

AoA Region: Eastern African Seas

Rolph Payet, Julius Francis, Kwame Koranteng

The Eastern African Seas region is made up of two main geographic areas – East Africa which includes Kenya, Mozambique, Somalia, South Africa and Tanzania and the Western Indian Ocean which includes the islands of Comoros, Madagascar, Mauritius, Réunion (France) and the Seychelles. The region has two recognized large Marine Ecosystems (LMEs) – the Agulhas Current LME and the Somali Current LME. Another area, the Mascarene Plateau, is yet to be categorized as an LME. The Eastern African Seas region is part of the United Nations Environment Programme (UNEP) Regional Seas Programme (the Nairobi Convention) and the Western Indian Ocean forms part of the Indian Ocean Commission.



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The Eastern African Seas coastal systems include extensive mangrove forests, which are under increasing pressure from human activities.

Table 1: Selected characteristics of countries in the Somali Current and Indian Ocean Islands sub-region

Country	Land Area (km ²)	Length of Coast (km)	Population (millions) 1998	Population (millions) 2015 – UNDP Estimate	Estimated Coastal Population as % of total	Continental Shelf (km ²) (estimated)
Somalia	80 315	2 000	9.6 (1996)	NA	15	60 700
Kenya	32 447	650	29.0	37.6	15	14 400
Tanzania	57 225	1425	32.1	47.2	15	41 200
Comoros	2 230	469	0.7	1.0	100	1416
Madagascar	581 540	9 935	15.1	23.1	75	96 653
Mauritius	2 030	496	1.1	1.3	100	27 373
Seychelles	450	747	0.07	0.1	100	31 479
Mozambique	801 590	2 470	18.6	22.5	11.1	NA
South Africa	1 221 037	2 798	42.8	44.2	17.1	NA

Compiled from multiple sources.

NA=data not available

1. BROAD ECOLOGICAL CHARACTERISTICS

The Indian Ocean is the smallest of the world's three major oceans and is one of the most ecologically diverse. The Eastern African Seas region has one-third of the 38 globally recognized marine and coastal habitats. The climate regime of monsoon and trade winds in the Indian Ocean is influenced by its geography. The monsoon regime occurs when the direction of average prevailing winds changes more than 90° from summer to winter. During the northeast monsoon season from December to April, wind bursts can occur when atmospheric pressure gets very low in association with the Intertropical Convergence Zone (ITZC). Monsoons and cyclones are thus formed in areas of atmospheric depression and are at their most active around January and February. Conditions for coastal upwelling are also influenced by monsoonal shifts. The strongest upwelling of the Indian Ocean occurs when the southwest monsoon season, which peaks between about June and September, produces strong Ekman transport away from the coasts of Somalia and Arabia.

The Eastern African Seas' coastal systems share similar ecological characteristics in terms of habitat types including coral reefs, seagrass beds, coastal vegetation and extensive areas (over 630 000 hectares) of mangrove forests. The East African Seas region is a biodiversity hotspot and an area where marine ecosystems such as coral reefs are under risk from human-induced destruction and climate change.

Although this region shares a similar geological and biological history with mainland Africa, there are notable Indo-Asian influences. The islands of Madagascar and the Seychelles in particular show high levels of endemism having been isolated from mainland Africa for thousands, and in some cases, millions of years. The Indian Ocean is also an important fisheries area, especially for tuna.

As documented through several regional assessments, economic growth in the Eastern African Seas region (especially in the tourism, artisanal and industrial fisheries, mining, aquaculture and manufacturing sectors) has increased pressure on coastal and marine ecosystems and resources. Current population growth trends indicate that the number of people living in urban coastal areas within the East African Seas region will double by the year 2025.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

A number of formal and informal institutions and projects conduct assessments in the Eastern African Seas region. These include:

- a. UNEP, through the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention);
- b. The Global Environment Facility (GEF), through the project Addressing Land-based Activities in the Western Indian Ocean (WIOLAB) project;
- c. Coral Reef Degradation in the Indian Ocean (CORDIO) programme;
- d. The Indian Ocean Tuna Commission (IOTC);
- e. Secretariat for Eastern African Coastal Area Management (SEACAM);
- f. The Western Indian Ocean Marine Science Association (WIOMSA); and
- g. The regional programmes of international non-governmental organizations (NGOs) such as the World Wildlife Fund (WWF) – Eastern African Marine Ecoregion Programme and the Wildlife Conservation Society (WCS) – Coral Reef Research project.

The GEF projects are implemented through its implementing agencies such as UNEP, the United Nations Development Programme (UNDP), the World Bank and the United Nations Industrial Development Organization (UNIDO).

Historically, the East Africa Marine Fisheries Research Organization (EAMFRO) operated under the auspices of the then East Africa Community. The EAMFRO had its headquarters in Zanzibar and had research stations in Dar es Salaam and Mombasa. Following the collapse of the East Africa Community in the late 1970s, EAMFRO was dissolved, paving the way for the establishment of the Tanzania Fisheries Research Institute (TAFIRI) and the Institute of Marine Sciences (IMS) in Tanzania and the Kenya Marine and Fisheries Research Institute (KMFRI) in Kenya. During its existence EAMFRO undertook several important assessments which could provide valuable information for future assessments.

A number of research cruises and expeditions in the Indian Ocean or the East African Seas region also resulted in the acquisition of considerable amounts of data. Examples of such expeditions include:

- a. The Russian TMA RV *Fiolent* 1972 cruise;
- b. The Monsoon and Lusiad 1960–1963, University of California, San Diego Scripps Institute of Oceanography cruises to the Indian Ocean;
- c. The USA National Oceanic and Atmospheric Administration (NOAA) Ship *Malcolm Baldrige*;

- d. The Joint Global Ocean Flux Study (JGOFS) cruises in the Indian Ocean;
- e. Indian Ocean and Arabian Sea oceanographic research cruises 2001;
- f. The Magfond 2 cruise;
- g. The R/V Hakuho-maru KH93-3 Indian Ocean Research cruise; and
- h. The 2008 Fridtjof Nansen cruise in the Eastern African Seas region.

Similarly, several national academic institutions, including universities in the region have become involved in carrying out various types of assessments. Through funding by the Belgium government and by Belgium institutions such as the Free University of Brussels and the University of Ghent, numerous studies have been undertaken, some of which have been published. Similar funding from the Swedish Development Agency (SIDA) has also resulted in a number of university level studies and reports. Through the European Union Environment Development Programme, a number of assessments have been undertaken in the islands of the Western Indian Ocean. The universities of Mauritius, Dar es Salaam, Nairobi, Eduardo Mondlane, Cape Town, Kwa Zulu Natal, among others, have also benefited from such support.

Other research institutions in the Eastern African Seas region include:

- a. Centre National de Recherches sur l'Environnement (CNRE), Madagascar;
- b. Kenya Marine and Fisheries Research Institute (KMFRI), Kenya;
- c. National Environment Laboratory (NEL), Mauritius;
- d. Council for Scientific and Industrial Research (CSIR), South Africa;
- e. Direction Nationale de l'Environnement (DNE), Comoros;
- f. Seychelles Bureau of Standards, and the Institute of Marine Sciences (IMS);
- g. University of Dar es Salaam, Tanzania; and
- h. The Oceanographic Research Institute (ORI) of South Africa.

Several networks operate in the region, bringing together scientists, managers and policy-makers. For instance, WIOMSA brings together scientists, the Working Group on Protected Areas brings together protected areas managers and the Nairobi Convention brings together policy-makers and coral reef managers.

Many of the assessments resulting from such research and collaborative efforts have depended on external funding, and many continue to remain dependant, although the organizations involved will often provide support using their core resources. Several donor countries and the GEF play an important role in mobilizing funding for conservation and environmental management in the region.

The Nairobi Convention has proved to be an important conduit between observations and research at the local level and policy-makers. Guidelines, training and other awareness-raising activities are usually built into those assessments.

3. DATA

3.1 Ecological data

Much of the ecological data in the Eastern African Seas region has been collected through various cruises, expeditions and research projects.

Notable examples include:

- a. Fish stock assessment data collected under the auspices of the Food and Agriculture Organization (FAO), IOTC and national fisheries bodies;
- b. The various projects of the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO) such as ODINAFRICA, the International Oceanographic Data and Information Exchange (IODE) and the Africa Marine Atlas;
- c. The State of the Coastal and Marine Environment reports, the EAF14 project undertaken under the auspices of Nairobi Convention through UNEP; and
- d. Data collected for the preparation of Transboundary Diagnostic Analysis (TDA) under the projects funded by the Global Environment Facility (GEF).

