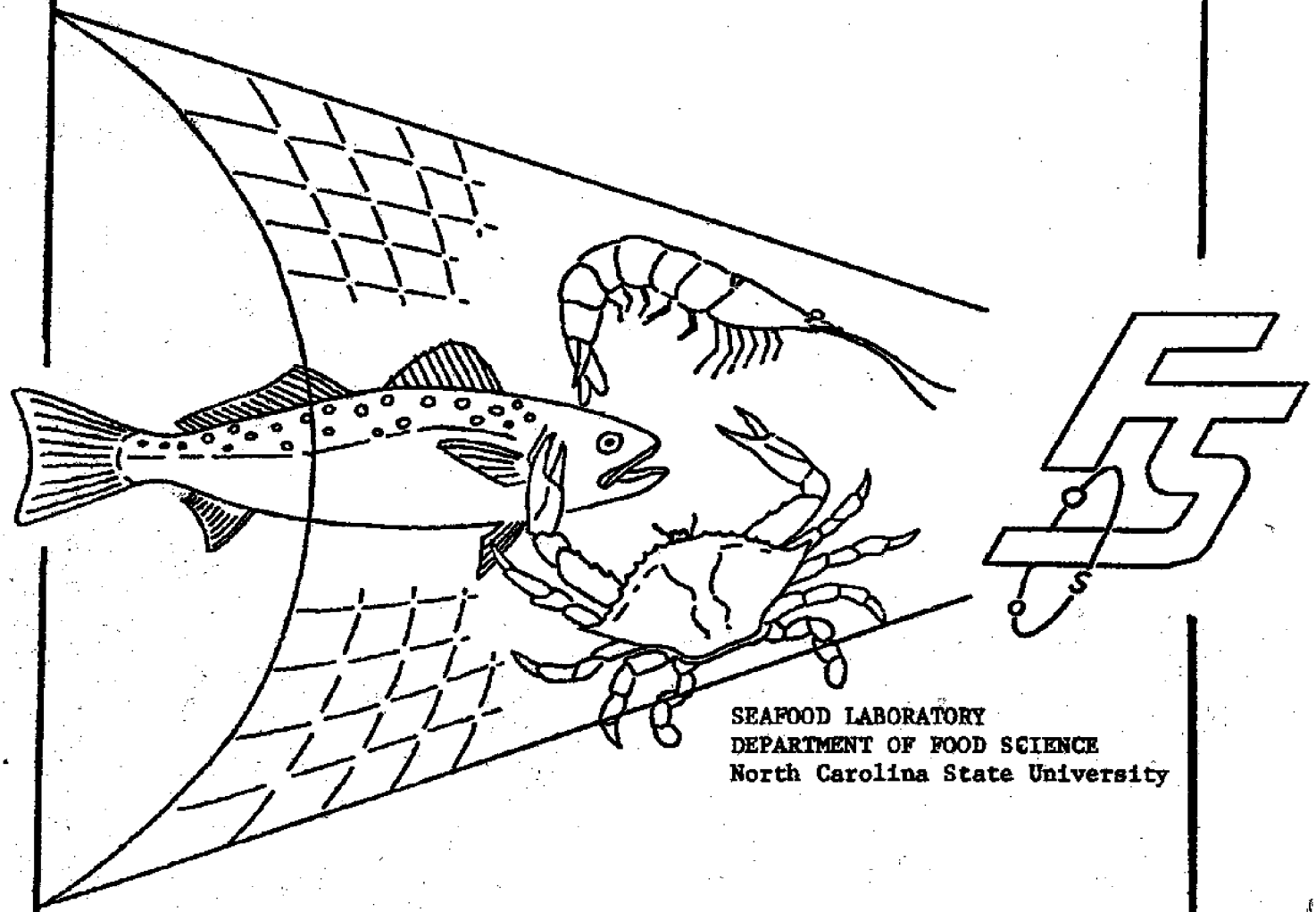
PROCEEDINGS OF THE WORKSHOP ON

SEAFOOD PROCESSING & MARKETING IN THE COASTAL PLAINS AREA



SEAFOOD LABORATORY
DEPARTMENT OF FOOD SCIENCE
North Carolina State University

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SEAFOOD PROCESSING AND MARKETING

IN THE

COASTAL PLAINS AREA[1,2,3]

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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.

Recent grey trout processing experiments are used to demonstrate how handling conditions at sea affect subsequent unfrozen and frozen shelf life after this fish has been packaged whole, or headed and gutted, or in the form of fillets. Subjective ratings at time of landing did not fully predict shelf life determined by taste panel evaluations. A consumer panel applied higher ratings than the laboratory panel, but both could not distinguish between cooked fillets from unfrozen and frozen fish. "Superchilling" was shown to offer potential for improved distribution methods.

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.

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.

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PREFACE

The material presented in this publication was developed from results of the pilot research project on fish processing and marketing. In addition, relevant information was compiled from previous publications, appropriately referenced. This report provided a basis for discussion at the SEAFOOD PROCESSING AND MARKETING WORKSHOP, held at Morehead City, N. C., July 29, 1975.

The information presented at the Workshop included pertinent information in this publication. Supplemental information and recommendations as a result of the Workshop will be included in two types of subsequent publications. Firstly, a report of the research finding of the project and recommendations for further research will be published. Secondly, a publication will be prepared on finfish handling, processing and marketing systems for the Coastal Plains area, using North Carolina as a working example. This publication will include a compilation of currently available information which can be used on a practical basis for assisting fishing, processing and marketing firms.

The authors wish to express their appreciation to the following Advisory Task Force members for their helpful advice in promulgating plans and guiding the direction of the investigations reported herein:

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Seafood Processing and Marketing Workshop

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Ms. Marjorie E. Sun
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Mr. Michael D. Taylor

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SEAFOOD PROCESSING IN NORTH CAROLINA

1.0 INTRODUCTION:

The Seafood Processing Project has been conducted by the Seafood Laboratory since February, 1975 with the following objectives:

A. To appraise the North Carolina seafood processing industry as it currently exists.

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

1.01 Audience:

This study is intended to help those concerned with improved utilization of the coastal fisheries and to help them define unsolved problems. Its thrust is directed towards:

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

2.0 SEAFOOD HANDLERS AND PROCESSORS:

2.01 Ports:

Page 2 shows the coastal portion of North Carolina to which this study 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 NMFS reporting of commercial fisheries statistical data.

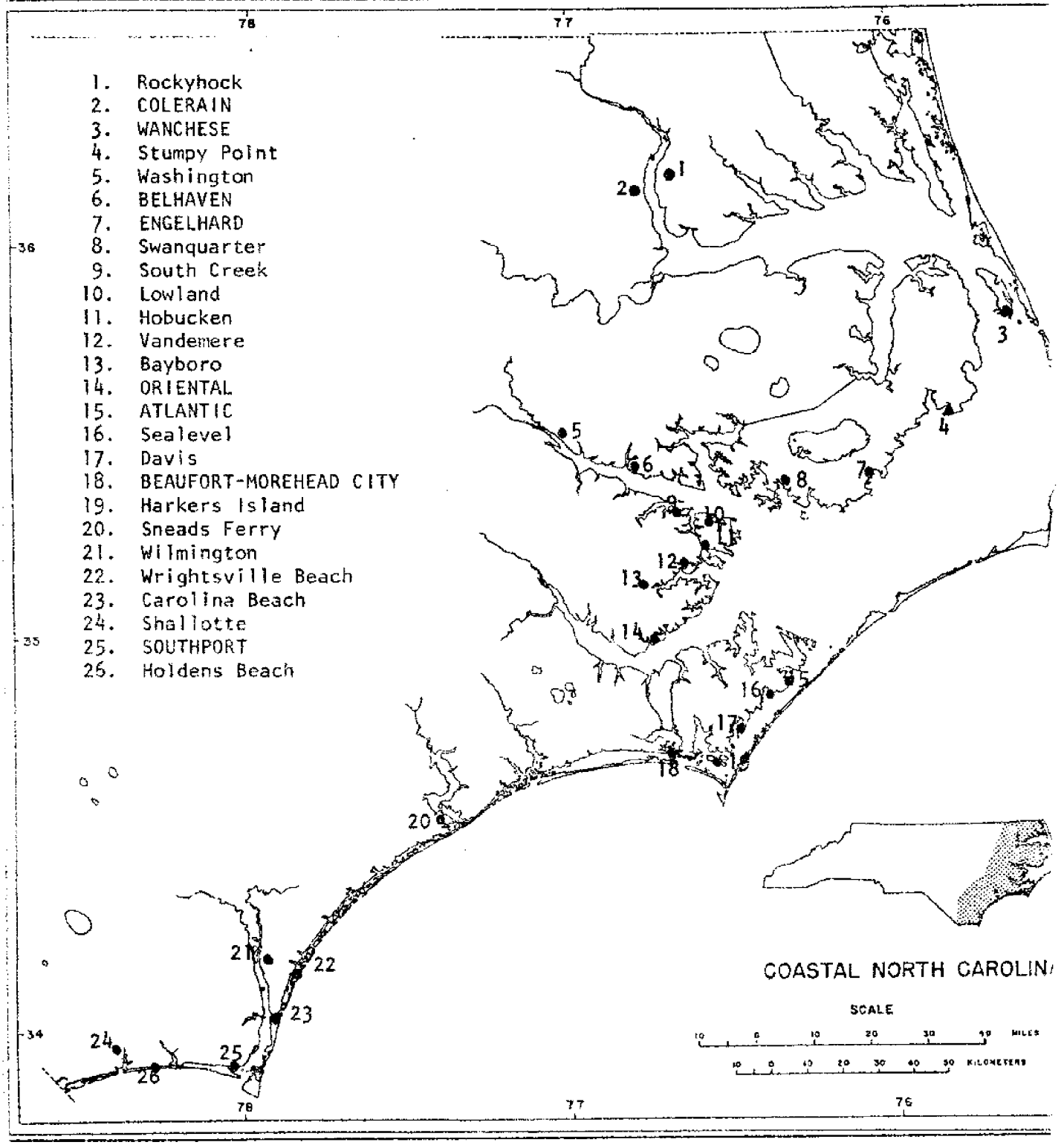
2.03 Handlers and Processors:

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

B. Processors: Conduct additional operations such as described below: (page 4)

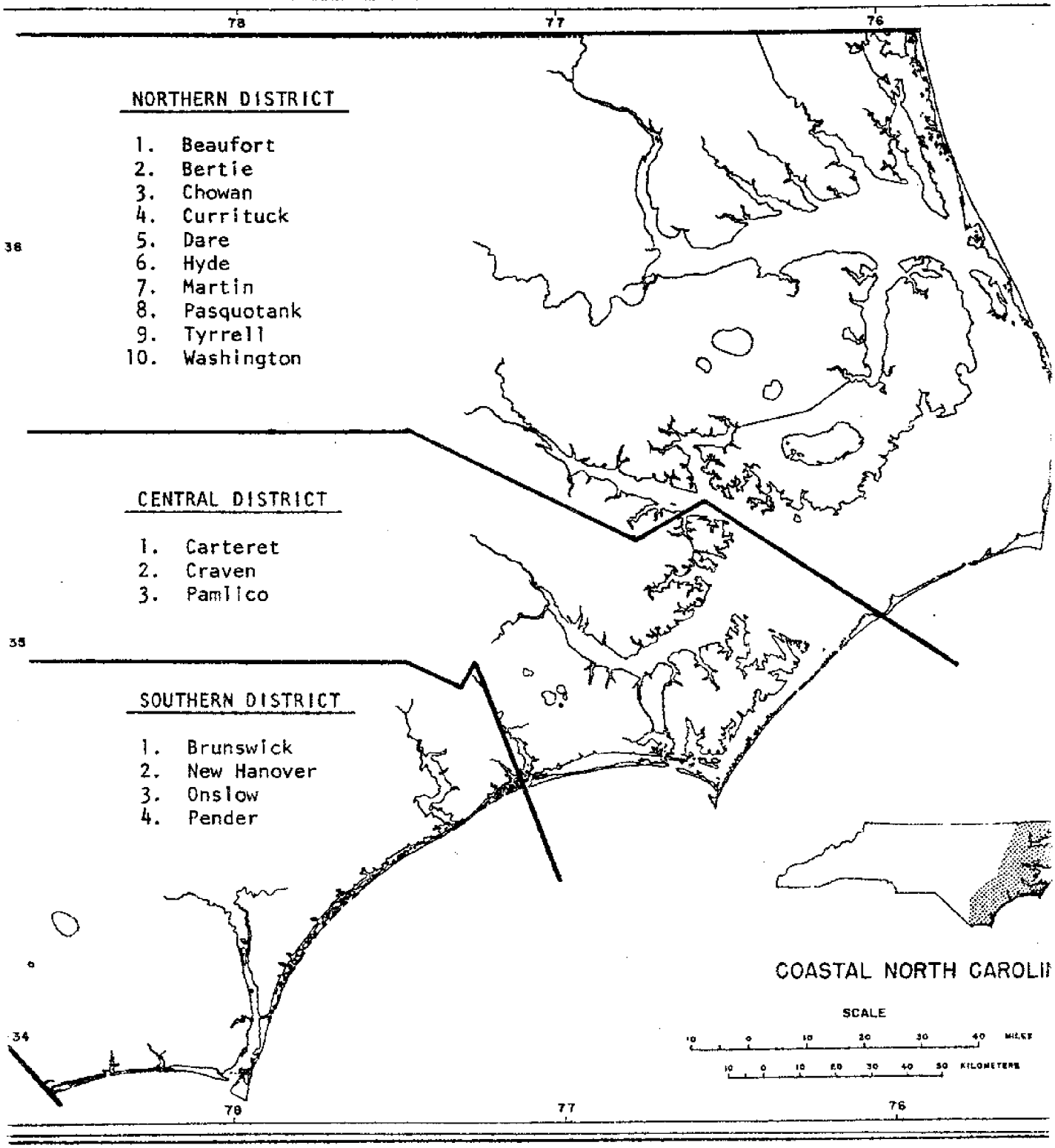
2.01 Ports

FISHING PORTS



2.02 Districts

NATIONAL MARINE FISHERIES SERVICE
COMMERCIAL FISHERIES STATISTICAL DISTRICTS



2.0 Seafood Handlers and Processors

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) Repacker
   (b) Shucker-Packer
   (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

2.03 Handlers and Processors

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

	Northern	Central	Southern
HANDLERS	220	128	247
PROCESSORS			
Finfish	50	69	51
Shrimp	25	29	21
Crabs	13	18	3
Oysters & Clams	7	22	9
Scallops	-	12	-
Industrial Fish	14	6	-

*SOURCE: "North Carolina Seafood Processors", N. C. Dept. of Natural and Economic Resources, Division of Commerce and Industry, 1974.

3.0 RESOURCE:

3.01 Commercial Landings:

Commercial landings of important sepcies, seasonal peaks, and ex-vessel prices, based on data collected by NMFS, are important in planning handling and processing operations.

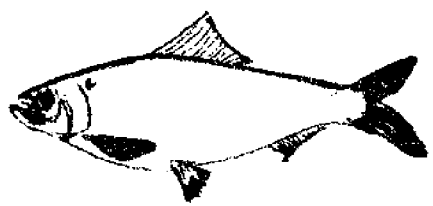
FINFISH:

SHELLFISH:

3.01 Commercial Landings

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	6,422	2.0
1951	12,534	1.0
1952	6,510	1.2
1953	13,842	1.0
1954	12,758	1.0
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



DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	19,762	11,520	12,720	11,237	7,925	6,209
¢/lb.	1.5	1.6	1.5	1.7	2.6	3.9
			Central District			
1,000 lbs.	-	-	0.4	-	1.0	0.7
¢/lb.	-	-	2.5	-	4.0	5.1
			Southern District			
1,000 lbs.	-	-	1.0	-	-	-
¢/lb.	-	-	4.0	-	-	-

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	-	-	-	-	-	6
Feb	-	12	-	11	24	12
Mar	375	772	280	292	428	453
Apr	12,588	7,143	9,796	9,484	6,658	5,341
May	6,759	3,572	2,621	1,438	801	397
Jun	0	-	-	-	0	0
Jul	0	0	0	0	0	0
Aug	0	-	0	0	0	0
Sep	0	0	0	0	0	0
Oct	0	0	0	0	0	0
Nov	0	0	0	0	0	0
Dec	0	0	0	0	0	0

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	1,272	14.2
1951	926	11.2
1952	736	11.3
1953	542	12.4
1954	323	12.1
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

BLUEFISH

DISTRICT LANDINGS & EX-VESSEL PRICES

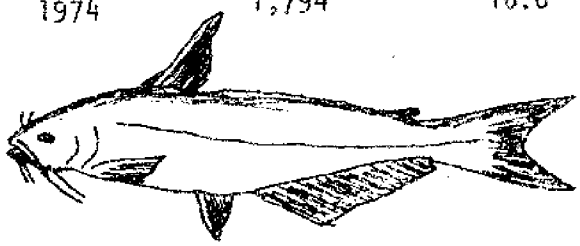
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	384	158	258	349	849	873
¢/lb.	12.2	8.9	10.0	9.1	7.4	5.0
			Central District			
1,000 lbs.	483	330	317	815	1,155	1,542
¢/lb.	10.0	8.0	10.2	8.1	7.6	8.7
			Southern District			
1,000 lbs.	5	8	3	3	4	15
¢/lb.	9.5	6.4	9.9	9.5	8.8	8.9

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	0	1	0.6	214	424	83
Feb	-	1	0.6	57	295	290
Mar	-	3	3	37	333	94
Apr	14	8	31	47	317	68
May	130	27	46	82	28	68
Jun	51	52	86	65	26	118
Jul	83	91	61	100	100	162
Aug	125	43	44	102	112	341
Sep	158	117	55	126	64	188
Oct	186	63	76	125	179	513
Nov	108	48	107	118	64	129
Dec	15	42	68	89	58	120

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	671	8.0
1951	530	9.4
1952	992	8.6
1953	943	8.4
1954	930	8.0
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	1,854	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



CATFISH & BULLHEADS

DISTRICT LANDINGS & EX-VESSEL PRICES

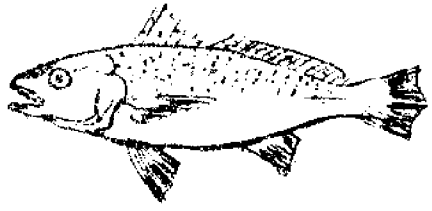
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	1,846	1,988	2,007	2,385	1,951	1,752
¢/lb.	14.3	14.3	13.9	13.8	14.6	16.0
			Central District			
1,000 lbs.	3	0.3	-	-	1	2
¢/lb.	15.3	15.0	-	-	10.0	16.9
			Southern District			
1,000 lbs.	5	7	23	13	6	40
¢/lb.	16.6	14.2	14.9	14.4	14.6	14.9

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	46	30	41	110	70	79
Feb	72	92	61	86	67	67
Mar	286	281	199	317	313	233
Apr	308	331	317	362	333	348
May	347	355	349	427	364	280
Jun	137	199	136	134	129	135
Jul	91	64	65	79	96	144
Aug	54	74	67	67	68	90
Sep	139	116	140	103	74	90
Oct	200	149	223	252	141	162
Nov	109	178	260	331	196	126
Dec	57	116	164	120	98	38

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	2,096	4.9
1951	2,102	5.3
1952	1,346	4.9
1953	1,434	4.8
1954	1,016	5.0
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



CROAKER

DISTRICT LANDINGS & EX-VESSEL PRICES

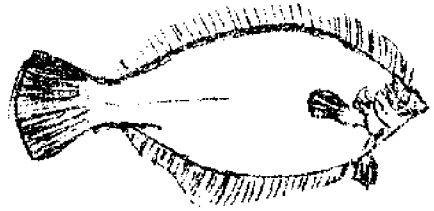
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	177	83	141	166	833	1,524
¢/lb.	3.9	3.6	6.3	7.2	9.3	10.4
			Central District			
1,000 lbs.	1,186	717	802	3,902	3,453	4,491
¢/lb.	4.5	4.7	5.5	5.4	8.4	9.7
			Southern District			
1,000 lbs.	6	7	4	40	38	57
¢/lb.	5.3	4.8	6.6	6.9	6.6	10.6

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	96	54	55	731	363	607
Feb	152	68	138	678	506	225
Mar	241	115	65	501	255	437
Apr	292	136	168	415	173	231
May	16	15	12	103	281	729
Jun	14	15	35	230	350	486
Jul	38	54	62	123	960	607
Aug	74	61	95	242	545	959
Sep	52	58	61	156	385	668
Oct	1	2	23	37	173	267
Nov	92	26	30	394	199	516
Dec	294	200	199	481	112	188

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	1,840	15.1
1951	1,478	17.2
1952	2,156	16.1
1953	1,844	14.9
1954	1,645	14.8
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



FLOUNDERS

DISTRICT LANDINGS & EX-VESSEL PRICES

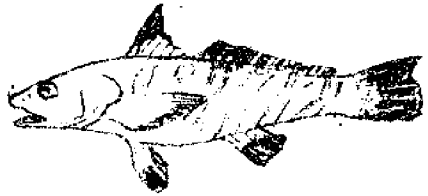
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	1,206	1,485	1.947	1,658	2.347	5.078
¢/lb.	26.0	23.9	27.3	28.8	29.3	23.6
			Central District			
1,000 lbs.	1,535	1,650	2,014	2,896	4,888	6.592
¢/lb.	25.0	25.2	28.3	30.4	29.4	24.3
			Southern District			
1,000 lbs.	25	28	50	102	130	143
¢/lb.	25.7	24.9	30.5	27.1	27.5	27.2

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	277	652	702	517	2,335	2,811
Feb	257	215	377	130	214	390
Mar	188	193	128	112	221	154
Apr	221	95	209	200	147	236
May	89	19	148	47	37	35
Jun	17	19	28	37	37	47
Jul	61	25	20	51	44	35
Aug	41	35	44	51	74	142
Sep	133	89	48	84	96	224
Oct	307	386	124	349	435	673
Nov	465	215	389	400	2,143	2,634
Dec	700	1,205	1,785	2,663	1,554	4,359

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	1,398	9.0
1951	1,122	8.9
1952	1,484	9.5
1953	1,490	8.9
1954	1,879	7.3
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



KING WHITING

DISTRICT LANDINGS & EX-VESSEL PRICES

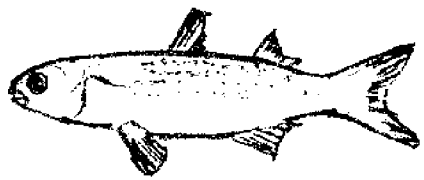
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	157	207	118	111	68	75
¢/lb.	13.3	14.4	11.9	11.7	13.4	16.0
			Central District			
1,000 lbs.	669	347	353	545	190	178
¢/lb.	11.4	12.3	11.4	12.0	13.7	16.1
			Southern District			
1,000 lbs.	17	8	8	27	171	61
¢/lb.	11.1	11.6	12.0	11.5	14.7	21.8

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	137	62	57	48	34	50
Feb	76	16	29	41	28	7
Mar	12	9	3	51	72	13
Apr	53	106	38	55	50	21
May	108	62	54	70	17	14
Jun	5	2	21	7	13	5
Jul	22	9	14	87	16	9
Aug	18	14	23	14	26	14
Sep	19	25	9	17	22	21
Oct	260	43	14	119	45	45
Nov	72	122	138	166	85	74
Dec	60	93	79	86	20	42

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	3,220	11.0
1951	4,013	10.0
1952	3,850	9.4
1953	2,506	9.7
1954	1,781	10.3
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



MULLET

DISTRICT LANDINGS & EX-VESSEL PRICES

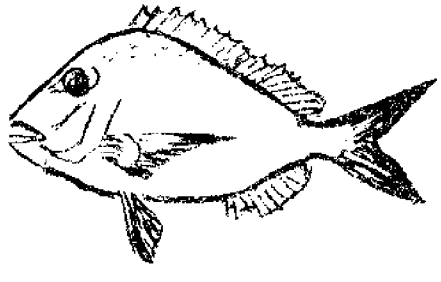
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	125	112	125	231	184	578
¢/lb.	8.0	7.2	8.8	8.6	8.7	11.0
			Central District			
1,000 lbs.	485	447	343	387	409	896
¢/lb.	7.9	5.5	7.1	9.0	9.5	9.2
			Southern District			
1,000 lbs.	479	565	245	559	500	664
¢/lb.	6.9	4.7	5.8	7.6	7.3	9.0

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	34	113	23	18	49	49
Feb	14	10	40	28	27	30
Mar	9	18	10	22	11	28
Apr	4	4	4	15	4	26
May	2	10	14	24	14	11
Jun	9	16	30	27	25	26
Jul	25	69	18	49	43	45
Aug	185	120	80	88	80	111
Sep	305	329	172	311	178	472
Oct	398	296	192	400	318	928
Nov	87	85	88	140	262	288
Dec	16	47	42	51	24	111

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	Not Reported	
1951	Not Reported	
1952	Not Reported	
1953	Not Reported	
1954	Not Reported	
1955	Not Reported	
1956	Not Reported	
1957	Not Reported	
1958	Not Reported	
1959	Not Reported	
1960	Not Reported	
1961	Not Reported	
1962	Not Reported	
1963	Not Reported	
1964	Not Reported	
1965	Not Reported	
1966	Not Reported	
1967	Not Reported	
1968	Not Reported	
1969	252	14.3
1970	212	12.7
1971	207	16.9
1972	39	23.0
1973	28	25.0
1974	66	30.0



DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	74	52	86	33	11	33
¢/lb.	12.3	13.7	15.2	21.8	20.0	30.3
			Central District			
1,000 lbs.	178	147	117	5	12	14
¢/lb.	14.4	11.7	17.3	24.4	29.6	31.0
			Southern District			
1,000 lbs.	0.4	13	4	1	5	18
¢/lb.	12.7	18.9	13.2	23.1	23.2	27.3

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	49	26	29	8	2	8
Feb	64	34	45	13	8	10
Mar	39	66	42	7	9	5
Apr	11	44	67	9	4	7
May	47	33	-	0	3	22
Jun	20	0	0	0	-	0
Jul	0	-	0	0	-	1
Aug	0	-	0	0	0	-
Sep	0	-	0	-	-	-
Oct	-	0	0	-	0	4
Nov	2	-	3	1	0	6
Dec	20	8	21	2	1	1

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	76	7.9
1951	94	10.6
1952	110	11.8
1953	82	12.2
1954	41	12.2
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

SEA BASS

DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	222	239	103	72	103	188
¢/lb.	17.5	18.3	19.4	29.5	31.3	32.4
			Central District			
1,000 lbs.	294	152	154	55	65	286
¢/lb.	18.4	18.3	21.8	31.7	33.4	42.7
			Southern District			
1,000 lbs.	530	738	490	508	516	843
¢/lb.	18.4	20.1	22.3	32.5	33.5	40.3

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	108	32	63	114	204	366
Feb	115	213	165	124	153	190
Mar	130	225	177	77	89	117
Apr	243	41	176	51	17	30
May	76	18	21	-	9	8
Jun	45	139	19	1	10	18
Jul	5	35	7	-	11	16
Aug	6	34	4	8	15	33
Sep	22	27	0	17	16	20
Oct	232	38	4	15	9	124
Nov	75	111	37	80	54	179
Dec	161	91	67	146	96	208

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	1,567	9.9
1951	1,262	10.0
1952	1,026	10.3
1953	1,897	9.8
1954	2,381	10.0
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

GREY TROUT

DISTRICT LANDINGS & EX-VESSEL PRICES

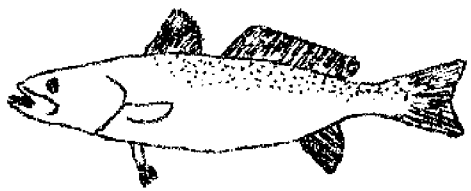
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	132	161	297	1,220	1,589	1,400
¢/lb.	10.6	11.8	8.1	5.8	9.6	12.4
			Central District			
1,000 lbs.	1,396	2,278	3,343	6,123	4,553	4,583
¢/lb.	6.7	5.5	6.0	5.3	8.4	9.8
			Southern District			
1,000 lbs.	10	3	5	29	79	71
¢/lb.	10.2	9.0	9.6	6.5	5.8	12.1

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	62	327	554	1,172	1,624	2,071
Feb	275	452	711	1,747	1,587	1,678
Mar	91	732	860	1,747	971	799
Apr	32	327	536	1,194	778	164
May	43	66	87	125	37	61
Jun	20	20	18	22	37	73
Jul	43	49	22	22	156	91
Aug	51	59	73	74	205	127
Sep	103	117	55	96	162	176
Oct	123	44	36	81	143	279
Nov	338	27	106	346	162	242
Dec	354	447	561	708	336	260

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	482	29.9
1951	267	30.0
1952	643	29.7
1953	632	24.5
1954	660	26.4
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



SPOTTED TROUT

DISTRICT LANDINGS & EX-VESSEL PRICES

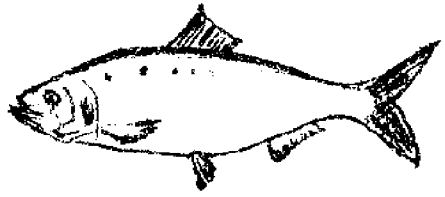
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	49	134	128	128	198	253
¢/lb.	30.6	27.6	28.9	31.4	31.3	12.3
			Central District			
1,000 lbs.	131	260	207	368	407	397
¢/lb.	28.8	26.0	31.5	30.0	27.8	30.4
			Southern District			
1,000 lbs.	9	10	3	6	6	19
¢/lb.	32.1	30.6	31.4	30.1	36.3	36.0

