

L. Scotian Shelf/Georges Bank/Gulf of Maine Pollock by R.K. Mayo

1.0 Background

Pollock, *Pollachius virens* (L.) Are assessed as a unit stock from the eastern Scotian Shelf (NAFO Division 4V) to Georges Bank and the Gulf of Maine (Subarea 5). 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 most recently evaluated in 1998 via index assessment (Mayo 1998). 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, and have remained relatively low since 1989. Indices derived from Canadian bottom trawl surveys, conducted on the Scotian Shelf, increased during the 1980s, but declined sharply during the early 1990s. The stock was then considered to be fully exploited, but at a low biomass level.

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 assessment was conducted in 1999 (Neilson et al. 1999), and it was noted that age 5+ population biomass reached a maximum in 1985 and then declined steadily to a minimum in 1995. Biomass has increased since 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.

2.0 The Fishery

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 L1, Figure L1). 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 L1).

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 some additional landings from Georges Bank east of the line delimiting the USA and Canadian fishery zones. This fishery has shifted westward over time,

and the contribution to the total catch from larger, mobile gear vessels has steadily diminished since 1981.

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.

3.0 Research Survey Indices

Indices of relative biomass (ln re-transformed), derived from NEFSC autumn research vessel bottom trawl surveys have varied considerably since 1963 (Table L2, Figure L1). Indices generally fluctuated between 2 and 5 kg per tow throughout most of the 1960s and 1970s, peaking at over 5-7 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 in 1994. Since 1994, biomass indices from the Gulf of Maine-Georges Bank region have generally increased, reaching 1.5 kg per tow in 1999 (Table L2, Figure L1). 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. After increasing slightly from 1994 to 1996, catch rate indices have continued to decline.

4.0 Assessment Results

As evident from recent trends in landings and NEFSC autumn biomass indices, exploitation ratios, derived from landings/NEFSC autumn biomass index, peaked in the mid-to-late 1980s after which they have steadily declined (Table L3, Figure L2). Despite this, measures of stock biomass in the Gulf of Maine-Georges Bank region and on the Scotian Shelf remain extremely low relative to past levels.

5.0 Harvest Control Rule

The Harvest Control Rule proposed for this stock by the Overfishing Definition Review Panel is based upon Yield and SSB per Recruit analyses combined with an estimate of average recruitment. According to this control rule, a target F should be set at 75% of the Fmsy proxy ($0.49 = 0.75 \times F_{20\%}$) when spawning stock biomass is greater than 102,000 mt and would decrease linearly to zero at 51,000 mt ($\frac{1}{2}$ of the SSBmsy proxy).

The index assessment presented above provides no basis with which to evaluate the present state of the stock relative to this control rule.

6.0 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

7.0 References

- Mayo, R.K. and B.F. Figuerido. 1993. Assessment of Pollock, *Pollachius virens* (L.), in Divisions 4VWX and Subareas 5 and 6, 1993. NMFS, Northeast Fisheries Science Center Reference Document 93-13, 108 p.
- Mayo, R.K. 1998. Pollock. In: Clark, S.H. (ed.) Status of Fishery Resources off the Northeastern United States for 1998. NOAA Tech. Mem. NMFS-NE-115, 149 p.
- NEFSC 1993a. Report of the 16th Northeast Regional Stock Assessment Workshop (16th SAW). Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. NMFS, Northeast Fisheries Science Center Reference Document 93-18, 118 p.
- NEFSC 1993b. Report of the 16th Northeast Regional Stock Assessment Workshop (16th SAW). The Plenary. NMFS, Northeast Fisheries Science Center Reference Document 93-19, 57p.
- Neilson, J., P. Perley and C. Nelson. 1999. The 1999 Assessment of Pollock (*Pollachius virens*) in NAFO Divisions 4VWX and Subdivision 5Zc. DFO Can. Stock Assess. Sec. Res. Doc. 99/160.

Table L1. Pollock landings (metric tons, live) from Divisions 4VWX and Subareas 5 and 6 by country, 1960-1999.

