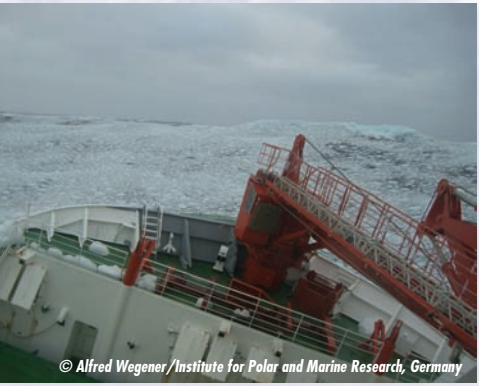
Annex IV: Regional Summaries

AoA Region: Southern Ocean

Hartmut Heinrich



Running marine observations in the Southern Ocean is not always "plain sailing". Data collection especially during the winter season is often made difficult or even impossible by sea ice and very harsh weather conditions. German Research Vessel "Polarstern".

The Southern Ocean comprises the seas around Antarctica. The International Hydrographic Organization (IHO) has designated the Southern Ocean as the oceanic division encircling Antarctica but its boundaries are not yet formally adopted because of a number of unresolved disputes. The Antarctic Convergence or Antarctic Polar Frontal Zone, which is a small ocean zone where two circumpolar currents meet, fluctuates seasonally between latitude 48° and 60° South. For scientific reasons this ocean zone is considered sometimes to separate the Southern Ocean from the Atlantic, Indian and Pacific Oceans. The region includes the Antarctic Large Marine Ecosystem (LME) and the countries involved are the Parties to the Antarctic Treaty. Consultative Parties, Non-Consultative Parties and Parties to the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) only are listed in Annex 1.

1. BROAD ECOLOGICAL CHARACTERISTICS

The Southern Ocean has depths of between 4 000 and 5 000 metres (m) over most of its extent, with only limited areas of shallow water. The maximum depth is 7 235 m. The Antarctic continental shelf is generally narrow and unusually deep because of the weight of the Antarctic ice shield. The edge of the ice shield reaches depths of up to 800 m and its widest point is 1000 kilometres in the Bellingshausen, Weddell and Ross Seas.

The Antarctic Circumpolar Current moves perpetually eastward with a length of 21 000 km, transporting 130 x 10^6 cubic metres of water per second. Sea surface temperatures vary from about 2–10°C. Cyclonic storms travel eastward around the continent and are intense. The ocean area from about latitude 40°S to the Antarctic Circle (66°32' S) has the strongest average winds found anywhere on Earth. In winter, the ocean freezes northward to

65°S in the Pacific sector and to 55°S in the Atlantic sector. The Antarctic pack ice fluctuates seasonally from an average minimum of 2.6 x 10^6 km^2 in March to about 18.8 x 10^6 km^2 in September.

There is no inflow from rivers, but melting icebergs release large amounts of freshwater and sediments to the sea. Nutrient-rich water rises to the surface where it fertilizes the Antarctic surface waters. The marine fauna in the Southern Ocean is far richer than in the Arctic Ocean with a high degree of endemism and great biomass. Antarctic benthic communities usually have several dominant species. The fish fauna is mostly endemic and adapted to below-freezing temperatures. The bird and marine mammal communities are similar at a given latitude in all parts of the Southern Ocean basin.

The ecological and biological characteristics of Antarctic marine species form a unique food chain in that it is peculiarly short and based predominantly on krill and on myctophids, which are key groups of zooplankton crucial to the sustainability and production of all other species in the region. The inherent physical and biological variability of the Southern Ocean has a strong influence on the zooplankton biomass. In some years it leads to a shortage in certain parts which has severe detrimental effects on its seabird, whale and seal predators.

Large areas of the seafloor around Antarctica are deep-sea environments and while the biology of Antarctica's shelf regions and slopes are relatively well-known, these deep-sea areas remain practically unexplored.

There are no native human populations in Antarctica and there are few human activities. While there are substantial fisheries, other activities are confined to scientific research from ships and a number of research stations on the vast continent (12 093 million km^2). The region is also attracting tourism, especially cruise ships, but they are restricted largely to the area around the Antarctic Peninsula during the Antarctic summer. Other than cruise ships and a few research ships, vessel traffic is limited to supply vessels servicing research stations.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

The Antarctic Treaty applies to the area south of 60°S and its Protocol on Environmental Protection (1998), prescribes comprehensive protective measures. All signatories to the Antarctic Treaty pledge to uphold these principles in accordance with international requirements and domestic legislation regarding the protection of the environment.

The Treaty is augmented by the Protocol on Environmental Protection to the Antarctic Treaty (1998), the Convention for the Conservation of Antarctic Seals (CCAS) (London 1972) and the CCAMLR (Canberra 1982).
The CCAS provisions on actual regulation of sealing have never been implemented because no commercial sealing has been carried out in the Southern Ocean since the treaty entered into force.

The Parties to the Treaty hold Antarctic Treaty Consultative Meetings (ATCM) to further the aims of the Antarctic Treaty and its Environmental Protocol. In its five Annexes, the Protocol on Environmental Protection to the Antarctic Treaty details provisions for assessing environmental impacts, conserving fauna and flora, managing waste, preventing marine pollution and setting aside specially protected or managed areas. The Protocol prohibits mineral resource extraction other than for scientific research purposes.

The Treaty and Protocol have an advisory Committee on Environmental Protection (CEP) to provide advice and recommendations to the decision-making body on matters such as:

a. The state of the Antarctic environment;
b. The effectiveness and implementation of measures adopted for environmental protection;
c. The collection, archiving, exchange and evaluation of information relating to environmental protection; and
d. The need for scientific research, including environmental monitoring.

The CEP consults with the Scientific Committee on Antarctic Research (SCAR), the Council of Managers of the National Antarctic Programmes (COMNAP), the Scientific Committee of CCAMLR and other relevant scientific, environmental and technical organizations or experts when considered necessary.

The area of CCAMLR, which extends to the Antarctic Convergence, came into force pursuant to the provisions of Article IX of the Antarctic Treaty. It was established in response to concerns that an increase in krill catches in the Southern Ocean could have a serious effect on populations of krill as well as on other marine life which depend on krill for food. The Convention is aimed at conserving the marine life of the Southern Ocean, while allowing for rational and sustainable harvesting. Achieving this objective requires collecting large amounts of information and the development of appropriate scientific and analytical techniques. A "precautionary" approach has been implemented to minimize risk associated with unsustainable practices under uncertain conditions. The overarching objective is to manage Antarctic living

resources on an ecosystem scale. The Scientific Committee of CCAMLR is responsible for undertaking assessments on matters such as commercial fish stocks, critical ecosystem components, sea birds and marine mammals.

COMNAP brings together the National Antarctic Programmes of countries from Europe, Africa, Asia, the Americas and Australasia. As a council of managers and operators, COMNAP is competent in the realm of operational implementation and safety as well as technology and information sharing. It provides the Antarctic Treaty parties, on request, with technical advice which has been developed using the members' pool of expertise. COMNAP has established an Antarctic Environmental Officers Network (AEON), which brings together national Antarctic programme officers dealing with the environmental management of Antarctic operations. This network is very active and makes significant contributions to the further development and improvement of environmental practices.

SCAR, which was established in 1958, is a committee of the International Council of Scientific Unions (ICSU) and is charged with the initiation, promotion and coordination of scientific research in Antarctica. SCAR also provides international, independent scientific advice to the Antarctic Treaty system by preparing reports and undertaking assessments on request.

Census of Antarctic Marine Life (CAML) is an international program in the framework of Census of Marine Life (COML) which will prioritize Antarctic marine organisms in terms of unknown aspects of marine biodiversity and ocean change. CAML is an information system assimilating data from field projects investigating what lives in six ocean realms (Human Edges, Hidden Boundaries, Central Waters, Active Geology, Ice Oceans and Microbe). It also combines data from projects designed to investigate the history of marine animal populations and to forecast the future of marine populations and ecosystems.

The International Whaling Commission (IWC) was set up under the International Convention for the Regulation of Whaling (ICRW; 1946). The purpose of the Convention is to provide for the proper conservation of whale stocks to make possible the orderly development of the whaling industry. The main duty of the IWC is to keep under review, and revise as necessary, the measures laid down in the Schedule to the Convention. It also requires the compilation of catch reports and other statistical and biological records. In addition, the Commission encourages, coordinates and funds whale research, publishes the results of scientific research and promotes studies on related matters such as killing operations by humans. In

1994, the IWC declared the Southern Ocean a whale sanctuary, although whaling for scientific purposes is permitted.

The Antarctic region is an independent partner programme to the United Nations Environment Programme (UNEP) Regional Seas Programme (RSP).

3. DATA

3.1 Ecosystem data

A number of national programmes conduct localized assessments of the impact of humans in Antarctica relating to specific chemical compounds, organisms and/or the activities of animal populations. These programmes are aimed at producing relevant data on the effects of hydrocarbon pollution, heavy metal accumulation in plants as well as the presence in animals of heavy metals, pesticides and other organic compounds. The data is made available to CCAMLR through regular national reporting. Although there is coordination or agreement on standardized methodologies, it is difficult to detect temporal and/or regional trends in environmental quality. There are few published summaries, bibliographies of monitoring (e.g., COMNAP 1998) or assessments relating to human impacts in the Antarctic.

The most important driver for certain narrowly focused assessments is the management of commercial fisheries. Data dealing with commercial fisheries are collected by the CCAMLR Ecosystem Monitoring Programme (CEMP), implemented in 1984. Information obtained is on harvested species such as krill, squid and the Patagonian Toothfish in various statistical areas as well as the impact on dependant species such as seabirds, penguins and seals. Data are held by CCAMLR and the Food and Agriculture Organization (FAO). There is free access to the data for CCAMLR members for analyses and for preparation of documents and data used in connection with published reports are for the public domain. To protect confidentiality, all data concerning the landings and trade details of individual companies must be aggregated, or encrypted before they are made available to working groups of the CCAMLR or its Scientific Committee. Most data from the Southern Ocean are collected for scientific purposes and are held in National Oceanographic Data Centres or scientific institutions. According to the Antarctic Treaty, access to these data is free, but usually is restricted until its official publication in scientific journals or reports.

3.2 Socio-economic data

There are annual exchanges of national reports on all human activities in the area, including those associated with tourism and its related environmental actions and activities.

4. ASSESSMENTS

4.1 Thematic/Sectoral assessments

While some of the organizations such as the CCAMLR and the IWC conduct assessments, they strongly favour specific sectors and focus on providing management advice on exploitable biological resources. Assessments of data collected within the COMNAP framework are very much focused on distinct problems and are usually published in scientific literature. There have been some activities designed to particularly assess habitat quality and extent in relation to defining protected areas for some fish species and krill.

The Protocol on Environmental Protection to the Antarctic Treaty requires monitoring to be taken into account in the planning and conduct of all Antarctic activities. Monitoring is required also to facilitate early detection of possible unforeseen environmental effects, both within and outside Antarctica. Monitoring is integral to the Environmental Impact Assessment process and is intended to guide the management of activities to minimize and mitigate their impact. Environmental monitoring in Antarctica of global, regional and local impacts has been conducted by a number of national programmes over many decades. However, there has been little international coordination of assessments.

Management advice on commercial fisheries within CCAMLR is provided through annual assessments using a system of scientific working groups. Scientists conduct assessments using data collected in accordance with CCAMLR's observer and monitoring procedures and reporting requirements and supplementing their own information with results from individual scientific investigations. The outcomes of the assessment are reviewed by the Scientific Committee of CCAMLR. The recommendations made by the Scientific Committee are considered by CCAMLR when making its decision on catch regulations. The advice to CCAMLR is purely scientific and does not include comments from administrators, fisheries managers, stakeholders and non-governmental organizations. The Scientific Committee of the IWC is responsible for best estimates of whale populations and carries out in-depth evaluations for certain whale stocks. There is good coordination between CCAMLR and the IWC.

SCAR has provided numerous reports and assessments requested by Parties to the Antarctic Treaty over several decades. These reports include studies of environmental impacts of waste disposal on Antarctica and studies on pathways of native species populations and the accidental introduction of potentially lethal virus infections originating outside Antarctica, such as a study on hull fouling as a source for non-indigenous alien species invasions. An assessment in 2006 covered the risk of impacts on marine animals from noise, including that from acoustic equipment used in the Southern Ocean, and from being struck by ships. A draft report on the effects of climate change was presented in 2008 for comment. SCAR is to prepare a report on pollution pressures in the region for the CEP meeting in 2009.

Under the CCAS agreement, SCAR is charged with providing information on the status of seal stocks and assessing the effects on a specific species or on the ecological system in any particular locality of any seal for scientific research purposes. Tables on the status of stocks are updated each year and posted on the website (http://www.seals.scar.org). However, updates are currently needed for the populations and stocks of some species. There is full exchange of information between CCAMLR and SCAR on seals and SCAR provides CCAMLR with a report on the status of seal stocks every five years. The next report is due to be released in 2010. In 2007, the Parties to the Antarctic Treaty requested SCAR to complete a review of population status and trends for the Southern Giant Petrel in the region in collaboration with CCAMLR and the Convention on Migratory Species (CMS) Agreement on the Conservation of Albatrosses and Petrels (ACAP).

