Woods Hole Oceanographic Institution

WOODS HOLE OCEANOGRAPHIC INSTITUTION 1930

NEW ENGLAND FISHING, PROCESSING AND DISTRIBUTION

by

Susan Peterson
and
Leah Smith

March 1979

TECHNICAL REPORT

Prepared for the National Marine Fisheries Service under Contract 03-6-043-35165, for the Pew Memorial Trust, the Department of Commerce, NOAA Office of Sea Grant under Grant 04-8-M01-149, and the Woods Hole Oceanographic Institution's Marine Policy and Ocean Management Program.

WOODS HOLE, MASSACHUSETTS 02543

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This document is the final report for NOAA Contract #03-6-043-35165, which supported most of the research. Research was also supported with funds from the Pew Memorial Trust and from the Department of Commerce, NOAA Office of Sea Grant under Grant #04-8-M01-149, and was sponsored by the Woods Hole Oceanographic Institution's Marine Policy and Ocean Management Program.

Approved for Distribution: Robert W. Morse

Robert W. Morse
Associate Director and Dean of Graduate Studies

ABSTRACT

The New England fishing industry is examined in terms of the capacity of the fishing fleet, of the processing plants, and of the transportation system. Limitations on the capacity of the industry, and its capability and flexibility, are explored in terms of social, economic and technical aspects. The study is based on interviews with fishermen, buyers, processors and distributors, and on data made available by the National Marine Fisheries Service. Although the fisheries is in a state of expansion and both vessels and plants have a greater capacity than is now being used, the major problems that may restrict expansion in both fishing and processing are quality control, species selection and market development.

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ACKNOWLEDGMENTS

This work could not have been done without the cooperation of the many fishermen, fish processors, dealers and others in the industry who responded to our questions throughout the study. We appreciate their cooperation and help. Our thanks also extend particularly to Margaret Linskey and Richard Pfeiffer, who conducted most of the interviews of the fishermen, and to Ann Martin, who handled the computer work required to carry out the organization and analysis of data we had collected and of data provided by the National Marine Fisheries Service. In addition to working with the statistical material, she helped to "translate" the data into readable English. Our thanks go to Lynda Davis, Ann Goodwin and Kaleroy Hatzikon for typing this paper repeatedly.

The National Marine Fisheries Service not only provided the major funding for this work but also cooperated throughout the study, making available to us their data on fishing vessels and processors. Partial support was also provided by the Pew Memorial Trust, Department of Commerce, NOAA Office of Sea Grant (grant #04-8-M01-149) and the Woods Hole Oceanographic Institution's Marine Policy and Ocean Management Program.

INTRODUCTION

Some of the fish in the sea are destined to repose on a dinner plate. But before arriving on that dinner plate, the fish are hauled out of the ocean and put through a system of handling, processing and distributing - a system which varies in efficiency at different points along the route. The research reported here describes the New England fishing industry by examining the capacity of the fishing fleet, of the processing plants and of the transportation system. We have explored the limitations on the capacity of the industry - the social, economic and technical aspects which hinder expansion and diversification. Rather than considering capacity in terms of a fixed number of tons or pounds, we have examined the capability and flexibility of the system that carries fish from the ocean to the consumer. This analysis is based on information given directly to us by fishermen, buyers, processors and distributors, and on data made available by the National Marine Fisheries Service.

The Data Base

The National Marine Fisheries Service (NMFS) maintains a computerized listing of vessels which unload fish at major New England ports. It contains physical information about each fishing vessel: length, tonnage, horsepower, year built, gear, port and number of crew. This information is provided to NMFS by the Coast Guard when each new vessel enters the fleet or when vessels change owners, and supplemented by information from the NMFS port agents - men who interview vessel captains on a regular basis. NMFS also maintains weigh-out records containing information by vessel on species caught, port where it was taken for sale, the pounds landed and dollar value of the trip, days spent fishing, and the gear used. The NMFS made the 1976 data available as well as some information for 1972, 1968 and 1964. We also used the NMFS 1976 year-end fish processing survey data, supplemented by an interview schedule[1] we mailed out to fish dealers and processors.

We assembled additional information through interviews on the following fishing vessel characteristics, which we examined in depth: vessel horsepower, gear, estimated hold capacity, and the number of crew; gross stock for 1976, and the owner's estimate of the value of his vessel and gear; the number of days fished per year by each vessel, the average length of a vessel's trip, and the average catch per trip; and the age and ethnic background of the skipper, and the type of owner - whether individual, group of individuals, kin group, or corporation. In addition, we collected information on the home port of the vessel, the ports where the catch was sold and the sales method, and the main species caught.

These interviews were intended to provide us with an operational measure of both average capacity used and potential capacity of the fishing vessels. We asked fishermen what they considered their capacity to be - how many pounds of fish they could carry. We also asked them for an estimate of their average catch per trip to find out what portion of the hold capacity was used. For an objective view of hold capacity we used the registered net

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[1] A copy of that interview schedule is in Appendix I.

tons of the vessel.[2] Of course there are variations along the coast in the amount of fish a vessel of a given size holds. Herring boats in Maine and whiting fishermen in Rhode Island use no ice on those fish and do not pack them carefully into the hold. Those fish are caught in large quantities, held on the vessel for less than twelve hours, and need no ice. However, cod, pollock, haddock and other sepcies are carefully sorted by size and packed in layers of ice in fish pens in the hold where they are kept fresh during fishing trips which, for some vessels, last up to 10 days. Thus, the hold capacity varies by species, with the largest capacity for those vessels which catch fish intended for reduction, and the smallest capacity for the most valuable fish products - with the exception of shellfish.

Although only one figure for hold capacity was given by the captain, the vessel's capacity is not really fixed: alternative uses of the vessel and skills of the captain and crew can alter the amount of fish a boat can carry. Few fishermen gave alternate hold capacities for iced and uniced fish because few of them change fisheries. Frequency of change in fisheries is discussed in a separate paper (Peterson and Martin 1977) found in Appendix II. We would eventually like to have both an objective method for measuring hold capacity and a method to predict changes in vessel use so that we could make accurate predictions of the volume of fish - by species and total biomass - likely to be har-

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[2] Net tons is defined as "the remainder after deducting from the gross tonnage of the vessel, the tonnage of crew spaces, Masters accomodations, navigation spaces, allowances for propelling power, etc. It is also expressed in tons of 100 cubic feet" in <u>Merchant Vessels of the United States</u>, 1 January 1976, Vol. 1, [illegible]

vested in the future by the New England fleet. Furthermore, we would like to be able to make accurate predictions for what fishermen may do in the future based on the experiences and skills of the fishermen we have observed.

To find out about fish processing, we mailed out 382 interview forms to wholesalers, processors and distributors of which 54 were returned in usable form or filled out during telephone or personal interviews. The interview form and comments on its efficacy are in Appendix I. We added information from the National Marine Fisheries Service annual survey of fish processors, which includes data on employment and production. Their list of fish processors combined with our list (which includes fish wholesalers) was the basis for the sample.[3] Our interview schedule asked about production and capacity in 1976, plans for expansion, descriptions of physical plants and sales by species and market. Five businesses from Connecticut, three from Rhode Island, twelve from Maine, two from New Hampshire and thirty-two from Massachusetts responded in detail to our questions. Information about the plants is summarized in Table 15.

Of the 54 plants in our sample, we can identify the species handled by 43 of them. The other eleven include four wholesalers, three distributors, three processors and one wholesaler-retailer.

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[3] The National Marine Fisheries Service has a complete list of processors in New England. Our list added wholesalers and distributors whose names were obtained from the yellow pages of telephone directories from all over New England, from the <u>New England Manufacturer's Directory</u> and from personal contacts with industry members.

In most cases where we identify species handled, we use the information provided by the NMFS 1976 Survey of Processed Products in New England. We supplemented these data with our own survey. As with the fishing vessel operators, we sought both subjective and objective estimates of the capacity of these businesses to process, pack, ship and sell fish products. There are several possible interpretations of plant capacity for production. Our survey questionnaire and interviews relied on management estimates of capacity currently used and capacity at which operation is preferred. This management-based interpretation of capacity is consistent with both major national surveys which estimate capacity utilization for industrial manufacturing: the Department of Commerce/Bureau of the Census Survey of Plant Capacity and the McGraw-Hill Survey. Since we are interested in the present and future capacity of the industry, we also asked specifically about expansion plans. These would, of course, increase capacity.

An estimate of fish processing capacity in Massachusetts and New Hampshire is also being developed by Georgianna, Greenwood, Ibarra and Ward (1977). They have chosen a more complicated technique for estimating capacity, the "peak to peak" method using the NMFS data collected over several years. This method estimates industry capacity over time by plotting production over time for a series of individual plants or groups of plants and then connecting the production peaks with straight lines. For the fresh fish processing industry, their measure includes only production peaks which also fulfill the condition that ex-vessel price of fish drops, an indication that processors are not willing to buy much more fish. The processors' constraints are the waste associated with spoilage of fish that cannot be cut and sold relatively fast, given a set amount of skilled labor, machinery and space. Peaks are taken at face value for the processors of frozen fish. For all fish processors, the marginal cost of adding production makes a jump at these peak capacity points.

The method of Georgianna et al has the advantage of consistent interpretation of "full capacity", a consistency which cannot be guaranteed by our questionnaire as interpreted by each plant manager. However, their method requires a much more expensive and long-term data collection process to ensure an objective measure of capacity. Our measure of percentage use of the capacity which is desired by the plant owners as compared to capacity now in use is an operational definition.

FISHING BOATS AND FISHERMEN

The following discussion gives details of the significant relationships among vessel characteristics collected by NMFS (such as net tons, length, horsepower) and the information obtained through interviews of fishing boat captains.[4] Estimating the ability and likelihood of a vessel's crew catching some given level of catch is difficult if not impossible. However, predictions about the capacity of the entire fleet can be made if information on the vessels, on fishing effort and on the characteristics of the captain and fishermen is available. Here we illustrate how age of captain, ethnicity and owner-operator relationships have been related to other characteristics of the fishing vessels and the value and volume of catch.

