Assessment Material Provided for the 1979 Supplements to the Mackerel, Hake, Herring, Squid, and Other Finfish PMP's

by

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Changes to the final EIS/PMP for the
Atlantic mackerel fishery of the Northwestern Atlantic.

II.C.1.b Replace Table 5 with enclosed table.

Page 24, second paragraph, last sentence: update with 1977 USA landings of 1,376 tons.

Page 26, first paragraph, last sentence: update with total commercial landings for 1977 of 77,598 tons.

Page 28: replace Table 6 with enclosed table.

II.C.1.c Table 6a. Change 1975-1977 statistics as follows and delete footnote no. 2.

Year	Recreational	Commercial	Total
1975	5,968	1,974	7,942
1976	4,202	2,712	6,914
1977	522	1,376	1,898

II.C.1.f(1). Table 15: change 1975-1977 statistics as follows and delete footnote no. 1.

Year	USA	Percent	Foreign	Percent	Total
1975	7,942	3	285,263	97	293,205
1976	6,914	3	239,021	97	245,935
1977	1,898	2	76,222	98	78,120

II.C.1.f(3). Delete first paragraph and replace with the following:

"Fisheries (main species sought category) in which mackerel were caught in SA 5 and SA 6 in 1976 are shown by country in Table 16. A total commercial mackerel catch of 241,733 tons was taken, of which 22,638 tons (9%) occurred as by-catch in fisheries directed toward other species. A total of 91% of this by-catch occurred in directed fisheries for silver hake (63%), herring (16%), squid (6%), and red hake (6%); and 81% was taken by the USSR (68%) and Poland (13%)."

In the second paragraph beginning with the third line, change the existing to: "The international mackerel fishery thus defined had a by-catch of 17% of its directed mackerel catch of 185,689 tons in 1976. Most of this by-catch was silver hake (36%), squid (21%), and other fish (19%). This

by-catch accounted for 14% (11,331 tons) of the silver hake catch in 1976, 13% (6,466 tons) of the squid catch in 1976, and 11% (5,987 tons) of the other fish catch in 1976. Table 17 lists the 1976....".

Replace Tables 16 and 17 with the enclosed Tables 16 and 17.

II.C.1.h. Update Table 20. See material prepared for Other Finfish PMP (in package from Woods Hole, NEFC).

II.C.2.b. In the 1978 Supplement to the Final EIS/PMP for mackerel, this section was deleted and replaced with an enclosure which was verbatim the assessment report on mackerel prepared by E.D. Anderson, NEFC, Woods Hole. This assessment has now been updated and a brief resumé report is enclosed. A more detailed report will be prepared later this summer.

Table 5. Commercial mackerel catches (MT) from the Northwest Atlantic (ICNAF SA 3-6) during 1804-1977.

Year	USA	Year	USA	Canada[1]	Total	Year	USA	Canada	Others[3]	Total
1804	1,631	1862	54,141	-	54,141	1920	8,737	6,456	-	15,193
1805	1,780	1863	63,703	-	63,703	1921	4,551	6,601	-	11,152
1806	1,707	1864	57,579	-	57,579	1922	5,782	11,393	-	17,175
1807	1,931	1865	55,200	-	55,200	1923	15,374	6,429	-	21,803
1808	1,583	1866	49,072	-	49,072	1924	12,292	9,777	-	22,069
1809	1,832	1867	43,400	-	43,400	1925	22,316	8,511	-	30,827
1810	2,605	1868	37,059	-	37,059	1926	30,975	5,238	-	36,213
1811	3,611	1869	48,187	-	48,187	1927	27,365	7,202	-	34,567
1812	1,221	1870	66,464	-	66,464	1928	20,365	5,614	-	25,979
1813	780	1871	55,029	-	55,029	1929	29,079	6,928	-	36,007
1814	278	1872	36,559	-	36,559	1930	23,524	8,094	-	31,618
1815	3,333	1873	37,327	-	37,327	1931	21,493	8,900	-	30,393
1816	6,428	1874	54,595	-	54,595	1932	27,598	8,093	-	35,691
1817	7,754	1875	25,374	-	25,374	1933	18,838[2]	11,942	-	30,780
1818	9,619	1876	45,026	14,223	59,249	1934	23,746[2]	8,654	-	32,400
1819	20,777	1877	22,697	22,474	45,171	1935	29,517[2]	7,279	-	36,796
1820	24,000	1878	33,413	25,129	58,542	1936	25,808[2]	10,324	-	34,132
1821	23,039	1879	37,517	25,994	63,511	1937	12,064	10,846	-	22,910
1822	33,267	1880	59,468	31,896	91,364	1938	19,632	12,951	-	32,583
1823	30,095	1881	66,608	14,699	81,307	1939	14,782	23,612	-	38,394
1824	39,775	1882	64,433	15,552	79,985	1940	18,427[2]	16,206	-	34,633
1825	52,795	1883	38,552	17,520	56,072	1941	21,024[2]	15,924	-	36,948
1826	32,945	1884	81,306	24,732	106,038	1942	23,163[2]	13,745	-	36,908
1827	39,496	1885	56,112	20,281	76,393	1943	26,981[2]	16,819	-	43,800
1828	49,254	1886	13,605	20,785	34,390	1944	33,644	15,543	-	49,187
1829	46,900	1887	15,011	16,415	31,426	1945	26,609[2]	18,234	-	44,843
1830	64,019	1888	8,938	8,595	17,533	1946	23,620[2]	13,387	-	37,007
1831	79,602	1889	4,631	8,646	13,277	1947	26,668	11,911	-	38,579
1832	46,168	1890	4,964	13,351	18,315	1948	23,156	11,735	-	34,891
1833	46,268	1891	8,781	18,393	27,174	1949	19,079	15,203	-	34,282
1834	52,483	1892	9,961	12,771	22,732	1950	10,020	12,349	-	22,369
1835	40,429	1893	11,444	10,220	21,664	1951	7,142	11,221	-	18,363
1836	36,197	1894	10,223	7,859	18,082	1952	8,248	9,973	-	18,221
1837	28,673	1895	5,431	5,775	11,206	1953	3,875	8,371	-	12,246
1838	22,983	1896	16,009	6,239	22,248	1954	1,822	11,570	-	13,392
1839	15,413	1897	4,808	3,783	8,591	1955	1,756	11,275	-	13,031
1840	10,479	1898	4,556	4,603	9,159	1956	1,829	9,584	-	11,413
1841	11,526	1899	6,114	4,708	10,822	1957	1,097	8,800	-	9,897
1842	15,678	1900	20,785	11,433	32,218	1958	2,074	7,299	-	9,373
1843	13,376	1901	15,768	10,501	26,269	1959	1,835	4,286	-	6,121
1844	17,928	1902	10,502	5,930	16,432	1960	1,396	5,957	-	7,353
1845	41,986	1903	11,592	11,352	22,944	1961	1,361	5,459	11	6,831
1846	37,256	1904	8,872	5,005	13,877	1962	938	6,801	175	7,914
1847	52,279	1905	10,121	6,828	16,949	1963	1,320	6,363	1,299	8,982
1848	62,289	1906	5,328	9,309	14,637	1964	1,644	10,786	801	13,231
1849	43,365	1907	11,109	7,001	18,110	1965	1,998	11,185	2,945	16,128
1850	50,343	1908	9,449	10,316	19,765	1966	2,724	11,577	7,951	22,252
1851	68,332	1909	7,691	7,446	15,137	1967	3,891	11,181	19,047	34,119
1852	41,117	1910	2,569	3,166	5,735	1968	3,929	11,134	65,747	80,810
1853	27,673	1911	5,470	4,088	9,558	1969	4,364	13,257	114,189	131,810
1854	28,090	1912	4,608	4,897	9,505	1970	4,049	15,690	210,864	230,603
1855	43,990	1913	6,130	9,771	15,901	1971	2,406	14,735	355,892	373,033
1856	44,479	1914	9,516	6,518	16,034	1972	2,006	16,254	391,464	409,724
1857	35,014	1915	10,550	8,208	18,758	1973	1,336	21,247	396,759	419,342
1858	27,313	1916	13,450	7,078	20,528	1974	1,042	16,701	321,837	339,580
1859	20,695	1917	16,743	7,576	24,319	1975	1,974	13,544	271,719	287,237
1860	48,914	1918	9,146	8,924	18,070	1976	2,712	15,746	223,275	241,733
1861	40,322	1919	7,358	10,425	17,783	1977[4]	1,376	22,477	53,745	77,598

[1]Data not available prior to 1876. [2]Partly estimated.

[3]Data not available prior to 1961. [4]Provisional.

Table 6. Commercial mackerel catches (MT) from ICNAF Subareas 3, 4, and 5 and Statistical Area 6 in 1960-1977.

Year	Bulgaria	Canada	Cuba	FRG	France	GDR	Italy	Japan	Poland	Romania	Spain	USSR	USA	Other	Total
								Subarea 3							
1960	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1961	-	1,010	-	-	11	-	-	-	-	-	-	-	-	-	1,021
1962	-	586	-	-	64	-	-	-	-	-	-	-	-	-	650
1963	-	274	-	-	99	-	-	-	-	-	-	-	-	-	373
1964	-	819	-	-	27	-	-	-	-	-	-	-	-	-	846
1965	-	184	-	-	3	-	-	-	-	-	-	-	-	-	187
1966	-	83	-	-	10	-	-	-	-	-	-	-	-	-	93
1967	-	54	-	-	-	-	-	-	-	-	-	-	-	-	54
1968	-	136	-	-	-	-	-	-	42	-	-	142	-	-	370
1969	-	311	-	-	-	6	-	-	-	-	-	-	-	2	319
1970	-	837	-	-	-	-	-	-	-	-	-	5	-	-	842
1971	-	1,299	-	-	-	-	-	-	-	-	-	-	-	-	1,299
1972	-	1,544	-	-	25	-	-	-	-	-	-	-	-	-	1,579
1973	-	2,339	-	-	164	-	-	-	-	-	-	-	-	-	2,503
1974	-	1,842	-	-	109	-	-	-	-	-	-	-	-	-	1,951
1975	-	3,802	-	-	291	-	-	-	-	-	-	76	-	-	4,169
1976[1]	-	5,231	-	-	-	-	-	-	45	-	-	-	-	-	5,276
1977[1]	-	7,863	-	-	-	-	-	-	-	-	-	2	-	-	7,865
								Subarea 4							
1960	-	5,957	-	-	-	-	-	-	-	-	-	-	-	-	5,957
1961	-	4,449	-	-	-	-	-	-	-	-	-	-	-	-	4,449
1962	-	6,215	-	-	-	-	-	-	-	-	-	-	-	-	6,215
1963	-	6,089	-	-	-	-	-	-	-	-	-	11	-	-	6,100
1964	-	9,967	-	-	-	-	-	-	-	-	-	147	-	-	10,114
1965	-	11,001	-	-	-	-	-	-	-	-	-	402	-	-	11,403
1966	-	11,494	-	-	-	-	-	-	-	-	-	1,234	-	-	12,728
1967	-	11,127	-	-	-	-	-	-	-	-	-	62	-	-	11,189
1968	-	10,932	-	-	-	-	-	19	98	-	-	9,419	-	-	20,468
1969	-	12,946	-	2	-	1,265	-	1	27	-	-	4,075	-	-	18,316
1970	-	14,853	-	208	-	1,047	-	-	49	-	-	3,987	-	-	20,144
1971	-	13,436	-	32	-	10	-	-	2	18	-	9,492	-	-	22,990
1972	-	14,699	37	-	-	31	-	-	245	-	-	5,769	-	-	20,781
1973	-	18,855	36	-	-	-	-	18	-	-	-	16,766	-	-	35,675
1974	-	14,859	-	383	-	-	-	-	1	-	-	27,461	-	-	42,704
1975	19	9,738	200	666	-	-	-	-	-	-	-	21,466	-	-	32,089
1976[1]	11	10,515	408	278	-	-	-	-	-	1	-	16,576	-	-	27,789
1977[1]	-	14,443	180	190	-	-	-	1	19	-	-	250	-	-	15,083
								Subarea 5							
1960	-	-	-	-	-	-	-	-	-	-	-	-	1,011	-	1,011
1961	-	-	-	-	-	-	-	-	-	-	-	-	1,027	-	1,027
1962	-	-	-	-	-	-	-	-	111	-	-	-	822	-	933
1963	-	-	-	-	-	-	-	-	-	-	-	896	1,202	-	2,098
1964	-	-	-	-	-	-	-	-	-	-	-	533	1,264	-	1,797
1965	-	-	-	-	-	-	-	-	1	11	-	2,475	1,467	-	3,954
1966	-	-	-	-	-	-	-	-	6	3	-	5,446	1,903	-	7,358
1967	-	-	1	90	-	48	-	-	507	138	-	11,907	3,216	-	15,907
1968	-	-	68	119	-	3,184	-	1	10,160	253	-	33,961	3,001	-	50,777
1969	1,966	-	253	89	-	2,021	-	197	13,421	140	-	47,547	3,873	-	69,507
1970	1,949	-	-	1,004	-	2,920	-	463	40,987	758	-	56,457	3,092	-	107,630
1971	1,632	-	145	1,175	-	7,090	-	272	43,682	1,774	3	59,074	1,593	-	116,440
1972	7,452	1	9	757	-	25,372	-	209	61,486	515	6	103,686	1,025	-	200,518
1973	24,369	53	-	1,260	-	54,574	-	150	100,729	905	-	132,335	621	-	315,296
1974	3,615	-	-	483	-	10,509	329	13	38,542	1,719	-	96,325	475	-	152,010
1975	12,060	4	401	466	-	25,587	3	62	28,499	74	22	99,144	761	25	167,111
1976[1]	515	-	5,371	965	-	2,752	40	5	30,634	1,816	72	58,892	1,311	1	102,374
1977[1]	138	71	465	-	-	782	366	-	37	-	22	2,867	694	-	5,442
								Statistical Area 6							
1960	-	-	-	-	-	-	-	-	-	-	-	-	385	-	385
1961	-	-	-	-	-	-	-	-	-	-	-	-	334	-	334
1962	-	-	-	-	-	-	-	-	-	-	-	-	116	-	116
1963	-	-	-	-	-	-	-	-	-	-	-	293	118	-	411
1964	-	-	-	-	-	-	-	-	-	-	-	94	380	-	474
1965	-	-	-	-	-	-	-	-	-	-	-	33	531	-	564
1966	-	-	-	-	-	-	-	-	-	-	-	1,252	821	-	2,073
1967	-	-	-	-	-	162	-	45	-	-	-	6,087	675	-	6,969
1968	-	16	-	2	-	158	-	310	448	-	-	7,333	928	-	9,195
1969	117	-	-	-	-	193	-	327	4,977	-	-	37,563	491	-	43,668
1970	2,058	-	-	45	-	2,711	-	1,037	27,153	-	-	68,026	957	-	101,287
1971	26,875	-	-	1,620	-	62,083	-	753	68,612	2,747	47	68,754	813	-	232,304
1972	16,104	-	-	13	-	55,165	800	895	80,513	2,004	-	30,371	981	-	186,845
1973	7,374	-	-	267	-	21,884	375	296	16,525	4,971	-	13,461	715	-	65,868
1974	17,108	-	-	-	-	49,468	91	57	57,561	5,247	-	12,816	567	-	142,915
1975	6,697	-	-	-	-	22,756	46	142	45,782	-	10	7,168	1,213	54	83,868
1976[1]	13,414	-	1,189	-	-	35,398	520	41	20,870	3,579	49	29,833	1,401	-	106,294
1977[1]	2,972	100	272	-	-	7,199	-	15	17,130	1,070	45	19,723	682	-	49,208
								Total							
1960	-	5,957	-	-	-	-	-	-	-	-	-	-	1,396	-	7,353
1961	-	5,459	-	-	11	-	-	-	-	-	-	-	1,361	-	6,831
1962	-	6,801	-	-	64	-	-	-	111	-	-	-	938	-	7,914
1963	-	6,363	-	-	99	-	-	-	-	-	-	1,200	1,320	-	8,982
1964	-	10,786	-	-	27	-	-	-	-	-	-	774	1,644	-	13,231
1965	-	11,185	-	-	3	-	-	-	1	11	-	2,930	1,998	-	16,128
1966	-	11,577	-	-	10	-	-	-	6	3	-	7,932	2,724	-	22,252
1967	-	11,181	1	90	-	210	-	45	507	138	-	18,056	3,891	-	34,119
1968	-	11,134	68	121	-	3,342	-	330	10,748	283	-	50,855	3,929	-	80,310
1969	2,083	13,257	253	91	-	3,485	-	525	18,425	140	-	89,185	4,364	2	131,310
1970	4,007	15,690	-	1,257	-	6,678	-	1,500	68,189	758	-	128,475	4,049	-	230,603
1971	28,507	14,735	145	2,827	-	69,183	-	1,025	112,296	4,539	50	137,329	2,406	-	373,033
1972	23,556	16,254	46	770	25	80,568	800	1,104	142,244	2,519	6	139,826	2,006	-	409,724
1973	31,743	21,247		1,527	164	76,758	375	464	117,254	5,876	-	162,562	1,336	-	419,306
1974	20,723	16,701	-	866	109	59,977	420	70	96,104	6,966	-	136,602	1,042	-	339,580
1975	18,776	13,544	601	1,132	291	48,343	49	204	74,281	74	32	127,854	1,974	82	287,237
1976[1]	13,940	15,746	6,968	1,243	-	38,150	560	46	51,549	5,396	121	105,301	2,712	1	241,733
1977[1]	3,110	22,577	917	190	-	7,981	366	16	17,156	1,070	67	22,342	1,376	-	77,598

[1] Provisional.

able 16. By-catches and by-catch ratios of mackerel (tons) taken in 1976 in SA 5 and 6 in designated fisheries (main species sought category) by country.

	Main species sought							
ountry	Silver hake	Red hake	Herring	Squid	Flounders	Groundfish	Other pelagics	Other fish
uba	1,065 .452							
RG			965 .110					
DR			7 .001	283 .283				258 .535
taly				420 .099				100 .543
apan				46 .006				
oland			2,449 .277	425 .570				
omania	5 .037						8 .296	
pain				121 .009				
SSR	13,082 .316	1,271 .078	42 .004	96 .023				826 .292
SA	53 .003		167 .003	16 .013	7 .001	219 .021	352 .041	355 .022
OTAL	14,205	1,271	3,630	1,407	7	219	360	1,539

Table 17. By-catch ratios and catches for the SA 5 and 6 mackerel fishery by country for 1976.

	Cod	Haddock	Redfish	Pollock	Silver hake	Red hake	Mackerel	Herring	Squid	Flounder	Other groundfish	Other pelagics	Other fish	TOTAL
All countries combined							1.000	.012	.035	-	.007	.009	.032	1.168
Ratio	.002	-	.001	-	.061	.009	185,689	2,200	6,466	70	1,290	1,658	5,987	216,901
Catch	376	9	213	25	11,331	1,587								
Bulgaria							1.000	.008	.002		.001	.002	.018	1.048
Ratio					.017		13,929	105	23		18	27	256	14,591
Catch					233									
Cuba							1.000	.047	.019	.012			.127	1.487
Ratio	.002	.002			.253	.025	5,495	257	105	68			700	8,170
Catch	9	9			1,392	135								
GDR							1.000		.006		-		.021	1.027
Ratio	-				-		37,602		239		8		771	38,623
Catch	2				1									
Italy							1.000						.375	1.375
Ratio							40						15	55
Catch														
Poland							1.000	.035	.114		.026	.027	.034	1.243
Ratio	.002			.001	.004		48,630	1,684	5,547		1,241	1,317	1,643	60,389
Catch	90			25	212									
Romania							1.000	.020	.002		.001	.026	.006	1.144
Ratio	-				.081	.008	5,382	109	13		5	140	31	6,163
Catch	1				437	45								
USSR							1.000	-	.007	-	-	.002	.035	1.193
Ratio	.004		.003		.123	.019	73,408	24	538	2	15	146	2,555	87,630
Catch	274		213		9,048	1,407								
USA							1.000	.017	.001		.002	.023	.013	1.063
Ratio					.007		1,203	21	1		3	28	16	1,280
Catch					8									

Assessment of the Northwest Atlantic mackerel stock - 1978

by

W. J. Overholtz and E. D. Anderson

Catch Statistics

Catch for the ICNAF SA 3-6 mackerel stock totaled 78,000 tons in 1977. The previous assessment (Anderson 1977) estimated that the catch in 1977 would be 92,000 tons or 88% of the TAC of 105,000 tons. Previous estimates of USA recreational catch for 1975-77 were also modified slightly.

Abundance Indices

Information from the 1978 USA spring bottom trawl survey was added to the data base used in the previous assessment. Stratified mean catch per tow in numbers increased from a low in 1977 of 0.946 to 2.614 in 1978. The mean catch per tow in weight (kg) index also increased from 0.199 in 1977 to 0.447 in 1978.

