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Implementation of Ecosystem-Based Management in Marine Capture Fisheries

Case studies from WWF's Marine Ecoregions

Chris Grieve and Katherine Short

Contents

Foreword

The myriad of life beneath the surface of coastal seas and open ocean stir wonder in all who experience it. Humanity derives aesthetic, economic, nutritional, cultural, social and emotional value from the marine environment and the life within. Unfortunately however, the litany of threat is well documented despite calls to action by the more responsible and legitimate industry, governments and community-based voices at the annual cycle of international meetings and conferences. Overall though, the decline continues across the world; however as this compilation of case studies attests, in some places the attitude has turned, predominantly in coastal environments, but also on the high seas.

In certain places near collapses have stirred communities and legislators to act. In others, collapses have been prevented and restoration is underway. This publication presents a short catalogue of good news stories describing how key actors are pursuing more sustainable solutions. These case studies illustrate the steps in an approach to managing human maritime activities known as ecosystem-based management (EBM). EBM has been used in terrestrial resource management for about 15 years, but its application to marine resource management only began more recently. WWF was the first global conservation organisation to proffer an EBM framework for marine fisheries, thus creating a testing ground for precautionary, conservation-oriented EBM for all relevant maritime sectors. The case studies presented here further indicate that EBM for the oceans is no longer a hypothetical concept. It can be, and has been, implemented and is making significant gains.

At this point, WWF and partners internationally have experience of EBM and evidence that if applied, it can produce significant wins for stakeholders, marine ecosystems and their surrounding environment. Much of this experience was gained through developing ecoregional conservation in the early 1990s, a methodology designed to bring a larger-scale, multi-stakeholder and science-based approach to conservation. Ecoregional conservation and EBM have many complementary elements and most of the examples here draw on work in WWF's focal marine ecoregions. These examples were specifically selected to illustrate the range of the various tools being used and, most importantly, the critical involvement of stakeholders. It is an important and key aspect of EBM that no one organisation or approach can solve complex resource management challenges.

There are a number of other current EBM case studies underway including field-based pilot projects funded mainly by the David and Lucile Packard Foundation. One is profiled here in Step 10: Birds Head Peninsula – Indonesia. The Convention on Biological Diversity (CBD) Secretariat is also collating EBM case studies. Mostly in the United States, other specific EBM science, policy and data tools are being developed.

WWF is embarking on a process of applying EBM to other maritime sectors and invites those interested in collaborating to join this next stage of the journey to strengthen marine resource management, lessen human impacts and restore the bounty of the oceans and livelihoods that depend on them.

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VP AND MANAGING DIRECTOR - MARINE PORTFOLIO
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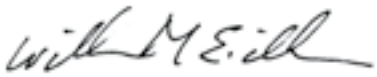

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Introduction

WWF's Global Marine Programme focuses its activities on the most significant threats facing the marine environment today, and where WWF has the expertise to provide solutions for the future. The WWF marine team consists of marine scientists, policy experts, economists, lawyers and communications experts who work in over 40 countries. The work is focused in more than 20 prioritised, diverse marine ecoregions around the world – from polar ice caps and highly productive upwellings, to coral reefs, mangrove forests and deep-sea habitats.

The WWF Global Marine Programme aims to develop and advocate solutions for sustainable fishing and the creation and management of Marine Protected Areas. This involves championing sustainable livelihoods and the conservation of oceans and coasts by working closely with fishers and local communities; commissioning and publishing impartial research and data; developing political advice for governments; trying to harmonise the work of governments and other non-governmental organisations (NGOs); campaigning through the media; lobbying decision-makers; and bringing people and governments together to co-operate on managing their shared marine resources.

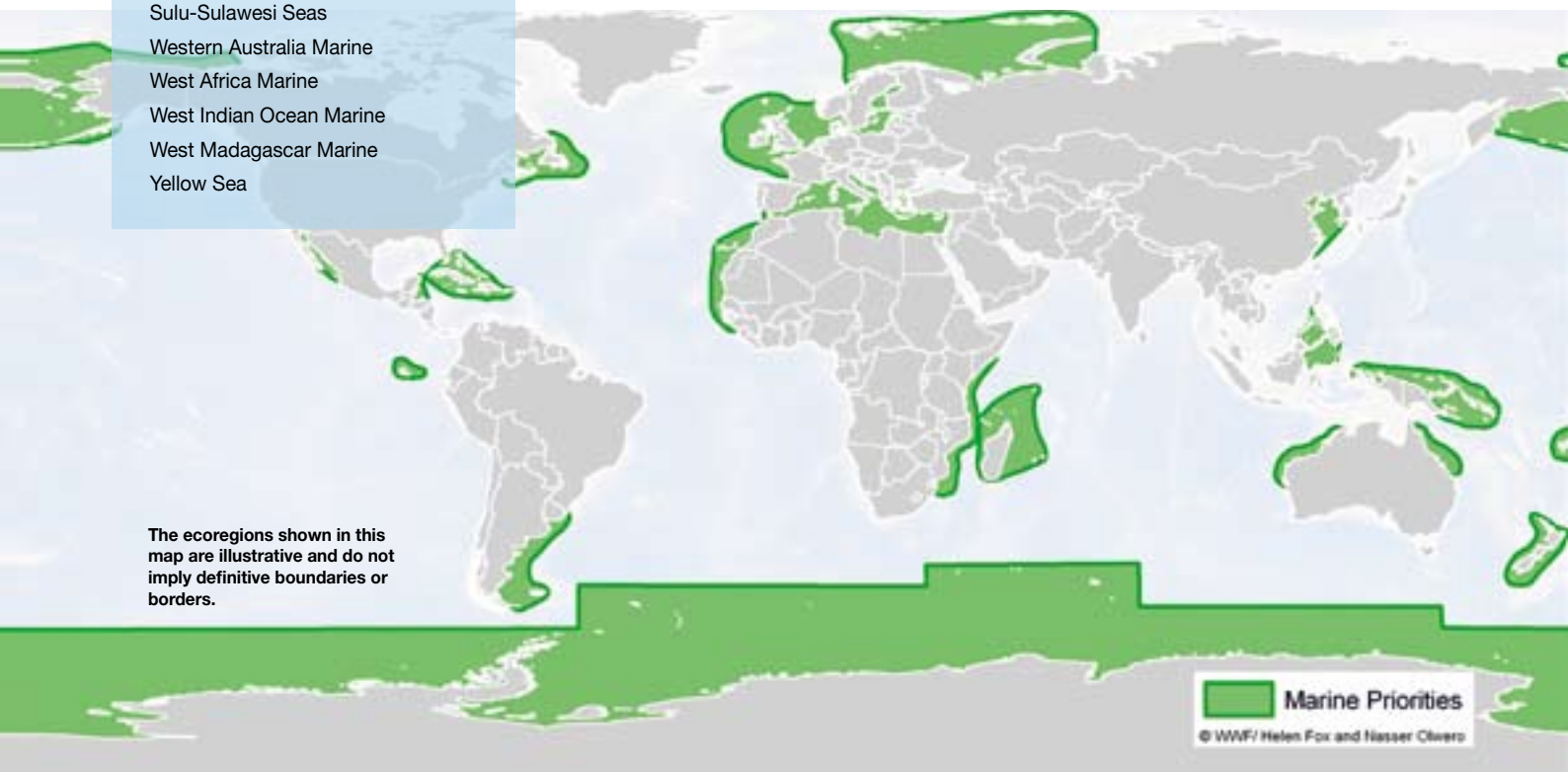
The work features a large-scale ecoregional approach that incorporates ecosystem-based management (EBM), with priorities guided by established targets and milestones. An ecoregion is a large geographical area, often covering tens of thousands of square kilometres and crossing national borders. Each ecoregion may have characteristic or distinct ecosystems, that is, species assemblages, habitats and environmental conditions. Initiatives and hundreds of on-the-ground projects, involving many partners are aimed at addressing specific issues.

Two key aspects of the WWF ecoregion approach are:

1. The sustainable management of fisheries and other marine resources through ecosystem-based management.
2. The establishment of well-managed, representative networks of Marine Protected Areas.

WWF'S PRIORITY MARINE ECOREGIONS

Barents-Kara Seas
Bering Sea
Bismarck-Solomon Seas
Canary Current
Eastern African Marine
Fiji Barrier Reef
Galápagos Marine
Grand Banks
Greater Antillean Marine
Great Barrier Reef
Gulf of California
Mediterranean Sea
Mesoamerican Reef
New Zealand Marine
Northeast Atlantic
Patagonian Southwest Atlantic
Southern Ocean
Sulu-Sulawesi Seas
Western Australia Marine
West Africa Marine
West Indian Ocean Marine
West Madagascar Marine
Yellow Sea



The ecoregions shown in this map are illustrative and do not imply definitive boundaries or borders.

Ecosystem-based management (EBM) in marine capture fisheries

WWF's approach to EBM is guided by a comprehensive policy framework, *Policy Proposals and Operational Guidance for Ecosystem-Based Management of Marine Capture Fisheries*[1]. EBM aims to achieve 'sustainability' in exploiting natural resources. Two main themes run through the concept: the effect of the environment on the resource, and conversely, the effect of resource exploitation on the environment. EBM is a highly integrated approach that encompasses all the complexities of ecosystem dynamics, the social and economic needs of human communities, and the maintenance of diverse, functioning and healthy ecosystems. Scientists have constructed a set of principles for this approach.

Implementing EBM in marine capture fisheries requires taking careful account of the condition of ecosystems that may affect fish stocks and their productivity. It also requires taking equally careful account of the ways fishing activities may affect marine ecosystems.

Marine ecosystems are very complex, our knowledge of them limited, and the ways in which fisheries affect them is poorly understood, so the EBM approach to managing fisheries accepts that decisions will often be made in a climate of uncertainty. However, uncertainty should never be an excuse for inaction. Management decisions are best made using multiple lines of evidence and a precautionary approach: "when in doubt, err on the side of conservation".

THE PRINCIPLES OF EBM

Ecosystem-based management has objectives and targets that:

- Focus on maintaining the natural structure and function of ecosystems and their productivity
- Incorporate human use and values of ecosystems in managing the resource
- Recognize that ecosystems are dynamic and constantly changing
- Are based on a shared vision of all stakeholders
- Are based on scientific knowledge, adapted by continual learning and monitoring.

In a fishery managed under EBM principles, the burden of proof for demonstrating there are no major unacceptable impacts from fishing rests with the fishery. Some fisheries already use performance evaluation procedures that measure the populations and productivity of fish stocks, for example, to determine future Total Allowable Catches (TACs) of target fish species. Evaluating the success of a fishery in meeting EBM principles will necessarily be more complex, because in addition to fish stocks, a range of habitat and species indicators need to be used to determine the health of the ecosystem. However, the general evaluation methods and approach of an EBM system will be familiar to many fishery managers, including the familiar problems of data weakness and model uncertainty. Overall, the EBM concept offers the best prospect of achieving fisheries that appropriately recognise the ecological issues and provide for the conservation of biodiversity.

SIX ELEMENTS FOR SUCCESSFUL EBM IN FISHERIES:

1. Operate within a policy framework designed to incorporate EBM principles
2. Recognise economic, social and cultural interests
3. Recognise the risk of the impacts of resource exploitation on ecological values
4. Incorporate adequate information on exploited species
5. Ensure the fishery management system is adequate for EBM to be effective
6. Consider externalities that may affect the resource

Implementing EBM in a fishery

For EBM to be effective, the principles and elements of EBM need to be translated into actions and control measures that are applied within a fishery. WWF has identified 12 operational components that form the basis for implementing EBM in a typical fishery (see box, next page).

These components, or steps, provide detailed guidance for fisheries managers to develop and apply EBM within the context of their own fishery. Also, the details of intended outcomes are identified to permit cooperative implementation in conjunction with the community of stakeholders and partners.

[1] Ward, T., D. Tarte, E. Hergel and K. Short (2002) *Policy Proposals and Operational Guidance for Ecosystem-Based Management of Marine Capture Fisheries*. WWF-Australia, Sydney. 80pp.

Creating an EBM-In-Action-Toolkit

WWF's forests, freshwater and marine programmes are all starting to make EBM operational in conservation policy and practice. The WWF Global Marine Programme guidelines, *Policy Proposals and Operational Guidance for Ecosystem-Based Management of Marine Capture Fisheries* (Ward et al. 2002)[1], draw on 6-8 major pieces of work by a range of significant bodies, including the US Ecosystem Advisory Panel, to define and interpret EBM in a fisheries context. Shortly following the production of WWF's guidelines, in 2003, the United Nations Food and Agriculture Organisation (FAO) produced Technical Guidelines, *The ecosystem-approach to fisheries,* and more recently the Pew Ocean Science Institute has also published extensively on the subject. While there are subtle and in places quite important differences between some of these frameworks, the important similarity is the need to ensure that specific fisheries impacts on marine ecosystems are minimised and where necessary marine ecosystems are managed for recovery.

Upon the release of the EBM policy proposals and guidance by Ward et al. (2002)[1], WWF produced a summary brochure highlighting the importance of the guidance and calling for action based upon nine proposals for accelerating the uptake of EBM to benefit fisheries. These included: getting the message across through the publication of WWF's guidance document; developing best practices models for effective stakeholder engagement; defining procedures in close collaboration with a small number of fisheries for good EBM planning; undertaking an ecological audit of major global fisheries; promoting the benefits of Marine Protected Areas for fisheries; integrating regional planning and management; developing a global Fishery Restructure Fund; designing and implementing case studies to demonstrate how EBM can be improved or make a difference; and finally, extending EBM to other sectors.

Whilst the Ward et al. (2002)[1] document provides some operational guidance, it is a policy framework: a more practical step-by-step toolkit is now needed containing materials to educate different audiences and influence more consistent delivery of EBM implementation. In 2003, a 'temperature check' assessment of WWF's marine ecoregions delivering EBM indicated that 21 ecoregions were implementing elements of EBM. WWF in partnership with NOAA and IUCN produced a toolkit entitled *How is Your MPA Doing* which included an approach to evaluate delivery. Ideally an EBM toolkit would also include evaluation approaches and be produced in collaboration with other partners.

As part of a practical toolkit containing education materials, 12 case studies of the application of EBM to fisheries are presented in this report, drawing on the 12 steps described in the WWF EBM framework (Ward et al. (2002)[1].

Methodology

The case studies were developed by conducting extensive literature reviews, distributing questionnaires to practitioners on the ground and, where necessary, carrying out follow-up interviews to elicit more detailed information. The people on the ground, usually but not always WWF staff, were asked to describe the work they have been doing, and how that work relates to EBM in general and more specifically to the relevant EBM step being highlighted in each case study. In addition, practitioners were asked to identify any outcomes that were realised, expected or unexpected, as well as lessons that were learned during the process that may strengthen or help adapt future projects and implementation of EBM in their part of the world.

Thus each case study follows a similar structure, beginning with a brief description of the physical and ecological ecoregional or sub-regional context, as well as an overview of the particular EBM step being highlighted. Where relevant, a brief account of the specific project or initiative is then given. Each

TWELVE OPERATIONAL COMPONENTS, OR STEPS, FOR IMPLEMENTING EBM IN FISHERIES

1. Identify the stakeholder community
2. Prepare a map of the ecoregions and habitats
3. Identify partners and their specific interests
4. Establish the ecosystem values
5. Determine the major factors that could affect the ecosystem values
6. Conduct an ecological risk assessment
7. Establish objectives and targets for specific elements of ecosystems
8. Establish strategies within the fishery for achieving targets
9. Design an effective information system, including monitoring
10. Establish research and information needs and priorities
11. Design performance assessment and review processes
12. Prepare an education and training package for outreach to fishers and other stakeholders

case study briefly outlines how the specific EBM step was put into practice, who was involved and the role WWF played in the process, either as leaders of the project, as partners in a collaborative project or as stakeholders in a wider process. Where projects or actions followed the progressive flow of the EBM steps, the steps implemented prior to that showcased in the case study and those that follow are also described. In addition, activities that are consistent with the overarching principles guiding EBM, but don't fit as neatly into the EBM steps, are highlighted. Results and outcomes are described, and in some cases practical lessons that have been learned are discussed. In some instances, subsequent EBM-related projects that emerged from the earlier processes are showcased, as are plans developed and actions taken to influence broader uptake of EBM in the ecoregion in the future.

Ecoregion conservation and ecosystem-based management arose as conservation concepts at about the same time and while WWF's marine ecoregions are the structure around which these steps are illustrated, the case studies show that EBM requires all players to share the development and achievement of objectives. Some of the steps are finite and discrete and not necessarily used in every ecoregion, for example, ecological risk assessment in the Benguela Large Marine Ecosystem, whereas others are much more 'whole of ecoregion' tools used as part of a systematic ecoregional planning process like the mapping or biodiversity assessment steps. This does not render each step more or less important than another but does require rigorous analysis at each point to determine when each 'tool' is most opportunely used. Additionally, in some case studies, WWF is the lead champion of the particular step, while in others, the partners lead and WWF plays a supporting role. Again, this is meant to show the necessity for this type of longer term, more sustainable process-based conservation, of having all stakeholders meaningfully recognised and engaged. It is important to note EBM does not require ecoregions or ecoregional conservation to be in place. EBM can, is and should be done wherever there is fishing.

Ecoregion conservation is a broad-scale approach for conservation planning and action to develop and implement a comprehensive strategy that conserves the species, habitats, and ecological processes of the ecoregion.

The key principles of ecoregion conservation include:

1. planning and implementing conservation on the scale at which natural ecosystems operate
2. articulating a 50-year biodiversity vision that conserves the full range of species, natural habitats, and ecological processes characteristic of an ecoregion over the long term
3. providing a geographical/ecological flagship for developing a sense of stewardship.

Source: www.worldwildlife.org/science/ecoregions/erc.cfm

WWF acknowledges there are also other EBM case study exercises underway such as those being prepared by COMPASS and the CBD Secretariat. This set is not the definitive illustration of EBM in action, however it is a timely benchmark ensuring that evidence of effective EBM operational activity and experience to catalyse more efficient delivery are available to practitioners.

Fisher with tuna catch. Philippines

Yellow Sea Marine Ecoregion

1

The Yellow Sea Marine Ecoregion includes the Yellow Sea, the Bohai Sea and part of the East China Sea. The Yellow Sea itself is a semi-enclosed body of water bordering China to the west and North Korea and South Korea to the east (see map). It covers an area of approximately 40,000 square kilometres. With marked seasonal variations, the Yellow Sea supports both cold temperate species such as Pacific herring, cod and flatfish, as well as warm water species like small yellow croaker, fleshy prawn and southern rough shrimp. Approximately 1,600 species have been reported from marine and coastal habitats in the Yellow Sea, including 17 species species of whales, four species of seals and sea lions and about 170 species of waterbirds including endemic and threatened species such as black-faced spoonbills and Saunders' gulls.

EBM STEP 1 ~ IDENTIFY THE STAKEHOLDER COMMUNITY

By involving stakeholders, a formal network can be identified with whom fishery representatives can collaborate to manage and review performance in the fishery. A transparent and fully accountable process can be conducted that enables the participation of interested parties in the process of managing a fishery using EBM principles.

Stakeholders might include fishery management agencies, conservation agencies, conservation NGOs, community groups, scientific and academic research organisations, fishing industry and fisher associations, higher and lower levels of government, at local, national or international levels, post harvest interests and indigenous representatives.

Source: Ward et al. (2002)[1]

About 600 million people live in the Yellow Sea catchment area, with over a dozen urban areas with populations over one million people. Many species of fish and invertebrates are commercially valuable, meaning that landings from coastal and offshore fisheries in the Yellow Sea contribute to about one-third of total landings in the region. People living around the Yellow Sea depend on the sea as a source of marine resources for nutrition, economic development and recreation. The principal economic sectors are wild capture fisheries, aquaculture, shipping, oil exploitation and tourism.

The region is one of the most heavily exploited in the world with fishing mainly by Chinese, Korean and some Japanese vessels. Around 100 species are fished commercially in the Yellow Sea, and important fisheries catch small yellow croaker, spanish mackerel, southern rough shrimp and Japanese squid[2]. Between the 1960s and 1980s fish and invertebrate populations declined by an estimated 40%, with cold-water species such as Pacific cod becoming almost commercially extinct[2]. Overfishing resulted in larger, commercially important species like large and small yellow croakers and hairtail being replaced by smaller or less valuable species like Pacific herring and chub mackerel during the 1970s. Now species like Japanese anchovy, Acetes shrimp, spotted sardine and scaled sardine are the most abundant in the Yellow Sea[2]. Overexploitation is thought to be the main driver affecting the structure of fish communities causing so-called 'biomass flips', as well as negatively affecting the 'self-regulatory mechanism of the Yellow Sea ecosystem'[2]. Significant population declines resulting from overfishing have been recorded in fisheries on both the Korean and Chinese sides of the Yellow Sea.

Land- and sea-based pollution, as well as extensive coastal development around the Yellow Sea are also major threats to natural resources and habitats in the Yellow Sea Marine Ecoregion.

In the last decade, declines in fisheries resources have led to an estimated decline in coastal community employment of between 30-50% in the Yellow Sea ecoregion[2]. The outlook for fisheries and subsequent coastal community livelihoods in the region is uncertain, perhaps even pessimistic[2]. Fisheries on both the Korean and Chinese sides of the Yellow Sea are open access, common property resources[2]. This means that fishing effort could continue to increase without restriction unless some other form of management approach can be implemented.

[2] Teng, S. K. and H. Yu, Y. Tang, L. Tong, C.I. Choi, D. Kang, H. Lui, Y. Chun, R.O. Juliano, E. Rautalahti-Miettinen and D. Daler (2005) *Yellow Sea: GIWA Regional Assessment 34. Global International Waters Assessment*. University of Kalmar, United Nations Environment Programme. 114 pp.

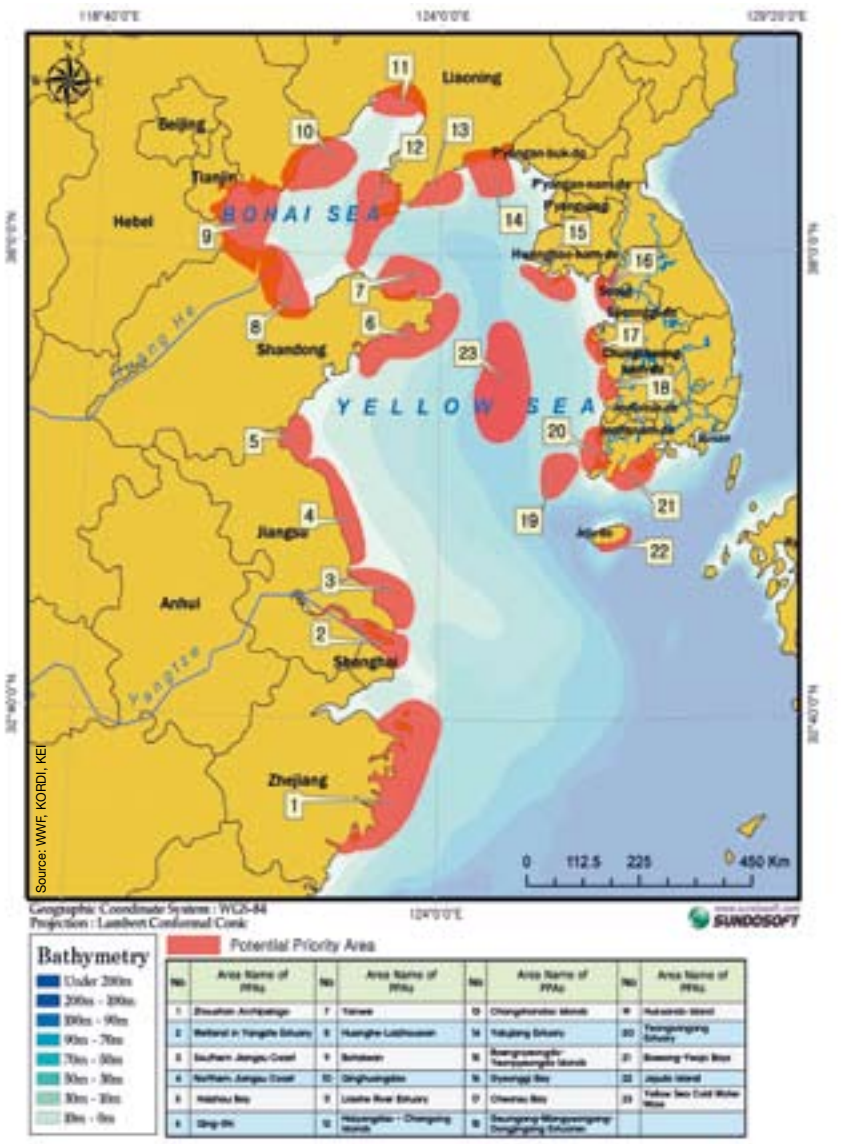
Step 1 in action ~ identify the stakeholder community

In a prototypical demonstration of ecosystem-based management (EBM), the ideal would involve working through the steps or components of EBM in a progressive, systematic way, each step building neatly upon the first until the ultimate outcome is achieved. In the real world, we rarely have the luxury of beginning with a blank canvas, nor working through such a tidy process. Moving towards EBM might be characterised in many parts of the world as more evolutionary than revolutionary, negotiated incrementally through existing political and economic realities, with the right elements already in place for some of the EBM steps and more work to be done on others. This approach makes sense and will be adapted uniquely for each region or local subdivision, determined entirely by the reality confronting people working on the issues. This case study highlights work in connection with the Yellow Sea, with a focus on the cooperation within part of the stakeholder community, as well as the challenges ahead for people and organisations working on marine ecosystem and fisheries related issues.

In July 2002, WWF-Japan and WWF-China launched a joint ecoregion planning programme in the Yellow Sea. The project also involves research institutes in China and South Korea, including the Korean Ocean Research Institute (KORDI) and the Korean Environment Institute (KEI) in a regional partnership to prioritise conservation actions based upon scientific data[3]. Later, in 2005, a UNDP/GEF funded project entitled *Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem* was officially launched with the participation of the Chinese and South Korean governments and other stakeholder organisations.

For WWF and partners, the long-term goal of the Yellow Sea Ecoregion Planning Programme is to help achieve conservation and sustainable use of biodiversity and ecological processes within the Yellow Sea ecoregion for human welfare and sustainable development at local, national and international levels. By 2005, having built a respectable amount of knowledge on areas of ecological significance from conservation and resource exploitation perspectives, the planning programme strategy had become: 1) prioritising conservation actions in the Yellow Sea Ecoregion (YSE); 2) building human and institutional capacity to implement an Ecoregion Action Plan for YSE; and 3) taking early action to enable a smooth transition from planning to implementation.

Potential priority areas in the Yellow Sea Marine Ecoregion (China and South Korea)



Source: Source: WWF, KORDI, KEI

The strategy of building the scientific foundation involved bringing together acknowledged scientific experts from China, South Korea and Japan to participate in a process to find potential priority areas and determine appropriate EBM actions[4].

The first stage involved determining appropriate criteria to enable selection of indicator species and habitat types which are important for biodiversity conservation. Six animal and plant groups were chosen against which the criteria would be applied, including fish, molluscs, mammals, birds, coastal plants and algae. The criteria were then applied to each taxonomic group using data publicly available from China and South Korea. In the case of the fish group, data from

[3]WWF, KORDI, KEI (2006) *Fish of the Yellow Sea ecoregion and their habitats. Fact sheet No. 4.* WWF, Korean Ocean Research and Development Institute and Korea Environment Institute. 2pp.
[4]WWF, KORDI, KEI (2006) *Potential priority areas for biodiversity conservation of the Yellow Sea ecoregion. Fact sheet No. 8.* WWF, , Korean Ocean Research and Development Institute and Korea Environment Institute. 2pp.

1 Yellow Sea Marine Ecoregion

Japanese fishing activities in previous decades was also made available for the assessment[3].

While this process was broader than simply applying an ecological planning process to fisheries resource management issues, the fact that fishing is one of the key factors influencing the integrity of the Yellow Sea ecosystem guaranteed the special attention granted to it through the ecoregion planning programme. This provided the opportunity for the project partners to identify and bring together a specific element of the stakeholder community.

Scientists from fisheries and ocean research institutes in China, South Korea and Japan, and other countries, came together in a workshop to cooperate on reviewing and identifying important indicator fish species and their habitats in the Yellow Sea. Research agencies engaged in the process included the Yellow Sea Fisheries Research Institute, as well as the National Fisheries Research and Development Institute from the Republic of Korea. The Seikai National Fisheries Research Institute in Japan was consulted on fisheries data to support the planning process and an academic from the Ocean Research Institute at the University of Tokyo undertook an analysis of the Japanese data sets. Then, national Biological Assessment papers were compiled by the participating scientists to prepare for the next analysis workshop.

Scientists ensured that the data were made available so that, in the fisheries workshop, stakeholders could apply an agreed methodology. Having chosen 38 possible 'indicator species', four criteria were applied to determine whether the species would become priority species: 1) representativeness; 2) endemism; 3) vulnerable species; and 4) commercial importance, both by value and volume[3]. Fisheries scientists also adopted an additional criterion: changes in biological characteristics in response to fishing pressure. Collectively, participants were able to agree priority fish species and ecologically important habitats such as spawning grounds.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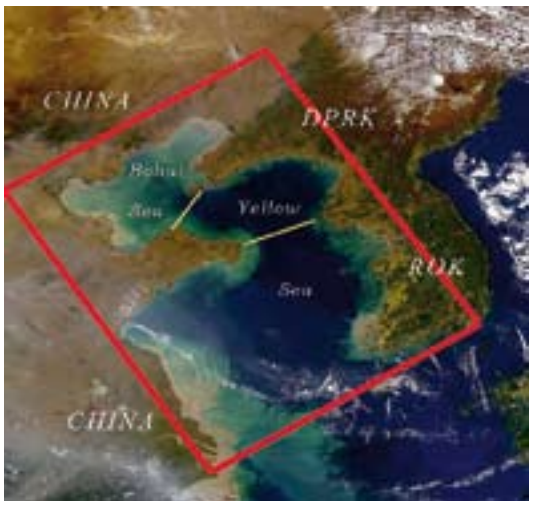
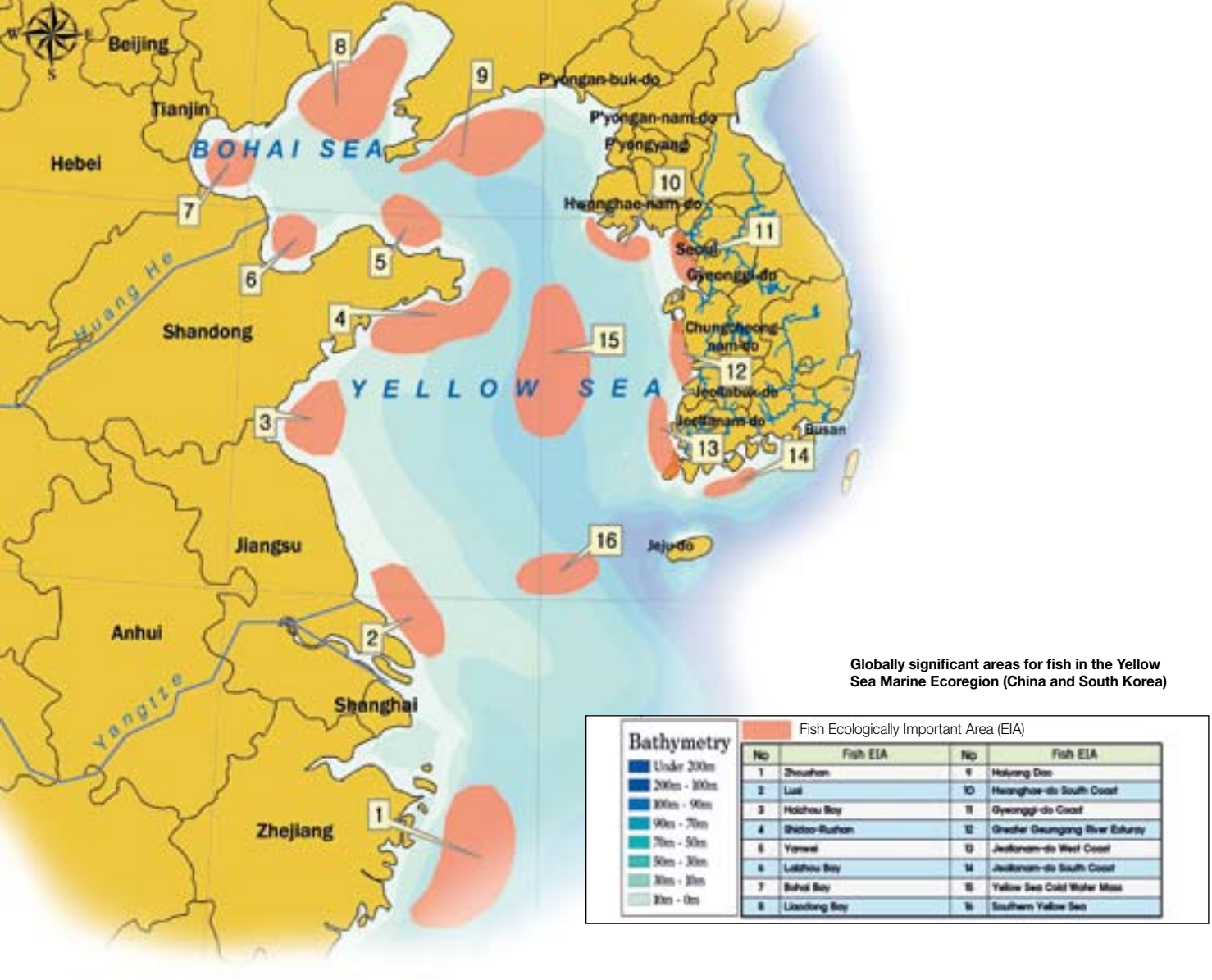
The overarching process resulted in the development of maps and agreement upon priorities for individual Ecologically Important Areas for each of the six taxonomic groups, which were then overlaid as a combined set of Ecologically Important Areas which would help build a picture of potential priority areas for conservation activity[3].