National academic and research institutions have also been involved in the collection of ecological data in the region. Most of these institutions have received support in the past from UNEP, FAO, UNESCO, UNDP, SAREC (Swedish Agency for Research Cooperation with Developing Countries) and the European Union (EU), to carry out various types of assessments such as:

- a. 1993–1995: EEC-STD III project on Interlinkages between East African Coastal Ecosystems;
- b. 1996–1998: EU-INCO project on the ‘Anthropogenically induced changes in groundwater outflow and the quality and functioning of the Eastern Africa near-shore ecosystems’;
- c. 1998–1999: Intergovernmental Oceanographic Commission of UNESCO – IOC-SIDA GIPME/MARPOLMON project;
- d. 1999–2002: Flemish Inter-University Council–University of Nairobi (MIR-IUC-UON) project on Coastal Zone Management and Research (MASCOR); and

- e. 2002–2003: International START/IGBP-LOICZ Afri-Basins/catchments (AfriCAT) project on the Coastal Impacts of damming and water abstraction in Africa.

While a moderate amount of information exists at the regional level, most of it is inaccessible to all interested parties in the East African Seas region. Data availability varies from country to country in both quantity and quality. A clearing-house mechanism, consisting of datasets in remote sensing, socio-economic aspects, elevation and bathymetry, has been established under the Nairobi Convention/GEF WIOLAB project. National Oceanographic Data Centres such as those in Kenya, Mozambique and Tanzania have datasets consisting of oceanographic station data, baseline maps and ecological field data. Mauritius has a database of marine organisms.

Lack of data is often cited as a constraint in conducting assessments in the region. Several studies have identified a number of information gaps and the GEF WIOLAB project recognized a number of areas in which to address these gaps, especially those associated with land-based sources of pollution. For example, priority information gaps for South Africa include a lack of understanding about the freshwater requirements of estuaries and the marine environment, and methods and techniques which help to create equity in shared river basins. In the case of Kenya and Tanzania, the lack of information on the short and long-term cumulative effects of pollution on marine ecosystem functions and on humans is a priority information gap.

Examples of assessments which considered the data issue are those conducted to produce the first “State of the Coast 2000” for Tanzania. In these assessments, comparative analyses of assessment methods were undertaken to determine which methods would provide results that could be regarded as a baseline for future reference. Recommendations were also made for the improvement of assessment methods.

In addition, through the IOC-UNESCO ODINAFRICA project, participating institutions in the region have developed an integrated database, as well as centres equipped with human resources and infrastructure focused on oceanographic and coastal data requirements. There is a need, however, to ensure sustainability of such centres in the longer term.

The GEF Agulhas and Somali Current Large Marine Ecosystems (ASLME) project as well as the GEF South Western Indian Ocean Fisheries (SWIOF) project will provide up-to-date quantitative data on the state of the marine environment in terms of fisheries, trophic levels, productivity and other

indicators. Both projects aim to undertake a series of ocean cruises to collect primary ocean and ecological data to determine the state of the region and to identify pressures. When compared to historical data, important inferences can be made as to the appropriate strategic action which could be undertaken by countries in the ASLME region. Both projects will have limited collection on data in shallow coastal environments.

3.2 Socio-economic data

The regional socio-economic monitoring network led by CORDIO has three-year datasets and a growing number of sites where socio-economic data is collected, especially data associated with coastal livelihoods and coral reefs. The aim of the project, which started with pilot sites, is to develop a socio-economic network throughout the Eastern African Seas region. A database has been developed to provide socio-economic data for national and regional assessments. The programme has developed capacity and training resources to enable long-term adoption of the methodology and to ensure credibility of the dataset. To support this initiative, WIOMSA has established an online presence in the region with the aim of establishing an on-line portal for the data.

Other institutions and projects that have collected socio-economic data include the WIOLAB project, WIOMSA through its research grants initiative and international organizations such as WWF and IUCN. Lack of access to these data in an accessible or published format prevents its wider use in regional assessments.

4. ASSESSMENTS

4.1 Thematic/sectoral assessments

The first major assessment to be undertaken in the region was the Indian Ocean Expedition in the early 1960s which focused on collecting data on physical, chemical and biological processes, especially those associated with the influence of the monsoons. In the years following the expedition, the emerging independent states of the Eastern African Seas region prioritized the development of fisheries resources to meet food security needs as well as to provide foreign exchange earnings. As a consequence, the countries in the Eastern African Seas region sought assistance for fisheries development and for conducting stock assessments, mostly through FAO and bilateral mechanisms.

Between 1978 and 1984, demersal trawl and acoustic fisheries surveys were conducted in the exclusive economic zones (EEZ's) of Kenya, Madagascar, Mauritius, Mozambique, Tanzania and Seychelles by the Norwegian Research vessel *Dr. Fridtjof Nansen*. Data from these surveys were analyzed and the pattern of distribution of demersal and semi-pelagic fish species in the region established. A new and modern research vessel, named after its predecessor, the *Fridtjof Nansen*, is undertaking major research campaigns in the Eastern African Seas region currently under the auspices of ASLME and SWIOF projects.

Following the signing, in 1985, of the Nairobi Convention and its two Protocols, Protected Areas and Wild Fauna and Flora in the Eastern African Region and Co-operation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region, the emphasis shifted from a fisheries focus to protection, management and development of the coastal and marine environment. One of the first assessments undertaken under the Convention was the assessment of land-based pollution as part of the project "Protection and management of the marine and coastal areas of the Eastern African Region (EAF/5)". In the first Work Programme of the Nairobi Convention (2000–2001), assessment of coral reefs and associated ecosystems, shoreline changes and land-based and marine sources of pollution were defined as priority areas. A number of sectoral and regional assessments are being implemented at the regional level through the WIOLAB (land-based sources of pollution), ASCLME (large marine ecosystems) and SWIOPF (fisheries) with financing from the GEF. These initiatives will provide the basis for a region-wide strategy for the management of the region's coastal and marine resources.

4.2 Integrated assessments

While most of the assessments are limited to evaluating the current status of the coastal and marine environment, there are some exceptions such as the GEF Medium-sized projects and the Global International Waters Assessment (GIWA), which evaluated policy options for the future. In the latter, a causal chain analysis was carried out and areas for priority interventions, including policy options, were identified. GIWA also analyzed the socio-economic impacts of the degradation of the marine environment. This included the effects of coral bleaching on fisheries and tourism in the Indian Ocean and the impacts of shoreline change on coastal infrastructure. Another example of an integrated assessment is the EU-funded, TRANSMAP project (Transboundary networks of marine protected areas for integrated

conservation and sustainable development: biophysical, socio-economic and governance assessment in East Africa).

The UNEP Regional Seas programme has undertaken a number of integrated assessments at the regional level, particularly through the Nairobi Convention and the WIOLAB project. These assessments cover land-based sources of pollution, physical alteration of coastal habitats, river-coast interactions, legal and institutional aspects and capacities for research and monitoring of the coastal environment.

Among the important ecosystems in the Eastern African Seas region, coral reefs, followed by mangroves, have been the most assessed. Following the coral bleaching event of 1998, the systematic assessment of the biophysical condition of various reefs and related socio-economic aspects in the Eastern African Seas region have been conducted annually, mainly by CORDIO and the Coral Reef Conservation project. The inclusion of socio-economic assessments was new in the Eastern African Seas region.

Over the years, other assessments covering various aspects have been conducted in the region. These include:

- a. Assessment of shoreline change conducted under the framework of the IOC-UNESCO Regional Committee for the Cooperative Investigation of the North and Central Western Indian Ocean;
- b. Assessment of Integrated Coastal Management initiatives in the Eastern African Seas region conducted through the Arusha-Seychelles Process and the Pan-African Conference on Sustainable Integrated Coastal Management; and
- c. The status, policies, regulations and management plans of the marine protected areas in the Eastern African Seas region by the International Coral Reefs Action Network.

5. PRIORITIZED ISSUES

Priority issues include pollution, urbanization, fisheries (particularly related to over fishing and the use of destructive fishing methods and equipment), climate change, physical alteration and destruction of habitats, land-based development and the implementation of Integrated Coastal Zone Management. For the assessment of shoreline changes, issues such as construction and mining, which interfere with the supply of sand to the beach, are considered to be of priority.

