPAs should be less about the merit of them as a fishery management tool and more about the trade-off between extractive values and non-consumptive values (SANCHIRICO, 2011).

#### **4 Conclusion**

In recent years, MPA research made several advances. First, important discoveries or confirmation of theory was made on how MPA effects are driven by different factors such as MPA age, size, or level of enforcement. The implications are strong for MPA design and management. For example, even if young and small MPAs can be effective in increasing fish population density, old and large MPAs can show even greater positive responses. Meanwhile no positive responses should be expected from MPAs with low levels of enforcement. Second, major advances were made on the numerous indirect ecological effects of protection, which are also time-dependent. These effects can involve trophic cascades and complex predator-prey relationships. Third, the potential socio-economic benefits of MPAs are now becoming clearer. Studies show, for example, that MPAs can lead to jobs and/or revenue increases in activities linked to MPAs such as fishing and tourism, as well as to the maintenance of traditional activities. Fourth, the general agreement among scientists that MPA networks can

optimize conservation and fisheries benefits has led to significant advances in network design and evaluation.

However, some questions are still unresolved. Efforts are urgently needed to understand if MPAs can increase the resilience of protected ecosystems. Existing results are, for now, contradictory. Determining if healthier or more "pristine" ecosystems within MPAs can cope with higher regional or global pressures before shifting to alternate states is fundamental to mitigating regional and global change. (Along the same line, understanding how MPAs may help buffer against human-induced selection pressures and protect phenotypic and genetic diversity - to support adaptation to future environmental change - is of major importance.) Understanding better patterns of connectivity among protected and unprotected areas of MPA networks is also needed, although recent advances have been made in this direction. This information is critical to designing effective ecological networks that can benefit multiple species at a time. The recent emergence of large-scale pelagic MPAs also calls for new research to better understand how protection can be effective in these habitats and how regulations can be applied offshore over such large, remote areas. Finally, MPA research publications still focus too often on a given discipline: ecology or economics or genetics or something else. MPAs are social-ecological systems. Future research needs to reflect this fact. Natural and social scientists in the MPA field need to collaborate more to make their work fully multidisciplinary.

## **5 Acknowledgements**

P. Guidetti, D. Mouillot, N.T. Shears, F. Micheli, R. Goñi, F. Badalamenti, M. Tupper, J.N. Sanchirico, V. Stelzenmüller, J.K. Pinnegar, K. Grorud-Colvert are deeply acknowledged.

## **6 References**

Agardy, T, Bridgewater, P., Crosby, M.P., Day, J. et al. (2003): Dangerous targets? Unresolved issues and ideological clashes around marine protected areas. *Aquatic Conservation-Marine and Freshwater Ecosystems* 13: 353-367.

Babcock, R.C, Shears, N.T., Alcalá, A.C., Barrett, N.S. et al. (2010): Decadal trends in marine reserves reveal differential rates of change in direct and indirect effects. *Proceedings of the National Academy of Sciences of the United States of America* 107: 18256-18261.

Christie, P. (2004): Marine protected areas as biological successes and social failures in Southeast Asia. *American Fisheries Society Symposium* 42: 155-164.

- Claudet J. & Guidetti, P. (2010): Improving assessments of marine protected areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 20: 239-242.
- Claudet J, Osenberg, C.W., Benedetti-Cecchi, L., Domenici, P. et al. (2008): Marine reserves: Size and age do matter. *Ecology Letters* 11: 481-489.
- Claudet J, Osenberg, C.W., Domenici, P., Badalamenti, F. et al. (2010): Marine reserves: Fish life history and ecological traits matter. *Ecological Applications* 20: 830-839.
- Claudet J. & Pelletier, D. (2004): Marine protected areas and artificial reefs: A review of the interactions between management and scientific studies. *Aquatic Living Resources* 17: 129-138.
- Claudet J, Pelletier, D., Jouvenel, J.Y., Bachet, F. et al. (2006): Assessing the effects of marine protected area (MPA) on a reef fish assemblage in a northwestern Mediterranean marine reserve: Identifying community-based indicators. *Biological Conservation* 130: 349-369.
- Côté IM, Mosqueira, I. & Reynolds, J.D. (2001): Effects of marine reserve characteristics on the protection of fish populations: a meta-analysis. *Journal of Fish Biology* 59: 178-189.
- Di Franco A., Bussotti, S., Navone, A., Panzalis, P. et al. (2009): Evaluating effects of total and partial restrictions to fishing on Mediterranean rocky-reef fish assemblages. *Marine Ecology Progress Series* 387: 275-285.
- García-Charton, J-A., Pérez-Ruzafa, A., Sánchez-Jerez, P., Bayle-Sempere, P.T. et al. (2004): Multi-scale spatial heterogeneity, habitat structure, and the effect of marine reserves on Western Mediterranean rocky reef fish assemblages. *Marine Biology* 144: 161-182.
- Goñi, R., Badalamenti, F. & Tupper, M. (2011): Effects of marine protected areas on local fisheries: Evidence from empirical studies. In Claudet J, editor. *Marine Protected Areas - A Multidisciplinary Approach*. Cambridge University Press, Cambridge, UK. 72-98
- Goñi, R., Hilborn, R., Díaz, D., Mallol, S. & Adlerstein, S. (2010): Net contribution of spillover from a marine reserve to fishery catches. *Marine Ecology Progress Series* 400: 233-243.
- Goñi, R., Quetglas, A. & Renones, O. (2006): Spillover of spiny lobsters *Palinurus elephas* from a marine reserve to an adjoining fishery. *Marine Ecology Progress Series* 308: 207-219.
- Grüss, A., Kaplan, D.M & Hart, D.R. (2011): Relative impacts of adult movement, larval dispersal and harvester movement on the effectiveness of reserve networks. *PLoS ONE* 6: e19960.
- Guidetti, P., Milazzo, M., Bussotti, S., Molinari, A. et al. (2008): Italian marine reserve effectiveness: Does enforcement matter? *Biological Conservation* 141: 699-709.
- Guidetti, P. & Sala, E. (2007): Community-wide effects of marine reserves in the Mediterranean Sea. *Marine Ecology Progress Series* 335: 43-56.

Lester S.E. & Halpern, B.S. (2008): Biological responses in marine no-take reserves versus partially protected areas. *Marine Ecology Progress Series* 367: 49-56.

Lester S.E., Halpern, B.S., Grorud-Colvert, K., Lubchenco, J. et al. (2009): Biological effects within no-take marine reserves: a global synthesis. *Marine Ecology Progress Series* 384: 33-46.

Lloret J, Zaragoza, N.R., Caballero, D., Font, T. et al. (2008): Spearfishing pressure on fish communities in rocky coastal habitats in a Mediterranean marine protected area. *Fisheries Research* 94: 84-91.

McClanahan, T.R & Kaunda-Arara, B. (1996): Fishery recovery in a coral-reef marine park and its effect on the adjacent fishery. *Conservation Biology* 10: 1187-1199.

McClanahan, T.R & Mangi, S. (2000): Spillover of exploitable fishes from a marine park and its effects on the adjacent fishery. *Ecological Applications* 10: 1792-1805.

Micheli, F, Halpern, B.S., Botsford, L.W. & Warner, R.R. (2004): Trajectories and correlates of community change in no-take marine reserves. *Ecological Applications* 14: 1709-1723.

Molloy, P.P, McLean, I.B. & Côté, I.M. (2009): Effects of marine reserve age on fish populations: a global meta-analysis. *Journal of Applied Ecology* 46: 743-751.

Mumby, P.J, Dahlgren, C.P., Harborne, A.R., Kappel, C.V. et al. (2006): Fishing, trophic cascades, and the process of grazing on coral reefs. *Science* 311: 98-101.

Planes S, Galzin, R., Rubies, A.G., Goni, R. et al. (2000): Effects of marine protected areas on recruitment processes with special reference to Mediterranean littoral ecosystems. *Environmental Conservation* 27: 126-143.

Sanchirico, J.N. (2011): Economically optimal spatial and inter-temporal fishing patterns in a metapopulation. In Claudet J, editor. *Marine Protected Areas - A Multidisciplinary Approach*. Cambridge University Press, Cambridge, UK. 99-120

Shears, N.T. & Babcock, R.C. (2003): Continuing trophic cascade effects after 25 years of no-take marine reserve protection. *Marine Ecology Progress Series* 246: 1-16.

Shears, N.T., Babcock, R.C. & Salomon, A.K. (2008): Context-dependent effects of fishing: Variation in trophic cascades across environmental gradients. *Ecological Applications* 18: 1860-1873.

Stelzenmüller V., Maynou, F., Bernard, G., Cadiou, G. et al. (2008): Spatial assessment of fishing effort around European marine reserves: Implications for successful fisheries management. *Marine Pollution Bulletin* 56: 2018-2026.

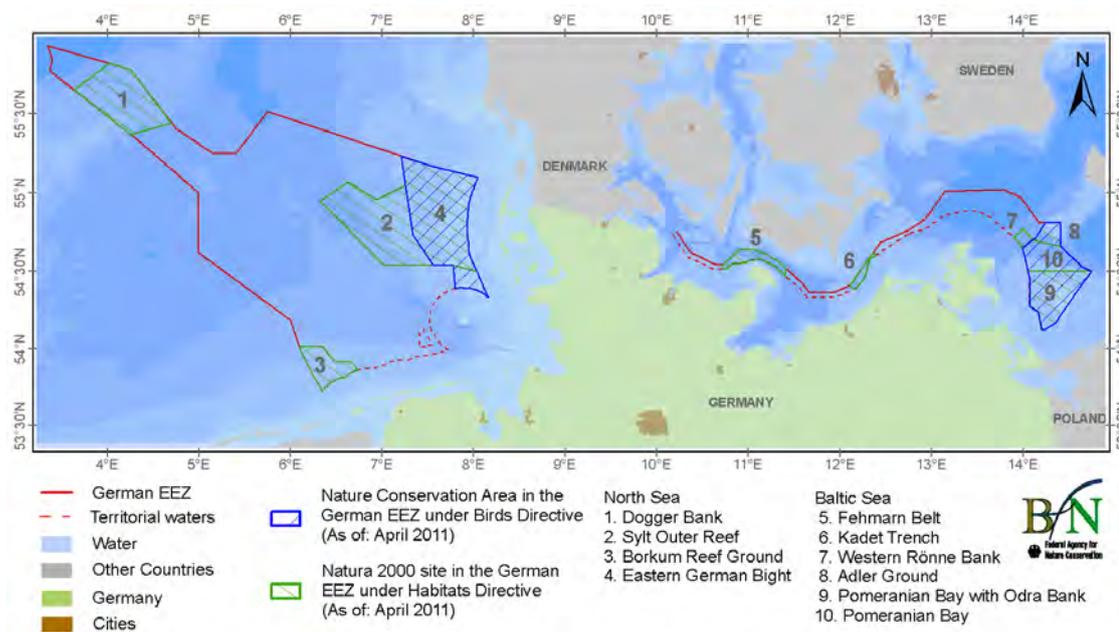
# Fishery Measures in German Natura 2000-sites

CHRISTIAN PUSCH

Federal Agency for Nature Conservation, Germany

## 1 Introduction

In 2004, Germany has nominated ten Natura 2000-sites in its Exclusive Economic Zone (EEZ) of the North Sea and the Baltic Sea to comply with the requirements of the EU Habitats (92/43/EEC) and Birds (2009/147/EC) Directives (Figure 1). The sites, covering an area of ca. 31 % of the German EEZ, were adopted by the European Commission as Sites of Community Importance (SCIs) in November 2007. According to the obligations of the European nature conservation directives appropriate management measures within the protected areas have to be implemented by the end of 2013.



**Figure 1:** Natura 2000-sites in the German EEZ of the North Sea and the Baltic Sea, which have been designated according to the Birds- and Habitats Directive.

The management of fisheries in Natura 2000-sites has been raising increasing awareness in EU member states in recent years. In 2005, when BfN started the process to develop fisheries management in marine Natura 2000-sites in its EEZ relatively little was known about fishing activities (intensity, temporal and spatial

distribution) and the impacts of fisheries on protected habitats and species. Since that time a number of research projects (e.g. FIMPAs in the Netherlands, BALTFIMPA HELCOM contracting parties) and processes with the target to implement fishery management measures in marine Natura 2000-sites have been initiated in other European member states in the North Sea and the Baltic Sea. Due to the fact that fisheries in the EEZ of each member state can only be managed in the framework of the EU Common Fisheries Policy (CFP) management measures have to be developed and negotiated in a multi-level process.

This article will give an overview about the progress that has been made in recent years regarding the development of fishery management measures in marine Natura 2000-sites in the German EEZ. Finally an outlook will be given, which further steps would be necessary to alleviate the process of implementation of fishery management measures in marine Natura 2000-sites.

## 2 Process

According to the obligations of the European nature conservation directives appropriate management measures within the protected areas have to be implemented as soon as possible and latest by the end of 2013. In a three years project, performed by the International Council for the Exploration of the Seas (ICES) and the German Federal Agency for Nature Conservation (BfN), the main conflicts between fishing activities and conservation objectives in the marine Natura 2000-sites have been analyzed (ICES, 2008a). In a subsequent advice by ICES (2008b) the following three main conflict areas have been identified: (1) impacts of mobile bottom-contacting fishing gears on reef and sandbank habitats and their typical benthic species in the North Sea; (2) bycatch of seabirds in static gears, especially bottom set gillnets and entangling nets in the Baltic Sea; (3) bycatch of harbour porpoise in static gears, mainly bottom set gillnets and entangling nets in the North Sea and the Baltic sea.

Since the EU Member States have delegated their competence for regulating marine fisheries to the European Union, necessary fisheries measures can be implemented in Natura 2000-sites only within the framework of the Common Fisheries Policy (CFP) (Fock, 2011). The European Commission (DG Environment and DG MARE) issued a guidance document<sup>1</sup> in 2008 for the implementation of fisheries management measures in marine Natura 2000-sites. This document outlines requirements (11

---

<sup>1</sup> European Commission 2008,  
[http://ec.europa.eu/environment/nature/natura2000/marine/docs/fish\\_measures.pdf](http://ec.europa.eu/environment/nature/natura2000/marine/docs/fish_measures.pdf)

points) which Member States have to take in consideration when requesting fisheries management measures for their Natura 2000-sites. A steering committee was set up by the competent German ministries, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), together with their respective agencies the Federal Agency for Nature Conservation (BfN) and the Thünen Institute (TI) and the relevant ministries of the coastal *Länder* (Mecklenburg-Western Pomerania, Lower Saxony and Schleswig-Holstein) to ensure that the requirements of the Habitats Directive and the Birds Directive are implemented in the Natura 2000-sites in German EEZ within the prescribed period (2013 at the latest). In May 2010, the steering committee commissioned a scientific working group (WG North Sea and Baltic Sea) consisting of representatives of the vTI and the BfN to develop proposals for fisheries management measures aiming at implementing the requirements of the Habitats Directive and the Birds Directive in the Natura 2000-sites in the German EEZ.

The BfN/vTI Working Group identified options for fisheries management measures for each Natura 2000-site which, from an expert point of view, appear to be best suited to implement the Habitats Directive and the Birds Directive with respect to the specific conservation objectives in the German EEZ. In doing so they aimed at minimizing the socio-economic impact these measures would have on fisheries. The working groups conjointly worked on points 1 through 9 and 11 of the European Commission's guidelines for the implementation of fisheries management measures in Natura 2000-sites.

### **3 Site specific assessment of the main conflicts between protected species and habitats and fishing activities**

The assessment of the main threats to the individual protected species and habitats arising from current fishing activities is based in part on findings from the project "Environmentally Sound Fisheries Management in Marine Protected Areas" (EMPAS, PUSCH & PEDERSEN, 2010) and the ICES Advice (ICES, 2008a). Furthermore, special BfN research projects were conducted to study the impact of bottom contacting gear on benthic habitat types (Schroeder et al. 2008) and to assess the bycatch rates of seabirds in static gears (BELLEBAUM, 2011). In the following the main conflicts and management proposals of the BfN/vTI working group for the Natura 2000-site Sylt Outer Reef and the Nature Conservation area Pomeranian Bay will be described as examples in more detail.

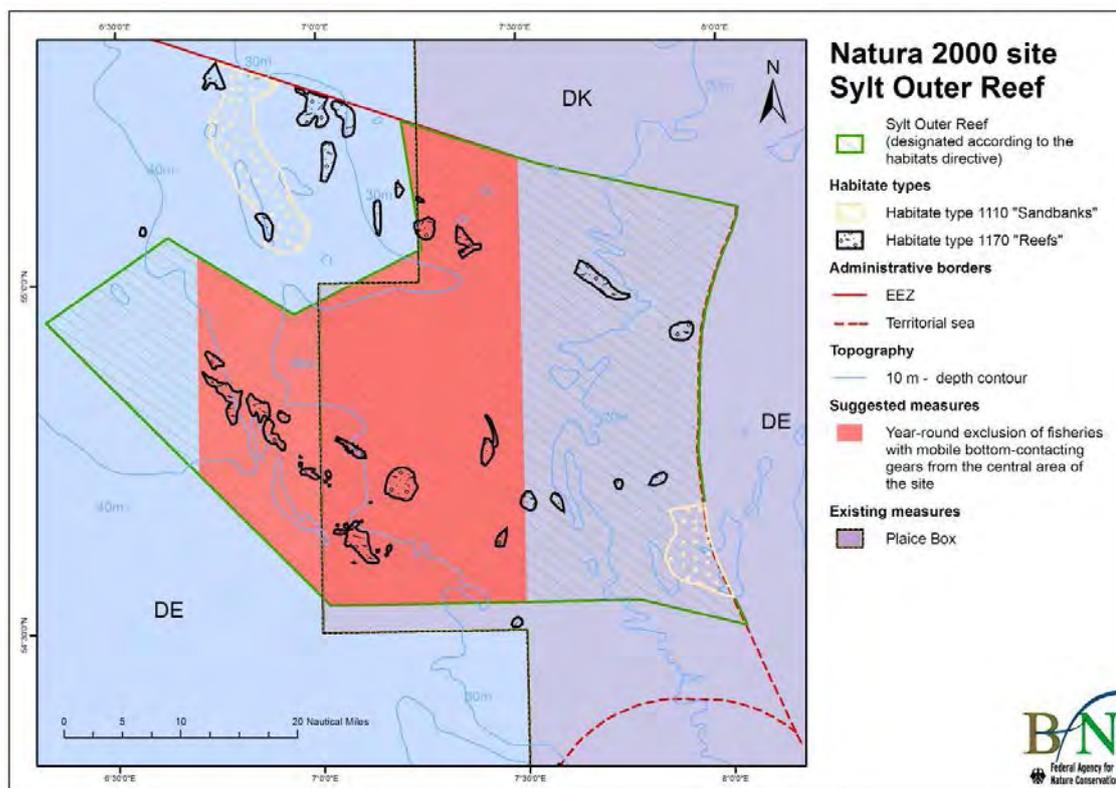
### **3.1 Natura 2000-site Sylt Outer Reef: Impact of mobile bottom contacting gears on benthic habitats and their typical species**

Fisheries with mobile bottom contacting gears have a negative impact on the protected habitat types sandbanks (1110) and reefs (1170). The degree of the impact on the benthic community is depending of the fishing gear, the weight of the gear, the trawling speed as well as of the specific habitat type, the benthic community and the sediment type (BERGMAN & HUP, 1992; KAISER et al. 1998; KAISER et al. 2006).

Beam trawls are one of the fishing gears with the highest negative impact on benthic habitats and communities. Beam trawls targeting flatfish (e.g. plaice, sole) are equipped with so called tickler chains to plough the upper sediment layers to flush the fishes into net. This kind of fishing gear has a specific negative impact on reefs and their typical species.

Using age-structured population models, Schröder et al. (2008) examined the impact of bottom contacting fishing gear on the protected habitat types 'sandbanks' (EU-Code 1110) and 'reefs' (EU-Code 1170) and their characteristic species. In order to generalise the findings, the benthic species communities were assigned to four defined ecotypes which can be categorised as r-selected or K-selected species and infauna or epifauna. The analysis showed that active bottom trawling impacts long-lived K-selected species significantly more severe than short-lived opportunistic r-selected species. Furthermore, the epifauna is considerably more sensitive to bottom trawling than the infauna.

The BfN/vTI working group proposed to exclude all fisheries with mobile bottom-contacting gears from the central area of the Sylt Outer Reef Natura 2000 site especially to protect the habitat type reef (1170) (Figure 2). The measures proposed for the other protected features (sandbanks, harbour porpoise) in the Sylt Outer Reef can be seen in Tab. 1a in the Annex.



**Figure 2:** Proposed measure to protect the habitat type reef (1170) in the Natura 2000-site Sylt Outer Reef: Year-round exclusion of fisheries with mobile bottom-contacting gears from the central-western part. (Existing management measure: "Plaice box" – Exclusion of demersal trawl fisheries with vessels >300 hp).

The measure should safeguard the protection of the habitat type reef and its benthic communities in the central-western part of the Natura 2000-site Sylt Outer Reef. From a conservation point of view this area has a higher priority, as it has been affected comparatively little and has therefore a high potential to reach the favourable conservation status (ICES, 2008a; SCHRÖDER et al., 2008).

Modelling of the impact of bottom contacting gears on benthic community's showed that the first two trawls result in the highest loss of benthic species. That means that in intensively fished areas even the reduction of fishing activities by 50 % will not have a measurable positive effect on benthic communities (SCHRÖDER et al., 2008). Additional it means that the maximum positive effect with relatively little change in overall fishing intensity can be reached by closing areas currently fished with rather low intensity. Another argument for the proposed closure for bottom-contacting gears is the fact that it would result in relatively little displacement of fishing effort in surrounding areas. The impact of displacement can therefore be neglected.

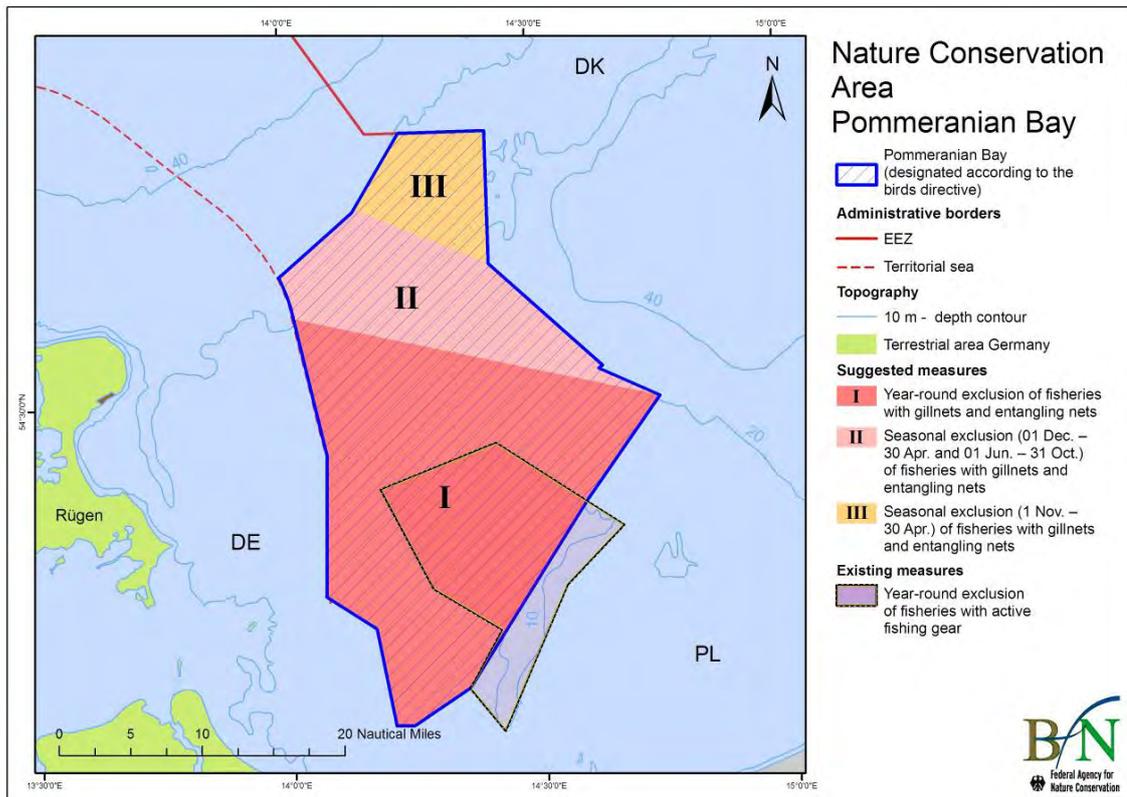
In combination with the protecting effects of the plaice box the disturbance of the reefs in the central part would remain the same and the conservation status of the western

and the northern reefs of the Sylt Outer Reef would be significantly improved. Additionally the proposed measure with its straight borders would be easier to control than a potential alternative with buffer zones around each of the reef structures. For the eastern part of the Sylt Outer Reef Nature 2000-site the so called plaice box is already offering some level of protection for the reefs occurring in this area.

### **3.2 Nature Conservation Area Pomeranian Bay: Bycatch of seabirds in gillnets**

One of the main threats for diving seabirds in the southern Baltic Sea is the bycatch in gillnets and entangling nets. The findings from a recent study from Zydalis et al. (2009) indicate, on the basis of local and small-scale field work, an annual bird bycatch of approximately 90,000 birds in the North Sea and the Baltic Sea. The bycatch risk results from the feeding behaviour of several seabird species, which get entangled in the fine (for seabirds invisible) meshes of gillnets while searching for benthic invertebrates (e.g. mussels, polychaets etc.) or fishes in the water column. Highest bycatch rates occur in areas, where the feeding grounds of seabirds and areas with gillnet fishing activities overlap (KIRCHHOFF, 1982; SCHIRMEISTER, 2003; BELLEBAUM, 2011).

Based on the distribution of fishing activities with gillnets and the occurrence of seabirds in the German EEZ as well as in the coastal waters of the Baltic Sea, the main conflict areas have been identified in the context of the EMPAS project (ICES, 2008a, b). The analysis revealed that the highest conflicts occurred in the nature conservation area Pomeranian Bay, especially in the area of the Adlerground during winter month (Nov.-April). In the area of the Odrabank conflicts occurred year round. In general the high abundance of seabirds in the area and the fishing activities with gillnets result in a year round conflict and thereby compromising the conservation targets in the nature conservation area Pomeranian Bay.



**Figure 3:** Proposed management measures for the Nature Conservation Area Pomeranian Bay: **Measure 1:** Year-round or seasonal exclusion of fisheries with gillnets and entangling nets in the Nature Conservation Area Pomeranian Bay. **Area I (“Odra Bank”):** Year-round closure, **area II (“Trench”):** Seasonal closure (December 1<sup>st</sup> – April 30<sup>th</sup> and June 1<sup>st</sup> – October 31<sup>st</sup>), **area III (“Adler Ground”)** Seasonal closure (November 1<sup>st</sup> – April 30<sup>th</sup>).

The BfN/vTI working group has proposed the following measure in the Natura 2000-site Pomeranian Bay to avoid the bycatch of seabirds: In area I a year round and in the areas II and III a seasonal exclusion of gillnet and entangling nets (Figure 3). These measures should reduce the bycatch of seabirds in gillnets and entangling nets to a minimum. Thereby it has been taken into account the abundance and distribution of the most vulnerable seabird species in the Natura 2000-site, which is dependent on the season and the bathymetry of the area. The spatio-temporal distribution of seabirds has been examined in the framework of various BfN research programs and regular monitoring activities, as well as using the “Seabirds at Sea” database (SONNTAG & GARTHE, 2010). In addition the spatial outline of the measures are mainly based on potential conflicts due to the overlap of fishing activities and occurrence of protected seabirds in the area of concern.

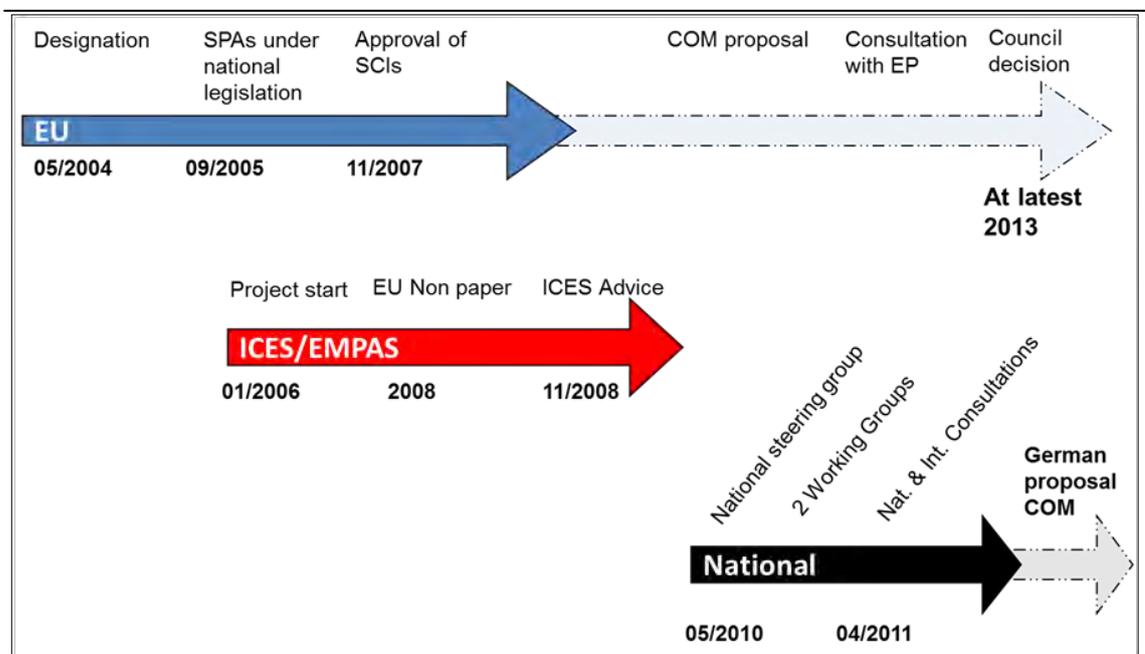
An overview of the measures in the marine Natura 2000-sites in the North Sea and the Baltic Sea is given in annexed tables 1a and 1b.

## 4 Discussion

The development of measures to manage fisheries in the marine Natura 2000-sites in the German EEZ is a time consuming and complex process (Figure 4). BfN started this process already in 2005 and it is yet to be finalized. Fishery measures within the EEZ have to be negotiated on national and European level. In Germany a major problem within the process is still the integration of interests from the fisheries and the nature conservation site to come to a common proposal for fisheries management measures.

Nevertheless reasonable progress within the process to develop fishery management measures in the German marine Natura 2000-sites has been made in recent years. E. g.; the accessibility of data on fishing effort has increased significantly since the start of the project. The availability of data from the Vessel Monitoring System (VMS) was a major step to analyse the spatial distribution and the intensity of fishing activities in all marine Natura 2000-sites.

The same is true for the methodology to analyse VMS and logbook data. A major problem especially in the Baltic Sea is still the lack of data about the fishing activities of smaller vessels (< 12 m length), which have no obligation to be equipped with VMS transmitters.



**Figure 4:** Overview and time schedule of the steps taken to develop fisheries management measures in marine Natura 2000-sites in the Germany EEZ on European and national level.

Progress was also made in the scientific assessment of the ecological effects of fishing activities. For example in the beginning of the process there was almost no analysis about the impact of bottom contacting gear on benthic habitats and associated communities. The results of the study of Schroeder et al. (2008) improved the knowledge on the impact of bottom-contacting gear on benthic communities and quantified for the first time the loss of benthic invertebrates by activities of bottom contacting fishing gears.

Likewise the problem of seabird bycatch in static gears in the Baltic Sea is better understood now. The study of Bellebaum et al. (2011) revealed that the bycatch of seabirds is a major problem in all fisheries using gillnets. A major lack of data still exists regarding the bycatch of harbour porpoise. Currently most assessments of bycatch numbers are based on data of stranded dead harbour porpoises and the identification of netmarks on their carcasses.

Since the start of the EMPAS project the communication between fishermen, nature conservationists and fishery scientist in Germany has improved considerably. Nevertheless, on a European scale until now there are very few cases where management measures have been implemented in Natura 2000-sites yet (e.g. Darwin Mounds, Scotland). In this context the cooperative initiative of three member states (The Netherlands, United Kingdom and Germany) to develop common management measures for the Natura 2000-sites on the Dogger Bank is a benchmark in the European process of developing management measures in EU waters. A common proposal for fishery management measures in the Natura 2000-sites in the Doggerbank by all three member states is expected in 2013.

In the future it will be necessary that EU member states get more support by the Commission in their efforts to develop management measures in their Natura 2000-sites. From the current singular processes in several EU member states it can be seen that the problems they face in the development of fisheries measures in Natura 2000-sites are largely shared. For example, the benthic habitat types affected by fisheries, their specific sensitivities as well as the fishing practices impacting upon them are highly comparable in most cases. A harmonized and more coordinated procedure would therefore enhance the use of synergies, speed up the overall process and lead to a more economic use of mostly narrow resources.

## **5 References**

Bellebaum, J. (2011): Untersuchungen und Bewertungen des Beifangs von Seevögeln durch die passive Meeresfischerei in der Ostsee, FKZ 350785090 Abschlussbericht, November 2009: Bundesamt für Naturschutz, Fachgebiet II 5.2. Meeres- und Küstennaturschutz. 79 pp.

Bergman, M.J.N. & Hup, M. (1992): Direct effects of beamtrawling on macrofauna in a sandy sediment in the southern North Sea. *ICES J. Mar.* 49: 5-11.

Fock, H. (2011): Integrating multiple pressures at different spatial and temporal scales: a concept for relative ecological risk assessment in the european marine environment. *Human and Ecological Risk Assessment* 17: 187–211.

ICES (2008a): Report of the Workshop on Fisheries Management in Marine Protected Areas (WKFMPA). ICES Council Meeting documents, Copenhagen. 157 pp.

ICES (2008b): The management of Natura 2000 sites in the German EEZ: summary and advice derived from the results of the EMPAS project, International Council for the Exploration of the Sea. 16 pp.

Kaiser, M.J., Clarke, K.R., Hinz, H., Austen, M.C.V., Somerfield, P.J. & Karakassis, I. (2006): Global analysis of response and recovery of benthic biota to fishing. *Mar. Ecol. Prog. Ser.* 311: 1-14.

Kaiser, M.J., Edwards, D.B., Armstrong, P.J., Radford, K., Lough, N.E.L., Flatt, R.P. & Jones, H.D. (1998): Changes in megafaunal benthic communities in different habitats after trawling disturbance. *ICES J. Mar.* 55: 353-361.

Kirchhoff, K. (1982): Wasservogelverluste durch die Fischerei an der schleswig-holsteinischen Ostseeküste. *Vogelwelt* 103: 81-89.

Pusch, C. & Pedersen, S.A. (2010): Environmentally Sound Fisheries Management in Marine Protected Areas. *Naturschutz und Biologische Vielfalt*: 92. Federal Agency for Nature Conservation, Bonn. 302 pp.

Schirmeister, B. (2003): Verluste von Wasservögeln in Stellnetzen der Küstenfischerei – das Beispiel der Insel Usedom. *Meer und Museum* 17: 160-166.

Schröder, A., Gutow, L. & Guský, M. (2008): Auswirkungen von Grundsleppnetzfishereien sowie von Sand- und Kiesabbauvorhaben auf die Meeresbodenstruktur und das Benthos in den Schutzgebieten der deutschen AWZ der Nordsee (MAR 36032/15). Abschlussbericht für das Bundesamt für Naturschutz (BfN), Bremerhaven: Alfred-Wegener-Institut für Polar- und Meeresforschung. 121 pp.

Sonntag, N. & Garthe, S. (2010): Grundlagenanalysen zur Entwicklung von Maßnahmen zur Regulierung der Fischerei in den Vogelschutzgebieten in der Ausschließlichen Wirtschaftszone, Forschungs- und Technologiezentrum Westküste (FTZ), büsum, 85 pp.

Zydelis, R., Bellebaum, J., Osterblom, H., Vetemaa, M., Schirmeister, B., Stipniece, A., Dagys, M., van Eerden, M. & Garthe, S. (2009): Bycatch in gillnet fisheries - An overlooked threat to waterbird populations. *Biol. Conserv.* 142 (7): 1269-1281.

**Acknowledgement:** I would like to thank the two anonymous reviewers for their excellent work.

**Table 1a:** Summary of proposed fisheries management measures in the Natura 2000-sites of the German EEZ in the North Sea.

North Sea	Protected features			
	Reefs	Sandbanks	Harbour porpoises	Seabirds
Dogger Bank		1: Experimental closure of 50% of the area for fisheries with mobile bottom-contacting gears	2a: Year-round exclusion of fisheries with gillnets and entangling nets in the entire Natura 2000-site (BfN) 2b: Year-round use of pingers on all gillnets and entangling nets (vTI)	
Sylt Outer Reef	1: Exclusion of fisheries with mobile bottom-contacting gears from the central area	2: Experimental closure of the Northern part (50%) of the Amrumbank for fisheries with mobile bottom-contacting gears	3: Exclusion of fisheries with gillnets and entangling nets 3a: Year-round (BfN) 3b: Seasonally (1 May – 31 August) and use of pingers on all gillnets and entangling nets throughout the year (vTI)	
Borkum Reef Ground	1: Exclusion of fisheries with mobile bottom-contacting gears in the entire Natura-2000 site	1: Exclusion of fisheries with mobile bottom-contacting gears in the entire Natura 2000-site	2a: Year-round exclusion of fisheries with gillnets and entangling nets in the entire Natura 2000-site (BfN) 2b: Year-round use of pingers on all gillnets and entangling nets (vTI)	
Eastern German Bight Nature Conservation Area				1: Exclusion of fisheries with gillnets and entangling nets; Northern part: Seasonally (1 Oct – 15 May) Southern part: Year-round

Blue: Measure proposed by both vTI and BfN; Beige: Proposal of two options.

**Table 1b:** Summary of proposed fisheries management measures in the Natura 2000-sites of the German EEZ in the Baltic Sea.

	<b>Protected features</b>			
<b>Baltic Sea</b>	Reefs	Sandbanks	<i>Harbour porpoises</i>	Seabirds
Fehmarn Belt	1:Exclusion of fisheries with mobile bottom-contacting gears in sandbank and reef areas	1:Exclusion of fisheries with mobile bottom-contacting gears in sandbank and reef areas	2a: Year-round exclusion of fisheries with gillnets and entangling nets in the entire area (BfN)  2b: Year-round use of pingers on all gillnets and entangling nets irrespective of vessel size (vTI)	
Kadet Trench	1:Exclusion of fisheries with mobile bottom-contacting gears in reef areas		2a: Year-round exclusion of fisheries with gillnets and entangling nets in the entire area (BfN)  2b: Year-round use of pingers on all gillnets and entangling nets irrespective of vessel size (vTI)	
Western Rønne Bank	1:Exclusion of fisheries with mobile bottom-contacting gears in the entire area		2a: Year-round exclusion of fisheries with gillnets and entangling nets in the entire area (BfN)  2b: Year-round use of pingers on all gillnets and entangling nets irrespective of vessel size (vTI)	
Adler Ground	1:Exclusion of fisheries with mobile bottom-contacting gears in the entire area	1:Exclusion of fisheries with mobile bottom-contacting gears in the entire area	2a: Year-round exclusion of fisheries with gillnets and entangling nets in the entire area (BfN)  2b: Year-round use of pingers on all gillnets and entangling nets irrespective of vessel size (vTI)	

Progress in Marine Conservation in Europe 2012

Pomeranian Bay with Odra Bank		<b>1:</b> Exclusion of fisheries with mobile bottom-contacting gears in sandbank areas	<b>2a:</b> Year-round exclusion of fisheries with gillnets and entangling nets in the entire area (BfN)  <b>2b:</b> Year-round use of pingers on all gillnets and entangling nets irrespective of vessel size (vTI)	
Pomeranian Bay Nature Conservation Area				<b>1:</b> Spatially differentiated year-round and seasonal exclusion of fisheries with gillnets and entangling nets; Area 1 ("Odra Bank"): Year-round closure; Area 2 ("Trench"): Seasonal closure (Dez-Apr and Jun-Oct); Area 3 ("Adler Ground"): Seasonal closure (Nov-Apr)

Blue: Measure proposed by both vTI and BfN; Beige: Proposal of two options.



