FISHING AND PETROLEUM INTERACTIONS ON GEORGES BANK

VOLUME II: THE CHARACTERISTICS OF THE TWO INDUSTRIES, POTENTIAL FUTURE TRENDS, AND AN ASSESSMENT OF FORESEEABLE CONFLICTS

ENERGY PROGRAM Technical Report: 77-1

NEW ENGLAND REGIONAL COMMISSION

PREFACE

This report is a product of the New England Regional Commission's Energy Research and Policy Formulation Program. The Energy Program will have several major outputs including:

- -Supply/demand data and projections for New England's energy requirements to 1990.
- -Effects on New England from petroleum related industrial development (including OCS development).
- -New England gas industry development study.
- -A review of electric power demand and supply trends and forecasts.
- -Impacts of recent energy shortages and price increases on New England.
- -Guidelines and a handbook for power plant siting.
- -Legal and Institutional project, including a compendium and analysis of energy facility related statutes, and an energy policy and decision-making study.
- -The New England Fishing Industry and the projected impacts of Outer Continental Shelf development.
- -Analysis and Regulatory Implications of the New England Power Pool.

A complete list of Energy Program publications is available from the Commission's Energy Program Director.

The goal of the Energy Program is to supply the members of the New England Regional Commission, which is comprised of the six New England Governors and a Federal Cochairman appointed by the President, with reliable baseline information on New England's energy requirements and vulnerability, and to provide the Governors and the region with viable energy policy options and recommendations to guide New England's energy future. The Commission's Energy Program staff works closely with the Energy Advisors to the Governors and Energy Offices of the six New England states in formulating, analyzing and disseminating the output and results of the Energy Program, thereby achieving a measure of regional coordination in tackling the complex of energy problems facing the region.

The Energy Program is also involved in a broad range of projects including examination and response to national energy policy, outer continental shelf policy formulation, regional petroleum and natural gas industry development programs, the New England Energy Management Information System, regional power management program, U.S.-Canadian cooperation on energy matters, and technical policy assistance to the staffs of the New England Governors on other numerous matters of regional energy policy formulation and analysis.

We sincerely hope that this report will be of use and will provide some contribution to the management of New England's energy problems.

Russell F. Merriman
Federal Cochairman

Ella Grasso
State Cochairman

FISHING AND PETROLEUM INTERACTIONS ON GEORGES BANK

Volume II: The Characteristics of the Two Industries, Potential Future Trends, and an Assessment of Foreseeable Conflicts

Prepared for

The New England Regional Commission

By

The Coastal Resources Center
Graduate School of Oceanography
University of Rhode Island

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The Study Team

Stephen Olsen, Project Coordinator
Coordinator, Coastal Resources Center

Dale Brown
Research Assistant, The Coastal Resources Center

Gayle Charles
Consultant

Thomas Grigalunas
Associate Professor, Department of Resource Economics

Tadeusz Kowalski
Associate Professor of Ocean Engineering

Virgil Norton
Professor of Resource Economics

Henry Parker
Research Assistant, The Coastal Resources Center

Saul Saila
Professor, Graduate School of Oceanography

Stephen Sedgwick
Research Assistant, The Coastal Resources Center

Jon Sutinen
Assistant Professor, Department of Resources Economics

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ABSTRACT

An assessment is made of available information on the Georges Bank environment and the fisheries it supports. Data are presented on the characteristics and condition of major New England ports and the magnitude and characteristics of major commercial fisheries at the regional, state and port level. The importance and economic value of sport fisheries are discussed. Foreign commercial fisheries on Georges Bank are described. Projections are presented of the potential changes that may take place in the region's commercial fisheries due to expanded national jurisdiction over offshore fisheries resources. The characteristics of potential offshore petroleum activities in a high and low find case, and the economic returns from individual hypothetical oil and gas fields are postulated. Data collected by the National Marine Fisheries Service on the fishing grounds where fish landed in New England ports were caught have been further refined and analyzed. The potential impact on commercial fisheries on grounds prempted by petroleum related structures is assessed. The potential impact of oil related debris on the domestic fishing industry is described. Competition between the offshore oil and gas industries and the commercial fishing industry is discussed in terms of labor, port facilities and vessel repair yards. The study suggests that potential conflicts between the two industries may be mitigated by proper advance planning and that the two industries need not be incompatable.

ACKNOWLEDGEMENTS

Jane Miner gathered together much of the data on domestic fisheries and oversaw the final production of this report. Deborah Zinser, Deborah Prefontaine and Deborah Giese all spent long hours typing drafts and the final manuscript. The fortitude of all these people is gratefully acknowledged. The graphics were all prepared by Henrietta Crandall.

SUMMARY AND CONCLUSIONS

This is the second and final volume of a study undertaken in June, 1975, at the Coastal Resources Center at the University of Rhode Island for the New England Regional Commission. The purpose was to investigate the probable interactions likely to take place between the petroleum and fishing industries in light of exploration for, and probable development of, oil and gas reserves off New England on Georges Bank[1]. Volume I, released in January, 1976, presented background information in the form of an atlas on the potential petroleum resources, and the commercial fisheries and fishery resources on Georges Bank.

In this volume, the two industries are examined in greater detail and potential conflicts are discussed. The principal findings and recommendations may be summarized as follows:

1. Georges Bank is one of the world's most productive fishing grounds; it is also a spawning ground for many commercially important species. Our understanding of how the physical and biological components of the Georges Bank ecosystem(s) interact with another and may respond to human-induced stress is minimal. Severe weather conditions are frequent and shallow water depths and predominently sandy sediments result in unstable bottom conditions in many areas. Current patterns are complex and poorly understood (Section 1).

2. New England's largest ports are at present underutilized. Small ports, however, are in many cases severely crowded, especially during the summer when large numbers of recreational craft compete with other users. The lack of adequate facilities and services hamper the development of fisheries in many rural ports (Section 2).

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[1]The term Georges Bank, except when otherwise noted, is used throughout this report to include the area encompassed by all the potential lease tracts in the Georges Bank vicinity.

3. Each fishing port is characterized by fisheries that concentrate on specific grounds and species. Data are presented on the present composition of fishing fleets in major ports and on the source and species composition of landings. These data are useful when assessing which ports would most likely be effected by petroleum related activities and extended national jurisdiction over fishery resources (Section 2).

4. A survey was conducted (Section 2) of commercial fishing craft vessels classified by the Coast Guard as vessels that operate from major New England ports. The survey resulted in a count of 739 vessels of which 38 percent are in the 50 to 69 foot length class and 7 percent are 100 feet or longer. Some 71 percent of these vessels are otter trawlers.

5. Although the volume of commercial landings has decreased over the past two decades, the unit value has greatly increased. Stocks of traditionally favored finfish species are presently at an all-time low and landings of the latest boom fishery, for offshore lobster, appear to have peaked. Landings by trawlers dominate those by any other gear in terms of both value and volume. In 1975, the total commercial New England landings were 497 million pounds with a dockside value of $149 million (Section 3).

6. New England's commercial fishing industries are fragmented; they are shaped by a varied response to many external problems. The fish buyers who purchase directly from fishermen have as yet not been entirely successful in changing their operations from one of high volume and low unit value to low volume and high unit value. The earnings of many fishermen are high, but in some ports the return to capital limits an improvement in the quality of vessels. The fishing industry has been hampered by the lack of an integrated and consistent national policy or program for fisheries (Section 3).

7. The Fisheries Management and Conservation Act of 1976 is expected to bring greater changes to the New England fishing industry than it has ever before experienced. Improvements are expected to be most significant in the groundfish fisheries. There is also a great potential for growth in fisheries for sea scallops and herring, and fisheries for other species presently little fished by domestic fishermen may develop. Depending upon the amount of assistance received from the federal government and the success of domestic fishery resource management,

growth in the groundfish fishery alone is projected to range from 75 to 242 new vessels and 925 to 2,428 additional fishermen. It is further estimated that permanent employment in groundfish processing plants could double; herring processing is labor-intensive and bigger landings would result in relatively greater increases in employment in the herring processing industry (Section 4).

8. Marine sportfishermen in New England and New York appear to land half as much fish as commercial fishermen if landings of industrial fish are excluded. Methods for assessing the economic impact of sportfisheries are discussed (Section 5).

9. Beginning in the late 1950's, fleets of foreign fishing vessels have dominated fisheries in Georges Bank. Many major stocks have been decimated and foreign vessels have claimed as much as 90 percent of total annual harvests. The tempo of foreign fishing on Georges Bank, however, has recently been decreasing due to a drastic decline in the size of the major fish stocks and the ability of U.S. enforcement agents to close fisheries when quotas are attained. Foreign finfisheries are presently limited to pelagic gear and concentrate upon squid, mackerel and herring (Section 6).

10. The potential characteristics of offshore petroleum activities are examined in Section 7. Exploratory drilling is expected to involve six to ten mobile rigs that could be active through the early 1980s. A maximum of 50 permanent rigs, one oil pipeline and two gas pipelines are postulated if large finds are discovered. Smaller finds are more likely and would result in many fewer platforms and perhaps one pipeline. If exploitable reserves are found, production is expected to peak in approximately 1990, at which time 3 to 17 percent of the region's oil needs could be met by Georges Bank reserves. Gas production could peak at 49 to 222 percent of the region's needs in 1990.

11. The enormous uncertainties over the quantities of oil and gas that may be present on Georges Bank, the size of individual fields and the prices at which the product may be sold make it extremely difficult to estimate the potential net regional economic benefits of exploiting these resources. In this report (Section 7) the exploitable resource assumptions are for a low case of 0.18 billion barrels of oil and 1.3 trillion cubic feet of gas and a high case assumption of 1.3 billion barrels of oil and

8.6 trillion cubic feet of gas. The economic benefits that could accrue depend primarily on the size of individual fields and the price at which the product is sold. The sizes of hypothetical fields used in making economic estimates in this report are as follows:

Field Size	Oil (Millions of barrels)	Gas (Trillion ft^3)
small	18.5	.11
medium	70.2	.42
large	321.8	1.93

It is not possible to predict how many fields, and of what size, may be found on Georges Bank. However, it is possible to estimate the economic benefits to the region that could accrue from individual hypothetical fields. The greatest benefits to the region would be produced by large gas fields if the gas was sold in the region at a regulated price set below its full value. If gas is sold in the region at a regulated price of 60 cents per thousand cubic feet when its true value is $2 (a hypothetical best case) consumer real income from a single hypothetical field would range from $5 to $634 million depending on the size of the field. Consumer real income benefits to the region from individual hypothetical oil fields range from $6 to $155 million. It may also be assumed that the region may receive 5 percent of the national economic benefits received by the producer and the federal government. The share of national economic returns received by the region from individual fields could be in the range of $2 to $39 million for oil fields and $3 to $32 million for gas fields.

12. In Volume I of this report it was estimated that ICNAF area 5Ze (Georges Bank) might produce a maximum an[illegible] sustainable yield of 924 million pounds [illegible] finfish. Since a large proportion of this catch would be species that command a low price on domestic and world markets it was further estimated that if the entire catch was taken by domestic fishermen it might be worth some $142 million (1974 dollars). It may be further estimated that these landings could generate for the region an annual total of $420 million in transactions of which $166 million would be personal income. These figures serve to illustrate the potential magnitude of New England fisheries if extended domestic jurisdiction permits stocks to recover and excludes foreign fisheries.

13. It is not possible, on the basis of the information presented in this study, to make a useful comparison between the potential total value to the region of the fishing industry as opposed to the offshore oil and gas industry. The economic data and projections are simply not comparable. To properly compare these two industries and other competing industries by placing them on an equal footing a regional input-output model would have to be developed.

14. In Section 8 an analysis is made of data collected in 1965, 1969 and 1974, by the National Marine Fisheries Service (NMFS) showing the fishing grounds where fish and shellfish landed in New England were caught. The average yield of the entire potential oil and gas lease area to New England fishermen during the three years studied was 176 million pounds with a dockside value of some \$33.4 million (constant 1974 dollars). Some 39 percent of these landings, by value, were flounders, 37 percent were other groundfish, and crustaceans and mollusks (excluding squid) contributed 11 percent each. The most productive broadly defined "grounds" produced an average of \$29,585 and 164,410 pounds per year per lease tract (approximately 5,700 acres). Both the data and interviews with fishermen, suggest, however, that some small areas of the Bank are much more valuable than these figures indicate.

15. Offshore petroleum related structures will pre-empt the use of certain areas to fishermen. It is assumed that fishing vessels operating towed gear will stay a minimum of 1,650 feet (500 meters) away from individual platforms. Estimates are made of the ground lost from other offshore structures. In a hypothetical worse case, 50 platforms grouped in small clusters could pre-empt 125 square miles from fishing with towed gear. On the basis of NMFS landings data for 1965, 1969 and 1974, this area could produce, if concentrated within the most productive broadly defined fishing grounds (a hypothetical worse case), 1.3 percent of the Georges Bank landings in pounds and 1.2 percent in dollars. Grounds for sea scallops and flounder are those most likely to be affected by development in the tracts being considered for the first lease sale. Impacts on these grounds could be most noticeable in the New Bedford fleet. Since a small alteration in the position of a structure can result in the preservation of a relatively large amount of fishing ground, fishermen should be consulted when the location of offshore structures is being planned. It is also important that every effort be made to inform fishermen of the precise position of subsea obstructions (Section 8).

16. The potential impacts of oil-related activities upon fishery resources are difficult to assess. Since eggs and larvae are concentrated at the surface and are killed by very low concentrations of oil, the occurance of a spill at a time and place where eggs and larvae are concentrated could have very serious consequences. Also of great concern are the potential sublethal effects of oil on adult organisms and the possible incorporation of oil into bottom sediments (Section 1).

17. A major expected impact of offshore petroleum activities on commercial fisheries is the debris on the seafloor resulting from petroleum activities. Debris is considered an unavoidable consequence of oil and gas exploration and development but many steps may be taken to mitigate the problem Oilmen should be educated to the consequences of dumping. Measures can be taken to minimize reasons for dumping or losing materials. An instutitional mechanism should be set up that will facilitate the reimbursement of fishermen for lost gear, catches and time. Steps should be taken to address the compensation problems caused by debris that cannot be attributed to a specific oil company (Section 9).

