

**1.1 Introduction**

One of the objectives of the coastal zone workshop was to identify the critical problems of the coastal zone, and this proved to be one of the easiest tasks. The workshop did not invent these problems, and the ones identified are probably no different from those that would have been defined by any other group with long and concerned interests about this part of our environment. The coastal zone was viewed as a unique national resource which is of great importance to a majority of our population. Conflicts result from a combination of population pressures combined with major and multiple demands upon the coastal zone area. Difficulties arise because of conflicting uses of the coastal zone. A good argument can be presented for a variety of uses, some of which are not compatible with others. We made no pretense about having all of the answers for these conflicting demands but hope that our conclusions and recommendations will help to clarify the areas of conflict and to identify those uses that are clearly a necessary part of coastal zone activities or that could be displaced to other parts of our environment and lessen the intensive pressures upon the coastal zone.

Other objectives of the workshop were to provide an interdisciplinary assessment of the effects of man's various activities on coastal zone processes, a definition of what is known and what needs to be learned, both about man's activities and about the natural processes which are affected, and the identification of scientific, legal, social, or economic constraints that prevent the rational management of coastal zone resources. The coastal environment constitutes a complex ecosystem that is an important and unique resource of our nation and that must be maintained for the benefit and use of mankind. Neither complete destruction of the natural environment nor complete prohibition of development and exploitation are acceptable goals for a national policy on coastal zone management. A balance of use, conservation, and preservation of the coastal zone should be maintained so as to optimize man's use of coastal resources through the long-term future which requires that the natural environmental processes on which most of the long-term continuing uses depend must also be maintained. Thus, maximum rational use of coastal resources consistent with the retention of life-support systems, beauties, and amenities of the coastal zone for the enjoyment of future generations must be the objectives of coastal zone management. Severe

complexities have arisen, because maximum use, even though rational, and maximum preservation of the natural ecosystems and amenities can rarely, if ever, be achieved in the same units of space and time. It is hoped that our conclusions and recommendations will aid in setting guidelines for future development of coastal management plans which will be able to achieve these contradictory but mutually desirable objectives for its utilization.

One of the complexities facing a coastal zone workshop is an acceptable definition of what constitutes the coastal zone. There is no generally agreed upon and acceptable definition, in a legal sense; and we have heard public presentations of definitions that range from a landward width of 300 feet beyond the mean high tide for certain legal actions in California, to a statement that public requirements and demands would define a 5-mile-wide strip of the eastern coast of Florida as the coastal zone belt. The seaward limits of the coastal zone are equally ambiguous or arbitrary. It is generally conceded that, although we all understand each other when we speak of the coastal zone, it is not possible to place precise boundaries, either landward or seaward of the high tide mark, because of the marked differences not only within our own national boundaries but also on an international scale. A working definition, which combines demographic, functional, and geographical considerations, was adopted for the purposes of the workshop as follows:

**The coastal zone is the band of dry land and adjacent ocean space (water and submerged land) in which land ecology and use directly affect ocean space ecology, and vice versa. The coastal zone is a band of variable width which borders the continents, the inland seas, and the Great Lakes. Functionally, it is the broad interface between land and water where production, consumption, and exchange processes occur at high rates of intensity. Ecologically, it is an area of dynamic biogeochemical activity but with limited capacity for supporting various forms of human use. Geographically, the landward boundary of the coastal zone is necessarily vague. The oceans may affect climate far inland from the sea. Ocean salt penetrates estuaries to various extents, depending largely upon geometry of the estuary and river flow, and the ocean tides may extend even farther upstream than the salt penetration. Pollutants added even to the freshwater part of a river ultimately reach the sea after passing through the estuary.**

The seaward boundary is easier to define scientifically, but it has been the cause of extensive political argument and disagreement. Coastal waters differ chemically from those of the open sea, even in areas where man's impact is minimal. Generally, the coastal water can be identified at least to the edge of the Continental Shelf (depth of about 200 meters), but the influence of major rivers may extend many miles beyond this boundary. For the purposes of the Coastal Zone Workshop, the seaward boundary has been defined as the extent to which man's landbased activities have a measurable influence on the chemistry of the water or on the ecology of marine life. (See Figure 1.1.)

We do not present any prophecy of impending doom, even though such prophecies have become extremely popular in this age of intense concern about environmental quality. We do recognize the present degraded state of the coastal zone ecosystem over large areas, but we also recognize that even larger areas are still in a natural condition. We have recommended preservation of some of these unmodified areas, and this will require changes in our present activities. Unregulated continuation of present activities will lead to insidious spread of degradation, and controls and modifications of man's actions will be necessary to preserve the essential characteristics of the coastal zone. It is necessary to recon-

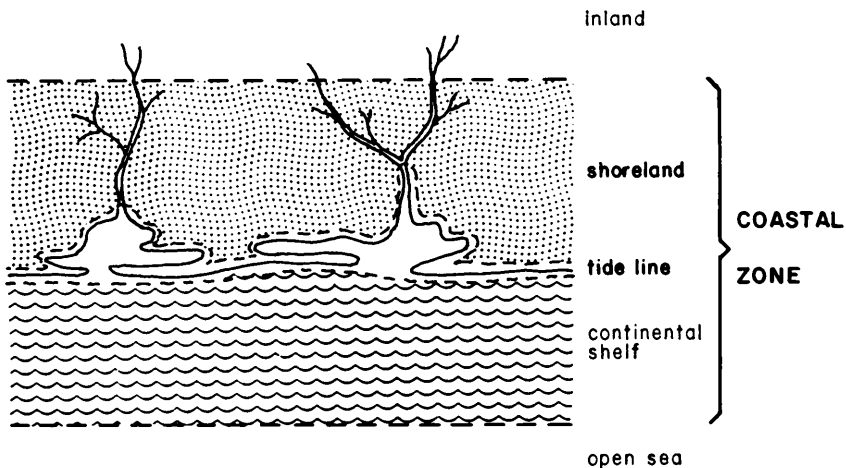


Figure 1.1 Schematic diagram of the coastal zone.

cile conflicting demands on coastal resources in such a way that full use of these resources is realized without destruction of natural processes required to renew them.

### 1.2 Characteristics of the Coastal Zone

In the coastal zone the land meets the sea, and this is an area in which processes depending on the interaction between land and sea are most intense. It is both the occurrence of these processes, and for human beings—which are land animals—the simple presence of the expanse of water, that make the coastal zone unique.

Since the coast is a junction of two environments, it is linear in nature, and the length is an essential characteristic. The area is small in comparison to length, since a large amount of land lies behind every bit of coastline, and it is faced by an even greater amount of sea. The effect of all of the events occurring at sea or on land are concentrated where they meet; thus the first important characteristic of the coastal zone is that it is an edge, limited in area, at which events are concentrated.

