TECHNICAL NOTE NO. 56 - CHEMICAL COMPOSITION AND LABORATORY FILLET YIELD OF 13 SPECIES OF MIDDLE AND SOUTH ATLANTIC FISH

ABSTRACT

Chemical composition of fillets and of fillet waste and laboratory fillet yield are presented for 13 species of fish caught off the coasts of the Middle and South Atlantic States.

INTRODUCTION

Since 1957, a number of miscellaneous determinations have been made at the U. S. Bureau of Commercial Fisheries Technological Laboratory at College Park, Md., on the chemical composition and the laboratory yield of edible meat of certain Middle and South Atlantic fish. The data were taken incidental to the main program of the laboratory and, accordingly, are not extensive. The purpose of this note is simply to make the data available because only limited data have been published on those species.

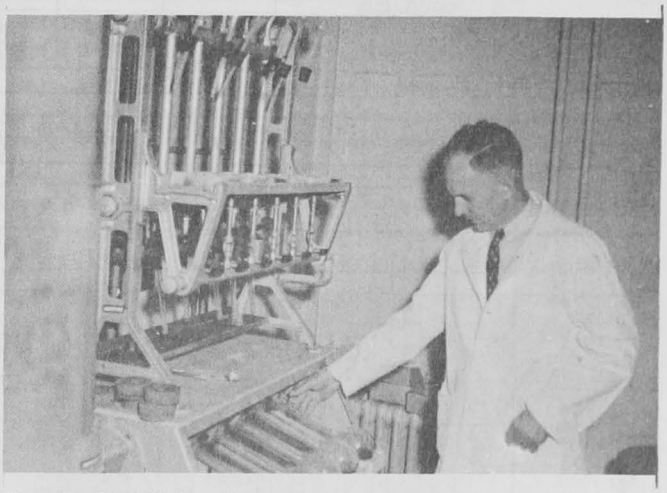

Fig. 1 - Kjeldahl analysis is utilized to determine protein content of fishery products.

METHODS AND ANALYSES

In almost all cases, the fish were obtained by laboratory personnel at coastal fishing ports, were frozen for transportation to the laboratory, and were kept frozen until thawed in air at room temperature for analysis. Protein (N x 6.25), ash, and moisture were determined by methods of the Association of Official Agricultural Chemists (1955). Oil was determined by extraction with 92-percent acetone in a Goldfisch extraction apparatus. The extract was dried, the residue extracted with petroleum ether and filtered into a tared beaker, the petroleum ether evaporated, and the residue in the beaker weighed and calculated as oil.

Season and location of catch have been included, since these variables are associated with differences in chemical composition of fish (Stansby 1954). When the fish differed considerably in size, the data were arranged according to arbitrary size classifications. The weight of edible meat obtained in the laboratory relative to the weight of fish is presented as fillet yield. Chemical analyses were usually performed on fillets from individual fish, which permitted calculation of the means and standard deviations of the means of the various values. With the fillet waste, analyses were performed on composites. The data are presented in tables 1 and 2.

