Workshop on the Development and Management of Marine Protected Areas

May 7th to 15th, Kasnäs - Finland

Edited by Thomas K. Sørensen

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Content

Foreword	7
Summary	11
1. Introduction	13
2. The Workshop	15
3. Summaries of presentations	21
3.1 An Introduction to Marine Protected Areas	21
3.2 Marine Biodiversity- A Framework for Inventory and Conservation	23
3.3 An Overview of Selection Approaches and the use of GIS & Decision Support Tools for Marine Protected Areas (MPA) Planning	25
3.4 MPAs and fisheries	42
3.5 Summary of presentations on marine management	48
3.6 Monitoring marine protected areas	56
3.7 Summary of Flamborough Head Candidate Special Area of Conservation (N & E Yorkshire, England) Subtidal Condition Assessment	63
4. Epilogue	67
Annexes 1-4: Reports from group sessions	69
Annex 1: Report from group session 1 on approaches to marine conservation, site selection and threats to the marine environment	71
Annex 2: Report from group session 2 on stakeholders and legal issues	81
Annex 3: Report from group session 3 on MPAs in relation to fish conservation	87
Annex 4: Report from group session 4 on monitoring of MPAs	92
Workshop Evaluation	97
Dansk Resumé	101
Suomenkielinen tiivistelmä (Finnish Summary)	103
Programme	105
Acknowledgements	107
List of Attendees	108

Foreword

Prologue

This report is a documentary of the Workshop on the Development and Management of Marine Protected Areas that was held at Metsähallitus “Blue mussel” Visitor Centre in Kasnäs, Finland 8-15 May 2004.

The workshop was organised by the Finnish Metsähallitus, the Finnish Ministry of the Environment, Tjärnö Marine Biological Laboratory in Sweden, the Danish Forest and Nature Agency (Skov- og Naturstyrelsen), IUCN- The World Conservation Union and the Helsinki Commission (HELCOM). The workshop received its main funding from The Nordic Council of Ministers and the Finnish Ministry of the Environment while Metsähallitus, IUCN- The World Conservation Union, and the Helsinki Commission (HELCOM) provided supplementary funding.

The aim of the workshop was, through presentations and group sessions, to equip the participants with the most important practical and theoretical tools, methods and approaches needed in selecting, developing and managing marine protected areas. The participants were government planners and managers (3/5), researchers (1/5) and NGO's (1/5) from nine different countries. *Emphasis was on the event itself, e.g. the presentations, demonstrations, the interactive group sessions, personal connections, new ideas etc.* This report provides written summaries of the presentations and main results from group sessions. In addition to the published report, a compact disc (CD) has been compiled during the workshop. This CD contains relevant publications (as PDF and Word files) provided by the lecturers, participants and the organisers. It also contains digital photographs taken during the workshop. This CD was first intended as a part of this report but, due to technical and financial reasons, will only be provided upon request.

Background

The idea to organise an international workshop on marine nature conservation in Finland was given by Rauno Väisänen, the Director of the Natural Heritage Services at Metsähallitus, who asked me to consider this idea at some point in the future. I interpreted this as an encouragement to take his idea further, should an opportunity arise to do so. The opportunity presented itself less than a week later at an MPA seminar in October 2002 in Stockholm, organised by WWF and Naturvårdsverket. At this seminar Per Nilsson and I recollected the courses organised by the Nordic Marine Biological Collegium in the 1980s and early 1990s. These courses were an excellent way to obtain an insight into a specific topic in only one or two weeks through the excellent guidance of first-class teachers. The feeling of equality, enthusiasm and humour on these courses was always

special. The new friends one made during these courses later enabled the exchange of ideas and the generation of new research projects. We were curious to know if the concept would still work – perhaps as a workshop with lectures combined with group work? The very same day we had the pleasure of listening to a string of presentations on marine protected areas given by Jon Day from the GBRMPA. During lunch that day, the idea of a Nordic MPA workshop was presented to Jon and he thought it was a good idea, and he made good suggestions regarding how to set it all up. I returned home with Rauno's idea wrapped up with the support provided by Per and Jon and put it on the shelf with other nicely wrapped ideas and almost forgot about it.

A month later Carl Gustav Lundin of IUCN visited Finland and we had a chance to chat about marine protection in general. Something made me unfold the MPA workshop idea to him and the need and potential of such a workshop once again became apparent. Carl Gustav made good suggestions on how to carry out the workshop.

The application to the Nordic Council of Ministers (NCM) was made less than half a year later by Penina Blankett, Per, Stig Helmig and myself. NCM was able to process the application rapidly and they gave us the green light in only a few months. The Finnish Ministry of Environment confirmed its funding somewhat later. With the funding in order, it was then time to take the first significant steps of making it all happen. I decided to make a phone call to John Baxter to ask for his advice on how to proceed.

John's experience and exceptionally good network of colleagues proved to be very useful. John supported our idea to have Jon Davies as our lecturer on the topic of marine monitoring (of course). Jon Davies became a part of our team of lecturers less than a week later. John Baxter also suggested that we contact John Roff and ask him to take care of the MPA site selection and network design part. I found myself in Durban at the World Park Congress before I had a chance to contact John Roff. Despite the impressive 3000 congress participants, I was lucky to run into Jon Day already on the first day and he surprised me by saying that John Roff, whom he knew well, was also at the conference. John Roff was happy to join us and the three of us had a chance to plan the workshop already in Durban. Carl Gustav Lundin too was at the conference and we were able to draft the next steps for the planning of the workshop programme. Things started to look very good indeed.

The next steps in the planning were taken at our planning meeting in Copenhagen, at Skov- og Naturstyrelsen, in early December 2003. Carl Gustav Lundin had asked Kirsten Martin, his colleague from IUCN, to join us in planning and organising. We agreed about the name and general structure of the workshop, acknowledging the suggestions given by three of our four Johns (Baxter, Day and Roff). At this point we still lacked a fish conservationist lecturer and someone who could introduce

the workshop to MPA site selection algorithms and software. John Roff and John Baxter helped us to find Jeff Hutchings who is a highly appreciated fish conservationist, a friendly guy and a good teacher. At the same time Hussein Alidina was suggested by John Roff as a good choice for our site selection lectures. Thereby all topics had their lecturers and our attention was then given to practical matters for the months to come.

We had already in Copenhagen realised that the practical workshop matters would require a lot of attention. Where would we find a good workshop assistant? I had at this point absolutely no idea and admitted that I had overlooked this when I wrote the budget - a clear mistake from my side. Stig Helmig mentioned that at his office Thomas Kirk Sørensen seemed very interested in becoming our workshop assistant. I received an email from Thomas right before Christmas but the lack of funding forced me to write that we at that point did not have any position to offer him, unfortunately. Nevertheless, matters improved rapidly already in January and I was able to contact Thomas with a joint offer from the Finnish Centre for International Mobility (CIMO) and Metsähallitus to employ him. He started his job as a workshop assistant at my office in March and immediately proved to be a very efficient and reliable person. I felt once again that we had been extremely lucky in our attempts to organise this workshop.

The good luck continued when Hussein Alidina and Jeff Hutchings both confirmed that they wanted to be part of the workshop. Applications for the workshop had by that time poured in and the workshop was soon completely booked with several on the waiting list. It was at about that time when we received news from Jeff Hutchings that he would not be able to take part in the workshop due to some unexpected and important family matters. With about a month to go before the workshop would begin, this put us in an awkward position since few experts, if any, would be able to replace Jeff on such short notice. We worked hard to look for a solution to this problem by searching for an expert outside our own group. I must admit that I was a bit worried. Then, again, Lady Fortuna helped us out. Per Nilsson suggested that he could take care of the fish conservation lecture.

The last weeks before the workshop were as hectic as one might expect with rapid shifts in the list of participants, arrival and departure arrangements, gathering of all the equipment we were going to need, and checking everything several times over. Thomas and Kirsten Martin's engagement in the preparation work was admirable and indispensable in making everything run like clockwork.

This report edited by Thomas Kirk Sørensen will give you a good idea of what we were doing at the workshop. Happy reading!

Jan Ekeboom

Main organiser and project leader for the workshop
Helsinki

Summary

Marine protected areas (MPAs) are increasingly being developed and utilised as management tools in efforts to conserve and protect fish stocks and marine biodiversity in Northern European seas. Different areas require different measures, but there are nonetheless several overarching themes that can and must be taken into consideration in all cases in order to ensure sound development and management of MPAs. The workshop aimed to provide planners and managers with knowledge of most of these themes and thus give marine conservation efforts a push forward.

The majority of the workshop programme was kept in a general, non-politicised setting, so that lessons learnt would be as widely relevant and applicable as possible. It was not the aim of the workshop to bring about official recommendations.

The international team of speakers consisted of Jon Day of the Great Barrier Reef Marine Park Authority, John Roff of Acadia University, Canada, Hussein Alidina of Dalhousie University and Canada/WWF-Canada, Per Nilsson of Tjärnö Marine Biological Laboratory, Sweden, John Baxter of Scottish Natural Heritage, Scotland, and Jon Davies of the Joint Nature Conservation Committee, UK.

Throughout the week, discussions and presentations revolved around topics such as marine biodiversity conservation, MPA site selection, Decision Support Systems (e.g. MARXAN software), mapping of marine areas, monitoring, fish conservation, stakeholder involvement, zoning, and management effectiveness. Lessons learnt from e.g. Australia and Canada were concurrently applied to the Nordic/Baltic setting.

Group sessions revealed large divergences among the participants' countries concerning the progress of establishing well-managed MPAs. Similar divergences existed concerning the frameworks in which MPAs are/can be established. However, save for a few exceptions, most participants encountered very similar obstacles in their daily work with marine conservation. The workshop in its entirety revealed a need for more workshops in the future with more specific themes, where MPA planners and managers can further discuss ways to overcome these obstacles.

The friendly and relaxed atmosphere of the workshop inspired open and frank discussions among the participants, resulting in new collaborations and strengthened relationships across sectors and borders.

1. Introduction

For many decades, our marine and coastal ecosystems have been under increasing pressure from human activities. Our seas are under constant bombardment from an arsenal of threats that include e.g. dredging, pollution (including run-off from land), coastal development, and invasive species (e.g. Salm et al 2000; Palumbi 2002). Commercial fishing has resulted in overfishing, and the use of fishing gear that dig into the seabed has permanently altered crucial habitats, leaving some heavily fished areas in a perpetual state of disturbance (Peterson & Estes 2001 in Palumbi 2002).

Marine protected areas, or MPAs for short, have become one of the most common and well-understood tools for mitigating these threats and managing marine and coastal ecosystems. Marine reserves, marine national parks and marine sanctuaries are but three examples of the dozens of different terms used to describe the equally numerous types of existing MPAs around the world. Many attempts have been made to find a universal definition for MPAs, but the one that is most commonly accepted is that of IUCN:

“Any area of intertidal or subtidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.”

(Kelleher 1999)

There is currently much activity in the field of marine conservation in general and marine protected areas in particular. The Helsinki Commission (HELCOM) in the Baltic Sea, the OSPAR Commission in the North-East Atlantic, the EU Natura 2000 Network, and the EMERALD Network of the Bern Convention all have marine protected areas (MPAs) under development in their respective programmes, and many countries are individually utilising MPAs in their national conservation programmes.

A growing number of scientists believe that systems or networks of MPAs are more effective in conserving species and habitats than individual MPAs established in isolation (e.g. Day & Roff 2000; Jones 2002; Gladstone et al 2003). The majority of all marine organisms have at least one life stage that is pelagic and therefore marine areas and ecosystems that are separated by distance can be far more interconnected than is the case for terrestrial areas (Jones 2002). True MPA networks (and not merely *sets* of MPAs) should consist of areas that represent the environ-

mental gradients in a region (e.g. habitats, species, bathymetry, salinity, currents, etc.) (Day & Roff 2000). Regions contain distinctive components of global biodiversity that can only be conserved by regional cooperation, because they occur across several countries that share a common sea area (Gladstone et al 2003). This in turn fosters international collaborations and the sharing of e.g. management expertise and human resources for mapping and monitoring of marine sites (Gladstone et al 2003).

Development and management of MPAs and networks of MPAs requires a collaboration between a.o. science, NGO's, administration and stakeholders, sometimes even across national borders. As potential sites for MPAs often have administrative overlaps, reluctant stakeholders, and an understanding of the marine environment that is usually lower than that on land, effective development and management of MPAs provides a challenge, and it is crucial that the objectives are clear and focused in order for MPAs to succeed. For instance, MPAs established for the conservation of biodiversity and/or fisheries should have a solid foundation in science to succeed, as MPAs with little biological value are like a bank account with little money yielding almost no interest (Roberts et. al 2003). Thus, in order to ensure effective selection, development and management of MPAs and networks of MPAs, it is necessary to have solid knowledge of existing habitats, species, oceanographic and physiographic features (Day & Roff 2000), and socio-economic factors (Pomeroy et al 2004).

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2. The Workshop

The presentations and the experience of the speakers made up the backbone of the workshop, providing the themes and the tools for further discussion. With an international group of participants consisting of approximately 1/5 university researchers, 1/5 NGOs and 3/5 government (see List of Attendees), these discussions had optimal conditions. In the intermissions and in the group sessions, the participants talked about issues, experiences and future plans among themselves, and continued to do so whenever the possibilities arose throughout the week.

Day 1, Saturday May 8

Having met in central Helsinki one day earlier for a planning meeting at HELCOM, the guest speakers and organisers joined the international group of workshop participants on Saturday morning May 8 2004 in central Helsinki. We boarded a bus and travelled the 200 km to Kasnäs, where the workshop on the development and management of marine protected areas was to take place over the following seven days. Kasnäs is known as one of the main gateways to the Southern Archipelago National Park and was, with its natural scenic beauty and proximity to the Gulf of Finland, considered an appropriate backdrop for a workshop on the protection of marine values.

After receiving our rooms in Hotel Kasnäs, we assembled in the national park's Blue Mussel Visitor Centre nearby where we were greeted and given an introduction to the area by centre manager Inkeri Holma. In the evening we all got to know one another during a welcome dinner.

In the largest of four conference rooms we had upon arrival established a workshop library that expanded substantially over the following days. By the end of the workshop it had turned into a fully fledged MPA library with general and country specific reports and much other literature that was brought by the organisers as well as collected from all of the participants. Many of these useful documents, along with a selection of photos and all of the Power Point presentations given at the workshop, were distributed to the participants in the form of a CD-ROM on the last day of the workshop.

Day 2, Sunday May 9

With three presentations on the programme, Sunday was the first working day of the workshop. In the morning, John Baxter of Scottish Natural Heritage gave an introductory presentation entitled "Why Marine Protected Areas?" The following are just some of the points covered by John Baxter:

MPA definitions and types

Do MPAs work?

MPAs are a tool

After a short break, John Roff of Acadia University, Canada began his presentation “Marine biodiversity- a framework for inventory and conservation”, among other things answering questions regarding the selection of sites for marine protection, the size of MPAs, distribution, etc.:

- approaches to marine conservation
- definitions and components of marine biodiversity
- representative & distinctive habitats and their mapping
- selecting networks of MPAs including connectivity
- coastal zone management
- assessing success in “capturing” marine biodiversity

In the afternoon, Hussein Alidina of Dalhousie University, Canada and WWF-Canada gave his lecture on “The use of mapping tools, GIS, site selection software and other tools in site selection, including a demonstration of the software MARXAN.”

Day 3, Monday May 10

Jon Day of the Great Barrier Reef Marine Park Authority gave the first part of his two-part presentation: “Development and management of MPAs...an overview”. As was the case for all of the speakers, Jon Day was very effective in relating the lessons learnt from his day to day work, i.e. with the Great Barrier Reef, to conditions closer to the Nordic countries, e.g. the Baltic Sea. This put many of the points into perspective and was very useful to the audience. In this first part of Jon Day’s presentation, he covered a.o. the following topics:

- establishing MPAs
- requirements for effective marine conservation
- threats to the marine environment, and whether or not MPAs can address them
- differing perspectives
- introduction to the Great Barrier Reef Marine Park (GBRMP) and its issues
- case study: rezoning the GBRMP (especially concerning public participation)
- lessons learnt from GBR planning and Representative Areas Programme

In the afternoon the participants were divided into four groups for group discussions based on the talks of John Roff, Hussein Alidina and Jon Day. For the outcomes of these and other group sessions, see Annexes 1-4.

