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Atlantic Redfish (Sebastes mentella) in ICNAF Divisions 4VWX: A Stock Assessment and an Estimate of the Total Allowable Catch (TAC) for 1980

by

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Introduction

Atlantic redfish (Sebastes mentella) ranked second in Canadian groundfish landings from the Scotian Shelf until 1973 when it dropped to third place. Provisional data indicate it has now dropped to fourth place after cod, haddock and 4VWX +5 pollock. The provisional landings for 1978 are 15,494 tonnes a drop of about 1,000 tonnes from 1977. This drop was due mainly to restrictions on the US portion of the fishery.

Catches

Provisional 1978 nominal catch statistics have been taken from ICNAF Circular Letters (monthly) and provisional catch/effort statistics of the Statistics Branch, Fisheries and Marine Service, Canada (Table 1). The distribution by ICNAF subdivision is indicated in Table 2.

Catch-at-age

Length frequency samples for 1978 were collected by Fisheries and Marine Service port samplers in the Maritimes and Newfoundland regions. ICNAF provided one sample from the Soviet by-catch fishery and NMFS provided samples of the USA catches from ICNAF subdivisions 4W and 4X.

Unfortunately the mesh sizes used by vessels landing redfish and in particular those from which samples are collected are not recorded. This becomes a very critical problem as the redfish fishery in ICNAF divisions 4VWX is unregulated for minimum mesh size. To make a valid estimate of the mesh size from which the samples were collected, selection ogives were synthesized (Clay, 1979) and Canadian R/V groundfish cruise length frequencies (from the same area) multiplied by the appropriate ogives. The resulting length frequencies were then compared to the sample in question to estimate the most probable mesh size.

Table 1. Provisional catch statistics for 1978 (taken from ICNAF Circular Letters and catch/effort data from Fisheries and Marine Service, Canada).

Mesh Size (mm)	60[1]	40-60[1]		60[1]	90[2]	90[3]	120[3]	90[4]	
	USSR	Japan	France	Cuba	USA	Canada (M&Q)[5]		Canada (N)[5]	Total
Jan					118		17	1	136
Feb						18	72	49	139
Mar						146	173		319
Apr	31				280	497	251	533	1592
May	62			8	726	997	180	1159	3132
Jun	13	21	18	21	269	1259	102	672	2375
Jul	123		9	20	100	926	238	387	1803
Aug	43			1	298	1217	67	316	1942
Sept					29	1006	92	536	1663
Oct		8	30		19	526	43	647	1273
Nov		9			4	223	26	141	403
Dec					8	235	26	22	291
Total[6]	272	39	97	51	2146	7050	1287	4556	15498

1. Mesh size estimated from International Observer Program where redfish is a by-catch of the silver hake/squid fishery.
2. Assumed - although no regulation is currently in effect - (Pers. Comm., R. Mayo, NMFS).
3. Assumed 90 mm mesh for directed redfish fishery as mesh is unregulated and 120 mm mesh for by-catch fishery.
4. Assumed - as no regulation is currently in effect.
5. Canadian statistics separated by Canadian (Maritimes and Quebec) and Canadian (Newfoundland).
6. Totals do not always add up to the sum of the monthly catches because the monthly statistics are not complete.

Table 2. Distribution of catch for 1978 for which areas are known. (These totals are not exactly the same as those of Table 1.).

ICNAF Subdivision	Mesh Size (mm) 60	90	120	Unknown	Total
4Vs		8538	624	97	9259
4Vn		1563	189		1752
4W	362	1033	293		1688
4X		2618	170		2788

The catches for the USSR, Japan, and Cuba during 1978 were all assumed to be from 60 mm mesh trawls. This assumption is based on observer reports from the International Observer Program. The catches for the USA and Canada (Newfoundland) are assumed to be directed to redfish in ICNAF divisions 4WX and 4V respectively. The Canadian (Maritimes & Quebec) catches have been divided into directed (over 50% of a vessel catch) and by-catch (less than 50% of a vessel catch) portions (Table 1). The directed fishery is assumed to use 90 mm small mesh gear while the by-catch fishery must use 120 mm mesh gear. Generally it appeared that the port samples (length frequency) had come from by-catch vessels (120 mm). Appropriate samples were made for the directed fishery based on the assumed mesh size of 90 mm using the technique described by Clay (1979). (Although not a view held by the author, it is possible the fisherman are able to choose their sites to yield the desired size range of redfish. This means availability may determine the catch length distribution.)

The samples for each appropriate mesh size were then bumped up by the corresponding catch. Weighting was done by ICNAF area, sex and by quarter whenever possible. An estimate of discards was added to these length frequencies (Table 3). Discards (by sex) were calculated by subtracting the percentage by weight of fish below 25 cm in the directed landings (for each area) from the percentage by weight in the research vessel catches (for same area) after the latter had been fished with a 90 mm selection ogive (Table 4). The difference was equal to approximately 1% by weight of the landings - this was applied to the 10,000 tonnes directed (90 mm) fishery of 4VWX (i.e. approximately 100 tonnes). The length frequencies used to distribute this additional catch are given in Table 5. It was assumed the by-catch fishery did not discard any redfish.

No reliable source of information is available to indicate the details of sample weightings for previous years. Because of this, some reservations have been expressed regarding the accuracy of earlier data (Halliday, pers. comm.). The partial recruitment has changed with the increase in the Soviet small mesh fishery during the sixties and early seventies and the dramatic reduction in 1977 accompanying Canada's extended jurisdiction. The reduction in removal of small fish will in the long run be beneficial to the fishery - however, these benefits may be lost to the expanding small mesh shrimp fishery with its accompanying redfish by-catch.

The catch-at-age by sex was calculated using a 1975 age-length-key taken from research vessel samples from ICNAF divisions 4WX and 5Y. The catch-at-age for males and females for 1978 were then combined and added to the catch table used by Mohn (1978). (Note:- The catch table (Table 6) has been reduced to age 25+. This is due to the leveling off of growth over 25 years of age and the subsequent difficulties in accurate ageing of older fish.)

Table 3. Catch-at-length for each sex of the Atlantic redfish (4VWX) catch in 1978. (Includes estimate for discards of 100 tonnes).

Total Length (cm)	Male	Female
10	0.	0.
11	0.	14.
12	14.	43.
13	0.	58.
14	0.	72.
15	83.	239.
16	87.	380.
17	63.	430.
18	104.	389.
19	165.	537.
20	131.	511.
21	308.	345.
22	438.	513.
23	904.	496.
24	1316.	544.
25	1450.	780.
26	1384.	1061.
27	1293.	1101.
28	1041.	1021.
29	1344.	834.
30	1180.	689.
31	872.	574.
32	599.	703.
33	405.	640.
34	397.	634.
35	440.	693.
36	518.	1005.
37	395.	909.
38	338.	861.
39	301.	627.
40	123.	443.
41	89.	415.
42	63.	233.
43	4.	168.
44	21.	79.
45	3.	129.
46	14.	26.
47	1.	6.
48	0.	1.
49	0.	0.
50	0.	0.

Weight-at-age

The weight-at-age for sexes combined has been estimated (with smoothing) from the 1975 age-length-key as follows:-

Age	Weight (kg)	Age	Weight (kg)	Age	Weight (kg)
1	-	11	0.350	21	0.750
2	-	12	0.420	22	0.830
3	0.044	13	0.440	23	0.904
4	0.079	14	0.487	24	0.979
5	0.110	15	0.536	25	1.050
6	0.135	16	0.550	25+	1.100
7	0.180	17	0.600		
8	0.200	18	0.630		
9	0.265	19	0.650		
10	0.290	20	0.700		

Table 4. Calculations to determine 1978 discard catch of Atlantic redfish in 4VWX.

% R/V catch (90 mm) below 25 cm (male)	= 6%
% R/V catch (90 mm) below 25 cm (female)	= 4%
% Landings (90 mm) below 25 cm (male)	= 5%
% Landings (90 mm) below 25 cm (female)	= 3%

Table 5. Length frequencies used in distributing the 100 tonnes estimated discard catch of Atlantic redfish in 4VWX. These were estimated from a comparison of R/V length frequencies and those of landings from the same area.

Total Length (cm)	Male	Female	% Discarded
15	275	236	100
16	310	260	100
17	215	150	100
18	180	20	100
19	40	71	100
20	4	87	75
21	4	45	60
22	105	50	50
23	210	100	40
24	300	60	20
25	0	0	0

Natural Mortality

The natural mortality (M) is that used in previous redfish assessments M=0.1. A lower M=0.075 was also tested to study the effect on the catch projections. The catch-at-age table and the catch at length table from Mohn (1978) indicate a modal age of 10-12 years or 25 cm in length. Looking at the slope of the catch curve above this size gives an indication of the total mortality (Z). The mean Z for 1965 to 1978 combined is 0.101 $\pm$ 0.008. This indicates the M of 0.1 used previously may be high. An M of 0.075 would allow a fishing mortality (F) of 0.026 which is similiar to the weighted F's found by Mohn (1978).

Table 6. Catch-at-age for Atlantic redfish of ICNAF sub-division 4VWX.

CATCH NUMBERS 24/ 5/79

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	61	70	27	1	0	2012	1318	35	467	283	3108	0	18	159
4	1198	2537	973	54	15	12738	13548	1258	5963	2948	9759	416	132	987
5	2841	5963	2146	118	55	20188	23886	4080	12690	6183	12380	1681	414	1589
6	3333	6260	2197	119	83	17089	22036	5001	12630	6385	9882	1910	548	1707
7	2877	5369	1663	169	278	5894	9207	6035	8149	4614	3314	2392	796	1097
8	1765	3343	929	60	90	2738	4688	3871	4728	2666	1582	1553	489	584
9	1734	3302	981	175	414	1530	4044	4022	3292	2267	1577	1313	588	690
10	11385	20559	5634	722	1439	10394	26606	25453	23498	15022	9088	9365	3580	3541
11	3871	7200	2164	531	1023	3505	9340	9034	7512	5101	3497	3251	1495	1358
12	7499	13796	4533	1315	2663	5230	16830	17881	12531	9403	6874	5969	3073	3109
13	3993	7636	2241	561	1193	2457	8969	9984	6654	5019	3825	3188	1594	1689
14	3421	6620	2193	884	1677	2662	8445	8671	5892	4529	3556	2903	1732	1548
15	3572	7089	2389	1154	2164	2964	9186	9303	6117	4801	4060	3186	2021	1802
16	2417	4525	1877	935	1763	2120	6077	6022	3937	3264	2666	2124	1390	1403
17	1277	2450	1145	872	1574	1628	3679	3201	2097	1834	1728	1158	1190	916
18	1845	3629	1787	1098	2034	2064	5176	4753	3103	2755	2394	1643	1370	1140
19	2213	4640	2421	1738	3245	3057	7038	5941	3907	3510	3250	2175	1986	1605
20	1708	3678	1975	1454	2668	2456	5232	4335	2932	2570	2349	1889	1715	1121
21	1461	3266	1840	1394	2619	2300	4483	3820	2492	2365	2275	1447	1626	1452
22	886	2192	1455	1255	2304	2017	3515	2581	1882	1722	1760	997	1423	1510
23	1438	3472	2090	1654	3058	2672	5002	4088	2821	2583	2489	1501	1863	1428
24	657	1630	1284	1039	1929	1625	2900	2126	1564	1426	1456	801	1030	698
25	856	2118	1068	839	1618	1408	2639	2251	1544	1394	1369	797	1093	740
25+	1606	3999	2505	2447	4404	3870	6295	4482	3322	2967	3291	1760	2969	1959

Age and Growth Parameters

The Von Bertalanffy growth equation used in the 1978 assessment (using 1975 age-length-key) is again used for this assessment.

male $L_m = 42.96\ (1-e^{-0.061\ (T+4.138)})$,

female $L_f = 49.07\ (1-e^{-0.060\ (T+2.774)})$,

combined $TL = 48.42\ (1-e^{-0.053\ (T+4.124)})$, where L_m and L_f is the total length of males and females respectively and T is the age.

