

Understanding and Managing the Oceans

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I am deeply honoured and grateful to the organisers for the invitation to deliver a key-note address at this important conference and for this distinguished audience. It is good to be here, with Phil Reynolds and the United Nations Associations, on this United Nations Day. Phil has devoted his whole life to the United Nations, and served it well.

We do have for the United Nations the same affection, the same “patriotism” that we have for our own countries, and there is no contradiction between the two; as a matter of fact, we know today that we cannot have one without the other.

We may be critical of one or the other thing that may be happening in our own countries; and we may be critical of the United Nations, of aspects of it that may need to be changes because the world is changing, and some aspects of the United Nations are obsolete.

Now the interesting thing is that the parts of the United Nations that deal with ocean affairs and the Law of the Sea are the most advanced parts: are the agents of change; are, in a way model for a renewed, revitalised United Nations for the next century.

Why should this be so? Why the oceans? Because the oceans are a medium very different from land: so different, in fact that they force us to think

differently, differently about some of the most fundamental concepts like security or sovereignty or boundaries or even ownership

I would like to begin by underlining the enormous importance of the oceans, and I would like to do this with some figures, whatever figures may be worth in dealing with a life support system. In the second part of my remarks I will deal with the emerging management or governance system.

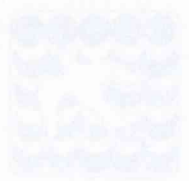
I have divided my calculation of the economic value of the ocean into three parts: First the current market value of ocean-related and ocean-dependent goods and services; second, the emerging new industries and their possible value in the next century, and, third, the value of the ocean as a life support system, or, as Bob Costanza calls it, the ecological services of the ocean.

The total monetarized value of the traditional marine-related goods and services, and excluding the commercial value of ports and harbours, which is another major factor, adds up to something of the order of \$6.5 trillion. This is a conservative estimate. More could be added, for instance, investments in ship construction, including tankers. The Global GDP today is of the order of 23 trillion, 18 of which are contributed by the OECD countries. Roughly, one might say that the contribution of ocean-related goods and services is about one third the present global GDP: not a negligible proportion!

7%
+

Let us have a quick look at the “futuristic” industries which certainly will make major contributions to the global GDP in the next century.

Many marine micro-organisms, as we all know, produce biologically active substances: enzymes, enzyme inhibitors, and compounds having antibiotic,



antitumor, antileukemia and other pharmacological value.

Literally thousands of pharmaceutically active substances have been isolated from a vast number of marine animals and plants. The Japanese alone, who are leaders in this field, have isolated about 3,000. The isolation of strains of bacteria capable of determined biological activities, and genetic engineering to enhance these capabilities, is going to be of great importance, not only for the pharmaceutical industry but for a number of other industries as well: replacing chemical and mechanical processes with biological processes, e.g., for the clean-up of oil spills or the extraction of metals from ores, through bacterial systems. The Mediterranean Blue Plan mentions a future bio-steel industry that could be developed, based on bacteria and solar energy.

Marine biotechnology is still in its infancy. It is a well protected baby, growing rapidly, in the secrecy of highly competitive, mostly private industries. New discoveries are being made daily, mostly in tropical seas, although bioactive substances may be present in the flora and fauna of colder waters as well, and financial rewards for developing even one successful product are considerable. Many sources cite potential sales of US\$1 billion or more annually for a successful product, particularly if it is an antiviral or anti-cancer drug. The antiviral compounds Ara-A and Ara-C, derived originally from a Caribbean tunicate, have been used for a number of years in the treatment of herpes, and currently maintain sales of US\$ 50 to 100 million a year.

Besides its multi-billion dollar economic potential, this new industry has complex political, legal and institutional and ethical implications if it is to be adapted to the goals of sustainable development and the equitable and

participational institutional framework this requires. .

A special case is constituted by the industrial utilisation of the genetic resources, in particular, the thermophile bacteria, of the deep seabed. The industries utilising this genetic resource include waste treatment, food processing, oil-well services, paper processing, and mining applications, together with the pharmaceutical industries. The potential market for industrial uses of hyperthermophilic bacteria has been estimated at \$3 billion per year.¹

And this is just the beginning. The biodiversity of the seabed has hardly been explored, and we simply do not know what may exist.²

The present and future value of these resources can be gauged by the brazen intransigence with which, in particular, the United States, under pressure from its bio-industries, is keeping the item off the agenda of the meetings of States Parties to the Biodiversity Convention, even though it is not even a Party to this Convention!

A third example of industries likely to considerably increase the “quantifiable” contribution of the ocean to the global GDP are the industries producing renewable energy from the ocean. Turbines to extract a tiny portion of the enormous amount of energy produced by ocean currents --updating projects

¹Lyle Glowka, “The Deepest of Ironies: Genetic Resources, Marine Scientific Research, and the Area,” *Ocean Yearbook*, 12. Chicago: Chicago University Press, 1996.

²The World Conservation Union has estimated that the deep sea may be home to 10 million species.

that were on the drawing board 20 or 30 years ago -- are in the headlines today. Tests recently conducted on the Florida Current (part of the Gulf Stream) have demonstrated that power from such units could be supplied at a competitive rates. Ocean Thermal Energy Conversion, also long on the drawing boards, is still considered to have a great potential The market for this technology, in the Pacific and Caribbean, is estimated to be, by the year 2015, about \$18.5 billion/year.

No figures at all are as yet available for the methane hydrates of the deep sea-bed which may become another source of energy during the next century .During recent years, the U.S. Geological Survey has stressed the importance of the Methane Hydrates of the deep sea, describing them as “a new frontier.” “The worldwide amounts of carbon bound in gas hydrates is conservatively estimated to total twice the amount of carbon to be found in all known fossil fuels on earth.”³ A great deal of research is being devoted to these hydrates, in the USA and in other industrial countries, and fascinating futuristic scenarios are already on the table. Dillon writes)

For example, fuel cells eventually might be placed on the sea floor to use hydrate-derived methane as an energy source to generate hydrogen, which could be piped ashore to support a nonpolluting, hydrogen-based energy distribution system and the waste carbon dioxide might be disposed of as a sea-bottom gas hydrate (carbon dioxide also forms gas hydrate at sea-floor conditions)⁴

³William Dillon, U.S. Geological Survey, Marine and Coastal Geology Program, September 1992.

⁴bdillon@nobska.er.usgs.gov

Hydrates are considered a future source of energy as well as a threat to the environment.⁵

From the above we may fairly safely assume that the "market value" of the ocean may double in the next century

The third category of value of the ocean, its function as a life support system, is the really the first, and it is not really quantifiable.

Believers in the market system have however made very interesting attempts, in recent years, to quantify, and express in monetary terms, the "eco-system services" performed by the oceans and other eco-systems. A group led by Robert Costanza has come up with the figure of \$33.3 trillion for 17 categories of "goods and services" -- including protection against storms and floods, nitrogen fixation, or plant-derived pharmaceuticals -- provided by 16 specialized "biomes," such as oceans, estuaries, tropical forests, etc.. The calculation was based on market prices, people's willingness to pay, or the cost of replacing the service. Considering the enormity of the ocean and coastal system, and the intensity of its interaction with the atmosphere, it is not surprising, that \$21 trillion of that amount is contributed by the ocean system.

