manual of Seafood Processing and Marketing in north carolina

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A University of North Carolina
Sea Grant College Publication
UNC-SG-80-04

MANUAL OF

SEAFOOD PROCESSING AND MARKETING

IN NORTH CAROLINA

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ABSTRACT

This jointly supported project is aimed at examining present and developing aspects of seafood processing and marketing in North Carolina, as a working example for the Coastal Plains area. "Processors" as distinguished from "Handlers" are defined, while commercial landings of important species, ex-vessel prices, and seasonal availability are shown for three coastal regions.

Seafood freshness is the most important requirement for processing, requiring that rapid cooling and adequate sanitation be initiated promptly at sea. Adequate hold insulation helps achieve rapid cooling, while small refrigeration units for cooling air in holds are suggested as an additional improvement.

Good Manufacturing Practices for unloading and subsequent processing are explained in the guideline publications listed. Subjective and laboratory tests for freshness, and requirements for freezing, thawing, glazing, and packaging are explained in terms relevant to the local fisheries.

In North Carolina most processing operations have evolved from existing shore handling facilities. Flow patterns are provided to show what applies to most operations. Logical development of processing and packaging facilities is therefore explained in terms of unit operations, building components, and basic equipment requirements. Identification of such factors as labor productivity, yields, product mix, and plant output enter into predictions of processing feasibility. Processing feasibility leads to investment analysis and capital budgeting, which are new elements included in this edition.

Technological aspects of marketing include such factors as quality, "frozen" vs. "fresh," inspection, consumer preferences, and use of seafoods as economical protein sources. Urgent needs for future development of processing and marketing are listed in Section 9.0, the most important being to develop and promote excellent frozen products capable of having the same acceptability as prime fresh unfrozen seafoods.

We must be quality conscious in all phases of seafood handling, from harvest to consumption. Therefore, quality control, sources of advisory assistance, addresses of regulatory agencies, and general references are provided for further assistance.

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PREFACE

REVISED EDITION

The success of the 1975 edition of this publication, entitled "Proceedings of the Workshop on Seafood Processing and Marketing in the Coastal Plains Area," has been marked by many favorable comments from industry, universities, and advisory agents. This earlier edition has been out-of-print for nearly eighteen months. Continuing inquiries have indicated a need for a revised 1980 edition.

In the preparation of this revision, a major portion of the original work on the conference and proceedings has been condensed. The statistical portion on landings and value by species has been revised to include the most recent data available. The continuing flux in the economic arena indicated drastic changes in cost of construction, equipment, and labor values.

The authors and editor have endeavored to keep this publication as a hands-on working document. Inclusion of new technology, packaging, investment analysis, and other new material tries to conform to the objectives of this revision.

Special thanks are due Dr. B. J. Copeland, Director, UNC Sea Grant College Program, for the special mini-grant permitting the revision of the 1975 edition. Freda Ramey has been our editor and for her excellent work we extend our sincere thanks.

Frank B. Thomas, Ph.D.
Extension Professor--Seafoods

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Bob Heidenreich, Packaging Products Corp., Plymouth, Mass.

Members of the Pilot Fish Processing Project Task Force

MANUAL OF SEAFOOD PROCESSING AND MARKETING IN NORTH CAROLINA

1.0 INTRODUCTION:

Seafood processing studies have been conducted by the NCSU Seafood Laboratory, Morehead City, since 1970, and at N. C. State University since 1964 with the following objectives:

A. To apprise the North Carolina seafood processing industry of its current status.

B. To define requirements for expanding, diversifying, and improving seafood processing activities in North Carolina.

1.01 Audience:

This publication is intended to help those concerned with improved utilization of the coastal fisheries and to help them define unsolved problems. Its concern is directed toward:

A. Fishermen
B. Seafood Handlers and Processors
C. Advisory Services, including those supported by Coastal Plains Regional Commission, UNC Sea Grant College Program, NCSU School of Agriculture and Life Sciences.

2.0 INDUSTRY ASSESSMENT:

2.01 Ports:

Page 2 shows the coastal portion of North Carolina to which this manual has reference. Those ports (unloading points) handling most of the catch are shown in capital letters while less active ports are shown in small letters.

2.02 Districts:

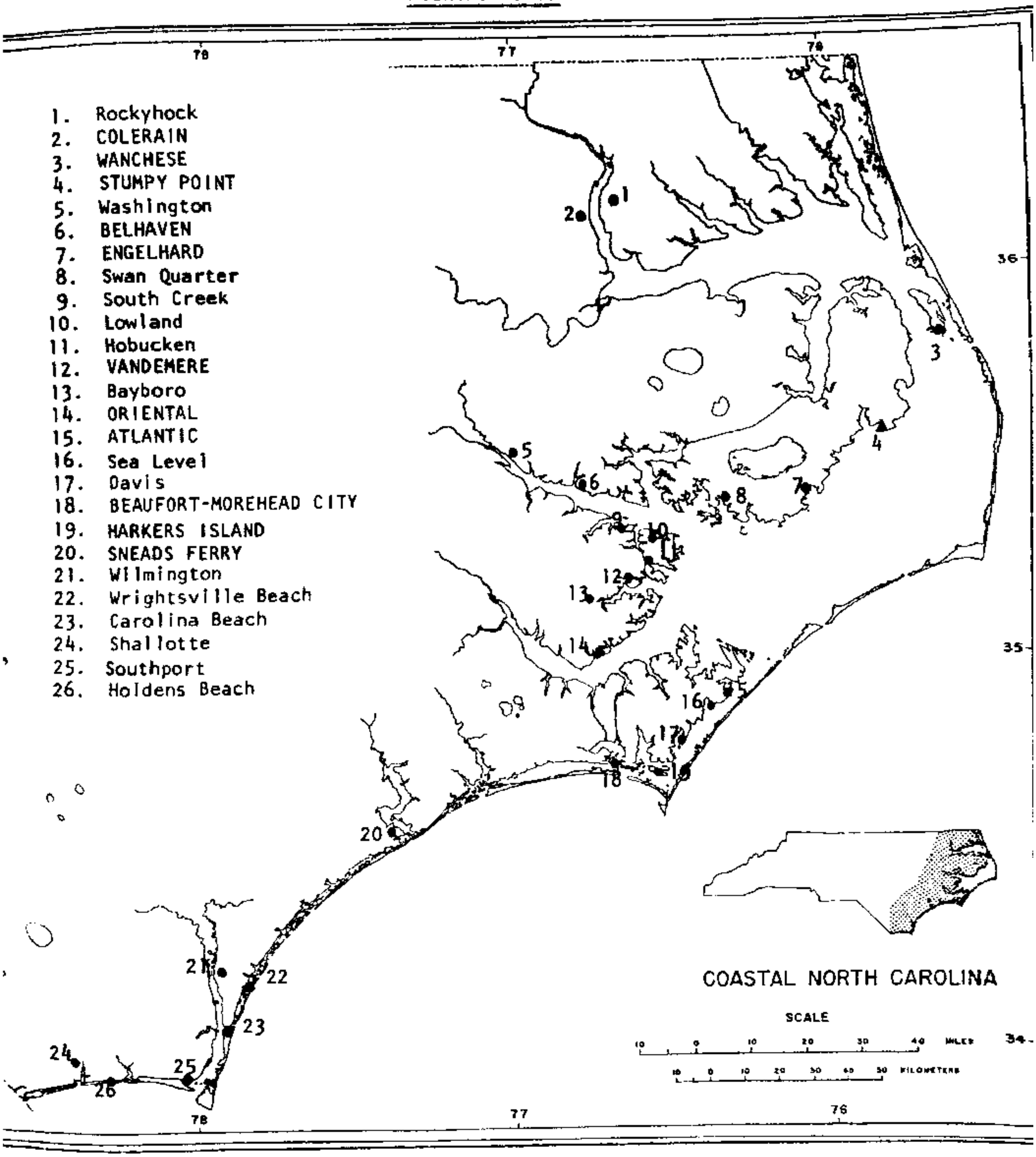
Page 3 shows a division of the North Carolina coastline into Northern, Central, and Southern Districts, a logical separation in considering processing aspects while coinciding with National Marine Fisheries Service (NMFS) and N. C. Division of Marine Fisheries reporting of commercial fisheries statistical data.

2.03 Licensed Fishing Boats:

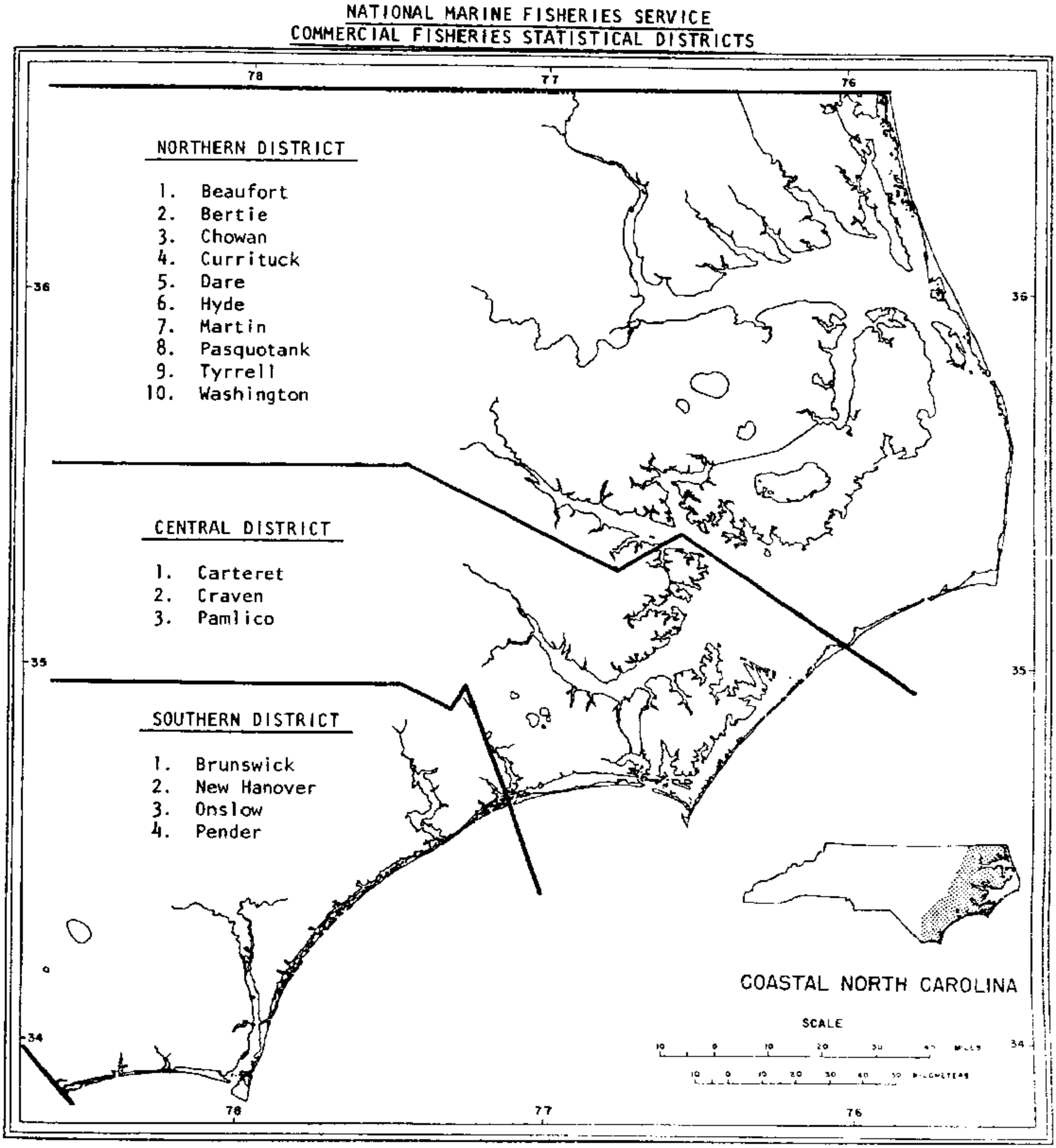
Pages 4 and 5 list the number of licensed fishing boats in North Carolina in 1979 by county and district.

2.01 Ports

FISHING PORTS



2.02 Districts



2.03 Licensed Fishing Boats

1979 LICENSED FISHING BOATS IN N.C.
(Coastal Counties)

County	Commercial Full Time	Commercial Part Time	Pleasure	Boat Lengths Under 21'	21-25'	26-50'	51-70'	71+
Northern District								
Beaufort	233	312	486	896	79	19	22	15
Bertie	19	30	74	119	4	-	-	-
Chowan	82	72	50	164	39	1	-	-
Currituck	106	202	42	316	26	8	-	-
Dare	566	452	124	749	215	139	12	27
Hyde	217	152	41	315	50	32	9	4
Martin	3	50	403	452	3	1	-	-
Pasquotank	45	103	42	181	5	3	-	-
Tyrrell	64	53	3	117	3	-	-	-
Washington	36	104	105	232	12	-	1	-
Total	1,371	1,530	1,370	3,541	436	203	44	47
Central District								
Carteret	1,218	1,237	1,005	2,719	431	261	30	19
Craven	61	328	1,068	1,369	63	18	4	3
Pamlico	253	198	391	605	88	94	26	29
Total	1,532	1,763	2,464	4,693	582	373	60	51

2.03 Licensed Fishing Boats

1979 LICENSED FISHING BOATS IN N.C.
(Coastal Counties)

County	Commercial Full Time	Commercial Part Time	Pleasure	Boat Lengths Under 21'	21-25'	26-50'	51-70'	71+
Southern District								
Brunswick	310	654	855	1,705	34	56	22	2
New Hanover	182	1,061	1,259	2,351	71	70	6	4
Onslow	255	746	650	1,514	61	61	13	2
Pender	53	404	366	796	17	6	3	1
Total	800	2,865	3,130	6,366	183	193	44	9
N.C. TOTAL (Coastal Counties)	3,703	6,158	6,964	14,600	1,201	769	148	107

2.04 Handlers and Processors:

Visits to 75 plants located in North Carolina coastal counties indicated that expansions in 7 years have involved the following:

	Total Facilities Added (1972 - 1978)
Handling and/or Processing Rooms, sq. ft.	170,919
Ice Rooms, cu. ft.	102,340
Ice Machines, tons/day	233
Cold Rooms, cu. ft.	186,600
Blast Freezers, cu. ft.	40,268
Frozen Storage Rooms, cu. ft.	292,096

Some of these facilities are located in 25 new handling or processing plants. The remaining facilities are housed in 35 handling or processing plant expansions.

Such findings indicate solid if modest growth, mostly accomplished with existing rather than over-capitalized financial resources. The kinds of operations normally conducted by handlers and processors can be summarized as follows:

A. Handlers: Operations limited to receiving, washing, sorting, icing, shipping.

B. Processors: Conduct additional operations such as described below:

1. Finfish:

   (a) Dresses appreciable amounts
   (b) Removes and preserves roe
   (c) Salts and/or pickles and/or smokes
   (d) Glazes and freezes, whole or dressed
   (e) Employs special forms of packaging materials

2. Shrimp:

   (a) Shells and veins
   (b) Glazes and freezes
   (c) Packages

3. Crabs:

   (a) Picks and packs crab meat
   (b) Steams whole crabs

(c) Further processes crab meat
(d) Produces clean carapaces

4. Oysters and Clams:

(a) Repacks
(b) Shucks and packs
(c) Produces clean clam shells

5. Scallops:

(a) Shucks and packs
(b) Freezes and packages

6. Industrial Finfish:

(a) Grinds and/or freezes for baits
(b) Dehydrates for animal feeds

N. C. HANDLERS AND PROCESSORS, by Districts
Number Concerned with Major Categories

	Northern	Central	Southern
HANDLERS	170	161	288
PROCESSORS			
Finfish	28	41	38
Shrimp	21	37	31
Crabs	15	12	2
Oysters & Clams	3	21	10
Scallops	2	18	-
Industrial Fish	3	4	1

2.05 Seafood Industrial Parks Concept:

The application of industrial park concepts to the fishing/seafood community has been under consideration in North Carolina throughout the last seven or eight years. The Wanchese Harbor Project, Dare County, is one of the several possible locations along the South Atlantic Seaboard with potential for seafood industrial park development.

Some basic requirements to be considered in planning for industrial parks include adequate deep water access, channelization, and stabilization; sufficient land area with adequate transportation facilities, utilities, labor resources; and provision of basic facilities necessary for industry, such as parking, fuel, docking, bulk-heading, fire protection, ice, ship stores, gear, engine, and electronic repair facilities.

Some of the potential benefits resulting from an industrial park include adequate fast handling facilities, easier fishery product inspection, and higher quality products provided by utilizing the shortest time possible between harvest and consumption. Solid and liquid waste disposal can be consolidated within the park through meal reduction plants handling the volume of solid wastes from fresh fish processing. Industrial parks could provide appropriately designed treatment plants for vessel discharges, wash-down water, and processing discharges.

A seafood park facility would allow consolidation of freezer storage, providing more efficiency and less cost than numerous smaller freezers and helping to assure inventory control. The industrial park would also facilitate financing, aid in quality product protection, and provide easy accessibility and allocation of fuels to vessels in a single distribution point.

3.0 RESOURCE:

3.01 Commercial Landings:

Commercial landings of important species, seasonal peaks, and ex-vessel prices, based on data collected by NMFS and N. C. Division of Marine Fisheries, are important in planning handling and processing operations. (A dash [-] under landings indicates fewer than 500 lbs. recorded.)

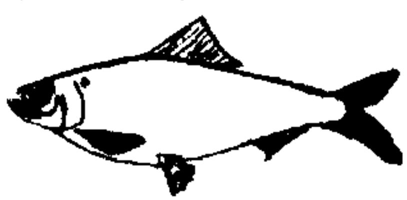
FINFISH:

3.01 Commercial Landings

A. ALEWIVES

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	12,648	1.0
1956	12,554	1.1
1957	11,773	1.0
1958	14,914	1.0
1959	14,154	1.0
1960	12,815	1.0
1961	11,951	1.0
1962	14,302	1.0
1963	15,100	1.0
1964	7,561	1.0
1965	12,826	1.0
1966	12,519	1.1
1967	18,486	1.7
1968	15,525	1.5
1969	19,762	1.5
1970	11,520	1.6
1971	12,722	2.7
1972	11,237	1.7
1973	7.926	3.3
1974	6,210	4.5
1975	5,952	4.0
1976	6,401	5.0
1977	8,524	5.0
1978	6,607	4.0
1979	5,119	6.1



ALEWIVES

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	6,209	5,952	6,401	8,524	6,606	5,118
¢/lb.	3.9	4.0	5.0	5.0	4.0	6.1
Central District						
1,000 lbs.	0.7	-	-	-	-	0.9
¢/lb.	5.1	-	-	-	-	5.0
Southern District						
1,000 lbs.	-	-	-	-	1	-
¢/lb.	-	-	-	-	7.0	-

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	6	5	2	1	2	4
Feb	12	52	104	13	20	29
Mar	453	568	749	1,444	854	785
Apr	5,341	3,306	5,495	6,990	5,428	3,503
May	397	2,021	50	43	303	798
Jun	0	0	1	32	0	-
Jul	0	0	0	0	0	-
Aug	0	0	0	0	0	-
Sep	0	0	0	0	0	-
Oct	0	0	0	0	0	-
Nov	0	0	0	0	0	-
Dec	0	0	0	0	0	-

3.01 Commercial Landings
B. BLUEFISH

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	435	12.2
1956	633	10.0
1957	816	13.1
1958	437	13.3
1959	740	11.9
1960	615	12.7
1961	752	12.5
1962	955	12.4
1963	813	11.9
1964	515	12.4
1965	704	7.0
1966	821	8.2
1967	888	9.1
1968	872	11.7
1969	871	11.0
1970	495	8.5
1971	578	10.2
1972	1,168	8.5
1973	2,008	6.5
1974	2,430	7.4
1975	1,975	8.4
1976	1,356	9.5
1977	2,331	9.4
1978	1,948	13.2
1979	3,406	19.2

BLUEFISH

DISTRICT LANDINGS & EX-VESSEL PRICES

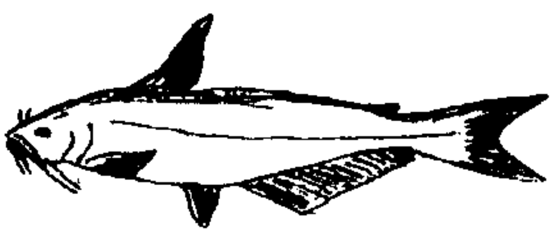
	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	373	873	627	939	851	1,518
¢/lb.	5.0	8.5	9.9	9.4	12.7	19.5
Central District						
1,000 lbs.	1,542	1,071	719	1,357	956	1,370
¢/lb.	8.7	8.1	9.0	8.9	11.3	14.6
Southern District						
1,000 lbs.	15	31	11	35	140	519
¢/lb.	8.9	13.6	13.6	24.6	28.9	30.7

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	83	132	137	153	159	409
Feb	290	97	9	331	301	853
Mar	94	298	53	601	246	601
Apr	68	211	22	335	142	351
May	68	232	89	59	73	230
Jun	118	66	37	77	59	71
Jul	162	145	205	41	34	62
Aug	341	152	184	66	49	49
Sep	188	119	155	104	82	45
Oct	513	302	175	205	173	303
Nov	129	132	34	126	132	218
Dec	120	91	257	232	498	212

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	951	8.0
1956	1,088	8.0
1957	1,259	8.0
1958	1,534	8.0
1959	1,465	8.0
1960	1,058	8.0
1961	1,093	8.0
1962	1,061	8.0
1963	1,230	9.0
1964	1,274	10.0
1965	1,531	10.6
1966	1,786	15.5
1967	1,785	15.5
1968	Not Reported	
1969	1,[illegible]54	14.4
1970	1,996	14.4
1971	2,030	14.4
1972	2,398	13.9
1973	1,957	14.6
1974	1,794	16.0
1975	1,687	16.6
1976	1,538	19.7
1977	2,073	20.5
1978	1,740	20.2
1979	1,652	20.0



CATFISH & BULLHEADS

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	1,752	1,654	1,500	2,068	1,706	1,501
¢/lb.	16.0	16.6	19.8	20.5	20.0	20.0
Central District						
1,000 lbs.	2	-	-	-	28	1
¢/lb.	16.9	-	-	-	12.0	10.9
Southern District						
1,000 lbs.	40	32	38	5	6	150
¢/lb.	14.9	16.0	18.3	20.0	21.8	31.2

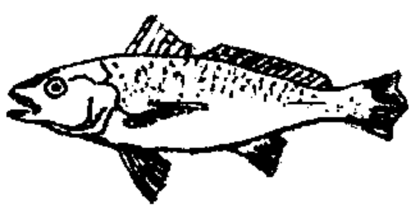
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	79	42	42	18	29	20
Feb	67	49	130	29	49	31
Mar	233	173	142	256	216	185
Apr	348	163	349	285	330	204
May	280	409	245	376	361	252
Jun	135	142	135	281	206	196
Jul	144	114	49	99	100	99
Aug	90	93	92	99	78	57
Sep	90	91	161	120	72	67
Oct	162	152	86	165	113	121
Nov	126	178	71	249	130	167
Dec	38	81	35	97	54	100

3.01 Commercial Landings
D. CROAKER

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	993	5.4
1956	4,829	6.0
1957	2,916	7.5
1958	6,921	7.6
1959	3,057	7.5
1960	2,093	7.5
1961	1,754	8.2
1962	1,663	8.8
1963	2,276	6.7
1964	1,867	7.4
1965	1,754	6.1
1966	1,267	5.0
1967	1,283	5.1
1968	1,201	5.0
1969	1,369	4.5
1970	807	4.7
1971	948	5.7
1972	4,109	5.5
1973	4,324	8.6
1974	6,072	9.9
1975	10,252	8.8
1976	15,038	10.5
1977	18,995	11.0
1978	19,945	13.7
1979	20,558	25.6



CROAKER

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	1,524	2,429	7,272	6,825	6,848	10,232
¢/lb.	10.4	9.0	11.0	12.0	13.9	21.3
Central District						
1,000 lbs.	4,491	7,747	7,692	12,076	12,976	9,893
¢/lb.	9.7	9.0	10.0	10.1	13.6	21.0
Southern District						
1,000 lbs.	57	76	74	93	121	433
¢/lb.	10.6	10.0	11.0	12.5	15.4	21.3

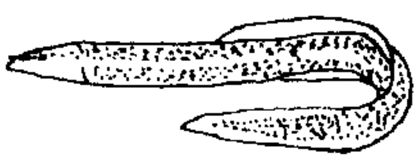
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	607	688	2,594	2,181	2,270	2,567
Feb	225	208	2,827	2,328	1,739	1,969
Mar	437	615	1,091	1,903	3,659	3,032
Apr	231	289	557	2,179	2,172	1,811
May	729	1,290	1,309	1,270	2,241	2,758
Jun	486	1,654	967	1,297	1,607	2,268
Jul	607	1,827	945	1,268	748	2,281
Aug	959	1,160	693	901	745	1,475
Sep	668	400	391	409	468	342
Oct	267	478	1,986	858	503	401
Nov	516	266	589	1,312	1,713	793
Dec	188	1,375	1,088	3,089	2,082	860

3.01 Commercial Landings
E. EELS, COMMON

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not Recorded	
1956	"	
1957	"	
1958	"	
1959	"	
1960	"	
1961	"	
1962	"	
1963	"	
1964	"	
1965	"	
1966	"	
1967	"	
1968	24	4.2
1969	18	4.5
1970	15	9.9
1971	167	15.9
1972	77	15.7
1973	134	41.8
1974	452	41.6
1975	238	35.4
1976	510	45.9
1977	258	43.5
1978	696	67.9
1979	955	89.8



EELS, COMMON

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	444	233	489	255	588	685
¢/lb.	41.7	35.5	45.8	43.5	68.9	81.2
Central District						
1,000 lbs.	7	3	20	3	60	202
¢/lb.	37.4	31.9	49.6	39.4	57.0	92.0
Southern District						
1,000 lbs.	2	1	1	-	47	67
¢/lb.	20.2	26.1	32.1	-	69.0	87.2