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

1996-1999 Canadian Data Preliminary

1994-1999 USA Data Preliminary

1999 DWF Data Preliminary

Table L2. Stratified mean catch per tow in numbers and weight (kg) for Scotian Shelf, Gulf of Maine, and Georges Bank pollock in **NEFSC offshore spring¹, summer², and autumn¹ bottom trawl surveys, 1963-2000.**

Year	Spring ³				Summer				Autumn			
	Weight		Numbers		Weight		Numbers		Weight		Numbers	
	Linear	Retrans- formed	Linear	Retrans- formed	Linear	Retrans- formed	Linear	Retrans- formed	Linear	Retrans- formed	Linear	Retrans- formed
1963	-	-	-	-	10.28	3.45	2.31	1.07	5.79	4.96	1.46	1.32
1964	-	-	-	-	5.27	2.32	2.06	0.96	4.35	2.42	1.63	1.04
1965	-	-	-	-	2.56	1.05	1.72	0.63	2.75	2.12	0.83	0.77
1966	-	-	-	-	-	-	-	-	2.35	1.61	0.97	0.58
1967	-	-	-	-	-	-	-	-	1.80	1.16	0.52	0.44
1968	4.50	2.90	1.10	0.93	-	-	-	-	3.17	2.30	0.69	0.62
1969	2.66	2.53	1.12	0.99	1.75	1.19	0.70	0.47	6.59	3.01	1.31	0.85
1970	4.91	3.53	1.67	1.47	-	-	-	-	2.59	2.00	0.64	0.62
1971	4.39	3.30	1.18	1.05	-	-	-	-	3.96	1.90	1.09	0.69
1972	5.67	4.07	4.43	2.62	-	-	-	-	4.37	3.13	1.41	1.16
1973	4.82	3.77	4.00	1.61	-	-	-	-	4.71	4.04	1.64	1.25
1974	4.10	4.43	1.39	1.24	-	-	-	-	3.18	1.52	0.90	0.56
1975	5.90	5.37	1.67	1.32	-	-	-	-	2.04	1.50	0.70	0.50
1976	6.84	7.02	1.59	1.48	-	-	-	-	16.66	7.32	3.69	1.70
1977	3.38	3.04	1.61	1.23	9.98	8.35	2.07	1.67	8.78	5.26	2.14	1.25
1978	6.56	3.71	2.48	1.06	4.05	3.80	1.29	0.92	5.83	3.56	0.98	0.67
1979	4.75	4.07	1.06	0.97	17.57	4.14	2.96	1.19	5.81	4.67	1.28	0.91
1980	4.40	3.92	1.52	1.17	9.83	6.61	12.21	2.25	4.63	3.32	0.83	0.68
1981	6.17	5.42	1.95	1.40	-	-	-	-	7.75	1.56	5.24	0.63
1982	6.62	3.68	3.98	2.02	-	-	-	-	3.14	1.63	1.40	0.78
1983	1.83	1.20	0.90	0.69	-	-	-	-	3.03	1.41	0.98	0.61
1984	2.87	2.06	1.00	0.84	-	-	-	-	1.10	0.70	0.43	0.38
1985	26.81	7.85	13.70	3.05	-	-	-	-	2.43	1.97	1.12	0.77
1986	7.69	4.10	1.84	1.25	-	-	-	-	1.83	1.20	0.88	0.58
1987	13.17	2.50	6.94	1.14	-	-	-	-	2.01	1.20	0.60	0.51
1988	1.98	1.36	0.89	0.74	-	-	-	-	12.83	1.75	3.71	0.86
1989	5.17	2.18	1.98	1.02	-	-	-	-	1.20	0.61	1.86	0.76
1990	1.79	1.14	0.75	0.55	-	-	-	-	2.11	1.05	0.83	0.60
1991	5.14	2.96	2.32	1.44	-	-	-	-	1.04	0.64	0.72	0.54
1992	3.35	2.17	1.79	1.24	-	-	-	-	1.69	0.92	1.05	0.65
1993	1.63	1.29	1.64	1.16	-	-	-	-	0.76	0.56	1.03	0.56
1994	1.17	0.94	0.59	0.54	-	-	-	-	0.72	0.41	0.50	0.37
1995	3.89	1.48	3.46	0.89	-	-	-	-	1.38	0.67	0.93	0.54
1996	1.07	0.75	0.65	0.51	-	-	-	-	1.10	0.70	1.02	0.69
1997	4.51	2.01	3.33	1.78	-	-	-	-	1.49	0.98	1.74	0.90
1998	2.69	1.65	2.64	1.56	-	-	-	-	1.29	0.76	2.07	0.74
1999	1.07	0.86	2.16	1.02	-	-	-	-	3.07	1.52	2.40	1.40
2000	1.35	0.98	1.49	0.98	-	-	-	-	-	-	-	-

