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REGIONAL AND NATIONAL DEMANDS ON THE MAINE COASTAL ZONE

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REGIONAL AND NATIONAL DEMANDS

ON THE MAINE COASTAL ZONE

A report to the Maine State Planning Office on estimates of regional and national demands on the water and related land resources of the Maine coastal zone.

January, 1971

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
2234 SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

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January 29, 1971

Mr. Philip M. Savage
Director
State Planning Office
Merrill Building
State Street
Augusta, Maine 04330

Dear Mr. Savage:

I am pleased to transmit a report on regional and national demands on the Maine coastal zone. As you know, the resources of the coast of Maine have special value and significance to the people of New England and the entire Nation as well as to the residents of Maine, and are under intense developmental pressures.

Across the country, the capability of government to preserve environmental values while simultaneously providing for developmental needs is being severely tested in the coastal zone.

We congratulate the State of Maine for responding to this critical issue by developing a pilot statewide coastal planning program which includes careful consideration of regional and national interests. We are proud to be associated with the State of Maine in this effort, and hope it may serve as a model for coastal states throughout the Nation.

We trust our contributions will prove useful, and look forward to continuing cooperation in Maine's efforts.

Sincerely yours,

Frank Gregg

Frank Gregg
Chairman

Errata

Regional and National Demands on the Maine Coastal Zone

1. Pages 46 and 47 are out of sequence and incorrectly numbered. The report's page 47 should be page 46 following page 45; and the report's page 46 should be renumbered page 47.
2. Page 56, Table 12 -- Title should read: "Estimated Future Regional Power Requirements"

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Cover photo of Wells Harbor by Stephen Nichols

BACKGROUND

As the principal agency for the coordination of federal, state, interstate, local and nongovernmental plans for the development of water and related land resources in the region, the New England River Basins Commission has developed a joint federal-state approach to coastal zone planning. This approach recognizes that the state should be the active leader in plan formulation. At the same time, the Commission strategy recognizes the significance of regional and national interests of the zone.

Under the leadership of the State of Maine and in cooperation with the New England Regional Commission, NERBC is actively involved in the development of a coastal zone plan for the Maine coast. This report represents a portion of the Commission's input to that planning effort.

OBJECTIVES

The objectives of this report are to set forth a preliminary framework forecasting future regional and national pressures on the water and related land resources of the Maine coastal zone.

Forecasts of these pressures are based largely upon past occurrences, assessments of present conditions, and a variety of possible future events. The projected trends are based upon current regional, national, and state policies as well as the present social, economic, technological, environmental, political, legal, and institutional framework. Significant changes in this framework could, of course, significantly change the projections. The forecasts presented in this report are not goals, objectives or proposals but only indications of what could or might occur given the extension of present conditions. One of the primary values of these forecasts is to give perspective to the future and thereby allow planners and decision-makers to assess the possible conflicts resulting from current happenings. A sound strategy for public and private policy to deal with the implications of present trends can then be developed.

The information included in this report should help to identify critical priority areas for the Maine coastal zone and assist in the preparation of a pilot plan for Penobscot Bay proposed for Phase II of the Maine coastal planning effort. In the final analysis, the primary objective of this report is to strengthen the planning and decision-making processes for determining the most appropriate and best uses of the coastal zone in the context of the regional, national and local interest.

SCOPE AND METHODOLOGY

Scope

This report brings together information which can be useful in assessing probable future demands on the Maine coastal zone. No new information or data was developed; instead, an attempt was made to unify many sources of existing information and place it in a sound context. No significant attempt has been made to reconcile varying points of view or subjective judgments which may have entered into the development of sections of the information presented.

Many of the forecasts included in the report are drawn from the North Atlantic Water and Related Land Resources Study (NAR) which is a broad assessment of future needs, available resources and identification of possible conflicts and alternative solutions for water and related land resources of an area extending from Virginia to Maine. The NAR Study is being led by the Corps of Engineers under the guidance of the national Water Resources Council with inputs by federal and state agencies having resources planning and management responsibilities.

Since the NAR study is nearing completion, minor modifications of the information prepared as a part of the study are likely prior to final publication. The information contained in this report is, therefore, preliminary.

The Maine coastal zone as defined by the State of Maine and used in this report consists of all coastal minor civil divisions on tidewater and associated marine areas within which conflicts may occur. This, in general, is a strip ten miles deep along the coastal and tidewater areas. The coastal zone includes: 139 minor civil division, 3,451 square miles, a permanent population of 443,717 and a combined summer resident and non-resident population of 614,627 in 1966. The area, shown on Figure 1, comprises 10.4% of the state's total land area.[1]

External demands, pressures or requirements are defined as thoseresource pressures that originate outside of the state,

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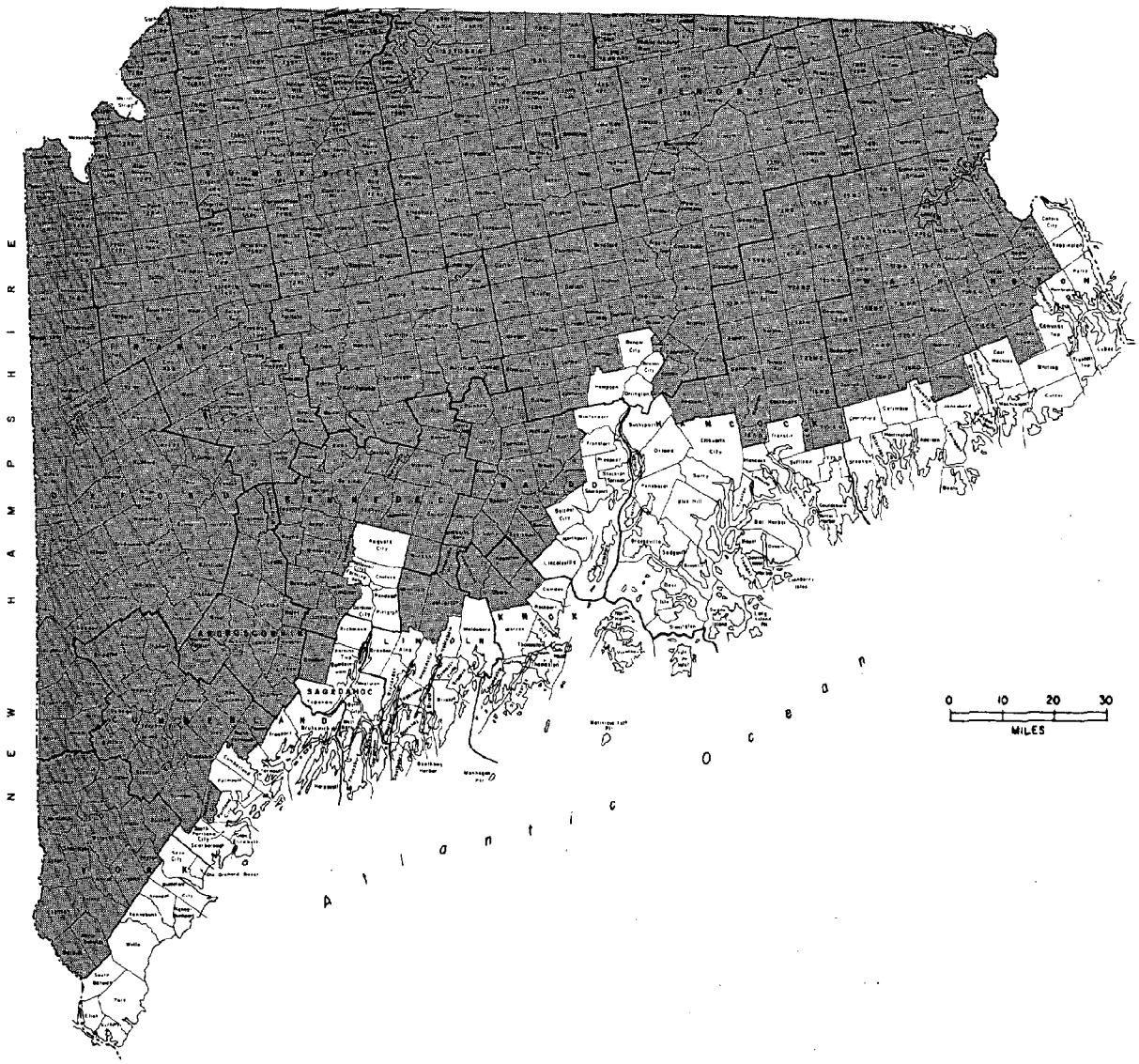
[1] Maine Coastal Development Plan, Phase 1 Report, Maine State Planning Office, 1970.



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BOSTON, MASSACHUSETTS
JANUARY 1971

MAINE COASTAL ZONE

FIG. 1 NO.

and include private or public investment decisions, seasonal or permanent population patterns, and market situations that exist out of state but have a powerful influence in governing resource management decisions within the state. Thus many enterprises with operations in Maine are owned and directed by out of state corporations and are considered external pressures. This is true of several forest products companies as well as several real estate ventures. Similarly seasonal non-residents may own property in Maine but if they are legal residents of another state they are considered to be external forces. The same applies to market situations where the primary market is out of state but the nature of Maine's resource situation is such that the economic activity is carried on within Maine even though the market served is out of state. Deep water port and nuclear energy interests are examples of this. These interests seek locations within Maine because of the natural configuration of the seabed and the abundance of cold water. The market for the oil brought into the deep water ports and for the electrical energy generated at coastal nuclear plants is primarily external to Maine.

External pressures reflect regional and national interests. Regional interests are those that have primary significance and impact on the other New England states. Thermal power facility siting, commercial fisheries, and scenic and recreational resources are examples of these interests. National interests are those that have impact and significance to the nation or parts of the nation beyond New England. Areas of direct federal involvement are included in this category. Examples of federal interests are fish and wildlife refuges, national parks, navigational channels, areas of unique historical or scenic value, and water quality.

National and regional interests can be further defined as those that have a unique value to the nation or to the region. For example, nationally, the public is interested in using federal money to protect the value of those things along the Maine Coast that are of unique value to the nation and is further interested in maximizing the return on each federal dollar invested along the Maine Coast. Examples of this national interest are the provision of public access and protection to the unique ecological and landscape values of Mt. Desert Island; protecting the production of the famous Maine lobster, and extending the recreational values of the traditional rock-bound coast of Maine, itself. These three examples are unique to Maine and of equal value to a man in Ann Arbor, Michigan, or Calais, Maine.

Examples of regional interest are the seven deep water harbors that could receive deep draft tankers and perhaps lower the cost of oil in New England, nuclear power plant sites near abundant cold water, which could provide less costly electric energy, and regional water-oriented recreational developments. It also includes insuring that regional environmental and economic values are preserved and maintained. A recent report noted that "the people living in the immediate vicinity of public lands have a strong desire that these lands contribute meaningfully to the quality of the environment in which they live" and "it is in the regional public interest to have the federal government, as land owner, pay its fair share of the costs of adequate local and state governmental services."[1]

Methodology

The regional and national interests in the coast of Maine are substantial. In setting forth these interests, relatively uniform criteria and standards must be applied. The following questions are suggested as a test to decide whether or not a resource system is of regional or national significance.

National Interest

1. Is it unique or valuable to the nation or major parts of the nation?

2. Does it have a significant impact on the nation and does the nation have a significant impact on it?

3. Is there direct federal involvement?

Regional interests are particularly difficult to define, especially concerning the demarcation between regional and national interests. The suggested test for defining the regional interest is as follows:

Regional Interest

1. Is it unique or valuable to New England or large parts of New England or to interests extending beyond local or state boundaries?

---

[1] One Third of the Nation's Land, Public Land Law Review Commission, June 1970.

2. Does it have an impact on New England extending beyond local or state boundaries, and is it significantly affected by action outside of the local area or state?

3. Is there regional concern or involvement?

The information included in this report is drawn largely from NAR and other private and governmental studies. NAR information for the Maine Coastal Zone is disaggregated into four major areas as shown in Figure 2 and as follows:

Area 2
Penobscot River Basin

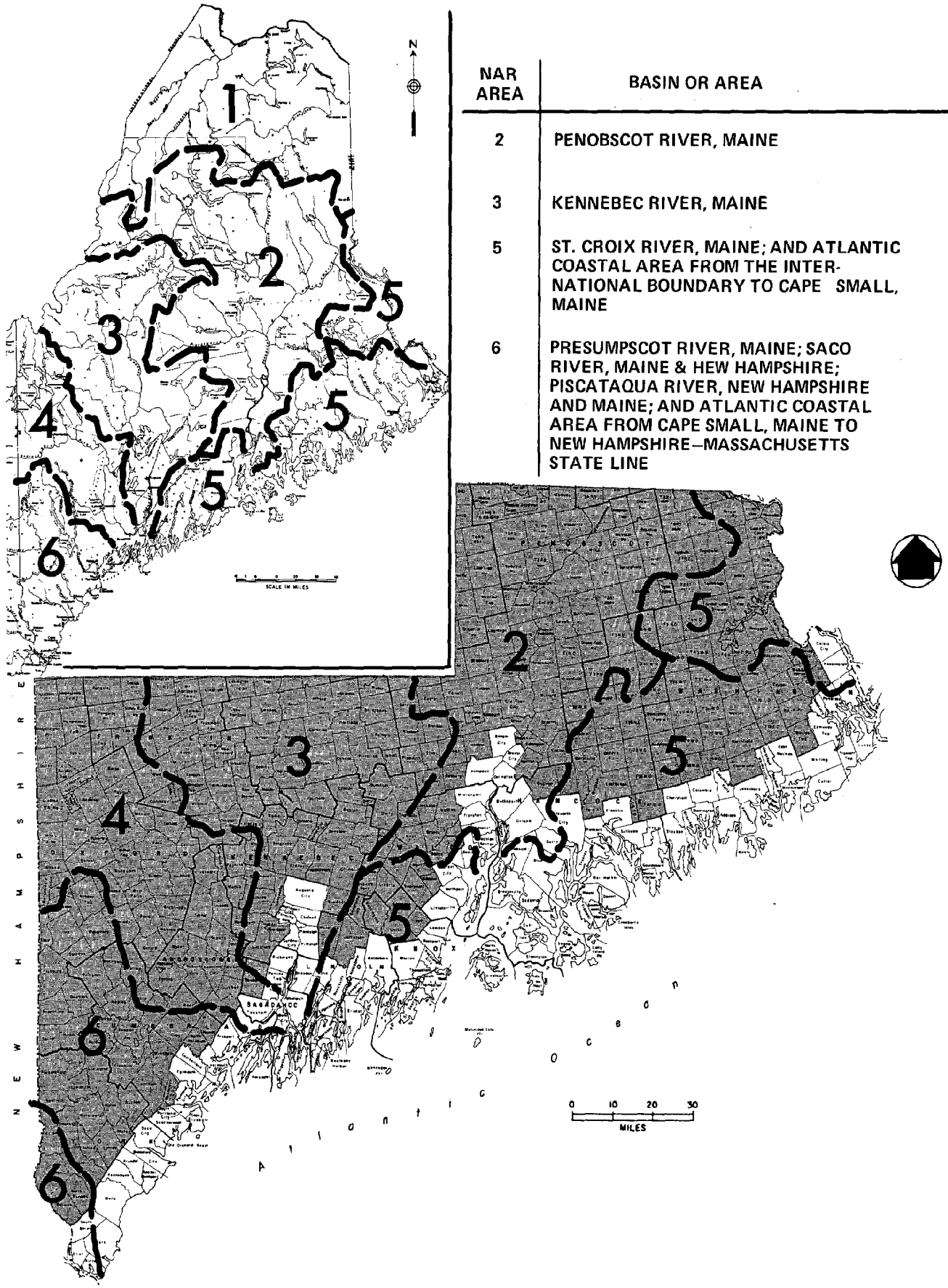
Area 3
Kennebeck River Basin

Area 5
St. Croix River Basin and Atlantic Coastal Area from the International Boundary to Cape Small, Maine

Area 6
Presumpscot River Basin, Saco River Basin, Piscataqua River Basin and Atlantic Coastal Area from Cape Small Maine to New Hampshire-Massachusetts State Line

Judgements and estimates were developed based upon population, area, and other varying factors concerning the demands placed upon resources within the coastal zone portion of these areas. Based upon those estimates, the following factors on percent of resource pressure of the total area placed on the coastal zone portion was prepared. This is shown in Tables 1 and 2.

The conversion factors were developed by considering what portion of each of the NAR areas was represented by the coastal zone as defined by the Maine planning program, and further estimating what percentage of each resource pressure was generated in the coastal zone. As an example, only a fraction of Penobscot Basin lies within the coastal zone area, but all of the navigation that takes place in the Penobscot takes place in the coastal zone, while only about 15 percent of the recreational activity in the same general area occurs in the coastal zone.



NAR AREA	BASIN OR AREA
2	PENOBSCOT RIVER, MAINE
3	KENNEBEC RIVER, MAINE
5	ST. CROIX RIVER, MAINE; AND ATLANTIC COASTAL AREA FROM THE INTERNATIONAL BOUNDARY TO CAPE SMALL, MAINE
6	PRESUMPSCOT RIVER, MAINE; SACO RIVER, MAINE & HEW HAMPSHIRE; PISCATAQUA RIVER, NEW HAMPSHIRE AND MAINE; AND ATLANTIC COASTAL AREA FROM CAPE SMALL, MAINE TO NEW HAMPSHIRE–MASSACHUSETTS STATE LINE

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BOSTON, MASSACHUSETTS

JANUARY 1971

NORTH ATLANTIC REGIONAL
WATER RESOURCES STUDY AREAS
OF THE MAINE COASTAL ZONE

FIG. 2 NO.

Table 1

NAR Resource Demand Conversion Factors

Resource	Percent of Resource Pressure in Coastal Zone NAR Area			
	2	3	5	6
Important Controlling Factors				
Navigation	100	100	100	100
Recreation & Environmental Quality				
Recreation	5	10	80	50
Visual & Cultural Environment	5	10	70	25
Fish & Wildlife	22	38	75	45
Power & Energy				
Electrical Production & Cooling	5	5	100	100
Resource Conversion & Manufacturing				
Public Water Supply	22	38	75	45
Industrially Self-supplied Water Supply	15	20	75	45
Additional Significant Problems				
Water Quality	not applicable			
Flood Damage Reduction	5	5	80	15
Erosion Control	5	5	50	15

Source: NERBC staff estimates based upon data from the U.S. Census of Population 1970, NAR, and Maine State Highway Commission Map of Maine

Use of these conversion factors provides a tool for transforming NAR resource demand data into useful planning inputs for the coastal zone. An attempt was then made to determine the portion of demand attributable to external interests. Table 2 presents these weighting factors.

Table 2

Demands on Coastal Resources Attributable to
Regional-National Out of State of Maine Interests

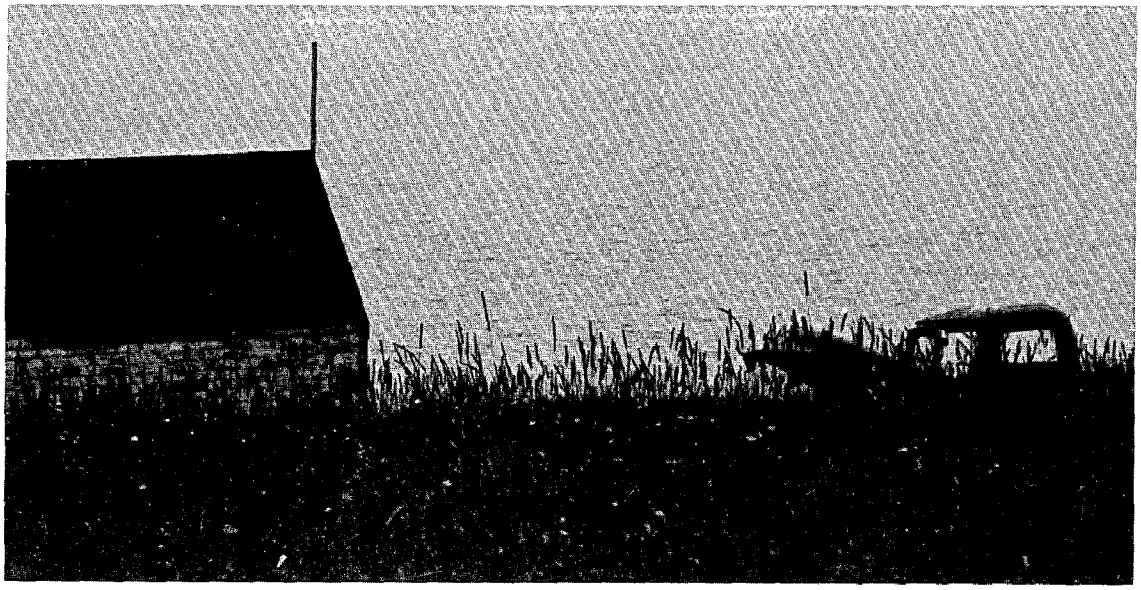
	Percent of total demand
Important Controlling Factors	
Navigation	90
Recreation & Environmental Quality	
Recreation	85
Visual & Cultural Environment	75
Fish & Wildlife	65
Power & Energy	
Electrical Power Production Cooling	50
Resource Conversion & Manufacturing	
Municipal & Industrial Water Supply	55
Industrially-Self Supplied Water Supply	85
Additional Significant Problems	
Water Quality	not applicable
Flood Damage Reduction	30
Erosion Control	50

Source: NERBC staff estimates based on data from Maine Pocket Data Book, Maine Department of Economic Development, August 1969, Thermal Pollution Aspects of the Maine Yankee Atomic Power Plant at Wiscasset, NERBC 1969.

