



**SEGMENT I: SUSTAINABLE DEVELOPMENT, OCEANS AND
THE LAW OF THE SEA**

**The 12th Meeting of the United Nations Open-ended Informal
Consultative Process on Oceans and the Law of the Sea
20th -24th June 2011**

***Relationship between the Oceans and the Three
Pillars of Sustainable Development***

By

Cherdsak Virapat
Executive Director
International Ocean Institute (IOI)
Malta

**Monday, 20th June 2011
15.00-18.00 hrs
The United Nations Headquarters**

Relationship between the oceans and the three pillars of sustainable development

The ocean is not only the source of life and its prime modulator and regulator, but also a primary provider of economic and social services to humankind.

“Sustainable development,” is a broad and often ambiguously used term. Its best definition perhaps is given by Brundtland, not in *Our Common Future*, but in an address (the Sir Peter Scott lecture) she delivered in Bristol on 8 October 1986¹:

There are many dimensions to sustainability. First, it requires the elimination of poverty and deprivation. Second, it requires the conservation and enhancement of the resource base which alone can ensure that the elimination of poverty is permanent. Third, it requires a broadening of the concept of development so that it covers not only economic growth but also social and cultural development. Fourth, and most important, it requires the unification of economics and ecology in decision-making at all levels.

The nexus between oceans and coasts indicates a continuity and long-term pressure to the oceans posed by the increase of human populations in coastal cities and climate change impacts. This will affect sustainable services and resources of the oceans².

Humans however failed to live with the ocean and from the ocean in a sustainable relationship. The economic and social welfare of humankind depends to a large degree on the oceans' productive sectors and services. The manner in which humans exploit those resources and services, have been anything but humane. With over exploitation and depletion of living resources compounded by land based and seaborne pollution has resulted in the current scarcity of affordable protein making a mockery of attempts to achieve MDG goals relating to health and poverty reduction.

Regrettably, however, the human impact on the ocean through use and exploitation has been destructive and unconscionable because humans have taken for granted the sustainability of the ocean. In so doing, and despite decades of efforts to evolve a global and comprehensive governance regime, the ocean's fragile ecosystem is being systematically destroyed.

Social development

The ocean covers almost three-quarters of the Earth's surface and by 2025 about 75 percent of the world's population could be living within 100 km of its coasts. While the total economic and social value of the ocean can never be fully or accurately estimated, humankind has an economic and social dependency on the goods, services, and uses provided by the ocean.

¹ Borgese, Elisabeth Mann. 1998. *The Oceanic Circle: Governing the Seas as a Global Resource: A Report to the Club of Rome*, United Nations University Press. 240 pp.

² Behnam, Awni. 2010. Concept Paper. *Water: Preserving Our Oceans*, Panel Discussion, 30th March 2010, 122nd Inter-Parliamentary Union Assembly and Related Meetings, Bangkok, Thailand, 27th March-1st April 2010. 18 pp.

- It is the largest source of protein for humankind. More than 90% of the planet's living biomass is found in the ocean.
- Moreover, 90% of the ocean is unexplored³. Given this fact and the fact that the ocean (particularly deep-sea ecosystems) is home to biodiversity unparalleled on land, it is quite likely that the ocean contains as-yet undiscovered secrets which could, like many of its resources, be used for the common good of humankind.
- Food security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO). As indicated in the UN Millennium Development Goals adopted by 189 nations and signed by 147 Heads of State and Governments during the UN Millennium Summit in September 2000, goal 1 is dedicated to eradication of extreme poverty and hunger by reducing by half the proportion of people living on less than a dollar a day between 1990 and 2015; achieve full and productive employment and decent work for all, including women and young people; and reduce by half the population of people who suffer from hunger between 1990 and 2015. The indicators for monitoring progress for the last target are the prevalence of underweight children under five years of age and proportion of population below the minimum level of dietary energy consumption.⁴
- Captured fisheries and aquaculture supplied the world with about 110 million tonnes of fish in 2006, providing an apparent per capita supply of 16.7 kg. Global captured fisheries production in 2006 was about 92 million tons with an estimated fish-sale value of US\$ 91.2 billion, comprising about 82 million tonnes from marine waters and a record 10 million tonnes from inland waters⁵. China, Peru, the United States of America, Indonesia, Japan, Chile, India, Russian Federation, Thailand and the Philippines are the top ten producing countries in 2006. World captured fisheries production has been relatively stable in the past decade with the exception of marked fluctuations driven by the catch of anchoveta – a species extremely susceptible to oceanographic conditions determined by the El Nino Southern Oscillation – in the South Pacific. Fluctuation in other species and regions tend to compensate for each other to a large extent.
- Fisheries and aquaculture, directly or indirectly play an essential role in the livelihoods of millions of people around the world. In 2006, an estimated 43.5 million people were directly engaged, part time or full time, in primary