Virtual Population Analysis (VPA)

Arbitrary fishing mortalities (F) were applied to the oldest age group and the last year of fishing. From these, improved estimates of the partial recruitment (PR) were obtained and the starting fishing mortalities recalculated. This was carried out until the relationship between F weighted by population numbers (3+ age groups) and effort (f) became nearly linear (see Table 7 and Fig. 1). The final PR was then calculated from the mean F of 1965-1973 and normalized to 1. The F's for age classes 5, 6, 10, and 12 were reduced to conform to the pattern of the surrounding age groups. This was done as these four age classes

Table 7. Atlantic redfish commercial catch (tonnes) and effort data (hrs) for ICNAF Div. 4VWX (updated from Mohn, 1978).

Year	Catch* OTB1-4 tonnes	Effort* OTB1-4 hours	C/E	4VXW Total Catch	Estimated Total Effort (Adjusted by the Chikuni method)
1965	1019	1919	.5310	19578	36870
1966	4507	5266	.8559	40836	47711
1967	2554	4077	.6264	18244	29125
1968	3213	4898	.6560	13103	19974
1969	5074	8575	.5917	22742	38435
1970	7154	12306	.5813	31579	54325
1971	15396	24565	.6267	62381	99539
1972	9473	16175	.5857	50300	85880
1973	6695	12332	.5429	40173	73997
1974	6916	14786	.4677	32819	70170
1975	4782	10222	.4678	27983	59818
1976	3934	8680	.4532	18459	40730
1977	4007	6771	.5918	16362	27648
1978	1726	3418	.5050	15494	30681

* Data for Canada (MQ) 150-499.9 tonne side otter trawl.

Figure 1. Fishing mortality (F) weighted by population numbers for 4VWX Atlantic redfish plotted against adjusted effort (see Table 7). Two runs based on natural mortalities (M) of 0.1 and 0.075 gave correlation coefficients of 0.9583 and 0.9597 respectively.

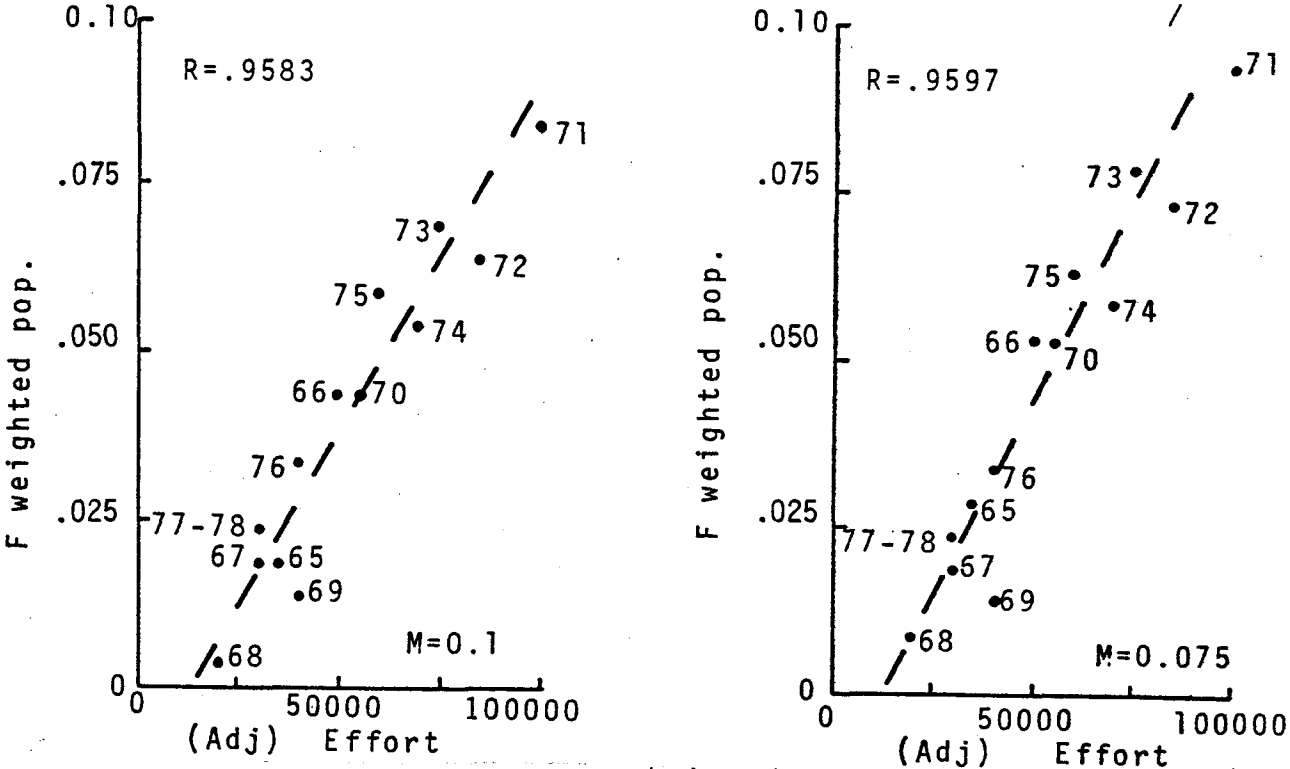
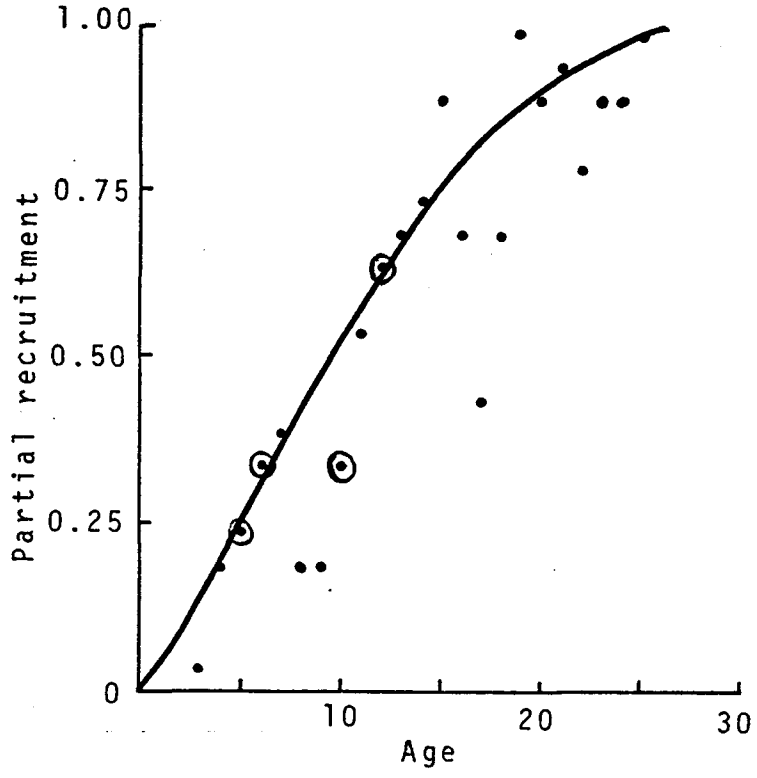


Figure 2. The partial recruitment (PR) of 4VWX Atlantic redfish. The 'o' indicates data after adjustments to age classes 5,6,10,and 12 (see text). The line represents the PR smoothed by eye.



