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Exploratory Extended Survivors Analysis (XSA) Model Fits to the Assessment
Data Set for American Plaice in NAFO Divisions 3L, 3N and 3O

C.Darby

CEFAS, Lowestoft Laboratory, Pakefield Rd.,
Lowestoft (Suffolk), England NR33 OHT, United Kingdom

Abstract

The Extended Survivors Analysis (XSA) stock assessment model was fitted to the assessment data for American Plaice in NAFO Divisions 3L, 3N and 3O in order to examine the information on stock dynamics inherent within the available survey data series. The diagnostics and population and exploitation dynamics from the fit of the model to combinations of the cpue time series are presented and compared.

Introduction

The Extended Survivors Analysis (XSA Shepherd 1999, Darby and Flatman 1994) was fitted to the catch at age and natural mortality data sets for American Plaice in NAFO Divisions 3L, 3N and 3O (Tables 1 and 2). The model was calibrated using two Canadian research survey data series (Spring and Fall, Morgan et. al. SCR 02/70) and a new surveys series derived from the Spanish survey in Division 3NO (Gonzalez-Troncoso et. al. SCR 02/02). The XSA cpue data input file is presented in Table 3.

After examination of the diagnostics from exploratory runs of the XSA model the following specification for the model structure was used for the comparative runs.

Catch data for the years 1960 to 2001 at ages 5 to 15.

Tapered time weighting not applied.

Catchability independent of stock size for all ages.

Catchability independent of age for ages greater than 10.

Survivor estimates shrunk towards the mean F of the final 3 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk 1.000

Minimum standard error for population estimates derived from each fleet .300

In order to compare the trends in the stock dynamics derived from model fits to the cpue series XSA assessment models were fitted with the following fleet weighting options.

Run	Survey weight		
	Canada Spr.	Canada Fall	EU Spain
1	1.0	1.0	0.0
2	0.0	0.0	1.0
3	1.0	1.0	1.0

Although the weight given to a data series within a model fit is zero, the model catchability residuals are presented in the XSA diagnostic output, allowing comparison with the stock dynamics estimated using the surveys assigned a non zero weight.

Results

Tables 4 – 6 and Figures 1 – 3 present the diagnostic output from the XSA runs 1 – 3. Figure 4 compares the survivors estimated in 2002 using each of the fitted models, Figure 5 compares the trends in estimated spawning stock biomass.

The diagnostic tables presented in Tables 4 – 6 illustrate that there is a marked difference between the trends in the population dynamics as estimated by an XSA fitted to the Canadian survey series and the EU Spain survey.

If the model is fitted to the Canadian survey series, the log catchability residuals for the EU survey have a marked positive trend indicating that the EU survey is anticipating a faster rate of stock increase than that estimated from the Canadian data series.

If the model is specified such that the EU survey is used to estimate the stock trends, a marked negative trend is induced into Canadian survey log catchability residuals. In addition the population abundances estimated in the last year of the assessment (Figure 4) are unrealistic. The uncertainty in the recent population dynamics results from the low fishing mortality that has occurred since the moratorium. Cohort abundances estimated during this period are extremely sensitive to the terminal population used to initiate the VPA (weak convergence), consequently the estimates of the EU catchability parameters, estimated for the same time period, are also poorly determined. In order to match the upwards trend in the EU survey cpue data the assessment model fits a severe increase in the population abundance to unrealistic levels. The estimated survivors are presented in Figure 4 which highlights the inconsistency between the assessment calibrated using the EU and Canadian surveys separately.

In run Run 3 the XSA model is fitted with the three survey series given equal initial relative weight and with inverse variance iterative reweighting applied within the fitting algorithm. The residual patterns and regression diagnostics indicate that the EU survey indicates a disproportionate increase in the rate of increase of the stock. The survey has a strong trend in the log catchability residuals and is consequently down weighted in the model fit. The full diagnostic output from the inverse variance model fit is presented in Appendix 1.

Discussion

The results of the comparative runs using XSA single fleet weighting indicate that there is a marked difference in the individual survey based interpretations of the dynamics of the American Plaice stock in NAFO Divisions 3L, 3N and 3O.

When the model is fitted to the Canadian surveys, the estimated population numbers are substantially lower than those estimated using the EU Spain survey information. The model fitted to the EU survey data alone, can only match the trend in the survey cpue by estimating a substantial and unrealistic increase in the population abundance in the most recent years.

The Canadian surveys cover the greater proportion of the stock distribution, whereas the EU surveys cover a relatively restricted area in the south. Stock distribution maps (Morgan et. al. SCR 02/70) illustrate that changes in the abundance in the region of the NAFO Regulatory Area that is covered by the Spanish survey have shown greater rates of increase than the proportion of the stock distributed within Canadian waters. The survey biomass time series derived from the Canadian survey in Divisions 3N and 3O (Morgan et. al. SCR 02/70), carried out in the same area as the Spanish survey, also demonstrate that the increase in those regions is disproportionate to the dynamics in the northern region of the stock distribution.

The results of the analysis indicate that the trend in the EU Spain survey cpue data is inconsistent with the alternative data series and the perceived dynamics of the stock. The disproportionate increase in the catch rates from this survey most likely result from localised changes in the stock abundance.

References

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Table 1. American Plaice in Divisions 3L, 3N, 3O catch numbers at age in thousands.

AMERICAN PLAICE NAFO 3LNO CATCH NUMBERS thousands											
1	2										
1960	2001										
5	15										
1											
44.7	318.8	841.8	1365.9	1738.3	2280	2540	3473.6	2752.5	2564.7	4588.8	1960
28.1	200.4	531.2	1230.9	2463.9	3174.2	2467.1	2272	3894.1	2579.4	5102.7	1961
62.4	445.1	657.2	1096.1	1184.5	1669.1	2432.4	2697.6	2409.5	3276.8	5958.8	1962
144.3	1029.7	1866.4	1434.1	1546.8	2237.6	3104.3	4174.8	3896.9	3851.9	5622.8	1963
268.6	1916.7	4997.5	3253.4	6174.5	8768.6	6960.2	6149.8	3245.9	3033.6	5552.8	1964
475.5	3157	7234.8	9305.9	7048	7562.9	5731.6	5790.8	5214.6	4333.2	6510.2	1965
1759.8	6271.7	10036.6	11132.5	9516.7	7266.3	7106.4	5667.6	5731	5009.8	8475.7	1966
433.9	3345.3	10834.8	7647.2	9504.5	13713.2	13672.7	14564.6	9495.5	6572.1	13247.8	1967
275.8	2342.3	4139.2	9785.9	11210.5	11631	7735.4	13842.2	8778	6339.2	8419.3	1968
690.3	2453.1	7875	14186.6	18181.9	12778.9	12735.3	10396.6	7053.8	5305.1	7666.2	1969
115.9	2172.2	2554.1	10006.8	13536.7	11286.1	11179.1	8248.5	5556.4	4661.3	9285	1970
1135.9	1749.6	8411.7	10457.6	15504.1	14164.8	10993.1	9026.5	5195.2	3720.6	7130.5	1971
578.2	2573.8	2367.8	7696.8	11301.7	12765.9	12718	10706	6783.8	4354	7033.1	1972
46.4	1079.1	6329.1	10518.1	13016.7	10042.3	9980.4	6762.3	6589.6	3733.8	7013.8	1973
354	5955	10475	10069	7768	9004	7086	4596	3809	2278	2164	1974
883	3128	7220	9433	9234	7903	5701	4732	3788	2617	2933	1975
837	3907	8781	19363	16597	12338	8323	5156	3024	2309	2241	1976
974	6723	8743	11730	13559	11157	6520	4257	2369	1493	1625	1977
1558	4467	9195	10397	12743	13881	9938	6823	3655	2239	2440	1978
1257	6551	13532	18747	14977	12506	8791	3775	1843	714	580	1979
263	2977	9531	12578	14111	14212	11288	8088	3732	1565	1022	1980
154	554	2248	4786	7921	11425	13565	11872	8693	5591	4697	1981
27	314	1814	4799	8946	12836	15801	14489	7942	4224	2943	1982
119	991	3053	5797	8343	7707	8493	7517	4588	2480	1771	1983
48	397	1516	3311	5853	9958	12887	8964	5072	2515	1602	1984
296	788	2362	5652	10694	15741	14528	9233	4108	1969	1792	1985
4407	9707	12556	12530	13372	13874	14246	10376	5947	2637	2155	1986
2237	4941	7691	10893	15867	17640	11404	6986	3076	1303	1046	1987
2908	3213	4853	7269	10123	10325	9260	6040	2692	1156	962	1988
12745	11553	11432	9652	14180	12387	8405	4972	2029	1027	715	1989
15134	7694	4489	4604	8666	8666	6452	3633	1702	945	548	1990
6103	12152	7846	9331	7856	6589	4394	2294	811	364	484	1991
148	1023	2591	3395	3618	2154	1507	875	576	513	579	1992
1172.4	3712.9	8820.9	11590.5	5720	3376.9	1853.1	1002.5	526.9	354.7	526.8	1993
4316.3	3837.1	5426.1	4459.7	2777	736.9	475.6	162.8	120.9	54.7	27.7	1994
99.2	313.9	453.2	333	203.3	65.5	13.6	4.1	0.1	0.1	0.4	1995
180.9	742.8	975	452.7	211.1	51.9	10.4	8.1	2.3	1	1.3	1996
19.4	134.9	543.7	719.4	409.4	149.3	93.5	56.8	26.2	1.4	1.4	1997
10.6	54.8	272.7	767.1	804.9	455.5	278.5	117.3	69	49.2	18.3	1998
26	174.5	268.4	579.2	1030	1079.5	627.5	278.6	126	45.1	27.5	1999
24.6	318.7	953.5	1380.5	1943.3	1773.3	1095.7	449.9	194.9	43.6	114.8	2000
110.2	330.6	1136.8	1410.6	1581.9	1593.6	1402.1	663.9	231.8	85.8	109	2001

