Northeast Fisheries Science Center Reference Document 07-17

Demographic and Economic Trends in the Northeastern United States Lobster (*Homarus americanus*) Fishery, 1970–2005

by Eric M. Thunberg

October 2007

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Table of Contents

List of Tables

List of Figures

List of Acronyms

ACFCMA	=	Atlantic Coastal Fisheries Cooperative Management Act
ALFMP	=	American Lobster Fishery Management Plan
ASMFC	=	Atlantic States Marine Fisheries Commission
EEZ	=	Exclusive Economic Zone
EMT	=	Effort Management Team
FCMA	=	Fisheries Conservation and Management Act
FMP	=	Fisheries Management Plan
GMRI	=	Gulf of Maine Research Institute
HMA	=	Herring Management Area
ISFMP	=	Interstate Fishery Management Plan
LCMA	=	Lobster Conservation Management Area
LCMT	=	Lobster Conservation Management Team
LIWG	=	Lobster Industry Working Group
MSA	=	Magnuson-Stevens Act
NEFMC	=	New England Fisheries Management Council
NFMB	=	Northeast Marine Fisheries Board
NMFS	=	National Marine Fisheries Service
NOAA	=	National Oceanic and Atmospheric Administration
PPI	=	Producer Price Index
TAC	=	Total Allowable Catch
URI	=	University of Rhode Island

Introduction

The present condition of the American lobster (*Homarus americanus*) industry and its involved communities is shaped not only by contemporary regulations or social and economic conditions, but by the accumulation of past events, including changes in resource conditions, coastal development, and shifts in management responsibilities. Identifying these changes over time and how they may have influenced today's lobster industry requires selecting a baseline period consistent with the temporal and geographic scope of both the lobster resource and the human communities that exploit it.

Acheson (1997) describes the commercial lobster fishery as beginning in the 1840s, with the development of the re-circulating seawater tank making it possible to ship lobsters to urban population centers in the Northeast. Even though the lobster fishery has been prosecuted on a commercial scale for more than 160 years, consistent landing statistics were not generally available prior to 1950. These statistics indicate that landings in the Northeast first reached 30 million lb in 1957 and remained relatively stable from 1957 through 1974 averaging 30 million lb before going on a prolonged annual increase in landings that lasted for the next 11 years (Figure 1). From 1985–2004 landings increased at a faster rate than in prior years, peaking in 1999 at 89 million lb. Note, however, that even though landings reached historic highs during the 1990s, the inter-annual variability in landings has also increased particularly since 1989.

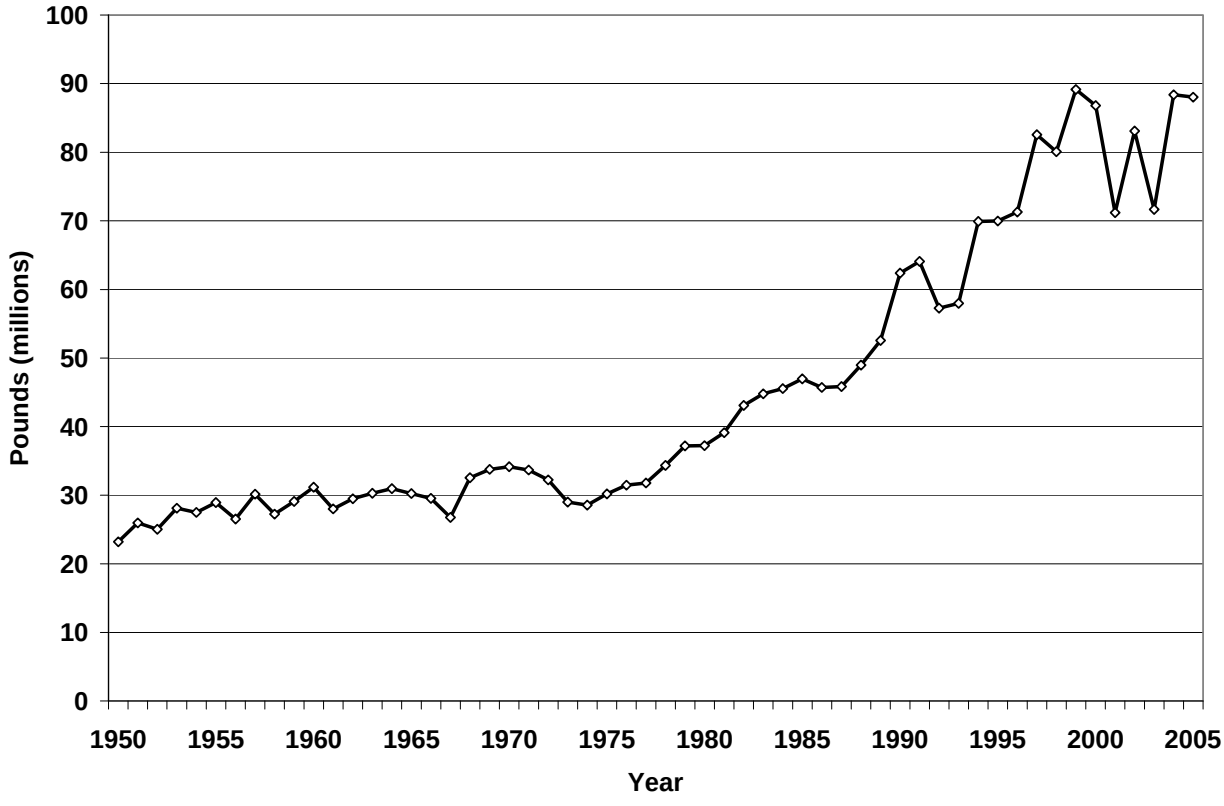

Figure 1. Landings of American lobster, 1950–2005 (Source, NOAA Fisheries Office of Science and Technology (http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html)

For much of its early history the lobster fishery was managed by individual states, with little formal attempt to coordinate either management or regulatory actions across states. Recognizing the need and potential benefit gained from such coordinated action, in 1972 states along the Atlantic seaboard initiated cooperative management and research through the auspices of the National Marine Fisheries Service (NMFS) State-Federal Partnership Program. An outgrowth of this program was the formation of a policy group known as the Northeast Marine Fisheries Board (NFMB). Following implementation of the 1976 Fisheries Conservation and Management Act (FCMA), the NMFB developed a comprehensive management plan which was submitted in November, 1978 to the newly created New England Fishery Management Council. This planning document (NFMB 1978) was the first comprehensive study of the biological, economic, social, and management history of the American lobster fishery. Of particular interest is the documentation of the condition of the social and economic characteristics of the lobster fishery as they existed at the time. For this reason the baseline condition described in the NFMB American Lobster Fishery Management Plan (ALFMP) and its related time period was selected as the temporal baseline for this report.

Although the American lobster ranges from Labrador to North Carolina, lobster is sparsely distributed in much of the southern extent of its range. Reported landings from Delaware southward are typically less than 0.1% of total landings. In fact, Delaware, Maryland, Virginia, and North Carolina have applied for, and received, de minimus status for American lobster under auspices of the Atlantic States Marine Fisheries Commission (ASMFC). This means that landings are not only well below that of states from Maine to New Jersey, there would also be minimal presence of either lobster or lobster-related activities in coastal economies. For this reason the geographic scope of this study was confined to coastal states of Maine through New Jersey.

In what follows, the past and present conditions of the social and economic factors affecting the lobster fishery are described. The discussion follows a format similar to that of the 1978 lobster Fishery Management Plan (FMP) prepared by the NMFB. Each section begins with a brief synopsis of the condition of the social and economic environment as described in 1978, followed by a discussion of changes that have occurred to the present time. The discussion begins with an overview of changes in management institutions affecting lobster fishing over time. The second section provides a description of the broad-scale demographic changes that have occurred in coastal counties over the last thirty years. The third major section provides a description of the lobster fishery itself: as it was in 1978; as it is today; and major changes along the way. The fourth major section describes the economic condition of the lobster fishery and surveys the economics literature. The final section identifies economic implications of environmental events and regulatory actions external to the lobster fishery.

Management Context

Over the past 30 years, management of American lobster has gone through what may be thought of as three significant phases distinguished by changes in jurisdictional responsibility. These phases include the years preceding 1976, the years from 1976 through 1994, and from 1995 to the present.

Pre-1976

From its earliest development as a commercial fishery until the passage of the FCMA in 1976, management of the lobster fishery was primarily the responsibility of individual states. Regulatory approaches differed from state to state resulting in a patchwork of laws governing the taking of lobsters. Attempts to establish some uniformity across states were undertaken with varying levels of success but it was not until 1972 that the lobster producing states agreed to work toward a uniform set of ten management precepts (Table 1) under the auspices of the NMFS State/Federal Fishery Management Program.

Other than serving as an intermediary to facilitate development of coast-wide approaches to lobster management, the Federal Government was not actively engaged in management activities because lobster fishing took place almost exclusively inside state waters (the offshore lobster fishery had not yet fully developed) and it lacked any jurisdiction over what was effectively international water.

As of 1977 most states required a license to fish for and land lobster. Licenses were not required in New Jersey, Maryland, and North Carolina, and no distinction was drawn between commercial and recreational lobster fishing. Maine was the only state to prohibit recreational lobster fishing. Annual reporting of catch and/or effort was required in Maine, New Hampshire, Massachusetts, Connecticut, New York, and Delaware, while daily reporting was required in Rhode Island and Connecticut.

Several states prohibited certain types of gears that may be used for taking lobsters. For example, Maine did not allow and continues to prohibit the landing of lobsters taken by mobile gear. Some states placed limits on the number of traps that may be used by recreational fishermen, while only Delaware limited the number of traps that may be used by commercial fishermen as well.

Table 1. List of 10 management precepts of the NMFS State/Federal Fishery Management Program (1972)

1. A program shall be developed to effectively control effort fishing effort on the lobster resource.
2. Reciprocal enforcement between states shall be effected.
3. All states shall establish a uniform legal carapace length of 3-1/2 inches with no State less than 3-3/16 inch carapace length by January 1, 1976.
4. Maximum size limit shall not be imposed on the lobster fishery.
5. All states shall enact uniform laws prohibiting the possession of egg bearing or scrubbed lobsters.
6. All states shall enact uniform laws prohibiting the landing of lobster meats.
7. All states shall enact uniform laws prohibiting the notching of female lobsters.
8. All states shall enact laws prohibiting the possession of detached tails, claws, or parts of lobster.
9. All lobster traps shall incorporate an escape vent of a size adequate to minimize retention of sub-legal lobsters.
10. All fishermen and primary dealers shall be licensed and shall be required to keep daily records of their activities on forms provided by the licensing agency.

Source: NFMB 1978, Table 18

Massachusetts was the only state with a moratorium on the number of commercial licenses issued. Where recreational fishing for lobster was permitted, New York and Delaware limited the daily number of lobsters that may be taken and several states limited the recreational fishing season. Landing of lobster meat and/or lobster parts was prohibited in all states except New Jersey and Maryland, while the taking of berried females was prohibited by all states. Only Maine had a maximum allowable size, and the majority of states had a $3^{3}/_{16}$" minimum size. The exceptions were Rhode Island, with a minimum size of $3^{1}/_{16}$", and New Hampshire and New Jersey, with a minimum size of $3^{1}/_{8}$".

1976 to 1995

The FCMA established extended jurisdiction over all fisheries to the 200-mile limit, and in doing so established management authority over any portion of the lobster fishery that may be prosecuted outside of a state's territorial waters. The act also established the fishery management council system and designated the NEFMC as the lead council for developing a lobster fishery management plan since nearly all landings were delivered to ports and harbors in New England. The lobster fishery management plan developed by the NMFB was the precursor to what became the New England Council's ALFMP adopted in 1983.

The initial ALFMP established several measures intended to provide uniform regulations in federal and state waters. These measures included a coast-wide $3^{3}/_{16}$" minimum size as well as prohibitions on landing lobster parts, berried females, and V-notched lobsters in much of the Gulf of Maine. The ALFMP also included requirements for escape vents, a permit program, and recommended a data collection system to facilitate improved monitoring and management of the lobster fishery. Some of these measures had a phased implementation schedule to permit individual states to make the necessary adjustments. For example, the minimum size and the escape vent requirements were to become effective on January 1, 1985, while the prohibition on taking lobster parts was to be effective by January 1, 1986.

Amendment 1 to the ALFMP was submitted in 1986. This amendment implemented standardized gear marking requirements for the offshore fishery to deal with gear conflicts with mobile gear and to avoid instances where one lobster vessel would set gear over another's. Additionally, Amendment 1 exempted fishermen engaged in a fish trap fishery for black sea bass from the escape vent requirements and designated red crab gear fished at depths exceeding 200 fathoms as gear not capable of catching lobsters.

Submitted in 1987, Amendment 2 to the ALFMP proposed a five-year implementation schedule to increase the minimum size from $3^{3}/_{16}$" to $3^{5}/_{16}$" in a series of $^{1}/_{32}$" increments. This action was prompted by the adoption of an identical schedule of gauge increases that had been enacted by the Maine legislature and that was subject to repeal without complementary Council action. Amendment 2 also proposed an increase in the size of the escape vent to conform to a $3^{5}/_{16}$" lobster, proposed a prohibition on taking V-notch lobsters throughout the range of the EEZ, and established a uniform national minimum size standard for American lobster.

The Amendment 2 implementation schedule called for the minimum gauge increases to start in 1988 with the vent size change taking effect in 1990. Amendment 3 (1989) to the ALFMP proposed to delay the implementation date for the escape vent size to 1992. The rationale for this delay was based on analysis of selection data showing that the larger escape vent would allow unacceptably high escapement of legal lobsters. Amendment 3 also proposed to require that a degradable panel be incorporated into each trap to reduce the impact of ghost fishing.

By 1991 the minimum gauge in the EEZ was $3^{9}/_{32}$". However, the state of Maine had repealed its scheduled gauge increases, stopping at $3^{1}/_{4}$". Likewise, Massachusetts, New Hampshire, and Rhode Island had enacted a $3^{1}/_{4}$" minimum size, and further increases were deemed unlikely. To further complicate matters, the Mitchell Bill (Prohibition J under the Magnuson-Stevenson Fisheries Conservation and Management Act [MSFCMA, or MSA]) had been enacted that prohibited interstate commerce in lobsters that were smaller than the minimum federal gauge. To alleviate the inconsistencies created by the differing gauge size between the EEZ and the states, Amendment 4 (1991) proposed a reduction in the minimum gauge to $3^{1}/_{4}$". The Amendment also modified the escape vent size to be consistent with the $3^{1}/_{4}$" minimum. However, the Council stipulated that unless a new plan amendment with an effort control program had been enacted within two years of the Amendment 4 implementation date, the Amendment 2 schedule of gauge increases would resume.

Faced with the prospect of defaulting to a higher gauge, a Lobster Industry Working Group (LIWG) was formed to develop a comprehensive statement of management principles. The LIWG report was submitted to the NEFMC Lobster Oversight Committee on January, 1993. The report reiterated support for a certain set of unified regulations that would be coastwide, but also advocated a more flexible approach to effort control that recognized the differing social, cultural, and economic circumstances in each lobster-producing region. It is notable that the likelihood that differences in fishing practices would not lend itself to a one-size-fits-all management approach was recognized by the NFMB in 1978. In addition to recommending a regional approach, the LIWG also recommended a moratorium on federal permits, restrictions on mobile gear, a mandatory data reporting system, and a revised overfishing definition. These industry recommendations were accepted in 1994 by the Council as the basis for Amendment 5. The Council formally appointed members to four regional Effort Management Teams (EMTs) and imposed a six-month deadline for each of the EMTs to report back to the Council with effort reduction plans that would meet conservation objectives.

Amendment 5 was partially approved in 1994. Of the proposed measures submitted by the NEFMC, the permit moratorium was implemented as was a revised overfishing definition and the EMT process was approved. The recommended measures limiting mobile gear and mandatory reporting were not approved. The former was rejected since it was believed to be appropriate to include mobile gear effort reduction within the EMT process, while mandatory reporting was disapproved due to the administrative burden that would have been created, since mandatory reporting had just been implemented for the groundfish and scallop fisheries.

The EMTs were not able to meet the required deadline and the NEFMC could not reach agreement on required conservation measures. This impasse set the stage for a transition to the present management context.

1995 to Present

Although the preceding discussion focused on management action taken at the Federal level, it is important to recognize that an Interstate Fishery Management Plan (ISFMP) had been developed and implemented by the ASMFC as early as 1978. The original plan's primary purpose was to establish regulatory uniformity across state and federal jurisdictions, and Amendments 1 and 2 to the ISFMP were developed largely as a response to regulations implemented at the federal level. By 1995, however, it was becoming clear that maintaining separate management authority by the ASMFC and its member states under the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) and the NMFS under the FCMA was not

accomplishing a unified approach to lobster management. Given the fact that the majority of the lobster resource and fishing effort takes place in state waters, the NMFS issued an Advance Notice of Proposed Rulemaking (ANPR) in September 1995 seeking public comment on options for lobster management including the option to transfer federal management authority to the ACFCMA. This transfer of authority was delayed until 1999, primarily due to concerns that the ISFMP be consistent with the National Standards under the 1996 reauthorized FCMA known as the Magnuson-Stevens Act (MSA).

In the intervening years between 1995 and 1999, the ASMFC developed and implemented Amendment 3 to the ISMFP which remains in effect today. Amendment 3 reaffirmed the concept that certain management measures should be uniform across all jurisdictions, but that some measures including effort reduction plans would be best developed on a regional basis. The latter reaffirmed the management principles originally espoused by the LIWG in 1992 and the EMTs by the NEFMC. The ASMFC identified seven different Lobster Conservation Management Areas (LCMAs) (see Figure 2) and approved the formation of Lobster Conservation Management Teams (LCMT) for each area in 1998. Each LCMT was charged with developing an effort reduction plan to achieve a specified schedule of conservation objectives beginning in calendar year 2000.

Under ACFCMA, the ASMFC now has the lead responsibility for developing management measures for the lobster fishery in both state and federal waters. Within this setting the ASMFC develops measures to be implemented by its member states and recommends complementary action to be taken by NMFS for federal waters. This institutional structure still retains the jurisdictional boundaries between regulatory actions taken by individual states and actions by NMFS but assures coordination across jurisdictions. Actions approved by the ASMFC are enforceable on member states through a provision of the ACFCMA that requires the Secretary of Commerce to prohibit fishing for any ASMFC-managed species in the territorial waters of any non-conforming state upon a finding by ASMFC, and Secretarial concurrence, of non-compliance with a required measure. Complementary action taken by NMFS must take the ASMFC recommendations into account, but NMFS may choose to deviate from them under certain circumstances where, for example, a recommended action may conflict with a National Standard, may be administratively burdensome, or may conflict with other applicable federal law.

From a contextual perspective the existing management framework has resulted in a couple of unanticipated results. First, the public notice and comment requirements under the Administrative Procedures Act (APA) as well as analytical requirements under the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act (RFA), various Executive Orders, and other applicable law means that federal complementary action may take considerable time to implement. By contrast, most states have far fewer process requirements and ASMFC-recommended changes may be implemented relatively quickly. The consequence of the differences in response time is that the hoped-for coordination between state and federal partners has been difficult to obtain. For example, Addendum 1 was approved by ASMFC in 1999 but the recommended complementary federal actions were not implemented until 2002, by which time ASMFC had already approved both Addendums II and III. The inability to achieve regulatory coordination in terms of timing between NMFS and ASMFC has been alleviated for the most part by the requirement that all permit holders abide by the more restrictive measures

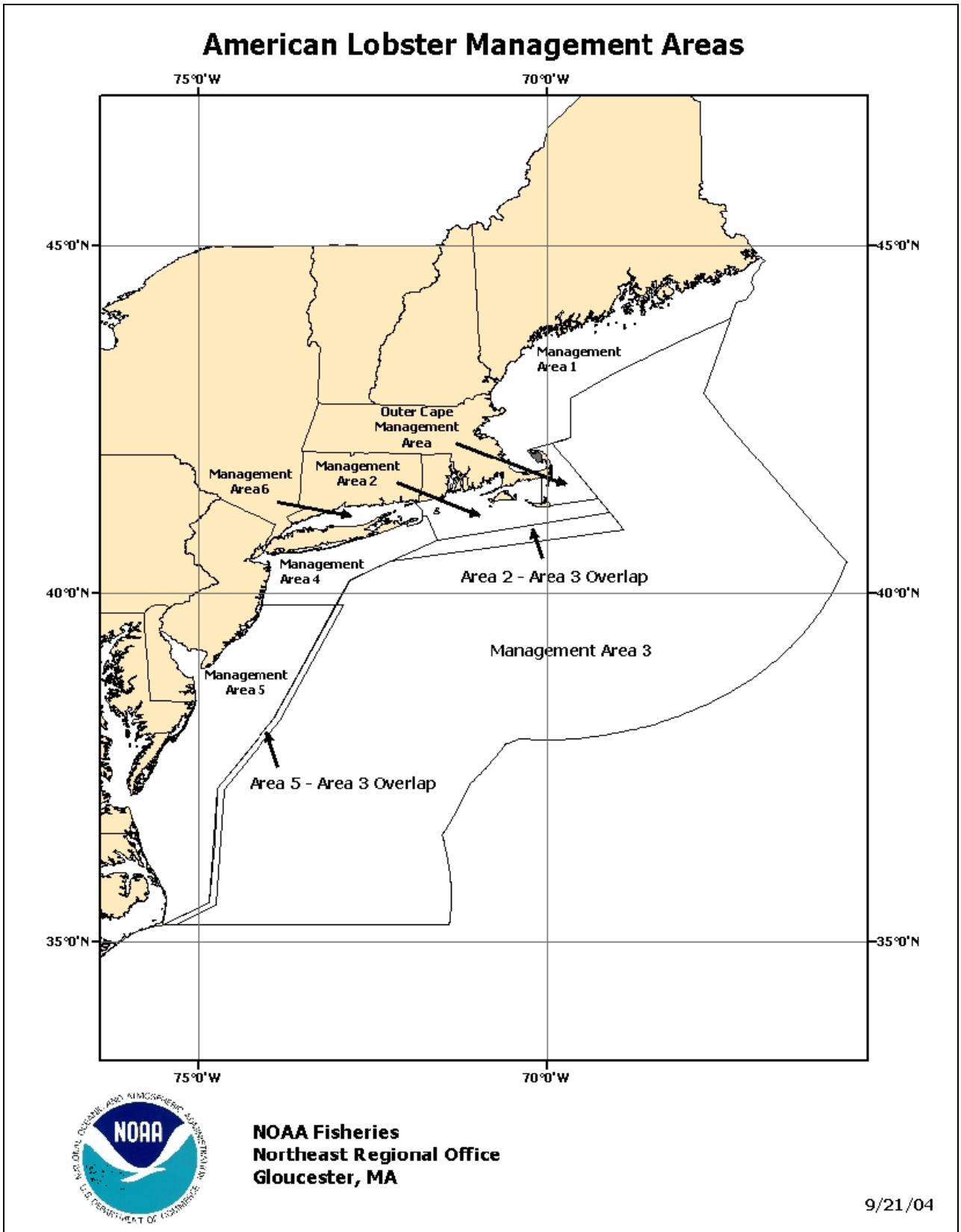

Figure 2. Chart showing Lobster Conservation Management Areas (LCMAs) designated by the ASMFC

wherever they fish. This means that since all lobster operators (including federal permits) must be permitted in at least one state, as a practical matter, as long as all states take coordinated action, there will be relatively few inconsistencies between the intended management effect even though complementary EEZ regulations have yet to be implemented. In many respects, complementary federal action has been a matter of "catching up" to what states have already implemented.

The second unanticipated result is a byproduct of the regional approach to management through the LCMTs. Amendment 3 to the ISFMP carried over much of the coast-wide measures that had been in place at the time. The Amendment provided default trap caps for LCMAs 1, 2, 3, and the Outer Cape that would be subject to change through Addendum 1 upon further consideration by each respective LCMT. LCMTs from LCMAs 4, 5, and 6 were asked to review the need for capping or reducing effort in their respective areas. The recommendations of each LCMT were subsequently incorporated into Addendum 1.

In Addendum 1, LCMAs 1, 2, and the Outer Cape adopted the Amendment 3 trap reduction schedule while LCMAs, 3, 4, 5, and 6 recommended historic participation programs with individual trap allocations. These differing approaches highlight two features of the LCMT process as it has evolved over time. First, the LCMT process has led to a tendency to construct regulatory boundaries that preserve the core group of operators' access to a lobster fishing area while discouraging others from entering, and second has resulted in less uniformity, hence greater complexity across and within jurisdictional boundaries. These differences across LCMT plans has only increased over time as different trap reduction schedules, minimum sizes, maximum sizes, and trap transferability have been adopted by one or more LCMTs. Viewed from the perspective of the individual operator, the level of complexity may not be apparent since he/she need only be concerned with where he/she fishes, but administering and enforcing size limits or trap programs that differ regionally introduces a level of complexity that earlier management efforts had sought to avoid.

Demographic Condition

Lobster harvesters, related businesses, and coastal communities do not exist in isolation from one another. Lobstering communities are affected by large-scale changes in population growth, urban sprawl and the effects of a land market creating pressures for altered use of shoreline property. Data from the US Bureau of the Census were used to characterize broad scale social and economic decadal trends affecting coastal regions in the primary lobster producing states from Maine to New Jersey. The Census Bureau defines coastal counties based on watersheds, which include counties that have no shoreline directly abutting saltwater coves, bays, or the ocean. Such counties are unlikely to include a substantial presence of lobster fishing or fishing-related businesses and were considered a non-coastal county for discussion purposes.

In 1978 the lobster communities of Maine were described as isolated with few job opportunities other than fishing (see NMFB 1978, p. 17-19). Many fishermen were said to be living at subsistence levels, with few marketable skills limiting job mobility for lobstermen. Income growth in lobster villages lagged behind that of other regions and the population tended to be older and less mobile.

In other New England states relatively little information was documented with respect to the lobster fishery, except to note that Massachusetts had an industrial-based economy which offered employment opportunities not necessarily available to Maine lobstermen. Income

growth in Massachusetts coastal economies was above the state average, and the development of a tourism-based economy on the Cape and Islands contributed to high levels of population and income growth. Income growth in Rhode Island was described as above average for the region. Expansion of the University of Rhode Island and a growing service sector were described as a contributing factor to higher population and incomes in the Newport–Point Judith region of Rhode Island. Fishermen in the Narragansett–South Kingston region were described as having higher levels of remuneration than factory workers, with little difference in either age or educational profiles. Coastal counties of both Connecticut and New York were described as affluent, but no information relative to the lobster industry was offered.