Where the land and the sea meet, the sea is shallowest and the land lowest. Flooding is common, both by daily tidal flooding of sand and mud flats and by storm tides that are individually unpredictable but certain to occur from time to time. Sea and tidal flooding is often augmented by river runoff and river flooding. In the coastal zone, new land is frequently claimed from the sea by rivers and currents and by strong winds piling sand above sea level or by human activities of diking or filling the shallows.

The shallowness of the sea, beginning some distance from the actual tide line, has an effect on the concentration of the sea's energy at the coast. Much of the energy of wind put into the sea surface is carried with little diminution until it meets the land where it is quickly dissipated, for example, in the breaking of waves against the shore. This concentration of energy collected by the water can have very large effects. A characteristic of coasts formed of mud and sand is their rapid change in shape as a result of the dissipation of this collected energy. The position of bars may be changed; channels may fill in; beaches move up and down the shore and may even disappear completely.

The shallower the shore and the more gradual its slope, the greater will be the distance over which the sea's energy is spent. On very gradually sloping coasts, large storms (hurricanes or typhoons) may raise the sea

level by several feet and effectively move the coastline inland. The effects of breaking waves are then moved in over low-lying land behind the normal tideline. On naturally steep rocky coasts, the concentrated energy will act only very slowly. Where the steepness is man made, the effects depend on the strength and resistance of the materials used.

In contrast to water in the sea, runoff from land does not concentrate its energy at the coast. It is mostly lost upstream. Rivers most typically are flowing rather slowly when they enter the sea. At sea level the water flows downward no further and loses what little momentum it had left. Any particles held in suspension will tend to settle at the freshwater-salt-water interface. Thus, there is a concentration of the products of land erosion at the coast where they encounter the concentration of the sea's energy, and these particles may eventually become distributed to wider areas where they settle out.

Fine silts and clays settle only in quiet waters where they may be held firmly in place by plant roots in marshes. Sand may settle more rapidly in protected areas but is heavy enough to form beaches where waves break. In many places there is a net sand transport to the coast from the coastal seabed as well as from the land.

Some of the changes of land form along the coast, produced by these concentrations of energy and materials, are cyclical, such as the seasonal movements of beaches and bars produced by changes in the patterns of waves and currents. Other changes are unidirectional, such as the filling of protected shallows. Another important unidirectional change characteristic of the coast is the rise in sea level which is significant even in human lifetimes; it is nearly as much as an inch in five years along the southern New England coast. Sea level rise plus river erosion produces both large and small estuaries. These partially sheltered bodies of mixtures of fresh and sea water serve as efficient sediment traps.

The currents that move and collect sediments along the coast will often sort them according to size and weight. As a result, in many places along the coast, deposits of uniformly sized sands and gravels occur. Concentrations of useful mineral deposits may be increased by the same winnowing processes. Some of these are produced by the shore processes themselves, while others are ordinary stream placer deposits which are subsequently placed in the coastal zone by rising sea level. Lime deposits of high purity occur in the coastal zones of the Bahamas and Florida. These oolites, as they are called, are deposited in place, principally by chemical processes

in warm shallow seas rather than as a result of the winnowing; but they are another mineral resource characteristic of the coastal zone. Shell deposits, whose formation depends on the high productivity of the zone, are characteristic lime resources along some parts of the coast.

Many chemical characteristics of the coastal zone result from the meeting of land, sea, and freshwater runoff. As fresh water is diluted by seawater, current patterns are produced so that seawater tends to flow into estuaries near the bottom and fresh water to flow out along the surface. This layered circulation helps to concentrate particulate substances heavier than water at the coast. Dissolved substances are also concentrated because of absorption by floating organisms and particulate matter. Once the organism dies, it becomes a particle that sinks and is carried into the estuary in the upstream flowing seawater.

In places of low rainfall and runoff, seawater may become more, rather than less, concentrated. Water evaporated by the sun's heat may concentrate salt which accumulates as a solid in natural or man-made shallows that are not flushed out with each tide. Since most of the water present in the coastal zone is seawater, which contains salt and other chemicals in high enough concentrations to constitute a resource, they can be utilized when further concentrated in this way.

Since natural sediments and some dissolved substances useful to organisms are concentrated at the coastal zone, we can expect, and unfortunately find, that many contaminants are also concentrated there by the same processes. Heavy metals tend to become trapped by the sulfides formed by the anoxic decomposition of organic matter. Substances dispersed in fresh water are flocculated by sea salts and settle to the bottom. Many industrial contaminants are adsorbed on particles and flocculants and so become trapped along the coast. But the water is also a dilutant for some contaminants and may disperse them so that they are made less harmful. Which process predominates depends on the behavior of the particular compound. The more it acts like water, the better it is diluted; the more it acts like a nutrient or particle, the more it will be retained and concentrated.

The most important biological characteristic of the coastal zone is high productivity, resulting from the concentration of nutrients for plant growth. This leads to a large concentration of organisms, including people. Tides and currents bring nutrients to plants, and the shallowness of the water permits the penetration of light to the bottom, so that fixed plants, growing in an area of flowing, nutrient laden water, grow

exceedingly well. Plant communities such as salt marshes and mangrove swamps, which grow intertidally, and fixed algae or seaweeds like rockweeds and kelp, turtle and eel grasses, that grow in shallow water, are highly productive. Floating algae, phytoplankton, which can grow throughout the aquatic part of the coastal zone, contribute the rest of the plant growth and are the principal producers in the deeper waters and the open sea.

The productivity is so large that it is not all consumed *in situ* but settles on the bottom, where it quickly accumulates, and the water and sediments become anoxic. In geological time, such organic deposits have produced and preserved oil and gas resources which are characteristic of the coastal zone.

Animals of the coastal zone feed on the fixed and floating plants so that animal productivity is also characteristically high. Many animals eat plants directly, including many fishes, clams, and crustacea. Because of this food resource, there are also many carnivores, including fishes, shellfish, birds, fur-bearing mammals, and humans concentrated in the coastal zone.

Coral reefs are characteristic of some stable tropical shores. These are very complex marine communities, which maintain their productivity by reusing their nutrients rather than by depending on a rapid flow of nutrients through the reef system.

Highly productive upland soils may be a feature of the coastal zone. Much of the silt load of rivers is dropped on floodplains near river mouths; and these floodplains, along with river deltas, contain some of the finest agricultural land and productive forest swamps in the country. The latter are the home of various mammals and birds, including game and fur-bearing species.

Various animals benefit from other characteristics of the coast as well as from its high production. The shallow edges of the waters, especially sheltered bays, protect juvenile stages from aquatic predators. Some animals take advantage of seasonal changes in salinity in estuaries to avoid predators which will not, or cannot, enter brackish water.