³ IUCN. 1997. Critical Ocean Issues: Ecosystems and Biodiversity in Deep Waters and High Seas, UNEP 2005 available on line www.iucn.org Ecological Economic Research and Application Inc.

⁴ United Nations. 2008. Goals, Targets and Indicators Effective 8 September 2003. UN Web Service Section, Department of Public Information, United Nations.

⁵ Food and Agricultural Organization of the United Nations. 2009. The State of World Fisheries and Aquaculture 2008.

production of fish either captured from the wild or in aquaculture, and a further 4 million people were engaged on an occasional basis (2.5 million of them in India). About 86% of fishers and fish farmers worldwide live in Asia, with China having the greatest number (8.1 million fishers and 4.5 million fish farmers). In 2006, other countries with a significant number of fishers and fish farmers were India, Indonesia, the Philippines and Viet Nam. Most fishers and fish farmers are small-scale, artisanal fishers, operating on coastal and inland fishery resources.

- Poverty alleviation of small-scale fishers should be done on both sides, i.e., income and expenditure. The income of fishers can be increased not only from their fishing activities but from eco-tourism and activities at home which could be other sources of income. However, in some communities where eco-tourism has well developed, outside investors have engaged in eco-tourism whilst trying to maximize exploitation benefits. This leads to highly unsustainable development in eco-tourism. Agencies concerned and NGOs should provide consultancy and assistance in eco-tourism management for communities.
- In order to maintain sustainable fisheries and food security, capacity building for individuals and organizations is required. Learning by doing is the best practice for capacity building. NGOs shall play an active role in capacity building programmes, they may provide technical assistance through training programmes and essential technical manuals that are written in a simple language understandable to all stakeholders.

Economic development

The economically and ecologically sustainable use of ocean resources involves much more such as fisheries, marine transport, and off-shore extraction of oil, gas and other minerals. It also involves recognition of the way in which land-based activities affect the oceans. The enormous increase in economic activity and the settling of more and more people in coastal zones are threatening the ecological value of the oceans⁶.

The combined value of the ocean ecosystem in goods and services is conservatively estimated at over US\$33 trillion per year, of which 63% (US\$ 20.9 trillion) is contributed by the oceans⁷; this estimate covers such uses as exploitation of living and non-living resources, transportation, communication, recreation, energy production, and waste disposal^{8,9}.

⁶ Soares, Mario, *et al.* 1998. *The Ocean Our Future: The Report of the Independent World Commission on the Oceans*. 248 pp.

⁷ WWF/IUCN. 1998. *Creating a Sea Change. The WWF/IUCN Marine Policy*. 64 pp.

⁸ Behnam, A. 2007. *Biodiversity - An Issue of Governance*. In *Wave of Change: Women, Youth and the Sea Conference, Partnering for the protection of the marine environment and the sustainable use of its resources*, Pacem in Maribus XXXII, Malta, 5-8 November 2007, Corinthia Palace Hotel, Attard, Malta. P. 67-74.

Environmental protection

Oceanus - the world ocean – is vast, covering 360 million square kilometers and holding close to 1.4 billion cubic meters of water⁹. This gigantic body of salt water, which wraps around the planet like an insulating blanket, literally makes life on Earth possible. The oceans are the engines that drive the world's climate, defining weather and storing huge quantities of solar energy in the process. As climatologists have discovered the oceans absorb and store carbon dioxide from the atmosphere. Since this invisible gas is one of the main climate-changing agents, this makes the oceans, like forests, an important carbon 'sink' that helps to modify human impacts on the global climate.