Day 4, Tuesday May 11

In the morning Jon Day presented the second part of his lecture, which consisted mostly of management aspects of MPAs:

- management tools (e.g. plans, permits, education, enforcement, site planning)
- adaptive management
- management effectiveness
- lessons learnt about MPA planning and management

After lunch, John Baxter gave a presentation on “Establishment of marine sites for the Natura 2000 network using the UK experience as an example”. In this presentation John Baxter illustrated a.o. the following points:

- summary of Natura 2000
- national legislation relevant to the UK SACs
- site selection process
- development of management schemes for SACs
- stakeholder relations, informing the public, tailoring outputs (e.g. videos)
- obstacles in implementation of SACs
- lessons learnt

In the afternoon we convened in three groups for group sessions, which mainly revolved around the subjects of stakeholders and legal issues pertaining to MPAs.

In the evening we enjoyed a traditional Finnish sauna.

Day 5, Wednesday May 12

Wednesday was dedicated to fish conservation. Per Nilsson of Tjärnö Marine Biological Laboratory, Sweden, gave morning and afternoon presentations on the subject and covered, a.o. the following points:

- the global importance and problems of fisheries
- shifting baselines
- fish population dynamics
- categories of overfishing
- trophic cascades effects
- MPA design for the protection of fish and/or fisheries
- management options (e.g. no-take), numbers and size of MPAs
- theoretical and documented effects of MPAs on fish and/or fisheries, incl. spillover effect
- case study: Kosterfjorden, Sweden.

In the afternoon we divided into three groups for the group sessions on the subject of fish conservation.

After supper we convened in the library for presentations by some of the workshop participants. Jochen Krause from Germany gave a presentation on “Conservation objectives and tools to identify and delineate Natura 2000 sites” and showed the video “Habitat Mare- Natura 2000”. Next, Alexei Zavarzin and Elena Lukina gave a presentation on “MPAs in the Russian Federation- with particular emphasis on Baltic Russia”.

In the adjoining room, Hussein Alidina conducted a MARXAN tutorial for those interested in getting better acquainted with this site selection software.

Day 6, Thursday May 13

Thursday was the day of our excursion. In sunshine we sailed through the archipelago to the Bangtskär lighthouse island. A guide told us the fascinating history of the lighthouse and warned us not to disturb the nesting eider ducks in the area. We explored the island and made our way to the top of the lighthouse, where there was a fantastic view of the archipelago.

After lunch we sailed to the island of Rosala. One thousand years ago Rosala and other parts of the Hitis Archipelago were home to the only known Viking harbours, markets and settlements found in Finland. At the Rosala Viking Centre we were given a presentation of Norse gods and myths, and we visited replicas of Viking churches and houses.

Back in Kasnäs we had dinner and then watched a video series produced by Scottish Natural Heritage, with an introduction by John Baxter.

Day 7, Friday May 14

Monitoring was the theme for Friday’s presentations and group sessions. Jon Davies of the Joint Nature Conservation Committee, UK gave a lecture on “Marine monitoring, based on the experiences from the UK Marine SAC’s project”. In his presentation, he answered a.o. the following questions:

- Why monitor MPAs?
- What is monitoring?
- What do you monitor?
- How do you monitor MPAs? Including a description of methods e.g. side scan sonar, aerial photography, etc.
- What to do with results?

A case study was presented by Kimmo Evans of English Nature on the “Flamborough Head European marine site condition assessment”.

In the afternoon we split into three groups for group sessions on the monitoring of MPAs.

In the evening we all met in the restaurant, where tables were reserved for our official workshop three-course dinner. After dinner, we convened in the lounge for a lively farewell-party.

Day 8, Saturday May 15

After a few words of thanks from Carl Gustaf Lundin of the IUCN Global Marine Programme and a quick morning wrap-up session, we all packed our things and boarded the bus for Helsinki.

3. Summaries of presentations

3.1 An Introduction to Marine Protected Areas

John Baxter

Scottish Natural Heritage, john.baxter@snh.gov.uk

The use of the term Marine Protected Area (MPA) is a growing phenomenon, but because of a lack of clarity and a plethora of definitions this growing interest in the idea is confused and uncoordinated. This is an ideal situation for opponents/detractors of the idea to divide and rule. There is an ever-increasing need for better protection and management of the marine environment and the appropriate use of MPAs is something that needs to be explored.

There is a danger that MPAs have become an end in themselves, rather than a means to an end. Many initiatives set out to identify and designate a set of MPAs and the success of such initiatives is measured simply in terms of the numbers of MPAs or the area of sea that they cover. The true measure of success, however, must be whether they achieve whatever is the primary purpose.

In developing greater protection and better management of marine biodiversity and other resources, there is a range of different options for how this can be achieved. It is essential that clearly defined aims for any initiative are identified and on the basis of these, then the best means of achieving such aims is sought. Where this involves defining an area in which protective measures are applied then some form of MPA is an option.

The confusion/resistance to the idea is further compounded by the belief that MPA is synonymous with no-take reserves. Such a management approach may have a legitimate place in a suite of management initiatives but again it should be applied where necessary rather than as a matter of course.

With the growing interest and enthusiasm for MPAs the concept is becoming further complicated with the promotion of ecologically coherent networks of MPAs. As with the MPA debate itself, which is blighted by lack of an agreed and consistently applied definition, so is the ecological network concept. In principle, it is a good idea, but there remains confusion what is meant by a network and what is ecological coherence other than exciting, sexy terms. In the true sense of the term, such a network should be designed in such a way that the various MPAs are mutually supportive, taking account of hydrological and biological parameters. In reality this is never what is achieved due to lack of clarity of purpose and

lack of will to embrace the scale of protected areas that may be required. In most cases where ecological networks are aspired to there are sets of selection criteria that are contrary to it being possible to achieving the intended network. A network of MPAs essentially equates to delivering sustainable management of the marine environment and as such it is a not inconsiderable challenge, but one that is not impossible given the will.

MPAs have their place and are a good thing when they are the right means to achieve an end. They are not the sole answer to the problem of declining condition in the marine environment, but nor are they necessarily the only answer to a specific aim.

An MPA is essentially a means of delineating an area within which specific management aims (be that biodiversity protection, fisheries management etc.) are set and achieved through appropriate management measures. It is the measures that determine the level of protection and may involve the zonation of management constraints.

3.2 Marine Biodiversity- A Framework for Inventory and Conservation

John Roff

Summary by T.K. Sørensen of a presentation by John Roff, Acadia University, Canada.

The overarching point of John Roffs (JR) presentation was the view that the prime concern for marine conservation is conservation of biodiversity. JR defined biodiversity and its components from genetic to ecosystem levels, based mainly on a paper written on the subject by Zacharias and Roff (2000).

He went on to define the various approaches to marine conservation, i.e. approaches based on analysis of habitat types and communities (representative areas), on individual 'focal' species and areas (distinctive areas), fisheries conservation, and coastal zone management. A description followed of the applicability of the individual approaches, as well as the prerequisites needed for each approach, e.g. mapping of habitats and the marine environment, data regarding the water masses, currents, origin of propagules (e.g. eggs, larvae), etc. JR also described the difference between representative and distinctive areas, emphasising the need to focus on both structures and processes in marine conservation.

Synthesising the approaches to marine conservation, JR described three phases in defining networks of MPAs:

The first phase consists of mapping, i.e. mapping representative and distinctive areas and next producing overlays of mapped distinctive areas, fisheries areas and existing protected areas with mapped representative areas in order to determine the proportion of each type of representative area captured within the selected distinctive, fisheries and existing areas. This would be a gap analysis of sorts that would help in identifying the areas most in need of representation.

Phase two is the definition of various 'candidate sets' of MPAs, where candidate sites are selected using a wide range of criteria ranging from socio-economic and legislative factors to habitat heterogeneity. Site selection software such as MARXAN can be used to support decisions made in this phase.

JR describes the third phase as moving from a *set* of candidate MPAs to determining the preferred *network* of MPAs, implying that there must be connectivity between the selected sites in the network (i.e. physical/biological inter-relationships). In short, to comprise a network, a set of MPAs must be oceanographically connected so that recruitment of species can take place within and among MPAs, and so that no species will lose all its recruits to areas outside the network, unless they recruit to *another* network.

With regard to the number and size of MPAs in these networks, the view of JR was that, in the marine environment, several large and many small MPAs is probably the best answer, depending on the demonstrated patterns of connectivity among areas.

In conclusion, John Roff described possible solutions with which we may be able to identify how elements of biodiversity (i.e. genes, species/populations, communities and ecosystems) are ‘captured’ by various conservation approaches. These solutions include an inventory of ecological marine ‘species types’ and an inventory across an ‘ecological hierarchy’ based mainly on Zacharias & Roff (2000) and Roff & Evans (2002).

Reference

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3.3 An Overview of Selection Approaches and the use of GIS & Decision Support Tools for Marine Protected Areas (MPA) Planning

Hussein Alidina:

Hussein M Alidina, Marine Conservation Planning Consultant, WWF-Canada & Marine Affairs Program, Dalhousie University, Halifax, Nova Scotia, Canada E-Mail: halidina@yahoo.com

Introduction:

MPAs are recognized as essential components of Marine Conservation in global and regional conventions as well national government policies. While MPAs have and continue to be associated primarily with biodiversity conservation, they are now also being designated for fisheries conservation, scientific research, education and the preservation of aesthetic and cultural values (Jones 2002). Proponents of MPAs have associated several ecological and economic benefits with MPAs. Identifying suitable areas where MPAs can be designated is therefore a critical consideration as this would be expected to have a significant bearing on whether MPAs meet their stated objectives and realise their promised benefits. The size and location of MPAs are just two of the issues that have received much attention and debate in MPA literature (Agardy et al. 2004, Jones 2002).

This paper will deal with some of the approaches and tools available for the initial identification of candidate areas for MPAs. It will begin with characterizing some of the general approaches that are observable with regards to selecting MPA sites and other priority conservation areas. It will examine and contrast how GIS and Decision Support Systems (DSS) have been used with these approaches. It will specifically examine the use of one such tool – MARXAN. The paper will end with some practical considerations with regards to the use of GIS and DSS for MPA planning.

General Characterization of MPA Selection Approaches:

It is not until relatively recently that formal designations of MPAs have been declared¹. Many of the early designations reflected aesthetic values or concerns about charismatic species or were only 'chance' selections associated with terrestrial lands. For instance, Royal National Park, New South Wales, Australia, cited as the oldest modern day designation was designated 1879, for recreational purposes and incidentally included 150 sq. Km of inter-tidal habitat (MPA News, 2001). Recent day MPA designations have been more focused as the definitions, roles and need for

¹ It is important to note more informal designation such as fisheries closures have been in practice by many traditional societies and have been widely documented to exist before the first modern day MPA designation (Johannes, 1978).

MPAs has become more explicitly articulated. The criteria to identify and select candidate MPAs have therefore also become more sophisticated, as have the tools that used to identify and select potential candidate areas. We can characterize the manner in which MPA site selection has proceeded in the recent past into four general categories: *Opportunistic*, *Delphic*, *Analytical* and *Hybrid*. These are somewhat similar to those identified by used by Ray (1999) as Opportunistic–Serendipitous, Delphic–Judgemental, and Scientific–Analytic. They are briefly described below.

a) Opportunistic

An opportunistic approach as the name suggests, is one that relies on unique opportunities as a strategy to establish or protect sites. Some have made reference to this as the ‘ad hoc’ approach to designating MPAs. Opportunities can from a crises that instigate the designation of a marine reserve or protected area. Sometimes there is overwhelming community support for the designation of an MPA.

There are many documented cases of community-instigated designations in tropical regions around coral reefs. In the Philippines for instance, communities have often declared and implemented closed areas with local government support in response to declining fish catches (Christie et al. 1994, Christie et al. 2001). In certain regions government agencies have acted to proactively protect areas where there is little resource conflict and an absence of intensive marine use in anticipation that such opportunities for designation may be foreclosed in the future. In the Great Barrier Reef for instance the recent RAP program has been opportunistic in increasing the no-take zones in certain offshore ecoregions that are less intensively used (J Day, Personal Communication)

The choice of selecting areas opportunistically is often rationalized in a local context (site by site basis) and relevant to local situations. There isn’t much consideration of regional perspective or explicit determination of criteria that aid in the selection of the site other than opportunity.

b) Delphic Approaches

Delphic Approaches undertake site selection on the basis of expert opinion. The decisions to select sites are based on the knowledge and opinion of experts in various relevant disciplines. Experts may be guided with some goals for the selection process and supplemental information, together with some selection rules. The experts however, perform the selection of the site. The choice of selecting sites in this approach may be somewhat subjective and can be biased by the expert participants present in the exercise.

Delphic approaches can be completed relatively quickly and have been commonly used where there is a rapid need to identify sites for conservation action, and where the data required for more data intensive approaches is not readily available. Another characteristic of these ap-

proaches is that they are often biased toward focal species and distinctive or unique habitats or areas that are relatively more studied.

Such approaches may be undertaken at a variety of planning scales, although they are often mixed in scale. For instance, the Baha to Bering (B2B) Planning Initiative that has elements of a Delphic approach spans almost the entire length of the coast of North America across several biogeographic regions. However, while planning for this broad region it also sought to identify priority sites in various localities using expert knowledge and available datasets (Morgan et al. 2004).

c) Analytical Approaches

Analytical approaches for site selection are data driven and executed in a systematic and objective manner with clearly defined goals and accompanying criteria for site selection. These approaches are guided by ecological principles and assumptions that are testable. They incorporate quantitative data into the selection process on habitats, species and ecological processes by seeking to represent these features in the selected sites.

These approaches are often time consuming and involve extensive data compilation and mining. Often the data required may be unavailable or have gaps and other methods that include the use of proxies or modelled data may need to be used. The selections of areas are made from the data through the use of spatial analysis and tools with decision rules for selection of areas. The selection of the sites is largely performed in an automated manner by these tools.

While these approaches can be undertaken at various scales, the spatial scale of any one analytical exercise is explicitly defined for mapping and data compilation purposes.

d) Hybrid Approaches

Hybrid Approaches are essentially a combination of Delphic and Analytical approaches and seek to draw on both expert knowledge and analytical data in selecting sites. Hybrid approaches have become more preferred because they tend to address both address the limitations of data by consulting expert opinion.

It is important to note that the choice of the approach is driven the setting site selection is being undertaken. Any one of these approaches may be appropriate at a given time based on the level of urgency, unique opportunity, data and/or expertise available. While analytical approaches or data-centred approaches may be preferred because of the objectivity associated with them, in many regions, there just aren't sufficient consistent data across large areas. Thus hybrid or combinations of approaches are the most pragmatic and applicable in such cases.

A Note on Criteria for Site Selection

Regardless of the approach, framework and tools to be used for selecting areas, it is critical that the determined goals and objectives of the MPAs guide the selection process. These goals have to be reflected in the criteria used to select sites. Much has been written about the criteria to be used for selecting or evaluating areas for selection (Kelleher and Kenchington 1993; Nilsson 1998, Roberts et al. 2003a). While it is not the aim of this discussion to go into specific criteria it is worthwhile mentioning that the Roberts et al. (2003b), provides a useful framework for organising criteria relevant to selecting candidate MPA sites.

Roberts et al. (2003b) differentiate three types of criteria; (a) prerequisite criteria; these are criteria that must be considered as prerequisites in selecting sites and include biogeography and habitat heterogeneity (b) excluding criteria; those that would exclude or disqualify sites from being selected, these include human and natural threats that cannot be mitigated, and (c) modifying criteria; those that may modify the evaluation of a site and where sites may be selected these may include considerations such as venerable life stages and species of special interest among others.

The point to be made here is that one has to have a clear understanding of the basis on which site selection is going to proceed by having explicitly stated criteria based on the goals and objectives of the MPAs that are sought to be designated.

Use of GIS and DSS to support MPA Planning

Geographical Information System (GIS) in of themselves are valuable as databases for storing information that is predominantly spatial in nature over expanses of the sea. The expanses of sea are not limited to two dimensions as on a geographic plane, indeed the depth, or the third dimension and time are as important in the marine environment. Current day standard GIS systems are well suited to address the two-dimensional geographic space but somewhat constrained in efficiently representing the third dimension and the temporal dimensions. This however, is recently beginning to change.