Table 3. American Plaice cpue tuning data for the Spanish survey in Division 3N and 3O and Canadian Spring and Fall surveys carried out in Division 3L, 3N, 3O

AMERICAN PLAICE NAFO 3LNO SURVEY TUNNING DATA															
103															
EU Spain															
1995	2001														
1	1	0.45	0.5												
5	15														
1	71.770	74.829	41.874	12.297	6.898	1.519	0.788	1.169	0.174	0.008	0.143	1995.5			
1	53.157	143.169	114.163	39.111	18.253	3.932	1.840	3.269	0.511	0.310	0.164	1996.5			
1	10.238	20.353	73.702	48.755	17.373	4.779	1.921	1.298	0.287	0.025	0.025	1997.5			
1	17.182	32.426	83.161	155.994	118.841	49.266	19.818	7.024	3.185	2.259	0.451	1998.5			
1	21.480	79.590	80.183	107.828	167.644	144.967	62.634	28.921	15.398	4.979	3.071	1999.5			
1	23.719	44.660	131.858	113.351	167.629	157.788	99.279	48.187	19.251	3.522	7.561	2000.5			
1	18.605	31.045	97.945	97.766	103.163	78.091	90.816	40.387	11.362	5.483	2.982	2001.5			
Can Spring															
1985	2001														
1	1	0.45	0.5												
5	18														
1	263.811	454.551	595.652	389.798	208.007	140.238	84.297	45.199	22.716	13.977	9.503	4.198	0.894	0.058	1985.5
1	256.002	561.361	577.156	307.058	193.651	98.117	45.955	34.378	21.735	8.903	7.325	3.760	2.144	0.576	1986.5
1	460.214	747.454	656.206	398.314	184.639	101.101	41.829	33.798	19.928	11.136	8.903	4.244	1.870	0.863	1987.5
1	368.612	616.621	543.875	314.972	217.849	85.292	48.628	32.575	18.745	11.969	8.714	4.763	1.626	0.793	1988.5
1	336.143	551.765	470.169	273.725	187.637	74.679	39.843	27.071	16.825	9.650	8.561	3.989	2.451	0.940	1989.5
1	618.749	377.901	371.001	200.264	130.479	77.524	32.385	21.463	14.428	8.809	6.967	4.172	2.596	0.917	1990.5
1	398.190	364.155	180.205	112.916	67.544	35.190	22.260	13.356	7.224	5.529	5.475	2.178	1.279	0.704	1991.5
1	110.276	190.141	150.915	63.403	34.120	17.503	9.447	5.402	3.343	1.767	2.962	1.613	0.271	0.544	1992.5
1	138.054	180.137	160.064	89.449	32.226	16.510	7.626	4.264	1.783	1.325	1.464	0.836	0.586	0.141	1993.5
1	99.220	106.040	85.372	43.270	19.992	5.397	3.952	1.396	1.241	0.996	0.474	0.260	0	0	1994.5
1	41.914	57.524	59.883	49.937	27.484	8.339	2.664	0.539	0.093	0.035	0	0	0	0	1995.5
1	133.678	130.513	97.122	39.511	16.189	4.502	1.942	2.233	0.518	0.250	0.252	0.168	0	0	1996.5
1	65.278	84.402	79.311	48.718	18.944	6.047	2.678	1.819	0.562	0.174	0.162	0.127	0	0	1997.5
1	69.797	69.196	76.743	79.391	47.909	19.560	9.928	3.281	1.624	0.445	0.556	0.136	0	0	1998.5
1	66.741	104.510	104.869	111.518	107.309	65.322	30.521	13.021	6.508	1.894	1.155	0.879	0.510	0.423	1999.5
1	34.977	67.015	78.009	64.565	59.164	47.188	27.929	9.536	4.042	0.900	1.218	0.629	0.394	0.192	2000.5
1	28.853	36.351	73.856	62.438	58.427	45.042	34.569	16.018	5.541	2.771	1.962	1.050	0.716	0.372	2001.5
Canada fall															
1990	2000														
1	1	0.85	0.9												
5	18														
1	853.098	642.862	369.626	191.668	124.519	55.198	29.201	17.43	12.054	9.316	5.416	4.453	1.635	0.206	1990.9
1	724.397	578.812	249.38	116.271	81.837	44.303	25.916	13.857	12.207	6.977	4.454	2.338	1.004	0.417	1991.9
1	367.927	499.192	226.077	76.712	35.653	17.68	8.451	6.848	3.333	3.151	1.146	1.17	0.522	0.274	1992.9
1	360.452	372.076	316.567	104.116	33	15.316	6.798	5.095	3.077	2.383	1.682	1.362	0.274	0.312	1993.9
1	190.297	151.085	134.913	89.251	28.649	7.822	2.667	1.723	0.919	1.168	0.395	0	0	0	1994.9
1	278.383	322.484	123.253	55.26	26.66	7.981	1.619	1.211	0.452	0.307	0.052	0	0	0	1995.9
1	208.293	174.079	82.201	21.365	8.82	3.077	1.781	0.587	0.098	0.116	0.347	0	0	0	1996.9
1	153.853	159.848	119.979	53.224	23.331	7.304	3.217	1.208	0.849	0.595	0.476	0.076	0	0	1997.9
1	121.174	129.09	112.639	83.42	68.417	17.949	6.944	3.63	2.041	0.844	0.181	0.377	0.445	0.052	1998.9
1	92.461	93.426	79.565	98.916	72.701	33.661	18.853	12.311	4.889	1.076	0.164	0.710	0.578	0.122	1999.9
1	73.671	132.006	115.595	83.788	61.816	48.924	25.380	7.069	3.091	0.843	0.526	0.244	0.712	0.000	2000.9

Table 4. American plaice in 3LNO tuning diagnostics for an XSA assessment in which the Canadian survey information is weighted as 1.0 and the EU survey 0.0.