18. Demands for labor are expected to rise concurrently in both the offshore petroleum and commercial fishing industries. It is estimated that a maximum of 2,000 New Englanders could be recruited for offshore jobs in the petroleum industries. Expanding domestic fisheries could generate as many as 6,000 additional jobs. The petroleum industries may draw labor away from the fishing industry, but the high earnings of fishermen and the fact that they frequently do not have seamen's papers or officers' licenses will probably offset the problem significantly. An increase in the demand for personnel with the skills of these presently working in shipyards could cause some disruptions. Steps should be taken to train personnel for the jobs that will be available in the two industries (Section 10).

19. Presently idle facilities in major New England ports and at recently excessed Navy holdings could provide all the port facilities required by petroleum related industries. However, if petroleum related vessels and activities were placed in many of the smaller ports in the region, or fishing vessels were displaced from one port to another, serious disruptions to the fishing industry could result (Section 11).

20. If the highest projected scenarios for offshore petroleum development and the expansion of commercial fisheries become a reality, the additional demand for the services of vessel repair yards could be equivalent to the output of seven moderate sized yards. The demand would probably be concentrated in southern New England. Large shipyards are presently not working at capacity and could absorb much of the additional demand. It is expected that some yards in southern New England will wish to expand and that they will probably be hampered by a lack of adjoining space and by inadequate water depths (Section 11).

21. It is highly unlikely that foreign fishing activities on Georges Bank will be eliminated before offshore oil related activities proliferate. Since foreign fishing vessels are large and numerous and frequently work in dense concentrations, and since communications between foreign fishermen and oilmen may be difficult, potential interactions between the two demand careful attention and planning. The potential for damage to oil related structures from large powerful foreign fishing vessels is greater than that resulting from domestic fishing activities (Section 6).

SECTION 1

PETROLEUM, FISHERIES AND THE GEORGES BANK ENVIRONMENT

Stephen Olsen
Dale Brown

Coastal Resources Center

INTRODUCTION

In the last few years several attempts have been made to draw together and summarize available information on the Northeast's marine and coastal environment (URI, 1973; TRIGOM, 1974, BLM Environmental Impact Statements, 1976). In this section only general comments are made on the Georges Bank environment since details are readily available elsewhere. The Appendix to this section provides an analysis of several years of data on the abundance and distribution of groundfish on Georges Bank. An analysis of this data has not appeared in the inventories mentioned above.

When attempting to assess the potential impacts of offshore petroleum exploration and development it becomes clear that the information available is in most cases fragmentary and that only very general conclusions can be drawn. What does emerge is that the waters over Georges Bank are frequently very rough with breaking waves and strong currents common over the shallows. Fog and severe storms are frequent. Over much of the bank the bottom is unstable and in some places it resembles a field of sand dunes that move with the forces of the currents and waves. Little is known about current patterns. Even less is known about how the various living components of the ecosystem interact and respond to stress. We do know that Georges Bank is one of the world's most productive fishing grounds. Because Georges Bank is so important to fisheries, more is known about the fish stocks than about any other component of the ecosystem.

GEOLOGY

Georges Bank is a shallow oval-shaped platform that lies between Cape Cod, Massachusetts, and Cape Sable, Nova Scotia, and includes some 12,000 square miles within the 100-fathom isobath. It is bounded to the north by the deeper Gulf of Maine and to the south by the edge of the Continental Shelf. The Northeast Channel (690 feet) and the Great South Channel (240 feet) separate Georges Bank from the Scotian Shelf and Nantucket Shoals (USGS, 1975).

It is believed (Shepard, Trefethen, and Cohee, 1934 in Emery and Uchupi, 1972) that the Bank was once a part of the mainland that became separated when what is now the Gulf of Maine was eroded by rivers and later by glaciers. Beds of freshwater and salt marsh peat (Emery, Wigley and Rubin, 1965 in Emery and Uchupi, 1972) that were formed along an ancient shoreline some 11,000 years ago have been explosed by migrating sand ridges on the northern portion of the Bank. The surface of the Bank was modified by glacial deposits when boulders, gravel, sand and finer sediments were left as part of a terminal moraine at the melting edge of the glacier. These deposits were later reworked by tidal currents and wave action, which removed the finer sediments.

The topography of Georges Bank is divided into two regions. The southern half, where oil and gas drilling probably will be concentrated, has a smooth sandy surface that slopes from 180 to 300 feet. The northern half, which is generally less than 180 feet deep, is irregular and characterized by large sand shoals that trend northwesterly and are separated by flat floored troughs. These shoals are commonly 6 miles apart and up to 46 miles long. In some places depths are so shallow that breaking seas are common; Georges Shoal rises to a mere 12 feet below the surface. On the flanks and tops of the shoals are sand waves that generally trend east-west and range 30 to 60 feet in height. Stewart and Jordan (1964) studied small sand waves some 24 feet high on Georges Shoal and concluded that they had moved westward a net distance of 900 feet between 1930 and 1958. The forces causing such movement are a combination of wave action and strong tidal currents. Fishermen report that sand waves may move significantly in a single storm. The movements of these sand waves could pose grave problems if petroleum-related structures were placed in areas of the Bank where they are knwon to be active. It is doubtful that pipelines could be buried successfully in areas where sand waves are active.

The most comprehensive information on the distribution of surface sediments on Georges is found in Schlee (1975) and a summary figure is reproduced in Plate 12 of Volume I of this report. Quartoze sand covers much of Georges Bank with average grain size decreasing from north to south. The major changes in sediment type occur off the Bank on the Continental Slope and to the north toward the Gulf of Maine where more silt and mud is found.

The depth of unconsolidated sediments on Georges Bank may be as much as 600 feet (Knott and Hoskins, 1968, in TRIGOM, 1974). Very little is known about these sediments since only a few shallow borings have so far been taken. The greatest potential for hydrocarbon reserves is believed to lie in lower cretaceous rocks that are found 0.6 to 2.5 miles below the sediment surface and may exceed 1.2 miles in thickness (USGS, 1975).

The probability of earthquake damage to normal construction is thought to be low in the Georges Bank area. However, data are scarce due to the low number of reporting stations in the vicinity. Large earthquakes occurred at Cape Ann, Massachusetts, in 1638 and 1755. A seismic trend running from Boston to Ottawa has been suggested and a southeast extension of this trend intersects Georges Bank. In a study of seismic activity by Smith, 1966 (in TRIGOM, 1974), no epicenters were reported along this trend from 1928 to 1959. More detailed information is needed to evaluate this potential hazard.

HYDROGRAPHY AND WATER CHEMISTRY

The circulation patterns on and near Georges Bank are crucial to the unusually high biological productivity of the area. Currents and mixing patterns are highly important factors in determining nutrient concentrations, and residence times of important life stages and elements of the food web. Hydrographic analysis is also a major tool in predicting the transport of oil released into ocean waters. Unfortunately, information on the hydrography of Georges Bank is sketchy. The various sources of current data are reviewed in the MIT study (1973) and the trends in surface currents as presented by Bigelow (1927) are shown in Plate 13 of Volume I of this study. More recent research has tended to support the patterns shown by Bigelow.

The principal characteristics of non-tidal surface circulation as it is presently understood may be summarized as follows (Colton and Temple, 1961; USGS, 1975):

(1) in the Gulf of Maine a counterclockwise gyre develops in the spring and breaks down in the fall;
(2) on Georges Bank a clockwise gyre exists for a similar period and is most evident in midsummer;
(3) with the exception of midsummer, surface drift on Georges Bank is offshore. This pattern is generally consistent with a southwesterly offshore drift along northern New England and Nova Scotia. This drift has been estimated at 0.4 to 0.7 knots.

The speed and direction of surface currents are highly variable due to the effects of winds and tides. Winds may set up currents in the surface to depths of 10 to 20 meters that may accentuate, weaken or alter the movements of surface waters. Tidal currents on Georges Bank are strong and flow in all directions over the tidal cycle. Velocities of 5 knots may be attained with heavy tidal rips forming over the shallowest portions. These characteristics at times combine to form a very difficult working condition for vessels towing, setting or retrieving gear.

The vertical tidal range is approximately two feet, although six-foot ranges may occur under certain conditions. Strong tidal mixing over most of the Gulf of Maine and more markedly over Georges Bank generally do not permit stratification of the water column even during the warmest months (Colton and Temple, 1961).

Bottom currents are more poorly defined than those at the surface, and are believed to be slower. Research reported by Bumpus (1973) that infers bottom circulation from drift bottle recoveries indicates that the circulation is similar to surface patterns but with a net drift to the west across Great South Channel.

Temperature data as reported by Colton and Stoddard (1972 and 1973). Air blowing off the continent is believed to influence the variations in water temperature observed on Georges Bank. The effect of seasonal changes in temperature is greater on Georges Bank, where maximums are higher and minimums are lower, than in the surrounding deep water.

Little is known about the chemistry of the seawater on Georges Bank. Available information on salinity, dissolved oxygen and nutrients has been reviewed by TRIGOM (1974). Noticeably lacking at present is baseline information on concentrations of contaminants, including hydrocarbons and heavy metals.

GEOLOGIC AND HYDROGRAPHIC CONCERNS RELEVANT TO FISHING AND PETROLEUM-RELATED ACTIVITIES

Man's activities on Georges Bank are not likely to disrupt hydrographic processess. However, the influence of current patterns on the fate of spilled oil gives high priority to research needs in this field. Information needed to predict the vertical, horizontal and temporal distribution of hydrocarbons released on Georges Bank includes more precise definitions of current patterns induced by density differences, tides and winds. The extent to which these forces influence oil spills must be determined. Rates of dilution and dispersion of contaminants must be determined to analyze biological impacts which are both time- and concentration-dependent. Among the factors to be considered are tidal mixing, wave action, interactions with suspended material and dissolution or volatilization of certain chemical fractions over time. Existing oil spill trajectary models for Georges Bank are inadequate to permit a complete understanding of the probable patterns of dispersion. Better information on transport and dispersion are also needed to understand fish population dynamics. The success of a year class may be largely dependent on whether currents carry eggs and larvae off the Bank.

Climate

On Georges Bank the main driving force of water circulation and ultimately sediment movement is the weather, particularly storms (USGS, 1975). Available data on weather conditions is much more detailed than data on hydrography, and a fairly detailed summary is found in the USGS Open File Report (1975).

Visibility: Data collected at the Nantucket airport for over 20 years show that heavy fog conditions exist for 98 days, and clear conditions for 86 days, in an average year. Averaged over 22 years, visibility was less than 1/4 nautical mile 35.5 percent of the time from April to September and 17.5 percent of the time for October to March (NOAA, 1975). Data based on observations from ships in passage indicate less frequent fog occurrence due to their avoidance of these conditions.

Winds: The average wind speed for the Boston sea area is 14.25 knots (BLM, 1976a). The prevailing winds in the summer are from the southwest and in the winter from the northwest. Winds exceed 34 knots 3.5 percent of the time over a year but 4.6 to 9.0 percent of the time from November to March (NOAA, 1975). These data are based on observations over the last 100 years made by ships in passage and thus are biased toward good weather.

Waves: Wave heights are normally 2 to 4 feet and are predominantly from the northwest. Waves greater than 10 feet in height occur 6.4 percent of the time (12 to 13 percent of the time from November to February). Again the data are biased toward good weather. Neu (1972, in TRIGOM) calculated that the maximum wave height likely to occur in a year is 36 feet and in 100 years 60 feet. The largest waves are from the northeast and are a result of northeast storms.

Major storms: Data for maximum winds, waves, swell and icing have been summarized by Anderson-Nichols and Company; Mortan, Proctor, Mueser and Rutledge (1954) (in USGS, 1975), and the most pertinent points may be summarized as follows. During the period of 1938 to 1953, data collected during the six major storms and hurricanes show wind velocities maintained for 8 to 30 hours averaged 40 to 90 mph. Maximum wind velocities were clocked at 120 mph during the 1938 hurricane but were substantially less in other major storms (50 to 90 mph). The average height of the highest 10 percent of the waves in the 1938 hurricane was calculated to be 32 to 66 feet but single maximum waves could have been up to 99 feet high, and one wave in 20,000 could have been even higher. Severe icing conditions existed during the winters of 1918 and 1934.

Boom containment of oil spills is presently not effective in waves greater than 5 feet. This condition is exceeded 40 to 60 percent of the time in winter and 10 to 20 percent of the time in the summer (WHOI, 1976). The shallow water depths on Georges Bank can cause severe wave conditions due to the refraction and focusing effects that shoal water has on long period ocean sweels. Apparently our understanding of these effects on Georges Bank is insufficient to permit the confident selection of sites where severe swell conditions will consistently be avoided (USGS, 1975).

Biology

A combination of physical factors makes Georges Bank one of the world's most productive fishing grounds. Strong currents and turbulence mix nutrient-rich bottom water into the upper sunlit layers and, according to one theory (Colton and Temple, 1961), circular currents on the Bank prevail often enough to keep eggs and larvae from being washed offshore where they could die. This permits Georges Bank to be a major nursery ground for several important fish and shellfish species. The high productivity of the Bank is well established but there is minimal understanding of how the many elements that give it its character interact. The complexity of the ecosystem, and the manner in which it responds to stresses, makes the task of predicting how it will respond to new impacts extraordinarily difficult and beyond our present capabilities in most instances. Georges Bank is a difficult and expensive place for scientists to work. Though considerable information is available on the fish populations, other types of data are scanty.

In the first part of this section the major biological components of the Georges Bank ecosystem are briefly discussed. In the second part, concerns related to petroleum activities are reviewed.

Phytoplankton: Phytoplankton, the microscopic plants which drift in the upper sunlit water layers, are responsible for the primary productivity that ultimately supports all life on the Bank. Adequate light for photosynthesis penetrates only 60 to 150 feet below the surface so there is no plant productivity in the water or on the bottom at greater depths. In addition to light, phytoplankton require nutrients (nitrogen, phosphorous, silicon, etc.) as well as trace amounts of vitamins and other substances for growth. Growth may be limited if one or more of these substances is in short supply. As phytoplankton die and sink or are consumed, there is a continuous loss of nutrients from surface waters. On Georges Bank the waters are shallow and turbulent and the nutrients in deep water are remixed with surface waters where they can be reutilized. The abundance of phytoplankton is also controlled by temperature and grazing pressure (consumption by herbivores). How all these controlling variables interact to produce observed patterns in abundance and distribution is but poorly understood. Accurate monitoring of the patterns themselves is difficult due to the rapid spatial and temporal changes that take place. We do know, however, that the abundance and species composition of the phytoplankton population as a whole follows a recognizable seasonal cycle; the available information is reviewed in the TRIGOM inventory (1974).