The New England offshore fishing fleet includes vessels of a wide variety using many different types of gear. Although otter trawls predominate, long lines, gill nets and purse seines are also

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[4]During the summer of 1977 we used Marine Policy funds and the labor of two undergraduates, Margaret Linskey, a volunteer from Boston College, and Richard J. Pfeiffer of Amherst College, to collect information from a 15% sample of the New England offshore fleet. Amy Fischer collected information on some of the sample boats in January 1978. Our base information was the NMFS vessel register, from which we selected all New England vessels of 50 feet and 40 tons or more - those vessels capable of fishing regularly further than 3 miles from shore. These vessels were sorted by state and county, and were listed alphabetically. Using a random number generator, we did a stratified systematic sampling of 15% for a total of 67 vessels. Ten of these were not interviewed: three of the missing vessels had sunk; five of them moved or were sold to ports outside New England; and two simply vanished without leaving a clue to their whereabouts. Our comparative information is based upon discussions with 57 vessel owners and/or captains.

significant types of gear. The mean length of New England boats in our study is about 75 feet, but boats in the sample ranged from 50 feet to 134 feet. Wood boats outnumber steel two to one, and some one-third of the steel boats were built before 1968. Boats now in the fleet were built as long ago as 1927; the average age of boats in 1976 was about twenty years, but in 1977 some 85 boats, many of them new, were added to the New England fleet, and even more were added in 1978.

The crews in the study number 6 on average but ranged in size from 2 to 13. Captains were from 25 to 65 years old and included Yankee, Italian, Portuguese, Norwegian and other ethnic groups. In most cases (73%) the captain was owner or part-owner of his boat; in other cases the boat was owned by a corporation or other individuals. There was substantial variation in the total number of days each year these captains were actively fishing as well as in the length of individual fishing trips - measured from the time the boat leaves the dock until returning.

Some general characteristics of the fishing vessels and crew in the sample are summarized in Table 1 and in histograms showing the distribution of these variables both for the sample and for the entire population (Appendix III). The relationships among the variables are shown in the Pearson Correlation matrix (Table 2) and in the significant results of the nonparametric statistical tests (Tables 4-13). The variables for significant results are plotted in Appendix IV.

We were interested not only in differences among vessels and fishermen, but also in whether or not significant differences among ports existed. They do, and these differences are summarized in Table 3. It is useful to know, for example, that in 1976 New Bedford boats spent an average of 42 more days out fishing than Newport boats. It is also important to recognize that these figures can change over time as the vessels enter new fishing or change ports. The existing data - total pounds landed per year, average pounds caught per trip, and average hold capacity for each port - are useful in anticipating the differential effects of management methods and in predicting possible areas of growth in fishing capacity. However, the considerable variation among and within ports in annual catch, gross stock and characteristics of boats and crew cannot be disregarded. While there are some generalizations or characterizations that can be made by port, it is important to keep in mind that such differences can change over time.

Each group of variables is examined in turn to demonstrate significant interrelationships between vessel and crew characteristics and to explain variation in potential capacity and capacity actually used.

Fishing Vessels

Year Built - The age of the fishing boats can be used to explain some of the variation in capacity. However, this variation is not always in the direction one might anticipate: while newer boats are bigger (i.e., greater net tons), the annual landings of these newer boats (built after 1967) are less than annual landings

Table 1

Mean, Standard Deviation and Distribution of Vessel, Crew and Effort Variables for 15% Sample of New England Fishing Vessels

	No. of Cases	Mean	Standard Deviation
Horsepower (MPOM)	57	433.9	192.3
Horsepower (NMFS)	67	386.0	197.5
Length of boat in feet (NMFS)	67	74.6	16.8
Year boat built (NMFS)	67	1955	12.2
Value of boat (MPOM)	41	$198,365.9	146,736.1
Net tons (NMFS)	67	64.3	33.9
Hold capacity in pounds (MPOM)	50	106,340.0	62,858.9
Average pounds per trip (MPOM)	48	31,625.0	28,519.2
Average pounds per trip (NMFS)	66	22,480.4	23,168.1
Number of crew (MPOM)	55	5.5	2.4
Number of crew (NMFS)	64	5.6	2.6
Age of skipper (MPOM)	48	44.4	10.2
Annual pounds caught (NMFS)	66	599,059.8	689,831.0
Annual gross stock (MPOM)	47	$253,637.0	172,439.8
Annual gross stock (NMFS)	66	$195,254.1	174,170.3
Average length of trip in days (MPOM)	56	6.7	4.5
Total days fished annually (MPOM)	43	184.9	47.8

Note: (MPOM) indicates that data collected by Peterson and Smith et. al.
(NMFS) indicates data from vessel register or weighouts.

Table 1 (Con't)

Mean, Standard Deviation and Distribution of Vessel, Crew and Effort Variables

Gear Used	No. of Cases (MPOM data)	No. of Cases (NMFS data)	Ports	No. of Cases Home Port (MPOM data)	No. of Cases Sale Port (NMFS data)	Owner-Type	Cases	Captain Ethnic Group	Cases
Otter trawl	41	52	New Bedford	17	21	Individual	34	Yankee	22
Scallop dredge	6	4	Gloucester	16	13	Corporation	9	Italian	15
Longline	4	4	Boston	2	4	Kin groups	11	Portuguese	7
Lobster pots	3	3	Cape Cod & Islands	3	8	Group of individuals	3	Norwegian	6
Gill net	1	0	Pt. Judith	6	7				
Purse seine	1	1	Newport	3	8				
Stop seine	1	0	Portland & Rockland	3	5	<u>Owner-Skipper</u>		<u>Union</u>	
Harpoon	0	1	Me.-other	3		Yes	40	Union	10
Haul seine	0	1	Portsmouth, N.H.	1		No	15	Non-union	15
<u>Sales Method</u>	<u>Cases</u>		<u>Construction of Vessel</u>		<u>Cases</u>				
Contract	24		Wood		43				
Auction	17		Steel		23				
Co-op	12								
Any buyer	10								
Ltd. no. of buyers	6								

ABBREVIATIONS:

MPHP - horsepower (MPOM interviews)

CREWNO - number of crew

GRSTOCK - gross stock - total annual revenue (MPOM interviews)

DAYSOUT - days fished per year

LTRIP - length of each trip

AGESK - age of skipper

NMFSAVTP - average pounds caught per trip (NMFS data)

NMFSLBS - Total lbs.landed per year (NMFS Data)

NETTONS - net tonnage (Coast Guard data)

LENGTH - length of vessel (Coast Guard data)

YRBLT - year vessel was built

MPAVGTRP - average pounds caught per trip (MPOM interviews)

MPVALUE - value of vessel and gear (MPOM interviews)

HOLDCPTY - vessel hold capacity estimated by captains (MPOM interviews)

MPCPCTY - captain's estimate of average trip/HOLDCPTY

NMFSCPTY - NMFSAVTP/NETTONS

Table 2

Pearson Correlation Matrix for Vessel, Crew, Effort and Fishing Variables

	MPHP	CREWNO	GRSTOCK	DAYSOUT	LTRIP	AGESK	NMFSAVTP	NMFSLBS
MPHP	1.0000 (0) S= .001	.6395 (55) S= .001	.7407 (47) S= .001	.3089 (43) S= .022	.0448 (56) S= .371	.2879 (48) S= .024	.5572 (57) S= .001	.4005 (57) S= .001
CREWNO	.6395 (55) S= .001	1.0000 (0) S= .001	.7861 (45) S= .001	.3286 (43) S= .016	.0791 (54) S= .285	.3337 (46) S= .012	.3403 (55) S= .006	.1041 (55) S= .225
GRSTOCK	.7407 (47) S= .001	.7861 (45) S= .001	1.0000 (0) S= .001	.3047 (36) S= .035	.1188 (47) S= .213	.3584 (40) S= .012	.3462 (47) S= .009	.2184 (47) S= .070
DAYSOUT	.3089 (43) S= .022	.3286 (43) S= .016	.3047 (36) S= .035	1.0000 (0) S= .001	-.3459 (43) S= .012	.5779 (36) S= .001	.4078 (43) S= .003	.2530 (43) S= .051
LTRIP	.0448 (56) S= .371	.0791 (54) S= .285	.1188 (47) S= .213	-.3459 (43) S= .012	1.0000 (0) S= .001	-.2885 (47) S= .025	-.0204 (56) S= .441	-.1810 (56) S= .091
AGESK	.2879 (48) S= .024	.3337 (46) S= .012	.3584 (40) S= .012	.5779 (36) S= .001	-.2885 (47) S= .025	1.0000 (0) S= .001	.2285 (48) S= .059	.0708 (48) S= .316
NMFSAVTP	.5572 (57) S= .001	.3403 (55) S= .006	.3462 (47) S= .009	.4078 (43) S= .003	-.0204 (56) S= .441	.2285 (48) S= .059	1.0000 (0) S= .001	.7133 (66) S= .001
NMFSLBS	.4005 (57) S= .001	.1041 (55) S= .225	.2184 (47) S= .070	.2530 (43) S= .051	-.1810 (56) S= .091	.0708 (48) S= .316	.7133 (66) S= .001	1.0000 (0) S= .001
NETTONS	.7718 (57) S= .001	.6293 (55) S= .001	.5788 (47) S= .001	.2304 (43) S= .069	.1540 (56) S= .129	.1761 (48) S= .116	.4891 (66) S= .001	.2522 (66) S= .021
LENGTH	.6971 (57) S= .001	.5107 (55) S= .001	.5173 (47) S= .001	.1625 (43) S= .149	.1505 (56) S= .134	.1694 (48) S= .125	.5256 (66) S= .001	.2982 (66) S= .008
YRBLT	.2080 (57) S= .060	.2456 (55) S= .035	.1932 (47) S= .097	.1335 (43) S= .197	-.0012 (56) S= .497	.0311 (48) S= .417	-.0660 (66) S= .299	-.1415 (66) S= .129
MPAVGTRP	.5981 (48) S= .001	.4247 (46) S= .002	.4418 (40) S= .002	.3479 (38) S= .016	.0176 (48) S= .453	.2483 (40) S= .061	.7795 (48) S= .001	.6140 (48) S= .001
MPVALUE	.2875 (57) S= .015	.3561 (55) S= .004	.2693 (47) S= .034	.2371 (43) S= .063	.0900 (56) S= .255	.0908 (48) S= .270	.2555 (66) S= .019	.1142 (66) S= .181
MBLDCPTY	.7550 (50) S= .001	.5672 (48) S= .001	.4943 (43) S= .001	.3664 (37) S= .013	-.0049 (50) S= .487	.3410 (41) S= .015	.7039 (50) S= .001	.4506 (50) S= .001
MPCPCTY	.1077 (45) S= .241	.0516 (43) S= .371	.1744 (39) S= .144	-.2457 (35) S= .077	.5126 (45) S= .001	-.3169 (37) S= .028	.2356 (45) S= .060	.3417 (45) S= .011
NMFSCPTY	.1874 (57) S= .081	.0964 (55) S= .242	.1151 (47) S= .220	.3085 (43) S= .022	-.1518 (56) S= .132	.1476 (48) S= .158	.7967 (66) S= .001	.5986 (66) S= .001