## **Implementation of Natura 2000 in the Dutch North Sea: Managing Fisheries**

HANS NIEUWENHUIS

Ministry of Agriculture, Nature Conservation and Food Quality, The Netherlands

### **Abstract**

This presentation gives an overview of the process for managing fisheries in 5 marine Natura 2000 sites in the Netherlands. It provides insight how two European regulatory frameworks can be reconciled: Natura 2000 and the European Common Fisheries Policy.

It first describes the fisheries management process for two sites in the coastal zone (VIBEG agreement): How were stakeholders involved in designing the measures? What outcome was achieved? How is it currently being implemented?

It subsequently deals with the process for designing fisheries measures for three sites in the EEZ (the FIMPAS project): How was scientific and stakeholder information used? How was international consultation achieved? And what is the current state of play? Although the regulatory processes are still underway, some important lessons learned are drawn.



# Development of Alternative Fishing Gear in the Swedish Small-scale Coastal Fisheries

SARA KÖNIGSON AND SVEN-GUNNAR LUNNERYD

Institute of Coastal Research, Swedish University of Agricultural Sciences, Sweden

## 1 Why do we need alternative fishing gear?

In the Swedish small-scale and coastal fisheries, alternative fishing gear has been, and is still being, developed. The main reason for the development is the seal inflicted damages to fishing gear and catch. Seals can cause damage by tearing holes in the fishing gear which shortens the livelihood of the fishing gear and in trap fisheries cause the catch to escape. Seals also consume or damage the catch caught in the fishing gear. There are three species of seals along the Swedish coast; the grey seal (*Halichoerus grypus*), the ringed seal (*Phoca hispida*) and the harbour seal (*Phoca vitulina*). All populations have increased in numbers. Grey seals are increasing by 7 to 8%, ringed seals by 4,5% and Harbour seals on the west coast by 12% (HAVET, 2011). The seals-fisheries conflict in the Baltic has escalated concurrently with the population increase (BALTSCHIEFFSKY, 1997; KAUPPINEN et al., 2005; WESTERBERG et al., 2000; LUNNERYD, 2001; FJÄLLING, 2004). The fisheries which are subjected to the seal-fisheries conflict to the greatest extent is the small-scale and coastal fisheries. Coastal fisheries are widely scattered along the Swedish coastline and they are of great importance to the local population in many villages. In addition to facing damage caused by seals, these fisheries tend to suffer from diminishing fish stocks and structural problems such as difficulties distributing the catch. There is a need to develop alternative fishing gear in order to decrease the seal fisheries conflict. Traps and pots are fishing gear where it is possible to protect the catch from seals. In traps and pots, the catch can be gathered in closed departments which in turn can be designed using a solid construction and a strong material which ensures a seal-safe fishing gear.

Nevertheless, there are many other reasons why we need alternative fishing methods. The environmental impact of alternative fishing gear such as traps and pots is considered less severe compared to traditional fishing methods. In comparison to trawls and other active fishing gear, alternative gears such as pots cause limited harm to the marine environment (JENNINGS et al., 2001; THOMSEN et al., 2010). SUURONEN et al., (2012) included pots in the compilation of LIFE (Low Impact and Fuel Efficient) fishing gear due to their low energy use, effective species selectivity and low gear construction costs. Another advantage with pots is that these can be designed to capture cod above a certain length limit (KÖNIGSON, 2011; OVEGÅRD et al., 2011)

as well as decreasing the bycatch of marine mammals and birds. There is a need to broaden the perspectives regarding fisheries management for every kind of fisheries, e. g., with life cycle assessment methods which evaluate the environmental impacts of products using a broad and systematic approach (HORNBERG et al., 2012).

Another equally important reason for considering alternative fishing gear is that the small-scale coastal fisheries suffer from low profitability and scant addition of young fishers, needs a positive development. Coastal or small scale fishery is often carried out by single fishers who make daily fishing trips and return every night to harbour. These fisheries could supply a local market with high quality fish and low transportation costs. However, in Sweden, Baltic fishers get a low price for the fish (on average less than 1.5 euro per kg cod) and the fish is often exported to central Europe as there are no other distribution channels. A positive development such as using alternative fishing gear could include ecolabelling fish or marketing the fish as locally caught which in turn could hopefully give the fishers a higher catch value and a higher income.

## **2 How do we develop alternative fishing gear?**

The seal-fisheries conflict, the environmental impact, practical handling of alternative fishing gear and, last but not at least, the catch efficiency of the alternative fishing gear must be taken into regard when developing alternative fishing. Our first priority has been to study the fishing efficiency of alternative fishing gear and whether catch from alternative fishing gear is comparable to traditional fishing gear. This work not only includes comparing the fishing efficiency but also studying which variables can affect the catch and how we can increase the fishing efficiency of alternative gear by for example modifying the gear or by using stimuli to attract fish.

The next priority is the environmental impact, such as increasing size selectivity of the fishing gear as well as decreasing the bycatch of marine mammals and birds. Pots and traps can effectively limit the catch of undersized fish by using selection panels (OVEGÅRD et al., 2011; LUNDIN et al., 2011). Decreasing the fuel costs and the extent of ghost fishing by lost gear are also factors which need to be taken into regard. By having an opening in the pot which is secured with degradable thread material as for example cotton, the opening will open after a couple of months and thereby create an escape for fish trapped inside the pot. Pots and traps also demand less fuel compared to gill nets which are normally set during one day and retrieved the following day. Pots and traps can be left in the water and emptied when the weather allows it or when there is an accentuated demand of fresh fish.

The last part of the work has been to actually develop a seal-safe fishing gear. This can be done by gathering the fish in a closed and solid compartment where seals cannot

access the catch. Making it hard for seals to access the catch will consequently minimize the reward for the seal and thereby decrease its motivation to raid fishing gear for food (KÖNIGSON et al., 2007). Handling and practicality of the fishing gear also needed to be taken into account.

Most important in the development of alternative fishing gear was the cooperation between fishers, manufactures and scientists. The following two chapters will describe two alternative fishing gears developed to decrease the seal-fisheries conflict in the Baltic.

### **3 Trap net fisheries in northern Baltic**

Salmon (*Salmo salar*, ) trout (*Salmo trutta*) and whitefish (*Coregonus laveratus*) traps are included in the gear category subject to the largest economic damage due to seals in the Swedish fishery and in this category, developing alternative fishing gear as a mitigation method has been highly prioritized (WESTERBERG et al., 2006). The trap net fishery in the Baltic is, in many respects, a model fishery - being selective, energy saving and harmless to the benthic environment. The trap nets used in the fisheries are huge constructions that comprise a leader arm, a trap (gathering compartments) and a fish chamber where the fish finally gather (Figure 1). The trap nets are often placed close to river mouths with the traps leader arm set perpendicular to the shore line. The fisheries are carried out with small boats normally operated by one single person. Salmon, trout, and whitefish follow the leader arm into the trap and finally get caught in the fish chamber.

A solution was found by redesigning the whole trap in such a way that it became a hindrance to the seals' fishing efforts, instead of assisting seals. The fish chamber was constructed with an outer protecting net. The outer net needed to be under tension to prevent seals from reaching the fish, and to accomplish this, the fish-bag had to be stiff. This led to a special arrangement for emptying the bag. Inflatable pontoons were mounted under the bag, lifting the fish chamber up to the surface with the help of an air compressor. Handling this new construction proved to be very labor saving and took less time than handling the original fish chamber. The opening into the fish chamber has a frame made of stainless steel with a width of 40 cm and a wire in the middle of the frame in order to prevent seals from entering the fish chamber. The trap connected to the pontoon fish chamber was designed without any narrow corners. The stretched mesh size of 400 mm allows the fish but not the seal to swim through the meshes during a chase inside the trap. Traditional traps have sharp corners and are made in a polyethylene material with a mesh size of 200 mm. These traps guide or lead the fish into the fish chamber where the fish gather. Lunneryd et al. (2002) showed that the mesh size can be large without losing the guiding properties. However, data showed

that there was a loss of salmon through the large meshes in the experimental trap which was independent from seal disturbance. In a following study, detailed damage records of 5,400 emptyings of conventional and large mesh traps with pontoon fish chambers were kept. The result showed that the catch of salmon and trout was 50% higher and that the number of incidents with damaged fish and gear decreased by 80% compared with conventional salmon traps (LUNNERYD & FJÄLLING, 2004).

This alternative fishing gear, a combination of the large mesh trap and the pontoon fish chamber, has been a successful development of seal-safe alternative fishing gear (LUNNERYD et al. 2003). The traps are now used by 86 % of the Swedish salmon trap fishermen along the northern Baltic coast (HEMMINGSSON & LUNNERYD, 2007).

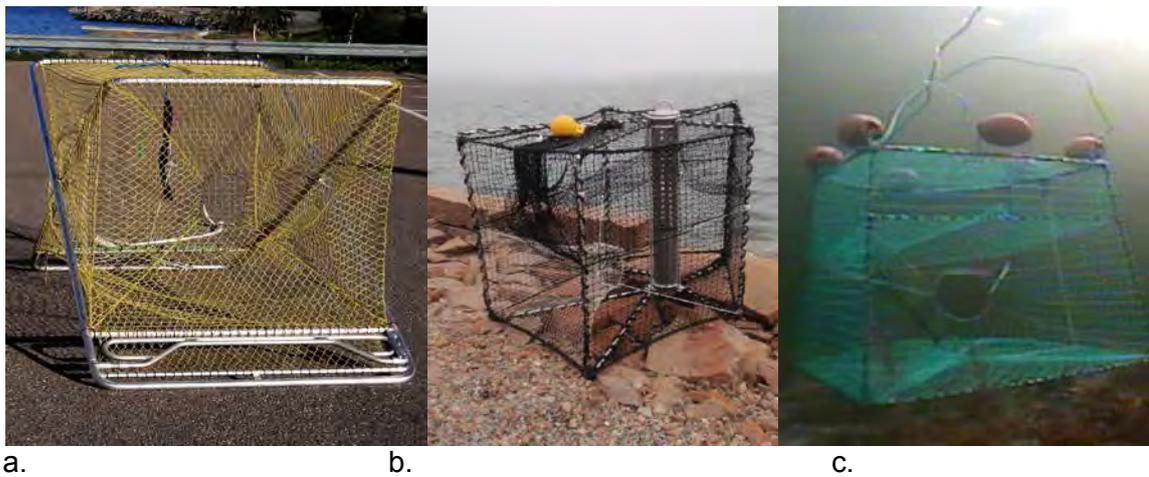
Pontoon traps are being developed for other fish species such as perch (*Perca fluviatilis*), pike perch (*Sander lucioperca*) and herring (*Clupea harengus*). The development of a seal-safe herring pontoon trap began in 2009. The traps can be used when the herring aggregate in coastal areas. A problem with traps used for herring is the possibility of large catches of small herring. However, the traps can be made selective by releasing the undersized herring with the use of selection grids (LUNDIN et al., 2011).



**Figure 1:** The 'pontoon' trap, here seen on its way up to be emptied, consists of a fish chamber connected to a large mesh trap.

#### 4 Cod pot fisheries in central Baltic

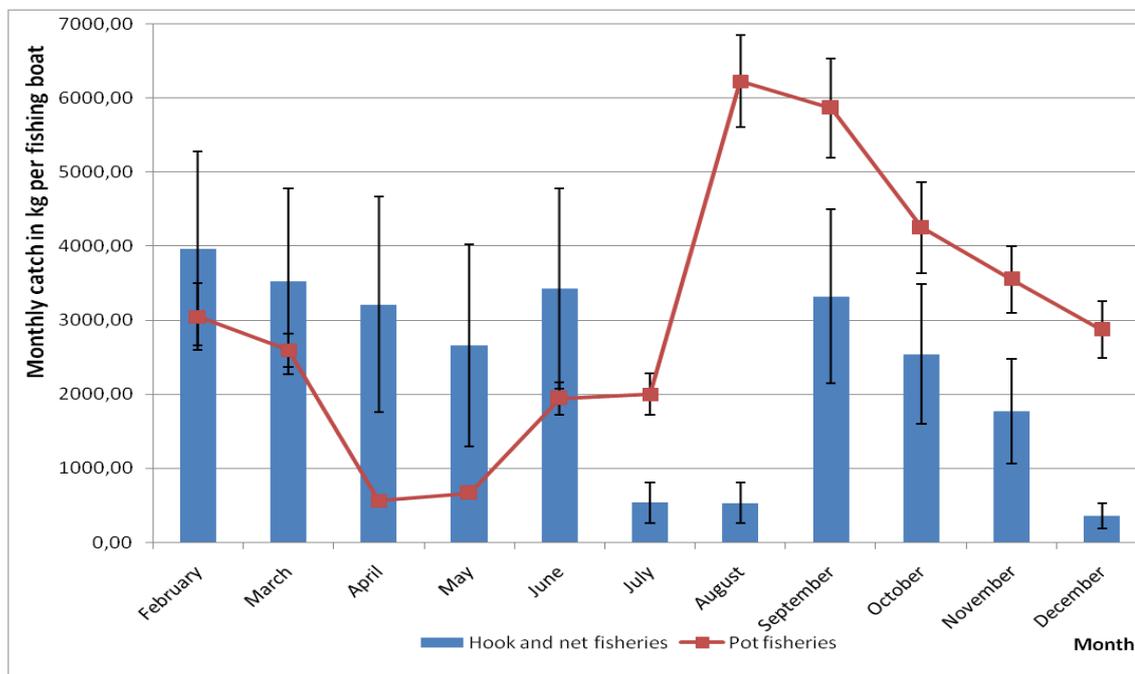
Another example of an alternative fishing gear which is under development is the cod pot. At this point, at least three models of the seal-safe cod pots have been produced by three fishing gear manufacturers (Figure 2). Two different two-chambered pots as well as one chambered pots are produced and the different models are currently being tried out by commercial fishers in the south Baltic. To meet the requirements of being a seal-safe gear, the construction needs to be rigid and made in a strong material. Therefore, the models are either collapsible or possible to stack on each other.



**Figure 2:** Three of the seal-safe models being developed in collaboration with fishing gear manufacturers, fisheries scientists and fishers. Model a and b are collapsible made in a material with a meshsize of around 30 mm mesh to mesh. Model c can be stacked on each other and has a mesh size of 45 mm. Model a has only one chamber, model b and c are two-chambered with an entrance chamber and a fish holding chamber. The two-chambered models are the most efficient pots compared to pots with only one chamber and an open entrance.

The first focus in developing cod pots has been to study whether pots have a potential as a commercial fishing gear in comparison to gillnet and hook fisheries in the central Baltic. To evaluate this, experimental fishing trials with two-chambered floating pots (described by OVEGÅRD et al., 2011; FUREVIK et al., 2008), were conducted in the southern Baltic Sea in 2009 and 2010. Trials were carried out in collaboration with local fishermen conducting a full-time fishery and using up to 100 pots. The pots were set in strings with up to 8 pots connected on a bottomline and a distance of 50 meter between pots. Results from experimental fishing trials showed that in the area where the experimental fishing was conducted cod pots had an economical potential as an alternative fishing gear compared to gillnets and hooks in the central Baltic (OVEGÅRD et al., 2011; KÖNIGSON et al., 2010). The catch in pots from the experimental fishing was compared to the catch from gillnet and hook fisheries reported to the EU logbook

from the same area as the experimental fishing. All licensed fishermen with a boat over 8 meters of length are obligated to report their daily catch and effort to the EU logbook. Extrapolating catch per pot from test fishing to the number of pots possible to use in a commercial pot fishery, preliminary results showed that in spring, pots caught less than gillnets (Figure 3). However, in fall, the monthly catch from pots increased and was comparable to the catch from the gillnet fisheries (Figure 3). There are many factors which can affect the pots temporal variation in the fishing efficiency. Pots are baited fishing gear and their catch per effort is affected by two factors - fish availability to the gear, such as fish distribution over time and space and the baited gears catchability (ENGÅS & LØKKEBORG, 1994; ARREQUIÑ-SAÑCHES, 1996). The gears catchability is dependent on environmental variables effecting fish activity, feeding motivation and fish ability to detect, locate and consume baits (STONER, 2004).



**Figure 3:** Extrapolating the catch per kg and month to a possible full-time cod pot fishery using 100 pots and comparing it to a full-time gillnet and hook fishery in the same area reported to the EU-logbook (from KÖNIGSON et al., 2010). In July and August, fishing with gillnets and hooks is not permitted. Therefore catches were small during this period.

Compared to other fishing gear, such as for example gillnets which can cover long distances, the general catch efficiency of pots is low (SUURONEN et al., 2012) and therefore there is a need to increase the fishing efficiency of the pots. High fishing efficiency of pots is usually maintained by attracting fish to the fishing grounds using bait (FUREVIK & LØKKEBORG, 1994; LØKKEBORG, 1998), but fishing efficiency could be improved further with other methods such as visual stimuli. Artificial light is a

stimulus which can be used to attract or affect fish in order to increase catch efficiency (BEN-YAMI, 1988). A study was carried out to investigate Atlantic cod behaviour when confronted by visual stimuli in floating cod pots and to determine whether it is possible to increase the pots catch efficiency when using a steady green light inside pots. Preliminary results showed that the catch increased significantly in pots with a green lamp inside (BRYHN et al., manuscript).

The subsequent focus in the development work was to study and if possible decrease the negative environmental impact of cod pots. A problem that needed to be solved regarding the pot fisheries was the high discard rates of undersized fish. Approximately 45–60% of the cod caught in the commercially available floating pot consists of fish below legal minimum landing size (FUREVIK et al., 2008). High discard rates of caught and thereby possibly fatally injured fish are not only a threat to the productivity of the stock; they are also a highly time-consuming problem for the fishermen (KELLEHER, 2005). Therefore, the effect on the size of cod captured in floating pots when modified with a selection panel of different mesh sizes was studied (OVEGÅRD et al., 2011). By comparing the proportion of catch from pots with selection panels to the total catch (pots with and without selection panels) at each length interval we received information on which mesh size or other kind of panel would be optimal for a certain length of fish. Using a selection panel with a square mesh of 45 mm, the absolute majority of fish below 38 cm (which is the minimum legal landing size on fish caught in the Baltic Sea) escaped from the pot. Results also showed that pots are not only size selective but also species selective, only the target species cod was caught in the pots. This is most likely because they are floating above the bottom preventing bottom-dwelling species such as flatfish to enter the pot.

However, the bycatch of marine mammals such as seals is a problem in the pot fisheries (KÖNIGSON et al.). Seals, in contrast to harbor porpoises, actively explore traps and pots for food and thereby risk getting caught in the fishing gear. One way of preventing seals from getting caught in pots is to stop them entering the pot with the aid of a Seal Exclusion Device (SED). Trials with the pontoon trap used in salmon fisheries in the Northern Baltic have shown that large grey seals could not enter the trap when an SED, in this case in the form of a rigid metal frame with a wire set in the middle of the frame, was placed in the entrance of the trap (HEMMINGSSON et al., 2008). The entrance of the pot was strengthened with a metal frame and the size of the entrance was reduced to prevent seals from forcing their way in. Results showed that SEDs decreased the bycatch of seals however depending on the size and shape of the SED the catch of cod was also affected (KÖNIGSON et al.). A square metal frame decreased the catch of cod while an oval frame increased the catch instead. However, results from this study did not give any clear indications as to which characteristics a

SED should have to maximize its fishing efficiency in terms of SED variation in shape, size and dimension of the steel bar of the frame.

## **5 Challenges and future work**

There is a need for alternative fishing gear in many fisheries along the Baltic coast due to many of the reasons mentioned in this report. When developing alternative fishing gears an overarching recommendation is the need for researchers to fully understand and work together with the subjected fishery. This usually requires collaborations between scientists, industry, and fishery managers.

Fishing gear, which catchability is dependent on the behavior of the target species such as for example pots, do most likely have different requisites in different areas. A fishing gear used in a certain area might not work for the same target species in another area due to abiotic factors which affects the species behavior. This is important to take into consideration when evaluating alternative fishing gears that potentially can be used in an area. Therefore, when developing alternative fishing gear, studies on the behavior of target fish species in relation to fishing gear characteristics as well as the surrounding abiotic factors are crucial. This knowledge can help determine what fishing gear characteristics are needed to develop alternative fishing gear for different target species.

We will most likely not be able to continue fishing the way we are used to in the future. For example we need to reduce the fuel consumption as well as the bycatch of non-target species and we need to increase the size selectivity of the fishing gear. However if we want to work towards a sustainable fishery then alternative fishing gear might be the solution in many fisheries. I believe there is a need to start thinking outside the box when developing fishing gear. We need to look at new fishing possibilities and taking the behavior of the target species into consideration might be a way forward. Developing fishing gear is challenging as well as time consuming, however hopefully the results will take us towards a sustainable fishery. The large-meshed push-up trap is an excellent example of a newly developed fishing gear taking the behavior of fish into consideration and thereafter having a successful implementation in the subjected fishery.

## **6 References**

Arregui'n-Sa'nchez, F. (1996): Catchability: a key parameter for fish stock assessment. *Reviews in Fish Biology and Fisheries* 6: 221–242.

- Baltscheffsky, S. (1997): Seals in the Bothnian Sea: From endangered species to coastal nuisance. *Enviro* 23
- Ben-Yami, M. (1988): Attracting fish with light. FAO, Rome, 72 pp.
- Bryhn, A.C. Königson, S. Lunneryd, S.-G. & Bergenius, M. (2012): Visual stimuli affecting the catch efficiency of floating cod (*Gadus morhua*) pots in the Baltic Sea. Manuscript, Swedish Agricultural University, Department of Aquatic Resources.
- Engås, A. & Løkkeborg, S. (1994): Abundance estimation using bottom gillnet and longline – the role of fish behaviour. In Fernö, A. & Olsen, S. (Ed.), *Marine Fish Behaviour in Capture and Abundance*. Oxford, Fishing News Books. 134–165 pp.
- Fjälling, A. (2004): Assessment and reduction of the conflicts between commercial fisheries and grey seals (*Halichoerus grypus*) in Swedish waters. Licentiate Thesis. Institute of Technology, Linköping University.
- Furevik, D. M. & Løkkeborg, S. (1994): Fishing trials in Norway for torsk (Brosme brosmes) and cod (*Gadus morhua*) using baited commercial pots. *Fisheries Research* 19: 219-229.
- Furevik, D.M. Humborstad, O.B. Jørgensen, T. Løkkeborg, S. (2008): Floated fish pot eliminates bycatch of red king crab and maintains target catch of cod. *Fisheries Research* 92: 23-27.
- Havet (2011): Om miljötillståndet i svenska vatten. Ges ut av Naturvårdsverket och Havsmiljöinstitutet. [www.havet.nu](http://www.havet.nu)
- Hemmingsson, M. & Lunneryd, S.G. (2007): Pushup-fällor i Sverige, Introduktionen av ett nytt sälsäkert fiskeredskap. (Push-up traps in Sweden, the introduction of a new seal-safe fishing gear). *Finfo Fiskeriverket informerar* 8 (in Swedish with English summary).
- Hemmingsson, M. Fjälling, A. & Lunneryd, S-G. (2008): The pontoon trap: Description and function of a seal-safe trap-net. *Fisheries Research* 93: 357-359.
- Hornborg, S. Nilsson, P. Valentinsson, D. & Ziegler, F. (2012): Integrated environmental assessment of fisheries management: Swedish *Nephrops* trawl fisheries evaluated using a life cycle approach. *Marine Policy* 34(6): 1193-1201
- Jennings, S. Kaiser, M. J. & Reynolds, J. D. (2001): *Marine Fisheries Ecology*. Blackwell, Oxford, 417 pp.
- Kauppinen, T. Siira A. & Suuronen P. (2005): Temporal and regional patterns in seal-induced catch and gear damage in the coastal trap-net fishery in the northern Baltic Sea: effect of netting material on damage. *Fisheries Research* 73: 99-109.
- Kelleher, K. (2005): Discards in the world's marine fisheries: an update. FAO Fisheries Technical Paper No. 470. Food and Agriculture Organization of the United Nations, Rome, Italy.

- Königson, S. Hemmingsson, M. Lunneryd, S-G. & Lundström, K. (2007): Seals and fyke nets: An investigation of the problem and its possible solution. *Marine Biology Research* 3: 29-36.
- Königson, S. Lunneryd, S-G. & Ljunghager, F. (2010): Cod pots, an alternative fishing gear to nets and hooks? Presentation at the ICES annual conference 2010, Nantes, France
- Königson, S. (2011) Seals and Fisheries - A Study of the Conflict and Some Possible Solutions. PhD dissertation, Gothenburg University, Gothenburg
- Königson, S. Lövgren, J. Ovegård, M. & Lunneryd, S-G. (2012): Seal Exclusion Devices can prevent seal bycatches in a cod pot fishery without necessarily reducing the fishing power of the gear
- Lundin, M. Calamnius, L., Hillström, L., and Lunneryd, S.G. (2011): Size selection of herring (*Clupea harengus membras*) in a pontoon trap equipped with a rigid grid. *Fisheries Research* 108: 81-87.
- Lunneryd, S.G. (2001): Fish preference by harbour seal (*Phoca vitulina*), with implications for the control of damage to fishing gear. *ICES Journal of Marine Science* 58(4): 824-829.
- Lunneryd, S. G. Westerberg, H & Wahlberg, M. (2002): Detection of leader net by whitefish *Coregonu lavaretus* during varying environmental conditions. *Fisheries Research* 54: 353–362.
- Lunneryd, S.G. Fjälling, A. & Westerberg, H. (2003): A large-mesh salmon trap: a way of mitigating seal impact on a coastal fishery. *ICES Journal of Marine Science* 60: 1194-1199.
- Lunneryd, S. G. & Fjälling, A. (2004): Lyckad introduktion av stormaskefällan och pushup fiskhuset. (A successful introduction of the large mesh trap and the pushup fish bag.) *Yrkesfiskaren* 13/14: 12-14
- Løkkeborg, S. (1998): Feeding behaviour of cod, *Gadus morhua*: activity rhythm andchemically mediated food search. *Animal Behaviour* 56: 371–378.
- Ovegård, M. Königson, S. Persson, A. & Lunneryd, S-G. (2011) Size selective capture of Atlantic cod (*Gadus morhua*) in floating pots. *Fisheries Research* 107: 239-244.
- Stoner, A.W. (2004) Effects of environmental variables on fish feeding ecology: implications for the performance of baited fishing gear and stock assessment. *Journal of Fish Biology* 65: 1445–1471.
- Suuronen, P. Chopin, F. Glass, C. Løkkeborg, S. Matsushita, Y. Queirolo, D. & Rihan, D. (2012): Low impact and fuel efficient fishing - looking beyond the horizon. *Fisheries Research* 119-120: 135-146.
- Thomsen, B. Humborstad, O.-B. & Furevik, D. M. (2010): Fish pots: fish behavior, capture processes and conservation issues. In: He, P (Ed.), *Behavior of Marine Fishes: Capture Processes and Conservation Challenges*. Blackwell, Oxford, 143-158 pp..

Westerberg, H. Fjälling, A & Martinsson, A. (2000): Sälskador i det svenska fisket. (Seal damage in the Swedish fishery). Fiskeriverket Rapport 3:4–38.

Westerberg, H. Lunneryd, S-G. Fjälling, A. & Wahlberg, M. (2006): Reconciling Fisheries Activities with the Conservation of Seals throughout the Development of New Fishing Gear: A Case Study from the Baltic Fishery–Grey Seal Conflict. American Fisheries Society Symposium 587-598.



# The Census of Marine Life, the Ocean Biogeographic Information System, and where do we go from here? Future perspectives

EDWARD VANDEN BERGHE<sup>1</sup>, RON K. O'DOR<sup>2</sup>, PAUL SNELGROVE<sup>3</sup>

<sup>1</sup>Ocean Biogeographic Information System, Rutgers University, USA

<sup>2</sup>Biology Department, Dalhousie University, Canada

<sup>3</sup>Canada Research Chair, Memorial University of Newfoundland, Canada

## Abstract

In this paper, we report on three inter-related activities: the Census of Marine life (Census), the Ocean Biogeographic Information System (OBIS), and Life in a Changing Ocean (LICO). The Census was a 10-year programme coordinating marine research to assess diversity, distribution, and abundance of marine life. OBIS comprises the primary data repository for Census data, and with the on-going addition of many other data sets has expanded to hold 36 million records of georeferenced species records; it now represents the single largest major marine biodiversity database. LICO, a fledgling initiative, seeks to build on the achievements of the Census and work with the same community to expand the work of understanding what lives in the ocean and what roles they play. Although this initiative remains in the planning stages, stalled by current funding challenges, the marine biodiversity community remains committed to its objectives that include periodic status reports on what we know and don't know about ocean life as we approach 2020, just as the Census did as part of its 2010 finale in London. The work conducted under the Census resulted in a first baseline, documented through OBIS. While OBIS is seen by many as the legacy of Census, so far it has been impossible to obtaining sustained funding. In spite of these difficulties, OBIS data have been used to support Ecosystem Approach to Fisheries Management and Vulnerable Marine Ecosystem activities of the Food and Agricultural Organisation, as well as the establishment of Ecologically and Biologically Significant Areas of the Convention on Biological Diversity.

## 1 Introduction

The oceans form the largest inhabitable space on Earth. They encompass roughly 70% of the surface area of our planet. But consider the truly three-dimensional nature of ocean habitat that can extend several kilometres deep and contrasts strongly with terrestrial life that is largely restricted to within the first 100 metres above the Earth's surface. Unfortunately, our knowledge of the marine environment is disproportionately

small compared to its volume – more easily accessible terrestrial systems are much better studied. Furthermore, most remote sensing techniques can only probe the upper layers of the Oceans, further hampering our efforts to understand our largest living environment. Towards the end of last century, Fred Grassle and Jesse Ausubel conceived the Census of Marine Life, to stimulate the study of biodiversity in the ocean, and to bring together existing efforts (AUSUBEL, 1999). They immediately recognized a need for an integrated database strategy, and began to develop the Ocean Biogeographic Information System (OBIS), that would bring together research results from the many activities, and create an information infrastructure that would go beyond individual disciplines (GRASSLE & STOCKS, 1999; GRASSLE, 2000). Both the Census and OBIS were generously sponsored by core funding from the Alfred P. Sloan Foundation that was then leveraged to attract a wide range of additional support from science agencies around the world.

## 2 The Census of Marine Life

The Census of Marine Life (hereafter referred to simply as 'Census') was a 10-year international effort undertaken in order to assess the diversity (how many different kinds), distribution (where they live), and abundance (how many) of marine life. It represented a task never before attempted on a global scale. The Census stimulated the discipline of marine science by tackling these issues globally, and engaging some 2,700 scientists from around the globe, who participated in 540 expeditions and countless hours of land-based research. The Census explored the oceans, from the coast to the deep sea, from the poles to the equator, from whales to microbes (SNELGROVE, 2010).



**Figure 1:** The Census according to Jim Toomey, author of 'Sherman's lagoon' and friend of the Census.

The Census scientists assessed the diversity, distribution and abundance of marine life and how it changed over time – leading to the Census’ three grand questions: What lived in the oceans? What does live in the oceans? What will live in the oceans? They agreed to explore the limits to knowledge of marine life, and to frame the state of our knowledge in terms of ‘the Known, the Unknown and the Unknowable’.

The scientific results were reported on 4 October 2010, at the Royal Institution in London. This first baseline picture of ocean life in the past, present, and future can be used to forecast, measure, and understand changes in the global marine environment, as well as to inform the management and conservation of marine resources. Collaboration in the Census led to the publication of several books that targeted scientific (MCINTYRE, 2010; SNELGROVE, 2010) and general audiences (CRIST ET AL., 2008) and many scientific papers (see YARINCIK & O’DOR, 2005; O’DOR ET AL., 2010 for an overview and many references to papers; O’Dor and Vanden Berghe 2012 for an overview of the achievements of Census projects, and how the collaboration between the field project resulted in something much bigger than the sum of its parts).

The Census investigated life in the global ocean from microbes to whales, from top to bottom, from pole to pole, bringing together the world’s preeminent marine biologists to share ideas, data, and results. During their 10 years of discovery, Census scientists discovered new species, habitats, and connections and unlocked many of the ocean’s long-held secrets. They found and formally described more than 1,200 new marine species, with another 5,000 or more in the pipeline awaiting formal description. The Census clearly demonstrated that the age of discovery is far from over. A few of the species newly discovered by Census scientists are illustrated below (Figure 2).

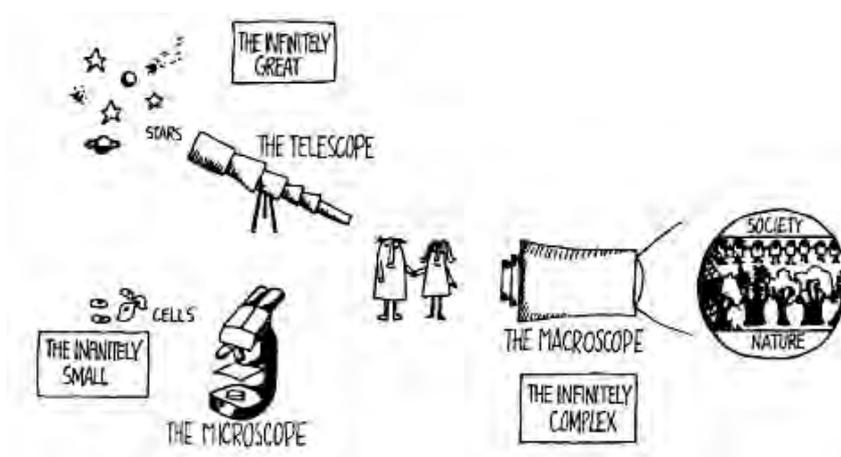


**Figure 2:** Some of the many new species discovered by Census scientists. From left to right: *Nanaloricus cinzia*, a loriciferan capable of living in anaerobic conditions – a first for multicellular animals (Image: Roberto Danovaro); the Yeti Crab, *Kiwa hirsuta*, owns its vernacular name to its white, hairy look (Image: Alexis Fifis, IFREMER); *Aureophycus aleuticus*, a kelp growth three metres long and occurring in near shore waters, is just one species that proves that discoveries of large new species can be made in relatively accessible areas.

The frequency of new discoveries was such that it proved impossible to extrapolate the total number of marine species remaining to be discovered. The Census also documented one of the major challenges in making such estimates: that most marine species are rare, and therefore difficult to detect. Census scientists were also very productive in resolving another complicating factor, namely that some species are morphologically very similar to each other despite important differences in their biology, but genetic analyses now differentiate between them unambiguously.

### 3 The Ocean Biogeographic Information System

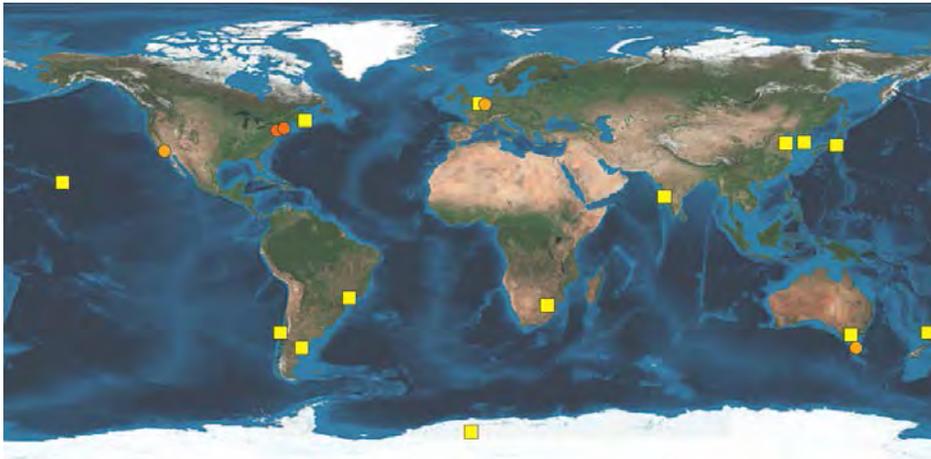
The Ocean Biogeographic Information System (OBIS) was created in 2000 as the data integration component of the Census. OBIS subsequently grew beyond its original scope and now integrates data from many sources and over a wide range of marine themes, from poles to the equator, from microbes to whales. Its ambition to become a 'Macroscope' (DE ROSNAY, 1979) for marine biodiversity will allow us to see past complexities and the idiosyncrasies of individual datasets to see the "big picture" of ocean life more clearly. OBIS already provides the world's largest online repository of geo-referenced data on marine species distributions, accessing data from well over 1,000 individual sources to produce a total of over 36 million species distribution records from the Census and from many studies that preceded it. Its integrated datasets can be seamlessly searched by species name, higher taxonomic level, geographic area, depth, and time. OBIS also allows users to identify biodiversity hotspots and large-scale ecological patterns, analyse distributions of species over time and space, and plot species' locations with temperature, salinity, and depth.



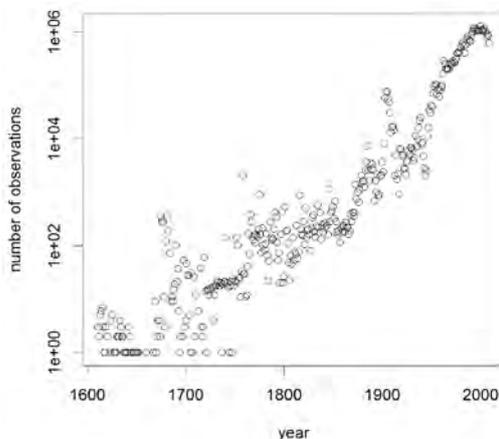
**Figure 3:** A new type of (virtual) scientific instrument, the 'Macroscope', as seen by Joel de Rosnay (DE ROSNAY, 1979). Reproduced with permission from the author.

A global network of Regional and Thematic OBIS Nodes assures the worldwide scientific support needed to fulfil its global mission. The map showing the regional node headquarters (Figure 4) clearly demonstrates the global OBIS reach, as do strong ties with many important international environmental organizations, such as the Global Biodiversity Information Facility (GBIF), the Encyclopedia of Life, the Convention on Biological Diversity, the Food and Agricultural Organization, and many others.

OBIS aims to stimulate taxonomic and systematic research, and generate new hypotheses concerning evolutionary processes, maintenance of species distributions, and roles of marine organisms in marine ecosystems. It serves as a basis for informed management of marine biodiversity by making data freely accessible over the Internet and interoperable with other data systems. We illustrate below some of the uses made of OBIS in this respect, explore the content of OBIS holdings, and identify some recently published analyses.

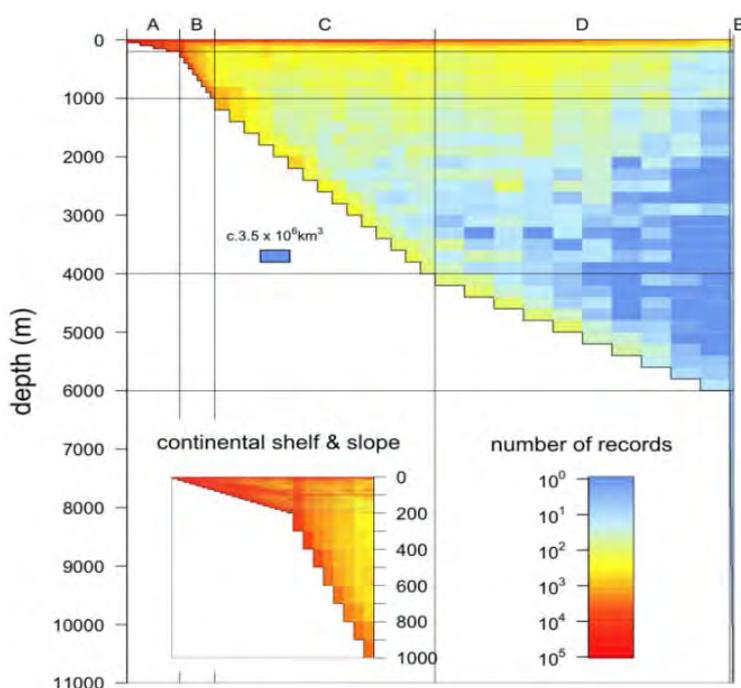


**Figure 4:** Location of the headquarters of Regional OBIS Nodes. Yellow squares: headquarters of Regional OBIS nodes. Red circle: international secretariat. Orange circles: mirror sites. Since the time of writing, the secretariat has been discontinued, and activities taken to Oostende, Belgium.