In 1994–95, COMNAP and SCAR convened technical workshops to provide the Antarctic Treaty Parties with advice on practical, scientifically sound and cost-effective monitoring which would meet the requirements of the Protocol on Environmental Protection (*Summary of Environmental Monitoring Activities in Antarctica* in 1997). A report, entitled *Monitoring of Environmental Impacts from Science and Operations in Antarctica* (1996), provided extensive guidance on the design and selection of indicators of chemical contamination and physical disturbance. This was followed by a manual of agreed methods for analytical protocols intended to promote standardization of monitoring efforts and to increase inter-comparability across programmes. In 2004, COMNAP presented the *Practical Guidelines for Developing and Designing Environmental Monitoring Programmes in Antarctica*. National programmes have also produced guidance and reference documents describing accepted

procedures and protocols for long-term monitoring programmes. In 2005, a workshop co-sponsored by COMNAP, the USA National Science Foundation and SCAR developed recommendations of *Practical Biological Indicators of Human Impacts in Antarctica*.

SCAR scientists have a working relationship with the assessment processes of the Intergovernmental Panel on Climate Change (IPCC) and the Environmental Effects Panel under the Ozone Convention/Montreal Protocol.

4.2 Integrated assessments

Although there are a number of obligations, recommendations and standards for monitoring human impacts in the Southern Ocean within the Antarctic Treaty system, integrated assessments are carried out only rarely.

5. PRIORITIZED ISSUES

The most important issue of current marine environmental assessment activities undertaken is the management of commercial fishing and the impacts it has on target species and predators. In 2007 under the Antarctic Treaty, the CEP provisionally agreed on priorities using a risk-based approach. The introduction of non-native species and tourism-related impacts such as pollution, litter and physical disturbance of birds and mammals receive high priority. There are a number of scientific assessments on seabirds, penguins, marine mammals and other elements of the ecosystem which have been used for scientific and management purposes, including threatened species assessments. Although a number of chemical and biological monitoring activities concerning human impacts are recommended in connection with the commercial and scientific use of the Antarctic and the surrounding Southern Ocean, progress in implementing those recommendations appears to be rather slow.

6. SUPRA-REGIONAL ISSUES

The Southern Ocean plays a major role in the climate system of the Earth. The down-welling of cold and freshly aerated water supplies oxygen and other gases to deep-sea environments and removes carbon dioxide (CO_2) from the atmosphere. As a result, changes in the physical conditions of the Southern Ocean, such as increasing temperature and enhanced freshwater input from melting Antarctic ice, may have a severe impact on the global climate. Additionally, this down-welling (deep-water production) which transports CO_2, also transfers contaminants from the atmosphere and from

surface waters to the deepsea. This transfer is likely to adversely change the chemistry or even pollute the Southern Ocean.

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

The Southern Ocean is a vast and rough sea area with great natural variability. Its ecosystem elements are fairly well known although the interaction between physical and chemical elements of the ecosystem processes are largely unknown. There are impacts resulting from direct human activities such as research and exploitation of resources, especially fish. The Southern Ocean region is of great importance for the physical behaviour of the global ocean in phenomena such as thermohaline circulation, sea level rise and gas exchange. It is a sensitive indicator of global changes and undertaking adequate marine observations and assessments in this region is crucial.

Within the Antarctic Treaty, a number of monitoring obligations exist, which, if fully implemented, could generate valuable data for integrated assessments. Member states should be motivated to fulfil their obligations. It is clear that in such a vast ocean, without direct riparian states, a monitoring programme would prove to be expensive and difficult to maintain. However, valuable information on the human impact in this region could be obtained through the enforcement of existing obligations in monitoring and assessment combined with modern global ocean observing systems such as Argo and satellite remote sensing.

The current collaboration between the CCAMLR Scientific Committee and the CEP on bioregionalization of the Southern Ocean has the potential to contribute to comprehensive assessment of the region.

REFERENCES

COMNAP (1998). *Summary of Environmental Monitoring Activities in Antarctica.* Council of Managers of National Antarctic Programs, 34 pp. http://pdf.comnap.aq/comnap/comnap.nsf/P/PDF/5/$FILE/Summary.pdf?Open&ext=.pdf

WEBSITES

Antarctic Treaty: http://www.ats.aq

CCAMLR: (http://www.ccamlr.org/pu/e/e_pubs/sr/drt.htm)

COMNAP: http://www.comnap.aq/publications/atcm/

IWC: http://www.iwcoffice.org

SCAR: http://www.scar.org

CAML: http://www.caml.aq

Annex 1: **Lists of Parties**

Consultative Parties

Country	Environment Protocol	CCAS	CCAMLR
Argentina	x	x	x
Australia	x	x	x
Belgium	x	x	x
Brazil	x	x	x
Bulgaria	x		x
Chile	x	x	x
China	x		x
Ecuador	x		
Finland	x		x
France	x	x	x
Germany	x	x	x
India	x		x
Italy	x	x	x
Japan	x	x	x
Republic of Korea	x		x
Netherlands	x		x
New Zealand	x		x
Norway	x	x	x
Peru	x		x
Poland	x	x	x
Russian Federation	x	x	x
South Africa	x	x	x
Spain	x		x
Sweden	x		x
Ukraine	x		x
United Kingdom	x	x	x
United States of America	x	x	x
Uruguay	x		x

Non-Consultative Parties

Country	Environment Protocol	CCAS	CCAMLR
Austria			
Belarus	x		
Canada	x	x	x
Colombia			
Cuba			
Czech Republic	x		
Denmark			
Estonia			
Greece	x		x
Guatemala			
Hungary			
North Korea (DPRK)			
Monaco			
Papua New Guinea			
Romania	x		
Slovak Republic			
Switzerland			
Turkey			
Venezuela			

Parties to CCAMLR only

Country	Environment Protocol	CCAS	CCAMLR
Cook Islands			x
European Community			x
Namibia			x
Vanuatu			x

AoA Region: Arctic Ocean

Gunnar Sander and Jake Rice

The Arctic Ocean is nearly encircled by the Eurasian and North American continents. The central Arctic Ocean is surrounded by Baffin Bay, Hudson Bay, the Canadian Arctic archipelago, Beaufort Sea, Bering Sea, Chukchi Sea, East Siberian Sea, Laptev Sea, Kara Sea, Barents Sea, and the Greenland Sea. In this summary, the region also includes the northernmost parts of the North East Atlantic Ocean (OSPAR Region I – Arctic waters), which also includes the Exclusive Economic Zones (EEZs) of Iceland and the Faeroe Islands. The countries referred to as Arctic states are the Member states of the Arctic Council: Canada, Denmark (Greenland and the Faeroe Islands), Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America.

The foraging and breeding patterns of polar bears are intimately associated with the sea ice. As sea ice extent and duration is reduced due to climate change, the status of polar bears and other ice-associated species are of increasing concern.

1. BROAD ECOLOGICAL CHARACTERISTICS

The central Arctic Ocean mostly consists of basins with depths of between 4 000 and 5 400 meters (m), divided by several ridges. Steep continental slopes rise from the basins to wide and shallow continental shelves, particularly north of Russia. Northeast Canada is a large archipelago. Svalbard and the Russian coast also have several island groups.

The Arctic Ocean has a high freshwater inflow from rivers. Other major characteristics are the low temperatures and ice-covered waters. There is, however, a large variability in climatic conditions, both geographically and within and between years. Relatively warm and salty waters flow into the Arctic Ocean, mainly with the North Atlantic Current, but also from the Pacific through the Bering Strait. Front systems are created when cold and warm waters meet, and along the ice edge. They give rise to high productivity, especially in the shallow Barents, Bering and Chucki Seas.

The position and timing of front systems and the marginal ice zone can vary substantially. This has consequences for the whole ecosystem and influences, for example, the strength of year classes of fish stocks. Areas in the ice-covered regions which remain ice-free more or less year-round (polynyas) also are very dynamic and highly productive. In the central Arctic Ocean basin, primary production occurs in the ice community and is more limited, whereas productivity from microalgae can be relatively high in some coastal areas.

Between 60 and 80 per cent of all annual primary production in Arctic marine areas occurs in a short and intense bloom of phytoplankton and ice algae between March and May. The energy is effectively transferred to higher trophic levels, typically by a few species of zooplankton in each area, and sustains large populations of fish, sea birds and mammals. Arctic species have special adaptations to the low temperatures and highly variable conditions and even the ice may contain hundreds of species. Nutrients from the ice-associated species sink to the bottom and give rise to rich benthic communities in many Arctic waters. Arctic pelagic ecosystems generally have low numbers of species but high numbers of individuals. Because of the strong seasonality, a number of species, particularly seabirds and marine mammals, utilize the area mostly in summer, migrating to southern areas in the fall.

For centuries indigenous peoples around the Arctic Ocean have subsisted on marine mammals, seabirds and fish. Large-scale commercial activities have been limited because of the harsh climate conditions. However, the more temperate areas in the North East Atlantic Ocean do sustain some of the world's richest fisheries, and also have several shipping routes and some offshore oil- and gas activity. (See future prospects below). (See also the regional summary for the North East Atlantic Ocean)

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

2.1 Regional organizations

The Arctic Council (AC) is a high-level intergovernmental forum to promote cooperation, coordination and interaction in particular on sustainable development and environmental protection. The members are the eight countries with territories north of the Polar Circle and representatives from six indigenous people's organizations given special status as permanent participants. Several non-Arctic countries and international organizations are observers.

The AC has built up a long record of assessments, starting in the early 1990s when the Arctic Monitoring and Assessment Programme (AMAP) was established. Later other working groups were engaged in assessments, particularly Conservation of Arctic Flora and Fauna (CAFF) and Protection of the Arctic Marine Environment (PAME). The AC assessments are scientific assessments which are conducted independently by scientists on specific mandate from the Ministers in the AC and usually include policy recommendations. They have advanced international understanding of how long-range transport of pollution and climate change affect the vulnerable Arctic environment and have influenced international conventions in these fields. Influence on the Member states from the non-binding AC recommendations is hard to evaluate.

PAME is both an AC working group and an independent Regional Seas Partner Programme. It was established in 1993 to address policy and non-emergency pollution prevention and control measures associated with both land-based and sea-based activities. The ecosystem approach is a guiding principle in the Arctic Marine Strategic Plan (Arctic Council 2004). To make it operational, 17 Large Marine Ecosystems (LMEs) are identified as units for future assessment and management

The International Arctic Science Committee encourages and facilitates cooperation in Arctic research. Many international and national scientific organizations are engaged in Arctic scientific activities with the International Polar Year (2007–2009) as a large-scale joint research effort involving scientists from 60 nations. The International Council for the Exploration of the Sea (ICES, founded 1902) and the North Pacific Marine Science Organization (PICES, founded 1990) are intergovernmental scientific bodies. ICES has a major advisory role for several marine conventions and national regulatory authorities, especially with their annual assessments and overview reports supporting fisheries management. PICES has worked more with assessments of changes in the ocean without having the same direct advisory role.

2.2 International conventions and multilateral collaboration

Many international conventions apply to the Arctic Ocean. The authors are not aware of any particular Arctic assessment activities from them, apart from:

- The Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) presented its Quality Status Reports in 2000,

including a regional report for the Arctic parts of its mandate area. ICES makes its regular assessments of the oceanographic environment available to OSPAR.

- Both the North East Atlantic Fisheries Commission (NEAFC) and The North Atlantic Salmon Conservation Organization rely on ICES for assessing the status of fish stocks within their area of responsibility, although both produce overviews of the fisheries resources under their responsibility.
- The International Whaling Commission, the North Atlantic Marine Mammal Commission, and the Bering Sea Pollock Convention[1] all have their own scientific bodies to assess stocks for which they have management responsibility.

2.3 Bilateral collaboration involving assessments

USA–Russian Federation, Canada–USA, Canada–Greenland, and Norway–Russian Federation have bilateral collaboration agreements. These often lead to research and monitoring of the marine environment, especially of oceanographic parameters and management-oriented topics concerning fish, marine mammals and sea birds. Assessments are conducted regularly for harvested stocks. Norway and the Russian Federation made a joint broad assessment of the Barents Sea in 1997 and plan to do so again in 2010.

2.4 Individual countries assessments

Canada, Norway, and the USA have developed national policies and legislation aimed at incorporating the ecosystem approach into ocean management. This has led to broader ecosystem assessments of the Eastern (Canadian) Beaufort Sea, the Norwegian part of the Barents Sea and the Bering Sea.

The Arctic states also conduct assessments of individual ecosystem components such as exploited fish stocks and marine mammals supporting subsistence hunts. Advice from ICES and numerous regional and national agencies is considered when quotas are set. Indigenous management boards and cooperative agreements in the USA and Canada have substantial autonomy in regulating their subsistence hunts and generally contribute traditional knowledge to assessments.

1 Full name: "Convention for the Conservation and Management of Pollock Resources in the Central Bering Sea"

2.5 Other organizations

The World Wildlife Fund published a biodiversity assessment of their Barents Sea Ecoregion in 2002 (WWF 2004), and has produced several overview reports.

3. DATA

3.1 Ecosystem data

Large parts of the vast Arctic Ocean are difficult to explore scientifically because of harsh climate conditions and expensive logistics. Scientific knowledge and monitoring of the marine area is therefore limited, both in geographical and seasonal coverage. There are limited data from some ice-covered and remote areas, particularly from the winter season. Furthermore, biological observations are biased towards near-shore habitats and harvested species such as fish, birds, seals and whales. Remote sensing augments the data available, but mostly on physical and meteorological features.