The reason for these increases is probably due to a change in availability and not to increased stock size. In the years prior to 1978 a major foreign fishery in SA 6 concentrated on this stock during the winter months. However, 1978 was the first year since 1962 that this large foreign component was not exploiting the stock, and thus the fish were more available at the time of the survey.

Survey results suggest that the 1976 and 1977 year-classes are poor, as previously assumed. Catches by the Soviet research vessel Argus 28 Jan to 23 March 1978, also show the low abundance of age 1 (1977) and age 2 (1976) fish in 1978. The 1974 and 1973 year-classes appear to be predominant in the stock at the present time.

Assessment Parameters

Fishing Mortality

The cohort analysis for 1962-1977 was rerun using an F of 0.36, at fully-recruited ages estimated for 1977 by Anderson and Paciorkowski (1978).

Recruitment Estimates

Estimates of the 1974-1977 year-classes at age 1 and 1974-76 year-classes at age 2 were obtained using the procedure outlined by Anderson (1977). Results suggest that the estimates for the 1974 and 1975 year-classes at age 1 were approximately correct as previously assumed (Anderson 1977). The 1976 and 1977 year-classes were both assumed to be 700 million fish.

Partial Recruitment

Recruitment to the fishery at age was assumed to be the same as in the last assessment (Anderson 1977): 9% at age 1, 39% at age 2, and 100% at ages 3 and older.

Assessment Results

Stock size (age 1+) continued to decline to a low of 517,000 tons at the beginning of 1978. Spawning stock biomass (50% of age 2 and 100% of age 3 and older) also declined to a low of 405,000 tons.

Six catch options for 1978 were considered because recent estimates of potential Canadian catch for 1978 are considerably larger than previously assumed. The first option assumes that the USA will catch its total allocation of 14,000 tons (commercial and recreational), foreign incidental catch will be the 1,200 ton

allocation, and the Canadian catch will be 25,000 tons. Options 2 and 3 assume the same USA and foreign catch as option 1, but assume a Canadian catch of 50,000 tons and 100,000 tons, respectively.

Option 4 assumes a USA catch (commercial and recreational) of 4,000 tons, a foreign incidental catch of 1,200 tons, and a Canadian catch of 25,000 tons. Options 5 and 6 assume the same USA and foreign catch as in option 4 but assume a Canadian catch of 50,000 tons and 100,000 tons, respectively.

If the desired objective is to maintain the 1980 spawning stock biomass at the 1978 level then under option 5, 55,000 tons could be removed in 1978 and 64,000 in 1979. If stock rebuilding is the desired goal then a lower catch option in 1978 (1 or 4) would rebuild the stock. For instance, if 40,000 tons is removed in 1978 (option 1) a similar amount could be removed in 1979 and stock rebuilding would occur. If catches in 1978 exceed 105,000 tons (option 6) spawning stock biomass in 1980 will decrease even at low levels of F in 1979.

Literature Cited

Anderson, E. D. 1977. Assessment of the Northwest Altantic mackerel stock. Int. Coun. Explor. Sea C.M. 1977/H:40 (mimeo).

_____ and A. L. Paciorkowski. 1978. A review of the Northwest Atlantic mackerel fishery. Int. Coun. Explor. Sea. Symposium on the Biological Basis of Pelagic Fish Stock Management. No. 11 (mimeo).

Table 1. Projected catch in 1979 and spawning stock size in 1980 from the SA 3-6 mackerel stock with fishing mortality ranging from 0.05 to 0.50 under six options of catch in 1978. The resulting changes in spawning stock size (%) that would occur in 1979 and 1980 if the catch option (1-6) were caught in 1978 are listed. All catch and stock sizes are in thousands of tons.

	[1]1978 catch = 40.2				[2]1978 catch = 65.2				[3]1978 catch = 115.2			
F	Catch in 79	Stock in 80	% change in stock from 1978	% change in stock from 1979	Catch in 79	Stock in 80	% change in stock from 1978	% change in stock from 1979	Catch in 79	Stock in 80	% change in stock from 1978	% change in stock from 1979
0.05	17.9	468.4	+15.6	+ 9.4	16.8	446.1	+10.1	+11.0	14.6	401.5	- 0.9	+14.9
0.10	35.1	450.5	+11.2	+ 5.2	32.9	429.2	+ 5.9	+ 6.8	28.6	386.8	- 4.6	+10.7
0.15	51.5	433.3	+ 6.9	+ 1.2	48.3	413.1	+ 1.9	+ 2.8	42.0	372.7	- 8.0	+ 6.6
0.20	67.2	417.0	+2.9	- 2.6	63.0	397.7	- 1.9	- 1.0	54.8	359.2	-11.4	+ 2.8
0.25	82.2	401.4	- 1.0	- 6.2	77.1	383.0	- 5.5	- 4.7	67.1	346.4	-14.5	- 0.9
0.30	96.6	386.5	- 4.6	- 9.7	90.7	369.0	- 9.0	- 8.2	78.9	334.1	-17.6	- 4.4
0.35	110.3	372.2	-8.2	-13.1	103.6	355.6	-12.3	-11.5	90.1	322.3	-20.5	- 7.8
0.40	123.5	358.6	-11.5	-16.2	116.0	342.8	-15.4	-14.7	100.9	311.1	-23.2	-11.0
0.45	136.1	345.6	-14.7	-19.3	127.8	330.5	-18.5	-17.7	111.3	300.3	-25.9	-14.1
0.50	148.2	333.2	-17.8	-22.2	139.2	318.8	-21.3	-20.7	121.2	290.1	-28.4	-17.0
	[4]1978 catch = 30.2				[5]1978 catch - 55.2				[6]1978 catch = 105.2			
0.05	18.4	477.3	+17.8	+ 8.8	17.3	455.0	+12.3	+10.4	15.1	410.4	+ 1.3	+14.0
0.10	35.9	459.0	+13.3	+ 4.6	33.8	437.7	+ 8.0	+ 6.2	29.5	395.2	- 2.5	+ 9.8
0.15	52.7	441.4	+ 8.9	+ 0.6	49.6	421.2	+ 3.9	+ 2.2	43.3	380.7	- 6.1	+ 5.8
0.20	68.8	424.7	+ 4.8	- 3.2	64.7	405.4	+ 0.0	- 1.7	56.5	366.9	- 9.5	+ 1.9
0.25	84.2	408.7	+ 0.8	- 6.8	79.2	390.4	- 3.7	- 5.3	69.1	353.7	-12.7	- 1.7
0.30	99.0	393.5	- 2.9	-10.3	93.0	376.0	- 7.2	- 8.8	81.2	341.0	-15.9	- 5.3
0.35	113.1	378.9	- 6.5	-13.6	106.3	362.2	-10.6	-12.2	92.8	329.0	-18.8	- 8.6
0.40	126.6	365.0	- 9.9	-16.8	119.0	349.1	-13.9	-15.3	103.9	317.4	-21.7	-11.8
0.45	139.5	351.7	-13.2	-19.8	131.2	336.6	-17.0	-18.4	114.6	306.4	-24.4	-14.9
0.50	151.9	338.9	-16.4	-22.7	142.8	324.6	-19.9	-21.3	124.8	295.8	-27.0	-17.8

OPTION 1: equal to US commercial and recreational catch of 14,000 MT, foreign incidental catch of 1200 MT and a Canadian catch of 25,000 MT.

2: same as Option 1, but Canadian catch of 50,000 MT

3: same as Option 1, but Canadian catch of 100,000 MT

4: equal to US commercial and recreational catch of 4,000 MT, foreign incidental catch of 1,200 MT, and a Canadian catch of 25,000 MT.

5: same as Option 4, but Canadian catch of 50,000 MT

6: same as Option 4, but Canadian catch of 100,000 MT

Changes to the final EIS/PMP for the
hake fisheries of the Northwestern Atlantic

II.C.1.b. Add the following catch statistics for 1975-77 to Table 8:

Year	Bulgaria	Canada	Cuba	FRG	GDR	Japan	Poland	Romania	Spain	USSR	USA	Other	Total
1975	1,021	2	1,304	26	29	1	125	122	3	55,795	4,588	49	63,065
1976	-	-	3,658	81	-	6	102	172	5	37,992	3,793	-	45,809
1977	1,305	-	-	-	-	-	-	-	9	39,200	3,749	-	44,263

Add the following catch statistics for 1975-77 to Table 9:

Year	Bulgaria	Cuba	FRG	GDR	Japan	Poland	Romania	Spain	USSR	USA	Other	Total
1975	896	212	-	8	-	16	-	19	32,241	8,278	44	41,871
1976	233	92	-	1	9	113	414	33	15,780	9,511	43	26,229
1977	114	269	-	-	35	83	12	22	13,943	9,452	-	23,921

Add the following catch statistics for 1975-77 to Table 10:

Year	Commercial	Recreational	Total
1975	8,278	197	8,475
1976	9,511	1,706	11,217
1977	9,452	3,948	13,400

Change the footnote to Table 10 to: "the 1960, 1965, 1970, and 1974-77 catches were estimated...."

Add the following catch statistics for 1975-77 to Table 11:

Year	Bulgaria	Romania	Canada	GDR	Japan	Poland	Spain	USSR	USA	Other	Total
1975	19	-	-	-	1	-	8	14,921	55	-	15,004
1976	-	20	-	-	-	-	-	16,738	37	329	17,124
1977	-	-	-	-	-	-	-	2,783	96	-	2,879

Add the following catch statistics for 1975-77 to Table 12:

Year	Bulgaria	GDR	Japan	Poland	Spain	Romania	USSR	USA	Other	Total
1975	14	-	-	-	4	-	11,195	2,065	-	13,278
1976	-	-	-	-	-	35	7,122	3,904	-	11,061
1977	-	-	-	-	1	8	2,370	2,514	37	4,929

II.C.1.f.(1) First sentence. Change "1960-1975" to "1960-1977".

Add the following statistics for 1975-77 to Table 26:

Year	USA Subdiv. 5Ze Landings	USA Subdiv. 5Ze Percent of total	Foreign Landings	Foreign Percent of total	TOTAL
1975	4,588	7	58,477	93	63,065
1976	3,793	8	42,016	92	45,809
1977	3,749	8	40,514	92	44,263

Year	USA Subdiv. 5Zw + SA 6 Landings	USA Subdiv. 5Zw + SA 6 Percent of total	Foreign Landings	Foreign Percent of total	TOTAL
1975	8,475	20	33,436	80	41,911
1976	11,219	40	16,716	60	27,935
1977	13,400	48	14,355	52	27,755

Add the following statistics for 1975-77 to Table 27:

Year	USA Subdiv. 5Ze Landings	USA Subdiv. 5Ze Percent of total	Foreign Landings	Foreign Percent of total	TOTAL
1975	55	<1	14,949	>99	15,004
1976	37	<1	17,087	>99	17,124
1977	96	3	2,783	97	2,879

	USA Subdiv. 5Zw + SA 6		Foreign		
Year	Landings	Percent of total	Landings	Percent of total	TOTAL
1975	2,117	16	11,213	84	13,300
1976	4,549	39	7,157	61	11,706
1977	3,264	57	2,416	43	5,680

II.C.1.f.(3) Replace the first paragraph with the following:

"Fisheries (main species sought category) in which silver hake were caught in SA 5 and 6 in 1976 are shown in Table 29 by country. A total silver hake catch of 81,797 tons was taken in SA 5 and 6 of which 17,623 tons (22%) occurred as by-catch. A total of 91% of this by-catch occurred in directed fisheries for mackerel (64%), red hake (16%), and groundfish (11%); and 86% was taken by the USSR (70%) and the USA (16%)."

In the second paragraph, beginning with the third sentence, add the following:

"The international silver hake fishery thus defined had a by-catch of 37,984 tons (60%) which occurred with its directed silver hake catch of 63,308 tons. Mackerel (37%), other fish (22%), and red hake (17%) comprised most of the by-catch, and these by-catches accounted for 7% (14,205 tons) of the mackerel catch in SA 5 and 6 in 1976, 15% (8,323 tons) of the other fish catch in 1976, and 23% (6,625 tons) of the red hake catch in 1976. Table 30 lists the 1976 by-catches and..."

Replace the fourth paragraph with the following:

"Fisheries (main species sought category) in which red hake were caught in SA 5 and 6 in 1976 are shown in Table 31 by country. A total red hake catch of 28,803 tons was taken in SA 5 and 6, of which 10,535 (37%) occurred as by-catch. A total of 78% of the by-catch occurred in directed fisheries for silver hake (63%) and mackerel (15%), and 97% was taken by the USSR (72%) and the USA (25%).

In the fifth paragraph, beginning with the third sentence, add the following:

"The international red hake fishery thus defined had a by-catch of 8,767 tons (49%) which occurred with its directed red hake catch of 18,018 tons. Silver hake (32%), squid (23%), other fish (19%), and

mackerel (14%) comprised most of this by-catch. These by-catches accounted for 3% (2,784 tons) of the silver hake catch in 1976, 4% (2,048 tons) of the squid catch in 1976, 3% (1,672 tons) of the other fish catch in 1976, and 1% (1,271 tons) of the mackerel catch in 1976. Table 32 lists the 1976 by-catches....".

Replace Tables 29-32 with the enclosed Tables 29-32.

II.C.1.h. Update Table 34 with table of cruises given in changes for Other Finfish PMP.

II.C.2.b. In second paragraph, change first sentence to: "It has been stated above (II.C.1.b.) that recreational catch data are available only for 1960, 1965, 1970, and 1974-77."

In second paragraph, third sentence should read: ".... where data was unavailable for the 1963-1973 period."

II.C.2.b.(3) First paragraph, first sentence; literature citation should be: (Almeida and Anderson, unpublished report).

First paragraph, third sentence should be: "Biomass then increased to 380,000 tons in 1975 but declined to 250,000 tons in 1978. The 1971-1974 year-classes were above average and the strongest observed since the 1964 year-class. The 1975-1977 year-classes appear to be poor based on current estimates, which has resulted in a decrease in stock biomass.

Second paragraph should be as follows: "The Subdiv. 5Zw and SA 6 silver hake stock increased from an average of 76,000 tons during 1955-59 to a period high of 454,000 tons in 1965 and then decreased to 82,000 tons in 1970 (Almeida and Anderson, unpublished report). Stock biomass has since increased, as a result of improved recruitment and reduced catches in 1976-77, to an estimated level of 376,000 tons in 1978".

Third paragraph should be: "The Subdiv. 5Ze red hake stock increased from 68,000 tons in 1968 to 101,000 tons in 1971, declined to 53,000 tons in 1974, increased briefly to about 60,000 tons in 1975-76, and then declined to about 50,000 tons in 1977-78 (Almeida, Anderson, and Herring, unpublished report). The 1974 year-class was strong, but the 1975 and 1977 year-classes are estimated to be quite poor. The current stock size is the lowest observed during the 1968-78 time series."

Fourth paragraph should be: "The Subdiv. 5Zw and SA 6 red hake stock biomass averaged about 133,000 tons during 1968-71, and then declined steadily to 41,000 tons in 1976 (Almeida, Anderson, and Herring, unpublished report). Stock biomass increased to about 60,000 tons in 1978. Recruitment at age 1 has been relatively constant during 1972-78, although these year-classes (1971-77) are 2-3 times smaller than the 9167-70 year-classes."

Table 29. By-catches and by-catch ratios of silver hake taken in SA 5 and 6 in 1976 in designated fisheries (main species sought category) by country.

Country	Main species sought							
	Red hake	Mackerel	Herring	Squid	Flounders	Groundfish	Other pelagics	Other fish
Bulgaria		233 .017						
Cuba		1,392 .253						
FRG			81 .009					
Japan				15 .002				
Poland		212 .004						
Romania		437 .081					15 .556	
Spain				38 .003				
USSR	2,066 .127	9,048 .123		281 .067		23 .138		887 .313
USA	718 .422	8 .007			216 .044	1,871 .182	2 .010	37 .008
Ireland				42 .013			1 .010	
TOTAL	2,784	11,330	81	376	216	1,894	18	924

Table 30. By-catch ratios and catches for the SA 5 and 6 silver hake fishery by country for 1976.

		Cod	Haddock	Red hake	Redfish	Pollock	Mackerel	Herring	Squid	Flounder	Other groundfish	Other pelagic	Other fish	Silver hake	Total
All countries combined															
	Ratio	.018	.001	.105	.003	.001	.224	.022	.034	.026	.027	.007	.131	1.000	1.599
	Catch	1,127	71	6,625	206	59	14,205	1,404	2,164	1,647	1,688	461	8,323	63,308	101,292
Cuba															
	Ratio			.082			.452[r]	.017	.068	.002			.024	1.000	1.645
	Catch			194			1,065	39	160	5			56	2,358	3,878
Romania															
	Ratio			.075			.037	.007	.030					1.000	1.149
	Catch			10			5	1	4					134	154
USSR															
	Ratio	.011		.110	.005		.316	.031	.017		.002	.001	.189	1.000	1.682
	Catch	461		4,550	187		13,082	1,288	721		83	47	7,848	41,457	69,727
USA															
	Ratio	.034	.004	.097	.001	.003	.003	.004	.066	.085	.083	.021	.022	1.000	1.423
	Catch	666	71	1,871	19	59	53	76	1,279	1,642	1,605	414	419	19,359	27,533

Table 31. By-catches and by-catch ratios of red hake taken in SA 5 and 6 in 1976 in designated fisheries (main species sought category) by country.

	Main species sought							
Country	Silver hake	Mackerel	Herring	Squid	Flounder	Groundfish	Other pelagics	Other fish
Cuba	194 .082	135 .025						
Romania	10 .075	45 .008						
USSR	4,550 .110	1,407 .019	97 .008	667 .160		144 .862		678 .240
USA	1,871 .097				71 .020	637 .059	18 .001	11 .002
TOTAL	6,625	1,587	97	667	71	781	18	689

Table 32. By-catch ratios and catches for the SA 5 and 6 red hake fishery by country for 1976.

	Cod	Silver hake	Red hake	Pollock	Flounder	Other groundfish	Herring	Mackerel	Other pelagic	Other fish	Squid	Total
All countries combined												
Ratio	.001	.155	1.000	.004	.013	.027	-	.071	.010	.093	.114	1.488
Catch	15	2,784	18,018	64	243	478	7	1,271	174	1,672	2,048	26,785
USSR												
Ratio		.127	1.000	.004		.009		.078	.008	.083	.122	1.431
Catch		2,066	16,317	64		150		1,271	132	1,354	1,991	23,356
USA												
Ratio	.009	.422	1.000		.143	.193	.004		.025	.187	.034	2.017
Catch	15	718	1,701		243	328	7		42	318	57	3,429

Assessment of Georges Bank silver hake - 1978

by

F. P. Almeida and E. D. Anderson

Catches

Table 1 lists catches by country for the period 1955-1977. Total catch increased from an average of 19,000 tons during 1955-61 to nearly 239,000 tons in 1965 followed by a rapid decline to 18,400 tons in 1969. Catches then increased again and stabilized at an average of about 68,000 tons during 1971-75. The catch then began to decline again in 1976 to 45,800 tons and continued in 1977 to its lowest level since 1970 of 44,300 tons.

USA catch averaged 18,200 tons during 1955-63, but then declined to average only 3,600 tons during 1968-77. The 1977 USA catch was 3,749 tons.

The 1978 foreign catch was 3,687 tons through May 15. Three options of US catch were assumed for use in this assessment to be 5,000, 10,000, and 16,000 tons, and therefore total catch options, assuming minimal foreign catch for the remainder of the year, were 9,000, 14,000, and 20,000 tons.

Catch Composition

Table 2 contains the estimated catch in numbers at age during 1955-77. Age 3 and 4 fish made up the majority of the 1977 catch (89%) following a similar trend in 1976 (87% age 3 and 4 fish).

Mean weights-at-age were applied to the numbers at age in Table 2 to obtain calculated catches. Ratios between observed and calculated catches range from 0.865 to 0.999 and averaged 0.931. The 1977 mean

weights (unadjusted) were used for the 1978-79 catch and stock size projections.

Abundance Indices

USA commercial catch-per-day increased from 22.8 tons in 1975 to 46.1 tons in 1976, the highest catch rate since 1959 but decreased in 1977 to 31.6, the highest rate (after 1976) since 1966. The USA catch-per-day index is based only on a small part of the total fishery and has fluctuated considerably from year to year, but nevertheless has roughly paralleled changes in stock abundance as determined from virtual population analysis since the advent of the USSR fishery began in 1962.

The 1977 USA spring bottom trawl survey catch-per-tow index was the highest observed in the 1968-79 series but dropped to 0.72 in 1978, still higher than any since 1973. The 1977 autumn survey index dropped in 1977 after recording its highest level in 1976. Although the survey indices have not been totally consistent with stock biomass estimates obtained from VPA, the recent increases in both indices do appear to reflect improvement in stock biomass.

