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EFFECTS OF CALCULATION PROCEDURE AND REDUCED SAMPLING EFFORT ON ABUNDANCE INDICES OF HERRING LARVAE AS MEASURE OF SPAWNING STOCK SIZE

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Abstract

The database from the International Herring Larvae Survey Program (IHLS) has been transferred from Aberdeen to Kiel and it has been agreed that the Institut für Meereskunde Kiel should continue to maintain this database and provide the abundance indices to be utilized by the Herring Assessment Working Group as one of the means for assessing the state of the herring stock in the North Sea. Calculation procedures for the abundance indices have been changed in some steps since the initiation of this programme and not all details could yet be identified. For establishing the calculation procedure at Kiel, it was necessary to decide on some specific details, which remained unclear so far in the most recently used procedure or which include subjective decisions. These details will be explained and the differences in results depending on the specific decisions made will be discussed.

Due to a substantial decline in ship time and sampling effort allocated to the Herring Larvae Surveys since the end of the 80's, it may be questioned, whether these surveys can still provide abundance and production indices (LAI and LPE) comparable to those of previous years and sufficiently reliable for the use as measure of stock size. Using the historical herring larvae data base, the effects of this decline in effort, and the required total effort and allocation of sampling in space and time will be evaluated.

Introduction

The ICES program of international herring larval survey in the North Sea and adjacent areas has been in operation since 1967. Surveys were carried out in specific time periods and areas, following the autumn/winter spawning activity of herring from north to south. Data of catches were reported to the ICES IHLS database and information of e.g. survey vessel, surveyed area and time, date and haul position, sampler and bottom depth, total number of larvae per haul and length distribution of larvae were archived since 1972. The main purpose is to provide quantitative estimates of the abundance of herring larvae, which have been used as a relative index of changes of spawning stock size.

A drastic decline in survey effort occurred since the end of the 80th. The traditional LAI and LPE, which rely on a complete coverage of the survey area, could not be estimated any longer due to the loss of information on larval abundance.

Instead, a multiplicative model was introduced for calculation of larval abundance index (MLAI, Patterson and Beveridge, 1995) from 1994 onwards. In this approach, the larvae abundances are calculated for a series of sampling units, defined by spawning area and sampling period; the total time series of data is used to estimate the year and the sampling unit effects on the abundance values and the unit effects are used to fill the sampling gaps so that a comparable abundance index (MLAI) can be estimated for each year.

In 1997, the IHLS database has been transferred to Kiel and the Institut für Meereskunde should continue to maintain this database and provide the abundance indices utilized by the Herring Assessment Working Group as one of the means for assessing the state of the herring stock in the North Sea.

However, when trying to recalculate the reported LAI values of previous years, it became obvious that several procedures have been changed since the initiation of the program and that not all steps necessary could be identified in detail. Therefore results were not comparable in all cases. Consequently, the information on relevant calculation procedures documented in several working group reports and manuals were collected and re-examined to establish a procedure which follows the historical methods as far as possible and produces results comparable with the traditional LAI. The software used by the database was completely re-written and SAS (Version 6.12) was introduced to the system instead of the former used Fortran and Basic versions.

Using this re-calculated data set, the impact of the decline in effort was evaluated by simulating different scenarios of survey coverage in space and time.

Material and Methods

Calculation procedure for larval abundance index (LAI)

In the present paper the general procedure for calculating the larval abundance follows in principal the procedure described in the IHLS documentation (Anon. 1995). The calculations are based on the IHLS database of the years 1972 to 1997 (for specific considerations 1981 to 1991) as well as on the (corrected) area definition file of the year 1985. The six relevant steps are

1. The survey files, containing all larvae and survey information, were combined with the area definition file, containing definitions of standard areas, fortnights, and 10x20" rectangles. Only data from standard positions were considered. Each 10x20" = 30x30 nm rectangle (abbreviated as 10x20 rectangle in the following) consists of nine 10x10 nm rectangles (abbreviated as 10x10 rectangle in the following) meaning that the area of one 10x10 rectangle is approximately 1/9 of that of the 10x20 rectangle. Coding the 10x10 rectangles with 1 to 9 than each 10x20 rectangle is defined as