Fleet : EU Spain																	
Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001							
5				0.26	0.34	-0.93	-0.35	0.01	0.6	0.04							
6				-0.05	0.67	-1.09	-0.43	0.54	0.11	0.24							
7				-0.61	0.2	-0.32	-0.2	-0.04	0.55	0.42							
8				-1.28	-0.18	-0.3	0.59	0.21	0.49	0.47							
9				-1.19	-0.55	-0.8	0.63	0.69	0.71	0.5							
10				-1.84	-0.92	-1.22	0.79	1.4	1.22	0.57							
11				-1.46	-1.09	-1.21	0.49	1.39	1.44	1.1							
12				0.36	0.51	-1.02	0.4	1.22	1.57	0.99							
13				-1.16	0.09	-1.48	0.19	1.56	1.2	0.55							
14				-2.12	-0.05	-2.52	1	0.98	0.45	0.3							
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-6.8417	-5.9951	-5.2645	-5.1872	-4.9468	-5.1914	-5.1914	-5.1914	-5.1914	-5.1914							
S.E.(Log q)	0.5086	0.6029	0.4162	0.6594	0.8104	1.2978	1.3061	1.043	1.1378	1.4798							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	0.99	0.031	6.89	0.53	7	0.55	-6.84										
6	1.09	-0.136	5.64	0.33	7	0.72	-6										
7	-4.92	-1.355	32.45	0.01	7	1.92	-5.26										
8	0.3	2.361	8.22	0.69	7	0.15	-5.19										
9	0.37	9.316	7.53	0.98	7	0.08	-4.95										
10	0.35	4.304	7.29	0.9	7	0.24	-5.19										
11	0.39	6.063	6.72	0.95	7	0.19	-5.1										
12	0.7	1.347	5.3	0.8	7	0.55	-4.61										
13	0.58	2.073	5.48	0.83	7	0.52	-5.05										
14	0.56	2.712	5.28	0.88	7	0.56	-5.47										
Fleet : Can Spring																	
Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	-0.51	-0.35	0.34	0	0.02	0.57	0.71	-0.32	0.1	-0.33	-1.09	0.43	0.09	0.22	0.32	0.16	-0.35
6	-0.33	-0.07	0.41	0.31	0.28	0.23	0.16	0	0.2	-0.1	-0.85	0.04	-0.2	-0.2	0.28	-0.02	-0.14
7	-0.04	-0.07	0.13	0.11	0.25	0.28	-0.05	-0.3	0.34	-0.03	-0.29	0	-0.28	-0.32	0.19	-0.01	0.1
8	-0.18	-0.34	-0.04	-0.24	-0.03	0.17	-0.06	-0.27	0.2	0.15	0.25	-0.05	-0.17	0.04	0.36	0.05	0.15
9	-0.39	-0.48	-0.36	-0.22	-0.14	0.08	0.02	-0.27	0.27	0.03	0.64	-0.23	-0.27	0.16	0.68	0.1	0.37
10	-0.24	-0.49	-0.41	-0.45	-0.44	0.1	0.03	-0.1	0.57	0.04	0.26	-0.38	-0.59	0.26	1	0.41	0.42
11	-0.3	-0.72	-0.74	-0.5	-0.46	-0.26	-0.03	-0.11	0.51	0.87	0.15	-0.64	-0.47	0.2	1.07	0.57	0.53
12	-0.32	-0.38	-0.23	-0.29	-0.25	0.04	0	-0.32	0.68	0.43	-0.01	0.53	-0.28	0.04	0.82	0.35	0.46
13	-0.14	-0.14	-0.06	-0.06	-0.13	0.19	0.04	-0.27	-0.25	1.77	-1.39	0.51	-0.41	-0.08	1.1	0.04	0.23
14	0.01	-0.09	0.08	0.11	0.11	0.21	0.2	-0.18	0.12	0.27	-0.24	0.14	-0.19	-0.22	0.42	-0.51	0.02
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-6.0085	-5.4598	-5.2263	-5.311	-5.3832	-5.5905	-5.5905	-5.5905	-5.5905	-5.5905							
S.E.(Log q)	0.4481	0.305	0.2094	0.1968	0.3443	0.4467	0.5688	0.4016	0.6611	0.2289							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	1.02	-0.181	5.89	0.8	17	0.47	-6.01										
6	0.91	1.13	5.95	0.91	17	0.27	-5.46										
7	0.94	1.031	5.57	0.95	17	0.2	-5.23										
8	1.13	-2.367	4.65	0.96	17	0.2	-5.31										
9	1.23	-2.641	4.34	0.9	17	0.36	-5.38										
10	1.16	-1.533	5	0.87	17	0.5	-5.59										
11	1.26	-2.226	4.79	0.83	17	0.64	-5.61										
12	1.16	-2.389	5.12	0.94	17	0.4	-5.52										
13	1.06	-0.558	5.42	0.84	17	0.72	-5.54										
14	0.96	1.181	5.61	0.99	17	0.22	-5.58										
Fleet : Canada fall																	
Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5						0.12	0.52	0.07	0.25	-0.47	-0.01	0.06	-0.01	-0.18	-0.31	-0.05	99.99
6						0.24	0.13	0.42	0.41	-0.25	0.32	-0.22	-0.25	-0.27	-0.52	-0.02	99.99
7						0.06	0.1	-0.13	0.93	0.3	0.18	-0.41	-0.26	-0.32	-0.47	0.02	99.99
8						0	-0.05	-0.17	0.49	0.93	0.19	-0.82	-0.37	-0.2	-0.05	0.05	99.99
9						-0.03	0.23	-0.27	0.52	0.45	0.43	-1.03	-0.37	0.21	-0.01	-0.12	99.99
10						-0.23	0.37	-0.1	0.85	0.44	0.06	-0.93	-0.69	-0.09	0.1	0.22	99.99
11						-0.31	0.24	-0.19	0.8	0.73	-0.51	-0.9	-0.57	-0.42	0.37	0.26	99.99
12						-0.08	0.12	-0.08	1.34	0.73	0.63	-0.97	-0.57	-0.12	0.53	-0.16	99.99
13						0.05	0.56	-0.26	0.46	2.07	0.01	-1.33	-0.26	-0.1	0.59	-0.47	99.99
14						0.28	0.37	0.58	0.98	0.36	1.75	-0.8	0.74	0.24	-0.41	-0.84	99.99
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-4.9794	-4.6897	-4.7536	-4.9218	-4.9661	-5.1997	-5.1997	-5.1997	-5.1997	-5.1997							
S.E.(Log q)	0.2647	0.3217	0.3963	0.4502	0.4516	0.5028	0.5605	0.705	0.8523	0.8272							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	0.87	1.433	5.72	0.93	11	0.22	-4.98										
6	0.74	2.534	6.23	0.91	11	0.19	-4.68										
7	0.82	0.821	5.73	0.7	11	0.33	-4.75										
8	0.92	0.304	5.33	0.6	11	0.43	-4.92										
9	0.94	0.296	5.24	0.71	11	0.44	-4.97										
10	0.88	0.695	5.61	0.8	11	0.46	-5.2										
11	0.91	0.564	5.5	0.9	11	0.53	-5.24										
12	1.01	-0.055	5.09	0.74	11	0.74	-5.11										
13	0.96	0.179	5.13	0.72	11	0.85	-5.08										
14	1.14	-0.805	4.78	0.78	11	0.89	-4.9										

Table 5. American plaice in 3LNO tuning diagnostics for an XSA assessment in which the Canadian survey information is weighted as 0.0 and the EU survey 1.0.

Fleet : EU Spain																	
Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001							
5				0.46	0.69	-0.54	-0.39	-0.05	0.16	-0.33							
6				0.18	0.74	-0.83	-0.13	0.41	-0.05	-0.31							
7				0.13	0.21	-0.47	-0.14	0.06	0.19	0.02							
8				-0.32	0.34	-0.52	0.23	0.07	0.36	-0.16							
9				-0.09	0.16	-0.55	0.13	0.05	0.27	0.02							
10				-0.7	-0.04	-0.72	0.76	0.61	0.28	-0.22							
11				-0.85	0.02	-0.38	0.9	1.22	0.43	-0.07							
12				1.73	1.1	0.05	1.12	1.48	1.16	-0.26							
13				-0.26	1.44	-0.96	1.15	2.1	1.27	-0.08							
14				-0.14	0.85	-1.21	1.31	1.79	0.83	0.22							
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-13.1015	-12.164	-11.247	-10.9961	-10.5517	-10.6347	-10.6347	-10.6347	-10.6347	-10.6347							
S.E.(Log q)	0.4699	0.5082	0.2387	0.339	0.2653	0.5948	0.7494	1.2299	1.3178	1.1447							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	0.55	1.888	14.62	0.78	7	0.21	-13.1										
6	0.45	2.068	14.39	0.74	7	0.18	-12.16										
7	1.29	-0.772	9.92	0.58	7	0.32	-11.25										
8	0.94	0.305	11.26	0.83	7	0.35	-11										
9	0.92	0.943	10.89	0.96	7	0.25	-10.55										
10	0.82	1.46	11.22	0.93	7	0.45	-10.63										
11	0.84	1.034	10.87	0.89	7	0.6	-10.45										
12	1.27	-1.322	9.14	0.83	7	0.88	-9.72										
13	0.98	0.054	9.98	0.68	7	1.19	-9.97										
14	0.81	1.208	10.02	0.89	7	0.78	-10.11										
Fleet : Can Spring																	
Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	3.54	3.68	3.13	3.08	1.49	2.12	1.43	-0.56	-0.83	-2.08	-3.02	-1.33	-1.63	-1.93	-1.85	-2.4	-2.83
6	3.37	3.63	4.08	2.73	2.96	1.24	1.23	0.33	-0.43	-1.46	-2.99	-2.26	-2.31	-2.27	-2.23	-2.55	-3.06
7	3.31	3.3	3.49	3.45	2.28	2.57	0.48	0.33	0.13	-1.2	-2.06	-2.49	-2.94	-2.76	-2.21	-2.87	-2.81
8	3.06	2.74	3.06	2.85	3.04	1.81	1.79	-0.2	0.18	-0.81	-1.39	-2.12	-2.99	-2.91	-2.37	-2.68	-3.07
9	2.62	2.55	2.47	2.65	2.72	2.9	1.17	1.07	-0.47	-0.91	-0.87	-2.12	-2.62	-2.94	-2.55	-2.94	-2.72
10	2.59	2.35	2.46	2.17	2.22	2.72	2.56	0.45	1.01	-1.67	-1.21	-2.11	-2.7	-2.35	-2.39	-3.14	-2.98
11	2.57	2.13	2.1	2.38	2.07	2.3	2.44	2.22	0.21	0.19	-1.84	-2.13	-2.26	-2	-1.71	-3.04	-3.25
12	2.58	2.53	2.62	2.56	2.67	2.36	2.38	1.94	2.39	-0.92	-1.25	-1.49	-1.63	-1.85	-1.53	-2.67	-3.4
13	2.59	2.8	2.91	2.8	2.72	3.19	2.11	1.85	1.65	2.07	-3.09	-0.76	-2.5	-1.74	-0.97	-2.5	-3.01
14	2.86	2.51	3.12	3.17	2.99	3.06	3.28	1.48	1.75	1.82	-0.87	-1.57	-1.48	-2.53	-1.38	-2.74	-2.67
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-10.159	-9.26	-8.7041	-8.5266	-8.3863	-8.4252	-8.4252	-8.4252	-8.4252	-8.4252							
S.E.(Log q)	2.4222	2.6008	2.5904	2.4614	2.3614	2.3691	2.2666	2.3262	2.4873	2.5034							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	-2.46	-12.366	27.81	0.46	17	1.84	-10.16										
6	-1.93	-22.497	25.05	0.6	17	0.88	-9.26										
7	-2.03	-39.562	24.92	0.92	17	0.53	-8.7										
8	-2.64	-19.147	26.44	0.65	17	1.33	-8.53										
9	-3.9	-10.543	29.96	0.24	17	3.28	-8.39										
10	-6.98	-7.058	37.81	0.05	17	8.18	-8.43										
11	-37.26	-5.919	124.58	0	17	47.46	-8.29										
12	-34.64	-5.016	94.75	0	17	49.84	-8.01										
13	-17.03	-4.063	38.09	0	17	29.24	-7.83										
14	33.62	-3.242	-23	0	17	63.38	-7.67										
Fleet : Canada fall																	
Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5						2.81	2.4	1.02	0.5	-1.06	-0.76	-0.52	-0.54	-1.14	-1.29	-1.42	99.99
6						2.44	2.37	1.96	0.96	-0.44	-0.6	-1.3	-1.14	-1.11	-1.8	-1.33	99.99
7						3.5	1.74	1.86	1.75	0.18	-0.41	-1.73	-1.73	-1.59	-1.7	-1.69	99.99
8						2.81	2.89	1.02	1.37	0.94	-0.26	-1.71	-2	-1.97	-1.59	-1.52	99.99
9						3.92	2.95	2.1	0.52	0.41	0.05	-1.78	-1.6	-1.77	-2.12	-2.08	99.99
10						3.41	3.89	1.36	1.87	-0.42	-0.37	-1.61	-1.76	-1.69	-2.31	-2.36	99.99
11						3.25	3.67	3.11	1	0.69	-1.46	-1.34	-1.33	-1.61	-1.44	-2.39	99.99
12						3.19	3.46	3.15	3.68	0.17	0.44	-1.95	-1.49	-1.01	-0.84	-2.22	99.99
13						4.14	3.6	2.83	3.21	2.72	-0.63	-1.55	-1.34	-0.76	-0.51	-2.02	99.99
14						4.2	4.54	3.05	3.35	2.89	2.18	-1.46	0.5	-1.14	-1.2	-2.06	99.99
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-10.3151	-9.7162	-9.4195	-9.3439	-9.1263	-9.0912	-9.0912	-9.0912	-9.0912	-9.0912							
S.E.(Log q)	1.4895	1.6167	1.8852	1.8911	2.0822	2.2764	2.2659	2.4188	2.5555	2.8508							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	-1.49	-5.149	24.79	0.32	11	1.18	-10.32										
6	-1.5	-8.939	24.32	0.59	11	0.81	-9.72										
7	-2.16	-26.325	26.5	0.88	11	0.49	-9.42										
8	-3.79	-12.311	32.04	0.42	11	1.79	-9.34										
9	-8.49	-7.833	48.2	0.07	11	6.67	-9.13										
10	-10.28	-6.076	45.85	0.03	11	10.92	-9.09										
11	-24.79	-4.847	72.54	0	11	31.03	-8.9										
12	-6.14	-4.832	21.85	0.05	11	7.97	-8.49										
13	-12.22	-3.526	23.52	0.01	11	19.89	-8.21										
14	-3.84	-4.213	11.88	0.08	11	5.81	-7.74										