6. SUPRA-REGIONAL ISSUES

Vulnerability of the region to external influences is well-recognized, especially with respect to climate change and its impact on the ecosystem. Coral reef rehabilitation and supplementary livelihood options have been promoted. A vulnerability analysis was conducted in the GEF Advisory Committee on Protection of the Sea assessment.

Table 2: Outcome of the GIWA assessment for the Indian Ocean Islands and Somali Current sub-regions showing rankings of major concerns based on present scores

Major Concerns	Indian Ocean Islands				Somali Current (East Africa)			
	Rank	Present Score	Change (+/-)	Future Score	Rank	Present Score	Change (+/-)	Future Score
Freshwater shortage	3	1.50	(-)	2	1	2.27	(-)	3
Pollution	1	1.65	(+/-)	2	3	1.85	(-)	2.6
Habitat and community modification	4	1.45	(-)	2	4	1.7	(-)	2.2
Unsustainable exploitation of fisheries and other living resources	2	1.59	(-)	3	2	2.1	(-)	2.6
Global Change	5	1.20	(-)	3	5	0.75	-	2

Key: Change (2000–2020): deterioration (-); improvement (+).

Score (2020): 0 = no known impact; 1 = slight impact; 2 = moderate impact; 3 = severe impact.

Source: Ruwa and others 2003, UNEP 2004

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

A number of regional organizations and instrumentalities have developed the capacity to undertake various types of assessments in the Eastern African Seas region. The region has adequate technical human capacity to undertake both national and regional assessments on the state of the coastal and marine environment. The technical capacity to carry out assessment resides in national research institutions and universities as well as in regional institutions.

The question is not one of technical capacity, but of funding required to sustain and conduct assessments. The IOTC for example depends on membership dues and contributions from the EU to undertake periodic stock assessments of tuna in the region. Countries in the Eastern African Seas region have been successful in bringing in new talent and engaging in capacity building to address new and emerging capacity needs.

There are limitations associated with availability of funds, because most of the academic and research institutions in the Eastern African Seas region are poorly funded by the State and still depend on donor funding (SAREC, EU, USAID, etc). Recently, partnerships between European universities and regional universities under EU programmes have allowed numerous research and assessments to be undertaken. However, the need remains to build capacity in certain areas, including oceanographic, fisheries, productivity and climate change related research. It is important to note that with the exception of South Africa, few countries in the region possess dedicated research vessels or have vessels at their disposal.

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AoA Region: Mediterranean Sea

Ljubomir Jeftic

The Mediterranean Sea is almost enclosed by Europe, Africa, and Asia with its only natural connections being to the Atlantic Ocean by the Strait of Gibraltar in the west and to the Sea of Marmara by the Strait of Canakkale and the Black Sea by the Strait of Istanbul in the east. The man-made Suez Canal in the southeast connects the Mediterranean Sea to the Red Sea. Twenty-one states have a coastline on the Mediterranean Sea. They are Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Slovenia, Spain, Syria, Tunisia, and Turkey.



Paola, the first sea turtle (Caretta caretta) released from Greece, to be tracked via satellite in the Mediterranean through an electronic transmitter fitted to her back.

1. BROAD ECOLOGICAL CHARACTERISTICS

The Mediterranean Sea covers an area of 2.5 million square kilometres and has a volume of about four million cubic kilometres, with an average depth of 1 500 metres. Located at mid-latitudes half-way between the subtropical and the temperate zones, the climatic and ecological characteristics of the Mediterranean Sea's region are partly maritime and partly continental which has resulted in it being used as a climatic model for other regions around the world. The Mediterranean climate is generally one of mild wet winters and hot, dry summers. Temperature stratification can occur during extended periods of calm seas, high temperatures and inflows of fresh water.

The Mediterranean Sea's unique mixture of subtropical and temperate elements has contributed to species diversity which has few equals in the world. Although the Mediterranean Sea accounts for only 1.5 per cent of the Earth's surface, it hosts approximately seven per cent of the known world marine fauna and 18 per cent of its known marine flora, of which 28 per cent is endemic to the Mediterranean Sea (Fredj and others 1992). Between 10 000 to 12 000 marine species have been recorded and new

species are regularly discovered and described although biomass in the Mediterranean Sea is low (UNEP/MAP/MED POL 2004). In most of the riparian countries, sea fisheries have not been sustainably developed and disturbing effects have been noticed in many areas. As a result, the need has been recognized for the pressure on fishing stocks to be reduced by limiting the fishing effort and improving the quality of fishing gear and its use in specific locations and at certain times.

The Mediterranean Sea's riparian coastal fringe is a high value economic zone, generating income from tourism, agriculture, manufacturing industries and fisheries. About 150 million people live on the 46 000 km of Mediterranean coastline, with approximately 200 million tourists arriving in the region every year. The Mediterranean region's unique landscape and monuments make it a popular tourist destination. Consequently, urbanization has been growing, particularly along the coastal strip, to accommodate both permanent and transient populations. This influx has resulted in substantial modification of the coast itself and adverse effects on the environmental quality.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

The organized international scientific exploration of the Mediterranean Sea was initiated by the International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM) which was created in 1919 to promote international research in the Mediterranean Sea and the Black Sea. ICSEM supports a network of several thousand marine researchers and holds a Congress every three years, with the latest in 2007 attracting of more than 700 scientific presentations.

In the framework of the Regional Seas Programme of UNEP, the Mediterranean Action Plan (MAP) was adopted in 1975 by 16 Mediterranean countries and the European Union (EU), with the main objectives to assist the Mediterranean countries to:

- a. Assess and control marine pollution;
- b. Formulate their national environment policies;
- c. Improve the ability of governments to identify better options for alternative patterns of development; and
- d. Optimize the choices for the allocation of resources.

The Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention) was adopted in 1976 by 16 Mediterranean countries and the EU, which are each party to the MAP. The 1976

Convention was amended in 1995. There are seven Protocols addressing specific aspects of the Mediterranean environment which complete the MAP legal framework. They are:

- a. The Dumping Protocol;
- b. The Prevention and Emergency Protocol;
- c. The Land-Based Sources and Activities (LBSA) Protocol;
- d. The Specially Protected Areas and Biodiversity Protocol;
- e. The Offshore Protocol;
- f. The Hazardous Wastes Protocol; and
- g. The Integrated Coastal Zone Management (ICZM) Protocol.

The main objectives of the Barcelona Convention are to:

- a. Assess and control marine pollution;
- b. Ensure sustainable management of natural marine and coastal resources;
- c. Integrate the environment in social and economic development;
- d. Protect the marine environment and coastal zones through the prevention and reduction of pollution and as far as possible, the elimination of pollution, whether land or sea-based;
- e. Protect the natural and cultural heritage;
- f. Strengthen solidarity among Mediterranean coastal states; and
- g. Contribute to the improvement of the quality of life.

The implementation of the MAP and Barcelona Convention and its related Protocols has been organized by the Mediterranean Coordinating Unit of MAP, which is located in Athens. Among the main MAP components involved in its implementation are:

- a. The Marine Pollution Assessment and Control Component (MED POL);
- b. The Mediterranean Commission on Sustainable Development (MCSD); and
- c. Six MAP Regional Activity Centres (RACs).

Various stakeholders, including non-governmental organizations (NGOs), academia, industry, and others are taking part in all aspects of the work associated with the MAP and are well-represented in the MAP technical and decision making meetings.

The preparation of regional and national activities to address land-based pollution and their adoption by the Contracting Parties of the Barcelona Convention of the Strategic Action Programme to Address Pollution from Land-Based Activities in the Mediterranean Region (SAP MED) are major breakthroughs in the efforts of Mediterranean countries to combat land-based pollution. The SAP MED is an action-oriented

initiative of the MED POL. This programme will identify priority target categories of polluting substances and activities to be eliminated or controlled by Mediterranean countries through a planned timetable for implementation by 2025 of specific pollution reduction measures and interventions. The reduction and phasing-out targets have been developed in accordance with related regional and international conventions and programmes, such as the EU Directives, policies and strategies as well as the Stockholm and Basel Conventions.

The Food and Agriculture Organization's (FAO) General Fisheries Commission for the Mediterranean (GFCM), which has been operating since 1952, is a regional body consisting of 23 member countries and the EU. The main objectives of the GFCM are to promote the development, conservation, rational management and most suitable utilization of living marine resources as well as the sustainable development of aquaculture in the Mediterranean Sea, the Black Sea and their connecting waters. GFCM is instrumental in coordinating efforts by governments to effectively manage fisheries at the regional level.

