U.S. COMMISSION ON OCEAN POLICY

PART I
OUR OCEANS: A NATIONAL ASSET

CHAPTER 1:

RECOGNIZING OCEAN ASSETS AND CHALLENGES

America's oceans and coasts are priceless assets. Indispensable to life itself, they also contribute significantly to our prosperity and overall quality of life. Too often, however, we take these gifts for granted, underestimating their value and ignoring our impact on them. Then our use of the oceans becomes abuse, and the productive capacity of our marine resources is harmed.

That is why the nation needs, and should adopt, a comprehensive national ocean policy, implemented through an integrated and coordinated management structure that calls for greater participation and collaboration in decision-making. By rising to the challenge and addressing the many activities that are degrading the oceans and coasts, America can protect the ocean environment, while creating jobs, increasing federal revenues, enhancing security, expanding trade, and ensuring ample supplies of energy, minerals, healthy food, and life-saving drugs.

EVALUATING THE VAST WEALTH OF U.S. OCEANS AND COASTS

America is a nation surrounded by and reliant on the oceans. From the fisherman in Maine, to the homemaker in Oregon, to the businessperson in Miami, and even the farmer in Iowa, every American influences and is influenced by the sea. Our grocery stores are stocked with fish, our docks bustle with waterborne cargo, and millions of tourists visit our coastal communities each year, creating jobs and pumping dollars into our economy. Born of the ocean are clouds that bring life-sustaining rain to our fields and reservoirs, microscopic plankton that generate the oxygen we breathe, energy that fuels our industry and sustains our standard of living, and biological diversity that is unmatched on land. Careful stewardship of our ocean and coastal resources is imperative to conserve and enhance the financial, ecological, and aesthetic benefits we have come to rely upon and enjoy.

Economic and Employment Value

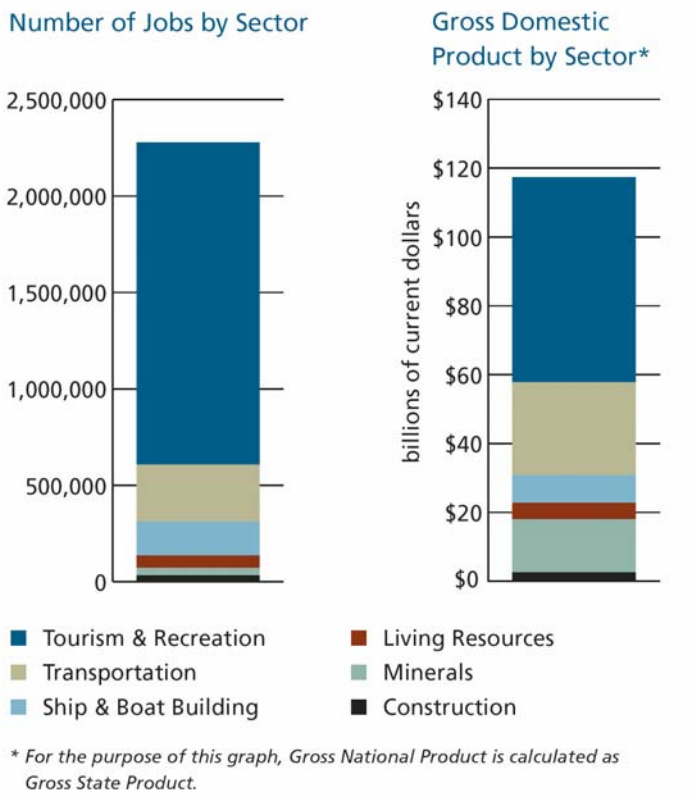
America's oceans and coasts are big business. The United States has jurisdiction over 3.4 million square nautical miles of ocean territory in its exclusive economic zone—larger than the combined land area of all fifty states. Millions of families depend on paychecks earned directly or indirectly from the resources of the sea. However, our understanding of the full economic value of these resources is far from complete. In contrast to sectors like agriculture on which the federal government spends more than $100 million a year for economic research, we do not make a serious effort to analyze and quantify the material contributions of our oceans and coasts. Standard government data are not designed to measure the complex ocean economy. They also ignore the intangible values associated with healthy ecosystems, such as clean water, safe seafood, healthy habitats, and desirable living and recreational environments. This lack of basic information has prevented Americans from fully understanding and appreciating the economic importance of our oceans and coasts.

To better inform the public and policy makers, the U.S. Commission on Ocean Policy partnered with the National Ocean Economics Project to produce an economic study, "Living Near…And Making A Living From...The Nation's Coasts And Oceans" (Appendix C). This study pulls together information from a wide range of sources and clearly shows that our oceans and coasts are among our nation's most vital economic assets.

In so doing, it distinguishes between the ***ocean economy,*** the portion of the economy that relies directly on ocean attributes, and the ***coastal economy,*** which includes all economic activity that takes place on or near the coast, whether or not that activity has a direct link to the sea.

In 2000, the ocean economy contributed more than $117 billion to American prosperity and supported well over two million jobs. Roughly three-quarters of the jobs and half the economic value were produced by ocean-related tourism and recreation (Figure 1.1). For comparison, ocean-related employment was almost 1½ times larger than U.S. agricultural employment in 2000, and total economic output was 2½ times larger than that of the farm sector.

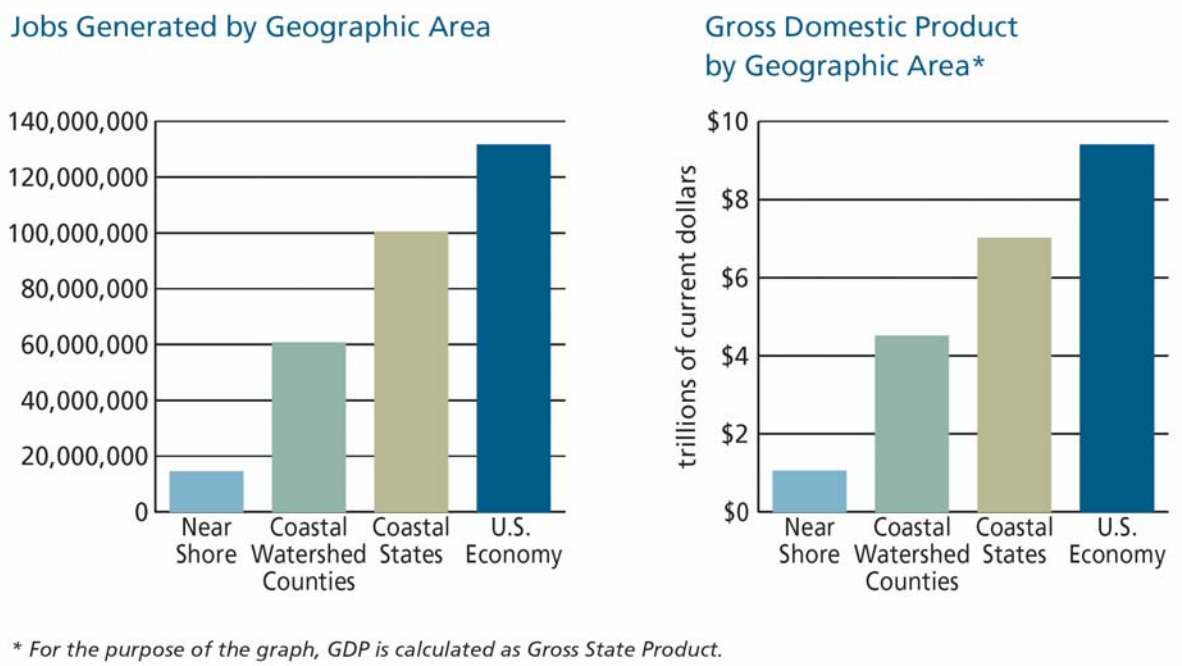
Figure 1.1. The Value of the Oceans



The ocean economy is the portion of the economy that relies directly on ocean attributes or that takes place on or under the ocean. The recreation and tourism sector is the largest in the ocean economy, providing approximately 1.6 million jobs.
Source: Living Near and Making a Living From the Oceans, Appendix C.

The level of overall economic activity within the coastal area is even higher (Figure 1.2). More than $1 trillion, or one-tenth, of the nation's annual gross domestic product (GDP) is generated within the *near shore* area, the relatively narrow strip of land immediately adjacent to the coast. Looking at all *coastal watershed counties*, the contribution swells to over $4.5 trillion, half of the nation's GDP. (For definitions of the different coastal zones, see the box on "Defining Coastal Areas.") The contribution to employment is equally impressive, with sixteen million jobs in the near shore zone and sixty million in coastal watershed counties. (See Appendix C for additional details.)

Figure 1.2. The Value of the Coasts



** For the purpose of the graph, GDP is calculated as Gross State Product.*

Coastal watershed counties, which account for less than a quarter of U.S. land area, are significant contributors to the U.S. economy. They are home to nearly half of the nation's jobs and generate a similar proportion of the nation's gross domestic product (GDP).
Source: Living Near and Making a Living From the Oceans, Appendix C.

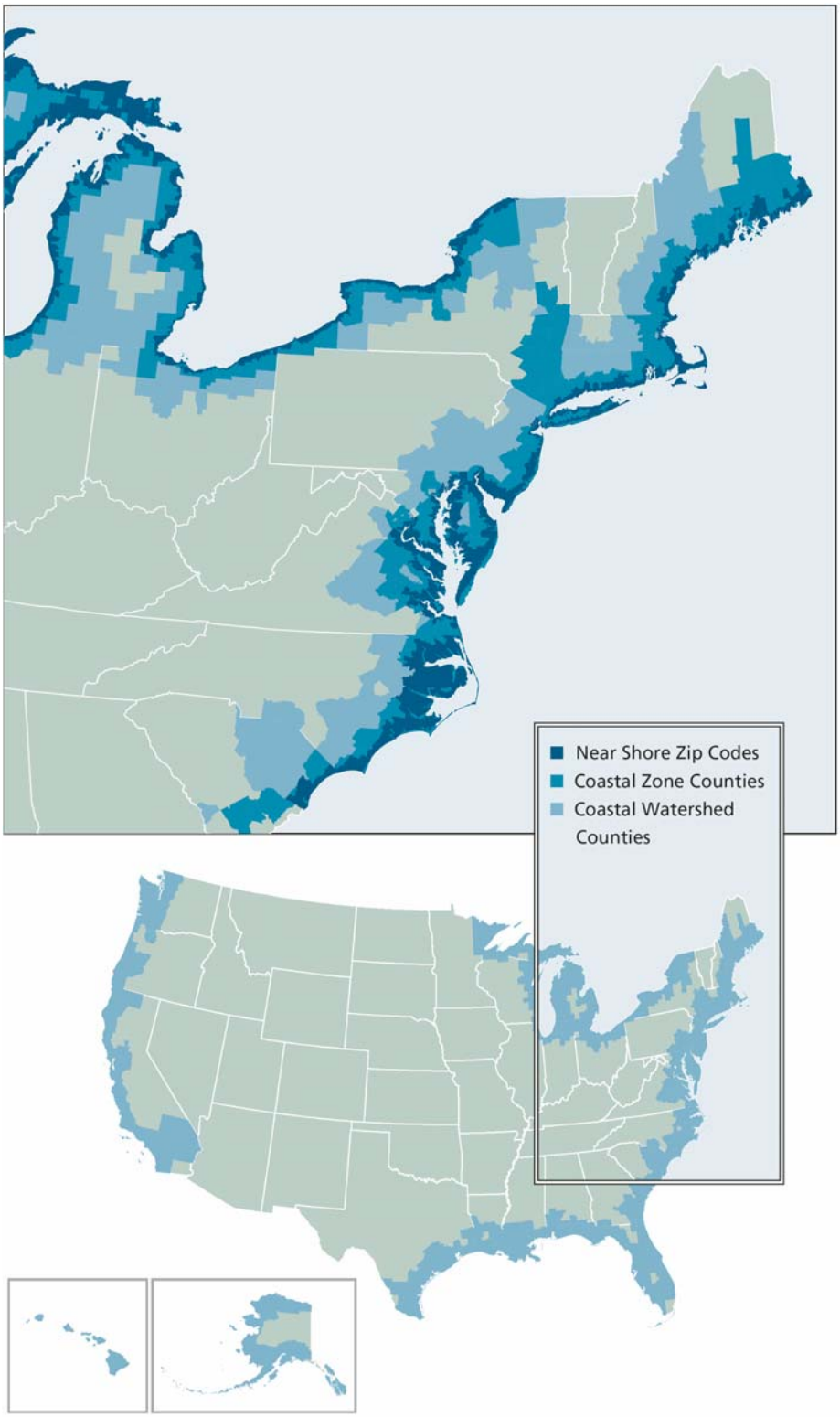
Even these remarkable numbers do not fully capture the economic contributions of coastal and ocean industries. More than thirteen million jobs are related to trade transported by the network of inland waterways and ports that support U.S. waterborne commerce.[1, 2] The oceans provide tremendous value to our national economy. Annually, the nation's ports handle more than $700 billion in goods,[3] and the cruise industry and its passengers account for $11 billion in spending.[4] The commercial fishing industry's total value exceeds $28 billion annually,[5] with the recreational saltwater fishing industry valued at around $20 billion,[6] and the annual U.S. retail trade in ornamental fish worth another $3 billion.[7] Nationwide retail expenditures on recreational boating exceeded $30 billion in 2002.[8] Governments at all levels, universities, and corporations provide many other jobs in oceans-related fields ranging from management and law enforcement to pollution prevention and research.

Our oceans and coasts are among the chief pillars of our nation's wealth and economic well-being. Yet our lack of full understanding of the complexity of marine ecosystems, and our failure to properly manage the human activities that affect them, are compromising the health of these systems and diminishing our ability to fully realize their potential.

Marine Transportation and Ports

The quality of life in America, among the best in the world, is made possible partly through access to goods and markets from around the globe. Our ports are endowed with modern maritime facilities and deep-water channels. Over the next two decades, overseas trade via U.S. ports, including the Great Lakes, is expected to double in volume; for some ports and types of trade, this increase will be even greater.[9] The expanding ferry and cruise line industries continue to provide economically valuable means of transportation for work and leisure. Marine transportation and ports also play a central role in national security as U.S. harbors and ports are major points of entry to our country.

Figure 1.3. The Coasts: From the Near Shore to Coastal Watersheds



Varying interpretations of the geographic area encompassed by the coast have hampered our ability to quantify the economic and ecologic importance of this dynamic region. Defining distinct regions, including the near shore, the coastal zone, and coastal watersheds, provides scientists and decision makers with clear boundaries as they develop policies and investigate coastal processes.

Source: Living Near and Making a Living From the Oceans, Appendix C.

Defining Coastal Areas

The coast is a widely used term encompassing numerous geographic subregions within the broad area where the land meets the sea. Areas of the coast identified in this and other chapters include coastal states, the coastal zone, coastal watershed counties, and the near shore (Figure 1.3). Some of these terms are defined in law, some agreed to by conventional usage, and others delineated specifically for use in this report.

Coastal States
This report uses the definition of a coastal state established by the Coastal Zone Management Act (CZMA). Under the CZMA, *coastal state* includes any state of the United States in, or bordering on, the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, Long Island Sound, or one or more of the Great Lakes, as well as Puerto Rico, the U.S. Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands and the Trust Territories of the Pacific Islands, and American Samoa. A total of thirty-five coastal states and territories fall under this definition.

Coastal Zone Counties
The term *coastal zone counties* refers to all counties that fall at least partly within a state's coastal zone, as defined under the CZMA. Under the CZMA, the coastal zone of most states with a federally approved coastal management program extends on its seaward side to 3 nautical miles offshore (the coastal zones of Texas and the west coast of Florida extend to 9 nautical miles, while those of Great Lakes states bordering Canada extend to the international boundary). The inland extent is determined by each participating state to include the upland region needed to manage activities with a direct and significant impact on coastal waters. Based on this definition, some states have designated their entire land area as the coastal zone, while others have specified certain political jurisdictions, distinct natural features, or geographic boundaries (Note: Although Illinois does not participate in the CZMA program, Cook and Lake Counties on Lake Michigan are considered coastal counties for the purposes of this report.)

Coastal Watershed Counties
Since approximately 1990, the National Oceanic and Atmospheric Administration has used a specific methodology,[10] also adopted by the U.S. Bureau of the Census after 1992, to define *coastal watershed counties.* The methodology combines the Census Bureau's delineation of counties and the U.S. Geological Survey's mapping of watersheds, identifying those counties with at least 15 percent of their land area in a coastal watershed. Based on this methodology, the United States has 673 coastal watershed counties: 285 along the Atlantic Ocean; 142 in the Gulf of Mexico region; 87 bordering the Pacific Ocean; and 159 fronting the Great Lakes.[11]

The Near Shore
To allow for more detailed analyses of economic conditions in the region closest to the coastline, this report defines the *near shore* as postal zip code areas that touch the shoreline of the oceans, Great Lakes, and major bays and estuaries.

