

# Groundfish Processing in Massachusetts During the 1970's

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## Introduction

Groundfish products, flounders, Atlantic cod (hereafter referred to as cod), haddock, pollock, and ocean perch, play a major role in the U.S. fresh fish industry. In 1979, fresh and frozen groundfish fillets accounted for 68 percent of the quantity and 76 percent of wholesale value for the fresh and frozen fillets from all species (USDC, 1980).

Most U.S. groundfish processing (72 percent by both quantity and wholesale value of fillets) is done in Massachusetts. In 1979, processing plants there produced 85 million pounds of the U.S. fresh and frozen groundfish fillet total of 119 million pounds and \$133 million of the total wholesale value of \$186 million<sup>1</sup>. Knowledge of Massachusetts' groundfish industry is obviously important in choosing management alternatives as

required by the Fishery Conservation and Management Act of 1976 (FCMA).

Fresh groundfish production in Massachusetts is a result of three separate but interconnected industries: Fishing, processing, and retailing. In 1979, about 450 boats (in excess of 5 tons gross weight) landed and sold their catch to processing firms and brokers at the various ports in Massachusetts<sup>2</sup>. Since most of these boats are owned by fishing families or are partnerships among the captain and various crew members, the sales of fresh groundfish by boats to processing firms are transactions between independent companies. Ex-vessel prices are determined either through auctions (as in Boston and New Bedford), individual negotiations, or consignment sales. Round or drawn fish arrive at the processing plants and are usually filleted, skinned, and pack-

aged into 10- or 20-pound containers. Other products include steaks, frozen fillets, frozen blocks, and frozen and packaged dinners and portions.

The final and most crucial part of fresh fish processing is sales. The rapid deterioration of fresh fish and the large variation in both supply and demand contribute to a constant crisis atmosphere in the sales departments of processing companies. As in most businesses, sales is the major determinant of production rates. Processing firms to sell to fish markets, supermarkets, restaurants, and institutions which, in turn, sell these groundfish products to final consumers. Except for cooking and other preparation in restaurants and institutions, retail products are sold in the same form as received from processing plants.

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<sup>1</sup>Massachusetts total from Georgianna, D., and J. Dirlam, 1981. A statistical summary of the groundfish processing industry in Massachusetts. Prog. rep., NMFS, Gloucester, Mass. U.S. Totals are from USDC, 1980.

<sup>2</sup>Pat Kurkul, Industry Economist, National Marine Fisheries Service, NOAA, Gloucester, MA 01930. Pers. commun.

*ABSTRACT—Massachusetts groundfish (flounders, Atlantic cod, haddock, pollock, and ocean perch) landings, production, and Canadian imports were compiled from 1970 to 1979. Generally, the first half of the 1970's was a period of stagnation for the Massachusetts groundfish industry. Its revitalization roughly corresponded with the passage of the Fishery Conservation and Management Act of 1976. From 1976 through 1979, landings, produc-*

*tion, and wholesale value of processed products increased by 44 percent, 50 percent, and 62 percent, respectively. Furthermore, wholesale prices increased steadily from a weighted average of \$0.60/pound in 1970 to \$1.56/pound in 1979, 50 percent more than the increase in the average wholesale price of meat, poultry, and fish.*

*Boston's and New Bedford's shares of Massachusetts' landings dropped about 30*

*percent with the difference being made up by Gloucester and the smaller ports. However, both Boston and New Bedford retained their share of processed production. With the large decline of yellowtail landings starting in the 1960's and extending into the 1970's, New Bedford, traditionally the leading port for this species, became a major port for cod and haddock as the fleet and processing plants switched to these species.*

The FCMA, which was enacted with considerable support from the New England fishing industry, added a political dimension to the financial interdependence among the sectors in the groundfish industry. The Act established a 200-mile offshore conservation zone and created Regional Fishery Management Councils to plan for the optimum utilization by the nation of traditional commercial species and to encourage the commercial development of nontraditional species. The New England Fishery Management Council has concentrated on conservation by means of quotas for the traditional species. Subsidies and gear development programs have been introduced to encourage landings of nontraditional species.

Quotas, when applied, have usually affected the ports in Massachusetts differently, since Massachusetts' ports have traditionally specialized by species: Boston has harvested and processed primarily cod, haddock, and pollock; New Bedford, flounders; and Gloucester, ocean perch (White, 1954; Smith and Peterson, 1977). The ports have tended to land the species they process, but there has been considerable movement of drawn and round fish among ports both within and outside of the Commonwealth. Therefore, the processing industry at each port has been more complex than is reflected by local landings.

In estimating capacity, industrial organization, and cost structure of the New England processing industry, we compiled basic data on the landings, production, and movement of fresh fish and decided to develop this statistical description of the Massachusetts fresh groundfish industry<sup>3</sup>. A general overview of the pattern of fish landings, processing, and processing employment among the ports is not only useful in computing production and predicting changes in processing

capacity but can also indicate economic effects on various ports and the reaction of the processing industry to changes in quotas and landings.

Information presented in this paper includes annual landings, annual processed production by the major ports and by species, employment and average plant size by port, and movement of unprocessed fish into and out of the state. These data are presented for 1970-79, except for landings (1964-79), and Canadian imports (1974-79).

### Methods

Data sources were the National Marine Fisheries Service (NMFS) Resource Statistics Division, Washington, D.C.; NMFS Northeast Fisheries Center, Woods Hole, Mass.; and NMFS Market News (New York and Boston). The data were obtained either from direct access or on magnetic tape or transcribed from computer printouts and published sheets. Unfortunately, NMFS did not retain processing production data prior to 1970, and Canadian import data for whole fresh groundfish by species were not available for the years prior to 1974.

Groundfish landings were compiled as landed weight (whole fish weight for flounders and ocean perch and drawn weight for cod, haddock, and pollock). Yearly rates of production have been presented as either product weight or converted to landed weight by multiplying by the conversion factors 2.63, 2.50, 2.19, 2.82, and 3.57 for cod, haddock, pollock, flounder, and ocean perch, respectively<sup>4</sup>.

Yearly rates of production and yearly value were estimated by totaling the rates and values by species for all plants that used fresh groundfish inputs. Since the NMFS data did not categorize by type of input, we determined the use of fresh or frozen inputs within a plant by interviewing plant managers, NMFS port agents, and NMFS Market News reporters.

Groundfish plants in Massachusetts usually processed from either fresh or frozen inputs, but rarely from both types. We estimated that there were fewer than five plants that used both types of inputs in Massachusetts, and these plants were included in the totals if they used mostly fresh inputs. Since employment is not reported by type of input, employment estimates were likewise totaled from fresh groundfish plants.