Table 1 - Physical Characteristics of Middle and South Atlantic Fish

Species of Fish		Number of Samples	Catch Data		Physical Measurements					
					Whole Fish				Fillet Yield	
					Length		Weight			
Common Name	Scientific Name		Season	Location	Mean	S.D.[1]	Mean	S.D.[1]	Mean	S.D.[1]
					(Centimeters)		(Grams)		(Percent)	
Alewife	Pomolobus pseudoharengus	12	Spring	Maryland	26.5	1.2	270	50	42.7	2.8
Butterfish	Poronotus triacanthus	4	Summer	Maryland	-	-	110	12	82.8	1.1
Croaker	Micropogon undulatus	4	Summer	Maryland	-	-	284	57	46.0	12.0
		2	Winter	Virginia	30.8	-	494	-	26.7	-
Flounder	Pseudopleuronectus americanus	5	Summer	Maryland	-	-	342	80	51.0	16.0
Grey sea trout	Cynoscion regalis	6	Winter	Virginia	22.8	2.2	175	35	40.7	2.5
King whiting (ground mullet)	Menticirrhus saxatilis	4	Spring	Maryland	-	-	317	70	37.0	3.5
		3	Summer	Maryland	-	-	220	-	35.3	-
		3	Winter	Virginia	26.8	-	351	-	42.6	-
		9	Spring	Georgia	25.1	2.2	176	64	39.0	2.4
Mullet	Mugil cephalus	6	Spring	Maryland	-	-	266	62	32.3	1.8
		5	Spring	Georgia	20.2	1.0	104	15	31.4	3.3
Scup (porgy)	Stenotomus chrysops	6	Spring	Maryland	-	-	514	170	32.5	3.8
		4	Spring	Virginia	29.2	0.8	565	50	30.9	5.4
Sea bass	Centropistes striatus	5	Spring	Maryland	-	-	443	64	32.8	1.3
		5	Winter	Virginia	25.7	1.8	452	88	30.0	2.0
		5	Winter	Virginia	20.8	0.7	258	26	35.8	2.8
Shad	Alosa sapidissima	6	Spring	Maryland	-	-	1,456	244	46.0	3.7
		2	Spring	Georgia	41.5	-	1,383	-	41.6	-
		2	Spring	Delaware	47.4	-	1,343	-	45.9	-
Spanish mackerel	Scomberomorus maculatus	5	Spring	Florida	42.8	3.0	607	100	58.6	2.5
Spot	Leiostomus xanthurus	4	Summer	Maryland	-	-	151.	28	80.0	14.0
Striped bass	Roccus saxatilis	5	Spring	Maryland	29.5	0.7	314	7	36.2	1.4
		4	Spring	Maryland	43.0	1.9	966	79	35.1	1.5

1/Standard deviation of the mean.

Table 2 - Chemical Composition of Middle and South Atlantic Fish Fillets and Fillet Waste

Species of Fish	Number of Samples	Chemical Composition											
		Protein			Oil			Ash			Moisture		
		Fillet		Waste	Fillet		Waste	Fillet		Waste	Fillet		Waste
		Mean	S.D.[1]	Mean	Mean	S.D.[1]	Mean	Mean	S.D.[1]	Mean	Mean	S.D.[1]	Mean
		(Percent)											
Alewife	12	17.5	0.6	15.6	4.8	1.6	10.1	1.2	0.0	3.1	76.4	1.6	70.2
Butterfish	4	17.9	1.1	14.4	0.9	0.3	4.6	1.2	0.1	2.8	80.4	0.5	77.4
Croaker	4	17.5	0.3	15.7	2.9	0.5	8.0	1.1	0.1	5.7	78.0	0.7	69.8
	2	14.1	-	14.3	0.4	-	0.4	0.9	-	7.1	84.3	-	77.5
Flounder (blackback)	5	19.9	1.5	16.3	0.3	0.1	2.2	1.2	0.1	5.4	79.5	0.3	75.4
Grey sea trout	6	15.7	1.3	13.6	4.2	1.9	10.8	1.3	0.2	3.1	78.2	1.3	74.5
King whiting (ground mullet)	4	16.6	0.2	14.0	0.7	0.1	1.1	1.0	0.1	3.6	81.7	0.3	80.6
	3	17.5	-	15.2	1.0	-	5.5	1.1	-	3.4	80.3	-	75.0
	3	16.5	-	14.3	6.1	-	11.0	1.1	-	3.6	76.3	-	70.6
	9	17.9	0.7	16.5	2.6	1.3	6.5	1.1	0.1	4.5	78.6	1.4	71.2
Mullet	6	18.1	0.8	17.3	0.2	0.1	1.2	1.0	0.0	8.6	80.2	0.6	72.0
	5	19.0	0.9	18.4	2.0	0.8	6.4	1.2	0.1	5.0	77.4	1.1	70.4
Scup (porgy)	6	18.9	0.8	15.7	5.9	1.7	14.2	1.2	0.1	7.2	73.6	2.1	61.0
	4	18.4	0.1	14.3	4.8	0.4	15.0	1.1	0.0	6.4	75.1	0.6	62.6
Sea bass	5	18.2	0.6	16.7	0.8	0.3	5.3	0.9	0.1	6.3	79.5	0.4	69.8
	5	18.5	0.5	15.6	3.0	1.0	9.5	1.0	0.1	2.9	77.8	0.6	73.2
	5	18.0	0.4	14.3	1.3	0.4	6.1	1.1	0.0	3.2	78.8	0.5	74.3
Shad	6	15.7	1.6	13.8	15.2	2.4	19.9	1.3	0.1	3.2	67.5	2.7	61.4
	2	17.5	-	20.7	9.0	-	11.5	1.2	-	3.4	71.3	-	63.8
	2	16.7	-	15.5	13.2	-	17.6	1.3	-	3.6	68.4	-	63.0
Spanish mackerel	5	17.6	0.9	16.0	6.8	1.8	12.4	0.9	0.1	3.6	74.6	1.8	67.4
Spot	4	17.9	0.6	14.8	3.1	0.8	10.6	1.1	0.1	4.6	77.5	0.6	68.9
Striped bass	5	16.6	0.4	15.7	1.5	1.3	4.4	1.0	0.0	4.9	80.7	0.5	74.0
bass	4	18.8	0.3	16.4	2.9	0.6	12.1	1.1	0.1	4.9	77.9	0.6	66.0