Table 6. American plaice in 3LNO tuning diagnostics for an XSA assessment in which the Canadian survey information is weighted as 1.0 and the EU survey 1.0.

Fleet : EU Spain																	
Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001							
5				0.28	0.39	-0.87	-0.37	0	0.53	0.03							
6				-0.04	0.67	-1.04	-0.36	0.52	0.09	0.17							
7				-0.57	0.19	-0.35	-0.17	0	0.51	0.39							
8				-1.24	-0.16	-0.32	0.55	0.22	0.52	0.41							
9				-1.15	-0.52	-0.78	0.69	0.63	0.71	0.52							
10				-1.79	-0.89	-1.19	0.8	1.36	1.15	0.57							
11				-1.43	-1.05	-1.18	0.52	1.4	1.37	1.01							
12				0.4	0.55	-0.97	0.42	1.25	1.57	0.9							
13				-1.11	0.13	-1.45	0.24	1.58	1.22	0.54							
14				-2.03	0	-2.48	1.04	1.03	0.47	0.32							
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-6.9172	-6.0682	-5.3218	-5.2345	-4.9826	-5.2288	-5.2288	-5.2288	-5.2288	-5.2288							
S.E(Log q)	0.4843	0.574	0.3914	0.6409	0.7899	1.2628	1.2689	1.0337	1.1327	1.4575							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	0.91	0.25	7.24	0.58	7	0.48	-6.92										
6	0.95	0.094	6.28	0.39	7	0.59	-6.07										
7	18.51	-1.01	-75.09	0	7	7.23	-5.32										
8	0.31	2.61	8.22	0.74	7	0.14	-5.23										
9	0.39	6.931	7.49	0.98	7	0.08	-4.98										
10	0.38	4.364	7.27	0.91	7	0.24	-5.23										
11	0.42	5.348	6.69	0.94	7	0.22	-5.14										
12	0.72	1.261	5.28	0.8	7	0.56	-4.64										
13	0.58	2.027	5.48	0.83	7	0.53	-5.06										
14	0.56	2.631	5.28	0.88	7	0.57	-5.46										
Fleet : Can Spring																	
Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	-0.47	-0.31	0.37	0.04	0.06	0.61	0.74	-0.29	0.12	-0.36	-1.13	0.44	0.11	0.16	0.26	0.05	-0.4
6	0.3	-0.03	0.44	0.34	0.31	0.35	0.19	0.03	0.23	-0.09	-0.88	0	-0.2	-0.18	0.22	-0.06	-0.25
7	-0.01	-0.05	0.15	0.13	0.28	0.31	-0.03	-0.28	0.36	-0.01	-0.28	-0.04	-0.34	-0.32	0.2	-0.08	0.03
8	-0.16	-0.32	-0.02	-0.22	-0.01	0.19	-0.04	-0.25	0.22	0.16	0.26	-0.05	-0.22	-0.03	0.35	0.06	0.06
9	-0.37	-0.46	-0.35	-0.2	-0.12	0.1	0.04	-0.25	0.29	0.05	0.64	-0.23	-0.28	0.1	0.6	0.08	0.37
10	-0.23	-0.48	-0.39	-0.43	-0.43	0.12	0.05	-0.08	0.59	0.05	0.29	-0.38	-0.58	0.25	0.94	0.32	0.4
11	-0.29	-0.7	-0.73	-0.49	-0.44	-0.24	-0.01	-0.1	0.53	0.89	0.17	-0.61	-0.47	0.2	1.06	0.48	0.42
12	-0.31	-0.37	-0.22	-0.28	-0.24	0.05	0.01	-0.31	0.7	0.46	0.01	0.64	-0.26	0.04	0.83	0.33	0.35
13	-0.13	-0.13	-0.06	-0.05	-0.12	0.2	0.05	-0.27	-0.25	1.81	-1.36	0.52	-0.4	-0.05	1.1	0.04	0.2
14	0.01	-0.09	0.08	0.11	0.12	0.21	0.2	-0.18	0.12	0.27	-0.17	0.17	-0.17	-0.21	0.44	-0.51	0.01
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-6.0445	-5.4916	-5.2506	-5.3309	-5.3979	-5.6065	-5.6065	-5.6065	-5.6065	-5.6065							
S.E(Log q)	0.4567	0.3189	0.22	0.1933	0.3313	0.429	0.553	0.3947	0.6642	0.2283							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	0.99	0.104	6.12	0.79	17	0.46	-6.04										
6	0.87	1.579	6.18	0.91	17	0.27	-5.49										
7	0.91	1.464	5.74	0.95	17	0.19	-5.25										
8	1.11	-1.943	4.78	0.95	17	0.2	-5.33										
9	1.22	-2.571	4.42	0.9	17	0.35	-5.4										
10	1.15	-1.501	5.05	0.87	17	0.47	-5.61										
11	1.25	-2.245	4.83	0.84	17	0.62	-5.63										
12	1.16	-2.464	5.13	0.94	17	0.39	-5.53										
13	1.07	-0.592	5.42	0.84	17	0.72	-5.54										
14	0.97	0.92	5.61	0.99	17	0.22	-5.98										
Fleet : Canada fall																	
Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5						0.17	0.56	0.11	0.28	-0.48	-0.04	0.08	0.03	-0.22	-0.35	-0.14	99.99
6						0.28	0.17	0.45	0.44	-0.23	0.29	-0.26	-0.24	-0.24	-0.58	-0.08	99.99
7						0.09	0.13	-0.1	0.95	0.32	0.19	-0.44	-0.31	-0.32	-0.46	-0.05	99.99
8						0.03	-0.03	-0.15	0.51	0.94	0.2	-0.82	-0.42	-0.27	-0.06	0.06	99.99
9						-0.01	0.25	-0.25	0.54	0.49	0.44	-1.01	-0.37	0.16	-0.08	-0.14	99.99
10						-0.21	0.4	-0.08	0.87	0.46	0.09	-0.92	-0.68	-0.09	0.03	0.13	99.99
11						-0.29	0.26	-0.17	0.83	0.75	-0.5	-0.87	-0.56	-0.41	0.36	0.17	99.99
12						-0.07	0.14	-0.07	1.37	0.77	0.65	-0.96	-0.94	-0.11	0.54	-0.18	99.99
13						0.06	0.57	-0.24	0.46	2.14	0.05	-1.3	-0.24	-0.07	0.6	-0.46	99.99
14						0.29	0.38	0.59	0.97	0.37	1.83	-0.77	0.77	0.26	-0.37	-0.84	99.99
Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time																	
Age	5	6	7	8	9	10	11	12	13	14							
Mean Log	-5.0277	-4.7259	-4.7827	-4.943	-4.9878	-5.2213	-5.2213	-5.2213	-5.2213	-5.2213							
S.E(Log q)	0.2948	0.3421	0.41	0.4527	0.4542	0.5018	0.5545	0.7106	0.8662	0.8419							
Regression statistics :																	
Ages with q independent of year class strength and constant w.r.t. time.																	
Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q										
5	0.84	1.689	5.97	0.92	11	0.23	-5.93										
6	0.71	2.743	6.44	0.91	11	0.19	-4.73										
7	0.79	0.914	5.91	0.69	11	0.33	-4.78										
8	0.91	0.297	5.36	0.57	11	0.44	-4.94										
9	0.94	0.29	5.26	0.7	11	0.45	-4.99										
10	0.89	0.639	5.6	0.79	11	0.46	-5.22										
11	0.91	0.541	5.5	0.81	11	0.52	-5.26										
12	1.02	-0.08	5.08	0.74	11	0.75	-5.12										
13	0.97	0.133	5.12	0.71	11	0.87	-5.08										
14	1.16	-0.886	4.77	0.77	11	0.91	-4.91										