We also estimated flows of unprocessed fish into and out of Massachusetts. Groundfish came into Massachusetts primarily from Canada, Maine, and Newport, R.I. To estimate this input, we assumed that all fresh, whole, or drawn Canadian groundfish that passed through the New England Customs Districts were processed in Massachusetts. The amount of Maine groundfish landings shipped to Massachusetts was estimated as the remainder after subtracting Maine's fresh and frozen fillet production and whole fish trucked to the Fulton Fish Market in New York from Maine landings. New Bedford fish dealers and fishermen informed us that all cod, haddock, and pollock landed in Newport was trucked to Massachusetts for further processing. However, since some of the flounder landed in Newport went to the Fulton Fish Market, we assumed that Newport dealers transported to New York the same percentage of flounder as did Massachusetts dealers, roughly 20 percent. The remainder, we assumed, came into Massachusetts.

Whole and drawn fish shipped out of state went primarily to the Fulton Fish Market and was recorded there by state of origin. Data for fish trucked to other states from Massachusetts were not systematically recorded, nor were data kept for fish coming into Massachusetts from the southern coastal states<sup>5</sup>.

<sup>3</sup>Georgianna, D., P. Greenwood, R. Ibara, and R. Ward. 1981. Fish processing capacity in Massachusetts and New Hampshire. Tech. rep. New England Fisheries Development Program, National Marine Fisheries Service, NOAA, Gloucester, MA 01930.

<sup>4</sup>Main, D. E., Port Agent, Resource Statistics Division, NMFS, New Bedford, MA 02740. Pers. commun.

<sup>5</sup>For further details on the method of estimating fish movement, see D. Georgianna et al., Fish processing capacity in Massachusetts and New Hampshire. Tech. rep., New England Fisheries Development Program, National Marine Fisheries Service, NOAA, Gloucester, MA 01930.

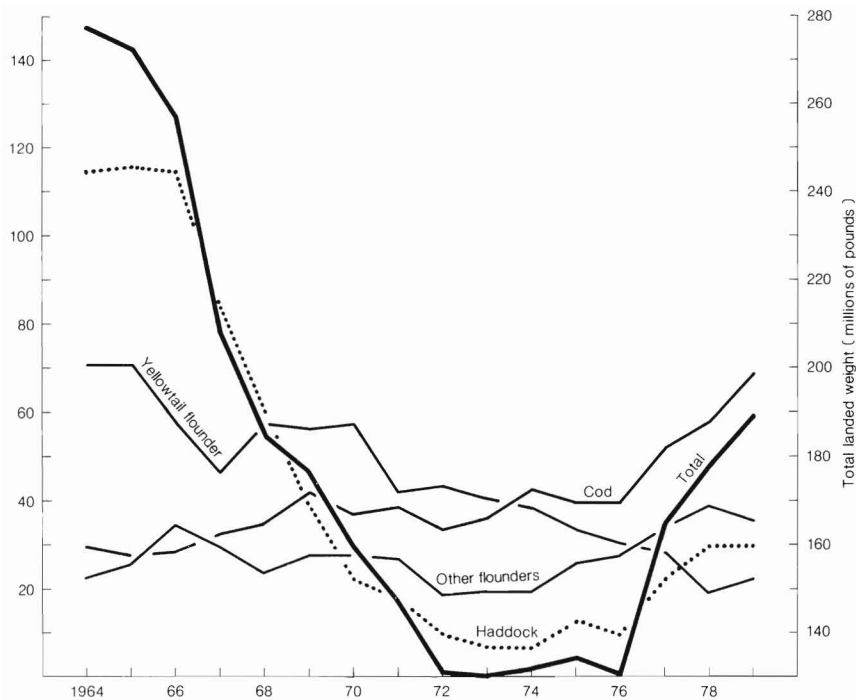


Figure 1.—Massachusetts landings of yellowtail flounder, other flounder species, cod, haddock, and total (including pollock and ocean perch, scale on right), 1964-79.

### Results

Significant changes in groundfish landings occurred between 1964 and 1979. From a high of 279 million pounds in 1964, landings decreased by 53 percent to a low of 130 million pounds in 1973 (Fig. 1). The trend in recent years has reversed with landings in 1979 recovering to 68 percent of 1964's landings primarily due to increased abundance and the growth of the New England fishing fleet since passage of the FCMA.

In terms of species, total flounder landings in 1979 were down by 36 million pounds from 1964, a 38 percent drop<sup>6</sup>. Yellowtail decreased fairly steadily after 1964, from 71 million

pounds to 23 million pounds in 1979, without any indication of recovery. However, landings of other species of flounder increased from 23 million pounds in 1964 to 36 million pounds in 1979. Total cod, haddock, and pollock (data not shown in Fig. 1) landings were 155 million pounds in 1964, dropped to 66 million pounds by 1970, and recovered to 115 million pounds by 1979. Cod landings increased steadily from 30 to 68 million pounds, a 230 percent increase from 1964 to 1979. The drop in haddock landings from 114 million pounds in 1964 to 7 million pounds in 1974 was sharp. Haddock landings have increased since 1974 but the 1979 landings of 29 million pounds were only 26 percent of the 1964 landings. Pollock landings (data not presented in Fig. 1), historically the least important of these three species, increased during the period to 17

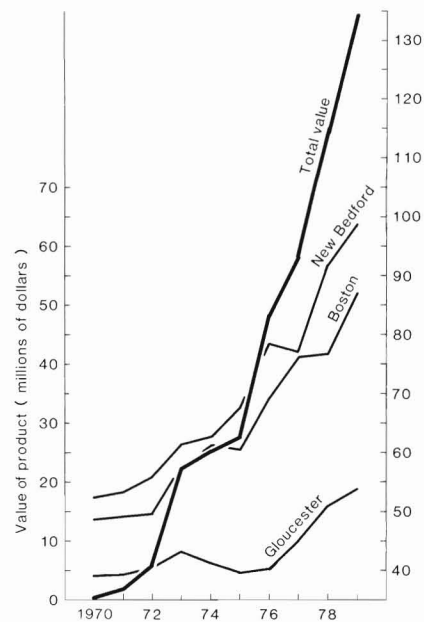


Figure 2.—Comparison of values of fresh groundfish production among the ports and the total Massachusetts value (scale on right) for the 1970's.

million pounds in 1979 from 11 million pounds in 1964 and varied from 5 million pounds in 1968 to 19 million pounds in 1978. The pattern of ocean perch landings (data not shown in Fig. 1) was similar to that for haddock with a drop of about 88 percent during the 1960's, from 30 to 4 million pounds from 1964 to 1968, respectively. A partial recovery occurred during the 1970's to 16 million pounds by 1979.

The yearly Massachusetts' landings, rate, and value of production for combined groundfish species increased during the 1970's. Groundfish landings increased by 29 million pounds, an increase of 18 percent (Table 1, Fig. 1). Rate of production increased by 28 million pounds in product weight, an increase of 47 percent. The value of processed products increased by \$99 million, a 281 percent increase (Table 1, Fig. 2).

<sup>6</sup>Landings not shown on Figure 1 are from the NMFS Northeast Fisheries Center, Woods Hole, Mass., and are available from the senior author.