Fishing Mortality

Fishing mortality in 1977, the terminal year for virtual population analysis, was estimated for fully recruited ages from a relationship between international fishing effort and fishing mortality. An F of 0.460 was estimated for 1977 based on a regression between fishing effort and fishing mortality values from a previous VPA (Anderson 1977). A new VPA was performed using 0.460 as the terminal F for ages 4 and older in 1977 and a linear regression between fishing effort and mean fishing mortality

values from the new VPA for 1959-75 was run. The predicted F for 1977 was 0.458 and the estimate of 0.460 was, therefore, accepted.

Results from the VPA indicated a continued decrease in F from a high of 1.42 in 1971 to 0.46 in 1977. Fishing mortality was at a low in 1961 at 0.14 but rose to 1.27 in 1965 at the peak of the USSR fishery.

Recruitment Estimates

Estimates of the size of the 1974-77 year classes at age 1 were obtained from a power curve relationship between spring survey catch-per-tow (numbers) at age 1 and year class size at age 1 from VPA. The autumn survey catch-per-tow (numbers) at age 0 has not been consistent with the spring index at age 1 or with year-class estimates from VPA.

The size of the 1974 year-class at age 1 was estimated to be 1,350 million fish, which would make it an above-average year-class exceeded in strength since 1954 only by the 1959-63 and 1973 year classes.

The 1975 and 1976 year classes at age 1 were estimated to be about 550 and 450 million fish, respectively, and are considered to be poor in strength. The largest year class observed was 3,257 million (1962), and the median and mean year-class sizes were 876 and 1,135 million, respectively. The estimated 1975 year-class is exceeded in strength by all but five (including 1976) of the observed or estimated year classes and only three were as poor or poorer than the size estimated for the 1976 year class.

The 1977 year class at age 1 was estimated to be approximately 280 million fish which would make it the poorest observed in the series.

Stock Size

Estimates of stock size for 1955-77 were obtained by VPA (Table 6). Mean weights at age were applied to stock numbers at age to obtain stock biomass values. The yearly biomass values were corrected using the

appropriate ratios between observed and calculated catch (Table 2). Stock size by age at the beginning of 1978 was determined by the relationship: $N_{78} = N_{77}e^{-Z_{77}}$.

Total stock biomass (age 1+) increased from 110,000 tons in 1955 to a high of 800,000 tons in 1963 and then declined to 170,000 tons in 1970. Biomass then increased again to 380,000 tons in 1975 and has since decreased to 250,000 tons in 1978.

Spawning biomass (age 2+) increased from about 93,000 tons in 1957 to 595,000 tons in 1964, decreased to 130,000 tons in 1971, and then increased again to 300,000 tons in 1976. Spawning biomass declined to 223,000 tons at the beginning of 1978.

Partial Recruitment

Silver hake have generally been fully recruited to the fishery in recent years by about age 3 as evidenced by age-specific fishing mortalities obtained by VPA. Partial recruitment, the fishing mortality at each age not fully recruited into the fishery expressed as a percentage of the mean F at the fully recruited ages, during 1977 was estimated to be 1% for age 1, 6% for age 2, 37% at age 3, and 100% for ages 4+. These values reflect to a certain degree the effect of the 60 mm mesh regulation which was implemented effective 1 March 1977 for the foreign hake fishery. These estimates of partial recruitment were also used in the projections of catch and stock size.

Catch and Stock Size Projections

A total stock biomass (age 1+) of 248,100 tons was estimated to be available at the beginning of 1978, a 20% decrease from the 1977 total stock biomass. The age 2+ or spawning stock biomass, was estimated to be 223,400 tons, a decrease from the 1977 estimate of 18%.

Equilibrium yield calculations under conditions of a constant level of recruitment at age 1 and partial recruitment coefficients of 1, 6, 37, and 100% at ages 1, 2, 3, and 4+, respectively, indicate an $F_{0.1}$ of about 0.80.

Catch projections for 1979 and the resulting age 2+ spawning stock biomass in 1980 were calculated with F ranging from 0.05 to 1.00 (Table 3). Three options of total 1978 catch of 9,000 tons requiring an F in 1978 for ages 4 and older of 0.068, 14,000 tons requiring an F of 0.108, and 20,000 tons requiring an F of 0.156 were calculated. An estimated 1978 year-class size of median strength (880 million fish) was also assumed. Fishing at $F_{0.1}$ in 1979 would result in a catch ranging from 75,400 tons, assuming a 1978 catch of 20,000 tons, to 80,300 tons assuming a 1978 catch of 9,000 tons. The resultant decrease in spawning stock biomass would range from 0.7% to 3.7%.

A catch of 71,300 tons (F = 0.680) could be taken in 1979 and still maintain the same spawning stock biomass in 1980 as in 1979, under option 1 (a total 1978 catch of 9,000 tons). Similarly, a catch of 72,500 tons (F = 0.722) could be taken in 1979 under option 2 (total 1978 catch of 14,000 tons) and a catch of 73,700 tons (F = 0.774) could be taken under option 3 (total 1978 catch of 20,000 tons), while still maintaining a constant spawning stock biomass in 1979 and 1980.

References

Anderson, E. D. 1977. Assessment of the Georges Bank silver hake stock. NMFS, NEFC, Woods Hole Lab. Ref. 77-21.

Table 1. Silver hake catch statistics from the Georges Bank stock[1]

Year	Catch (MT)														USA Catch/day (MT)	International effort as USA days fished
	Bulgaria	Canada	Cuba	FRG	GDR	Italy	Japan	Poland	Romania	Spain	USSR	USA	Other	Total		
1955	-	-	-	-	-	-	-	-	-	-	-	19,595	-	19,595	-	-
1956	-	-	-	-	-	-	-	-	-	-	-	20,729	-	20,729	51.50	403
1957	-	-	-	-	-	-	-	-	-	-	-	25,856	-	25,856	51.40	503
1958	-	-	-	-	-	-	-	-	-	-	-	14,498	-	14,498	42.76	339
1959	-	-	-	-	-	-	-	-	-	-	-	15,899	-	15,899	53.51	297
1960	-	-	-	-	-	-	-	-	-	-	-	22,070	-	22,070	35.89	615
1961	-	-	-	-	-	-	-	-	-	-	-	14,468	-	14,468	42.21	343
1962	-	-	-	-	-	-	-	-	-	-	41,900	16,339	-	58,239	39.46	1,476
1963	-	-	-	-	-	-	-	-	-	-	103,697	14,007	-	117,704	29.90	3,937
1964	-	-	-	-	-	-	-	-	-	-	164,763	5,522	-	170,285	41.52	4,101
1965	-	-	-	-	-	-	-	-	-	-	230,666	8,208	-	238,874	24.00	9,953
1966	-	-	-	-	-	-	-	-	-	-	88,086	12,713	-	100,799	26.09	3,864
1967	-	-	-	-	3	-	16	-	-	-	47,348	12,300	-	59,667	31.83	1,875
1968	-	-	-	-	-	-	37	887	-	-	28,013	6,451	14	35,408	25.31	1,399
1969	-	-	-	-	42	-	148	292	7	-	16,144	1,654	119	18,406	13.34	1,380
1970	-	-	-	-	-	-	31	15	73	-	20,548	4,238	-	24,905	23.81	1,046
1971	1,393	-	265	-	-	-	82	124	-	-	66,809	3,069	-	71,742	17.38	4,128
1972	1,914	-	354	226	111	-	104	-	42	-	73,882	879	-	77,512	8.66	8,951
1973	879	-	-	-	145	-	188	251	4	-	55,042	5,698	-	62,207	22.60	2,753
1974	740	1	-	49	36	-	43	70	204	-	62,938	2,283	-	66,364	15.02	4,418
1975	1,021	2	1,304	26	29	-	1	125	122	133	55,795	4,588	49	63,065	22.85	2,760
1976	-	-	3,658	81	-	-	6	102	172	5	37,992	3,793	-	45,809	46.07	994
1977	1,305	-	-	-	-	-	-	-	-	9	39,200	3,749	-	44,263	31.60	1,401

[1]Non-USA catches before 1968 are estimated.

Table 2. Silver hake catch at age (millions of fish) from the Georges Bank stock (+ denotes less than 0.1 million).

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12+	Total	Observed weight	Calculated weight[1]	Obs/Calc
1955	+	3.6	3.1	25.0	39.0	14.5	2.9	1.7	0.7	0.2	+	+	-	90.7	19,595	22,106	0.886
1956	+	2.3	3.5	20.8	42.8	17.2	2.9	1.4	0.6	0.2	+	+	+	91.7	20,729	23,916	0.867
1957	+	11.4	5.7	31.3	47.4	23.7	4.4	1.8	0.6	0.2	+	+	+	126.5	25,856	29,179	0.886
1958	+	4.4	5.5	16.3	22.5	12.5	2.9	1.6	0.5	0.1	+	+	+	66.3	14,498	16,756	0.865
1959	+	3.8	7.7	26.9	23.0	11.5	3.0	1.5	0.7	0.1	+	+	+	78.2	15,899	18,018	0.882
1960	-	2.2	11.7	46.9	33.0	12.6	3.8	2.1	1.0	0.2	+	+	-	113.5	22,070	23,868	0.925
1961	-	0.6	5.1	31.2	25.3	7.1	1.8	1.1	0.5	0.2	+	+	-	72.9	14,468	16,013	0.904
1962	-	1.8	19.1	106.9	109.7	40.5	6.7	3.6	1.0	0.2	+	+	+	289.5	58,239	61,296	0.950
1963	-	17.1	48.8	246.2	240.3	61.0	9.9	4.0	2.1	0.5	0.1	+	+	630.0	117,704	122,128	0.964
1964	+	0.9	80.1	313.6	268.8	98.4	31.9	18.7	9.0	2.3	0.1	0.2	+	824.0	170,285	181,068	0.940
1965	-	31.2	160.0	770.2	460.5	57.0	10.6	5.0	1.8	0.4	0.1	+	+	1,496.8	238,874	255,541	0.935
1966	-	17.1	173.7	264.3	160.1	29.3	8.5	4.1	2.6	0.5	0.1	0.1	+	660.4	100,799	108,727	0.927
1967	-	4.2	11.5	106.9	136.9	31.0	4.8	2.0	1.0	0.2	0.1	+	+	298.6	59,667	64,946	0.919
1968	-	1.6	4.8	76.1	56.5	31.0	6.2	1.9	0.8	0.3	+	0.1	-	179.3	35,408	39,028	0.907
1969	-	1.2	12.8	20.7	15.2	14.4	6.0	5.3	1.9	1.3	0.1	+	+	78.9	18,406	19,701	0.93
1970	-	38.0	27.1	33.0	37.9	14.6	4.2	3.3	1.3	0.3	0.1	+	+	159.9	24,905	25,397	0.981
1971	-	3.3	21.9	110.4	98.1	55.3	21.6	8.9	7.8	3.8	0.7	0.3	-	332.1	71,742	75,261	0.953
1972	0.4	148.2	148.4	102.1	28.2	5.7	3.4	2.2	0.8	0.4	0.2	0.1	0.1	440.2	77,512	82,821	0.936
1973	+	20.5	240.0	78.4	12.2	2.6	1.6	0.9	0.3	0.1	+	+	+	356.6	62,207	63,949	0.973
1974	+	12.0	150.3	122.5	25.3	3.5	3.8	1.6	0.4	0.2	0.1	+	+	319.7	66,364	68,096	0.975
1975	-	17.2	110.7	134.4	42.6	13.8	2.0	0.7	0.1	0.3	0.1	-	-	321.9	63,065	64,685	0.975
1976	-	1.6	20.0	114.2	85.8	7.9	0.9	0.1	-	-	+	-	-	230.5	45,809	45,941	0.997
1977	-	0.2	8.0	75.3	94.8	6.6	1.3	5.6	-	-	-	-	-	190.5	44,263	48,034	0.921

[1]Using mean weights at age.

Table 3. Projected catch (age 1+) from the Georges Bank silver hake stock with fishing mortality ranging from 0.05 to 1.00 under three options concerning the estimated 1978 catch. Resulting stock sizes (age 2+) in 1980 and the percentage changes (by weight) from 1979 are also given. All catch and stock size values are in thousands of tons.

	1978 catch = 9,000 MT			1978 catch = 14,000 MT			1978 catch = 20,000 MT		
F	1979 catch	1980 stock	% change in stock from 1979	1979 catch	1980 stock	% change in stock from 1979	1979 catch	1980 stock	% change in stock from 1979
.05	6.8	292.2	+21.0	6.6	288.5	+21.7	6.3	284.2	+22.5
.1	13.2	286.0	+19.3	12.8	282.4	+20.0	12.4	278.3	+20.9
.15	19.4	280.0	+17.6	18.9	276.6	+18.3	18.2	272.7	+19.2
.2	25.4	274.3	+15.8	24.6	271.0	+16.6	23.8	267.3	+17.6
.25	31.1	268.8	+14.1	30.2	265.7	+15.0	29.1	262.2	+16.0
.3	36.5	263.6	+12.4	35.5	260.7	+13.4	34.3	257.3	+14.4
.35	41.7	258.6	+10.8	40.6	255.8	+11.7	39.2	252.6	+12.8
.4	46.8	253.8	+ 9.1	45.4	251.2	+10.1	43.9	248.1	+11.2
.45	51.6	249.3	+ 7.4	50.1	246.7	+ 8.4	48.4	243.8	+ 9.7
.5	56.2	244.9	+ 5.8	54.6	242.5	+ 6.8	52.8	239.7	+ 8.1
.55	60.6	240.7	+ 4.1	58.9	238.5	+ 5.3	56.9	235.8	+ 6.6
.6	64.9	236.8	+ 2.5	63.0	234.6	+ 3.7	60.9	232.1	+ 5.1
.65	69.0	233.0	+ 0.9	67.0	230.9	+ 2.2	64.8	228.5	+ 3.6
.7	72.9	229.3	- 0.7	70.8	227.3	+ 0.6	68.5	225.1	+ 2.2
.75	76.7	225.8	- 2.2	74.5	224.0	- 0.8	72.0	221.8	+ 0.7
*.8	80.3	222.5	- 3.7	78.0	220.7	- 2.4	75.4	218.6	- 0.7
.85	83.8	219.3	- 5.2	81.4	217.6	- 3.8	78.7	215.6	- 2.1
.9	87.1	216.3	- 6.7	84.7	214.6	- 5.3	81.8	212.8	- 3.5
.95	90.3	213.3	- 8.2	87.8	211.8	- 6.7	84.9	210.0	- 4.9
1.00	93.4	210.5	- 9.6	90.8	209.1	- 8.0	87.8	207.4	- 6.2

*$F_{0.1}$

Assessment of Southern New England - Middle Atlantic Silver Hake - 1978

by

F. P. Almeida and E. D. Anderson

CATCHES

Table 1 lists catches by country for the period 1955-1977. Included in the table are estimates of USA recreational catch. Marine angler surveys provided estimates of the 1960, 1965, 1970, and 1974-77 recreational catches. The ratios between recreational and USA commercial catch were fairly constant in 1965 (0.129), 1970 (0.158), 1974 (0.149), and 1976 (0.179); the 1960 ratio was somewhat higher at 0.221, the 1977 ratio much higher, (0.419) while the 1975 ratio (0.024) was lower. It was felt that the recreational catch in each of the remaining years during 1955-1973 could be estimated by applying the above ratios to the commercial catches in those years. The 1960 ratio was used for 1955-59 and 1961-62, and the weighted average (0.139) of the 1965, 1970, and 1974 ratios was used for 1963-64, 1966-69, and 1971-73.

Total catches averaged about 16,800 tons during 1955-59, declined to 9,952 tons in 1960, and then improved steadily to 137,400 tons in 1966. Catches then dropped sharply to 50,900 tons in 1967 and have since fluctuated between 19,200 and 67,000 tons. Catches increased steadily from 19,200 tons in 1970 to 66,000 tons in 1973 and then declined to 27,900 tons in 1976. The 1977 catch decreased slightly to 27,800 tons.

USA commercial catches during 1955-65 ranged between 8,151 and 25,008 tons and averaged 14,800 tons per year. Catches during 1966-1977 were much lower, ranging between 4,989 and 9,840 tons and averaging approximately 7,400 tons or 18%

of the total catch per year. Estimated recreational catches during 1955-77 ranged between 197 and 3,948 tons and averaged about 1,975 tons per year. The USA commercial and recreational catches in 1977 were 9,431 and 3,948 tons respectively.

The 1978 foreign catch, as of 15 May, was 9,786 tons, and three options of US catch, both commercial and recreational, were assumed for use in this assessment to be 15,000, 20,000, and 25,000 tons. Under these assumptions , total catch options, in 1978, assuming minimal foreign catch for the remainder of the year, were 25,000 30,000, and 35,000 tons.

CATCH COMPOSITION

Table 2 contains the numbers-at-age catch data for 1955-77. Age 2 and age 3 fish have, in recent years, dominated the catch. In 1977, 32% of the catch (in numbers) was age 2 fish and 35% was age 3; as opposed to 54% and 27%, respectively in 1976.

Mean weights were applied to the numbers at age in Table 2 to obtain calculated catches (tons). Ratios between observed and calculated catches ranged between 0.862 and 1.091 and averaged 0.961. The 1977 mean weights (unadjusted) were utilized for the projections of 1979-80 catch and stock size.

ABUNDANCE INDICES

USA commercial catch-per-day increased steadily the last few years from 4.3 in 1974 to 7.7 in 1977 (Table 1). The 1977 index was the highest observed since 1970. Yearly values in this time-series (1964-77) have fluctuated between 4.3 and 7.7 but have not shown any long-term trends nor been totally consistent

with changes in stock biomass calculated from virtual population analysis (VPA). However, the continuous increase in the index since 1974 does not agree with an increase in stock biomass during that time indicated by VPA. The catch-per-day index was calculated using data from trips by vessels 50 gross tons or less from Point Judith, Rhode Island, fishing in waters 55 m (30 fath) or less which landed 50% or more of silver hake. The catch of silver hake on which the index was based averaged only about 1% of the total catch each year. The lack of consistency between the index and results of the VPA in measuring stock biomass may be due to the small percentage of catch from which the index was determined and also that these catches were taken relatively inshore whereas an average of over 75% of the annual catch was taken farther offshore by the foreign fishery. The USA index may reflect abundance of only that portion of the stock found inshore and taken by the USA fishery and may not be totally representative of the entire stock.

The USA autumn bottom trawl survey catch-per-tow index increased from a 1963-77 low of 1.36 kg in 1974 to 3.92 in 1976 and then decreased to 3.09 in 1977. The index initially increased to a peak of 7.62 kg in 1965 and then decreased, fluctuating considerably around a mean of 3.4 in succeeding years. Since 1966, the index has not shown a long-term consistency with the trend in stock biomass determined from VPA. The spring bottom trawl survey catch-per-tow index was lower in 1977 (1.16 kg) than in any other year (1968-78), but increased in 1978 to 1.83 after decreasing steadily since 1975. Since 1971 this index has fluctuated about an average of 1.9 and did not agree with the results of the VPA. In view of the inconsistency of both the autumn and spring survey abundance

indices with stock biomass changes indicated by VPA, it is difficult to evaluate the most recent results of the survey.

FISHING MORTALITY

Fishing mortality in 1977, the terminal year for virtual population analysis, was estimated for fully-recruited ages from a relationship between international fishing effort and fishing mortality. An F of 0.470 was estimated for 1977 based on a regression between fishing effort and fishing mortality values from a previous VPA (Anderson and Almeida 1977). A new VPA was performed using 0.470 as the terminal F for ages 4 and older in 1977, and a linear regression between fishing effort and the mean fishing mortality values from the new VPA from 1955-1975 was run. The predicted F for 1977 was 0.469 and the estimated of 0.470 was; therefore, accepted.

Fishing mortality for fully-recruited ages determined by the VPA between 0.32 and 0.80, averaging about 0.52 during 1955-68. F then increased to 1.05 in 1969, dropped to 0.49 in 1970, increased again to 1.05 in 1971, averaged 0.63 during 1972-74, increased to 1.10 in 1975 and has decreased to average 0.45 in 1976-77.

RECRUITMENT ESTIMATES

The 1975-77 year-class sizes at age 1 were estimated from a power curve relationship between the autumn survey catch per tow at age 0 and the year-class size at age 1 from VPA for 1969-73.

The 1974, 75, 76, and 77 year-classes at age 1 were estimated to be 860, 650, 1020, and 810 million fish, respectively, compared to the mean 1954-73 year-class

size of 750 million fish. The 1976 was estimated to be the strongest since the 1964 year-class and is exceeded in size only by the 1961-64 cohorts. Only eight other cohorts in the 23 year time series are larger than the estimated 1977 year-class.

