**4. MULTIPLE USES OF THE COASTAL ZONE**

The coastal zone is used extensively and increasingly for a large number of activities. These multiple uses are not always compatible and may result in a wide array of problems for resource users and decision-makers.

Coastal land is used for human settlement, agriculture, trade, industry and amenity. The coastal sea presents problems related to transport, fishing, dumping, mining, etc., stemming from an intensification and diversification of ocean uses. There is overexploitation of fishery resources, pollution by dumping and an array of conflicts due to the interaction among user groups in congested marine areas (Clark, 1991c).

Coastal zones are the “sink” for the continents; they receive and concentrate pollutants and other negative consequences of development activities taking place in the hinterlands. In particular, the flow of rivers has often been severely modified for irrigation purposes, and they carry to the coastal areas the pollutants coming from inland agricultural and industrial activities.

Because general development may result in overexploitation, pollution or alteration of natural systems, as well as conflicts between the users for limited, but highly prized, coastal and shoreline space, its impacts must be understood and countered (Box 4.1).

**4.1 Urban Settlement**

The shoreline is in increasingly strong demand for human settlements, agriculture, trade, industry, amenity and marine transport activities such as shipping, fishing boats and recreational marinas. This demand, which responds to essential needs for economic growth, leads to a linear approach to coastal development focusing on the exact shoreline (e.g., the line of Mean High Water and the real estate that straddles that line) with access to recreational beaches or outstanding views of the sea. Human settlements may crowd the seas with boats, overexploit resources, generate polluting industries, produce heaps of garbage, and create large amounts of chemical wastes. While waterfront expansion may be necessary for coastal cities, it can be threatening to coastal resources if development interests do not respect conservation principles.

The shoreline is an essential natural habitat (mangrove wetlands, tideflats, and sea grass beds) easily obliterated as settlements pre-empt the shallow seas by filling for real estate. Sewage treatment, water supply, electric power production and other utilities and services add strain on available resources and on natural systems. Electric power plants require huge amounts of seawater for cooling purposes and remove great quantities of water from the coastal sea complete with their contents: a mass of small fishes and planktonic organisms destined for death in passage through the plant.

The ocean beachfront is a most hazardous place to build. The berm/foredune/ backdune system (where these exist) signal high risk locations for buildings. Keeping development far enough inland to avoid the high risk zone is important in natural hazard prevention efforts. Therefore, a setback line should be delineated at a safe point inland from the beach and all construction kept behind this line.

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| **BOX 4.1 - COASTAL RESOURCE ISSUES LISTED BY USAID** |
| 1. Loss of mangrove forests due to rate of exploitation above that which would sustain the resource. | 5. Depletion of wildlife species such as turtles, crocodiles, deer, waterflow and manatees. |
| 2. Coral reef destruction leading to reduced yield of fish species associated with reefs; reduced tourism attraction; and loss of rare ecosystems due to: | 6. Pollution of coastal waters which adversely affects fisheries yield and tourism revenues due to: |
| -dynamiting to harvest fish from the reef,-harvesting of coral for construction material or, in the case of exotic coral species, for jewellery or souvenirs,-siltation and smotheringof coral from erosion associated with upstream deforestation, and-death of coral from deleterious effluents associated with mining or oil spills. | -industrial wastes,-sewage,-agricultural pesticide runoff,-oil spills,-bilge discharges, and-toxic contamination of fish/shellfish. |
| 7. Beach and coastline erosion caused by removal of coastal mangrove forests; construction of coastal installations which alter current and wave action patterns; or mining of beaches for sand. |
| 3. Congestion and intensive use of coastal resources such as water, species, and fisheries, due to high population density and continuing growth, expansion of tourism industry, and growth of commercial and industrial activity. | 8. Swampland filling that reduces fish spawning and“nursery” habitat and reduces fisheries yields. |
| 9. Upland deforestation leading to erosion and sedimentation. |
| 4. Inadequate institutional structures to address coastal resource problems and to administer planning, management, regulation, and enforcement where it is needed. | 10. Overfishing leading to reduced fisheries yield and in some cases species extinction. |
| 11. Salt water intrusion leading to loss of coastal agricultural lands and potable water supplies. |
| *Source: USAID (1984)* |