   1 2 3
   4 5 6
   7 8 9

   going from North to South and West to East. It is expected that at least one survey position lies within such a 10x10 rectangle which defines a "standard position". It should be mentioned here, that other positions than the standard positions are generally ignored here. Four spawning areas are distinguished and two to four sampling period per area. In order to define how complete the area and time units (LAI units as given below) have been sampled, a „coverage" value is defined and expressed as percentage standard positions sampled within each unit:

$$Coverage_{Year,\ LAI\ unit} = \frac{sampled\ positions_{Year,\ LAI\ unit}}{standard\ positions\ in\ the\ area\ definition\ file_{LAI\ unit}} \times 100$$

   This coverage is later used as the first weighting factor component in the caluation of MLAI values (MLAI = year effect parameter estimates) with the multiplicative model as described by Patterson et al. (1997). The complete area definition file is given in the Annex. The standard areas, fortnights and LAI units used here are

Standard area	(Code)	Fortnight	LAI unit code
Orkney/Shetland (abbreviated: Or/Sh)	B	30th August - 15th September	B1
		16th - 30th September	B2
Buchan	C	1st - 15th September	C1
		16th - 30th September	C2

Central North Sea (abbreviated: CNS)	D	1st - 15th September	D1
		16th - 30th September	D2
		1st - 15th October	D3
		16th - 31st October	D4
Southern North (abbreviated: SNS)	E	15th - 31st December	E6
		1st - 15th January	E7
		16th - 31st January	E8

2. Based on the data of step 1 for each year and standard position the measured larvae were aggregated into the following five length frequency distribution groupings (= grouped LFDs):

- 5mm ≤ larvae < 10mm (5 ≤ larvae < 11mm south of 5330 North)
- 10mm ≤ larvae ≤ 15mm (11 ≤ larvae ≤ 16 mm south of 5330 North)
- 5mm ≤ larvae ≤ 15mm (5 ≤ larvae ≤ 16 mm south of 5330 North)
- 10mm ≤ larvae ≤ 24mm (11 ≤ larvae ≤ 24 mm south of 5330 North)
- 5mm ≤ larvae ≤ 24mm.

All following calculations and considerations are carried out for each of the five LFD groups separately.

3. Larvae numbers per square meter were calculated for each year and standard position by the formulae given below for three time periods separately. The differences in these formulae reflect changes in the information given for flowmeter calibrations.

1972–1980

$$No./m^2_{Year,\ 10x10\ rectangle} = Grouped\ LFD \times \left(\frac{Total\ No./m^2}{Total\ LFD \times Efficiency\ Factor} \right)$$

1981 + 1982

$$Raising\ Factor = \frac{Total\ No.\ Caught}{Total\ LFD}$$

$$Calibration\ Factor = \frac{Flowmeter\ Calibration \times BottomDepth}{Flowmeter\ Reading \times \pi \times \left(\frac{Aperture}{2} \right)^2 \times Efficiency\ Factor}$$

$$No./m^2 No./m^2_{Year,\ 10x10\ rectangle} = Grouped\ LFD \times Raising\ Factor \times Calibration\ Factor$$

from 1983 onwards

$$Raising\ Factor = \frac{Total\ No.\ Caught}{Total\ measured}$$

$$Calibration\ Factor = \frac{Flowmeter\ Calibration \times BottomDepth}{Flowmeter\ Reading \times \pi \times \left(\frac{Aperture}{2} \right)^2 \times Efficiency\ Factor}$$

$$No./m^2_{Year,\ 10x10\ rectangle} = Grouped\ LFD \times Raising\ Factor \times Calibration\ Factor$$

4. In case of replicate sampling within a 10x10 rectangle and fortnight, the number of larvae obtained were averaged, using three day blocks. For example, the period 1st to 30th September is divided into periods 1-3,4-6,7-9 etc. If Dana caught 30 larvae on 4/9, Explorer 20 on 6/9, Dana 20 on 7/9, Clione 18 on 9/9 and 16 on 12/9, the average for the period is

Three day block	Days	Numbers caught
1	1 - 3	No catch
2	4 - 6	(30+20)/2 = 25
3	7 - 9	(20+18)/2 = 19
4	10-12	16
5	13-15	No catch
6		
Average		(25+19+16)/3 = 20

If the number of days within the period is not exactly divisible by three, the last block contained either two or four day periods.