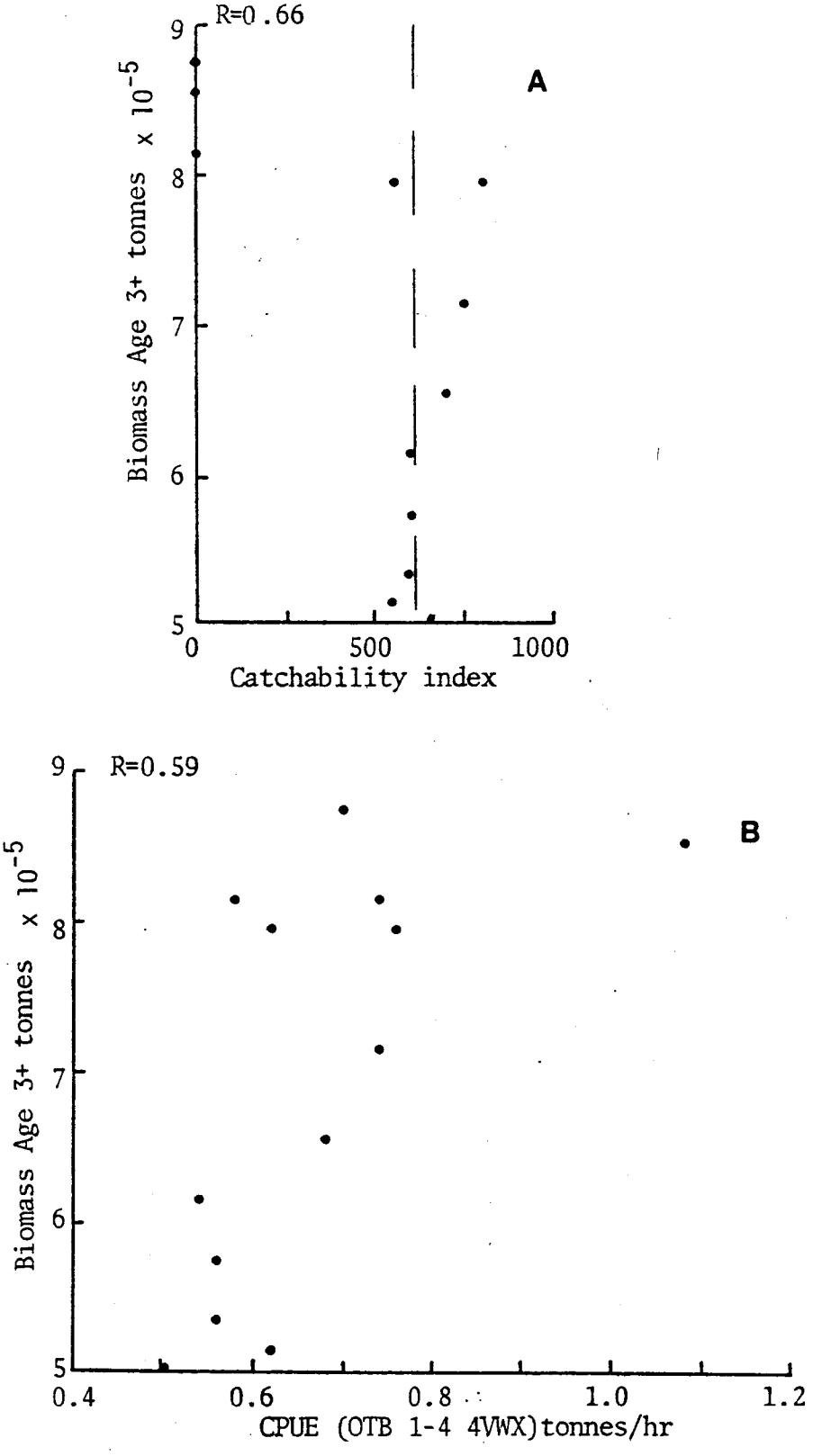


Figure 3. The 4Vs catchability index (A) as derived by the Chikuni method (see Fig.4) versus the population biomass. A similiar plot (B) of the CPUE of OTB1-4 side trawlers(Canadian M&Q) from 4VWX against population biomass.

were large in the 1975 age-length-key and thus dominated the population in all years despite what may have happened to the population in individual years. The PR's were then plotted (Fig. 2) and smoothed by eye. Using the above parameters the VPA was run to give the numbers-at-age (Appendix 1 Tables 8 and 9). A second run was made with an M=0.075, and similar results were obtained (Appendix 1). The population biomass in 1978 is similiar in both cases indicating the analysis is not overly sensitive to estimates of M at the levels tested.

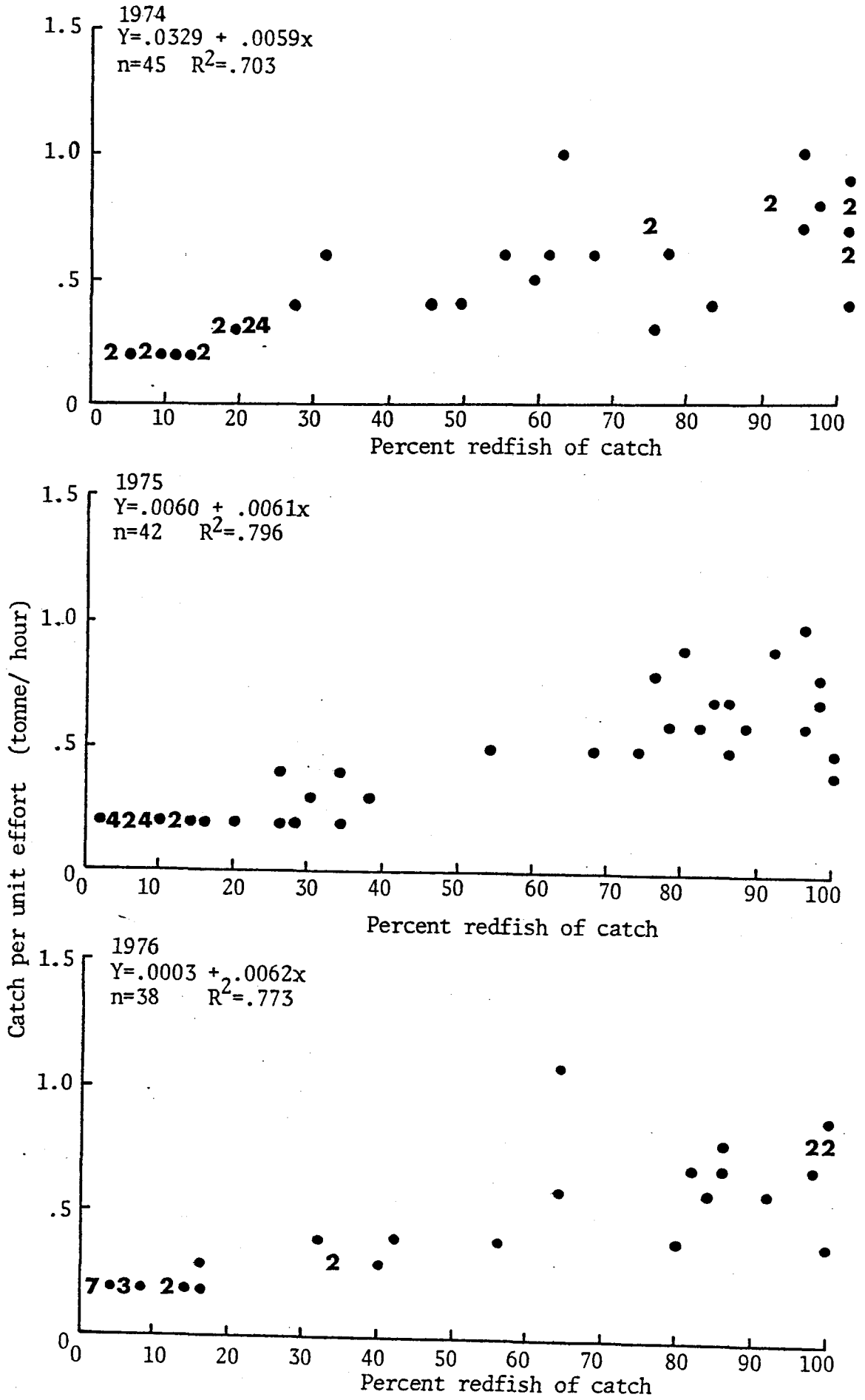
The relationship between VPA population biomass and catch per unit effort (CPUE) was not good (R=0.59). A plot of the catchability index was also used to test the VPA biomass estimates (Fig. 3). The catchability index was calculated by the method proposed by Chikuni (1976) (Fig. 4 shows sample calculations for 3 years). This relationship was slightly better (R=0.66) than that of straight CPUE. Figure 3A and to a lesser extent Figure 3B indicates that the catchability may be relatively constant over the observed range of population biomass. This may be the result of several factors working alone or in combination. One of these may be due to the fact that OTB1-4 trawlers are local vessels whose crews are very familiar with the fishery. These men find enough fish to make a trip economical (approximately 0.5 + tonnes per hour) or they direct their efforts elsewhere or to other species. A similar pattern was observed for Soviet vessels (OTB2-7) with Silver hake (Merluccisu bilinearis) prior to 1977 (Clay, 1979b). A second factor may be the geographical distribution of redfish. The very rugged nature of the bottom in these areas makes much of the range inaccessible to conventional bottom trawls. Subsequent disperal from the rugged havens may maintain a relatively constant population density in the fishable areas.

The CPUE for OTB1-4 trawlers does not reflect fluctuations in VPA abundance. Because F and effort are highly correlated an error must exist in the analysis. This error may involve the incorrect use of one of the basic techniques used for the assessment of Scotian Shelf fisheries. This method uses the regression of F on effort to provide an estimate of the starting F for the VPA. In order for this technique to be valid independent estimates are necessary of both F and effort. Generally effort is derived from the CPUE of a component of the fleet. If this component is both a relatively small portion of the fleet and covers a narrow range of values then variation in estimated total effort will be more a factor of total catch than of the effort of our fleet component. Because the F's prior to the current year are derived from the catch at age table (i.e. the catch) any relationship between F and effort in such a case be expected to give a good correlation. Although it is impossible to identify which portion of the input data is in error - there is a major error either in the CPUE of OTB1-4 trawlers, or the catch table and the accompanying parameters used in the VPA.

Yield Per Recruit

The yield-per-recruit (YPR) at M=0.10 is 0.116 kg at a fully recruited $F_{0.1}$ of 0.163. The F_{max} is 0.292 with a YPR of 0.125 kg. The YPR at M=0.075 is 0.151 kg at an $F_{0.1}$ of 0.144 and 0.160 kg at an F_{max} of 0.236.

Figure 4. Catchability of 4Vs Atlantic redfish as calculated from the slope of the plot of the catch of redfish per unit of total effort versus the percentage of redfish in the total catch.



Catch Projection

The recruitment appears to be dropping over the last few years with a geometric mean (1973-1978) of approximately 125 million fish at age 3. This recruitment was used in the catch projections with the $F_{0.1}$ of 0.163 for an M=0.1 to give the following results assuming the TAC of 20,000 tonnes for 1979 is taken:-

Year	Pop Numbers x10	Pop Biomass x10	Catch Numbers x10	Catch Biomass	Corrected Catch
				tonnes	
1978	1492	508	31.87	15219	15494
1979	1435	497	42.27	20000	20361
1980	1371	478	97.65	46992	47841 *
1981	1253	417	86.60	40764	41500
1982	1158	366	75.56	34371	34890
1983	1089	331	69.53	30702	31256
1984	1037	303	63.52	27237	27729
1985	995	280	58.36	24214	24652
1986	964	263	56.06	22703	23215
1987	938	247	54.65	21893	22289
1988	917	234	51.64	20012	20373

* The catch at $F_{0.1}$ for 1980 would be 48000 tonnes.

A second run at an M=0.075 and an $F_{0.1}$ of 0.144 gives a catch for 1980 of 45000 tonnes. (See Appendix I for tables of all runs).

Effect of change in selectivity of samples

The selection ogives of Atlantic redfish (see Fig. 3 of Clay, 1979) show a substantial change in retention between mesh sizes 90 and 120 mm. An adjusted catch-at-age table (Table 10) is the old table (Table 6) multiplied by a vector of values (Fig. 5) equal to the difference in the percent retention by length between the 90 and 120 mm selection ogives. This should adjust the 1965 to 1977 portion of the table to the same assumptions used for the 1978 samples. (Note: In some intermediate years, where the Soviet fleet used small mesh gear for a large portion of the total redfish catch, there will be over-compensation.) These adjusted age frequencies were then reduced by a factor to provide the true annual catch weights (see bottom line of Table 10). These latter values show the effect of the possible error in different years. It must be borne in mind that these calculations are mearly speculative and are intended to give an indication of the sensitivity of the analysis to certain assumptions.

