Northwest Atlantic Fisheries Organization

Serial No. N6330 **NAFO SC SCR 14/034**

SCIENTIFIC COUNCIL MEETING – JUNE 2014

VPA for American plaice in Div. 3LNO

by

K.S. Dwyer, M.J. Morgan, W.B. Brodie, R. Rideout, D. Maddock Parsons, B.P. Healey and D. Ings

Science Oceans and Environment Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, NF, Canada A1C 5X1

Abstract

Catches from this stock were generally in the range of 40,000 to 50,000 t per year throughout the 1970s and 1980s, before declining to low levels in the early 1990s. There has been no directed fishing on this stock since 1993 and the TAC has been set at 0 since 1995. By-catch of plaice in the Canadian yellowtail fishery increased in 2013 compared to 2011 and 2012 due to increased effort and a resolution to the market dispute. The majority of catch was taken in the NAFO regulatory area (NRA) in the skate, redfish and Greenland halibut fisheries. To estimate catch for 2011-2013 for Div. 3N, information on effort from NAFO observers and logbook data was used where possible with the assumption that CPUE has not changed substantially from 2010. A Virtual Population Analysis (VPA) was carried out using the ADAPTive framework with a reasonably good fit (0.31). Spawning stock biomass has been gradually increasing since the mid-1990s and in 2014 was 36, 000 t, still below the B*lim* of 50,000 t set for this stock (72% of B_{lim}). Recruitment has been generally poor since the 1986 year class, although numbers of recruits from 2003-2008 are higher than 1995-2002. A retrospective pattern indicates instability in estimates of SSB and recruitment and these are revised downward as data is added.

Estimated Catch in 2011-2013

A comparison of STATLANT 21 data with STACFIS estimates in previous years for Div. 3L and 3O determined that STATLANT 21 adequately reflected catch for those Divisions and so STATLANT 21 data were used for catch estimates for Div. 3L and 3O for 2011-2013. In Div. 3N, there was a substantial difference between STATLANT 21 and STACFIS catches for the past number of years where agreed catches were available. To estimate catch for 2011-2013 for Div. 3N information on effort from NAFO observers and logbook data was used where possible with the assumption that CPUE has not changed substantially from 2010. To estimate catch the ratio of effort in year *y+1* to year *y* was multiplied by the estimated catch in year *y* to produce catch in year *y+1*. For example for 2011 this was $Catch_{2011}$ = ($Effort_{2011}$/$Effort_{2010}$)*$Catch_{2010.}$ Effort for 2013 was considered provisional so this catch estimate could change if revised. This method is unlikely to be useful in future as CPUE is likely to change as the plaice population increases and as other fishing opportunities change.

In the most recent years, 2011-2013, when STACFIS was unable to get a precise estimate of catch, it was decided to estimate catch using the ratio of total effort (where effort was available) in Division 3N in the current year to the previous year and multiply by the agreed catch in the previous year (starting with 2010). This was carried through for three years.

Therefore

$Catch_{2011}$ = ($Effort_{2011}$/$Effort_{2010}$)*$Catch_{2010}$
$Catch_{2012}$ = ($Effort_{2012}$/$Effort_{2011}$)*$Catch_{2011}$
$Catch_{2013}$ = ($Effort_{2013}$/$Effort_{2012}$)*$Catch_{2012}$

Using this, the estimated estimates of catch were: 2944 t in 2011, 2015 t in 2012 and 3064 t in 2013.

Error in Catch at Age from 2010

An error in catch at age from 2010 was noticed and the 2011 Virtual Population Analysis (VPA) was rerun using the corrected catch at age. There was a slight difference in the plus group that gave an underestimate moving backwards which caused the estimate of SSB from the model to be lower than using the incorrect catch at age (Table 1). Final estimate using the corrected catch of SSB was 32000 t on Jan. 1, 2011.

Catch at age 2011-2013

Catch at age from Canadian fisheries in 2011-13

Results of the catch at age calculations for American plaice catches in 1993-2010 are given in detail in Rideout *et al*. (2011), and in earlier documents by Dwyer *et al*. (2005, 2007, 2009, 2010) and Morgan *et al*. (1999a,b; 2001; 2002, 2003). In 2011-13, sampling data collected by observers were available from by-catch of A. plaice in Canadian fisheries targeting yellowtail in Div. 3NO. In 2011, the Canadian catch of A. plaice in Div. 3LNO was only 450 tons, less than

45% of the average from 2008-2010 (Table 5). Most (82.4%) of the 2011 by-catch came from the directed fishery for yellowtail flounder. This percentage was lower than in 2007-10, when it was greater than 96% in all years. However the Canadian fishery for yellowtail was much reduced in 2011, due mainly to economic factors including closure of a major processing plant at mid-year. The ratio of A. plaice by-catch to the directed species of yellowtail (not to the total catch of all species in the yellowtail fishery, which is how the by-catch regulation is applied) was 8.6% in 2008, 19.8% in 2009, 13.9% in 2010, and 9.4 % in 2011. The only other significant contribution to Canadian by-catch of A. plaice on the Grand Bank in 2011 came from the fishery for redfish in Div. 3L, which caught 67 t (14.9% of the total by-catch) of A. plaice.

In 2012, the Canadian catch of A. plaice in Div. 3LNO was only 266 tons, 58% lower than the 2011 value (Table 6). Most of the by-catch (87% in 2012 and 91% in 2013) came from the directed fishery for yellowtail flounder. The ratio of A. plaice by-catch to the directed species of yellowtail was 14% in 2012 and 12% in 2013. Other bycatch of A. plaice in the Canadian fisheries in 2012 came from the fishery for redfish and Greenland halibut in Div. 3L, which caught 25 t, 55 t and 11 t, 36 t (9, 3 and 4, 5% of the total by-catch), respectively, of A. plaice.

The fishery for yellowtail on the Grand Bank reopened in 1998, and since the beginning of 2000, fishing for this species has been permitted in Div. 3L, resulting in some by-catch of American plaice there, although most of the by-catch in recent years, (62% in 2011 and 2012, and 70% in 2013) has come from Division 3N. There were also seasonal differences in the by-catch of A. plaice in the last few years, with most of the catch in in the most recent 3 years occurring in the first half of the year. In 2011, 84% of the by-catch occurred in the first half of the year (56% in May-June alone). In 2012, 61% of catches occurred from April-June. In 2013, catches were more evenly spread throughout the year, with catches occurring in all months except July (usually a closure of the Canadian yellowtail fishery during this time, intended to cover the main spawning period for yellowtail). This change has to do with the increase in fishing for yellowtail flounder because of the resolution of market disputes. By-catch rates of A.plaice in the yellowtail fishery have usually been highest in the spring period, but in the first quarter of the year they are generally much lower.

Sampling of the Canadian catch of A. plaice in Div. 3LNO in 2011 was improved over 2009-10 levels, and consisted of 3607 length measurements and 489 otoliths from 450 t catch, compared to 2010 (3332 length measurements and 331 otoliths from 1151 t catch) (Table 5). However, these levels were considerably lower than the sampling in 2007-08 (2007: 434 t, 9825 length measurements, 627 otoliths; 2008: 880 t, 15,497 measurements, 808 otoliths). The 2007-08 sampling levels (measurements/ton) were similar to the 2005 level (2007 was higher and 2008 lower), but lower than 2004, which was the last full year where 100% observer coverage existed in the Canadian yellowtail fishery. In 2012, the sampling was very low, with only 1817 measurements and 214 otoliths (mainly from only Div. 3N) from 266 t of catch (Table 6). The lower levels of otolith sampling in 2011 and 2012 is a concern, as it was not possible to calculate age compositions by Division without using age-length keys combined by Division, although length frequency data were available from all 3 Divisions in 2011 (but only from Divs. 3N and 3L for 2012). Industry related factors in the yellowtail fishery continued to affect catches in 2012.

The same weight-length relationship was used as in recent years (log weight = 3.3247 log length – 5.553) and the sum of products check in 2011 and 2012 was within 2% of the catch. The Canadian catch in 2011 and 2012 consisted of about 0.79 and 0.48 million A. plaice, respectively, compared to between 1.3 and 1.8 million fish per year in 2008-2010 (Tables 5-6). Ages in the 2011 catch ranged from 4 to 21, and catch was comprised mainly of fish aged 6 to 12 years old, with the peak being the 2002 year class (age 9). Ages in the 2012 catch ranged from 5 to 20, and catch was comprised mainly of fish aged 7 to 10 years old, with the peak being the 2002 year class (age 9). The peak age in the catch numbers declined from 9 or 10 in 1999-2001 to age 8 in 2002-03 and to age 7 in 2004-05, but increased in 2008 and 2009 to age 9 again, before declining in 2010. Age 6 comprised over 17% of the catch numbers in 2010, compared to less than 3% of the annual catch in numbers during 2007-09, and about 5% in 2011. However, almost 20% of the catch numbers in 2004 were age 6, and fluctuations such as these are not uncommon, depending on year class strengths as well as the location, timing, and directed fishery of the by-catches. Overall, the catch at age in 2011 and 2012 was similar to that calculated for 1999-2009, as well as that from the Canadian fishery for A. plaice on the Grand Bank in the early 1990s (Brodie et al. 1994).

The mean fish weight in the 2011 catch was 0.588 kg per fish and in 2012 was 0.575 kg per fish, continuing a decline from 2009 (0.802 kg/fish), and 2010 (0.673 kg/fish). The 2009 value was the highest in the recent period, and the 2012 value the lowest. Reasons for the annual fluctuations are likely due to the considerable seasonal and temporal differences in the catches, as noted above. In particular the 2011 and 2012 fisheries occurred mostly in the first half of the year, and had a lower percentage of catch in Div. 3N, unlike most recent years. Both these factors would be expected to contribute to lower overall weights at age. However, the lower sampling levels in recent years, particularly 2009-10, add uncertainty to comparisons of the age compositions and weights at age.

Although sampling was incomplete for the Canadian bycatch in 2013, it is already improved (1971 otoliths and 9609 length measurements) over 2011 and 2012. Only data from Quarters 1 and 2 for Divs. 3NO was available; as only this data had undergone quality control. This rest of the data should be available in the future. Therefore 2013 Canadian catch at age should be considered interim catch at age. It is expected that catch at age will change somewhat as the data is added. Canadian catch in 2011 and 2013 consisted of about 1.6 million A. plaice. Ages in the 2013 catch ranged from 4 to 26, and catch was comprised mainly of fish aged 7 to 10 years old, with the peak being age 9. The mean fish weight in the 2013 catch was 0.67 kg per fish (back up around the levels of 2010).

Catch at age from other countries

For 2011-2013, length frequency data were available from EU-Portugal and EU-Spain. There was some sampling from Russia, but usually there is not much data and the catch is bumped up. Details on the sampling levels and descriptions of the fisheries are contained in Vargas *et al.* (2012; 2013; 2014), González-Costas *et al.* (2012; 2013; 2014) and Pochtar and Fomin (2012); Pochtar *et al.* (2013) and Fomin and Khlivnoy (2014). In all cases, age-length keys from the Canadian spring surveys in Div. 3LNO were used to derive age compositions, which were then combined and adjusted to the total catch to account for all non-sampled catches. Catch

at age, weight at age (using the weight-length relationship used above) and sum of products (SOP) for 2011-13 are given in Tables 8-9.

In 2011 American plaice were taken as by-catch in the Canadian yellowtail fishery, EU-Spain and EU-Portugal skate, redfish and Greenland halibut fisheries. Length frequency data were available from the Canadian by-catch of American plaice in Div. 3LNO, mainly from the yellowtail fishery. Length frequency sampling came from all Divisions in the 130 mm mesh fisheries from Portugal, and from Div 3N in the 280 mm mesh from the skate fishery. Most of the catch ranged between 20-30 cm for sampling in Div 3L and 3N (130 mm) and 26-40 cm for sampling in Div. 3O and Div. 3N (280mm). Spanish frequencies indicated a peak at 34 cm. Catch from Portugal indicated a peak at age 9, whereas the peak for Spain was at age 6. The small amount of sampling data available for Russia indicated a peak at 33 cm and another at 43 cm.

Mean lengths and weights at age in the Canadian fishery were slightly higher at younger ages than in international catches, likely a result of larger mesh size used in the Canadian fishery and also the use of research vessel age-length keys for the catches of non-Canadian fleets.

There was less age sampling of the 2012 by-catch in the Canadian fishery and length sampling of by-catch in the Canadian, EU-Spain, EU-Portugal and Russian (only two length frequency samples) fisheries. The Spanish length frequencies indicated a peak at 28 cm for the 130 mm mesh portion of the fishery and another at 36 cm for the 280 mm portion. Age 7 (2005 YC) was the most abundant age in the Spanish catch. Sampling was only available for Div 3N 130 mm mesh from the Portuguese fishery and this showed a peak at 30 cm. Most fish captured in this fishery were age 9 (ages 6-9 being the most abundant); the same was true of Canadian catches (with 7-10 being most abundant).

In 2013, length frequencies from the Portuguese commercial sampling (130 mm mesh) peaked at about 32 cm, and the 280 mm length frequency was spread out towards larger sizes. The most abundant year class in the Portuguese catch in 2013 was age 7. The by catch from the 130 mm mesh size in the Spanish fisheries indicated a peak at 22 cm and from the 280 mm mesh size at 38 cm. Age 7 was also the most abundant age. Overall, ages 7-10 were the most abundant. This catch at age is considered to be an interim catch at age.

Virtual Population Analysis (VPA)

A formulation of ADAPT using the same base structure that was used in the accepted VPA from the 2011 assessment (Rideout *et al*., 2011) was run. Formulations were similar to previous assessments (Morgan et al., 1999a; 1999b; 2001; 2002; 2003; Dwyer *et al*., 2007a, 2008, 2009, 2010). The ADAPT used catch–at-age for ages 5 to 14 with an age 15 plus group which included all catch from ages 15 to 22 (Table 12). The ratio of F on the plus group to F on the last true age was set at 1.0. M was set at 0.2 except at 0.53 for all ages from 1989 to 1996 (Morgan and Brodie, 2001; Dwyer *et al*., 2007b; 2008). Beginning of the year weights-at-age and maturities-at-age are given in Tables 13 and 14. The calibration matrix consisted of the following input data (details given in Dwyer et al., 2014):

- Canadian spring RV survey (1985-2013) (no 2006 data point) abundance at age (ages 5-14);
- Canadian autumn RV survey (1990-2013) (no 2004 data point) abundance at age (ages 5-14); and
- EU-Spain Div. 3NO survey (1998-2013) abundance at age (ages 5-14) (Table 11).

The results of an ADAPT run using the formulation described above are given in Table 15 and Figures 1-7. The model provides a reasonable fit to the data. The mean square of the residuals was 0.31. Relative errors on the population estimates ranged from 0.12 to 0.33. The relative errors on the catchabilities (q) were all less than 0.2. The residuals from the Canadian spring survey showed an increasing trend until around 1994 and no real discernable pattern thereafter. Residuals from the Canadian fall survey appear to be lower after about 1996. The residuals from the EU-Spain Div. 3NO survey showed very little pattern (Figure 1). In all surveys, there is some evidence of auto-correlation in the residuals. The fit of predicted and observed survey estimates is relatively good for the Canadian spring and fall survey but not as good for the EU-Spain Div. 3NO survey (Figure 2). Residuals are larger for the older ages in the fall survey but are fairly low overall (Figure 3). The value for age 5s in the EU-Spain Div. 3NO survey is also high. Survey qs show little variability, perhaps with some tendency for lower qs for the youngest fish (Figure 4). Fall surveys catch more small fish than spring surveys. Qs from the EU-Spain Div. 3NO survey show a different pattern than the other surveys and may catch a larger proportion of older fish.

Population numbers and F from this run are shown in Tables 16 and 17. Biomass was calculated by multiplying the population numbers at age by the beginning of the year weights at age. The VPA analyses showed that population abundance and biomass declined fairly steadily from the mid 1970's. Biomass has been relatively stable since 1995 (Figure 5) increasing over the last number of years. Average F on ages 9 to 14 showed an increasing trend from about 1965 to 1985. There was a large peak in F in 1993, which may be an artifact of extremely low catches during the moratorium. F since 1995 has been generally lower than in the earlier period but increased fairly steadily from 1995 to 2000. F has been decreasing since then. Average F on ages 9-14 in 2013 was 0.11 (Table 17; Figure 5).

Spawning stock biomass was calculated by multiplying the biomass at age by the female maturity ogive (Table 18). SSB has shown 2 peaks, one in the mid-1960s and another in the early to mid-1980s. It declined to a very low level (less than 10 000 t) in 1994 and 1995 but has been increasing slowly since that time (Table 18; Figure 6). Recruitment has been generally poor since the 1986 year class, although numbers of recruits from 2003-2008 are higher than 1995-2002 (Figure 6). An examination of the stock recruit scatter shows that above 155 000 t only good recruitment has been observed and no good recruitment observed at SSB below 50 000 tons (B_{lim}) (Figure 7). The most recent (2008) year class is in the lower left of the plot. The estimate of SSB at the beginning of 2014 was 36, 000 t, 28% below the Blim of 50 000t.

Retrospective Analysis

Retrospective analyses were conducted by sequentially removing one year of data from the most recent year for a comparison of 5 years. There is a retrospective pattern present (Tables

19 and 20, Figure 8) indicating instability in estimates of SSB and recruitment and these are revised downward as data is added.

Reference Points

The SSB for this stock is estimated to be below B_{lim} (50 000 t) and fishing mortality in 2013 was below F_{lim} (0.31).

VPA run excluding EU-Spain Div. 3NO survey

Because of the differences in abundance at age between the Canadian surveys and the EU-Spain survey, an ADAPT was run with only spring and fall Canadian surveys included (Tables 9-13 and Figures 21). The MSE is lower (0.26) than if the EU-Spanish survey is included. The predicted versus observed index fits the remaining surveys better than in the formulation with three surveys. Finally the retrospective pattern on SSB is slightly better than the model including three surveys but is still present. SSB using this model gives an SSB on Jan. 1, 2014 as 32,300 t (65% of B_{lim}).

Stochastic Projections

Simulations were carried out to examine the trajectory of the stock under 2 scenarios of fishing mortality: $F = 0$ and $F = F_{2013}$ (0.11).

For these simulations the results of the VPA and the covariance of these population estimates were used. The following assumptions were made:

Age	Estimate of 2014 population numbers ('000)	CV on population estimate	Weight-at-age mid-year (avg. 2011-2013)	Weight-at-age beginning of year (avg. 2011-2013)	Maturity-at-age (avg. 2011-2013)	Rescaled PR relative to ages 9-14 (avg. 2011-2013)
5			0.136	0.08	0.011	0.104
6	50489	0.333	0.201	0.237	0.042	0.245
7	31270	0.239	0.284	0.314	0.22	0.557
8	23866	0.201	0.397	0.415	0.569	0.747
9	11569	0.185	0.509	0.524	0.809	0.837
10	8315	0.175	0.632	0.643	0.942	1.029
11	7280	0.166	0.75	0.769	0.975	1.056
12	2787	0.165	0.905	0.946	0.99	1.340
13	1493	0.174	1.08	1.203	0.996	0.939
14	1479	0.162	1.311	1.414	0.999	0.799
15	2473	0.121	1.927	1.67	1	0.799

Simulations were limited to a 3-year period. Recruitment was resampled from three sections of the estimated stock recruit scatter, depending on SSB. The three sections were 50 000 t of SSB and below (only low recruitment), greater than 50 000 t to 155 000 t (low and high recruitment), and greater than 155 000 t (only high recruitment). The simulations contained a plus group at age 15.

Under no removals (F=0), spawner biomass is projected to increase with $P(\text{SSB}>B_{lim})$ in 2017 of >0.95 (Table 22; Figure 14). SSB was projected to have a probability of 0.30 of being greater than B_{lim} by the start of 2017 when $F = F_{2013}$ (0.11). Current fishing mortality is delaying the recovery of this stock.

Under status quo fishing mortality (F_{2013}) projected removals increase slightly in each year (Table 22 and 23).

Appendix A

Analyses were conducted to evaluate the internal consistency in each survey index series, the consistency of the contribution of each year-class to the total survey index, and the consistency of the age-specific information across the survey series.

Pair-wise plots of the each of the survey indices (by cohort on the log-scale) are presented in Appendix A.1 – A.3. The data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear least squares regression line. Numeric values in the panels above the diagonal provide the correlation coefficient between the survey data at these ages. The p-values for testing whether or not the correlation is significantly different in each panel are indicated by the key shown on the right hand side. Regression and correlations are only computed if there are at least 5 points (i.e. cohorts) available for a given pair of ages. The scatter plots reveal that some of the lower correlation values at some of the ages for some of the survey indices are partially due to one or two outlying points; mostly there are high correlations of ages between cohorts for all surveys.

