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A Comparison of Divisions 3NO Cod ADAPT Results Using Different Tuning Indices

Joanne Morgan

Dept. of Fisheries and Oceans, PO Box 5667
St. John's, NL A1C 5X1, Canada

Abstract

The effect of including different indices on the SPA for Div. 3NO cod is examined. The base for comparison is the SPA from the 2005 assessment of this stock. This formulation includes 3 tuning indices; Canadian spring, fall and juvenile research vessel series. The effect of removing the short juvenile series was examined. The mean square error was slightly larger for the run excluding the juvenile survey. There was and increase in error on the parameter estimates when the survey was excluded. The exclusion of the Canadian juvenile survey results in a model fit that is slightly worse than when the index is included. The mean square error was larger for the run including the survey by EU-Spain (0.845) compared to the run including only the Canadian spring, autumn and juvenile indices (0.706). There was an increase in the relative error for estimates of catchability when the indices from the survey from EU-Spain were included. The inclusion of the EU-Spain survey results in a model fit that is worse than when the index is excluded.

Key words: Div. 3NO cod; SPA; survey indices

Introduction

Cod in Div. 3NO is assessed using a SPA conducted with the ADAPTive framework. The tuning indices include a survey conducted to determine the distribution and abundance of juvenile flatfish. This survey was conducted from 1989 to 1994. It therefore includes little or no information relevant to recent year-classes. In addition there is a clear pattern in the residuals for this survey (Power *et al.*, MS 2005). In 2005 STACFIS noted the poor model fit in the SPA to the Canadian juvenile survey series and considered that an improvement may be realized by excluding the index from the ADAPT, accordingly, STACFIS **recommended** that *a sensitivity analysis be conducted to investigate the impact of excluding the Canadian juvenile survey index from the SPA.*

In addition to the survey indices currently used to tune the SPA, there is available a survey conducted by EU-Spain in the regulatory area of Div. 3NO. STACFIS noted the availability of the converted Spanish spring survey data from the NRA area of Div. 3NO and **recommended** that *the utility of the converted mean per tow at length data from the spring survey series conducted by EU-Spain in the NRA of 3NO since 1997 be explored as an additional index in the SPA calibration.*

This paper examines the effect of excluding the Canadian juvenile survey index from the SPA and of including the index from the survey by EU-Spain.

Methods

The effect of removing the Canadian juvenile survey index from the SPA was simply addressed by running the SPA with the same formulation as last year, but without this index. The results, in particular measurements of error, were compared to last years run.

To examine the impact of including the surveys conducted by EU-Spain, catch-at-age in this survey was first constructed. The mean numbers per to at length from the survey by EU-Spain were applied to annual age length keys from the Canadian spring survey of Div. 3NO. These mean numbers per tow at age were then included as an additional index in the SPA with the same formulation as last year.

Results and Discussion

Juvenile Survey

The mean square error was slightly larger for the run excluding the juvenile survey (Table 1). This is because although there is a clear pattern in the residuals from fit to the juvenile survey, the size of those residuals is small compared to the spring and fall survey (Fig. 1 and Fig. 2). The pattern and size of the residuals for the spring and fall survey are unaffected by the presence of the juvenile survey (Fig. 3). The sum of the square of the residuals for the residuals only from those two surveys is 221.9 when the juvenile survey is included and 221.3 when the juvenile survey is not included.

Although there was little difference in the mean square error or residual pattern for runs with and without the juvenile survey there was and increase in error on the parameter estimates when the survey was excluded (Table 1). This was true for every estimate, both population numbers and catchabilities. The relative error on the population number estimates is on average 13% higher and on the catchabilities 7% higher.

Estimates of total 2+ population numbers were very similar for both runs as were estimates of recruitment at age 2 (Fig. 4).

The exclusion of the Canadian juvenile survey results in a model fit that is slightly worse than when the index is included.

EU-Spain Survey

The numbers at age produced from the survey by EU-Spain are given in Table 2 and Fig. 5. The survey index as a whole was much higher in 2001 and this is reflected in much greater numbers at age in that year.

The mean square error was larger for the run including the survey by EU-Spain (0.845) compared to the run including only the Canadian spring, autumn and juvenile indices (0.706) (Table 3). There is no clear pattern in the residuals from the survey from EU-Spain but the magnitude of these residuals was generally higher than from the other surveys (Fig. 6).

There was an increase in the relative error for all estimates of catchability when the indices from the survey from EU-Spain were included (Table 3). The relative error on the estimates of catchability was on average 9% higher.

The inclusion of the survey from EU-Spain does not result in a different perception of the overall trend in population size (Fig. 7). There are however some differences in the most recent years. Total population numbers and recruitment are both higher for the run including the survey by EU-Spain in the last two years. Much of the difference in 2+ population size in 2004 and 2005 comes from the higher estimate for age 2 in 2004 and age 3 in 2005 for the run including the survey by EU-Spain.

The inclusion of the EU-Spain survey results in a model fit that is worse than when the index is excluded.

References

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Table 1 Results of ADAPT runs including and excluding the juvenile survey as a tuning index. Parameter estimates and relative error and relative bias are shown.