For the MPA planner, it is interesting to know how features of interest are distributed across space and time and sometime depth over the area of interest. These features could be geological and more stable in nature like substrate types, or topographic features such as underwater canyons, basins or seamounts. They could be more dynamic associated with oceanographic processes such as upwelling or temperature or salinity fronts representing different water masses. The features could be related to species and their behaviour and habitat or communities of species and their patterns of distribution. Almost all the time these data have to be collected, either by physically sampling and making observations out on or in the water or by remote means such as satellite detection for surface features and newer methods such as sonar for sub-surface features. The na-

ture of the marine environment and the available data collection methods that all have limitations (technical, financial and other) limit the extent and intensity over which data can be collected. For a Marine Planner, incomplete data, lack of adequate spatial coverage and inconsistent data are experiences of a daily existence.

Thus, for an MPA Planner there are two major groups of challenges, one relates to the data required for planning – identifying what data are required for the planning process, what are most appropriate and dealing with issues of accuracy, coverage (spatial and temporal) and completeness. The other relates to how to proceed to identification of areas based on the data that are available or indeed in the absence of data and what the rationale framework and decision rules are to be used for selecting areas.

Delphic exercises in many ways recognize the issues relating to lack of data and seek to utilize expert opinion and knowledge where complete quantitative datasets are not available. GIS are predominantly used to present and display base datasets that may be available and as a tool to guide and capture selections of areas proposed by experts. These may be coarse base datasets that could be for bathymetry, currents, known areas of species aggregations, Chl *a* derived from remotely sensed data. The data are often presented to experts as maps or, in an interactive workshop forum, as an aid to guide them in identification of sites. It is important to note that the identification of sites itself is done by the experts on the basis of some form of consensus. Experts may be asked to select sites on the basis of a particular group of species or habitats or other features within a predetermined framework with some 'ground rules', such as a constraint on the amount of area that can be selected. The eco-region conservation planning methods used by WWF to identify priority areas in marine environments are a good illustration of this. Experts are segregated on a taxonomic basis and asked to identify important areas for each species group (Figure 1, Kramer and Kramer, 2002). The different selections from these overlapping areas (Figure 2) may then become some set of priority areas that may be further analysed. The recent identification of Priority Conservation Areas completed for the Baja to Bering Initiative also involved segregating groups of experts to generate selections. The expert selections of areas in this case were constrained to no more than 40% of the planning area (Morgan et al. 2004).

Analytical Approaches usually use GIS in a more sophisticated manner than Delphic approaches. Analytical functions within GIS systems can be employed with the predefined criteria and decision rules to generate spatial overlays and/or scoring systems. For instance simple overlay procedures on thematic data representing features of conservation interest can help identify areas of overlap from which identification of candidate areas can proceed (figure 3).

Figure 1: The framework for an eco-region conservation planning exercise to identify priority areas in the Meso-American Caribbean Reef. The process of identifying Taxa/Guild Priority areas (circled) is based on expert knowledge guided by existing information. Subsequent consideration of threat allows for the identification of priority areas. Source Kramer and Kramer (2002)

Figure 2: Maps showing overlapping Taxa priority areas delineated by the process described above. GIS is used to map and identify overlap of areas identified by different taxonomic experts

Figure 3: A simple overlay of Focal Species and Special Element layers to identify areas of high conservation value areas. Occurrence of a focal species or special element is assigned a value of 1. All the layers are overlaid together to generate an overlay score that shows areas of high overlap of conservation features and helps identify Areas of High Conservation Value. Source King (2004).

A more sophisticated set of tools are now available that employ algorithms to aid in the selection of areas. The algorithms are primarily meant to optimize the selection of areas and seek to find combinations of areas that meet the predefined criteria within the least space as possible. Various tools as MARXAN (Ball and Possingham, 2000), CPlan (NSW National Parks & Wildlife Service, 2004), Portfolio (Landscape Ecology Lab, 2004), TRADER (De'ath 2002) make use algorithms, seeking to optimally select areas. While it is beyond the scope of this paper to assess the relative strengths and merits of the various tools listed above, readers should be aware that a recent paper evaluating these is in a peer review process and should be available shortly (S.M.J. Evans, personal communication).

MARXAN: A Decision Support Tool for MPA Planning

MARXAN is shorthand for Marine Reserve Design using Spatially Explicit Annealing. MARXAN is a software package that was commissioned by the GBRMPA (Great Barrier Reef Marine Park Authority) and was developed by Ian Ball and Hugh Possingham (Ball and Possingham,

2000). It has since been widely used to assist planners as a decision support tool to select and identify areas for marine conservation.

The Premise on which MARXAN works:

MPA Planners have to consider multiple ecological, social and economic criteria when selecting marine reserves. The challenge is to efficiently select sites that meet these multiple criteria. An efficient selection refers to one that meets all selection criteria with the least amount of area and the least economic cost. MARXAN essentially provides a way in which to efficiently select sites, thus we can refer to it as an optimization tool. Optimization within MARXAN is achieved by the use of algorithms. Various algorithms enable the software to evaluate an extremely wide range of possibilities when considering the selection areas. Each of these possibilities is assessed with regard to how well it meets the criteria set and targets set for representing various features in the selection. Over millions of such assessments, MARXAN can produce a set of results containing selections that it considers optimal. MARXAN also provides a way with which to account for and quantify the amounts and proportions of the features that are captured in the results it provides.

Note: Workshop participants had the benefit of a more technical presentation on the workings of MARXAN. The piece reported here is more general in nature and does not enter into many technical details. Readers interested in getting a more practical exposure are directed to the MARXAN website and other resources including the Publications CD provided at the workshop.

Before Running MARXAN – Some requirements:

There are a few fundamental things that are required before MPA Planner or Planning Team can begin using MARXAN or for that matter any other DSS for site selection. These requirements are as follows:

- a) The criteria to be used for site selection must be articulated:
As discussed earlier, the decision on what criteria are appropriate will be based on what the intended goals and objectives of the areas being selected are. For instance if the goals of the areas being selected are primarily to enhance or sustain fisheries, then the criteria for site selection are going to be oriented to capturing important areas or critical life history stages of commercial fish species. On the other hand if the goals are related to biodiversity conservation in general then it may be more appropriate to ensure protection of a proportion of all habitat types in the region of interest.
- b) Selecting corresponding spatial features and data sets that represent those criteria:
The criteria identified must be matched with corresponding datasets and those datasets must be compiled and created for the planning

area. For instance if the criteria relates to selecting critical life history stages for commercial fish species, than one of the corresponding datasets may relate to spawning sites for each of the commercial species that are being considered. Spawning areas or areas of importance to juveniles may need to be mapped or delineated in some manner, through compilation of observations, egg/juvenile density measurements or gravid female abundances.

Often the datasets have to be compiled and there will be difficulty in finding a dataset that will match or reflect the criteria. Sometimes surrogates or substitute indicator datasets may need to be used and or data may need to be modelled. For instance, there are often too few observational data to compile a keystone or focal species distribution datasets. However, environmental data are quite common. As a surrogate one may choose to use focal species habitat data modelled using the observational and environmental data.

a) Setting targets amounts for spatial features:

Each dataset that is compiled in b) above, must have associated with it a set of target amounts that indicate the proportion of the features that are to be desired in the areas that are to be selected. For instance, returning to the above example, if one of the datasets that are supposed to indicate spawning sites is mapped as areas, that the target level might be a certain proportion of the areas determined to be spawning sites. The manner in which targets are set will depend on the quanta or the measure that the dataset represents, therefore not all targets will be area based. Exploratory data analyses on the distribution of each of the data layers often help better to visualize the data before deciding on a target.

b) Determining if there are any spatial configuration requirements:

Some criteria and the datasets that represent them may have spatial configuration requirements. For instance, it may be desirable to ensure that spawning areas for a particular species are represented in at least two different sites that are some distance away. This relates to the concept of replication or ensuring that all your eggs are not in one basket. MARXAN can handle such spatial configuration requests.

Running MARXAN:

Once these four conditions are met, data formatting and setting up of parameters in MARXAN can be completed. MARXAN requires data on the features from which selections are to be made be assembled and summarised by Planning Units. Planning units may be uniform in shape and size (regular sized squares, hexagons) or irregular and based on natural features (e.g. coral reefs) or both a combination of irregular and regular shapes and sizes. Each Planning unit contains information about the

features it contains and the quantity of that feature. Planning units are defined by the user and usually take into account the scale of planning (e.g. offshore vs. inshore). MARXAN does not select individual features, rather it makes selection of planning units. Among the other information that needs to be provided to MARXAN are the target level to which for each feature should be represented in the selection process as well as any spatial configuration requirements (replication, clumping etc). In addition the user must select the algorithm to be used for and the number of times (runs) that will be executed. Some of the basic inputs, outputs and parameters required by MARXAN are illustrated in figure 4.

MARXAN runs as an independent program outside the GIS system and mapped data must be exported from the GIS or other spatial databases and provided to MARXAN. The outputs that MARXAN generates are also in this form and must be returned and mapped in the GIS to be visualised.

Once Run, MARXAN generates several types of output. Some of them are as follows (see figure 5 for some illustrations):

- An optimal set of areas or the Best Solution contains the selection of planning units that MARXAN has in all its runs deems to be the most optimal. Optimality here means that the solution will be efficient (least area to meet targets) under the conditions given.
- The frequency with which each planning unit was selected in all the runs MARXAN executes or the Summed Solution. The summed solution maps identify areas that are repeatedly selected and can reveal important areas.
- Post-Hoc Reports such as the Missing Values file contain information on each run and report how well the selections made by MARXAN met the targets for all the representing the various features.

Some recent papers illustrating the use of MARXAN in MPA Planning processes are recommended to readers seeking a deeper appreciation of the tool and its application. These are Ardron et al. (2002), Leslie et al (2003), Airame et al. (2003), Stewart and Possingham (2003). In addition, the MARXAN web page at the Ecology Centre at the University of Queensland (<http://www.ecology.uq.edu.au/marxan.htm>) has several other links to ongoing work.

Figure 4 (Above): The use of MARXAN illustrating some Input, Settings and Outputs

The map above shows one the results of the 'Best Run'

The map below shows an example of a summed solution. Darker shades indicate a greater frequency of selection

Figure 5 (Above): Some sample output from MARXAN mapped for the Gulf of Maine Scotian Shelf Region Source WF/CLF (2003). Criteria and Data used are provided in Appendix I

Some parting thoughts with regards to use of GIS and DSS

Your data – know it well! This cannot be stressed enough. Always be suspicious of your data. The planner must understand where the data come from, what the compilation methods were and where the major gaps and limitations are. Spatial accuracy is also important to understand and it must be appropriate for the scale at which the planning is occurring. The statement Garbage In – Garbage Out is highly relevant here. DSS will produce outputs regardless of the data they are provided. Having a handle on the limitations of the data will help you assess how valid your results may be.

Spend time exploring the Tools and Outputs: Often much time and effort will be spent preparing data, this is often necessary when compiling and integrating diverse datasets. Proportionally less time will be spent undertaking the analysis and exploring the output. The argument here is that at least as much time should be spent on the analysis and exploration of results. The planner must strive to understand the inner workings of the DSS. The DSS is often seen as a black box. Parameters required by the DSS should be used without a proper understanding of them and their effects. Often time the ‘behaviour’ and workings of the DSS depend on the nature of the data that they are provided to work on. Thus it is essential that the planner explore the use of different parameters and the effect they have on the output. DO NOT use output to support decision-making without a complete understanding of the tools in use.

Summary

We have identified and described some of the approaches in use to identify and select candidate MPA sites. The manner in which GIS and DSS systems are used with these approaches varies and some illustration of this was provided. It is important to recognize the limitations of data and the tools being used and to understand the workings of these systems before using results that are generated to inform decision-making.

Contextually the use of GIS and DSS should be guided by the goals and objectives of the MPAs and the planning process objectives. It is also important to recognize that the use of these tools is not an end in itself but as that related to a larger process. Those larger processes often have to examine issues relating to the implementation of MPAs and socio-economic realities and negative consequences of MPAs. Tools like MARXAN enable the consideration of some of the socio-economics and they help generate and initial proposition for areas that may be candidate MPAs. What then follows is a political and negotiating process through which MPAs get designated and implemented. This context is summarised as an illustration in Figure 6 below.

Figure 6: The context into which GIS and DSS fit into larger processes for MPA Planning

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Appendix I: Criteria Summary Information and Notes used in a preliminary MARXAN Analysis for the Gulf of Maine and Scotian Shelf Region from WWF/CLF (2003)

	CRITERION	Description/Data NOTES	DATA SOURCE	# OF TYPES (Conservation Features)
REPRESENTATIVE AREAS	Benthic Seascap Representation	Seascapes are essentially ecological units that are characterized by enduring and recurring abiotic features (i.e. physiographic and oceanographic features). They represent environment types that capture some of the fundamental conditions that affect the distribution of marine life (i.e. water masses, depth, substrate, stratification regimes). Seascapes have been mapped for both the pelagic and benthic realms at a spatial resolution of 5'. Documentation is available from WWF. Also see Day and Roff (2000)	WWF Benthic Seascapes dataset	96 Types
	Pelagic Seascap Representation		WWF Pelagic Seascapes dataset	64 Types
	Bio-geographic Representation	Bio-geographic regions recognized in the literature for our study area. 5 bio-geographic regions have been delineated.	Literature Survey/Bathymetry	5 Regions
	Physiographic Unit Representation	Broad scale characterization of the seabed on the basis of geology and physiography. Examples of these include banks, channels, gullies etc	NS Museum of Natural History	35 units
BIOLOGICALLY DISTINCTIVE AREAS	Benthic Fish – Richness	Cumulative Richness was used (total number of species surveyed at any location) for 3 monthly time periods that correspond to the spring, summer, and fall seasons. Note: we recognize that average richness of a location may be a better measure to use and that we have to correct for sampling effort (i.e. richness/tow)	ECNASAP Trawl dataset (20,000 tows over 30 years)	3 seasons
	Benthic Fish - Presence of Gravid Females (Ripe and Spawning)	Abundance of sampled species/tow that were either ripe or spawning Note: this also requires scaling and correcting for effort, as above.	DFO/NMFS Trawl	12 managed species
	Cetacean Abundance/Presence	Two data sets spanning different regions of the study are had to be used (1) Abundance of listed cetacean species corrected for survey effort. Count per Unit Effort (CPUE). Data was available for only part of the Gulf of Maine, Georges and Western Shelf. (2) 'Presence only' of listed cetacean species in regions were CPUE was not available (Eastern Shelf)	NARWC (CPUE). DFO, PIROP, Blanford, Whitehead (Presence)	8 listed species
	Seabird Presence	Presence Only Data	PIROP (CWS)	10 Rep Species
	Coral Occurrences	Deep Sea Coral Occurrences (soft and hard). Data only available for Scotian Shelf	Observer and Trawl Survey	8 species
	Benthic Invert Richness	Macro Benthic Inverts. Only for Scotian Shelf, summer season since 2000. Cumulative Family Richness was used.	DFO Trawl data set.	1 measure

3.4 MPAs and Fisheries

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Fisheries: important but problematic

Fisheries worldwide are currently undergoing tremendous changes, perhaps even crises, but fishing is still important socially and economically. The fishing industry is facing serious problems in many parts of the world, with declining stock and changed composition of the catch (with commercially valuable species declining more than other species). Although the importance (in terms of economy and employment) is declining in many developed countries, it is increasing in many developing countries.

Ecosystem effects becoming more severe and widespread

The scale of fisheries today have large consequences for marine ecosystems, such as:

- a) Major changes in trophic web, with possible effects on whole ecosystems
- b) Large-scale seafloor impact in particular from towed gear (such as trawls and dredges). However, the severity of this impact on the seafloor is debated
- c) New areas are affected: technology development makes it possible to fish in areas previously not accessible
- d) There are documented negative effects on some bycatch species (both commercial and non-commercial species)

Assessment and management an increasing burden

Many of the stocks are today undergoing complex and expensive monitoring and assessment. As more species are targeted by the fishing fleets, the task of assessing stock status of all these species become increasingly difficult and expensive. This means that it becomes increasingly important to find management tools which are less data intensive. MPAs are being put forward as one such management tool.

