M. Georges Bank/Gulf of Maine Pollock by R.K. Mayo, L. Col and M. Traver

1.0 Background

Pollock, *Pollachius virens* (L.) have traditionally been assessed as a unit stock from the Scotian Shelf (NAFO Divisions 4VWX) to Georges Bank, the Gulf of Maine and portions of the Mid-Atlantic region (Subareas 5 and 6). This stock was last assessed over its range *via* VPA at SAW 16 in 1993 (Mayo and Figuerido 1993, NEFSC 1993a, 1993b). At that time, spawning stock biomass had been declining since the mid-1980s, and was expected to reach its long-term average (144,000 mt). Fishing mortality was estimated to be 0.72 in 1992, above F20% (0.65) and well above Fmed (0.47). The stock was then considered to be fully exploited and at a medium biomass level.

The state of this stock was first evaluated *via* index assessment in 2000 (Mayo 2001). At that time, it was noted that biomass indices for the Gulf of Maine-Georges Bank portion of the stock, derived from NEFSC autumn bottom trawl surveys, had increased during the mid-1970s, declined sharply during the 1980s, but have been generally increasing since the mid-1990s. Indices derived from Canadian bottom trawl surveys, conducted on the Scotian Shelf, increased during the 1980s, but declined sharply during the early 1990s. The index assessment provided no basis with which to evaluate the state of the stock relative to the control rule as determined by the Overfishing Definition Review Panel (Anon. 1998).

An assessment of this stock over the major portion of its range (NAFO Divisions 4VWX and Subdivision 5Zc) has been conducted by Canada since 1989. The most recent full stock assessment was conducted in 1999 (Neilson et al. 1999) and the most recent update was performed in 2001. In 1999, it was noted that age 5+ population biomass reached a maximum in 1985 and then declined steadily to a minimum in 1995. Biomass had increased slightly after 1995 due to recruitment from the 1992 year class. Recent recruitment has been declining, and it was concluded that most indicators of stock status suggest that the resource remains depleted. The 2001 update indicated a further decline in the relative biomass indices and a reduction in the size structure of the population.

A Canadian Framework Assessment process was initiated in 2003 and continued through 2004 to develop a revised framework for assessing the state of the resource in Divs. 4VWX and Subdivision 5Zc. Based on these reviews it was concluded that pollock inhabiting the easternmost portions of the Scotian Shelf are sufficiently spatially isolated from those found in the most of Division 4X to warrant separate management units (Anon 2004, Neilson et al. 2004a). Given the low biomass currently found in the eastern management unit, the most recent evaluation of stock status (Neilson et al. 2004b) provides F and biomass estimates only for the western component inhabiting portions of Div. 4X and Subdivision 5Zc. This assessment indicated that fishing mortality (ages 4-9) declined to 0.28 in 2003, but remains high (1.0 or higher) on older fish (ages 6-9). Biomass (ages 2+) continues to rebuild, doubling since 1999, but remains low compared to the 1984 maximum.

In 2002, index-based biological reference points were developed for a portion of the pollock stock primarily under US management jurisdiction (Subareas 5 and 6), including a portion of

eastern Georges Bank (Subdivision 5Zc) that is under Canadian management jurisdiction (NEFSC 2002). The most recent assessment of the resource inhabiting the area comprising this management unit was conducted in October, 2002 at the first Groundfish Assessment Update Meeting (GARM I). At that time it was determined that the index of current biomass was greater than ½ of the Bmsy proxy reference point and that the index of current F was below the Fmsy proxy reference point (Mayo and Col 2002).

2.0 The Fishery

2.1 Divisions 4VWX and Subareas 5&6

Nominal commercial catches from the Scotian Shelf, Gulf of Maine, and Georges Bank region increased from an annual average of 38,200 mt during 1972-76 to 68,800 mt in 1986 (Table M1, Figure M1). Canadian landings increased steadily from 24,700 mt in 1977 to an annual average of 43,900 mt during 1985-87, while U.S. landings increased from an average of 9,700 mt during 1973-77 to more than 19,000 mt annually from 1985-1987, peaking at 24,500 mt in 1986. Landings by distant-water fleets declined from an annual average of 9,800 mt during 1970-73 to less than 1,100 mt per year during 1981-88. Distant-water fleet landings increased to 3,300 mt in 1991, but have since declined to negligible levels. Over time, most of the distant water fleet catch has been taken by the USSR/Russian fleet on the Scotian Shelf (Table M1).

By 1996, USA and Canadian landings had declined to 2,963 mt and 9,145 mt, respectively, the lowest landings by either country in over 3 decades. Landings by distant water fleets fishing on the Scotian Shelf remained almost negligible. Since 1996, USA and Canadian landings have increased slightly but remain low relative to past levels. From 1999 to 2004, USA landings fluctuated between 4,111 and 4,600 mt, and Canadian landings ranged from 5,700 to 7,700 mt (Table M1).

Since 1984, the USA fishery has been restricted to areas of the Gulf of Maine and Georges Bank west of the line delimiting the USA and Canadian fishery zones. The Canadian fishery occurs primarily on the Scotian Shelf and additional landings are obtained from Georges Bank east of the line delimiting the USA and Canadian fishery zones. This fishery on the Scotian Shelf has shifted westward over time, and the contribution to the total catch from larger, mobile gear vessels has steadily diminished since 1981.

2.2 Subareas 5&6

The commercial fishery in Subareas 5&6 is dominated by United States vessels; additional catches are taken by Canada and, for a period primarily during the 1970s, by some distant water fleets. The total landings increased steadily from less than 10,000 mt during the 1960s to a maximum of over 26,000 mt in 1986 (Figure M2). Landings declined sharply during the late 1980s and have remained below 10,000 mt throughout most of the 1990s. Landings since 1999 have fluctuated between 5,000 and **7,000** mt.