There have been several initiatives from the AC working groups to harmonize monitoring in the Arctic states, especially for contaminant and climate change, and more recently, biodiversity. Monitoring has provided a basis for the pan-Arctic assessments, although harmonization and coverage of sampling still need to be improved. Some thematic data centres have been created, but reporting is limited in many areas and data and meta-data are not readily available to the public. The Sustaining Arctic Observing Network is a joint effort involving international scientific organizations and the AC and is designed to extend the efforts from the International Polar Year through continued collaboration on observations as well as on enhanced and coordinated access to data.

Traditional/aboriginal/local knowledge has been used to supplement the scientific data, both in the Beaufort Sea regional assessment and in the Arctic Climate Impact Assessment. As a result there is a broader understanding now of the importance of collaboration between the scientific community and other knowledge holders.

3.2 Socio-economic data

The AC has elaborated statistics on the economy of the north (Glomsrød and Aslaksen 2007) and a statistical database on the socio-economic conditions of the peoples of the whole of the Arctic region (http://www.arcticstat.org).

4. ASSESSMENTS

4.1 Assessments covering the whole Arctic Ocean

The AC is the only organization which has undertaken assessments for the whole Arctic area. However, no integrated marine assessment has been carried out. The closest is a report written by PAME in 1996, which was the basis for the Arctic Marine Strategic Plan. The typical AC assessments follow activities or pressures on the environment:

- Arctic Pollution Issues (1997/98, 2002, 2006, 2009);
- Arctic Climate Impact Assessment (2004) with a cryosphere follow-up (2009/2011);
- The Arctic Oil and Gas Assessment (2008); and
- The Arctic Marine Shipping Assessment (2009).

However, CAFF has assessed the state of Arctic Flora and Fauna (CAFF 2001). Its upcoming Arctic Biodiversity Assessment (2012–2013) will have a holistic view of biodiversity as a starting point and will analyse the different pressures affecting the status of Arctic species and ecosystems.

4.2 Integrated assessments for seas within the Arctic Ocean

Integrated marine assessments have been elaborated by governments for the northernmost part of the North East Atlantic Ocean (through OSPAR), the eastern (Canadian) Beaufort Sea, and the western Barents Sea. The latter two assessments are particularly interesting because they are linked to management of the areas, and will be updated. PAME promotes similar assessment and management pilot studies for the LMEs of the West Bering Sea and the Beaufort Sea.

Both the Global International Waters Assessment and the international LME programme have assessed seas within the Arctic Ocean. These activities have been mostly decoupled from governments and their management activities.

5. PRIORITIZED ISSUES

The Arctic Ocean receives hazardous substances from southern regions through the air, rivers and ocean currents. Persistent organic pollutants (POPs) in particular can have severe impacts on Arctic marine wildlife. Many substances accumulate in the marine food chain and pose hazards for both top predators and humans with a high intake of marine foodstuff.

Climate change has significant impacts on the Arctic Ocean. The most visible change is the retreat of the sea ice, which reached a record minimum extent during the summer of 2007. It is hard to make reliable predictions on the speed of the melt, but it is perceivable that within a couple of decades, the summer ice may disappear before the winter freeze starts. Large-scale changes to the ecosystems are expected to follow as sea temperatures increase and the sea ice decreases. Cold water and ice-associated species, with the polar bear as the most well-known symbol, are most at risk of major declines, whereas increasing numbers of traditionally more southern species have been observed in recent years.

Diminishing ice will accelerate global warming and provide easier access to the natural resources in the Arctic Ocean. Shipping, offshore oil and gas, tourist cruises and fishing activities are likely to increase, bringing new environmental threats into an ocean that, so far, has been largely inaccessible because of the ice. It is therefore urgent to assess the adequacy of existing regulatory regimes to meet these new developments and to identify gaps and options for improving such regimes where gaps are found.

6. SUPRA-REGIONAL ISSUES

The Arctic is especially vulnerable to global warming, and the climate impacts in the Arctic will have global effects. Air, river and ocean circulation link the Arctic environment to discharges of contaminants further south. The high numbers of migrating species utilizing the Arctic in summer also link biodiversity issues of the region to southern areas. The Arctic regions of the Arctic states have traditionally been peripheral in the economic and political development nationally, but have been providers of raw materials for economic developments outside the region.

7. CAPACITY OF THE REGION TO UNDERTAKE FUTURE ASSESSMENTS

The AC with its tradition for scientific assessments has good potential to contribute to a global marine assessment. Contributions can be based on either the marine components of their existing assessments or on new integrated marine assessments for the whole Arctic Ocean. The latter would also be an important step in the development of an ecosystem approach for management of the Arctic Ocean. The success in bringing traditional/aboriginal/local knowledge into some Arctic assessments suggests that greater efforts in this direction may compensate, to an unknown extent, for the limitations in time-series data.

REFERENCES

Arctic Council (2004). *Arctic Marine Strategic Plan.* (http://arcticportal.org/pame/amsp)

Glomsrød, S. and Aslaksen, I. (eds.) (2007). *The Economy of the North.* Statistical Analysis (SA 84), Statistics Norway (SSB), Oslo

PAME (1996). PAME Working Group on the Protection of the Arctic Marine Environment. Report to the Third Ministerial Conference on the Protection of the Arctic Environment, 20–21 March 1996, Inuvik, Canada. Ministry of the Environment, Norway, T-1131

Stokke, O. S. and Hønneland, G. (eds.) (2007). *International Cooperation and Arctic Governance: Regime Effectiveness and Northern Region Building.* Routledge, London

Thomas, D. N. (2004). *Frozen Oceans. The Floating World of Pack Ice.* Natural History Museum, London

LINKS TO WEBSITES OF ORGANIZATIONS MENTIONED IN THE TEXT

Arctic Council: http://www.arctic-council.org/

Arctic Monitoring and Assessment Programme: http://www.amap.no/

Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea (CCBSP): http://www.afsc.noaa.gov/REFM/CBS/Default.htm

International Arctic Science Committee (IASC) http://arcticportal.org/iasc

International Council for the Exploration of the Sea (ICES) http://www.ices.dk/aboutus/contactus.asp

International Polar Year (IPY): http://www.ipy.org/

International Whaling Commission (IWC): http://www.iwcoffice.org/

North Atlantic Marine Mammal Commission (NAMMCO): http://www.nammco.no/Nammco/Mainpage/

North Atlantic Salmon Conservation Organization (NASCO): http://www.nasco.int/

North East Atlantic Fisheries Commission (NEAFC): http://www.neafc.org/

North Pacific Marine Science Organization (PICES): http://www.pices.int/

OSPAR: http://www.ospar.org/

Protection of the Arctic Marine Environment (PAME): http://arcticportal.org/en/pame

WWF Arctic programme: http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/arctic/index.cfm

LINKS TO ASSESSMENTS MENTIONED IN THE TEXT

AMAP's website http://www.amap.no/ gives access to these assessments:

- *Arctic Pollution Issues* (separate evaluation in GRAMED database)
- *Arctic Climate Impact Assessment* (separate evaluation in GRAMED database)
- *The Arctic Oil and Gas Assessment*

CAFF (2001): Arctic Flora and Fauna, Status and Conservation. http://arctic-council.org/filearchive/AFF%20Status%20and%20Trends.pdf

CAFF (in prep): *Arctic Biodiversity Assessment.* http://arcticportal.org/en/caff/aba

GIWA website with access to their assessments: http://www.unep.org/dewa/giwa/

The Joint Norwegian-Russian Commission on environmental co-operation 1997: *Status report on the Marine Environment of the Barents Region*. The state committee on Environmental Protection of the Russian Federation and the Ministry of Environment, Norway. (not available electronically)

OSPAR (2000): *Quality Status Report 2000 for the North-East Atlantic, region 1, Arctic waters*. http://www.ospar.org/content/content.asp?menu=00790830300000_000000_000000

PAME (2009) *The Arctic Marine Shipping Assessment*. See http://arcticportal.org/en/pame/amsa-2009-report

WWF (2004). *The Barents Sea Ecoregion: A biodiversity assessment*. WWF Barents Sea Ecoregion Programme, Oslo. See http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/arctic/what_we_do/marine/barents/publications/index.cfm?uNewsID=12202

AoA Region: Baltic Sea

Matti Perttilä

The Baltic Sea plays an important role in the lives of some 85 million people as a source of recreation, fishing and shipping.

The Baltic Sea region includes the Baltic Sea Large Marine Ecosystem (LME) and involves nine countries, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, the Russian Federation and Sweden as well as the European Union (EU). These are all contracting Parties to the Helsinki Commission (HELCOM). Other countries in the catchment area include Belarus, the Czech Republic, Slovakia and Ukraine.

1. BROAD ECOLOGICAL CHARACTERISTICS

The Baltic Sea is the world's largest brackish waterbody, covering an area of about 420 000 square kilometres (km^2). The Sea's drainage area is almost four times larger than its surface area, extending over some 1.7 million km^2. It is a semi-enclosed coastal sea, connected to the world's oceans by the narrow and shallow waters of the Sound and the Belt Sea. This limits the exchange of water with the North Sea, with the same water remaining in the Baltic for up to 30 years, along with all the organic and inorganic matter it contains. Because of this mixture of seawater from the North Sea and freshwater from rivers and rainfall, the Baltic Sea water is brackish. During mild and normal winters, 15 to 50 per cent of the surface area is covered by ice, mainly in the Gulf of Finland and the Gulf of Bothnia, but during very severe winters the whole sea may be covered (Omstedt and Chen 2001).

At an average depth of just 53 metres (m), the Baltic Sea is much shallower than most of the world's seas. It contains 21 547 cubic kilometers (km^3) of water, roughly two per cent of which is added each year by rivers. For a recent review of the Baltic Sea water budget, see Omstedt and Nohr (2004). The Baltic Sea's drainage area is home to almost 85 million people. Population densities vary from more than

500 inhabitants per km^2 in the urban areas of Poland, Germany, and Denmark, to less than 10 inhabitants per km^2 in the northern parts of Finland and Sweden. Principal human activities in the Baltic Sea include fishing, shipping and tourism. Nutrients and hazardous substances originating from cities, farmland, commercially managed forests, industrial and energy plants, transport and other human activities in the drainage area reach the sea via rivers. Pollutants from an even larger area can enter the Baltic Sea from the air while emissions and discharges from shipping and fish farms enter the sea directly. Because of the weak water exchange with the North Sea, most of the pollutants and nutrients remain in the Baltic Sea to end up in the sediments.

The brackish water of the Baltic Sea resulting from the mixture of seawater from the North Sea and freshwater from rivers and rainfall causes the salinity levels of its surface waters to vary from around 20 (PS scale) in the Kattegat to one to two in the northernmost Bothnian Bay and the easternmost Gulf of Finland, compared to 35 in the open oceans. For a detailed review of the salinity distribution see Rodhe (1998).

Salinity levels vary with depth. Saltier water flowing in through the Sound and the Belt Sea does not mix easily with the less dense water already in the Baltic Sea and tends to sink into the deeper basins. At the same time, less saline surface water flows out of the Baltic Sea. The boundary between these two water masses, the halocline, consists of a layer of water in which salinity levels change rapidly. In the Baltic Proper and the Gulf of Finland, for instance, the halocline lies at a depth of around 60 to 80 m. Like a lid, the halocline limits the vertical mixing of water. This means that the oxygen content of the deep basins of the Baltic Proper is replenished mainly by oxygen-rich saltwater flowing in from the North Sea along the sea floor. In the Gulf of Bothnia, the halocline is very weak or absent.

Low oxygen conditions and total oxygen deficiency in deep water below the halocline is a serious problem in the Baltic Sea, affecting both the biota and the amounts of nutrients in the water. The resulting nutrient surplus in deep water layers is a potential source of nutrients for the surface layers, leading to a vicious cycle in which eutrophication increases the oxygen deficiency, which, in turn, increases eutrophication. The ventilation of the deep layers is controlled mainly by the lateral transfer of highly saline North Sea water, flowing infrequently into the Baltic Sea and renewing its deep water to a significant degree (Matthäus and Franck 1992, Schincke and Matthäus 1998).

In addition to nutrient discharges into the Baltic Sea, excessive inputs of hazardous substances are considered to be a source of major environmental problems (HELCOM 2003a, BSH 2004). This gradual pollution by hazardous substances has caused a serious threat to the environment, and may even threaten the health of future human generations. Although monitoring indicates that the loads of some hazardous substances have been reduced considerably over the past 20 to 30 years, problems still persist. Not enough is known about the impact of the most widely used chemicals and their combined effects on human health and the environment (HELCOM 2003a).

While an overall reduction in the concentrations of chlorobiphenyls and DDTs has been reported, the concentrations are still high. The populations of all three seal species inhabiting the Baltic Sea are recovering as a result of diminishing levels of organic contaminants in the environment, although reproductive dysfunction remains widespread. Many female seals are unable to produce pups as a result of uterine occlusion related to polychlorinated biphenyls and dioxins in the environment. In the Baltic Proper, the harbour seal and grey seal populations are affected by contaminants, habitat destruction and fishing, and are recovering more slowly than in the Gulf of Bothnia (grey seals) and the Kattegat (harbour seals) (HELCOM 2002, 2003a).

Increasing shipping raises the risk of a serious oil or chemical spill and leads to the inadvertent introduction of alien invasive species (AIS). Anti-fouling paints on ship hulls and illegal oil spills at sea contribute to the total burden. In spite of the existing restrictions aimed at preventing discharges of oil at sea, violations are frequent, although long-term statistics indicate a slight decreasing trend over the years. (HELCOM 2002, 2003a, 2007f).