The density of urban population creates demand for factories, power plants, warehouses, homes, docks, streets, automobiles, water supplies, resource depletion and waste disposal. It results in competition with the needs of Nature, threatens the system's integrity and impinges on the sensibilities of mankind by reducing natural diversity and creating ugliness. Although impacts are an unavoidable consequence of human survival, they often can be greatly reduced by appropriate planning and management.

**4.2 Industrial Development**

Industries are attracted to the coastal zones when they: 1) benefit from access to low-cost marine and inland transportation systems, 2) use seawater for process or cooling purposes, 3) deal with marine transportation, and 4) depend directly on the marine environment for raw material. Industries are also attracted by the vicinity of population centres, even when they do not depend directly on water or water access.

Coastal locations for heavy industry may engender a wide variety of environmental problems with impacts that extend considerably beyond the plant sites. A new factory may require dredging of a deep-water channel (which raises a number of ecological problems) or put increased pressure on land and air transportation links, each with its own potential for ecological disruption. Also, coastal factories have often pre-empted mangroves or other critical habitats which are obliterated by seawalls, docks, landfills, and buildings.

The waste waters from coastal heavy industries have potential negative impacts on coastal ecosystems. These impacts range from relatively minor disturbances (such as temporary, localized turbidity increase) to major disruptions (e.g., water pollution caused by discharge of toxic chemicals). But much of the industrial pollution can be eliminated by the application of existing, affordable, waste treatment technology. Also, many estuaries, lagoons, and bays which are now polluted can be successfully reclaimed if the wastes entering them are adequately treated.

Satellite industries may often be attracted in the coastal zone by the development of large factories and may be environmentally damaging, imposing higher costs on the community for streets, police, fire protection, schools, and other essential services. Therefore, planning decisions relating to industrial siting must include the secondary development such industry will induce.

**4.3 Waste Disposal**

Harbours of large coastal cities and industrial ports give the worst examples of pollutants discharges. Both pollution from oxygen-depleting organic wastes (e.g., sewage) and from toxic industrial wastes damage coastal environments and resources and pose risks to human health.

Lagoon and estuary degradation is often related to their fate as pollutant discharge areas. Aside from outright fish kills and other dramatic effects, pollution causes pervasive and continuous degradation that is evidenced by the gradual disappearance of fish or shellfish or a general decline in the natural carrying capacity of the system. Coastal seas are particularly susceptible to pollution conveyed by streams and rivers, including agricultural runoff.

Coastal communities are sources of serious problems of waste. Some have concentrations of septic tanks or cesspools that leach large amounts of nutrient into shallow waters. Some others dump large amounts of solid wastes along the shore which disfigure the coastal landscape and leach pollutants into the coastal seas.

Land-based sources of pollution are believed to be responsible for more than three-quarters of marine pollution, via rivers, direct discharges, and the atmosphere. Most of the rest comes from shipping, dumping, and offshore mining and oil production. Impacts of inland activities include: the discharge to coastal seas of pesticides, heavy metals, and other harmful wastes; changes in salinity regimes as a result of damming rivers and siltation due to deforestation and cultivation. Coral reefs have been destroyed and benthic communities degraded by siltation and by increased nutrients from nearby sources and by sewage and agricultural runoff. Otherwise, the damage seems to be concentrated in lagoons/estuaries, and shallow littoral waters of the open coast.

The persistence of pesticides and other chemicals in enclosed seas is of great concern. These can have a direct impact on the suitability of fish for the human diet. The need to protect human health provides a strong incentive to avoid discharges of such chemicals into the marine environment.