5. The results of step 3 and 4 were used to calculate mean numbers of larvae per square meter for each 10x20 rectangle within the LAI units; these values were raised by the surface area of the corresponding 10x20 rectangle, i.e.

$$\overline{No./m^2_{Year,\ 10x20\ rectangle}} = \frac{1}{n}\sum No./m^2_{Year,\ 10x10nm\ rectangle}$$

$$LAI_{Year,\ 10x20\ rectangle} = \overline{No./m^2_{Year,\ 10x20\ rectangle}} \times Area_{10x20\ rectangle}$$

6. Results from step 5 were summed up to calculate larval abundance indices and related coefficients of variance (CVs) for each LAI unit and year, i.e.

$$LAI_{Year,\ LAI\ unit} = \sum LAI_{Year,\ 10x20\ rectangle}$$

$$CV(LAI_{Year,\ LAI\ unit}) = \frac{\sigma(LAI_{Year,\ LAI\ unit})}{\overline{LAI_{Year,\ LAI\ unit}}} \times 100$$

where $\sigma(LAI_{Year,\ LAI\ unit})$ is the standard deviation and $\overline{LAI_{Year,\ LAI\ unit}}$ the mean LAI calculated per each year and LAI unit. The CVs are later used as the second of two weighting factor components for the computation of a weighted MLAI index by the multiplicative model.

Evaluation procedure for testing survey strategies

All following considerations concerning the evaluation of the IHLS survey strategy (effort reduction in terms of time and space) are based on the above LAI calculations (i.e. the results of step 6 of the previous paragraph) as well as in principle on the MLAI computations described in Patterson et al. (1997).

It should be mentioned that the way used here differs in one point from that described in the IHLS documentation (see Anon. 1995): no missing value correction has been included for standard positions which have not been sampled.

The first (intuitive) reason is that we want to investigate the effect of reduced sampling effort on the quality of the MLAI computations measured in terms of prediction performance for the spawning stock biomass (SSB). The second (statistical) reason is that only 5 to 10% (at maximum) of missing values are reliable to be filled in without loss in the statistical quality of the data (see Hand 1989). From the coverage values calculated according to step 1 of the previous paragraph (results see Annex) it can easily be seen that especially in the last years the amount of missing value stations overexceeded the 5% limit sometimes by far.

On the other hand, from the authors point of view it does not appear reasonable to completely exclude LAI unit with incomplete coverage; the available expensive information should be utilized as far as possible. Thus, per each LAI unit two weigthing components are computed, one is the area coverage itself (in %) and the other the LAI variation in terms of the above mentioned CV (also in %). The idea is that the coverage is expected to be representative for and to be proportional to a prospectively inherent sampling error, assuming the lower the coverage the higher may be the sampling error induced by smaller sample sizes. The implementation of the CV as a second component of the weighting factor assumes that the higher the variation, the higher the uncertainties about the calculated LAI values for the associated LAI unit. I.e. the lower is their representativity. Both factors combined are balancing out some distortions, which might be included by using only one factor alone. It could well be the case that sampling results from few stations with a low variation are as representative as results from many stations with a high variation. Hence, the following weighting factor is introduced

$$Weight_{Year,\ LAI\ unit} = Coverage_{Year,\ LAI\ unit} \times \frac{1}{CV(LAI_{Year,\ LAI\ unit})}$$

This weighting factor is used when calculating the MLAIs per year and LAI unit in the multiplicative model. In such a case the least-squares estimators (LSQEs) are weigthed by a weighting matrix W, i.e.