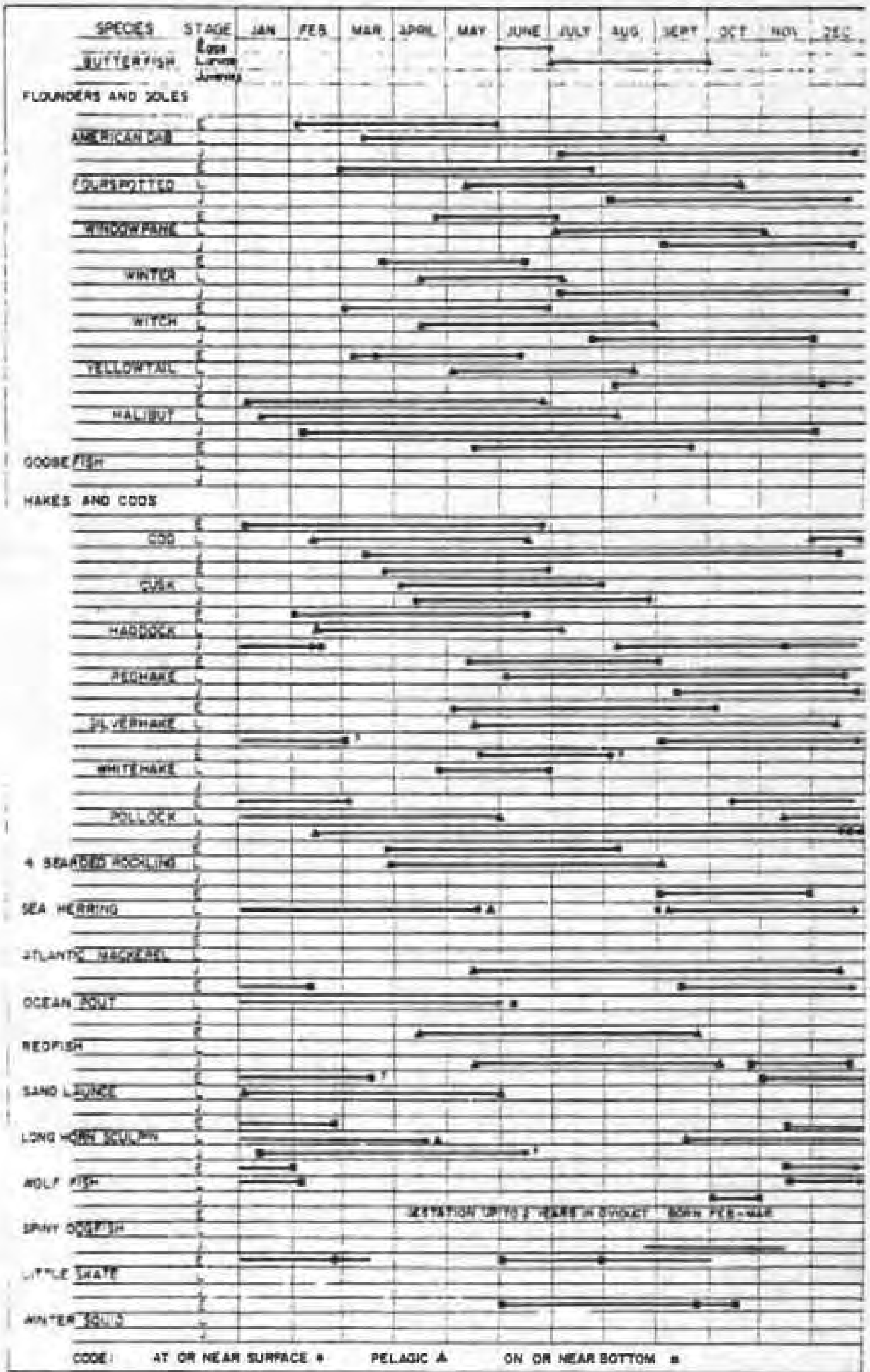
Zooplankton: Planktonic animals representing nearly every phylum in the animal kingdom consume phytoplankton and are the primary means by which organic matter is transferred to higher levels in the food web. Some species (holoplankton) spend their entire lives drifting with the currents. Others (meroplankton), which include the eggs and larvae of many important fish and shellfish, are planktonic at only certain stages in their life history. Zooplankton are a primary food source for some fish and bottom-dwelling (benthic) species. Zooplankton may be found at all depths but are concentrated with the phytoplankton in the upper sunlit layers. Peaks in zooplankton abundance generally follow phytoplankton blooms but the spawning of species with planktonic eggs and larvae also have a significant effect on their abundance. Table 1 summarizes available information on the position in the water column, by months, of eggs, larvae and juveniles of species of commercial importance in the Georges Bank vicinity.

Nekton: These are the animals that swim freely throughout the water column. The group is dominated by fish but includes some invertebrates and marine mammals. Because of their high commercial value, fish stocks have been studied far more extensively than any other species group on the Bank. Volume I of this study provides tables that summarize available information on the migratory and spawning behavior of the principal fish and shellfish species. Plate 19 in Volume I shows the distribution of known specific spawning grounds for several finfish species. Although the life histories of most commercially important finfish are known, our understanding of how species interact with each other and with the physical aspects of their environment is slight. It is clear that man is the major predator for a great many species and that virtually all the commercially important species have been overexploited. The effects of drastic changes in the abundance of some species are not known but it may be assumed that predator-prey relationships have been altered.

Very little is known about the mammal population of Georges Bank. Georges is known to be an important feeding ground for several species of whales. There is some evidence that suggests that toothed whales breed on Georges. Seals have also been observed.

Benthos: Animals living on or in the bottom are known as the benthos. On Geroges Bank, scouring or, at greater depths, lack of light, excludes plants from benthic communities. Most benthic organisms are invertebrates ranging in size from microscopic to larger, more familiar species such as lobsters and scallops. Most species that are benthic as adults produce planktonic eggs and larvae. Benthic communities show distinct spatial variation in abundance and species composition. Much of the variation may be correlated to sediment type. The size and composition of sediment particles determines the amounts of water, organic matter and oxygen present and the suitability of

Table 1. Position, by month, of early life stages of important Georges Bank fish species.



Note: This table was prepared for inclusion in Vol. II; data references are found in that volume.

various locomotor, attachment and feeding mechanisms used by benthic organisms. In general, coarser sediments on Georges Bank appear to support more productive communities with a greater abundance of organisms than fine sediments (Wigley, 1961). Most benthic organisms are larger, slower growing and have longer life spans than planktonic organisms. Annual variations in standing stock are therefore less pronounced.

The role of benthic communities in cycling nutrients and food energy through the ecosystem is particularly important in shallow oceanic environments such as Georges Bank. Benthic organisms rely on a wide variety of food sources. They may feed on living or detrital matter sinking from the overlying water or brought in by currents. Deposit feeders utilize organic matter contained in the sediments. Larger organisms may prey on smaller animals within the community. Since sinking losses are not a factor as they are in the water column, there is greater opportunity for recycling of energy sources within the benthic community than in either the plankton or nekton. Benthic communities, in turn, provide the food resources for groundfish, including many highly valuable commercial species. In addition, the degradation of the organic material continually falling from overlying areas of production allows the regeneration of nutrients and other elements necessary to support life processes. Descriptive information on the biology of benthic organisms in the Georges Bank region may be found in the TRIGOM inventory (1974).

FISHING, PETROLEUM AND THE ENVIRONMENT

The problem of overfishing certain stocks on Georges Bank has been a concern for more than a century, but most of the argument has been over who gets the fish, and not the well-being of the Georges Bank ecosystme. The effects of fishing are dramatic and in some cases long lasting. Once-abundant populations of species such as halibut were greatly reduced long ago and more recently one formerly abundant species after another has been overfished. It is obvious that such wholesale alterations to the fish populations must have significant consequences to the ecology of the area. Clearly, predator-prey relationships have been affected. However, our understanding of these matters is minimal. Advances in the science of fisheries biology now permit us to assess the size of fish stocks and at least monitor overfishing as it takes place. This gives us the confidence to feel that we can manage these resources and enjoy the benefits of the high productivity of Georges without causing unacceptable damage.

Fishing has impacts on the environment other than the removal of the species desired by fishermen. Otter trawls sweep over the bottom and distrub or destroy organisms other than those sought by the fishermen; shellfish dredges dig into the sediment and cause further disruption. These impacts have been given little attention.

Exploration for, and the possible development of, oil and gas reserves on Georges Bank poses a new series of potential hazards to the environment. The projected size of petroleum reserves is not considered to be great and it is doubtful that the structures that may be placed on the Bank will in themselves have a significant impact. At present the only cause for concern appears to be that platforms and pipelines could be placed on the spawning grounds of a commercially important species such as herring, a species that spawns in small, well established locations and whose eggs remain on the bottom. Of far greater concern are the potential impacts of oil pollution. The following is a brief review of the problems and issues involved.

It should first be recognized that 84 percent of the sources of petroleum in the world's marine environment may be classified as intentional; these include tankers (18 percent), coastal refineries (3 percent), municipal wastes (5 percent) and river runoff (26 percent); unintentional sources account for only 6 percent of the petroleum in the marine environment and only 1 percent is produced by offshore petroleum production (National Academy of Sciences, 1975, recalculated by Hyland and Schneider, 1976). The contribution of different sources in specific locations may of course by very different.

The exploitation of petroleum reserves may lead to oil spills and it may also lead to chronic low-level oil pollution. The problems in attempting to assess the impacts of these happenings on the environment are great, not least because marine toxicology is a science in its infancy. The methods used have not been standardized and most of the studies performed to date have investigated the effects of oil on specific organisms under controlled conditions in laboratories. Matters are far more complicated in the natural environment where a change must be noted, the cause established, and finally the significance of the change assessed. Our ability to accomplish these three steps on Georges Bank is greatly impaired by a lack of information on what the environment is and how it works. The baseline studies that are presently being undertaken, in the expectation that petroleum resources will be found, will not provide all the information needed to recognize the enviromental changes that may later prove to be significant and attributable to petroleum-related activities. We do not in many instances possess the skills and the knowledge to do this. These problems were explored in detail at the Bentley College Workshop (1975) at which scientists from the New England region were brought together to discuss these matters. The Proceedings of the workshop underscore the need to understand the processes that take place in the environment that will determine how oil will move and at what speed, how it will degrade, what concentrations we may expect in given locations, how it will be cycled through the food web, how we distinguish the effects of low-level chronic discharges and how we assess sublethal effects on marine organisms and communities. We do not know the answers to most of these questions and will not know them before oil exploration and production is underway or even completed.

The effects of oil on individual organisms may be categorized as follows (Moore, 1973 in Hyland and Schneider, 1976):

(1) direct lethal toxicity
(2) sublethal disruption of physiological or behavioral activities
(3) the effects of direct coating by oil
(4) incorporation of hydrocarbons in organisms which may cause tainting of edible species and/or accumulation of potentially carcinogenic polycyclic aromatic hydrocarbons in food chains
(5) changes in biological habitats

It has been established that the primary cause of mortality (except to birds) is not "oil" but the soluble aromatic hydrocarbon derivatives (S.A.D.s) in petroleum products. The concentration of S.A.D.s in various petroleum products varies; for example, crude oil may contain a maximum of 0.1 to 10 percent whereas No. 2 fuel oil may contain 1 to 30 percent. A summary of the lethal toxicity of various petroleum products on marine species groups is presented in Table 2. Generally speaking, lethal effects on adult marine organisms are found at S.A.D. concentrations of 0.1 to 10 ppm (parts per million) and sublethal effects for some species of ecologic and/or commercial value are found at concentrations of 1 to 10 ppb (parts per billion). Sublethal effects include the production of abnormal fish spawn and the inhibition of the mating response in some crabs. Tainting may occur when fish or shellfish are exposed to concentrations of 1 ppb; human beings can taste concentrations in animal tissue of 5 to 50 ppm (Hyland and Schneider, 1976).

The effects of oil pollution on the previously described communities on Georges Bank may be summarized as follows:

Phytoplankton: Since it is difficult to monitor changes in the abundance and distribution of phytoplankton even under normal conditions it will be difficult to discern significant changes that may be brought about by oil pollution. No major effects on phytoplankton were noted in relation to the Torrey Canyon spill or the Santa Barbara blowout (Smith, 1968; Straughan, 1971; Straughan, 1970 in Hyland and Schneider, 1976). The quick reproduction from losses caused by a spill would be rapid.

Zooplankton: Here, also, monitoring change is a problem and assigning the causality of a change and its significance is even more difficult. Since the eggs and larvae of many commercially important species are concentrated at or near the surface, there is considerable concern that oil pollution could cause significant damage if these highly sensitive life stages were destroyed. Most vulnerable would be short-lived species; species that live for several years could probably better sustain the loss of a year class without serious stock reduction (U.S. Council on Environmental Quality, 1974).

Nekton: Fish and mammals would probably avoid spills. The major danger appears to be that eggs and larvae of fish might be destroyed.

Birds: Birds are highly susceptible to oil pollution, since coating alone frequently causes death. Recovery of bird populations may be slow since birds are relatively long-lived and are not prolific breeders.

TABLE 2

SUMMARY OF LETHAL TOXICITY[a]

Class of Organisms	Estimated Conc. (ppm)[b] of S.A.D.[c] Causing Toxicity	Estimated Amount (ppm) of Various Petroleum Substances Containing Equivalent Amounts of S.A.D. #2 Fuel Oil (Est. Max. % S.A.D. = 1-30)	Crude Oil (Est. Max. % S.A.D. = 0.1-10)	Kerosene (Est. Max. % S.A.D. = 1-20)	Dispersant (BP 1002) (Est. Max. % S.A.D. = 1-20)	Residual (Est. Max. % S.A.D. = 0-1)
Flora	10-100	50-500	10^4-10^5	10^2-10^3	10^2-10^3	10^3-→ (no effect)
Finfish	5- 50	25-250	10^4-10^5	50-500	50-500	500-→
Larvae (all species)	0.1-1.0	0.5- 5	10^2-10^3	1- 10	1- 10	10-→
Pelagic Crustaceans	1- 10	5- 50	10^3-10^4	10-100	10-100	10^2-→
Gastropods	10-100	50-500	10^4-10^5	10^2-10^3	10^2-10^3	10^3-→
Bivalves	5- 50	25-250	10^4-10^5	50-500	50-500	500-→
Benthic Crustaceans	1- 10	5- 50	10^3-10^4	10-100	10-100	10^2-→
Other Benthic Organisms (Polychaetes, etc.)	1- 10	5- 50	10^3-10^4	10-100	10-100	10^2-→
Birds			← Coating →			

[a]Adopted with modifications from Moore.[2]

[b]Based on a review of the literature by Moore et al.[1] and their estimates of S.A.D. in the bioassay solutions.