Costanza's calculations have been widely criticized. A Cornell University ecologist, David Pimentel, and his colleagues, argued that the figure is far too high. According to their estimate, these "goods and services" amount to no more than

⁵See P. Englezos, "Clathrate Hydrates," in *Industrial & Engineering Chemistry Research* 1993, Vol. 32, No.7.

\$3 trillion.⁶ The mere fact that calculations may diverge by orders of magnitude should make us wonder about the value of these calculations. Why do we need them? I have cited them merely to underline the enormous importance of the oceans in terms that may disabuse our political leaders from the traditional opinion that the oceans are of secondary importance in national and international context in which we are living.

What, then, is it we want our political leaders to do?

The present trend towards more and more “privatisation” and “deregulation”: and its emphasis on short-term narrowly defined “profit” is incompatible with “sustainable development” in the oceans or anywhere else, but in the oceans more so than anywhere else. The elaboration of new economic principles, based on a value system that includes non-Western philosophies and can be adapted to the needs of the post--industrial age and the information revolution, will transcend the market system as well as the centrally planned system. As a matter of fact, it will transcend economics as a sectoral science and re-insert it into a wider socio-political, cultural and ethical framework, emphasising cooperation rather than competition, common heritage rather than private ownership, the common good rather than individual profit. It is on this basis of the Economics of the Common Heritage that sustainable development in the oceans and in the world at large can be attained.

⁶Wade Roush, “Putting a Price Tag on Nature’s Bounty,” *Science*, Vol. 276, 16 May 1997.

environment cannot be considered separately, sector by sector but must be seen in their interaction, which may be positive or negative. The recognition that “the problems of ocean space are closely interrelated and must be considered as a whole,” enshrined in the Preamble to the United Nations Convention on the Law of the Sea, has institutional implications of some magnitude. For, if these problems must be so considered, there must be fora or institutions or decision-making mechanisms or processes capable of doing it, whether at the local, the national, the regional or the global level. Councils, Committees or Commissions comprising all actors in the marine environment, and the governmental as well as the nongovernmental sector, are needed at the municipal level; inter-ministerial and inter-departmental mechanisms, headed by a lead-agency or by the Prime Minister, are beginning to appear in many States. As the Brundtland Report has it, “boundaries” are becoming transparent, not only between levels of governance, but equally between Departments and disciplines. Scientific institutions must be placed in a position where they can make their needed input into decision making and management; social and natural scientists must learn to dialogue; science and politics must enter a new relationship.

“Participational” means that regulation must not be imposed by central or federal governments, then to be ignored or flouted by local communities whose livelihood depends on the ocean, but that these communities must be involved in the making of regulation and in management. Thus the notion of “co-management” is gaining ground in countries as far apart, culturally, as Canada

and India,⁸ South Africa and Jamaica..

Institutional arrangements, based on these four principles, will vary from community to community, from country to country, depending on existing local infrastructure, level of economic and technological development, resource base, and cultural tradition, but this is undoubtedly the general direction of the evolution of ocean governance or coastal and ocean management. Case studies are available in India as in Brazil, in the Netherlands as in Canada, in Senegal as in Kenya, in Jamaica as in Costa Rica, to name only a few examples. Our Summit Legacy Draft emphasizes the importance of local communities as guardians of marine waters, and I fully agree with this emphasis.

The Regional Seas Programme provides the most comprehensive institutional framework for regional cooperation in the seas and oceans. Initiated by UNEP following the Stockholm Conference on the Human Environment, it was one of the success stories of the United Nations system.

However, it necessarily reflected the sectoral approach which still prevailed in the early 'seventies. Stockholm generated the establishment of sectoral Ministries of the Environment at the national level, the Regional Seas Programme for the Protection of the Environment at the regional level, and

⁸ See *Canadian Ocean Assessment*, Report on the Canadian Hearings conducted by the International Ocean Institute for the Independent World Commission on the Ocean. Halifax: IOI Operation Centre at Dalhousie University, 1996. Co-management has important cultural implications, e.g., in indigenous communities, and is an essential instrument for the "transfer" of ecotechnologies, i.e. the blending of science and high technology with indigenous experience and native wisdom.



UNEP, as a sectoral programme, at the global level.

Between 1972 (Stockholm) and 1992 (Rio) global awareness moved from a sectoral to a comprehensive approach, from the protection of the environment to sustainable development.

This change has a number of institutional implications which the parties to Regional Seas Conventions, Protocols, and Action Plans have now to face. A most promising beginning has already been made with the revision of the Barcelona Convention and Action Plan in 1995.

The updating and restructuring of Regional Seas Programmes is absolutely essential for the implementation not only of the Law of the Sea Convention, but of all the post-UNCED Conventions and action programmes as well as for the strengthening of regional security, including economic and environmental security. All these new instruments call for and rely on regional cooperation and organisation as an essential element: whether one looks at the Climate or Biodiversity Conventions, Agenda 21, the Barbados Action Plan for Small Island Developing States; the Nordwijk recommendations on integrated coastal management, the agreement on straddling stocks and highly migratory stocks, . The Global Plan of Action on Protection of the Marine Environment from Land-based Activities, or the Secretary-Generals Agendas for Peace and for Development.

The restructuring of Regional Seas Programmes must be based on the same principles as the structuring of national and local governance: Comprehensiveness, consistency, interdisciplinarity, and participation. If there is a mismatch between levels of governance, they cannot properly interact and

compatibility between rules and regulation at the national and regional level becomes impossible.

The change from a sectoral to a comprehensive approach, the new tasks arising from the implementation of Chapter 17 (and others) of Agenda 21, as well as the new emphasis on integrated coastal and ocean management, clearly broadens the mandate of the Conventions. This mandate now must cover all peaceful uses of the regional sea, including fisheries management, surveillance and enforcement; shipping, minerals and offshore oil, a growing number of new industries, such as, e.g., pharmaceuticals and cosmetics from the sea, as well as coastal management, tourism, port management, etc. Some of them are covered by regional organisations (e.g., fisheries; marine scientific research); others are not.

Thus it is not suggested that UNEP's Regional Seas Programme should try to duplicate what other organisations, such as FAO, IOC, UNDP, etc., are already doing in the region. What is suggested is that a framework has to be established where all such organisations, including also regional development banks and UN Regional Commissions as well as science, industry and the NGO sector can cooperate.

UNEP has already begun to create such an institutional framework for the implementation of the Global Plan of Action on Protection of the Marine Environment from Land-based Activities.⁹ This single-sector purpose, however,

⁹Institutional Arrangements for Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, Submitted by the Programme of Action Interim Coordination Office, Water Branch, UNEP to the 19th session

must now be set into the broader inter-sectoral context of sustainable development, including the mandates of UNEP's partner agencies such as food security (FAO); eradication of poverty (UNDP), scientific cooperation (IOC), etc.

The meetings of parties of the Regional Seas Conventions (usually every two years) must be restructured so as to reflect this changed mandate and represent all sectors. In other words, it can no longer be the Ministry of the Environment that represents a State at these meetings, but it must be the interministerial body responsible for the making of an integrated ocean and coastal policy at home that must be represented. Also represented must be the regional offices of FAO, IOC, etc., The UN Regional Commissions and regional banks, as well as the nongovernmental sector. The Parties to the Barcelona Convention have already initiated this development.

Integrated coastal and ocean management covers eco-systems including the EEZ on the seaward side and the watershed on the landward side. It necessarily includes the management of rivers which may originate in land-locked countries. It will therefore become necessary to include land-locked countries of the hinterland in the membership of regional seas programmes.