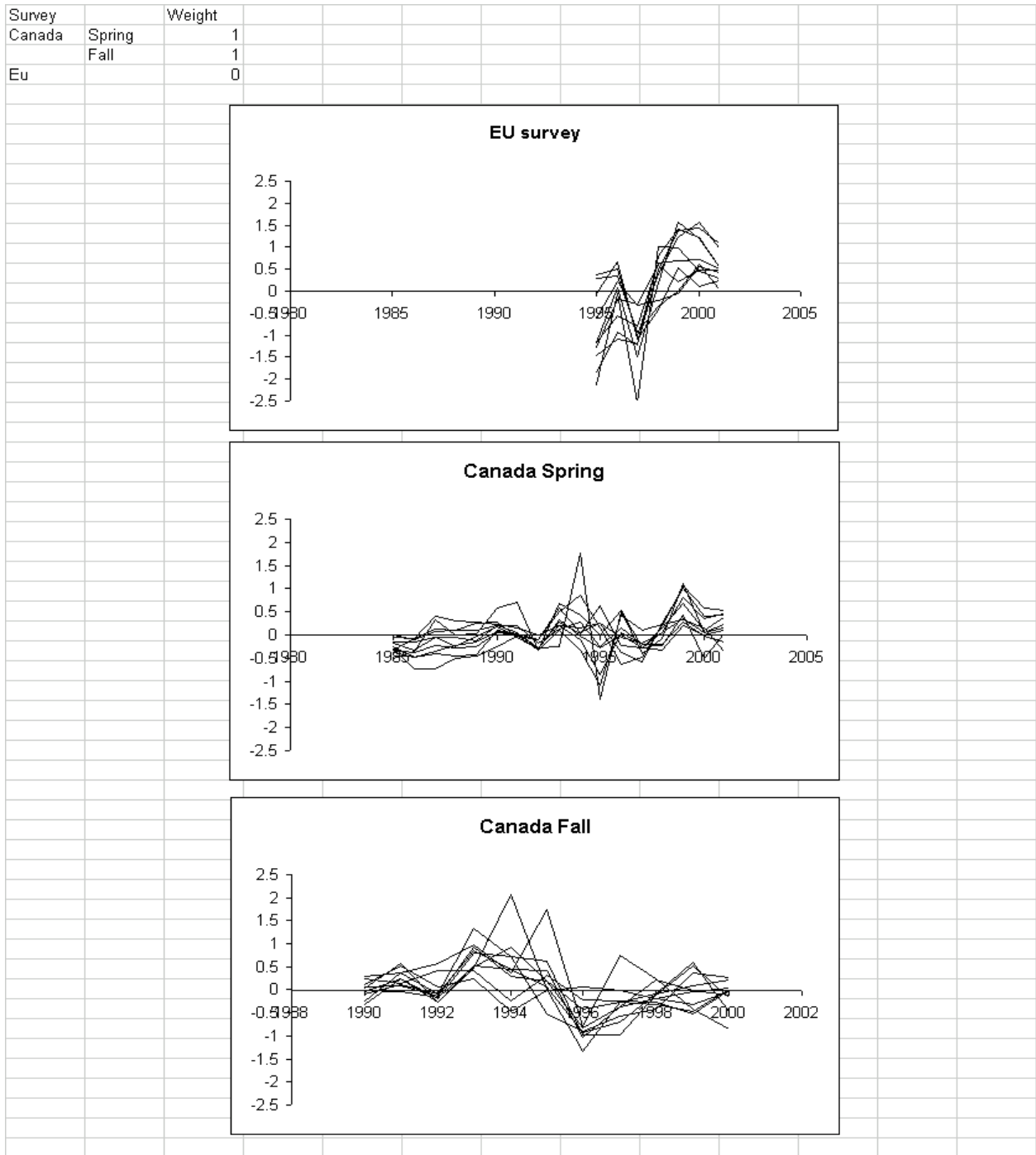


Fig. 1. American plaice in 3LNO log catchability residuals resulting from an XSA assessment in which the Canadian survey information is weighted as 1.0 and the EU survey 0.0.

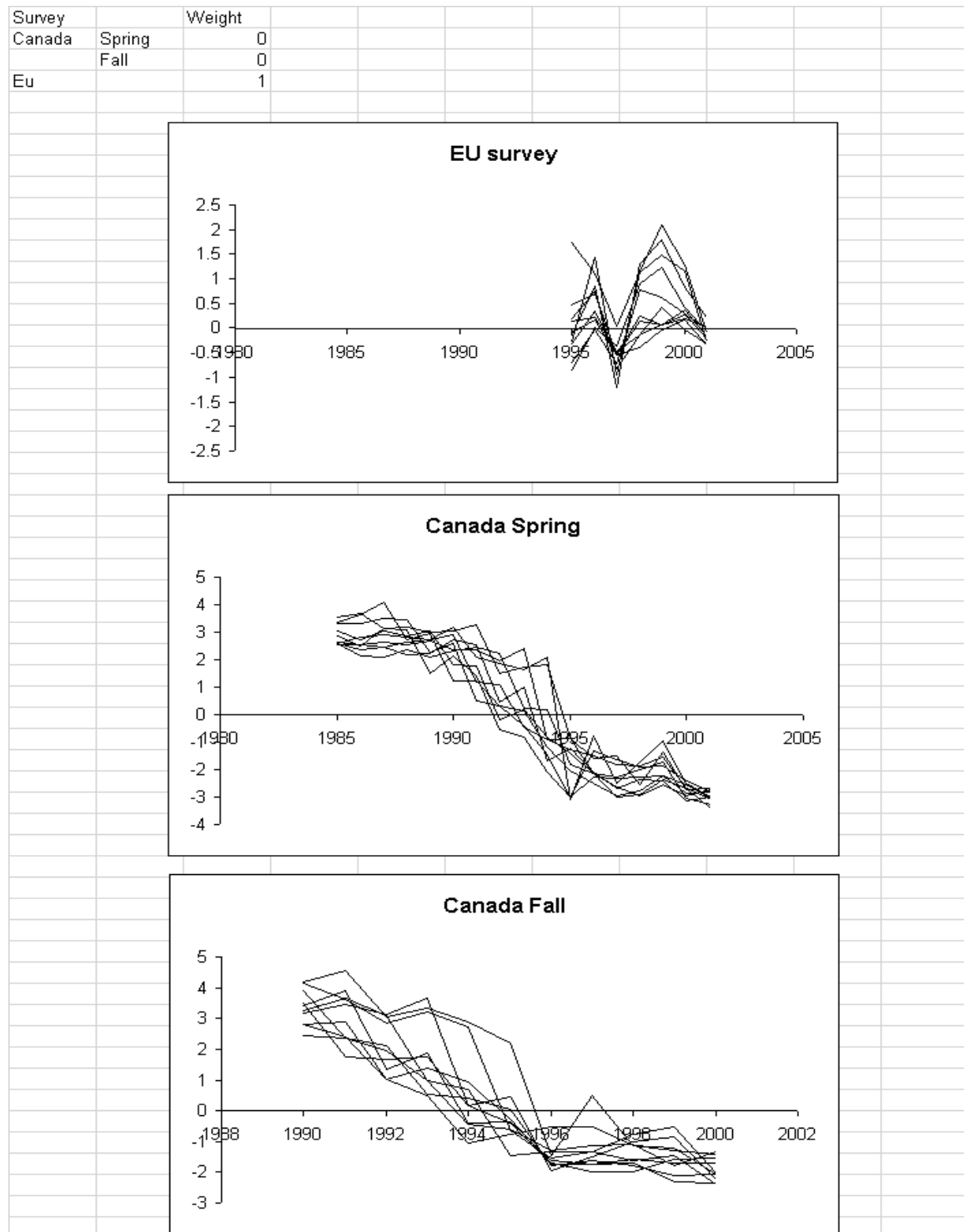


Fig. 2. American plaice in 3LNO log catchability residuals resulting from an XSA assessment in which the Canadian survey information is weighted as 0.0 and the EU survey 1.0.