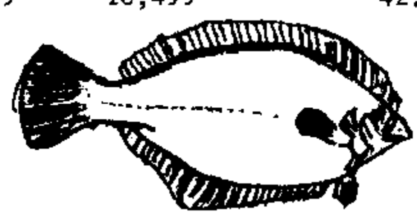
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	70	18	1	1	-	3
Feb	36	2	2	-	-	3
Mar	22	6	20	9	10	41
Apr	42	20	64	33	37	118
May	18	11	104	17	34	121
Jun	40	21	60	65	33	26
Jul	41	11	17	3	14	40
Aug	25	28	38	15	43	55
Sep	77	34	114	9	180	98
Oct	66	3	74	38	206	240
Nov	16	83	23	52	103	143
Dec	-	-	3	16	35	66

3.01 Commercial Landings
F. FLOUNDERS

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	1,126	12.3
1956	1,002	11.2
1957	1,236	12.0
1958	842	12.5
1959	1,529	12.2
1960	1,236	11.0
1961	1,897	12.1
1962	1,876	12.1
1963	2,674	16.5
1964	2,450	19.6
1965	4,721	20.1
1966	4,017	18.5
1967	4,391	19.7
1968	2,602	24.0
1969	2,766	25.5
1970	3,163	24.6
1971	4,011	27.9
1972	4,655	29.8
1973	7,364	29.3
1974	11,813	24.0
1975	11,510	30.8
1976	11,452	35.4
1977	11,137	44.9
1978	12,317	51.2
1979	18,499	42.5



FLOUNDERS

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	5,078	5,882	4,797	5,003	5,762	8,567
¢/lb.	23.6	31.2	33.8	45.0	53.4	48.5
Central District						
1,000 lbs.	6,592	5,411	6,284	5,881	6,283	8,838
¢/lb.	24.3	30.3	36.8	44.8	49.2	47.0
Southern District						
1,000 lbs.	143	216	371	253	272	1,051
¢/lb.	27.2	33.1	32.3	44.0	51.7	51.5

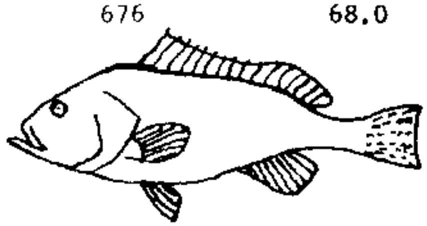
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	2,811	2,668	2,754	1,414	1,612	3,515
Feb	390	527	347	543	538	1,568
Mar	154	363	440	105	1,320	2,416
Apr	236	237	479	242	996	1,203
May	35	78	61	88	147	421
Jun	47	26	45	56	184	113
Jul	35	65	55	70	87	281
Aug	142	139	114	66	164	286
Sep	224	141	123	60	270	237
Oct	673	666	862	384	1,001	1,263
Nov	2,634	2,364	2,567	3,880	1,600	3,061
Dec	4,359	4,236	3,604	4,231	4,397	4,017

3.01 Commercial Landings
G. GROUPERS

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not Recorded	
1956	"	
1957	"	
1958	"	
1959	"	
1960	"	
1961	"	
1962	"	
1963	"	
1964	"	
1965	"	
1966	"	
1967	"	
1968	"	
1969	-	-
1970	-	-
1971	14	18.0
1972	-	-
1973	16	24.0
1974	70	40.4
1975	45	48.6
1976	12	55.5
1977	29	53.6
1978	597	54.1
1979	676	68.0



GROUPERS

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-
Central District						
1,000 lbs.	62	24	-	7	3	21
¢/lb.	41.1	50.4	-	57.4	48.7	72.3
Southern District						
1,000 lbs.	8	20	12	22	594	655
¢/lb.	35.0	46.6	55.6	52.5	54.1	67.5

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	-	-	-	-	19	8
Feb	-	-	-	6	5	19
Mar	-	1	-	-	-	52
Apr	-	5	-	-	16	74
May	-	7	-	2	89	90
Jun	-	-	-	8	100	71
Jul	17	1	-	2	101	72
Aug	14	3	3	3	71	122
Sep	-	12	-	-	83	70
Oct	11	12	4	-	42	32
Nov	21	4	4	1	36	34
Dec	6	1	-	6	36	32

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not Recorded	
1956	"	
1957	"	
1958	"	
1959	"	
1960	"	
1961	"	
1962	"	
1963	"	
1964	"	
1965	"	
1966	"	
1967	"	
1968	"	
1969	16	22.3
1970	12	24.3
1971	9	25.0
1972	9	29.9
1973	26	26.4
1974	40	60.2
1975	100	60.1
1976	156	70.0
1977	245	51.5
1978	172	62.7
1979	382	72.0

KING MACKEREL

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	8	65	131	228	115	286
¢/lb.	61.5	57.0	70.1	51.0	67.3	73.0
Central District						
1,000 lbs.	21	25	18	5	24	24
¢/lb.	57.9	72.6	70.0	77.0	50.9	54.5
Southern District						
1,000 lbs.	11	9	7	11	32	72
¢/lb.	63.8	48.0	48.8	50.0	55.0	72.9

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	-	-	-	-	1	1
Feb	-	4	-	-	-	-
Mar	-	-	-	-	-	1
Apr	-	1	-	2	1	23
May	1	3	1	22	10	25
Jun	1	1	2	-	2	5
Jul	-	-	1	4	1	6
Aug	-	1	2	1	1	6
Sep	1	11	7	4	5	31
Oct	15	14	33	92	49	94
Nov	17	63	106	104	86	105
Dec	4	2	4	15	17	84

3.01 Commercial Landings

1. KING WHITING

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	1,281	8.0
1956	1,434	8.0
1957	1,600	9.0
1958	1,054	9.3
1959	780	9.2
1960	927	9.1
1961	1,476	9.2
1962	1,262	9.6
1963	1,071	10.4
1964	1,141	8.4
1965	1,337	8.9
1966	767	7.6
1967	839	8.7
1968	635	10.7
1969	843	11.9
1970	563	13.1
1971	479	11.7
1972	683	12.2
1973	429	14.2
1974	315	17.1
1975	213	14.9
1976	124	16.3
1977	205	16.6
1978	154	19.2
1979	311	22.0

KING WHITING

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	75	74	54	84	37	130
¢/lb.	16.0	14.3	15.5	15.8	18.8	20.6
Central District						
1,000 lbs.	178	80	47	76	87	90
¢/lb.	16.1	14.9	16.2	17.4	18.9	20.6
Southern District						
1,000 lbs.	61	59	22	44	30	90
¢/lb.	21.8	15.6	18.3	16.6	20.4	26.8

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	50	15	31	17	3	10
Feb	7	3	2	86	-	23
Mar	13	11	3	7	13	21
Apr	21	21	7	15	6	22
May	14	23	5	21	4	6
Jun	5	3	1	6	5	6
Jul	9	7	3	8	9	20
Aug	14	6	7	3	13	21
Sep	21	8	8	12	21	16
Oct	45	29	19	11	38	16
Nov	74	42	15	14	34	34
Dec	42	44	21	5	6	117

3.01 Commercial Landings
J. MULLET

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	1,888	10.2
1956	2,194	8.0
1957	2,127	6.8
1958	2,229	7.0
1959	2,326	6.8
1960	3,236	8.0
1961	2,194	8.0
1962	2,285	7.0
1963	1,911	6.4
1964	1,220	7.4
1965	1,260	6.6
1966	1,445	6.9
1967	1,063	6.9
1968	1,172	7.7
1969	1,090	7.5
1970	1,123	5.3
1971	713	7.0
1972	1 177	8.3
1973	1,093	8.4
1974	2,138	9.7
1975	1,953	10.4
1976	2,072	10.0
1977	1,835	10.5
1978	1,752	13.2
1979	1,768	19.0

MULLET

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	578	569	853	425	195	314
¢/lb.	11.0	10.1	10.5	10.9	16.9	17.6
Central District						
1,000 lbs.	896	714	585	651	1,126	976
¢/lb.	9.2	10.6	8.8	9.7	11.9	19.0
Southern District						
1,000 lbs.	664	670	634	759	431	478
¢/lb.	9.0	10.5	10.6	11.1	14.8	21.5

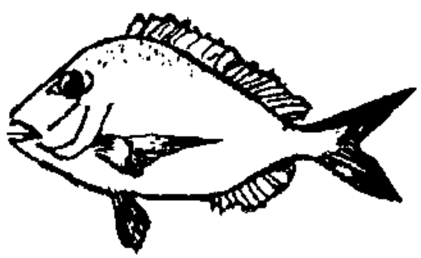
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	49	51	87	173	14	67
Feb	30	25	163	153	172	115
Mar	28	19	41	21	42	46
Apr	26	29	66	15	6	25
May	11	26	32	25	10	56
Jun	26	32	55	57	9	53
Jul	45	49	54	54	46	87
Aug	111	214	184	50	218	106
Sep	472	384	153	127	544	329
Oct	923	532	760	771	556	568
Nov	288	452	301	324	81	269
Dec	111	140	176	65	55	46

3.01 Commercial Landings
K. SCUP (or PORGY)

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not	Reported
1956	"	"
1957	"	"
1958	"	"
1959	"	"
1960	"	"
1961	"	"
1962	"	"
1963	"	"
1964	"	"
1965	"	"
1966	"	"
1967	"	"
1968	"	"
1969	252	14.3
1970	212	12.7
1971	207	16.9
1972	39	23.0
1973	28	25.0
1974	66	30.0
1975	149	31.8
1976	216	33.2
1977	136	35.7
1978	1,212	35.8
1979	1,695	40.0



SCUP (or PORGY)

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	33	107	204	115	1,054	1,284
¢/lb.	30.3	33.2	32.9	35.3	34.9	34.0
Central District						
1,000 lbs.	14	14	-	8	1	36
¢/lb.	31.0	28.7	-	38.4	36.0	49.3
Southern District						
1,000 lbs.	18	29	12	14	157	375
¢/lb.	27.3	29.7	38.1	37.7	42.1	58.0

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	8	4	36	41	173	26
Feb	10	18	87	11	535	430
Mar	5	97	87	6	47	690
Apr	7	3	53	71	263	273
May	22	5	-	2	74	33
Jun	0	-	-	-	25	30
Jul	1	11	-	5	17	58
Aug	-	3	1	-	14	49
Sep	-	6	-	-	12	31
Oct	4	1	-	-	17	27
Nov	6	-	-	-	13	25
Dec	1	-	2	-	21	24

3.01 Commercial Landings
L. SEA BASS

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	19	15.8
1956	80	10.0
1957	36	11.1
1958	27	11.1
1959	41	9.7
1960	126	10.3
1961	635	11.0
1962	1,287	11.4
1963	739	10.4
1964	906	13.5
1965	1,090	13.5
1966	1,267	55.3
1967	1,994	15.2
1968	1,193	Not Reported
1969	1,047	18.3
1970	1,179	19.4
1971	748	21.9
1972	635	32.3
1973	684	33.2
1974	1,317	39.7
1975	1,148	38.9
1976	573	51.0
1977	1,465	43.0
1978	1,149	46.7
1979	396	53.0

SEA BASS

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	188	453	294	1,076	988	710
¢/lb.	32.4	32.9	46.2	40.1	44.1	62.5
Central District						
1,000 lbs.	286	194	5	151	56	158
¢/lb.	42.7	42.4	38.7	44.6	50.6	46.6
Southern District						
1,000 lbs.	843	501	274	238	106	506
¢/lb.	40.3	43.1	56.3	54.9	65.8	56.4

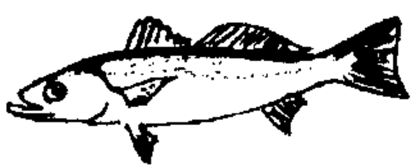
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	366	166	140	319	197	269
Feb	190	373	76	332	133	211
Mar	117	180	225	389	519	266
Apr	30	174	53	235	176	187
May	8	38	7	10	13	36
Jun	18	8	2	47	5	4
Jul	16	7	3	8	2	8
Aug	33	18	15	4	3	8
Sep	20	52	3	-	5	6
Oct	124	23	4	6	4	20
Nov	179	15	6	13	28	144
Dec	208	93	38	101	65	215

3.01 Commercial Landings
M. SEA TROUT, GREY

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	1,356	10.0
1956	1,842	8.0
1957	2,210	7.1
1958	3,810	5.7
1959	2,913	5.7
1960	2,240	5.5
1961	2,308	5.5
1962	2,160	6.9
1963	1,761	7.6
1964	1,966	6.8
1965	1,959	6.6
1966	1,896	5.8
1967	1,769	6.0
1968	2,236	4.7
1969	1,539	7.1
1970	2,442	6.0
1971	3,645	6.2
1972	7,372	5.4
1973	6,222	8.7
1974	6,055	10.4
1975	6,725	12.0
1976	8,714	11.0
1977	8,671	12.1
1978	10,849	18.1
1979	14,759	20.0



SEA TROUT, GREY

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	1,400	3,251	3,680	3,874	4,061	6,576
¢/lb.	12.4	11.7	11.5	13.3	12.0	20.8
Central District						
1,000 lbs.	4,583	3,408	4,949	4,764	6,777	7,732
¢/lb.	9.8	12.3	10.6	11.1	16.4	19.1
Southern District						
1,000 lbs.	71	67	11	5	12	451
¢/lb.	12.1	11.0	13.3	15.5	21.8	22.2

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	2,071	834	1,791	1,142	1,894	2,623
Feb	1,678	1,440	2,059	1,616	2,125	3,919
Mar	799	1,260	1,407	1,728	1,745	2,082
Apr	164	273	211	363	333	1,098
May	61	172	113	164	231	296
Jun	73	37	166	600	502	214
Jul	91	114	239	563	556	384
Aug	127	366	325	648	508	608
Sep	176	542	510	356	483	476
Oct	279	478	352	304	427	570
Nov	242	291	353	353	703	1,132
Dec	260	917	1,188	834	1,342	1,368

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	442	30.0
1956	389	30.0
1957	578	25.0
1958	177	24.9
1959	389	24.9
1960	171	25.1
1961	209	24.9
1962	205	29.8
1963	232	31.9
1964	205	35.1
1965	175	30.3
1966	116	29.3
1967	122	29.5
1968	97	32.0
1969	189	29.6
1970	404	26.7
1971	337	30.9
1972	503	30.4
1973	611	29.8
1974	670	30.9
1975	632	32.9
1976	637	34.3
1977	323	33.0
1978	97	38.4
1979	105	43.0

SEA TROUT, SPOTTED

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	253	276	278	67	62	40
¢/lb.	12.3	31.5	33.4	35.5	39.2	41.4
Central District						
1,000 lbs.	397	334	329	247	35	65
¢/lb.	30.4	33.8	35.1	32.0	36.8	43.7
Southern District						
1,000 lbs.	19	23	30	9	-	0.5
¢/lb.	36.0	36.0	35.2	41.7	-	41.9

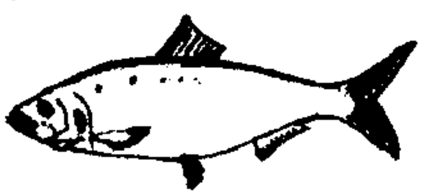
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	19	70	52	200	10	14
Feb	27	26	43	4	1	30
Mar	11	15	17	15	4	3
Apr	27	45	25	8	3	4
May	17	45	67	5	1	7
Jun	37	21	23	21	6	3
Jul	42	41	50	14	4	3
Aug	65	124	78	13	4	2
Sep	92	32	78	15	9	7
Oct	134	98	124	14	31	9
Nov	136	104	40	4	13	12
Dec	61	12	40	11	11	12

3.01 Commercial Landings
O. SHAD

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	649	24.7
1956	773	25.0
1957	837	25.0
1958	493	25.0
1959	419	25.0
1960	507	25.0
1961	673	25.0
1962	765	25.0
1963	693	24.2
1964	640	19.8
1965	1,069	20.0
1966	701	25.5
1967	777	19.9
1968	842	16.4
1969	719	19.1
1970	954	20.2
1971	680	17.2
1972	468	23.9
1973	321	26.5
1974	369	28.7
1975	241	34.3
1976	167	39.0
1977	121	45.3
1978	402	36.1
1979	218	44.0



SHAD

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	249	164	118	96	299	175
¢/lb.	26.2	33.9	38.3	44.0	31.1	35.2
Central District						
1,000 lbs.	100	54	42	9	70	51
¢/lb.	33.5	35.7	40.3	45.2	49.4	61.8
Southern District						
1,000 lbs.	20	23	7	16	33	52
¢/lb.	32.5	34.3	43.9	52.9	52.6	54.9

MONTHLY LANDINGS (1,000 pounds)

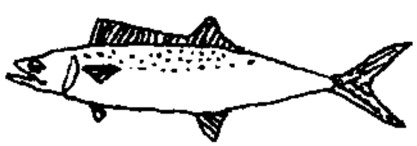
MONTH	1974	1975	1976	1977	1978	1979
Jan	35	15	8	1	-	2
Feb	12	76	53	4	2	20
Mar	158	95	77	58	266	199
Apr	40	48	25	42	120	51
May	2	7	4	11	13	5
Jun	14	-	-	2	-	-
Jul	-	-	-	-	-	-
Aug	-	-	-	-	-	-
Sep	-	-	-	-	-	-
Oct	-	-	-	-	-	-
Nov	-	-	-	3	-	-
Dec	-	-	-	-	-	1

3.01 Commercial Landings

P. SPANISH MACKEREL

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	165	15.1
1956	346	15.9
1957	248	14.9
1958	211	15.2
1959	156	14.7
1960	118	15.3
1961	134	14.9
1962	83	14.5
1963	135	14.8
1964	78	15.4
1965	117	10.3
1966	78	12.8
1967	73	11.0
1968	69	10.1
1969	89	13.5
1970	63	14.3
1971	95	14.7
1972	96	13.5
1973	64	14.0
1974	73	12.8
1975	49	14.0
1976	31	14.8
1977	46	15.3
1978	40	20.4
1979	13	28.0



SPANISH MACKEREL

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	4	16	13	14	1	10
¢/lb.	15.0	13.5	13.1	17.2	30.0	30.2
Central District						
1,000 lbs.	68	29	17	32	29	3
¢/lb.	12.7	14.2	16.0	14.4	20.0	20.8
Southern District						
1,000 lbs.	1	4	0.2	0.1	10	0.3
¢/lb.	12.6	15.0	15.2	12.3	20.2	25.6

MONTHLY LANDINGS (1,000 pounds)

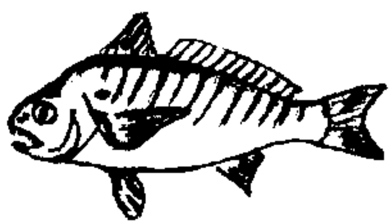
MONTH	1974	1975	1976	1977	1978	1979
Jan	-	-	-	-	-	-
Feb	-	1	-	-	-	-
Mar	-	1	-	-	-	-
Apr	-	-	-	-	-	-
May	11	1	1	-	-	-
Jun	6	5	9	-	2	-
Jul	5	3	5	3	1	-
Aug	18	13	11	7	-	-
Sep	18	8	4	10	2	1
Oct	14	14	-	13	3	1
Nov	2	2	-	10	22	8
Dec	-	-	-	-	10	1

3.01 Commercial Landings

Q. SPOT

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	1,898	10.0
1956	2,575	7.0
1957	2,158	7.2
1958	2,321	7.5
1959	2,265	6.5
1960	2,610	6.9
1961	2,056	5.6
1962	1,218	6.5
1963	916	9.2
1964	1,251	8.9
1965	913	7.6
1966	1,091	8.6
1967	3.048	6.7
1968	1,575	11.9
1969	1,488	12.6
1970	1,528	9.3
1971	1,190	14.5
1972	3,902	9.7
1973	5,397	12.5
1974	5,607	11.1
1975	8,300	10.4
1976	2,674	13.0
1977	3,805	12.3
1978	4,878	12.9
1979	7,303	20.0



SPOT

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	513	760	589	515	878	1,362
¢/lb.	13.4	10.1	13.1	12.6	14.8	18.7
Central District						
1,000 lbs.	4,676	7,281	1,854	3,169	3,771	5,487
¢/lb.	10.6	10.3	12.6	12.2	12.2	19.4
Southern District						
1,000 lbs.	418	259	232	121	229	455
¢/lb.	14.3	13.6	16.1	14.1	15.8	24.7

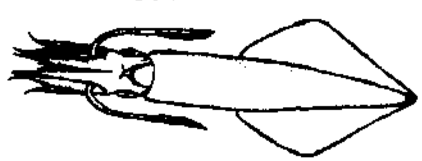
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	-	33	34	174	84	81
Feb	-	1	49	84	83	114
Mar	11	2	2	33	204	239
Apr	17	24	35	52	118	207
May	90	139	92	102	160	618
Jun	196	529	280	340	359	499
Jul	280	387	219	501	384	637
Aug	432	732	397	477	294	565
Sep	1,716	1,071	440	506	596	577
Oct	2,321	4,133	789	988	1,959	2,900
Nov	465	1,212	165	173	475	600
Dec	62	36	171	374	163	267

3.01 Commercial Landings
R. SQUID

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not Recorded	
1956	"	
1957	"	
1958	"	
1959	"	
1960	"	
1961	"	
1962	"	
1963	"	
1964	"	
1965	"	
1966	"	
1967	"	
1968	"	
1969	"	
1970	"	
1971	"	
1972	"	
1973	28	11.3
1974	75	15.9
1975	60	11.3
1976	36	13.5
1977	21	15.5
1978	132	36.7
1979	564	33.7



SQUID

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	38	40	11	16	116	423
¢/lb.	15.1	11.7	10.7	15.3	37.8	35.0
Central District						
1,000 lbs.	38	18	24	5	15	70
¢/lb.	16.7	10.1	14.8	16.0	27.9	25.7
Southern District						
1,000 lbs.	-	2	-	-	1	2
¢/lb.	-	13.8	-	-	46.4	38.9

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	34	22	5	9	7	87
Feb	5	20	3	3	18	135
Mar	2	7	-	2	51	159
Apr	2	5	2	4	18	40
May	1	-	1	-	2	3
Jun	-	-	-	-	4	2
Jul	-	-	-	-	-	7
Aug	-	-	-	-	-	1
Sep	1	-	-	-	-	60
Oct	1	-	-	-	-	44
Nov	14	-	10	-	1	3
Dec	16	5	15	2	29	21

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	736	16.3
1956	764	15.6
1957	597	15.1
1958	1,096	18.0
1959	872	18.1
1960	782	16.0
1961	550	16.0
1962	747	16.1
1963	736	15.6
1964	714	16.4
1965	484	15.9
1966	653	15.3
1967	1,817	13.9
1968	1,912	20.1
1969	1,568	20.8
1970	2,318	20.7
1971	1,449	21.7
1972	1,261	28.4
1973	1,752	33.8
1974	1,016	38.7
1975	1,303	48.3
1976	1,038	50.3
1977	572	70.9
1978	698	89.3
1979	614	94.0

STRIPED BASS

DISTRICT LANDINGS & EX-VESSEL PRICES

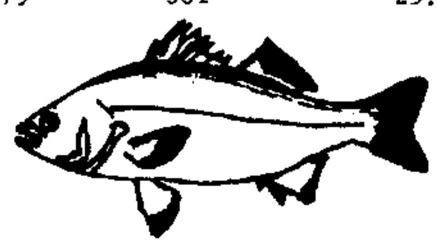
	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	992	1,188	1,026	570	604	374
¢/lb.	38.7	48.0	50.5	71.0	86.8	96.0
Central District						
1,000 lbs.	23	111	11	1	93	161
¢/lb.	34.2	53.0	35.8	48.4	1.06	83.4
Southern District						
1,000 lbs.	0.7	4	2	1	1	19
¢/lb.	41.8	26.3	57.6	53.3	74.0	1.27

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	200	209	268	49	58	47
Feb	249	257	237	48	175	83
Mar	76	93	96	64	127	247
Apr	106	59	89	33	67	64
May	17	37	43	22	22	32
Jun	24	6	26	18	12	11
Jul	18	2	29	6	9	5
Aug	15	6	15	14	8	5
Sep	35	31	23	22	17	13
Oct	60	101	41	63	74	42
Nov	112	256	79	119	57	33
Dec	102	246	92	114	33	31

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	799	8.5
1956	417	7.9
1957	472	10.0
1958	381	10.0
1959	442	10.0
1960	304	9.9
1961	346	10.1
1962	320	10.0
1963	259	10.0
1964	340	10.6
1965	261	10.3
1966	402	6.0
1967	384	12.0
1968	Not Reported	
1969	206	11.7
1970	211	14.2
1971	367	12.3
1972	202	13.4
1973	145	15.2
1974	309	18.4
1975	289	18.0
1976	184	16.1
1977	268	14.2
1978	498	25.4
1979	381	25.0



WHITE PERCH

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	308	288	184	268	498	349
¢/lb.	18.1	18.0	16.1	14.2	25.4	27.0
Central District						
1,000 lbs.	1	-	-	-	-	2
¢/lb.	20.0	-	-	-	-	17.8
Southern District						
1,000 lbs.	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	27	6	27	21	26	12
Feb	60	14	22	52	106	67
Mar	52	107	71	115	187	214
Apr	100	73	27	40	106	44
May	10	26	6	2	31	8
Jun	12	6	2	3	2	2
Jul	11	4	2	2	1	2
Aug	9	9	8	3	-	1
Sep	4	8	6	3	6	1
Oct	17	11	2	9	7	4
Nov	6	17	6	11	14	3
Dec	2	8	4	8	11	2

3.01 Commercial Landings
U. WHITING

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not Recorded	
1956	"	
1957	"	
1958	"	
1959	"	
1960	"	
1961	"	
1962	"	
1963	"	
1964	"	
1965	"	
1966	"	
1967	"	
1968	-	-
1969	-	-
1970	-	-
1971	285	11.1
1972	2	10.0
1973	-	-
1974	2	19.3
1975	2	10.6
1976	-	-
1977	14	8.0
1978	-	-
1979	856	11.7