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	5	5	28	7	205	19
Feb	-	1	7	17	44	27
Mar	0	3	4	23	104	11
Apr	3	2	32	50	47	27
May	3	5	11	40	24	17
Jun	5	8	13	39	18	37
Jul	7	16	22	34	32	42
Aug	8	18	14	35	33	65
Sep	31	32	14	44	27	92
Oct	89	49	62	20	26	134
Nov	28	150	94	66	31	136
Dec	11	116	35	114	18	61

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	1,100	30.9
1951	1,244	24.1
1952	1,479	25.5
1953	1,188	24.7
1954	1,445	17.9
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



SHAD

DISTRICT LANDINGS & EX-VESSEL PRICES

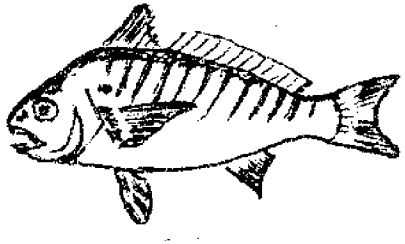
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	431	561	423	249	173	249
¢/lb.	16.7	19.6	14.6	21.7	26.2	26.2
			Central District			
1,000 lbs.	238	345	217	156	116	100
¢/lb.	22.8	20.5	21.8	26.4	25.7	33.5
			Southern District			
1,000 lbs.	50	47	41	64	32	20
¢/lb.	20.4	23.6	16.8	25.5	30.2	32.5

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	6	2	13	2	8	35
Feb	195	227	16	68	74	12
Mar	408	590	328	250	186	158
Apr	100	129	173	143	45	40
May	8	6	5	4	8	2
Jun	-	0	-	0	0	14
Jul	0	0	0	0	0	0
Aug	0	0	0	0	0	0
Sep	0	0	0	0	0	0
Oct	0	0	0	0	0	0
Nov	-	0	0	0	0	0
Dec	0	1	-	1	0	0

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	5,172	4.5
1951	4,614	4.6
1952	5,548	4.5
1953	2,815	6.3
1954	2,390	6.7
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



DISTRICT LANDINGS & EX-VESSEL PRICES

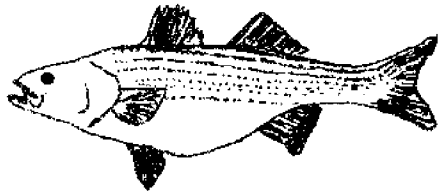
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	239	371	284	511	524	513
¢/lb.	13.8	9.7	14.4	10.3	14.3	13.4
			Central District			
1,000 lbs.	1,123	1,023	684	2,971	4,561	4,676
¢/lb.	12.4	8.7	14.1	9.6	12.2	10.6
			Southern District			
1,000 lbs.	125	135	223	421	312	418
¢/lb.	12.6	12.8	15.8	9.5	14.7	14.3

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	0	0	0	-	119	-
Feb	0	-	0	-	146	-
Mar	-	-	0	-	54	11
Apr	-	8	2	-	38	17
May	37	80	64	31	135	90
Jun	147	206	218	230	259	196
Jul	125	208	180	140	567	280
Aug	202	211	170	219	475	432
Sep	527	309	224	1,069	810	1,716
Oct	436	440	200	1,233	2,035	2,321
Nov	9	55	112	617	723	465
Dec	-	3	18	347	5	62

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	796	20.7
1951	702	19.0
1952	647	18.7
1953	757	18.1
1954	1,122	16.8
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



STRIPED BASS

DISTRICT LANDINGS & EX-VESSEL PRICES

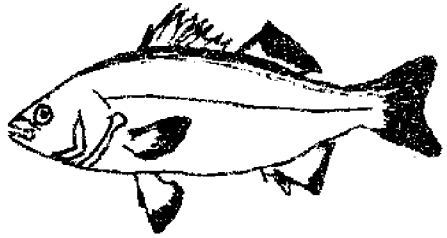
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	1,564	2,213	1,444	1,237	1,692	992
¢/lb.	20.7	20.8	21.6	28.3	33.7	38.7
			Central District			
1,000 lbs.	0.4	101	2	21	58	23
¢/lb.	21.3	16.6	17.9	28.9	33.4	34.2
			Southern District			
1,000 lbs.	3	4	2	3	1	0.7
¢/lb.	22.3	24.3	24.6	30.0	33.8	41.8

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	220	554	504	227	568	200
Feb	168	556	241	154	266	249
Mar	158	229	158	115	233	76
Apr	85	102	91	69	84	106
May	14	25	19	6	4	17
Jun	55	28	22	4	5	24
Jul	22	30	12	1	21	18
Aug	52	23	13	5	18	15
Sep	229	46	42	25	19	35
Oct	102	67	28	67	28	60
Nov	166	250	103	20	212	112
Dec	292	394	213	561	291	102

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	510	9.8
1951	394	10.7
1952	458	9.2
1953	696	6.8
1954	1,505	6.8
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



WHITE PERCH

DISTRICT LANDINGS & EX-VESSEL PRICES

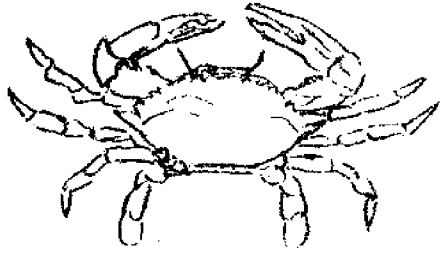
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	206	211	367	202	145	308
¢/lb.	11.6	14.2	12.2	12.9	14.4	18.1
			Central District			
1,000 lbs.	-	-	-	-	-	1
¢/lb.	-	-	-	-	-	20.0
			Southern District			
1,000 lbs.	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	25	22	11	9	8	27
Feb	22	16	51	36	10	60
Mar	56	47	54	65	37	52
Apr	51	80	177	60	51	100
May	6	13	14	12	14	10
Jun	3	4	6	2	5	12
Jul	5	3	3	2	4	11
Aug	1	5	2	1	1	9
Sep	16	2	4	4	1	4
Oct	6	5	11	38	2	17
Nov	6	8	16	26	7	6
Dec	10	7	18	6	4	2

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	6,680	4.0
1951	7,822	2.7
1952	6,162	3.2
1953	10,487	3.4
1954	9,727	3.6
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



DISTRICT LANDINGS & EX-VESSEL PRICES

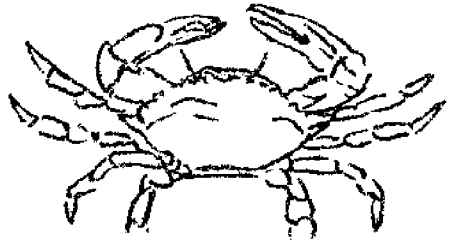
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	15,043	12,874	9,409	8,354	8,173	8,253
¢/lb.	9.4	6.0	7.4	10.0	12.7	10.3
			Central District			
1,000 lbs.	6,690	7,599	4,752	4,482	3,528	4,636
¢/lb.	9.8	5.8	8.3	9.5	13.1	10.4
			Southern District			
1,000 lbs.	427	407	314	643	262	274
¢/lb.	10.4	4.7	9.0	10.7	12.6	10.9

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	22	606	58	243	144	290
Feb	44	835	101	189	179	290
Mar	731	1,232	709	1,051	407	698
Apr	2,947	2,965	1,123	1,240	825	856
May	2,637	1,984	1,158	1,307	1,268	1,040
Jun	4,010	3,383	796	1,523	2,129	2,146
Jul	4,520	3,550	3,228	2,709	2,596	2,922
Aug	2,947	2,756	2,707	2,305	1,555	2,317
Sep	1,817	1,775	2,027	1,456	1,436	974
Oct	1,440	960	1,028	822	706	724
Nov	753	585	1,115	485	490	724
Dec	222	146	362	0	167	132

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	208	11.5
1951	167	14.4
1952	124	14.5
1953	168	20.2
1954	95	14.7
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



DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	29	18	17	22	33	16
¢/lb.	41.3	44.1	47.0	45.4	59.3	66.6
			Central District			
1,000 lbs.	64	42	32	26	13	17
¢/lb.	45.3	39.0	54.8	69.2	66.6	70.5
			Southern District			
1,000 lbs.	-	-	-	1.4	-	-
¢/lb.	-	-	-	45.-	-	-

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	0	-	0	-	0	2
Feb	0	0	0	0	0	-
Mar	0	0	0	0	0	-
Apr	4	3	0	0	0	3
May	31	20	23	25	11	5
Jun	31	11	2	1	14	11
Jul	21	13	15	5	13	4
Aug	5	6	5	9	4	7
Sep	1	2	2	9	3	1
Oct	1	2	1	-	0	-
Nov	-	2	-	-	0	-
Dec	-	0	1	0	0	0

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	836	18.8
1951	834	23.0
1952	724	23.0
1953	445	26.0
1954	244	29.5
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

CLAM

DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	11	-	-	-	-	-
¢/lb.	54.5	-	-	-	-	-
			Central District			
1,000 lbs.	31	65	82	77	137	66
¢/lb.	53.3	53.8	55.5	55.2	81.7	1.05
			Southern District			
1,000 lbs.	211	217	172	197	242	221
¢/lb.	56.0	56.0	59.2	61.1	75.2	1.14

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	32	0	31	47	28	36
Feb	29	27	32	31	22	34
Mar	30	43	35	18	79	29
Apr	24	39	8	26	48	25
May	23	29	36	18	16	15
Jun	11	8	17	32	9	20
Jul	18	31	8	13	9	18
Aug	17	16	5	13	16	18
Sep	18	16	13	25	59	16
Oct	26	11	7	13	22	27
Nov	7	15	28	16	42	26
Dec	17	22	35	0	0	23

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	836	18.8
1951	834	23.0
1952	724	23.0
1953	445	26.0
1954	244	29.5
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
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1971	254	58.3
1972	274	59.5
1973	380	77.4
1974	288	1.12

CLAM

DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	11	-	-	-	-	-
¢/lb.	54.5	-	-	-	-	-
			Central District			
1,000 lbs.	31	65	82	77	137	66
¢/lb.	53.3	53.8	55.5	55.2	81.7	1.05
			Southern District			
1,000 lbs.	211	217	172	197	242	221
¢/lb.	56.0	56.0	59.2	61.1	75.2	1.14

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	32	0	31	47	28	36
Feb	29	27	32	31	22	34
Mar	30	43	35	18	79	29
Apr	24	39	8	26	48	25
May	23	29	36	18	16	15
Jun	11	8	17	32	9	20
Jul	18	31	8	13	9	18
Aug	17	16	5	13	16	18
Sep	18	16	13	25	59	16
Oct	26	11	7	13	22	27
Nov	7	15	28	16	42	26
Dec	17	22	35	0	0	23

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	1,322	42.0
1951	1,532	41.1
1952	1,620	37.0
1953	1,525	35.2
1954	1,009	39.2
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

DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
Northern District						
1,000 lbs.	103	149	201	175	312	294
¢/lb.	73.5	71.8	68.1	75.4	82.6	77.4
Central District						
1,000 lbs.	104	90	98	102	68	100
¢/lb.	72.8	73.3	69.0	75.2	82.3	92.1
Southern District						
1,000 lbs.	211	217	172	197	242	221
¢/lb.	56.0	56.0	59.2	61.1	75.2	1.14

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	70	0	86	67	92	80
Feb	40	49	50	51	45	107
Mar	27	45	70	66	62	47
Apr	9	9	11	23	180	18
May	2	1	4	5	38	-
Jun	1	1	2	1	0	-
Jul	-	0	0	0	0	-
Aug	6	-	0	0	0	0
Sep	1	-	1	-	0	4
Oct	43	37	31	69	43	72
Nov	97	76	67	99	126	119
Dec	79	112	103	0	0	111

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	72	52.7
1951	183	52.4
1952	254	49.6
1953	65	50.8
1954	52	50.0
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

DISTRICT LANDINGS & EX-VESSEL PRICES

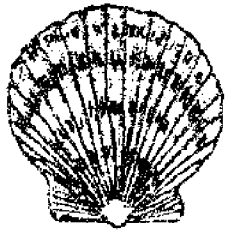
	1969	1970	1971	1972	1973	1974
Northern District						
1,000 lbs.	-	1	-	-	-	-
¢/lb.	-	1.00	-	-	-	-
Central District						
1,000 lbs.	611	129	60	128	37	220
¢/lb.	62.3	70.3	70.0	85.9	89.1	90.4
Southern District						
1,000 lbs.	1	-	-	-	-	-
¢/lb.	66.5	-	-	-	-	-

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	98	46	4	37	0	56
Feb	80	33	0	29	1	58
Mar	119	19	0	42	0	53
Apr	95	3	0	21	0	26
May	60	0	0	0	0	0
Jun	48	0	0	0	0	0
Jul	42	0	0	0	0	0
Aug	16	0	0	0	0	0
Sep	0	0	0	0	0	0
Oct	0	0	0	0	0	0
Nov	0	0	0	0	0	0
Dec	54	29	56	0	36	27

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	Not Reported	
1951	Not Reported	
1952	Not Reported	
1953	Not Reported	
1954	Not Reported	
1955	Not Reported	
1956	Not Reported	
1957	Not Reported	
1958	Not Reported	
1959	Not Reported	
1960	Not Reported	
1961	Not Reported	
1962	Not Reported	
1963	Not Reported	
1964	Not Reported	
1965	Not Reported	
1966	Not Reported	
1967	Not Reported	
1968	Not Reported	
1969	0	0
1970	1,574	31.6
1971	1,285	33.6
1972	1,050	46.8
1973	556	63.4
1974	-	-



SCALLOP, CALICO

DISTRICT LANDINGS & EX-VESSEL PRICES

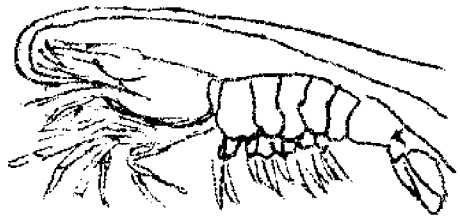
	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	0	0	-	-	-	-
¢/lb.	0	0	-	-	-	-
			Central District			
1,000 lbs.	-	1,574	1,285	1,050	556	-
¢/lb.	-	31.6	33.6	46.8	63.4	
			Southern District			
1,000 lbs.	-	-	-	-	-	-
¢/lb.	-	-	-	-	-	-

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	0	0	137	2	0	0
Feb	0	0	244	24	0	0
Mar	0	85	173	185	0	0
Apr	0	153	267	280	185	0
May	0	168	153	228	224	0
Jun	0	170	167	184	104	0
Jul	0	214	69	68	43	0
Aug	0	189	68	44	0	0
Sep	0	195	-	33	0	0
Oct	0	148	0	-	0	0
Nov	0	142	0	0	0	0
Dec	0	107	0	0	0	0

N. C. LANDINGS & EX-VESSEL PRICES

YEAR	1,000 lbs.	¢/lb.
1950	8,311	24.0
1951	8,200	23.8
1952	8,712	21.9
1953	14,645	24.7
1954	9,182	19.9
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



SHRIMP, SALTWATER

DISTRICT LANDINGS & EX-VESSEL PRICES

	1969	1970	1971	1972	1973	1974
			Northern District			
1,000 lbs.	1,792	1,082	1,602	761	804	1,436
¢/lb.	61.1	51.8	69.8	75.6	1.03	54.4
			Central District			
1,000 lbs.	5,247	2,890	4,195	3,078	2,727	5,462
¢/lb.	55.8	48.8	63.2	67.1	93.2	54.1
			Southern District			
1,000 lbs.	815	1,082	1,818	1,724	1,473	1,558
¢/lb.	55.2	48.0	54.7	52.6	92.8	56.5

MONTHLY N. C. LANDINGS (1,000 pounds)

MONTH	1969	1970	1971	1972	1973	1974
Jan	0	0	0	0	0	0
Feb	0	0	0	0	0	17
Mar	0	0	-	0	0	8
Apr	0	0	-	0	0	76
May	181	35	259	751	250	514
Jun	471	243	800	462	760	784
Jul	3,000	1,162	1,592	990	961	1,433
Aug	2,529	1,243	2,551	1,797	941	4,163
Sep	966	1,142	1,104	1,152	951	708
Oct	471	829	655	762	745	556
Nov	228	379	525	317	355	135
Dec	0	0	114	0	20	-

3.02 Sport Fish Landings:

A. Anglers:

U. S. anglers caught 1.6 billion pounds of fish in 1970, according to "1970 Salt Water Survey". In this study, it was reported that the coastal area extending from Cape Hatteras to East Florida Keys accounted for more than 25% of the U. S. total, indicating it to be the most prolific area. The more important species caught in this southeast area were as follows:

Species	Million Pounds
Barracuda	3.7
Bass, Black	12.4
Billfishes	12.5
Bluefish	19.3
Catfishes	16.6
Croakers	5.9
Dolphin	27.8
Drum, Black	12.1
Drum, Red	13.4
Flounders, Summer	8.9
Groupers	24.1
Grunts	26.0
Jacks	33.1
Kingfishes	14.5
Mackerel, King	34.9
Mackerel, Spanish	14.6
Porgies	24.0
Puffers	4.4
Sea Trout, Spotted	24.0
Snappers, Red	5.7
Snappers, Yellowtail	20.2
Snook	18.0
Spot	9.8
Tunas	5.9

Total of landings of these and other species in S. E. coastal area = 404 million pounds, i.e., more than 25% of 1.577 billion pounds U. S. total.

B. Head Boats:

Huntsman[1] surveyed the fishery extending from Hatteras to Charleston involving in 1973 a total of 23 boats of which 10 operated offshore and 13 inshore:

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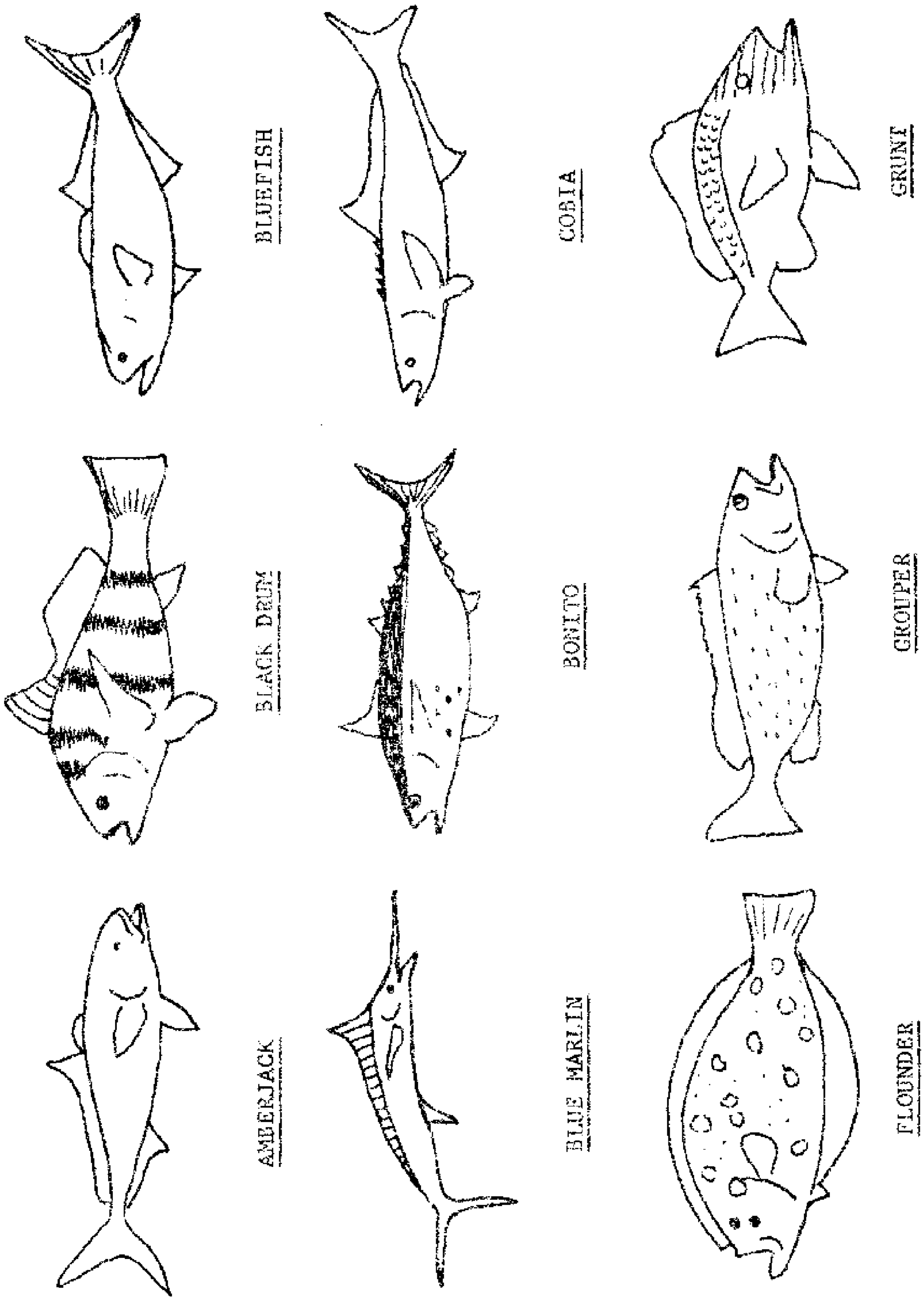
1. Dr. Gene R. Huntsman, Offshore Demersal Fisheries, NMFS, Resource Assessment Seminar, September 18-19, 1974.

3.02 Sport Fish Landings

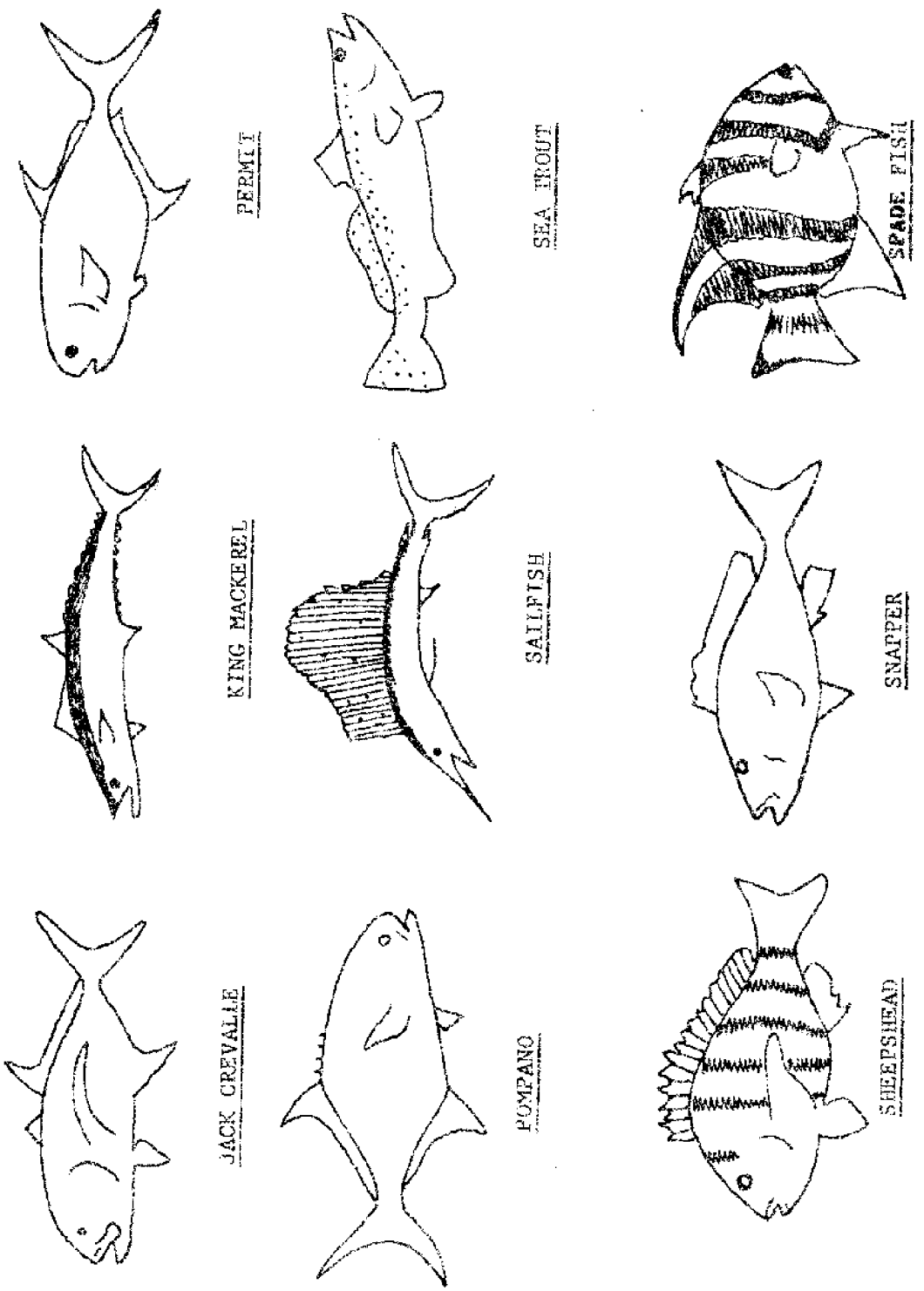
SPORT FISH



Sports Fish Illustrations by L. L. Miller, Institute of Marine Sciences

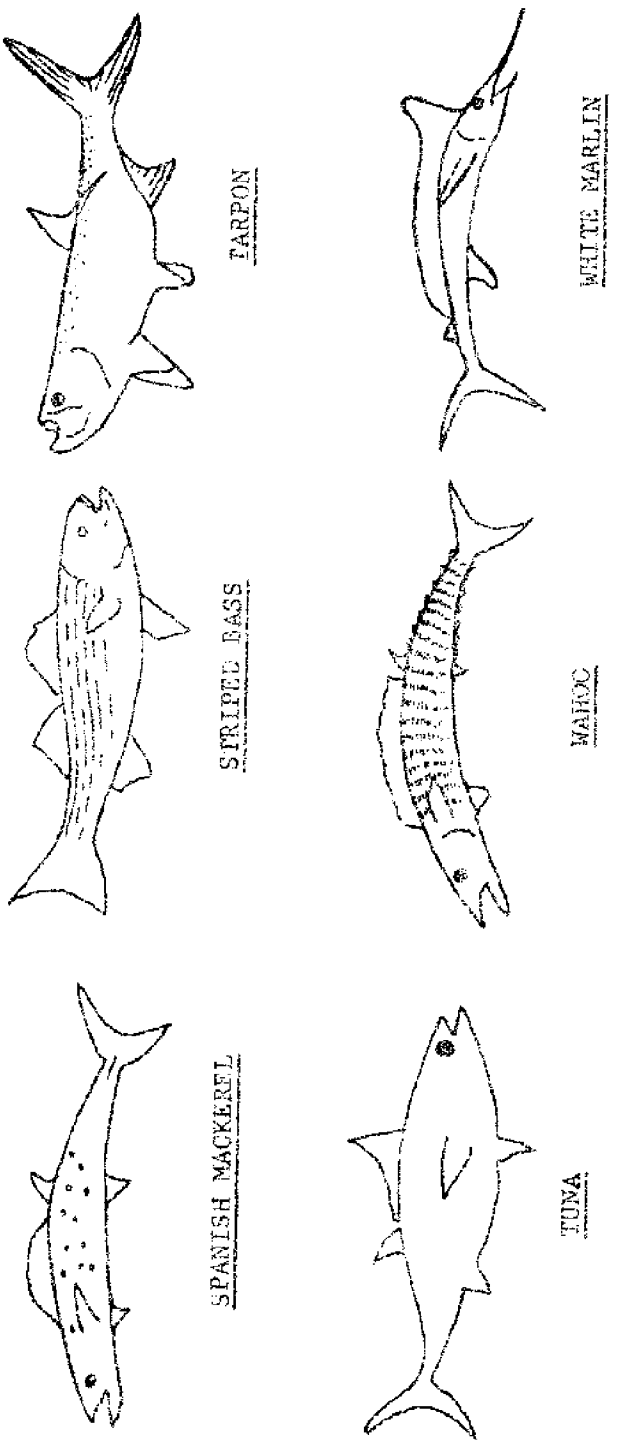
3.02 Sport Fish Landings

SPORT FISH



3.02 Sport Fish Landings

SPORT FISH



3.02 Sport Fish Landings

HEAD BOAT LANDINGS 1974
N.C. & S.C.

Porgies	746,000 lbs.	
Grunts	143,000 lbs.	
Snapper	157,000 lbs.	
Grouper	263,000 lbs. }	362,000 lbs.
Grouper, other species	99,000 lbs. }	
Red Snapper	60,000 lbs.	
Others	127,000 lbs.	
TOTAL	1.6 million pounds	

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 and other conditions best suited for prolonged survival.

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 freeing from 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 measures to avoid possibility of contamination coming from this source is necessary.

C. Gentle Handling:

Rough handling of raw material is not acceptable.

D. Fast Handling:

Minimize exposure to ambient temperature.