Integrated coastal management thus necessarily includes integrated water management. Fresh-water and sea-water systems in the coastal zone interact. The recent reorganisation of divisions for integrated water management within UNEP and in the World Bank is a promising first step in this direction.

Coastal and ocean management must be people oriented. Most people in

The Brundtland Report *Our Common Future*⁷ and, in much greater detail, *Agenda 21*, contain clear guidelines with regard to the institutions needed for the implementation of sustainable development. They can be summed up under four headings: this institutional framework must be

- ◆ comprehensive,
- ◆ consistent,
- ◆ trans-sectoral or multidisciplinary; and
- ◆ participational, bottom-up rather than top down.

“Comprehensive” means that it must reach from the local level of the coastal community through the levels of provincial and national governance to regional and global levels of international organisation. This, in response to the fact that, as the Brundtland Report puts it, the “boundaries” between levels of governance -- local, national regional, global -- have become “transparent”: in the oceans, obviously, even more so than on land.

“Consistent” means that regulation and decision-making processes and mechanisms at all levels of governance must be compatible. The importance of this principle was highlighted in the discussions on straddling fish stocks and highly migratory fish stocks in areas under national jurisdiction and in the high seas, but it is equally important for all other aspects of sustainable management in the oceans.

“Trans-sectoral” or “multidisciplinary” means activities in the ocean

⁷The World Commission on Environment and Development, *Our Common Future*, Oxford/New York: Oxford University Press, 1987.

technologies, micro-electronics and information technology, the production of more selective fishing gear; waste recycling; water treatment technologies including sewage treatment; renewable energy from the sea such as OTEC or methane production by deep-sea microbes. Lists would have to be refined region by region, according to needs.

A possible model (following the EUREKA pattern but opening it to the participation of developing countries) was elaborated by the IOI, in cooperation with UNIDO and UNEP in 1979.¹⁰

With regard to the importance of sustainable marine technology, I would like to refer again to our Summit Legacy Draft.

The identification of "new sources of funding" is a requirement for effective regional development; the establishment of a small tax on tourist should be seriously investigated. It might be a pilot experiment..

The broadened mandate of the Regional Seas Conventions requires the establishment of stronger Executive bodies. The Executive Committee would have to have a "High-level Segment," attended by Ministers Plenipotentiary, from the Ministries responsible for the subject matter on which a decision is to be taken. This should include the Ministers of Defense when issues of regional security are on the agenda. We know that "security" is not what it used to be 50 years ago. We understand "security today as comprising "economic security" and "environmental security." We understand it as "human security." And this has

¹⁰Project for the Establishment of a Mediterranean Centre for Research and Development in Industrial Technologies, Malta: Foundation for International Studies and International Ocean Institute, 1979. Feasibility Study, Malta: International Ocean Institute, 1981.

institutional implications. This sort of rotating ministerial council or high-level segment might be a solution. There is, incidentally already a precedent for it. The Timor Gap Treaty between Australia and Indonesia of 1989 is, I think, the first international ocean treaty that integrates peaceful uses with regional security, through a rotating Ministerial Council of the kind I indicated.

The Mediterranean States have established a Mediterranean Commission on Sustainable Development. Its composition is extremely interesting. The NGOs are given an important role. They have practically the same rights as States, including the right to vote. The possibility of establishing regional Commissions on Sustainable Development should be seriously studied in other regional seas. It could greatly contribute to enhancing the efficiency of the United Nations Commission on Sustainable Development which is presently a fairly weak body.

Regional Seas differ greatly among them, with regard to resource bases, social and economic development, cultures, and institutional infrastructures. Different regions therefore will adopt different development strategies and institutional arrangements. The points raised at the beginning of this section, however, may be globally applicable.

When, with the adoption and opening for signature of the Law of the Sea Convention, UNCLOS III came to its end in 1982, it was clear that there no longer existed a body in the UN system, capable of considering the closely inter-related problems of ocean space as a whole. During the decade and a half that has passed since then, the need for such a body became ever more glaring.

There are a number of possibilities to solve this problem. By far the best

we have been able to come up with would be the establishment of a Committee of the Whole of the General Assembly, which should meet every second year for about eight weeks to seriously discuss and adopt an integrated ocean policy, based on inputs coming from local communities through States through regional systems. The General Assembly is the only body with a universal membership, including the States Parties not only of the Law of the Sea Convention but but also those of all the post-Rio Conventions, Agreements and Programmes whose ocean-related parts must be considered together with the Law of the Sea Convention.

There are two more institutional problems at the global level that should be taken care of to complete the local-national-regional-global institutional architecture.

One is the better coordination and policy integration of the U.N. Specialized Agencies dealing with the oceans. This is a problem that cannot be solved at the inter-Secretariat level as is presently being attempted. It can be solved if an integrated policy is adopted at the General Assembly level, then to be executed by the specialized agencies.

If one wanted to compare intranational and international institutional arrangements, one could envisage the "Ocean Assembly" as the counterpart to a national parliament that determines policy. The Specialized Agencies and Programmes would execute this policy like the Ministries and Departments of a national government. The ACC subcommittee would act like an interministerial committee or council responding to the interdisciplinary and trans-sectoral challenges of ocean and coastal management. Linkages between the upgraded Regional Seas Programmes and the decision-making process of the "Ocean Assembly" must be as effective as the linkages between the Government and the governments of States/Provinces in a Federal State.

All this could be achieved without touching the Charter of the United Nations.

The third piece, to complete the structure would require Charter Amendment. It concerns a new function that might be assigned to the Trusteeship Council which, with the completion of the decolonisation process is, so to speak, unemployed. Some time ago, the Government of Malta put forward a proposal that a new mandate should be given to the Trusteeship Council: It should become the custodian of the concept of the Common Heritage of Mankind, in the oceans and anywhere else where it is or may become applicable as a basis for sustainable development. Recently, the Secretary-General of the United Nations has taken up this proposal and recommended its consideration. The Trusteeship Council might become a sort of Senate of wise men to advise the General Assembly on these matters which will be of profound significance for the next century.

There can be no doubt: a new ocean regime, based on the United Nations Convention on the Law of the Sea, 1982, in its interaction with the legal instruments and action programmes emanating from the Rio Conference on Environment and Development, 1992, is in the making. The trends are clear, and many of the building blocks are already in place. What is needed is "vision": an architectural plan to put the pieces together, fully utilizing what is already there, without creating new institutions, bureaucracies, and financial burdens. What is needed is a change in attitude: a full realisation of the enormity of the changes that have already taken place during the past 50 years since the end of World War II, on which we must and can build. Intellectual and institutional inertia will slow down the process. Blockage and unblockage may take the form of violence. But in a world in which uncertainty is the name of the game, the only thing that is certain is that this world will change.

Looking at this process of change as a whole, it would appear that the building of the new ocean regime is at the vanguard of the systems change. The way it is directed and steered will affect the system as a whole. The oceans, as was said many times, are our great laboratory for the making of a new world order, reaching from the local community to a restructured United Nations..