WHITING

DISTRICT LANDINGS & EX-VESSEL PRICES

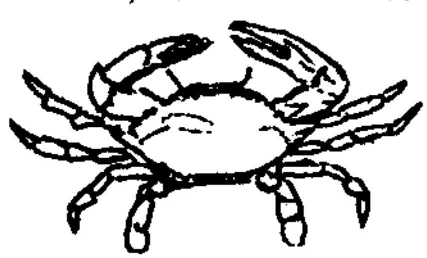
	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	2	-	-	14	-	816
¢/lb.	19.3	-	-	8.0	-	12.0
Central District						
1,000 lbs.	-	2	-	-	-	40
¢/lb.	-	10.6	-	-	-	8.2
Southern District						
1,000 lbs.	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	-	0.9	-	-	-	1
Feb	-	0.7	-	-	-	339
Mar	0.2	-	-	-	-	440
Apr	0.1	-	-	14	-	78
May	-	-	-	-	-	-
Jun	-	-	-	-	-	-
Jul	-	-	-	-	-	-
Aug	-	-	-	-	-	-
Sep	-	-	-	-	-	-
Oct	-	-	-	-	-	-
Nov	-	-	-	-	-	-
Dec	2	-	-	-	-	-

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	9,480	6.0
1956	8,245	5.0
1957	11,572	5.7
1958	12,523	5.7
1959	14,739	5.8
1960	14,937	4.8
1961	15,880	3.8
1962	12,221	4.0
1963	18,835	5.0
1964	24,092	5.3
1965	22,334	5.7
1966	18,914	4.6
1967	14,272	4.9
1968	Not Reported	
1969	22,160	9.6
1970	20,880	5.9
1971	14,475	7.8
1972	13,479	10.0
1973	11,963	12.8
1974	13,163	10.4
1975	11,067	13.1
1976	11,732	20.5
1977	12,221	17.6
1978	23,559	18.4
1979	26,618	17.0



CRABS, BLUE, HARD

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	8,253	6,481	7,341	8,141	12,003	14,538
¢/lb.	10.3	13.1	20.8	17.4	18.9	16.8
Central District						
1,000 lbs.	4,636	4,344	4,202	3,817	10,084	10,677
¢/lb.	10.4	13.2	20.1	18.0	17.8	18.2
Southern District						
1,000 lbs.	274	246	189	263	1,472	1,403
¢/lb.	10.9	12.4	19.9	16.7	17.5	17.4

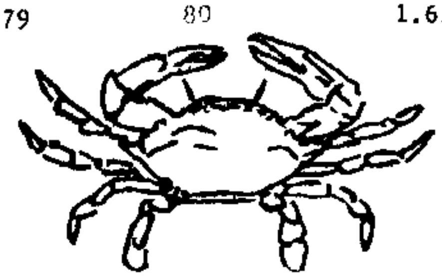
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	290	214	138	176	681	89
Feb	290	642	655	155	428	213
Mar	698	747	908	311	1,993	1,184
Apr	856	901	823	663	2,442	2,497
May	1,040	916	1,024	931	2,181	3,301
Jun	2,146	504	1,655	2,430	2,781	3,985
Jul	2,922	1,645	2,168	1,400	3,205	3,849
Aug	2,317	2,745	1,341	1,778	2,911	3,758
Sep	974	1,233	1,101	1,813	2,546	3,175
Oct	724	804	1,122	1,355	2,084	2,103
Nov	724	345	631	730	1,425	1,604
Dec	132	371	166	479	881	861

3.01 Commercial Landings
W. CRABS, BLUE, SOFT & PEELER

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	26	19.2
1956	71	19.7
1957	64	25.0
1958	76	27.6
1959	124	29.8
1960	91	35.2
1961	101	34.7
1962	98	34.7
1963	83	45.8
1964	70	47.1
1965	237	35.9
1966	126	44.4
1967	86	43.0
1968	84	37.0
1969	93	45.2
1970	60	38.3
1971	49	51.0
1972	50	58.0
1973	45	62.2
1974	33	70.0
1975	20	84.0
1976	20	1.32
1977	16	1.06
1978	47	1.92
1979	80	1.62



CRABS, BLUE, SOFT & PEELER

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	16	12	11	11	28	27
¢/lb.	66.6	83.1	1.33	1.08	1.98	1.52
Central District						
1,000 lbs.	17	8	9	5	19	53
¢/lb.	70.5	85.3	1.31	1.03	1.81	1.66
Southern District						
1,000 lbs.	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	2	-	-	-	-	-
Feb	-	-	1	-	-	-
Mar	-	2	-	-	-	-
Apr	3	-	1	-	6	9
May	5	2	2	-	13	24
Jun	11	-	1	2	13	12
Jul	4	7	-	2	4	28
Aug	7	5	3	-	3	6
Sep	1	2	6	-	4	1
Oct	-	1	3	10	1	-
Nov	-	-	2	1	2	-
Dec	-	2	-	-	-	-

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	122	28.7
1956	148	35.1
1957	243	40.3
1958	278	40.0
1959	340	40.0
1960	432	40.0
1961	490	31.8
1962	247	40.0
1963	332	39.2
1964	225	43.5
1965	313	43.8
1966	285	38.6
1967	287	46.3
1968	253	52.5
1969	293	52.6
1970	336	51.8
1971	254	58.3
1972	274	59.5
1973	380	77.4
1974	288	1.12
1975	285	79.3
1976	306	84.3
1977	739	1.45
1978	892	2.74
1979	1,455	3.08

CLAMS, HARD (MEATS)

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	-	18	-	-	-	-
¢/lb.	-	70.0	-	-	-	-
Central District						
1,000 lbs.	66	80	93	543	583	777
¢/lb.	1.05	77.1	82.9	1.50	2.64	2.92
Southern District						
1,000 lbs.	221	188	214	196	309	678
¢/lb.	1.14	81.1	84.9	1.29	2.93	3.25

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	36	24	46	31	56	143
Feb	34	30	15	30	53	164
Mar	29	29	49	81	75	127
Apr	25	28	20	26	27	113
May	15	16	13	7	29	125
Jun	20	9	44	82	60	99
Jul	18	3	19	54	115	144
Aug	18	31	11	83	88	121
Sep	16	57	49	151	50	99
Oct	27	27	2	53	112	83
Nov	26	10	3	16	113	82
Dec	23	22	35	125	114	154

3.01 Commercial Landings
Y. OYSTERS (MEATS)

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	731	39.1
1956	1,318	42.8
1957	1,086	44.1
1958	1,041	41.7
1959	1,311	44.8
1960	1,216	46.0
1961	1,209	51.0
1962	962	50.4
1963	694	51.4
1964	728	57.0
1965	865	54.7
1966	726	53.4
1967	518	61.0
1968	403	66.7
1969	370	70.3
1970	382	70.4
1971	424	68.2
1972	470	73.2
1973	548	81.4
1974	559	78.0
1975	425	77.6
1976	333	87.6
1977	366	96.7
1978	450	1.22
1979	665	1.39

OYSTERS (MEATS)

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	294	216	125	199	92	242
¢/lb.	77.4	76.6	89.4	96.1	1.18	1.22
Central District						
1,000 lbs.	100	118	89	67	82	204
¢/lb.	92.1	81.0	87.8	1.05	1.43	1.52
Southern District						
1,000 lbs.	221	91	120	92	276	220
¢/lb.	1.14	75.8	85.7	92.3	1.17	1.45

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	80	111	46	21	53	109
Feb	107	73	111	52	32	122
Mar	47	69	67	57	34	48
Apr	18	32	19	68	-	-
May	-	11	1	1	-	1
Jun	-	-	-	94	-	-
Jul	-	-	-	1	-	-
Aug	-	3	1	-	-	-
Sep	4	2	-	3	1	1
Oct	72	24	23	11	138	79
Nov	119	40	10	11	117	150
Dec	111	60	55	47	124	156

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	78	50.0
1956	125	50.4
1957	109	33.9
1958	169	34.3
1959	134	40.3
1960	181	39.8
1961	128	39.8
1962	168	39.9
1963	321	38.0
1964	340	50.9
1965	1,342	37.0
1966	2,256	24.5
1967	1,776	29.3
1968	Not Reported	
1969	612	62.6
1970	130	1.70
1971	60	70.0
1972	128	85.9
1973	37	89.1
1974	220	90.4
1975	139	79.7
1976	248	78.2
1977	412	1.72
1978	219	1.78
1979	193	2.66

SCALLOPS, BAY (MEATS)

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	-	-	-	155	-	-
¢/lb.	-	-	-	1.30	-	-
Central District						
1,000 lbs.	220	135	89	206	219	193
¢/lb.	90.4	77.6	87.8	2.14	1.78	2.66
Southern District						
1,000 lbs.	-	-	120	-	-	-
¢/lb.	-	-	85.7	-	-	-

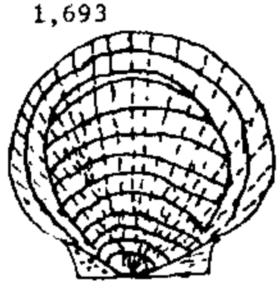
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	56	49	69	65	143	11
Feb	58	16	19	10	46	41
Mar	53	12	120	55	15	13
Apr	26	11	13	6	10	6
May	-	2	9	1	4	1
Jun	-	6	-	68	-	-
Jul	-	-	-	1	-	-
Aug	-	-	-	-	-	-
Sep	-	-	-	-	-	-
Oct	-	-	-	-	-	-
Nov	-	6	-	-	-	-
Dec	27	38	19	207	-	63

3.01 Commercial Landings
AA. SCALLOPS, SEA (MEATS)

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	Not Recorded	
1956	"	
1957	"	
1958	"	
1959	"	
1960	"	
1961	"	
1962	"	
1963	"	
1964	"	
1965	"	
1966	"	
1967	"	
1968	42	1.00
1969	13	1.00
1970	-	-
1971	-	-
1972	-	-
1973	-	-
1974	-	-
1975	-	-
1976	1,107	1.29
1977	657	1.45
1978	1,976	2.26
1979	1,693	2.89



SCALLOPS, SEA (MEATS)

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	-	-	737	155	1,333	1,094
¢/lb.	-	-	1.28	1.60	2.28	3.00
Central District						
1,000 lbs.	-	-	370	398	643	600
¢/lb.	-	-	1.33	1.44	2.21	2.69
Southern District						
1,000 lbs.	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-

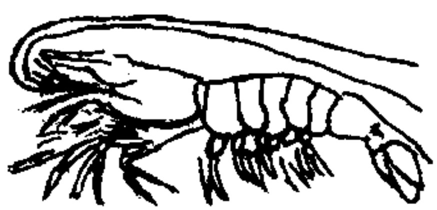
MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	-	-	-	-	-	2
Feb	-	-	-	-	-	-
Mar	-	-	-	-	-	41
Apr	-	-	60	88	-	81
May	-	-	167	42	128	393
Jun	-	-	257	157	302	448
Jul	-	-	241	47	550	403
Aug	-	-	157	104	405	192
Sep	-	-	123	62	231	71
Oct	-	-	48	2	174	55
Nov	-	-	29	-	124	3
Dec	-	-	25	155	61	5

3.01 Commercial Landings
BB. SHRIMP, SALTWATER (HEADS ON)

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1955	10,324	22.9
1956	6,243	25.5
1957	7,933	28.5
1958	2,519	28.5
1959	6,378	22.2
1960	5,988	26.8
1961	3,016	27.5
1962	5,805	38.6
1963	3,374	31.6
1964	4,279	35.1
1965	5,416	31.7
1966	7,679	33.3
1967	4,919	36.8
1968	4,612	Not Reported
1969	7,854	57.0
1970	5,054	49.3
1971	7,615	62.6
1972	5,563	63.8
1973	5,003	71.0
1974	8,456	54.6
1975	5,157	98.0
1976	6,643	1.23
1977	5,600	1.29
1978	2,961	1.31
1979	4,941	1.97



SHRIMP, SALTWATER (HEADS ON)

DISTRICT LANDINGS & EX-VESSEL PRICES

	1974	1975	1976	1977	1978	1979
Northern District						
1,000 lbs	1,436	495	1,319	1,406	419	265
¢/lb.	54.4	1.18	1.34	1.41	1.54	2.48
Central District						
1,000 lbs.	5,462	3,192	4,082	3,475	1,656	2,849
¢/lb.	54.1	97.7	1.21	1.27	1.27	1.87
Southern District						
1,000 lbs.	1,558	1,477	1,242	720	886	1,827
¢/lb.	56.5	91.6	1.17	1.16	1.28	2.05

MONTHLY LANDINGS (1,000 pounds)

MONTH	1974	1975	1976	1977	1978	1979
Jan	-	-	-	-	-	3
Feb	17	-	-	-	-	-
Mar	8	-	49	-	1	4
Apr	76	37	145	10	1	98
May	514	684	501	19	17	377
Jun	784	834	683	221	81	661
Jul	1,433	1,228	1,907	2,191	861	1,633
Aug	4,163	1,002	1,708	1,561	1,193	1,126
Sep	708	582	1,013	1,028	353	396
Oct	556	514	541	379	200	400
Nov	135	244	96	192	175	217
Dec	-	33	-	-	78	43

SHELLFISH:

3.02 Sport Fish Landings:

A. Anglers:

In the "1975 Salt Water Survey" for U. S. anglers, the landings reported for the coastal area extending from Cape Hatteras to East Florida Keys were 120.6 million pounds. The more important species caught in this southeast area were as follows:

Species	Million Pounds
Bass, Black	2.7
Bluefish	7.4
Catfishes	2.3
Croakers	5.2
Dolphin	5.5
Drum, Black	1.4
Drum, Red	5.0
Flounders	2.4
Groupers	7.6
Grunts	1.8
Jacks	2.6
Kingfishes	1.8
Mackerel, King	2.0
Mackerel, Spanish	1.6
Porgies	1.4
Sea Trout, Spotted	7.6
Snappers, Red	2.8
Snook	3.0
Spot	5.8

B. Head Boats:

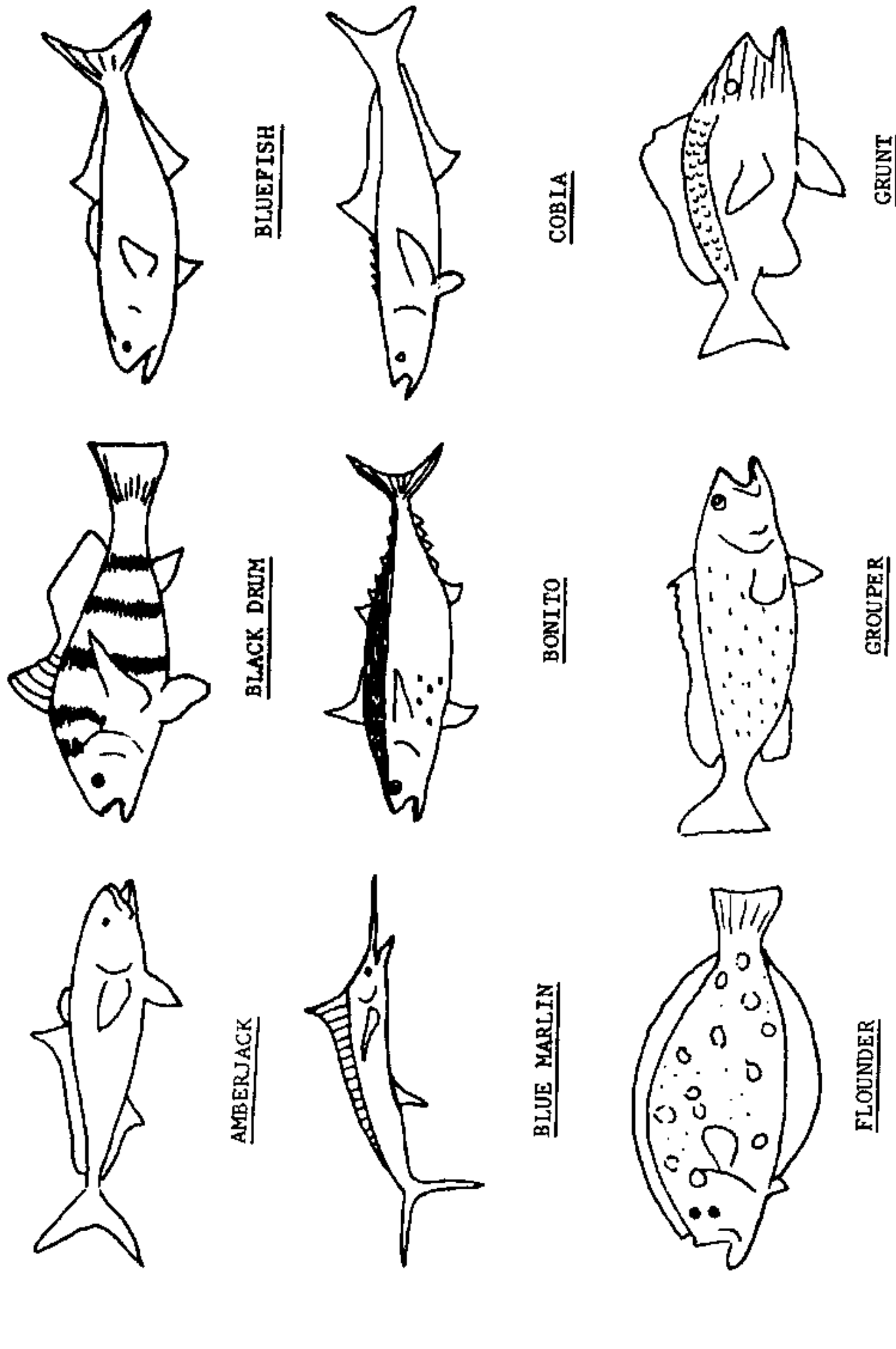
NMFS reported 9 head boats in operation in North Carolina in 1980.

N. C. HEAD BOAT LANDINGS - 1978

Porgies	191,446 lbs.	
Grunts	72,881 lbs.	
Snapper	44,985 lbs.	
Grouper	90,459 lbs.)	96,984 lbs.
Grouper, other species	6,525 lbs.)	
Red Snapper	12,394 lbs.	
Others	2,888,457 lbs.	
TOTAL	3.3 million pounds	

3.02 Sport Fish Landings

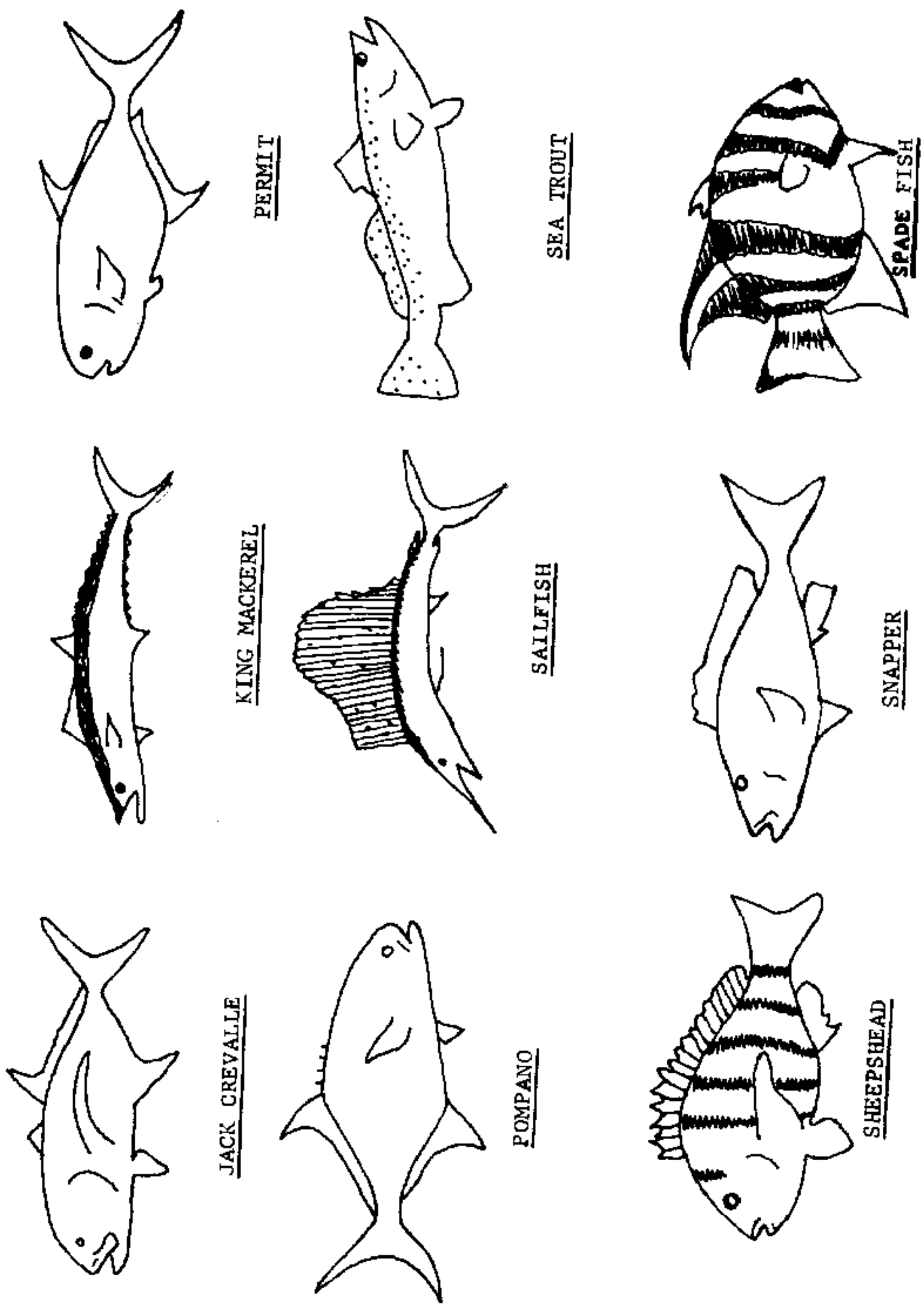
SPORT FISH



Sport Fish Illustrations by Leslie L. Miller

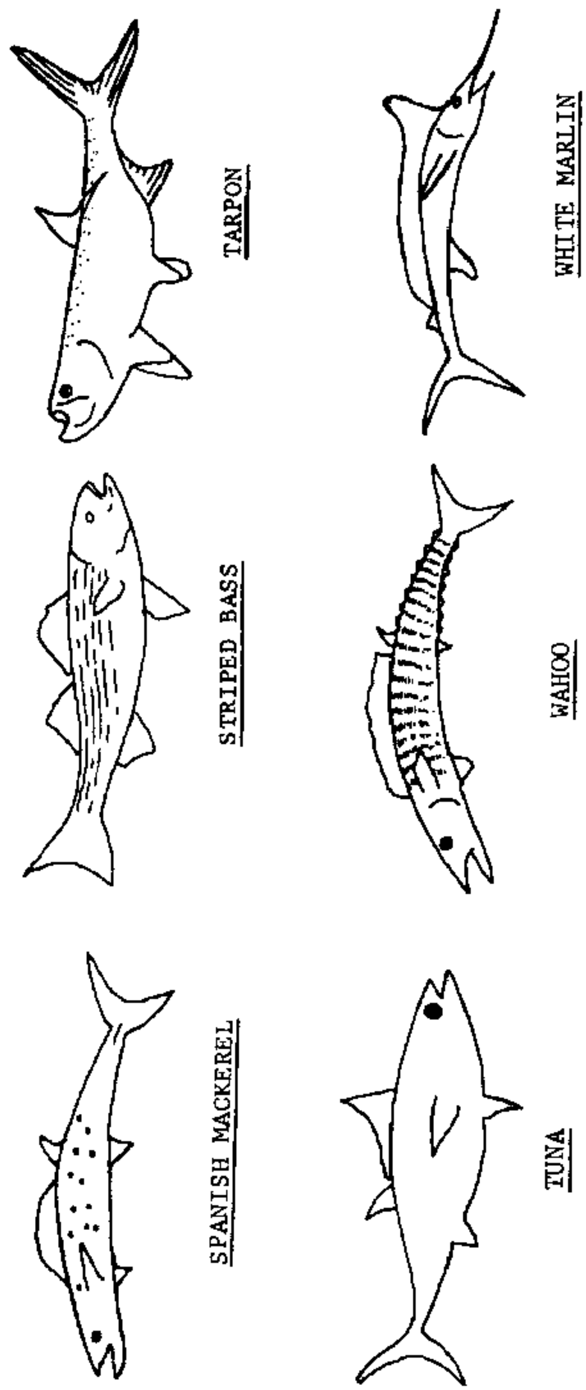
3.02 Sport Fish Landings

SPORT FISH



3.02 Sport Fish Landings

SPORT FISH



C. Charter Boats:

NMFS reported 134 charter boats in operation in North Carolina in 1978.

N. C. CHARTER BOAT LANDINGS (TROLLING) - 1978	
Amberjack	45,045 lbs.
Bluefish	353,269 lbs.
Dolphin	332,280 lbs.
Mackerel, King	532,783 lbs.
Mackerel, Spanish	12,397 lbs.
Marlin, Blue	79,332 lbs.
Marlin, White	144,704 lbs.
Others	306,614 lbs.
Trolling	1,806,424 lbs.
Bottom Fishing	227,191 lbs.
TOTAL	2,033,615 lbs.

3.03 The Two Hundred Mile Limit:

By passing Public Law 94-265, the Fishery Conservation and Management Act of 1976 (FCMA), Congress extended U. S. jurisdiction of fisheries out to 200 miles. In addition to granting first right to the fish stocks within this 200 mile limit, called Fishery Conservation Zone (or FCZ), to U. S. commercial and recreational fishermen and U. S. seafood processors, the law implemented eight Regional Fishery Management Councils.

The function of these regional councils is to develop Fishery Management Plans to manage both domestic and foreign fishing within the 200 mile limit. The councils are to recommend regulations for each fishery in the region designed to produce optimum yield annually.

The South Atlantic Fishery Management Council, headquartered in Charleston, S. C., is responsible for the management and conservation of fish stocks off the coasts of North Carolina, South Carolina, Georgia, and Florida. The South Atlantic Council acts as lead council in preparing Fishery Management Plans for billfish and swordfish, and works jointly with the Gulf Council regarding plans for king and Spanish mackerel and spiny lobster. The South Atlantic Council is also preparing plans for calico scallops, snappers, and groupers.

With the increase in relatively rich fishing areas and the reduction in overall harvesting pressure by foreign fishing, the passage of FCMA makes available larger catches for U. S. fishing vessels.

4.0 HANDLING BEFORE PROCESSING:

4.01 General Principles:

PRIME FRESH SEAFOODS constitute the only raw material suitable for processing. Keeping seafoods suitable for processing depends on:

A. Rapid Cooling:

Spoilage starts when death occurs. This is equally true if the catch dies in the net. Rapid reduction of temperature to 32°F or below is required to limit bacterial growth and other damaging effects.