Since 1978 the coastal county population and economy has undergone several notable changes. Population growth has resulted in an increasingly urbanized coastal county population. The underlying structure of the regional economy has shifted away from manufacturing to technology-based industries. These economic changes have been accompanied by higher levels of education, increases in household income, and reductions in poverty rates. These changes suggest a much less isolated condition, with more sources of alternative employment

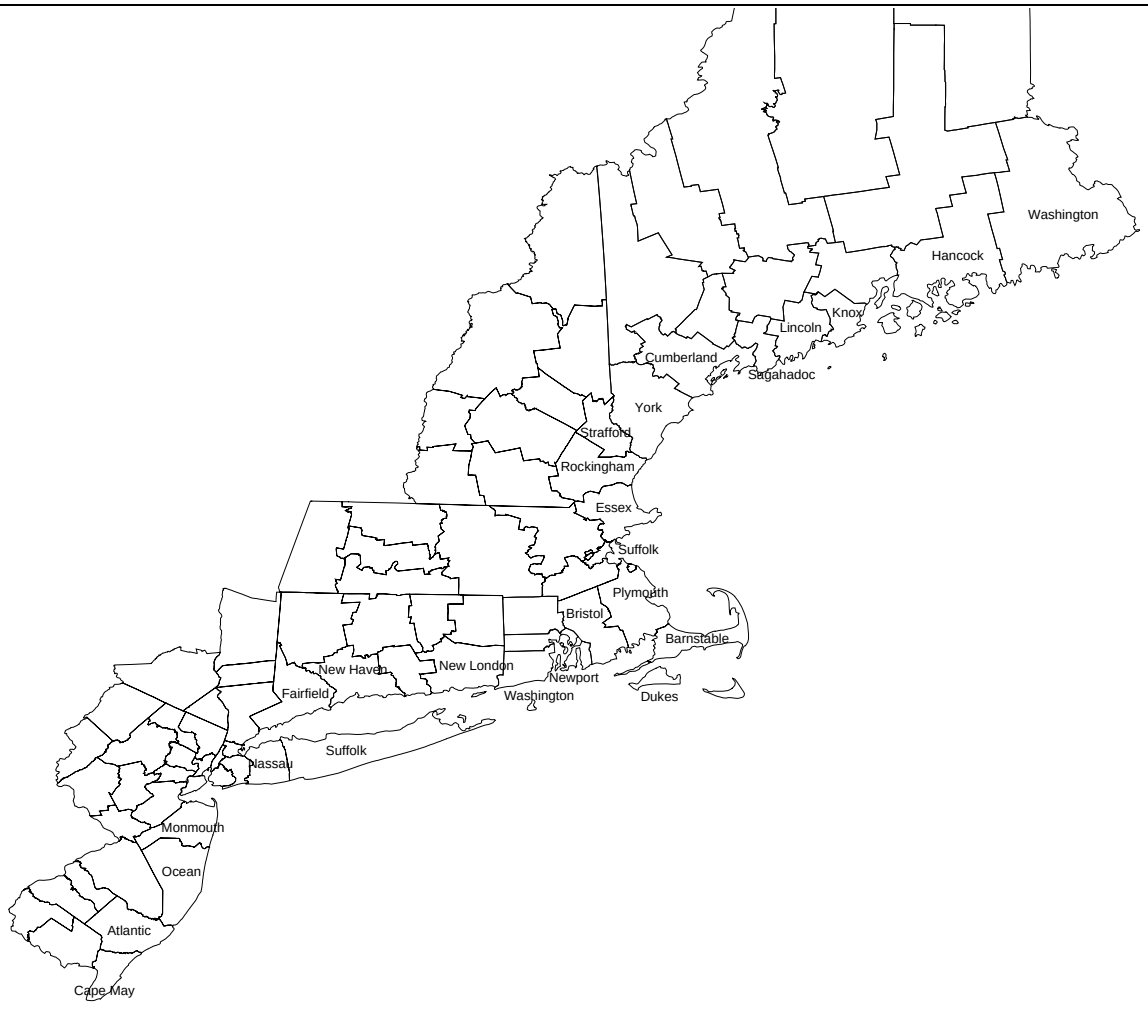

Figure 3. Lobster-producing counties

available to lobstermen than described in 1978. The following provides an overview of these demographic trends in the lobster-producing counties (defined as counties where reported lobster landings were consistently at least 1% of state totals from 1989 to 2004) from Maine to New Jersey (Figure 3). The majority of demographic data are reported in terms of percentage changes between census decades and for the 30-year period represented by the 1970–2000 census years.

Demographic Trends 1970–2000

Population Growth

Total population in the Maine to New Jersey region increased by 9.4% from 1970 to 2000. Population growth from 1970 to 2000 was substantially above that of region-wide growth

Table 2. Decadal population change in lobster coastal counties by state and county

	1970 to 1980	1980 to 1990	1990 to 2000	1970 to 2000
Maine, state-wide	**13.2%**	**9.2%**	**3.8%**	**28.3%**
Washington	17.1%	1.0%	-3.9%	13.7%
Hancock	20.8%	12.4%	10.3%	49.7%
Knox	13.5%	10.2%	9.1%	36.6%
Lincoln	25.1%	18.2%	10.7%	63.7%
Sagadahoc	22.8%	16.5%	5.0%	50.2%
Cumberland	12.1%	12.7%	9.2%	38.0%
York	25.2%	17.8%	13.5%	67.4%
New Hampshire, state-wide	**24.8%**	**20.5%**	**11.4%**	**67.5%**
Strafford	21.3%	22.0%	7.7%	59.4%
Rockingham	37.0%	29.2%	12.8%	99.6%
Massachusetts, state-wide	**0.8%**	**4.9%**	**5.5%**	**11.6%**
Essex	-0.7%	5.8%	8.0%	13.4%
Suffolk	-11.6%	2.1%	3.9%	-6.2%
Norfolk	0.3%	1.6%	5.6%	7.5%
Plymouth	21.6%	7.4%	8.6%	41.9%
Barnstable	53.0%	26.1%	19.1%	129.9%
Dukes	46.2%	30.2%	28.8%	145.0%
Bristol	6.8%	6.7%	5.6%	20.3%
Rhode Island, state-wide	**-0.2%**	**5.9%**	**4.5%**	**10.5%**
Newport	-13.9%	7.1%	-2.0%	-9.7%
Washington	8.9%	17.9%	12.3%	44.2%
Connecticut, state-wide	**2.5%**	**5.8%**	**3.6%**	**12.3%**
New London	3.5%	6.9%	1.6%	12.5%
New Haven	2.2%	5.6%	2.5%	10.6%
Fairfield	1.8%	2.5%	6.6%	11.3%
New York, state-wide	**-3.7%**	**2.5%**	**5.5%**	**4.1%**
Suffolk	14.2%	2.9%	7.4%	26.2%
Nassau	-7.5%	-2.6%	3.7%	-6.5%
New Jersey, state-wide	**2.7%**	**5.0%**	**8.9%**	**17.4%**
Monmouth	9.5%	9.9%	11.2%	33.9%
Ocean	66.0%	25.2%	17.9%	145.1%
Atlantic	10.9%	15.6%	12.6%	44.3%
Cape May	38.1%	15.6%	7.6%	71.8%

in Maine and New Hampshire, with respective increases of 28.3% and 67.5%, although the decadal change in population from 1990-2000 was lower than in previous decades. Population growth in coastal counties was similar to that of non-coastal counties in most states except in Maine, New Hampshire and Massachusetts. Maine had the largest difference in population growth between coastal and non-coastal counties. In 1970 less than half (47%) of the Maine state population lived in a coastal county, but by 2000 the proportion of the state population living in a coastal county had increased to 54%.

In Maine's northernmost coastal county (Washington County) population increased by 17.1% from 1970 to 1980, but virtually stagnated from 1980 to 1990 and declined by almost 4% from 1990 to 2000 (Table 2). Thus, even though the Washington county population was 13.7% higher in 2000 than it was in 1970, the county population was declining from 1990 to 2000. No other coastal county in Maine exhibited such a pattern of population growth over the past 30 years. Population growth from 1970 to 2000 was negative in Suffolk County, Massachusetts, Newport County, Rhode Island, and Nassau County, New York. By contrast, population doubled in Rockingham County, New Hampshire and more then doubled in the Massachusetts counties of Barnstable and Dukes, and in Ocean County, New Jersey.

Household Income

Median household income adjusted by the New England region urban CPI index was highest in Connecticut in all years from 1969 to 1999, with the exception of Massachusetts median income in 1979 and New Jersey median income in 1999. Note that each decadal census collects data on annual household income from the year just prior to the census year. The relative change in median household income in each coastal state was positive indicating higher median income in 1999 than it was in 1969 (Table 3). However, much of these gains were made from 1979 to 1989 as these years corresponded with a particularly robust regional and National economy. From 1989 to 1999 median household income declined in most states.

On average, coastal counties in all New England costal states and New York fared better than non-coastal counties in terms of household income. For example, even though household income fell from 1969 to 1979 in both Maine costal and non-coastal counties, the reduction in coastal county income was lower than the reduction in non-coastal counties. Similarly, while household income rose from 1979 to 1989, the median household income increased by 18% in coastal Maine counties compared to just below 7% in non-coastal Maine counties. By contrast, median household income grew at a faster rate in New Jersey non-coastal counties than in coastal counties.

While household income in coastal counties generally fared better than non-coastal counties the performance across coastal counties varied considerably. Of the coastal counties in Maine, median household income was at least 90% of the statewide median in all counties except Washington County. Further, while median household income in Washington County was 4.9% higher in 1989 than it was in 1969, inflation adjusted household income declined from 1989 to 1999.

In both York and Sagahadoc counties median household income increased by nearly 25% from 1969 to 1999, and grew by 16% in Cumberland County. In Knox and Lincoln counties median household income declined from 1969 to 1979 but increased over the next 20 years to levels in 1999 that were about 25% greater than 1969 levels.

Table 3. Decadal change in CPI-adjusted median household income in coastal counties by county and state				
	1969 to 1979	**1979 to 1989**	**1989 to 1999**	**1969 to 1999**
Maine	**-2.7%**	**14.1%**	**-0.9%**	**10.0%**
Washington	0.9%	8.4%	-4.1%	4.9%
Hancock	-4.2%	17.7%	5.1%	18.6%
Knox	-1.8%	18.7%	7.3%	25.1%
Lincoln	-2.5%	25.2%	1.1%	23.4%
Sagadahoc	4.3%	21.7%	-2.8%	23.5%
Cumberland	-3.3%	19.0%	1.1%	16.3%
York	4.9%	19.4%	-0.3%	24.9%
New Hampshire	**1.3%**	**20.9%**	**0.9%**	**23.6%**
Strafford	-1.1%	15.2%	1.2%	15.4%
Rockingham	6.6%	24.8%	2.9%	36.9%
Massachusetts	**9.2%**	**3.1%**	**1.3%**	**14.1%**
Essex	-2.5%	18.7%	0.8%	16.7%
Suffolk	-13.3%	30.0%	-0.8%	11.8%
Norfolk	-4.6%	19.5%	1.7%	16.0%
Plymouth	-3.6%	23.5%	24.3%	47.9%
Barnstable	0.7%	15.6%	7.2%	24.8%
Dukes	-6.2%	33.5%	5.5%	32.2%
Bristol	-3.2%	15.3%	2.3%	14.2%
Rhode Island	**-3.8%**	**13.2%**	**-3.1%**	**5.6%**
Newport	5.1%	20.4%	4.4%	32.1%
Washington	6.7%	15.5%	6.5%	31.3%
Connecticut	**-4.9%**	**17.6%**	**-4.2%**	**7.2%**
New London	-2.2%	17.1%	0.1%	14.7%
New Haven	-7.5%	18.2%	-5.9%	2.8%
Fairfield	-1.1%	23.0%	-3.1%	17.9%
New York	**-7.5%**	**12.1%**	**-2.4%**	**1.2%**
Suffolk	-2.0%	24.4%	-1.5%	20.1%
Nassau	-3.0%	17.8%	-1.6%	12.3%
New Jersey	**-1.7%**	**17.0%**	**-0.1%**	**14.9%**
Monmouth	2.7%	23.4%	3.8%	31.5%
Ocean	0.8%	15.5%	4.0%	21.1%
Atlantic	12.4%	21.2%	-3.4%	31.5%
Cape May	6.3%	22.6%	1.3%	32.0%

Poverty

The Bureau of the Census measures poverty based on family income including wages, alimony, child support, social security payments, and other forms of public assistance weighed against predetermined poverty thresholds. Poverty thresholds are established for different households depending on household size, age and number of adults in the household, and number of children in differing age categories (thresholds are adjusted in each Census year to account for changing economic conditions).

Regionwide, the proportion of the regional population living below poverty was nearly 19% higher in 2000 than it was in 1970. The proportion of the coastal state population from Maine to New Jersey below the poverty threshold ranged from 9.8% in 1970 to 11.7% in 2000 (Table 4). Compared to 1970, the proportion of population below the poverty line in 2000

Table 4. Decadal proportion of population below the poverty line in coastal counties by county and state					
	Proportion of Population Living Below Poverty by Census Year				**Change in Poverty Status**
	1970	**1980**	**1990**	**2000**	**1970 to 2000**
Maine	**13.6%**	**13.0%**	**10.8%**	**10.9%**	**-19.7%**
Washington	23.0%	21.6%	19.3%	19.0%	-17.5%
Hancock	16.9%	14.6%	10.0%	10.2%	-39.5%
Knox	15.9%	14.4%	11.9%	10.1%	-36.7%
Lincoln	15.7%	16.7%	9.6%	10.1%	-35.4%
Sagadahoc	13.4%	11.2%	7.2%	8.6%	-35.6%
Cumberland	10.6%	10.5%	8.0%	7.9%	-25.7%
York	11.6%	9.8%	6.8%	8.2%	-29.6%
New Hampshire	**9.1%**	**8.5%**	**6.4%**	**6.5%**	**-28.2%**
Strafford	9.6%	10.4%	8.2%	9.2%	-4.4%
Rockingham	8.2%	6.6%	4.4%	4.5%	-45.2%
Massachusetts	**8.6%**	**9.6%**	**8.9%**	**9.3%**	**8.9%**
Essex	7.8%	9.1%	9.3%	8.9%	14.3%
Suffolk	15.2%	19.1%	18.1%	19.0%	24.9%
Norfolk	4.9%	5.5%	4.5%	4.6%	-6.2%
Plymouth	7.2%	8.0%	6.6%	6.6%	-7.8%
Barnstable	11.1%	8.9%	7.5%	6.9%	-38.1%
Dukes	9.1%	9.7%	6.7%	7.3%	-19.7%
Bristol	10.5%	10.1%	9.1%	10.0%	-4.8%
Rhode Island	**11.0%**	**10.3%**	**9.6%**	**11.9%**	**8.3%**
Newport	13.3%	9.9%	7.5%	7.1%	-46.4%
Washington	13.0%	8.2%	6.8%	7.3%	-43.9%
Connecticut	**7.2%**	**8.0%**	**6.8%**	**7.9%**	**9.4%**
New London	9.8%	8.2%	6.4%	6.4%	-35.2%
New Haven	8.1%	9.4%	7.9%	9.5%	17.5%
Fairfield	6.3%	7.5%	6.1%	6.9%	10.2%
New York	**11.0%**	**13.4%**	**13.0%**	**14.6%**	**32.1%**
Suffolk	5.9%	6.6%	4.7%	6.0%	1.5%
Nassau	4.4%	4.8%	3.7%	5.2%	19.6%
New Jersey	**8.1%**	**9.5%**	**7.6%**	**8.5%**	**4.3%**
Monmouth	7.7%	7.5%	5.0%	6.3%	-18.1%
Ocean	8.6%	8.1%	6.0%	7.0%	-18.8%
Atlantic	13.1%	12.6%	9.4%	10.5%	-20.1%
Cape May	12.6%	9.1%	8.3%	8.6%	-31.7%

declined only in Maine and New Hampshire (19.7% and 28.2%, respectively). The proportion of population living in poverty increased in all other states.

The proportion of population living in poverty in Maine coastal counties was about 10% in 2000. However, there were substantial differences in poverty status among Maine coastal counties that were masked by aggregated statistics. In particular, there was a difference in poverty status between Maine's three southernmost counties and coastal counties northward of Sagadahoc County. For example, even though the proportion of population in the 2000 census in Washington County declined 17.5% compared to the 1970 census, still 19% of the Washington County population was living below poverty; about two to three times that of every other Maine coastal county. The census data suggests that poverty rates in Maine's three southernmost counties of Sagahadoc, Cumberland, and York have been lower compared to what has been

traditionally known as the Mid-Coast and Downeast Maine counties. Among these latter counties poverty rates were similar in Hancock, Lincoln, and Knox counties, all of which were just over 10% in the 2000 census.

Essex and Suffolk counties were the only Massachusetts coastal counties where the proportion of population living below poverty was higher in 2000 than it was in 1970. The poverty rate in Suffolk County was the highest in Massachusetts, but still lower in most census years than poverty rates in Washington County, Maine. Compared to 1970 levels, the largest change in poverty status occurred in Barnstable and Dukes counties, where poverty rates were reduced by at least 20%. Note, however, that in Dukes County the proportion of population below the poverty line increased from 1990 to 2000. In most census years poverty rates in Norfolk and Plymouth counties were lower than other coastal counties, but were largely unchanged from 1970 to 2000. Poverty rates in Bristol County were also relatively stable and were just over 10% in 1970, 1980, and 2000.

In Rhode Island the proportion of population below the poverty line declined from 1970 to 2000 by 43% and 46% in Washington and Newport counties, respectively. Note that the change in poverty status in Newport County was larger than any other coastal county.

In both New York coastal counties of Suffolk and Nassau, the proportion of population living below poverty was among the lowest in any other state. Poverty levels in these two counties ranged from 3.7% to 6.6%. However, compared to 1970, the proportion of population living below the poverty line in 2000 increased by almost 20% in Nassau County.

In each New Jersey coastal county the proportion of population living below the poverty line in 2000 was at least 18% below that of the 1970 census. In general the largest gains in lowering the proportion of population below the poverty line were achieved between the 1980 and 1990 census years. However, the proportion of population living below the poverty line did increase by about one percentage point from 1990 to the 2000 census.

Education

Educational attainment was measured by the proportion of population age 25 or greater that had less than a high school diploma, a high school diploma, some college education, an associates degree, or had completed college. In the Maine to New Jersey region as a whole and in each coastal state there has been a significant shift in educational attainment toward higher levels of attainment. In 1970, 46% of the region-wide adult population (age 25+) had not completed high school and 22% of the population had attended or completed some form of post-secondary school education (Table 5). By 2000 the proportion of the adult population that had not completed high school had dropped to 18%, and the proportion that had attended or completed college or an associates program had increased to 54%.

In Maine the reduction in adults age 25 or greater with less than a high school education was similar to that of the region as a whole, but proportionally fewer individuals (50%) had attended or completed some form of post-secondary education. Note, however, that Maine had the lowest proportion of college graduates in 1970, but had increased by 174% by 2000; an increase second only to Rhode Island. By 2000 New Hampshire had the highest proportion of population with at least a high school education, while Rhode Island had the lowest, with almost 21% of the state population with less than a high school education.

Table 5. Decadal change in educational attainment of state population age 25 or older					
	1970	**1980**	**1990**	**2000**	**1970–2000**
Maine					
Less than High School	45.3%	31.3%	23.3%	14.2%	-68.6%
High School Graduate	35.1%	39.3%	40.8%	36.3%	3.5%
Some College/Associate	11.2%	15.0%	15.2%	26.5%	135.5%
College Graduate	8.4%	14.4%	20.7%	23.0%	174.9%
New Hampshire					
Less than High School	42.4%	27.7%	19.8%	12.3%	-71.1%
High School Graduate	34.4%	37.2%	35.2%	30.2%	-12.4%
Some College/Associate	12.3%	16.9%	17.9%	28.8%	134.5%
College Graduate	10.8%	18.2%	27.1%	28.8%	165.1%
Massachusetts					
Less than High School	41.5%	27.8%	21.9%	14.1%	-66.0%
High School Graduate	34.9%	36.4%	32.5%	27.6%	-20.8%
Some College/Associate	11.0%	15.8%	15.8%	24.6%	123.4%
College Graduate	12.6%	20.0%	29.8%	33.6%	167.9%
Rhode Island					
Less than High School	53.6%	38.9%	30.7%	20.8%	-61.2%
High School Graduate	29.0%	32.8%	32.3%	28.2%	-2.7%
Some College/Associate	8.0%	12.9%	13.7%	25.0%	212.6%
College Graduate	9.4%	15.4%	23.3%	26.0%	177.1%
Connecticut					
Less than High School	43.9%	29.7%	22.9%	15.2%	-65.3%
High School Graduate	31.7%	34.4%	32.5%	28.7%	-9.5%
Some College/Associate	10.7%	15.3%	14.6%	24.3%	128.4%
College Graduate	13.7%	20.7%	30.0%	31.7%	132.0%
New York					
Less than High School	47.3%	33.7%	27.7%	19.5%	-58.9%
High School Graduate	31.2%	34.1%	32.5%	28.3%	-9.4%
Some College/Associate	9.6%	14.3%	14.3%	24.4%	154.6%
College Graduate	11.9%	17.9%	25.5%	27.9%	134.5%
New Jersey					
Less than High School	47.5%	32.6%	26.0%	17.0%	-64.3%
High School Graduate	31.9%	35.9%	34.7%	29.7%	-6.7%
Some College/Associate	8.8%	13.2%	11.6%	23.2%	162.1%
College Graduate	11.8%	18.3%	27.7%	30.1%	154.6%
Region-Wide					
Less than High School	46.3%	32.3%	25.9%	17.6%	-62.1%
High School Graduate	32.0%	35.0%	33.2%	28.8%	-10.0%
Some College/Associate	9.7%	14.4%	14.1%	24.2%	148.8%
College Graduate	12.0%	18.4%	26.8%	29.4%	145.8%

Even though there were differences in educational attainment between coastal and non-coastal counties, the general change toward increasing levels of educational attainment was still the dominant trend over the past 30 years. Nevertheless, a few differences among costal counties are worth noting. In terms of magnitude of change, Washington County had the largest increase in the proportion of college graduates among Maine costal counties and the second largest increase in the proportion of adults with some college or associates degree. However, in 2000 Washington County still had the highest proportion of the county population with less than a

high school diploma (19.8%) and had the lowest proportion of population that had completed college (14.7%). Similarly, educational attainment increased considerably from 1970 to 2000 in Bristol County, Massachusetts, yet in 2000 the county had the highest proportion of population with less than a high school diploma and the lowest proportion of population with a college degree than any other Massachusetts coastal county.

Occupation

Changes in educational attainment have been driven by a changing regional economy that has evolved from manufacturing to one that is technology–based, demanding higher levels of educational competency. These changes are reflected in the relative importance and mix of occupational categories in the economies of coastal lobster-producing states. Across all states major shifts have occurred with substantial increases in professional/technical, managerial, sales, and service occupations, and reductions in clerical, machine operators, and craftsmen positions.

In 1970, machine operators, clerical workers, and craftsmen represented 19%, 25%, and 15%, respectively, of the coastal state workforce from Maine to New Jersey (Figure 4). By 2000 the proportion of the workforce in these occupations had declined to 5%, 20%, and 12%, respectively. These occupations had been replaced by professional/technical, administrative/ managerial, and sales positions. The proportion of the workforce in professional/technical occupations increased from 5% in 1970 to 9% in 2000. Administrative/managerial occupations increased from 10% to 17%, and sales positions increased from 8% of the workforce in 1970 to 13% in 2000. Note that the proportion of service sector occupations also increased from 1970 to 2000 as did the proportion of laborers. The proportion of farming, forestry, and fisheries occupations represented less than 1% of the labor force in both 1970 and in 2000.

In a general sense, many of the work force changes that took place over the past thirty years in the region as a whole have also occurred in each coastal state, although the magnitude of change has varied. Additionally, changes in the composition of workforce occupations among different coastal counties were also similar to the workforce changes for coastal counties as a whole. Most counties have experienced a shift away from craftsmen, machine operators, and unskilled labor to a workforce that contains a larger proportion of professional/technical, executive/managerial, sales, service, and clerical occupations. However, key differences exist among some coastal counties in terms of the proportion of farm, forestry, and fisheries occupations.

In Maine, the proportion of the workforce in farm, forestry, and fishing occupations was higher in Washington, Hancock, Knox, and Lincoln counties than in Maine's three southernmost coastal counties. Of these counties, the proportion of natural resource-based occupations was highest in 1970 in Washington County (2.5%) (Table 6). This proportion increased to almost 11% in Washington County in 1980, declined to 7.6% in 1990, and increased to 8.2% in 2000. Note that the proportion of farm, forestry, and fishing occupations in Washington County in 2000 was larger than both machine operator and sales occupations and was equivalent to both executive/managerial and laborer occupations. In no other coastal county in Maine – or, for that matter, any other coastal county from Maine to New Jersey – were farm, forestry, and fishing occupations as important to the workforce. In Sagahadoc, Cumberland, and York counties the proportion of the workforce in a farm, forestry, or fishing occupation peaked in 1980, ranging from about 2–3%. However, the proportion of natural resource-based occupations declined in

both 1990 and in 2000 to 1.3% in Sagahadoc and to less than 1% in both Cumberland and York counties.

