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Quality of the Surveys Information in Relation with the Greenland Halibut Assessment of Subarea 2 and Divisions 3KLMNO

by

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Abstract

The aim of this paper is to provide a study of the quality of the surveys information in relation with the Greenland halibut assessment of the NAFO Subarea 2 and Divisions 3KLMNO.

The surveys abundance correlation within surveys, between surveys and XSA showed that the surveys had many difficulties to track ages older than 6 years. For Flemish Cap survey and Canadian Spring Survey, the problem to track these ages could be principally the depth coverage of the surveys, but for the other surveys this lack of tracking could be due to different reasons as age reading inconsistencies and changes in catchability of these ages in the surveys.

Introduction

The aim of this paper is to provide a study of the quality of the surveys information in relation with the Greenland halibut assessment of the NAFO Subarea 2 and Div. 3KLMNO. To carry out this study, the last Greenland halibut assessment approved by NAFO SC in 2005 was updated with the 2005 data (Healey and Mahé, 2006). This assessment was performed with the Extended Survivors Analysis (XSA, Shepherd, 1999; Darby and Flatman, 1994). Although the Spanish 3NO survey was not include in the assessment as tuning fleet, we have included it in this study.

Materials and Methods

The Extended Survivors Analysis stock assessment model was fitted to the 2005 updated stock data for the Greenland halibut in NAFO Subarea 2 and Div. 3KLMNO. The set up model was the same as last year approved assessment. Table 1 shows the characteristics of the surveys used in this study and Table 2 (a-d) presents the mean numbers per tow (MNPT) by survey, year and age. In both these tables we have added the information of the Spanish 3NO survey.

Results

Consistency of Different Indices

In the following sections consistency is analyzed as suggested by Beare *et al.* (2003) in EVAREST project.

- ***Within surveys consistency***

Annual abundance indices have been log transformed, because common assessment techniques refer to such transformed variables. $U_{a,y,s}$ is the (logarithmic) abundance index for age a, year y and survey s. Correlation coefficients calculated over years between the $U_{a,y,s}$ and $U_{a+1,y+1,s}$ offer a first indication of the ability of survey s to track year class strength effects. To allow for zeros, the log of ($U_{a,y,s}+0.1\bar{U}_{a,y,s}$) was used.

Figure 1 (a-d) presents the regressions and R^2 between ages for the different surveys and Fig. 2 shows the coefficient of correlation between ages for all surveys.

Flemish Cap Survey (3M): The correlation and R^2 is quite good (>0.5) for ages less than 6-7 years old. For ages older than 7 the correlation is weak and R^2 is close to 0.

Canadian Autumn Survey (CO): More or less is similar as the Flemish Cap survey; for ages less than 6-7 years old the correlation is not too bad, R^2 is about 0.50 for these ages, but for ages 6-7, 7-8, 8-9 and 11-12 the correlation is near 0. For ages more than 9 (except 11-12), is better than in the Flemish Cap survey; the value of R^2 is about 0.35.

Canadian Spring Survey (CS): The correlation and R^2 is quite good for all ages, except in ages 1-2, that is about 0.2, and for ages 7-8, where is near zero.

Spanish 3NO survey (3NO): For ages between 3 and 9 the correlation is not too bad, except for ages 7-8, that is almost a plane line, with a R^2 almost 0. For the rest of the ages, except 10-11, the R^2 is very low, less than 0.1 in all cases.

In Fig. 2, it can be appreciated that for all surveys the correlation coefficients are quite good for ages less than 6, except for Spanish 3NO survey in the youngest ages. For the ages 6-7 and 7-8 these coefficients decrease considerably for all surveys. For ages older than 8 years old the coefficient varies according to the survey. For EU Flemish Cap survey, the coefficient decreases sharply up to age 11, to then increase in the last age used for this survey. For Spanish 3NO survey the coefficient presents big variations between ages, reaching very low correlations between ages 11 and 13. The Canadian Autumn survey indices show big variations, too, reaching its minimum in the ages 8-9, but for the ages older than 11 the correlation is better than the one in the Spanish 3NO survey.

- ***Between Surveys Consistency***

In this case, we examine the correlation for a given age between abundance indices of different surveys.

$$X_{1,y} = U_{a,y,s_1} \text{ and } X_{2,y} = U_{a,y,s_2}$$

A review of the corresponding correlation coefficients makes it possible to assess the consistency between surveys for each age. Figure 3 shows the results and it can be observed that all surveys have a quite good correlation for ages less than 7 years. For ages older than 7 years the correlation is weaker than for younger ages and is more variable between surveys. The surveys that show a better correlation in some of the older ages (10-11) are Spanish 3NO survey and Canadian Autumn survey.