3.0 Research Survey Indices

Indices of relative biomass (ln re-transformed), derived from NEFSC autumn research vessel

bottom trawl surveys covering Georges Bank and the Gulf of Maine have varied considerably since 1963 (Table M2, Figure M2). Indices generally fluctuated between 2 and 5 kg per tow throughout most of the 1960s and 1970s, peaking at over 8 kg per tow during the mid-to-late 1970s, reflecting recruitment of several moderate-to strong year classes from the early 1970s. Strong year classes were also produced in 1979 and 1980, after which recruitment began to diminish during the 1980s.

Biomass indices declined rapidly during the early 1980s, and continued to decline steadily through the early 1990s, remaining below 1 kg per tow and reaching a minimum during the mid-1990s. Since then, biomass indices from the Gulf of Maine-Georges Bank region have generally increased, reaching 1.5 kg per tow in 1999 and have recently been fluctuating between 2 and 2.5 kg/tow (Table M2, Figure M2). On the Scotian Shelf, Canadian biomass indices, derived from commercial fishery catch rates, declined rapidly after 1985, following the recruitment of the 1979 year class. Apart from a sharp spike in 1996, Canadian survey indices continued to decline through 2000 but have increased slightly thereafter (Neilson et al. 2004b).

4.0 Assessment Results

4.1 Subareas 5&6

As evident from recent trends in total landings from Subareas 5 and 6 and NEFSC autumn biomass indices calculated for the Gulf of Maine-Georges Bank region, exploitation ratios (Subarea 5&6 landings/NEFSC autumn biomass index) peaked in the mid-to-late 1980s after which they steadily declined (Table M3, Figure M3). Biomass indices from the Gulf of Maine-Georges Bank region have been increasing throughout the late 1990s and now indicate that biomass may have returned to levels evident during the early 1980s.

Relative Exploitation Rate and Replacement Ratio Analyses

An index of relative exploitation (catch/survey biomass index) corresponding to a replacement ratio of 1.0 was developed by the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish (NEFSC 2002) for the portion of the unit stock of pollock primarily within the USA EEZ (NAFO Subareas 5&6) including a portion of eastern Georges Bank (Subdivision 5Zc) that is under Canadian management jurisdiction. Autumn NEFSC survey biomass indices from the Gulf of Maine and Georges Bank region from 1963 through 2001 were used to calculate the replacement ratios, defined as the biomass index in the current year divided by the average biomass indices from the previous 5 years. The biomass indices and total landings from the same region were used to compute the relative exploitation rates, defined as the catch in the current year divided by the 3 year average survey biomass index for the current year and the previous 2 years. These relative exploitation rates (or relative F) may be considered a proxy for F on that portion of the pollock stock considered in this analysis.
The relationship between replacement ratios and relative F was evaluated by a linear regression of the Log_e replacement ratio on Log_e relative F (NEFSC 2002) and the results were used to derive an estimate of relative F corresponding to a replacement ratio of 1.0. Results for pollock

were highly significant (NEFSC 2002), and the estimate of the relative replacement F (F rel rep) has a low standard error compared to the point estimate (5.88). The regression indicates that, on average, when the relative F is greater than 5.88, the stock is not likely to replace itself in the long-term.

Trends in 3 year average relative F (exploitation ratio) and replacement ratios are given in Figures M3 and M4, respectively and the values are listed in Table M3. Prior to the 1980s, a high proportion of the replacement ratios equaled or exceeded 1.0 (Figure M4). During the 1980s and early 1990s, most of the replacement ratios were less than 1.0, with ratios greater than 1.0 appearing again by the late 1990s as the biomass indices began to gradually increase from the very low levels of the mid-1990s.

The information displayed in Figure M5 also provide a means to derive a biomass index which relates to the replacement ratios. In this case, it is evident that most of the replacement ratios below 1.0 occurred during the 1980s when the biomass index was less than about 3.0 (Figure M5). During this period the relative F was also well above relative replacement F (Figure M6). This biomass index may be considered as the biomass proxy for Bmsy that corresponds to the relative F proxy for Fmsy.

5.0 Biological Reference Points

Since the relative F relates the catch directly to survey biomass, the catch corresponding to the Bmsy proxy can be estimated from the relative F and the biomass index of Bmsy. For pollock, this computes to 3.0 * 5.88 = 17.64, or 17,640 mt as a proxy for MSY. The following biological reference point proxies were obtained from an index-based model of replacement ratios (NEFSC 2002) derived from indices of relative exploitation (Table M3):

MSY	17,640 mt
B_{MSY}	3.00 kg/tow
F_{MSY}	5.88 (Relative F)

Since the mid-1990s, the NEFSC autumn survey biomass has been increasing towards the 3.0 kg/tow Bmsy proxy and and the replacement ratio has remained at or above 1.0. More recently, since 1999, the relative F has remained below the 5.88 Fmsy proxy.

6.0 Summary

In 2004, the 3-year average biomass index for pollock was 1.99, approximately 66% of the 3.00 Bmsy proxy an increase from the 2001 value of 1.601. Thus, current biomass is estimated to be between ½ Bmsy and Bmsy. In 2004, the 3-year average relative F was 3.51, approximately 60% of the 5.88 Fmsy proxy, a slight decrease from the 2001 value of 3.55. Thus, current F is estimated to be below Fmsy. Accordingly, in 2004 the stock was not overfished and overfishing was not occurring. Total landings in 2004 were 7,000 mt, a 23% increase from the 2001 value of 5,680 mt.