Statistics in the report have been derived from NAR and other data sources by calculating the percent of resource pressure that occurs in the coastal zone, simply multiplying the percentage from Table 1 and converting it to represent external demand by multiplying the percentages contained in Table 2. The projected trends developed within the report are based upon current regional, national and state policies as well as the present social, economic, technological, environmental, political, legal and institutional framework.

The forecasts have been prepared largely relating to past occurences, assessment of present conditions and estimated probable future alternative occurences.

In general, the demands shown in Table 2 are derived from considering the amount of out of state interest represented in the use of the resource. Considering navigation, for example, 90 percent of total demand is estimated to represent out of state regional and national interests since about 80 percent of the commercial import tonnage is oil that is piped to Canada from Portland and an additional 10 percent is for servicing federal military installations and the Bangor Airport which is considered an international jetport. Evaluating recreation, for instance, out of state pressures comprise 85 percent of total demand.



Matinicus Island

OVERVIEW OF REGIONAL AND NATIONAL DEMANDS

Characteristics of the Maine Coastal Zone

The Maine coastal zone of Maine has irreplacable natural resources of important value and significance to the state, the New England region, and the nation. Because of mounting pressures on the coast and recognition of its importance, questions have been raised about appropriate uses of the coast that serve the public interest, whether that be local, regional or national.

The Maine coast has not been despoiled to a major extent by the activities of man. It, therefore, remains a unique area of high environmental values and offers unusual opportunities for maintaining these values. At the same time, economic opportunity has seemingly evaded the Maine coast. Some would argue that this is more than compensated for in the values of the quality of environment. Nevertheless, the characteristics and natural values of the coast can be considered a vital economic asset which can be mobilized to provide economic stability to the area and concurrently preserve those natural systems, characteristics and values of the coast which are of intrinsic importance.

Maine is on the fringe of the northeastern megalopolis. This fact itself is certain to engender external demands and pressures which heretofore were not visible. Vacation homes and limited tourism were principal external pressures of the past. More intensive tourism, aquaculture, increased commercial fishing, industrialization and research and education are possible external demands of the future.

Some of the factors which preserved the Maine coast and maintained low population were poor transportation systems, lack of natural resources susceptible to economic development, and a relatively harsh climate. These factors and the effects of these factors are changing and are likely to continue to change. Regional and national demands on the Maine coast have been relatively modest in the past. External demands on the Maine coastal zone are increasing and forecasts for future demands indicate mounting regional and national pressures.

There are several important features of the Maine coastal zone that give it special significance in terms of regional and national interest. Geographically it encompasses a combination of unique resource systems of high economic and environmental value. It is a heavily glaciated coast of 2,208,000 acres of which 200,000 acres are located on 109 coastal islands and islands groups. Many streams and lakes are interspersed along the rocky,

hilly, 3,500 miles of meandering shoreline. The combination of deep coves and well watered hills creates a natural landscape of high visual quality.

Six major rivers, numerous streams, and many lakes drain the coastal zone providing an abundance of fresh water of varying water quality. The heavily indented coastline contains numerous harbors of which seven have a mean low tide depth of at least 80 feet. The mean annual water temperature has been 48°F for the last two years.[1] Climatic conditions over the last decade have created an annual air temperature of 45.5°F with a range from a harsh January mean temperature of 23.8°F to a pleasant August mean temperature of 66°F.[2]

The Maine coast is sparsely settled, with a density of only 54 people per square mile, and has a relatively low population of 440,000. Only 19 towns have populations in excess of 5,000 and only nine have a population in excess of 10,000. Most of the landscape is forest or abandoned farmland that is returning to a natural wild condition or being subdivided for second homes.

Analysis of the 1970 U.S. Census data for Maine indicates some significant population characteristics. First, the Maine coastal zone concentrates 45 percent of the state's permanent population on only 11 percent of the land (443,717 to a state total of 992,048). Second, despite population concentration along the coast, the density is only 129 people per square mile. Third, the rate of population growth for the coastal zone is a low 1.5 percent per decade, only slightly lower than the state's growth rate of 2.4 percent per decade. However, the data indicates a significant population reduction in the industrial cities of Bangor, Bath, and Portland and in the economically depressed areas of Washington County. This suggests that people are leaving the depressed industrial cities and rural areas, and a much higher rate of population growth (8 percent per decade) is occurring in other areas where tourism is providing a sound economic base. This is particularly evident in Lincoln, Hancock, Cumberland, and York Counties. For example, Lincoln County, which is almost entirely in the coastal zone, experienced about a 9 percent population increase from 1960 to 1970 (16,509 to 17,950) and has an estimated seasonal population of 40,000 people.

---

[1] Water temperatures at Boothbay Harbor have fluctuated from 47°F in 1935 to 52°F in 1953 but are expected to decrease from the present 48°F over the next decade.

[2] Telephone conversation with Maine Sea and Shore Fisheries, Augusta, Maine; and U.S. Weather Service, Boston, Massachusetts, January 1971.

It is important to realize that population concentration, density, and growth are not current problems on the coast. Population trends are shown in Table 3 and Figure 3. One level assumes a continuation of the current relatively slow 1.5 percent per decade population growth. This has been selected as the lower limit because identifiable housing and economic development plans make it difficult to conceive of any slower rate.

The higher level assumes an 8 percent per decade population growth based on a continuation of people moving to environmentally attractive places, more people taking advantage of the economic benefits of a growing tourist industry, and an expansion of the megalopolis into the Maine coastal zone. This higher growth rate reflects the possibility of Maine going the way of New Hampshire.[1] Even if the higher projected growth rate is achieved, this would mean a reasonably low 2020 population of 715,000 or a density of 207 persons per square mile. Therefore projected permanent population levels give no significant indications of coastal resource pressure.[2]

For purposes of comparison Figure 3 illustrates the projected growth of the permanent population of the Maine Coast with the population growth projected by the NAR study for the North Atlantic Regional Study area. This NAR area of course includes the northeast megalopolis.

Characteristics of Regional and National Interest and Demands

In the past half decade regional and national interest in the nation's coastal zone has intensified. The problems, opportunities, and natural values of the coastal zone and acknowledgment of the zone as an irreplaceable national resource have been a basis for a framework of action for improved planning and management.

---

[1] Over the last decade neighboring New Hampshire had a growth rate of 21.5 percent. The primary force in New Hampshire is the growth of high technology industries that desire to be close to the expanding Boston metropolitan technological base, but to locate within New Hampshire so as to enjoy its tax and cost advantages.

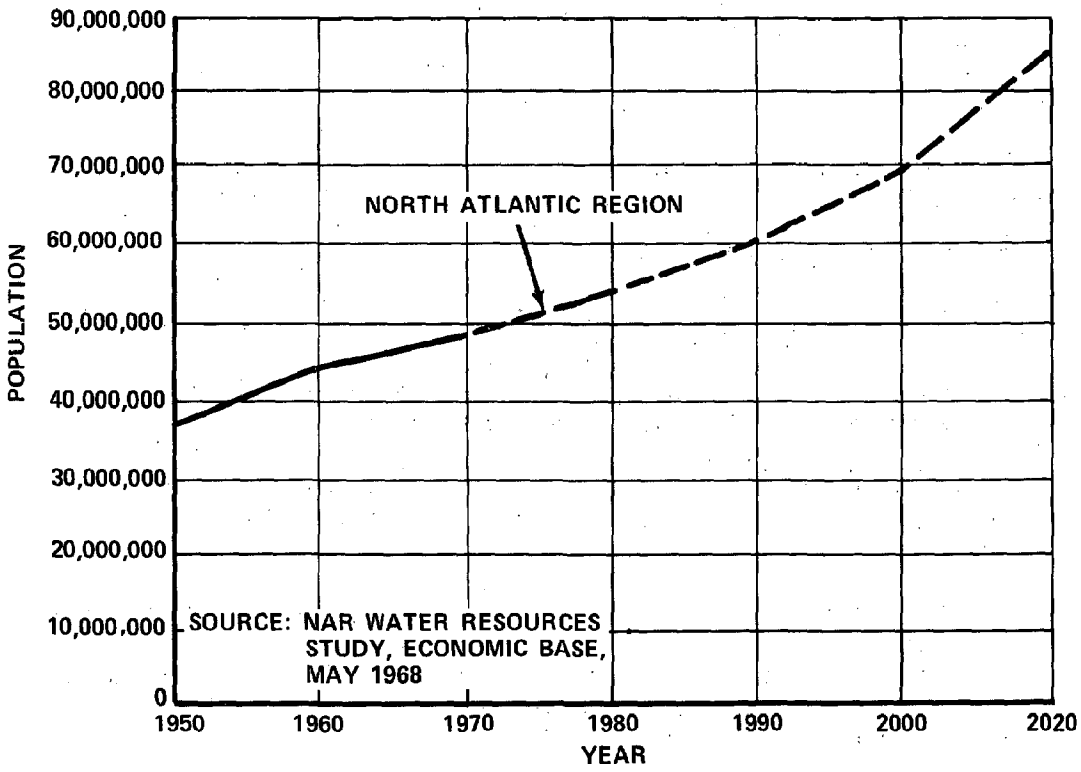
[2] This is a very light density when compared to the 1960 average of 781 for the Atlantic Seaboard area from Augusta, Maine to Prince William County, Virginia which contains the most densely settled areas of the nation. The U.S. Department of the Interior in its "The National Estuarine Pollution Study," projects an increase in density to 1,050 people per square mile by the year 2000 for this area.

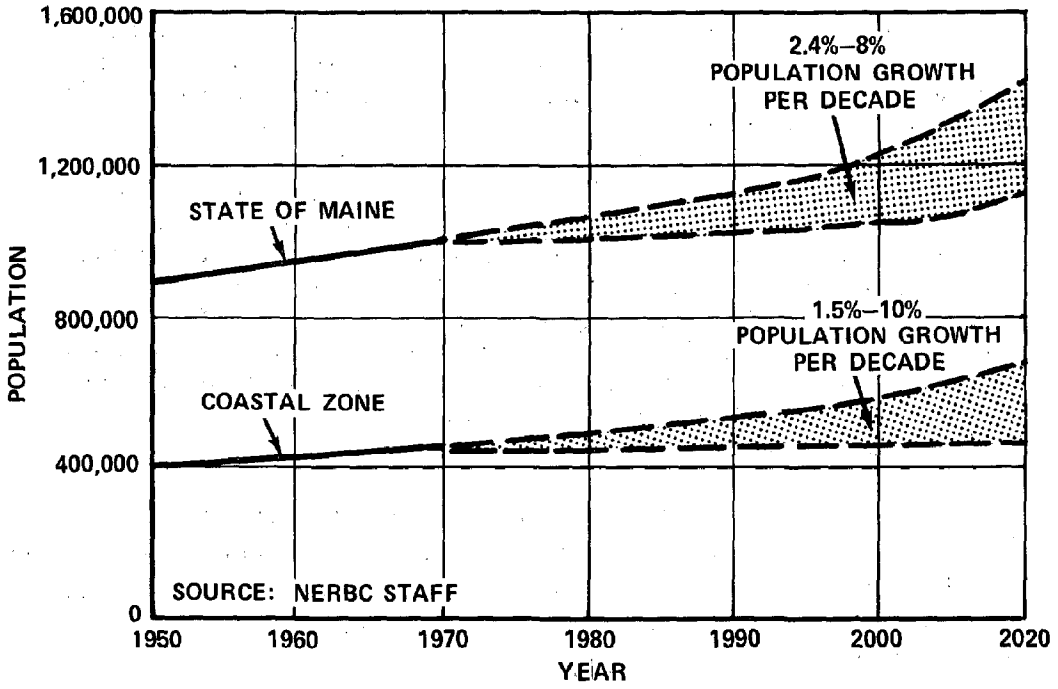
Table 3

Population Trends of the Maine Coastal Zone

	1950	1960	1970	1980	2000	2020
Population, persons	408,296	437,158	443,717	450,000 -488,000	464,000 -591,000	478,000 -715,000
Growth rate of decade		6.9%	1.5%			
Density, people per sq. mile	118	127	129	130-141	134-171	139-207
Percent of State population in Coastal Zone	44.7%	45.1%	44.7%			

Source: NERBC staff projection based on U.S. Census information





NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	POPULATION TRENDS OF THE MAINE COASTAL ZONE	FIG. 3 NO.

National Interests

On the federal level, based on Congressional directive, several national studies have investigated and proposed a strategy for national action for preserving the values and guiding appropriate development of the coastal zone.

The Commission on Marine Science Engineering and Resources in January 1969 completed a report titled Our Nation and the Sea -- A Plan for National Action. The Federal Water Quality Administration recently completed the National Estuarine Pollution Study and the Fish and Wildlife Service has prepared a National Estuary Study directed at the fisheries and wildlife values of the estuarine zone. This last report specifically investigated the feasibility and desirability of establishing a nationwide system of estuaries and estuarine areas. Also, the National Shoreline (Erosion) Study is being completed by the Corps of Engineers. Each of these studies has set forth the national, regional, and local interests and implications of the coastal zone.

The National Oceanographic and Atmospheric Administration has recently been formed as a result of an executive order by the President, and major national legislation dealing with planning and management of the coastal zone is now before the Congress and will probably be enacted during the next session.

The role of the federal government in the coastal zone has historically been and still is pointed at navigation, commercial shipping (interstate and international commerce), and national defense. It has however become increasingly clear that the federal interest extends beyond this limited view and includes recreation, fisheries and wildlife, mineral exploitation, water quality, shore erosion control, and flood damage reduction. In the Maine coastal zone, Acadia National Park, commercial and recreational shipping channels at Portland, Bar Harbor, Belfast Harbor, Bucksport Harbor and many others; Rachel Carson Fish and Wildlife Refuge, the water pollution enforcement conference on Penobscot Bay, and a National Fisheries Biological Laboratory at Boothbay Harbor are all positive indicators of federal interests.

The Maine coastline represents about 62 percent of the New England coastline and 5 percent of the nation's. The point of view that the value and responsibilities of the coastal zone should be shared by all citizens whether they live in Maine or in Idaho has been convincingly put forward.

Regional Interest

Regional action and interest towards the coastal zone has similarly intensified. A New England Marine Resources Information Program (NEMRIP) has been established and housed at the University of Rhode Island. The New England Regional Commission (NERCOM) in cooperation with other regional marine groups, such as The Research Institute of the Gulf of Maine (TRIGOM), is looking toward advancing aquaculture as an important component of the New England economy. NERCOM has also participated in deliberations for the establishment of Machiasport as a regional oil facility and has proposed to investigate the feasibility of solid waste residual disposal at sea as a possible regional short-term solution of solid waste management. In developing its agenda for action, NERCOM has identified ocean resources as a significant element of New England's future economic vitality. Included in their proposals are support for marine industry development, coastal zone planning and management and strengthening of marine science research, education, and manpower training.

As the principal agency responsible for the coordination and development of plans for water and related land resources, NERBC has proposed a cooperative program with the Regional Commission to initiate coastal zone planning with the New England coastal states. The Maine coastal zone planning effort, of which this report is a part, is a demonstration of this approach to federal-state development of coastal zone plans.

The nature and character of the development of the Maine coast is certain to have regional impact. Conversely, regional action will, in large part, significantly influence the shape of development of the coast. Some specific areas of consideration include navigation and port development (Portland and Machiasport), marine resource development (aquaculture, lobsters, clams, seaworms, fish) recreation, tourism, and environmental quality (Old Orchard, York, Acadia, Boothbay Harbor, Mount Desert), mineral exploitation (oil, sand and gravel), fisheries and wildlife (flyways, breeding and spawning areas), industrial development (petroleum refinery proposals), and nuclear power plant siting (Wiscasset). Some areas of regional and national interest in the Maine Coastal Zone are shown in Figure 4.

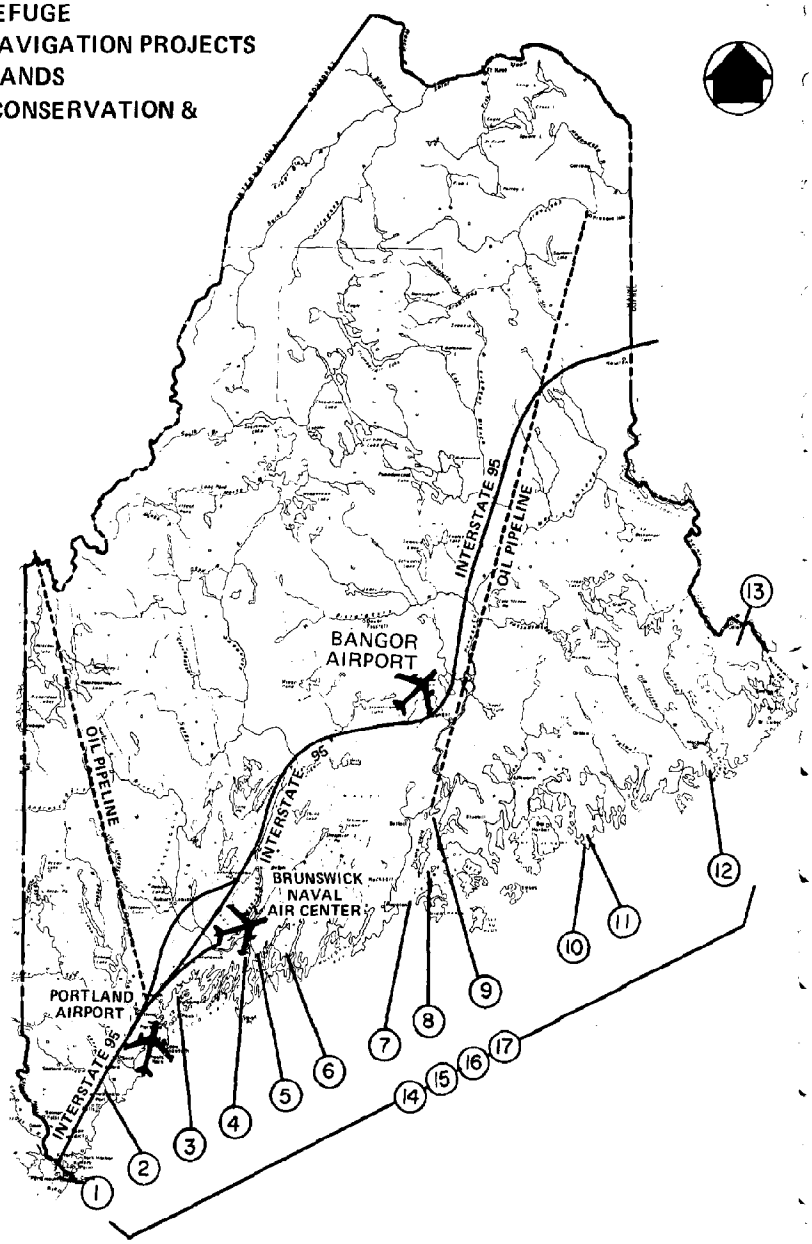
Megalopolitan Pressures

In assessing the characteristics of regional and national demands, it is necessary to look first at the characteristics of the North Atlantic urban megalopolis and than at the characteristics of federal involvement along the coast of Maine.