Life cycles and migration patterns are essential to MPAs

The life cycles of marine organisms differs tremendously, which has large implications for the design and eventual success of MPAs. Fisheries management is usually directed towards individual species- therefore the spatial extent of life-cycles of fishes are crucial to assess if MPAs is to be an efficient tool for fisheries management.

Marine protected areas, fish and fisheries – theoretical and documented effects.

WARNING: Much confusion comes from the fact that we often do not define the objects of MPAs: be careful to state if you talk about fisheries benefits (i.e. benefits to the people who fish), benefits to the fish species (e.g., stock enhancement), or biodiversity benefits.

Proposed effects of protected areas on commercial fish species

It is generally important to separate effects occurring within an MPA, or effects occurring outside the MPA ("export"). The former is probably easier to achieve, and certainly better documented so far. A number of theoretical studies, and during the last couple of years also reviews of case studies, have listed potential or documented benefits of MPAs on fisheries and fish species. Such benefits include:

Some proposed effects on commercial fish species within MPAs

- Decreased fishing mortality
- Increased population size
- More "natural" population structure
- Increased reproduction
- Improved habitat quality

Some proposed effects on commercial fish species outside MPAs

- Increased population size (spillover and export)
- Less fishery-induced selection
- Lower temporal variability in population size
- Lower risk of population collapse

Some proposed effects of MPAs on fisheries management

- Control/reference areas
- Insurance against management failures
- Easier (quicker/less expensive) to enforce

Some proposed negative effects of MPAs on fisheries

- Loss of fishing opportunities
- Displacement of fishing (fishermen)
- Increased cost per unit caught

Generally accepted benefits to fisheries of MPAs

Several of the effects listed above are somewhat speculative, and solid information on the generality of these effects are still lacking. However, there are some positive effects of MPAs that are generally accepted, even by opponent to the idea of MPAs as an important fisheries management tool:

- MPAs helps to protect vulnerable life stages (e.g., spawning aggregation)
- MPAs helps to protect important habitats
- MPAs may help to restore severely depleted (exploited) stocks
- MPAs helps to protect sedentary species

Effects of MPAs where fisheries are regulated: reviews of case studies

- Positive effect on biodiversity is well documented
- Effect on target species within MPAs is well documented
- Spill-over effects to other areas are little studied, but there is strong circumstantial evidence indicating that this is common
- Effects have been found also in small MPAs

Characteristics of the target species

Both theoretical and practical work show that the biology of the target species influence the effects of an MPA:

- *Life span* : shorter life span means faster effects
- *Migration pattern* : less migration means greater effects
- *Behaviour* : schoolforming species are more likely to benefit from MPAs
- *Fishing pressure* : highly exploited species will benefit more from an MPA
- *Density - reproduction relationship*: species requiring high densities for reproduction will benefit more.

The ecology and life history of many invertebrates (e.g., crustaceans, molluscs, echinoderms) suggest that these are likely candidates for benefiting from MPAs.

Marine protected areas - design for the conservation of fish and/or fisheries

Different users - who owns the sea?

User resistance or support naturally influence how easy it is to form MPAs, and the value of an MPA will differ among user groups:

MPAs: No benefit to users?

Users not dependent on living resources

- Shipping
- Mining
- Windpower

MPAs: Indirect benefit to users?

Users not directly dependent on wild living resources, but depending on a "healthy" environment

- Aquaculture
- Visiting industry (parts)

MPAs: Direct benefit to users?

Users dependent on wild living resources

- Fishing
- Visiting industry (part)

Overfishing - problems to overcome

Just to say that a stock is overfished is not enough: the problem can differ, and different types overfishing may be addressed with different management actions.

Growth overfishing – fishing pressure is so high that fish are caught when they are smaller than would be commercially optimal.

Reproduction overfishing – fishing pressure is so high that the reproduction is lowered

Genetic overfishing – selection and other effects from fishing result in most individuals being too genetically similar, and may also result in unwanted selection of e.g. slow-growing individuals

Economic overfishing – fish stocks so low that it is not possible to get a reasonable economical income

Ecologic overfishing – fish stocks so low, or average fishes so small, that the species is losing its ecological function

Characteristics of sites: consequences for MPAs

Very simplistic rules of thumb for selecting a site for fisheries MPAs:

- If objective is *stock enhancement* - choose places with high Catch per unit effort
- If objective is *conservation of an exploited species* - choose places with critical habitats
- If objective is *conservation of other species (biodiversity)*- choose places with low fishing effort (such sites are less disturbed, and this may avoid effort displacement(see below))

Managing fish: consequences for MPAs

Fisheries management strategies include:

Stock-size dependent strategies:

Quota system (TAC)

- a) biomass
- b) recruitment
- c) catch/landings

Size limit strategies

- Age/size - recruitment relationships
- Gear selectivity

Effort limit strategies:

- Time limits (periodic harvest)
- Gear limits (sizes, numbers)
- Migration patterns
- Reproductive patterns
- Gear selectivity
- Catchability

MPA = Area-specific management:

Fishing allowed, area-specific regulations

- a) Season
- b) Gear
- c) Size/sex

Fishing not allowed - "No-take areas", "marine reserves", "non-exploitive areas"

What can be achieved with marine protected areas where fishing is managed but allowed?

This depends on what kind of restrictions are implemented in the MPA:

- Temporal restrictions= seasonal closures
- Biodiversity: May lower bycatch for some species
- Reproduction overfishing: Protect spawning aggregations (lowering fishing pressure?)
- Reproduction overfishing: Protecting juveniles (lowering mortality)
- Little protection value for "other" biodiversity?
- Little effect on overall fishing pressure?

Restricting gear types: allowing only static gear

- Less damage to bottoms - biodiversity conservation.
- May also be more selective -target and other species (but not necessarily)
- May have large socio-economic implications

Restricting gear types: more selective gear

- Lowers fishing mortality on some size classes or species, but may increase fishing pressure on others. May prevent Recruitment overfishing, Growth overfishing, Ecological overfishing and Genetic overfishing
- Does not necessarily protect other biodiversity

Special size restrictions

- Lowers fishing mortality on some size classes, but may increase fishing pressure on other size classes. May prevent Recruitment

overfishing, Growth overfishing, Ecological overfishing and Genetic overfishing

- Does not necessarily protect other biodiversity

What can be achieved with marine protected areas where no fishing is allowed - No-take?

Permanent no-take

- Protect bottoms, prevents bycatch – protects other biodiversity.
- Lowers fishing mortality – prevents Growth overfishing, Recruitment overfishing, Genetic overfishing and ecological overfishing

Important: Displacement of fishing effort

If forming an MPA means that the overall fishing pressure is lowered, this may lead to long-term benefits but short-term loss for the fishermen, and probably to conservation benefits.

If effort is not lowered, but re-allocated elsewhere:

- May not led to fisheries benefits as a whole
- May lead to more environmental pressure (e.g increased fuel use because fishermen have to travel further)
- May lead to more seafloor effects, if other places have less catch per unit effort

Therefore, the cost and effect of an MPA is dependent on additional management actions!

The size of individual MPAs

- If the object of an MPA is biodiversity conservation, usually the bigger the better.
- This also applies for effects within a *fisheries* MPA, but some medium size may be optimal for spillover effects (i.e. effects outside the MPA).

Conclusion: MPAs are suitable for fisheries!

- Positive effect for fish stocks within MPA likely for both MPAs with fishery allowed and for no-takes.
- No-takes offer some additional advantages beyond other MPAs
- Security (stability) effects (both for fishermen and for biodiversity) important
- Protection of habitats is an important effect which benefits both fishermen and biodiversity.
- Effects on stock beyond MPA dependent on species characteristics and other management actions.
- MPAs not likely to replace but to be a part of "traditional" management

3.5 Summary of Presentations on Marine Management

Jon Day:

Lecture 1 – Overview of MPA management

Management

- As MPA managers, we rarely manage natural systems *per se*
- “*Management most usually is the attempt to deal with crises of almost wholly human origin*” (Walton 1996)

Marine connectivity – refer to example of ‘The Blue Highway’ depicting the cross-self connectivity for one species of fish. Connectivity is a critical aspect in MPA design and management, although not generally understood or easily explained to others.

MPA – the broadest term for any area set aside for protection of any aspect of the marine environment

Multiple use MPAs

- multiple use MPAs over broad areas can provide for high levels of protection in specific areas while allowing a range of reasonable uses to occur in other zones within MPA.
- a common approach in multiple-use MPAs is for ‘core’ areas as ‘no-take’, buffered from more general use areas.
- A spectrum of zones may also be required if MPA is very large or a complex area.

Advantages of the multiple use approach

- A broad area, managed as an integrated ‘whole’, is preferable to a series of isolated protected areas surrounded by ‘a sea’ of unmanaged activities.
- Broad-area multiple use is more effective:
 - *Ecologically* – recognises spatial scales at which ecosystems operate
 - *Practically* – easier to manage, it buffers and dilutes the impacts from the adjacent areas
 - *Socially* - can ensure all reasonable uses can occur and minimize conflicts

The complexities of managing marine areas

- Extent of interconnectedness
 - *connectivity*

- *'downstream' issues*
- 3 dimensional
 - *not easily viewed*
 - *not easily delineated nor managed*
 - *logistics to monitor/manage*
- lack of knowledge & understanding
- Ownership
- Sectoral views

Requirements for effective marine conservation

Effective marine conservation requires a lot more than just MPAs

Essential requirements for effective marine conservation (*after Thorne-Miller & Catena, 1991*) include:

1. Regulation of land-based and maritime sources of pollution
 - pollution = single greatest threat to marine ecosystems and many marine species (particularly cumulative long-term damage)
 - more pollution enters the sea from land-based activity than from any other source; seas continue to accumulate most wastes for as long as pollutants remain in circulation.
 - no country in the world has the capacity to adequately combat a major oil spill - avoiding spills is far more important than preparing for their clean-up.
 - however such spills are inevitable, so adequate preparation is still a priority.
2. Direct regulation of marine resource use
 - overfishing (both commercial and recreational interests) is becoming more prevalent
 - impacts occurring on non-target species (*by-catch*) and habitat
 - very few (*if any?*) fisheries are considered by most experts to be adequately managed for ecological sustainability
 - increased regulation of fisheries and other harvesting/ collecting activities in the oceans is becoming increasingly critical

3. Establishment/management

MPAs provide a key contribution to long term maintenance & viability of marine ecosystems; enhanced even more if :

- the network of MPAs has a representative basis; and
- the MPAs are adequate in size and connectivity
- Without a broader integrated strategy, any MPA (or network of MPAs) lacks a context. MPAs can only be as 'healthy' as the surrounding marine waters because of the fluid nature of the marine environment and biological interdependency of neighboring communities.

- Given a choice, ecosystem approach which includes MPAs (*and as broad representation of marine ecosystems as possible*) is preferable to isolated highly protected enclaves within otherwise unmanaged waters.
4. Integrated coastal zone/ocean management (ICZOM)
- ICZOM increasingly accepted as the most effective means of dealing with complex issues across coastal/marine areas
 - ICZOM recognizes interrelated functions of catchments, the coastal zone and marine areas
 - The term 'integrated' in ICZOM must include:
 - *Inter-governmental* – all jurisdictions
 - *Land-water interface* - clearly integration across this land-water boundary is essential & minimise habitat destruction
 - *Inter-sectoral* – across different user groups (*minimise segregated "sector" management*).
 - *Inter-disciplinary* – ecological, social, economic & cultural; and
 - *Inter-generational*

Threats to marine biodiversity

Not all threats to marine biodiversity can be addressed by MPAs:

1. Examples of threats occurring within an MPA which are more readily addressed by an appropriately zoned or managed MPA:
 - over-fishing /over-exploitation
 - physical destruction of marine habitat eg dredging
 - sea dumping
 - direct marine pollution
 - depletion of spawning sites
 - incidental take/by-catch
 - inappropriate development

2. Examples of threats that are not so easily addressed (and may not be addressed) by an appropriately zoned or managed MPA alone:
 - indirect marine pollution (non-point source)
 - introduction of exotic organisms/biological invasions
 - bioaccumulation of noxious materials (eg heavy metals)
 - disease/parasitic infections
 - marine debris/net entanglement
 - siltation
 - toxic blooms/red tides
 - inappropriate aircraft overflights

3. Examples of threats which are unlikely to be addressed by an MPA:

- climate change
- rising sea temperatures
- rising sea levels
- salinity changes
- destruction of adjoining watersheds
- impacts of adjacent or upstream land uses (eg effluent discharges)
- downstream impacts of reduced water regimes

Lecture 2 – The Great Barrier Reef and the recent rezoning program

The GBR is diverse & complex

- It is more than just coral reefs – it includes seagrass beds, mangroves, algal beds, soft sediments, deep water areas, etc
- All these habitats are as equally important as coral reefs and we need to protect all habitats on which species depend
- High level of ‘inter-connectivity’ between marine habitats

Biological diversity of the GBR

Over 1/3 of the world's soft coral species	Over 1500 species of fish
Six of the world's 7 species of marine turtle	World's largest green turtle breeding area
Seagrass beds > 40,000 km ²	Algal and sponge gardens
Mangrove estuaries	54% of world's mangrove diversity

The value of the GBR

- a major part of Australia's economy - estimated economic worth within GBR catchment in excess of A\$14 billion per annum (*incl > A\$1 billion directly from marine area alone*)
- inestimably high value in conservation and cultural terms & other intangible ways

Goal of the Marine Park Authority - To provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef in perpetuity through the care and development of the Great Barrier Reef Marine Park.

The Great Barrier Reef is ‘under pressure’; pressures include:

- Downstream effects of landuse (water quality issues)
- Increasing fishing effort and impacts
- Increasing coastal developments
- Shipping & pollution incidents
- Increasing tourism and recreation
- Coral bleaching

The Representative Areas Program (RAP) for the Great Barrier Reef... an ecosystem planning approach for protecting biodiversity

- **PRIMARY AIM:** To increase protection of biodiversity of the GBR by establishing a new network of 'no-take' areas (*green zones*) to protect representative examples of all habitats & marine communities.
- **WHY?** Existing zoning did not protect the range of biodiversity now known to exist throughout the GBR
- RAP was a phased approach to planning that included:
 - Developing a bioregionalisation (70 bioregions or broad scale habitat types)
 - Developing operational principles
 - Two phases of formal public participation
 - Release of a draft zoning plan
 - Finalisation of a revised zoning Plan based on public input and additional information

Major changes did occur during RAP; refer to changes in map between:

- Pre RAP zoning
- The Draft Zoning Plan (*released 2002*) - 10,000 public submissions
- The revised Zoning Plan (*Nov 2003*) - 21,000 public submissions

Changes to the maps were a result of public submissions and the receipt of improved planning information. However, throughout RAP we maintained the operating principles (in both the DZP and the revised ZP)

1. Lessons learnt when developing a bioregionalisation

Experts alone will not develop a regionalisation useful for broad-scale planning

- There is never 'perfect' information for a regionalisation
- Don't get 'hung up' on trying to determine perfect bioregion boundaries
- The immense value of a robust regionalisation

2. Lessons learnt - the value of clear, transparent operating principles

- A clear and transparent set of operating principles assists everyone
- All the operating principles need to be considered as 'a package', and not in isolation
- The operating principles are not targets or 'ideal' amounts
- The operating principles are based on the best available advice but can always be improved

3. Lessons learnt about public participation

- People needed to understand there was a problem before accepting that a solution was required
- Many stakeholders had little understanding of the key issues

- RAP was not about managing fisheries but rather about protecting biodiversity
- There is no simple way of creating a conflict-free consultative mechanism
- Different messages for different target audiences (differing cultural and sectoral views – need for a strategic approach)
- Some elements of each phase of public participation were more successful than others
- How to deal with a large number of submissions
- Dealing with spatial submissions (ie. maps)
- Having a good knowledge & understanding of all sectors
- There are those that support the proposed increase in the level of protection but who will not overtly state their views

4. Lessons learnt identifying options for no-take area networks

- Analytical tools can help a lot in developing spatial outcomes
- Help stakeholders understand in a logical transparent way
- Analytical approach cannot produce the final pragmatic, politically-acceptable solution
- ‘Post-hoc accounting’ is an invaluable aspect of an analytical approach.
- A logical framework which achieves defensible outcomes – supported

Main lessons learnt

- Use of best available science and a holistic view of ecosystems as open, complex and changing
- Flexible management that must be regularly reviewed and adaptive to new knowledge and understanding
- Collaborative decision making drawing on a range of expertise – ecological, social, cultural, political & generational
- Socially defined goals and objectives rather than narrow scientific concepts focussed on single issues/species

How might the RAP approach be applied elsewhere?