[c]Soluble aromatic hydrocarbon derivatives (mono- and dicyclic aromatics, naptheno-aromatics).

Source: Hyland and Schneider, 1976, in press.

Benthos: Although potential rates and quantities of hydrocarbons transported to the bottom are unknown, oil may be incorporated into the sediments with long-lasting effects. The U.S. Council on Environmental Quality (1974) estimates that the recovery time for an offshore sandy bottom in the Georges Bank region may be two to three years and that soft bottom communities would take longer. Potential sublethal effects are worrying when one considers such possible effects as changes in lobster behavior and the tainting of mollusks. It should also be remembered that most of the highest value commercial fish species are bottom feeders.

In conclusion, there are many concerns about the effects chronic discharges and spills might have on the Georges Bank environment. The most troublesome aspect of the problem is that we know too little about the effects of oil and too little about the Georges Bank environment to be confident that we will recognize significant impacts if they occur.

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Section I

Appendix A

AN ANALYSIS OF DATA FROM THE NATIONAL MARINE FISHERIES SERVICE GROUNDFISH SURVEY FOR USE IN ASSESSING OIL-RELATED ENVIRONMENTAL IMPACTS

Robert A. Pikanowski
Graduate School of Oceanography

Acknowledgements: This analysis would not have been possible without the generous cooperation of the NMFS Northeast Fisheries Center at Woods Hole which provided us with the groundfish survey data they have collected over the past ten years.

INTRODUCTION

Commercial fisheries landings statistics such as those published annually by the National Marine Fisheries Service (NMFS) provide an indication of the abundance of fish populations, but in order to more accurately monitor the condition of stocks a standardized scientific sampling program must be undertaken. The NMFS Northeast Fisheries Center has conducted such a survey for groundfish species in the Georges Bank area since 1963. The following analysis of that data provides information that is useful in attempting to understand the distribution of species and species groups on Georges Bank and the degree to which their abundance in given areas has varied in recent years.

METHODS AND RESULTS

In any objective sampling procedure it is essential that variability in results caused by the sampling procedure be measured. Since conversion factors to equalize the sampling efficiency of different gear types are not known, only data taken with a single net type were analyzed (a No. 36 Yankee trawl towed for 10 minutes at 3.5 knots). This gear was used during the spring surveys 1968 to 1972 and for fall surveys 1964 to 1974. Because drastic overfishing of many groundfish species occurred in the mid-1960s, fall survey data for 1974 to 1967 were also excluded from the analysis as data from these years would bias the results and provide a less accurate representation of the current condition of stocks.

In conducting the groundfish survey, the NMFS makes from 4 to 12 replicate tows in each of a number of survey areas, known as strata, which have been defined by sediment type and depth (Figure 1). The strata in the Georges Bank area which were examined include number 9 through 25. Unfortunately, the small number of tows taken in each stratum do not permit an analysis of areas smaller than those contained within a single stratum.

Since, for the purposes of this analysis, an indication of the biomass of the groundfish is most useful, the weights of the fish taken were analyzed. The species and species groups are listed in Table 1.

Table 1

SPECIES AND SPECIES GROUPS EXAMINED

1. Yellowtail (Limanda ferruginea)
2. Silver Hake (Merluccius bilinearis)
3. Cod (Gadus morhua)
4. Haddock (Melanogrammus aeglefinus)
5. Other Gadids: pollock, white hake, red hake, spotted hake, long-finned hake (Pollachius virens, Urophycis tenuis, U. chuss, U. regius, U. chesteri)
6. Other flatfish: halibut, american dab, fluke, four spot, blackback, gray sole, windowpane, gulfstream and deepwater flounders (Hippoglossus hippoglossus, Hippoglossoides platessoides, Paralichthys dentatus, P. oblongus, Pseudopleuronectes americanus, Glyptocephalus cynoglossus, Scophthalmus aquosus, Citharichthys arctifrons, Monolene sessilicauda)
7. Cartilaginous fishes: smooth, chain, and spiny dogfishes, torpedo, barndoor, big, clear nose, leopard, little, smooth tailed, and thorny skates (Mustelus canis, Scylorhinus retifer, Squalas acanthias, Torpedo nobiliana, Raja laevis, R. ocellata, R. eglanteria, R. garmani, R. erinacea, R. senta, R. radiata)
8. Other groundfish: conger eel, slime and snake eels, halfbeak, four bearded rockling, cusk, sea bass, scup, redfish, hook eared, mailed, short horn and long horned sculpins, grubby, sea raven, striped sea snail, lumpfish, northern, striped and armored sea robins, ocean pout, cusk eel and goosefish. (Conger oceanicus, Simenchelys parasiticus, Omochelys cruentifer, Hyporhamphus unifasciatus, Enchelyopus cimbrius, Brosme brosme, Centropristes striatus, Stenotomus chrysops, Sebastes marinus, Artiediellus uncinatus, Triglops ommatistius, Myoxocephalus scorpius, M. octodecimspinosus, M. aeneus, Hemitripterus americanus, Liparis liparis, Cyclopterus lumpus, Prionotus carolinos, P. erolans, Peristedion miniatum, Maerozoarces americanus, Lepophidium cervinum, Lophius americanus).
9. All species combined.

Analyses were performed on the standard trawl data for spring and fall surveys for the years selected. Tables 2 and 3 provide the following information on the abundance of species and species groups in each stratum for the spring and fall:

top number:	gives the transformed (natural log + 1) average weight per tow for that species or species group during the years analyzed.[1]
middle number:	provides the rank by strata of the abundance of that species or species group (from least 1, to most, 17). Zeros indicate that no fish were taken.
lower number:	gives the magnitude of change that would have to be noted before it could be considered statistically significant at the 95 percent confidence level. If the difference between the historical average (top number) and the average weight taken in 10 replicate standard tows is as great or greater than the number listed, then a statistically significant change may be considered to have occurred.

These data therefore provide an indication of the relative abundance of species and species groups in each stratum and how great an alteration in abundance would have to be noted before one could claim that the change was statistically significant under the assumptions used in this analysis.

The rating by strata of the relative abundance of species and species groups (the middle number in Tables 2 and 3) does not indicate that the differences between strata are statistically significant. Tables 4 and 5 group those strata that are not significantly different from one another for each species and species group at the 95 percent confidence level. For example, the spring data for yellowtail flounder provide five groups of strata that are significantly different from one another. If an individual strata is found in two or more sets it is not significantly different from either. If only one comparison were to be made based upon the trawl data,

Table 2: Transformed average weight, rank and magnitude of future change considered statistically significant for each species group and strata. Spring data. (See text for explanation).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
3.3[illegible] 13 .513	2.002 11 .918	.039 1 .132	0	2.152 12 .865	.104 3 .268	0	1.598 9 .927	.279 4 .555	0	1.965 10 1.016	.691 7 .729	.456 5 .683	0	1.05 8 .926	.087 2 .214	[illegible] 6 .774
0	.661 6 .665	1.662 9 .935	2.566 11 1.135	.173 4 .271	1.933 10 .877	2.615 12 1.007	0	.173 3 .35	.603 7 1.025	.016 1 .074	0	0	.897 8 .872	.027 2 .104	.398 5 .449	0
2.351 9 1.309	1.217 4 1.065	0	0	1.205 2 1.032	0	0	2.28 8 1.186	1.208 3 1.239	.267 1 .583	2.695 11 1.122	2.833 13 1.017	2.205 7 1.274	1.269 5 1.176	2.832 12 1.162	1.687 6 1.358	[illegible] [illegible] 1.[illegible]
.331 3 .633	.639 5 .932	0	0	1.76 12 1.147	.199 1 .399	0	1.786 13 1.322	1.665 9 1.417	.439 4 .848	2.14 14 1.207	.953 6 1.062	1.74 11 1.121	1.694 10 1.309	1.477 8 1.256	1.458 7 1.136	[illegible] [illegible] [illegible]
.365 4 .658	.781 7 .786	1.453 11 .999	2.327 15 1.097	.6 5 .930	2.003 12 1.008	2.288 14 1.024	.083 1 .280	1.428 10 1.176	2.238 13 1.431	.144 2 .420	.293 3 .549	1.058 9 1.033	2.835 17 1.180	.758 6 .868	2.662 16 .909	[illegible] [illegible] 1.513
2.611 17 .688	2.199 14 .737	1.035 5 1.007	.464 2 .57	1.106 6 .618	1.199 8 .909	1.139 7 .743	1.282 9 .969	.318 1 .532	.638 3 .682	2.445 16 .729	2.014 13 .91	.762 4 .822	1.913 12 1.006	1.704 10 1.000	2.253 15 .596	[illegible] 11 1.151
4.022 17 1.061	3.458 15 1.061	1.596 5 1.480	1.029 1 1.139	2.715 7 1.261	1.328 3 .991	1.256 2 1.214	2.819 8 .949	2.099 6 1.165	1.517 4 .931	3.29 10 1.213	3.391 13 1.155	3.411 14 1.288	3.524 16 1.378	3.368 12 1.049	3.344 11 .768	[illegible] [illegible] [illegible]
3.975 17 .918	2.150 12 .938	1.253 2 1.256	1.447 4 1.354	1.909 9 .783	.889 1 .856	1.994 11 1.335	2.235 13 1.026	1.819 5 1.448	2.734 15 1.622	1.885 7 .978	1.433 3 1.043	1.878 6 1.305	1.931 10 1.12	2.235 14 1.057	3.063 16 1.233	[illegible] [illegible] [illegible]
5.511 17 .381	4.606 12 .711	3.192 1 1.361	3.795 4 .896	4.238 7 .791	3.226 2 .887	4.036 5 .646	4.417 8 .865	4.075 6 .946	3.743 3 1.402	4.744 13 .859	4.587 11 .592	4.47 10 .898	4.873 15 .782	4.784 14 .518	5.014 16 .521	[illegible] [illegible] [illegible]

Table 3: Transformed average weight, rank and magnitude of future change considered statistically significant for each species group and strata. Fall data. (See text for explanation).

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1.874 11 1,021	1.454 10 1.053	0	0	1.997 13 1.127	.089 3 .332	.046 1 .257	1.966 12 .951	.452 5 .737	.066 2 .08	1.254 7 .924	.389 4 .741	.845 6 .826	0	1.387 9 .996	0	1.303 8 .879
1.215 11 .841	1.468 14 .714	.395 1 .630	.846 7 .965	.943 8 .604	1.33 13 .641	1.075 9 .855	.557 3 .433	.637 4 .713	1.231 12 1.066	.72 5 .519	.739 6 .731	1.171 10 .835	1.89 17 .932	1.7 16 .827	1.539 15 .824	.528 2 .806
.429 3 .869	.256 2 .57	0	0	.163 1 .448	0	0	.902 5 .948	1.309 7 1.138	1.104 6 1.276	.87 4 .938	2.343 9 1.296	2.557 10 1.076	1.382 8 1.317	2.687 12 1.254	2.563 11 1.287	3.227 13 1.315
0	.111 1 .592	0	0	.138 2 .964	0	0	.927 5 .997	1.751 8 1.128	1.492 7 1.458	.309 3 .998	.315 4 .951	.924 6 1.259	2.503 12 1.264	2.192 10 1.196	2,462 11 1.043	1.99 9 1.191
.655 3 .814	1.488 11 .932	.996 5 .756	.708 4 .893	1.369 10 .775	1.289 8 .756	1.6 13 .893	.998 6 .775	1.321 9 1.218	1.844 14 1.197	.63 2 .683	.487 1 .718	1.515 12 1.062	3.716 17 1.043	2.171 15 .923	2.783 16 .829	1.172 7 1.035
2.12 13 1764	1.497 10 .797	.303 2 .542	.298 1 .407	1.249 8 .796	.606 5 .453	.462 3 .573	1.14 7 .689	.477 4 .704	.766 6 .819	1.904 12 .853	1.879 11 1.014	1.279 9 .971	2,297 15 1.108	2.255 14 .903	2.558 16 .64	2.888 17 .976
4.659 17 .986	2.441 8 1.201	.085 1 .68	.233 2 .447	2.452 9 1.044	.587 3 .677	.742 4 .926	2.709 10 1.008	1.521 5 .880	1.706 6 .957	3.672 15 .68	3.811 16 1.052	3.459 13 1.123	2.24 7 1.257	3.593 14 .924	3.305 12 .871	3.162 11 1.124
2.316 14 1.014	1.386 7 .978	.673 1 .912	1.490 8 1.225	1.608 9 .851	1.119 3 .866	1.119 4 1.074	2.151 11 .919	1.131 5 1.049	1.896 10 1.232	1.299 6 .895	1.084 2 1.012	2.645 16 .937	[illegible] 17 1.176	2.281 12 .939	3.176 17 .938	2.477 15 1.687
5.201 17 .849	3.867 7 .949	1.579 1 .895	2.159 2 1.101	3.776 6 .778	2,528 3 .772	2.638 4 1.752	4.039 9 .772	3.515 5 .976	4.02 8 1.059	4.244 10 .724	4.62 11 .919	4.737 12 .711	[illegible] [illegible] [illegible]	[illegible] 15 [illegible]	5.124 16 [illegible]	[illegible] 14 [illegible]

TABLE 4

Clusters of Significantly Different Strata by Species Group
Spring Data

Species	
1	(11 24 14 17 21 25 20) (16 19 10) (21 25 20 23) (19 10 13) (9)
2	(19 23 17 13 24) (10 18 22) (24 10 18) (12 15) (11 14)
3	(24 21 16 9 25) (18 13 17 10 22) (17 22 24 21) (21 16 9 25 19 23 20) (13 17 10 22 24)
4	(24 23 17 22 21 13 16 19) (20 24 23 17 22 21 13) (14 25 9 18 10 20) (18 20 24 23)
5	(23 10 25 21 17 11) (9 13 23 10 25 21) (20 9 13 23 10) (19 20 9 13 23) (14 18 15 12 24) (18 15 12 24 22) (11 14 18 15) (17 11 14 18) (16 19 20 9)
6	(18 21 11 13 15 14 16) (12 18 21 11 13 15 14) (25 22 20 10 24 19 9) (11 13 15 14 16 23) (23 25 22 20 10 24) (15 14 16 23 25 22) (17 12 18 21 11)
7	(25 19 24 23 20 21 10 22 9) (13 16 25 19 24 23 20 21 10 22) (17 13 16 25) (12 15 14 18 11 17)
8	(12 17 21 19 25 13 22 15 10 16 23) (11 20 12 17 21 19 25 13 22 15 10 23) (17 21 19 25 13 22 15 10 16 23 18) (14 11 20 12 17 21 25 22 15) (18 20)
9	(15 17 13 16 25 22 20 10 19 23 22) (25 21 20 10 19 23 22 24) (18 12 15 17 13 16 25 21) (11 14 18 12) (22 24 9)