3. DATA

3.1 Ecosystem data

Almost all of the documents prepared in the framework of the MAP, the Barcelona Convention and its Protocols, the MED POL and those of the MCSD, as well as six of the RACs, are published either as documents prepared for numerous meetings or in the MAP Technical Reports Series (MTS). Most of the substantive documents were issued in the MTS series which includes 165 volumes since 1986. These documents provide an enormous capital of knowledge on many aspects of the Mediterranean Sea. Of all the volumes published so far, many assess particular problems and propose activities to reduce and, where possible, solve the problem. Of the 165 volumes published so far, more than 100 deal with pollution research, monitoring, various assessments, guidelines and action plans. The remaining volumes deal with various activities in the framework of Specially Protected Areas and protected species, the Priority Actions Programme, coastal areas management projects in specific Mediterranean locations, socio-economic aspects, prospective studies, effects of climate change and other aspects of the MAP activities.

In the framework of the GEF/UNEP Project on the implementation of the SAP MED, countries have prepared an inventory and have quantified

all pollution sources on the Mediterranean coast (the Baseline Budget of Emissions and Releases) and have prepared national diagnostic analyses indicating priority issues. The major contribution, however, was the preparation of National Action Plans (NAPs) to address land-based pollution. The plans were endorsed by the Contracting Parties to the Barcelona Convention in 2005. The NAPs describe the policy and actions which each country intends to undertake to reduce pollution in line with SAP targets. The plans incorporate mechanisms for information exchange, technology transfer, the promotion of cleaner technology, public participation and sustainable financing. The fundamental goals of these mechanisms are to:

- a. Develop and implement concrete pollution reduction projects which mobilize both stakeholders and resources;
- b. Become a cyclical process on which to build; have the plans included in relevant institutional, budgetary, and policy frameworks; and
- c. Incorporate lessons learnt in the process in future directions.

The NAP implementation process is expected to greatly enhance economic, technological and coastal development at the local level and make a significant contribution towards sustainable development.

3.2 Socio-economic data

The majority of data collected so far in the Mediterranean Sea and riparian areas are associated with ecosystem, fisheries and pollution, but there is little data on socio-economic aspects and even less on the inter-relation of these two categories. This is a major gap in data and knowledge in the Mediterranean region.

There is no central data repository in the Mediterranean region.

4. ASSESSMENTS

4.1 Thematic/sectoral assessments

The MED POL assists Mediterranean countries in the assessment of the state of pollution, formulation and implementation of pollution monitoring programmes, including pollution control measures. The programme is also responsible for drafting action plans aimed at eliminating pollution from land-based sources. Since its inception MED POL has published more than 70 documents dealing with various aspects of pollution research and monitoring. A list of 54 documents relevant to the assessment of various aspects of the Mediterranean marine environment is presented as a

separate, complementary document to this text. Of the 54 documents, most deal with various aspects of pollution as well as specially protected areas and endangered species. All of these documents cover the whole of the Mediterranean Sea but some also cover certain sub-regional aspects. Thirteen of the documents deal with several issues, while each of the remaining 41 deal with a single issue. Nineteen of these 41 documents deal with assessment of the state of the marine environment relevant to pollution by single categories of pollutants. Sixteen others deal with the issue of specially protected areas and endangered species. Very few documents deal with socio-economic aspects of the marine environment.

Some of the main assessment documents are: Transboundary Diagnostic Analysis (TDA) for the Mediterranean Sea (UNEP/MAP/MED POL 2004); Assessment of Transboundary Pollution Issues in the Mediterranean Sea (MAP 2003); Protecting the Mediterranean from Land-Based Pollution (UNEP/MAP 2001); State and Pressures of the Marine and Coastal Mediterranean Environment (EEA 1999); State of the Marine and Coastal Environment in the Mediterranean Region (UNEP 1996); Identification of Priority Hot Spots and Sensitive Areas in the Mediterranean (UNEP/MAP/WHO 1999); Strategic Action Programme (SAP) to Address Pollution from Land-based Activities in the Mediterranean Region (UNEP/MAP 1998); Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the Mediterranean Region (UNEP/MAP/SPA 2005); European Lifestyles and Marine Ecosystem (ELME) – Priority Issues in the Mediterranean Environment (Langmead and others 2007); Priority Issues in the Mediterranean Environment (EEA 2004); and Assessment of the State of Microbial Pollution of the Mediterranean Sea (MAP/WHO 2007). The latter is one of the 19 documents dealing with the assessment of the state of the pollution in the Mediterranean Sea by various groups of pollutants, particularly those listed in Annexes I and II of the Mediterranean Land-Based Sources Protocol.

The priority for the GFCM is to assess stocks of living marine resources which are exploited by more than one of its members. Thirty-eight shared stocks have been identified so far and the GFCM holds a database on information associated with stock assessments. The results of stock assessments are used in developing integrated management advice with conservation, economic and social considerations. The importance of incorporating ecosystem objectives into the management of sustainable marine fisheries is being promoted by the GFCM through:

- a. The use of indicators, performance measures and targets, and limit reference points for fisheries ecosystem management objectives; and
- b. The use of marine protected areas in combination with management tools and measures to achieve sustainable fisheries and marine ecosystems.

The GFCM considers the use of indicators and reference points for the sustainable management of fisheries in the Mediterranean Sea to be vital and thus further promotes:

- a. The establishment of reference points to be used for (i) monitoring; (ii) management implementation; and (iii) determination of the state of stock or “restoration”; and
- b. The identification of specific reference points, understood by all stakeholders. Indicators for reference points are obtained through catch assessment surveys and direct methods used in estimating the biomass of fish assemblages.

In the studies carried out by the MAP and the GFCM, indicators and reference points were used quite often in pollution, fisheries and biodiversity assessments.

4.2 Integrated assessments

Thirteen of the documents listed above are based on an integrated approach and deal with human pressures on the environment. They also recommend activities and policy options for improving the situation. Another integrated assessment is the TDA prepared under the GEF Mediterranean SAP MED Project. In addition, the GFCM often uses integrated approaches in its assessment documents.

5. PRIORITIZED ISSUES

Key priorities for the Mediterranean states are to:

- a. Bring about a massive reduction in pollution from land-based sources to protect marine and coastal habitats and threatened species;
- b. Make maritime activities safer and more conscious of the Mediterranean marine environment by intensifying integrated planning of coastal areas and monitoring the spread of invasive species;
- c. Limit and intervene promptly on oil pollution;
- d. Further promote sustainable development in the Mediterranean region; and
- e. Assess stocks of living marine resources exploited by more than one of the GFCM members, which is a priority also for the GFCM.

From the review of the results of the work done in the framework of the MAP during the past 30 years, the work of relevant programmes and consideration of available data and information, the perceived major problems could be identified as:

- a. Degradation of coastal and marine ecosystems;
- b. Unsustainable exploitation of marine resources;
- c. Loss of habitats supporting marine and other resources;
- d. Decline in biodiversity;
- e. Worsened human-related environmental conditions; and
- f. Inadequate protection of the coastal zone and marine environment.

Root causes for the perceived major problems were identified as:

- a. Inadequate legal and institutional framework;
- b. Inadequate planning and management at all levels;
- c. Insufficient human and institutional capacity;
- d. Insufficient involvement of stakeholders; and
- e. Inadequate financial mechanisms and support.

6. SUPRA-REGIONAL ISSUES

A number of issues of importance to the Mediterranean Sea and its riparian region warrant consideration and study at the global (supra-regional level).

Among these are:

- a. Effects of climate change and concomitant issues;
- b. Control of land-based activities which impact on the state of the marine environment;
- c. Sewage collection, treatment and disposal;
- d. Nutrients over-enrichment and eutrophication as well as concomitant algal bloom and harmful algal blooms;
- e. Biodiversity and endangered species;
- f. Sustainable management of fisheries;
- g. Invasive species; and
- h. Physical alteration and destruction of habitats and ICZM.

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

The network of participating scientific and professional institutions and individuals developed over the years by MED POL and SPA/RAC is very competent to carry out assessments. The available data and information was satisfactory for the preparation of a certain number of competent

assessment documents. To continue and improve such a process, however, it would be necessary to allocate more funds and apply greater effort to systematically collect reliable data and information. Any assessment document will multiply its value if it is part of a cycle which includes decision making, action plans for reducing or eliminating the problem and an evaluation of the whole process.