With Juvenile survey
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION
ORTHOGONALITY OFFSET..... 0.001103
MEAN SQUARE RESIDUALS..... 0.706305

Parameter	Est.	Rel. Err.	Rel. Bias
N[1994 12]	8.92E+01	0.806	0.179
N[1995 12]	5.36E+01	0.502	0.102
N[1996 12]	3.21E+01	0.378	0.067
N[1997 12]	6.83E+01	0.344	0.058
N[1998 12]	9.55E+01	0.36	0.063
N[1999 12]	4.76E+01	0.377	0.066
N[2000 12]	5.23E+01	0.328	0.052
N[2001 12]	4.62E+02	0.302	0.045
N[2002 12]	2.20E+02	0.296	0.044
N[2003 12]	3.13E+01	0.297	0.043
N[2004 12]	3.89E+01	0.315	0.046
N[2005 3]	7.01E+02	0.617	0.201
N[2005 4]	2.65E+02	0.478	0.117
N[2005 5]	1.48E+02	0.525	0.128
N[2005 6]	1.86E+02	0.533	0.134
N[2005 7]	4.13E+02	0.509	0.12
N[2005 8]	5.33E+02	0.439	0.087
N[2005 9]	1.71E+02	0.42	0.079
N[2005 10]	2.57E+01	0.349	0.06
N[2005 11]	8.98E+01	0.335	0.051
N[2005 12]	6.61E+01	0.324	0.048
spring 2	1.13E-03	0.19	0.008
spring 3	1.41E-03	0.189	0.008
spring 4	6.81E-04	0.19	0.009
spring 5	4.38E-04	0.193	0.01
spring 6	3.07E-04	0.196	0.012
spring 7	3.20E-04	0.2	0.013
spring 8	3.38E-04	0.205	0.015
spring 9	3.94E-04	0.208	0.018
spring 10	4.86E-04	0.213	0.022
fall 2	1.10E-03	0.229	0.013
fall 3	1.12E-03	0.227	0.014
fall 4	8.95E-04	0.232	0.016
fall 5	7.69E-04	0.237	0.018
fall 6	6.65E-04	0.242	0.021
fall 7	4.22E-04	0.249	0.024
fall 8	3.87E-04	0.255	0.027
fall 9	3.23E-04	0.267	0.032
fall 10	4.34E-04	0.283	0.044
juvenile 2	3.61E-03	0.346	0.053
juvenile 3	1.89E-03	0.345	0.053
juvenile 4	1.37E-03	0.347	0.054
juvenile 5	1.13E-03	0.348	0.053
juvenile 6	8.30E-04	0.351	0.051
juvenile 7	6.16E-04	0.357	0.052
juvenile 8	4.91E-04	0.362	0.055
juvenile 9	3.17E-04	0.369	0.062
juvenile 10	2.82E-04	0.381	0.076

Without Juvenile survey
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION
ORTHOGONALITY OFFSET..... 0.000844
MEAN SQUARE RESIDUALS..... 0.784918

Parameter	Est.	Rel. Err.	Rel. Bias
N[1994 12]	9.86E+01	0.967	0.266
N[1995 12]	4.49E+01	0.652	0.171
N[1996 12]	2.95E+01	0.478	0.105
N[1997 12]	5.49E+01	0.422	0.086
N[1998 12]	8.15E+01	0.431	0.089
N[1999 12]	4.55E+01	0.427	0.084
N[2000 12]	4.37E+01	0.375	0.067
N[2001 12]	4.00E+02	0.344	0.058
N[2002 12]	1.99E+02	0.329	0.055
N[2003 12]	2.78E+01	0.329	0.054
N[2004 12]	3.35E+01	0.356	0.059
N[2005 3]	6.84E+02	0.651	0.224
N[2005 4]	2.58E+02	0.505	0.131
N[2005 5]	1.42E+02	0.557	0.146
N[2005 6]	1.77E+02	0.567	0.153
N[2005 7]	3.87E+02	0.544	0.139
N[2005 8]	4.96E+02	0.472	0.103
N[2005 9]	1.58E+02	0.454	0.095
N[2005 10]	2.37E+01	0.377	0.072
N[2005 11]	8.20E+01	0.366	0.062
N[2005 12]	6.04E+01	0.355	0.058
spring 2	1.15E-03	0.201	0.008
spring 3	1.44E-03	0.199	0.009
spring 4	7.00E-04	0.201	0.009
spring 5	4.54E-04	0.204	0.01
spring 6	3.21E-04	0.208	0.011
spring 7	3.37E-04	0.213	0.013
spring 8	3.59E-04	0.219	0.016
spring 9	4.20E-04	0.225	0.019
spring 10	5.20E-04	0.232	0.026
fall 2	1.13E-03	0.241	0.014
fall 3	1.16E-03	0.24	0.015
fall 4	9.34E-04	0.245	0.017
fall 5	8.13E-04	0.251	0.019
fall 6	7.11E-04	0.258	0.021
fall 7	4.58E-04	0.267	0.025
fall 8	4.24E-04	0.276	0.029
fall 9	3.56E-04	0.292	0.037
fall 10	4.76E-04	0.312	0.055