The coastal zone is the last area where migrating birds can rest on solid ground before launching out over water. Large concentrations of shorebirds and waterfowl are found on the beaches and marshes partly because of the high concentration of animal food. Small birds rest in forests and fields near the coastline before starting their migration over the sea.

People also cluster on the coast for many reasons. Transport by ship

must give way there to land transport; the best fishing is there; the presence of the sea provides a large water resource for the removal of wastes and the cooling of industrial plants. Many of the world's largest cities are located in the coastal zone, and where there are cities and industries, there are jobs. The aesthetic characteristics also attract people. Great numbers of people retire near the sea, and the numbers that visit the shore for recreation are tremendous, as can be seen by the pictures of Coney Island beach on a hot summer day. It is a cliché that people go either to the mountains or to the beach during their summer holidays. Both areas have features in common—a cool or cooler climate, a view, and the feeling of open space.

The climate of the coast is tempered by water. It is both cooler in summer and warmer in winter than inland areas on the same latitude. The difference in heating and cooling between the land and sea produces sea breezes, which aid in cooling and provide dependable winds for sailing. There is water to play in and sunny beaches to lie on. Historical sites abound along the coast, for here are all the original sites of discovery and settlement. There is a certain excitement associated with the mysterious sea, as ships appear on the horizon. A feeling of spaciousness exists so that, even with a city at your back, you can feel uncrowded while looking out to sea.

The coastal zone is thus a limited border between the two major parts of the earth's surface, land and water. It is rich in resources, from minerals and petroleum, to ducks, fish, oysters, and recreation. It is the site of much human activity and business and the recipient of much of man's pollution. It is fragile in many ways, resilient in others, and worth planning and managing so that it will continue to have attraction and usefulness in the future.

### **1.3 Man's Uses of the Coastal Zone**

Man has only recently come to realize the finite limitations of the coastal zone as a place to live, work, and play and as a source of valuable resources. This realization has come along with overcrowding, overdevelopment in some areas, and destruction of valuable resources by his misuse of this unique environment.

More than 50 percent of the population of the United States lives in the counties bordering the Great Lakes and the ocean, and the percentage is increasing. By the year 2000, it is estimated that 200 million people



may live in the coastal zone of the United States. This high population along our coasts must dispose of its waste products; and, whether these are put into rivers or into ocean outfalls, they ultimately reach the sea.

These people are concentrated in large urban centers. In many cities or clusters of cities, the coastal waters have been ruined for other uses by the mismanagement of industrial and domestic waste disposal in the sea. Fisheries, recreation areas, and prime ecological habitats have all been destroyed by mismanagement or, more accurately, nonmanagement. Man has not consciously decided to wreak this destruction. It has come about by an exponential growth of human activities in the coastal zone in the absence of any planning at all. These processes are continuing, and although heroic attempts are being made in a few places to stem the flow, reversal of the process seems almost hopeless. The rising human population, with its attendant industrial and commercial activity and the resulting wastes, has become one of our most critical coastal zone problems.

Man also harvests food from the coastal zone. Last year, United States fishermen harvested nearly 5 billion pounds of fish—most of it coming from coastal waters. This figure does not include the harvest from the U.S. coastal zone by foreign vessels. Fish harvest in the coastal zone and estuaries seems to be approaching the limit of the natural system. Though opinion differs on this point, many believe that it has already reached the limits for sustained harvest. Half of the biological productivity of the world's oceans, in fact, occurs along the coasts, and the estuaries which dot the coastline are the most productive areas known on earth. They exceed the productivity per unit area of most agriculture by a factor of 2 or more. Yet it is the estuaries which are most severely stressed by human urban and industrial activities. Loss of wetlands due to land filling and development and highly concentrated waste sources place irresistible pressures on these highly productive areas. In the past 20 years, California alone has lost 67 percent of its coastal estuarine habitats in the process of coastal development.

As agriculture has increased productivity on land, so aquaculture could increase productivity in the sea. The high productivity of the coastal waters offers the potential of greatly increased food production. Already experiments in Florida have indicated that shrimp farming on a large scale is economically feasible. Yields of one million pounds per acre have been achieved under highly controlled conditions. Experiments

with other marine organisms also promise a similar hope of success. Such use of our coastal waters could be highly valuable to man, perhaps yielding more of value per acre than any other human activity.

But aquaculture requires high quality water and a high degree of control over the environment. It can tolerate almost no other use in the same water area. Its potential is great, however, and inevitably it will play an important role in man's uses of the coastal zone in the future.

The waters of the coastal zone blanket vast reserves of minerals and oil. As our needs for these resources grow, the economic and engineering constraints on recovering them will no doubt be surmounted. The U.S. Geological Survey estimates that the potential recoverable reserves of oil on the continental margin amount to 200 billion barrels—about 5 times present proven U.S. reserves. For gas, the figures are 900 trillion cubic feet—about 3 times the proven reserves. In economic terms, U.S. offshore petroleum production in 1967 was valued at \$1 billion, or one-half of the total dollar value of all coastal zone resources that year. Gas accounted for another 15 percent of that value. It is clear from these figures that production of oil and gas will continue to be among man's major uses of the coastal zone.

Underwater mining and offshore oil extraction are expected to increase drastically in the next few decades. Some mineral resources of the coastal zone are already being harvested in staggering quantities, nearshore shell deposits are being overexploited, and underwater sand and gravel deposits are under increasing pressure. In 1970, five tons of sand and gravel were extracted for every man, woman and child in the United States. Of this, over 10 percent came from beneath our rivers, bays, and sounds, and this percentage is increasing yearly. The environmental impact of recovering these materials from coastal waters need not be great if care is given to the location of the mining operation. Areas of high sand mobility would be good ones to exploit, for example, since these are known not to be very biologically productive. While sand and gravel represent a resource that we can exploit if we are careful, there are others that may best be left alone. For example, while it is economically and technically feasible to mine the phosphorite deposits along the Atlantic coast, doing this would completely destroy the fragile and valuable salt marshes overlying them.

Man also relies on the coastal zone for recreation. More than half of all Americans vacation on the coasts, and with current population trends, this use of the coasts will no doubt continue to expand. Many reasons

for this return to the sea can be suggested, and each of us perhaps has his own. Certainly there is a wide variety of recreational activity taking place along the coastal zone, ranging from swimming, sailing, and sport fishing, to more contemplative activities like wildlife observation or simply sitting along the water's edge.

Attaching a dollar value to these activities is difficult, but we do know that recreation is a booming coastal industry. It is estimated that by 1975, \$5.5 billion will be spent yearly for swimming, surfing, skin diving, pleasure boating, and sport fishing. This is more than double the 1967 value of material marine resources garnered from coastal waters.