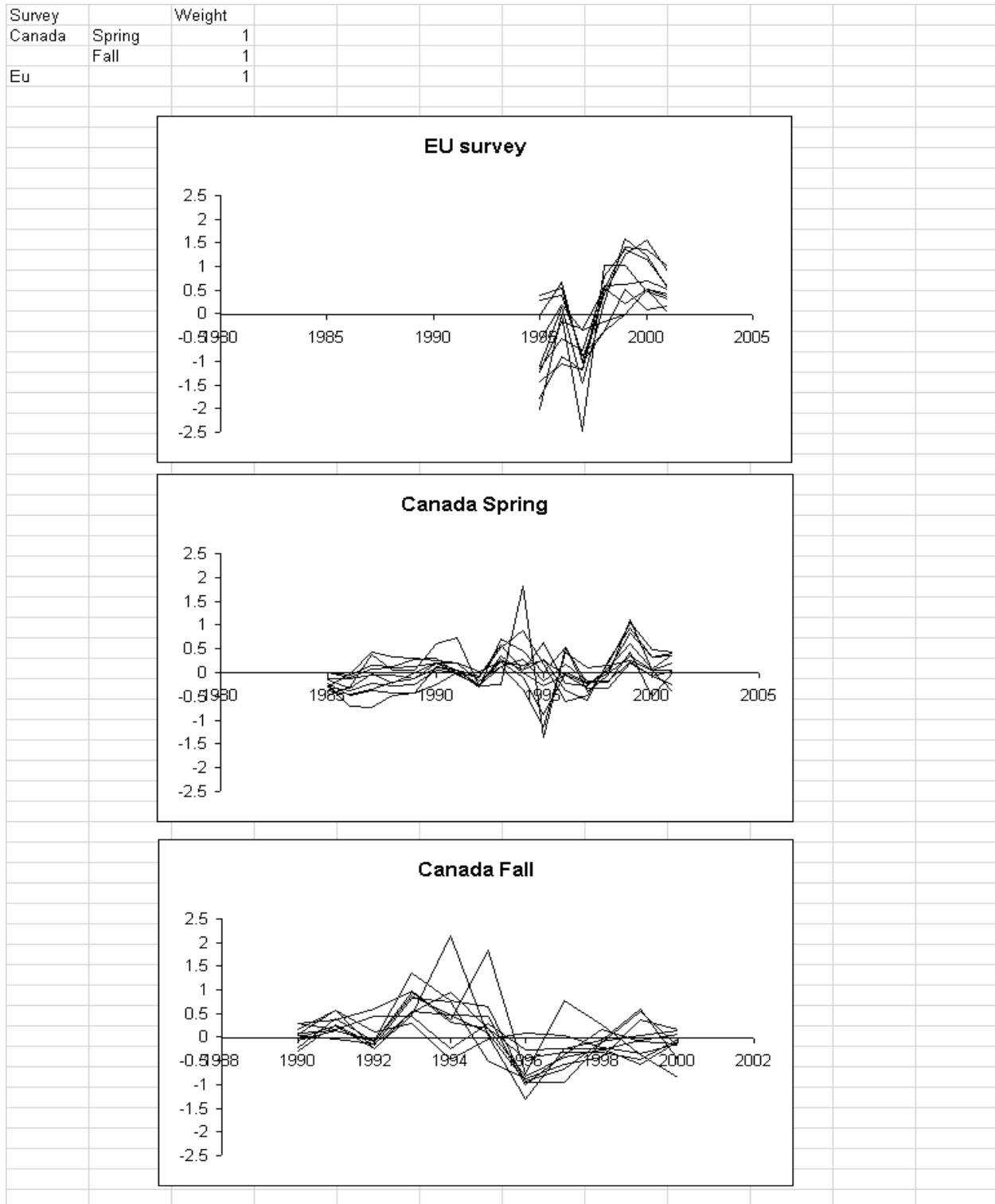


Fig. 3. American plaice in 3LNO log catchability residuals resulting from an XSA assessment in which the Canadian survey information is weighted as 1.0 and the EU survey 1.0.

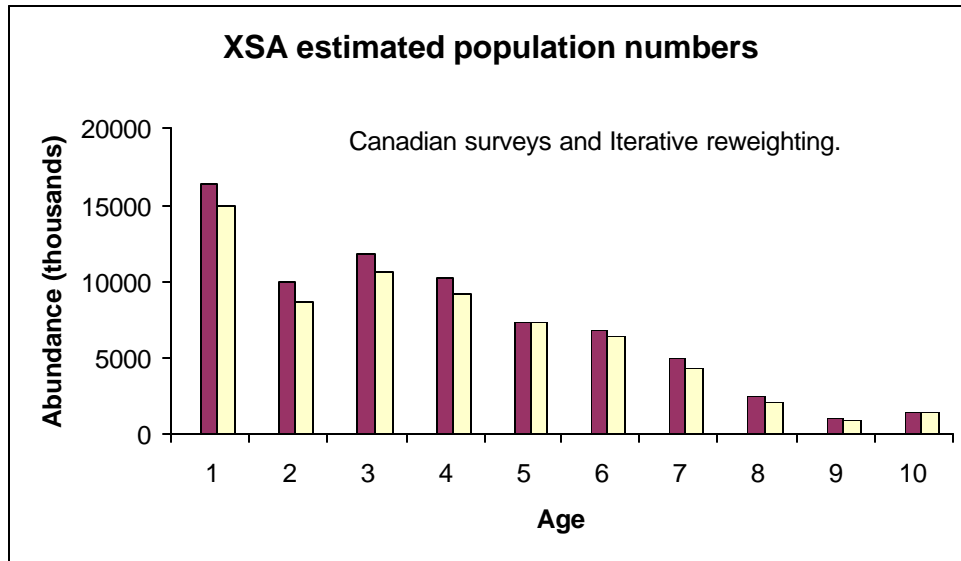
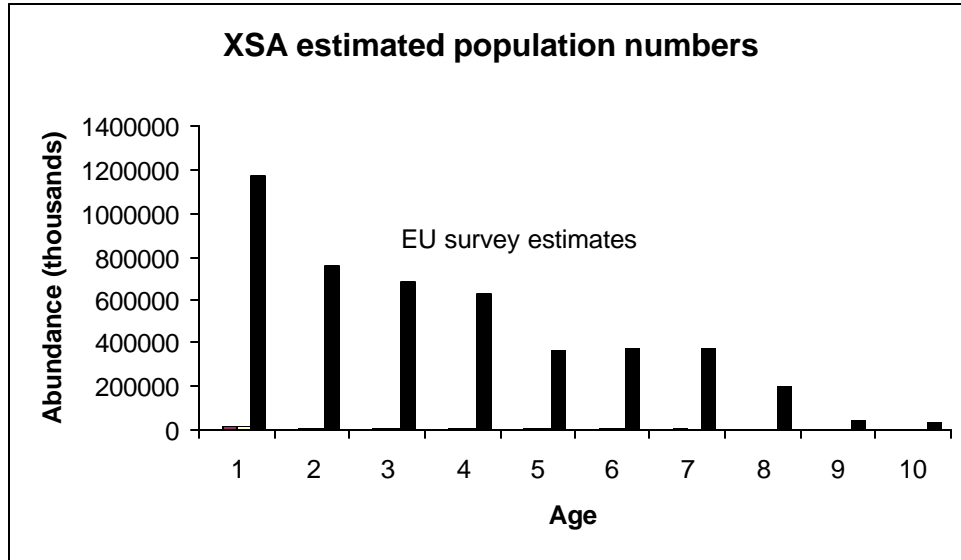


Fig. 4 a,b. The population numbers at age estimated within an XSA assessment model fitted to the data for the American plaice in 3LNO. Figure 4a presents the estimates from the xsa model fitted to the EU surveys, Figure 4b presents the estimates from a model fitted to the Canadian data and using iterative reweighting.