**Table 1.—Groundfish landings, production, and product value by port<sup>1</sup> (landed and product weight in millions of pounds; wholesale processed value in millions of dollars).**

Year	Item	Boston	Gloucester	New Bedford	Other <sup>2</sup>	Total
1970	Landed	30.8 (19%)	30.9 (19%)	81.9 (51%)	16.0 (10%)	159.6
	Processed	22.6 (39%)	8.6 (15%)	27.2 (46%)		58.4
	Value	\$13.6	\$ 4.2	\$17.5		\$ 35.3
1971	Landed	30.0 (20%)	34.1 (23%)	58.7 (40%)	24.2 (16%)	147.0
	Processed	20.0 (38%)	8.8 (16%)	24.5 (46%)		53.3
	Value	\$14.2	\$ 4.3	\$18.3		\$ 36.8
1972	Landed	19.4 (15%)	36.0 (28%)	52.7 (40%)	22.4 (17%)	130.5
	Processed	15.8 (32%)	9.2 (19%)	24.2 (49%)		49.2
	Value	\$14.6	\$ 5.5	\$20.8		\$ 40.9
1973	Landed	22.5 (17%)	33.0 (26%)	50.5 (39%)	23.9 (18%)	129.9
	Processed	24.3 (39%)	11.9 (19%)	25.9 (42%)		62.1
	Value	\$22.6	\$ 8.1	\$26.5		\$ 57.2
1974	Landed	23.5 (18%)	28.7 (22%)	53.5 (41%)	25.5 (19%)	131.2
	Processed	24.9 (42%)	9.3 (16%)	25.1 (42%)		59.3
	Value	\$26.1	\$ 6.3	\$27.7		\$ 60.1
1975	Landed	20.9 (15%)	34.6 (26%)	57.4 (43%)	21.3 (16%)	134.2
	Processed	21.5 (42%)	5.6 (11%)	23.8 (47%)		50.9
	Value	\$25.5	\$ 4.7	\$32.5		\$ 62.7
1976	Landed	19.7 (15%)	38.7 (30%)	50.4 (38%)	22.1 (17%)	130.9
	Processed	26.2 (46%)	4.8 ( 8%)	26.2 (46%)		57.2
	Value	\$34.3	\$ 5.3	\$43.5		\$ 83.1
1977	Landed	19.0 (12%)	59.6 (36%)	57.1 (35%)	28.5 (17%)	164.2
	Processed	32.0 (47%)	9.7 (14%)	26.6 (39%)		68.3
	Value	\$41.1	\$10.0	\$42.1		\$ 93.2
1978	Landed	23.1 (13%)	65.7 (37%)	52.6 (30%)	35.9 (20%)	177.3
	Processed	28.6 (37%)	14.8 (19%)	33.2 (43%)		76.6
	Value	\$41.8	\$15.9	\$56.8		\$114.5
1979	Landed	25.9 (13%)	61.6 (33%)	63.8 (34%)	37.5 (20%)	188.8
	Processed	33.6 (39%)	14.0 (16%)	38.3 (45%)		85.9
	Value	\$51.8	\$18.8	\$63.8		\$134.4

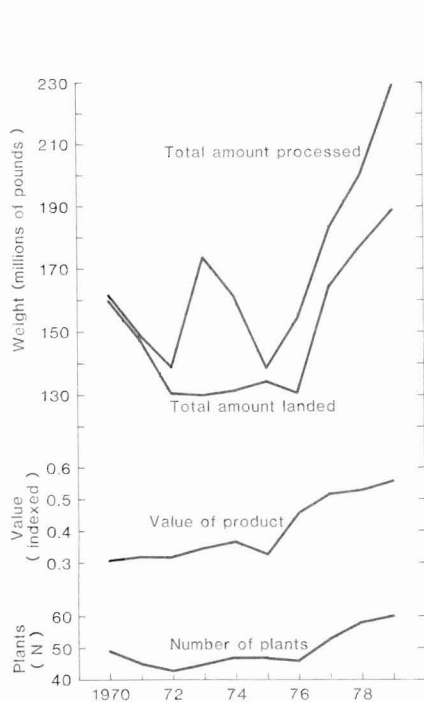
<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Processed products of "Other" ports were included in the nearest major port.

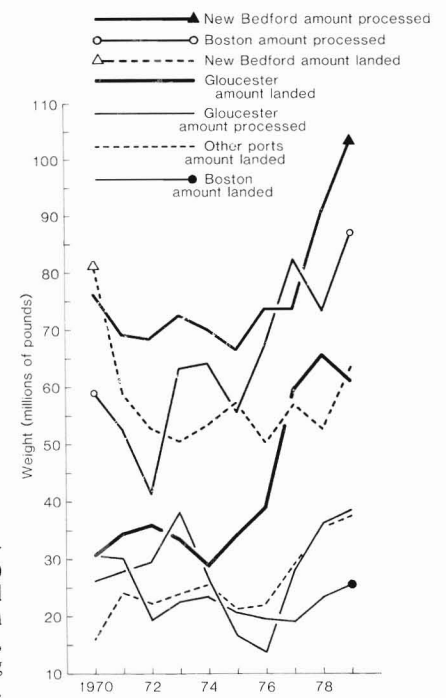
Since product weight averages around 30 percent of landed weight, it can be seen that production increased at a faster rate than landings (Fig. 3). Large shipments of unprocessed groundfish were coming into Massachusetts from Canada, Maine, Rhode Island, and other southern coastal states.

Among the ports, Boston's share of landings dropped from 19 to 13 percent while its share of processed production remained relatively constant around 40 percent (Table 1, Fig. 4). The pattern in New Bedford was similar with its share of landings dropping from 51 to 34 percent while its share of processed production remained about 45 percent. Gloucester's share of landings increased from 19 to 33 percent while its share of processed production remained at about 15 percent. During the 1970's, the smaller ports produced an insignificant amount of processed products, but their share of landings increased from 10 to 20 percent.

While the shares of total processed groundfish products among ports remained constant, the species composi-



**Figure 3.—Comparison of Massachusetts groundfish landings (Total amount landed), processed production (Total amount processed, converted to landed weight), value of production (Value of product, indexed by wholesale price of processed meats, poultry, and fish), and number of processing plants (Number of plants) for the 1970's.**



**Figure 4.—Comparison of groundfish landings (Amount landed) among the three major ports and the "other" ports, and groundfish production (Amount processed, converted to landed weight) among the ports for the 1970's.**

tion of groundfish production by port changed significantly, reflecting the decreased ex-vessel supply of flounders and increased ex-vessel supply of cod, haddock, and pollock. Massachusetts' flounder landings decreased by 26.6 million pounds (313 percent), as processed production decreased by 7.4 million pounds (88 percent) and value increased by \$32 million (165 percent) between 1970 and 1979 (Table 2). New Bedford suffered the bulk of the loss in flounder landings, a decrease of 43.3 million pounds (62 percent), while flounder landings increased in Gloucester and the smaller ports by 19 million pounds (170 percent). As a result, New Bedford's share of Massachusetts flounder landings decreased from 82 to 45 percent between 1970 and 1979.