A comparison of standardized indices illustrating the consistency of dataset currently used to calibrate the analytical assessment is presented in Figure Appendix A.4. In these figures each survey-age time-series is standardized to have mean 0 and variance 1 and are directly comparable. As mentioned in SCR 14/31, indices at age between the EU survey and the Canadian surveys no longer appear to be showing the same trends. The EU-Survey indicates lower levels of ages 2-5 and higher levels of ages 6-11 and age 13.

Plots of the standardized proportions by age across years (SPAY) provide additional perspective on the cohort consistency within each of the survey indices (Figures A.5). In the SPAY plots, the annual index proportions were standardized at each age to have a mean of 0 and a variance of 1. (Cohorts are identified with text labels in the margin.) Cohorts can be tracked in all surveys, but especially at the youngest ages in the Canadian fall surveys. Yearclasses that appear strong in the younger ages of the Canadian surveys are less strong by the time they enter the analytical assessment (age 5). However, the 2005 and 2006 year classes seem to become important in the EU-Spain survey by the time they reach ages 7 and 8.

References

Brodie, W.B., M.J. Morgan, and D. Power. 1994. An assessment of the American plaice stock in Divisions 3LNO. NAFO SCR Doc. 94/55, Ser. No. N2426, 43 p.

Dwyer, K. S., M. J. Morgan, D. Maddock Parsons, W. B. Brodie, B. P. Healey, P.A. Shelton and H. Murua. 2005. An assessment of American plaice in NAFO Divisions 3LNO. NAFO SCR Doc. 05/61, Ser. No. N5147.

Dwyer, K.S., M. J. Morgan, D. Maddock Parsons, W. B. Brodie and B. P. Healey. 2007a. An assessment of American plaice in NAFO Div. 3LNO. NAFO SCR Doc. 07/56, Ser. No. N5408, 72 p.

Dwyer, K.S., B. P. Healey and M. J. Morgan. 2007b. Part I of American plaice in NAFO Divisions 3LNO research recommendations: data explorations with ADAPT analyses. NAFO SCR Doc. 07/62, Ser. No. N5416, 24 p.

Dwyer, K.S., B.P. Healey and M. J. Morgan. 2008. Part II of American plaice Div. 3LNO research recommendations: data explorations with ADAPT analyses with varying natural mortality. NAFO SCR Doc. 08/42, Ser. No. N5543, 21p.

Dwyer, K.S., M. J. Morgan, D. Maddock Parsons, W. B. Brodie and B. P. Healey. 2009. An assessment of American plaice in NAFO Div. 3LNO. NAFO SCR Doc. 09/35, Ser. No. N5671, 73 pps.

Dwyer, K.S., M.J. Morgan, D. Maddock Parsons, W.B. Brodie and B.P. Healey. 2010. An assessment of American plaice in NAFO Div. 3LNO. NAFO SCR Doc. 10/39.

Dwyer, K. S., M.J. Morgan, W.B. Brodie, R. Rideout, D. Maddock Parsons, B.P. Healey and D. Ings. 2014. Survey indices and STATLANT 21A bycatch information for American plaice in NAFO Div. 3LNO. NAFO SCR Doc. 14/031, Ser. No. N6327, 52 pps.

Fomin, K. and V. Khlivnoy. 2014. Russian research report for 2013. NAFO SCS Doc. 14/13, Ser. No. N6308, 27 pp.

González-Costas, F., D. González-Troncoso, G. Ramilo, E. Román, J. Lorenzo, M. Casas, C. Gonzalez, A. Vásquez and M. Sacau. 2012. Spanish research report for 2011. NAFO SCS Doc. 12/09, Ser. No. N6023, 35 p.

González-Costas, F., D. González-Troncoso, G. Ramilo, E. Román, J. Lorenzo, M. Casas, C. Gonzalez, A. Vázquez, and M. Sacau. 2013. Spanish research report for 2012. NAFO SCS Doc. 13/07, Ser. No. 6150, pp.

González-Costas, F., D. González-Troncoso, G. Ramilo, E. Román, M. Casas, M. Mandado, M. Sacau, J. L. del Rio and. J. Lorenzo. 2014. Spanish research report for 2013. NAFO SCS Doc. 14/06, Ser. No. N6287, 37 pp.

Morgan, M.J., W.B. Brodie, and D. Maddock Parsons. 1999a. Virtual population analyses of the American plaice stock in Div. 3LNO from 1975 to 1997. NAFO SCR Doc. 99/58, Ser. No. N4117, 36p.

Morgan, M.J., W.B. Brodie, and W.R. Bowering. 1999b. An assessment of American plaice in NAFO Divisions 3LNO. NAFO SCR Doc. 99/40, Ser. No. N4099.

Morgan, M.J., W.B. Brodie, B.P. Healey, D Maddock Parsons, D. Stansbury, and D. Power. 2001. An assessment of American plaice in NAFO Divisions 3LNO. NAFO SCR Doc. 01/59, Ser. No. N4437, 70p.

Morgan, M. J., and W. B. Brodie. 2001. An exploration of virtual population analyses for Div. 3LNO American plaice. NAFO SCR Doc. 01/4, Ser. No. N4368, 20p.

Morgan, M.J., W.B. Brodie, B.P. Healey, D. Maddock Parsons, K.S.Dwyer and D. Power. 2002. An assessment of American plaice in NAFO Divisions 3LNO. NAFO SCR Doc. 02/70, Ser. No. N4683, 68p.

Morgan, M. J., W. B. Brodie, D. Maddock Parsons and B. P. Healey. 2003. An assessment of American plaice in NAFO Divisions 3LNO. NAFO SCR Doc. 03/56, Ser. No. N4874.

Pochtar, M. V. and K. Fomin. 2012. Russian research report for 2011. NAFO SCS Doc. 12/05, Ser. No. N6018, 36 p.

Pochtar, M., K. Fomin, and V. Zabavnikov. 2013. Russian research report for 2012. NAFO SCS Doc. 13/09, Ser. No. N6159, 27 pps.

Rideout, R. M., M. J. Morgan, D. Maddock Parsons, W. B. Brodie, B. P. Healey, D. Power, and K.S. Dwyer. 2011. An assessment of American plaice in NAFO Div. 3LNO. NAFO SCR Doc. 11/032, Ser. No. N5917, 70 p.

Vargas, J., R. Alpoim, E. Santos and A. M. Ávila de Melo. 2012. Portuguese research report for 2011. NAFO SCS Doc. 12/08, Ser. No. N6022, 49 pps.

Vargas, J., R. Alpoim, E. Santos and A. M. Ávila de Melo. 2013. Portuguese research report for 2012. NAFO SCS Doc. 13/05, Ser. No. N6145, 30 pps.

Vargas, J., R. Alpoim, E. Santos and A. M. Ávila de Melo. 2014. Portuguese research report for 2013. NAFO SCS Doc. 14/08, Ser. No. N6301, 49 pps.

Table 1. Corrected catch at age for 2010.

	2010																					
	Portugal				Spain				Canada				Overall (LF data available)				Portugal 3O	Russia	Estonia	Lithuania	France (SP)	
	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.						Total (000s)
1	0	0.0	0.000	0	0	0.0	0.000	0					0	0.0	0.000	0						0
2	198	17.7	0.039	8	1338	15.3	0.024	32					1536	15.6	0.026	40						2
3	4744	21.9	0.080	378	3476	17.2	0.036	125					8220	20.2	0.061	503						9
4	54926	25.0	0.125	6863	14394	24.9	0.122	1760	11000	29.7	0.224	2464	80320	25.8	0.138	11086						85
5	58816	25.9	0.139	8197	16720	28.8	0.198	3316	43000	33.2	0.330	14190	118537	29.5	0.217	25703						126
6	199796	28.4	0.191	38161	136854	31.3	0.264	36098	309000	35.9	0.426	131634	645649	33.2	0.319	205894						687
7	245900	31.4	0.266	65395	213410	33.5	0.328	70040	370000	37.6	0.496	183520	829310	35.1	0.385	318955						882
8	76802	35.4	0.394	30292	189899	36.0	0.418	79396	255000	38.4	0.529	134895	521701	37.3	0.469	244584						555
9	57377	37.6	0.485	27837	215604	38.0	0.502	108223	181000	41.0	0.655	118555	453981	39.3	0.561	254615						483
10	61295	41.6	0.675	41402	219983	41.1	0.650	143015	263000	42.1	0.720	189360	544277	41.8	0.687	373777						579
11	52148	43.1	0.762	39762	211812	42.7	0.735	155713	120000	43.4	0.795	95400	383960	43.0	0.758	290875						409
12	68416	46.6	0.983	67259	142320	45.1	0.884	125840	67000	47.8	1.091	73097	277735	46.2	0.958	266196						296
13	24734	47.0	1.012	25028	71637	48.0	1.085	77721	50000	49.6	1.244	62200	146370	48.5	1.127	164948						156
14	12023	51.8	1.404	16884	33316	48.0	1.086	36186	38000	53.7	1.614	61332	83339	51.5	1.373	114403						89
15	17168	53.5	1.565	26866	54049	56.0	1.821	98428	36000	52.6	1.492	53712	107217	54.6	1.670	179006						114
16	29197	55.5	1.763	51477	30993	52.4	1.453	45019	20000	56.1	1.865	37300	80190	54.6	1.668	133796						85
17	12644	57.2	1.944	24579	19015	57.5	1.980	37643	8000	58.4	2.104	16832	39659	57.6	1.993	79054						42
18	6316	56.0	1.820	11493	9736	60.5	2.353	22905	6000	59.1	2.176	13056	22052	58.9	2.152	47454						23
19	7364	56.9	1.916	14110	7006	60.6	2.357	16516	5000	60.8	2.427	12135	19370	59.4	2.208	42761						21
20	0	0.0	0.000	0	0	0.0	0.000	0					0	0.0	0.000	0						0
21	0	0.0	0.000	0	0	0.0	0.000	0					0	0.0	0.000	0						0
22	0	0.0	0.000	0	0	0.0	0.000	0					0	0.0	0.000	0						0
23	795	58.5	2.101	1671	934	58.5	2.101	1963					1730	58.5	2.101	3634						2
UNK	327	69.5	3.726	1219	1908	69.4	3.700	7060					2236	69.4	3.703	8279						2
Total SOP				498880				1067000				1199682				2765562						1.06
Catch				498880				1067000				1155000					45120	41000	5000	6000	80000	

Table 2. Canadian catches of American plaice by Division, month and gear during 2011.

	3L		3N	3O	3LNO
	Gillnet	OT	OT	OT	Total
Jan		5	45	1	51
Feb					
Mar			14	0	14
Apr		0	59	0	60
May		5	61	64	131
Jun	0	12	100	10	122
Jul	1			5	6
Aug	0				0
Sept	0				0
Oct					
Nov		19			19
Dec		48			48
Total	**1**	**88**	**280**	**81**	**450**

Summaries: GN = 1
OT = 449

3L = 89
3N = 280
3O = 81

Bycatch in directed yellowtail fishery = 371
Bycatch in directed G. halibut fishery = 12
Bycatch in other directed fisheries = 67

Table 3. Canadian catches of American plaice by Division, month and gear during 2012.

	3L			3N	3O	3LNO
	Gillnet	Longline	OT	OT	OT	Total
Jan						
Feb						
Mar			3			3
Apr				20	0	20
May				63	3	65
Jun	0		11	61	7	78
Jul	0					0
Aug	0					0
Sept	0	0				0
Oct					4	4
Nov			3	23	33	59
Dec			27		10	37
Total	0	0	43	166	57	267

Summaries: GN < 1 3L = 43
LL < 1 3N = 166
OT = 266 3O = 57

Bycatch in directed yellowtail fishery = 231
Bycatch in directed G. halibut fishery = 11
Bycatch in other directed fisheries = 25

Table 4. Canadian catches of American plaice by Division, month and gear during 2013.

	3L		3N	3O		3LNO
	Gillnet	OT	OT	Gillnet	OT	Total
Jan		10	16		0	26
Feb		2	27		7	36
Mar		4	137		0	141
Apr		8	35		0	43
May		28	130		15	174
Jun		8	119		4	132
Jul						
Aug	0		12	0	24	37
Sept	0	1	41		43	85
Oct		0	114		40	155
Nov		0	61		54	116
Dec		39	43		15	97
Total	0	101	737	0	203	1041

Summaries: GN < 1
OT = 1041

3L = 101
3N = 737
3O = 203

Bycatch in directed yellowtail fishery = 950
Bycatch in directed G. halibut fishery = 36
Bycatch in other directed fisheries = 91

Table 5. Catch at age (000 of fish) and mean length (cm) and weights (kg) at age from the Canadian catch of A. plaice in Div. 3LNO in 2011.
S.O.P. is sum of products of catch numbers x mean weights.
An asterisk indictates catch of less than 500 fish

			2011		3LNO
Age	Total	Pctg	Mean len	Mean wgt	S.O.P. (t)
4	0.4	0.05	30.5	0.241	0.1
5	13	1.66	31.1	0.260	3.4
6	39	4.98	33.0	0.320	12.5
7	137	17.44	35.4	0.407	55.9
8	175	22.24	37.6	0.496	86.9
9	181	22.95	38.2	0.517	93.5
10	82	10.42	39.7	0.591	48.5
11	64	8.16	42.4	0.743	47.7
12	54	6.86	45.0	0.902	48.8
13	13	1.69	48.7	1.154	15.4
14	5	0.59	51.7	1.423	6.6
15	9	1.13	55.4	1.772	15.8
16	7	0.92	54.8	1.781	12.9
17	4	0.54	57.8	2.056	8.7
18	1	0.14	60.3	2.325	2.6
19	1	0.14	62.2	2.657	2.8
20	0.5	0.06	62.3	2.622	1.3
21	0.1	0.01	68.5	3.549	0.4
22					
Total	788	100.00			464
				Catch =	450

Table 6. Catch at age (000 of fish) and mean length (cm) and weights (kg) at age from the Canadian catch of A. plaice in Div. 3LNO in 2012.
S.O.P. is sum of products of catch numbers x mean weights.
An asterisk indictates catch of less than 500 fish

			2012		3LNO
Age	Total	Pctg	Mean len	Mean wgt	S.O.P. (t)
4					
5	2	0.48	31.5	0.268	0.6
6	40	8.68	32.5	0.306	12.3
7	77	16.59	33.9	0.349	26.7
8	76	16.46	37.9	0.511	38.8
9	135	29.28	39.1	0.562	76.0
10	59	12.86	39.7	0.593	35.2
11	23	5.05	44.3	0.845	19.7
12	25	5.51	44.8	0.886	22.5
13	13	2.81	48.2	1.130	14.6
14	5	0.99	51.5	1.414	6.5
15	3	0.56	57.4	2.008	5.2
16	1	0.23	59.5	2.240	2.4
17	1	0.27	58.3	2.100	2.6
18	0.6	0.12	60.6	2.366	1.4
19	0.2	0.05	60.5	2.349	0.6
20	0.2	0.05	60.5	2.349	0.6
21					
22					
Total	462	100.00			266
				Catch =	267

Table 7. Catch at age (000 of fish) and mean length (cm) and weights (kg) at age from the Canadian catch of A. plaice in Div. 3LNO in 2013.
S.O.P. is sum of products of catch numbers x mean weights.
An asterisk indictates catch of less than 500 fish

			2013		3LNO
Age	Total	Pctg	Mean len	Mean wgt	S.O.P. (t)
4					
5	5	0.33	31.2	0.260	1.4
6	45	2.82	33.3	0.327	14.6
7	145	9.13	35.4	0.402	58.4
8	236	14.83	37.1	0.469	110.6
9	290	18.27	38.8	0.547	158.9
10	357	22.42	40.7	0.643	229.3
11	193	12.12	41.8	0.697	134.3
12	129	8.11	44.8	0.881	113.6
13	70	4.40	45.6	0.940	65.7
14	40	2.51	48.7	1.161	46.3
15	30	1.91	50.1	1.293	39.4
16	24	1.54	52.6	1.502	36.8
17	10	0.65	56.1	1.854	19.1
18	4	0.28	55.4	1.864	8.3
19	4	0.24	59.7	2.284	8.9
20	5	0.29	58.0	2.079	9.7
21	1	0.05	63.3	2.735	2.4
22	1	0.06	61.6	2.533	2.6
23	0	0.01	66.1	3.291	0.3
24	0	0.02	68.5	3.549	1.4
25	0	0.00	60.5	2.349	0.2
26	0	0.03	68.1	3.480	1.5
Total	1590	100.00			1062
				Catch =	1041

Table 8. Catch at age for 2011.

	Portugal				Spain				Canada				Overall (LF data available)				France (SP)	Lithuania	Estonia	Russia	Cuba	USA	Total (000s)
	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.							
1	0	0.0	0.000	0	0	0.0	0.000	0					0	0.0	0.000	0							0
2	18.8	15.9	0.028	51	408	16.5	0.031	13					2226	16.1	0.029	63							2
3	223.80	22.0	0.081	18197	30381	21.8	0.079	2410					25436.1	22.0	0.081	20607							261
4	369.97	24.6	0.118	43827	59252	25.1	0.127	7510	374	30.5	0.241	90	42962.2	24.7	0.120	51427							440
5	742.65	26.3	0.148	109882	182608	28.2	0.186	33974	1308.5	31.102	0.26	3402	99805.7	26.8	0.157	147258							951
6	664.714	28.5	0.192	127589	302475	30.6	0.244	73832	3929.9	32.952	0.32	12547	100639.8	29.4	0.213	213968							1031
7	491.021	31.8	0.277	136101	589404	34.1	0.350	206181	13734	35.419	0.407	55895	121775.8	33.4	0.327	398176							1248
8	348.907	35.5	0.400	139652	625449	36.5	0.436	272839	17519.3	37.565	0.496	86896	114595.48	36.4	0.434	499387							1178
9	122.133	38.5	0.522	63803	185238	38.8	0.536	99357	18079.2	38.15	0.517	93469	48816.4	38.6	0.526	256629							500
10	146.672	43.0	0.753	110509	207889	42.5	0.725	150792	8209.7	39.66	0.591	48519	43666.58	42.2	0.710	309820							447
11	101.678	44.1	0.823	83646	153503	44.0	0.816	125330	6426.3	42.415	0.743	47747	31944.4	43.8	0.804	256723							327
12	103.481	45.2	0.891	92216	139935	45.8	0.934	130689	5406.9	45.011	0.902	48770	29748.5	45.5	0.913	271675							305
13	26.947	48.9	1.158	30501	55813	50.0	1.249	69693	1333.9	48.722	1.154	15393	9549.8	49.6	1.210	115588							98
14	11.308	50.2	1.264	14296	23134	51.8	1.399	32368	467.3	51.679	1.423	6650	3911.5	51.4	1.363	53313							40
15	2.437	50.1	1.254	3057	13430	53.0	1.516	20365	89.35	55.352	1.772	15833	2480.2	53.7	1.583	39355							25
16	4.550	54.3	1.637	7448	24652	55.6	1.771	43653	722.3	54.787	1.781	12864	3642.5	55.4	1.756	63965							37
17	6.18	50.5	1.289	797	22005	58.2	2.065	45448	425.2	57.84	2.056	8742	2687.6	58.0	2.046	54087							28
18	5.27	54.5	1.663	877	10387	58.2	2.067	21467	112.5	60.301	2.335	2627	1203.9	58.3	2.074	24971							12
19	2.94	56.5	1.872	551	19040	61.3	2.458	46804	106.9	62.177	2.657	2840	2040.3	61.4	2.460	50195							21
20	0	0.0	0.000	0	4876	63.0	2.682	13078	51.1	62.321	2.622	1340	538.7	62.9	2.676	14417							6
21	0	0.0	0.000	0	305	57.3	1.963	599	11.6	68.5	3.549	412	42.1	60.9	2.400	1010							0
22	0	0.0	0.000	0	2316	61.9	2.539	5882					231.6	61.9	2.539	5882							2
23	0	0.0	0.000	0	129	63.6	2.776	359					129	63.6	2.776	359							0
UNK	0	0.0	0.000	0	2701	69.5	3.718	10040					2701	69.5	3.718	10040							3
Total SOP				983000				1412680				466037				2859717							1.02
Catch				983000				1412680				450000					14000	26000	3000	14000	4000	9000	

2011

Table 9. Catch at age for 2012.