Table 2. Numbers at age for Div. 3NO cod derived from survey by EU-Spain. The highlighting simply shows the largest number in each year.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1997	0.000	0.000	0.004	0.610	0.320	0.219	0.204	0.444	0.153	0.003	0.000	0.007	0.000	0.000	0.002
1998	0.000	0.043	0.016	0.137	3.652	3.774	0.889	0.689	1.462	1.392	0.169	0.149	0.000	0.000	0.000
1999	0.000	1.296	3.946	2.378	0.263	0.501	0.196	0.075	0.030	0.066	0.077	0.005	0.001	0.002	0.001
2000	0.000	0.255	1.378	4.367	1.584	0.329	0.495	0.255	0.127	0.049	0.206	0.157	0.012	0.000	0.000
2001	0.000	0.000	0.619	9.513	21.533	8.634	0.438	0.415	0.021	0.003	0.001	0.011	0.029	0.007	0.000
2002	0.000	0.094	0.224	2.529	5.569	3.476	0.935	0.003	0.013	0.055	0.000	0.000	0.000	0.011	0.000
2003	0.000	0.149	0.536	0.499	0.498	1.421	1.289	0.217	0.010	0.010	0.012	0.000	0.000	0.012	0.010
2004	0.000	4.560	0.986	1.326	0.889	0.302	0.421	0.337	0.110	0.014	0.034	0.027	0.005	0.000	0.000

Table 3 Results of ADAPT runs excluding and including the EU-Spain survey as a tuning index. Parameter estimates and relative error and relative bias are shown.

Without EU Spain (as 2005 assessment)
APPROXIMATE STATISTICS ASSUMING LINEARITY
NEAR SOLUTION
ORTHOGONALITY OFFSET..... 0.001103
MEAN SQUARE RESIDUALS 0.706305

Parameter	Est.	Rel. Err.	Rel. Bias
N[1994 12]	8.92E+01	0.806	0.179
N[1995 12]	5.36E+01	0.502	0.102
N[1996 12]	3.21E+01	0.378	0.067
N[1997 12]	6.83E+01	0.344	0.058
N[1998 12]	9.55E+01	0.36	0.063
N[1999 12]	4.76E+01	0.377	0.066
N[2000 12]	5.23E+01	0.328	0.052
N[2001 12]	4.62E+02	0.302	0.045
N[2002 12]	2.20E+02	0.296	0.044
N[2003 12]	3.13E+01	0.297	0.043
N[2004 12]	3.89E+01	0.315	0.046
N[2005 3]	7.01E+02	0.617	0.201
N[2005 4]	2.65E+02	0.478	0.117
N[2005 5]	1.48E+02	0.525	0.128
N[2005 6]	1.86E+02	0.533	0.134
N[2005 7]	4.13E+02	0.509	0.12
N[2005 8]	5.33E+02	0.439	0.087
N[2005 9]	1.71E+02	0.42	0.079
N[2005 10]	2.57E+01	0.349	0.06
N[2005 11]	8.98E+01	0.335	0.051
N[2005 12]	6.61E+01	0.324	0.048
spring 2	1.13E-03	0.19	0.008
spring 3	1.41E-03	0.189	0.008
spring 4	6.81E-04	0.19	0.009
spring 5	4.38E-04	0.193	0.01
spring 6	3.07E-04	0.196	0.012
spring 7	3.20E-04	0.2	0.013
spring 8	3.38E-04	0.205	0.015
spring 9	3.94E-04	0.208	0.018
spring 10	4.86E-04	0.213	0.022
fall 2	1.10E-03	0.229	0.013
fall 3	1.12E-03	0.227	0.014
fall 4	8.95E-04	0.232	0.016
fall 5	7.69E-04	0.237	0.018
fall 6	6.65E-04	0.242	0.021
fall 7	4.22E-04	0.249	0.024
fall 8	3.87E-04	0.255	0.027
fall 9	3.23E-04	0.267	0.032
fall 10	4.34E-04	0.283	0.044
juvenile 2	3.61E-03	0.346	0.053
juvenile 3	1.89E-03	0.345	0.053
juvenile 4	1.37E-03	0.347	0.054
juvenile 5	1.13E-03	0.348	0.053
juvenile 6	8.30E-04	0.351	0.051
juvenile 7	6.16E-04	0.357	0.052
juvenile 8	4.91E-04	0.362	0.055
juvenile 9	3.17E-04	0.369	0.062
juvenile 10	2.82E-04	0.381	0.076

With EU Spain
APPROXIMATE STATISTICS ASSUMING LINEARITY
NEAR SOLUTION
ORTHOGONALITY OFFSET..... 0.000739
MEAN SQUARE RESIDUALS 0.844808