The fisheries dimension emerged as a very high priority and the results of the application of the criteria influenced the selection of the final 'potential priority areas'. There were clearly overlapping ecologically important areas for some taxonomic groups, for example, waterbirds and coastal plants in inshore or coastal areas, as well as areas where clearly no overlaps occurred at all – i.e., some of the offshore fisheries habitats and spawning grounds. In total, 23 areas were chosen as priorities, with over 80% of these being crucial fish habitats[4]. Now that potential areas for a different approach to conservation and management have been identified, the project partners are planning to conduct two demonstration projects: one in China and the other in South Korea. These demonstration areas are likely to involve at least one of the ecologically important areas for multiple taxonomic groups, such as for birds and coastal plants, as well as an area that is ecologically important for fisheries.

Yellow Sea Marine Ecoregion





Globally significant areas for fish in the Yellow Sea Marine Ecoregion (China and South Korea)

The demonstration project for fisheries may consider an option of closing an area to fishing, i.e., the creation of a Marine Protected Area to protect vulnerable stocks, amongst other conservation options. The project partners acknowledge there is much work to do in terms of developing a multi-sector, multi-stakeholder approach to win support from influential decision-makers and academics, and buy-in from fishing communities and the fishers themselves. In that respect, they are aware that the process is not a short-term proposition and that care and sensitivity must be applied to ensure stakeholders are involved each step of the way.

Some stakeholders, including some academics and government scientists from both China and South Korea, are not convinced that this approach is feasible. The practical and possible financial challenges posed by the need to monitor and patrol closed spawning grounds have been suggested as reasons why the approach may not succeed. China already operates a seasonal closure during the three summer months were fishing is prohibited. This approach is deemed by some stakeholders as more manageable from a monitoring and surveillance perspective and therefore more likely to achieve beneficial outcomes.

The value of a demonstration project is, however, to test the hypothesis that by closing an ecologically important area it will yield longer-term benefits from a fisheries and ecosystem-based management perspective, hopefully by helping to rebuild depleted fish stocks. If fishers and other stakeholders can see the value in using such a management mechanism and reap the benefits, this could result in another useful tool to use in a broader ecosystem-based approach to managing resources in the Yellow Sea.

Challenges ahead

There are issues facing stakeholders in developing an ecosystem-based approach to managing the Yellow Sea. The three countries bordering the Yellow Sea share a lot of historical and cultural background, but have different political systems, political and economic alignment, and levels of economic development[5].

Project partners are carefully discussing the next stages of the work, but as described above there is a significant amount of work to do to convince some stakeholders of the value of the overall approach.

In the fisheries context, the partners in both the

[5] http://na.nefsc.noaa.gov/lme/text/lme48.htm
Large Marine Ecosystem LME 48: Yellow Sea

1 Yellow Sea Marine Ecoregion

Yellow Sea Ecoregion Planning Programme and the UNDP/GEF project hope that multi-sector, multi-stakeholder processes which bring fishing communities, fishers and industry representatives together will harness their knowledge and gain their support to pursue an outcome that should yield benefits for all. But there are other trans-boundary issues and political differences that will need to be overcome, including potential reform from a governance perspective. In that sense, the project partners will need to begin the first step of the EBM process again. Having identified and engaged with a robust and inclusive research and scientific community, along with a connected conservation and environmental network, the work needed now is to identify and bring together elements of the broader stakeholder community including fishing interests, government officials, and others who will be able to influence decisions and/or may be affected by decisions made about fisheries and marine conservation in the Yellow Sea ecoregion.

Step 2 of the EBM operational framework examines work undertaken to delineate the boundaries of an area in which EBM may be applied. As has been demonstrated in this example, the various Yellow Sea projects have built a wealth of knowledge from which maps have been generated, laying out the high-priority areas for action. These will be valuable resources as the broader multi-sector, multi-stakeholder process gets underway to develop management and conservation work further in the region.

The second case study examines work carried out in the Eastern African Marine Ecoregion to map the boundaries and areas of global, ecoregional and sub-regional importance for biodiversity conservation and resource use.

REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM ~ UNDP/GEF AND THE YELLOW SEA PARTNERSHIP

There is an associated forum for fisheries-related discussion within the Yellow Sea Large Marine Ecosystem project. The United Nations Development Programme/Global Environment Facility (UNDP/GEF) project has established a series of regional working groups on five high-priority components of the project (biodiversity, fisheries, ecosystem, pollution and investment). The Regional Working Group for the Fisheries Component has been working for two years and mainly discusses the scientific and technical aspects of fisheries in the Yellow Sea Marine Ecosystem. These include stock assessment, developing methods to analyse carrying capacity, joint research programmes on mariculture and meeting technical and capacity building needs. Since September 2006, WWF-China has been an official observer on the fisheries regional working group.
In December 2006 UNDP/GEF project organisers hosted a seminar during the East Asian Seas Congress to demonstrate how a partnership composed of different types of organisations can enhance public awareness and participation, as part of marine environmental management. The example provided was the “Yellow Sea Partnership” that has been established under the auspices of the UNDP/GEF Yellow Sea Project together with members of the Partnership. The Partnership has 13 members:

- Global Village of Beijing (GVB)
- Korea Ocean Research and Development Institute (KORDI)
- Marine Stewardship Council (MSC)
- Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)
- The Nature Conservancy (TNC) Beijing
- UNEP Regional Seas Programme Northwest Pacific Action Plan (NOWPAP)
- UNDP/GEF Yellow Sea Large Marine Ecosystem (YSLME) Project
- United Nations Development Programme (UNDP) China
- Wetlands International (WI)
- WWF-China
- WWF-Hong Kong
- WWF- Japan
- WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme (YSEPP)

Source: The UNDP/GEF YSLME project and the Yellow Sea Partnership (www.yslme.org)

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Mr Tobai Sadayosi, Senior Conservation Officer, Marine Programme Leader /Yellow Sea Ecoregion Programme Coordinator, WWF-Japan

Mr Wang Songlin, Marine Programme Officer, WWF-China

Eastern African Marine Ecoregion

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EBM STEP 2 ~ PREPARE A MAP OF THE ECOREGIONS AND HABITATS

This step focuses on involving stakeholders in creating maps of relevant ecosystems, including habitats, at scales of resolution consistent with the scale of the relevant fishery or fisheries and their potential impacts. Main considerations:

- Maps are consistent with other ecosystem classification initiatives, at larger and smaller scales
- Major features and exceptions are documented (for example, highly migratory species, oceanographic features or boundary mismatches)
- Major uncertainties are identified and documented as guidance for research and investigation programmes
- Focus on where fish are, where they are fished, any specific spawning, nursery or similar obligate habitats or locations
- Primary production habitats such as algal beds, seagrasses, mangroves or coral reefs are shown.

Source: Ward et al. (2002)[1]

Stretching southwards along 4,600 kilometres of coastline from Chisimayu in southern Somalia in the north to Sodwana Bay on the Natal shores of South Africa, the Eastern African Marine Ecoregion takes in the entire coastlines of Kenya, Tanzania and Mozambique (see map)[6]. Located in the western Indian Ocean, the waters of the Eastern African Marine Ecoregion are characterised by consistent tropical environmental conditions resulting in seawater temperatures of between 24º and 31ºC. Marine and coastal habitats include mangrove forests, seagrass beds, coral reefs and open water, and support a rich biodiversity[7]. Over 11,000 species of plants and animals live in these warm seas, including over 1,500 species of fish and a remarkable 3,000 species of molluscs such as oysters, cockles, clams and mussels. Ten to fifteen per cent of marine life here is found nowhere else on earth, and 60-70% is only found in tropical waters across the Indo-Pacific (stretching from eastern Africa to the eastern Pacific islands of Polynesia)[7].

The coastal population in the ecoregion has been estimated at approximately 22 million people and is growing at around 3% per year[6]. The sea, and fisheries in particular, play a vital role for many people in the region for food supplies and livelihoods. Seafood provides the main source of protein for most coastal communities and those inland who eat dried and salted products[7]. Fisheries are also an important source of foreign income from distant water fishing nations although the vast majority of fishers in the region are artisanal, using diverse small craft and gear combinations like hook and line, woven fish traps and hand spears[7,8]. A significant proportion of the coastal population in the ecoregion lives in poverty, and from environmental and socio-economic perspectives, they, along with people from the island states of Madagascar, Mauritius, Seychelles, Comoros and French Reunion, are among the most vulnerable in the region[8]. There is a need to look for new opportunities to replace fish with other sources of food and find alternatives to fishing and the post-harvest sector as employment[8].

The last 50 years have seen human impacts begin to alter the ecosystem. Although some areas remain undisturbed, the rate of impact is expected to increase given current population trends[6]. Apart from artisanal fishing, which includes destructive fishing with dynamite and gillnets, other significant threats to the Eastern African Marine Ecoregion include the development of mariculture (e.g., prawn farming), intensive collection of some marine animals and destruction of habitats from trawling, bycatch from industrial fishing, coastal infrastructure development including oil and gas and tourism, climate change, unsustainable harvesting of mangroves, sand-mining and beach erosion[6].

Fisheries in the ecoregion yield approximately 200,000 tonnes a year, with a catch composition of over 500 species of fish[7]. Foreign exchange earners are mainly invertebrate fisheries such as prawns (shrimp), lobster, octopus and beche-de-mer (sea cucumber)[8]. In the last 20 years fisheries for tuna and tuna-like species have also developed offshore, mainly by the distant water fishing nations of Japan, Taiwan, Spain and France which fish through access agreements negotiated with coastal states in the western Indian Ocean region[8].

Mafia Island Marine Park zoning plan

[6]WWF Eastern African Marine Ecoregion Programme (2004) *Eastern African Marine Ecoregion Conservation Plan* (2005-2009). WWF-Tanzania, Dar es Salaam. 62pp.
[7]Richmond, M. and I. Kamau (2002) *The Eastern African Marine Ecoregion: a large-scale approach to the management of biodiversity*. WWF-Tanzania Programme Office. 11pp.
[8]Mbendo, J. and A. Ngusaru (2005) *Towards sustainable and equitable fisheries access agreements in the western Indian Ocean region*. Eastern African Marine Ecoregion Programme. WWF-Tanzania, Dar es Salaam. 52pp.

Step 2 in action ~ prepare a map of the ecoregions and habitats

As we saw in the first step of the WWF ecosystem-based management (EBM) framework put forward by Ward et al. (2002)[1], the process involves identifying and engaging with the stakeholder community as the foundation operational element of successful EBM. This basic step ensures that EBM includes shared human goals, as well as individual and collective aspirations for resources and the ecosystem[9]. Step 2 involves delineating the boundaries for the management system, including ecologically defined spatial boundaries and relevant ecological and socio-economic factors influencing the productivity of resources and the integrity of their ecosystem[9]. One of the more practical ways of doing this is through engaging stakeholders in a mapping exercise, possibly in conjunction with other operational steps of EBM such as the evaluation of risks to the ecosystem, development of a shared vision for the future of an ecoregion, and determination of strategies to achieve the vision.

Work on developing an ecoregional conservation approach in eastern Africa began in 1999 in partnership with a broad range of eastern African agencies. At the heart of the strategic approach was the desire for it to be driven by a common vision, at broader geographical, ecological and socio-economic scales than national boundaries dictate, while combining science with traditional knowledge and practical politics[10].

In order to integrate conservation into a bigger vision of sustainable development, the most practical approach for stakeholders in the region was to determine priorities for shorter-term action that would enable the longer-term vision to be achieved. Using a participatory approach that involved natural and social scientists and other stakeholder interests from most of the countries in the ecoregion, biodiversity conservation activities as integral components of protecting resources and the economies that depend upon them were determined through a series of workshops. Culminating in Mombasa in April 2001, Eastern African Marine Ecoregion planning workshops were convened to:

- Collect and analyse existing data and information on the biological, socio-economic, policy, legal and institutional characteristics of the ecoregion
- Assess conservation needs and opportunities
- Analyse threats and root causes for biodiversity loss, tradeoffs and options
- Develop a long term vision for the ecoregion
- Build on approaches consistent with national priorities.
- Identify key sites of biodiversity that should be prioritised for their conservation value[10].

One of the key outcomes of the Mombasa meeting was a comprehensive vision stating that in 50 years the Eastern African Marine Ecoregion should be:

"*A healthy marine and coastal environment that provides sustainable benefits for present and future generations of both local and international communities, who also understand and actively care for its biodiversity and ecological integrity.*" [10]

So as to identify an agreed list of high priority sites for conservation and sustainable resource management, workshop participants provided their expert knowledge, information and data to help map areas for species and community groups. Two important criteria were used to help select the various sites: 1) their contribution to global or ecoregion biodiversity; and 2) their contribution to national economies[10].

Twenty-one sites, or seascapes, were selected, eight of which were considered to be of global importance and thirteen considered important at ecoregion or sub-region level (see map). Three globally important sites that have special significance from a fisheries perspective are the Lamu Archipelago Complex off the coast of Kenya, the Rufiji-Mafia Complex off the coast of Tanzania and the Mtwara-Quirimbas Complex, a cross border site off the coasts of Tanzania and Mozambique. Sites of ecoregional or sub-regional importance, also significant for fisheries in Mozambique, are the Ilhas Primeiras e Segundas and Sofala Bank[10].

The Lamu Archipelago (Site 3) off the coast of Kenya was chosen because it has the most northerly coral reefs in the ecoregion, mangrove forests in river deltas and basins covering 345 square kilometres, 160 square kilometres of which are in pristine condition, colonies of Roseate terns, breeding sites for osprey and pelican, and breeding populations of olive ridley, green and hawksbill turtles and dugongs. Upwellings provide rich fishing grounds for finfish, crustaceans and molluscs. Offshore humpback, Sei, pilot and sperm whales migrate seasonally along the coast. The adjacent North Banks provide attractive habitat for top-level predators such as black marlin and sailfish[10].

Rufiji-Mafia-Kilwa seascape

The Rufiji-Mafia Complex (Site 11) off the coast of Tanzania was selected because it takes in the Rufiji River delta, Mafia Island and the Songo Songo Archipelago, and is a very important breeding area for shrimp and fish. It also has high coral diversity (>45 genera), extensive mangroves, an abundance of top predators such as crocodile, and is important for dugongs, marine turtles and resident populations of hippopotamus[10].

The Mtwara-Quirimbas Complex (Site 12) stretches from Mtwara town in southern Tanzania to Pemba town in northern Mozambique. The site was chosen as globally important because it is located where the South Equatorial Current meets the African coast, creating a divergence which may be of critical importance as a source of marine larvae for both southern and northern parts of the ecoregion. The site has an extensive complex of reefs, with high coral diversity (>48 genera). It is an important marine turtle feeding and nursery site, and feeding area for crab plovers and migratory birds. It is also an important area for humpback whales and pelagic fish.[10]

The Mombasa visioning workshop also concluded that in order to realise the vision, partners would have to engage with a wide range of stakeholders including other professionals. Filling information gaps and generating a greater understanding of how resources and habitats are used were acknowledged as important needs to be fulfilled. Public awareness about the value and role of biodiversity in the ecoregion was also necessary if the vision were to become a reality.

There was also a shared understanding that a


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[9] Ward, T., D Tarte, E. Hegerl and K. Short (2002) *Policy proposals and operational guidance for ecosystem-based management of marine capture fisheries*.WWF-Australia, Sydney. 80pp.
[10] WWF Eastern African Marine Ecoregion Programme (2004) *The Eastern African Marine Ecoregion Vision: A large scale conservation approach to the management of biodiversity*. WWF-Tanzania, Dar es Salaam. 53pp.

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Eastern African Marine Ecoregion

© WWF-Canon / Jason Rubens

Mafia Island, Tanzania.

balanced approach would be necessary to support the practical implementation of the bold vision: between human needs and species; between present and future generations; and between conservation and consumption.

Implementing strategic action within the Eastern African Marine Ecoregion

Since the 50 year vision was developed and the high priority areas were identified, the Eastern African Marine Ecoregion programme has developed a comprehensive strategic conservation framework and a conservation action plan[6] to help achieve the vision. The conservation action plan includes detailed National Action Plans that were developed in 2003 in workshops under the umbrella of the Eastern African Marine Ecoregion Partnership[11]. A five-year WWF conservation action plan has also been developed including a conceptual model, which identified key targets for natural resource management within the ecoregion (fisheries, species of special concern, mangroves, coral reefs, coastal dunes, seagrasses and coastal wetlands).

Having identified targets, the major factors that influence the targets, including direct and indirect threats, were described, as well as the relationships between the factors. A prioritisation exercise was applied in order to determine where limited resources would be directed at mitigating the threats, by ranking these against three criteria: 1) how extensive an **area** is affected by the threat; 2) what is the **intensity** or how severe is the impact of the threat; and 3) how **urgent** is it to take immediate action to deal with the threat.

Another set of criteria were then overlaid upon the results of the first ranking exercise to determine WWF priorities, including whether WWF might be most appropriate organisation to work on the issue, whether there was a window opportunity or any institutional gaps that would enable partnerships to be developed, and whether WWF had the skills and expertise to facilitate the work needed. The outcome that emerged from these ranking exercises was that the top two priorities were both related to fishing: to develop strategies for reducing inappropriate artisanal and inappropriate industrial fishing practices, including bycatch.

As was recognised earlier in this case study, fishing is a significant source of income and employment for hundreds of thousands of people in the ecoregion countries, contributing significantly to the economy of the Eastern African Marine Ecoregion[10]. Food from the sea is also the principal source of protein for a majority of the population. In all the countries within the ecoregion, both industrial and artisanal fishing occur on a large scale. In Mozambique alone, up to 80,000 artisanal fishers depend on fishing, taking by far the largest share of the catch (estimated to be 90-95%[7]) and in the other regional countries the situation is similar. Overfishing in coastal waters is commonplace and there are regular social and gear conflicts between artisanal

[11] WWF Eastern African Marine Ecoregion Programme (2004) *The Eastern African Marine Ecoregion Biodiversity Conservation Strategic Framework 2005 – 2025*. WWF-Tanzania, Dar es Salaam. 54pp.

fishers and commercial fishing companies. Most commercial fisheries are dominated by foreign interests targeting high-value export species. Illegal fish harvesting and bycatch problems are also widespread. Despite being illegal in some ecoregion countries, the use of dynamite, small mesh and beach seines have destroyed coral reefs and seagrass beds. Many fisheries are still predominantly open access, causing the overfishing and continued poverty. While these threats are significant and urgent, in spite of them, there are still many biodiversity-rich areas, some in pristine condition. WWF's strategic action on the fisheries front involves working in partnership with country agencies and stakeholders in the ecoregion to facilitate and encourage the development of action plans including:

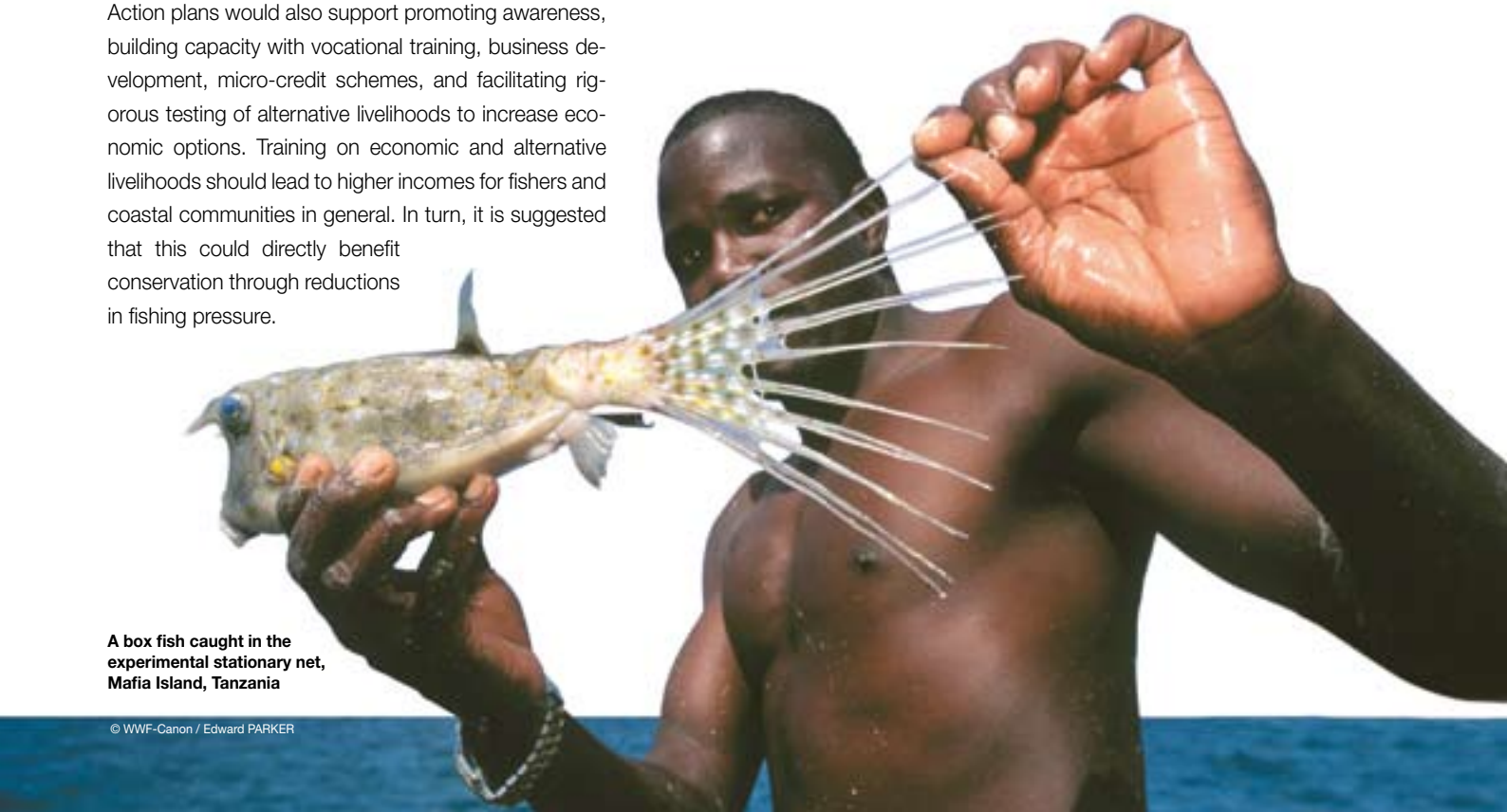
- Collaboration of stakeholders on developing fisheries management in pilot areas, including creating forums for negotiating new fisheries management regimes (collaborative/co-management) between fisheries governing bodies, fishing communities, local and international NGOs and other participants.
- Formulation of fisheries management institutions at all levels in coastal communities (starting with pilot areas) including promoting the formation of community fisheries management bodies and groups to deal with fisheries management and development activities.
- Developing co-management plans in Eastern African Marine Ecoregion seascapes (e.g. village and district plans).

Action plans would also support promoting awareness, building capacity with vocational training, business development, micro-credit schemes, and facilitating rigorous testing of alternative livelihoods to increase economic options. Training on economic and alternative livelihoods should lead to higher incomes for fishers and coastal communities in general. In turn, it is suggested that this could directly benefit conservation through reductions in fishing pressure.

Another strand in the strategy for improving fisheries outcomes is to influence markets for high value export species by working on developing sustainable fisheries management practices with a view to certification of some fisheries to the environmental standard set by the Marine Stewardship Council.

A practical example ~ Rufiji-Mafia-Kilwa seascape project

One of the eight globally significant areas that emerged from the Eastern African Marine Ecoregion visioning and mapping exercise was the Rufiji-Mafia Complex off the coast of Tanzania. The WWF-Tanzania Programme Office in collaboration with the Eastern African Marine Ecoregion Programme partnership has developed a five-year project on sustainable resource management and biodiversity conservation for the Rufiji-Mafia-Kilwa Seascape, marking the first project in eastern Africa at an ecoregional scale. The planning for this new generation of conservation projects in the Eastern African Marine Ecoregion started in 2004 in partnership with the Tanzanian Vice President's Office and the National Environment Management Council (NEMC), which is also the focal institution for the Eastern African Marine Ecoregion Programme in Tanzania. Other key players were the Kilwa District Council, Rufiji District Council, Mafia District Council and Mafia Island Marine Park.



A box fish caught in the experimental stationary net, Mafia Island, Tanzania

2

Eastern African Marine Ecoregion

The project aims to improve the socio-economic well-being of coastal communities in Rufiji, Mafia & Kilwa districts through sustainable, participatory and equitable use and protection of their marine and coastal natural resources. While still in the establishment phase, the objectives of the project are to ensure:

- Collaborative engagement is strengthened between district authorities and other stakeholders, resulting in improved planning for collaborative coastal and marine resource management and more proactive participation in implementation of relevant management initiatives.
- Knowledge is shared and awareness raised amongst stakeholders on issues relating to sustainable management of marine and coastal resources.
- The environment for small- and medium-scale enterprise is improved through better access to micro-credit and market information, and demand-led capacity-building in entrepreneurship, financial management and technical skills to diversify income sources.
- Threatened habitats and species are protected and the control of destructive activities is improved through collaborative initiatives.
- Information availability is improved for natural resource management decision-making within districts, Mafia-Island Marine Park and communities, through developing and strengthening sustainable data gathering and information management systems.[12]

The third step or operational element in the WWF ecosystem-based management framework[9] being highlighted in this series of case studies builds on the developing stakeholder relationships demonstrated in steps 1 and 2 and focuses in on identifying the partners in the EBM process and their interests and responsibilities. As we have seen in this case study, the Eastern African Marine Ecoregion Programme has continued to develop through active partnerships in each of the countries in the ecoregion. Engaging with supportive stakeholders and promoting an integrated and collaborative process can set the stage for achieving long-term objectives efficiently and cooperatively. The next case study on the Baltic Sea explores this aspect of making EBM operational.

Acknowledgements

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Philipp Goeltenboth, Senior Program Officer, Africa and Madagascar Marine Ecoregions, WWF-US

[12] Rubens, J. (2005) *Rufiji – Mafia – Kilwa Seascape Programme Tanzania*. WWF-Tanzania, Dar es Salaam. 2pp.

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Baltic Sea Marine Ecoregion

3

EBM STEP 3 ~ IDENTIFY PARTNERS AND THEIR INTERESTS & RESPONSIBILITIES

In order to promote the opportunity for coordination and integration of management activity, as well as improve efficiency across agencies and strive for more effective long term solutions and shared approaches to marine ecological challenges, the particular focus of Step 3 is to clarify specific roles and responsibilities for management in the marine environment and to engage with other supportive interests.

Including fisheries management agencies, the fishing industry and other fisheries stakeholders, partners could include:

- Conservation and environment protection agencies
- Coastal planning agencies from all levels of government
- Major users and managers of other resources (e.g., tourism, mining, oil, gas or mineral extraction, transport, and communications)
- Directly affected local communities.

Source: Ward et al. (2002)[1]

The Baltic Sea is an almost entirely enclosed sea in northeast Europe, connected only to the North Sea by the shallow and narrow strip of the Sound and Belt Seas (the Danish Straits)[13,14]. With an area of about 404,000 square kilometres, the Baltic is a small sea by global standards, but is one of the largest bodies of brackish water in the world[14]. It has an average depth of just 53 metres and its deepest recorded depth is a little over 450 metres[14]. Water exchange between the North and Baltic Seas is limited, meaning that water, including all organic and inorganic matter, can stay in the Baltic for up to 30 years[14]. This means the Baltic Sea is a very vulnerable environment, easily impacted by human activities in its catchment area[14]. With nine countries bordering the Baltic (Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany and Denmark), around 85 million people live within its catchment area. This includes about 15 million people living within 10 kilometres of the Baltic coastline[14].

Marine and offshore habitats of the Baltic Sea are considered very young compared to surrounding geological structures. They were created at the end of the last glacial period by rising sea-levels caused by the melting of the ice sheet. This process began about 15,000 years ago in the southernmost Baltic Sea and 6,000 years later further north[15]. The Baltic Sea has experienced both freshwater (Ancylus Lake) and marine phases (Yoldia Sea) which is reflected in the species composition found in the ecoregion. Coastal habitats include deep bays, extensive archipelagos and open coast.

The brackish water of the Baltic Sea is a mixture of freshwater from rainfall and rivers and seawater from the North Sea[14]. Layers of shallow, low salinity water and deeper more saline water are permanently separated, or stratified[13]. The Baltic's brackish environment means it has relatively low biodiversity and a simplified food web with high numbers of individual species[15]. It does have some marine and freshwater species that have adapted to the environment, as well as some true brackish water species[14]. The relatively limited number of species means that each one has special significance for the integrity of the ecosytem, but this also makes them extremely vulnerable to external disturbances[14].

A global waters regional assessment published in 2005 by the United Nations Environment Programme and the Global Environment Facility ranked eutrophication (i.e., the over-enrichment of a body of water with nutrients resulting in excessive growth of algal organisms and depletion of oxygen) and overexploitation as severe impacts in the Baltic region[13].

There are only few marine mammal species in the Baltic Sea area such as harbour, grey and ringed seals and harbour porpoise. The Baltic is an important wintering area for migratory birds like geese and waders. Cormorants and Baltic white-tailed eagles seem to be thriving, while there are declining populations of black-tailed godwit and lesser black-backed gulls. Marine species like cod and red algae are found in the higher salinity areas, generally in the central Baltic and southern Kattegat regions[15]. There are only about 100 fish species, of which three are commercially dominant: cod, herring and sprat[16]. The number of species is related to levels of salinity which decreases from the

The Baltic Sea and its catchment area

[13] Lääne, A., E. Kraav, and G. Titova. (2005) UNEP *Baltic Sea, GIWA regional assessment 17*. University of Kalmar, Kalmar, Sweden. 88pp.
[14] HELCOM (2003) *The Baltic Marine Environment: 1999-2002*. Helsinki Commission. Baltic Marine Environment Protection Commission. Finland. 48pp.
[15] WWF (2004) *WWF Baltic Ecoregion Conservation Plan. Biodiversity conservation and ecosystem-based management in the Baltic Sea*. WWF-Sweden. 61pp.
[16] WWF (2006) *A sustainable future for Baltic Sea cod and cod fisheries*. WWF-Denmark. 23pp.

Danish Straits to almost freshwater in the eastern Gulf of Finland and Gulf of Bothnia.

Fishing has long standing significance in the lives of many coastal people living around the Baltic with fish being an important source of food for many, especially in Estonia, Latvia and Lithuania[13]. As mentioned above, important commercial fisheries in the Baltic Sea include cod, herring, sprat and salmon in the central and southern Baltic, and pike, perch, whitefish and herring in the northern Baltic[13]. There are two cod stocks in the Baltic – eastern and western, both of which are considered by scientists from the International Council for the Exploration of the Seas (ICES) to be significantly overfished[16]. ICES advice in 2006 recommended that the eastern Baltic cod stock be closed to fishing in 2007 and a recovery plan be implemented, while the Total Allowable Catch for the western stock should be severely restricted[16].