	NETTONS	LENGTH	YRBLT	MPAVGTRP	MPVALUE	MBLDCPTY	MPCPCTY	NMFSCPTY
MPHP	.7718 (57) S= .001	.6971 (57) S= .001	.2080 (57) S= .060	.5981 (48) S= .001	.2875 (57) S= .015	.7550 (50) S= .001	.1077 (45) S= .241	.1874 (57) S= .081
CREWNO	.6293 (55) S= .001	.5107 (55) S= .001	.2456 (55) S= .035	.4247 (46) S= .002	.3561 (55) S= .004	.5672 (48) S= .001	.0516 (43) S= .371	.0964 (55) S= .242
GRSTOCK	.5788 (47) S= .001	.5173 (47) S= .001	.1932 (47) S= .097	.4418 (40) S= .002	.2693 (47) S= .034	.4943 (43) S= .001	.1744 (39) S= .144	.1151 (47) S= .220
DAYSOUT	.2304 (43) S= .069	.1625 (43) S= .149	.1335 (43) S= .197	.3479 (38) S= .016	.2371 (43) S= .063	.3664 (37) S= .013	-.2457 (35) S= .077	.3085 (43) S= .022
LTRIP	.1540 (56) S= .129	.1505 (56) S= .134	-.0012 (56) S= .497	.0176 (48) S= .453	.0900 (56) S= .255	-.0049 (50) S= .487	.5126 (45) S= .001	-.1518 (56) S= .132
AGESK	.1761 (48) S= .116	.1694 (48) S= .125	.0311 (48) S= .417	.2483 (40) S= .061	.0908 (48) S= .270	.3410 (41) S= .015	-.3169 (37) S= .028	.1476 (48) S= .158
NMFSAVTP	.4891 (66) S= .001	.5256 (66) S= .001	-.0660 (66) S= .299	.7795 (48) S= .001	.2555 (66) S= .019	.7039 (50) S= .001	.2356 (45) S= .060	.7967 (66) S= .001
NMFSLBS	.2522 (66) S= .021	.2982 (66) S= .008	-.1415 (66) S= .129	.6140 (48) S= .001	.1142 (66) S= .181	.4506 (50) S= .001	.3417 (45) S= .011	.5986 (66) S= .001
NETTONS	1.0000 (0) S= .001	.8087 (67) S= .001	.2378 (67) S= .026	.5945 (48) S= .001	.3843 (67) S= .001	.7793 (50) S= .001	.0244 (45) S= .437	.0173 (66) S= .445
LENGTH	.8087 (67) S= .001	1.0000 (0) S= .001	-.2328 (67) S= .029	.6781 (48) S= .001	-.0145 (67) S= .454	.8222 (50) S= .001	.1829 (45) S= .115	.1205 (66) S= .168
YRBLT	.2378 (67) S= .026	-.2328 (67) S= .029	1.0000 (0) S= .001	.0032 (48) S= .492	.5152 (67) S= .001	.0624 (50) S= .334	-.1536 (45) S= .157	-.1631 (66) S= .095
MPAVGTRP	.5945 (48) S= .001	.6781 (48) S= .001	.0032 (48) S= .492	1.0000 (0) S= .001	.2866 (48) S= .024	.7640 (45) S= .001	.4308 (45) S= .002	.3348 (48) S= .010
MPVALUE	.3843 (67) S= .001	-.0145 (67) S= .454	.5152 (67) S= .001	.2866 (48) S= .024	1.0000 (0) S= .001	.3168 (50) S= .012	-.0114 (45) S= .470	.0823 (66) S= .256
MBLDCPTY	.7793 (50) S= .001	.8222 (50) S= .001	.0624 (50) S= .334	.7640 (45) S= .001	.3168 (50) S= .012	1.0000 (0) S= .001	-.0528 (45) S= .365	.2951 (50) S= .019
MPCPCTY	.0244 (45) S= .437	.1829 (45) S= .115	-.1536 (45) S= .157	.4308 (45) S= .002	-.0114 (45) S= .470	-.0528 (45) S= .365	1.0000 (0) S= .001	.1436 (45) S= .173
NMFSCPTY	.0173 (66) S= .445	.1205 (66) S= .168	-.1631 (66) S= .095	.3348 (48) S= .010	.0823 (66) S= .256	.2951 (50) S= .019	.1436 (45) S= .173	1.0000 (0) S= .001

Table 3

Average Values of Sample* for Variables According to Saleports

Major Saleports (NMFS)	No. of boats total	No. of boats sample	NMFS lb/yr	MPOM gross stock($)	Hold cap.avg. (1000lbs.)	MPOM days fished per year	NMFS year built	MPOM capacity used(%)	MPOM age of skipper	Skipper Ethnicity: Yankee	Norwegian	Portuguese	Italian	Other
New Bedford	123	21	434,083 (21)	350,000 (14)	103 (14)	199 (11)	1958 (21)	32 (12)	48 (12)	3	5	4	1	1
Gloucester	80	13	1,092,764 (13)	242,832 (11)	110 (11)	183 (12)	1951	27 (9)	43	2	0	1	10	0
Point Judith	40	7	744,767	159,000 (5)	54 (7)	177 (4)	1954	34 (6)	42 (6)	6	0	1	0	0
Newport	48	8	209,663	174,540 (5)	90 (4)	157 (5)	1955	26 (4)	40 (4)	2	0	0	2	0
Cape Cod & M. Vineyard	53	8	164,081	135,500 (6)	93 (7)	191 (7)	1957	16 (7)	45 (6)	5	1	1	0	0
Boston	24	4	949,743	366,667 (3)	195 (3)	183 (2)	1952	36 (3)	41 (3)	0	0	0	2	1
Portland & Rockland	35	5	842,796	192,272 (4)	174 (4)	188 (2)	1953	33 (4)	49 (4)	4	0	0	0	0

* Number of boats in sample is shown in parentheses below average value for each calculation.

for boats built before 1968. Consistent with these findings is the significantly larger percentage of hold space used by boats built in 1967 and earlier. In comparing new boats (built in 1968 and later) to very old boats (built in 1945 and earlier), we also found that the newer boats carry more crew on the average. Not surprisingly, the newer boats have a significantly higher value (see Tables 2 and 4).

These results have some interesting implications for the capacity of the fleet as older boats stop fishing and the newer boats represent an increasingly larger proportion of the fleet. For the boats built between 1968 and 1974 (about 27 percent of the sample), there is a large amount of unused hold capacity, and despite their larger hold space, average annual landings have been smaller than for the older boats. Therefore, even before the addition of a large number of boats after 1974, there was a substantial potential for increasing catch among the newer boats in the fleet, providing the availability of stocks was high. The recent additions of vessels to the fleet will obviously add to the fleet's potential capacity, but this addition does not ensure increased catch levels, particularly if the vessels were built to harvest the small amounts of cod, haddock and yellowtail flounder now available. Considering the addition of these new, larger, more expensive boats, it is interesting that the newer boats did not have significantly larger gross stocks than the older boats.

Table 4: Year Vessel Built

Differences Significant at .05 Level (Mann-Whitney)

Dep. Variable		No. of Cases	Mean Rank	U	2-Tailed Probability
Value of boat	≤1945	9	5.83	7.5	.000
	≥1968	14	15.96		
Net tons	≤1945	21	14.95	83.0	.005
	≥1968	17	25.12		
Value of boat	≤1967	27	16.57	69.0	.001
	≥1968	14	29.54		
Net tons	≤1967	50	30.54	252.0	.013
	≥1968	17	44.18		
% capacity utilized	≤1967	33	26.14	94.5	.008
	≥1968	12	14.38		

Gear - Most of the vessels (72%) in the sample are otter trawlers; other vessels have gear types such as scallop dredges, longlines, lobster pots, gill net, purse and stop seines (Table 1). About one-fifth of the New England fishing boats use more than one gear type; gear adaptability is discussed in Appendix II. Otter trawlers, which include vessels fishing as side trawlers and as stern trawlers, typically seek a larger variety of fish species and have more innate flexibility than the other gear included in the sample; the significant differences listed below demonstrate some of the advantages. Boats with otter trawls on an average trip brought back more pounds of fish than boats with other gear, although they were out for fewer days; and otter trawlers landed more total pounds for the year, on average (Table 5). Most important, boats with otter trawls used a larger percentage of their total hold capacity than the other vessels; these vessels which fill larger proportions of their holds may be considered to operate more efficiently. However, other gear types are more efficient for catching some species, such as swordfish, lobster, shellfish, halibut, tuna, bluefish. Thus no major shift away from the less commonly used gear types is foreseen, although increased market demand for the less popular species, such as squid, hake and adult herring, may dictate adjustments in the gear used by the fleet and in vessel design, particularly in refrigeration facilities.

Boat Construction - About 35% of the sample boats were steel, the

Table 5: Gear Type

Differences Significant at .05 Level (Mann-Whitney)

		No. of Cases	Mean Rank	U	2-Tailed Probability
Length of trip	otter trawl	41	25.12	169.0	.010
	other	15	37.73		
MPOM avg. trip	otter trawl	36	28.32	78.5	.001
	other	12	13.04		
NMFS avg. trip	otter trawl	41	31.88	210.0	.036
	other	16	21.63		
NMFS lbs/ trip	otter trawl	41	33.68	136.0	.001
	other	16	17.00		
% capacity used	otter trawl	35	25.34	93.0	.025
	other	10	14.80		

remainder wood, while of all offshore New England vessels, 32% were steel. However, the proportion of steel vessels has risen dramatically since 1968 and will continue to rise as more boats are added to the fleet. In our sample, all but two of the vessels built since 1967 have been steel, but about one-third of all the steel vessels were built before 1968. Vessel construction is associated with variation in other boat characteristics: steel boats averaged significantly higher value, larger engine horsepower, greater length, larger hold capacity and more net tons (Table 6). None of these associations is unexpected. Other significant differences between steel and wooden vessels are that steel vessels have larger crews and make longer trips consistent with the generally larger size of such vessels. Therefore, the fact that a fishing boat is wood or steel is tied to its other physical characteristics but does not in itself explain differences in the way those vessels are used.