Excess nutrients received by the aquatic environment from land sources sometimes may enhance fisheries through increased nutrient supply, but the benefits of eutrophication seem to be outweighed, in most cases, by negative impacts (excessive algae, oxygen deficiency, etc.).

**4.4 Shore Protection Works**

Intertidal areas are especially important parts of the coastal ecosystem, including the mangrove forests, salt marshes, tide-flats, and beaches. They define the ecological boundary between land and sea. But, when shoreline development begins, these habitats are often the first to be obliterated - by seawalls, groins, bulkheads, and gabions.

Coastal habitats, such as mangroves and other wetlands, coral reefs, and coastal barrier islands and lagoons, are often recognized by natural hazards experts as the best defences against sea storms and erosion, deflecting and absorbing much of the energy of sea storms. If obliterated or allowed to deteriorate, storm waves and surges can pound the shore without mercy (see Figure 4.1).

Sinking and receding shorelines must be given special attention. The phenomena are caused partially by human activity and partially by the long term trend of rising sea level in response to “global warming”. As the sea level rises, the shoreline will move inland. New “soft engineering” technologies which require much less concrete and rock and are protective of coastal environments are available to deal with areas susceptible to sea level rise, storm waves, storm surges, coastal flooding, and persistent erosion.



***Figure 4.1 Erosion of the Seawall at Kilkhida on the Southeastern Black Sea. Source: Hayes (1985)***

**4.5 Ports and Marine Transportation**

Port development and coastal support facilities are required by four types of activities: 1) offshore oil and gas development requires port facilities, oil storage capacity, refineries and other infrastructure support; 2) the shipping industry requires channels, port facilities,

shipyards and extensive land areas for container storage; 3) fisheries development requires breakwaters, channels, ports, processing plants and other facilities for the fishing fleet; and 4) military operations will require port facilities, infrastructure, and support services. These support facilities can often be used by more than one maritime activity but military operations will usually require exclusive use of certain port and harbour sites.

Major threats from port development are: 1) pre-emption of fringing mangrove wetlands for development sites; 2) dredging channels with destructive disposal of dredge spoils; 3) dredging and filling operations, and obliteration of seagrass meadows; and 4) spills and persistent pollution. In some countries, harbours and marinas built primarily for recreational use by small boats may disturb more of the coastal zone than commercial and industrial uses.

**4.6 Land Transportation Infrastructure**

Roadways, bridges, airports, and other transportation infrastructure create special problems along the coast. These constructions often pollute the sea, pre-empt critical intertidal habitats, and obstruct natural water flows. Therefore, their locations and engineering designs must be carefully planned in accordance with conservation guide-lines. These infrastructure usually become development corridors and commercial nuclei and may jeopardize coastal ecosystems. They should therefore be controlled. Fortunately, planners can predict the type and extent of development caused by roadway routings and terminal locations and modify plans for the purpose of ecosystem protection.

**4.7 Water Control and Supply Projects**

Quantity and seasonal cycles of water flowing to the sea should be maintained because they are very important for sustaining coastal ecosystems. Many fisheries (salmon, sciaenids, herrings, shrimp, oysters) are strongly dependent upon river flows that enter the sea. These rivers may transport beneficial nutrients to coastal ecosystems and sand to the beaches. They establish beneficial brackish conditions for mangrove forests and juvenile fish “nurseries” in the estuaries as well as for nesting of colonial water birds. Dams and water diversion or withdrawal schemes can seriously unbalance such river-dependent ecosystems and reduce their productivity and species diversity by diverting water from the ecosystem or changing the beneficial hydro-period through use of store-and-release tactics created for irrigation, flood control, water supply, etc.