- ***Consistency between Survey Indices and XSA stock abundance.***

Figure 4 presents the results of the correlation coefficient between the surveys abundance indices ($U_{a,y,s}$) and the abundance of assessment approved by NAFO SC in 2005 and update with the 2005 data. For ages less than 7 the correlation is high (more than 0.6) for all surveys, but for ages 6, 7 and 8 the correlation decreases substantially, being the minimum in age 8 in all cases. For ages older than 8, the correlation is more variable between surveys and ages. Canadian Autumn survey shows the best correlation with the XSA abundance for the older ages.

Discussion

The surveys abundance correlation within surveys, between surveys and XSA showed that the surveys had many difficulties to track ages older than 6 years. For Flemish Cap survey and Canadian Spring survey the problem to track these ages could be principally due to the depth coverage of the surveys but for the other surveys this lack of tracking could be caused by different reasons as age reading inconsistencies and changes in catchability of these ages in the surveys.

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Table 1 Characteristic of the tuning Surveys.

Survey	Gear	Depth range (m)	Divisions	Month	Years	Ages (XSA)
Flemish Cap	Trawl	<750	3M	July	1995-2005	1-12
Canadian Fall	Trawl	<1500	2J3K	Sep-Dec	1996-2005	1-13
Canadian Spring	Trawl	<730	3LNO	Mar-May	1996-2005	1-8
Spanish 3NO	Trawl	<1450	3NO	May-June	1997-2005	1-13

Table 2a. Mean Numbers per Trawl (MNPT) of the Flemish Cap Survey used as tuning in the 2005 assessment of Greenland halibut Subarea 2 Div. 3KLMNO.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12
1995	1.62	0.26	0.43	1.31	2.87	1.61	2.75	0.66	0.58	0.44	0.18	0.02
1996	2.09	1.57	0.56	1.27	2.30	2.80	2.42	1.31	0.58	0.34	0.17	0.08
1997	1.77	1.55	0.97	0.86	1.27	1.92	2.02	1.57	0.97	0.26	0.13	0.05
1998	1.78	1.24	1.70	1.79	1.92	2.97	2.66	1.47	0.79	0.27	0.11	0.06
1999	12.41	2.54	2.23	1.91	2.66	5.10	3.77	2.12	1.31	0.26	0.07	0.02
2000	5.84	7.97	2.42	3.04	4.20	5.82	2.49	1.62	0.42	0.09	0.03	0.04
2001	3.33	3.78	6.00	6.50	7.11	8.46	4.99	2.15	0.66	0.22	0.03	0.02
2002	2.74	2.13	7.69	11.00	12.33	11.30	7.84	2.62	0.75	0.20	0.03	0.01
2003	1.06	0.70	3.01	10.47	13.41	12.58	5.55	1.82	0.35	0.10	0.01	0.00
2004	3.75	0.29	0.60	2.17	7.09	14.10	5.40	2.32	0.45	0.11	0.05	0.00
2005	8.03	1.43	1.81	0.99	2.79	7.79	6.63	3.21	0.18	0.05	0.01	0.00

Table2b. Mean Numbers per Trawl (MNPT) of the Canadian Autumn Survey used as tuning in the 2005 assessment of Greenland halibut Subarea 2 Div. 3KLMNO.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13
1995	49.930	51.100	15.130	6.031	6.629	1.993	0.387	0.116	0.018	0.010	0.004	0.002	0.001
1996	98.680	47.820	32.010	9.539	6.283	2.466	0.836	0.191	0.179	0.039	0.024	0.012	0.017
1997	28.050	58.620	43.610	21.130	10.370	5.007	1.998	0.641	0.203	0.055	0.032	0.022	0.009
1998	23.350	25.070	31.190	21.870	10.860	4.452	2.066	0.565	0.132	0.059	0.028	0.021	0.013
1999	15.990	34.420	24.070	28.280	20.040	10.530	3.811	0.703	0.139	0.072	0.021	0.006	0.025
2000	38.570	21.940	16.430	13.200	13.760	7.207	2.161	0.502	0.063	0.030	0.015	0.004	0.000
2001	43.900	22.720	17.000	14.070	9.765	7.591	3.403	0.692	0.112	0.023	0.014	0.004	0.011
2002	40.670	24.080	12.500	9.679	6.027	1.974	0.719	0.190	0.039	0.013	0.004	0.000	0.003
2003	45.700	26.670	11.690	9.490	6.389	2.271	0.893	0.268	0.040	0.017	0.010	0.006	0.002
2004	32.490	32.930	13.890	12.310	9.209	2.684	1.198	0.358	0.083	0.032	0.006	0.004	0.008
2005	15.490	16.120	8.400	13.400	10.300	6.559	3.847	0.662	0.116	0.034	0.027	0.009	0.007

Table 2c. Mean Numbers per Trawl (MNPT) of the Canadian Spring Survey used as tuning in the 2005 assessment of Greenland halibut Subarea 2 Div. 3KLMNO.