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

The beginning of international cooperation in the study of the Baltic Sea environment can be traced back to the establishment of the International Council for the Exploration of the Sea (ICES) in 1903. As a result of the deteriorating marine environment and political differences in the coastal states, the development of a Baltic Sea specific convention and cooperation unit became necessary. All sources of pollution, as well as monitoring and assessment activities around the entire sea were made subject to a single convention, signed in 1974 by the then seven Baltic coastal states. The 1974 Convention came into force on 3 May, 1980. In light of the political changes and developments in the EU and in international environmental and

maritime law, a new convention, the 1992 Convention on the Protection of the Marine Environment of the Baltic Sea Area or the Helsinki Convention (HELCOM), was developed and came into force on 17 January, 2000.

The Convention covers the entire Baltic Sea area, including inland waters, the water of the sea itself and the seabed. Measures are also taken in the whole drainage area surrounding the Baltic Sea to reduce land-based pollution. HELCOM is the governing body of this convention and is responsible for coordinating the monitoring and publication of regular marine environmental assessments for the whole Baltic Sea region, although many Baltic Sea countries maintain national monitoring networks and publish assessments at irregular intervals. One of the most important duties of HELCOM is to make recommendations on measures to address certain pollution sources or areas of concern and other human actions likely to affect the Baltic Sea and its riparian environment. These recommendations are to be implemented by the Contracting Parties through their national legislation. Since the beginning of the 1980s, HELCOM has adopted more than 200 HELCOM Recommendations for the protection of the Baltic Sea. In 2007, HELCOM adopted a joint action plan for the Baltic Sea (HELCOM 2007a). Another important duty of HELCOM is to follow-up on the implementation of the Helsinki Convention and HELCOM Recommendations. Reporting via the Contracting Parties (who provide the information) helps with the assessment of the status of implementation, with the effectiveness of the required measures, as well as with the identification of gaps.

HELCOM's five main groups implement policies and strategies and propose issues for discussion at the meetings of the Heads of Delegations, where decisions are made. The five groups are the Monitoring and Assessment Group (HELCOM MONAS), the Land-based Pollution Group (HELCOM LAND), the Nature Protection and Biodiversity Group (HELCOM HABITAT), the Maritime Group (HELCOM MARITIME) and the Response Group (HELCOM RESPONSE). HELCOM MONAS looks after one of HELCOM's key tasks by assessing trends in threats to the marine environment, their impacts, the resulting state of the marine environment and the effectiveness of adopted measures. This forms the basis for the work of HELCOM's other main groups and helps to define the need for additional measures. HELCOM MONAS aims to ensure that HELCOM's monitoring programmes are efficiently used through liaison and coordination between the Commission's five permanent working groups.

As part of an international effort to combat the environmental degradation of the Baltic Sea, the World Bank, acting on behalf of the Global Environment

Facility (GEF), supported the Baltic Sea Regional Project (BSRP). The Baltic Sea Regional Seas Programme is an independent Regional Seas Programme.

The environmental analyses reported in HELCOM assessments are used to develop policy recommendations to be approved at Ministerial-level meetings which are held approximately every three years. However, because HELCOM is not a legal authority that can enforce adjustments in national policy, its recommendations are not automatically transferred into government policies and legislation by the individual member countries. Nevertheless, together with the World Wildlife Fund (WWF) and other non-governmental organizations (NGOs) such as Coalition Clean Baltic (CCB), and through the Baltic 21, pressure could be exerted on the governments to incorporate the recommendations into national legislation.

The Stockholm Resilience Center, founded in 2005, includes the Baltic NEST Institute (http://www.balticnest.com), which hosts the decision support system Baltic Nest (http://nest.su.se/nest/). The Nest Decision Support System was developed within the Mistra-financed MARE-project, an eight-year research programme which ran between 1999 and 2006 and involved 30 scientists from around the Baltic Sea. The aim of the model is to understand the biogeochemical cycles of organic matter and nutrients in the Baltic Sea and how they are altered in relation to eutrophication. This is accomplished by using data on nutrient loading from land and air and by modeling internal processes such as denitrification, nitrogen fixation and phosphorous release as well as flows of nutrients between sub-basins. This system has been developed mainly to provide a basis for decision-making at international negotiations. Baltic Nest also provides data and information from the entire Baltic drainage basin and the entire Baltic Sea, and links measures on land with effects to the sea.

3. DATA

3.1 Ecosystem data

For the Baltic Sea, ICES is a focal data centre in two ways – it receives, stores, and distributes the HELCOM monitoring data and it collects, stores, and assesses fisheries data. The HELCOM monitoring data include hydrographic and hydrochemical, contamination of water, sediments, fish and benthic animals as well as biological data which include information on phytoplankton, zooplankton and benthic animals. Pollution loads into the Baltic Sea are regularly monitored and reported by HELCOM (e.g., HELCOM 2004a, 2005a, 2005b, 2007b).

All contracting Parties to the Convention carry out regular monitoring activities in the Baltic Sea and report the results and findings, as described in the HELCOM manual and guidelines (HELCOM 2006a, 2006b, 2006c, 2008). Quality control requirements are included in the manual and guidelines, and adherence to them is expected to be reported together with the data. Marine monitoring data from all participants are collected at ICES and are accessible through the website (http://www.ices.dk). A large dataset is also available at the Baltic Nest Institute (http://nest.su.se), along with extensive data analysis and graphics software. The Nest system serves as a decision support system for developing and testing strategies to reduce eutrophication in the Baltic Sea and includes mainly hydrographic and hydrochemical data.

In some cases, national monitoring data and basic data analysis and graphics software are available at institutes responsible for monitoring (e.g., http://www.fimr.fi/en and http://www.bsh.de). Large-scale salinity and temperature data and distribution graphics are available at the LME Information Portal http://www.lme.noaa.gov/. Fact sheets on threatened biotopes and species are also available (http://www.helcom.fi/environment2/biodiv/endangered/en_GB/fact_sheets/).

For most parameters on both living resources and water quality indicators, reference points are set by either baseline-type dedicated studies (e.g., for contaminants in sediments, see Perttilä and others 2003; for hot spots, see HELCOM 2004c, 2004d) or time series of observations to allow for agreement on environmental goals to be used as reference points against which progress can be quantitatively measured.

The Baltic Nest Institute maintains the Baltic Environmental Database (BED), which was initiated in 1990 as part of a research project titled Large-scale Environmental Effects and Ecological Processes in the Baltic Sea and financed by the Swedish Environmental Agency (Wulff and Rahm, 1990). The basic idea has been to make available, the data which has been set on the conditions in the Baltic Sea and on forcing functions, so that budget and models of the physical and of the biogeochemical cycles of organic matter and nutrients can be developed.

3.2 Socio-economic data

The concern for the marine environment of the Baltic Sea is reflected in wider international cooperative frameworks. The Rio Declaration and the global Agenda 21 outlined a comprehensive action plan for the global transition to sustainable development. A number of initiatives have been undertaken

subsequently to translate the intentions and perspectives of Agenda 21 into concrete policies and actions. Baltic 21 is one such initiative and involves all countries around the Baltic Sea although for the Russian Federation, only the north-western part is included. The mandate to develop an Agenda 21 for the Baltic Sea region, with the objective of Sustainable Development, stems from the heads of governments of the region and the meeting of Ministers for Foreign Affairs of the Baltic Sea region, within the framework of the Council of the Baltic Sea States, including the EU. The latter was also a participant in the elaboration of Baltic 21.

Baltic 21 is intended to be a democratic, open, and transparent process which is directed by the Senior Officials Group (SOG), with members from the Governments of the Council of the Baltic Sea States and the European Commission (EC), NGOs, inter-governmental organizations (IGOs) and the International Development Banks. All Baltic 21 documentation, including background documents, SOG meeting reports, workshop reports and draft texts are published on the Baltic 21 website (http://www.ee/baltic21).

The WWF promotes public awareness of the Baltic Sea environment by means of active reporting and commenting on developments, and by initiating projects calling for the participation of citizens. Recently, WWF launched a project with the aim of reducing oil discharges into the Baltic Sea. The CCB was established in 1990 as a joint forum for non-governmental environment organizations in the Baltic Sea region (http://www.ccb.se). Together, WWF and CCB have embarked on an initiative to declare the Baltic Sea a Particularly Sensitive Sea Area (PSSA) under the International Maritime Organization (IMO). This status, including routing systems and "areas to be avoided", was given in 2005.

Socio-economic data are collected systematically in EU countries and are available at national statistical centres. Basic socio-economic data on population, industry, trade, and other activities are available on the EU website (http://europa.eu). Extensive data on fishing statistics and activities are available at ICES (http://www.ices.dk).

4. ASSESSMENTS

Many Baltic Sea countries maintain a well-established national monitoring and assessment programme, usually with emphasis on their respective sea areas (e.g., BSH 2004, Olsonen 2006, Pitkänen 2004, Stockholm Marine Research Centre 2006). The assessments are usually not intended

to initiate changes in legislation or monitoring programmes but are directed more at describing the marine environmental situation and changes. The degree of detailed information varies, although eutrophication, oxygen deficiency and pollution are commonly discussed. Baltic Sea regional assessments are coordinated and published by HELCOM. Periodic general assessments (such as HELCOM 2002 and HELCOM 2003a), and thematic assessments, as well as specialized reports on the Baltic Sea marine environment are available on the HELCOM website.

Originally, HELCOM prepared assessments at five-year intervals with the first periodic assessment covering the period 1980 to 1985. The slowness and lack of timelines of the traditional assessments led HELCOM to revise its monitoring and assessment strategy in 2003 to include indicator fact sheets, thematic assessments and holistic assessments as the main products. Holistic assessments deal mainly with nutrient distributions and eutrophication, oxygen deficiency, pollutants in different environment compartments, AIS and fish stocks and diseases. They usually cover long time-series and current distribution at the time of writing. The readability of HELCOM holistic assessments has increased significantly over the years, and can be seen as reviews intended for non-specialists. The annual indicator facts sheets contain up-to-date information. The themes for thematic assessments vary according to emerging needs and to an increasing extent, are being based on indicators. HELCOM is developing indicator-based assessment tools for its focal areas of interest, which include eutrophication, biodiversity, nature conservation, organic pollutants and maritime activities (HELCOM 2003a, HELCOM 2004b), as well as radionuclides (HELCOM 2003b) and other hazardous substances, including toxic metals such as mercury, lead, and cadmium (HELCOM 2003a).

Ecological objectives are to be assessed using specific and larger numbers of indicators. Some objectives, such as clear water and natural nutrient concentrations, can be assessed with a single indicator or a few indicators while others may need several indicators, especially for assessments of issues such as healthy wildlife and biodiversity objectives. The approach is to use indicators which are based on data originating from existing monitoring programmes. The development of a coherent set of ecosystem assessment indicators for the Baltic Sea is a major task for future activities within HELCOM. Currently, almost 40 annually updated indicator fact sheets are available on the HELCOM website and are being furnished with target levels or limit values. Together with data from the HELCOM COMBINE monitoring programme, these targets and criteria make it

possible to evaluate the achievement of ecological objectives. In the near future, an important function of the indicators will be to show how the ecological objectives and targets set by HELCOM are being met. Defining reference levels and acceptable deviations from these levels are needed for indicators of hazardous substances and biodiversity.

The joint HELCOM and Convention for the Protection of the Marine Environment of the Northeast Atlantic (HELCOM/OSPAR) Ministerial Declarations of 2003, explicitly place a new management concept, the ecosystem approach to the management of human activities, at the centre of HELCOM's work.

An overall mapping of specific pollution sources, or hot spots was carried out in 2001 and 2002, resulting in an evaluation of principal measures to prevent pollution (HELCOM 2004c, HELCOM 2004d). A sediment base-line study concentrating on radioactive substances, was carried out by the HELCOM Project Group for Monitoring of Radioactive Substances in the Baltic Sea (HELCOM MORSPRO) from 2000 – 2005. This report (HELCOM 2007c) describes the extent and distribution of several radioactive isotopes. The horizontal and vertical distribution of trace elements and organic pollutants in the Baltic Sea sediments has been assessed and is based on an earlier ICES/HELCOM sediment baseline study in 1993 (Perttilä and others 2003).

In order to determine the potential effects of human activities on coastal fish communities, as well as the impact of amelioration measures, a programme of annual monitoring of coastal fish in the Baltic Sea was initiated in the mid-1980s. A recently published thematic report (HELCOM 2006a) shows that there are a number of threatened fish species in the Baltic Sea, several of which are either of local or global importance. As many as 184 fish species have been proposed for inclusion in the HELCOM high priority Red List of threatened and declining species. Fish stock assessments covering the Baltic Sea are prepared annually by ICES and serve as the basis for ICES advice on fisheries quotas.

HELCOM and ICES are jointly managing the BSRP, based on the LME concept. The long-term objective of the BSRP is to introduce ecosystem-based assessments to strengthen the management of Baltic Sea coastal and marine environments. This will be achieved through regional cooperation and targeted, cost-effective trans-boundary coastal, marine and watershed activities. In this context, a general overview of the status of the Baltic Sea, its past and its future, has been reported (Thulin and Andrushaitis 2003).