The decrease in flounder landings and processed products was more than offset by the increase in the landing and processing of cod, haddock, and pollock, with New Bedford receiving the bulk of the cod and haddock increases. Cod landings increased by 31 million pounds (83 percent), production by 46 million pounds (154 percent), and value by \$33 million (566 percent) between 1970 and 1979 (Table 3). Boston processed 65 percent of the cod in 1970 while New Bedford processed only 24 percent. But, by 1979, Boston had dropped to 46 percent of Massachusetts' totals while New Bedford had increased its share to 40 percent. Gloucester maintained a relatively constant proportion of production, approximately 12 percent, throughout the 1970's.

Haddock landings increased by 7 million pounds (33 percent), production by 22 million pounds (95 percent), and value by \$24 million (329 percent) between 1970 and 1979 (Table 4). In the early 1970's, Boston landed approximately half and processed about 85 percent of the fresh haddock in Massachusetts. By 1979, Boston's share of haddock landings dropped to 22 percent and production dropped to 55 percent. The drop in Boston's share was accompanied by increases in New Bedford's and Gloucester's shares. In the early 1970's,

Table 2.—Flounder landings, production, and product value by port<sup>1</sup> (landed and product weight (converted to landed weight) in millions of pounds and wholesale processed value in millions of dollars).

Year	Item	Boston	Gloucester	New Bedford	Other <sup>2</sup>	Total
1970	Landed	3.8 (4%)	4.5 (5%)	69.7 (82%)	6.9 (8%)	84.9
	Processed	9.0 (11%)	6.2 (7%)	68.5 (82%)		83.7
	Value	\$ 2.3	\$ 1.4	\$15.7		\$ 19.4
1971	Landed	4.4 (6%)	4.2 (6%)	46.7 (68%)	13.5 (20%)	68.8
	Processed	8.5 (12%)	4.2 (6%)	61.2 (82%)		73.9
	Value	\$ 2.5	\$ 0.9	\$16.3		\$ 19.7
1972	Landed	2.2 (4%)	3.0 (5%)	44.3 (72%)	12.2 (19%)	61.7
	Processed	7.3 (10%)	2.3 (3%)	63.4 (87%)		73.0
	Value	\$ 2.4	\$ 0.6	\$19.3		\$ 22.3
1973	Landed	3.1 (5%)	3.8 (6%)	39.7 (67%)	12.8 (22%)	59.4
	Processed	3.5 (10%)	8.2 (10%)	65.1 (80%)		81.8
	Value	\$ 3.5	\$ 2.3	\$24.1		\$ 29.7
1974	Landed	2.7 (5%)	3.0 (5%)	39.4 (68%)	13.0 (22%)	58.1
	Processed	6.2 (9%)	2.8 (4%)	58.4 (87%)		67.4
	Value	\$ 2.8	\$ 1.2	\$23.5		\$ 27.5
1975	Landed	1.7 (3%)	4.4 (7%)	42.4 (72%)	10.5 (18%)	59.0
	Processed	6.5 (10%)	1.4 (2%)	59.5 (88%)		67.4
	Value	\$ 3.9	\$ 0.5	\$29.4		\$ 33.8
1976	Landed	1.5 (3%)	6.9 (12%)	35.5 (62%)	13.5 (23%)	57.4
	Processed	7.9 (11%)	1.1 (1%)	65.7 (88%)		74.7
	Value	\$ 4.6	\$ 0.6	\$39.7		\$ 44.9
1977	Landed	1.2 (2%)	11.2 (18%)	32.9 (53%)	16.7 (27%)	62.0
	Processed	8.7 (13%)	4.8 (7%)	53.6 (80%)		67.1
	Value	\$ 6.1	\$ 2.1	\$33.0		\$ 41.2
1978	Landed	1.6 (3%)	13.9 (24%)	24.9 (42%)	18.1 (31%)	58.5
	Processed	7.9 (11%)	5.1 (7%)	56.6 (82%)		69.6
	Value	\$ 7.0	\$ 2.3	\$39.5		\$ 48.8
1979	Landed	1.6 (3%)	11.8 (20%)	26.4 (45%)	18.5 (32%)	58.3
	Processed	10.7 (14%)	5.1 (7%)	60.6 (79%)		76.4
	Value	\$ 8.0	\$ 2.8	\$40.6		\$ 51.4

<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Processed products of "Other" ports were included in the nearest major port.

New Bedford landed about 20 percent of Massachusetts' haddock landings and processed less than 1 million pounds, 3 percent of Massachusetts' production. By 1979, however, New Bedford landed 10 million pounds, 34 percent of Massachusetts' haddock landings and processed 12 million pounds, 26 percent of Massachusetts' production. Gloucester increased its share of haddock landings from 24 percent to 38 percent and production from 13 percent to 19 percent between 1970 and 1979.

Pollock landings and production increased by 10 million pounds (139 and 125 percent, respectively), while wholesale value increased by \$6 million (500 percent) between 1970 and 1979 (Table 5). Boston dominated production throughout the 1970's, producing from 66 to 88 percent of Massachusetts' fresh pollock. How-

ever, Boston's share of landings decreased from about 50 to 20 percent while Gloucester and New Bedford increased their share of landings to 59 and 11 percent, respectively, between 1970 and 1979.

Ocean perch landings increased by 8 million pounds (87 percent), production decreased by 2 million pounds (12 percent), and value increased by \$4 million (211 percent) (Table 6). In 1970, Gloucester landed 87 percent and processed 73 percent of Massachusetts' totals for ocean perch. By 1979, its share of landings and production dropped to 60 and 64 percent, respectively, losing some of the market to Boston.

In general, more unprocessed fish came into Massachusetts than went out, and the excess of incoming fish, except for ocean perch, increased with time (Table 7). Even though landings



in Massachusetts increased by 44 percent between 1974 and 1979, the demand for fresh fish inputs increased by even more as the net imports into Massachusetts increased from 16.9 million pounds to 28.1 million pounds over the period.

The species brought unprocessed into Massachusetts in the largest quantities were flounders and haddock. In 1979, the net shipment into Massachusetts of whole flounders was 11 million pounds. According to processing plant managers, fishermen, New York Market News reporters, and port agents, most of the yellow-tail flounder landed in New England were processed in New Bedford, while winter flounder and other flounders were trucked to New York. Unfortunately, neither the production data nor Canadian imports were recorded by species of flounder. Recently, from the landings and processing data, it seems likely that more winter flounder and other flounders were processed in New Bedford.

During the 1970's, virtually no unprocessed haddock left Massachusetts while large amounts of drawn haddock were brought into the Commonwealth. In 1974, more drawn haddock was brought into Massachusetts than was landed there, while in the late 1970's shipments into Massachusetts totaled about one-third of local landings.