The northeast megalopolis extends along the eastern seaboard of the United States from Virginia to New Hampshire.

LEGEND

1 – PORTSMOUTH-KITTERY NAVAL SHIPYARD
2 – RACHEL CARSON NATIONAL WILDLIFE REFUGE
3 – LONG ISLAND OIL TERMINAL
4 – BATH IRON WORKS
5 – WISCASSET NUCLEAR POWER PLANT
6 – NATIONAL FISHERIES BIOLOGICAL LAB–BOOTHBAY
7 – NOAA TIDAL ESTUARINE FLUSHING FORECASTING SYSTEM
8 – FEDERAL WATER QUALITY ENFORCEMENT CONFERENCE ON PENOBSCOT BAY
9 – SEARSPORT OIL TERMINAL
10 – SCHOODIC POINT NAVAL BASE
11 – ACADIA NATIONAL PARK
12 – MACHIASPORT OIL FACILITY PROPOSAL
13 – MOOSEHORN NATIONAL WILDLIFE REFUGE
14 – 64 COMMERCIAL & RECREATIONAL NAVIGATION PROJECTS
15 – PROPOSED NATIONAL SYSTEM OF ISLANDS
16 – DEPT. OF AGRICULTURE RESOURCE CONSERVATION & DEVELOPMENT PROJECTS
17 – 28 SMALL WATERSHED PROJECTS



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

JANUARY 1971

SOME CURRENT REGIONAL & NATIONAL INTERESTS IN THE MAINE COASTAL ZONE

FIG. 4 NO.

Major metropolitan areas include Boston, Providence, New York, Philadelphia, Baltimore, Washington D. C., Richmond, and Norfolk. Over 45 million people now live in the megalopolis - more than one fifth of the nation's population on less than two percent of the nation's land. This population is growing at the rate of 2 percent per year and is expected to reach 54 million by 1980. The relationship between the Maine coastal zone and the megalopolis is shown in Figure 5.

The average megalopolitan resident's median family income has increased from $6,859 in 1960 to $8,492 in 1967 (in 1967 dollars). Perhaps even more significant, the proportion of families with annual incomes under $5000 has dropped from 38.6 percent in 1960 to 20.3 percent in 1967; families in the $10,000 and over bracket increased from 23.4 percent in 1960 to 38.0 percent in 1967. [1]

Although Maine has incurred only minor direct resource pressure from the megalopolis to date, pressures are increasing along the entire coast. The southern coast of Maine lies within two hours driving time of Boston and six hours of New York City, while the northern coast is only two hours beyond. Figure 6 illustrates relationships between major urban centers and the driving time to the Maine coast.

The vitality of the urbanized northeastern United States is dependent on a steady inflow of resources that can be used in the activities and operation of the urban areas. There are five categories of Maine coastal resource demand and supply directly related to megalopolitan demands. These are:

1. Important controlling factors such as transportation development including navigation facilities, electric utility lines, highways, and airports.

2. Recreational facilities and access to high quality landscape environment.

3. Production of electric power and energy resource.

4. Conversion of resources into manufactured, marketable commodities.

5. Additional significant resource management problems including water quality management, flood damage reduction, and erosion control.

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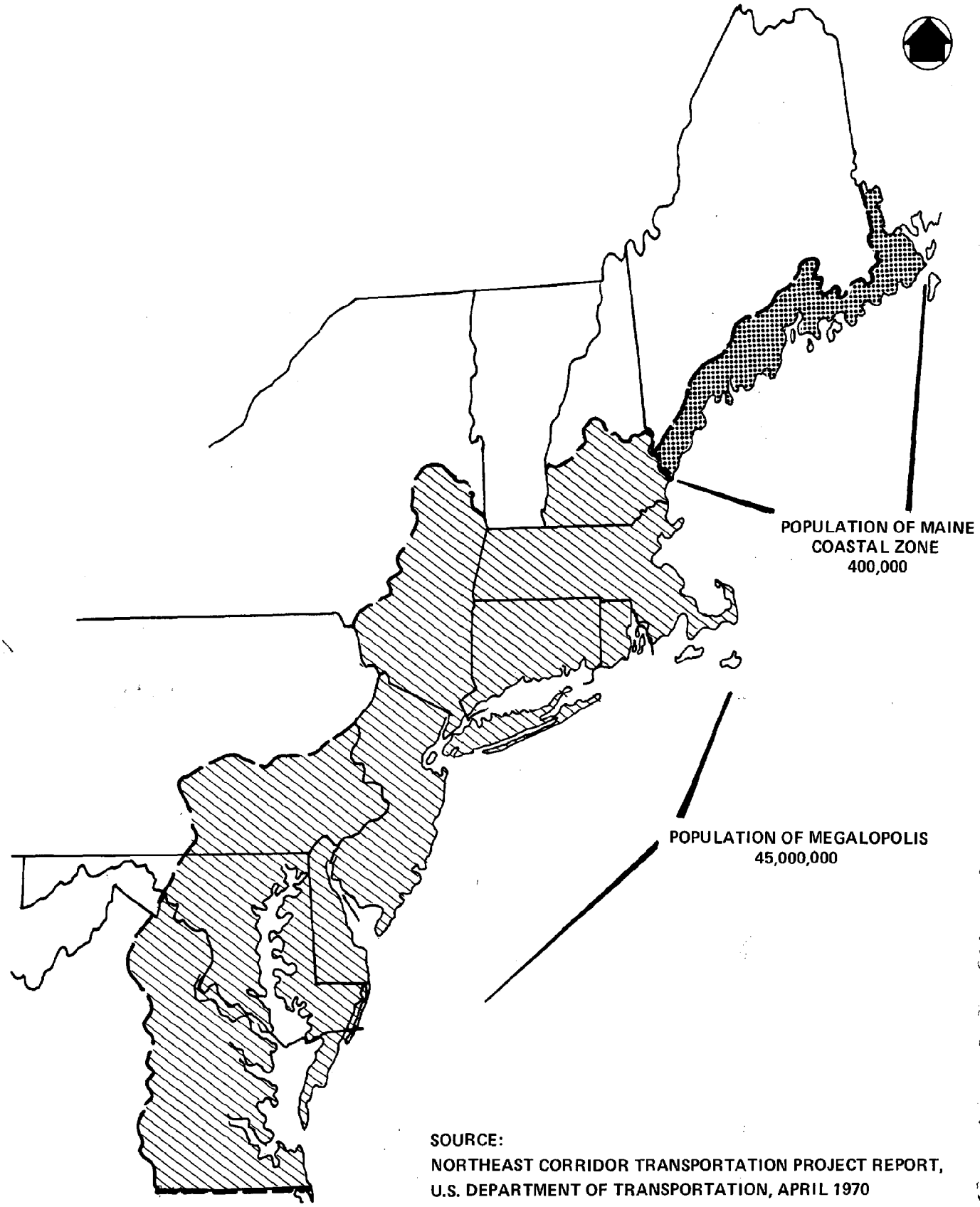
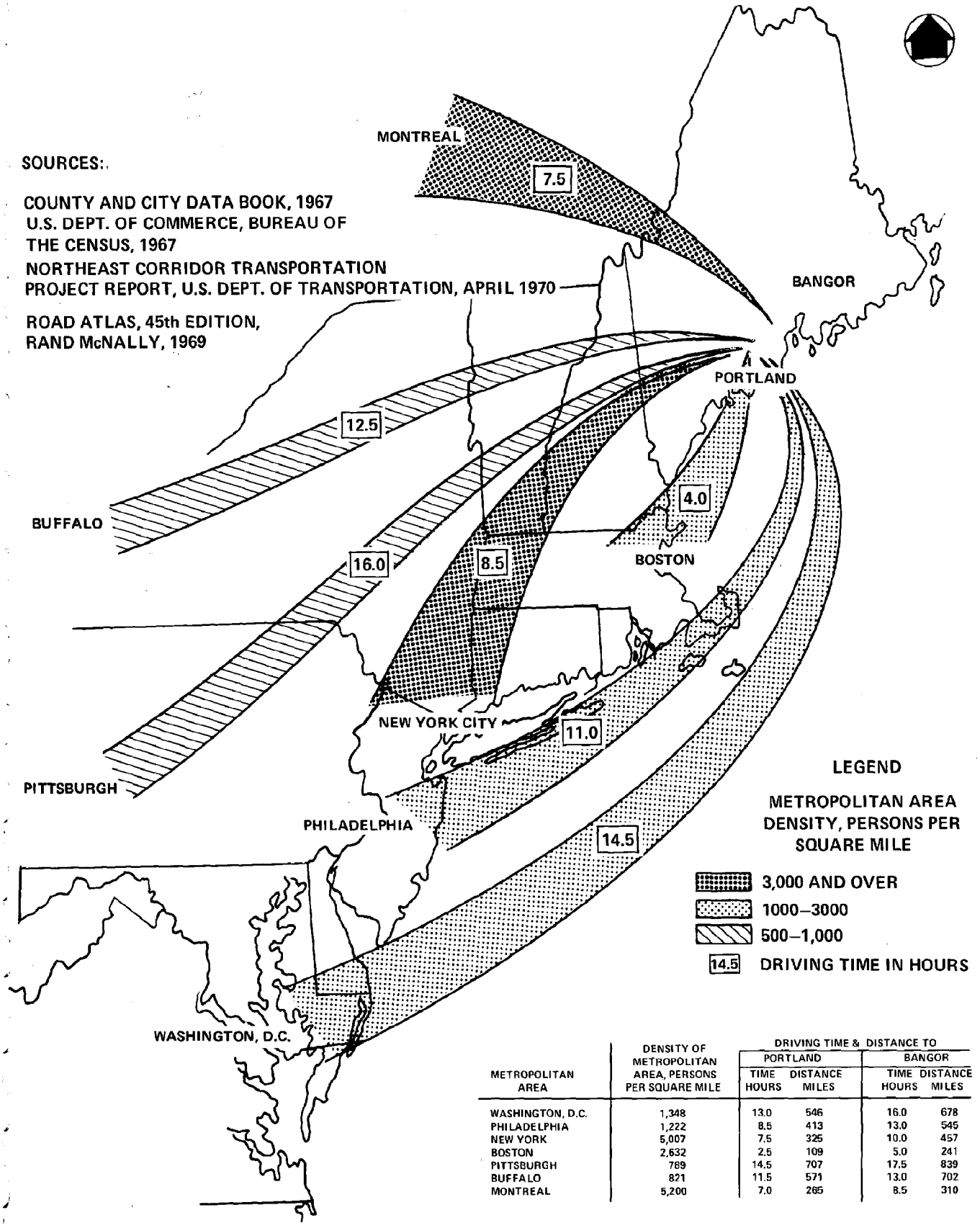
[1] Northeast Transportation Corridor Report, Department of Transportation, 1968.



SOURCE:
NORTHEAST CORRIDOR TRANSPORTATION PROJECT REPORT,
U.S. DEPARTMENT OF TRANSPORTATION, APRIL 1970

NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	NERBC	POPULATION RELATIONSHIPS– THE MAINE COASTAL ZONE AND THE NORTH ATLANTIC MEGALOPOLIS	FIG. 5 NO.



METROPOLITAN AREA	DENSITY OF METROPOLITAN AREA, PERSONS PER SQUARE MILE	DRIVING TIME & DISTANCE TO PORTLAND TIME HOURS	PORTLAND DISTANCE MILES	BANGOR TIME HOURS	BANGOR DISTANCE MILES
WASHINGTON, D.C.	1,348	13.0	546	16.0	678
PHILADELPHIA	1,222	8.5	413	13.0	545
NEW YORK	5,007	7.5	325	10.0	457
BOSTON	2,632	2.5	109	5.0	241
PITTSBURGH	789	14.5	707	17.5	839
BUFFALO	821	11.5	571	13.0	702
MONTREAL	5,200	7.0	265	8.5	310

NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

JANUARY 1971

NERBC

POPULATION DENSITIES OF MAJOR POPULATION CENTERS AND DRIVING TIMES TO THE MAINE COASTAL ZONE

FIG. 6 NO.

The national interest in assisting in the management of these megalopolitan pressures may be assessed from the extent of the federal interest in specific programs and projects along the Maine coast. Of the total federal funds spent in Maine in 1969, 72 percent was allocated for expenditure within the coastal counties.[1]

Examples of significant specific federal interest are as follows:

1. Important Controlling Factors--67 navigation projects (Corps of Engineers), disposal of Dow Air Force Base to civilian control (General Services Administration) $36.3 million in highway and Coast Guard funds representing 94.7 percent of the total 1969 statewide Department of Transportation allocation to Maine, port terminal development in Portland (New England Regional Commission), operation of naval shipyard at Kittery and air station at Brunswick (Department of the Navy).

2. Recreation and Environmental Quality -- 40,000 acres of federally administered land at Acadia National Park, Moosehorn and Rachel Carson National Wildlife Refuges, eleven national historic landmarks, and Islands of America Study recommending a series of island trusts along the coast of Maine (Department of Interior), National Estuary Study (Department of Interior).

3. Power and Energy--licensing of the Maine Yankee atomic electrical power plant at Wiscasset (Atomic Energy Commission), administration of oil import quota (Department of the Interior).

4. Resource Conversion and Manufacturing--national coastal zone study Our Nation and the Sea (Commission on Marine Science Engineering and Resources), three resource conservation and development projects for rural economic development (Department of Agriculture), National Marine Biological Laboratory at Boothbay Harbor (Department of Interior), contracts for commercial vessels at Bath Iron Works (Department of Commerce).

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[1] NERBC staff derivation from Federal Outlays in Maine, 1969, U.S. Office Economic Opportunity, 1970.

5. Additional Significant Resource Management Problems--water quality enforcement conference on Penobscot Bay, Estuarine Pollution Study (Department of Interior), National Shoreline (erosion) Study (Army Corps of Engineers).

Old Orchard Beach

ANALYSIS OF STATE, REGIONAL AND NATIONAL RESOURCE DEMANDS

IMPORTANT CONTROLLING FACTORS OF REGIONAL AND NATIONAL DEMANDS

There are several important factors that can act to control regional and national demands on Maine's coastal zone. Four that have been identified in this report are:

1. The degree of transportation facility development.
2. The nature of the climate.
3. The location of the coast relative to other centers of demand and supply.
4. The availability of marketable resources.

These four factors do not necessarily cause resource pressures in themselves, but act as controlling factors to regulate the intensity of external pressure.

Transportation Development

Urban centers are dependent upon transportation facilities to bring goods, services, and people in and out of the urban area. Maine has not yet been subject to a great amount of transportation development pressure from the megalopolis. The state has only 22,000 miles of highways. A major super-highway runs north-south but touches the coastal zone only below Bangor as shown in Figure 4. Driving times from major metropolitan centers are also shown on Figure 6. Ninety percent of the recreational visitors driving to Maine go to the coastal zone.[1]

The New England Regional Commission is currently studying the implications and the feasibility of a major east-west highway that would link upstate New York with the northeast coast of Maine.

Railroads are used for hauling forest products and certain other manufactured items out of state but there is no passenger service. Railroad tonnage hovers around 15 million tons a year

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[1] Public Investment Plan, Recreation Component (Cycle 4) Maine State Planning Office, 1971.

and shows no signs of significant change.[1]

Major pipelines transport oil from Portland to Montreal and from Searsport to Bangor and Presque Isle as shown in Figure 4. The capacities of these pipelines have more than doubled over the last decade. Canadian demand for oil suggests that this trend will continue.

Navigation activity has doubled over the last decade making Portland the second busiest east coast oil port. Most of this increase has been caused by the expansion of the Portland-Montreal pipeline. Tankers with a 45 foot draft can visit Portland all year round, while the 27-foot draft St. Lawrence Seaway is frozen for several months each winter thereby limiting surface vessel accessibility to Montreal.

Maine has seven harbors with a depth in excess of 80 feet -- the only deep water harbors along the east coast.[2] During the past year there has been significant out of state interest in developing deep water oil ports at Machiasport, Sears Island in Penobscot Bay and Long Island in Casco Bay. Projected tonnage of waterborne commerce in the Maine coastal zone is shown in Table 4. Alternative navigation trends related to pipeline and deepwater port development is graphically presented in Figure 7.

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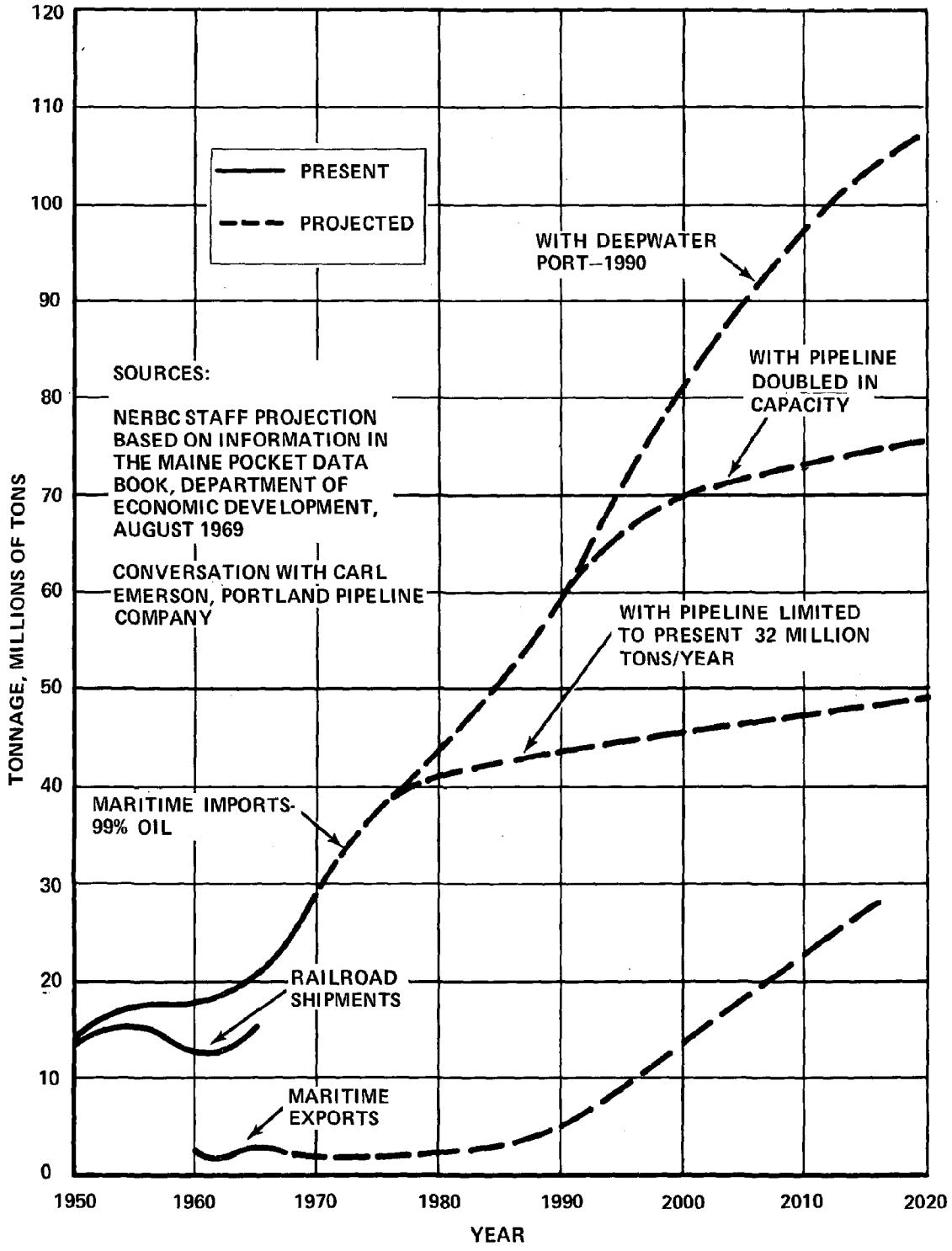
[1] Maine Pocket Book, Maine Department of Economic Development, August, 1969.

[2] Conversation with Edward Langlois, Chairman, Maine Port Authority, December, 1969.



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	LAND AND WATER SHIPMENTS TO AND FROM THE MAINE COAST	FIG. 7 NO.