Species (such as crabs and oysters) which must be kept alive require temperature adjustment for prolonged survival. For best results store at temperatures from 36°-45°F.

B. Adequate Sanitation:

The higher the bacterial count the more rapid the spoilage. Convenient and effective arrangements are needed for quick washing of product and removal of extraneous materials. Contact surfaces must be smooth and clean. Ice, suitable for human consumption, must be stored and handled under sanitary conditions. Complete drainage of runoff liquids to avoid possibility of contamination is necessary.

C. Gentle Handling:

Rough handling of raw material is not acceptable.

D. Fast Handling:

Minimize exposure to temperatures above 5°C (41°F).

4.02 Specific Requirements:

FINFISH:

Stowage rules:

A. Icebed should be about 6 inches deep.
B. Jagged ice should not be used.
C. Ice buffer of 3 inches should be placed between fish and sides of container.
D. Fish layers should be arranged for most effective heat removal by the ice.
E. Shelving should be employed to relieve pressure.
F. Ice should be used generously.

Special handling based on size:

G. Small Fish:

Apply ice without dressing fish.

H. Large Fish:

The following rules, specified in Norway[1], should be considered for certain species:

"Throat Cutting - Shall be effected either by the knife being introduced below the gullet and as near the head as possible so as not to damage the earbones of the fish, and as far as the backbone so as to sever the main arteries (double cut method) or by cutting across the heart and the gills (single cut method)."

"Evisceration - Fish to be marketed in the fresh or frozen state shall be eviscerated as soon as possible after it has been drained of blood, preferably within one hour after being caught. At mospheric temperatures of over 5°C (41°) the fish may not be kept uneviscerated for more than four hours."

SHRIMP:

Rules for handling on board:

A. Cull from secondary products, storing each separately.
B. Avoid trampling, or piling deeply on deck.
C. Protect from sun and drying effects of wind.
D. Wash thoroughly with clean sea water.
E. Heading is desirable when practical or permitted.
F. The shrimp should be dispersed throughout finely crushed ice, 1 1/2 times the weight of the shrimp.
G. Draining runoff liquids must be unhampered.
H. SODIUM BISULFITE treatments must be controlled in order to be effective and to limit residual sulfite. Recommended method is to dip shrimp (in wire basket) in a solution of 1.25% sodium bisulfite, the immersion lasting about one minute, then remove. The basket should be vigorously shaken while in the solution and again after removal.

CRABS, BLUE:

Live crabs should not be in direct contact with ice. Avoid rapid temperature reduction. Dead raw crabs deteriorate quickly, even when iced to minimize spoilage, resulting in mushy meat texture.

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1 "Royal Resolution of 8 April 1960 on the quality control of fish and fisheries products." 11 March 1961. Norsk Lovtidend No. 10, 13 April 1961, pp. 174-201.

Other important considerations include:

A. Holding area or containers should be clean.
B. Rough handling or exciting should be avoided.
C. Runoff liquids (including bilge) must be kept away.
D. Shocking in cold water should be avoided.
E. Cover with damp material to arrive at evaporative cooling.
F. Protect from sun and wind while assuring damp atmosphere.
G. Limit holding time for live crabs to one day.

OYSTERS AND CLAMS:

Shellfish are the most perishable of seafoods, easily contaminated and requiring sanitary harvesting, handling, and processing. Product safety requires live delivery to the user with cool temperatures helping to extend viability.

A. Shellfish should be taken only from approved growing areas.
B. Boat should be equipped with closed toilets.
C. Harvester should accept responsibility for culling, and washing shellstock with water from approved growing areas, or washing with potable water.
D. Runoff liquids, including bilge, should be kept away from catch.
E. Holding areas, sacks, or containers should be clean.

SCALLOPS: (Bay, Calico, and Sea)

Boat holds should be sanitary and well-drained. Catch should be shaded from sun, sheltered from wind, and preferably continually sprayed with clean salt water. Upon unloading, catch should be freed of extraneous matter. Truck transport should provide clean, well-drained, covered holding areas; the load should be well-iced.

INDUSTRIAL PRODUCTS: (Certain finfish, crab waste, shrimp heads)

Keep fresh until processed.

4.03 Rapid Cooling of Catch:

Ice provides the best means of removing heat from seafoods. It is also the only basis of refrigeration employed aboard most North Carolina fishing boats; therefore, it is essential to fully understand its use:

A. Clean Ice:

Must be made from potable water; must be delivered and stored under sanitary conditions.

B. Cold Ice:

Melting while aboard the boat must be minimized since slushy ice has lower cooling value:

Example:

(1) Fish weighing 100 pounds at 70°F requires at least 25 pounds of ice to reduce temperature to 32°F.
(2) Fish weighing 100 pounds at 70°F requires about 33 pounds of slush ice to accomplish the same cooling (32°F), imposing heavier labor requirement on the crew and increasing refrigeration costs.

Superchilled ice (below 32°F) does not add appreciably to cooling ability.

Example:

(1) Suppose the ice is at 23°F.
(2) Its ability to chill fish is 3% greater than ice at 32°F.

Seawater ice (below 32°F) is only slightly more effective in chilling fish than ice made from fresh water.

C. Flaked vs. Crushed Ice:

Jagged, large lumps which bruise the catch should be avoided. Finely divided ice results in quicker cooling.

D. Washing Effect:

Ice cannot remove heat from seafood without melting. The washing effect of melted ice is part of effective preservation.

E. Ice Requirements:

The catch requires 25% of its weight in ice for reducing temperature from 70°F to 32°F and at least an equal amount for overcoming heat exchange from the hull, from air in the hold, and exchange due to other factors.

Depending upon vessel construction, weather conditions, water temperatures, and trip length, the icing requirement ranges from 50 to 100% of the catch weight.

F. Hold Losses:

Uninsulated holds permit sufficient heat exchange to melt about 2 pounds of ice per day per square foot of vertical surfaces involved in storing the seafood. An 80-foot trawler has about 600 square feet of such surfaces, excluding overhead.

G. Salt as Melting Agent:

The importance of rapidly melting ice in intimate contact with the catch in order to achieve rapid cooling has been explained. One way to speed up the process is to add a limited amount of salt at the time the ice is applied.

4.04 Hold Insulation:

The insulation most used in North Carolina is sprayed-on polyurethane foam. Basic steps in its application involve:

A. Preparing Hold Surface:

Metal must be clean, free of grease and rust, then primed with suitable paint. Wood must be completely dry and free of grease and dirt. The foam is applied with special spraying equipment and bonds tightly to these surfaces.

B. Applying Urethane:

Should be at least 2 inches thick, providing a surface level with structural members so that skin can be readily applied.

C. Skin Materials:

Plaster, fiberglass, USDA-approved elastomer, or thin stainless steel sheeting has been used in various installations.

D. Cost:

Material plus application cost is about 60¢/board foot.

Example:

80-foot trawler, 1,167 square feet of hold surfaces to be insulated with average urethane foam thickness of 3 inches.

3 X 1167 X .6 = $2,100 (foam installation only).

4.05 Marine Refrigeration:

Marine refrigeration requires careful study before implementation. Equipment is costly to install and maintain; therefore, equipment that offers simple maintenance and availability of spare parts should be chosen. Backup systems should be considered; at times it is more practical to use two smaller units than to depend entirely on a single large unit.

Icing a vessel at the docks to keep the product chilled at sea has worked well for North Carolina trawlers and will continue to be the more practical way for many boats to operate. Often, however, simple icing of the catch is inadequate; many products on ice have reached, or are near, the limit of their shelf life by the time the vessel is unloaded. Furthermore, larger vessels with sophisticated gear and modern crew quarters are now being built to make extended fishing trips on distant grounds. To ensure product quality on these vessels, on-board refrigeration should be strongly considered.

Freezing of fish at sea can be accomplished by blast or forced air freezing, contact plate freezing, or immersion freezing (which involves submerging the product in a brine at 18° to 20°F). Sometimes the target species and market will dictate the type of system installed. Selecting the right method depends on which offers the best chance of safeguarding product quality by economically feasible means. Tuna, for example, are generally frozen whole at sea by immersion in 20°F brine; however, smaller tuna boats find it more practical to spread the fish out in a forced air freezer. Squid are packaged and frozen in a plate freezer. Shrimp are sometimes headed and bagged in 40 to 50-pound sacks to be blast frozen and stored at -20°F.

5.0 SHORE HANDLING AND PROCESSING:

5.01 Good Manufacturing Practices (GMP's):

U. S. Food and Drug Administration, May 29, 1969, issued "Human Foods; Current Good Manufacturing Practice (Sanitation) in Manufacture, Processing, Packing, or Holding," (presently Title 21, Part 110 of the Code of Federal Regulations), describing such criteria as sanitation, plant and grounds, equipment and utensils, sanitary facilities and controls, sanitary operations, processes and controls, and personnel. These apply in determining "whether the facilities, methods, practices, and controls used in the manufacture, processing, packing, or holding of food are in conformance with or are operated or administered in conformity with good manufacturing practices to assure that food for human consumption is safe and has been prepared, packed, and held under sanitary conditions."

5.02 Guidelines for Seafood Handling and Processing Plants:

A. Finfish:

(1) "Sanitation Recommendations for Fresh and Frozen Fish Plants," Lane, Fishery Facts--8, National Marine Fisheries Service, Seattle, 1974.

(2) "Draft Code of Practice for Frozen Fish," Organization for Economic Cooperation and Development, International Institute for Refrigeration, Paris, 1969.

(3) "Recommended International Code of Practice for Fresh Fish," Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission, CAC/RCP 9, 1976.*

B. Shrimp:

(1) "Code of Practice for Shrimp or Prawns," CX/FFP 77/7, FAO Fisheries Circular No. C322, Rev. 1, 1977.*

(2) "Recommended International Standard for Quick-Frozen Shrimps or Prawns," Joint FAO/WHO Food Standards Programme, Codex

Alimentarius Commission, CAC/RS 92, 1976.*

C. Crabs:

(1) "Development of Improved Handling, Holding and Transporting Techniques for North Carolina Blue Crab," Angel, Crow, Webb, Otwell, Dept. of Food Science, N. C. State University, 1974.

(2) "Technical Operations Manual for the Blue Crab Industry," Miller, Webb, Thomas, Dept. of Food Science, N. C. State University, Sea Grant No. UNC-SG-74-12, 1974.

(3) "Rules Governing the Sanitation of Handling, Packing, and Shipping of Crustacea Meat," Division of Health Services, Sanitary Engineering Section, N. C. Dept. of Human Resources, 1976, amended July, 1977.

D. Oysters and Clams:

(1) "National Shellfish Sanitation Program Manual of Operation. Part II. Sanitation of Harvesting and Processing of Shellfish," U. S. Dept. of HEW, Public Health Service, Publication No. 33, 1965.**

(2) "Rules Governing the Sanitation of Shellfish," Division of Health Services, Sanitary Engineering Section, N. C. Dept. of Human Resources, 1976, amended July, 1977.

(3) "Sanitary Control of Shellfish," U. S. Food and Drug Administration, 1971.**

E. Scallops:

(1) "Quality Control and Operating Manual for the Scallop Industry," Webb, Thomas, Dept. of Food Science, N. C. State University, N. C. Division of Commercial and Sports Fisheries, 1968.

(2) "Water Uptake in Scallops: Methods of Analysis and Influencing Factors," Thomas, N. C. State University, Porter, U.N.C. Institute of Marine Sciences, Special Scientific Report No. 29, Division of Marine Fisheries, N. C. Dept. of Natural Resources and Community Development, 1978.

(3) "Rules Governing the Sanitation of Scallops," Division of Health Services, Sanitary Engineering Section, N. C. Dept. of Human Resources, 1976, amended July, 1977.

F. Industrial Fish:

(1) "Sanitation Guidelines for Salmonella Control in Processing Industrial Fishery Products," U. S. Dept. of Agriculture, ARS 91-51, 1965.

(2) "U. S. Salmonella Control Program Relating to Fish Meal," E. Spencer Garrett, Microbial Safety of Fishery Products, Academic Press, New York, 1973.

Copies of Regulations Governing Processed Fishery Products can be obtained by writing to the U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Fishery Products Research and Inspection Division, Washington, D.C. 20240.

* Available from National Marine Fisheries Service, Pascagoula, Mississippi, 39567, or N.M.F.S., Washington, D.C. 20240.

** Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

5.03 Seafood Quality Criteria:

Seafood quality descriptions vary with geographic locations, species being handled, venders, and buyers. Common objectives include describing what is required to achieve customer acceptance, product safety, and tolerances commensurate with the realities of commercial handling.

A. Finfish:

(1) Fresh:

++"Freshness" is described by checking and defining the properties of certain parts of fish, including:

ROUND FISH:

Subjective - External

(a) Eyes - Prominent, clear, bright.

(b) Gills - Pink to dark, or bright in color; no bad odor.

(c) Slime - Moderate amount; characteristic odor.

(d) Skin - Shiny, color not faded; scales adhere tightly.

(e) Flesh - Firm and elastic.

(f) Belly - Neither swollen nor collapsed nor torn.

++ "Off-Condition" is even more difficult to define than "freshness." In most instances, even one bad characteristic makes fish unsuitable for human consumption.

(g) Mutilation - No evidence of rough handling, fork holes, or bruises.

Subjective - Internal

(h) Belly Cavity - Free of bad odor after dressing; flesh adheres to backbone; belly walls firm, elastic, and relatively free of discoloration.

(i) Viscera - Smooth, shiny, and adheres to wall of visceral cavity.

(j) Organoleptic - Appraisal after cooking results in texture, flavor, and odor ratings of "good" to "excellent." Cooking is based on employing a method which does not mask undesirable characteristics. Example: Place the unseasoned product in a boilable film-type pouch, immerse in boiling water, cook to internal temperature 160°F (71°C).

Objective Tests

(k) Parasites - Substantially lacking.

(l) Electronic Testing - Electronic equipment such as the Torrymeter, developed and tested by Torry Research Station, Aberdeen, Scotland, can be used to determine freshness of whole fish or fillets. Requiring standardization for each species to be checked, the meter assesses the relative quality of wet fish by measuring changes in the electrical properties of fish flesh during storage.

(m) Laboratory Criteria - Include volatile bases (under 30 mg/100 gm), trimethylamine nitrogen (under 3 mg/100 gm), and hydrogen ion concentration (below 6.5 microequivs.).

Organoleptic changes due to bacterial growth may initially be caused by anaerobic conditions in underlying surfaces, along pen boards and bottoms, resulting in "bilginess," an odor resembling hydrogen sulfide. With exposure to oxygen, aerobic organisms can multiply rapidly if conditions are favorable, generating such off-odors as slight musty, sweet, milky, soapy, and yeasty. Generally, microbiological spoilage in fish is the prime factor in causing flavor changes. "Rancidity" as judged by taste panels does not necessarily correlate with other methods of measuring fat oxidation, i.e., peroxide, TBA, and iodine number. Undoubtedly, oxidation can be an important factor in the onset of off-flavors.[2, 3, 4]

Bacteriological examinations include total plate count and examination for pathogens if safety is in question. However, such indices have not been established specifically for North Carolina finfish and it is doubtful that such values can be related to organoleptic changes occurring within acceptable limits of freshness.

DRESSED, FILLETS, STEAKS

Dressed portions of fresh fish should be in accordance with (a) through (m) above, and in addition should have the following properties:

(n) Dressing and Cutting - Should be cleanly cut and trimmed in accordance with best commercial practice.

(2) Frozen:

"Freshness" definitions for frozen fish are identical to those applying to iced fish with exception of slightly different texture.

ROUND, DRESSED, FILLETS, STEAKS

(a) Storage - Should not exceed holding time needed to assure "good acceptability" and must have been held continuously at less than 0°F (-18°C).

(b) Glazing - Should be sufficiently thick to prevent oxidation and dehydration.

(c) Drip Loss - Relatively small drip losses indicate good practice. "Drip" refers to fluid which is not reabsorbed by fish tissue when frozen fish thaws, and which separates freely without aid of external forces other than gravity.

B. Shrimp:

(1) Fresh:

Fresh shrimp slip crisply over one another, handle dryly,

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2 Symposium on Foods: Lipids and Their Oxidation, H. W. Schultz, ed., The Avi Publishing Co., Inc., 1962, pp. 173-175.

3 The Freezing Preservation of Foods, Donald K. Tressler, ed., The Avi Publishing Co., Inc., 1968, pp. 179-196.

4 Microbiology of Foods and Food Processing, John T. Nickerson, American Elsevier Publishing Co., 1972, pp. 152-157.

have no offensive odor, are firm-fleshed and semi-transparent.

(a) Odor - Should not smell of hydrogen sulfide or ammonia. If treated with sodium bisulfite, sulfite odor should not be apparent.

(b) Flesh - Firm, elastic, and not mushy.

(c) Color - Normal for species; free of "black spot."

(d) Extraneous Matter - Free of seaweed, fish, and grit.

(e) Mutilation - Should be gently handled; individuals should remain undamaged.

(f) Organoleptic - Flavor, odor, and texture good to excellent after pouch cooking described in 5.03 A. (1) (j).

(g) Laboratory Criteria - Checks for prime condition during first few days of iced storage based on contents of glycogen sugar, acid soluble orthophosphate, and lactic acid. Freshly caught shrimp have a pH of about 7.2, which increases gradually to 8.0 and above, where the quality becomes unacceptable. "Black spot" (melanosis) is caused by a complex oxidative reaction. Bisulfite compounds, used in its control, should be employed judiciously. Onset of spoilage may be indicated by increase in trimethylamine nitrogen, volatile acids, Nessler ammonia, sulfhydryl groups, and a rapid rise in total plate counts (bacterial content). Carroll, Reese, and Ward[5] demonstrated enzymic and bacterial effects on cellular structure by employing histological methods.

(2) Frozen:

Shrimp have excellent freezing characteristics provided the raw material has been selected for optimum freshness, properly packaged, and held at sufficiently low storage temperature.

(h) Color - Free of greyish-white discoloration.

(i) Glaze - Used if packaging has limitations in protective value. Should be uniformly applied, avoiding ice accumulations.

(j) Storage - Similar to 5.03 A. (2) (a).

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5 "Microbiological Study of Iced Shrimp: Excerpts from the 1965 Iced-Shrimp Symposium," B. J. Carroll, G. B. Reese, B. Q. Ward, U. S. Dept. of the Interior, Circular 284, May 1968, pp. 13-16.

(k) Drip Loss - Similar to 5.03 A. (2) (c).

C. Crabs, Blue:

Quality criteria for crab meat is discussed in the publication listed under 5.02 C. (2), pages 26 to 29. Although assumed that crab meat cannot be successfully frozen, appreciable amounts are in fact held in frozen storage as a necessary method of keeping up with customer demand.

D. Oysters and Clams:

Fresh shellstock should have tightly closed shells, bright meat, and should be full of clear liquid. Upon shucking, the meats should be bright in color, solid, plump, and free of sunken areas. Good commercial practice should limit free liquid to about 5%. Oyster meats will be in the 6.5 to 6.7 pH range when fresh, and will drop to below 6.0 when stale. For oysters and clams, fecal coliforms must be below 230 MPN while total plate count should desirably be under 100,000/ml but no higher than 500,000/ml.

Storage temperature of frozen oysters is especially critical in achieving more than several months of storage life. Clam meats are easier to store but require raw material of prime quality if results are to be acceptable.

E. Scallops:

Fresh shellstock should be received alive, with shells closed. Meat quality is described in the publications listed under 5.02 E. 1, 2, & 3.

5.04 Freezing:

The freezing of seafoods must be sufficiently fast to prevent or to minimize adverse quality changes (physical, biochemical, and bacteriological) which affect flavor, odor, and texture. There is basis for believing that raw material of high initial quality can be subjected to freezing times ranging from a few hours to as much as one day without significant influence on quality.[6]

Freezing should be carried out with equipment designed to freeze the product...not simply by placing the product in the frozen storage area. Such equipment should not be loaded beyond its capacity to freeze all of the raw material within one day. A suggested freezing rate of penetration is 0.25 inches per hour.

One should be aware of the weight losses that can occur when a raw material is placed in a blast freezer. This can be minimized by

6 "Draft Code of Practice for Frozen Fish," Organization for Economic Cooperation and Development, International Institute for Refrigeration, Paris, 1969.

placing whole or dressed fish in molds covered with plastic film, or by employing plastic bags providing low oxygen and moisture permeability. (See page 55)

Fillets are best protected from oxidation and dehydration by attractive arrangement in packages sufficiently thin to allow freezing to progress at the required speed. If individually frozen (IQF), it is desirable to apply a protective film in the form of a glaze to supplement the protective effect of a plastic film.

5.05 Thawing:

A "rule of thumb" is that 125 BTU's are required for thawing one pound of fish, although fatty fish require less heat. Many thawing methods have been suggested, but air blast or circulating water are those immediately available, equated on the following basis:

A. Air Blast:

Saturated air at 70°F (21°C), moving 1500 ft/min, is effective in limiting thawing time. An irregular mass with interspaces, such as whole fish, will thaw quickly while a 4-inch block will require about 5 hours.

B. Water:

Should not be above 70°F (21°C), moving at 4 ft/min. This will accomplish thawing at about the same rate as an air blast under conditions described in A. above.

5.06 Glazes:

Ice glazes are formed either by dipping frozen seafood in water or applying water with a spray. The resulting film should be clear and thick enough to prevent dehydration and oxidation. Unless protected by packaging materials, such glazes evaporate and must be restored frequently. Also, an ice glaze is brittle, tending to flake and expose the product.

Suggested thickening agents are sodium alginate or carboxymethylcellulose. Glazing is most effective when applied to whole fish intended for further processing. Consumers dislike a thick glaze which melts in an unsightly manner.

An edible coating, applied in two stages, is claimed to provide structure control, a sealing of flavor, and a barrier against oxygen and moisture.[7]

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7 "Edible Coating Isolates Oxygen and Moisture, Controls Structure - Seals in Flavor," Richard D. McCormick, Food Product Development, Vol. 9, No. 4, May 1975, p. 14.

5.04 Freezing

PROPERTIES OF PLASTIC FILMS

PROPERTY	MATERIAL		
	Low density polyethylene	High density polyethylene	PVDC
YIELD (m^2/kg) (for 25 um film)	42.6	41.2	23.4
TENSILE STRENGTH (MN/m^2)	8.6-17.3	17.3-34.6	48.4-138
ELONGATION AT BREAK (%)	500	300	20-40
TEAR STRENGTH (Elmendorf) (g/25 um)	200-300	20-60	10-30
BURST STRENGTH (Mullen) (kN/m^2) (for 25 um film)	330	--	205-485
WATER VAPOR TRANSMISSION (g/m^2/day) (for 25 um film at 90% R.H. and 38°C)	15-20	5	1.5-5.0
OXYGEN PERMEABILITY (cm^2/m^2/day/atm) (for 25 um film)	6,500-8,500	1,600-2,000	8-25
CARBON DIOXIDE PERMEABILITY (cm^2/m^2/day/atm) (for 25 um film)	30,000-40,000	8,000-10,000	50
RESISTANCE TO OILS AND GREASES	Some oils cause swelling	Good	Excellent

Source: J. H. Briston, Plastic Films, John Wiley & Sons, 1974, p. 286.

An edible coating, described by Miller et al.,[8] was employed in the tests reported in Section 6.0:

Gelatine	1.6%
Ascorbic Acid	2.5%
Lemon Juice	12.5%
Water	83.4%

6.0 PROCESSING INVESTIGATION:

A major work, completed in July, 1975, was undertaken to provide guidance on some basic problems of concern to North Carolina processors, including:

A. Effect of conditions at sea on storage characteristics of iced or frozen finfish.
B. Finding simple approaches to processing and packaging.
C. Selecting suitable methods of judging quality and shelf life.

Plans for the processing investigation were broadly outlined by the Pilot Fish Processing Project Task Force, meeting January 16, 1975, at Wrightsville Beach, N. C. It was decided that the work would be confined to a single commercially important species, i.e., grey trout, Cynoscion regalis.

Processing studies have continued to be a major part of the seafood utilization program at N. C. State University Raleigh campus and at the NCSU Seafood Laboratory, Morehead City.

A brief summary of the early work follows.

6.01 Test Plan:

Three trips taken aboard a commercial fishing vessel started three weeks apart on 1/26/75, 2/16/75, and 3/9/75. NCSU Seafood Lab personnel observed finfish handling practices and collected two basic samples:

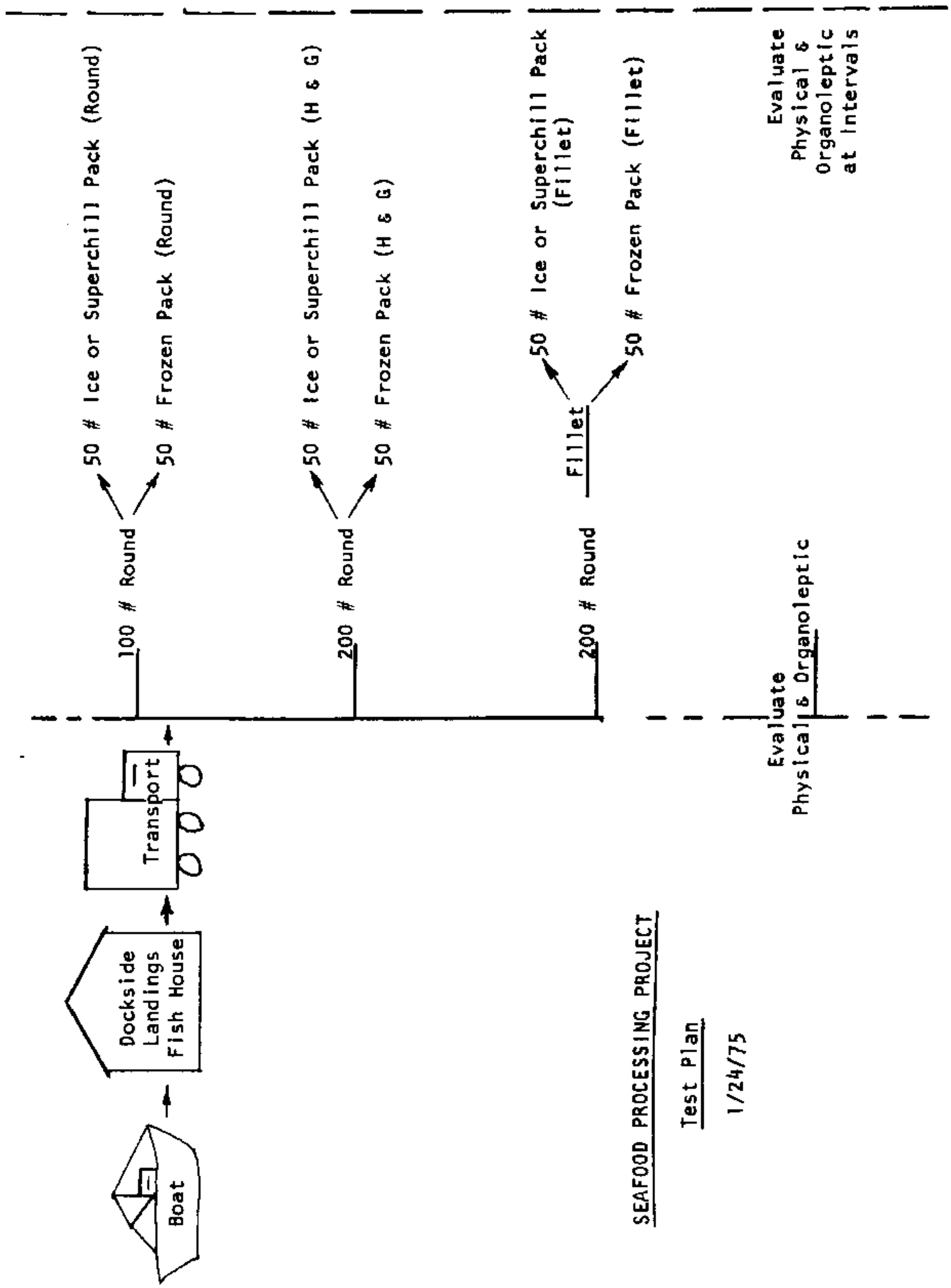
A. Average of trout caught during trip - 500 lbs.
B. Trout, superchilled with salt-ice - 500 lbs.