**4.8 Sea Fisheries**

Planners often underestimate the economic role of fisheries. With close to 100 million t of fish per year, the sea provides more protein worldwide than beef and mutton combined. Fisheries provide also livelihood for fishermen and their families and for others in the fishing industry, including boat builders, trap and net makers, packers, distributors, and retailers - all of which enhances social, cultural, economic, and political stability in the coastal areas.A strong domestic fishery promotes self-sufficiency and reduces the outflow of foreign exchange. Also, profitable coastal fisheries reduce rural population migrations to already overcrowded cities.

Fisheries management has been the major concern of national and regional fisheries administrations for half a century, and the UN Convention on the Law of the Sea (UNCLOS) provides its framework. This concern is being overshadowed by the problems resulting from loss or degradation of the estuarine, riverine, and coastal seas habitats. Sustainability of marine fisheries is now threatened by coastal degradation for the great majority of species that spend their youngest stages in near coast, estuarine-brackish, or fresh waters. In fact, maintenance of the present seafood production and further enhancement, through improved fishing or aquaculture, will be difficult in the absence of environmental management of coastal and enclosed seas.

In the planning process a balance is required between the need to conserve marine resources and environments for present and future generations, and the need to sustain fishing industries. The problems of overfishing are also seen in other harvests and collecting, such as live fish for aquariums, corals and shells for decoration, and so forth. Overcollecting and use of dynamite and chemicals must be prohibited. Coral reef ecosystems are particularly beset with abuse.

**4.9 Aquaculture**

Marine species aquaculture spreads across the boundary between land and sea where it uses either the land (shrimp ponds) or the sea (salmon cages or artificial reefs). It represents one of the faster growing sectors of the coastal zone in some countries and is seen not only as a valuable supplement to local diets but a means of earning foreign currency through export. Aquaculture may, however, be both a petitioner for a clean environment and a polluter. On the one hand, success in aquaculture requires a clean water supply from the environment and on the other hand, intensive aquaculture practices themselves may pollute the environment.

Uncontrolled aquaculture expansion and resulting habitat conversion could reduce the natural reproduction potential of species used in aquaculture and biodiversity. It could reduce, as well, other natural values and contribute to pollution of shallow coastal waters.

Early expansion of shrimp culture required the conversion of mangrove forests to open water ponds with all the implications that loss of such wetland implies. But recently it has proved practicable to use “salinas” and other lowlands that lie behind the wetlands. In the Philippines between 1967 and 1977, aquaculture facilities accounted for 80 percent of the loss of mangrove (WRI, 1986). In Ecuador, mangrove loss for ponds is implicated in the crisis in shrimp production (“the post-larvae crisis”) of the early 1980s. As stated by Snedaker et al. (1986): “To the extent that mangroves are being destroyed… there is loss of marine seafood production.”

Another example is the conversion of rice fields to shrimp ponds (e.g., in East Java, Indonesia, and Khulma, Bangladesh) which require bringing saline water into agricultural areas.

Culture of finfish in impoundments and cages, in fjords and bays, can also cause environmental problems such as local eutrophication and depletion of benthic faunas through the accumulation of food residues and excrement and also toxic pollution through the escape of pharmaceutical and antifouling products. But such problems can often be overcome by locating cages in places of vigorous water circulation and regulating the use of chemicals.

**4.10 Coastal Forest Industries**

Mangrove forests are a major resource of the coastal zone in sheltered coastlines where wave activity tends to be moderate. They contain a high number of plants and animals (e.g., crustaceans, molluscs, fishes and birds) which form a significant part of the mangrove resource, indicating their important contribution to marine biodiversity.

In many parts of the world, human populations rely heavily upon the variety of products that can be obtained from mangrove forests such as timber, tannins, fuelwood and charcoal, honey production, and sundry domestic products. It is the various uses of mangrove forest products and the plant and animal material associated with them that lead to pressures concerning their utilization (Table 4.1). ICZM planning, which involves simultaneous attention to all sectors and considers the maximum sustained yield of each resource, including fisheries, is an approach which is especially important in the management of mangrove forests.