7.0 GARM Panel Comments

The Panel sought clarification on the use of the multi-year averages applied to the survey biomass indices in both replacement ratios and relative exploitation rates. It was explained that the 5 and 3-year average survey biomass index used for the replacement ratios and relative exploitation rates respectively were applied to smooth annual noise in the autumn survey biomass indices.

8.0 Sources of Uncertainty

- Survey indices for pollock exhibit considerable inter-annual variability
- Movement of pollock among the NAFO Divisions comprising the stock unit is likely to vary over time, contributing to the year effects noted in the surveys

9.0 References

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Table M1. Pollock landings (metric tons, live) from Divisions 4VWX and Subareas 5 and 6 by country, 1960-2001.

Year	Canada	USA	FRG	GDR	Japan	Spain	USSR	Cuba	Others	Total DWF	Total
1960	29470	10132	0	0	0	783	0	0	1	784	40386
1961	26323	10265	0	0	0	982	0	0	1	983	37571
1962	31721	7391	0	0	0	0	0	0	0	0	39112
1963	28999	6650	126	0	0	0	793	0	28	947	36596
1964	30007	6006	208	0	0	0	4603	0	429	5240	41253
1965	27316	5303	71	0	0	1361	2667	0	11	4110	36729
1966	18271	3791	0	0	0	2384	9865	0	12	12261	34323
1967	17567	3312	0	0	0	1779	644	0	15	2438	23317
1968	18062	3276	0	0	0	1128	372	0	7	1507	22845
1969	15968	3943	1188	2195	0	1515	227	0	7	5132	25043
1970	10753	3976	3233	4710	40	532	527	0	0	9042	23771
1971	11757	4890	633	6849	15	912	2216	0	3	10628	27275
1972	18022	5729	475	4816	8	616	3495	0	58	9468	33219
1973	26990	6303	1124	948	1570	3113	3092	0	36	9883	43176
1974	24975	8726	149	2	40	1500	2301	0	62	4054	37755
1975	26548	9318	236	95	0	708	2004	0	124	3167	39033
1976	23568	10863	994	24	0	303	1466	0	390	3177	37608
1977	24654	13056	368	0	1	2	182	0	53	606	38316
1978	26801	17714	0	0	110	0	502	141	39	792	45307
1979	29967	15541	7	0	19	0	1025	50	23	1124	46632
1980	35986	18280	0	0	81	0	950	32	99	1162	55428
1981	40270	18171	0	0	15	0	358	0	90	463	58904
1982	38029	14357	0	0	3	0	297	84	44	428	52814
1983	32749	13967	0	0	6	0	226	261	22	515	47231
1984	33465	17903	0	1	1	0	97	123	46	268	51636
1985	43300	19457	0	0	17	0	336	66	77	496	63253
1986	42845	24542	0	0	51	0	564	387	81	1083	68470
1987	45407	20353	0	0	82	0	314	343	28	767	66527
1988	41690	14960	0	0	1	0	1054	225	0	1280	57930
1989	41093	10553	0	0	1	0	1782	99	478	2360	54006
1990	36178	9645	0	0	0	0	1040	261	3	1304	47127
1991	37931	7950	0	0	38	0	1117	459	167	1781	47662
1992	32002	7183	0	0	72	0	1006	1015	9	2102	41287
1993	20253	5629	0	0	0	0	176	644	0	820	26702
1994	15240	3768	0	0	0	0	0	10	0	10	19018
1995	9781	3358	0	0	0	0	0	58	0	58	13197
1996	9145	2963	0	0	0	0	6	129	0	135	12243
1997	11927	4267	0	0	0	0	0	64	0	64	16258
1998	14371	5583	0	0	0	0	1	9	0	10	19964
1999	7737	4594	0	0	0	0	0	6	0	6	12337
2000	5676	4043	0	0	0	0	0	0	0	0	9719
2001	6306	4111	0	0	0	0	0	0	0	0	10417
2002	7090	3580	0	0	0	0	0	6	0	6	10670
2003	8090	4794	0	0	0	0	0	0	0	0	12884
2004	7000	5061	0	0	0	0	0	0	0	0	12061

1994-2004 USA Data Preliminary

Table M2. Stratified mean catch per tow in weight (kg) and numbers for Scotian Shelf, Gulf of Maine, and Georges Bank pollock in NEFSC offshore spring and autumn bottom trawl surveys[1], 1963-2005[3]. Indices for the total stock and the mature component are listed.