Table 10. The adjusted catch-at-age table for 4VWX Atlantic redfish. The lower row of numbers are the factors used to reduce the increased length frequencies to achieve the true catch (landings).

CATCH AT AGE TABLE (ADJUSTED FOR POSSIBLE CHANGE IN SELECTIVITY OF LANDINGS SAMPLES)

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	89	108	53	5	0	1929	1636	59	533	402	4032	0	48	159
4	3506	7840	3823	492	139	24426	33639	4207	13618	8370	25321	1359	709	987
5	12473	27642	12648	1613	762	58068	88962	20468	43471	26333	48181	8239	3334	1589
6	19510	38692	17264	2169	1533	65539	109428	33451	57687	36257	51279	12482	5884	1707
7	21051	41481	16335	3851	6417	28256	57151	50460	46526	32751	21496	19540	10684	1097
8	12915	25828	9125	1367	2078	13126	29100	32366	26994	18924	10262	12686	6564	584
9	6344	12756	4818	1994	4778	3667	12551	16814	9398	8046	5115	5363	3946	690
10	18327	34944	12175	3620	7308	10962	36334	46820	29515	23458	12969	16830	10572	3541
11	4249	8344	3188	1815	3542	2520	8697	11330	6433	5431	3402	3983	3010	1358
12	5816	11298	4720	3176	6516	2658	11074	15848	7584	7075	4726	5168	4372	3109
13	2045	4130	1541	895	1928	825	3897	5843	2659	2494	1737	1823	1498	1689
14	1502	3069	1292	1209	2323	766	3145	4350	2018	1929	1384	1423	1395	1548
15	1307	2738	1173	1315	2498	710	2851	3889	1746	1704	1317	1301	1356	1802
16	743	1468	774	895	1709	427	1584	2115	944	973	726	729	784	1403
17	318	644	382	676	1235	265	776	910	407	443	381	322	543	916
18	378	785	491	701	1315	277	900	1113	496	548	435	376	515	1140
19	389	860	571	950	1798	352	1048	1192	535	598	506	426	640	1605
20	275	625	427	729	1355	259	714	797	368	401	335	339	506	1121
21	235	555	398	699	1330	243	612	703	313	369	325	260	480	1452
22	130	339	286	572	1064	193	436	432	215	244	228	163	382	1510
23	210	536	411	754	1412	256	621	684	322	367	323	245	500	1428
24	96	252	252	474	891	156	360	356	179	202	189	131	277	698
25	125	327	210	382	747	135	328	376	176	198	178	130	293	740
FACTOR REQUIRED TO CORRECT FOR CATCH WEIGHT														
	0.146	0.155	0.196	0.456	0.462	0.096	0.124	0.167	0.114	0.142	0.130	0.163	0.268	

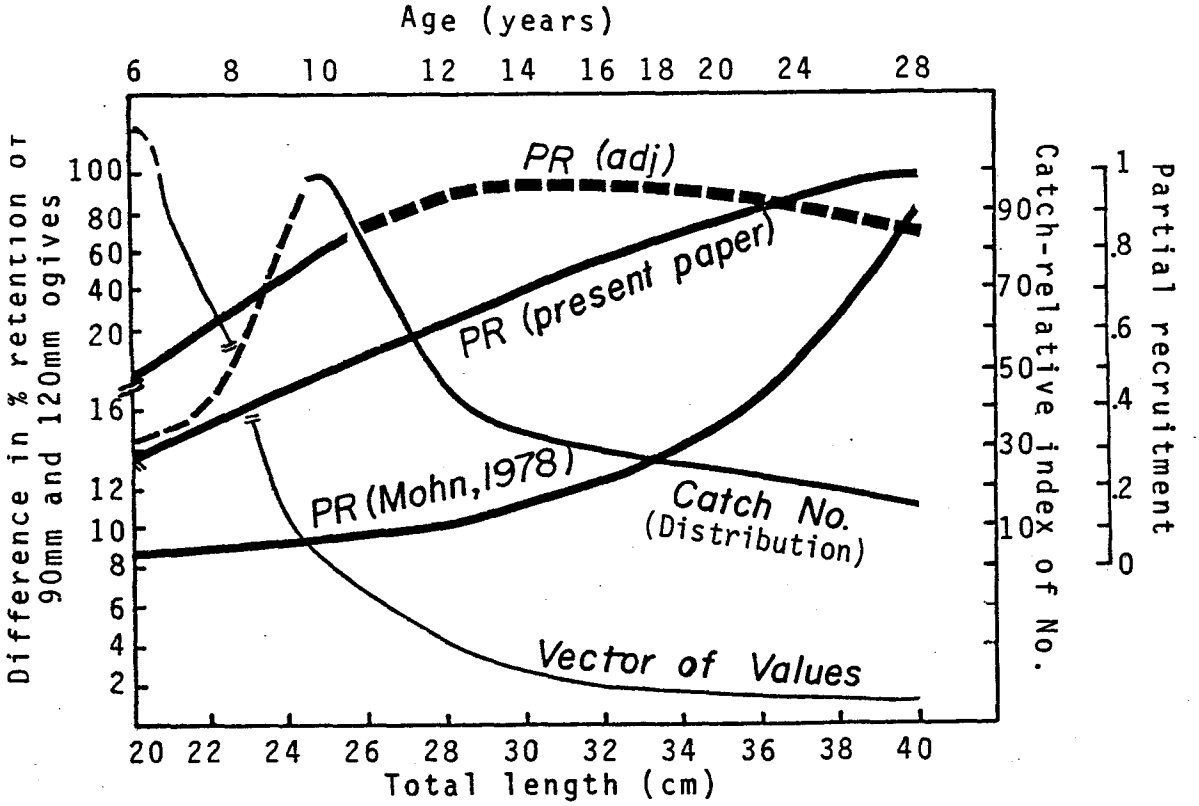
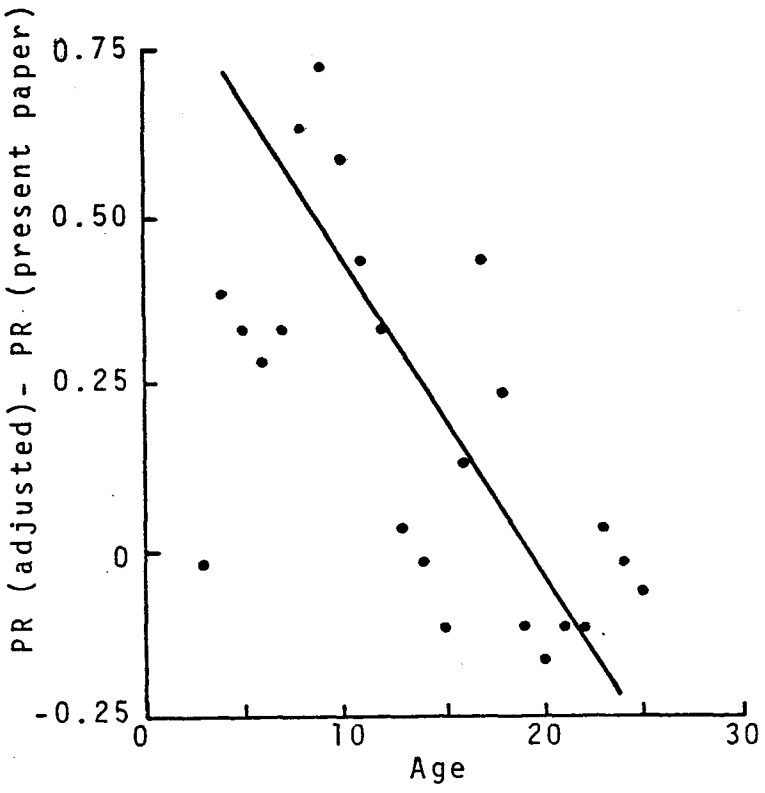


Fig.5. (Left) Partial recruitment (PR) curves for 1978, 1979, and 1979 (adjusted) showing typical catch distribution for reference.

Fig.6. (Right) Difference between the 1979 partial recruitment (PR) and the PR from the adjusted catch-at-age table (Table 10).



The PR for this new table was calculated in the same manner as that described previously. Figure 5 shows the PR's for each of the two catch tables. Figure 6 shows the difference between the two PR's.

The yield-per-recruit for the new PR at M=0.1 is 0.108 kg for an $F_{0.1}$ of 0.113. This would give a 1980 allowable catch of 7,000 tonnes with a 1979 catch equal 20,000 tonnes. Table 11 summarizes this output. This great difference from the 48,000 tonnes calculated previously shows the importance of gear selection assumptions on catch projections. The major effect on the analysis of this change would be in the population biomass. This drops four fold with the shift to the smaller mesh size, resulting in the same catch weight being distributed over younger age groups, thus reducing the biomass with time.

Discussion

The catch indicated by the catch projection for 1980 is extremely high in light of the apparent decline in the catches of recent years. This decline in catch may however be the result of quota restrictions more than stock decline. Three possible errors in assumption should be considered during this analysis. First, the 4VWX redfish may not be a unit stock. Cursory inspection of R/V length frequencies indicate a possible break up might necessary to allow accurate appraisal of fishing effects on the stock. If such a stock separation is in fact true and the distribution of fish is uniform, then the allowable catch could very well be 40,000 tonnes for 4VWX, however allocation by area would be necessary. This is especially true in light of the fact that at present 4Vs accounts for approximately 60% of the landings. The second error could be the effect (prior to 1978) of incorrectly assuming the port samples are from the directed fleet (90 mm) when in effect they are from the by-catch fishery (120 mm). The effect of correcting this, would be to lower the age of full recruitment which would lower the $F_{0.1}$ from the YPR calculation and subsequently drop the catch although the long-term yield would increase. The above calculations on the effect of change in the selectivity of the samples demonstrates that an immediate drop could be in expected in the catch. The third and last error (although not an assumption) is due to the use of only one age-length-key (1975) which will affect the PR with a bias in year-class strength.