Year/Age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1996	1.621	4.241	4.599	2.183	0.827	0.284	0.057	0.001
1997	1.162	3.924	5.160	3.227	1.461	0.507	0.099	0.013
1998	0.220	0.814	3.847	6.186	4.955	1.238	0.326	0.072
1999	0.292	0.552	1.149	1.982	3.388	1.090	0.242	0.050
2000	0.793	1.069	1.068	1.506	1.954	2.037	0.556	0.031
2001	0.565	0.714	0.739	0.676	0.796	0.716	0.279	0.023
2002	0.642	0.572	0.603	0.581	0.608	0.208	0.049	0.006
2003	0.926	2.137	1.663	1.569	1.055	0.206	0.051	0.008
2004	0.662	0.572	1.181	1.184	1.161	0.259	0.041	0.020
2005	0.353	0.306	1.090	0.946	1.372	0.823	0.206	0.025

Table 2d. Mean Numbers per Trawl (MNPT) of the Spanish 3NO Survey.

Year/Age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1997	9.92	5.52	3.49	3.81	2.24	1.97	1.22	0.60	0.07	0.05	0.05	0.02	0.01
1998	1.71	5.24	9.08	8.47	5.06	2.77	1.10	0.66	0.21	0.08	0.03	0.03	0.02
1999	4.38	4.80	7.21	9.31	6.29	2.92	0.77	0.49	0.23	0.09	0.03	0.05	0.03
2000	2.92	0.49	0.80	1.39	3.84	4.42	2.56	0.71	0.28	0.08	0.06	0.04	0.05
2001	8.87	5.90	1.18	1.07	2.84	3.96	1.56	0.22	0.06	0.05	0.04	0.05	0.05
2002	2.91	0.64	1.02	0.69	1.14	0.92	0.44	0.23	0.02	0.01	0.02	0.02	0.01
2003	3.56	2.40	1.68	1.91	1.58	0.90	0.78	0.26	0.06	0.04	0.01	0.07	0.01
2004	1.22	6.96	2.09	2.06	1.24	0.85	0.51	0.21	0.05	0.03	0.01	0.03	0.02
2005	0.76	1.22	1.55	1.12	1.25	1.56	0.78	0.22	0.05	0.11	0.03	0.03	0.03