STOCK SIZE

Estimates of stock size for 1955-77 were obtained from VPA. Mean weights at age were applied to stock size (numbers) at age to obtain stock biomass values. The summed biomass values for each year were adjusted using the appropriate ratios between observed and calculated catch (Table 2). Stock size by age in 1978 was calculated using the relationship:

$$N_{78} = N_{77}e^{-Z77}.$$

Total stock biomass (age 1+) increased from an average of 76,000 tons during 1955-59 to a period high of 454,000 tons in 1965 and then decreased to 82,000 tons in 1970. Biomass increased again to 209,000 tons in 1973, decreased somewhat to average about 189,000 tons during 1974-76, and then increased to 376,000 tons in 1978, the highest biomass observed since 1965.

Spawning stock biomass (age 2+) averaged about 60,000 tons during 1955-60 before increasing to a high of 376,000 tons in 1965. Spawning biomass declined to 66,000 tons in 1970-71, increased to 146,000 tons in 1973-74, dropped to 102,000 tons in 1975, and then increased to 310,000 tons in 1978.

PARTIAL RECRUITMENT

Silver hake have generally been fully recruited to the fishery in recent years by about age 3 as evidenced by age-specific fishing mortalities obtained by VPA. Partial recruitment, the fishing mortality at each age not fully

recruited into the fishery, expressed as a percentage of the mean F at the fully recruited ages, during 1977 was estimated to be .2% for age 1, 19% for age 2, 28% at age 3, and 100% at ages 4 and older. These values reflect to a certain degree the effect of the 60 mm mesh regulation which was implemented effective 1 March 1978 for the foreign hake fishery. These estimates of partial recruitment were used in the porjections of catch and stock size.

CATCH AND STOCK SIZE PROJECTIONS

A total stock (age 1+) biomass of 376,400 tons was calculated to be available at the beginning of 1978. The available spawning stock (age 2+) was calculated to be 310,200 tons. These estimates represent a 23% increase in total stock and 40% increase in spawning stock biomass over the previous year.

Equilibrium yield calculations under conditions of a constant level of recruitment at age 1 and partial recruitment coefficients of .2, 19, 28, and 100% at ages 1, 2, 3, and 4+, respectively, indicate an $F_{0.1}$ of about 0.65.

Catch projections for 1979 and the resulting age 2+ spawning stock biomass in 1980 were calculated with F ranging from 0.05 to 1.00. Three options of total 1978 catch of 25,000 tons requiring an F in 1978 for ages 4 and older of 0.250, 30,000 tons requiring an F of 0.306, and 35,000 tons requiring an F of 0.364 in 1978 were calculated. An estimated 1978 year-class of median strength (650 million fish) was also assumed. Fishing at $F_{0.1}$ in 1979 would result in a catch ranging from 71,200 tons, assuming a 1978 catch of 35,000 tons, to 75,100 tons, assuming a 1978 catch of 25,000 tons. The resulting decrease in spawning stock biomass would range from 8.3% to 10.0%.

Under option 1 (total 1978 catch of 25,000 tons) a catch of 45,900 tons (F = 0.362) could be taken in 1979 and still maintain the same spawning stock biomass in 1980 as in 1979. A catch in 1979 of 46,600 tons (F = 0.380) could be taken under option 2, (total 1978 catch of 30,000 tons) and 47,400 tons (F = 0.400) could be taken in 1979 while still maintaining the same spawning stock biomass in both 1979 and 1980.

REFERENCES:

Anderson, E.D. and F.P. Almeida. 1977. Assessment of the Southern New England Middle Atlantic silver hake stock. NMFS, NEFC, Woods Hole Lab. Ref. 77-30.

Table 1. Silver hake catch statistics from the Southern New England - Middle Atlantic Stock[1].

Year	Catch (MT)													USA catch/day (MT)	International effort as USA days fished
	Bulgaria	Cuba	FRG	GDR	Japan	Poland	Romania	Spain	USSR	USA commercial	USA recreational	Other	Total		
1955	-	-	-	-	-	-	-	-	-	12,412	2,743	-	15,155	-	-
1956	-	-	-	-	-	-	-	-	-	13,390	2,959	-	16,349	-	-
1957	-	-	-	-	-	-	-	-	-	15,390	3,400	-	18,790	-	-
1958	-	-	-	-	-	-	-	-	-	12,039	2,660	-	14,699	-	-
1959	-	-	-	-	-	-	-	-	-	15,398	3,402[2]	-	18,800	-	-
1960	-	-	-	-	-	-	-	-	-	8,151	1,801[2]	-	9,952	-	-
1961	-	-	-	-	-	-	-	-	-	10,562	2,334	-	12,896	-	-
1962	-	-	-	-	-	-	-	-	-	11,932	2,636	-	14,568	-	-
1963	-	-	-	-	-	-	-	-	4,191	17,666	2,451	-	24,308	-	-
1964	-	-	-	-	-	-	-	-	19,434	25,008	3,469[2]	-	47,911	6.90	6,944
1965	-	-	-	-	-	-	-	-	68,493	20,998	2,717[2]	-	92,208	5.68	16,234
1966	-	-	-	-	-	-	-	-	126,211	9,840	1,365	-	137,416	4.60	29,873
1967	-	-	-	-	22	-	-	-	41,242	8,493	1,178	-	50,935	5.23	9,739
1968	-	-	-	-	44	121	-	-	30,812	8,163	1,132	-	40,272	5.25	7,671
1969	746	-	-	2	123	-	-	-	57,820	7,235	1,003[2]	-	66,929	6.24	10,726
1970	439	-	-	-	299	-	40	-	11,493	6,005	950[2]	-	19,226	7.66	2,510
1971	621	-	-	-	70	24	432	-	21,714	4,989	692	-	28,542	4.85	5,885
1972	1,629	474	-	16	101	-	127	-	27,146	5,552	770	-	35,815	6.22	5,758
1973	668	-	1	15	268	92	45	-	57,928	6,098	846[2]	-	65,961	4.77	13,828
1974	1,792	-	-	2	64	70	125	-	49,175	7,200	1,075[2]	-	59,503	4.29	13,870
1975	896	212	-	8	-	16	-	19	32,241	8,278	197[2]	44	41,911	5.26	7,968
1976	33	92	-	1	9	113	414		15,780	9,513	1,706[2]	-	27,935	6.61	4,226
1977	114	269	-	-	35	83	12	13	13,943	9,452	3,948[2]	43	27,755	7.65	3,628

[1]Non-USA catches before 1968 are estimated.

[2]From angler survey; remaining years estimated (see text).

Table 2. Silver hake catch at age (millions of fish) from the Southern New England - Middle Atlantic stock (+ denotes less than 0.1 million).

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12+	Total	Observed weight	Calculated weight[1]	Obs / calc
1955	0.4	19.8	10.9	22.7	24.5	9.9	2.1	0.8	0.3	0.1	+	-	-	91.5	15,155	15,696	.966
1956	-	68.5	51.7	22.7	16.9	6.0	1.4	0.8	0.2	0.1	+	+	-	168.3	16,349	16,536	.989
1957	-	2.8	25.6	36.1	26.1	11.1	3.0	1.2	0.4	0.1	+	+	+	106.4	18,790	19,843	.947
1958	-	23.5	31.8	28.4	17.8	6.2	1.6	0.8	0.2	+	+	+	-	110.3	14,699	15,457	.951
1959	-	13.8	13.4	42.8	28.8	10.2	2.3	0.8	0.2	+	+	+	+	112.3	18,800	20,025	.939
1960	-	13.7	19.3	14.2	11.9	5.5	1.8	1.0	0.4	0.1	+	+	+	67.9	9,952	10,363	.960
1961	-	0.5	6.3	27.0	22.1	5.7	1.5	1.0	0.4	0.2	+	+	+	64.7	12,896	13,788	.935
1962	-	0.6	6.4	29.0	27.0	7.2	1.5	0.8	0.4	0.2	0.1	+	+	73.2	14,568	15,106	.964
1963	-	5.7	24.3	46.8	43.0	13.6	2.0	0.5	0.2	0.1	+	+	-	136.2	24,308	26,189	.928
1964	-	26.2	39.4	106.3	82.4	26.1	4.5	1.8	0.5	0.4	0.2	+	-	287.8	47,911	49,493	.968
1965	-	22.7	66.8	253.2	160.5	31.2	8.4	3.8	1.3	0.4	0.1	+	+	548.4	92,208	95,227	.968
1966	-	8.6	216.8	332.1	192.4	61.0	19.8	8.6	3.5	0.9	0.1	+	+	843.8	137,416	141,433	.972
1967	-	13.6	27.5	118.4	106.6	22.2	4.5	1.7	0.7	0.2	+	+	+	295.4	50,935	52,485	.970
1968	-	9.6	23.2	96.1	64.8	20.3	8.8	3.9	1.2	0.6	0.1	+	+	228.6	40,272	43,546	.925
1969	-	1.5	20.4	120.5	108.5	40.1	10.2	9.1	3.5	1.6	0.1	0.1	-	315.6	66,929	77,721	.861
1970	-	31.8	11.0	10.3	22.5	18.3	5.3	4.3	2.4	0.9	0.2	+	0.1	107.1	19,226	19,940	.964
1971	-	7.5	35.0	50.5	26.6	8.0	3.7	5.9	5.4	2.8	1.0	0.3	+	146.7	28,542	28,968	.985
1972	0.1	52.5	82.4	41.8	13.1	1.7	0.5	0.4	0.1	+	+	-	-	192.6	35,815	40,237	.890
1973	0.1	64.3	173.8	75.5	24.6	3.7	0.9	0.5	0.1	+	-	-	-	343.5	65,961	69,672	.947
1974	+	18.2	136.7	78.0	32.2	3.0	1.4	1.3	0.3	0.3	+	-	-	271.4	59,503	59,840	.994
1975	-	4.6	39.0	90.3	34.4	10.5	1.6	0.1	-	-	-	-	-	180.5	41,911	42,348	.990
1976	0.2	7.6	75.7	38.4	14.1	3.4	0.6	0.1	-	-	-	-	-	140.1	27,935	27,985	.998
1977	+	0.9	30.2	33.1	22.0	6.2	0.9	0.2	-	-	-	-	-	93.5	27,755	26,248	1.057

[1]Using mean wts at age from Table 3.

Table 3. Projected catch (age 1+) in 1979 from the southern New England-Middle Atlantic silver hake stock, with fishing mortality ranging from 0.05-1.00 under three options concerning the 1978 catch. Resulting stock size (age 2+) in 1980 and the percentage change (by weight) from 1979 are also given. All catch and stock size values are in thousands of tons.

	1978 catch = 25,000 MT			1978 catch = 30,000 MT			1978 catch = 35,000 MT		
Fishing mortality	1979 catch	1980 stock	% change in stock from 1979	1979 catch	1980 stock	% change in stock from 1979	1979 catch	1980 stock	% change in stock from 1979
.05	7.1	381.1	+10.9	6.9	376.6	+11.3	6.7	372.1	+11.7
.1	13.9	373.8	+ 9.1	13.9	369.5	+ 9.6	13.1	365.1	+10.0
.15	20.4	366.7	+ 7.4	19.9	362.6	+ 7.9	19.3	358.4	+ 8.4
.2	26.8	359.9	+ 5.6	26.1	356.0	+ 6.2	25.3	352.0	+ 6.7
.25	32.9	353.4	+ 3.9	32.0	349.6	+ 4.4	31.2	345.7	+ 5.0
.3	38.8	347.1	+ 2.1	37.8	343.5	+ 2.7	36.8	339.7	+ 3.3
.35	44.5	341.0	+ 0.4	43.4	337.5	+ 1.0	42.2	334.0	+ 1.7
.4	50.1	335.2	- 1.3	48.8	331.8	- 0.7	47.4	328.4	0.0
.45	55.4	329.5	- 3.1	54.0	326.3	- 2.4	52.5	323.0	- 1.7
.5	60.6	324.1	- 4.8	59.0	320.9	- 4.1	57.4	317.8	- 3.3
.55	65.6	318.8	- 6.6	63.9	315.8	- 5.8	62.2	312.7	- 5.0
.6	70.4	313.7	- 8.3	68.6	310.8	- 7.5	66.8	307.9	- 6.7
* .65	75.1	308.8	-10.0	73.2	306.0	- 9.2	71.2	303.2	- 8.3
.7	79.6	304.0	-11.7	77.6	301.4	-10.8	75.6	298.6	-10.0
.75	84.0	299.4	-13.5	81.9	296.9	-12.5	79.7	294.2	-11.6
.8	88.3	295.0	-15.2	86.1	292.5	-14.2	83.8	290.0	-13.2
.85	92.4	290.7	-16.9	90.1	288.3	-15.9	87.7	285.9	-14.9
.9	96.5	286.5	-18.6	94.0	284.2	-17.6	91.6	281.9	-16.5
.95	100.3	282.5	-20.2	97.8	280.3	-19.2	95.3	278.0	-18.1
1.00	104.1	278.6	-21.9	101.5	276.5	-20.8	98.8	274.2	-19.8

*$F_{0.1}$

Assessment of Georges Bank red hake - 1978

by

F. P. Almeida, E. D. Anderson, and H. A. Herring

CATCHES

Table 1 lists catch by country for the period 1955-77. Catch by USA vessels is taken as by-catch from effort directed towards other species and consequently, the USA catch averaged only 3% of the total annually during 1963-77.

Total catch increased from 860 tons in 1960 to a peak of 53,200 tons in 1965, decreased to 1,900 tons in 1970 and averaged 19,600 tons during 1971-76. The 1977 catch was only 2,900 tons. The USA catch ranged from 5 to 1,518 tons during 1960-1977 and averaged 400 tons annually. The 1977 USA catch was 100 tons.

The 1978 foreign catch as of 15 May was 778 tons. To date, there have been no USA catches of red hake reported in 1978. Assuming a minimal foreign catch for the remainder of the year, the total 1978 catch was estimated to be 1,000 tons for use in this assessment.

CATCH COMPOSITION

Table 2 contains the numbers-at-age catch data for 1955-77. The most abundant age groups in nearly all years were ages 2 and 3. These two ages made up approximately 75% of the catch in 1976-76 but in 1978 the dominance shifted towards ages 3 and 4.

Mean weights-at-age were applied to the numbers-at-age in Table 2 to obtain calculated catches (tons). Ratios between observed and calculated catches varied from 0.975 to 1.005 and averaged 0.992. The 1977 mean weights (unadjusted) were utilized in the projections of 1978-80 catch and stock size projections.

ABUNDANCE INDICES

Due to the nature of the red hake fisheries, both foreign and domestic, there are no commercial catch-per-effort indices for this stock. Effort data for red hake are impossible to separate from effort directed towards other species reported by foreign nations, primarily the USSR, because of the by-catch status this species holds in the fishery.

The USA autumn bottom trawl survey catch-per-tow index decreased from a period high of 7.87 kg in 1963 to a low of 0.72 in 1967 and then fluctuated between 1.01 and 3.02 (average = 1.71) during 1968-74. Catch-per-tow increased in 1975 to 7.63 kg, dropped to 4.42 in 1976, and then increased slightly to 4.98 in 1977. The spring survey catch-per-tow index increased from 0.26 in 1968 to a high of 1.52 kg in 1971 and then decreased to a low of 0.06 in 1978. The two data series do not exhibit similar patterns.

The changes in stock biomass as measured by the spring survey during 1968-77 correspond very well with the results of the virtual population analysis (VPA), whereas the autumn survey indices bear no relationship with the VPA results. The decline shown by the autumn survey from 1963 to 1967 may have reflected a decline in the stock as a result of the high USSR catches during those years. Unfortunately, commercial sampling data do not extend back to 1963 to facilitate

calculation of numbers-at-age data for use in VPA for comparison with the autumn survey results. However, no explanation is currently available concerning the lack of agreement between the autumn survey indices and the changes in stock biomass exhibited by both the spring survey and the VPA.

FISHING MORTALITY

Fishing mortality (F) for fully recruited ages in 1977 was estimated from a linear relationship between fishing effort (calculated by dividing total catch by USA spring survey catch-per-tow) and fishing mortality. An estimate of F=0.960 for 1977 was obtained using the above estimate. Anderson and Almeida (1978) contains a detailed description of the method used in achieving this value as a starting F for the virtual population analysis (VPA).

Fishing mortality from the VPA was low during 1968-71 averaging 0.13 but increased sharply to 1.29 in 1972. By 1974 F decreased to 0.44 but increased to average 1.13 during 1975-77.

RECRUITMENT

The sizes of the 1967-1974 year-classes as age 1 were estimated from the VPA. The 1968 year-class was the largest on record (282 million fish) an increase from 270 million fish in 1967. Since 1968 the size decreased steadily to 147 million fish for the 1973 year-class.

A highly significant linear relationship ($r = 0.956$) was found to exist between the spring survey catch per tow and spawning stock (age 2+) biomass from the VPA (1968-75) and from this relationship, the 1976 and 1977 spawning stock biomass estimates were obtained. From these estimates, and a highly significant

(r=.859) power curve relationship between USA autumn survey (age 0) and VPA age 1 recruitment estimates (1971-1975), the remaining age 1 and 2 stock sizes were determined. For a detailed explanation of the methods used, see Anderson and Almeida (1978). From these calculations, estimates of the 1976 and 1977 year-classes were obtained which were approximately 130 and 85 million fish, respectively.

For the purposes of catch and stock size projections, for 1978-80, the 1978 year-class size at age 1 was assumed to be equal to the median year-class size (145 million fish).

STOCK SIZE

Stock size estimates for 1968-1977 were determined from the VPA. Mean weights-at-age were applied to stock numbers-at-age to obtain stock biomass values. The 1978 stock size at age was determined from the relationship: $N_{78} = N_{77}e^{-Z77}$.

The total stock biomass (age 1+) increased from 68,300 tons in 1968 to a high of 101,100 tons in 1971, declined to 52,600 tons in 1974, increased briefly to average 59,500 tons during 1975-76 and had declined again to 50,700 tons in 1978.

Spawning stock biomass (age 2+) increased from 44,200 tons in 1968 to 85,800 tons in 1971, decreased to 53,700 tons in 1973 and has averaged 37,200 tons since. The estimated 1978 biomass was 38,800 tons.

PARTIAL RECRUITMENT

Red hake have generally been fully recruited into the fishery by age 3 as indicated by age-specific fishing mortalities obtained by the VPA. Partial recruitment, the fishing mortality at each age not fully recruited to the fishery,

expressed as a percentage of the mean F at the fully recruited ages, during 1977 was estimated to be 0% for age 1, 4% for age 2, 10% for age 3 and 100% for age 4 and older. These recruitment values reflect to a certain degree the effect of the 60 mm mesh regulations implemented effective 1 March 1977 for the foreign hake fishery and were used in the projections of catch and stock size.

CATCH AND STOCK SIZE PROJECTIONS

A total stock biomass (age 1+) of 50,700 tons was calculated to be available at the beginning of 1978, and a spawning stock biomass (agd 2+) was calculated to be 38,800 tons. These estimates represent increases of 1.2% and 21% respectively over 1977.

Equilibrium yield calculations under conditions of a constant level of recruitment at age 1 and partial recruitment coefficients of 0, 4, 10, and 100% at ages 1, 2, 3,, and 4+ respectively indicate an $F_{0.1}$ of about 0.80.

Catch projections for 1979 and the resulting age 2+ spawning stock biomass in 1980 were calculated with F ranging from 0.05 to 1.00. A total estimated catch of 1,000 tons, requiring an F for ages 4 and older in 1978 of 0.077, was assumed. Fishing at $F_{0.1}$ in 1979 would result in a catch of 9,500 tons and would allow the spawning stock biomass to increase approximately 4%.

A catch of 11,000 tons (F=0.995) could be taken in 1979 and still maintain the same spawning stock biomass in 1980 as in 1979.

REFERENCES

Anderson, E.D. and F.P. Almeida. 1978. Assessment of the Georges Bank red hake stock. NMFS, NEFC, Woods Hole Lab. Ref. 78-01.

Table 1. Red hake catches (MT) from the Georges Bank stock.[1]

Year	Bulgaria	Canada	Cuba	GDR	Japan	Poland	Romania	Spain	USSR	USA	Other	Total
1960	-	-	-	-	-	-	-	-	-	855	-	855
1961	-	-	-	-	-	-	-	-	-	1,518	-	1,518
1962	-	-	-	-	-	-	-	-	-	963	-	963
1963	-	-	-	-	-	-	-	-	3,205	750	-	3,955
1964	-	-	-	-	-	-	-	-	3,533	5	-	3,538
1965	-	26	-	-	-	-	-	-	52,680	496	-	53,202
1966	-	11	-	-	-	-	-	-	51,181	607	-	51,799
1967	-	7	-	-	-	709	-	61	22,938	458	13	24,186
1968	-	-	-	5	-	-	-	-	4,509	545	-	5,059
1969	-	-	-	-	-	-	-	-	4,237	51	-	4,288
1970	-	-	-	-	-	-	-	-	1,815	100	-	1,915
1971	1,366	-	-	88	6	-	-	-	10,404	111	-	11,975
1972	1,043	-	-	5	187	11	-	-	37,960	160	-	39,366
1973	172	-	-	-	-	9	-	5	24,406	74	-	24,666
1974	72	-	-	-	-	-	149	57	9,145	77	-	9,500
1975	19	-	-	-	1	-	-	8	14,921	55	-	15,004
1976	-	-	329	-	-	-	20	-	16,738	37	-	17,124
1977	-	-	-	-	-	-	-	-	2,783	96	-	2,879

[1]Non-USA catches before 1968 are estimated.