Length of Vessels - The longer fishing vessels have larger hold capacities, bigger engines, more crew members, higher gross stocks, longer trips, higher values for vessels, and they catch more pounds on an average trip (Tables 2 and 7). They use the same proportion of hold space used by shorter boats. Perhaps because of reduced catches in the late 1960's, the trend since the early 1970's has been towards building shorter boats than those built previously (Smith and Peterson 1977). While higher

Table 6: Boat Construction

Differences Significant at .05 Level (Mann-Whitney)

		No. of Cases	Mean Rank	U	2-Tailed Probability
Crew no.	wood	36	24.35	210.5	.017
	steel	19	34.92		
Length of trip	wood	37	24.36	198.5	.008
	steel	19	36.55		
Value of boat	wood	26	15.63	55.5	.000
	steel	15	30.30		
Hold cap.	wood	34	21.96	151.5	.012
	steel	16	33.03		
Net tons	wood	44	26.91	194.0	.000
	steel	23	47.57		

Table 7: Length of Vessels

Differences Significant at .05 Level (Mann-Whitney)

		No. of Cases	Mean Rank	U	2-Tailed Probability
Number in crew	less than 80'	43	24.45	105.5	.002
	81' or more	12	40.71		
Gross stock	less than 80'	36	19.99	53.5	.000
	81' or more	11	37.14		
Value of boat	less than 80'	37	19.38	14.0	.008
	81' or more	4	36.00		
Hold cap.	less than 80'	40	21.01	20.5	.000
	81' or more	10	43.45		
MPQM avg. trip	less than 80'	37	20.80	66.5	.001
	81' or more	11	36.95		
NMFS avg. lb/ trip	less than 80'	49	28.94	193.0	.001
	81' or more	17	46.65		
NMFS gross stock	less than 80'	49	29.27	209.0	.002
	81' or more	17	45.71		
NMFS total pounds	less than 80'	49	30.39	264.0	.025
	81' or more	17	42.47		
Net tons	less than 80'	50	27.91	120.5	.000
	81' or more	17	51.91		

fuel costs encourage the use of smaller fishing vessels with smaller engines, the need to go further offshore to exploit stocks previously not sought by the U.S. fleet makes larger vessels more attractive. It is difficult to predict what the outcome of these and other conflicting pressures on fishing boat size will be, but it is most likely that a wide range of sizes will continue to be represented in the fleet.

Fishing Effort

Days Fished Per Year - One direct measurement of fishing effort is the number of days fished per year by each vessel. Estimates of the number of days fished per year were obtained in interviews with boat captains. We found that the day fishermen - the men who go out in the morning and back in the evening of the same day, or who fish less than 24 hours at a time - had a good idea of the number of days they had fished, while the trip fishermen kept their information as the total number of trips. For example, a captain would know he made 26 trips eight days long and 2 "broken" trips - trips that lasted less than 8 days because of weather or equipment problems. Boats spending more than 181 days (the average) at sea had significantly larger engine horsepower, made longer individual trips, had higher values for their vessels and greater hold capacities (Table 8). Boats with larger crews and older captains stayed out more days in a year. The fact that older captains spent more time fishing may result from the fact that younger fishermen often speak of leading balanced lives.

Table 8: Fishing Effort:Days Fished Per Year

Differences Significant at .05 Level (Mann-Whitney)

	Days Fished	No. of Cases	Mean Rank	U	2-Tailed Probability
Crew no.	1-181	31	23.79	241.5	.024
	182+	24	33.44		
Gross stock	1-181	25	19.86	171.5	.027
	182+	22	28.70		
Length of trip	1-181	32	24.73	263.5	.044
	182+	24	33.52		
Value of boat	1-181	24	17.83	128.0	.044
	182+	17	25.47		
NMFS avg. trip	1-181	42	29.26	326.0	.018
	182+	24	40.92		
NMFS gross stock	1-181	42	27.88	268.0	.002
	182+	24	43.33		
NMFS total pounds	1-181	42	29.60	340.0	.029
	182+	24	40.33		

Rather than having fishing as the focus of their existence, many young men want time to spend with their families and friends. These vessels with large crews and older captains caught more fish on an average trip and had a larger gross stock than boats with smaller crews and younger captains. What this says about fishing effort is that if a captain has a boat capable of offshore fishing during all kinds of weather - that is, a boat with greater than average size and horsepower, and probably more valuable than the average - he can make more money by taking on a good-sized crew and going fishing as often as he can. In contrast to many jobs available to Americans, fishing is one where hard work - long hours - results directly in more pounds of fish and more dollars.

The potential for expansion of fishing effort without the introduction of additional vessels depends on incentives encouraging fishermen to increase the number of days at sea. In this sample of fisherman, the number of days fished per year varied from 100 to 300, illustrating that many fishers do expend substantially more effort than the average for the fleet and some expend much less. An increase in the average number of days of fishing per year could increase the catch of the existing fleet, but this will happen only if the fish sought are reasonably abundant and command a price adequate to repay the costs of fishing.

The physical capacity of the fleet is used in most of our analysis here. The economic capacity is defined somewhat differently. In addition to size of boat and days of fishing, which are part of the physical capacity, economic capacity depends on the price fish will fetch in the markets. This economic capacity and the cost of finding the fish is what actually determines the supply of fish in any given period and reflects the " capacity" of the U.S. fleet to catch a particular species. For the scallops and groundfish sought by most of the boats included in this study, price was very high most of the time and did not limit the effort expended to catch these fish. Rather, the high prices encouraged new entrants into the fishery and encouraged existing boats to concentrate their effort on the traditional species. Catch levels were limited by quota regulations and scarcity of fish rather than by lack of economic incentive.

Length of Trip - The length in days of each trip is dictated by a variety of considerations, including distance to fishing grounds, size of the fishing vessel, and the willingness of the crew to stay out for more than a few days. Fishermen's unions have well established rules regarding the number of days out at sea and the number that must then be spent ashore. But many fishermen are not governed by these rules because they are not union members. The longer trips result in fewer total days fished - fewer days away from home - and the younger skippers make longer individual trips. In an attempt to determine whether day trip boats make different uses of their hold capacity than do boats with long trips (eight or more days), these two groups were compared on a variety of characteristics (Table 9). As expected, boats making long trips were larger vessels and had greater horsepower, greater available hold capacity, more crew members, greater value; these boats also had more valuable average trips and higher gross stocks for the year. More important, boats with trips lasting eight or more days used a larger proportion of their hold capacity. (Total pounds caught were also larger for boats making longer trips, but the difference was not significant at the .05 level). The same differences were also significant between one-to-two and three-to-seven day trips. That is, boats making day trips averaged smaller annual gross stock than boats making longer trips. The trend in some ports to shorter trips may also mean a more than proportionate reduction in total (per boat) value and pounds of catch unless the current patterns shift.

The implications of these relationships and the recent developments in fisheries management (i.e., moratoriums on popular species at the end of a quarterly allocation, the need to expand to stocks of formerly underutilized species located farther off shore) are the longer trips may become more desirable for economic reasons in order to increase catch and gross stock. This should be considered when devising management techniques and estimating industry capacity in the near future.

Table 9: Length of Trip

Differences Significant at .05 Level (Mann-Whitney)

		No. of Cases	Mean Rank	U	2-Tailed Probability
Number in crew	1-2 days 8+ days	10 27	10.25 22.24	47.5	.002
Gross stock	1-2 days 8+ days	10 23	8.70 20.61	32.0	.001
Value of boat	1-2 days 8+ days	9 19	9.67 16.79	42.0	.032
Hold cap.	1-2 days 8+ days	10 22	10.90 19.05	54.0	.023
MPOM avg. trip	1-2 days 8+ days	8 23	7.81 18.85	26.5	.003
NMFS avg. trip	1-2 days 8+ days	20 27	17.40 28.89	138.0	.005
NMFS gross stock	1-2 days 8+ days	20 27	15.40 30.37	98.0	.000
Net tons	1-2 days 8+ days	21 27	17.71 29.78	141.0	.003
% capacity used (MPOM)	1-2 days 8+ days	8 20	9.38 16.55	39.0	.037
% capacity used (NMFS)	1-2 days 8+ days	20 27	19.45 27.37	179.0	.050
Number in crew	1-7 days 8+ days	28 27	20.63 35.65	171.5	.000
Gross stock	1-7 days 8+	24 23	17.73 30.54	125.5	.001
Days out per year	1-7 days 8+ days	22 21	17.52 26.69	132.5	.017
Value of boat	1-7 days 8+ days	22 19	17.32 25.26	128.0	.034
MPOM avg. trip	1-7 days 8+ days	25 23	19.68 29.74	167.0	.013
NMFS avg. trip	1-7 days 8+ days	39 27	28.62 40.56	336.0	.013
NMFS gross stock	1-7 days 8+ days	39 27	27.21 42.59	281.0	.001
Net tons	1-7 days 8+ days	40 27	28.32 42.41	313.0	.004
MPOM avg. trip	1-2 days 3-7 days	8 17	7.19 15.74	21.5	.007
NMFS gross stock	1-2 days 3-7 days	20 19	15.45 24.79	99.0	.011
% capacity used (MPOM)	1-2 days 3-7 days	8 17	8.44 15.15	31.5	.033

Crew and Captains

Number of Crew - There are more fishermen on the larger boats and they catch more pounds on average trips, work on vessels with larger capacity, higher gross stock and so forth (Table 2). Boats with seven or fewer crew have lower horsepower, gross stock,capacity, length and value of boat compared to boats carrying eight or more crew (Table 10). Similar significant differences appear for very small crews (one to three members) when compared to crews of four to seven. The complex relationships among these variables make it difficult to sort out the precise influence of crew size. We can say, however, that larger boats with larger crews harvest more fish than do smaller boats over the entire year, not just for the average trip, and that the largest boats, with eight or more crew members, exert greater fishing effort by spending more days fishing during the year. By one measure, boats with crews of four or more also use more of their capacity than do boats with one to three crew members.