TABLE 5

Clusters of Significantly Different Strata by Species Group
Fall Data

Species	
1	(15 18 14 20 17 21) (21 19 25 23 10) (25 23 10 9) (9 16 13)
2	(11 25 16 17 19 20 12 13 15) (21 9 18 14 10 24 23) (12 13 15 21 9 18 14) (15 21 9 18 14 10 24) (25 17 19 20 12 13 15 21) (17 19 20 12 13 15 21 18) (18 14 10 24 23 22)
3	(20 21 24 23) (9 19 16 18) (13 10 9) (19 16 18 17 22) (21 24 23 25)
4	(10 13 19 20) (18 17 25 23) (25 23 24 22) (16 21 18) (19 20 16 21)
5	(11 25 14 17 13 10 21 15 18) (12 11 16 25 24 17 13 21) (11 16 25 14 17 13 21 15) (20 19 9 12 11 16 25) (9 12 11 16 25 14) (15 18 23) (24 22)
6	(12 11 15 17 14 18) (20 19 9 23 22) (16 13 21 10) (9 23 22 24) (18 16 13 21) (10 20 19) (22 24 25)
7	(25 24 21 23 19 20) (18 22 10 13) (22 10 13 16) (11 12 14 15) (17 18 22) (16 15)
8	(11 20 14 15 17 19 10 12) (20 14 15 17 19 10 12 13 18) (18 16 23 22 9 25 21) (12 18 16 23 22 9) (25 21 24)
9	(20 21 22 25 23 24 9) (17 13 10 18 16) (13 10 18 16 19) (18 19 20 21) (12 14 15) (11 12)

a simple t-test would be sufficient. An example is a comparison between stratum 9 and stratum 20 based on the abundance of haddock in the fall. If the chosen confidence level ( ) is .95 then there would be only a 1 in 20 chance of being wrong if a t-test showed a significant difference. However, since it is likely that multiple comparisons will be made, the chance of there being an error will become greater than .05. Actually it will be .95N, where N is the number of comparisons. Thus, if 10 differences are tested, the chance of all 10 being properly classified (significant or nonsignificant) would only be about 0.6.

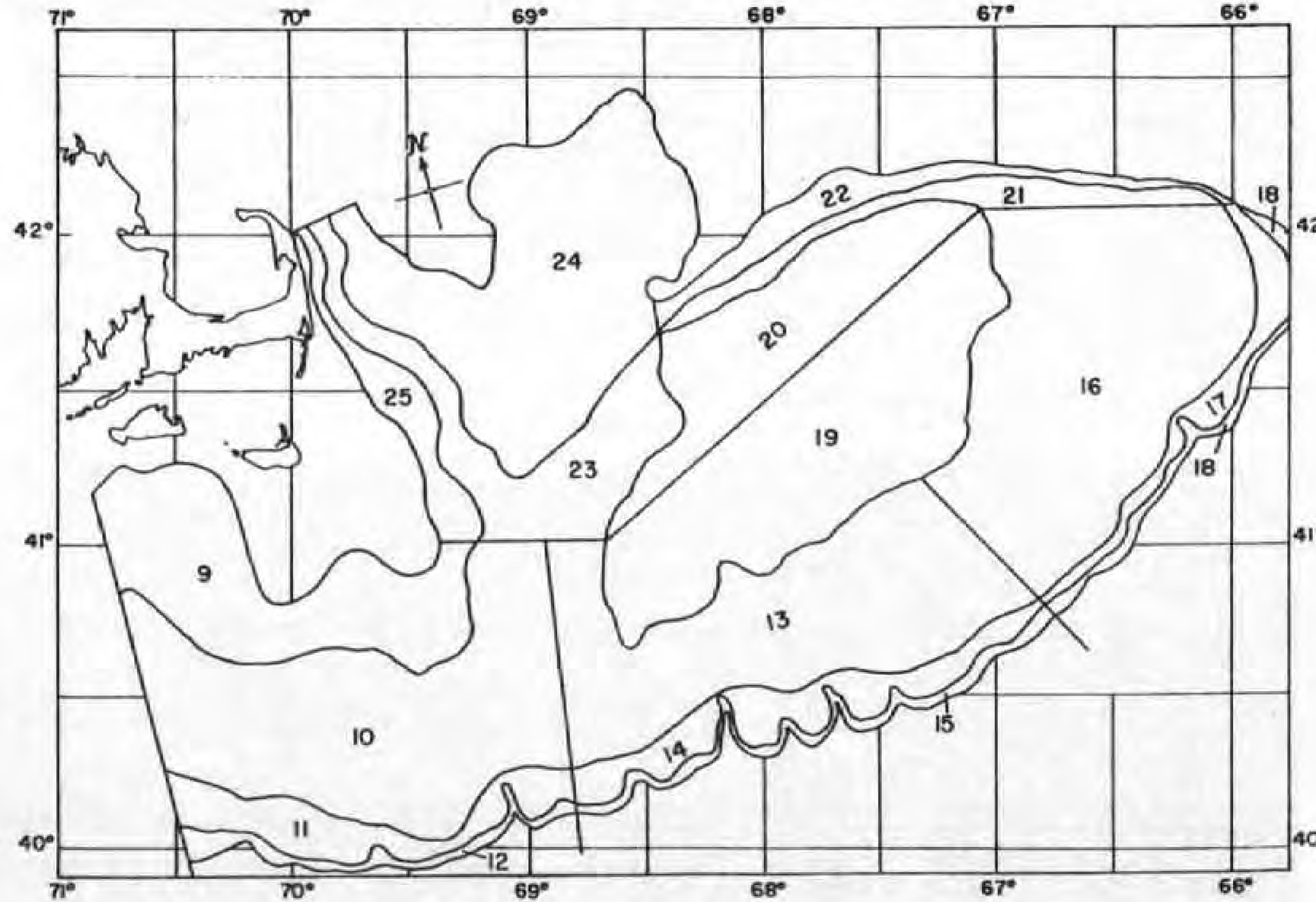
Duncan's New Multiple Range Test circumvents this problem. It allows any or all possible comparisons to be made with the confidence level remaining at the specific percentage. Using this technique the clusters (sets) shown in Tables 4 and 5 were generated. The technique specifies that members of a set are not significantly different at a chosen confidence level (in this case .95). Inferentially, strata not belonging to the same set are significantly different. To test for differences between strata (and thus the tracts contained in them) based upon spring and fall abundance of a particular species find the clusters listed for that species and season. Those strata appearing in the same cluster are not significantly different. For example: to decide between strata 9, 18 and 20 based on fall total (species grouping 9) abundance find the appropriate clusters in Table 5. Strata 9 and 18 do not belong to a same set and are thus significantly different. Stratum 20 occurs in a set with stratum 9 and also with stratum 18 and is thus not significantly different from either. Strata with zero means (no fish of the particular species grouping were taken) were not included in this analysis and are automatically assumed different from the non-zero strata.

Conclusions: The analyses discussed above provide some indication of the relative geographic abundance of species and species groups of groundfish on Georges Bank. The results summarize the information available in the NMFS groundfish survey in a manner which may prove useful when attempting to examine the differences in biomass between specific areas for species or species groups.

Footnotes

[1]It was found that weight per tow in trawl sampling is not normally distributed, and, moreover, sampling variances are correlated with the mean (variances increase approximately with the squares of the means). However, the logarithmic transformation, (ln weight + 1), yields somewhat normal distributions, independence of the variance from the mean, and homogeneity of variance between years (shown by Bartlett's Test of Homogeneity of Variance). This allows parametric tests to be run on the statistic (ln lbs + 1) of a fish species per tow. This statistic does not reflect absolute abundance in itself but can be used to examine relative abundances, as between years or strata. It should be remembered that, because of the transformation, a difference between two means of .693 indicates a doubling or halving of relative abundance.

Fig. 1. Georges Bank Groundfish Survey Strata



Section 2

A PROFILE OF NEW ENGLAND PORTS

Stephen Olsen
Coastal Resources Center

Thomas Grigalunas
Department of Resource Economics

INTRODUCTION

With the exception of petroleum products, waterborne commerce has declined in recent years, and New England's largest ports, once busy and prosperous, are now underutilized. The problem is compounded in several major ports by a chronic need for dredging, both to maintain previously dredged channels and to increase the water depth so that large, deep-drafted vessels can be accommodated. Dumping dredge spoils in coastal waters is looked upon with disfavor by the environmentally aware and by fishermen, and federal regulations, impact statements and the like combine to make dredging projects very difficult to implement. Finally, the Navy recently decided to abandon many of its New England facilities and is now in the process of making available to the private sector several large port facilities. Large piers and wharfs suitable for a great variety of craft and onshore activities presently lie unutilized in Quonset, Davisville, Melville and Coddington Cove in Rhode Island and in Boston, Massachusetts. These facilities could readily accommodate all the vessels that might be needed by the offshore petroleum industry even if projected high finds become a reality on Georges Bank and in the mid-Atlantic. It cannot be assumed, however, that all the needs of the petroleum industry for port facilities will be met by the excessed Navy lands. Other major New England ports are underutilized and may prove suitable for at least some activities.

Several of New England's smaller ports could be attractive, at least at first glance, to the petroleum industries. Small ports on Cape Cod, for example, are the closest to Georges Bank. These and many other small ports, however, are frequently heavily utilized, especially in the summer months when recreational boaters strain the limited facilities available. The smaller ports also tend to lack the physical attributes that are needed by petroleum-related vessels. Many of these smaller ports also have sizable fishing fleets, and competition for space and services from petroleum company vessels could cause serious problems. Such problems can, and should, be avoided.

New England Fishing Vessels

A major effort has been made as a part of this study to account for commercial fishing vessels classified as over 5 net tons in major New England ports. The estimated number of vessels are listed by port, by lenghth and by gear in Table 1. Data presented in NMFS statistics are not used in this report since in some cases vessels that have been tied up or even sunk for several years are listed as active. Inactive vessels are not listed in Table 1. However, our figures must be taken as estimates. It is extermely difficult to identify every vessel and assign it to one port, since many vessels land regularly in more than one and may be counted more than once. A few vessels that land only in small ports have not been included.

It is important to recognize that craft classified as under 5 net tons are considered by the U.S. Coast Guard as boats and are not registered with that agency. There are significant numbers of craft that are on the borderline between the two categories, some of which are in the length range of the smallest vessels (38-49 feet). It must be remembered, therefore, that the total number of commercial fishing craft in New England is considerably more than the number of vessels listed in Table 1. On Cape Cod, for example, it is estimated that a total of some 150 commercial boats and vessels fish offshore, including some lobster boats only 20 feet long that work on Nantucket Shoals. Table 1 gives figures for Provincetown and Chatham and accounts for 80 vessels on Cape Cod. Some of the remaining 70 or so craft should probably appear in Table 1; many have been built in Nova Scotia and since fishermen do not have to pay heavy import tariffs if a craft is under 5 net tons it is in their interest to classify borderline craft as boats and not as vessels.

Another problem is found in assigning vessels to a gear category since some vessels fish several gear types. For example, vessels in Maine and Massachusetts that trawl for shrimp at least part of the year are classified as groundfish trawlers in Table 1.

TABLE 1

ESTIMATED NUMBER OF FISHING VESSELS
OVER 5 NET TONS IN NEW ENGLAND
BY MAJOR PORTS, BY LENGTH, BY GEAR*

State	Port	Gear	Length (feet)				Total
			38-49	50-69	70-99	-100	
			(number)				
Conn.	Stonington	Otter Trawl (Groundfish)	1	6	-	-	7
		Other	3	-	-	-	3
	Total		4	6	-	-	10
Total			4	6	-	-	10
Rhode Island	Point Judith	Otter Trawl (Groundfish)	14	33	5	-	52
		Otter Trawl (Lobster)	-	-	-	-	-
		Trap (Lobster)	15	16	2	1	34
		Dredge (Scallop & Clam)	2	2	2	-	6
		Other	8	5	-	-	13
	Total		39	56	9	1	105
	Newport	Otter Trawl (Groundfish)	11	12	5	1	29
		Otter Trawl (Lobster)	-	1	4	-	5
		Trap (Lobster)	2	3	1	-	6
		Dredge (Scallop & Clam)	8	-	-	-	8
		Other	2	4	-	-	6
	Total		23	20	10	1	54
Total			62	76	19	2	159
Mass.	Boston	Otter Trawl (Groundfish)	5	2	4	4	15
		Trap (Lobster)	-	3	2	-	5
		Other	3	-	-	-	3
	Total		8	5	6	4	23
	Gloucester	Otter Trawl (Groundfish)	3	35	32	24	94
		Purse Seine (Herring & Menhaden)	-	1	3	2	6
		Other	19	5	-	-	24
	Total		22	41	35	26	124

TABLE 1 (continued)

State	Port	Gear	Length (feet) 38-49	50-69	70-99	-100	Total
			(number)				
	New Bedford	Otter Trawl (Groundfish)	17	49	65	1	132
		Dredge (Scallop & Clam)	1	1	17	-	19
		Other	12	16	4	1	33
	Total		30	66	86	2	184
	Province-town	Otter Trawl (Groundfish)	16	28	5	1	50
		Dredge	15	1	-	-	16
		Other	5	1	-	1	7
	Total		36	30	5	2	73
	Chatham Total		7	-	-	-	7
Total			103	142	132	34	411
Maine	Portland	Otter Trawl (Groundfish)	22	14	1	6	43
		Otter Trawl (Shrimp)	6	11	2	-	19
		Trap (Lobster)	11	1	-	-	12
		Other	3	1	-	-	4
	Total		42	27	3	6	78
	Rockland	Otter Trawl (Groundfish)	7	2	1	11	21
		Otter Trawl (Shrimp)	3	4	-	-	7
		Trap (Lobster)	4	-	-	-	4
		Other	3	3	-	-	6
	Total		17	9	1	11	38
	Boothbay	Otter Trawl (Groundfish)	13	5	1	-	19
		Otter Trawl (Shrimp)	4	12	-	-	16
		Other	2	-	-	-	2
	Total		19	17	1	-	37
	Eastport	Otter Trawl (Groundfish)	5	3	-	-	8
		Other	1	-	-	-	1
	Total		6	3	-	-	9
Total			84	56	5	17	162

TABLE 1 (continued)

State	Port	Gear	Length (feet) 38-39	50-69	70-99	-100	Total
			(number)				
New England Major Ports		Otter Trawl (Groundfish)	114	189	119	48	470
		Otter Trawl (Shrimp & Lobster)	13	28	6	-	47
		Dredge (Scallop & Clam)	23	4	19	-	46
		Other	100	59	12	5	176
	Total		250	280	156	53	739
		Average Crew Size	2.5	4.5	7	11	
		Estimated Total Crew (N.E. Major Ports)	625	1260	1092	583	3560

*Vessels are classified by major gear use. Many vessels use several types of gear. For example, many vessels in Maine and Massachusetts trawl for shrimp at least part of the year but are classified here as groundfish trawlers.