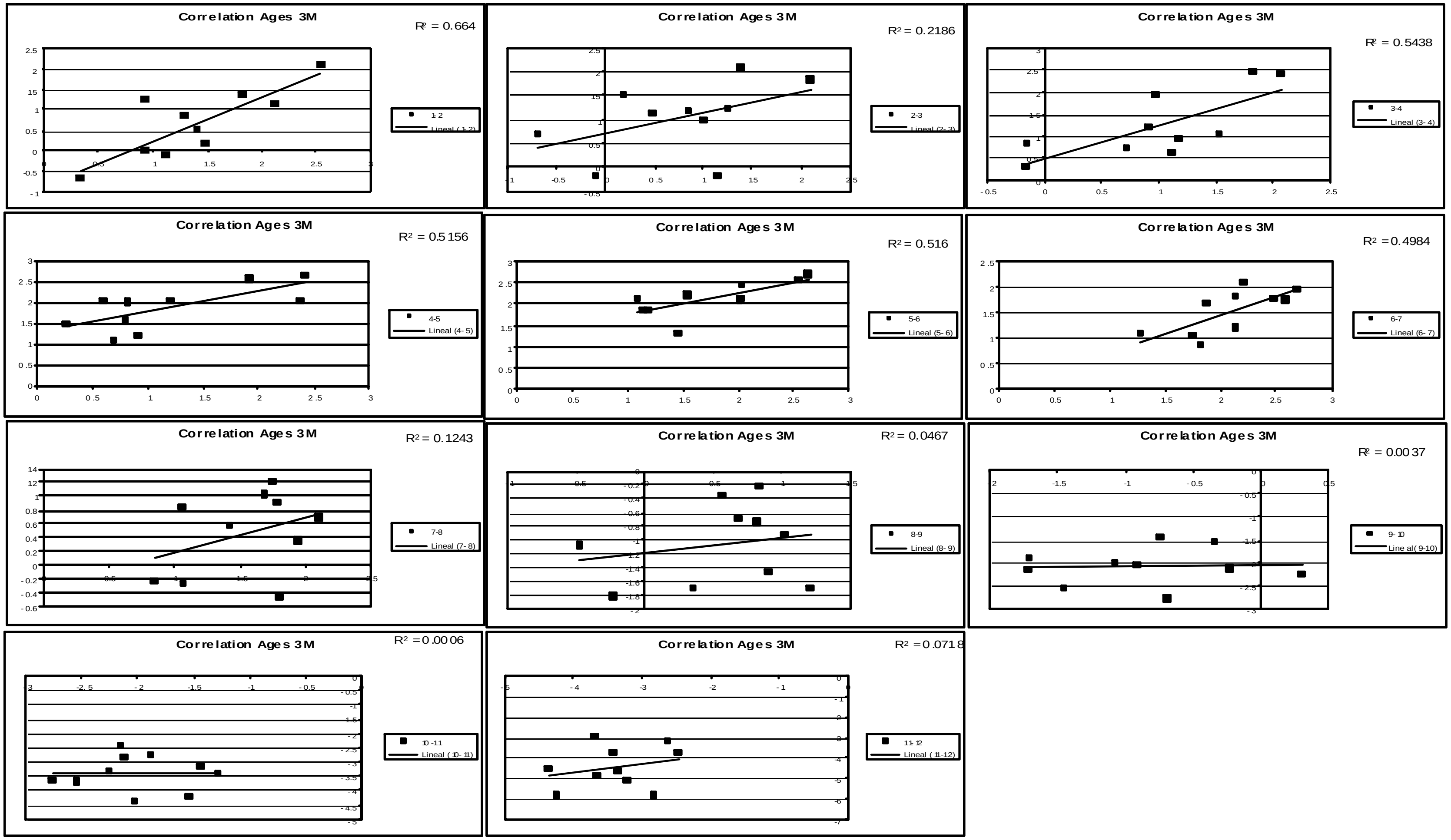


Fig. 1a. Correlation and R^2 between ages in the Flemish Cap survey.