Table 2. Red hake catch-at-age (millions of fish) from the Georges Bank stock (+ denotes less than 0.1 million).

Year	Age 0	1	2	3	4	5	6	7	8	9	10+	Total	Observed weight	Calculated weight[1]	Obs/calc.
1968	-	0.1	2.4	6.9	6.0	3.4	1.1	0.5	0.2	0.1	+	20.6	5,059	5,093	.993
1969	-	0.1	17.5	7.2	2.6	1.0	0.3	0.2	0.1	+	+	29.0	4,288	4,396	.975
1970	-	0.5	5.4	3.4	1.3	0.7	0.3	0.1	0.1	+	+	11.8	1,915	1,962	.976
1971	-	5.9	17.1	13.9	10.5	6.1	2.4	1.0	0.6	0.2	+	57.7	11,975	12,120	.988
1972	-	6.6	42.6	55.8	48.2	28.5	9.0	3.1	1.4	0.5	0.1	195.8	39,366	39,336	1.001
1973	+	8.1	29.7	34.8	14.3	5.6	2.1	0.7	0.4	0.1	0.3	96.1	24,666	24,540	1.005
1974	0.1	14.5	12.1	11.3	5.2	1.6	0.5	0.2	0.1	+	0.7	46.3	9,500	9,557	.994
1975	-	6.6	29.0	21.6	8.7	2.5	1.1	0.7	0.3	0.1	+	70.6	15,004	14,992	1.001
1976	-	3.9	40.4	20.1	10.5	3.4	1.2	1.2	0.2	+	+	80.9	17,124	17,261	.992
1977	-	-	1.9	7.2	4.0	0.4	0.1	0.1	0.1	+	+	13.8	2,879	3,130	.920

[1]Using mean weights at age.

Table 3. Projected catch (age 1+) in 1979 from the Georges Bank red hake stock with fishing mortality ranging from 0.05 to 1.00. Resulting stock sizes (age 2+) in 1980 and the percentage changes (by weight) from 1979 are also given. All catch and stock size values are in thousands of tons.

Fishing mortality	Catch = 1,000 MT		
	1979 catch	1980 stock	% change in stock from 1979
.05	0.8	51.4	+21.5
.10	1.6	50.5	+20.1
.15	2.3	49.7	+18.8
.20	3.0	48.9	+17.5
.25	3.7	48.2	+16.3
.30	4.3	47.5	+15.1
.35	4.9	46.8	+13.8
.40	5.5	46.2	+12.7
.45	6.1	45.6	+11.5
.50	6.6	45.0	+10.4
.55	7.2	44.4	+ 9.1
.60	7.7	43.9	+ 8.1
.65	8.2	43.4	+ 7.1
.70	8.6	42.9	+ 6.0
.75	9.1	42.4	+ 4.9
*.80	9.5	41.9	+ 3.7
.85	9.9	41.5	+ 2.8
.90	10.3	41.1	+ 1.9
.95	10.7	40.7	+ 0.9
1.00	11.1	40.3	- 0.1

*$F_{0.1}$

Assessment of Southern New England - Middle Atlantic Red Hake - 1978

by

F. P. Almeida, E. D. Anderson, and H. A. Herring

CATCHES

Table 1 lists catch by country, both commercial and USA recreational, for the period 1955-1977. Marine angler surveys provided estimates of the 1960, 1965, 1970, and 1974-77 recreational catches. Because of a fairly uniform ratio between recreational and USA commercial catches in the years estimated by the angler-surveys, these ratios were used to estimate the recreational catches in the intervening years. A description of the methods used is found in Anderson and Almeida (1978). Estimated recreational catches ranged from between 52 tons in 1975 to 892 tons in 1962 and averaged 456 tons per year between 1960-77.

Total catches increased from 4,500 tons in 1960 to 61,200 tons in 1966, followed by a considerable fluctuation, due primarily to the variability in the USSR catch which averaged about 80% of the total each year. In recent years, the total catch has declined from 41,800 tons in 1973 to 5,700 tons in 1977. The 1977 catch is the second smallest during 1955-1977.

The 1978 foreign catch as of 15 May was 1,300 tons with the likelihood of minimal additional catches for the remainder of the year. USA commercial and recreational catches for 1978 were assumed to be 4,700 tons, an increase of about 1,500 tons over 1977. The total catch for 1978 was assumed to be 6,000 tons.

CATCH COMPOSITION

Table 2 contains the numbers-at-age catch data for 1955-77. Age 2 and 3 fish dominated the catch in most years except 1968-69 and 1973, when ages 3 and 4 were predominant. In 1976, the catch at age 2 was greater than in any other year, approximately 47%, but in the 1977 catch, ages 2 and 3 again made up the bulk of the catch (61%).

Mean weights-at-age were applied to the numbers at age in Table 2 to obtain calculated catches (tons). Ratios between observed and calculated catches ranged from 0.887 to 1.042 and averaged 0.990. The 1977 mean weights (unadjusted) were utilized in the projections of 1979-80 catch and stock size.

ABUNDANCE INDICES

Due to the difficulty of defining the USA directed red hake effort since most are caught in a mixed fishery situation, there are no commercial catch-per-effort indices for this stock. This same situation holds true for the foreign fishery because of a general inability to distinguish directed red hake effort in the reported statistics.

The USA autumn bottom trawl survey catch-per-tow index exhibited a considerable amount of fluctuation during 1963-77, declining from 8.05 kg in 1963 to 2.67 in 1967, increasing to 6.62 in 1972, dropping to a low of 0.59 kg in 1974, increasing to 4.34 in 1975, and then decreasing to 3.15 kg in 1977. The spring survey catch-per-tow index increased from 1.65 kg in 1969 to 5.55 in 1972, decreased to 1.43 in 1975, increased sharply to 3.54 kg in 1976, dropped to a low of 0.93 in 1977, and then increased sharply again

to 3.59 in 1978. The autumn and spring indices exhibited similar year-to-year fluctuations beginning in about 1971. However, neither index demonstrates a close relationship with the changes in stock size determined from virtual population analysis (VPA) except in terms of showing a stock build-up in the early 1970's followed by a decline. Of the two, the spring index shows a closer correspondence to the results of the VPA.

FISHING MORTALITY

Fishing mortality (F) for fully recruited ages in 1977 was estimated from a linear relationship between fishing effort (calculated by dividing total catch by USA spring survey catch-per-tow) and fishing mortality. An estimate of F = 0.450 for 1977 was obtained using the above relationship. Anderson and Almeida (1978) contains a detailed description of the method used in achieving this value as a starting F for the virtual population analysis.

Fishing mortality increased sharply from 0.25 in 1968 to 0.98 in 1969, dropped to 0.35 in 1971, then increased to average 0.92 during 1973-76 and dropped to 0.45 in 1977.

RECRUITMENT

The sizes of the 1967-74 year-classes at age 1 were estimated from the VPA. The 1969 year-class was the largest on record (615 million fish) an increase from 337 million fish in 1967. Since 1969, the year-class size decreased steadily to 130 million fish in 1974. A highly significant linear relationship (r=0.971) was found to exist between the spring survey catch-per-

tow (numbers) at age 1 and the year-class size at age 1 from the VPA for the 1967-74 year-classes. From this relationship, the 1975 year-class size at age 1 was estimated to be 175 million fish. This same relationship was used in estimating the 1976 and 1977 year-class sizes which were approximately 175 and 250 million fish, respectively.

For the purposes of catch and stock size projections, for 1979-80, the 1978 year-class size at age 1 was assumed to be equal to the median year-class size (225 million fish).

STOCK SIZE

Stock size estimates for 1968-1977 were determined from the VPA. Mean weights-at-age were applied to stock numbers-at-age to obtain stock biomass values. The 1978 stock size at age was determined from the relationship: $N_{78} = N_{77}e^{-Z}77$.

Total stock biomass (age 1+) ranged from 121,100 tons to 143,600 tons during 1968-71 averaging 133,300 tons, then dropped steadily to 40,800 tons in 1976. The estimates have shown a slight increase from the low in 1976 reaching 59,800 tons in 1978.

Spawning stock biomass (age 2+) ranged from 88,900 tons to 125,200 tons during 1968-71 averaging 106,800 tons, steadily decreased to a low of 25,300 tons in 1976. These estimates have increased slightly since 1976 and reached 42,500 tons in 1978.

The sudden drop in stock biomass in 1970 resulted from the sharp increase in catch from 15,100 tons in 1968 to 51,000 tons in 1969 (Table 1). The catch dropped in 1970 to 10,700 tons and the stock was able to recover

briefly in 1971 due, in large part, to the strong 1969 year-class, but then declined in the following years as a result of increased catches and reduced recruitment.

PARTIAL RECRUITMENT

Red hake have generally been fully-recruited into the fishery by about age 3 as evidenced by age-specific fishing mortalities obtained by the VPA. Partial recruitment; the fishing mortality at each age not fully recruited to the fishery, expressed as a percentage of the mean F at the fully recruited ages, during 1977 was estimated to be 10% for age 1, 20% for age 2 and 100% for ages 3 and older. These values reflect to a certain degree the effect of the 60 mm mesh regulations implemented 1 March 1977 for the foreign hake fishery and were used in the projections of catch and stock size.

CATCH AND STOCK SIZE PROJECTIONS

A total stock biomass (age 1+) of 59,800 tons was calculated to be available at the beginning of 1978 and a spawning stock (age 2+) biomass was calculated to be 42,500 tons. These estimates represent increases of 38% and 36% respectively over the previous year.

Equilibrium yield calculations under conditions of a constant level of recruitment at age 1 and partial recruitment coefficients of 10, 20, and 100% at ages 1, 2, 3+ respectively indicate an $F_{0.1}$ of about 0.65.

Catch projections for 1979 and the resulting age 2+ spawning stock biomass in 1980 were calculated with F ranging from 0.05 to 1.00. A total

estimated catch of 6,000 tons requiring an F for ages 4 and older in 1978 of 0.269 was assumed. Fishing at $F_{0.1}$ in 1979 would result in a catch of about 16,700 tons and would allow the spawning stock biomass to increase by 4%.

A catch of 18,500 tons (F = 0.743) could be taken in 1979 and still maintain the same spawning stock biomass in 1980 as in 1979.

REFERENCES:

Anderson, E.D. and F.P. Almeida. 1978. Assessment of the Southern New England - Middle Atlantic red hake stock. NMFS, NEFC, Woods Hole Lab. Ref. 78-06.

Table 1. Red hake catch (MT) from the Southern New England - Middle Atlantic stock.[1]

Year	Bulgaria	Cuba	GDR	Japan	Poland	Romania	Spain	USSR	USA commercial	USA recreational	Total
1960	-	-	-	-	-	-	-	-	4,174	317[2]	4,491
1961	-	-	-	-	-	-	-	-	8,047	612	8,659
1962	-	-	-	-	-	-	-	-	11,737	892	12,629
1963	-	-	-	-	-	-	-	770	29,608	770	31,148
1964	-	-	-	-	-	-	-	8,427	32,622	848[2]	41,897
1965	-	-	-	-	-	-	-	17,611	24,759	634[2]	43,004
1966	-	-	-	-	-	-	-	57,430	3,629	94	61,153
1967	-	-	-	-	39	-	-	29,539	5,788	150	35,516
1968	-	-	-	-	-	-	-	8,698	6,464	575	15,737
1969	114	-	-	-	-	-	-	44,913	5,491	489[2]	51,007
1970	197	-	-	-	-	-	-	5,534	4,591	410[2]	10,732
1971	1,218	-	9	8	-	-	-	23,234	3,225	287	27,981
1972	471	-	40	549	5	43	-	33,368	1,995	177	36,648
1973	216	-	-	2	25	-	-	37,640	3,603	317	41,803
1974	401	-	-	-	-	51	-	20,917	2,182	191[2]	23,742
1975	14	-	-	-	-	-	4	11,195	2,065	52[2]	13,330
1976	-	-	-	-	-	35	-	7,122	3,904	645[2]	11,706
1977	-	37	-	-	-	8	1	2,370	2,514	750[2]	5,680

[1]Non-USA catches before 1968 are estimated.

[2]From angler surveys; remaining years estimated (see text).

Table 2. Red hake catch-at-age (millions of fish) from the Southern New England-Middle Atlantic stock (+ denotes less than 0.1 million).

Year	Age 1	2	3	4	5	6	7	8	9	10+	Total	Observed weight	Calculated weight	Obs calc.
1968	2.7	14.3	24.4	20.5	5.8	2.5	1.2	0.5	0.2	0.2	74.1	15,737	17,748	.887
1969	1.6	25.6	98.4	64.3	20.4	6.2	2.1	1.0	+	+	219.6	51,007	51,441	.992
1970	5.3	12.1	19.8	10.7	3.4	1.4	0.7	0.3	0.1	+	53.8	10,732	10,903	.984
1971	3.2	74.4	50.3	21.2	5.9	2.3	1.1	0.7	0.3	0.1	159.5	27,981	27,537	1.016
1972	5.6	72.4	84.4	39.0	10.8	4.4	1.6	0.9	0.1	+	219.2	36,648	36,363	1.008
1973	6.3	27.6	60.6	36.5	27.1	4.8	2.2	1.7	0.3	+	167.1	41,803	40,111	1.042
1974	4.7	30.9	39.8	19.1	13.2	1.9	0.9	0.8	0.2	-	111.5	23,742	23,852	.995
1975	5.8	20.0	19.7	10.9	3.5	2.1	1.1	0.2	0.7	+	63.9	13,330	13,340	.999
1976	3.0	30.2	17.1	8.2	2.6	1.4	0.7	0.1	0.6	+	64.0	11,706	11,860	.987
1977	6.3	8.0	9.4	3.1	1.1	.3	.2	.1	-		28.5	5,680	5,721	.993

Table 3. Projected catch (age 1+) in 1979 from the Southern New England-Middle Atlantic red hake stock with fishing mortality ranging from 0.05-1.00. Resulting stock sizes (age 2+) in 1980 and the percentage changes (by weight) from 1979 are also given. All catch and stock size values are in thousands of tons.

	1978 catch = 6,000 MT		
	1979 catch	1980 stock	% change in stock size from 1979
.05	1.6	76.6	+22.6
.10	3.2	75.1	+21.1
.15	4.6	73.5	+19.4
.20	6.0	71.7	+17.4
.25	7.4	70.7	+16.2
.30	8.8	69.3	+14.5
.35	10.0	68.0	+12.9
.40	11.3	66.7	+11.2
.45	12.4	65.5	+ 9.5
.50	13.6	64.4	+ 8.0
.55	14.7	63.2	+ 6.2
.60	15.7	62.2	+ 4.7
*.65	16.7	61.1	+ 3.0
.70	17.7	60.1	+ 1.4
.75	18.7	59.1	- 0.3
.80	19.6	58.2	- 1.8
.85	20.4	57.3	- 3.4
.90	21.3	56.4	- 5.1
.95	22.1	55.5	- 6.8
1.00	22.9	54.7	- 8.3

*$F_{0.1}$

General Information

Commercial Fisheries:

Georges Bank:

The 1977 catches totaled 2,127 MT of which the US harvested 361 MT (Table 1). These catches were primarily during the winter/spring period in the Mid-Atlantic and Southern New England waters prior to extended jurisdiction.

The foreign allocation of 21,000 MT was not realized due to a failure of the fishery in the "herring window" during the spawning season.

For 1978 there is no foreign allocation in this fishery. The US catches from the winter/spring fishery were 2,057 MT (preliminary).

Gulf of Maine:

There was no foreign allocation in 1977 or 1978 for herring in the Gulf of Maine.

The US catch from the adult fishery in 1977 totaled 17,891 MT a decline of 6.8% from 1976 catches of 19,204 MT.

The 1977 winter/spring fishery showed an increase, while the catches in the autumn on spawning fish declined.

In 1978 the winter/spring catches declined to 10,685 MT (preliminary), a decrease of 18% from 1977 levels.

The 1970 and 1973 year-classes were dominant in the 1977 catches and the first quarter 1978 landings.

The catchesin the 1977 Maine juvenile fishery increased over 1976 levels, 32,357 vs. 30,195 MT and the age composition was dominated by the 1975 year-class (Table 2).

The catch of 1975 year-class (age 2), and 1976 year-class (age 1) fish were the highest recorded in the juvenile fishery since 1968 and 1971, respectively (Table 2).

Survey Results:

In January 1978 the US R/V ALBATROSS IV conducted an inshore (≤15 faths.) herring survey between Cape Cod and Cape Hatteras. Additional surveys in the winter/spring were conducted by the R/Vs ANTON DOHRN (FRG), WIECZNO (Poland), ARGUS (USSR) and ALBATROSS IV (US) in the offshore sampling strata.

The age composition (numbers) in the inshore survey revealed that the 1973, 1970, 1975 and 1974 year-classes predominated.

In contrast to this, in the offshore surveys, for the Georges Bank to Mid-Atlantic region, the 1975 year-class (57.6%) in numbers dominated the age composition. It was also noted that the 1970, 1971, and 1972 year-classes accounted for less than 2% of the offshore age composition.

Tagging Studies:

Tagged herring have continued to be recovered in the 1978 winter/spring fisheries off Pt. Judith, R.I., in Cape Cod Bay, and in Chedabucto Bay (NS). These returns represent fish tagged under the International Herring Tagging Program (INT) on Jeffreys Ledge and the Great South Channel area of Georges Bank in April-May 1977, and Canadian tagging along SW Nova Scotia during the summer-autumn 1977.

Table 1. Catch of herring from Georges Bank

Year	USA	Canada	FRG	GDR	USSR	Poland	Japan	Bulg	France	Iceland	Norway	Romania	Others	Cuba	Total
1960															
1961	105				67,550										67,655
1962	101				151,864	277									152,242
1963	322				97,646										97,968
1964	489				130,914	35									131,438
1965	1,191				38,262	1,447						1,982			42,882
1966	4,308			1,133	120,113	14,473						2,677			142,704
1967	1,211	1,306	28,171	22,159	126,759	37,677	40					1,420			218,743
1968	758	13,674	71,086	67,719	143,097	75,080	171			292		1,656	65		373,598
1969	3,678	945	61,990	44,624	138,673	45,021	583	812		12,786	1,224	337	85		310,758
1970	2,011	7	82,498	28,063	61,579	70,691	1,412	348				605			247,294
1971	3,822	12,863	54,744	18,447	81,258	88,325	2,466	4,551				898			267,374
1972	2,782 (4,000)	53 (5,800)	27,703 (31,600)	40,016	48,072 (48,200)	49,392 (49,400)	1,161 (1,200)	2,355	500			2,156 (600)	(8,200)		174,190 (150,000)
1973	4,627 (5,250)	5,083 (5,050)	31,501 (31,600)	53,326	52,340 (48,200)	49,275 (49,400)	1,722 (1,200)	1,380	2,784			297 (1,300)	(8,000)		202,335 (150,000)
1974	3,370 (6,955)	217 (2,980)	23,690 (23,900)	31,530 (31,440)	41,541 (41,725)	39,312 (39,000)	2,442	1,773	3,617			2,018	(4,000)		149,510 (150,000)
1975	4,582 (8,400)	0 (3,000)	22,957 (23,750)	30,901 (31,150)	40,945 (41,100)	38,392 (38,400)	1,878	421	3,304			1,544	10 (4,200)	1,162	146,096 (150,000)
1976	744 (12,400)	- (1,000)	8,806 (9,200)	7,891 (9,300)	12,996 (12,190)	10,517 (11,000)	868 (1,100)	105 (900)	1,166 (1,100)			115 (800)	3 (10)	296 (1,000)	43,507 (60,000)
1977	361 (12,000)	2 (1,000)	-- (4,725)	-- (4,825)	1,492 (3,400)	119 (5,100)	--	1 (100)	-- (1,000)			-- (100)	(50)	152 (700)	2,127 (33,000)

Note: National allocations in parentheses.

Table 2. Maine juvenile fishery herring catches (metric tons).