The need for detailed analysis of the historic data for this fishery is obvious. Until this is done no faith can be placed on a catch derived from either a stock assessment or observation of trends in CPUE. An investigation of Canadian R/V surveys (Koeller, 1979) indicates high variability in redfish abundance estimates. Despite this variability, particularly obvious in ICNAF Division 4W, there would appear to be an increasing trend in biomass estimates between 1975 and 1978. This apparent increase in biomass coupled with the long-term Schaefer production model estimate of 30-40,000 tonnes (Mayo and Miller, 1976) indicates that consideration should be given to increasing the TAC from the 20,000 tonne level of the past three years. Although the VPA of this stock assessment is based upon some very tenuous assumptions it does indicate a level comparable to that given by the general production model. This projected 1980 allowable catch of 48,000 tonnes however, must be looked at in perspective. The

population biomass is calculated for ICNAF Divisions 4VWX while research vessel abundance indexes indicate that 75% of the minimum trawlable biomass is found in ICNAF Division 4W. The landings however are not distributed in either of these patterns and 60% of the catch in 1978 was taken in Division 4Vs. Therefore if the TAC is increased from the 20,000 tonnes of the last three years consideration must be given to area allocations.

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Jim Simon assisted in the tabulation and calculation of data to provide the 1978 catch at age matrix. Peggy M^{c}Calla drew the figures for the text. Dr. Halliday gave constructive criticism of the manuscript.

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Appendix I

Output values for the two runs (M=0.1 and M=0.075) of the catch projection of 4VWX Atlantic redfish (see text for other input values).

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Output values for two runs (M=0.1 and M=0.075) of the VPA of 4VWX Atlantic redfish (see text for other input values).

Table 8. Fishing mortalities for Atlantic redfish of ICNAF sub-division 4VWX.

FISHING MORTALITY M=0.10 27/ 5/79

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	0.000	0.000	0.000	0.000	0.000	0.012	0.003	0.000	0.004	0.003	0.023	0.000	0.000	0.001
4	0.004	0.010	0.004	0.000	0.000	0.042	0.095	0.003	0.042	0.030	0.111	0.003	0.001	0.009
5	0.011	0.023	0.009	0.001	0.000	0.109	0.093	0.034	0.036	0.051	0.153	0.023	0.004	0.013
6	0.014	0.028	0.009	0.001	0.000	0.103	0.149	0.023	0.124	0.021	0.097	0.029	0.008	0.018
7	0.016	0.026	0.008	0.001	0.001	0.036	0.067	0.050	0.043	0.055	0.012	0.028	0.013	0.019
8	0.009	0.020	0.005	0.000	0.000	0.016	0.033	0.033	0.045	0.016	0.022	0.006	0.006	0.011
9	0.007	0.018	0.007	0.001	0.003	0.009	0.027	0.032	0.032	0.025	0.011	0.020	0.003	0.010
10	0.058	0.101	0.035	0.005	0.010	0.073	0.189	0.211	0.237	0.178	0.118	0.072	0.064	0.018
11	0.029	0.043	0.012	0.004	0.009	0.027	0.079	0.082	0.080	0.066	0.051	0.051	0.013	0.028
12	0.070	0.123	0.031	0.008	0.021	0.050	0.155	0.190	0.139	0.122	0.108	0.105	0.056	0.031
13	0.038	0.086	0.024	0.004	0.009	0.022	0.103	0.116	0.090	0.069	0.060	0.060	0.033	0.036
14	0.036	0.075	0.029	0.011	0.014	0.021	0.087	0.123	0.084	0.074	0.057	0.054	0.038	0.037
15	0.043	0.088	0.031	0.017	0.029	0.029	0.086	0.117	0.107	0.082	0.079	0.060	0.043	0.045
16	0.035	0.064	0.027	0.014	0.030	0.032	0.068	0.067	0.060	0.069	0.054	0.048	0.030	0.035
17	0.020	0.040	0.019	0.014	0.026	0.031	0.065	0.042	0.027	0.032	0.043	0.027	0.031	0.023
18	0.031	0.066	0.034	0.020	0.038	0.039	0.118	0.101	0.047	0.041	0.049	0.047	0.036	0.034
19	0.044	0.093	0.051	0.038	0.069	0.066	0.164	0.173	0.102	0.062	0.055	0.051	0.067	0.049
20	0.039	0.086	0.047	0.036	0.067	0.062	0.139	0.130	0.109	0.081	0.048	0.037	0.047	0.044
21	0.039	0.089	0.051	0.038	0.075	0.068	0.137	0.128	0.092	0.108	0.086	0.034	0.037	0.046
22	0.028	0.069	0.047	0.040	0.074	0.068	0.127	0.098	0.078	0.077	0.098	0.045	0.038	0.039
23	0.053	0.129	0.078	0.062	0.116	0.103	0.215	0.191	0.133	0.130	0.136	0.102	0.099	0.044
24	0.022	0.071	0.058	0.046	0.086	0.075	0.139	0.120	0.093	0.083	0.091	0.053	0.085	0.044
25	0.032	0.081	0.055	0.044	0.084	0.075	0.151	0.137	0.108	0.102	0.096	0.059	0.086	0.048

FISHING MORTALITY M=0.075 27/ 5/79

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	0.000	0.000	0.000	0.000	0.000	0.014	0.004	0.000	0.005	0.003	0.025	0.000	0.000	0.001
4	0.005	0.012	0.005	0.000	0.000	0.050	0.109	0.004	0.047	0.033	0.119	0.004	0.001	0.009
5	0.014	0.029	0.012	0.001	0.000	0.125	0.109	0.038	0.041	0.056	0.163	0.024	0.004	0.013
6	0.019	0.035	0.012	0.001	0.001	0.120	0.171	0.026	0.139	0.023	0.104	0.030	0.008	0.018
7	0.020	0.033	0.010	0.001	0.002	0.042	0.077	0.057	0.048	0.060	0.013	0.029	0.014	0.019
8	0.011	0.026	0.006	0.000	0.001	0.019	0.037	0.037	0.050	0.017	0.023	0.007	0.006	0.011
9	0.009	0.023	0.008	0.001	0.003	0.010	0.031	0.036	0.035	0.027	0.011	0.021	0.003	0.010
10	0.075	0.128	0.043	0.007	0.011	0.084	0.214	0.236	0.260	0.193	0.126	0.075	0.065	0.018
11	0.036	0.054	0.016	0.005	0.010	0.031	0.089	0.092	0.089	0.072	0.055	0.053	0.014	0.028
12	0.087	0.152	0.039	0.010	0.025	0.058	0.176	0.213	0.155	0.133	0.115	0.110	0.057	0.031
13	0.047	0.105	0.029	0.005	0.010	0.025	0.117	0.131	0.100	0.075	0.065	0.063	0.034	0.036
14	0.044	0.091	0.035	0.013	0.017	0.025	0.100	0.138	0.093	0.080	0.061	0.056	0.039	0.037
15	0.052	0.106	0.038	0.020	0.034	0.034	0.099	0.133	0.119	0.090	0.084	0.063	0.044	0.045
16	0.041	0.076	0.032	0.016	0.034	0.038	0.078	0.076	0.067	0.076	0.058	0.051	0.031	0.035
17	0.023	0.047	0.022	0.017	0.030	0.036	0.074	0.047	0.030	0.036	0.046	0.028	0.032	0.023
18	0.036	0.075	0.039	0.023	0.043	0.044	0.132	0.113	0.052	0.044	0.052	0.049	0.037	0.034
19	0.049	0.105	0.058	0.042	0.077	0.074	0.183	0.192	0.112	0.067	0.059	0.054	0.068	0.049
20	0.044	0.095	0.052	0.039	0.074	0.068	0.153	0.143	0.120	0.088	0.052	0.039	0.048	0.044
21	0.043	0.097	0.055	0.042	0.081	0.074	0.149	0.139	0.100	0.117	0.092	0.036	0.038	0.046
22	0.030	0.073	0.050	0.043	0.078	0.073	0.135	0.105	0.083	0.082	0.105	0.047	0.039	0.039
23	0.056	0.135	0.082	0.065	0.122	0.108	0.224	0.200	0.139	0.136	0.142	0.107	0.101	0.044
24	0.022	0.073	0.060	0.047	0.088	0.077	0.143	0.122	0.096	0.085	0.093	0.054	0.087	0.044
25	0.032	0.081	0.055	0.044	0.084	0.075	0.151	0.137	0.108	0.102	0.096	0.059	0.086	0.048

Table 9. Numbers-at-age for Atlantic redfish of ICNAF sub-division 4VWX.

POPULATION NUMBERS M=0.10 27/ 5/79

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	301015	262008	246697	251449	358482	175967	462381	167082	116101	107958	141674	154118	129537	125394
4	308813	272312	237008	223195	227520	324368	157309	417126	151149	104608	97415	125237	139452	117193
5	267241	278286	243986	213528	201904	205854	281393	129467	376235	131097	91851	78874	112924	126056
6	243760	239109	246135	218727	193096	182638	167086	231921	113268	328369	112745	71354	69770	101784
7	195658	217395	210404	220624	197799	174642	149023	130259	205096	90493	291051	92628	62748	62610
8	215747	174303	191603	188800	199468	178712	152420	126092	112128	177033	77496	260203	81539	56020
9	251235	193538	154538	172486	170776	180400	159102	133459	110413	96963	158376	68618	233965	73315
10	212265	225678	171981	138899	155906	154131	161778	140117	116935	96776	85581	141805	60840	211141
11	142843	181245	184670	150260	124995	139701	129587	121125	102624	83509	73305	68804	119411	51648
12	115819	125570	157154	165039	135456	112127	123075	108380	101014	85720	70714	63005	59167	106626
13	111126	97671	100516	137890	148084	120034	96486	95381	81091	79501	68632	57455	51339	50616
14	100948	96755	81121	88821	124234	132857	106275	78784	76820	67052	67166	58465	48958	44938
15	88189	88090	81257	71317	79528	110817	117684	88138	63050	63911	56368	57394	50143	42652
16	74614	76402	72972	71254	63433	69903	97454	97756	70913	51239	53268	47146	48905	43450
17	67757	65216	64831	64243	63584	55721	61235	82405	82731	60424	43261	45665	40640	42930
18	62721	60095	56681	57573	57301	56037	48870	51912	71521	72865	52930	37502	40218	35642
19	54307	54998	50928	49588	51050	49914	48742	39303	42456	61765	63312	45618	32372	35089
20	46435	47036	45356	43780	43217	43109	42259	37421	29922	34704	52552	54198	39210	27404
21	39860	40392	39065	39163	38232	36569	36672	33269	29743	24289	28960	45318	47245	33848
22	34112	34678	33445	33599	34111	32105	30904	28925	26475	24545	19731	24042	39630	41203
23	29154	30024	29295	28880	29209	28675	27133	24624	23720	22167	20573	16181	20807	34506
24	32209	25013	23869	24521	24560	23524	23408	19804	18400	18784	17604	16251	13216	17057
25	28694	28520	21083	20377	21200	20390	19742	18426	15899	15163	15641	14545	13943	10979
	3024523	2914334	2744595	2674012	2743142	2608195	2700018	2401176	2137706	1899736	1760205	1644427	1555976	1492100