(a) *The Economic Impact of Global Marine Industries - Table 2*

Group	US\$ millions	Activity	Economic impact US\$ millions	Value added US\$ millions	Value-added factor ¹
Oil & Gas ²	138,130	Natural gas	20,960	16,978	0.81
		Crude oil	117,170	94,908	0.81
		Total	138,130	111,886	
Tourism ³	423,000	Worldwide annual receipts	423,000	296,100	0.70
Sea-borne Trade ⁴	5,196,000	Total goods loaded	5,196,000	247,000	c. 0.05
Naval Defence ⁵	167,287	Navies	167,287	83,644	0.50
Shipbuilding ^{6 7}	53,426	Cruiseships	1,626	537	0.33
		Cargoships	51,800	17,094	0.33
		Total	53,426	17,631	
Marine Insurance ⁸	17,024	Shipping	17,024	8,512	0.50
Fish ⁹	183,535	Capture & Culture	79,535	39,678	0.55
		Processing	100,000	21,000	0.21
		Seaweed	4,000	840	0.21
		Total	183,535	61,518	
Submarine Telecoms ¹⁰	44,850	Telephone Service	44,850	22,425	0.50
Ports and Harbours ¹¹	?				
Marine Tech. Equipment ¹²	?				
Coastal ¹³	32,400	Construction	25,920	5,443	0.21
		Crossings	6,480	4,017	0.62
Environmental ¹⁴	16,416	Waste disposal	14,976	5,391	0.36
		Survey	1,440	720	0.50
Safety & Salvage ¹⁵	9,984	Salvage	1,440	720	0.50
		Lighthouses	3,216	1,769	0.55
		Lifeboats	2,736	684	0.25
		Coastguards	2,592	648	0.25
Education & Training ¹⁶	7,392		7,392	4,879	0.66
Marine Research ¹⁷	2,400	Marine Research	2,400	1,584	0.66
Aggregates & Placers ¹⁸	756,000	Non-fuel minerals	756,000	196,560	0.26
Fresh Water ¹⁹	11,965	Submarine springs	365		
		Desalination	11,600		
Tidal Energy ²⁰	10,100	Annual estimated global potential	10,100		
TOTAL	7,069,909 million		7,069,909	1,071,131	

Endnotes:

1. The adopted method of estimating the contribution of the marine sector to GDP has been based on the measurement of output values from each ocean sector activity, where the total output is then reduced by a value-added factor which varies between zero and one. The value-added factors are from J. Westwood and H. Young, 1997. *The Importance of Marine Industry Markets to National Economies*. Proceedings of the MTS/IEEE Oceans '97 Conference, Halifax, October 1997.
2. Data is based on the 1995 global offshore natural gas production of 35,892 million cu.ft./day and the 1995 average world price of US\$ 1.60 per 1,000 cu.ft.; and the 1995 global offshore crude oil production of 19,200 billion barrels/day and the June 1997 average world price of US\$ 16.72 per barrel. Sources: American Petroleum Institute and US Department of Energy, Energy Information Division. Value added is 81%.
3. Source: World Tourism Organisation. The value added is 70% since this is a high labour force industry.
4. Data is a 1996 estimate. The value of the goods (total output) is included in the 5.196 billion figure, so a value-added factor of less than 5% is used to reflect freight rates only. Source: Awni Behnam, UNCTAD, personal communication.
5. Naval expenditure is assumed to be 30% of the total 1996 world military expenditure of US\$ 557,624 million. (NATO military expenditure totaled \$394,943 million). Source: Stockholm International Peace Research Institute, 1997. *World armaments and disarmament: SIPRI Yearbook*, Cambridge, Mass: MIT Press. The value added factor is 50%.
6. Cruiseship data is based on scheduled newbuildings in 1997 of seven ocean-going cruise vessels totaling 395,190 GT. Thirty vessels totaling 2,103,924 GT and priced at US\$ 8,818 million are scheduled between 1997 and 2000, while 13 vessels are pending. Source: G.P. Wild (International) Limited via Bob Fuller, Cruise Lines International Association, New York, personal communication. The value added is 33%.
7. Cargoship data is based on the 1996 total of 1,745 completed new ships totaling 25.9 million gross tons, with a proxy value of US\$ 2,000 per ton. Source: Maritime Transportation and Shipbuilding Status. *Sea Technology*, September 1997, Vol. 39 (9): 69-73. The value added is 33%.
8. Lloyds of London report that in 1994 the London share of the marine premiums market was £3.192 billion, which is 30.6% of the world market, a percentage which has remained steady over the past decade. The total was calculated from the value of the world market using the conversion 1 £ = 1.6 US\$. Source: J. Westwood and H. Young. (see note 1). The value added is 50%.
9. Capture and culture data is the 1995 estimated landed value less freshwater production. Source: *FAO Yearbook Fishery Statistics: Commodities*, Vol 81. 1995. Processing data is the estimated world trade in marine fishery commodities. Seaweed data is from J. Westwood and H. Young, (see note 1). The value added is 55% for capture and culture and 21% for processing and seaweed.
10. Data is based on 65% of the 1996 international telephone service revenue totaling US\$ 69,000 million, as 65% of international telecommunication traffic is carried by submarine cables. Sources: World Telecommunication Development Report 1996/97: Trade in Telecommunications. Executive Summary. International Telecommunication Union. Geneva, February 1997. On website <<http://www.itu.int>>; and J. Westwood and H. Young, (see note 1). A value-added factor of 50% is assumed for the manufacture and installation of cables.
11. According to the Tokyo-based International Association of Ports and Harbours, no system exists for valuing the economic impact of ports and harbours globally. The following figures may be indicative of orders of magnitude. The American Association of Port Authorities provides the following figures for 1994: 15.9 million jobs; a contribution of US\$ 783.3 billion to GDP; personal incomes of US\$ 515.1 billion; tax revenues at all levels of US\$ 210 billion; and business sales of US\$ 1.623 trillion. Ninety-five percent by weight of all US foreign trade moves through US ports. Rotterdam estimates that the port creates 70,000 jobs directly and 295,000 indirectly. For small countries like the Netherlands, Singapore, and formerly Hong Kong, their wealth is directly dependent on their port activities. The Canadian Ports Corporation gives the following summary of Canada's port system in 1990: 36,872

direct jobs; 28,876 induced jobs; 65,748 total jobs. Revenue impact: CAS 5.7 billion; personal income impact: CAS 3.2 billion; tax impact: CAS 1.2 billion.

12. Marine and ocean technology is a difficult sector to estimate due to the lack of data relating specifically to *marine* equipment, since much equipment is produced with the manufacturer being unaware of its end use. Globally this sector generates billions of dollars in revenue.

13. The revenues in this sector have been extrapolated from the UK marine economy revenues calculated by Westwood and Young (see note 1). British revenues in this sector were converted to US dollars by the conversion of 1 £ = 1.6 US\$ and multiplied by 30. Since the global monetarized marine GDP of US\$ 1.5 trillion is approximately 30 times the UK marine GDP of US\$ 44 billion, this approach provides a reasonable approximation of the value this sector contributes to the global marine economy.

14. See note 13.

15. See note 13.

16. See note 13.

17. See note 13.

18. Data is the production value at 1993 and 1994 year prices. Sources: Fillmore Earney, 1990. *Marine Mineral Resources*; David Cronan, 1992. *Marine Minerals in Exclusive Economic Zones*; Natural Resources Canada, 1995. *Canadian Minerals Yearbook*; US Bureau of Mines, 1995. *Minerals Yearbook*. A value added of 26% is assumed.