Table 4

Projected Tonnage of Waterborne Commerce *
in the Maine Coastal Zone

	1952	1970	1980	2000	2020
Total tonnage, million tons per year	13.5	27.0	35.7	58.4	94.2
External requirements, million tons per year	12.1	25.9	34.3	56.1	90.4

*Assumes continued utilization of existing facilities and an additional deep water site by 1990.

Source: NAR Study data

Because regional and national dependency upon oil as a basic source of energy is expected to continue to increase, pressure for deepwater port development may also be expected to increase.

There are eleven airports along the coastal zone. Bangor International Airport was originally an $83 million U.S. Air Force Base, but is now a civilian airport servicing intercontinental jet flights. Bangor airport refuels transcontinental jets and provides a customs clearance function.

Changes in any of the highway, railroad, pipeline, navigation, or airport facilities could significantly alter the external pressure on the Maine coast.

Climate

The Maine coast has a pleasant climate during the summer months, with a mean temperature at Bar Harbor in August of 66°F. However, the winter months are cold. Bar Harbor has a mean January temperature of 23°F. These climatic conditions restrict social and economic activities and thereby provide a limiting effect on population growth. The mean water temperature at Boothbay Harbor has fluctuated around 48°F over the last

several decades. Even summer water temperatures of about 60°F are considered to be too cold for prolonged swimming. Meterologists forecast that water temperatures may decrease as much as three degrees over the next decade.[1] The temperature of the water affects recreational development, fish habitat, and industrial cooling and processing water uses.

Location

The coast of Maine is in the northeast corner of the United States. This gives it certain locational disadvantages relative to major internal U.S. markets and places it at the end of major transportation routes. The lack of highway and railroad development reflects this situation. Oil port development interests have recently been attracted to Maine primarily due to the deep water harbors that can take the deep draft super tankers, rather than its location close to major oil markets or sources of supply. The Bangor Airport offers locational advantages in that it is the closest U.S. airport to certain European airports. Perhaps Maine's greatest locational asset is that its remoteness from major markets and population centers has reduced economic development and thereby preserved the natural systems and environmental quality of the region. This valuable asset serves as a basis for present and future economic activity associated with tourism, recreation, and education.

Availability of Marketable Resources

Water is probably the Maine coast's most important resource. Water using industries such as paper, fish and food processing, chemical, nuclear electrical generation, leather, textile, and oil refining industries, have been attracted to the state's abundant cold waters. The land adjacent to this water resource is only lightly used. There is an average of five acres per resident, very little industrialization, very little farming, and of the 139 towns only nine have a population over 10,000. Much of the land between the towns is held in large undeveloped parcels. Although this has never been regarded as a resource rich area in the past, the availability and scenic quality of this uncommitted land and water resource acts as a magnet that is beginning to pull the crowds and industries of the megalopolis to it. The nature of the control over this resource will affect both the nature and the intensity of future external pressures.

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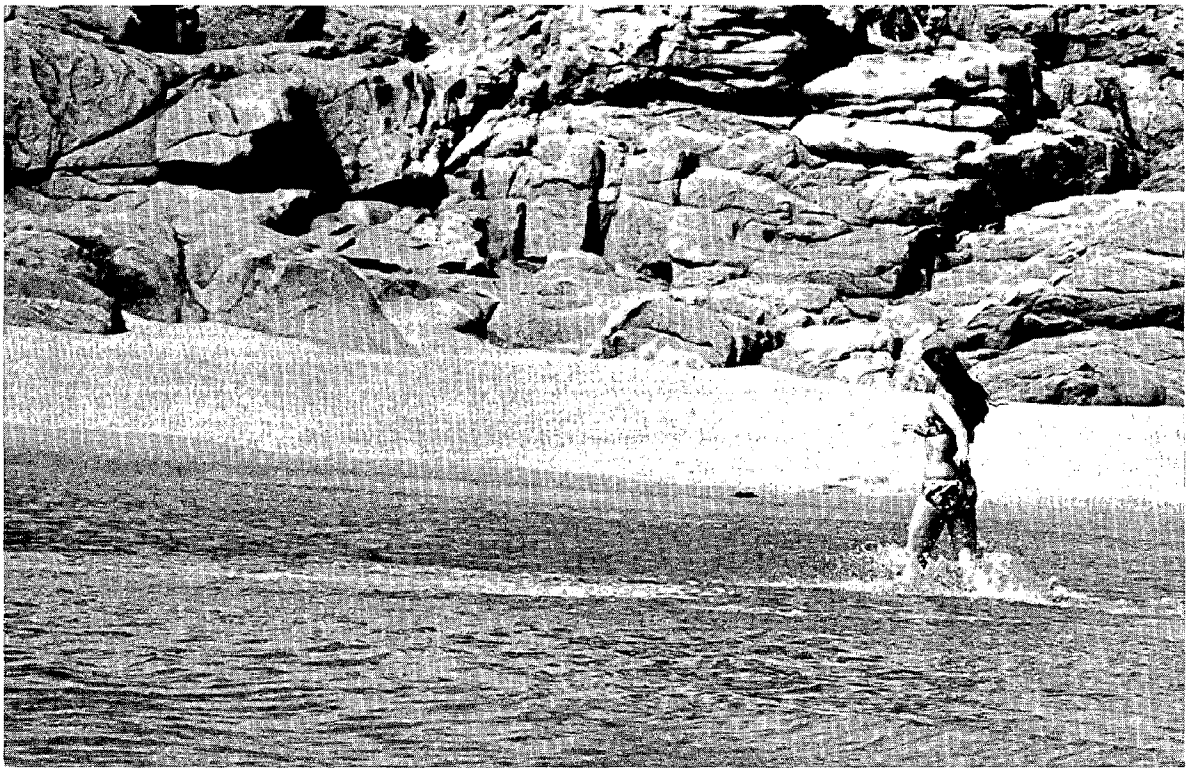
[1] Conversation with Brad Sterl, Maine Sea and Shore Fisheries concerning the findings of Robert Dow, Maine Sea and Shore Fisheries and Dr. Willet of M.I.T.



Girl on Sandy Beach

Photo by Stephen Nichols

ENVIRONMENTAL QUALITY AND RECREATION

The environmental quality of the Maine coastal zone and the recreational satisfaction it provides is the coastal zone's most important attribute. Recreation contributes more to the Maine economy than any other coastal activity.[1] Because 85 percent of this activity is generated by visitors to Maine, and because there is great potential for working with the coastal landscape to draw an increasing number of recreational visitors, environmental quality and recreation represent the most important regional and national value of the Maine coast.

Regional and National Demand for Environmental Quality and Recreation

To understand regional and national pressures for recreation in Maine, it is useful to look at several characteristics of the northeastern megalopolis from which the greatest portion of this pressure originates. The northeastern megalopolis is characterized by general affluence, uniformity of economic development, and complexity of social organization. These characteristics cause the population to periodically seek recreation in an environment that contrasts markedly with the megalopolis. The frequency of this phenomenon may be judged from the weekend spectacle of urban superhighways jammed with cars crawling bumper to bumper out of the city toward the beaches, lakes, and mountains. The dimension of this phenomenon may be seen in the national statistics on national park visitors that show an absolute increase from 72,300,000 in 1960 to 164,000,000 in 1969 for a relative increase of 125 percent.[2] Driving times between major northeastern metropolitan centers and areas with significant landscape values are shown on Figure 8. This figure indicates that within the northeastern megalopolis, the predominance of high quality landscape is concentrated within Maine and New Hampshire and that these areas are within reasonable driving distance from major metropolitan areas.

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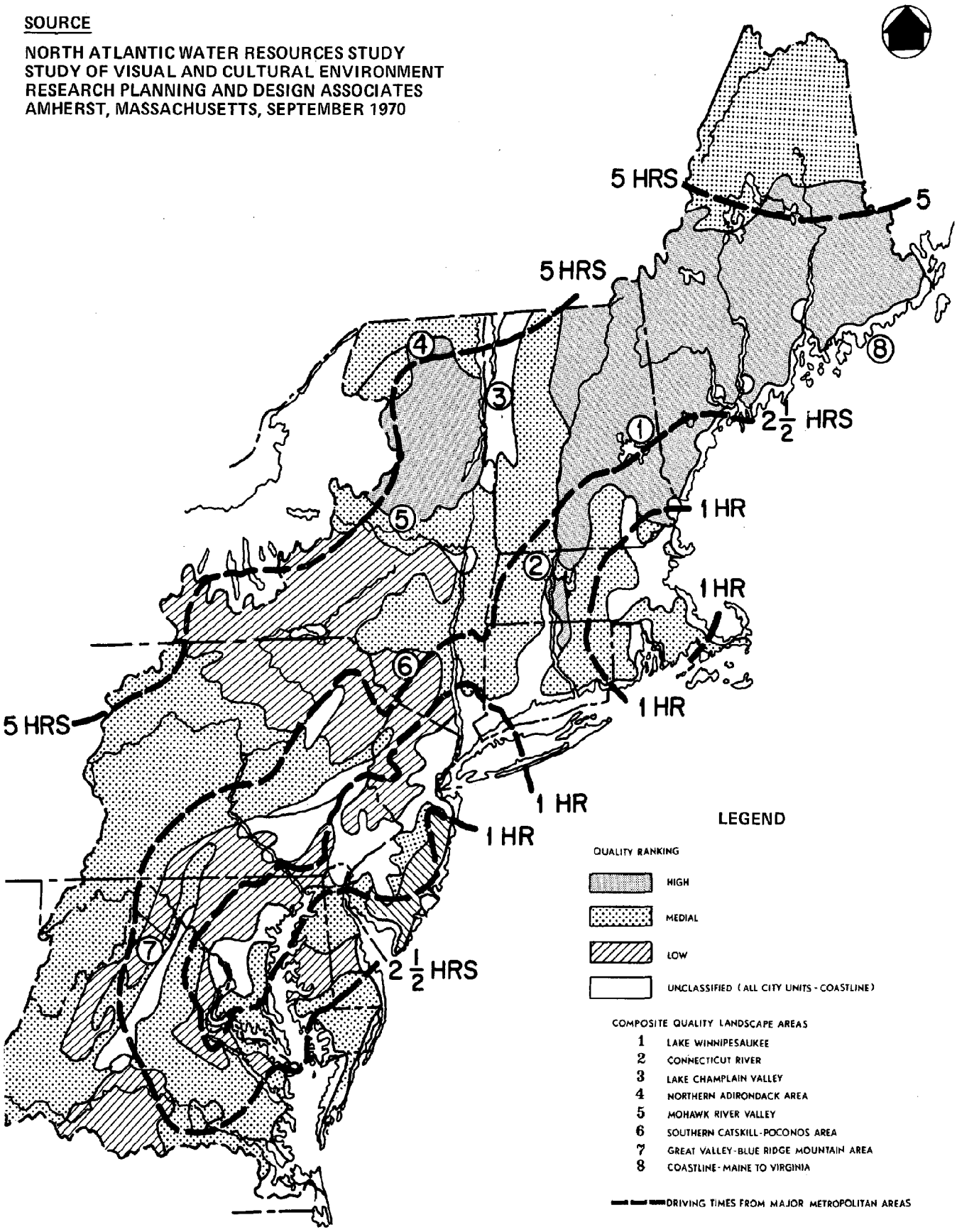
[1] Maine Pocket Data Book, 1969, Maine Department of Economic Development, 1970; and Public Investment Plan, Recreation Componant, Cycle 4, Maine State Planning Office, 1971.

[2] National Park Service Public Information Office, Philadelphis, Pennsylvania.

SOURCE

NORTH ATLANTIC WATER RESOURCES STUDY
STUDY OF VISUAL AND CULTURAL ENVIRONMENT
RESEARCH PLANNING AND DESIGN ASSOCIATES
AMHERST, MASSACHUSETTS, SEPTEMBER 1970



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	LANDSCAPE QUALITY & DRIVING TIME FROM MAJOR METROPOLITAN AREAS IN THE NORTHEASTERN MEGALOPOLIS	FIG. 8 NO.

The out of state coastal recreation public is estimated to have spent 12 million visitor days in the coastal zone in 1969,[1] and this figure is increasing at the annual rate of 8 percent.[2] The extent of seasonal non-resident population increase for each coastal town is illustrated in Figure 9. The data upon which this figure is based are preliminary estimates which have not been confirmed through a census. Nevertheless, this information may serve to show the relative degree of increase for each town. Appendix A presents the absolute increase of the seasonal non-resident who owns property in Maine and vacations there for a month or more, and the tourist-vacationer who occupies public accommodations for a period of less than a month.

The first group, the seasonal non-resident, spent about 8.4 million visitor days in Maine in 1969. Although recreational development trends would tend to indicate this population is increasing, there is no reliable data available to corroborate these increases. Vacation homes comprise about 20 percent of the total coastal homes (33,012 seasonal homes versus 179,973 total homes in 1969).[3] With a few exceptions, there has not yet been significant pressure for second home development on lands of high natural values. However, these exceptions are significant. They include about 20 lineal miles of shoreline between Portland and Kittery. Here non-residents have clustered small vacation cottages along the shoreline. These clusters substitute a view of crowded vacation homes for a view of the natural coastline. A recent report noted that the same type of development is beginning to occur further east:

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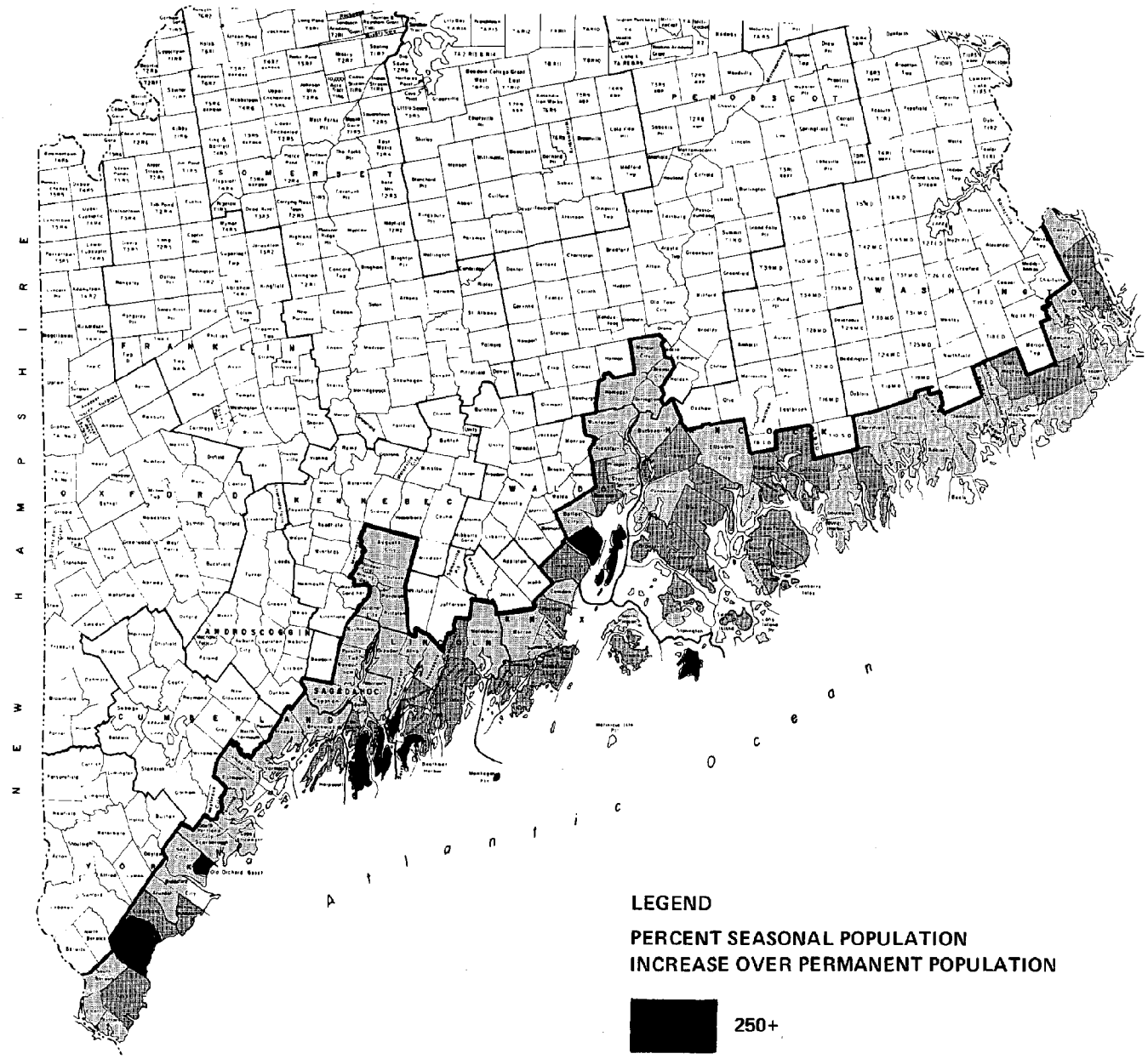
[1] NERBC Staff estimates based on Public Investment Plan, Recreation Component (Cycle 4), Maine State Planning Office, 1971 and Maine Coastal Development Plan, Phase 1 Report, Maine State Planning Office, 1970; and Northern New England Vacation Home Study 1966, Department of the Interior, Bureau of Outdoor Recreation, 1967. 12 million visitor days is calculated: 33,000 seasonal homes times 255 visitor days (Table 5) plus 3.6 million public and private recreation area visitor days.

[2] ibid., Public Investment Plan.

[3] ibid.



SOURCE:
MAINE COASTAL DEVELOPMENT PLAN , PHASE 1
REPORT, MAINE STATE PLANNING OFFICE ,1971

NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971		SEASONAL POPULATION PRESSURES IN MUNICIPALITIES OF THE STATE OF MAINE COASTAL ZONE

FIG. 9 NO.

"The coastal region stretching from Portland to Acadia National Park is rapidly becoming the summer habitat of thousands of out-of-state residents. According to local reports most of the coastal area is owned by such people."[1]

A 1966 study indicated that a vacation home in Maine receives less usage than its counterpart in New Hampshire and Vermont. Table 5 illustrates this comparison.

Table 5

Average Vacation Home Seasonal Usage
in Visitor Days
1966

	Northern New England	Maine	New Hampshire	Vermont
Days in summer	224.8	199.7	247.2	229.4
Days in fall	38.2	28.8	45.0	42.0
Days in winter	10.2	3.1	14.9	13.6
Days in spring	31.6	24.1	36.9	34.6
Annual use	304.8	255.17	344.10	319.6

Source: Northern New England Vacation Home Study, 1966, U. S. Department of the Interior, Bureau of Outdoor Recreation, 1966.

[1] National Estuary Study, Department of the Interior, Bureau of Sports Fisheries and Wildlife, 1970.

Vacation homes in New England are estimated to have increased at the rate of 2.7 percent per year between 1956 and 1966.[1] No estimate is available for Maine but there are major second home developments planned for many coastal areas of Maine including Roque Bluffs, Frenchman's Bay, Englishman's Bay, and Swans Island.

The tourist-vacation group, spent about 3.6 million visitors days in the coastal zone in 1969.[2] Of this group, those who visited state and national public parks increased 85 percent from 1,655,351 in 1960 to 3,069,522 in 1969.[3] Of this three million total, 87 percent or 2.7 million is estimated to be out-of-state demand, and 55 percent or 1.7 million is estimated to be regional demand originating within the other New England states.[4] Visitors to Acadia National Park have increased 53 percent (1,520,000 in 1960 to 2,230,000 in 1969) while visitors to state parks in general increased 620 percent (135,000 to 841,000).[5] The absolute amount of increase is comparable for the two park categories (708,900 national park versus 705,700 state park).[6] When the rate of increase of visitors to Acadia National Park is compared with the rate of increase of visitors to all national parks, it is evident that Acadia's 53 percent rate of increase is substantially below the national level of 125 percent. This relation is portrayed graphically in Figure 10.

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[1] Northern New England Vacation Home Study - 1966, U. S. Department of the Interior, Bureau of Outdoor Recreation, 1966.