Parameter	Est.	Rel. Err.	Rel. Bias
N[1994 12]	8.63E+01	0.894	0.22
N[1995 12]	5.25E+01	0.551	0.123
N[1996 12]	3.15E+01	0.414	0.081
N[1997 12]	6.70E+01	0.376	0.071
N[1998 12]	9.38E+01	0.394	0.076
N[1999 12]	4.69E+01	0.413	0.079
N[2000 12]	5.35E+01	0.336	0.056
N[2001 12]	4.70E+02	0.306	0.047
N[2002 12]	2.61E+02	0.289	0.044
N[2003 12]	3.30E+01	0.29	0.043
N[2004 12]	3.68E+01	0.32	0.049
N[2005 3]	1.43E+03	0.558	0.168
N[2005 4]	4.85E+02	0.418	0.096
N[2005 5]	1.90E+02	0.465	0.105
N[2005 6]	1.52E+02	0.514	0.127
N[2005 7]	3.49E+02	0.491	0.115
N[2005 8]	5.56E+02	0.406	0.079
N[2005 9]	1.69E+02	0.397	0.074
N[2005 10]	2.12E+01	0.343	0.059
N[2005 11]	7.47E+01	0.336	0.053
N[2005 12]	5.92E+01	0.324	0.049
spring 2	1.07E-03	0.207	0.011
spring 3	1.38E-03	0.206	0.012
spring 4	6.82E-04	0.207	0.013
spring 5	4.45E-04	0.21	0.013
spring 6	3.11E-04	0.214	0.014
spring 7	3.23E-04	0.218	0.016
spring 8	3.43E-04	0.223	0.018
spring 9	4.00E-04	0.227	0.02
spring 10	4.90E-04	0.232	0.025
fall 2	1.02E-03	0.248	0.018
fall 3	1.08E-03	0.247	0.019
fall 4	8.95E-04	0.251	0.02
fall 5	7.91E-04	0.258	0.022
fall 6	6.79E-04	0.264	0.024
fall 7	4.28E-04	0.271	0.028
fall 8	3.96E-04	0.278	0.031
fall 9	3.31E-04	0.292	0.038
fall 10	4.39E-04	0.309	0.051
juvenile 2	3.59E-03	0.378	0.064
juvenile 3	1.86E-03	0.377	0.064
juvenile 4	1.35E-03	0.379	0.064
juvenile 5	1.12E-03	0.38	0.063
juvenile 6	8.31E-04	0.383	0.061
juvenile 7	6.20E-04	0.39	0.062
juvenile 8	4.95E-04	0.396	0.066
juvenile 9	3.20E-04	0.404	0.073
juvenile 10	2.85E-04	0.417	0.09
EU Spain 2	1.72E-04	0.341	0.042
EU Spain 3	1.25E-03	0.336	0.041
EU Spain 4	2.01E-03	0.339	0.043
EU Spain 5	2.33E-03	0.345	0.046
EU Spain 6	1.75E-03	0.352	0.051
EU Spain 7	7.49E-04	0.357	0.055
EU Spain 8	3.61E-04	0.362	0.059
EU Spain 9	2.19E-04	0.365	0.062
EU Spain 10	2.33E-04	0.418	0.085

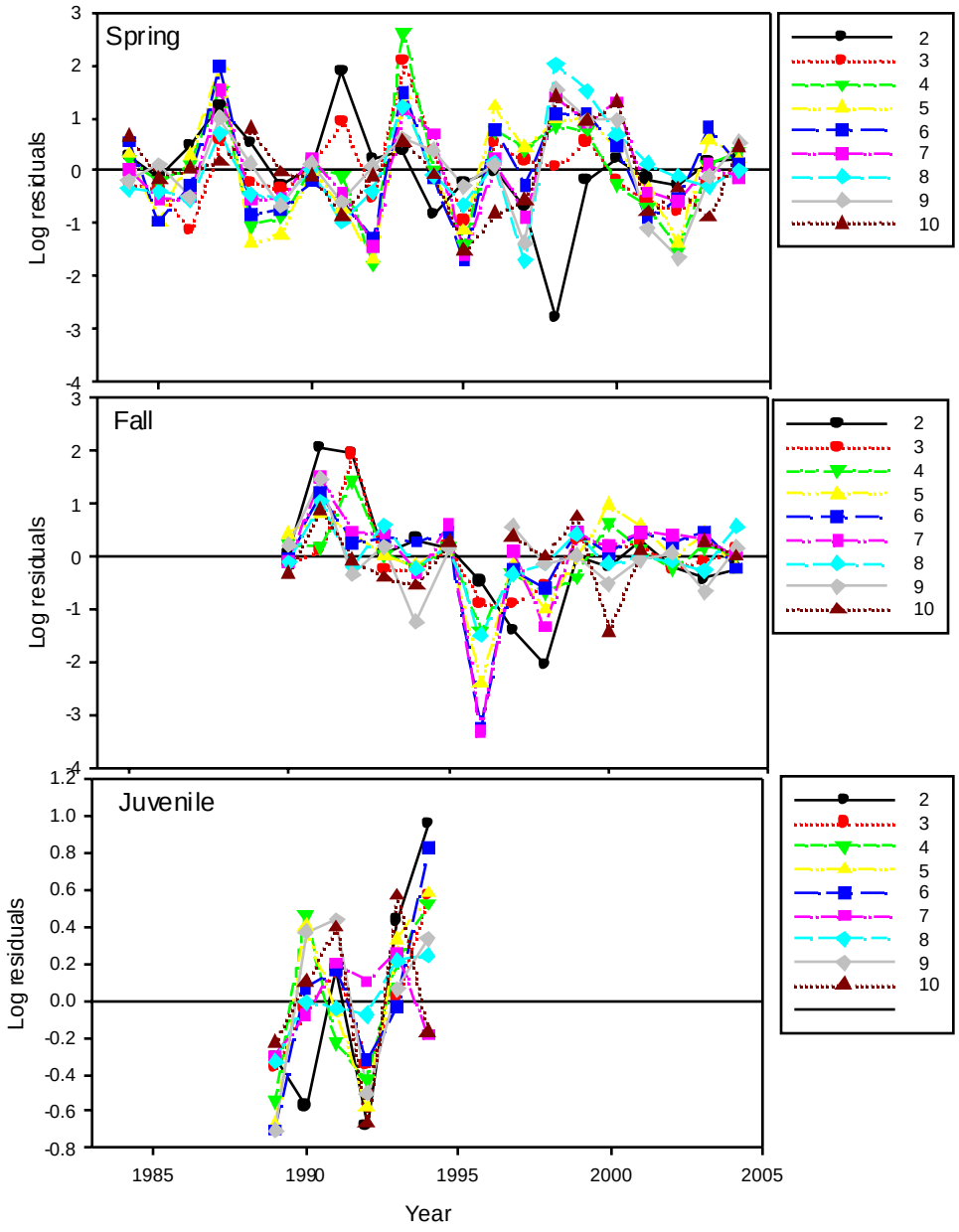

Fig. 1. Residuals from SPA fit to survey data for run including the spring, fall and juvenile surveys.