$$\hat{\beta} = (X'WX)^{-1}\ X'Wy$$

where W contains the individual values $Weight_{Year,\ LAI\ unit}$ on its diagonal. This has the effect that a weighted residual sum of squares (WLSQ) is minimized, i.e.

$$WLSQ = \sum\left[Weight_{Year,\ LAI\ unit} \times (LAI_{Year,\ LAI\ unit} - \hat{LAI}_{Year,\ LAI\ unit})\right] \rightarrow Min.$$

$\hat{LAI}_{Year,\ LAI\ unit}$ means the estimated LAI values from the multiplicative model. As long as the weights for the LAIs are proportional to the reciprocals of the error variances then the weighted least-squares estimators (WLSQEs) are unbiased (see Anon. 1989).

Taking all these considerations into account the basic idea is to vary as well as reduce the combination of LAI units included into the calculation of the MLAI in order to see which combination results in the best relationship between MLAI and SSB (spawning stock biomass) in terms of SSB prediction power. This is done by regressing the estimated MLAI values of the multiplicative model (regressand, y axis) on SSB values (regressor, x axis). The construction of the causal relationship within this regression approach is based on the assumption that the SSB produces the larvae (larvae abundances, LAIs, MLAIs). Hence in order to predict the SSB (given a new MLAI) this regression must be inverted leading formally to an inverse prediction of the SSB. Thus, the prediction power is measured by means of the inverse prediction error (IPE). Since the size of the prediction error as well as the inverse prediction error depends on the size of the SSB for which it is calculated, a specific position must be determined which should be kept the same for all related LAI unit exclusion experiments.

It is known that in case of a normal regession the regression line always goes through the centre of the sample, i.e. through the point defined by the mean MLAI and the mean SSB. At this point the inverse prediction is smallest. Exactly this point is taken as that fixpoint for what all inverse prediction errors are calculated and compared with eachother. For the present purpose the centre of the samples, i.e. the mean value of SSB, has been used as the standard position for comparing the inverse prediction errors. Following the common definition of Neter et a. (1985) the inverse prediction error is

$$s^2(SSB_{new}) = \frac{SSE}{\hat{b}^2\,(n-2)}\left[1 + \frac{1}{n} + \frac{(\hat{SSB}_{new} - \overline{SSB})^2}{\sum_{year}(SSB_{year} - \overline{SSB})^2}\right]$$

$$SSE = \sum_{year} u^2_{year} = \sum_{year}(MLAI_{year} - \hat{MLAI}_{year})^2 .$$

where in this special case SSB_{new} will be replaced by the mean SSB. Furthermore, also the coefficient of determination r^2 together with some other statistical measures are computed to indicate the degree of explained variance.

<u>The principal steps of the evaluation analysis are:</u>

1. Calculation of the linearized multiplicative model after Patterson et al. (1997)

$$\ln(LAI_{year,\ LAI\ unit}) = constant + MLAI_{year} + MLAI_{LAI\ unit} + u_{year,\ LAI\ unit}$$

where $\ln(LAI_{year,\ LAI\ unit})$ is splitted into a year effect $MLAI_{year}$ (= regression parameter estimates concerning year as factor levels) and a LAI unit effect $MLAI_{LAI\ unit}$ (= regression parameter estimates concerning LAI units as factor levels). The $u_{year,\ LAI\ unit}$ are the corresponding residuals. These calculations were performed with and without weighting (see above). Reference year was 1981, reference LAI unit was B1. If B1 was excluded during the numerical experiments B2 was taken as the alternative reference LAI unit which left the year effect $MLAI_{year}$ uninfluenced.

2. Regression of the estimated $MLAI_{year}$ values of step 1 against SSB, i.e.

$$MLAI_{year} = a + b \times SSB_{year} + u_{year}$$

and calculations of r^2, of the root of the mean square error (RMSE) and of the inverse prediction error (IPE) as measure of the quality of the fit.