The Mediterranean Sea and the riparian region have very good capacity for the preparation of various assessments relevant to the state of the marine environment. Through the MAP structure there is an existing, impressive network of institutions and individual experts capable of preparing complex assessments. The importance of professional assessments for the policy cycle is not fully recognized still by decision-makers, policy-makers or administrators. No effort should be spared to improve the relationship between those conducting assessments and policy-makers to achieve full synergy between the two groups.

Capacity for researching pollution and biodiversity issues is much greater than for socio-economic issues and efforts should be made to bring these two lines of work closer to improve the understanding of the interrelation between them.

There is no doubt that the MAP is the appropriate platform for further work on regional assessment and its coordination. As someone said “the Mediterranean basin as a whole was last “coordinated” under the Roman Empire to serve the interests of that Empire. The MAP is a current attempt to engage a modern era of regional coordination, fundamentally in the interest of the whole human race”.

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AoA Region: North Central Pacific Ocean

Andrew A. Rosenberg

The North Central Pacific Ocean includes waters north of the Equator to the boundary between the subtropical and subarctic oceanographic gyres. It also includes the Insular-Pacific Hawaiian Large Marine Ecosystem (LME), the only LME located in the middle of an ocean, as well as islands under the jurisdiction of the United States of America and other Pacific Islands, excluding American Samoa.



Fisheries sustainability is a major issue in this region.

1. BROAD ECOLOGICAL CHARACTERISTICS

The North Central Pacific Ocean region is characterized by a vast extent of deep ocean and small island land masses. It is connected by the North Equatorial Current and influenced by the North Pacific gyre as a whole. Major environmental drivers of system dynamics for most of the North Pacific include the Pacific Decadal Oscillation (PDO), the North Pacific Gyre Oscillation and the El Niño-Southern Oscillation as well as the variability in the position of the subtropical front. Region-scale changes in primary and secondary productivity and in the productivity of higher trophic levels important to the functioning of the marine ecosystem and its human uses, especially fisheries, have been attributed to the PDO.

The LME has a high diversity of marine species but relatively low biomasses because of limited ocean nutrients (NOAA 1999). A major characteristic is the high percentage of endemic species with about 18 to 25 per cent of its shore fishes, molluscs, polychaete worms, seastars, and algae existing only in this LME. Populations of highly migratory marine mammals, turtles, and seabirds are found in this large ocean area, which is a major habitat for the North Pacific humpback whale. Another key ecological feature is the occurrence of both shallow and deep water coral reefs.

Traditional uses of the marine area are fishing, aquaculture, trade and transportation. Coral reef ecosystems and fisheries have major cultural and economic importance, with pelagic fisheries for tuna and other highly migratory fish species occurring throughout the North Central Pacific Ocean. Tourism is another important economic activity in region.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

National institutions, particularly research institutions from the USA, have extensive ongoing assessment efforts for oceanography, fisheries, protected species, coral reefs and socio-economic factors. The Hawaii Coral Reef Assessment and Monitoring Programme was created in 1997–1998 by leading coral reef researchers, managers and educators in Hawaii. In addition, through collaborative work, the South Pacific Regional Environment Programme (SPREP) and other international agencies have made major contributions to the assessment of the marine ecosystems in the North Central Pacific Ocean. This includes wetland conservation (e.g., mangroves), pollution control and biodiversity conservation as well as climate change impacts and responses. Other institutions undertaking assessment in the region are the North Pacific Marine Science Organization (PICES), the Inter-American Tropical Tuna Commission (IATTC) and the International Whaling Commission (IWC).

3. DATA

3.1 Ecosystem data

There is extensive fisheries data for the North Central Pacific Ocean, particularly for economically important migratory large pelagic species. Data on other fishery resources are available for some areas such as bottom fish in the Hawaiian and Northwest Hawaiian Islands. Extensive data on shallow water coral reefs have been collected and, more recently, on deep water coral resources.

3.2 Socio-economic data

Socio-economic data associated with fisheries have been collected and analysed for some parts of the North Central Pacific Ocean. The extent of such data for other sectors of the economy is unknown at the time of this report.

4. ASSESSMENTS

4.1 Thematic/sectoral assessments

A substantial body of assessment work on fisheries, coral reefs, marine mammals and sea turtles is available from the US NOAA Fisheries Laboratory in Hawaii, the US Coral Reef Task Force, and other agencies. The US Environmental Protection Agency monitors and assesses water quality for Hawaii and the US Territories. SPREP has prepared assessments for pollution and habitat-associated issues for other countries in the region. The Hawaii Coral Reef Assessment and Monitoring Programme has developed a state-wide monitoring network consisting of more than 30 long-term coral reef monitoring sites and an associated database. Following completion of this network the focus was expanded to include rapid quantitative assessments and habitat mapping on a state-wide spatial scale.

4.2 Integrated assessments

Pertinent integrated assessments include the Global International Waters Assessment (GIWA) for the Eastern Equatorial Pacific and the Insular-Pacific Hawaiian LME in the UNEP/GEF/NOAA LME publication. PICES developed an extensive assessment of the entire North Pacific marine ecosystem in 2004 and is scheduled to update this analysis in 2009.

5. PRIORITIZED ISSUES

Fisheries sustainability is a major issue for the North Central Pacific Ocean because of the economic, cultural and food security importance of fishery resources. However, fisheries management challenges are substantial because of the large oceanic areas and the fishing activities by distant water vessels of many foreign nations. Illegal, unlicensed and unregulated fishing are major issues in this region and contribute significantly to the problems associated with over fishing and by-catch of non-target species. Populations of other animals including marine mammals, seabirds and sea turtles are also at risk from fishing, pollution and habitat degradation and loss.

Ongoing conservation concerns for coral reefs are a major issue throughout the North Central Pacific Ocean. Coral reefs are affected by overfishing, climate change impacts, pollution and other factors while deep water corals are facing an increased risk as fisheries expand into deeper waters and the effects of climate change including ocean acidification become apparent.

An over-riding emerging issue for the North Central Pacific Ocean is the impact of climate change. Regime shifts have been well-documented, with warming in the western North Pacific observed when the eastern areas cool. Projected scenarios of the effects of global warming show that the current warming trend is likely to affect water temperature and sea level as well as precipitation patterns and storm events over this region. For some of the islands, sea level rise is an immediate problem and adaptation strategies are needed urgently. In addition, ocean acidification resulting from climate change is a critical problem for coral reefs, shellfish and other resources and habitats of major importance in this region.

6. SUPRA-REGIONAL ISSUES

Because of the strong connections between the Central North Pacific and the South Pacific, many of the issues confronting the island territories and nations in the north are also critical in the south. This is particularly the case for the fisheries, coral reef and climate changes issues, which occur on both sides of the Equator.

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

Although regional capacity for assessments appears to be moderately high in some thematic areas, resource limitations are a major challenge for the North Central Pacific Ocean's vast geographical area. The limited capacity for biodiversity and habitat assessments presents an even greater challenge. New international agreements such as the Western and Central Pacific Fisheries Convention may help coordinate and improve assessment capabilities, particularly for the highly migratory tuna species.

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AoA Region: North East Atlantic Ocean

Alan Simcock



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Fin whale (Balaenoptera physalus) in the Bay of Biscay. The protection of threatened and endangered species and habitats is a priority for the region.

The North East Atlantic region consists of the north eastern quadrant of the Atlantic Ocean, which is broadly to the east of the mid-Atlantic ridge, although some parts of the region are to the west of this feature, and north of the latitude of the entry to the Mediterranean Sea (this area is referred to here as “the region”). There also are several contiguous areas of sea which are usually described separately from the Atlantic Ocean proper including the Bay of Biscay, the Celtic Sea, the Irish Sea, the Malin Sea and the Minches, referred to collectively as the Celtic Seas, the English Channel, the North Sea, the

Greenland Sea, the Norwegian Sea and the Barents Sea with the last three being referred to as the Nordic Seas. There is a broad continental shelf which underlies these separately named seas. The Greenland/Scotland ridge divides the Nordic Seas from the main basin. Three Large Marine Ecosystems (LMEs) are covered by the region – the Iberian Coastal, the Celtic-Biscay Shelf and North Sea.

The coastal states are Belgium, Denmark, including the self-governing territories of the Faeroes and Greenland, France, Germany, Iceland, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom, including the self-governing territories of the Channel Islands and the Isle of Man. Two land-locked states in the catchment basins draining into the North East Atlantic (Luxembourg and Switzerland) participate in the OSPAR Commission, but the third (the Czech Republic) currently does not take part¹.