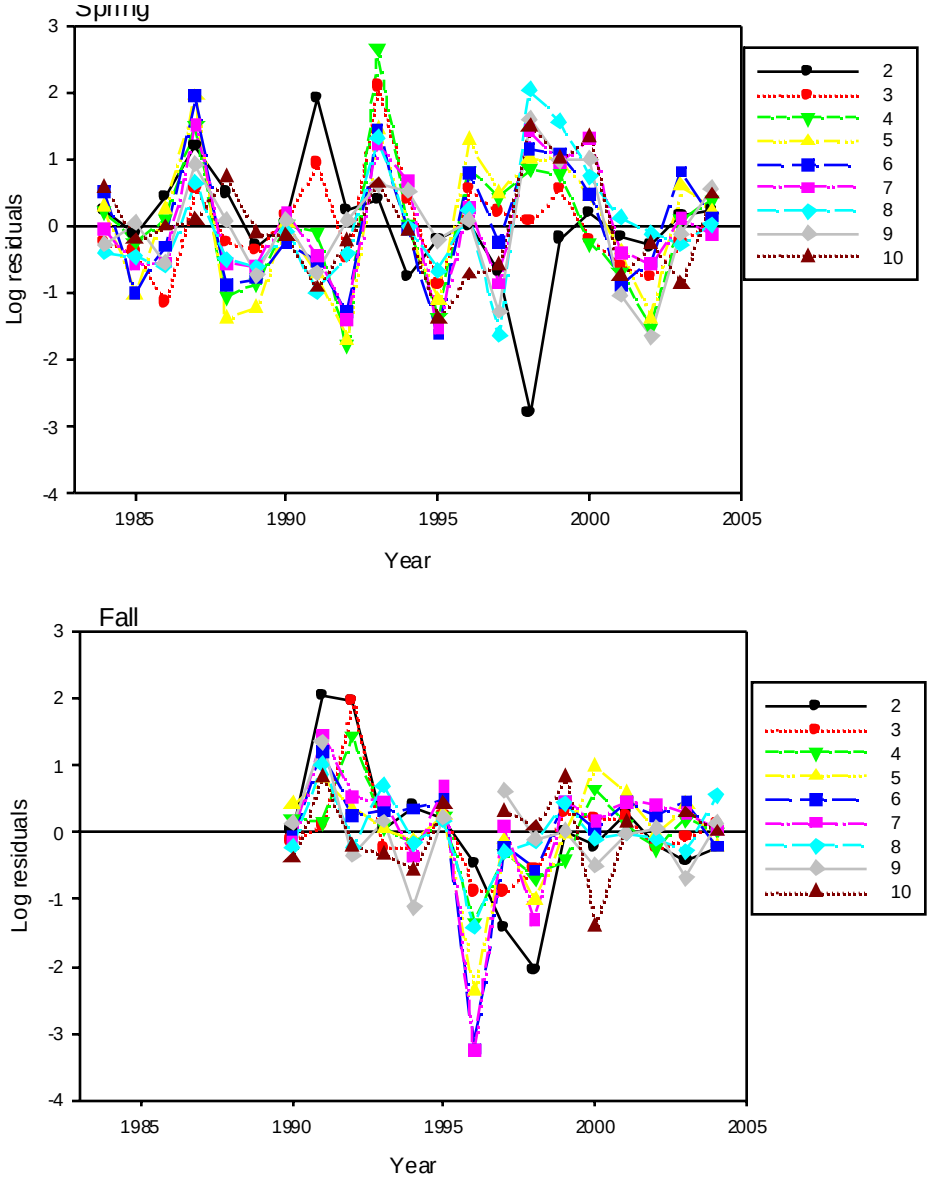

Fig. 2. Residuals from SPA fit to survey data for run including the spring and fall surveys.