	NEFSC Spring Survey[2]								NEFSC Autumn Survey							
	Total Biomass		Mature Biomass		Total Numbers		Mature Numbers		Total Biomass		Mature Biomass		Total Numbers		Mature Numbers	
	Linear	Re-trans	Linear	Re-trans	Linear	Re-trans	Linear	Re-trans	Linear	Re-trans	Linear	Re-trans	Linear	Re-trans	Linear	Re-trans
1963	-	-	-	-	-	-	-	-	5.502	4.939	5.164	4.636	1.401	1.289	1.113	1.024
1964	-	-	-	-	-	-	-	-	4.755	2.716	4.092	2.337	1.770	1.136	0.975	0.626
1965	-	-	-	-	-	-	-	-	2.977	2.362	2.657	2.108	0.903	0.847	0.555	0.521
1966	-	-	-	-	-	-	-	-	2.567	1.795	2.003	1.401	1.060	0.637	0.488	0.293
1967	-	-	-	-	-	-	-	-	1.973	1.310	1.809	1.201	0.560	0.478	0.391	0.334
1968	4.537	2.876	4.292	2.721	1.121	0.932	0.677	0.563	3.494	2.654	3.343	2.539	0.758	0.696	0.569	0.522
1969	2.723	2.584	2.404	2.281	1.157	1.014	0.519	0.455	7.208	3.424	6.994	3.322	1.395	0.884	1.248	0.791
1970	5.295	3.920	4.928	3.648	1.659	1.449	0.994	0.868	2.251	1.699	2.082	1.571	0.609	0.588	0.377	0.364
1971	3.474	2.831	3.266	2.661	0.973	0.897	0.593	0.547	4.365	2.189	3.833	1.922	1.201	0.778	0.612	0.396
1972	5.003	3.618	4.051	2.930	3.871	2.140	0.867	0.479	4.589	3.279	4.079	2.915	1.448	1.174	0.733	0.594
1973	4.927	3.835	3.508	2.731	4.329	1.710	1.018	0.402	4.683	4.037	4.382	3.778	1.267	1.106	0.865	0.755
1974	3.951	4.157	3.553	3.738	1.344	1.176	0.755	0.661	3.332	1.542	2.912	1.348	0.953	0.576	0.654	0.395
1975	5.919	5.580	5.409	5.099	1.621	1.298	1.014	0.812	2.087	1.494	1.905	1.364	0.718	0.493	0.381	0.262
1976	7.204	7.490	6.798	7.068	1.612	1.483	1.227	1.129	18.261	8.567	17.406	8.166	4.038	1.895	3.674	1.724
1977	3.591	3.295	3.205	2.941	1.717	1.318	0.882	0.677	9.376	5.628	8.789	5.276	2.272	1.303	1.739	0.997
1978	5.130	3.107	4.272	2.587	1.898	0.835	1.091	0.480	6.275	3.862	6.033	3.713	1.064	0.723	0.790	0.537
1979	4.585	3.750	4.348	3.556	1.036	0.939	0.785	0.712	4.770	4.074	4.504	3.847	0.865	0.719	0.718	0.597
1980	4.191	3.531	3.711	3.127	1.451	1.069	0.987	0.727	3.298	2.647	3.202	2.570	0.580	0.544	0.470	0.441
1981	5.749	5.391	5.415	5.078	1.395	1.221	0.989	0.866	2.683	1.083	2.178	0.879	1.033	0.341	0.672	0.222
1982	6.372	3.349	5.839	3.069	3.755	1.767	2.076	0.977	2.118	1.364	1.966	1.266	0.759	0.574	0.493	0.373
1983	1.592	1.018	1.533	0.980	0.897	0.662	0.251	0.185	2.989	1.274	2.834	1.208	0.976	0.579	0.479	0.284
1984	3.119	2.298	3.002	2.212	1.084	0.914	0.688	0.580	0.909	0.564	0.778	0.483	0.421	0.367	0.188	0.164
1985	29.132	8.446	26.404	7.655	14.587	2.725	12.014	2.244	2.114	1.742	1.875	1.545	1.080	0.708	0.454	0.298
1986	8.256	4.283	8.123	4.214	1.973	1.333	1.686	1.139	1.707	1.089	1.466	0.935	0.898	0.571	0.528	0.336
1987	2.778	1.870	2.510	1.690	1.616	0.738	0.599	0.274	2.035	1.223	1.924	1.156	0.597	0.506	0.383	0.325
1988	2.015	1.384	1.950	1.339	0.907	0.758	0.339	0.283	13.021	1.787	12.088	1.659	3.754	0.869	3.131	0.725
1989	5.216	2.156	5.041	2.084	1.998	1.024	1.577	0.808	1.223	0.619	0.723	0.366	1.883	0.771	0.461	0.189
1990	1.821	1.165	1.675	1.072	0.760	0.560	0.442	0.326	2.079	0.994	1.888	0.903	0.823	0.586	0.502	0.357
1991	5.051	2.797	4.738	2.624	2.303	1.399	1.762	1.070	1.055	0.649	0.851	0.524	0.728	0.535	0.409	0.301
1992	3.349	2.166	3.139	2.030	1.787	1.242	0.755	0.525	1.697	0.910	1.507	0.808	1.051	0.643	0.520	0.318
1993	1.602	1.248	1.358	1.058	1.648	1.163	0.534	0.377	0.769	0.505	0.570	0.374	1.043	0.567	0.195	0.106
1994	1.065	0.840	0.972	0.767	0.562	0.504	0.380	0.341	0.603	0.328	0.500	0.272	0.422	0.311	0.270	0.199
1995	3.716	1.307	2.659	0.935	3.432	0.820	1.984	0.474	1.017	0.504	0.787	0.390	0.840	0.465	0.516	0.286
1996	1.080	0.758	1.023	0.718	0.650	0.510	0.342	0.268	1.060	0.654	0.862	0.532	1.009	0.666	0.435	0.287
1997	4.573	2.060	3.866	1.742	3.369	1.802	1.693	0.906	1.512	1.003	1.095	0.726	1.766	0.921	0.611	0.319
1998	2.643	1.564	2.139	1.266	2.609	1.506	0.900	0.520	1.308	0.772	0.860	0.508	2.104	0.748	0.539	0.192
1999	1.069	0.862	0.745	0.601	2.165	1.022	0.419	0.198	3.099	1.532	2.595	1.283	2.414	1.394	1.161	0.670
2000	1.369	0.997	1.222	0.890	1.502	0.973	0.434	0.281	1.441	0.844	0.522	0.306	2.770	1.333	0.583	0.278
2001	2.029	1.275	1.854	1.165	1.693	1.272	0.728	0.547	3.567	2.448	3.067	2.105	2.385	1.811	1.361	1.033
2002	1.578	1.247	1.475	1.166	0.760	0.630	0.482	0.400	5.920	1.855	5.420	1.698	3.135	1.460	2.305	1.073
2003	0.890	0.667	0.731	0.548	1.439	0.734	0.242	0.123	7.951	2.197	6.348	1.754	7.363	2.043	4.790	1.329
2004	0.744	0.585	0.703	0.553	0.487	0.380	0.180	0.140	4.206	1.925	3.440	1.574	3.221	1.395	2.122	0.919
2005	5.700	2.426	5.537	2.357	2.046	1.258	1.612	0.991								

[1] NEFSC Strata 01130-01300, 01330-01340, 01360-01400.