Captain - Several facts about the captain of a fishing vessel seemed potentially relevant to the capacity used by the boats, but not all of them were statistically significant in fact. One might, for example, assume that a captain who owned his vessel would expend greater fishing effort. However, owner-

Table 10: Number of Crew

Differences Significant at .05 Level (Mann-Whitney)

	No. of Crew	No. of Cases	Mean Rank	U	2-Tailed Probability
MPOM gross stock	1-7 8+	40 7	21.35 39.14	34.0	.002
Days out per year	1-7 8+	37 6	20.30 32.50	48.0	.027
Value of boat	1-7 8+	36 5	19.13 34.50	22.5	.007
NMFS avg. trip	1-7 8+	58 8	31.69 46.63	127.0	.039
NMFS gross stock	1-7 8+	58 8	30.03 58.63	31.0	.000
Net tons	1-7 8+	59 8	31.24 54.38	73.0	.002
MPOM gross stock	1-3 4+	11 36	13.45 27.22	82.0	.004
Length of trip	1-3 4+	11 45	13.00 32.29	77.0	.000
Value of boat	1-3 4+	9 32	11.00 23.81	54.0	.004
Hold cap.	1-3 4+	11 39	15.55 28.31	105.0	.010
MPOM avg. trip	1-3 4+	10 38	13.50 27.39	80.0	.005
NMFS Avg. trip	1-3 4+	20 46	22.00 38.50	230.0	.001
NMFS gross stock	1-3 4+	20 46	18.75 39.91	165.0	.000
NMFS total pounds	1-3 4+	20 46	23.45 37.87	259.0	.005
Net tons	1-3 4+	21 46	24.48 38.35	283.0	.007
MPOM gross stock	1-3 4-7	11 29	13.18 23.28	79.0	.015
Length of trip	1-3 4-7	11 37	11.64 28.32	62.0	.000
Value of boat	1-3 4-7	9 27	10.44 21.19	49.0	.008
Hold cap.	1-3 4-7	11 33	14.55 25.15	94.0	.017
MPOM avg. trip	1-3 4-7	10 32	12.60 24.28	71.0	.008
NMFS avg. trip	1-3 4-7	20 38	20.90 34.03	208.0	.005
NMFS gross stock	1-3 4-7	20 38	18.75 35.16	165.0	.000
NMFS total pounds	1-3 4-7	20 38	21.80 33.55	226.0	.012
Net tons	1-3 4-7	21 38	23.43 33.63	261.0	.029

captains had significantly smaller average trips, used less of their boats' hold capacity, had less valuable boats and spent fewer days of the year fishing (Table 11). Moreover, individually owned boats, when compared with boats owned by groups or corporations, had smaller horsepower, less value, smaller net tons and only half the average annual pounds of catch (Table 12). Corporations, in contrast, own boats with significantly larger capacities and average trips. This difference can be explained, at least partly, by the financial resources of corporations and their access to larger loans to build bigger boats. Owner-operators indicated that they sought rewards other than the financial ones associated with larger catches. Time spent ashore was highly valued as was the freedom to avoid fishing in heavy weather.

Older captains skippered boats with larger gross stock, more horsepower, and greater number of crew (Table 12). While the ethnicity of skippers[5] did not explain any variation in the capacity used, Yankee skippers averaged significantly smaller crews and smaller gross stock, largely a reflection of their relative abundance in some of the smaller ports (Table 13). Nor-

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[5] See Smith and Peterson (1977) for a discussion of the role of ethnicity in the different New England ports.

Table 11: Captain/Ownership: Type of Ownership

Differences Significant at .05 Level (Mann-Whitney)

Dep. Variable		No. of Cases	Mean Rank	U	2-Tailed Probability
Days out	Captain is owner	34	19.71	75.0	.050
	Captain is not owner	8	29.13		
Value of boat	Captain is owner	33	18.92	63.5	.024
	Captain is not owner	8	29.56		
NMFS avg. trip	Captain is owner	42	25.29	159.0	.011
	Captain is not owner	14	38.14		

Table 12: Ownership of Boat

Differences Significant at .05 Level (Mann-Whitney)

Dep. Variable		No. of Cases	Mean Rank	U	2-Tailed Probability
Hold cap.	Individual or Group	41	22.96	80.5	.024
	Corporation	8	35.44		
NMFS avg. trip	Individual or Group	57	31.26	129.0	.048
	Corporation	8	45.38		
Net tons	Individual or Group	58	31.42	111.5	.018
	Corporation	8	48.56		

Table 13: Ethnicity of Captain

Differences Significant at .05 Level (Mann-Whitney)

		No. of Cases	Mean Rank	U	2-Tailed Probability
Crew no.	Yankee	20	18.30	156.0	.004
	All others	30	30.30		
Gross stock	Yankee	19	15.71	108.5	.001
	All others	26	28.33		
NMFS gross stock	Yankee	21	19.52	179.0	.006
	All others	31	31.23		
Crew no.	Norwegian	6	42.92	27.5	.001
	All others	44	23.13		
Gross stock	Norwegian	6	35.83	40.0	.010
	All others	39	21.03		
Length of trip	Norwegian	6	41.25	49.5	.011
	All others	46	24.58		
Value of boat	Norwegian	5	30.50	27.5	.017
	All others	33	17.83		
NMFS gross stock	Norwegian	6	38.50	66.0	.039
	All others	46	24.93		
Net tons	Norwegian	6	40.33	55.0	.017
	All others	46	24.70		
NMFS total pounds	Italian	15	35.47	143.0	.007
	All others	37	22.86		

wegian skippers, although there were only six in the sample, tended to have larger and more valuable boats, more crew, longer trips and higher gross stock. Italian skippers, mainly in Gloucester, followed the pattern of that port in bringing back higher total pounds of catch in a year.

Use of Data - In the course of this study we established that a great deal of useful information related to the capacity of the New England fishing fleet is already collected by NMFS.

We experimented with the development of an index that would show vessel hold capacity and what percentage of that capacity was used. Average catch per trip from NMFS statistics divided by net tons was compared with average catch per trip estimated by boat captains divided by their estimate of hold capacity. The correlation coefficient of the two was insignificant. However, net tons taken by itself is highly correlated (.78) with fishermen's estimates of their potential hold capacity. To illustrate the relationship of the approximate translation between these two variables, the average net tons of 63.16 corresponds to an average hold capacity of 104,640 pounds as estimated by the captains for the same 50 vessels. Also, average pounds per trip reported by NMFS as part of the weigh - out data was correlated .78 (significant at the .05 level) with average catch estimated by captains.

The data in the NMFS vessel register and on the weigh-out tapes include critical information about vessel and crew size and about the average and total catches of at least those vessels which land at major ports. Our survey shows that estimates of average pounds of catch per trip and annual gross stock made up by vessel captains are higher than but correlated with NMFS average catch per trip and annual gross stock. For the same group of 48 boats, NMFS reported an average of 24,406 pounds caught per trip, while the MPOM interview figures averaged 31,104 pounds per trip. For the same group of 47 boats, NMFS gross stock averaged $231,880, compared to MPOM gross stock average $253,637.

Additional divergence between the MPOM and NMFS data can be explained by the fact that our data could not be collected for several boats which had sunk or otherwise left the New England fishery. The boats which had left the fishery were less successful: fewer pounds per trip, smaller annual gross stock while they were in New England. Boats added to the fleet after 1976 have a larger potential capacity than these drop-outs. A study of the historical change in potential and useful capacity from year to year could help fisheries managers to determine new capacity by applying an index to available figures on previous years' catch.

FISH BUYING AND PROCESSING

The capacity of processors who use the fish caught by the New England fishermen and who import fresh and frozen fish from outside the region was studied using information from interviews, questionnaires and the NMFS. Annual and seasonal fluctations in the volume of fish which the boats can deliver is a problem shared by all proces- sors and buyers of fresh fish. The fluctuations are a result of variable weather conditions which inhibit fishing, changing availabili- of stocks of fish, and luck. Some of the fluctuation can be anticipated, although the uncertainty of the supply is a dominant aspect in catching and selling fish. Although fresh fish dominates the public interest in New England, frozen fish are also important to the New England economy. Much of the expansion proposed by New England processors is in the area of frozen fish for domestic consumption and for export.

The fluctuations in catch have to be considered in discussing the capacity of the fish buyers and processors to handle the fish, in cold storage/freezer space available, and in transportation facilities. Most fish buyers take the fish from the vessel and truck it to a processor within hours of purchase, but when fish is very abundant the buyers may have to store it for several days before they find alternative outlets for the product. At times, processors have been compelled to freeze fish originally intended for the fresh fish market.[6]

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[6] Estimates of fish in cold storage are available through the Market News Division of NMFS. As of 31 January 1976 there was 2,690,000 cu.ft. of cooler space and 21,666,000 cu. ft. of freezer space in New England, of which 14,551,000 is in Massachusetts.

Supply and Integration

Fish buyers and processors have several alternative ways to ensure larger or more dependable supplies or broader markets for their products. One solution to the classical problem of reliable supply and demand is for a business to integrate vertically, that is, to own several businesses along the line from the boat to the consumer. The five companies in our sample which were vertically integrated attempted to achieve this goal in a number of ways. Seven companies owned boats, twenty had their own vehicles for trucking and transport, nine had retail markets - and only one retail market did not have its own trucks for pickup and delivery. Three had restaurants, five had another processing company to buy their products, three had other outlets, and two owned their own fish carriers to bring fish from fishing boats to plants.

Although many of the fish buyers and processors own only one plant, several respondents to our questionnaire own more than one plant. Perhaps the best example of a processing industry which must deal with a product available for only part of the year is the herring industry. The herring industry includes a number of multiplant companies which deal only with herring as juveniles and/or adults. However, the volume of herring caught by U.S. fishermen and processed in New England is expanding. Once the industry caught juvenile herring and canned them as sardines. In recent years, the processors have been buying adult herring for canning, for freezing as bait or for filleting and freezing as exports to European markets. A few plants pickle, salt or smoke herring. Several herring processors have diversified in other ways. Reduction plants for fish meal, fish oil and pearl essence using trash fish, menhaden and the frames of food fish are associated with several of the herring processing plants. Companies can alleviate some of the problems associated with seasonality if they handle several species, but a few fish processors whom we interviewed deal with non-fish products as well. One company uses its facilities to process fish by-products, chicken by-products and other edible protein by-products. Another uses different sections of a plant to process fish and beef.

Plants which process frozen fish blocks also have problems with guaranteeing supply since they are dependent upon foreign suppliers, but they do have some security in the price they will pay because they contract for large volumes at a fixed price. Since raw material is provided to them in blocks of the same size regardless of species, their labor and capital equipment problem in changing species mix is not as involved as it is for fresh fish processors. Fresh fish processors generally have more labor-intensive production than do frozen block processors. Frozen block production requires skilled labor, but the skills are not specific to particular groups of species such as filleting flat fish (yellowtail flounder,etc.) versus roundfish(cod, haddock, pollock) in the fresh market.