POPULATION NUMBERS M=0.075 27/ 5/79

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	228922	202839	196344	206431	293658	148787	386888	144661	102807	97426	130101	144815	124795	123859
4	237546	212322	188115	182131	191514	272440	136099	357663	134175	94929	90114	117708	134351	115760
5	206963	219228	194537	173585	168918	177661	240492	113227	330608	118739	85231	74212	108802	124516
6	187903	189273	197646	178414	160929	156660	145399	200129	101118	294503	104208	67163	67231	100542
7	150701	171116	169570	181250	165408	149221	128896	113696	180853	81660	267075	87168	60471	61846
8	165111	137042	153583	155716	167990	153189	132764	110721	99671	159940	71318	244586	78566	55336
9	193549	151482	123921	141591	144407	155765	139484	118658	98994	87918	145817	64641	225418	72419
10	163995	177894	137357	114023	131192	133574	143037	125511	106212	88672	79382	133762	58706	208564
11	113242	141187	145258	122008	105088	120327	113918	107115	91968	75946	67816	64902	115083	51018
12	93380	101333	124054	132679	112681	96510	108258	96698	90681	78093	65549	59550	57083	105328
13	89466	79416	80738	110726	121826	101975	84502	84246	72515	72073	63403	54198	49503	50000
14	82347	79158	66329	72747	102185	111874	92241	69766	68553	60872	62035	55140	47213	44391
15	72593	73103	67067	59425	66639	93187	101228	77449	56382	57929	52114	54129	48361	42134
16	62130	63909	60999	59921	54020	59741	83600	85073	62901	46422	49122	44441	47151	42921
17	57385	55313	54935	54785	54691	48419	53383	71710	73130	54567	39926	43007	39185	42406
18	54047	52009	48958	49864	49986	49224	43353	45985	63447	65827	48858	35378	38784	35208
19	47584	48366	44758	43700	45203	44416	43680	35241	38088	55876	58418	43023	31240	34663
20	41337	42015	40406	39194	38869	38814	38265	33754	26980	31576	48460	51068	37821	27071
21	36108	36706	35439	35585	34962	33493	33645	30466	27145	22209	26821	42697	45560	33437
22	31557	32093	30910	31108	31672	29915	28859	26901	24590	22785	18329	22694	38219	40702
23	27513	28424	27664	27276	27652	27166	25812	23392	22474	21001	19481	15311	20094	34087
24	31052	24141	23030	23653	23713	22711	22631	19137	17770	18136	16999	15679	12760	16849
25	28345	28175	20828	20130	20944	20143	19506	18206	15708	14981	15453	14369	13775	10847
	2402776	2346543	2232447	2215939	2314148	2249210	2345939	2109404	1906768	1722078	1626029	1549640	1500172	1473903

M=0.1

Output for catch projections.

POPULATION NUMBERS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	[illegible]	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000
4	117123	116310	110721	110138	[illegible]	[illegible]	112138	112138	112138	112138	112138
5	[illegible]	105102	101228	99039	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	98535
6	101704	[illegible]	93477	87727	85717	85713	[illegible]	85311	85311	85311	85311
7	[illegible]	[illegible]	99471	79716	73047	73150	[illegible]	[illegible]	72783	72783	72783
8	56020	55609	79977	84639	67830	63606	62217	61931	61931	61931	61931
9	[illegible]	50134	49589	69490	73944	57179	55564	54308	54037	54032	54032
10	211141	46682	44770	43419	61018	64556	51815	40650	47551	47309	47309
11	51648	187682	58050	38196	37043	52058	55162	44206	41506	40568	40362
12	105676	45442	163643	17877	31567	30551	42955	45195	36459	34232	33458
13	50516	92524	39459	133588	39084	25716	24940	35049	37139	29763	27945
14	46935	44194	80722	31729	107416	31426	20678	20054	28103	29863	23932
15	42652	39190	38085	64655	25413	85036	25171	16562	16062	22573	23919
16	43450	36881	33394	29655	50341	17788	65993	19600	12896	12507	17577
17	42930	37981	31882	26956	23938	40638	15973	56077	15821	10410	10096
18	35642	37973	33351	26763	22628	20095	34114	13409	45595	13281	8739
19	35089	31166	32841	26951	21627	18286	16238	27567	10836	36684	10732
20	27404	30224	26422	25249	20721	16637	14058	12484	21194	8331	28203
21	33848	23730	25804	20674	19756	16213	13010	11000	9769	16584	6518
22	41203	29247	20201	20045	16060	15347	12595	10107	8545	7588	12983
23	34506	35847	25124	16053	15929	12762	12195	10008	8031	6790	6030
24	17057	29865	30584	19625	12539	12442	9969	9526	7817	6273	5304
25	10979	14770	25497	23929	15355	9811	9735	7800	7453	6117	4908
	1492100	1435579	1371253	1253324	1158323	1089467	1037170	995610	964398	938613	917655

POPULATION BIOMASS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	5517.34	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00
4	9258.21	8951.49	8904.97	8859.70	8859.70	8859.70	8859.70	8859.70	8859.70	8859.70	8859.70
5	13866.14	11561.20	11146.13	10894.24	10838.86	10838.86	10838.86	10838.86	10838.86	10838.86	10838.86
6	13740.86	15194.15	12614.01	11843.46	11575.81	11516.96	11516.96	11516.96	11516.96	11516.96	11516.96
7	11269.75	16285.55	17904.85	14348.93	13472.39	13167.94	13100.99	13100.99	13100.99	13100.99	13100.99
8	11204.01	11121.75	15975.49	16927.87	13565.98	12737.27	12449.42	12386.13	12386.13	12386.13	12386.13
9	19428.39	13285.44	13141.07	18467.81	19568.77	15682.39	14724.40	14391.65	14318.48	14318.48	14318.48
10	61230.89	19047.74	12983.41	12591.40	17695.34	18750.25	15026.43	14108.50	13789.67	13719.56	13719.56
11	18076.69	65688.66	20317.44	13368.62	12964.97	18220.34	19306.54	15472.24	14527.08	14198.79	14126.61
12	44783.07	19085.57	68730.02	20108.18	13230.92	12831.44	18032.67	19107.69	15312.88	14377.46	14052.55
13	22270.97	41150.63	17362.12	58778.71	17196.75	11315.24	10973.60	15421.75	16341.12	13095.76	12295.77
14	21884.82	21522.30	39311.49	15451.80	52311.39	15301.62	10070.24	9766.19	13724.93	14543.14	11654.85
15	22861.61	21005.93	20413.45	34655.16	13621.58	46115.26	13491.83	8877.45	8607.41	12099.25	12820.55
16	23897.44	20284.33	18366.53	16310.31	27689.42	10883.62	36846.03	10779.96	7093.07	6878.91	9667.28
17	25757.72	22783.87	19123.92	16173.42	14362.73	24383.08	9584.03	32446.31	9492.74	6246.10	6057.51
18	22454.33	23923.28	21011.40	16860.64	14255.60	12659.62	21491.77	8447.57	28598.88	8367.11	5505.45
19	22807.72	20258.16	21346.43	17518.24	14057.55	11885.60	10554.95	17918.75	7043.16	23844.30	6976.07
20	17182.58	21156.94	18495.35	17673.96	14504.38	11639.07	9840.78	8739.06	14835.98	5831.44	19742.09
21	25386.17	17797.78	19353.07	15505.67	14817.05	12159.82	9757.67	8250.07	7326.44	12437.82	4888.82
22	34198.83	24275.07	16767.19	16637.58	13330.03	12738.03	10453.64	8388.54	7092.48	6298.44	10692.63
23	31193.71	32405.80	22712.43	14511.59	14399.42	11536.81	11024.45	9047.36	7260.08	6138.36	5451.15
24	16698.47	29238.17	29941.26	19212.81	12275.58	12180.70	9759.17	9325.76	7653.31	6141.42	5192.54
25	11528.30	15508.57	26772.00	25125.63	16122.70	10301.23	10221.60	8189.55	7825.84	6422.38	5153.66
	508498.09	497037.40	478199.03	417325.74	366216.92	331207.82	303425.74	280881.05	263048.20	247161.37	234518.22

CATCH NUMBERS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	159	403	1006	1006	1006	1006	1006	1006	1006	1006	1006
4	987	1261	3109	3094	3094	3094	3094	3094	3094	3094	3094
5	1589	1749	4163	4069	4048	4048	4048	4048	4048	4048	4048
6	1707	2490	5081	4771	4663	4639	4639	4639	4639	4639	4639
7	1097	2091	5646	4525	4249	4153	4132	4132	4132	4132	4132
8	584	766	2721	2883	2310	2169	2120	2109	2109	2109	2109
9	690	623	1527	2146	2274	1822	1711	1672	1664	1664	1664
10	3541	1453	2435	2361	3318	3516	2818	2646	2586	2573	2573
11	1358	6500	4893	3220	3122	4388	4650	3726	3499	3420	3402
12	3109	1744	15244	4460	2935	2846	4000	4238	3396	3189	3117
13	1689	4106	4185	14170	4146	2728	2645	3718	3939	3157	2964
14	1548	2002	8827	3470	11747	3437	2261	2193	3082	3266	2617
15	1802	2175	5060	8591	3377	11431	3344	2201	2134	2999	3178
16	1403	1567	3432	3048	5174	2034	6885	2014	1325	1285	1806
17	916	1068	2194	1855	1647	2796	1099	3721	1089	716	695
18	1140	1598	3397	2726	2304	2046	3474	1366	4623	1353	890
19	1605	1872	4704	3861	3098	2619	2326	3949	1552	5255	1537
20	1121	1625	3405	3253	2670	2143	1811	1609	2731	1073	3634
21	1452	1337	3478	2787	2663	2186	1754	1483	1317	2236	879
22	1510	1409	2344	2326	1064	1781	1461	1173	992	881	1495
23	1428	1949	3273	2091	2075	1663	1589	1304	1046	875	786
24	698	1606	3942	2530	1616	1604	1285	1228	1008	809	684
25	740	849	3582	3132	2157	1378	1368	1026	1047	259	690
	31873	42265	97650	86602	75556	69526	63520	58363	56058	54646	51638