Marine Fisheries

Sustainable sources of fish and shellfish are critical to the United States as a source of healthy food, financial revenue, and jobs. Americans consume more than 4 billion pounds of seafood at home or in restaurants and cafeterias every year. This represents about $54 billion in consumer expenditures.[12] As the population grows and problems such as heart disease and obesity continue to plague our nation, the desire and need for a relatively low-fat source of protein will rise. If every person in America followed the American Heart Association's recommendation to eat at least two servings of fish per week, the United States would need an additional 1½ billion pounds of seafood each year.

Worldwide, fish are even more important as a source of protein. More than 3 billion people derive at least one-fifth of their needed protein from freshwater and saltwater fish, and in some parts of the world fish provide the sole source of animal protein. The aquaculture industry, which has become the fastest growing sector of the world food economy, now supplies more than 25 percent of the globe's seafood consumption.[13,14]

In addition to their dietary value, fish are fundamental to the economy, culture, and heritage of many coastal communities in the United States. Fishing has deep cultural, even spiritual roots in many seafaring cities and villages where it has provided both a vocation and recreation for hundreds of years.

Offshore Energy, Minerals, and Emerging Uses

Valuable oil and mineral resources are found off our shores and in the seabed; they fuel our cars and our economy, provide materials for construction and shoreline protection, and offer exciting opportunities for the future. Currently, about 30 percent of the nation's oil supplies and 25 percent of its natural gas supplies are produced from offshore areas.[15] These energy supplies also provide a major source of revenue and tens of thousands of jobs. Since the start of the offshore oil and gas program, the Department of the Interior has distributed an estimated $145 billion to various conservation funds and the U.S. Treasury from bonus bid and royalty payments related to ocean energy.[16]

While advances in technology are enabling the offshore industry to drill deeper, cleaner, and more efficiently, increasing energy demands coupled with environmental concerns have spurred efforts to find alternative sources of power. Modern technology is creating the opportunity to use wind, waves, currents, and ocean temperature gradients to produce renewable, clean energy in favorable settings. Extensive gas hydrates in the seabed also hold promise as a potential—though not yet economically and environmentally feasible—source of energy.

In addition to energy, our offshore waters and the underlying seabed are also rich sources of non-petroleum minerals and sand. As easily accessible sand resources are depleted, offshore areas along the mid-Atlantic and Gulf coasts will be used increasingly to provide sand to restore and protect coastal communities, beaches, and habitat. Minerals, such as phosphates, polymetalic sulfides, and deposits that form around high-temperature vents, may also have commercial value some day if technical and economic barriers to their extraction can be overcome.

Interest in the ocean goes beyond the traditional resource industries. The telecommunications industry's investment in submerged cables will continue as international communication needs expand. There is also growing interest in other offshore uses including aquaculture, carbon dioxide sequestration, artificial reefs, conservation areas, research and observation facilities, and natural gas offloading stations.

Human Health and Biodiversity

The ocean provides the largest living space on earth and is home to millions of species, with perhaps as many more yet to be discovered. Within this vast biological storehouse, there exists a treasure trove of potentially useful organisms and chemicals that provide the foundation for a budding multibillion-dollar marine biotechnology industry.

Over the past two decades, thousands of marine biochemicals have been identified. Many have potential commercial uses, especially in the fields of health care and nutrition. For example, a chemical originally derived from a sea sponge is now the basis of an antiviral medicine and two anticancer drugs. Blood drawn from the horseshoe crab is used to detect potentially harmful toxins in drugs, medical devices, and water. A synthetic drug that copies the molecular structure of a salmon gland extract is one of the new treatments

available to fight osteoporosis. And coral, mollusk, and echinoderm skeletons are being tested as orthopedic and cosmetic surgical implants.

Scientists are also growing marine organisms in the laboratory and using them as models for physiological research. For example, they are using the damselfish to study cancer tumors, the sea hare and squid to investigate the nervous system, and the toadfish to investigate the effects of liver failure on the brain. In addition, bacteria and other organisms living in extreme deep-sea environments hold promise for the bioremediation of oil spills and other wastes.

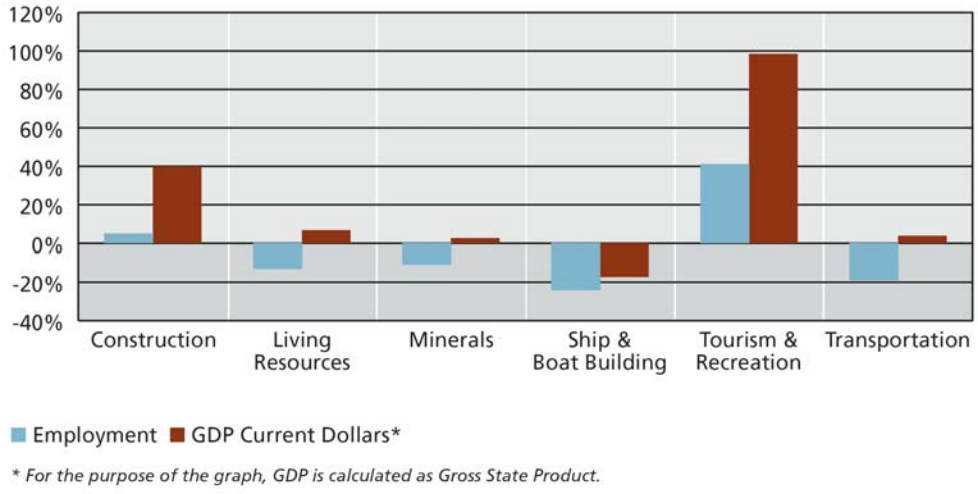
Remarkably, in this first decade of the 21st century about 95 percent of the world's ocean area remains unexplored. We have barely begun to comprehend the full richness and value of the diverse resources residing beneath the surface of the sea.

Tourism and Recreation

Every year, hundreds of millions of American and international visitors flock to the nation's coasts to enjoy the many pleasures the ocean affords, while spending billions of dollars and directly supporting more than a million and a half jobs. Millions of other tourists take to the sea aboard cruise ships, and still more visit the nation's aquariums, nautical museums, and seaside communities to learn about the oceans and their history. Tourism and recreation constitute by far the fastest growing sector of the ocean economy (Figure 1.4), extending virtually everywhere along the coasts of the continental United States, southeast Alaska, Hawaii, and our island territories and commonwealths. This rapid growth will surely continue as incomes rise, more Americans retire, and leisure time expands.

The value of ocean recreation, however, extends beyond the number of jobs and income produced, for there are benefits to society in the relaxation and exercise derived from a day at the beach or on the water. While there is no universally agreed upon method to calculate the economic value of such intangible benefits, several studies have attempted to do so. In southern California, just one beach, Santa Monica, generates more than an estimated $200 million in user values.[17] Two Ohio beaches generate annual values of $9.6 million. [18] Coral reefs are also a major source of recreational values, with those in Hawaii generating an estimated $360 million.[19]

Figure 1.4. The Shift from Goods to Services in the Ocean Economy



Between 1990 and 2000, the ocean economy followed national trends with a significant increase in the importance of service oriented activities. This trend is clearly illustrated by the dramatic increase in both employment and industry output associated with the tourism and recreation sectors of the ocean economy. Shifts in employment and revenue in the traditional goods producing sectors— minerals, living resources, transportation, ship and boat building— were impacted by changes in technology, national priorities, and the status of living and nonliving resources.
Source: Living Near and Making a Living From the Oceans, Appendix C.

Coastal Real Estate

It is no secret that people are attracted to our coasts. They want to buy property and raise their families near the ocean, and visit it during vacations and on the weekends. They want to fish, sail, swim, and listen to the waves crashing, and gaze upon the watery horizon at sunset. This has made areas close to the seashore some of the most sought-after property in our nation. Coastal watershed counties comprise less than 25 percent of America's land area, yet they are home to more than 50 percent of our population (Appendix C). Nine of our country's ten largest cities are located in coastal watershed counties.[20] Waterfront properties often sell or rent for several times the value of similar properties just a short distance inland. Even a decade ago, eighteen of the twenty wealthiest U.S. counties (ranked by per capita income) were coastal counties.[21] [22]

Nonmarket Values

Many of the most valuable assets of our oceans and coasts are not readily measurable by market-based accounting. Most dramatically, of course, we need the oceans to live and breathe. Other ocean assets, such as functioning coastal habitats, contribute to the health of our environment and the sustainability of commercial and recreational resources. Still others assist in what our nation's founders referred to as the "pursuit of happiness." It may not be possible to assign a dollar value to all the functions of the sea, but it is necessary to bear each in mind when determining the rightful priority of marine management and protection on the policy agenda of our nation.

Life Support and Climate Control

The oceans provided the cradle from which all life evolved. They sustain life through evaporation which fills the atmosphere with vapor, producing clouds and rain to grow crops, fill reservoirs, and recharge underground aquifers.

The oceans can absorb over a thousand times more heat than the atmosphere, storing and transporting it around the globe. They also hold sixty-five times more carbon than the atmosphere and twenty times more than terrestrial biomass,[23] a critical factor in counteracting the excess carbon dioxide emitted by human activities. Ocean carbon is used by the sea's immense population of phytoplankton to produce oxygen for our atmosphere. The oceans' dominant role in the cycling of water, heat, and carbon on the planet has profound, and poorly understood, impacts on global climate change.

Marine Habitat

Wetlands, estuaries, barrier islands, seagrass and kelp beds, coral reefs, and other coastal habitats are vital to the health of marine and estuarine ecosystems. They protect the shoreline, maintain and improve water quality, and supply habitat and food for migratory and resident animals. An estimated 95 percent of commercial fish and 85 percent of sport fish spend a portion of their lives in coastal wetlands.[24]

Coral reefs cover only about one-fifth of 1 percent of ocean area and yet provide home to one-third of all marine fish species and tens of thousands of other species. Coral reef fisheries yield 6 million metric tons of seafood annually, including one-quarter of fish production in developing countries.[25] In addition to their immense ecological and direct economic benefits, healthy marine habitats offer highly valuable recreation and tourism opportunities and enhance the worth of coastal real estate.

Exploration, Inspiration, and Education

Throughout history, the ocean's mysteries and our reliance on its resources have inspired great works of literature and art, spurred the human instinct to explore, and provided diverse forms of entertainment. Shipwrecks, prehistoric settlements, and other submerged sites document and preserve important historical

and cultural events, while offering unique opportunities for both professional archeologists and recreational divers and for educating the public.

With only about 5 percent of the ocean having been explored, the sea also offers something rare on Earth today: the unknown. Only thirty years ago, no one contemplated the existence of vast biological communities living in the deep sea at hydrothermal vents or the associated mineral-rich flows that form towers more than 50 feet high. Today, we are just beginning to learn about the immense scope of microbial life within and below the seabed.

The ocean provides an exciting way to engage people of all ages in learning and inspire academic achievement in the nation's schools. Using the oceans as a unifying theme, students can participate in research at sea, and teachers can connect mathematic and scientific principles with real-world problems, environmental issues, and the use of modern technology. From young to old, in formal and informal education, the ocean offers an unparalleled tool to improve the literacy and knowledge of our citizens. If we are sufficiently creative, we can produce an entire new generation of experts and cultivate a fresh appreciation and understanding that will deepen the stewardship ethic within our society.

International Leadership

Most nations border or have access to the sea, and all are affected by it. People everywhere have a stake in how well the oceans are managed, how wisely they are used, and how extensively they are explored and understood. For the United States, this means the oceans provide an ideal vehicle for global leadership. From international security, to ocean resource management, education, scientific research, and the development of ocean-related technology, the United States can gain respect by demonstrating exemplary policies and achievements at home and seeking to spread positive results through collaborative efforts around the world.

The "Fourth Seacoast"

As explained by Michael J. Donohue in testimony before the Commission (Appendix 2), the Great Lakes system enjoys global prominence, containing some 6.5 quadrillion gallons of fresh surface water, a full 20 percent of the world's supply and 95 percent of the United States' supply. Its component parts—the five Great Lakes—are all among the fifteen largest freshwater lakes in the world. Collectively, the lakes and their connecting channels comprise the world's largest body of fresh surface water. They lend not only geographic definition to the region, but help define the region's distinctive socioeconomic, cultural and quality of life attributes, as well.

An international resource shared by the United States and Canada, the system encompasses some 95,000 square miles of surface water and a drainage area of almost 200,000 square miles. Extending some 2,400 miles from its western-most shores to the Atlantic, the system is comparable in length to a trans-Atlantic crossing from the East Coast of the United States to Europe. Recognized in U.S. federal law as the nation's "fourth seacoast," the Great Lakes system includes well over 10,000 miles of coastline. The coastal reaches of all basin jurisdictions are population centers and the locus of intensive and diverse water-dependent economic activity. Almost 20 percent of the U.S. population and 40 percent of the Canadian population resides within the basin.

UNDERMINING AMERICA'S OCEAN AND COASTAL ASSETS

Human ingenuity and ever-improving technology have enabled us to harvest—and significantly alter—the ocean's bounty. Our engineering skills have allowed us to redirect the course of rivers, deflect the impacts of waves, scoop up huge quantities of fish, and transform empty shorelines into crowded resort communities. Yet the cumulative effects of these actions threaten the long-term sustainability of our ocean and coastal

resources. Through inattention, lack of information, and irresponsibility, we have depleted fisheries, despoiled recreational areas, degraded water quality, drained wetlands, endangered our own health, and deprived many of our citizens of jobs. If we are to adopt and implement an effective national ocean policy, we must first understand and acknowledge the full consequences of failing to take action.

Degraded Waters

Despite some progress, America's ocean and coastal ecosystems continue to show signs of degradation, thereby compromising human health, damaging the economy, and harming marine life. In 2001, 23 percent of the nation's estuarine areas were impaired for swimming, fishing, and supporting marine species.[26] Meanwhile, pollution could jeopardize the safety of drinking water for millions of people living near or around the Great Lakes.

Excess Nutrients

The oversupply of nitrogen, phosphorus, and other nutrients in coastal ecosystems is one of our nation's most widespread pollution problems. Runoff from agricultural land, animal feeding operations, and urban areas, along with discharges from wastewater treatment plants, storm sewers, and leaky septic systems, adds nutrients to waters that eventually enter the sea.

All told, more than eighty of our bays and estuaries show signs of nutrient overenrichment, including oxygen depletion, loss of seagrass beds, and toxic algal blooms.[27] And not all of these excess nutrients come from local sources. The Gulf of Mexico's "dead zone" is the result of cumulative drainage from the Mississippi–Atchafalaya River Basin, which includes all or parts of thirty states.[28] In addition, atmospheric deposition from agriculture, power plants, industrial facilities, motor vehicles, and other often distant sources accounts for up to 40 percent of the nitrogen entering estuaries.[29, 30]

Other Contaminants

A 2003 National Research Council report found that every year, more than 28 million gallons of oil from human activities enter North American waters. Land-based runoff accounts for well over half of this. Much smaller amounts of oil enter our waterways from tanker and barge spills and from recreational boats and personal watercraft. [31]

Pollution from sewage treatment plants has been reduced as the result of tighter regulation during the past thirty years, but concerns remain about the release of untreated human pathogens, pharmaceuticals, toxic substances, and chlorinated hydrocarbons. In 2002, more than 12,000 beach closings and swimming advisories were issued across the nation, most due to the presence of bacteria associated with fecal contamination. The number of such actions continues to rise,[32] costing many millions of dollars a year in decreased revenues for tourism and recreation and higher costs for health care.

Harmful Algal Blooms

For reasons not yet clearly understood, harmful algal blooms are occurring more frequently both within America's waters and worldwide. The consequences are particularly destructive when the algae contain toxins.

Marine toxins afflict more than 90,000 people annually across the globe and are responsible for an estimated 62 percent of all seafood-related illnesses. In the United States, contaminated fish, shellfish, and other marine organisms are responsible for at least one in six food poisoning outbreaks with a known cause, and for 15 percent of the deaths associated with these incidents.[33] In the last two decades, reports of gastrointestinal and neurological diseases associated with algal blooms and waterborne bacteria and viruses have increased. [34] Though seafood poisonings are probably underreported, they also seem to be rising in incidence and geographic scope.[35]

Harmful algal blooms cost our nation an average of $49 million a year[36] due to fisheries closures, loss of tourism and recreation, and increased health care and monitoring expenses.

Sediment Contamination

A study conducted at more than 2,000 sites representing over 70 percent of the nation's total estuarine area (excluding Alaska) found that 99 percent of the sediments tested contained five or more toxic contaminants at detectable levels. More than 600 sites had contamination levels high enough to harm fish and other aquatic organisms.[37] Because some chemicals tend to bind to particles and thus accumulate in sediments, bottom-dwelling and bottom-feeding organisms are especially at risk. As sediment-bound pollutants enter these organisms and move up through the food web, larger animals and humans are also affected. Excess sediments can also cause harm by smothering stationary bottom-dwelling marine communities.