- Don’t need high tech to achieve a good planning outcome
- Do need a need a systematic approach and clear ‘operating principles’
- Important to adopt the ‘representative’ approach... not protecting just key/ special sites

Lecture 3 – More on management aspects

Definitions

- *monitoring* – process of repeated observation for specified purposes, according to prearranged schedules in space and time and using comparable data collection methods (*after Meijers, 1986*)
- *adaptive management* – managing according to a plan by which decisions are made and modified as a function of what is known and learned about the system, including information about the effect of previous management actions (*after Palma et al, 1998*).

Why monitoring & adaptive management?

- Most, if not all, management approaches need to be periodically reviewed and updated.
- No successful management regime can be inflexible to new information.
- Aim to get monitoring & evaluation as part of the management/planning cycle
- Need to consider a much wider context than just within your MPA

Need to be cognizant of changes in all MPAs:

- rapidly changing patterns of use
- technological change
- social- economic changes
- political change
- dynamic systems => natural changes

Monitoring - lessons learnt

- Monitor wisely at ecologically- and socially-relevant temporal and spatial scales
- Many monitoring programs ‘do the thing right’ (*ie precise local measurements*) rather than ‘doing the right thing’!
- In some instances a combination of methods may provide better assessments than using just one.
- If possible use MPA managers or other users to assist with monitoring (*not just researchers*)
- Value of quick, easily accessible results for managers

Reporting - lessons learnt

- Assessments should be open, transparent and accessible to community
- ‘A picture paints a thousand words’ (importance of visuals, graphs to show trends etc)
- Important to think about reporting means at the outset of project, and to tailor the report style and level of detail to the target audience.

- Timing/release of a report can be critical, espec if using media

Other lessons learnt

- The process of MPA design/selection must be flexible
- No one MPA model should be nationally or internationally applicable
- No MPA will not be perfect when first developed (information not always immediately available)
- Need to be scientific, transparent and accountable to community in decision-making
- Need well-defined objectives for MPAs
- The ultimate process of selection & proclamation of MPAs is usually socio-political
- MPAs will not instantly resolve all marine conservation issues
- MPAs can act like a ‘magnet’ for visitors
- Priority should be to obtain a network of representative MPAs.
- If any doubt, apply the precautionary approach

For more information about GBRMPA’s activities or the RAP rezoning, go to the GBRMPA website: www.gbrmpa.gov.au

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3.6 Monitoring marine protected areas

Summary by Jon Davies

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Monitoring is a key process if a marine protected area (MPA) is to achieve its goal. It provides the essential information to determine whether the management regime is effective in ensuring the long-term persistence of the MPA and its designated feature(s). Successful and effective monitoring requires a clearly defined objective (equivalent to a hypothesis in a scientific investigation). Where no such objective exists, it is unlikely that a MPA monitoring programme will provide the necessary information to support the management regime. Having a clear objective is the most important 'take home' message and cannot be over emphasised!

Monitoring is a generic term that covers a very wide range of activities that are impossible to describe in a short paper. Consequently, this paper will provide a brief overview of monitoring, highlighting the main points for consideration when establishing a monitoring programme, and provide references and/or links to other sources of information. It also links with the case study of a recent monitoring programme on a Special Area of Conservation (SAC) in UK (Evans 2004). There are many texts on marine monitoring: Davies *et al.* (2001) and Wilkinson *et al.* (2003) focus on MPAs and are available on-line. This paper will consider MPA monitoring through a series of basic questions:

- Why monitor a Marine Protected Area?
- What is monitoring?
- What do you monitor?
- How do you monitor a MPA?
- What do I do with the results?

Why monitor a Marine Protected Area?

By stating the obvious, a MPA sets out to 'protect' part of the marine environment from a potential or an actual threat, most likely an anthropogenic threat. One could argue that most MPAs would not be necessary if anthropogenic pressures were not adversely affecting the marine environment. In response to threats, a MPA monitoring programme should advise the management regime that:

- The site and/or the feature(s) for which it was designated still exist and are present in appropriate quantity: for example offshore volcanic islands have disappeared and features such as biogenic reefs have been destroyed.
- A designated feature remains at an appropriate quality: for example, the population of a protected species remains stable.

- A licensed anthropogenic activity is continuing to have an adverse impact on the status of the protected feature, suggesting the terms of the license should be re-considered. For example, a fish population is declining despite a fishery remaining within its allowable catch.

It may also be a legislative requirement that a MPA is monitored to enable the legislating authority to establish the success of its legislation. Being forced to monitor will, however, often result in the monitoring objective simply addressing the legislative requirement rather than establishing an objective to provide appropriate information to a management regime for the long-term benefit of the MPA.

What is monitoring?

Unfortunately, the term ‘marine monitoring’ encompasses a wide range of quite different activities and therefore it is necessary to clearly define ‘monitoring’. Its dictionary definition refers to ‘..regularly checking the condition and/or progress of an entity..’ that implies both a consideration the current state (condition) and a trend over time (progress). In the context of MPA monitoring, the aspects of determining current state and any temporal trend are important aspects of a management regime: the current status provides a measure of the success (or failure) of the current management, and; the historical trend provides information to determine how the type and intensity of management intervention affects status, hopefully to set appropriate future management in response to current status.

For MPAs, the following definitions are considered most appropriate:

- *Survey*: A set of standard observations, usually obtained with a standard method and within a restricted time period
- *Surveillance*: A continued programme of biological surveys systematically undertaken to provide a series of observations in time.
- *Monitoring*: A survey undertaken to check that the desired standards for a habitat or species are being maintained
- *Monitoring system*: a system designed to reveal the extent to which the ecological and socio-economic objectives of a MPA are being met, as a basis for management actions (Committee on the Evaluation, Design, and Monitoring Marine Reserves and Protected Areas in the United States, 2003)

Monitoring in the context of a MPA is therefore a series of activities that records the current status of the designated feature and then compares this status with that expected or required for the MPA. Establishing and quantifying this required standard may be problematical depending upon the current level of anthropogenic activity: for a pristine area, a MPA will most likely aim to maintain the status present at designation. For areas subject to current or historical anthropogenic impact, the desired state

will probably be ‘better’ than current state but it is difficult to describe unless there are pre-impact data available.

Marine monitoring activities are invariably expensive, particularly in remote areas or areas away from the coast where bespoke survey vessels are required. It is imperative that marine monitoring is cost-efficient and provides appropriate data to assess the status of the designated feature. Effective monitoring requires a clear objective: for MPA monitoring, this objective should equate to the conservation objective for the MPA and/or its designated feature. Once this objective is established, it should be possible to determine the most appropriate characteristics, also known as attributes, to measure to assess whether the site/feature is at the required status. Such characteristics should be carefully selected to ensure there is sufficient information to quantify required status, known as the target value, and are straightforward to measure in an unambiguous manner. For the latter, it is important to understand potential sources of error and any natural variability that may mask an anthropogenic impact. If a MPA is subject to a known threat or impact, at least one attribute should be selected that would clearly show the level of impact on the designated feature.

What should be monitored?

Selecting the most appropriate attributes to monitor is arguably the most difficult decision when establishing a MPA monitoring program. Particularly where a MPA is established to protect rich and diverse habitats or populations of species, our knowledge of the functional dynamics of populations of single or multiple species (communities) is often relatively poor. Our first reaction, and the traditional approach, is to establish an ecological monitoring programme to directly record the ecological status of our designated feature. Such an approach is, however, often based on attributes for which little is known about the natural variability, or how these attributes respond to anthropogenic pressures. Furthermore, change is the norm rather than the exception in the marine environment and so we must expect a level of change in any attribute – we simply need to know when such change is unnatural!

An alternative approach is to consider monitoring socio-economic activities within and adjacent to the MPA on the basis that if there are no anthropogenic threats or impacts, the MPA’s status should be at the desired state (its natural state). Monitoring anthropogenic activities is often more straightforward than ecological monitoring, particularly since many activities are subject to a licence where the licensing authority record compliance with its terms and conditions. For MPAs that allow limited levels of activity, it is more difficult to establish the ‘acceptable’ intensity of an activity particularly where there are potential synergistic effects between activities that would magnify the level of an impact. Nevertheless, socio-economic monitoring is potentially a cost-effective method for indirectly determining the status of a MPA. In practise, a MPA monito-

ring programme should be a combination of direct and indirect measures to establish whether its objectives are being met and whether the existing management regime is appropriate.

Selection of ecological attributes will depend on the type of designated feature but, as a broad framework, it should consider aspects of its quantity, quality and ecological functionality. In the UK, specialist groups from the government conservation agencies developed guidance on setting objectives, selecting attributes and establishing targets for features on protected sites (Anon, 2004). Guidance on marine features may be downloaded from the web (<http://www.jncc.gov.uk/csm/guidance/marine.htm>). Typical measures for quantity would refer to the extent of a habitat or the population size of species. Quality measures are tightly linked to the objective of the MPA but typical measures would include the number of types of community present, species richness and diversity within communities, or a 'health' measure for a species (body size of breeding individuals). Functional ecological measures are more difficult to generalise but should consider the essential biological and physical processes that maintain the designated feature: for example, the water quality and water flow necessary to maintain the primary producers within a plant dominated community such as a kelp forest or seagrass bed.

How do you monitor a MPA?

Deciding how to monitor, or in other words what field activity is required, will often be relatively straightforward once the objective is defined and the appropriate attributes selected. For some attributes, there may only be a single method of measurement but often, there will be a range of techniques that could provide a measure. At this stage, our key objective is the accurate measure of the attribute to avoid the risk of making an error in the final judgement of status. A 'false negative' result where a designated feature is considered to have failed to meet its target status where in reality it does meet the requirement, may result in unnecessary additional management activity will nevertheless ensure the feature is maintained. A 'false positive' where the feature is deemed to meet the target status where in reality it is actually below target status is a more serious error since it is likely to result in a further decline because management action will not be implemented following the monitoring. Establishing the risk of making an error should be considered when selecting an appropriate technique to measure an attribute although unfortunately, the risk is more often linked to financial considerations of deployment rather than the measuring technique or device itself. For example, taking more samples will generally reduce the risk of making an error, but will require extra expense on sample analysis. The following figure gives an example of the type of considerations when planning a monitoring campaign.

Geographic scale is a further important consideration when establishing how to deploy a technique in a MPA. It is often appropriate to ensure measurements are taken throughout the site unless there are *a priori* reasons for limiting the scale, for example where a measure is considering a localised impact. An overall ecological monitoring strategy should take into account the broad picture of the whole MPA together with detailed information collected in a small number of appropriate locations; in other words, a ‘top-down’ monitoring strategy should be developed.

Before finalising the details of a monitoring programme, it is necessary to consider the consequences of a monitoring survey showing the designated feature is below its target status. What management action will be required and who will be affected by such management action? When commercial interests are likely to be compromised by management action, those organisations will most likely require assurance that the decision was based on robust, quality assured data. Quality assurance must be built into all monitoring programmes with appropriate quality control procedures for data collection and analysis. Quality considerations will have additional resource implications but it must be viewed as a necessary investment to avoid any future problems where the reliability of results could prevent timely management action to protect the MPA. Quality assurance measures should ensure that all monitoring activities follow established protocols such as international or national standards. In addition, a clear audit trail must be implemented to document all stages of planning, field deployment, data analysis and assessment to provide proof of the quality assurance programme. Quality control procedures should consider bias in the results from different observers both in the field and the laboratory, particularly in aspects of taxonomic identification and enumeration.

What do you do with the results from a monitoring programme?

Hopefully the results from the monitoring programme will generate appropriate information to draw conclusions against the (conservation) objective of the MPA. There are two important points to note: firstly it is unlikely that ecological monitoring will deliver a categorical answer and therefore some expert judgement will be necessary. All judgements involve a degree of subjectivity and the outcome will be influenced by the knowledge and previous experience of the person making the assessment. Such matters are difficult to quality assure and it will be vital that there is some process for a third party to consider the outcome (or validate) any assessment, particularly where the consequence will be an expensive management action. The second point to note is that it is usual for a number of parameters to be measured and therefore the final decision will require some integration of the results. Such integration can either follow a *default-based* approach where the failure of one attribute to meet its target condition results in the whole feature being deemed to fail, or a *weighted* approach where the relative 'value' of each attribute to the overall judgement varies depending on its relationship to the key conservation interest of the MPA/feature. A default-based approach is simpler to operate and more transparent but it does place extra reliance on the selection of appropriate attributes and target values; the EC Water Framework Directive will apply a default-based approach to integrate the different quality elements in the overall assessment of status. A weighted approach offers more opportunity to downgrade the results from an attribute where subsequent studies demonstrate it is less relevant to the overall measurement of status, for example where a species was originally considered rare but was subsequently found to have a more widespread distribution. However, the judgement aspect of the weighing must be carefully evaluated to avoid any bias or suggestion that important negative factors are being overlooked to ensure the area meets its status for reasons unrelated to conservation. In the UK, the guidance developed to support its monitoring programme of marine sites provides further discussion on the assessment process together with a suggested decision pathway (see: <http://www.jncc.gov.uk/csm/guidance/marine.htm>).

Conclusions

Monitoring is an essential process in the effective management of a MPA since it provides a measure of the current status of the feature(s) of interest and an measure of the MPA's 'performance' over time in offering protection to this feature. Marine monitoring is a complex and potentially expensive exercise and therefore it is vital that a monitoring programme is carefully planned to ensure it is appropriate and cost-effective. The following points are the key messages:

- Effective monitoring requires a clearly defined objective for a MPA

- The degree of ecological monitoring should be linked to the intensity of anthropogenic pressure on a MPA – fewer pressures should require less monitoring
- Change is the norm in marine ecosystems – we must determine what is acceptable change in our MPA, and
- Assessing the status of a MPA is a subjective process and requires knowledge and experience of the ecology of the feature and the site itself

The following figure provides a summary of the main steps in monitoring a MPA:

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3.7 Summary of Flamborough Head Candidate Special Area of Conservation (N & E Yorkshire, England) Subtidal Condition Assessment.

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The process of assessing condition of subtidal features within the Flamborough Head candidate Special Area of Conservation according to JNCC Common Standards (http://www.jncc.gov.uk/marine/marine_habitat/survey/csm.htm) was carried out in October 2003. This is the first time the process has been carried out for non-SSSI subtidal features.

The practical assessment process is broken down further below.

Flamborough Head European marine site includes part of Flamborough Head SPA, candidate SAC and SSSI. The subtidal area consists of reefs, including kelp forest and circalittoral faunal turf communities. Sea caves are also an interest feature of the cSAC. Activities within the site include static and mobile gear fishing, recreation and one dredge disposal site.

Summary

The condition assessment (CA) process involves methodical checking of attributes defined in the Favourable Condition Table (FCT) against data gathered through site monitoring and baseline survey to date, according to JNCC Common Standards Monitoring procedure. Each attribute is then assigned a condition², which is revisited and revised if necessary in light of additional contextual information, such as levels of shore access and collection of shoreline animals, or fishing activities. The FCT was revised in light of new information and the strength of chosen attributes in light of scrutiny through the assessment process. A requirement for unitisation of subtidal (non-SSSI) parts of the site was identified, based on operational requirements arising from different site activities and habitats in discrete areas. It was found that attributes currently used within the FCT did not adequately represent indicators of fishing impacts, particularly demersal activities in deeper parts of the site, given the natural variability in the biotopes selected.

The final list of attributes that are deemed mandatory to assess condition are:

- Extent of reefs
- Biotope composition

² Condition is based on EN standards: Favourable, unfavourable recovering, unfavourable no change, unfavourable declining, partially destroyed or destroyed.