Employment and Plant Size

Although labor costs are high throughout the region, the cost of labor in the fishing industry is not nearly as serious as the problem of finding the kind of labor which can adapt to the fluctuations of an uncertain fish supply. Our research showed no significant correlation between labor cost and any variables except for energy cost.

We looked at employment levels in two ways - the average employment during the year and the highest employment during one month; the latter was to indicate the top range when fish to be processed was most abundant. But it doesn't seem to matter whether average or high monthly employment are used because as either increases, so does the size of the plant, the cold storage space, value of equipment, gross sales, value added[7] and percentage of imported frozen fish.

The employment levels varied enormously from one plant to the next. Thirty-eight plants in the survey had less than 100 employees at the most, and their average was 19 people. Only 9 plants had more than 100, and these ranged from 113 to 641 employees. Economies of scale are present in the New England processing industry: companies which handle more pounds per year average higher production per employee (see Figure 1 and

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[7]Value added is the difference between total value of product produced and cost of inputs to production - raw materials, etc. Respondents to the questionnaire did not all interpret "value added" in the same way, so its relationship to other variables in the data is not to be taken as absolutely reliable.

Table 14). This agrees with our earlier studies (Smith and Peterson 1977). We expect that economies of scale would be more pronounced for plants with similar products. The subsamples in the present sample are not large enough to establish the significance of this tendency.

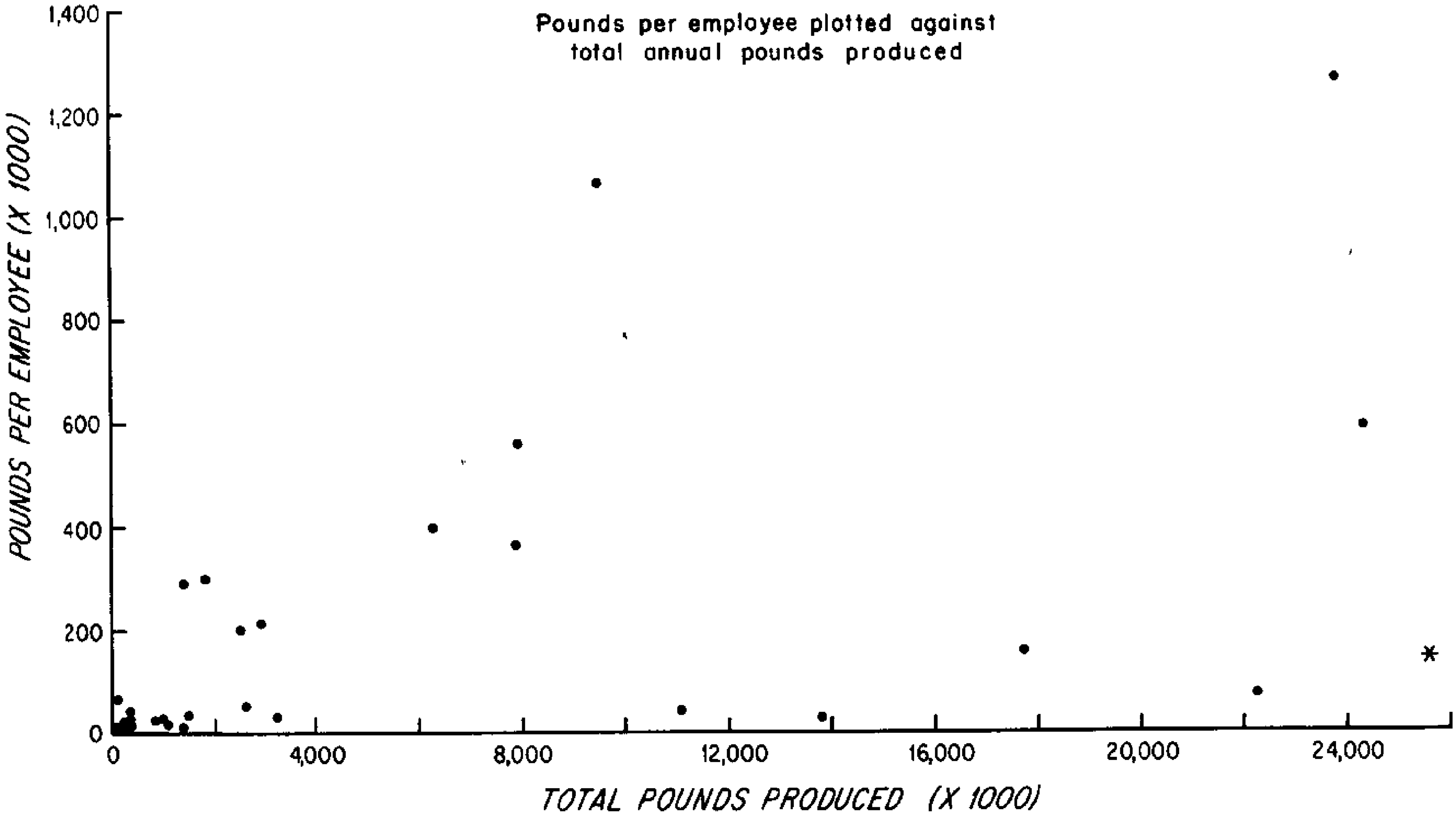
The businesses in the sample represent the entire age range of the New England fish processing and distributing industry. One was founded in 1848, one in 1849, four between 1860 and 1890, and then six more between 1900 and 1939. Twelve established themselves in the industry in the 1940's, eight in the 1950's ten more in the 1960's and only six were established in the 1970's. Newer companies have smaller plant sizes, less cold storage, less valuable equipment, fewer employees and a higher proportion of capacity used for lobsters and shellfish and for foods canned for human consumption. (see Table 14).

Five plants handled so many species that we had to create a category "everything". More plants (11) handled cod and haddock than any other species, but none of them handled only these. In addition to cod and haddock, six also dealt in pollock, five in flatfish, four in redfish, three in whiting, and three in shrimp. Two handled lobsters, two

FIGURE 1

ECONOMIES OF SCALE

Pounds per employee plotted against total annual pounds produced



*Two firms with more than 24,000,000 pounds produced had per employee production of 131 and 447 pounds per employee.

Table 14

Pearson Correlation Matrix for Dealer, Processor, and Distributor Variables

	MP Space	MP Freezer	Cld Storage	Eq. Value	Gr. Sales	Value Added	Energy Cost	Labor Cost	Dom. Fresh	Imp. Fresh	Dom. Frzn	NMFS lbs.	High Emp.	Avg. Emp.
MP space														
MP freezer														
Cold storage	.8621 (21) S=.001	.8185 (16) S=.001												
Eq. value	.8877 (34) S=.001	.5769 (21) S=.003	.4890 (21) S=.012											
Gr. sales	.6957 (36) S=.001		.5306 (24) S=.004	.7070 (37) S=.001										
Value added	.7076 (22) S=.001	.6829 (14) S=.004	.6582 (13) S=.007	.9470 (20) S=.001	.9436 (23) S=.001									
Energy cost	.8627 (35) S=.001	.5472 (22) S=.004	.8166 (23) S=.001	.9402 (34) S=.001	.7636 (37) S=.001	.9603 (21) S=.002								
Labor cost	.9220 (34) S=.001		.7628 (24) S=.001	.8934 (34) S=.001	.8979 (39) S=.001	.8142 (21) S=.001	.9995 (38) S=.001							
Dom. fresh	-.3419 (25) S=.047	-.5546 (15) S=.016	-.4143 (18) S=.044	-.3403 (28) S=.038	-.5771 (33) S=.001	-.9527 (16) S=.001	-.5543 (27) S=.001	-.4663 (29) S=.005						
Imp. fresh						.9255 (4) S=.037			-.7174 (11) S=.006					
Dom. frozen						-.9959 (3) S=.029								
Imp. frozen	.6473 (14) S=.006	.6312 (12) S=.014	.6855 (9) S=.021	.6684 (12) S=.009	.6221 (13) S=.012		.7246 (14) S=.002	.7176 (14) S=.002	-.7407 (7) S=.028		-.8223 (6) S=.022			
NMFS lbs.	.3771 (26) S=.029			.5705 (26) S=.001	.4751 (27) S=.006		.4119 (26) S=.018	.4888 (27) S=.005						
High Emp.	.9614 (38) S=.001		.7582 (25) S=.001	.8825 (40) S=.001	.6540 (45) S=.001	.6482 (23) S=.001	.8439 (39) S=.001	.9044 (41) S=.001				.4466 (31) S=.006		
Avg. Emp.	.9620 (38) S=.001		.8108 (25) S=.001	.9116 (40) S=.001	.5972 (45) S=.001	.7625 (23) S=.001	.8723 (39) S=.001	.9400 (41) S=.001				.4669 (31) S=.004	.9838 (54) S=.001	
lbs. per employee												.3863 (31) S=.016		
Year firm established	-.5748 (38) S=.001		-.5139 (25) S=.004	-.3629 (40) S=.011			-.4701 (39) S=.001	-.5520 (40) S=.001					-.4971 (50) S=.001	-.4949 (50) S=.001

hake, one herring and one anglerfish.[8]

The sample includes wholesalers who need little physical space and processors who set up production lines and need a lot of space. The physical size of the plants varies from 500 sq. ft. to 190,000 sq. ft., with the average plant size approximately 31,000 sq. ft. Larger plants have significantly more cold storage space, higher market value of equipment, larger gross sales and greater value added; they also handle a higher percentage of domestic fresh fish and imported frozen fish than do smaller plants (see Table 14). Freezer space and cold storage space at the plant are also important if we are to consider the flexibility of these businesses to handle exceptionally large volumes of fish or to last through periods of low price/low demand. Twenty of the firms had their own freezer space, and the variation in space was substantial. Thirteen of them had less than 10,000 cubic feet, and for those with more space the range was from 11,000 to

---

[8] Nine plants handled flatfish (Flounder, yellowtail, fluke, sole), and three of them handled only flatfish. Four of the remainder combined flatfish with pollock and redfish; one plant dealt in shrimp and scallops, another in lobsters and shrimp. Clams were the leading raw material for seven of the plants - three of them dealt only in clams. The others combined clams with lobsters, shrimp, and oysters. Two plants handled only lobsters, and two handled flatfish, groundfish and shrimp as well as lobsters. There were five plants which handled herring alone; two others also handled menhaden, and a third dealt in herring, groundfish, whiting and shrimp. In our sample, only one of the firms dealt in scallops. We were glad the sample was broad enough to encompass crabs, mussels and conchs.