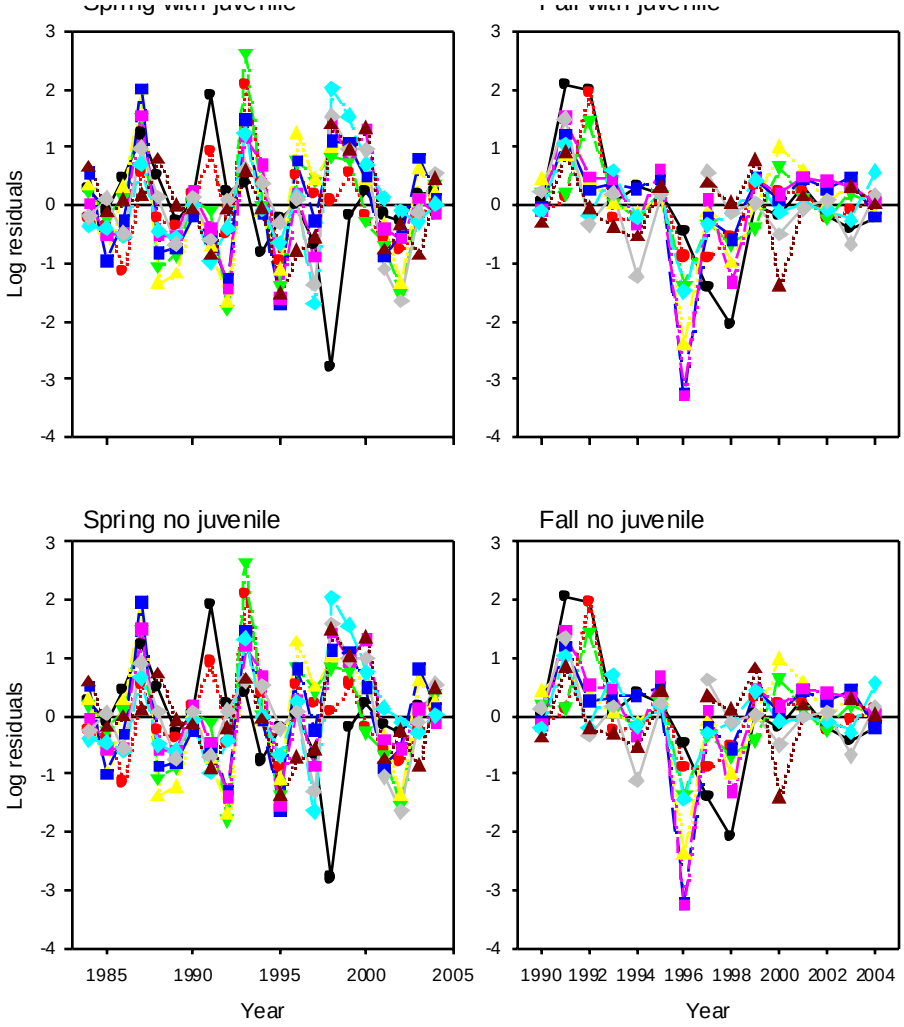

Fig. 3. Residuals from spring and fall surveys for SPA runs including (top) and excluding (bottom) the Canadian juvenile survey index. Symbols are as in figures 1 and 2.

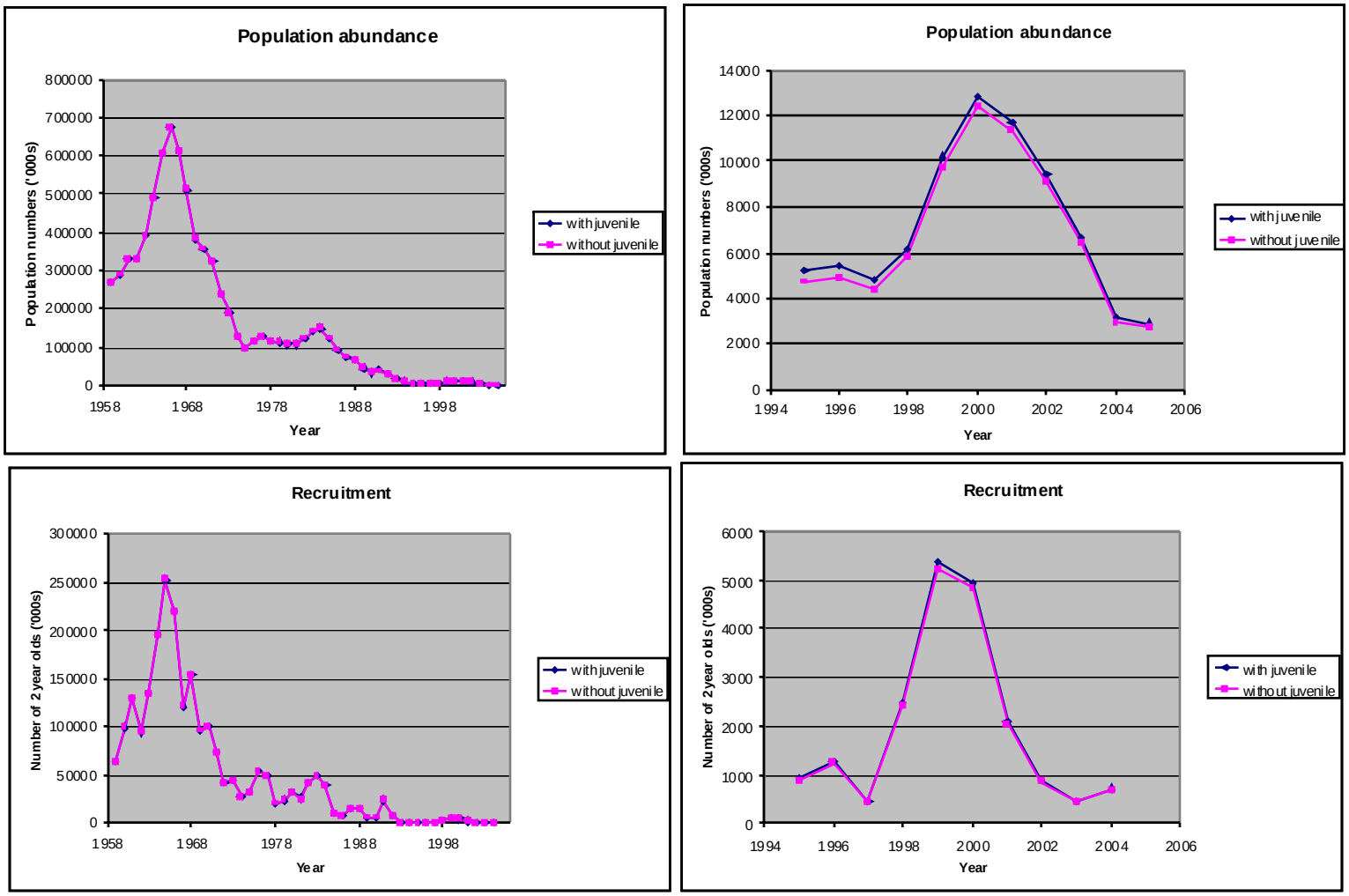

Fig. 4. Population estimates including and excluding the Canadian juvenile RV index.