The oceans are also the liquid heart of the Earth's hydrological cycle - nature's great solar-driven water pump - which causes roughly 430,000 km² of water to evaporate from the oceans every year. Of this amount, around 110,000 km² fall as freshwater precipitation over land (the rest falling over the sea), replenishing surface and ground waters and eventually completing the cycle by returning to the sea. Ocean currents - the blue planet's super highways - transfer great quantities of water and nutrients from one place to another. The Gulf Stream, for instance, pushes more water than is carried by all the rivers on Earth from the Gulf of Mexico and the Caribbean across the Atlantic into northern Europe. Where currents converge - for instance, off the west coast of South America, West Africa, and the North Atlantic - upwelling of nutrient-rich bottom water fuel as the explosion of marine life, including great quantities of phytoplankton and zooplankton that form the basis of the marine food chain.

The marine environment, which embraces the oceans, seas and adjacent coastal waters, forms an integrated whole that is an essential component of the whole environment and also the main part of environmental consideration¹⁰.

The joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) has classified marine environmental harm into three categories, namely;

- marine pollution (sewage, eutrophication, algal blooms, health threats; classic pollution-metals, oils, organics, radionuclides, endocrine-disrupting chemicals, man-made debris-litters);
- ecological balance (overfishing and destructive fishing practices, reduced biodiversity, transfer of alien species);
- and habitat change (climate change, sea-level rise and coastal flooding; marine habitat destruction-coral reefs, mangroves, wetlands; deforestation and

⁹ United Nations, Division for Ocean Affairs and the Law of the Sea. 2002. Ocean Source of Life, UNCLOS 20th Anniversary Publication, United Nations, New York.

¹⁰ Huang, Y. 2009. Compensation of Damage to the Marine Environment. In Responsibility and Liability in the Marine Context. Peter Ehlers and Rainer Lagoni (eds.). Hamburg.

changes in hydrology, turbidity, sedimentation; mineral, sand and gravel extraction)^{11,12}.

Perspective on the preservation of oceans

Sustainable development correlates directly with community knowledge and empowerment. Participation of all stakeholders in the strategic planning process, interdisciplinary approach, empowerment and capacity building of all individuals and community organizations, and sustainable management of natural resources and environment are the key principles for sustainable development.

The application of ecosystem approaches to ocean management is important for the achievement of sustainable development. The common denominator for ecosystem approaches is that they are a comprehensive and science-based approach for the conservation and management of natural resources. They build on the concept of integrated ocean management, which involves comprehensive planning and regulation of human activities towards a complex set of interacting objectives and aims at minimizing user conflicts while ensuring longer-term sustainability. Adopting and implementing an ecosystem approach should therefore be considered an evolutionary step. Increased focus should be placed on ways to facilitate its implementation both at the regional and national levels. Because ecosystems do not respect maritime boundaries, regional cooperation is essential. As the scientific understanding of ocean ecosystems is still very limited, further research is needed as well as the application of the precautionary approach in the face of uncertainty¹⁰.

In the context of fisheries management, an ecosystem approach requires, in particular, the use of the best scientific evidence available for the conservation and management of marine living resources. It also requires improved monitoring, not only of the status and trends of fisheries, but also of the status of the key environmental factors, habitats, endangered species and non-target and dependent species associated with the target species. The ecosystem approach should reflect due concern about the long-term effects of fisheries management on marine ecosystem by restricting the environmental impacts of fishing to acceptable levels, including by reducing by-catch and incidental mortality of non-target species.

Today, about 2.8 billion people (more than 40% of the total global population) live in coastal cities. This has significant implications to the coastal environment, inhabitants and ecosystem stability¹⁰. UN-Habitat stated that there are 3,351 cities in the low elevation coastal zones around the world. Of these cities, 64% are in developing regions; Asia alone accounts for more than half of the most vulnerable cities, followed by Latin America and the Caribbean (27%) and Africa (15%)¹³. Two-thirds of these cities are in Europe, and almost one-fifth of all cities in North America are in low elevation coastal zones. The world's eighteen largest coastal cities listed by the

¹¹ Formerly known as the group of experts on the scientific aspects of marine pollution. It was established in 1967 by a number of United Nations Agencies and deals with all scientific aspects on the prevention, reduction and control of the degradation of the marine environment to sustain life support system, resources and amenities. Referred by Y. Huang. 2009.