Compromised Resources

Fishery declines, degraded coastal habitats, and invasive species are compromising our ability to meet current and future demands for healthy, productive marine resources.

Fishery Declines

Experts estimate that 25 to 30 percent of the world's major fish stocks are overexploited,[38] and a recent report indicates that U.S. fisheries are experiencing similar difficulties. Of our nation's 259 major fish stocks—representing 99 percent of total commercial landings—roughly 25 percent are either already overfished or experiencing overfishing.[39] The same report indicates that the status of 650 other fish stocks—most of which are not subject to commercial fishing pressure—is unknown, limiting both our understanding of the overall state of the nation's fisheries and of their role in the marine ecosystem.

Declining fish populations are the result of overfishing, the unintentional removal of non-targeted species (known as bycatch), habitat loss, pollution, climate change, and uneven management. The cumulative impacts of these factors is serious. As fishing boats turn to smaller, less valuable, and once discarded species, they are progressively "fishing down the food web," thereby causing changes in the size, age structure, genetic makeup, and reproductive status of fish populations. This seriously compromises the integrity of marine ecosystems, the ecological services they provide, and the resources upon which Americans rely.

Although U.S. fishery management has been successful in some regions, failures elsewhere have resulted in substantial social and economic costs. For example, the collapse of the North Atlantic cod fishery in the early 1990s resulted in the loss of an estimated 20,000 jobs and $349 million.[40, 41] In the Northwest, decreasing salmon populations have cost 72,000 jobs and more than $500 million.[42] This tally does not begin to assess the social and psychological impacts these events have had on individuals, families, and communities for whom fishing has been a tradition for generations.

Questions also exist about how best to manage our growing marine aquaculture industry. This industry is vital to increase seafood supplies, but its potential impact on the ocean environment and wild populations of fish and shellfish present serious concerns. These include the discharge of wastes and chemicals, the spread of disease or genetic changes resulting from the escape of farmed species, the demand for wild-caught fish as aquaculture feed, and the appropriation of sensitive habitats to create aquaculture facilities.

Coastal Habitat Loss

Since the Pilgrims first arrived at Plymouth Rock, the lands that now comprise the United States have lost over half of their fresh and saltwater wetlands—more than 110 million acres.[43] California has lost 91 percent of its wetlands since the 1780s.[44] And Louisiana, which currently is home to 40 percent of the coastal wetlands in the lower forty-eight states, is losing 25–35 square miles of wetlands each year.[45]

Pollution, subsidence, sea level rise, development, and the building of structures that alter sediment flow all contribute to the problem. With the loss of the nation's wetlands, shorelines are becoming more vulnerable to erosion, saltwater is intruding into freshwater environments, flooding is on the rise, water quality is being degraded, and wildlife habitat is being fragmented or lost.

The nation is also losing thousands of acres of seagrass and miles of mangrove and kelp forests. More than 50 percent of the historical seagrass cover has been lost in Tampa Bay, 76 percent in the Mississippi Sound, and 90 percent in Galveston Bay.[46] Extensive seagrass losses have also occurred in Puget Sound, San Francisco Bay, and along Florida's coasts.

Coral reef habitats are also increasingly under siege. Recent research suggests that direct human disturbances and environmental change are two major causes of harm to coral reefs, although a host of other factors also contribute. Many reefs, particularly those within range of growing human populations, are under threat of destruction as evidenced by dramatic declines in Florida, the Caribbean, and parts of Hawaii.[47, 48] Coral reef declines are exacerbated by cumulative impacts, such as when overfishing, coral bleaching, and disease decrease a reef's resilience. As the reefs disappear, so do the fish they harbor and the millions of dollars in jobs and economic revenue they provide.

Invasive Species

Across the nation and throughout the world, invasive species of plants and animals are being intentionally and unintentionally introduced into new ecosystems, often resulting in significant ecological and economic impacts. We know that over 500 non-native species have become established in coastal marine habitats of North America and that hundreds can be found in a single estuary.[49] Asian and European shore crabs inhabit the coasts of New England and California, damaging valuable fisheries. A massive horde of zebra mussels has assaulted the Great Lakes, clogging power plant intakes and fouling hulls, pilings, and navigational buoys. And in the Chesapeake Bay, an alien pathogen has contributed to the decline of the native oyster population.[50]

Most non-native marine animals and plants are introduced through the discharge of ships' ballast water and holding tanks. At least 7,000 different species of marine life are transported around the world every day, and every hour some 2 million gallons of ballast water arrive in U.S. waters carrying at least a portion of this immense fleet of foreign organisms.[51, 52] Further contributors to the spread of invasive species include the aquarium trade, fisheries-related activities, floating marine debris, boating, navigational buoys, and drilling platforms. Strains on coastal environments caused by other factors may make them even more vulnerable to the spread of non-native species.

The economic impact of invasive species can be substantial. From 1989 to 2000, zebra mussels alone caused between $750 million and $1 billion in losses to natural resources and damage to infrastructure in the Great Lakes. California has spent more than $2 million to control and monitor the spread of the Mediterranean green seaweed *Caulerpa taxifolia* and more than $3 million investigating the impacts of Atlantic cordgrass on the Pacific Coast. Invasive species can also cause significant ecological damage by outcompeting native species, altering local food webs, and reducing the resources available for other organisms.[53]

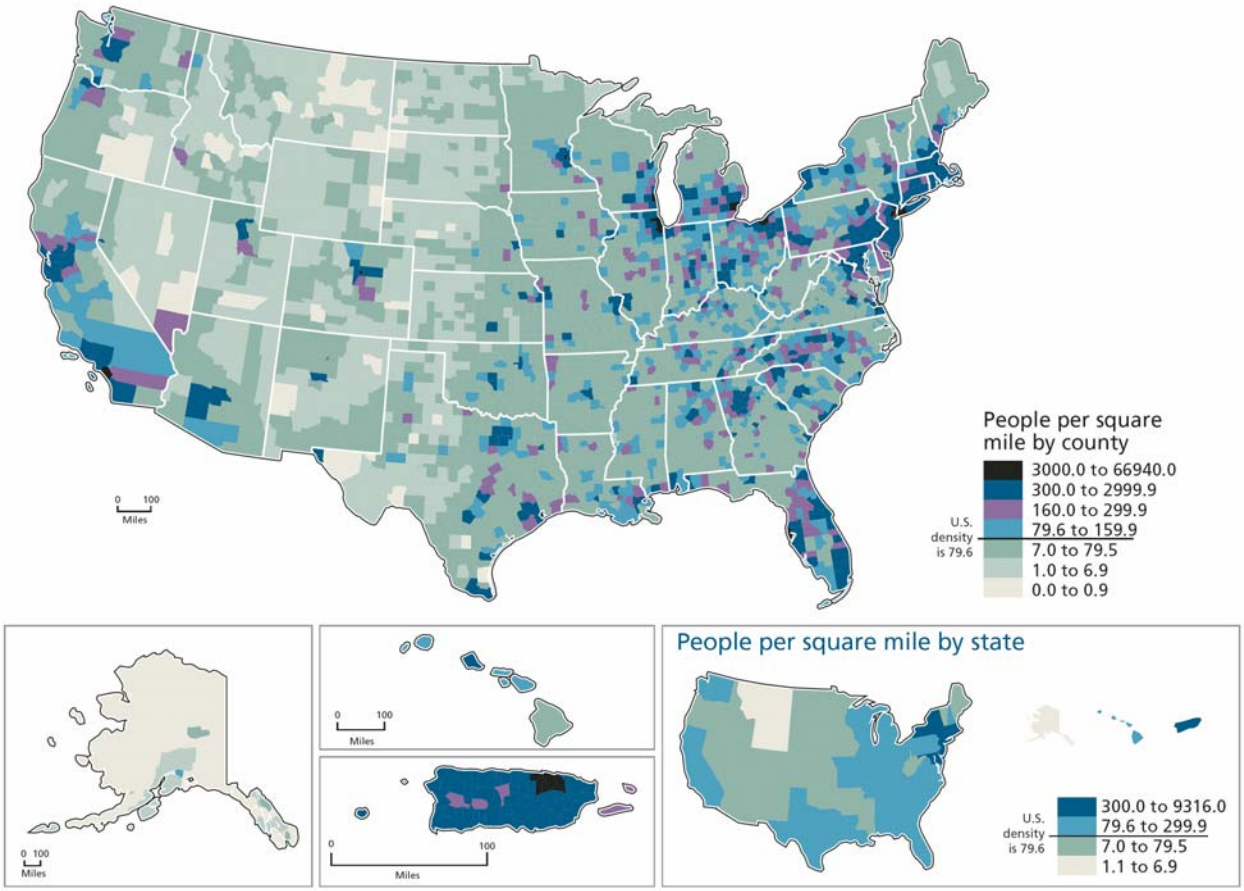
Conflicts Between Man and Nature

As population density has risen in coastal watersheds, so has environmental stress. Coastal planning and management polices implemented over the past thirty years have limited, but not prevented, harmful impacts—both incremental and cumulative—on the marine ecosystem.

Coastal Population Growth and Land Use

Contrary to popular perception, the coasts have experienced a relatively stable rate of population growth since 1970; coastal watershed counties representing 25 percent of the nation's land area have continued to support approximately 52 percent of the U.S. population over the past three decades (Appendix C). Between 1970 and 2000, the population of coastal watershed counties grew by 37 million people (Appendix C) and is projected to increase by another 21 million by 2015. [54] At that point, the U.S. coasts will have absorbed more than 58 million additional residents since 1970—more than 1.1 million a year. This steady influx of people into a relatively small area has already created coastal population densities that are on average two to three times higher than that of the nation as a whole (Figure 1.5).

Figure 1.5. Population Density Peaks Near the Shore



As shown by the 2000 U.S. Census, population density is generally highest in coastal counties, including counties surrounding the Great Lakes. General population growth and increasing population density in coastal counties reflects the attraction of the coast but also results in increased environmental impacts on coastal ecosystems.
Source: U.S. Census Bureau, Census 2000 <www.census.gov> (Accessed March, 2004).

The environmental impacts of rising population density in the coastal zone have been magnified by a relative shift in population and housing development away from expensive shoreline property and toward the upland

reaches of coastal watersheds. This has had the effect of expanding environmental consequences over larger geographic areas and has eroded the health of ecosystems and resources throughout coastal watersheds.

Most development profoundly changes the landscape. Impervious materials such as concrete or asphalt typically cover 25–60 percent of the land surface in medium-density, single-family-home residential areas, and more than 90 percent in strip malls, urban areas, and other commercial sites.[55] Research indicates that nearby water bodies can become seriously degraded when more than 10 percent of a watershed is covered by roads, parking lots, rooftops, and similar surfaces.[56] A one-acre parking lot produces sixteen times the volume of runoff that comes from a one-acre meadow.[57] Expanding coastal sprawl can also destroy natural habitats, thus compromising the environment's ability to provide food and refuge for wildlife or supply ecosystem services, such as maintaining water quality.

These concerns are exacerbated by the fact that land is being developed for housing at more than twice the rate of population growth.[58] This is partly the result of a decline in the size of the average American household from 3.14 people in 1970 to 2.59 people in 2000.[59] Near shore areas also experience spurts of temporary population growth—from commuters, vacationers, day-tourists and others—creating a robust demand for seasonal housing. The result is pressure for development in near shore areas accelerating at a rate far greater than might be expected based simply on population trends.

A less apparent, but still important contributor to developmental pressures is the increasing rate of overall economic growth that is occurring in near shore areas. Although population and housing are moving upstream within coastal watersheds, economic growth has been occurring more rapidly—and more intensely—along the near shore. This growth has tended to focus on the trade and service industries, which use more land per unit of output than other types of activity. Thus, it is important to understand the significance of the growing recreation and tourism industry and the relative impact its related businesses are having on the coast, in addition to managing coastal population growth.

Natural Hazards

As the nation's shores become more densely populated, people and property are increasingly vulnerable to costly natural hazards. Before 1989, no single coastal storm had caused insured losses greater than $1 billion.[60] Since then, at least ten storms have resulted in such losses, including Hurricane Andrew, with insured losses of $15.5 billion and total economic losses estimated at $30 billion (in 1992 dollars).[61, 62]

Coastal erosion, storm surges, tsunamis, and sea level rise are serious threats to people living and working along the shore, particularly in low-lying areas. Roughly 1,500 homes and the land on which they are built are lost to erosion each year, with annual costs to coastal property owners expected to average $530 million over the next several decades.[63] In some instances, American engineering capability has improved protection against natural hazards along the coast; in others, however, it has made us more vulnerable. The loss of wetlands and other shoreline vegetation increases susceptibility to erosion and flooding. The installation of seawalls, groins, and other coastal armoring structures can alter patterns of sediment and current flow, eventually accelerating erosion, rather than preventing it.

Climate Change

Average global temperatures have been rising over the last several decades. Scientists believe these changes are probably due primarily to the accumulation of greenhouse gases in Earth's atmosphere from human activities, although natural variability may also be a contributing factor.[64] The Intergovernmental Panel on Climate Change reports that the average near-surface temperature of the Earth increased by about 1°F between 1861 and 1990, but is expected to increase by another 2.5 – 10.4°F by the end of this century.[65] As oceans warm, the global spread and incidence of human diseases, such as cholera and malaria, may also increase.[66, 67] Marine organisms that are sensitive to temperature must either alter their geographic distribution or face extinction. Already, changing ocean conditions in the North Pacific have altered ecosystem

productivity and have been associated with poor ocean survival of young salmon and modifications in the composition of near shore fish populations.[68]

One of the most immediate phenomena associated with increasing global temperatures has been a change in average sea level, which is estimated to have risen by 4–8 inches during the 20th century. By 2100, sea level is projected to rise by another 4–35 inches.[69] Although the exact amount and rate of the increase are uncertain, the fact that the ocean will continue to expand is not. As this occurs, low-lying coastal regions and island territories will be particularly vulnerable to flooding and storms. In the Pacific, for example, entire archipelagos have maximum elevations of only a few meters above sea level, leaving both human communities and natural ecosystems in danger. This vulnerability is compounded by the concentration of human activities along the water's edge, the point of greatest risk. Many island jurisdictions are already facing problems associated with long-term sea level rise, including saltwater contamination of fresh water sources, coastal erosion, damage to natural barriers such as coral and mangroves, and loss of agricultural sites and infrastructure. Saltwater intrusion has rendered aquifers on the Marshall Islands unusable, and ocean waters regularly flood the airport. A steady increase in sea level rise could cause whole islands to disappear.

Polar regions are exhibiting dramatic signs of change due to rising temperatures, with thinning ice caps and melting glaciers. The average thickness of sea ice in the Arctic has decreased by almost 10 feet over the last thirty to forty years.[70] Dramatic changes are also occurring in Arctic permafrost, with potentially significant economic and ecological impacts.[71] In the tropics, coral reef diseases and bleaching are occurring more frequently, and coral growth may be inhibited by increasing concentrations of dissolved carbon dioxide in the sea.[72]

The transport and transformation of heat, carbon, and many other gases and chemicals in the ocean play a central role in controlling, moderating, and altering global climate. In fact, research into ancient climate cycles suggests that change can actually occur much more rapidly than once expected.[73] Rather than the scenario of gradual surface temperature increases often envisioned for the next century, sudden shifts in polar ice and ocean circulation could result in drastic temperature changes occurring within a decade or less.[74]

The specter of abrupt change, and a growing awareness of the impacts climate change could have on coastal development, terrestrial and marine populations, and human health, calls for a significant improvement in climate research, monitoring, assessment, and prediction capabilities.

Acting Today for Tomorrow's Generations

For centuries, Americans have been drawn to the sea. We have battled the tides, enjoyed the beaches, and harvested the bounty of our coasts. The oceans are among nature's greatest gifts to us. The responsibility of our generation is to reclaim and renew that gift for ourselves, for our children, and—if we do the job right—for those whose footprints will mark the sands of beaches from Maine to Hawaii long after ours have washed away.

The nation's ocean and coastal assets are worth hundreds of billions of dollars to society and untold more to the Earth and its complex ecosystems. Although losses in some areas have been significant and continue, in other areas sound policy and sustained investments have slowed or reversed harmful trends. There is every reason to believe that wise actions taken today, based on the best available science, can restore what has been lost and create benefits even greater than we see today. But to obtain these benefits, our nation's leaders must take immediate steps to formulate a coherent, comprehensive, and effective national ocean policy. Implementation of the far-reaching recommendations offered throughout this report can halt the losses and help restore, protect, and enhance America's ocean assets.