**Figure 5:** Number of observations available through OBIS, as a function of the time of observation.

Because it takes time and resources for data to become available through OBIS (scientists have to be able to publish on their data before they make them publicly available, thus creating a lag that can be several years), most OBIS data are from the second half of the 20<sup>th</sup> century. Nonetheless, most Census data are also now available in OBIS. One of the projects associated with the Census of Marine Life, the 'History of Marine Animal Populations' (HMAP), distilled biogeographic information from historical records. Extending the time frame of data available in OBIS will facilitate better predictions for the future.



**Figure 6:** Density of observations in OBIS, as a function of sample depth (vertical) and bottom depth (horizontal). Updated from Webb et al. 2010.

Data are currently available on 110,000 marine species – less than half of the number of species described. Moreover, the number of species currently described likely reflects a very incomplete fraction of the actual number out there; recent estimates suggest globally 2.2 million species live in the ocean (MORA ET AL., 2011). Clear biases exist in the data available through OBIS, where larger animals are disproportionately represented. For example, OBIS contains records for all species of marine mammals, but only 20% of known bryozoan species are represented – not even a single record exists for the other 80% of the species in this group. Also strong geographic biases are apparent, with more data available from the northern hemisphere, and from coastal areas. OBIS data have already illustrated an absence of samples in the deep pelagic (Figure 6; WEBB ET AL., 2010). This type of gap analysis can serve to guide setting of priorities for future effort.

Incomplete and imperfect as it may be, OBIS offers the best overall available information on marine species distribution. If aggregated to a sufficiently coarse grain, it certainly allows exploration of global patterns in marine biodiversity. As such, OBIS can and does support management of marine living resources. OBIS is one of the founding organisations of the Global Ocean Biodiversity Initiative (GOBI, [www.gobi.org](http://www.gobi.org)), an IUCN-led, German-sponsored consortium of like-minded organisations interested in management application of marine biodiversity knowledge; GOBI is reported on elsewhere in this volume. OBIS data has been used, through GOBI, to assist the Secretariat of the Convention on Biological Diversity on the location of Ecologically and Biologically Significant Areas (EBSAs), including establishment of management strategies for ocean areas beyond national jurisdictions. OBIS also collaborates with the Food and Agricultural Organisation (FAO), through the iMarine (<http://www.i-marine.eu>) project, funded by the EU. The objective of this project is to build a Virtual Research Environment, a system that combines data from many sources with analytical tools and processing power, in order to build applications in support of FAO's Vulnerable Marine Environments programme, and thus support its ecosystem approach to fisheries management. Unfortunately, not all OBIS news is good. Mobilising adequate resources to run OBIS to deliver services appropriate to its potential has been a constant struggle. OBIS was formally created as a scientific project, and was expected to gain funding in competition with other scientific projects. But this model failed OBIS, which has become a part of the international scientific infrastructure. Since 2011, OBIS has operated as an activity of UNESCO's Intergovernmental Oceanographic Commission; unfortunately, this status as intergovernmental activity has not resulted in a substantial increase in available resources, and the future growth and stability of OBIS remains uncertain.

#### **4 Life in a Changing Ocean**

The Life in a Changing Ocean (LICO) initiative was developed by a small subset of scientists involved with the Census in consultation with the broader Census community. Through that process, and with input from members of the Scientific Steering Committee of the Census, this new steering committee (see [www.lifeinachangingocean.org](http://www.lifeinachangingocean.org)) proposes a new international scientific program to advance and expand marine biodiversity discovery and knowledge to support healthy and sustainable ocean ecosystems. Specifically, it builds on the first Census' successful focus on discovery on diversity, distribution, and abundance of ocean life to address the specific roles played by living organisms in sustainable oceans. Using the 2010 baseline established by the Census considered in tandem with new experiments and ocean observation capacity, the program will gauge and expand our knowledge of ocean life and identify gaps to inform management on ocean issues leading up to

2020. Despite all the efforts of the Census and OBIS, critical scientific data to support the management of marine living resources are still lacking. This data gap comes at a time when the ocean and all of Earth's ecosystems face unprecedented pressure from competing human uses, exploitation, and changing environmental conditions.

Initial discussions about the organisation of this new programme were held at the second World Conference on Marine Biodiversity in Aberdeen, 26-30 September 2011. Three interlinking scientific themes in LICO will work independently and collaboratively to paint a clearer picture of marine biodiversity in the global ocean:

- Biodiversity Discovery in Space and Time. Building on the tradition of the Census of Marine Life, collaboration in this theme will be geared towards continued discovery and inventory of the biodiversity in our oceans, identifying hotspots of ocean life activity such as migration corridors and biodiversity hotspots, and developing tools to understand where and why these hotspots occur.
- Biodiversity and Ecosystem Functions and Services will work to understand how the wealth of marine biodiversity contributes to the many ecosystem functions that maintain healthy oceans (processes such as nutrient recycling and oxygen production and cycling) and how these functions add to the ecosystem services on which humans depend, such as commercial fisheries and ecotourism.
- Biodiversity and Human Exploitation. This theme will address how to meet growing demands on marine living resources by combining knowledge of oceans past with new strategies to maintain populations and ecosystems and aid recovery of depleted species.

Each of these themes will address basic scientific research questions but also use the scientific results to provide policy makers and other ocean stakeholders with needed data, insights, tools, and indicators to help them decisions that will better regulate and manage ocean resources.

If you are interested in this venture, please contact Paul Snelgrove at [psnelgro@mun.ca](mailto:psnelgro@mun.ca), or any of the theme leaders listed on <http://lifeinachangingocean.org>.

## **5 Acknowledgments**

The authors wish to thank Prof. Fred Grassle and Jesse Ausubel for their foresight and vision in creating the Census and OBIS, and the Alfred P. Sloan Foundation for generous support throughout the decade of the Census. Thanks also to Ian Poiner, chair of the Census scientific Steering Committee and other Steering Committee

Members. Most of all we thank the many colleagues in the Census for the wonderful collaboration, and to all contributors to OBIS, either directly or through one of the regional or thematic nodes.

## 6 References

Ausubel, J. (1999): Towards a Census of Marine Life. *Oceanography* 12(3): 4-5.

Crist, D.T., Scowcroft, G. & Harding, J.M. (2010): *World Ocean Census. A global Survey of Marine Life.* Firefly Books.

de Rosnay, J. (1979): *The Macroscope.* Harper & Row, New York.

Grassle, J.F. (2000): The Ocean Biogeographic Information System (OBIS): an on-line, worldwide atlas for accessing, modelling and mapping marine biological data in a multidimensional geographic context. *Oceanography* 13(3): 5-7.

Grassle, J.F. & Stocks, K.I. (1999): A Global Ocean Biogeographic Information System (OBIS) for the Census of Marine Life. *Oceanography* 12(3): 12-14.

IUCN (2010): *Global Ocean Biodiversity Initiative: Working towards high seas conservation.* [www.gobi.org](http://www.gobi.org).

McIntyre, A.D., editor. (2010): *Life in the world's oceans: Diversity, distribution and abundance.* Oxford: Blackwell Publishing Ltd.

Mora, C., Tittensor, D.P., Adl, S., Simpson, A.G.B. & Worm, B. (2011): How many species are there on earth and in the ocean? *PLoS Biology* 9(8): e1001127. doi:10.1371/journal.pbio.1001127.

O'Dor, R.K., Miloslavich, P. & Yarincik, K. (2010): Marine biodiversity and biogeography – regional comparisons of global issues, an introduction. *PLoS ONE* 5(8): e11871. doi:10.1371/journal.pone.0011871

O'Dor, R.K. & Vanden Berghe, E. (2012): Hidden beneath the seas. *World Policy Journal* Fall 2012: 101-108.

Snelgrove, P.V.R. (2010): *The Census of Marine Life: Making Ocean Life Count.* Cambridge University Press. 286 pp.

Vanden Berghe, E., Stocks, K.I. & Grassle, J.F. (2010): Data integration: the Ocean Biogeographic Information System. In A.D. McIntyre, 2010: *Life in the world's oceans: Diversity, distribution and abundance.* Oxford: Blackwell Publishing Lt, 333-354 pp.

Webb, T., Vanden Berghe, E. & O'Dor, R.K. (2010): Biodiversity's big wet secret: The global distribution of marine biological records reveals chronic under-exploration of the deep pelagic ocean. *PLoS ONE* 5(8): e10223. doi:10.1371/journal.pone.0010223

Yarincik, K. & O'Dor, R.K. (2005): The Census of Marine Life: Goals, scope and strategy. *Sci Mar* 69(Sup. 1): 201–208.



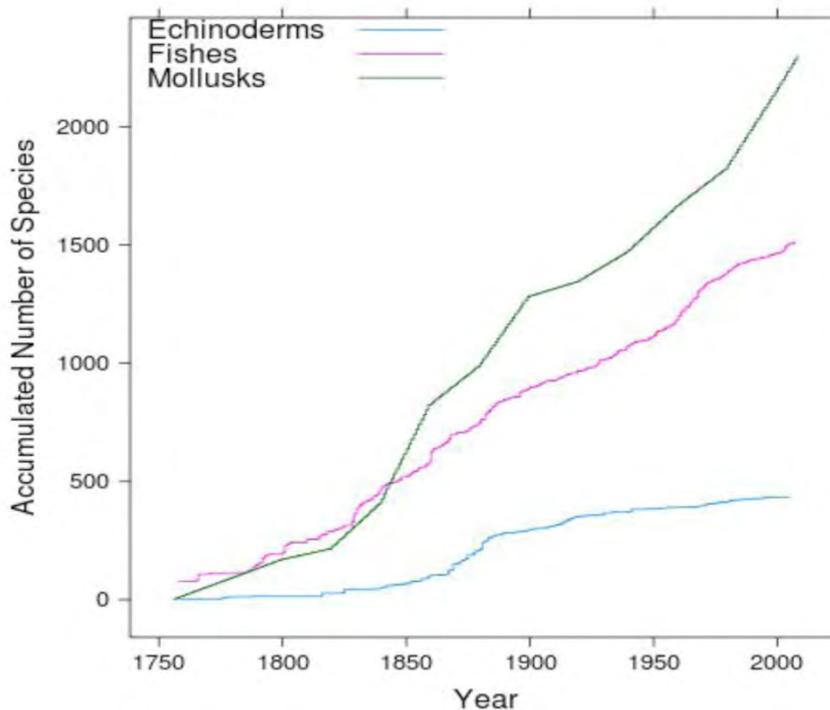
# Seabed Mapping and its Contribution to the Goal of Sustainable Management in the Ocean

PHIL WEAVER AND VEERLE HUVENNE

National Oceanography Centre, Southampton, United Kingdom

## 1 Introduction

The pressure on the oceans is increasing dramatically with over one billion people depending on fish as their primary source of protein, hydrocarbon exploitation extending to over 2000 metres water depth and the minerals mining sector gearing up to exploit metals from a number of ocean environments. If we are to continue to use the oceans into the distant future we will need to find ways to bring them under sustainable management, and this will need to be applied from the coast to the deep sea. One of the problems is that we are exploiting the oceans far faster than we are researching them. Although the first major scientific expeditions to investigate the oceans date back to the Challenger expeditions of 1872-1876, the size and remoteness of much of the deep sea, and the relatively small effort that has gone into deep-sea research, means that it remains poorly understood. Recent campaigns such as the Census of Marine Life have identified over 5,500 new marine species worldwide, but this is still a small fraction of those waiting to be discovered, as illustrated in graphs showing the number of new marine species identified with time (Figure 1, MILOSLAVICH ET AL., 2010). These show no sign of levelling off in the identification of new species, even for fish. Recent estimates indicate that the total number of Eukarotes in the ocean is ca. 2.2 million with only 9% of these described to date (MORA ET AL., 2011), suggesting that we still have a long way to go just to produce an inventory of species, especially in the deep ocean. Similarly, the rate of discovery of new deep-sea habitats continues to increase (RAMIREZ-LLODRA ET AL., 2010). Research to understand the functioning of marine ecosystems lags significantly behind the identification of species and habitats, and thus the impact of human interference (HALPERN ET AL., 2008) in these ecosystems is generally difficult to predict. A fundamental step in understanding the distribution of species and habitats in the oceans is to make a map, and although low resolution maps such as the GEBCO One Minute Grid ([http://www.gebco.net/data\\_and\\_products/gridded\\_bathymetry\\_data/](http://www.gebco.net/data_and_products/gridded_bathymetry_data/)) and the Sandwell and Smith ([http://www.ngdc.noaa.gov/mgg/announcements/announce\\_predict.html](http://www.ngdc.noaa.gov/mgg/announcements/announce_predict.html)) maps exist they do not convey enough information to determine habitats. Swath bathymetry mapping provides much higher resolution data but it is slow to collect on a global scale (ICES, 2010). In this paper we assess the contribution of seabed mapping as a first step towards marine management and highlight some of the issues associated with obtaining and using mapping information.



**Figure 1:** Plot showing discovery of new species with time for the Caribbean Sea. Note graphs continue an upward trajectory indicating there are many new species yet to discover. (after MILOSLAVICH ET AL., 2010).

## 2 Marine habitat mapping

In recent years we have begun to map marine habitats using swath bathymetry and reflectivity data combined with photographic and sampling evidence (e.g. HARRIS & BAKER, 2011). The aim is to build up as much geographic information as possible about the environment, so as to identify different habitats and then to use scientific information to understand the species relationships within the habitats and the effect of human impacts. There are several good examples of marine spatial planning where swath bathymetry has been used as a base map, to which is added reflectivity data to give seabed type (hard, soft, sandy), and then sampling and seabed photography to provide the verification of habitat type. The EU project MESH marked the beginnings of the discipline of marine habitat mapping in European waters (<http://www.searchmesh.net/>). The efforts and results obtained by the MAREANO project off Norway (<http://www.mareano.no/english/>) are another example of what can be achieved under a coordinated programme. The ICES report (ICES, 2010) lists a number of other National mapping programmes in Europe. The EC is attempting to gather all marine spatial data within EC waters under its EMODNET project

(<https://webgate.ec.europa.eu/fpfis/iwt/category/162>). Once habitats are identified, legislation must be used to determine the acceptable level of impact on the environment, as well as on the target and non-target species in the case of fisheries.

Thus spatial planning and sustainable management rely heavily on scientific input and especially seabed mapping. For most of the ocean however, including the majority of areas within national jurisdiction, maps at sufficient resolution do not exist. Even in Europe the coverage of swath-mapped areas is poor and until recently there has been no systematic Europe-wide initiative to create offshore maps. This makes it extremely difficult to achieve a spatial plan and very difficult to suggest and impose any regulation since this needs to be evidence based.

Legislation, however, frequently calls for the use of, or collection of, marine scientific data, as can be seen in these two extracts from the Convention on Biological Diversity COP9 Decision IX20 (<http://www.cbd.int/cop9/doc/>) -

“.....the Convention on Biological Diversity has a key role in supporting the work of the General Assembly with regard to marine protected areas beyond national jurisdiction, by focusing on the provision of scientific and, as appropriate, technical information and advice relating to marine biological diversity, the application of the ecosystem approach and the precautionary approach, and in delivering the 2010 target,.....”

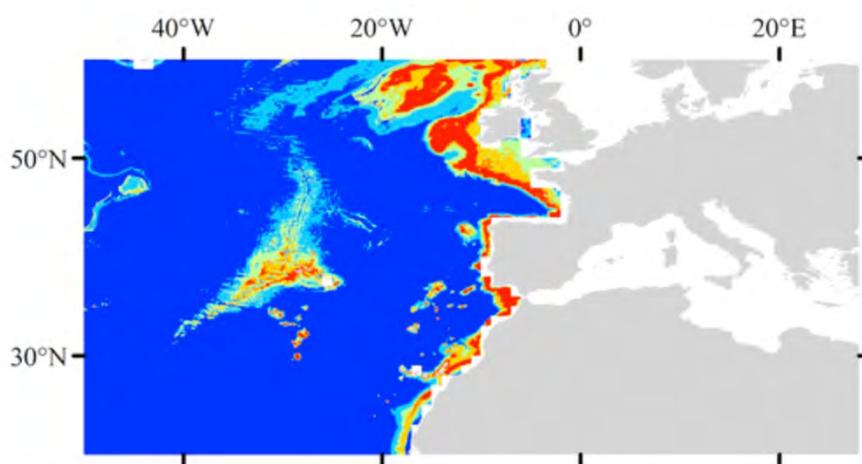
and

“.....the synthesis and review of the best available scientific studies on priority areas for biodiversity conservation.....”

What appears to be missing is a connection within Governments between the policy makers and the science funders, with policy makers requiring increasing amounts of scientific information, but the science funders not responding to this demand. As mentioned above many governments are realising the value of habitat mapping and spatial planning within their own EEZs, but they are less enthusiastic to fund high seas programmes.

One option to gather information, in the absence of detailed bathymetry and habitat mapping, is to use predictive habitat modelling (DAVIES & GUINOTTE, 2011; FORNEY et al., 2012; YESSON et al., 2012) (Figure 2). Here, a spatial statistical model is built, based on all the known (and available) parameters that may control the distribution of a key species e.g. cold-water corals, to estimate the probability of occurrence of that species in each location. Apart from the importance of these key species in their own right, they can be considered as ‘ambassadors’, representing an entire, often

vulnerable ecosystem with a high diversity of species that supports their presence (e.g. in case of top predators), or that is supported by their occurrence (e.g. in case of habitat-forming species such as corals). Mapping of these organisms can then be used as a proxy to map the distribution of the species they live with or feed on. The predictive maps can be used to focus real mapping efforts or, using the precautionary principle, to limit commercial activities that might impact the vulnerable habitat even without the mapping. In comparison to land based activities there are relatively few Species Distribution Models for the marine world (ROBINSON et al., 2011) although more are being produced (see above). An important process is to test the Species Distribution Models in as many cases as possible so that they can be refined and used with confidence, simply because the oceans are so large that they may never be completely swath mapped. In shallower water areas this is much easier to achieve and progress with these techniques has been faster here (e.g. KRIGSMAN et al, 2012; MAXWELL et al., 2009; PESCH et al., 2008; REISS et al., 2011). The outcomes of the models can also provide further insight into the ecology and functioning of key species and assemblages (linked to key habitats) in terms of critical environmental conditions that control their occurrence.

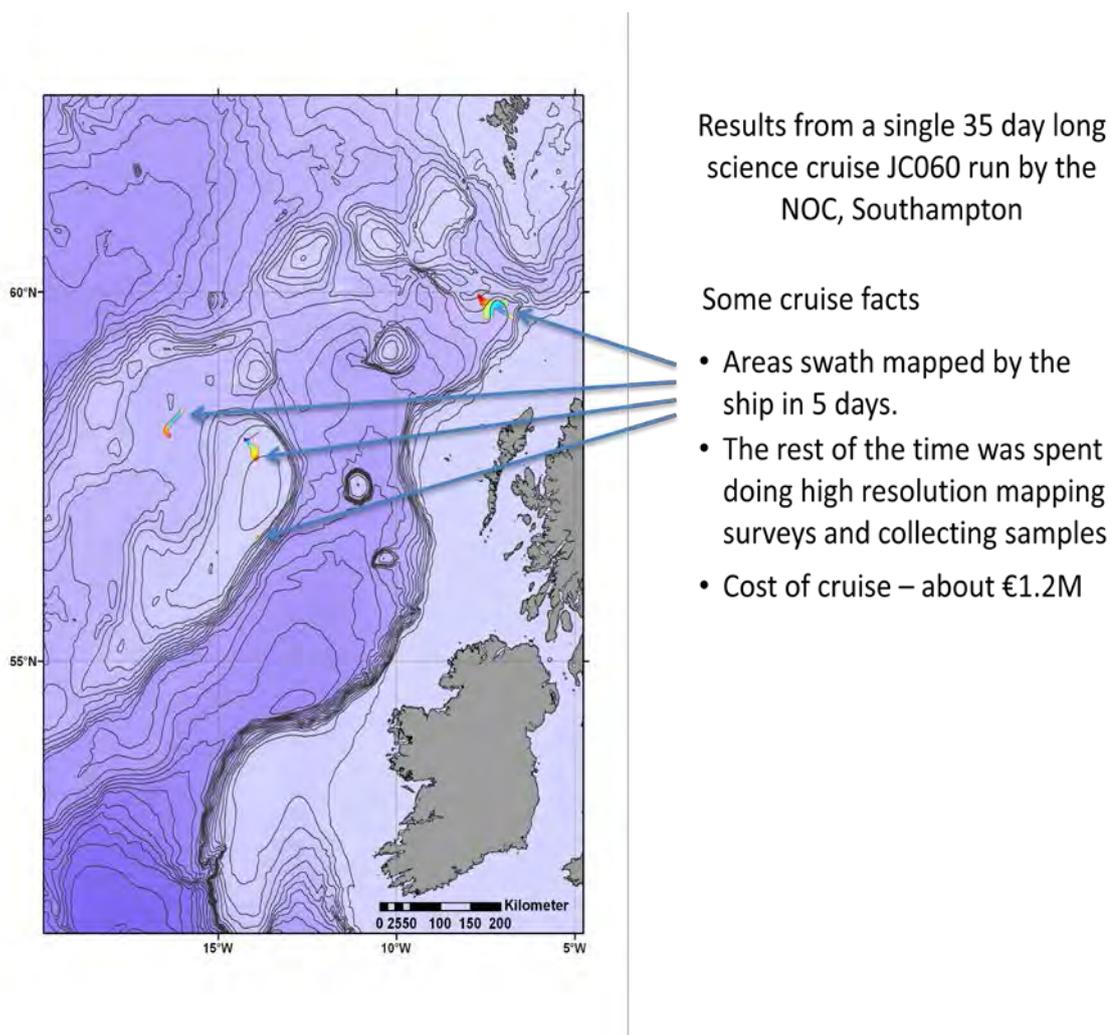


**Figure 2:** Predicted distribution of the cold-water coral *Lophelia pertusa* in the NE Atlantic. (after DAVIES AND GUINOTTE, 2011).

### 3 An example of a recent mapping effort in the NE Atlantic

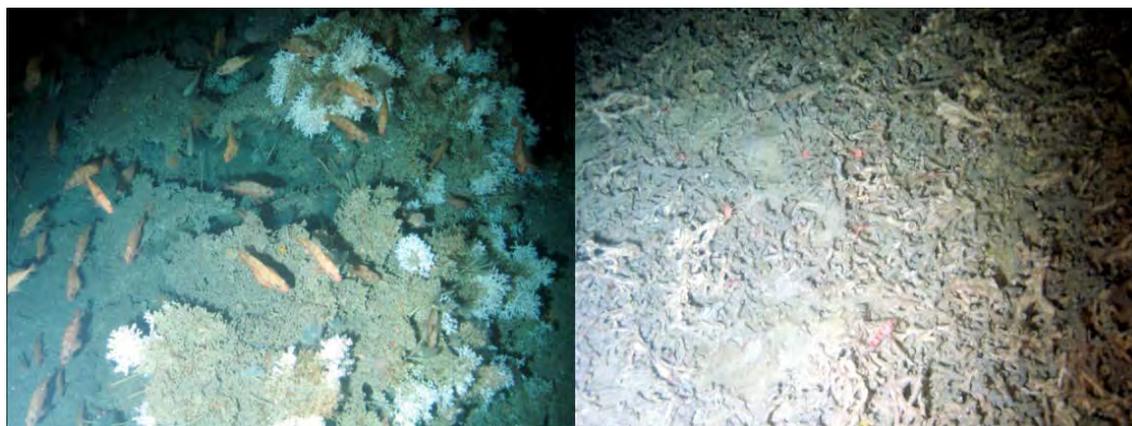
A habitat mapping survey in the Hatton-Rockall area of the NE Atlantic was carried out by the National Oceanography Centre, Southampton, UK in 2011 (HUVENNE et al, 2011). Figure 3 shows the very small areas that were swath mapped during 5 days of the cruise, using a shipboard multibeam system. The mapping was then used to locate more detailed surveys by autonomous underwater vehicle (AUV), while in addition a Remotely Operated Vehicle (ROV) was also used to carry out photographic surveys

and sampling (Figure 4). The data are currently being analysed using multivariate and spatial statistical techniques to create comprehensive habitat maps and species assemblage interpretations. One specific study area consisted of a NEAFC fisheries closure that was also proposed as candidate Special Area of Conservation (cSAC) under the Habitats Directive. The proposed cSAC included 2 additional extensions to protect presumed areas of cold-water corals. In one of these areas coral rubble caused by trawling activity was predominant, whilst the other area contained rich coral and fish communities.



**Figure 3:** Overview map of the study areas visited during expedition JC060 on board the RRS James Cook in 2011 (HUVENNE et al., 2011).

Thus only one of the areas would have fulfilled the requirement for protection of existing habitat under the EU Habitats Directive. This small example shows how difficult it is to predict areas that need protection in regions where commercial activity (bottom fishing in this case) is ongoing, unless high-resolution acoustic or photographic surveys are carried out. These are expensive and cover very small areas of seafloor.



**Figure 4:** Contrast between natural cold-water coral habitat and trawled area of corals on NW Rockall Bank. Images courtesy of the National Oceanography Centre, Southampton, UK.

## 4 Discussion

Information from the scientific community is essential to fulfil the international obligations entered into by many states with regard to marine conservation in the high seas. Collecting this information is very expensive and is not being carried out in any systematic way on the high seas although there are increasing efforts within the EEZs of some countries. With tightening budgets for research, the situation can only get worse. Choices of survey areas, survey methods and techniques to extrapolate information gathered on small areas to larger extents (e.g. spatial and predictive mapping) will have to be made in a more strategic way. Nested survey methodologies, in which predictive models steer broad-scale mapping efforts, followed by more detailed surveys and groundtruthing will become the norm. If science cannot provide the data required by the increasing legislative demands then either a more precautionary approach should be taken, or extra information could be sought through a partnership between science and industry, with offshore industries collecting more environmental data and working with scientists and policy makers to create sustainable management plans. This would clearly provide more data, especially in those areas that are of immediate interest to offshore industries. However, this would require a culture change for some offshore industries that traditionally guard their data under a shroud of confidentiality. A combined approach of education about the value of sharing data and legislation may be required to bring about this culture change. Legislation will

also be required to prevent severe environmental impacts associated with a “free-for-all” if new data reveals many new routes to exploitation.

## 5 Conclusions

1. Multiple and increasing uses of the seas and oceans make marine spatial planning an essential management tool combined with legislation for protecting habitats and vulnerable ecosystems
2. However bathymetric mapping is only the first step towards a spatial plan and full habitat mapping is required based on seabed photography and sampling.
3. Nested surveys including mapping efforts at various scales will form the most economic solution to the large extent of the mapping task.
4. Rates of scientific research are slow especially in comparison to the rates of exploitation and so offshore industries should be required to create and share more environmental data

## 6 References

- Davies, A. J., Guinotte, J.M. (2011): Global Habitat Suitability for Framework-Forming Cold-Water Corals. *PLoS ONE* 6(4): e18483. doi:10.1371/journal.pone.0018483.
- Forney KA, Ferguson, M.C., Becker, E.A., Fiedler, P.C., Redfern, J. V., Barlow, J., Vilchis, I. L., Balance, T. (2012): Habitat-based spatial models of cetacean density in the eastern Pacific Ocean. *Endang Species Res* 16: 113–133.
- Halpern BS, Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D’Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M.P., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R., Watson, R. (2008): A global map of human impact on marine ecosystems. *Science* 319: 948–952.
- Harris, P.T. & Baker, E.K. eds. (2011): *Seafloor Geomorphology as Benthic Habitat : Atlas of Seafloor Geomorphic Features and Benthic Habitats*. Elsevier, London, 936 pp.
- Huvenne, V.A.I. et al, (2011) : RRS James Cook Cruise 60, 9 May -12 June 2011. Benthic habitats and impact of human activities in Rockall Trough, on Rockall Bank and in Hatton Basin. National Oceanography Centre Cruise Report, No 04, Southampton, 133 pp.
- ICES (2010): Report on the Working Group on Marine Habitat Mapping (WGMHM), 3–7 May 2010, Calvi, Corsica, France. ICES CM 2010/SSGSUE:01. 86 pp.

Krigsman L. M., Yoklavich, M.M., Dick, E.J., Cochrane, G.R. (2012): Models and maps: predicting the distribution of corals and other benthic macro-invertebrates in shelf habitats. *Ecosphere* 3: art3.

Maxwell DL, Stelzenmüller, V., Eastwood, P.D., Rogers, S.I. (2009): Modelling the spatial distribution of plaice (*Pleuronectes platessa*), sole (*Solea solea*) and thornback ray (*Raja clavata*) in UK waters for marine management and planning. *Journal of Sea Research* 61: 258–267.

Miloslavich P, Díaz, J.M., Klein, E., Alvarado, J.J., Díaz, C. et al. (2010): Marine Biodiversity in the Caribbean: Regional Estimates and Distribution Patterns. *PLoS ONE* 5(8): e11916. doi:10.1371/journal.pone.0011916.

Mora C, Tittensor, D.P., Adl, S., Simpson, A.G.B., Worm, B. (2011): How Many Species Are There on Earth and in the Ocean? *PLoS Biol* 9(8): e1001127. doi:10.1371/journal.pbio.1001127.

Pesch R, Pehlke, H., Jerosch, K., Schröder, W., Schlüter, M. (2008): Using decision trees to predict benthic communities within and near the German Exclusive Economic Zone (EEZ) of the North Sea. *Environmental Monitoring and Assessment* 136: 313–325.

Ramirez-Llodra, E., Brandt, A., Danovaro, R., De Mol, B., Escobar, E., German, C.R., Levin, L.A., Martinez Arbizu, P., Menot, L., Buhl-Mortensen, P., Narayanaswamy, B.E., Smith, C.R., Tittensor, D.P., Tyler, P.A., Vanreusel, A., Vecchione, M. (2010): Deep, diverse and definitely different: unique attributes of the world's largest ecosystem. *Biogeosciences*, 7, (9): 2851-2899. (doi:10.5194/bg-7-2851-2010)

Reiss H, Cunze, S., Knig, K., Neumann, H., Kröncke, I. (2011): Species distribution modelling of marine benthos: a North Sea case study. *Mar Ecol Prog Ser* 442: 71–86.

Robinson, L. M., Elith, J., Hobday, A.J., Pearson, R.G., Kendall, B.E., Possingham, H.P., Richardson, A.J. (2011): Pushing the limits in marine species distribution modelling: lessons from the land present challenges and opportunities. *Global Ecology and Biogeography*, 20: 789–802.

Yesson C, Taylor, M.L., Tittensor, D.P., Davies, A.J., Guinotte, J., Baco, A., Black, J., Hall-Spencer, J.M., Rogers, A.D. (2012): Global habitat suitability of cold-water octocorals. *Journal of Biogeography* 39:1278–1292.

## Mapping of Underwater Noise

MAX SCHUSTER

DW-ShipConsult, Germany

### Abstract

Many human activities in the oceans come along with underwater noise. This matter has gained in importance especially since offshore wind turbines are planned to be installed: A large number of them is to be built on piles which are hammered into the seabed. Thereby impulsive sounds at high levels are radiated, these have the potential to severely injure marine mammals. There are strong indications that high sound levels also have an influence on fish. Further research is currently being carried out on this.

Underwater noise has become an official descriptor to evaluate the current state of a marine protected area. Therefore the European Marine Strategy Framework requires to regularly monitor ambient noise levels in marine protected areas, especially trends shall be identified. The methods how to carry out the monitoring technically are not yet defined.

The Federal Agency for Nature Conservation funded a project to increase knowledge both on the technical and on the biological side. Continued research is carried out to determine the hearing thresholds of harbor porpoises and on grey seals, to gain knowledge on stress reactions due to sound exposure and to analyze behavioral reactions taking into account ambient noise. The gained results shall serve as a basis to evaluate the results of long term noise measurements.

This presentation will give an overview on the technical part of the project to measure background noise in the Natura2000 areas in the Baltic Sea and in the North Sea. During summer and autumn 2012 multiple autonomous acoustic recorders will be deployed in the protected areas of the Baltic Sea over a period of several months. Deployments in the North Sea will be carried out in 2013. Based on the measurements a spatial and temporal distribution of background noise is calculated. The data will be also a large basis to carry out further research on the anthropogenic and natural noise sources.



# Optimising the Lighting Equipment on the Mittelplate Drilling and Production Island in the German Wadden Sea Tidelands

HEINER MATTFELD<sup>1</sup>, FABIAN EHLERS<sup>1</sup> AND MARC REICHENBACH<sup>2</sup>

RWE Dea AG, Germany, ARSU GmbH, Germany

## 1 Introduction

Since October 1987, RWE Dea AG and Wintershall Holding GmbH have been developing Germany's most significant oil deposit, RWE Dea AG as the operator and Wintershall as a partner. The production of more than 25 million tons of crude oil to date has chiefly been carried out via the artificial island Mittelplate and a station based on the mainland. Mittelplate Island is located about 7 km off the coast near the southern border of the national park "Schleswig-Holsteinisches Wattenmeer", which has also has the status of a world natural heritage site since 2009 ( Figure 1). Against the backdrop of this sensitive ecology, the drilling and production island is internationally seen in compliance with particularly high safety and environmental protection requirements, ensuring incident-free operation of all activities since production began.



**Figure 1:** Location of the drilling and production island in Schleswig-Holstein's Wadden Sea tidal flats with pipeline links and the border (dotted line) of the national park (Photograph: RWE Dea AG).

The island with dimensions of 70 x 95 metres (Figure 2) is built in the form of a compact, leak-proof steel-and-concrete basin and protected from any liquids escaping uncontrolled to the outside; even rain and spray water are collected and processed.

In order to minimise potential effects of light emanating from Mittelplate island on the environment and, in particular, the bird world, in the year 2010 the lighting equipment was subjected to a fundamental revision, with appropriate changes being made.



**Figure 2:** Mittelplate Drilling and Production Island (Photograph: RWE Dea AG).

## **2 Current findings on the impacts of artificial light on birds**

It has already been known for some time now that in poor visibility conditions, nocturnally migrating birds are attracted by large, artificial sources of light and suffer impairments in the form of disorientation, energy loss, collisions and increased decimation by predators (HAUPT, 2009; KUBE, 2011). Examples are mass collisions of migratory birds in conditions of high air humidity due to strong floodlights of lighthouses, and to a lesser degree, lights on radio and TV towers. This phenomenon of disorientation is particularly prevalent in the offshore region as installations such as oil rigs, which have extensive illumination by night, exert a strong attraction on an otherwise dark sea. In order to avoid predators and strong winds, most bird migrations take place at night. Singing and wading birds are primarily affected by artificial light sources.

On the offshore drilling and production platform L 15-FA1, in the year 2000 experiments were carried out by alternating between the platform lighting on and off to show that the attraction of birds is actually attributable to this artificial light source (VAN DE LAAR, 2007). The range of this influence is estimated at approx. 3 to 5 km. On that

basis, in view of the number and proliferation of offshore platforms in the North Sea, it is assumed that approx. 6 million migratory birds are affected per season.

High losses of birds to offshore installations almost always occur during certain weather conditions, namely low cloud cover and limited vision after an initially clear night. In these conditions, birds cannot navigate by sight according to the stars above but use a magnetic form of compass orientation. However, this is influenced by artificial light. In certain autumn nights with strong migration some exhausted or dead birds could also be found on the artificial Mittelplate island. As a consequence RWE Dea AG developed an optimized lighting concept in order to minimize the impact on bird migration due to attraction of the illuminated island.

It was established in laboratory research that different wavelengths of light can affect the operation of a magnetic compass and, therefore, have varying effects on the sense of orientation (WILTSCHKO et al., 1993; WILTSCHKO & WILTSCHKO, 1995; MUHEIM et al., 2002, all cited in POOT et al., 2008). Hence, the visual world of birds evidently has a great deal more richness and variety of colours than the human eye, making it difficult to assess the meaning of different colours of light.

Experiments on a gas production facility on Ameland in 41 nights during the autumn migration of 2003 showed that nocturnally migrating birds are attracted and adversely affected by white and red light, while the impact of blue and green is considerably lower (POOT et al., 2008).

In order to reduce lighting-related bird losses, a large part of the externally facing lighting equipment on the offshore drilling and production island L 15-FA1 (152 of 173 lamps) were converted to a type of lighting that had a significantly lower long-wave red segment, making the light appear green to the human eye. The effect of this conversion was examined in autumn of 2007 during three nights of heavy bird migrations in suitable weather conditions (cloud cover, partly light fog) (VAN DE LAAR, 2007). As a result, it was shown that the number of birds adversely impacted under the new lighting conditions was reduced by a factor of 2-10 (compared with the figures from previous studies in comparable conditions). The authors assume that the extensive replacement of the lighting equipment on the platform can achieve a reduction in bird impairment by approx. 90%.

However, Evans et al. (2007) found exactly the opposite was true. Their results from Ithaca, New York, show that birds were attracted by the white (250 W, 500 W and 1500 W), green and blue light of a halogen lamp (tested in various intensities from time to time), but not by red light, even though the spectral intensity in this case was twice as high as that of green and three times as high as that of blue light.

It can therefore be assumed that conflicting findings and theories apply with regard to the influence of different wavelengths on the orientation of birds and the underlying

causes. In particular, it is also uncertain whether the findings of laboratory experiments on isolated factors can be transferred to free-range conditions in which a large number of different factors exert an influence on the orientation of birds.

A project (known as “Avilux”) sponsored by the German Federal Ministry for the Environment is currently studying whether certain colours of lighting equipment possibly have a lower degree of attraction than others. Once the results of the study are presented, hopefully more empirical statements will be possible in this regard, in turn providing better options for reducing the level of attraction of offshore installations to nocturnally migrating birds.

RWE Dea AG has drawn the conclusion from these findings that the deployment of e.g. green light on Mittelplate drilling and production island will not be expedient for the time being; instead, an effort should be made to reduce the light emanating from the island into the environment. To this end, various measures have been implemented on Mittelplate island to date.



**Figure 3:** A robin resting on Mittelplate drilling and production island (Photograph: Mathias Reinkemeier).

### **3 Measures to optimise the lighting equipment on Mittelplate drilling and production island**

In particular, the lighting equipment on Mittelplate serves to facilitate the employees' orientation and illumination in the workplace. About 400 fluorescent tubes are deployed along with 20 mercury lamps and 13 sodium vapour lamps.

With the objective of reducing the light emanating from Mittelplate, all lighting equipment potentially emitting light to the outside was recorded, classified and examined for optimisation potential. In the process, photographs taken in the dark from

outside Mittelplate were used to detect the light sources which were emanating light into the surrounding Wadden tidelands.

The following optimisation measures were implemented on the basis of the light sources identified:

### **3.1 Decommissioning**

Wherever possible, light sources were dismantled. For instance, the number of lamps installed on the southern pier outside the sheet pile wall of Mittelplate island was reduced from 28 to 14. Of the remaining lamps, only 3 are still in non-stop operation. The remaining 11 lamps are only switched on when required via the Mittelplate process control system.

### **3.2 Switching**

In many areas on Mittelplate, work is not carried out non-stop, especially during the night. In these areas, light sources were equipped with switches.

Wherever the use of light switches is impractical, light barriers were installed in order to ensure the necessary lighting automatically on crossing them. Above all, this was done in the area of the staircase towers of the Mittelplate living quarters in order to ensure that adequate lighting is available particularly on the external steps (cf. Figure 4 to Figure 6).



**Figure 4:** Living quarters prior to optimisation (Photograph: Studio B8 on behalf of RWE Dea AG).

### **3.3 Optimum alignment and light guidance shields**

The light sources were ideally positioned to minimise light being emanated into the surroundings of Mittelplate island. Where necessary, additional light guidance shields

were installed on the lighting equipment to achieve this objective. As a further step, one of two lamps was switched off. The examples shown in Figure 7 Figure 7 and Figure 8 serve to document the measures carried out on the standby electricity generator.