¹² Gold, supra, note 17, p.59, citing Sources of Marine Pollution, GESAMP, 2004. Referred by Y. Huang. 2009.

¹³ UN-HABITAT (2008), Few coastal cities to be spared by climate change. Press Release.

United Nations include Los Angeles, New York, Lima, Rio de Janeiro, Sao Paulo, Buenos Aires, Istanbul, Lagos, Karachi, Mumbai, Calcutta, Tianjin, Shanghai, Hong Kong, Manila, Tokyo, Osaka and Jakarta¹⁴.

These coastal cities have all the symptoms of urban cities and urban challenges, in addition, they have a nexus to the ocean which provide for both economic opportunities and the need to manage a sustainable relation with the ocean and coast. Such coastal cities have to address such challenges as dredging, the erosion of shores, construction, port development and marine pollution on a large scale¹⁵. Rice University's Shell Center for Sustainability in 2006 has initiated an interdisciplinary study with various research institutions in China on five problems endemic to coastal cities, namely; flooding, severe storms, air pollution, congestion and ethnic tension¹⁶.

The importance of knowing how to prepare and respond to disasters has also led to the evolution of disaster management from an almost ad-hoc response to nature's disturbances to a holistic system of preventing and mitigating risks and adaptation. New ways of addressing disasters have taken advantage of the advances in information and communication technology. It has also integrated various disciplines and concerns including stakeholder involvement, governance and policy issues at the local and national level and the threat of climate change, which put a global perspective on an otherwise local concern. One of the most challenging issues facing the oceans today is the urbanization revolution, the implications of which have yet to be fully assessed, especially in terms of the earth's coastlines. Today more than half of the world's population lives within 60 km of the coastline and more than 50 % live in cities. Mega-cities in coastal areas have the highest forecasted population growth in coastal areas for the next decades.

Natural disasters such as earthquakes, tsunamis, flash floods, landslides, wild fires, hurricanes, and droughts have severe impacts on coastal zones. Various Governments around the world have established their national disaster warning centers to function as a national central command center in nation-wide end-to-end multi-hazard disaster early warning. Other measures are training and public awareness creation to build up coastal communities and tourists 'awareness and resilience for these disasters. For the private sector and tourism industry, there is a need to consider hotel responsibility and reliability.

It was found that major challenges remain as communication gaps between governments and communities for effective early warning, mitigation and preparedness. Lack of common understanding of preparedness and prevention arrangements is significant which is a priority for effective disaster management approaches at the government function levels and the community levels. Good practices have been developed and will need to be scalable and expanded to cover multi-hazard frameworks and communities within the Southeast Asian Sea Region which are highly vulnerable to risks and disasters. In order to strengthen the founding initiatives at the local, national and regional levels, a regional training course on disaster management shall be designed and developed for interagency government

¹⁴ United Nations referred by Jaffe, A. (2006).

¹⁵ WMO (2004). Weather Climate and Sustainable Development, WMO-No. 974.

¹⁶ Jaffe, A. (2006). Geopolitical Insight of the Year: The Coastal-Cities Phenomenon.

agencies. This can be done through financial support from regional member countries and international development organizations.

Future implementation, replication and scaling up of efforts will be needed as multi-cooperation among countries within the region and among regions. The tasks are too large for any single international or regional agency framework such as UNISDR, IOC, UNDP and USAID to solely coordinate on early warning, mitigation and preparedness at the national and local levels, since they will have to deal with a large number of populations at risk particularly in the coastal zones. Sharing of knowledge and lessons learned, planning and implementation on adaptive management approaches will be urgently needed. NGOs such as the International Ocean Institute has a significant role to play in the coordination, strategic planning and implementation at government function levels and community levels.