According to our method of estimation, relatively large amounts of drawn pollock (4 to 6 million pounds) came into Massachusetts from Maine yearly from 1976 through 1979, even though the data indicate that Massachusetts landings alone roughly equaled processed production (Table 5). We cannot explain this difference. Unfortunately, there has been very little investigation into the production and distribution of pollock.

During most of the years between 1974 and 1979, more drawn cod was trucked to the Fulton Fish Market from Massachusetts than was brought into the Commonwealth from Maine, Canada, and Newport, R.I. The net outflow has decreased in recent years even though Massachusetts landings

Table 3.—Atlantic cod landings, production, and product value by port<sup>1</sup> (landed and product weight (converted to landed weight) in millions of pounds and wholesale processed value in millions of dollars).

Year	Item	Boston	Gloucester	New Bedford	Other <sup>2</sup>	Total
1970	Landed	10.6 (28%)	10.6 (29%)	8.1 (22%)	7.8 (21%)	37.1
	Processed	19.2 (65%)	3.4 (11%)	7.1 (24%)		29.7
	Value	\$ 3.6	\$ 0.7	\$ 1.6		\$ 5.9
1971	Landed	11.0 (30%)	9.9 (26%)	8.3 (22%)	9.1 (24%)	38.3
	Processed	20.5 (68%)	2.9 (10%)	6.8 (22%)		30.2
	Value	\$ 4.5	\$ 0.7	\$ 1.8		\$ 7.0
1972	Landed	8.1 (24%)	10.0 (30%)	6.5 (20%)	8.6 (26%)	33.2
	Processed	14.5 (66%)	2.9 (13%)	4.5 (21%)		21.9
	Value	\$ 4.3	\$ 0.9	\$ 1.3		\$ 6.5
1973	Landed	9.7 (27%)	8.3 (23%)	8.9 (25%)	9.0 (25%)	35.9
	Processed	25.5 (71%)	3.4 (9%)	7.1 (20%)		36.0
	Value	\$ 7.7	\$ 1.0	\$ 2.3		\$ 11.0
1974	Landed	10.0 (23%)	9.7 (23%)	12.2 (29%)	10.5 (25%)	42.4
	Processed	22.1 (60%)	3.7 (10%)	11.3 (30%)		37.1
	Value	\$ 7.4	\$ 1.0	\$ 4.1		\$ 12.5
1975	Landed	7.1 (18%)	12.1 (31%)	11.1 (28%)	9.3 (23%)	39.6
	Processed	18.2 (68%)	2.9 (11%)	5.5 (21%)		26.6
	Value	\$ 7.3	\$ 1.0	\$ 2.3		\$ 10.6
1976	Landed	6.9 (18%)	13.2 (33%)	11.8 (30%)	7.6 (19%)	39.5
	Processed	21.2 (71%)	1.6 (5%)	6.9 (24%)		29.7
	Value	\$ 9.5	\$ 0.8	\$ 3.4		\$ 13.7
1977	Landed	7.4 (14%)	19.6 (38%)	15.9 (31%)	8.8 (17%)	51.7
	Processed	29.7 (58%)	4.9 (10%)	16.1 (32%)		50.7
	Value	\$13.0	\$ 1.8	\$ 7.2		\$ 22.0
1978	Landed	8.4 (15%)	17.7 (31%)	18.1 (31%)	13.3 (23%)	57.5
	Processed	25.0 (42%)	13.9 (24%)	20.3 (34%)		59.2
	Value	\$13.2	\$ 5.6	\$10.0		\$ 28.8
1979	Landed	7.9 (12%)	18.9 (28%)	25.5 (37%)	15.7 (23%)	68.0
	Processed	35.0 (46%)	10.5 (14%)	30.0 (40%)		75.5
	Value	\$18.7	\$ 5.5	\$15.1		\$ 39.3

<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Processed products of "Other" ports were included in the nearest major port.

of cod have increased significantly, implying an increase in the demand for cod.

The net inflow into Massachusetts agreed fairly well with the difference between landings and processing in the Commonwealth (Tables 1-6). The unexplained difference between landings and processed production was within the range of 5-20 percent except for pollock in recent years and haddock in 1974. We think that the variation was acceptable considering the diverse sources of data and estimation techniques.

Over the decade, the number of processing plants increased in Gloucester and New Bedford and decreased slightly in Boston (Table 8, Fig. 3). Gloucester gained 2 plants and New Bedford 11 plants while Boston lost 2 plants. Average plant

size (total groundfish production) increased by 61 percent in Boston and 30 percent in Gloucester between 1970 and 1979, while the average plant size decreased 21 percent in New Bedford. In 1970, average plant size in New Bedford was approximately double that in Boston and Gloucester. While the difference has narrowed, plant size is still slightly larger in New Bedford than in other ports. Plant size in Massachusetts has remained relatively constant throughout the decade. Therefore the number of plants has closely followed the increase in rate of production.

In terms of number of people working, the total employment of the groundfish processing plants decreased in the middle 1970's but recovered for an increase of 8 percent by 1979 over 1970 (Table 9). In 1970,

**Table 4.—Haddock landings, production, and product value by port<sup>1</sup> (landed and product weight (converted to landed weight) in millions of pounds and wholesale processed value in millions of dollars).**

Year	Item	Boston	Gloucester	New Bedford	Other <sup>2</sup>	Total
1970	Landed	11.6 (52%)	5.4 (24%)	4.0 (18%)	1.1 ( 6%)	22.1
	Processed	19.3 (84%)	3.0 (13%)	0.7 ( 3%)		23.0
	Value	\$ 6.2	\$ 0.8	\$ 0.2		\$ 7.2
1971	Landed	9.0 (50%)	4.3 (24%)	3.5 (20%)	1.1 ( 6%)	17.9
	Processed	15.3 (84%)	2.5 (14%)	0.5 ( 2%)		18.3
	Value	\$ 6.0	\$ 0.8	\$ 0.2		\$ 7.0
1972	Landed	3.9 (41%)	3.1 (32%)	1.8 (19%)	0.8 ( 8%)	9.6
	Processed	12.5 (89%)	1.3 ( 9%)	0.3 ( 2%)		14.1
	Value	\$ 6.5	\$ 0.6	\$ 0.1		\$ 7.2
1973	Landed	3.4 (50%)	1.5 (22%)	1.3 (19%)	0.6 ( 9%)	6.8
	Processed	15.8 (88%)	1.8 (10%)	0.3 ( 2%)		17.9
	Value	\$ 8.5	\$ 0.7	\$ 0.1		\$ 9.3
1974	Landed	3.0 (45%)	1.5 (23%)	1.5 (22%)	0.7 (10%)	6.7
	Processed	21.0 (91%)	1.8 ( 8%)	0.3 ( 1%)		23.1
	Value	\$11.2	\$ 0.9	\$ 0.1		\$ 12.2
1975	Landed	5.0 (39%)	3.7 (29%)	3.4 (26%)	0.7 ( 6%)	12.8
	Processed	17.0 (83%)	2.3 (11%)	0.3 ( 6%)		20.6
	Value	\$10.4	\$ 1.0	\$ 0.7		\$ 12.1
1976	Landed	3.7 (38%)	3.2 (33%)	2.3 (24%)	0.4 ( 4%)	9.6
	Processed	21.8 (91%)	1.8 ( 7%)	0.5 ( 2%)		24.1
	Value	\$15.1	\$ 1.3	\$ 0.3		\$ 16.7
1977	Landed	5.2 (24%)	8.7 (39%)	6.5 (29%)	1.7 ( 8%)	22.1
	Processed	28.0 (77%)	5.0 (14%)	3.3 ( 9%)		36.3
	Value	\$16.6	\$ 2.5	\$ 1.7		\$ 20.8
1978	Landed	6.5 (22%)	12.3 (42%)	8.1 (28%)	2.3 ( 8%)	29.2
	Processed	25.3 (60%)	4.0 (10%)	12.8 (30%)		42.1
	Value	\$15.9	\$ 2.1	\$ 6.9		\$ 24.9
1979	Landed	6.5 (22%)	11.2 (38%)	10.1 (35%)	1.6 ( 5%)	29.4
	Processed	24.8 (55%)	8.3 (19%)	11.8 (26%)		44.9
	Value	\$18.0	\$ 5.5	\$ 7.4		\$ 30.9