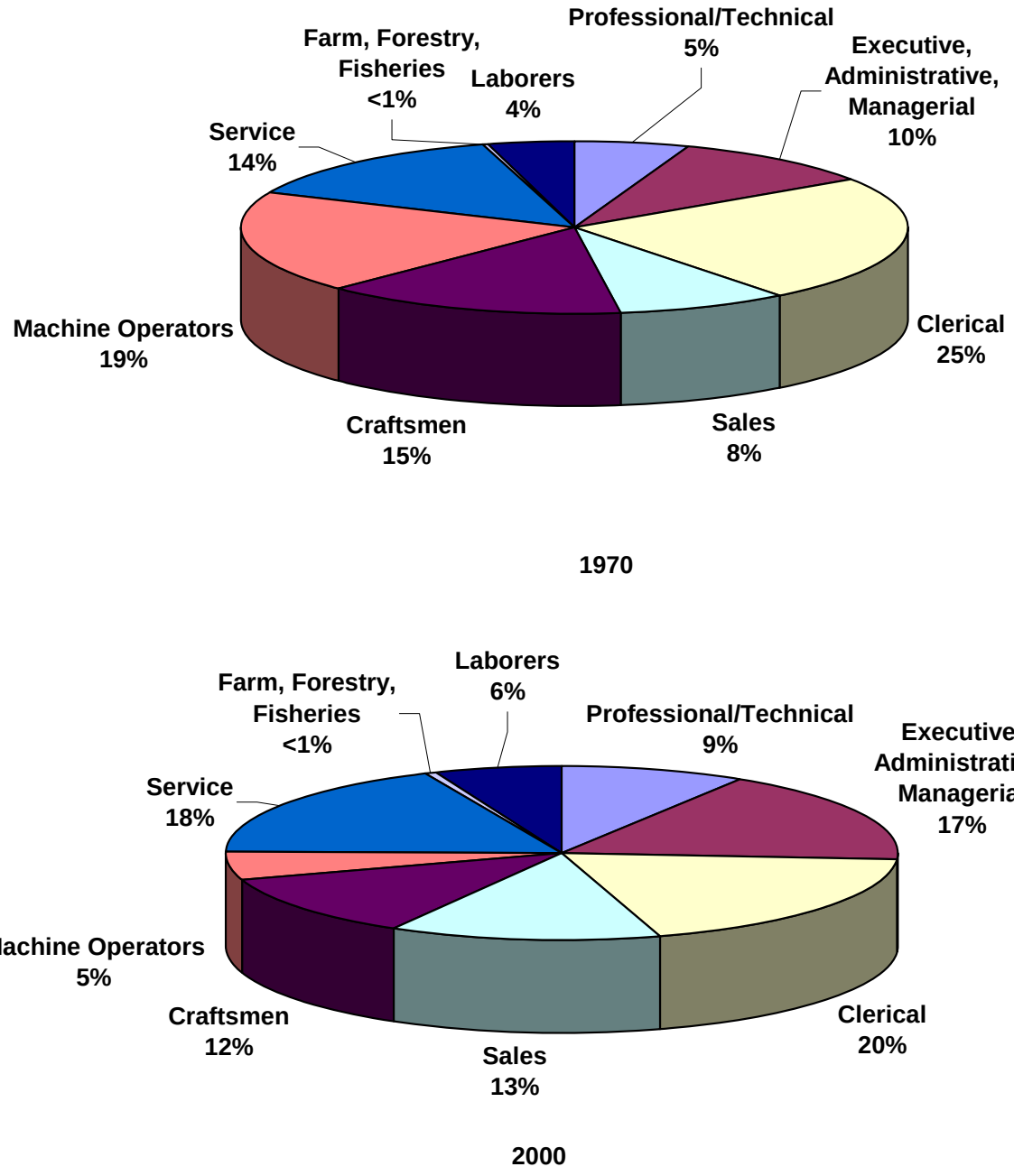

Figure 4. Occupational composition of the regional workforce in 1970 and 2000

Table 6. Proportion of the county workforce in farm, forestry, and fisheries occupations					
	1970	**1980**	**1990**	**2000**	**1970 to 2000**
Maine					
Washington	2.5%	10.6%	7.6%	8.2%	224.3%
Hancock	0.5%	9.5%	5.7%	4.1%	767.8%
Knox	1.4%	8.0%	5.7%	5.0%	261.9%
Lincoln	1.6%	8.7%	5.4%	5.1%	226.3%
Sagadahoc	1.1%	3.0%	2.0%	1.3%	21.1%
Cumberland	0.4%	1.7%	1.5%	0.6%	61.6%
York	0.7%	1.9%	1.7%	0.7%	-7.9%
New Hampshire					
Strafford	0.7%	1.4%	1.4%	0.5%	-37.0%
Rockingham	0.4%	1.2%	1.0%	0.4%	-15.6%
Massachusetts					
Essex	0.2%	1.0%	0.9%	0.3%	55.5%
Suffolk	0.1%	0.4%	0.4%	0.1%	96.0%
Norfolk	0.2%	0.5%	0.6%	0.1%	-53.2%
Plymouth	0.4%	1.1%	1.2%	0.3%	-33.4%
Barnstable	0.5%	2.8%	2.8%	0.7%	28.8%
Dukes	1.2%	6.4%	4.4%	0.6%	-44.2%
Bristol	0.4%	1.3%	1.3%	0.4%	-7.1%
Rhode Island					
Newport	0.8%	2.1%	2.8%	0.7%	-12.1%
Washington	0.5%	2.1%	2.6%	1.1%	123.9%
Connecticut					
New London	0.5%	1.8%	1.4%	0.4%	-23.7%
New Haven	0.2%	0.7%	0.8%	0.1%	-35.7%
Fairfield	0.2%	0.7%	1.1%	0.1%	-39.1%
New York					
Suffolk	0.3%	1.4%	1.3%	0.3%	-13.0%
Nassau	0.1%	0.8%	0.8%	0.1%	3.6%
New Jersey					
Monmouth	0.4%	1.0%	1.2%	0.2%	-50.9%
Ocean	0.2%	1.1%	1.3%	0.2%	0.5%
Atlantic	0.6%	1.2%	1.3%	0.4%	-24.9%
Cape May	0.4%	2.1%	2.1%	0.8%	117.2%

Across Massachusetts coastal counties the proportion of the workforce in farm, forestry, or fishing occupations exceeded 2% in any census year in only Barnstable and Dukes counties. In both Essex and Bristol counties, which have the two largest ports in Massachusetts, the proportion of farm, forestry, and fishing occupations was approximately 1% in 1980 and 1990, but below 1% in both 1970 and 2000. In Rhode Island, the proportion of the workforce in farm, forestry, or fisheries occupations exceeded 2% in both Newport and Washington counties in 1980 and 1990. By the 2000 census, however, the proportion of these occupations in Newport and Washington counties had been reduced to less than 1%. The proportion of the workforce in New York coastal counties engaged in a farming, forestry, or fishing occupation was almost 1.5% in 1980 and 1990 but was less than 1% by 2000.

Fishery Trends

Landings

Aggregate landings of lobster increased in every year from 28 million lb in 1974 to 64 million lb in 1991 before declining to 57 million lb in 1992 (Figure 5). Landings rebounded to almost 70 million lb in 1994 and continued to increase to a time series high of 89 million lb in 1999. More recently, lobster landings had been falling and rising in opposing years by nearly 15 million lb from 2000 to 2004 before stabilizing in 2005 at about the same level as that of 2004. Compared to a much longer time series (see Figure 1) the 1970–2005 period represents a substantial expansion of lobster landings. This expansion has been attributed to a number of factors that range from favorable environmental conditions to an expansion of effort.

Although Maine has always been the leading producer of lobsters, its share of total landings fluctuated over time. Throughout the 1970s Maine accounted for between 52% and 61% of total lobsters landed from Maine to New Jersey (Table 7). Expansion of lobster landings during the 1980s, particularly in Massachusetts, reduced the share of Maine lobster supplies to less than 50% from 1983 through 1992. However, since 1993 the contribution of the Maine lobster fishery to total landings increased steadily to more than 80% of the domestic harvest in 2004 before declining to 78% of total landings in 2005. The increasing proportion of Maine landings was due to a combination of increased landings in Maine and declining landings in just about every other state.

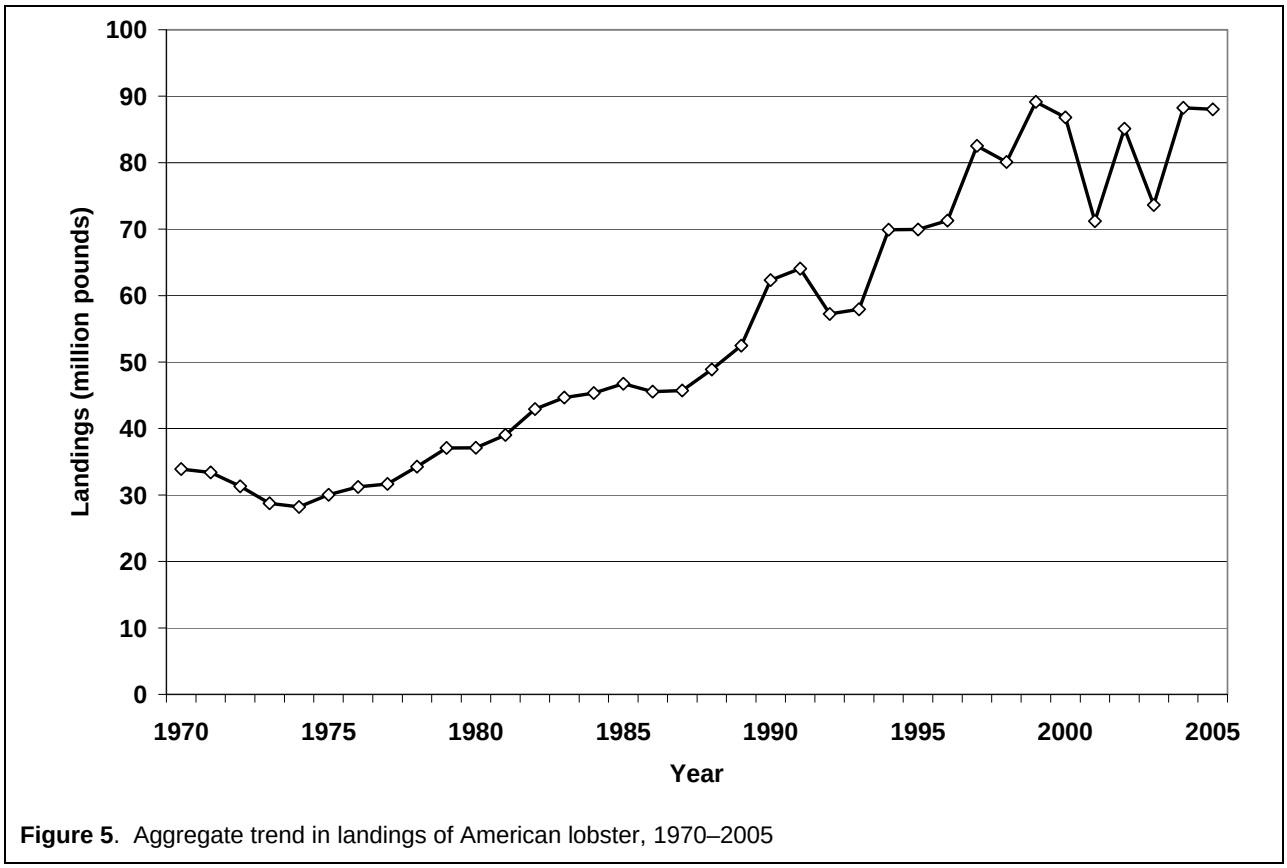

Figure 5. Aggregate trend in landings of American lobster, 1970–2005

Table 7. Annual share of lobster landings by state, 1970–2005

Year	ME	NH	MA	RI	CT	NY	NJ
1970	53.6%	2.0%	16.8%	15.3%	2.0%	4.9%	5.4%
1971	52.6%	2.0%	18.4%	16.1%	1.6%	5.4%	4.0%
1972	51.9%	2.2%	25.6%	10.7%	1.7%	3.7%	4.2%
1973	59.3%	1.7%	19.6%	9.6%	1.9%	3.1%	4.7%
1974	58.3%	1.8%	18.7%	12.1%	2.3%	2.6%	4.2%
1975	56.6%	1.6%	22.4%	12.3%	2.0%	2.2%	2.8%
1976	60.9%	1.5%	21.1%	10.9%	1.5%	1.9%	2.1%
1977	58.4%	1.5%	22.9%	11.0%	2.0%	1.7%	2.5%
1978	55.8%	1.4%	27.8%	8.2%	2.3%	1.7%	2.7%
1979	59.7%	2.1%	25.8%	6.2%	2.2%	1.9%	2.2%
1980	59.3%	2.0%	26.8%	6.5%	2.2%	2.0%	1.4%
1981	58.0%	2.0%	28.8%	4.8%	2.6%	2.3%	1.5%
1982	53.0%	1.9%	30.6%	7.4%	2.5%	2.6%	2.0%
1983	49.2%	2.9%	27.8%	11.5%	4.2%	2.7%	1.7%
1984	43.1%	3.5%	32.4%	11.6%	4.4%	2.9%	2.0%
1985	43.0%	2.6%	34.9%	11.0%	3.6%	2.7%	2.3%
1986	43.3%	2.1%	33.1%	12.4%	3.6%	3.1%	2.5%
1987	43.2%	2.7%	33.1%	11.6%	3.8%	2.5%	3.1%
1988	44.5%	2.3%	32.5%	9.7%	4.2%	3.6%	3.2%
1989	44.5%	2.7%	29.4%	10.9%	4.0%	4.5%	3.9%
1990	45.0%	2.7%	27.4%	11.6%	4.2%	5.5%	3.5%
1991	48.1%	2.8%	25.8%	11.6%	4.2%	4.9%	2.6%
1992	46.9%	2.7%	27.6%	11.8%	4.3%	4.6%	2.1%
1993	51.7%	2.9%	24.7%	10.8%	3.8%	4.6%	1.6%
1994	55.7%	2.4%	23.0%	9.3%	3.2%	5.7%	0.8%
1995	53.2%	2.6%	22.5%	7.7%	3.6%	9.5%	0.9%
1996	50.6%	2.3%	21.5%	7.4%	4.1%	13.2%	0.9%
1997	57.0%	1.7%	18.3%	7.0%	4.2%	10.8%	1.0%
1998	58.7%	1.5%	16.6%	7.0%	4.6%	10.6%	0.9%
1999	60.0%	1.5%	17.4%	9.1%	2.9%	7.9%	1.0%
2000	65.9%	2.0%	18.2%	8.0%	1.6%	3.3%	1.0%
2001	68.3%	2.8%	17.0%	6.3%	1.9%	2.9%	0.8%
2002	74.8%	2.4%	15.1%	4.5%	1.3%	1.7%	0.3%
2003	74.7%	2.7%	15.5%	4.7%	0.9%	1.3%	0.3%
2004	81.1%	0.4%	12.8%	3.5%	0.7%	1.1%	0.4%
2005	78.4%	2.9%	11.2%	4.9%	0.8%	1.3%	0.4%

Lobster landings in Maine were relatively stable throughout the 1970s and 1980s, averaging about 20 million lb (Figure 6). Landings began climbing throughout the 1990's and have continued to increase, although the interannual variability in landings has also increased. By contrast, as lobster landings remained relatively constant in Maine throughout much of the 1980s, landings were increasing at an average annual rate of about 6% in Massachusetts and 15% in Rhode Island (Figure 7). By 1991, however, landings in both states had peaked and have been declining ever since, with the exception of a short-lived spike in landings that occurred in 1999 in both Massachusetts and Rhode Island. In 2005, Massachusetts landings continued to decline but Rhode Island landings increase by more than one million lb.

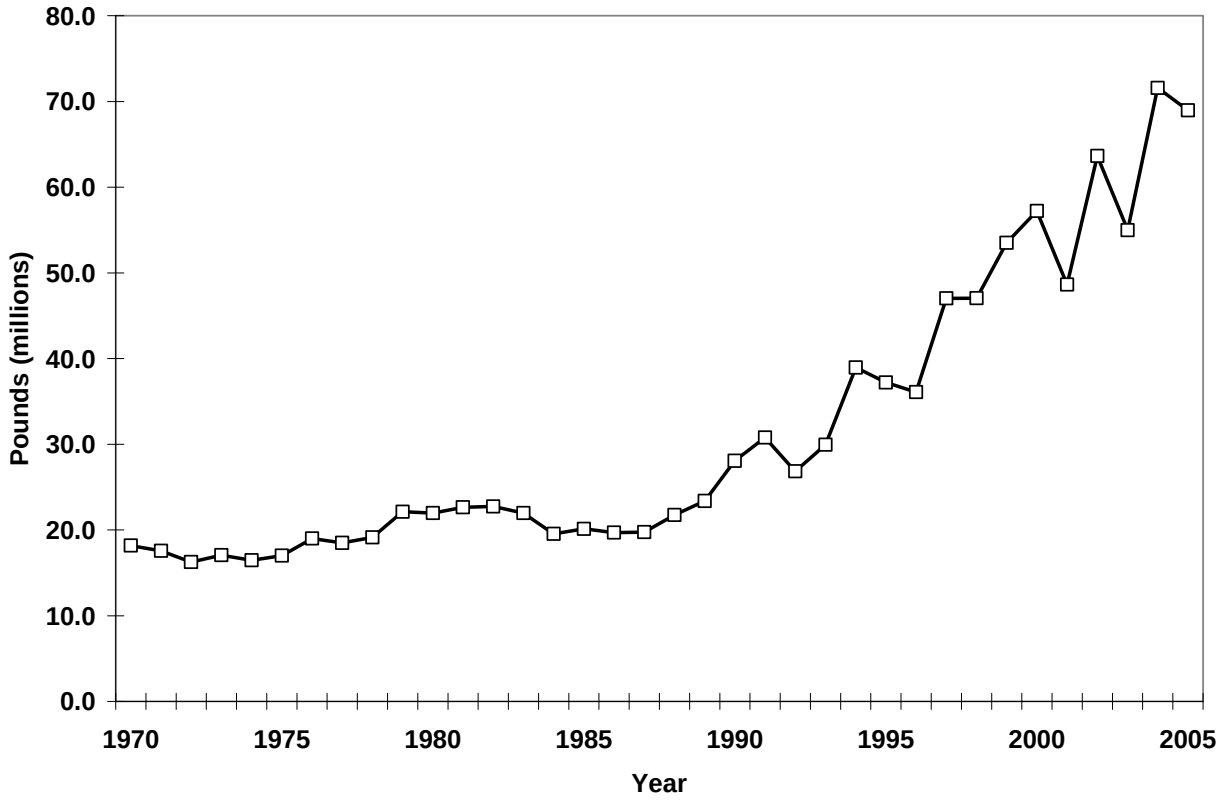

Figure 6. Annual American lobster landings in Maine, 1970–2005

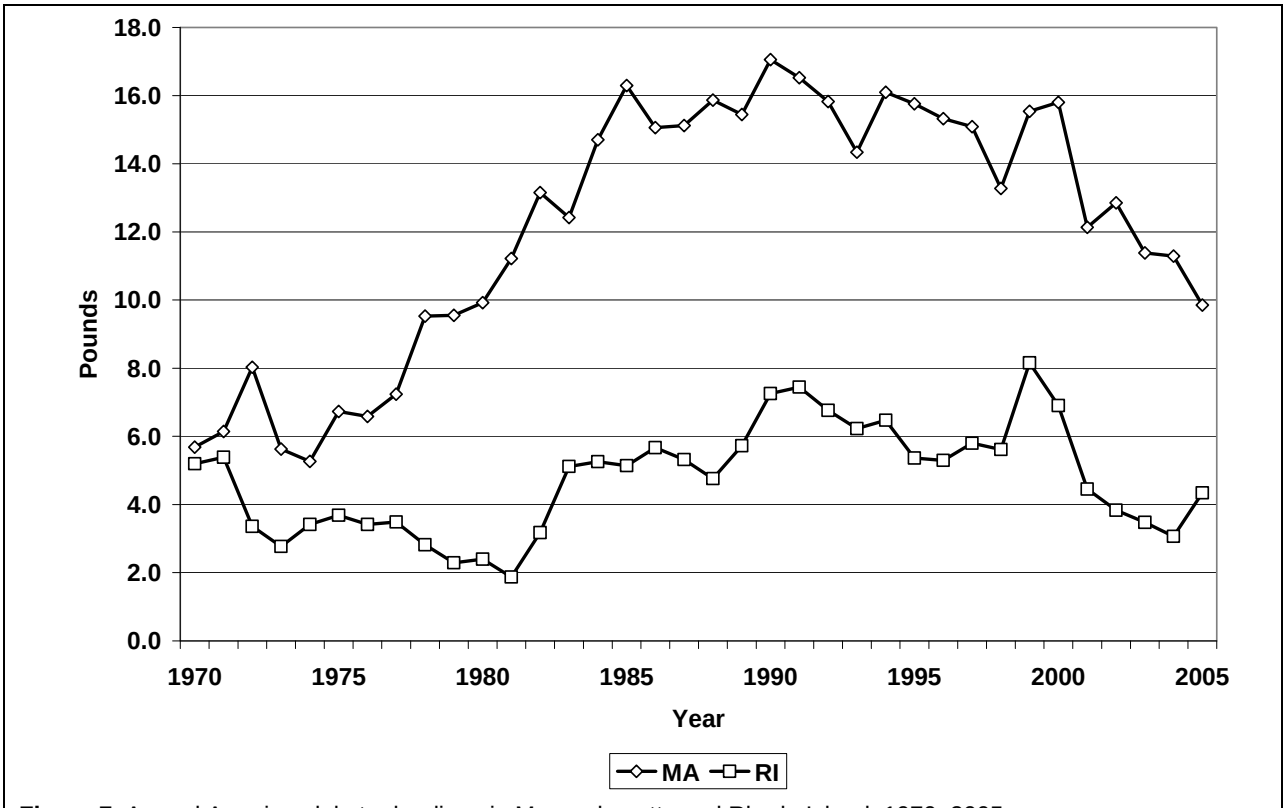

Figure 7. Annual American lobster landings in Massachusetts and Rhode Island, 1970–2005

Lobster landings in Connecticut, New York, and New Jersey were declining during the early 1970s but began to increase steadily from 1980 to 1990 (Figure 8). In New Jersey lobster landings peaked in 1990 at 2.2 million lb but have been declining ever since to less than half a million lb in 2004. Landings of lobster in both Connecticut and New York come primarily from the Long Island Sound fishery where landings increased substantially beginning in 1993 and peaking in 1996 in New York and 1998 in Connecticut at 9.4 and 3.7 million lb respectively. A die-off of lobsters occurred in 1999 in Long Island Sound precipitating a large drop-off in lobster landings to less than one million lb in both Connecticut and New Jersey. Landings in New York have made small gains over the past two years.

Seasonality

Landings follow a seasonal pattern that is tied into the biological cycle of American lobster, much of which is temperature dependent. This timing largely explains why the seasonal distribution of landings (Figure 9) has remained largely unchanged over the past 35 years even as landed quantities have increased. The majority of lobsters are landed in the 4-month period of July–October. Throughout the year landings have been generally low from January through April, accounting for no more than 4% of total annual landings. Landings begin to pick up in May, June, and July. With the exception of 2005, peak landings usually occur in August, with July and September coming in either second or third before tapering off throughout the fall and into December.

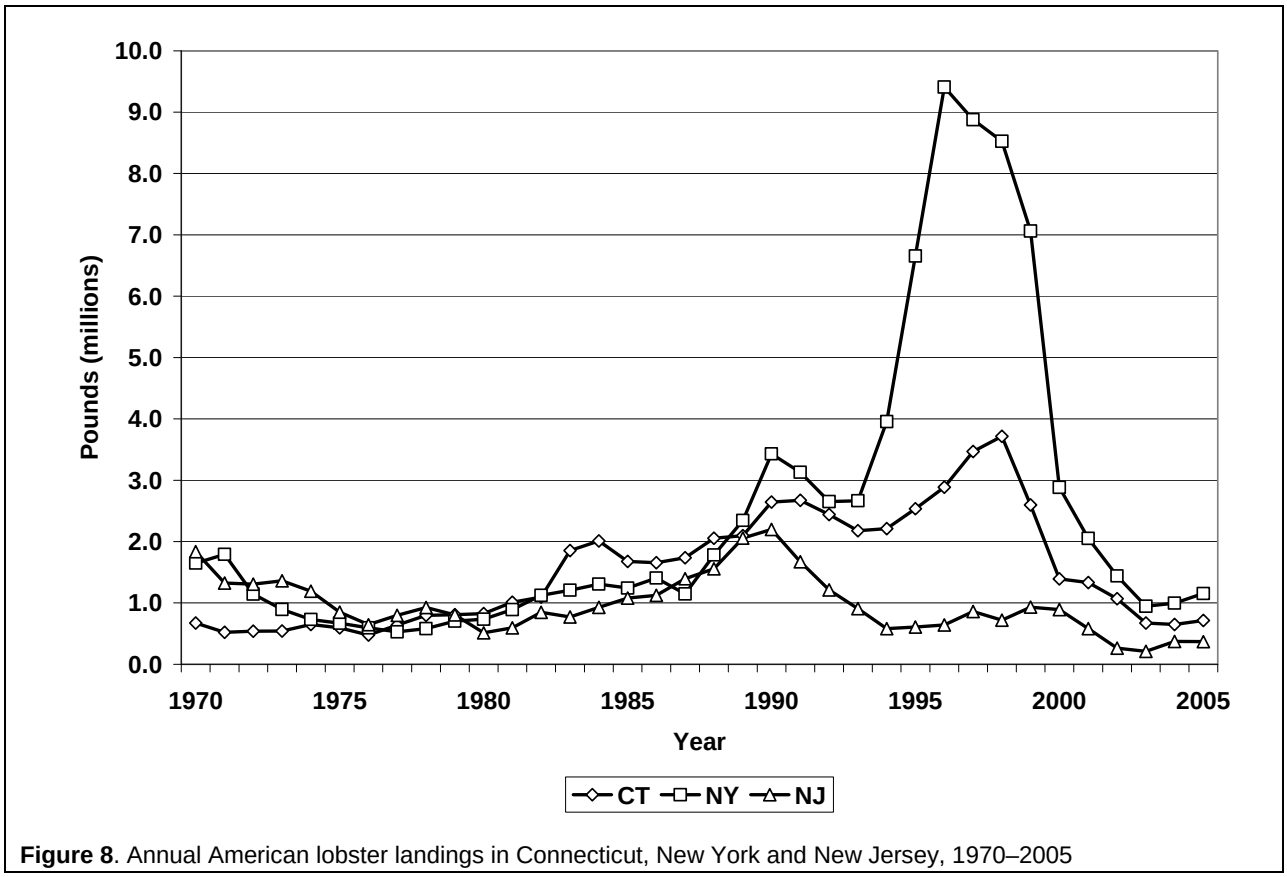

Figure 8. Annual American lobster landings in Connecticut, New York and New Jersey, 1970–2005

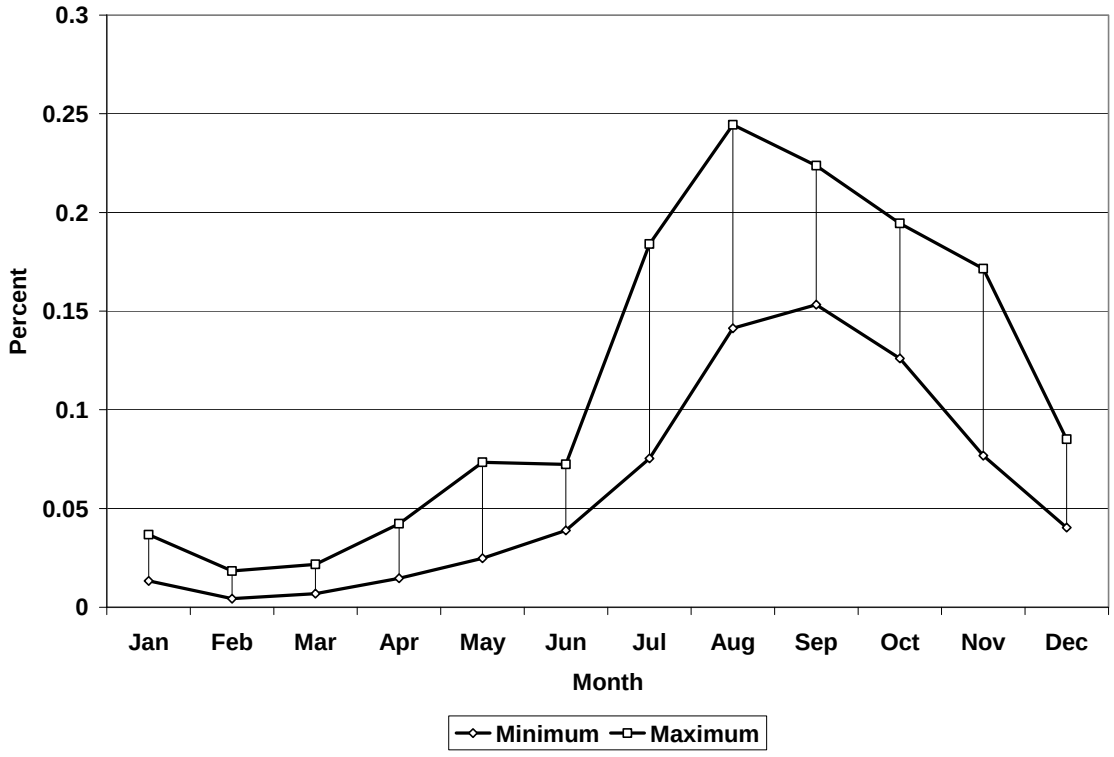

Figure 9. Envelope of minimum and maximum monthly landings shares by month, 1970-2005

Water temperature affects the seasonal pattern of landings. Compared to the Gulf of Maine, landings tend to increase earlier in the year south of Cape Cod due to warming ocean temperatures. This pattern is evident when comparing the average annual cumulative percentage of landings by month in Rhode Island and Maine.[1] The cumulative distribution of 30-year average Rhode Island landings lies leftward of that of Maine in every month from January to October (Figure 10). The relative positioning of the two cumulative distributions is indicative of an earlier season for lobster in Rhode Island than in Maine. For example, 10% of Rhode Island landings have been taken by March, but Maine landings do not reach 10% of the annual total until two months later.

Gear

The overwhelming majority (over 90%) of lobsters are landed using baited traps. Small quantities of lobster are landed in traps used to target black sea bass (*Centropristis striata*) or scup (*Stenotomus chrysops*). Prior to the development of hydraulic haulers, offshore landings from deeper water came principally from mobile gear. In 1970 mobile gear landings represented about 14% of total landings, but reported landings declined in subsequent years to average about 2% of total landings from 1980 to 2005.