Year	Age									
	1	2	3	4	5	6	7	8	8+	Total
1947	1,368.66	32,500.70	31,616.64							65,486
1948	4,341.62	27,440.88	44,654.50							76,437
1949	11,992.70	29,915.12	32,121.18							74,029
1950	280.73	30,644.49	59,631.78							90,557
1951	18,017.60	8,048.73	8,344.67							34,411
1952	5,357.71	44,618.57	29,162.72							79,139
1953	20,032.93	18,271.15	20,032.92							58,337
1954	6,067.15	19,969.68	38,030.17							64,067
1955	8,714.25	19,238.35	15,553.40							43,506
1956	5,292.92	33,306.85	27,894.23							66,494
1957	3,218.42	43,802.06	21,602.52							68,623
1958	4,498.28	36,591.90	39,668.82							80,759
1959	2,238.16	15,805.03	34,993.81							53,037
1960	949.57	37,864.02	20,534.41							59,348
1961	2,702.67	14,575.12	6,853.21							24,131
1962	624.38	64,519.68	4,231.94							69,376
1963	735.85	17,927.86	48,231.29							66,895
1964	1,209.57	16,644.74	4,023.13	4,154.61	262.95					26,295
1965	449.23	24,675.67	5,872.10	352.97	738.03					32,088
1966	174.31	6,330.20	18,452.09	274.52	648.05	199.02	74.71	24.90		26,178
1967	224.50	6,635.10	14,575.42	5,819.10	113.40	698.43	-	-	424.05	28,490
1968	79.80	21,036.80	7,931.70	743.90	376.30	-	32.60	-	-	30,205
1969	71.56	6,702.41	15,909.28	882.52	71.56	95.41	71.56	23.85	23.85	23,852
1970	294.48	6,257.70	4,421.51	2,672.51	531.29	726.21	294.48	265.03	117.79	15,581
1971	1,908.50	2,837.80	1,731.20	3,388.10	1,792.50	409.40	127.20	126.30	86.30	12,407
1972	3.1	17,360.3	832.8	491.8	242.0	318.3	264.3			19,513
1973	164.	8,100.	7,456.	193.	164.	80.	121.	55.	65.8	16.400
1974	486.	9,074.	5,489.	3,780	230.	75.	9.			19,143
1975	796.5	8,450.8	2,538.7	924.5	1,248.8	96.3	7.7	120.1		15,182
1976	477.6	13,227.6	12,740.2	1,202.7	1,121.7	1,389.9	11.0	5.5	16.2	30,195
1977	1,316	18,541	8,022	2,161	535	381	1,358	3.3	39.7	32,357

II.C.1.b. The catch rapidly increased to a high of 42,918 tons in 1972, declined to 15, 926 tons in 1973, and fluctuated between 18,000 to 21,000 tons for the years 1974-1977.

Page 31 (2nd paragraph): The US herring fishery off Pt. Judith, R.I., is a winter/spring inshore fishery. Catches ranged between 2,000 and 4,000 tons during the period 1969-1975. In 1976 and 1977 catches sharply declined to 744 tons and 361 tons, respectively.

Page 31 (end of 1st paragraph): Total catches declined 235% in 1976 due to a greatly reduced TAC (60,000 tons) down from 150,000 tons set in 1975. The international fishery in 1977 was restricted to the "herring window" east of Cultivator Shoals. The failure to find concentrations of spawning fish resulted in catches less than 500 tons. The major portion of the 1977 catch of 2127 tons was taken in the winter/spring period prior to extended jurisdiction.

Page 31 (2nd paragraph last sentence): The Canadian catch has declined from a peak catch of 13,674 tons in 1968 to 217 tons in 1974 and 2 tons or less in 1975 - 1977.

II.C.1.f.(3) Non-target Species Mortalities -

First paragraph, 2nd sentence: A total sea herring catch of 93,906 tons was taken, of which 3,993 tons (4%) occurred as by-catch in fisheries directed toward other species. A total of 90% of this by-catch occurred in directed fisheries for two species, mackerel (55%), and silver hake (35%), and 77% was taken by two countries Poland (42%) and USSR (35%). Herring caught as by-catch accounted for approximately 6% of the total TAC allocation of 67,000 tons in the Gulf of Maine and Georges Bank.

Page 48 (2nd sentence): The international herring fishery thus defined had a by-catch of 11% of the directed herring catch of 89,795 tons. Mackerel (38%), other pelagics (23%) and squid (17%) constituted most of the by-catch. These by-catches accounted for 2% (5077 tons) of the mackerel catch in 1976, for 1% (3349 tons) of the other pelagics catch in 1976, and for 5% (2274 tons) of the squid catch in 1976. Talbe 23 lists 1976 by-catches and by-catch ratios in the herring fishery for all countries combined and for individual countries.

II.C.2.b and c. Abundance and Current Status

This section should be updated to reflect the following:

1. An analytical assessment of the status of Georges Bank and Gulf of Maine herring stocks is currently not available.

2. Recent (Winter-Spring 1978) research vessel surveys have indicated that the 1970 year-class has apparently been fished out of the offshore Georges Bank stock. The surveys also indicate that the 1971-1972 year-classes are extremely weak. The fact that these 3 year-classes only accounted for 2% of the fish captured in offshore surveys may in part explain the total failure of the Autumn 1977 Georges Bank fish. The 1977 total catch of herring from the Georges Bank stock was only 2,127 MT (although the OY was 33,000 MT). Only about 500 tons was taken in the Autumn Georges Bank fishery within the "herring window" although the bulk of the 21,000 MT foreign allocation was available to be filled at that time. The 1978 research vessl surveys indicate that about 73% of the offshore herring stock (in numbers) from Georges Bank to the Mid Atlantic region is from the 1975-1976 year-classes. These young fish would not have been expected to contribute to the 1977 Autumn spawning ground fishery.

   The evidence to data indicates that the 1975 year-class and possible also the 1976 year-class are probably stronger than average. Nevertheless, because of the failure of the fishery in 1977 and the uncertainty of the size of the recruiting year-classes, it is appropriate to make the conservative assumption that the Georges Bank stock is currently in a depressed state.

3. The spring (first quarter) 1978 Gulf of Maine adult herring fishery was heavily dependent on older fish (1970 and older year-classes comprising about 40% of the catch. The 1973-1975 year-classes constituted most of the remaining catch. As with the Georges Bank stock, the 1971-1972 year-classes appear to be extremely weak.

   The preliminary estimate of the 1978 winter/spring catch of herring in the Gulf of Maine was 10,685 MT, 18% lower than in 1977. The total catch of the 1977 Gulf of Maine adult fishery was about 7% lower than in 1976. This declining trend in catch of an unregulated fishery for a valuable resource may indicate a continuation of the decline in abundance indicated by earlier assessments. The surplus yield of the Gulf of Maine adult

herring fishery is heavily dependent on the size of recruiting year-classes and above average size year-classes would be necessary to have offset catches of the magnitude that have occurred in recent years. Thus, it is likely that the current stock is substantially below the optimum stock size established by ICNAF for the Gulf of Maine adult herring population. Unless the 1976 year-class is particularly strong, it is necessary to reduce the catch in 1979 if further declines in abundance are to be avoided. Data from the juvenile fishery does indicate that both the 1975 and 1976 year-classes may be particularly strong, but the reliability of the catch data from the juvenile fishery is an index of year-class strength is questionable because; (1) the fishing mortality rate in the juvenile fishery has probably increased in recent years and (2) the proportion of the Maine juvenile catch from stocks other than the Gulf of Maine is unknown and probably varied from year to year.

II.C.3.b. Optimum Yield

This section should be modified to reflect decisions based on discussion in II.C.2. b and c. and other biological, social and economic considerations. Note 1978 PMP and proposed FMP indicate no foreign surplus.

II.C.e.b.c. Update, particularly if there is no foreign surplus.

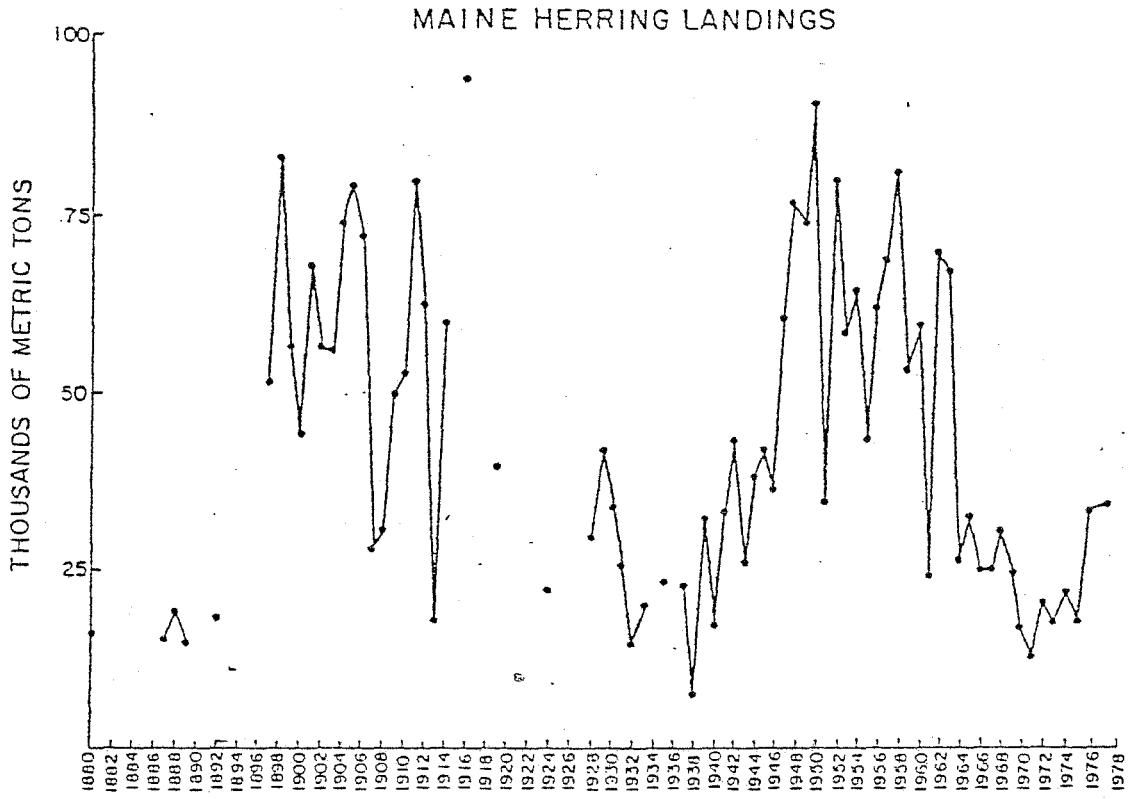

Figure 3. The catch of Atlantic herring along the coast of Maine used primarily by the sardine industry.

Table 22. By-catches (metric tons) and by-catch ratios of herring taken in 1976, in the Gulf of Maine and Georges Bank fisheries (main species sought category) by country.

Country	Main Species Sought					
	Silver hake	Red hake	Mackerel	Other fish	Squid	Other Pelagics
Bulgaria			105 .008			
Cuba	39 .017		257 .047			
GDR				3 .006	74 .074	
Japan					156 .020	
Poland			1684 .035			
Romania	1 .007		109 .020			5 .185
USSR	1288 .031		24 -	91 .032		3 -
USA	76 .004	7 .004	21 .017	50 .007		
TOTALS	1404	7	2200	144	230	8

Table 23. Herring by-catch ratios and catches by nation for ~~1974.~~ 1976

	Cod	Redfish	Pollock	Silver Hake	Red Hake	Other groundfish	Herring	Mackerel	Other pelagics	Other fish	Squid	Total
All countries combined	-	-	.002	.001	.001	.003	1.00	.040	.025	.017	.018	1.107
Catch	9	14	143	86	97	297	89795	3630	2263	1504	1613	99451
France												1.47
Ratio			.003			.044	1.00					
Catch			3			51	1166					1220
FRG												1.486
Ratio	.001		.015	.009			1.00	.110	.238		.113	
Catch	5		134	81			8806	965	2098		996	13085
GDR											.010	1.012
Ratio			.001				1.000	.001				
Catch			6				7814	7			75	7902
Japan												1.091
Ratio							1.00			.038	.053	
Catch							7.2			27	38	777
Poland												1.401
Ratio						.028	1.00	.277	.019	.033	.044	
Catch						245	8833	2449	165	288	391	12371
USSR												1.161
Ratio	-	.001			-	.008	1.00	.004		.102	.010	
Catch	3	14			3	97	11593	42		1178	113	13043
USA												1.169
Ratio	-				-	-	1.00	.003		.166		
Catch	1				2	1	49950	167		11		50132
Canada												1.00
Ratio							1.00					
Catch							921					921

Table 26 (update) - Summary of cruises by nation and year providing data of potential value for herring in the Gulf of Maine and Georges Bank.

1976	Poland	WIECZNO	Herring larvae Bottom trawl survey
	GDR	E. HAECKEL	Juvenile herring survey and plankton
	FRG	ANTON DOHRN	Juvenile herring survey Herring larvae
	USSR	BELOGORSK	Bottom trawl survey
		BELOGORSK-YUBILINIY	Herring tagging
		BELOGORSK	Herring larvae
	France	CRYOS	Squid, herring survey
	USA	ALBATROSS IV	Herring larval
		DELAWARE II	Bottom trawl survey
		ALBATROSS IV	Bottom trawl survey
		SPIRIT OF 76	Bottom trawl and plankton survey
		ANNANDALE	Herring larvae
		SILVER LINING	Herring tagging
		RESEARCHER	Herring larvae
1977	Poland	WEICZNO	Bottom trawl and plankton survey
			Juvenile herring survey
			Larval herring survey
			Herring predator-prey survey
	GDR	GORLITZ	Juvenile herring and plankton survey
	FRG	ANTON DOHRN	Juvenile herring and mackerel survey
			Adult herring survey
			Larval herring survey

1977	USSR	NOGLIKI	Herring tagging
		YUBILEINIY	Herring tagging
	USA	DELAWARE II	Bottom trawl survey
			Plankton and primary productivity survey
			Larval herring survey
		ALBATROSS IV	Bottom trawl survey
			Hydroacoustic survey
		MT. MITCHELL	Ichthyoplankton, oceanographic, and primary productivity survey
		KELEZ	Ichthyoplankton, oceanographic, and primary productivity survey
1978	Poland	WIECZNO	Young herring and mackerel survey
	FRG	ANTON DOHRN	Young herring survey
	USSR	ARGUS	Squid, mackerel, and herring survey
	USA	ALBATROSS IV	Herring survey
			Larval fish survey
		DELAWARE II	Ichthyoplankton survey

Table 8. Quantities of herring processed in Maine sardine plants (metric tons) and imports from Canada.

Year	Total Maine catch	Total imports of Canadian herring into Maine	Canadian herring purchased by Maine sardine plants	Cases of sardines packed (millions)	Year	Total Maine catch	Total imports of Canadian herring into Maine	Canadian herring purchased by Maine sardine plants	Cases of sardines packed (millions)
1880	15,738				1935	23,107	21,893		1655
	-				1936	-	27,662		1846
1887	15,227				1937	22,658	14,870		1680
1888	18,508				1938	7,283	7,528		672
1889	14,585				1939	31,572	18,103		2210
	-				1940	17,244	12,521		1118
1892	18,446				1941	32,931	37,674		3165
	-				1942	42,637	33,584		2873
1897	51,079				1943	25,941	44,014		2505
1898	62,673				1944	37,244	41,470		3252
1899	56,086				1945	41,999	33,769		2725
1900	44,068				1946	36,337	51,889		3275
1901	67,380				1947	65,486	44,220		3014
1902	55,957				1948	76,437	37,327		3682
1903	55,549				1949	74,029	21,123		3075
1904	73,642				1950	90,557	22,282		3544
1905	78,694				1951	34,411	22,833	12,083	1677
1906	71,515				1952	79,139	17,462	9,724	3531
1907	27,649				1953	58,337	13,715	11,594	2783
1908	30,940				1954	64,067	16,287	15,522	2935
1909	49,716				1955	43,506	3,502	1,836	1269
1910	52,399				1956	66,494	5,015	4,104	2231
1911	79,466				1957	68,623	23,772	5,316	2217
1912	62,138				1958	80,759	17,575	1,655	2103
1913	17,772				1959	53,037	29,350	9,785	1755
1914	59,743				1960	59,348	33,704	9,253	1998
1915	-				1961	24,131	19,732	3,827	754
1916	93,935				1962	69,376	28,153	5,425	2144
1917	-				1963	66,095	20,618	4,992	1637
1918	-				1964	26,295	44,125	3,727	855
1919	39,453			2450	1965	32,088	53,521	9,223	1227
	-				1966	26,177	70,121	14,070	1533
1924	21,741			1900	1967	28,575	54,521	19,179	1250
	-				1968	31,072	75,207	30,059	1730
1926	-	26,302		1718	1969	23,852	42,687	15,600	1043
1927	-	10,418		1262	1970	15,617	35,595	12,194	907
1928	29,341	31,241		2056	1971	12,960	30,238	21,734	931
1929	41,668	21,206		2026	1972	20,271	41,973	25,520	1532
1930	33,538	15,545		1399	1973	16,886	33,299	17,181	955
1931	25,304	8,967		885	1974	21,499	34,918	22,540	1093
1932	14,510	6,793		546	1975	17,348	39,571	23,646	1704
1933	19,856	14,361		981	1976	31,858	26,145	13,163	1067
1934	-	21,207		1143	1977	33,135	17,791	12,786	1004

Table Catch of herring in Gulf of Maine.

Year	USA Juvenile fishery	USA Adult fishery	USA Total catch	Canada	Germany(FR)	Germany (DR)	USSR	Poland	Japan	Bulgaria	Other	5Y Total	Total without juvenile fishery
1967	28,577	2,581	31,158	5,226								36,384	7,807
1968	31,073	10,403	41,476	21,497								62,973	31,900
1969	23,853	4,834	28,687	10,106	10,446	7,020						56,259	32,406
1970	15,617	13,564	29,181	17,912	6,079	2,580		43	9			55,804	40,187
1971	12,408	19,077	31,491	15,518	1,723	2,257						50,983	38,575
1972	19,498	18,698 (21,000)	38,196	11,638 (6,000)	2,930 (2,500)	9,296	256 (other =	100 500				62,416	42,918 (30,000)
1973	16,400	5,201 (19,750)	21,601	4,107 (4,000)	876 (1,000)	5,284	69 (other	11 250)		378		33,259	15,926 (25,000)
1974	19,142	10,233 (16,750)	29,376	4,044 (6,000)	2,463 (1,000)	1,008 (1,000)	98 (others	103 250)			149	36,916	18,098 (25,000)
1975	15,182	16,410 (10,750)	32,046	4,500 (4,200)	57 (500)	(500)	(others	71 71)			38	36,655	21,530 (16,000)
1976	30,195	19,150 (6,000)	49,398	921 (990)							(10)	50,399	20,125 (7,000)
1977	32,357	17,891 (6,000)	50,248	(990)							(10)	50,248	17,891 (7,000)

Note: National allocation in parentheses.

Comments for Updating the Preliminary Fishery Management Plan for the Squid Fisheries of the Northwest Atlantic

By: Anne M.T. Lange

II.B.4.a This section appears irrelevant.

II.C.1.b. The following changes should be made to the tables in this section:

Table 10 - update as follows: add 1976 catch data and 1977 preliminary catch data listed below.

Table 11 - update as follows: add 1976 catch data and 1977 preliminary catch data listed below.

Change the fifth line of the second paragraph to read: "Japan and Spain have taken the bulk of the catch in recent years (averaging 11,564 and 7,264 tons, respectively, since 1970). (Table 11).

Change the 7th and 8th lines of the second paragraph to read: "Estimated Illex landings rose from 1,000 tons in 1967 to 24,940 tons in 1976. Japan, Spain, Poland, and the USSR have accounted for most of the landings in recent years (averaging 2,855, 4,707, 3,399, and 4,733 tons, respectively, since 1972). (Table 11).

II.C.1.c. Change first paragraph, third through fifth lines to read: "In 1974 through 1977, some 30 to 40 small and medium otter trawlers from Massachusetts ports conducted a short-term directed fishery for Loligo on spring spawning concentrations near Nantucket. Catches were generally processed for export. Loligo had comprised about 86% of the USA squid catch in recent years, until 1977 when it dropped to an estimated 58%.

II.C.1.F.(1) The following changes should be made to the tables of this section:

Table 20 should be updated as follows: add 1976 Loligo catch data and 1977 preliminary catch data listed below.

II.C.1.f.(3) The 1976 by-catch ratios in the squid fishery and of squid in other directed fisheries are available. If they are to be used in place of 1974 values, the following changes should be made to this section:

Replace tables 23 and 24 with attached tables 23 and 24.

Change text as follows: first paragraph, second and third lines to read:

"A total squid catch (Illex and Loligo) of 47,024 tons was taken in 1976, of which 11,907 tons (approximately 25%) occurred as by-catch. A total of 92% of this by-catch occurred in a directed fishery for four other species catagories: mackerel (54%); red hake (17%); herring (14%); and silver hake (7%); and 79% was taken by 2 countries: Poland (50%) and the USSR (29%)."