<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Processed products of "Other" ports were included in the nearest major port.

Boston plants employed an average of 624 persons per month, 43 percent of Massachusetts' fresh groundfish processing workforce. However, Boston's average decreased to 391 per month, 25 percent of the employment in Massachusetts by 1979. The average monthly employment in Gloucester plants increased from 285 per month to 363 per month between 1970 and 1979. The New Bedford plants greatly increased their monthly employment from 532 to 798 per month from 1970 to 1979. Of Massachusetts' fresh fish workers, New Bedford employed 37 percent in 1970 and 51 percent in 1979.

However, comparison between ports is suspect because the questionnaire did not differentiate between part-time and full-time employees. The contract in Boston between the

processing firms and the Seafood Workers Union guaranteed 40 hours of work per week for a union employee who worked Monday while the New Bedford contract did not have such a clause, and Gloucester plants were nonunion. Therefore, in New Bedford and Gloucester, where workers could be called in by the day or hour, there were more part-time workers.

### Discussion and Conclusions

The first half of the 1970's may be characterized as a period of industrial stagnation for the groundfish industry in Massachusetts. Landings declined until 1977, averaging only about half of what they were in the early 1960's. Revitalization of the groundfish industry began with the FCMA in 1976; by the end of the decade, landings,

production, and wholesale value of processed products had increased by 44, 50, and 62 percent, respectively.

After falling steadily throughout the 1960's and early 1970's, the abundance of haddock roughly doubled on Georges Bank and in the Gulf of Maine between 1975 and 1979, matching the increase in cod abundance due to unusually large year classes for both species in 1975<sup>7</sup>. Vessels and processing firms that depended upon haddock landings must have had very difficult times during the late 1960's and early 1970's.

However, not all species shared in the recovery. Yellowtail flounder, the leading groundfish species, steadily declined in landings and production due to a large drop in abundance after 1972<sup>8</sup>.

While effort among species in a multispecies fishery is difficult to measure, it seems reasonable that the fleet in Massachusetts, especially in New Bedford, increased concentration on cod and haddock as the stocks increased and the abundance of yellowtail decreased. Overall effort directed at these species increased as the size of the New England fleet of vessels over 60 tons increased from 256 to 430 vessels (68 percent) between 1976 and 1979<sup>9</sup>.

The sharp drop in ocean perch landings in Massachusetts from 1964 through 1970 does not seem to have been due to declining abundance in the Gulf of Maine (Clark and Brown, 1977). Rather, the aging fleet of large steamers, built in the 1930's and used

<sup>7</sup>Clark, S., R. Mayo, and E. Faulk. 1981. Georges Bank and Gulf of Maine haddock stock status - 1981. Lab. ref. doc. 81-05. NMFS Northeast Fisheries Center, Woods Hole, Mass. Serchuk, F., and P. Wood, Jr. Assessment and Status of the Georges Bank and Gulf of Maine Atlantic Cod Stocks - 1981. NMFS Northeast Fisheries Center, Woods Hole, Mass.

<sup>8</sup>Clark and Brown (1977) and Clark, S., L. O'Brien, and R. Mayo. 1981. Yellowtail flounder stock status - 1981. Lab. ref. doc. 81-10. NMFS Northeast Fisheries Center, Woods Hole, Mass.

<sup>9</sup>Draft environmental impact statement for the interim fishery management plan for Atlantic groundfish, 1981. New England Fishery Management Council, Saugus Office Park, 5 Broadway, Saugus, MA 01906.

in Gloucester and Maine, were not being replaced. The 5 million pound increase in Massachusetts ocean perch landings since 1974 is misleading since landings in Maine dropped by 13 million pounds over the same period. The overall recent decline in ocean perch landings is due to declining abundance in the Gulf of Maine and the restriction of U.S. vessels from the Canadian grounds since 1978.<sup>10</sup>

Between 1970 and 1974 the quantity of ocean perch processed in Massachusetts was about double what was landed there. The difference was made up from Canadian imports and Maine landings (Table 7). The major products during that period (about 40 percent of the total) were frozen breaded fillets, which could be produced from imported Canadian fresh or frozen fillets. From 1975 through 1979, processed products roughly equaled landings in the Commonwealth as frozen breaded fillets dropped to 20 percent of the total and imported Canadian fresh and frozen fillets dropped from an average of 62 million pounds during 1970 through 1974 to 47 million pounds during the second half of the decade.<sup>11</sup> While more investigation is needed, our data imply that as landings of cod, haddock, pollock, and ocean perch increased and transportation facilities for fresh fillets improved, fresh fillets were substituted for frozen breaded ocean perch fillets.

The pattern of landings by species throughout Massachusetts has changed. Groundfish landings decreased in Boston and New Bedford during the 1970's while landings more than doubled in Gloucester and the other ports. However, Boston and New Bedford processing plants continued to dominate the processing sector with

<sup>10</sup>Stephen Clark, NMFS Northeast Fisheries Center, Woods Hole, Mass. Pers. commun.

<sup>11</sup>Production totals are from processed products data, NMFS Resource and Statistics Division, Washington, D.C. Summary statistics on ocean perch are available from the senior author. Import statistics are from the U.S. Bureau of Census and are available from R. Cory, Center for Ocean Management Studies, U.R.I., Kingston, RI 02881.

Table 5.—Pollock landings, production, and product value by port<sup>1</sup> (landed and product weight (converted to landed weight) in millions of pounds and wholesale processed value in millions of dollars).