	2012																							
	Portugal				Spain				Canada				Overall (LF data available)				Other Portugal	Russia	Estonia	Lithuania	France (SP	Cuba	USA	
	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.								Total (000s)
1					0	0.0	0.000	0	0				0	0.0	0.000	0								0
2	0	0.0		0	0	0.0	0.000	0	0				0	0.0	0.000	0								0
3	688	14.5	0.020	14	57	20.3	0.062	4	0				745	15.2	0.024	18								1
4	4949	19.6	0.055	272	5779	23.4	0.099	573	0			0	10728	21.8	0.079	845								19
5	61704	22.5	0.087	5392	43991	25.9	0.140	6163	2213	31.45	0.268	593	107909	24.3	0.113	12148								189
6	84355	26.1	0.143	12070	108601	27.6	0.173	18737	40084	32.54	0.306	12266	233041	28.2	0.185	43073								408
7	206387	27.6	0.173	35626	131297	31.1	0.256	33633	76621	33.858	0.349	26741	414305	30.1	0.232	96000								726
8	179438	30.2	0.233	41871	138248	35.4	0.394	54516	75992	37.938	0.511	38832	393678	33.9	0.343	135219								690
9	89762	31.9	0.280	25157	153463	38.6	0.528	80970	135213	39.068	0.562	75990	378439	37.6	0.481	182116								663
10	30340	35.1	0.384	11638	84870	40.1	0.599	50830	59392	39.669	0.593	35219	174602	39.3	0.559	97687								306
11	9837	37.2	0.465	4573	65495	43.2	0.764	50032	23303	44.277	0.845	19691	98635	43.0	0.753	74296								173
12	2753	42.6	0.730	2010	58582	45.6	0.915	53631	25433	44.781	0.886	22534	86768	45.4	0.901	78175								152
13	2574	44.4	0.839	2159	41927	47.5	1.049	43969	12963	48.209	1.13	14648	57465	47.6	1.058	60776								101
14	857	47.1	1.023	877	19866	50.0	1.249	24809	4585	51.547	1.414	6483	25308	50.3	1.271	32170								44
15	467	50.0	1.244	581	5994	52.8	1.492	8943	2602	57.368	2.008	5225	9063	54.2	1.627	14749								16
16	0	0.0	0.000	0	7446	54.3	1.643	12236	1076	59.546	2.24	2410	8522	55.1	1.719	14647								15
17	0	0.0	0.000	0	9286	55.0	1.709	15872	1239	58.282	2.1	2602	10525	55.4	1.755	18474								18
18	0	0.0	0.000	0	9684	58.4	2.084	20185	575	60.56	2.366	1360	10259	58.5	2.100	21546								18
19	0	0.0	0.000	0	2747	56.7	1.891	5196	236	60.5	2.349	554	2983	57.0	1.927	5750								5
20	0	0.0	0.000	0	561	56.5	1.872	1049	236	60.5	2.349	554	797	57.8	2.013	1604								1
21	0	0.0	0.000	0	532	64.5	2.907	1547	0			0	532	64.5	2.907	1547								1
22	0	0.0	0.000	0	0	0.0	0.000	0	0				0	0.0	0.000	0								0
23	0	0.0	0.000	0	0	0.0	0.000	0	0				0	0.0	0.000	0								0
24	0	0.0	0.000		1179	62.6	2.633	3106	0				1179	62.6	2.633	3106								2
UNK	0	0.0	0.000	0	0	0.0	0.000	0					0	0.0	0.000	0								0
Total SOP	0			142240				486000				265703				893943								1.75
Catch				142240				486000				267000					461760	59000	33000	2000	87000	6000	23000	

Table 10. Catch at age for 2013.

	2013																			
	Portugal				Spain				Canada				Overall (LF data available)				Russia	Estonia	USA	Total (000s)
	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.	3LNO	Mean len	Mean wgt	S.O.P.				
1	0	0.0	0.000		0	0.0	0.000	0	0				0	0.0	0.000	0				0
2	482	16.4	0.031	15	0	0.0	0.000	0	0				482	16.4	0.031	15				1
3	2479	18.7	0.048	118	40	20.5	0.064	3	0				2519	18.8	0.048	120				3
4	24339	21.6	0.076	1850	6288	23.6	0.103	649				0	30628	22.0	0.082	2499				36
5	198457	25.6	0.134	26535	78422	25.9	0.140	11007	5213	31.16	0.26	1355	282092	25.8	0.138	38898				332
6	330641	28.6	0.194	64118	135622	28.4	0.189	25663	44791	33.30	0.327	14647	511054	29.0	0.204	104428				601
7	558421	31.8	0.276	153895	192589	31.5	0.269	51878	145274	35.42	0.402	58400	896284	32.4	0.295	264173				1055
8	443144	35.1	0.384	170318	165197	35.8	0.411	67877	235791	37.14	0.469	110586	844132	35.9	0.413	348781				993
9	304441	37.7	0.486	148014	150891	38.8	0.536	80815	290492	38.80	0.547	158899	745823	38.4	0.520	387728				878
10	196586	39.9	0.587	115401	125182	41.1	0.649	81271	356636	40.71	0.643	229317	678404	40.7	0.628	425989				798
11	90624	41.2	0.652	59105	61185	42.8	0.742	45406	192733	41.79	0.697	134335	344542	41.9	0.693	238845				405
12	55918	45.2	0.888	49654	55762	46.2	0.958	53437	128984	44.77	0.881	113635	240664	45.3	0.901	216725				283
13	25721	46.8	0.997	25636	28485	47.2	1.029	29314	69945	45.61	0.94	65748	124150	46.4	0.972	120698				146
14	15975	50.7	1.303	20813	27548	52.9	1.500	41322	39855	48.72	1.161	46272	83377	50.6	1.300	108407				98
15	6062	49.2	1.183	7169	13188	54.2	1.628	21468	30446	50.11	1.293	39367	49696	51.4	1.368	68004				58
16	8059	53.2	1.528	12312	17164	56.6	1.881	32288	24490	52.60	1.502	36784	49713	54.3	1.637	81384				58
17	1547	53.0	1.508	2333	11291	59.4	2.213	24986	10302	56.14	1.854	19100	23139	57.7	2.006	46418				27
18	5408	55.0	1.710	9245	20068	58.8	2.133	42812	4458	55.38	1.864	8310	29933	57.8	2.017	60366				35
19	2629	55.2	1.731	4549	5660	57.8	2.021	11438	3892	59.67	2.284	8889	12181	58.0	2.042	24877				14
20	464	60.6	2.360	1095	7397	65.6	3.078	22767	4662	58.05	2.079	9692	12523	62.9	2.679	33555				15
21	300	62.5	2.618	786	7400	64.9	2.959	21900	872	63.26	2.735	2385	8572	64.6	2.925	25071				10
22	0	0.0	0.000	0	0	0.0	0.000	0	1014	61.55	2.533	2568	1014	61.9	2.533	2568				1
23	0	0.0	0.000	0	0	0.0	0.000	0	89	66.13	3.291	293	89	67.0	3.291	293				0
24	0	0.0	0.000		5791	71.7	4.127	23899	386	68.50	3.549	1370	6177	71.5	4.091	25269				7
25									68	60.50	2.349	160	68	60.5	2.349	160				0
26									433	68.07	3.48	1507	433	68.1	3.480	1507				1
UNK	24	54.5	1.660	40	0	0.0	0.000	0					24	54.5	1.660	40				0
Total SOP				873000				690200				1060582				2626819				1.18
Catch				873000				690200				1041000					240000	111000	113000	

Table 11. Numbers at age of American plaice from the (a) Canadian fall RV survey (1985-2013; no 2006), (b) Canadian spring RV survey (1990-2013; no 2004) and (c) EU-Spain Div. 3NO survey (1998-2013).

Fall	5	6	7	8	9	10	11	12	13	14
1990.9	853.098	642.862	369.626	191.668	124.519	55.198	29.201	17.430	12.054	9.316
1991.9	724.397	578.812	249.380	116.271	81.837	44.303	25.916	13.857	12.207	6.977
1992.9	367.927	499.192	226.077	76.712	35.653	17.680	8.451	6.848	3.333	3.151
1993.9	360.452	372.076	316.567	104.116	33.000	15.316	6.798	5.095	3.077	2.383
1994.9	190.297	151.085	134.913	89.251	28.649	7.822	2.667	1.723	0.919	1.168
1995.9	295.940	336.345	151.960	61.447	39.520	10.745	1.880	1.308	0.452	0.307
1996.9	208.293	174.079	82.201	21.365	8.820	3.077	1.781	0.587	0.098	0.116
1997.9	153.853	159.848	119.979	53.224	23.331	7.304	3.217	1.208	0.849	0.595
1998.9	121.174	129.090	112.639	83.420	68.417	17.949	6.944	3.630	2.041	0.844
1999.9	92.461	93.426	79.565	98.916	72.701	33.661	18.853	12.311	4.889	1.076
2000.9	73.671	132.006	115.595	83.788	61.816	48.924	25.380	7.069	3.091	0.843
2001.9	53.977	67.182	97.770	63.670	48.712	27.344	26.360	11.691	2.834	1.128
2002.9	105.561	42.394	72.913	75.893	41.055	26.800	26.982	15.759	7.846	0.989
2003.9	325.025	85.303	49.333	35.469	19.314	12.574	11.135	6.373	1.987	0.857
2005.9	170.458	196.940	131.951	38.038	13.807	13.226	7.264	5.099	4.833	3.319
2006.9	74.278	141.128	138.301	108.766	26.315	9.192	10.458	9.922	5.594	3.616
2007.9	118.060	67.983	128.426	121.169	74.096	24.413	9.052	8.624	2.724	4.867
2008.9	515.631	146.418	117.517	103.649	69.111	28.220	8.278	4.662	2.591	2.692
2009.9	229.210	230.664	78.367	52.176	41.569	21.308	14.410	3.746	3.075	2.354
2010.9	200.451	254.779	135.445	46.448	28.197	35.688	11.202	4.373	3.335	2.846
2011.9	286.531	184.782	145.065	91.253	29.255	16.977	14.320	10.137	3.661	1.222
2012.9	279.111	226.040	106.830	64.731	47.429	19.187	10.661	7.576	4.283	1.482
2013.9	359.929	371.144	165.714	92.998	47.019	21.058	13.961	11.331	6.773	2.269

Spring	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1985.5	263.811	454.551	595.652	389.798	208.007	140.238	84.297	45.199	22.716	13.977
1986.5	256.002	561.361	577.156	307.058	193.651	98.117	45.955	34.378	21.735	8.903
1987.5	460.214	747.454	656.206	398.314	184.639	101.101	41.829	33.798	19.928	11.136
1988.5	368.612	616.621	543.875	314.972	217.849	85.292	48.628	32.575	18.745	11.969
1989.5	336.143	551.765	470.169	273.725	187.637	74.679	39.843	27.071	16.825	9.650
1990.5	618.749	377.901	371.001	200.264	130.479	77.524	32.385	21.463	14.428	8.809
1991.5	398.190	364.155	180.205	112.916	67.544	35.190	22.260	13.356	7.224	5.529
1992.5	110.276	190.141	150.915	63.403	34.120	17.503	9.447	5.402	3.343	1.767
1993.5	138.054	180.137	160.064	89.449	32.226	16.510	7.626	4.264	1.783	1.325
1994.5	99.220	106.040	85.372	43.270	19.992	5.397	3.952	1.396	1.241	0.996
1995.5	41.914	57.524	59.883	49.937	27.484	8.339	2.664	0.539	0.093	0.035
1996.5	133.678	130.513	97.122	39.511	16.189	4.502	1.942	2.233	0.518	0.250
1997.5	65.278	84.402	79.311	48.718	18.944	6.047	2.678	1.819	0.562	0.174
1998.5	69.797	69.196	76.743	79.391	47.909	19.560	9.928	3.281	1.624	0.445
1999.5	66.741	104.510	104.869	111.518	107.309	65.322	30.521	13.021	6.508	1.894
2000.5	34.977	67.015	78.009	64.565	59.164	47.188	27.929	9.536	4.042	0.900
2001.5	28.853	36.351	73.856	62.438	58.427	45.042	34.569	16.018	5.541	2.771
2002.5	56.503	41.334	51.938	53.824	38.253	24.420	20.028	12.561	4.006	2.010
2003.5	188.242	72.503	46.058	49.745	39.965	18.074	13.764	11.463	4.506	2.168
2004.5	96.532	161.935	51.282	29.336	19.920	15.555	9.207	8.200	4.490	2.707
2005.5	149.659	163.831	143.874	55.103	31.863	16.505	13.679	8.236	6.219	4.662
2007.5	193.863	89.640	144.469	115.486	82.606	16.796	10.938	5.057	4.373	3.821
2008.5	238.975	116.455	91.953	117.024	70.142	42.584	14.799	7.295	3.804	3.320
2009.5	72.302	130.149	44.734	34.017	36.716	24.987	16.124	6.078	1.739	1.933
2010.5	85.360	146.905	138.157	40.600	28.065	18.356	12.122	8.913	3.263	1.226
2011.5	189.294	116.466	97.004	66.676	20.587	13.165	10.890	10.524	3.073	0.965
2012.5	157.622	171.561	113.053	70.765	46.910	22.730	11.922	7.027	4.479	2.055
2013.5	233.095	207.679	136.215	85.291	40.384	23.416	15.706	9.659	5.101	3.142

Span	5	6	7	8	9	10	11	12	13	14
1998.5	8.58	14.25	29.99	48.49	33.83	13.68	5.39	1.97	0.95	1.03
1999.5	12.89	37.92	32.15	42.53	60.52	50.12	20.46	9.19	5.00	1.87
2000.5	11.00	19.64	49.71	39.49	51.90	46.98	29.09	13.56	6.38	0.97
2001.5	4.81	11.44	30.59	28.50	27.17	20.44	21.20	8.26	2.27	0.96
2002.5	38.40	11.40	10.04	18.84	14.28	8.86	10.67	7.45	1.84	1.03
2003.5	235.17	56.43	22.53	16.91	19.43	8.11	8.50	10.41	3.88	1.73
2004.5	76.80	204.71	47.14	12.83	11.17	11.95	6.44	7.90	4.39	3.80
2005.5	40.63	91.46	121.13	42.37	17.82	6.11	4.39	4.29	3.30	2.38
2006.5	105.85	85.84	92.85	78.66	57.88	25.60	11.87	6.46	3.47	2.28
2007.5	97.64	33.62	61.14	45.09	56.80	10.92	3.75	3.07	2.24	2.27
2008.5	282.61	121.99	36.95	75.11	38.91	32.57	8.91	4.69	1.69	2.44
2009.5	50.51	97.16	35.08	19.65	17.17	23.13	20.54	8.02	1.50	1.11
2010.5	43.50	108.88	141.00	29.71	13.66	9.56	9.44	11.11	3.50	1.34
2011.5	116.78	137.16	128.10	82.41	14.83	9.97	8.76	6.36	2.18	0.90
2012.5	71.40	167.96	125.20	84.46	49.52	17.64	6.98	5.10	2.67	1.65
2013.5	132.64	160.50	182.84	64.82	41.94	21.77	8.17	5.23	2.62	1.31

Table 12. Catch at age used in the virtual population analyses. Age 15 is a plus group. Please note there have been some corrections to the catch at age in the most recent years.

Catch	5	6	7	8	9	10	11	12	13	14	15
1960	44.7	318.8	841.8	1365.9	1738.3	2280.0	2540.0	3473.6	2752.5	2564.7	4588.8
1961	28.1	200.4	531.2	1230.9	2463.9	3174.2	2467.1	2272.0	3894.1	2579.4	5102.7
1962	62.4	445.1	657.2	1096.1	1184.5	1669.1	2432.4	2697.6	2409.5	3276.8	5958.8
1963	144.3	1029.7	1866.4	1434.1	1546.8	2237.6	3104.3	4174.8	3896.9	3851.9	5622.8
1964	268.6	1916.7	4997.5	3253.4	6174.5	8768.6	6960.2	6149.8	3245.9	3033.6	5552.8
1965	475.5	3157.0	7234.8	9305.9	7048.0	7562.9	5731.6	5790.8	5214.6	4333.2	6510.2
1966	1759.8	6271.7	10036.6	11132.5	9516.7	7266.3	7106.4	5667.6	5731.0	5009.8	8475.7
1967	433.9	3345.3	10834.8	7647.2	9504.5	13713.2	13672.7	14564.6	9495.5	6572.1	13247.8
1968	275.8	2342.3	4139.2	9785.9	11210.5	11631.0	7735.4	13842.2	8778.0	6339.2	8419.3
1969	690.3	2453.1	7875.0	14186.6	18181.9	12778.9	12735.3	10396.6	7053.8	5305.1	7666.2
1970	115.9	2172.2	2554.1	10006.8	13536.7	11286.1	11179.1	8248.5	5556.4	4661.3	9285.0
1971	1135.9	1749.6	8411.7	10457.6	15504.1	14164.8	10993.1	9026.5	5195.2	3720.6	7130.5
1972	578.2	2573.8	2367.8	7696.8	11301.7	12765.9	12718.0	10706.0	6783.8	4354.0	7033.1
1973	46.4	1079.1	6329.1	10518.1	13016.7	10042.3	9980.4	6762.3	6589.6	3733.8	7013.8
1974	354.0	5955.0	10475.0	10069.0	7768.0	9004.0	7086.0	4596.0	3809.0	2278.0	2164.0
1975	883.0	3128.0	7220.0	9433.0	9234.0	7903.0	5701.0	4732.0	3788.0	2617.0	2933.0
1976	837.0	3907.0	8781.0	19363.0	16597.0	12338.0	8323.0	5156.0	3024.0	2309.0	2241.0
1977	974.0	6723.0	8743.0	11730.0	13559.0	11157.0	6520.0	4257.0	2369.0	1493.0	1625.0
1978	1558.0	4467.0	9195.0	10397.0	12743.0	13881.0	9938.0	6823.0	3655.0	2239.0	2440.0
1979	1257.0	6551.0	13532.0	18747.0	14977.0	12506.0	8791.0	3775.0	1843.0	714.0	580.0
1980	263.0	2977.0	9531.0	12578.0	14111.0	14212.0	11288.0	8088.0	3732.0	1565.0	1022.0
1981	154.0	554.0	2248.0	4786.0	7921.0	11425.0	13565.0	11872.0	8693.0	5591.0	4697.0
1982	27.0	314.0	1814.0	4799.0	8946.0	12836.0	15801.0	14489.0	7942.0	4224.0	2943.0
1983	119.0	991.0	3053.0	5797.0	8343.0	7707.0	8493.0	7517.0	4588.0	2480.0	1771.0
1984	48.0	397.0	1516.0	3311.0	5853.0	9958.0	12887.0	8964.0	5072.0	2515.0	1602.0
1985	296.0	788.0	2362.0	5652.0	10694.0	15741.0	14528.0	9233.0	4108.0	1969.0	1792.0
1986	4407.0	9707.0	12556.0	12530.0	13872.0	13874.0	14246.0	10376.0	5947.0	2637.0	2155.0
1987	2237.0	4941.0	7691.0	10893.0	15867.0	17640.0	11404.0	6986.0	3076.0	1303.0	1046.0
1988	2908.0	3213.0	4853.0	7269.0	10123.0	10325.0	9260.0	6040.0	2692.0	1156.0	962.0
1989	12745.0	11553.0	11432.0	9652.0	14180.0	12387.0	8405.0	4972.0	2029.0	1027.0	715.0
1990	15134.0	7694.0	4489.0	4604.0	8666.0	8666.0	6452.0	3633.0	1702.0	945.0	548.0
1991	6103.0	12152.0	7846.0	9331.0	6589.0	4394.0	2294.0	811.0	364.0	484.0	
1992	148.0	1023.0	2591.0	3395.0	3618.0	2154.0	1507.0	875.0	576.0	513.0	579.0
1993	1172.4	3712.9	8820.9	11590.5	5720.0	3376.9	1853.1	1002.5	526.9	354.7	526.8
1994	4316.3	3837.1	5426.1	4459.7	2777.0	736.9	475.6	162.8	120.9	54.7	27.7
1995	99.2	313.9	453.2	333.0	203.3	65.5	13.6	4.1	0.1	0.1	0.4
1996	180.9	742.8	975.0	452.7	211.1	51.9	10.4	8.1	2.3	1.0	1.3
1997	19.4	134.9	543.7	719.4	409.4	149.3	93.5	56.8	26.2	1.4	1.4
1998	10.6	54.8	272.7	767.1	804.9	455.5	278.5	117.3	69.0	49.2	18.3
1999	26.0	174.5	268.4	579.2	1029.9	1079.4	627.4	278.1	125.6	39.6	38.3
2000	15.2	226.3	726.8	915.1	1442.7	1532.7	979.1	429.1	195.2	43.9	116.6
2001	111.0	331.5	1139.1	1413.3	1583.8	1595.5	1403.9	665.1	232.4	86.1	109.1
2002	312.2	308.3	609.9	1488.3	1431.7	1082.1	1059.3	605.2	203.5	62.4	60.6
2003	1212.4	983.0	1104.7	1707.9	1993.6	1201.8	999.9	879.7	358.2	156.5	131.8
2004	346.2	1898.8	1215.9	967.5	1086.1	1013.6	739.9	591.1	320.1	201.4	124.4
2005	58.6	289.0	999.0	842.9	778.7	579.7	536.2	341.9	260.0	178.0	250.4
2006	76.1	228.4	637.2	558.5	469.0	354.4	311.7	252.7	210.7	154.5	238.8
2007	53.9	73.3	375.1	627.6	738.8	366.3	283.3	249.6	247.8	247.3	564.6
2008	82.3	136.2	292.8	722.4	736.4	511.0	226.9	198.8	111.5	101.3	564.6
2009	189.3	689.5	544.6	691.0	787.2	645.5	472.2	214.3	88.4	87.3	356.0
2010	126.1	687.0	882.4	555.1	483.1	579.1	408.6	295.5	155.7	88.7	289.9
2011	961.0	1031.0	1247.6	1177.7	500.1	447.3	327.3	304.8	97.8	40.1	134.7
2012	189.0	408.2	725.6	689.5	662.8	305.8	172.8	152.0	100.6	44.3	76.8
2013	331.9	601.3	1054.6	993.2	877.6	798.2	405.4	283.2	146.1	98.1	227.8