Sample A was collected and packed in ice during the unloading, sorting, and icing process while Sample B was removed from a pen in the boat hold and packed in salt-ice mixture.

Processing, packing, and subsequent storage shown in the test plan, page 57, were carried out. Since different conditions and durations occurred during each sea trip, the purpose of the investigation was to evaluate the effects of these uncontrolled factors in terms of storage characteristics.

[8] T. M. Miller, Carteret County Seafood Processing Project - Part 3, April 1969, p. 56.

6.01 Test Plan



6.02 Composition as Related to Storage:

References showed grey trout (weakfish) to be in the limited shelf life range when judged on the basis of proximate composition examined in terms of protein to fat ratio. Analytical data indicated that when grey trout components are examined separately, there are areas even more likely to present preservation problems, i.e., high levels of subcutaneous fat in belly flaps.

These considerations, together with published estimates assigning 2 to 3-month prime quality storage life to trout, led to defining a standard to be used in instructing a laboratory taste panel. This is shown on page 59. For purposes of this study, a hedonic rating of 2.5 to 4.0 was defined as representing the "Good Acceptability" predicted for trout in the illustrated table.

6.03 Experimental Processing:

Samples prepared for storage were washed briefly in water, drained, dipped in gelatine-lemon juice-ascorbic acid solution (described in Section 5.06), then again drained.

Packing for iced or salt-iced storage involved arranging the three forms, i.e., round, scaled headed and gutted, and filleted, in layers in 16"x12"x1 3/4" waxed cartons, with pliofilm dividers between layers and top surfaces covered with pliofilm. Closed boxes were surrounded by ice or salt-ice mixture, then held in a cold room at 34°F. Refrigerating materials were replenished every few days to hold the products at 32°F and 28°F between sampling intervals.

Packing for frozen storage involved arranging the three forms in sampling units and wrapping in PVDC (polyvinylidine chloride) film. These units were arranged in waxed cartons up to 2 1/2 inches depth. The cartons were placed on perforated metal shelves and subjected to rapidly circulated air at below 0°F. Complete freezing occurred within 8 hours. After 24 hours, the cartons were placed in 1.5-mil pliofilm bags and packed in sealed corrugated master cartons. Frozen samples were stored at below 0°F.

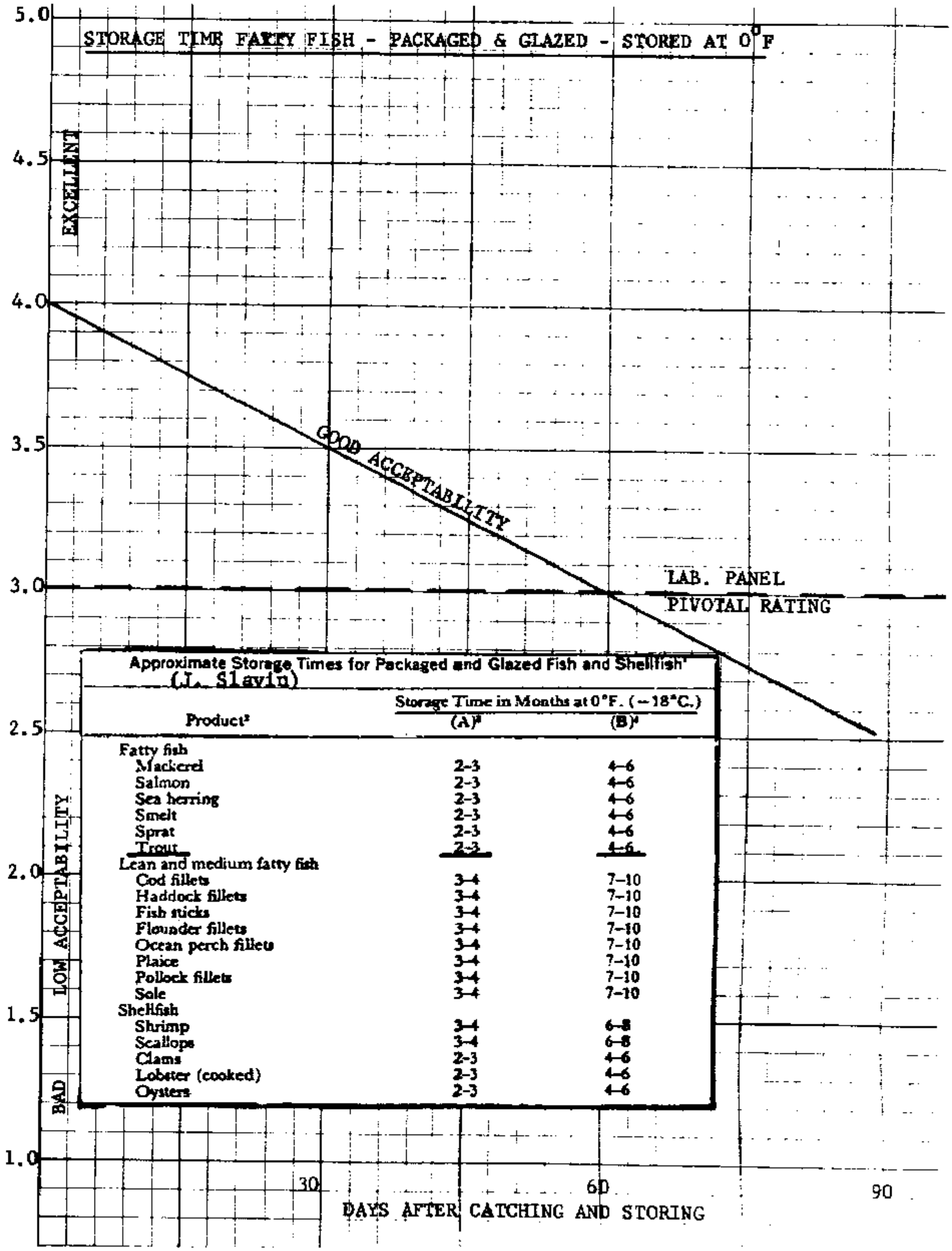
6.04 Evaluation Methods and Results:

Subjective testing involved the following methods: round fish rating, raw fillet rating, cooked fillet rating, and a consumer rating form. Laboratory support was limited to proximate analyses and the thiobarbituric acid (TBA) reaction.

A. Observations at Sea:

Three sampling trips were undertaken in connection with the experimental work. It was observed that boat sanitation was good, there was plenty of ice, and hold pens were insulated. Time at sea, natural factors, and catch rates provided distinctly different pre-handling conditions before processing was initiated:

6.02 Composition as Related to Storage



Approximate Storage Times for Packaged and Glazed Fish and Shellfish[1]
(J. Slavin)

Product[2]	Storage Time in Months at 0°F. (−18°C.) (A)[3]	(B)[4]
Fatty fish		
Mackerel	2-3	4-6
Salmon	2-3	4-6
Sea herring	2-3	4-6
Smelt	2-3	4-6
Sprat	2-3	4-6
Trout	2-3	4-6
Lean and medium fatty fish		
Cod fillets	3-4	7-10
Haddock fillets	3-4	7-10
Fish sticks	3-4	7-10
Flounder fillets	3-4	7-10
Ocean perch fillets	3-4	7-10
Plaice	3-4	7-10
Pollock fillets	3-4	7-10
Sole	3-4	7-10
Shellfish		
Shrimp	3-4	6-8
Scallops	3-4	6-8
Clams	2-3	4-6
Lobster (cooked)	2-3	4-6
Oysters	2-3	4-6

	1st Trip	2nd Trip	3rd Trip
Length of Trip, Days	2.5	1.0	4.0
Av. Ambient Temp., °F	63	50	42
Av. Sea Temp., °F	45	46	44
Fish Quant./Tow	Small	Large	Medium
Hrs. before Icing	1.5	4.0	7.0
Hrs. before Salt-Icing	1.5	4.0	6.3
Hrs. from Time Caught until Processing	76	37	105

Trip No. 1 provided the best preservation conditions before processing.

B. Raw Fish Ratings:

Ratings of all fish handled unfrozen in the round and of raw fillets handled or prepared in connection with taste panel evaluations were recorded and examined in an effort to find relationships between physical appearance, odor when raw, and the reactions of taste panels to cooked samples. This data failed to establish a correlation.

It was concluded that most of these observations applied to the raw trout samples would not serve to predict consumer reaction as long as the products remained in good to excellent condition.

C. Cooked Fish Ratings:

(1) Conducted by laboratory taste panel:

Evaluations were conducted on samples taken from unfrozen and frozen storage.

The results are interpreted as follows:

(a) This work was intended to measure the effect of conditions at sea on storage properties. Observations at sea showed that Trip 1 provided the most favorable handling conditions, while Trip 2 was the least favorable. In general, results of the storage tests were related to what occurred at sea.

(b) Salt-icing had a definite effect on the shelf life of unfrozen samples from Trips 1 and 3. The benefits were not demonstrated with the frozen samples.

(c) Processed forms, i.e., round, headed & gutted, and fillet, did not show consistent differences in storage life. This indicates that if there is rapid initial chilling and holding, a good shelf life can be expected from any processed form.

Perhaps the most noteworthy observation was the panel's inability to make a distinction between unfrozen and frozen fillets.

(2) Conducted by consumers:

Successful marketing depends on products which are highly acceptable to consumers. Laboratory taste panels try to predict such reactions, but the consumer has the last word.

Samples used in this experiment were as follows:

(a) Secured during Trip No. 1, iced, then 5-oz. fillets frozen, thawed when 34 days old.

(b) Secured during Trip No. 1, salt-iced, then 5-oz. fillets frozen, thawed when 35 days old.

(c) *Fresh-Unfrozen, av. wt. fillets = 5 oz.

(d) *Fresh-Unfrozen, av. wt. fillets = 8 to 12 oz.

The above samples, kept anonymous by geometric symbols, were packed in trays, overwrapped with plastic film, and refrigerated at 34°F until distributed to families; "a" or "b" was compared with either "c" or "d". Most of the samples were prepared and cooked within 24 hours.

Reactions to each of the four groups were rather similar, the greatest difference being between "a" and "b". However, the frozen samples appear to have been received as well as "c" and "d". Size of the fillets, as indicated by "c" and "d", did not appear to have much effect on the results.

* Purchased from retail outlet. Estimate fish about 3 days old.

7.0 PROCESSING FACILITIES:

The North Carolina seafood industry consists of many independent operators and mostly limits activities to basic forms of processing. It seems that most companies can best be helped by discussing requirements in terms of components likely to be needed. The handler of seafoods may assess his present facilities and find that he has much of what is required to conduct primary processing steps, i.e., scaling, dressing finfish, and heading shrimp. The building of an additional facility capable of complying with Sections 5.01 and 5.02 ("Good Manufacturing Practices" and "Guidelines for Seafood Handling and Processing Plants") may then follow modular concepts, involving shapes and sizes capable of achieving desired output and permitting additions for future needs while minimizing initial investment.

7.01 Product Forms and Packaging:

A. Superchill Pack:

Round, dressed, or filleted fish can be superchilled and packed in strong corrugated paper cartons equipped with a waterproof pliofilm bag liner into which an absorbent material has been inserted. The sealed cartons, tightly stacked, and kept in a 28°F atmosphere while in transit, can be delivered to customers without employing ice, will have longer shelf life than ice-packed finfish, and can be delivered with greater payload. This method is used effectively in delivering unfrozen poultry to retail outlets.

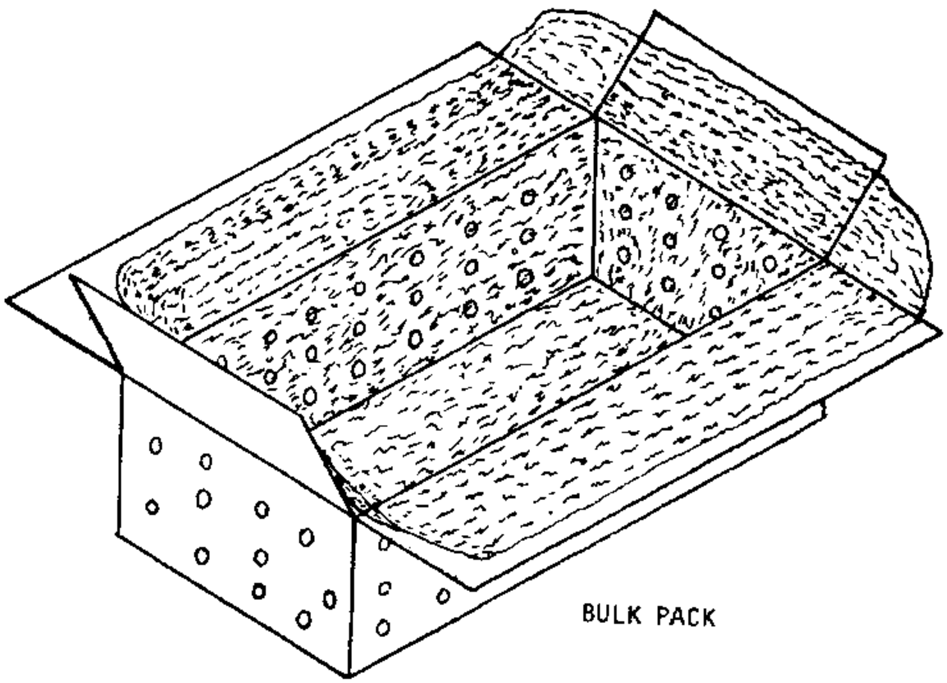
B. IQF (Individually Quick-Frozen) Bulk Packs:

Finfish and shrimp, individually frozen by arranging on metal trays or passing through a blast freezer by conveyor, are then rapidly dipped in or sprayed with cold water to make an ice glaze. The IQF products can then be packed in pliofilm bags and the bags sealed and placed in master cartons for frozen storage. Time of exposure to the blast freezer should be kept at a minimum because of dehydration or oxidative reactions.

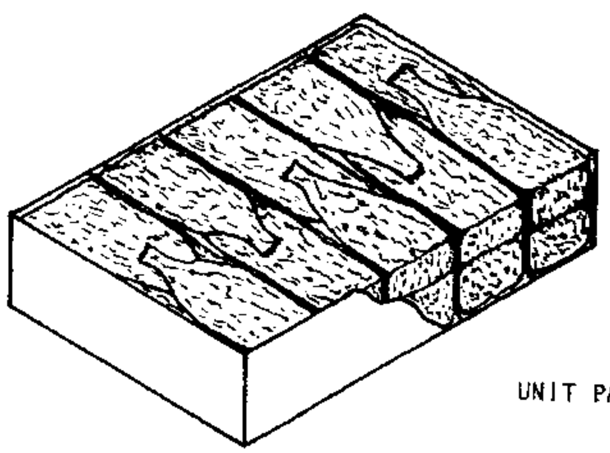
C. Bulk Packs:

Typical corrugated cartons involved in this packing method (illustrated on page 63) measure 24" x 12" x 7" for the 25-pound size, 22" x 16" x 11" for the 50-pound size, and 26" x 16" x 15" for the 100-pound size. The 25-pound "biddy box" is illustrated on the next page. The sides of this box have many openings to permit free entry of cold air. A pliofilm bag, about 3 mils thick, is used as a liner. Round or dressed fish are placed in the bag after which the top is folded and held in position by the closed carton. It is important to use pliofilm of sufficient thickness to reduce moisture loss and entry of oxygen. The success of this method also depends on how well the bag is folded for complete sealing. Dipping in an adherent glaze before packing should be considered.

7.01 Product Forms and Packaging



BULK PACK



UNIT PACK

Other bulk systems for fresh or thawed product employ 10 or 20-pound capacity polyethylene boxes closed with a heat-seal top film and packed in master cartons. The unwaxed fiberboard master cartons are lined with rigid foam insulation panels and contain a polyethylene bag liner to prevent leakage if icing of the inner containers is desired. Icing is not necessary with this method if proper refrigeration is available, however. In addition to the system described here, a variety of polyethylene or other plastic bulk containers with plastic lid closures is available to processors.

D. Unit Packs: (illustrated on page 63)

A method employed in the Seafood Laboratory involves dipping the product in gelatine glazing solution, draining, then placing on sheets of PVDC (polyvinylidine chloride) film in "sardine" or other convenient arrangement. The film is folded over the product with edges overlapping and held together by its electrostatic properties. The units are then packed in 5-pound (11 1/2" x 6 1/4" x 2 3/4") or 10-pound (13 1/2" x 9 1/4" x 2 1/2") boxes which help mold the packages into uniform shapes. Upon leaving the blast freezer, the boxes are placed in corrugated paper master cartons for holding in frozen storage. The unit pack method enables convenient removal of desired amounts from the boxes, the PVDC film then readily separating from the frozen product.

E. Layer Packs: (illustrated on page 65)

Boxes employed in layer packing must be strong enough to resist sagging when loaded, must hold desired weights while limiting thickness to what can be frozen readily, and must have dimensions which fit the master carton.

Round, dressed, or filleted fish can be packed in these boxes in layers separated by pliofilm, parchment, or waxed paper. The problem is to achieve easy separation. A really satisfactory layer pack would enable easy removal of components and would be less expensive than producing IQF products, while providing the important advantage of better shelf life.

F. Blocks: (illustrated on page 66)

Miller et al.[9] described the use of wooden frame molds of various sizes in which large sheets of plastic film were placed before filling with round, dressed, or filleted finfish. The plastic was then folded over the contents to make an effective seal, after which pressing into shape and freezing were accomplished by means of a plate freezer. A variety of products

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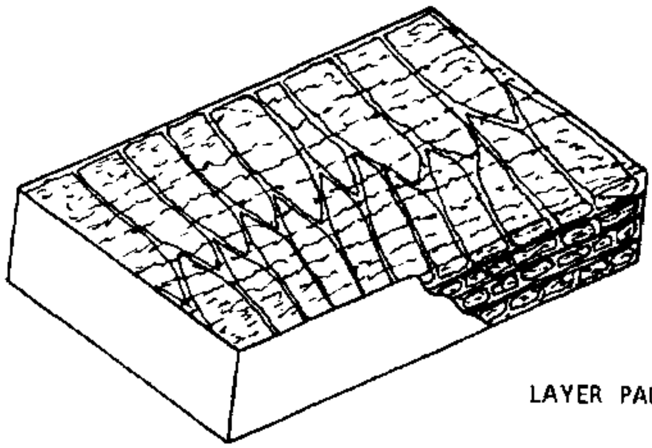
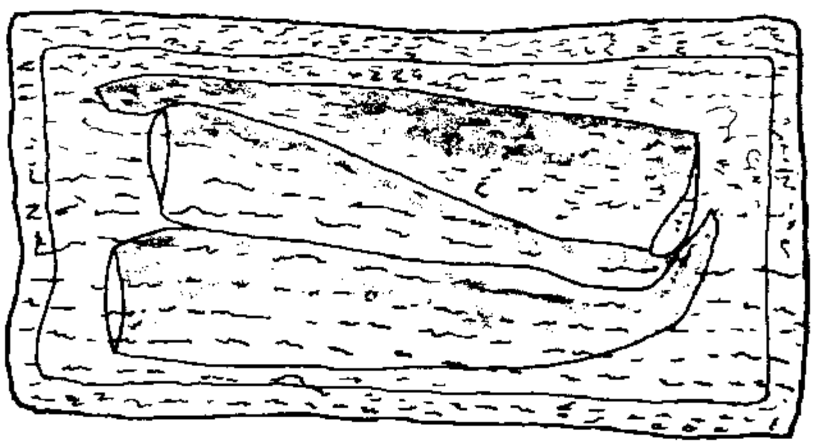
[9] Miller, p. 46.

.01 Product Forms and Packaging



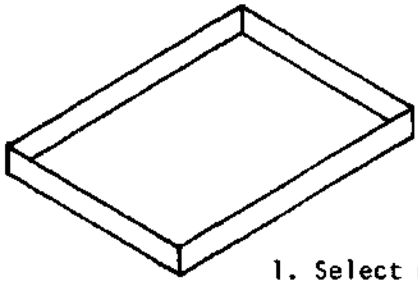
LAYER PACK



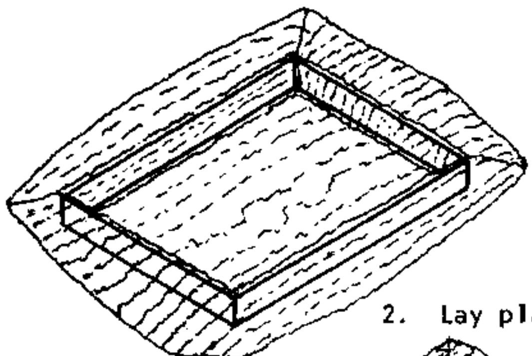
POUCH PACK

7.01 Product Forms and Packaging

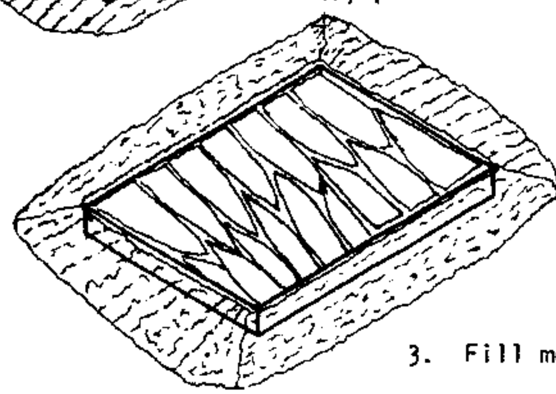
F. Steps in Producing Fish Blocks



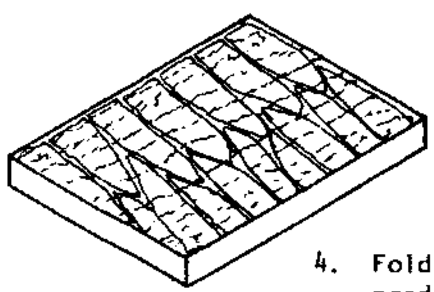
1. Select mold of required size.



2. Lay plastic film over mold.



3. Fill mold with product.



4. Fold plastic over product and press product into mold.

was frozen into blocks of less than 2-inch thickness and packed in master cartons. They conserved space in frozen storage rooms and had excellent shelf life. These blocks were also convenient to handle in fish markets since the products separated readily when left in ice overnight.

A similar block can be made by employing a reasonably strong box (16" x 12" x 1 3/4") over which is laid a large sheet of plastic film. The plastic film is folded over contents, which are then pressed into position with the lid. The box can then be placed on metal shelves butted against other boxes to help support the sides, and frozen in a blast freezer.

G. Consumer Packs:

(1) Frozen Product:

Pouches provide a packaging method which can be undertaken without much investment, offering an attractive way to display package contents which can be thawed easily by holding the pouch under cold water. Pouches provide excellent moisture and oxygen barriers for extended storage. This is a good way to pack dressed or filleted fish (see page 65), peeled and deveined shrimp, and other seafoods.

For maximum quality retention, vacuum packaging in heat-shrink bags presents a highly favorable alternative. Such a package may possibly contain a foam or paperboard tray or backing or may be contained in a paperboard exterior box with graphics and recipe information. A viewing window in such an exterior package would promote visibility of the product within. In addition to protecting the product from rancidity and freezer burn, the skin-tight packaging prevents inner frost accumulation which detracts from the appearance of the product.

A more commonly encountered packaging method is block-frozen, IQF, or layer-packed product simply placed within a wax or plastic-coated paperboard container. Such seafood is highly susceptible to freezer deterioration. In no case should seafood be frozen in film-wrapped trays of the fresh meat case variety. These not only fail to protect the product but project a poor quality image to the consumer.

(2) Fresh or Thawed Product:

A common type of package for shellfish meats is the round one-pound container with snap lid closure. These may have viewing windows made of clear plastic at the side or top with the remainder of the package being either plastic or wax-coated paperboard. Several sizes and shapes are available in this type package.

Recently, a semi-rigid plastic container with a heat-seal film top has been introduced for packaging of seafoods. Equipment is designed for gas flushing (carbon dioxide or nitrogen) of the package interior, if desired, to extend the shelf life of the product. The package is formed on-line from roll-stock and may be molded to any shape. The normal capacity of such packages ranges from 1 to 3 pounds of product. The packages have good consumer appeal, are leak-proof and odor-proof, and may be conveniently packed in master cardboard containers for shipping.