4.02 Specific Requirements:

4.02 Specific Requirements

FINFISH:

Stowage rules:

A. Icebed should be about 6" deep.
B. Jagged ice should not be used.
C. Ice buffer of 3" between fish and sides.
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.

H. Large Fish:

The following rules, specified in Norway[2], 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 atmospheric temperatures of over 5°C (41°F) the fish may not be kept uneviscerated for more than four hours".

SHRIMP:

Handling on board should be as follows:

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. Icing should be based on using 1½ times the weight of the shrimp, dispersing them throughout finely crushed ice.
G. Draining runoff liquids must be unhampered.
H. SODIUM BISULFITE treatments must be controlled in order to be ef-

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2. "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.

4.02 Specific Requirements

fective 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 1 minute, then removing. 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. 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, cool temperatures helping 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, load 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

4.03 Rapid Cooling of Catch

also the only basis of refrigeration employed aboard North Carolina fishing boats, making it essential to fully understand its use:

A. Clean Ice:

Must be made from potable water, 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 its 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 also 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 over-

4.03 Rapid Cooling of Catch

coming heat exchange through the hull, to air in the hold, and 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 rapid 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 limited amount of salt at 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, rust, then primed with suitable paint. Wood must be free of grease and dirt, completely dry. The foam is applied with special spraying equipment, tightly bonding to these surfaces.

B. Applying Urethane:

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

C. Skin Materials:

Plaster, fibreglass, USDA approved elastomer, or thin stainless steel sheeting have been used in various installations.

D. Cost:

Material plus application cost is about 40¢/board foot.

Example:

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

4.04 Hold Insulation

3 X 1167 X .4 = $1,400 (Foam installation only).

4.05 Mechanical Refrigeration:

It has frequently been proposed that mechanical refrigeration be considered for use aboard N. C. trawlers. It is usually assumed that this would eliminate the need for shore icing facilities. A decision to completely refrigerate a vessel is not a simple one. There are a number of alternatives to consider in selecting the right system, depending upon which offers the best chance of safeguarding product quality. For example, the use of refrigerated sea water, successfully used aboard menhaden boats, is open to question because of adverse effects on flavor of seafoods.

Besides the cost of the initial investment in fully refrigerating a vessel, there is also the problem of shore maintenance, shorter operating life of equipment used at sea, and power limitations. Basically, making ice in a shore based facility is the least cost approach to refrigeration.

The above comments indicate the need for further investigation. However, there is a partial approach to mechanical refrigeration at sea which merits consideration. In effect this would be used to supplement what can be accomplished with insulation. It would involve cooling the air which circulates in the hold thereby reducing the melting of ice which would threaten the catch.

The use of an overhead convecting cooling unit to reduce air temperature in the hold has been suggested.

5.0 SHORE HANDLING AND PROCESSING:

5.01 Good Manufacturing Practices (GMP's):

Food and Drug Administration, May 29, 1969, issued 'Human Foods: Current Good Manufacturing Practice (Sanitation) in Manufacturing, Processing, Packaging or Holding', 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, PACKAGING, OR HOLDING OF FOOD IN CONFORMANCE WITH OR OPERATED OR ADMINISTERED IN CONFORMITY WITH GOOD MANUFACTURING PRACTICES TO ASSURE THAT FOOD FOR HUMAN CON-SUMPTION IS SAFE AND HAS BEEN PREPARED, PACKED, AND HELD UNDER SANITARY CONDITIONS'.

Action announced in Federal Register, Volume 34, Number 80, April 26, 1969.

5.02 Guidelines for Seafood Handling and Processing Plants:

5.02 Guidelines for Seafood Handling and Processing Plants

A. Finfish:

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

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

(3) "Inspection Guidelines for Fish Processing Plants", N. C. Food and Drug Administration, 1974.

B. Shrimp:

(1) "Revised Draft of Practice for Shrimps or Prawns", FAO Dept. of Fisheries, Rome, 1974.

C. Crabs, Blue:

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

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

D. Oysters and Clams:

(1) "Sanitation of the Harvesting and Processing of Shellfish", National Shellfish Sanitation Program Manual of Operations, Part II, U. S. Dept. HEW, 1965.

(2) "Laws, Rules and Regulations Relative to the Sanitation of Shellfish", Dept. Health Services, N. C. Dept. Human Resources, 1973.

E. Scallops:

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

(2) "Rules and Regulations Relative to the Sanitation of Scallops", N. C. State Board of Health, 1968.

(3) "Fish Inspection Regulations", The Canada Gazette, II, No. 2, 12 Jan. 1955.

F. Industrial Fish:

5.02 Guidelines for Seafood Handling and Processing Plants

(1) "Sanitation Guidelines for Salmonella Control in Processing Industrial Fishery Products", USDA 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.

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 - Prominant, 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.

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

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

5.03 Seafood Quality Criteria

(i) Viscera - Smooth, shiny and adhering 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) 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.[3, 4, 5]

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

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

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

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

5.03 Seafood Quality Criteria

occurring within acceptable limits of freshness.

DRESSED, FILLETS, STEAKS

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

(m) 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 occurrence of oxidation and dehydration.

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

B. Shrimp:

(1) Fresh:

Fresh shrimp slip crisply over one another, handling dryly, without 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 - Gently handled, individuals undamaged.

5.03 Seafood Quality Criteria

(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 iced storage based on contents of glycogen sugar, acid soluble orthophosphate, and lactic acid. Freshly caught shrimp has a pH of about 7.2, increasing 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 used 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[6] demonstrated enzymic and bacterial effects on cellular structure by employing histological methods.

(2) Frozen:

Shrimp has 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).

(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 shells tightly closed, meat bright,

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6. "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.

5.03 Seafood Quality Criteria

and 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, dropping 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, but no higher than 500,000/ml.

Storage temperature of frozen oysters is especially critical in arriving at 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.

Freezing should be carried out with equipment designed to freeze the product...not by placing 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 placing whole or dressed fish in molds covered with plastic film, or by employing plastic bags providing low oxygen and moisture permeability. (See page 45).

Fillets are best protected from oxidation and dehydration by arranging attractively 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:

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

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 (Muller) (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^3/m^2/day/atm) (for 25 um film)	6,500-8,500	1,600-2,000	8-25
CARBON DIOXIDE PERMEABILITY (cm^3/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.

5.05 Thawing

A "rule of thumb" is that 125 BTU is required for thawing one (1) pound of fish although fatty fish requires 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 921°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" block will require about 5 hours.

B. Water:

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

5.06 Glazes:

Ice glazes are formed by dipping the frozen seafood in water or applying it 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, tends 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 a barrier against oxygen and moisture, structure control and sealing of flavor.[8]

An edible coating, described by Miller, et al.[9] was employed in the tests reported in Section 6.0:

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

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8. "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.

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

6.0 Processing Investigation

6.0 PROCESSING INVESTIGATION:

This work was undertaken to provide guidance on some basic problems of concern to North Carolina processors, including:

A. Effect of Conditions at Sea Upon 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.

Those items presented so far in Sections 1.0 through 5.0 had a great deal of relevance to this investigation while the implications of the research are discussed in succeeding Sections 7.0 PROCESSING FACILITIES, 8.0 MARKETING IMPLICATIONS, and 9.0 FUTURE RESEARCH.

Plans for this 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.

6.01 Trout as a Raw Material:

A. Grey and White Trout Landings:

These are reported on page 48 in terms of states along the Atlantic and Gulf seaboards. Because of variable landings in any one area it is necessary to consider alternate landing points as well as the possibility of having to rely upon white trout if a shortage of grey trout develops.

B. Common and Scientific Names:

Grey Trout, Weakfish, Squeteague	- Cynoscion regalis
Spotted Trout, Speckled Trout	- Cynoscion nebulosus
White Trout, Sand Trout	- Cynoscion arenarius

C. Weight-Length Relationship:

Merriner[10] provided data of possible use to processors in estimating size relationships and yields, as shown on page 49.

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10. "Assessment of the Weakfish Resource, A Suggested Management Plan, and Aspects of Life History in North Carolina", John V. Merriner, PhD Thesis, North Carolina State University, 1973.

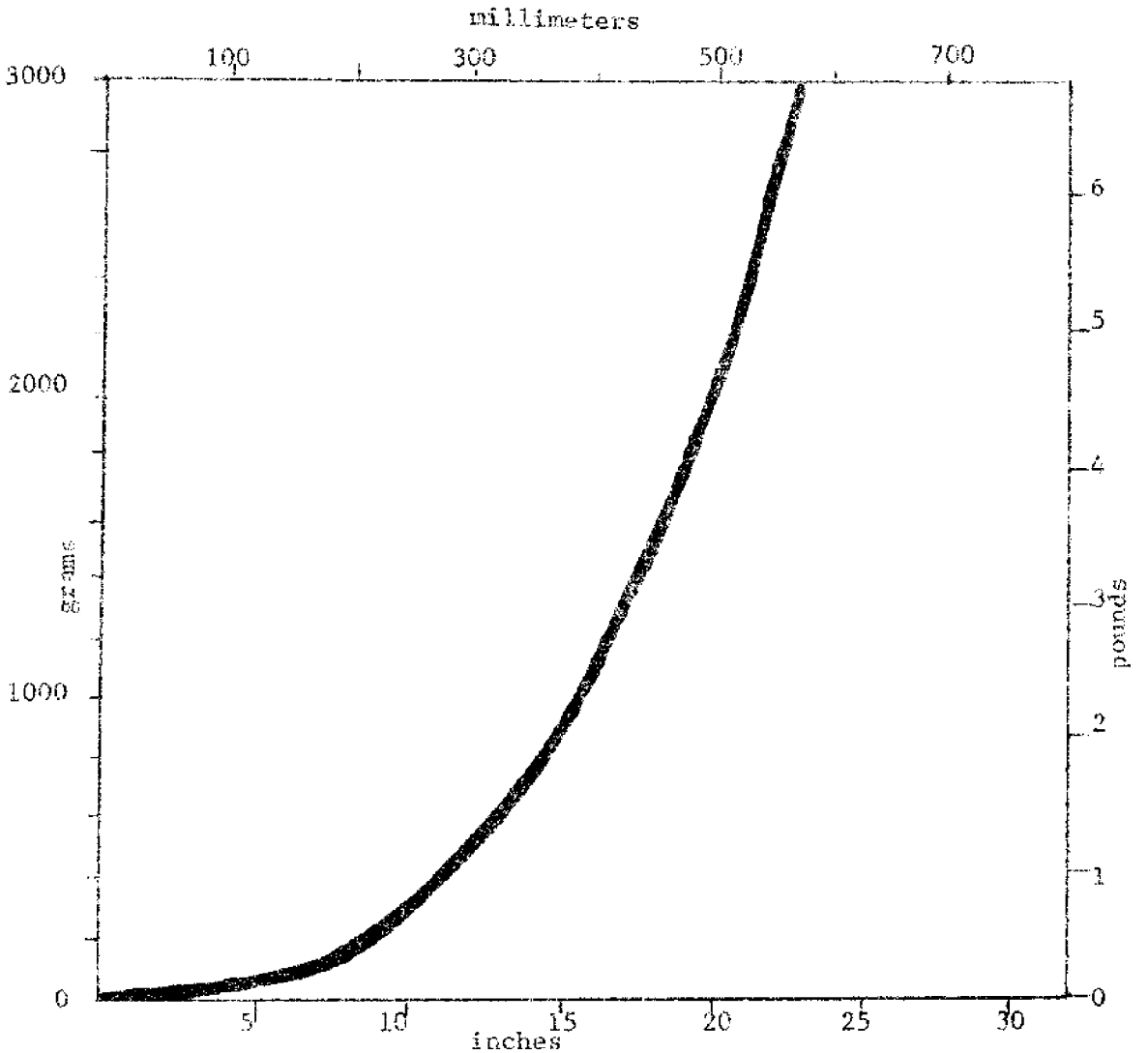
WHITE & GREY TROUT LANDINGS

STATE	YEAR (1,000 Pounds)			
	1974	1973	1972	1971
		GREY TROUT		
Maryland	371	522	313	408
Virginia	2765	5023	2615	2285
North Carolina	6056	6222	7372	3645
South Carolina	2	2	-	-
Georgia	-	-	-	-
Florida, E.	38	207	175	144
		WHITE TROUT		
Florida, W.	34	226	244	278
Alabama	1591	1522	936	980
Mississippi	267	118	157	163
Louisiana	135	151	149	132
Texas	-	6	20	2

Source: NMFS Statistics

6.01 Trout as a Raw Material

WEIGHT-LENGTH RELATIONSHIP--WEAKFISH CAUGHT IN N.C.



Source: J.V. Merriner, thesis

6.02 Test Plan:

On three occasions, Michael Taylor of the Seafood Laboratory went to sea aboard the "Sonya Glenn", operated by Captain Willie Ethridge, Jr. of Wanchese. These trips, which started three (3) weeks apart on 1/26/75, 2/16/75, and 3/9/75 were aimed at observing finfish handling practices, and at collecting two basic samples:

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

Upon returning to Wanchese the vessel was unloaded at the facility operated by Willie Ethridge, III. 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, packed in salt-ice mixture. Both samples were transported to Morehead City and held overnight in the cold room at Ottis' Fish Market.

Processing, packing and subsequent storage shown in the Test Plan, page 51, was carried out the day after receipt at Ottis'. Since different conditions and durations occurred during each sea trip, it was the effects of these uncontrolled factors which were to be evaluated in terms of storage characteristics.

The effect of these varying conditions at sea were to be measured on a number of processed samples, as follows:

Preservation at Sea	Preservation & Storage Ashore	Packaged Processed Form
Ice @ 32°F	Ice @ 32°F	Round Headed & Gutted Fillet
Ice @ 32°F	Fz Held @ 0°F*	Round Headed & Gutted Fillet
SI @ 28°F	SI @ 28°F	Round Headed & Gutted Fillet
SI @ 28°F	Fz Held @ 0°F*	Round Headed & Gutted Fillet

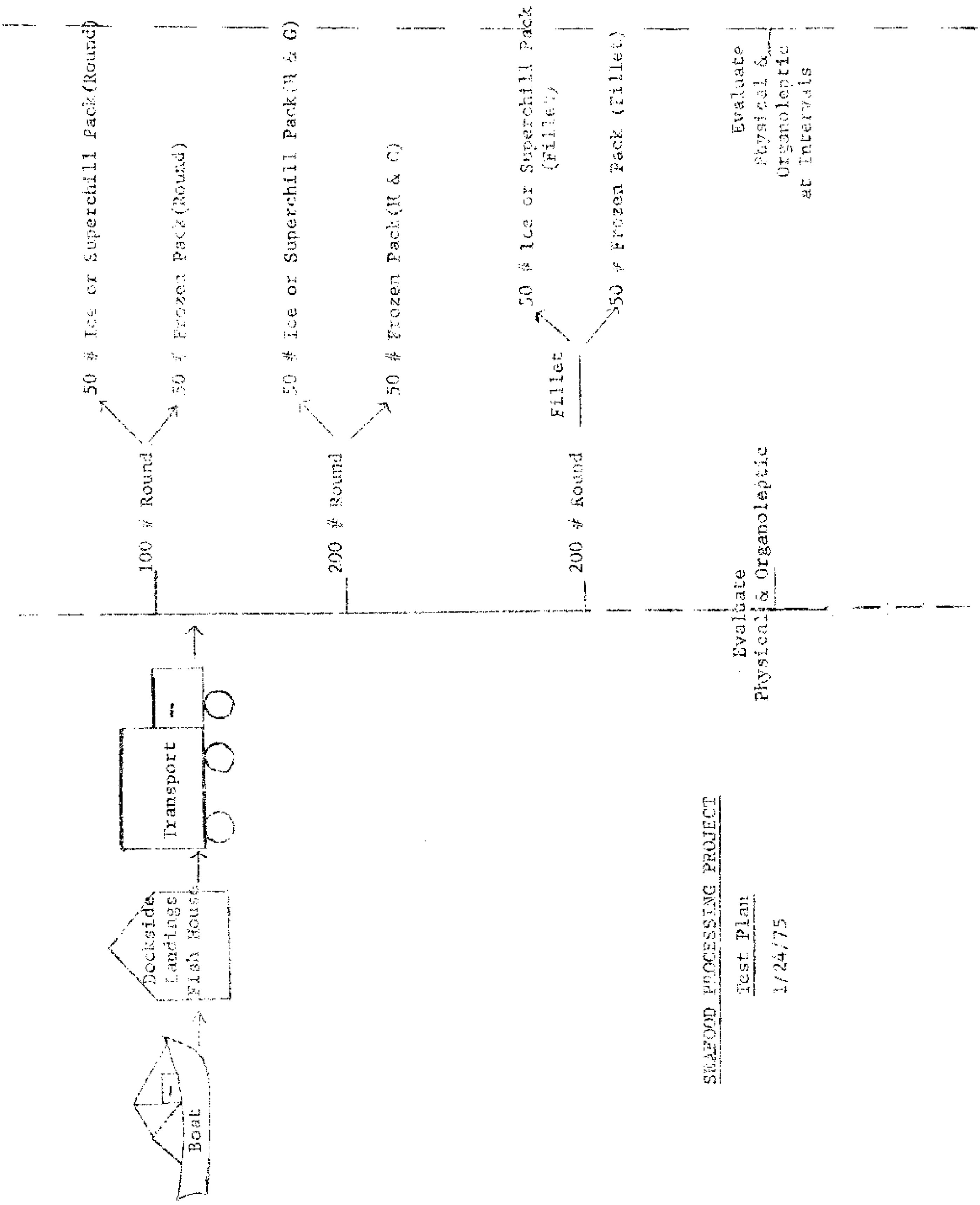
* Storage - up to 90 days

Fz = Frozen
SI = Salt-Ice

6.03 Composition as Related to Storage:

A tentative prediction of shelf life in frozen storage can be made

6.02 Test Plan



6.03 Composition as Related to Storage

by examining the ratio of protein to fat in finfish. This is shown on page 53. "Relative Suitability" of various species as determined from experience is compared with Protein/Fat (P÷F) ratios calculated from other data. Widely used proximate compositions for some varieties of finfish landed in North Carolina appear on page 54. Again, these are examined in terms of P/F ratio. Grey trout (Weakfish) is shown to be in the limited shelf life range when judged on this basis.

Analytical data, appearing on pages 55 and 56 indicate 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 and in belly flaps.

These considerations together with published estimates assigning 2-3 month prime quality storage life to trout, led to defining a standard to be used in instructing the laboratory taste panel. This is shown on page 57. 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.

6.04 Experimental Processing:

Experimental processing of samples collected from the three trips resulted in the following yields:

Sample (Initial Preservation)	Count	Processed Form	Yield
A (Iced)	83	SH&G	67%
		Fillet	56%
B (S.I.)	84	SH&G	65%
		Fillet	56%
H (Iced)	82	SH&G	67%
		Fillet	58%
I (S.I.)	88	SH&G	68%
		Fillet	59%
P (Iced)	100	SH&G	61%
		Fillet	51%
Q (S.I.)	100	SH&G	61%
		Fillet	51%

Estimates of labor involved in this experimental processing appear on page 58.

RELATIVE SUITABILITY OF FISH
FOR FREEZING AND FROZEN STORAGE

High Suitability	P+F	Medium Suitability	P+F	Low Suitability	P+F
Haddock	18.3	Ocean Perch	15.0	Mackerel	1.6
Cod	58.7	Whiting	6.1	Tuna	6.1
Flounder	20.1	Hake	41.3	Catfish (Freshwater)	5.7
Halibut	17.4	Red Snapper	22.0	Sea Herring	1.5
Pollock	22.6	Rockfish	10.5	Spanish Mackerel	1.9
		Swordfish	4.8	Chub	1.7
		Alewife	4.0		

Sources: Relative Suitability Ratings - "The Freezing Preservation of Foods", Tressler, Arsdel, and Copley, The Avi Publishing Co. (1968) Chapter 8. J. W. Slavin, page 183.

Protein and Fat Data - "Composition of Foods - Raw, Processed, Prepared", Ag. Handbook No. 8, USDA (Rev. Dec. 1963).

6.03 Composition as Related to Storage

COMPOSITION DATA

Finfish (Raw)	Composition and Ratio			Protein / Fat	
	Moisture	Protein (P)	Fat (F)	Ratio P:F	Ash
Alewife	74.4%	19.4%	4.9%	4.0	1.5
Black Sea Bass	79.3%	19.2%	1.2%	16.0	1.2
Bluefish	75.4%	20.5%	3.3%	6.2	1.2
Croaker (Atlantic)	79.2%	17.8%	2.2%	8.1	1.3
Flatfishes	81.3%	16.7%	0.8%	20.1	1.2
Kingfish	77.3%	18.3%	3.0%	6.1	1.3
Mackerel (Atlantic)	67.2%	19.0%	12.2%	1.6	1.6
Mullet (Striped)	72.6%	19.6%	6.9%	2.8	1.3
Ocean Perch (Atlantic Redfish)	79.7%	18.0%	1.2%	15.0	1.1
Porgy & Scup	76.2%	19.0%	3.4%	5.6	1.3
Shad	70.4%	18.6%	10.0%	1.9	1.3
Spot	65.3%	17.6%	15.9%	1.1	1.2
Weakfish					
Raw	76.7%	16.5%	5.6%	2.9	1.2
Cooked, Broiled	61.4%	24.6%	11.4%	2.2	2.6

Source: "Composition of Foods - Raw, Processed, Prepared", Agricultural Handbook No. 9, USDA (Rev. Dec. 1963).

PROXIMATE ANALYSIS

Trout (Grey) Components

	Moisture	Protein (P)	Fat (F)	Ratio P÷F	Ash
Headed and Gutted	75.45%	16.88%	6.28%	2.7	1.14%
Fillet	77.83%	16.56%	4.01%	4.1	0.98%
Skin and Underlying Fat of Fillet	70.95%	14.99%	11.54%	1.3	0.85%
Abdominal Cavity	69.85%	13.58%	12.84%	1.1	0.79%

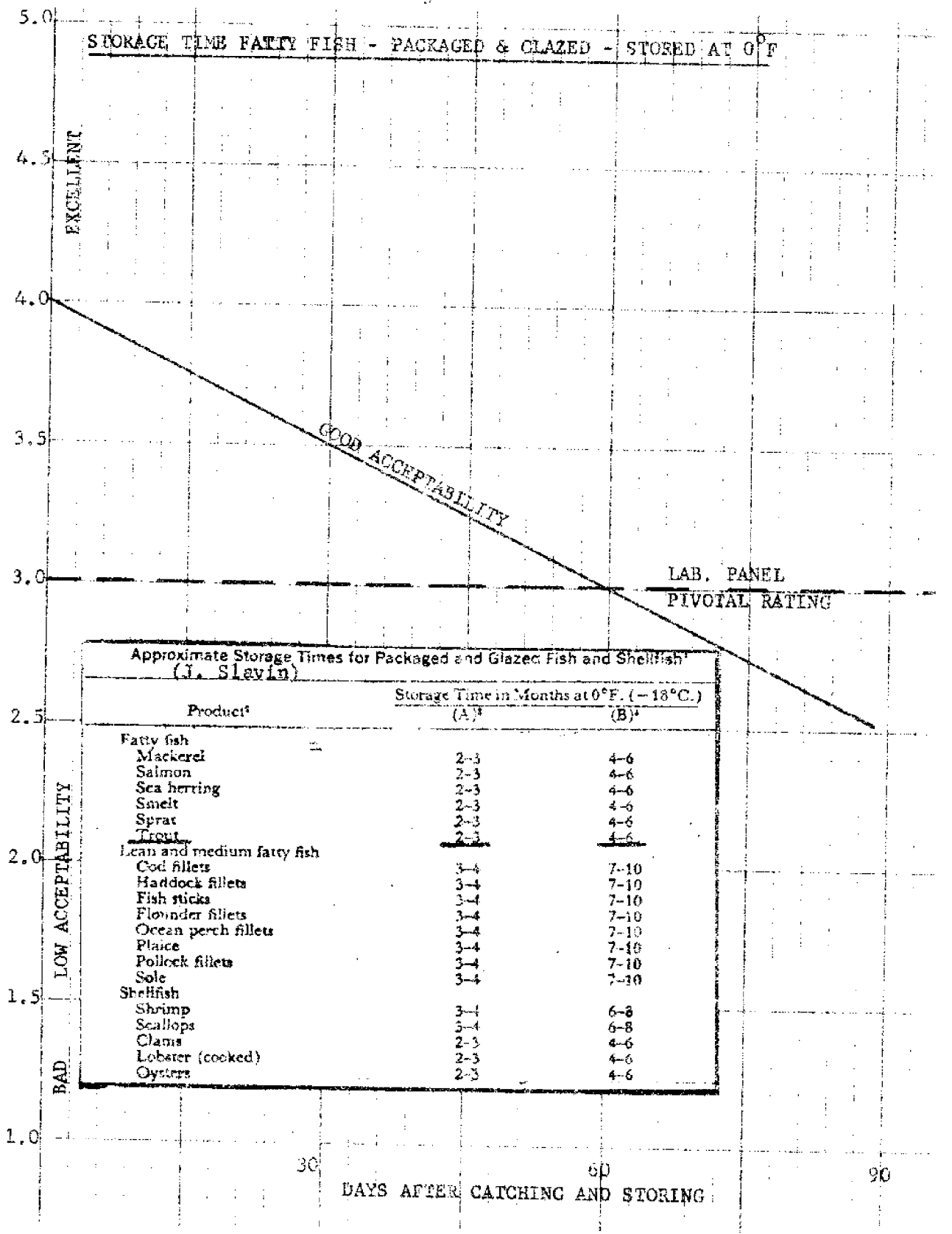
Source: Keith Gates, Seafood Laboratory, Morehead City, N. C. 3/3/75

COMPOSITION OF GREY TROUT SAMPLES - TRIP NO. 3

63 - 78 Days in Frozen Storage

STORAGE FORM	PRETREATMENT	PORTION ANALYZED	MOISTURE	PROTEIN	FAT	ASH
Rnd	I-Fz	Fillet	78.99%	17.65%	1.60%	1.03%
			76.77%	17.28%	3.86%	1.17%
Rnd	I-Fz	Belly Flap	75.41%	15.42%	2.01%	0.95%
			73.80%	17.57%	9.70%	1.21%
H&G	I-Fz	Fillet	74.45%	17.74%	5.27%	1.20%
			72.34%	17.27%	3.58%	1.26%
H&G	I-Fz	Belly Flap	69.36%	17.27%	16.43%	1.08%
			73.23%	17.76%	7.48%	1.15%
F	I-Fz	Fillet	74.30%	17.79%	7.30%	0.95%
			73.30%	17.74%	8.36%	1.35%
F	I-Fz	Belly Flap	69.27%	16.57%	18.32%	0.75%
			66.57%	14.81%	14.77%	1.44%
Rnd	SI-Fz	Fillet	77.07%	16.95%	3.16%	1.22%
			74.76%	16.83%	6.58%	1.48%
Rnd	SI-Fz	Belly Flap	71.11%	17.01%	7.14%	1.48%
			63.47%	15.53%	17.94%	1.77%
H&G	SI-Fz	Fillet	78.08%	17.58%	2.44%	1.06%
			77.89%	16.67%	3.29%	1.22%
H&G	SI-Fz	Belly Flap	75.26%	14.67%	5.67%	0.95%
			76.75%	16.52%	5.98%	1.43%
F	SI-Fz	Fillet	75.75%	18.20%	4.09%	1.09%
			76.17%	17.23%	5.65%	1.24%
F	SI-Fz	Belly Flap	73.33%	17.95%	9.46%	0.93%
			72.00%	15.52%	11.30%	1.24%

6.03 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

LABOR TIME FOR OPERATIONS

SAMPLE AND OPERATION INVOLVED		RATE (2 MEN)
Salt-ice fish in round	- scaled by hand, headed, gutted = 200#/35 min.	343 lbs/hr
Salt-ice fish in round	- scaled by hand, filleted, frames cleaned = 166#/35 min.	285 lbs/hr
Iced fish in round	- machine scaled, headed, gutted = 100#/37 min.	162 lbs/hr
Iced fish in round	- machine scaled, filleted, frames cleaned = 100#/39 min.	154 lbs/hr

6.04 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" x 12" x 1 3/4" waxed cartons, employing pliofilm dividers between layers. Top surfaces were covered as completely as possible with pliofilm, the boxes closed and surrounded by ice, or salt-ice mixture, then held in a cold room with ambient temperature of 34°F. Refrigerating materials were replenished every few days, the products thereby being held at 32°F and at about 28°F between sampling intervals.

Packing for frozen storage involved arranging the three forms in units convenient for intermittent sampling, and wrapping in PVDC film. These units were then arranged in waxed cartons of up to 2½" 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 which were then packed in sealed corrugated master cartons. Frozen samples were stored at under 0°F at Carteret Quick Freezing Co., Inc, Beaufort.

6.05 Evaluation Methods:

Subjective testing involved use of the following methods of recording observations:

A. Fish Rating Form - page 60
B. Raw Fillet Rating Form - page 61
C. Cooked Fillet Rating Form - page 62
D. Consumer Rating Form - page 63
   (Directions for Consumer Form) - page 64

Gould and Peters[11] discuss biochemical indices of quality in fish, with special reference to frozen products. Most apparent in this review is lack of objective methods capable of indicating undefinable flavor changes potentially objectionable to consumers. Laboratory support was therefore limited to proximate analyses and the thiobarbituric acid reaction.

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11. "On Testing the Freshness of Frozen Fish", Edith Gould and John A. Peters, Fishing News (Books), Ltd., 1971.