¹ Strata 13-40 (See Figure 3).

² Strata 21-28 and 37-40 (See Figure 3).

³ The "36 Yankee" trawl was used from 1968-1972, and 1982-1999; the "41 Yankee" trawl was used from 1973-1981. No gear conversion factors are available to adjust for differences in fishing power.

Table L3. Total commercial landings (mt), NEFSC autumn survey biomass index (kg/tow, Ln, retransformed), and calculated exploitation ratio for pollock in NAFO Divisions 4VWX and Subara 5.

Year	Total Landings (mt)	NEFSC Autumn Survey Biomass Index (kg/tow)	Exploitation Ratio
1963	36596	4.960	0.074
1964	41253	2.420	0.170
1965	36729	2.120	0.173
1966	34323	1.610	0.213
1967	23317	1.160	0.201
1968	22845	2.300	0.099
1969	25043	3.010	0.083
1970	23771	2.000	0.119
1971	27275	1.900	0.144
1972	33219	3.130	0.106
1973	43176	4.040	0.107
1974	37755	1.520	0.248
1975	39033	1.500	0.260
1976	37608	7.320	0.051
1977	38316	5.260	0.073
1978	45307	3.560	0.127
1979	46632	4.670	0.100
1980	55428	3.320	0.167
1981	58904	1.560	0.378
1982	52814	1.629	0.324
1983	47231	1.414	0.334
1984	51636	0.700	0.738
1985	63253	1.967	0.322
1986	68470	1.205	0.568
1987	66527	1.202	0.553
1988	57930	1.753	0.330
1989	54006	0.608	0.888
1990	47127	1.054	0.447
1991	47662	0.640	0.745
1992	41287	0.920	0.449
1993	26702	0.496	0.538
1994	19018	0.409	0.465
1995	13197	0.667	0.198
1996	12243	0.704	0.174
1997	16258	0.984	0.165
1998	19964	0.758	0.263
1999	12337	1.522	0.081