19. Data is the potential production in 1997 based on 2 million cu.m./day from submarine springs and 20.3 million cu.m./day from desalination, assuming an average cost of \$0.50/cu.m. The desalination figure was provided by J.D. Birkett, West Neck Strategies, Maine.

20. Data is based on a potential 64 Gw global capacity x 8,760 h/yr x 20% efficiency producing 112,128 Gwh/yr, and uses the 1997 price of 1 Gw/h = \$90,000. The site at La Rance, France, is a 240 Mw facility. The Annapolis Royal 20 Mw facility in Nova Scotia generates 2.5 Gwh/month (30 Gwh/yr), with annual revenue of CAS 2.7 million.

Understanding and Managing the Oceans

Elisabeth Mann Borgese

I am deeply honoured and grateful to the organisers for the invitation to deliver a key-note address at this important conference and for this distinguished audience.

Responding to the title of our Conference, "Understanding and Managing the Oceans," I would like to begin by underlining the enormous importance of the oceans, and I would like to do this with some figures, whatever figures may be worth in dealing with a life support system. In the second part of my remarks I will deal with the emerging management or governance system.

I have divided my calculation of the economic value of the ocean into three parts: First the current market value of ocean-related and ocean-dependent goods and services; second, the emerging new industries and their possible value in the next century, and, third, the value of the ocean as a life support system, or, as Bob Costanza calls it, the ecological services of the ocean.

The total monetarized value of the traditional marine-related goods and services, and excluding the commercial value of ports and harbours, which is another major factor, adds up to something of the order of \$6.5 trillion. This is a conservative estimate. More could be added, for instance, investments in ship construction, including tankers. The Global GDP today is of the order of 23 trillion, 18 of which are contributed by the OECD countries. Roughly, one might say that the contribution of ocean-related goods and services is about one third the present global GDP: not a negligible proportion!

Let us have a quick look at the “futuristic” industries which certainly will make major contributions to the global GDP in the next century.

Many marine micro-organisms, as we all know, produce biologically active substances: enzymes, enzyme inhibitors, and compounds having antibiotic, antitumour, antileukemia and other pharmacological value.

Literally thousands of pharmaceutically active substances have been isolated from a vast number of marine animals and plants. The Japanese alone, who are leaders in this field, have isolated about 3,000. The isolation of strains of bacteria capable of determined biological activities, and genetic engineering to enhance these capabilities, is going to be of great importance, not only for the pharmaceutical industry but for a number of other industries as well: replacing chemical and mechanical processes with biological processes, e.g., for the clean-up of oil spills or the extraction of metals from ores, through bacterial systems. The Mediterranean Blue Plan mentions a future bio-steel industry that could be developed, based on bacteria and solar energy.

Marine biotechnology is still in its infancy. It is a well protected baby, growing rapidly, in the secrecy of highly competitive, mostly private industries. New discoveries are being made daily, mostly in tropical seas, although bioactive substances may be present in the flora and fauna of colder waters as well, and financial rewards for developing even one successful product are considerable. Many sources cite potential sales of US\$1 billion or more annually for a successful product, particularly if it is an antiviral or anti-cancer drug. The antiviral compounds Ara-A and Ara-C, derived originally from a Caribbean tunicate, have been used for a number of years in the treatment of

herpes, and currently maintain sales of US\$ 50 to 100 million a year.

Besides its multi-billion dollar economic potential, this new industry has complex political, legal and institutional and ethical implications if it is to be adapted to the goals of sustainable development and the equitable and participational institutional framework this requires. .

A special case is constituted by the industrial utilisation of the genetic resources, in particular, the thermophile bacteria, of the deep seabed. The industries utilising this genetic resource include waste treatment, food processing, oil-well services, paper processing, and mining applications, together with the pharmaceutical industries. The potential market for industrial uses of hyperthermophilic bacteria has been estimated at \$3 billion per year.¹

And this is just the beginning. The biodiversity of the seabed has hardly been explored, and we simply do not know what may exist.²

The present and future value of these resources can be gauged by the brazen intransigence with which, in particular, the United States, under pressure from its bio-industries, is keeping the item off the agenda of the meetings of States Parties to the Biodiversity Convention , even though it is not even a Party to this Convention!

¹Lyle Glowka, "The Deepest of Ironies: Genetic Resources, Marine Scientific Research, and the Area," *Ocean Yearbook*, 12. Chicago: Chicago University Press, 1996.

²The World Conservation Union has estimated that the deep sea may be home to 10 million species.

A third example of industries likely to considerably increase the “quantifiable” contribution of the ocean to the global GDP are the industries producing renewable energy from the ocean. Turbines to extract a tiny portion of the enormous amount of energy produced by ocean currents --updating projects that were on the drawing board 20 or 30 years ago -- are in the headlines today. Tests recently conducted on the Florida Current (part of the Gulf Stream) have demonstrated that power from such units could be supplied at a competitive rates. Ocean Thermal Energy Conversion, also long on the drawing boards, is still considered to have a great potential The market for this technology, in the Pacific and Caribbean, is estimated to be, by the year 2015, about \$18.5 billion/year.

No figures at all are as yet available for the methane hydrates of the deep sea-bed which may become another source of energy during the next century.

From the above we may fairly safely assume that the “market value” of the ocean may double in the next century

The third category of value of the ocean, its function as a life support system, is the really the first, and it is not really quantifiable.

Believers in the market system have however made very interesting attempts, in recent years, to quantify, and express in monetary terms, the “eco-system services” performed by the oceans and other eco-systems. A group led by Robert Costanza has come up with the figure of \$33.3 trillion for 17 categories of “goods and services” -- including protection against storms and floods, nitrogen fixation, or plant-derived pharmaceuticals -- provided by 16 specialized “biomes,” such as oceans, estuaries, tropical forests, etc.. The calculation was

based on market prices, people's willingness to pay, or the cost of replacing the service. Considering the enormity of the ocean and coastal system, and the intensity of its interaction with the atmosphere, it is not surprising, that \$21 trillion of that amount is contributed by the ocean system.

Costanza's calculations have been widely criticized. A Cornell University ecologist, David Pimentel, and his colleagues, argued that the figure is far too high. According to their estimate, these "goods and services" amount to no more than \$3 trillion.³ The mere fact that calculations may diverge by orders of magnitude should make us wonder about the value of these calculations. Why do we need them? I have cited them merely to underline the enormous importance of the oceans in terms that may disabuse our political leaders from the traditional opinion that the oceans are of secondary importance in national and international context in which we are living.

What, then, is it we want our political leaders to do?

We want them to contribute to the attainment of the goal of sustainable development of ocean and coastal resources and environments.

The present trend towards more and more "privatisation" and "deregulation": and its emphasis on short-term narrowly defined "profit" is incompatible with "sustainable development" in the oceans or anywhere else, but in the oceans more so than anywhere else. The elaboration of new economic principles, based on new forms of cooperation between private and public sector,

³Wade Roush, "Putting a Price Tag on Nature's Bounty," *Science*, Vol. 276, 16 May

on a value system that includes non-Western philosophies and can be adapted to the needs of the post--industrial age and the information revolution, will transcend the market system as well as the centrally planned system. As a matter of fact, it will transcend economics as a sectoral science and re-insert it into a wider socio-political, cultural and ethical framework, emphasising cooperation rather than competition, common heritage rather than private ownership, the common good rather than individual profit. It is on this basis of the Economics of the Common Heritage that sustainable development in the oceans and in the world at large can be attained.