[1] U.S. Department of Transportation. *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. Washington DC: U.S. Government Printing Office, 1999.
[2] Bureau of Transportation Statistics. *2003 Pocket Guide to Transportation*. Washington, DC: U.S. Department of Transportation, 2003.
[3] U.S. Department of Transportation. *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. Washington DC: U.S. Government Printing Office, 1999.
[4] U.S. Department of Transportation. *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. Washington DC: U.S. Government Printing Office, 1999.
[5] National Marine Fisheries Service. *Fisheries of the United States, 2002*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2003.
[6] American Sportfishing Association. *Sportfishing in America: Values of Our Traditional Pastime*. Alexandria, VA, 2002.
[7] National Marine Fisheries Service. *Fisheries of the United States, 2001*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2002.
[8] National Marine Manufacturers Association. http://www.nmma.org/facts/boatingstats/2002/files/retailexpenditures.asp Accessed January 22, 2004.
[9] U.S. Department of Transportation. *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. Washington DC: U.S. Government Printing Office, 1999.
[10] National Oceanic and Atmospheric Administration, National Ocean Service, Management and Budget Office, Special Projects Unit.
[11] National Oceanic and Atmospheric Administration. *Spatial Patterns of Socioeconomic Data from 1970 to 2000: A National Research Dataset Aggregated by Watershed and Political Boundaries*. Silver Spring, MD, 2001.
[12] National Marine Fisheries Service. *Fisheries of the United States, 2001*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2002.
[13] "How Fish Farming Could Feed the World." *Financial Times*, January 13, 2004.
[14] Food and Agriculture Organization of the United Nations. *The State of World Fisheries and Aquaculture*. Rome, Italy: United Nations, 2002.
[15] Minerals Management Service. *Our Ocean Role.* Washington DC: U.S. Department of Interior, Fall 2003.
[16] Minerals Management Service. <http://www.mrm.mms.gov/Stats/pdfdocs/coll_off.pdf> Accessed January 22, 2004.
[17] Hanemann, M., L. Pendleton, and D. Layton. Summary Report on the Beach Expenditure Module. Southern California Beach Valuation Project. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service, 2001.
[18] Sohngen, B., et al. *The Value of Lake Erie Beaches*. Columbus, OH: Ohio State University Sea Grant Program, 1999.
[19] Cesar, H.P., et al. *Economic Valuation of the Coral Reefs of Hawaii: Final Report (FY 2001–2002)*. Hawaii Coral Reef Initiative Research Program. Honolulu, HI: University of Hawaii, 2002.
[20] Bureau of the Census. *Demographic Trends in the 20th Century*. Washington, DC: U.S. Department of Commerce, November 2002.
[21] Culliton, T.J. *Population, Distribution, Density and Growth: NOAA's State of the Coast Report*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 1998.
[22] The H. John Heinz III Center for Science, Economics and the Environment. *The Hidden Costs of Coastal Hazards: Implications for Risk Assessment and Mitigation.* Washington, DC, 2000.
[23] Field, J.G., G. Hempel, and C.P. Summerhayes. *Oceans 2020: Science, Trends, and the Challenge of Sustainability*. Washington DC: Island Press, 2002.
[24] U.S. Environmental Protection Agency. *National Coastal Condition Report*. EPA #620R01005. Washington, DC, 2001.
[25] National Oceanic and Atmospheric Administration, Office of Protected Resources. <http://www.nmfs.noaa.gov/prot_res/PR/coralhome.html> Accessed January 22, 2004.
[26] U.S. Environmental Protection Agency. *National Coastal Condition Report*. EPA #620R01005. Washington, DC, 2001.
[27] Bricker, S.B., et al. *National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation's Estuaries*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service Special Projects Office and the National Centers for Coastal Ocean Science, 1999.
[28] Committee on Environment and Natural Resources. *Integrated Assessment of Hypoxia in the Northern Gulf of Mexico*. Washington, DC: National Science and Technology Council, 2000.
[29] Paerl, H.W. "Coastal Eutrophication and Harmful Algal Blooms: The Importance of Atmospheric Deposition and Groundwater as "New" Nitrogen and Other Nutrient Sources." *Limnology and Oceanography* 42 (1997): 1154–65.
[30] Paerl, H.W., and R. Whitall. "Anthropogenically-Derived Atmospheric Nitrogen Deposition, Marine Eutrophication and Harmful Algal Bloom Expansion: Is There a Link?" *Ambio* 28 (1999): 307–11.
[31] National Research Council. *Oil in the Sea III: Inputs, Fates and Effects*. Washington, DC: National Academy Press, 2003.
[32] Dorfman, M. *Testing the Waters XII: A Guide to Water Quality at Vacation Beaches*. New York, NY: National Resources Defense Council, July 2002.
[33] Fleming, L.E., et al. "The Epidemiology of Seafood Poisoning." In *Seafood and Environmental Toxins*, ed. Y.H. Hui, D. Kits, and P.S. Stanfield, 287–310. New York, NY: Marcel Dekker, 2001.
[34] Epstein, P., et al. *Marine Ecosystems: Emerging Diseases as Indicators of Change*. Cambridge, MA: Harvard Medical School, 1998.
[35] Fleming, L.E., et al. "The Epidemiology of Seafood Poisoning." In *Seafood and Environmental Toxins*, ed. Y.H. Hui, D. Kits, and P.S. Stanfield, 287–310. New York, NY: Marcel Dekker, 2001.
[36] Anderson, D.M., et al. *Estimated Annual Economic Impacts from Harmful Algal Blooms (HABs) in the United States*. Technical Report WHOI-2000-11. Woods Hole, MA: Woods Hole Oceanographic Institute, 2000.
[37] The H. John Heinz III Center for Science, Economics and the Environment. *The State of the Nation's Ecosystems: Measuring the Lands, Waters, and Living Resources of the United States*. Washington, DC, 2002.
[38] Food and Agriculture Organization of the United Nations. *The State of World Fisheries and Aquaculture*. Rome, Italy: United Nations, 2002.

[39] National Marine Fisheries Service. *Annual Report to Congress on the Status of U.S. Fisheries—2002*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2003.
[40] Weber, P. *Net Loss: Fish, Jobs, and the Marine Environment*. Worldwatch Paper 120. Washington, DC: Worldwatch Institute, 1994.
[41] McGinn, A.P. *Rocking the Boat: Conserving Fisheries and Protecting Jobs*. Worldwatch Paper 142. Washington, DC: Worldwatch Institute, 1998.
[42] Pew Oceans Commission. *Socioeconomic Perspectives on Marine Fisheries in the United States*. Arlington, VA, 2003.
[43] Fretwell, J.D., J.S. Williams, and P.J. Redman. *National Water Summary on Wetland Resources*. USGS Water-Supply Paper 2425. Washington, DC: U.S. Geological Survey, 1996.
[44] Dahl, T.E. *Wetlands Losses in the United States: 1780s to 1980s*. Washington, DC, and Jamestown, ND: U.S. Fish and Wildlife Service and Northern Prairie Wildlife Research Center, 1990.
[45] National Wetland Research Center. *Louisiana Coastal Ecosystem*. USGS Fact Sheet #FS-015-00. Washington, DC: U.S. Geological Survey, 2000.
[46] Bookman, C.A., T.J. Culliton, and M.A. Warren. "Trends in U.S. Coastal Regions, 1970–1998." Addendum to *Trends and Future Challenges for U.S. National Ocean and Coastal Policy*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service, 1999.
[47] Wilkinson, C., ed. *Status of Coral Reefs of the World: 2000*. Queensland, Australia: Australian Institute of Marine Science, 2000.
[48] Pauly, D., et al. "Fishing Down Marine Food Webs." *Science* 279 (1998): 860–63.
[49] Ruiz, G.M. Written testimony before the U.S. House of Representatives, Committee on Science, Subcommittee on Environment, Technology, and Standards. June 20, 2002.
[50] Ruiz, G.M., et al. "Invasion of Coastal Marine Communities in North America: Apparent Patterns, Processes, and Biases." *Annual Review of Ecology and Systematics* 31 (2000): 481–531.
[51] Carlton, J.T., D.M. Reid, and H. van Leeuwen. *Shipping Study. The Role of Shipping in the Introduction of Nonindigenous Aquatic Organisms to the Coastal Waters of the United States (Other Than the Great Lakes) and an Analysis of Control Options*. The National Sea Grant College Program/Connecticut Sea Grant Project R/ES-6. Report #CG-D-11-95. Washington, DC, and Groton, CT: U.S. Department of Transportation and U.S. Coast Guard, 1995.
[52] Carlton, J.T. "The Scale and Ecological Consequences of Biological Invasions in the World's Oceans." In *Invasive Species and Biodiversity Management,* ed. O.T. Sandlund, P.J. Schei, and A. Viken. Dordrecht, Netherlands: Kluwer Academic Publishers, 1999.
[53] Carlton, J.T. *Introduced Species in the U.S. Coastal Waters: Environmental Impacts and Management Priorities*. Arlington, VA: Pew Oceans Commission, 2001.
[54] Bureau of the Census. "World Population Projections" <http://www.census.gov/cgi-bin/ipc/idbrank.pl> Accessed October 2, 2003.
[55] Natural Resources Defense Council. *Stormwater Strategies: Community Responses to Runoff Pollution*. New York, NY, 1999.
[56] Beach, D. *Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States*. Arlington, VA: Pew Oceans Commission, 2002.
[57] Schueler, T., and H.K. Holland. *The Practice of Watershed Protection*. Ellicott City, MD: Center for Watershed Protection, 2000.
[58] Beach, D. *Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States*. Arlington, VA: Pew Oceans Commission, 2002.
[59] Bureau of the Census. *United States Census 2001*. Washington, DC: U.S. Department of Commerce, 2001.
[60] Bookman, C.A., T.J. Culliton, and M.A. Warren. "Trends in U.S. Coastal Regions, 1970–1998." Addendum to *Trends and Future Challenges for U.S. National Ocean and Coastal Policy*. Silver Spring, MD: National Oceanic and Atmospheric Administration National Ocean Service, 1999.
[61] Institute for Business and Home Safety. *The Insured Cost of Natural Disasters: A Report on the IBHS Paid Loss Data Base*. Boston, MA, 1998.
[62] Pielke, Jr., R.A., and R.A. Pielke, Sr. *Hurricanes: Their Nature and Impacts on Society*. London: Wiley and Sons, 1997.
[63] The H. John Heinz III Center for Science, Economics and the Environment. *Evaluation of Erosion Hazards Summary*. Washington, DC, 2000.
[64] National Research Council. *Climate Change: An Analysis of Some Key Questions.* Washington, DC: National Academy Press, 2001.
[65] Houghton, J.T., et al., eds. *Climate Change 2001: The Scientific Basis*. New York, NY: Cambridge University Press and Intergovernmental Panel on Climate Change, 2001.
[66] National Research Council. *From Monsoons to Microbes: Understanding the Ocean's Role in Human Health*. Washington, DC: National Academy Press, 1999.
[67] Ibid.
[68] National Research Council. *The Bering Sea Ecosystem*. Washington, DC: National Academy Press, 1996.
[69] Houghton, J.T., et al., eds. *Climate Change 2001: The Scientific Basis*. New York, NY: Cambridge University Press and Intergovernmental Panel on Climate Change, 2001.
[70] Statement of G. Newton before the U.S. Commission on Ocean Policy, Appendix 2.
[71] U.S. Global Change Research Program.
<http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewalaska.htm> Accessed January 22, 2004.
[72] Harvell, C.D., et al. "Emerging Marine Diseases: Climate Links and Anthropogenic Factors." *Science* 285 (1999): 1505–10.
[73] Kennet, J.P., and L.C. Peterson. "Rapid Climate Change: Ocean Responses to Earth System Instability in the Late Quaternary." *JOIDES Journal* 28, no. 1 (2002): 5–9.
[74] National Research Council. *Abrupt Climate Change: Inevitable Surprises*. Washington, DC: National Academy Press, 2002.

CHAPTER 2:

UNDERSTANDING THE PAST TO SHAPE A NEW NATIONAL OCEAN POLICY

The phrase national ocean policy *encompasses a vast array of issues, each of which requires policy makers to answer some key questions: what goals do we want to achieve, what rules, if any, are to apply, and who is to formulate and enforce those rules? They must also be prepared to justify their decisions to a wide variety of interested people and find a way to place decisions about particular uses of the oceans into a larger framework so the results will be coherent and enduring. In considering how to craft such a framework for the future, the U.S. Commission on Ocean Policy reviewed the lessons of the past and listened closely to affected individuals around the country.*

OCEAN POLICY FROM WORLD WAR II TO THE OCEANS ACT OF 2000

Volumes have been written about the intricacies of ocean policy and its development in the United States. The following sections offer a brief glimpse of this history, setting the stage for the work of the U.S. Commission on Ocean Policy.

Formative Years

U.S. ocean policy developed slowly and fairly consistently from the founding of the United States until the immediate aftermath of World War II. Since then, it has zigged and zagged in response to shifting public attitudes based on major events related to national security, the environment, and political philosophy. American policy—or more accurately the amalgamation of many policies—has been shaped by the nation's unique status as both the world's leading maritime power and the possessor of a long and rich shoreline, giving us a stake both in protecting freedom of navigation and in expanding the resource jurisdiction of coastal countries. Over time, our management of ocean issues has been roiled by conflicting interests of the federal and state governments, torn by tensions between short- and long-term needs, blurred by ideological disagreements, and complicated by the wide variety of uses we make of our vast and versatile—but also vulnerable—seas.

One ongoing challenge for policy makers has been to find the right balance between the exploitation of marine resources, whether living or nonliving, and the conservation of those resources and protection of the marine environment. Petroleum exploration, commercial fishing, and marine mammal protection are just three of the arenas where this drama has played out. The United States has also shown a tendency to swing back and forth between internationalism and unilateralism—at times working with other countries to shape global rules, and at other times asserting the right to establish our own rules outside of, or in advance of, the global consensus.

The nation's primary maritime concerns have been to preserve the right to free navigation while asserting jurisdiction over fishing and law enforcement in U.S. waters. In a letter from Secretary of State Thomas Jefferson to the governments of Britain and France in 1793, the United States officially claimed authority over a 3 nautical mile territorial sea. Over the next century and a half, the federal government's role in the oceans was limited primarily to the activities of the U.S. Navy, the U.S. Coast Guard, and the Coast and Geodetic Survey; the promotion of the U.S. Merchant Marine; and diplomatic negotiations over access to the rich fishing grounds off the North Atlantic coast and the taking of fur seals in the North Pacific and Bering Sea.

Interestingly, the problem of depleted fish stocks, often assumed to be a recent development, is not new. In 1871, the federal government established the Office of the Commissioner of Fish and Fisheries to study the dilemma. Warnings have been issued and various remedies proposed periodically ever since. In 1882, the first U.S. research vessel built exclusively for fisheries and oceanographic research entered service, and for the next thirty-nine years the 234-foot USS *Albatross* plied waters around the globe.

It was not until after World War II that a process referred to as *enclosure of the oceans* began in earnest. In contrast to the traditional view of the oceans as belonging to everyone (and therefore to no one), a movement to extend the rights of coastal states gathered momentum. Among the factors driving this trend was competition for oil and gas. On September 28, 1945, President Truman issued a proclamation asserting control over the natural resources of the continental shelf beneath the high seas adjacent to the territorial waters of the United States. In 1947, the Supreme Court decision in *United States* v. *California* awarded the federal government jurisdiction over all U.S. ocean resources from the tidemark seaward. This judgment, highly unpopular in coastal regions, led to the passage of the Submerged Lands Act of 1953, which returned resource jurisdiction within the 3 nautical mile territorial sea to coastal states. A companion bill enacted in the same year, the Outer Continental Shelf Lands Act, authorized the Secretary of the Interior to lease federal areas of the continental shelf for oil and gas exploration and development.

From Sputnik to Stratton

On October 4, 1957, the Soviet Union launched Sputnik, the world's first space satellite. This was one of several major events that would sharply alter the direction of U.S. ocean policy during the last half of the twentieth century. The show of Soviet prowess shocked America, spurring national resolve. It seemed suddenly as if every arena of activity, from the construction of intercontinental ballistic missiles to the training of athletes for the Olympic high jump, had become a test of dueling national wills. The foremost areas of competition were technology and science.

In 1959, the National Research Council released a report that recommended doubling the federal government's commitment to oceanography, building a new research fleet, and forging stronger partnerships with academic institutions.[1] The recommendations served as the basis for ocean policy under President Kennedy and attracted strong support from such influential senators as Warren Magnuson of Washington who warned, in the spirit of the times, "Soviet Russia aspires to command the oceans and has mapped a shrewdly conceived plan, using science as a weapon to win her that supremacy."[2]

This era of scientific enthusiasm and advancement saw the Navy and the National Science Foundation (NSF) take on critical roles in developing U.S. ocean capabilities. The post World War II period brought significant Navy investment in basic research into ocean processes, resulting in the development of most of today's oceanographic instruments. The Navy's ocean data holdings have been called the crown jewels of global oceanography, and its investment in operational ocean infrastructure has contributed greatly to U.S. ocean capability and influence in international ocean affairs. NSF came into existence at the end of World War II, largely due to the recognition that support for basic research was essential to national well being. Since that time, NSF has increasingly become the leader in support for ocean research and related infrastructure.