Step 3 in action ~ identify partners, their interests & responsibilities

As with any management system for human activity, be it for an organisation, business or a natural system, it is more likely to be successful if management occurs within a system based upon a shared vision and a set of objectives developed amongst stakeholders. Step 3 making ecosystem-based management (EBM) operational builds upon work which may have begun with the first two steps that identified the broader stakeholder community and mapped out (literally and figuratively) the domain in which EBM will take place. A clear distinction between Step 1 (identifying stakeholders) and Step 3, is that this step is about working within, or creating, more formal institutional structures and clarifying people's responsibilities within these.

The identification of partners, their interests and responsibilities ideally means creating a true partnership, where stakeholders are empowered within the system to make real decisions about the management of the ecosystem within which they have a real stake. In many fisheries management systems this is not the reality. However, there are degrees of participation that can create enabling environments through which successful outcomes can be realised. There is a substantial and growing amount of research that supports the idea that clearly defined roles, rights and responsibilities can help align fishery participants' interests with overall objectives of sustainability[17]. If the system enables effective stakeholder participation in all aspects of the management process and institutional changes result in increased participation and cooperation amongst stakeholders, this could help create such an 'enabling' environment.

Creating an enabling environment for the management of fisheries in the Baltic Sea

Jurisdiction for the management of Baltic fish stocks used to belong to the International Baltic Sea Fishery Commission (IBSFC). Established in 1973, its members were the European Community, Sweden, Finland, East and West Germany, Poland and the Soviet Union, including Estonia, Latvia and Lithuania. By 2005, with the exception of the Russian Federation, the remaining countries, including a unified Germany, had become members of the European Union. Because of this, the European Union withdrew from the Convention in

[17] de Young, B. and R.M. Peterman, A.R. Dobell, E. Pinkerton, Y. Breton, A.T. Charles, M.J. Fogarty, G.R. Munro, and C.T. Taggart (1999) Canadian marine fisheries in a changing and uncertain world. *Can. Spec. Publ. Fish. Aquat. Sci*. 129. 199pp.

SUSTAINABILE SEAFOOD ON THE SWEDISH MARKET ~ A PATH TOWARDS DIALOGUE

FISK TILL MIDDAG? ~ FISH FOR DINNER?

Following WWF-Germany's successful launch of a seafood guide for consumers in 2000, WWF-Sweden began its European fisheries campaign aimed at consumers in 2001 with the development of the Swedish consumer guide "Fisk till middag?"(Fish for dinner?). Using a simple traffic light system to indicate: **RED** – don't buy; **AMBER** – exercise care; and **GREEN** – enjoy; to rate the sustainability of popular species sold in the Swedish market, the guide was an easy to understand, handy tool to get a powerful message across. The first edition was published in April 2002 with a print run of 10,000 copies. A **GREEN light** was given to pike-perch, a freshwater species subsequently certified in 2005 by the independent Marine Stewardship Council, while a **RED light** was given to cod from the Baltic and North Seas.

Part of the campaign strategy involved giving the three largest fish retailers in Sweden advance warning about the press conference that would accompany WWF's release of the fish guide and its damning recommendations for some species, so that they could respond in advance to WWF's recommendations. The press conference had a huge impact within the Swedish media and the story was widely reported throughout the country, raising WWF's profile and credibility. Coop, Hemköp and ICA declared they would stop buying cod and they did.

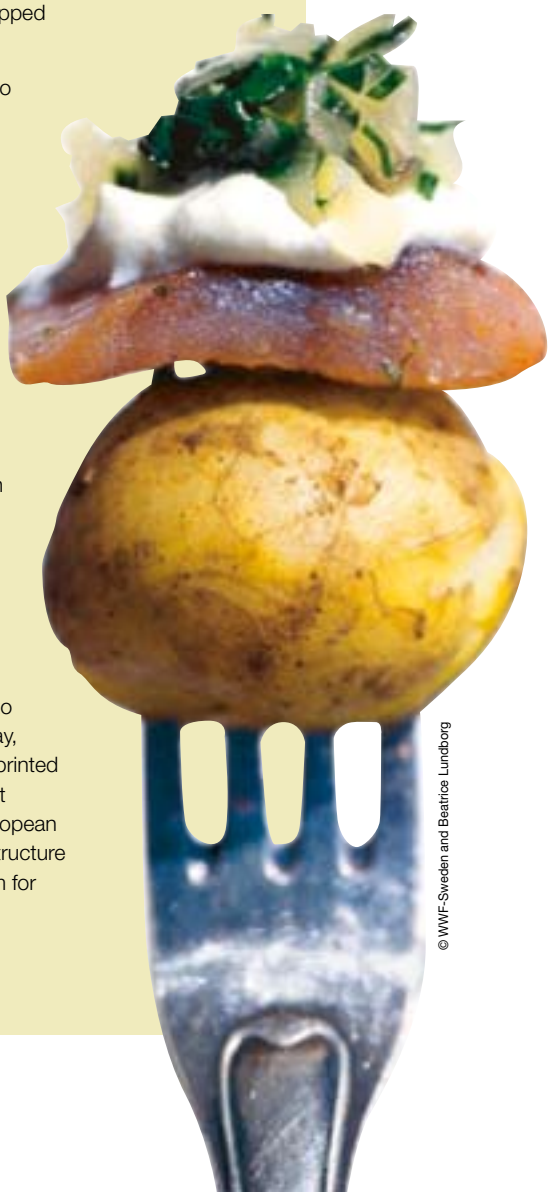
The immediate reaction from the Swedish Board of Fisheries, the Swedish Fishermen's Federation and the Swedish Fisheries Minister was to criticise WWF for basing its conclusions on inaccurate data about cod stocks. Bearly two months later, in June 2002, independent scientists from ICES recommended a total ban on cod fishing in the Baltic and North Seas to protect overexploited stocks. WWF then became involved in roundtable discussions with two Swedish political parties in the run up to the 2003 general election, further lifting its profile and resulting in The Green Party also campaigning for a total cod ban in the Baltic. Anedotal reports suggest that cod sales dropped by 50% in a seven to eight month period.

By September 2002, however, the Swedish Fishermen's Federation contacted WWF to open dialogue and the Swedish Fisheries Minister had publically withdrawn her criticism of the scientific basis for the fish guide's conclusions about cod, while continuing to insist that fish taken from legally agreed quotas was acceptable for people to consume. A revised second edition of the fish guide was published in September 2002 with another print run of 5,000 copies. By 2003, WWF, its fish guide and related issues were being reported in the Swedish media about once a month and the guide has become the most downloaded document from WWF-Sweden's website (by 2004 it had been downloaded 5,000 times).

In June 2003, after several months of genuinely productive dialogue, WWF and the Swedish Fishermen's Federation released a joint 10 point programme for sustainable fisheries, and WWF was invited to participate on the offical Swedish delegation that year to the International Baltic Sea Fisheries Commission. The relationship still had its challenges and at a joint seminar in August 2004 where WWF and the Swedish Fishermen's Federation jointly presented the idea of looking at spatial tools as part of fisheries management, and the synergies between Marine Protected Areas and closed areas, a public dispute arose over no take zones. Meanwhile the third edition of the fish guide had been released and by October 2004 WWF was invited for the first time to the Swedish Fishermen's Federation annual congress.

The campaign proved successful for influencing buyers and consumers, as well as bringing industry and other stakeholders together to work more closely. This success led to the preparation of WWF fish guides in 2005-06 for release in Denmark, Finland and Norway, while the German consumer guide appeared in its fourth edition with half a million copies printed for distibution. WWF-Finland is also collaborating with well known Finnish chefs to connect gastronomic values with the protection of sustainable fish stocks. In the meantime the European Union's Common Fisheries Policy reform had established the Regional Advisory Council structure and in March 2006, the Baltic Sea Regional Advisory Council had been created as a forum for geniune dialogue about Baltic fisheries management.

Source: Inger Näslund & Lasse Gustavsson, WWF Baltic Ecoregion Programme



3 Baltic Sea Marine Ecoregion

December 2005 and signalled its desire to enter into a bilateral arrangement with the Russian Federation to manage the shared fisheries resources of the Baltic.

Following the reform of the European Union Common Fisheries Policy in 2002, the European Commission established new regional institutional structures through which stakeholders from EU Member States could provide fisheries advice to the Commission, and ultimately the Council of Ministers (which makes European Community level decisions), on fisheries management matters. A network of five Regional Advisory Councils (RACs) was established to provide a forum for dialogue between fishing industry representatives, scientists and other stakeholders. RACs were envisioned, according to the European Commission, to enable the fishing industry to work more closely with scientists to formulate scientific and management advice, and they may also provide recommendations and suggestions on any aspect of fisheries management with their respective regions[18].

The Baltic Sea Regional Advisory Committee (BSRAC) came into being in March 2006 and has already been confronted with some challenging circumstances about which to give advice to the European Commission.

In the years leading up to the creation of the BSRAC, many environmental and other non-industry stakeholders in the Baltic were effectively bystanders in the fisheries management process controlled by the IBSFC. Without a voice in the political or decision-making process, WWF used market-based, consumer-directed advocacy to attract the fishing industry into dialogue to try to broaden the scope of fisheries management and consider important environmental concerns. WWF ran several campaigns focussing on harnessing consumers' purchase power within the seafood market, aiming to change people's and supply chains' fish buying behaviour and bring financial pressures to bear on the industry. During the early 2000s, WWF national offices in Finland, Germany and Sweden launched consumer campaigns in the form of guides about purchasing sustainable seafood. This succeeded in bringing environmental campaigners and fishing industry associations closer together to engage in genuine dialogue about how to tackle fisheries sustainability challenges (the Swedish case is provided as an example, see box)[19,20].

As the relationships in sections of the stakeholder community in the Baltic Sea ecoregion were evolving, the European Union created the RACs in response to calls from almost every group affected by, or with an interest in, fisheries decisions to broaden the ability of stakeholders to engage in the decision-making process. In March 2006, the BSRAC came into existence with funding provided by the European Commission and Baltic Member States, and sponsorship from a Danish fish processing company[21].

A European Community regulation and related Council of Ministers decision give effect to the legal framework, structure and potential membership of the new RACs. While acknowledging that regions are differ-

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[18] http://ec.europa.eu/fisheries/cfp/governance_en.htm
Governance page from European Commission's Fisheries' website
[19] Lasse Gustavsson, personal communication.
[20] The WWF-Sweden example serves as a single illustration of the kind of work being carried out in the Baltic Marine Ecoregion by WWF national offices in the countries surrounding the Baltic Sea, including but not limited to, WWF-Denmark, WWF-Finland, WWF-Germany and WWF-Sweden.
[21] http://www.bsrac.org/ About the Baltic Sea RAC

ent, thus requiring a bespoke mix of stakeholders, the basic framework for each RAC is the same. Members of RACs, including the BSRAC, are drawn from the fishing industry, producer organisations, the post-harvest sector (including processors and marketers) and women's networks (collectively called the 'fisheries sector' by the European Commission), as well as aquaculture producers, recreational and sports fishers, consumer organisations and environmental NGOs (collectively referred to as 'other interest groups').

A General Assembly is formed with all members. There are 42 member organisations represented in the BSRAC General Assembly. General Assemblies meet once a year and have responsibility for approving the annual budget and strategic plan, as well as electing an Executive Committee which, for each RAC, is limited to 24 members. RACs may establish Working Groups to help the Executive Committee conduct its work.

Fully two-thirds of the seats of any RAC are alloted to members of the 'fisheries sector' and one-third to representatives of 'other interest groups' affected by the Common Fisheries Policy[22]. Non-members may be invited to participate and can include scientific experts, officials from EU Member State administrations and representatives from other bodies, including fisheries representatives from other affected fisheries in the region that fall outside the jurisdiction of the EU Common Fisheries Policy. Meetings of the General Assembly are open to the public, as are those of the Executive Committee unless exceptional reasons agreed by a majority of members dictate otherwise.

RACs function ideally by consensus, or if consensus cannot be reached, then by majority vote. Dissenting opinions are recorded in the recommendations that are forwarded to the European Commission.

General Assemblies elect a Chairperson, who, in the case of BSRAC, is Chris Karppinen of the Federation of Finnish Fisheries Associations and the Chairperson of the Executive Committee is Reine J. Johansson, former Chairman of the Swedish Fishermen's Federation. From its earliest days through to August 2006, the BSRAC's Executive Committee Vice Chair was a representative of the environmental community, Ms Katarina Veem from WWF, who stepped down only to move to a new post.

The BSRAC has created three species-based working groups to provide specialist advice to the the Executive Committee: 1) demersal fisheries; 2) pelagic fisheries; and 3) fisheres for salmon and sea trout.

Cod management in the Baltic

One of the first challenges the newly formed BSRAC had to confront was the cod situation in the Baltic. With scientists advising the European Commission that there should be significant reductions in Total Allowable Catches of western cod and a total ban on fishing for eastern cod, the Demersal Working Group of BSRAC needed to provide recommendations, preferably consensus-based, to the Executive Committee, which in turn would provide its recommendations to the European Commission.

In July 2006, the European Commission developed a proposal for a multi-annual management plan for cod stocks in the Baltic Sea. Among other things, the plan suggested that an annual reduction in fishing effort of 10% be implemented until the defined target for fishing mortality is reached[16]. The proposal immediately tested the ability of the newly formed RAC to achieve consensus. Some issues were relatively straightforward, for example, everyone agreed a new management plan for cod is necessary. However, fisheries sector representatives could not agree to long-term, year on year, fishing effort reductions, while environmental representatives considered that 10% reductions were modest and that more would be needed to achieve an ecologically balanced fishery[23]. While other issues also divided the members, such as the length and efficacy of spawning period closures, the BSRAC was able to come to a clear consensus about the detrimental effect Illegal, Unregulated and Unreported (IUU) fishing in the Baltic is having on the ability of cod stocks to be managed sustainably.

The members of BSRAC's Executive Committee also agreed to make a clear statement to the Commission about IUU fishing:

"*Recognizing that the lack of compliance to existing*

[22] Council Decision (2004) *Establishing Regional Advisory Councils under the Common Fisheries Policy*. (2004/585/EC).
[23] BSRAC (2006) *Key points and recommendations from the Demersal Working Group meeting held in Klaipeda on August 22nd and 23rd 2006*. Baltic Sea Regional Advisory Council, Denmark. 10pp.

regulation is one of the major barriers to the establishment of sustainable fisheries in the Baltic Sea, the Baltic Sea RAC ExCom encourages the European Commission to actively promote the implementation of the EU Community Plan of Action to combat IUU and the FAO International Program of Action to prevent, deter and eliminate IUU and Member States to apply appropriate measures. The Baltic Sea RAC ExCom members will support the European Commission and Members States in their efforts to combat illegal fisheries." [24]

The Executive Committee also agreed to organise a conference in 2007 to discuss how to combat IUU fishing in the Baltic and to invite the European Commission to attend.

Unhappily for some stakeholders, even though consensus could not be reached within BSRAC, the outcome of the Council of Ministers' deliberations on cod management at the end of 2006 did not result in the kinds of reductions to Total Allowable Catches or fishing mortality that environmental organisations wanted, nor that scientists were recommending. WWF expressed its concern and dismay via the press, denouncing the Ministers' decision and saying that Fisheries Ministers had effectively written-off cod in the Baltic.

An evolving and maturing process of dialogue?

The new RAC process within European fisheries management, particularly in the Baltic, has had a challenging birth. Some difficult issues have had to be confronted and for some players, participating in this kind of forum and attempting to gain consensus about topics that directly or indirectly affect things they feel passionate about, is a brand new experience. For many, the RAC process represents a significant cultural shift from an old way of doing business and potentially a meaningful step towards EBM. For some, however, it could be perceived as only a new name for business as usual.

Some stakeholders are concerned that the political decision-making process by Fisheries Ministers overlaid on top of the RAC process could routinely undermine good dialogue and work that occurs at the regional council level. Though consensus may be difficult to reach on some issues, the politicking that occurs later outside the RAC process, and which involves the Fisheries Ministers of all European Community Member States not just those represented in the RACs, ultimately decides the fate of fisheries management recommendations by

the RACs. There are some who express scepticism that the RACs can evolve and mature while stakeholders, be they fishing interests or environmental interests, can do an 'end run around' the RAC process and begin lobbying politicians, who have inherently short, politically determined horizons and consistently demonstrate this by making politically expedient, short-term decisions to the detriment of European fisheries, ecosystems and all who rely upon them.

Other stakeholders prefer to sound a note of optimism. The RAC process may take years to develop trust and maturity, but the BSRAC has already provided a forum where geniune dialogue about the future sustainability of Baltic fisheries has taken place. Relationships between stakeholders are evolving, but the future remains uncertain. From an EBM perspective, one potential enabling structure has been put in place. The next step in making EBM operational involves establishing ecosystem values (Step 4), as a step towards creating a shared vision for the future. It remains to be seen whether the new RAC forums can be used to create shared visions for the future and become places where fisheries management partnerships are productive and relentless in their pursuit of benefits that achieve that elusive balance between enlightened self-interest and stewardship of ecosystems.

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[24] BSRAC (2006) *Recommendations on the management of demersal fisheries, September 2006*. Baltic Sea Regional Fisheries Advisory Council, Denmark. 3pp.

Fiji Islands Marine Ecoregion

4

Lying in the heart of the western Pacific Ocean, the Fiji Islands Marine Ecoregion covers an area of nearly 1.3 million square kilometres and includes about 844 high islands, cays and islets. The archipelago has a total land area of over 18,000 square kilometres, with about 87% of this accounted for by the two largest islands: Viti Levu (10,386 km^2) and Vanua Levu (5,534 km^2)[25]. This huge and remote tropical ecoregion includes the open ocean, the warm waters of shallow marine habitats from oceanic reefs to near-shore fringing reefs, mangrove forests, seagrass beds, lagoons, and deep oceanic drop-offs. It is an area of high biodiversity with many species unique to Fiji. An estimated 3-4% of the world's coral reefs are found here including the world's third longest barrier reef, the Great Sea Reef (known locally as *Cakaulevu*).

Within this extraordinary ecological web of life are nearly 400 species of coral, 1,200 varieties of fish and many invertebrates, as well as endemic species like the Fiji petrel, humphead wrasse and the bumphead parrot fish. Five species of marine turtle migrate, feed and breed in the ecoregion's waters. Fiji's territorial waters have been designated as a whale sanctuary since 2003 with 12 whale species migrating through and/or breeding in the ecoregion's warm waters[26].

About 80% of Fiji's multi-racial population of over 840,000 people live on the coast and many rely upon the sea's resources for food and cash income. Fijian people's lifestyles, customs, history and traditional knowledge reflect their important relationship with the sea[25].

Fiji's principal economic sectors are tourism, sugar cane production and other natural resource exploitation, including fisheries, various other agricultural crops and forestry. The fisheries sector is Fiji's fourth largest export industry, accounting for about 1.5% of GDP in 2005-06[27]. The Fijian government expects this percentage to grow as investment and expansion of the tuna industry occurs[27].

The main export fisheries include yellowfin, bigeye, albacore and skipjack tunas. Farmed resources include prawns, seaweed, giant clams and tilapia[27]. Many coastal households fish for subsistence, although the time spent, techniques used and the contribution the catch makes to the people's livelihoods varies considerably[28]. It has been estimated that in Fiji, up to 30,000 people engage in subsistence fishing, taking approximately 17,000 tonnes of fish a year[29, 30].

Traditional fishing grounds are known as *i qoliqoli*. The State and indigenous Fijian kinship units share joint ownership of Fiji's coastal and foreshore waters and their marine resources, including fisheries[30], although it seemed possible this might have changed in favour of indigenous Fijians, the customary owners, if a proposed Fisheries Management Bill introduced to the Fijian Parliament in 2006 were to be enacted. The future of the Bill and other government reforms relating to indigenous rights, are now highly uncertain following the military coup in December 2006. The proposed Fisheries Management Bill is understood to be a source of tension between the government and the military since the Bill was proposed in a previous form prior to the government's re-election in May 2006. The Bill was reintroduced in August 2006, but the military came out publicly against it at a Parliamentary Select Committee

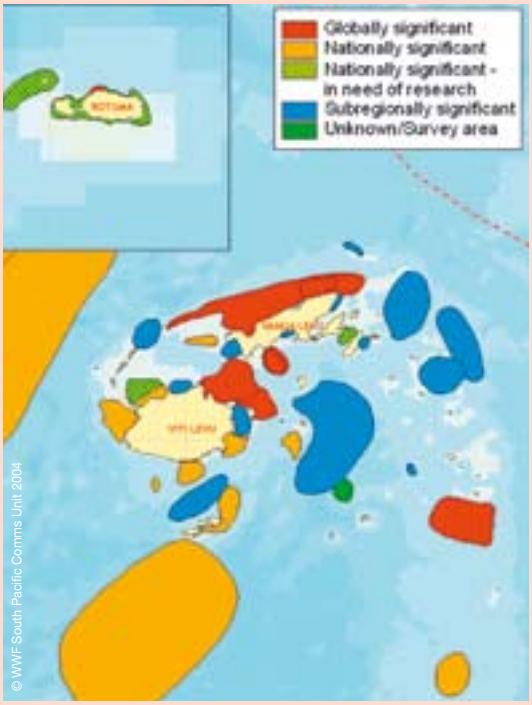
EBM STEP 4 ~ ESTABLISH THE ECOSYSTEM VALUES

The focus of this step is for stakeholders, partners and interested parties to create a detailed distributional analysis of the main attributes of the ecosystem where relevant fisheries operate. The intention is that the process results in a clear and agreed expression of the ecosystem's natural and use values. These could include:

- Fishing, spawning grounds, recruitment areas and migration paths for commercial species
- Traditional hunting grounds
- Highly valued habitats
- Representative areas dedicated as reserves
- Protected species feeding, breeding or resting grounds
- Areas of high cultural or historic value
- Highly productive areas such as upwellings
- Areas popular for recreational fishing or diving
- Areas used for ports and harbours
- Areas of high scenic and wilderness value
- Areas of high tourism value
- Areas used for dumping of waste, dredging, defence training, shipping, etc.

Source: Ward et al. (2002)[1]

Fiji Islands Marine Ecoregion priority seascapes



[25] Richards, A. and M. Lagibalavu, S. Sharma & K. Swamy (1994) *Fiji Fisheries Resources Profiles*. FFA Report No. 94/4. Forum Fisheries Agency, Solomon Islands.
[26] Heaps, L. (2005a) *Setting Priorities for Marine Conservation in the Fiji Islands Marine Ecoregion*. WWF South Pacific Programme Regional Office. Suva, Fiji.
[27] Anon. (2006) *Fiji Today 2005 – 2006*. Fiji Government. www.fiji.gov.fj
[28] Gillett, R. and C. Lightfoot (2002) *The contribution of fisheries to the economies of Pacific Island Countries. A report prepared for the Asian Development Bank, the Forum Fisheries Agency and the World Bank*. Asian Development Bank, Manila, Philippines.

hearing in October 2006, demanding its withdrawal. According to media reports, opposition was based upon suggestions that ethnic Indians, who make up about 40% of Fiji's population, would have been disadvantaged by the return of ownership of traditional fishing grounds to indigenous Fijians. Another reason for opposition by the military was the potential damage the Bill may do to hotel owners' rights and tourism in the country.

The *qoliqoli* were managed by traditional owners long before so-called modern management arrived in Fiji. Permission to fish in certain waters, under existing law, requires the consent of the chief of the *qoliqoli*, before the Fisheries Department can then grant a commercial fishing licence. Before scientific or conservation organisations introduced such concepts as protected areas or set-aside, traditional 'tabu' areas were a common management tool where fishing was temporarily or permanently controlled[30].

The issues relating to rights stirred up by recent events may be a non-issue for communities who are not fishing rights owners but have developed respectful relationships with *qoliqoli* owners. *Qoliqoli* owners who are also members of the "Fiji Locally-Managed Marine Area Network" (FLMMA)[31], especially those *qoliqolis* that have a cross section of the population (non-fishing rights owners, Fijians from other parts of Fiji, Indians and others) have realised that to safeguard the sustainability of their *qoliqoli,* all users need to be part of the management process. The *qoliqoli* owners have willingly been working towards including non-*qoliqoli* residents in sharing the management of fishing grounds. Owners have been making sure users are aware of management plan activities to enable collective compliance with management rules[32].

Meanwhile, researchers and stakeholders have expressed concerns that traditional systems of natural resource allocation and management have been eroded by the shift from resource use for subsistence living to that of a cash economy which has led to overfishing, habitat degradation and unsustainable fishing practices[30]. For example, some popular varieties of edible mollusc are facing local extinction in some communities due to fishing pressure. Other threats to the ecoregion's marine environment include unregulated extraction of other marine resources, land-based pollution, increasing sedimentation from logging and poor land use practices, climate change and associated coral bleaching, and increased tourism and urbanisation[26].

WEAVING A TAPESTRY OF PROTECTION & SUSTAINABILITY33 PARTNERSHIP

By early 2005, after partners had joined WWF in its *Big Win* vision, the then Fijian government came on board.
In recognition of their contribution to marine conservation and sustainable resource management, in January 2005 the Fijian government declared its commitment to implement a comprehensive suite of marine protected areas and by 2020 to have 30% of Fiji's inshore and offshore qoliqoli within an effectively managed and financed network.

Source: WWF Fiji Islands Marine Ecoregion Team, 2004[33]

Step 4 in action ~ establish ecosystem values

As we have seen in the first three steps, the process of implementing ecosystem-based management (EBM) might logically begin by identifying the stakeholders, mapping the ecoregion and habitats, and clarifying specific roles and responsibilities of partners in the management process. While the steps do offer a logical sequence to follow, they are not prescriptive, nor do they need to be rigidly sequential. As we shall see, in some cases it is most effective and makes most sense to conduct some of the steps together.

[29] FAO (2002) *Fishery country profile: Fiji*. http://www.fao.org/fi/fcp/en/FJI/profile.htm
[30] Nair, V. (2003) *Fiji Islands Marine Ecoregion: An overview of outstanding biodiversity, threats, opportunities and key stakeholders for conservation*. WWF-Fiji Programme, Suva, Fiji.
[31] The Locally-Managed Marine Area (LMMA) Network is a group of practitioners involved in various marine conservation projects around the globe who have joined together to increase the success of their efforts. The LMMA Network is learning network, meaning that participating projects use a common strategy and work together to achieve goals. The Fiji LMMA (FLMMA) Network is the first country-level network to operate independently of the overall Network. FLMMA received the prestigious 2002 Equator Initiative Award from the United Nations Development Programme. LMMA is funded by the David and Lucile Packard Foundation and John D. and Catherine T. MacArthur Foundation. http://www.lmmanetwork.org/
[32] Kesaia Tabunakawai, personal communication.

The adverse impacts described earlier in this case study, as well as the dependence of coastal communities on marine resources coupled with the limited options for people to generate alternative income, means the marine environment is under unprecedented pressure. In response, in December 2003 and using methodologies developed for ecoregional-based conservation, WWF convened a wide range of stakeholders to discuss the importance of, and to gather current scientific and anecdotal information about, the biodiversity and threats to Fiji's marine environment. More than 80 representatives and experts from the scientific community, government, non-government organisations, local communities and other marine resource user groups gathered together and identified and mapped areas of global, national or local importance, according to their unique biological, geological or cultural attributes[26].

Five areas were considered to be globally significant, with a further 15 of national importance (mainly national fisheries areas) and 15 of sub-regional importance. These areas, 35 seascapes in total, represent those species, habitats and ecological communities that make the Fiji Islands Marine Ecoregion unique, and if managed appropriately, could contribute to maintaining the integrity of all Fiji's marine systems[26].

4 **Fiji Islands Marine Ecoregion**

After establishing the ecosystem values, what happened next?

The 2003 biodiversity workshop convened by WWF contributed a great deal to mapping biodiversity-rich areas and has already informed the development of a Marine Protected Area network. It has crucially also furthered the consolidation and expansion of knowledge and capacity building in Fiji for implementing effective marine conservation and sustainable resource management. The subsequent action plan verified priority areas, identified possible future Marine Protected Areas and closely involved stakeholders in implementation.

In April 2004 a "*Big Win*" idea, to accelerate conservation commitments and delivery, was developed by WWF Fiji. By early 2005 partners in the vision included Ministry of Fisheries officials, *i qoliqoli* owners from Macuata province, conservation NGOs (Wildlife Conservation Society, Wetlands International), FLMMA, and research and educational institutions like the University of the South Pacific[33].

[33] WWF FIME Team (2004) *Weaving a tapestry of protection and sustainability*. WWF South Pacific Programme Regional Office, Suva Fiji.
[34] Heaps, L. (2005b) *Fiji's Great Sea Reef: the hidden gem of the South Pacific*. WWF South Pacific Programme Office, Suva, Fiji

Naduri villagers honoured Isabelle Louis, Director of the WWF Asia-Pacific Programme, with a very rare traditional welcoming ceremony fit for a queen.

4

Fiji Islands Marine Ecoregion

Fiji is famous throughout the world for spectacularly rich and vibrant soft coral reefs. Fed by nutrient-rich currents, these soft coral gardens are havens and food sources for thousands of species of fish and invertebrates.

In December 2004, also as part of the *Big Win* plan, WWF, Wetlands International, the Wildlife Conservation Society, the University of South Pacific Institute of Applied Science, the local community members and international experts undertook a twelve day reef survey financed by the Vodafone Foundation Fiji. This was the first systematic effort to document the marine biodiversity of the Great Sea Reef, *Cakaulevu*. The survey involved visiting and studying 23 sites to assess threats to the reef and identify potential sites for further conservation action and revealed marine life of global, regional, national and local significance. Preliminary results brought to light unique mangrove island habitats, endemic fish species and some coral and fish species found outside their normal range[34]. WWF Fiji continues to work in partnership with the above organisations on the Macuata EBM project described below. This added to, and helped verify, the understanding of the values identified in the first visioning, mapping and scientific assessment exercise.

Fiji's Vatu-i-Ra Heritage Seascape Ecosystem-Based Approach Project

The coasts of Macuata province on Vanua Levu, the smaller of Fiji's main islands, are fringed by the Great Sea Reef. On learning that the Great Sea Reef was of global importance, Ratu Aisea Katonivere, the Paramount Chief of Macuata Province, together with representatives from 37 villages in five provincial districts, worked closely with WWF and FLMMA to develop ideas for protecting the reef system and managing its resources sustainably. Through working in partnership and through communication, shared understanding of the value of coupling sustainable management with marine conservation has grown and the many people in the communities of Macuata are supporting the implementation of a Marine Protected Area network in the customary fishing grounds: *Qoliqoli Cokovata i Macuata*[34].

The EBM project includes the development and management of a total of nine areas that have so far come under protection. Local traditional fishing ground

owners reported that the reef fishery was in decline, which is mirrored in national trends according to fish market surveys. The areas for protection were identified based upon local knowledge of fishing areas, local community needs and their ability to monitor them. The protected areas include spawning areas as well as mangrove islands where most reef fishes spend their juvenile lifecycle stages. The network of protected areas should afford species of importance to local communities some protection. Several major changes have already been implemented and communities are reporting that they are seeing benefits already. For example, some species like the endangered humphead wrasse (*Cheilinus undulates*) are returning to areas where they have not been seen for some years, and larger fish of other species are being observed closer to shore[34].

As an aid to securing more community buy-in to the process of implementing EBM in Macuata province, WWF Fiji has established a "Community Messaging Network" to narrow the information gap between project managers, stakeholders, the *qoliqoli* owners and settlers in this area of Macuata. The network engages the services of village head men to disseminate project information to each of the households in the 37 village communities relevant to the project and will enable information to be distributed, feedback to come in to project managers and monitoring to occur.

During August and September 2006 a detailed marine and freshwater survey of Macuata *qoliqoli* was undertaken. The protected areas will be reviewed once the analysis from socio-economic surveys, as well as the marine and freshwater scientific surveys are completed at a proposed workshop in March 2007. A more comprehensive set of scientific data is expected to be available for scrutiny by local communities and other stakeholders and should inform decision making about the final shape and size of the protected areas network in forest, freshwater and marine environments in Macuata province.

During October 2006, Financial Literacy Training was conducted in all 37 villages in the project area. The purpose of the training, jointly undertaken with the National Council of Small Micro-Enterprise Development, is to enable households to establish their earning and spending patterns and encourage savings against long-term financial targets that they work towards in the course of the EBM period. The basic premise is: if current earnings can be used efficiently, then additional income from sources introduced through EBM can be put to other planned uses, including contributing to further savings targets. Financial management skills acquired through this training are life skills, that, it is hoped, will impact positively in the long term on natural resource use through people taking only what is needed by means that reduce avoidable damage.