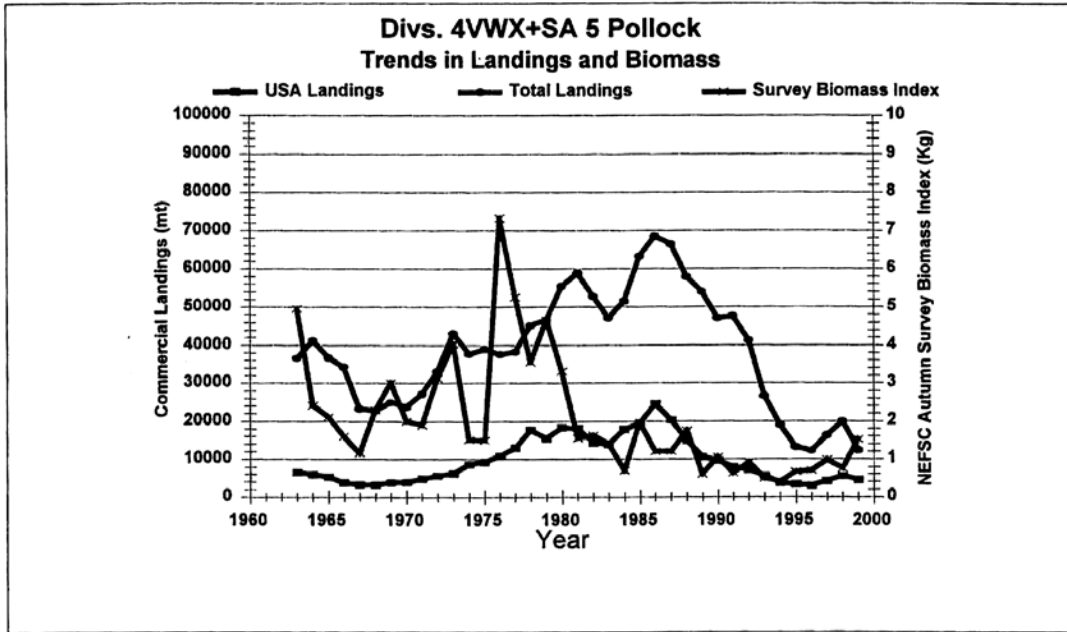


Figure L1. Total and USA commercial landings of pollock from NAFO Divs. 4VWX and Subarea 5, and NEFSC autumn biomass index (kg/tow, re-transformed).

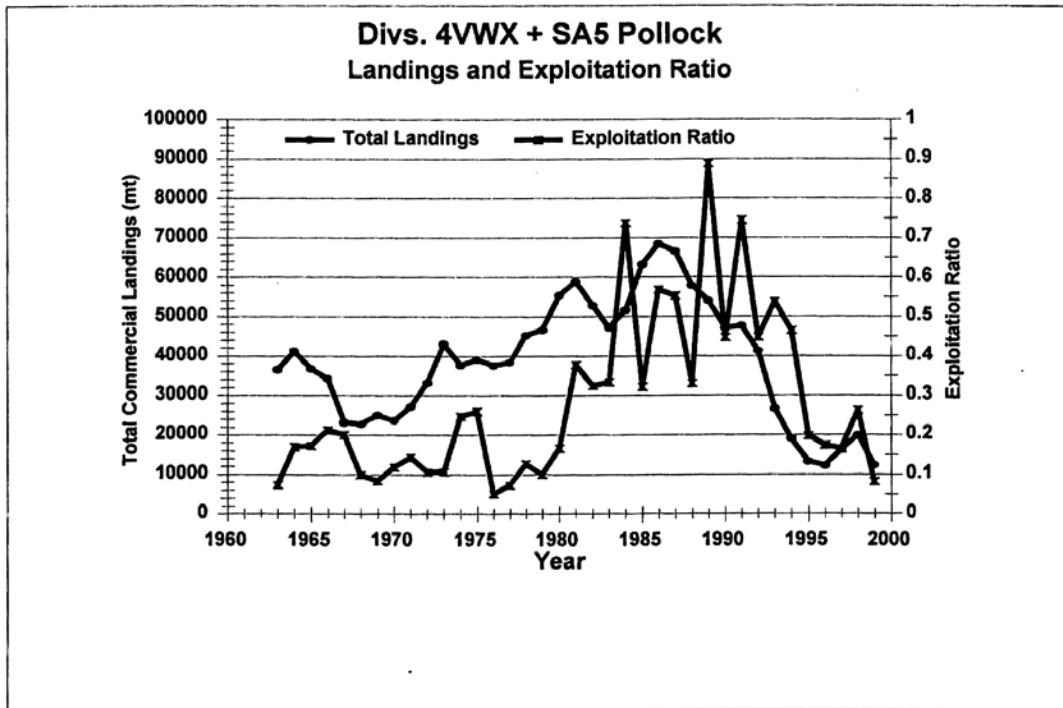


Figure L2. Total commercial landings of pollock from NAFO Divs. 4VWX and Subarea 5, and exploitation ratio derived from NEFSC autumn biomass index (kg/tow, re-transformed).