As man and his activities usurp more and more space on some parts of the earth, and particularly on the coastal zone, the survival of natural habitats and of plant and animal species is threatened. In 20 years, dredging and filling have destroyed over half a million acres of our country's important fish and wildlife habitats. Some coastal preserves have already been established, but as use pressure mounts and we approach total human saturation in some areas, the opportunity to establish adequate additional preserves is fast disappearing. This use of coastal areas must be given high priority since, once lost, these natural habitats cannot be retrieved.

In general, man's uses of the coastal zone can be divided into 6 major categories:

1. Living space and recreation. This is the source of a great deal of pressure on the coastal zone.
2. Industrial and commercial activities. We have only mentioned a few, but this includes power production, mining, and commercial development.
3. Waste disposal. Man uses the coastal zone to dump both industrial and domestic wastes.
4. Food production. As we have seen, this is largely fisheries, but includes aquaculture, a promising future use.
5. Natural preserves.
6. Special government uses. This is a proportionately small area of the coastal zone which includes military and coast guard installations, NASA bases, and government parks and lands.

This array of present uses of the coastal zone and the problems they present is familiar to most of us. It would be interesting to foresee man's future uses—especially their relative importance and impacts. Unfortunately, our crystal ball is cloudy, even after gazing into it for the two

weeks of the workshop. We do know that offshore oil extraction and mining are almost certain to increase dramatically. Recreation is increasing rapidly, and space requirements for this use are becoming critical. Human population trends along the coast are more of an enigma. While burgeoning in some areas, population is streaming out of others. Unless we understand and achieve some predictive skill in these population migration and settlement patterns, we will not be able to plan adequately for the living space, waste disposal, and other demands that humans will surely make on the coast.

As we view the uses man makes, and will continue to make, of the coastal zone, we become aware of the constraints put on these uses, both by the environment itself and by their interaction with other uses. For example, fish harvests are ultimately limited by the natural productivity of the coastal waters; in fact, they may have reached that limit already. At the same time, improper waste disposal and the loss of marshes and estuarine wetlands will also reduce the productivity of the system, and hence fish harvests.

If we are to arrive at an effective management scheme for the coastal zone, we will need to sort out these kinds of interrelationships of uses, and recognize the constraints that they impose on each other. We can begin by asking a simple question: Is the use being considered compatible with other uses? If so, which ones, how can they be combined, where, and what limits must be placed on each to ensure that they do not conflict with one another in the long run? This is the familiar "multiple-use" concept. Clearly compatible uses, for example, would be waste disposal, shipping, recreational boating, and urban housing. These are inherently incompatible with others, however, such as scientific preserves and aquaculture, which are examples of exclusive uses.

Some uses of the coastal zone may be displaceable to other locations. As long as use pressures on coastal areas remain low, there is no need for this approach. With increasing demands on the finite and inherently linear coastal environment, we must be selective in what we choose to place there. Clearly, some uses, such as fisheries and wildlife preserves, cannot be displaced. Others, such as power plants and high-density human habitation, could be moved inland or, as some have suggested, placed offshore.

In short, there are three strategies in dealing with coastal zone uses:

1. Multiple use,
2. Exclusive use, and
3. Displaceable use.

If compatible or multiple uses are allowed to grow until they exceed the carrying capacity of the environment or begin to interfere with one another, conflicts arise. Examples of such conflicts arise every day. Conflicts in use patterns require difficult management decisions, but, ideally, most could be avoided by proper advance planning. In some cases there may be technological solutions to problems of conflicting uses, but these solutions should not be limited to single-use conflicts. In other cases, two or more "problems" can be converted to an opportunity. An example is the use of nutrient-rich domestic sewage to enhance the production of food by aquaculture or to raise the level of productivity of existing ecosystems. In temperate or cold climates, waste heat from power plants might be used to control spawning and increase growth rates of fish and shellfish or to warm swimming beaches.

Judgment on the economic feasibility of such solutions should not be based solely on the dollar value of the product or direct benefits resulting from the technological system. The benefits of eliminating or reducing damage to the environment or the savings realized by eliminating the need for other direct, and perhaps costly, technical operations should also be included on the plus side of the ledger.

Understanding the uses man makes of the coastal zone and its resources, understanding the impact and constraints of these uses, and developing strategies to deal with these uses are not enough. Managing the coastal zone for human benefit demands more than economic analysis, more than the opinions of experts, more than any technological solution, elaborate planning technique, or political arrangement can provide. Managing the coastal zone for human benefit rests upon an inherent respect for what the coastal zone is for—its uniqueness and wealth.

In the late 1940s, Wisconsin's great naturalist, Aldo Leopold, made a plea for mankind to develop what he called the "land ethic," which, he wrote, "changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow members and also respect for the community as such." Man has not yet achieved this ideal, but perhaps it is now time for man to adopt a "sea ethic," time he reached some feeling of responsibility for the health of the coastal zone and an ecological conscience in its management.

There is an element of self-interest in this philosophy. After all, man relies heavily on the coastal zone for a great variety of things—recreation, aesthetic refreshment, and resources such as fish and petroleum, to name a few. An insult to this coastal system, however minor, will

eventually be paid for by decreased value of the system to man in the form of depleted resources or deteriorated water quality. In this light, harmony of man's uses with the physical, chemical, and biological functioning—in short, the total ecological functioning—of the system should be the overriding goal.

If we attach a quantitative value to this harmony, we shall continue to enjoy the wealth of this unique system. If environmental considerations are built into the cost-benefit analysis of any proposed use, for example, we shall eventually get the most return for our investment. If they are not, and we insist on raping the system, we are doomed to take a loss, whatever our short-term gains.

The acceptance of a sea ethic will not be achieved without sacrifice. Man will have to sacrifice the way in which he now attaches values to things. If he persists in valuing the coastal zone only for the uses which he can make of it today, and the resources he can take from it, he will ultimately destroy it. But if he can better understand what he wants from the coastal zone, what impacts his current practices are having on it, and if he can develop and implement rational and ethical strategies to deal with these uses, he will enhance and preserve this unique area and will be rewarded for his efforts.

#### **1.4 Allocating Coastal Resources**

Deliberate changes in the way humans utilize coastal resources must be made if negative environmental impacts are to be reduced. Obtaining public action to protect the natural ecology of the coast is not, as some would hope, simply a matter of making information about the problem known. Defining, agreeing upon, and implementing measures that require a large and heterogeneous body of people to forego or reduce the level of utilization of valued resources is seldom easy. Yet this is the task that must be accomplished for the wise management of the coastal zone.

Marine biologists, oceanographers, and ecologists have made the complexity and fragility of marine ecosystems understandable. Social scientists must also make it clear that the social, economic, and political processes that exercise important influences over the formulation and administration of governmental policy are also highly complex. Creating another governmental agency or passing new laws may or may not achieve the goals that gave impetus to them.