5. PRIORITIZED ISSUES

In 2007, HELCOM Ministers and other high-level representatives adopted a regional implementation of the ecosystem approach to management of human activities, the HELCOM Baltic Sea Action Plan (BSAP) (HELCOM 2007a) which is aimed at achieving a Baltic Sea in good ecological status by 2021. The plan is focused on four priority problem areas -eutrophication, biodiversity and nature conservation, hazardous substances, and maritime activities (HELCOM 2007d – 2007g). It is based on a system of vision and strategic goals, as well as on ecological and management objectives and includes preliminary indicators and targets which correspond to the fundamental aim of a good ecological status. Most importantly, the BSAP contains commonly agreed actions and measures to achieve the environmental objectives and targets. Monitoring and assessments will play a crucial role in the implementation of the BSAP and in determining whether the targets are being reached. Example objectives include clear water, an end to excessive algal blooms, and the existence viable species populations. Targets for good ecological status are based on the best available scientific knowledge. The timeframe for reaching these targets is a political decision. With the application of the ecosystem approach, the protection of the marine environment is no longer seen as an event-driven pollution reduction activity to be taken sector-by-sector. Instead, the starting point is the ecosystem itself and a shared concept of a healthy sea with good ecological status. This vision will determine the need for further reductions in pollution loads and the extent of various human activities.

In the BSAP, a major emphasis is given to eutrophication, which has been often mentioned as the most severe environmental problem in the Baltic Sea. Before good ecological status of biological diversity can be restored, nutrient loading to the Baltic Sea must be decreased and the eutrophication process halted, and preferably reversed. In order to achieve this, the BSAP contains measures for enhanced nutrient reduction in wastewater treatment plants as well as through a Baltic-wide ban of phosphates in detergents and a scheme for agriculture. The country-wise nutrient reduction requirements, which are based on the NEST ecosystem model, are open to revision when new and appropriate data becomes available. NEST has played an instrumental role in identifying the maximum allowable nutrient input needed to achieve a good environmental status as defined by international decision makers in HELCOM. Using the Nest Decision Support System, the Swedish branch of Baltic Nest developed country-wise nutrient reduction targets, which were adopted in the BASP by HELCOM on November 15, 2007. This is

a unique science-based method for dividing needed nutrient reductions between riparian countries and is a milestone in the process of improving the health of the Baltic Sea.

In spite of restrictions on the use and discharges of pollutants, toxic substances still threaten the Baltic Sea environment. They include heavy metals, persistent organic pollutants, oil pollution, artificial radionuclides and dumped munitions. The anthropogenic loads of cadmium, lead and mercury to the Baltic Proper are five to seven times higher than the natural loads, and the copper and zinc loads are double the natural loads (Thulin and Andrushaitis 2003). Sediment studies indicate that in the case of metal pollution, the peak was reached in the 1960s and 1970s. However, it is also noted that the apparent reductions in heavy metals in sediments in the 1980s may be masked by eutrophication signals (Thulin and Andrushaitis 2003). HELCOM monitoring activities indicate that the loads of some heavy metals to the sea have declined over the past 10 to 20 years. Concentrations of some heavy metals have also decreased in many parts of the Baltic Sea, although high concentrations can still be found in certain marine organisms (HELCOM 2003a). Relatively few organic pollutants are fully understood or even identified at the time of this report. Another problem is that the degradation and transformation of these substances in the marine environment may change their structure and reactive properties. These unknown substances could pose a considerable threat to the environment.

Increasing shipping leads to the introduction of AIS, which may endanger the local food-web mechanism. The introduction of alien species into marine environments can be viewed as a pollution agent. This has received attention recently and a method has been developed to evaluate the impact at different levels of bio-pollution within water quality assessments (Olenin and others 2007). During recent years the number of oil spills has decreased, probably as a result of effective enforcement and an enhanced fee system (HELCOM 2008).

The biodiversity and nature conservation segment of the BSAP is tightly linked to the three other segments of eutrophication, hazardous substances and maritime activities because the status of biodiversity is directly affected by each. The recently published list of threatened or declining biotopes and species, as well as the soon to be published thematic assessment on biodiversity, identify the status and recent trends of species and habitats, and assess human activities adversely impacting on marine biodiversity (Boedeker and von Nordheim 2007, HELCOM 2009). In order to protect

a significant portion of the Baltic Sea environment and biota, HELCOM agreed in 1994, on a network of Baltic Sea Protected Areas, which today consists of 91 sites with an average size of more than 3000 hectares (ha). The BSAP and a joint work programme of HELCOM and OSPAR, agreed in 2003, states that the network should be ecologically coherent by 2010. To achieve this objective, contracting states are invited to designate new marine areas to the network, especially in off-shore areas. In addition, the favourable status of fish populations has been given a significant role in the biodiversity segment of BSAP. Fish stock assessments, which are prepared regularly by ICES, show that catches of almost all commercially important fish stocks, including cod, wild Baltic salmon, herring and sprat are outside safe biological limits (Thulin and Andrushaitis 2003). Among other things, the BSAP encourages countries to implement new management measures for fisheries within marine protected areas and to assess, protect and restore rivers with wild salmon and sea trout populations. As a new approach, HELCOM brings together authorities from fisheries and environmental sectors to discuss and decide on the implementation of the biodiversity segment of the BSAP.

6. SUPRA-REGIONAL ISSUES

Water exchange with the North Sea and its relation to oxygen levels is a widely studied process in Baltic Sea assessments. In addition, the increasing occurrence of AIS emphasizes the interaction with other regions of the world. Global change, especially the climate-related changes in the Baltic marine environment, is gaining growing emphasis (HELCOM 2007h).

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

There is a long history of assessments in the Baltic Sea region. As well as the joint efforts initiated and coordinated by HELCOM, most coastal states maintain their national monitoring programmes, leading to national, mainly riparian assessments. This activity is motivated by the large geographical and hydrographical variations of the Baltic Sea. The region has a large number of marine scientists working in both monitoring and science. As a result, the expertise required is available and the interaction between marine science, monitoring and assessments is ongoing. No immediate capacity needs from outside the region can be identified.

REFERENCES

Boedeker, D. and von Nordheim. H. (eds.) (2007). *HELCOML Lists of Threatened and/or Declining Species and Biotopes/Habitats in the Baltic Sea Area.* http://www.helcom.fi/environment2/biodiv/endangered/en_GB/fact_sheets/ (17.6.2008)

BSH (2004). *Meeresumwelt 1999–2002* OSTSEE, 126 pp. http://www.bsh.de/de/Meeresdaten/Beobachtungen/BLMP-Messprogramm/PDF/Ber_99_02/Ostsee9902d.pdf (in German) (10.4.2008)

HELCOM (2002). *Fourth Periodic Assessment of the State of the Baltic Marine Environment 1994–1998.* Baltic Sea Environment Proceedings 82B, 215 pp. http://www.helcom.fi/stc/files/Proceedings/bsep82b.pdf (17.6.2008)

HELCOM (2003a). *The Baltic Marine Environment 1999–2002.* Baltic Sea Environment Proceedings 87, 47 pp. http://www.helcom.fi/stc/files/Proceedings/bsep87.pdf (10.4.2008)

HELCOM (2003b). *Radioactivity in the Baltic Sea 1992–1998.* Baltic Environment Proceedings 85. http://www.helcom.fi/stc/files/Proceedings/bsep85.pdf (10.4.2008)

HELCOM (2004a). *The Fourth Baltic Sea Pollution Load Compilation* (PLC-4). http://www.helcom.fi/stc/files/Proceedings/bsep93.pdf (10.4.2008)

HELCOM (2004b). *Dioxins in the Baltic Sea.* 19 pp. http://www.helcom.fi/press_office/news_helcom/en_GB/dioxin_report_2004/?u4.highlight=Dioxins (10.4.2008)

HELCOM (2004c). *Thematic Report: Status of the Hot Spots in Saint-Petersburg and the Leningrad Region.* Baltic Sea Environment Proceedings 98, 66 pp. http://www.helcom.fi/stc/files/Proceedings/bsep98.pdf (10.4.2008)

HELCOM (2004d). *Thematic Report: Status of the Hot Spots in Denmark, Finland, Germany and Sweden.* Baltic Sea Environment Proceedings 99, 90 pp. http://www.helcom.fi/stc/files/Proceedings/bsep99.pdf (10.4.2008)

HELCOM (2005a). *Nutrient Pollution to the Baltic Sea.* Baltic Sea Environment Proceedings 100, 22 pp. http://www.helcom.fi/stc/files/Proceedings/bsep100.pdf (104.2008)

HELCOM (2005b). *HELCOM Monitoring and Assessment Strategy.* http://www.helcom.fi/groups/monas/en_GB/monitoring_strategy/ (10.4.2008)

HELCOM (2006a). *Assessment of the Coastal Fish in the Baltic Sea.* Baltic Sea Environment Proceedings 103, 23 pp. http://www.helcom.fi/stc/files/Proceedings/bsep103a.pdf (10.4.2008)

HELCOM (2006b). *Manual for Marine Monitoring in the COMBINE Programme of HELCOM.* http://www.helcom.fi/groups/monas/CombineManual/en_GB/main/ (17.6.2008)

HELCOM (2006c). *Guidelines for the Compilation for Waterborne Pollution Load to the Baltic Sea (PLC-Water).* http://www.helcom.fi/groups/monas/en_GB/plcwaterguide/ (17.6.2008)

HELCOM (2007a). *HELCOM Baltic Sea Action Plan.* http://www.helcom.fi/BSAP/en_GB/intro/ (10.4.2008)

HELCOM (2007b). *Heavy Metal Pollution to the Baltic Sea in 2004.* Baltic Sea Environment Proceedings 108, 33 pp. http://www.helcom.fi/stc/files/Proceedings/bsep108.pdf (10.4.2008)

HELCOM (2007c). *Long-lived Radionuclides in the Seabed of the Baltic Sea. Report of the Sediment Baseline Study of HELCOM MORS-PRO in 2000–2005.* Baltic Sea Environment Proceedings 110, 33 pp. http://www.helcom.fi/publications/bsep/en_GB/bseplist/_files/77128670081450078/default/bsep110.pdf (18.5.2009)

HELCOM (2007d). *Towards a Baltic Sea Unaffected by Eutrophication – HELCOM Overview 2007.* HELCOM Ministerial meeting Krakow 2007. 35 pp. http://www.helcom.fi/stc/files/Krakow2007/Eutrophication_MM2007.pdf (10.4.2008)

HELCOM (2007e). *Towards a Baltic Sea Unaffected by Hazardous Substances – HELCOM Overview 2007.* HELCOM Ministerial meeting Krakow 2007. 48 pp. http://www.helcom.fi/stc/files/Krakow2007/HazardousSubstances_MM2007.pdf (10.4.2008)

HELCOM (2007f). *Towards a Baltic Sea with Environmentally Friendly Maritime Activities – HELCOM Overview 2007.* HELCOM

Ministerial meeting Krakow 2007. 32 and 14 pp. http://www.helcom.fi/stc/files/Krakow2007/Maritime_activities_MM2007.pdf (10.4.2008)

HELCOM (2007g). *Towards Favourable Conservation Status of Baltic Sea Biodiversity – HELCOM Overview 2007*. HELCOM Ministerial meeting Krakow 2007. 35 pp. http://www.helcom.fi/stc/files/Krakow2007/Biodiversity_MM2007.pdf (10.4.2008)

HELCOM (2007h). *Climate Change in the Baltic Sea Area – HELCOM Thematic Assessment 2007*. 49 pp. http://www.helcom.fi/stc/files/Proceedings/bsep111.pdf (10.4.2008)

HELCOM (2008). *Guidelines for Monitoring of Radioactive Substances*. http://www.helcom.fi/stc/files/Guidelines/MORSGuidelines2008.pdf (17.6.2008)

HELCOM (2008). Illegal discharges of oil in the Baltic Sea during 2007. A HELCOM Indicator FactSheet. http://www.helcom.fi/environment2/ifs/ifs2008/en_GB/illegaldischarges/

HELCOM (2009). *HELCOM lists of threatened and/or declining species and biotopes/habitats in the Baltic Sea area.* Baltic Sea Environment Proceedings 113, 18pp. http://www.helcom.fi/stc/files/Publications/Proceedings/bsep113.pdf (18.5.2009.

Matthäus, W. and Franck, H. (1992). Characteristics of Major Baltic inflows – a Statistical Analysis. *Cont. Shelf Res.* 12:1375–1400

Olenin, S., Minchin, D. and Daunys, D. (2007). Assessment of Biopollution in Aquatic Ecosystems. *Mar. Poll. Bull.* 55: 379–394. http://www.sciencedirect.com (17.6.2008)

Olsonen, R. (ed.) (2006). *FIMR Monitoring of the Baltic Sea Environment – Annual Report 2006*. MERI – Report Series of the Finnish Institute of Marine Research 62, 2008. http://www.fimr.fi/fi/julkaisut/fi_FI/julkaisut/) (in English)

Omstedt, A. and Chen, D. (2001). Influence of Atmospheric Circulation on the Maximum Ice Extent in the Baltic Sea. *J. Geophys. Res.* 106 (C3): 4493– 4500

Omstedt, A. and Nohr, C. (2004). Calculating the Water and Heat Balances of the Baltic Sea Using Ocean Modelling and Available Meteorological, Hydrological and Ocean Data. *Tellus* 56A: 400–414

Perttilä, M., Albrecht, H., Carman, R., Jensen, A., Jonsson, P., Kankaanpää, H., Larsen, B., Leivuori, M., Niemistö, L., Uscinowicz, S. and Winterhalter, B. (2003). Contaminants in the Baltic Sea Sediments – Results of the 1993 ICES/HELCOM Sediment Baseline Study. *Meri* 50: 1–69

Pitkänen, H. (ed.) (2004). *The State of Coastal and Open Sea Areas at the Turn of the New Millenium.* Background Documents of the Finland's Programme for the Protection of the Baltic Sea. 104 pp. http://www.ymparisto.fi/download.asp?contentid=16872&lan=fi (in Finnish)

Rodhe, J. (1998). The Baltic and the North Seas: a Process-oriented Review of the Physical Oceanography. In *The Sea,* Vol. 11, Robinson, A. and Brink, K. (eds.), Wiley, New York, pp. 699–732

Schincke, H. and Matthäus, W. (1998). On the Causes of major Baltic inflows – an Analysis of Long Time-series. *Cont. Shelf Res.* 18: 67–97

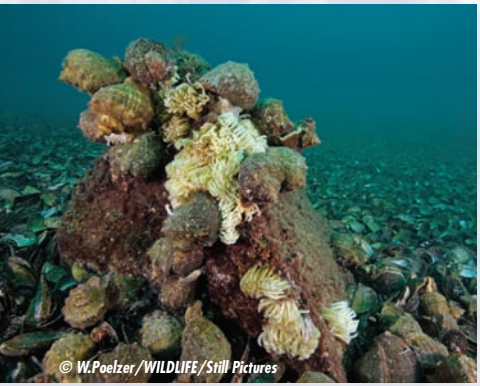
Stockholm Marine Research Centre (2006). *Miljötillstånd i egentliga Östersjön 2005.* 64 pp. http://www.smf.su.se/nyfiken/ostersjo/arsrapp/Ostersjo2005/02005hela.pdf (in Swedish) (10.4.2008)

Thulin, J. and Andrushaitis, A. (2003). *The Baltic Sea: its Past, Present and Future.* http://www.ices.dk/projects/balticsea.asp

Wulff, F. and Rahm, L., 1990. A database and its tools. In: Wulff, F. 1990. Large-scale environmental effects and ecological processes in the Baltic Sea : research programme for the period 1990-1995 and background documents. Rapport / Naturvårdsverket: 225p.