Note: These data were collected by Virgil Norton, URI, Dept. of Resource Economics.

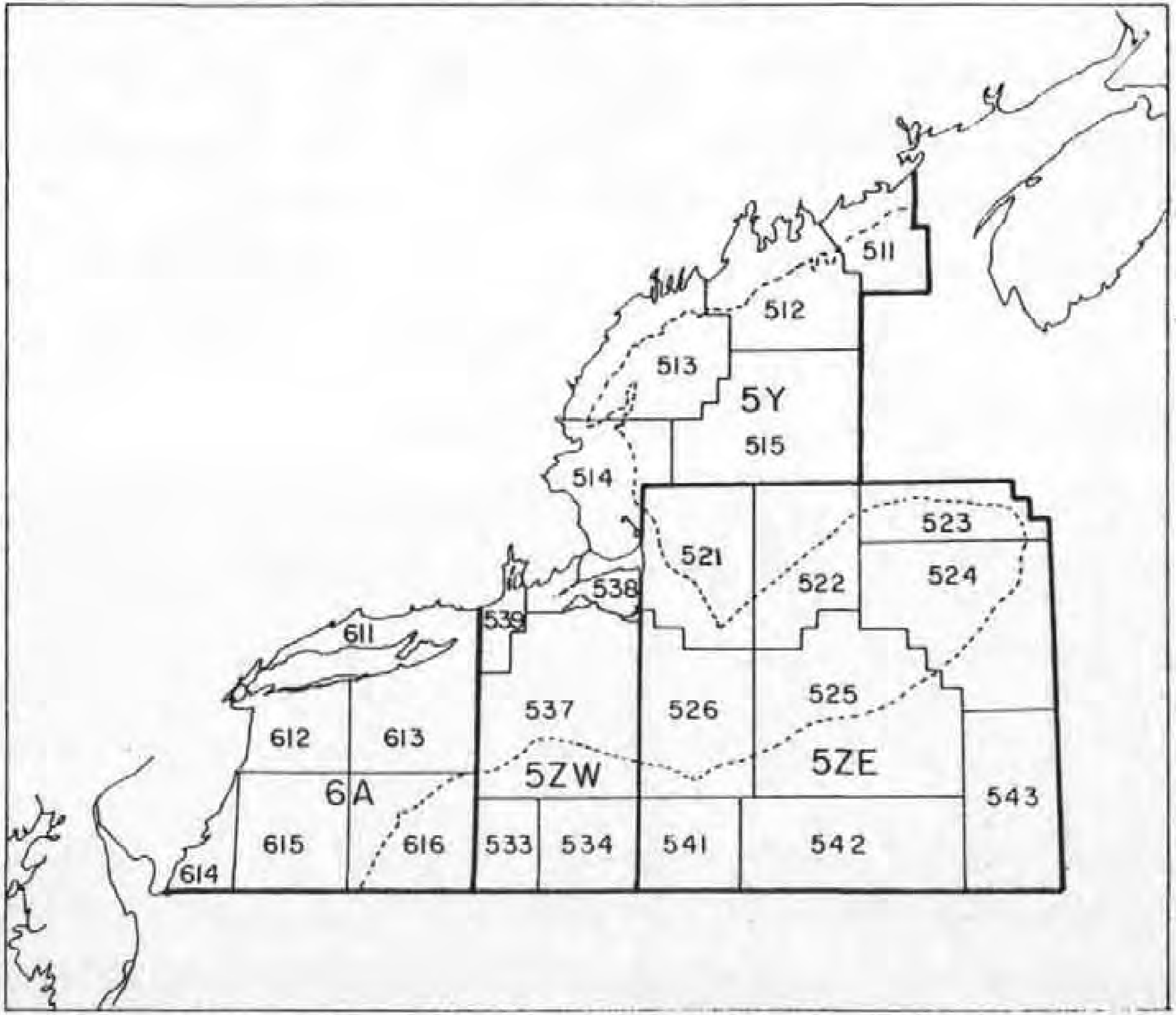
Landings by Port

The NMFS routinely samples the landings of a sample of fishing craft in all the major ports in the region. Detailed information is recorded on the species landed, and how and where they were caught. Information on the geographic distribution of catches on Georges Bank is examined in detail in Section 8. In this section more generalized information is presented for landings at major ports from the Georges Bank area. Figures presented in this section for "percentage of landings from Georges Bank area" include total catches taken in areas 521 through 526 (Figure 1) and thus include landings from all of Georges Bank, Great South Channel and Nantucket Shoals. This area is approximately the same as that covered by all the potential oil and gas lease tracts. The data presented are preliminary and may be slightly modified by NMFS at a later date.

Physical Attributes of Ports

Throughout this section, information on the physical characteristics of ports has been taken from the TRIGOM inventory (1974) and the United States Coastal Pilot (1974). This information was corroborated and expanded through interviews with officials in each port.

Fig. 1. NMFS Areas 511-616 and ICNAF Areas 5 and 6A



Note: ICNAF areas are those large areas outlined with heavy lines.

NEW HAVEN, CONNECTICUT

New Haven Harbor in central Connecticut is two miles wide and includes the navigable portions of the West, Mill and Quinnipiac Rivers. New Haven is 18.1 hours steaming time from the hypothetical center of concentrated oil interest on Georges Bank, and 14.5 hours steaming time from the Mid-Atlantic oil interest area.[1]

Port Activity and Present Utilization

The number of inbound trips in 1972 totaled 4,200. New Haven ranked third in New England for the amount of petroleum products handled in 1972 with 11.8 million short tons. Dry cargo amounted to 1.2 million short tons for the same year. The Port of New Haven is currently underutilized. The Port Development Committee is considering a multimillion-dollar proposal to dredge the 38-foot channel to a depth of 50 feet or more. This would permit large tankers to land oil products.

Physical Characteristics

Inside West Breakwater and the southwest half of Luddington Rock Breakwater, anchorage is available for vessels with a draft of up to 20 feet. Vessels may anchor northward of Southwest Ledge Light in depths of 18 to 20 feet. Deep-draft vessels awaiting berthing assignments may anchor about 1 mile southward of the sea buoy. Control depths in the channel are currently 38 feet.

Port and berthing space for deep-draft vessels consists of eight major piers, wharfs or docks located along the north and east sides of the inner part of New Haven Harbor. Smaller vessels use facilities on the Mill, Quinnipiac and West Rivers. There are 40 piers in the port with 1,640 linear feet of berthing space with water depths alongside of 22 of 35 feet.

Warehouse space consists of 142,000 square feet of dry storage and 353,000 cubic feet of cold storage. No facilities exist for making major repairs or for drydocking deep-draft vessels; the nearest repair facilities for large vessels are in New London.

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[1] Throughout this section, steaming times are calculated using the conversion factor of 14 miles/hr (12 knots).

All the facilities have direct highway connections and most have railroad connections. Interstate Routes 91 and 95 are nearby and Tweed is the local airport.

Fisheries

Once an active port in the Long Island oyster fishery, New Haven now sees no significant commercial fishing activity.

NEW LONDON, CONNECTICUT

New London Harbor is near the eastern end of Long Island Sound at the mouth of the Thames River. The distance to the hypothetical center of oil interest on Georges Bank is approximately 200 miles or about 13.3 hours steaming time. The city of New London is located on the west bank of the Thames River about 2.5 miles from its mouth. The town of Groton, on the east bank, is connected to New London by both a highway and railroad bridge. The Electric Boat Division of General Dynamics is located in Groton. A naval submarine base is on the east side of the Thames River about 2 miles above New London.

Port Activity and Present Utilization

The harbor is used primarily by vessels drawing 9 to 30 feet, though vessels with a 33 foot draft may be accommodated. Petroleum products, chemicals, lumber and general cargo are the principal waterborne products handled.

Physical Characteristics

The main harbor comprises the lower 3 miles of the Thames River and includes Shaw Cove, Green Harbor and Winthrop Cove. The harbor is approached through a main entrance channel extending from Long Island Sound to the upper harbor. A current federal project provides for a channel 33 feet deep to the State Pier and 23 feet deep in the waterfront channel and in Winthrop Cove. In 1970, control depths of 33 feet were maintained above the bridges of New London to the north end of a turning basin opposite Smith Cove. Depths of 23 feet are found up to Allyn Point and thence 19 feet up to and within a turning basin at the city of Norwich. There are three anchorages (one naval) in the Thames River and on in Long Island Sound.

New London Harbor has more than 30 wharfs and piers. Most of these are used to repair berths or moorings for recreational craft, fishing vessels, barges and government vessels. Depths alongside these facilities vary from 10 to 30 feet. New London's present petroleum-handling facilities consist of 8 berths with a total of

4,775 feet of docking space and 40 storage tanks with a combined capacity of 1,129 barrels. (TRIGOM, 1974 table 23-8).

Deep-water facilities are found at the State Pier and the Hess oil dock. The State Pier has 2,000 linear feet of berthing with depths alongside from 28 to 38 feet. 205,000 square feet of covered storage, 6 acres of open storage space, railroad and highway connections are all available at the State Pier.

New London Harbor has two major repair facilities, the larger of which has a floating drydock, a graving dock and a marine railway. These facilities are used primarily for the construction and repair of naval vessels.

Cranes and floating derricks that can handle up to 110 tons are available in New London. New London has good rail and highway connections.

Fisheries

Commercial fisheries are not significant in New London.

STONINGTON, CONNECTICUT

Stonington Harbor, at the eastern end of the state, is protected by Watch Hill Point and breakwaters on either side of the port. Stonington is some 13.4 steaming hours to the hypothetical center of the petroleum interest on Georges and 10 hours from the mid-Atlantic area of interest.

Port Activity and Present Utilization

The limited port facilities available are well utilized by a great number of pleasure craft during the boating season. Commercial fishing craft are concentrated at the town pier and there is little or no room for an expanded fishing fleet.

Physical Characteristics

An anchorage area inside the west breakwater provides depths of 15 to 18 feet. The controlled depth in the inner harbor is 11 feet. There is a railroad station in the town of Stonington but rail spurs to the wharf were removed in 1974. Westerly airport is the closest commercial airport; Interstate Route 95 is three miles to the north.

Fisheries

Stonington was an active fishing port in the years immediately following World War II. In later years the lack of a fish buyer and support facilities forced the port's few small trawlers to land primarily at Greenport, Long Island, and Point Judith, R.I. The fishing industry is now experiencing something of a resurgence. A buyer has constructed a cold storage facility and guarantees a market for commercial catches. Community support for commercial fishing appears to be improving. The present fleet consists of some 10 to 15 small trawlers which fish nearby grounds, and several inshore lobster boats. Only 10 craft classify as vessels (Table 1).

POINT JUDITH, RHODE ISLAND

The Point Judith Harbor of Refuge is formed by three massive stone breakwaters. A breachway into Salt Pond leads to the villages of Jerusalem and Galilee. Piers for a flourishing fishing fleet are concentrated in Galilee, on the eastern side of Salt Pond. All waterfront property along the Galilee harborside is state-owned and is leased to individual users. Steaming times to the hypothetical centers of offshore petroleum activity are 12 hours to both Georges and the mid-Atlantic.

Port Activity and Present Utilization

The port is highly congested. Maintenance dredging scheduled for the winter of 1976-77 will relieve a chronic problem with shoaling water in the inner harbor and will permit fuller utilization of existing piers. Point Judith is primarily a busy commercial fishing port, but facilities are also available for some recreational craft. Point Judith held fifth place in 1974 among New England ports in terms of the value of landings and third place in terms of pounds.

Physical Characteristics

Control depths are 18 feet in the breachway channel and 15 feet in the turning basin and along the southern Galilee piers. The present dredging program will enlarge the turning basins and extend the 15-foot depth to include more piers to the north. The control depth at the state pier at Jerusalem is 12 feet. Some 128 fishing vessels and boats were utilizing the port in 1975. Approximately 75 vessels were in the 50- and 100-foot class. Present plans to dredge the harbor and build new piers will allow for a significant increase in the number of vessels using the harbor. There is at present limited vacant land in Galilee available for industrial development. The state is committed to giving priority use for this land to industries directly related to the fishing industry. There are two boatyards capable of servicing fishing vessels in Great Salt

Pond. Both are limited, however, by low water depths in the channel connecting them to Galilee Harbor. Other services in the immediate vicinity include marine engine and electronic repair. The Point Judith Fishermen's Cooperative operates a supply store providing a wide variety of items required by fishermen.

There is no rail access to Point Judith, and automobile and truck access is by way of a small connecting road to U.S. Route 1 and thence to Interstate Route 95.

Point Judith is an area of tourist and recreational interest, and there is considerable traffic congestion during the summer season. The nearest major airport is in Warwick, some 28 miles to the north.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
51,913.4	$4,720.1	843.5	$150.8	65.2	$16.7	52,939.7	$6,247.8

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
2.9	10.5	2.4	1.9	---	---	2.9	8.4

The Point Judith fishing fleet rose to prominence in the early 1950's with the rapid growth of the trawler fishery for industrial fish, principally red hake and whiting. The primary reason for the remarkable success of Point Judith is the Fishermen's Cooperative, a unique organization that is tailored to meet the needs of fishermen. The Co-op has developed good markets for fresh food fish and has been resourceful in handling a wide variety of species. New fisheries have developed at Point Judith with assistance from the University of Rhode Island.

The majority of the vessels in the Point Judith fishing fleet are owned by the men who operate them. In 1974, approximately 126 trawlers and lobster pot vessels landed at the Co-op and of these 107 were active throughout the year. Table 1 accounts for 105 vessels at Point Judith of which 56 are in the 50- to 69-foot class.