[1] Although monthly data were available for Maine, Massachusetts, and Rhode Island for the entire time series, these two states were selected because Massachusetts landings could not be readily separated between Gulf of Maine and Southern New England.

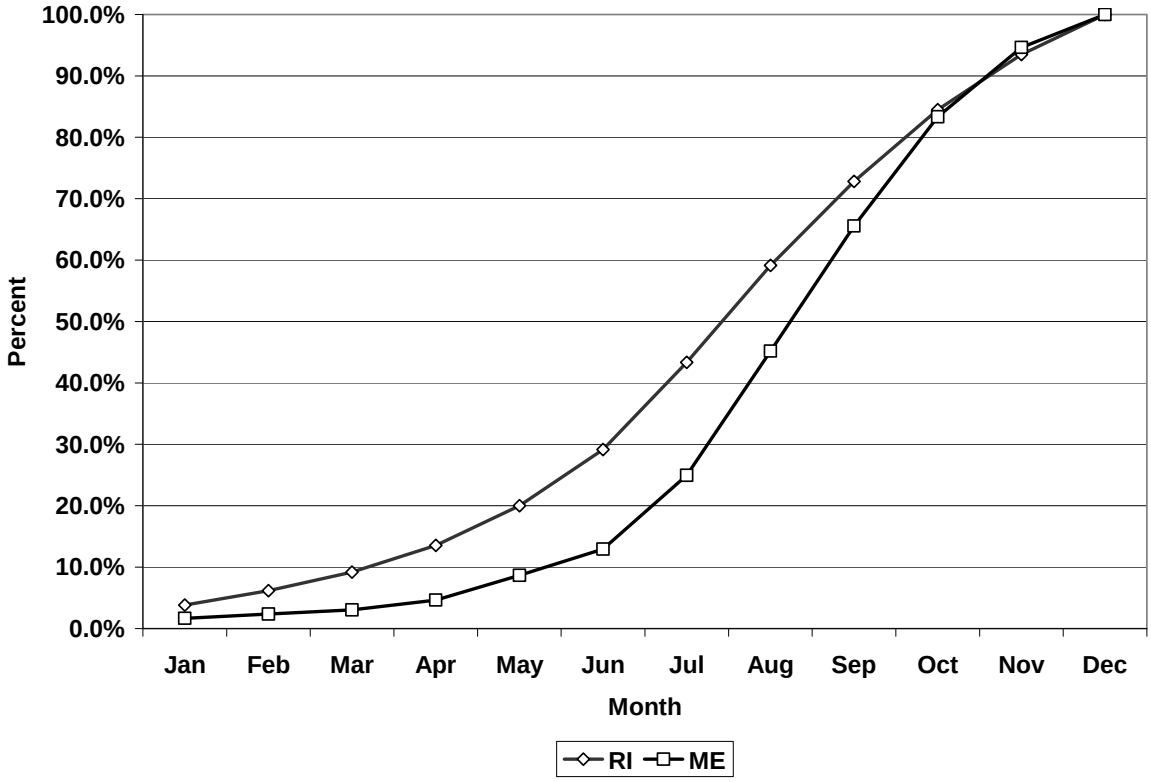

Figure 10. Monthly average cumulative percentage of American lobster landings in Rhode Island and Maine, 1970–2005

Incidental Fisheries

In 1978 the NMFB noted that crabs and black sea bass were the only notable species taken as incidental catch in the lobster fishery. Both rock crab (*Cancer irroratus)* and Jonah crab (*Cancer borealis*) were taken in the nearshore fishery, although the contribution to landings was estimated to be small since no more than 9% of the total crabs caught were actually landed due to low prices. Red crab (*Chaceon quinquedens*) was noted as being caught in deep water offshore; however, the NFMB noted that red crab and lobster were thought to prefer different depths and did not co-occur in large numbers on the same bottom. Black sea bass was the only finfish species noted as being a meaningful contribution to lobster fishing income principally in the Southern New England to New Jersey portion of the fishery. The potential role of black sea bass fishery in lobster fishing was not known due to a lack of available data at the time.

Available data are not adequate to characterize incidental catch fisheries, particularly for the Southern New England and Mid-Atlantic states prior to 1986 since these states were not included in the NMFS dealer data. To examine the importance of incidental species on trips targeting lobster, trip-level data were constructed from NMFS dealer reports for records where lobster was at least 50% of the total trip value. For lobster trap gear the only species that were found to comprise at least 1% of the landed catch in any year were Jonah crabs and rock crabs. Crabs represented as much as 14% of the landed catch in some years and as little as 3% in others (Figure 11). The proportion of crabs on trips targeting lobsters using lobster trap gear generally declined from 1987 to 1996. The proportion of crabs was constant at 5% from 1997 to 1999 but increased somewhat, averaging about 10% from 2000 to 2003. During calendar years 2004 and

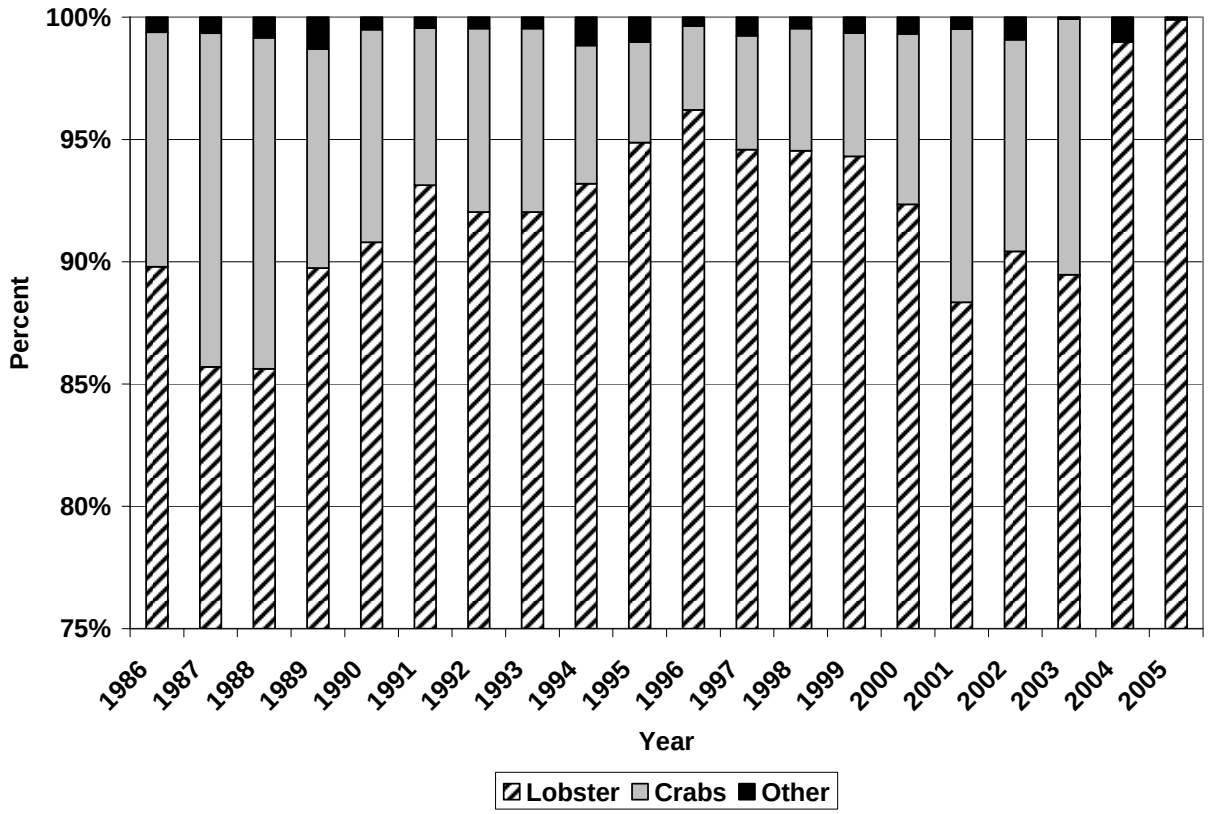

Figure 11. Proportion of lobster, crabs, and other species landed on targeted lobster trips using lobster trap gear

2005, the reported proportion of crab on directed lobster trap trips was nearly zero. Substantial changes were made to dealer reporting protocols, so the drop-off in recorded landings of crabs may be an artifact of this change rather than an absence of crab catch in the directed lobster trap fishery.

Although the NFMB indicated a relationship between black sea bass and lobsters using trap gear, black sea bass made up only a very small proportion of landed catch on directed lobster trips. Likewise, existing data indicate the proportion of lobster taken in all black sea bass fish traps has been on a declining trend since 1995. Thus, available data does not suggest that there has been any notable increase in targeting of lobsters using fish traps in the black sea bass fishery.

From 1986 to 2005 there were 9 different species that comprised at least 1% of landed catch on trips using otter trawl gear that targeted lobster (50% or more trip revenue from lobster) on at least 4 different years. Of these species only monkfish (*Lophius americanus*) was at least 1% of the landed catch in all years except 2005 (Figure 12). Cod (*Gadus morhua*), winter flounder (*Pseudopleuronectes americanus*), and skates were at least 1% of the landed catch on trawl gear trips targeting lobsters on at least 13 separate years. Of the remaining species only scallops has comprised at least 1% of landed catch in any year since calendar year 2000. Thus, while squids (*Illex illecebrosus* and *Loligo pealeii*), silver hake (*Merluccius bilinearis*), yellowtail flounder (*Limanda ferruginea*), and windowpane flounder (*Scophthalmus aquosus*)

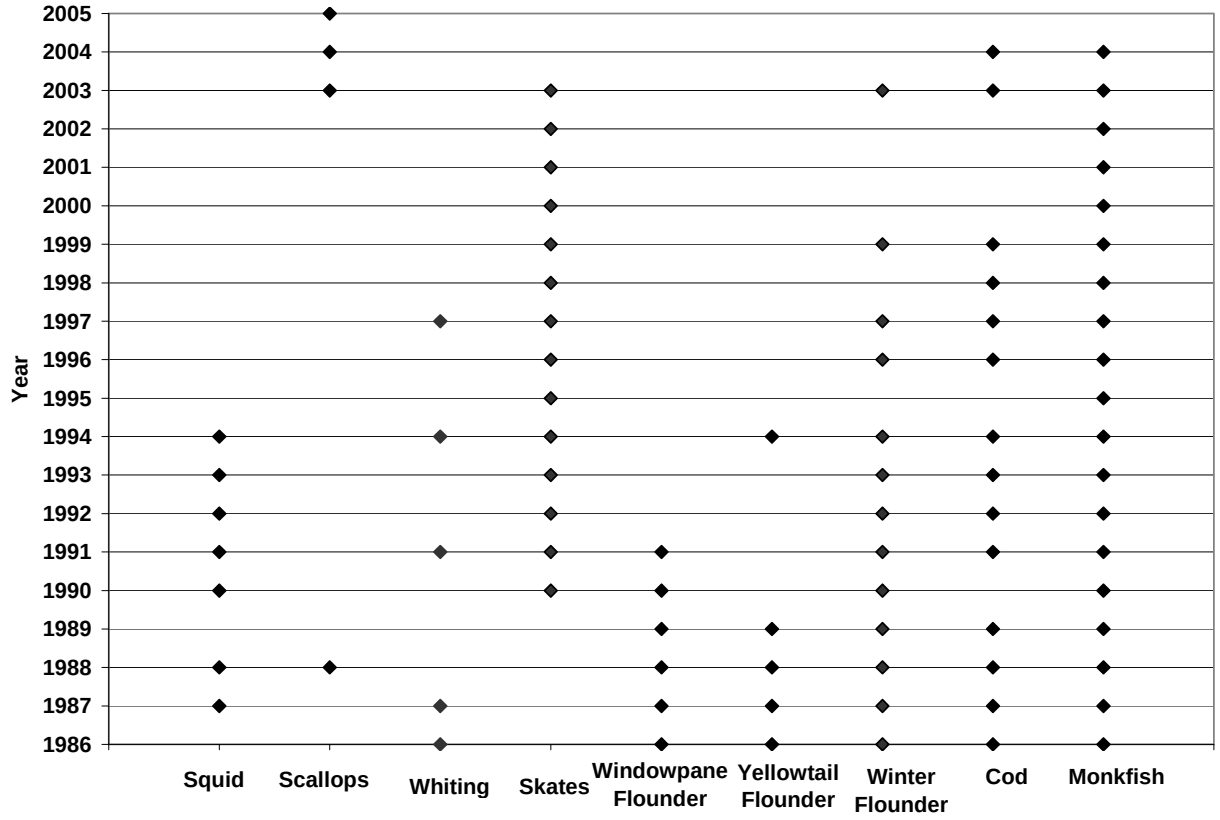

Figure 12. Calendar years in which incidental landings of species in the lobster trawl fishery were at least 1% of total landed catch, 1986–2005

appear to have been important incidental species to the trawl gear lobster fishery prior to 1994, their importance has diminished in more recent years.

Value and Prices

From 1970 to the present, American lobster has been either the most or second most valuable fishery in the Northeast region. Since 2000, revenues from lobster averaged 27% of region-wide totals. In nominal terms the dockside value of American lobster increased steadily from $33 million in 1970 to $122 million in 1984 before declining slightly to $116 million in 1985 (Figure 13). From 1985 onward nominal value continued to increase throughout the late 1980s and early 1990s to $166 million before declining in to $160 million in 1993. Note that annual changes in nominal value were quite small from 1970 through 1993. However, over the past 10 years interannual changes in dockside values have increased even as nominal values continued to increase to an all-time high of $417 million in 2005. During these years much of the interannual fluctuations followed a similar pattern to that of landings in Maine, since landings from Maine have represented an increasing share of total regional lobster supplies.

Using the Producer Price Index (PPI) for unprocessed finfish and shellfish (1982 = 100) to adjust for inflationary pressures also shows a general increase in dock-side value from $112 million in 1970 to $187 million in 2005 (Figure 13). In real terms, dockside value declined from 1970 through 1979. Over the next 13 years the PPI-adjusted dockside value fluctuated without trend between $86 and $111 million before following an increasing trend from 1994 to 2005.

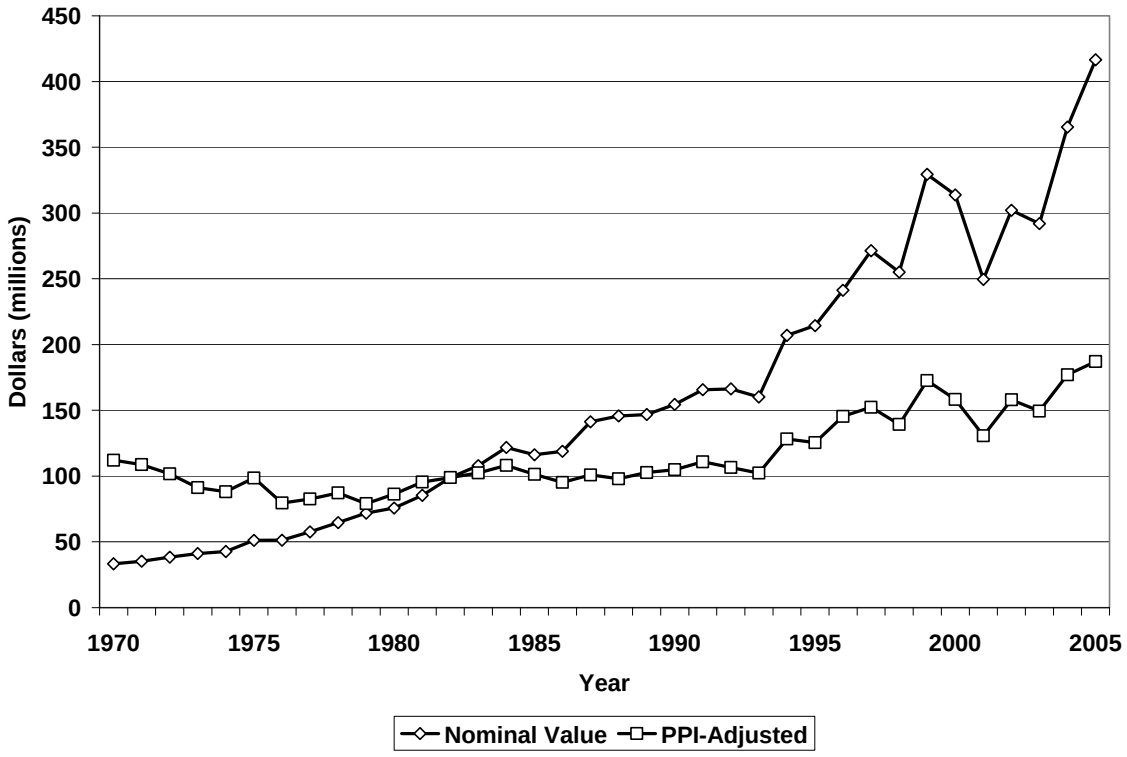

Figure 13. Nominal and PPI-adjusted dockside value of lobster, 1970–2005

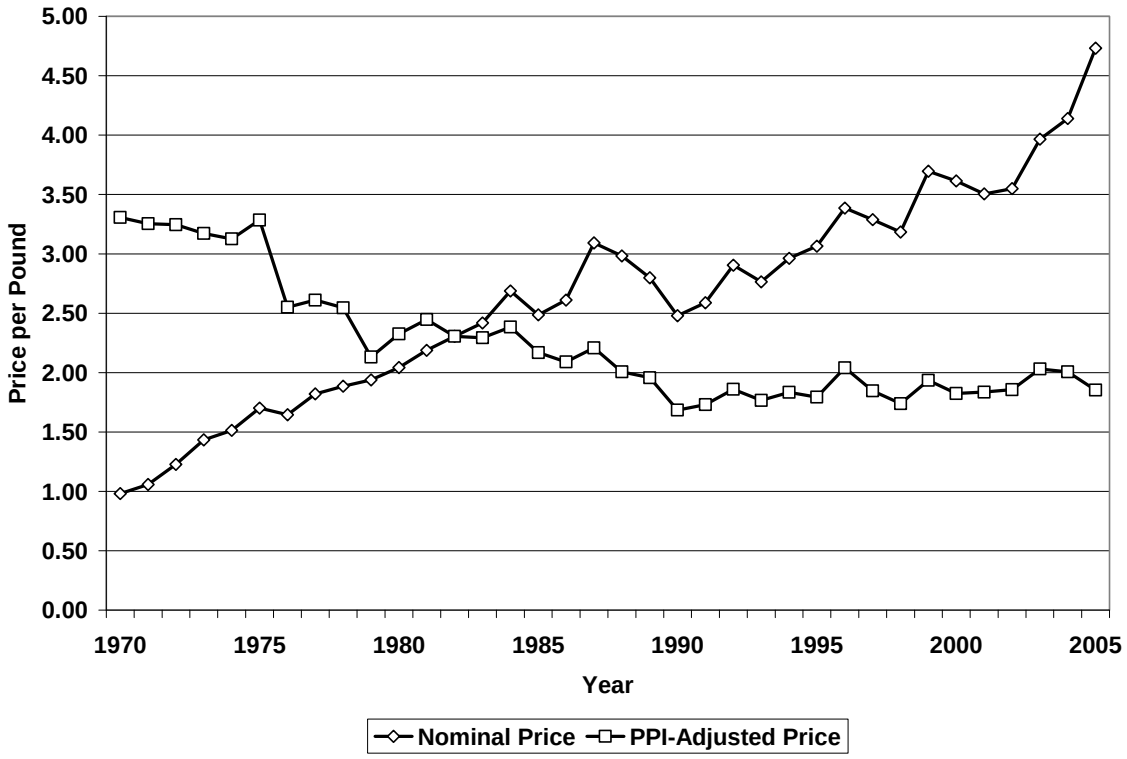

Figure 14. Nominal and PPI-adjusted average price per pound for lobster, 1970–2005

Average nominal prices show an increasing trend starting out at just under $1.00 per pound in 1970 and reaching a high of $4.73 per pound in 2005 (Figure 14). Inflation-adjusted prices indicate a different perspective on average lobster prices with a generally declining trend from 1970 to 1990. Since 1990, the PPI-adjusted price has been nearly constant, averaging $1.85 per pound.

Economic theory predicts that the quantity demanded for lobster depends on quantities supplied conditional on income and tastes and preferences, where the latter two are referred to as demand shifters. Given fixed income and preferences, changes in quantities demanded represent movements along a demand relation. A scatter plot of prices and quantities supplied shows three apparent clusters that may represent three different periods of changing demand for lobsters (Figure 15). From 1970 to 1975 lobster demand may have been higher than that of the 1976–1993 period since prices tended to be higher for similar supplied quantities. Note also, that these higher prices are consistent with declining landings that occurred during the early 1970s (see Figure 5). From 1976 to 1993 a pattern consistent with a stable downward sloping demand is evident, which explains the declining PPI-adjusted price as landed quantities of lobster were increasing throughout the period. After 1993 lobster demand appears to have shifted but it is difficult to determine the nature of the demand change since this period also coincides with a general increase in the variability of landings, which may cause some instability in observable demand relationships.

Lobster prices vary seasonally and price premiums are paid based on differences in quality due to the shell condition (hard or soft) and size. Consistent with market conditions of supply and demand, average lobster prices follow a seasonal pattern that mirrors monthly

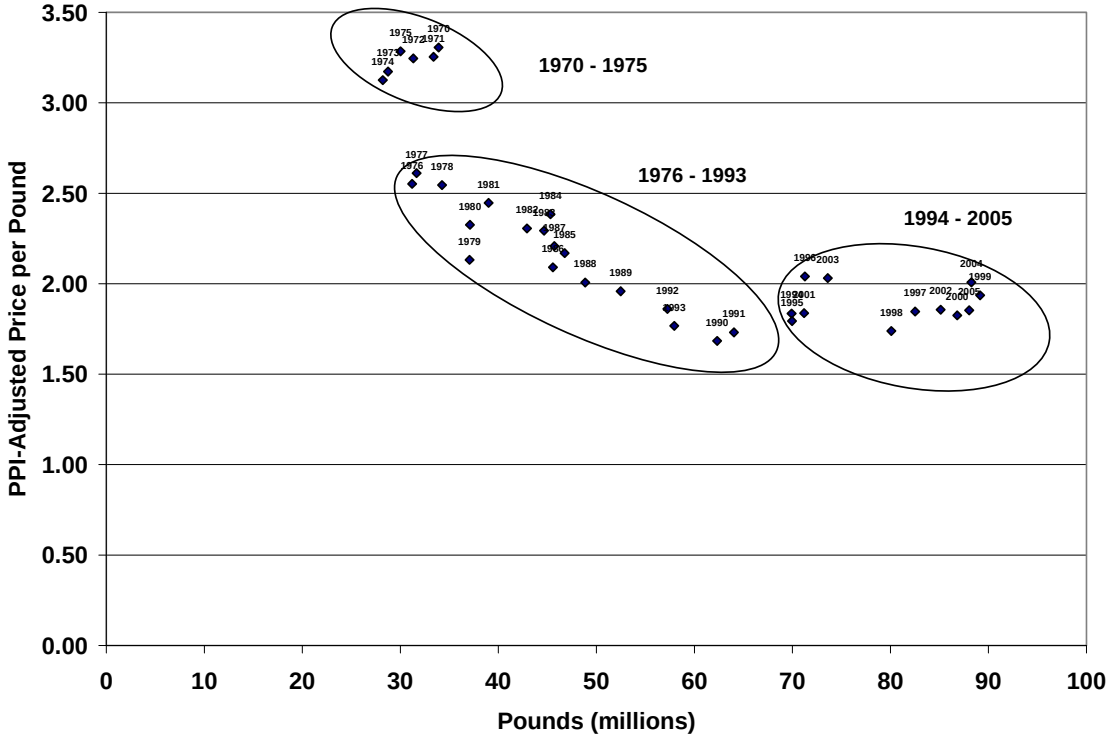

Figure 15. Scatter plot of lobster landings and PPI-adjusted prices, 1970–2005

landings. Average prices are higher during the winter months when available landings are low, while prices decline during the late summer/early fall as landings are peaking (Figure 16). As noted previously, monthly average prices peak during February/March, then generally decline from April through September before beginning to increase somewhat in October and November.

Price premiums are typically paid for larger lobsters, and while market categories are maintained in the NMFS dealer data the majority of dealers do not report landings and value by market category. Prices for different market categories (chicken or chix [one pound], quarters, [pound and a quarter], halves [pound and a half] and selects [two lb+]) are recorded by the NMFS Market News Office at the Fulton Fish Market (Department of Commerce 1987; 1988; 1989; 1990; 1991; 1992; 1993; 1994; 1995; 1996; 1997; 1998; 1999; 2000; 2001; 2002; 2003; 2004). These data are recorded by month and by origin (Maine, Massachusetts, etc.) and reported in annual summaries for 1987–2004 (the 2005 annual summary is not yet available). The Fulton Fish Market is a wholesale market but price premiums paid at the wholesale level are assumed to be transmitted through dealers to vessels, although the magnitude of the price premium may differ. For any given month lobster sales may not be recorded, so an annual average price for each market category was computed by omitting months with zero observations. Price premiums were then calculated as a percentage markup from the chicken lobster market category. In this manner, the effects of inflation are removed while retaining the relative difference in price premiums by size, and permits comparisons of how these premiums may be changing over time.