The next step in the process of making EBM operational is determining the major factors that influence the ecosystem's values. As we have seen through the visioning process conducted in December 2003, general impacts to marine ecosystems are known and priority areas were able to be identified for further action through the *Big Win* idea. The research work already underway could facilitate more understanding of the impacts of human activity, as well as provide further baseline information from which to monitor impacts of the EBM management strategies.

The political tensions and insecurity brought about by the December 2006 military coup will have unknown effects throughout Fiji. The coup could be a major destabilising influence on the economy and much of everyday life, drawing in all kinds of initiatives and projects that were underway under the former democratically elected government. The sensitivity of the new military regime to issues relating to ownership of *qoliqoli* and rights to fish is a matter of public record. Whether this impacts upon EBM-related work in Fiji, especially as it relates to the former government's declarations regarding *qoliqoli* and commitments to implement a representative network of Marine Protected Areas in 30% of Fiji's waters remains, to be seen.

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Kesaia Tabunakawai, WWF Fiji Country Programme Manager

North West Atlantic Marine Ecoregion – The Grand Banks

5

The Grand Banks is a distinct region within WWF's Northwest Atlantic Ecoregion (see map). Lying off the east coast of the Canadian Province of Newfoundland and Labrador, the Grand Banks region covers an area of over 450,000 square kilometres The convergence of the cold Labrador Current and the warm waters of the Gulf Stream produces harsh environmental conditions, including heavy fog, icebergs and severe storms. The mixing of these water masses and the upwelling of nutrient-rich water to the surface creates excellent conditions for plankton, a major food source for fish and other marine life.

EBM STEP 5 ~ DETERMINE THE MAJOR INFLUENCING FACTORS THAT COULD AFFECT ECOSYSTEM VALUES

The focus of this step is for stakeholders, partners and interested parties to identify hazards to marine ecosystems and their values from the full range of actual and potential human impacts that occur in the fisheries region. These might include:

- Effects of the removal of biomass of harvested species (in all fisheries) on trophically dependent species
- Extent of loss/damage of marine habitats
- Effects of specific fishing gear on benthic habitats
- Risk of marine pest invasion and disruption to critical habitat or fishing operations.

Source: Ward et al. (2002)[1]

The rich and productive ecosystem of the Grand Banks includes many fish species such as Atlantic cod, redfish, yellowtail flounder, and capelin. Invertebrates like American lobster, snow crab and northern shrimp are also abundant. Marine mammals include the endangered blue whale and North Atlantic right whale, while fin whales, humpback whales and harp seals are common. The Grand Banks ecosystem also supports a variety of seabirds, including the common murre and Leach's storm petrels.

Atlantic Canada supports approximately 2.3 million people. The Province of Newfoundland and Labrador, with its population of over 500,000, has been sustained largely by fishing for hundreds of years and most coastal communities continue to have close ties to the fishing industry. Fish harvested from the Grand Banks is exported to the United States, Europe and Asia. Countries like Spain, Portugal and France also have a long history of fishing the Grand Banks. Historically the area supported some of the world's most productive fisheries, but overfishing led to drastic declines in cod and other species and seriously altered the ecosystem that was once dominated by predatory groundfish. By 1995 all major cod fisheries and most flounder fisheries were closed and other species such as Greenland halibut (also known as turbot) and redfish had their catches severely restricted[35]. Against a backdrop of major population depletions of some species, invertebrates like snow crab and northern shrimp experienced record yields and became the new mainstays of Newfoundland fishing[36]. Some scientists refer to these profound changes as an ecological regime shift.

© Fisheries and Oceans Canada/Bedford Institute of Oceanography

Gorgonian coral with redfish (*Sebastes sp.*) in the Northwest Atlantic.

Fisheries management on the Grand Banks falls under both Canada's national jurisdiction and the international jurisdiction of the Northwest Atlantic Fisheries Organisation (NAFO). Many Grand Banks fish stocks, except sedentary species and salmon, either straddle or occur outside Canada's 200-nautical mile exclusive economic zone and are therefore managed by NAFO. A clear exception is tunas and swordfish, which are managed under the International Commission for the Conservation of Atlantic Tunas (ICCAT). There are thirteen Contracting Parties to the NAFO Convention, but Canada, Greenland, France (Saint-Pierre et Miquelon) and the United States are the only coastal states adjacent to its Regulatory Area.

There are 11 species, divided into 19 separate stocks, managed by NAFO. Many of these stocks have been severely overfished and nine are currently under moratoria but continue to be caught in significant amounts as bycatch in fisheries targeting other species. Most moratoria stocks are not rebuilding, the long-term health of other stocks is threatened and excessive bycatch mortality is considered to be a major impediment to stock recovery in the NAFO Regulatory Area[35, 37].

[35] Rosenberg, A., R.J. Trumble, J.M. Harrington, O. Martens, and M. Mooney-Seus (2006) *High Seas Reform: Actions to Reduce Bycatch and Implement Ecosystem-Based Management for the Northwest Atlantic Fisheries Organization*. Prepared for WWF-Canada by MRAG Americas, Inc., Tampa, Florida. 60pp

[36] Hamilton, L.C. and M.J. Butler (2001) Outport adaptations: social indicators through Newfoundland's cod crisis. *Human Ecology Review*: Vol.8, No.2. 11pp.

[37] Rosenberg, A., M. Mooney-Seus & C. Ninnes (2005) *Bycatch on the high seas: a review of the effectiveness of the Northwest Atlantic Fisheries Organization*. A report prepared for WWF-Canada by MRAG Americas, Inc., Tampa, Florida. 164pp

Step 5 in action ~ determining major factors affecting ecosystem values

The progression through the WWF framework for implementing ecosystem-based management (EBM) in marine capture fisheries is not necessarily a hierarchical or sequential one. Following each step can lead one through a process of identifying stakeholders and potential partners, delineating the boundaries of the fisheries to which EBM will be applied and establishing ecosystem values through stakeholder consensus. Our case studies on steps 1 to 4 have highlighted examples where these activities have been, more or less, undertaken. While the concept of EBM is said by Ward et al. (2002) to be hierarchical, the operational activity itself need only be embedded within overarching EBM principles, and not necessarily singular or applied in a stepwise fashion[38]. The steps ought to be adapted to each situation as appropriate and one kind of activity may meet several operational EBM needs. This case study demonstrates how WWF-Canada approached the process of determining the major influencing factors affecting the ecosystem values in the Grand Banks region, as well as successfully implemented a significant number of other elements set out in the EBM framework.

WWF-Canada systematically assessed the available literature and data on threats to biodiversity and the status of key species in the Grand Banks region, including fishes, marine mammals, turtles and seabirds. The exercise revealed that fishing practices represent the primary threat to biodiversity in the region. Cod stood out as a high profile commercial species that was severely depleted and showing no signs of recovery. Cold-water corals were also identified as a key species group because of their sensitivity to bottom fishing. It was also found that seabirds were under considerable threat from ship source oil pollution on the Grand Banks.

After the initial assessment, WWF-Canada hosted a series of expert workshops and many bilateral consultations with government, the fishing industry and academics, with the aim of better understanding the major conservation issues and discussing solutions. Relationships were established with many key Canadian players and efforts were made to reach out to European stakeholders. Through this process initial conclusions about the major influencing factors affecting the ecosystem values, and potential solutions, in the Grand Banks region were tested and refined.

During the consultation period it became clear that the ineffectiveness of NAFO was an issue that would have to be addressed if fish stocks were to recover and an ecosystem-based approach to management was to be adopted. To further explore the problems with NAFO,

WWF-Canada commissioned the report *Bycatch on the High Seas: A Review of the Effectiveness of the Northwest Atlantic Fisheries Organization*[37]. This technical report identified the major issues facing NAFO as:

- Bycatch of moratoria stocks
- Bycatch of non-commercial species
- Degradation of critical habitat
- Ecosystem changes from fishing
- Fisheries on juveniles
- Illegal, Unregulated, and Unreported (IUU) fishing
- Ineffective monitoring and enforcement
- Lack of compliance with management measures
- Overfishing of unmanaged and newly managed stocks
- Setting Total Allowable Catches (TACs) above scientific advice and exceeding TACs.

[38] Ward, T., D. Tarte, E. Hergl and K. Short (2002) *Policy proposals and operational guidance for ecosystem-based management in marine capture fisheries*. WWF-Australia, Sydney. 80pp.

5 North West Atlantic Marine Ecoregion – The Grand Banks

Following the release of the report, four projects became the focus of WWF-Canada's work on the Grand Banks because together it is believed that these are the most strategic and opportune approaches to influence major players, secure conservation outcomes and progress toward ecosystem-based management. The four projects are: *Reducing Cod Bycatch* which aims to reduce bycatch of cod in a 100,000 square kilometre area of the southern Grand Banks which straddles the Canadian Exclusive Economic Zone (EEZ); *Reducing Cold-Water Coral Bycatch* which aims to protect coral hotspots in the broader Grand Banks region; *Habitat Protection on the Grand Banks* which is about establishing a network of Marine Protected Areas in the region; and *Sustainable Seafood*, an emerging project that will focus on market driven solutions to fishing problems on the Grand Banks. This case study focuses on WWF-Canada's efforts on cod recovery and coral protection.

Reducing cod bycatch

Bycatch of southern Grand Banks cod in other fisheries is the major impediment to the recovery of this stock. Canadian, Spanish, Portuguese and Russian vessels targeting yellowtail flounder, redfish, Greenland halibut, white hake and skates are responsible for most of this bycatch. Current NAFO rules allow for significant bycatch from this severely depleted cod population. Despite a moratorium on targeting cod, it is estimated that as much as 5,400 tonnes – nearly 80% of the southern Grand Banks population – was taken as bycatch in 2003[37]. In some cases, so-called bycatch makes up to 80% of some vessels' landed catch, leading WWF campaigners and other stakeholders to conclude that massive abuse of the bycatch rules must be occurring with operators purposefully fishing in areas where bycatch is likely to occur. Scientists and stakeholders have concluded that this bycatch is the major obstacle to recovery of cod stocks on the southern Grand Banks.

The principal objective of WWF's bycatch reduction project is *to reduce cod bycatch on the southern Grand Banks by 80% of 2003 levels by 2007*. To identify solutions to the bycatch problem, WWF-Canada commissioned independent scientists to produce the report *High Seas Reform: Actions to Reduce Bycatch and Implement Ecosystem-Based Management for the Northwest Atlantic Fisheries Organization*[35]. The report identified a suite of management measures needed to address cod bycatch and move toward EBM, providing the scientific basis for WWF-Canada's conservation work in the NAFO Regulatory Area. In September 2006, WWF-Canada became the first environmental NGO to be granted observer status for a NAFO Fisheries Commission meeting. This achievement provided WWF-Canada with an opportunity to strengthen relations with

NAFO decision-makers and engage them on the need to reduce cod bycatch and implement EBM.

Protecting cold-water corals

Coral forests along the slopes of the Grand Banks can take hundreds of years to form and are sensitive to disturbance. Research indicates they serve as important habitat for other species such as redfish. The major threat to cold-water corals in the Grand Banks region is damage and bycatch from bottom fishing operations. Recent research suggests that coral bycatch in Newfoundland and Labrador waters is highest in the Greenland halibut fishery[39].

The primary goal of WWF's coral project is to *protect priority coral "hotspots" from bycatch in the Northwest Atlantic Ecoregion*. A similar approach to that of the cod project was implemented for WWF-Canada's cold-water corals work. Building the conservation case in the broader Northwest Atlantic Ecoregion was a priority and aided by working closely with academics, other environmental NGOs, government officials and the fishing industry. These efforts culminated with the commissioning of a report that presented all available information on corals in the broader ecoregion and the development of an associated conservation strategy. In 2003, WWF-Canada published *Conservation of deep-sea corals in the Atlantic*.[40]

This work contributed to the establishment by the Canadian Department of Fisheries and Oceans (DFO) of several coral-specific protected areas in the Scotian Shelf region of the Northwest Atlantic Ecoregion (see map) and enabled a subsequent shift of focus to the Grand Banks region where WWF-Canada helped fund scientific reporting of coral distribution[39]. The results of this work have been promoted with DFO and the NAFO Scientific Council. Finally, a working group involving DFO, WWF and others was recently formed with the aim of developing a conservation strategy for cold-water corals on the Grand Banks for presentation to NAFO at its 2007 annual meeting.

Taking an EBM approach

Tackling these critical issues requires a change of approach within NAFO, and the governments of the Contracting Parties and coastal states. A single species management approach is not delivering the desired stock recovery outcomes, nor is it protecting other valued parts of the Grand Banks ecosystem, such as cold-water corals. While focusing attention on a single species, i.e., cod, may seem at odds with an ecosystem-based approach, cod is an iconic spe-

[39] Edinger, E, K. Baker, R. Devillers and V. Wareham (In prep.) *Deep-sea coral distribution and bycatch from commercial fisheries off Newfoundland and Labrador*. Prepared for WWF-Canada. Halifax, Nova Scotia. 24pp.
[40] Gass, S.E. (2003) *Conservation of deep-sea corals in the Atlantic*. WWF-Canada. Halifax, Nova Scotia.

5

North West Atlantic Marine Ecoregion – The Grand Banks

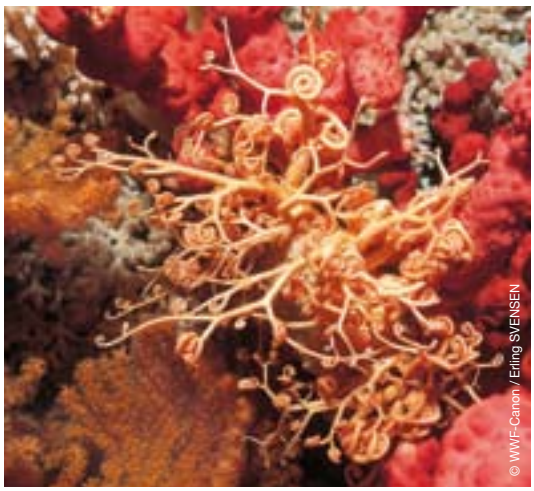
cies that has been severely depleted, once a dominant predator in the ecosystem, now a symbol of overfishing and fisheries management failure. WWF believes cod could serve as an indicator of ecosystem recovery, while cold-water corals are sensitive, under threat and could also serve as indicators of deep-sea ecosystem health. The successful recovery of cod and protection of corals will require non-traditional approaches to fisheries management, such as the use of spatial closures, which are consistent with EBM. Thus, focusing on cod and corals will open the door for a more comprehensive EBM regime on the Grand Banks.

Working closely with DFO, through a signed formal collaborative agreement, WWF-Canada is contribution to cod recovery planning and coral conservation strategies. WWF is also working with academics at the Memorial University of Newfoundland on mapping coral distribution. Strong relationships have developed between WWF and the NAFO Scientific Council, emerging through WWF's attendance at council meetings and consultations around key issues. Similarly, a good working relationship has been forged with the Fishermen's Union in Newfoundland and other key representatives of the Canadian fishing industry with whom cod recovery and coral protection are being discussed.

An important milestone in the quest for a more ecosystem-based approach to managing marine capture fisheries in the Grand Banks region, and in response to pressure, came in September 2005, when NAFO committed to implement an ecosystem approach to fisheries management (as distinct from an EBM approach which involves spatial management in a broader context than just fisheries) as part of an overall reform process. WWF has subsequently been focussing its efforts on influencing the reform process by presenting a practical framework in the commissioned report *High Seas Reform: Actions to Reduce Bycatch and Implement Ecosystem-based Management for the Northwest Atlantic Fisheries Organization*[35], recommending four areas of management measures:

- Preventing or reversing overfishing
- Minimising bycatch
- Identifying and protecting essential habitat
- Maintaining species diversity and key ecological interactions.

The report provides the scientific basis for taking an ecosystem-based approach in the NAFO Regulatory Area, includes a detailed case study of the southern Grand Banks cod situation and highlights the need to protect cold-water corals from detrimental impacts



from bottom trawling. It is being used as a basis for discussions with NAFO Contracting Parties including Canada and the European Union, as well as the NAFO Scientific Council, about how bycatch of cod might be reduced, cold-water corals protected and an ecosystem approach may be implemented.

There is a steady paradigm shift occurring in oceans management both globally and within the Northwest Atlantic. EBM is seen by many stakeholders as the approach that will enable fisheries management, conservation and recovery objectives to be met. The transition to a comprehensive EBM approach may take time and not be realised in the ecoregion for another five or more years, so in the meantime individual and immediate conservation priorities, such as cod bycatch reduction and protection of cold-water corals, will continue to be the focus.

Several steps of the EBM framework guidelines of Ward et al. (2002)[38] have been successfully implemented in the Grand Banks work presented in this case study. Key stakeholders have been identified and involved in processes relating to the Grand Banks work led by WWF. Available habitat and species data has been gathered and preliminary maps for key ecosystem values have been produced. A subset of ecosystem values has been selected and objectives and targets for the work on those values have been determined. The vision is that these actions will result in the recovery and maintenance of ecosystem health, which in turn should ultimately help ensure the long term sustainability of commercial fish stocks.

Acknowledgements

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Dr. Robert Rangeley, Vice President, Atlantic Region, WWF-Canada

Benguela Current Marine Ecoregion

6

EBM STEP 6 ~ CONDUCT AN ECOLOGICAL RISK ASSESSMENT

The focus of this step is for stakeholders, partners and interested parties to identify and agree estimates of high, medium and low risks of the fishery [fisheries] to the ecosystem. These might include risks to protected species, habitats, species and genetic diversity. The process should involve:

- The use of a broad multi-disciplinary knowledge base
- Identifying key areas of uncertainty
- Being open for public scrutiny and review
- Being peer reviewed by independent authorities.

Source: Ward et al. (2002)[1]

The Benguela Current Marine Ecoregion in the southern Atlantic Ocean extends from the high water mark to the edge of the exclusive economic zones off the west coast of South Africa, northwards along the entire Namibian coast to northern Angola. This large marine ecosystem is the strongest wind-driven upwelling system known, and is unique because its cold waters are bounded by the warm equatorial waters of the Eastern Atlantic Current in the north, and in the south by the warm Agulhas Current from the Indian Ocean (see map).

While the ecoregion is said to be relatively low in marine biodiversity, it is considered one of the most highly productive in the world[41]. Its intense coastal upwellings drive the production of plankton which in turn support rich biomasses of pelagic and demersal fish, crustaceans, marine mammals and seabirds. The system itself is characterised by its complexity and high variability, with the primary driving force in the ecoregion being climate. Intensive fishing is considered to be the second major driving force affecting the system[42].

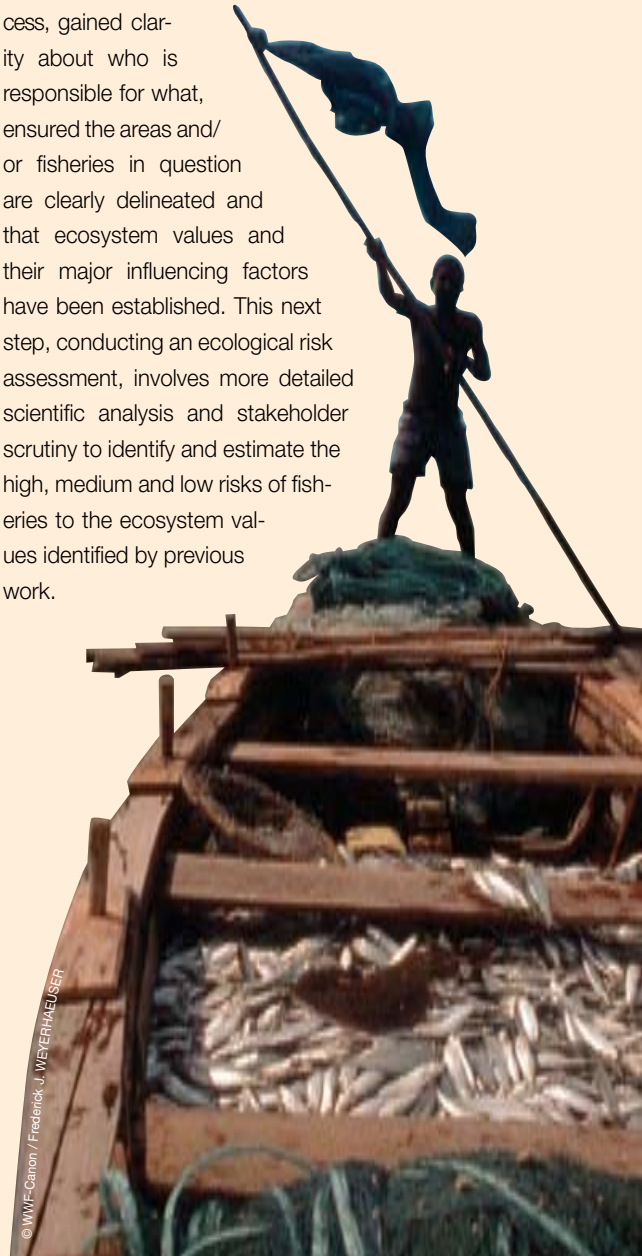
The principal fisheries, which sometimes yield over 1 million tonnes per annum, target hakes and haddocks, horse mackerel, tuna, small pelagics such as anchovy and sardine, rock lobster and in the north, shrimp[41,43]. Some of these species move seasonally within the ecoregion, crossing national boundaries and therefore presenting challenges for integrated management of straddling stocks. As the ecosystem is highly variable, stock status and yields are difficult to predict[42]. There are stark differences in the scale of fishing activities within the ecoregion, from artisanal, small-scale fishing in the north in Angola, through to the sophisticated, highly mechanised modern fleets operating out of South Africa and Namibia.

Approximately 57 million people live in the three neighbouring coastal states. Apart from commercial and artisanal fishing, other major economic activities affecting the ecosystem include coastal and offshore oil and gas exploration and extraction, as well as marine diamond mining. Coastal and urban development present additional challenges. Nature-based tourism focusing on whales, dolphins, sharks and seabirds is becoming an increasingly valuable economic activity within the ecoregion[42].

Since the establishment of the Benguela Current Large Marine Ecosystem (BCLME) Programme in 1995 (see box overleaf), governmental management and research agencies, environmental NGOs and fishing industry organisations have collaborated on over 75 projects (~ $US 10 million) to improve knowledge and management of marine resources in the ecosystem[43].

Step 6 in action ~ conduct an ecological risk assessment

Ideally, prior action leading to this point in the process of making ecosystem-based management (EBM) operational will have made sure the right stakeholders are engaged in the process, gained clarity about who is responsible for what, ensured the areas and/or fisheries in question are clearly delineated and that ecosystem values and their major influencing factors have been established. This next step, conducting an ecological risk assessment, involves more detailed scientific analysis and stakeholder scrutiny to identify and estimate the high, medium and low risks of fisheries to the ecosystem values identified by previous work.



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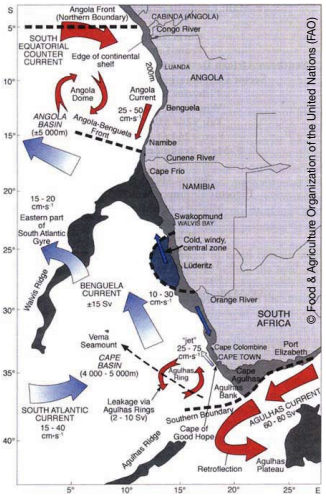
[41] UN Atlas of the Oceans – www.oceansatlas.org – maintained by NOAA LME Program Office
[42] http://na.nefsc.noaa.gov/lme/text/lme29.htm#economic – maintained by NOAA LME Program Office
[43] Attwood, C. and M. O'Toole (2006) *A coldwater lifeline*. African Geographic, August 2006: 47-53.

6

Benguela Current Marine Ecoregion

The complexity and variability of the Benguela Current Marine Ecoregion lend particular challenges to assessing the ecological risks within the ecosystem. Research and monitoring has shown that in the last 50 years significant changes have occurred in the ecosystem and scientists are beginning to talk about a 'regime shift' occurring, with tentative suggestions that large-scale environmental change may be associated with global climate change[43]. Along with pronounced warming trends in certain areas of the ecosystem, there appear to be eastward shifts in distribution and abundance of some fish and bird species[43]. Coupled with intensive fishing activity, the consequences of these recorded ecosystem changes for sustaining large scale fisheries could be serious.

The Benguela Current Large Marine Ecosystem (BCLME)



Printed in *Management Of Shared Hake Stocks In The Benguela Marine Ecosystem*. Rashid Ussif Sumaila, Chris Ninnes and Burger Oelofsen.

Under the BCLME Programme, a specific EAF project, jointly contracted to the Food and Agriculture Organization and Marine and Coastal Management (MCM) in South Africa, with the FAO being the project's international coordinators, aims to investigate the feasibility of EAF management in the BCLME region. (Source: www.bclme.org LMR/EAF/03/01,GEF (2005) Independent Mid Term Evaluation of the Project: Integrated Management of the Benguela Current Large Marine Ecosystem (BCLME). Project No.RAF/00/G32/A/1G/31. By Evaluators D.H. Vousden and M. Ngoile.)

Within this EAF project, a dedicated regional EAF Working Group was established in 2004 for Southern Africa. This group included members of a previously established South African EAF Working Group set up by the Marine and Coastal Management branch of the Department of Environmental Affairs and Tourism who were tasked with coordinating the implementation of EAF in South African fisheries[44].

WWF focuses its work in two priority marine ecoregions in southern Africa: the Benguela and Agulhas Current Marine Ecoregions. WWF actively supports the BCLME programme which drew on the ecological risk assessment process developed in Australia[45], renaming it Risk Assessment for Sustainable Fisheries (RASF), to facilitate six workshops on behalf of the regional EAF Working Group. These were attended by researchers, industry organisations, environmental NGOs and other interested parties to identify and prioritise issues and ecosystem effects in major southern African fisheries, including, but not limited to the South African Cape hake fishery, small pelagic purse seine fisheries, and the west coast rock lobster fishery[44,46]. The modified Australian process was also used as a means to reconcile stakeholder perceptions and needs in relation to ecological, socio-economic and management aspects of Benguelan fisheries[44].

The process involved discussions between stakeholders to reach a general consensus about the problems or issues confronting each fishery, assigning them a priority and proposing ways the issues could be addressed in an EAF context. In order to identify and prioritise risks, a scoring and categorisation system was

THE BENGUELA CURRENT LARGE MARINE ECOSYSTEM PROGRAMME…

… is a joint initiative by the governments of Angola, Namibia and South Africa to "manage and utilise the resources of the Benguela Current Large Marine Ecosystem in a sustainable and integrated manner".
The programme is funded by the Global Environment Facility and implemented by the United Nations Development Programme, with the three member countries providing in-kind and financial contributions. Its purpose is to address transboundary problems in three key areas of activity:

- the sustainable management and use of living resources
- the assessment of environmental variability, ecosystem impacts and improvement of predictability
- the maintenance of ecosystem health and management of pollution.

The Benguela Current Commission was formally established in 2006 (pending signatures by the Angolan government) to take a wider EBM approach that marks a departure from traditional fisheries management, and lay the foundations for a long term collaborative management system.

Source: www.bclme.org

[44] Shannon, L.J., P.M. Cury, D. Nel, C.D. van der Lingen, R.W. Leslie, S.L. Brouwer, A.C. Cockcroft, and L. Hutchings (2006) How can science contribute to an ecosystem approach to pelagic, demersal and rock lobster fisheries in South Africa? *African Journal of Marine Science* Vol. 28, No. 1: 115-157

[45] Fletcher, W.J. (2005) The application of qualitative risk assessment methodology to prioritize issues for fisheries management. *ICES Journal of Marine Science* 62: 1576-1587.

[46] Tingley, G, J. Powers, D. Japp, and A. Hough (2006) *Surveillance report for the South African hake fishery, May 2006*. Moody Marine Ltd. 18pp.

applied. Scores were allocated to two components: 1) the likelihood of a negative outcome and 2) the severity of effects of a potential negative outcome, and then these two scores were multiplied to arrive at a single risk score. Issues were then categorised as either 'extreme', 'high', 'moderate' or 'low' risk based upon the combined score[44]. Three examples are selected to highlight the outcomes of the ecological risk assessment process, involving three distinct fishery types (small pelagics, hake and lobster) and three separate issues (predator-prey relationships involving the target species, gear impacts on habitat and long-term environmental change).

Selected outcomes ~ small pelagics

Sardines (*Sardinops sagax*) have been targeted in South Africa since the 1940s, with catches peaking in the 1960s and stocks collapsing after that due, it is thought, to overfishing. To compensate for reduced catches there was a shift to targeting anchovy (*Engraulis encrasicolus*) but rebuilding strategies mean that since the mid-1990s catches of the two species are now almost equal[44]. Most anchovy are reduced to fish meal and fish oil, while some sardines are canned and frozen for human consumption. The average annual landed value of small pelagics between 2001 and 2004 was about 82 million Euros[44]. The following table is a single selection taken from the published journal article reporting the outcomes of the RASF process described in *How can science contribute to an ecosystem approach to pelagic, demersal and rock lobster fisheries in South Africa?*[44] It shows the logical assessment used to address one example of an issue in the "extreme risk category".

The issue	Indicators	Research approaches	Technical management	Implementation
Impacts of removal of forage fish on species bound to breeding sites on land (i.e. seabirds)	Bird population sizes; breeding success (fledgling weight, fledglings raised per breeding pair, breeding proportion; seabird diet composition; spatial indicators (e.g. overlap of seabird foraging and pelagic fisheries)	Routine monitoring of seabird colonies; satellite tracking to assess foraging ranges; minimum realistic models; spatial models of pelagic fish around seabird colonies Quantify and formalise the link between the pelagic fishery and seabirds; quantify functional responses of seabirds to small pelagic prey and identify thresholds below which there are serious negative implications for seabirds	Avoid populations falling below levels that exceed limit reference points according to IUCN conservation criteria by reducing Total Allowable Catches (TACs) or closing areas within foraging ranges; allow sufficient escapement of forage fish for predators; avoid threshold levels of pelagic fish below which the implications for seabirds are detrimental	Good potential for implementation of management response / ability to manage

The Benguela Current is a highly productive upwelling system that supports millions of predators, such as these Cape gannets (*Morus capensis*) feeding on small pelagic fish.

Several species of albatross and petrel are killed in longline fishing operations in the Benguela Current Ecoregion.

Selected outcomes ~ hake demersal fishery

South Africa's Cape hake trawl fishery started as far back as 1899. Technological advances after the second world war through to the 1960s resulted in significant increases in landings and the need for rebuilding strategies following the declaration of South Africa's Exclusive Economic Zone (EEZ) in the late 1970s. The fishery's value in 2002 was approximately 195 million Euros, meaning the hake fishery is South Africa's single most valuable fishery, accounting for almost half the wealth generated by fisheries resources in South Africa[44]. As with the selection above, this case study highlights a single example from the published literature, this time a marginally lower level of risk, i.e., the "high risk category" [44].

The issue	Indicators	Research approaches	Technical management	Implementation
Physical impact of trawls on benthic biota and habitat	Species composition and diversity in Marine Protected Areas (MPAs) compared with trawl areas	Incorporate available data into Geographical Information Systems (GIS) **Future**: identify recovered or minimally damaged areas to create MPAs for use as reference site. Map habitat type data and systematic benthic distributions, comparative studies of areas subjected to range of trawling pressure	Retain regulations banning the use of destructive heavy bobbin trawl gear Encourage the implementation of future technological advances in less destructive trawl gear Aim for World Summit on Sustainable Development (WSSD) target of protecting 20% of representative habitat (also offshore) **Currently no offshore grounds formally protected**	Good potential for implementation of management response / ability to manage

Selected outcomes ~ West Coast rock lobster fishery

Taken in both commercial and recreational fisheries in South Africa, West Coast rock lobster (*Jasus lalandii*) is fished in shallow water with hoop nets and in deeper water with traps. Commercial fishing began in the late 19th century and is now worth more than 32.5 million Euros a year[44]. An example of a "high risk category" outcome of the RASF process from the published literature is highlighted.

The issue	Indicators	Research approaches	Technical management	Implementation
Fisheries and management implications of southward and eastward shifts in lobster distribution (caused by long-term climate change)	Measures of abundance per area, within accepted statistical threshold (abundance, growth, size-structure, sex structure); catch per unit of effort (cpue)	Continue annual offshore and inshore Fishery Independent Monitoring Survey (FIMS); continue monitoring of commercial catches **Future**: investigate factors and mechanisms causing distributional shift in lobster	Marine Protected Areas (MPAs) are in place and efficacy has been evaluated; re-evaluate the MPAs and possibly reposition if necessary Assess feasibility of moving to a spatially disaggregated model for the optimal parameter values	Fair potential for implementation of management response / ability to manage

Assessing & reducing the impacts of fishing on vulnerable species

The next steps in the EBM framework involve establishing objectives and targets (Step 7), and then strategies to achieve the targets (Step 8), in order to deal with the prioritised risks that emerge from the ERA process. One of the principal objectives of WWF-South Africa's marine programme is to assist in the implementation of an ecosystem-based approach to fisheries management in South Africa. A key target in meeting this objective is to reduce negative impacts of fishing to acceptable levels by 2012.