6.05 Evaluation Methods

FISH RATING FORM

Evaluator _____ Date _____ Time ____ AM ____ PM

Samples Involved _____

CHARACTERISTIC	RATING SYSTEM			RATING
a. Surface	Bright, Lustrous 0	Slight Dark 3	Excess Dull 10	
b. Eyes	Prominent, Clear 0	Flattened, Part Cloudy 3	Sunken, Cloudy 10	
c. Color of Gills	Bright Red 0	Dull Red 3	Dark Red 10	
d. Oder of Gills	No off Odor 0	Slight Disagreeable 5	Offensive 10	
e. Scales	Glisten, Tight 0	Dull, easily Removed 3	Dull, Loose 5	
f. Flesh Texture	Firm, Resilient 0	Slightly Soft 3	Soft 5	
g. Blood in Belly Cavity	Bright Red 0	Faded Red 3	Dark, Dirty Brown 5	
h. Belly Area	Firm 0	Soft 3	Broken 5	
i. Handling Damage	None 0	Minor 3	Excessive 10	
SCORE				

6.05 Evaluation Methods

PROCESSING PROJECT - RAW FILLET RATING FORM

Evaluator _____ Date _____ Time ____ AM ____ PM

Samples involved _____

1 = Poor; 5 = Excellent

Code No.	Sample No.	Color	Lack of Cutting Defects	Belly Cavity	Odor	Texture	Comments

6.05 Evaluation Methods

PROCESSING PROJECT - ORGANOLEPTIC RATINGS - COOKED

Evaluator _____ Date _____ Time _____AM _____PM

			MAIN PORTION OF FILLET				SKIN & BELLY PORTIONS		
	CODE	SAMPLE	ODOR	FLAVOR	TEXTURE	COMMENT	ODOR	TEXTURE	COMMENT
1	A B C								
2	A B C								
3	A B C								
4	A B C								
5	A B C								
6	A B C								
7	A B C								
8	A B C								
9	A B C								
10	A B C								

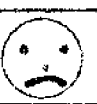
ABBREVIATIONS

B - Bitter
D - Discolored
F - Fishy
M - Mushy
O - Oily
R - Rancid
T - Tough

6.05 Evaluation Methods

Consumer Rating Form
TROUT FILLETS

State Age and Sex of Each Person Sampling Fillets		SAMPLE MARKING =				
Age	Sex					

State Age and Sex of Each Person Sampling Fillets		SAMPLE MARKING =				
Age	Sex					

6.05 Evaluation Methods

March 3, 1975

INSTRUCTIONS

1. We have given you two samples of three trout fillets, each identified by a geometric form such as a triangle △, rectangle ▭, or square □. Keep refrigerated. All fillets must be cooked in the same way, but you can select the method you like best, provided you confine it to BAKING or BROILING.

2. A suggested cooking method: Brush melted butter or margarine on both sides of fillets. Lay on pan, skin side down, sprinkle with salt, pepper, paprika, parsley, lemon juice, as desired. Bake in 350°F oven 20 to 30 minutes (until fish flakes easily with fork).

3. Be sure you can identify the samples after cooking, then ask each member of your family to express an opinion on both samples, placing a check mark in the column under the facial expression most nearly expressing their reactions. The middle face  can be considered as representing an average reaction.

6.05 Evaluation Panels:

A. Rating Unfrozen Round Fish:

One or more staff members conducted these evaluations, depending upon time, place, and availability of observers. Those involved were familiar with fresh seafoods, having little difficulty in arriving at fair agreement on scores. The form shown on page 60 is based on a scoring system of zero for a perfect fish up to 70 for a completely bad fish. Conversion to the Hedonic Scale, used in comparing results with what was obtained in rating cooked fillets, was accomplished by assuming a 1 to 5 scale to be inversely proportional to the 70 to 1 scale employed in scoring.

B. Rating Raw Fillets:

One or more staff members were involved in applying Hedonic Ratings to raw fillets subsequently cooked and tried by the Laboratory Taste Panel.

C. Laboratory Taste Panel:

Hundreds of observations were made by a Taste Panel consisting of four non-smokers, 1 male, 3 female, all under forty. The Rating form first used in this work did not require separate evaluation of skin and belly portions. It was soon noted that these portions caused lower ratings than would be assigned to the larger part of the fillets. As a result the revised form shown on page 62 was adopted.

Fillets taken from various samples during iced, salt-iced, and frozen storage were dipped for 15 minutes in 3% salt solution, drained, and baked in a uniform manner without further seasoning. The cooked fillets were submitted to the panel either in pairs, or in a triangular configuration consisting of paired and single samples.

Results of a paired vs. single sample test, fed randomized for each trial, are shown on page 66. This test indicates ability to detect differences.

Some trials involved comparing samples baked without flavoring while identical combinations were cooked with butter, pepper and mild spices. The latter cooking method increased Hedonic Ratings by about one (1) point.

D. Consumer Panel:

This test, involving 140 people of various ages, was based on supplying fillets to families, permitting them to cook the samples as desired. The form and directions shown on pages 63

6.06 Evaluation Panels

LABORATORY TASTE PANEL

TRIANGLE TEST - TROUT FILLETS
HEDONIC RATINGS
(5 = Excellent)

SAMPLE	PANELIST				AVERAGE
	LSB	JAT	MT	FT	
A	2.8 *	4.0 *	3.7 *	3.7 *	3.6
A	3.1	3.5	4.0	4.3	
M	1.7	2.7	3.0	2.0	2.4
B	2.1	3.8	3.3	4.3	3.4
B	2.8	3.6	4.0	3.6	
L	*3.8	3.0	*4.0	*4.7	3.8
C	2.8	3.8	4.3	3.3	3.2
C	1.2	2.7	3.8	4.0	
K	3.0	*3.5	*4.7	*5.0	4.1
D	2.8 *	4.0	4.3 *	4.7	3.6
D	2.5	3.0	4.7	2.5	
J	2.2	*4.7	4.3	*3.7	3.7
E	2.8 *	3.5 *	4.0	5.0	3.9
E	3.5	3.2	3.7	4.3	
I	3.0	2.8	*4.2	*5.0	3.8
F	3.3 *	4.2 *	4.0 *	4.0	4.1
F	3.8	4.7	5.0	4.0	
H	3.5	2.8	3.8	4.0	3.5

* Individual Panelist Assigned Higher Rating to this Sample

6.06 Evaluation Panels

and 64 were employed in this experiment.

6.07 Experimental Results:

A. Observations at Sea:

The three sampling trips undertaken in connection with the experimental work were aboard a good trawler operated by an excellent captain. 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 prehandling conditions before processing was initiated:

	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 to Processing	76	37	105

Trip No. 1 provided the best preservation conditions before receipt in Morehead City.

Trip No. 2 had heavy catches which couldn't be handled expeditiously, while Trip No. 3 encountered rough weather and difficulty in stowing the catch.

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.

6.07 Experimental Results

The TBA values appearing on page 69 were determined on processed and frozen samples from Trip No. 3 at storage intervals of 63 and 73 days. When these figures are averaged the following values become apparent:

Treatment before Freezing	Form in which Stored	Part Sampled	T.B.A. Absorbance
Iced	Round	Fillet	0.182
Salt-Iced	Round	Fillet	0.157
Iced	Round	Belly F.	0.066
Salt-Iced	Round	Belly F.	0.834
Iced	H&G	Fillet	0.170
Salt-Iced	H&G	Fillet	0.312
Iced	H&G	Belly F.	0.095
Salt-Iced	H&G	Belly F.	0.239
Iced	Fillet	Fillet	0.079
Salt-Iced	Fillet	Fillet	0.139
Iced	Fillet	Belly F.	0.012
Salt-Iced	Fillet	Belly F.	0.531

The higher absorbance values, believed to indicate something about the onset of oxidation, did not appear when the fish was stored in the round, but the effect of the salt-ice treatment upon the other samples seems apparent.

On two occasions, trout purchased from a local source were subjected to the TBA test. Subjectively, these were rated as being in poor to fair condition. In one instance the absorbance values were 0.195 for the fillet and 0.417 for the belly flap. In the other, the values were 0.733 and 1.223, respectively.

6.07 Experimental Results

T.B.A. VALUES - GREY TROUT SAMPLES

(Trip No. 3)

STORAGE FORM	PRETREATMENT	PORTION ANALYZED	T.B.A. ABSORBANCE[12]
Rnd	I-Fz	Fillet	0.157 0.207
Rnd	I-Fz	Belly Flap	0.000 0.131
H&G	I-Fz	Fillet	0.155 0.185
H&G	I-Fz	Belly Flap	0.124 0.065
F	I-Fz	Fillet	0.115 0.042
F	I-Fz	Belly Flap	0.000 0.025
Rnd	SI-Fz	Fillet	0.174 0.139
Rnd	SI-Fz	Belly Flap	0.654 1.015
H&G	SI-Fz	Fillet	0.391 0.232
H&G	SI-Fz	Belly Flap	0.233 0.245
F	SI-Fz	Fillet	0.129 0.149
F	SI-Fz	Belly Flap	0.162 0.900

12. "A New Extraction Method for Determining 2-Thiobarbituric Acid Values of Pork and Beef During Storage", Vernon C. Witte, Gary F. Krause, Milton E. Bailey, Journal of Food Science, Vol. 35, pp. 582-585, 1970.

Absorbance values read in Spectronic 20.

6.07 Experimental Results

C. Cooked Fish Ratings:

(1) Conducted by Laboratory Taste Panel:

The Laboratory Taste Panel was discussed under 6.06 A. C. Evaluations were conducted on samples taken from unfrozen and frozen storage. As previously explained, those samples which had been packed and stored in the round, or headed and gutted, were filleted. The fillets so obtained, as well as those initially filleted and held in storage in this form, were then placed in 3% salt solution for 15 minutes before cooking. This step served to make the groups which had been initially preserved in ice indistinguishable from those which had been preserved in salt-ice.

Graphs appearing on pages 71 to 76 summarize many hedonic evaluations for odor, flavor and texture of stored samples checked at various intervals. The table on page 77 interprets these graphs in terms of number of days for Hedonic Ratings of odor, flavor and texture to decrease to 2.5. Page 57 defines "Good Acceptability" as being in the 2.5 to 4.0 hedonic range. It must be assumed that odor, flavor, and texture are equally important. Consequently, the first one to drop to 2.5 determines the shelf life.

These results are interpreted as follows:

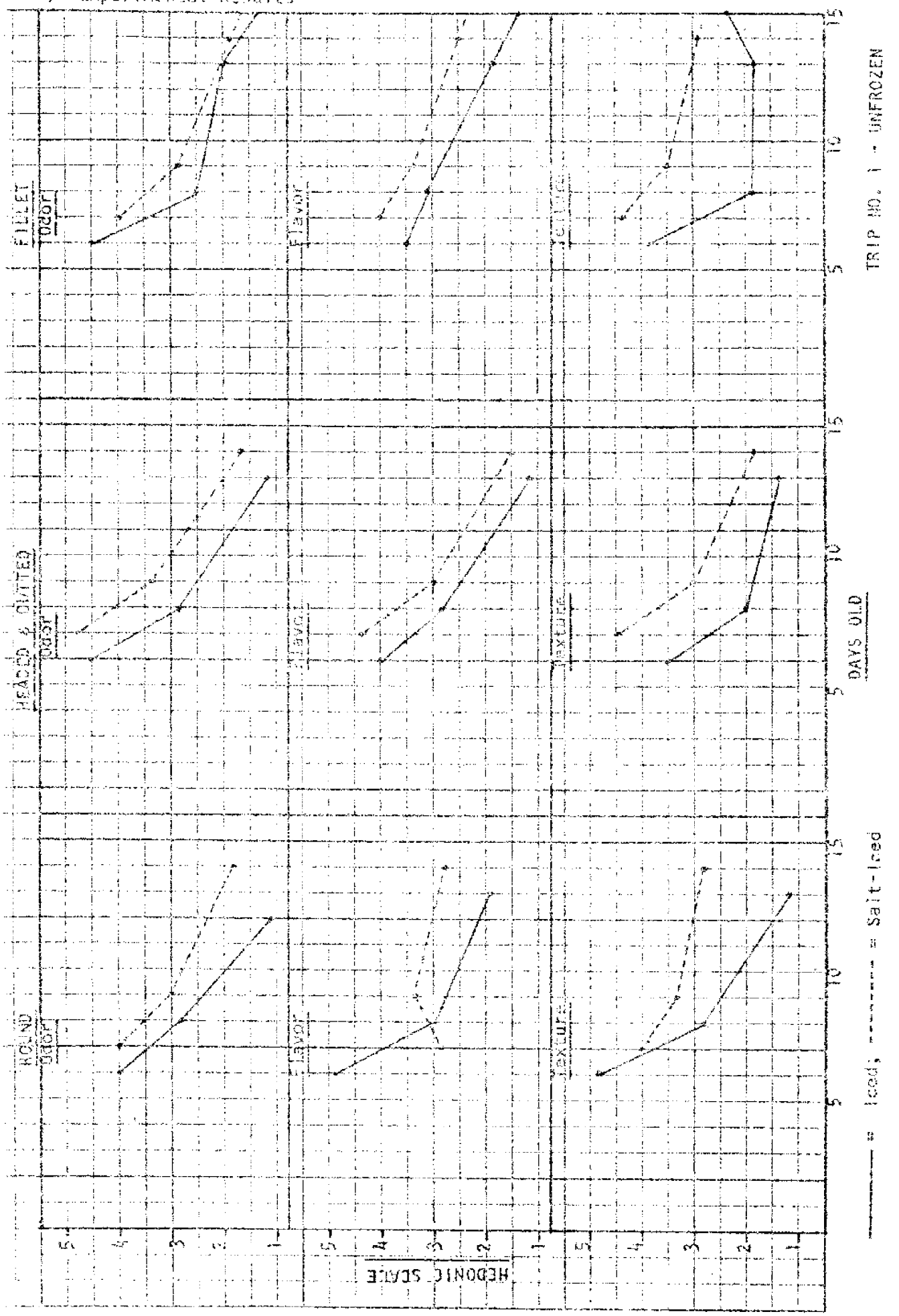
(a) This work was intended to measure the effect of conditions at sea upon storage properties. Observations at sea showed that Trip 1 provided the most favorable handling conditions, while Trip 2 was the least favorable. In general, results of the storage tests were related to what occurred at sea.

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

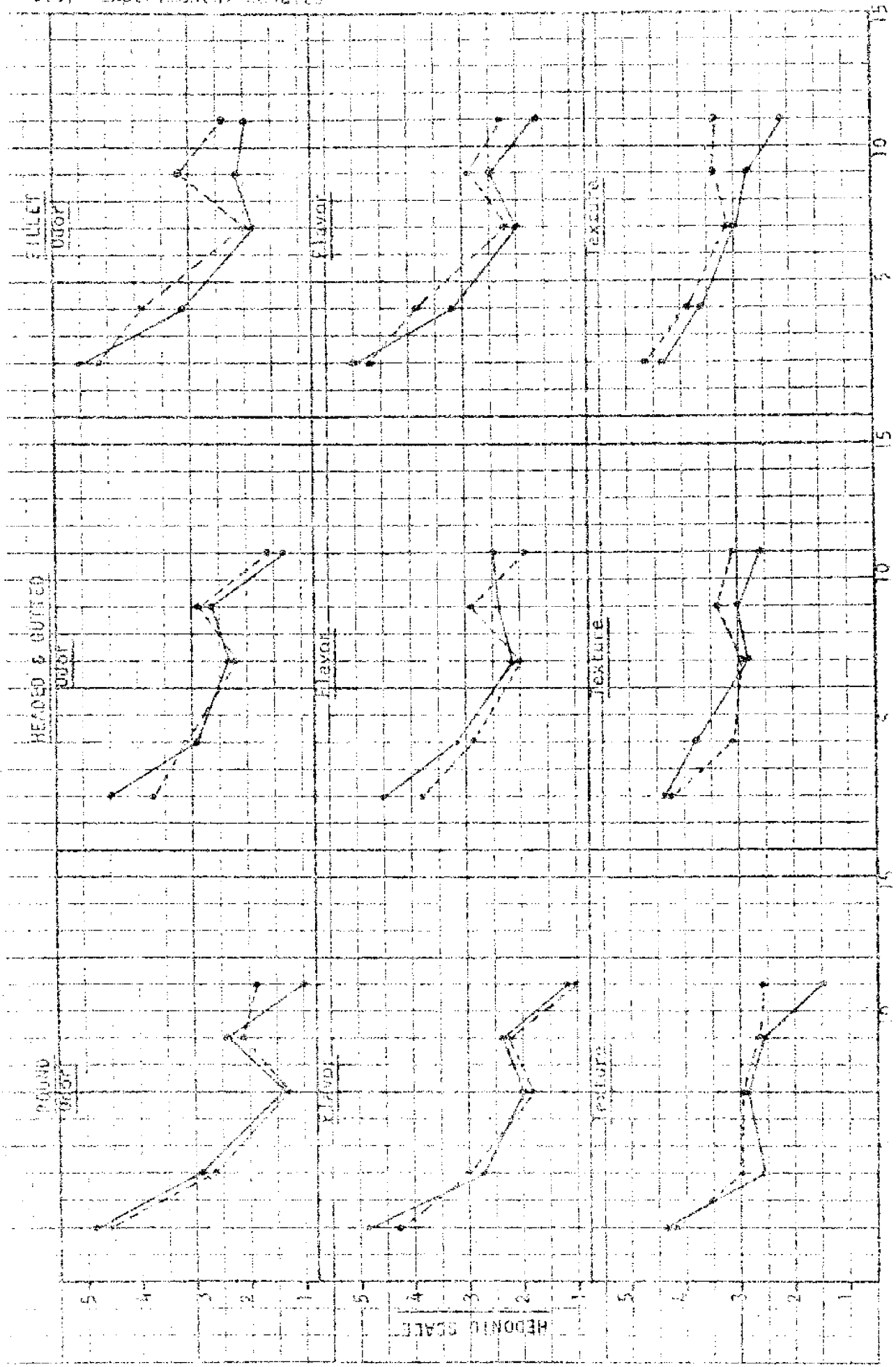
(c) Processed forms, i.e. Round, H&G and Fillet did not show consistent differences in storage life. This indicates that if there is rapid initial chilling and holding, a good shelf life can be expected from any processed form.

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

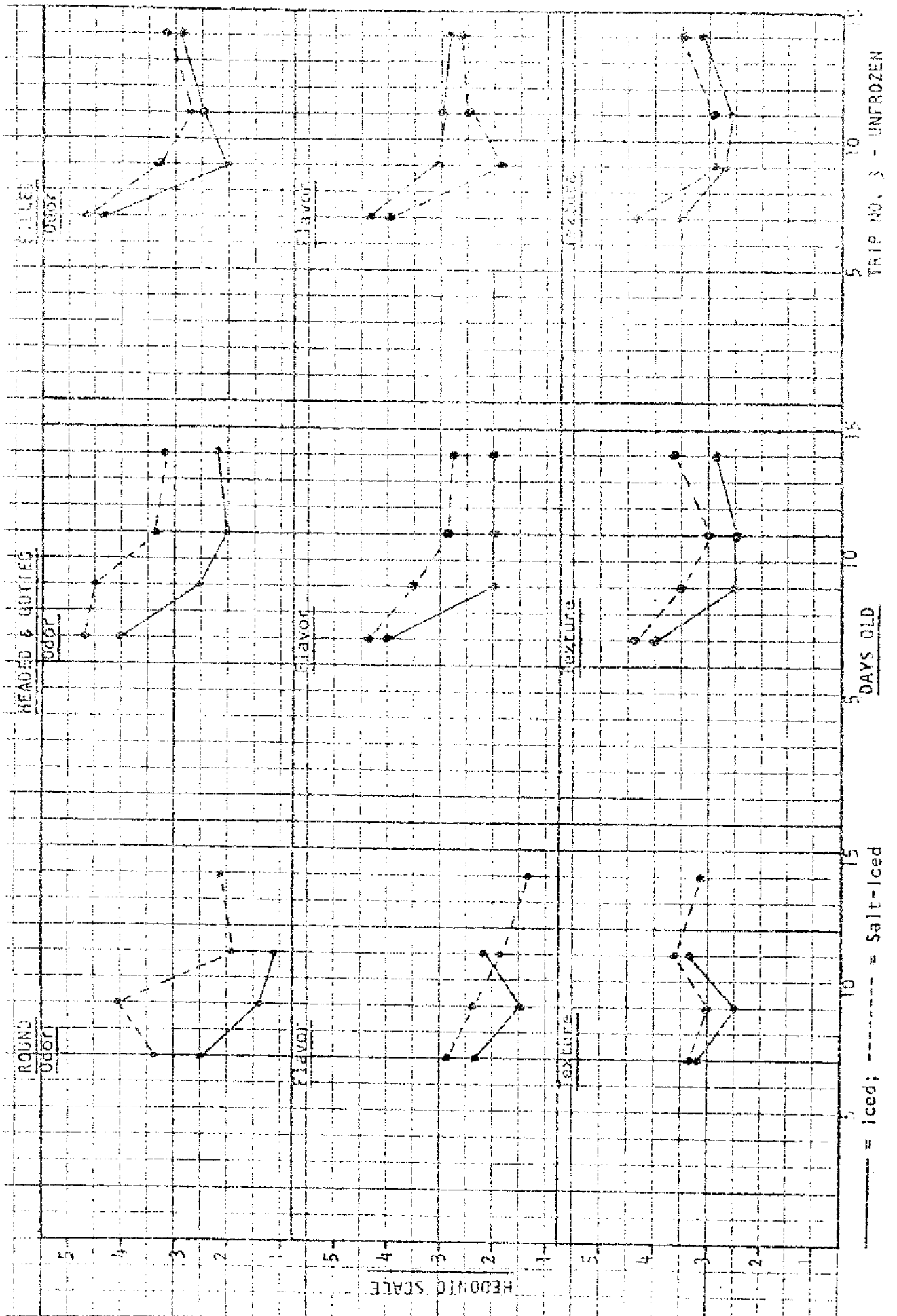
6.07 Experimental Results

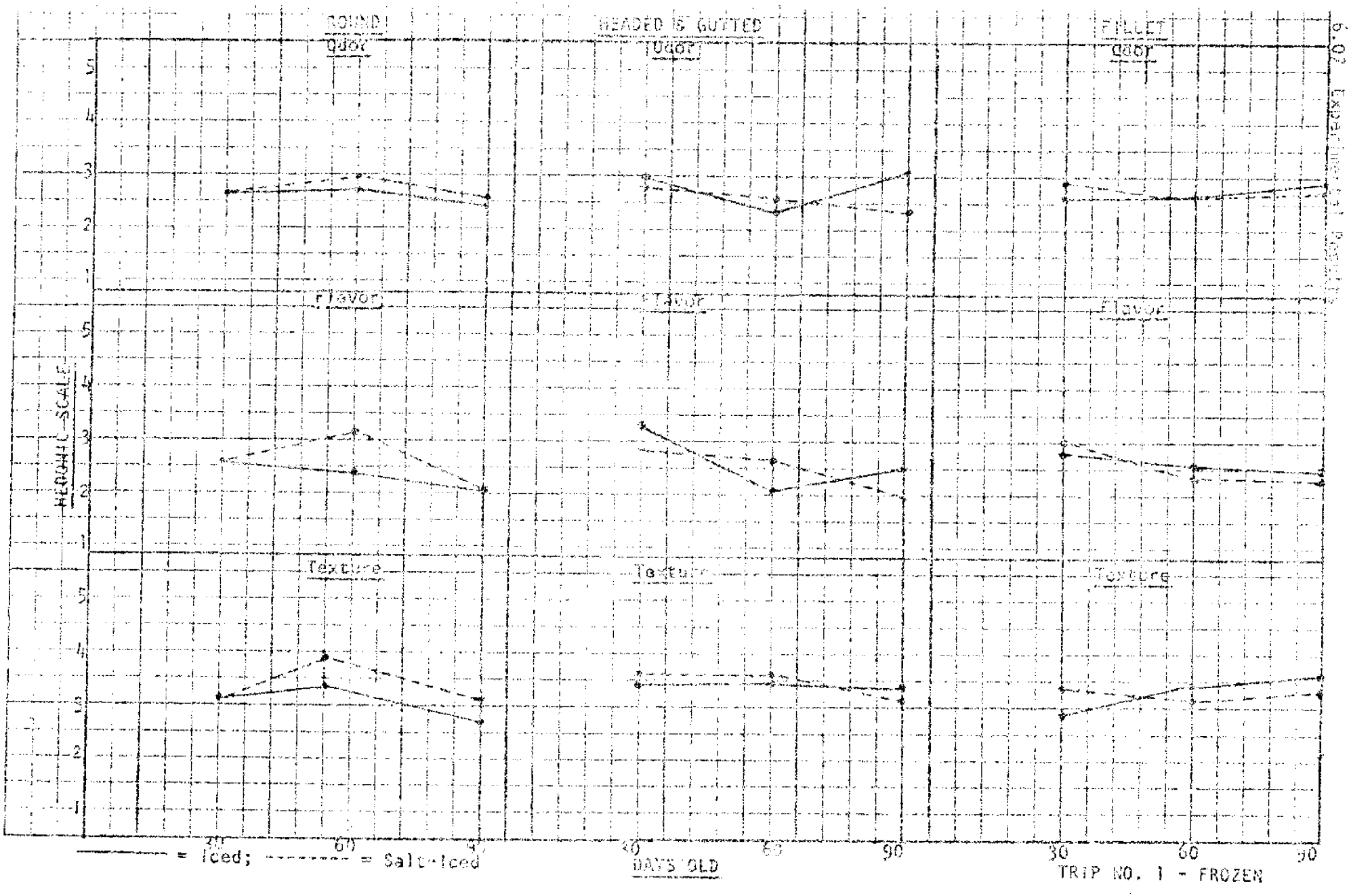


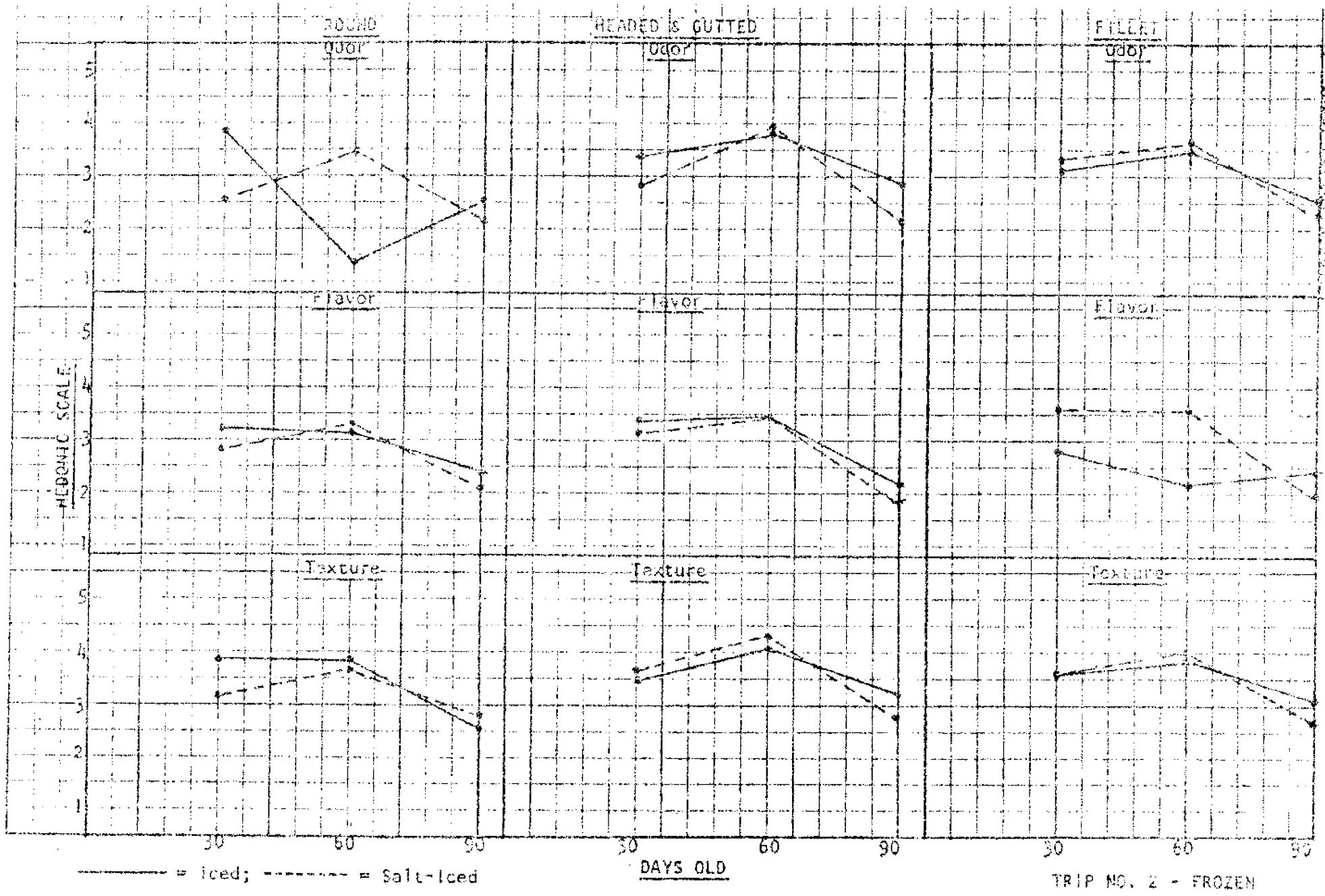
6.07 Experimental Results



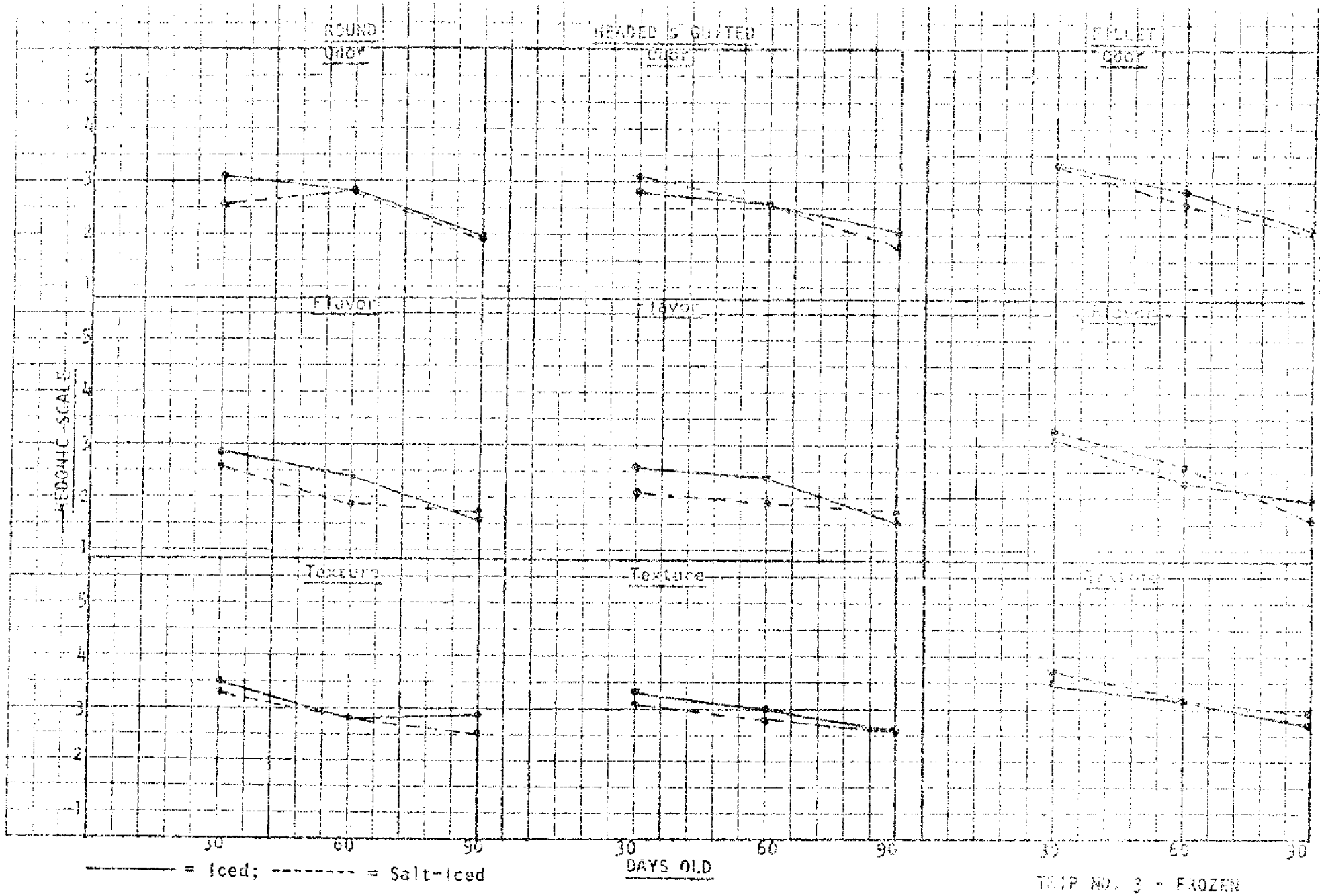
6.07 Experimental Results




ROUND
Odor
HEADED & GUTTED
Odor
FILLET
Odor
Flavor
Flavor
Flavor
Texture
Texture
Texture
HEDONIC SCALE
9
8
7
6
5
4
3
2
1
30
60
90
DAYS OLD
= Iced; = Salt-Iced
TRIP NO. 1 - FROZEN