Table 13. Stock weight-at-age for Div. 3LNO American plaice (Jan. 1).

beg of year	5	6	7	8	9	10	11	12	13	14	15+
1960	0.23	0.20	0.23	0.32	0.42	0.54	0.66	0.78	0.87	1.04	1.27
1961	0.23	0.20	0.23	0.32	0.42	0.54	0.66	0.78	0.87	1.04	1.27
1962	0.20	0.19	0.23	0.33	0.44	0.55	0.66	0.81	0.88	1.03	1.28
1963	0.18	0.22	0.23	0.33	0.45	0.57	0.67	0.79	0.88	1.02	1.36
1964	0.18	0.24	0.29	0.38	0.46	0.58	0.69	0.79	0.88	1.02	1.35
1965	0.18	0.25	0.32	0.43	0.55	0.62	0.73	0.81	0.89	1.08	1.42
1966	0.18	0.24	0.33	0.43	0.56	0.70	0.83	0.90	0.92	1.10	1.44
1967	0.18	0.24	0.33	0.42	0.55	0.71	0.82	1.00	1.03	1.16	1.56
1968	0.18	0.24	0.32	0.42	0.53	0.65	0.82	0.92	1.05	1.22	1.61
1969	0.18	0.25	0.30	0.38	0.50	0.64	0.74	0.91	1.02	1.23	1.62
1970	0.19	0.24	0.31	0.36	0.47	0.62	0.73	0.81	1.01	1.11	1.50
1971	0.18	0.23	0.30	0.37	0.44	0.57	0.72	0.85	0.93	1.09	1.35
1972	0.19	0.24	0.31	0.40	0.46	0.56	0.68	0.82	0.92	1.10	1.37
1973	0.19	0.23	0.28	0.38	0.50	0.58	0.72	0.89	1.04	1.12	1.47
1974	0.19	0.23	0.29	0.35	0.46	0.60	0.76	0.95	1.19	1.40	1.70
1975	0.19	0.23	0.30	0.38	0.48	0.63	0.79	0.99	1.21	1.44	1.82
1976	0.18	0.24	0.30	0.38	0.48	0.61	0.76	0.95	1.11	1.33	1.68
1977	0.19	0.23	0.31	0.39	0.50	0.61	0.76	0.92	1.12	1.27	1.63
1978	0.15	0.23	0.31	0.38	0.47	0.61	0.72	0.90	1.10	1.30	1.63
1979	0.17	0.25	0.31	0.40	0.48	0.56	0.66	0.85	1.06	1.41	1.68
1980	0.16	0.26	0.36	0.42	0.50	0.56	0.63	0.72	0.96	1.29	1.76
1981	0.18	0.28	0.36	0.43	0.48	0.54	0.56	0.66	0.77	0.99	1.45
1982	0.21	0.25	0.37	0.42	0.47	0.51	0.57	0.64	0.81	1.00	1.34
1983	0.29	0.31	0.38	0.45	0.53	0.58	0.61	0.67	0.84	1.09	1.50
1984	0.24	0.31	0.38	0.47	0.55	0.61	0.68	0.77	0.92	1.18	1.64
1985	0.22	0.30	0.37	0.43	0.50	0.60	0.68	0.85	1.12	1.46	1.92
1986	0.08	0.20	0.30	0.42	0.51	0.60	0.71	0.90	1.20	1.57	2.08
1987	0.22	0.19	0.28	0.35	0.45	0.60	0.75	0.93	1.17	1.50	2.02
1988	0.16	0.24	0.32	0.42	0.46	0.55	0.71	0.93	1.23	1.56	2.06
1989	0.06	0.18	0.26	0.36	0.47	0.55	0.70	0.91	1.22	1.57	2.07
1990	0.10	0.16	0.25	0.34	0.46	0.59	0.75	0.99	1.32	1.70	2.05
1991	0.17	0.21	0.32	0.41	0.52	0.66	0.84	1.10	1.48	1.88	2.22
1992	0.23	0.24	0.33	0.42	0.51	0.67	0.86	1.10	1.41	1.81	2.33
1993	0.09	0.23	0.28	0.36	0.45	0.57	0.73	0.93	1.21	1.47	2.01
1994	0.08	0.15	0.24	0.32	0.44	0.61	0.73	0.91	1.16	1.44	1.79
1995	0.17	0.17	0.25	0.34	0.51	0.74	1.10	1.23	1.31	1.85	1.78
1996	0.12	0.19	0.27	0.39	0.54	0.81	1.06	1.46	1.63	2.11	2.35
1997	0.16	0.19	0.27	0.38	0.54	0.74	0.95	1.19	1.53	1.92	2.61
1998	0.14	0.17	0.26	0.35	0.49	0.63	0.81	0.99	1.26	1.73	2.01
1999	0.15	0.21	0.23	0.32	0.41	0.55	0.67	0.86	1.06	1.36	1.81
2000	0.12	0.24	0.31	0.36	0.44	0.57	0.72	0.90	1.15	1.36	1.76
2001	0.19	0.23	0.34	0.43	0.47	0.58	0.75	0.93	1.16	1.39	1.79
2002	0.18	0.27	0.36	0.44	0.51	0.58	0.72	0.94	1.13	1.40	1.74
2003	0.21	0.27	0.37	0.44	0.54	0.64	0.76	0.94	1.20	1.41	1.88
2004	0.18	0.28	0.37	0.47	0.57	0.71	0.84	0.98	1.20	1.53	1.98
2005	0.17	0.28	0.39	0.49	0.58	0.71	0.86	1.01	1.22	1.46	1.93
2006	0.12	0.23	0.38	0.50	0.59	0.69	0.88	1.00	1.21	1.52	1.86
2007	0.22	0.23	0.34	0.47	0.58	0.68	0.81	1.11	1.21	1.38	1.71
2008	0.17	0.26	0.34	0.48	0.59	0.72	0.84	1.10	1.32	1.48	1.63
2009	0.14	0.22	0.31	0.41	0.53	0.66	0.80	0.96	1.33	1.45	1.71
2010	0.20	0.24	0.31	0.39	0.49	0.60	0.71	0.87	1.06	1.36	1.65
2011	0.11	0.24	0.32	0.43	0.54	0.66	0.79	0.98	1.23	1.43	1.67
2012	0.05	0.23	0.31	0.41	0.52	0.64	0.77	0.94	1.21	1.41	1.68
2013	0.08	0.24	0.31	0.41	0.52	0.63	0.76	0.93	1.17	1.40	1.67
2014	0.08	0.24	0.31	0.41	0.52	0.64	0.77	0.95	1.20	1.41	1.67

Table 14. Estimated proportion mature-at-age for Div. 3LNO American plaice.

	5	6	7	8	9	10	11	12	13	14	15
1960	0.002	0.004	0.016	0.040	0.127	0.232	0.561	0.810	0.932	0.977	0.992
1961	0.003	0.005	0.014	0.046	0.105	0.333	0.564	0.810	0.932	0.977	0.992
1962	0.002	0.009	0.013	0.041	0.126	0.250	0.632	0.847	0.932	0.977	0.992
1963	0.001	0.006	0.027	0.037	0.117	0.298	0.486	0.855	0.960	0.977	0.992
1964	0.001	0.002	0.019	0.082	0.100	0.291	0.556	0.728	0.953	0.990	0.992
1965	0.005	0.004	0.009	0.056	0.218	0.240	0.559	0.787	0.884	0.986	0.998
1966	0.013	0.016	0.017	0.038	0.158	0.468	0.474	0.797	0.916	0.956	0.996
1967	0.005	0.033	0.050	0.063	0.141	0.371	0.735	0.720	0.924	0.970	0.984
1968	0.003	0.012	0.082	0.143	0.209	0.404	0.649	0.897	0.880	0.974	0.990
1969	0.003	0.008	0.031	0.190	0.346	0.509	0.737	0.853	0.965	0.955	0.991
1970	0.001	0.009	0.023	0.078	0.381	0.627	0.802	0.921	0.948	0.989	0.984
1971	0.000	0.002	0.025	0.062	0.183	0.618	0.842	0.941	0.980	0.983	0.996
1972	0.000	0.002	0.008	0.065	0.160	0.372	0.809	0.944	0.984	0.995	0.994
1973	0.000	0.001	0.007	0.026	0.158	0.353	0.610	0.918	0.982	0.996	0.999
1974	0.002	0.001	0.006	0.025	0.086	0.338	0.611	0.806	0.967	0.994	0.999
1975	0.002	0.006	0.007	0.025	0.085	0.248	0.581	0.818	0.917	0.987	0.998
1976	0.002	0.007	0.021	0.029	0.108	0.258	0.537	0.790	0.928	0.967	0.995
1977	0.001	0.007	0.023	0.070	0.121	0.359	0.563	0.803	0.911	0.974	0.987
1978	0.000	0.004	0.023	0.073	0.212	0.386	0.723	0.827	0.935	0.965	0.991
1979	0.001	0.001	0.015	0.070	0.209	0.491	0.742	0.924	0.947	0.980	0.987
1980	0.001	0.004	0.008	0.057	0.193	0.469	0.775	0.929	0.983	0.985	0.994
1981	0.002	0.006	0.024	0.047	0.192	0.432	0.747	0.925	0.984	0.996	0.996
1982	0.000	0.010	0.031	0.122	0.224	0.483	0.707	0.908	0.978	0.996	0.999
1983	0.001	0.003	0.051	0.152	0.442	0.628	0.786	0.884	0.971	0.994	0.999
1984	0.000	0.009	0.030	0.229	0.501	0.818	0.908	0.936	0.960	0.991	0.998
1985	0.004	0.005	0.064	0.228	0.620	0.850	0.962	0.983	0.983	0.987	0.997
1986	0.008	0.022	0.055	0.345	0.738	0.900	0.970	0.993	0.997	0.996	0.996
1987	0.004	0.036	0.112	0.424	0.803	0.964	0.980	0.994	0.999	1.000	0.999
1988	0.002	0.018	0.155	0.412	0.904	0.969	0.996	0.996	0.999	1.000	1.000
1989	0.002	0.010	0.077	0.474	0.796	0.992	0.996	1.000	0.999	1.000	1.000
1990	0.003	0.009	0.050	0.272	0.815	0.956	0.999	0.999	1.000	1.000	1.000
1991	0.006	0.013	0.052	0.209	0.626	0.956	0.992	1.000	1.000	1.000	1.000
1992	0.001	0.022	0.059	0.241	0.573	0.883	0.991	0.999	1.000	1.000	1.000
1993	0.005	0.008	0.082	0.232	0.647	0.872	0.971	0.998	1.000	1.000	1.000
1994	0.026	0.034	0.067	0.260	0.595	0.914	0.972	0.993	1.000	1.000	1.000
1995	0.075	0.106	0.195	0.377	0.579	0.877	0.984	0.994	0.999	1.000	1.000
1996	0.009	0.173	0.345	0.627	0.837	0.843	0.972	0.997	0.999	1.000	1.000
1997	0.004	0.040	0.349	0.701	0.921	0.977	0.954	0.994	1.000	1.000	1.000
1998	0.018	0.026	0.159	0.578	0.913	0.988	0.997	0.988	0.999	1.000	1.000
1999	0.020	0.066	0.137	0.463	0.779	0.979	0.998	1.000	0.997	1.000	1.000
2000	0.008	0.074	0.217	0.488	0.797	0.900	0.995	1.000	1.000	0.999	1.000
2001	0.045	0.044	0.245	0.521	0.851	0.947	0.959	0.999	1.000	1.000	1.000
2002	0.052	0.145	0.213	0.567	0.810	0.972	0.988	0.983	1.000	1.000	1.000
2003	0.081	0.155	0.382	0.614	0.841	0.943	0.995	0.997	0.993	1.000	1.000
2004	0.019	0.198	0.379	0.692	0.903	0.955	0.985	0.999	0.999	0.997	1.000
2005	0.056	0.062	0.409	0.669	0.891	0.982	0.989	0.996	1.000	1.000	0.999
2006	0.018	0.139	0.187	0.661	0.870	0.967	0.997	0.997	0.999	1.000	1.000
2007	0.021	0.065	0.304	0.442	0.846	0.957	0.991	0.999	0.999	1.000	1.000
2008	0.028	0.073	0.211	0.542	0.733	0.939	0.987	0.997	1.000	1.000	1.000
2009	0.032	0.097	0.225	0.507	0.762	0.904	0.977	0.996	0.999	1.000	1.000
2010	0.008	0.098	0.284	0.516	0.798	0.897	0.970	0.992	0.999	1.000	1.000
2011	0.003	0.043	0.259	0.594	0.798	0.938	0.959	0.991	0.997	1.000	1.000
2012	0.015	0.027	0.201	0.530	0.844	0.936	0.983	0.985	0.997	0.999	1.000
2013	0.015	0.056	0.199	0.583	0.785	0.952	0.982	0.996	0.994	0.999	1.000
2014	0.015	0.056	0.220	0.687	0.886	0.922	0.987	0.995	0.999	0.998	1.000

Table 15. Results of ADAPT for Div. 3LNO American plaice using Canadian Div. 3LNO spring and fall surveys and EU-Spain Div. 3NO survey.

Orthogonality Offset: 0.000598
Mean Squared Residuals: 0.314300

Parameter	Estimate	Standard Error	Bias	Rel. Err.	Rel.Bias
N[2014 6]	5.049E+04	1.684E+04	2.847E+03	0.333	0.056
N[2014 7]	3.127E+04	7.470E+03	9.086E+02	0.239	0.029
N[2014 8]	2.387E+04	4.789E+03	4.828E+02	0.201	0.020
N[2014 9]	1.157E+04	2.144E+03	1.900E+02	0.185	0.016
N[2014 10]	8.315E+03	1.456E+03	1.172E+02	0.175	0.014
N[2014 11]	7.280E+03	1.206E+03	8.973E+01	0.166	0.012
N[2014 12]	2.787E+03	4.586E+02	3.217E+01	0.165	0.012
N[2014 13]	1.493E+03	2.601E+02	1.804E+01	0.174	0.012
N[2014 14]	1.479E+03	2.395E+02	1.593E+01	0.162	0.011
N[2014 15]	2.473E+03	2.992E+02	1.291E+01	0.121	0.005
q ID#[1]	8.317E-03	1.002E-03	5.329E-05	0.121	0.006
q ID#[2]	9.970E-03	1.192E-03	6.369E-05	0.120	0.006
q ID#[3]	1.004E-02	1.197E-03	6.493E-05	0.119	0.006
q ID#[4]	8.955E-03	1.067E-03	5.896E-05	0.119	0.007
q ID#[5]	7.690E-03	9.175E-04	5.150E-05	0.119	0.007
q ID#[6]	6.129E-03	7.330E-04	4.183E-05	0.120	0.007
q ID#[7]	5.817E-03	6.992E-04	4.060E-05	0.120	0.007
q ID#[8]	5.951E-03	7.205E-04	4.271E-05	0.121	0.007
q ID#[9]	5.182E-03	6.319E-04	3.762E-05	0.122	0.007
q ID#[10]	5.180E-03	6.365E-04	3.815E-05	0.123	0.007
q ID#[11]	3.584E-03	3.894E-04	1.872E-05	0.109	0.005
q ID#[12]	5.476E-03	5.909E-04	2.856E-05	0.108	0.005
q ID#[13]	6.482E-03	6.972E-04	3.387E-05	0.108	0.005
q ID#[14]	6.196E-03	6.656E-04	3.289E-05	0.107	0.005
q ID#[15]	5.647E-03	6.070E-04	3.045E-05	0.107	0.005
q ID#[16]	4.532E-03	4.880E-04	2.483E-05	0.108	0.005
q ID#[17]	4.430E-03	4.785E-04	2.476E-05	0.108	0.006
q ID#[18]	4.651E-03	5.048E-04	2.654E-05	0.109	0.006
q ID#[19]	4.009E-03	4.378E-04	2.319E-05	0.109	0.006
q ID#[20]	3.906E-03	4.291E-04	2.287E-05	0.110	0.006
q ID#[21]	2.312E-03	3.381E-04	2.196E-05	0.146	0.010
q ID#[22]	3.643E-03	5.269E-04	3.412E-05	0.145	0.009
q ID#[23]	4.473E-03	6.438E-04	4.207E-05	0.144	0.009
q ID#[24]	4.397E-03	6.321E-04	4.193E-05	0.144	0.010
q ID#[25]	4.514E-03	6.494E-04	4.374E-05	0.144	0.010
q ID#[26]	3.997E-03	5.767E-04	3.947E-05	0.144	0.010
q ID#[27]	3.860E-03	5.600E-04	3.904E-05	0.145	0.010
q ID#[28]	4.208E-03	6.157E-04	4.380E-05	0.146	0.010
q ID#[29]	2.855E-03	4.217E-04	3.035E-05	0.148	0.011
q ID#[30]	2.614E-03	3.901E-04	2.837E-05	0.149	0.011

Table 16. . Bias adjusted population numbers (000 t) from VPA.

Pop #s Bias Adj(a	5	6	7	8	9	10	11	12	13	14	15
1960	299711	215972	141212	120313	90754	59599	48429	34426	21984	16264	29100
1961	283342	245342	176535	114854	97270	72734	46737	37358	25054	15519	30700
1962	265661	231955	200688	144055	92923	77414	56684	36039	28536	17006	30925
1963	270974	217448	189507	163716	116952	75009	61874	44214	27073	21190	30932
1964	260403	221724	177102	153470	132744	94355	59392	47856	32435	18655	34147
1965	288220	212957	179802	140486	122713	103109	69345	42353	33640	23629	35500
1966	250042	235545	171504	140679	106625	94109	77596	51606	29459	22846	38652
1967	223369	203128	187185	131359	105137	78715	70496	57122	37142	18963	38224
1968	176502	182487	163286	143478	100647	77508	52103	45415	33683	21879	29058
1969	174804	144258	147292	129950	108641	72298	52983	35691	24763	19692	28456
1970	164081	142494	115893	113486	93606	72579	47691	31933	19890	13941	27770
1971	204824	134234	114703	92579	83891	64445	49259	28997	18734	11295	21647
1972	242725	166670	108321	86323	66372	54731	40026	30446	15643	10674	17241
1973	292802	198204	134134	86548	63734	44166	33335	21363	15334	6744	12668
1974	280066	239684	161301	104107	61381	40472	27132	18336	11425	6663	6330
1975	293988	228979	190860	122612	76157	43255	25040	15849	10883	5939	6656
1976	276670	239899	184647	149745	91877	54031	28301	15376	8729	5515	5353
1977	232208	225762	192885	143252	105155	60285	33145	15701	7966	4437	4829
1978	218534	189236	178769	150030	106705	73876	39317	21271	9032	4396	4791
1979	200747	177513	150900	138065	113454	75878	47994	23261	11295	4125	3351
1980	193540	163222	139422	111344	96149	79395	50864	31382	15646	7589	4956
1981	188527	158220	130947	105551	79824	66011	52211	31495	18428	9455	7943
1982	191313	154214	129039	105180	82098	58213	43761	30561	15155	7327	5105
1983	189913	156610	125976	104010	81783	59152	36119	21673	12089	5332	3808
1984	191544	155380	127326	100384	79925	59436	41486	21937	11007	5790	3688
1985	187590	156780	126856	102877	79198	60157	39697	22404	9942	4483	4080
1986	159693	153318	127648	101728	79128	55207	35113	19489	10085	4466	3649
1987	142167	126767	116768	93189	71997	52746	32734	16003	6715	2973	2387
1988	162312	114377	99328	88663	66479	44678	27370	16580	6859	2751	2289
1989	190555	130264	90743	76943	66035	45312	27298	14108	8165	3206	2232
1990	185767	102535	67959	44809	38026	28265	17450	9829	4628	3292	1909
1991	92488	97923	54544	36610	22905	15908	10204	5509	3104	1468	1951
1992	63287	49829	48492	26208	14593	7669	4522	2783	1557	1223	1380
1993	55087	37139	28555	26584	12872	5891	2912	1545	989	491	730
1994	61845	31536	19062	10261	7150	3387	1034	392	196	200	101
1995	58049	33142	15674	7184	2769	2163	1443	261	111	29	116
1996	38582	34093	19270	8883	3977	1477	1223	839	151	65	85
1997	25817	22573	19505	10605	4886	2181	830	712	488	87	87
1998	23682	21119	18359	15478	8034	3631	1651	595	532	376	140
1999	23854	19380	17242	14785	11980	5852	2563	1101	382	373	361
2000	15818	19507	15709	13874	11582	8880	3820	1534	652	200	531
2001	13612	12937	15766	12206	10533	8182	5890	2248	871	358	454
2002	13727	11044	10292	11881	8719	7198	5264	3561	1243	504	490
2003	20218	10957	8764	7876	8386	5850	4918	3357	2371	835	703
2004	16339	15459	8084	6180	4913	5074	3708	3127	1958	1618	1000
2005	17628	13065	10946	5524	4189	3046	3243	2371	2029	1315	1850
2006	13773	14380	10436	8061	3763	2728	1972	2172	1633	1427	2205
2007	17048	11207	11567	7969	6096	2658	1915	1334	1551	1147	2619
2008	32723	13909	9110	9132	5958	4325	1847	1312	867	1046	2353
2009	29006	26717	11265	7194	6825	4215	3081	1307	895	610	2486
2010	30038	23577	21252	8732	5267	4878	2869	2097	877	653	2136
2011	45952	24479	18683	16603	6648	3877	3472	1981	1451	578	1942
2012	46312	36755	19111	14171	12531	4992	2771	2547	1348	1099	1906
2013	58557	37746	29724	14992	10980	9661	3811	2113	1949	1013	2351
2014	49949	47643	30361	23384	11378	8198	7190	2755	1474	1464	2460

Table 17. Bias adjusted fishing mortalities from VPA.