The multiple use of mangroves leads to conflict between governement ministries and between the economic sectors involved. Mangrove ecosystem deterioration, caused by man's intensive activities aimed at maximizing short-term gains, and the negative economic consequences on the coastal communities in both the short and long term, is causing increased concern in many countries and international agencies and calls for management. The other lowland and wetland forest types such as nypa palm, hardwood hammocks, freshwater tidal swamps, and so forth, need equal attention and management.

The removal of forest cover in watersheds, among other effects, increases sediment loadings of rivers and direct fresh water runoff to coastal seas, and this has particular effects on riverine fisheries, and on some valuable anadromous species (e.g., salmonids). It also leads to smothering of estaurine organisms such as oysters. Perhaps its most serious effect is “smothering” of coral reefs and submerged vegetation (seagrasses and seaweed beds) of key importance as fish habitat (see Box 4.2).

It is important to recognize that many of the forces which detrimentally alter mangroves have their origins outside the mangrove ecosystem. Therefore, programmes for mangrove conservation and utilization require integrated planning. One solution is to ensure that proposed developments and incidental actions that could effect the mangrove ecosystem are reviewed and approved by a governmental agency operating an ICZM-type programme. Specific conservation guidelines for mangrove forests are given by Snedaker and Getter (1985) in Coastal Publication No. 2.

**4.11 Coastal Agriculture**

Conversion of natural coastal lowlands to rice farming and other agricultural uses to meet food security needs create resource conflicts. Lowlands and wetlands are drained and planted but the potential of such reclaimed soils may be quite low because peaty conditions cause acid-sulphate soils and because there may be a high incidence of waterlogging. In addition, coastal lowland/wetland developments have potentially harmful side effects on coastal ecosystems; e.g., pollution from the release of agricultural chemicals into riverine and coastal waters, pre-emption of mangrove forests and other critical wetland habitats.

Lowlands conversion exacerbates flood hazards. In particular, flooding from rainstorms and cyclonic sea storms will be exacerbated by the clearing and draining of coastal lowlands and wetlands. Such floods not only destroy property and risk lives, they may also drown or salinize crops and can overwhelm estuary or lagoon ecosystems with sediment and organic and chemical pollutants.

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| Table 4.1 Products of Mangrove Ecosystems. Source: Saenger et al. (1983) |
| Fuel | Firewood (cooking, heating)CharcoalAlcohol |  | Condiments from barkSweetmeats from propagulesVegetables from propagules, fruit or leaves Cigar substitute |
| Construction | Timber, scaffolds |  |  |
| Heavy construction (e.g.bridges) | Household items | Furniture |
| Railroad ties | Glue |
| Mining pit props | Hairdressing oil |
| Boatbuilding | Tool handles |
| Dock pilings | Rice mortar |
| Beams and poles for buildings | Toys |
| Flooring, panelling | Matchsticks |
| Thatch or matting | Incense |
| Fence posts, water pipes, chipboards, glues |   |
|  | Agriculture | Fodder and green manure |
| Fishing | Poles for fish traps |  |  |
| Fishing floats | Paper products | Paper of various kinds |
| Wood for smoking fish |  |  |
| Fish poison | Other products | Packing boxes |
| Tannins for net and line preservation | Wood for smoking sheet rubber |
| Fish attracting shelters | Wood for burning bricks |
|  | Medicines from bark, leaves and fruit |
| Textiles, leathers | Synthetic fibres (e.g. rayon) |  |  |
| Dye for cloth |  |  |
| Tannins for leather preservation |  |  |
| Food, drugs and beverages | Sugar |  | Fish |
| Alcohol |  | Crustaceans |
| Cooking oil |  | Shellfish |
| Vinegar |  | Honey |
| Tea substitute |  | Wax |
| Fermented drinks |  | Birds |
| Dessert topping |  | Mammals |
|   |   | Reptiles and reptile skins |
|   |   | Other fauna (amphibians, insects) |