Several crucial tasks must be undertaken if public institutions and rules are to be designed which will give adequate weight to environmental

values in allocating coastal resources. One such task is to identify the way in which social, economic, and political processes mediate between the welter of issues which individuals and groups must resolve by governmental authority and ultimate action. The content of any coastal policy that is adopted will be affected by these processes. The constraints these processes place upon the capacity of various types of governmental agencies or laws to modify existing patterns of human behavior in relation to coastal resources must be understood. The design of public policy concerning the coast and the agencies to carry it out is too serious a matter to be done without taking certain "realities" into account.

Humans place a high value on access to the coast and engage in a variety of activities there. As previously mentioned, more than one-half of the population of the United States is located in close proximity to the coast, and the percentage is expected to increase. No adequate public policy can be formulated without a clear understanding that there are immense social and economic pressures for increasing the amount of coastal area that is devoted to residential, recreational, and industrial use. Consequently, management of the coastal zone must be concerned with ways of assuring human access. Methods to increase the carrying capacity of the coast for human activities in ways that produce a minimum environmental impact may be essential. Humans, particularly in well-organized groups, are quite innovative in devising strategies for circumventing or neutralizing regulations that interfere with the achievement of highly desired values.

Our governmental system is complex and characterized by a great number of points where policy influence can be exercised. There is little likelihood that all authority concerning the allocation of coastal resources could, even if it was desired, be placed solely in special coastal management agencies. Market transactions, voting, bargaining, and adjudication, as well as administrative agencies with overlapping responsibilities, all interact in the allocation of most major resources in this country. The establishment of any coastal zone management agency must be done with awareness that it will be in competition with other allocative mechanisms in some cases and be able to use them for complementary purposes in others.

Finally, decisions about the coast cannot be made in isolation from the broader geographic regions of which the zone is part. For example, the public interest is not served if an activity that is barred from the coast is located at an inland site where it produces greater overall dam-

age. A means must be available to choose between coastal and inland sites or require that the activity be modified or eliminated. Cases also will arise in which the demand for a widely desired use of the coast exceeds the resource. If the carrying capacity of the coast itself cannot be increased through technology or greater management efficiency, it will be necessary to identify and develop inland sites where similar or substitute water-related activities can take place. A coastal zone management agency, then, will not be in a monopoly position for determining the allocation of coastal resources. Neither can it be given a set of final and inflexible rules to administer. The content and interplay of physical, biological, social, psychological, and economic values concerning uses of the coastal zone are not static. The same is true of the number and influence of special interest groups associated with particular values. They will change over time as will their strategies for influencing policy.

Formulating coastal zone policy will not simply be a matter of deciding on rules to preserve marine ecosystems. Whatever the policy outcome of the current debate over coastal legislation, it will be the result of two sets of trade-offs. One will involve broad choices between environmental and social and economic values. Then there will be a need to ration or choose among the possible alternative uses of the resources that are available and to determine who will be able to use them.

To a large extent, the success of efforts to manage coastal areas will depend upon the ability of the overall political process to provide general guidelines and the capacity of the governmental agencies created to administer them to operate in a dynamic social, economic, and political environment. This will mean that methods must be established to provide fair access to the decision process, a socially equitable distribution of the coastal resources that are available for use, and adequate information for determining the social, economic, and environmental effects of the policies and rules that are considered and adopted.

### **1.5 The Structure of Management and Planning for the Coastal Zone**

Our concern over the future of the coastal zone ultimately focuses on man's ability to control the impact of his activities on its resources. This draws us to an inevitable consideration of the policies, programs, and institutions by which man can exercise his power of rational decision making. Historically, the policies, programs, and institutions which deal with the coastal zone have been lumped under the rubric "coastal zone management." The term has been used to describe anything from



theoretical studies of how traditional economics might be used to allocate the resources of the coastal zone to detailed programs for establishing operational agencies and procedures to regulate use of the coastal zone.

In a management sense, the seaward limit or boundary defined in state jurisdictions is suitable for most management programs. In cases of national concern, the limits of federal jurisdiction may be needed. On the landward side, overlapping existing jurisdiction, land-use patterns, and special districts produce a variable definition that relates limits of marine influence inland as defined by each state, since the boundary must relate to the problem being considered.

The multiple political interests and power structures in the coastal zone have made it difficult to manage. Overlapping jurisdiction that we cannot ignore causes nonuniform guidelines and regulations. Furthermore in traditional resource management or planning, man has dealt with each resource subsystem individually—the land, the water, and the submerged lands. We need to view the coastal zone as a natural system in order to utilize resources in harmony with the ecological web that characterizes this zone.

Localized impacts may involve the development of individual units, for example, a nuclear power plant or some other industrial complex. In this class of problem, the issues must be resolved primarily by action at local (or regional) levels. The Hilton Head chemical complex provides a good example of the issues in this category. Some localized impacts have national involvement. The current energy crisis provides an excellent example here. The increasing demand for energy and the projections of national demands suggest that quite soon we may need to develop new deep ports or other offshore facilities for handling super-tankers. Although local areas will feel the direct impact of such facilities, the need for fuel is nationwide, and the beneficiaries of the new facility would include a broad cross section of the country.

Historical usage presents a separate set of problems. The New York Bight in its role as septic system for the metropolitan area is a classical example for this category. Can such areas be reclaimed? A willingness to break with past traditions and to reexamine past uses of coastal regions to determine possible new thrusts for action is imperative for future coastal zone management.

Coastal zone management is a process designed to achieve a set of stated objectives. In the coastal zone, the stated objective would be to maintain

and to improve its usefulness for man by ensuring the quality and extent of the natural system upon which he depends. This should be done for both the present and the future in ways that would be acceptable to our expressed or imputed economic, social, and environmental goals. With such a best-use objective in mind, we propose a basic definition of coastal zone management which should include (1) developing and understanding of the coastal zone as a system, (2) using this knowledge to create a dynamic plan for its best use, and (3) implementing and enforcing that plan.

The functions of management within this structure are based on the principles of allocation of resources, establishment of priorities, and regulation, including positive use of resources through, for example, incentives, pricing, and other strategies for management. The allocation process requires resource inventory and classification as a resource base line from which allocative decisions can be made, and a plan developed for the future use of various coastal zone resources. This process in turn leads to a program of evaluating and monitoring how well the system is functioning.

In order to achieve these goals, it will be necessary to determine what man's desires are in using the coastal zone and what values and priorities need to be assigned to these desires. It will be necessary to determine the capacity of the coastal zone in relationship to these desires and to determine which uses are compatible within a defined area of capacity. If capacities and uses cannot be matched, trade-offs will be necessary, and the public must be informed concerning the losses they must incur for a given use. Complex mechanisms will be necessary to regulate and promote compatible uses and to determine which parts of the coastal zone should be set aside for exclusive uses. For example, industrial development and preservation are not compatible, but both are desirable uses of the coastal zone system.