To aid pursuit of the challenging target, the BCLME Programme has funded an operational project initiated by WWF-South Africa and partners BirdLife South Africa, Ministry of Fisheries and Marine Resources (Namibia) and Instituto de Desenvilvimento da Pesca Artesanal (Angola). The project is aimed at understanding the nature and scale of longline fisheries bycatch of seabirds, sharks and marine turtles in the ecosystem. The productive waters of the ecosystem are an important foraging area for 13 species of seabirds that are killed in significant numbers by longline fisheries. Eleven of these species are threatened with extinction, (according to IUCN criteria; BirdLife International 2000), mostly due the effects of longline and trawl fishing. Furthermore, 36 threatened shark species and five marine turtle species are also potentially killed in longline-fishing operations in this area. The project has been implemented in South Africa, Namibia and Angola and focuses on increasing the understanding of the nature and scale of impacts; raising awareness of the conservation issues; training and capacity building; demonstration trials and testing of known mitigation measures and gear modifications; and increasing the engagement of the fishing industry in dealing with this issue.

Another related project, funded by the International Association of Antarctic Tour Operators, and implemented by the WWF & BirdLife Responsible Fisheries Programme, is aimed at understanding the threats from midwater trawl fishing to seabirds, dolphins and marine turtles in southern African waters. While South Africa's demersal trawl fishery for hake is its largest and most valuable fishery, South Africa and Namibia also support a substantial mid-water trawl fishery for horse mackerel.

Midwater trawls are of particular concern because their higher trawl speeds have the potential to snare birds in the trawl nets when they are at the surface. Midwater trawlers also have a high potential bycatch of other non-fish species such as dolphins and marine turtles. This project builds on the regional linkages and expertise on the bycatch of non-fish species that have developed within southern Africa.

Achievements so far and lessons learned along the way

Research into the fishing impacts on vulnerable species has thus far resulted in the assessment of the pelagic and demersal longline fleets in both South Africa and Namibia, as well as the demersal and midwater trawl fleets in South Africa[47,48]. Mitigation trials have been conducted in both longline and trawl fisheries and changes to demersal and pelagic longline and trawl fishery regulations are beginning to be implemented. These include the use of bird-scaring lines and the distribution of 43 bird scaring lines to fishing operators so far.

Eight multi-stakeholder workshops have been conducted throughout South Africa and Namibia for fishing operators in the demersal and pelagic longline and demersal trawl fisheries.

A total of 89 on-board observers have been trained in South Africa, and five courses for fisheries compliance officers trained 55 people on existing and new management measures, especially those relating to ecosystem-based management.

The benefits of taking an ecosystem-based approach to manage fisheries is becoming clear to many stakeholders in southern Africa. Long-term sustainability of fisheries, access to fishing rights and access to discerning markets are among the benefits that can be realised by responsible fishing operators in fisheries in the southern Africa region. The players are also realising that education and communication are vitally important, being key elements in whether an EBM approach will succeed or fail. Each link in the chain is critical and working with industry, environmental NGOs, fisheries compliance staff, researchers and government managers can lead to successful outcomes. This highlights both the benefit and absolute need to build multi-stakeholder, multi-sector relationships in order to achieve the challenging goal of moving from single-species management approaches to implementing an ecosystem-based approach to marine capture fisheries in the Benguela Current Large Marine Ecosystem.

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MARINE STEWARDSHIP COUNCIL CERTIFICATION ~ HAKES (*MERLUCCIUS SPP*)

The South African hake trawl fishery was first certified in 2004 as meeting the environmental standard set by the Marine Stewardship Council's *Principles and Criteria for Sustainable Fishing*. According to the second annual surveillance audit report in 2006, a requirement for continued certification, the fishery continues to meet the MSC standard and is making progress on a number of important ecosystem related fronts[46]. This includes the funding by the South African Deep-Sea Trawling Industry Association, through BirdLife International, of a research programme to investigate the magnitude and mitigation of seabird, trawl gear interactions, particularly in hake directed trawling. This proactive approach by the industry association, in collaboration with a prominent environmental NGO, has been commended by the independent certification body, Moody Marine Ltd, which certifies the fishery against the MSC standard and ensures it continues to meet requirements.

[47] Voges, L. (2005) *Bycatch of threatened seabirds, sharks and turtles in longline fisheries in the Benguela large marine ecosystem (BCLME): an integrated approach . Initial assessment report of the longline fishery and potential bycatch of seabirds, sharks and turtles for Namibia*. BCLME Report 48pp.

[48] Petersen, S. and S. Kirkman (2005) *Initial bycatch assessment: demersal longline fishery, July 2000-November 2004*. Seabird Conservation Programme, BirdLife South Africa, Percy Fitzpatrick Institute, University of Cape Town, South Africa. 30pp.

Heard & McDonald Islands, Kerguelen & Crozet Islands, the Prince Edward Islands and CCAMLR

7

EBM STEP 7 ~ ESTABLISH OBJECTIVES AND TARGETS

Step 7 focuses on stakeholders, partners and interested parties agreeing to comprehensive and precautionary goals for specific elements of ecosystems, as well as performance objectives and targets for important elements of ecosystems. They could include:

- Maintaining or recovering populations sizes of protected species
- Maintaining the distribution, area, species diversity and trophic structure of important habitats
- Reducing fishing effort in specific areas to help protect populations of benthic fauna
- Increasing the distribution and diversity of benthic fauna considered to be affected by fishing
- Rehabilitating marine ecosystems to a past (healthier) condition.

Source: Ward et al. (2002)[1]

Located in the sub-Antarctic region of the southernmost reaches of the Indian Ocean are the remote island groupings known as Heard and McDonald, Prince Edward, Crozet, and Kerguelen (see map overleaf). Although separated by thousands of kilometres, these islands share similarly extreme ocean and weather conditions. The cold, inhospitable climate dominates, with sea-fogs, strong winds and violent storms generating very rough seas. Each island grouping and surrounding waters are buffeted and influenced to varying degrees by the Antarctic polar fronts, circumpolar currents and convergences where the nearly freezing polar waters of the Southern Ocean meet the cold, temperate waters of the Indian Ocean. These oceanographic confluence zones support abundant marine life, with the waters around each island being home to species that live nowhere else on the planet.

Heard and McDonald Islands are the sovereign territory of Australia. The Kerguelen Islands, an archipelago of over 300 islands, are the sovereign territory of France. Separated by approximately 500 kilometres, these islands are the surface extensions of the once volcanic Kerguelen Plateau – a 2,300 kilometre long, underwater geological formation.

The Crozet Islands, also the sovereign territory of France, are nearly 2,000 kilometres west of the Kerguelen Plateau. The Prince Edward Islands, the largest being Marion Island, are the sovereign territory of South Africa and are another 900 kilometres or so further west of the Kerguelen Plateau, in the middle of an oceanic area with several distinct habitats: the Southwest Indian Ridge, a plateau area with seamounts and rises; and an abyssal area[49].

The islands and their waters have been visited and their resources exploited by humans over the last 200 or more years. Some species of seals and whales were hunted almost to the point of extinction, probably altering the diversity of those marine ecosystems on a long-term basis[50]. The main species now harvested are finfish such as toothfish, mackerel icefish and rockcod. The serial decline of whale populations by the 1960s and 1970s led, in part, to the transfer of distant-water fishing effort mainly by fleets from the former Soviet Union and Japan, but also from Chile, Poland and Korea, to finfish and krill found in Antarctic and sub-Antarctic waters[51]. Rapid expansion of longline fishing for Patagonian toothfish occurred around the Kerguelen Islands, then later Heard and Prince Edward Islands from the late 1980s[51]. Concern mounted about overfishing, especially that caused by Illegal, Unregulated and Unreported (IUU) fishing and the associated impacts on other fish populations, seabirds and marine mammals. Climate change, marine debris and pollution are also considered to be significant threats to these marine ecosystems.

While the islands and their Exclusive Economic Zones (EEZs) fall under the sovereign jurisdiction of coastal states, their relative positions mean they are inside the areas managed under the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The Convention, part of the Antarctic Treaty System, entered into force in 1982 and was the first international fisheries management regime to have conservation of ecosystems as one of its primary objectives[51]. The objectives are codified in Article II of the Convention and include not only conservation, but managing the 'rational use' of resources within an area defined to follow the approximate boundary of the Antarctic Polar Front[51]. The CCAMLR management approach aspires to balance conservation with harvesting, to maintain ecological relationships between harvested, dependent and related species, and to avoid changes

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[49] Lombard, A.T, B. Reyers, L.Y. Schonegevel, J. Cooper, L.B. Smith-Adao, D.C. Nel, P.W. Froneman, I.J. Ansorge, M.N. Bester, C.A. Tosh, T. Strauss, T. Akkers, O. Gon, R.W. Leslie and S.L. Chown (in press 2006) Conserving pattern and process in the Southern Ocean: designing a Marine Protected Area for the Prince Edward Islands. *Antarctic Science*. 45pp.
[50] WWF (2003) *Heard and McDonald Islands Marine Reserve*. Gift to the Earth #90, 19 August 2003. WWF International. 2pp.
[51] Agnew, D.J. (2004) *Fishing South*. Government of South Georgia and South Sandwich Islands. The Penna Press. 127pp.

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in the marine ecosystem that are irreversible in 20-30 years. Using an ecosystem-based approach, CCAMLR applies precautionary limits and considers uncertainties in its decision rules and management processes for exploited species.

Step 7 in action ~ establishing objectives and targets

The previous ecosystem-based management (EBM) case studies have described a series of steps where, having identified the stakeholders, engaged with partners, gathered together the best available scientific information and agreed upon ecosystem values, as well as risks of particular activities, it is necessary to establish appropriate objectives and/or targets to guide the choice of management strategies to be implemented.

This case study briefly describes efforts by WWF and relevant fishing industry interests, different government agencies, researchers and other stakeholders to secure declaration of Marine Protected Areas in the waters of these remote sub-Antarctic island groups.

A commonly understood and agreed major threat to Patagonian toothfish stocks, seabird populations and other species in all the case study areas from the late 1980s has been IUU fishing. Each nation, aided at times by legitimate fishing operators, battled against the IUU scourge, sometimes collaboratively, sometimes alone, with varying degrees of success. Meanwhile, during the late 1990s and early 2000s, the policies of Australia, France and South Africa helped to influence, or began aligning with, international treaty statements which translate into measurable targets. Some relatively recent and high profile international government statements about Marine Protected Areas as a management tool include the 2002 World Summit on Sustainable Development (WSSD) and 2004 World Parks Congress which effectively set government targets to protect 20-30% of marine habitats under their jurisdiction by 2012[49].

More recently, the parties to CCAMLR have begun to formally discuss how to reconcile CCAMLR's stated objectives of conservation and management in a bioregional context consistent with its EBM approach. Another groundswell of national and international policy alignment is the growing desire to move away from managing fisheries by single species approaches, as well as evolve spatial management approaches from being driven by a purely species-led paradigm, i.e., the emerging thinking about EBM.

Consistent with stakeholders' interests and government obligations to protect marine biodiversity and sustainably manage marine resources of the southern oceans, four separate but related WWF initiatives coalesce around an overarching objective to develop a system of Marine Protected Areas within the southern oceans, specifically in the area managed under the international convention CCAMLR.

Heard and McDonald Islands, Australia (HIMI)

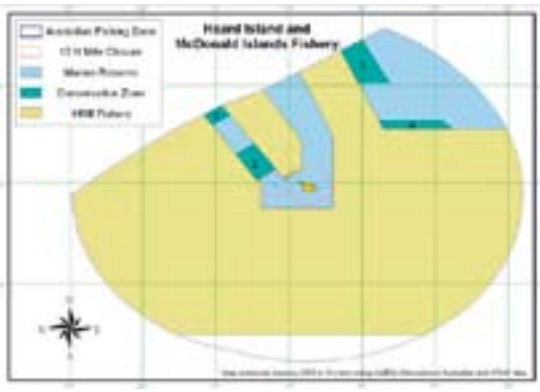
In 1998 *Australia's Oceans Policy* set forth a renewed commitment by Australia's Federal government to accelerate the declaration of Marine Protected Areas in HIMI waters within a programme targeted at developing a "National Representative System of Marine Protected Areas"[52].

The journey towards declaring the HIMI Marine Protected Area gained momentum from informal discussions between Australian fishing industry representatives who had rights to fish in the HIMI area, WWF-Australia, the then Environment Australia and the Australian Fisheries Management Authority (AFMA). With many players in government and non-government spheres (including industry) aligned in a common desire to move forward, this evolved into a formal round table collaboration between the industry, fisheries managers from AFMA, scientists from the Commonwealth Scientific & Industrial Research Organisation (CSIRO) and Australian Antarctic Division (AAD), officers of various government departments including those concerned with foreign affairs, environment and conservation, international fisheries policy and other environmental NGO stakeholders.

WWF was a catalyst for a collaborative meeting of key influencers and stakeholders, from which emerged preliminary suggestions for Marine Protected Area boundaries. In early 2001, the Federal environment agency began formal stakeholder consultations on an initial proposal for a Marine Reserve. The proposal also drew on an AAD report documenting the conservation values of the region[52]. By mid-2002, following an 18 month statutory consultation period, 85% of the original proposed area was classified a highly protected marine reserve and 15% classified a conservation zone requiring further assessment before possible inclusion in the marine reserve in the future[50]. The declaration received WWF's *Gift to the Earth* award which provides recognition and support for significant conservation actions around the world[50].

A formal management plan for the marine reserve was published in 2005 by AAD. The objectives of the plan are to protect the: World Heritage and conservation values of the area; unique features of the benthic and pelagic environments; representative parts of the different marine habitat types; and marine areas used by land-based marine predators for foraging. Fishing is prohibited within the marine reserve[52].

The HIMI marine reserve covers an area of approximately 65,000 square kilometres. Fishing takes place outside the marine reserve in the adjacent HIMI fishery. The fishery is managed by AFMA under a statutory management plan using an ecosystem-based approach. The fishery's management also falls under the jurisdiction of CCAMLR which sets overall catch limits in accordance with its EBM objectives. The mackerel



Source: Australian Fisheries Management Authority

MARINE STEWARDSHIP COUNCIL CERTIFICATION ~ AUSTRALIAN MACKEREL ICEFISH (*CHAMPSOCEPHALUS GUNNARI*)

The Australian mackerel icefish fishery, managed by the Australian Fisheries Management Authority in HIMI waters, was certified in April 2006 as meeting the environmental standard set by the Marine Stewardship Council's *Principles and Criteria for Sustainable Fishing*. According to the independent certification body, Scientific Certification Systems, which certifies the fishery, the fishery met or exceeded the performance levels required by the MSC standard.

As with all MSC fishery certifications to date, the Australian mackerel icefish fishery certificate required agreement on certain fishery improvements, or conditions. This means that in a limited number of instances, performance needs to increase to the best practice within timeframes. Agreed improvements for the mackerel icefish fishery include the need to reduce uncertainty about how the precautionary approach is applied, as well as the use of reference points and application of harvest strategies in the management of the fishery. An assessment of the fishery's ecological risks and further information about icefish's trophic role in the ecosystem are also required.

Logo Source: Marine Stewardship Council
Picture Source: FAO

[52] AAD (2005) *Heard and McDonald Island Marine Reserve Management Plan*. Australian Antarctic Division, Tasmania. 208pp.

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icefish fishery was recently certified against the Marine Stewardship Council's environmental standard for sustainable and well-managed fisheries (see box).

The Australian government has a demonstrated long term commitment to monitoring, control and surveillance in the HIMI fishing zone which has been further strengthened by cooperation with France on surveillance and enforcement (see below). This will benefit the protection of the declared marine reserves in both nation's EEZs, as well as the protection of fishing zones from IUU fishing.

Source: www.ecologie.gouv.fr (French Ministry for Ecology and Sustainable Development)

Kerguelen and the Crozet Islands, France

The French government, in October 2006, announced it was also declaring a series of Marine Protected Areas in its sovereign territory, taking in not only some of the waters around the Kerguelen Islands, but also the sub-Antarctic waters around the Crozet archipelago and the islands of St Paul and Amsterdam[53]. The combined designated regions cover a large marine area totalling approximately 15,000 square kilometres.

Citing the scientific interest of the rich ecological diversity of the islands and surrounding marine ecosystems, as well as the historical and international significance of the island territories and the ocean environment, the French government committed to join other international efforts to protect these areas against common risks and threats.

Bilaterally, Australia and France had cooperated on compliance and enforcement in the Marine Protected Areas and fisheries. Although beginning as surveillance and enforcement activity to protect sovereign fishing zones, there is also potential for this to protect the integrity of the Marine Protected Areas.

The governments of Australia and France agreed in 2006 to sign a new cooperative treaty on enforcement of fisheries laws between the two countries[54], building upon surveillance and enforcement activities by joint French and Australian patrols in the EEZs of their island territories. According to AFMA, most French patrols now have Australian fisheries and customs officers on board and French officials also join Australian patrols. The treaty empowers the respective officials to take enforcement action under the other nation's laws[54].

The French government deploys warships to patrol the Southern Ocean, including helicopter-carrying frigates, as well as older, former North Sea trawlers converted into gunboats. This presence complements the efforts of the Royal Australian Navy and Australian patrol vessel, *Ocean Viking*, to reduce IUU fishing and associated negative impacts within the respective EEZs.

Prince Edward Islands, South Africa

Throughout the early 2000s, the South African government publicly committed to international targets to protect between 20-30% of marine habitats in its jurisdiction. To that end, the government announced its intention to declare the largest South African Marine Protected Area within the EEZ of the Prince Edward Islands[49]. This will extend the protection to the marine ecosystem that is now afforded to the land masses of the islands, which were declared Special Nature Reserves in 1995[49].

South Africa faced similar problems to Australia and France in its sub-Antarctic territory – IUU fishing of Patagonian toothfish leading to a population so overexploited that its spawning biomass has been estimated to have declined to only a few percent of pre-exploitation levels in only ten years[49]. High bycatch of albatross and petrels, as well as other seabirds, from toothfish poaching by longline vessels also contributed to global concerns about their survival.

WWF-South Africa has, in partnership with the South African government, facilitated and coordinated the multi-stakeholder work to date to develop Marine Protected Areas in the Prince Edward Islands including funding, coordinating and facilitating the planning and stakeholder engagement processes.

One of the preferred approaches from the outset was to use systematic conservation planning techniques to delineate any potential Marine Protected Area by collating all spatially explicit biodiversity data, expert

[53] Anon (2006) Rapport *Sur La Reserve Naturelle des Terres Australes Françaises*. Ministère de l'écologie et du développement durable. 2pp.
[54] AFMA (2006) New treaty to strengthen the fight against illegal fishing. *Fishing Future Vol. 4, Issue 3, September 2006*. Australian Fisheries Management Authority, Canberra. 20pp.

knowledge and stakeholder input into a Geographic Information System (GIS) planning domain. Biodiversity and conservation targets and objectives were then developed, where possible including quantitative expressions of a region's conservation goals[49]. Importantly, planning rules were established based on stakeholder input, for example, trying to avoid known fishing areas as much as possible without compromising conservation targets. A set of draft Marine Protected Area boundaries were then taken to stakeholders including the fishing industry, government representatives, scientific experts and others. A final plan with recommended reserves (according to IUCN categories), including boundaries, then emerged.

The main objectives of a future Marine Protected Area around the Prince Edward Islands are likely to be:

- To contribute to a national and global representative system of Marine Protected Areas
- To serve as a scientific reference point that can inform future management of the area
- To contribute to the recovery of the Patagonian toothfish
- To reduce bycatch in the toothfish fishery of albatross and petrels.

The planning and engagement projects enabled improved fishing industry understanding of the environmental situation and the need to conserve the unique biota of the Prince Edward Islands. The process also helped clarify that not only could the objectives and targets be met without significant harm to the fishing industry, but in actual fact the declaration of Marine Protected Areas may enhance the prospects of rebuilding toothfish stocks. The key to the eventual success of declaring the Marine Protected Area may well lie in the inclusion of stakeholders every step of the way and the honest and transparent dialogue between stakeholders during the process[55].

Lombard et al[49] noted that it is important that the South African Marine Protected Area system around the Prince Edward Islands, the exact nature and regulatory regime of which is still being developed, be nested within a regional conservation plan for the CCAMLR region.

CCAMLR

Regionally, as more nations announce their intent to declare, as well as enforce, Marine Protected Areas across large areas of the southern Indian Ocean, this should result in better conservation and management of fish populations, seabirds and many other species and habitats. There is enormous cooperation and goodwill between many stakeholders, from the industry, to environmental NGOs through to national governments.

Waved albatross (*Diomedea irrorata*) in flight

CCAMLR has been developing its approach and carefully considering how it may participate in the international moves to bring spatial management into its ecosystem-based conservation and management framework. In September 2005, CCAMLR's Scientific Committee hosted a workshop to discuss Marine Protected Areas. This led to recommendations being made to CCAMLR itself. The November 2005 CCAMLR meeting resulted in clarification of CCAMLR's responsibilities in Marine Protected Area development in the Southern Ocean, recognition of existing commitments and targets from WSSD and the Convention on Bio-

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diversity, agreement on taking an holistic approach to design and implementation, the need to take various considerations into account in determining which areas need protection, the allocation of tasks and the establishment of a Steering Committee, and finally, the need to conduct a further workshop on bioregionalisation in 2007[56].

In September 2006, WWF and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), with funding from the Antarctic expedition specialist Peregrine Travel, co-hosted an "Experts Workshop on Bioregionalisation of the Southern Ocean". While not the officially hosted CCAMLR workshop, the goals of the workshop were to define regions of similar environmental characteristics using data from the Southern Ocean and to present these findings to CCAMLR, including possible candidate areas for protection[57].

WWF, in the lead up to the October 2006 CCAMLR meeting, called upon Members to support the outcomes of the experts workshop. The workshop, WWF said, established a 'proof of concept' for adopting a bioregional approach in the Southern Ocean, making an important initial contribution to a range of scientific, management and conservation goals, including the development of a representative system of Marine Protected Areas. The methods developed during the workshop for undertaking a broad-scale bioregionalisation, and issues identified for further work on this topic, will be of significant value in work towards the 2007 CCAMLR workshop on bioregionalisation. WWF then called upon CCAMLR Members to:

- Support broad-scale bioregionalisation efforts for the Southern Ocean
- Commit resources to finer-scale analysis of sub-regional biodiversity
- Develop governance models for establishment of High Seas Marine Protected Areas.

The WWF/ACE CRC report from the experts workshop on bioregionalisation was well received by CCAMLR's Scientific Committee at its meeting in October 2006. During the Commission meeting in October-November 2006, a number of countries indicated their commitment to finer-scale assessment of biodiversity and the possibility of adopting a bioregional approach to conservation. During 2006 CCAMLR formed a Bioregionalisation Steering Committee[58]. From 13-17 August 2007 in Brussels, the Belgian Government will host a formal CCAMLR workshop as the next step in its work on the concept of bioregionalisation as a tool to aid CCAMLR's EBM approach in the Southern Ocean. In

order to establish a system of Marine Protected Areas 'harmonised for the protection of the Antarctic marine environment'[58], two components of work will need to be undertaken:

1. Technical development of methods for bioregionalisation of the Southern Ocean
2. Consideration of methods for selection and designation of Marine Protected Areas.

The workshop in 2007 will focus on the first component, with the aim of providing advice on fine scale subdivision of bio-geographic provinces. Work on the second element will be conducted in parallel through papers and submissions to the CCAMLR Scientific Committee or its working groups[58].

Conclusion

This case study has demonstrated that a stakeholder-based approach is a powerful way to facilitate successful outcomes. There are many other conservation-based relationships between WWF, other environmental organisations, legitimate fishing industry interests, governments and research agencies in Australia, France and South Africa that contribute to building trust and enable the gradual use of the inter-governmental and domestic conservation processes to secure considerable wins for biodiversity conservation and sustainable use of fisheries resources.

Acknowledgements

Margaret Moore, Senior Marine Policy Officer, WWF-Australia

Dr. Deon Nel, Marine Programme Manager, WWF-South Africa

Indrani Lutchman, Senior Fellow, Institute for European Environmental Policy, United Kingdom

[55] D. Nel, pers. comm.
[56] Cohen, H.K. (2006) *Marine Protected Areas: discussions and decisions in the CCAMLR context*. IUCN Information Paper to COP8, March 2006. The World Conservation Union. 17pp.
[57] Grant, S., Constable, A., Raymond, B. and Doust, S. (2006) *Bioregionalisation of the Southern Ocean: Report of Experts Workshop, Hobart, September 2006*. WWF-Australia and ACE CRC. 48pp.
[58] CCAMLR (2006) Report of the twenty-fifth meeting of the Scientific Committee. SC-CAMLR-XXV. 171pp.

South West Atlantic Patagonian Shelf Marine Ecoregion ~ San Matías Gulf

8

EBM STEP 8 ~ ESTABLISH STRATEGIES FOR ACHIEVING OBJECTIVES AND TARGETS

Step 8 focuses on stakeholders, partners and interested parties identifying appropriate and workable strategies to achieve specific objectives and targets, including who is responsible, funds and timeframes, controls, reporting and assessment. Strategies might include:

- Research on improving gear design to reduce impacts on a sensitive habitat, or reduce the bycatch of an important species
- Improved fishery-independent monitoring of catch or bycatch
- Pursuing independent certification of the fishery against an environmental standard, such as the Marine Stewardship Council eco-label
- Implementing industry codes of practice to reduce risks of fishing practices to ecologically related species
- Establishing zones where only specific activities, or types of fishing, are permitted
- Declaring a network of protected zones.

Source: Ward et al. (2002)[1]

The South West Atlantic Patagonian Shelf Marine Ecoregion stretches along the entire coast off eastern Argentina. It includes the one of the largest continental shelf areas in the world. Rich oceanic conditions bring nutrients, plankton and fish into Argentine waters. In the 1990s unsustainable fishing practices offshore in continental shelf fisheries led to overfishing and the risk of commercial collapse of six major fisheries and the loss of some 20,000 jobs[59].

Within the ecoregion, San Matías Gulf covers an inshore area of approximately 19,500 square kilometres and is part of Argentina's Río Negro Province (see map). More than 50,000 people live in the San Matías coastal zone. The main economic activities in the coastal region include commercial fishing (classified as industrial or artisanal), tourism and some industries.

The principal fisheries in the San Matías Gulf are hake (both industrial and artisanal) and other demersal finfish, artisanal and dive fisheries for molluscs, a hand fishery targeting octopus, snails and seahorses, and an industrial squid jig fishery. The relatively healthy status of resources in the Gulf means there are opportunities to test different management strategies, like pursuing Marine Stewardship Council (MSC) certification and implementing ecosystem-based management (EBM).

Step 8 in action ~ establish strategies for achieving objectives and targets

The previous case studies have provided examples of the building blocks for implementing EBM in marine capture fisheries: from the earliest identification and engagement of stakeholders and partners, through to delineating the boundaries of the area or fisheries to which EBM will be applied, understanding the ecological characteristics and agreeing ecosystem values. Once ecological risks and uncertainties have been described or analysed in a systematic way, objectives and targets for managing activities would usually be agreed. Having undertaken these steps either sequentially or concurrently, attention turns to developing practical strategies or operational activities that will deliver successful outcomes in relation to the stated objectives and/or targets.

The Argentinean environmental organisation *Fundación Vida Silvestre Argentina* (FVSA), which has been affiliated with WWF since 1988, began talking with potential partners in 2002 about the certification of San Matías Gulf fisheries against the MSC *Principles and Criteria for Sustainable Fishing*. These discussions resulted in formal agreements with provincial authorities and strategic partnerships with key stakeholders promoting MSC certification. Based on the recommendations of the hake pre-assessment, in 2004 scientists from the Instituto de Biología Marina y Pesquera Almirante Storni (the research branch of the Río Negro Province Fisheries Administration) applied for funds to the National Agency of Scientific and Technological Promotion, with the aim of developing a research and management project to solve some of the issues and progress towards EBM and the full MSC assessment process in the future[60]. This three-year project (2005-2008) is designed to develop a conceptual and methodological framework for ecosystem-based management of coastal and artisanal fisheries in the San Matías Gulf.

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[59] www.panda.org/about_wwf/where_we_work/latin_america_and_caribbean/

[60] González, R., and M. Narvarte, A. Gagliardini (2003) *Desarrollo de un marco conceptual y metodológico para el manejo ecosistémico de las pesquerías artesanales y costeras del Golfo San Matías: tomando ventajas del uso de sensores remotos y otras herramientas tecnológicas*. Proyecto PID (2003) Nº 371. FONCyT, Agencia Nacional de Promoción Científica y Tecnológica. Instituto de Biología Marina y Pesquera Almirante Storni (Universidad nacional del Comnahue / Ministerio de Producción de Río Negro). 26pp.

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South West Atlantic Patagonian Shelf Marine Ecoregion ~ San Matías Gulf

Adopting the Ecosystem Approach to Fisheries (EAF) described in the FAO literature[61] as the conceptual basis to guide the project, one of the aims is to encourage policy changes within the Argentinean fisheries administration and integrate EAF-based operational objectives and measures into routine fisheries management. The South African case study in this report which highlights Step 6, proposes the idea that while EAF is not identical to the concept of EBM that is characterised in this report, it essentially amounts to the same thing. That is, management of human activities in the marine environment needs to integrate long term ecosystem and human needs (economic and social), involve partnerships with stakeholders, have a scientific basis and use adaptive and precautionary management strategies.

The San Matías Gulf project, which includes several initiatives like the ecosystem approach to fisheries[60] and MSC certification, involves partners from FVSA, researchers from the Institute of Marine Biology and Fisheries "*Almirante Storni*", as well as the Institute of Astronomy and Space Physics. Fishing company representatives, fishers, government representatives, local politicians and local environmental NGOs are also involved. FVSA is working towards creating a common vision for the sustainable use of the San Matías Gulf – an area of healthy, productive ecosystems that inspire development of sustainable fisheries that can be recognised at regional, national and international levels[62].


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The San Matías Gulf project provides an ideal example for FVSA to demonstrate alternative ways of managing and administering marine resources because of the possibilities of self management in the region, the quality of its institutions, and the decisions already demonstrated by local politicians that support sustainable fishing and initiatives aimed at creating market incentives[62].

In the context of the above mentioned integrated initiatives, the operational objectives under active consideration for the San Matías Gulf ecosystem in order to manage it sustainably include:


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- To improve the management system
- To preserve ecosystem structure
- To maintain the reproductive capacity of target resources
- To maintain biological diversity
- To establish protected habitats and marine areas (Marine Protected Areas)
- To reduce discards, bycatch and ghost fishing
- To improve research capacity and management planning.

The range of strategies implemented in the San Matías Gulf ecosystem has been broad and includes research activities, participative management planning, development of more sophisticated ecological models and monitoring systems than previously was the case. The project is specifically working on:

- Performing seasonal research surveys of demersal, pelagic and benthic assemblages to enhance scientific information of target and non-target species in the ecosystem.

[61] Garcia, S.M, A. Zerbi, C. Aliaume, T. Do Chi, G. Lasserre (2003) *The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook*. FAO Fisheries Technical Papers T443. 81pp.

[62] Cañete, G. (2006) *Proyecto certificación de la pesquería multiespecífica de invertebrados del ecosistema del Golfo San Matías, Argentina*. Fundación Vida Silvestre Argentina, Mar del Plata. 15pp.