Through their investments in basic and applied research, operations, education and infrastructure, NSF and the Navy helped create a robust and influential ocean research community in the United States.

In the 1960s, faith in the power of science was at its apogee. Said *Time* magazine:

> U.S. scientists and their colleagues in other free lands are indeed the true 20th century adventurers, the explorers of the unknown, the real intellectuals of the day, the leaders of mankind's greatest inquiry into the mysteries of matter, of the earth, the universe and of life itself. Their work shapes the life of every human presently inhabiting the planet, and will influence the destiny of generations to come.[3]

In this context, the appetite for exploring the unknown was seemingly insatiable, applying not only to outer space but also to inner space—the mysterious depths of the sea. In addition to ongoing investments in ocean research by the Navy and NSF, in 1966 Congress created a National Sea Grant College program within NSF, based on the long-established model of Land Grant colleges. After a modest beginning, Sea Grant evolved into a popular initiative within the marine science community and the public and became a prime source of support for research in marine-related subjects outside oceanography, including fisheries and law.

Support grew for the creation of an independent national ocean agency, a watery counterpart to the National Aeronautics and Space Administration. To prepare the way, Congress approved the Marine Resources and Engineering Development Act, signed by President Johnson on June 17, 1966. The Act included a declaration of U.S. policy, the formation of a national council chaired by the Vice President, and the establishment of a presidential Commission on Marine Science, Engineering and Resources. Julius Stratton, president emeritus of the Massachusetts Institute of Technology and chairman of the Ford Foundation was named as chair of that Commission.

During the next two years, the Stratton Commission's fifteen members and four congressional advisers conducted hearings and held meetings in every coastal region of the country. In January 1969, the Commission issued its report, *Our Nation and the Sea*, containing 126 recommendations.[4] The report had a catalytic impact for several reasons. It was the first truly comprehensive study of American ocean policy. It went beyond oceanography to examine a wide range of marine issues, including: the organization of the federal government; the role of the ocean in national security; the potential economic contributions of oil, gas, and other marine resources; the importance of protecting coastal and marine environments; and the need to promote American fisheries. Some recommendations were never realized (such as building offshore nuclear power plants), but others comprised the foundation for a new era in U.S. ocean policy, leading most directly to creation of the National Oceanic and Atmospheric Administration (NOAA) in 1970 and the enactment of the Coastal Zone Management Act (CZMA) in 1972.

The Stratton Commission called for the centralization of federal civilian ocean management efforts within a single new agency—envisioning a NOAA that would be independent and in charge of virtually every nonmilitary aspect of maritime policy. This did not happen. The White House budget office opposed the establishment of an independent agency, the Secretary of Transportation was unwilling to give up the Coast Guard, and the Maritime Administration remained separate. So when NOAA was born on July 9, 1970 (via Reorganization Plan #4), its prospects for thriving within the bureaucracy were slim. Lodged within the U.S. Department of Commerce, it lacked cabinet status, independence, a congressional charter, and control over many federal marine activities. NOAA did, however, become a center of federal ocean expertise, bringing together nine programs from five departments, including the Environmental Sciences Services Administration, the Bureau of Commercial Fisheries, and the Sea Grant program.

The impact of the Stratton Commission report was magnified by its timeliness. Once again, events were occurring that would guide the direction of ocean policy, this time toward greater environmental awareness. In 1966, seismic tests in the Georges Bank fishing grounds caused an explosion that halted fishing for three weeks and prompted calls for a ban on oil and gas activity in the area. In January 1969, Union Oil's Platform A in the Santa Barbara Channel blew out, spilling some 3 million gallons of oil, killing marine life, and affecting more than 150 miles of shoreline. The images of soiled beaches, oil-soaked birds, and belly-up fish generated widespread public concern and contributed to the enactment of a law that would profoundly affect the approach of the federal government to natural resources of every description—the 1969 National Environmental Policy Act (NEPA).

Years of Activism

To an extent not seen before or since, the political climate between 1969 and 1980 was ripe for initiatives to expand the federal role in ocean and environmental management. The Stratton report had sounded the trumpet, calling upon "Congress and the President to develop a national ocean program worthy of a great sea nation." Segments of the American public, aroused by the Santa Barbara oil spill and the inaugural Earth Day on April 22, 1970, lent support to a new generation of activist environmental organizations demanding federal action. Members of Congress, empowered by internal reforms that enlarged staffs and somewhat weakened the seniority system for selection of committee chairs, were eager to play a policy-making role. Internationally, the United Nations Conference on the Human Environment met in Stockholm in 1972, a milestone for the environmental movement. Both at home and overseas, the oceans were caught up in the larger pro-environment trend.

As a result, the stewardship ethic embodied by NEPA—the idea that the government should study, plan, and offer the opportunity for public comment before acting—was applied to the oceans. This principle was at the heart of the new law dealing with America's increasingly populous coastal zone. The CZMA constituted a marriage of federal activism and states' rights. Entirely voluntary, the program offered grants to states to help develop and implement coastal management plans tailored to local needs but reflecting broad national interests. To encourage states to enforce their plans, the federal government agreed to honor them as well. This pledge to make federal actions affecting the coastal zone consistent with state plans (referred to as the federal consistency provisions) was novel and would, at times, prove controversial.

Other major ocean-related legislation enacted during this period included measures to improve our nation's water quality, regulate ocean dumping, designate marine sanctuaries, prohibit the taking of marine mammals, protect endangered species, license deep-water ports, promote aquaculture, and encourage the development of ocean thermal energy conversion as a renewable source of power. The most dramatic expansion of federal ocean activity, however, resulted from enactment of the Fishery Conservation and Management Act, later renamed the Magnuson–Stevens Fishery Conservation and Management Act. According to its terms, on March 1, 1977, American fisheries jurisdiction was extended from 12 to 200 nautical miles, an expansion in area roughly equal to the size of the continental United States. This action reflected a triumph of America's interest in championing the rights of coastal nations to control resources over its interest in defending the maximum degree of freedom on the high seas.

The legislation was prompted by the anger of U.S. fishermen, especially in the North Atlantic and off Alaska, regarding the presence on their traditional fishing grounds of massive foreign factory trawlers scooping tons of fish from the sea. The trawlers, many from the Soviet Union, were able to operate at all hours, even in harsh weather, catching fish and freezing them on the spot. By the end of the 1960s, America had dropped from second to sixth in its share of world fishery catch and a substantial segment of the U.S. commercial fishing industry was in deep trouble. Compared to the large, modern, efficient Soviet trawlers, most U.S. vessels were small and inefficient. Although the U.S. Department of State urged Congress to delay action

pending the outcome of global negotiations on the U.S. Law of the Sea Convention, those discussions were going slowly, and the pressure to act became overwhelming.

The management scheme created by the Magnuson–Stevens Act was imaginative, yet complicated: Regional Fishery Management Councils were appointed and required to develop and submit plans for managing particular species to the Secretary of Commerce for approval. The intention was to harness regional expertise in the national interest, make full use of scientific data, and give the industry a voice in designing the means of its own regulation. The Coast Guard was tasked with achieving the law's main selling point—foreigner fishing fleets out, Americans in—and various measures were developed to encourage new investment in the U.S. fishing fleet. The explicit intent of the statute was to prevent overfishing, rebuild overfished stocks, and realize the full potential of the nation's fishery resources. Despite the challenge of persuading fiercely independent fishermen to accept restrictions on their activities, there was much optimism in the early years that the Magnuson–Stevens Act's ambitious goals would be met.

Meanwhile, policy makers were coping with another pressing concern: the Arab oil embargo triggered by the 1973 Middle East war had a direct impact on the lives of millions of Americans. Heating costs soared, and the simple act of filling up at the local gas station turned into a nightmare. The country's vulnerability to disruptions caused by dependence on uncertain supplies of foreign oil became a major economic and national security issue. In response, the Nixon administration proposed a massive expansion of outer Continental Shelf (OCS) oil and gas leasing to include frontier areas off the Atlantic, Gulf, and Pacific coasts. This proposal ran counter to the pro-environmental currents then circulating, and posed a challenge to lawmakers searching for a way to address ecological and energy supply concerns simultaneously. The result was the OCS Lands Act Amendments of 1978, the product of three years of bipartisan legislative effort, designed to encourage leasing subject to new planning requirements, more rigorous environmental standards, and measures to ensure that the views of state and local governments were taken into account.

The many ocean-related laws spawned during the 1970s addressed urgent needs, introduced creative management concepts, and multiplied the scope of federal responsibility. But they lacked an overarching vision critical to a coherent national ocean policy. NOAA was neither equipped nor authorized to set priorities across more than a small portion of the spectrum of marine activities, and most of the laws enacted were aimed at a single purpose or ocean use, and implemented with little reference to others.

The inherent difficulty of managing diverse activities over a vast geographic area, and the incremental manner in which the federal ocean regime was assembled, inevitably resulted in fragmentation. The three presidents who served between 1969 and 1981 did not provide strong policy direction on ocean issues. In the absence of such direction, neither the executive branch nor Congress was structured in a way that fostered a comprehensive approach to the oceans. No federal department could claim the lead, and crosscutting legislative initiatives were referred to multiple congressional committees where differing perspectives tended to cancel each other out. Notwithstanding the Stratton Commission's call for centralization, by 1980 federal responsibility for ocean-related programs was distributed among ten departments and eight independent agencies.

Contention and Stalemate

The 1981 inauguration of President Reagan altered the direction of America's approach to maritime issues. For the first time since the days of Presidents Kennedy and Johnson, the White House was the source of clear policy direction for the oceans. While the consensus in the 1970s had favored a larger federal role, the new administration wanted to reduce the size of government. While legislation approved in the 1970s called for a steady increase in investments to achieve marine-related goals, the Reagan philosophy called for cutbacks. While the mood of the 1970s leaned heavily in the direction of environmental protection, the new administration favored a minimum of restrictions on the private sector.

U.S. Department of the Interior (DOI) Secretary James Watt departed from the earlier practice of offering limited offshore areas for energy leases and proposed instead opening practically the entire outer continental shelf simultaneously. During his first eighteen months in office, 265 million acres were offered for lease. At the same time, the administration proposed to eliminate funding for the Sea Grant and Coastal Zone Management programs, reduce investments in oceanographic research, and privatize a number of functions carried out by NOAA. Congress responded to Secretary Watt's proposals by including a provision in the 1982 DOI appropriations bill that prohibited it from leasing certain offshore areas. This practice of legislating moratoria soon took hold, leading eventually to 50 nautical mile no-leasing buffer zones along much of the Atlantic and Pacific coasts. President Reagan's successors later removed almost all new areas from leasing consideration through 2012. As the OCS program gyrated from one extreme to the other, the balanced approach Congress sought when amending the OCS Lands Act in 1978 was never fully tested, despite the still-compelling need for secure energy supplies.

The Reagan administration also changed the tenor of American ocean policy internationally. Since 1958, efforts had been underway to negotiate a convention on the law of the sea spelling out a global consensus on such matters as freedom of navigation, fisheries jurisdiction, continental shelf resources, and the width of the territorial sea. At the request of less developed nations, the third round of negotiations, begun in 1973, included consideration of an elaborate international regime to govern the mining of minerals from the deep seabed in areas outside the jurisdiction of any country. Advocates argued that minerals found beneath international waters should be considered part of the Common Heritage of Mankind, with revenues shared on a global basis. The Reagan administration, with support from many in both parties of Congress, argued that the deep seabed was a frontier area that should be open to exploration and exploitation without a requirement to share profits. When the Law of the Sea negotiations concluded in 1982, the United States was one of the few countries to vote against the resulting convention.

Despite this, the administration soon took two steps recognizing provisions in the convention that the United States did support. In 1983, President Reagan declared a 200 nautical mile exclusive economic zone (EEZ), changing what had been a continental shelf and fishery resource jurisdictional system into an exclusive regime governing access to all ocean and continental shelf resources, including the water column itself (though not impeding the right to free navigation). Five years later, the United States officially extended its territorial sea from 3 to 12 nautical miles. The administration, however, did not offer any significant plans for exploring or exercising a new management role in these areas.

The architects of ocean-related programs in the 1970s built on the foundation of the Stratton Commission, creating a multidimensional framework for the management of America's stake in the oceans. The Reagan administration saw much of that framework as unrelated to—or even interfering with—the core government functions of national defense and fostering free enterprise. The result was an ongoing clash that ratified the vision of neither side, producing a stalemate. The administration did not succeed in eliminating programs such as Sea Grant and Coastal Zone Management, but it was able to hold the line or reduce financial support for most of them. Funding for NOAA's ocean research, for example, declined from $117.9 million in 1982 to $40.7 million in 1988. Many managers, earlier preoccupied with implementing their programs, spent much of the 1980s trying to save them.

Search for Coherence

Recent years have been characterized neither by the rapid growth in federal ocean activity characteristic of the 1970s, nor by the change in course that took place in the 1980s. The *EXXON Valdez* oil spill in Prince William Sound, occurring a few months after President George H.W. Bush took office in 1989, helped revive support for environmentally protective legislation. The spill led directly to enactment of the 1990 Oil Pollution Act, mandating double hulls for tankers carrying oil in U.S. waters by 2015 and setting liability

standards for oil spills. That same year, amendments to the CZMA clarified that OCS lease sales are subject to the federal consistency provisions of the statute. Frustrated by the persistence of marine pollution, Congress continued to search for effective ways to reduce pollution from nonpoint sources, such as urban runoff and agriculture. Mounting alarm about the depletion of major groundfish stocks, despite two decades of management under the Magnuson–Stevens Act, led to the 1996 Sustainable Fisheries Act, designed to prevent overfishing.

On the world stage, the United Nations Conference on Environment and Development—the Earth Summit—held in Rio de Janeiro in 1992 made recommendations in seven program areas dealing with the conservation of marine and coastal resources. It also produced the United Nations Framework Agreement on Climate Change (ratified by the United States in 1992) and the United Nations Convention on Biological Diversity (which the United States has not ratified). In 1994, an agreement was reached addressing U.S. concerns on implementing the deep seabed mining provisions of the United Nations Convention on the Law of the Sea, and the Clinton administration sent the treaty to the Senate for advice and consent, where it still lingers, though it is in force internationally.

The dominant trend in U.S. ocean policy in the 1990s was a growing sense of dissatisfaction with the ad hoc approach. Much had changed since the Stratton Commission report was issued in 1969. New opportunities, such as offshore aquaculture and marine biotechnology, were being held back by the lack of an appropriate management structure to guide development. Pressures on ocean and coastal areas continued to intensify and new threats loomed, such as sea level rise and increased storm frequency attributable to global climate change, as well as puzzling and sometimes deadly algal blooms. The link between science and policy that had seemed so essential and exciting to the nation in the 1960s now suffered from insufficient investment and high-level neglect. On many key ocean issues, debate was leading not to consensus, but rather to heightened disagreements that could not be resolved under existing laws and arrangements, and often to litigation.

The sense of partial paralysis was strengthened by the existence through most of the decade of divided government, with different parties in control of the White House and Congress. None of the many centers of power was able to lead with sustained success. In search of coherence, panels assembled by the National Research Council, as well as expert groups brought together under other auspices, recommended a detailed study of the nation's ocean-related laws, programs, activities, and needs.

Consensus for Change

Since the publication of the Stratton Commission's report, seventeen Congresses and seven presidents have created, expanded, and remodeled the current framework of laws governing ocean and coastal management. At last count, more than 60 congressional committees and subcommittees oversee some 20 federal agencies and permanent commissions in implementing at least 140 federal ocean-related statutes.

Recognition of the growing economic importance and ecological sensitivity of the oceans and coasts, our responsibility to future generations, and the inadequacies of the current management regime set the stage for enactment of the Oceans Act of 2000 (Appendix A), establishing the U.S. Commission on Ocean Policy in August 2000. Although publicly financed, the Commission is fully independent and is charged with carrying out the first comprehensive review of marine-related issues and laws in more than thirty years to assist the nation in creating a truly effective and farsighted ocean policy.

In enacting the Oceans Act, Congress cited the pressing need for a coherent national system of ocean governance. Factors contributing to this need include rising coastal populations, increased competition for ocean space, demand for port facilities, the emergence of potential new ocean uses, the decline of vital commercial fishery stocks, unresolved debates over offshore energy and mineral development, the persistence

of marine pollution, the contamination of seafood, the loss of coastal wetlands, and the prospect that enhanced knowledge of the oceans will improve our ability to comprehend the causes of climate variability and other not yet fully grasped environmental threats.