[2] The "36 Yankee" trawl was used from 1970-1972, and 1982-2002; the "41 Yankee" trawl was used from 1973-1981. No gear conversion factors are available to adjust for differences in fishing power.

[3] BMV oval doors were used from 1970-1984; since 1985 Portuguese polyvalent doors have been used. No door conversion factors were applied. Surveys performed using *R/V Albatross IV* and *R/V Delaware II*; No vessel conversion factors were applied.

Table M3. Total commercial landings (mt), NEFSC autumn survey biomass index (kg/tow, LN retransformed), exploitation ratio (relative F) and replacement ratio For pollock in NAFO Subareas 5&6, 1963-2004.

	Landings	Mean Weight (kg) per Tow		Exploitation Ratio (Rel. F)		Replacement Ratio
	SA5&6	Annual	3-yr Avg	Annual	3-yr Avg	5-yr Avg
1963	6241	4.939		1.264		
1964	9008	2.716		3.317		
1965	9000	2.362	3.339	3.810	2.695	
1966	9847	1.795	2.291	5.486	4.298	
1967	8534	1.31	1.822	6.515	4.683	
1968	5222	2.654	1.920	1.968	2.720	1.011
1969	9822	3.424	2.463	2.869	3.988	1.580
1970	11976	1.699	2.592	7.049	4.620	0.736
1971	15203	2.189	2.437	6.945	6.238	1.006
1972	13013	3.279	2.389	3.969	5.447	1.454
1973	13076	4.037	3.168	3.239	4.127	1.524
1974	12393	1.542	2.953	8.037	4.197	0.527
1975	13871	1.494	2.358	9.284	5.883	0.586
1976	13382	8.567	3.868	1.562	3.460	3.416
1977	16273	5.628	5.230	2.891	3.112	1.487
1978	22305	3.862	6.019	5.776	3.706	0.908
1979	18452	4.074	4.521	4.529	4.081	0.966
1980	23539	2.647	3.528	8.893	6.673	0.560
1981	22068	1.083	2.601	20.377	8.483	0.219
1982	19466	1.364	1.698	14.271	11.464	0.394
1983	17816	1.274	1.240	13.984	14.364	0.489
1984	20633	0.564	1.067	36.583	19.331	0.270
1985	21069	1.742	1.193	12.095	17.656	1.256
1986	26507	1.089	1.132	24.341	23.423	0.903
1987	22347	1.223	1.351	18.272	16.537	1.014
1988	17304	1.787	1.366	9.683	12.665	1.516
1989	11903	0.619	1.210	19.229	9.840	0.483
1990	11201	0.994	1.133	11.269	9.883	0.769
1991	9600	0.649	0.754	14.792	12.732	0.568
1992	10225	0.91	0.851	11.236	12.015	0.863
1993	9873	0.505	0.688	19.550	14.350	0.509
1994	7099	0.328	0.581	21.643	12.219	0.446
1995	4362	0.504	0.446	8.655	9.788	0.744
1996	4164	0.654	0.495	6.367	8.406	1.129
1997	5483	1.003	0.720	5.467	7.612	1.729
1998	7441	0.772	0.810	9.639	9.190	1.289
1999	5591	1.532	1.102	3.649	5.072	2.349
2000	5240	0.844	1.049	6.209	4.994	0.945
2001	5680	2.448	1.608	2.320	3.532	2.547
2002	5170	1.855	1.716	2.787	3.013	1.406
2003	6215	2.197	2.167	2.829	2.868	1.474
2004	7000	1.925	1.992	3.636	3.513	1.084