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| **BOX 4.2 - MANGROVE CONSERVATION IN PHILLIPPINES** |
| **CASE STUDY** |
| Using the Phillippines as an example, the major problems concerning mangroves that should be addressed by an **ICZM**-type programme are: |
| - | Socio-cultural attitude towards mangrove resource utilization. There still exist different attitudes towards the utilization of this coastal resource. This may be attributed to some existing beliefs which, up to the present, are still practised. This is somehow related to the manner of how people treat it for their own use. |
| - | Conflict between ecological function and economic resource. The mangrove area plays a significant role economically and ecologically. One of the environmental concerns is the issue on mangrove forest destruction. The conversion of the mangrove area into fishponds and into reclamation sites has been increasing so that its ecological significance has decelerated. From 1952 through 1975, the area used for aquaculture has increased from 88 681 hectares to 176 032 hectares. The increasing trend of developing the mangrove area into fishponds may have negative impacts on the coastal ecosystem. The management of the mangrove ecosystem with regard to its utilization should be given attention. |
| - | Degradation of the mangrove ecosystem through denudation. Thousands of hectares of mangrove areas are being declared for such uses as land reclamation, human settlements and other commercial and industrial sites and purposes. The removal of the mangrove stands for such purposes has caused the deterioration of the coastal area. |
|  | ***Source:NEPC, 1983*** |

**4.12 Extractive Industries**

Mining for beach sand has been an important industry in many countries. Sand for construction is a valuable commodity, but it must be remembered that the key to the natural protection provided by the beachfront is the sand which is held in storage and yields to storm waves, thereby dissipating the force of their attack. Consequently, taking sand from any part of the beach or the nearshore submerged zone can lead to erosion and recession of the beachfront. Therefore, beach conservation should start with the presumption that any removal of sand is adverse and should be prohibited, unless it can be shown to be naturally replaceable (i.e., it is a renewable resource).

Coral mining requires similar restrictions. It is extensively undertaken in some island countries in the Indian Ocean and Southeast Asia and leaves the shoreline exposed to erosion and storm surges, causing serious loss of beach and shoreland and damage to coastal human and marine resources habitats.

The effects of oil spills in the oceanic environment are more visible, but perhaps less serious in the long run, than discharges of nutrients and toxic chemicals, except for big spills in semi-enclosed seas - such as the extensive recent Persian Gulf “spill” - where effects of oil on coastal ecosystems and habitats essential to fisheries can be particularly severe.

Oil pollution is an ever-present danger to coastal seas ecosystems (**OECD**, 1990). But few countries have adequate contingency plans and emergency response procedures. Current international agreements have greatly reduced oil pollution from shipping, but they need stricter enforcement, along with provisions of guidelines. The International Maritime Organization is preparing a convention on emergency preparedness and response (1990). Sea pollution does not usually come directly under **ICZM** but rather a national pollution control authority.

**4.13 Tourism, Recreation and Carrying Capacity**

A powerful tool for national development, tourism is one of the fastest growing areas of international trade, particularly for smaller coastal countries and island countries with limited development options. It is also a potential area of conflict, particularly in developed countries where, in the absence of food security problems, pressures from recreational lobbies and public opinion (often ill-informed) may threaten fishermen's livelihood.

Environmental deterioration threatens the tourism industry in many regions. For tourism, the environment is itself a significant part of the product which a country has to offer. A successful tourism strategy will, therefore seek to maximize the total benefits to development, while preserving the natural environment and improving the cultural milieu upon which it depends.

Beaches are the focal point for coastal recreation and tourism and a major source of revenue for many countries. The land immediately adjacent to the beach is the preferred site for tourist hotels in the Caribbean basin and elsewhere. People are willing to travel thousands of miles and spend large sums of money to lie, sit, or walk on the beach. Good beaches attract tourists and liberal spending. Degraded beaches discourage tourism.