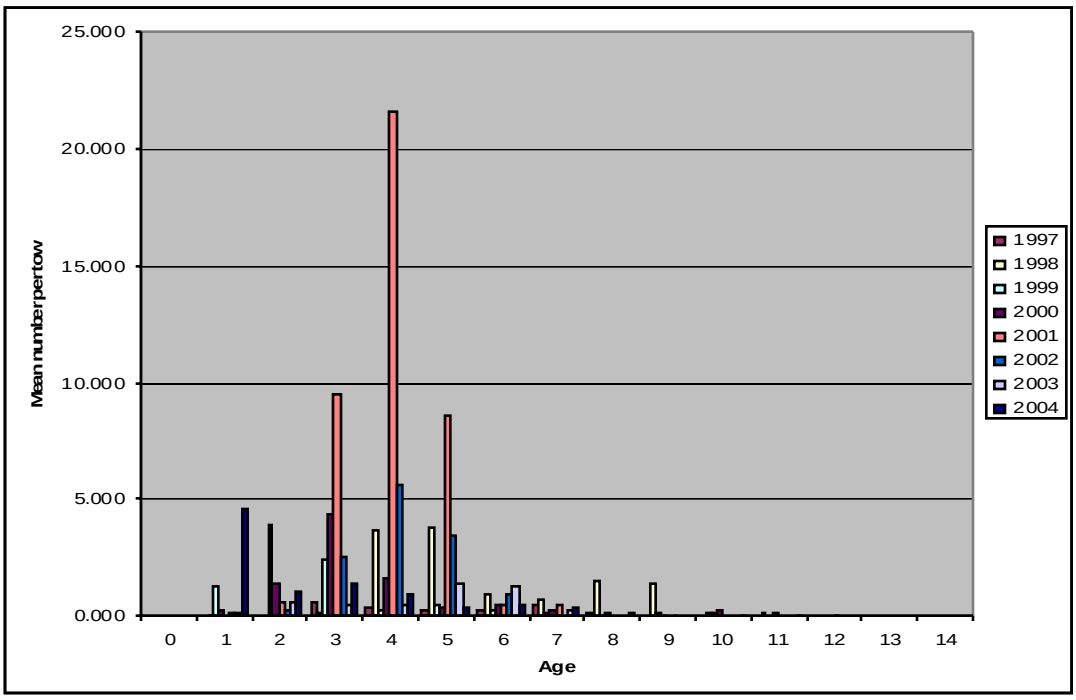

Fig. 5. Mean number per tow at age for Div. 3NO cod from the survey by EU-Spain.