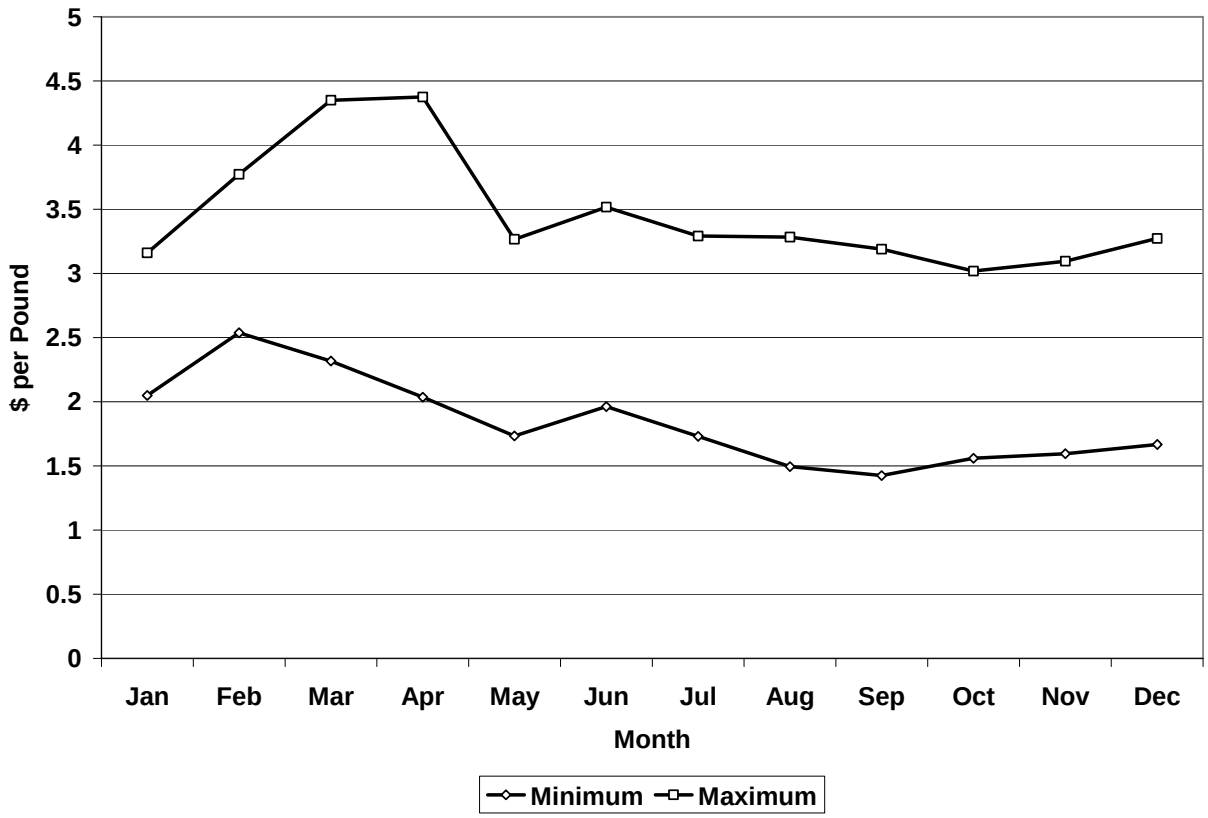

Figure 16. Envelope of PPI-adjusted monthly average lobster prices, 1970–2005

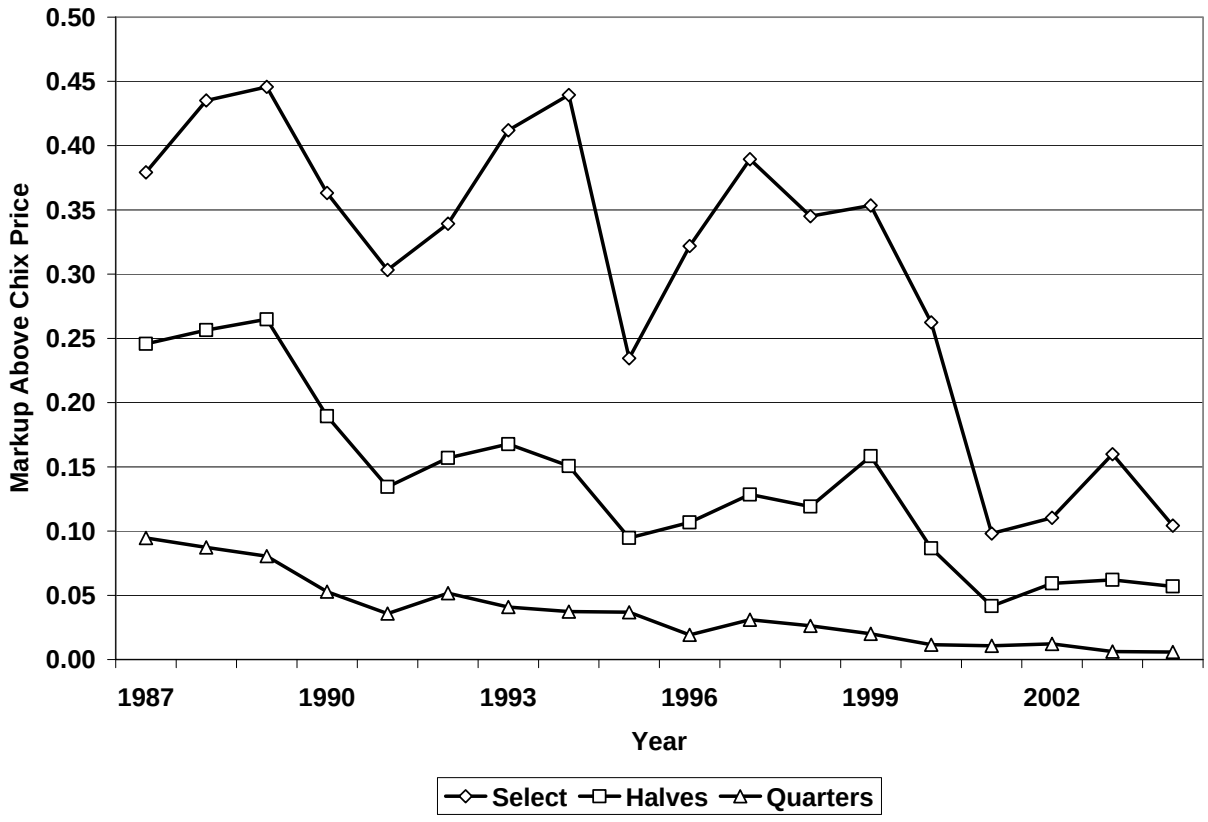

Figure 17. Annual average Fulton Fish Market percentage mark-up over chix price, 1987–2004

In 1987 the markup for quarters was about 10% more than the chicken price (Figure 17). Since 1987, the markup between the chicken and quarters price has declined considerably and has been no more than 1% in every year since 2000. Similarly, the markup over the chicken price for halves and selects were about 25% and 37% respectively in 1987, but have declined over time to a markup of 10% for selects and 6% for halves in 2004.

In addition to size premiums, "soft" shell or "new" shell lobsters receive a lower price since the meat yield is lower than "hard" shell lobsters. Hard shell lobsters may also be in a better condition for longer distance shipping and may fetch a premium price as a result. New shell lobsters are available and marketed during the shedding season, when a mix of new shell and hard shell lobsters are harvested. Dealer reports do not distinguish between lobsters based on shell condition, but the NMFS Market News Office at the Fulton Fish Market has been recording prices for new shell and hard shell lobsters by market category since 1996. However, since the shedding season varies over time depending on interannual water temperature regimes and since market news reports depend on whether or not lobsters are actually traded in any given month, available data are not adequate to calculate price differences and identify trends in hard and new shell prices over time. Fulton Fish Market news reports tended to be more complete for hard and new shell lobsters from Maine for July–October. These data were pooled across years to obtain an estimate of the average markdown in price for new shell lobsters by market category.

The markdown for new shell lobsters averaged just over $0.60/pound for select lobsters (2+ lb) in July (Figure 18). The average markdown for select lobsters remained between $0.55–

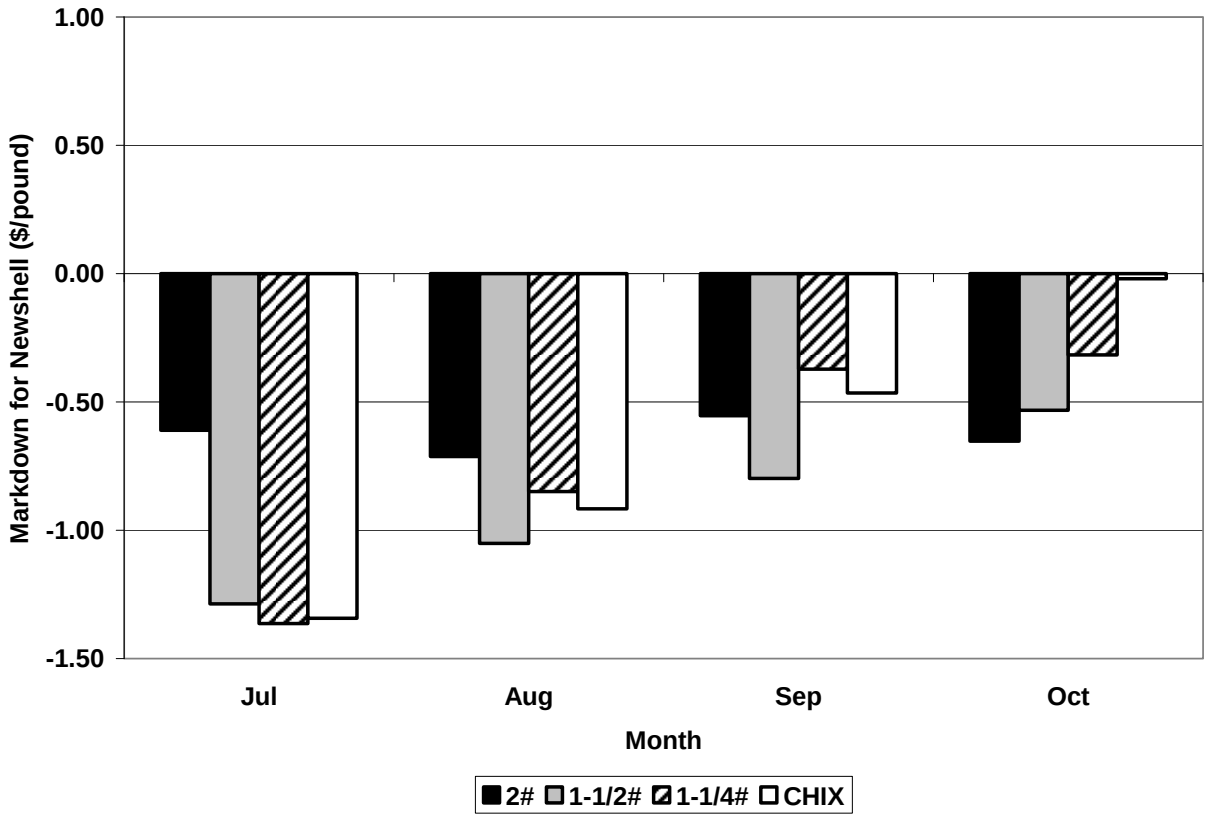

Figure 18. Average markdown for new shell lobsters at Fulton Fish Market,1996–2004

0.70/lb from August through October, while markdowns for all other market categories tended to decline. For example, the average markdown for new shell chicken lobsters was about $1.35/pound in July, but by October this price differential had nearly disappeared. Similarly, new shell halves and quarters were priced around $1.30/lb lower than hard shell lobsters, but this markdown had shrunk to $0.53 and $0.32, respectively, by October. The declining markdown for new shell lobsters in most market categories corresponds with the shedding season in which new shell lobsters would be most abundant while hard shell lobsters would be less so.

Trade

Trade in American lobster is an important component to the marketing of lobster in the United States. Canada is the most important trading partner accounting for nearly all of imported lobster products and the majority of US exports moving through the customs districts of St. Albany, Vermont; Portland, Maine; and Boston, Massachusetts.[2] Canada plays a dual role in live lobster markets in particular as a source of harvested product and as a holder of inventory through pounding operations. The net effect of US-Canada trade in live lobster is to reduce the

[2] Note that since customs data do not distinguish between American lobster and other species of lobster, these customs districts were selected for purposes of analysis because of their proximity to American lobster-producing areas.

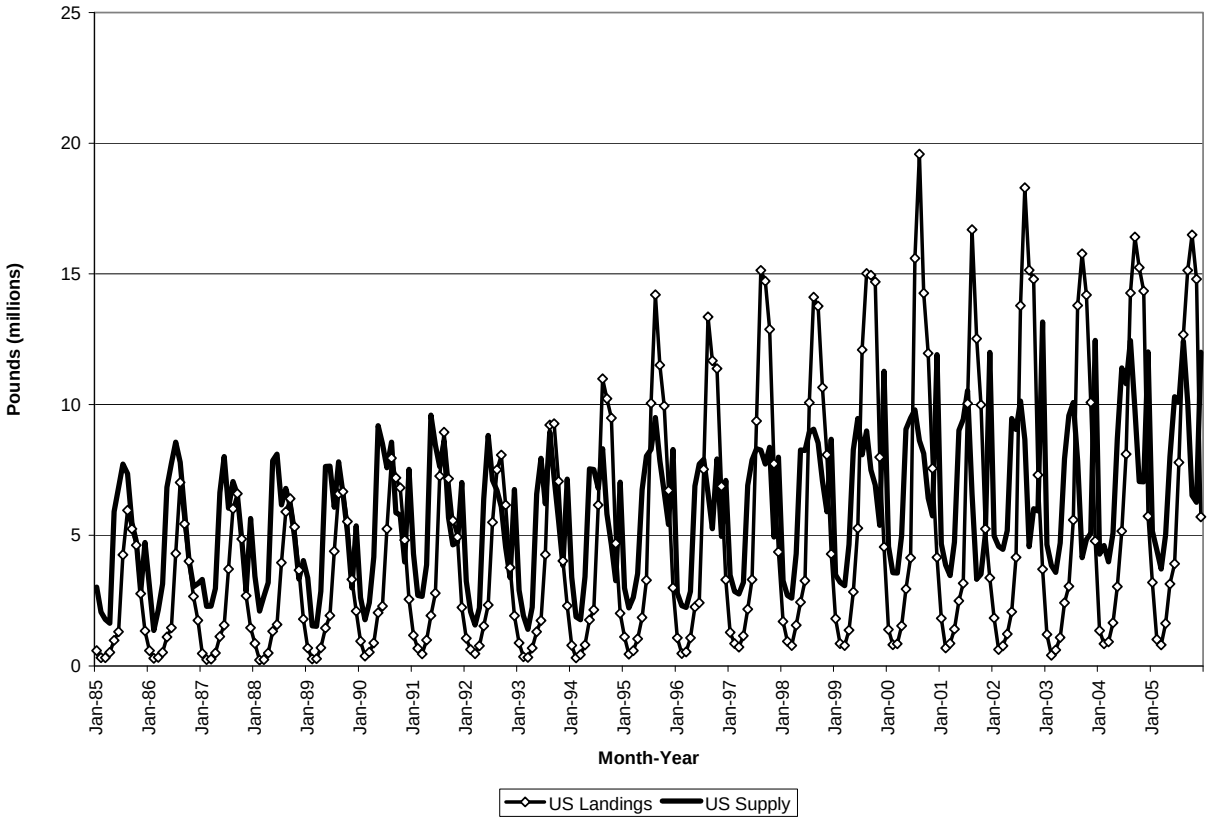

Figure 19. Monthly US domestic landings and US market supply of live lobster, 1995–2005

seasonal variability in American lobster supplied to the US market. For example, the standard deviation in monthly domestic landings was 4.7 from 1985 to 2005, whereas the standard deviation in the US supply of live lobster was 2.7.

The relative role of US-Canada trade has changed over time. From 1985 to 1993, monthly US-Canada trade was virtually one-directional with Canadian imports of live lobster supplementing that of domestic landings on all but a handful of occasions (Figure 19). Annually, Canadian imports accounted for at least one-third and as much as one-half of US live lobster supplies during those years.

Since 1994, US-Canada trade has evolved into more of a bilateral relationship in which Canadian imports supplement US supplies of live lobster from January to June and in December when domestic landings are low, and absorbs excess domestic landings occurring July through October. This relationship plays an even more important role in smoothing out variability in domestic supplies (the standard deviation of monthly US landings increased to 5.5 while the standard deviation of monthly US supplies increased slightly to 2.8) as well as dampening the price effects of large seasonal changes in landings. With exports to Canada playing a more prominent role, the annual balance of trade in terms of volume has been reduced substantially. However, the timing of US-Canada trade means that the bulk of US exports correspond with seasonal lows in price while Canadian imports enter the US when domestic landings are low and prices are high. That is, even in years when the US exported more live lobster to Canada than it imported (1997 and 1999), the trade balance in terms of value was still negative (Figure 20).

While the balance of payments does favor Canada, the trade relationship still provides benefits to both countries. An assessment of the US-Canada trade in lobster by Hasselbeck

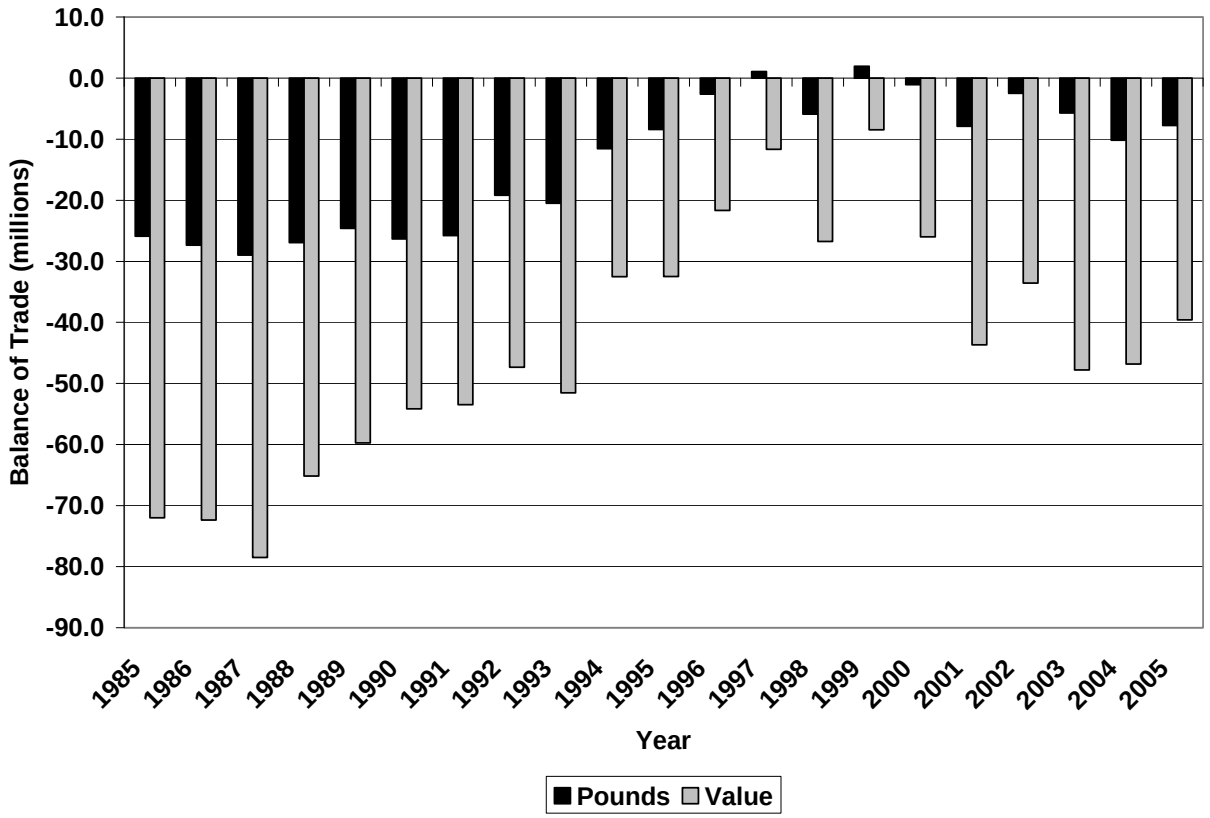

Figure 20. US-Canada trade balance in pounds and inflation-adjusted value, 1985–2005

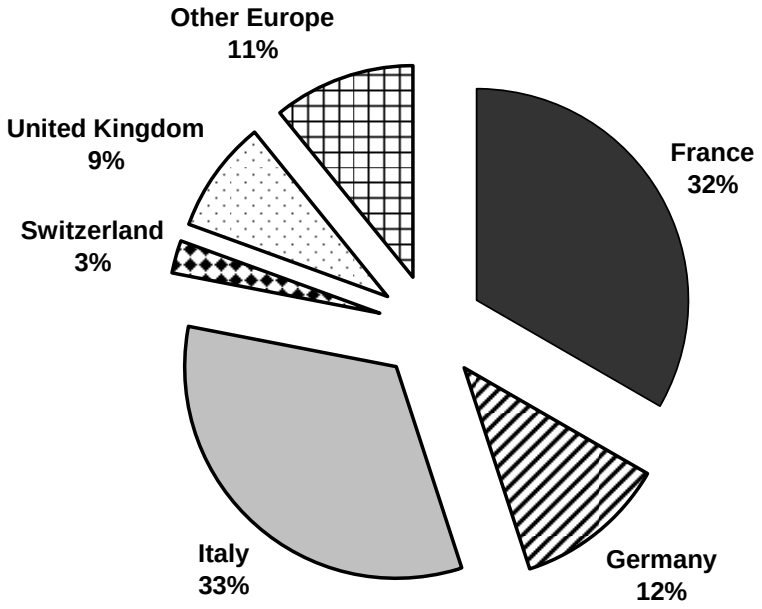

Figure 21. Average export shares of lobster exports to Europe in terms weight by country, 1995–2005

et al. (1981) concluded that Canadian imports suppressed ex-vessel prices received by US fishermen resulting in revenue losses to US lobstermen. This conclusion was later rebutted by Cheng et al. (1991). These authors demonstrated that the seasonal pattern of imports and exports was mutually beneficial and nearly optimal; that is, even though Canadian imports had a price-reducing effect during the winter and early spring, ex-vessel prices would have been much lower when domestic landings were highest if the Canadian export market were unavailable. On balance, revenues in both countries were enhanced by US-Canada trade relations.

Canada is not the only export market for US American lobster. Small quantities are exported to Pacific rim counties (principally Japan) while the vast majority are exported to Europe. During 1995–2005 about two-thirds of lobster exports were destined in equal parts to France and Italy, while the remainder was sent to Germany, the United Kingdom, Switzerland, and other European nations (Figure 21).

User Groups

Mobile Gear

The NEFMB described vessels using otter trawl gear as the first to develop and exploit lobster resources in the deepwater offshore canyons in Southern New England during the 1950s and 1960s. However, with the advent of hydraulic haulers, vessels using trap gear that had been largely confined to nearshore waters began to expand into offshore areas and eventually displaced the otter trawl fishery. According to NMFS dealer reports, mobile gear landings of lobster valued at almost $8 million (PPI-adjusted, base year 1982 = 100; http://www.bls.gov/ppi/home.htm Series ID : WPU0223) were more than 3 million lb in 1970 but dropped precipitously in subsequent years to just over 200 thousand lb in 1982 (Figure 22). Since 1982, total reported mobile gear landings have remained below 1 million lb and inflation-adjusted value has fluctuated between just over $2.5 million and $0.7 million, but has been at least $1.5 million in every year since 1996. Note that data reported throughout the 1970–2005 time period may underrepresent the full extent of the mobile gear fishery for two reasons. First, there have been several data base changes in the dealer reports which have increased coverage, particularly since 1994. In general, these changes may not have a large influence on estimates of mobile gear landings because the dealer data does cover landings for the entire time series in both Massachusetts and Rhode Island, the states where the majority of mobile gear lobster landings have occurred.

The second source of potential under-estimation of mobile gear lobster landings is the practice of giving lobsters to the crew as so-called “shack.” Shack refers to any catch that is not sold to a dealer by the vessel but is provided to crew as supplemental remuneration, since the crew would be able to sell the lobster themselves. Since these sales are not recorded, total mobile gear landings of lobsters would be underreported. The extent to which this practice was prevalent in the past and whether it continues today is uncertain, making the magnitude of underreporting difficult to assess.

The number of vessels that landed lobster using mobile gear on at least one trip increased from 100–150 vessels in the early 1970s to almost 400 vessels in 1995–1998 (Figure 23). Since 1998, however, the number of vessels landing lobster using mobile gear declined in consecutive years before increasing slightly to 276 vessels in 2005. As would be expected, the number of mobile gear trips that landed lobster follows a similar trend to that of the number of vessels; i.e., trips rise and fall with the number of participating vessels.

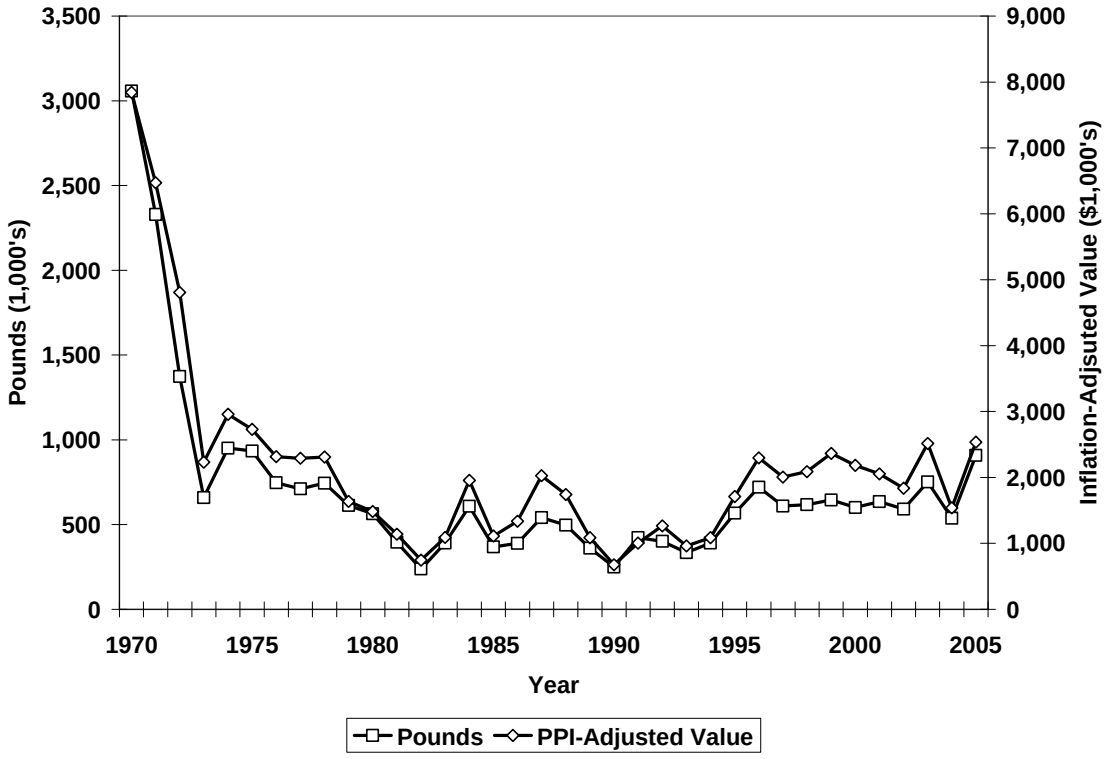

Figure 22. Landings and PPI-adjusted value of lobster landings using mobile gear, 1970–2005

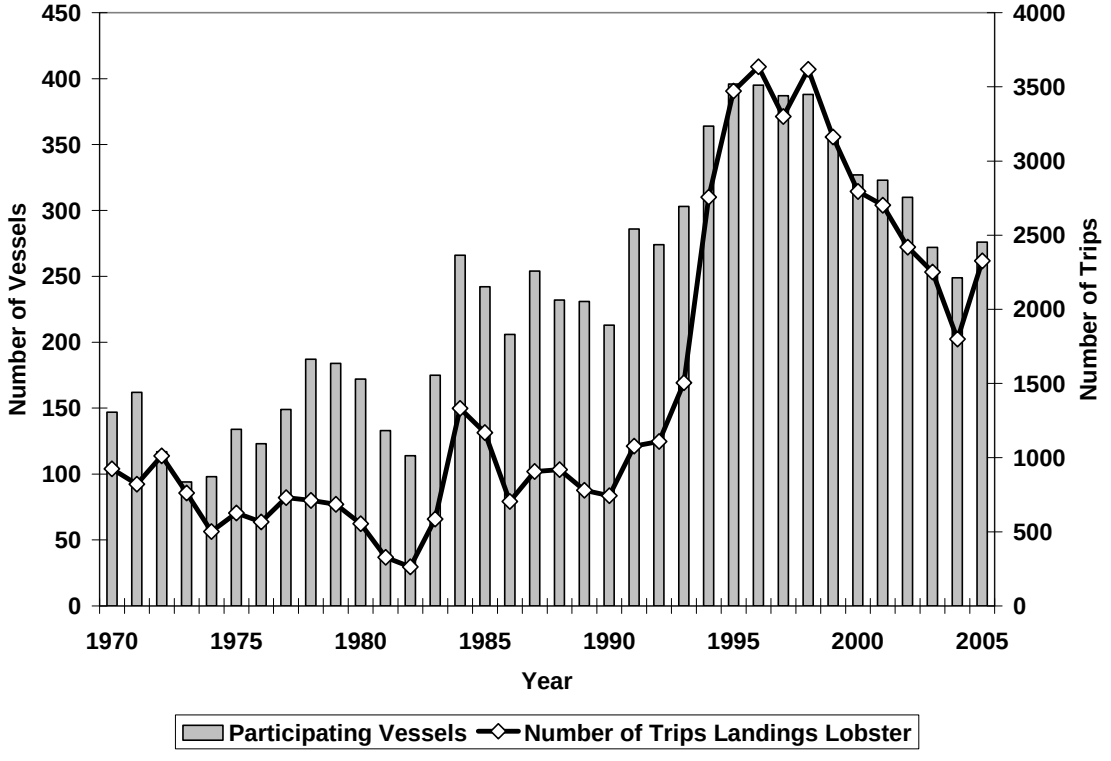

Figure 23. Number of participating mobile gear vessels and number of trips landing lobster, 1970–2005