The Brundtland Report *Our Common Future*⁴ and, in much greater detail, *Agenda 21*, contain clear guidelines with regard to the institutions needed for the implementation of sustainable development. They can be summed up under four headings: this institutional framework must be

- ◆ comprehensive,
- ◆ consistent,
- ◆ trans-sectoral or multidisciplinary; and
- ◆ participational, bottom-up rather than top down.

“Comprehensive” means that it must reach from the local level of the coastal community through the levels of provincial and national governance to regional and global levels of international organisation. This, in response to the fact that, as the Brundtland Report puts it, the “boundaries” between levels of

⁴The World Commission on Environment and Development, *Our Common Future*, Oxford/New York: Oxford University Press, 1987.

governance -- local, national regional, global -- have become "transparent": in the oceans, obviously, even more so than on land.

"Consistent" means that regulation and decision-making processes and mechanisms at all levels of governance must be compatible. The importance of this principle was highlighted in the discussions on straddling fish stocks and highly migratory fish stocks in areas under national jurisdiction and in the high seas, but it is equally important for all other aspects of sustainable management in the oceans.

"Trans-sectoral" or "multidisciplinary" means activities in the ocean environment cannot be considered separately, sector by sector but must be seen in their interaction, which may be positive or negative. The recognition that "the problems of ocean space are closely interrelated and must be considered as a whole," enshrined in the Preamble to the United Nations Convention on the Law of the Sea, has institutional implications of some magnitude. For, if these problems must be so considered, there must be fora or institutions or decision-making mechanisms or processes capable of doing it, whether at the local, the national, the regional or the global level. Councils, Committees or Commissions comprising all actors in the marine environment, and the governmental as well as the nongovernmental sector, are needed at the municipal level; inter-ministerial and inter-departmental mechanisms, headed by a lead-agency or by the Prime Minister, are beginning to appear in many States. As the Brundtland Report has it, "boundaries" are becoming transparent, not only between levels of governance, but equally between Departments and disciplines. Scientific institutions must be placed in a position where they can make their needed input into decision making

and management; social and natural scientists must learn to dialogue; science and politics must enter a new relationship.

“Participational” means that regulation must not be imposed by central or federal governments, then to be ignored or flouted by local communities whose livelihood depends on the ocean, but that these communities must be involved in the making of regulation and in management. Thus the notion of “co-management” is gaining ground in countries as far apart, culturally, as Canada and India,⁵ South Africa and Jamaica..

Institutional arrangements, based on these four principles, will vary from community to community, from country to country, depending on existing local infrastructure, level of economic and technological development, resource base, and cultural tradition, but this is undoubtedly the general direction of the evolution of ocean governance or coastal and ocean management. Case studies are available in India as in Brazil, in the Netherlands as in Canada, in Senegal as in Kenya, in Jamaica as in Costa Rica, to name only a few examples. Our Summit Legacy Draft emphasizes the importance of local communities as guardians of marine waters, and I fully agree with this emphasis.

The Regional Seas Programme provides the most comprehensive

⁵ See *Canadian Ocean Assessment*, Report on the Canadian Hearings conducted by the International Ocean Institute for the Independent World Commission on the Ocean. Halifax: IOI Cooperation Centre at Dalhousie University, 1996. Co-management has important cultural implications, e.g., in indigenous communities, and is an essential instrument for the “transfer” of biotechnologies, i.e. the blending of science and high technology with indigenous experience and native wisdom.

institutional framework for regional cooperation in the seas and oceans. Initiated by UNEP following the Stockholm Conference on the Human Environment, it was one of the success stories of the United Nations system.

However, it necessarily reflected the sectoral approach which still prevailed in the early 'seventies. Stockholm generated the establishment of sectoral Ministries of the Environment at the national level, the Regional Seas Programme for the Protection of the Environment at the regional level, and UNEP, as a sectoral programme, at the global level.

Between 1972 (Stockholm) and 1992 (Rio) global awareness moved from a sectoral to a comprehensive approach, from the protection of the environment to sustainable development.

This change has a number of institutional implications which the parties to Regional Seas Conventions, Protocols, and Action Plans have now to face. A most promising beginning has already been made with the revision of the Barcelona Convention and Action Plan in 1995.

The updating and restructuring of Regional Seas Programmes is absolutely essential for the implementation not only of the Law of the Sea Convention, but of all the post-UNCED Conventions and action programmes as well as for the strengthening of regional security, including economic and environmental security. All these new instruments call for and rely on regional cooperation and organisation as an essential element: whether one looks at the Climate or Biodiversity Conventions, Agenda 21, the Barbados Action Plan for Small Island Developing States; the Nordwijk recommendations on integrated coastal management, the agreement on straddling stocks and highly migratory

stocks, . The Global Plan of Action on Protection of the Marine Environment from Land-based Activities, or the Secretary-Generals Agendas for Peace and for Development.

The restructuring of Regional Seas Programmes must be based on the same principles as the structuring of national and local governance: Comprehensiveness, consistency, interdisciplinarity, and participation. If there is a mismatch between levels of governance, they cannot properly interact and compatibility between rules and regulation at the national and regional level becomes impossible.

The change from a sectoral to a comprehensive approach, the new tasks arising from the implementation of Chapter 17 (and others) of Agenda 21, as well as the new emphasis on integrated coastal and ocean management, clearly broadens the mandate of the Conventions. This mandate now must cover all peaceful uses of the regional sea, including fisheries management, surveillance and enforcement; shipping, minerals and offshore oil, a growing number of new industries, such as, e.g., pharmaceuticals and cosmetics from the sea, as well as coastal management, tourism, port management, etc. Some of them are covered by regional organisations (e.g., fisheries; marine scientific research); others are not.

Thus it is not suggested that UNEP's Regional Seas Programme should try to duplicate what other organisations, such as FAO, IOC, UNDP, etc., are already doing in the region. What is suggested is that a framework has to be established where all such organisations, including also regional development banks and UN Regional Commissions as well as science, industry and the NGO sector can

cooperate.

UNEP has already begun to create such an institutional framework for the implementation of the Global Plan of Action on Protection of the Marine Environment from Land-based Activities.⁶ This single-sector purpose, however, must now be set into the broader inter-sectoral context of sustainable development, including the mandates of UNEP's partner agencies such as food security (FAO); eradication of poverty (UNDP), scientific cooperation (IOC), etc.

The meetings of parties of the Regional Seas Conventions (usually every two years) must be restructured so as to reflect this changed mandate and represent all sectors. In other words, it can no longer be the Ministry of the Environment that represents a State at these meetings, but it must be the interministerial body responsible for the making of an integrated ocean and coastal policy at home that must be represented. Also represented must be the regional offices of FAO, IOC, etc., The UN Regional Commissions and regional banks, as well as the nongovernmental sector. The Parties to the Barcelona Convention have already initiated this development.

Integrated coastal and ocean management covers eco-systems including the EEZ on the seaward side and the watershed on the landward side. It necessarily includes the management of rivers which may originate in land-locked countries. It will therefore become necessary to include land-locked

⁶Institutional Arrangements for Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, Submitted by the Programme of Action Interim Coordination Office, Water Branch, UNEP to the 19th session UNEP Governing Council Documents Task Force, 28 October 1996.

countries of the hinterland in the membership of regional seas programmes.

Integrated coastal management thus necessarily includes integrated water management. Fresh-water and sea-water systems in the coastal zone interact. The recent reorganisation of divisions for integrated water management within UNEP and in the World Bank is a promising first step in this direction.