TRIP NO. 2 - FROZEN


ROUND
DRESSED
HEADED & GUTTED
DRESSED
FILLET
DRESSED
Flavor
Flavor
Flavor
Texture
Texture
Texture
HEDONIC SCALE
30
60
90
30
60
90
30
60
90
DAYS OLD
= Iced; -------- = Salt-Iced
TRIP NO. 3 - FROZEN

STORAGE LIFE - BASED ON DROPPING TO 2.5 HEDONIC RATING

UNFROZEN

SEA HANDLING - ICED

TRIP NO.		DAYS TO H.R. = 2.5		
		ROUND	H&G	FILLET
1	Odor	8.8*	9.0	8.0
	Flavor	10.0	9.0	10.2
	Texture	9.0	7.2*	7.2*
2	Odor	4.8	6.0*	5.5*
	Flavor	5.0	6.0*	5.8
	Texture	4.0*	11.0	9.0
3	Odor	7.0*	9.0	8.5*
	Flavor	7.0*	8.3	15.0+
	Texture	9.0	8.0*	11.0

SEA HANDLING - SALT-ICED

TRIP NO.		DAYS TO H.R. = 2.5		
		ROUND	H&G	FILLET
1	Odor	11.2*	11.4	10.8*
	Flavor	15.0+	10.9*	14.0
	Texture	15.0+	11.0	15.0+
2	Odor	4.2*	6.0	6.3*
	Flavor	5.2	5.2*	6.4
	Texture	11.0	15.0	15.0+
3	Odor	10.3	15.0+*	15.0+
	Flavor	8.4*	15.0+*	8.2*
	Texture	15.0+	15.0+*	15.0+

FROZEN

SEA HANDLING - ICED

TRIP NO.		DAYS TO H.R. = 2.5		
		ROUND	H&G	FILLET
1	Odor	84	50	90+
	Flavor	42*	48*	85*
	Texture	90+	90+	90+
2	Odor	47*	90+	90
	Flavor	85	83*	43*
	Texture	90	90+	90+
3	Odor	75	65	70
	Flavor	55*	34*	53*
	Texture	90+	90+	90+

SEA HANDLING - SALT-ICED

TRIP NO.		DAYS TO H.R. = 2.5		
		ROUND	H&G	FILLET
1	Odor	90	85	60
	Flavor	70*	67*	80*
	Texture	90+	90+	90+
2	Odor	85	87	84
	Flavor	80*	78*	80*
	Texture	90+	90+	90+
3	Odor	73	65	65
	Flavor	35*	<30*	60*
	Texture	90	90+	90+

* For purposes of this study, lowest hedonic rating assigned odor, flavor, or texture determines length of time that sample has "Good Acceptability."

6.07 Experimental Results

(2) Conducted by Consumers:

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

The form and directions shown on pages 63 and 64, were supplied to families with enough fillets for a family meal.

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" being compared with either "c" or "d". Most of the samples were prepared and cooked within 24 hours.

Results appearing on page 79 show that 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 exert much effect on the results.

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

CONSUMER TROUT FILLET RATINGS - STARTED 3/3/75

Hedonic Scale (HS) 5 = Excellent)

Age Range	A9 (34 days old) - thawed (Av. Fillet Wt. = 5 oz.)	B9 (35 days old) - thawed (Av. Fillet Wt. = 5 oz.)	Fresh - Unfrozen (Av. F. Wt.=5 oz.)	Fresh - Unfrozen (F. Wt. = 8 to 12 oz.)
1 - 10	3.9 (8)	3.8 (12)	3.6 (13)	4.6 (7)
11 - 20	4.3 (12)	3.4 (12)	3.6 (21)	3.5 (4)
21 - 30	4.2 (19)	4.2 (13)	4.3 (21)	3.8 (10)
31 - 45	3.5 (22)	3.8 (19)	4.1 (30)	4.1 (12)
56 - Up	4.3 (14)	3.6 (17)	3.7 (27)	4.3 (3)
AVERAGE	4.2 (73)	3.8 (73)	3.9 (112)	4.1 (36)

Source: Seafood Laboratory, Morehead City, N. C.

7.0 PROCESSING FACILITIES:

The North Carolina seafood industry consists of many independent operators, mostly limiting 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, permitting additions for future needs, while minimizing initial investment.

7.01 Products To Be Produced:

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 a porous 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 delivery can be accomplished with greater payload. This method is used effectively in delivering unfrozen poultry to retail outlets.

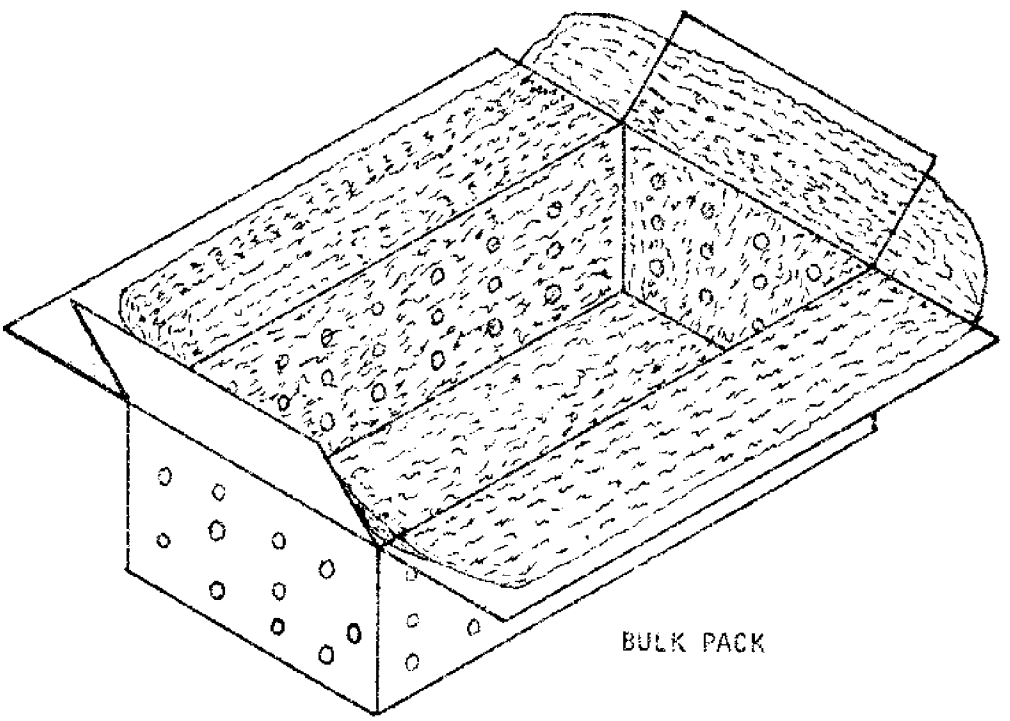
B. IQF Bulk-Packs:

Finfish and shrimp, individually frozen by arranging or spreading on metal trays, covered with waxed paper, or passed through blast freezer by conveyor, are then rapidly dipped in, or sprayed with cold water to make an ice glaze. These IQF products can then be packed in pliofilm bags, 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.

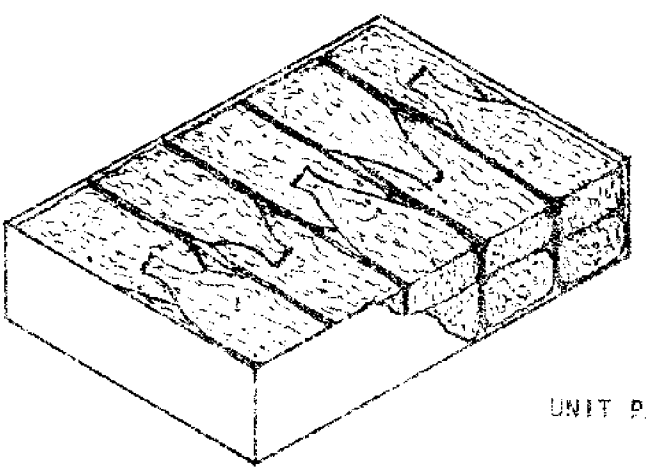
C. Bulk Packs: (shown on page 81)

Typical corrugated cartons involved in this packing method measure 24"x12"x7" for the 25 pound size, 22"x16"x11" for the 50 pound size, and 26"x16"x15" 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 is placed

7.01 Products To Be Produced



BULK PACK



UNIT PACK

7.01 Products To Be Produced

in the bag after which the top is folded and held in position by the closed carton. It is important it use pliofilm of sufficient thickness to reduce moisture loss and entry of oxygen. The success of this method also depends upon how well the bag is folded for complete sealing. Dipping in an adherent glaze before packing should be considered.

D. Unit Packs: (shown on page 81)

A method employed in the Seafood Laboratory involves dipping the product in gelatine glazing solution, draining, then placing on sheets of PVDC film in "sardine" or other convenient arrangement. The film is folded over the product with edges overlapping, held together by its electrostatic properties. The units are then packed in 5 pound (11-1/2"x6-1/4"x2-3/4") or 10 pound (13-1/2"x9-1/4"x2-1/2") 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: (shown on page 83)

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.

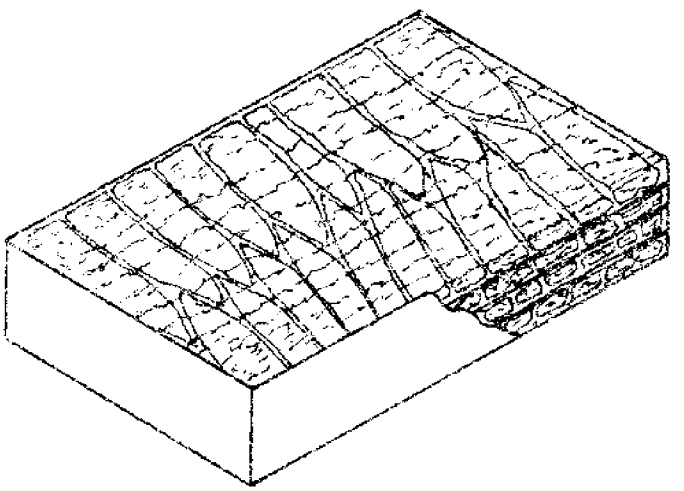
Round, dressed or filleted fish can be packed in these boxes in layers separated by pliofilm, parchment, or waxed paper. The problem is to achieve easy separation. A really satisfactory layer pack would enable easy removal of components, would be less expensive than producing IQF procucts while providing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

F. Blocks: (shown of page 84)

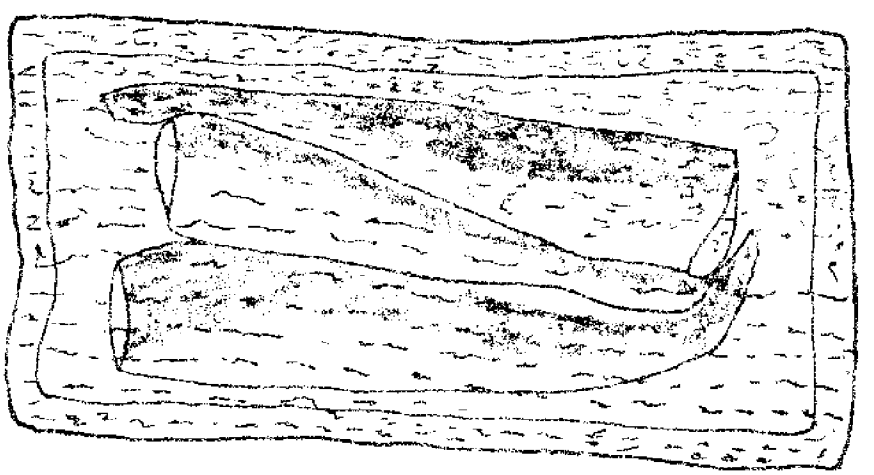
Miller, et al.[13] described the use of wooden frame molds of various sizes in which large sheets of plastic film were placed before filling with round, dressed or filleted finfish. The plastic was then folded over the contents to effectively seal after which pressing into shape and freezing was accomplished by means of a plate freezer. A variety of products were frozen into blocks of less than 2" thickness, were packed in master cartons, were shown

13. Miller, p. 46.

7.01 Products To Be Produced



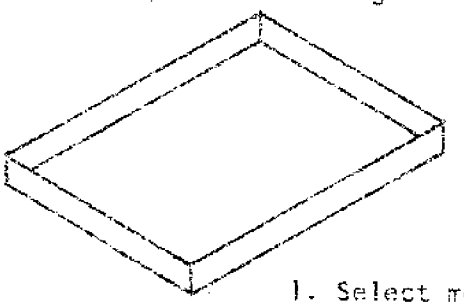
LAYER PACK



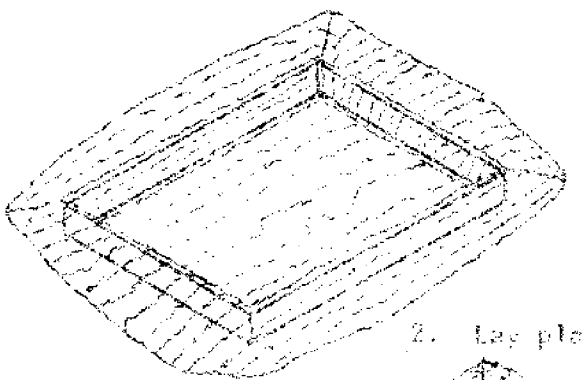
POUCH PACK

7.01 Products To Be Produced

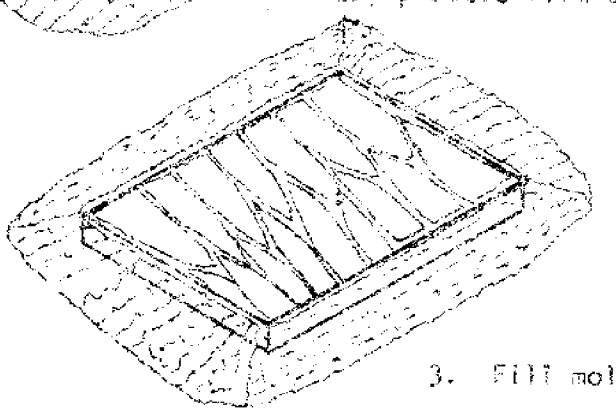
F. Steps in Producing Fish Blocks



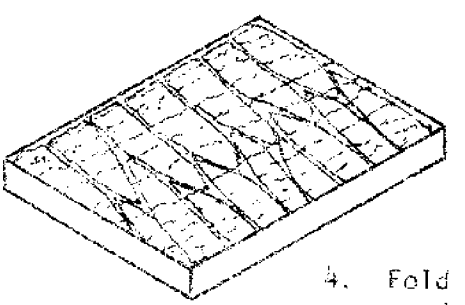
1. Select mold of required size.



2. Lay plastic film over mold.



3. Fill mold with product.



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

7.01 Products To Be Produced

to conserve 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"x12"x1-3/4)over which is laid a large sheet of plastic film. The contents are then arranged and the plastic film folded over the 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. Pouches and Trays:

Pouches provide a packaging method which can be undertaken without much investment, offering a way to attractively display package contents which can be thawed easily by holding the pouch under cold water, and also capable of providing excellent moisture and oxygen barriers for extended storage. This is a good way to pack dressed or filleted fish (see page 83), peeled and deveined shrimp, and other seafoods.

An important advantage that tray packs have over pouches is ease of filling. The tray-film combinations employed by retail outlets in packing red meats are not necessarily suitable for finfish or shellfish, so the recommendations of the supplier must be considered.

Pouch packed products must be laid on flat metal surfaces and contents carefully arranged before freezing. Tray packs with suitable plastic film should also be arranged on level metal trays for freezing, or other customers may require delivery without freezing.

7.02 Plant Components:

Having examined the product forms, then 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 in two seperate buildings or areas. The primary steps can be conducted in many existing handling facilities while the secondary ones require more careful handling, conducted in a better environment.

Raw Material Handling Building or Area: (page 87)

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 steges of processing.

Processing Building or Area: (page 88)

(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:

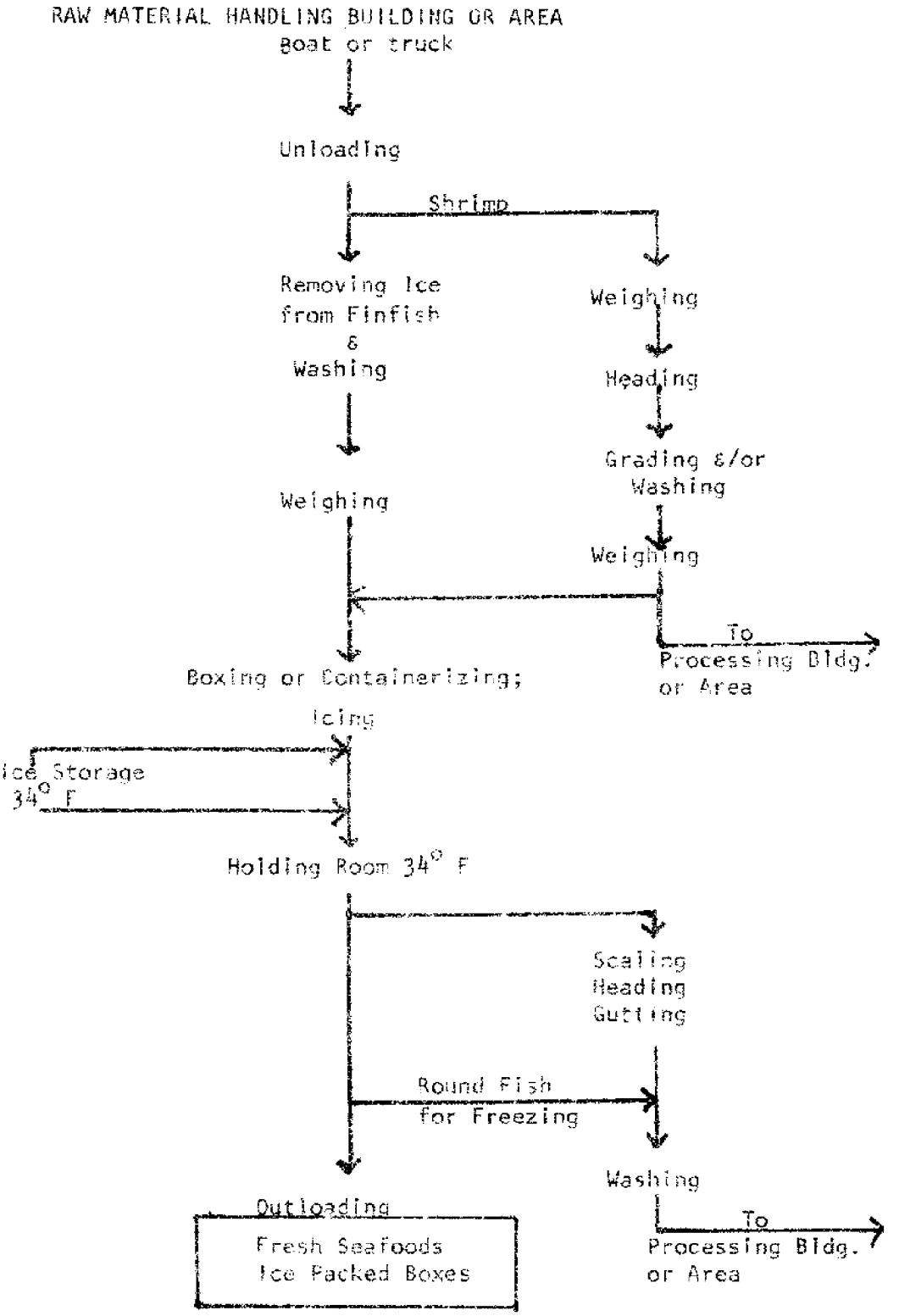
Washing,by passing through water, or by using strong sprays, should be accomplished rapidly to minimize changing moisture content, removing flavors, and leaching out nutrients.

(c) Glazing:

Glazing, employing a one-step dip or spray, is a logical and needed part of preparing the product for packaging.

7.02 Plant Components

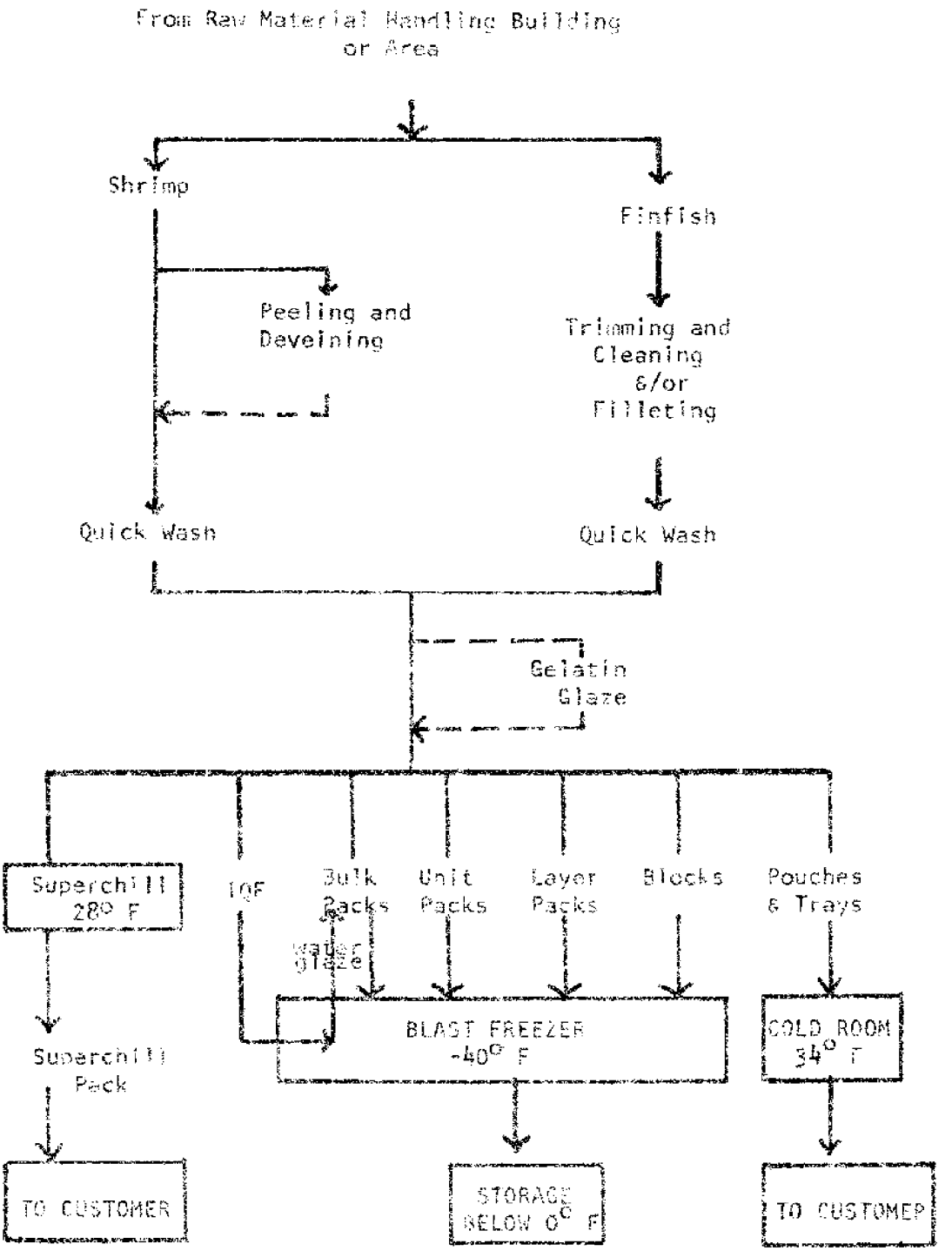
A. Flow Pattern



7.02 Plant Components

A. Flow Pattern

PROCESSING BUILDING OR AREA



7.02 Plant Components

(d) Product Forms:

These are discussed in Section 7.01, and appear in the flow pattern shown on page 88.

(e) Mechanization:

Conveyors and machines can be introduced to improve the efficiency of operations placing reliance on hand labor. However, if previous experience with processing is lacking, the basis for relying upon 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 are discussed in Section 7.01, and appear in the flow pattern shown on page 88.