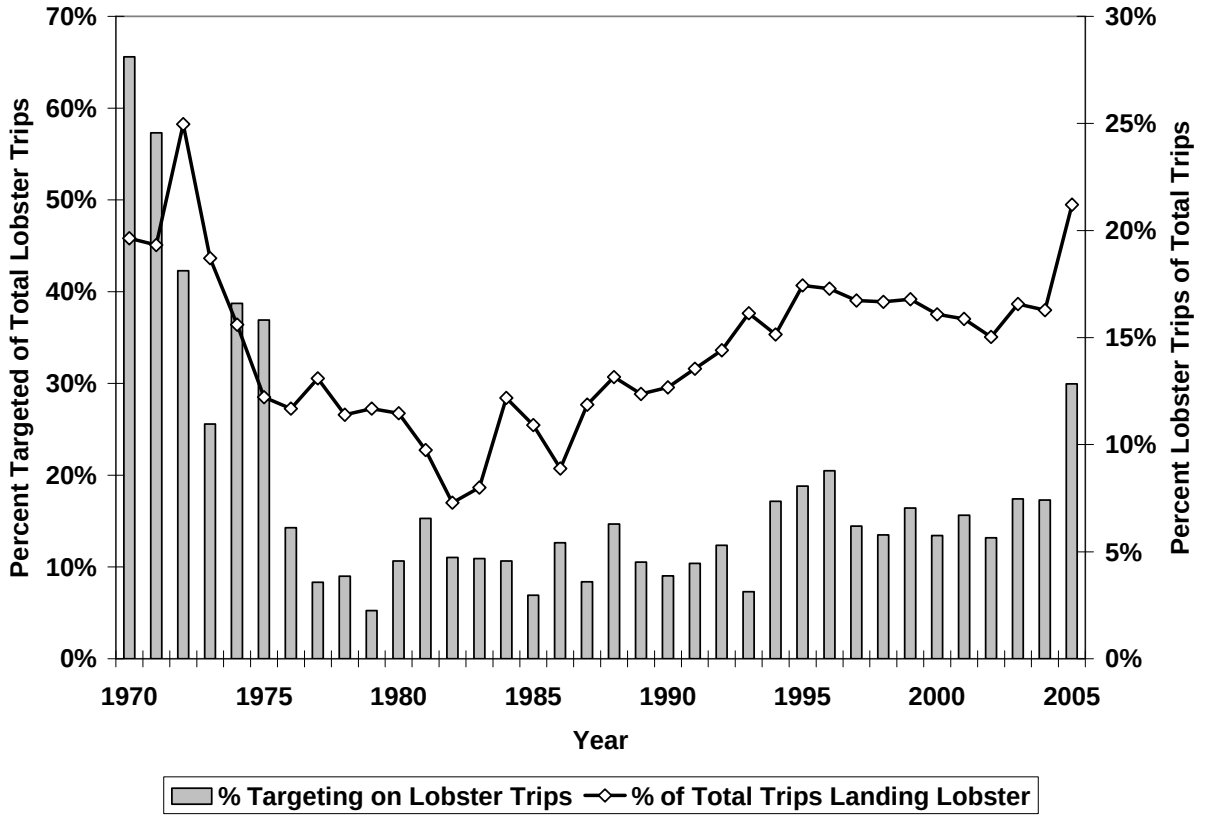

Figure 24. Percentage of total mobile gear trips landing lobster and percentage of trips targeting lobster, 1970–2005

In 1970, 20% of all mobile gear trips landed lobster (Figure 24), of which two-thirds targeted lobster (i.e., the value of lobster was at least 50% of total trip value). The percentage of mobile gear trips landing lobster rose to 25% in 1972 but declined steadily over the next 10 years to 7% in 1982. Since 1982 the percentage of total mobile gear trips that landed lobster has trended upward reaching 21% in 2005. By contrast, the percentage of trips targeting lobster has fluctuated without any notable trend, although the number of targeted mobile gear lobster trips was nearly one-third of all trips landing lobster in 2005, the highest percentage since 1975.

Available data indicate that lobster has been becoming more important in mobile gear vessel income particularly over the past five years. However, the importance of lobster in mobile gear fishing income varies considerably among different vessels. For example, over the past 35 years half of the vessels earned no more than 7% of total mobile gear revenue from the sale of lobsters (Figure 25). By contrast, at least in 1970 one-quarter of all vessels earned between 5–51% of total revenue from lobsters, and earnings from lobster represented at least 84% of total income for 10% of mobile gear vessels. Since 1982 the median share of lobster revenue in total earnings has ranged between 6–20% for vessels at the upper end of the 80% interval around the median, and has remained at less than 0.1% at the lower 80% interval. As noted above, the relative importance of lobster sales to mobile gear vessels does appear to have increased since calendar year 2000. For example, the median share of lobster revenues nearly doubled from 1.4% in 2000 to 2.7% in 2005. Similarly, the lobster revenue share increased from 11.2% to

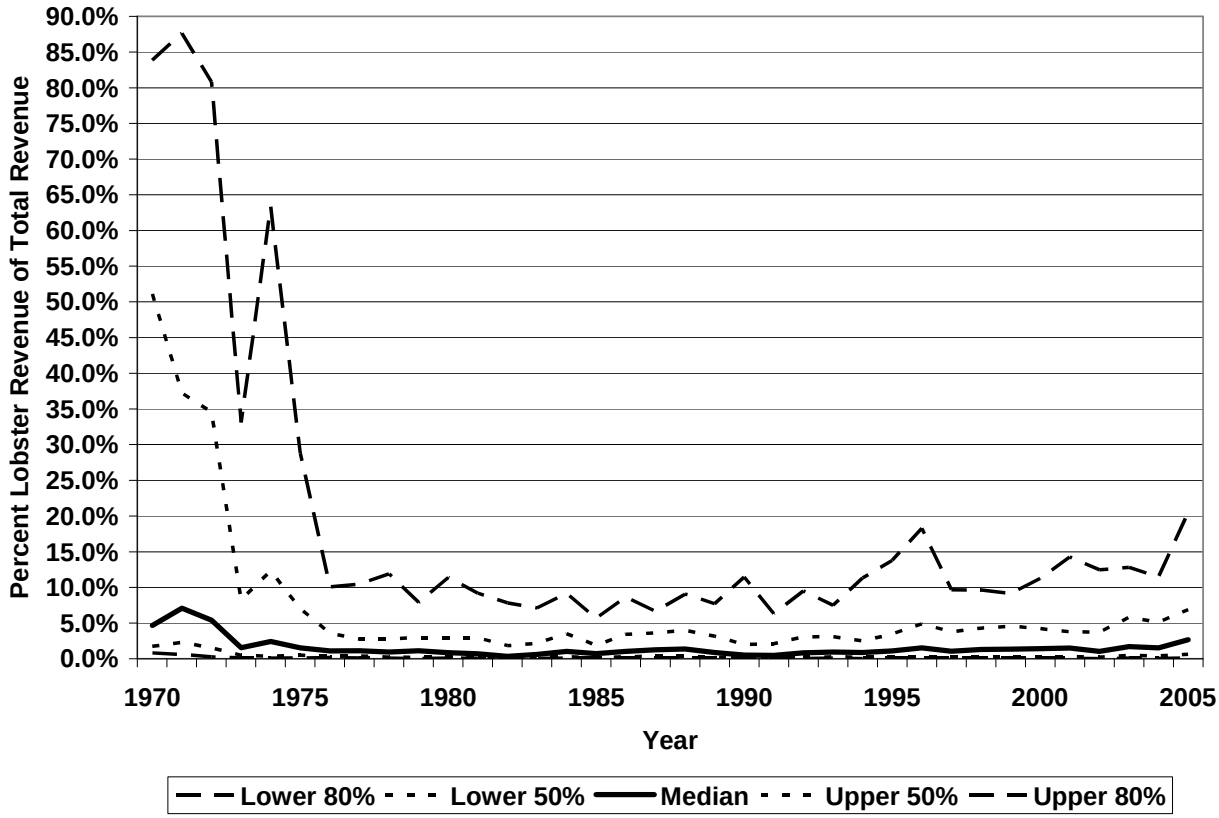

Figure 25. Proportion of lobster income to total revenue from all species for vessels using mobile gear that also landed lobster, 1970–2005

20.4% for vessels in the upper 80% of the mobile gear fleet that landed lobster in 2000 and 2005. This increase in the importance of lobster revenue to mobile gear vessels may be due to reductions in other fishing opportunities, particularly in the groundfish fishery – making the sales of species like lobster an increasing component of fishing income.

The increased importance of lobster in the business income for some mobile gear vessels came at a time when mobile gear possession limits were implemented. That is, beginning in calendar year 2000 mobile gear vessels were limited to a possession limit of 100 lobsters/day up to a maximum of 500 lobsters per trip. To assess the impact of this possession limit on mobile gear trips, the VTR data were queried to estimate how average landings of lobsters by weight on trips of 1-, 2-, 3-, 4-, and 5-day duration have changed compared to average landings for a baseline period of 1995–1999.

On average, lobster landings by weight declined for 1-day, 2-day, and 3-day trips compared to the 1995–1999 baseline average (Figure 26). By contrast, the average weight of landed lobsters on both four day and five day trips was higher from 2000 to 2005 than in the 1995–1999 baseline. Note that the increase in average landings indicates that the possession limit may not be constraining mobile gear landings on longer trips.

Even though average lobster landings on 1-, 2-, and 3-day trips have declined, average total trip revenue in constant dollars (1982 = 100) has increased compared to the 1995–1999 baseline (Figure 27). This means that at least part of the reduced lobster landings has been offset by higher earnings from species other than lobster.

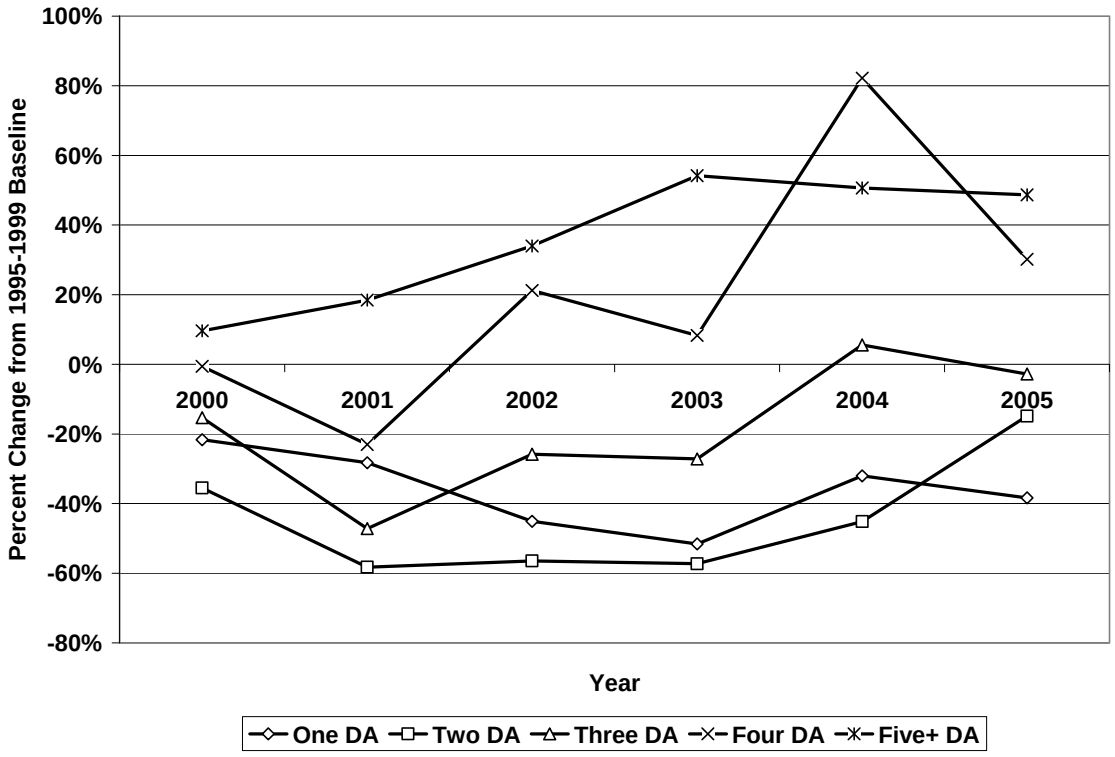

Figure 26. Change in average lobster landings on mobile gear trips by trip duration in calendar years 2000–2005

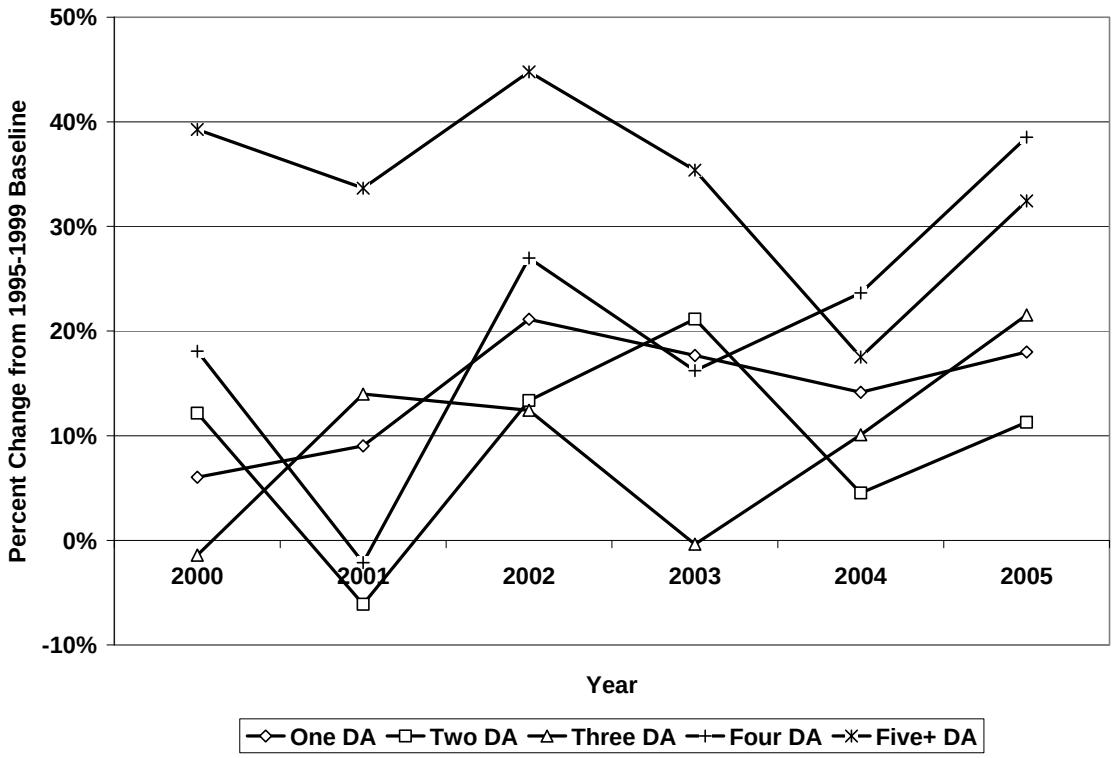

Figure 27. Change in constant dollar average trip revenue by trip duration compared to 1995–1999 baseline average

Trap Gear

The NFMB (1978) estimated that there were 10,356 vessels participating in the inshore trap fishery and 117 vessels participating in the offshore fishery during calendar year 1976. The inshore fishery directly employed 12,621 people, implying that at least 78% of all vessels operated without a sternman. By contrast, 429 people were employed in the offshore fishery, indicating that each vessel operated with 2–3 crew members in addition to the vessel owner or hired captain. Data reported by the NFMB suggest that the total number of people directly engaged in the lobster trap fishery in 1976 had declined from a high of 14,455 in 1974, but was still substantially higher than employment in prior years.

Other than the data reported by the NFMB, information on numbers of either operating units or numbers of people employed in the lobster trap fishery over time is not generally available. The difficulty in assessing participation in the lobster trap fishery is due to the inability to link license information with reported activity, since many states have no mandatory reporting requirement and federal lobster regulations do not require reporting by either vessels or dealers that possess only a federal lobster permit. In more recent years the trap tag program makes it is possible to identify how many vessels have purchased trap tags. However, while purchasing trap tags may be presumed to reflect the intention to fish, without the ability to link to a record of activity it is not possible to confirm participation.

Approximately 2700 federal lobster permits were issued to vessels using trap gear in 2003, 2004, and 2005 (Table 8). In 2005, the majority of permits were issued to Maine-based vessel owners followed by Massachusetts, Rhode Island, New Hampshire, New Jersey, New York, and Connecticut.

Just over 1700 federal permit holders that used trap gear actually purchased trap tags in each fishing year (Table 9). Assuming vessel owners that purchase trap tags actually participate in the lobster trap fishery, approximately 70% of all permitted trap vessels are active. This estimate differs substantially across states, with at least 80% of federal permit holders from Maine being active compared to less than 20% of Rhode Island permit holders that also purchased trap tags.

Table 8. Federal lobster permits to vessels using trap gear by state and fishing year, 2003–2005*

State	**2003**	**2004**	**2005**
CT	32	28	26
MA	733	690	651
ME	1,416	1,484	1,488
NH	90	100	94
NJ	121	97	92
NY	74	73	76
RI	254	235	226
Other States	42	38	40
Total	2,762	2,745	2,693

* May 1 to April 30

Table 9. Number of federal lobster permit holders that were issued trap tags by state and fishing year, 2003–2005*

	2003		2004		2005	
State	Permits	% of Issued	Permits	% of Issued	Permits	% of Issued
CT	18	56%	13	46%	13	50%
MA	463	63%	423	61%	445	68%
ME	1,155	82%	1,204	81%	1,187	80%
NH	45	50%	43	43%	49	52%
RI	47	19%	38	16%	22	8%
Total	1,728	68%	1,721	68%	1,716	69%

* May 1 to April 30

A telephone survey was conducted to collect baseline information on lobster trap fishermen engaged in the fishery during calendar year 2005. The survey was designed by researchers at the Gulf of Maine Research Institute (GMRI) and was administered by a Portland, Maine based market research firm Market Decisions. The sample frame was license holders from Maine, New Hampshire, Massachusetts, and Rhode Island yielding a total of 9701 operating units. The sample frame was stratified by the seven lobster management zones in Maine and by LCMAs 1, 2, and 3. Note that the strata did not include the Outer Cape LCMA or LCMAs 4, 5, and 6. The telephone survey was administered during calendar year 2005 and achieved a sample size of 1156 for an overall response rate of 40%. The survey gathered information on demographics, job skills, children's education, years of involvement in the lobster trap fishery, vessels characteristics, seasonal activity, effort, other fishing activity, lobster business characteristics, household income, health insurance, and retirement plans.

Given the stratified random design, each observation was weighted to produce population estimates from the sample data. Point estimates as well as 95% confidence intervals were computed for variables of interest. In this manner, comparisons between components of the population are made possible. Specifically, the point estimates for two variables may be said to be statistically significant at the 0.05 level of significance if the confidence intervals do not overlap.

The primary focus of the survey was on active participants which were defined as being anyone that landed at least 1000 lb of lobster during calendar year 2005. Nevertheless, a subset of questions was asked of individuals that did not land 1000 lb or that did not fish at all. The survey found that 87% (± 3%) of lobster businesses did participate in the lobster fishery during calendar year 2005. The percentage of participants differed across LCMAs, with 89% of individuals in LCMA 1 reporting some level of fishing activity while 65% and 69% of individuals reported activity in LCMA 2 and LCMA 3, respectively. These survey-based participation rates are much higher than that estimated from trap tag data. However, the trap tag estimates were for federal permit holders only. The survey included all permit holders. If inshore participation were much higher than that of federal permit holders then the estimated participation rate would also be higher since federal permit holders represent less than a third of the survey population.

Survey participants were divided into three categories: individuals that did not fish lobster at all during calendar year 2005; individuals that did fish but less than 1000 lb; and individuals that landed 1000 lb or more. Approximately 72% (±3.6%) of all lobster businesses landed at least 1000 lb of lobster, while 13% (± 2.9%) of lobster businesses did not engage in

lobster fishing during calendar 2005. Of the individuals that did not fish lobster, at all 28% were inactive due to an illness, 13% were engaged in an alternative job or career, 14% were working for another lobsterman or in another fishery, 9% just wanted to maintain a license but did not fish, and 7% could not earn enough money to cover expenses.

The majority of individuals (65%) that did not fish also had not landed more than 1000 lb of lobster in any year from calendar year 2000 to 2004. Among individuals that did fish lobster during 2005 but did not land more than 1000 lb, 71% also had not landed more than 1000 lb of lobster in any prior year since at least calendar year 2000. These results indicate that more than one-quarter of license holders had not been active at all or had participated in the lobster trap fishery at low levels for at least the previous 5 years.

On average, individuals that landed more than 1000 lb of lobster had been involved in the lobster fishery for 31 years, and had held a lobster license for 28 years (Table 10). A statistically significant difference was found between these license holders and license holders that fished in 2005 but landed less than 1000 lb. Specifically, on average, license holders that landed more than 1000 lb had more experience and had held a license for longer than less active license holders. However, no such significant differences were found between more active license holders and license holders that did not fish at all during calendar year 2005. All confidence intervals (denoted as +/- in Table 10) were calculated as a 95% confidence interval, and the confidence intervals for inactive and license holders that landed less than 1000 lb are larger than those of individuals that landed more than 1000 lb due to much lower sample sizes.

On average, license holders that landed at least 1000 lb were younger (50 ± 1 year) than inactive license holders. However, no significant difference was found between the average age of these license holders and those that landed less than 1000 lb. There was also no significant difference between license holders landing less than 1000 lb and inactive license holders.

The proportion of license holders that were married ranged from 62–75% depending on 2005 fishing activity status, although no statistically significant differences were found between license holders that did not fish and license holders that did. Similarly, no differences were found with respect to average household size (2.6–2.9) or the proportion of households with

Table 10. Characteristics of license holders by activity status for calendar year 2005

	Inactive License Holders		License Holders that Landed Less than 1,000 lbs.		License Holders that Landed At Least 1,000 lbs.	
	Estimate	**+/-**	**Estimate**	**+/-**	**Estimate**	**+/-**
Years Involved in Lobster	28	3.3	24	3.8	31	1.2
Years holding a license	23	3.2	20	3.3	28	1.2
Average Age	55	3.3	52	4.4	50	1.1
Proportion Married	70%	12%	62%	12%	75%	3%
Average Household Size	2.6	0.3	2.9	2.4	2.7	0.1
Proportion of Households with Children	31%	12%	36%	12%	34%	4%
Proportion with Children Plan to Lobster	28%	13%	38%	13%	51%	5%
Proportion Without High School	13%	6%	28%	13%	17%	3%
Proportion High School Graduates	47%	13%	24%	8%	46%	4%
Proportion with Vocational Training	20%	8%	18%	11%	21%	3%
Proportion College Graduates	19%	10%	30%	10%	15%	3%

children age 17 or younger (31–36%). Among license holders with children, a significantly higher proportion of license holders that landed more than 1,000 lb (51%; ±5%) indicated that one or more of their children planned to be involved in the lobster fishery compared to inactive license holders (28%; ±13%).

In terms of educational background there were no statistically significant differences in the proportion of license holders that had not completed high school (13–28%) or that had completed or attended a vocational school (18–21%) between license holders that did not fish in 2005 and license holders that did fish. The proportion of high school graduates was lower (24%) for license holders that landed less than 1000 lb but was counterbalanced with the highest estimated proportion of college graduates (30%). Note that the proportion of college graduates was found to be statistically significant from that of license holders that landed more than 1000 lb (15%) but was not found to differ from that of license holders that did not fish (19%).

Since the primary focus of the baseline survey was on the so-called active lobstermen (landed at least 1000 lb in 2005) the remainder of this discussion will be on these permit holders. As noted previously, the baseline survey collected information on the financial aspects of active lobster businesses in addition to other characteristics of the license holder. The financial aspects of the lobster businesses are discussed in a subsequent section. This section provides summary statistics on license holder characteristics as well as vessel and trap management strategies. For purposes of analysis, active lobstermen were divided into three categories to reflect potential differences between individuals that may fish lobster full-time (defined herein as fishing in at least three consecutive quarters of calendar year 2005) and license holders that may fish seasonally. A seasonal license holder was defined as anyone that fished in only two consecutive quarters where two types of seasonal participants were identified; a summer seasonal participant (fished during quarters 2 and 3); and a fall/winter seasonal participant (fished during quarters 1 and 4). Wherever possible these data were also summarized by LCMA.

Specialized Training and Alternative Occupations

About 60% of active LCMA 1 full-time and seasonal participants reported having some type of specialized training or skill. About half of all full-time LCMA 2 and LCMA 3 participants had some type of specialized training, while 78% of part-time LCMA 2 participants had received specialized training. Note that even though the magnitude of these point estimates differed they were not found to be statistically significant.

When asked about what type of job or skills for which respondents had received training, 42% mentioned some type of trade such as carpentry or mechanic while 22% mentioned some form of commercial fishing, merchant marines, or boat building and repair (Table 11). Although 42% of active license holders had some training in the construction and building trades, only 33% of respondents indicated that they would be likely to take a job in the construction industry if they were unable to continue lobstering. By contrast, 31% of active license holders said that they would remain in some type of marine-related industry even though fewer respondents had actually received any specialized training. In general, the percentage of respondents that indicated that they would take a job and had received training for that type of job was approximately the same only for running a business and as a truck driver or equipment operator. These findings indicate that past skill or job training in a particular field is not necessarily a good predictor of what jobs lobster industry participants may prefer to take if they were unable to continue fishing for lobster.

Involvement in the Lobster Fishery and Lobster Business Characteristics

On average, active license holders have been involved with the lobster fishery for between 26 and 31 years (Table 12). While average years of involvement for full-time operators tended to be higher than for seasonal participants, these differences were not found to be statistically significant. Similarly, the average number of years differed across LCMA and participation status but none of these differences were found to be significant.

In LCMA 3, vessels were larger than in either LCMA 1 or LCMA 2, averaging 55' with a main engine horsepower of 469 (Table 12). Full-time LCMA 1 vessels were larger (i.e., statistically significant) than seasonal LCMA 1 participants, averaging 33' with an average horsepower or 238. Similarly, vessel size for full-time LCMA 2 participants was found to be statistically different from that of seasonal LCMA 2 participants. The average age of vessels ranged from 16 to 22 years, although the only significant difference was between full-time LCMA 1 participants and full-time LCMA 2 participants.