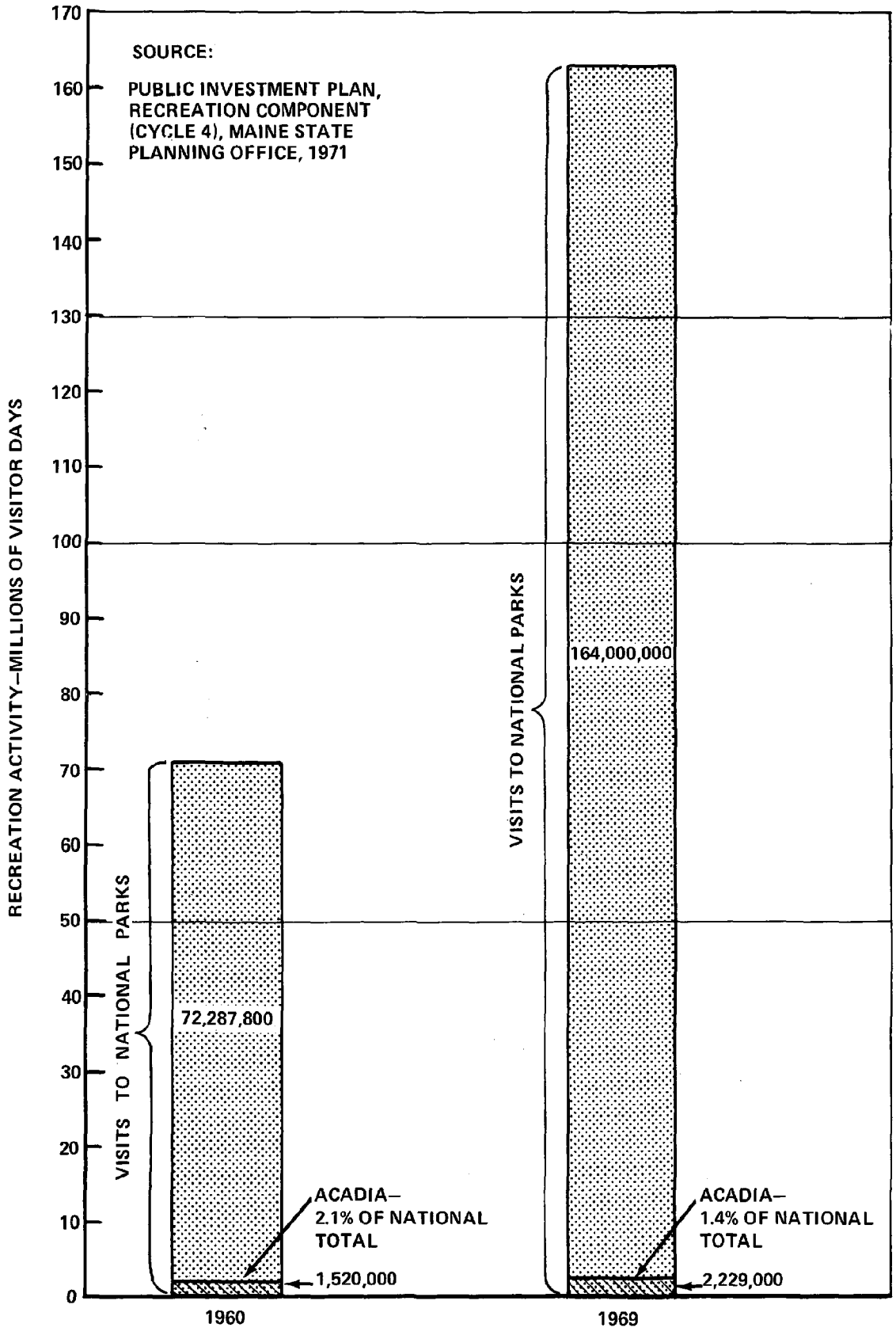
[2] Calculated from the data in Table 7 by estimating that 75 percent of the commercial rooms are used by out-of-staters, and that 85 percent of the other five categories are used by out-of-staters.

[3] Public Investment Plan, Recreation Component, Cycle 4, Maine State Planning Office, 1971.

[4] Ibid

[5] Ibid

[6] Ibid



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	RECREATION ACTIVITY AT ACADIA NATIONAL PARK COMPARED TO NATIONAL PARKS	FIG. 10 NO.

Out of state recreation demand for visits to public parks has been projected at three alternate levels. Table 6 and Figure 11 present these projections. The 27.5 percent per decade level (Alternate A) approximates the NAR rate. The 40 percent per decade (Alternate B) is slightly under the rate of increase for Acadia National Park. The 80 percent per decade (Alternate C) is well below the national level of 125 percent for total visitors to national parks, but is roughly equal to the rate of increase for all state and national Maine coastal zone parks. The highest projection is reasonable when one considers the effects of possible future transportation improvements and patterns of leisure time and recreation.

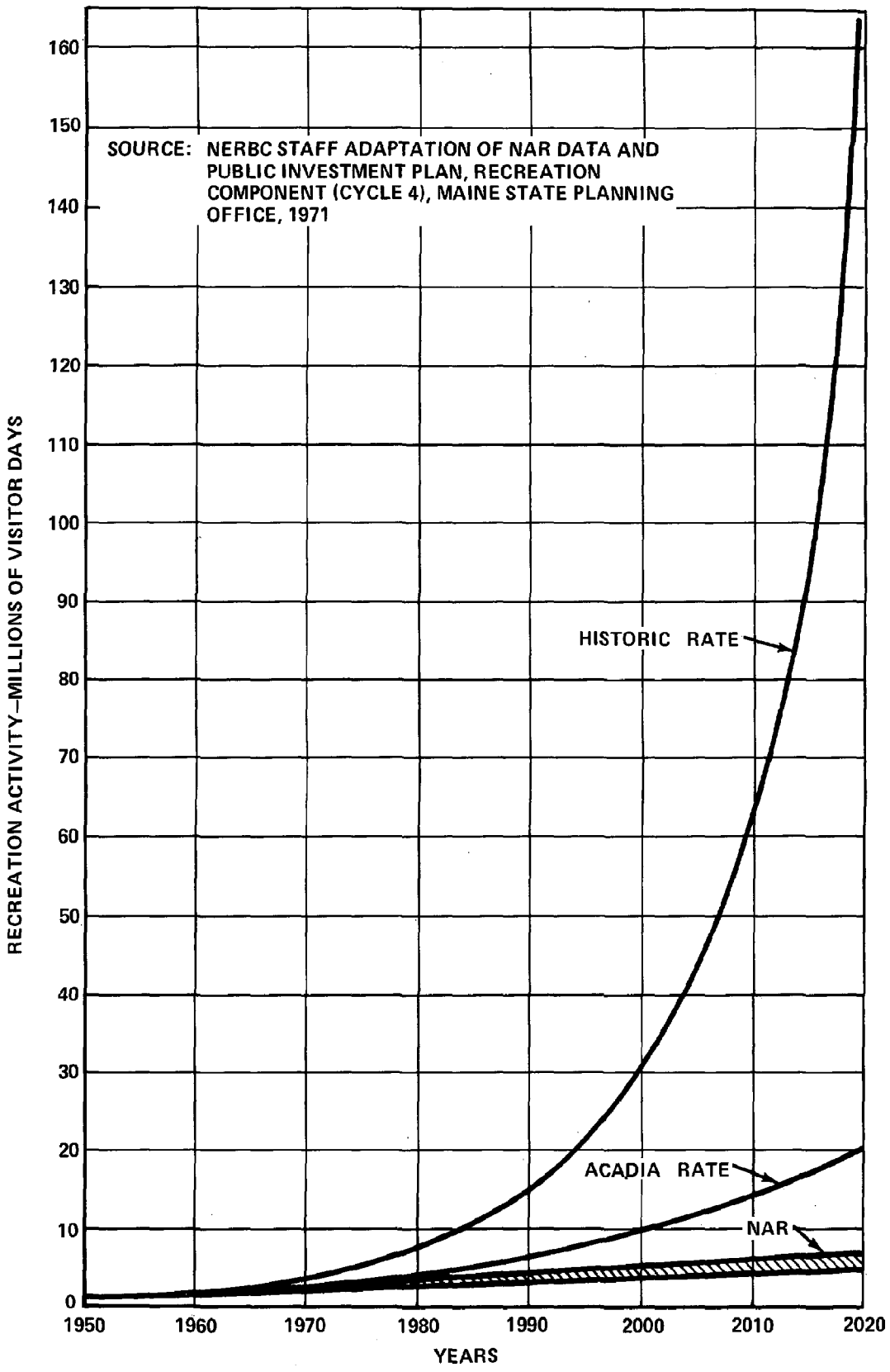
Table 6

Comparative Estimates of Regional and National Demand at Public Recreation Areas in the Maine Coastal Zone (millions of visitor days)

	1960	1969	1980	2000	2020
Alternate A	1.7	3.0	4.2	6	11
Alternate B	1.7	3.0	4.7	10	22
Alternate C	1.7	3.0	7.0	33	155

Sources: NERBC Staff estimates based on NAR Study, and Public Investment Plan, Recreation Component, Cycle 4, Maine State Planning Office, 1971.

As a further indication of regional and national demand for recreation it is useful to consider the use of overnight accommodations. The following table indicates that there are overnight accommodations for about 93,339 persons along the Maine coast at any one time, and that they were used by 4.9 million overnight users in 1968. It is estimated that these accommodations have a high level of occupancy of about 63 percent during the busy



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971		PROJECTED VISITORS TO PUBLIC RECREATION AREAS IN THE MAINE COASTAL ZONE	FIG. 11 NO.

months of July and August.[1] If we assume that 75 percent of the users of commercial rooms were out-of-state recreators, and that 85 percent of the other five categories of recreators shown in Table 7 were from out of state then there were 3.6 million out of state recreational visitors to the coastal zone. This compares favorably with the previous estimate of the 3 million visitors to public parks and leaves 600,000 visitors who visited only private recreation facilities.

Table 7

Capacity and Use of Overnight Accommodations
Along the Maine Coastal Zone

Category	Number of Accommodations	Capacity, persons	Use, visitor-days
Public campgrounds	850	3,400	292,000
Commercial rooms	743	61,248	2,449,000
Youth camps	189	19,769	870,000
Trailer courts	172	3,873	542,000
Tenting grounds	75	3,091	433,000
Private Camp grounds	35	1,958	274,000
		93,339	4,860,000

Source: Public Investment Plan, Recreation Componant Cycle 4, Maine State Planning Office, 1971.

The non-resident sport fisherman and hunter is increasing the pressure on the fish and wildlife resources of Maine. In 1962, non-residents purchased 28 percent (103,394) of the total

[1] NERBC Staff calculation based upon data in Table 7.

fishing and hunting licenses throughout the state amounting to a state revenue of $1 million; while by 1968 non-residents purchased 35 percent (122, 997) of the total licenses for a revenue of $1.5 million.[1] Statewide non-resident demand for fishing licenses grew at an annual rate of 1 percent for the period 1962-1968. However, in 1967-1968 the demand increased 10 percent NERBC staff estimates that coastal non-resident fisherman comprise 22 percent of the total. These figures reflect only fresh water fishing demand since salt water fishing does not require a license.

Restoration of the Atlantic Sea Salmon to the Penobscot River should significantly increase non-resident fishing demand in the coastal area. The dramatic 1967-68 increase may already anticipate this potentiality. Opening the Penobscot salmon run is likely to increase fishing demand at the existing salmon runs on the Narraguagus, Pleasant, and Machias rivers. To compare alternate possibilities, coastal non-resident demand has been projected in Table 8 at both the historic 1 percent level (Alternate A) and at a rate equal to the growth rate of recreation visitors of 8 percent per year (Alternate B).

Table 8

Estimated Future Demand for Non-Resident Sport Fishing in the Maine Coastal Zone

	1962	1968	1980	2000	2020
Non-resident freshwater fishermen					
Alt. A	22,650	26,250	44,000	79,000	142,000
Alt. B	22,650	26,250	66,600	306,000	1,430,000

Source: NERBC Staff estimates based on Maine Pocket Book, 1969, Maine Department of Economic Development, 1970.

[1] Maine Pocket Data Book, 1969, Maine Department of Economic Development, 1970.

Factors influencing demand for use of pleasure craft include the nature of island and shoreline recreation development, transportation patterns, and regional and national affluence. While recreational boating is scattered along the coast on both freshwater lakes and salt water coves, coastal areas receiving particularly heavy boating usage are Wells, Kittery, Kennebunkport, Boothbay Harbor, Brunswick, Freeport, Casco Bay, Penobscot Bay, and Mt. Desert Island. [1]

Table 9

Estimated Pleasure Craft Within the Maine Coastal Zone

	1970	1980	2000	2020
Alternate A				
Registered boats	54,800	71,600	86,000	104,000
All boats	96,200	107,000	185,000	328,000
Alternate B				
Registered boats	12,000	31,000	207,000	1,400,000
All boats	24,000	61,000	414,000	2,800,000

Source: NAR Study, and Maine Bureau of Water Craft Registration & Safety.

The demand for water contact sports along the Maine coastal zone is most intense along the southern Maine coastal sand beaches and at scattered lakes. The cold water temperatures and rocky shoreline severely restrict swimming demands at other coastal locations. The magnitude of water contact activity demand for the coastal zone has not been documented.

[1] Conversation with Mr. Robert Johnson, Maine Bureau of Water Craft Regulation and Safety, January, 1971.

The NAR Study has projected fishing and hunting demand at a level of 4 percent for the next decade and then at 1-2 percent for the period from 1980 to 2020. It is useful to consider the possibility of a higher 8 percent growth rate which would reflect the effects of increased sport fishing opportunities created by pollution control, aquaculture developments, more leisure time, and improved public access to fishing areas.

Recreational boating is a popular coastal activity in Maine. There are 12,000 boats of 10 horsepower or larger, and probably an equal number unregistered (smaller than 10 horsepower) and non-powered pleasure craft.[1] This is significantly lower than the NAR Study estimate of 54,800 registered boats. State data indicates that demand for pleasure craft has grown at the rate of 10 percent per year over the last decade. This varies substantially from the national 6 percent growth rate[1] and from the level used by the NAR Study for Maine which assumed a 2.5 percent annual growth rate. Table 9 projects growth rates at the NAR Study level (Alternate A) and at the state historic level (Alternate B).

No information is available on the percentage of out of state ownership or on the numbers of boats visiting Maine from other areas, but a visual April to October check of any coastal yacht basin will reveal that there are many out of state boats cruising the Maine coast. Many of the seasonal non-residents have boats registered in Maine.

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[1] Statewide there are 39,600 registered pleasure craft. It is estimated there are an equal number of non-registered pleasure craft. There are 4,400 commercial craft all of which are estimated to be in the Coastal Zone. (From a conversation with Robert Johnson, State of Maine, Bureau of Water Craft Registration and Safety, Jan. 1971).

[2] Tourism and Recreation, A. D. Little, October 1966. Estimated are for 1951-65 period.

Environmental Quality and Recreational Facilities

Maine's greatest coastal asset from the standpoint of recreation is its coastal landscape. This landscape is classified as forest-wilderness from the Canadian border to Acadia National Park, and as forest-town from Acadia to the New Hampshire Border. [1] Areas of special environmental value are shown in Figure 12. The towns are small, only 19 out of 139 being over 5,000 population. [2] The largest city is Portland with a population that has declined from 72,000 in 1960 to 65,000 in 1970. [3] The coastal landscape encloses numerous fresh water lakes and salt water coves within a great variety of steep hills, peninsulas, and dramatic headlands as shown in Figure 13. The steep hills in the vicinity of the mouth of the Penobscot River and within Mount Sesert Island add particular drama to the central portion of the long coastline as shown in Figure 14.

About 929 square miles or 27 percent of the coastal zone landscape is subject to some form of landscape protection. Of this, only 60,000 acres or 3 percent is preserved landscape. Preserved landscape includes Acadia National Park, Moosehorn and Rachel Carson Wildlife Refuges, and the state park and wildlife areas including Camden Hills State Park and the Scarboro Marsh. The remaining protected landscape is subject to zoning controls in 32 out of the 139 towns. These 32 towns have zoned 25 percent of the total landscape.

To protect the environmental quality of this landscape, Maine is administering legislation that seeks to ensure that economic development, including second home sub-divisions, will be compatible with environmental values. This is important because numerous second home real estate developments are being planned for shoreline and other ecologically fragile and environmentally valuable areas.

Table 10 shows estimates of the acreage which should be subject to protection if the visual and cultural values of the Maine Coast are to be maintained.

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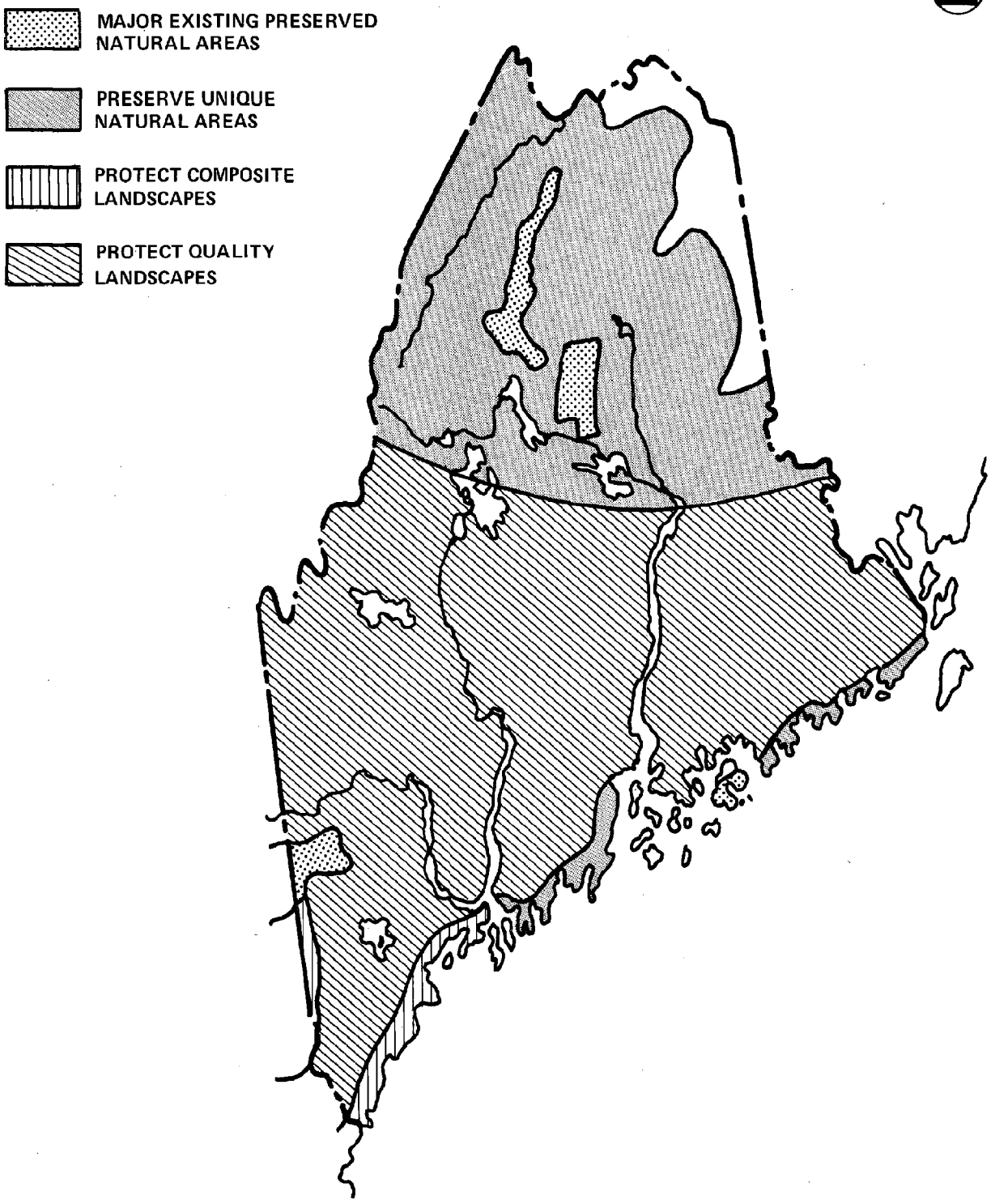
[1] NAR Study.

[2] Maine Coastal Development Plan, Phase 1 Report, Maine State Planning Office, 1970.

[3] U.S. Bureau of the Census, Dept. of Commerce, 1971.