One of the most serious impacts from tourism development, worldwide, is that of a decline in local water quality (Saenger, 1989). Sewage discharges, particularly if poorly sited or inadequately treated, are the most common source of adverse effects on the biota. For example, in the Caribbean region, less than 10 percent of the sewage generated is treated and bacterial levels regularly exceed international standards for recreational contact waters (typically 200 MPN coliforms).

Biodiversity reduction, resource depletion and human health problems may result from the accumulated environmental effects of tourism. When the situation deteriorates sufficiently, there is also loss of jobs, income, and hard currency earnings, factors that lead to socio-political instability. Such problems can be alleviated by appropriate planning mechanisms and development controls (Clark, 1992).

Many coastal countries are caught in the typical dilemma of tourism. They want the income it generates while at the same time they deplore the negative social and environmental impacts. While environmental change is an unavoidable consequence of the growth of coastal tourism, it is necessary to keep the change within acceptable bounds.

Clearly, in small countries dependent upon coastal tourism, disturbances do extend into the social and economic scene. Resource plundering and environmental deterioration are often root causes of social disruption (Figure 4.2). For example, Dunkel (1984) states that “…mass tourism subverts the indigenous culture” and that “… economic benefits have been inflated”.

If tourism development is to be controlled, plans have to be formulated, guidelines and standards derived, parks and reserves have to be created, and rules have to be written, implemented, and enforced by governments. These should be based on knowledge of social and environmental carrying capacity and proved methods of visitor management (Clark, 1992). Carrying capacity refers to the capacity of an ecosystem to sustain specified resource uses.

Sadler (1988) believes that the idea of carrying capacity provides a frame of reference for tourism and “… is widely used to underline the importance of maintaining a level and mix of development which is environmentally and culturally sustainable”.

It should be noted that carrying capacity is not fixed but can be reduced by human or natural damage or increased through selected management procedures (see Box 4.3). The Economic Commission for Latin America and the Carribbean (ECLAC, 1985) reports that to their knowledge, megascale carrying-capacity levels are only estimated for Barbados, Saint Croix Island (US Virgin Islands) and Bermuda. In the case of Bermuda, capacity was established at half a million visitors annually based on physical carrying capacity levels (e.g., maximum 14 500 hotel rooms). Barbados used limitations on docking space and the US National Park Service at Saint Croix has limited the number of commercial tour boats allowed to go to the Buck Island coral reef daily.

Also, it should be noted that the Seychelles Islands in the Indian Ocean recently declared that their tourist capacity had been reached and announced a prohibition on future increases. Ecuador set a limit for the Galapagos Island national Park of 12 000 visitors/year in 1973; raised it to 25 000 in 1982 but actually allowed 47 000 in 1990. Everglades National Park (Florida, USA) was unable to set a carrying-capacity for the fishery in Florida Bay, so banned it completely.



***Figure 4.2 Carrying Capacity and Tourist-Resident Relationships Source: Murphy (1983)***

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| **BOX 4.3 - METHODS OF CONTROL FOR LOWERING VISITOR IMPACT** |
| The following visitor control measures may be employed to reduce visitor impacts and/or increase carrying capacity at coastal and marine national parks and reserves (created by participants of the Third International Seminar on Marine Parks). |  |
| **ADMINISTRATIVE** |
| 1. Concessions: Control numbers/activities by limits on concessionaires (lodging/ meal facilities, tour operators, etc.). |  |
| 2. Time separation: Includes seasonal closure and time intervals. |  |
| 3. User fees: Controls numbers by “ability to pay” the fee. |  |
| 4. Speed limits: Also engine horsepower, size and type of craft. |  |
| 5. Activity restriction: e.g., no spearfishing, jet-skiing, etc. |  |
| 6. Access restriction: Special places (zones) and time periods. |  |
| 7. Zoning: For assigning specific uses to specific areas; this is considered the most fundamental measure, always to be done. |  |
| 8. Quotas: Numerical limits on visitors; the most direct method. |  |
| **PHYSICAL** |
| 1. Signage/exhibits: For directions and education/awareness. |  |
| 2. Trails/routings: Surface or underwater to guide visitors. |  |
| 3. Mooring buoys: Reduce anchor damage, provide positioning, and control numbers of boats on a site. |  |
| 4. Ramps and docks : Limit launchings, provide orientation. |  |
| 5. Guides: Guidebooks, brochures, enhance visitor awareness. |  |
| 6. Transport: Special interpretive craft (subs, glass bottoms). |  |
| 7. Dry observatory: View of nature without entering the water. |  |
| 8. Artificial habitat: Enhances nature and attracts visitors. |  |
| *Source: Adapted from Clark (1991c)* |