Steps 1 and 2 are carried out for different combinations of LAI units which are systematically reduced. The best result is choosen to be that combination of LAI units which leads to the smallest inverse prediction error. This should also show the highest degree of explained variance in terms of the coefficient of determination. Step 2 is separately performed with weighted and with unweighted MLAIs.

For comparative reasons both steps are separately carried out for different LFDs in order to see which of the different larvae length groups has (or have) the closest relationship to the SSB. Furthermore, it is also done for two different time periods where period 1 are the years 1981 to 1991 and period 2 is the complete IHLS period of the years 1972 to 1997 with sometimes relatively low coverage of the standard areas. Period 1 is assumed to give more unbiased results since the coverage is consistently high for all these years whereas especially the coverage especially during the period from 1992 onwards has largely been reduced.

Results

The step by step analysis of previously employed procedures for the estimation of LAI values was finally successful. Accordingly recalculated LAI values are highly comparable with the previously reported values on LAI unit level. Some minor differences occur especially for the years 1972 to 1979, but can be neglected for practical purposes. The estimations for the period from 1980 onwards fit exactly in most cases. The calculated values are presented in table 1 for LFD groups, years and LAI units separately. Accompanying information on percent coverage and the variation of data is included in addition (Annex, table 9). The remaining differences and discrepancies between the historical and the current versions of the LAI calculation on year and LAI unit level may be due to rounding errors, the use of another (now verified) area definition file, no correction for missing values in the present case and the use of different programming tools probably with differently installed platform options (precision etc.). Due to some inconsistensies and inconformities in the (national) area coding between survey data file and area definition file all area codes of the survey data file were totally ignored. Merging the area definition file with the survey data file is therefore done by year, fortnight and position whereby only positions coded with priority 0, 1, 2 are included here (see table 1 in the Annex). The SAS system (Version 6.12) was used as well for data management purposes as for all LAI and other statistical calculations.

For comparison reasons also the traditional LAI estimations encoded as "AbSmall" are included in table 1 (see the Annex), while the specific recalculated ones are given there as "L.<=9".

Inspecting table 1 (see the Annex) shows that the coverage is partly extremely low, especially for years before 1981 and after 1991. It also can be inferred from this table that the coverage varied strongly over time, also in the more completely covered period 1981 to 1991. A view on the CVs shows that also the variation differs drastically between years as well as LAI units and this on a high level of usually some hundred percent of the related mean. This alone makes it plausible that some weighting may help to reduce the negative effects of both factors.

Calculating abundance estimates for several selected length classes (LFDs) in years with a relatively complete coverage (1981 - 1991) under inclusion of all LAI units and comparing the resulting MLAIs (unweighted case) with the SSB revealed that the abundance of small larvae (5 < 10 mm) represents the best index in relation to the SSB. The coefficient of determination here is 0.859, compared to an r^2 of 0.674 for length class 10 to 15 mm and an r^2 of 0.623 for all larvae larger than 10 mm. Including the total LFD (5 to 24 mm) gives an intermediate result, slightly better than that for the LFDs 10 to 15 mm and 10 to 24 mm but worse in contrast to that of the larvae smaller than 10 mm. The inverse prediction error of SSB indicates the best model fit also for small larvae in terms of prediction power (see tables 4, 6 and 8 in the Annex). Calculating the same for LFDs 5 to 9 mm and 10 to 24 mm by use of the weighting factor let increase the corresponding coefficients of determination and decrease the inverse prediction error in both cases: for LFD 5 to 9 mm r^2 = 0.907 and for LFD 10 to 24 mm r^2 = 0.688 (see tables 5 and 7 in the Annex).

The same computation for LFD 5 to 9 mm but including the whole period (1972 - 1997) is resulting in both cases (unweighted and weighted) in slightly smaller coefficients of determination due to a varying coverage especially in the later years (see tables 2 and 3 in the Annex), i.e. for the unweighted case is r^2 = 0.822, for the weighted case r^2 = 0.872.

Obviously weighting the MLAI on survey coverage and inverse variance increases the coefficient of determination by approximately five percent in both cases (periods 1972 to 1997 and 1981 to 1991).