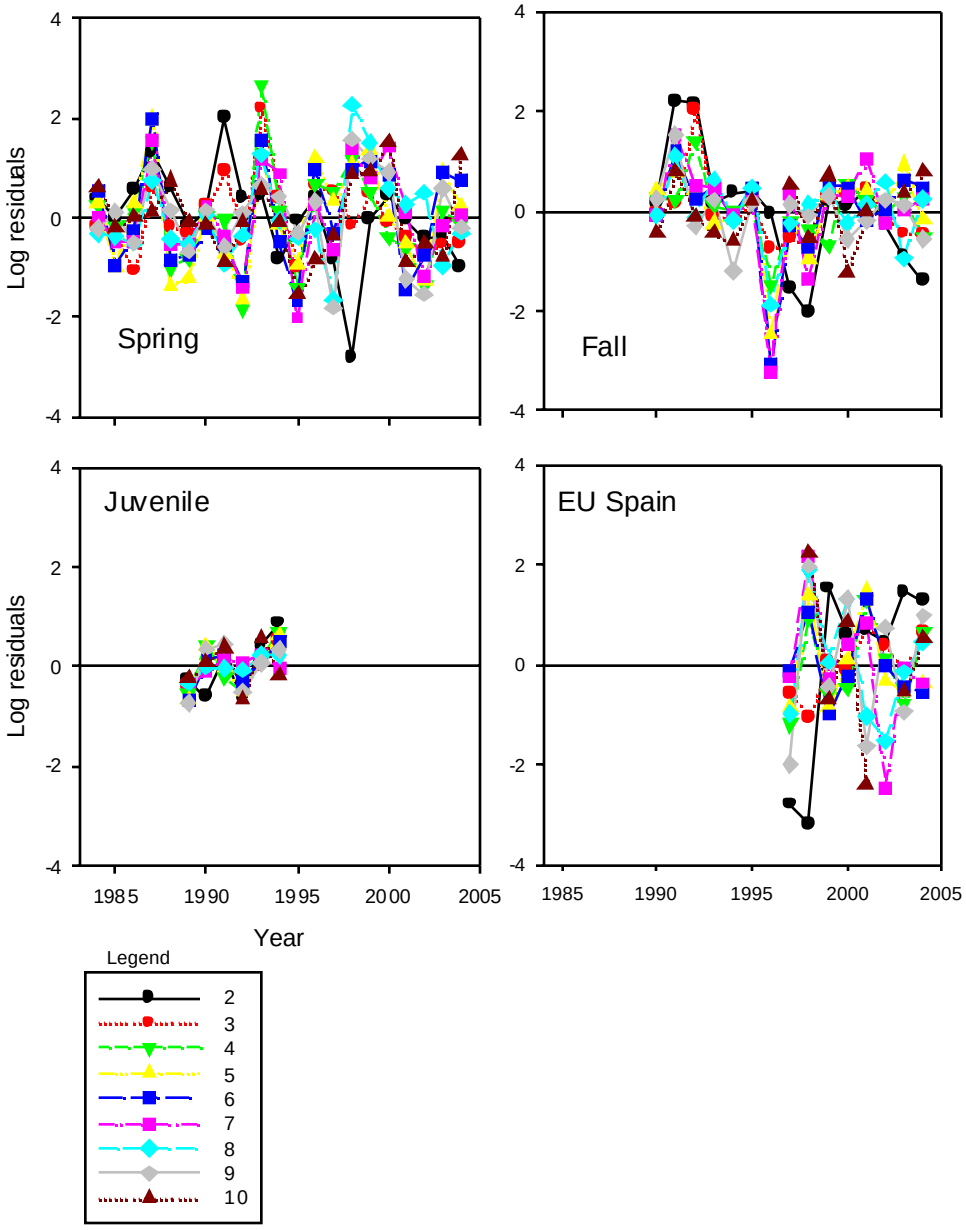

Fig. 6. Log residuals from spring, fall, juvenile and EU-Spain surveys for SPA runs including all four indices.

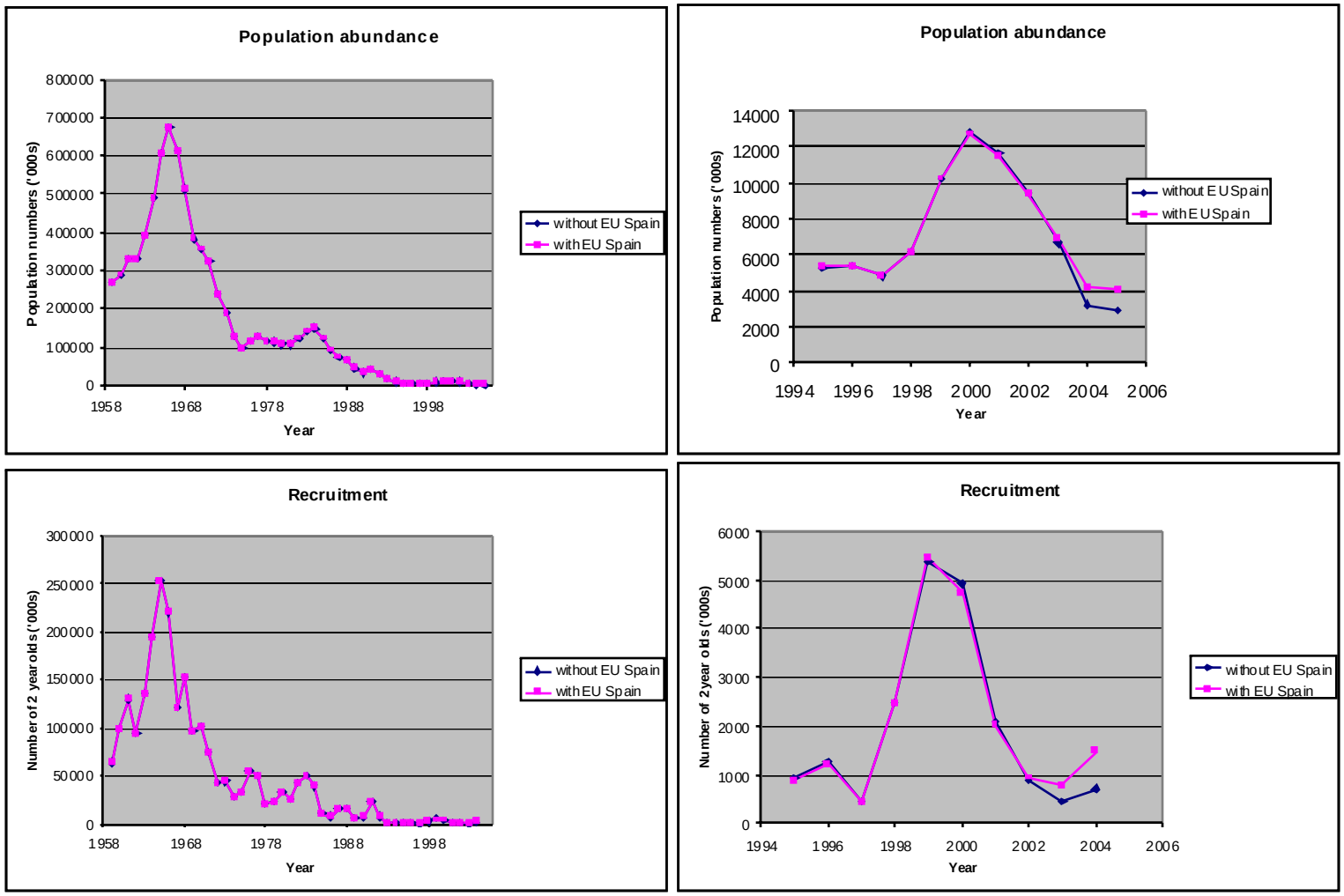

Fig. 7. Population estimates including and excluding the survey by EU-Spain.