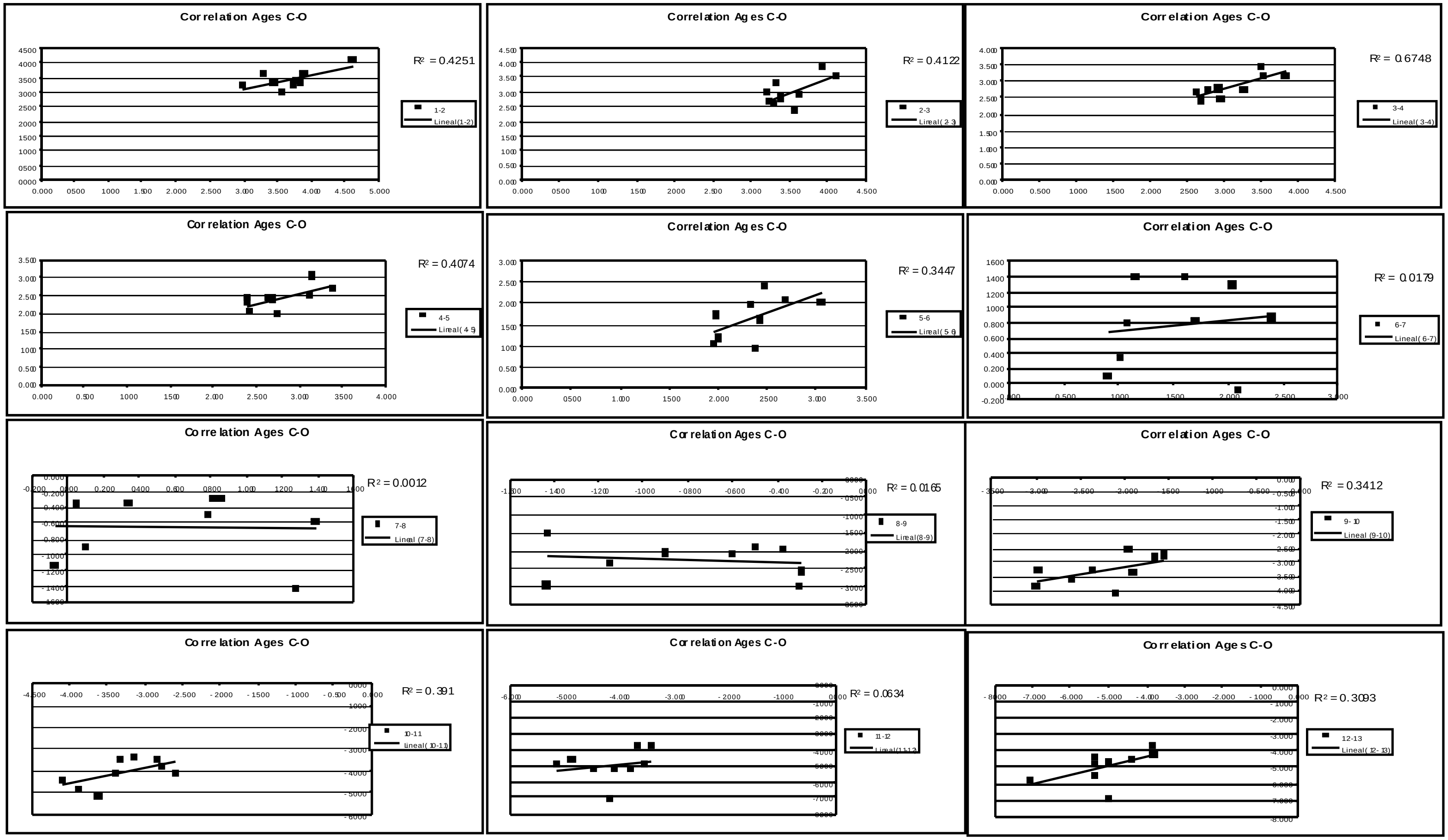


Fig. 1b. Correlation and R^2 between ages in the Canadian Autumn survey.