Film-overwrapped shallow trays of paperboard, plastic, or plastic foam, such as are used for packaging meat and poultry, have been widely adopted for seafood as well. These trays can leak, however, if not carefully sealed and are somewhat fragile for prepackaging at the processor's plant unless a sturdy master carton is used for shipping.

Vacuum bags and films, usually in conjunction with a shallow tray as described above, provide a tighter seal and a skin-tight, attractive package. Elimination of air from the package provides protection against rancidity and, to a lesser degree, microbial growth. Rancidity is a prime factor in the spoilage of thawed seafoods. At present, barrier films which seal out all oxygen have not been fully evaluated for safety with unfrozen product in terms of the remote possibility that the anaerobic (no oxygen) package might promote the growth of Clostridium botulinum. This organism will grow only at temperatures above 38°F in the absence of oxygen and produces a deadly toxin. Tests are currently underway to fully assess if vacuum packaging presents a danger in this respect. Vacuum bags are available which permit some oxygen to enter the package; these reportedly prevent odor buildup in the package, which may be detected initially by a consumer upon opening the package. However, a phosphate dip prior to packaging reportedly minimizes this problem. Vacuum-type bags may be used in conjunction with gas flushing to achieve longer shelf life. The bag may be used as part of the master carton to provide a protective atmosphere around the aerobically (air-containing, air permeable) packed consumer-sized packages within the carton during the period of shipping.

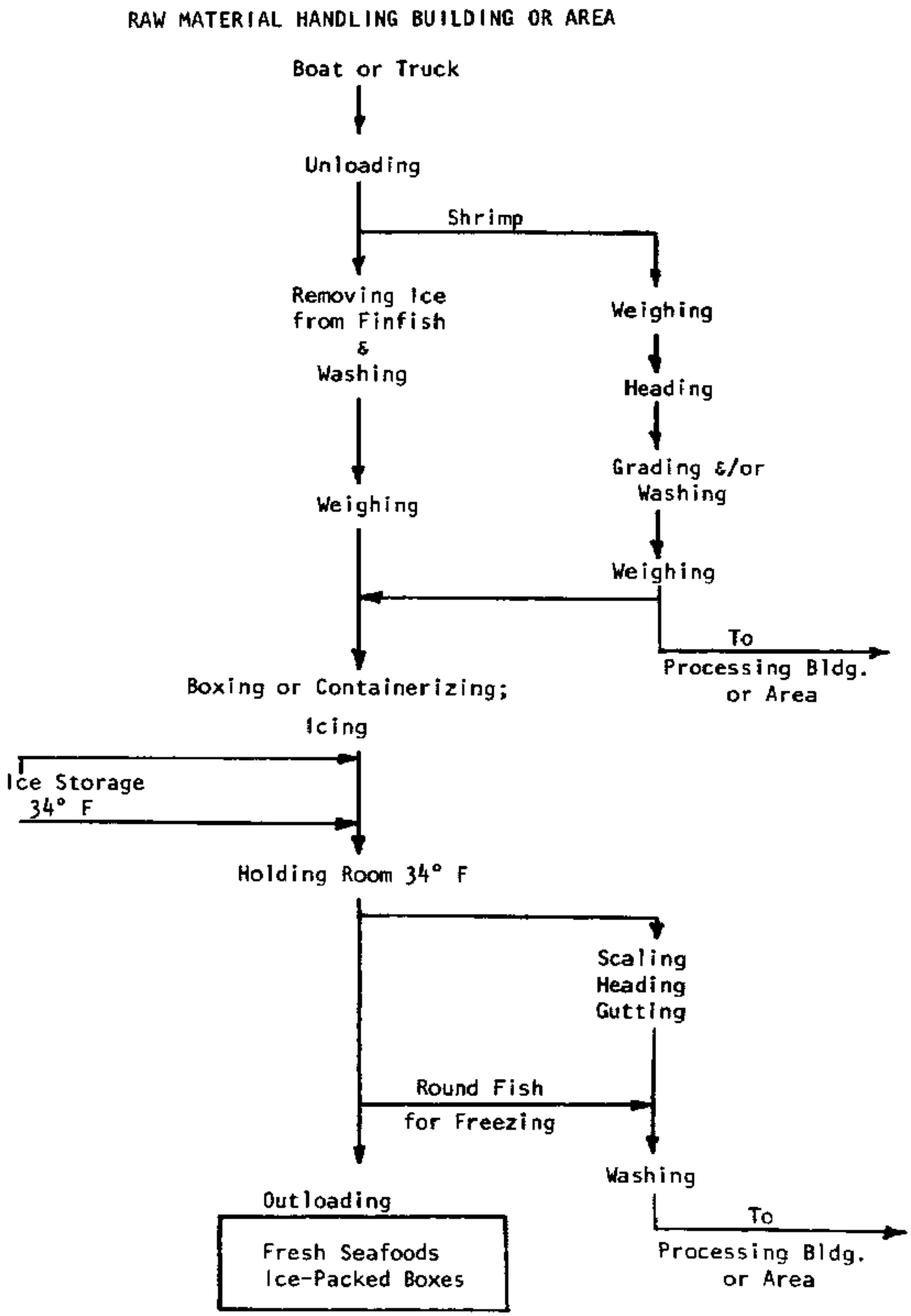
7.02 Plant Components:

After examination of the product forms, the plan to produce them should start with (1) preparing a flow diagram outlining the operation from unloading to shipment, and (2) estimating some equipment, space, capacity, costs, and labor requirements.

A. Flow Pattern:

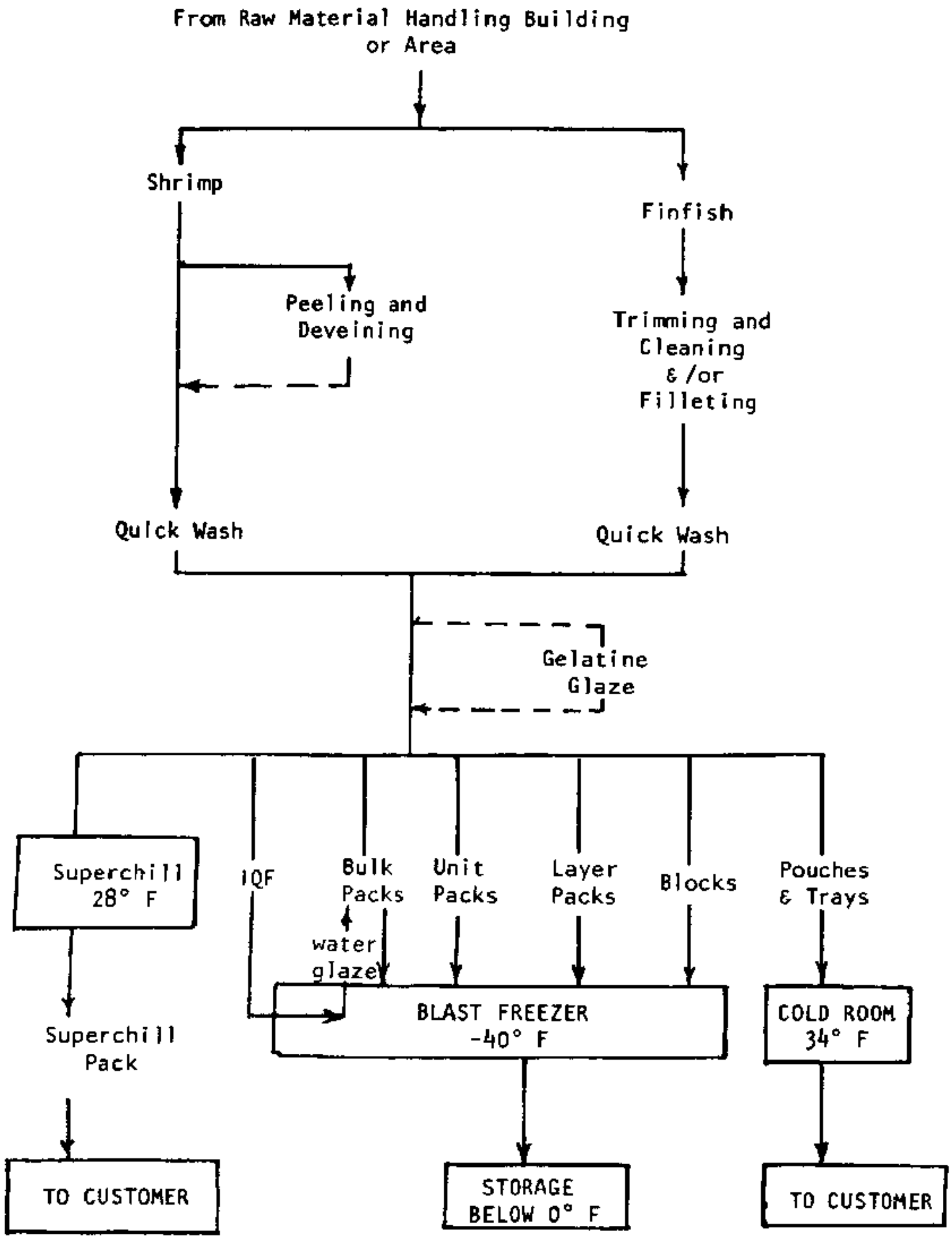
Flow diagrams on the next two pages indicate primary and secondary handling and processing of finfish and shrimp, accomplished

7.02 Plant Components



7.02 Plant Components

PROCESSING BUILDING OR AREA



in two separate buildings or areas. The primary steps can be conducted in many existing handling facilities while the secondary ones require more careful handling in a better environment.

Raw Material Handling Building or Area: (page 69)

One should consider accomplishing initial processing steps where the raw material is unloaded, not only because of proximity, but because bacterial levels are harder to control during these stages. Scaling, heading, and gutting of finfish, or shrimp heading, are steps which release large numbers of bacteria. Consequently, there must be separation from activities involving preparation of seafoods for iced shipments. The need for controlling bacterial loads becomes even more rigid when the raw materials enter secondary stages of processing.

Processing Building or Area: (page 70)

(1) Finfish:

(a) Trimming, Cleaning, Filleting, Steaking:

These steps must be designed to eliminate defects, off-color body parts, and extraneous materials not acceptable in an edible product. Products must be cut correctly and uniformly.

(b) Washing:

Washing, by passing through water or by using strong sprays, should be accomplished rapidly to minimize changing of moisture content, removing of flavors, and leaching out of nutrients.

The NCSU Seafood Lab has recently examined the available literature on washing of fish as it may relate to quality, shelf life, equipment used, and general sanitation. It had become evident that fishery technologists have at times emphasized radiation, chemical, microbial, and antibiotic treatments to control spoilage in fishery products. More often it appears that the basics of handling, washing, and general sanitation procedures have been overlooked.*

(c) Glazing:

Glazing, employing a one-step dip or spray, is a logical

* For further references on the washing of fish, see NCSU Seafood Lab publication, "The Washing of Fish: A Literature Assessment," Ramey, Taylor, Thomas, Dept. of Food Science, N. C. State University, UNC Sea Grant College Publication No. UNC-SG-79-07. Study funded by National Fisheries Institute.

and needed part of preparing the product for packaging.

(d) Product Forms:

These appear in the flow pattern shown on page 70 and are discussed in Section 7.01.

(e) Mechanization:

Conveyors and machines can be introduced to improve the efficiency of operations that rely on hand labor. However, if previous experience with processing is lacking, the basis for relying on manual operations is that investment is minimized and mistakes avoided. Mechanization can then be planned carefully as part of future improvements supported by earnings.

(2) Shrimp:

(a) Peeling and Deveining:

Peeling and deveining equipment should be considered to extend plant capabilities. In this instance it is difficult to find justification for hand operations.

(b) Product Forms:

These appear in the flow pattern shown on page 70 and are discussed in Section 7.01.

B. Component Parts:

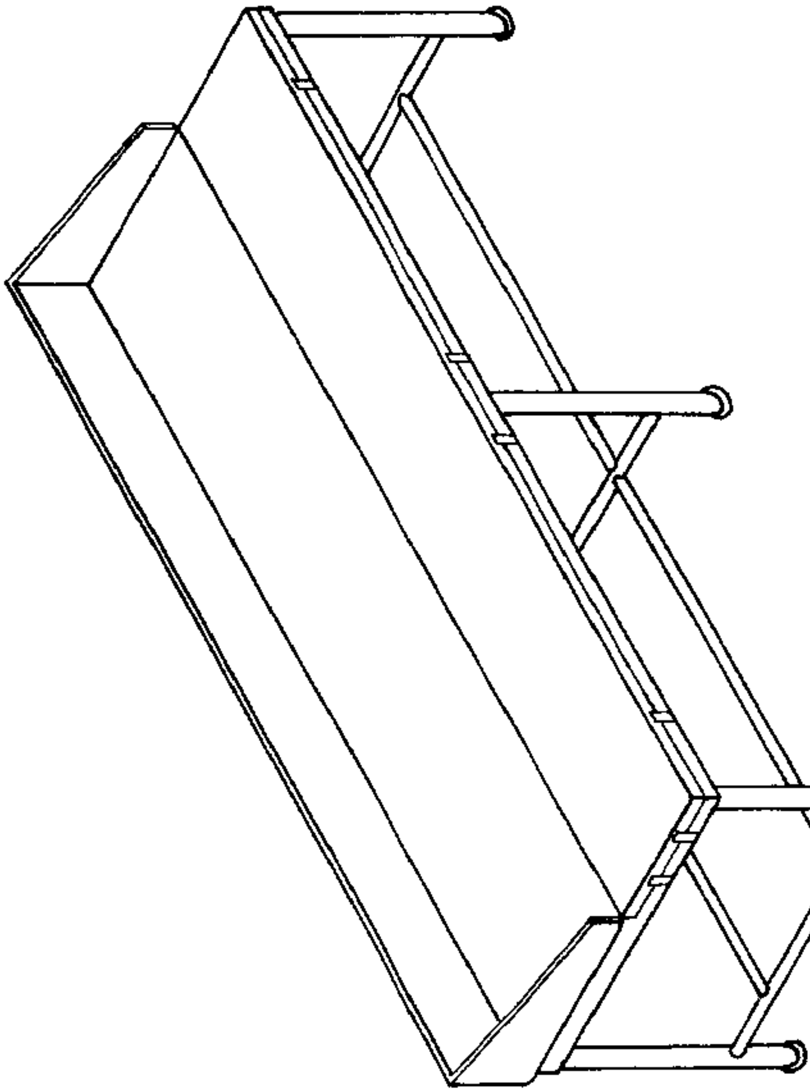
The following list shows some basic units, space requirements, capacities, and costs which may be involved:

UNIT	SPACE RQD.	CAPACITY	COST
Bandsaw, Heading	3' x 3'	1,000 lbs/hr	$ 996
Grader, Shrimp (Stainless Contact Surface)	3' x 12'	6,000 lbs/hr	45,000
Machine, Glazing, Stainless	3' x 10'	+1,000 lbs/hr	12,073
Packaging, Seal & Shrink	3' x 8'	300 lbs/hr	1,610
Packaging, Table Top Sealer	2' x 2'	120 lbs/hr	750
Packaging, Table Top Wrapper	2' x 3'	200 lbs/hr	175
Refrigeration, Ice Machine and Flake Ice Storage	11'7"x11'7"x10'6" (1408 cu.ft.)	4 tons/day	22,000

UNIT	SPACE RQD.	CAPACITY	COST
Refrigeration, Cold Storage (28° or 34° F)	11'7"x30'9"x10'6" (3739 cu.ft.)	680 boxes (Storage)	17,500
Refrigeration, Blast Freezer (-30° to -40° F)	11'7"x15'5"x10'6" (1875 cu.ft.)	5,000 lbs/day	32,500
Refrigeration, Frozen Storage (-15°F)	21'2"x30'9"x10'6" (6832 cu.ft.)	190,000 lbs (Storage)	39,500
Scaler, Electric, Hand	1' x 1'	300 lbs/hr	443
Scaler, Electric, Simor	3' x 10'	5,000 lbs/hr	13,450
Scale, Platform	3' x 3'	1,000 lbs max. capacity	500
Scale, Spring	3' x 3'	150 lbs max. capacity	570
Table, Cutting, Stainless (shown on pages 74 & 75)	4' x 16' (2 units)	650 lbs/hr	1,847
Table, Cutting, Wood (shown on page 76)	4' x 16' (2 units)	650 lbs/hr	400 (Built locally)
Table, Packing, Stainless	4' x 8'	650 lbs/hr	444
Table, Shrimp Heading, Stainless	4' x 16'	500 lbs/hr	1,600
Table, Shrimp Heading, Wood	4' x 16'	500 lbs/hr	500
Table, Sorting w/ conveyors	5' x 20'	5,000 to 10,000 lbs/hr	4,100
Tank, Wash (De-icing)	4' x 8'	5,000 lbs/hr	2,800 (Built locally)
Unloader, Hoist and Bucket	4' x 4'	5,000 lbs/hr	1,000 (Built locally)
Unloader, Deck Conveyor	2' x 20'	5,000 lbs/hr	Not available

Note: Much equipment is locally designed and built; such items are usually less expensive than the commercial prices mentioned above.

7.02 Plant Components



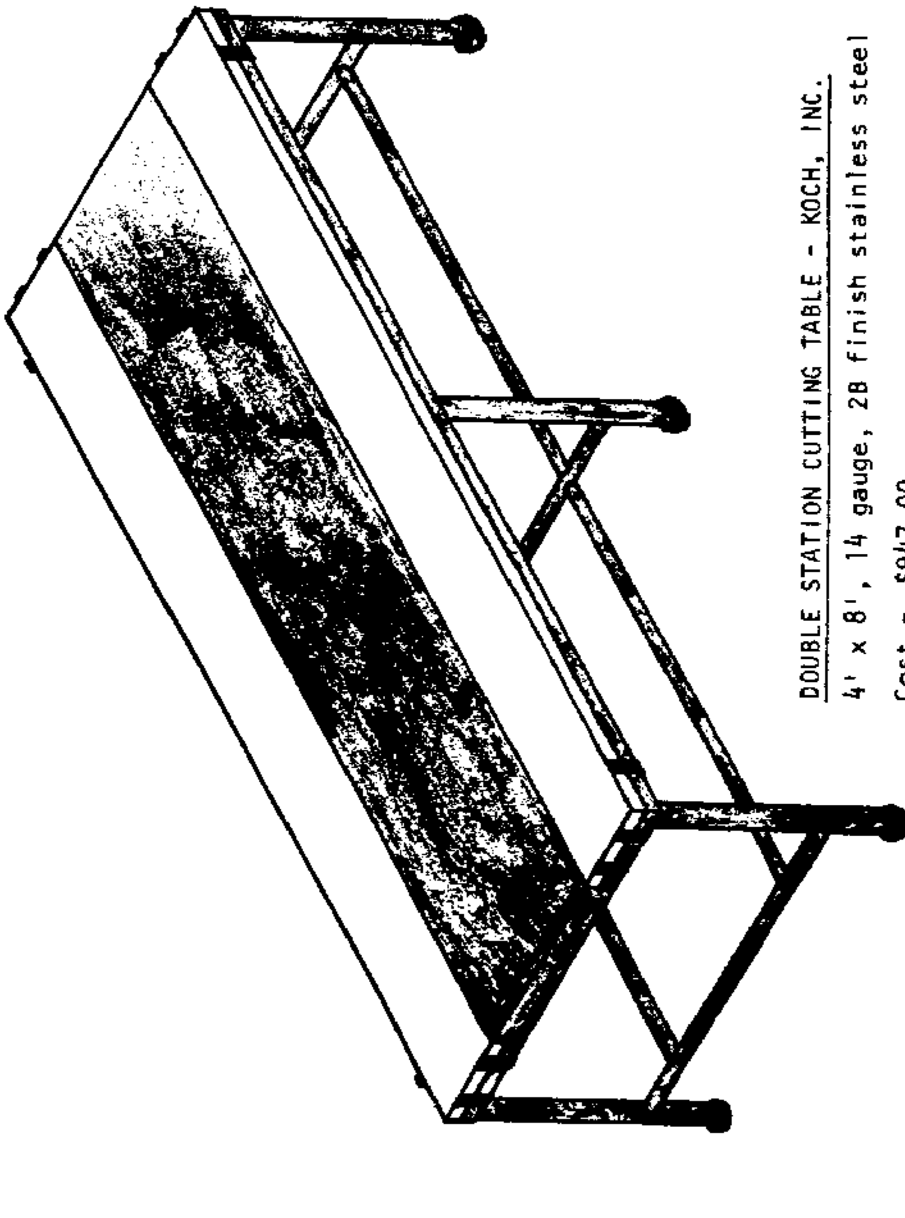
TRIMMING TABLE WITH BACKSPLASH - KOCH, INC.

42" x 8' with 10" Backsplash, 14 gauge,

2B finish stainless steel

Cost - $900.00

7.02 Plant Components

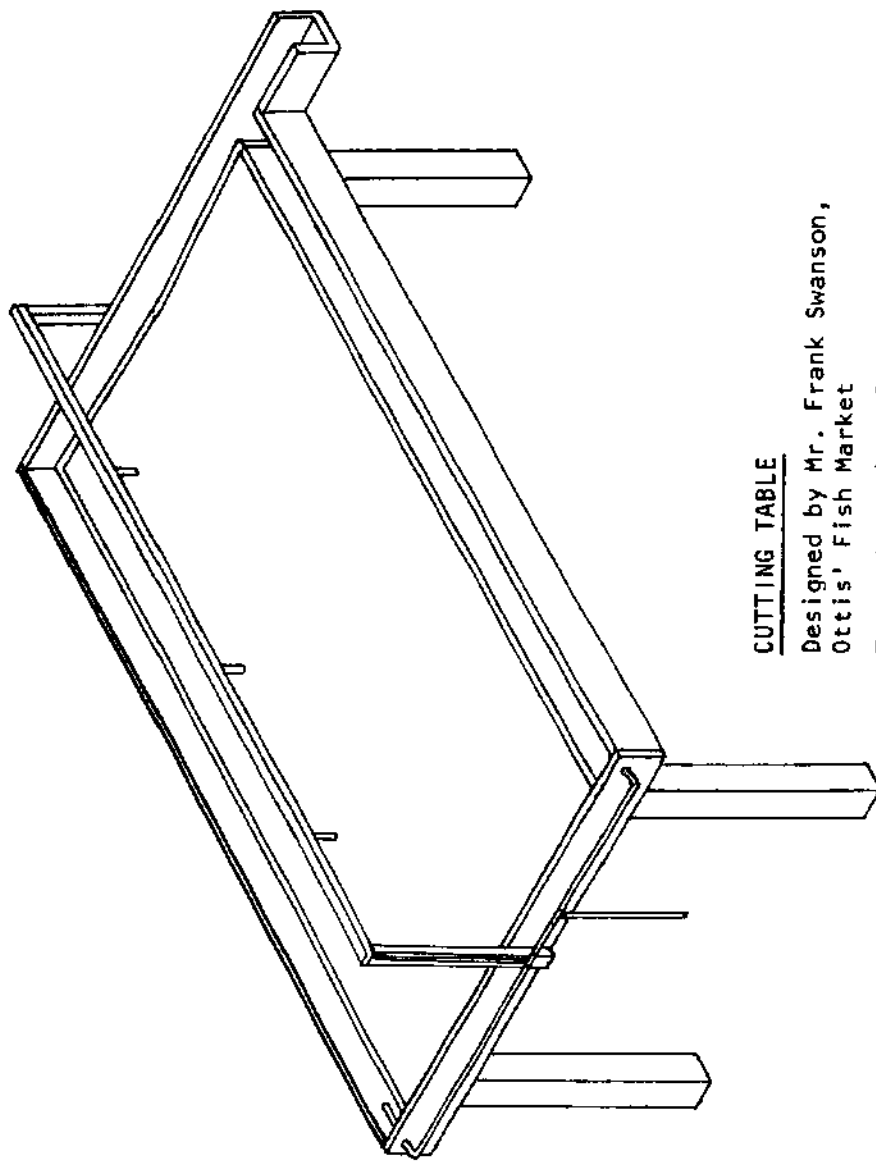


DOUBLE STATION CUTTING TABLE - KOCH, INC.

4' x 8', 14 gauge, 2B finish stainless steel

Cost - $947.00

7.02 Plant Components



CUTTING TABLE

Designed by Mr. Frank Swanson, Ottis' Fish Market

Top made of 4' x 8' marine plywood

Cost incl. labor - **$200.00**

It should be noted that wooden tables must be tightly made and completely sealed with varnish or other non-toxic coating. Since wood is not usually recommended, it is important to have the approval of the regulatory agencies if it is used.

Calculating the amount refrigerated rooms will hold is based on assuming 2/3 of cubic capacity as usable space. The following carton volumes help estimate holding capacity:

25-lb. freezer carton = 1.2 cubic feet
50-lb. freezer carton = 2.3 cubic feet
100-lb. freezer carton = 3.6 cubic feet
100-lb. wooden box = 4.1 cubic feet

C. Labor Requirements:

(1) Unit Operations:

(a) Unloading Boats - Operating hoist and bucket requires 5 people. The deck conveyor eliminates 1 person.
(b) Washing and Removing Ice - Keeping this tank and conveyor combination in operation requires 1 person.
(c) Sorting - People required depends on size and variety of species, but 10 to 20 people are usually involved in operating a 20-foot sorting belt.
(d) Weighing - A platform scale can be operated by 1 person, but a spring scale may require 2 people because of additional lifting.
(e) Scaling - A large machine can be operated by 1 person.
(f) Heading - A bandsaw speeds up subsequent dressing operations. This equipment can be operated by 1 person.
(g) Packing - Placing dressed fish, fillets, and steaks in containers requires about half as many people as are required for cutting.

(2) Cutting:

If the plant is based mostly on hand labor, estimates of labor requirements must start with cutters required, then the number of persons needed to keep the process in motion must be determined. It is estimated that experienced cutters can fillet 60 pounds small-sized, 80 pounds medium-sized, and 100 pounds large-sized whole flounder per hour to produce 6-8 ounce, 8-10 ounce, and 10-12 ounce fillets, respectively. Similar figures apply to 6-8 ounce, 8-10 ounce, and 10-12 ounce whole dressed flounder.

Pan trout (200 to 250 count) can be headed and gutted by an experienced cutter at a rate of 80 pounds of round trout per hour. Mechanical removal of heads may double this rate. It is estimated that larger whole trout (100 count) can be handled at a rate of 75 to 80 pounds per hour, while this figure may exceed 100 pounds per hour if heads are mechanically removed.