Year	Item	Boston	Gloucester	New Bedford	Other <sup>2</sup>	Total
1970	Landed	3.8 (54%)	2.9 (42%)		0.3 ( 4%)	7.0
	Processed	6.8 (88%)	0.9 (12%)			7.7
	Value	\$ 1.1	\$ 0.1			\$ 1.2
1971	Landed	4.6 (53%)	3.5 (41%)		0.5 ( 6%)	8.6
	Processed	4.6 (81%)	1.1 (19%)			5.7
	Value	\$ 0.7	\$ 0.2			\$ 0.9
1972	Landed	3.6 (36%)	5.6 (56%)		0.8 ( 8%)	10.0
	Processed	3.9 (66%)	2.0 (34%)			5.9
	Value	\$ 0.9	\$ 0.4			\$ 1.3
1973	Landed	3.9 (39%)	4.7 (46%)		1.5 (15%)	10.1
	Processed	9.3 (82%)	2.0 (18%)			11.3
	Value	\$ 2.3	\$ 0.4			\$ 2.7
1974	Landed	6.0 (46%)	5.5 (42%)	0.4 ( 3%)	1.2 ( 9%)	13.1
	Processed	10.0 (75%)	3.3 (25%)			13.3
	Value	\$ 2.5	\$ 0.7			\$ 3.2
1975	Landed	4.7 (39%)	6.2 (51%)	0.5 ( 4%)	0.8 ( 6%)	12.2
	Processed	9.4 (80%)	2.2 (18%)	0.2 ( 2%)		11.8
	Value	\$ 2.8	\$ 0.6	\$ 0.1		\$ 3.5
1976	Landed	5.0 (38%)	6.7 (51%)	0.8 ( 6%)	0.6 ( 5%)	13.1
	Processed	10.8 (79%)	2.6 (19%)	0.2 ( 2%)		13.6
	Value	\$ 3.3	\$ 0.9	\$ 0.1		\$ 4.3
1977	Landed	2.9 (20%)	8.2 (57%)	1.9 (13%)	1.3 ( 9%)	14.3
	Processed	10.9 (78%)	2.6 (19%)	0.4 ( 3%)		13.9
	Value	\$ 3.9	\$ 0.8	\$ 0.2		\$ 4.9
1978	Landed	3.8 (20%)	11.5 (60%)	1.5 ( 8%)	2.2 (12%)	19.0
	Processed	10.9 (72%)	3.5 (23%)	0.7 ( 5%)		15.1
	Value	\$ 4.2	\$ 1.1	\$ 0.3		\$ 5.6
1979	Landed	3.5 (20%)	10.0 (59%)	1.8 (11%)	1.7 (10%)	17.0
	Processed	11.4 (66%)	4.6 (27%)	1.3 ( 7%)		17.3
	Value	\$ 5.1	\$ 1.5	\$ 0.6		\$ 7.2

<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Processed products of "Other" ports were included in the nearest major port. New Bedford totals to 1974 (less than 0.5 million pounds) were included in Boston since there were less than three processors of pollock in the port.

Gloucester plants maintaining their 15 percent share of the market. Boston processing plants increased their purchases of unprocessed cod, haddock, and pollock from Gloucester, other ports in Massachusetts, Maine, and Canada, while New Bedford primary dealers sold less unprocessed cod and haddock to Boston.

The traditional specialization of landings and processing of groundfish by species among the major ports in Massachusetts has also changed. New Bedford traditionally was very highly specialized, primarily landing and processing flounders, particularly yellowtail flounder. But, as the landings of yellowtail flounder dropped from a high of 71 million pounds in 1965 to 20 million pounds in 1978, the New Bedford fleet and groundfish

plants adjusted by landing and processing a greater amount of cod and haddock. Flounder production dropped by 8 million pounds while cod production increased by 23 million pounds and haddock production increased by 11 million pounds in New Bedford processing plants during the 1970's. For both cod and haddock, the increase in landings in New Bedford preceded the increase in processed products until the late 1970's when processed products overtook landings for both species.

While the increase in landings and production of all species is recent, wholesale prices increased steadily throughout the 1970's from a weighted average of \$0.60/pound in 1970 to \$1.56/pound in 1979, approximately 50 percent larger than the increase in



**Table 6.—Ocean perch landings, production, and product value by port<sup>1</sup> (landed and product weight (converted to landed weight) in millions of pounds and wholesale processed value in millions of dollars).**

Year	Item	Boston	Gloucester	New Bedford	Other <sup>2</sup>	Total	Total (excluding breaded fillets)
1970	Landed	1.1 (13%)	7.5 (87%)			8.6	8.6
	Processed	4.6 (27%)	12.5 (73%)			17.1	10.7
	Value	\$ 0.6	\$ 1.2			\$ 1.8	\$ 0.8
1971	Landed	1.1 (8%)	12.2 (92%)			13.3	13.3
	Processed	3.6 (17%)	17.1 (83%)			20.7	12.5
	Value	\$ 0.5	\$ 1.8			\$ 2.3	\$ 1.3
1972	Landed	1.6 (10%)	14.5 (90%)			16.1	16.1
	Processed	3.2 (13%)	20.7 (87%)			23.9	16.1
	Value	\$ 0.5	\$ 3.0			\$ 3.5	\$ 2.2
1973	Landed	2.4 (14%)	14.7 (86%)			17.1	17.1
	Processed	3.9 (15%)	22.5 (85%)			26.4	17.2
	Value	\$ 0.8	\$ 3.7			\$ 4.5	\$ 2.7
1974	Landed	1.9 (17%)	8.6 (79%)	0.4 (4%)		10.9	10.9
	Processed	5.0 (25%)	15.0 (75%)			20.0	13.9
	Value	\$ 1.0	\$ 2.2			\$ 3.2	\$ 2.0
1975	Landed	2.4 (23%)	8.1 (77%)			10.5	10.5
	Processed	4.3 (35%)	7.9 (65%)			12.1	10.4
	Value	\$ 1.1	\$ 1.5			\$ 2.6	\$ 2.2
1976	Landed	2.6 (23%)	8.7 (77%)			11.3	11.3
	Processed	5.7 (46%)	6.8 (54%)			12.5	12.1
	Value	\$ 1.7	\$ 1.8			\$ 3.5	\$ 3.4
1977	Landed	2.2 (16%)	11.9 (84%)			14.1	14.1
	Processed	5.0 (32%)	10.4 (68%)			15.4	14.3
	Value	\$ 1.6	\$ 2.8			\$ 4.4	\$ 4.0
1978	Landed	2.8 (21%)	10.3 (79%)			13.1	13.1
	Processed	4.7 (33%)	9.6 (67%)			14.3	10.7
	Value	\$ 1.5	\$ 2.7			\$ 4.2	\$ 3.3
1979	Landed	6.4 (40%)	9.7 (60%)			16.1	16.1
	Processed	5.4 (36%)	9.6 (64%)			15.0	12.2
	Value	\$ 2.2	\$ 3.4			\$ 5.6	\$ 5.3

<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Processed products of "Other" ports were included in the nearest major port. New Bedford totals (less than 0.5 million pounds) were included with Boston figures since there were less than three processors of ocean perch in the port.