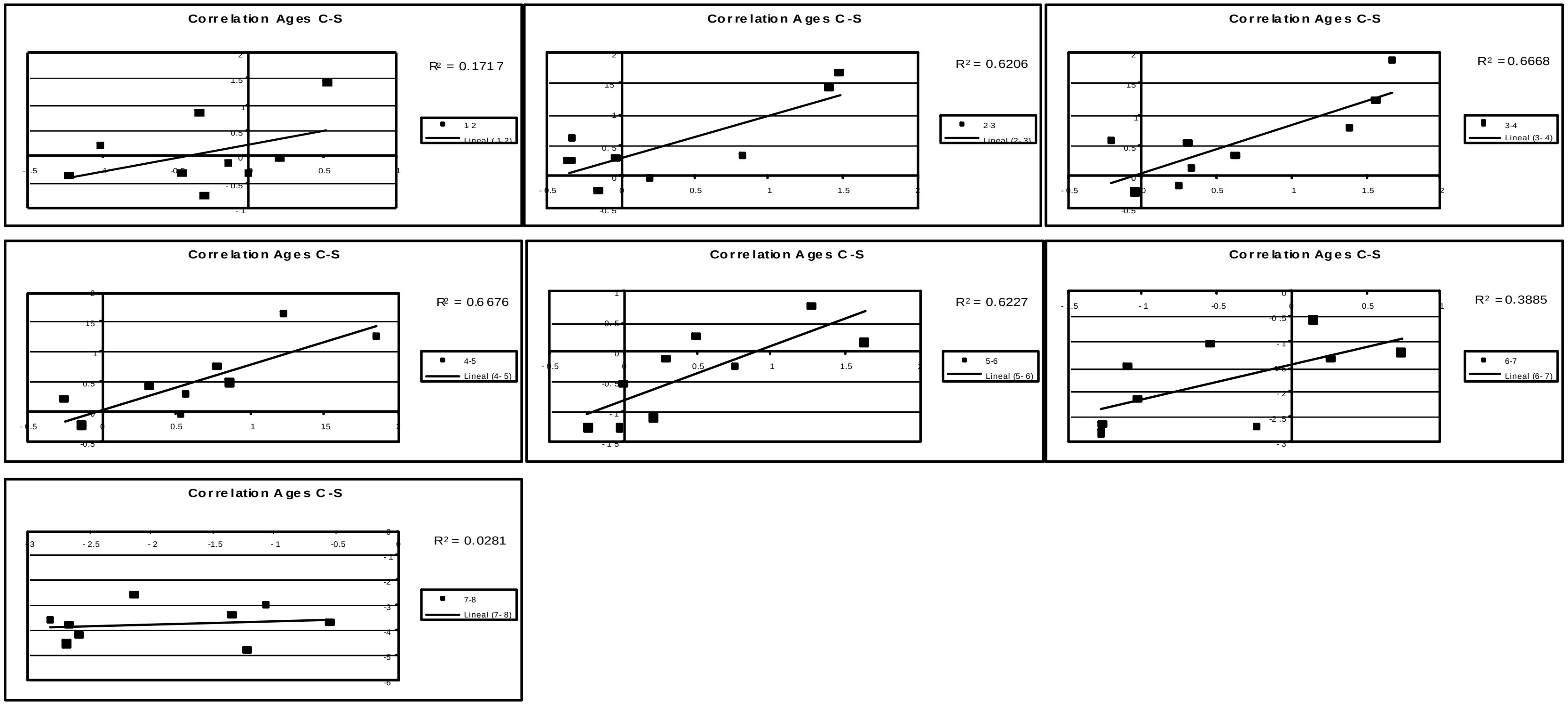


Fig. 1c. Correlation and R^2 between ages in the Canadian Spring survey.

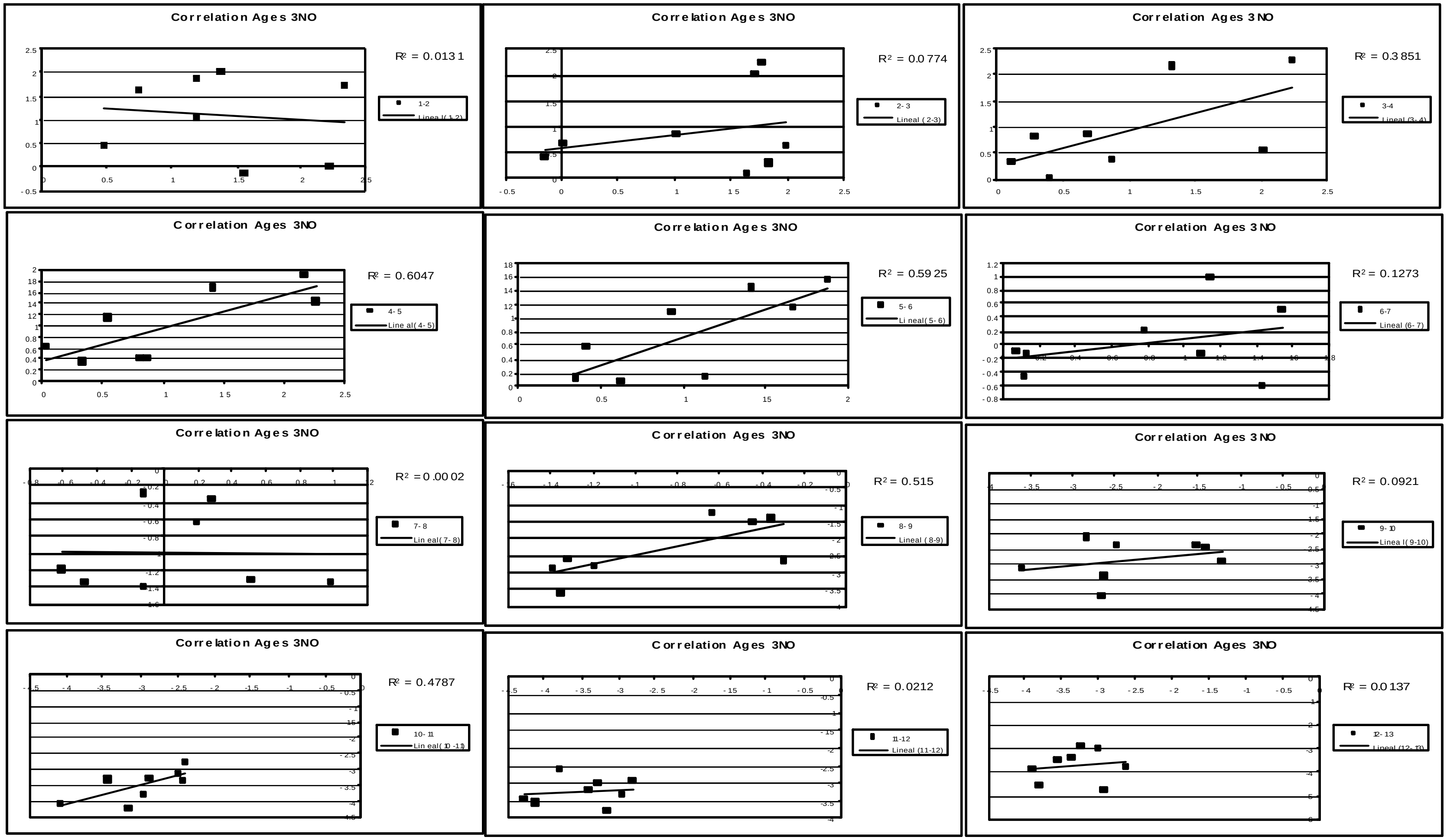


Fig. 1d. Correlation and R^2 between ages in the Spanish 3NO survey.