B. Component Parts:

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

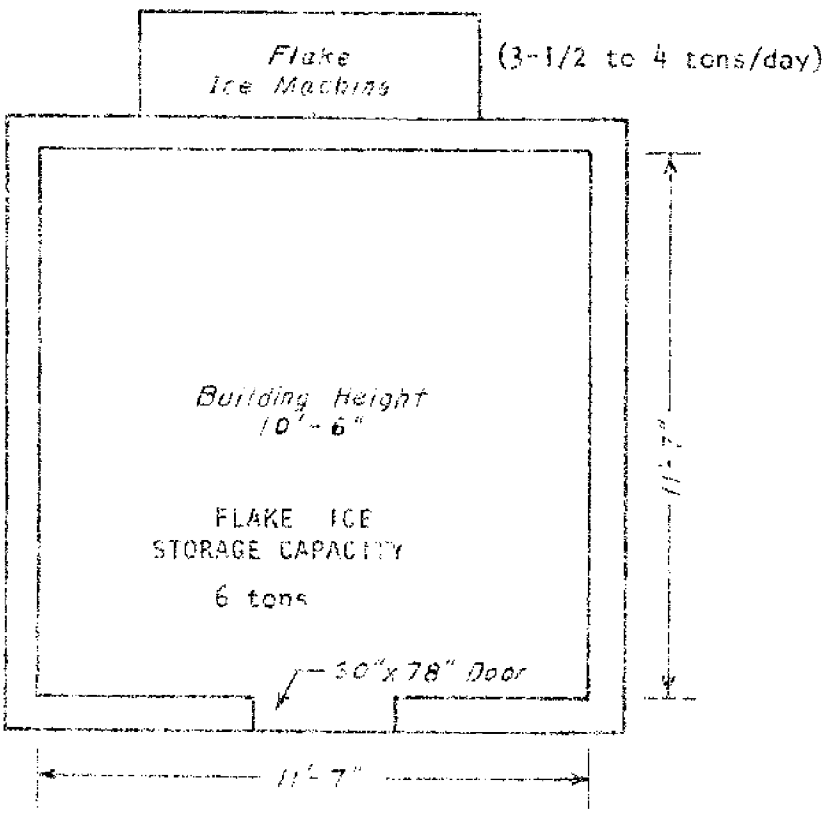
UNIT	SPACE REQD.	CAPACITY	COST
Bandsaw, Heading	3' x 3'	1000 lbs/hr	$ 400
Grader, Shrimp	3' x 12'	650 lbs/hr	350
Packaging, Seal & Shrink	3' x 8'	300 lbs/hr	1,200
Packaging, Table Top Sealer	2' x 2'	120 lbs/hr	75
Packaging, Table Top Wrapper	2' x 3'	200 lbs/hr	120
Refrigeration, Ice Machine and Flake Ice Storage, p.91	11'7"x11'7"x10'6" (1408 cu.ft.)	4 tons/day	14,040
Refrigeration, Cold Storage (28° or 34° F) ,p.92	11'7"x30'9"x10'6" (3739 cu.ft.)	680 boxes (Storage)	11,000
Refrigeration, Blast Freezer (-30° to -40° F), p.93	11'7"x15'5"x10'6" (1875 cu.ft.)	5,000 lbs/ day	24,200

7.02 Plant Components

UNIT	SPACE REQ.	CAPACITY	COST
Refrigeration, Frozen Storage (-5° to 0° F), p.94	21'2"x30'9"x10'6" (6832 cu.ft.)	190,000 lbs (Storage)	32,000
Scaler, Electric, Hand	1' x 1'	300 lbs/hr	285
Scaler, Electric, Simor	3' x 10'	5,000 lbs/hr	10,000
Scale, Platform	3' x 3'	500 lbs max. capacity	450
Scale, Spring	3' x 3'	100 lbs max. capacity	100
Table, Cutting, Stainless, p.95-6	4' x 16'	650 lbs/hr	1,100
Table, Cutting Wood, p.97	4' x 16'	650 lbs/hr	350 (Built Locally)
Table, Packing, Stainless	4' x 8'	650 lbs/hr	600
Table, Packing, Wood	4' x 8'	650 lbs/hr	75
Table, Shrimp Heading, Stainless	4' x 16'	500 lbs/hr	1,200
Table, Shrimp Heading, Wood	4' x 16'	500 lbs/hr	300
Table, Sorting w/ conveyors	5' x 20'	5,000 to 10,000 lbs/hr	+1,000 (used) +5,000 (new)
Tunnel, Glazing, Stainless	3' x 10'	+1,000 lbs/hr	3,500
Tunnel, Washing, Stainless	3' x 8'	+1,000 lbs/hr	2,500
Unloader, Hoisting Bucket	4' x 4'	5,000 lbs/hr	500 (Built locally)
Unloader, I-Beam & Movable Hoist	2' x 5'	5,000 lbs/hr	2,200 (Built locally)
Unloader, Deck Conveyor	2' x 20'	5,000 lbs/hr	300
Unloader, Fish Pump	4' x 8'	8,000 to 10,000 lbs/hr w/8" hose	2,500 (Built locally)

7.02 Plant Components

B. Refrigeration, Ice Machine
Flake Ice Storage

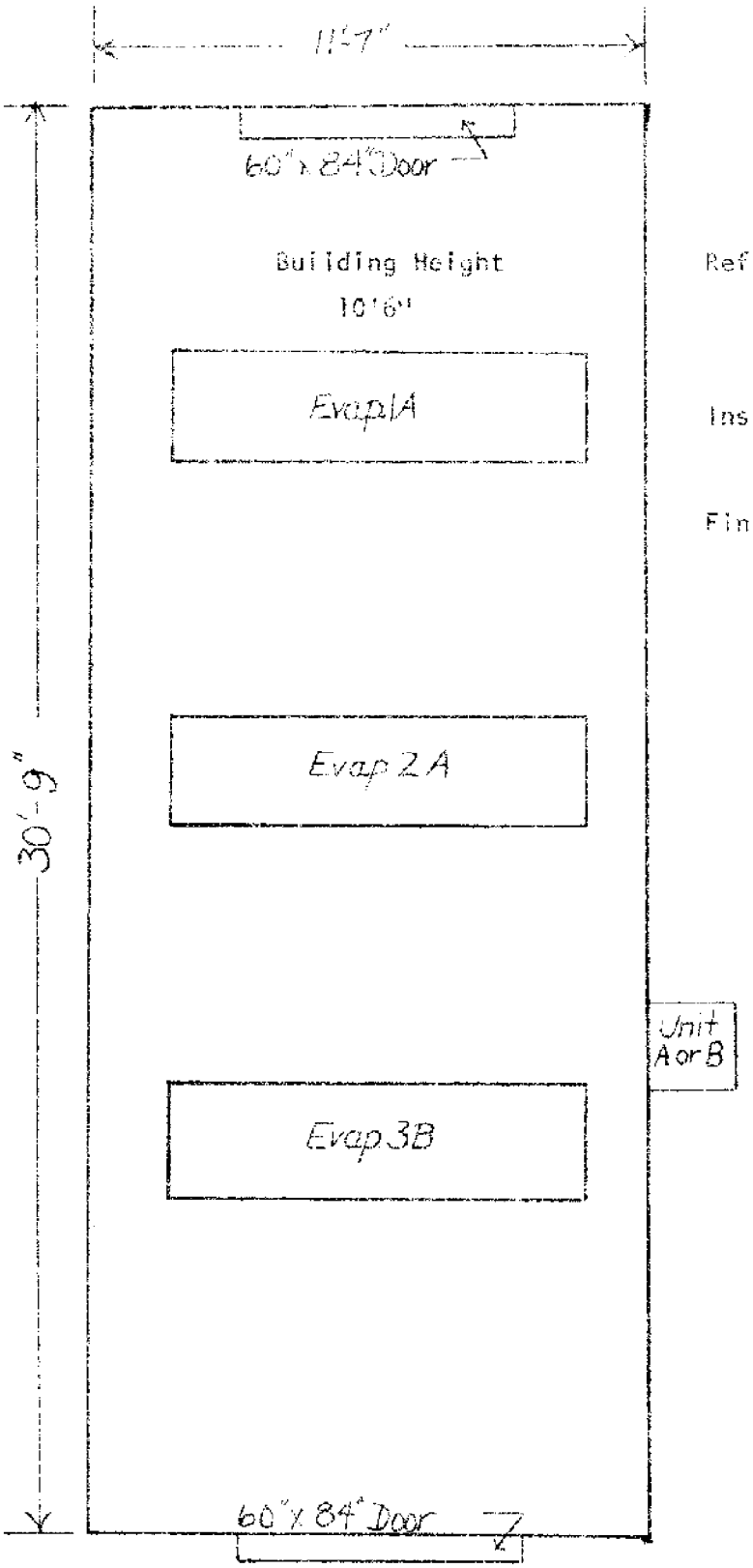


Refrigeration Equipment - 1 - 1 HP Unit
(Maintaining 33° - 35° F) gravity evaporator

Insulation - 4" urethane, "k" - 0.118

Finish - galvanized steel

7.02 Plant Components
B. Cold Storage Room



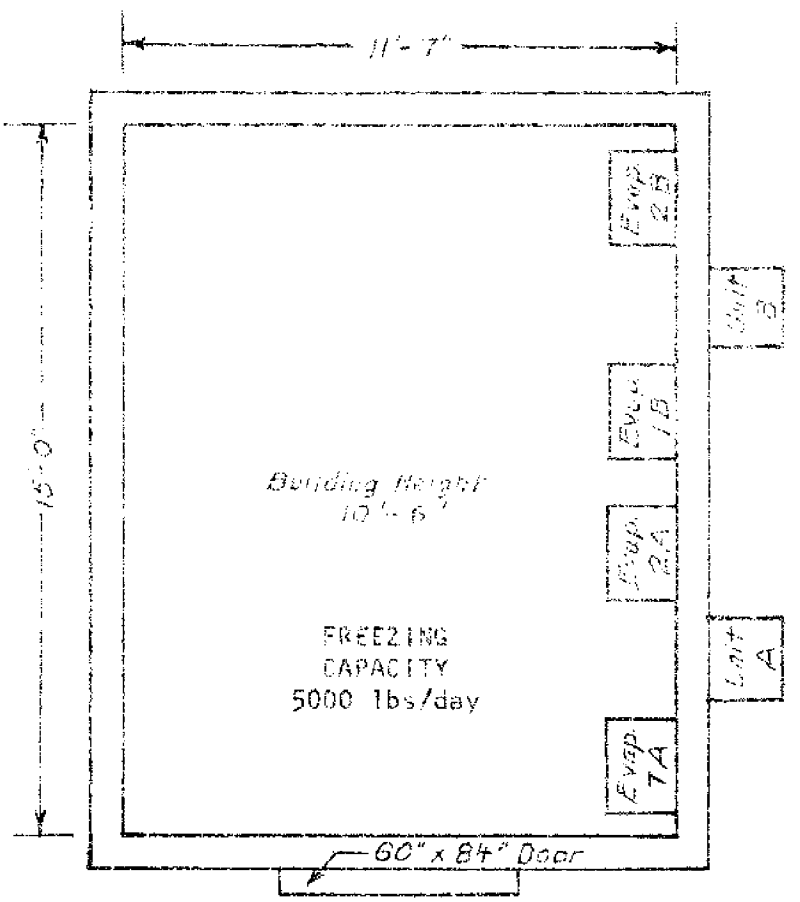
Refrigeration Equipment
A = 3 HP for 32°-35°F
B = 5 HP for 28°-32°F

Insulation - 4" urethane
"K" - 0.118

Finish - galvanized steel

7.02 Plant Components

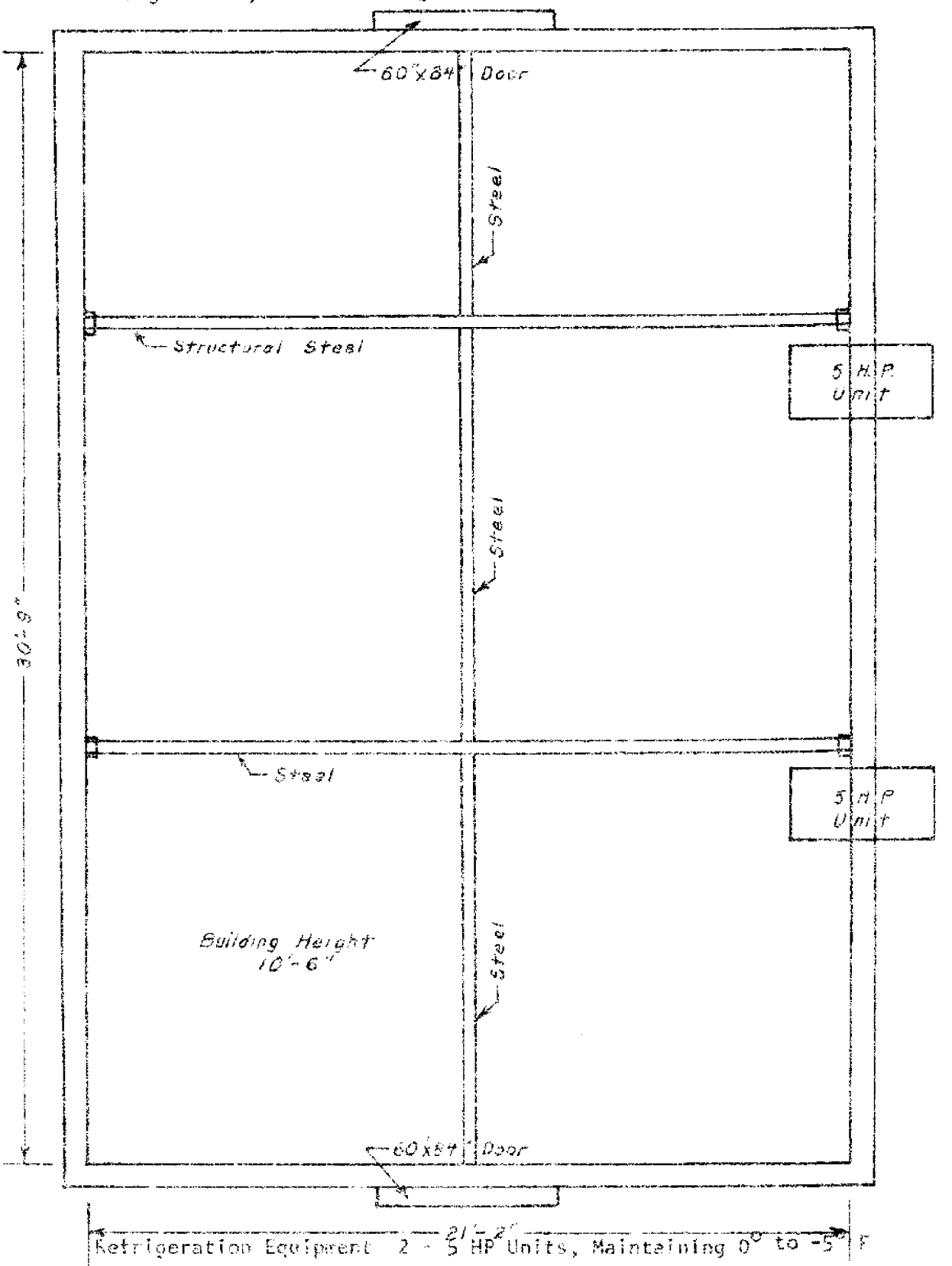
B. Refrigeration - Blast Freezer



Refrigeration Equipment - 2 - 15 T Units
(-30° to -40°F)
Insulation 4" urethane, "K" - 0.118
Finish - galvanized steel

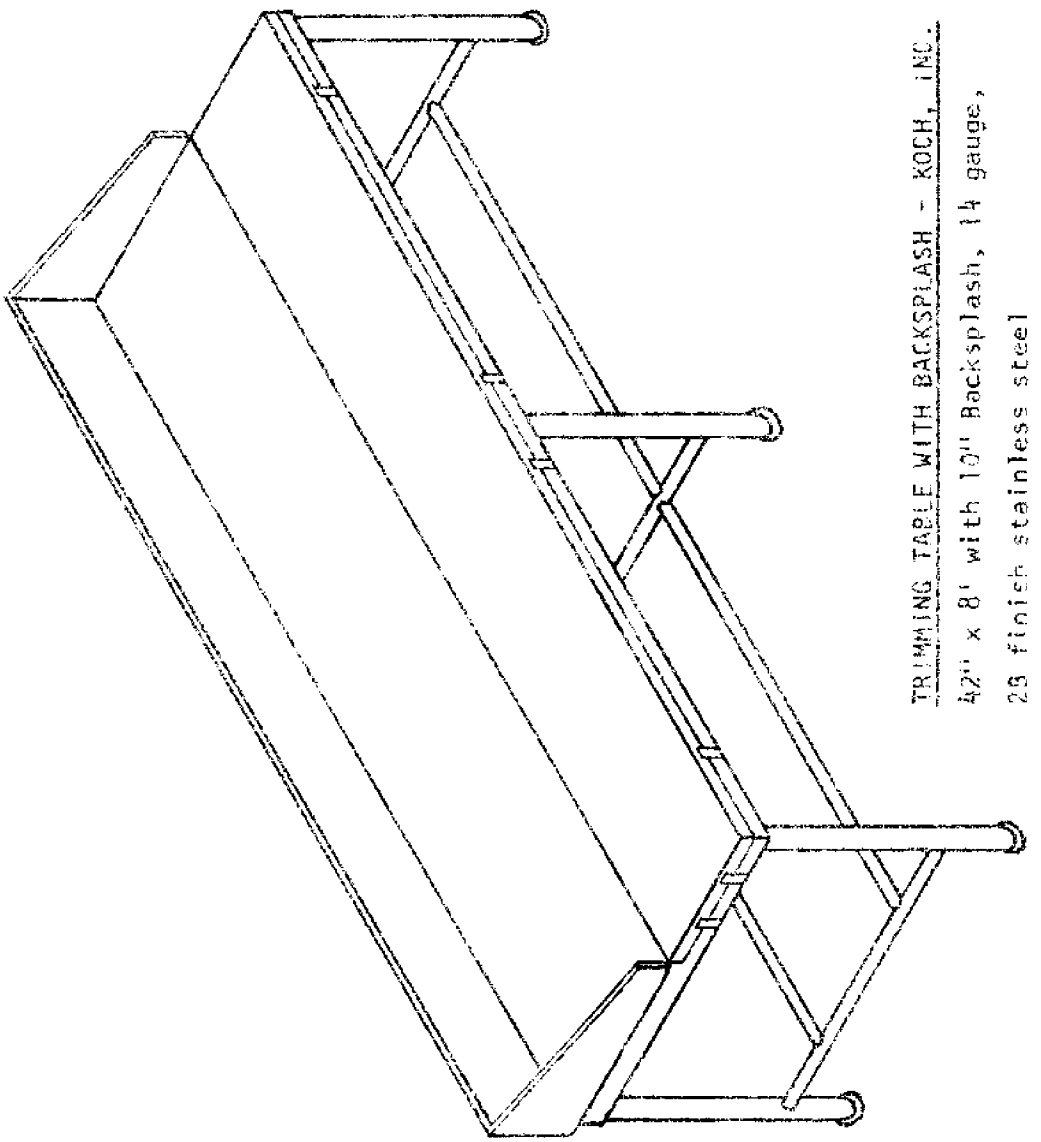
7.02 Plant Components

B. Refrigeration, Frozen Storage



7.0 Processing Facilities

7.02 Components



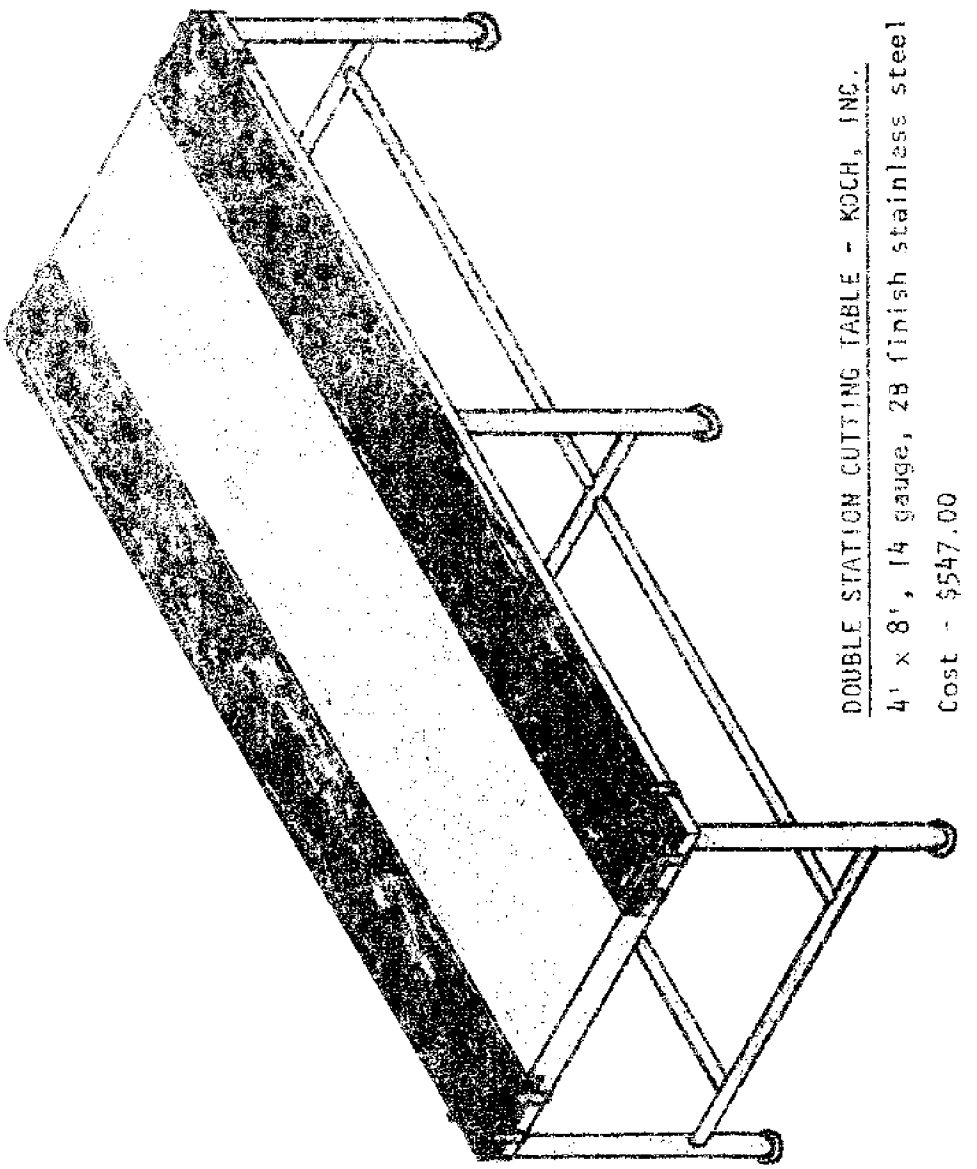
TRIMMING TABLE WITH BACKSPLASH - KOCH, INC.

42" x 8' with 10" Backsplash, 14 gauge, 2B finish stainless steel

Cost - $594.40

7.0 Processing Facilities

7.02 Components



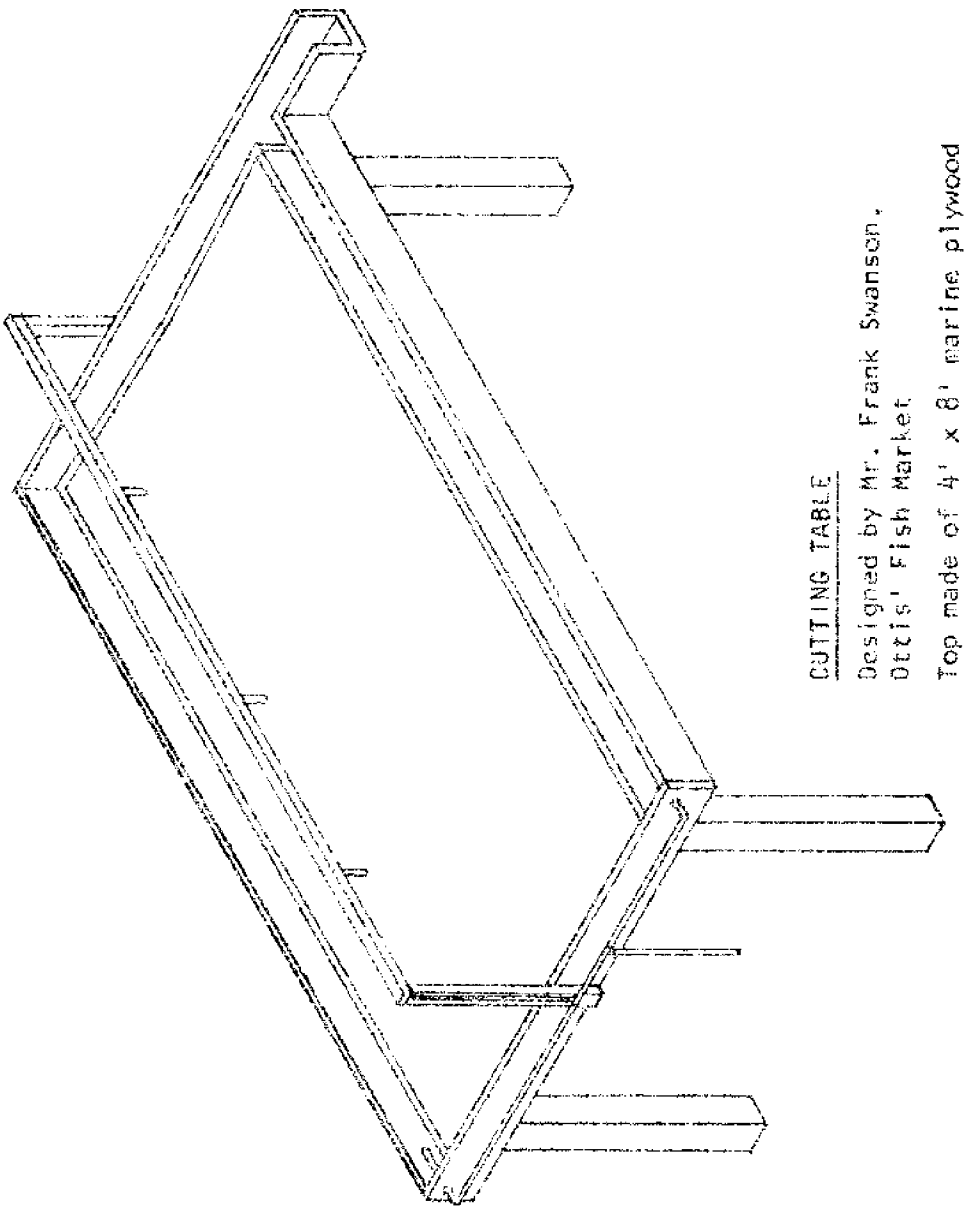
DOUBLE STATION CUTTING TABLE - KOCH, INC.

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

Cost - $547.00

7.0 Processing Facilities

7.02 Components



CUTTING TABLE

Designed by Mr. Frank Swanson,
Ottis' Fish Market

Top made of 4' x 8' marine plywood

Cost incl. labor = $125.00

7.02 Plant Components

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 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:

Manpower requirements for some unit operations include:

(a) Unloading Boats - Hoist and bucket requires 5 men while the I-Beam unloader requires 4. The deck conveyor eliminates one man. The fish pump requires 4 men.
(b) Washing and Removing Ice - Keeping this tank and conveyor combination in operation requires 1 man.
(c) Sorting - People required depends upon size and variety of species, but 10 to 20 people are usually involved in operating a 20' sorting belt.
(d) Weighing - A platform scale can be operated by 1 man, but a spring scale may require 2 men because of additional lifting.
(e) Scaling - A large machine can be operated by one man.
(f) Heading - A bandsaw speeds up subsequent dressing operations. This equipment can be operated by one man.
(g) Packing - Placing dressed fish, fillets and steaks in containers requires about half as many people as required for cutting.

(2) Cutting:

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

7.02 Plant Components

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 102 is an example of a tentative layout which enables arriving at preliminary cost estimates. This building should be able to handle over 1,000,000 pounds per year of finfish, a product mix consisting of finfish, shrimp and other species:

A. Basic Construction Requirements:

BUILDING AND ACCESSORIES	APPROX. COST, 1975 PRICES BLOCK BUILDING	PREFAB BUILDING
Building - Cost per sq. ft. Includes concrete foundation, floor drains, water and sewage lines, walls, roof, and labor	$ 16/sq.ft. $ 28,800	$ 6/sq.ft. $ 10,800
Insulation - (including labor) Polyurethane Foam @40¢/bd.ft. Blown Insulation @20¢/bd.ft.	360	3,360
Air Conditioning - (including labor) "A"coil unit with two sets of overhead ducts. cooling unit - 7-1/2 ton(90,000 BTU)	6,000	6,000
Framing - For walls and partitions		
Top and Bottom Plates (#2 Pine)	27	167
Precut Studs	52	180
Rafters (2"x6" - #2 Pine)		281
Plywood - 3/8" thick (C-D Grade)	506	825
Glue-In-Place Paneling @40¢/sq.ft.	1,900	1,900
7 Doors (36" x 80") @$12.25 each	86	86
Bathroom Fixtures and Sinks	1,500	1,500
Wiring (400 amp - 3 phase panel) Including - motor circuit w/conduit @ 60¢/linear foot Lighting Circuits w/conduit @ 40¢/linear foot	1,500	1,500

7.03 Prototype Plant

BUILDING & ACCESSORIES	APPROX. COST, 1975 PRICES BLOCK BUILDING	PREFAB BUILDING
Paint - Exterior @$8.25/gallon w/150 sq. ft. coverage	$ 200	$
Labor - 1-1/2 times material costs	8,657	9,659
Estimated Cost	$ 49,588	$36,258

B. Special Building Requirements:

(1) Building Site:

Suitable land with good water supply, above flood level, well drained, away from neigrbors who might contribute pollution via air or 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 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" per foot for easy washdown, strategically located drains minimum of 4" 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 water-proof and well-sealed to the walls. One should consider insulating the processing areas.

(5) Doors and Windows:

Doorways through which products move should be minimum of 5' wide; 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.