F Bias Adj(analyt	5	6	7	8	9	10	11	12	13	14	15
1960	0.000	0.002	0.007	0.013	0.021	0.043	0.060	0.118	0.148	0.190	0.190
1961	0.000	0.001	0.003	0.012	0.028	0.049	0.060	0.069	0.187	0.202	0.202
1962	0.000	0.002	0.004	0.008	0.014	0.024	0.048	0.086	0.098	0.238	0.238
1963	0.001	0.005	0.011	0.010	0.015	0.033	0.057	0.110	0.172	0.223	0.223
1964	0.001	0.010	0.032	0.024	0.053	0.108	0.138	0.152	0.117	0.197	0.197
1965	0.002	0.016	0.045	0.076	0.065	0.084	0.095	0.163	0.187	0.225	0.225
1966	0.008	0.030	0.067	0.091	0.103	0.089	0.106	0.129	0.241	0.276	0.276
1967	0.002	0.018	0.066	0.066	0.105	0.213	0.240	0.328	0.329	0.477	0.477
1968	0.002	0.014	0.028	0.078	0.131	0.180	0.178	0.407	0.337	0.382	0.382
1969	0.004	0.019	0.061	0.128	0.203	0.216	0.306	0.385	0.374	0.350	0.350
1970	0.001	0.017	0.025	0.102	0.173	0.188	0.298	0.333	0.366	0.456	0.456
1971	0.006	0.014	0.084	0.133	0.227	0.276	0.281	0.417	0.363	0.447	0.447
1972	0.003	0.017	0.024	0.103	0.207	0.296	0.428	0.486	0.641	0.590	0.590
1973	0.000	0.006	0.053	0.144	0.254	0.287	0.398	0.426	0.633	0.921	0.921
1974	0.001	0.028	0.074	0.113	0.150	0.280	0.338	0.322	0.454	0.469	0.469
1975	0.003	0.015	0.043	0.089	0.143	0.224	0.288	0.396	0.480	0.656	0.656
1976	0.003	0.018	0.054	0.154	0.221	0.289	0.389	0.458	0.477	0.611	0.611
1977	0.005	0.033	0.051	0.095	0.153	0.227	0.244	0.353	0.394	0.460	0.460
1978	0.008	0.026	0.058	0.079	0.141	0.231	0.325	0.433	0.584	0.809	0.809
1979	0.007	0.042	0.104	0.162	0.157	0.200	0.225	0.197	0.198	0.211	0.211
1980	0.002	0.020	0.078	0.133	0.176	0.219	0.279	0.332	0.304	0.257	0.257
1981	0.001	0.004	0.019	0.051	0.116	0.211	0.336	0.531	0.722	1.026	1.026
1982	0.000	0.002	0.016	0.052	0.128	0.277	0.503	0.727	0.845	0.983	0.983
1983	0.001	0.007	0.027	0.063	0.119	0.155	0.299	0.477	0.536	0.708	0.708
1984	0.000	0.003	0.013	0.037	0.084	0.204	0.416	0.591	0.698	0.643	0.643
1985	0.002	0.006	0.021	0.062	0.161	0.338	0.511	0.598	0.600	0.653	0.653
1986	0.031	0.072	0.115	0.146	0.206	0.323	0.586	0.866	1.021	1.024	1.024
1987	0.018	0.044	0.075	0.138	0.277	0.456	0.480	0.647	0.693	0.651	0.651
1988	0.020	0.031	0.055	0.095	0.183	0.293	0.463	0.508	0.560	0.614	0.614
1989	0.090	0.121	0.176	0.175	0.319	0.424	0.491	0.585	0.378	0.517	0.517
1990	0.110	0.101	0.089	0.141	0.341	0.489	0.623	0.623	0.619	0.450	0.450
1991	0.088	0.173	0.203	0.390	0.564	0.728	0.769	0.733	0.402	0.377	0.377
1992	0.003	0.027	0.071	0.181	0.377	0.438	0.544	0.505	0.623	0.741	0.741
1993	0.028	0.137	0.494	0.783	0.805	1.210	1.474	1.533	1.067	1.959	1.959
1994	0.094	0.169	0.446	0.780	0.666	0.323	0.847	0.730	1.381	0.424	0.424
1995	0.002	0.012	0.038	0.061	0.099	0.040	0.012	0.020	0.001	0.004	0.004
1996	0.006	0.028	0.067	0.068	0.071	0.046	0.011	0.013	0.020	0.020	0.020
1997	0.001	0.007	0.031	0.078	0.097	0.078	0.132	0.092	0.061	0.018	0.018
1998	0.000	0.003	0.017	0.056	0.117	0.149	0.205	0.244	0.154	0.156	0.156
1999	0.001	0.010	0.017	0.044	0.099	0.227	0.313	0.325	0.447	0.124	0.124
2000	0.001	0.013	0.052	0.075	0.147	0.210	0.330	0.366	0.398	0.276	0.276
2001	0.009	0.029	0.083	0.136	0.181	0.241	0.303	0.392	0.346	0.306	0.306
2002	0.025	0.031	0.068	0.148	0.199	0.181	0.250	0.207	0.198	0.146	0.146
2003	0.068	0.104	0.149	0.272	0.302	0.256	0.253	0.339	0.182	0.231	0.231
2004	0.024	0.145	0.181	0.189	0.278	0.248	0.247	0.233	0.198	0.147	0.147
2005	0.004	0.025	0.106	0.184	0.229	0.235	0.201	0.173	0.152	0.161	0.161
2006	0.006	0.018	0.070	0.079	0.148	0.154	0.191	0.137	0.153	0.127	0.127
2007	0.003	0.007	0.036	0.091	0.143	0.164	0.178	0.230	0.193	0.270	0.270
2008	0.003	0.011	0.036	0.091	0.146	0.139	0.145	0.182	0.153	0.113	0.113
2009	0.007	0.029	0.055	0.112	0.136	0.184	0.185	0.199	0.115	0.171	0.171
2010	0.005	0.033	0.047	0.073	0.106	0.140	0.170	0.168	0.217	0.162	0.162
2011	0.023	0.048	0.076	0.081	0.087	0.136	0.110	0.185	0.077	0.079	0.079
2012	0.005	0.012	0.043	0.055	0.060	0.070	0.071	0.068	0.086	0.045	0.045
2013	0.006	0.018	0.040	0.076	0.092	0.095	0.125	0.160	0.086	0.113	0.113

Table 18. Spawning stock biomass from VPA output.

	5	6	7	8	9	10	11	12	13	14	15
1960	114	190	532	1528	4864	7455	18016	21629	17877	16539	36787
1961	183	230	558	1707	4321	13049	17502	23471	20374	15781	38809
1962	103	396	611	1923	5158	10610	23763	24732	23535	17199	39328
1963	27	286	1191	1991	6105	12732	20081	29864	22759	21145	41669
1964	51	125	971	4777	6068	15880	22698	27483	27258	18906	45816
1965	274	228	550	3442	14844	15363	28181	27097	26474	25062	50291
1966	569	929	945	2286	9515	30903	30497	37174	24957	23912	55593
1967	184	1632	3058	3445	8164	20721	42310	41263	35185	21347	58774
1968	87	521	4221	8537	11165	20415	27685	37325	31202	25983	46357
1969	110	283	1377	9330	18961	23351	28888	27827	24371	23068	45793
1970	19	317	808	3207	16744	28173	27925	23887	19080	15249	40849
1971	18	67	859	2100	6786	22793	30045	23193	17114	12062	29198
1972	12	73	254	2234	4894	11342	21987	23514	14194	11706	23411
1973	18	53	257	847	5050	8983	14578	17356	15626	7501	18545
1974	87	79	257	890	2448	8205	12583	14049	13145	9245	10779
1975	119	307	371	1164	3151	6724	11469	12889	12054	8438	12074
1976	120	397	1122	1665	4765	8492	11502	11597	8986	7104	8962
1977	43	394	1360	3855	6423	13259	14210	11577	8119	5492	7777
1978	8	170	1270	4216	10607	17528	20426	15790	9267	5531	7718
1979	25	64	708	3880	11304	20790	23382	18204	11349	5717	5560
1980	30	183	423	2685	9205	20879	24815	21005	14724	9643	8659
1981	59	250	1140	2137	7416	15355	21864	19316	13867	9358	11440
1982	14	373	1467	5345	8631	14329	17485	17710	12039	7337	6815
1983	63	158	2416	7049	19146	21630	17314	12866	9878	5782	5713
1984	17	417	1460	10699	22164	29600	25457	15815	9763	6752	6029
1985	168	211	2982	9972	24662	30715	25959	18697	10942	6475	7814
1986	95	689	2107	14767	29739	30032	24272	17431	12016	6979	7566
1987	128	864	3630	13793	26122	30469	24040	14723	7878	4456	4808
1988	54	502	4880	15392	27840	23665	19412	15423	8420	4290	4720
1989	20	236	1793	13292	24518	24502	18921	12821	9977	5039	4619
1990	51	152	854	4151	14372	15837	12993	9681	6095	5587	3912
1991	91	268	911	3126	7464	10046	8550	6079	4586	2760	4341
1992	15	267	942	2625	4298	4517	3857	3044	2198	2208	3212
1993	24	71	658	2213	3770	2916	2066	1429	1191	720	1466
1994	135	158	311	855	1873	1897	730	353	228	289	182
1995	723	589	770	924	825	1407	1565	318	146	54	206
1996	41	1143	1764	2149	1786	1004	1258	1219	244	138	200
1997	18	171	1808	2822	2439	1588	755	840	746	167	227
1998	57	89	748	3138	3629	2270	1327	579	670	651	281
1999	71	272	534	2164	3837	3167	1721	947	405	506	653
2000	15	345	1068	2437	4104	4522	2722	1374	748	271	932
2001	112	132	1331	2705	4193	4524	4237	2093	1013	498	812
2002	133	429	781	2931	3598	4067	3757	3293	1402	708	853
2003	341	464	1233	2144	3817	3513	3720	3157	2828	1175	1324
2004	54	855	1142	2000	2527	3438	3059	3051	2356	2477	1977
2005	166	224	1730	1796	2168	2121	2746	2389	2474	1920	3569
2006	30	456	734	2651	1921	1814	1723	2158	1970	2162	4105
2007	76	164	1182	1652	2991	1728	1542	1481	1876	1585	4473
2008	159	263	661	2355	2563	2916	1532	1436	1141	1544	3832
2009	131	568	773	1500	2746	2508	2422	1255	1192	885	4260
2010	48	557	1862	1766	2076	2618	1982	1805	926	887	3532
2011	15	256	1543	4206	2843	2394	2617	1917	1786	826	3235
2012	36	235	1196	3077	5491	2980	2090	2347	1624	1552	3197
2013	68	506	1850	3574	4450	5810	2825	1949	2260	1416	3915
2014	58	635	2097	6663	5281	4856	5458	2594	1772	2065	4107

Table 19. Retrospective comparison of SSB at age estimated from ADAPT. Table entries provide the ratio of the estimated numbers from the current assessment to those estimated from last year's assessment (model formulation unchanged). Shaded entries highlight changes in excess of ± 10%.

	5	6	7	8	9	10	11	12	13	14	15
1960	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1961	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1964	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1965	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1966	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1967	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1968	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1969	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1970	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1971	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1972	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1973	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1974	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1975	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1976	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1977	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1978	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1979	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1981	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1982	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1983	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1984	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1985	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1986	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1988	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1989	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1990	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1992	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1994	1.01	1.00	1.00	1.00	1.00	1.01	1.00	1.00	1.00	1.01	1.01
1995	1.01	1.01	1.01	1.01	1.00	1.01	1.01	1.01	1.01	1.01	1.01
1996	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1997	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1998	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1999	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
2000	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01
2001	1.03	1.02	1.02	1.02	1.02	1.01	1.02	1.01	1.02	1.02	1.02
2002	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
2003	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.03
2004	0.81	1.04	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
2005	0.95	0.81	1.05	1.04	1.04	1.03	1.04	1.04	1.04	1.04	1.04
2006	1.00	0.95	0.80	1.05	1.05	1.05	1.04	1.05	1.05	1.05	1.05
2007	0.96	1.00	0.94	0.79	1.06	1.05	1.06	1.05	1.06	1.05	1.05
2008	0.87	0.96	1.00	0.94	0.78	1.07	1.06	1.07	1.07	1.07	1.07
2009	0.93	0.87	0.96	1.00	0.94	0.75	1.08	1.07	1.09	1.08	1.08
2010	0.99	0.93	0.86	0.96	1.00	0.93	0.71	1.10	1.09	1.10	1.10
2011	0.95	0.99	0.92	0.86	0.95	1.00	0.92	0.68	1.12	1.12	1.12
2012	1.19	0.95	0.99	0.92	0.85	0.95	1.00	0.91	0.64	1.13	1.13
2013		1.19	0.95	0.99	0.91	0.84	0.94	1.00	0.90	0.62	1.13

Table 20. Retrospective comparison of F at age estimated from ADAPT. Table entries provide the ratio of the estimated numbers from the current assessment to those estimated from last year's assessment (model formulation unchanged). Shaded entries highlight changes in excess of ± 10%.

	5	6	7	8	9	10	11	12	13	14	15
1960	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1961	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1964	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1965	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1966	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1967	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1968	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1969	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1970	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1971	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1972	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1973	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1974	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1975	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1976	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1977	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1978	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1979	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1981	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1982	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1983	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1984	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1985	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1986	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1988	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1989	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1990	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1992	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1994	0.99	0.99	1.00	1.00	0.99	0.99	0.99	0.99	1.00	0.99	0.99
1995	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
1996	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
1997	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
1998	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
1999	0.98	0.99	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
2000	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99
2001	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
2002	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
2003	0.96	0.97	0.97	0.98	0.97	0.97	0.97	0.97	0.97	0.97	0.97
2004	1.24	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.96	0.96
2005	1.06	1.24	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
2006	1.00	1.06	1.25	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
2007	1.04	1.00	1.06	1.27	0.94	0.95	0.94	0.94	0.94	0.94	0.94
2008	1.16	1.04	1.00	1.06	1.31	0.93	0.94	0.93	0.93	0.93	0.93
2009	1.08	1.16	1.05	1.00	1.07	1.36	0.92	0.92	0.92	0.92	0.92
2010	1.01	1.08	1.16	1.05	1.00	1.08	1.43	0.90	0.91	0.90	0.90
2011	1.05	1.01	1.09	1.17	1.05	1.00	1.09	1.52	0.89	0.89	0.89
2012	0.84	1.05	1.01	1.09	1.19	1.06	1.00	1.10	1.59	0.89	0.89

Table 21. Retrospective comparison of SSB at age estimated from ADAPT run with EU-Survey excluded. Table entries provide the ratio of the estimated numbers from the current assessment to those estimated from last year's assessment (model formulation unchanged). Shaded entries highlight changes in excess of ± 10%.

	5	6	7	8	9	10	11	12	13	14	15
1960	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1961	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1964	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1965	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1966	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1967	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1968	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1969	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1970	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1971	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1972	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1973	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1974	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1975	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1976	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1977	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1978	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1979	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1981	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1982	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1983	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1984	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1985	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1986	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1988	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1989	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1990	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1992	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1994	1.01	1.01	1.00	1.00	1.00	1.01	1.01	1.00	1.00	1.01	1.01
1995	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1996	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1997	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1998	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1999	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
2000	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01
2001	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
2002	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.03	1.03
2003	1.04	1.03	1.03	1.02	1.03	1.03	1.03	1.03	1.03	1.03	1.03
2004	0.80	1.05	1.03	1.04	1.03	1.03	1.03	1.04	1.04	1.04	1.04
2005	0.95	0.80	1.05	1.04	1.04	1.04	1.05	1.04	1.04	1.04	1.04
2006	1.02	0.95	0.79	1.06	1.05	1.06	1.05	1.06	1.05	1.05	1.05
2007	1.00	1.02	0.95	0.78	1.07	1.06	1.07	1.06	1.06	1.06	1.06
2008	0.89	1.00	1.02	0.95	0.77	1.08	1.07	1.08	1.08	1.08	1.08
2009	0.95	0.89	1.00	1.03	0.94	0.74	1.09	1.08	1.10	1.09	1.09
2010	1.02	0.95	0.89	1.00	1.03	0.94	0.70	1.11	1.10	1.11	1.11
2011	0.92	1.02	0.95	0.89	1.00	1.03	0.93	0.66	1.13	1.13	1.13
2012	1.14	0.92	1.02	0.94	0.88	1.00	1.04	0.92	0.62	1.15	1.15
2013		1.14	0.92	1.03	0.94	0.87	1.00	1.04	0.92	0.60	1.15

Table 22. Results of stochastic projections under various fishing mortality options. Labels p10, p50 and p90 refer to 10th, 50th and 90th percentiles of each quantity.

	F = 0		
	SSB ('000 t)		
	p10	p50	p90
2014	31	34	38
2015	39	44	48
2016	47	53	60
2017	54	62	71

	F_{2013} = 0.11					
	SSB ('000 t)			Yield ('000 t)		
	p10	p50	p90	p10	p50	p90
2014	31	34	38	3.5	3.9	4.3
2015	36	40	44	4.0	4.5	5.0
2016	40	45	51	4.2	4.7	5.5
2017	41	47	55			

Table 23. Risk assessment of the probability of being below B_{lim} under various fishing scenarios. Yield is median projected value.

	Yield			$P_{(SSB>Blim)}$			$P_{(SSB2017 > SSB2014)}$
Fishing Mortality	2014	2016	2017	2015	2016	2017	
F = 0	-	-	-	<0.05	0.76	>0.95	1.00
F_{2013} = 0.13	3910	4456	4732	<0.05	0.13	0.30	1.00

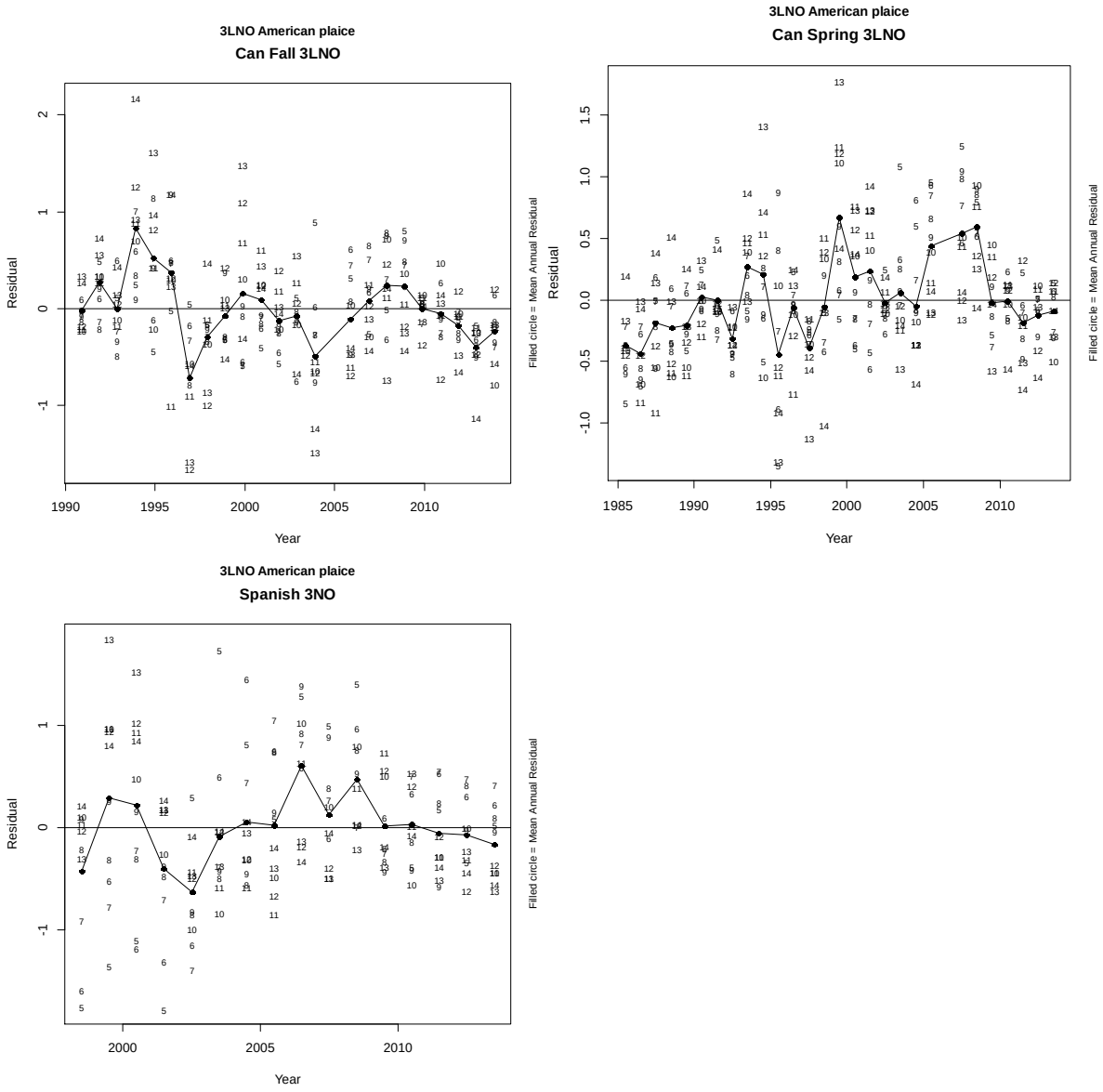

Figure1. Residuals by year and month (numbers represent ages) for Canadian fall survey (top left), spring survey (middle) and EU-Spain Div. 3NO survey (right). Filled circle is the mean annual residual. Note the scales are different for each plot.