Coastal and ocean management must be people oriented. Most people in the coastal areas live in megacities; a shrinking number lives in poor coastal villages, mostly fishing villages.. The problems of urban sprawl and megacities and the problem of poverty in coastal villages must be tackled together. One cannot be solved without the other.

Integrated coastal and ocean management requires, as a complement, integrated regional management. A comprehensive, integrated system at the national level and a sectoral system at the regional level cannot interact effectively.

The broadened mandate of regional seas conventions must include the establishment of regional systems for technology cooperation. The Law of the Sea Convention mandates, in Articles 276 and 277, the establishment of regional centres (which, in line with contemporary developments, might be regional *systems*) for technology development and transfer.

- ◆ Such systems should be based on the most advanced concepts of technology development, *generating a synergism of investments from the private and the public sector, at the regional level.*
- ◆ They should be conceived and structured in such a way that they can serve the needs of the Law of the Sea Convention *as well as all post-UNCED*

Conventions and programmes. They would provide a needed institutional link between all these convention regimes and eliminate duplication of efforts.

- ◆ A list of priority technologies to be developed/transferred (i.e., “co-developed”) can be gleaned from the Conventions and Plans of Action themselves. They would include aquaculture and genetic engineering technologies, micro-electronics and information technology, the production of more selective fishing gear; waste recycling; water treatment technologies including sewage treatment; renewable energy from the sea such as OTEC or methane production by deep-sea microbes. Lists would have to be refined region by region, according to needs.

A possible model (following the EUREKA pattern but opening it to the participation of developing countries) was elaborated by the IOI, in cooperation with UNIDO and UNEP in 1979.⁷

With regard to the importance of sustainable marine technology, I would like to refer again to our Summit Legacy Draft.

The identification of “new sources of funding” is a requirement for effective regional development; the establishment of a small tax on tourist should be seriously investigated. It might be a pilot experiment..

The broadened mandate of the Regional Seas Conventions requires the establishment of stronger Executive bodies. The Executive Committee would

⁷Project for the Establishment of a Mediterranean Centre for Research and Development in Industrial Technologies, Malta: Foundation for International Studies and International Ocean Institute, 1979. Feasibility Study, Malta: International Ocean Institute, 1981.

have to have a “High-level Segment,” attended by Ministers Plenipotentiary, from the Ministries responsible for the subject matter on which a decision is to be taken. This should include the Ministers of Defence when issues of regional security are on the agenda. We know that “security” is not what it used to be 50 years ago. We understand “security today as comprising “economic security” and “environmental security.” We understand it as “human security.” And this has institutional implications. This sort of rotating ministerial council or high-level segment might be a solution. There is, incidentally already a precedent for it. The Timor Gap Treaty between Australia and Indonesia of 1989 is, I think, the first international ocean treaty that integrates peaceful uses with regional security, through a rotating Ministerial Council of the kind I indicated.

The Mediterranean States have established a Mediterranean Commission on Sustainable Development. Its composition is extremely interesting The NGOs are given an important role. They have practically the same rights as States, including the right to vote. The possibility of establishing regional Commissions on Sustainable Development should be seriously studied in other regional seas. It could greatly contribute to enhancing the efficiency of the United Nations Commission on Sustainable Development which is presently a fairly weak body.

Regional Seas differ greatly among them, with regard to resource bases, social and economic development, cultures, and institutional infrastructures. Different regions therefore will adopt different development strategies and institutional arrangements. The points raised at the beginning of this section, however, may be globally applicable.

When, with the adoption and opening for signature of the Law of the Sea Convention, UNCLOS III came to its end in 1982, it was clear that there no longer existed a body in the UN system, capable of considering the closely inter-related problems of ocean space as a whole. During the decade and a half that has passed since then, the need for such a body became ever more glaring.

There are a number of possibilities to solve this problem. By far the best we have been able to come up with would be the establishment of a Committee of the Whole of the General Assembly, which should meet every second year for about eight weeks to seriously discuss and adopt an integrated ocean policy, based on inputs coming from local communities through States through regional systems. The General Assembly is the only body with a universal membership, including the States Parties not only of the Law of the Sea Convention but also those of all the post-Rio Conventions, Agreements and Programmes whose ocean-related parts must be considered together with the Law of the Sea Convention.

There are two more institutional problems at the global level that should be taken care of to complete the local-national-regional-global institutional architecture.

One is the better coordination and policy integration of the U.N. Specialized Agencies dealing with the oceans. This is a problem that cannot be solved at the inter-Secretariat level as is presently being attempted. It can be solved if an integrated policy is adopted at the General Assembly level, then to be executed by the specialized agencies.

If one wanted to compare intranational and international institutional arrangements, one could envisage the "Ocean Assembly" as the counterpart to a national parliament that determines policy. The Specialized Agencies and Programmes would execute this policy like the Ministries and Departments of a national government. The ACC subcommittee would act like an interministerial committee or council responding to the interdisciplinary and trans-sectoral challenges of ocean and coastal management.. Linkages between the upgraded Regional Seas Programmes and the decision-making process of the "Ocean Assembly" must be as effective as the linkages between the Government and the governments of States/Provinces in a Federal State.

All this could be achieved without touching the Charter of the United Nations.

The third piece, to complete the structure would require Charter Amendment. It concerns a new function that might be assigned to the Trusteeships Council which, with the completion of the decolonialisation process is, so to speak, unemployed. Some time ago, the Government of Malta put forward a proposal that a new mandate should be given to the Trusteeship Council: It should become the custodian of the concept of the Common Heritage of Mankind, in the oceans and anywhere else where it is or may become applicable as a basis for sustainable development. Recently, the Secretary-General of the United Nations has taken up this proposal and recommended its consideration. The Trusteeship Council might become a sort of Senate of wise men to advise the General Assembly on these matters which will be of profound significance for the next century.

There can be no doubt: a new ocean regime, based on the United Nations Convention on the Law of the Sea, 1982, in its interaction with the legal instruments and action programmes emanating from the Rio Conference on Environment and Development, 1992, is in the making. The trends are clear, and many of the building blocks are already in place. What is needed is "vision": an architectural plan to put the pieces together, fully utilizing what is already there, without creating new institutions, bureaucracies, and financial burdens. What is needed is a change in attitude: a full realisation of the enormity of the changes that have already taken place during the past 50 years since the end of World War II, on which we must and can build. Intellectual and institutional inertia will slow down the process. Blockage and unblockage may take the form of violence. But in a world in which uncertainty is the name of the game, the only thing that is certain is that this world will change.

Looking at this process of change as a whole, it would appear that the building of the new ocean regime is at the vanguard of the systems change. The way it is directed and steered will affect the system as a whole. The oceans, as was said many times, are our great laboratory for the making of a new world order, reaching from the local community to a restructured United Nations..

The Wealth of the Ocean
Quantifiable - monetarized

<i>Sector</i>	<i>Volume</i>	<i>Value</i> <i>US\$/yr</i>	<i>Trends</i>
Fisheries ² Total marine production: Capture & aquaculture	91.9 million tonnes	42,000,000,000	aquaculture growing by 6% per annum; capture fisheries stagnating
Offshore Natural Gas ³	35,892,000,000 cu.ft/day	20,960,000,000	increasing
Offshore Crude Oil ⁴	19,200 bb/day	117,170,000,000	Increasing

²Source: FAO

³Source: American Petroleum Institute and US Department of Energy, Energy Information Administration.