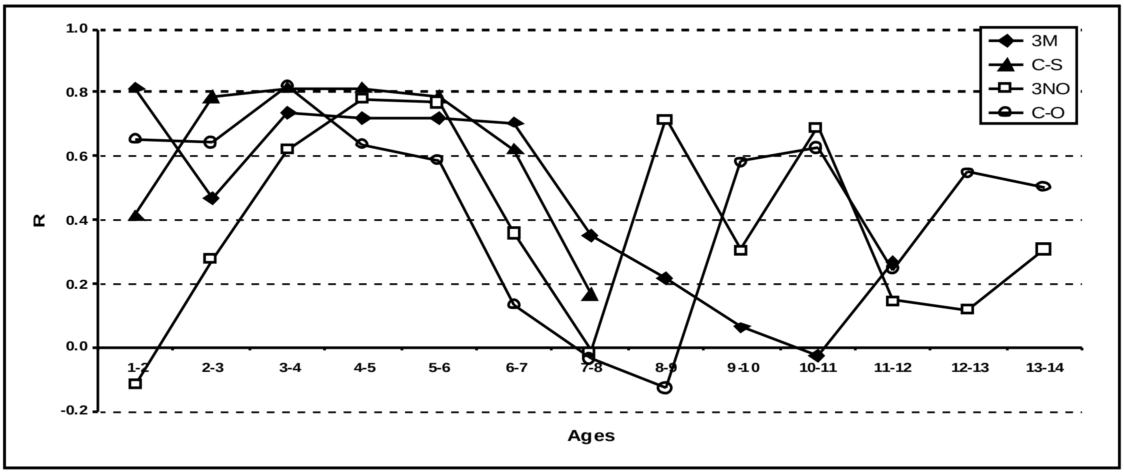
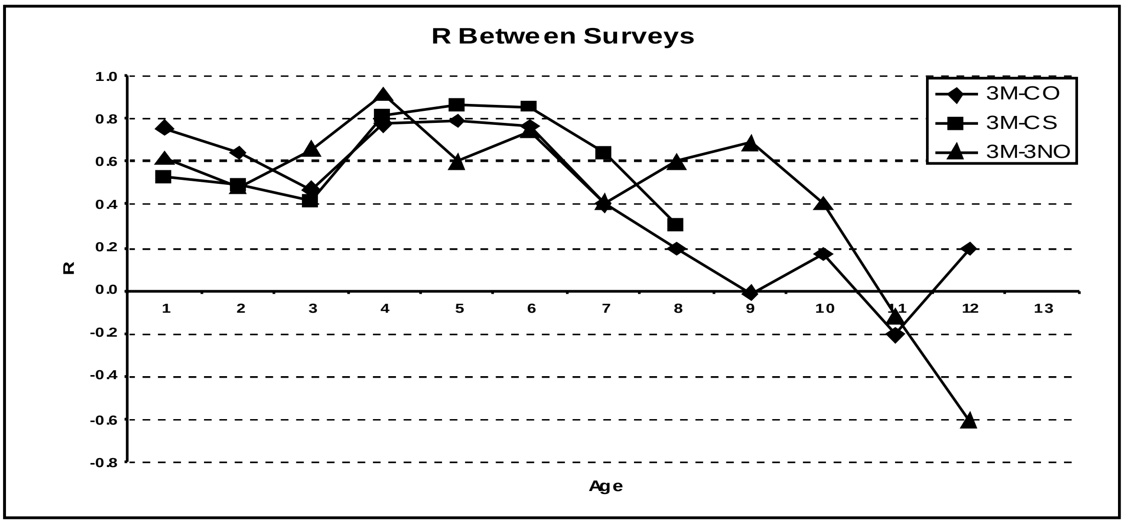


Fig. 2. Correlation coefficient between ages abundance of each survey.