LEGEND



SOURCE

NORTH ATLANTIC WATER RESOURCES STUDY
STUDY OF VISUAL AND CULTURAL ENVIRONMENT
RESEARCH PLANNING AND DESIGN ASSOCIATES
AMHERST, MASSACHUSETTS, SEPTEMBER 1970

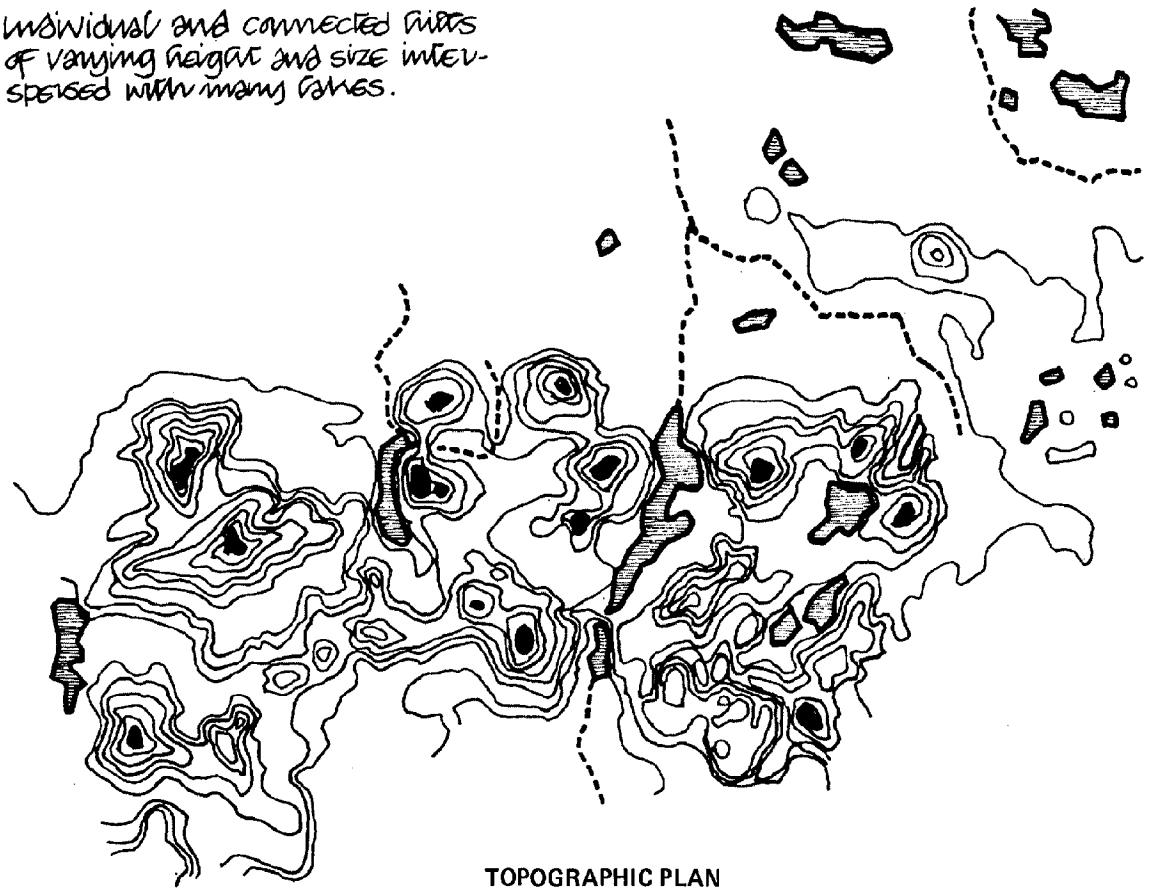
NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	NERBC	AREAS FOR SPECIAL ENVIRONMENTAL PROTECTION IN THE STATE OF MAINE	FIG. 12 NO.

Emerged rocky cliffs

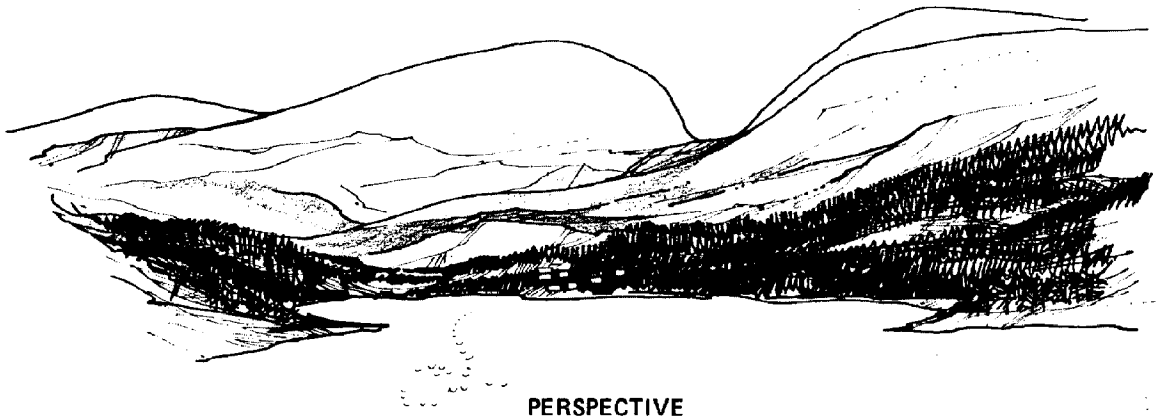
SOURCE: NORTH ATLANTIC WATER RESOURCES STUDY
STUDY OF VISUAL AND CULTURAL ENVIRONMENT
RESEARCH PLANNING AND DESIGN ASSOCIATES
AMHERST, MASSACHUSETTS, SEPTEMBER 1970

NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	EASTERN MAINE COASTLINE	FIG. 13 NO.

individual and connected cliffs of varying height and size interspersed with many lakes.



TOPOGRAPHIC PLAN



PERSPECTIVE

SOURCE: NORTH ATLANTIC WATER RESOURCES STUDY
STUDY OF VISUAL AND CULTURAL ENVIRONMENT
RESEARCH PLANNING AND DESIGN ASSOCIATES
AMHERST, MASSACHUSETTS, SEPTEMBER 1970

NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	PENOBSCOT AREA NORTHERN STEEP HILLS	FIG. 14 NO.

Table 10

Estimated Land Requirements to be Subjected to Landscape Protection in the Maine Coastal Zone

	1970	1980	2000	2020
Total requirements, thousands of acres	50	899	1,564	2,118
75% attributable to external demand, thousand of acres	38	670	1,173	1,580

Source: NERBC Staff adaption of NAR data.

Increasingly significant for landscape values are the 225,000 acres of Maine's 1,000 islands. Development pressures, stemming from recreational and commercial navigation interests, second home developments, and industrial site location for oil storage, oil refining, and electrical utilities, threaten island landscape values. The U.S. Bureau of Outdoor Recreation has recommended that some of the pressure for coastal recreation should be alleviated by establishing a number of national island trusts.[1] Within Maine, five such island trusts are proposed with the pilot program centering on Casco Bay. Eventually 200,000 island acres that are now privately owned would be subject to landscape protection through a system of easements and development restrictions, and 6,000 acres would be in direct ownership.

[1] Islands of America, U.S. Department of the Interior, Bureau of Outdoor Recreation, 1970. Beside the islands of Casco Bay, the report recommends the islands of Sheepscot Bay, Muscongus Bay, Penobscot Bay, and Upper Eastern Coast.

The amount of land available for general public recreation is small. Publically owned camp grounds, parks and recreation areas occupy only about 2 percent (40,000 acres) of the total Maine coastal landscape. At least two thirds of this is in Acadia National Park with the remaining acreage scattered among several state coastal parks. A recent report noted:

> "The State of Maine has acquired several seashore parks but these are not sufficient to meet the demands placed on them. While the marine resources values are high, they usually are found in relatively small, localized areas. In some of these, human pollution is a problem. Conservation of these marine resources values is believed to be a state problem." [1]

A National Park Shoreline Survey in 1955 found that most of the prime coastal recreation areas south of the Penobscot estuary had already been developed.[2] It noted, however, that there were 14 miles of shorelines in the Popham St., John and Crescent areas that could be acquired for public recreation.

Suggestions have arisen from many sources including the Sierra Club, the framework planning work performed by the State of Maine, the NAR Study, and the Islands of America Study of the Bureau of Outdoor Recreation that more public parks be developed along the Maine coast and on the Maine islands. The control over Acadia National Park will soon be extended over 70 islands in the region of Mt. Desert Island. Maine is considering additional parks in the Branch Lake and Roque Bluffs areas.[3] The Sierra Club has suggested the creation of a national seashore in the down east portion of Washington County.

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[1] National Estuary Study, Bureau of Sport Fisheries and Wildlife, Department of the Interior, January, 1970.

[2] Our Vanishing Shoreline, National Park Service, 1955.

[3] Conversation with Mr. Lawrence Stuart, Director, Maine Parks and Recreation, January, 1971.

These potential public park and recreation needs have been projected in Table 11 which compares a 4 percent annual increase in visitors (Alternate A) with a 10 percent growth rate that approximates the national level (Alternate B). This latter rate assumes that recreation facilities for intensive uses will be developed following 1980. Therefore, the acreage requirements do not follow a straight line projection. These acreage requirements include land for camping, hiking, and shoreline access for swimming, boating and fishing.

Table 7 shows that there are accommodations for only 93,300 travelers at any one time along the coastal zone. The distribution of these accommodations is such that many popular areas are not able to meet the seasonal demand for accommodations.[1]

Public protection for fish and wildlife resources constitutes only 0.8 percent of the coastal zone. The federal government, recognizing the regional and national interest in wildlife maintenance and the ecological relationship of Maine's habitat to the total Atlantic Flyway, has purchased about 7,700 acres for wildlife refuges and intends to purchase an additional 1,400 acres. The state has a similar awareness and has purchased about 9,800 acres for wildlife refuges.[2] If these acreages are combined with the acreages in federal and state parks, lands that offer a degree of wildlife habitat protection then comprise about 3 percent of the total coastal acreage.

Public saltwater swimming is limited to the quarter mile sand beach of Acadia National Park, and to the approximately 25 miles of public beaches between Popham Beach and Kittery. These areas receive capacity crowds during the summer. Cold water temperatures and the dominantly rocky shore limit extensive swimming opportunities elsewhere. Fresh water swimming is popular on most of the freshwater lakes in the coastal zone, but public access is limited due to the dominance of privately owned shorelines. Also, the lakes within Acadia National Park serve as water supply reservoirs and the general public is excluded from swimming in these.

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[1]NERBC Staff experience and discussions with Sheraton Plaza Hotel Staff in Boston.

[2]Public Investment Plan, Recreation Component (Cycle 4), Maine State Planning Office, 1971.

Table 11

Comparative Estimates of
Public Recreation Land Requirements in
the Maine Coastal Zone

	1970	1980	2000	2020
Alternate A				
Visitor growth rate		4%	4%	4%
Coastal shoreline acres		4,850	7,150	12,700
Lake shoreline acres		4,150	6,100	10,800
Non-shoreline acres including facilities		4,200	6,150	11,000
Total acres	42,000	13,100	19,300	34,500
Cumulative total acres	42,000	55,100	74,400	108,900
Total lineal shoreline miles of access		45	66	117
Alternate B				
Visitor growth rate		10%	10%	10%
Coastal shoreline acres		8,200	20,000	60,000
Lake shoreline acres		7,100	17,000	51,000
Non-shoreline acres including facilities		7,200	17,000	52,000
Total acres	42,000	22,500	54,000	163,000
Cumulative total acres	42,000	64,500	118,500	281,500
Total lineal shoreline miles of access		76	183	550

Source: NERBC staff adaption of NAR data.

Power and Energy

Power and energy needs of New England and the northeastern megalopolis have exerted an important impact on the coast of Maine and are likely to continue to do so in the future. The resource pressures produced by these power and energy needs are likely to significantly influence resource management decision making in the Maine coastal zone.

Power

Electrical power demands in the United States have been doubling every six to ten years. Forecasts of future electrical usage indicate that this trend is likely to continue unless legal, institutional, or social restraints are placed upon public electrical consumption. Past electrical usage and projected future use is presented in Table 12and Figures 15 and 16.

Table 12

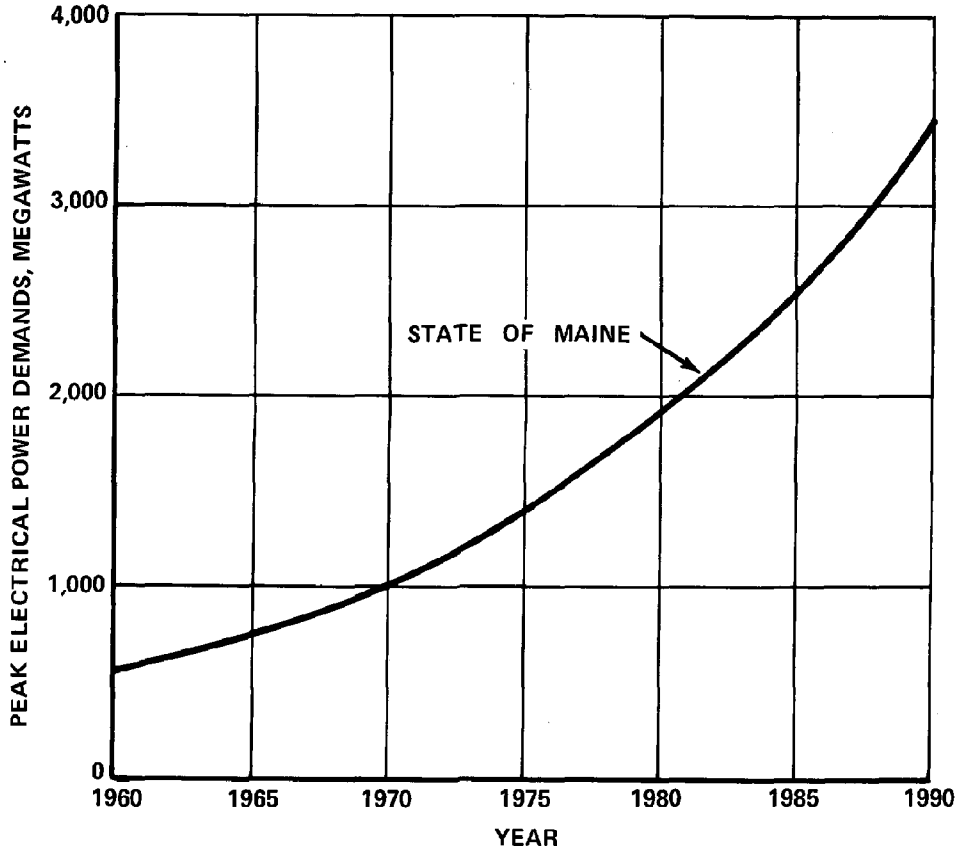
Estimated Future Regional Power Requirements in the Maine Coastal Zone

	1960	1970	1980	1990	2000	2020
Estimated Peak demand, megawatts						
State of Maine (1)	565	1,003	1,879	3,529		
New England (1)	6,181	11,900	25,100	52,800		
Northeastern United States (2)	27,517	51,230	92,770	164,640		
NAR Region (3)			115,895		348,200	853,800

Source: (1) A Study of the Electric Power Situation in New England 1970-1990, The New England Regional Commission, September, 1970.

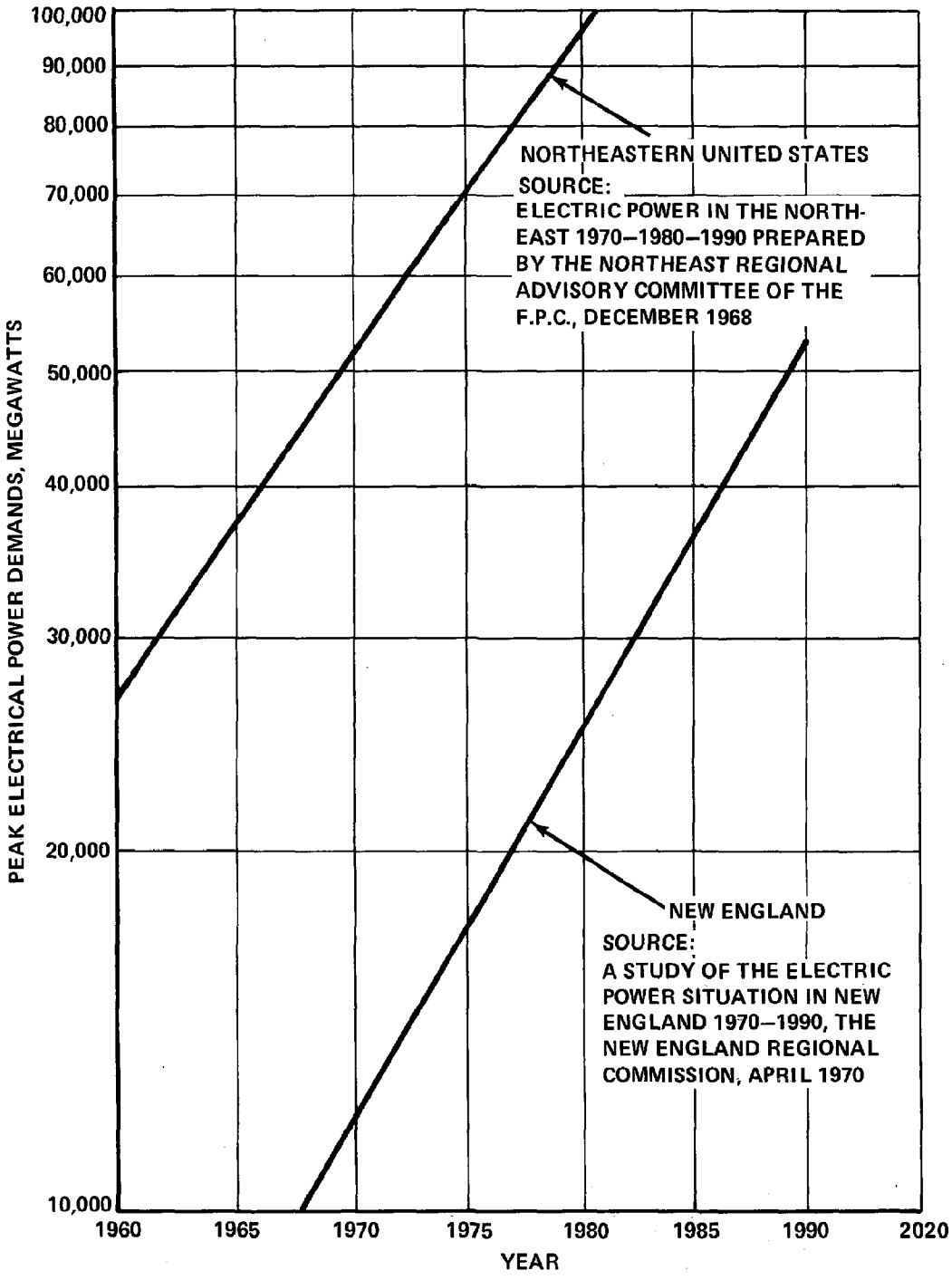
(2) Electric Power in the Northeast 1970-1980-1990, The Northeast Regional Advisory Committee of the Federal Power Commission, December 1968.

(3) NAR study data.



SOURCE: A STUDY OF THE ELECTRICAL POWER SITUATION IN NEW ENGLAND 1970–1990, THE NEW ENGLAND REGIONAL COMMISSION, APRIL 1970

NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	NERBC	PROJECTED FUTURE ELECTRICAL POWER DEMANDS FOR THE STATE OF MAINE	FIG. 15 NO.



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971	PROJECTED FUTURE REGIONAL ELECTRICAL POWER DEMANDS	FIG. 16 NO.

Power requirements in New England are expected to increase more than four times in the next 20 years. The historical growth rate in New England has been almost 7 percent annually and is increasing each year.[1] Nuclear power facilities are slated to be a major element of a more economical and reliable future power system for the region. These plants require large amounts of cooling water for their operation.

Concurrently with the growing power demands have come increasing complexities in the siting of power generation facilities. Social, environmental, economic, political, and legal considerations pose special problems in the site selection of a power generating facility.

A recent study[2] indicates that, by 1990, 70 percent of the electrical power produced in New England will be generated by nuclear power plants. The report points to the economic benefits of such a development. Nuclear power plants, however, are relatively inefficient in terms of heat utilization and generally are of large size requiring significant quantities of cooling water. Approximately 0.7 to 1.0 million gallons of water per day are required for each megawatt of electrical energy produced. The water used for cooling purposes is raised approximately 20 to 30°F in the process.