Since the lighting equipment as a whole consists of a mix of emergency and normal lighting, the allocation of emergency and normal light was adjusted in particular in the area of the staircase towers of the living quarters in order to reduce reflection of the white wall to the outside in minimised lighting conditions. This was achieved by relocating the lamps in such a manner as to ensure that the living quarters are no longer directly illuminated in minimised lighting conditions (cf. Figure 4 to Figure 6).



**Figure 5:** Living quarters without staircase illumination (Photograph: Studio B8 on behalf of RWE Dea AG).



**Figure 6:** Living quarters in current normal operation – without staircase and port lighting (Photograph: Studio B8 on behalf of RWE Dea AG).

### 3.4 Control via the process control system

The concept as a whole also includes control of the entire external lighting equipment. Both the lighting on and outside Mittelplate island (escape route jetty) is controlled via the process control system of the central control station or via on-site switches and light barriers. The plant operator can intervene in the lighting control system and adjust the lighting equipment as required. In this way, it is possible for areas in which work is under way to be lit up well whereas areas in which nobody is present remain with reduced lighting. In order to ensure that no light is on unnecessarily, the entire external lighting is automatically switched off in adequate daylight conditions by the process control system via a twilight switch. The twilight switch causes the external emergency lighting to be turned on again if it gets too dark. The remaining lighting is to be manually activated on demand in each section of the island.



**Figure 7:** Deployment of light guidance shields on standby electricity generator (Photograph: Studio B8 on behalf of RWE Dea AG).



**Figure 8:** View of a lamp on a standby electricity generator with light guidance shield and illumination to half (Photograph: Studio B8 on behalf of RWE Dea AG).

### **3.5 Encasing the drilling tower**

Moreover, encasing the previously open drilling tower with steel sheeting led to a further reduction of light emissions. As a result, a number of light sources within the drilling tower were prevented from emanating to the outside.

### **3.6 Taking account of safety at work**

It goes without saying that occupational safety also enjoys priority in the context of optimising the lighting equipment on Mittelplate island. The parameters laid down by the German Federal Mining Ordinance (Allgemeine Bundesbergverordnung (ABergV)) for lighting equipment refer to the period in which employees are actually present in the relevant areas. Accordingly, the lighting can be reduced to a minimum as long as nobody is present in areas in question. A detailed on-site inspection of the relevant external areas on Mittelplate together with Germanischer Lloyd (an independent expert for technical marine plants and equipment) confirmed compliance with the parameters stipulated by the ABergV. For instance, care was taken to ensure that all escape routes are adequately illuminated by emergency lighting at all times. Areas in which the installation of automatic light switches were unsuitable were equipped with light barriers. These light barriers automatically switch on additional lighting equipment as soon as the relevant areas are entered. The Germanische Lloyd described the concept as successful, also from the perspective of safety at work.

## **4 Before / after comparison**

In order to facilitate a before/after comparison, photographs were taken from outside Mittelplate from exactly the same positions (determined by GPS) before and after implementation of the various measures described above. This was done in the dark under identical conditions (New Moon, identical camera settings: aperture: 2.8; exposure time 1/100 sec.; ISO: 2000; focal length: 50 mm).

The comparison of photographs shown in Figure 9 for the various views of the drilling and production island impressively documents the reduction of the light emitted into the Mittelplate environment. Without having conducted a concrete monitoring programme the experiences after implementation of the measures show that fewer exhausted or dead birds are found on the Mittelplate island.

In strict compliance with safety at work rules and regulations, by implementing these measures it was therefore possible to bring about a mitigation of the impacts of Mittelplate particularly on nocturnally migrating birds.



**Figure 9:** Comparison of lighting before (A) and after (B) from the various directions: North (1), south (2), east (3) and west (4) from a distance of 300 m (Photographs: Studio B8 on behalf of RWE Dea AG).

## 5 List of References

- Evans, W. R., Akashi, Y., Altmann, N.S. & Manville, A.M. (2007): Response of night migrating songbirds in cloud to coloured and flashing light. *North American Birds* 60 (4): 476-488.
- Haupt, H. (2009): Der Letzte macht das Licht an! – Zu den Auswirkungen leuchtender Hochhäuser auf den nächtlichen Vogelzug am Beispiel des „Post-Towers“ in Bonn. *Charadrius* 45 (1): 1-19.
- Kube, J. (2011): Options for mitigation of bird collisions at offshore wind farms: a European perspective. In: *Proceedings: Conference on Wind energy and Wildlife impacts*, 2.-5. May 2011, Trondheim, Norway, eds. May, R. & Bevanger K.. *NINA Report* 693: 33.
- Muheim, R., Bäckman, J. & Åkesson, S. (2002): Magnetic compass orientation in European robins is dependent on both wavelength and intensity of light. *The Journal of Experimental Biology* 205: 3845-3856.
- Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R. & Marquenie, J.M. (2008): Green light for nocturnally migrating birds. *Ecology and Society* 13 (2): 47.
- Van de Laar, F. J. T. (2007): Green light to birds. Investigation into the effect of bird-friendly lighting. [http://www.waddenzee.nl/fileadmin/content/Dossiers/Energie/pdf/green\\_light\\_to\\_birdsNAM.pdf](http://www.waddenzee.nl/fileadmin/content/Dossiers/Energie/pdf/green_light_to_birdsNAM.pdf) (06.06.2012).
- Wiltschko, R. & Wiltschko, W. (1995): *Magnetic orientation in Animals*. Springer Verlag, Berlin, Heidelberg, New York.
- Wiltschko, W., Munro, U., Ford, H. & Wiltschko, R. (1993): Red light disrupts magnetic orientation of migratory birds. *Nature* 364: 52, 5-527.

## **Blue Reef - a Danish Reef Restoration Project in a Natura 2000 Site**

LONNIE MIKKELSEN<sup>1</sup>, KARSTEN DAHL<sup>1</sup>, ELSE MARIE STAMPHØJ<sup>2</sup> AND CLAUS STENBERG<sup>3</sup>

<sup>1</sup>Department of Bioscience, Aarhus University, Denmark

<sup>2</sup>Danish Nature Agency, Denmark

<sup>3</sup>National Institute of Aquatic Resources, Technical University of Denmark

### **1 Background**

In Denmark, cave forming reefs on shallow waters have almost vanished as a result of intensive exploitation of boulders used for construction of harbour piers and for coastal protection (DAHL et al., 2009). As part of the obligations to fulfil the EU Habitat Directive and the EU Bird Directive a total of 252 terrestrial, freshwater and marine Natura 2000 areas have been designated in Denmark. It comprises a network of protected areas, with the objective of protecting and preserving certain types of nature and species of plants and animals that are rare, threatened or particularly characteristic of certain regions in Europe. The habitat type “Reefs” (1170) is one of the habitats for designating Natura 2000 areas in Danish waters.

The marine Natura 2000 site “Læsø Trindel and Tønneberg Banke” is designated due to the presence of several reef areas (type H1170) as well as “Submarine structures made by leaking gases” (H1180) The area is located 12 km north east of the island of Læsø in the Northern Kattegat and covers around 80 km<sup>2</sup> (Figure 1).

Læsø Trindel was included in the Danish National Marine Monitoring Program in 1991. However, its conservation status has been assessed as poor (DAHL ET AL., 2009). Removal of the larger stabilizing boulders over the past 100 years has changed the water depth from 1½ m (according to an old navigation chart) to approximately 4 m and has furthermore initiated an erosion of the reef by wind induced wave which has resulted in a further degeneration of the reef. The fauna and flora was at that time, before the reconstruction, dominated by fast growing opportunistic species with low biomasses.



**Figure 1:** – Location of Natura 2000 site ‘Læsø Trindel and Tønneberg Banke’ in the northern part of Kattegat, Denmark. • Læsø Trindel reef • Reference reef – Per Nilen.

## 2 Aim

In 2006 the Danish Forest and Nature Agency, Aarhus University and DTU-Aqua initiated the Blue Reef nature restoration project with co-financing from EU’s financial instrument LIFE. The aim of the project is among others to 1) re-establish a stable cavernous boulder reef at Læsø Trindel, 2) restore the former vertical distribution of the reef and 3) improve the biodiversity and biomasses of algal forest, benthic invertebrates and fish. This restoration project is expected to be an important step to restore a favourable conservation status for the specific Natura 2000 site. At the same time it will provide new and essential knowledge on how to create the unique conditions associated with cavernous boulder reefs, and on the effects of the plant and animal life. On a wider ecological scale, Læsø Trindel, with its location in the Northern Kattegat, is also expected to become an important stepping-stone in the network of marine Natura 2000 sites in the North Sea, Kattegat and Inner Danish waters.

## 3 Reef restoration and investigations

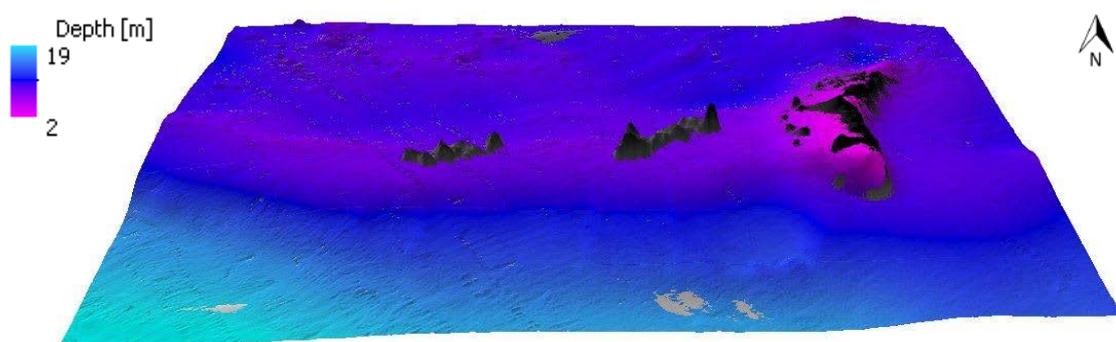
The project was initiated with a series of preliminary investigations examining the geological, seismic and hydrographical conditions as well as the impact on sediment transport, all necessary to determine the optimal reef design (MADSEN, 2008). Several requirements had to be fulfilled in the design, among others criteria covering reef durability and stability in relation to extreme weather conditions as well as creation of

cavernous areas at different depths and of different sizes to ensure a morphological variability as great as possible, primarily intended as a hide-out for lobster and fish.

To reconstruct the reef area approximately 100.000 tons of boulders from a Norwegian quarry were transported on barges to Læsø Trindel (Figure 2). Boulders were dumped on specific sites with specific size classes covering an area of approximately 45.000 m<sup>2</sup>. Placement of boulders lasted over 3 weeks in the summer of 2008. Some re-allocation was necessary during the spring 2009 to fulfil the construction plan. The re-established reef structures at Læsø Trindel are shown in Figure 3.



**Figure 2:** Left: Boulder dumping in 2008. Middle and right: pictures of the new reef at Læsø Trindel in 2008.



**Figure 3:** Læsø Trindel after the first construction phase and before the final adjustment of boulders. The black parts indicated the placement on boulders on the seabed. The new structures on the deeper part (left) are nearly 6 m high and the former depth distribution of 1½ m is restored on the shallow part (right). In the northern part of the shallow area deployment of boulders were more scattered with the main purpose to stabilize the existing reef. In the other areas dense and multi-layered placement of boulders creates caves between and beneath the boulders increasing the physical complexity to benefit the habitat quality for benthic invertebrates and fish.

An important part of the Blue Reef project was to demonstrate the ecological benefits of the restoration project. A large biological baseline study was carried out before the

actual restoration took place quantifying biomasses of seaweeds, invertebrates and fish on the sandy and gravel dominated seabed on the reef (DAHL et al., 2009). This study demonstrated that the biodiversity was almost comparable to the biodiversity of another study area where boulders were still plentiful (DAHL et al., 2005) but that biomasses of algal and benthic fauna were poor on Læsø Trindel. The study on Læsø Trindel also included an investigation of the fish fauna. Species abundance and composition has been studied by catches in fykes and multimesh gillnets and migration of lobsters and cod has been followed by acoustic telemetry tagging. Furthermore, trophic interactions and feeding ecology of key fish species has been analysed.

The Blue Reef project also provided the unique opportunity to investigate harbour porpoise (*Phocoena phocoena*) activity at the Læsø Trindel reef before and after the restoration. A specific project was initiated by Aarhus University to study the effect on this small cetacean as an add-on to the Blue Reef project. Porpoises were monitored at Læsø Trindel and at a nearby reef selected as reference site (Figure 1). This investigation has been conducted during the summer 2006-2012 with static acoustic monitoring devices T-PODs.

#### **4 Preliminary results**

Surveillance studies conducted on the reef in 2009, 2010 and 2011 on a selected site at 4-5m depth on the shallow part demonstrated that the biological colonization by animals and macroalgae was in full progress. Opportunistic filamentous macroalgae were still dominating on the top and side of many boulders but perennial algae species like *Laminaria hyperborica* and *Laminaria digitata* were increasing in numbers in 2010 and 2011 and fish species were numerous (DAHL & LUNDSTEEN, 2010). Sea anemones and hydrozoan species also colonized the reef and were typically located on the vertical side of boulders and often in more shadowy places. Sea anemones were not observed before the restoration took place. Examples of biological colonisation of the new substrate are shown in figure Figure 4.

New large scale biological investigations are on-going in the summer 2012 and results will be reported early 2013. Quantification of gained biomasses of seaweed forests and hard bottom fauna will be reported as well as gain or loss in biodiversity of macroalgae, invertebrate and fish species. Studies on changes in utilisation of food resources will be reported as well as migration patterns.



**Figure 4:** Pictures from the new reef at Læsø Trindel in 2010/11. Left: New algae at the top. Middle: Fauna growing on the side of the boulders. Foto: Peter Stæhr. Right: Cuckoo Wrasse (*Labrus mixtus*) seen at the reef. Foto: Karsten Dahl.

Data collected on harbour porpoise activity from 2006 to 2010 were analysed in 2011 and showed that the restoration had an immediate positive effect on the porpoise activity. Porpoises were detected more often in the years following restoration, and when present they also stayed for longer periods of time, indicating the presence of prey (MIKKELSEN et al., Submitted). Furthermore, a distinct diel pattern in porpoise activity was found. Porpoises visited Læsø Trindel mainly at night as opposed to the reference station where most activity occurred during day time. The nightly activity might be linked to nocturnally active prey species. Acoustic tagging of juvenile cod in 2007 showed a pronounced diel pattern in the summer months. Cod moved into the reef at sunset and returned to deeper waters at sunrise (DAHL et al., 2009). It seems plausible that porpoises follow the same pattern as these cods.

The presence of a top predator such as the harbour porpoise might be an indicator of good conservation status for the reef and could thus be considered a suitable indicator in future monitoring of re-established reefs. The results seen here are an indication that the restoration had a profound and presumably positive effect on the ecosystem at Læsø Trindel.

## 5 References

Anonymous (2006a): BlueReef - Rebuilding of Marine Cavernous Boulder Reefs in Kattegat. Danish Ministry of the Environment. Available at: <http://www.naturstyrelsen.dk/Naturbeskyttelse/Naturprojekter/Projekter/Vendsyssel/BlueReef/English/>

Dahl, K. & Lundsteen, S. (2010): Blue Reef - Status for den biologiske indvandring på Læsø Trindels nye rev i 2010. Tech Rep no 262, National Environmental Research Institute, Denmark, Roskilde (In Danish) Available at: <http://www2dmudk/Pub/AR262pdf>.

Dahl, K., Lundsteen, S. & Tendal, O.S. (2005): Mejlgrund og Lillegrund. En undersøgelse af biologisk diversitet på et lavvandet område med stenrev i Samsø Bælt. Danmarks Miljø-

undersøgelser & Århus Amt, Natur & Miljø. 87 pp. – Faglig rapport fra DMU nr. 529. Available at: <http://faglige-rapporter.dmu.dk>

Dahl, K., Stenberg, C., Lundsteen, S., Støttrup, J., Dolmer, P. & Tendal, O.S. (2009): Ecology at Læsø Trindel - a reef impacted by the extraction of boulders. Technical Report no 757, National Environmental Research Institute, Roskilde, Denmark. Available at: <http://www2dmudk/Pub/FR757pdf>

Madsen, K.N. (2008): Naturgenopretning af stenrev på Læsø Trindel - Design beskrivelse og konsekvensvurdering. Danish Ministry of the Environment. (In Danish) Available at: <http://www.naturstyrelsen.dk/NR/rdonlyres/6A8DAA54-E3BE-4150-87B2-1E772EF88EF1/89424/Designogkonsekvensvurdering.pdf>

Mikkelsen, L., Mouritsen, K.N., Dahl, K., Teilmann, J. & Tougaard, J. (in review): Re-established stony reef in Kattegat, Denmark, attracts harbour porpoises (*Phocoena phocoena*). Marine Ecology Progress Series

## **Short Notes / Project Reports**

---



# Identifying and proposing MPAs in the Baltic Sea and the Mediterranean

PILAR MARÍN, NICLAS FOURNIER, HANNA PAULOMÄKI

Oceana in Europe

## Abstract

In this crucial year for marine conservation, it is fair to recognize that efforts to establish a network of well managed Marine Protected Areas (MPAs) in Europe have fallen short of ambitions. Most of our waters are still unprotected and the majority of EU Member States lags behind international targets. All the more alarming is the delay in establishing network of MPAs because their environmental benefits are only detectable after a few years and build up over time to become more evident the longer the MPA remains functional.

Oceana advocates for and supports the creation of MPAs as an effective conservation and fisheries management tool. Using scientific expeditions to support the identification of areas to propose for MPA designation, Oceana's approach is broad enough to apply to the Mediterranean and the Baltic Sea, despite their political, geographical and ecological differences.

This is how Oceana's MedNet and Baltic conservation proposals were developed, to fully embrace the precautionary principle and bridge the science-policy gap. Oceana values a holistic approach to the establishment of MPA networks, engaging international cooperation and taking into account ecological coherence and connectivity at regional level.

Both proposals demonstrate that despite limited knowledge, recent advances in marine research allow us to act immediately to protect important marine features. We are now able to comprehensively document and assess ecologically important areas, vulnerable marine habitats and species as well as the associated impacts and threats from human activities. Simple compiling and integration of these data offer a good basis for strategic planning and initiating effective spatial protection measures.

## 1 Marine conservation and protection: an international commitment

According to the Millennium Ecosystem Assessment (UNEP, 2006), marine and coastal ecosystems are among the most endangered on the planet. Fish stocks continue to decline, pressure on coastal ecosystems continues to increase and climate change places ever more stress on a weakened environment, diminishing its capacity to produce goods and services. We have detailed knowledge of the reach of the effect of human activity due to extended resource exploitation (deforestation, pollution, fishery overexploitation, etc.) even though significant changes have been generated in trophic relationships in food chains (SALA, 2004).

Even now, in the 21st century, there is a general gap in our knowledge regarding the treasures of the oceans and the processes ruling them. This gap is particularly serious when it comes to the deep sea. However, in this context of limited knowledge of ecosystems and resources (currently or potentially exploited), international recommendations necessitate the implementation of a Precautionary Approach (CONVENTION ON BIOLOGICAL DIVERSITY, 2010). This involves considering a series of conservative (and/or conservation) measures, including the establishment of MPAs. In turn, this approach should be supported by greater efforts in researching deep sea and off shore ecosystems coupled with better management and long-term monitoring activities.

MPAs have been described as efficient tools for preserving biodiversity (ALLISON et al. 1998; HALPERN, 2003), so global efforts to use them have gradually increased in order to protect the marine environments and ecosystem services those provide. Despite this progress, MPAs represent scarcely 4% protection of coastal areas and 1% of open seas (see Table 4).

**Table 1:** Summary of the global increase in MPAs in number and surface (TOROPOVA ET AL., 2010).

	YEAR							
	2003		2006		2008		2010	
<b>NUMBER of MPAs</b>	4116		4435		5045		5850	
MPA COVERAGE	Mill. Km <sup>2</sup>	%						
<b>GLOBAL TOTAL</b>	1.64	0.45	2.35	0.65	2.59	0.72	4.21	1.17
Within Exclusive Economic Zone	1.14	1.14	2.35	1.63	2.59	1.80	4.12	2.86
On continental shelf					1.20	4.09	1.27	4.32
Off-shelf					1.39	0.42	3.01	0.91

The importance of protected areas is globally acknowledged and according to United Nations Convention on The Law of the Sea, protecting and preserving the marine environment is a 'General Obligation' of the States (UNCLOS Part XII. Art.192). Thus, in 2004 during the 7<sup>th</sup> Conference of the Parties to the Convention on Biological Diversity (CBD), the following objectives were established as regards marine protection to be reached by 2012:

–'To establish a global network of MPAs through national and regional systems of protected areas which are efficiently managed and ecologically representative' (Decision VII/28)

–'At least 10% of each of the marine ecoregions must be effectively conserved' (Decision VII/30)

Later, and in order to create representative networks including open sea areas and deep sea habitats, a series of guiding criteria for selecting priority areas was produced (UNEP, 2007; 2008; 2009), as well as a list of areas which would fulfil the scientific criteria to be identified as 'Ecologically and Biologically Significant Areas' (EBSA). These include various habitats, species, and formations, divided into three categories: benthic, pelagic habitats, and vulnerable and/or highly migratory species. In this sense, the following are just some of those considered as requiring protection: seamounts, cold-water coral reefs, submarine canyons, upwelling areas, sharks, whales and turtles.

Despite a progressive increase in the number of designated MPAs in recent decades, the data shows that the aforementioned targets are far from being met. Years after agreeing on the CBD commitments and despite recommendations from the most relevant conservationist organisations that 10% target should be increased to 20-30% to be truly significant (BALMFORD et al., 2004), the delay in achieving them was evident (WOOD et al., 2008). For that reason, during the 10<sup>th</sup> Conference of the Parties to the CBD (Nagoya 2010), it was decided to postpone the targets to 2020 (CONVENTION ON BIOLOGICAL DIVERSITY, 2010).

Besides, that the marine environments are generally insufficiently protected, most of the protected areas are also small in size, largely located in coastal waters, and lacking protection of off-shore waters. Furthermore, looking globally one must consider the large difference in protection between different ecosystems; in other words, the high representation of mangrove, coral reefs and seagrass meadows in comparison, for example, with seamounts (WOOD et al., 2008). Although the existing protection is completely justified, a wider and more innovative direction needs to be taken, encompassing lesser known ecosystems, such as seamounts, submarine canyons, cold water corals, cold seeps, pelagic habitats, etc. These are important parts of the

ocean systems and needed in order to achieve a coherent global network of marine protected areas (SECRETARIAT OF THE CBD, 2008).

International Union for Conservation of Nature (IUCN) data (TOROPOVA et al., 2010) shows that the current list of MPAs cannot be regarded as an effective "network of networks" (national/regional/global), and points out that regional efforts (OSPAR, Barcelona Convention, HELCOM) are greater than those performed on a national scale.

### **1.1. The marine protection: a pending task in continued delay**

One of the main mistakes made in marine conservation on a global scale is the delay in the designation of MPA often justified by a lack of available scientific information. As a result of this, there is a significant imbalance between protected land and protected marine areas. To date, only 1% of the world's oceans is protected, compared to nearly 15% of terrestrial areas (CONVENTION ON BIOLOGICAL DIVERSITY, 2010). Nevertheless, the latest advances in marine research have provided significant information on the geological and oceanographic characteristics which generate habitats of greater biodiversity and vulnerability. Thus, on the basis of the Precautionary Approach, there is no longer any excuse for further delay.

Human activities are jeopardizing the health of world's oceans and threatening also human well-being by disturbing the production and maintenance of ecosystem goods and services the oceans are providing. The well-known problems of overfishing, endangered and threatened species, climate change, chronic pollution, habitats destruction, invasive species, etc. together with a lack of proper MPA coverage have led to the accelerated loss of marine biodiversity, which is probably irreversible in some cases. Faced with this situation, and in its role of protecting and preserving the world's oceans, Oceana is committed to encouraging governments to act urgently before it is too late.

Regarding the aforementioned global situation and threats, Oceana actions in the Mediterranean and the Baltic Seas aim to contribute to reaching the targets established by the CBD and regional sea conventions in order to protect and preserve/restore? the marine environments and their resources.

## **2 Mediterranean and Baltic Seas: protection status**

Both seas, despite being very different environments due to their geographical location, deep and climatic conditions, contain some similarities: they are among the most polluted in the world, are under great pressures from human activities (e.g. shipping,

energy) or their fishing resources are overexploited. But they also have very different characteristics, such as socio-political status or marine jurisdictions, as in the Mediterranean Sea there is still no division for Economic Exclusive Zone (CHEVALIER, 2005). This special situation of the Mediterranean Sea influences on decision-making from a conservation point of view and from a fisheries perspective, as the management beyond the Territorial Seas depends on the regional authorities.

The status of marine protection is also very different in these two areas. The MPA coverage is only 4% in the Mediterranean and about 12% in the Baltic Sea. However, the latest assessments of these MPA networks show similar results: neither network can be considered as ecologically coherent nor representative, MPAs are scarcely connected and with a lack of effective management (HELCOM, 2010a; ABDULLA et al., 2008).

In the Baltic Sea, almost all designated MPAs are part of the EU Natura 2000 network. But the fact that an area is designated as an MPA does not mean it is actually well protected. Oceana evaluates that only 13% of the Baltic Sea MPAs actually have a comprehensive management plan - in other areas destructive fishing, fisheries with high bycatch rates, dredging and other unsustainable activities are still allowed (PAULOMÄKI et al., 2011). MPAs are also poorly used in the fisheries management despite the shown benefits of MPAs in sustaining the fish stocks. In the Baltic Sea, five out of seven main commercial stocks remain overfished. Only cod in the Eastern Baltic and herring in the Bothnian Sea are fished at maximum sustainable yield rates (EUROPEAN COMMISSION, 2012). Scientists also found that the areas in the current network are small, poorly distributed with mixed performances between countries and lack ecological coherence (HELCOM, 2010a).

In the Mediterranean Sea, around 4% (including Pelagos Sanctuary) has been protected. Most of those MPAs are concentrated in the northern coast (European countries) likely as result of the Habitats Directive implementation responding to the protection of 'priority habitat' type as in the case of *Posidonia oceanica*. Consequently, southern coasts and the Eastern basin are practically unprotected as well as the open and deep sea, and pelagic habitats and species. In addition, the current state of Mediterranean fish stocks is alarming, as scientific advice are being repeatedly ignored since several years, as illustrated by a recent which pointed out that 80% of the Mediterranean stocks are overfished (EUROPEAN COMMISSION, 2012). Urgent actions and policies are needed to phase out overfishing and guarantee the sustainable exploitation of resources. Several initiatives have been launched to protect the Mediterranean Sea, the main one falls under the Barcelona Convention and more specifically within the Regional Activity Centre for Specially Protected Areas. Under its work, 10 EBSAs have been identified as priority areas where Specially Protected Areas

of Mediterranean Importance (SPAMI) can be designated (UNEP-MAP-RAC/SPA, 2010). Other initiatives include: protecting Essential Fish Habitats and Sensitive Habitats (DE JUAN & LLEONART, 2010); Marine Peace Parks within the framework of the Mediterranean Science Commission (CIESM, 2011); Fisheries Restricted Areas based on General Fisheries Commission for the Mediterranean recommendations (GFCM, 2006); the proposal for protection of cetaceans within the ACCOBAMS regional agreement; or even the 'Marine Reserves' proposed by Greenpeace (Greenpeace, 2006). However, several of them have a certain 'pelagic bias' and have the common trait that they do not propose specific sites to be protected, but rather large areas within which MPAs might be located.

### **3 Oceana's proposals**

For all the reasons abovementioned, Oceana has selected the Mediterranean and Baltic Seas as priorities areas where to focus conservation efforts. Based on information gathered annually through at sea expeditions, Oceana has collected evidences to justify the protection of high value ecological areas or species. Since 2006 in the Mediterranean and 2011 the Baltic Sea, Oceana has compiled scientific information to propose new MPAs to support decision makers in developing comprehensive and coherent proposals and ultimately comply with their national and regional obligations as well as their international commitments (MARÍN et al., 2011; PAULOMÄKI et al., 2011).

#### **3.1. Oceana MedNet: the Mediterranean MPA network proposal**

The Oceana's proposal for the Mediterranean Sea is called. It is mainly focused in those open and deep sea features not covered by the existing MPA network. The proposal defines 100 areas (see Figure 10) including seamounts, submarine canyons, cold seeps, etc. that would make up a coherent, well-distributed and representative Mediterranean MPA network. Those sites have been chosen through a systematic selection of sites based on biological, geomorphological and oceanographic criteria, as well as potential threats (MARÍN et al., 2011; MARÍN et al., 2012).



**Figure 1:** Oceana MedNet proposal.

According to De Juan and Lleó (2010), an MPA network should be representative of the habitat diversity, permit connectivity between protected areas and should be sufficiently large to enable a structured habitat and to eliminate (or mitigate) the negative influences of human activity (e.g. fishing) in surrounding areas. In order to have a well-connected network, Oceana MedNet has been designed taking into account the main ocean circulation patterns in the Mediterranean Sea and including pelagic and benthic ecosystems (see Figure 11).

Oceana MedNet covers over 200,000km<sup>2</sup> distributed along the entire basin which would contribute more than 8% to the CBD target. If added to existing MPA coverage, would reach 12% of the Mediterranean Sea protected (MARÍN et al., 2011).

The Oceana's proposal for the Mediterranean Sea could be considered as an interesting and useful strategic tool for identifying areas in need of protection beyond Territorial Seas. In addition, the proposal calls on riparian Mediterranean States and regional bodies to enhance integration and cooperation at regional level to conserve marine resources in open sea due to the special jurisdictional situation of the basin.

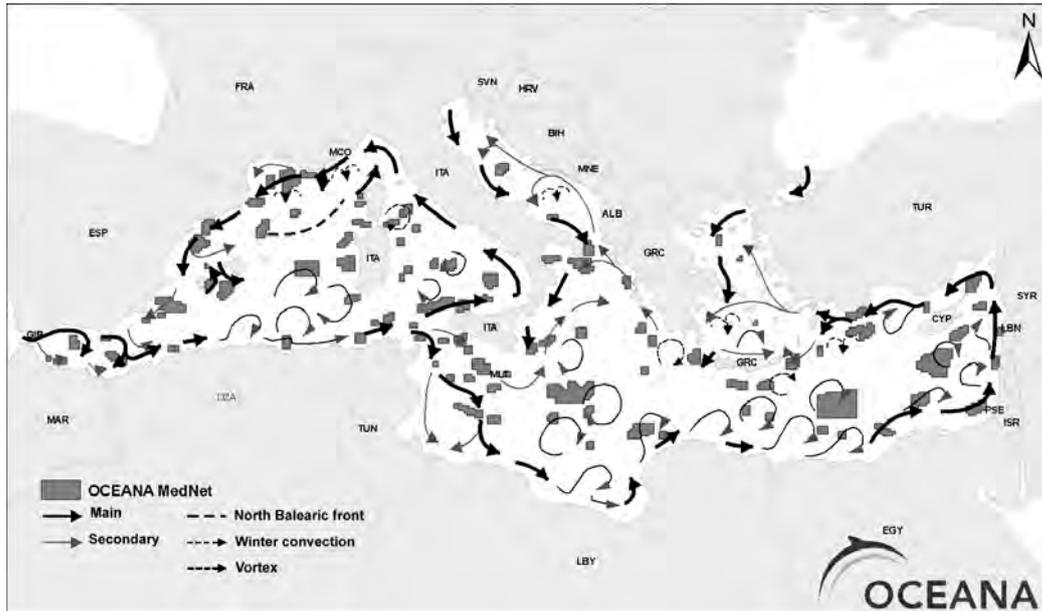


Figure 2: Main and secondary currents and MedNet.

### 3.2. The Baltic Sea proposals

The areas selected in the Baltic Sea and Kattegat include features that are currently underrepresented in the network (Figure 12): Offshore sites in the Bothnian Bay, Baltic Proper and Kattegat; Deep water areas that still have healthy oxygen levels (Bothnian Bay deep, Kattegat trench); - Areas with high and distinctive biodiversity, including declining and threatened species (the Sound, Kattegat); Extensions of existing protected areas to allow a full range of depths and ecosystems covered (Hanko peninsula, Ulkokrunni, Groves flak, Djupa rännan trench); and new sites in areas where protection is lacking (Åland Islands, Bothnian Bay). Recent studies indicate that in order to provide comprehensive protection for the full of range of biodiversity and biological processes in the Sea, the current protected areas network coverage should be doubled at the very least (LIMAN et al., 2008; HELCOM, 2010b). The HELCOM (2010b) study showed that the minimum conservation objective (12% of each sub-basin protected) would not be enough to build-up an ecologically coherent network but the current network should be at least doubled in order to meet this goal. Therefore, adding these new sites would be an important step towards an ecologically coherent network of marine protected areas, as the Baltic Sea countries have aspired. Though the current proposals would not guarantee the ecological coherency, the inclusion of the proposed sites to the existing network would be a move in the right direction as it would add features currently missing or critically underrepresented. Some of these areas have also been discussed and proposed by other organisations (GREENPEACE, 2004; SØRENSEN, 2005; GOLDBERG & NEJRUP, 2010). Oceana supports these proposals and adds in new information with our findings.

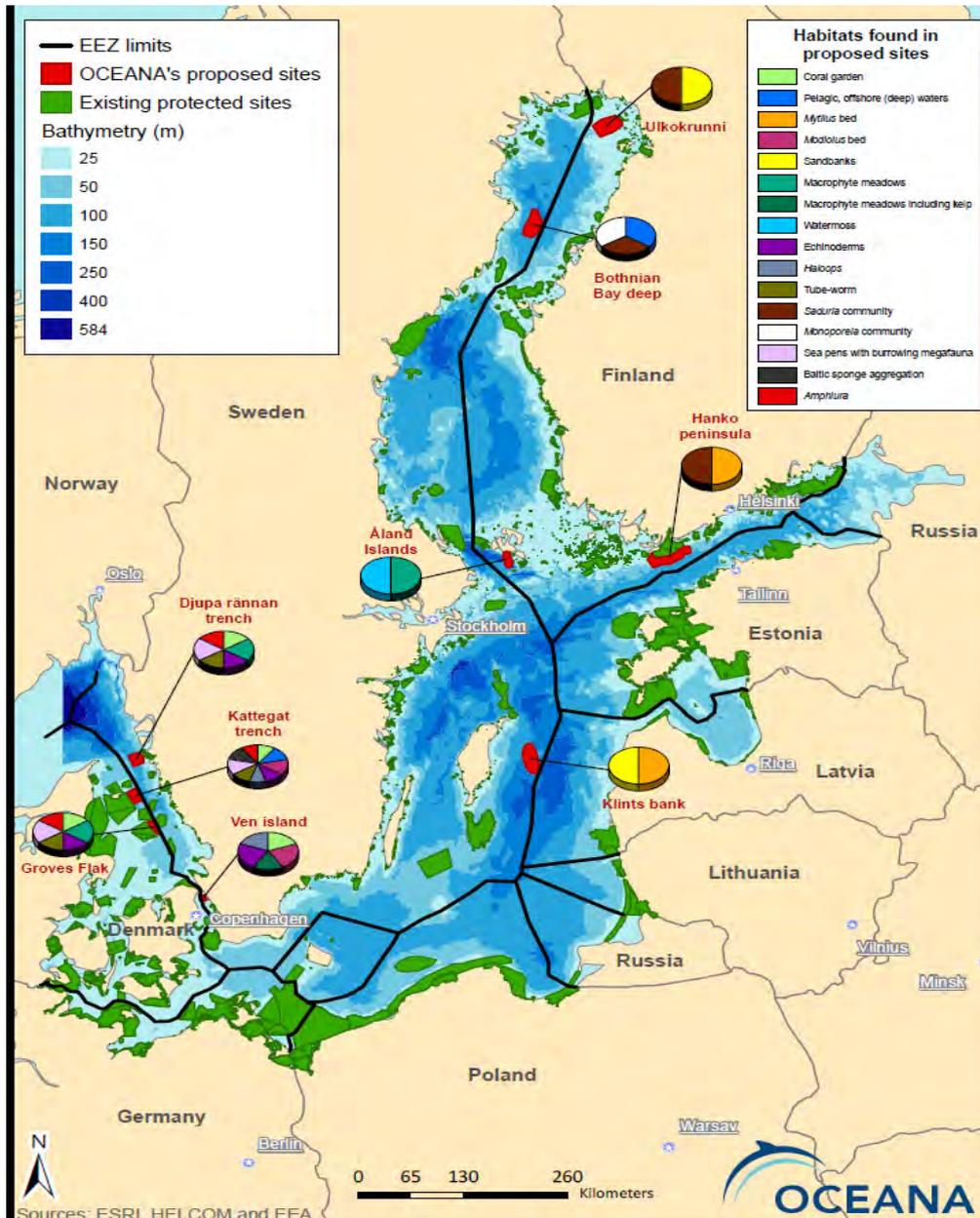


Figure 1: The Oceana's Baltic Sea proposal.

#### 4 Final discussion

Countries around the world have committed to protecting the world's oceans. These commitments have been further affirmed by several regional sea conventions, like Barcelona Convention in the Mediterranean Sea, HELCOM in the Baltic Sea and OSPAR for North-East Atlantic. These conventions have engaged into strategies to create well-managed, ecologically coherent networks of MPAs. Therefore it is particularly important to guarantee that these networks are representative of each eco-marine regions and comprise at least important ecological areas (such as spawning,

feeding and resting grounds) as well as protect priorities endangered and threatened species and habitats. But the networks should also cover areas large enough to sustain ecological processes on a long-term basis, including with sufficiently large no take zones (or reserves) where all forms of exploitation is prohibited and human activities severely limited in order to protect the most critical ecosystems. An ecologically coherent network buffers against human disturbances and increases the overall resilience of the ecosystems, enabling better and faster recovery after potentially destructive events. Without designating more and larger MPAs the Mediterranean and Baltic Sea, countries will not be able to fulfil their commitment, and consequently will fail to restore a Good Environmental Status to European waters, and worst will not move Europe towards cleaner and better managed seas. The precautionary approach and ecosystem-based management should be used to prevent further deterioration of the marine environments. Particular activities that have detrimental effects on the food chains, like fisheries, should be better managed both in and outside marine protected areas to safeguard and sustain the marine ecosystems function on a long-term basis. With both approaches exposed in this article, Oceana's objective is twofold: first contribute to achieve the CBD targets of 10% coverage for MPAs by 2020 at the latest, and go beyond this minimalistic goal, as we aspire raise this target to a 20-30% protection as recommended by scientists (IUCN World Parks Congress, 2003). And also improve management of already established MPAs, including through the creation of no-take zones ("reserves") and the establishment of effective monitoring programmes.

## 5 Bibliography

Abdulla, A., Gomei, M., Maison, E., Piante, C. (2008): Status of Marine Protected Areas in the Mediterranean Sea. IUCN, Málaga and WWF, France. 152 pp.

Allison, G.W., Lubchenco, J., Carr, M.H. (1998): Marine reserves are necessary but not sufficient for marine conservation. *Ecological Applications*, 8: 79–92.

Balmford, A., Gravestock, P., Hockley, N., McClean, C.J., Roberts, C.M. (2004): The worldwide costs of marine protected areas. *Proceedings of the National Academy of Sciences*, June 29, 2004 vol. 101 no. 26 9694-9697. doi: 10.1073/pnas.0403239101

Chevalier, C. (2005): Governance of the Mediterranean Sea. Outlook for the Legal Regime. IUCN-Med, Málaga (Spain).

CIESM (2011): Marine Peace Parks in the Mediterranean. A CIESM proposal. N° 41 in CIESM Workshop Monographs [F. Briand Ed.], Monaco, 128 pp.