175,000 cubic feet. Sixty-two thousand was the average for those with more than 10,000 feet. Cold storage space has an even wider range, from 1,000 feet 1,800,000 cubic feet (average: 26,774 cubic feet).

We found that larger plants had more valuable equipment and that this was related to the proportion of imported frozen fish. The larger plants also had higher gross sales, higher energy and labor costs and greater value added (See Table 14). In addition, energy costs went up as the plants got older, accumulated more expensive equipment, did higher gross sales, produced more pounds of finished product, employed more people and used more imported frozen fish.

Plants handling domestically caught fresh fish had lower energy costs and labor costs, primarily because plants using mostly fresh domestic fish tend to be smaller than plants using more frozen fish. Plants which process fresh fish move the fish as quickly as possible, using less energy for cold storage or freezer facilities, and relying more on skilled labor than on expensive machinery.

Scale of Fresh and Frozen Fish Processors

Scale of processing plants is manifested in the number of employees, size of physical plant and volume of production. The assessment of variations in scale is complicated by the non-homogenous products of different plants. Larger volume wholesalers will sometimes require less space than a smaller volume operator producing standard-size portions of a wide range of fish and shellfish for the specialized restaurant market. However, the physical scale of frozen block plants is systematically larger than the fresh-fish plants. They usually maintain a higher volume of production, and their specialized capital equipment takes up more space than a simple conveyor belt with cutters standing along each side. The required cold storage and freezer space are also, of course, larger for a frozen block processor. Scale in terms of number of employees is not so different, because the more labor-intensive character of fresh fish plants offsets the larger volume of frozen fish plants.

To summarize, businesses involved in frozen imported fish are bigger - they have more space, more equipment, greater gross sales, while domestically caught fish handling is associated with lower gross sales and value added, and with low energy and labor costs.

Plant Capacity Use

We asked plant owners what proportion of their capacity they used versus what they would like to be using and looked at this proportion against a number of other variables. Although few of these variables were correlated, we found that the percent of desired capacity used for frozen fish was significantly correlated (.52 for processors, .42 for all plants) with total floor space of plants.[9] We also found that the percent of desired capacity

---

[9] As in other tests used throughout this report, the .05 level of significance was used. In this pair of correlations, the "all plants" category included only one plant more than the "processors". In the correlation for frozen fish, all plants responding were processors.

used for fresh finfish was significantly negatively correlated (-.64) for processors) with value added. In other words, larger plants were more likely to operate near their capacity for frozen fish and smaller value added was associated with a higher percentage use of desired capacity for fresh fish.

When we looked at the processors' data and ignored those who just bought fish, the same correlations were significant with three additions: percentage of imported fresh fish was correlated (.91) with amount of cold storage, percentage used of desired capacity for frozen fish was positively correlated with high (.43) and average (.45) employment. The simple percentage of capacity used was also tested with other variables, and we found that plants which used a larger percentage of their frozen fish capacity had more square footage (.54) and larger average (.43) and yearly high (.41) employment. This is consistent with the above generalizations about characteristics of frozen fish plants. See Table 15 for generalizations about processing plants.

Expansion: Plans and Barriers

Plans for expansion are an important part of future capacity of the industry. In our sample of plants, despite widespread interest in expansion, plant managers listed a number of impediments to expansion. There were 34 who felt that an uncertain fish supply was a serious deterrent to expansion; 19 felt labor supply was a problem. Eleven felt capital was hard to come by, nine felt marketing problems were serious enough to deter expansion. Nine were concerned about pollution control regulations which would be encountered by expanding. (See Table 15.)

Table 15

Dealer, Processor and Distributor - Means, Standard Deviation and Distribution of Variables

	No. of Cases	Mean	Standard Deviation
Year plant established	50	1943	31.06
Pounds processed in year (NMFS)	31	7,691,266	10,531,100
High employment (NMFS)	54	75	135.64
Average employment (NMFS)	54	58	111.69
Size of plant (MPCM)			
sq.ft. of enclosed space	38	31,334	51,084.15
cu.ft. of freezer space	23	26,774	44,951.77
cu.ft. of cold storage	25	144,132	413,038.1
Value of equipment	40	457,925	749,999.6
Gross sales (MPCM)	45	4,485,467	9,645,428
Value added	23	1,004,870	2,229,565
Energy cost	39	76,821	124,941
Labor cost	41	533,537	928,264
% of capacity			
used-fresh fish	22	74	26.67
ideal-fresh fish	22	98	8.27
used-fresh lobster	6	79	16.56
ideal-fresh lobster, shellfish, crabs	5	96	8.9
used-frozen fish	16	51	32.85
ideal-frozen fish	17	93	13.22
used-frozen lobster, shellfish, crabs	1	60	0.00
ideal-frozen lobster, shellfish, crabs	1	80	0.00
used-canned for human consumption	4	47	10.50
ideal-canned for human consumption	5	92	10.95
used-cured	2	26	34.65
ideal-cured	1	100	0.00
used-meal, oil, solubles	1	50	0.00
ideal-meal, oil, solubles	1	90	0.00
% of Processed Product			
domestic fresh	35	84	27.50
imported fresh	11	28	18.04
domestic frozen	7	47	36.98
imported frozen	14	48	39.79

Table 15 (Con't)

Dealer, Processor, Distributor Data for 1976

	No. of Cases
Type of Plant	
processor	38
wholesaler	8
distributor	5
retailer	2
Type of Product	
fresh fish	27
fresh lobster, shellfish, and crabs	7
frozen fish	24
frozen lobster, shellfish, and crabs	1
canned-human consumption	5
canned-non-human consumption	2
cured-meal,oil, solubles	2
Type of Market	
local	30
regional	27
national	28
exports	11
Expansion Plans - Products	
frozen fish	12
fresh fish	9
canned goods	3
flatfish & groundfish	6
swordfish	2
others	13

	No. of Cases
Expansion Plans - facilities	
additional processing plants	18
distribution systems	14
processing frozen blocks	10
fishing boats	7
retail outlets	9
restaurants	5
other	3
Expansion Problems	
fish supply	31
labor supply	19
capital	11
market demand	9
pollution control	9
other	4
State of Plant Location	
Massachusetts	32
Maine	12
Connecticut	5
Rhode Island	3
New Hampshire	2

Impediments to expansion in the fishing industry may be typical of those faced by any industry introducing a new product to the market, but Peterson (1977) feels that one of the major impediments to the expansion of the fresh fish buying and processing sectors is the existence of a well established network of people - a network several generations old in some cases. Most fish buyers prefer dealing with the same customers every day because they know the usual payment arrangements, range of volume, quality, species mix and size ranges that are acceptable. Of course, buyers and processors have fallings out, so the relationships are not always constant. But since the number of alternative processors from which the buyers of fresh fish can choose is limited, the various combinations of relationships are likely to occur and reoccur within a relatively short time - 5 to 10 years - regardless of the frequently expressed feelings of many buyers that they will never deal with so-and-so again.

Some of the bottlenecks confronting New England fish processors are highlighted in the example of a large processor which recently closed its plant in New England. Many of the concerns of the managers of this enterprise are shared by others in the industry: obtaining a steady, reliable source of high-quality fresh fish, maintenance of stable and not too high prices in their selling market so volume can remain high, need for education of all levels of management, sales force and consumers to improve the quality of fish handling and extend the range of acceptable fish species and products. The company's closing of its plant was precipitated by the need to decide whether to expand into the newly popular batter-type frozen prepared product, a product which requires extensive new capital equipment. The decision about whether to produce internally or to contract out these new products forced a reassessment of other problem areas: availability and cost of additional space, what to do with equipment useful only for the older breaded style products, and high cost of labor.

Despite the problems, expansion is a live issue. There were 35 businesses which wanted to expand; 18 felt that additional processing plants would be valuable, 10 wanted to increase their capacity by processing frozen blocks of fish (seven of these would do it by building new processing plants), seven of them hoped to buy fishing boats, 14 wanted to improve their distribution system, 9 contemplated retail outlets as a method for selling more fish, five would open restaurants.

Marketing less well-known fish remains a serious problem in New England. New England fishermen have long argued that they can catch anything - that their problem is selling it. Although many stocks of fish are available for harvest on Georges Bank, few are commercially harvested, and the arguments against catching or selling the "underutilized species" are simple. The fishermen say that the price they receive is too low to cover their time and expenses. The fish buyers say there are no markets for the non-traditional species - and few individuals are willing to develop a market at their own expense in time and effort.

Historically, a limited market has prevented <u>fresh</u> fish dealers and processors from increasing the volume of fish handled.

As part of this survey we collected general information on market areas. All but a few of the 23 businesses which produce fresh fish as more than 50% of their product (as opposed to frozen, canned or cured) had substantial local markets, and five businesses had only local markets for their products. Seven businesses had a combination of local and regional (including New York) markets, while two others claimed local, regional and national markets, and four claimed national markets - i.e., they intended their product for nation-wide consumption. Only one company sold its product in local, regional, national and international markets. Three other companies had international markets as well as local and regional market outlets, The development of broader markets, better distribution systems, methods of ensuring supply or demand for products, are recognized as problems throughout the industry.

Distribution

The distribution system, _per se_, is not inadequate nor a hindrance to expansion, but quality control in handling is if markets -- both domestic and foreign -- are to be expanded. Most processors and dealers prefer to hire trucking services rather than have their own trucks. Truck rental and trucking services, even for specialized refrigerator and freezer transportation, are inexpensive relative to other costs in the industry. For those firms which operate their own trucks, cost is not as important as the reliability of the vehicle. There is no reason to expect bottlenecks in the New England fish industry to result from a lack of transportation facilities - trucks, trains and air transport. The risky part of transportation services is in obtaining quick and quality conscious handling.

CONCLUSIONS

The general conclusion of this study is not surprising: major problems in expanding the New England fishing and processing industry are in quality control, expanding species selection, and market development. Solving these problems will require additional equipment incorporating technology not now widely used in the fishing fleet and improved fish handling techniques at all stages of production. Our analysis shows that the New England fisheries are presently in a state of expansion, and that neither vessels nor plants lack the physical capacity to accommodate greater volumes of fish than are now entering the system. This physical expansion, however, conceals problems of inflexibility which eventually may damage the industry.