Cooling towers provide an alternative but less economical method of cooling; they are not technically feasible with saline waters, however, the use of cooling towers could increase power costs up to five percent above once through cooling water use.

The report further notes that environmental considerations must be paramount in the design and siting of future power plants and transmission lines, and suggests that the waste heat must be used or managed in a manner that will not be excessively disruptive to the area ecology.

The report concludes that New England has advantages over most sections of the country for waste heat disposal because its abundant cold water affords a unique opportunity to dispose of the excess heat from large generating plants without disturbing the ecological balance.

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[1] A Study of the Electric Power Situation in New England 1970-1990, New England Regional Commission, September 1970.

[2] Ibid.

The Maine coast with its cold waters (60° F or lower during the summer) and remote locations offers special advantages for the location of thermal power plants. The Wiscasset nuclear plant is the first major power plant now under construction in the state. This facility will use about 600 mgd of water and will generate 830 MW.

Attempts will likely be made to generate large blocks of electrical energy along the Maine coast for export out of the state to service the megalopolitan areas to the south. Alternative projected electrical power generation along the Maine coast and associated cooling water requirements are presented in Tables 13 & 14 and are shown graphically in Figure 17. The present maximum capacity of a power plant is about 1,000 MW.

Table 13

Estimated Future Power Generation in the Maine Coastal Zone

	1968	1970	1980	2000	2020
Total electric generation capacity, megawatts (1)	200	200	2,300	17,000 21,500	41,600 60,000
Total cooling water requirements, * million gallons per day (2)	150	150	3,000	13,500 19,000	25,000 45,000

*Water requirements are based upon once through cooling water use.

Source: (1) NERBC staff adaption of NAR study data.

(2) NERBC staff estimates.

Table 14

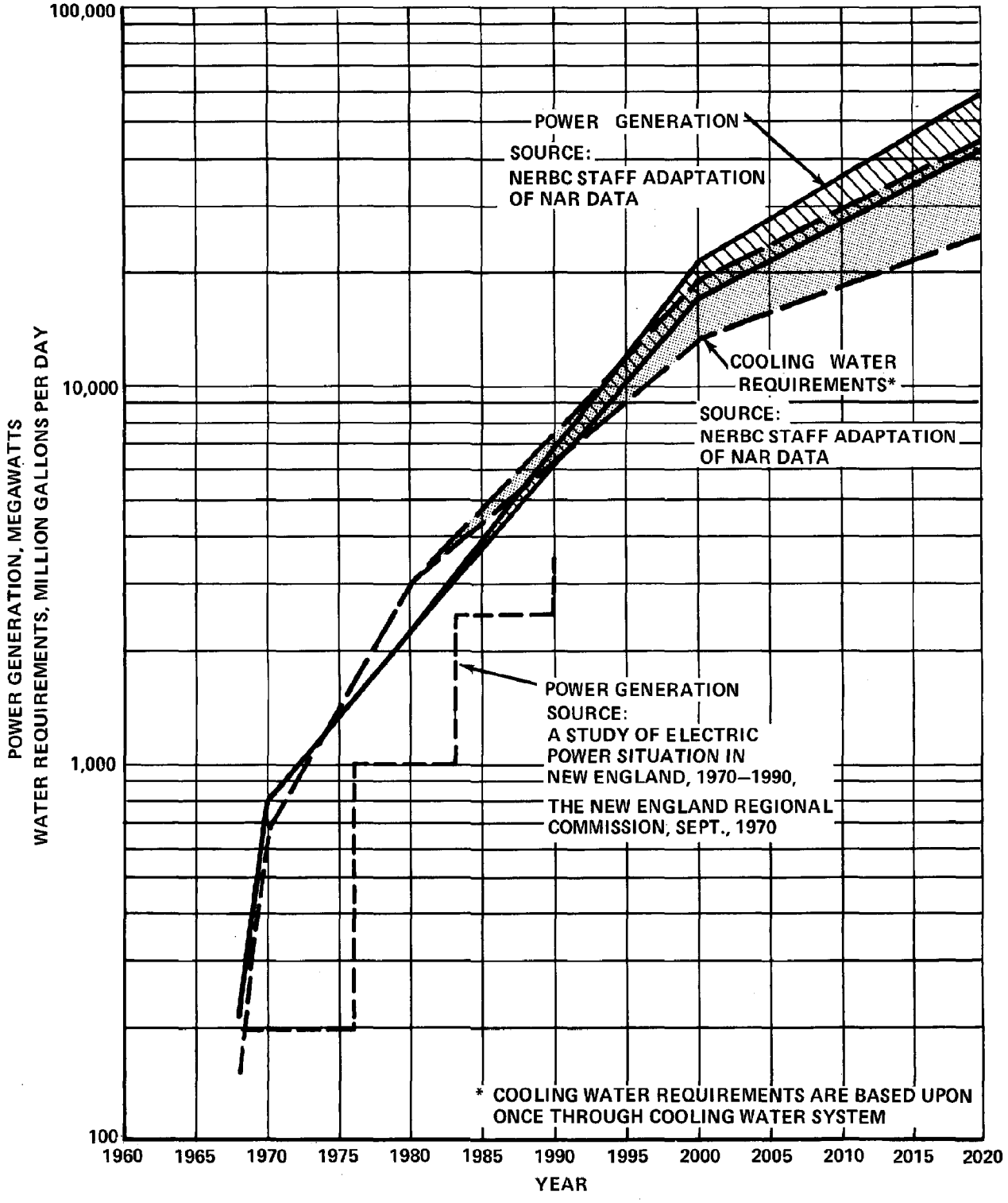
Estimated Future Power Generation in the Maine Coastal Zone

	1968	1970	1976	1983	1990
Total electric generation capacity, mega-awatts	200	200	1,030	2,430	3,430

Source: A Study of Electric Power Situation in New England 1970-1990, The New England Regional Commission, September 1970.

Siting and land requirements for power plants are an additional important consideration. At present, the Wiscasset plant requires about 200 acres of land for siting including a buffer zone. Projections indicate a requirement for additional plants to occupy 400 acres by 1980, 1200 acres by 2000 and 7,500 acres by 2020. This estimate anticipates 20 to 30 power facility sites in the state by the year 2020.

A broad analysis of the social, environmental, economic and political problems of thermal power plant siting was developed in a report titled Considerations Affecting Steam Power Plant Site Selection prepared by The (federal) Energy Policy Staff of Office Science and Technology in December of 1968. Using this report as a basis for its action the New England River Basins Commission has adopted the following policy statement on thermal power plant siting in New England.



NEW ENGLAND RIVER BASINS COMMISSION BOSTON, MASSACHUSETTS JANUARY 1971		POSSIBLE FUTURE ELECTRICAL POWER GENERATION IN THE MAINE COASTAL ZONE & ASSOCIATED COOLING WATER REQUIREMENTS	FIG. 17 NO.

Statement on Thermal Power Plant Siting

Adopted by the New England River Basins Commission
February 13, 1969

Definition of Problem

Peak electrical power demand in New England is approximately 12,000 megawatts (MW) at the present time. By 1980 the demand is expected to approach 20,000 MW and by the year 2000, 70,000 MW may be required. Current trends in New England power development indicate that a major block of the baseload power will be generated by nuclear fueled power plants. The remainder would be fossil fueled. Three significant constraints related to these facilities are that (1) the plants must be of high capacity (usually nuclear plant capacities exceed 500 MW.) in order to be economically feasible, (2) large quantities of waste heat must be dissipated to a coolant, usually water, and (3) exhaust gases may be toxic. Approximately one million gallons per day of cooling water are required per MW of power plant capacity. Several unresolved environmental factors are associated with the siting of these power plants. These factors include: (1) the aesthetic aspects of siting adjacent to major bodies of water, (2) the ecological effects of thermal and nuclear waste disposal and (3) the health effects of toxic air pollutants.

In addition to the numerous fossil fuel thermal plants, seven using nuclear fuel have been completed, are under construction or firmly proposed in New England. Land acquisition for an additional plant has been publicly announced. By 1980 three additional plants will be required, and by the year 2000 the total for New England may approach 18.

The Commission considers siting of thermal power plants to be an urgent issue.

Factors Affecting Siting

The Commission recognizes the need for thermal power generating facilities in New England and the several unresolved environmental issues associated with the siting of these facilities. Recently, the Energy Policy Staff, Office of Science and Technology in cooperation with the Atomic Energy Commission, Department of Health, Education and Welfare, Department of Interior, Federal Power Commission, Rural Electrification Administration and Tennessee Valley Authority published a report entitled Considerations Affecting Steam Power Plant Site Selection. Page VIII of that report lists 11 factors to be considered in thermal power plant siting. The remainder of the report substantiates these factors. The factors are as follows:

1. Comply with the safety criteria for nuclear plants as prescribed by AEC.

2. Comply with air pollution criteria and standards as established by the States and the National Air Pollution Control Administration of HEW.

3. Comply with the water quality standards for thermal effects as established by the States and the Federal Water Pollution Control Administration of the Department of the Interior.

4. Develop the opportunities for public recreation at plant sites and avoid impairing existing recreational areas.

5. Consider aesthetic values and give adequate attention to the appearance of power plant facilities and associated transmission lines.

6. Recognize the rural development considerations in plant siting.

7. Consider the siting and lead-time requirements for reliability of service.

8. Consider the impact on defense preparedness of particular sites and power plant capacities.

9. Consider the routing of associated transmission lines and the problems of rights-of-way at various alternative plant locations.

10. Assure that the plant will be of sufficient size to meet regional loads including mutually agreeable arrangements for meeting the bulk power needs of the small utilities.

11. Consider prospects for combining power plants with other purposes such as desalting plants, industrial centers, and even new cities.

The Power and Environment Committee of the New England River Basins Commission has been intensively studying the subject of thermal plant siting. The findings of the committee are consistent with the comments on environmental factors of the study of the U.S. Energy Policy Staff. The Commission urges that all public and private organizations which propose, evaluate or approve thermal power plants consider those factors which relate to use of or effects on water and related land resources. Special attention should be given to thermal pollution--to more precise determination of thermal effects, and to careful implementation of protective criteria in State and Federal water quality standards programs. The Commission notes that thermal plant siting factors should include compliance with State as well as Federal criteria.

It is the judgment of the Commission that existing procedures for public agency review and approval of thermal power plant construction projects do not provide for adequate consideration of the effects of such power plants on water and related land resources. The Commission will consider and recommend ways

of improving procedures related to water and related land resources, and may offer recommendations for improvement of State and Federal review and approval of programs.

The Commission will, within existing authority, work informally during the months ahead to help evaluate sites proposed for early development from the standpoint of water and related land use. The Commission believes that a special region wide study of future sites from this standpoint is urgently needed, and will work with appropriate public and private institutions to attempt to get such a study underway.

Energy

The major source of energy for New England and the northeastern United States is petroleum. The importation of oil and petroleum products has had a significant role in shaping the resource use of several areas along the Maine coast including Portland and Searsport. Based on past trends and current activities, development relating to oil importation will exert significant pressures on the maine coastal zone in the future. Table 15 indicates the past trend of oil imports to the Maine coast. These trends suggest that oil imports have more than doubled in an eight-year period.

Table 15

Past Trends in Oil Imports to the Maine Coastal Zone

	1960	1965	1968
Total tonnage, million tons per year	16.3	19.1	27.2

Source: Maine Port Authority

Estimates by the New England Fuel Institute indicate that the consumption of fuel in New England will increase approximately 4 percent annually. Approximately 10 percent[1] of the oil currently consumed in New England is used by the electrical power industry. Electric generation demands for oil in the Northeastern United States are shown in Table 16 which indicates a substantial reduction in the oil requiremnts of the power industry over the next two decades.

[1] Bureau of Mines.

Table 16

Projected Electric Generation Demands for
Oil in the Northeastern United States

	1966	1970	1975	1980	1985	1990
Electrical energy generated by oil, billion kilowatt - hours	43.4	43.8	36.5	30.1	26.0	23.6

Source: Electrical Power in the Northeast 1970-1980-1990, The Northeast Regional Advisory Committee to the Federal Power Commission, December 2, 1968.

Eighty to ninety percent of the oil imported is used outside of Maine. Significant factors in determining quantity of petroleum imports are the oil pipelines from Portland to Montreal, and Searsport to Bangor. Approximately 80 percent of the 26 million tons of oil imported to Portland is pumped to Montreal via the pipeline. During the winter months when the St. Lawrence Seaway is frozen and closed to tanker traffic, this pipeline serves as a major energy source. In addition much larger tankers can dock at Portland than can navigate to Montreal.

The future possible pressures for additional petroleum importation and refining facilities along the Maine coast are real but dependent on many variables. Certainly the deep water harbor areas of the coast including Machiasport, Sears Island in Penobscot Bay and Long Island in Casco Bay offer special attractions for oil importation. On the other hand, major questions concerning environmental control, oil import quotas, free trade zone designation, Alaska oil development and Canadian petroleum development will continue to exert significant influence on the public-private decision making process for development of these ports.

Wells Harbor Breakwater

Resource Conversion and Manufacturing

The northeastern United States has traditionally not looked towards the Maine coastal zone for major resource conversion or manufacturing activities. The region has, in general, exerted only light pressures on Maine's coastal resources in this regard.

The major economic activities that have converted Maine coastal resources into urban demand commodities have principally been the food and fiber industries. The state's principal industrial element, pulp and paper, transforms forest resources into paper products. About 20 percent of the pulp and paper industry in the state is located in the coastal zone.[1] The food processing industry, principally poultry and seafoods, also constitutes an important industrial activity in the coastal zone.

The poultry industry uses large amounts of fresh water and the seafood processing industry uses great quantities of saline waters. These industries have, therefore, had an important impact on water quality since their waste production has deteriorated significant areas of the coastal zone.

Present developmental interests along the Maine coast include more intensive commercial fishing, the initiation of a more expansive practice of aquaculture, oil or mineral extraction, and bulk shipping and processing facilities associated with deep water ports. The future viability of these interests is dependent on multiple social, economic, environmental, legal and institutional variables, and forecasts would, therefore, be highly speculative.

Resource conversion and manufacturing can induce severe use conflicts in the coastal zone both in terms of land requirements and environmental stress. The scale and intensity of these economic activities will largely dictate the degree of conflict.

Commercial Fisheries

The fisheries resources of the Maine coast includes commercial fishing, shell fishing, lobster trapping, bloodworm harvesting and the special national consideration of anadromous fisheries (Atlantic salmon). Fisheries farming of the ocean or aquaculture has recently achieved significance. Well over 80 percent of the

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[1] NERBC staff estimates based upon Lockwood's Directory of the Paper and Allied Trades, Lockwood Publishing Co., 1967.

requirements for these activities are generated by out-of-state demands.[1]

For the last decade, the commercial value of Maine's fish catch has been 5 percent of the national total. The amount and value of the fish catch fluctuates markedly from year to year depending on both the abundance of marine fisheries and on market conditions. Generally, supply and demand are increasing at the rate of 5 percent per year. The landed value of 1968 was $25 million which equals an economic value to Maine of $74 million. Lobster has accounted for 60 percent of this catch, and while bloodworms and shrimp each occupy only 6 percent of the total, they show the fastest growth rate. Shrimp nationally comprise 55 percent of the value of the total fish consumed by Americans, but the Maine catch occupies only 0.5 percent of this total.[2] Nevertheless, commercial fishing is an important element in Maine's economy with Maine being the fifth largest employer of commercial fishermen among the fourteen Atlantic coastal states.[3]

Coastal zone pollution is a severe problem in terms of commercial clam production in that about 71,000 acres of shellfhish beds are closed to commercial and recreational harvesting due to health restrictions stemming from pollution. These closings represent an economic loss equal to $2 million.[4]

Pressure on Maine's fisheries habitat until recently has not been great; less than 1 percent of the state's coastal wetlands between 1954-1964 were destroyed due to dredging, filling, or other activities.[5] A recent study indicates that Maine's 29,000 acres of wetlands and undesignated acres of oepn shoal estuaries rank twelfth in size among the fourteen Atlantic seaboard states.[6]

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[1] Maine State Planning Office.

[2] Aquaculture: The Determinants of Success, The Research Institute of the Gulf of Maine, 1970.

[3] Conversation with Marvin Boussu, National Marine Fisheries Service, Gloucester, Mass.

[4] Maine Sea and Shore Fisheries.

[5] Supplementary Report on the Coastal Wetlands Inventory of Maine, U.S. Fish and Wildlife Service, June 1965.

[6] A Plan for the Marine Resources of the Atlantic Coastal Zone, American Geographic Society, 1969.

Maine has purchased 2200 acres of the Scarboro Marsh below Portland along with 500 acres by Merrymeeting Bay, and other marshes on the Pleasant River near Addison. The federal government has purchased about 1,700 acres and is acquiring the remaining acreage of the approximately 2,400 acre boundary of the extended Rachel Carson National Wildlife Refuge between Kittery and Cape Elizabeth.

Attempts to regulate the filling of coastal marshlands by the state has met with legal difficulties.

The state is also engaged in a major effort to restore the Atlantic salmon to the Penobscot River. Salmon runs are currently maintained in the Machias, Narraguagus, and Pleasant Rivers. Pollution and dams currently hamper efforts for expeditious completion of the program, however, the National Anadromous Fisheries Restoration Act provides a helpful framework for acceleration of the effort.

Industrial Self-supplied Processing and Cooling Water

Water developed and used in the coastal zone by industry includes surface and groundwater sources, and saline and fresh water. Well over 80 percent of this water is withdrawn from rivers or the ocean.

The pulp and paper industry is the principal water user in the coastal zone with an estimated use in 1965 of 83 mgd. On a statewide basis, this industry accounts for almost 90 percent of the industrial water used.[1] A judgement may be made that this is also true in the coastal zone.

Food processing including fisheries products represents an important segment of industrial water use although the quantities of water being used are minor in comparison to the water used for pulp and paper products. Between 1965 and 1969 the shrimp catch along the Maine coast doubled each year (2 million to 24 million pounds). This increased production brought with it a sharp increase in saline water used for processing.

A major consideration for industrial water use in the Maine

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[1] NERBC staff estimates based on Water Use in Manufacturing, U.S. Department of Commerce, November 1966.

coastal zone is the degraded water quality along many areas of the ocean shoreline and the major rivers. Major areas of industrial water use in the coastal zone are Saco, Topsham, Westbrook, Belfast and Bucksport.

The major factors which will affect future industrial water use will be the availability of adequate quality fresh and saline water, the waste treatment requirements, and the nature of the industry. Stringent waste treatment requirements will induce reduced water usage by current and future industries. Estimated future industrial water requirements for the Maine coastal zone are shown in Table 17. Industrial self-supplied water has been increasing approximately 60 percent per decade.[1] This growth rate will probably be reduced to 30 percent per decade as a result of waste treatment requirements.

Table 17

Estimated Future Requirements for
Industrial Self-supplied Processing and Cooling Water
in the Maine Coastal Zone

	1965	1970	1980	2000	2020
Total estimated requirements, million gallons per day	70	120	160	270	455

Source: NERBC staff estimates based on Estimated Use of Water in the United States 1960 & 1965, U.S. Geological Survey.

External water demands are estimated to represent 85 percent of the total estimated requirements.

Future industrial water use along the coast will be dependent to a large extent on the type of industry which may locate in the zone. As an example, oil refining, aluminum refining and pulp and paper processing are heavy water using industries. Electronics manufacture and printing are examples of light water using industries.

[1] Estimated Use of Water in the United States, 1965, U.S. Geological Survey, 1966.

Minerals

Minerals of significance in the Maine coastal zone include sand, gravel, oil and gas. Development of either of these resources would have important national, regional and local implications.

Traditionally, Maine's coastal mineral resources development has consisted of quarrying for building rock for export out of state, limestone for transformation into cement and fertilizer, and sand and gravel. Copper, lead, zinc, gold, silver, molybdenite, mica, serpentine and grinding pebbles have been produced in the past in the Maine coastal zone. Although the Maine coastal area has led the other regions of Maine in value and tonnage of current mineral output in the past, output of many commodities has declined. [1]

Quarrying, which was particularly active on the coastal islands, is fairly dormant today. Other mineral commodities which are being produced or have been until recently are beryl, crushed stone, feldspar, granite, limestone, peat, and sand and gravel. Base metal sulfide deposits along the coast extend from Penobscot Bay to the New Hampshire border and are presently the subject of geological investigation for commercial extraction. Silver is mined at Cape Rosier on Penobscot Bay. Sand and gravel account for $6 million of the $17 million mineral industry. [2]

Off-shore mining of oil and gas involves a highly complex system of exploration and mining processes, fixed water and land facilities, and transport mechanisms which not only affect the marine environment but economic and physical development patterns of coastal lands as well.