¹ Tiny parts of Italy and Poland are also in the catchments of the Rhine and the Elbe, respectively, and thus of the North East Atlantic, but these are of no significance for it.

1. BROAD ECOLOGICAL CHARACTERISTICS

Warm Atlantic surface water flows across the region in a north westerly direction towards the Norwegian Sea as the North Atlantic Current. The southern boundary of the region is marked approximately by the Azores Current. As extensions of the Gulf Stream, these two currents form the southern edge of the sub-polar gyre and the north eastern edge of the subtropical gyre respectively. On the edge of Europe, a warm northward-flowing eastern boundary current is found intermittently. A western boundary current flows south from the Fram Strait as the East Greenland Current and, its extension, the Labrador Current. The northward transport of warm surface waters towards the Arctic Ocean is balanced by a southward return flow of intermediate and deep water from the Nordic Seas via the Denmark Strait and from both the Faeroe–Shetland Channel and the Labrador Sea. There is a significant up-welling off the Iberian Peninsula. The water circulation of the European shelf seas is dominated by tidal and wind generated currents. The Mid-Atlantic Ridge is volcanically active and supports hydrothermal vent colonies. These and further details of the overall natural ecology of the North East Atlantic are set out in the Quality Status Report 2000 (QSR 2000) of the OSPAR Commission (OSPAR 2000).

The coastal states of the North East Atlantic region are all developed, industrialised nations. The industrialization in many parts of the region dates back at least 250 years. Some of the coastal areas, such as much of the Netherlands and England have human population densities near the top of the global range. Human impacts are therefore very significant for the state of the marine environment. However many coastal areas, especially in Iceland, Ireland and Norway, have low population densities and some waters are therefore scarcely affected by land-based activities. Other significant coastal areas are impacted by tourism (OSPAR 2005b).

Shipping also exerts a significant impact on the North East Atlantic region's seas, especially through the English Channel and the North Sea, the Straits of Gibraltar and the Galician Cape Finisterre. A substantial part of the total world trade passes through these areas. This impact is expected to grow, both with the economic revival of Eastern Europe, trade from which will tend to pass through the region, and with the development of Russian Federation oil and gas exports. There is also a substantial offshore oil and gas industry, with its own impacts. Fisheries and mariculture (that is, salt-water aquaculture) are significant activities in the region, although, with the exception of Iceland, they play only a very small part in the economies of the coastal states.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

All the coastal states have long had well developed institutions dealing with the monitoring and assessment of their local marine environments, some dating back to the early 18th century. These national institutions have been the foundation of cooperation in the study of the wider questions of the marine environment.

International cooperation in the study of the marine environment of the North East Atlantic region goes back to the establishment of the International Council for the Exploration of the Sea (ICES) in 1903. For many decades, the emphasis on this work was on oceanography and fisheries. The establishment of the Oslo and Paris Commissions to implement the 1972 Oslo and 1974 Paris Conventions on marine pollution from dumping and land-based sources respectively, led to a need for assessment of the state of the environment in the North East Atlantic from other points of view. From the start, this involved cooperation between ICES and the two Commissions. The high-seas living marine resources in the North East Atlantic have been managed by the North-East Atlantic Fisheries Commission (which includes both coastal states and other states such as the Russian Federation and Poland) to achieve sustainable use of the stocks. ICES has provided the scientific basis for the work of this commission as well.

Dissatisfaction with the rate of progress in tackling pollution in the North Sea led Germany to summon the First North Sea Conference in Bremen in 1983. Brief assessments of the state of the North Sea were produced for both the First and Second (London-1987) North Sea Conferences. However, it became clear that the materials for satisfactory assessments were lacking. The Second North Sea Conference then initiated collaboration between ICES and the Oslo and Paris Commissions to produce a comprehensive Quality Status Report (QSR) on the North Sea. This was completed in late 1993, after a considerable amount of new information had been gathered.

The advantages of a comprehensive assessment were clear, and when the Oslo and Paris Conventions were revised and unified in the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), there was early, unanimous agreement that the new conventions should require the regular preparation and publication of comprehensive assessments of the state of the marine environment, including evaluations of both the effectiveness of the measures taken and planned, and the identification of priorities for action.

In 1994, the joint meeting of the Oslo and Paris Commissions set up the Joint Assessment and Monitoring Programme (JAMP), which was aimed at delivering the first QSR under the 1992 Convention in 2000. This objective was approved by the first Ministerial Meeting of the new OSPAR Commission in 1998, together with approval for the admission of non-governmental organizations (NGOs) to participate in all stages. The arrangements adopted proved just adequate and the six years proved barely adequate. Existing specialist working groups were used for the programme which were complemented by new Regional Task Teams for the sub-regional reports and coordinated by a new Assessment Coordinating Group (ACG), chaired by a scientist made available by one contracting party. But it was difficult to get sufficient resources to meet deadlines. Much of the work which had been planned to be sequential ended up being done in parallel. The role of the ACG chairman was crucial. The role of the NGO observers proved to be more to add the oxygen of publicity than to make any inputs of substance, although there were exceptions.

A substantial amount of assessment work is undertaken also at the national level, which flows through to the regional assessment work. This includes the work of such bodies as the Sir Alister Hardy Foundation, a charitable body supported significantly by the UK government, which is now responsible for the Continuous Plankton Survey. This survey was started in 1931 and carried on continuously since 1946 using ships on regular routes across the North Atlantic and the North Sea to collect samples of plankton, which are then analysed for species make-up.

There a number of international fisheries management bodies in the region, including the North East Atlantic Fisheries Commission (NEAFC), the North Atlantic Salmon Commission (NASCO), the International Control Commission for Atlantic Tuna (ICCAT) and the European Union (EU) which manages the exclusive economic zones (EEZs) of its Member states. All rely heavily on the work of ICES to develop the fisheries assessments on which to base their work.

More recently, other Europe-wide bodies have become active in the field. These include the European Environment Agency, the Marine Board of the European Science Foundation, and the European Fisheries and Aquaculture Research Organization. The work consequent to the adoption of the EU Marine Strategy Framework directive will bring the institutions of the European Union into marine assessment work in the future.

3. DATA

The assessment work of both ICES and OSPAR depends crucially on the databases and time-series which have been built up over decades at the national level. Finding shared quality assurance mechanisms and ways to make data from different states inter-comparable has been crucial. Equally important has been the struggle to obtain sufficient resources. Vital elements in mobilizing resources has been Ministerial meetings providing clear, public political commitments to the importance of the work and the personal interest of key Ministers.

ICES operates a major data repository, which also includes a substantial amount of the information collected through the OSPAR system. OSPAR holds most of the remaining data it collects, with air pollution data being managed by a specialist centre that also services the European air-pollution convention. All data is publicly available when its quality has been assured. ICES has a long record of establishing coherent and comparable data collection. From its inception, the OSPAR system has worked with the aid of ICES advice to establish consistent monitoring and reporting systems which would allow effective comparison of data from different states. However, there proved to be major problems aligning long-standing national systems because states were unwilling either to break national time-series or to work on two different bases.

3.1 Ecosystem data

The ICES/OSPAR systems focus on ecosystem data. The OSPAR system has three long-standing components:

- a. A comprehensive monitoring process for a specified set of nutrients and hazardous substances in sea-water, sediments and biota, alongside which there is a process also to collect data on the use and discharge of a wider range of hazardous substances identified as being of concern;
- b. A study of riverine inputs of nutrients and hazardous substances; and
- c. A reporting process for discharges of radioactive substances from nuclear installations alongside which is being developed a process to collect data on discharges of radioactive substances from the most significant non-nuclear sources.

In addition to these measures, OSPAR is developing methods to bring together national monitoring of threatened and declining plant and animal species, and to monitor a range of ecological quality objectives.

The ICES systems cover, on the one hand, fisheries statistics from all the countries active in fisheries in the North East Atlantic, and, on the other,

oceanographic and other data from governmental and non-government marine research establishments.

3.2 Socio-economic data

There is very little international collection of socio-economic data apart from data collected by the European Commission for its purposes. For assessments, it is normally necessary to draw on national data which are wide-ranging and effectively collected, but there can be problems in bringing the data together on a comparable basis.

4. ASSESSMENTS

Over a long period of time, ICES has carried out assessments of the commercial fish stocks in the North East Atlantic. Over time, these have been extended to cover all significant stocks. Based on annual scientific surveys, these have been of high quality and give a high level of knowledge of these resources (ICES 2004 et seq).