The immediate attention of countries and governments is to co-manage disaster management with the local community in disaster management focusing on an adaptive management approach. Sustainable financial inputs will need to be allocated for local adaptive learning on multi-hazards disaster management. A long-term plan for example a 10 year plans should be developed.

Another important area where cooperation is of vital importance is maritime security and safety. Creating the conditions that enable the safe and efficient navigation of ships through the world's oceans is essential for global trade. As today's challenges to maritime security are wide-ranging, global in scope and often connected, cooperation on all threats to security issues is crucial for their prevention and suppression as well as for safety of navigation. It is therefore important to intensify cooperation at all levels to address threats to maritime security and safety in a comprehensive manner through bilateral and multilateral instruments and mechanisms aimed at monitoring, preventing and responding to such threats¹⁰.

At the Global Ocean Policy Day, 13th May 2009 of the World Ocean Conference 2009 in Manado, Indonesia, the IOI proposed a concluding statement obtained from the back-to-back meeting on ocean governance and sustainable development workshop, 6-7 May 2009 in Nonthaburi, Thailand¹⁷ with strong support for the Appointment by the United Nations Secretary-General of a Special Representative for the ocean. The special task of such a position should be to monitor the development in maritime issues under the influence of climate change (Maritime transport and security, marine pollution such as nuclear waste, exploitation of living and non-living resources, etc.) and give guidance for necessary action. The United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea should continue to be the forum for discussing these issues.

At the meeting of *Pacem in Maribus* XXXIII held in Beijing, People's Republic of China from 2nd to 4th September 2010, the Beijing Declaration¹⁸ was proposed by the

¹⁷ Minutes of the Ocean Governance and Sustainable Development Workshop prior to the World Ocean Conference in Indonesia, 6th -7th May 2009, Richmond Hotel in Nonthaburi, Thailand. 13 pp.

¹⁸ The Beijing Declaration. *Pacem In Maribus* XXXIII & Celebration of the 50th Anniversary of the UNESCO/IOC, International Conference on Oceans, Climate Change and Sustainable Development: Challenges to Oceans and Coastal Cities, 2nd -4th September 2010.

participants at the Conference to call on the attention of the people of the globe to the potential of threats to their future peace and wellbeing resulting from climate and ocean changes and the widespread degradation of coastal and marine systems. This degradation has a direct and potentially very deleterious influence on the environmental, social, cultural and economic sustainability of human communities worldwide and, especially, that of coastal communities. As ecological services are progressively degraded, coastal inhabitants will need to adjust their means of living and their level of dependence on natural resources. The impacts of ecological damage vary across social groups, with more vulnerable members of society being particularly susceptible to negative impacts. Adaptive capacities are also unequal across society, and are strongly correlated to levels of wellbeing. Furthermore, the policy responses of coastal and ocean management are complicated by the fact that coastal zones (in their ecological sense) often extend across multiple political jurisdictions.

They express their concern about the negative destabilizing consequences brought about by causes such as coastal urbanization, pollution, overexploitation of resources, rising sea levels, ocean acidification, and damaging hazard events. The implications of these negative influences are of particular concern given the growing numbers and proportions of people living in coastal zones; this trend of demographic growth is likely to further aggravate driving forces of change and to render negative impacts of such changes as a matter of even greater humanitarian concern. Many of these issues also have the potential to affect each nation's security, and to displace human populations, potentially constituting a threat to peace. We, therefore, set forth numerous steps that can be undertaken as an effective means of improving and safeguarding the conditions of sustainable human societies, security and peace across all nations, satisfying the vital needs and ensuring the legitimate environmental rights of all.

Regarding oceans and climate: they emphasize the emergent need for an intelligent and prudent approach to address our long-term wellbeing and security. They propose an approach based on the understanding and communication of the risks of changing climate and oceans, on the evaluation of effective and expeditious management options, targeted towards making their marine and human communities more sustainable and prepared for climate-induced damage. Our times call for a vastly improved integrated understanding of science and technology, communication, and governance structures that effectively manage our interdependent air, land, marine and human systems. Open and collaborative research, data collection, sharing and analysis, and modeling are needed at the global, regional and local levels. Appropriate science based recommendations for governance mechanisms to shape our mitigation and adaptation strategies to changing climate, ocean, and human security needs are necessary. Socially - just policies that take into account the adaptation needs of vulnerable populations must be a cornerstone of all recommendations. Communicating and 'framing' the issues so we are understandable and actionable by all peoples is an important corollary to the integration of science into sound policies.