**Table 7.—Shipments of unprocessed fish into Massachusetts (In) from Canada, Maine, and Newport, R.I., and out of Massachusetts (Out) to the Fulton Fish Market<sup>1</sup> (landed weight in millions of pounds).**

Year	Item	Flounders	Cod	Haddock	Pollock	Ocean perch
1974	In	13.4	4.3	7.6	2.0	9.2
	Out	10.4	7.8	0.0	1.3	0.1
	Diff.	3.0	(3.5)	7.6	0.7	9.1
1975	In	11.6	0.8	7.7	3.6	2.0
	Out	11.3	7.1	0.0	1.1	0.1
	Diff.	0.3	(6.3)	7.7	2.5	1.9
1976	In	13.4	5.4	8.5	4.9	0.0
	Out	9.7	6.4	0.0	1.0	0.0
	Diff.	3.7	(1.0)	8.5	3.9	0.0
1977	In	15.6	8.7	7.3	6.4	0.0
	Out	11.5	6.7	0.0	1.1	0.0
	Diff.	4.1	2.0	7.3	5.3	0.0
1978	In	16.1	8.0	8.6	7.4	0.0
	Out	11.8	8.8	0.0	1.3	0.0
	Diff.	4.3	(0.8)	8.6	6.1	0.0
1979	In	22.4	8.2	10.4	5.2	0.0
	Out	11.4	8.7	0.0	1.1	0.1
	Diff.	11.0	(0.5)	13.6	4.1	(0.1)

<sup>1</sup>Compiled from data supplied by the Northeast Fisheries Center, NMFS, NOAA, Woods Hole, Mass., and the *New York Market News*, NMFS, NOAA, New York, N.Y.

**Table 8.—Number of fresh groundfish plants (P) and average yearly production per plant (AP) by port<sup>1</sup> (product weight in thousands of pounds).**

Year	Item	Boston	Gloucester	New Bedford	Totals
1970	P	27	8	14	49
	AP	837	1,075	1,943	1,192 <sup>2</sup>
1971	P	24	8	13	45
	AP	833	1,100	1,885	1,184
1972	P	22	7	14	43
	AP	718	1,314	1,729	1,144
1973	P	23	8	14	45
	AP	1,057	1,488	1,850	1,380
1974	P	24	7	16	47
	AP	1,038	1,329	1,569	1,262
1975	P	23	7	17	47
	AP	935	300	1,400	1,083
1976	P	23	6	17	46
	AP	1,139	800	1,541	1,243
1977	P	23	9	21	53
	AP	1,391	1,078	1,267	1,289
1978	P	25	11	22	58
	AP	1,144	1,345	1,509	1,321
1979	P	25	10	25	60
	AP	1,344	1,400	1,532	1,432

<sup>1</sup>Compiled from data supplied by the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

<sup>2</sup>Weighted average yearly production of plants in the major Massachusetts ports.

**Table 9.—Employment in fresh groundfish plants by port<sup>1</sup> (yearly average number employed per month).**

Year	Boston	Gloucester	New Bedford	Total
1970	624	285	532	1441
1971	585	268	591	1444
1972	579	263	545	1387
1973	618	381	552	1551
1974	585	273	594	1452
1975	516	251	588	1355
1976	397	223	594	1214
1977	348	351	666	1365
1978	346	421	737	1504
1979	391	363	798	1552

<sup>1</sup>Compiled from data supplied by the Resource Statistics Division, NMFS, NOAA, Washington, D.C.

the average wholesale price of meat, poultry, and fish over the same period (Fig. 3 and USDL, 1971-79). During the early 1970's the price increase was apparently due to a reduction in supply. In the late 1970's the increase in supply was overshadowed by the increase in demand, perhaps due to increasing public awareness of circulatory diseases associated with high cholesterol diets.

These results indicate that established processing plants and fishing vessels found it more profitable to turn to other traditional species rather than toward nontraditional species, when the favored traditional species became less available. The increase in wholesale prices during the 1970's helps to explain why processing firms were not anxious to turn toward nontraditional species. Also, developing markets for nontraditional species was costly and could not be recouped over a long period, since, once the market was established, other processing firms would enter and bid down the high rates of return. The increasing prosperity of the traditional groundfish industry was much more appealing to established processing firms.

The choice of a different traditional species over a nontraditional species is easy to understand once the components of a switch to nontraditional species are considered. Boats must change gear, work procedures, and trip patterns. Skippers must learn the location and habits of the new species. Unloading facilities and methods must be changed. Processing plant equipment and work must be adapted to the new species. And, most importantly, plant owners, managers, and sales people must make new marketing arrangements with new customers in an initial atmosphere of apprehension between buyer and seller. Furthermore, all these changes require financing and must happen more or less simultaneously among participants who may not have been especially cooperative in the past. The

choice of another traditional species must be a welcome relief to a local fishing industry.

However, the promotion of a nontraditional species succeeded when pollock was introduced in Boston. The Boston Fisheries Association and the U.S. Bureau of Commercial Fisheries (predecessor to the NMFS) promoted pollock through advertising, supermarket displays, and subsidies for pollock landings during the 1960's in a successful campaign to encourage demand and supply for pollock when haddock was becoming scarce. Boston processing plants were able to initiate and maintain their predominance of the pollock market throughout the 1970's. Plans to utilize nontraditional species should consider the experience of the Boston pollock industry. However, pollock may be a special case, since it is a close substitute to cod and haddock in fishing, processing, and retailing.

Finally, while some technological changes occurred in the fishing sector in the 1970's—including the change-over from side trawlers to stern trawlers and toward larger vessels with greater fishing power—there was little technological change in the processing sector. The overall average plant size in Massachusetts remained about the same, increasing somewhat in Boston and Gloucester and decreasing in New Bedford. Currently the average plant size is about the same in the three ports, averaging 28,000 pounds of product per week. Fresh groundfish plants are small, labor intensive, and family owned because of the rapid deterioration of the product and large

variation in supply and demand. There is a very recent trend toward automated filleting machines. These were available prior to the 1970's but apparently the low volume of landings, the inconsistency of input, or relatively low wages of cutters, or a combination of the three did not justify their cost.

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#### Literature Cited

- Clark, S. H., and B. E. Brown. 1977. Changes in biomass of finfishes and squids from the Gulf of Maine to Cape Hatteras, 1963-74, as determined from research vessel survey data. *Fish. Bull.*, U.S. 75:1-21.
- Smith, L., and S. Peterson. 1977. The New England fishing industry: a basis for management. Tech. rep., Woods Hole Oceanographic Institution, Woods Hole, Mass., 130 p.
- USDC. 1980. Fisheries of the United States, 1979. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Curr. Fish. Stat. 8000.
- USDL. 1971-79. Monthly labor review. U.S. Dep. Labor, Wash., D.C.
- White, D. 1954. The New England fishing industry. Harvard Univ. Press, Cambridge, Mass., 205 p.