Table 11. Summary of specialized skill or job training and likely occupational alternative to lobstering

	Skill or Job Training		**Other Occupation**	
	Mean	**+/-**	**Mean**	**+/-**
Carpentry/Trades/Mechanic	42%	4.9%	33%	4.0%
Other Marine Related	22%	4.1%	31%	3.8%
Other Business	11%	3.3%	10%	2.5%
Education	6%	2.6%	3%	1.3%
Other	6%	2.2%	13%	2.9%
Police/Fire/EMT/Military	6%	2.4%	2%	1.1%
Truck Driver/Equipment Operator	5%	2.2%	4%	1.8%
Engineering	2%	1.3%	*1%*	1.2%
Retired			3%	1.4%

Italicized text denotes confidence interval includes zero

Table 12. Summary of lobster business characteristics and involvement in the lobster fishery

	LCMA 1				**LCMA 2**				**LCMA 3**	
	Full-time		**Seasonal**		**Full-time**		**Seasonal**		**Full-time**	
	Mean	+/-	Mean	+/-	Mean	+/-	Mean	+/-	Mean	+/-
Years in Lobstering	31	1	31	3	27	3	26	5	30	5
Years with a License	29	1	28	3	25	3	24	6	26	6
Average Vessel Length	**33**	1.4	29	2.4	**36**	2.7	29	3.4	**55**	9.1
Average Vessel Horsepower	**283**	14.0	204	19.5	**293**	44.9	207	40.9	**469**	113.0
Average Vessel Age	**16**	1.1	18	2.0	20	2.6	22	4.7	17	4.5
Owner-Operator	25%	4%	**42%**	8%	48%	13%	**75%**	20%		
One Sternman	**68%**	4%	54%	8%	45%	12%	25%	20%	34%	22%
Two or More Sternmen/Crew	7%	2%	4%	3%	7%	6%			**66%**	22%
Distance From Residence to Mooring	**4.6**	0.6	6.6	2.3	7.5	1.8	6.8	4.6	7.8	4.6
Land Catch at Mooring Location	86%	3%	79%	7%	88%	7%	78%	22%	82%	19%

Bolded text denotes statistically significant difference

In LCMA 1, one quarter of all active license holders operated without a sternman while 42% of seasonal participants operated without a sternman; a statistically significant difference. Similarly, the difference between the percentage of active seasonal license holders in LCMA 2 that did not hire a sternman (75%) and full-time participants (48%) was statistically significant. Sixty-eight percent of full-time operators in LCMA 1 hired one sternman. This percentage was statistically significant compared to both seasonal LCMA 1 participants (54%) and full-time LCMA 2 participants (45%). Very few active license holders in LCMA 1 or LCMA 2 hired more than one sternman, but two thirds of LCMA 3 license holders hired at least two sternmen or crew.

On average, full-time LCMA 1 participants had to travel 4.6 miles to the place where their boat is moored. This distance was found to be statistically different from that of full-time operators in LCMA 2 (7.5 miles) but was not different from any other category based on either LCMA or participation status. The majority (78–88%) of active license holders landed and sold their catch in the same harbor or port where their boat was moored. This finding indicates a high degree of fidelity to a single point of sale and suggests that impacts of changes in the lobster fishery would be highly localized.

Table 13. Summary of quarterly trap management by area and participation status

	LCMA 1				**LCMA 2**				**LCMA 3**	
	Full-time		**Seasonal**		**Full-time**		**Seasonal**		**Full-time**	
Quarterly Trap Management	**Mean**	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**
Quarter 1 (Jan – Mar)										
Maximum Traps	442	31			374	80			**1,041**	294
Average Trips per Week	1.7	0.1			1.8	0.3			2.0	0.6
Average Traps Hauls per Trip	234	15			200	36			**939**	345
Total Landed Pounds	2,893	546			1,900	861			5,618	2,937
Quarter 2 (Apr – Jun)										
Maximum Traps	**492**	21	280	98	**443**	66	152	43	**1,058**	224
Average Trips per Week	3.4	0.1	3.4	0.7	3.0	0.3	2.1	0.7	2.5	0.9
Average Traps Hauls per Trip	**215**	8	150	35	**186**	25	114	34	**888**	280
Total Landed Pounds	**3,954**	438	2,695	1,611	2,372	507	1,268	1,268	**12,411**	5,172
Quarter 3 (Jul – Sep)										
Maximum Traps	**613**	20	407	34	**502**	67	273	107	**1070**	201
Average Trips per Week	**4.7**	0.1	**4.0**	0.2	**4.2**	0.4	2.6	0.7	3.1	0.9
Average Traps Hauls per Trip	**235**	8	189	14	204	27	151	49	**887**	282
Total Landed Pounds	**11,418**	3,471	11,000	9,178	5,912	1,515	3,040	1,993	**27,275**	9,852
Quarter 4 (Oct – Dec)										
Maximum Traps	**598**	21	395	37	447	70	463	259	**1,035**	223
Average Trips per Week	**4.0**	0.1	**3.3**	0.3	2.6	0.3	3.3	1.1	2.4	0.8
Average Traps Hauls per Trip	**231**	8	196	14	188	28	151	93	**849**	279
Total Landed Pounds	**13,237**	3,536	**5,609**	1,350	3,342	1,113	1,164	1,138	**29,497**	11,720

Bolded text denotes statistically significant difference.

Quarterly Trap Management

Across all quarters the average active license holder in LCMA 3 fished more traps and hauled more trips on a typical trip than active participants in LCMA 1 or LCMA 2 (Table 13). The maximum number of traps in the water for active LCMA 3 participants average just over 1000 traps. Additionally, the number of traps hauled during a typical trip did not vary much, ranging from a high of 939 trap hauls in the first quarter 1 to 849 hauls in the fourth quarter.

Overall, several generalizations emerge from the estimates of quarterly activity. Although not statistically significant in all cases, fishing activity by LCMA 1 full-time vessels tended to be higher than seasonal vessels in LCMA 1 or LCMA 2 and was higher than full-time LCMA 2 vessels. Fishing activity by full-time vessels tended to be higher than that of seasonal vessels, and activity levels for seasonal LCMA 1 vessels tended to be higher than that of seasonal vessels in LCMA 2. For full-time vessels, the number of traps and the number of trips tended to follow a seasonal pattern that increased in the second and third quarters then decreased in the fourth quarter. However, the number of trap hauls on a typical trip did not change very much from quarter to quarter. These data indicate that full-time lobstermen tend to operate by keeping the number of trap hauled on a given trip about the same while making strategic adjustments to the number of traps fished and number of trips.

Lobster Business Investments

The majority of active license holders had made some type of investment in their lobster business ranging from a low of 63% of seasonal participants in LCMA 2 to a high of 96% of LCMA 3 participants (Table 14). Of the active license holders that had made an investment, half of LCMA 3 participants and about one third of full-time operators in LCMA 1 and LCMA 2 had

Table 14. Summary of investment status by LCMA and participation status

	LCMA 1				**LCMA 2**				**LCMA 3**	
	Full-time		**Seasonal**		**Full-time**		**Seasonal**		**Full-time**	
	Mean	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**
Percent With Business Investments	83%	3%	75%	7%	70%	11%	63%	24%	**96%**	7%
Percent Making Investments due to Regulation	32%	5%	23%	8%	39%	16%	*9%*	16%	49%	24%
Mean Percent Investment Due to Regulation	18%	5%	11%	9%	**43%**	22%	*9%*	9%	*25%*	30%
Invest More in Calendar Year 2006	36%	4%	33%	8%	28%	11%	40%	26%	20%	18%
Invest Less in Calendar Year 2006	17%	3%	19%	7%	19%	11%	*9%*	13%	20%	17%
Invest the Same	47%	5%	47%	8%	53%	13%	51%	26%	60%	22%
Percent with Adequate Source of Financing	**86%**	3%	**75%**	7%	54%	14%	78%	23%	73%	20%
Percent that Have Outstanding Loans	**52%**	5%	33%	7%	17%	9%	*4%*	9%	**59%**	22%

Bolded text denotes statistically significant difference.
Italicized text denotes confidence interval includes zero.

done so to comply with either a state or federal regulation. A smaller percentage of seasonal LCMA 2 (9%) and LCMA 1 (23%) participants had made a business investment due to regulation. When asked about planned investments for calendar year 2006 the majority of active participants indicated that they would invest about the same amount in their business as they had in calendar year 2005.

With the exception of full-time LCMA 2 participants, at least 73% of active license holders felt that they had adequate sources for funding planned investments. The percentage of participants that currently had an outstanding business loan ranged from a high of 59% of LCMA 3 participants to a low of 4% of seasonal LCMA 2 participants. In general, the percentage of LCMA 2 participants with a current business loan was lower than in either LCMA 1 or LCMA 3.

The average loan amount was $55,097 for active for LCMA 1 license holders that had an outstanding loan (Table 15). More than two thirds of these loans were obtained to finance the purchase of a new boat or major overhaul of an existing boat. Fifteen percent of LCMA 1 participants had loans to pay for a new or rebuilt engine while 22% had taken a loan to purchase new gear or equipment. Note that some individuals had taken out loans for more than one purpose so the percentages in Table 15 do not sum to one. The average loan amount for LCMA 2 participants was $20,015; less than half that of LCMA 1 participants. Almost half of these participants had used the loan to finance the purchase of a truck or other vehicle while 44% of active LCMA 2 individuals had financed the purchase of a new boat or engine. Given the different scale of operation involved, the average outstanding loan for active LCMA 3 participants was $145,757. In all of these cases the purpose of taking out a loan was to finance the purchase of a new boat or overhaul of an existing one.

Business loans may be financed in a variety of ways and individuals may use more than one financial instrument. The most common source to finance a business loan was through personal savings. Fifty-seven percent of LCMA 1 participants had used personal savings to finance a loan, while 46% and 42% of LCMA 2 and 3 participants relied on personal savings to fund business investments (Table 16). At least 15% of all active participants with an outstanding loan had used a home equity loan, and at least 18% had use a personal credit card as a means of finance. This means that a substantial number of individuals had linked business investments to their home and/or personal or household income and savings.

Table 15. Summary of average current loan amount of purpose by LCMA

	LCMA 1		**LCMA 2**		**LCMA 3**	
	Mean	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**
Average Amount Owed on Business Loans ($)	**55,097**	7,510	20,015	14,017	**145,757**	99,760
New Boat	66%	6%	30%	2%	90%	19%
New/Rebuilt Engine	15%	4%	*14%*	19%	*10%*	19%
Gear/Equipment	22%	5%	19%	*22%*		
Truck/Vehicle	12%	3%	49%	30%		
Boat Repair/Overhaul	6%	3%			*20%*	22%

Bolded text denotes statistically significant difference.
Italicized text denotes confidence interval includes zero.

Table 16. Summary of sources of financing for current business loans by LCMA						
	LCMA 1		**LCMA 2**		**LCMA 3**	
	Mean	**+/-**	**Mean**	**+/-**	**Mean**	**+/-**
Personal Savings	57%	4%	46%	11%	42%	22%
Home Equity Loan	15%	3%	16%	8%	25%	19%
Personal Credit Card	19%	3%	18%	8%	23%	20%
Business Credit Cards	11%	2%	26%	16%	11%	15%
Business Line of Credit	16%	3%	13%	7%	17%	18%
Business Income	6%	2%	6%	5%	9%	13%
Cash	2%	1%				
Whatever Possible	*0.1%*	0.2%				
Other	14%	3%	18%	9%	19%	17%
Italicized text denotes confidence interval includes zero.						

Importance of Lobster Business, Alternative Income Sources, and Household Income

Less than half of all active LCMA 1 participants held either a state or federal permit for species other than lobster (Table 17). By contrast, the majority of LCMA 2 and 3 license holders had at least one other permit besides their lobster license. For LCMAs 1 and 3, less than 20% of individuals that were eligible to fish for something other than lobster actually reported having done so. The opposite was the case in LCMA 2; that is, a substantial majority of active full-time and seasonal LCMA 2 license holders that held a permit to fish in another fishery reported income from fishing activities in addition to lobster.

Average household income ($101,327) was statistically significantly higher for LCMA 3 participants compared to either LCMA 1 or LCMA 2 participants. No statistically significant differences in household income were found between active license holders in either LCMA 1 or LCMA 2.

About two thirds of household income for full-time LCMA 1 license holders and just over three quarters of household income in LCMA 3 came from lobster. These values were statistically significant compared to seasonal participants in LCMA 1 and to both full-time and seasonal participants in LCMA 2. The contribution of lobster to household income was approximately the same (44% and 42% respectively) for seasonal LCMA 1 and full-time LCMA 2 participants. The average contribution of lobster income to household income was lowest (21%) for seasonal LCMA 2 participants. Reflecting the relatively low rate at which other fishing permits were actually used, the contribution to household income from other fishing activity averaged no more than 5% for all LCMA 1 and 3 participants. Among LCMA 2 participants, income from other fish accounted for about 20% of household income.

Compared to LCMA 3 and full-time LCMA 1 and 2 participants, the average contribution of non-fishing income to household income was at least twice as large for seasonal participants (at least two thirds). Similarly, the contribution from other family members tended to be higher for seasonal compared to full-time participants, although these differences were not statistically significant.

Table 17. Summary of calendar year 2005 household income and sources of household income by LCMA and participation status

	LCMA 1				LCMA 2				LCMA 3	
	Full-time		Seasonal		Full-time		Seasonal		Full-time	
	Mean	+/-	Mean	+/-	Mean	+/-	Mean	+/-	Mean	+/-
Other Fishing Permits	42%	4.5%	33%	7.6%	**78%**	10.3%	**94%**	11.0%	59%	25.1%
Income from Other Fishing	15%	3.2%	15%	5.5%	**61%**	12.0%	**79%**	21.3%	17%	15.9%
Total Household Income ($)	71,540	4,264	61,017	8,144	75,519	13,294	54,293	12,040	**101,327**	34,051
Percent of Income from Lobster	**67%**	3%	**44%**	6%	**42%**	8%	21%	12%	**76%**	17%
Percent of Income from Other Fish	2%	1%	4%	2%	**22%**	8%	19%	12%	*5%*	13%
Percent of Income from Non-Fishing	15%	2%	**33%**	6%	17%	7%	**35%**	18%	*7%*	15%
Percent of Income from Other Member	16%	2%	19%	4%	20%	6%	25%	14%	11%	9%

Bolded text denotes statistically significant difference.
Italicized text denotes confidence interval includes zero.

Economic Condition of the Lobster Fishery

Financial data are not part of any systematic data collection program either among different states or at the federal level. There have been a small number of special studies that have attempted to measure the level of investment and financial performance of lobster fishing businesses; these studies include some limited information provided in NFMB (1978), a survey of lobster businesses in Massachusetts and Rhode Island conducted by the Atlantic Offshore Fishermen's Association (Liebzeit and Allen 1989), a set of focus group interviews conducted in 1995 (University of Rhode Island [URI], Department of Environmental and Natural Resource Economics 1995), and more recently a telephone survey of lobster businesses from Maine to Rhode Island (Market Decisions 2006). As each of these studies was conducted using different methods, covered different components of the lobster fishery, and did not collect the same financial data, it is difficult to use the studies to construct a reliable indicator of how profitability in the lobster fishery may have changed over time. The following provides a summary of the findings of each study, and where possible compares financial performance over time.

NFMB (1978)

Investment in capital equipment including vessels, gear, and fishing-related items was estimated to be $168 million in 1976 for the inshore and offshore fishery combined, and another $13 million in capital investment in the offshore mobile gear fishery (NFMB 1978). Average gross return per vessel was estimated to $4122 for the inshore trap fishery, $62,522 per vessel for

Table 18. Average trap vessel costs and net profit as a percentage of gross stock (Source: NFMB 1978, Table 12)

	Cost as a Percentage of Gross Stock	
Cost Category	**Total**	**Sub-Total**
Materials and Supplies	23.99	
Fuel		7.33
Bait		11.82
Other		4.84
Purchased Services	9.9	
Insurance		0.48
Maintenance		5.99
Other		3.43
Value Added	66.11	
Payroll		43.01
Capital Costs		
Interest		5.75
Depreciation		4.71
Other		0.69
Net Profit		11.95

the offshore trap fishery, and $56,025 per vessel in the offshore trawl fishery. No information was provided for cost breakdowns for either otter trawl or offshore trap businesses. Reported cost breakdowns as a percentage of gross stock for a typical or representative inshore fishing business were noted (Table 18); however, the data upon which these estimates were based is uncertain. According to these estimates, the average inshore lobster trap business spent 24% of gross stock on material and supplies including fuel, bait, and miscellaneous other expenses. Ten percent of gross stock was allocated to insurance, maintenance, and other services, leaving about 66% for payroll and capital costs. The residual of value added after accounting for payroll, interest expense, and depreciation was estimated to be a net profit of about 12%. According to the NFMB (1978), most inshore businesses were owner-operated and tend to undervalue the owner's opportunity cost; that is, return to owner operator labor was below the prevailing wage, meaning that economic returns were negative even though net return was positive strictly from an accounting perspective.

Liebzeit and Allen (1989)

Data on fishery participant characteristics, level of capital investment, and cost and earnings were collected from a sample of Rhode Island and Massachusetts inshore and offshore lobster businesses. The survey was administered by telephone during calendar year 1988. The purpose of the survey was to identify differences in operational aspects as well as financial differences between the limited access Massachusetts fishery and the open access Rhode Island fishery.

The study did find that the open access fishery in Rhode Island tended to have owners with fewer years in the lobster business and that levels of equity were lower than those of Massachusetts lobstermen. This difference in owner equity was attributed to higher levels of borrowing among Rhode Island businesses to finance the purchase of new vessels and equipment or for expansion, compared to Massachusetts lobstermen that used higher levels of personal resources to finance capital investment.

Table 19. Median cost and returns for commercial inshore lobster businesses in Massachusetts and Rhode Island by vessel size class (Source: Liebzeit and Allen 1989)

	20'-29'		30'-40'		41'-50'	
	MA	**RI**	**MA**	**RI**	**MA**	**RI**
Returns	8,162	5,000	45,000	32,000	102,525	92,500
Variable Costs ($)	2,906	2,600	13,500	12,000	41,000	38,800
Variable Costs % of Gross	36%	52%	30%	38%	40%	42%
Fixed Costs ($)	2,223	1,323	7,149	7,550	20,000	27,550
Fixed Costs % of Gross	27%	26%	16%	24%	20%	30%
Total Costs ($)	5,129	3,923	20,649	19,550	61,000	66,350
Net Return ($)	3,033	1,077	24,351	12,450	41,525	26,150
Net Return % of Gross	37%	22%	54%	39%	41%	28%
Opportunity Cost of Capital ($)	1,238	522	2,508	2,007	5,687	3,345
Opportunity Cost of Labor ($)	6,730	3,963	17,500	8,256	23,000	16,252
Economic Profit ($)	-3,697	-2,886	6,851	4,194	18,525	9,898
Economic Profit % of Gross	-45%	-58%	15%	13%	18%	11%

In addition to capital investment, Liebzeit and Allen collected data on operating and fixed costs, where operating costs included fuel, bait, crew wages, repairs, gear, and other miscellaneous expenses. Fixed costs included insurance, license fees, property taxes, depreciation, and dockage fees. Note that the NFMB identified many of the same expense items, but Liebzeit and Allen only reported total variable and fixed costs so it is not possible to compare their results with that reported by the NFMB in 1978.

Based on the data collected by Liebzeit and Allen, net return was positive for all vessel size classes ranging from a low of 28% of gross revenue to a high of 54% of gross (Table 19). Note that although data were collected for vessels 19' and below, these data are not reported herein because the sample size for vessels in this size class was limited to only one observation for both Massachusetts and Rhode Island. While net returns above variable and fixed costs were all positive, they do not account for the opportunity cost of capital or the opportunity cost of the owner's labor. These opportunity costs provide a measure of whether capital would be better used in an alternative investment and whether the vessel owner would be better off financially in an alternative occupation. Liebzeit and Allen calculated opportunity cost of capital by multiplying the market interest rate for 1988 by the reported capital investment by each vessel owner; the opportunity cost of labor was based on the survey respondent's self-assessment of what could be earned in an alternative occupation. After taking these economic costs into account, net returns to vessels in the 20–29' size range were negative, while economic profit to vessels in larger size classes was positive, ranging from a return of 11–18% of gross revenue.

Department of Environmental and Natural Resource Economics, URI (1995)

Researchers from the Department of Environmental and Natural Resource Economics at URI conducted a series of focus group style interviews with lobstermen from a series of ports ranging from Maine to Long Island. In each case, questions were asked regarding typical lobster businesses including vessel characteristics, initial investment/replacement costs, operating costs, fixed expenses, and seasonal characteristics of trap management. These data were collected as part of a larger project to build a computer simulation model of the lobster fishery. A focus group approach was adopted because it was considered more cost-effective than a formal statistically-based survey. The researchers also reasoned that the focus group approach would

yield more reliable and complete information, since participants would be speaking to what they believed to be average or representative for their port rather than revealing personal financial information about their own business. For this reason, the data cannot be used to create financial profiles of lobster fishing businesses of different sizes because individual financial information was not collected; rather, data were representative of all lobster businesses in the focus group participant's port. Note that this also means that the information collected cannot be readily extrapolated beyond the ports where focus groups were held. Further, it is likely that much of the data are representative of full-time operators since the focus group participants themselves were likely to be full-time operators.

The survey was conducted during calendar year 1993 in a total of 29 ports representing a total of 2704 operating units. These ports were further broken down into regional aggregations comprising a northern inshore, a southern inshore, and an offshore fleet.

The northern inshore fleet included 14 different ports (2209 vessels) from downeast Maine to Gloucester, Massachusetts. Estimated initial investment for this fleet averaged $184 thousand per vessel including boat, engines, traps and related gear, electronics, safety equipment, vehicles, and shorefront property. Total initial investment for the northern inshore fleet was estimated to be $406.7 million.

The southern inshore fleet consisted of 412 vessels from 10 different ports from Boston, Massachusetts to Long Island, New York. Initial investment for this fleet was estimated to be $166 thousand per vessel, amounting to $68 million for the fleet as a whole. The focus group surveys for the offshore fleet were conducted in 5 different locations representing a total of 84 operating units. Due to a much larger scale of operation, average initial investment for the offshore fleet was $671 thousand, or $56 million for the offshore fleet as a whole.

The combined initial investment for vessels represented in the URI focus groups was $531.4 million for 1993. Note that this estimate of total investment is limited to the 2209 vessels from the ports where focus groups were conducted. As such, the investment value or replacement cost for the lobster fishing fleet as it existed in 1993 would be considerably higher. How much higher is uncertain since the population of lobster fishing businesses comprises a mix of full-time, part-time, and occasional operators. As noted previously, the survey methods were likely to result in estimates of financial performance for predominately full-time operators. This means that applying the estimated average investment value from the survey to the population of operating units would likely overestimate the value of invested capital in the lobster trap fishery as a whole.

The caveats regarding extrapolation of the focus group estimates of capital investment to businesses that do not operate on a full-time basis also apply to estimated cost and returns. Operating costs, including repair and maintenance of boat and gear, supplies, fuel, bait, vehicles, and payments to a sternman, were estimated to be about $38 thousand or 34% of gross stock for the northern inshore fleet (Table 20).

Operating costs for the southern inshore fleet were estimated to be about $18 thousand higher than the northern inshore fleet, but since estimated gross stock was also higher, operating costs, as a percentage of gross, were similar (32%). By contrast, operating costs were estimated to be 71% of gross for the offshore fleet due primarily to much larger payments for fuel, bait, and crew.

Table 20. Estimated cost and returns to commercial lobster fishing businesses by region for calendar year 1993 (Source: Department of Environmental and Natural Resource Economics, URI, 1995)

	Northern Inshore	Southern Inshore	Offshore
Gross Stock	**110,510**	**174,006**	**480,260**
Operating Costs	**38,080**	**56,260**	**339,593**
Boat Repair and Maintenance	3,225	4,344	30,000
Supplies	1,308	3,763	6,000
Food	146	389	18,000
Gear Maintenance	3,962	4,133	21,333
Fuel and Lubricants	3,411	6,133	35,000
Bait	8,482	11,389	70,260
Vehicles	2,296	3,250	9,000
Sternman Payment	15,250	22,858	150,000
Operating Cost as % Gross	34%	32%	71%
Fixed Costs	**18,323**	**52,009**	**72,800**
Permits	202	336	533
Moorage	940	2,363	3,333
Interest on Operating Loan	1,933	8,860	500
Interest on Long Term Loan	5,088	24,167	13,500
Insurance for Boat	1,607	2,238	16,667
Insurance for Sternman	738	633	19,500
Property Taxes	832	175	433
Gear Loss	5,550	7,571	18,333
Shorefront Property	1,433	5,667	0
Fixed Cost % of Gross	17%	30%	15%
Total Cost	**56,403**	**108,269**	**412,393**
Net Revenue	**54,107**	**65,737**	**67,867**
Net Revenue % of Gross	49%	38%	14%
Opportunity Cost of Labor	**22,202**	**25,468**	**23,636**
Net Return to Capital and Profit	**31,905**	**40,269**	**44,231**
Net Return to Capital and Profit % of Gross	29%	23%	9%

Fixed costs included permits, moorage, interest payments on short- and long-term loans, insurance for the boat and crew, property taxes, gear loss, and shorefront property. These costs were 17% of gross stock for the northern inshore fleet, 30% of gross for the southern inshore fleet, and 15% of gross for the offshore fleet. Net return was estimated to be 49%, 38%, and 14% of gross stock for the northern inshore, southern inshore, and offshore fleets, respectively.

The focus group survey did not collect information on potential income from alternative occupations, so the average per capita income for 1993 in states encompassing each region was used as a proxy for the opportunity cost of labor. Based on these values, the net return to invested capital and owner profit was estimated to be 29%, 23%, and 9% for the northern inshore, southern inshore, and offshore fleets, respectively. This means that, on average, vessel owners in each fleet segment were earning at least as much as the average income for the regional population as a whole; however, at least for the offshore fleet, the estimated residual return to capital and owner profit may not be considered sufficient to cover the opportunity cost of capital. This means that offshore vessels in 1993 may have been operating at an economic loss even though net returns were positive from an accounting perspective.

Market Decisions (2006)

As noted previously, researchers at the GMRI designed a survey of state and federal commercial lobster license holders that was administered during calendar year 2006. In addition to demographic information, some data were collected on fixed and variable costs.

Collection of operating cost data was limited to fuel, bait, and sternman payments. Fixed cost data were limited to total insurance and principal and interest payments. These costs were collected because they comprise the majority of operating and fixed cost expense for most lobster businesses. Fortunately, respondents were also asked to report total net return for calendar year 2005, so it was still possible to ascertain average net return although neither total operating nor total fixed costs could be estimated.

All offshore vessels reported hiring crew during calendar year 2005, but not all vessels in LCMAs 1 and 2 reported hiring a sternman for the year. Therefore, separate estimates of cost and earnings were developed for full-time and part-time vessels that did and did not hire a sternman. In LCMA 1, average gross revenue during calendar year 2005 for vessels operating with a sternman was approximately twice that of vessels operating without one, as were operating costs (Table 21). As a percentage of gross revenue, net return for full-time vessels with a sternman was nearly identical to that of full-time vessels without a sternman, even though the nominal value of net return was more than twice as high ($35,267 compared to $15,418). Net return to vessels operating during the fall/winter season that hired a sternman averaged $20,172 (37% of gross revenue) compared to $7535 (29% of gross) for fall/winter vessels that did not hire a sternman. Unlike other LCMA 1 lobster businesses, there was only a modest difference in net return for vessels that operated during the summer season between vessels that did ($12,288) and those that did not hire a sternman ($9244).