Regarding the role of oceans in sustainable development: We are experiencing profound changes in coastal and oceanic environments, connected with a loss of living resources and a decline in ecosystem services, both of which are crucial to coastal populations. We have to develop and apply management approaches to withstand the degradation of our coastal seas and to counter the undermining of

human rights in coastal communities. New tools have to be developed and existing instruments have to be applied to address the challenges connected to climate and anthropogenically-induced impacts. Policies and strategies relating to marine economic development have to be adapted to be sustainable into the future. We thus need a new strategy for a marine industry which is now facing the problems induced by climate change on the one hand, and the global economic crisis, on the other. They strongly recommend implementation of existing management tools such as Marine Spatial Planning and Marine Sustainable Development, based on the principles of good Integrated Coastal Zone Management. Technical innovation also has to be enhanced to reduce dependence on fossil fuels and we need to focus increasingly on renewable energies and green and bio technologies.

Regarding challenges to coastal cities: The unique challenges which coastal cities face require a broad, transdisciplinary and ecosystem-based approach to management. Such an approach needs to take into account the ecological scale and dynamics of the coastal system, and the full spatial remit of influence. Feasible management of coastal cities requires a long-term perspective, built on all four components of sustainability (environment, economy, culture and society), manifested through strategic assessments and through an understanding of cumulative and synergistic effects. Ecosystem management advocates full involvement of all affected and interested stakeholders for purposes of collaborative management, also enabling a better understanding of linkages and connections between coastal and urban systems. It is thus crucial that an integrated and participatory approach is adopted to ensure the inclusion of scientific, socio-political and economic factors, while considering issues identified at local, regional and national levels as well as from the perspective of all key players. Climate change also brings with it increased vulnerability to certain natural hazards, with attendant risks for coastal zones. These risks can be reduced through strategies involving: (i) risk and vulnerability assessments, (ii) sound development planning, and (iii) emergency response plans (preparedness, early warning alert and mitigation).

Human society must change its behavior to achieve goals of sustainable interaction with the environment and the oceans

Overall conclusion presented in the World Ocean Review: Living with the oceans is given below as a wake-up call with the message that human society must change its behavior with the goal of achieving sustainable interaction with the environment and the oceans in particular¹⁹.

In this first “World Ocean Review”, we present a report on the state of the oceans which will be followed by periodic updates in the future. Our aim is to reveal the consequences of intense human intervention for the ocean realm, including the impacts of climate change. We already understand some of the effects, but many unanswered questions remain. What is certain, however, is that human society must change its behaviour with the goal of achieving sustainable interaction with the environment and the oceans in particular. Worldwide, the winter of 2010 was the

¹⁹ Maribus in cooperation with future ocean: Kiel Marine Science, International Ocean Institute (IOI) and Mare. World Ocean Review 2010: Living with the Oceans. 232 pages.
<http://www.worldoceanreview.com>

warmest in the past 131 years. Global climate change has caused a gradual rise in the Earth's average temperatures. In the coming years the rate of glacial melting will probably accelerate. Sea-level rise will become more rapid. Present calculations indicate that there will probably be a rise of at least 80 centimeters within this century, with as much as 180 centimeters being predicted for the worst-case scenario.

The immense water masses of the ocean act as a buffer, storing considerable amounts of carbon dioxide and heat from the atmosphere. Climatic changes therefore only gradually become noticeable. Scientists anticipate that if greenhouse gas emissions continue unchecked, the sea level could rise by as much as 5 metres by the year 2300. Most of the "mega-cities", with populations greater than 10 million, are located on or near the coasts. It would require enormous sums of money to protect them, and presumably many of them will have to be abandoned. The ocean may be buffering the most severe consequences of climate change for now. But in the long run we can only hope to avoid these if we strictly curb greenhouse gas emissions today. Experts are concerned that hundreds of thousands of tonnes of methane hydrate could break down due to the warming of seawater – gas masses that are lying inertly in solid, frozen form in the sea floor sediments today. A portion of the methane, which is a powerful greenhouse gas, could then rise into the atmosphere and further accelerate the process of climate change – a vicious circle.