AoA Region: Black Sea

Laurence Mee and Ljubomir Jeftic



Rapana venosa *continues to devastate benthic communities throughout the Black Sea.*

The Black Sea region is surrounded by six countries, Bulgaria, Georgia, Romania, the Russian Federation, Turkey, and Ukraine. Although only six countries border the Black Sea, its catchment area extends entirely or partially over 17 countries and covers 2.5 million square kilometres (km^2), which is five times larger than its surface area. The region includes the Black Sea Large Marine Ecosystem (LME). Because of its almost landlocked aspect and permanent anoxic conditions in its deep waters, the LME is particularly vulnerable to environmental stresses originating from human activities in the catchment, especially from the Danube, Dnieper and Don River basins (Murray 2005). Climate change is also increasing the LME's vulnerability to stress.

Principal uses of the Black Sea include shipping, fisheries and tourism. In the immediate area of the Black Sea and in its river basins, there is virtually every type of heavy manufacturing and processing industry as well as agriculture.

1. BROAD ECOLOGICAL CHARACTERISTICS

The Black Sea is a 423 000 km^2 basin with a maximum depth of more than 2 200 metres (m). The permanent anoxic conditions, or absence of oxygen in the bottom waters of the Black Sea underlie a freshwater dominated surface layer. Eighty per cent of the total river discharge of about 300 cubic kilometres a year enters the north-western shelf. It is minimally ventilated vertically or by limited exchange with the Mediterranean Sea through the Turkish Straits called the Strait of Istanbul and the Strait of Canakkale and the waterway between the two, the Sea of Marmara. The 35 km Strait of Istanbul is only 35 m deep at it shallowest point and 700 m wide at its narrowest point. It carries all of the seawater influx to the Black Sea in its lower layer and the efflux of surface waters in its upper layer, creating an

almost enclosed environment with a surface salinity of about 17 parts per thousand (ppt) or about half that of the Mediterranean Sea. This isolation and the relatively large river influx dominated by the Danube, Dnieper and Don Rivers (Europe's second, third and fourth largest rivers respectively) has led to the unique hydrographic and ecological characteristics of the Black Sea. There is a strong pycnocline (density gradient between isohalines of 18.5 and 21.5) between the 90 to 120 m thick mesohaline surface layer and the underlying seawater. The low replenishment rate of the bottom water coupled with the high oxygen demand of material falling from the surface has led to anoxia and high hydrogen sulphide concentrations (H_2S) in the deep layers of water below the pycnocline. This situation has persisted for at least the past 7 000 years and the Black Sea is currently the world's largest anoxic basin.

The Black Sea's north-western shelf, which extends over about 80 000 km^2, is sufficiently shallow to be within the oxic layer. The large natural influx of terrestrial surface water to this region has made it more productive than the rest of the Black Sea. A permanent feature of the upper layer circulation is the encircling Rim Current which forms a sharp (40 to 80 km wide) salinity front over the continental slope and dynamically decouples the coastal and open sea waters. Permanent and transient meso-scale anticyclonic circulations develop between the jet current and the coast, providing a mechanism for coastal-open sea exchange. Because of its isolation however, the Black Sea, and in particular its north-western shelf, is very vulnerable to eutrophication, mostly as a result of agricultural and urban runoff from its 2.5 million km^2 catchment.

The Black Sea's continental shelf hosts diverse habitats. A particular feature is a vast red algal (*Phyllophora* sp.) field mostly located in Ukrainian waters, which is probably the largest habitat of its kind in the world and is associated with extensive mussel beds. These habitats are heavily impacted by a massive influx of nutrients and pollutants from the surrounding coastal areas. From the 1970s to the 1990s, the delivery of nitrogen and phosphorus to the north-western Black Sea increased by factors of 3 and 10 respectively, mostly as a result of more intensive agriculture. At the same time, silica decreased by a factor of about four, leading to significant modification of inorganic nutrient ratios. Eutrophication and increasing oxygen deficiency as a result of human activities in coastal regions and river basins caused significant changes in the ecosystem along with the introduction of an alien invasive species, the ctenophore or comb jelly (*Mnemiopsis leidyi*), which achieved dominance in the Black Sea.

The dramatically increased input of faeces and particles to the sea floor in the early 1970s resulted in a seasonal 'dead zone' which covered up to half of the north-western shelf and virtually eliminated the red algal beds and their associated unique benthic ecosystem. This situation persisted to varying degrees through the 1980s. It was exacerbated further by overfishing, uncontrolled sewage discharge and dumping of wastes, which all added to the Black Sea's ecological problems and promoted the establishment of a series of opportunistic predatory alien species, mostly transported accidentally in ships' ballast waters (Zaitsev and Mamaev 1997, Zaitsev and Öztürk 2001).

The most ecologically significant of these invasions was the sea snail (*Rapana venosa)* from the East Asian Seas in the 1950s, and the comb jelly (*Mnemiopsis leidyi)*, probably from the eastern seaboard of the United States of America, in around 1986. *Rapana venosa* continues to devastate benthic communities throughout the Black Sea, but supports a local fishing industry, which frequently uses destructive techniques such as dredging. Because this fishery targets animals well above sexual maturity, it has not reduced the proliferation of *Rapana venosa*. For its part, *Mnemiopsis leidyi* became the unchallenged main predator for zooplankton in the pelagic environment, attaining large biomasses of up to 5 kilograms per cubic metre around 1990. The accidental arrival of another comb jelly, *Beroe ovata*, in the early 1990s has led to a sharp decline in the *Mnemiopsis leidyi* population, as it is the *Beroe ovata's* selective prey. The simplification of the ecosystem is evident in the decline of the top species of predator fish, with the sturgeon population becoming critically endangered, as well as in the extinction of the Black Sea monk seal as a result of habitat loss.

The severe economic decline experienced by many Black Sea countries following the collapse of communism, led to decreases in discharges of nutrients and toxic chemicals to the sea. Shelf hypoxia has ended and there is evidence of a partial recovery of benthic communities, although the system is now dominated by opportunistic species and a return to pre-eutrophication conditions is extremely unlikely.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

2.1 Name and type of institution:

a. Global Environment Facility (GEF);
b. Black Sea Environment Programme (BSEP) and its successor; and
c. GEF Black Sea Ecosystem Recovery Project (BSERP).

Character: International

BSEP was founded in 1993 and was charged with assisting the Black Sea Governments to implement the 1993 Odessa Ministerial Declaration and with preparing a Transboundary Diagnostic Analysis (TDA) (BSEP 1997) to support the development of the Black Sea Action Plan (1996). Some of this work and the specialist institutional network was transferred to the Black Sea Commission (see below) when it was established in 1999. The BSERP, a follow-up GEF project, completed a new TDA in 2007 (BSERP 2007). The project closed in 2008. The BSEP and BSERP assessments are the most comprehensive conducted to date in the Black Sea. The 1996 assessment included extensive country and regional reports on biological diversity which were published as separate volumes, a pollution assessment and an economic analysis. The 2007 assessment includes a more detailed interdisciplinary analysis. BSERP also funded a number of research cruises in the region.

d. Black Sea Commission.

Character: International

The Black Sea Commission for the Bucharest Convention on the Protection of the Black Sea against Pollution (BSC) Secretariat has responsibility for implementing the Bucharest Convention and the Black Sea Action Plan under the Black Sea Regional Seas Programme. BSC took over the BSEP institutional network in 1999 and has participated in assessment work for the purposes of the Convention and in response to specific requests from organizations such as the European Environmental Agency. BSC published a state of the environment of the Black Sea Report in 2002 (mostly containing information from other reports). Currently, the Bucharest Convention statutory monitoring network is partially operational.

e. General Fisheries Council for the Mediterranean.

Character: International

The General Fisheries Council for the Mediterranean (GFCM), as an organ of the Food and Agriculture Organization (FAO), has assisted countries to implement the 1959 Varna Fisheries Agreement between Bulgaria, Romania and Turkey to exchange fisheries data (the former USSR was not a member of FAO but former Soviet Union countries have provided data for recent reports). Stock estimates were produced in 1997 and a new fisheries evaluation is being completed. Data quality is considered to be generally unreliable, partly because of the lack of a formal fisheries convention for the Black Sea.

f. European Commission DG-Research.

Character: European Union (EU)

Recent European Commission (EC) Directorate General for Research (DG-Research) has focused on countries joining the EU including current members – Bulgaria and Romania – or an aspiring member like Turkey, although there is additional participation from the other countries in some projects. Major projects have included:

a. Nutrient Management in the Danube Basin and its Impact on the Black Sea (DANUBS), which was completed in 2006 and focused on the discharge of the Danube River and its consequences to the Black Sea (Kroiss and others 2005);
b. European Lifestyles and Marine Ecosystems (ELME) (completed in 2007), which examined the Black Sea as a case study; and
c. Science and Policy Integration for Coastal System Assessment (SPICOSA) (ongoing), which is ongoing and is examining the Black Sea and Mediterranean Sea and their coupling.

3. DATA

3.1 Ecosystem data

There is a large amount of available data mostly resulting from national studies for variable periods of time as well as numerous scientific publications dealing with various aspects of the oceanography of the Black Sea. However, these data were generated using highly variable strategies, equipment and monitoring stations, which makes assessment difficult. There have been some fairly regularly monitored stations in Romania and Bulgaria, but there is no central data repository. During the period of the Soviet Union there was a rigorous network of stations for the current Ukrainian, Russian Federation and Georgian areas of the Black Sea, but much of the data was classified. A few considerable data and meta-data sets on the Black Sea, including those classified during the Soviet period became available for the international scientific community in the past decade. These sets were formed within the framework of projects involving international organizations such as the EC and the North Atlantic Treaty Organization (NATO). The projects are:

a. Mediterranean Data Archaeology and Rescue/Mediterranean Hydrographic Atlas (MEDAR/MEDATLAS II);
b. Rescue of Black Sea Hydrological Data;
c. Black Sea Data Base; and
d. Pan-European Network for Ocean & Marine Data and Information Management (Sea-Search).

Efforts are continuing to create data and meta-data sets within the framework of the following EU projects:

a. Black Sea Scientific Network (Black Sea Scene);
b. Pan-European Infrastructure for Ocean and Marine Data Management (SEADATANET); and
c. The International Oceanographic Data and Information Exchange (IODE) project Ocean Data and Information Network for the Black Sea (ODINBLACKSEA).

The Black Sea interdisciplinary, multivariable historical database was created in the framework of the NATO Ecosystem Modelling as a Management Tool for the Black Sea (TU-Black Sea) project in 1994–1997 and is maintained in the framework of the NATO Science for Peace Operational Database Management System (SfP ODBMS) Black Sea Projects. It includes all the main physical, chemical and biological variables for the entire Black Sea basin and serves as a baseline for contemporary and future research activities and management purposes in the region. Very old records dating back to 1890 also exist in some places. The availability of these data sets has allowed tracking of the aforementioned changes in the biogeochemistry and ecology of the Black Sea over the past few decades. However, major work is still required on the old data sets. Following the break-up of the Soviet Union, the monitoring networks deteriorated. There were some important early efforts in joint oceanographic monitoring funded by the NATO Science for Peace and Science for Stability programmes, which included occasional inter-calibration exercises and coordinated research cruises between 1992 and 1996. A regional committee of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) was set up at the same time and has varying degrees of activity, with its reports providing a useful source of meta-data on oceanographic parameters.

Related assessments have also been conducted by:

a. The GEF Danube Programme (now completed);
b. The International Commission for the Danube River;
c. The GEF Dnieper River project (ongoing);
d. The EC Sixth Framework Programme on Southern European Seas: Assessing and Modelling Ecosystem Changes (6FP SESAME) Project on Black Sea ecosystem and its coupling with the Mediterranean Sea;
e. The European River Ocean System (EROS)-2000 project on the interaction between River Danube and the north-western Black Sea;

f. The Regional Capacity Building and Networking Programme (ARENA), A Supporting Program for Capacity Building in the Black Sea Region towards Operational Status of Oceanographic Services (ASCABOS) and the European Coastal Sea Operational Observing and Forecasting System (ECOOPS) projects, which intend to build operational capacity in the Black Sea; and
g. The Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS).