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CATCH BIOMASS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	7	18	44	44	44	44	44	44	44	44	44
4	78	100	246	244	244	244	244	244	244	244	244
5	175	192	458	448	445	445	445	445	445	445	445
6	230	336	686	644	630	626	626	626	626	626	626
7	197	376	1016	815	765	747	744	744	744	744	744
8	117	153	544	577	462	434	424	422	422	422	422
9	183	165	405	569	602	483	453	443	441	441	441
10	1027	421	706	685	962	1020	817	767	750	746	746
11	475	2275	1713	1127	1093	1536	1627	1304	1225	1197	1191
12	1306	733	6403	1873	1233	1195	1680	1780	1426	1339	1309
13	743	1807	1842	6235	1824	1200	1164	1636	1733	1389	1304
14	754	975	4299	1690	5721	1674	1101	1068	1501	1590	1275
15	966	1166	2712	4605	1810	6127	1793	1180	1144	1608	1703
16	772	862	1888	1676	2846	1119	3787	1108	729	707	994
17	550	641	1316	1113	988	1678	660	2233	653	430	417
18	718	1007	2140	1717	1452	1289	2189	860	2913	852	561
19	1043	1217	3058	2509	2014	1703	1512	2567	1009	3416	999
20	785	1137	2383	2277	1869	1500	1268	1126	1912	751	2544
21	1089	1003	2609	2090	1997	1639	1315	1112	988	1677	659
22	1253	1170	1946	1931	1547	1478	1213	973	823	731	1241
23	1291	1762	2959	1891	1876	1503	1436	1179	946	800	710
24	683	1572	3860	2477	1582	1570	1258	1202	987	792	669
25	777	912	3761	3530	2265	1447	1436	1150	1099	902	724
	15219	20000	46992	40764	34271	30702	27237	24214	22803	21893	20012

FISHING MORTALITY 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.001	0.003	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
4	0.009	0.012	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
5	0.013	0.018	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
6	0.018	0.024	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
7	0.019	0.025	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
8	0.011	0.015	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
9	0.010	0.013	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
10	0.018	0.024	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
11	0.028	0.037	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093
12	0.031	0.041	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103
13	0.036	0.047	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118
14	0.037	0.049	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122
15	0.045	0.060	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
16	0.035	0.046	0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114
17	0.023	0.030	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
18	0.034	0.045	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113
19	0.049	0.065	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
20	0.044	0.058	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
21	0.046	0.061	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
22	0.039	0.052	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
23	0.044	0.059	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147
24	0.044	0.058	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
25	0.073	0.064	0.159	0.159	0.159	0.159	0.159	0.159	0.159	0.159	0.159

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POPULATION NUMBERS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	125859	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000
4	115760	114757	115585	115103	115103	115103	115103	115103	115103	115103	115103
5	124516	106445	105251	104489	104053	104053	104053	104053	104053	104053	104053
6	100942	113989	97070	93922	93242	92853	92853	92853	92853	92853	92853
7	61846	91633	103355	87506	82733	82134	81791	81791	81791	81791	81791
8	55336	56321	82999	90830	75144	72706	72180	71879	71879	71879	71879
9	72419	50775	51514	74568	81403	67510	65321	64847	64577	64577	64577
10	208564	66522	46506	46427	67204	73544	60943	58870	58443	58200	58200
11	51018	190084	60316	40966	40896	59198	64782	53395	51856	51481	51266
12	105328	46024	170092	51568	35024	34964	50619	45837	44821	44335	44014
13	50000	94724	41020	114115	43692	29675	29624	42882	38928	38023	37564
14	44391	44741	83927	31294	120487	36529	24810	24767	35852	32934	32458
15	42134	39693	39599	69927	28574	100309	30436	20671	20636	29871	32689
16	42921	37355	34731	32182	56830	23223	81586	24735	16800	16771	24276
17	42406	38469	33147	29137	25998	47676	19481	68444	20751	14094	14069
18	35208	38460	34661	28784	25302	23445	41401	16917	59436	18020	12239
19	34663	31566	34142	29106	24171	21247	19687	34765	14906	45910	15131
20	27071	30613	27484	27438	23391	19425	17675	15821	27939	11416	40110
21	33437	24035	26837	22432	22395	19091	15855	13936	12914	22804	9318
22	30702	29623	21011	21765	18193	18163	15484	12858	11303	10473	18494
23	34037	36308	26126	17384	18008	15052	15028	12811	10639	9352	8665
24	16849	30249	31808	21292	14168	14676	12267	12247	10410	8670	7621
25	10847	14960	26518	25960	17377	11563	11978	10012	9995	8521	7076
	1473903	1452367	1418700	1332195	1259587	1207218	1167249	1134246	1109214	1087230	1068449

POPULATION BIOMASS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	5449.81	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00
4	9145.04	9065.77	9131.18	9093.13	9093.13	9093.13	9093.13	9093.13	9093.13	9093.13	9093.13
5	13696.76	11708.97	11577.62	11493.76	11445.86	11445.86	11445.86	11445.86	11445.86	11445.86	11445.86
6	13573.15	15388.50	13104.48	12679.46	12587.62	12535.16	12535.16	12535.16	12535.16	12535.16	12535.16
7	11132.22	16494.01	18603.98	15391.10	14891.92	14784.05	14722.44	14722.44	14722.44	14722.44	14722.44
8	11067.11	11264.13	16599.88	18165.93	15028.71	14541.28	14435.95	14375.79	14375.79	14375.79	14375.79
9	19190.94	13455.33	13651.25	19760.53	21624.76	17890.20	17309.96	17184.58	17112.96	17112.96	17112.96
10	60483.53	19291.24	13486.78	13463.72	19489.06	21327.69	17644.43	17072.16	16948.51	16877.87	16877.87
11	17856.44	66529.51	21110.62	14338.03	14313.51	20719.16	22673.83	18758.10	18149.71	18018.25	17943.16
12	44237.70	19330.29	71438.77	21658.61	14710.21	14685.06	21256.99	23262.40	19245.02	18620.85	18485.97
13	21999.96	41678.53	18048.64	63410.46	19224.61	13057.08	13034.75	18868.13	20648.17	17082.26	16528.23
14	21618.56	21798.60	40872.41	16701.39	58677.14	17789.57	12082.42	12061.76	17459.70	19106.87	15807.14
15	22583.87	21275.67	21225.03	37480.93	15315.55	53808.27	16313.44	11079.85	11060.91	16010.94	17521.43
16	23606.58	20545.16	19102.22	17700.24	31256.55	12772.13	44872.45	13604.31	9239.85	9224.05	13352.04
17	25443.60	23081.38	19888.27	17481.98	16198.91	28605.38	11688.80	41066.38	12450.39	8456.13	8441.67
18	22181.02	24229.76	21836.35	18134.17	15940.11	14770.20	26082.45	10657.88	37444.41	11352.30	7710.31
19	22530.82	20518.17	22192.51	18918.69	15711.18	13810.27	12796.68	22597.45	9233.83	32441.29	9835.46
20	18949.47	21429.17	19238.57	19206.77	16373.41	13597.42	11952.26	11075.04	19557.23	7991.52	28076.69
21	25077.80	18026.59	20127.81	16824.21	16796.41	14318.62	11891.01	10452.31	9685.17	17102.88	6988.62
22	33782.95	24587.25	17439.49	18065.21	15100.15	15075.19	12851.32	10672.47	9381.21	8692.68	15350.26
23	30814.71	32822.08	23617.82	15715.52	16279.38	13607.43	13584.94	11580.90	9617.45	8453.83	7833.37
24	16495.56	29614.08	31139.76	20844.44	13870.08	14367.73	12009.54	11989.69	10220.98	8488.10	7461.12
25	11388.90	15707.95	27843.47	27258.32	18246.27	12141.23	12576.85	10512.60	10495.23	8946.98	7430.09
	502306.48	503342.14	496776.94	449286.60	407674.52	380242.12	358354.67	340168.39	325623.10	311652.12	300428.77

CATCH NUMBERS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	159	398	898	898	898	898	898	898	898	898	898
4	987	1260	2850	2838	2838	2838	2838	2838	2838	2838	2838
5	1589	1749	3868	3840	3824	3824	3824	3824	3824	3824	3824
6	1707	2490	4727	4573	4540	4521	4521	4521	4521	4521	4521
7	1097	2091	5254	4347	4206	4175	4158	4158	4158	4158	4158
8	584	765	2528	2767	2289	2215	2199	2189	2189	2189	2189
9	690	623	1418	2053	2246	1858	1798	1785	1778	1778	1778
10	3541	1453	2265	2261	3272	3581	2963	2867	2846	2834	2834
11	1358	6499	4561	3098	3092	4476	4899	4053	3921	3893	3877
12	3109	1744	14222	4312	2928	2923	4232	4631	3831	3707	3680
13	1689	4106	3908	13732	4163	2828	2823	4086	4471	3699	3579
14	1548	2003	8246	3370	11838	3589	2438	2434	3523	3855	3189
15	1802	2175	4735	8361	3416	12003	3639	2471	2467	3571	3908
16	1403	1567	3206	2970	5246	2143	7531	2283	1551	1548	2241
17	916	1068	2044	1797	1665	2940	1201	4221	1280	869	868
18	1140	1598	3170	2633	2314	2144	3786	1547	5436	1648	1119
19	1605	1872	4404	3754	3118	2741	2539	4484	1832	6468	1952
20	1121	1625	3186	3181	2711	2252	1979	1834	3239	1323	4650
21	1492	1337	3256	2721	2717	2316	1923	1691	1567	2767	1130
22	1510	1409	2191	2270	1897	1894	1615	1341	1179	1092	1929
23	1428	1949	3062	2038	2111	1764	1761	1502	1247	1096	1015
24	698	1606	3609	2469	1643	1702	1423	1420	1211	1005	884
25	760	869	3354	3283	2198	1462	1515	1266	1264	1078	895
	31873	42257	91042	83565	75173	71090	66503	62345	61971	60631	57757

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STOCK NUMBERS 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	7	18	40	40	40	40	40	40	40	40	40
4	78	100	225	224	224	224	224	224	224	224	224
5	175	192	434	422	421	421	421	421	421	421	421
6	230	336	638	617	613	610	610	610	610	610	610
7	197	326	946	782	757	752	748	748	748	748	748
8	117	153	506	553	458	443	440	438	438	438	438
9	183	165	376	544	595	492	477	473	471	471	471
10	1027	421	657	656	949	1039	859	831	825	822	822
11	475	2275	1596	1084	1082	1567	1714	1418	1372	1362	1357
12	1306	733	5973	1811	1230	1228	1777	1945	1609	1557	1546
13	743	1807	1720	6042	1832	1244	1242	1798	1967	1628	1575
14	754	975	4016	1641	5765	1748	1187	1185	1716	1877	1553
15	966	1166	2538	4481	1831	6433	1950	1325	1322	1914	2095
16	772	862	1763	1634	2885	1179	4142	1256	853	851	1232
17	550	641	1226	1078	999	1764	721	2533	768	521	521
18	718	1007	1997	1659	1458	1351	2385	975	3425	1038	705
19	1043	1217	2863	2440	2027	1781	1651	2915	1191	4185	1269
20	785	1137	2230	2224	1898	1576	1386	1284	2267	926	3255
21	1009	1003	2442	2041	2038	1737	1443	1268	1175	2075	848
22	1253	1170	1819	1884	1575	1572	1340	1113	978	907	1601
23	1091	1762	2768	1842	1908	1595	1592	1357	1127	991	918
24	683	1572	3611	2417	1608	1666	1393	1390	1185	984	865
25	777	913	3522	3448	2308	1536	1591	1330	1327	1132	940
	15219	20000	43896	39567	34500	31998	29333	26877	26061	25723	24053

FISHING MORTALITY 27/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.001	0.003	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
4	0.009	0.011	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
5	0.013	0.017	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
6	0.018	0.023	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
7	0.019	0.024	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054
8	0.011	0.014	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
9	0.010	0.013	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
10	0.018	0.023	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
11	0.008	0.036	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
12	0.031	0.040	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
13	0.036	0.046	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
14	0.037	0.048	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107
15	0.045	0.059	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
16	0.035	0.045	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101
17	0.023	0.029	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
18	0.034	0.044	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
19	0.049	0.064	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144
20	0.044	0.057	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128
21	0.046	0.059	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134
22	0.039	0.051	0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114
23	0.044	0.057	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
24	0.044	0.057	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128
25	0.073	0.062	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141

Table 11. Output for projection based on adjusted catch-at-age (Table 10).

