

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 Annapolis Royal 20 Mw facility generates 2.5 Gwh/month (30 Gwh/yr) with a revenue of CA\$2.7 million.

⁷Assumes average cost of \$0,50/cu.m. Figures provided by Dr. James D. Birkett, West Neck 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 | Iatruneculin 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 | pseudopterodin 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