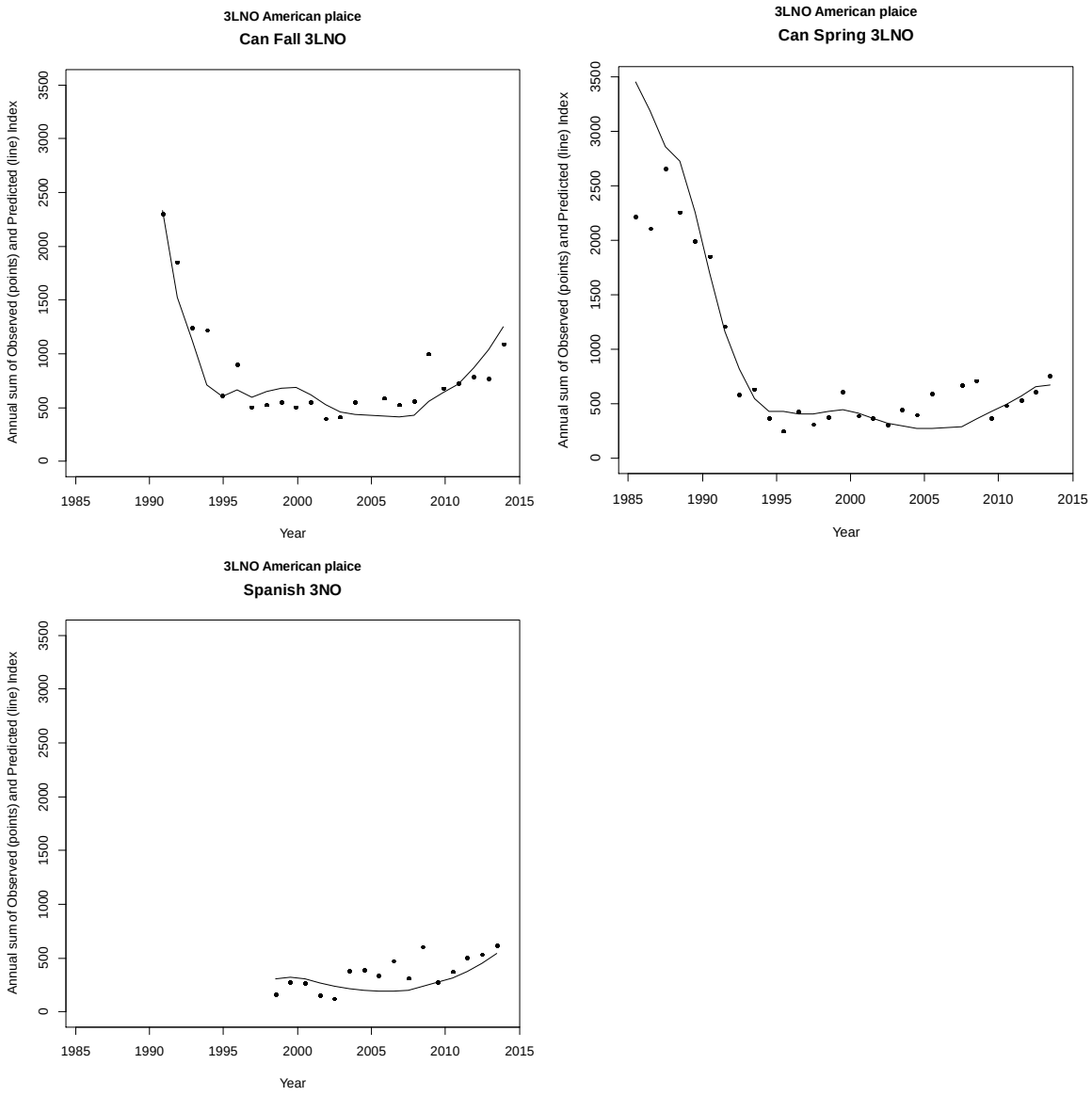

Figure 2. Observed versus predicted abundance for Canadian Div. 3LNO spring and fall and EU-Spain Div. 3NO indices over time.

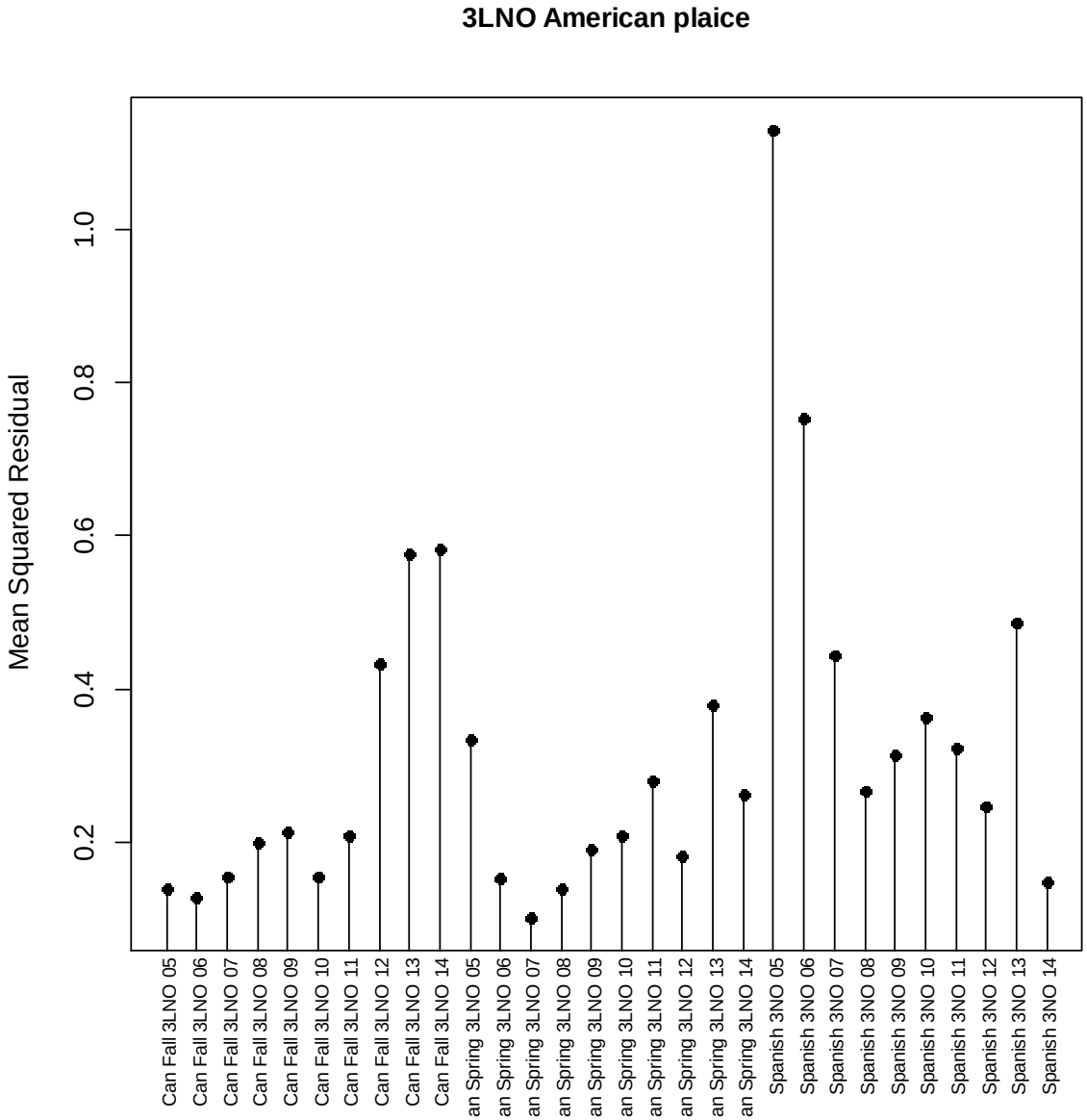

Figure 3. Mean squared residuals by age for fall, spring and EU-Spain Div. 3NO surveys.

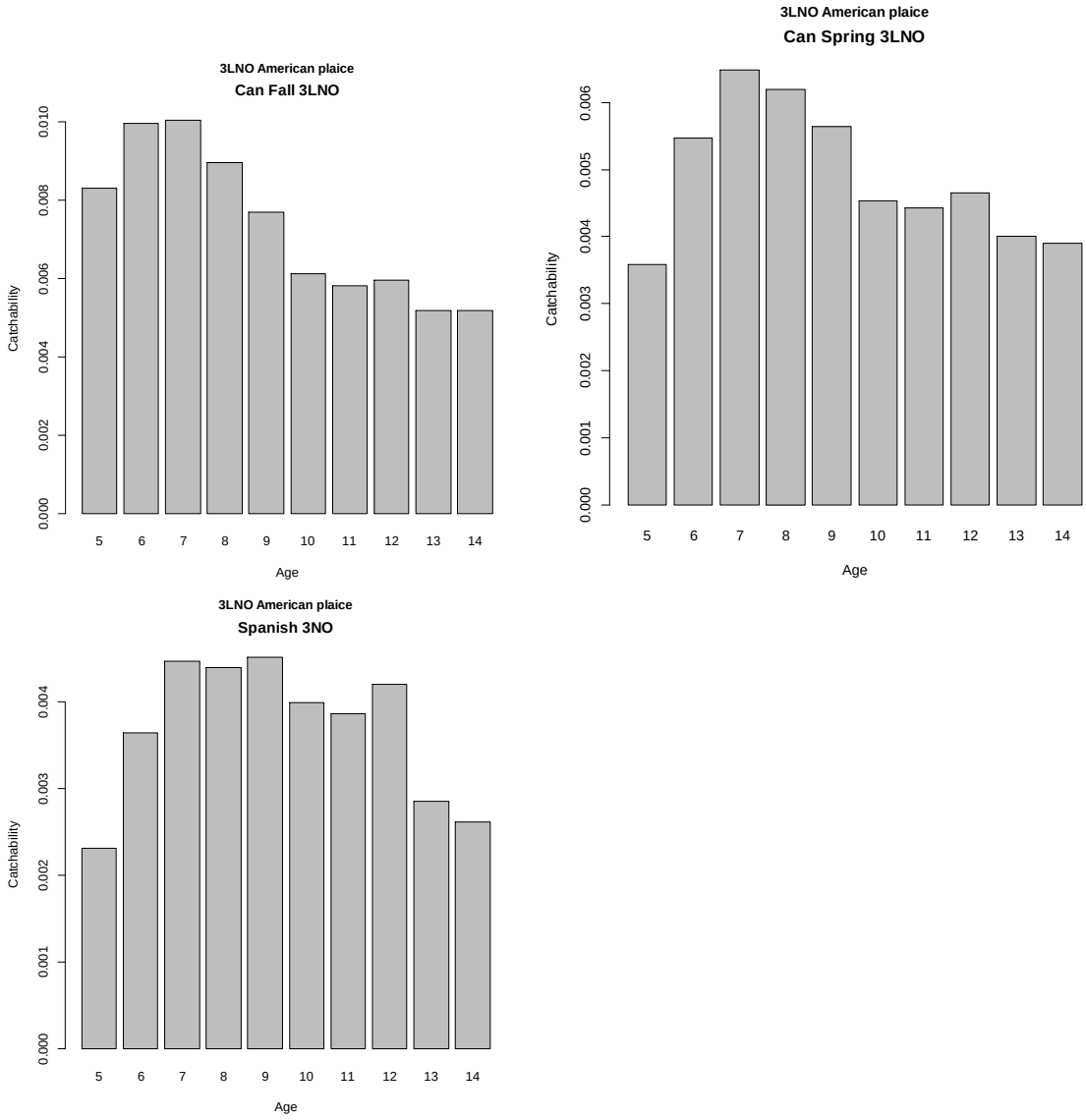

Figure 4. Bottom panel shows the survey catchabilities (q) for each survey by age.

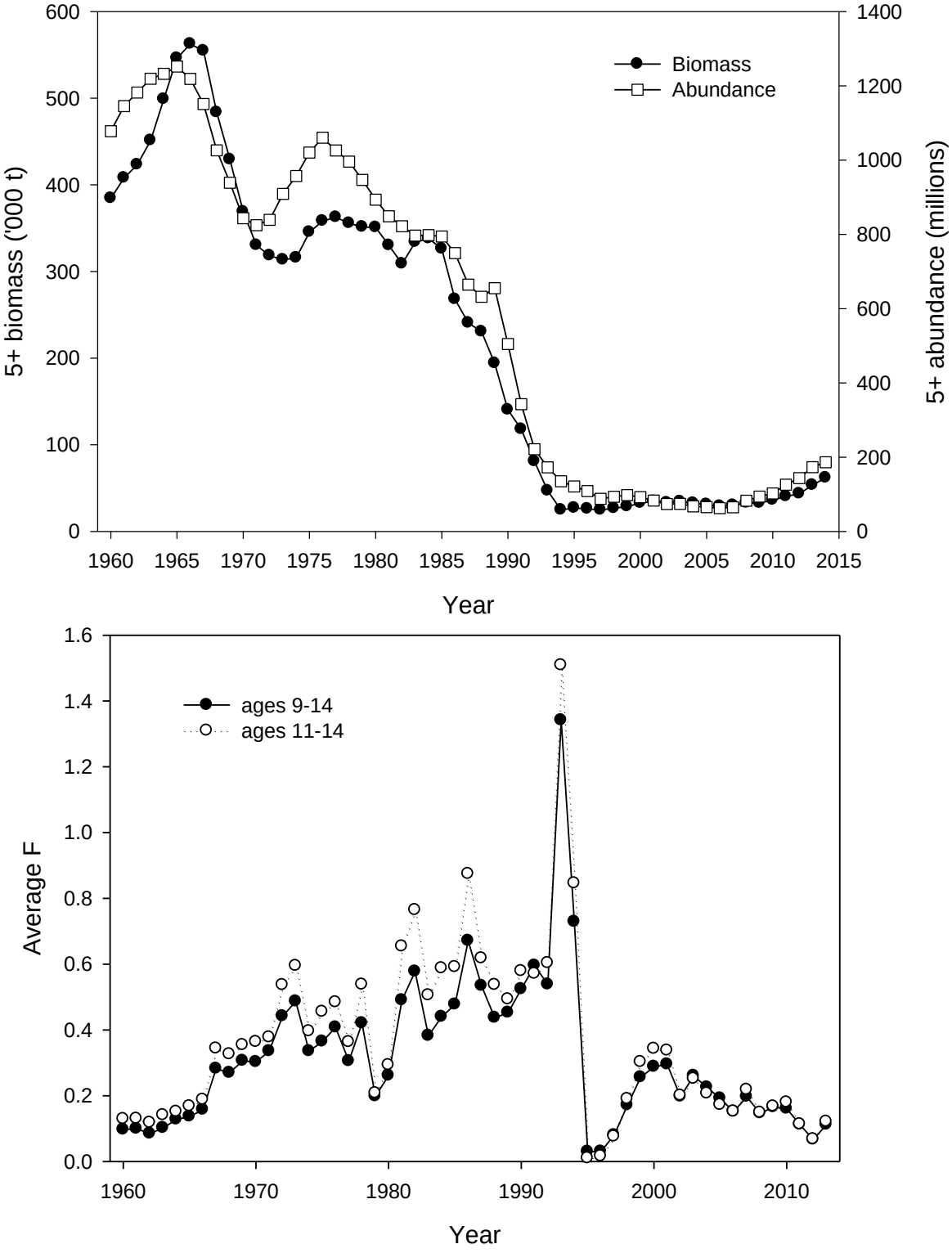

Figure 5. 5+ biomass and abundance (top) and average fishing mortality on ages 9 to 14 and ages 11 to 14 (bottom) from VPA.

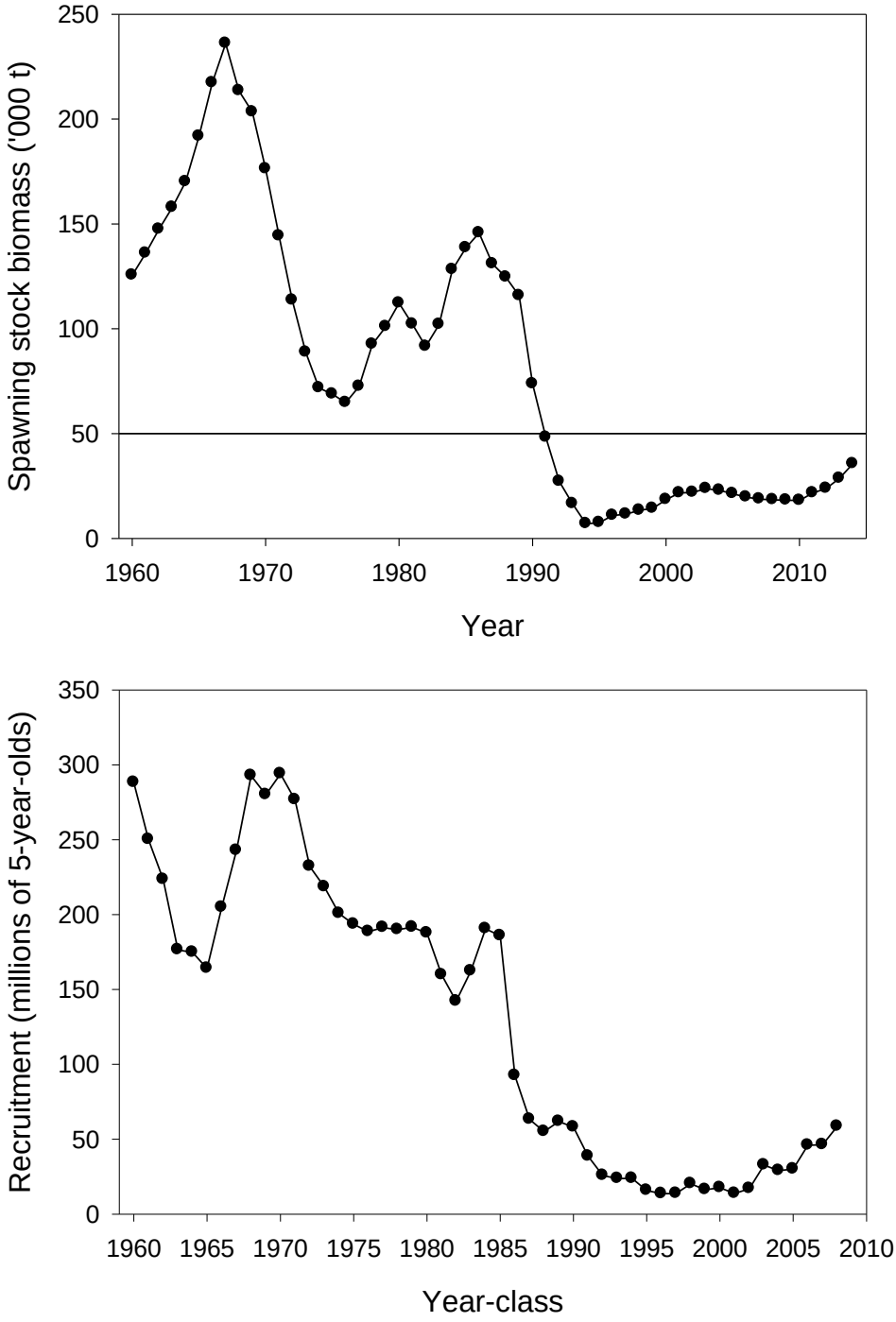

Figure 6. Spawning stock biomass (‘000 t) (top panel) and age 5 recruits (year-class) (bottom panel) from VPA. Horizontal line represents B_{lim}.(50 000 t).