The EU Nutrient Management in the Danube Basin and its Impact on the Black Sea (DANUBS) project could not find a reliable (validated) historical data set for nutrient fluxes from the Danube River or other rivers and as a result, based their work on model outputs. This makes comparative assessments very difficult. Recent BSERP funded cruises have focused on assessing ecosystem recovery on the north-western Black Sea shelf by using conventional techniques as well as video surveying. Monitoring of the Danube River has improved as a result of the work of the International Commission for the Protection of the Danube River (ICPDR) headquartered in Vienna, but the temporal resolution of the BSERP cruises was insufficient to monitor the changes in the post-eutrophication state of the ecosystem.

There have been a number of European cruises since 1990, mostly focusing on the deep basin of the Black Sea and on assessment of gas hydrate reserves and on circulation. USA cruises of 2001, 2003 and 2005 focused on hydrology, biogeochemistry, eutrophication, pollution and microbiology. Ukrainian scientists based in Sevastopol and Turkish scientists from Erdemli remain active in conducting research on hydrochemistry, productivity and physical oceanography. Initial operational observing and forecasting systems are developed in the framework of the Black Sea Global Ocean Observing System (GOOS) and European Community Framework Programme (FP) projects, including the deployment of a number of surface drifters and Argo floats. There have not been any joint stock assessments for fish or marine mammals. Marine mammal work focuses on gathering information from volunteer observations.

3.2 Socio-economic data

This aspect is particularly weak in the Black Sea region, although the limit on available material is much less pronounced in the Danube basin because of the efforts of the ICPDR. There is very little disaggregated data available, on which meaningful assessments can be based, and very little (if any) work

has been done on issues of data quality or comparability. This situation is typified by the 2007 Black Sea TDA which uses information from the World Bank Development Indicators database, together with a limited amount of information on the proportion of population living in coastal areas. It is extraordinary to note that more is known about bivalve populations than human populations. Better information is available from national reports, although the data are not centrally archived and still require considerable interpretative effort and information exchange. There are no comprehensive studies on the economic and social costs of environmental degradation in terms of the loss of human welfare.

4. ASSESSMENTS

4.1 Thematic assessments

a. Activities/pressures on the ecosystem

The continuing limitations of data has made it difficult to produce meaningful detailed studies of the activities and pressures affecting the Black Sea ecosystem. The 2007 TDA has successfully gathered existing information and examined causal chains, linking pressures and changes to the state of the environment. There are estimates of sectoral pressures, particularly those associated with nutrient fluxes and eutrophication. Causal links are mostly qualitative. The report states frankly that there are major information gaps which impede further progress in this area with some countries unable to contribute comprehensive information to the report, thus weakening its conclusions. Similar issues were encountered in research studies such as ELME where the causal links were tested using modelling techniques (Langmead and others, in press). The situation is much better for the Danube Basin countries, most of which are now EU Member states and have statutory duties to report. The ICPDR Roof report (ICPDR 2004) is a good example of an integrated assessment of a river basin district. The recent EU funded project SESAME provided an opportunity for the Black Sea riparian countries to perform detailed ecosystem modelling studies.

b. Compartments of the ecosystem

There have been substantial efforts to assess biological diversity in the Black Sea region. The first was the work conducted by the BSEP between 1994 and 1996. The work resulted in two National Biological Diversity Reports, one published in English by UN Publications (New York) for all countries except the Russian Federation. The second was a regional report, also published by the UN. This led to the publication

of a Black Sea Species Red Book of endangered species. A Black Sea Pollution Assessment followed in the same series in 1999 (Mee and Topping 1999). Earlier oceanographic data on the Black Sea was synthesized into a book by Prof. Yu Sorokin entitled The Black Sea: Ecology and Oceanography (Sorokin 2002), which was published with support from UNESCO. The 1996 and 2007 TDAs also contain valuable summarized assessments of the overall ecological situation in the Black Sea, including some new data. Fisheries assessments produced by FAO-GFCM have mostly relied on national statistics. The 1997 report, Environmental Management of Fish Resources in the Black Sea and their Rational Exploitation by Prodanov and others (1997) is the best regional summary, although this information has been updated in a number of research publications. Numerous research publications on Black Sea oceanography are produced each year and summary reports have been published as specialist books.

4.2 Integrated assessments

Conditions in the Black Sea have changed substantially in the past two decades, politically, economically, socially and ecologically. Assessments quickly become out-dated unless they are repeated at regular intervals (at least every 10 years). The BSERP TDA is the most up-to-date assessment of the situation in the Black Sea and covers the entire marine area and the pressures on it from land-based activities. The TDA has major limitations, but these cannot be resolved without a more concerted and systematic primary-data gathering process, particularly in the socio-economic domain. The BSC is currently preparing a state of the Black Sea Environment Report for 2000–2006/7. This document will be available in 2009.

5. PRIORITIZED ISSUES

5.1 Key socio-ecological issues are:

a. Pressure from poorly regulated fisheries degrading the ecosystem;
b. Alien invasive species causing fundamental ecosystem changes;
c. Likely return of eutrophication unless land-based sources are properly regulated;
d. Inappropriate coastal development affecting natural habitats;
e. Pollution from the international shipment of oil and other products;
f. Climate-induced changes in the intensity of ventilation of waters and water dynamics; and
g. Limited implementation of the Bucharest Convention and its protocols.

5.2 Key assessment issues are:

a. Compliance by coastal countries with agreed monitoring procedures;
b. Absence of appropriate socio-economic data necessary for assessment;
c. Limited studies of the impacts of current environmental degradation on human welfare;
d. The lack of a common understanding of the importance of joint action to protect the environment;
e. The necessity to identify and deal with pollution hot spots;
f. A lack of validated information on fishing effort, catches and discards; and
g. The need for a statutory requirement to regularly update integrated assessments.

6. SUPRA-REGIONAL ISSUES

The Black Sea is the world's most isolated marine basin. Despite this, it has suffered severe damage from alien invasive species, which are transported to it by ships. The Black Sea has become a secondary source or stepping stone for these species to invade other regional seas such as the Caspian (defined by some EU Member States as a lake) and most recently, the Baltic. High organic loads in outflow from the Black Sea also impact on the northern Aegean, although there is no rigorous assessment available of its extent or consequences.

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

There is considerable regional capacity to conduct biological diversity studies. The research infrastructure in some countries is dilapidated, however, and the entire region currently lacks appropriate modern vessels to carry out systematic monitoring or occasional comprehensive international surveys. To some degree, this reflects the low priority given by the countries to this work; salaries for those involved are often extremely low and there are few incentives for change. This is not just a matter of supplying new equipment (the GEF and EU/Tacis – Technical Aid to Commonwealth of Independent States have already done this), but also involves embedding marine environmental assessment in national environmental policies and plans as well as adequately financing and supporting the activities. There are serious issues surrounding capacity in socio-economic assessment relating to information technology and the scarcity of specialists in this field. The Black Sea Commission is seriously under-funded and under-staffed, and international efforts to support it have so far not resulted in achieving the necessary critical mass of expertise.

The Black Sea case clearly shows that ecosystems can display a complex response to human-induced changes which could take a long time to reverse. Assessments and environmental monitoring indicate a perceptible and gradual improvement in the state of some biotic components of the ecosystem in the western coastal waters, including a decrease in nutrient input which has resulted in a reduction in the frequency and intensity of algal blooms. However, the Black Sea case study also emphasizes that a complex response trajectory does not necessarily imply the presence of alternative regimes. The multitude of ways in which both natural and anthropogenic changes affect ecosystems can generate complex developmental trajectories. The latter may appear as hysteresis loops when projected in a two-dimensional effect-response plot, but in reality include the effects of multiple natural and anthropogenic pressures on ecosystem dynamics. The recent availability of reliable computational tools has enhanced the predictability capacity based on the integration of up-to-date data and numerical models. Further monitoring and improvement of environmental conditions based on reduced riverine nutrient input will allow confirmation of the predicted trend.

REFERENCES

BSEP (1997). *Black Sea Transboundary Diagnostic Analysis.* United Nations Publications, New York. ISBN 92-1-126075-2, 142 pp

BSERP (2007). *Black Sea Transboundary Diagnostic Analysis.* GEF Black Sea Ecosystem Recovery Project, Istanbul, 269 pp

ICPDR (2004). *Danube Basin Analysis (WFD Roof Report 2004).* International Commission on the Protection of the Danube River, Vienna, 190 pp + Annexes

Kroiss, H., Zessner, M. and Lampert, C. (2005). *Nutrient Management in the Danube Basin and its Impact on the Black Sea.* DaNUbs final report EVK-1CT-2000-00051. Section 6: Detailed Report

Langmead, O., McQuatters-Gollop, A., Mee, L.D., Friedrich, J., Gilbert, A.J., Jackson, E.L., Knudsen, S., Todorova, V., Minicheva, G. and Gomoiu, M.T. (2008). *Recovery or Decline of the Black Sea: A Societal Choice Revealed by Socio-ecological Modelling.* Ecological Modelling, *In press, corrected proof available online 3 January 2009*

Mee, L.D. and Topping, G. (eds.) (1999). *Black Sea Pollution Assessment.* Black Sea Environmental Series Vol. 10. UN Publications, New York, ISBN 92-1-129506-8, 380 pp

Murray, J. W, (Ed.) (2005). *Black Sea Oceanography,* in Special issue of Oceanography, Vol. 18, No.2.

Prodanov, K., Mikhailov, K., Daskalov, G., Maxim, K., Chashchin, A., Arkhipov, A., Shlyakhov, V. and Ozdamar, E. (1997). *Environmental Management of Fish Resources in the Black Sea and their Rational Exploitation.* Studies and Reviews No. 68, General Fisheries Council for the Mediterranean (GFCM), FAO, Rome, 178 pp

Sorokin, Y. (2002). *The Black Sea: Ecology and Oceanography.* Backhuys, Leiden, The Netherlands, 875 pp

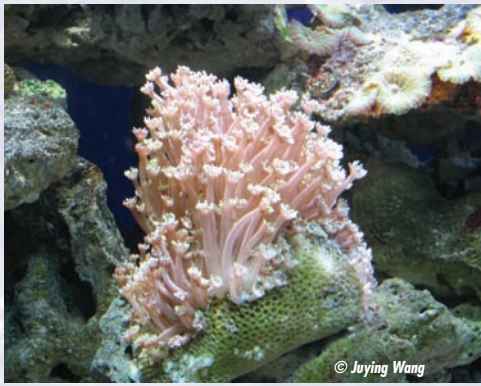
Zaitsev, Y. and Mamaev, V. (1997). *Marine Biological Diversity in the Black Sea. A Study of Change and Decline.* United Nations Publications, New York, 208 pp

Zaitsev, Yu. and Öztürk, B. (eds.) (2001). *Exotic Species in the Aegean, Marmara, Black, Azov and Caspian Seas.* TUDAV 8, 265 pp

AoA Region: East Asian Seas

Juying Wang

The East Asian Seas region is bordered by 12 countries, Brunei Darussalam, Cambodia, China, Democratic People's Republic of Korea, Indonesia, Japan, Malaysia, Philippines, Republic of Korea, Singapore, Thailand and Vietnam. It also includes six sub-regional seas or Large Marine Ecosystems (LMEs), namely the Yellow Sea, East China Sea, South China Sea, Sulu-Celebes (Sulawesi), Indonesian Seas and Gulf of Thailand.



The region hosts 30 per cent of the world's coral reefs and mangroves, but these rich and diverse ecosystems are being threatened by various human activities.

1. BROAD ECOLOGICAL CHARACTERISTICS

The East Asian Seas are semi-enclosed with a total surface area of seven million square kilometres (km^2), a coastline of 234 000 kilometres (km) and a total watershed area of about 8.6 million km^2. The region is strongly influenced by monsoons. The seas of East Asia are rich in natural resources and are some of the most productive marine waters in the world. They sustain 30 per cent of the world's coral reefs and mangroves, produce about 40 per cent of the world's fishery catch and 80 per cent of its aquaculture, and represent one of the world's centres for tropical marine biodiversity (PEMSEA 2007).

The region contains some of the most heavily populated countries in the world. Approximately two billion people live in the region, with this number expected to increase to three billion by 2015 (PEMSEA 2007). The main economic sectors include fisheries, aquaculture, forestry, agriculture, manufacturing, oil exploitation, shipping and tourism. Rapid population growth, economic development, rising global demands for fisheries and aquaculture products as well as rapidly increasing shipping traffic collectively exert tremendous pressure on the region's marine ecosystems.

2. INSTITUTIONS UNDERTAKING ASSESSMENTS

A number of formal institutions are involved in undertaking assessments in this region. The Global Environment Facility (GEF) is supporting a number of projects in this region, including the Yellow Sea Large Marine Ecosystem (YSLME) project (Reducing Environmental Stress in the Yellow Sea LME, UNDP), PEMSEA project (Partnerships in Environmental Management for the Seas of East Asia, UNDP/IMO), Global International Waters Assessment (GIWA) regional assessments (UNEP) and the South China Sea (SCS) project (Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand, UNEP). The UNEP SCS project was executed through the East Asian Seas/Regional Coordinating Unit (EAS/RCU).