Figure M1

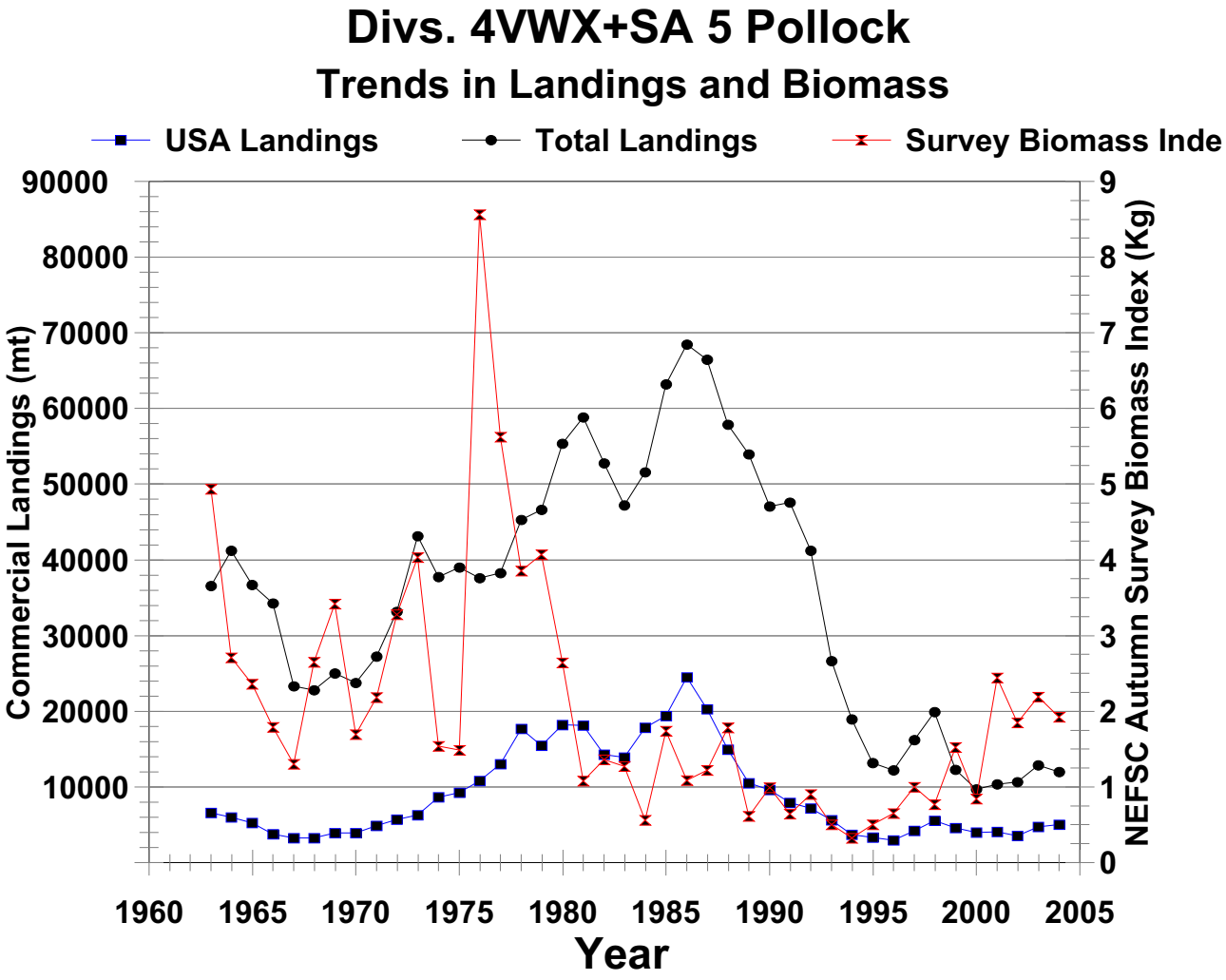

Divs. 4VWX+SA 5 Pollock
Trends in Landings and Biomass
USA Landings
Total Landings
Survey Biomass Inde
Commercial Landings (mt)
NEFSC Autumn Survey Biomass Index (Kg)
90000
80000
70000
60000
50000
40000
30000
20000
10000
9
8
7
6
5
4
3
2
1
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