- Distribution and spatial pattern of biotopes³

Attributes determined as discretionary but important context for change are:

- Extent of notable biotopes (inc. species at northerly or southerly limit)
- Water clarity
- Water density

Lessons learned

Supporting information must be used to ensure the outcome of the assessment has not missed a vital threat/ perceived impact going on at the site. For example, there may not have been enough coverage to pick up the effect of an activity in a particular area of a site.

If all of the attributes for a feature are judged favourable, then the feature should be judged favourable. If an attribute fails, then the feature should be judged unfavourable, either at a unit or whole site level, depending on the scale of the assessment. Although a slight departure from JNCC CSM guidance, site management could then be looked at alongside the nature of the unfavourable judgement to determine whether it is recovering (+ve management action), no change (one off impact) or declining (deteriorating). It has become clear from the CA process that emphasis will continue to be placed on contextual information in determining condition. *Emphasis should therefore be placed on continually updating and improving this contextual information, alongside our scientific knowledge, about the Ems.*

In the case of Flamborough Head, trawling in deeper parts of the site was identified as having potential to damage features, specifically circalittoral faunal turf communities. The assessment process indicated that attributes chosen to monitor this feature were unlikely to indicate directly the impact of deeper-water fishing activities. This highlights the need for good quality (quantitative) contextualising information. There remains a need to examine activities in the context of the foreseeable risk, of deterioration or disturbance, that they may have on the features of interest for which the site has been selected.

The North Eastern Sea Fisheries Committee have since introduced byelaws limiting certain trawling activities in this area and are also in the process of repeating the fishing effort surveys.

³ This attribute was identified as requiring updating in light of CSM guidance

Supporting figures

Monitoring extent

Extract from Bates, C.R. (2004) Flamborough Head Sidescan Sonar Evaluation

Biotope distribution

Extract from Howson, C. (2003) Flamborough Head sublittoral monitoring 2002

Extract from Senior, R. (1999)

Trawling:

- Mean days in SAC = 91 per vessel per year
- 24 vessels trawled in the SAC
- The trawl limit was then 3nm for vessels greater than 18.3m (it's now 6nm)
- The figures on the effort map are the number of skippers interviewed that said they fish at some time during the year in that 1km box.

4. Epilogue

The workshop itself went very well indeed. It gave us the inspirational kick we so badly needed to improve the basic know-how in marine nature conservation in the Nordic countries. The workshop lectures were excellent and the group work gave us a chance to try out what we had learned and to discuss different scenarios and case studies.

However, the workshop was much more than that. The good humour among the lecturers immediately rubbed off on the rest of us from the first moment, creating a relaxed and friendly working atmosphere that lasted for the entire week. A workshop organiser can not guarantee that this will happen, no matter how much detailed planning and thorough preparation is done, as the good atmosphere is always created by the people present. When it happens it is like magic. I feel very lucky that such a good atmosphere presented itself at this particular workshop.

The Nordic Council of Ministers always looks for the Nordic benefit in the projects that they fund. I have reason to believe that this workshop benefits the Nordic countries in many ways. It increased the Nordic profile in marine nature conservation and it also improved our know-how as well as our network of colleagues. I am also sure that new ties of friendship were made at the workshop. Several of us have already been able to use what we have learned. I also know about several project ideas that were brought forward at the workshop or after it. It also inspired us.

I will use this final opportunity to once again thank everybody for a fantastic input. From an organiser's point of view this workshop made all my dreams come true. A special thanks to all our lecturers – John B, John R., Jon D × 2, Hussein, and Per. You were the backbone of the workshop. A big thank you goes to Kirsten and Thomas that made a superb input as organisers. The staff at the Blue Mussel and the Kasnäs Hotel were more than helpful and I can warmly recommend Kasnäs as a workshop venue. Finally, my humblest appreciation to the institutes that have funded this workshop – thanks for trusting us!

I realise that we need more workshops in the future in order to compensate for the fact that so few universities provide courses in marine nature conservation. I therefore encourage you all to consider the possibility to host a similar event. It's worth all the trouble.

Jan Ekebom (main organiser)
Helsinki, January 9, 2005

Annexes 1-4:

Reports from group sessions

Note!

The following reports capture the flavour of what was discussed in the group sessions. The reports may not be completely accurate. Please forgive any eventual reporting errors or misinterpretations. Thank you.

Annex 1: Report from group session 1 on approaches to marine conservation, site selection and threats to the marine environment.

Following are the general and country-specific topics and questions discussed regarding threats and approaches to site selection. The different approaches mentioned can be found in the presentations of Hussein Ali-dina and John Roff (on the workshop CD) and in the paper by Hussein Alidina in this report:

Finland:

What approaches to marine conservation are happening in your region?

Mostly conservation efforts are based on traditional knowledge, however, the Opportunistic and Delphic approaches are widespread, and very little analytical and research-based site selection is done. There is no single approach or set of approaches that can be used for all sites in Finland. Historically, marine areas have been quite opportunistic and delphic e.g. for selecting HELCOM sites (BSPAs). The terrestrial areas and approaches have been quite analytical and have included some marine areas.

Natura 2000 has forced a more analytical approach to protect habitats and species. New sites are proposed under the Habitats Directive. A more analytical approach has been used for Baltic MPAs, mapped Natura 2000 sites and additional identified sites. Thus, it sounds like the general approach now is analytical.

In the future, should we establish new sites or further develop existing sites?

It is important to keep areas that were previously selected, whatever new selections may come. There is a need to polish up the existing activities, before selection of new areas. There are several systems that are half implemented (also in Sweden) and Natura 2000 sites need management plans. Time is needed for science and analysis – areas need to be checked, and a gap analysis can help in finding what is needed and what we have.

Inventories must be done of coastal habitats as a scientific basis for conservation so that we know where MPA borders should be drawn. We need time to build a solid platform to justify MPAs. We also need to reconsider existing areas and trade-off areas.

What do you need to get “the job done”? What is preventing you from MPA selection and establishment?

An international approach (e.g. HELCOM and EU) is not the solution, because it is our national governments that are preventing the respective next steps (usually through channelling of funds).

Has your government defined its goals and targets?

We don't have clearly defined goals and targets.

Sweden:

What approaches to marine conservation are happening in your region?

Historically, no approach or legislation on the establishment of MPAs exists. Different approaches have been taken by different county boards. There is one board at the regional county level establishing fish spawning closures in small bays, i.e. drawing areas that they think are suitable and making overlay stakeholder maps with overlaps. This was considered to be most successful. However, there are very few areas of this type. Areas protected around the Swedish Archipelago are protected because of what is on land, while the water is not managed in any way.

What do you need to get “the job done”? What is preventing you from MPA selection and establishment?

There is little knowledge available on the state of marine habitats. No systematic categorisation or mapping of habitats. The system used for categorisation of habitats is extrapolated from the one used on land. However, for the Swedish Archipelago there is some mapping data.

What do you see in the future?

Stockholm county has a unique and representative areas approach with existing marine areas, but we are not sure what will happen with these areas. Natura 2000 will concentrate on west coast of Sweden. There are mainly new areas which will be more Fisheries Management Areas – individual handling of fishers, gear size & time limitations that have an impact on biodiversity, while only few of the areas that existed before that will be incorporated. Environmental goals – environmental seascape and landscape plans will need to be done by each county.

Denmark:

What approaches to marine conservation are happening in your region?

The approach taken is rather Delphic.

What do you need to get “the job done”? What is preventing you from MPA selection and establishment?

Mapping is a big problem. There are well mapped areas from Skagen and southward but mainly for algal vegetation, i.e. there is no real data for marine fauna. There exists “biological inventory and water quality”-data, but this is rather scattered. A geographically wide range of habitat inventory is missing. No new inventories are being done, as the EU Directives do not call for them. State obligations make the basic site selection process very difficult, i.e. only selecting areas for which there is sufficient scientific data available. However, the national legal basis for MPA establishment is there, as there is a Conservation Act which applies up to 200 nm offshore.

Has your government defined its goals and targets?

Yes. It is now mainly to “reduce the levels of nitrogens in our waters to address sources of eutrophication”.

UK/England:

What approaches to marine conservation are happening in your region?

Site selection is a mixture/hybrid, but usually a more Delphic approach. Site selection approach is also a bit analytical, i.e. there are very good inventories around the English coast as a result to dive sampling, but not all collected data used, e.g. in Lundy marine reserve. England has collected relatively little oceanographic information in its waters.

There is national legislation and there are a number of nationally protected sites. There are only five statutory marine nature reserves in all of UK. There were conservation volunteer partnerships from the very start of site selection procedures. However, the selected SACs which have been chosen are all very close to the coast.

Systematically collected data is available, but most of it has not been analysed and used, i.e. mapped regions exist in data form. The UK is moving towards wider protection measures, but they are definitely coming from the small-scale side and angle.

What do you need to get “the job done”? What is preventing you from MPA selection and establishment?

It is difficult to choose the appropriate scale of selecting/designing MPAs.

Iceland

What approaches to marine conservation/site selection are happening in your region?

Iceland has guidelines on how to select areas: i.e. a nature conservation strategy from 1999 for the whole country. Includes most relevant info,

habitats, ecosystem, unique characteristics, cultural heritage. For land/coastal and EEZ areas. Habitat types, ecosystems, geological formation, shall be included – rare species, highly rich areas, economic species, social, economic and cultural value, international nature conservation value. There are a number of criteria. Thus it cannot be an opportunistic approach, as it has some planning – i.e. the approach is proactive rather than reactive. Doing this requires data and agencies have to pay for data, even within government agencies. Some 80 areas were picked for special species, feeding grounds in connection with the Red List/Bern Convention. They are mainly terrestrial areas, a few are coastal based on the information available. Iceland used a Birdlife Report to pick sites.

Icelandic case:

One selected site is a small area with “white chimneys” (geological formation), which experiences threats ranging from recreational divers to deep sea tourism. 30 m depth to the chimneys means that boats must anchor. There were ministerial consultations on activities – people now need a permit for some activities, and they need registration for all visits. Reasons for the choice of this site were mostly related to tourism and threats.

In the future, should we establish new sites or further develop existing sites?

A few years ago it was decided not to protect any new areas, but this did not work well. We should “Freeze” areas as registered special sites for the future. We should set the sites aside and have some kind of designation, while not necessarily excluding all activities. Rules for these areas may become stronger or weaker over time.

What do you need to get “the job done”? What is preventing you from MPA selection and establishment?

Fisheries Management is dominant. The Quota system. Changing lifestyles.

Effect of fisheries within the EU and pieces of Common Fisheries Policy legislation.

Russia:

What approaches to marine conservation/site selection are happening in your region?

No specific legislation or overarching federal legislation for protected areas. Several laws on terrestrial PAs exist. There are legal acts for certain regulations for the marine environment, and we have some criteria for selecting areas as well as legal procedures that are needed for selecting areas. Areas are typically selected with opportunistic and delphic approaches. Thus, there is a federal and a regional system of protected

areas and also municipal (terrestrial) PAs. Some of the criteria (abundance, flagship, unique species, cultural historical values, geological features, commercial species) are set. Scientists and NGOs are the driving forces, by using a combination of opportunistic and delphic approaches. According to NGOs, regional MPAs are accepted on paper, but they are not working to address threats.

Examples of MPA's? Federal Artic Nature Reserve, which was supposed to protect waterfowl and/or seals. This was driven by HELCOM and science/research is pushing this.

Regarding industrial developments, the protection agency is under the resource use agency, which forces the use of an opportunistic approach.

Future approaches?

For future sites it is expected that a hybrid, more analytical approach will be used.

There is a need for a coordinated approach for site/area selection in addition to what we have. HELCOM framework is in place for this and provides useful input, but HELCOM doesn't plan to discuss site selection criteria. Furthermore, HELCOM and OSPAR are recommendations and therefore not binding. Further development of these areas is a logical way of accomplishing this goal.

In the future, should we establish new sites or further develop existing sites?

Both approaches – we need to preserve what we can – more like a moratorium, earmark them – and not allow new activities, but “freeze” them before going through the official process of designation. There is also a need to concentrate on improvement of existing areas and to document benefits that can advocate the designation of future areas. The MPA establishment process in Russia has been prohibitive – this has created an air of exclusion, which must be changed through good management.

In General:

The opportunistic approach is valuable when the public/stakeholders are reluctant in agreeing to selection of new sites, but in most cases MPA site selection will ultimately be a combination/hybrid of approaches.

There is a need to get information out to the public and change the way in which PAs are accepted by the general public. Fishermen (including recreational fishers) are in some areas thinking more tactically about MPAs these days, e.g. voluntarily suggesting sites for protection. Their suggested sites do not affect them and it is their hope that the opportunistic approach is utilised, and that the inevitable “MPA-threat” to their livelihoods thus will be diffused.

Pan-European and Baltic or European regions all need to get stakeholders identified before starting any protection program. This was a pro-

blem with the Habitats Directive: areas were too quickly designated and stakeholder involvement was rushed.

It is important to have an efficient network of MPAs. We must get our programme and vision established, rather than MPAs that pop up like mushrooms.

On the Single/Focal species approach

We do not want to be driven by the single species approach because it is too narrow, does not meet our general goals. There is agreement that the single species approach is a bit passé, but it still exists many places. Single species approach can be advantageous if the public supports e.g. killer whale or seal conservation MPAs. Birds can also be used as public awareness “magnets” in a greater marine conservation programme.

There is, however, a danger that fishermen may get mad if “cute” animals are used in marine conservation. And in addition, species come and go, therefore we must focus on habitats. If a threatened species recovers, then the MPA may become obsolete. What then? If single species is the core of the conservation effort, other values must be found and highlighted. Single species should be discussed as a broad issue.

On the Fisheries approach

The fisheries approach should be integrated into marine conservation in general, since fishing can have negative effects on the marine environment. However, you need to speak with the fishers or they might fish in an MPA anyway. Fishermen can be our allies, but it is important that we approach them as equals. If we approach as managers then we can make laws and they will not cooperate. Approach them as who you are, i.e. if you are a biologist, you have a task. Different people have different tasks and it is important that fishers accept this fact.

First step to find this common ground, e.g. we all want more fish. Making both industry and individuals aware of the problem is the first step. And communicating the problem.

Any other approaches?

Knowledge reserves, i.e. areas from which we have a lot of existing data. These areas should be protected so we can build on this data.

The Spaces approach includes everything and one group agreed that the best approach is a hybrid spaces/habitat approach, but that we have not used it in practice.

For large marine organisms and metapopulations the idea of “roaming MPAs” (MPAs that move along with the migration routes of the respective species) was mentioned more than once. There are “roaming MPAs” established for migrating Atlantic salmon in Finland.

How are we (some participating regions/countries) currently selecting sites?

International frameworks for establishing MPAs = OSPAR, HELCOM, NATURA 2000.

How should we be selecting sites?

Stage 1: One group agreed that the first stage of the process should be to establish the biogeographic regions (internationally) based on oceanographic, geological and physical data. The minimum goals for each habitat should be set for each region. (i.e. 20% minimum level)

Stage 2: Each country seeks to identify its own possible MPAs.

Stage 3: Discussion with all national stakeholders (what is gained and what is the loss?)

At the moment site selection has been done on a national level, but we need to take it on an international/regional/network level (e.g. Baltic). This is important for convincing the political stakeholders.

We must make guidelines and regulations at a national level, but implement them on a local level. The process should be both top-down and bottom up.

Do we have enough knowledge? What data are missing? What sources might be tapped?

Data should be collected at a national level, and put together at an international level (i.e. military data).

One approach includes multibeam mapping, which has been done in Canada. They have taken this mapping information to the fishers. Now many fishing boats have this technology and are effectivising their catch, at the same time authorities are allowed to keep track of the boat.

There is ongoing mapping of the seafloor in the territorial waters of e.g. France and Holland (MESH). They call it holistic mapping. They get data in one uniform format, which includes birds and larger animals. Holistic habitat mapping should be done.

What sort of criteria should be used to perform the data selection for the MPA?

Habitats, depleted commercial species and endangered species, key species, charismatic species, focal and "special" habitats should be considered. Representativeness and "negative" criteria, (e.g. for avoiding problem areas: heavily polluted areas, shipping routes, harbours, wind farms) should also be used to perform data selection.

The Baltic Sea

Can we get this together to become a regional Baltic effort?