The Commission was established because the nation is not now sufficiently organized legally or administratively to make decisions, set priorities, resolve conflicts, and articulate clear and consistent policies that respond to the wealth of problems and opportunities ocean users face. In the words of the Senate Committee on Commerce, Science and Transportation: "Today, people who work and live on the water, from fishermen to corporations, face a patchwork of confusing and sometimes contradictory federal and state authorities and regulations. No mechanism exists for establishing a common vision or set of objectives."[5]

In September 2001, a major event again altered the lens through which America views ocean policy. Terrorist attacks on U.S. soil resulted in the placement of a higher priority on maritime security issues. That very month, the Commission's initial organizational meeting was held. The Coast Guard was soon transferred to the new U.S. Department of Homeland Security. Meanwhile, partly as a result of the war on terror, constraints on the domestic discretionary part of the U.S. government's budget raised new questions not only about what U.S. ocean policy should be, but also about what policy choices the nation can afford.

LAUNCHING THE U.S. COMMISSION ON OCEAN POLICY

A Broad Mandate

The Commission was directed to address numerous challenging issues ranging from the stewardship of fisheries and marine life to the status of knowledge about the marine environment, as well as the relationships among federal, state, and local governments and the private sector in carrying out ocean and coastal activities. The Oceans Act requires that the Commission suggest ways to reduce duplication, improve efficiency, enhance cooperation, and modify the structure of federal agencies involved in managing the oceans and coasts.

With input from the states, a science advisory panel, and the public, the Commission was instructed to prepare a report presenting recommendations to the president and Congress on ocean and coastal issues for the purpose of developing a coordinated and comprehensive national ocean policy. The Oceans Act states that this national ocean policy should promote protection of life and property, responsible stewardship of ocean and coastal resources, protection of the marine environment and prevention of marine pollution, enhancement of marine commerce, expansion of human knowledge of the marine environment, investment in technologies to promote energy and food security, close cooperation among government agencies, and preservation of U.S. leadership in ocean and coastal activities. In developing its recommendations, the Commission must give equal consideration to environmental, technical feasibility, economic, and scientific factors.

Specifically, the Commission's report was required to include the following elements:

- an assessment of ocean facilities including vessels, people, laboratories, computers, and satellites (Appendix 5);
- a review of the cumulative effect of federal laws (Appendix 6);
- a review of the supply and demand for ocean and coastal resources;
- a review of the relationships among federal, state, and local governments and the private sector;
- a review of the opportunities for investment in new products and technologies;
- recommendations for modifications to federal laws or the structure of federal agencies; and
- a review of the effectiveness of existing federal interagency policy coordination.

Finally, the Oceans Act requires the Commission to solicit comments from the governors of coastal states and include those comments in its final report. This preliminary report has been created specifically to fulfill that purpose.

The Commission Members

In accordance with guidelines set forth in the Oceans Act, in July 2001 President George W. Bush appointed sixteen citizens knowledgeable in ocean and coastal activities to serve on the U.S. Commission on Ocean Policy. The President selected twelve members from lists submitted by the Senate Majority Leader, the Senate Minority Leader, the Speaker of the House of Representatives, and the Minority Leader of the House. The remaining four members were chosen directly by the President. The Commission members (listed at the front of this report) come from positions and diverse professional backgrounds in: federal, state and local governments; private industry; and academic and research institutions involved in marine-related issues. Admiral James D. Watkins, USN (Retired), was elected chairman by his fellow commissioners at the first Commission meeting.

How the Commission Did Its Work

This report was developed after careful consideration of materials gathered during public meetings, through public comment, from existing literature, and through input of science advisors and other noteworthy experts. The input received from all of these sources served to guide the development of this report.

Regional Meetings

Because of the vast scope of topics the Commission was required to address, it sought input from a wide range of experts across the country. After two initial organizing meetings in Washington, D.C., the Commission heard testimony on ocean and coastal issues in nine different areas around the United States during a series of regional meetings and related site visits. The Commission was required to hold at least one public meeting in Alaska, the Northeast (including the Great Lakes), the Southeast (including the Caribbean), the Southwest (including Hawaii and the Pacific Territories), the Northwest, and the Gulf of Mexico. To obtain information from an even greater segment of U.S. marine-related interests, the commissioners held three additional regional meetings. The commissioners also learned about important regional issues through site visits (Table 2.1).

The public meetings provided government agencies, nongovernmental organizations, industry, academia, and the public the opportunity to directly discuss ocean and coastal concerns with the Commission. Commissioners held dialogues with invited speakers and sought comments from members of the public to gain insight into issues and opportunities facing each region, and to solicit recommendations for Commission consideration. The regional meetings highlighted relevant case studies and regional models with potential national applicability.

Invited panelists were selected based on their expertise on the topics highlighted at each meeting, with a strong effort to maintain a balance of interests and gain perspectives from all sectors (Figure 2.2). Four additional public meetings were held in Washington, D.C., after completion of the regional meetings. At the last few meetings, the commissioners publicly presented and discussed many of the policy options that served as the foundation for the Commission's recommendations. Overall during its fifteen public meetings, the Commission heard from some 445 witnesses, including over 275 invited presentations and an additional 170 comments from the public, resulting in nearly 1,900 pages of testimony (Appendices 1 and 2).

Table 2.1. Public and Regional Meetings of the U.S. Commission on Ocean Policy
The commissioners held fifteen public meetings and conducted seven regional site visits to examine a wide range of important issues and gain input from local, state, and regional ocean communities throughout the United States.

Washington, D.C.
September 17–18, 2001

Washington, D.C.
November 13–14, 2001

Southeast—Delaware to Georgia
January 14–16, 2002:
January 14: Regional site visits (Annapolis, MD; Charleston, SC)
January 15–16: Public meetings in Charleston, SC

Florida and the Caribbean
February 21–22, 2002:
February 21: Regional site visits (Puerto Rico; South Florida East Coast; West Coast, Tampa–Sarasota)
February 22: Public meetings in St. Petersburg, FL

Gulf of Mexico—Alabama to Texas
March 6–8, 2002:
March 6: Regional site visits (Texas A&M University, February 19; offshore New Orleans, LA; Stennis Space Center, MS)
March 7–8: Public meetings in New Orleans, LA

Southwest—California
April 17-19, 2002:
April 17: Regional site visits (San Diego and Monterey, CA)
April 18–19: Public meetings in San Pedro, CA

Hawaii and Pacific Islands
May 13–14, 2002:
May 13–14: Public meetings in Honolulu, HI

Northwest—Washington and Oregon
June 12–14, 2002:
June 12: Regional site visits (Olympia and Seattle, WA)
June 13–14: Public meetings in Seattle, WA

Northeast—New Jersey to Maine
July 22–24, 2002:
July 22: Regional site visits (southern New England; New York–New Jersey; northern New England)
July 23–24: Public meetings in Boston, MA

Alaska
August 21–23, 2002:
August 21–22: Public meetings in Anchorage, AK
August 23: Regional site visits (Dutch Harbor and Juneau, AK)

Great Lakes
September 23–25, 2002:
September 24–25: Public meetings in Chicago, IL

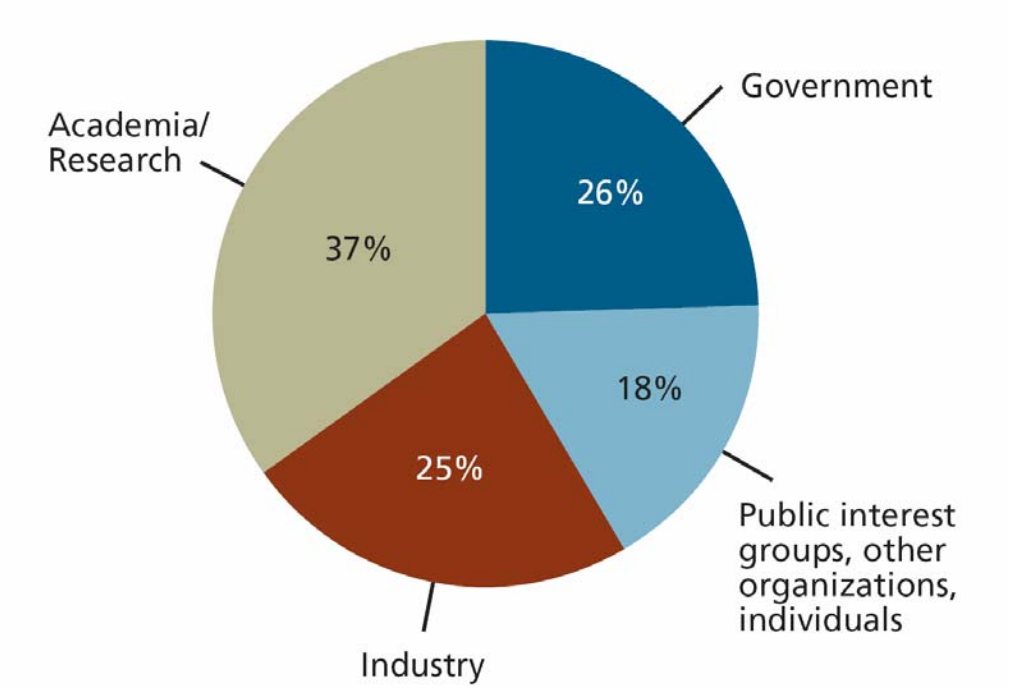
Washington, D.C.
October 30, 2002

Washington, D.C.
November 22, 2002

Washington, D.C.
January 24, 2003

Washington, D.C.
April 2–3, 2003

Figure 2.2. Invited Panelists Represented all Sectors of the Ocean Community



This breakdown of the panelists invited to present testimony before the U.S. Commission on Ocean Policy during its public meetings, held from September, 2001 to November, 2002, illustrates the breadth of input received.

Working Groups

During the first Commission meeting in September 2001, the commissioners agreed to establish four working groups in the areas of: Governance; Stewardship; Research, Education, and Marine Operations; and Investment and Implementation. These working groups were charged with reviewing and analyzing issues within their area and reporting their findings to the full Commission.

Based on extensive reviews of the testimony, public comments, background papers prepared by expert consultants, existing literature, and discussions with a broad cross-section of the marine-related community, the working groups identified key issues and outlined possible options for addressing them. The working groups shared their work with each other throughout the deliberative process to ensure thorough integration and coordination in developing the final Commission report and recommendations.

The Governance Working Group examined the roles of federal, state, and local governments as they relate to the oceans. It also assessed the management of the coastal zone and nonliving marine resources and provided options for improvement.

The Stewardship Working Group addressed living marine resources, pollution, and water quality issues and assessed the current status of ocean stewardship, the behavior of people with respect to the oceans, and incentives for responsible actions. The group concentrated on actions to achieve responsible and sustainable use of the ocean and its resources.

The Research, Education, and Marine Operations Working Group examined ocean and coastal research, exploration, air-ocean interaction research, education, marine operations, and related technology and facilities.

This group analyzed the current status in these areas to assess their adequacy in achieving the national goals set forth in the Oceans Act.

Finally, the Investment and Implementation Working Group discussed the new investment and implementation strategies needed to carry out the Commission's proposed ocean policy. This working group concentrated on answering the question, "Given the recommendations from the other working groups, what federal structures, processes, or investments are necessary to integrate, implement, and sustain the Commission's recommendations?"

Science Advisory Panel

The Oceans Act directed the Commission, with assistance from the National Academy of Sciences, to establish a multidisciplinary science advisory panel consisting of experts in living and nonliving marine resource issues from outside the federal government. The panel, listed at the front of this report, included many of the finest ocean science and marine policy practitioners and researchers in the nation and reflected the breadth of issues before the Commission. Panel members provided expert advice on a range of issues and reviewed draft materials to ensure the Commission's report was based on the best scientific information available.

Other Sources of Information

Throughout its work, the Commission continuously sought advice from experts on specific issues of concern through formal seminars and conferences, informal meetings and discussions, and preparation of background reports. Striving to maintain communication with all interested parties and to gain knowledge from a range of sources, the Commission also encouraged members of the public to submit information for the official record throughout the Commission's fact-finding and deliberative phases. An active Web site was maintained to facilitate public input.

As a result of the Commission's outreach efforts, more than 3,000 pages of information have been filed in the official Commission record. This vast wealth of accumulated information provided examples of successful approaches and formed the basis for the Commission's recommendations.

The Result

This report of the U.S. Commission on Ocean Policy, along with its extensive appendices, is the culmination of more than two years of discussion, deliberation, review, and refinement. It represents a consensus of the sixteen Commission members on the best course of action this nation should take to realize a coordinated and comprehensive national ocean and coastal policy. Meaningful change will require a reorientation of political, economic, and social attitudes and behaviors. Such change is likely to take time, but it must begin now if we are to reverse a continuing decline in the health and economic vitality of ocean and coastal waters.

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[1] National Research Council, Committee on Oceanography. Oceanography 1960–1970. Washington, DC: National Academy of Sciences, 1959.
[2] Wenk, Jr., E. The Politics of the Ocean. Seattle, WA, and London, England: University of Washington Press, 1972.
[3] "1960: U.S. Scientists [Men of the Year]." Time Magazine. January 2, 1961.
[4] U.S. Commission on Marine Science, Engineering, and Resources. Panel Reports of the Commission on Marine Science, Engineering, and Resources. Washington, DC: U.S. Government Printing Office, 1969.
[5] U.S. Congress. Senate. Committee on Commerce, Science, and Transportation. Oceans Act of 2000. 106th Cong., 2d sess. S. Rept. 106301. May 23, 2000.

CHAPTER 3: SETTING THE NATION'S SIGHTS

The first step in any call for change should be to paint a picture of the desirable end result and specify the principles that will guide the changes. For U.S. ocean policy to improve, it must be based on a positive vision for the future, broad guiding principles, and translation of those principles into an effective governance system with working policies and programs. In keeping with the latest scientific understanding about the world, management based on ecosystems rather than political boundaries should be at the heart of any new ocean policy framework. Success also depends on greatly improved public awareness of the relationship between the oceans and human existence, the connections among the land, air, and sea, the balance of benefits and costs inherent in using ocean and coastal resources, and the role of governments and citizens as ocean stewards.

IMAGINING A BRIGHTER FUTURE

The potential benefits associated with oceans and coasts are vast; however, the problems we face in protecting them and realizing their full potential are numerous and complex. There is a growing awareness of the connectivity within and between ecosystems and the impacts of human activities on the marine environment. The need for change emerged as a compelling theme at each of the U.S. Commission on Ocean Policy's public meetings—change not only in management and policies, but also in public awareness and education, and in the use of science and technology. However, before attempting to reform any system, it is important to identify the desired result. What would an improved ocean management system achieve? What would be its most important attributes? How would the oceans and coasts benefit from this improved system? What would the world look like after such reforms were realized?

In the desirable future, the oceans and coasts would be clean, safe, and sustainably managed. The oceans would contain a high level of biodiversity and contribute significantly to the economy, supporting multiple beneficial uses, including food production, development of energy and mineral resources, recreation, transportation of goods and people, and the discovery of novel life-saving drugs and other useful products. The coasts would be attractive places to live, work and play, with clean water and beaches, easy public access, vibrant economies, safe bustling harbors and ports, adequate roads and services, and special protection for sensitive habitats. Beach closings, toxic algal blooms, proliferation of invasive species, and vanishing native species would be rare. Better land use planning and improved predictions of severe weather and other natural hazards would save lives and money.

In the desirable future, management of the oceans and coasts would follow ecosystem boundaries, looking at interactions among all elements of the system, rather than addressing isolated areas or problems. In the face of scientific uncertainty, managers would balance competing considerations and proceed with caution. Ocean governance would be effective, participatory, and well coordinated among government agencies, the private sector, and the public.

An improved ocean governance framework would recognize the critical importance of good information and provide strong support for physical, biological, social, and economic research. Investments would be made in the tools and technologies needed to conduct this research: ample, well-equipped surface and underwater research vessels; reliable, sustained satellites; state-of-the-art computing facilities; and innovative sensors that withstand harsh ocean conditions. A widespread network of observing and monitoring stations would provide data for research, planning, marine operations, timely forecasts, and periodic assessments. Scientific findings and observations would be translated into practical information, maps, and products used by decision makers and the public.

Better education would be a key element of the desirable future, with the United States once again joining the top ranks in math, science, and technology achievement. An ample, well-trained, and motivated workforce would be available to study the oceans, set wise policies, apply technological advances, engineer new solutions, and teach the public about the value and beauty of the oceans and coasts throughout their lives. As a result of this lifelong education, people would understand the links among the land, sea, air, and human activities and would be better stewards of the nation's resources.

Finally, the United States would be a leader and full partner globally, sharing its science, engineering, technology, and policy expertise, particularly with developing countries, to facilitate the achievement of sustainable ocean management on a global level.