The scope of the problems and the common resources involved require that government agencies manage the coastal zone. Federal, state, interstate regional groupings, and local levels (a collective term that includes all levels of government below the state level, such as counties, municipalities, towns, villages, and various groupings thereof) must have clearly defined responsibilities.

The central issues are centralization and decentralization, a fundamental management question, not unique to the coastal zone. Generally,

higher levels of government lead to centralization, but also to more general perspective, more objectivity, more access to expert talent, and more funds and political impact. Moving toward decentralization, the lower the level of government, the more intimate the knowledge of the problems, the more myopic the outlook, and the greater the likelihood of living with the effects, whether good or bad, of the decisions. Furthermore, if higher government does not limit its own decision-making appetite, it can become hopelessly bogged down in detail at the expense of the perspective it claimed in the first place.

It is appealing to try to seek out a middle ground, ideally one that preserves the recognized unique attributes of the extremes. To distribute authority in the coastal zone among the various levels of government involved, it is necessary to invoke the principle of delegation of authority. Under this principle, coastal decision making is delegated to the lowest level of government consistent with the scope of the problem, but decisions must conform to the goals and restrictions articulated by successively higher levels. The restrictions are generally formulated to ensure that the external effects of the local decisions are kept within tolerable bounds. A workable system incorporating the principle of delegation of authority and its corollary, management by exception, would place decision making at the lowest level commensurate with the anticipated impact of the decision, while prescribing the policy framework and type of external considerations that must be referred to a higher level.

### **1.6 Legal Aspects of the Coastal Zone**

As already stated, the concentration of population along the coast, the increasingly intensive use of coastal resources in some areas, shoreline development, and waste disposal all have effects that call for consideration of environmental consequences. Man's activities are not only producing substantial effects on the environment, but also foreclosing important future options for society.

Our focus was on those decisions that influence man's use of the coastal zone. One primary concern has been decisions about development. The need for assessment of the environmental impact of man's activities is greatest where there is the most pressure for extension of metropolitan-type use and development into areas of the coast which had previously received comparatively little development.

Pressure from metropolitan centers is felt most acutely at the level of local government. Demands to use beach areas are often met with responses to exclude nonresidents from locally owned or operated beaches. Or, sometimes, the use of the coast by outsiders is favored, as in local communities whose economies depend upon the tourist trade. The exclusion of outsiders raises constitutional questions of "equal protection" of citizens, but local policies that permit too intensive use or development often produce environmental impacts that affect the ecology and resources to the detriment of the wider state and national interests. Both reasonable access and use policies, and policies for appropriate protection of the environment, must be applied in coastal decisions.

Jurisdictional authority in the coastal zone is divided, with several important discontinuities vitally affecting coastal zone law. On the land side of the coastal zone, state law and sovereignty, with the associated police powers for the regulation of public health, safety and general welfare, dominate. Actually, zoning authority in most states is delegated to the county or local municipal governments, and this aspect of the police power is not ordinarily exercised at the state level. The federal government typically exercises little authority on the land side of the coastal zone, although the power to regulate interstate commerce and the ownership of extensive areas of the coast in some states give it a basis for substantial jurisdictional and practical power. The salient point is that the bulk of the decisions on the land side of the coastal zone are zoning and other regulatory decisions made at local levels of government.

When we move into the water areas, we encounter the navigation jurisdiction of the federal government. Under the Commerce Clause of the Constitution, the navigation power extends a jurisdiction throughout the navigable waters of the United States. Construction in these navigable waters is regulated by the federal government, and conservation and environmental factors are now being taken into account in the making of these decisions. Additionally, federal water quality legislation provides for federally approved state water quality guidelines and serves as an additional basis for federal jurisdiction. To the extent that federal law does not preempt state law in these areas, the state also has substantial authority in the water areas of the coastal zone. Thus, the fundamental discontinuity of jurisdiction at the water's edge, with the primary influence of local decisions on one side of the line and the direct and substantial jurisdiction of federal and state governments on the other must be emphasized. While natural processes, and the patterns of man's use,

cross this land and water line freely, the discontinuity of jurisdictional authority is a major problem for coastal zone management. Until recently, this discontinuity left gaps in the legal regulation of coastal activities. In the past several years, however, with increasing awareness of the environment in decision making, and with a broadened view of the federal authority over navigable waters to include environmental and water quality responsibilities, there is an increased possibility of federal, state, and local conflicts in decision policies.

Another discontinuity of jurisdiction occurs where the water meets the submerged land. The federal jurisdiction over the waters, as described above, meets the state's ownership of the submerged lands from the coastline out to the territorial sea, and in some cases, beyond. Another major problem with the limits of jurisdiction is that the lateral geographic boundaries of the lower governmental units do not correspond with the natural boundaries of coastal features and thus do not meet the needs of effective coastal zone management.

The proposals usually advanced to deal with these problems of distribution of authority advocate solutions by means of cooperation or coordination of the government levels, or by raising the decisions to higher government levels so that an adequate scope is available for management of activities and resources. While elements of these approaches will undoubtedly be found in future coastal zone programs, they are generally not adequate. Coordination and cooperation has its limits when the interests of the affected government entities do not converge. Elevating decisions to state or federal levels in most cases is impractical, and wasteful of available manpower. Until alternate means of funding at local levels of government are found, conflict will be produced by excluding them from the decision concerning conservation and development of local coastal areas. An alternative approach is the use of guidelines at federal and state levels, with more specific controls provided at the lower government level. Guidelines are a technique with both power and flexibility for assisting coastal zone management.

Recent proposals for land-use management have been made as a means of displacing local decision making. The general approach of these legislative proposals, and of the legislation on this subject recently adopted in Florida, is to provide for the selection of decisions which are of "regional" or "environmental" impact. For these decisions on matters of "critical concern," the decision-making power of the lower levels of government is displaced so that the important choices are determined by

the state or federal government. Such an approach necessarily either removes a large proportion of the present decision authority of local and state governments or provides for but a small percentage of the decisions to be so affected. In the coastal zone, the construction of even a small pier or dock, or the dredging of even one submerged acre may have a substantial effect on the local environment. At present the development activities in the water areas of the coastal zone involve local, state, and federal jurisdiction. Accommodating the policies for the land and for the water decisions should be a prime objective, but not by selecting a small percentage of the land decisions for state or federal jurisdiction. The technique of establishing guidelines can achieve the objective of securing conformity of the lower levels of government with standards necessary for regulation of the activities in the coastal zone without losing the participation of local government.

### **1.7 A Systems View of Coastal Zone Management**

With the onset of the technological age, we are witness to environmental destruction of unprecedented scope and magnitude. In recognition of the fact that the present trends cannot long continue without great danger to the life-support system itself, the development of a sophisticated society-environment management system, through which a reasonable balance may be achieved and maintained in perpetuity, is needed.