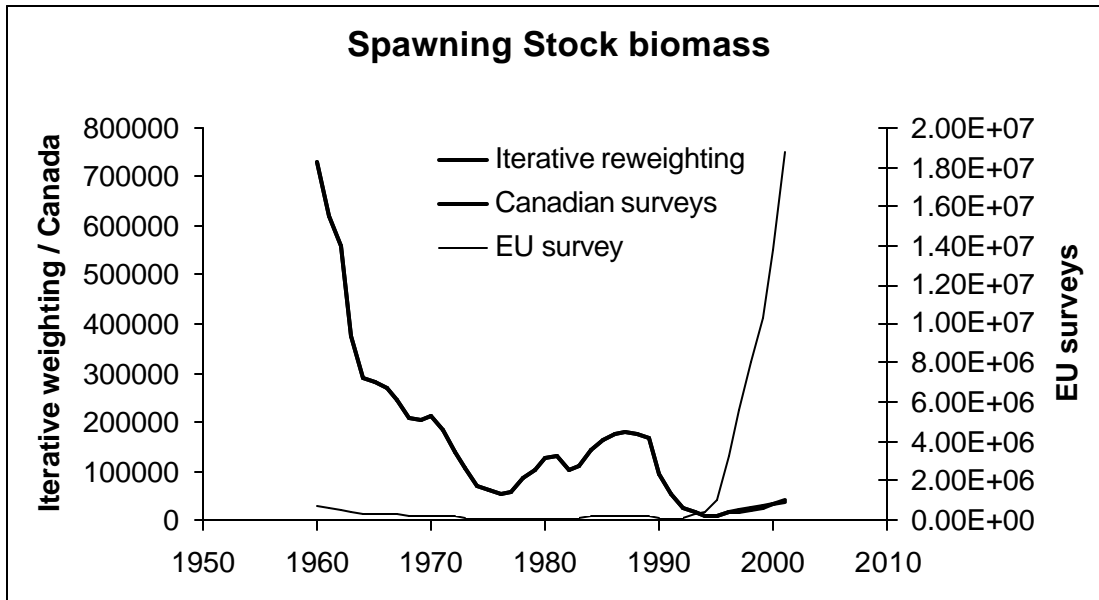


Fig. 5 The trends in spawning stock biomass estimated from XSA models fitted to the Canadian and EU survey data series and using iterative reweighting.

Appendix 1. An XSA assessment of the American plaice in 3LNO using iterative reweighting to determine the contribution of each calibration data source.

Lowestoft VPA Version 3.1

19/06/2002 20:59

Extended Survivors Analysis

AMERICAN PLAICE NAFO DIVISION 3LNO INDEX OF INPUT FILES APRIL 2000

CPUE data from file tun.dat

Catch data for 42 years. 1960 to 2001. Ages 5 to 15.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU Spain	1995	2001	5	14	0.45	0.5
Can Spring	1985	2001	5	14	0.45	0.5
Canada fall	1990	2001	5	14	0.85	0.9

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages ≥ 10

Terminal population estimation :

Survivor estimates shrunk towards the mean F of the final 3 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 47 iterations

Regression weights

1 1 1 1 1 1 1 1 1 1 1

Fishing mortalities

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	0.002	0.023	0.073	0.002	0.005	0.001	0	0.001	0.002	0.006
6	0.023	0.108	0.139	0.009	0.024	0.005	0.003	0.009	0.018	0.029
7	0.069	0.419	0.335	0.03	0.051	0.026	0.014	0.017	0.059	0.083
8	0.206	0.789	0.593	0.042	0.054	0.058	0.046	0.036	0.11	0.117
9	0.38	1.063	0.67	0.065	0.048	0.074	0.085	0.08	0.163	0.179
10	0.423	1.321	0.536	0.039	0.029	0.051	0.111	0.156	0.193	0.195
11	0.54	1.464	1.071	0.022	0.011	0.081	0.127	0.22	0.235	0.23
12	0.444	1.652	0.685	0.029	0.023	0.089	0.138	0.181	0.242	0.218
13	0.493	0.85	1.993	0.001	0.028	0.116	0.149	0.216	0.186	0.189
14	0.896	1.098	0.269	0.009	0.018	0.025	0.332	0.137	0.107	0.116

1

XSA population numbers (Thousands)

YEAR	AGE									
	5	6	7	8	9	10	11	12	13	14
1992	8.02E+04	5.84E+04	5.04E+04	2.38E+04	1.49E+04	8.15E+03	4.71E+03	3.18E+03	1.93E+03	1.13E+03
1993	6.72E+04	4.71E+04	3.36E+04	2.77E+04	1.14E+04	6.00E+03	3.14E+03	1.62E+03	1.20E+03	6.94E+02
1994	7.96E+04	3.87E+04	2.49E+04	1.30E+04	7.41E+03	2.32E+03	9.43E+02	4.28E+02	1.82E+02	3.02E+02
1995	7.02E+04	4.35E+04	1.98E+04	1.05E+04	4.23E+03	2.23E+03	7.98E+02	1.90E+02	1.27E+02	1.46E+01
1996	4.70E+04	4.13E+04	2.54E+04	1.13E+04	5.91E+03	2.33E+03	1.26E+03	4.59E+02	1.09E+02	7.47E+01
1997	2.71E+04	2.75E+04	2.37E+04	1.42E+04	6.31E+03	3.32E+03	1.33E+03	7.35E+02	2.64E+02	6.22E+01
1998	2.75E+04	2.22E+04	2.24E+04	1.89E+04	1.10E+04	4.80E+03	2.58E+03	1.01E+03	5.51E+02	1.92E+02
1999	2.39E+04	2.25E+04	1.81E+04	1.81E+04	1.48E+04	8.25E+03	3.52E+03	1.86E+03	7.18E+02	3.88E+02
2000	1.54E+04	1.95E+04	1.83E+04	1.46E+04	1.43E+04	1.12E+04	5.78E+03	2.31E+03	1.27E+03	4.74E+02
2001	2.00E+04	1.26E+04	1.57E+04	1.41E+04	1.07E+04	9.94E+03	7.56E+03	3.74E+03	1.48E+03	8.64E+02

Estimated population abundance at 1st Jan 2002

0.00E+00 1.63E+04 1.00E+04 1.18E+04 1.03E+04 7.32E+03 6.70E+03 4.92E+03 2.46E+03 1.01E+03

Taper weighted geometric mean of the VPA populations:

1.48E+05 1.21E+05 9.66E+04 7.45E+04 5.44E+04 3.73E+04 2.43E+04 1.50E+04 8.93E+03 5.42E+03

Standard error of the weighted Log(VPA populations) :

0.8484 0.8536 0.8635 0.9461 1.0814 1.2477 1.4413 1.6859 1.8943 2.1503

Log catchability residuals.

Fleet : EU Spain

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	99.99	99.99	99.99	0.28	0.39	-0.87	-0.37	0	0.53	0.03
6	99.99	99.99	99.99	-0.04	0.67	-1.04	-0.36	0.52	0.09	0.17
7	99.99	99.99	99.99	-0.57	0.19	-0.35	-0.17	0	0.51	0.38
8	99.99	99.99	99.99	-1.24	-0.16	-0.32	0.55	0.22	0.52	0.41
9	99.99	99.99	99.99	-1.15	-0.52	-0.78	0.59	0.63	0.71	0.52
10	99.99	99.99	99.99	-1.79	-0.89	-1.19	0.8	1.36	1.15	0.57
11	99.99	99.99	99.99	-1.43	-1.05	-1.18	0.52	1.4	1.37	1.01
12	99.99	99.99	99.99	0.4	0.55	-0.97	0.42	1.25	1.57	0.9
13	99.99	99.99	99.99	-1.11	0.13	-1.45	0.24	1.58	1.22	0.54
14	99.99	99.99	99.99	-2.03	0	-2.48	1.04	1.03	0.47	0.32

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	5	6	7	8	9	10	11	12	13	14
Mean Log q	-6.9172	-6.0682	-5.3218	-5.2345	-4.9826	-5.2288	-5.2288	-5.2288	-5.2288	-5.2288
S.E(Log q)	0.4843	0.574	0.3914	0.6409	0.7899	1.2628	1.2689	1.0337	1.1327	1.4575

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
5	0.91	0.25	7.24	0.58	7	0.48	-6.92
6	0.95	0.094	6.28	0.39	7	0.59	-6.07
7	18.51	-1.01	-75.09	0	7	7.23	-5.32
8	0.31	2.61	8.22	0.74	7	0.14	-5.23
9	0.39	8.931	7.49	0.98	7	0.08	-4.98
10	0.38	4.354	7.27	0.91	7	0.24	-5.23
11	0.42	5.348	6.69	0.94	7	0.22	-5.14
12	0.72	1.261	5.28	0.8	7	0.56	-4.64
13	0.58	2.027	5.48	0.83	7	0.53	-5.06
14	0.56	2.631	5.28	0.88	7	0.57	-5.46

Fleet : Can Spring

Age	1985	1986	1987	1988	1989	1990	1991
5	-0.47	-0.31	0.37	0.04	0.06	0.61	0.74
6	-0.3	-0.03	0.44	0.34	0.31	0.26	0.19
7	-0.01	-0.05	0.15	0.13	0.28	0.31	-0.03
8	-0.16	-0.32	-0.02	-0.22	-0.01	0.19	-0.04
9	-0.37	-0.46	-0.35	-0.2	-0.12	0.1	0.04
10	-0.23	-0.48	-0.39	-0.43	-0.43	0.12	0.05
11	-0.29	-0.7	-0.73	-0.49	-0.44	-0.24	-0.01
12	-0.31	-0.37	-0.22	-0.28	-0.24	0.05	0.01
13	-0.13	-0.13	-0.06	-0.05	-0.12	0.2	0.05
14	0.01	-0.09	0.08	0.11	0.12	0.21	0.2