7.03 Prototype Plant:

The prototype plant shown on page 81 is an example of a tentative layout which enables estimating preliminary costs. This building should be able to handle over 1,000,000 pounds per year of finfish, or a product mix consisting of finfish, shrimp, and other species.

A. Basic Construction Requirements:

	APPROX. COST, 1980 PRICES	
BUILDING AND ACCESSORIES	BLOCK BUILDING	PREFAB METAL BUILDING
	Contractor's estimated cost = \$23/sq.ft. Total cost for 30'x60' bldg. = \$41,400	
Concrete foundation, floor drains, water & sewage lines, water valves & heater, walls, and labor	5,274	Estimated cost @ \$10/sq.ft. = \$18,000
Insulation	1,000 (insulating block & 6" roll fiberglass above ceiling)	Included in sq.ft. estimate
Air Conditioning & Heat (7 1/2 ton unit)	10,000	10,000
Framing - For interior walls and partitions	647 (including 4"x8"x16" block, mortar, sand, and labor)	554 (including 2"x4" studs; top & bottom plates for walls; 1"x4" strips for support of side walls)
Rafters	1,085 (pre-cut & nail trusses)	N/A
Plywood Sheathing 1/2" thick (C-D Grade)	532	N/A

BUILDING AND ACCESSORIES	APPROX. COST, 1980 PRICES	
	BLOCK BUILDING	PREFAB METAL BUILDING
Shingles	$ 564	$ N/A
In-Place Wall Panels w/ dropped ceiling	1,800 (dropped ceiling)	4,750 (finished walls & ceiling)
Doors - 5 (3'x6'8")	143	143
2 (8'x8' overhead)	400	400
Bathroom Fixtures & Sinks	1,500	1,500
Wiring (400 amp 3-phase) including motor & lighting circuits w/ conduits	2,600	2,600
Paint - Interior	520 (primer & FDA-approved epoxy finish)	N/A
Paint - Exterior	420	N/A
Labor; builder's overhead, insurance, and profit	14,915	7,579
Estimated Cost	$ 41,400	$ 45,526

B. Special Building Requirements:

(1) Building Site:

Suitable land with good water supply, above flood level, well-drained, away from neighbors who might contribute pollution via air, water, odors, insects, and rodents. The land must be adequate for effluent handling or accessible to city sewers.

(2) Foundation:

Construction should be adequate for present and future loads and should be planned in advance for additions to building.

(3) Floors:

Floors should be smooth, non-skid, and resistant to movement of heavy loads, sloped 1/4 inch per foot for easy washdown, equipped with strategically located drains a minimum of 4 inches in diameter. Floors in low temperature rooms are a separate and distinct problem.

(4) Walls:

Walls should be surfaced with impervious material, smooth, and completely washable. The curbing should be waterproof and well-sealed to the walls. One should consider insulating the processing areas.

(5) Doors and Windows:

Doorways through which products move should be a minimum of 5 feet wide and should provide screens or fly chase fans. Windows should be screened and tightly sealed into the walls with ledges having a 45° slope for easy washing.

Doors of toilet and dressing rooms should be solid, self-closing, and should completely fill openings.

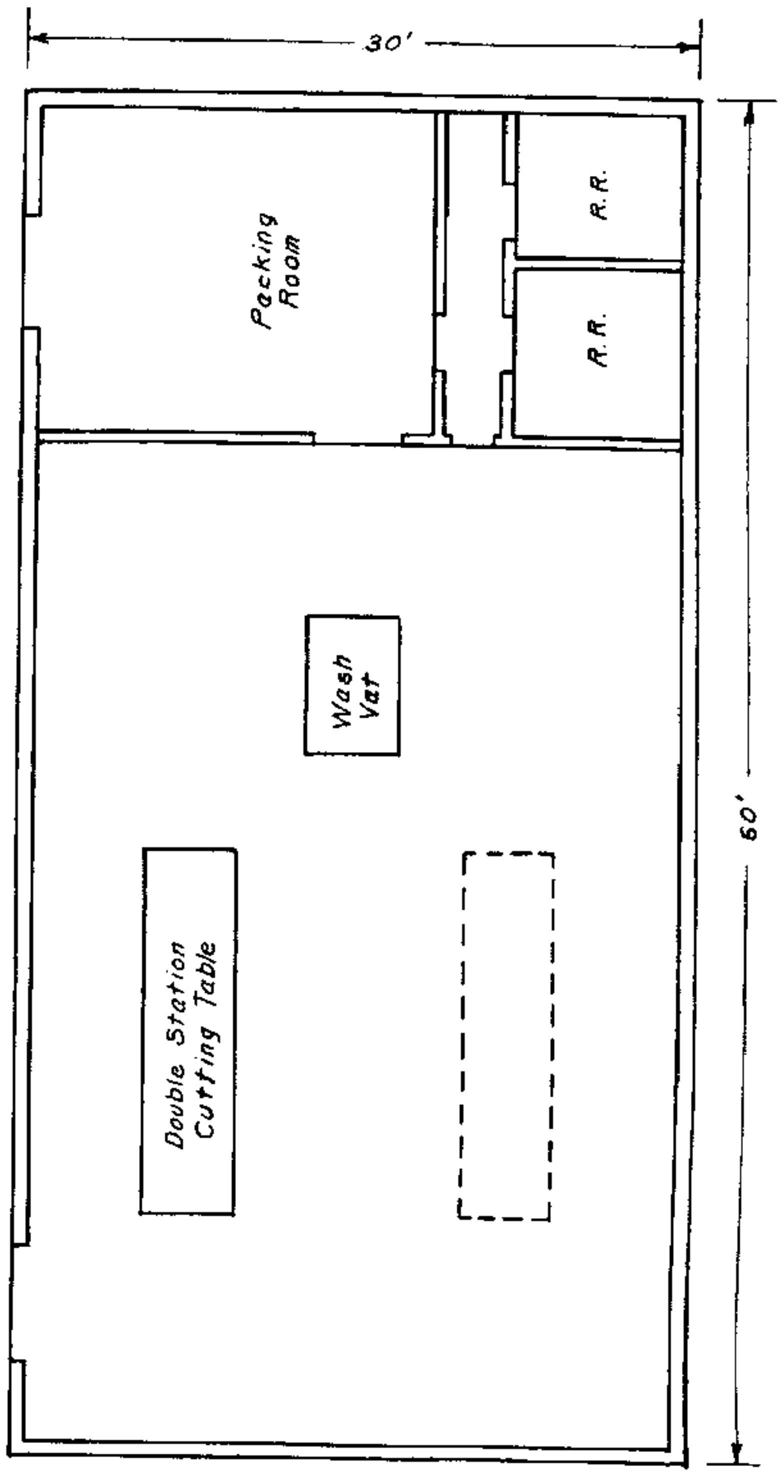
(6) Electrical and Lighting Suggestions:

Consider installing two separate lines for 3-phase, plus a single-phase circuit, the latter for lighting. Heavy-duty motors should be balanced on the two 3-phase circuits for optimum economy. Electrical wiring should be overhead, above the ceiling, the 3-phase wiring in thick wall conduit and the single-phase distributed to strategic locations in thin wall conduit. Lighting fixtures should be vapor-proof and equipped with shields of non-shattering material.

(7) Water Supply and Plumbing:

There must be adequate potable water supply, certified by proper authorities. Ample hot water is needed, and there should be sanitary drinking fountains. Discharge of various effluents should be into approved systems with toilet lines separate from processing lines and without cross-connections. There should be at least one wash basin for each twenty-five employees and one stool for each fifteen persons of each sex. Toilet rooms should have outside ventilation.

7.03 Prototype Plant



SECONDARY PROCESSING BUILDING

C. Total Financial Requirement:

In calculating financial requirement for overall new processing facilities, it should be considered that working capital is a necessary component of the investment. This would include such expenditures as insurance, property taxes, payroll, and cost of improvements. Many times, new and/or expanded operations are severely restricted by not having available lines of credit and/or sufficient funds to adequately manage and maintain their operation.

7.04 Processing Feasibility:

Before getting into the actual steps of figuring if finfish processing pays, some recent trends in fish consumption and landings should be reviewed. The trends hold some interesting implications.

Per capita consumption of seafood products in the U. S. (total number of pounds of seafood products consumed in one year divided by the total population) has increased to 13.3 pounds, reported for 1979.[10] During the period 1968 through 1973, average per capita consumption was 11.7 pounds. In 1976, this figure was established at 13 pounds.[11] Seafood consumption has been slowly increasing for the last decade and shows promise to continue its upward trend. This is due, at least partly, to high meat prices.

With relatively stable commercial landings of edible fishery products, rising imports might be thought of (in general) as one result of increasing demand for fishery products. Another factor which has become increasingly important, given recent consumer concern with nutrition, is the low fat content of fish--and most of the fat is polyunsaturated.

In general, fish consumption does not tend to respond to income changes as rapidly as some of the other major protein sources, such as beef. The quantity of fish consumed may, however, respond more significantly to changes in prices of other protein sources, especially in less active inland markets. This point is conjecture since little research has been undertaken along these lines, but if this is the case, then fish consumption will in part depend on future meat and poultry prices.

Future fish consumption should continue to increase, though perhaps slowly. An important factor in the industry's growth has been, and will continue to be the effect of rising costs, particularly fuel, on the fisherman, and from the demand side, the effects of rising

10 "Fisheries of the United States, 1979," Current Fisheries Statistics No. 8000, National Marine Fisheries Service, 1980, p. 76.

11 "Export & Domestic Market Opportunities for Underutilized Fish & Shellfish, Study Report," National Marine Fisheries Service, 1978, p. 192.

fuel prices on the tourist traffic. If tourist traffic is significantly reduced, the industry may need to explore expanded inland marketing with less reliance on the traditional local markets. Such shifts in marketing could also dictate alterations in product forms.

Turning to the North Carolina fishery, National Marine Fisheries Service statistics indicated an estimated industry employment of 2,870 full-time and 1,443 part-time commercial fishermen in 1979. Receipts of these fishermen were just under 59 million dollars for almost 390.5 million pounds landed. Of these receipts, shrimp were the single most valuable specie with a value of 9.7 million dollars.

Chart 1 illustrates landings poundage and value for North Carolina from 1965 to 1979.[12] (See page 84) Although the chart does not indicate the landings of individual species, menhaden accounted for a large percentage of the increase in landings for 1978-79. Also noteworthy is that croaker landings have steadily increased from 10 million pounds in 1974 to over 20 million pounds in 1979. Landings of other species suitable for processing have also increased.

As fresh markets become more saturated with increasing landings of processible finfish, the natural reaction of the industry is to look increasingly at the potential for processing. Larger quantities of fish moving into processing would tend to reduce the fluctuations that occur in price, which should also aid the fishermen. However, an important question which we have addressed and will continue to work on is this: Are the peak harvesting seasons of processible finfish (those with an established market for the processed product) long enough, together with sufficient landings, to pay the investor to process? Since some processing is now being done, the extension of this question is, given our landings and season lengths, what size plant will return the highest yield on the dollars invested? More pressing business management problems for those in industry who are considering a processing line or facility probably revolve around the question, "Will it pay?" The following discussion sets forth issues that should be incorporated into decision-making regarding this question.

The figures that follow are tentative and may be outdated, hence the cost of a particular item or the absolute amount of dollar returns may not be accurate. The point of this discussion is the technique involved in arriving at projected returns and not the figures themselves.

Suppose you are considering investing in a processing plant or a processing line within your existing plant. You may have a hunch that it will pay, but how much will it pay? What would be your decision if the projected rate of return on your investment were

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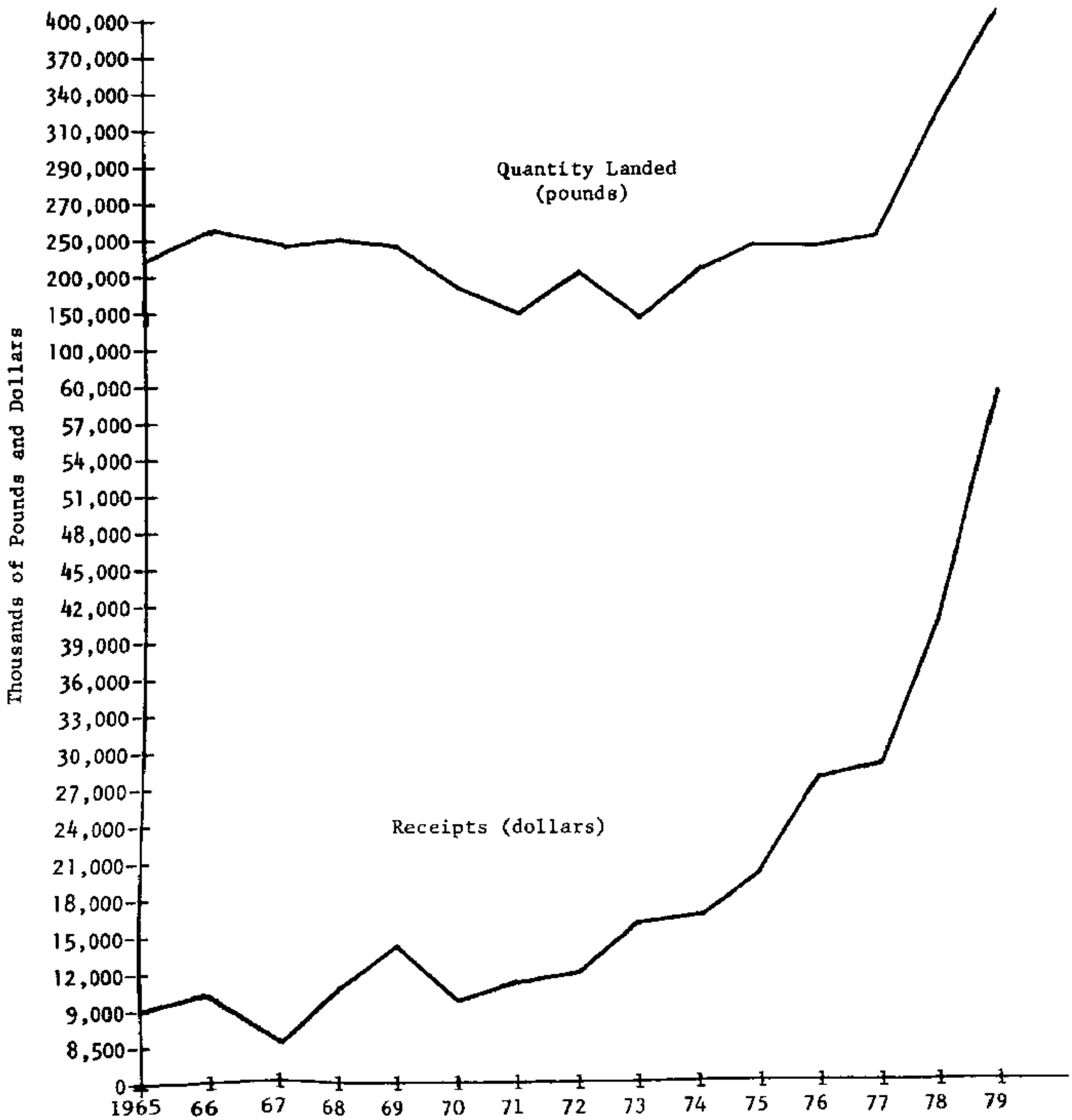
12 Based on National Marine Fisheries Service, Preliminary Landing data.

7.04 Processing Feasibility

CHART 1

NORTH CAROLINA LANDINGS
1965 - 1979



17 percent? What if it were 3 percent? Would your banker view these differently?

As an example, consider a hypothetical plant that is capable of processing 750,000 to 1,000,000 pounds of fish per year, depending on the number of days it operates. A point worth noting here is that the more days per year of anticipated operation, the more of one of the following will be necessary to earn the greatest return on investment. First, larger freezer space might be necessary in order to buy and store more fish during peak harvesting. Second, more purchases of out-of-state fish during local off-season might be necessary. A third is to simply purchase the fish locally and process as long as the supply lasts. Some combination of these alternatives may be feasible, but each leads to a different input price which should be accounted for in the computations.

Assume that flounder, grey trout, and croaker will be handled with the output mix of:

Flounder - 54 percent
Trout - 36 percent
Croaker - 10 percent

Assume further that the type of processing is the following, with the respective yields:

Flounder - 55 percent - Fillet
Trout - 51 percent - Fillet
Croaker - 50 percent - Headed & Gutted

These yields directly affect costs and revenues. For example, the higher these yields, the lower the purchases of raw material necessary to achieve a given output, hence the lower the costs.

An additional important figure entering the projections is labor productiveness related to various species and product forms. Those shown below were used to compute net revenue.

Labor Productivities Used to Compute Net Revenue (in pounds per day)

	Fillet	H & G
Flounder	280	-
Trout	440	-
Croaker	-	800

The productivity figures, like the yield percentages, are crucial to net revenue projections. These in essence determine the number of cutters needed to produce a given quantity per day (month, etc.), hence also have a large impact on net revenue.

How these are used in projecting net revenue for a hypothetical plant is as follows: First, using output mix percentages and a target level of output desired, compute the number of cutters needed to achieve the desired output for each specie. Then, output per day divided by the above productivity figures (on a per day basis) yields the number of cutters necessary. That is,

$$\text{Number of cutters} = \frac{\text{Output per day}}{\text{Productivity}}$$

One could work the other way as well: given the number of cutters and the productivity figures, output per day is easily computed by simply multiplying the two.

Revenue per day by specie is then computed by multiplying expected price of the product by pounds per day produced for each specie and adding.

To compute the daily raw material needed (and its cost), the following computations are required:

$$\text{Input poundage} = \frac{\text{Output poundage}}{\text{Percent yield}}$$

for each specie. Then, the multiplication

Input Poundage x Input Prices = Input Raw Material Cost

gives the cost for each specie. Add these for total raw material cost. One can easily see why it is crucial to employ an accurate yield figure in the above computations.

Without going into a great deal of detail, the next step is to list the various plant and equipment items. These are used to compute annual costs (those that are incurred regardless of the number of days the plant operates). This publication lists many examples of these. Plant components are listed in modular form to allow for different systems. From this listing a depreciation schedule can be set up on plant and equipment components. These can be totaled for a yearly depreciation charge. Additionally, property taxes, insurance, and expected maintenance charges should be included in the annual cost. Economists also consider a further item as an annual cost--the interest on the investment (not necessarily the mortgage interest). The reason for this charge is that once the capital is invested, there is a foregoing of some interest return on those funds, hence it represents an additional cost. Total all these for yearly costs.

Operating expenses should be projected also. Labor charges, utilities, sales fees, raw material costs, and foregone interest charges on working capital are examples of the major annual charges. If possible, these should be computed on or converted to an hourly or daily basis.

By computing costs on an hourly basis, one can ascertain the effects of varying days of plant operation on net revenue. It is impossible to predict the exact length of the harvesting season for a given specie, so it is even more important to gain some understanding of the impact of varying days of operation on net revenue before committing capital to processing.

Likewise, since it is difficult to project prices paid for raw material, they can be varied in the projections. Net revenue, which can be computed for different input prices and different days of operation, is highly responsive to changes in raw material prices, number of days of operation, and input prices. Both revenue and costs fall as operating days are reduced, but revenue falls faster. This results from the fixed yearly costs being spread over a smaller quantity of product.

To summarize, these types of computations are valuable management aids. If one is considering investing in finfish processing, he should learn all he can about the expected costs and returns.

7.05 Investment Analysis:

Owners and managers of seafood handling firms are often faced with decisions of whether to add to the firm's capacity, install cost saving devices, or add a line to the firm's output (for example, adding a filleting line). A common theme to these and similar decisions is an addition to the firm's durable assets (those generally expected to be used for more than one year). Specific examples of such investments would include the purchase of a truck, the installation of a freezer, or perhaps adding a conveyor system. How do you evaluate whether an investment is worthwhile? Or if you are considering several investments and you cannot undertake all of them, which do you choose? The brief discussion that follows will introduce some techniques that are helpful in evaluating such decisions.

A. Partial Budgeting:

Some investment decisions do not involve the entire business; i.e., the decision does not significantly affect product flow or cash flow in the rest of the firm. Examples of the types of investment for which partial budgeting analysis is appropriate are the purchase of a machine or adding a new product or service. The relevant question to ask is, what are the additional costs and additional revenue resulting only from this particular investment likely to be? Another way of asking this question is, how much net revenue will this investment contribute?

Partial budgeting is an appropriate tool for this type of analysis. In a nutshell, it simply compares the added costs and added revenues expected from making the investment. Keep in mind, though, that additional costs incurred include any income lost as a result of the change, and additional revenues include any savings in cost. To avoid confusion, it is worthwhile to simply list the cost and revenue changes anticipated. An example will help illustrate the partial budgeting technique. Suppose you retail fish and you are thinking of converting one of your fresh fish lines to a frozen line. Will this be a profitable change? (Note: The numbers chosen to illustrate the technique may not be accurate but are used to illustrate how the analysis is done.) What we want to do is list all conceivable additional costs and additional revenue, then look at the difference between them.

Additional Annual (or Seasonal) Revenue

Net income (gross income less cost of goods sold) from new frozen line (5,000 lbs. @ avg. mark-up of $.49/lb.)		$2,450
Reduced costs:		
Reduced ice purchases	$ 50	
Reduced spoilage	250	
Reduced labor	150	450
Total additional revenue		$2,900

Additional Annual (or Seasonal) Costs

New display freezer		
Depreciation	$350	
Electricity	150	
Interest (on inventory)	100	600
Reduced profits from existing fresh fish line		1,800
Total additional costs		$2,400
Net change in income		+ $500

In this example, the partial budget shows an increase in annual profits of $500 if the frozen line is added. To quickly review the example, our best estimate of the income from sale of frozen fish less the cost of the raw material (already frozen) is $2,450. To this we add estimated cost reductions in handling fresh fish (labor), from using less ice, and from incurring less spoilage than in the fresh fish line. Additional costs are those expected as a result of changing lines and exceeding costs already incurred. For example, the electricity charge is the additional charge estimated as a result of larger power requirements of the freezer display compared to cold storage display. Similarly, if there is longer holding of frozen fish, higher interest costs of inventory are incurred. The loss in profits from the fresh fish line to be replaced is estimated to be $1,800. Hence, based on the net change in profit of $500 annually, one might well choose to change lines.

There are several advantages and disadvantages of the partial budgeting analysis. Important advantages are that the technique is quick, it can be done for several alternatives, and it does not require use of all costs and revenues in the business. Important disadvantages are that it may be difficult to isolate the effects on costs and/or revenues of the business, it does not reflect the effects of the proposed change on the firm's financial position, and it does not account for the time value of money, which will be discussed shortly.

As pointed out earlier, the partial budgeting technique is inappropriate if a significant part of the firm is to be affected by an investment. Attention is now turned to a method appropriate for evaluating major investments and for comparing alternative investments.

B. Capital Budgeting:

The essence of an investment decision is whether or not it is profitable to acquire durable assets that yield a flow of revenue over time. What is the rate of return on an investment that produces income over time? Which investment yields the greatest return if more than one are being considered?

Central to the analysis is the idea that money has a time value. This is because there are many alternatives for investing money and earning a return--a rate of interest. A major cost of an investment is the opportunity cost of tying up funds in a particular endeavor. That opportunity cost is what could have been earned by the funds in the next best alternative. Most of us would rather have $1 now than $1 a year from now. That is because we could invest that $1 today and have more than $1 a year later. How much more depends on our risk preferences and going rates of interest.

Before analyzing an investment decision, it is helpful to understand compounding and discounting. Compounding is simply a procedure for determining future values. The future value of some current sum of money is given by

$$V_N = P_o (1 + i)^N,$$

where V_N = future value

P_O = principal invested

i = interest rate per period (months, years, etc.)

N = number of periods

For example, $100 invested at 10 percent per year for 4 years would give us a future value of:

$$V_4 = \$100\ (1 + .10)^4$$

$$= \$100\ (1.464)$$

$$= \$146.40$$

Discounting is simply a procedure for determining the current, or present, value of a sum of money to be received at some future date. The present value of some future amount is:

$$V_O = \frac{P_N}{(1 + i)^N} = P_N(1 + i)^{-N}$$

where V_O = present value

P_N = future value to be realized

i = interest rate per period

N = number of periods

Present value factors, $(1 + i)^{-N}$, are shown in the table on page 94. As an example, suppose you are to receive $500 two years from now. What is the present value of that amount if the interest rate is 12 percent? To solve, substitute the values into the above equation, or:

$$V_O = \$500\ (1 + .12)^{-2}$$

$$= \$500\ (.797)$$

$$= \$398.60$$

If we think about present value, we are really asking what amount would we need to invest today at the stated interest rate to yield that expected future value. In this example, the present value of $500 two years from now is $398.60, because we could invest that amount at 12 percent and have $500 in two years; i.e., the values are equivalent when we adjust for potential interest earnings. We will use this present value concept shortly in analyzing future income flows.

Suppose we are considering two alternative investments of equal amounts, say $10,000, and we want to know which to choose. Suppose the net cash flow (revenues less costs actually paid) looks like the following over time:

Year	Net Cash Flow Project A	Net Cash Flow Project B
0 (period of investment)	-$10,000	-$10,000
1	5,000	1,000
2	4,000	2,000
3	3,000	3,000
4	1,000	4,000
5	0	5,000
6	0	6,000

In this example, year 0 is the year at which the investment is to be made, with the expected cash flows generated in years 1-6 under the two alternatives. Which would you choose? One selection criterion that is sometimes used is the payback period, the length of time required for an investment to pay itself out. Using this criterion, we simply sum up net cash inflow until it equals the initial outlay. The length of time this requires is the payback period. For the projects above, the payback period is 2 1/3 years for A, 4 years for B. Hence, using this criterion, we would select project A. One problem with this technique is that it ignores the time value of money. It also ignores cash flows beyond the payback period itself; hence, it is biased against longer-term investments. We mention it only because it is often used, yet it is not very satisfactory.