The Coordinating Body for the Seas of East Asia (COBSEA) is a United Nations Environment Programme (UNEP) initiated and supported body which was formed in 1981 to provide overall policy coordination of the East Asian Seas Action Plan (EASAP) under the UNEP East Asian Seas Regional Seas Programme. In 1991 the EAS/RCU was established in the United Nations (UN) office in Bangkok. It functions as the Secretariat for COBSEA-approved projects executed under the Action Plan and manages the larger regional projects. By 1994, COBSEA's membership expanded to 10 countries with the addition of Australia, Cambodia, China, Republic of Korea and Viet Nam.

The Asia-Pacific Fishery Commission (APFIC) was established under APFIC agreement as the Indo-Pacific Fisheries Council in 1948 by the Food and Agriculture Organization (FAO). APFIC's area of competence (the Asia-Pacific) is the world's principal producer of fisheries and aquaculture products. APFIC provides advice, coordinates activities and acts as an information broker to increase knowledge of fisheries and aquaculture in the Asia Pacific region to underpin decision making. A regular overview of the status and potential of fisheries and aquaculture in the Asia-Pacific region is provided by APFIC.

Other institutions involved in the assessment of the East Asian Seas region include the following: Southeast Asian Fisheries Development Center (SEAFDEC), International Maritime Organization (IMO), FAO, UN Office for Project Services (UNOPS), World Resources Institute (WRI), The North Pacific Marine Science Organization (PICES) and the International Coral Reef Action Network (ICRAN). In addition, East Asian Seas countries maintain national monitoring networks and publish assessments at regular intervals.

3. DATA

3.1 Ecosystem data

A substantial amount of environmental data is used in the assessments, particularly in the Transboundary Diagnostic Analysis (TDA). These may come from various sources including online databases, data information centres, previous assessments, research papers, scientific publications, surveys, government reports, status reports, Environmental Impact Assessment reports and economic reviews as well as through interviews with regional experts. In the YSLME and SCS projects, data have been collected and gaps identified. In addition, some of the data from the SCS project were assessed as good, fair and poor in the TDA report. In the YSLME project, data were collected on phytoplankton, zooplankton, fisheries, seaweeds and preliminary analysis and estimations were undertaken of the carrying capacity of the lower trophic levels.

Data on the status and modification of protected species and on biodiversity loss are included in many East Asian Seas regional assessments. For example, in the UNEP/SCS assessments, the loss of biodiversity, including of marine turtle species, was covered. In the YSLME project, identification and status of threatened and vulnerable marine species such as birds and marine mammals was assessed. The primary causes leading to the changes in species composition and habitat loss were also analysed.

For most assessments, effective arrangements were designed to facilitate access to and use of the data and information. However, these need further maintenance and updating based on an effective international data management and exchange policy. The SCS meta-database is a central, online repository for the collation of and search for meta-data on coastal habitats and fisheries in Southeast Asia. Development of the SCS meta-database is a collaborative effort of the UNEP/GEF South China Sea project, Southeast Asia Regional Learning Centre and the Southeast Asia SysTem for Analysis, Research and Training Regional Centre (START). The YSLME project was contracted to relevant national institutions for data and information. For example, the National Fisheries Research and Development Institute in the Republic of Korea and the First Institute of Oceanography in China were contracted to undertake the acquisition of existing data and information relating to perceived biodiversity issues. All data and information are available on the Project's GIS and meta-databases. In the Reefs at Risk in Southeast Asia (RRSEA) assessment, apart from the data in the report additional information is available at http://www.wri.org/wri/reefsatrisk.

The RRSEA model produced map-based indicators of human pressure on coral reefs in five broad categories including coastal development, overfishing, destructive fishing, marine pollution and sedimentation as well as pollution from inland activities.

For the entire region, or much of it, there is good coverage of data on the physical and chemical background of the marine environment, marine habitats, fisheries, mariculture, waste disposal, land-based development and litter. Data on offshore wave and wind energy generation and maritime catastrophes is sparse. Information on living aquatic resources is usually inadequate, incomprehensive, unsystematic and sometimes contradictory. Standardization among countries on data collection, and international cooperative surveys is needed to obtain more comparable and consistent data. In addition, there is a need for long-term, well-planned biodiversity studies to develop a species composition checklist and determine temporal and spatial changes.

3.2 Socio-economic data

Large gaps remain in the socio-economic data at the regional scale as well as in data on the impact on humans of environmental changes such as maritime catastrophes, contaminated seawater and/or contaminated fish and shellfish and climatic events such as the El Niño Southern Oscillation phenomenon, hurricanes and typhoons. Most of the data collected relates to the ecosystem and aspects of human activities, and although there is little data on socio-economic aspects, there is even less on the inter-relationship between these two categories. Water Environment Partnership in Asia (WEPA) aims to promote good governance in water environment management by providing necessary and relevant information and knowledge through a series of databases. The WEPA includes four individual databases on policies, technologies, non-governmental organizations (NGOs), community-based organizations (CBOs) and activities and sources of water-related information.

4. ASSESSMENTS

4.1 Thematic/sectoral assessments

Pollution, habitat and community modification, exploitation of fish and other living resources and global change were assessed for the whole East Asian Seas region. The assessment, Status and Potential of Fisheries and Aquaculture in Asia and the Pacific, conducted by APFIC was a regular

overview of the status and potential of fisheries and aquaculture in the Asia-Pacific region. This assessment was aimed at informing APFIC Member states of the current status and potential of fisheries and aquaculture in the region as well as of the emerging issues and many challenges facing the sector.

Assessments such as the Regional Governance Analysis for the UNDP/GEF YSLME project and the Reports of the Regional Task Force on Legal Matters of the SCS project (e.g. UNEP 2004a, 2004b) focused on policy, legal and institutional issues. The latter could influence policy by contributing legal information and providing legal advice to national executing agencies in finalizing the Strategic Action Programme (SAP). It will assist also in identifying weaknesses in the current legislation and/or its enforcement and in advising on possible ways to strengthen these arrangements at the national level.

The focus of the Regional Governance Analysis report will assist the YSLME project in identifying policy, legal and institutional issues as well as future interventions at the regional level. The latter report intends to complete the reviews of national legislation which is relevant to the project components as well as review the legal obligations for regional cooperation implied by acceptance of the global environmental conventions. The objective of carrying out a Regional Governance Analysis under the YSLME project is to understand the underlying root causes of the problems in the Yellow Sea ecosystem. This will be done through analysis of the whole political situation which affects the environment and which provides the basic foundation for identifying possible future interventions as part of the preparation to develop a SAP for the Yellow Sea.

The assessment entitled Reefs at Risk in Southeast Asia conducted by WRI and ICRAN focused on only coral reefs and biodiversity. The assessment considered the pressure on the reefs from fishing, destructive fishing practices, sedimentation and pollution from land-based sources, shipping lanes, dredging, landfill, sand and coral mining, coastal construction, discharge of sewage along with global climate change.

The PEMSEA Manila Bay Integrated Environmental Monitoring Programme (MBEMP) is intended to develop a cross-sectoral, integrated monitoring programme by building on existing efforts to address the major impact areas, uncertainties and data gaps as identified in the Refined Risk Assessment of Manila Bay 2002. It could also provide continuous, reliable information on key environmental indicators to improve the basis for impact

assessment and priority selection of the rehabilitation efforts to support sustained beneficial development of Manila Bay. In the MBEMP, indicators will be determined for each of the components of the assessment, which will be based on certain parameters and regularly conducted at weekly, monthly, quarterly, bi-annually, annually or 5-yearly intervals.

The PEMSEA Integrated Coastal Management (ICM) component is intended to develop a coastal management framework as well as mechanisms and processes which ensure the participation of various stakeholders, including governments, NGOs, the private sector and local communities and others in decision making and developing coastal policies. ICM demonstration projects in Batangas (Philippines) and Xiamen (China) were successfully launched and more "parallel" demonstration sites are being developed in the participating countries. The success of the PEMSEA/ICM component could be evaluated using indicators such as environmental status, stress or pressure, process, response, sustainability and impact.

The main components of the EASAP are assessments of the effects of human activities on the marine environment, control of coastal pollution, protection of mangroves, sea-grasses and coral reefs and waste management.

The Marine Ecosystem of the North Pacific conducted by PICES focused on the status and trends of marine ecosystems (plankton, fish, invertebrates and marine mammals) in the Yellow Sea, East Asian Sea and other sea areas.

The Annual Report of National Marine Environment Quality as well as the Biodiversity Management in the Coastal Area of China's South Sea (SCCBD) report are two national assessments in China. The former aims at addressing the status and trend of marine environment quality of China and the latter seeks to ensure the long-term conservation and sustainable use of coastal and marine biodiversity in four sites along China's South Sea coastline through innovative demonstrations and cross-learning among multiple sites.

4.2 Integrated assessments

The YSLME TDA (UNDP/GEF 2007) and SCS TDA (Talaue-McManus 2000) as well as the GIWAs for the Yellow Sea (UNEP 2005a), East China Sea (UNEP 2005b), South China Sea (UNEP 2005c), Sulu-Celebes Sea (UNEP 2005d) and Indonesian Sea (UNEP 2005e) were all integrated assessments, covering nearly all aspects of the marine environment, including the status and impacts of human activities. In these assessments,

priority concerns were identified along with their immediate and root causes. Analysis and identification of the Options for Intervention or policy options also were presented. The TDAs form the basis for development of the SAPs, implementation of which will be facilitated by the YSLME and SCS projects.

5. PRIORITIZED ISSUES

Based on the TDAs and GIWAs, the most important prioritized issues in the East Asian Seas region include:

a. Unsustainable exploitation of fish and other living resources, including overexploitation and destructive fishing practices;
b. Decline in landings of many traditional commercially important species and increased landing of low value species, including changes in dominant species;
c. Habitat loss and degradation, including significant losses of sea grass beds, corals and mangroves;
d. Modification of ecosystems and increased frequency of harmful algal blooms as well as change in species composition, abundance and biomass;
e. Eutrophication, especially nitrogen enrichment; and
f. Effects on the environment as a result of land-based activities such as large dam construction and land reclamation.

6. SUPRA-REGIONAL ISSUES

There are several issues in the East Asian Seas region that warrant consideration and study at the global or supra-regional level. These include:

a. Effects of global climate changes and concomitant issues, including sea level rise, sea water intrusion and land salinization;
b. Modification of ecosystems and the loss of biodiversity; and
c. Marine and atmospheric transport of pollutants.

7. CAPACITY OF THE REGION TO UNDERTAKE ASSESSMENTS

COBSEA can provide an appropriate platform to conduct various types of assessment and undertake corresponding work if a global marine assessment is undertaken. The substantial amount of available data and information contained in the existing assessments can facilitate subsequent assessments. However, as previously mentioned, information on living

aquatic resources is usually inadequate, incomprehensive, unsystematic, and sometimes contradictory. As a result long-term and well-planned biodiversity studies are needed. The links between environmental issues and socio-economic aspects need to be better understood and evaluated. The East Asian Seas region has a large number of marine scientists working in both monitoring and science. Consequently, the expertise is available and the interaction between marine science, monitoring and assessments is direct and rapid. Nevertheless, the East Asian Seas region, like many other regional seas, faces many challenges. The lack of sustainable financial support remains the main challenge for nations in the region. Following termination of donor assistance, most regional activities halt, although some activities continue on a smaller scale as in-country activities but this is dependant on government policies, priorities and funding availability. Future regional activities should address the issue of maintaining regional activities after project termination.

REFERENCES

PEMSEA (2007). PEMSEA: Partnerships in Environmental Management for the Seas of East Asia (1994–2010): A Regional Mechanism Facilitating Sustainable Environmental Benefits in River Basins, Coasts, Islands and Seas. PEMSEA IEC Material 2, 5pp

Talaue-McManus, L. (2000). *Transboundary Diagnostic Analysis for the South China Sea.* EAS/RCU Technical Report Series No. 14. UNEP, Bangkok, Thailand

UNDP/GEF (2007). UNDP/GEF project: Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem. Transboundary Diagnostic Analysis

UNEP (2004a). Report of the Second Meeting of the Regional Task Force on Legal Matters. UNEP/GEF / SCS/RTF-L.2/3, 1-9pp

UNEP (2004b). Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand. Review of obligations of signatory States under global environmental conventions with regard to regional cooperation. UNEP/GEF/SCS/RTF-L.1/13, 1-17pp

UNEP (2005a). Teng, S.K., Yu, H., Tang, Y., Tong, L., Choi, C.I., Kang, D., Liu, H., Chun, Y., Juliano, R.O., Rautalahti-Miettinen, E. and Daler, D. *Yellow Sea. GIWA Regional assessment 34*. University of Kalmar, Kalmar, Sweden

UNEP (2005b). Qu, J., Xu, Z., Long, Q., Wang, L., Shen, X., Zhang, J. and Cai, Y. *East China Sea. GIWA Regional assessment 36*. University of Kalmar, Kalmar, Sweden

UNEP (2005c). Wilkinson, C., DeVantier, L., Talaue-McManus, L., Lawrence, D. and Souter, D. *South China Sea. GIWA Regional assessment 54*. University of Kalmar, Kalmar, Sweden

UNEP (2005d). De Vantier, L., Wilkinson, C., Souter, D., South, R., Skelton, P. and Lawrence, D. *Sulu-Celebes (Sulawesi) Sea. GIWA Regional assessment 56*. University of Kalmar, Kalmar, Sweden

UNEP (2005e). Abdullah, A. and others. *Indonesian Seas. GIWA Regional assessment 57*. University of Kalmar, Kalmar, Sweden