7.03 Prototype Plant

(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 three phase circuits for optimum economy. Electrical wiring should be overhead, above the ceiling, the three 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 provided with shields of non-shattering material.

(7) Water Supply and Plumbing:

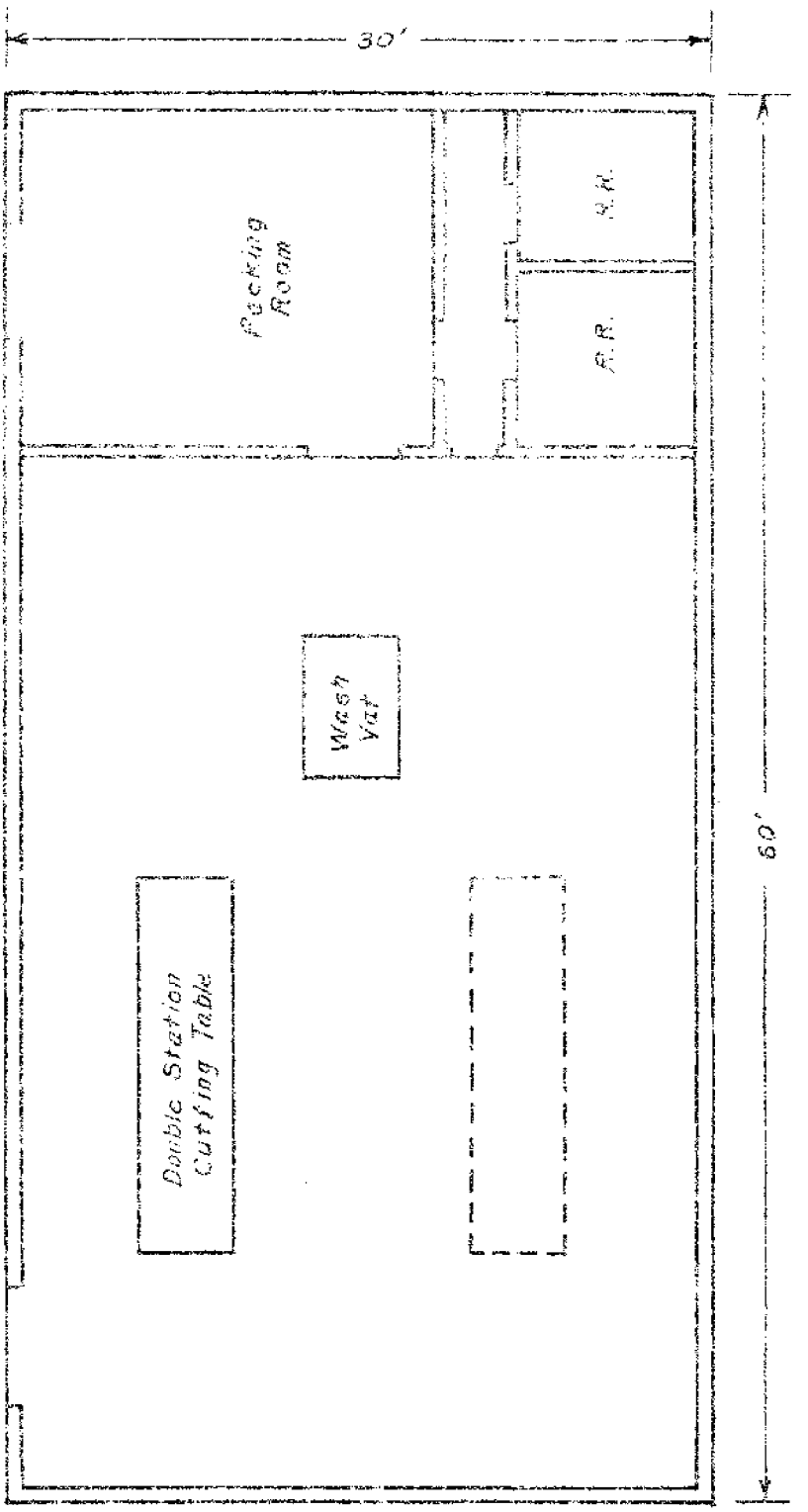
There must be adequate potable water supply, certified by proper authorities. Ample hot water is needed, and there should be sanitary drinking fountains. Discharge of various effluents should be into approved systems with toilet lines separate from processing lines and without cross-connections. There 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.

Special Information Sources:

Refrigeration: Mr. Roger Collins III
Coastal Refrigeration Company
Greenville, North Caroline

Packaging: Mr. Bob Heidenreich
Packaging Products Corporation
Rockland, Maine

7.03 Prototype Plant



SECONDARY PROCESSING BUILDING

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 - though speculative at this point - for future seafood marketing.

The first chart shows the trends in per capita consumption in the U.S. for various seafood product forms. As the top chart illustrates, per capita consumption of fish and shellfish remained quite stable over the period 1960 to 1967, averaging 10.6 pounds per year.[15] Beginning in 1968, a definite upward trend has developed as illustrated by Chart 1. During the period 1968 through 1973, average per capita consumption was 11.7 pounds - an increase over the 1960-1967 period of 1.1 pounds, or 10.4 percent.

The peak per capita consumption in 1972 of 12.6 pounds is probably in part a result of the sharp increase in prices of meats and poultry and the consumer's attempt to substitute lower-priced sources of protein. Higher meat and poultry prices in 1973 resulted in a drop in per capita consumption of all meats (beef, veal, pork, chicken, and turkey) to 226 pounds, a drop of 6 percent from the 1972 level.[16]

Rising demand for edible fishery products has been increasingly met by imported product, perhaps in part as a result of insufficient processing of domestic product, or insufficient domestic supply of processible product. The supply of total edible product accounted for by commercial landings decreased from 57.4 percent of total supplies in 1961, to 38.1 percent in 1973, with imported product making up the difference.[17] Chart 2 shows the breakdown in total supplies available for consumption between imports and domestic commercial landings. A significant percentage of imports is in frozen form. Little variation has occurred in domestic landings of edible fishery products.

With relatively stable commercial landings of edible fishery products, rising imports might be thought of (in general)

"Commercial Fishing: An Overview", presented at the Commercial Fishing Seminar held April 24, 1975 at the East Carolina University Regional Development Institute, by Dr. J. E. Easley, Jr.

"Fisheries of the United States, 1973", Current Fisheries Statistics No. 6500, 1974, p. 76, National Marine Fisheries Service.

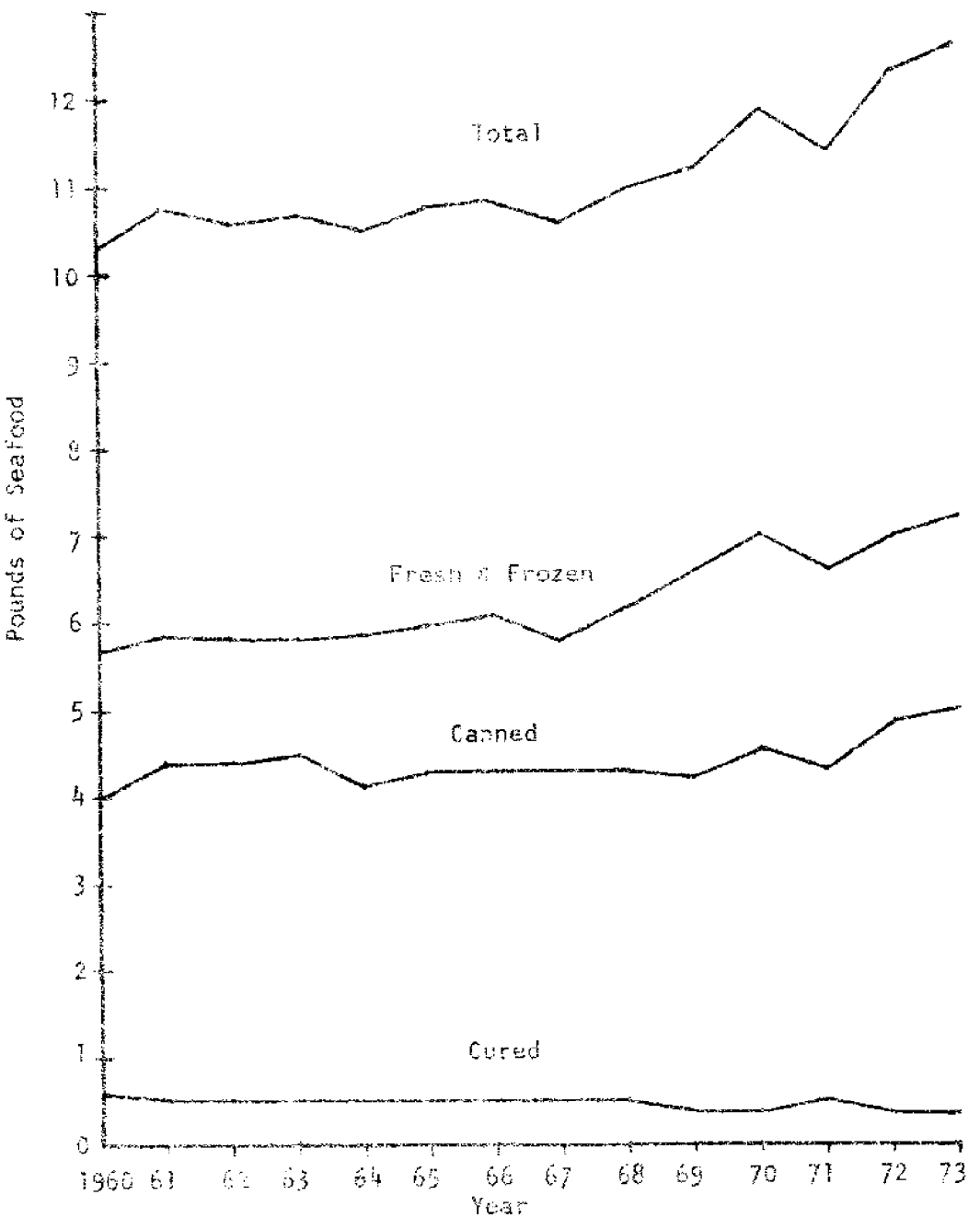
"Shifts in Food Consumption", Charles Brooks, Extension Economics Outlook Information, N. C. State University, October 15, 1975.

National Marine Fisheries Service, p. 55.

7.04 Processing Feasibility

CHART 1

U.S. Per Capita Consumption of
Commercial Fish & Shellfish
1960-1973

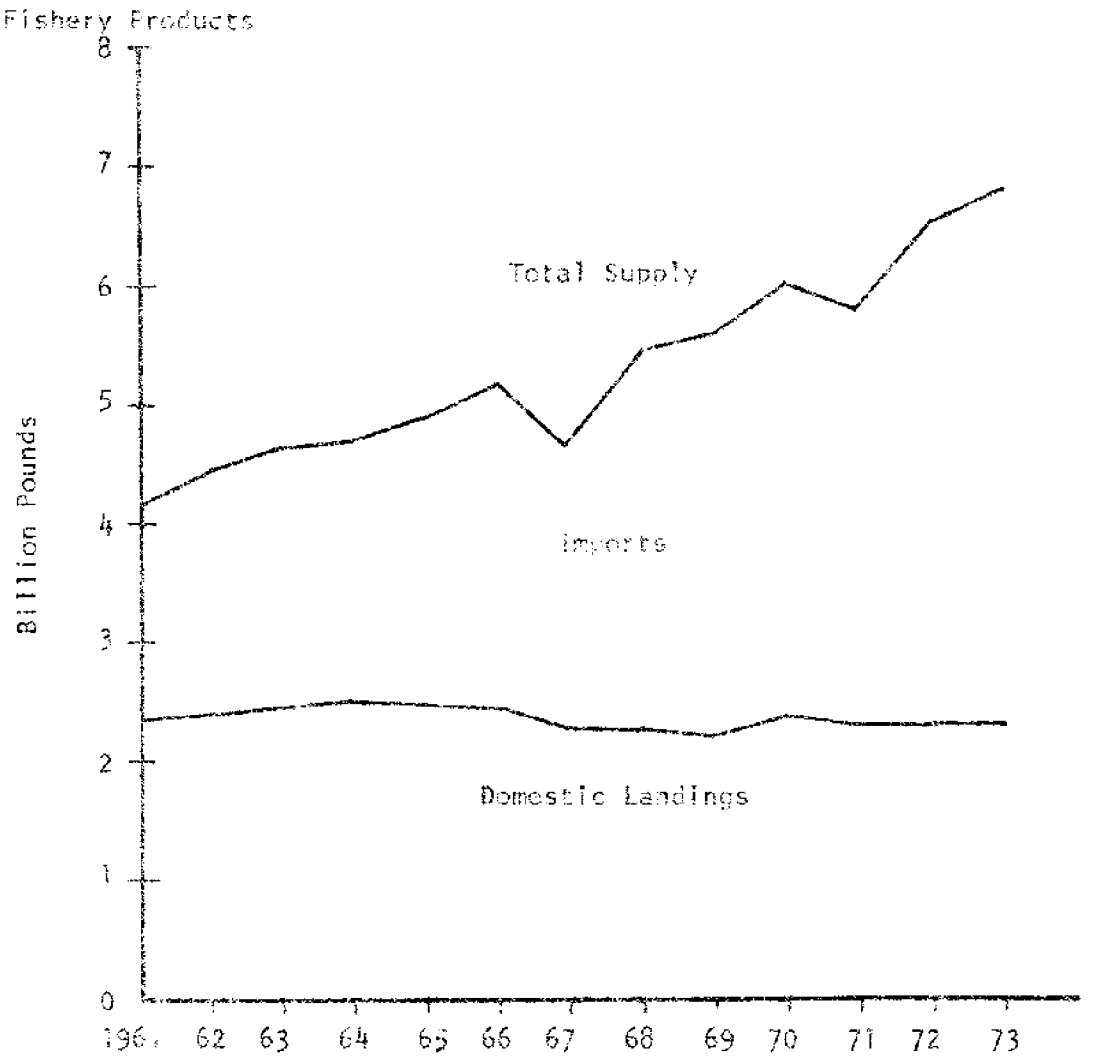


7.04 Processing Feasibility

CHART 2

Supply of Edible Commercial Fishery Products, 1961-73

(Round weight)



7.04 Processing Feasibility

as one result of increasing demand for fishery product. Another factor which could become increasingly important, given recent consumer concern with health foods, is the low fat content of fish - together with the characteristic of polyunsaturated fats. Table 1 contains a cost comparison of 20 grams of several protein sources. (Twenty grams represents one-third of the daily amount recommended for a 20 year-old man.) Note than the two fishery products are both in the medium price range. As consumers become more educated over time as to the food values of different items, these figures suggest that fish may fare better in the market, at least with respect to the cost of protein.

Table 1. Cost of 20 Grams of Protein from Selected Meats and Meat Alternatives

Food item	Cost of 20 Grams of Protein (dollars)
Dry beans	.09
Peanut butter	.14
Turkey, whole	.18
Chicken, whole	.21
Ocean trout, dressed	.21
Hamburger	.24
Tuna fish, canned	.25
Cheese, cheddar	.27
Pork sausage	.35
Rib roast of beef	.51
Bacon, sliced	.68

Source: "Minimizing Cost of Protein Foods," John Ikerd and Charles Brooks, Extension Economics Outlook Information, N. C. State University, October 15, 1974.

In general, however, 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 these other protein sources, especially in less active inland markets. This point is conjecture as 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.

While there may be "shake-out" periods in the fishery such as those occurring in summer, 1974, with shrimp, future fish consumption should continue to increase, though perhaps slowly. An important factor in the industry's growth will be the effect of rising costs, particularly fuel, on the fisherman, and from the demand side, the effects of rising fuel prices on the tourist traffic. If tourist traffic is significantly reduced in the future, then the industry may have to explore expanded inland marketing with less reliance on the traditional local markets. Such shifts in marketing could also dictate alterations in product forms. While these ideas are purely speculative at this point, they might be worth watching as well as researching in the future.

Turning to the North Carolina fishery, the industry accounted for employment of 2,290 full-time and 1,615 part-time commercial fishermen in 1973.[18] Receipts of these fishermen in 1973 were just under 16 million dollars for almost 130.5 million pounds landed. Of these receipts, shrimp were the single most valuable specie with a value of 4.7 million dollars.[19] Preliminary 1974 figures of the National Marine Fisheries Service indicate landings of 196 million pounds, valued at approximately 17.4 million dollars.

Chart 3 illustrates landings poundage and value for North Carolina from 1960 to 1974. (see page 108). The overall decline in quantity landed during this period for the most part is accounted for by the declining menhaden catch, which has suffered from overfishing and deterioration of nursery areas.[20] Though Chart 3 does not show it, the quantity landed of several finfish species suitable for processing has increased in recent years.[21] Among these species are flounder, croaker, and grey trout.

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18. National Marine Fisheries Service, p. 82.

19. "North Carolina Fisheries Data", J. E. Easley, Jr. and Beth Sossamon, N. C. Agricultural Extension Service, Miscellaneous Extension Publication 128, November, 1974, p. 4.

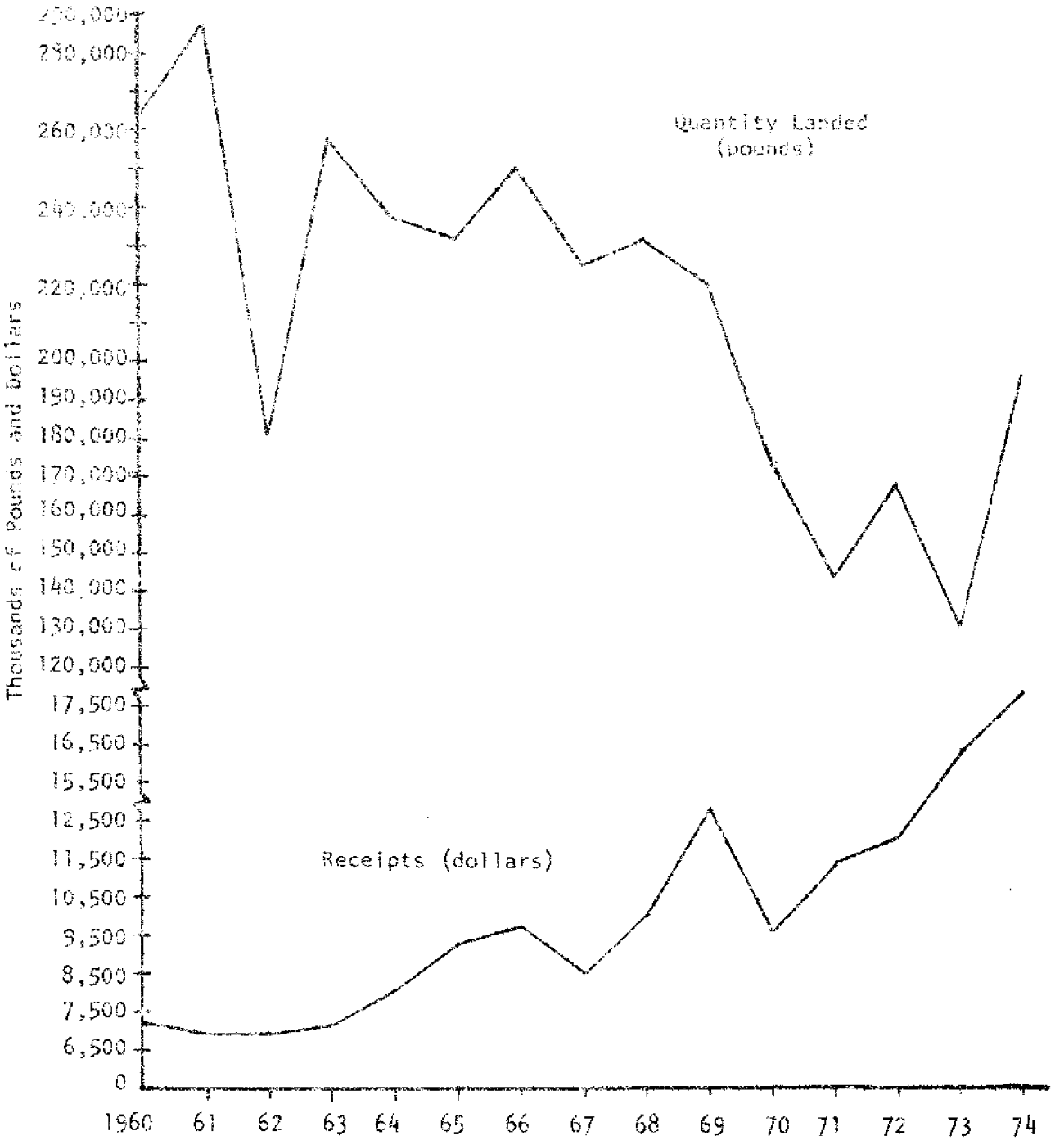
20. "History and Status of North Carolina's Marine Fisheries", Walter F. Godwin, et al., Division of Commercial and Sports Fisheries, Information Series Number 2, July 1971, p. 12.

21. Easley and Sossamon, pp. 12-13.

7.04 Processing Feasibility

CHART 3

North Carolina Landings
1960-1974



7.04 Processing Feasibility

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 been addressing recently 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? This is a question which we are currently pursuing. More pressing business management problems for those in industry who are considering a processing line or facility probably revolve around the question of, "Will it pay?" The following discussion lays out some of the issues dealing with this question that should be incorporated into decisionmaking.

The figures that follow are tentative and may be outdated, hence the cost of a particular item or the absolute amount of dollar returns, etc., 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 17 percent? What if it were 3 percent? Would your banker view these differently? Some of the problems in projecting costs and revenues are highlighted within the context of a technique for computing these costs and returns.

As an example, figure a hypothetical plant that is capable of processing anywhere from 750,000 to 1,000,000 pounds of fish per year, depending upon 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 off-season here might be necessary. A third is to simply purchase the fish here 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.

7.04 Processing Feasibility

In order to illustrate how some of the findings generated in this project can be used in simulating a plant's costs and revenue, we will briefly outline how and where these enter the computations. Let's 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 (H&G)

*Project findings suggest this yield should be 55 percent.

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. One result of the project has been an improvement in our knowledge of what these are, at least for trout.

In the table of net revenue figures, the output mix is assumed to consist of 70 percent frozen and 30 percent fresh. These can be set in any proportion for generating net revenue.

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; however, the project findings again suggest that an update is needed.

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

	Fillet	H & G
Flounder	250	-
Trout*	440	-
Croaker	-	800

*Project findings suggest this figure should be approximately 600 pounds per day.

7.04 Processing Feasibility

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 upon net revenue.

How these are used in projecting net revenue for a hypothetical plant is as follows: First, using output mix percentages and some 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) (Input Prices) =

Input Raw Material Cost,

gives us the cost for each specie. Sum 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). The project report lists many examples of these. Plant components are listed in modular form to allow for different systems, etc. From this listing a depreciation schedule can be set up on plant and equipment components. These can be totaled for a yearly depreciation charge. However, don't forget to include property taxes, insurance, and expected maintenance charges as part of the annual cost. Economists also include

7.04 Processing Feasibility

an additional 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, it is difficult to project prices paid for raw material, hence these can be varied in the projections. To illustrate some of these effects, the following table contains net revenue computed for different input prices and different days of operation. One could vary other figures (such as interest rates, etc.) to get some idea of the sensitivity of net revenue to that item.

Though the figures contained in the table need to be reworked, some idea is gained of how sensitive net revenue is to factors such as days of operation and input prices. Note that both revenue and costs fall as operating days are reduced, but revenue falls faster. This results from the fixed yearly costs (in a sense) being spread over a smaller quantity of product.

To ascertain the effect of varying the days of operation, observe net revenue for a given price set across days of operation. For example, net revenue under price set I for 200 days is $99,635; under the same price set for 160 days, net revenue drops to $71,927 - a 28 percent drop in revenue for a 40-day decline in operating period.

Net revenue is highly responsive to changes in raw material prices. For a given number of days operation, note the drop in net revenue when moving to the higher input prices making up price set II. The price changes embodied in price set II are $.05 per pound higher for flounder, and $.03 per pound higher for trout and croaker. These appear to be small price changes, yet look at the effects.

SUMMARY OF NET REVENUE COMPUTATIONS

	Days of Operation					
	200		180		160	
	Price Set I	Price Set II	Price Set I	Price Set II	Price Set I	Price Set II
Lbs. Output[1]	974,400	974,400	876,960	876,960	779,520	779,520
Oper. Cost/lb (cents)[2]	18.86	18.91	18.86	18.91	18.86	18.91
Annual Cost/lb. (cents)[3]	3.95	3.95	4.39	4.39	4.94	4.94
Annual + Operating Cost/lb. (cents)	22.81	22.86	23.25	23.30	23.80	23.85
Total Revenue ($)	891,696	891,696	802,526	802,526	713,357	713,357
Less: Op + An. Costs[4]	(222,261)	(222,744)	(203,893)	(204,332)	(185,526)	(185,916)
Equals	669,435	668,952	598,633	598,194	527,831	527,441
Less: Raw Material Costs[5]	(569,800)	(643,400)	(512,892)	(579,060)	(455,904)	(514,720)
Equals Net Revenue	99,635	25,548	85,741	19,134	71,927	12,721

* Exclude land cost, income taxes, charges for waste treatment, and potential income from the sale of scrap material.

[1] Lbs. output = daily output rate multiplied by number of operating days.

[2] Operating cost per lb. from preceding table.

[3] Annual cost per lb. = annual cost divided by annual lbs. output - annual cost = $38,496.

[4] Operating + annual costs = annual + operating costs per lbs. in dollars multiplied by lbs. output. Eg. 222,261 = .2281 x 974,400.

[5] Raw material costs = daily raw material cost estimates - shown in section covering Assumption, number 6 - multiplied by number of days of operation.

7.04 Processing Feasibility

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. One aim of this project has been to improve our knowledge of some of the figures necessary for the computations.

8.0 MARKETING:

Frey[22] lists two basic concepts of marketing as follows:

"Marketing is an organized system of business activities that makes possible the flow of goods through productive stages to ultimate consumption"

and

"Marketing strives to match production and consumption by representing the producer to the consumer, and the consumer to the producer".

These concepts make it apparent that much more than buying and selling is involved in marketing. An important factor determining price and consumer acceptance is "quality", the measuring and preservation of which requires technology. Similarly, correct flow of goods through manufacturing, storage and subsequent handling falls within the purview of the present study.

In representing the producer to the consumer, and vice versa, there must be judgements of product acceptability. Such judgements can be helped by awareness of organoleptic changes occurring in seafoods between time of catch and final consumption. The findings of taste panels then provide answers as to why some products meet strong resistance while others are highly acceptable. Other questions which should be considered by the researcher and which bear on marketing include the following:

A. Can quality be overlooked?

B. Is supply dependable?

C. Is "frozen" as good as fresh?

D. Will Federal inspection help?

E. What is the selling problem?

F. What are consumer preferences?

G. Do product forms influence acceptability?

H. Will health benefits sell seafoods?

I. Can economies be exploited?

J. Is enjoyment being overlooked?

K. Can nostalgia help build markets?

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22. "Marketing Handbook", Albert Wesley Frey, editor, The Ronald Press Co., New York, 1965, Section 1-2.

8.01 Implications:

A. Quality:

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

B. Supply:

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

C. "Frozen":

Evidence reported in this publication supports observations 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:

Voluntary Federal inspection seems a long range rather than immediate possibility for most companies. Plants must first achieve complete compliance with the recommended processing guidelines. 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

8.01 Implications

his personal bias to cloud his judgement. The reactions of retailers and consumers to specific species, to selling fresh or frozen product forms, is documented in detail by Sanchez and Konopa[23] and Konopa[24]. Selling requires expertise and knowledge of geographic differences in product acceptability.

G. Forms:

This publication, in reporting storage characteristics of whole, headed and gutted, and filleted grey trout, produced evidence that it is feasible to freeze in the round. Alternate methods of packaging were shown to held promise of meeting specific requirements of customers. If consideration is given to such approaches there should be increased customer interest in local products, designed to meet their needs.

H. Health:

National Marine Fisheries Service has provided much of the basic information supporting the use of seafoods in maintaining health, 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 many seafoods offer tremendous savings which should be explained in promoting seafoods. (See Tables on pages 107, 108)

J. Enjoyment:

There is no doubt that North Carolinians like seafoods served in most restaurants, but variety in preparing seafoods is usually lacking. The institutional sales can increase if more variety is introduced, based on employing underutilized species.

K. Nostalgia:

The North Carolina fisheries have a "captive audience" who

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23. "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.

24. "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.

8.01 Implications

since childhood have been coming to the coast to enjoy the bounty of the fisheries. The challenge is to bring this "fresh-caught" flavor to any part of state, so that between visits they can enjoy something of equal quality at home.

8.02 Comments:

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

An important attribute of these enterprises is that they form the backbone of small coastal communities. In one way or another they have arrived at marketing systems which have supported their enterprises.

The planning of this project was based on the assumption that good as well as bad points are present in seafood handling and processing operations. The objective, as stated initially, is to examine the industry in its present state and consider how step-wise improvements can be achieved.

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 towards solution of the problems of expanding the product lines and finding new customers seems to be what is needed.