The necessity and feasibility of developing an analytical model capable of handling a great variety of social and environmental data and of displaying such information in a form suitable for decision making should be recognized. The development of such analytical and display capability is considered to be one of the essential ingredients to wise long-range management. Another essential ingredient is the development of the capability of reaching rational decisions, once the information is freely available. Rationality is a relative matter, subject to the basic values of the decision makers. The underlying value adopted by the workshop is the continuing benefit of the coastal zone for the entire population of the United States. Present managerial systems are simply not equipped to handle the widespread environmental problems attendant upon intensive coastal zone use. A better way is urgently needed.

A most powerful approach developed for attacking complex and otherwise intractable problems is the application of systems analysis. Coastal zone management, while characterized by many special features and

uncertainties, belongs to a class of problems to which operations research specialists have devoted much attention. Already available are the general conceptual framework; an inventory of management, social, and physical environmental models; some experience in simulation; and fully adequate computer resources which together provide a strong basis for the development of systems analysis approach.

Managerial data requirements are far less demanding than those required for full scientific understanding, with informed judgments and approximations often providing a quite adequate basis for decision making. Truly refined management at the ecological and socioeconomic levels is, at best, a very long-term goal, the progressive introduction of systematic approaches and of machine support for better human decision making can begin now and would certainly result in substantial practical management improvements.

The advent of the systems approach provides a means of summarizing vast bodies of information and of translating them into various levels of perception, analysis, and action. The use of these techniques, however, bears the risk of losing concrete applicability with every stage of translation. Consequently, great precision in terms and procedures must be linked with continuous scrutiny by those expert in each language—for example, substantive specialists in biology, physics, engineering, or sociology—if the potentialities of systems analysis and integration for improved discovery and decision making are to be realized. This results in a viable man-machine rather than a machine-man process. Over the next decade, the generation of computers and software now being built will together provide great margins of capability for any conceivable data or computational requirements of coastal zone management. Directed by society and constrained by the fragile environment, technology is a means, not an end in itself, and can assist man with the solution to his seemingly overwhelming problems.

The total time horizon with which we are dealing is unlimited, yet it must be phased into foreseeable horizons for short-term planning. Therefore, our immediate objective in planning for a rational future is to establish the framework for a realistic pattern of decision making which is responsive to the many conflicts that are inevitable as demands exceed resources. Thus, as we proceed into the future by a successive series of approximately informed and rational decisions, we can periodically adjust coefficients of the use-environmental quality equations for achieve-

ment of successively perceived optimum states. These optimum states, in turn, will, we hope, reflect a wiser and better informed consensus of public opinion.

### **1.8 Workshop Recommendations**

The recommendations made by the Coastal Zone Workshop were guided by the recognition that existing research, managerial, regulatory, and action agencies already develop information and make decisions which they consider in the best interest of all involved parties. Regional zoning schemes, complex transportation programs, Chamber of Commerce advertising, taxing policies, and commercial development contribute to the existing policies, goals, and objectives for the use of the coastal zone. The coastal zone should be considered as an environmental bank. We can withdraw the interest on the capital; but when we withdraw the capital itself, we reduce the interest. Our concern must be to utilize the yield of this environment without destroying its ability to renew its resources. The primary aim of all the recommendations is to provide for the evaluation and development of man's use of the ecosystem.

Legislation at the state and federal level have been discussed and considered in the formulation of these recommendations. The recommendations reinforce some which have been presented in previous reports on the coastal zone. The passage of time has allowed a better definition of the needed focus, and the interdisciplinary nature of the participants in the workshop has produced some novel and innovative approaches.

Management of the coastal zone is of great national concern, but lacks a definitive policy or recognized national goal. The absence of definitive national policy or recognized national goals concerning the numbers, distribution, and movement of people, and the distribution and utilization of natural resources including land, air, materials, energy, and recreational areas, make the development of guidelines for specific regions of the coastal zone very difficult.

Within the limits of our combined interdisciplinary capabilities, the Coastal Zone Workshop has examined the general changes required to meet the proposed goals. The recommendations emphasize actions that we feel to be central to each of the several basic concepts relating to man's use of the coastal zone. These recommendations will require general changes in attitudes, activities, legal structures, management arrangements, and information availability. Some are specific and concern



man's use which may appear detailed, but the need for their early implementation is considerable.

The workshop brought together a diverse group, and real communication was not always easy. The participants in the workshop worked diligently and with dedication in an effort to establish and maintain the necessary interaction. The following recommendations were discussed at length and represent the professional opinion of a majority of the workshop participants.

### **General Recommendations**

#### *The Coastal Zone Workshop Recommends—*

##### **I.**

The development of a vigorous and comprehensive *National Coastal Zone Policy* by the federal government in cooperation with the states that will provide for the wise use of the marine, estuarine, wetland, and upland areas bordering the American shores. All future uses of the coastal zone must be designed to maintain the natural ecosystems and to provide for the use of contiguous resources by the people of the United States. Cooperative action by cognizant federal, regional, state, and local governments will be required. The integral element of the National Coastal Zone Policy should be the focus of management responsibility at the state level, with the active participation of local governments, under federal policies that provide grants and set guidelines for creative and effective programs.

##### **II.**

The President of the United States request the National Academies of Sciences and Engineering to create a multidisciplinary *Coastal Zone Task Force* to formulate a management program. The Task Force should assist the federal government in designing the national program and evolving model guidelines for state coastal zone management authorities. The Task Force should work with the coastal states, regional agencies, and the federal government in preparing specific plans for coastal regions of the United States.

##### **III.**

The development of *legal institutions and procedures* to make coastal zone management more effective. Substantial improvements in the exist-

ing types of decision procedures and laws are required and consideration should be given to—

Development of innovative approaches through new coastal land and water use accommodations;

Alternative means for the regulation of coastal development besides the taking of private property;

Improvement of statutes and administrative regulations for land, water, and submerged land activities;

Increased access of individuals, groups, and governmental units to administrative and judicial proceedings;

Establishment by state legislatures of Environmental Review Boards for appeals of local administrative decisions concerning activities that have coastal and environmental impact;

Establishment by Congress of an expert federal Environmental Court with broad jurisdiction over private persons, state and local government agencies, and federal agencies in controversies involving coastal and environmental impact.

#### IV.

The establishment of regional *Coastal Zone Centers* to develop and coordinate natural science, social science, and legal research and to provide relevant information about the coastal zone to government agencies and the public. These centers should cooperate with existing research organizations to resolve basic questions of the environment in that region, help appraise management techniques, and provide inventories of coastal resources. Coastal Zone Centers should be established in regions corresponding to the major types of coastal environments and may be international in character.

#### V.

The creation of a national system of *Coastal Area Preserves* for the permanent protection of the basic genetic stocks of plants and animals and the essential components of their environments, which together constitute ecosystems. These Coastal Area Preserves should be severely restricted in use. Some other coastal areas should be developed for recreational usages that are compatible with the natural life of the area.