Although the survey did collect information on alternative occupations if any given individual was not fishing lobster, data on the expected remuneration from these alternatives

Table 21. Estimated average cost and earnings for full-time and seasonal lobster businesses in LCMA 1 for calendar year 2005

	Full-time		Fall/Winter Season		Summer Season	
	No Sternman	Sternman	No Sternman	Sternman	No Sternman	Sternman
Gross Revenue	48,104	107,099	26,053	55,256	29,751	51,901
Sternman Payment	NA	22,105	NA	9,217	NA	5,187
Sternman Payment % of Gross	NA	21%	NA	17%	NA	10%
Fuel Cost	4,852	9,512	3,636	5,274	2,450	11,120
Bait Cost	7,488	15,531	4,013	7,758	3,500	13,267
Fuel & Bait % of Gross	26%	23%	29%	24%	20%	47%
Insurance P&I	1,196	2,519	472	1,902	1,148	392
Net Return	15,418	35,267	7,535	20,172	9,244	12,288
Net Return % of Gross	32%	33%	29%	37%	31%	24%
Opportunity Cost of Labor	32,649	32,649	16,325	16,325	16,325	16,325
Economic Return to Capital and Owner Profit	-17,231	2,618	-8,789	3,847	-7,081	-4,037
Economic Return % of Gross	-36%	2%	-34%	7%	-24%	-8%
Proportion of Businesses with Positive Economic Return to Capital	8%	36%	11%	35%	20%	17%

was not collected. A proxy estimate of the opportunity cost of labor was estimated by computing the weighted average of the calendar year 2005 per capita income by state (http://www.bea.gov/bea/regional/spi) where the weight was based on the proportion of license holders in each state in the sample data. For both fall/winter and summer season businesses, this estimate was multiplied by 50% to reflect the 6-month period of activity for these individuals.

After accounting for the opportunity cost of labor, only full-time vessels and fall/winter seasonal operators that hired a sternman were found to be earning at least as much as the weighted average per capita income for the general population in LCMA 1. Note that this finding is based on average costs and returns for full- and part-time businesses. For example, while the average economic return to owner labor was negative for full-time operators that did not hire a sternman, 8% of these businesses earned more than the regional average personal income. Of course, this also means economic returns to owner labor were negative for 92% of full-time operators without a sternman. By contrast, net earnings in 2005 were above the regional average per capita personal income for 36% of full-time LCMA 1 lobstermen. While some portion of LCMA 1 lobster businesses were able to cover owner's opportunity cost, the residual return to capital was generally low. This means that taking the opportunity cost of capital into account, on average, lobster businesses in LCMA 1 were operating at an economic loss during calendar year 2005; that is, even though the average LCMA 1 vessel earned positive net return after all expenses were paid, earnings from the lobster business were below average earnings for the general population and return on invested capital was less than what could have been earned in an alternative investment.

Gross revenue for full-time lobster businesses in LCMA 2 averaged $44,524 for vessels that did not carry a sternman and $112,206 for vessels that did (Table 22). As was the case for LCMA 1, full-time net return as a percentage of gross revenue was virtually identical whether a sternman was hired or not, although nominal net return to lobster businesses that hired a sternman was more double that of full-time operators that did not hire a sternman. After

Table 22. Estimated average cost and earnings for full-time and seasonal lobster businesses in LCMA 2 for calendar year 2005

	Full-time		Fall/Winter Season	Summer Season
	No Sternman	**Sternman**	**No Sternman**	**No Sternman**
Gross Revenue	44,524	112,206	38,562	21,627
Sternman Payment	NA	18,666	NA	NA
Sternman Payment % of Gross		17%		
Fuel Cost	5,031	10,620	3,966	2,025
Bait Cost	5,267	12,765	3,701	685
Fuel & Bait % of Gross	23%	21%	20%	13%
Insurance P&I	2,067	3,071	1,750	956
Net Return	14,074	35,979	11,485	7,556
Net Return % of Gross	32%	32%	30%	35%
Opportunity Cost of Labor	36,048	36,048	18,024	18,024
Economic Return to Capital and Owner Profit	-21,974	-69	-6,539	-10,469
Economic Return % of Gross	-49%	0%	-17%	-48%
Proportion of Businesses with Positive Economic Return to Capital	4%	25%	13%	10%

accounting for the opportunity cost of labor, full-time operators were earning less than the average income for the regional population as a whole, indicating below-zero economic profit even before accounting for the opportunity cost of invested capital. Note that this was the case for all but 4% of LCMA 2 full-time lobster businesses that did not hire a sternman and 25% of full-time businesses that did.

Due to low sample size, a reliable estimate of profitability for seasonal lobster businesses that hired a sternman could not be calculated. Gross revenue for LCMA 2 lobster businesses operating during the calendar year 2005 fall/winter season averaged about $17,000 more than operators that fished during the summer. Expenses for fuel, bait, and insurance were higher for the fall/winter participants, but the difference in gross revenue more than offset these higher costs as net return was $11,485, compared to $7556 for summer participants. However, neither of these two types of seasonal participants earned sufficient average revenue after paying all expenses to cover the opportunity cost of labor. The proportion of LCMA 2 seasonal businesses that were able to cover the opportunity cost of labor was 13% for fall/winter and 10% for summer season lobster fishing businesses.

The offshore fishery operates on a much larger scale from that of the inshore fishery. Average gross revenue was estimated to be over $400 thousand, but total costs for bait, fuel, and crew payments were about $335 thousand (Table 23). Net return as a percentage of gross revenue was 21%, which was lower than the return to LCMA 1 or LCMA 2 fishing businesses. However, average economic return was 12% of gross revenue, and vessel owner earnings in calendar year 2005 were at least as much as regional average per capita income for 60% of offshore businesses. The average return to capital may be sufficient to earn positive economic profit.

Studies of lobster fishery cost and earnings have consistently found that, on average, after accounting for the opportunity cost of capital and labor, economic return to most lobster businesses is negative. That is, data reported in 1978, 1989, 1993, and most recently in 2005 show that while net returns are positive from an accounting perspective, most lobster businesses earn lower income than the general population, and invested capital is earning a lower return in lobstering than in alternative investments. The underlying factors perpetuating these economic conditions are complex, involving social ties to lobstering as well as economic interests creating an environment resistant to change.

Table 23. Estimated average cost and earnings for offshore lobster businesses for calendar year 2005

	Full-time
Gross Revenue	423,905
Crew Payment	136,528
Crew Payment % of Gross	32%
Fuel Cost	51,259
Bait Cost	50,983
Fuel & Bait % of Gross	24%
Insurance P&I	15,845
Net Return	89,357
Net Return % of Gross	21%
Opportunity Cost of Labor	36,712
Economic Return to Capital and Owner Profit	52,645
Economic Return % of Gross	12%
Proportion of Businesses with Positive Economic Return to Capital	60%

Economic studies of the lobster fishery have consistently demonstrated substantial economic benefits from reducing lobster fishing effort (Bell 1972; Bell and Fullenbaum 1973) or through an increase in the minimum size (Acheson and Reidman 1982; Botsford et al. 1986). In each of these studies, economic improvements are achieved by taking advantage of the existing price structure for lobsters in which a premium is paid for larger lobsters. Thus, while fewer lobsters are harvested, industry revenues increase over the longer term. Other studies have demonstrated that economic improvements could be achieved without changing the minimum size or effort by changing the timing of harvest (Cheng and Townsend 1993) or reducing costs through trap reduction (Townsend 1986; Gates 2000). The former would increase the value of harvested lobster by timing the harvest of lobster to market conditions and by increasing the proportion of more valuable hard shell lobsters; the latter would make the fishery more cost efficient by reducing redundant traps. For example, Gates (2000) estimated that the cost of harvesting lobster may be 25% higher due to inefficient use of inputs.

In general these economic studies have demonstrated that economic improvements in the lobster fishery are attainable, but they tend to ignore their allocative implications, which to some extent explains why the recommendations have not been adopted. Effort reductions or changing the minimum size may result in increased economic returns over the longer term, but they would result in revenue losses at both ex-vessel and wholesale market levels (Acheson and Reidman 1982; Wang and Kellogg 1988) in the near term. Analysis of proposed gauge increases by Richardson (1992) found that ex-vessel revenues would eventually increase with a gauge increase, but that wholesale revenues would actually decline even over the longer term.[3] Given the low level of economic returns to the fishery, such revenue losses would compromise the ability of some lobster businesses to remain in operation. Thus, even though the financial performance of the lobster industry as a whole would be improved, there are few volunteers willing to leave the fishery. Similarly, changing the timing of the lobster harvest would fundamentally alter how fishery revenues would be distributed, which would make some harvesters better off while making others worse off.

Even though the economic gains from more efficient use of inputs have been difficult to realize on a region-wide basis, the institutional structure of lobster management has enabled components of the lobster fishery to adopt measures that offer potential economic efficiencies. These measures include limited entry based on historical participation in LCMAs 2, 3, 4, and 5 and the Outer Cape as well as individual trap allocations. The potential gains from limited entry were documented by Acheson (1975, 1989), as profitability of so-called "perimeter defended" areas was noted to be higher than "nucleated" areas due to the greater ability to exclude other participants, as well as cost efficiencies associated with lower input use. Although the geographic scope of each LCMA makes it unlikely that the gains documented by Acheson in Maine's island communities would be realized from limited entry alone, it is an important component to gains that may be achievable through other means. Replacing trap caps with individual allocations creates the opportunity to preserve the relative competitive position within LCMA participants. The added feature of making trap allocations transferable (implemented by Massachusetts for the Outer Cape and approved for implementation by the ASMFC for LCMA 2 and 3) creates opportunities for efficiency gains as well as providing a mechanism to allow voluntary changes in competitive position through exchange. Among states, Maine's zone

[3] Note that the difference in performance between harvester and wholesale revenue is due to differences in the slope of the demand curve at the two market levels. Specifically, dealers face a less steeply sloped demand, which makes it harder to pass on increased ex-vessel prices to consumers.

management policy provided opportunities for participants in each zone to adopt measures to improve economic conditions that would not have been possible on a state-wide basis due to regional opposition (Acheson et al. 2000).

In some respect, the mechanism at work within the LCMAs and Maine's lobster zones is to break up the decision-making units into smaller, increasingly like-minded individuals to enable mutually beneficial agreements to be reached. Thus far, these agreements have focused on creating opportunities to improve cost efficiencies through limiting entry and creating transferable trap programs, but creating the incentives for increasing the value of harvested lobster has remained elusive.

Factors Affecting the Economic Condition of the Lobster Fishery

The lobster fishery is directly affected by the condition of the resource itself as well as any regulations affecting the timing or manner in which lobsters may be harvested. The economic condition of the lobster fishery is also shaped by general economic forces, environmental conditions, and regulatory changes in other fisheries that have indirect impacts on the lobster fishery. General economic forces affect the cost of running a lobster business, and also act as the engine to drive changing land use patterns in coastal areas. Environmental factors include specific events, such as the North Cape oil spill that occurred in 1996 or the sudden die-off of large numbers of lobster in Long Island Sound that occurred in 1999. Environmental factors also include more subtle changes in oceanic conditions that have resulted in increased incidence and the spread of shell disease. Changes to the regulatory climate have resulted in introduction of limited access in many fisheries. Heightened concern over the status of large whales in the Northeast region has also led to the need to alter lobster fishing gear, and additional measures to reduce ship strikes may add impacts on some larger lobster vessels. The potential impacts of these economic, environmental, and regulatory factors are described in more detail below.

General Economic Conditions

Fuel and bait may represent 50% or more of all trip expenses other than hired crew or sternmen. As such, a change in the price of either of these two inputs has a large influence on profitability. At least 10% of individuals surveyed in LCMAs 1, 2, and 3 said that rising costs had been a major change that they had observed over the past 5–10 years, and that bait availability and rising costs would continue to be a problem in the future.

In all years except 1990, the average nominal price of diesel fuel in New England to commercial or institutional end users ranged between $0.60 and $0.80 per gallon from 1986 through 1999 (Figure 28). In 2002 the average annual price was $0.89 per gallon; however, the average price increased by 18% in 2003, 20% in 2004, and another 40% to $1.81 in 2005. After adjusting for inflationary effects, the increase in fuel price was more modest, but still went up 4% in 2003, 9% in 2004, and jumped 20% in 2005. Over the same years, inflation-adjusted lobster prices increased by 9% in 2003 but declined in both 2004 and 2005. This suggests that the rate of increase in the cost of fuel has exceeded that of lobster prices, leading to shrinking profit margins for lobster businesses, all other things being equal.

Atlantic herring is the single largest source of bait for the majority of lobster businesses. The bait supply is affected by regulatory action through the quota setting process as well as the relative difference in price between the bait market and the international market for human

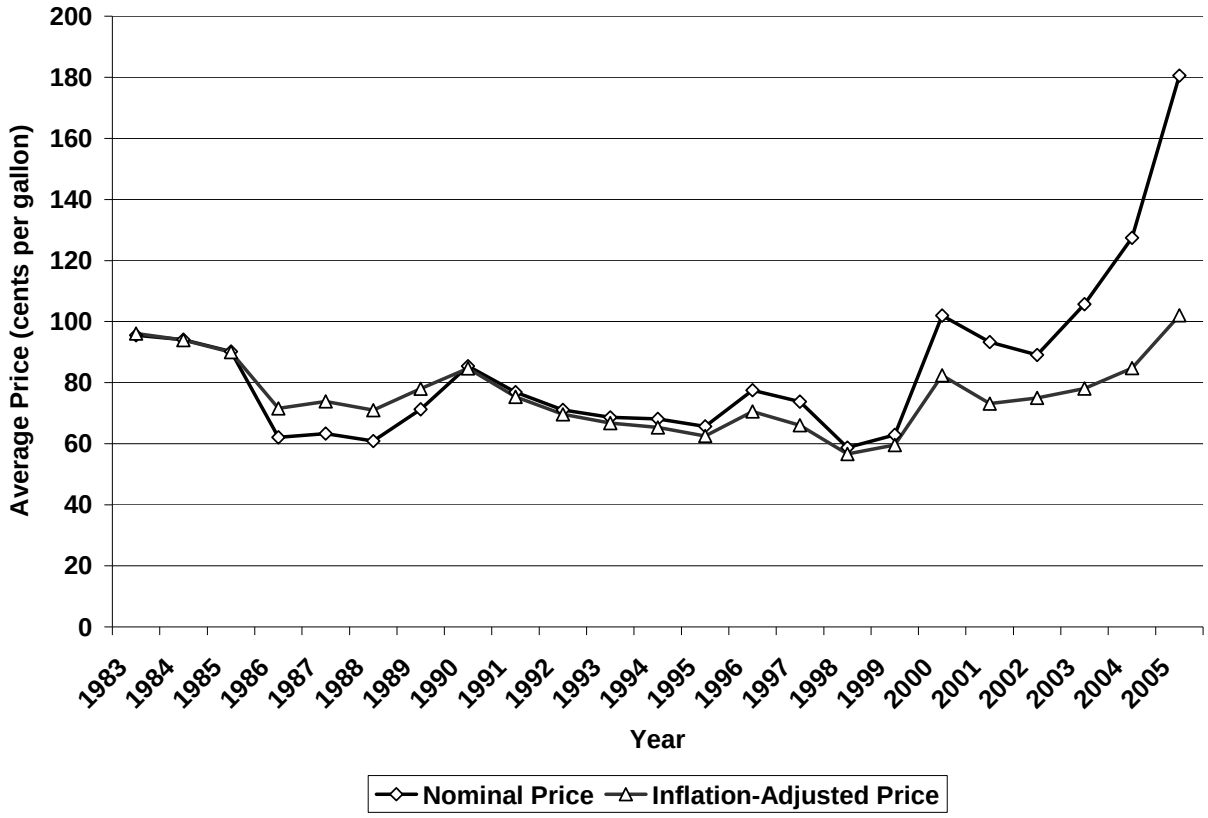

Figure 28. Average annual price in New England for #2 diesel fuel to commercial/institutional end users (Source: Energy Information Administration, http://tonto.eia.doe.gov/dnav/pet/pet_pri_dist_a_EPD2_PCS_cpgal_a.htm)

consumption. Currently, the primary source of herring for the bait market comes from Herring Management Area (HMA) 1A. Recently the NEFMC endorsed a reduction of 10,000 mt to the Total Allowable Catch (TAC) for HMA 1A. If this were the sole source of product for the bait market the availability of bait would decline and the price of bait would be expected to increase; however, the TACs for HMAs 1B, 2, and 3 are not affected and have typically not been reached. This means that the potential shortfall in the HMA 1A TAC could be offset by increased landings from the other areas. Unfortunately, these areas are further from shore and there are seasonal differences in the availability of herring compared to HMA 1A. This means that the transportation costs of getting herring to the bait market may increase, which would result in higher bait prices. Differences in seasonal availability may also result in localized shortages. These shortages could be ameliorated by freezing and storage of bait to smooth out seasonal supply problems, but this would also tend to increase the cost of servicing the bait market.

Much of the demand for herring for human consumption comes from overseas markets. The price received in these markets is higher than the bait market price. To date, landings of herring have been sufficient to meet the demand in both markets, and the international demand for U.S.-produced herring has not been large. However, a change in global supplies of herring for human consumption could alter this situation, resulting in a shift in local markets that could divert herring from bait to more lucrative international markets. Such a change would reduce the availability of bait herring, resulting in an increase in the price of bait.

As noted previously, most active lobster license holders, particularly in Maine, live less than 5–7 miles from where their boat is moored. There has been increasing concern within the lobster fishing industry, as well as the commercial fishing industry as a whole, over the potential loss of fishing related infrastructure and access to the waterfront. The dominant force in these conversions has been a real estate market that has bid up the value of shoreline property for residential, recreational, and tourism development. The depressed state of the fishing economy may be hastening the pace of land use conversion, but even a robust fishing economy provides no guarantee that waterfront land use conversion will not continue unabated. That is, land in a commercial use earns an annual flow of income. If the value of the land in an alternative use exceeds the present value of the flow of income in its present commercial use, land owners are better off selling. Local communities may adopt a variety of instruments such as zoning or current use taxation that would tend to increase the economic return to current landowners and slow or inhibit the pace of land use change.

Environmental Factors

The lobster fishery in Southern New England suffered two significant events in the 1990s that had both immediate and lasting impacts on the lobster resource and affected the economic condition of lobster businesses in the affected areas.

The North Cape Oil Spill

In 1996, a tugboat and oil-carrying barge ran aground off Mongoose Beach in Rhode Island. The resulting oil spill poured 828 thousand gallons of home heating oil into local waters killing large numbers of clams, fish, seabirds, and an estimated 9 million lobsters (Rhode Island Department of Environmental Management 2006). Although the localized impact may well have been dramatic, the oil spill had no apparent impact on Rhode Island landings, since 1996, 1997, and 1998 landings were approximately the same or slightly more than in 1995. Lobster landings increased dramatically in 1999 before declining precipitously from 2000 through 2004. The decline in Rhode Island landings that occurred during these years was also evident throughout much of LCMA 2.

The downturn in the lobster resource has since been credited with a significant wave of attrition in the LCMA 2 fishery. However, in 2000 a settlement was reached with the owner of the marine transportation company, providing $800 thousand for lobster restoration in addition to several million dollars for a variety of other environmental mitigation activities. The lobster restoration program involved compensating individual lobstermen to V-notch and return to the water legal female lobsters (i.e., non egg-bearing and of legal size) that would otherwise have been harvested. A total of 150 lobster harvesters in Rhode Island and Massachusetts participated in the program, which was completed in 2006. Given the poor catch rates that were experienced at the time, the supplemental income received may have been sufficient to prevent at least some portion of these businesses from folding.

The Long Island Sound Die-Off

The second environmental event was a large die-off of lobsters during the fall of 1999 in Long Island Sound. This die-off affected lobstermen fishing from ports primarily in Connecticut and New York. In prior years, landings from Long Island Sound ranged from 7 to 11.7 million

lb with about 1200 commercial licenses issued (Balcom and Howell 2006). In 2004, commercial landings were just 1.6 million lb and less than 900 licenses were issued. The die-off prompted the governors of the affected states to request a declaration of a fishery failure, and disaster assistance under Section 312(a) of the MSA. Assistance was provided to compensate affected lobstermen and to investigate the potential causes of the die-off.

Assistance to fishermen took the form of income compensation based on documented 1998 income from lobster, as well as an effort reduction program to purchase trap tags. According to an assessment of the economic impact of the die-off, 70% of active license holders lost 100% of their lobster income while the remaining license holders lost between 30% and 90% of income (Balcom and Howell 2006). Direct payments to these affected individuals totaled $3.6 million to Connecticut license holders and $3.5 million to eligible New York license holders. The state of Connecticut also set aside $110 thousand for job retraining programs and $1.1 million for a trap-tag buyout program. New York also allocated $1 million for a trap buyout. Between the two states, a total of 141,743 traps were removed from the fishery amounting to an overall reduction of about 22% of the total number of traps fished.

The impact of the die-off on dealers and lobster distributors was assessed in 2002 through a survey conducted by Center for Survey Research and Analysis at the University of Connecticut (2002). The survey found that while impacts differed across seafood businesses, the majority of dealers and seafood restaurants were able to meet local supply requirements by sourcing product from New England and Canada (Balcom and Howell, 2006).

Shell Disease

Shell disease is caused by invasive bacteria that enter through pores in the exoskeleton of a lobster (Somers 2005). The disease can range in severity from pits in the shell to lesions that cause the shell and membrane underneath the shell to fuse. A lobster in this condition may die during molting because it is unable to shed the old shell. The presence of shell disease does not affect the quality of the meat but may be unsightly and become unmarketable as a higher-valued live product.

Shell disease is not new, but its prevalence in Southern New England waters has been increasing. Castro and Angell (2000) noted that the proportion of lobsters with shell disease had increased from low levels in 1995 and 1996 to 20% in 1999. According to Somers (2005) the incidence of disease has increased to 30% of lobsters in Coastal waters of Southern New England and Long Island Sound. While shell disease is known to occur in the Gulf of Maine its prevalence has been much lower.

The economic effect of shell disease on lobster markets and/or lobster businesses has not been studied. If, as has been hypothesized, shell disease has resulted in an increase in natural mortality, then rebuilding the lobster resource will require larger reductions in man-induced fishing mortality to achieve a given biological objective. This means that regulatory measures may need to be more restrictive, which would make their attendant costs greater. At a minimum, the presence of shell disease would tend to result in lower revenues to harvesters and dealers, since the prices for lobsters with shell disease may be expected to be lower as it would enter a processing market instead of the more lucrative live market.

Regulatory Conditions

As noted previously, many people that hold a lobster license also hold licenses or permits for other fisheries. This means that regulatory action affecting fisheries may also have an impact on lobster fishery participants. In addition to fishery regulations measures taken to protect large whales particularly right whales have meant that many lobster trap fishery participants have been required to modify gear and alter their fishing patterns to reduce entanglement risk. Pending regulations to reduce large whale deaths due to ship strikes may have additional impacts on certain segments of the lobster fishery.

Regulatory Action in Other Fisheries

At least until 1994 the majority of fisheries in the Northeast region were open access. This allowed lobster participants to pursue a variety of different fisheries without having to qualify for any specific permit. However, as noted earlier, landings in the lobster fishery were increasing rapidly throughout the 1980s and early 1990s in Maine, Massachusetts, and Rhode Island, and have continued to increase in Maine. This increase in landings made the lobster fishery an attractive alternative to other fisheries for increased investment. As limited entry was introduced in groundfish and scallops in 1994 and several other fisheries since, some lobster participants were unable to qualify for these fisheries since they had shifted to fishing exclusively for lobster for much of the qualifying years. The passage of Amendment 13 to the groundfish FMP has left some lobstermen that did qualify for a limited access permit without any allocated days-at-sea. Note that regulatory action was originally taken to restore depleted groundfish stocks whose historic range had shrunk so much, particularly in downeast Maine, that groundfish had ceased to be an economically viable fishery. The combination of resource depletion and increasingly stringent groundfish regulations has resulted in a contraction of the fishing industry that has increased dependence on lobstering to sustain many fishermen in Maine (Richardson 2003).

The Maine coastline being such an attractive tourism and recreation destination puts considerable pressure on the real estate market. There is a growing concern that a downturn in the lobster fishery would be the demise of many traditional lobstering and commercial fishing harbors, as current owners would be forced to sell out to real estate developers (Portland Press Herald 2003).

Large Whale Protection

The objective of right whale and other large whale protection measures is ultimately to eliminate deaths from entanglement in commercial fishing gear and from ship strikes. To date, much of the regulatory actions affecting the lobster fishery have been directed at reducing the number of vertical lines in the water, gear marking, reducing the use of floating line, and installing weak links. These gear requirements are more restrictive in specified areas associated with right whale critical habitat areas. With modification, the basic components of these gear restrictions have been in place since 1997.

In addition to the gear modifications, a system of seasonal area restrictions were implemented in 2002. These restrictions established specified time and area restrictions requiring the use of gear with a low risk of entanglement in what are established migratory

corridors (i.e., a Strategic Area Management or SAM) and for any area where aggregations of right whales have been sighted (i.e., Dynamic Area Management or DAM).

The economic impacts of current large whale protection measures are uncertain but are likely to vary considerably, depending on where individuals choose to fish as well as on seasonal fishing patterns. Impacts on fishing operations would be expected to be minimal for vessels that do not typically fish in the vicinity of right whale critical habitat. Many lobster trap vessels that fish in inshore waters of Maine would be affected by the less stringent universal gear requirements. By contrast, the right whale critical habitat areas include substantial portions of both state and federal waters off the coast of Massachusetts. Thus, the economic impact on Massachusetts boats is likely to be higher compared to Maine lobster boats. Vessels fishing offshore are required to use specified gear and if they also fish on Georges Bank they are also likely to be subject to the SAM gear requirements and may be likely to be affected by actions taken under DAM. Gear modifications to comply with these measures would require affected lobster trap businesses to replace all of their ground gear with sinking or neutrally buoyant line. Since many of the gear and area management measures have been in place for several years, lobster trap vessel owners have probably already incorporated these changes into their annual business plans. However, new measures are currently being proposed under the Large Whale Take Reduction Plan.

The new measures would modify existing regulations designed to reduce entanglement as well as ship strike risk. The primary measures to reduce entanglement risk include modifications to the breaking strength of weak links and replacement of floating rope on all groundlines with neutrally buoyant lines, coupled with phasing out the SAM and DAM programs (NOAA Fisheries 2005). Although these measures as well as several other alternatives are still under consideration, NOAA Fisheries, in collaboration with the National Fish and Wildlife Foundation, initiated a gear buyback and recycling program in the Mid-Atlantic during calendar year 2006 (NOAA Fisheries Northeast Region 2006). Participating fishermen received a voucher to purchase replacement groundline based on the amount of floating line that was turned in. This program provided fixed gear fishermen with the incentive to voluntarily convert to groundline, which would reduce entanglement risk as well as mitigating the compliance costs in anticipation that the conversion may become mandatory in the future. A similar rope buyback program is under development for New England fixed gear fishermen.

Measures to reduce ship strike risk are being developed separately from that of entanglement risk measures since most of the affected entities would be different. Whereas, entanglement risk reduction is focused on fixed gear commercial fisheries the ship strike regulations are directed at commercial shipping and navigation. Nevertheless, the proposed regulations would apply to any vessel 65 feet or more transiting through specified areas (NOAA Fisheries, 2006). The measures may include rerouting shipping lanes to avoid concentrations of right whales as well as reducing ship speeds. The majority of inshore lobster vessels would not be affected by these ship strike measures since they are less than 65 feet. However, many offshore vessels that fish in LCMA 3 may be affected depending on which of six alternatives is selected. The economic analysis performed for the ship strike DEIS indicates that the total commercial fishing impacts would be a maximum of $1.0 million. The analysis does not indicate what portion of this estimated compliance cost may be attributable to offshore lobster.

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