- Developing Integrated Management Plans for demersal and benthic fisheries. The process for management plan development is participative, involving fishers, scientists, government representatives, politicians, environmental NGOs and other stakeholders.
- Improving data capture and storage through the development of fisheries statistics and relational database systems.
- Identifying and delineating critical zones for target stock and other species conservation.
- Developing quantitative ecosystem indicators for use in Integrated Management Plans.
- Exploring the application of tropho-dynamic models as supplementary Integrated Management Plan tools. Also expanding existing data collection and analysis to include oceanographic and ecological information, using technologies such as Geographical Information Systems (GIS) and satellite imagery.
- Improving the selectivity and performance of fishing gears in order to reduce bycatch, discards and impacts on benthic habitats. This includes the potential use of grids, square mesh panels and other selectivity adaptations for trawl gear.
- Permanently monitoring fishing operations and assessing the impact on the ecosystem through the development of a Fishing and Oceanographic Monitoring System which includes Vessel Monitoring Systems, and potentially, electronic logbooks, data loggers, electronic scales for observers and on-board digital camera systems. This also includes consolidating the existing On-board Observer Program.
- Pursuing Marine Stewardship Council certification of fisheries in the San Matías Gulf ecosystem, noting that the artisanal and industrial hake fisheries passed the pre-assessment in 2004 and the desire is to also see multi-species invertebrate fisheries gain certification under a separately funded artisanal fisheries certification project (see below).
- Studies, based upon monitoring of incidental catches, have shown that artisanal longline fishing for hake resulted in little to no seabird bycatch in the last few years. However, sea lion / longline interactions are thought to be a cause of sea lion mortality. This is being studied at present.

A multi-disciplinary research group has been formed and research capacity has increased significantly, along with the implementation of the Fisheries and Oceanographic Monitoring System and On-board Observer Program.

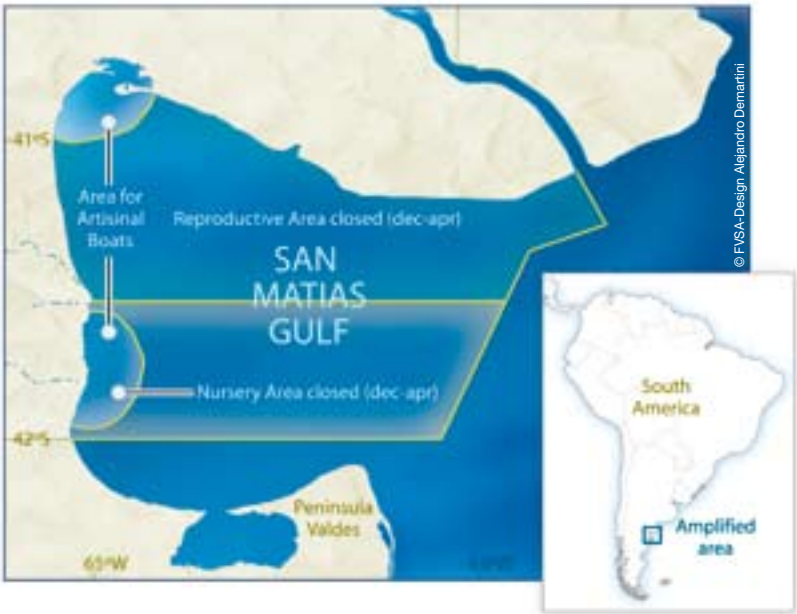
A sea of resources within hand's reach

In July 2006, as part of the second year of a separate two-year project funded by FVSA, WWF-Netherlands, the Sustainable Fisheries Fund and the Río Negro Provincial Government, FVSA and partners hosted a workshop aimed at bringing a wide range of stakeholders and community representatives together to focus on regional development and integration in the San Matías Gulf, with a particular focus on showing how responsible management of resources can benefit nature and people at the same time[62].

Under the umbrella of the project to develop an integrated management plan in preparation for MSC certification of the artisanal mollusc fishery which targets scallops, clams, mussels and octopus, FVSA wanted to create a space that would generate enthusiasm and ideas about the sustainable use of the San Matías ecosystem and explore the potential for developing a regional brand or approach that incorporates not only certified seafood from artisanal fishers in the area, but also brings regionally important economic linkages with sectors such as tourism and the restaurant trade.

Using the tag line "*the sustainability of San Matías Gulf is in our hands*" and a logo to cleverly emphasise the point that the fishery is low intensity and low impact, FVSA brought together fishers and industry representatives, as well as people from the tourism, restaurant, education, hotel, small business, environmental and

San Matias Gulf, management areas for hake



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South West Atlantic Patagonian Shelf Marine Ecoregion ~ San Matías Gulf

media sectors. Over 60 people attended the workshop and listened to presentations from a variety of stakeholders about the certification project, the status of fisheries resources, as well as information about other initiatives in the region such as responsible tourism, seafood and the restaurant trades. Participants then shared ideas and developed actions to implement them. FVSA hopes that the outcomes of the workshop will provide the foundation for a shared vision for the San Matías Gulf and an integrated approach to using the marine resources of the area.

Written feedback gathered at the end of the workshop indicated that a majority of participants are willing to participate in future projects connected to regional sustainable development and that it was important to continue to work with the broad range of sectors represented at the workshop.

FVSA has developed a website, www.golfosan-matias.org outlining and promoting the ideas that emerged from the workshop.

Conclusion

Both projects described in this case study highlight elements of Step 8, as well a logical progression of the elements of other EBM steps. The project to develop a conceptual and management framework for ecosystem-based management in the San Matías Gulf also serves as a specific example of Step 9 – designing an effective information system, including monitoring. The next case study on the Gulf of California Marine Ecoregion delves into Step 9 in more detail.

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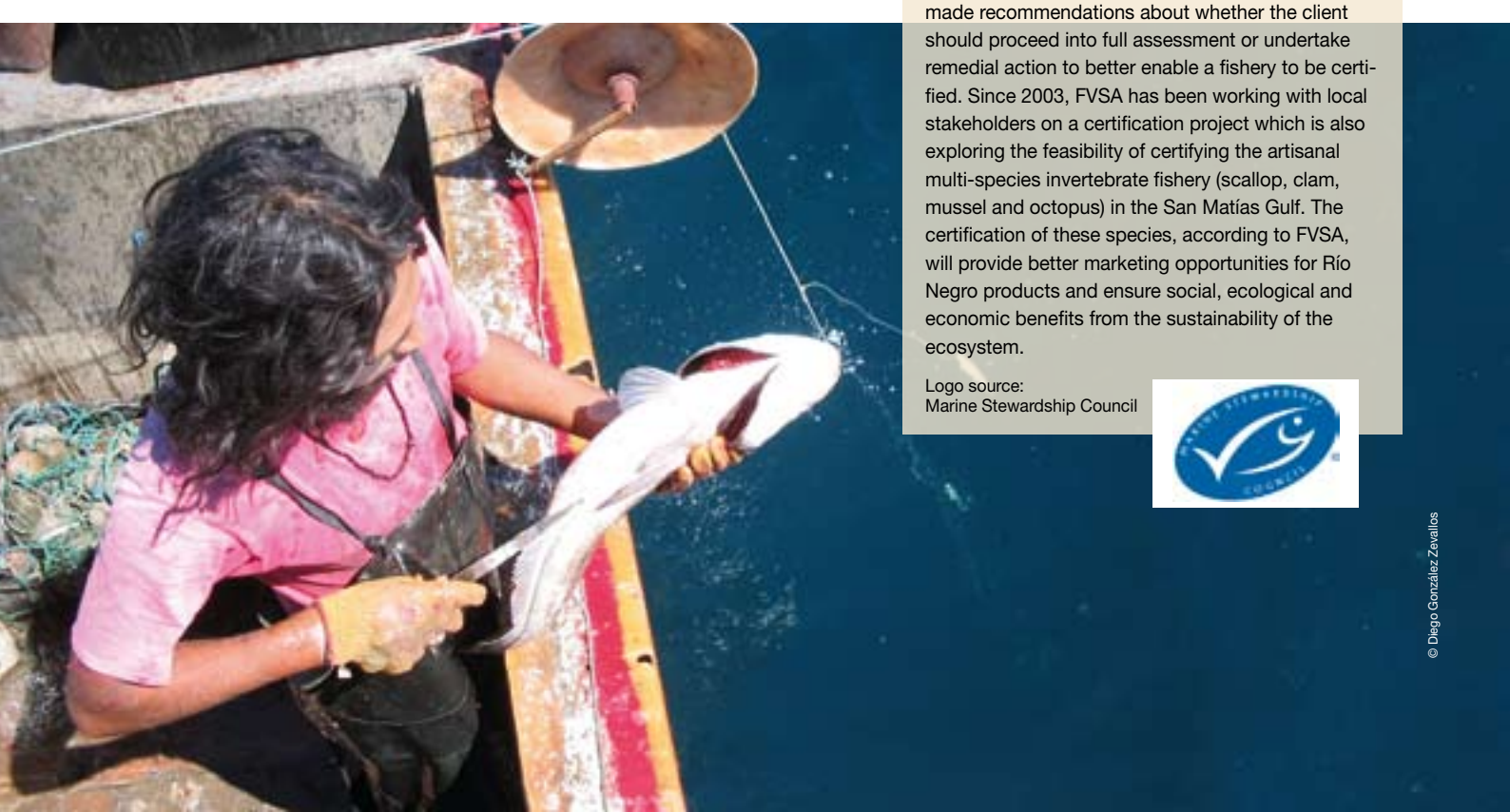
MARINE STEWARDSHIP COUNCIL CERTIFICATION IN ARGENTINA PATAGONIAN SCALLOP (*ZYGOCHLAMYS PATAGONICA*) AND SAN MATÍAS GULF FISHERIES

The Patagonian scallop fishery was certified in December 2006. The independent certification body that assessed the fishery, *Organización Internacional Agropecuaria*, determined that the fishery meets the environmental standard set out in the Marine Stewardship Council's *Principles and Criteria for Sustainable Fishing*. When a fishery certificate is granted and the supply chain from boat to the point at which a label is displayed upon the scallop products is certified against the MSC's *Chain of Custody* standard, consumers will be able to look for and buy Patagonian scallops with the distinctive 'fish-tick' MSC eco-label.

This certification is not the only fishery in Argentina to undergo the independent, science-based assessment process. In 2004, the artisanal and industrial hake fisheries in the San Matías Gulf were the subject of pre-assessments, which looked at the likelihood of a fishery passing the MSC standard and made recommendations about whether the client should proceed into full assessment or undertake remedial action to better enable a fishery to be certified. Since 2003, FVSA has been working with local stakeholders on a certification project which is also exploring the feasibility of certifying the artisanal multi-species invertebrate fishery (scallop, clam, mussel and octopus) in the San Matías Gulf. The certification of these species, according to FVSA, will provide better marketing opportunities for Río Negro products and ensure social, ecological and economic benefits from the sustainability of the ecosystem.

Logo source:
Marine Stewardship Council



Gulf of California Marine Ecoregion ~ Mexico

9

EBM STEP 9 ~ DESIGN AN EFFICIENT AND EFFECTIVE INFORMATION SYSTEM, INCLUDING MONITORING

Step 9 involves stakeholders designing a system that will capture appropriate information and data to determine if: strategies are working as expected; objectives and targets are being achieved; unwanted fishery impacts are being reduced; and to identify specific effects of fisheries strategies on ecosystem values. Information could include:

- Periodic mapping of important habitat distributions
- Population census of important protected species
- Species diversity in fished habitats
- Distribution of fishing effort by gear types and fine spatial scale
- Size/age classes in harvested species
- Species diversity in closed areas.

Source: Ward et al. (2002)[1]

The Gulf of California Marine Ecoregion is a large, semi-enclosed sea of approximately 258,000 square kilometres in Mexican territorial waters[63]. Over 1,100 kilometres long and up to 200 kilometres wide, the Gulf is bounded on one side by the Baja California Peninsula and the Mexican mainland on the other. It is bordered on the southern mainland by tropical rainforests, in the north by the deserts of Sonora and Baja California and, on its eastern land border, the Sierra Madre mountain range which rises 2,000 metres above sea level. The northern reaches of the Gulf are influenced by the Colorado River delta and the south by the deep Pacific Ocean[63]. The size and scale of the Gulf of California means there is significant climatic and ecosystem diversity.

Marine and coastal habitats in the Gulf include deep oceanic waters, shallow, high salinity areas, a coral reef, coastal wetlands and mangroves, estuaries, rocky headlands and sandy beaches. There are over 800 islands and islets providing homes to many endemic reptile, mammal and plant species. The Gulf's rich marine life includes nearly 900 species of temperate and tropical fish, 34 species of marine mammals, five species of marine turtles, nearly 5,000 known species of marine macro-invertebrates and over 600 species of macro algae. The Gulf ecoregion also provides nesting, feeding and breeding sites for hundreds of residential and migratory birds, including about 170 sea and shore bird species[64].

Though the region has relatively low population density, there is a history of intense fishing. Nearly 50% of Mexico's commercial fisheries production comes from the Gulf of California[63]. Important fisheries include shrimp trawling, small pelagics such as sardine and anchovy, jumbo squid, snappers and groupers. Sharks and rays are also targeted. Sport fishers chase prized marlin and sailfish, as well as tuna, jacks and dolphinfish. Nearly 85% of all fisheries have been officially recognised as either at their maximum capacity (75%) or overexploited (10%)[65].

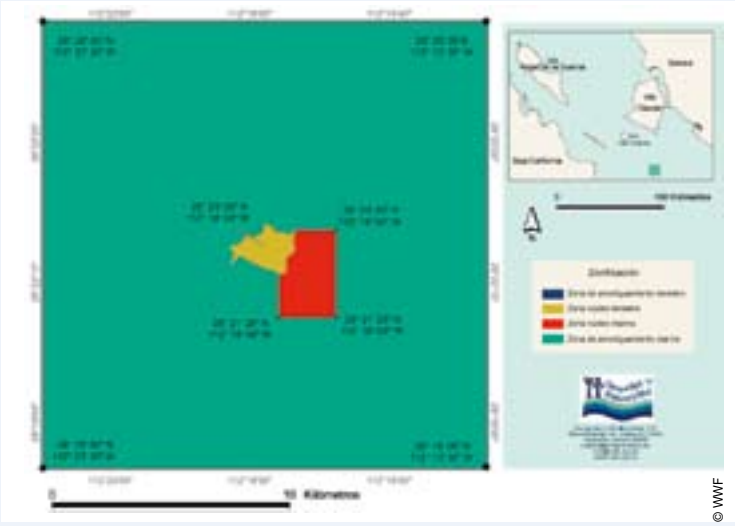
Fishing, extensive tourism, urban and coastal development, such as poorly designed marinas and aquaculture installations, as well as pollution runoff from agriculture and the disruption of the freshwater that once flowed into the Gulf from the Colorado River watershed in the US, contribute to increasing human pressures on the marine ecosystem[63].

Step 9 in action ~ design an information system, including monitoring

Step 8 demonstrated some of the strategies that might be put in place in order to meet ecosystem-based management (EBM) objectives and targets. The next step is to ensure that there is a feedback loop built into the management system enabling data, knowledge, experience and information to be captured routinely and used to inform managers as to whether strategies are meeting stated objectives.

Against a backdrop of the 'shifting baseline' phenomenon[66,67], the current status of most fish stocks[65], and growing evidence of fishing down the food web[68], it was a logical conclusion that single species manage-

San Pedro Martir Island Biosphere Reserve. Red = no-take zone. Green = buffer. Note change of scale between both.



[63] Brusca, R.C. and L.T. Findley, P.A. Hastings, M.E. Hendrickx, J.T. Corre and A.M. van der Heiden (2005) Macrofaunal diversity in the Gulf of California. Part II: Patterns of species diversity and ecological importance of natural ecosystems. In: *Biodiversity, Ecosystems and Conservation in Northern Mexico*. J.E. Cartron, G. Ceballos and R.S. Felger, Eds. Oxford University Press. 514pp.
[64] www.panda.org/about_wwf/where_we_work/latin_america_and_caribbean/
[65] M.A. Cisneros-Mata, pers. comm.

ment is unsuccessful in achieving sustainable fisheries. These phenomena have been demonstrated in the Gulf of California and evidence suggests a change in equilibrium, so WWF-Mexico and its partners decided that an ecosystem-based approach should be applied to attempt to improve or restore ecosystem status and sustainable fisheries. Two WWF targeted EBM-related projects are underway: one described in this case study (San Pedro Mártir Island), and the second in two coastal shrimp fisheries in the upper Gulf of California and in an area of coastal wetland.

Giant shrimp found in the Gulf of California support a rich fishery.

The San Pedro Mártir Island Biosphere Reserve, located in the northern half of the Gulf of California (see map), was declared in 2002. This was the first of three islands in the Gulf of California to begin a process to extend the protected area to the surrounding waters to become a Biosphere Reserve, after an extensive analysis based on ecological and socioeconomic criteria. This decree was the result of the effort of the National Commission of Protected Areas (CONANP), the Federal agency charged with managing protected areas, and Comunidad y Biodiversidad A.C. (COBI A.C.), a local NGO with experience in community monitoring of Marine Protected Areas, beginning in 2000, with financial support from WWF.

Now, WWF-Mexico is partnering with COBI A.C., as well as CONANP to develop a model or exemplary marine reserve to demonstrate that Marine Protected Areas in the Gulf of California are appropriate biodiversity conservation and fisheries management tools. The Isla San Pedro Mártir Biosphere Reserve, a relatively compact 302 square kilometres - including 11.1 square kilometres of no-take zone - is the marine reserve that will be used as a model Marine Protected Area to prove the concept works by testing adaptive management approaches.

The reserve was chosen because its waters had already shown signs of overfishing. There were documented declines in the abundance of top predators such as groupers and increases in the numbers of sea urchins. As well as being an important source of fish for neighbouring coastal communities, the marine waters of the reserve are home to several important species that depend on fish and invertebrates, including sperm whales, sea lions and various seabird species. To ensure the maximum possibility of success, the active participation of the area's fishers has been secured. Indeed, the fishers from the community of Bahía de Kino supported the establishment of the Reserve in the first place.

The key objectives and targets for the EBM project are:

- By 2011 the San Pedro Mártir Biosphere Reserve is operating effectively using an adaptive management approach
- By 2011 fishing activities (small scale, industrial and sport fishing) are occurring in a sustainable way.

A strategic plan was developed in 2006 by the partner organisations following the methodology of Foundations of Success. In it, six marine conservation targets were identified (four relating to ecosystem types, one relating to a species and one to ecological process). Each target has a specified conservation goal, strategies and short- and long-term objectives to achieve the target. Objectives are focussed on ecosystem health and goals to reduce threats. An important strategy will be the 'no-take' of all species from a fraction of the Reserve, especially top-order predators. A key test for this strategy will be whether there are positive effects on elements of value in the ecosystem within the remaining Reserve area, such as spill over of fish from within the protected area to the surrounding waters.

The fishers from the community of Bahía de Kino will be directly involved in the monitoring, decision making and operation of the Reserve and a training programme will be developed for divers in the community to also aid the monitoring process by COBI A.C.

A milestone in developing the design of an efficient and

Isla San Pedro Mártir

[66] The 'shifting baseline' phenomenon is where our perception of what is natural and pristine changes over time, particularly between generations, where perspectives change such that we fail to appreciate the extent of past modifications to the environment by humanity. There is a body of literature suggesting that the phenomenon is a danger from resource management and conservation perspectives because it masks the true social and ecological costs of fisheries. See Sáenz-Arroyo, A et al. (2005), below, and Pauly, D. (1995) Anecdotes and the shifting baseline syndrome of fisheries. *Trends Ecol. Evol*. 10, 430.

[67] Sáenz-Arroyo, A. and C.M. Roberts, J. Torre, M. Cariño-Olvera and R. R. Enríquez-Andrade (2005) Rapidly shifting environmental baselines among fishers of the Gulf of California. *Proc. R. Soc. B*. 272: 1957–1962

[68] Sala, E. and O. Aburto-Oropeza, M. Reza, G. Paredes, and L. G. López-Lemus. 2004. Fishing down coastal food webs in the Gulf of California. *Fisheries* Vol. 29, No. 3:19-25

effective information system, which includes monitoring, was a meeting in November 2006 between the three partner organisations to define criteria for the information and monitoring system.

It is important to note that the system itself has not yet been finalised, and will not be until the partner organisations meet and consultation is undertaken. However, some ideas drawn from the 2006 Strategic Plan have already been generated to guide the partners in developing the information system design.

Potential EBM-related indicator types that are explicitly linked to the goals and objectives and designed to monitor and evaluate management effectiveness were derived from the Strategic Plan. Indicators will also need to be developed for biophysical, socio-economic and governance performance and might include:

- Economic and social indicators of fishers using the resources in the Reserve, including measures of the distribution of income among fishers, relative importance of fish income compared to other sources of income, numbers of user/stakeholder conflicts resolved, rule compliance and fisher organisation information
- Indicators to assess the effectiveness of the no-take zone, including indices relating to resilience, species diversity, richness, interconnectedness, rarity, etc., as well as abundance and age/size structure of predator and prey species, fishing effort and stock assessments, including potential limit and target reference point indices
- Management indicators of the Reserve itself, including the potential development of a finance plan and a formal management plan.

The indicators that emerged from the planning and design process beginning in November 2006 will be incorporated into a monitoring work plan which will clearly define the responsibilities of the partner organisations and the fishers. Time frames for collection of data and information, analysis, sharing and integration of monitoring results will be also built into the monitoring plan. A database will also need to be designed to manage all the information and data that is collected. The process is likely to take about six months after the initial design session in November 2006.

The November 2006 meeting was also used to establish research and information needs and priorities, which is the suggested next stage, i.e., Step 10, in the EBM operational process.

Taking an EBM approach in the broader ecoregion context

WWF's Gulf of California ecoregion programme has set an active agenda which focuses on specific, measurable success in the next few years (such as the San Pedro Mártir Island project). These directed projects are aimed at helping to achieve the broader objectives of the ecoregion programme:

- Promotion of sustainable fishing in the ecoregion
- Improved performance of current, and creation of new, effective Marine Protected Areas
- Minimize tourist impact and foster better tourist practices
- Watershed management to ensure freshwater for environmental use
- Better practices in aquaculture.

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Jorge Torre, COBI A.C.

King angelfish (*Holocanthus passer*) Gulf of California, Mexico.

Bismarck Solomon Seas Marine Ecoregion ~ Bird's Head Peninsula, Indonesia

10

EBM STEP 10 ~ ESTABLISH RESEARCH AND INFORMATION NEEDS AND PRIORITIES

Step 10 focuses on stakeholders, partners and interested parties identifying specific high priority areas of uncertainty, and on quality science outcomes, for both stock and ecosystem issues, to develop comprehensive, collaborative research programmes targeted at resolving key ecosystem and stock issues.

Research programmes could include:

- Habitat mapping
- Impact of fishing on specific habitat types
- Effects of coastal development on recruitment of harvested species
- Design of monitoring programmes to resolve important changes in habitats
- Biological data of key species (both utilised and non-utilised)
- Determining the dietary preferences of harvested species and their major predators
- Species composition of bycatch with different gear types used in the fishery.

Source: Ward et al. (2002)[1]

The Bird's Head Peninsula Seascape[69] lies within the WWF Bismarck Solomon Seas Marine Ecoregion, which stretches from Papua in eastern Indonesia to the Solomon Islands[70]. The Bird's Head Peninsula Seascape covers approximately 180,000 square kilometres, with around 2,500 islands and submerged reefs in the coastal waters off north west Papua, Indonesia. Within this area, a further spatial level takes in the Raja Ampat archipelago in the western part of the Bird's Head Peninsula Seascape (see map) and is the special focus of a joint NGO initiative by Conservation International, The Nature Conservancy and WWF-Indonesia.

The Raja Ampat archipelago is in the "Coral Triangle", believed to be the world's epicentre of marine and coral reef biodiversity[71]. The archipelago supports a remarkable 1,000 plus species of fish, around 700 species of molluscs and nearly 540 species of coral, estimated to be 70-75% of the world's corals[70,71]. The region encompasses 46,000 square kilometres of largely intact reefs, seagrass beds, mangroves and rocky coastline.

The human population is classified as low density and there is minimal industrial development. However, the area is a target for development, from fisheries and marine tourism to the oil and gas sectors[71].

Coastal people remain highly dependent on the resources of the sea for their livelihoods. Fisheries include live lobster, grouper and wrasse for export into the Asian live seafood markets, as well as subsistence fishing and fishing for a variety of shark species for their valuable fins.

The abundant ecosystem attracts a growing recreational dive industry and the Indonesian government has earmarked the area for listing as a World Heritage Site. This objective, however, seems at odds with the government's goal of expanding Indonesia's fishing activities to the east of the country, including into this region. Some threats already identified in the broader ecoregion include overfishing and destructive fishing practices, including the use of explosives and cyanide to stun and capture fish for the lucrative live reef fish trade[70].

Step 10 in action ~ establish research & information needs & priorities

The previous operational steps or elements that help to make ecosystem-based management (EBM) a practical reality have focussed on building towards the development and implementation of management strategies. In theory, if one was following the steps sequentially, stakeholders involved in the planning process would come to Step 10 after having developed a vision for the future management of their marine ecosystems and fisheries, and Step 10, which is about establishing research and information needs, would be informed by the EBM objectives and strategies themselves. This case study takes a look at the development of practical EBM, and the establishment of research and information needs in particular, from a different angle. The Bird's Head Seascape Initiative has established research and information needs *in order* to understand what might

[69] A seascape is a smaller area within a wider ecoregion within which there is some geographical or ecological distinctiveness, therefore being more suitable and practical for conservation and marine resource management activities.

[70] Green, A. and P.J. Mous (2004) *Delineating the Coral Triangle, its ecoregions and functional seascapes: Report on an expert workshop held at the Southeast Asia Center for Marine Protected Areas, Bali, Indonesia (April 30 – May 2, 2003)*. The Nature Conservancy, Southeast Asia Center for Marine Protected Areas, Bali Indonesia. 26pp.

be needed in an EBM plan. This demonstrates another important consideration about implementing EBM: that it needs to be applied flexibly and appropriately within the cultural, social, scientific and policy context of the region or area.

The primary goal of the Bird's Head Seascape Initiative is to develop a comprehensive EBM plan for the marine and coastal resources of the seascape, with a special emphasis on the seascape's "crown jewel", the Raja Ampat archipelago. The initiative is science-based and seeks to explore, in partnership with local stakeholders, the ecological, socio-economic and governmental processes that are most important to understand and include in management decisions in the seascape. This recognises that EBM is integrated and collaborative and takes account of the effects of interactions among living organisms, the physical and biotic environment, and the human actors in the ecosystem to achieve sustainable use of marine resources[71,72].

Created by Conservation International for the fact-sheet, *Ecosystem-Based Management Of The Bird's Head Seascape*[71].

Thirteen separate studies are being conducted over a two year period from 2005 to 2007 and will help reveal the most critical processes and factors for designing EBM plans for the regencies (local government divisions) and cities in the Bird's Head Peninsula Seascape.

The scope of the scientific studies includes identified research needs and priorities in three broad categories:

- **Ecosystem science** involving strategic field sampling across the seascape to enrich data on organisms, the environment and their interactions
- **Institutional framework assessment** involving analysis of existing institutions to evaluate their readiness to adopt a broader ecosystem focus
- **Socio-economic impact studies** including surveys of human fishers to evaluate existing livelihoods, their impacts upon marine resources, and how they might be impacted by improved management and the adoption of more sustainable practices.

The results of the studies will be used to develop and refine a synthesis ecosystem model, to enable analysis and assessment of the consequences of different management scenarios. Importantly this will show the different trade-offs and support the balancing of conservation and economic development objectives. The final component of this comprehensive project will be a first 'test-case' EBM plan for the Raja Ampat Regency[71].

The joint initiative between Conservation International, The Nature Conservancy and WWF-Indonesia includes other partner organisations including the local NGO KONPERS, national and international academia such as the State University of Papua (UNIPA) and the University of British Columbia (UBC) in Canada, national level fisheries and nature conservation agencies (PHKA and DKP), and local governments.

Ecosystem science studies

Genetic connectivity of marine ecosystems in the Bird's Head Peninsula Seascape

The extent to which larval marine organisms move between reefs in the Bird's Head Peninsula Seascape determines the amount of "connectivity" between these reefs. The principle applies to the larvae of tuna, lobster and corals and is important from an EBM perspective. The objective of this study is to understand the patterns of connectivity between the ecosystems in the seascape. The results will enable local governments to set policies that can ensure long term sustainability of their reefs and fisheries[71].

[71] Rotinsulu, C. (2005) *Ecosystem-based management of the Bird's Head Seascape*. Factsheets 1-15 for the Joint Initiative by Conservation International, The Nature Conservancy and WWF-Indonesia funded by the David and Lucille Packard Foundation. CI, Indonesia. 17pp.
[72] Ward, T, D. Tarte, E. Hegerl and K. Short (2002) *Policy proposals and operational guidelines for ecosystem-based management of marine capture fisheries*. WWF-Australia, Sydney. 80pp.

10

Bismarck Solomon Seas Marine Ecoregion - Bird's Head Peninsula, Indonesia

Satellite tagging of hawksbill and green turtles

Of the seven marine turtle species known worldwide, six are found in Indonesian waters. While the area of the Bird's Head Peninsula Seascape is known to include the largest remaining nesting area for Pacific leatherback turtles, recent surveys have also shown that green and hawksbill turtles forage and nest in the seascape too. Both these species are considered endangered and they face a variety of threats within the seascape. The aim of this study is to understand the migration and dispersal of the green and hawksbill turtles in their habitats within the Raja Ampat Archipelago and the greater Bird's Head Peninsula Seascape[71].

© Misool Jones/Shimlock - Secret Sea.

Seascape with karst islands, Raja Ampat, Papua, east Indonesia.

Sea surface temperature monitoring

One of the most important physical factors influencing the growth, health and distribution of marine organisms in the Bird's Head Peninsula Seascape is sea surface temperature. The onset of global climate change means that reef organisms are increasingly subject to extreme temperature variations. Severe bleaching and degradation because of unusually warm water means that coral reefs are less productive for fisheries. Some reefs seem more resilient to coral bleaching than others, perhaps due to upwellings of colder water or previous adaptation to warmer water events. It is hypothesised that protection of the more resilient reefs will enable them to function as larval sources of fish, coral and other organisms and potentially aid recovery in degraded reef areas. The aim of the study is to reveal sea surface temperature patterns from a wide range of reef areas and oceanographic conditions throughout the seascape.[71]

Fisher surveys to locate spawning aggregation sites

Some of the larger predatory reef fish such as the tiger grouper, marbled grouper and Napoleon wrasse are severely threatened by overfishing. They are vulnerable because they are commercially valuable for the live reef fish trade, slow growing, and easy to catch because they spawn at the same, predictable sites each year in large spawning aggregations made up of a large proportion of the adult population. Researchers are interviewing fishers to determine locations and characteristics of fish spawning aggregations for a number of target species. Information on levels of exploitation and potential support for protection is gathered at the same time[71].

Monitoring of reef fish spawning aggregation sites

Field teams from Conservation International, The Nature Conservancy and WWF-Indonesia have already begun to interview fishers, and field observations show that most spawning aggregation sites are already fished out. Only Ayau atoll, in the northernmost part of Raja Ampat, still has functioning spawning aggregation sites. Over the next year, a monitoring team will regularly dive at the spawning aggregation site to observe species composition, numbers and sizes of aggregating fish and the seasonality in aggregating behaviour. Also, a study is underway to describe how fertilised eggs disperse from the aggregation sites. Results will be used to inform local government agencies and co-managing community members how to better manage aggregation sites[71].

Biomass assessments of coral reef fish functional groups

Functional groups are assemblages of species that affect major ecosystem processes in similar ways, for example, large carnivores like groupers or snappers, or bio-eroders like parrot fish. The aim of this study is to contribute to understanding how functional groups interact with each other, and how the management of one functional group may affect another group by assessing the spatial distribution of each functional group. This in turn will provide baseline data for the ecosystem simulation model, as well as data to assess the status of exploited fish populations[71].

Marine resource utilisation surveys

Information on some aspects of resource use can be obtained by village surveys and through fishery statistics. However, a more comprehensive description of marine resource utilisation patterns in an area can only be obtained by direct observation of the fishery in the field. A study of who is doing what, where, when and how, combined with direct observations on catch quantity and composition is analogous to a study of feeding behaviour of top order predators. Therefore, the information obtained during this survey can be used to inform the holistic ecological model of the Bird's Head Peninsula Seascape[71].

Historical ecology of the Bird's Head Peninsula Seascape

The 'shifting baseline' phenomenon – where our perception of what is natural and pristine changes over time and we forget what truly healthy reefs or fish stocks look like – has emerged as a real danger from conservation and resource management perspectives[73]. The main objective of this study is to reconstruct, to the extent possible, a broad picture of the original status of the living marine and coastal resources of the Bird's Head Peninsula Seascape prior to the onset of commercial fishing and logging. This data will be used to create management targets for fish biomass and other stock densities, and ecosystem and historical baseline conditions[71].