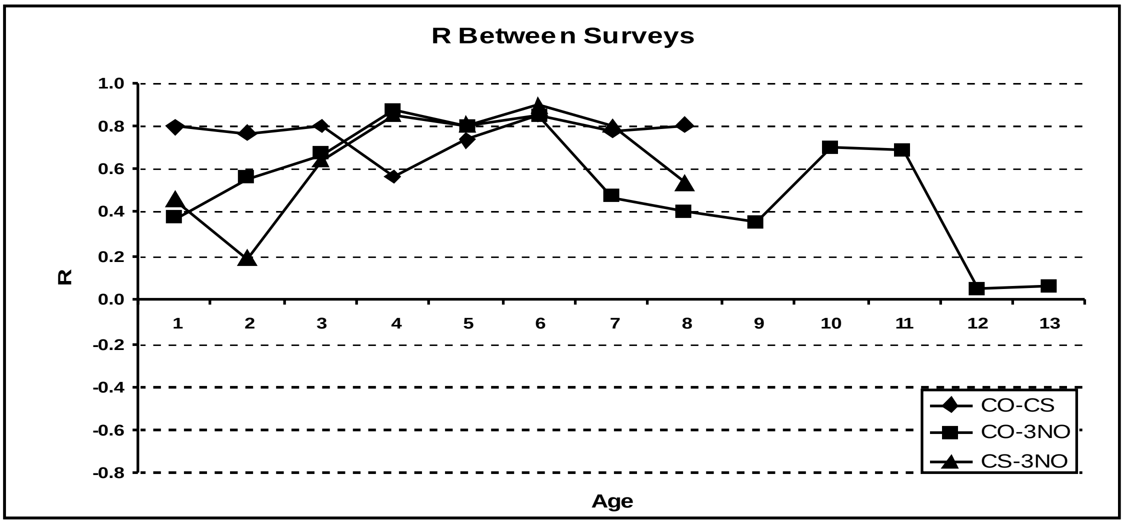


Fig. 3. Correlation coefficient between the abundances of same ages of the different surveys.

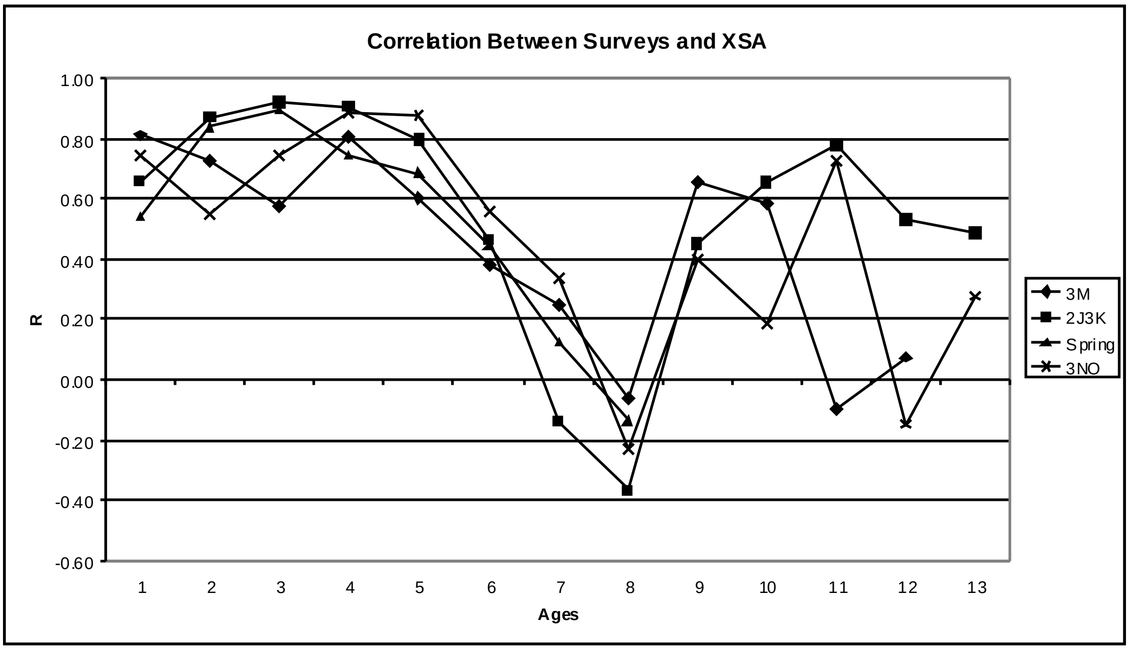


Fig. 4. Correlation coefficient between age abundances in the surveys and the final XSA abundance results.