The Point Judith fleet engages in a wide variety of fisheries. A large number of trawlers fish nearshore grounds for industrial species and yellowtail in the winter and spring, and for scup, butterfish and fluke in the summer. A few vessels fish more distant waters extending to Georges Bank to the north and waters off New Jersey to the south. As may be seen in the table above, a relatively small proportion of the total landings is taken in the Georges Bank area. There is a profitable nearshore winter fishery for sea herring.

Lobster is landed from both nearshore and offshore grounds. Several vessels fish exclusively for ocean quahogs with hydraulic dredges on grounds in Block Island and Rhode Island Sounds.

NEWPORT, RHODE ISLAND

Before World War II, Newport was the undisputed center of all shipping and fishing in Rhode Island. In later years the port declined as a fishing center and the town's prosperity was centered upon its large Navy base and the America's Cup and Bermuda sailing races. In 1973 the Navy withdrew most of its activities from Rhode Island, and today Newport is growing as a resort and a major center for recreational boating. Newport has also experienced a rapid increase in commercial fisheries and in 1975 ranked seventh among New England ports in terms of volume of landings and fourth in terms of value. Newport is near the mouth of the East Passage of Narragansett Bay and has both an inner and outer harbor. It is approximately 11.2 steaming hours from the hypothetical center of petroleum interest on Georges and 12.9 hours from the center in the mid-Atlantic.

Port Activity and Present Utilization

During the summer months particularly, Newport is highly congested with recreational craft. There is little room for commercial fishing vessels and this forces rafting (several vessels mooring abreast) at the few available piers.

Physical Characteristics

Vessels with more than an 18-foot draft anchor in the outer harbor in depths of 37 to 100 feet. In the inner harbor water depths are 11 to 18 feet along numerous private wharfs and the one town pier. A variety of marine services are available, catering especially to yachtsmen. There are several vessel repair facilities in Newport, the largest of which has a marine railway capable of hauling a 300-foot vessel with 3,000 tons displacement. Newport has a small commercial airport just outside the city; Route 24 leads to Interstate 195.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
15,583	4,809.5	2,210.6	3,781.8	926.9	187.4	18,726.0	8,779.8

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
62.8	66.7	77.8	76.8	12.4	13.2	62.1	69.9

Newport re-emerged as an important commercial fishing center in the late '60s when a number of New Bedford trawlers began landing there. In 1973 there were eight Newport-based trawlers and an additional 12 to 15 out-of-state vessels landed regularly. Approximately 30 other trawlers occasionally landed their catches throughout the year. In the summer, several vessels from New Jersey and South Carolina also landed at Newport (Olsen and Stevenson, 1975). Table 1 assigns 54 fishing vessels to Newport, of which 29 are groundfish trawlers. In 1975, flatfish and lobster, primarily from Georges Bank, dominated Newport landings in terms of value. More lobsters were landed at Newport that year than at any other New England port. Newport landings were worth $8.8 million compared with $6.2 million at Point Judith, but the volume of landings was three times greater at Point Judith.

Newport fish dealers have been attracting boats that would otherwise land at New Bedford by offering them a better market for their catches. There are two large fish buyers at Newport--Anthony Seafood and Parascandolo, Inc. Anthony Seafood accounted for approximately 30 percent of the finfish in 1973. Approximately 75 percent of this was sold to New Bedford processing firms and about 25 percent was trucked to New York City. A small amount was sold at retail on the waterfront. Parascandolo does not sell at retail but ships to New Bedford and New York City. There is no fish processing in Newport. Three firms operate fish traps but together these accounted for only about 4 percent of the fish landed in 1973. There are two major firms that deal only in lobster (Olsen and Stevenson, 1975).

PROVIDENCE, RHODE ISLAND

The city of Providence is on the Providence River at its junction with the Seekonk River some 7 miles from the head of Narragansett Bay. The port includes both sides of the upper navigable waters of the river. Providence is 12.7 steaming hours from the hypothetical petroleum interest center on Georges Bank and is 14.4 steaming hours from the mid-Atlantic oil interest area.

Port Activity and Present Utilization

Providence ranks fourth in New England in the amount of petroleum products handled; 7.8 million short tons were landed in 1972. Other waterborne commerce, amounting to 878,000 short tons in 1972, includes cement, scrap metal, coal and general cargo. The Port of Providence is presently operating at only a fraction of its potential because shallow water at the piers prevents large vessels from entering. Efforts are being made to find a site for the spoils that would be produced by dredging along the piers, but to date no solution has been found. Land adjacent to the piers is limited and this could restrict major increases or changes in the activities of the port.

Physical Characteristics

A federal project provides for the maintenance of a 40-foot-deep channel from Prudence Island to Fox Point, near the junction of the Providence and Seekonk Rivers. Vessels anchor alongside the main channel between Fields Point and Fox Point.

The Port of Providence (city-owned facilities) has six 500-foot berths. Berths 1 through 4 have drafts of 30 feet and berths 5 and 6 have 35-foot drafts. An application has been filed to dredge two of the 35-foot draft berths to 40 feet.

Piers and wharfs are located on both sides of the Providence River above Fox Point. Deepwater facilities on the east side of the Providence River include several private oil company piers and wharfs. Depths alongside these facilities are in excess of 30 feet. Water depths of 30 feet or greater are also found along the west side of the river.

The port is a major petroleum distribution center for southern New England. Tankers discharge directly into tanks owned by six major oil companies that have a total storage capacity of over 8 million barrels.

All facilities have highway connections which lead to nearby Interstate Routes 95 and 195 and most have railroad connections as well. Green Airport in Warwick is the nearest commercial airport.

Fisheries

Commercial fishing activities are not significant at Providence. Though the upper Providence River is rich in quahogs, pollution prevents harvesting.

EXCESSED NAVY LANDS, RHODE ISLAND

Rhode Island was until recently a major center for the United States Navy. In 1973, however, the majority of the Navy facilities were surplused and negotiations began to transfer them to the state. These negotiations are still going on and this has delayed and complicated plans for reutilization. The available facilities are large and they present major opportunities for new industries, including those related to offshore petroleum exploration and commercial fisheries. The following is a brief description of the major port facilities available.

Coddington Cove: Coddington Cove is on the east side of Narragansett Bay, north of Newport Harbor. The Cove is 11.2 hours steaming time from the hypothetical petroleum interest center on Georges Bank and 12.9 hours steaming time from the Mid-Atlantic oil interest area. The Cove was formerly used by the Navy for logistic support and berthing for a cruiser and destroyer fleet. Pending an environmental impact statement, the state has approved plans to develop a shipbuilding and repair facility at the Cove which would utilize all or most of the excessed facilities. The 56-acre port area contains eight major buildings and two long finger piers. The piers include 6,516 linear feet of berthing space with control depths of 35 feet. Protected storage space measures 86,000 square feet. Pier 1 is 1,535 feet by 100 feet and has rail spurs on either side. Pier 2 is 1,573 by 200 feet. A turning basin and protected anchorage with a 33-foot minimum depth lies between Coddington Point and a 4,000-foot stone breakwater.

Melville: Melville is to the north of Coddington Cove and was used by the Navy primarily for fuel storage. At present there are plans to develop 30 of the 1,164 available acres and a small boat basin into a marina and boat building and repair facility. South of the small boat basin a fuel pier 2,130 feet long and a 12-acre boat basin with depths from 6 to 34 feet have been excessed. The piers are of wood and concrete construction. Railroad spurs and warehouse space are available nearby.

Quonset Point and Davisville: These facilities are some 12 hours steaming time from the Georges Bank area of interest and 13.7 hours from the mid-Atlantic. A dredged channel with a 33-foot water depth leads from the East Passage of Narragansett Bay north of Jamestown to a turning basin off Quonset Pier. The Quonset carrier pier, 1,400 feet long and 65 feet wide, is constructed of concrete on steel pilings. There are railroad spurs on both sides of the pier and the water depth is 29 feet. Considerable office and warehouse space is available nearby. The Davisville piers are 1.5 miles north of Quonset and are approached by a 31-food-deep channel. The piers are 1,200 feet long and provide 3,400 feet of wharfage. Water depths at the piers are approximately 30 feet. Considerable warehouse and office space as well as open space for outdoor storage are available. Rail spurs lead to the piers. The Davisville piers have been used to service the COST offshore drilling project and several "mud companies" have leased facilities in anticipation of imminent offshore drilling. Quonset-Davisville is serviced by its own airport, and Interstate 95 is nearby.

FALL RIVER, MASSACHUSETTS

At the mouth of the Taunton River in Mount Hope Bay, Fall River is approached through the East Passage of Narragansett Bay. The city is 12.6 steaming hours from the hypothetical center of petroleum interest on Georges and 14 hours from the mid-Atlantic center.

Port Activity and Present Utilization

Petroleum is the most important cargo handled by Fall River; 3,988 short tons passed through the port in 1972. Dry cargo amounted to 89,000 short tons in the same year. The port is presently underutilized due to the need for dredging the Mount Hope Bay channel to the port. If federal approval is given, the 30-foot channel will be deepened to 40 feet.

Physical Characteristics

Vessels using the port of Fall River are limited by the 30-foot depths in the approach to Mount Hope Bay. The Channel across the Bay itself has a 35-foot depth. A side channel leading to the Tiverton waterfront also has control depths of 35 feet. There are three major docking facilities with railroad connections on the east side of the Taunton River where water depths are 22 to 35 feet. On the west side of the river are two other docks, one of which is used primarily for coal and the other for petroleum. Neither of these has rail connections. Water depths range from 34 to 37 feet. There are no major vessel repair facilities in Fall River.

Interstate 195 runs through Fall River; New Bedford municipal airport is close by.

Fisheries

A once significant quahog fishery in Mount Hope Bay has for many years been inactive because of poor water quality. A few lobster fishermen presently operate out of Fall River.

NEW BEDFORD, MASSACHUSETTS

A port with a long tradition of whaling and fishing, New Bedford is today the leading New England port in the value of fish landings and ranks fifth among all United States ports. The harbor is at the mouth of the Acushnet River with New Bedford on the west bank and Fairhaven on the east bank. The harbor is 12 hours from the hypothetical petroleum center on Georges and 14.3 hours from the center in the mid-Atlantic.

Port Activity and Present Utilization

Facilities available for both cargo and fishing vessels are underutilized. In 1972, 70,000 short tons of dry cargo and 353,000 tons of petroleum products were handled. Total fishery landings were 105,945.2 thousand pounds in 1975. The city of New Bedford is undergoing large-scale renovation which involves major alterations to the land adjacent to the two port terminals. At present there is considerable unused space. Some 140 fishing vessels utilize New Bedford harbor and approximately half of these dock on the Fairhaven side. It is estimated that the port of New Bedford could accommodate some 250 fishing vessels if it were fully utilized (Saunders, 1975).

Physical Characteristics

There are two major anchorage areas in the outer harbor outside the hurricane barrier south of Clark's Point. Water depths are 20 to 30 feet. There are also two smaller anchorage areas in the inner harbor with dredged depths of 25 to 30 feet. New Bedford South Terminal Wharf, just inside the hurricane barrier on the New Bedford side, has 500 feet of bulkhead. There are 250,000 cubic feet of refrigerated storage adjacent to the wharf. Depths alongside the wharf are 30 feet. The 1,825-foot State Pier has 90,000 square feet of covered storage and 240,000 square feet of open storage. Depths alongside the State Pier are 30 feet.

The North Terminal is limited by the Fairhaven swivel bridge, which does not open to vessels when vehicular traffic is heavy. The 1,000-foot bulkhead is adjacent to 14 acres of open storage space. Water depths accommodate vessels with drafts of up to 32 feet and there is a sizable turning basin. Current plans are to use the North Terminal for non-fishing purposes. The South Terminal is designed to serve the fishing industry, and much adjoining land is utilized by processing plants. Four vessel repair yeards service the fishing fleet on the Fairhaven side and a wide variety of repair and supply business are to be found in the immediate vicinity. The largest marine railway can haul a 130-foot vessel of 500 tons. There is rail access to the port and Interstate 195 passes through the city. New Bedford Municipal Airport is currently underutilized.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
62,645.4	$21,001.6	231.2	392.2	43,067.9	$9,778.5	105,945.2	$31,172.4

Percent Landings from Georges Bank Area 1975

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
88.9	88.1	95.8	96.6	35.6	36.9	67.2	72.1

New Bedford may be characterized as a "quality port" where high value species are emphasized and there is considerable concern for the quality of the fish landed. Relative to comparable vessels from Boston and Gloucester, New Bedford vessels make shore trips. Flatfish are especially important to the trawler fleet. New Bedford is also the home of the Massachusetts scallop fleet, which at present includes some 17 vessels. Table 1 assigns 184 fishing vessels to New Bedford of which 132 are ground fish trawlers. In 1975 total landings were 105,945,180 pounds worth 31.2 million dollars. As may be seen from the table above, the great bulk of all landings except for scallops came from the Georges Bank area. Recently, however, scalloping vessels have tended to concentrate more on traditional grounds in Great South Channel and the southern part of the Bank.

New Bedford trawlers commonly make trips of several days' duration. The low volume of landings has placed a great strain on fish processors, many of whom are presently operating at one-third capacity. The traditional yellowtail flounder has been supplemented by a variety of other flatfish including gray sole and dab. Despite the low volume, high prices are permitting fishermen to prosper, and several new vessels have been added to the fleet in recent years.

SANDWICH, MASSACHUSETTS

Sandwich Harbor is one mile from the east entrance to the Cape Cod Canal. The harbor is 12.5 steaming hours from the hypothetical center of petroleum interest on Georges and 21.8 hours from the interest area in the mid-Atlantic.

Port Activity and Utilization

The harbor is heavily used by recreational craft in the summer months. Limited wharfage and water depth and heavy competition for space among recreational boaters limit commercial fishing activities.

Physical Characteristics

The town pier has 84 berths that commonly accommodate boats up to 50 feet in length. Water depths are 8 to 13 feet. The nearest anchorage for vessels is the Cape Cod Canal, where the depth is 32 feet. The closest vessel-berthing facilities are at the Massachusetts Maritime Academy on the north side of the canal; there are 600 feet of dock with a 25-foot water depth. Route 6A passes close to Sandwich and there is a small airport in Barnstable.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
7,455.8	$2,488.7	359.0	$521.8	265.3	$72.6	8,080.8	$3,083.3

Percentage of Landings from Georges Bank Area

Fish and Squid		Crustaceans		Mollusks		Total	
%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
30.6	52.4	81.2	84.4	7.3	6.1	32.1	56.7

Facilities for commercial fishing craft are limited and competition with recreational interests is severe during the summer months. A privately operated cold storage facility encourages landing of such species as herring and squid. Four or five small vessels land regularly at Sandwich and an additional ten may land seasonally, including some New Bedford trawlers. One groundfish buyer operates in Sandwich.