Figure M2

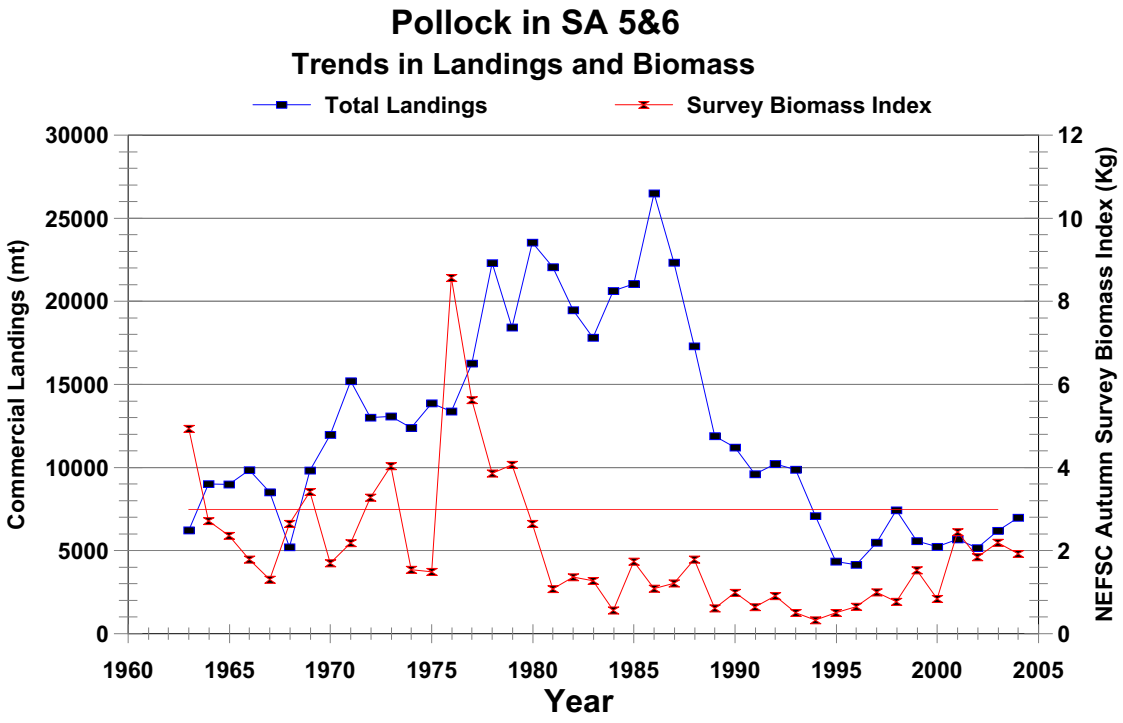


Figure M3

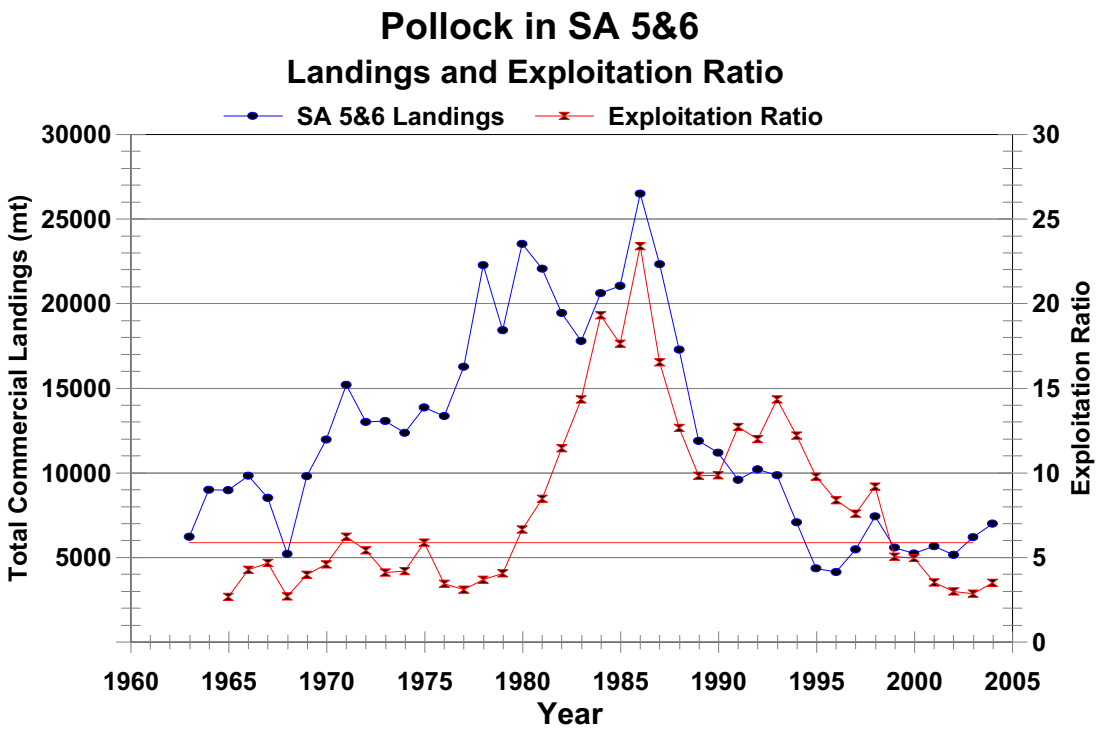


Figure M4

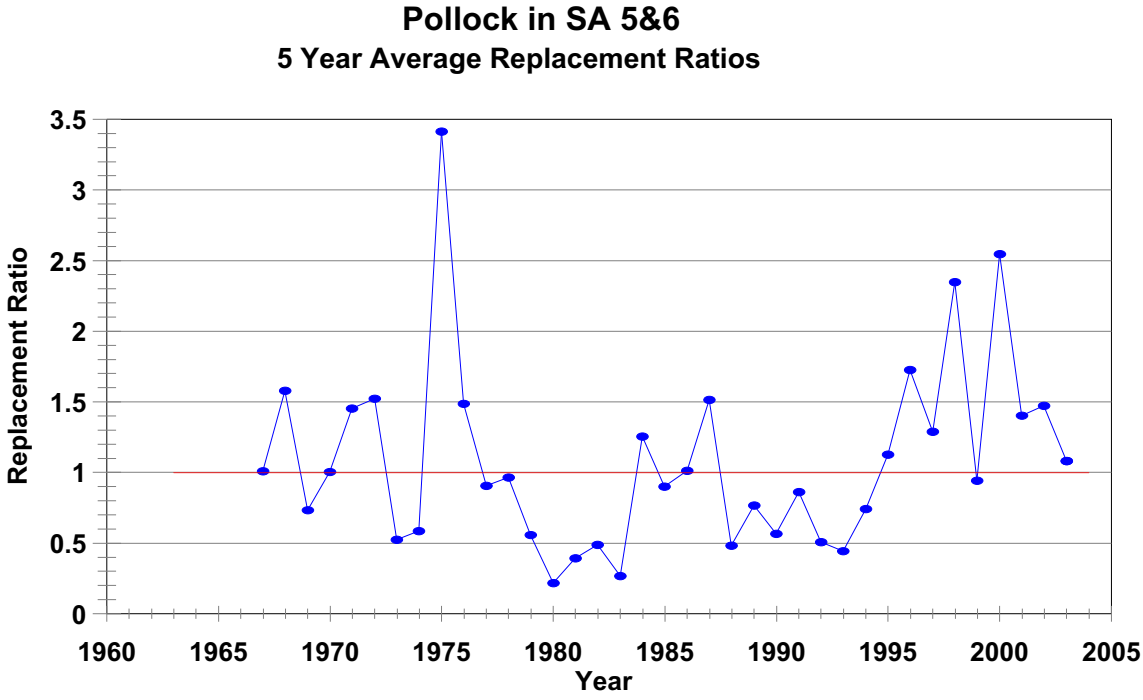


Figure M5

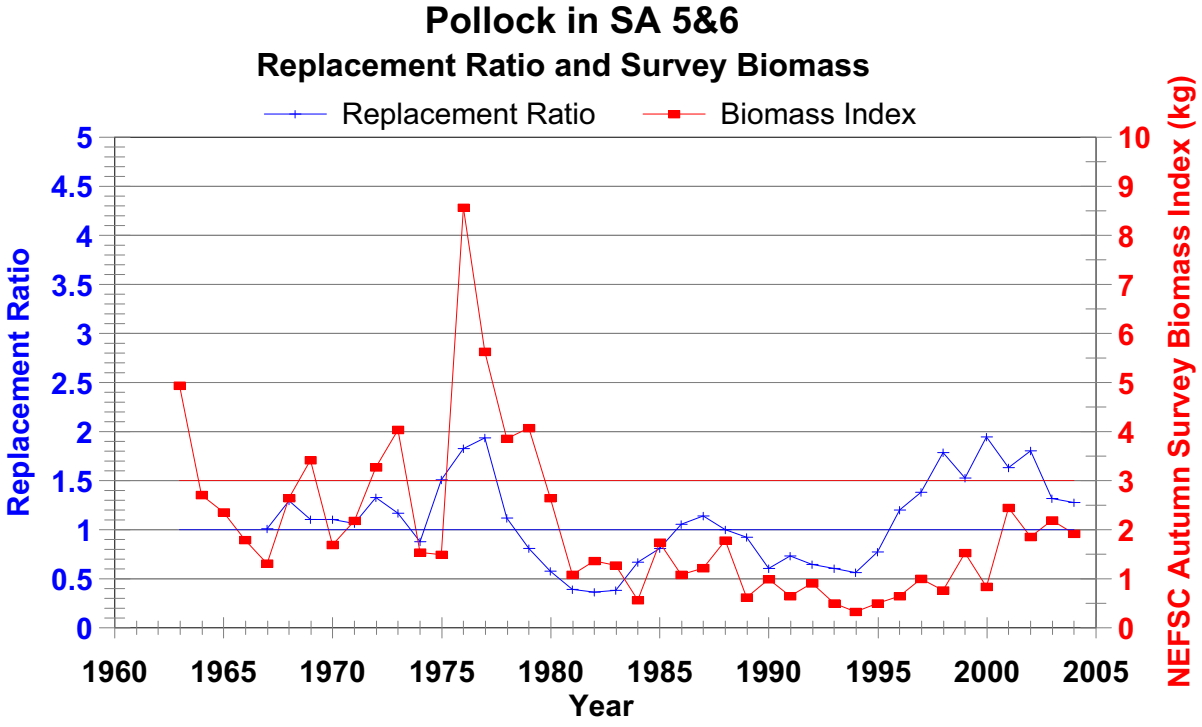
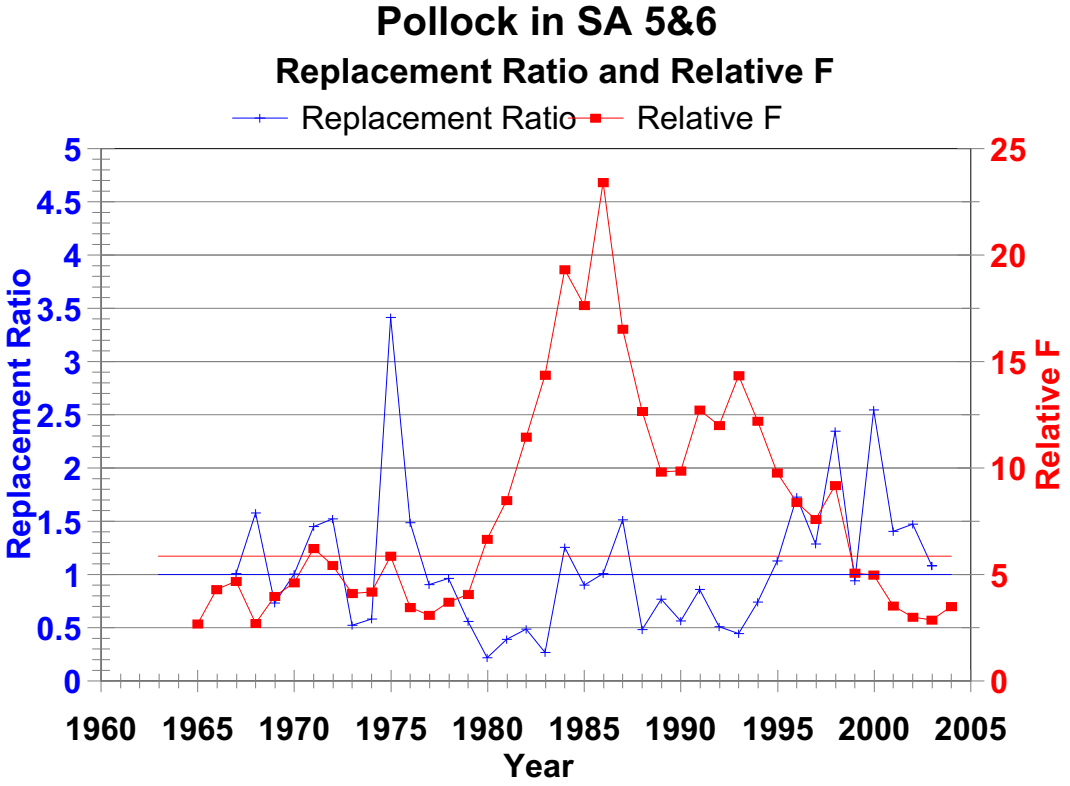


Figure M6


Pollock in SA 5&6
Replacement Ratio and Relative F
Replacement Ratio
Relative F
Replacement Ratio
Relative F
Year
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
5
10
15
20
25
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005