Convention on Biological Diversity (2010): COP 10 Decision X/29. Marine and coastal biodiversity. URL: (Accessed July 2012)

De Juan, S., Leonart, J. (2010): A conceptual framework for the protection of vulnerable habitats impacted by fishing activities in the Mediterranean high seas. *Ocean & Coastal Management*, Volume 53, Issue 11, November 2010, Pages 717-723, ISSN 0964-5691. doi: 10.1016/j.ocecoaman.2010.10.005

European Commission (2012): Communication from the Commission concerning a consultation on Fishing Opportunities for 2013. Brussels, 7.6.2012. COM(2012) 278 final

GFCM (2006): Recommendation GFCM/30/2006/3 on the establishment of fisheries restrictive areas in order to protect the deep sea sensitive habitats.

Goldberg, C. & Nejrup, L. (2010): Velegnede lokaliteter for marine nationalparker. Danmarks Naturfredningsforening, 22 pp.

Greenpeace (2004): Rescuing the North and Baltic Seas: Marine Reserves - a key tool. 40 pp.

Greenpeace (2006): Marine Reserves for the Mediterranean Sea

Halpern, B.S. (2003): The impact of marine reserves: do reserves work and does reserve size matter?. *Ecological Applications*, 13(1) Supplement, 2003, S117–S137 pp.

HELCOM (2010a): Ecosystem Health of the Baltic Sea 2003-2007: HELCOM Initial Holistic Assessment. Baltic Sea Environment Proceedings No. 122. URL: <http://www.helcom.fi/stc/files/Publications/Proceedings/bsep122.pdf> (Accessed July 2012)

HELCOM (2010b): Towards an ecologically coherent network of well-managed Marine Protected Areas - Implementation report on the status and ecological coherence of the HELCOM BSPA network. Baltic Sea Environment Proceedings No. 124B. URL: <http://www.helcom.fi/stc/files/Publications/Proceedings/bsep124B.pdf> (Accessed July 2012)

Liman, A-S., Andersson, Å & Huggins, A. (2008): Towards a Representative Network of Marine Protected Areas in the Baltic Sea. Balance Interim Report No 24. 72 pp. URL: <http://balance-eu.org/xpdf/balance-interim-report-no-24.pdf> (Accessed July 2012)

López-Sanz, A., Vert, N., Zabala, M., Sabatés, A. (2009): Small-scale distribution of fish larvae around the Medes Islands marine protected area (NW Mediterranean). *Journal of Plankton Research*. Vol 31. No 7: 763-775

Marín, P., Aguilar, R., García, S. (2011): Oceana MedNet: MPA network proposal for the Mediterranean Sea. 100 reasons to reach 10%. Oceana. 96 pp. URL: [http://oceana.org/sites/default/files/reports/OCEANA\\_MEDNet\\_ING\\_16012012.pdf](http://oceana.org/sites/default/files/reports/OCEANA_MEDNet_ING_16012012.pdf)

Marín, P., Aguilar, R., García, S., Fournier, N. (2012): Oceana MedNet: a complementary approach for the Mediterranean N2000 in open and deep sea. Oceana. 18 pp. URL: [http://oceana.org/sites/default/files/reports/OCEANA\\_COMPLEMENTARY\\_APPROACH\\_MEDITERRANEAN\\_N2000\\_OPEN\\_AND\\_DEEP\\_SEA\\_\\_Jul2012.pdf](http://oceana.org/sites/default/files/reports/OCEANA_COMPLEMENTARY_APPROACH_MEDITERRANEAN_N2000_OPEN_AND_DEEP_SEA__Jul2012.pdf)

Paulomäki, H., Abel, C., Aguilar, R. (2011): Baltic: Conservation proposals for ecologically important areas in the Baltic Sea. *Oceana*, S. L. 127 pp. URL: [http://oceana.org/sites/default/files/reports/OCEANA\\_Baltic\\_report\\_2011\\_ENG.pdf](http://oceana.org/sites/default/files/reports/OCEANA_Baltic_report_2011_ENG.pdf)

Sala, E. (2004): The past and present topology and structure of Mediterranean subtidal rocky-shore food webs. *Ecosystems* 7: 333–340.

Secretariat of the Convention on Biological Diversity (2008): Synthesis and Review of the Best Available Scientific Studies on Priority Areas for Biodiversity Conservation in Marine Areas beyond the Limits of National Jurisdiction. Montreal, Technical Series No. 37, 63 pp

Sørensen, K. T. (2005): Beskyttelse af havnaturen i indre danske farvande - status og anbefalinger. WWF Danmark, 84 pp.

Toropova, C., Meliane, I., Laffoley, D., Matthews, E., Spalding, M. (eds.) (2010): Global Ocean Protection: Present Status and Future Possibilities. Brest, France: Agence des aires marines protégées, Gland, Switzerland, Washington, DC and New York, USA: IUCN WCPA, Cambridge, UK: UNEP-WCMC, Arlington, USA: TNC, Tokyo, Japan: UNU, New York, USA: WCS, 96pp.

UNEP (2006): Marine and coastal ecosystems and human wellbeing: A synthesis report based on the findings of the Millennium Ecosystem Assessment. UNEP, 76pp

UNEP (2007): Report on the expert workshop on ecological criteria and biogeographic classification system for marine areas in need of protection. UNEP/CBD/EWS.MPA/1/2. URL: <http://www.cbd.int/doc/meetings/mar/ewsebm-01/official/ewsebm-01-02-en.pdf> (Accessed July 2012)

UNEP (2008): Decisión adoptada por la Conferencia de las Partes en el Convenio sobre la Diversidad Biológica en su novena reunión. Diversidad biológica marina y costera. UNEP/CBD/COP/DEC/IX/20. <http://www.cbd.int/doc/decisions/cop-09/cop-09-dec-20-es.pdf>

UNEP (2009): Report of the expert workshop on scientific and technical guidance on the use of biogeographic classification systems and identification of marine areas beyond national jurisdiction in need of protection. UNEP/CBD/EW-BCS&IMA/1/2\*, 22 December

UNEP-MAP-RAC/SPA (2010): Overview of scientific findings and criteria relevant to identifying SPAMIs in the Mediterranean open seas, including the deep sea. By Notarbartolo di Sciara, G. and Agardy, T. Ed. RAC/SPA, Tunis, 71 pp.

United Nations (1982): Convention on the Law of the Sea. URL: [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/unclos\\_e.pdf](http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf) (Accessed July 2012)

Wood, L.J. Fish, L., Laughren, J., Pauly, D. (2008): Assessing progress towards global marine protection targets: shortfalls in information and action. *Oryx* Vol. 42, 340-351 pp.

Vth IUCN World Parks Congress, Rec 5.22 Building a Global System of Marine and Coastal Protected Area Networks, Durban, South Africa, 2003

## **European Marine Strategy Framework Directive (MSFD)**

---



## **The EU Marine Strategy Framework Directive (MSFD) - state of implementation in Germany -**

Britta Knefelkamp<sup>1</sup>, Jochen Krause<sup>2</sup>, Ingo Narberhaus<sup>2</sup>, Ulli Claussen<sup>3</sup>

<sup>1</sup>University of Vechta, Germany, <sup>2</sup>Federal Agency for Nature Conservation, Germany, <sup>3</sup>Federal Environment Agency, Germany

On 15 July 2008, the European Marine Strategy Framework Directive (2008/56/EC; MSFD; EUROPÄISCHE UNION, 2008) came into force as the environmental pillar of the maritime policy for the European Union. Targets of the MSFD are the protection of the marine environment, the sustainable use of marine goods and services as well as the achievement of good environmental status (GES) in all European seas by 2020 and its sustainable maintenance. These targets shall be achieved by setting up programmes of measures that fulfill the application of an ecosystem-based approach, the precautionary and polluter pays-principle as well as a coherent and integrative approach within the respective marine regions.

In Germany, the MSFD can be implemented in a pragmatic way, when a consistent procedure for the preparatory steps is chosen. A successive approach by taking into account the principles of nature conservation would allow for taking the chances given by the MSFD to protect marine biodiversity in German seas. To what extent Germany takes chance of these opportunities, can only be evaluated by the success of future implemented programmes and measures.

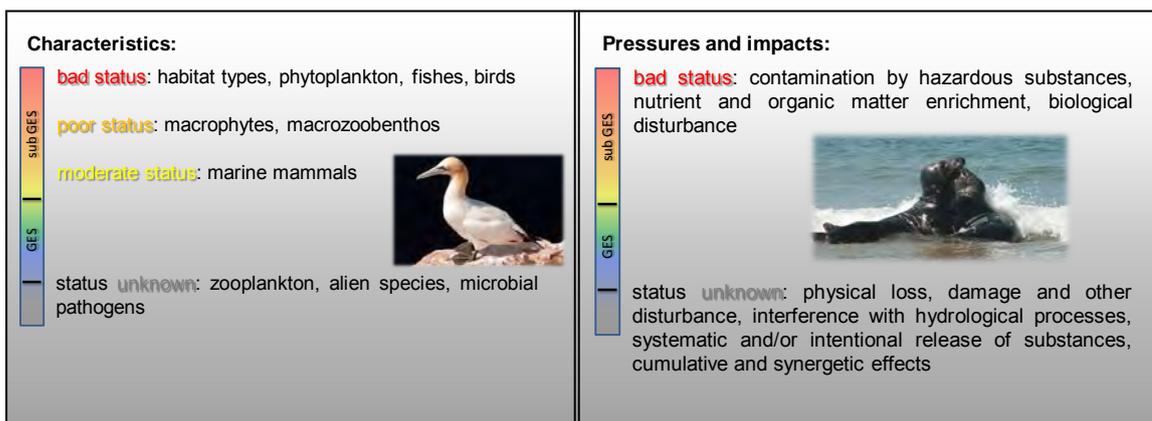
### **1 German MSFD Reports 2012**

The main tasks given by the directive to reach GES in 2020 are the preparatory steps of assessing the actual state, determine the desired state (GES) and establish environmental targets to guide progress towards achieving GES. Furthermore monitoring programmes shall be established to observe the development of actual state, achievement of targets and efficiency of programmes of measures. The principal item of implementing the MSFD are the programmes of measure to achieve the environmental targets and - provided that these targets are ambitious enough and in line with an ecosystem-based approach, the precautionary and polluter pays-principle - the GES in 2020.

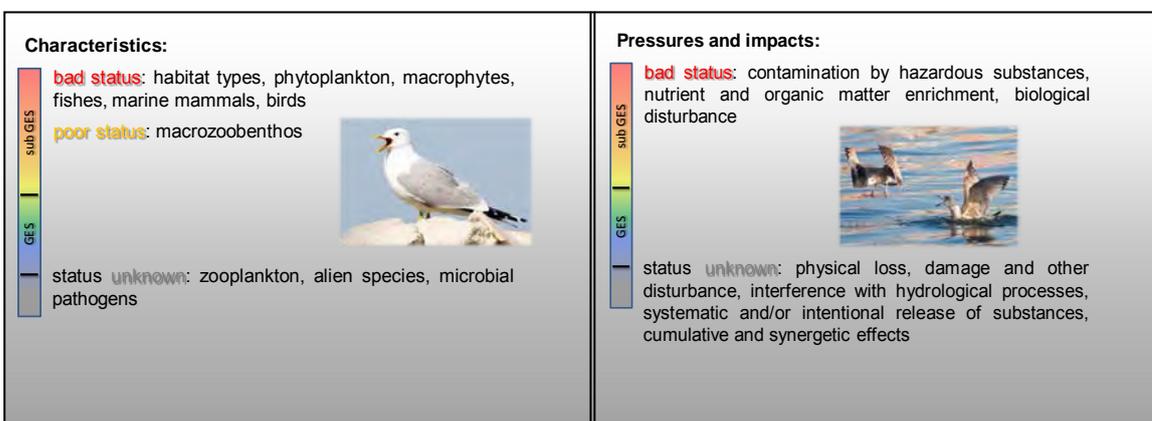
### 1.1 Assessment of state

For the assessment of state, Germany made use of existing sources of information. Basing on the work carried out for the OSPAR (OSPAR-ÜBEREINKOMMEN, 1992) and Helsinki (HELSINKI-ÜBEREINKOMMEN, 1992) convention, the Trilateral Wadden Sea Cooperation (TWSC, 1982/2010), the Habitats (EUROPÄISCHE UNION, 1992), Water Framework (EUROPÄISCHE UNION, 2000) and Environmental Quality Standards (EUROPÄISCHE UNION, 2008b) Directive as well as species-specific agreements (e.g. ASCOBANS, 1992) and Red Lists (BfN, 2009; FRICKE R. et al., 1998; RACHOR, E. et al, im Druck; RIECKEN, U., 2006; THIEL, R, im Druck), essential issues have been taken into account for the initial assessment. However, referring to some aspects, gaps remained with regard to scientific and regional coverage of information.

Overall, the state of characteristics, pressures and impacts in the German North Sea does currently not reach GES or is unknown:



The same is true for the current state of characteristics, pressures and impacts in the German Baltic Sea:



## 1.2. Determination of GES

GES is defined qualitatively by 11 descriptors of the MSFD (Annex 1 MSFD, Figure 1) and has been further specified by criteria and indicators (2010/477/EU; EUROPÄISCHE UNION, 2010). In Germany these criteria and indicators are not yet covered entirely by the existing monitoring data and assessment methods. Nonetheless, on the basis of GES descriptions for species and habitats under the Natura2000 Directives (EUROPÄISCHE UNION, 1992; EUROPÄISCHE UNION, 2009) biological quality elements under the Water Framework Directive (EUROPÄISCHE UNION, 2000), species and habitats under the OSPAR (OSPAR-ÜBEREINKOMMEN, 1992) and Helsinki (HELSINKI-ÜBEREINKOMMEN, 1992) convention, the Trilateral Wadden Sea Cooperation (TWSC, 1982/2010), Red Lists (BfN, 2009); Fricke, R., 1998; Rachor, E., im Druck; Riecken, U., 2006; Thiel, R., im Druck) as well as species-specific agreements (e.g. ASCOBANS, 1992) the requirements of the MSFD have been fulfilled for the reports in 2012.

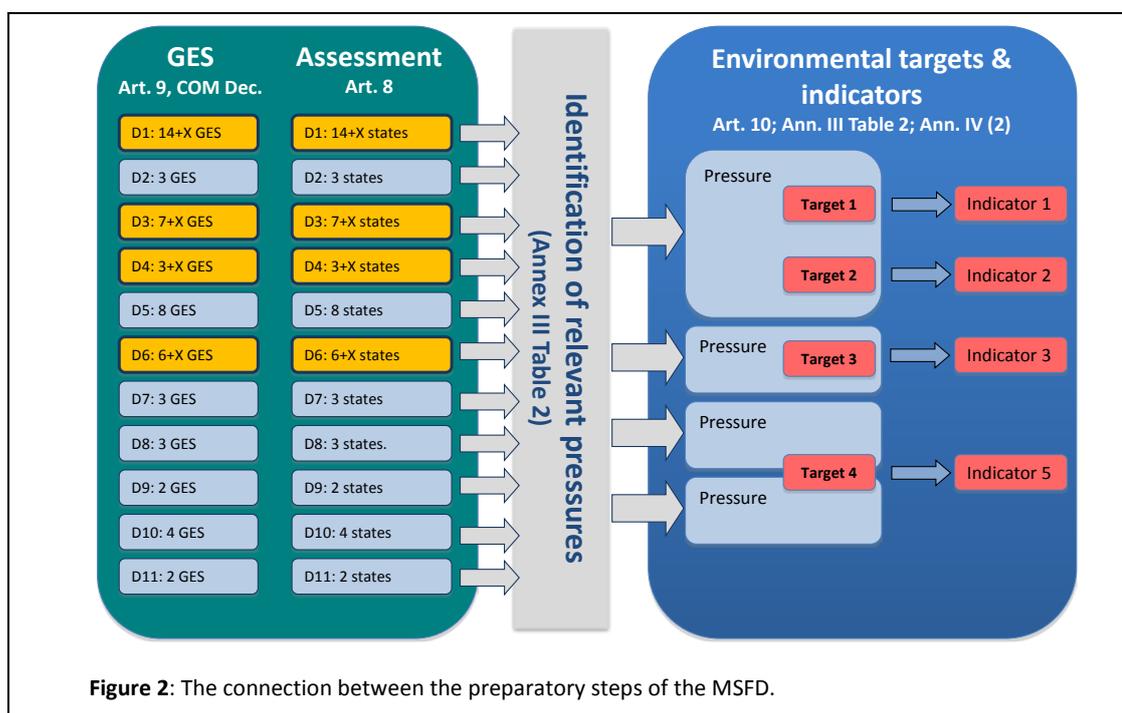


**Figure 1:** The qualitative descriptors of the MSFD address 11 aspects of GES.

## 1.3. Establishment of targets

Environmental targets are meant to reduce a negative deviation between actual and desired state of a characteristic, pressure or impact, or to maintain an already existing GES. The targets can either be adjusted in a pressure based direction, allowing for a direct management of human activity to enhance the actual state and an easy definition of reference values, implementation of programmes of measure and monitoring of progress, or in a state based direction, allowing for a support of the spatial and temporal specification of programmes of measure.

On the basis of existing environmental targets i.e. the UN Convention on the Law of the Sea (SRÜ, 1982), the Convention on Biological Diversity, the OSPAR and Helsinki, Convention, the Trilateral Wadden Sea Cooperation, the Habitats, Birds, Water Framework and Environmental quality Standards (EUROPÄISCHE UNION, 2008b), Directive, the EU Biodiversity Strategy (EU-KOMMISSION, 2011), the National Strategies on Biological Diversity (BMU, 2007) and for the Sustainable Use and Protection of the Seas (BMU, 2008) as well as species-specific agreements (e.g. ASCOBANS), Germany defined seven areas of problems that need to be approached to reach GES in 2020. These areas were headed by the following targets:



- Seas without adverse effects by anthropogenic eutrophication
- Seas without pollution by hazardous substances
- Seas without adverse effects of human activities on marine species and habitats
- Seas with sustainable and ecologically sound use of resources
- Seas without impacts by litter
- Seas without adverse effects by anthropogenic introduction of energy
- Seas with natural hydromorphological condition

The targets were further specified by 30 operational targets and 68 quantifiable indicators.

For example the target “*Seas without adverse effects of human activities on marine species and habitats*” covers the operational target “*There exist sufficient retreating and resting zones - both in space and time - for ecosystem components. To protect marine life from anthropogenic disturbances, e.g. areas and times of prohibited and/or restricted usage (no-take zones and no-take times, for fisheries based on the rules of the Common Fisheries Policy, or CFP) are established (cf. for example, Recital 39 of the MSRL)*”. This operational target shall be quantified by the extent of the retreating and resting areas (as a percentage of the sea area), the time period for the retreating and resting areas (breeding, rearing, and moulting times), the low or natural population levels of opportunistic species as well as the occurrence of characteristic perennial and large forms of vegetation and animal species on and in characteristic types of sediment.

## 2 What needs to be done

Though the reporting commitments 2012 can be fulfilled by using existing information, there do exist content-related and regional gaps. The ecosystem-approach, polluter pays principle and precautionary principles need further analysis to be applied accurately. The economic and social analysis (ESA) as well as cumulative aspects need further development, too. Additionally, the harmonisation and intercalibration with other directives, conventions and policies (e.g. CFP, CAP) as well as harmonisation on the regional level is not defined by the MSFD and therefore needs further effort. Another important aspect is to set into relation the existing and at times heterogeneous information (i.e. assessment systems) and to transfer them to answer the requirements of the MSFD.

Furthermore, referring to the assessment of state that needs to be updated in 2018, it is necessary to fill regional and scientific gaps in the existing monitoring and assessment methods, i.e. in respect to zooplankton, alien species, microbial pathogens, physical loss, damage and other disturbance, interference with hydrological processes, systematic and/or intentional release of substances and cumulative and synergetic effects. Additionally, an assessment method to analyse uses and costs of degradation (ESA) and the harmonization of assessment on a regional level (RSC) is needed.

What needs to be done for fulfilling the complete requirements of the MSFD for the determination of GES is the establishment of monitoring and assessment of all indicators and parameters needed (incl. development of the technical basis and

assessment systems), the quantitative determination of GES for those indicators and parameters where it does not yet exist, the development of additional indicators to sufficiently analyse GES (scientifically and in respect to the overall targets of the MSFD) and the harmonization of GES determination on a regional level (RSC).

### 3 Next steps

As the 2012 reporting is still not completed, the next steps are to finalize the textual reports on July 15<sup>th</sup> 2012 and to finalize the electronic reports on October 15<sup>th</sup> 2012. After this, monitoring programmes have to be established and implemented (2014) to assess state without gaps, determine GES as appropriate and to check the achievement of targets and the efficiency of programmes of measures. Furthermore, programmes of measure have to be established (2015) and implemented (2016) to achieve the environmental targets and with this GES. With this, it has to be decided how to deal with discrepancies between differing interests (i.a. environmental protection on the one hand and fisheries or agriculture on the other).

### 4 References

ASCOBANS (1992): Abkommen zur Erhaltung der Kleinwale in der Nord- und Ostsee, des Nordostatlantiks und der Irischen See. <http://eelink.net/~asilwildlife/ascobans.html>.

BfN (2009): Bundesamt für Naturschutz. Rote Liste gefährdeter Tiere, Pflanzen und Pilze Deutschlands. Naturschutz und Biologische Vielfalt, 70(1). Bonn - Bad Godesberg.

BMU (2007): Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. Nationale Strategie zur Biologischen Vielfalt. Reihe Umweltpolitik, 180 S. [http://www.bmu.de/files/pdfs/allgemein/application/pdf/biolog\\_vielfalt\\_strategie\\_nov07.pdf](http://www.bmu.de/files/pdfs/allgemein/application/pdf/biolog_vielfalt_strategie_nov07.pdf)

BMU (2008): Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. Nationale Strategie für die nachhaltige Nutzung und den Schutz der Meere, 68 S. [http://www.bmu.de/files/pdfs/allgemein/application/pdf/broschuere\\_meeresstrategie\\_bf.pdf](http://www.bmu.de/files/pdfs/allgemein/application/pdf/broschuere_meeresstrategie_bf.pdf)

CBD (1992): Convention on biological diversity (with annexes). Concluded at Rio de Janeiro on 5 June 1992. Übereinkommen über die Biologische Vielfalt.

EU-Kommission (2011): Mitteilung der Kommission an das Europäische Parlament, den Rat, den Europäischen Wirtschafts- und Sozialausschuss und den Ausschuss der Regionen. Lebensversicherung und Naturkapital: Eine Biodiversitätsstrategie der EU für das Jahr 2020. KOM(2011) 244 endgültig

[http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/comm\\_2011\\_244/1\\_DE\\_ACT\\_part1\\_v2.pdf](http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/comm_2011_244/1_DE_ACT_part1_v2.pdf)

Europäische Union (1992): Richtlinie 92/43/EWG des Rates vom 21. Mai 1992 zur Erhaltung der natürlichen Lebensräume sowie der wildlebenden Tiere und Pflanzen. ABl. L 206 vom 22.7.1992, 7-50 pp.

Europäische Union (2000): Richtlinie 2000/60/EG des Europäischen Parlaments und des Rates vom 23. Oktober 2000 zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik. ABl. L 327 vom 22.12.2000, 1-73 pp.

Europäische Union (2008): Richtlinie 2008/56/EG des Europäischen Parlaments und des Rates vom 17. Juni 2008 zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Meeresumwelt. ABl. L 164 vom 25.6.2008, S. 19-40.

Europäische Union (2008b): Richtlinie 2008/105/EG des Europäischen Parlaments und des Rates vom 16. Dezember 2008 über Umweltqualitätsnormen im Bereich der Wasserpolitik und zur Änderung und anschließenden Aufhebung der Richtlinien des Rates 82/176/EWG, 83/513/EWG, 84/156/EWG, 84/491/EWG und 86/280/EWG sowie zur Änderung der Richtlinie 2000/60/EG. ABl. L 348 vom 24.12.2008, 84-97 pp.

Europäische Union (2009): Richtlinie 2009/147/EG des Europäischen Parlaments und des Rates vom 30. November 2009 über die Erhaltung der wildlebenden Vogelarten (kodifizierte Fassung). ABl. L 20 vom 26.1.2010, 7-25 pp.

Europäische Union (2010): Beschluss 2010/477/EU der Kommission vom 1. September 2010 über Kriterien und methodische Standards zur Feststellung des guten Umweltzustands von Meerestgewässern. ABl. L 232 vom 2.9.2010, 14-24 pp.

Fricke R., Berghahn, R., Rechlin, O., Neudecker, T., Winkler, H.M., Bast, H.D., Hahlbeck, E. (1998): Rote Liste der in Küstengewässern lebenden Rundmäuler und Fische (Cyclostomata & Pisces). In M. Binot, R. Bless, P. Boye, H. Gruttke, P. Pretscher (Hrsg.), Rote Liste gefährdeter Tiere Deutschlands. Schriftenreihe für Landschaftspflege und Naturschutz 55: 60-64.

Helsinki-Übereinkommen (1992): Convention on the protection of the marine Environment of the Baltic Sea Area.

OSPAR-Übereinkommen (1992): Das Übereinkommen über den Schutz der Meeresumwelt des Nordostatlantiks vom 22.09.1992 (Oslo-Paris- oder kurz OSPAR-Übereinkommen; seit 25.03.1998 völkerrechtlich in Kraft) (BGBl 1994 II, S. 1360)

Rachor E., Bönsch, R., Boos, K., Gosselck, F., Grotjahn, M., Günther, C.P., Gusky, M., Gutow, L., Heiber, W., Jantschik, P., Krieg, H.J., Krone, R., Nehmer, P., Reichert, K., Reiss, H., Schröder, A., Witt, J., Zettler, M.L. (im Druck): Rote Liste der bodenlebenden wirbellosen Meerestiere. Bonn-Bad Godesberg (Bundesamt für Naturschutz). Naturschutz und Biologische Vielfalt.

Riecken U., Finck, P., Raths, U., Schroder, E., Ssymank, A. (2006): Rote Liste der gefährdeten Biototypen Deutschlands - zweite fortgeschriebene Fassung 2006. Naturschutz und Biologische Vielfalt, 34, ISBN 987-3-7843-3934-4. 318 pp.

Thiel R., Winkler, H., Böttcher, U., Dänhardt, A., Fricke, R., George, M., Kloppmann, M., Schaarschmidt, T., Ubl, C., Vorberg, R. (im Druck): Rote Liste und Liste der etablierten Neunaugen und Fische (Petromyzontida, Elasmobranchii & Actinopterygii) der marinen Gewässer Deutschlands. In Haupt H., Ludwig G., Gruttke H., Binot-Hafke M., Otto C., Pauly A. (Hrsg.). Rote Liste gefährdeter Tiere, Pflanzen und Pilze Deutschlands. Band 2. Bundesamt für Naturschutz, Bonn.

SRÜ (1982): Seerechtsübereinkommen der Vereinten Nationen vom 10.12.1982, BGBl. 1994 II: 1798 pp.

TWSC (1982/2010): Trilateral Wadden Sea Cooperation. Joint Declaration on the Protection of the Wadden Sea 1982. unter: <http://www.waddensea-secretariat.org/tgc/Declaration.html>. Joint Declaration on the Protection of the Wadden Sea. Zugriff unter: [http://www.waddensea-secretariat.org/tgc/DocumentsSylt2010/2010%20Joint%20Declaration\\_final.pdf](http://www.waddensea-secretariat.org/tgc/DocumentsSylt2010/2010%20Joint%20Declaration_final.pdf)

## The Dutch Approach on the Implementation of the EU – Marine Strategy Framework Directive

WIM VAN URK

Ministry of Infrastructure and the Environment, The Netherlands

The *Marine Strategy for the Dutch part of the North Sea 2012-2020 Part I* sets the course for the activities to be undertaken between 2012 and 2015 to implement the EU – Marine Strategy Framework Directive (MSFD). The Marine Strategy Part I consists of the *initial assessment* of the marine ecosystem of the Dutch part of the North Sea, the *environmental targets* for 2020 towards reaching the *good environmental status*, and related *indicators* for monitoring, as required by the MSFD. It also contains the supplementary policy assignments wherever needed, as the first step towards the decision on the programme of measures in 2015. Furthermore does the Marine Strategy Part I contain the knowledge agenda accompanying the implementation of the MSFD.

In May 2012 The Dutch Cabinet approved the Draft Marine Strategy Part I. At the time of publishing this paper, the draft strategy is subject to public consultation after which the Dutch Cabinet will endorse it.

This paper briefly covers the highlights of the contents of the Marine Strategy Part I and the process of coming about:

- the ambition of the Dutch Marine Strategy and the approach towards the implementation (section 1);
- Governance: stakeholder participation and international coordination during the formation of the Marine Strategy Part I (section 2);
- The primary conclusions of the Marine Strategy Part I on the environmental status of the Dutch part of the North Sea up till 2020 and beyond, the targets to be reached and supplementary policy assignments to take on towards good environmental status (section 3);
- A preview on the elaboration of the Marine Strategy until 2020 (section 4).

## 1 Ambition and approach

### 1.1 Ambition

The ambition of the Netherlands is to establish good environmental status and biodiversity of the North Sea for current and future generations, and safeguard it as a key resource for the economy and the food supply. The Marine Strategy sets the Cabinet's course between 2012 and 2015.

This aspirational aim is part of the National Water Plan 2009-2015 (NWP): *The North Sea is a healthy and resilient marine ecosystem that can be used in a sustainable manner*. This way, the Marine Strategy serves to implement the NWP, setting the (spatial) preconditions for the sustainable, spatially efficient and safe use of the North Sea, in balance with the marine ecosystem's interests as documented in the Water Framework Directive (WFD), the Marine Strategy Framework Directive (MSFD), and the Birds and Habitats Directives (BHD) (see Figure 2). The ecosystem approach and the precautionary principle are actively implemented.

#### Box 1: Obligations of the MSFD

##### **The obligations of the European Marine Strategy Framework Directive in short**

The Marine Strategy Framework Directive ((MSFD, Directive 2008/56/EC) obliges Member States of the EU to take the necessary measures to achieve, maintain or restore good environmental status in the seas under their management by the year 2020 at the latest. This is to be effected in coordination with other Member States in the same marine region. The Marine Strategy must comprise the following elements:

1. an initial assessment of the marine environment, to be completed in 2012;
2. a determination, to be established in 2012, of good environmental status in 2020 for the waters concerned;
3. establishment, in 2012, of a series of environmental targets that guide way to good environmental status, and associated indicators;
4. establishment and implementation, in 2014, of a monitoring programme for ongoing assessment and regular updating of targets;
5. development, by 2015 at the latest, of a programme of measures designed to achieve and/or maintain good environmental status in 2020. This programme of measures is to become effective by 2016 at the latest.

### 1.2 Approach

#### **Building on existing policy**

From the 1970's of the twentieth century onward many policies were initiated worldwide and on a European level, as well as on a national level to counter the pollution of the

oceans and the deterioration of the marine biodiversity, and to promote sustainable use of the seas. Milestones include the implementation of the OSPAR convention, the Biodiversity Convention, ASCOBANS, BHD, WFD, EU-Common Fisheries Policy (CFP), the legislation on shipping pollution within the framework of MARPOL and the integral national policy framework of the National Waterplan 2009-2015 (NWP), to name the most important ones. These policies have created a solid foundation on which the Marine Strategy can build.



**Figure 1:** Coverage of the Marine Strategy in the Dutch part of the North Sea.

The Dutch Marine Strategy determines to what extent existing and initiated policy within the context of the NWP and framed by EU legislation as the BHD, WFD, CFP and international conventions contributes to the MSFD challenge (see Figure 2). By doing so and supplementing policy, where required (“filling” the ‘holes’ and ‘question marks’ in figure 2), the Marine Strategy provides a complete overview of what needs to be done until 2020 to achieve good environmental status. In short, the Marine Strategy

complements existing and initiated policy as part of the integral North Sea policy of the NWP.

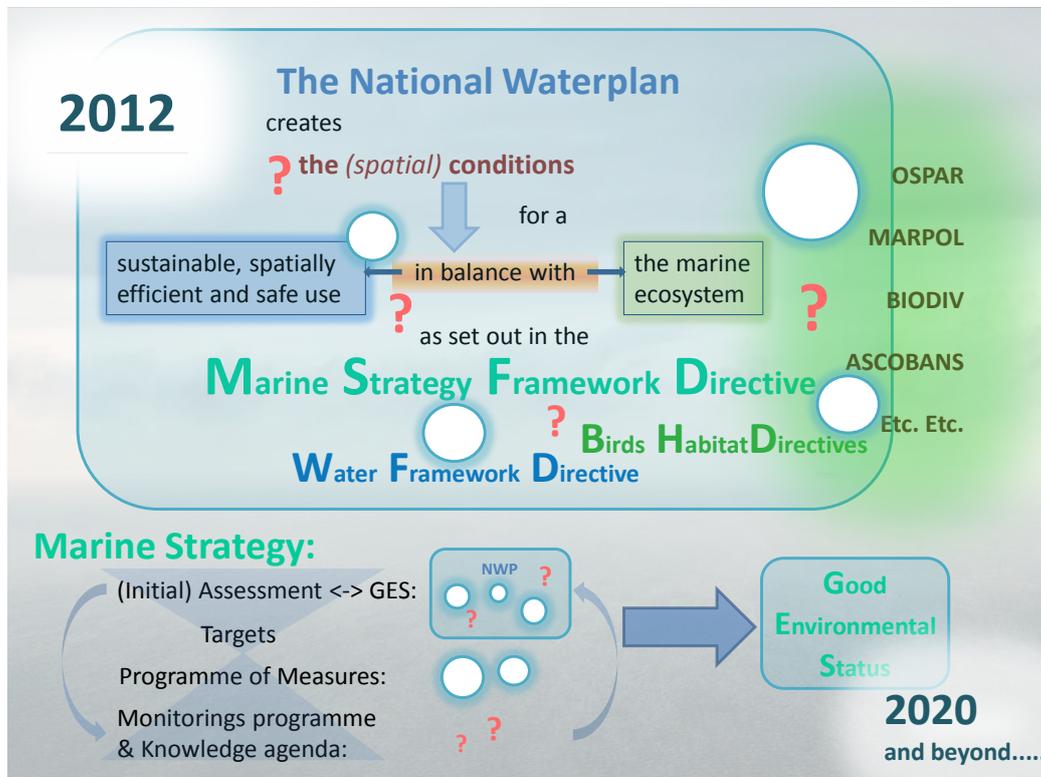


Figure 2: The Netherlands approach on the Marine Strategy.

### Common sense, pragmatism and realism

In implementing the MSFD, the Cabinet is taking a pragmatic, common-sense approach: do what is necessary and attainable. To achieve good environmental status, the Dutch Cabinet is taking a risk-based approach, tackling what are, according to the latest insights, the biggest risks for the environment and biodiversity in relation to achieving good environmental status in the period up to 2020. Realism prevails here. Adaptive management is expressed in the six-yearly update of the targets and measures based on an update of the initial assessment of the marine ecosystem (as required by the MSFD), which is, in turn, based on the information from the monitoring programme to be drafted, and on progressive knowledge on the effect of use, on pollution, on changing circumstances and on the effectiveness of measures for the ecosystem. This process is supported by the progressive exchange of experiences and insights by means of international multi- and bilateral alignment consultations. This adaptive approach does not rule out interim policy revisions.

It will not always be possible to achieve good environmental status as set out in the MSDF in every respect by 2020 using the measures that have been or are yet to be taken. This is because of the physical conditions of our marine waters, the inherently very limited controllability of the impact on the marine environment (including the climate) and dependence on other, international policy fields. Current knowledge may also be insufficient to properly determine the disturbances on the marine environment or the effect of policy. These circumstances have been taken into consideration when setting the goals for 2020, as well as when formulating the supplementary policy. If there is insufficient or incomplete proof of negative effects on the ecosystem, but there are reasonable grounds for concern, the Netherlands applies the precautionary principle.

## **2 Governance**

### **2.1 Stakeholder participation**

The Marine Strategy Part I came about in consultation with North Sea users and other stakeholders. Also the feedback from the public consultation will be taken into account.

#### **Stakeholders**

The stakeholders involved in the North Sea are officially represented a nation-wide consultative body of stakeholders called the *Overleg Infrastructuur en Milieu* (OIM, a consultative body attached to the Ministry of Infrastructure and the Environment). In 2010, within the OIM a core group was formed consisting of stakeholders who wanted to hone in on the details and discuss the establishment of the initial assessment, good environmental status, environmental targets and indicators. The stakeholders' core group represents all of the major North Sea sectors: fisheries, shipping, nature and the environment, hydraulic engineering, the offshore industry and leisure activities. The core group has met seven times between 2010 and 2012 to discuss the progress, products and key policy questions. This process was aimed at *joint fact-finding* during the formulation of the Deltares and IMARES scientific recommendations for the different components of the Marine Strategy Part I, and at proper coordination during formulation of the Cabinet's decision.

#### **Citizens**

The Kust & Zee association is a collaborative venture of the Dutch and Belgian members and member organisations of the European Coastal & Marine Union (EUCC). Kust & Zee is committed to a rich, healthy and attractive coast and sea for people and nature alike, where conservation, use, management and development go hand in hand.

On behalf of the Ministry of Infrastructure and the Environment, the association looks after the exhibition about the MSFD at the Scheveningen Pier.

TNS-NIPO conducted a survey on citizens' perception of the North Sea. The study *Beleving van de Noordzee* [Perception of the North Sea] surveyed 600 citizens, whose knowledge of and affinity with the North Sea were examined in a random sample. They were also presented with various environmental problems and asked to prioritise possible solutions and their consequences.

### **Public consultation**

From May 25<sup>th</sup> until July 5<sup>th</sup> 2012 inclusive, the Marine Strategy will be made available to the public for consultation for a period of six weeks. During this process, citizens and neighbouring countries have the opportunity to peruse the document and submit their opinion on the Marine Strategy, if they wish.

## **2.2 International coordination**

### **OSPAR**

Following acceptance of the Marine Strategy Framework Directive in 2008, the Netherlands took the initiative within OSPAR to raise the discussion on how the structure and working methods of the OSPAR Commission could be improved and adjusted. The aim was to be able to meet the Directive's requirement that Member States coordinate implementation within the relevant regional marine conventions and also collaborate with third countries on that. The OSPAR ministerial meeting of 2010 held in Bergen, Norway, concluded agreements on this, which has resulted in a regrouping of the theme committees and a new OSPAR Coordination Group. This Coordination Group supervises and heads the 'horizontal' subjects, such as collaboration on and harmonisation of implementation of the MSFD. The Netherlands advocated this and developed many initiatives, including some relating to the formulation of the OSPAR Quality Status Report 2010. In 2010 and 2011, the Netherlands organised workshops on coordination regarding litter at sea, and on biodiversity indicators and monitoring, which are subjects that are under a great deal of development. Previously – in 2009 – a workshop was held in the Netherlands on the ecosystem assessment of cumulative effects of human activities at sea.

### **EU**

Another process of relevance to international coordination is the establishment of the Common Implementation Strategy (CIS) of the European Commission and the Member States of the MSFD. This process is headed by the informal meeting of Marine Directors of the EU. The strategic marine coordination group and the working parties

that report to it ensure coordination between the 27 Member States of subjects relevant to the implementation of the Directive. Activities are primarily aimed at a common understanding of establishing good environmental status, the environmental targets and the reports to the European Commission, and at performing socio-economic analyses. Knowledge development and monitoring are other key subjects for future steps towards the implementation of the Directive. The Netherlands has been active in all these areas in the EU CIS groups, earmarking manpower and money for channelling policy developments on such subjects as underwater noise and litter. In addition, the EU takes formal decisions in the regulatory committee under Article 25, MSFD, in which the Netherlands, applying a risk-based approach, made a key contribution to detailing the concept of good environmental status.

### 3 Policy towards good environmental status

This section provides an oversight of the primary conclusions of The Marine Strategy Part I on the environmental status of the Dutch part of the North Sea up till 2020 and beyond, the targets to be reached and supplementary policy assignments to take on towards good environmental status. This broadly follows the sequence of the eleven descriptors set by Annex 1 of the MSFD.

• Marine Ecosystem	→	Supplementary policy assignment: yes; knowledge assignment: yes
• Non-indigenous species	→	No supplementary policy assignment
• Eutrophication	→	No supplementary policy assignment; knowledge assignment: yes
• Hydrographic characteristics	→	No supplementary policy assignment; knowledge assignment: yes
• (Chemical) Pollution	→	No supplementary policy assignment;
• (Chemical) pollution in fish products	→	No supplementary policy assignment
• Marine litter	→	Supplementary policy assignment: yes; knowledge assignment: yes
• Underwater noise	→	No supplementary policy assignment; knowledge assignment: yes

**Figure 3:** Overview of the needs for supplementary policy towards good environmental status (on top of current policies), and knowledge assignments.