There's the Baltic Sea Declaration. Regarding our vision for areas in the Baltic, we need to have time to do things properly, get best out of science, stakeholders, etc...

In the Baltic, coastal and marine area inventories are being extended & starting up. Lack of data is an issue for decision-making, but there's always a lack of data. Political decision makers will make their decision regardless of the state of existing data bases. Sweden, Latvia and Estonia have done some data collection work.

Which of John Roff's four approaches are most appropriate to use within the Baltic?(one group)

One group agreed that it would be beneficial to use both an analytical and a Delphic approach. The analytical approach should be preferred. In places you do not have data, you could use a Delphic approach. There is substantial data, which should be used together with a Delphic approach. It does not need to start with a Delphic approach, i.e. there is no defined sequence of approaches.

Not every country has to participate in all components of an eventual network.

Planning units are too small in some cases, i.e. spawning areas of fish populations lie outside of their planning units. In these cases, the planning unit should be the whole Baltic sea.

What are the top four threats to the Baltic Sea? Can MPAs be a useful tool against these threats?

Eutrophication: can only be solved on an ecosystem level, but mpas can be part of it, e.g. protected areas with mussel beds filtrate water.

Chemical: No, MPA's can't address that. Chemicals is a broad, CZM problem.

Fishing: Yes, MPAs can address this.

Shipping: Yes, MPAs can partly address this. What other tools exist for mitigating shipping-related threats? Some shipping routes can be/are being changed, ship design, legislation of shipping, PSSA Status, reduced speed, etc.

Resilience due to MPAs is important in all cases.

What objectives/aims can you formulate to address the threats above?

One group agreed on the following possible objectives:

- 1) To adequately protect representative biological communities and habitats as well as sites of geological interest by informed management of human activities.
- 2) To provide for reference areas and reservoirs of biodiversity and species abundance.

- 3) To facilitate sustainability and interpretation of marine and estuarine systems for the purpose of conservation, recreation, scientific understanding and public education.
- 4) To protect natural hydrodynamics and variability at the ecosystem scale (e.g. fronts, upwellings, etc.).
- 5) To protect and manage significant archaeological, historical and cultural sites for present and future generations.

One group agreed that the above objectives indeed do address the above mentioned threats.

Another group decided to address overall objectives by defining an MPA: A marine park to protect marine biodiversity including management of resources, to deliver sustainable development (including fisheries).

What are the ranked threats to marine environments (in the Baltic and Iceland) and can they be addressed by MPAs?

Baltic	Iceland		Can be addressed by MPAs?
3	1	Fisheries	(yes)
2	2	Pollution (POPs and heavy metals)	(yes/no)
11		Species extinction	(yes)
4		Alien species	(yes/no)
10		Wind farm	(yes)
12		Oil/Gas	(yes)
2	4	Shipping	(yes)
5		Extraction of natural resources / dredging	(yes)
8		Recreation	(yes)
13		Coastal defences	(yes)
6	3	Aquaculture	(yes)
1	2	Agriculture	(yes/no)
9	6	Erosion	(no)
7	5	Climate changes	(no)
	7	volcanic activity	(no)

What are the obstacles in the way of MPA establishment in the Baltic and Iceland?

Lack of

- political will
- legislation
- resources
- awareness (political, public, scientific)
- transparency (Problem in not having access to data)
- proof that MPAs work

Existing

- resistance from industry / fisheries / farmers etc.
- private ownership ("NIMBY")
- Sectoral responsibility (lack of integration)
- Tradition

What can we do to address these obstacles?

Baltic

1. Identify key target audiences, show personal benefit (political will, awareness, legislation)
1. Show political and economic benefits (political will – legislation)
2. Re-organisation of bodies to a common steering board, with senior political involvement (sectoral responsibility)
2. Look for links to other programmes, and coordination of programmes, levy on shipping (resources)

Iceland

Proving MPAs, then review experience from Iceland and elsewhere.

On Connectivity:

Connectivity is a useful management and conservation tool across different scales. It helps to capture organisms and habitats across scales.

The only good examples and study cases for connectivity measurements are:

- 1) physical oceanographic models and
- 2) genetic resource studies

Annex 2: Report from group session 2 on stakeholders and legal issues.

The groups were first asked, in light of presentations by John Baxter and Jon Day, to construct a matrix of stakeholders regarding MPA establishment and management, and possible effective ways to approach these stakeholders.

It was agreed by one group that “everyone out there is a stakeholder” and that the correct term should be “interest groups”.

Through useful discussions, each group came up with a matrix. The Swedish and Finnish groups found time to complete the matrix with X’s marking the channels through which the listed interest groups could best be approached. Following are the three matrices:

Finland

Target audience	open meetings	newspaper articles / targeted publications	closed meetings	media / radio / tv	WEB / Internet	focal person	talks / exhibits	targeted correspondence	practical happenings	study circles	public enquiry
fishermen			x			x		x			
local communities	x	x		x		x		x			x
water- and land owners			x					x			x
boaters	x	x							x		
hunters			x			x		x			
fish farmers	x		x					x			
farmers		x		x							
tourists		x			x		x		x		
shipping			x					x			
coastal government institutes			x					x		x	
researchers				x	x		x				
NGOs					x	x					x
media						x			x		
educations		x		x	x		x		x		
local government			x						x		x
developers				x							
regional government			x						x		
national government			x					x	x		
local politicians	x		x			x					
regional politicians						x					
national politicians	x						x	x	x		
EU politicians								x			
divers / water sports		x							x	x	
anglers		x	x	x							
tourist					x	x			x		

Sweden

Audience / Stakeholders	Why approach / message	How approach?							
		Written, direct	Workshop	Working groups	Info System (web)	Media	Meeting "1+1"	Public Meeting	Informal networks
EU	Funding Reporting Feedback	x	x	x	x				
Government	Influence Legislation/Action Urgency Reporting/Feedback	x petitions (NGO)			x	x	x	x	
Reg. agreements e.g. HELCOM	Action/collaboration Better use of funds/ resources		x			x			x
Nat. agencies	Highlight responsibilities "Combined effort up + down" "Best use of legislation" "Highlight MPA issues"		x	x	x	x NGO	x		x
The media (national press/TV)	Use their influence Raise awareness of MPAs Raise own profile	x					x	x	
Municipality, Country administration Science, research	Responsibilities Support/Advice for their functions, the need for action, combined efforts Data sharing Cooperation Focus/ Priorities	x evidences, "simple"	x	x	x		x		x
Local communities	Encourage cooperation (taking into account local competence) Awareness leads to acceptance of need for MPA MPA positive	x Leaflets, maps, codes questionnaires	x Events for diff. users	x Part of process, involvement	x	x	x Open house meetings, Question/ Answer	x	x Capture expertise
Private Sector	What the MPA means Awareness/important Support/ Alternatives	x		x	x		x	x	x Trade associations

Denmark, Germany, Russia, Australia, Iceland

[illegible]

of Natura 2000, e.g. the Water Act, Fisheries Act, Building and Land Use Act and Forest Act.

A great number of organisations and governmental bodies are involved in MPA management in Finland, e.g. regional environment centres, Forest and Parks Services, Finnish Game and Fisheries Research Institute, county administrations, Forest Research Institute, employment and economic development centres, universities, the Navy, Coast Guard, the Finnish Institute of Marine Research, the Geological Survey of Finland, the National Board of Land Survey, Customs, etc.

- As an exercise, the Swedish group listed the legal committees and legislation in a geographical order through the Swedish archipelago, from land to sea.

In the Swedish archipelago, the course of MPA establishment is complicated further by “old” coastal land ownerships, as these include ownership of the adjacent coastal waters extending to 300 metres.

Annex 3: Report from group session 3 on MPAs in relation to fish conservation.

What is the common ground between fisheries and marine conservation, i.e. which aims/objectives do we have in common?

- Biodiversity: to conserve biological diversity in our seas.
- Research and knowledge: to learn from one another. E.g. information regarding the seabed is of equal importance and value to fishers and scientists.
- Resilience: it is important for all that the ecosystems are robust and able to withstand natural changes.
- Healthy, clean habitats: to protect habitats that are important to fish species. For instance, some habitats are important for recruitment.
- Healthy fish stocks in the future: to assure ecological functions that are important for fish stocks, e.g. spawning grounds
- Network of MPAs: an ecologically coherent network of well-functioning MPAs that causes change and improves resilience of marine resources while providing fishery benefits in the form of e.g. spillover effect.
- To reduce discard and unwanted bycatch: the development of technical solutions to reduce discard and unwanted bycatch of e.g. marine mammals and non-target species. This eases the work of fishermen and simultaneously improves selectivity of fisheries.
- Others: e.g. education, economically sustainable use, combatting alien species, etc.

One group constructed a matrix of conservation aims in relation to fisheries and marine conservation, including their common ground:

Conservation aim		Use= U Structure= S Function= F	Conservation	Fisheries	Fish conservation	Common
Habitat condition		F, S	x	x (-)	x	(y)
Biodiversity	Genetic	S	x	(x)	x	(y)
	species	S	x	x	x	y
	habitats	S	x	x	x	y
	Ecosystem	F	x	x	x	y
Exploited species		U	x	x	x	y
Rare species		S	x	-	(x)	n
Endemic species		S	x	(x)	x	(y)
Traditional use		U	x (c+n)	x (c)	-	n
Sociocultural use		U	x (-)	-(x)	-	n
Geological features	Distinctive	S	x	(x)	(x)	(y)
	Representative	S	x	-	(x)	n
Education		U	x	-(x)	x	(y)
Research		U?	x	x	x	y
Recreation		U	x	-	-	n
Historical/cultural sites		U?	x	(x)	-	n
Productivity		F	x	X	(x)	(y)
Sustainable use		U	x(-)	(x)	x	(y)
Econom. sustain. use		U	(x)	X	(x)	(y)
Resilience		F	x	X	x	y
Involvement, awareness		U	x	(x)	x	(y)
Combat invasive species		F	x	x(-)	x	(y)

x = yes, - = no, (x) = potentially, (-) = sometimes no, (c + n) = cultural and natural

Is the establishment of no-take MPAs feasible in your region?

Russia: In the Gulf of Finland there is very little fishing activity, so this is feasible.

Finland: Only if the MPA is on a small scale and recreational fishing is permitted. There are some no-take and closed areas in the Gulf of Finland, but these areas are for research. New no-take MPAs would be difficult to establish at the moment due to Natura 2000 activities.

Iceland: There are no “true” and permanent no-take areas in Iceland, but there are temporary fish closures for certain fish species. There is also an area with a 3 nm trawl-free zone. There are other temporary no-take areas around the Icelandic islands, and it may be possible to establish more of these. Permanent no-take MPAs would not be very feasible in the Southern part of Iceland and not in areas close to shore, since coastal land-owners strongly defend their interests.

Sweden: Sweden is currently looking into possibilities of establishing no-take MPAs. Now there are seasonal closures and a 4 nm trawl-free zone. On the East coast of Sweden some no-take areas exist, but most of

them are not under heavy fishing pressure. Seasonal closures exist that have been designated by the fishers themselves. On the West coast the situation regarding biodiversity, structure and legislation is different from the East coast and thus a different strategy is needed.

Denmark: There are no convincing no-take MPAs existing in Denmark to date. There are a very few restricted areas that have actually been implemented. There some no-trawl areas and a few small spots of temporary closure. A public and political opposition makes it difficult to establish new no-take areas.

UK: Yes they are feasible. No-take MPAs have already been established.

What are the risks/disadvantages of MPAs being established solely as fish conservation tools?

- Risks and disadvantages depend on the objectives of the MPA (e.g. restore fish biomass or preserve fish biodiversity?).
- Potential conflict between fishermen and marine species eating the fish, e.g. seals.
- The fishermen might feel “targeted” if we focus 100% on fisheries.
- Tendency to forget about positive consequences of conservation on other parts of the environment, as well as the significant socio-economic effects.
- All resources might be allocated only to the fish conservation issues.
- Potential risk that fish conservation can go overshadow conservation of other species. E.g., danger of missing out on biodiversity conservation.
- Risk of establishing no-take zones by “promising” enhancement of fisheries in the future. It can backfire and hinder future a MPA establishment. Thus, there is a risk of diminishing people’s perception of the point that MPAs actually work and a risk of losing public support if areas are only established/closed for fish.
- Risk of alienating other stakeholders who are not “fisheries-driven”.

What are the minimum information needs when planning/designing MPAs for conservation of fish stocks?

- Good, detailed maps and data regarding habitats.
- Detailed information regarding fished species (e.g. population dynamics, stock size, life cycles, habitat requirements and distribution of habitats, etc).
- Understanding of the problem (e.g. recruitment overfishing?)
- What are the aims of involved organisations and stakeholders?
- Mutually validated information
- Honesty and transparency regarding the proposed MPA’s probability of success, the effects and the time table.

What is the level of awareness among consumers in your country regarding the fish that they eat and the way in which they are captured?

Russia: The level of awareness is very low.

Iceland: Many people in Iceland are fishermen themselves, and most others buy directly from the boats. Usually consumers trust that the fish has been caught in a sustainable way. There is a consumer agreement with Greenland on shrimp and salmon, i.e. no information on origin or capture methods is given. There are different traditions and consumer cultures in the North and South of Iceland.

Denmark: There is a low level of awareness. Only a small part of the Danish population is concerned about the origin of the food, since the most important issue is the price. However, people do prefer to eat domestic fish.

Finland: As in Denmark, only a small part of the Finnish population is concerned about the origin of the food, since the most important issue is the price. In Finland people also prefer to eat fish caught in Finland. Salmon is labelled as being either farmed or wild, and other fish have information about their origins. There are great differences in the fish consumption and preferences between North and South. There is no real awareness of the issue regarding cod fisheries.

Sweden: Over the last two or three years awareness has increased rapidly. An increasing part of the population is demanding information about the origin of fish and their capture methods (especially frequent fish eaters). Consumers fuel the cod problem, since many still want to eat the cod from the Baltic, but there are also cases of cod “boycotts”. Large supermarkets in Sweden have switched fish suppliers and minimum sizes of fishes sold. Even the fishermen themselves are supporting WWF-Sweden’s Consumer Guide to seafood.

Germany: Awareness is increasing but still low. Prices drive the choices of consumers. Only a small percentage is concerned about the origin of the food they eat.

UK: Retailers in the UK are becoming more aware. There are examples of e.g. creel-caught lobsters (i.e. as opposed to trawling) fetching higher prices in the market.

In your country, to what degree are fish stocks considered nature? A resource?

Russia: Fish are considered a resource by most.

Iceland: Fish are widely considered to be a resource. One exception is the “Tamigan”, which is a temporary fishery closure because of “natural value and protection need”. There is an increasing understanding of whales as being “nature”.

Denmark & UK: Fish are a resource, but there is an increasing understanding that fish are a part of nature.

Sweden: Fish are a resource, but there is an increasing understanding that fish are a part of nature. Recreational fishers, however, consider fish to be nature.

In general, it was summarised that when we go to the store, fish are a resource, while they are nature when we go fishing.

Annex 4: Report from group session 4 on monitoring of MPAs.

How should a monitoring programme be set up to ensure that the objectives of a MPA are fulfilled in order to conserve biodiversity?

- Monitoring should be a mixture of both biological and anthropogenic monitoring, but balance depends on each particular case (e.g., a multiple use site versus a highly controlled area).
- Anthropogenic impact monitoring (especially impacts from local activities may be important): adapt to different threats addressed by different MPAs (i.e. fit single MPAs). However, a common goal in biodiversity conservation requires common methods in monitoring of an MPA network!
- Biological monitoring should also be continued for research, but how to make scientific monitoring more cost effective? (often lack of funding and thus minimization of monitoring programme, which requires evaluation beforehand).
- Concentrate the limited resources on (biological and anthropogenic) monitoring sites with the main purpose to inform managers, and try to couple this with more detailed scientific monitoring if possible.
- Need for reference sites to distinguish between natural change and change through anthropogenic activities. Reference sites do not have to be close or in the same country.

How can this be set up?

1. Narrow it down to something that is measurable, e.g. possible indicators.

Decide at which extent/hierarchical level monitoring should be applied (not an easy task, since there are technical and ecological problems associated with it).