The Commission believes this vision is practical and achievable.

BUILDING OCEAN POLICY ON SOUND GUIDING PRINCIPLES

To achieve the vision, national ocean policy should be guided by a set of overarching principles. Although existing ocean policies address specific issues or resources with varying degrees of success, there are no broad principles in place to guide the development and implementation of new policies, provide consistency among the universe of different policies, and assess the effectiveness of any particular policy. The fundamental principles that should guide ocean policy include the following:

- **Sustainability:** Ocean policy should be designed to meet the needs of the present generation without compromising the ability of future generations to meet their needs.
- **Stewardship:** The principle of stewardship applies both to the government and to every citizen. The U.S. government holds ocean and coastal resources in the public trust—a special responsibility that necessitates balancing different uses of those resources for the continued benefit of all Americans. Just as important, every member of the public should recognize the value of the oceans and coasts, supporting appropriate policies and acting responsibly while minimizing negative environmental impacts.
- **Ocean–Land–Atmosphere Connections:** Ocean policies should be based on the recognition that the oceans, land, and atmosphere are inextricably intertwined and that actions that affect one Earth system component are likely to affect another.
- **Ecosystem-based Management:** U.S. ocean and coastal resources should be managed to reflect the relationships among all ecosystem components, including humans and nonhuman species and the environments in which they live. Applying this principle will require defining relevant geographic management areas based on ecosystem, rather than political, boundaries.
- **Multiple Use Management:** The many potentially beneficial uses of ocean and coastal resources should be acknowledged and managed in a way that balances competing uses while preserving and protecting the overall integrity of the ocean and coastal environments.

- **Preservation of Marine Biodiversity:** Downward trends in marine biodiversity should be reversed where they exist, with a desired end of maintaining or recovering natural levels of biological diversity and ecosystem services.
- **Best Available Science and Information:** Ocean policy decisions should be based on the best available understanding of the natural, social, and economic processes that affect ocean and coastal environments. Decision makers should be able to obtain and understand quality science and information in a way that facilitates successful management of ocean and coastal resources.
- **Adaptive Management:** Ocean management programs should be designed to meet clear goals and provide new information to continually improve the scientific basis for future management. Periodic reevaluation of the goals and effectiveness of management measures, and incorporation of new information in implementing future management, are essential.
- **Understandable Laws and Clear Decisions:** Laws governing uses of ocean and coastal resources should be clear, coordinated, and accessible to the nation's citizens to facilitate compliance. Policy decisions and the reasoning behind them should also be clear and available to all interested parties.
- **Participatory Governance:** Governance of ocean uses should ensure widespread participation by all citizens on issues that affect them.
- **Timeliness:** Ocean governance systems should operate with as much efficiency and predictability as possible.
- **Accountability:** Decision makers and members of the public should be accountable for the actions they take that affect ocean and coastal resources.
- **International Responsibility:** The United States should act cooperatively with other nations in developing and implementing international ocean policy, reflecting the deep connections between U.S. interests and the global ocean.

TRANSLATING PRINCIPLES INTO POLICY

While articulating a vision for the future and identifying fundamental principles are necessary first steps, these must then be translated into working policies and programs. Four concepts serve as guideposts for developing and implementing new ocean policies: ecosystem-based management; incorporation of scientific information in decision-making; improved governance; and broad public education.

Ecosystem-based Management

Sound ocean policy requires managers to simultaneously consider the economic needs of society, the need to protect the nation's oceans and coasts, and the interplay among social, economic, and ecological factors. These factors are closely intertwined, just like the land, air, sea, and marine organisms. Activities that affect the oceans and coasts may take place far inland. For example, land-based sources of pollution, such as runoff from farms and city streets, are a significant source of the problems that plague marine ecosystems. Ocean policies cannot manage one activity, or one part of the system, without considering its connections with all the other parts. Thus, policies governing the use of U.S. ocean and coastal resources must become ecosystem-based, science-based, and adaptive.

Ecosystem-based management looks at all the links among living and nonliving resources, rather than considering single issues in isolation. This system of management considers human activities, their benefits, and their potential impacts within the context of the broader biological and physical environment. Instead of developing a management plan for one issue (such as a commercial fishery or an individual source of

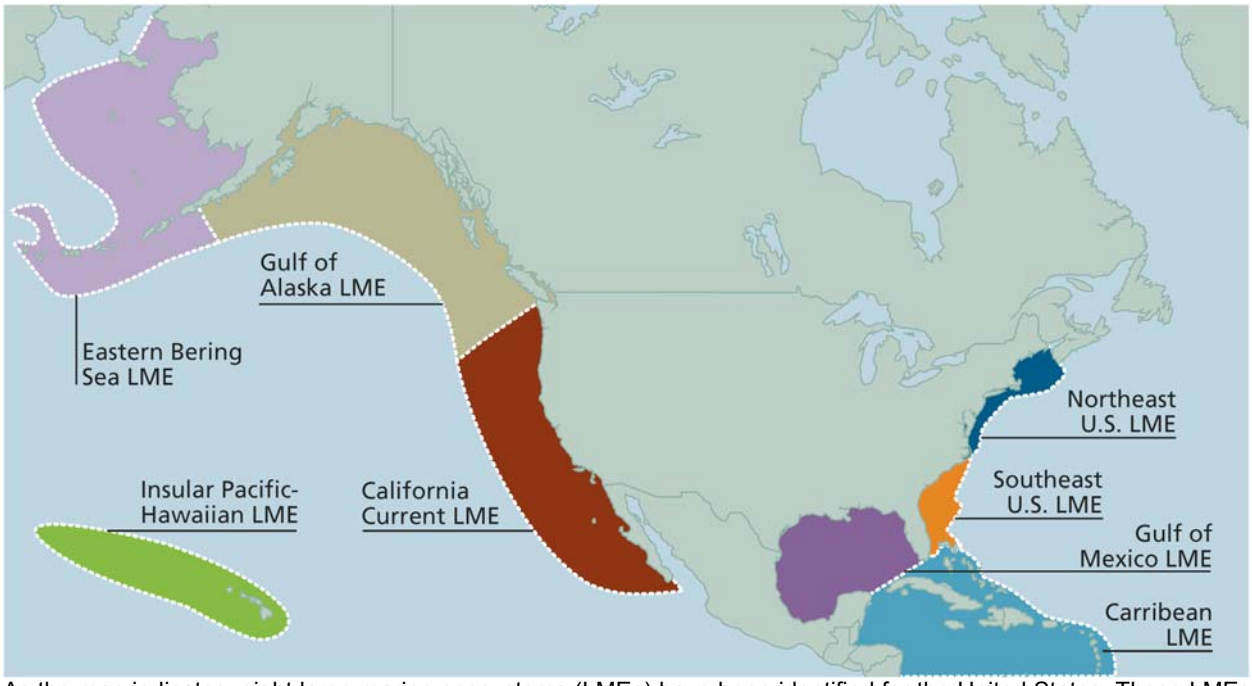
pollution), ecosystem-based management focuses on the multiple activities occurring within specific areas that are defined by ecosystem, rather than political, boundaries.

Defining New Management Boundaries

Splitting the natural world into clearly defined management units is a somewhat arbitrary process. Existing management boundaries primarily follow political lines. However, new scientific understanding of ecosystems makes it possible to design management areas that conform more closely to ecological units.

Since the 1960s, scientists have developed and refined the concept of "large marine ecosystems." These regions divide the ocean into large functional units based on shared bathymetry, hydrography, productivity, and populations and encompass areas from river basins and estuaries to the outer edges of continental shelves and seaward margins of coastal current systems (Figure 3.1).[1] Large marine ecosystems are not currently used as management boundaries, although they were a basis for the fishery management regions defined by the Magnuson–Stevens Fishery Conservation and Management Act. On land, watersheds have generally been identified as appropriate ecosystem-based management units, particularly for issues related to hydrology and water pollution. Because of the connection between land-based activities and ocean conditions, an appropriate geographic boundary for ecosystem-based management of ocean areas would combine large marine ecosystems with the watersheds that drain into them.

Figure 3.1. Large Marine Ecosystems Correspond to Natural Features



As the map indicates, eight large marine ecosystems (LMEs) have been identified for the United States. These LMEs are regions of the ocean encompassing coastal areas out to the seaward boundaries of continental shelves and major current systems and take into account the biological and physical components of the marine environment as well as terrestrial features, such as river basins and estuaries, that drain into these ocean areas.
Source: University of Rhode Island Environmental Data Center, Department of Natural Resources <http://mapper.edc.uri.edu/website/lmeims/viewer.htm> (Accessed January, 2004).

While determining appropriate new boundaries is necessary for ecosystem-based management, it is also important to maintain sufficient flexibility to manage on both larger and smaller scales when necessary. For example, air pollution problems must be dealt with on national and even international levels, while certain water pollution issues may need to be addressed on a small-scale watershed level. Managers should be able to adapt to the scale of different activities and the ecosystems they affect.

Aligning Decision-making within Ecosystem Boundaries

The current political and issue-specific delineation of jurisdictional boundaries makes it difficult to address complex issues that affect many parts of the ecosystem. Economic development in a coastal area may fall under the jurisdiction of several local governments, and natural resource management under the jurisdiction of one or more states, while pollution control and environmental monitoring of the same area may be overseen by several federal agencies. Yet water, people, fish, marine mammals, and ships flow continually across these invisible institutional borders.

Ecosystem-based management can provide many benefits over the current structure. The coordination of efforts within a specific geographic area allows agencies to reduce duplication and maximize limited resources. It also provides an opportunity for addressing conflicts among management entities with different mandates. Less obvious, but equally important, ecosystem-based management may engender a greater sense of stewardship among government agencies, private interests, and the public by promoting identification and connection with a specific area.

Finally, ecosystem-based management makes it easier to assess and manage the cumulative impacts of many different activities. For example, the U.S. Army Corps of Engineers' wetlands permitting program has been criticized for not evaluating cumulative impacts in its review of individual dredge-and-fill permits. A true ecosystem-based management approach would ameliorate this fragmented approach.

While ecosystem-based management is being attempted in some places on a limited basis, applying it broadly and successfully will take time and effort. In particular, the transition to such management will require explicit recognition of the uncertainty of current information and understanding. This uncertainty creates risks. One widely accepted guideline for managing in the face of uncertainty and risk is to adopt a precautionary and adaptive approach.

Precautionary and Adaptive Management

Scientific uncertainty has always been, and will probably always be, a reality of the management process. Because scientists cannot predict the behavior of humans or the environment with 100 percent accuracy, managers cannot be expected to manage with complete certainty. Nevertheless, scientists *can* provide managers with an estimate of the level of uncertainty associated with the information they are providing. Managers must incorporate this level of uncertainty into the decision-making process, support the research and data collection needed to reduce the uncertainties, and be prepared to adapt their decisions as the information improves.

The *precautionary principle* has been proposed by some parties as a touchstone for managers faced with uncertain scientific information. In its strictest formulation, the precautionary principle states that when the potentially adverse effects of a proposed activity are not fully understood, the activity should not be allowed to proceed. While this may appear sensible at first glance, its application could lead to extreme and often undesirable results. Because scientific information can never fully explain and predict all impacts, strict adoption of the precautionary principle would prevent most, if not all, activities from proceeding.

In contrast to the precautionary principle, the Commission recommends adoption of a more balanced *precautionary approach* that weighs the level of scientific uncertainty and the potential risk of damage as part of every management decision. Such an approach can be explained as follows:

> **Precautionary Approach:** To ensure the sustainability of ecosystems for the benefit of future as well as current generations, decision makers should follow a balanced precautionary approach, applying judicious and responsible management practices based on the best available science and on proactive, rather than reactive, policies. Where threats of serious or irreversible damage exist, lack of full scientific certainty shall not be used as a justification for postponing action to prevent environmental degradation. Management plans and actions based on this precautionary approach should include scientific assessments, monitoring, mitigation measures to reduce environmental risk where needed, and periodic reviews of any restrictions and their scientific bases.

According to this approach, scientific uncertainty—by itself—should neither prevent protective measures from being implemented nor prevent uses of the ocean. Managers should review the best available science and weigh decisions in light of both the level of scientific uncertainty and the potential for damage. When the level of uncertainty is low and the likelihood of damage is also low, the decision to proceed is clearly supported. At the other extreme, when the level of uncertainty is high and the potential for irreversible damage is also high, managers should clearly not allow a proposed action to proceed. In the real world, managers will most likely face decisions between these two extremes, where the correct outcome will require balancing competing interests, using the best available information despite considerable uncertainty, and imposing some limits or mitigation measures to prevent environmental damage. After a decision is made, managers must continue to gather the information needed to reduce uncertainty, periodically assess the situation, and modify activities as appropriate.

Goals and Objectives for Ecosystem-based Management Plans

As with any major, complex undertaking, ecosystem-based management should be guided by clear, measurable goals and objectives. These goals should cover multiple uses and should be based on a combination of policy judgments, community values, and science. Although good science is essential for solving problems and scientists should advise managers about the consequences of various courses of action, science cannot determine the "best" outcome in the absence of clearly identified management goals. The setting of goals and objectives will depend on a blending of values and information.

Where multiple desirable but competing objectives exist, it is not possible to maximize each. For example, both recreational boating and marine aquaculture are potential uses of nearshore marine waters. Both provide benefits and costs to society, and both have impacts on the environment that can be lessened with proper planning. However, these activities can also conflict with each other: a large-scale aquaculture operation would prevent access by recreational boaters to certain waters. Science can inform managers of the potential positive or negative impacts of each activity but cannot ultimately determine whether to favor aquaculture or boating. Instead, a community judgment must be made, weighing the value of each activity against its potential impacts.

Ecosystem-based management will lead to better decisions that protect the environment while balancing multiple uses of ocean areas. Managers will need to work with the scientific community to develop the information and understanding needed to support such complex decisions. But the critical process of setting goals to guide management will require active participation by many different stakeholders with divergent views. This will be difficult to achieve without changes to the existing governance system.

Biodiversity

One of the central goals for ecosystem-based management should be the explicit consideration of biodiversity on species, genetic, and ecosystem levels. While humans have always depended on particularly valued marine species for food, medicine, and other useful products, there has been a tendency to ignore species that do not have a clear, recognizable impact on society. However, it is now understood that every species makes some contribution to the structure and function of its ecosystem. Thus, an ecosystem's survival may well be linked to the survival of all species that inhabit it.

Species diversity, or the number of species within an ecosystem, is one measure of biodiversity. However, biodiversity is also significant at larger and smaller scales. Within a single-species population, it is important to preserve *genetic diversity*—the bedrock of evolution. Maintaining genetic diversity is important for species to adapt to changing environmental conditions. It is also important to understand and protect *ecosystem diversity,* the number of different ecosystems, and different kinds of ecosystems, on Earth.

Because scientists have tended to study specific habitats, such as coral reefs, mangroves, or wetlands, quantitative measures of marine biodiversity at larger scales are rare. Nevertheless, there is broad consensus that the biodiversity of life in the oceans is being affected by human activities. Studies indicate that in many marine and coastal locations, community composition has changed to conditions that are less valuable from ecological, economic, and even cultural perspectives.[2] There have been reductions in food and medicinal species and alterations of aesthetic and recreational values important to humans, including much greater abundance of less desirable species like toxic algae and bacteria.

Despite the importance of biodiversity to ecosystem functions and values, we still know very little about how biodiversity arises, is maintained, and is affected by outside forces including climate change and direct human impacts.

Science for Decision-making

Ecosystem-based management provides many potential benefits, but also imposes new responsibilities on managers. The need to collect good information and to improve understanding is perhaps foremost among these new responsibilities. Despite considerable progress over the last century, the oceans remain one of the least explored and most poorly understood environments on the planet.

Greater knowledge can enable policy makers and managers to make science-based decisions at the national, regional, state, and local levels. Existing research and monitoring programs, which tend to be agency- and issue-centric, should be reoriented to become ecosystem-based. This will help resolve the current mismatch between the size and complexity of marine ecosystems and the many fragmented research and monitoring programs for coastal and ocean ecosystems.

In addition to the need for better understanding, the nation lacks effective mechanisms for incorporating scientific information into decision-making processes in a timely manner. As knowledge improves, it must be actively incorporated into policy through an adaptive process. To make this policy translation effective, local, state, regional, and national managers need an avenue to communicate their information needs and priorities.

Better coordination can facilitate more efficient use of existing funds. However, to significantly improve U.S. management of oceans and coasts and make ecosystem-based management a reality, the nation will need to commit to greater investments in ocean science, engineering, exploration, observations, infrastructure, and data management. Increased investments will help restore the pre-eminence of U.S. ocean capabilities, which has eroded since the end of the Cold War.