A more thorough technique is the net benefit-cost ratio. Using this technique, we compute present values of the net cash flows and then form a ratio of the present value of benefits to costs, where costs represent the initial outlay. Using the same examples above and our present value formula (see the table on page 94 for present value factors), the computations are as follows:

Year (1)	Present Value Factor @ 12% (2)	Net Cash Flow A (3)	Net Cash Flow B (4)	Present Value of Cash Flow A (5)	Present Value of Cash Flow B (6)
1	.893	$5,000	$1,000	$ 4,465	$ 893
2	.797	4,000	2,000	3,188	1,594
3	.712	3,000	3,000	2,136	2,136
4	.636	1,000	4,000	636	2,544
5	.567		5,000	0	2,835
6	.507		6,000	0	3,042
		Sum of present values		$10,425	$13,044

To obtain present values, we simply multiply the cash flows for the two projects shown in columns (3) and (4) by the present value factor in column (2) to get columns (5) and (6). These values represent the present values of the dollar flows in each year of projected returns. Next, we add the numbers in columns (5) and (6) to get the present value of the cash flows over the expected lives of the two projects. The last step is to form the ratio as follows:

$$\text{Benefit-Cost Ratio} = \frac{\text{Net Present Value of Cash Flow}}{\text{Investment}}$$

<u>Project A</u>

$$\text{B-C Ratio} = \frac{\$10,425}{\$10,000} = 1.0425$$

<u>Project B</u>

$$\text{B-C Ratio} = \frac{\$13,044}{\$10,000} = 1.3044$$

The decision rule is to choose that project with the highest B-C ratio, in this case project B. Note that this project would not have been selected had we used the payback period decision rule. In addition, we would not choose a project with a B-C ratio less than 1.0. In that event, the investment itself would exceed the present value of the expected future cash flow; hence, we would be worse off if we made the investment.

The net cash flows by periods have to be estimated for each project. These represent revenue generated from the investment, less operating costs, material costs, etc. However, only those costs that actually represent outflows from the firm are used in computing the flows. Likewise, only actual cash inflows are used in computing revenues. One must also choose the rate of interest with which the future flows are discounted. The rate chosen should approximate your opportunity cost of the funds invested; i.e., if you could earn 12 percent with the investment in some other asset with approximately the same risk, then you might consider using 12 percent for discounting flows. Alternatively, one could use the cost of borrowed funds for the investment, but this rate should be thought of as a floor, or lower limit. It should be noted that if comparing several investments with different years of expected cash inflows, the choice of a discount rate itself may influence which investment you might select. Higher discount rates tend to make more attractive those investments whose cash inflows occur closer in time to the period of investment. Lower rates will tend to favor investments with cash inflows further off in time. The point is that the selection of a discount rate will affect the computed present values; hence, the rate should be selected with care to reflect as accurately as possible your opportunity cost of funds.

The flows shown in the simple examples above are assumed to be pre-tax flows. One might choose to compute present values and analyze the benefit-cost ratio based on after-tax flows. In this event, depreciation, even though it is not a cash outflow, is used as a cost since it is tax deductible and affects taxes paid. The procedure for doing an after-tax analysis is as follows:

1) Estimate the total investment (including installation costs, etc.) for year 0.

2) Estimate annual revenues.

3) Estimate cost, or cash outflows, including depreciation.

4) Estimate taxable income (revenues less costs).

5) Based on your tax bracket, estimate taxes on the additional revenue from the project. Also estimate investment tax credit, if eligible, and subtract from taxes.

6) Compute net cash outflow for the analysis by adding cost outflows (but in this step, do not add depreciation) plus taxes that would be paid (net of tax credit).

At this point, you have the revenue and cost cash flows necessary for an after-tax analysis. The procedure then follows the above example, i.e., compute present values of the flows, sum them over the expected project life, and form the benefit-cost ratio. In selecting the discount rate, or present value factor, however, it should also represent an after-tax rate. If your before-tax rate is, for example, 15 percent, and your marginal tax rate (the rate applying to additional earnings) is 30 percent, then the after-tax discount rate is

$$\text{After-tax discount rate} = \text{Before-tax rate } (1 - \text{tax rate}),$$

or, using our example,

$$\begin{aligned}\text{After-tax discount rate} &= .15\ (1 - .3)\\ &= .105,\end{aligned}$$

or 10.5 percent. It is this rate that we would use to find the present value factors in the table on the next page.

TABLE

Present value of $1

$(1+i)^{-N}$

Year hence	1%	2%	4%	6%	8%	10%	11%	12%	13%	14%	15%	16%	17%	18%	20%	22%	24%	25%	30%	35%	40%	45%	50%
1	0.990	0.980	0.962	0.943	0.926	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.833	0.820	0.806	0.800	0.769	0.741	0.714	0.670	0.667
2	0.980	0.961	0.925	0.890	0.857	0.826	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.694	0.672	0.650	0.640	0.592	0.549	0.510	0.476	0.444
3	0.971	0.942	0.889	0.840	0.794	0.751	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.579	0.551	0.524	0.512	0.455	0.406	0.364	0.328	0.296
4	0.961	0.924	0.855	0.792	0.735	0.683	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.482	0.451	0.423	0.410	0.350	0.301	0.260	0.226	0.198
5	0.951	0.906	0.822	0.747	0.681	0.621	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.402	0.370	0.341	0.328	0.269	0.223	0.186	0.156	0.132
6	0.942	0.888	0.790	0.705	0.630	0.564	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.335	0.303	0.275	0.262	0.207	0.165	0.133	0.108	0.088
7	0.933	0.871	0.760	0.665	0.583	0.513	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.279	0.249	0.222	0.210	0.159	0.122	0.095	0.074	0.059
8	0.923	0.853	0.731	0.627	0.540	0.467	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.233	0.204	0.179	0.168	0.123	0.091	0.068	0.051	0.039
9	0.914	0.837	0.703	0.592	0.500	0.424	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.194	0.167	0.144	0.134	0.094	0.067	0.048	0.035	0.026
10	0.905	0.820	0.676	0.558	0.463	0.386	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.162	0.137	0.116	0.107	0.073	0.050	0.035	0.024	0.017
11	0.896	0.804	0.650	0.527	0.429	0.350	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.135	0.112	0.094	0.086	0.056	0.037	0.025	0.017	0.012
12	0.887	0.788	0.625	0.497	0.397	0.319	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.112	0.092	0.076	0.069	0.043	0.027	0.018	0.012	0.008
13	0.879	0.773	0.601	0.469	0.368	0.290	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.093	0.075	0.061	0.055	0.033	0.020	0.013	0.008	0.005
14	0.870	0.758	0.577	0.442	0.340	0.263	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.078	0.062	0.049	0.044	0.025	0.015	0.009	0.006	0.003
15	0.861	0.743	0.555	0.417	0.315	0.239	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.065	0.051	0.040	0.035	0.020	0.011	0.006	0.004	0.002
16	0.853	0.728	0.534	0.394	0.292	0.218	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.054	0.042	0.032	0.028	0.015	0.008	0.005	0.003	0.002
17	0.844	0.714	0.513	0.371	0.270	0.198	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.045	0.034	0.026	0.023	0.012	0.006	0.003	0.002	0.001
18	0.836	0.700	0.494	0.350	0.250	0.180	0.153	0.130	0.111	0.095	0.081	0.069	0.059	9.051	0.038	0.028	0.021	0.018	0.009	0.005	0.002	0.001	0.001
19	0.828	0.686	0.475	0.331	0.232	0.164	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.031	0.023	0.017	0.014	0.007	0.003	0.002	0.001	0.000
20	0.820	0.673	0.456	0.312	0.215	0.149	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.026	0.019	0.014	0.012	0.005	0.002	0.001	0.001	0.000
21	0.811	0.660	0.439	0.294	0.199	0.135	0.112	0.093	0.077	0.064	0.053	0.044	0.037	0.031	0.022	0.015	0.011	0.009	0.004	0.002	0.001	0.000	0.000
22	0.803	0.647	0.422	0.278	0.184	0.123	0.101	0.083	0.068	0.056	0.046	0.038	0.032	0.026	0.018	0.013	0.009	0.007	0.003	0.001	0.001	0.000	0.000
23	0.795	0.634	0.406	0.262	0.170	0.112	0.091	0.074	0.060	0.049	0.040	0.033	0.027	0.022	0.015	0.010	0.007	0.006	0.002	0.001	0.000	0.000	0.000
24	0.788	0.622	0.390	0.247	0.158	0.102	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.013	0.008	0.006	0.005	0.002	0.001	0.000	0.000	0.000
25	0.780	0.610	0.375	0.233	0.146	0.092	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.010	0.007	0.005	0.004	0.001	0.001	0.000	0.000	0.000
30	0.742	0.552	0.308	0.174	0.099	0.057	0.044	0.033	0.026	0.020	0.015	0.012	0.009	0.007	0.004	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000
35	0.706	0.500	0.253	0.130	0.068	0.036	0.026	0.019	0.014	0.010	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
40	0.672	0.453	0.208	0.097	0.046	0.022	0.015	0.011	0.008	0.005	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.639	0.410	0.171	0.073	0.031	0.014	0.009	0.006	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.608	0.372	0.141	0.054	0.021	0.009	0.005	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Reproduced from Jeffrey S. Royer, "Investment Analysis," paper presented at Agribusiness Management Seminar, McKimmon Center, N. C. State University, Raleigh, North Carolina, January 25, 1979.

8.0 MARKETING:

Frey[13] describes marketing as "an organized system of business activities that makes possible the flow of goods through productive stages to ultimate consumption," and that it "strives to match production and consumption by representing the producer to the consumer, and the consumer to the producer." Such statements make it apparent that the processor must completely assess the needs and requirements of consumers in each area in order to satisfy all requirements involved in building a market for his products.

Two key factors involved in attaining product acceptance are high quality and ability to supply what consumers really like. Quality can be lost if any one of the unit operations from sea to consumer is incorrectly carried out. Even slight chemical and physical changes in the raw materials can result in adverse effects on flavor, odor, and texture. It seems certain that some consumers react adversely to such changes, the most likely effect being to avoid the product on other occasions.

In preparing to sell a new product, one should avoid relying on individual judgment in designing it for the market. Food and taste preferences will vary according to geographic areas, ethnic backgrounds, and financial status, and many other considerations determine demand for certain seafoods, the forms in which they are offered, and the preservation methods employed. The following items are stated as a means of providing some indication of the more important points to be kept in mind.

8.01 Considerations:

A. Quality:

It must be accepted as the ground rule of processing that seafood when brought ashore and throughout subsequent steps must be kept in prime fresh condition. Anything less is not acceptable in achieving a stable market.

B. Supply:

This publication presents statistical summaries to assist in determining a product mix likely to be available to plants at various seasons. Gaps in supply can be reduced by frozen storage. Alternate sources must also be considered as dictated by transportation costs and ex-vessel prices in other localities. Developing markets for less-used species will help the supply situation, e.g., try to develop a market for bluefish.

C. "Frozen":

Evidence reported in this publication supports observations

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13 Marketing Handbook, Albert Wesley Frey, editor, The Ronald Press Co., New York, 1965, Sections 1-2.

made in a (Carteret County) study that consumers cannot distinguish between fresh and frozen finfish. These findings do not necessarily conflict with other studies which indicate changes caused by freezing. It simply means that if prime quality seafoods are correctly handled, protected from dehydration and oxidation, and frozen under reasonably good conditions, the reduction in quality, i.e., textural changes, is not detected by most consumers.

D. Inspection:

The U. S. Dept. of Commerce National Marine Fisheries Service voluntary inspection program resulted from the need to establish standards of quality for fishery products. Consumers want assurance that products are of acceptable quality and the processor wants the consumer to have confidence in seafood products. The Packed Under Federal Inspection seal on the product package indicates that the product meets USDC standards, while the Grade A Shield marks the highest quality in fishery products. Certifications placed on inspected products undoubtedly help sell products.

E. Selling:

All possibilities cannot be covered here, but two important considerations become evident. First, the unique nature of the North Carolina fishery, in its variety of delicious species, must be promoted, not simply equated with what comes from distant fisheries. Second, since retailing and institutional sales often depend interchangeably on fresh and frozen supplies, there must be well-documented support of the concept that both forms are equally good.

F. Preferences:

In looking for potential markets, the seller must not permit his personal bias to cloud his judgment. The reactions of retailers and consumers to specific species and to selling fresh or frozen product forms are documented in detail by Sanchez and Konopa[14] and Konopa[15]. Selling requires expertise and knowledge of geographic differences in product acceptability.

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14 "Fish as a Household Menu Item, Attitudes of Consumers in Cuyahoga and Summit Counties, Ohio," Peter Sanchez and Leonard J. Konopa, Institute for 21st Century Business, Kent State University, 1974.

15 "Survey of Selected Retail Food Stores Handling Fish in Cuyahoga and Summit Counties, Ohio," Leonard J. Konopa, Institute for 21st Century Business, Kent State University, 1973.

G. Forms and Packaging:

The product's perishability and freshness quality determine the role the packaging system must play in maintaining a proper temperature to insure good storage life. Thus the most modern methods of packaging to extend shelf life are useful only when clean, high quality seafood is initially packaged. Careful consideration should be given to determine what packaging features would accentuate the product's attractiveness and high quality and protect the seafood from physical abuse. Additionally, the processor's need to inventory product, especially during times of glut supply and low prices, is a consideration, as are the distance to the market and the expected time required to sell and use the product.

H. Health:

Basic information, available through National Marine Fisheries Service and other agencies, supports the use of seafoods in maintaining health, and in geriatric, low-cholesterol, and reducing diets. Simple brochures relating these facts to North Carolina species will help build markets.

I. Economies:

In these days of high-priced animal proteins, seafoods can offer savings which should be explained in the promotion and marketing of seafood products.

8.02 Export Marketing:

Much of the recent interest in exporting seafoods is due to the marketability of certain species in foreign countries. Squid, eel, and dogfish are examples of species that have little or no value to the fisherman, are abundant in local waters, and are in demand in certain countries. Once a market is located, the product must fit that market's specifications. Many of the "underutilized species" need to be handled in specific ways. The potential buyers usually specify how the product should be handled, processed, and packaged. Squid, for instance, must be chilled and packaged rapidly and frozen within 4 hours of harvest. Although strict quality control must be met, many fishermen and exporters are finding it profitable to market products abroad.

8.03 State Marketing Program:

At present there is no state marketing or promotion program for seafood. There is, however, strong support for a new marketing effort to be developed in the N. C. Division of Marine Fisheries.

8.04 Comments:

In the course of the field studies involved in these projects, an impressive number of new or expanding operations was noted. There continues to be evidence of the vitality and activity needed to make these processing endeavors successful, thereby contributing to the prosperity of coastal Carolina.

While the construction of seafood industrial parks may alter the landscape of coastal areas in the future, present processing enterprises continue to form the backbone of small coastal communities. In one way or another, they have arrived at marketing systems which have supported their operations.

The array of improvements recently seen aboard boats and in shore facilities provides basis for believing that the industry is "on the move." Judicious rather than headlong development, avoiding over-financing, staying within known operating and marketing patterns as a means of remaining solvent, while moving in a well-planned way toward solution of the problems of expanding the product lines and finding new customers, seem to be what is needed.

9.0 RECOMMENDATIONS:

This section is concerned with outlining some of the subject areas requiring effort on the part of those who are intimately connected with the handling and processing activities discussed in this publication, i.e., industry people, researchers, technologists, engineers, and others whose expertise can be usefully applied. The following sections list important needs and problem areas facing the industry.

9.01 General Principles:

The need for reliable product quality has been emphasized repeatedly. An early detection method for seafoods not suitable for processing is another primary consideration.

Methods of rapidly and inexpensively removing heat from seafoods require investigation by engineers as well as technologists.

One limitation in sea handling methods has to do with the neglect of large fish brought aboard. In most instances, a bleeding technique or partial dressing method should be applied without delay.

Reference has been made to the use of bisulfite on shrimp. The correct application of this chemical and permissible limits of residual sulfur dioxide require clarification.

9.02 Rapid Cooling of Catch:

Stowing and icing of the catch aboard trawlers require examination of labor requirements and methods employed as well as consideration of innovations which would speed up and simplify the job.

Long haul boats especially need hold modifications to enable rapid cooling of finfish when caught.

9.03 Hold Insulation:

Suitable smooth, protective materials are needed to cover sprayed-on insulation.

9.04 Marine Refrigeration:

Several refrigeration options for trawlers should be subjected to feasibility studies.

9.05 Seafood Quality:

Freshness tests leave much to be desired. Subjective tests appear to have limitations, chemical indices for North Carolina remain to be worked out, and there is not always time for cooking tests. Temperature recorders or other indicators of cooling conditions would be helpful, but specific approaches to the quality control problem are needed. Determination of quality by electronic devices is presently available.

9.06 Freezing Equipment:

Equipment and building construction options applicable to small and medium-sized seafood processing plants should be prepared and made available.

9.07 Thawing:

Detailed directions for partially thawing finfish held in the round, processing, packaging, and refreezing would help establish such processing steps as practical and safe.

9.08 Glazes:

Various combinations for single-step application of highly protective edible coatings should be explored and applied when practical.

9.09 Resource:

National Marine Fisheries Service statistics are undoubtedly carefully prepared and extremely valuable. However, such figures are conservative in unavoidably missing "off-the-cuff" landings. A more accurate assessment of the resource and landings in North Carolina has resulted from the cooperative agreement signed in 1977 by the N. C. Division of Marine Fisheries and NMFS to conduct a joint fisheries statistics program in the state. Also needed is data dealing with amount and extent of resources being delivered from other states.

Accurate statistics are needed to determine to what extent processing plants should plan to handle species brought in by sports fishermen.

Requiring study is the logistics of trucking vs. having boats return long distances to home ports, and how such transfers relate to preservation of the catch. More efficient vessel design and fishing gear, alternative fishing methods, alternative fuels, and use of efficient electronic methods of locating catches merit consideration.

9.10 Product Forms and Packaging:

Alternate packing methods should be assessed in terms of costs, product stability, and acceptability to consumers.

Methods for easily separating tightly packed seafoods might provide an acceptable replacement for costly IQF methods.

Institutional requirements should be fully defined in terms of the needs of restaurants, hospitals, schools, prisons, and military.

9.11 Plant Construction:

Profitability of expanded or new operations must be subjected to careful analysis of basic costs, depreciation, overhead, maintenance, and other data. Alternate materials and approaches in achieving sanitary design must be examined as a way to avoid overcapitalization. Specific information should help predict labor requirements and the economics of replacing hand labor with mechanization. Realistic estimates of compliance with requirements set forth by EPA, FDA, OSHA, and other regulatory agencies should be included.

9.12 Marketing:

The unique wide selection of seafoods provided by the coastal fishery should provide a solid basis for exploitation in the best possible manner. Steps should be taken to convince consumers of the superiority and dependability of the local supply. Frozen North Carolina seafoods must be produced under rigid manufacturing codes if the end products in fact are to be judged equal to those supplied fresh, packed in ice.

10.0 QUALITY ASSURANCE RESOURCES:

10.01 Quality Control:

Inspection and quality control in the processing of fishery products help assure benefits for both processors and consumers. The voluntary inspection program established by the National Marine Fisheries Service (U. S. Department of Commerce) aids the processor in identifying and evaluating quality and sanitary standards while ensuring the consumer a safe and wholesome product. To enter the voluntary program, a plant undergoes the NMFS Initial Plant Survey of plant design, procedures, product quality, and sanitary conditions. After the plant acts on the agency's recommendations of the level of inspection appropriate for the firm, it becomes eligible for inspection.

The first level of inspection is for plant sanitation: Sanitary Inspected Fish Establishment (SIFE), in which inspectors periodically visit the plant to assist in improving and maintaining sanitary standards. Approved SIFE plant names are circulated on the USDC Approved List to school lunch programs, food chains, and other mass purchasers.

The second level of inspection includes product as well as plant sanitation: in addition to meeting SIFE standards, the firm submits a fee for an on-site USDC inspector to oversee the processing and packaging of the product. This gives the firm the right to put the Packed Under Federal Inspection mark on the product packages meeting requirements. The USDC Approved List then includes product names as well as company names.

The characteristics judged by the USDC inspector include the quality of fish flesh, ratio of flesh to breading, odor, color, taste, uniformity of size, absence of holes and blemishes, and processing methods. The inspection program gives the processor documented proof of the product's quality and provides the consumer with quality assurance.

At the international level of food product standards and quality control, the Codex Alimentarius Commission was created in 1963 under the joint sponsorship of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) of the United Nations. The purpose of the Joint FAO/WHO Food Standards Program is to develop and administer a means of drafting recommended international food standards which will protect the health of consumers worldwide and ensure fair practices in the food trade. When adopted by participating countries, the recommended food standards are applied by those countries to their domestic products and their imports and exports.

The Codex Alimentarius Commission sets forth food standards and codes of hygienic and technological practice covering a wide range of food commodities. The commission has recently made available the following: Recommended International Code of Practice for Fresh Fish and Recommended International Code of Practice for Canned Fish. The Codes of Practice are available through National Marine Fisheries Service.

10.02 Advisory Sources:

Direct assistance with fishery technology and marketing is available through National Marine Fisheries Service and National Fisheries Institute, Inc., Washington, D. C.

The NCSU Seafood Laboratory, through Extension Services (N. C. Agricultural Extension Service) and Advisory Services (UNC Sea Grant College Program), provides field and laboratory support.

The Branch of Statistics, National Marine Fisheries Service, at Pivers Island, Beaufort, N. C., not only collects information but has provided much assistance in interpreting statistical data important in understanding fishery resources available for processing. Their personnel have firsthand knowledge of various fishing centers and details concerning the catch which do not appear in formal releases. Other knowledgeable groups under the N. C. Department of Natural Resources and Community Development include the Division of Marine Fisheries which is concerned with fishery management, enforcement of management regulations, statistics and data analysis, and the Fisheries Management Section which investigates the biological aspects of various species.

The problem of assisting in the growth of N. C.'s fishing industry is one of proper communication between industry and the various agencies so that the right kind of help can be provided. Leadership is needed within the industry to arrive at realistic appraisals of problems and goals. The industry association is a suitable vehicle for bringing about this assessment of long-range needs and objectives and for communicating to the concerned agencies just what is needed. Such assessments should include realistic appraisal of growth limiting factors which include improper handling of catch, variability of supply, and catches which are approaching sustainable yields. There must also be correct definition of the type of fishery existing in the area, recognizing its advantages in supplying varied highly regarded species for the fresh seafood market rather than those which fit into tightly structured demands of the U. S. market as a whole. Those engaged in processing in North Carolina will have to become aware of the need for raw materials from other eastern seaboard and Gulf coast states if they are to arrive at an acceptable number of operating days per year.

10.03 Regulatory Agencies:

The following federal and state agencies exercise regulatory control in areas of processing and marketing and should be consulted. Although regulatory agencies are not obligated to provide information concerning methodology, they are in fact often helpful in suggesting corrective measures, plant layouts, and handling methods which meet their requirements:

N. C. Department of Agriculture
Food and Drug Protection Division
Blue Ridge Road
Raleigh, N. C.

Department of Health, Education and Welfare
U. S. Food and Drug Administration
Federal Building
Raleigh, N. C.

N. C. Division of Health Services
Shellfish Sanitation
Camp Glenn
Morehead City, N. C.

Copies of Regulations Governing Processed Fishery Products can be obtained by writing to the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Fishery Products Inspection Division, Washington, D. C. 20240.

10.04 General References:

Compendium of Methods for the Microbiological Examination of Foods
Edited by Marvin L. Speck
American Public Health Association, 1976

Conference: The Production and Utilisation of Mechanically Recovered Fish Flesh (Minced Fish), 7/8 April 1976, Proceedings
Edited by James N. Keay
Torry Research Station, Aberdeen, Scotland, 1976

Control of Fish Quality
J. J. Connell
Fishing News (Books) Ltd., Surrey, England, 1975

Expanding the Utilization of Marine Fishery Resources for Human Consumption
FAO Fisheries Report, No. 175, 1975

Fish in Nutrition
Edited by Eirik Heen and Rudolf Kreuzer
Fishing News (Books) Ltd., London, England, 1962

Fish Inspection and Quality Control
Edited by Rudolf Kreuzer
Fishing News (Books) Ltd., London, England, 1971

Fishery Products
Edited by Rudolf Kreuzer
Fishing News (Books) Ltd., London, England, 1974

Freezing and Irradiation of Fish
Edited by Rudolf Kreuzer
Fishing News (Books) Ltd., London, England, 1969

Guidelines for Pasteurizing Meat from the Blue Crab (Callinectes sapidus) 1. Water Bath Method
Mahlon C. Tatro
Dept. of Seafood Processing, Natural Resources Institute, University of Maryland, Contribution No. 419, July, 1970

Mechanical Recovery and Utilization of Fish Flesh
Edited by Roy E. Martin
National Fisheries Institute and National Marine Fisheries Service, Washington, D. C., 1972

Microbiological Techniques Manual for Seafood Quality Control
Edited by J. David Baldock, Donn R. Ward, George J. Flick, R. V. Lechowich, and Mary C. Holliman
National Fisheries Institute, Washington, D. C. and Sea Grant Extension Division, Virginia Polytechnic Institute and State University, Blacksburg, Virginia

On Testing the Freshness of Frozen Fish: A Review of Biochemical Indices of Quality in Fish, with Special Reference to Frozen Products
Edith Gould and John A. Peters
Fishing News (Books) Ltd., London, England, 1971
Revised and Enlarged Edition

Processes for Low-Acid Canned Foods in Metal Containers
National Canners Association, Washington, D. C., Bulletin 26-L, 11th Edition, April, 1976

Sanitation Notebook for the Seafood Industry
Edited by George J. Flick, Jr., Cherrie L. Kassem, Frank Huang, Donn R. Ward, Mary Jane Thompson, Carmen Fletcher, Sandra Lofton, and Roy E. Martin
National Fisheries Institute, Washington, D. C. and Sea Grant Extension Division, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, Publication No. VPI-SG-78-05, 1978

Second Technical Seminar on Mechanical Recovery and Utilization of Fish Flesh
Edited by Roy E. Martin
National Fisheries Institute and National Marine Fisheries Service, Washington, D. C., 1974

The Technology of Fish Utilization
Edited by Rudolf Kreuzer
Fishing News (Books) Ltd., London, England, 1965

Thermal Processing--Pasteurization Manual for the Blue Crab Industry

Edited by George J. Flick, Charles F. Shoemaker, Donn R. Ward, Charles B. Wood, Clayton L. Rudolph, Michael Moody, John Janssen, and Edmund Nelson

Sea Grant Extension Division, Virginia Polytechnic Institute and State University, Blacksburg, Virginia