2. Select indicators according to threat and objectives, considering e.g.

- Time, duration and sequence for monitoring
- Are there other people considering or collecting useful information, inside or outside the MPA?
- Is there a network of MPAs to include in the monitoring program?

3. Rank their desirability. E.g. (scale of 1-5)

- Indicator species (1-5) depending to wrong or right species) choosing the species is critical.
- Biotype/Communities (4-5): Long-term dataset, some will be very strong indicators, stable communities. Got to pick the right biotope, some biotopes may be more appropriate
- Water Chemistry: (3) Depends on the
- Anthropogenic Activities (5)

- Primary Production same as water chemistry
- Physical conditions (1-5)

How much evidence of deterioration of the features for which an MPA is designated is needed before management action is required?

- There is no useful/approved set of indices/indicators yet and no fixed limits set to help answer the question.
- Depends if reversible or irreversible deterioration.
- We need to know more about natural resilience.
- Threshold levels would be usable, but are difficult to establish.
- Sometimes sufficient to efficiently gather presence-absence data that can be calibrated against “reference” sites with different levels of impact. (e.g. as a first cost-effective check)
- A precautionary approach is the safest, but legal issues may prohibit this approach. Surveillance schemes can then help on a long term temporal scale.
- Doing nothing on the grounds of not having enough evidence is another approach/action. But one cannot measure everything!
- On the other hand, stakeholder interests can overrule conservation interests or public opinion independent of the evidence.

How should a monitoring programme be set up to measure pressures or threats to a network of MPAs?

- Search for a common goal, identified through scale-adapted monitoring methods, to find out how the network “is doing” concerning specific aspects such as meta-populations. (Little information exists on other extra values MPA networks can provide, but new cases might bring additional information soon (e.g. GBRMP)).
- A matrix with threats (plus time, duration, sequence), pressures and measures to monitor for both the MPAs and areas outside (important for assessing wide scale impacts and pressures such as fisheries, diffuse contamination and eutrophication).
- The set up is dependent on the pressures concerned; measuring pressure can be more cost-effective than measuring impact on biota.
- Who might be monitoring? (within or with other agencies, community involvement and training?) There is a need for cooperation.
- Can technology save time and efforts? Check the wide range of methods.
- International programmes could be implemented for policy development: a regional or national assessment of how pressures are affecting MPAs, to control the activity in a broader national or international scale.

- The emphasis changes with the spatial scale of our network. A matrix like this one may be useful:

	Management effects	Connectivity	Representativity	Ecosystem function
Local	X			
Regional		X		
Bioregional			X	
International				X

How can monitoring, as a tool, be used to distinguish between natural variation and an anthropogenically driven deterioration?

- Tool: reference areas for monitoring of changes in the environment.
- Monitoring different habitats: natural vs. affected, outside MPA vs. inside MPA, etc.
- Try to set the context upon which we are monitoring, assess/determine limits of acceptable change... Natural is not likely to exist in most MPAs – we have to determine what we are willing to accept and what the objectives of the MPA, i.e. what is our baseline?
- Experiments of replicated human activity on environment e.g. intentional trawls to see the effects of trawling and assess recovery rates of affected areas
- Cumulative Impacts considered with isolated impacts.
- Scientific studies on the resilience of the ecosystem.

What do we need to be aware of when setting up a monitoring programme, in order to ensure that the network of MPAs fulfills its purpose on a local to international scale?

- Availability and comparability of the data, compatibility of methods and consistency in monitoring in general.
- Biogeographical approach for the international assessment. If the network is going to fulfill the international requirements, there needs to be a coordinated way of recording the data (i.e. cooperation and information exchange).
- There is no such thing as the *perfect* monitoring system.
- Put emphasis on data analysis rather than collection.

Key messages and topics of monitoring group sessions:

- Monitoring is essential
- There is need for different methodologies
- Identify Threats
- Need MPA network & set up monitoring right from start
- Can monitor anthropogenic activities easily, cheaply, extrapolate through to threats. Should be done more systematically...
- Systematic collection and analysis of knowledge, more ecosystem approach, look at it through ecosystem perspective.

- Choose monitoring to address objectives of MPA
- Need for precautionary approach
- Keep focused on developing long-term data sets
- Use all available monitoring options (e.g. community members, other agencies, consultancies, etc.)

Workshop Evaluation

At the end of the workshop, evaluation sheets were handed out to the participants. Of these, only 12 were returned, but it was deemed that this was enough to gain a rough overview of the general perception of the workshop. Following are the results of the individual questions.

It is clear that the workshop was considered valuable by all those that answered the questionnaire. In fact, almost all responses were very positive. However, there were a few questions that received less positive replies, and these questions will be addressed below.

Regarding the usefulness of the groupwork and exercises (question 6), there may be several explanations for the lukewarm response. There is the obvious possibility that the questions were simply not clearly formulated. However, the sessions did reveal that the participants had come with a wide variety of expectations, objectives and areas of expertise, which in some cases resulted in general discussions rather than specific results. This in turn signals a need for workshops in the future, with a more homogenous group of participants, that zoom in on individual topics.

Regarding the length of the workshop, it was expressed by several of those with children that a workshop that includes two weekends is very impractical.

In spite of these duly noted criticisms, it is evident that most participants share the view of the organisers, i.e. that the workshop was a success.

The following are examples of comments and suggestions for future workshops:

- More socio-economics would be good in a future workshop.
- Workshop literature should be distributed at an early stage, e.g. through a website.
- Groupwork questions should be handed out at least one day in advance. Groupwork objectives were not specific. Groupwork could have been based on a virtual site. More analysis of groupwork results by groups themselves was needed, i.e. evening networking.
- More tools for collaboration between managers and scientific organisations should have been discussed.
- More country specific problems should have been addressed.
- Too many lectures concentrated on EU.
- No female lecturers were present.
- Too much paper was distributed as e.g. slides etc.
- The workshop library was a great idea.
- A follow-up workshop a good idea with more focus on the work of participating countries as a second step. A workshop like this one is needed regularly to uphold cooperation between researchers, planners and managers.

The following are some of the lessons learned according to some of the participants:

- Everyone has their own definition of an MPA.
- There is a need to be clear when addressing public and stakeholders.
- Use of MARXAN in making management decisions.
- Marine habitat mapping is very important in order to make correct management decisions.
- MPA management models that can be used at home.
- The process of managing/approaching stakeholders.
- Good overview of the whole MPA process and strengths and weaknesses of other countries.

Dansk Resumé

Beskyttede eller lukkede havområder bliver stadig oftere udviklet og benyttet som redskab i forvaltningen af fiskebestande og marint biodiversitet i Nordeuropa. For at sikre en effektiv udvikling og forvaltning af disse områder er der flere gennemgående temaer, som man nødvendigvis må tage i betragtning, som f.eks. udvælgelse af egnede områder til beskyttelse, kortlægning og inventering af habitater og arter, monitorering, bevarelse af fiskebestande, zoner, forvaltningseffektivitet og borgerindflydelse. Disse temaer m.fl. blev ved denne workshop grundigt gennemgået og diskuteret, og i præsentationer blev erfaringer fra Australien og Canada løbende oversat til nordiske og baltiske tilstande.

Formålet med workshop'en var at udstyre forvaltere og beslutningstagere med en solid baggrundsviden om disse gennemgående temaer og dermed indirekte at give marin naturbeskyttelse et skub i den rigtige retning. De fleste punkter i det ugelange program blev behandlet i et generelt og upolitisk lys, således at budskabernes relevans og anvendelighed blev så bred som muligt. Det var ikke hensigten at udarbejde egentlige resolutioner eller budskaber.

Det internationale hold af foredragsholdere bestod af Jon Day fra Great Barrier Reef Marine Park Authority, John Roff fra Acadia University i Canada, Hussein Alidina fra Dalhousie University og WWF-Canada, Per Nilsson fra Tjärno Marinbiologiske Laboratorium i Sverige, John Baxter fra Scottish Natural Heritage og Jon Davies fra Joint Nature Conservation Committee i Storbritannien.

Gruppearbejde afslørede store forskelle mellem de respektive deltagerlandes fremskridt i etableringen af velforvaltede beskyttede havområder, og ligeledes mellem de sociale og politiske rammer, hvori sådanne områder kan etableres. Derimod viste det sig, at de fleste deltagere var stødt på de samme forhindringer i deres daglige arbejde med beskyttede havområder. I sin helhed viste workshop'en, at der er et stort behov for flere lignende møder i fremtiden, hvor mere specifikke emner diskuteres, og hvor deltagerne sammen kan diskutere, hvorledes disse forhindringer kan overvindes.

Suomenkielinen tiivistelmä

(Finnish summary)

Merialueiden suojelu Pohjois-Euroopassa kehittyy koko ajan. Näitä alueita käytetään sekä kalaston että mereisen luonnon monimuotoisuuden suojeluun. Meriluonnon monimuotoisuuden suotuisan suojelun kannalta on aiheellista valita suojelun piiriin tärkeimmät ja parhaiten yhteen sopivat merialueet. Alueiden valinta sekä alueiden jakaminen eri käyttöasteen omaaviin vyöhykkeisiin edellyttää myös että luontotyyppien ja lajien inventointi on järjestetty hyvin. Alueiden hoidon ja käytön hyvä suunnittelu, alueiden hallinta, alueiden seuranta sekä hoidon ja käytön tehokkuuden arviointi ovat edellytyksiä sille että luontotyyppien ja lajien suotuisa suojelutaso säilyy. Hoidon ja käytön suunnittelu vuorostaan edellyttää onnistunutta yhteistyötä alueen sidosryhmien välillä. Usein on myös huomioitava omana asianaan kalaston suojelu.

Nämä teemat tulivat hyvin käsiteltyä Kasnäsissa pidetyssä workshopissa. Workshopissa maailman parhaimmat meriluonnonsuojeluasiantuntijat Australiasta, Kanadasta ja Isosta Britanniasta sekä Ruotsista antoivat jokaiselle teemalle alustukset aamupäivän aikana ja heidän kokemukset antoivat osallistujille tietoa jota he pystyvät soveltamaan omissa maisaans, etenkin Itämeren alueella. Workshopin tavoitteena oli opastaa etenkin valtionhallinnossa toimivia virkamiehiä meriluonnonsuojelun uusimpiin menetelmiin ja toimintamalleihin. Teemat käsiteltiin mahdollisimman objektiivisesti jotta tiedon soveltaminen eri tarkoituksiin olisi mahdollisimman helppoa. Tavoitteena ei siis ollut julistuksien tai suosituksien valmistelu kuten vastaavissa workshoppeissa joskus on tapana.

Workshopin kansainväliset asiantuntijat olivat Jon Day (Great Barrier Reef Marine Park Authority, Australia), John Roff (Acadia University, Kanada), Hussein Alidina (Dalhousie University, Kanada ja WWF-Canada), Per Nilsson (Tjärno Marinbiologiska Laboratorium, Ruotsi), John Baxter (Scottish Natural Heritage) ja Jon Davies (Joint Nature Conservation Committee, Iso-Britannia).

Ryhmätyöt paljastivat että workshop:iin osallistuvien maiden välillä on meriluonnonsuojelualueiden toteutuksessa huomattavia eroja. Yhtäläisyyksiäkin maiden välillä löytyi. Useimmat osallistajat olivat kokeneet samoja ongelmia työssään. Workshop pyrki antamaan eväitä selviytyä näistä ongelmista. Workshop onnistui ja osoitti myös tarpeen järjestää vastaavia tapahtumia jatkossakin.

Programme

Saturday, May 8th - Day 1 Arrival day for participants

- 11.30: Meeting at the statue of Aleksis Kivi at the Helsinki Railway Square
- 12.00: Bus departure from Helsinki
- 16.00: Arrival in Kasnäs
- 16.30 to 17.30: An introduction to the Kasnäs area by Inkeri Holma, Centre Manager. We all get a chance to see the Blue Mussel Visitor Centre.
- 18.00: Dinner

Sunday, May 9th – Day 2 Introduction, site selection & network design

- 08.00 to 08.45: Breakfast
- 09.00 to 10.00: John Baxter: Why MPAs?
- 10.00 to 10.15: Short break
- 10.15 to 11.45: John Roff (part 1): A holistic approach as a first step to marine nature conservation, site selection and network design
- 12.00 to 13.00: Lunch
- 13.00 to 14.30: John Roff's lecture continues (part 2)
- 14.30 to 15.00: Coffee and Tea
- 15.00 to 17.30: Hussein Alidina: The use of mapping tools, GIS, selection software and other tools in site selection, including a demonstration of the selection software MARXAN.
- 18.00: Supper

Monday, May 10th – Day 3 Marine management I.

- 07.30 to 08.45: Breakfast
- 09.00 to 11.45: Jon Day: Marine management (Part 1).
- 12.00 to 13.00: Lunch
- 13.00 to 14.00: Jon Day's presentation continues
- 14.00 to 14.30: We divide into 3-4 groups; coffee and tea
- 14.30 to 17.00: Group work I: on management (2 h 30 min.)
- 17.00 to 18.00: Supper

Tuesday, May 11th – Day 4 Marine management II.

- 07.30 to 08.45: Breakfast
- 09.00 to 11.45: Jon Day: Marine management II
- 12.00 to 13.00: Lunch
- 13.00 to 14.00: John Baxter: Establishment of marine sites for the European Natura 2000 network using the UK experience as an example.
- 14.00 to 14.30: We divide into 3-4 groups; coffee and tea
- 14.30 to 17.30: Group work II: on legal issues and public participation (3 hours)

17.30: Supper

18.00 to 21.00: Sauna

Wednesday, May 12th – Day 5 Fish conservation

07.30 to 08.45: Breakfast

09.00 to 11.45: Per Nilsson: An introduction to fish conservation

12.00 to 13.00: Lunch

13.00 to 14.00: Per Nilsson's lecture continues (part 2).

14.00 to 14.30: We divide into 3-4 groups; coffee and tea

14.30 to 17.30: Group work III: on fish conservation (3 h)

18.00: Supper

19.00: Evening activities: Presentations from Jochen Krause, Germany and Alexei Zavarzin & Elena Lukina, Russia. Hussein Alidina will conduct a MARXAN tutorial.

Thursday, May 13th – Day 6 Field trip by boat to the Archipelago (whole day excursion)

First destination is Bengtskär lighthouse island. After lunch we proceed to the island of Rosala.

07.30 to 08.45: Breakfast in the hotel restaurant

09.00: Boat departs from Kasnäs

17.00: Arrival in Kasnäs

18.00: Supper

19.00: Presentation of video series on marine sites in Scotland. Introduction by J. Baxter of Scottish Natural Heritage.

Friday, May 14th – Day 7 Monitoring of MPA's

07.30 to 08.45: Breakfast

09.00 to 11.45: Jon Davies: Marine monitoring, based on the experiences from the UK SAC's project.

12.00 to 13.00: Lunch

13.00 to 14.00: Jon Davies' presentation continues (part 2). Presentation of a case study by Kimmo Evans.

14.00 to 14.30: We divide into 3-4 groups; coffee and tea

14.30 to 17.30: Group work IV: on marine monitoring (3 h)

18.00: The Workshop Dinner

Saturday, May 15th – Day 8 Closing and departure day

07.30 to 08.45: Breakfast in the hotel restaurant

09.00 to 11.00: Wrap-up session

11:45 to 12.00: Boarding and departure from Kasnäs

16.00: The bus arrives in Helsinki, final stop at the Railway Square.

Acknowledgements

We thank all the participants for their input and enthusiasm, the speakers in particular for their vast insight and friendly assistance, and the staff of Hotel Kasnäs for their kind flexibility and great help.

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Per Nilsson for the excellent presentations prepared with very short notice. Inkeri Holma and Bodil Rehn of Metsähallitus. Michael Haldin for photographing the events. HELCOM for their hospitality and for allowing us to use their conference facilities. Stig Helmig of Skov- og Naturstyrelsen, Denmark and Penina Blankett of the Finnish Ministry of the Environment for co-organising the workshop.

Last but not least we wish to thank the Nordic Council of Ministers for assisting us in the preparation of this report.

Jan Ekebom & Thomas Kirk Sørensen

Pomeroy, R.S., Parks, J.E. and Watson, L.M. (2004). How is your MPA doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness. IUCN, Gland, Switzerland and Cambridge, UK. xvi + 216pp.

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