⁴Source: Ibid.

Tidal Energy ⁵	112,128 Gwh/yr	10,100,000,000 ⁶	increasing
Fresh water			
Submarine springs	2 million cu.m/day	365,000,000	
Desalination	20.3 million cu.m/day	11,600,000,000	
		Total:	
		11,965,000,000 ⁷	

⁵64 Gw capacity x 8,760 h/yr x 20% efficiency

⁶Assuming 1Gw/h = \$90,000. The site at La Rance, France, is a 240 Mw facility. The nnapolis Royal 20 Mw facility generates 2.5 Gwh/month (30 Gwh/yr) with a revenue of A\$2.7 million.

⁷Assumes average cost of \$0,50/cu.m. Figures provided by Dr. James D. Birkett, West eck Strategies.

Nonfuel offshore minerals ⁸			
Barite	7,725,000 tonnes	287,524,000	
Bromine	500,000 tonnes	400,000,000	
Cobalt	35,000 tonnes	1,925,000,000	
Copper	10,290,000 tonnes	25,107,600,000	
Coral	150 tonnes	900,000,000	
Coal (est.)	10,000,000,000 tonnes	454,500,000,000	
Industrial Diamonds	28,600,000 carats	269,126,000	
Feldspar	3,992,000 tonnes	419,160,000	
Gold	1,517,852 Kg	18,845,650,000	
Lead	4,150,000 Tonnes	2,282,500,000	
Magnesium	6,532,000 tonnes	23,515,200,000	
Manganese	11,794,000 tonnes	28,305,600	
Nickel	1,028,000 tonnes	6,517,520,000	
Phosphate	175,800,000 tonnes	3,589,836,000	
Sand & gravel	9,072,000,000 tonnes	181,440,000,000	
Salt (bulk	205,027,000 tonnes	12,301,620,000	
Silica sand	236,000,000	11,800,000,000	
Sulphur	65,800,000 tonnes	1,881,880,000	
Tin	296,000 tonnes	1,628,000,000	
Zink	8,055,000 tonnes	8,860,500,000	
Total		756 Billion	

⁸Sources: Filmore Earny, *Marine Mineral Resources*, 1992; David Cronan, *Marine Minerals in Exclusive Economic Zones*, 19..; 1994 Minerals Yearbook, US Bureau of Mines; 1995 Canadian Minerals Yearbook, Natural Resources, Canada.

Sea-born Trade ⁹	4,758,000,000 tonnes	5,196,000,000,000	Increasing
Ports & Harbours ¹⁰	?	?	Increasing
Tourism ¹¹	1996 worldwide arrivals 592,000,000	1996 worldwide receipts 423,000,000,000	

The total monetarized value of these traditional marine-related goods and services, and excluding the commercial value of ports and harbours, which is

⁹Source: Awni Behnam, UNCTAD, personal communication

¹⁰According to the Tokyo-based International Association of Ports and Harbours, there exists no system for valuing the economic impact of ports and harbours globally. The following figures may be indicative of orders of magnitude. The American Association of Port Authorities gives the following figures for 1994: 15.9 million jobs; a contribution of US\$ 783.3 billion to GDP; personal incomes of US\$ 515.1 billion; tax revenues at all levels, of US\$ 210 billion; business sales of US\$ 1.623 trillion. 95 percent by weight of all US foreign trade moves through US ports. Rotterdam estimates that the port creates 70,000 jobs directly and 295,000 indirectly. For small countries like the Netherlands, Singapore and formerly Nong Kong, their wealth is directly dependent on their port activities..

The Canadian Ports Corporation gives the following summary of Canada's port system for 1990: Direct jobs: 36,872; induced jobs: 28,876; total jobs: 65,748. Revenue impact: CA\$ 5.7 billion; personal income impact CA\$ 3.2 billion; tax impact: CA\$ 1.2 billion.

¹¹Source: World Tourism Organisation

Table 3

Sample pharmaceuticals and Bioactive Marine Resources

Class of organism	Example organism	Bioactive substance	Uses actual & potential	Comments
Porphyra				Possible activity irrespective of depth or latitude of source organism
Japan	Halichondria okadai	Halichondrin B	ovarian cancer, melanoma, leukemia	very promising anticancer drug
New Zealand	Ircinia variabilis		antibiotic, antiviral	
Palau	Luffariella variabilis	manoalide	analgesic, anti-inflammatory	"beestings to arthritis"
Caribbean		Cytarabine	antiviral	
Bahamas	Discodermia dissoluta	discodermolide	immunosuppressive	organ transplant tissue anti-rejection
Tunicates				
Caribbean Gulf of California Mediterranean	Aplydium albicans	didermin B	antiviral, anthelmintic, activity against leukemia & melanoma, ovary, breast, kidney, colorectal cancer	potently antiproliferative, impressive cytotoxicity against lymphomas
Bryozoans	Bugula neritina	bryostatin	anti-tumour, anti-leukemia, anti-AIDS	
Echinoderms sea urchins, sea cucumbers	Strongylocentrotus Holothurians		male contraceptive	
Nudibranchs				

Guam, Marshall Islands Australia	Chromodoris elizabethiana	latrunculin A	antimicrobial (Staphylococcus and Candida)	
Sea squirts	Ecteinascidia turbinata		antineoplastic (cancer tumour)	“striking,” “remarkable,” organism widely available
Fungi				
	Cephalosporium acremonium	Cephalosporin C	antimicrobial	
Corals				
Bahamian Gorgonian	Pseudopterogorgia elisabethae	pseudopterosin C	psoriasis and arthritis	“Resilience” (TM)skin care (Estée Lauder)
Hawaiian coral	Telesto riisei		anti-cancer	remarkable cytotoxicity
skeletal coral			bone grafts	provides “natural” structure
Fishes & shellfishes				
Puffer fish		tetrodotoxin	muscle spasms, palliative in terminal cancer	traditional usage in the Orient
angler fish				possible tissue rejection and organ transplant studies
horseshoe crab	Limulus polyphemus	crab blood	coagulant, detect meningitis and septic shock bacteria	
squid		axon studies	nerve cell skeleton studies	Parkinson’s and Alzheimer’s, epilepsy

blue mussel (Edible)	Mytilus edulis	adhesives	cornea and retina repair, dental work	
sea hare Indian Ocean	Dolabella auricularia	dolastatin-10	anti-tumour, melanoma	high life extension for patients at low dose levels
Algae				
Red (Eg Irish moss)	Chondrus et al.	Carrageenan	anti-peptic, anti- ulcer	
	Digenea simplex	kainic acid	anti-parasitic	
Brown (Laminarians)	Styropodium Laminaria et al		anti-tumour, hypotensive, anti- fungal, anticoagulant, cervical dilation (physical, not chemical action)	
Diatomes and dinoflagellates	Nitzschia et al	domoic acid et al	central nervous system studies	
	Dysidea		"Iolide pump"	helpful in understanding thyroid action

Source: W. Irwin Judson, "Marine Pharmaceuticals: A Special Case of the Common Heritage of Mankind," unpublished.

Besides its multi-billion dollar economic potential, this new industry has complex political, legal and institutional and ethical implications if it is to be adapted to the goals of sustainable development and the equitable and participational institutional framework this requires. To this we shall return in the