Each year about one billion tons of sand and gravel are mined in the United States along our estuaries. Reliable figures for the value of sand, gravel, and other non-metal industrial materials are not available but an estimate of the value of sand and gravel production in the United States from the land is $850 million in 1964. Off-shore production of sand and gravel is estimated at perhaps $10 million additional. Nevertheless, quantities available are large

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[1] The Resources of New England, New York Region, NENYIAC, 1954.

[2] Maine Pocket Book, Maine Department of Economic Development, August 1969.

and recovery could be increased, given appropriate economic conditions and more detailed information on distribution and thickness. [1]

Sand and gravel used primarily as aggregate for concrete structures and highways, are extracted economically only when supplies are reasonably close to where they are used. Since transportation costs frequently exceed the value of the product, deposits of sand and gravel are much in demand only when they are close to large urban centers of consumption.

In urban areas adjoining estuaries, one answer to the need for maintaining short hauls, is to exploit sand and gravel deposits in bays, beaches, and harbors in the cities themselves. As a result of glacial transport of sand and gravel, the New England states have abundant deposits. Local restrictions on their development however, limits the value and usefulness of these reserves.

Though most of the Continental Shelf is mantled with sand, the seafloor of the Gulf of Maine is not. Sand is more patchy there, being restricted mainly to shallow, isolated banks and to shallow near shore areas. It is mixed with silt, clay, and gravel in some hummocky areas in the central gulf and is almost lacking from the very fine grain sediments in basins of the gulf. Thus, for metropolitan areas such as Boston and Portland, offshore sources of sand are less plentiful than they are for New York and Providence.

Gravel deposits have a much more restricted distribution than sand. Gravel in the Gulf of Maine is associated with a poorly sorted matrix of sand, silt, and clay in till-like deposits. Sources of gravel fairly close to land are quite rare along the Maine coast.

Major demands for sand and gravel can be expected to originate in southern New England metropolitan areas such as Boston, Providence, and the New York metropolitan area. Prime areas for sand and gravel are likely to be found on shallow coastal shelves around Cape Cod and Massachusetts Bays, Rhode Island Sound and the inner shelf adjacent to Long Island and New Jersey. Therefore, those areas will be likely to supply their own need. It is for these reasons that Maine can expect to be insulated from the economic benefits and environmental costs of sand and gravel production in the near shore area. If, however, major urban development or a major new highway construction program were

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[1] Sand and Gravel on the Continental Shelf off the Northeastern United States, U.S. Geological Survey, 1968.

to be initiated in the Maine Coastal Zone, these expectations could be reversed. [1]

Extensive exploration for oil resources in the international waters near Georges Bank indicate the likelihood of substantial off-shore oil fields. Oil interests outside of Maine have shown some interest in exploring the waters off the Maine coast for oil resources. The exploitation of off-shore oil fields would intensify interest in searching for oil near the Maine coast and in developing oil storage and refining facilities along the Maine coast.

The future of petroleum mining in the Gulf of Maine is very speculative. Should major new deposits be discovered, however, conflicts of this activity with marine research, commercial fishing, and all recreational water sport activities could be expected. In addition, there would be renewed pressure for large blocks of waterfront lands to support refineries, storage facilities, and ancillary industries, such as petro-chemical plants. These activities could have a tremendous impact on the coastal environment and other land and water uses.

In summary, the level of mining activity in Maine is expected to rise only slightly as a result of the continued development and exploitation of newly discovered mineral resources and in response to increased demands for gravel and sand. Unless there are major changes in the economics or technology of sand, gravel and petroleum production, or the discovery of any major new deposits in the Gulf of Maine, the mineral industry in the Maine coastal zone is not likely to impose major conflict. The future impact of the minerals industry on the Maine coastal zone, both in terms of economic development and environmental aspects is uncertain but there is a possibility it could pose significant stress on the natural systems of the region.

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[1] Sand and Gravel on the Continental Shelf off the Northeastern United States, U.S. Geological Survey, 1968.

Additional Significant Coastal Resource Problems

Three current major resource management problems are likely to increase in intensity and pose special consideration as additional megalopolitan development pressures are exerted along the Maine coast. These are water quality control, flood damage reduction, and erosion control.

Water Quality

One of the major areas of current and future conflict on the Maine coast is water quality. Although the quality of the waters are reasonably good, local areas of water quality degradation do exist, particularly along the many bays, harbors and inlets. The shoreline represents the critical area for water quality. An indication of this degradation is that 71,000 acres of shellfish beds are closed to harvesting due to pollution effects of domestic and industrial wastes, representing an economic loss of about $2,000,000.[1] A federal water pollution conference on Penobscot Bay was held on April 20, 1967, and indicated that, "for the total area of Penobscot Bay affected by the recent shellfish closure, the estimated population was placed at 96,545 bushels of marketable soft clams valued from a community standpoint at $1,875,868."

The conflict between water pollution and fishing and shellfishing in Maine is longstanding. Swimming is also limited by water quality. In some areas, water pollution severely affects the aesthetics and environmental quality which in turn affects tourism, recreation and boating. Heated water discharges from nuclear power plants are a recent water quality consideration.

The water quality of Maine's coastal zone is deteriorated by municipal and industrial wastes which flow down the major rivers to the ocean, including the Androscoggin, Kennebec and Penobscot Rivers. Coastal communities and industries such as Portland, Rockland and Bar Harbor also contribute to the problem. Combined sewer overflows from these communities pose a stubborn,complex issue. Many of the residential dwellings built along the coast in the past were constructed on or above rock formations with pipelines running to the ocean for waste disposal. This causes additional local water quality degradation.

Water quality goals have been established by Maine for all coastal waters and an implementation program is underway. By the mid 1970s significant water quality improvement is expected and most coastal waters will be suitable for all uses. Excep-

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[1] Maine Sea and Shore Fisheries.

tions to this will include parts of Portland Harbor, Rockland Harbor, Upper Penobscot Bay, Belfast and other communities where combined sewers are operative. Tourism, environmental quality, recreation, boating, fishing and shellfishing, fisheries and wildlife habitat, research and education, and aquaculture all place stringent future requirements on water quality. At the same time heavy industry and increasing population can place severe stress on the systems required to maintain high levels of water quality. Table 18 indicates varying uses of the coastal zone and their corresponding water quality requirements. The future potential for these activities on the Maine coast will depend in large measure upon the ability of the state to provide adequate water quality.

Table 18

Water Quality Requirements for
Uses of the Maine Coastal Zone

Uses	Quality of Water Required
Commercial fishing and fisheries habitat	high
Commercial shellfishing	high
Sport fishing	high
Boating	moderate
Hunting and wildlife habitat	high
Swimming	high
Skin Diving	high
Residences	moderate
Transportation	low
Research and education	high
Environmental quality	high
Industrial development	moderate-low

Flood Damage Reduction

Coastal flooding occurs along the Atlantic coastal zone, often as a result of the high winds associated with hurricanes and other major storms. These floods can be particularly severe at the heads of bays and harbors, partly because development tends to concentrate there and partly because of the funnel effect of the land enclosures on high tides. Although the geography of the indented Maine coastline creates a special vulnerability to flooding of this type, the state lies outside the path of most late-summer hurricanes. Still, coastal flooding problems have been noted in 12 towns, most of them along Penobscot Bay or the York and Cumberland county coastlines. In addition, local coastal flooding occurs at other scattered locations along the Maine coast. Present and future demands for summer home construction further intensify the pressure for residential development of flood-prone coastal land.

Flood prone areas[1] include parts of:

Belfast	Cape Elizabeth	Kittery
Bucksport	Eastport	Old Orchard Beach
Calais	Gardiner	South Portland
Camden	Kennebunk	Yarmouth

Present and projected levels of coastal flooding are shown in Table 19.

Table 19

Average Annual Flood Damages in the Maine Coastal Zone *

	1960	1980	2000	2020
Total, dollars	100,000	180,000	300,000	600,000
External, dollars	30,000	54,000	90,000	180,000

*Assumes no additional restrictions on flood prone area development.

Source: NERBC staff adaptation of NAR study data.

[1] Corps of Engineers and Maine State Planning Office.

Adoption of local or state development regulations for the flood-prone areas is likely to significantly reduce the figures shown in Table 17. A positive move toward effective flood plain management is the Executive Order of the Governor of Maine, dated March 4, 1968, which directs all state agencies to order their programs so as to preclude, to the greatest practicable extent, the "uneconomic, hazardous, or unnecessary use of flood plains." This order applies to direct state spending for roads, buildings, etc., and also to state grants, loans, and state-approved financing. Acceleration of the flood hazard mapping program by the Corps of Engineers could further assist to strengthen flood plain management and reduce potential flood hazards.

Erosion Control

Erosion is a problem along the Maine coast, although the geologic structure of massive ledge and rocky shorefront which comprises much of this coastal area prevents erosion from being a critical factor.

Erosion has become critical for a small area of the coast, primarily south of the Kennebec River encompassing Maine's recreational beach areas. Of equal importance is the occurence of erosion on lands within the coastal zone which have been devoted to agriculture and forests. Such erosion occurs primarily as these lands are transferred from their traditional use to real estate development.

Historical records of erosion along the Maine coast are not detailed; it may be assumed that little change has occurred through the years in the rocky areas. In the erosion prone beach areas along the southern part of the coast, few coastal erosion studies have been undertaken to provide detailed information. The diminution of coastal zone agriculture is not a recent development, but has been occurring at an increasing rate as agricultural opportunities increase and are exploited in other parts of the country. This trend has been significant as transfers in land use have become more widespread.

Critical erosion areas of the Maine coast have been identified as the York and Kennebunk Beach shorefronts, Old Orchard Beach, Hills and Ferry Beaches south of Portland, as well as Popham Beach to the north. Although only 20 miles of shoreland is experiencing critical erosion, it is a crucial area to the resource picture of the Maine coast. This 20 miles represents more than 90 percent of Maine's recreational beaches. Critical erosion of this area is of greater concern than the area's size alone would indicate. The beaches of Maine are a vital component of the state's recreation and economic resources and their

diminution could seriously impair the growth of tourism within the state.[1]

The number of visitors to Maine has increased by an estimated 225 percent from 1962 to 1970.[2] The preponderance of visitors has brought increasing pressure on the coastal areas and has resulted in an acceleration of land use transfers from agriculture and forests to real estate development to accommodate changing recreational patterns. During such a period of change, when erosion is most likely to occur, erosion control is a significant environmental factor. The estimated future erosion control requirements are shown in Table 20.

Table 20

Estimated Erosion Control Requirements in the Maine Coastal Zone

	1980	2000	2020
Total requirements thousands of acres	40	53	63.4
Requirements placed by external demands, thousands of acres	21	26	32

Source: NERBC staff adaptation of NAR study data.

[1] National Shoreline Study, Corps of Engineers, August, 1970

[2] Robert Eliot, Director of Vacation and Travel, Marine Department of Economic Development.

CONCLUSIONS AND IMPLICATIONS

The Maine coast lies on the fringe of the northeastern megalopolis which includes 45 million people--one fifth of the nation's population. It is an area of high environmental values but is disadvantaged economically.

Regional and national demands on the Maine coastal zone are increasing and are forecast to continue to intensify placing severe pressures on the unique natural systems and values of the coast.

Specific major conflicts identified in this study which are emerging and are forecast to increase include environmental quality, recreation, tourism, second home development, nuclear power plant siting, port development associated with deep water navigation, commercial fishing and fish processing, and mineral extraction. The pivotal issue which must be resolved is the determination of the appropriate economic development which can be accommodated in the coastal zone and still maintain the viability and value of the natural systems of the area.

As these pressures mount, conflicts will occur over the uses of the coastal zone. A key question which confronts all levels of government and private industry is "What are the appropriate uses of the Maine coastal zone which serve the public interest whether that be local, regional, or national?"

A sound decision-making process must evolve in order to assure appropriate uses of the coastal zone. This decision-making process must provide for recognition of the unique natural values of the coast while simultaneously considering the economic development requirements of an increasingly affluent population. A viable legal and institutional framework is an essential component of a coastal zone management system. The coastal zone planning effort currently ongoing under the leadership of the State of Maine is a firm foundation for the development of a solid coastal zone management system which is responsive to both environmental and economic needs of the society and which provides a basis for a responsible legal and institutional framework.

APPENDIX A

APPENDIX A

PERMANENT AND SEASONAL POPULATIONS OF COASTAL MINOR CIVIL DIVISIONS

County and Municipality	Square Miles	1966 Population Est. Permanent	Seasonal	Percent Change
York				
South Berwick	33	3,169	3,349	5.6
Eliot	20	3,515	3,744	6.5
*Kittery	18	10,590	11,892	12.3
*York	56	4,692	13,392	185.4
*Wells	63	3,504	16,861	381.2
*Kennebunk	35	4,995	8,945	79.0
Arundel	26	1,054	1,340	27.1
Kennebunkport	19	2,155	3,233	50.0
*Biddeford	31	24,068	24,475	1.7
*Saco	40	11,273	15,133	34.3
*Old Orchard Beach	8	5,074	22,571	344.6
Total County	349	74,089	125,475	69.3
Cumberland				
*Scarborough	49	7,060	12,240	73.4
*Cape Elizabeth	16	7,083	7,544	6.5
*South Portland	12	23,334	23,816	2.1
*Portland	22	69,013	79,671	15.4
*Falmouth	25	6,398	7,302	14.1
*Cumberland	26	4,198	5,237	24.7
*Yarmouth	14	4,253	5,289	24.3
*Freeport	35	4,795	6,330	32.1
*Brunswick	48	18,269	20,312	11.2
Harpswell	25	2,015	6,892	242.1
Total County	272	146,418	174,643	19.3
Sagadahoc				
West Bath	12	799	1,980	147.8
*Bath	10	9,846	10,137	2.9
Phippsburg	29	1,151	4,716	309.7
Arrowsic	8	174	307	76.4
*Topsham	33	5,644	6,117	8.3
Bowdoinham	34	1,420	1,622	14.2
Perkins Township	3	3	3	0
*Richmond	30	2,121	2,812	32.5
Woolwich	36	1,563	1,909	22.1
Georgetown	19	652	2,306	253.7
Total County	214	22,373	31,909	42.6

County and Municipality	Square Miles	1966 Population Est. Permanent	Seasonal	Percent Change
Kennebec				
*Gardiner	16	6,511	6,832	4.9
Farmingdale	11	2,069	2,095	1.3
Hallowell	5	3,235	3,276	1.3
Augusta	56	22,507	26,069	15.4
Chelsea	20	2,102	2,102	0
Randolph	2	1,664	1,678	0.8
Pittston	32	1,667	1,675	0.5
Total County	142	39,755	43,727	9.9
Lincoln				
Dresden	31	756	895	18.4
Wiscasset	24	2,084	2,380	14.2
Westport	9	133	475	257.1
Alna	21	294	362	23.1
Newcastle	29	1,298	1,601	23.4
Edgecomb	18	558	1,113	99.9
Boothbay	22	1,833	4,189	128.5
*Boothbay Harbor	4	2,090	5,150	146.4
Southport	5	380	2,473	550.8
Nobleboro	20	863	1,743	101.9
Damariscotta	13	1,140	1,736	52.3
South Bristol	14	612	1,568	64.0
Bristol	34	1,460	4,215	52.9
Bremen	16	365	1,037	211.5
Waldoboro	72	3,089	3,693	19.5
Monhegan Plantation	1	65	528	712.3
Total County	333	17,020	33,158	94.8
Knox				
Warren	48	1,728	2,115	22.4
Friendship	14	746	1,365	82.9
Cushing	20	457	966	111.4
St. George	12	1,204	2,371	96.9
South Thomaston	25	496	1,344	170.9
*Thomaston	11	2,698	2,836	5.1
Owls Head	9	1,104	2,168	96.4
*Rockland	13	9,110	10,389	14.4
Rockport	22	1,900	2,871	51.1
Camden	19	3,888	5,427	39.6
North Haven	12	413	917	12.2
Vinalhaven	23	1,069	1,785	66.9
Matinicus Isle Plantation	2	81	88	8.6
Isle Au Haut	12	55	228	314.5
Criehaven Township	1	14	14	0
Total County	243	25,263	29,457	16.6

County and Municipality	Square Miles	Permanent	Seasonal	Percent Change
Waldo				
Lincolnville	37	814	2,197	157.6
Northport	24	634	2,457	287.5
*Belfast	33	5,685	6,919	21.7
Searsport	29	1,888	3,310	75.3
Stockton Springs	20	1,189	1,539	29.4
Prospect	19	355	427	20.3
Frankfort	24	655	759	15.8
Winterport	36	2,221	2,397	7.9
Islesboro	14	344	1,382	301.7
Total County	236	14,028	21,991	56.7
Penobscot				
*Hampden	38	5,014	5,370	7.1
*Bangor	34	42,635	43,763	2.7
*Brewer	16	10,014	10,865	8.5
*Orrington	24	2,922	3,654	23.9
Total County	112	60,585	63,652	5.1
Hancock				
Bucksport	53	3,501	4,373	24.9
Verona	6	378	701	85.4
Orland	48	1,206	2,337	93.8
Penobscot	47	639	826	29.3
Castine	8	675	1,240	83.7
Brooksville	32	477	1,630	241.9
Sedgwick	27	504	851	68.8
Deer Isle	27	956	2,149	124.8
Stonington	10	1,278	1,714	34.1
Brooklin	18	469	1,134	139.7
Blue Hill	56	1,176	1,899	61.5
Surry	37	553	1,626	194.0
*Ellsworth	85	4,872	6,595	35.4
Trenton	19	324	1,384	432.1
Lamoine	16	594	1,161	95.4
Hancock	32	919	1,809	96.8
Franklin	26	729	1,292	77.2
Sullivan	26	676	1,212	79.3
Sorrento	4	142	470	230.9
Gouldsboro	47	1,344	1,841	36.9
Winter Harbor	14	1,188	1,561	31.4
T 7 SD	21	6	6	0
*Bar Harbor	43	3,634	7,951	118.6
*Mount Desert	37	1,724	3,705	114.9
Southwest Harbor	14	1,372	2,334	70.1
Tremont	17	1,008	1,448	43.6

County and Municipality	Square Miles	1966 Population Est. Permanent	Seasonal	Percent Change
Hancock (Cont.)				
Cranberry Isles	3	167	474	183.9
Long Island Plantation	7	41	54	31.7
Swans Island	14	283	526	85.9
Total County	794	30,835	54,303	76.1
Washington				
Steuben	39	561	1,048	86.8
Cherryfield	44	733	991	35.2
Millbridge	24	1,001	1,361	36.9
Harrington	21	670	941	40.4
Columbia	36	151	205	35.7
Columbia Falls	21	432	484	12.0
Addison	42	686	867	26.4
Jonesport	32	1,430	1,806	26.3
Beals Island	10	635	652	2.7
Jonesboro	38	514	699	35.9
Roque Bluffs	10	135	187	38.5
Marshfield	14	237	260	9.6
Whitneyville	15	200	208	4.0
Machias	15	2,328	2,967	27.4
Machiasport	22	1,368	1,456	6.5
East Machias	34	971	1,575	62.2
Whiting	50	234	580	147.9
Cutler	47	676	832	23.1
Trescott Township	28	181	181	0
Lubec	33	2,236	2,489	11.3
Edmunds Township	40	307	307	0
Dennysville	15	319	359	12.5
Pembroke	28	748	1,072	43.3
Perry	30	622	1,133	82.1
Eastport	4	1,932	2,172	12.4
Robbinston	27	383	766	100.0
*Calais	37	4,546	5,598	23.1
Passamaquoddy Indian Res.	--	293	293	0
Total County	756	24,529	31,489	28.3
Total (Maine Coastal)	3,451	454,895	609,804	34.1

Source: Maine Coastal Development Plan, Phase 1 Report, Maine State Planning Office, 1970

*Indicates municipality with zoning controls.

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