8.03 N.E.R. Marketing Program:

Mr. Alvah Ward[25] provided the following information:

"The state of North Carolina has an ongoing Seafood Marketing Systems Development Program, assigned to the Division of Economic Development, Department of Natural and Economic Resources. The Marketing staff, consisting of Fay McCotter Lewis (Seafood Consumer Specialist) and A. Paul Allsbrook (Seafood Marketing Specialist), has assigned responsibilities for programs designed to aid and assist North Carolina's sea-

25. Memorandum dated July 23, 1975

RECOMMENDED DAILY ALLOWANCES OF PROTEIN

	AGE (years)	WEIGHT (lbs.)	HEIGHT (in.)	PROTEIN (gm.)
CHILDREN	2 - 3	31	36	25
	4 - 6	42	43	30
	8 - 10	62	52	40
MALES	12 - 14	95	59	50
	18 - 22	147	69	60
	35 - 55	154	68	65
	55 - 75+	154	67	65
FEMALES	12 - 14	97	61	50
	16 - 18	119	63	55
	18 - 22	128	64	55
	35 - 55	128	63	55
	55 - 75+	128	62	55

Source: Food and Nutrition Board, National Academy of Sciences, National Research Council, 1968.

ONE CHAIN STORE, MOREHEAD CITY, N. C.

PRODUCT	PRICE	COST OF 100 gm PROTEIN	FISH SPECIES	LBS. OF WHOLE FISH TO PRODUCE 100 gm PROTEIN
Beans with pork	.29/lb.	1.04	Alewife	2.3
Broilers, oven ready	.69/lb.	1.20	Bass, Black, Sea	2.9
Eggs	.74/doz.	.88	Bluefish	2.1
Turkey	.65/lb.	.99	Croaker, Atlantic, raw	3.6
Hamburger, regular	.95/lb.	1.17	Eel, American, raw	1.8
Frankfurters, regular	.79-1.43/lb.	2.00	Flounder	4.0
Salami, cooked	.69/4 oz.	3.46	Kingfish (Whiting)	2.7
Bologna, sliced	.79/8 oz.; .99/12 oz.	2.20	Shad	2.5
Sirloin Steak	2.28/lb.	3.23	Spanish Mackerel	1.9
Bacon, sliced	1.39-1.89/lb.	4.19	Weakfish	2.8

Source: Seafood Laboratory, Morehead City, N. C.

8.03 N.E.R. Marketing Program

food industry in establishing new market outlets for their products, in developing these markets, and in informing and educating the consumer as to the proper preparation, nutritious use, and promotion of North Carolina fishery products.

Its assignment to the state's industrial development agency lends emphasis to the role of seafood marketing in North Carolina as a vital tool of expansion and development of plants and facilities vitally needed to create and maintain employment, as well as increase per capita income, in the coastal areas."

9.0 FUTURE RESEARCH

Many of the industry needs will become apparent during the Work-shop meeting. A limited list of especially important problem areas appears below.

3.0 Resource:

A. Section 3.01 Commercial Landings:

1. N.M.F.S. Statistics: Unavoidably misses "off-the-cuff" landings.

2. Resource Assessment: Complicated by landings at ports outside of North Carolina.

3. Fuel Shortage: Logistics of trucking vs. having boats return long distances to home ports. Also, how this choice relates to preservation of the catch.

B. Section 3.02 Sport Fish Landings:

1. N. C. Landings: More accurate figures are needed to judge extent that processing plants should plan upon custom handling those species landed by sportsmen on a custom basis.

4.01 General Principles:

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

B. Crab Handling: Information needed on how to keep crabs alive and effects of in transit mortality upon meat quality.

C. Handling Large Fish: The possibility that a bleeding technique or other partial dressing method should be applied

9.0 FUTURE RESEARCH

4.01 General Principles

as means of improving acceptability should be investigated.

D. Bisulfite used on Shrimp: The correct application of this chemical and limits of residual sulfur dioxide needs clarification.

4.03 Rapid Cooling of Catch:

A. Transportation and Storage of Ice: A realistic appraisal of the cost, supply, availability as these factors effect boats and shore installation is needed.

B. Stowing and Icing Catch: Methods of immediately and economically putting catch below deck and correctly icing is a paramount problem on trawlers.

C. Long Haul Boats: Some way must be devised to rapidly cool the fish when caught.

4.04 Hold Insulation:

A. Suitable smooth skin materials to cover sprayed-on insulation are needed.

4.05 Mechanical Refrigeration:

A. Mechanical Refrigeration: Feasibility study dealing with several refrigeration options aboard trawlers is needed.

5.0 Shore Handling and Processing:

5.03 Seafood Quality:

A. Testing for Freshness: Subjective tests often seem unreliable. Should temperature recorders or other indications of cooling conditions be the criteria? What other dockside tests are available? When should cooking tests be applied? What chemical indices are fully established as applying to North Carolina species?

5.04 Freezing Equipment:

Well prepared statement of equipment and building construction options.

5.05 Thawing:

Thawing: Alternate approaches most useful in terms of North

9.0 FUTURE RESEARCH

5.05 Thawing

Carolina packaging methods.

5.06 Glazes:

Glazes: Various combinations for single step application of highly protective edible coatings.

7.0 Processing:

7.01 Products to be Produced:

A. Easy Separation: Additional work on methods of easily separating tightly packed seafoods as possible replacement of costly IQF methods.

B. Cost Analysis: Alternate packing methods assessed in terms of costs, stability of product and consumer acceptability.

C. Blocks: What can be done to increase acceptance of frozen whole fish, put up in blocks, as method of delivering "Fresh-caught" flavor to seafood markets.

D. Institutional Requirements: Define specific needs of restaurants, hospitals, schools, prisons, military and measures to be taken to enter this market.

7.02 Plant Components:

A. Economic Considerations: More basic cost, depreciation, annual overhead, maintenance and other data needed to accurately predict profitability of operation.

B. Construction Materials: Suitability costs of alternate materials including such problems as how well plaster coatings work when applied to urethane insulation. Low cost methods achieving sanitary surfaces are needed.

C. Time Studies: More specific information concerning labor needs and economics of replacing manpower with mechanization is required before greater processing efficiency can be attained.

D. Pollution: Realistic cost assessments of control measures to comply with regulations.

8.0 Marketing:

A. Emphasizing North Carolina Seafoods: What support does

9.0 FUTURE RESEARCH

8.0 Marketing

the industry need to market its coastal catch?

B. Frozen North Carolina Seafoods: Steps to be taken to develop and promote frozen products which are in fact equal to fresh.

C. Price Differentials: What must be done to justify price differences between local and imported products, and to convince consumers of the value of quality and dependability.

10.0 WORKSHOP PROCEEDINGS:

. . . . . A N N O U N C I N G . . . . .

INDUSTRY WORKSHOP MEETING

Tues., July 29 & Weds., July 30, 1975

SEAFOOD PROCESSING AND MARKETING IN NORTH CAROLINA

Chairman - Dr. Neil B. Webb

You are invited to participete in an important WORKSHOP, July 29, Auditorium, Carteret Technical Institute, Morehead City, N. C.

You are invited because you are a processor, or considering going into processing, or supplying goods, equipment and services to processors, or interested in buying, distributing and selling processed seafoods. This meeting provides an opportunity to exchange ideas all day Tuesday and the following day if you come the the Seafood Laboratory Open House.

TUESDAY

9:00 to 9:30 AM	REGISTRATION (No Fee)	Auditorium
9:30 to 10:00 AM	"GETTING THE MOST OUT OF PROCESSING	Neil Webb
10:00 to 10:30 AM	"PINPOINTING PROBLEMS"	Ted Miller
10:30 to 10:45 AM	Coffee Break	
10:45 to 11:15 AM	"TROUT STORAGE HAS PROBLEMS"	Ted Miller
11:15 to 11:45 AM	"FIGURING IF FINFISH PROCESSING PAYS"	Jim Easley, Jr.
12:00 to 1:30 PM	Lunch - Pick Your Own Restaurant	
1:30 to 1:45 PM	"MAKING BEST USE OF THE RESOURCE"	Ed McCoy
1:45 to 2:15 PM	"KEEP IT COLD"	Roger Collins, III
2:15 to 2:45 PM	"PACKAGING CAN BE SIMPLE"	Bob Heidenreich
2:45 to 3:15 PM	"GETTING THE PRODUCT TO THE CONSUMER"	Melton Evans
3:15 to 3:30 PM	Coffee Break	
3:30 to 4:00 PM	"THE PRODUCT MUST FIT THE MARKET"	Frank Thomas
4:00 to 4:45 PM	IDEA EXCHANGE (Panel - Roy Martin, Alvah Ward, Skipper Crow, and Jim Easley)	Frank Thomas
4:45 to 5:00 PM	WRAP-UP	Neil Webb

10.0 WORKSHOP PROCEEDINGS

NEIL B. WEBB
Associate Professor
Department of Food Science
N. C. State University
Raleigh, N. C. 27607

B.S. - Animal Science, West Virginia University; M.S. - Meat Science, University of Illinois; PhD - Meat Science, University of Missouri. Fields of research interest include biochemistry and texture of protein foods, comminuted meat and seafood products, microbiological problems associated with plant and product sanitation. In charge of the Applied Research program of the Seafood Laboratory group.

GETTING THE MOST OUT OF PROCESSING

The program to be presented today is the culmination of a research project on fish processing recommended by the Commercial Fisheries Committee of the N. C. Marine Science Council approximately four years ago. The objectives of this research project were to evaluate methods, define problems, and develop improved techniques for the handling, processing and marketing of finfish. This research has been jointly sponsored by the Coastal Plains Center for Marine Development Services, Coastal Plains Regional Commission, National Fisheries Institute, U.N.C. Sea Grant Program, N. C. Agricultural Experiment Station, and North Carolina Agricultural Extension Service.

Within a broad scope, marketing is defined as a function of every step from harvesting through consumption. Probably the most important factor in marketing activities is the delivery of a consistent product to the consumer. Unless systems are developed and monitored which will give fishery products which are of consistently high quality we cannot develop and maintain strong markets. Even with inconsistent supplies, a consistent quality will build a strong reputation in the marketplace.

In the handling and processing of fishery products the problems are numerous, the solutions few, e.g. when adequate technological and operational solutions are developed, economics may prohibit implementation. Since

[illegible]

[illegible] of activities concerning [illegible] utilization. [illegible] designed to pinpoint [illegible] objectives which [illegible] to be solved by future [illegible] with the [illegible] handling conditions [illegible] product quality, development [illegible] processing and pack[illegible] of [illegible], and the application of methods for judging quality [illegible]. [illegible] product handling, processing and distribu[illegible] [illegible] are shown on pages [illegible] and 88 of the conference re[illegible]. The experimental design is shown on page [illegible] of the conference report, which shows that both [illegible] and superchilled grey trout were used [illegible] subsequently transferred to the pilot laboratory at Morehead City where they were packaged in round, headed and gutted, and filleted forms. These samples were evaluated and then divided into various storage tests including iced, [illegible] at 28°F, and frozen. Evaluations were conducted both by laboratory and consumer panels. Additional inputs into the project included economic analyses, plant surveys and a survey of restaurant utilization of fish.

This conference has been planned to include the results of this research investigation but, very importantly, to supplement the results of the study with inputs from individuals who have worked with various segments of the industry which were not included in the study.

IC.9 WORKSHOP PROCEEDINGS

TED M. MILLER
Food Science Extension Specialist (Seafoods)
Department of Food Science
N. C. State University
Seafood Laboratory
Morehead City, N. C. 28557

B.S. - Chemistry (Chemical Engineering), Johns Hopkins University. Research and quality control in the menhaden industry for 23 years. Vice-President in Charge of Research, Wallace Menhaden Products, Inc., of New Orleans. Concurrently, served as Director, Marine Chemurgics, Inc., Ocean, N. C., a consulting firm dealing with fishery technology. Has occupied present position for 3 years.

PINPOINTING PROBLEMS

This publication has been distributed to processors in order to provide background for the workshop. "Processing" is defined in terms of how it applies to North Carolina fisheries. Seafood landings are through 26 ports, located in 17 coastal counties. There are 595 seafood handlers while those companies engaged in some form of processing total 170 handling finfish and 75 conducting operations concerned with shrimp. In most instances the operations classifying them as "processors" are of limited scope.

As basis for undertaking or expanding processing the report lists the economically more important finfish and shellfish in terms of catch histories, peak months and regional landings. It notes the extensive sports fish landings as offering opportunities for custom dressing, packaging and freezing.

Prime fresh seafoods are a must for processing. Seafoods require rapid cooling immediately after landing, and sanitary measures followed consistently. Such precautions as holding at low temperatures, rapid and careful handling must prevail when landed and upon shipment to the consumer.

Freezing must be sufficiently rapid, requiring adequate capacity, suit-

able rooms and equipment. Products must be protected from oxidation and moisture loss. Glazes and suitable packaging methods are employed as part of the protective system.

The report describes various methods of packaging in relation to the processing facilities and components described in Section 7.0 Technological considerations involved in marketing include quality, supply, inspection, and most important, a realistic assessment of frozen vs. unfrozen seafoods in terms of consumer acceptance.

TROUT STORAGE HAS PROBLEMS

The research reported in Section 6.0 (beginning on page 47) of this publication, deals with grey trout, selected as a commercially important species suitable for demonstrating how handling conditions at sea can influence unfrozen and frozen storage characteristics. The previously known difficulties encountered in preserving the fresh caught flavor of trout provided an experimental basis for testing how conventional icing vs. superchilling affected shelf-life as evaluated on basis of organoleptic ratings of a laboratory taste panel and by a group of consumers.

This work indicated that handling conditions at sea exerted appreciable influence upon storage life of trout held in ice while holding in superchilled (28°F) extended storage life by several days. There were indications that 90 days frozen storage was more successful when initiated with rapidly chilled and correctly iced raw material. Freezing in the round vs. fillets vs. headed and gutted indicated that these forms did not show appreciably different storage characteristics. The consumer panel found frozen vs. fresh fillets to be equally acceptable. The belly flaps of trout were found to be the part of the fillets most likely to develop bad flavors and odors while in storage.

10.0 WORKSHOP PROCEEDINGS

J. E. EASLEY, JR.
Extension Economist, Seafoods
Economics Department
N. C. State University
Raleigh, North Carolina 27607

B.A. - Economics, N.C.S.U.; M.A. - Economics, Southern Methodist University; PhD - Economics, N.C.S.U.
Taught economics at Campbell College 1968-1969 through 1970-1971 academic years. Current position since September 1973. Interested in economics of processing, management tools and/or applications for commercial fishermen.

FIGURING IF FINFISH PROCESSING PAYS

One of the objectives of this research project has been the more precise identification of certain ratios (e.g. labor productivities in processing) that are necessary for an economic feasibility study. This topic treats the use of some of these ratios within the context of how one might determine the economic feasibility of processing. The emphasis is on the methodology involved in a feasibility study as a financial management tool rather than the results per se. Special treatment is given to how labor productivities and percent yields in processing finfish (filleting and heading and gutting) affect costs and returns. Some treatment is also given the effects of varying season length (days of plant operation) and input raw material prices on net revenue. Tentative figures are used for illustrative purposes.

10.0 WORKSHOP PROCEEDINGS

EDWARD G. McCOY
Director, Division of Marine Fisheries
Morehead City, N. C. 28557

M.S. - Marine Biology, N.C.S.U. Shrimp was one of his main areas of study. Formerly Chief, R & D Section, N. C. Division of Commercial and Sports Fisheries and now Director, Division of Marine Fisheries, N.E.R.

MAKING BEST USE OF THE RESOURCE

Species appearing on pages 7 through 28 of the report discussed in terms of catch trends, which ones are most promising as source of supply for processing, also seasonal aspects of catching each species. In discussing 200 mile extended jurisdiction, states that this should help develop a squid fishery. It also is a potentially important resource for N. C. The R/V Dan Moore trawling in 80 to 100 fathoms reported catching 250 lbs/hr plus an abundance of other species such as butterfish (2 to 10 times weight of squid per hour). This was in spite of the fact that the grounds had been heavily fished by foreign vessels. Suggested that potential of many species rests in deboning operations (mechanical deboning). Scrap fish offers potential of 10-20 million lbs/hr for deboning. The biologist is not able to accurately predict availability of fish from one year to another because there is insufficient information on stocks and catch per unit effort.

Question: What is the potential market for squid?

Answer: There's a tremendous market for squid in 10 lb. frozen quantities overseas, particularly to Italians and other western European countries.

Question: Has it been definitely proven that foreign fisheries are responsible for the decline in the river herring fishery? (Alewife)

Answer: Yes. On the basis that adding U.S. catch to what is reported in foreign landings the total equals what was caught in pre-

vious years (domestically).

Question: Since landings of alewife in 1938 were 5 million pounds, doesn't this indicate that the species is cyclic?

Answer: This particular instance was not explained, however levels since 1938 were rather constant.

10.0 WORKSHOP PROCEEDINGS

ROGER M. COLLINS, III (Accompanied by Mr. R. C. Holland, V.P.)
Secretary/Treasurer
Coastal Refrigeration Co., Inc.
Greenville, N. C.

This company was requested to supply a speaker because of their extensive involvement in supplying refrigerated equipment to the Coastal North Carolina seafood handlers and processors. This service has been rendered since 1946, presently representing seven different equipment manufacturers and specializing in pre-fab freezer units, ice manufacturing machines, ice rooms, blast freezers, cold storage rooms, and storage freezers.

KEEP IT COLD

Refrigeration equipment and ice equipment should be designed and matched to a specific need, looking to future expansion possibilities.

I. What is a ton of refrigeration?

A. 144 BTU's required to change one pound of ice at 32°F to one pound of water at 32°F

B. 2000 lbs. ice x 144 BTU's = 288,000 BTU's
288,000 BTU's ÷ 24 hr. = 12,000 BTU's/hr
one ton = 12,000 BTU's/hr

II. How do we figure a refrigeration product load?

Formula - $Q = W /c(t_1 - t_2) + h_f + c (t_2 - t_3) /$

Q = heat to be removed, BTU
W = weight of product, pounds
c = specific heat above freezing (BTU to raise or lower 1 pd.1°F above freezing)
$t_1 - t_2$ = difference between entering and product freezing temperature
h_f = latent heat of fusion, BTU's to change product to solid
c_1 = specific heat below freezing
$t_2 - t_3$ = freezing temperature of product minus desired room temperature

2000 # shrimp to 0°F entering at 50°F, freeze at 28°F
Q = 2000 /.86(50-28) + 119 + .45 (28-0)/
Q = 2000 /.86 (22) + 119 + .45 (28)/
Q = 2000 /150.52/
Q = 301,040 BTU

Pages 91 through 94 etc.

10.0 WORKSHOP PROCEEDINGS

III. Factors affecting freezing time
   A. Size and shape of package
   B. Refrigeration unit capacity
   C. Temperature of the cooling medium - Rate of heat exchange through evaporator

As to freezers, it is essential to maintain 500-100 cu.ft. per minute of air moving through evaporators and around product. Normal heat removal will give approximately 1/4" penetration per hour; the thinner or smaller size packages provide better penetration.

Warned against storing fish and ice in same room. Concerning rooms for superchilling at below 32°F, described the need for an electric defrost system, while above 32°F, an air defrost system is adequate. Never use direct blower evaporators in storage rooms for ice or seafood when the room temperature is to be above 32°F. These blowers tend to melt ice more quickly and remove moisture from unpackaged seafood products.

Discussed boat refrigeration possibilities, mostly in terms of the air cooling system described on page 38 of the report. In relation with insulated holds, which are rapidly gaining popularity because of ice saving ability, refrigeration systems are being investigated which could keep hold temperatures to approximately 35°F. Hold temperature varies with boat characteristics. Without refrigeration these holds are seldom below 45° to 50°F. A small refrigeration unit with gravity evaporators could reduce ice requirements as much as 50% per trip.

10.0 WORKSHOP PROCEEDINGS

ROBERT G. HEIDENREICH
Vice President
Packaging Products Corporation
236 Weymouth Street
Rockland, Mass. 02370

B.S. - Business Administration, Lehigh University. Also, graduate study in law.
Member U.S. Army Reserve, Major
Business experience includes market development with Ludlow Papers and Monsanto, Line Sales with Ekco Products, Inc. Joined Packaging Products Corporation as a principal in 1969.

PACKAGING CAN BE SIMPLE

This company is the largest distributor of diversified packaging materials, catering to the seafood industry along the east coast. No other state has been as active in promoting seafood industry through the academic community as North Carolina. Referring to page 80 concerning superchill packs, one approach used in Canada is to use plastic containers and chill before the product goes into them. A second method is to put the fillets into the freezer in the afternoon. Then take out the next day before completely frozen, sending them this way to the market. Since product will show no signs of freezing by the time it reaches the market, this provides a very attractive glistened look to the product. Some superchilled products are shipped out of Boston in insulated containers packed in dry ice.

IQF is used in this area more than in New England and requires an additional amount of labor and glazing after freezing. The irregular shapes constitute a packaging problem. One approach is to put in clear or white poly bags.

Bulk Packs - These are put out in 25# and 50# boxes lined with poly bags. As used in North Carolina industry are normally 1 1/4 to 1 1/2 mil. Those present agreed that it should be increased to 2 mils. Demonstrated method of folding top of poly bags, but a sealing method could also be

employed, using portable heat elements.

Uni Pack - Referred to cello pack employed in wrapping crabs individually or, individual fillets (showed 5# mackerel package). The use of Saran film is difficult as it becomes brittle when in frozen condition. On the other hand, polyethylene remains flexible.

Layer Pack - Used instead of IQF. Needs to be frozen as quickly as possible - mostly in 5# and 10# units. So far, polyethylene and cello appear best. Showed method of separation by dropping package.

Block Packs - Least desirable because this is mostly used on skinless products. However, later discussion indicated that the method of using blocks as suggested in the report is worthy of consideration.

Overwrapping Cartons - Described the use of stretch film employing a machine similar to one used in the supermarkets. Shrink films applied in a more sophisticated way employing polyethylene, a sealer and a shrink tunnel.

Preservative Dips - May be usefully employed prior to packaging.

Labeling - One of the most neglected areas of completing packaging. Suggested pressure sensitive labels or non-stick labels with clear overwrap. Covered minimum legal requirements for product identification.

10.0 WORKSHOP PROCEEDINGS

MELTON EVANS
President
Evans Seafood Co.
Washington, N. C.

Mr. Evans is a wholesale distributor of iced and some frozen N. C. seafoods with 30 years experience. He furnishes seafood to northern metropolitan areas and believes that he can be helpful in supplying processing companies with year-round supplies of raw material.

GETTING THE PRODUCT TO THE CONSUMER

Explained that he is a distributor (wholesaler) of fresh seafoods distributing from eastern North Carolina into New Jersey and points north. Basically, he buys during periods of plentiful supply and distributes to areas with inadequate supplies. He buys almost exclusively from the primary sources, i.e. the seafood dealers or handlers. At this time of year he handles a lot of N. C. seafoods, delivering to New Jersey and Philadelphia such species as croaker and trout. In summer and spring he distributes seafoods from Cape Charles, Virginia - this year largely involving large grey trout and supplying these to processors. His facility at Washington is completely modern and operated under stringent sanitary conditions. His greatest problem is obtaining top quality seafoods from fishermen. Poor quality at dock results in delivery of something unacceptable on the consumer's table. He urged handlers to put seafoods in clean boxes and again emphasized that the fisherman is the starting point of good seafood. Another problem area mentioned is that seafood retailers do not always keep sufficient ice on display seafoods. The seafood handlers also do not always put enough ice on seafoods, especially on the bottoms of the cartons. A good clean package will help sell seafoods. Good quality seafood has made his company a success.

Question: How do you check the quality of fish?

Answer: Based on his long experience can tell by looking at the fish. However, many people have trouble determining freshness.

10.0 WORKSHOP PROCEEDINGS

Question: What species are important for year-round supply?

Answer: Flounders, croaker, trout. Croaker sells well in eastern N. C. Flounder is the main seller everywhere because it is easily filleted. Most housewives insist upon filleted fish. Large trout sold well this year because it makes a good fillet and is being used in hospitals, etc. This species can be dressed in a way to be completely boneless.

Question: Can you sell filleted bluefish?

Answer: Not well in this area. However, sells in the northern markets and this includes the large sizes. Best in Philadelphia and Boston.

Question: How about butterfish?

Answer: Hasn't handled any during the past 2 years. Did catch some around Cape Charles. But there aren't many along the eastern coast.

Question: How about an incentive system for encouraging fishermen to take better care of the catch?

Answer: No. The handlers are the ones who should accept the responsibility since they generally supply the fishermen with ice.

10.0 WORKSHOP PROCEEDINGS

FRANK B. THOMAS
Extension Professor (Seafoods)
Department of Food Science
North Carolina State University
Raleigh, North Carolina 27607

B.S. - University of Delaware; M.S. - Penn State; PhD - Penn State; Post-doctoral studies - M.I.T.; Sabbatical - University of Hawaii Joined N. C. Agricultural Extension Service in 1958. Helped initiate extension to seafood industry in 1958. Helped establish research program in seafoods in 1964. Since 1970 has been involved in Sea Grant Advisory Services - Seafood Laboratory, Morehead City to better serve the coast.
Member - Commercial and Sports Fisheries Advisory Committee to Marine Fisheries Commission.

THE PRODUCT MUST FIT THE MARKET

Marketing is a sequence of events from ocean to table. Two interesting possibilities include the juvenile feeding market and the geriatric market. The problem with the baby food market is the reluctance of the mothers to accept this particular food. The geriatric market is very promising because of the nutritional implications of seafoods. As far as the school market is concerned, one problem is to change the attitudes of the young people towards fish and other seafoods.

One out of three people is on a diet and this provides a good basis for using fish every day instead of only on Friday. Big chain stores offer excellent markets but the product must be presented in attractive forms. There are certainly dollars to be made in seafoods. The seafood section of the supermarket is often neglected from the standpoint of the appearance of the merchandise and its variety.

Eleven pounds per year per capita consumtion was reported in 1968. This has not gone up as much as one would normally expect presently being at a level of 12 pounds per year. The necessity of attractive seafood displays has been mentioned - also might provide menu and recipe suggestions to greater extents, specific to N. C. Such dishes must not only meet

gourmet tastes but have an appeal to everyday diets. There are so many ways to prepare fish with so little being used! Some of the product problems mentioned include coating defects, incomplete cleaning, voids in packaged fish, oxidative rancidity. This is the time for originality in marketing. The small processor definitely has a place in gaining new markets.

10.0 WORKSHOP PROCEEDINGS

ROY MARTIN
Director, Science and Technology
National Fisheries Institute, Inc.
Washington, N. C.

B.S. - Chemistry, Valparaiso University, Northwestern University Seventeen years with Swift and Co., Chicago. Pioneered edible soy proteins. Joined National Fisheries Institute, Inc. three and one-half years ago. This organization represents 600 processors, fishermen, brokers, wholesalers and dealers.

COMMENTS DURING PANEL DISCUSSION

The biggest problem in the U.S. seafood industry is quality. The interior of the country is a tremendous untapped market. Each person in the U.S. consumes only 12 pounds of seafood per year vs. 200 pounds of red meat. The 200 mile limit will provide an "economic zone" for fisheries. The U.S. is going to need an alternate source of protein other than red meat and this demand will depend to some extent upon economic conditions. We must speak out on the need for better instruction of fishermen as to what is needed, stressing that quality begins on the water. While N.C. does not have a large basic processing industry, it has a great potential for one. One way to accomplish this is to re-evaluate nomenclature. There's a need for changing the names of certain fish such as croaker to something like "ocean whitefish". Processing requires technology and there is need for competent people in such organizations.

10.0 WORKSHOP PROCEEDINGS

ALVAH WARD
N. C. Dept. N.E.R.
Raleigh, N. C.

B.S. - Commerce, Citadel; M.B.A. - UNC School of Business
Native of Dare County, owned and managed Ice and Coal Storage freezing operation in Manteo. Joined State government in 1969 - Seafood Industry Consultant, Division of Commerce and Industry. Coordinated and directed seafood marketing program organized in 1972 and now serves as advisor to this program.

COMMENTS DURING PANEL DISCUSSION

The U.S. catch at dockside in 1973 was valued at $907 million but may have had a cumulative impact on the U.S. economy of $6.7 billion. If foreign imports were replaced by domestic production there would be another $3 billion increase. North Carolina has made a modest effort to assist in development of marketing systems since 1972. The program has been gaining momentum in its effect on various areas of consumer protection developing new marketing systems. National Marine Fisheries Service has a marketing program with nation-wide implications while Sea Grant has a number of projects concerning various aspects of marketing. Coastal Plains Regional Commission has provided support for such programs including the one under discussion today. All of this indicates the need for coordination in working out programs which will be aimed at the most needed areas of effort.

10.0 WORKSHOP PROCEEDINGS

GENE L. (SKIPPER) CROW, JR.
Research Technician II
N. C. State University
Seafood Laboratory
Morehead City, N. C. 28557

Experience includes 4 years as commercial fisherman and also served as first mate on sport fishing boat. Spent 2 years with Engineering Advisory Services, School of Engineering, N. C. State University working with gear technology, harvesting underutilized species, twin trawl, live blue crab handling, wild eel harvesting and eel aquaculture.

COMMENTS DURING PANEL DISCUSSION

In gathering information presented in Section 7.0 (Processing Facilities) visited 37 processing, handling, and distributing facilities. During these visits it became apparent that quite a few were planning to expand present facilities to include some form of processing. Many details provided in Section 7.0 are based on these field observations.

Currently in N. C. and northern S. C. there are 60 trawlers with insulated holds. This indicates that the fisherman is becoming interested in arriving at the dock with top quality seafoods.