M=0.10

$F_{0.1}$=0.1126

POPULATION NUMBERS 28/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	33615	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
4	11853	30292	89706	90173	90173	90173	90173	90173	90173	90173	90173
5	6911	9787	25389	76202	76598	76598	76598	76598	76598	76598	76598
6	5153	4656	7446	19752	64351	64686	64686	64686	64686	64686	64686
7	3220	3050	3482	6245	16866	53970	54251	54251	54251	54251	54251
8	2277	1881	2242	2900	5200	13798	44950	45186	45186	45186	45186
9	4980	1507	1324	1835	2374	4258	11295	36800	36992	36992	36992
10	9269	3851	1038	1075	1490	1927	3357	9170	29876	30031	30031
11	9468	5034	2643	843	871	1208	1563	2905	7935	24273	24319
12	13595	7278	3483	2139	681	704	977	1263	2266	6011	19584
13	14648	9171	4990	2782	1733	552	571	791	1024	1836	4870
14	14128	11649	6635	4131	2303	1434	457	472	656	847	1520
15	15264	11313	8529	5518	3435	1915	1193	380	393	545	705
16	15271	12100	8139	7044	4557	2837	1580	985	314	325	450
17	15101	12485	8909	6692	5792	3747	2333	1300	810	258	267
18	12895	12793	8759	7039	5472	4736	3064	1907	1063	662	211
19	12138	10584	8849	7121	5723	4449	3850	2491	1551	864	538
20	10027	9458	7392	7222	5812	4671	3631	3142	2033	1266	706
21	12222	8008	6893	6136	5995	4825	3878	3014	2609	1688	1051
22	14727	9680	5752	5689	5065	4948	3982	3201	2498	2153	1393
23	8329	11891	7190	4812	4759	4236	4139	3331	2677	2081	1801
24	5509	6181	8239	5850	3915	3872	3447	3367	2710	2178	1693
25	2923	4322	4367	6755	4796	3210	3175	2826	2761	2222	1786
	353266	296973	329050	377954	417663	452755	483252	508139	528549	540075	558839

POPULATION BIOMASS 28/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	1480.37	4400.00	4400.00	4400.00	4400.00	4400.00	4400.00	4400.00	4400.00	4400.00	4400.00
4	936.38	2393.06	7086.80	7123.69	7123.69	7123.69	7123.69	7123.69	7123.69	7123.69	7123.69
5	749.26	1076.59	2572.84	8382.17	8425.81	8425.81	8425.81	8425.81	8425.81	8425.81	8425.81
6	696.36	628.55	1005.27	2666.53	8687.40	8732.63	8732.63	8732.63	8732.63	8732.63	8732.63
7	580.95	549.00	626.68	1124.13	2981.80	9714.55	9765.13	9765.13	9765.13	9765.13	9765.13
8	455.50	376.22	448.30	579.96	1040.33	2759.52	8990.35	9037.16	9037.16	9037.16	9037.16
9	1319.79	399.33	350.82	486.28	629.09	1128.47	2993.30	9752.02	9802.79	9802.79	9802.79
10	2688.07	1116.84	301.15	311.68	432.03	558.90	1002.56	2659.33	8663.94	8709.05	8709.05
11	3313.89	1762.05	925.85	294.68	304.98	422.75	546.90	981.04	2602.23	8477.94	8522.08
12	5625.75	3056.66	1442.04	898.24	285.90	295.89	410.14	530.59	951.78	2524.62	8225.09
13	6444.94	4035.10	2195.72	1224.01	762.43	242.67	251.15	348.13	450.37	807.87	2142.92
14	6880.37	5673.28	3231.33	2011.63	1121.39	698.51	222.32	230.09	318.94	412.61	740.14
15	8181.48	6063.88	4571.50	2957.72	1841.29	1026.43	639.36	203.50	210.61	291.94	377.67
16	8399.03	6654.94	4476.40	3874.05	2506.48	1560.38	869.84	541.82	172.45	178.48	247.40
17	9060.43	7490.91	5165.69	4015.33	3475.03	2248.31	1399.66	780.24	486.01	154.69	160.10
18	8123.60	8059.72	5517.96	4434.83	3447.23	2983.37	1930.21	1201.63	669.85	417.25	132.80
19	7899.53	6879.90	5751.87	4628.79	3720.18	2891.72	2502.61	1619.17	1007.99	561.91	350.01
20	7019.18	6620.94	5174.50	5055.62	4068.48	3269.86	2541.69	2199.68	1423.17	885.98	493.89
21	9166.78	6006.30	5169.92	4602.35	4496.62	3618.63	2908.31	2260.65	1956.46	1265.81	788.01
22	13223.14	8034.55	4774.57	4722.19	4203.77	4107.20	3305.24	2656.44	2064.87	1787.02	1156.19
23	7529.42	10749.33	6499.63	4349.63	4301.92	3829.63	3741.66	3011.08	2420.02	1881.10	1627.98
24	5393.58	6051.04	8065.65	5726.73	3832.40	3790.36	3374.24	3296.72	2653.02	2132.24	1657.41
25	3068.97	4538.21	4585.58	7093.17	5036.25	3370.32	3333.35	2967.40	2899.23	2333.14	1875.16
	117226.79	102616.41	84340.09	80963.42	77124.50	77199.60	79410.16	82723.94	86238.15	90108.85	94493.09

CATCH NUMBERS 28/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	159	818	326	326	326	326	326	326	326	326	326
4	987	4233	5228	5255	5255	5255	5255	5255	5255	5255	5255
5	1589	1484	1485	4840	4865	4865	4865	4865	4865	4865	4865
6	1707	770	518	1375	4481	4504	4504	4504	4504	4504	4504
7	1097	546	264	473	1254	4086	4107	4107	4107	4107	4107
8	584	399	203	263	472	1252	4078	4099	4099	4099	4099
9	690	343	130	180	232	417	1106	3603	3621	3621	3621
10	3541	885	103	106	147	191	342	908	2958	2973	2973
11	1358	1183	268	85	88	123	159	284	754	2457	2470
12	3109	1681	342	213	68	70	97	126	226	599	1950
13	1689	1752	405	226	141	45	46	64	83	149	395
14	1548	2120	511	318	177	110	35	36	50	65	117
15	1802	2210	709	459	286	159	99	32	33	45	59
16	1403	2465	707	612	396	247	137	86	27	28	39
17	916	2675	790	614	532	344	214	119	74	24	24
18	1140	2874	846	680	529	458	296	184	103	64	20
19	1605	2303	826	665	534	415	359	232	145	81	50
20	1121	1754	581	568	457	367	285	247	160	100	55
21	1452	1574	577	513	502	404	324	252	218	141	88
22	1510	1653	414	410	365	356	287	230	179	155	100
23	1428	2657	691	462	457	407	398	320	257	200	173
24	698	1291	736	523	350	346	308	301	242	195	151
25	740	966	419	649	461	308	305	271	265	213	172
	31873	38636	17081	19815	22373	25054	27933	30452	32552	34266	35615

Table 11. con't.

CATCH FIGURES 28/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	7	36	14	14	14	14	14	14	14	14	14
4	78	334	417	415	415	415	415	415	415	415	415
5	179	163	163	532	535	535	535	535	535	535	535
6	260	104	70	186	605	608	608	608	608	608	608
7	197	98	47	85	226	735	739	739	739	739	739
8	117	80	41	53	94	250	816	820	820	820	820
9	103	91	34	48	62	110	293	955	960	960	960
10	1027	257	30	31	43	55	99	263	858	862	862
11	475	414	94	30	31	43	55	100	264	860	864
12	1306	706	144	89	28	29	41	53	95	251	819
13	743	721	178	99	62	20	20	28	37	66	174
14	754	1032	249	155	86	54	17	18	25	32	57
15	966	1185	380	246	153	85	53	17	18	24	31
16	772	1356	389	337	218	136	76	47	15	16	22
17	550	1605	474	369	319	206	128	72	45	14	15
18	718	1811	533	429	333	288	187	116	65	40	13
19	1043	1497	537	432	347	270	234	151	94	52	33
20	785	1228	407	397	329	257	200	173	112	70	39
21	1089	1181	432	385	376	303	243	189	164	106	66
22	1253	1372	344	340	303	296	238	191	149	129	83
23	1291	2402	624	418	413	368	359	289	232	181	156
24	683	1264	721	512	342	339	301	295	237	190	148
25	777	1014	440	681	484	324	320	285	278	224	180
	15219	20000	6759	6282	5810	5741	5993	6373	6777	7209	7654

FISHING MORTALITY 28/ 5/79

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.005	0.009	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
4	0.091	0.159	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
5	0.260	0.173	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069
6	0.425	0.191	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076
7	0.440	0.208	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
8	0.313	0.251	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
9	0.157	0.272	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108
10	0.510	0.276	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
11	0.163	0.283	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113
12	0.279	0.277	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.110
13	0.129	0.224	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
14	0.122	0.212	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084
15	0.132	0.229	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
16	0.101	0.240	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
17	0.066	0.254	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101
18	0.097	0.269	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107
19	0.149	0.259	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103
20	0.125	0.216	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086
21	0.133	0.231	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
22	0.114	0.197	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079
23	0.198	0.267	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106
24	0.143	0.247	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098
25	0.308	0.267	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106