1/ Standard deviation of the mean.

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SEASONAL VARIATIONS OF PHYSICAL CHARACTERISTICS AND CHEMICAL COMPOSITION OF FISH FROM MIDDLE ATLANTIC STATES

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ABSTRACT

Sea bass (Centropristes striatus), flounder or blackback (Pseudopleuronectes americanus), fluke (Paralichthys dentatus), and scup or porgy (Stenotomus chrysops) were obtained in the fresh state from both spring and summer catches at New Jersey coastal ports and the New York City Fulton Fish Market. Data were obtained on the size of the fish; on the percentage yields of fillet, head, frame, viscera, skin, and scales; and on the moisture, protein, oil, and ash contents of those component parts.

INTRODUCTION

An investigation to determine the physical characteristics and chemical composition of various species of fish obtained from the waters of the Middle Atlantic States is being made by the staff of the U. S. Bureau of Commercial Fisheries Technological Laboratory, College Park, Md. Such information is of value to fish processors, nutritionists, and members of the medical profession. The chemical composition of the nonedible portion of fish is of value in the pet-food and other animal-feed industries.

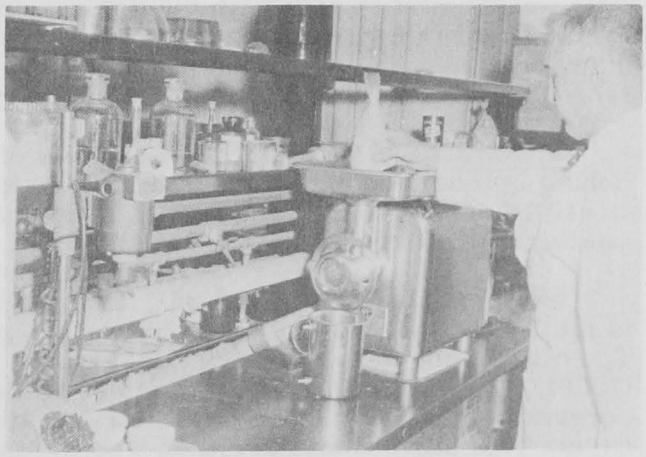

Fig. 1 - To prepare samples, a Hobart grinder is used.

Variations in physical characteristics and chemical composition are considered important, since it has been generally realized for some time that these factors differ considerably, not only from species to species but often to an even greater extent from one fish to another of the same species. These variations--according to Atwater (1892), Tressler and Lemon (1951), and Stansby (1954)--may be due to the season of the year when the fish are caught, the geographical area in which the fish are located, the age of the fish, or other factors that have not been identified. For composition data to be of real value, then, it is necessary to determine the extent of differences that may exist.

In this report information is presented on the seasonal variations in the physical measurements and the chemical composition of four species of commercially-important fish of the Middle Atlantic States.

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EXPERIMENTAL PROCEDURE AND RESULTS

SAMPLING: Fresh fish were obtained from both spring and summer catches from New Jersey coastal ports and the New York City Fulton Fish Market. The species were sea bass (Centropristes striatus), flounder or blackback (Pseudopleuronectes americanus), fluke (Paralichthys dentatus), and scup or porgy (Stenotomus chrysops). The fish were packed in ice and transported to the laboratory, where they were stored in polyethylene bags at approximately -12° C. (10.4° F.) until analyzed.