The oceans absorb many millions of tonnes of carbon dioxide annually. They are the largest "sink" for anthropogenic CO₂ emissions. The excess carbon dioxide, however, upsets the chemical equilibrium of the ocean. It leads to acidification of the oceans, the consequences of which are unpredictable. Acidic water disrupts the sense of smell in fish larvae, carbonate formation by snails, and the growth rates of starfish. The phytoplankton, tiny algae in the ocean and vital nutrient basis for higher organisms, are also affected by acidification.

The coastal environment is still being damaged by effluent and toxic discharges, and especially by nutrients conveyed to the ocean by rivers. Thousands of tonnes of nitrogen and phosphorus compounds flow into the ocean around the world, causing an explosion in algal reproduction. In many coastal regions the catastrophe begins with the death of the algae. Bacteria feed on the algal remains and consume oxygen in the water. In these oxygen depleted zones all higher life forms die off. Efforts to reduce nutrient levels have been successful in Western Europe. Worldwide, however, the input of nutrients is becoming increasingly problematical. People are, without a doubt, abusing the oceans in many respects, and this is increasing the stress on marine organisms. Through over fertilization and acidification of the water, rapid changes in water temperature or salinity, biological diversity in the ocean could drop worldwide at increasing rates. With the combination of all these factors, the disruption of habitats is so severe that species will continue to disappear.

It is still uncertain what consequences will ensue from the gradual poisoning of the marine environment with pollutants such as polyfluorinated compounds, which have been used for years as components in non-stick surfaces for pans and in outdoor jackets. These substances become concentrated in the nutrient chain and have recently been detected in the tissue of polar bears. Clearly the oceans continue to be the "last stop" for the dregs of our civilization, not only for the persistent chemicals, but also our everyday garbage. Six million tonnes of rubbish end up in the ocean

worldwide every year. The trash is a fatal trap for dolphins, turtles and birds. Plastic is especially long-lived and, driven by ocean currents, it collects in the central oceans in gyres of garbage covering hundreds of square kilometres. A new problem has been identified in the microscopically small breakdown products of plastics, which are concentrated in the bodies of marine organisms.

In the medium term, however, there is a positive trend with regard to ocean pollution. The number of oil spills has decreased. Spectacular tanker accidents now only contribute around 10 per cent of the oil contamination in the oceans. Less conspicuous oil pollution, on the other hand, continues to be a problem. Around 35 per cent of the worldwide oil pollution originates from everyday shipping operations. This source is much more difficult to deal with. As was demonstrated by the explosion of the “Deepwater Horizon” drilling rig, new problems may arise with the trend towards producing oil and gas from wells from greater water depths.

Humans are destroying the marine environment not only through pollution, but also through greed. 80 million tonnes of fish with a market value of around 90 billion US dollars are caught every year. As a result, the fish stocks are now severely overfished or are completely depleted. This situation has been caused by a flawed fisheries policy that strongly subsidizes fishing. Protection of jobs has always been more important than the protection of living resources. This is an extremely shortsighted view. The Common Fisheries Policy (CFP) adopted by the European Union is a notorious example. The European Union’s Council of Ministers has regularly set the catch quotas too high, overriding the recommendations of fishery biologists who have long been warning of overexploitation and depletion of stocks.

Fish are not the only living resource that humans harvest from the ocean. The recovery of medically and industrially useful materials from the sea is becoming more interesting for scientists and commercial enterprises. In recent years substances extracted from marine organisms have been used in cancer therapy and to fight viruses. Businesses have long resisted joining in the expensive search for active agents in the oceans. But with the establishment of new start-up companies, the commercialization of marine medicine has accelerated. The young businesses, however, rely heavily on government subsidies initially.