Institutional framework assessment

Monitoring of knowledge, attitudes and practices among resource users & policy makers in the Bird's Head Peninsula Seascape

Resource users, especially fishers, are an integral part of the seascape, and their practices co-determine ecosystem dynamics. As their practices are influenced by their attitudes and knowledge, achieving behavioural change through management intervention requires study of these three attributes. The aim of this study is to produce both qualitative and quantitative data, identify cultural and socio-economic factors that may obstruct or facilitate adoption of more environmentally responsible practices, and provide information about management interventions that are more likely to change behaviour. The programme will also provide baseline information to enable monitoring of trends in perceptions about management effectiveness and the state of natural resources[71].

Institutional mapping and assessment of marine tenure systems in the Bird's Head Peninsula Seascape

EBM requires broad stakeholder involvement and a decision-making framework that encompasses the formal and informal institutions who play a role in determining resource management policies and influence resource user behaviour. The key objective of this study is to conduct an institutional mapping exercise to understand the local context and primary institutions (from the village up to the provincial, national and even international level) that act as either formal decision-makers or influential actors in marine and coastal management in the seascape. The study also focuses on understanding and possibly mapping the traditional marine and coastal tenure systems that currently exist in select areas[71].

[73] Pauly, D. (1995) Anecdotes and the shifting baseline syndrome of fisheries. *Trends Ecol. Evol.* 10, 430.

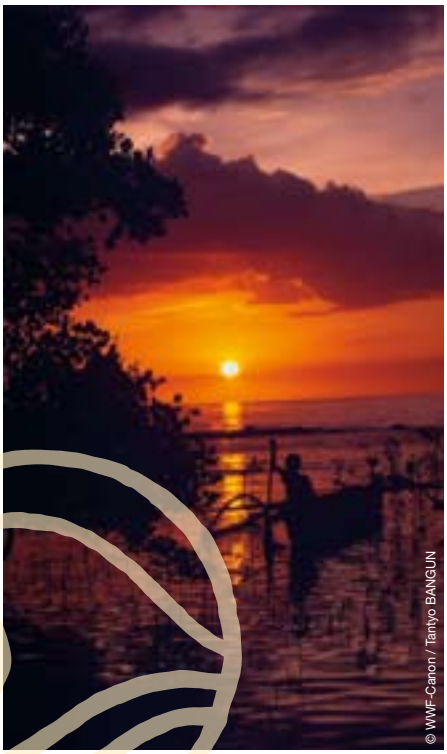
Traditional boat of Indigenous Matbat people used for fishing activities. The boat serves as a home for whole families, complete with a cooking facility. Raja Ampat, Papua, East Indonesia.

10

Bismarck Solomon Seas Marine Ecoregion ~ Bird's Head Peninsula, Indonesia

Design of an effective framework for collaborative EBM of Bird's Head Peninsula Seascape

EBM relies upon a collaborative management approach to implementation, where primary stakeholders play a part in the decision-making process. This study thoroughly examines the stakeholder situation in various areas of the Bird's Head Peninsula Seascape. Based upon this assessment and the results of the related institutional mapping and traditional tenure study, an effective framework for collaborative EBM of the seascape will be designed[71].



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Socio-economic impact studies

Valuation of ecosystem services and assessment of current livelihood sectors in Raja Ampat

The primary objective of this study is to provide governmental decision-makers with a more comprehensive understanding of the current economic values of the natural resources in their regencies and the role they play in supporting the livelihoods of local villagers. This will enable decision-makers to conduct more effective cost-benefit analyses when considering new large-scale investments in natural resource exploitation sectors[71].

Raja Ampat sustainable development options

A major concern for local governments within the seascape is to plan the best economic development course in their area – one which maximises government revenue while ensuring the long-term welfare of local people. Unfortunately, often the former objective clouds the latter. The aim of this study is to provide local governments with a full range of sustainable development options that explicitly account for the economic, environmental and social implications of each option. This information will be useful in and of itself, but also in the overall EBM synthesis model which will evaluate the most optimal EBM framework for the Bird's Head Peninsula Seascape[71].

Synthesis ~Development of a marine ecosystem model of the western part of the Bird's Head Peninsula Seascape (Raja Ampat)

This final part of the project is drawing together the results and outcomes of the previously described studies to help build a spatially-explicit ecosystem model of Raja Ampat and the surrounding seascape. This cutting-edge model will be used to explore potential consequences of different management scenarios, the inputs for which will be shaped by the results of the previous studies. The results of model simulations will be shared with stakeholders and a final workshop will be conducted to draft a strategic EBM plan for the seascape to integrate inputs from scientists, local government agencies, NGOs and local communities[71].

Each of the studies has started and many have already produced useful data. The project and concept of EBM has been shared with stakeholders in the Bird's Head Peninsula Seascape area during two intensive workshops. This resulted in significant commitments by local government to use the outcomes and recommendations from the project in their management and conservation planning. All data so far collected are also being used by scientists from the University of British Columbia, for the decision support model.

Conclusion

The next step in the EBM framework incorporates processes designed to evaluate and assess the performance of management strategies in delivering the objectives of EBM plans, as well as processes to review and assess whether the objectives themselves remain the right ones to pursue. The following case study on the work of CCAMLR in relation to Antarctic krill highlights how elements of Step 11 are operational in an international fisheries organisation.

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Southern Ocean ~ Antarctic Krill

11

EBM STEP 11 ~ DESIGN PERFORMANCE ASSESSMENT AND REVIEW PROCESSES

Step 11 focuses on a participatory process that reviews and assesses fishery performance and reviews monitoring data, objectives and targets periodically. Attributes of the process include:

- Locations, timing and resourcing enables stakeholder participation in reviews of performance of the fishery in relation to stock and ecosystem values.
- Performance outcomes may be peer reviewed by independent authorities.

Source: Ward et al. (2002)[1]

Antarctica, one of the coldest, driest and most isolated places on earth, is encircled by the Southern Ocean (see map). Covering about 10% of the ocean's surface, the Southern Ocean supports rich and productive marine life[74]. Some of the strongest winds on earth influence the waters of the Southern Ocean, as do circumpolar currents. In winter the sea freezes over. As its cold polar waters converge with more temperate southern Atlantic, Indian and Pacific Oceans, the Southern Ocean plays a crucial role in global climate, ocean circulation and life systems[75]. These oceanic convergence zones act as a barrier effectively creating a closed ecosystem around the Antarctic continent. Research has shown that the key factors determining both biological productivity and the extent of sea ice in the Southern Ocean are water circulation and the variable northward pushing boundaries of the circumpolar currents[76,77].

Krill, the common name for Euphausiids, are pelagic, shrimp-like crustaceans that prefer cold water. In the Southern Ocean, Antarctic krill (*Euphausia superba*) are the most prolific. Winter sea ice acts as a nursery area for larval krill, as well as refuge for adults from predators. They feed on phytoplankton and survive during winter by eating algae growing on the underside of the sea ice[77]. Adult krill, measuring up to 60 mm and living for 5-7 years, form swarms which are thought to be the largest known aggregations of marine life on the planet[78]. Some swarms have been estimated to be 450 square kilometres and contain an estimated 2 million tonnes of krill[79]. They are often referred to as the lynchpin of Antarctic ecosystems, which means krill are an important source of food for complex food webs that involve squid, fish, seals, whales and seabirds, including penguins. Estimates of krill consumption in the Scotia Sea by these species are between 16 and 32 million tonnes a year[77]. Krill distribution is circumpolar, found offshore in open water, but generally close to the continental shelf and associated with the islands in the Weddell Sea and the Scotia Arc[79] (an underwater ridge extending from the southern tip of South America, into the south Atlantic and back to the Antarctic Peninsula which influences the direction and intensity of Southern Ocean currents[77,80]). Winter distribution of krill is less well understood[79].

Ecosystem changes from global warming and increasing demand for krill and its by-products are potential threats to krill populations and therefore the integrity of the Antarctic ecosystem[81].

CCAMLR

Management of krill fishing in the Southern Ocean falls under the jurisdiction of the international Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Part of the Antarctic Treaty System, CCAMLR entered into force in 1982. CCAMLR is generally acknowledged as the first international fisheries agreement to codify an ecosystem-based approach to fisheries resource management[77]. It is also thought by some to be a leading organisation in the development of best practice in the application of an ecosystem-based management approach to fishing activities in waters outside national jurisdiction[84].
Since the late 1980s CCAMLR has required the use of a precautionary approach to setting catch limits in commercial fisheries and mandated the incorporation of uncertainty into its fisheries management decision-making[84]. Precautionary catch limits are CCAMLR's way of making the general objectives set out in the Convention operational, with the aim being to avoid adverse impacts on predators through excessive removal of prey species[77]. CCAMLR's fishery management units are based on the FAO's statistical units (Areas 48, 58 and 88) and further sub-divided into statistical sub-areas and divisions based upon general oceanographic and biological considerations.

Source: www.ccamlr.org

Krill fishing in the Southern Ocean

Fishing for krill began over 40 years ago with exploratory trawling in 1961-62, eventually leading to full scale commercial fishing by the mid-1970s[79]. The main krill fishing nations were the then Soviet Union and Japan. Later, Poland, Chile and South Korea also began fishing for krill[80]. The highest total krill catch of over 500,000 tonnes was recorded in 1982, with more than 90% of this landed by the Soviet Union[79,80].

A number of factors caused a decline in the fishery by the early 1990s, including technical problems such

[74] Grant, S., A. Constable, B. Raymond and S. Doust (2006) *Bioregionalisation of the Southern Ocean: Report of Experts Workshop, Hobart, September 2006*. WWF-Australia and ACE CRC. 48pp.
[75] http://aad.gov.au/ Oceanography in Antarctica
[76] http://aad.gov.au/ Sea ice, circulation and the east Antarctic ecosystem
[77] Hewitt, R.P., J.L. Watkins, M. Naganobu, P. Tshernyshkov, A.S. Brierley, D.A. Demer, S. Kasatkina, Y. Takao, C. Goss, A. Malyshko, M.A. Brandon, S. Kawaguchi, V. Siegel, P.N. Trathan, J.H. Emery, I. Everson and D.G.M. Miller (2002) Setting a precautionary catch limit for Antarctic krill. *Oceanography* Vol. 15, No. 3: 26-33
[78] Mangel, M. and S. Nicol (2000) Krill and the unity of biology. *Can. J. Fish. Aquat. Sci*. 57(Suppl. 3): 1-5.
[79] Nicol, S. and Y. Endo (1999) Krill fisheries: development, management and ecosystem implications. *Aquat. Living Resour*. 12 (2): 105-120.

as the discovery of high fluoride levels in krill shells preventing human consumption and rapid spoiling of the catch due to digestive enzymes breaking down body tissue; the break-up of the Soviet Union in 1991 resulting in the cessation of fuel and other subsidies; and declining global demand for krill by-products[79,80]. Total landings, by the early 1990s, were between 80,000 and 100,000 tonnes annually[80]. From the late 1990s until the 2004-05 season, annual catches were between 100,000 and 126,000 tonnes [82,83]. In 2004-05, the total annual catch was estimated at 165,000 tonnes, a 33% increase over the previous year's total[83]. Krill fishing nations now include Japan and Poland, although their catches are declining, and increasingly, South Korea, Vanuatu (thought to be Flag of Convenience vessels) and Norway[83].

Most krill fishing has taken place on the continental shelf breaks in the South Atlantic sector of the Southern Ocean (FAO Area 48), specifically, around the South Shetland Islands, South Orkney Islands and South Georgia Island (Sub-areas 48.1 to 48.3 respectively) (see map). These are the only areas that have predictable and dense enough krill swarms to ensure fishing is economically viable[80]. These are also the areas of krill distribution accessible to land-based krill predators.

Expansion of the krill fishery was constrained by economic, political and technological factors. However, in the last two or three years signals of change have been picked up by members of CCAMLR's Scientific Committee, the Commission and stakeholders, with the potential for a rapid expansion of fishing effort and krill catches in the very near future[82,83]. Demand for krill as fish meal and fish oil products in aquaculture feeds has been rising steadily. Global demand for aquaculture products is growing while other marine sources of fish meal and oil have become limited and more expensive. The combined knock-on effect for krill could be significant. Research by the food processing industry continues to investigate methods to extract krill protein for human consumption, especially in value-added foods. Dietary supplements using krill oil as a rich and superior source of Omega-3 are being marketed and the potential of krill by-products for use in medicine and the pharmaceutical industry is also being explored[81]. Spoilage has been overcome with flash-freezer technology and new harvesting technology has also meant that fishing effort and krill catches could substantially increase. The challenge for CCAMLR, to continue to achieve its conservation and rational use objectives, is to ensure management keeps pace with developments in the fishery.

SIGNATORIES TO THE CONVENTION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES (CCAMLR)

Decisions are made by the members of the Commission, who also contribute to the organisational budget. Membership of the Commission is open to the States that originally adopted the Convention. There are 24 Members of the Commission and ten other nations party to the Convention.
The Members are:
Argentina, Australia, Belgium, Brazil, Chile, European Community, France, Germany, India, Italy, Japan, Korea, Namibia, New Zealand, Norway, Poland, Russia, South Africa, Spain, Sweden, Ukraine, United Kingdom, United States of America and Uruguay.
Other States party to the Convention:
Bulgaria, Canada, China, Cook Islands, Finland, Greece, Mauritius, Netherlands, Peru and Vanuatu.

Source: CCAMLR

Step 11 in action ~ design performance assessment & review processes

The previous ecosystem-based management (EBM) steps described in these case studies are designed to create an enabling environment in which to implement EBM in marine capture fisheries. The steps build progressively from the earliest identification of who should be involved in the process, through agreement about the 'playing field', what is important, and the outcomes being attempted. Practical action follows with the implementation of appropriate management strategies and decisions about the most important information, research (Step 10) and who will undertake it. Step 11 is all about creating a feedback loop to enable partners in the management process understand whether the fishery's management is in fact achieving the intended outcomes, or from time to time, whether the outcomes

DEVELOPMENTS IN KRILL HARVESTING TECHNOLOGY

New harvesting technology has been fitted to a Norwegian flagged, former factor trawler, the *Saga Sea*. The exact nature of the new technology is not clear, however, according to some reports it involves a continuous fishing system that suction pumps krill from the cod end of the midwater (pelagic) trawl without having to retrieve the fishing gear[83]. With flash-freezer capacity onboard and hauls lasting for several days, news reports suggest that it might be possible for a single vessel to take about 120,000 tonnes of krill in a single fishing season.

Source: www.fis.com

[80] Agnew, D. (2004) Fishing South. The history and management of South Georgia fisheries. The Penta Press. 128pp.
[81] NET (2006) *Krill count: conserving the integrity of the Antarctic ecosystem*. Antarctic Krill Conservation Project. National Environmental Trust. 18pp.
[82] CCAMLR (2003) *Report of the twenty-second meeting of the Scientific Committee*. SC-CAMLR-XXII. 563pp.
[83] CCAMLR (2005) *Report of the twenty-fourth meeting of the Scientific Committee*. SC-CAMLR-XXIV. 630pp.

Minke whale (*Balaenoptera acutorostrata*)

themselves are still the right ones to pursue. That is, that successful management is adaptive and based on scientific knowledge, continual learning and embedded monitoring processes[90].

Performance assessment and review processes for CCAMLR's management strategies within its science-policy framework are well established and internationally recognised, involving long-standing institutional structures and mandated procedures through the Commission, its Scientific Committee and official Working Groups. CCAMLR requires catch, effort and other fisheries-related data from fishing operations and receives fishery-independent survey and other research data from Members to help with assessment and review[84]. CCAMLR has also established its International Scheme of Scientific Observation and the CCAMLR Ecosystem Monitoring Program (CEMP) which provide the scientific basis for performance review and assessment processes within the CCAMLR science-policy framework[80,84,85].

Constable et al. (2000)[85] describe how in 1991 the Commission recognised the need to develop "some form of feedback management, which involves the continuous adjustment of management measures in response to information…". While CCAMLR did not at the time have enough information upon which to implement feedback management procedures for the krill fishery, the Commission did agree to set a precautionary limit on annual krill catches[85]. To help set the precautionary catch limits, in 2000 CCAMLR's Scientific Committee coordinated a multinational survey of krill stocks in the South West Atlantic sector of the Southern Ocean[77,84].

There is a three-part decision rule for deciding precautionary catch limits for krill, involving calculating a long-term harvest rate expressed as the proportion of an estimated pre-exploitation biomass[86]. The first part of the rule is designed to safeguard the stock and recruitment to the stock, and the second part to safeguard the integrity of the ecosystem[80]. Model simulations for each part of the decision rule, using potential catch levels, estimate population trajectories that extend 20 years from the present day. Levels of constant catch that satisfy the first and then the second parts of the decision rule are found. The third and final part of the decision rule states that the most conservative catch level that satisfies both the first and second parts is the lower of the two, and that this is then the one chosen[80].

For Area 48 where most krill fishing occurs, a region-wide model calculated the harvest rate to be 9.1% of an estimated krill biomass of 44 million tonnes, i.e.,

[84] Constable, A. (2006) *International implementation of the ecosystem approach to achieve the conservation of Antarctic marine living resources*. Presentation to UNICPOLOS 7, June 2006. 25pp.

[85] Constable, A.J., W.K. de la Mare, D.J. Agnew, I. Everson and D. Miller (2000) Managing fisheries to conserve the Antarctic marine ecosystem: practical implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). *ICES Journal of Marine Science* 57: 778-791.

[86] Pre-exploited biomass or initial biomass is a reference point that emerges from model simulations which create a set of distributions of pre-exploitation biomass, biomass during, and biomass at the end of a 20-year projection from the present day. Statistical distributions of krill spawning biomass are obtained by "Monte Carlo" projections of a population model that takes into account the effects of uncertainties in krill demography and unexploited biomass (see Constable, 2000 and Agnew, 2004).

4 million tonnes[77]. This limit remains in force in 2005-06. An additional conservation measure also in force states that if the krill catch in any one fishing season exceeds 620,000 tonnes the Commission may apply catch limits to smaller management units within Area 48 – this is generally referred to as the trigger limit.

Another highly significant part of the science-policy framework aimed at protecting the integrity of the ecosystem, especially in the context of krill fishing, is the CEMP. As noted above, it is an integral part of CCAMLR's ability to review and assess the performance of individual measures and the management system. The CEMP was established to monitor krill predators, to detect changes in their annual performance and determine whether fishing or natural causes are responsible for these changes[80]. According to Agnew (2004)[80], up to 15 performance indicators for seven bird and seal species at 16 sites around the Antarctic are monitored. Small-scale indicators such as foraging behaviour through to large scale indicators like population size are monitored[80], providing data and information to CCAMLR's Working Groups and Scientific Committee to analyse and evaluate what is happening within the ecosystem, the results of which form the basis of advice to the Commission itself.

Adelie Penguin (*Pygoscelis adeliae*)

Developments in krill fishery management as new information comes to light

An important part of CCAMLR's precautionary approach to management and conservation are rules for developing fisheries in the absence of data. These are aimed at ensuring fisheries do not develop at a pace faster than CCAMLR can evaluate potential outcomes and whether its overarching objectives can be satisfied[84,85]. Since the early 1990s CCAMLR Members have been required to notify either their intention to undertake a new fishery or further exploration after a new fishery has been initiated[84]. The krill fishery is subject to these measures, along with the precautionary catch limits and the limit triggering management in smaller units[87].

There are some uncertainties not incorporated into the region-wide krill harvest rate model, including uncertainties about how krill production might vary in space, whether there are long-term changes in krill production not accounted for in the model and the requirements of krill predators in different locations[77]. Consequently, the local-scale effects of the expanding fishery are not well understood[79]. Inherent to the CCAMLR science-policy framework is the feedback-management system which incorporates objectives, target species and ecosystem assessments, thus as new information or improved methodologies evolve, CCAMLR can revise the yield estimates in the models and change precautionary catch limits[85].

CCAMLR, since its earliest days, has been grappling with determining the most appropriate long-term management strategy for krill. Scientists have acknowledged for years that the complexities of abundance, distribution and the need to consider the proximity of fishing to colonies of land-based krill predators probably mean that krill should be managed in Small-Scale Management Units (SSMU). This means precautionary catch limits would be set at a finer scale than the current region-wide precautionary limits to ensure CCAMLR's ecosystem objectives can be met on scales consistent with all elements of the ecosystem[84].

These, and other ideas, have been formally discussed in the context of krill by the Working Group on Ecosystem Monitoring and Management and by the Scientific Committee itself. Various decision rule scenarios have been discussed and debated, for example, the wisdom of having the decision rule in Area 48 which leaves the imposition of more precautionary limits by smaller management units until after catches exceed 620,000 tonnes. Some observers suggest that as total annual catches have not been especially close to this figure for more than two decades, there has been relatively little pressure to make decisions about how specifically to implement more spatially explicit management units for krill.

There are uncertainties about the impact that krill fishing might have on other elements of the ecosystem including larval fish, immature krill and other small pelagic species, as well as uncertainties about selectivity and mortality of krill themselves[83]. In 2005, CCAMLR's Scientific Committee encouraged dialogue between Working Group members and fishing operators to ensure this information informs the management

[87] Noting that, unlike all other fisheries managed by CCAMLR, the krill fishery does not have mandatory observers or vessel monitoring systems. This is an important shortcoming by krill fishers that needs to be rectified.
[88] CCAMLR (2006) *Report of the twenty-fifth meeting of the Scientific Committee*. SC-CAMLR-XXV. 171pp.

process[83]. As it had in the previous year, in 2006 the Scientific Committee noted a number of fundamental areas requiring data from observations of the krill fishery, including accurate catch rates; biological samples to determine selectivity; total krill mortality and overlap between fisheries and predators at small scales; differences between vessels, fishing methods and gear configurations; bycatch rates of fish larvae; and incidental mortality of marine mammals and seabirds[88].

As a consequence of its reviews and assessments of fishery performance, in 2005, CCAMLR's Scientific Committee advised the Commission that "*the krill fishery is changing its pattern of operation, in respect of the nations involved, the composition of its products and in the harvesting technology being used*." These developments, combined with evidence of increasing catches, led to advice saying that changes are needed in the type of data collected, reporting formats and the level of observer coverage[83]. By 2006, the Scientific Committee noted that it still had inadequate information upon which to base management advice in the krill fishery, noting repeated requests for information and lack of response from most nations about fishing methodologies, technology and fishing operations, especially on fishing selectivity and total mortality[88]. The Scientific Committee draw the Commission's attention to the conclusions of the Working Group on Fish Stock Assessment which stated that an increase in observer coverage across the krill fleet is needed, and the Working Group on Ecosystem Monitoring and Management that systematic observation of all krill fishing activities is necessary[88].

The management challenge, as noted earlier, is to ensure that CCAMLR can keep pace with the intensification of fishing effort and rising catch levels. Some stakeholders are urging immediate action be taken to prevent undesirable consequences from the combined global demand for krill and significant increase in catches through the use of new harvesting technology[81]. At the same time, other stakeholders suggest that the key issue is about whether CCAMLR's precautionary, ecosystem-based approach to management is prepared for the changes that are occurring in the fishery and that the rate of intensification of the krill fishery should not be a concern in and of itself.

Most agree that the SSMU approach must be developed scientifically. Some also argue that using SSMUs is the management approach that will best deal with the pace of change being seen in the krill fishery and thus needs to be implemented urgently, along with 100% observer coverage and the same monitoring and control measures applied to other fisheries in the Convention area[81]. In April 2006, the Antarctic Krill Conservation Project was launched by a coalition of environmental NGOs (see box). The pace of international decision-making through CCAMLR processes has been thought by some stakeholders to be too slow to deal with rapid change and, in a desire to advocate that krill and the Antarctic ecosystem are managed with precaution, the coalition is calling for urgent management action.

In November 2006, at its annual meeting (CCAMLR XXV) in Australia, the speed with which CCAMLR can make decisions was put to the test when, during the meeting, Vanuatu sent a late, informal notice that five Vanuatu flagged "super trawlers" intended to fish for krill in the coming 2006-07 fishing season[89]. This has the potential to more than double the 2005-06 catch (which is likely to be similar to 2004-05's 165,000 tonnes).

Adelie penguin (*Pygoscelis adeliae*)

When combined with catches by the other vessels that eight CCAMLR members notified were intending to fish in 2006-07, concern was raised that the total catch could jump within a single season close to the trigger level of 620,000 tonnes requiring finer-scale management to be implemented. A revised conservation measure was quickly agreed by CCAMLR which prohibits Contracting Parties from fishing unless they have notified CCAMLR, with the appropriate data and fishing plans, at least four months ahead of the annual Commission meeting and prior to the season in which they intend fishing.

The next test may well be how long it takes once the trigger level is reached to implement a science-based SSMU management approach. Some stakeholders hope that the NGO krill campaign will assist this process to occur more rapidly.

Conclusion

The final piece of the EBM-in-action framework put forward by Ward et al. (2002)[90] is the preparation of education and training packages for fishers, including creating outreach programmes to provide support for fishing operators about new fisheries management, or other EBM initiatives (Step 12). The purpose is also to provide technical support for assessment and resolution of ecosystem issues. In practice Ward et al. (2002) suggest that this step should begin at the same time as the EBM process itself thus being an integral part of a holistic EBM approach rather than a sequential step.

In the context of CCAMLR, there is not an identifiable 'step' to construct and integrate such a programme per se, and given it is an international, intergovernmental institution, it is arguable whether this is its role. There are, however, many resources publicly available for officials, fishers, researchers and observers, indeed anyone with an interest, from the CCAMLR website. Manuals, schedules, forms and information are available to enable rules and protocols to be followed, scientific methodologies to be applied and standard methods to be used in monitoring. Also there are information booklets, for example, *Fish the Sea, Not the Sky*, a book published by CCAMLR about how to avoid catching seabirds when longline fishing. It is available in multiple languages and CCAMLR Members have "undertaken to make every possible effort to ensure that this book will be made available on board each and every vessel fishing under their flags in the Southern Ocean." CCAMLR Commission and Scientific Reports are freely accessible to anyone and there is a vast array of other published literature. There is also an educational section of the website aimed at school children and teachers, and finally a Members Only area that provides access to more detailed data and information.

As this case study on Antarctic krill management has demonstrated, in the context of Step 11 of the EBM framework, performance assessment and review processes within CCAMLR's ecosystem-based approach focus on setting precautionary catch limits and determining the most appropriate management strategy to ensure CCAMLR's objectives can be achieved. Operational objectives manifest in scientifically measurable terms and the science-policy framework embodies rules and procedures for dealing with uncertainty, as well as measures to deal with developing fisheries involving evaluation of potential consequences to satisfy conservation objectives while still enabling reasonable fishing opportunities[84]. There are some data deficiencies to overcome, a need to ensure adequate levels of monitoring, control and surveillance and the need

Crabeater seal (*Lobodon carcinophagus*) within Mawson vicinity

ANTARCTIC KRILL CONSERVATION PROJECT

The Antarctic Krill Conservation Project, launched in April 2006, is a network of organisations working together to promote krill conservation. The project has two primary objectives:

1. For CCAMLR to manage krill using the same monitoring, control and surveillance measures as it mandates for all other fisheries
2. For CCAMLR to approve precautionary, ecosystem-based catch limits at sufficiently small scales to protect other Antarctic species that are dependent on krill.

The project Steering Committee involves three organisations:

- The Pew Charitable Trusts
- The Antarctic and Southern Ocean Coalition
- National Environmental Trust

Other partner organisations:

- Centro de Conservación Cetácea
- Centro Ecoceanos
- Conservation International
- Greenpeace
- Oceana
- Tasmanian Conservation Trust
- WWF

Source: www.krillcount.org/

[89] AKCP (2006) *International conference takes new steps for Antarctic marine life: stronger protections for krill, new measures to control pirate fishing for Chilean sea bass*. Press Release. Antarctic Krill Conservation Project. www.krillcount.org /pr_06_11_03.html

[90] Ward, T., D. Tarte, E. Hegerl and K. Short (2002) *Policy proposals and operational guidance for ecosystem-based management of marine capture fisheries*. WWF-Australia, Sydney. 80pp.

to refine the krill management system to make it more spatially explicit. In the meantime, CCAMLR's Ecosystem Monitoring Program is under review with the aim of refining and including its outputs in a feedback management procedure for krill[84].

Challenges confronting Parties to CCAMLR more broadly than krill management include the need for greater international cooperation between States with an interest in conservation and use of the high seas to deal with non-Party States who allow their vessels to fish in the Convention area, often illegally or unreported; and the need for binding regional complementary arrangements in waters to the north of the Convention area[84]. But, in terms of EBM, CCAMLR is recognised by many as a leading organisation dealing with EBM and conservation in waters outside national jurisdiction[90], and is achieving advances in EBM in the international arena. Many of the EBM elements advocated by WWF are implemented by CCAMLR, and the process, including stakeholder participation, is continuing to evolve in positive ways.

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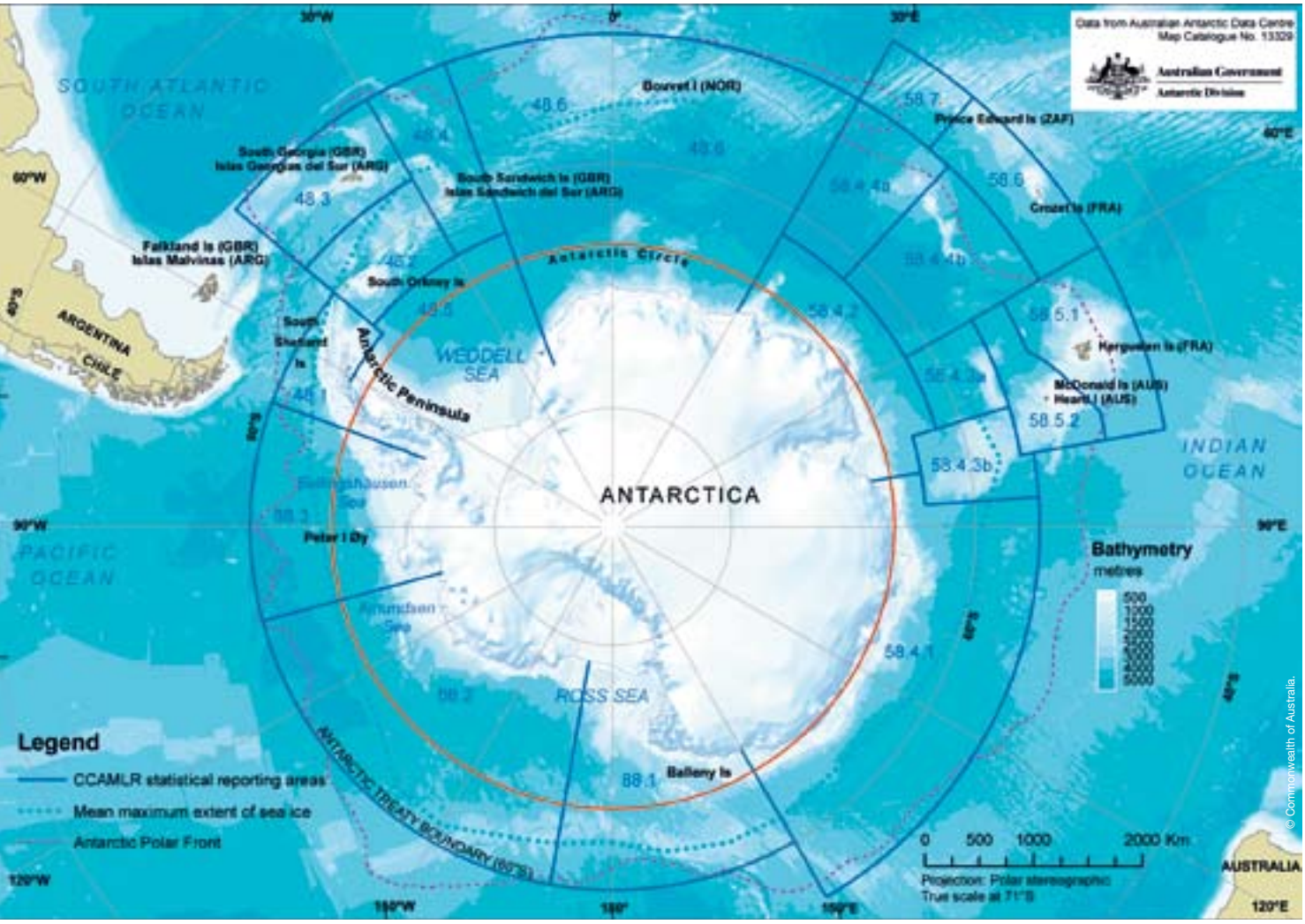
Margaret Moore, Senior Marine Policy Officer, WWF-Australia

FAO areas in the Southern Ocean



Produced by Susie Grant (ACE Cooperative Research Centre) and Susan Doust (Australian Government Antarctic Division) using data provided by the Australian Antarctic Data Centre.