PHYSICAL MEASUREMENTS: After being thawed at room temperature (no drip occurred), each fish weighed and measured for length, depth, and thickness. Length was determined by measuring the fish from the snout to the tip of the tail. Individual weights were determined for the whole fish and for various component parts of the fish, including fillet, viscera, frame, head, skin, and scales. The term frame is used to indicate the total weight of the beheaded skeleton after filleting, and includes tail,

Table 1 - Physical Measurements and Yields of Component Parts of Middle Atlantic Fish

Description of the Whole Fish: Species	Season of Catch	Item	Physical Characteristics of the Whole Fish: Length	Depth	Thickness	Weight	Yield of Component Parts: Fillet	Viscera	Frame	Head	Skin	Scales	Loss
			(Centimeters)			Grams	(Percent)						
Sea bass[1] (Centropristes striatus)	Spring	Mean of 9 fish	33.5	8.9	4.9	522	33.5	3.3	16.0	36.0	6.8	2.5	1.9
		Standard deviation	2.4	0.6	0.5	86	3.1	0.5	1.3	2.5	0.8	0.4	0.4
	Summer	Mean of 9 fish	38.9	11.1	6.3	866	35.4	6.4	15.7	27.3	6.6	2.6	1.7
		Standard deviation	2.3	0.5	0.5	111	3.7	2.5	2.7	3.4	2.1	0.4	0.5
	Significance of F test 7/		6/	6/	6/	6/	None	6/	None	6/	None	None	None
	Seasonal difference of means		5.4	2.2	1.4	344	1.9	3.1	0.3	8.7	0.2	0.1	0.2
Flounder or blackback[2] (Pseudopleuronectes americanus)	Spring	Mean of 6 fish	36.9	14.7	2.9	594	24.9	10.4	30.3	14.7	12.2	0.9	6.7
		Standard deviation	1.2	1.2	0.2	131	4.8	3.2	2.0	0.8	2.2	0.2	1.4
	Summer	Mean of 6 fish	54.0	21.6	4.9	2,189	48.0	8.5	16.5	9.2	13.7	1.8	2.3
		Standard deviation	0.8	0.9	0.1	116	2.0	1.3	1.5	1.1	1.0	0.4	0.8
	Significance of F test		6/	6/	6/	6/	6/	None	6/	6/	None	6/	6/
	Seasonal difference of means		17.1	6.9	2.0	1,595	23.1	1.9	13.9	5.5	1.5	0.9	4.4
Fluke[3] (Paralichthys dentatus)	Spring	Mean of 6 fish	44.3	16.9	3.2	904	39.0	1.8	26.8	19.8	9.1	1.7	1.8
		Standard deviation	2.0	0.7	0.3	107	2.5	0.4	1.2	1.7	1.6	0.5	0.4
	Summer	Mean of 6 fish	50.7	19.1	3.8	1,438	47.3	5.6	18.6	15.8	7.4	1.8	3.5
		Standard deviation	2.1	0.7	0.1	158	1.7	0.5	1.0	1.6	0.9	0.3	0.8
	Significance of F test		6/	6/	6/	6/	6/	6/	6/	6/	6/	None	6/
	Seasonal difference of means		6.4	2.2	0.6	534	8.3	3.8	8.2	4.0	1.7	0.1	1.7
Scup or porgy[4] (Stenotomus chrysops)	Spring	Mean of 8 fish	33.0	11.8	4.4	665	30.6	7.1	20.3	30.7	6.4	3.5	1.5
		Standard deviation	2.4	0.6	0.5	133	2.7	1.8	1.9	1.3	1.1	0.5	1.0
	Summer	Mean of 7 fish	30.0	10.5	3.7	474	31.9	8.4	14.3	30.3	6.5	4.9	3.6
		Standard deviation	1.5	0.7	0.2	88	1.1	1.3	1.6	1.3	0.7	0.9	1.3
	Significance of F test		5/	6/	6/	6/	None	None	6/	None	None	6/	6/
	Seasonal difference of means		3.0	1.3	0.7	191	1.3	1.3	6.0	0.4	0.1	1.4	2.1