The large oil and mining companies are looking for very different kinds of marine resources. Drilling for oil in the oceans has been going on around the world for decades. The proportion of gas and oil extracted from the ocean has been growing steadily, and today it represents around one-third of worldwide production. Moreover, in the coming years the mining of ores and manganese nodules will likely begin on a large scale. Methane hydrates are also becoming increasingly interesting. If the industrial production of methane becomes viable, we will have tapped a gigantic energy reservoir. In theory, the hydrates would be dissolved at the sea floor under controlled conditions and the methane extracted. However, it is not sure that this will work. Critics are concerned that large quantities of methane could escape uncontrolled from the sediments.

Humankind is forging into the depths as never before. Because of the scale at which resources on land are being depleted, mining in the ocean depths is becoming more attractive and potentially lucrative. In 2007 and 2008, before the economic crisis,

mineral resources had reached exorbitant prices. The mining of the ocean, experienced a period of high interest in the 1970s. Overall conclusion < 213 before becoming inactive for a time, thus became attractive again in spite of the subsequent crisis. Presently, the precious-metal rich ores near once-hot submarine springs and manganese nodules in the central Pacific appear to be especially promising. Mining of the ore deposits could begin in the near future. Environmentalists, however, fear that this could cause the destruction of deep-sea habitats. The large-scale harvesting of manganese nodules is also viewed critically by some. The first claims in the Pacific have already been awarded to various countries, including Germany.

The development of renewable energy in the oceans as an alternative resource, on the other hand, harbours much less risk. Present approaches include systems for wind and wave energy, tidal and ocean-current power plants, and even plants that use salinity and temperature differences to produce electricity. All of these technologies combined could satisfy a considerable proportion of the world's energy needs. As a general principle, however, before environmentally friendly techniques of energy production can be established, their potential impacts on the marine environment need to be investigated. Some marine regions will undoubtedly be excluded from development for ecological reasons. Scientists recommend that regions be identified where different technologies can be combined, such as wind turbines and ocean-current systems.

Just a few decades ago, no one took it for granted that ocean regions could be surveyed and exploited. There was frequent controversy over the ocean regions. The international community was not able to find any common ground until the adoption of the United Nations Convention on the Law of the Sea (UNCLOS) in 1982. This convention is the most comprehensive agreement in international law that has ever been achieved in the history of humankind. It regulates the areas of interest for coastal nations as well as exploitation of the high seas. A UN agency, in turn, oversees the extraction of resources from the sea floor and equitably allocates claims for the mining of manganese nodules, for instance. In spite of these regulations, there has long been a smouldering controversy among the Arctic countries over who can exploit the resources of the floor of the Arctic Ocean if the sea ice continues to melt.

On the other hand, shipping traffic, which has undergone huge changes in recent decades, is efficiently regulated today. One important milestone was the introduction of the standard shipping container, which has so expedited the loading and unloading of ships that the shipping companies can run their freighters under tight schedules not unlike those of a city bus line. There are now over 53,000 cargo ships, tankers, bulk freighters and container ships carrying goods around the world. The total carrying capacity of the commercial fleet amounts to over 1000 million tonnes.

It is both fascinating and unsettling to think that climate change could open up the legendary Northern Sea Route through the Arctic. Because the Arctic sea ice now thaws extensively in the summer, the sea route from Europe to the Pacific Ocean along the Siberian coast will be open in the future for several weeks a year. This route is much shorter than travelling through the Suez Canal or around the Cape of Good Hope, but its cost effectiveness, considering stray sea ice and possible passage fees, is not yet clear. Nonetheless, it would allow traffic to avoid the dangerous route through the Gulf of Aden and past the Somali coast, at least in the summer. The number of

pirate attacks there has greatly increased recently. The situation in the waters east of Africa, however, should not detract from the fact that piracy has been declining worldwide in recent years.

During the more than two years of work on this report, we have often asked ourselves whether it is possible to portray the ocean in all of its facets. The only honest answer to this question is “no”. The oceans are too large and the subject matter too complex to even begin to claim complete coverage of the topic. Moreover, many scientific questions are still unresolved. We have nonetheless tried to draw as comprehensive a picture of the state of the oceans as possible. We hope that this report will make at least a small contribution towards steering a sustainable course.

Nikolaus Gelpke and Martin Visbeck