West African Marine Ecoregion and New Zealand Marine Ecoregion

12

EBM STEP 12 ~ PREPARE EDUCATION AND TRAINING PACKAGE FOR FISHERS

Step 12 focuses on stakeholders, partners and interested parties being involved in creating an outreach programme that provides training and support for fishers about new fishery management, ecosystem or other EBM initiatives and provides local technical support for assessment and resolution of ecosystem issues. Ideally this step begins at the same time as the first step in the EBM process.

Source: Ward et al. (2002)[1]

West Africa

Located off the coasts of Mauritania, Senegal, Gambia, Cape Verde, Guinea Bissau and Guinea, the West African Marine Ecoregion covers about 3,500 kilometres of coastline. The coastal waters of the eastern, central Atlantic are dominated by the powerful Canary Current. Year-round trade winds push the warmer surface waters away from the coast, which in turn drags colder, nutrient rich waters up from the depths. When the tropical sun hits this rich soup, plankton thrives and is the source of a highly productive and diverse food web.

Marine and coastal habitats range from the coral reefs of Cape Verde, which support many endemic species, to seagrass prairies in the north and mangrove forests and river estuaries in the south. There are more than 1,000 species of fish, ten species of dolphin (including an isolated population of long-beaked common dolphin and the endemic Atlantic humpback dolphin), eleven species of whales, five species of endangered marine turtles and the largest remaining breeding colony of monk seals. Before their return to Europe for spring, over six million migrating birds feed in the rich west African coastal waters.

The coastal population in the ecoregion has been estimated at approximately eight million people. The sea, and fisheries in particular, play a vital role for many people in the region for food supplies and livelihoods. According to IUCN, fish provide up to 60% of animal protein in the diets of most coastal people in the region[91]. In Senegal, artisanal fishers catch up to 80% of the country's annual catch of 400,000 tonnes, whereas in Mauritania only 20% of its 600,000 tonnes a year is taken by artisanal fishers. The remaining 80% is caught by foreign industrial fleets fishing under access agreements negotiated by governments on behalf of fishing interests. The European Union, Japan and China have fishing access agreements that allow them to fish in the waters of western African countries. The main species caught are small pelagics including scads, sardines, pilchards, anchovies and mackerels, as well as sharks, tunas and prawns.

Created in 2000, WWF's West African Marine Ecoregion (WAMER) programme is led from Dakar, Senegal with the primary purpose of addressing critical marine biodiversity and fisheries issues in the ecoregion. The programme involves four main areas of activity, as well as a comprehensive communications strategy, including: 1) supporting and creating Marine Protected Areas; 2) sustainable artisanal fisheries; 3) fisheries access agreements; and 4) threatened species.

Step 12 in action ~ prepare education and training packages for fishers ~ an example from West Africa

The twelfth step in the ecosystem-based management (EBM) process is not a final sequential step to be undertaken after all other steps are complete. Ideally, managing fisheries using EBM involves a continuous cycle of partnership, engagement, outreach, capacity building and support for stakeholders, especially fishers and fishing communities, to enable them to assess and manage their resources according to the principles outlined in the EBM framework[92].

In the West African Marine Ecoregion the comprehensive *Legui doyna* campaign in Senegal in 2003 concentrated on the problems arising from catching fry

West African Marine Ecoregion

[91] PCRM (2006) *Regional Coastal Marine and Conservation Programme Annual Report 2005*. PCRM. 28pp.
[92] Ward, T., D. Tarte, E. Hegerl and K. Short (2002) *Policy proposals and guidance for ecosystem-based management for marine capture fisheries*. WWF-Australia, Sydney. 80pp.

and juveniles for long-term sustainability of fisheries resources. Using multimedia approaches and on-the-ground discussion and debate with fishers and fishing communities, WWF and its partners l'Océanium and the Fisheries Ministry took a visually and intellectually stimulating campaign about unsustainable fishing practices to the people who could most directly affect sustainability by altering their behaviour.

In the local *Wolof* language "*Legui doyna*" means "That's enough!", or in French "*Ça suffit*!". This headline was accompanied by a sub-title which effectively means "let's stop fishing for small fry and juveniles".

Destructive and damaging fishing methods in Senegal mean that vast numbers of juveniles are caught with beach seines, purse seines, prawn trawling and dynamite. The objective of the campaign was to reduce fishing of juveniles by 50% within two years. One of the strategies put forward as a way of achieving this was the banning of gear like beach seines.

In early 2003, WWF engaged in a partnership with l'Océanium, the Kayar Fishing Committee, the Association for the Development of Yoff, and the Association for the Marine Environment. After much discussion, the Senegalese Fisheries Ministry also joined the partnership.

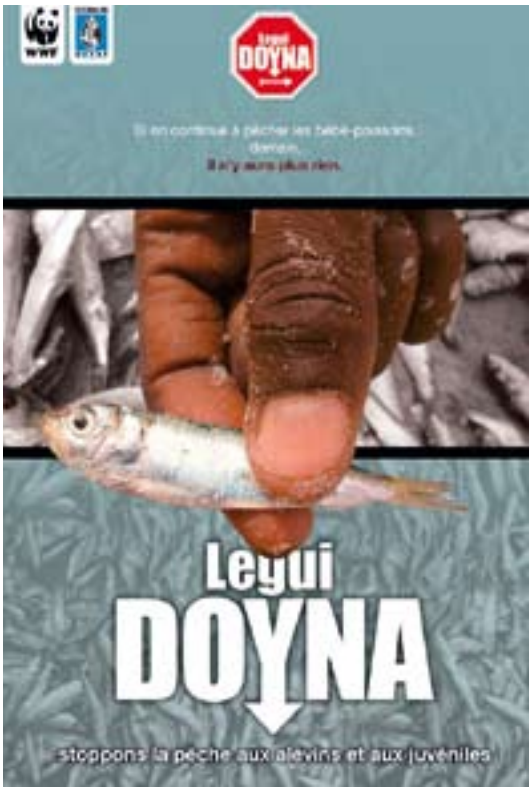
The campaign involved making a documentary film, short television and radio messages and a CD-ROM of photographs. The slogan, posters, stickers and T-shirts were also designed for give-aways. A press kit and a quiz on juvenile fishing were also developed.

For nearly three months in late 2003 the partners took their campaign on the road to 13 villages and towns in the Dakar region and three in the Thiès region. Debates, radio spots and theatre productions using actors were programmed during the campaign. Upon arrival in a coastal community, music would be played to attract a crowd. Once a critical mass was achieved the documentary would be screened. After the documentary was shown, the floor would be open for discussion and debate about people's reactions to the proposal to ban fishing for juveniles.

Theatre shows were also used to attract a crowd (also using music and percussion to draw people's attention). The show would only go on after the campaign's objectives and the fisheries code had been explained to the audience. T-shirts were handed out as prizes to people who answered questions about juvenile fishing, species and mesh sizes correctly. Similarly, radio shows were produced live in the villages, with local people being encouraged to participate. Presentations were made in schools and children competed in the specially designed quiz.

The campaign was designed to be as participative and interactive as possible, based on idea exchanges between partners, fishers, wholesale fish merchants, the women who process seafood, consumers and the public. Evaluations showed that the campaign was successful in drawing out issues linked to catching live bait, using monofilament gear, catching juvenile fish, industrial fishing and domestic waste contaminating the sea. In only one village did the campaigners receive a negative response where local fishers refused to allow the documentary to be shown because they disagreed with its core messages.

Poster for the *Legui doyna* campaign



On the whole, the target audience of active fishers, ship owners, wholesale fish merchants and women working in the seafood sector responded positively to the campaign. L'Océanium estimated that about 18,000 people and 4,000 school children were reached directly, with 85% being active professionals, 10%

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being women processors and small-scale fish merchants and 5% being children from fishing families. A wider public audience was also reached by the campaign. Indications are that professional organisations, local authorities and youth associations may work towards supporting recommendations by the State and its partners.

Some of the key suggestions that emerged from the campaign included:

- The need to revise the Fisheries Code and make it easier for people to understand
- The need to improve surveillance of marine areas where industrial trawlers are prohibited from fishing
- Ban or dramatically reduce the use of beach seines, small sized hooks, etc; enforce the bans on prohibited gears; and punish people who break the law
- Systematically close factories that process juveniles if they don't want to process only mature fish
- Set up Marine Protected Areas on spawning and feeding grounds that are already identified as such by fishing professionals, researchers and the fishing administration
- Regulate national and foreign discards.

WWF's own programme of fisheries-related work in the West African Marine Ecoregion will continue to build on the progress that has been made. The focus will continue to be on promoting equitable fisheries access agreements that are compatible with sustainable use of resources; strengthening local capacity to monitor and protect species of significance; promoting sustainable fishing practices; and strengthening efforts to establish sustainable artisanal fisheries. Marine Protected Areas and species protection will also feature in the marine programme.

PROGRAMME RÉGIONAL DE CONSERVATION DE LA ZONE CÔTIÈRE ET MARINE EN AFRIQUE DE L'OUEST (PRCM)

The Regional Marine and Coastal Conservation Programme for West Africa (PRCM) is a partnership between IUCN-The World Conservation Union, WWF, Wetlands International (WI) and the International Foundation for the Banc d'Arguin (FIBA), in partnership with the Subregional Fisheries Commission (CSRP). It has grown into a coalition of nearly 50 partner institutions whose aim is to coordinate conservation action directed at the coastal zone of the sub-region's seaboard countries: Mauritania, Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone and Cape Verde.

PCRM's activities in the fisheries sector involve demonstration projects to show it is possible to achieve more sustainable and equitable management of fisheries resources. The goal for the fisheries component of the PCRM is to *promote concerted management frameworks to ensure sustainable exploitation of fisheries resources while respecting the integrity and functioning of ecosystems and contributing to socioeconomic development*.

Some of the on-the-ground projects by the partner organisations (either individually or collaboratively) include strong elements of capacity building, training and support for new management or EBM-related activities. A selection of projects underway as part of the PRCM 2004-2008 strategic plan includes:

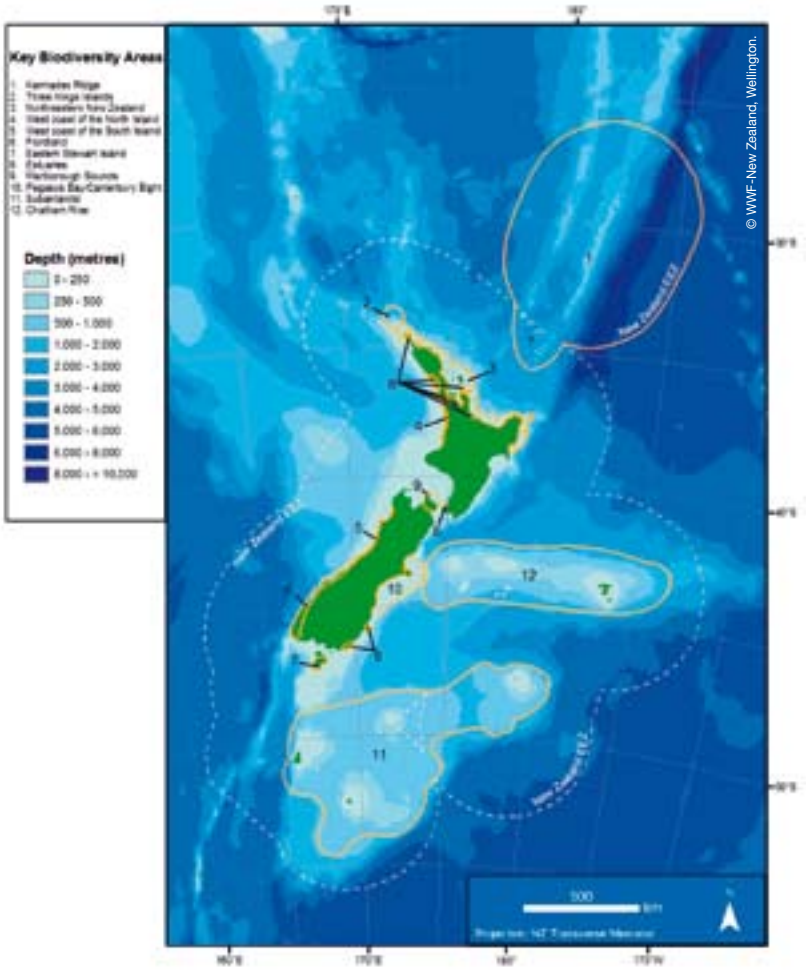
- **Capacity building in the area of fishing agreement negotiation** for Fisheries Department representatives from seven West African countries who worked on a plan for training in negotiating techniques, capacity building in multi-disciplinary monitoring and evaluation, analyzing financial effects and identifying alternatives.
- **Concerted management of coastal pelagic species shared by Senegal and Mauritania**, which involved developing the first concerted trans-boundary management plan. Activities included the approval of a common research programme for the two countries, training survey staff, establishing a system of micro-credit for those who process the products, and supporting their efforts to improve product quality.
- **Sub-regional action plan for skate and shark management**, which involved training (workshop on species identification, ecology and statistics gathering, finalizing an identification guide), research and surveys (surveys on empirical knowledge about sawfish and threatened shark species in five countries, conducted jointly with the NGO Noé Conservation, characterisation studies on specialized fishing sites in six countries, the initiating of studies on trends in shark fisheries in seven countries) and a project on management policies (support to the national action plan validation process and for the preparation of the CITES file on endangered sawfish).
- **Community management of fisheries and the Kayar marine environment** in Senegal was about reducing accidents at sea, building capacity in seafood processing, improving food safety & hygiene of fisheries products and landing sites, reinstating savings & loan instruments, and promoting a community-based approach to fisheries management. Training on financial management and fisheries management and the environment were conducted.
- **Women and shellfish** focuses on the island communities of the Delta du Saloum Biosphere Reserve. The main goal is to help women safeguard shellfish resources for the future, while improving their management skills, working conditions and living standard.

Source: www.prcmarine.org

New Zealand

Located in the southern Pacific Ocean, New Zealand is a long, narrow archipelago spanning over 30 degrees of latitude (see map). Lying on top of a bathymetric platform where the Pacific and Indo-Australian continental plates meet, New Zealand's location determines the flow of warm sub-tropical and cold sub-Antarctic currents and surface waters[93].

Key fish biodiversity areas in the New Zealand Marine Ecoregion



Source: WWF (2004)[93]

New Zealand's exclusive economic zone and territorial sea is some 15 times the size of its land area, taking in more than 4.2 million square kilometres of ocean. Its relative isolation, the surrounding major ocean currents, the variation in climate from sub-tropical to sub-Antarctic and the range and complexity of habitats have created highly diverse marine communities[93].

Habitats include open water, deep sea trenches, seamounts, rocky reefs, kelp and seagrass beds, mudflats and mangrove forests. The convergence of cold and warm waters in some habitats results in unexpected species communities.[93]

New Zealand's Ministry of the Environment estimates that there are over 20,000 marine species, but only about 12,000 have been identified[93]. Many species are known only to exist in New Zealand waters, with around 80% of the country's indigenous biodiversity thought to be found in the sea[93]. There are more than 1,000 known species of fish, 2,000 molluscs, 50 marine mammals and 126 species of seabird[93]. Endemic species such as Hector's dolphin and the New Zealand sea lion are found in New Zealand waters, as are eight endemic species of penguin, almost half the world's known species of cetacean, shearwater and shag species, and fully three-quarters of the world's albatross, penguin and petrel species[93].

The world's fourth-largest fishing zone is controlled by New Zealand and it produces commercial catches of nearly 600,000 tonnes a year[94]. Over 1,500 commercial fishing vessels catch and sell more then 130 different species. Sought after inshore species include snapper, rock lobster and abalone. Over 70% of annual catches are mid- or deep-water species such as hoki, orange roughy, squid, hake and ling, while species like tuna and small pelagics such as mackerel make up about 12% of New Zealand's annual commercial catch[94].

Step 12 in action ~ an example from New Zealand

WWF-New Zealand's marine programme focuses on four main areas of activity: 1) sustainable fishing; 2) threatened species; 3) protected areas; and 4) the marine ecoregion. The Sustainable Fishing programme concentrates on working with fishing operators and the industry on promoting sustainable fishing practices and takes part, as a stakeholder, in the process to certify fisheries against independent environmental standards such as the Marine Stewardship Council's (MSC) *Principles and Criteria for Sustainable Fishing*. In 2003, WWF-New Zealand along with WWF offices in Australia and the South Pacific began a project entitled *Consumer Choices for Sustainable Seafood* which aims to support healthy and well managed fisheries in the western Pacific, Australia and New Zealand, to promote certification of fisheries and to provide technical input on stock management and issues relating to environmental management[95].

[93] WWF (2004) *Shining a spotlight on the biodiversity of New Zealand's marine ecoregion. Expert's Workshop on Marine Biodiversity, 27-28 May 2003, Wellington, New Zealand*. A. Arnold (Editor). WWF-New Zealand. 88pp.
[94] http://www.fish.govt.nz/ New Zealand Fisheries at a Glance. Commercial Fisheries. NZ Ministry of Fisheries official web pages.
[95] www.wwf.org.nz/ Sustainable Fishing. WWF-NZ web pages.

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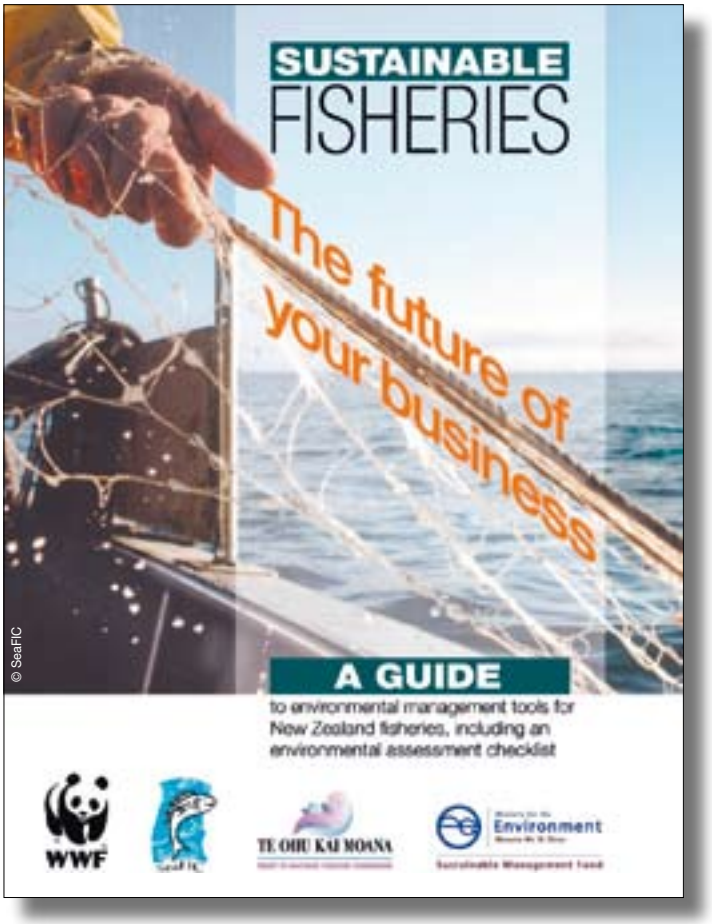
West African Marine Ecoregion and New Zealand Marine Ecoregion



The cover of WWF-New Zealand's fishing industry guide[96]

In addition to promoting the purchase of MSC-labelled seafood to consumers through its website, WWF-New Zealand has also produced educational material in the form of a guide for the fishing industry relating to improving environmental performance. This guide was the result of collaborative project between the New Zealand Seafood Industry Council, Te Ohu Kai Moana – the Treaty of Waitangi Fisheries Commission, and WWF-New Zealand, and partly funded by the New Zealand Ministry for the Environment. *Sustainable Fisheries: The Future of your Business*[96] is designed to help the fishing industry identify and better manage the interactions between fisheries and the marine environment. Based upon experiences of fishing operators and fishery managers, the guide provides an environmental assessment checklist and management options to enable fishers and managers to identify issues, determine goals, and monitor their progress towards those goals. It does not offer pre-determined solutions, but encourages the industry to find the answers that best meet identified needs and issues.

The guide's creators see it as a practical tool for the industry and are committed to it being a 'living document' that may be amended as experience and learning are shared. Indeed feedback and suggestions are actively encouraged to ensure the best possible solutions are made available to others using the guide in the future.

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[94] www.fish.govt.nz New Zealand Fisheries at a Glance. Commercial Fisheries. New Zealand Ministry of Fisheries official web pages

[95] www.wwf.org.nz Sustainable Fishing. WWF-New Zealand web pages

[96] WWF (2003) *Sustainable fisheries: the future of your business. A guide to environmental management tools for New Zealand fisheries, including an environmental assessment checklist*. WWF-New Zealand. 37pp.

Conclusion

In 2002, as part of a process to develop a workable approach to ecosystem-based management (EBM) in marine capture fisheries, WWF published its policy proposals and guidelines to encourage and inform the global debate about EBM, as well as offer an operational interpretation about how EBM might be applied in a fisheries management context[97]. While there is great diversity of views and practical experience with EBM in different jurisdictions, Ward et al. (2002) encountered reasonable consensus about the principles that underpin and empower the implementation of EBM, summarising these foundation principles as:

1. Maintaining the natural structure and function of ecosystems, including the biodiversity and productivity of natural systems and identified important species, is the focus of management
2. Human use and values of ecosystems are central to establishing objectives for use and management of natural resources
3. Ecosystems are dynamic; their attributes and boundaries are constantly changing and consequently interactions with human uses also are dynamic
4. Natural resources are best managed within a management system based on a shared vision and set of objectives developed amongst stakeholders
5. Successful management is adaptive and based on scientific knowledge, continual learning and embedded monitoring processes.[97]

EBM is evolving into modern management systems that deal with the environmental and ecosystem interactions that result from the effects of resource exploitation on the environment and the effects of the environment on the resources being exploited. Some theoretical constructs of EBM take a strictly ecological focus, others extend the concept to include human goals and aspirations because the idea of 'sustainability' is a human construct driven by the socio-economic and cultural context within which resource management must reside[98]. Thus, the concept of EBM, as characterised by WWF's policy framework, explicitly recognises the human dimension, acknowledging that as managers we can only manage the activity of human beings within the system.

To make EBM operational in a practical, real world sense, some constructive lessons for operational implementation were suggested by Ward et al. (2002), which helped them build WWF's 12-step operational framework upon which we based our case studies of EBM-in-action. These lessons included the need to *develop outcome oriented objectives* for management activities; *delineate boundaries for the management system* including ecologically defined spatial boundaries and relevant ecological and socio-economic factors influencing the productivity of the resource and integrity of the ecosystem; and *involve stakeholders* in all aspects of management leading to shared understanding and agreed individual and collective aspirations for the resource and associated ecosystems. Also, procedures and elements of any EBM system must flexible, be scientifically robust but not science-controlled, admit socio-economic factors, and encompass (or facilitate) a clear connection between the various levels of planning and management[98].

The concept of EBM is hierarchical, where the operational aspects should be guided by and nested within the terms of EBM principles. The linkages, however, do not have to be singular: a single operational activity can meet the needs of more than one principle[97]. Nor do operational elements, as set out in the framework's 12 steps, need to be followed sequentially or rigidly. While a prototypical demonstration of EBM could involve working through the steps or components of EBM in a progressive, systematic way, each step building neatly upon the first until the ultimate outcome is achieved, in the real world, we rarely have the luxury of beginning with a blank canvas, nor working through such a tidy process. Moving towards EBM might be characterised in many parts of the world as more evolutionary than revolutionary, negotiated incrementally through existing political and economic realities, with the right elements already in place for some of the EBM steps and more work to be done on others. This approach makes sense and can be adapted uniquely for each region or local sub-division, determined entirely by the reality confronting people working on the issues. Indeed, during our research to develop these 12 case studies, this is what we encountered. WWF practitioners around the world are working carefully within pre-existing networks, developing new partnerships, or identifying gaps where there are opportunities for new or modified structures to deliver ecosystem-related outcomes more rapidly, transparently or efficiently.

Successful EBM may well depend on embracing all the higher level principles and implementing many or most of the operational elements or steps. In these 12 case studies we have tried to show how practitioners

[97] Ward, T. and D. Tarte, E. Hegerl and K. Short (2002) *Policy proposals and operational guidance for ecosystem-based management in marine capture fisheries*. WWF-Australia, Sydney. 80pp.
[98] Ward et al., after Pirot, J.Y. and P.J. Meynell and D. Elder (2000) *Ecosystem management: lessons from around the world. A guide for development and conservation practioners*. IUCN, Gland, Switzerland.

from marine ecoregions around the world are managing to work effectively using EBM principles, creating an enabling environment for 'outbreaks' of EBM-like activity, or, in some cases, helping stakeholders to implement a holistic EBM approach.

Some of the work going into trying to create or facilitate an enabling environment for EBM-related activity can be seen in our case studies on the Yellow Sea (Step 1) and the Baltic Sea (Step 3). These demonstrate and discuss what some stakeholders are trying to do to broaden the stakeholder base and expand the management focus away from a purely species-led paradigm. Each case study highlights people's efforts in management systems that have challenging socio-political dimensions, but where there might be potential for the development of shared goals and aspirations for the future of fisheries and the integrity of the ecosystem.

By contrast, there are extensive ecoregional planning activities and early EBM-related projects being implemented in eastern Africa (Step 2), the Fiji Islands (Step 4) and the Bird's Head Peninsula Seascape in Indonesia (Step 10). These projects are incorporating broad conservation and biodiversity priorities as well as the socio-economic interests and needs of people and communities, especially when it comes to fishing, and developing and using an extensive science-base.

Similarly, there are systematic approaches being implemented to deal with issues confronting the Grand Banks off Canada (Step 5), the Gulf of California in Mexico (Step 9) and the San Matías Gulf in Argentina (Step 8). And in southern Africa, a highly participatory, science-based approach was facilitated and coordinated to assess the ecological risks in and from fisheries in South Africa, Namibia and Angola (Step 6).

In the international arena, CCAMLR is pioneering and leading the way (Step 11), especially when it comes to assessing performance and reviewing fisheries management outcomes against ecosystem-based objectives. While some might argue that this forum does not provide a good model of stakeholder engagement, there are long-standing, productive relationships between delegation members, scientific advisers and industry and environmental NGOs. Refreshingly, many of the players would agree there is more and different work needed to refine the management system, especially when it comes to krill management. But this is surely another example of what EBM is about – it is adaptive, based on scientific knowledge, continual learning and embedded monitoring processes.

There is great strength demonstrated in the relationships and partnerships that resulted in three governments declaring marine reserves in important fishing areas in the sub-Antarctic (Step 7), with the drive, motivation and support of industry and the environmental NGO community, not purely for conservation, but also as an adjunct to EBM in marine capture fisheries. This feeds into pioneering work that may emerge on the international stage in high seas or international governmental jurisdictions such as CCAMLR.

Finally, we saw the creative and fun way fundamental messages about unsustainable fishing practices, fishing for juveniles, were taken to the people of west Africa in Senegal (Step 12) offering us an example of ways to engage grass roots communities and create a shared understanding of the issues that need to be confronted in order to build or maintain sustainable fisheries.

When WWF released its policy proposals and guidance framework in 2002, delivery mechanisms and enabling activities were proposed – the intention was to design and implement actions in close consultation with stakeholders including policy managers, scientists, fishery managers, fishers and their representatives, local NGOs, and the international donor and aid communities. The original delivery mechanisms proposed are listed below and initial assessment shows that considerable progress has been made:

Delivery Mechanism	Status
1. Promoting education about ecosystem-based management	See Case Studies 4 and 12 – Fiji Islands, West Africa and New Zealand
2. Developing models for stakeholder engagement	See Case Studies 2, 4 and 10 – East Africa,Fiji Islands and Bird's Head Peninsula. See Case Study 3 – Baltic Sea
3. Defining procedures for developing ecosystem-based management objectives, indicators and targets	See Case Study 11 – CCAMLR
4. Ecosystem assessment of major global fisheries	See Case Study 6 – Southern Africa for an ecological risk assessment approach
5. Promoting the benefits of fully protected Marine Protected Areas for fisheries	Discussed in all Case Studies except number 6
6. Integrated regional planning and management	Some of our case studies show elements of this occurring, but it is not as deliberate as proposed by the framework
7. Developing a Global Fishery Restructure Fund	No progress except continued statements internationally about the challenges of overcapacity in fisheries catching and processing
8. Case studies	This publication offers desk-based review and information based upon interaction with practitioners engaged in EBM-related projects
9. Developing guidance for other sectors	WWF is considering this in the next iteration of its Global Marine Programme

The case studies proposed as delivery mechanisms (see 8. in table, this page), as envisaged by Ward et al. (2002)[97], could more accurately be described as demonstration projects. Our case studies are not demonstration projects, however, the David and Lucile Packard Foundation has funded regional demonstration projects, including the Bird's Head Peninsula project described in this report, which are designed to demonstrate EBM principles in action. The 12 case studies in this collection are the collation and presentation of detailed and summary information about particular activities and programmes around the world that together also provide evidence that EBM is indeed in action.

Although there are examples of each step and a number of other delivery mechanisms underway, and although there are many other related initiatives by other organisations that are not captured here, there is clearly a lot more work to be done in order to achieve EBM objectives, especially in marine capture fisheries. In essence, more of the steps need to be implemented, in more places around the world.

We hope these case studies will be useful to demonstrate practical activity that is being implemented in real world scenarios, improving highly complex management systems like fisheries, where local flexibility is required and many aspects are highly uncertain, and will also be useful to inform people about what works, and what to avoid, adapt or adopt.

We hope this compiled suite of examples empowers and motivates all who interact with the world's oceans, as users, managers, protectors, or researchers, to know that taking more care, working more collaboratively, and being cautious can reap benefits and reward.

About the authors

Chris Grieve, Meridian Prime, UK

Chris Grieve is a fisheries policy and management specialist with over 17 years international experience. In April 2005 she founded and became Executive Director of Meridian Prime Ltd, a UK-based sustainable development and management services consultancy. Before this she was the International Policy Director for the Marine Stewardship Council (MSC), the international eco-labelling organisation for sustainable and well-managed fisheries. As Policy Director, Chris's role involved developing, implementing and evaluating policies and methodologies relating to the MSC's Principles and Criteria for Sustainable Fishing. She remains an Associate Director of the MSC working on strategic policy projects.

Before joining the MSC, Chris was a Research Fellow and the head of the Sustainable Fisheries Policy Research Programme at London-based think tank, the Institute for European Environmental Policy. Major accomplishments included hosting the European conference on Integrating Environmental Concerns into the Common Fisheries Policy and the publication of a manifesto entitled: *Reviewing the Common Fisheries Policy: EU Fisheries Management for the 21st Century*. She was the Editor of the bilingual (English/French) magazine on European fisheries and the environment: *El Anzuelo*.

This work was preceded by a decade of fisheries management and research in Australia. As manager and senior manager at the Australian Fisheries Management Authority, Chris managed some of the Australian Federal Government's most complex and controversial fisheries. Working in partnership with the fishing industry, scientific community, environmental organisations and government representatives, Chris oversaw the introduction of statutory management plans and strategic research programmes. She participated in a number of collaborative stock and fishery assessment groups with a broad range of stakeholders. Her fisheries career began as a research assistant at Australia's Bureau of Resource Sciences where she worked on a diverse range of fisheries projects in tuna, pearl and multi-species fisheries. She is a co-author of the 400+ page book *Australia's Fisheries Resources* published in 1993 after three years' work.

Chris has been educated to post-graduate level in applied science (fisheries management) and is a Fellow of the Royal Society for the encouragement of the Arts, Manufactures and Commerce (RSA). Chris also holds a Certificate in Professional Development (Executive Coaching) from the University of Strathclyde, Scotland.

Katherine Short

The myriad of life that is biodiversity under and on the water is the inspiration for Katherine's work with WWF. An ecologist, Katherine combines her fascination for the marine environment with a technical approach to identifying and addressing the challenges facing us all. Understanding how those reliant on the marine environment for their livelihoods can and are able to change their practices, and adopt more sustainable methods is critical to achieving this and Katherine approaches this with passion and honesty.

Katherine has been with WWF ten years including three years at WWF-New Zealand, then five years with WWF-Australia promoting the Marine Stewardship Council, ecosystem-based management of fisheries and establishing a regional fisheries project. She is now the fisheries officer for WWF International assisting the WWF Global Marine Programme to deliver marine conservation through enhancing fisheries management.

WWF is one of the world's largest and most experienced independent conservation organizations, with almost 5 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.

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