Although multiple use conflicts are common in coastal and ocean environments, efforts to understand the social, cultural, and economic dimensions of ocean issues have received surprisingly little support. Because of this, studies of humans and their behavior—so critical to virtually every ecosystem—deserve special emphasis.

Effective Ocean Governance

National ocean policy can only be implemented if an effective governance system is in place. Many of the guiding principles defined in this chapter speak directly to this need. An effective governance system will be predictable, efficient, and accountable. Laws, policies, and programs must be well coordinated and easily understood by regulated parties and the public. A comprehensive framework should be in place that defines the appropriate roles for all levels of government, the private sector, and citizens in managing ocean and coastal resources. Equally important, decision makers and the public should be accountable for decisions and actions that affect the ocean and its resources.

Participation by a broad sector of the public is essential to a successful ocean governance system. Facing an array of complex problems and competing desires, interested parties must reach agreements on what actions are needed, which are of greatest priority, and how to implement decisions once they are made. Public input is critical to this decision-making process so that all interests are fairly represented and support is built from the ground up. Without a truly participatory form of ocean governance, dispute and litigation are inevitable. At the same time, clear roles, jurisdictions, and authorities must be delineated to avoid gridlock and allow progress.

Today, no federal entity has the mission to evaluate the vast array of federal actions affecting ocean and coastal resources and to advocate for more effective approaches, prioritized investment, improved agency coordination, and program consolidation where needed. Nor is there a coherent national policy for ocean management that guides the missions of various federal agencies. A more unified federal voice is also needed in discussing policy options with the many nonfederal stakeholders.

Not since the Stratton Commission in the 1960s has an opportunity such as this existed. To propose major modifications in ocean governance that will create positive change for today and for future generations is one of the top priorities of this Commission.

Public Education

Education has provided the skilled and knowledgeable workforce that made America a world leader in technology, productivity, prosperity, and security. However, rampant illiteracy about science, mathematics, and the environment now threaten the future of America, its people, and the oceans on which we rely.

Testing results suggest that, after getting off to a good start in elementary school, by the time U.S. students graduate from high school their achievement in math and science falls well below the international average.[3] Ocean-related topics offer an effective tool to keep students interested in science, increase their awareness of the natural world, and boost their academic achievement in many areas. In addition, the links between the marine environment and human experience make the oceans a powerful vehicle for teaching history, culture, economics, and other social sciences. Yet teachers receive little guidance on how they might use exciting ocean subjects to engage students, while adhering to the national and state science and other education standards that prescribe their curricula.

A 1999 study indicated that just 32 percent of the nation's adults grasp simple environmental concepts, and even fewer understand more complex issues, such as ecosystem decline, loss of biodiversity, or watershed degradation.[4] It is not generally understood that nonpoint source pollution threatens the health of our coastal waters, or that mercury in fish comes from human activities via the atmosphere. Few people understand the tangible value of the ocean to the nation or that their own actions can have an impact on that resource. From excess applications of fertilizers, pesticides, and herbicides on lawns, to the trash washed off city streets into rivers and coastal waters, ordinary activities can contribute significantly to the degradation of the marine environment. Instilling a stewardship ethic in the American public is an important element of a national ocean policy. Without an acknowledgement of the impacts associated with ordinary behavior and a willingness to take the necessary action—which may incur additional costs—achieving a collective commitment to more responsible lifestyles and new policies will be difficult.

Excellent lifelong education in marine affairs and sciences is essential to raising public awareness of the close connection between the oceans and humans, including our history and culture. This awareness will result in better public understanding of the connections among the ocean, land, and atmosphere, the potential benefits and costs inherent in resource use, and the roles of government and citizens as ocean stewards.

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[1] Sherman, K., and L. Alexander, eds. *Variability and Management of Large Marine Ecosystems*. AAAS Selected Symposium 99. Boulder, CO: Westview Press, 1986.

[2] Norse, E., ed. Global Marine Biological Diversity: A Strategy for Building Conservation into Decision Making. Washington, DC: Island Press: 1993.

[3] Calsyn, C., P. Gonzales, and M. Frase. *Highlights from TIMSS* [Third International Mathematics and Science Study]. Washington, DC: National Center for Education Statistics, 1999.

[4] National Environmental Education & Training Foundation [NEETF]. *1999 National Report Card: Environmental Readiness for the 21st Century*. Washington, DC: NEETF/Roper Starch Worldwide, 1999.

PRIMER ON OCEAN JURISDICTIONS:
DRAWING LINES IN THE WATER

Although invisible to the naked eye, governments have carved the world's oceans into many zones, based on both international and domestic laws. These zones are often complex, with overlapping legal authorities and agency responsibilities. Internationally, the closer one gets to the shore, the more authority a coastal nation has. Similarly, for domestic purposes, the closer one gets to the shore, the more control an individual U.S. state has.

This primer explains the ocean jurisdiction of the United States under international law, as well as the domestic distinction between federal and state waters (Figure P.1).

THE BASELINE (0 Miles)

For purposes of both international and domestic law, the boundary line dividing the land from the ocean is called the *baseline*. The baseline is determined according to principles described in the 1958 United Nations Convention on the Territorial Sea and the Contiguous Zone and the 1982 United Nations Convention on the Law of the Sea (LOS Convention), and is normally the low water line along the coast, as marked on charts officially recognized by the coastal nation. In the United States, the definition has been further refined based on federal court decisions; the U.S. baseline is the mean lower low water line along the coast, as shown on official U.S. nautical charts. The baseline is drawn across river mouths, the opening of bays, and along the outer points of complex coastlines. Water bodies inland of the baseline—such as bays, estuaries, rivers, and lakes—are considered "internal waters" subject to national sovereignty.

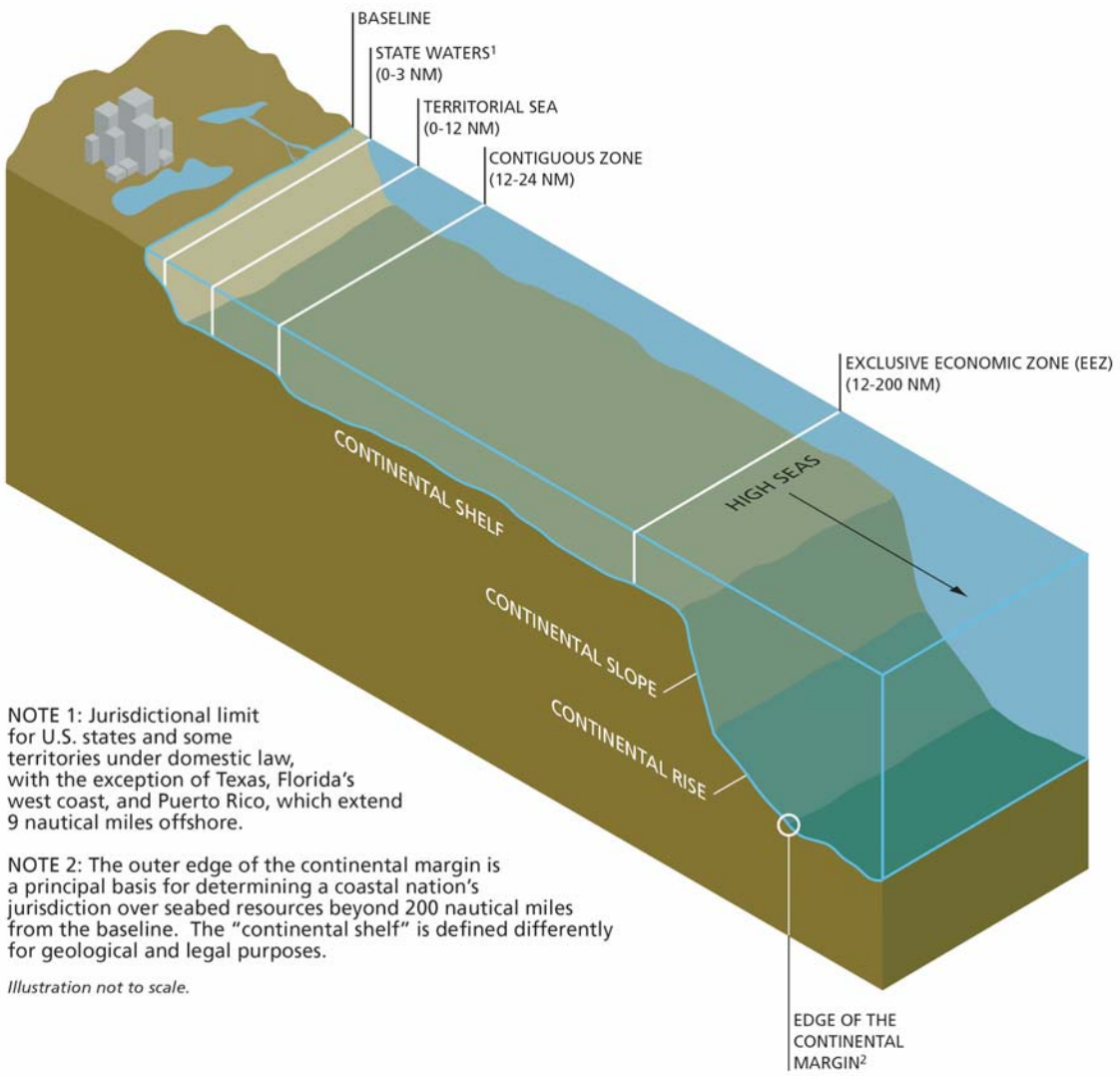
STATE SEAWARD BOUNDARIES IN THE UNITED STATES

(0 to 3 Nautical Miles; 0 to 9 Nautical Miles for Texas, Florida's Gulf Coast and Puerto Rico)

In the 1940s, several states claimed jurisdiction over mineral and other resources off their coasts. This was overturned in 1947 when the Supreme Court determined that states had no title to, or property interest in, these resources. In response, the Submerged Lands Act was enacted in 1953 giving coastal states jurisdiction over a region extending 3 nautical miles seaward from the baseline, commonly referred to as *state waters*. For historical reasons, Texas and the Gulf Coast of Florida are an exception, with state waters extending to 9 nautical miles offshore. (Note: A nautical mile is approximately 6,076 feet. All references hereafter to miles in this Primer are actually nautical miles.) Subsequent legislation granted the U.S. Virgin Islands, Guam, and American Samoa jurisdiction out to 3 miles, while Puerto Rico has a 9-mile jurisdictional boundary.

The federal government retains the power to regulate commerce, navigation, power generation, national defense, and international affairs throughout state waters. However, states are given the authority to manage, develop, and lease resources throughout the water column and on and under the seafloor. (States have similar authorities on the land side of the baseline, usually up to the mean high tide line, an area known as state tidelands.)

Figure P.1. Lines of U.S. Authority in Offshore Waters



Several jurisdictional zones exist off the coast of the United States for purposes of international and domestic law. Within these zones, the United States asserts varying degrees of authority over offshore activities, including living and nonliving resource management, shipping and maritime transportation, and national security. A nation's jurisdictional authority is greatest near the coast.

In general, states must exercise their authority for the benefit of the public, consistent with the public trust doctrine. Under this doctrine, which has evolved from ancient Roman law and English common law, governments have an obligation to protect the interests of the general public (as opposed to the narrow interests of specific users or any particular group) in tidelands and in the water column and submerged lands below navigable waters. Public interests have traditionally included navigation, fishing, and commerce. In recent times, the public has also looked to the government to protect their interests in recreation, environmental protection, research, and preservation of scenic beauty and cultural heritage.

THE TERRITORIAL SEA (0 to 12 Nautical Miles)

Under international law, every coastal nation has sovereignty over the air space, water column, seabed, and subsoil of its *territorial sea*, subject to certain rights of passage for foreign vessels and, in more limited circumstances, foreign aircraft.

Prior to 1988, the United States claimed a territorial sea out to 3 miles. In that year, President Reagan proclaimed a 12-mile territorial sea for the United States, consistent with provisions in the LOS Convention. The proclamation extended the territorial sea only for purposes of international law, explicitly stating that there was no intention to alter domestic law.

Acknowledging Change: The Need to Update Federal Laws

Over the past twenty years, U.S. presidents have issued a series of proclamations changing the extent and nature of U.S. authority over the oceans. The changes, creating a territorial sea to 12 miles, a contiguous zone to 24 miles, and an exclusive economic zone to 200 miles, have not been comprehensively reflected in domestic laws. Many laws also use imprecise or inconsistent terms to refer to ocean areas, such as "navigable waters," "coastal waters," "ocean waters," "territory and waters," "waters of the United States," and "waters subject to the jurisdiction of the United States." These terms can mean different things in different statutes and sometimes are not defined at all.

Legal disputes have already occurred over the seaward extent of jurisdiction of the Endangered Species Act and the National Environmental Policy Act. The Clean Water Act and the Oil Pollution Act both refer to the 3-mile territorial sea. Inconsistencies or ambiguities in geographic definitions have caused problems in civil and criminal cases unrelated to natural resources, such as the regulation of offshore gambling. Congress has amended some laws regulating marine commerce to reflect the 12-mile U.S. territorial sea. However, there has been no systematic effort to review and update all ocean-related U.S. statutes and regulations.

THE CONTIGUOUS ZONE (12 to 24 Nautical Miles)

International law recognizes a *contiguous zone* outside the territorial sea of each coastal nation. Within its contiguous zone, a nation can assert limited authority, primarily related to customs, fiscal, immigration, and sanitary laws. In 1999, President Clinton proclaimed a U.S. contiguous zone from 12 to 24 miles offshore enhancing the U.S. Coast Guard's authority to take enforcement actions against foreign flag vessels throughout this larger area.

THE EXCLUSIVE ECONOMIC ZONE (12 to 200 Nautical Miles)

The LOS Convention allows each coastal nation to establish an *exclusive economic zone* (EEZ) adjacent to its territorial sea, extending a maximum of 200 miles seaward from the baseline. Within its EEZ, the coastal nation has sovereign rights for the purpose of exploring, exploiting, conserving, and managing living and nonliving resources, whether found in ocean waters, the seabed, or subsoil. It also has jurisdiction over artificial islands or other structures with economic purposes.

The U.S. EEZ occupies the area between 12 miles (the seaward limit of the territorial sea) and 200 miles offshore for international purposes. Consistent with international law and traditional high-seas freedoms, the U.S. does not generally assert control over surface or submarine vessel transit, aircraft overflight, or the laying of cables and pipelines on the ocean floor. The United States does not assert jurisdiction over marine scientific research in the U.S. EEZ, although the LOS Convention would allow it.

THE CONTINENTAL SHELF (12 to 200 Nautical Miles or Outer Edge of Continental Margin)

The legal concept of the continental shelf has evolved over the last sixty years. A 1945 proclamation by President Truman first asserted a U.S. claim to resources on its continental shelf. This proclamation set a precedent for other coastal nations to assert similar claims over resources far from their shores. The need to establish greater uniformity was one of the driving forces behind the 1958 United Nations Convention on the Continental Shelf. However, the 1958 Convention showed limited vision, defining the continental shelf based on a nation's ability to recover resources from the seabed. As technological capabilities improved, uncertainty began anew about the seaward boundary of a nation's exclusive rights to continental shelf resources.

The LOS Convention generally defines the *continental shelf* for purposes of international law as the seafloor and subsoil that extend beyond the territorial sea throughout the natural prolongation of a coastal nation's land mass to the outer edge of the continental margin or to 200 miles from the baseline if the continental margin does not extend that far. The legal definition of the continental shelf thus overlaps geographically with the EEZ.

Where a coastal nation can demonstrate that its continental margin extends beyond 200 miles, the LOS Convention has a complex process for asserting such claims internationally. The U.S. continental margin extends beyond 200 miles in numerous regions, including the Atlantic Coast, the Gulf of Mexico, the Bering Sea, and the Arctic Ocean. However, because the United States is not a party to the LOS Convention, it can not assert its claims through the LOS mechanism (see Chapter 29).

THE HIGH SEAS (Areas Beyond National Jurisdictions)

International law has long considered areas of the ocean beyond national jurisdiction to be the *high seas*. On the high seas, all nations have certain traditional freedoms, including the freedom of surface and submerged navigation, the freedom to fly over the water, harvest fish, lay submarine cables and pipelines, conduct scientific research, and construct artificial islands and certain other installations. These freedoms are subject to certain qualifications, such as the duty to conserve living resources and to cooperate with other nations toward this end. In addition, a nation exercising its high seas freedoms must give due regard to the interests of other nations.

Originally defined as the area beyond the territorial seas of coastal nations, today the high seas are defined by the LOS Convention as the area seaward of the EEZs of coastal nations. Sixty percent of the world's oceans remain in this zone, where the traditional freedom of the seas still prevails. Even on the high seas, the United States and other coastal nations have some limited ability to exercise governmental authority. For example, U.S. citizens on the high seas remain subject to U.S. law, as do people on U.S.-flagged vessels and aircraft.