### **3.1 Marine ecosystem**

#### **Assessment**

The effects of physical, chemical and biogenic disturbances in the past century have contributed to the current status of the marine ecosystem to differing degrees. For certain is that vulnerable benthic ecosystems in particular have been affected by physical damage to the seabed as a result of bottom-disturbing activities, including traditional beam trawling in particular. The balance in the diversity of the fish stock has also been affected. Populations of some vulnerable species have declined; a number of shark, skate and ray species in particular has suffered heavily. Fish species that migrate up river have become rare due to the barrier effect of dykes and coastal structures. Discarding by-catches is an enormous waste. While alternative, more environment-friendly fishing techniques are available, they are only allowed to a limited extent under the European Common Fisheries Policy (CFP). Non-indigenous species introduced by shipping or aquaculture affect the ecosystem.

The management plans being developed for Natura 2000 areas comprise such measures as fishing restrictions and mitigation of the barrier effect by engineering structures. These are intended to prevent an accumulation of disturbances in the coastal zone. Prevailing policy for non-indigenous species, pollution and eutrophication results in a dramatic decrease in the risks to the marine environment (see below). Consequently, improving the status of the marine ecosystem outside the protected areas will depend mainly on the ongoing sustainable exploitation of fisheries within the framework of revision of the CFP (expected term 2013-2022).

#### **Supplementary policy assignment(s) until 2020**

- As regards the revision of the CFP, the Cabinet is focusing mainly on the sustainable use and preservation of natural marine resources and ecosystems. This includes the reducing the impact of bottom trawling and preventing the by-catch of vulnerable species.
- In addition to the existing Natura 2000 areas, the Friese Front (Frisian Front) and Centrale Oestergronden (Central Oyster Grounds) are considered search areas for protective measures aimed at bottom trawling to be taken within the CFP framework. If necessary, other uses will also be explored.

The negotiations on the CFP revisions are ongoing. It is difficult to evaluate in advance to what extent the new CFP will contribute to the Netherlands' ambitions. Collaboration with other Member States is another key condition given the international dimensions of fisheries and the transboundary distribution of some fish stocks.

Given the current state of the marine ecosystem of the North Sea, it is hard to predict the rate of recovery as a reaction to current policy and supplementary policy assignments as described. The Cabinet's interim target for 2020 is to reverse the trend of degradation of the marine ecosystem due to damage to seabed habitat and biodiversity.

### **3.2 Non-indigenous species**

#### **Assessment**

Non-indigenous species also pose a threat to biodiversity in the Dutch part of the North Sea. The food supply of the common scoter, for example, has become more limited because its staple food, the bivalve *Spisula subtruncata* has been replaced by the Atlantic jackknife clam. The European flat oyster has been ousted by the Pacific oyster. Human intervention in these processes is virtually impossible. Prevailing policy is expected to dramatically decrease the risk of new introductions between 2020 and 2030. With respect to the introduction of non-indigenous species the status in 2020 can be defined as good environmental status.

#### **Supplementary policy assignment until 2020**

None.

### **3.3 Hydrographical conditions**

#### **Assessment**

Large-scale interventions in the past, such as the construction of the Delta Project and Maasvlakte 1, brought about hydrographical modifications that mainly affect the North Sea coastal ecosystem (including upstream fish migration). These interventions are of national importance and irreversible.

The scope of a number of activities that may affect hydrographical conditions has increased: sand extraction for coastal defences and filling sand, dredging waterways to seaports, construction of wind farms, sinking oil/gas pipelines and laying cables. The physical damage as a result of these activities is local. Where necessary, requirements stipulated for licensing based on environmental impact assessments provide for mitigating or compensatory measures. The conclusion is that maintaining the current policy is sufficient to safeguard good environmental status.

#### **Supplementary policy assignment until 2020**

None.

### **3.4 Pollution/eutrophication/contaminants in fish and other seafood products**

Until recently, pollution and eutrophication of the North Sea posed a threat to the marine ecosystem. The expectation is that the risk of harmful effects of eutrophication and contaminants on the ecosystem will be minor between 2020 and 2027. This is the result of past and prevailing policy (based on the Water Framework Directive, MARPOL, OSPAR and European legislation on food safety).

#### **Supplementary policy assignment until 2020**

None.

### **3.5 Litter**

#### **Assessment**

The expectation is that the quantity of litter from the key sources, i.e. shipping, fisheries, leisure activities and rivers, will not decrease in the coming years, despite prevailing and initiated policy. Although little is known about the environmental effects of microplastics in the sea, there are indications of potentially major risks for food webs. The target for 2020 is a decrease in the quantity of litter on the beach and a downward trend in the quantity of litter in marine organisms.

#### **Supplementary policy assignment until 2020**

The aim, at an international level, is to reduce litter and explore the presence and effects of marine litter, particularly microplastics. In terms of reducing litter, the Cabinet is focusing mainly on prevention. Possible tracks being explored are an integrated source approach, raising awareness, a more efficient use and reuse, and collection. The feasibility of removal is also being investigated.

Due to a lack of knowledge about the full scope and effects of litter on the ecosystem, it is not possible to make any predictions on the achievement of good environmental status.

### **3.6 Underwater noise**

#### **Assessment**

The underwater noise produced by shipping and other human activities has increased significantly since the mid-20th century. Due to lack of measurement data it is not known to what extent underwater noise poses a problem in the North Sea and what the possible cumulative effects are. The target for 2020 is to prevent adverse impact, at populations or ecosystem level, especially on marine fauna, resulting from specific,

isolated activities such as pile-driving and seismic surveys. Thereof as a precaution, the production of impulse noise from pile-driving for wind farms is regulated; where required, rules for other activities, such as the use of seismic for oil and gas exploration, will also be drawn up. Targets at an ecosystem level resulting from cumulation and background noise will be set in 2018, when more knowledge has been gathered.

### **Supplementary policy assignment until 2020**

None for the time being.

Due to a lack of knowledge about the effects of underwater noise on the ecosystem, good environmental status cannot be described exactly at this point in time. Aspects to be investigated are: determining the character of the sources of noise, noise levels (including temporal and spatial variations) and the nature of the main noise disruptions. The accumulation of the effects of different kinds of noise is also important.

## **4 Towards elaborating the Marine Strategy until 2020**

### **4.1 Indicators and monitoring programme**

The indicators for the MSFD monitoring programme to be completed by 2014 have been outlined in general in the Marine Strategy Part I. This is necessary to be able to assess during the six-yearly update of the Marine Strategy whether the environmental targets are being met and whether good environmental status will eventually be within reach or has been maintained. The monitoring programme is the basis for adaptive management.

Some existing indicators are being adjusted and new indicators may be developed. The Netherlands seek to monitor efficiently and at a reasonable cost, and to collect specific information to assess the effectiveness of the policy. Where possible, the MSFD monitoring programme uses parameters already measured (or to be measured) in relation to OSPAR, WFD, BHD or CFP level. Where possible, the monitoring programme will be developed together with neighbouring countries (synergy, coherence, cost effectiveness).

### **4.2 Programme of measures**

Through its commitment to supplementary policy assignments for fisheries, seafloor protection and litter, the Netherlands want to have reversed the downward trend in the marine ecosystem to one of recovery and to reduce the amount of litter in the marine environment by 2020. A decision on measures to be implemented will be taken by

2015 at the latest, in the successor to the National Water Plan (NWP). Where possible, measures may be implemented earlier.

The three spearheads of the Marine Strategy will be detailed in the context of the 'green growth' concept. The strategy is aimed mainly at seizing opportunities for sustainable development and innovation, and strengthening ecology and economy together with the stakeholders at sea. This is preferable to excluding and regulating.

#### **4.5 The next MSFD cycle**

The Directive decides that the Marine Strategy be updated every six years, for the first time in the 2018-2021 period. The initial assessment will be updated in 2017-2018 and, where necessary, the descriptions of good environmental status, environmental targets and indicators adjusted. This will be followed in 2020 and 2021 by the second monitoring programme and the second programme of measures, respectively. In this way, policy can be reconciled with the latest insights into the ecosystem and into the effectiveness of policy, and with international developments, thereby fleshing out the adaptive management approach prescribed in the Directive.

## **5 References**

Ministry of Infrastructure and the Environment, Marine Strategy for the Dutch part of the North Sea 2012-2020 Part I (The Hague, November 2012)

## **Economic Aspects of the MSFD: Why and how to estimate the Benefits of Measures?**

EDUARD INTERWIES AND STEFAN GÖRLITZ

InterSus - Sustainability Services, Germany

### **Abstract**

In June 2008, the Marine Strategy Framework Directive (2008/56/EC - MSFD) of the European Parliament and European Council was published. This Directive obliges the Member States to achieve or maintain “Good Environmental Status” (GES) in their marine environments by the year 2020 at the latest. It establishes a framework for community action in the field of marine environmental policy, expanding the EU Water Policy to encompass all European waters. At the same time, the MSFD represents the environmental pillar of the integrated EU maritime policy.

For the purpose of achieving or maintaining GES, marine strategies containing programs of measures shall be developed and implemented in order to protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected. Prior to implementing such measures, however, the MSFD requires the Member States to conduct Impact Assessments, including economic assessments of the planned measures, namely Cost-Benefit-Analyses (CBA). Such economic assessments (beside CBA also cost-effectiveness analyses/CEA) have to be conducted also in the context of the Water Framework Directive (WFD), and pose a significant challenge to Member States’ administrative bodies. In this context, the estimation of the economic benefits of environmental protection measures - to be included into cost-benefit assessments - is especially challenging.

Theoretical concepts for conducting such economic estimations exist in abundance, the lack of quantifiable data, however, results in the need of combining quantitative and qualitative information (e.g. through multi-criteria analysis/MCA). To give more political weight to economic estimations of environmental benefits, further development of methodologies and a reliable data base are necessary.

The German Federal Environment Agency’s research project “*Methodological basis for socio-economic analyses and assessment of the impact of measures including cost-benefit analysis in accordance with European Marine Strategy Framework Directive*”, lead by InterSus - Sustainability Services, aims at closing parts of the “methodology gap”, through developing a methodological basis and a “Practitioner’s Guidebook” for

the evaluation of benefits of marine protection measures. The present article is based partly on the work conducted within this project.

## 1 Background

The economic evaluation or "monetization" of benefits of measures is not directly mentioned in the MSFD. However, in Article 13 (3), the Directive states that "*...Member States shall ensure that measures are cost-effective and technically feasible, and shall carry out impact assessments, including cost-benefit analyses, prior to the introduction of any new measure.*"

The term "cost-benefit analysis" (CBA) encompasses various forms of assessments of both the costs and benefits of projects or measures, ranging from the purely quantitative analyses of "classic" CBA (Interwies/Cools 2010) - widely used, for example, in the planning process of big infrastructure projects (e.g. the deepening of the riverbed of the Elbe), where the costs of planned measures are compared to the expected benefits in terms of increased economic activity, e.g. the increase in goods shipped on a dredged watercourse - to semi-quantitative or even qualitative assessments such as the multi-criteria analysis (MCA), which describes a "*wide range of techniques that share the aim of combining a range of positive and negative impacts [of measures/projects] into a single framework to allow easier comparison*" (EC, 2009).

The benefits of marine protection measures, and hence the assessment thereof, does not fall under the first, easily identified category of benefits. Instead of direct increased economic output, such measures usually create benefits that are more difficult to grasp and to assess, namely "environmental benefits" that result from an increased quality of the ecosystem(s) at hand (EC, 2010). These may consist of the economic benefits of an increased attractiveness of landscapes for leisure and tourism activities (increasing tourism revenues), reduced costs resulting from naturally cleaned water (reducing the need for technological water purification) or a lesser degree of disturbances (e.g. reduces cost for cleaning beaches). But these benefits may also consist of even more difficult-to-grasp benefits such as increased biodiversity and the value of the future usage of the ecosystem (option values).

Or, differently put, the "environmental benefits" of protection measures consist of the "profits" derived from an increase in "*environmental goods and services*" (EGS) provision (MEA, 2005; MEA, 2011). A range of possible EGS and resulting benefits is pictured in figure 1, by the example of a wetland's EGS:

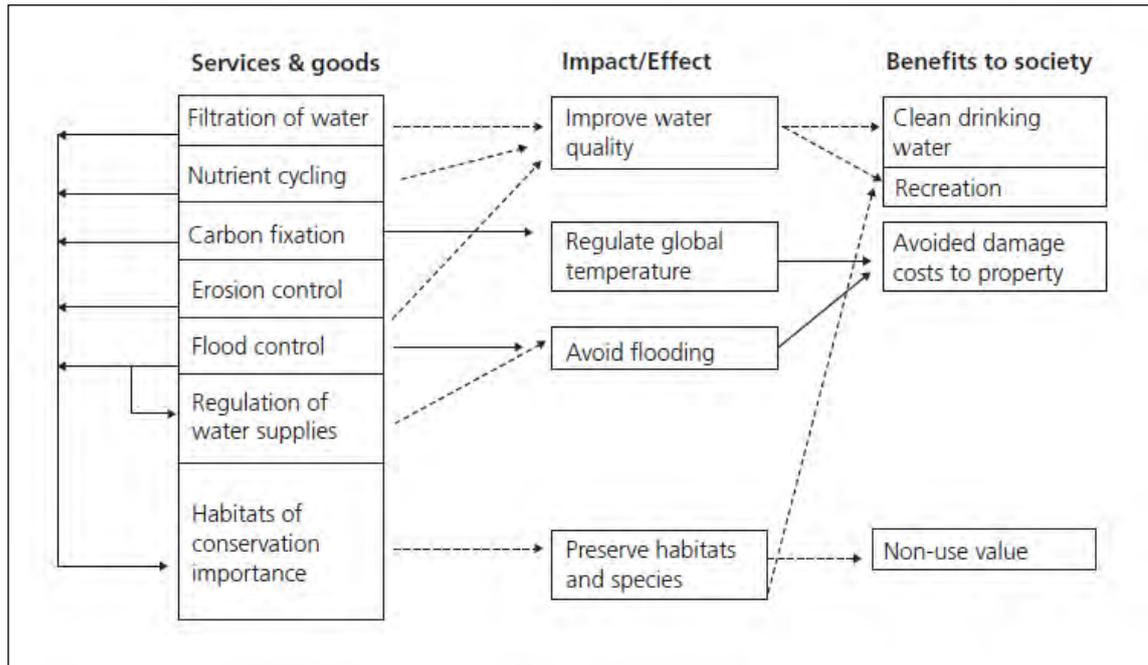


Figure 1: A wetland's EGS and associated benefits (DEFRA 2007).

## 2 Why and how to evaluate such "environmental benefits"?

The basic idea behind evaluating - or "monetizing" - environmental benefits, or EGS, is to support decision makers in choosing between various alternatives to reach policy targets (which is exactly the case in Article 13 MSFD). Including monetary values of environmental benefits should ideally strengthen the case for environmental improvements, and convince stakeholders to support measures that do not have direct, easily accountable positive economic consequences. Thus, the evaluation of EGS can be regarded similarly as a tool for better communicating the significance of measures and projects that benefit the environment in the first place (and the general populace and profiting economic sectors in the second place) (FISHER et al., 2008).

The basic difficulty in evaluating and monetizing these benefits lies within their very nature: as they are not "traded on markets" - meaning that there is usually no "buyer" and "seller" of e.g. an increased attractiveness of a landscape, only users - and therefore lack a price that could be used as a default value, as is the case with the dredging of a river and resulting increase in shipped goods.

Therefore, a variety of alternative methods to put a value onto such benefits exists, of which the mostly used comprise of the following (according to DEFRA, 2007 and INTERWIES/COOLS, 2010):

*Pricing approaches* aim at capturing the monetary value of a certain environmental benefit by analyzing market prices "either as direct measures of economic value of an

*ecosystem service or as a proxy for the value*" (DEFRA, 2007). In the first category fall assessments of market prices for certain goods provided by ecosystems (fuel, timber, food), or the damage costs avoided by a reduced disturbance to ecosystems (e.g. less damage to ship's propellers through a reduction in marine litter). The second category is also referred to as "cost-based approaches", which consider the costs that arise in relation to the provision of EGS, including assessing the "opportunity costs" (i.e. foregone opportunities) and replacement costs (e.g. wetlands which provide flood protection may be valued on the basis of the cost of man-made flood defenses of equal effectiveness).

*Revealed and stated preference methods*, alternatively, attempt to determine the preference of the public for environmental improvements (or the degree of acceptance of a deterioration) in monetary terms. Of these methodologies, contingent valuation (CV) studies to elicit the people's willingness-to-pay (WTP) have been widely applied. In such surveys, people are actually asked what they would be willing to pay (on a weekly/monthly/yearly basis, or as a single payment) for the ecosystem improvement at hand.

All of these evaluation methods have inherent methodological and other problems, rendering their proper interpretation and usage difficult. Often, these problems are caused by a lack of the basic understanding of the relation between the improvement of the ecosystem's quality, the change in EGS provision related to this improvement, and the resulting change in associated benefits (e.g. how much does the provision of fish increase by ecological quality improvements of the species' nursing habitats?). Other major problems and difficulties with such economic evaluation studies include:

- Lack of proper information: often, the necessary information to apply the study's results to other ecosystems or regions are lacking. Such necessary information includes a quantitative description of the ecosystem's improvement, e.g. in terms of a reduction of nutrient input, or of a certain amount of reduced litter.
- Also, study's results tend to be applicable only in the often very localized context of the survey, further hindering its usage in another context.
- Stated preference studies, additionally, are based on the assumption that the stated preference (e.g. the WTP) equals the "revealed preference", meaning such studies basically assume that people would in reality be willing to actually pay the amount stated in the survey, which is to be doubted.
- Last not least, all stated and revealed preference study's outcomes are very much depending on the design of the survey and the interpretation of the results, leading to occasionally very high variabilities (of several orders of magnitude). Closely related to

the design of the surveys are further problems such as the so-called embedding effect (describing the notion that people are likely to state varying WTP for individual measures/projects and a "bundle" of the same measures, or WTP not factually related to the actual "amount" of ecological improvement).

Summing up, the significant methodological problems associated with economic evaluation methodologies, especially with stated preference methods, cause major uncertainties in using and applying many of the results. This is of special relevance in the context of decision making, such as choosing measures to reach GES in the context of Article 13 MSFD (see below).

### **3 Benefit evaluation in Germany and current research**

In contrast to other countries, especially the UK and U.S., where economic evaluations have a longer tradition of being used, there is little experience in Germany regarding the inclusion of EGS into political and administrative decision making, and the economic evaluation of environmental benefits is not yet established as a decision support tool. The research project "*Methodological basis for socio-economic analyses and assessment of the impact of measures including cost-benefit analysis in accordance with the MSFD*", funded by the German Federal Environment Agency (UBA), is aiming at filling a part of this "methodology gap", through the development of a methodological framework to benefit evaluation in the context of the MSFD, and the creation of a "Practitioner's Guidebook" to assist decision makers facing the provisions of Article 13 to navigate through the difficulties of evaluating the benefits of marine protection measures<sup>61</sup>.

### **4 Near Future: Development of a "Practitioner's Guidebook"**

Prior to the development of the Practitioner's Guidebook, the methodological framework has been applied in two case studies, to test it and to be able to draw conclusions regarding the framework's practicability, understandability and acceptability by the "target group" (i.e. the authorities responsible for or involved in selecting measures). The case studies' topics were chosen according to the "Pressures and Impacts" of Annex III, Table 2 MSFD, and have been "Marine Litter in the North Sea" and "Eutrophication of the Baltic Sea".

Especially through the first case study, important lessons for the Practitioner's Guidebook could be learned.

---

The "Practitioner's Guidebook" and other project reports will be available via the UBA website at the end of 2012. Alternatively, contact the authors for further information: [goerlitz@intersus.eu](mailto:goerlitz@intersus.eu).

First of all, it was concluded that the methodological framework as developed was not entirely suitable for being transferred directly to the Practitioner's Guidebook, as high necessary amount of work combined with very significant uncertainties led to low practicability and acceptability. Additionally, the test results obtained by including stated preference evaluation studies into the assessment were by three orders of magnitude higher than without the stated preference studies (i.e. one thousand times higher).

The high amount of work was mainly caused by the very nature of the data needed for performing economic evaluations, especially during the step of the procedure in which the results of evaluation studies had to be transferred to the German North Sea. This data - information about the benefitting sectors or groups, for example - was not available at the scale necessary for such transfers, and therefore needed to be created by assumptions to fill data gaps.

The high uncertainties involved in the procedure were not due to an individual step of the procedure. Instead, during most of the procedural steps, some assumptions had to be made to fill ever-present data gaps that, combined with the inherent uncertainties of the evaluation studies (see above), in the end amounted to a level of uncertainty that rendered the results of the assessment highly insecure and not directly usable in a decision-making context at this stage.

It was concluded, therefore, that with the presently available data, purely quantitative analyses are not suitable for supporting decision making.

Hence, the Practitioner's Guidebook incorporates the following recommendations:

- Not to use stated preference methods in such economic assessments, if it can be avoided. If such studies should nevertheless be used, it is strongly recommended to only use customized studies performed in the German context (such as MEYERHOFF/ANGELI, 2011).
- Instead, to rely more on price- and cost based approaches, which have much more political weight<sup>1</sup> (especially reduced damage costs).
- In case of values that cannot be monetized through price- or cost based approaches, and for which no customized German evaluation study exists, not to aim at quantifying these values, but to describe them qualitatively. It is hoped that these recommendations - and the procedure for benefit evaluation outlined in the Practitioner's Guidebook - will be of assistance to decision makers facing the difficulties of evaluating environmental benefits of marine protection measures.

---

<sup>1</sup> In some cases methodological difficulties evolve when incorporating cost-based benefit information into cost-benefit analyses; for more details, see DEFRA, 2007.

## 5 Conclusion

The present article aimed at illustrating the chances and challenges that are incorporated in the provisions of Article 13 MSFD. The obligation to perform cost-benefit analyses, and therefore to include environmental benefits into the process of measure selection, can strengthen the role of marine protection measures that otherwise may have been deemed overly expensive or not feasible. However, in the course of the UBA research project "*Methodological basis for socio-economic analyses and assessment of the impact of measures including cost-benefit analysis in accordance with the MSFD*", it has been concluded that trying to "monetize everything" is not to be recommended in the context of supporting decision makers. The high uncertainties that surround certain evaluation techniques, and the insufficient data situation, render many results too insecure to still be used in the context of Article 13 MSFD. Nevertheless, the knowledge gained in this way clearly aids in formulating a usable Practitioner's Guidebook that supports a semi-quantitative approach to evaluating benefits, and is thusly more suitable for application in the context of MSFD implementation<sup>2</sup>.

## 6 References

DEFRA (ed.) (2007): An introductory guide to valuing ecosystem services. Department for Environment, Food and Rural Affairs, London. Online available: <http://archive.defra.gov.uk/environment/policy/natural-environ/documents/eco-valuing.pdf>.

EC (European Commission) (2009): Impact Assessment Guidelines. Online available: [http://ec.europa.eu/governance/impact/commission\\_guidelines/commission\\_guidelines\\_en.htm](http://ec.europa.eu/governance/impact/commission_guidelines/commission_guidelines_en.htm).

EC (European Commission) (2010): Scoping study on the requirements for economic assessment in the Marine Strategy Framework Directive - Final report.

Fisher, B., Turner, K., Zylstra, M., Brouwer, R., De Groot, R., Farber, S., Ferraro, P., Rhys, G., Hadley, D., Harlow, J., Jefferiss, P., Kirkby, C., Morling, P., Mowatt, S., Naidoo, R., Paavola, J., Strassburg, B., Balmford, A. (2008): Ecosystem Services and Economic Theory: Integration for Policy-Relevant Research. In: *Ecological Applications*, 18(8), 2008, 2050–2067 pp.

Interwies, E., Cools, J. (2010): Practical methods for the valuation of wetlands for the non-EU sites & possible MCA-methodology for identifying the "best compromise" solution for wetland management. International report of the WETwin project.

---

<sup>2</sup> The project's results will be online in Autumn 2012 at <http://www.umweltbundesamt.de/wasser/themen/meere/aktuelles.htm>. (PS: wissen wir von Rechi, dass es unter dieser Adress sein wird? Falls nicht, dann lieber nur [www.umweltbundesamt.de](http://www.umweltbundesamt.de))

MEA (2005): Ecosystems and Human Well-Being: Wetlands and Water – A Synthesis. World Resources Institute, Washington, DC, USA. Online available: <http://www.maweb.org/documents/document.358.aspx.pdf>.

MEA (2011): Overview of the Millennium Ecosystem Assessment. What is the Millennium Ecosystem Assessment? Online available: <http://www.maweb.org/en/About.aspx>.

Meyerhoff, J., Angeli, D. (2011): Ermittlung der Zahlungsbereitschaft in Deutschland für Maßnahmen zur Reduzierung der Eutrophierung in der Ostsee (BalticSTERN/Sun).

## **Protection of Marine Endangered Species**

---



## Restoration of Oysters: a Missing Habitat.

JANET H BROWN<sup>1</sup> AND ELIZABETH C ASHTON<sup>2</sup>

<sup>1</sup>The Shellfish Team, United Kingdom

<sup>2</sup>Queen's University Marine Laboratory, United Kingdom

### 1 History

The native oyster, *Ostrea edulis*, has seen a substantial change in its population and fortunes in the past 200 years from food of the poor, as chronicled in Charles Dicken's *Pickwick Papers*, to a food more associated with expensive restaurants. It has always however been a highly valued food even since Roman times. These changes reflect the variations in its abundance but also mask what could be far more serious changes in the European marine habitat that urgently require addressing. The need for restoration of the native oyster as habitat provider is arguably of far greater consequence than any re-establishment of its fishery. The benefits in terms of biodiversity and the value of the ecosystems services such restoration could provide could well repay any investment in such initiatives.

Evidence of the historic harvesting pressures and the resulting changes in abundance of the native oyster are not difficult to collect. Wolff (2005) quotes figures of 145 boats fishing for oysters in 1765 in the Dutch Wadden Sea and says that to be profitable each vessel needed to harvest 100,000 oysters per annum. On the Firth of Forth, Scotland, an area of 1528 km<sup>2</sup>, the highest annual catch recorded was 31million oysters in the late 18th century and again in the mid-19th century but there was also high demand for seed oysters and illegal trading so figures are likely to be conservative (FULTON 1896). In both these areas the native oyster has been considered extinct until very recent finds in the Firth of Forth (ASHTON, 2010).

The dramatic losses in yields in the 1870s in the UK led to the first introductions attempting to restore populations; of native *O. edulis* from Holland and France and even introductions of *Crassostrea virginica* from the USA (UTTING et al., 1992). This was the start of the associated introductions of disease and pests that have adversely affected populations of native oyster ever since. While there was clearly heavy harvest pressure for marketable oysters there was also a large practice already established in transferring spat from one site to another for on-growing. The Firth of Forth oysters were extensively moved to other on-growing sites. Attempts at control of this trade were made at various times between the 1660s and 1814 by the City of Edinburgh (FULTON, 1896).

This transfer of the spat to "beds" was widely practised and was known to have an effect on the performance of oysters. Step (1901) says "Left on their natural banks Oysters are full grown in about four years, but when dredged and laid down in their culture beds they take several years longer."

The effect of these movements arguably had a greater impact other than simply reducing yields of native oysters. The native oyster when it breeds incubates the fertilised ova internally. Fertilisation itself is also internal so there is a greater need for adults to be close enough to each other to allow this to take place. Under natural growing conditions this closeness is ensured by a preference for its young to settle on adults of the same species. In experimental trials Kennedy (1999) demonstrated that the spat would settle in preference on live shells, then dead shells and then anything else. In a closely related species, *Ostrea puelchana*, this preference has been shown to be chemically mediated (PASCUAL et al., 1995). There is also supporting evidence from historic papers. Korringa (1946) alludes to the fact that the best settlement site for oyster spat is the new growth of adult oysters, often being the only clean surface available - "this is the reason why oysters are so often found in clusters on the natural beds instead of singly". While this specific preference for new growth or even for a clean surface is discounted by Waugh (1972) he does report significantly greater settlement on live shellfish than on cultch (dead shells) provided for settlement. Once oysters settle and cement themselves in place they never move again – unless moved by man.

### **History interacting with biology**

This behavioural preference of the spat would ensure settlement on live oysters and would mean over time that *O. edulis* would form reefs or at least conglomerations of shells forming a stable structure that could ensure suitable breeding distance. Did this behaviour confer other benefits to the oysters themselves? It could provide protection from predators perhaps and it could also have other defence benefits? The question has already been raised that the practice of separating stocks of oysters for their eventual harvest could be selecting against disease resistance by selecting animals for breeding not adapted to living in high densities such as they would find living in reef conditions (ASKEW, 2005). Is it too far-fetched to suggest disease problems became greater once reef structures were totally absent? The long established practice of moving spat to beds, or of managing oyster beds for marketing where oysters are routinely separated when found attached to each other (HUGH JONES, 2011) mitigates against reef creation and formation of a stable structure. Similarly the long established practice of bringing in part grown oysters to on-growing sites means not only are there no stable structures formed but the oysters so introduced can equally well be harvested up, sometimes in an "unregulated manner" (SMYTH et al., 2009).

Oysters are thus programmed to form reefs and historically these reefs must have covered large areas but because of practice of both fishery management and restoration over the past 150 years – any introduced oysters (i.e. oysters moved to an on-growing site) will not form new attachments; hence can easily be collected out – either for official marketing or “unregulated harvesting” to the extent that the concept of oyster reefs is simply not recognised amongst some scientists.

The evidence for reefs of *O. edulis* is sparse. In recent years large reefs have been reported from the Black Sea (TODOROVA et al., 2009) –“massive reefs of up to 7m in height, 30m in length and 10m in width extended from 7 to 23m depth” but with no live oysters still present. For more evidence we need to go back to historic times. The map provided in the Piscatorial Atlas of the North Sea, English and St George’s Channels of 1883 highlights an area 24,000km<sup>2</sup> as “oysters”. Roberts (2007), referring to this map, in his book “the Unnatural History of the Sea” describes: “these oyster grounds consisted of reefs built of oysters, knitted and interlaced with countless other invertebrates. The bottom of the North Sea was hardened by a living crust, something that many scientists today find hard to believe” From this map of the historical extent of oysters around the coast it is clear to see that the losses have been enormous.

The major changes in the oyster populations around the British Isles seem to have come about between roughly 1850 and 1870. Utting et al. (1992) suggest that the expansion of the railway network in the mid-19th century led to a great increase in exploitation of the beds in the Thames estuary and report that nearly 30,000 tons were sold in Billingsgate market in 1864 (YONGE, 1960). It is likely however that this increase is actually more complex and follows from the discovery in the early 1850s of deep beds of oysters in the English Channel along with the general relaxation of control on trawling following “The Report of the Royal Commission on Sea Fisheries” of 1866.

Reading the description of the exploitation of the deep channel beds can make one wish to turn back time. To give one brief example;-The Report of the Royal Commission on Sea Fisheries talks about the provision of “close time”, the control of any movement of oysters within 3 miles of the shore between May 1<sup>st</sup> and September 1<sup>st</sup>, and they report complaints about the ill effects of discontinuing dredging at this time on the inshore oyster beds. But coincidentally, it was at this time that the deep beds in the English Channel at 15 to 24 fathoms in depth (27-44m) were first being exploited – the oysters from these beds were described as large and coarse. (The Report of the Royal Commission on Sea Fisheries 1866 p lxxxvii). (It is also likely that it was the discovery of these “deep beds” that reduced the price of oysters so dramatically that they were the food of the poor at this time. As many as 300 vessels of 25 t were working the deep water “reefs” at the time of the Commission (NEILD, 1995).) Fishermen argued to be allowed to dredge these deep Channel oysters in the close

season to take to their inshore beds. But to what extent might these deep “reef” oysters have been supplying the spat for the inshore oysters? This questioning view is supported by Berghahn et al. (2005) arguing against “no take” zones as a solution to restoration in the Wadden Sea. They make a valuable point when suggesting the populations of oysters could have relied more on chance settlements from spawning of the North Sea stocks. They also make a particularly interesting point that, once established, a spawning stock of the European oyster can tolerate long periods of recruitment failure, since an oyster’s lifespan is 20 to 30 years (MUUS et al., 1973).

## **2 Benefits of oyster reefs**

The really important question is to what extent has the loss of the habitat provided by the oyster reefs been felt in the European marine environment. The effect of the loss of this major habitat cannot be known but indications can be deduced from elsewhere. There has been considerable investment in oyster restoration in the USA and it was the gap between the European and American experience that was the motivating force for the organisation of the International Conference for Shellfish Restoration (ICSR) conference in Stirling, Scotland in 2011 ([www.aqua.stir.ac.uk/shellfish2011/](http://www.aqua.stir.ac.uk/shellfish2011/)).

Not all the investment has been effective but there is a huge amount we can learn from the USA experience. Their research has provided information on how restoration of reefs can have dramatic impacts on increasing total macrofauna (RODNEY et al., 2006), fish populations (KINGSLEY-SMITH et al., 2011), affecting the nitrogen cycling (KELLOGG et al., 2011), and providing effective shoreline defences (SCYPHERS, 2011), but furthermore they have learnt a great deal about the reefs themselves. Reef height, size and complexity have all been shown to affect development (LENIHAN et al., 1998, 1999). Interstitial space on the reefs can affect early spat survival (BARTOL et al., 1999) and the reef patch size can affect both the oyster populations and reef communities (LUCKENBACH et al., 2005). Where the oysters themselves are situated on a reef can affect their growth, survival and disease status (POWERS et al., 2009). The summary of what can be learnt from the USA oyster restoration work was presented at ICSR 2011 (LUCKENBACH, 2011). In addition to the information given above this presentation stressed that restoration now concentrated more on restoration for ecological services and ecosystem services rather than just fisheries. He also stressed that “monitoring has rarely been designed as part of the restoration programme in a manner that can teach us how to do restoration better or apply effective adaptive management” The effectiveness of work on the restoration of oyster populations in Maryland and Virginia has recently been reviewed by Kennedy et al. (2011). The focus on restoration in the USA has come to be more that highly degraded habitats cannot be fully restored but the need is to identify specific ecological services that can be rehabilitated or

enhanced. There is however one crucial difference when comparing activities on the eastern seaboard of the USA and potential restoration activity in Europe. Their native species is *C. virginica* which has a more inter-tidal habit than *O. edulis* which prefers deeper waters. The other and more important point is that *C. virginica* is their main aquaculture species. In Europe for the most part, the main aquaculture species is *C. gigas* while the native species is *O. edulis*. Some of the ecological functions can be provided by *C. gigas* by virtue of its mode of life but its manner of building reefs and even its preference for the intertidal suggest it would not be so hospitable to the native fauna and flora. This also means that Europe cannot rely on oyster aquaculture for natural re-establishment of the native oyster population but must take special measures.

Oyster restoration in Europe has a long history which has for the most part been private and aimed at restoring a local fishery. Many of these are reported in LOW (2006). Some restoration appears to have been fortuitous – commercial stocks of *O. edulis* left in Strangford Lough over one summer resulted in greatly enhanced recruitment which may also have been associated with lack of fishing pressure (KENNEDY et al., 2006). More formal attempts at restoration have often resulted in increased "unregulated collection" (SMYTH et al., 2009). The ecosystem services (the outputs of ecosystems from which people derive benefits) provided by oyster reefs have been studied in the USA, and these include, besides the obvious one of food provision, services in regulation (erosion protection, bioremediation) as detailed above, cultural and supporting (AUSTEN, 2011). Many of these services can also be provided by shellfish aquaculture. There is no reason to doubt that such services would be equally well supplied by native oyster reefs but with two important additions. The fact that they could additionally be a tourist attraction can be shown by evidence of the reef discovered in the Black Sea (TODOROVA et al., 2009) but if the evidence from just one mini reef is anything to go by the benefits in terms of biodiversity could be considerable (Figure 1).



**Figure 1:** Biota associated with "mini-reef" found on West coast of Scotland.

Such findings could indicate that a major beneficiary of native oyster restoration could be shellfisheries. Research on restocking of lobster, *Homarus gammarus*, carried out at laboratories in Conwy and Lowestoft, UK found that survival for postlarvae depended particularly on the habitat where they were released – it needed to be made up of small stone and cobble to provide hiding places (HOWARD, 1988). This is just such an environment that oyster reefs would have provided in the past, a hard stable substrate with many potential hiding places. Contributions of the native oyster to biodiversity as well as its biogenic engineering qualities have been documented in Strangford Lough (SMYTH et al., 2010). The value of biogenic reefs in recovery of oyster populations has been demonstrated in New Zealand where presence of other shellfish aided recovery of the native oyster population (CRANFIELD et al., 2004), which argues that fisheries cannot be managed sustainably without conservation of habitat on the scale of the fishery. In many parts of Europe those original native oysters have been completely lost so more radical approaches will be required. As Berghahn et al. (2005) pointed out, no-take zones would not necessarily allow re-establishment of missing species and habitats if there was no means for their re-establishment and this particularly applies to the native oyster. Restoration of native oyster reefs does however need researching and another important question to ask is whether the existence of native oyster within a reef community confers any benefit to the species itself. Closeness for breeding is one such benefit since the presence of a small population of adults in close proximity (80m<sup>-2</sup>) one summer in Strangford Lough was shown to benefit recruitment very substantially (KENNEDY et al., 2006). If movement affected their growth (STEP, 1901) could there not be other benefits in reef dwelling in terms of disease and parasite resistance as might be indicated from the research in the USA (e.g. POWERS et al., 2009). A consortium of researchers from the University of Stirling, Queen's University Belfast and the Universities of Southampton and Bangor prepared a proposal to investigate precisely this but was unfortunately not funded. A small part of the proposed work is currently being undertaken at Southampton University using artificial reefs with populations of native oysters attached to compare how the oysters in a reef compare with singleton oysters. Parameters to be investigated include oyster growth and physiological performance, gonadal development and haemolymph vitellogenin, larval recruitment to the water column and settlement, and epibiotic abundance and biodiversity associated with communal versus singleton oysters. The original proposal included work on the effects of reef situation on immunity and genetic expression but this work can no longer be covered by the funding available. This work could be usefully expanded to make a European wide project if preliminary results prove encouraging. Such research will be costly and especially so since when carrying out any restoration work it is extremely important for adequate pre- and post-restoration monitoring to be carried out as has been highlighted from the USA experience (LUCKENBACH, 2011). When compared however to the potential value of the ecosystems services that could accrue from successful restoration these research costs might turn out to be negligible. Estimates

have been made for the value of marine biodiversity in the United Kingdom as a whole (BEAUMONT et al., 2008) which would certainly support this view. Attempting to put values on the shellfish contribution to this is difficult except in terms of the provisioning value. Preliminary work from Austen 2011 who collated some relevant data on this suggests that this in itself is an area which needs more examination. The importance of biogenic reefs is undoubtedly widely understood. The particular value of oyster reefs and the degree to which they have been lost worldwide have been highlighted (BECK et al., 2011). What we are not appreciating fully in Europe is the extent to which we have lost a major ecosystem engineer and that some radical measures are needed to restore the species, the habitat and the ecosystem services it can provide. Discussion of Marine Protected Areas for increasing biodiversity is of little value if a keystone species is missing from the habitat.

### 3 References

Ashton, E.C. (2010): The native oyster rediscovered in the Firth of Forth. BRISC Recorder News 76: 1-3.