Pressures for greater integration of fisheries and environmental policy, emphasized by a 1997 North Sea Ministerial Meeting and the QSR 2000, led to the development by ICES of more integrated working methods for the development of its advice, especially on fisheries management. From 2003, its fisheries advice has taken account explicitly of single-stock management issues as well as multi-species and ecosystem aspects. From 2005, all its advice has been presented as a coherent package. At the same time, there has been a drive to improve acceptability of the scientific advice to fishermen, based on special conferences organised by an international consortium of local authorities, the creation of EC regional advisory committees and the admission of fishermen's representatives and NGOs as observers to the ICES Advisory Committees. More recently, ICES has made major efforts to develop integrated assessments of the marine environment of the North Atlantic, although the results have not been formally published. More effort has also been devoted to explaining the scientific advice to policy-makers. The basic strength of ICES, however, continues to be its scientific working groups, which provide forums in which scientists can develop advice essentially free from any political pressures.

The OSPAR QSR 2000 gave a comprehensive assessment of all aspects of the marine environment. It covered the whole of the North East Atlantic region, including the high seas, although in less detail than the coastal

waters. It did not explore the social and environmental aspects other than as drivers of environmental pressures. It was largely unable to also explore the linkages between different aspects, mostly because of a lack of tools to integrate the assessment. Nevertheless, it served a valuable purpose in justifying the strategies which had been adopted in parallel with it and in identifying priorities, both for information-gathering and research, and for policy action. The mechanisms for ensuring specialist scientific input, liaison with policy-makers through the normal meetings and peer-review worked well and the QSR 2000 was generally well received, although labelled as complacent by environmental pressure groups.

In its format, the QSR 2000 followed the recommendations of GESAMP on the conduct of quality status assessments. This meant that the main sections covered geography, oceanography and climate; human activities; chemistry; biology and concluded with an overall assessment. In the chemistry section, particular attention was paid to the impact on water quality of certain hazardous substances such as heavy metals, certain pesticides, and by-products of the chemical industry as well as the effects of nutrients, especially nitrogen and phosphorus. Based on the Continuous Plankton Survey, which has been collecting data since 1945 through the use of merchant ships sailing regularly on many transects, clear conclusions could be drawn on the lower trophic levels. Assessments were also made of higher trophic levels, including the main commercial fish species, all marine mammals and larger reptiles (for example, migrating sea turtles) found in the North East Atlantic region as well as the main seabird species.

Following the QSR 2000, a new JAMP has been developed to lead to a QSR 2010. This new JAMP is focused more on evaluating progress with the OSPAR strategies, than providing a general description, although an overall evaluation will be included. A series of thematic assessments on particular issues is under way and a synthesis of the first batch was published in 2005/6 (OSPAR 2005a, c, d, OSPAR 2006 a, b).

The QSR 2010 will report specifically on progress towards the goals of the five thematic strategies adopted in 1998/1999 in the light of the developing output of the QSR 2000. The five themes cover biological diversity, eutrophication, hazardous substances, offshore oil and gas and radioactive substances. The QSR 2010 will form the output of the current round of the sixth OSPAR Strategy on environmental monitoring and assessment. Among other things, the QSR 2010 will cover the:

- a. Identification of threatened and declining species and the progress of programmes and measures to protect them; the establishment of marine protected areas;
- b. Hazardous substances to which the goal of cessation of discharges, emissions and losses is to apply and progress towards that goal in relation to each of them;
- c. Success of programmes and measures in eliminating eutrophication;
- d. Progress in introducing comprehensive environmental management systems for offshore installations and the reduction of discharges of produced water from them; the progress in the reduction of discharges of radioactive substances from both the nuclear and non-nuclear industries; and
- e. Assessment of progress towards the suite of ecological quality objectives (EcoQOs), which will give a comprehensive, integrated picture of the state of the marine environment of the North East Atlantic;
- f. Impact of climate change and the acidification of the seas.

The development of ecological quality objectives (EcoQOs), which is a process involving both ICES and OSPAR, will be fundamental to improving the integration of future assessments by providing a way of reading across from one field to another. The EcoQOs, in effect, provide reference points against which to assess a wide range of aspects of the marine environment, which together create a comprehensive and integrated picture.

The implementation of the new EC Marine Strategy Framework Directive (MSFD) will significantly influence future progress (OSPAR 2005b). The 2000 EC Water Framework Directive set up a mandatory system for monitoring freshwater, estuaries and the immediate coast of its Member states and for remedying shortcomings. However, these requirements have been diverting resources from marine monitoring. The MSFD redresses the imbalance by requiring assessments of at least all marine waters within national jurisdiction and action to deal with problems. At the same time, it will lay down a mandatory framework for the waters of EC Member states in the Baltic, Black Sea and the Mediterranean for monitoring, reporting and assessment. There will have to be a period of adjustment as the new obligations directly binding on the EU and European Economic Area (EEA) Member states are reconciled with existing practice.

5. PRIORITIZED ISSUES

Both ICES and OSPAR assessments have identified issues which need to be given priority in improving information collection and analysis, and policy

formulation and implementation. The main issues which have been identified by both series of assessments have been:

- a. The impact of commercial fisheries;
- b. Eutrophication;
- c. Land-based pollution where the most recent assessments have shown reductions in levels of both inputs and concentrations of important contaminants in many areas; and
- d. The protection of threatened and endangered species and habitats.

6. CAPACITY TO UNDERTAKE ASSESSMENTS

All the coastal states of the North East Atlantic region have highly developed marine science institutions and extensive networks between these institutions for data collection and management. These networks ensure that experts in marine ecosystems are in regular contact both with each other and with policy-makers. Networking between ecosystems experts and the experts in relevant socio-economic fields are less well developed. The implementation of the EU Marine Strategy initiative will tend to improve the coherence and inter-comparability of the data collection and management as well as the integration of environmental, social and economic factors, and the assessments based on them.

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AoA Region: North East Pacific Ocean

Andrew Rosenberg and Jake Rice

The North East Pacific region extends from southern Alaska in the north to Colombia in the south and includes 10 countries, Canada, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama and the United States of America. Four GEF Large Marine Ecosystems (LMEs) and other programs are found in this region.



The Panama Canal is the hub of maritime traffic in the region.

1. BROAD ECOLOGICAL CHARACTERISTICS

The North East Pacific is a highly productive and biologically diverse ecosystem which supports major fisheries as well as populations of marine mammals, seabirds, invertebrates and other species. The broad continental shelf of the eastern Bering Sea is strongly affected by seasonal patterns and the counter-clockwise currents formed by the Alaska Stream. The Gulf of Alaska and the area further south are characterized by deeper waters with a narrow continental shelf. These waters are dominated oceanographically by the Alaska Current flowing counter-clockwise in the Gulf of Alaska and the California Current flowing southwards along the Canadian, USA and Baja California coasts. On the west coast of Central America the equatorial currents have greater influence. Upwelling is a major source of nutrients and promotes high productivity along the west coast of North and Central America. The effects of El Niño and La Niña are critically important to the ocean climate and ecosystem condition in this region. A notable physical feature is the volcanic and hydrothermal vents in the Guaymas Trench in the Gulf of California.

The Pacific Decadal Oscillation (PDO) represents a major environmental driver of system dynamics for most of the North East Pacific region. Varying with a periodicity of approximately 11 years, the PDO has been documented to cause regional-scale changes in primary and secondary

productivity as well as in the productivity of a number of fish and macro-invertebrates important to the functioning of the North East Pacific region's marine ecosystems and to human uses, especially fisheries.

Human population density is low north of Vancouver in British Columbia, very high in a series of urban centres in the Georgia Basin – Puget Sound area, the Columbia River outfall, the San Francisco Bay Area and the Ensenada (Mexico)-to-Santa Barbara (California) megopolis with moderate to low population densities between them, and low again along the Gulf of Cortez and Pacific coast of Mexico with locally dense populations around communities. Tourism, fishing, transportation, oil drilling, agriculture and manufacturing and processing industries are among the major economic activities. Fisheries are socially and economically important throughout the region, with community-based fisheries important in many areas of Central America. Ecotourism has been increasing in importance in recent years. The hub of maritime traffic in the region is the Panama Canal.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

Various institutions contribute to the assessment work in the region, including regional and international organizations such as the Inter-American Tropical Tuna Commission (IATTC), the International Pacific Halibut Commission, the North Pacific Anadromous Fish Commission, the Latin American Organization for the Development of Fisheries (Spanish acronym OLDEPESCA), the Pacific Salmon Commission and the North Pacific Marine Science Organization (PICES). Many assessments are done by governmental institutions and academic institutions in the bordering countries, with key agencies including the USA National Oceanic and Atmospheric Administration (NOAA) Fisheries Science centers, the Canadian Department of Fisheries and Oceans, the California, Oregon, Washington and Alaska departments of fish and game, the Pacific States Marine Fisheries Commission and the federal government of Mexico.