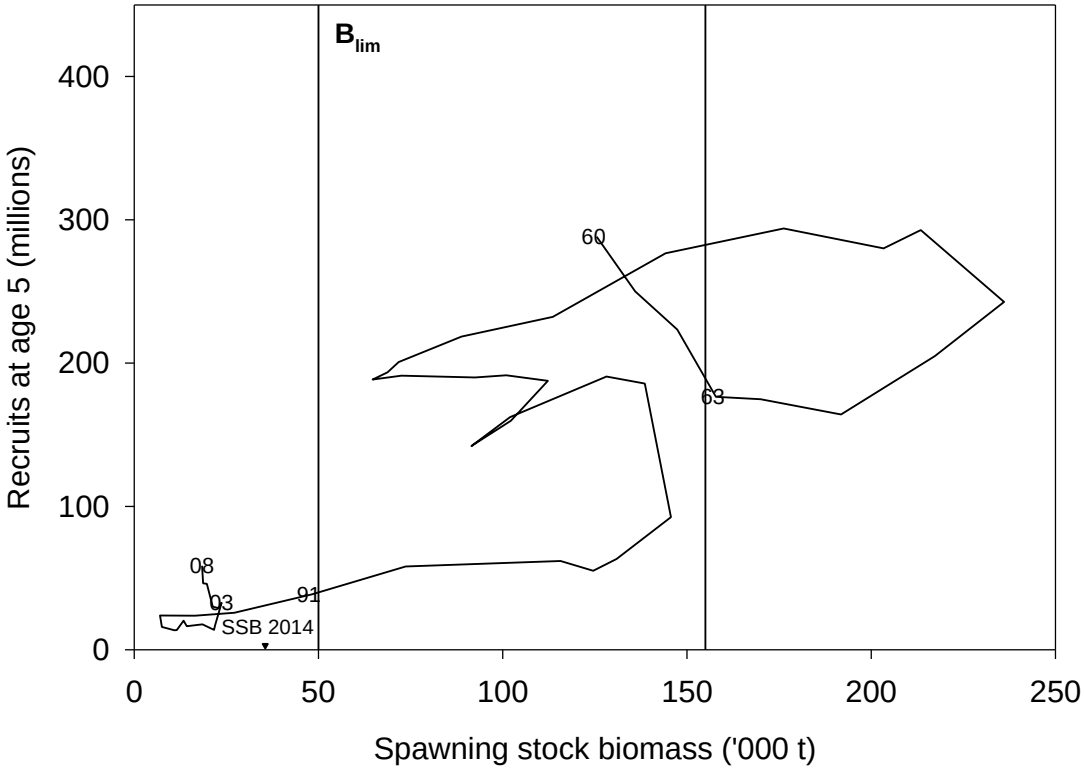

Figure 7. Observed stock recruit scatter. Vertical line at 50, 000 t illustrates Blim, vertical line at 150, 000 t indicates SSB above which recruitment has been very good.

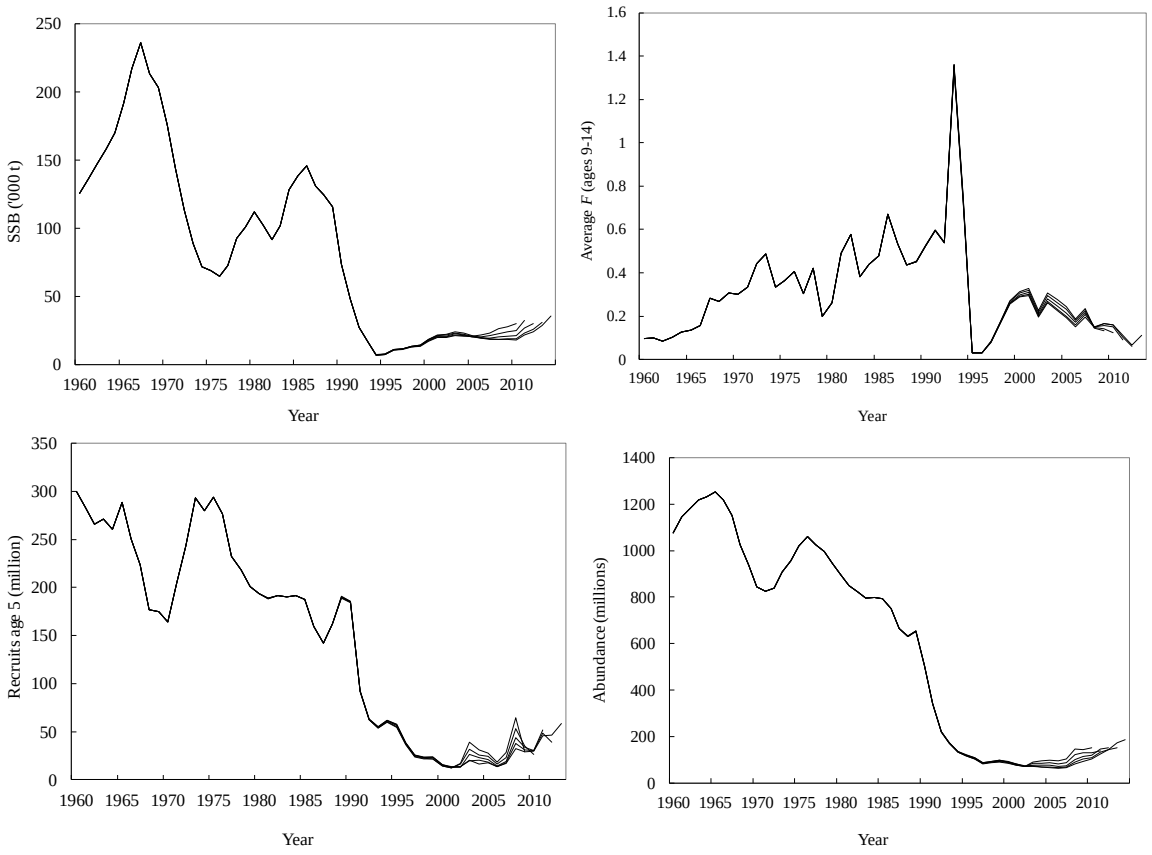

Figure 8. Results of retrospective analysis for Div. 3LNO American plaice.

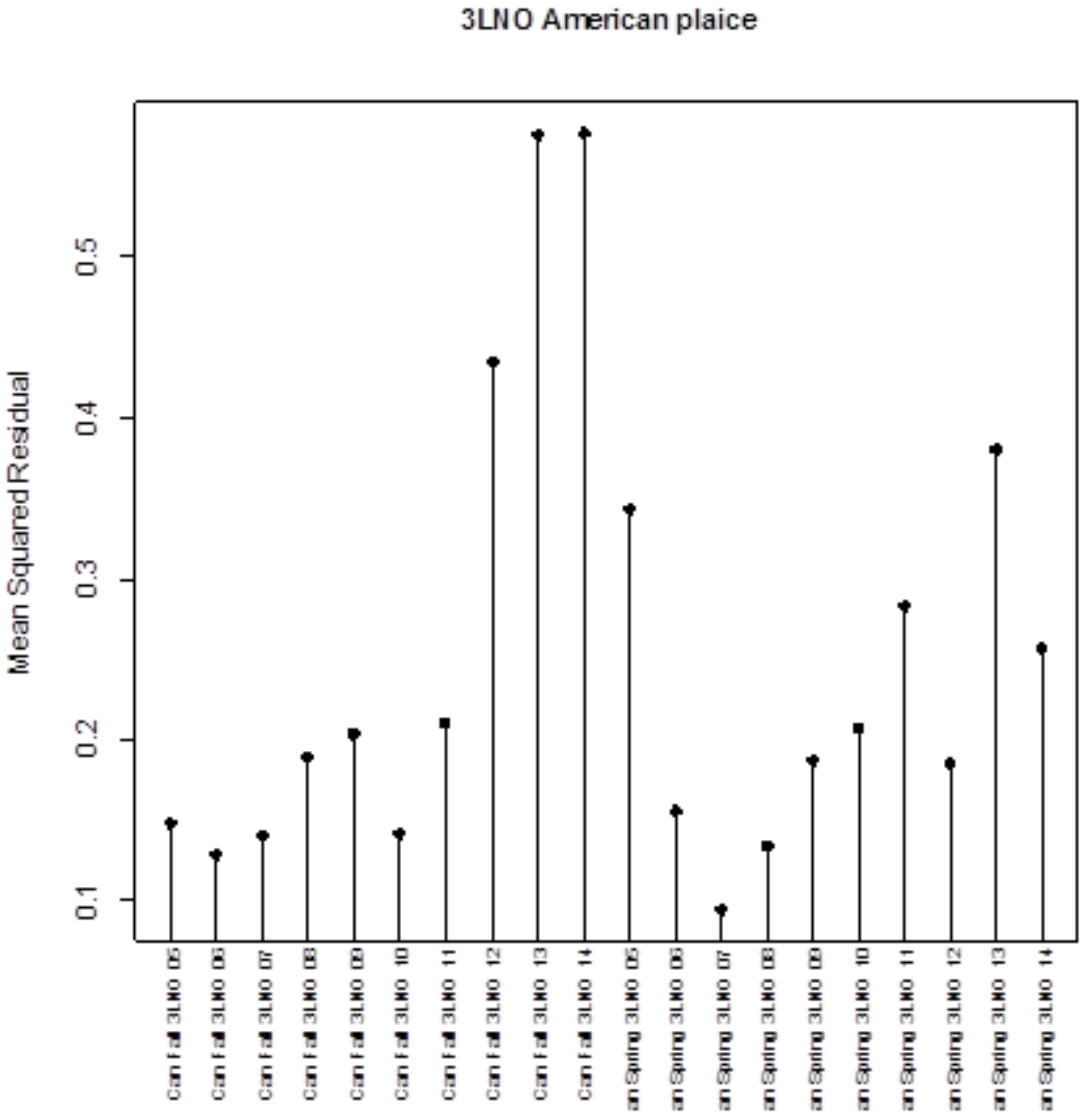

Figure 9. Mean squared residuals by age for fall and spring Canadian surveys from ADAPT run with Eu-Spain Div. 3NO survey not included.

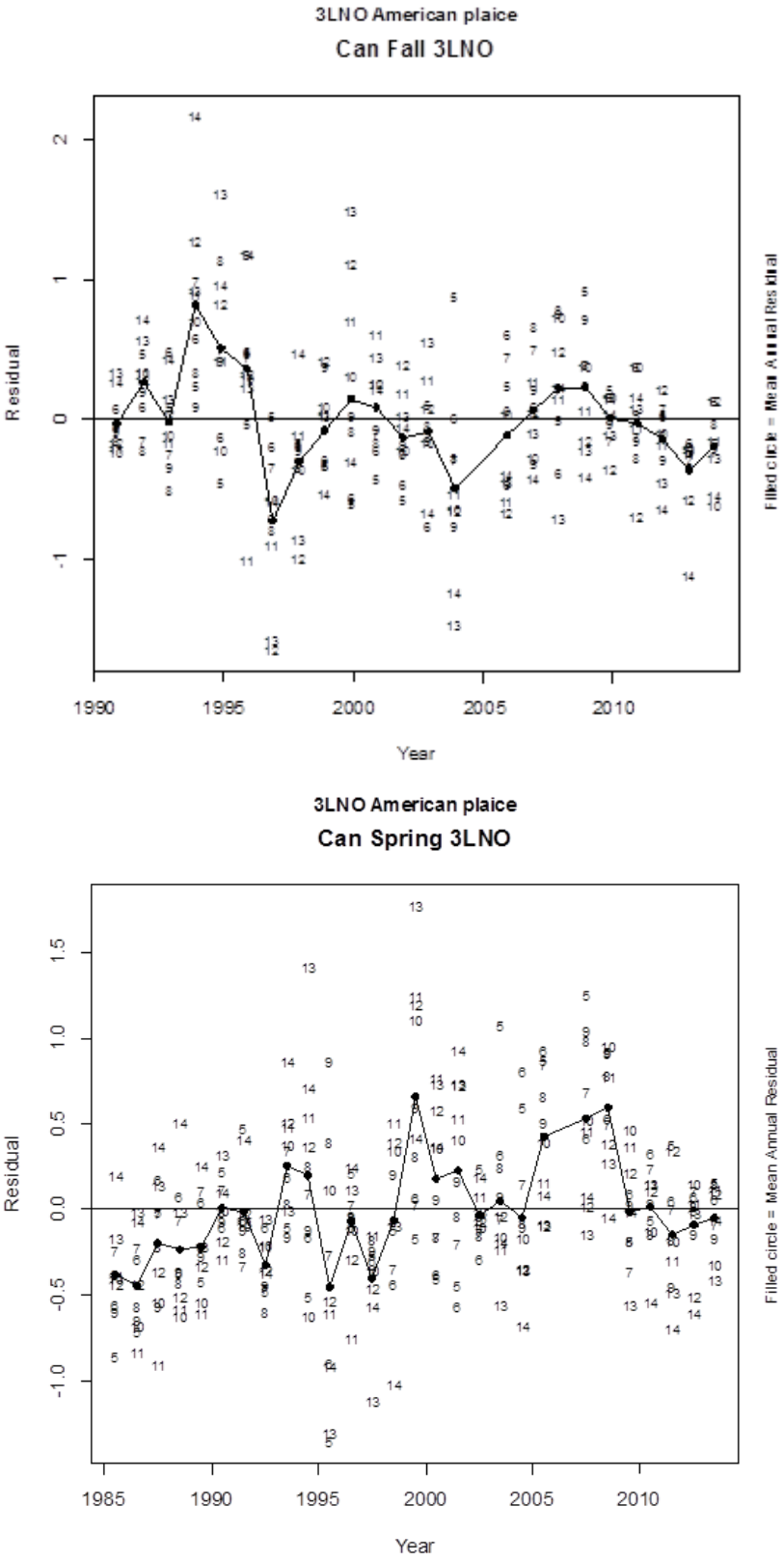

Figure 10. Residuals by year and month (numbers represent ages) for Canadian fall survey (top left) and spring survey (bottom). Filled circle is the mean annual residual. Note the scales are different for each plot.

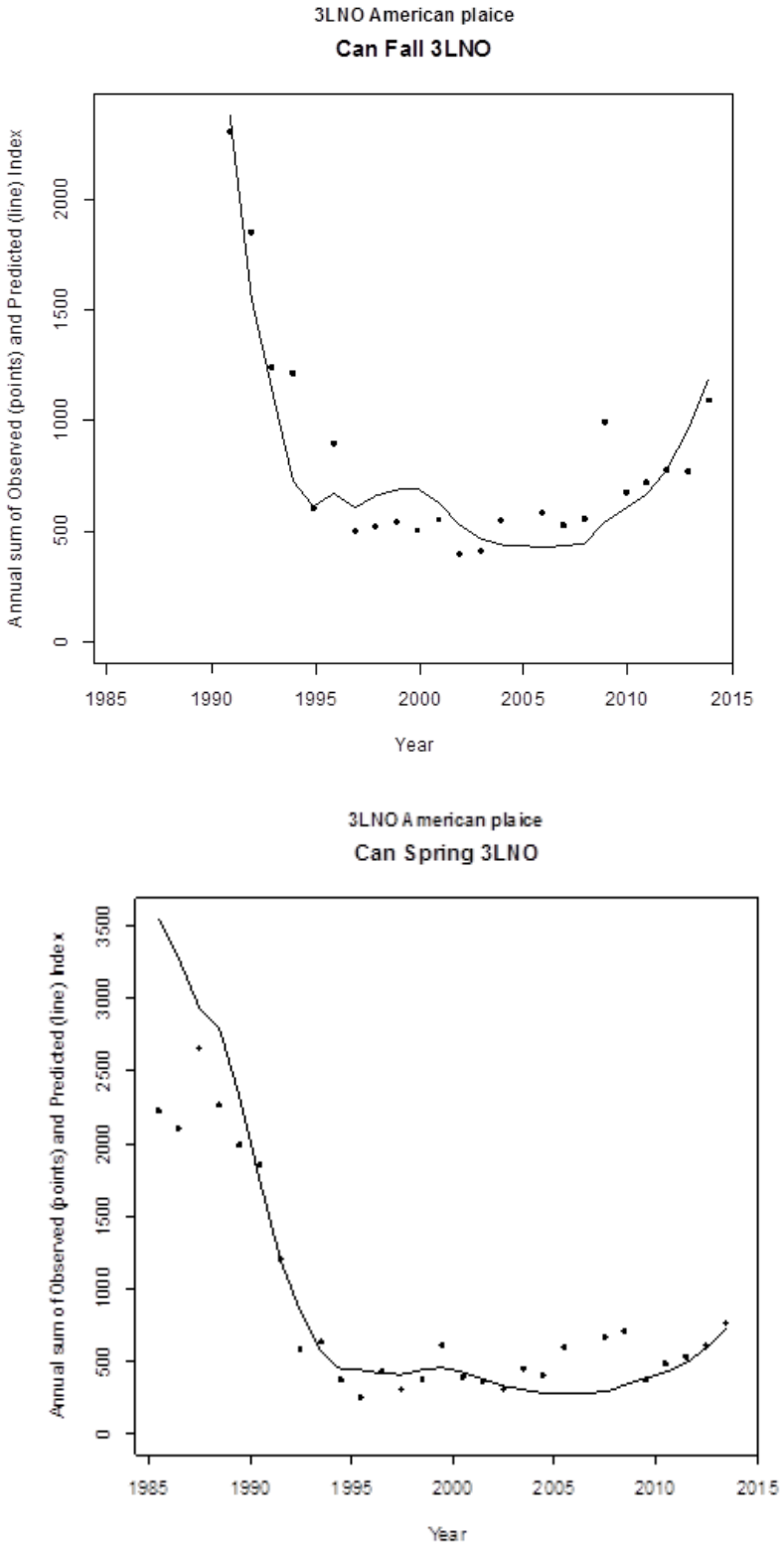

Figure 11. Observed versus predicted abundance for Canadian Div. 3LNO spring and fall surveys over time.

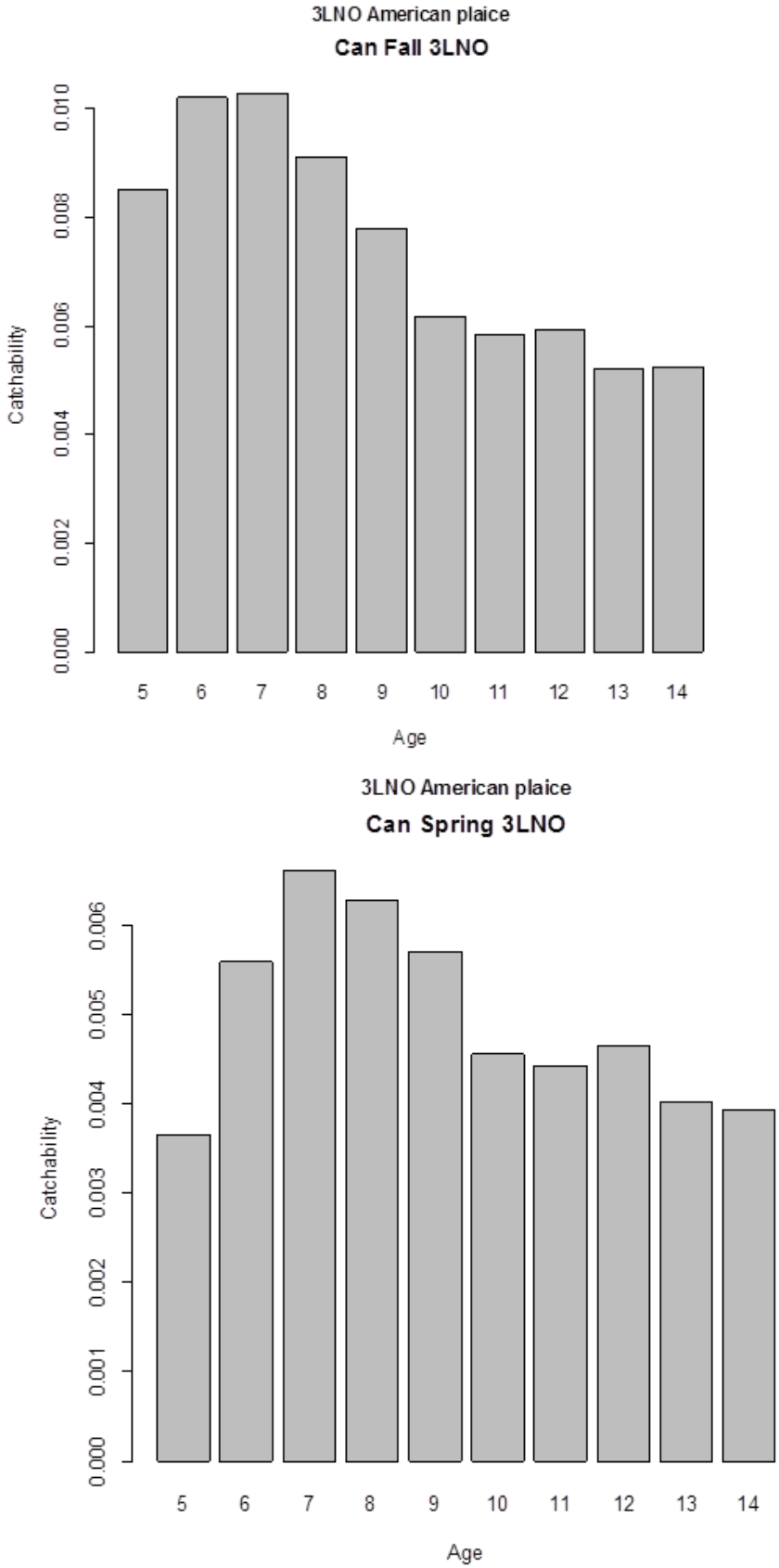

Figure 12. Catchabilities of Canadian fall and spring surveys from ADAPT run with the EU-Spain 3NO survey excluded.