Askew, C. (2005): A Hypothesis for Long Term Population Cycles in the Flat Oyster *Ostrea edulis* and Consequences for Stock Restoration Efforts Paper given at 8th ICSR Conference Brest, France, October 2 – 5, 2005

Bartol, I K., Mann, R., Luckenbach, M. (1999): Growth and mortality of oysters (*Crassostrea virginica*) on constructed intertidal reefs: effects of tidal height and substrate level. Journal of Experimental Marine Biology and Ecology. 237: 157-184

Beaumont, N.J., Austen, M.C, Mangi, S.C., Townsend, M. (2008): Economic valuation for the conservation of marine biodiversity. Marine Pollution Bulletin 56: 386–396

Beck, M.W., Brumbaugh, R.D., Airoidi, L., Carranza, A., Coen, L.D., Crawford, C., Defeo, O., Edgar, G.J., Hancock, B., Kay, M.C., Lenihan, H.S., Luckenbach, M.W., Toropova, C.L., Zhang, G., Guo, X. (2011): Oyster reefs at risk and recommendations for conservation, restoration and management. Bioscience 61(2): 107-116.

Berghahn, R., Ruth, M. (2005): The disappearance of oysters from the Wadden Sea: a cautionary tale for no-take zones. Aquatic Conservation: Marine and Freshwater Ecosystems, 15: 91–104

Cranfield, H.J., Rowden, A.A., Smith, D.J., Gordon, D.P., Michael, K.P. (2004): Macrofaunal assemblages of benthic habitat of different complexity and the proposition of a model of biogenic reef habitat regeneration in Foveaux Strait, New Zealand. Journal of Sea Research. 52. 109-125

Dickens, C. (1836): The Posthumous Papers of the Pickwick Club (chapter 22).

- Fulton, T.W. (1896): The past and present condition of the oyster beds in the Firth of Forth. Rep. Fish. Bd. Scot. (III) 14, 244-293 pp.
- Howard, A.E. (1988): Lobster behaviour, population structure and enhancement. Symposium of the Zoological Society of London. 59: 355-364.
- Hugh-Jones, T. (2011): Loch Ryan native oyster beds Our Undervalued resource? Available electronically at [www.aqua.stir.ac.uk/shellfish2011/presentations](http://www.aqua.stir.ac.uk/shellfish2011/presentations) (accessed May 30th, 2012).
- Kellogg, M.L. (2011): Bivalve restoration and aquaculture: The role of associated organisms in enhancing ecosystem services. Available electronically at <http://www.aqua.stir.ac.uk/shellfish2011/presentations> (accessed April 30th 2012).
- Kennedy, R.J. (1999): Aspects of flat oyster (*Ostrea edulis*) biology with a view to the restoration of the native oyster beds in Strangford Lough. PhD Thesis Queens University Belfast.
- Kennedy, R.J., Roberts, D. (2006): Commercial oyster stocks as a potential source of larvae in the regeneration of *Ostrea edulis* in Strangford Lough, Northern Ireland. Journal Marine biology Association of the UK 86: 153-159.
- Kingsley-Smith, P.R., Joyce, R., Arnott, S.A., Roumillat, W.A., Reichert, M.J.M. (2011): The role of oyster reefs in the provision of habitat for diverse assemblages of nektonic organisms with varied life history strategies. Available electronically at <http://www.aqua.stir.ac.uk/shellfish2011/presentations> (accessed 30 May, 2012).
- Korringa, P. (1946): A revival of natural oyster beds? Nature 158: 586-587
- Lenihan, H.S., Peterson, C.H. (1998): How Habitat Degradation through Fishery Disturbance Enhances Impacts of Hypoxia on Oyster Reefs. Ecological Applications, 8(1) (Feb., 1998): 128-140.
- Lenihan H.S. (1999): Physical-Biological Coupling on Oyster Reefs: How Habitat Structure Influences Individual Performance. Ecological Monographs, 69 (3), (Aug., 1999): 251-275.
- Low, P.J. (2006): Conservation status of the native oyster (*Ostrea edulis*) in Scotland. Unpublished PhD thesis, University of London.
- Luckenbach, M.W., Coen, L.D., Jr. Ross, P.G., Stephen, J.A. (2005): Oyster Reef Habitat Restoration: Relationships Between Oyster Abundance and Community Development based on Two Studies in Virginia and South Carolina. Journal of Coastal Research, SPECIAL ISSUE NO. 40. Coastal Restoration: Where Have We Been, Where Are We Now, and Where Should We Be Going? pp. 64-78.
- Luckenbach, M.W. (2011): 20 years of oyster restoration in the Chesapeake Bay, USA: What have we learned and where do we go from here? Available electronically at [www.aqua.stir.ac.uk/shellfish2011/presentations](http://www.aqua.stir.ac.uk/shellfish2011/presentations) accessed March 30th, 2012).
- Muus B.J., P. Dahlström (1973): Meeresfische BLV: München, 336 pp.

- Neild, R. (1995): p40 .The English, The French and The Oyster. Quiller Press, London.212 pp.
- Pascual, M. S., Zampatti, E.A. (1995): Evidence of a Chemically Mediated Adult Larval Interaction Triggering Settlement in *Ostrea puelchana* - Applications in Hatchery Production. Aquaculture. 1995 May 15; 133(1): 33-44.
- Powers, S.P., Peterson, C.H., Grabowski, J.H., Lenihan, H.S. (2009): Success of constructed oyster reefs in no-harvest sanctuaries: implications for restoration. Marine Ecology Progress Series. 389. 159-170.
- Roberts, C. (2007): p158. The Unnatural History of the Sea. Published by Gaia, a division of Octopus Publishing Group Ltd. 448 pp.
- Royal Commission (1866): The Report of the Royal Commission on Sea Fisheries, 1866.
- Scyphers, S.B., Powers, S.P., Jr. Heck, K.L., Byron, D. (2011): Oyster Reefs as Natural Breakwaters Mitigate Shoreline Loss and Facilitate Fisheries. PLoS ONE 6(8): e22396
- Smyth, D. (2007): Impacts of stock-enhancement strategies on *Ostrea edulis* in Strangford Lough. PhD Thesis Queen's University Belfast.
- Smyth, D., D. Roberts (2010): The European oyster (*Ostrea edulis*) and its epibiotic succession. Hydrobiologia 655: 25-36.
- Smyth, D., Roberts, D., Browne, L. (2009): Impacts of unregulated harvesting on a recovering stock of native oysters (*Ostrea edulis*). Marine Pollution Bulletin 58: 916-922.
- Step, E. (1901): Shell Life. An Introduction to the British Mollusca. p80 Frederick Warne and Co Publications 414 pp.
- Todorova, V., Micu, D., Klisurov, L. (2009): Unique Oyster Reefs Discovered in the Bulgarian Black Sea. Dokladi Na Bolgarskata Akademiya Na Naukite, 62(7): 871-874.
- Utting, S. D. & Spencer, B. E. (1992): Introductions of Marine Bivalve Molluscs into the United Kingdom for Commercial Culture Case Histories. ICES Marine Science Symposia 194: 84-91.
- Waugh, G.D. (1972): Settlement of *Ostrea edulis* (L.), in relation to the cultivation of oyster grounds. Fishery Investigations Series II 27 (2): 1-33.
- Wolff, W.J. (2005): The exploitation of living resources in the Dutch Wadden Sea:a historical overview Helgoland Marine Research (2005) 59: 31–38.
- Yonge, C.M. (1960): Oysters. Collins New Naturalist series. London 209 pp.

### **Acknowledgements**

The authors gratefully acknowledge the financial support of the Scottish Aquaculture Research Forum (SARF contract number 056), The Crown Estate, Scottish Natural Heritage (SNH) and the in kind contributions from the University of Stirling for carrying out the preliminary research work.



# Mediterranean Monk Seal Conservation. The Role of Marine Protected Areas and 'Horizontal' Measures for the Preservation of the Species in Greek Seas

VANGELIS I. PARAVAS, P. DENDRINOS, M. PSARADELLIS, E. TOUNTA, S. ADAMANTOPOULOU AND A. A. KARAMANLIDIS

MOM/Hellenic Society for the Study and Protection of the Monk Seal, Greece

## 1 Introduction

The Mediterranean monk seal *Monachus monachus* has been designated a Critically Endangered Pinniped by the International Union for the Conservation of Nature (IUCN), since 1996. Once abundant throughout the Mediterranean basin, the Black Sea and the African coast of the Eastern Atlantic, it is now extirpated from most of its former range and threatened with extinction (Figure 2). Its small populations, most of them isolated from each other, survive in remote colonies at Cap Blanc at the Atlantic coast of Mauritania, in the Archipelago of Madeira in the eastern Atlantic, and in the thousand islands and extensive coasts of the Aegean and Ionian seas in the eastern Mediterranean Sea. Recently published and unpublished data "guestimate" the current population size for the whole range of the species to not more than 600 individuals (JOHNSON et al., 2006).

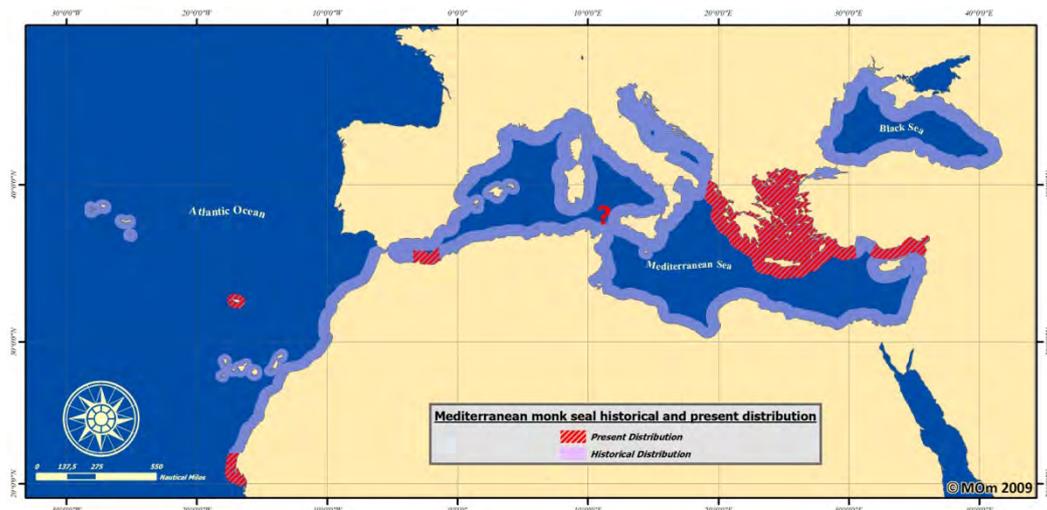


**Figure 1:** Mediterranean monk seal "Victoria" rehabilitated by MOM and released to the wild February 2008.

## 2 Mediterranean monk seal in Greek Seas

The eastern and western extremities of the species populations across its range are isolated (PASTOR et al., 2007). Currently, *Monachus monachus* have been eliminated from the largest part of the western Mediterranean, since most of its important monk seal colonies have become extinct during the past four decades (JOHNSON et al., 2006). Regarding the Mediterranean monk seal in the Greek Seas, current data set the minimum population size at no less than 180 individuals, excluding pups (MOM, 2007), with other grey literature estimates being a bit more optimistic, providing sizes of approximately 300 individuals. However and despite its critical size the species is still widely distributed across the 3,000 islands and islets and the 16,000 km of coastline of the Greek Seas (ADAMANTOPOULOU et al., 1999).

Regardless of the above described gloomy status, data stemming from research and conservation activities conducted during the last three decades has shown that the Greek part of the Mediterranean monk seal population presents a persistence and stability in pup production (MOM, 2007, MOM, 2008a, MOM, 2009a, MOM, 2010). Supportive to the latter are the optimistic research surveys that have recently unveiled numerous scattered nuclei in the Greek Seas, which host substantial reproductive colonies of this charismatic species. Hopefully, we may have already evaded the Cassandra's scientific predictions of the late 80's and early 90's supporting that the species would have become extinct by the year 2000 (GOEDICKE, 1981). In any case though, we are still far from being assured for the survival of the species, since long and demanding work is necessary to reverse its decline to its historical state.



**Figure 2:** Historical and present distribution of the Mediterranean monk seal.

Monk seals are shy marine mammals and very rare to observe in their natural habitat. They prefer remote and isolated submerged marine caves as their terrestrial habitat, where they rest, give birth, lactate and nurse their pups (JOHNSON et al., 2006) (DENDRINOS et al., 2007b). The pupping period for the Greek populations starts in middle August and ends in December. Males reach adulthood at an age of 4 to 5 years with a total length of approximately 3 meters and a weight of 300 to 350 kilogrammes, whereas females reach adulthood between 3 and 4 years, being slightly smaller than males (SAMARANCH & GONZALEZ, 2000). They forage on a large number of bonny fish species, some of which commercially important (*Dicentrarchus labrax*, numerous species from Sparidae and Scorpidae families, etc), but mostly prefer the common octopus (*Octopus vulgaris*) as their main prey (MOM, 2009b, KARAMANLIDIS et al., 2009, KARAMANLIDIS et al., 2011, PIERCE et al., 2011). Their dives reach depths of approximately 200 meters (DENDRINOS et al., 2007a) (MOM, unpublished data). Mediterranean monk seals lack natural enemies and larger predators other than humans.

### **3 Threats**

A number of threats and pressures have resulted in this grave situation for the Mediterranean monk seal, most, if not all of them stemming from human activities and behaviours. Human related mortality, such as deliberated killings, illegal fishing practices like the use of dynamite, as well as entanglement in fishing gear pose a constant and serious threat to the survival of the species (JOHNSON et al., 2006). Deliberate killing, mostly perpetrated by fishermen, are a major threat to adult seals, whereas entanglement is a serious and constantly increasing threat to the inexperienced sub-adults and juveniles depredating on fishing nets (Karamanlidis et al., 2008). Other human practices culminating the degradation or even the complete destruction of monk seal habitats are caused by unregulated coastal development, increasing boat traffic, increasing pollution, overfishing and fish depletion. Additional and critical impact to the pressures described above may have also other natural or stochastic factors such as diseases, natural catastrophes and climate change (JOHNSON et al., 2006).

### **4 Monk seal conservation actions in Greece**

Greece is currently the country hosting the largest remaining Mediterranean monk seal population on a global level, thus constituting the most important area worldwide for the species (MOM, 2007). Considering this fact and since the formal designation of the Mediterranean monk seal as a protected species under Greek law in 1981, numerous and diverse initiatives have been undertaken in order to promote the preservation of

the species and its natural habitat. A key and prominent role in monk seal conservation actions and strategies have been undertaken by MOm/Hellenic Society for the Study and Protection of the Monk Seal. Since 1988 MOm, a Greek environmental, non-governmental and non-profit organisation has been dedicated to the conservation, treatment and rehabilitation, research, environmental education, awareness, and in advocacy and policy actions on a national, European and international level for the preservation of the species.

During the last three decades monk seal conservation in Greece has been based on international good practice examples stemming from scientific research, and on legislating and enforcing relevant proactive and reactive measures. The current status of all efforts for the conservation of *Monachus monachus* and its natural environment in Greece are deriving from a double-axis approach, based on the establishment and operation of Marine Protected Areas (MPAs), or other spatially designated areas, as well as on the implementation of 'horizontal' -on a national scale- conservation measures.

On the first axis, Greece has established three MPAs, in accordance to the Greek environmental law in Greek seas. These are the National Marine Park of Alonnisos, North Sporades (NMPANS) in the North-western Aegean Sea, the Regional Marine Park of Northern Karpathos and Saria (RMPNKS) in the South-eastern Aegean Sea and the National Marine Park of Zakynthos (NMZ) in the Ionian Sea. However, the latter focuses mainly on the protection of the loggerhead sea turtle *Caretta caretta*, not on the conservation of the Mediterranean monk seal. Additionally, one more MPA is in the process of designation. Other spatially identified areas with significant Monk seal populations include numerous designated Natura 2000 sites, which are part of the European Union Network of protected areas.

On the other axis numerous laws and decrees, international treaties and European Union Directives highlight the protected status of the Mediterranean monk seal and its habitat nation-wide. Furthermore, long-term national conservation actions along with awareness, environmental education campaigns and rehabilitation activities have been carried out throughout the country for the last 3 decades.

## **5 Marine and other spatially protected areas for the Mediterranean monk seals in Greece**

The first Marine Protected Area in Greece, the NMPANS was formally established by Presidential Decree in 1992 in the Northern Sporades, a key area for the Mediterranean monk seal on an international level, since the local population is estimated to be over 50 individuals, excluding pups, amounting nearly up to 10% of the global population. Furthermore the RMPNKS is hosting a key breeding habitat for more than 20 adult Mediterranean monk seals. Currently one more marine area in South-western Aegean Sea, the island complex of Kimolos-Polyaigos, also important on an international level, is in the process of formal designation as an MPA. Research has showed that the latter area is providing shelter to approximately 50 adult individuals, a significant percentage of the global population (MOM, 2005; MOM, 2008b). Unfortunately, the designation process is extremely bureaucratic and time-consuming. Additional to the above areas 64 important Mediterranean monk seal sites are incorporated within the Greek Natura 2000 Network. Among the latter a unique area hosting over 60 individuals, beside pups, is also included. This area is an isolated uninhabited islet in the middle of the Aegean Sea, belonging to the Greek State, where monk seals exhibit unique behaviour, using open beaches for hauling out, resting, giving birth and lactating their pups (DENDRINOS et al., 2008).

Following the above facts nearly the minimum estimate of the Mediterranean monk seal population resident in Greek Seas uses important and key terrestrial as well as marine habitats that are protected at least under legislation, in some cases under specific regulations.

The established MPAs in Greece, and especially the NMPANS, have contributed significant positive results for the protection of the species and the improvement of its status over the last two decades of their operation. The conservation measures that have been applied in their boundaries have resulted in increasing birth rates and stable trends of monk seal populations, hosted in the MPAs (NOTARBARTOLO DI SCIARA et al., 2009). However, their successful operation has to be based on specific prerequisites: the constant and binding enforcement of all measures and legislation regarding the MPA, the efficient monitoring actions of ecological factors and human related activities within the MPA's boundaries, the close co-operation of the MPA administration with the local stakeholders and especially parties that perceive monk seals as competitors to their professional activities, the support of central and regional governmental authorities, as well as of policy makers and the persistent and steady financial support of the operation of the MPA.

Taking into account that the NMPANS is, up to a substantial extent, the sole fully operational and successful MPA, explicitly aiming at the conservation of the Mediterranean monk seal (KARAMANLIDIS et al., 2004, TRIVOUREA et al., 2011), it is evident that it will serve also as a best practice example that will provide the necessary experience and knowledge to implement and put into effect several new MPAs in Greek seas, interconnected into an operational network. On the other hand the conservation picture of the Natura 2000 sites including monk seal populations and habitats, which are not integrated into an operational MPA, is gloomy, since they have failed to provide significant results to the conservation of the species. Accountable for the latter is the lack of any enforced regulations, implemented measures or monitoring activities in these areas.

## **6 Horizontal, on a national scale conservation measures for the protection of the Mediterranean monk seal in Greece**

In Greece the Mediterranean monk seal was designated as a protected species in 1981 by law. Ever since a significant number of legislative acts has been sanctioned by the Greek parliament in order to effectively take measures against its alarming decline. Currently, at least 13 different laws and decrees have been approved and put into effect nationally providing a large arsenal of measures for the protection of the species and its habitats, for regulating its scientific research and rehabilitation or treatment, as well as for intervening in some cases of critical human - monk seal interactions. Furthermore, Greece has ratified 7 international conventions, relevant to the species, and integrated numerous environmental directives of the European Union, the most notable being 92/43EEC on the conservation of natural habitats and of wild fauna and flora, and the 2008/56EEC Marine Strategy Directive.

Additional to the above legislative measures, numerous actions and initiatives have been implemented by the Hellenic Society for the Study and Protection of the Monk Seal on a horizontal level. The latter actions are of critical importance with overwhelming results and have been accomplished under constrained financial and human resources. The most significant conservation actions implemented over the last three decades are the following:

- Greece maintains a national rescue and information network for the monk seal, established, operated and funded solely by MOm (ADAMANTOPOULOU et al., 1999).
- Extensive environmental education and awareness campaigns have been carried out continuously for nearly the last 3 decades solely by NGOs
- Treatment and rehabilitation of monk seals is operated by MOm, either *in situ* or in its privately owned and unique for the Mediterranean basin Monk seal Rehabilitation

Centre, and has resulted in the safe release of approximately 21 animals back to the wild during the last 24 years (ANDROUKAKI et al., 2006).

- National conservation projects have been implemented in order to tackle the increasing monk seal mortality due to anthropogenic causes, as well as to mitigate the alarming consequences of monk seal-fishery interactions (MOM, 2009b).
- Research on the species biology, ecology and behaviour has been an exclusive initiative by NGOs and mostly MOM, providing the scientific data to ensure efficient conservation practices and facilitate the establishment of research protocols and methods.
- Finally, Greece holds a National Strategy and Action Plan for the conservation of the species, which can serve as a road map for the effective implementation of all essential actions that could reverse its declining course (NOTARBARTOLO DI SCIARA et al., 2009) . On the negative side the horizontal, -on a national scale- measures suffer from standing and numerous weaknesses, minimising their successful results. Most prominent of these are: The inability of the Greek state to enforce the existing legislation on a national level, and to support, by means of financial resources and political will the implementation of conservation actions; the reluctance of national competent authorities to implement existing Action Plans for the mitigation of monk seal-fishery interactions; major obstacles are also the extremely time consuming and inefficient bureaucratic processes for establishing new measures; lastly and of leading significance is the fact that most local communities remain still unconvinced on the long-term positive results and advantages that conservation can offer not only to the threatened species, but most importantly to their well being and prosperity.

## 7 Conclusions

Despite the lack of more than two operating Marine Protected Areas focusing on the conservation of the Mediterranean monk seal in Greek Seas, their example has resulted in valuable accomplishments. Monk seal conservation can not succeed in the absence of MPAs. Nevertheless, MPAs alone will not save the monk seals; horizontal measures, legal regulations, their active enforcement and *in situ* concrete conservation actions are vital to preserve the species, its habitats and the marine environment on a broader scale throughout our densely populated seas, coastlines and islands. Such horizontal initiatives have the ability to establish the conservation and preservation of wildlife as an essential need to the minds and hearts of the Greek public, steering social behaviours towards environmental friendly and responsible attitudes. The Mediterranean Sea might be a lesser sea by volume and area, but hosts a high number of charismatic species, most of them threatened with extinction by our own pressing activities.

In order to reverse the dire status of the Mediterranean monk seal across its range and ensure a sustainable future for the whole Mediterranean Sea, including both human communities and marine wildlife, we have to invest more than ever in co-operative and joint actions with local communities and relevant local stakeholders and opponents. We have to demand extensive and sufficient support and resources from the national authorities and the European Union, not only from the standing point of conservationists and managers but also as responsible citizens and members of our society. We have to establish the monk seal conservation not only as a Greek national priority, but further more as a Mediterranean priority. We have to use all the accumulated expertise and knowledge we have treasured the past decades and propagate all positive examples and best practices to convince that conservation measures, either on an MPA or on a horizontal level, are not only necessary for a sustainable future, but could also prove profitable for all of us!

## 8 References

Adamantopoulou, S., Androukaki, E. & Kotomatas, S. (1999): The Distribution of the Mediterranean Monk Seal in Greece based on an information network. Contributions to the Zoogeography and Ecology of the Eastern Mediterranean Region 1: 399-404.

Androukaki, E., Chatzisprou, A., Adamantopoulou, S., Dendrinou, P., Komnenou, A., Kuiken, I., Tounta, E. & Kotomatas, S. (2006): Investigating the causes of death in monk seals, stranded in coastal Greece (1986-2005). In I. Kuklik ed. 20th Conference of the European Cetacean Society. ECS, Gdynia, Poland, 112 pp.

Dendrinou, P., Karamanlidis, A.A., Androukaki, E. & McConnell, B.J. (2007a): Diving development and behavior of a rehabilitated Mediterranean monk seal (*Monachus monachus*). Marine Mammal Science 23: 387-397.

Dendrinou, P., Karamanlidis, A.A., Kotomatas, S., Legakis, A., Tounta, E. & Matthiopoulos, J. (2007b): Pupping habitat use in the Mediterranean monk seal: a long-term study. Marine Mammal Science 23: 615-628.

Dendrinou, P., Karamanlidis, A.A., Kotomatas, S., Paravas, V. & Adamantopoulou, S. (2008): Report of a New Mediterranean Monk Seal (*Monachus monachus*) Breeding Colony in the Aegean Sea, Greece. Aquatic Mammals 34: 355-361.

Goedicke, T. R. (1981): Life Expectancy of Monk Seal Colonies in Greece. Biological Conservation 20: 173-181.

Johnson, W. M., Karamanlidis, A.A., Dendrinou, P., de Larrinoa, P.F., Gazo, M., Gonzalez, L.M., Güçlüsoy, H., Pires, R. & Schnellmann, M. (2006): Monk Seal Fact Files. Biology, Behaviour, Status and Conservation of the Mediterranean monk seal, *Monachus monachus*. The Monachus Guardian.

Karamanlidis, A. A., Androukaki, E., Adamantopoulou, S., Chatzistryrou, A., Johnson, W.M., Kotomatas, S., Papadopoulos, A., Paravas, V., Paximadis, G., Pires, R., Tounta, E. & Dendrinis, P. (2008): Assessing accidental entanglement as a threat to the Mediterranean monk seal *Monachus monachus*. *Endangered species research* 5: 205-213.

Karamanlidis, A. A., Curtis, J., Androukaki, E., Joseph, E., Psaradelli, M., Tounta, E. & Dendrinis, P. (2009): Isotopic tracking of foraging of Mediterranean monk seals (*Monachus monachus*) in the eastern Mediterranean Sea. 18th Biennial Conference on the Biology of Marine Mammals, Workshop "Research, Management, Conservation and Policy in Monk seal recovery: A global Perspective". Quebec City, Canada.

Karamanlidis, A. A., Dendrinis, P., Tounta, E. & Kotomatas, S. (2004): Monitoring human activity in an area dedicated to the protection of the endangered Mediterranean monk seal. *Coastal Management* 32: 293-306.

Karamanlidis, A. A., Kallianiotis, A., Psaradellis, M. & Adamantopoulou, S. (2011): Stomach contents of a subadult Mediterranean monk seal (*Monachus monachus*) from the Aegean Sea. *Aquatic Mammals* 37: 280-283.

MOm (2005): Status report of the Mediterranean monk seal populations in Kimolos - Polyaigos and Karpathos - Saria areas. MOm/Hellenic Society for the Study and Protection of the Monk Seal, Athens, 1-42 pp.

MOm (2007): Status of the Population of the Mediterranean Monk Seal (*Monachus monachus*) in Greece. MOm/Hellenic Society for the Study and Protection of the Monk seal, Athens, Greece, 1-42 pp.

MOm (2008a): Annual Technical Report 2007, on the Status of the Mediterranean Monk Seal (*Monachus monachus*) in Greece. Athens, Greece. 1-13 pp.

MOm (2008b): Final Report on the Monitoring of the Status of the Population of the Monk Seal, in Karpathos and Saria. MOm/Hellenic Society for the Study and Protection of the Monk seal, Athens, Greece, 1-77 pp.

MOm (2009a): Annual Technical Report 2008, on the Status of the Mediterranean Monk Seal (*Monachus monachus*) in Greece. Athens, Greece, 1-15 pp.

MOm (2009b): MOFI project: "Monk seal and fisheries: Mitigating the conflict in Greek seas. MOm/Hellenic Society for the Study and Protection of the Monk seal.

MOm (2010): Annual technical report of the year 2009 on the population status of the Mediterranean monk seal (*Monachus monachus*) in Greece. MOm/Hellenic Society for the Study and Protection of the Monk Seal, Athens, 1-17 pp.

Notarbartolo di Sciara, G., Adamantopoulou, S., Androukaki, E., Dendrinis, P., Karamanlidis, A.A., Paravas, V. & Kotomatas, S. (2009): National strategy and action plan for the conservation of the Mediterranean monk seal in Greece, 2009-2015. MOm, Athens, 1-19 pp.

Pastor, T., Garza, J.C., Aguilar, A., Tounta, E. & Androukaki, E. (2007): Genetic diversity and differentiation between the two remaining populations of the critically endangered Mediterranean monk seal. *Animal Conservation* 10: 461-469.

Pierce G.J, Hernandez-Milian, G., Santos, M.B., Dendrinis, P., Psaradellis, M., Tounta, E. Androukaki, E. & Eldridge, A. (2011): Diet of the Monk Seal (*Monachus monachus*) in the Greek Waters. *Aquatic Mammals* 37: 284-297.

Samaranch, R. & Gonzalez, L.M. (2000): Changes in morphology with age in Mediterranean monk seals (*Monachus monachus*). *Marine Mammal Science* 16: 141-157.

Trivourea, M. N., Karamanlidis, A.A., Tounta, E., Dendrinis, P. & Kotomatas, S. (2011): People and the Mediterranean monk seal (*Monachus monachus*): A study of the socioeconomic impacts of the National Marine Park of Alonissos, Northern Sporades, Greece. *Aquatic Mammals* 37: 305-318.

# Conservation and Management of Northeast Atlantic Sharks

SARAH FOWLER

Naturebureau International, United Kingdom

## Abstract

In 2006, the IUCN (World Conservation Union) Shark Specialist Group (SSG) held a workshop to assess the threatened status of Northeast Atlantic sharks and their relatives (skates, rays and chimaeras) in the Northeast Atlantic and to make recommendations for their conservation and management. This was a contribution towards the SSG's Global Shark Red List Assessment, now concluded. The PMCE 2012 presentation reviews and updates these results for the 107 species that occur in the Northeast Atlantic and sets this into a global context.

Although this region does not have the highest shark biodiversity, endemism and conservation risk in the world (sharks in other seas are in much greater trouble), the long history of largely unregulated target and bycatch fisheries has left its mark. Some large-bodied shallow seas species that were formerly widespread and common have virtually been extirpated and in some cases partly replaced by smaller bodied animals. Offshore, the Northeast Atlantic falls within one of the world's three black spots for threatened deepwater shark species. Our pelagic sharks have been very heavily fished – the Northeast Atlantic is (or was) home to some of the world's largest shark fishing nations and the biggest supplier of shark fins to Asian markets.

When comparing the threatened status of sharks to that of Europe's land animals, it is shocking to see that over 30% of Northeast Atlantic sharks are assessed as threatened by IUCN, compared with only 14% of European land mammals and birds. Furthermore, the proportion of 'Least Concern' sharks, at 31%, is much less than half the proportion of 'Least Concern' European mammals and birds. Globally also, sharks and their relatives have the lowest proportion of 'Least Concern' species of all the vertebrate groups, and of all marine taxa that have so far been assessed.

The presentation will conclude with some good news. In 2006, very few conservation and management measures were in place for sharks and their relatives. Most seriously threatened species had no legal protection. Where quotas had been adopted for depleted stocks, these were usually significantly higher than scientific recommendations and ineffective in restricting effort or catches. Nowadays, most of the scientific advice on shark catch limits from the International Council for the Exploration

of the Seas (ICES) is being implemented by the EU and other Northeast Atlantic fishing states. The European Commission has developed a Shark Plan, endorsed by the Council of Ministers. Shark conservation and management measures have been adopted by the regional fisheries management bodies (the Northeast Atlantic Fisheries Commission (NEAFC) and the International Council for the Conservation of Atlantic Tunas (ICCAT)), as well as by OSPAR and the Convention for the Conservation of Migratory Species. Although there is still much to be done to secure the future of our threatened species, to rebuild depleted stocks, and to improve the management of shared stocks, particularly in international waters, the baseline established by the Shark Specialist Group will allow these improvements to be monitored, both in the Northeast Atlantic and globally.

# Conservation Plan for the Harbour Porpoise (*Phocoena phocoena*) in The Netherlands: towards a favourable conservation status

C.J. CAMPHUYSEN<sup>1</sup> AND MARIJE SIEMENSMA<sup>2</sup>

<sup>1</sup>Royal Netherlands Institute for Sea Research, The Netherlands,

<sup>2</sup>Marine Science & Communication, The Netherlands

## 1 Introduction

In 2011, at the request of the Dutch Ministry of Economics, Agriculture & Innovation, a species conservation plan for the Harbour Porpoise *Phocoena phocoena* was established, based on current seasonal occurrence and abundance of porpoises within waters under Dutch jurisdiction aiming to achieve favourable conservation status. Harbour Porpoises have increased markedly in numbers in the southern North Sea in recent decades. The conservation status of the Harbour Porpoise in The Netherlands has recently been evaluated as 'Inadequate', the population as 'Vulnerable'.

Reasons for concern were unknown causes for a recent shift in Harbour Porpoise distribution within the North Sea at large, the age structure and reproductive condition of porpoises in Dutch waters, and reported incidental bycatches in fishing gear. An important step for this conservation plan was to research and discuss observed as well as expected population threats, by providing a summary of existing scientific evidence. Potential threats or other issues that could affect the conservation status have been evaluated.

The conservation plan is generic rather than area-orientated as recent research in Dutch waters failed to identify areas of particular ecological significance for any significant length of time. Based on available scientific evidence and experiences in other countries, mitigation measures and suggestions for urgently needed additional scientific research have been formulated.

A comprehensive stakeholder consultation has been part of the process. Two scientists, independent from the Ministry wrote the plan, guided by an advisory committee. In this committee stakeholders (industry, government, NGOs and scientists) were represented.



**Figure 1:** Stakeholder engagement.

## 2 Current knowledge

The Harbour Porpoise is the smallest and most abundant cetacean in NW European continental shelf waters. Harbour Porpoises have an average life-span of 8-10 years and become sexually mature between 3 and 4 years of age. Adult females produce one offspring on average every 1-2 years; gestation lasts 10-11 months. The Harbour Porpoise is a relatively small, endothermic predator with limited energy storage capacity, dependent on foraging throughout the year without prolonged periods of fasting. They are positioned near the top of the marine food web, but they are not quite apex predators. They are heavily reliant on echolocation for prey capture, communication and possibly for navigation. This makes them vulnerable to acoustic pollution in the marine environment. Harbour Porpoises are most abundant in relatively shallow sea areas and often forage near or at the sea bottom. Their prey spectrum includes pelagic and demersal prey species: different species of fish, cephalopods, crustaceans and polychaetes.

From 1900 to the early 1950s, Harbour Porpoises were abundant and widespread in coastal waters throughout the southern North Sea, including Dutch waters. The animal declined and was considered locally extinct during the 1960s-1980s. Harbour Porpoises have increased markedly in numbers in the southern North Sea in recent decades. Given changes in distribution and abundance, the conservation status of porpoises in Dutch waters is likely to require an update in the near-future.

The global abundance of the Harbour Porpoise is at least about 700,000 individuals. Within the North Sea at large, in 2005, total abundance was estimated at 230,000 individuals (SCANS II, 2008). A marked change in distribution was found, with considerably larger numbers of porpoises in the southern half of the North Sea in the 2005 than during an earlier census in 1994. Aerial surveys

covering 50% of the Dutch sector of the North Sea produced 37,000 Harbour Porpoises in Feb-April 2009 (SCHEIDAT & VERDAAT, 2009). Aerial surveys covering ~ 80% of the Dutch sector of the North Sea produced 56,000 in Mar 2010 (SCHEIDAT et al., 2011).

There were no areas or regions of particular ecological significance for Harbour Porpoises for any significant length of time within the Dutch sector of the North Sea, even though certain clusters in sightings occasionally pointed at habitat preferences. An exception is the Oosterschelde area (Delta) where a very small but increasing, resident stock became established after 2001.

### 3 Observed threats

Incidental capture in fishing gear (bycatch) is considered to be the most significant threat to Harbour Porpoise populations worldwide. In The Netherlands, some 150-250 animals washing ashore per annum are at least bycatch-suspect. The main type of fishing gear responsible for drowning is currently unknown, but set-nets (passive gear) are the main suspects. Bycatches occurred year-round and throughout the study area. The catch composition during which most porpoise strandings occurred varied and no set-net fisheries should be excluded *a priori* from an observer scheme. An onboard observer scheme should be established *with priority* in the winter fisheries, Dec-Mar, in the northern coastal zone (IJmuiden-Vlieland).

While there is concrete evidence for avoidance behaviour of loud (explosive) underwater sounds (such as pile driving for windfarm construction, seismic exploration, underwater explosions, and naval sonar operation), there is no factual evidence for lethal damage. Adequate studies of hearing damage and death as a result of underwater sound are lacking.

The distributional shift of Harbour Porpoises from more northerly parts of the North Sea into the Southern Bight may have been caused by a reduction in available prey in the north. Studies of the ecology of Harbour Porpoises in the southern North Sea are required to shed more light on prey availability and resources (stocks). With between a fifth and a third of all porpoises studied during necropsies in recent years being in poor condition (starved to death or severely emaciated), the indication that current resources may not be plentiful is too strong to be ignored.

Siting, vessel strikes, the operational phase of windfarms, offshore mining, marine litter, chemical pollution, (chronic) marine oil pollution, natural predators, infectious disease, and parasites are all issues of concern that may in part require additional

study, none of which required local (or regional, i.e. on a southern North Sea scale) mitigation measures, but rather on a higher governance level.

None of the demonstrated threats can be quantified satisfactorily, given the slender factual data currently at hand. It is obvious that further research is required, before effective mitigation measures for anthropogenic threats can be proposed and the precautionary approach (UNESCO, 2005) could be the safest way forward.

#### **4 Policy & legislative context**

Porpoises are legally protected in The Netherlands following international, European and national legislation. National legislation imposes a strict protection of the Harbour Porpoise, which is legally protected under the 1998 Flora and Fauna Act and the 1998 Nature Conservation Act, both applying to the territorial sea and not reaching beyond the 12 nautical mile zone. Extension of both acts is expected in a few years now, but it is still unclear when this will happen. This geographical gap is an obstacle impeding an adequate conservation.

Under the EU Habitats Directive, which applies to the EEZ, the Harbour Porpoise has been awarded the highest protective status by being listed on both Annex II and Annex IV of the Habitats Directive. Article 2 of the Habitats Directive asks for a favourable conservation status, which is the aim of this conservation plan.

Despite its highest protective status under European nature conservation law, fisheries activities, causing one of the main threats – bycatch – to the species, are mainly dealt with by the European community in its Common Fisheries Policy (CFP). To prevent bycatch of small cetaceans, Council Regulation 812/2004 has been issued, which requires the use of acoustic devices and monitoring of bycatch. However, the current Dutch set-net fisheries fleet does not fall under the defined criteria regarding vessel length and gear specifications and does not have any obligation under the CFP to prevent and monitor bycatch.

The existing gap between fisheries regulations and nature conservation instruments is another obstacle. A Member State can fulfil criteria required under the Common Fisheries Policy, while at the same time infringing with both the Habitats Directive and the Flora and Fauna Act. This discrepancy is further worsened by the fact that fisheries regulations have to be dealt with at European Community level rather than at national level. Member States do have opportunities and obligations to address certain threats at national level, but measures are only effective and politically acceptable when they apply to both national and foreign fisheries fleets.

The exploration, production and mining of minerals, such as oil and gas, are regulated in the 2002 Mining Act (Mijnbouwwet). The Mining Decree (Mijnbouwbesluit) describes the rules for seismic acquisition offshore the Netherlands, for which no license is required. Under the Mining Decree a soft-start (ramp-up) is required to alert marine mammals in the survey area, but no further measures are compulsory, such as noise reduction or observers on board. Licenses for offshore wind parks fall under the 2009 Water Act. An Environmental Impact Assessment (EIA) prior to the license procedure is obligatory. Once implemented as policy, this conservation plan and its measures have to be taken into account and considered in the EIA.

## **5 Research proposals & mitigation measures**

Although policy and mitigation measures focus at the main identified threats, bycatch and loud explosive underwater noise, other (potential) threats need to be addressed as well. However in general, these cannot be addressed effectively at a national level. Nevertheless it is imperative that the problems caused by, for example marine litter and pollution should be addressed simultaneously at both national and international levels and call for an international, coordinated approach.

### **5.1 Research needs**

Several of the observed threats, at the moment, cannot be addressed appropriately because too many factors are still unclear. High quality research is needed to find out where the problems are most prominent. It can be concluded that (in order of priority) the most prominent regional threats are (1) bycatch, (2) pile-driving during the installation of windfarms, (3) underwater explosions, and (4) other particularly loud underwater sounds (e.g. sonar, seismic surveys). There are serious concerns regarding available resources (food), in the southern North Sea as well as in the North Sea at large. Additional research is needed for the first, immediate mitigation measures are proposed for the other impacts. All aspects require future monitoring, to assess the scale, the exact impact, but also the effectiveness of mitigation measures.