1/ Spring catch obtained in April 1958, near Cape May, N. J.; summer catch in July 1958, near Wildwood, N. J.
2/ Spring catch obtained in April 1958, near Monmouth Beach, N. J.; summer catch in September 1958, from the Fulton Fish Market, New York City, and fish were caught off southern Massachusetts.
3/ Spring catch obtained in April 1958, near Cape May, N. J.; summer catch in September 1958, from the Fulton Fish Market, New York City, and fish were caught off southern Massachusetts.
4/ Spring catch obtained in April 1958, near Atlantic City, N. J.; summer catch in July 1958, near Atlantic City, N. J.
5/ Indicates a significant difference between spring and summer values at a 5-percent level of probability.
6/ Indicates a significant difference between spring and summer values at a 1-percent level of probability.
7/ A statistical test used to determine if differences between measurements may be considered as real.

vertical and dorsal fins, and adhering meat. The term loss is used to indicate the total weight of each fish less the determined sum of the weights of all component parts of that fish. A percentage yield of component parts was determined by dividing the weight of each component part by the total weight of each fish and multiplying by 100. Data obtained on the physical measurements are tabulated in table 1.

CHEMICAL ANALYSES: The fillets of each fish were individually ground in a Hobart grinder, ground further in a Lourdes multimixer, and stored in glass jars at -10° C. (14° F.) until analyzed. Composites of the inedible component parts were similarly prepared for analysis.

Moisture, protein (N x 6.25), and ash determinations were conducted according to methods of analysis of the Association of Official Agricultural Chemists (1955). The oil content was determined by a slight modification of the method of Dambergs (1956). The method used consisted of extraction of the sample with a mixture of 92 percent acetone and 8 percent water for 4 hours in a Goldfisch fat extraction apparatus. The solvent mixture then was evaporated, and the residue was dissolved in petroleum ether. The solution was filtered through No. 42 Whatman filter paper, the petroleum ether was evaporated, and the residue was weighed and calculated as oil. Data on chemical composition are tabulated in tables 2 and 3.

Table 2 - Chemical Composition of Fillets From Middle Atlantic Fish

Description of the Fish Species	Season of Catch	Item	Proximate Composition			
			Moisture	Protein	Oil	Ash
			(Percent)			
Sea bass (Centropristes striatus)	Spring	Mean of fillets from 9 fish	78.5	18.9	1.62	1.15
		Standard deviation	1.2	0.7	1.04	0.10
	Summer	Mean of fillets from 9 fish	77.3	18.3	2.92	1.20
		Standard deviation	1.1	0.5	1.43	0.06
	Significance of F test		1/	None	1/	None
	Seasonal difference of means		1.2	0.6	1.30	0.05
Flounder or blackback (Pseudopleuronectes americanus)	Spring	Mean of fillets from 6 fish	80.8	17.1	0.23	1.29
		Standard deviation	0.9	0.5	1.11	0.12
	Summer	Mean of fillets from 6 fish	75.4	19.9	0.83	1.21
		Standard deviation	0.5	0.9	0.46	0.05
	Significance of F test		2/	2/	1/	None
	Seasonal difference of means		5.4	2.8	0.60	0.08
Fluke (Paralichthys dentatus)	Spring	Mean of fillets from 6 fish	79.7	18.8	0.32	1.08
		Standard deviation	0.7	0.9	0.12	0.21
	Summer	Mean of fillets from 6 fish	76.8	20.0	1.02	1.13
		Standard deviation	0.6	0.4	0.41	0.08
	Significance of F test		2/	1/	2/	None
	Seasonal difference of means		2.9	1.3	0.70	0.05
Scup or porgy (Stenotomus chrysops)	Spring	Mean of fillets from 8 fish	75.4	18.9	4.06	1.20
		Standard deviation	1.0	0.5	1.19	0.07
	Summer	Mean of fillets from 7 fish	77.0	19.1	1.21	1.30
		Standard deviation	0.6	0.4	0.61	0.11
	Significance of F test		2/	None	2/	2/
	Seasonal difference of means		1.6	0.2	2.85	0.10

1/ Indicates a significant difference between spring and summer values at a 5-percent level of probability.
2/ Indicates a significant difference between spring and summer values at a 1-percent level of probability.