There is no question that the New England fleet has a much larger potential capacity than is now being used. The number of boats and total hold capacity are not restrictive in New England's fish catching industry. A plethora of boats, both newly built and used boats bought from other regions (such as the Gulf of Mexico and the Pacific Coast) entered the fishery in 1977, suggesting that availability of capital funds is not a serious barrier to entry into the industry. We have not yet found out precisely how these new boats are equipped, but limited personal contacts inform us that most are equipped for traditional methods of fishing - most are rigged with otter trawls to catch groundfish and lack on-board refrigerated storage.

Again, at the processing stage the fish business appears to have no lack of capacity. In fact, many processors, particularly those dealing with frozen and processed fish and shellfish, have expanded in recent years. Processors feel impeded from using existing capacity or adding new capacity primarily by problems of securing steady supplies of traditionally marketed fish. Supply of these fish is, of course, influenced by seasonal variation; but the depressed stocks of many popular species have exacerbated the problem. Increasingly the size of those stocks will take time, and both fishermen and processors will need patience with restrictive quotas until the stocks are rebuilt. Fresh fish trucked in from Canada and frozen imported blocks of fish have helped to even out supplies of raw material to the processors; they will probably continue to provide needed raw material in the future. With a scarcity of popular white fish becoming a problem in more fishing grounds around the world, and with ever-increasing restrictions on foreign fleets in the Northwest Atlantic and in the North Pacific, these supplies are likely to rise in price. As long as cod, haddock, and yellowtail flounder remain scarce and high-priced, they are too attractive to the fishermen as a high-value market product to be easily replaced by more plentiful but less expensive species.

The scarcity of the traditionally popular groundfish, which results in half-filled holds in the fishing boats and in reliance by processors on imported fish, must lead to consideration of the so-called underutilized species -- fish which are plentiful in New England's fishing grounds, but which lack a demanding market. The handling of non-traditional species in ways which will preserve high quality is a problem at the level of producer, processor and distributor.

The harvesting of these fish by the present fleet is limited by storage problems on board the vessels and by the fish-handling techniques required by such species. Although New England's vessels are well equipped for traditional fishing, they are not readily adaptable to the catching of non-traditional species. Some of the stocks which have not been targets of the New England fishermen in the past but which have a potential as valuable under-utilized species require special handling which most of the boats are unable to provide. Adult herring from offshore can be successfully handled by vessels with refrigerated or slush ice/ circulating sea water holds; only a handful of New England vessels are so equipped. High-quality of whiting and squid at the dock is achieved now by only a few boats which make short trips; special handling and prompt processing (freezing) are required if these species are caught on longer trips and are to be delivered to shore in good condition. Few of the "new" vessels entering the fleet incorporate sophisticated equipment for keeping fish in good condition between catching and landing.

In other words, the New England fleet includes some boats which can catch any given species or which incorporate modern techniques, but many more boats with special design and equipment will be required to do the kind of fishing needed for the future.

The export market potential for many species of limited appeal in the U.S. depends on producing a reliable high-quality product. Some New England producers and processors do maintain high-quality control, but others have had difficulty in meeting the requirements of export markets in Europe. Many U.S. processors lack contacts in European markets, and although foreign buyers have expressed increased interest in U.S. produced fishery products, few Americans have made specific contacts in European markets. The exception to this is the growing export market for adult herring and increasing experimentation with frozen squid, redfish, whiting. Part of the problem in expanding foreign markets is in learning about foreign expectations about quality, size, packing method, quantity to be shipped, and so forth; the U.S. seller must adapt his process to meet these demands.

Development of a larger U.S. market for non-traditional species requires in addition that producers, processors, distributors, retailers and consumers learn methods for catching, holding, preserving, processing and preparing the product. Average annual direct consumption of seafood has increased in the U.S. in recent years and it is likely to increase with the growing health consciousness of Americans. In addition there is the potential growth for American-produced products in processed foods in supermarkets, restaurants and fast food chains now supplied by foreign-caught fish - if the U.S. fishermen could begin to supply larger quantities at lower prices per pound. Naturally, the fishermen will usually choose to catch low volumes of high-priced fish if they can make more money this way.

Extensive expansion of the U.S. industry into frozen fillets and prepared products will require more freezer capacity. If some of this expansion is to rely on domestically caught fish, cold storage will also have to be added. Managers have told us they prefer to create their own cold storage and freezer capacity when they expand rather than rely on rental facilities. Although freezer space and cold storage space is generally available, much of this space earns income on seasonally available products, such as cranberries, which displace the fishery products.

Future expansion and successful adaptation to changing supply and market situations will require some changes in the operations of the individuals in the New England fishing and processing industries. There will be many opportunities in the next decade; the potential for success certainly exists.

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APPENDIX I

SURVEY OF FISH PROCESSORS IN NEW ENGLAND

1976 PROCESSING CAPACITY SURVEY

"This report is authorized by law (18 U.S.C. 1854(c)). While you are not required to respond, your cooperation is needed to make the results of this survey comprehensive, accurate & timely."

APPROVED: OMB No. 41-S-77062
EXPIRES: December 1977

Survey of Fish Processors in
New England - 1976 Processing Capacity Survey

Susan B. Peterson and Leah J. Smith
Woods Hole Oceanographic Institution

Company Name ____________________

Address ____________________

Report made by - signature ____________________ phone __________

Position ____________________

1. At what percent of total capacity was your plant running for all of 1976 in each of the following finished product categories? Please fill in the blank, or check "no capacity" for each product.

Finished product	percent	no capacity	Finished product	percent	no cap
Fresh fish	____%	____	canned - non-human consumption	____%	____
Frozen fish	____%	____	cured fish	____%	____
Canned - human consumption	____%	____	fish meal, oil solubles	____%	____

2. At what percent of total capacity would you have preferred to operate for 1976 in each of the following finished product categories? Please fill in the blank, or check "no capacity" for each product.

Finished product	percent	no capacity	Finished product	percent	no cap
Fresh fish	____%	____	canned - non-human consumption	____%	____
Frozen fish	____%	____	cured fish	____%	____
Canned - human consumption	____%	____	fish meal, oil solubles	____%	____

3. If you were to expand your production with different products, what one or ones would you prefer to produce?

4. How difficult would it be for you to expand into these products? Check one.

Very difficult_____ Difficult_______ Easy_____ Very easy_________

5. In what area or areas would your problems(s) be most serious? Check one or more.

Labor supply _____ Fish supply ______ Capital ________

Market demand (sales) ____ Pollution control _______ no problems _________

6. Do you own fishing boats, distribution vehicles, retail markets, restaurants, etc. in addition to your processing plant?

Yes____ No _____ if yes, please specify ______________________________

7. Do you have plans to expand in the direction of:

Additional processing plants a._______
Processing frozen blocks b._______
Fishing boats c._______
Distribution systems d._______
Retail outlets e._______
Restaurants f._______
Other ____

8. Please fill in the following information about your plant:

Year company established _________
Square feet of enclosed space _______sq. ft.
Value of equipment $__________
(machines, conveyor belts, trucks, etc.)
Freezer capacity _________________cubic feet
Cold storage capacity _______________cubic feet

9. Does your plant use mechanized skinners and/or boners? Yes____ No____

10. What were your gross sales in 1976? $_______________

11. What was your value added in 1976? $_______________

12. What was your cost of energy in 1976? $_____________

13. What was your total labor cost in 1976 $_____________

14. What percent of the fish that your process is:

Domestic fresh ____________%
Imported fresh ____________%
Domestic frozen ___________%
Imported frozen ___________%

15. Markets for product:

Local ________
Regional (incl. New York) _________
Nationwide ________
Exports ___________

We thought our questionnaire was both simple and comprehensive; some of the replies reminded us of the complexity of the industry, and we found when compiling the data that we had omitted several vital questions.

We should have asked each plant to identify itself as a processor, wholesaler, distributor or retailer; conversely, we should not have used the word Processor in the title of the form - a number of plants did not reply because they did not classify as processors - and we wish they had.

Another time we would ask each plant to list the species of their raw material, by importance in pounds used.

In question one, among the Finished Products, we would include the categories Fresh Lobsters - Shellfish - Crabs - Shrimp and Frozen Lobsters - Shellfish - Crabs - Shrimp. In question eleven we should have included a definition of the term "value added"; many respondents did not know how to interpret the term.

We listed six categories of problems in question five. No one checked the No Problems entry. On the other hand, some of the plants wrote in types of problems which we had not considered: lack of space (acreage and dock facilities) for expansion, the fish quotas, transportation, and a labor problem that is qualitative rather than quantitative - the lack of capable, experienced workers.

Finally, we wish we had plainly stated that for this report we are bound by the same rules of confidentiality as are government agencies. Perhaps more of the plants would have volunteered cost and sales figures if they had realized that these numbers would not be publicized.

APPENDIX II

FISHING GEAR ADAPTABILITY -- THE USES OF DATA

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Manuscript submitted for publication.
Copies available on request to the authors.

APPENDIX III

HISTOGRAMS: DISTRIBUTION OF VESSEL CREW AND FISHING VARIABLES

The material included in this appendix is available from

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APPENDIX IV

GRAPHS OF VARIABLES FOR MANN-WHITNEY TESTS SIGNIFICANT AT .05 LEVEL

(NMFS weighout and vessel register data is from 1976. MPOM interviews collected data for 1976; they were conducted in 1977)

The material included in this appendix is available from

Dr. Leah J. Smith
Dr. Susan B. Peterson
Marine Policy & Ocean Management
Woods Hole Oceanographic Institution
Woods Hole, Mass. 02543

March 1979

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			11. Contract/Grant No. 03-6-043-35165 04-8-M01-149
12. Sponsoring Organization Name and Address National Marine Fisheries Service, Pew Memorial Trust, Department of Commerce			13. Type of Report & Period Covered Technical
			14.

15. Supplementary Notes

16. Abstracts

The New England fishing industry is examined in terms of the capacity of the fishing fleet, of the processing plants, and of the transportation system. Limitations on the capacity of the industry, and its capability and flexibility, are explored in terms of social, economic and technical aspects. The study is based on interviews with fishermen, buyers, processors and distributors, and on data made available by the National Marine Fisheries Service. Although the fisheries is in a state of expansion and both vessels and plants have a greater capacity than is now being used, the major problems that may restrict expansion in both fishing and processing are quality control, species selection and market development.

17. Key Words and Document Analysis. 17a. Descriptors

1. Fisheries
2. New England
3. Socio-economic

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

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