The following research needs are listed with the highest priority

- Assessments of Harbour Porpoise population through state of the art aerial surveys, including analysis of seasonality and spatial patterns
- Innovative studies of the (foraging) ecology and habitat requirements of Harbour Porpoises in the Southern North Sea

- Prioritise an observer scheme on all fleets with set-nets to assess bycatch rates according to internationally accepted protocols
- Continue to assess bycatch rates in the most important fisheries (regarding bycatch) and evaluate the effectiveness of mitigation measures
- Establishment of a national scientific research steering group. This would be a suitable instrument to deal with aspects such as research needs, research quality and the evaluation of the quality and conclusions of study reports. Such a steering group should be sufficiently authoritative, but also sufficiently “distant” from the ongoing research. It is proposed that such a committee should meet and advise annually, and be composed of at least two foreign marine mammals experts, one Dutch Harbour Porpoise expert, and (vitaly) one statistician.

## **5.2 Mitigation measures**

Several of the proposed mitigation measures are in fact research dependent, others could be implemented immediately, or when needed. The research needs described earlier should guarantee that developing threats, or new insights, should be taken into account in future work. For the moment, the most urgent issues regarding a favourable conservation status of Harbour Porpoises are seemingly bycatch issues and loud (explosive) underwater noise, both with regional or local characteristics (km scales). The first are basically research dependent, and gear-specific mitigation measures (other than draconic steps such as complete closures of entire fisheries) cannot be implemented at the moment. For underwater noise, even if studies of the effectiveness of proposed measures are highly important, the mitigation measures could be implemented directly.

### **5.2.1 Bycatch mitigation in fishing gear**

Depending on the results of the recommended observer programme (observers and CCTV/camera monitoring) several mitigation measures to mitigate bycatch are recommended. Measures to apply at present are: to facilitate the landing and reporting of bycatch; to control recreational gillnetting in Dutch waters; to control illegal fisheries; to amend EC 812/2004 or align with the CFP given the current inadequacy for set-net fisheries in Dutch waters; to explore gear switch to gear types causing less impact on the marine environment and porpoises in particular; to continue exploring ways to modify gear which reduces bycatch; to investigate bycatch in hook and line fisheries and to use acoustic devices in a controlled way when bycatch is defined.

Measures dependent of further research could include decreasing the total effort of set-net fisheries; instalment of time and/or area closures and the establishment of a take limit resulting in restriction of fisheries for a certain period and/or a certain area, taking into account displacement of effort which might even increase bycatch. Ideally a system of bycatch monitoring by all Member States bordering the North-western North Sea and Eastern Channel (i.e. Management Unit 9) Sea will be established, keeping track of all reported bycatches and as soon as the 1% limit has been exceeded MU9 will be closed for a certain time and period or other mitigation measures will be required for the fisheries responsible of bycatch.

### **5.2.2 Mitigation of adverse effects of impulsive sound under water**

When designing measures to mitigate adverse (disturbance, temporary physical damage) and potential lethal effects of loud explosive sounds under water, a precautionary approach to management and regulation of underwater noise is recommended.

A general measure applicable to all loud explosive sounds should be the requirement of an EIA, including a BACI study (before and after control impact) using aerial surveys prior to operations. Another general measure that should apply to all loud explosive sounds is the development of a system of standards, setting thresholds for underwater noise.

Prior to any action causing loud explosive underwater noise a marine mammal observation protocol is recommended by international approved guidelines, using both visual and/or acoustic observation methods. As the porpoise is a notoriously difficult animal to observe at sea, this does not necessarily guarantee the absence of animals, nor do following mitigation measures prevent any potential adverse effects at a larger distance, unless sound reducing mitigation tools are used.

Guidelines are proposed to mitigate effects of loud explosive sounds. The recommendations in this plan indicate the necessary measures within these guidelines. However, these guidelines need to be finalized and fine-tuned, preferably in cooperation with the regulatory body, that is responsible for the implementation and compliance of the guidelines. Such a set of guidelines should also be adapted whenever new knowledge, developments and insights become available.

Regarding seismic surveys both a license requirement is recommended and the creation and implementation of guidelines. A set of guidelines should be also established for controlled explosions under water similar to that proposed for seismic surveys.

Regarding pile driving a set of recommendations is given, comprising the avoidance of pile driving and the use of alternative foundation methods available. Explosives for the demolition of a windfarm should be avoided.

### **5.2.3 Monitoring & compliance**

For both fisheries and underwater noise mitigation measures, an appropriate monitoring and enforcing scheme should be established in order to check compliance to the prescribed measures. Procedures to assess the effectiveness of any mitigation measures introduced should be developed and implemented by the appropriate bodies.

### **5.2.4 Stakeholder engagement**

A general recommendation is to involve stakeholders in the process of establishing a conservation and management plan. Promoting the cooperation and debate between scientists, NGOs, policymakers and industry would enhance a mutual understanding and acceptance of measures taken to protect the Harbour Porpoise. Also communication to inform stakeholders and the general public on activities related to the conservation of the Harbour Porpoise is recommended.

## **6 Implementation & future management**

In 2012 the Ministry of EL&I establishes an action plan to give effect to the recommendations of the conservation plan. The focus will be on: further research prioritized on underwater noise, bycatch and bycatch mitigation, and population structure and diet; a national research steering group; measures to mitigate underwater noise and bycatch. The implementation will be done together with stakeholders and in cooperation with other countries around the North Sea.

## **7 Conclusion & discussion**

With a substantial part of the North Sea stock in waters under Dutch jurisdiction, even if this is only during part of the year, we share the responsibility for the general well-being of the Harbour Porpoise with other North Sea states (Habitats Directive, OSPAR, ASCOBANS). Current policy in The Netherlands doesn't accomplish adequate protection of this species. Implementing the research and mitigation measures, as advised in this species conservation plan, serves to get porpoises into the desired conservation status, to fulfil obligations of the relevant international legal treaties. Measures should be concrete and specific and need to be

implemented and complied with. This does require an active and also flexible management approach, turning this conservation plan into an action plan.

## 8 References

Camphuysen C.J., Siemensma, M.L. (2011): Conservation plan for the Harbour Porpoise *Phocoena phocoena* in The Netherlands: towards a favourable conservation status. NIOZ Report 2011-07, Royal Netherlands Institute for Sea Research, Texel.

SCANS II (2008): Small Cetaceans in the European Atlantic and North Sea. Final Report submitted to the European Commission under project LIFE04NAT/GB/000245, Available from SMRU, University of St Andrews, St Andrews, UK.

Scheidat M., Aarts, G., Verdaat, H. (2011): Using aerial surveys to estimate density and distribution of Harbour Porpoises in Dutch waters. *Manuscript IMARES*.

Scheidat M., Verdaat, H. (2009): Distribution and density of Harbour Porpoises in Dutch North Sea waters. Report C125/09, IMARES, Texel, 23pp.

UNESCO (2005): The Precautionary Principle. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), United Nations Educational, Scientific and Cultural Organization, Paris.

The conservation plan can be downloaded at:

[http://www.noordzeenatura2000.nl/index.php?option=com\\_docman&task=cat\\_view&gid=57&Itemid=89&lang=en](http://www.noordzeenatura2000.nl/index.php?option=com_docman&task=cat_view&gid=57&Itemid=89&lang=en)



# The Baltic Sea Harbour Porpoise (*Phocoena phocoena*): What do we know and what do we need to know?

JENS C. KOBLITZ

German Oceanographic Museum, Germany

The harbour porpoise (*Phocoena phocoena*) is the only cetacean species reproducing in the Baltic Sea. Historical records show that it was once so abundant that hunting was profitable, but:

## 1 How many porpoises are in the Baltic Sea nowadays?

Two big surveys for cetaceans were attempted successfully in European waters in 1994 and 2005. In SCANS I (1994), aerial and ship-based surveys were carried out in the western part of the Baltic Sea, whereas in SCANS II (2005) only ships were used as survey platforms in the Baltic. A recent re-analysis of these data sets for the area defined as **Belt Sea** by Sveegaard (2011) show a decrease from 27,800 to 10,900 animals within the 11 years (based on 160 and 122 porpoise groups sighted, respectively). Due to large confidence intervals, this decrease of 60% is statistically not significant. No sightings of porpoises were made east of the island of Fehmarn in both surveys.

In the **Baltic Proper**, two aerial surveys of the same area between the coasts of Poland, eastern Germany and southern Sweden resulted in abundance estimates of 599 groups in 1995 and 93 groups in 2002 based on 3 and 2 sightings of single animals, respectively (BERGGREN et al., 2004).

For the **area between the Belt Sea** (as analyzed by SVEEGAARD, 2011) **and the Baltic Proper** (i.e., for the area between the island of Fehmarn and the Darß Sill), Gilles et al. (2011) provide a series of abundance estimates for the period 2002 to 2011 ranging from 0 to almost 2000 individuals based on frequent aerial surveys. Unfortunately no such data are available prior to 2002.

From the 1990s to the last decade, the population decrease amounted to about 60% in the Belt Sea and 84% in the Baltic Proper. Due to the lack of data from the 1990s for the area between the Belt Sea and the Baltic Proper (i.e., between Fehmarn and Darß), no trend can be estimated here. The available results indicate an **overall decrease of about 58%** from perhaps 28,700 to about 12,040 individuals in the whole Baltic southeast of Kattegat. Therefore, we need to act now, if we want to preserve the harbor porpoise in the Baltic Sea and in the Kattegat.

**Table 1:** Population estimates and trends for the different areas of the Baltic Sea. \*Average group size was assumed to be 1.5.

	1990s	Population trend	2000s
<b>Belt Sea</b>	27,800	-60%	10,900
<b>Baltic Proper</b>	900 (599 groups)*	-84%	140 (93 groups)*
<b>Fehmarn to Darss Ridge</b>	?	?	1000
<b>Sum</b>	<b>28,700</b>	<b>-58%</b>	<b>12,040</b>

## 2 Are there different populations of porpoises in the Baltic Sea?

There are clear genetic and morphological differences between North Sea and Baltic Sea harbor porpoises (HUGGENBERGER et al., 2002; WIEMANN et al., 2010).

There are also differences between the Belt Sea and Baltic Proper populations. These differences are not as pronounced, most likely due to the relative young porpoise population in the Baltic Sea.

### Genetic population differences

Wiemann et al. (2010) found evidence for genetically distinct porpoise populations with separations between the North Sea and Belt Sea population in Kattegat (with two possible borders). The separation between the Belt Sea and Baltic Proper population is either east of the Danish-German border (based on mitochondrial DNA) or along the Darß Sill (based on nuclear DNA).

### Morphological population differences

Huggenberger et al. (2002) and Galatius et al. (2012) investigated differences between populations using skull morphology and found boundaries between populations at Darß Sill and at Fehmarn, respectively. It is important to point out that the morphological changes are not continuous, but the Baltic Proper population is showing characteristics more similar to the North Sea than to the Belt Sea population (GALATIUS et al., 2012).

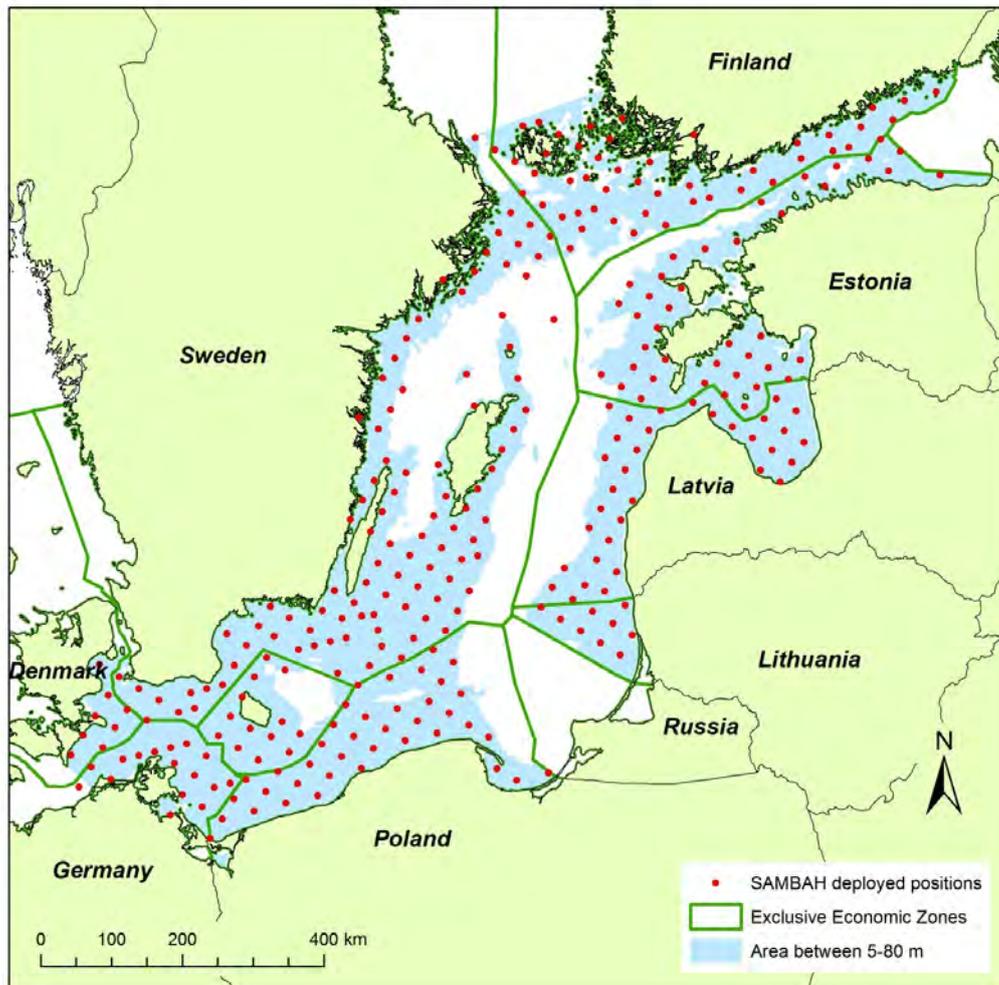
### **3 Acoustic Monitoring of the harbour porpoise in the German waters of the Baltic Sea**

Aerial and ship-based surveys can provide only snapshot information on a population and are limited by weather conditions. In addition, visual surveys in low density areas result in very few sightings and thus in large confidence intervals. Acoustic monitoring registers the animals' presence based on the recordings of its echolocation clicks and provides a high temporal coverage irrespective of weather conditions. The German Oceanographic Museum has been using acoustic monitoring for a decade in the German waters of the Baltic Sea. Porpoise click detectors, so called T-PODs were deployed between the island of Fehmarn and the Polish border from 2002 to 2011. In summary, the recorded data show that porpoises are present in all parts of the German Baltic Sea. Porpoise presence, described as the number of days when porpoises were detected, however, decreases drastically from West to East. Additionally, in some areas the porpoise distribution follows a clear seasonal pattern with higher registration rates in the summer. In more detail, the data can be grouped for three subareas "Fehmarn" (3 monitoring stations), "Kadet Trench" (4 monitoring stations) and "Pomeranian Bay" (5 monitoring stations). The click detectors in the westernmost subarea (around Fehmarn) recorded porpoise presence year-round with lowest rates of 40-60% porpoise-positive days per month (ppd/month) in late winter (February to March). In the remainder of the year, porpoise presence was positively registered here on 95-100% of the days per month. This pattern was accentuated farther east at the Kadet Trench with an average of 70-100% ppd/month during May to November and only 0-25% during January to March. In the easternmost subarea (in the Pomeranian Bay east of the island of Rügen), click rates only ranged from 0-20% ppd/month with lower values usually in the first half of the calendar year and higher ones in the second half (Benke et al., in prep.).

### **4 SAMBAH-Project**

The extensive experiences of the German Oceanographic Museum and international partner institutions with automatic click detectors led to the creation of the SAMBAH (**Static Acoustic Monitoring of the Baltic Sea Harbour porpoise**) project. For a total of two years (May 2011 to May 2013), 305 porpoise click detectors are evenly distributed in the EU waters of the Baltic Proper to collect data on porpoise presence or absence. The so called C-PODs are deployed in areas with water depths ranging from 5 to 80 m and are either moored with a surface marker or in areas with heavy shipping or strong ice formation with acoustic release devices. Most of the 305 devices are deployed in Swedish waters (99), followed by Finland (47), Estonia (40), Poland (39) and Latvia (34). Denmark (21), Germany (16) and Lithuania (9) have comparably few devices in

their waters. Click registrations, combined with other information such as average click rate, click source level and group size, animal abundance and distribution in the Baltic Proper will be calculated. In the first year of data collection, porpoise echolocation clicks were recorded by all 16 click detectors in German waters. This supports the results from the ongoing long-term monitoring, showing the porpoise presence in all areas of the German Baltic Sea.



**Figure 1:** Map showing the positions of SAMBAH monitoring stations. The red dots show initially deployed click detectors. Some stations had to be shifted from their planned positions due to conflicts with shipping lanes or naval activities.

## **5 Anthropogenic influences**

Until 1945 hunting of the harbour porpoise was most influential on the population. Since the ban of hunting and increase of fishing activity, by-catch of animals in set gillnets has a strong negative impact on the harbor porpoise population.

In addition, intense impulsive sounds, e.g. from explosions of ammunition and pile-driving can lead to a permanent threshold shift in the hearing of animals close to the sound source. Noise in general can cause a temporary threshold shift in hearing or animal displacement or masking and other changes in behavior. Furthermore, the accumulation of contaminants of animals high up in the food-web can reduce their fertility and immune response.

## **6 Research needed**

In order to ensure effective conservation, the following research is needed:

It is important to estimate the current animal abundance in the Baltic Sea and to monitor it constantly to assess the effectiveness of conservation measures to come. Calving and nursing areas and feeding hotspots have to be identified. Possible displacement or behavioral changes of harbour porpoises caused by anthropogenic noise needs to be understood. Furthermore, alternative fishing methods that do not cause by-catch have to be developed and their effectiveness for fishing and porpoise survival has to be ensured.

## **7 Conservation actions**

The primary goal is to reduce the by-catch using alternative fishing gear. The use of pingers in MPAs ("Natura 2000" areas) provides no solution as this might cause displacement of the animals into areas of unmanaged fishing. The impact of anthropogenic noise has to be reduced through silent construction methods as well as through the development of effective sound mitigation technologies. Marine protected areas with enforced restrictions would have to be established especially for calving and nursing areas.

## **8 Acknowledgements**

The long-term acoustic monitoring carried out by the German Oceanographic Museum is funded by the German Federal Agency for Nature Conservation (BfN). The German contribution to the EU-Life+ Project "SAMBAH" is also financed by the German Federal

Agency for Nature Conservation (BfN). In the absence of national support, continuation of the SAMBAH project between 01.06.2011 to the 30.09.2011 was possible through a donation from the European Association of Zoos and Aquaria ([www.carnivorecampaign.eu](http://www.carnivorecampaign.eu)). These monitoring results and this presentation were only made possible by the dedicated decade-long efforts of the porpoise research group of the German Oceanographic Museum in Stralsund. I would like to thank Stefan Bräger for fruitful discussions.

## 9 References

Benke, H., Bräger, S., Dähne, M., Gallus, A., Hansen, S., Honnef, C.G., Koblitz, J.C., Krügel, K., Liebschner, A., Narberhaus, I., Verfuß, U.K. (in prep): Baltic Sea harbour porpoise populations: Status and conservation needs derived from recent survey results.

Berggren P., Hiby, L., Lovell, P., Scheidat, M. (2004): Abundance of harbour porpoises in the Baltic Sea from aerial surveys conducted in summer 2002. Paper SC/56/SM7 presented to the IWC Scientific Committee, July 2004, Sorrento, Italy.

Galatius, A., Kinze, C.C., Teilmann, J. (2012): Population structure of harbour porpoises in the Baltic region: evidence of separation based on geometric morphometric comparisons. *Journal of the Marine Biological Association of the United Kingdom*.

Gilles, A., Peschko, V., Siebert, U., Gallus, A., Hansen, S., Krügel, K., Dähne, M., Benke, H. (2011): *Marine Säugetiere und Seevögel in der deutschen AWZ von Nord und Ostsee*.

Huggenberger, S., Benke, H., Kinze, C.C. (2002): Geographical variation in harbour porpoise (*Phocaena phocaena*) skulls: Support for a separate non-migratory population in the Baltic proper. *Ophelia* 56: 1-12.

Sveegaard, S. (2011): Spatial and temporal distribution of harbour porpoises in relation to their prey. In *NERI*, vol. PhD, pp. 128: Aarhus University.

Wiemann, A., Andersen, L.W., Berggren, P., Siebert, U., Benke, H., Teilmann, J., Lockyer, C., Pawliczka, I., Skora, K., Roos, A. et al. (2010): Mitochondrial Control Region and microsatellite analyses on harbour porpoise (*Phocoena phocoena*) unravel population differentiation in the Baltic Sea and adjacent waters. *Conservation Genetics* 11: 195-211.

## Recovery of the Grey Seal (*Halichoerus grypus*) Population in the Southern Baltic

ANDERS GALATIUS

Aarhus University, Denmark

### Abstract

The Baltic Sea grey seal is a distinct population which has different phenology of breeding and moulting to that of Atlantic grey seals. It is thought that there may previously have been as many as 100,000 grey seals in the Baltic Sea and the species used to be distributed throughout the marine area. During the 20<sup>th</sup> century, anthropogenic impacts, especially hunting and pollution, brought the abundance of Baltic grey seals down to around 2,000 individuals in the late 1970s. Since then pollution with persistent organochlorines has decreased and the seals have enjoyed protection and numbers have steadily increased. However, until recently, the Baltic grey seal distribution was largely limited to areas north of N 58°. During the last 10 years, grey seals have reappeared in the southern Baltic in increasing numbers, especially in southern Sweden and Denmark, but also in Poland and Germany.

This presentation focuses on the results of the Danish marine mammal monitoring programme regarding the grey seal and the future initiatives to understand the impacts of the return of the largest predator to the ecosystem. Seal haul-out sites in Denmark have been covered by a programme of aerial survey during the pupping and moulting seasons of the harbour seal since 1979. During the last 10 years, irregular surveys have also been performed during the pupping and moulting seasons of the Baltic grey seal, in February/March and May/June, respectively. In 2011 a dedicated monitoring programme of the grey seal in Danish waters commenced. In the Danish and southern Swedish Baltic, we have performed surveys during the grey seal moult in 8 of the last 10 years. Between 2002 and 2009 we obtained counts ranging from 78 to 145 with an increasing trend. In 2010 and 2011 we counted 301 and 766, respectively. The count for 2011 was almost the same as the number of harbour seal counted during the moulting period of this species. Concurrently, we have experienced an increasing amount of reports from fishermen regarding seal conflicts. Further north, in Kattegat, we have never recorded more than 50 seals during any one survey, and it is unclear whether grey seals here are immigrants from the Atlantic or the Baltic.

The first grey seal pups since the reappearance of the grey seal was registered at Rødsand in 2003. Since then, grey seal pups have been observed at Rødsand in most years, the highest number in one year being five. Over the last eight years, two pups

have been recorded in Kattegat. Grey seals females are known to be very philopatric with regard to pupping, so reestablishment of a large number of breeding grey seals in Danish waters may prove to be a slow and gradual process. Given the low number of pups born in Danish waters, it is clear that increasing numbers of grey seals are caused by immigration from neighbouring areas. In the Baltic at large, there has been a substantial growth in grey seal numbers during the last 10 years, but recently the increasing trend has leveled off. It is probable that the population is approaching carrying capacity in the inner Baltic, which is a likely explanation for the reappearance of the grey seal in Denmark in large numbers.

As immigration of such numbers of a large predator will have profound impacts on the ecosystem, we are planning to intensify our grey seal research with diet studies, genetics, telemetry and photo identification, in order to assess impacts on fish stocks, competition with harbour seals, contributing areas and conflicts with fisheries.

## **Annex**

---



## List of speakers

**Dieter Boedeker**

Federal Agency for Nature Conservation  
Isle of Vilm  
18581 Putbus  
Germany  
dieter.boedeker@bfn-vilm.de

**Dr. Janet Brown**

The Shellfish Team  
2 Annfield Grove, Stirling  
FK8 2BN  
jan.brown@dsl.pipex.com

**Dr. Anne Christine Brusendorff**

Executive Secretary  
International Council of the Exploration of the Sea  
H.C. Andersens Boulevard 44-46  
1553 Copenhagen  
Denmark  
anne.christine@ices.dk

**Dr. Joachim Claudet**

National Center for Scientific Research  
  
University of Perpignan  
66860 Perpignan cedex  
France  
joachim.claudet@gmail.com

**Dr. An Cliquet**

Department of Public International Law  
  
Ghent University  
Volderstraat 3  
9000 Gent  
Belgium  
An.Cliquet@ugent.be

**Prof. Dr. Detlef Czybulka**

University of Rostock  
Faculty of Law and Interdisciplinary Faculty of Research  
Richard-Wagner-Straße 31  
18051 Rostock  
Germany  
detlef.czybulka@uni-rostock.de

**Dr. Kim Detloff**

Policy Officer for Marine Conservation  
Nature and Biodiversity Conservation Union  
Charitéstraße 3  
10117 Berlin  
Germany  
kim.detloff@nabu.de

**Jens Enemark**

Secretary  
Common Wadden Sea Secretariat  
Virchowstrasse 1  
26382 Wilhelmshaven  
Germany  
enemark@waddensea-secretariat.org

**Sarah Fowler**

Principal Scientist  
Save Our Seas Foundation  
123 Greenham Road  
Newbury RG14 7JE  
United Kingdom  
fowler.sarah.123@gmail.com

**Prof. Dr. Rainer Froese**

Helmholtz-Centre for Ocean Research  
Duesternbrooker Weg 20  
24105 Kiel  
Germany  
rfroese@geomar.de

**Dr. Anders Galatius**

Aarhus University  
Department of Bioscience  
4000 Roskilde  
Denmark  
agj@dmu.dk

**Dr. Stefan Garthe**

University of Kiel  
Hafentörn 1  
25761 Büsum  
Germany  
garthe@ftz-west.uni-kiel.de

**Josh Gibson**

Great Barrier Reef Marine Park Authority  
PO Box 1379 Townsville  
4810 Australia  
josh.gibson@gbrmpa.gov.au

**Stefan Görnitz**

InterSus - Sustainability Services  
Chodowieckistr. 2  
10405 Berlin  
goerlitz@intersus.eu

**Heike Imhoff**

Federal Ministry for the Environment, Nature  
Conservation and Nuclear Safety  
Robert-Schuman-Platz 3  
53175 Bonn  
Germany

**Prof. Dr. Beate Jessel**

President  
Federal Agency for Nature Conservation  
Konstantinstraße 10  
53179 Bonn  
Germany

**Dr. Britta Knefelkamp**

Ministry of Energy, Agriculture,  
the Environment and Rural Areas  
Mercatorstraße 3  
24106 Kiel  
Germany  
britta.knefelkamp@melur.landsh.de

**Jens Koblitz**

German Oceanographic Museum  
Katharinenberg 14-20  
18437 Stralsund  
Germany  
jens.koblitz@meeresmuseum.de

**Sara Königson**

Swedish University of Agricultural Sciences  
Department of Aquatic Resources  
Turistgatan 5  
453 21 Lysekil  
Sweden  
sara.konigson@slu.se

**Dr. Jochen Krause**

Federal Agency for Nature Conservation  
Isle of Vilm  
18581 Putbus  
Germany  
jochen.krause@bfn-vilm.de

**Dr. Dan Laffoley**

Vice Chair/Senior Advisor  
World Commission on Protected Areas/  
Global Marine and Polar Programme, IUCN  
28 rue Mauverney  
CH-1196 Gland  
Switzerland  
danlaffoley@btinternet.com

**Christophe Lefebvre**

French MPA Agency  
Nausicaa- Bd Sainte Beuve  
62200 boulogne sur mer  
France  
christophe.lefebvre@aires-marines.fr

**Karin Lüdemann**

Wissenschaftsbüro  
Telemannstr. 56a  
20255 Hamburg  
Germany  
luedemann@wissensbuero-hh.de

**Pilar Marin**

Marine Habitats Scientist  
Oceana  
Plaza España - Leganitos, 47  
28013 Madrid  
Spain  
pmarin@oceana.org

**Katharina Maschner**

German Oceanographic Museum  
Katharinenberg 14-20  
18439 Stralsund  
Germany  
office@pmce2012.de

**Lonnie Mikkelsen**

Aarhus University  
Frederiksborgvej 399  
4000 Roskilde  
Denmark  
lonniemik@hotmail.com

**Dr. Ingo Narberhaus**

Federal Agency for Nature Conservation  
Isle of Vilm  
18581 Putbus  
Germany  
ingo.narberhaus@bfn-vilm.de

**Hans Nieuwenhuis**

Ministry of Economic Affairs, Agriculture & Innovation  
PO Box 20401  
The Hague  
The Netherlands  
j.w.nieuwenhuis@mineleni.nl

**Dr. Jenny Oates**

UK Marine Protected Areas Adviser  
Joint Nature Conservation Committee  
Monkstone House/City Road  
Peterborough  
PE1 1JY  
United Kingdom  
jenny.oates@jncc.gov.uk

**Tim Packeiser**

WWF  
High Seas & Marine Ecoregions  
Mönckebergstraße 27  
20095 Hamburg  
Germany  
tim.packeiser@wwf.de

**Fotios Papoulias**

European Commission  
DG Environment - Unit B.3  
1049 Brussels  
Brussels  
fotios.papoulias@ec.europa.eu

**Vangelis Paravas**

MOm Hellenic Society for the Study  
and Protection of the Monk Seal  
Solomon street 18  
10682 Athens  
Greece  
v.paravas@mom.gr

**Dr. Christian Pusch**

Federal Agency for Nature Conservation  
Isle of Vilm  
18581 Putbus  
Germany  
christian.pusch@bfn-vilm.de

**Dr. Marc Reichenbach**

ARSU GmbH  
Escherweg 1  
26121 Oldenburg  
Germany  
reichenbach@arsu.de

**Marie Romani**

Executive Secretary  
Mediterranean Protected Areas Network  
avenue Alexis Godillot  
83400 Hyeres  
France  
marie.romani@medpan.org

**Max Schuster**

DW-ShipConsult GmbH  
Lise-Meitner-Strasse 1-7  
24223 Schwentinental  
Germany  
schuster@dw-sc.de

**Marije Siemensma**

Marine Science & Communication  
Bosstraat 123  
3971 XC Driebergen-Rijsenburg  
The Netherlands  
m.siemensma@msandc.nl

**Edward Vanden Berghe**

Ocean Biogeographic Information System  
Rutgers University  
Institute for marine and Coastal Sciences  
71 Dudley Road  
New Brunswick  
NJ 08901  
USA  
evberghe@gmail.com

**Wim van Urk**

Projectmanger Marine Strategy  
Ministry of Infrastructure and the Environment  
Plesmanweg 1-6  
Postbus 20904 2500EX  
Den Haag  
The Netherlands  
wim.van.urb@minienm.nl

**Dr. Henning von Nordheim**

Scientific Director  
Federal Agency for Nature Conservation  
Isle of Vilm  
18581 Putbus  
Germany  
henning.von.nordheim@bfn-vilm.de

**Prof. Phil Weaver**

National Oceanograph Centre  
European Way  
Southampton  
United Kingdom  
ppew@noc.ac.uk

**Dr. Lindy Weilgart**

Dalhousie University  
Department of Biology  
1355 Oxford St.  
B3H 4R2 Halifax  
Canada  
lweilgar@dal.ca

**Katrin Wollny-Goerke**

Kakenhaner Weg 170  
22397 Hamburg  
Germany  
info@meeresmedien.de

## Conference Programme: Progress in Marine Conservation in Europe 2012

### Monday, 18 June 2012

17:30 - 20:00 Arrival and Registration

18:00 - 22:00 Get-Together-Party

**Venue: German Oceanographic Museum**

Main entrance: Mönchstraße/Bielkenhagen, Stralsund

### Tuesday, 19 June 2012

**09:15 Opening by the Federal Agency for Nature Conservation**

**09:20 Welcome**

Harald Benke, Director of the German Oceanographic Museum

**09:30 Key Issues in Marine Conservation in Europe and Introduction to the Conference**

Beate Jessel, President of the Federal Agency for Nature Conservation, Germany

**10:00 Coffee/Tea**

**10:50 Key Note: Today`s Global Oceans Stresses, Impacts and Solutions - The State of the Ocean Report**

Dan Laffoley, World Commission on Protected Areas and the Global Marine and Polar Programme, IUCN

**11:30 Lunch**

### Marine Biodiversity and Networks of Marine Protected Areas

**13:30 Towards a Global Network of MPAs**

Henning von Nordheim, Federal Agency for Nature Conservation, Germany

**14.10 Natura 2000 Networks in European Marine Areas in Relation to the Marine Strategy Framework Directive (MSFD)**

Fotios Papoulias, European Commission, Brussels

**14:50 Network of MPAs in the Maritime Area of OSPAR and HELCOM by 2012**

Tim Packeiser, World Wide Fund for Nature, Germany

Dieter Boedeker, Federal Agency for Nature Conservation, Germany

**15:30 MPAs in the Mediterranean Sea - Coherence and Efficiency**

Marie Romani, Mediterranean Protected Areas Network, France

**15:50 Progress of the UK's MPAs towards an Ecologically Coherent Network**

Jenny Oates and Jon Davies, Joint Nature Conservation

Committee, United Kingdom

**16:30** *Coffee/Tea*

**Management and Monitoring of Marine Protected Areas**

**17:10 Towards the Management of MPAs in the German EEZ of the North- and Baltic Sea**

Jochen Krause, Federal Agency of Nature Conservation, Germany

Detlef Czybulka, University of Rostock, Germany

**17:50 Wadden Sea World Heritage - Recent Progress in Protecting and Managing the World's largest Tidal Barrier Island System**

Jens Enemark, Executive Secretary, Common Wadden Sea Secretariat

**19:30** *Conference Buffet/Venue: German Oceanographic Museum*

Main entrance: Mönchstraße/Bielkenhagen, Stralsund

**Wednesday, 20 June 2012**

**Management of Anthropogenic Impacts on Marine Ecosystems**

**09:00 International Council of the Exploration of the Sea and Marine Biodiversity**

Anne Christine Brusendorff, Executive Secretary, International Council of the Exploration of the Sea, Denmark

**09:30 Minimizing Underwater Sound from Offshore Wind Park Constructions**

Karin Lüdemann, Wissenschaftsbüro Hamburg, Germany

Sven Koschinski, Meereszoologie, Germany

**10:10 Alternative Quieter Technologies to Seismic Airguns for Collecting Geophysical Data**

Lindy Weilgart, Dalhousie University, Canada

**10:50 Marine Litter - Projects and Solutions**

Kim Detloff, Nature and Biodiversity Conservation Union, Germany

**11:10** *Coffee/Tea*

**11:40 Sensitivity of Seabirds to Anthropogenic Activities: a multi-factorial Approach**

Stefan Garthe, Research and Technology Centre Westcoast, Germany

**12:20 Conflicting Interests between Windfarm Development and the Designation of a Natura 2000 Site: a Belgium Case Study**

An Cliquet and Hendrik Schoukens, Ghent University, Belgium

**12:40 Great Barrier Reef Marine Park Authorities Strategic Assessment of planned and potential future Development on the Great Barrier Reef**

Josh Gibson, Great Barrier Reef Marine Park Authority, Australia

**13:20 Lunch**

**14:30 Excursions**

- Guided Sight-Seeing Tour through the old Hanseatic City of Stralsund
- Guided Tour through the Ozeaneum, Stralsund
- Guided Tour through the German Oceanographic Museum, Stralsund
- Guided Tour to the Isle of Vilm, Rügen
- Guided Tour to the Jasmund National Park, Rügen

**Thursday, 21 June 2012**

**Marine Nature Conservation and Fisheries in Europe**

**09:00 Towards Sustainable Fisheries in Europe**

Rainer Froese, Geomar, Germany

**09:40 Role of No-take Marine Reserves in the Protection of Marine Biodiversity**

Josh Gibson, Great Barrier Reef Marine Park Authority, Australia

**10:20 Positive Effects of MPAs on the Mediterranean Marine Biodiversity**

Joachim Claudet, University of Perpignan, France

**11:00 Coffee/Tea**

**11:30 Fisheries Measures in German Natura 2000 Sites**

Christian Pusch, Federal Agency for Nature Conservation, Germany

**12:10 Implementation of Natura 2000 in the Dutch North Sea: Managing Fisheries**

Hans Nieuwenhuis, Ministry of Agriculture, Nature Conservation and Food Quality, The Netherlands

**12:50 Lunch**

**14:10 Alternative Fishing Gear - Some Possible Solutions**

Sara Königson, University of Agriculture Science, Sweden

### Short Notes/Project Reports

**14:50 Census of Marine Life and the Ocean Biogeographic Information System (OBIS) - Where do we go from here? - Future Perspectives**

Edward Vanden Berghe, Rutgers University, USA

**15:20 Seabed Mapping and its Contribution to the Goal of Sustainable Management in the Ocean**

Philip Weaver, National Oceanography Centre, United Kingdom

**15:40 Mapping of Underwater Noise**

Max Schuster, DW-ShipConsult, Germany

**16:00 *Coffee/Tea***

**16:30 Reduction of Light Emissions of an Offshore Oil Platform to minimize Impacts on Bird Migration**

Marc Reichenbach, Arsu GmbH, Germany

**16:50 BlueReef - a Danish Marine Nature Restoration Project**

Lonnie Mikkelsen, Aarhus University, Denmark

### Conference Announcements and Presentations of New Marine Films/Books

**17:10 Protecting European Seas: Designating MPAs in the Baltic and the Mediterranean**

Nicolas Fournier, Oceana, Belgium

**17:25 Introduction to the IMPAC 3 Congress 2013, Marseille: a Dive in the "Oceankind"**

Christophe Lefebvre, French MPA Agency and IUCN, France

**17:35 Threatened Biodiversity in the German North and Baltic Seas - New BfN Book Publication**

Ingo Narberhaus, Federal Agency for Nature Conservation, Germany

### Friday, 22 June 2012

#### European Marine Strategy Framework Directive (MSFD)

**09:00 Implementing the Marine Strategy Framework Directive (MSFD) – a Challenge in every Respect**

Heike Imhoff, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany

**09:20 The European Marine Strategy Framework Directive (MSFD) – State of Implementation in Germany**

Britta Knepfkamp, University of Vechta, Germany

Ingo Narberhaus & Jochen Krause, Federal Agency for Nature Conservation, Germany

Uli Claussen, Federal Environment Agency, Germany

**10:00 Status Quo of the Marine Strategy Framework Directive (MSFD) in The Netherlands**

Wim van Urk, Ministry of Infrastructure and the Environment, The Netherlands

**10:40 Economic Aspects of the MSFD: Why and how to estimate the Benefits of Measures?**

Stefan Görlitz & Eduard Interwies, InterSus - Sustainability Services, Germany

**11:00** *Coffee/Tea*

**Protection of Marine Endangered Species**

**11:30 Restoration of European Oyster (*Ostrea edulis*) Reefs**

Janet Brown, Association of Scottish Shellfish Growers, United Kingdom

**11:50 Mediterranean Monk Seal Conservation: The Role of MPAs in Hellenic Seas**

Vangelis Paravas, Hellenic Society for the Study and Protection of the Mediterranean Monk Seal, Greece

**12:10 Conservation and Management of Northeast Atlantic Sharks**

Sarah Fowler, Naturebureau International, United Kingdom

**12:30 The Netherlands Harbour Porpoise (*Phocoena phocoena*) Species Conservation Plan**

Marije Siemensma, Marine Science and Communication,  
The Netherlands

**12:50 Trends in Harbour Porpoise (*Phocoena phocoena*) Populations in the Baltic Sea and Respective Management Requirements**

Jens Koblitz, German Oceanographic Museum, Germany

**13:10 Recovery of Grey Seal (*Halichoerus grypus*) Populations in the North- and Baltic Seas**

Anders Galatius Jørgensen, Aarhus University, Denmark

**13:30** *Closing of Conference*