PICES, which held its first annual meeting in 1992, is an intergovernmental scientific organization established by convention among the countries around the North Pacific. The organization brings together government and non-government scientists from all around the North Pacific. Although it does not play a formal advisory role to governments on policy or management questions, PICES does conduct

scientific assessments of ecological issues which are relevant to policy and management. In 2004, PICES synthesized the major assessments which cover several issues in the northern part of the North East Pacific region. Many of the component assessments in this synthesis come from government organizations and have a direct link to policy making by national and international decision making bodies.

Canada, Mexico and the USA have formal science advisory processes which conduct assessments and provide advice to the respective governments on policy and management. These processes primarily engage experts employed by the governments, but each ensures participation by experts from academia or other countries. The Canadian process includes participation by invited resource users, experts in traditional knowledge and, in some cases, environmental non-governmental organizations (NGOs). The Canadian process also has a commitment to increase the representation of Aboriginal Traditional Knowledge in all assessments. The USA process has more open observer access, although it has more constraints on participation by non-scientific experts. Mexico's management process also includes the participation of resource users organized in social groups such as fishing cooperatives and in the national fishermen chamber (Spanish acronym CANAINPESCA). Tuna and other highly migratory species are assessed and managed through multinational efforts, mostly through the IATTC, which has a long-standing tradition and experience in the assessment and monitoring of these resources.

Regional initiatives include the Convention for Cooperation in the Protection and Sustainable Development of the Marine and Coastal Environment of the Northeast Pacific (Antigua/Guatemala Convention), which was signed in 2002 by Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. Assessments are conducted under the Northeast Pacific Regional Seas Programme, which is based on the Antigua/Guatemala Convention and includes Colombia, Costa Rica, El Salvador, Guatemala, Honduras and Panama. Regional research activities covering fish stocks and fisheries off Mexico, Central America and Panama have been conducted, many with the technical and/or financial assistance of international, regional or sub-regional organizations, such as the European Commission, the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), the Norwegian Agency for Development Cooperation, OLDEPESCA and the Regional Assistance Programme for Fisheries Development in the Central American Isthmus (Spanish acronym PRADEPESCA).

3. DATA

3.1 Ecosystem data

There are extensive data in time-series which cover the North East Pacific region's biophysical environment during much of the past 50 years, particularly off the coasts of the USA and Canada. These data come from fisheries, coastal development, oil exploration and drilling, transportation and other activities under management as well as from directed research and monitoring efforts of governments and academia. There is a well-developed science programme for the region. For the northern part of the North East Pacific region, coordination through PICES has integrated the work to a significant extent, culminating in the 2004 assessment. Regional quantitative and qualitative assessments of basic ecosystem status are conducted annually for the waters off Canada and Alaska.

There are a variety of regional surveys and monitoring programmes conducted by individual states in the USA and by the federal governments which cover both ocean physics and chemistry and a variety of trophic levels ranging from primary productivity and zooplankton to seabirds and marine mammals. Although none are on full regional scales, many cover large areas of coastal waters and extend for multiple decades.

3.2 Socio-economic data

Socio-economic data are included in individual management planning and environmental assessment documents associated with specific management actions, but are not widely available or synthesized like the biophysical data. Some synoptic data are available in the USA Ocean Economy project, but it contains little time-series information and cannot be used to evaluate status and trends. In Canada, most economic data on the non-fisheries sectors are collected and archived at the provincial level. There are even fewer socio-economic data for areas to the south of northern Mexico.

While extensive data on fishing activities in the region are available, data on other human activities are sparse. The fisheries data can be readily disaggregated by commercial and recreational fisheries as well as on a variety of spatial scales.

Apart from small amounts of data from directed research projects and proprietary data associated with hydrocarbon exploration, in general, all physical, chemical and biological data are held by national laboratories and academic institutions. Social and economic data are held by Provincial and State governments. NOAA is developing databases on demography and economic aspects of coastal communities and industries.

4. ASSESSMENTS

4.1 Thematic/sectoral assessments

For the northern part of the North East Pacific region, periodic assessments are conducted by each of the accountable government institutions, including Fisheries and Oceans and Environment Canada, NOAA, Environmental Protection Agency and Department of the Interior in the USA and their state counterparts. These bodies conduct and report regular assessments of a number of ecosystem components, particularly exploited fish and invertebrate populations, protected species, seabirds, marine mammals, water quality, habitats, ecosystem processes and physical and biological oceanography. In the Latin American countries, fisheries assessments are regularly conducted by government bodies and are based mainly on statistical registers. Academic research studies provide substantial detail for specific areas and ecosystem components. Apart from fisheries, assessments of status and trends of social and economic uses of the Central American countries are infrequent and opportunistic.

In general, the assessments of the Canadian, Mexican and USA science advisory processes have been of specific ecosystem components and the impacts of individual industrial sectors. These assessments often include the impact of specific environmental drivers on the dynamics of the fish stock or other ecosystem component being assessed.

4.2 Integrated assessments

The 2004 PICES overview synthesizes the major assessments from the northern part of the North East Pacific region. It summarizes a substantial body of work on oceanography and climate, water quality and fisheries. The Canadian and USA governments are initiating actions to periodically undertake assessments which will be more integrated across ecosystem components. Canada has completed a major integrated assessment of biological and physical information for the North Coast and Queen Charlottes area, with some incorporation of socio-economic aspects. Descriptive integrated assessments for the three major sub-areas of the Canadian portion of the North East Pacific region also have been completed.

5. PRIORITIZED ISSUES

Fisheries sustainability is a major issue in the North East Pacific region. Many of the fisheries, at least for the principal target species, are well-managed and appear to be healthy and resilient. Other fish stocks, however, have been overexploited and are seriously depleted. Recovery plans aimed at reversing this depletion have met with mixed success.

Protection and recovery attempts are underway for other depleted marine animal populations, including several species of seabirds and marine mammals. Notable among these are polar bears, some whales, fur seals and albatross as well as sea lions in some parts of the North East Pacific region.

Land-sea connections, including the interaction between ocean and river systems, are a major issue for much of the region, particularly the more developed central and southern portions. An obvious concern is the decline of major salmon populations along the coast to the south of Alaska. There is significant debate about the contribution to these declines of climatic factors, fisheries and human impacts on habitat quality. Less obvious is the impact of run-off and nutrient enrichment that creates seasonal hypoxia in the coastal waters off some of the rivers.

Invasive species, including from mariculture, are a major concern, particularly in certain areas such as San Francisco Bay, which also has experienced substantial habitat (wetland) loss.

Throughout the North East Pacific region, but particularly in the central and northern areas, increasing empowerment of aboriginal peoples in governance and the role of aboriginal traditional knowledge in assessments are issues in policy, management and assessments. In the southern parts of the region the sustainability of large and small-scale fisheries is a major concern. Large-scale fisheries are less common in these areas, where artisanal fisheries are of greater importance. Many large commercial and artisanal fisheries are fully or overexploited and fish stock rebuilding programmes are a major issue in these areas. There is a compromise between sharing fishing opportunities, expanding commercial fisheries and conservation initiatives.

An over-riding emerging issue for the North East Pacific region is the impact of climate change. Regime shifts have been well-documented for the Gulf of Alaska and the eastern Bering Sea region as well as the effects on ocean-climate of the shift in the Aleutian Low.

6. SUPRA-REGIONAL ISSUES

The strong interactions between the North East Pacific region, western North Pacific and the Arctic are strengthening further with a changing climate. Ocean circulation and changing contaminant patterns, species range and habitat changes, transportation and energy infrastructure development along with conservation are all relevant supra-regional issues in the North East Pacific region. Other relevant supra-regional issues are potential deep water fisheries and the management of shared international fisheries.

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

Regional capacity for assessment is very high, although capacity for social and economic assessment may be lower than that for biophysical assessment. Detail studies of contaminants have often been site-specific rather than broad-based such as with the Exxon Valdez related work. Land-sea-climate interaction studies are a major new area of research which needs to be brought into the policy making setting as soon as possible.

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