## Specific Recommendations

### *To Improve Our Knowledge, the Coastal Zone Workshop Recommends—*

1. The acceleration and expansion of comparable surveys and complementary inventories of coastal resources, including demographic patterns, ownership and land-use patterns, and other socioeconomic data in addition to new base-line ecological studies of natural and modified coastal systems.
2. The further development of predictive models to aid in understanding the effect of activities and structures upon the coastal zone environment and to improve the management of the coastal zone by evaluating the impact of alternative actions.
3. Improved environmental impact statements should be prepared for each new or additional activity and structure in the coastal zone to determine the extent to which they would have social as well as environmental effects. More stringent requirements for the preparation, detail, and use of such statements in making specific decisions should be developed.
4. Basic biological, chemical, and physical research directed toward the following types of problems in the coastal zone:
  - a. Transport, dispersion, upwelling, and cycling of nutrient and hazardous chemicals as they affect the functioning and stability of coastal zone ecosystems;
  - b. Surveillance of input levels of contaminants, especially chlorinated hydrocarbons, petroleum, and heavy metals;
  - c. Effects of solid waste disposal;
  - d. Effects of chronic, long-term, sublethal contaminants on organisms and ecosystems;
  - e. Assimilative capacity of coastal zone for all kinds of wastes;
  - f. Epidemiologic and virologic studies;
  - g. Recovery processes in damaged ecosystems;
  - h. Factors affecting stability, diversity, and productivity of coastal zone ecosystems;
  - i. Techniques for increasing production of desirable species or systems.

5. Research in the legal, political, economic, and social aspects of the coastal zone should be directed toward the following types of problems:
  - a. Exercise of property rights in wetlands and shore areas;
  - b. Administrative and judicial enforcement of codes;
  - c. Statutory guidelines and their interpretations with respect to shoreline development;
  - d. The decision-making process for the coastal zone at local, state, and national levels;
  - e. Group interests and political pressures in coastal zone uses;
  - f. Value systems that affect management practices in coastal zone activities;
  - g. Cost-benefit analysis of ultimate uses of the coastal zone, including ecological effects;
  - h. Economic models for policy guidance in calculating inputs and outputs;
  - i. Economic factors and mixes in resource evaluation.
6. Research on the environmental social, economic, and legal effects of:
  - a. Siting, construction, and operation of coastal and offshore power plants and deep ports;
  - b. Dredging and deposition of spoil.
7. The creation of regional and national monitoring systems to collect continually chemical, physical, and biological data with a capacity to give advanced warning on conditions that may be hazardous to the ecosystem of the coastal zone.
8. A sustained national commitment to education and training of the necessary talent for the management of the resources of the coastal zone. The goal should be a widespread awakening in the public to the importance of maintaining a sound coastal zone environment as well as the preparation of a future generation of natural and social scientists to manage wisely their environmental heritage.

*In Order to Allocate Political Responsibilities Efficiently,  
the Coastal Zone Workshop Recommends—*

9. That the federal government establish a national coastal zone management program, which should be vested in one of the existing federal agencies and should coordinate all agencies involved in coastal zone activities. The federal agency should administer grants to state coastal

zone programs and set appropriate guidelines for such programs as well as for the management of federal coastal lands.

10. The federal and state governments, acting together, create regional councils to assist in carrying out the national coastal zone policy. Such councils would work in concert with federal and state agencies in advising on regional problems of national interest and implement appropriate policies where consensus exists between federal and state governments.

11. The state coastal zone authority should be established as an independent agency, with its expertise and primary responsibility exercised in cooperation with other state agencies involved in the coastal zone. Management programs should view the coastal zone as a complete natural system and not be restricted by political boundaries. Incentive policies, as well as regulatory powers, should be used to improve the management of the coastal zone. Local governments should be strongly encouraged to evolve their own local plans and programs within the guidelines of the state coastal zone program, while citizen's advisory boards should be used to gain public participation in the policy-making process.

12. The application of environmental quality standards and performance criteria based upon monitoring or surveys to be evaluated by all government agencies involved in the management of the coastal zone. They should take into account socioeconomic needs of the community, and resort to general regulations, zoning, and other codes only when necessary for compliance.

13. Recognition of the interest of people dwelling outside the coastal zone, but who are directly affected by its environmental conditions or its productivity. The needs of individuals and groups who have limited resources for competing in the political bargaining process in reaching coastal zone policy decisions must be considered.

14. The cooperation of industry, public utilities, state agencies, and the federal government in the development of regional planning and utilization of energy, including fossil, nuclear, or other fuels in the coastal zone so that costs and benefits of alternative sites of development within and outside the coastal zone can be compared. Public authorities should be guided by both the urgency of protecting the environment and the demand for energy in the United States.

15. Public authorities at all levels should consider methods of increasing the carrying capacity of the coastal zone through technical and managerial means, utilizing airspace over land and water as well as submerged areas in order to achieve community goals.

16. The conduct of a comprehensive investigation by the federal government, in concert with state agencies, into the present management of coastal fisheries and an appraisal of the policies and costs of existing programs. The inquiry should include thorough study of the merits of limited entry to fisheries and lead to an effective national fisheries management policy under the aegis of the federal government. Fishery conservation on the high seas beyond national jurisdiction should be vigorously pursued by the federal government and the right of access to coastal resources by domestic fishermen must be preserved.

17. The federal government lead in establishing regional *Coastal Zone Centers*. However, academic institutions, private foundations and enterprises, state governments, and granting agencies of the federal government should greatly increase their support of both fundamental and applied research in the natural sciences, law, and the social sciences in order to feed original information into the regional Coastal Zone Center and/or to public agencies for improving the management of the coastal zone.

18. Adequate funds be provided for activities that have developed information whose results should be analyzed and published. Where useful, raw data exist that have not been subjected to adequate analysis, funds should be provided to complete the analysis and make the results available to users.

*To Provide Special Uses, the Coastal Zone Workshop Recommends—*

19. The immediate intact preservation of selected natural land and water areas in shoreline and estuary regions of the United States valued for their unique ecological character. Such areas should be severely restricted from any private or public coastal zone activity.

20. The protection from environmental degradation of those coastal wetlands and estuaries that are highly productive habitats, spawning areas, or nurseries for aquatic life or contain rare and endangered species. Only coastal activities that will not markedly degrade the diversity

and productivity of the existing ecological system in these areas should be permitted.

21. The monitoring of activities in the coastal zone not only for their effect upon the near-shore waters, but upon the seas and oceans. Chemicals, airborne and waterborne, from the coastal zone, as well as certain drilling, dredging, and dumping may cause serious harm to the marine environment and should be regulated to avoid serious damage to oceanic ecosystems.