Table 3 - Chemical Composition of Inedible Components From Middle Atlantic Fish

Description of the Fish Species	Season of Catch	Component 1/	Proximate Composition			
			Moisture	Protein	Oil	Ash
			(Percent)			
Sea bass (Centropristes striatus)	Spring	Viscera	74.8	14.7	7.98	1.45
		Frame	69.8	15.7	6.22	7.45
		Head	69.7	16.2	5.03	7.40
		Skin	73.4	19.9	6.43	0.87
		Scales	62.4	22.6	0.08	14.50
	Summer	Viscera	76.5	13.0	6.91	1.40
		Frame	66.3	17.4	7.73	8.41
		Head	70.4	16.6	5.31	7.85
		Skin	68.7	21.7	9.61	1.45
		Scales	44.1	30.3	0.42	25.83
		Roe	76.5	16.9	3.82	1.55
Flounder or blackback (Pseudopleuronectes americanus)	Spring	Viscera	81.4	10.1	2.79	2.41
		Frame	77.0	16.6	1.11	6.93
		Head	75.2	15.8	1.74	6.13
		Skin	77.1	19.7	0.89	1.49
		Scales	62.9	21.4	0.46	15.17
	Summer	Viscera	71.1	12.9	9.39	3.99
		Frame	67.5	18.1	7.40	7.41
		Head	69.9	16.5	5.87	6.13
		Skin	68.2	18.9	11.01	1.69
		Scales	61.1	24.3	0.35	14.83
		Roe	-	-	-	-
Fluke (Paralichthys dentatus)	Spring	Viscera	82.4	13.0	1.43	1.11
		Frame	76.6	15.7	2.20	4.82
		Head	73.0	17.2	3.34	6.04
		Skin	75.7	20.9	1.05	0.95
		Scales	53.5	28.8	0.17	18.53
	Summer	Viscera	78.5	13.5	5.19	1.17
		Frame	67.1	18.0	6.92	6.91
		Head	69.2	17.6	5.35	7.49
		Skin	69.0	23.6	6.45	1.38
		Scales	49.1	33.2	0.31	18.96
		Roe	-	-	-	-
Scup or porgy (Stenotomus chrysops)	Spring	Viscera	70.1	12.1	6.93	7.18
		Frame	60.9	17.3	15.64	6.81
		Head	61.2	15.5	13.98	8.93
		Skin	61.1	18.3	20.79	0.93
		Scales	37.9	30.3	0.46	33.12
	Summer	Viscera	73.1	13.0	2.88	6.42
		Frame	68.2	17.1	8.63	6.47
		Head	67.9	15.9	7.19	9.43
		Skin	64.2	23.5	6.98	2.16
		Scales	35.2	33.4	0.18	29.37
		Roe	-	-	-	-

1/ Composites of each component part.

DISCUSSION

VARIATIONS IN PHYSICAL MEASUREMENTS: Within each species, individual fish varied in size and percentage yield of the component parts. Of the 4 species studied, 3 from the summer catch--sea bass, flounder, and fluke--were larger than the same species from the spring catch. On the other hand, scup or porgy were larger in the spring.

Any difference in size of fish was accompanied by differences in the weight of the component parts. However, the changes in weight were not proportional to changes in the size of the fish. Therefore, the percentage yields of the different component parts varied seasonally. Generally, spring-caught fish contained higher percentage of frame and head coupled with lower percentage of viscera and fillet compared to the summer-caught fish. An exception was noted for scup, where seasonal differences were small in the proportions of the component parts.

VARIATIONS IN CHEMICAL COMPOSITION: The mean oil content of sea bass, flounder, and fluke was significantly lower for the spring catch as compared to the summer catch and was accompanied by a correspondingly higher moisture content. A similar relationship existed between the oil content and the moisture content of scup except that in this case, a significantly greater oil content and a correspondingly lower moisture content were obtained in the spring catch as compared to the summer catch. Similar ratios of oil and water content were reported by Clark and Almy (1920).

The mean protein content of flounder, fluke, and scup for the summer catch was significantly greater than that for the spring catch. The seasonal differences in the mean protein content for sea bass and ash content of the four species were not significant within species.

SUMMARY

Results obtained from the study of the seasonal differences in physical measurements and chemical composition of four species of Middle Atlantic fish indicated that sea bass, flounder, and fluke caught in the summer were larger than these species from the spring catch. The mean size of scup from the spring catch, however, was larger than that of fish from the summer catch. Seasonal changes in yield of component parts were not proportional to changes in the size of the fish. Important differences noted in chemical composition were significantly higher oil content coupled with lower moisture content for summer-caught sea bass, flounder, and fluke and spring-caught scup as compared with spring-caught sea bass, flounder, and fluke, and summer-caught scup.

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