Many marine parks, particularly coral reef parks, are installing special boat moorings in visited areas and discouraging visitors from free-anchoring. In this way, the visiting boats can be limited in number and located appropriately - when the time comes for control. Looe Key Marine Sanctuary (Florida, USA), with 52 such moorings, is a good example of this approach.

After considerable study, Costa Rica has set limits on the number of tourists that can visit sea turtle nesting beaches; for example - 25 per night at Nancite Beach (Santa Rosa National Park), to protect seabirds; Queensland (Australia) limits beach occupancy to 100 persons at Michelmas Cay.

Its advocates hope that through “ecotourism”, the more rapacious resource activities, such as clear-cutting of mangroves, mining of coral reefs, and hunting of endangered species, can be discourgaed in favour of the lighter footprint of selective tourism - much of it directed to national parks and nature reserves.

However, carrying capacity has to be addressed to ensure that natural resources are not overused nor the parks overwhelmed by tourists. Ecotourism is no miracle solution for environmental problems - development control based on carrying capacity is still necessary.

**4.14 National Security**

Extensive security interests exist in the coastal zone and coastal seas because they are at the frontier, the border zone, where invasion or other negative activities (smuggling) might occur. Naval ports and harbours, coastal airfields, and special bases of all kinds are sited in the coastal zone, usually with a high priority and intense security. However, with the correct approach, the military can be expected to cooperate in coastal zone conservation so long as it is not in conflict with national security needs. Therefore, the defence establishment should be included as a party to any ICZM programme.

**4.15 Lagoons and Estuaries**

As mentioned in section 3, coastal lagoons are special habitats for biological resources but also the locus of substantial economic activity(e.g., in the Caribbean, in West Africa and in the Mediterranean). The pressure on them will increase as the population and economy of a country expands. Fisheries, shipping, commerce, industry, tourism, housing, and institutions all crowd along their shores and, if this growth is not managed, the result can be rapid and severe degradation of the lagoon ecosystems and loss of natural resources. Large areas of lagoons and estuaries have been reclaimed (drained and/or filled) to create ports, real estate or agricultural land, most notably in land-scarce regions (such as in Japan and the Netherlands). Improperly planned, sectorally-oriented development along the shores of estuaries and lagoons creates a variety of short and long-term economic losses and opportunity costs as the result of resource collapse.

Impoundment or diversion of rivers at the upstream locations add threat to the well-being of estuaries/lagoons. When portions of the coastal watershed system are altered or short-circuited, the natural flow pattern is disrupted and estuaries may be subject to surges of fresh water. This not only disturbs the ecosystem, but also increases flood hazards.

Enclosed and semi-enclosed seas (such as the Mediterranean, the Baltic, the Red Sea and the Black Sea) are particularly vulnerable because of their limited area and relatively shallow nature, the high density of the populations they support and, as a consequence, the high density of industries using their shores. The problems are exacerbated by the relatively low level of exchange of their waters with larger oceanic areas.

Confined embayments need the maximum protection: wetlands, tidal flats, and beaches conservation; establishment of “buffer strips” around wetlands; control of sewage and storm drainage effluents; adoption of safeguards against runoff of soils, fertilizers, and biocides from the coastal upland; restrictions on industrial siting; and so forth.