Change second paragraph, fourth line to: "The international squid fishery thus defined had a reported by-catch of 17% of its directed

catch in 1976. The predominant by-catches were of other finfish and mackerel representing 54% and 24% of the total by-catch, respectively. This by-catch accounted for 8% (3,140 tons) of the other finfish catch in 1976, and 1% (1,392 tons) of the mackerel catch in 1976. Table 23 lists the 1976.....".

II.C.1.h. This section could be updated to include survey cruises, from 1976-1978, which provided data on squid.

Table 27. Update to include the following:

USSR	1976	BELOGORSK	Groundfish survey
	1977	ARGUS	Squid survey
	1978	ARGUS	Mackerel, squid, herring survey
France	1976	CYROS	Squid survey
USA	1976	ALBATROSS IV	Groundfish survey
		DELAWARE II	Groundfish survey
	1977	ALBATROSS IV	Groundfish survey
		DELAWARE II	Groundfish survey
	1978	ALBATROSS IV	Groundfish survey
Japan	1977	SUZUKA MARU	Squid survey
Spain	1978	PESCA PUEATA SEGUNDA	Squid Survey

II.C.1.g. Description of foreign regulation under PMP (1977-1978) should be included.

II.C.2.b. Replace Table 30 with new biomass estimates given below. Replace last sentence of page 63 with current description of trends in Loligo biomass, including downward trend (Table 30) since 1976, in autumn biomass estimates. Also mention that in recent years the autumn survey catches have been made up of individuals of smaller mean size, and that there has also been a downward trend in Loligo abundance indices from our spring surveys (decreasing 43% and 20% in So. New England and Mid-Atlantic areas, respectively, from the 10 year average 1968-1977).

Update first paragraph of page 64 to include more recent estimates of Illex population size, from the USSR 1977 research report. These are from areal expansion of survey catches for the area of Georges Bank and Nova Scotia. They are: 100,000 MT in 1971; 58,000 MT in 1972; 197,000 MT in 1975, and 258,000 MT in 1976. (Konstantinov and Noskov, MS 1977). (Reference: Konstantinov, L.G. and A.S. Noskov. MS 1977. Report of the USSR investigation in the ICNAF area, 1976. Annu. Meet. Int. Comm. Northw. Atlant. Fish., 1976, Summ. Doc. No. 77/VI/15).

II.C.2.b(2). Insert section from last years update.

II.C.2.e: Current status of the fishery. Describe recent trends in catch off the USA. Foreign failure to reach allocation for either Loligo or Illex and the decrease in USA Loligo catches in 1977 from 3,200 to 1,400 MT. Also note the recent trend in the Illex fishery off Canada, increasing from a 5 year (1970-1974) average of 4,495 MT to 17,760 MT in 1975, then to 41,767 MT in 1976 and doubling to 80,630 MT in 1977.

II.C.3.b. The following comments merit consideration in the determination of OY. The Mid Atlantic Fisheries Management Council has determined OY for Illex as 30,000 tons not 35,000 tons. The last recommendation of a TAC for SA 5+6 Illex by STACRES was also 30,000 tons. Rapid expansion of the fishery for Illex in Canadian waters may adversely affect the population in SA 5+6. Therefore a conservative management strategy is probably merited. In light of the downward trend in survey abundance of Loligo, the trend toward smaller individuals (which probably suffer a high natural mortality rate) and the indication of reduced availability to inshore domestic fishermen, a more conservative approach toward Loligo management might also be considered.

Table 10. Annual squid catches by country and area (ICNAF SA 5 and 6)

Area	Year	Cuba	Can	Bulg	Fra	Ire	FRG	Jap	Ita	Spa	Pol	Rom	USSR	USA	GDR	Total
5+6	1976	265	54	23		3,283	1,123	8,285	4,421	13,200	6,756	22	7,644	3,831	313	50,220
5	1976	263	54			466	1,123	2,633	12	3,927	5,536	21	6,236	2,674	1,098	24,043
6	1976	2		23		2,817		5,652	4,409	9,273	1,220	1	1,408	1,157	215	26,177
5+6	1977(1)	32		47				12,372	4,222	13,771	729		7,054	2,434		40,661

(1) Preliminary 1977 catches.

Table 11. Estimated species breakdown in ICNAF SA 5 and 6.

Year	Cuba	Can	Bulg	Fra	Ire	FRG	Jap	Ita	Spa	Pol	Rom	USSR	USA	GDR	Total
							Loligo								
1976	257		23		1,042	22	5,029	3,304	9,137	1,706	13	832	3,230	317	24,912
1977(1)	28						7,663	2,264	5,836	232		22	1,413		17,458
							Illex								
1976	8	54			2,241	1,101	3,256	1,117	4,063	5,050	9	6,812	601	996	25,308
1977(1)	4		47				4,709	1,958	7,935	497		7,032	1,021		23,203

(1) Preliminary 1977 catches.

Table 20. USA and foreign landings of Loligo in metric tons and per cent.

Year	USA landings Metric tons	USA landings Per cent of total	Foreign landings Metric tons	Foreign landings Per cent of Total	Total landings Metric tons
1976	3,230	13	21,682	87	24,912
1977(1)	1,413	8	16,045	92	17,458

(1) Preliminary catch.

Table 21. USA and foreign landings of Illex in metric tons and by per cent.

Year	USA landings Metric tons	USA landings Per cent of total	Foreign landings Metric tons	Foreign landings Per cent of total	Total landings Metric tons
1976	601	2	24,707	98	25,308
1977(1)	1,021	4	22,182	96	23,203

(1) Preliminary catch.

Table 23. By-catches (metric tons) and by-catch ratios of squid taken in 1976 in SA 5 and 6 in designated fisheries (main species sought category) by country.

	Main species sought						
Country	Silver hake	Red hake	Other groundfish	Herring	Mackerel	Other pelagic fish	Other finfish
Bulgaria					23 (.002)		
Canada			0 (0.00)	0 (0.00)			
Cuba	160 (0.068)				105 (0.019)		
France				0 (0.00)			
FRG			127 (0.167)	996 (0.113)		0 (0.00)	
GDR			0 (0.00)	75 (0.010)	239 (0.006)		0 (0.00)
Italy							180 (0.978)
Japan				38 (0.053)		516 (0.071)	
Poland				391 (0.044)	5,547 (0.114)		
Romania	4 (0.030)				13 (0.002)	5 (0.185)	
Spain			7 (0.004)				
USSR	721 (0.017)	1,991 (0.122)	2 (0.012)	113 (0.010)	538 (0.007)		114 (0.040)
Ireland						2 (0.010)	
Total	885	1,991	136	1,613	6,465	523	294

Table 24. By-catch ratios and catches (metric tons) in squid fishery for 1976, by country

Country	Cod	Haddock	Red-fish	Silver hake	Red hake	Pollock	Amer. plaice	Witch fldr.	Yellow-tail fldr.	Other fldr.	Her-ring	Mack-erel	Squid	Other fish	Total
Total															
ratio		.000	0	.011	.019	.000	0	.000	0	.000	.007	.041	1.000	.091	1.169
catch		2	0	376	667	5	0	5	0	15	233	1,392	34,360	3,140	40,195
Canada															
ratio		.500	0	0	0	0	0	0	0	0	0	0	1.000	.500	2.000
catch		2	0	0	0	0	0	0	0	0	0	0	4	2	8
GDR															
ratio		0	0	0	0	.005	0	0	0	0	.074	.283	1.000	.023	1.385
catch		0	0	0	0	5	0	0	0	0	74	283	999	23	1,384
Italy															
ratio		0	0	0	0	0	0	0	0	0	0	.099	1.000	.267	1.366
catch		0	0	0	0	0	0	0	0	0	0	420	4,241	1,133	5,794
Japan															
ratio		0	0	.022	0	0	0	0	0	0	.020	.006	1.000	.094	1.176
catch		0	0	15	0	0	0	0	0	0	156	46	7,731	725	8,673
Poland															
ratio		0	0	0	0	0	0	0	0	0	0	.570	1.000	.559	2.070
catch		0	0	0	0	0	0	0	0	0	0	425	746	417	1.588
Spain															
ratio		0	0	.003	0	0	0	.000	0	0	.000	.009	1.000	.016	1.028
catch		0	0	38	0	0	0	4	0	0	3	121	13,193	205	13,564
USSR															
ratio		0	0	.067	.160	0	0	.000	0	0	0	.023	1.000	.060	1.310
catch		0	0	281	667	0	0	1	0	0	0	96	4,165	252	5,462
Ireland															
ratio		0	0	.013	0	0	0	0	0	.005	0	.000	1.000	.117	1.135
catch		0	0	42	0	0	0	0	0	15	0	1	3,281	383	3,722

Table 30. *Loligo* minimum stock size estimates.

Year	Biomass (tons	Number ($x10^6$)
1968	29,114	1212
1969	48,053	2393
1970	19,640	1946
1971	14,050	1106
1972	21,039	1533
1973	44,252	3092
1974	46,442	4757
1975	48,636	4789
1976	51,436	4372
1977	27,421	3157

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II.B.2.e. Revised section appended

II.B.4.a. Material beginning at the top of Page 15 revised (appended).

II.C.1.a. Revised section appended.

Table 3 - Revised (appended).

II.C.1.b. Statistical History of Exploitation - amend first two paragraphs to read:

"USA commercial landings of other finfish species from New England to Virginia (1930-1963) are given in Table 4. These data reveal fluctuations ranging from a low of 27,143 tons[1] in 1942 to a high of 267,741 tons in 1953. Overall, average commercial landings have increased from 74,612 tons in the 1930's to 163,088 tons from 1961-1963.

Commercial catches of other finfish by country as reported to ICNAF for the Gulf of Maine to Cape Hatteras area for the period 1964-1977 are given in Table 5. International commercial landings reached a peak level of 212,748 tons in 1969 and averaged 147,078 tons from 1970-1974 before declining to an average of 84,646 tons in 1975-1976. Provisional ICNAF statistics for 1977 indicate a catch of 82,825 tons. During this period the USA and USSR have taken the bulk of the landings, although the GDR, Japan, and Poland have also taken substantial catches in recent years. Other nations, notably Bulgaria, Canada, and Romania, have taken smaller amounts."

Table 5 - Revised (appended)

Table 6 - Revised (appended)

Page 24, second and third sentences - amend to read: "In 1970, the combined USA recreational catch of other finfish species (139,824 tons) was more than double the USA commercial catch of 59,770 tons, while in 1974 the recreational figure was 106,462 tons compared to a total USA commercial harvest of 60,136 tons. Total USA commercial and recreational landings have averaged 187,905 tons since 1964; however, landings have declined from former levels and have averaged only 149,884 tons since 1970".

Table 7 - Revised (appended)

Table 8 - Revised (appended)

II.C.1.f.(1) Amend to read:

Competition for available stocks - USA and foreign landings data for other finfish from the Gulf of Maine to Cape Hatteras are given in Table 16. The USA percentage in terms of total catch declined from 85% in 1964 to 19% in 1972 and has since increased steadily; in 1977, the USA accounted for 78% of the total catch under extended jurisdiction. Decreased USSR catches of alewives and argentines since 1972, combined with second-tier TAC regulations under ICNAF, also appear to have been signficant in reducing foreign catches since that year. The USSR, Poland, GDR, and Japan have taken the largest portion of the foreign catch as noted in earlier sections. Large catches by distant water fleets reduced the catch of USA coastal mixed species fisheries and increased competition for any available surplus during 1966-1974.

II.C.1.a. Areas and Stocks Involved

The other finfish group includes over 60 finfish species in the Gulf of Maine to Cape Hatteras area for which individual species assessments are usually unavailable or available only in preliminary form. Specifically, this category excludes tunas, billfishes, large sharks, menhaden, American eel, and white perch (which are captured primarily inshore in the Middle Atlantic area) as well as cod, haddock, redfish, silver hake, red hake, pollock, sea herring, mackerel, and flounders. There is no biological basis for recognizing this group of species as a stock, as a number of individual species-stocks are included; also, substantial overlap of individual species-stocks undoubtedly occurs both in the Gulf of Maine - Fundian Channel area, e.g., white hake, argentine, cusk, skates, and rays, as well as in the Cape Hatteras area. Further, many species are highly migratory and migratory pathways have often not been clearly defined; also, considerable movement occurs both along the coastline as well as inshore and offshore.

The species included in this PMP as "other finfish" constitute a significant part of the total recreational finfish catch. In 1970, the catch of these species by recreational anglers was 140,000 metric tons or 60% of the total finfish recreational catch of 233,000 metric tons.

Similarly for 1974, the recreational catch of 106,000 metric tons of other finfish was 65% of the total estimated recreational finfish catch of 164,000 metric tons. Clearly, the recreational catch of other finfish is a significant part of the total recreational catch representing a large part of the total value of the fisheries. Table 3 shows the important recreational "other finfish" species ranked by weight for 1960, 1965, 1970, and 1974.

Table 16 revised (appended)

II.C.1.f.(3) Revised (appended)
Tables 17 and 18 revised (appended)

II.C.1.h. Amend to read:

Management of the other finfish stocks from the Gulf of Maine to Cape Hatteras (ICNAF SA 5 and 6) began in 1974, when a commercial TAC of 125,000 tons[1] was established; this figure represents an MSY (maximum sustainable yield) approximation based on commercial catches and trends in research vessel survey data. Commercial TACs of 150,000 tons were set for 1975 and 1976. An OY of 275,000 tons (commercial and recreational) was established for 1977.

Cooperative research on these stocks has involved research vessel surveys (Table 21) and assessment studies and related work by USSR and USA scientists (II.C.5.). In addition, the FRG, Japan, Romania, the USSR, and the USA have reported length-frequency and age sampling data to ICNAF in recent years (Table 22).

Tables 21 and 22 revised (appended)

II.C.2.a. First paragraph

1. Change first sentence to read, "The distribution of these species is complex and not totally defined".

2. Change "(Clark and Brown in press)" to (Clark and Brown 1977).

3. Change last sentence to read, "Others, such as bluefish, striped bass, and dogfish are noted for making extensive migrations throughout the area."

II.C.2.b.&c. Revised (appended)

Supplementary references appended.

II.B.2.e. Biology of the Regulated Species

The fish communities of the Northwest Atlantic continental shelf of the United States from the Gulf of Maine to Cape Hatteras are highly diverse. More than 300 species occur in this area; nearly 50% of these are taken by recreational fishermen while nearly 25% are exploited commercially. Most of the species of lesser commercial importance are taken as by-catch, although some (e.g., argentine and alewife) have been the targets of directed fisheries. Obviously, development of assessments and management plans for all of these species would be a prohibitive task not only in terms of manpower requirements but also because the commercial/recreational data base often is very limited. Consequently, the approach taken has been to manage a number of species as a unit under a collective OY until satisfactory data bases become available and the appropriate individual species assessments can be developed.

This OY category, considered as "other finfish" in International Commission for the Northwest Atlantic Fisheries (ICNAF) regulations through 1976, includes all species except cod, haddock, redfish, silver hake, red hake, pollock, sea herring, mackerel, flounders, and large pelagic fish (i.e, tunas, billfishes, and sharks other than dogfish). In addition, certain species taken primarily in inshore waters in the Middle Atlantic area (i.e., menhaden, American eel, and white perch) are also excluded as they are not subject to capture in demersal trawling operations. A complete list of the species considered in this plan is provided in Appendix I. Thus the term "other finfish" encompasses a variety of demersal, semi-demersal, and pelagic species including recreationally important ones, such as scup, black sea bass, and bluefish, and commercial species of lesser domestic importance (e.g. angler, cusk, ocean pout, and white hake), and

other types formerly exploited chiefly by foreign nationals, e.g., argentine and dogfish. This group of other species is estimated to comprise about 25% of the total finfish-squid biomass at present (Clark and Brown 1977).

It is recognized that some of the species considered migrate north of the Gulf of Maine and south of Cape Hatteras; this may require modifications and realignment of current boundaries as additional data become available.

Trends in biomass levels suggest that it is reasonable to establish an OY on the group as a whole and individual OY's for certain species within it.

(all species combined) during each year. The total biomass TAC was less than the sum of the TACs for all stocks since it is unlikely that the yield from all stocks can be maximized simultaneously. Such an approach also served as an effective constraint against by-catch.

In March of 1977, PL94-265 (the Fishery Conservation and Management Act of 1976) became effective, under which the USA assumed jurisdiction over a "Fishery Conservation Zone" extending 200 miles seaward of the baseline from which the 3-mile territorial sea is measured. Under the provisions of this law, regional fishery management councils were established to manage fishery resources in USA waters; two of these (the New England and Mid-Atlantic Fishery Management Councils) are jointly responsible for development of management plans for fishery resources of the Gulf of Maine to Cape Hatteras area. Prior to implementation of PL94-265, however, the Department of Commerce was required to provide Final Environmental Import Statement/Preliminary Fishery Management Plans (EIS/PMPs) for a number of stocks for which a foreign surplus was anticipated during 1977. The initial version of the EIS/PMP for finfish caught incidental to the trawl fisheries of the northwestern Atlantic (January 1977) was included in the group; the present version represents an update of this EIS/PMP based on information which has become available since the above date.

Table 3. Ranking of "other finfish" species by total weight of recreational catch along the northeastern United States coast.

	Year[a]			
	1960	1965	1970	1974
1	striped bass	bluefish	bluefish	bluefish
2	bluefish	striped bass	striped bass	striped bass
3	tautog	northern puffers	northern puffer	weakfish(squeteagu
4	scup	scup	spot	tautog
5	black sea bass	tautog	tautog	scup
6	red drum	black sea bass	weakfish (squeteague)	spot
7	Atlantic croaker	spot	Atlantic sea robins	black sea bass
8	spot	Atlantic croaker	American shad	Atlantic searobin
9	northern puffer	American shad	scup	Atlantic croaker
10	black drum	Atlantic searobins	Atlantic croaker	black drum

[a]Data for 1960, 1965, and 1970 for Maine to Cape Hatteras; data for 1974 for Maine-Virginia. The latter survey was conducted on a different basis than the three earlier ones and while more precise is not strictly comparable.

Table 5. Catches[a] of other finfish[b] (metric tons) from the Gulf of Maine to Cape Hatteras, by nation, 1964-1977.

Country	YEAR[c] 1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Bulgaria	-----	-----	-----	-----	-----	1,753	2,263	6,862	7,630	1,278	3,365	1,192	278	334
Canada	256	584	1,535	2,463	1,766	1,022	1,028	1,315	891	782	841	634	501	617
Cuba	-----	-----	-----	-----	-----	126	-----	740	586	-----	-----	-----	-----	351
France	-----	-----	-----	-----	11	-----	-----	-----	-----	19	13	-----	-----	-----
FRG	-----	-----	-----	24	304	21	31	57	170	1,611	290	490	-----	-----
GDR	-----	-----	-----	456	592	10,798	2,853	10,055	4,592	13,856	2,794	2,318	1,284	75
Italy	-----	-----	-----	-----	-----	-----	-----	-----	-----	375	-----	-----	-----	796
Japan	-----	-----	-----	156	4,735	6,939	11,696	13,382	6,774	14,627	6,285	3,624	7,959	2,083
Poland	-----	1,116	1,304	2,008	1,829	10,847	7,394	18,722	9,445	13,771	9,948	4,576	3,111	1,921
Romania	-----	345	304	196	551	41	205	2,069	253	770	259	-----	104	53
Spain	2	-----	-----	-----	-----	6	63	17	253	93	207	-----	-----	625
USSR	17,127	22,218	67,396	21,262	66,967	109,174	36,897	54,366	106,863	52,509	46,219	27,215	15,933	11,078
UK	10	-----	4	3	-----	-----	-----	-----	-----	-----	6	-----	-----	-----
USA	134,448	136,057	101,676	88,085	76,779	72,021	59,770	48,908	32,896	56,291	60,136	50,080	48,753	64,992
Other	6,579	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	716	523	-----
Total	158,422	160,320	172,219	114,653	153,534	212,748	122,200	156,493	170,353	155,982	130,363	90,845	78,446	82,825

[a] Includes industrial landings.

[b] Includes all finfish species reported to ICNAF except menhaden, billfishes, tunas, large sharks, American eel, and white perch.

[c] As reported to ICNAF for SA 5 and 6. Data for 1964 were taken from ICNAF Summ. Doc. 75/10; data for 1965-1974 were taken from ICNAF Summ. Doc. 76/VI/11; data for 1975 and 1976 were taken from ICNAF statistical bulletins 25 and 26; and data for 1977 were taken from ICNAF Summ. Doc. 78/VI/28 (incomplete).

Table 6. Commercial landings of selected[a] other finfish species (metric tons) in SA 5 and 6, 1964-1975.