CHATHAM, MASSACHUSETTS

On the southern side of Cape Cod, Chatham is a wealthy residential center. The harbor is limited by low water depths and is heavily utilized. It is highly unlikely that the citizenry as a whole would favor a dredging program or major alterations to the port. Chatham is the closest port to the hypothetical center of petroleum interest on Georges Bank-only 8 hours steaming time away. The mid-Atlantic area is 17.4 steaming time away.

Port Activity and Present Utilization

The port is heavily utilized by fishing and recreational craft.

Physical Characteristics

At low water, the channel leading to the open ocean across the Chatham bar has water depths of only 3 to 4 feet. Limiting depths in the harbor are 6 feet. There are no railroad connections to Chatham. Route 3 leads to the nearest highway, Route 28. The local airport is in Hyannis.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
6,386.4	$1,504.2	---	---	---	---	6,386.4	$1,504.2

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
95.9	95.2	---	---	---	---	95.9	95.2

A fleet of some 60 to 70 commercial fishing craft work nearshore grounds from Nantucket Shoals to the southern part of Georges and off the tip of Cape Cod. Only seven of those craft classify as vessels in Table 1. Some longliners range as far as the tilefish grounds 100 miles offshore. The size of the craft is limited by the lack of depth in the harbor. Three-quarters of the landings are handled by a boat owners' cooperative.

PROVINCETOWN, MASSACHUSETTS

At the tip of Cape Cod and 12 steaming hours to the hypothetical center of petroleum interest on Georges (20.1 hours from the mid-Atlantic), Provincetown has a large harbor some two miles wide. Renowned as a tourist center, Provincetown has also long been an important commercial fishing center.

Port Activity and Present Utilization

Provincetown is so crowded with recreational craft in the summer that it is not uncommon for pleasure craft to be denied a berth. The 20 year old town pier is increasingly in need of repairs.

Physical Characteristics

The approach and entrance to the harbor offers a sizable anchorage with water depths of 12 to 57 feet. In the summer, floats are set out that can accommodate pleasure craft up to 40 feet in length. Depths at the 1,300-foot town pier are 13 feet and numerous finger piers provide additional docking space. There are two boatyards in Provincetown and good ship chandlery services. Provincetown has its own airport and is approached by road on Route 6.

Fisheries

Total Landings 1975, Thousands of Pounds of Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
15,892.1	$3,886.8	47.1	$79.6	1,111.4	$246.5	17,053.5	$4,213.7

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
32.6	38.7	97.6	97.3	11.8	12.5	31.4	38.3

Provincetown's fishing tradition is strong. Most of the 73 fishing vessels listed in Table 1 are small and work nearshore grounds, usually making day trips. Of the 50 groundfish trawlers listed, 44 are in the 38- to 69-foot class. Several boats fish till nets and longlines. A fisheries cooperative handles about half the total landings.

BOSTON, MASSACHUSETTS

Boston is the largest seaport in New England. It is 13 steaming hours from the hypothetical center of concentrated oil interest on Georges Bank, and 23.9 steaming hours from the area of petroleum interest in the mid-Atlantic.

Boston has three major approach channels which lead from the open sea to President Roads, a deepwater anchorage at the entrance to the outer harbor where all major channels converge.

Port Activity and Present Utilization

Boston Harbor is the busiest port in New England. Waterborne commerce included 2.19 million short tons of petroleum products and was second only to Portland Harbor in this category. Other cargo amounted to 3.1 million short tons in 1972.

The Port of Boston is highly underutilized, largely as a consequence of the military cutbacks of 1973 and the general decline in waterborne commerce apart from petroleum products. However, many of the underutilized and unutilized facilities are in poor condition. Some lack direct railroad access.

About 227 acres at the South Boston Naval Annex/Army Base are presently owned by the federal government but are potentially available due to the military cutbacks of 1973. Existing facilities at the Army Base include 4,150 feet of berthing space, with 35-foot depths alongside the wharf. This facility presently is in use for general cargo shipping. Five abandoned finger piers also may become available but are in very poor condition. Two large dry docks also are available, one 700 feet long, the other 1,200 feet.

Physical Attributes/Facilities

The Boston North Channel is the principal entrance to the inner harbor and is used primarily by deep-draft vessels. A federal project provides for a channel 1,500 feet wide with depths ranging from 35 to 40 feet.

The Boston South Channel has a control depth of 27 feet and is rarely used by deep-draft vessels. The Narrows channel has a control depth of about 25 feet.

The anchorage on the north side of President Roads is the most commonly used. A second anchorage at Nantasket Roads, west of the entrance to the Narrows, has depths of 50 feet. Another anchorage area on the west side of Georges Island has depths up to 36 feet.

There are more than 150 piers, wharfs and docks in the Port of Boston but many of these facilities are in disrepair. The port has over 30 miles of berthing space, most of it on the main channel with depths of 30 feet or more. There are numerous warehouse and cold storage facilities adjacent to wharfs.

Several companies operate waterfront facilities for the construction and repair of ocean-going vessels; vessels of up to 18,000 tons and 622 feet in length may be accommodated.

Several interstate highways and two railroad lines serve Boston. All port facilities have highway access and most have at least limited rail connections. Logan International Airport is on Boston Harbor.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
24,270.2	$6,253.8	5.9	$5.9	---	---	24,280.7	$6,262.1

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
64.7	63.6	100	100	---	---	64.7	63.6

Once the home of a large and flourishing fishing fleet, Boston now lands only a fraction of what it did several decades ago. Today, some of the largest of New England trawlers fish out of Boston, and several Gloucester-based trawlers land there fairly regularly. Much of the fish landed is caught on Georges Bank. A number of small craft not listed in Table 1 also fish out of Boston; many of them are lobster-trap boats that work nearshore grounds. As fish prices have increased, Boston's large trawlers have become more profitable and today are some of the best equipped vessels of their classes in New England. Several of them fish the more distant grounds on Georges Bank throughout the winter. The larger Boston trawlers are apt to be company-owned. Though it has declined as a landing port, Boston is an important fish-marketing center.

GLOUCESTER, MASSACHUSETTS

Gloucester is 26 miles north of Boston, 12.3 steaming hours from the center of petroleum interests on Georges and 23.2 hours from the petroleum interest area in the mid-Atlantic.

Port Activity and Present Utilization

More fish is landed in Gloucester than at any other port, and shipping is also important. In 1972, 22,000 short tons of petroleum products were handled and the total number of inbound trips, predominantly by fishing vessels, was 7,069. Vessel traffic is heavy year-round. The Army Corps of Engineers is presently maintaining the 23-foot depth of the inner harbor. A proposal to reconstitute the fishing piers is being considered.

Physical Characteristics

Gloucester has an outer and inner harbor. Water depths in the outer harbor range from 18 to 52 feet, and in the inner harbor, from 15 to 24 feet. The channel leading into the outer harbor is 400 yards wide with depths from 38 to 47 feet. The control depth of the inner harbor entrance channel is 20 feet and tapers off to 15 feet. Anchorage depths range from 23 to 30 feet in the Southeast and Western Harbors.

The many wharfs along the Inner Harbor of Gloucester are used primarily by the fishing industry. 2,110 linear feet of berthing space is available with water depths ranging from 15 to 25 feet alongside. The combined capacity of the available cold storage facilities is 4 million cubic feet. Vessel repair facilities in Gloucester can haul vessels up to 140 feet in length. A wide variety of vessel services are available.

Rail service is operated by the Boston & Maine Railroad. Facilities for private aircraft are found at a municipal airport in Beverly, about 12 miles from Gloucester. The nearest commercial air service is at Logan International Airport in Boston.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
116,960.8	$11,949.2	4,842.6	$1,496.7	---	---	125,594.3	$14,500.1

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
20.8	31.2	4.6	25.0	---	---	19.5	28.4

Table 1 shows 124 fishing vessels in Gloucester, of which 24 are groundfish trawlers over 100 feet in length and 32 are in the 70- to 99-foot range. A number of small vessels fish gillnets (listed as "other" in Table 1), and the herring purse seine fishery is expanding. There are also several lobster-trap boats operating out of Gloucester. Many of the vessels are in poor condition. The bulk of the landings is taken in the Gulf of Maine. Gloucester is an important fish processing center, particularly for foreign imports.

PORTSMOUTH, NEW HAMPSHIRE

Portsmouth, New Hampshire's only major harbor, is at the mouth of the Piscataqua River. The city is on the south bank of the river about 4 miles above the entrance to the harbor. Portsmouth is approximately 195 miles or 14 hours steaming time northeast of the hypothetical center of oil interest on Georges Bank and 25.4 steaming hours from the center of mid-Atlantic oil interest.

Port Activity and Present Utilization

Petroleum products are the chief cargo, with 1.9 million short tons handled in 1972; dry cargo amounted to 326,000 short tons in 1972. Plans are presently being considered for extensive dredging in the harbor channel to increase depths to 50 feet or more.

Physical Characteristics

Outside the harbor, vessels may anchor in depths of 48 to 66 feet. The channel into the harbor has a depth of some 35 feet. Little Harbor, has permanent mooring space for small craft utilizing 3- to 12-foot depths. In the main harbor water depths along the wharfs are 27 to 50 feet. The eight major wharfs have a combined berthing space of 3,000 linear feet. There are limited covered and open storage facilities. Wharf facilities have access to railroad connections. The nearest commercial airport is Manchester Municipal, about 50 miles away.

Fisheries

A few small draggers and combination gillnet-longline vessels land in the Portsmouth area. Total landings were 1,510 thousand pounds worth 0.968 million dollars in 1972. Lobster landings dominate the fishery in terms of value. Insignificant quantities of fish and crustaceans are taken in the Georges Bank area.

PORTLAND, MAINE

Portland Harbor, at the western end of Casco Bay, is the most important port on the coast of Maine. The ice-free harbor offers secure anchorages to deep-draft vessels in all weather and serves as the Atlantic terminus of pipeline shipments of petroleum products to Canada. The port is 15 hours steaming time from the hypothetical petroleum interest center on Georges Bank and 27.5 hours from the mid-Atlantic center.

Port Activity and Present Utilization

Portland leads all New England ports in the volume of petroleum products handled; 30.2 million short tons were handled in 1972. In the same year 121,000 short tons of dry cargo including wood, paper, seafood and general cargo, were handled. In recent years shipments of petroleum to Canada have been cut back and the port is underutilized. A plan is being considered to increase the depth of the main channel so that deeper draft vessels can be accommodated.

Physical Characteristics

Portland, a manufacturing, fishing and industrial center, is on the north side of the inner harbor and has extensive rail connections, cargo terminals and piers. South Portland, on the opposite side of the harbor, has all the petroleum handling terminals and pipeline facilities. Diamond Island Roads, with depths of 34 to 45 feet, is the principal deepwater anchorage in the outer harbor; an additional anchorage near Fish Point has depths of 25 to 60 feet. Depths in the main entrance to the port are 40 feet or more. A federal project maintains two channels with depths of 45 and 35 feet that lead into a large turning basin. Deepwater docking facilities include eight petroleum and three general terminals. The general terminals total 4,613 feet of wharfage with depths ranging from 30 to 35 feet. Depths alongside the petroleum wharfs range from 20 to 48 feet.

A shipyard in South Portland has three marine railways, the largest of which can haul a 15-foot vessel of 500 tons displacement and 12-foot draft. Portland has its own airport and direct access onto Interstate 95.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
27,905.2	$2,245.1	1,826.2	$497.3	---	---	29,834.6	$2,754.4

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
2.4	6.7	---	---	---	---	2.3	5.5

Portland has a sizable fishing fleet that operates almost exclusively in the Gulf of Maine. The fleet includes seven large trawlers and 36 trawlers in the 30- to 70-foot range. An additional 19 trawlers fish primarily for shrimp. There are also several lobster-trap boats. Landings are dominated by groundfish, particularly red perch.

ROCKLAND, MAINE

Rockland Harbor is on the west shore of West Penobscot Bay. Rockland is approximately 16.7 hours steaming time from the hypothetical center of oil interest on Georges Bank and 29.3 steaming hours from the mid-Atlantic area of oil interest.

Port Activity and Present Utilization

The port of Rockland is not heavily utilized. The port facilities are used primarily by fishing craft and other small vessels. Prock Marine Company, which owns four acres in the port, is currently reviewing plans for a new commercial facility. A federal project will soon provide a treatment facility in the harbor to handle waste materials from the fish processing plants.

Physical Attributes/Facilities

A federal project provides for an approach channel 18 feet deep and three branch channels 14 feet deep, each with a turning basin.

An anchorage for large vessels is situated east of Rockland Harbor in depths of 30 to 35 feet. There are anchorages for smaller vessels in the northern and central part of the harbor with depths of 12.5 and 14 feet, respectively.

The Rockland Port District Terminal Wharf, the ferry terminal, is 280 feet long with depths alongside of about 11 feet. There are several private and public wharfs and piers on the west side of the harbor that are used by vessels and barges engaged in coastal shipping. Depths at these facilities are reported to range from 6 to 14 feet. A municipal marina with a 6-foot depth is available for small craft.

Route 1 is the nearest highway connection for Rockland Harbor and Interstate 95 is a few miles to the west. American Airport in Knox County offers the nearest commercial air service.

Fisheries

Total Landings 1975, Thousands of Pounds and Dollars

Fish and Squid		Crustaceans		Mollusks		Total	
lbs	$	lbs	$	lbs	$	lbs	$
15,329.2	$1,221.6	4.8	$1.2	140.0	$35.8	15,468.9	$1,258.8

Percentage of Landings from Georges Bank Area

%lbs	%$	%lbs	%$	%lbs	%$	%lbs	%$
3.5	4.3	---	---	---	---	3.5	4.3

Rockland has a sizable fishing fleet with some 11 groundfish trawlers over 100 feet in length. Virtually all of the fishing, however, is conducted in the Gulf of Maine. Many of the larger trawlers are owned by one company. A total of 38 fishing vessels are listed for Rockland in Table 1. Redfish and herring are among the most important species taken.

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