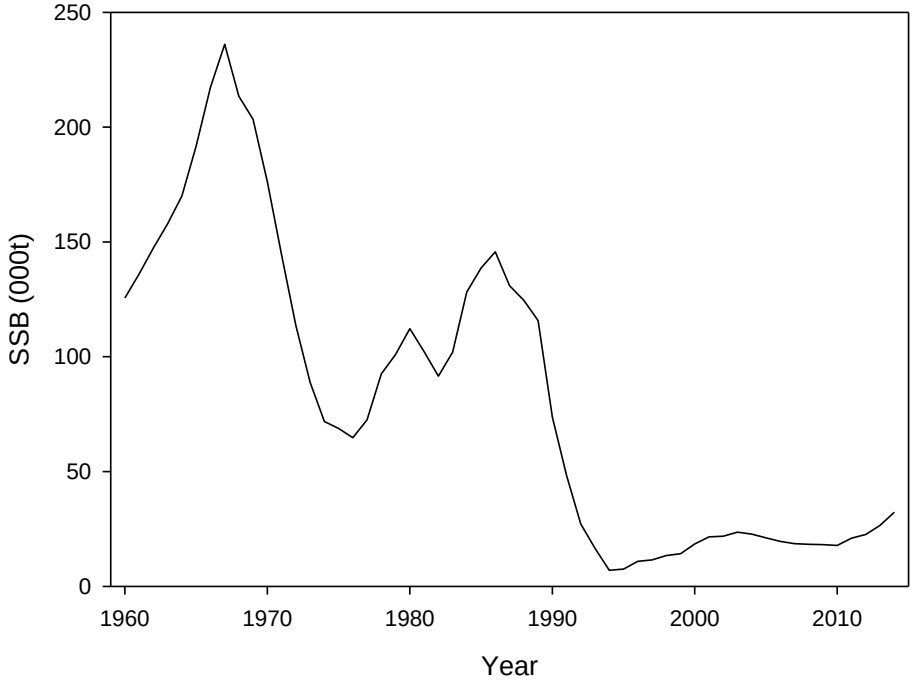

Figure 13. Spawning stock biomass (000t) for ADAPT run with EU-Spain Div. 3NO excluded.

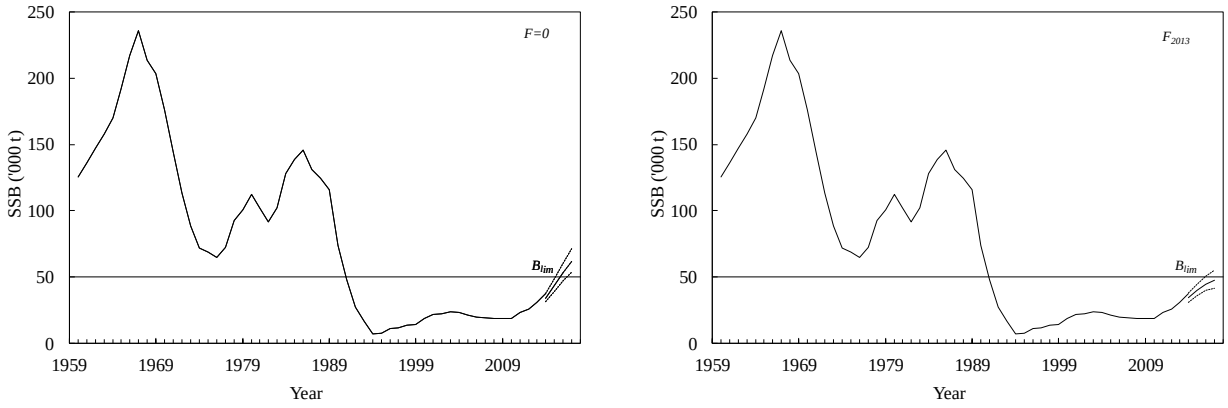

Figure 14. Spawning stock biomass from projections along with 10th and 90th percentiles (dotted lines) for F=0 (left) and F_{2013} (right).

Appendix A – Analysis of surveys used to calibrate data

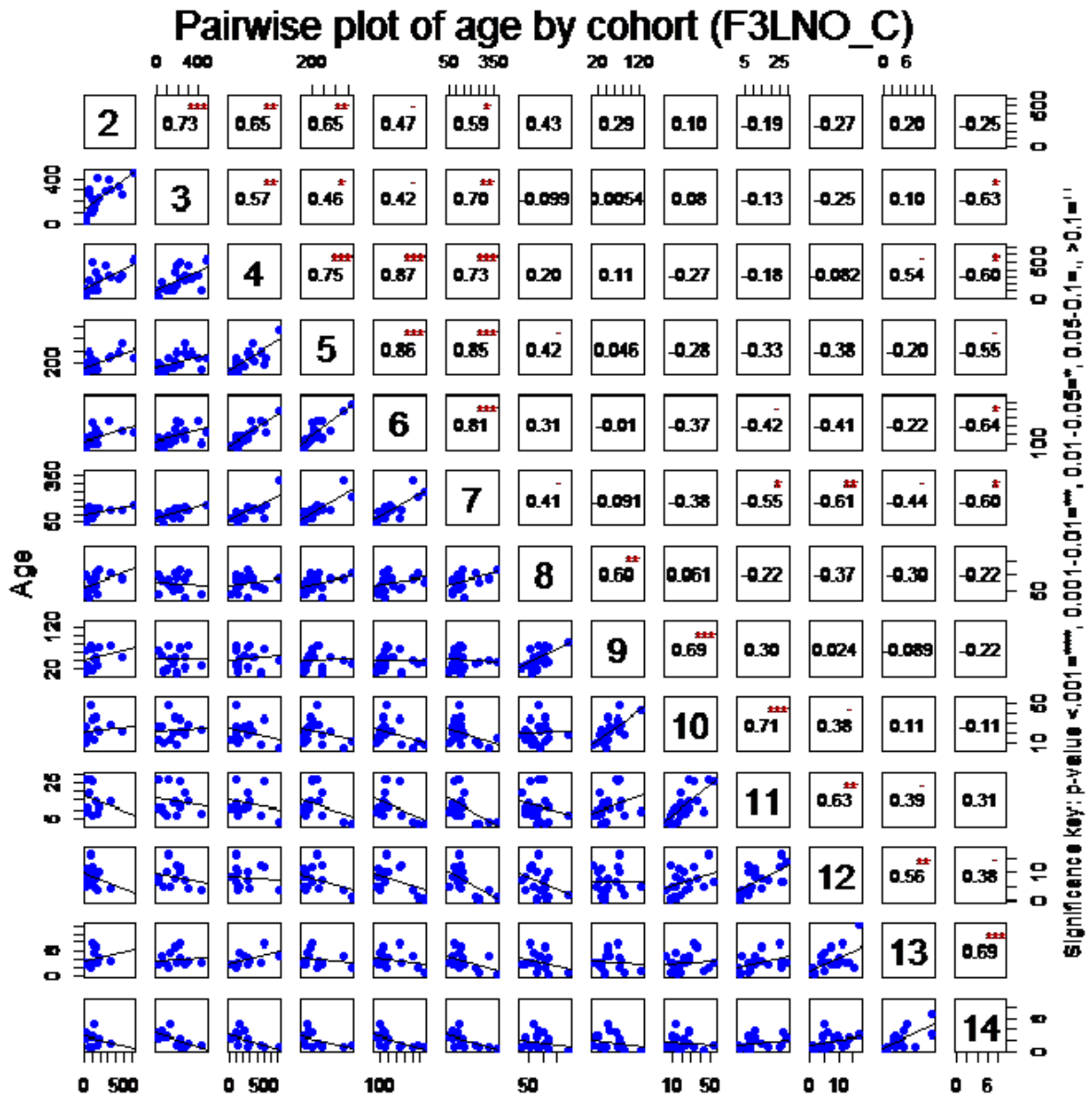

Figure A.1 Pairwise plots of each of the survey indices (Canadian fall survey) by cohort on the log scale.

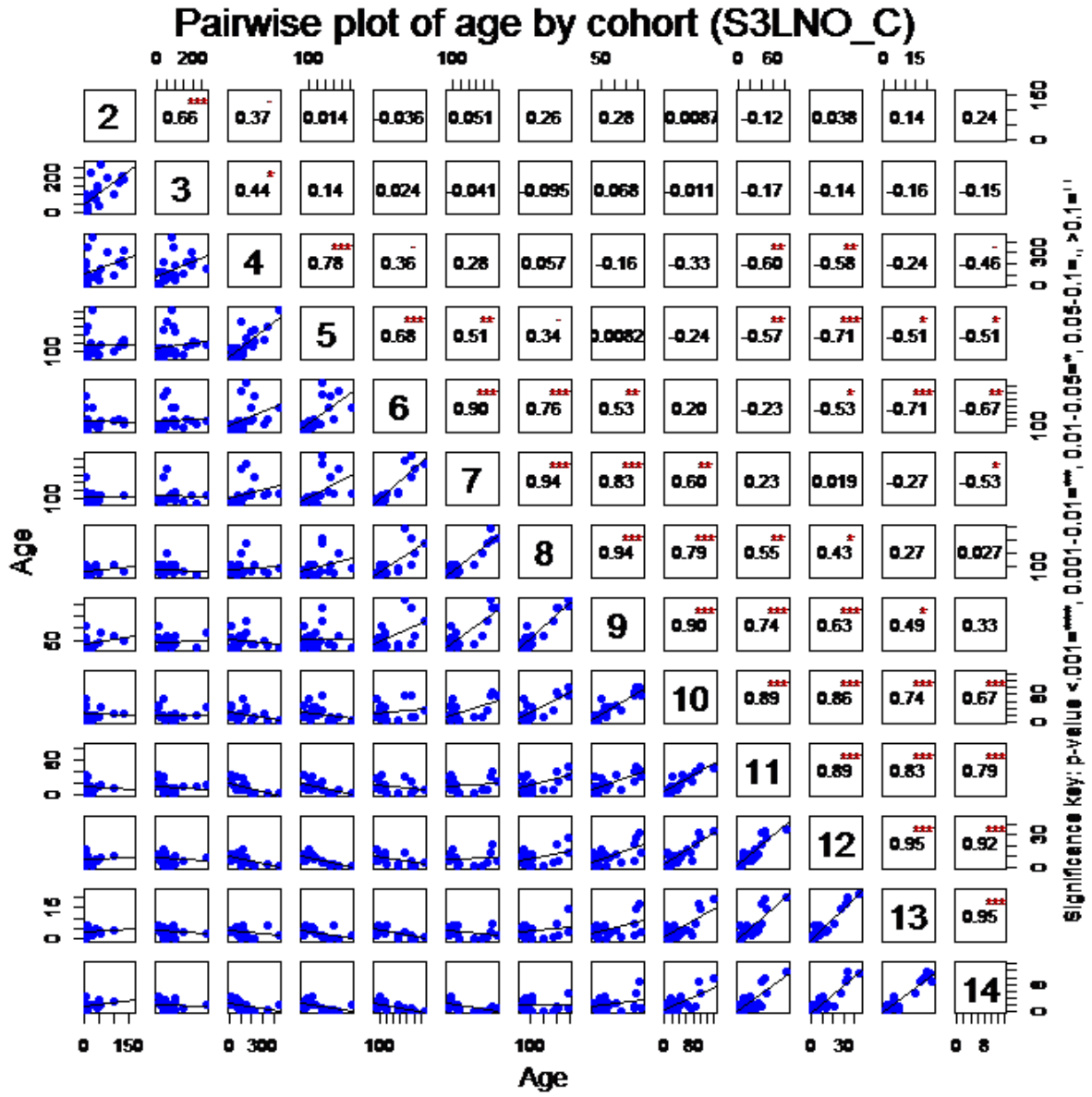

Figure A.2 Pairwise plots of each of the survey indices (Canadian spring survey) by cohort on the log scale.

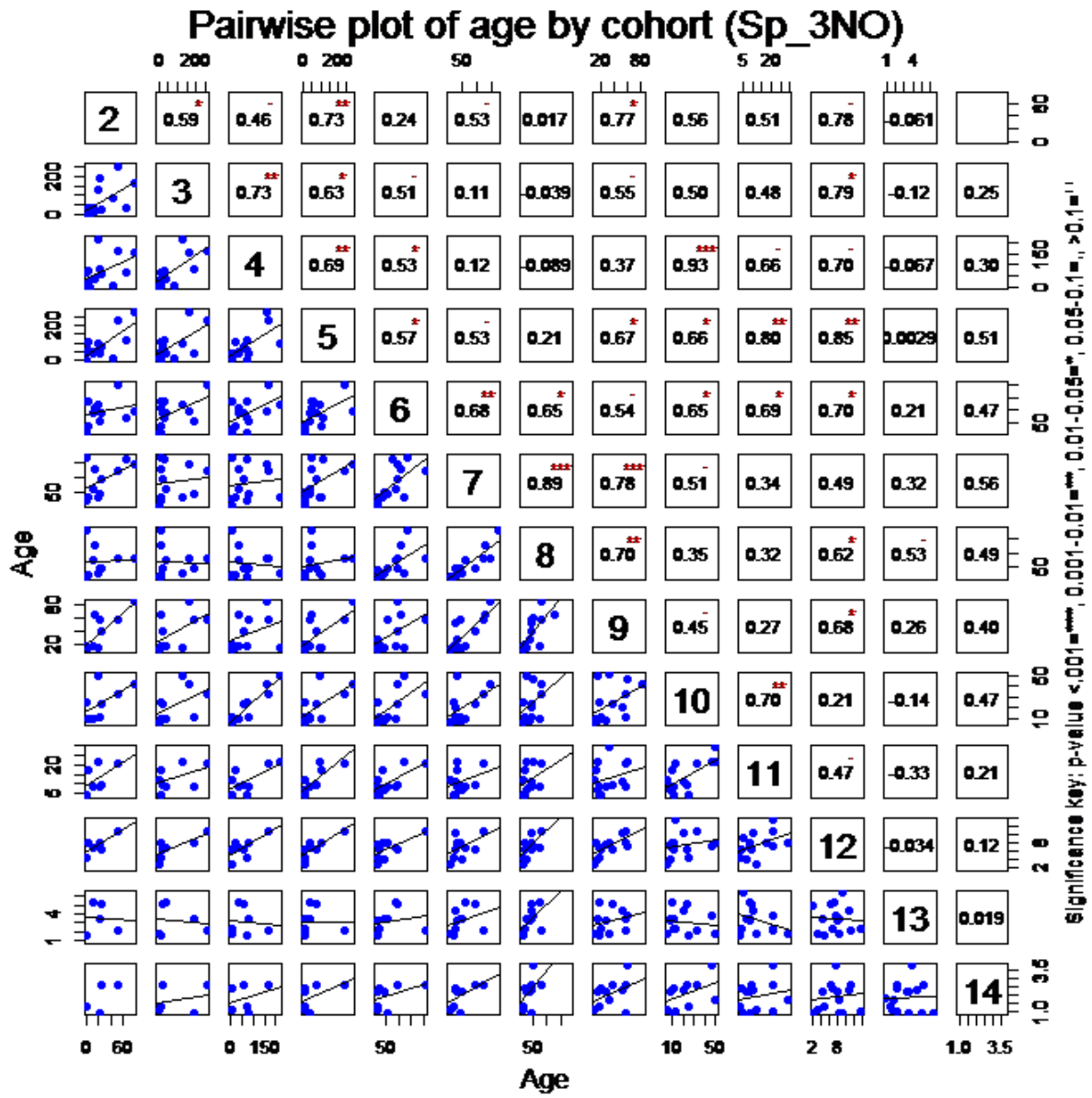

Figure A.3 Pairwise plots of each of the survey indices (EU-Spain survey) by cohort on the log scale.

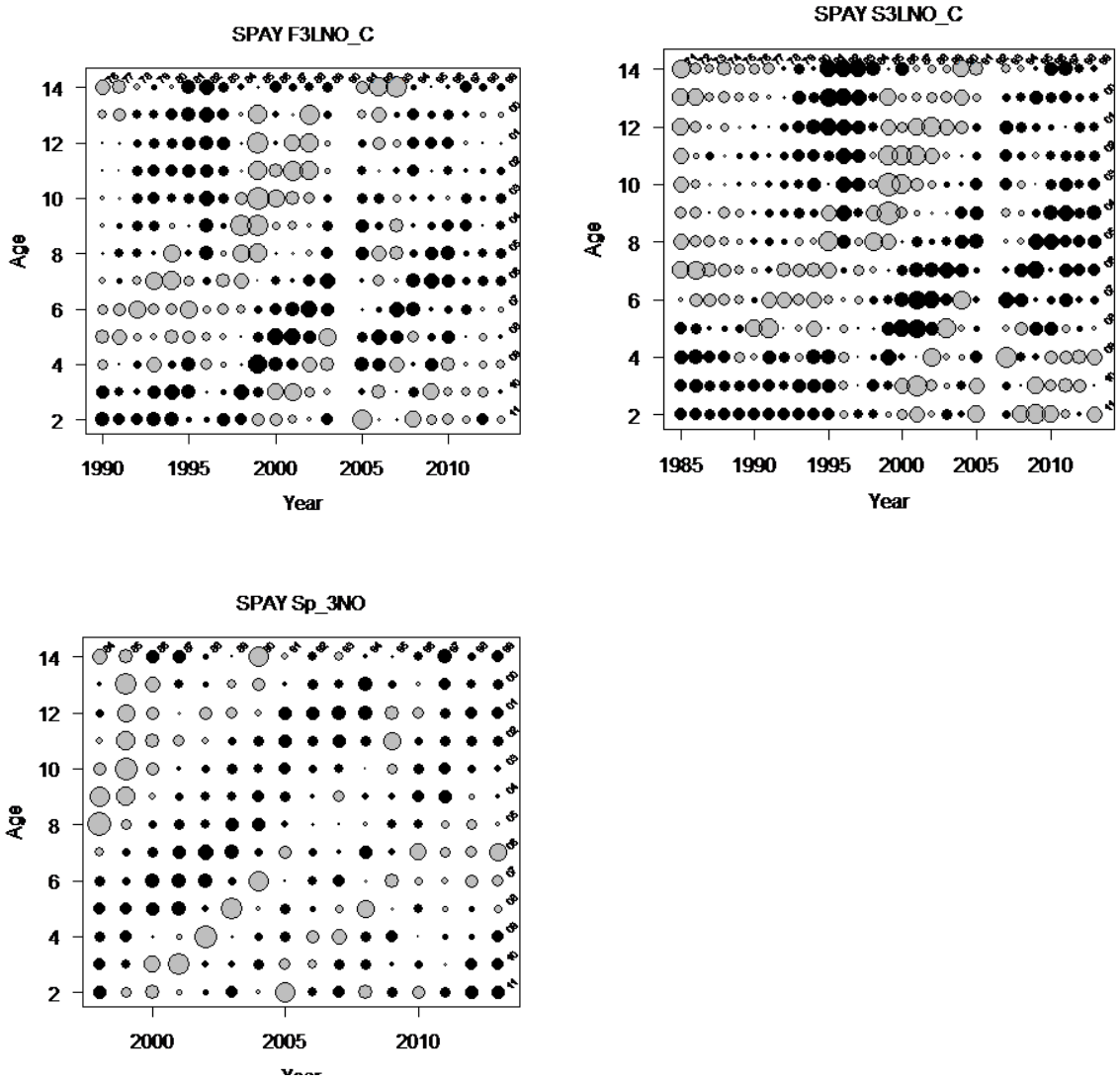

Figure A.4 Plots of standardized proportions by age across years (SPAY) for Can. Fall, Can. Spring and EU-Spain surveys.