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	-0.29	0.12	-0.36	-1.13	0.44	0.11	0.16	0.26	0.05	-0.4
6	0.03	0.23	-0.09	-0.88	0	-0.2	-0.18	0.22	-0.08	-0.25
7	-0.28	0.36	-0.01	-0.28	-0.04	-0.34	-0.32	0.2	-0.08	0.03
8	-0.25	0.22	0.16	0.26	-0.05	-0.22	-0.03	0.35	0.06	0.06
9	-0.25	0.29	0.05	0.64	-0.23	-0.28	0.1	0.6	0.08	0.37
10	-0.08	0.59	0.05	0.29	-0.38	-0.58	0.25	0.94	0.32	0.4
11	-0.1	0.53	0.89	0.17	-0.61	-0.47	0.2	1.06	0.48	0.42
12	-0.31	0.7	0.46	0.01	0.54	-0.26	0.04	0.83	0.33	0.35
13	-0.27	-0.25	1.81	-1.36	0.52	-0.4	-0.05	1.1	0.04	0.2
14	-0.18	0.12	0.27	-0.17	0.17	-0.17	-0.21	0.44	-0.51	0.01

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	5	6	7	8	9	10	11	12	13	14
Mean Log q	-6.0445	-5.4916	-5.2506	-5.3309	-5.3979	-5.6065	-5.6065	-5.6065	-5.6065	-5.6065
S.E(Log q)	0.4567	0.3189	0.22	0.1933	0.3313	0.429	0.553	0.3947	0.6642	0.2283

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
5	0.99	0.104	6.12	0.79	17	0.46	-6.04
6	0.87	1.579	6.18	0.91	17	0.27	-5.49
7	0.91	1.464	5.74	0.95	17	0.19	-5.25
8	1.11	-1.943	4.78	0.95	17	0.2	-5.33
9	1.22	-2.571	4.42	0.9	17	0.35	-5.4
10	1.15	-1.501	5.05	0.87	17	0.47	-5.61
11	1.25	-2.245	4.83	0.84	17	0.62	-5.63
12	1.16	-2.464	5.13	0.94	17	0.39	-5.53
13	1.07	-0.592	5.42	0.84	17	0.72	-5.54
14	0.97	0.92	5.61	0.99	17	0.22	-5.58

Fleet : Canada fall

Age	1985	1986	1987	1988	1989	1990	1991
5	99.99	99.99	99.99	99.99	99.99	0.17	0.56
6	99.99	99.99	99.99	99.99	99.99	0.28	0.17
7	99.99	99.99	99.99	99.99	99.99	0.09	0.13
8	99.99	99.99	99.99	99.99	99.99	0.03	-0.03
9	99.99	99.99	99.99	99.99	99.99	-0.01	0.25
10	99.99	99.99	99.99	99.99	99.99	-0.21	0.4
11	99.99	99.99	99.99	99.99	99.99	-0.29	0.26
12	99.99	99.99	99.99	99.99	99.99	-0.07	0.14
13	99.99	99.99	99.99	99.99	99.99	0.06	0.57
14	99.99	99.99	99.99	99.99	99.99	0.29	0.38

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	0.11	0.28	-0.48	-0.04	0.08	0.03	-0.22	-0.35	-0.14	99.99
6	0.45	0.44	-0.23	0.29	-0.26	-0.24	-0.24	-0.58	-0.08	99.99
7	-0.1	0.95	0.32	0.19	-0.44	-0.31	-0.32	-0.46	-0.05	99.99
8	-0.15	0.51	0.94	0.2	-0.82	-0.42	-0.27	-0.06	0.06	99.99
9	-0.25	0.54	0.48	0.44	-1.01	-0.37	0.16	-0.08	-0.14	99.99
10	-0.08	0.87	0.46	0.09	-0.92	-0.68	-0.09	0.03	0.13	99.99
11	-0.17	0.83	0.75	-0.5	-0.87	-0.56	-0.41	0.36	0.17	99.99
12	-0.07	1.37	0.77	0.65	-0.96	-0.94	-0.11	0.54	-0.18	99.99
13	-0.24	0.46	2.14	0.05	-1.3	-0.24	-0.07	0.6	-0.46	99.99
14	0.59	0.97	0.37	1.83	-0.77	0.77	0.26	-0.37	-0.84	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	5	6	7	8	9	10	11	12	13	14
Mean Log q	-5.0277	-4.7259	-4.7827	-4.943	-4.9878	-5.2213	-5.2213	-5.2213	-5.2213	-5.2213
S.E(Log q)	0.2948	0.3421	0.41	0.4627	0.4542	0.5018	0.5545	0.7106	0.8662	0.8419

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
5	0.84	1.689	5.97	0.92	11	0.23	-5.03
6	0.71	2.743	6.44	0.91	11	0.19	-4.73
7	0.79	0.914	5.91	0.69	11	0.33	-4.78
8	0.91	0.297	5.36	0.57	11	0.44	-4.94
9	0.94	0.29	5.26	0.7	11	0.45	-4.99
10	0.89	0.639	5.6	0.79	11	0.46	-5.22
11	0.91	0.541	5.5	0.81	11	0.52	-5.26
12	1.02	-0.08	5.08	0.74	11	0.75	-5.12
13	0.97	0.133	5.12	0.71	11	0.87	-5.08
14	1.16	-0.886	4.77	0.77	11	0.91	-4.91

Terminal year survivor and F summaries :

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU Spain	16856 0.518	0	0	1	0.403	0.006
Can Spring	10922 0.47	0	0	1	0.489	0.009
Canada fall	1 0	0	0	0	0	0
F shrinkage mea	88016 1				0.109	0.001

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
16315	0.33	0.46	3	1.411	0.006

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU Spain	14710 0.396	0.18	0.45	2	0.201	0.02
Can Spring	8625 0.269	0.141	0.52	2	0.435	0.034
Canada fall	8714 0.308	0	0	1	0.332	0.034
F shrinkage mea	30197 1				0.032	0.01

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10034	0.18	0.14	6	0.804	0.029

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU Spain	14451 0.288	0.123	0.43	3	0.215	0.069
Can Spring	12175 0.2	0.084	0.42	3	0.442	0.081
Canada fall	9349 0.233	0.134	0.57	2	0.323	0.104
F shrinkage mea	33944 1				0.019	0.03

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11832	0.13	0.09	9	0.689	0.083

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
EU Spain		13479	0.265	0.218	0.82	4	0.189	0.09
Can Spring		11010	0.167	0.068	0.41	4	0.483	0.11
Canada fall		7613	0.205	0.144	0.71	3	0.312	0.155
F shrinkage mea		19227	1				0.016	0.064

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10283	0.12	0.09	12	0.814	0.117

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
EU Spain		6373	0.253	0.248	0.98	5	0.173	0.203
Can Spring		8221	0.15	0.092	0.62	5	0.503	0.161
Canada fall		6395	0.189	0.114	0.61	4	0.308	0.202
F shrinkage mea		12369	1				0.015	0.11

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7324	0.11	0.08	15	0.764	0.179

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
EU Spain		6537	0.249	0.239	0.96	6	0.16	0.199
Can Spring		7210	0.142	0.133	0.94	6	0.505	0.182
Canada fall		5973	0.175	0.076	0.44	5	0.32	0.216
F shrinkage mea		8672	1				0.015	0.154

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6700	0.1	0.08	18	0.786	0.195

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1990

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU Spain	6391	0.245	0.194	0.79	7	0.153	0.181
Can Spring	4941	0.138	0.187	1.36	7	0.5	0.229
Canada fall	4288	0.166	0.064	0.39	6	0.331	0.259
F shrinkage mea	5896	1				0.016	0.195

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4918	0.1	0.09	21	0.931	0.23

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1989

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU Spain	3317	0.274	0.197	0.72	7	0.12	0.166
Can Spring	2465	0.133	0.185	1.39	8	0.536	0.218
Canada fall	2177	0.161	0.134	0.83	7	0.327	0.244
F shrinkage mea	2906	1				0.018	0.188

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2460	0.1	0.1	23	1.01	0.218

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1988

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU Spain	974	0.299	0.321	1.07	7	0.108	0.195
Can Spring	1055	0.132	0.119	0.9	9	0.542	0.181
Canada fall	937	0.159	0.136	0.85	8	0.331	0.202
F shrinkage mea	1037	1				0.02	0.184

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1006	0.1	0.09	25	0.882	0.189

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1987

Fleet	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
EU Spain	560	0.4	0.413	1.03	7	0.062	0.13
Can Spring	677	0.126	0.112	0.89	10	0.629	0.109
Canada fall	575	0.16	0.182	1.13	9	0.292	0.127
F shrinkage mea	326	1				0.017	0.213

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
630	0.1	0.09	27	0.962	0.116