Species	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Angler	22	205	2,542	223	2,483	2,456	690	3,762	4,344	7,643	1,171	3,382	1,193	1,573
Cusk	945	1,112	1,973	2,362	1,663	1,168	1,365	1,823	1,685	1,803	1,731	1,827	1,491	1,400
Ocean pout	2,123	877	13,380	7,361	13,061	26,973	7,188	7,867	3,355	5,825	1,162	277	678	1,060
Sculpins	-----	-----	3,964	8,187	6,993	12,601	5,475	2,694	7,299	8,582	2,805	172	603	98
Scup	14,703	18,305	13,102	9,884	8,984	5,225	4,805	4,206	5,087	5,918	8,068	8,283	7,315	8,479
Searobins	161	300	1,471	784	9,343	3,649	588	1,022	3,920	1,903	2,304	1,135	1,622	3,307
Tilefish	223	595	435	48	27	26	136	61	121	390	606	755	1,015	2,046
White hake	3,201	2,633	972	361	370	1,544	2,186	3,029	3,124	3,226	3,887	2,859	3,266	4,420
Wolffishes	290	238	578	276	350	273	165	287	285	431	366	392	483	483
Bluefish	792	1,183	1,306	768	1,001	1,272	1,875	1,741	1,708	2,819	248	3,679	3,453	3,276
Butterfish	3,046	4,089	6,480	4,767	7,241	17,497	10,894	7,850	6,476	19,454	12,862	11,047	11,808	4,088
Alewife	18,623	28,523	25,522	32,467	47,322	61,544	36,302	35,861	13,802	16,629	16,102	14,560	8,255	6,654
Argentine	13,782	9,619	33,938	2,022	2,334	2,613	1,379	7,293	32,707	2,512	19,695	1,463	322	-----
Croaker	418	881	716	209	25	108	96	243	204	1,026	1,481	3,977	6,780	7,857
Black sea bass	4,846	3,780	1,647	1,304	1,210	1,193	1,098	596	720	1,146	977	1,852	1,686	2,425
Dogfish	1	141	7,855	2,698	4,108	9,124	4,954	11,516	21,526	13,876	17,856	18,365	14,481	7,496
American shad	2,346	2,860	2,292	2,280	2,131	2,213	2,827	1,461	1,723	1,825	1,046	692	681	704
Skates	4,083	2,363	2,844	4,898	6,483	9,462	4,128	5,905	8,823	7,963	3,651	3,968	1,212	1,405
Spot	1,615	794	644	2,332	704	597	3,092	545	1,583	1,370	1,241	1,242	817	1,067
Weakfish[b]	1,131	1,425	903	626	907	1,445	-----	-----	3,291	4,975	4,296	6,647	7,142	6,121
Striped bass	3,059	3,421	4,105	4,666	5,018	5,618	5,031	3,490	3,843	5,336	4,345	3,851	2,962	2,322

[a]Excludes a variety of species of very minor importance caught primarily in the Middle Atlantic area.

[b]Squeteague.

Table 7. Sport fish catches of other finfish species of major importance (metric tons) recorded in NMFS 1960, 1965 and 1970 saltwater angling surveys and the 1974 regional survey.

Species or species group	Saltwater angling surveys[a]			Regional[b] survey
	1960	1965	1970	1974
Bass, black sea	5,398	4,172	3,323	1,603
Bluefish	16,765	35,932	45,305	57,952
Croakers	3,352	2,152	1,738	1,031
Puffers	2,232	10,794	11,098	584
Scup	7,530	6,529	2,006	2,776
Searobins	1,030	1,620	4,120	1,467
Spot	3,225	2,214	9,785	1,826
Weakfish	1,742	1,027	7,114	9,139
Striped bass	16,851	25,107	33,160	18,062
Tautog	9,244	5,082	7,824	4,900
Other	11,184	30,941	14,351	7,122
Total	78,553	125,570	139,824	106,462

[a]Maine to Cape Hatteras, North Carolina.

[b]Maine to Virginia. The 1974 survey was done on a different basis than the earlier survey and while more precise than the earlier survey is not strictly comparable.

Table 8. Sport fish catch of other finfish species (metric tons) in the northeastern USA, June 1973-June 1974, as determined from NMFS sport fishing surveys.

Species	Catch		
	SA 5[a]	SA 6[b]	Total
Bass, black sea	175	1,428	1,603
Bluefish	2,607	55,345	57,952
Croakers	-----	1,031	1,031
Cunner	92	57	149
Cusk	93	12	105
Drum, black	-----	822	822
Drum, red	-----	176	176
Kingfishes	-----	166	166
Mackerel, Spanish	-----	195	195
Puffers	70	514	584
Scup	828	1,949	2,776
Searobin	290	1,178	1,467
Shad	-----	659	659
Sharks (dogfishes)	513	1,559	2,072
Skates	43	194	237
Smelt	236	1	237
Spot	-----	1,826	1,826
Striped bass	2,209	15,853	18,062
Tautog	1,203	3,697	4,900
Tilefish	-----	242	242
Toadfish	13	197	210
Weakfish	-----	9,139	9,139
Other[c]	67[c]	1,785	1,852
Totals	8,439	98,025	106,462

[a]Maine, New Hampshire, and Massachusetts.

[b]Rhode Island to North Carolina.

[c]Includes alewife, dolphin, conger eel, goosefish, rays, spotted seatrout, tomcod, wolffish, and other miscellaneous species.

Table 16. USA commercial and foreign commercial landings (metric tons) of other finfish from the Gulf of Maine to Cape Hatteras expressed as relative percentages of the total quantity landed in 1964-1975.

Year	USA landings	&	Foreign landings	%	Total landings
1964	134,448	85	23,974	15	158,422
1965	136,057	85	24,263	15	160,320
1966	101,676	59	70,543	41	172,219
1967	88,085	77	26,568	23	114,653
1968	76,779	50	76,755	50	153,534
1969	72,021	34	140,727	66	212,748
1970	59,770	49	62,430	51	122,200
1971	48,908	31	107,585	69	156,493
1972	32,896	19	137,457	81	170,353
1973	56,291	36	99,691	64	155,982
1974	60,136	46	70,227	54	130,363
1975	50,080	55	40,765	45	90,845
1976	48,753	62	29,693	38	78,446
1977	64,892	78	17,933	22	82,825

II.C.1.f.(3) Nontarget Species Mortalities - Fisheries (main species sought category) in which other finfish were caught in SA 5 and 6 in 1974 are shown in Table 17 by country. A total other finfish catch of 78,446 tons was taken, of which 32,617 (42%) occurred as incidental by-catch. Of the incidental catch, 72% occurred in directed fisheries for silver hake, herring, and mackerel; red hake and squid directed fisheries accounted for much of the remainder (16%). On a country basis, Poland, the USSR, and the USA accounted for most of the by-catch (15%, 42%, and 21%, respectively). Other finfish caught as by-catch accounted for approximately 22% of the total TAC.

The other finfish fishery is difficult to identify under the present catch recording scheme, since it is a mixed fishery. A procedure was adopted whereby a catch record[1] which had other finfish as the largest catch was assigned to the other finfish fishery. The international fishery thus defined had a by-catch of 63% of the other finfish directed catch (45,829 tons) in 1976 (Table 18). Of the directed catch 41,317 tons were taken by the USA. The species which constituted most of the by-catch were cod (23%), with haddock, silver hake, pollock, other flounder and squid accounting for most of the remainder (52%). These catches accounted for 6,676 tons (22%) of the cod catch in 1976, 2,428 tons (39%) of the haddock catch in 1976, 2,651 tons (3%) of the silver hake catch in 1976, 3,669 tons (27%) of the pollock catch in 1976, 3,554 tons (13%) of the other flounder catch in 1976, and 2,570 tons (5%) of the squid catch in 1976. Table 18 lists the 1976 by-catches and by-catch ratios in the other finfish fishery for all countries combined and for individual countries.

By-catch ratios should be regarded as very tentative as the ICNAF records lump several directed fisheries together under a mixed fishery classification. The direction of the error would be to give higher ratios than actually occur.

II.C.1.f.(4) Economic Interactions - A number of economic interactions are possible which could influence the USA fishery. Declines in stock abundance resulting from increased exploitation could result in declining catch per unit of effort, thus increasing costs per pound landed and adversely affecting profitability (such declines have been noted for river herring in SA 6). Similarly, foreign imports could impact on ex-vessel prices, further affecting profitability. It is not know to what extent profitability has been affected by these factors.

With regard to recreational fishing, declining availability due to foreign fishing could adversely affect angler's success. It is conceivable that a reduction in angler's success could lead to a reduced demand for the fishing experience. This could have a severe adverse impact on certain coastal communities.

[1]A catch record lists the catches in a month by species, for gear-tonnage class cagetory in an ICNAF Division.

Table 17. By-catches (metric tons) and by-catch ratios of other finfish taken from the Gulf of Maine to Cape Hatteras in 1976 in designated fisheries (main species sought category) by country.

	Main species sought												
ountry	Cod	Haddock	Redfish	Silver hake	Red hake	Pollock	American plaice	Witch	Yellow-tail	Other flounder	Herring	Mackerel	Squi
ulgaria												301 0.022	
anada	256 0.181	60 0.079	1 0.007			92 0.054				0 0.000	0 0.000		2 0.500
uba				56 0.024								700 0.127	
rance											51 0.044		
RG						63 0.083					2098 0.238		
DR						0 0.000					0 0.000	779 0.021	23 0.02
taly												15 0.375	113 0.26
apan											27 0.038		725 0.09
oland											698 0.079	4201 0.086	35 0.48
omania				0 0.000								176 0.033	
pain	13 0.008												205 0.01
SSR	0 0.000			7978 0.192	1636 0.100						1178 0.102	2716 0.037	252 0.06
SA	629 0.049	4 0.008	276 0.033	2438 0.126	688 0.404	705 0.159	73 0.108	32 0.164	166 0.013	1616 0.147	12 0.000	47 0.039	78 0.06
celand													383 0.11
otal	898	64	277	10472	2324	860	73	32	166	1616	4064	8935	2836

Table 18. Catches (metric tons) and by-catch ratios by species in other finfish fisheries from the Gulf of Maine to Cape Hatteras in 1976.

Country	Species														
	Cod	Haddock	Redfish	Silver hake	Red hake	Pollock	American plaice	Witch	Yellow-tail	Other flounder	Herring	Mackerel	Squid	Other fish	Total
Canada	90	30	0	0	0	3	0	0	1	8	0	0	0	197	329
	0.457	0.152	0.000	0.000	0.000	0.015	0.000	0.000	0.005	0.041	0.000	0.000	0.000	1.000	1.670
FRG	0	0	0	0	0	0	0	0	0	0	0	0	0	184	184
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000
GDR	12	0	0	0	0	0	0	0	0	0	3	258	0	482	755
	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.535	0.000	1.000	1.566
Italy	0	0	0	0	0	0	0	0	0	0	0	100	180	184	464
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.543	0.978	1.000	2.521
Romania	0	0	0	15	0	0	0	0	0	0	5	8	5	33	66
	0.000	0.000	0.000	0.455	0.000	0.000	0.000	0.000	0.000	0.000	0.152	0.242	0.152	1.000	2.000
USSR	22	0	43	887	678	0	3	0	0	0	91	826	114	3432	6096
	0.006	0.000	0.013	0.258	0.198	0.000	0.001	0.000	0.000	0.000	0.027	0.241	0.033	1.000	1.776
USA	6552	2398	1493	1749	613	3666	1125	556	743	3546	48	634	2271	41317	66711
	0.159	0.058	0.036	0.042	0.015	0.089	0.027	0.013	0.018	0.086	0.001	0.015	0.055	1.000	1.614
All countries combined	6676	2428	1536	2651	1291	3669	1128	556	744	3554	147	1826	2570	45829	74605
	0.146	0.053	0.034	0.058	0.028	0.080	0.025	0.012	0.016	0.078	0.003	0.040	0.056	1.000	1.629

Table 21. Summary of cruises by nation and year providing data of potential value for other finfish species in SA 5 and 6, 1963-1977.

Nation	Year	Vessel	General objective
USSR	1967	ALBATROS	Groundfish survey, gear comparison plankton sampling
	1968	BLESK	Groundfish survey, gear comparison
	1969	PROGNOZ	Plankton sampling (2)
		EKLIPTIKA	Groundfish survey
	1970	KVANT	Groundfish survey, gear comparison (2)
	1971	BLESK	Groundfish survey, gear comparison
		VIANDRA	ICNAF Plankton survey
	1972	BLESK	Groundfish survey, gear comparison
	1973	BELOGORSK	Groundfish survey, juvenile fish survey gear comparison
	1974	BELOGORSK	Groundfish survey, gear comparison
	1975	BELOGORSK	Groundfish survey, gear comparison
	1976	BELOGORSK	Groundfish (2), plankton (2)
		KVANT	Plankton survey
	1977	ARGUS	Groundfish survey, plankton
		NOGLIKI	Plankton survey
		YUBILEINIY	Plankton survey (2)
Canada	1968	THETA	Plankton sampling studies
France	1971	CRYOS	ICNAF Plankton survey
	1973	CRYOS	ICNAF Plankton survey
FRG	1971	W. HERWIG	ICNAF Plankton survey
	1973	W. HERWIG	Fish survey, ICNAF plankton survey
	1974	W. HERWIG	Groundfish survey, plankton
	1975	W. HERWIG	Groundfish survey, plankton
	1976	ANTON DOHRN	Groundfish survey, plankton (2)
	1977	ANTON DOHRN	Groundfish survey, plankton (2)

Table 21. (cont'd)

Nation	Year	Vessel	General objective
GDR	1975	ERNST HAECKEL	Fish survey
	1976	ERNST HAECKEL	Groundfish survey, plankton
	1977	GOERLITZ	Groundfish survey
Poland	1973	WIECZNO	Fish survey, ICNAF plankton survey
	1974	WIECZNO	Groundfish survey, plankton
	1975	WIECZNO	Groundfish survey, plankton
	1976	WIECZNO	Groundfish survey, plankton (2)
	1977	WIECZNO	Groundfish survey (2), plankton
USA	1963	ALBATROSS IV	Groundfish survey (2)
	1964	ALBATROSS IV	Groundfish survey (3)
	1965	ALBATROSS IV	Groundfish survey (4)
	1966	ALBATROSS IV	Groundfish survey (2), plankton (5)
	1967	ALBATROSS IV	Groundfish survey, gear comparison, plankton
	1968	ALBATROSS IV	Groundfish survey (2), gear comparison (3)
	1968	DELAWARE	Groundfish survey
	1969	ALBATROSS IV	Groundfish survey (3), plankton (3)
	1970	ALBATROSS IV	Groundfish survey (4), plankton
		DELAWARE II	Groundfish survey, gear comparison
	1971	ALBATROSS IV	Groundfish survey(2), gear comparison (2), plankton (2)
	1972	ALBATROSS IV	Groundfish survey (3), gear comparison (2)
	1973	ALBATROSS IV	Groundfish survey (2), gear-comparison (2)
	1974	ALBATROSS IV	Groundfish survey (4), gear comparison,plankton
	1975	ALBATROSS IV	Groundfish survey (4), gear comparison, plankton
	1976	ALBATROSS IV	Groundfish survey (2), plankton (4)
		DELAWARE II	Groundfish survey (2), plankton
	1977	ALBATROSS IV	Groundfish survey (3)
		DELAWARE II	Groundfish survey (5), plankton (4)

Table 22. Total number of other finfish[a] length-frequency and age samples reported to ICNAF by nation and year for SA 5 and 6, 1970-1975.

Year	USA		Japan		Other[b]	
	Length-frequency	Age	Length-frequency	Age	Length-frequency	Age
1970					1	
1971			2			
1972			16			
1973	3		17		99	4
1974	21		65		10	2
1975			103		34	

[a]Includes white hake, alewife, blueback, scup, and butterfish.

[b]Includes USSR, FRG, and Romania.

II. C. 2. b and c. Abundance and Current Fishing Status

Assessment information for other finfish species is limited. An assessment of butterfish (Murawski and Waring MS 1977) indicated a rapid increase in exploitation from 1968-1976, with juvenile fish comprising a considerable portion of the catch since 1973; stock size estimates (tons) declined from 70,600 tons to 31,900 tons during 1973-1976. However, the total catch of butterfish including discards under FCMA regulations in 1977 was considerably lower in 1977 than in 1976 while the recruitment index for 1976 was above average, indicating that the current condition of the stock is probably good relative to previous years (Mid-Atlantic Fishery Management Council, 1978). Murawski (MS 1978) obtained an equilibrium yield estimate of 21,635 tons at a mesh size of 82 mm (stretched) assuming a constant annual recruitment of 1138.5 million fish, a figure which he suggested could be regarded as "MSY" for planning purposes (however, sustainable yields would be less with smaller mesh sizes). Murawski (MS 1977) also prepared an assessment for weakfish which indicated that recruitment in recent years has been relatively strong and that this stock is being exploited at or near the MSY level.

The river herring (alewife and blueback herring) resource in the Middle Atlantic area has attracted considerable attention in recent years due to pronounced declines in abundance. Declines in stock abundance of alosine fishes have been documented since the late 1960's in Virginia (Loesch and Kriete 1976) and North Carolina (Street and Davis MS 1976); based on studies by VIMS (Hoagman et al. 1974) and North Carolina Division of Marine Fisheries personnel (Street et al. 1975) it appears that the trend can be attributed to increased offshore catches by distant-water fleets (Johnson et al. 1977).

A preliminary MSY range of 23-28,000 tons has been estimated for river herring (Hoagman et al. 1974); however, stock size appears to have been depressed considerably below the MSY level in recent years.

Virginia sample data for 1974-1977 also suggest that recruitment in the immediate future may be poor, although the annual juvenile abundance index increased in 1977 over 1976 levels in both Virginia and North Carolina (Loesch et al. 1978).

Depletion of American and hickory shad in North Carolina waters in recent years has also been documented (Sholar 1977; Marshall 1977).

Information for other species appears to be more limited. Grosslein (Ms 1974) provides an MSY approximation of 40,000 tons for spiny dogfish in the area extending from the Scotian Shelf to Cape Hatteras, while Clark and Brown (1977) have documented pronounced declines in abundance since the mid-1960's for ocean pout, scup, and sea robins, and lesser declines for angler, butterfish, and skates and rays; on the other hand, white hake abundance appears to have increased. Continued close monitoring of the resource is considered essential, and analytical assessments for certain heavily exploited species (e.g., river herring) should be completed at the earliest possible date.

Analyses conducted to estimate maximum sustainable yield and optimum yield in the following sections include both commercial and recreational data. However, recreational catch data for these species are available only for 1960, 1965, 1970, and 1974, and for recent years, no consistent trends in total catch have been evident. (It might be noted that in contrast to previous surveys the 1974 survey was based on somewhat different procedures and excluded the North Carolina coast north of Cape Hatteras; bias associated with these factors is unknown.) We estimated total recreational catches for recent years by averaging total catch data for 1965, 1970, and 1974 and combined the resulting average with available commercial catch figures for 1964-1975 as reported to ICNAF to obtain total catch figures for MSY-OY calculations. We

used this set of statistics in preference to data for earlier years due to reporting discrepancies and omissions and due to the fact that earlier catch statistics for the USA were not strictly comparable on a per-area basis. It will be recognized that even if adequate catch data from recreational fisheries were available estimates of maximum sustainable yield for such a mixed resource would be difficult to obtain. We have calculated a preliminary approximation of 275,000 tons from commercial landings and the above recreational catch estimates corresponding to an optimum stock size level of perhaps 800,000 tons. Again, it must be stressed that these figures are preliminary and may require revision as additional data become available.

Recent catch levels considerably below the MSY value, coupled with increases in the autumn bottom trawl survey index for this group, suggest that stock abundance is improving compared to the early 1970's. The 1977 abundance index (stratified mean catch per tow, kg) increased 24% from the 1975-1976 average, i.e., from 51.1 to 63.6 kg/tow, the highest value observed since 1969. Declines in commercial landings since 1972 (Tables 6 and 16) are thought to reflect increasingly intensive regulations under ICNAF and under extended jurisdiction.

In summary,neither commercial nor research vessel survey data indicate that biomass of this group of species as a unit is declining under current catch levels. However, indices of abundance for certain species declined markedly during the 1963-1974 period as noted above. Commercial data also reveal major fluctuations in landings for a number of species since 1964, notably ocean pout, scup, butterfish, alewife, angler, and dogfish (Table 6); furthermore, landings for alewife, ocean pout, and scup have declined drastically in recent years. Street and Davis (1976) also reported a 40% decline in inshore landings of alewife in Virginia and North Carolina since 1966, together

with substantial declines in catch per unit effort. As a rule, declines in catches for certain species have been offset by increases in landings for other species with the result that combined landings data since 1970 do not reveal a consistent trend. However, the species changes referred to above imply that shifts in species composition may be occurring which could have far-reaching biological and economic consequences. Considerable study will be required to properly address this question.

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