When simulating reduced survey effort and calculating the corresponding MLAI for larval lengths below 10 mm and period 1981 to 1991 for the unweigthed case (see table 4 in the Annex) the relative importance of specific units for the survey purpose became evident. Eliminating all surveys in the CNS (i.e. LAI units D1 to D4) results in a 0.2% decline of the coefficient of determination ($r^2 = 0.857$ instead of $r^2 = 0.859$ for the complete case). A minimum of about 38% of explained variance was reached when only surveying C1, B1 and E8. A reduced survey effort which reproduced the surveys in the North Sea best could be localized for LAI unit combination C1, B2 and E6 ($r^2 = 0.874$). This value is higher than that when including all LAI units. For this case the inverse prediction error also reaches its lowest value. In other words, the concentration on LAI units C1, B1, E6 would increase the prediction power in the unweighted case.

Considering the weigthed case results in a slightly different best LAI unit combination (see tables 5 in the Annex). The exclusion of the CNS results in a decline of the coefficient of determination of about 10% points ($r^2 = 0.806$ instead of 0.907 for the complete case). The proportion of explained variance is at its minimum for LAI unit for LAI unit combination C1, B1 and E8 ($r^2 = 0.434$). The best result is reached for LAI unit combination C1, B2 and E8 ($r^2 = 0.874$), the second best for LAI unit combination C1, B2 and E6 ($r^2 = 0.872$). Correspondingly, also here the minimum inverse prediction error is reached. Between the second best and the remainding LAI unit combinations a more substantial diffenerence of about 7% points occurs.

Comparing these results with that of the entire data set of the years 1972 to 1997 the best fit is also achieved for LAI unit combination C1, B2 and E6 without weighting and for C1, B1, B2 and E6 with weighting (see tables 2 and 3 in the Annex).

Discussion

When trying to analyse and reproduce the traditional procedure used for calculating LAI values, a complete identification of all details turned out to be difficult. This is due to the fact that the methods have evolved in the course of time and changes have been made in calibration procedures, handling of the missing value problem, definition and coding of standard areas, the way of merging information from different co-existing area files with those from the survey files etc. It is thus strongly suggested to decide on a new standard definition of the calculation procedure for LAI's per sampling unit and per year, and we propose the procedure described in this paper as the basis for any further discussion in the corresponding planning and working groups of ICES.

The results presented here for different size groups of larvae, indicate that the MLAI values for the group of smallest larvae (< 10 mm) show the best relation to the spawning stock biomass (SSB) of the same year (i.e. without any time lag). This is intuitively plausible *as* the abundance of older larvae should depend to a larger extend on varying environmental influences.

The comparison of results obtained from different sampling effort have in general confirmed that, LAI values based on reduced effort lead to a reduced precision of SSB estimates. This can already be seen from the 5-10% better fit obtained when using the less extended but more completely covered time period 1981 to 1991 compared to using the entire data set (1972 to 1997), with less consistent sampling and largely reduced effort during the last years. The MLAI values obtained from systematically varied subsets of sampling units also lead to weaker relationships with SSB in general. The differences, however, were not very substantial. In a few cases even a slight increase in percentage of explained variance was obtained compared to the complete coverage. This may be expected by chance in case of generally similar values.

The latter effect may also be related to some degree to the use of a weighting factor which is inversely proportional to the variation. Such a factor leads to a harmonized MLAI data set. I.e., it is reducing not only the internal but also the external LAI unit variation. Furthermore, the use of such a weighting factor provides not only a helpful tool but also a more objective instrument to balance out extreme values (as for instance in case of the extremely high larvae numbers of the southern North Sea in 1997). The alternative of leaving out extreme values from the entire analysis does not only mean dropping valuable information but also biasing the results in an arbitrary way. Furthermore, the fact that the combined weighting factor used here also includes a coverage component makes it unnecessary to stick on an arbitrary missing value elimination, by which information is lost, or correction procedure, which may bias the results. The data fit could actually be improved this way.

The effect of reduced sampling effort is obviously depending on the sampling units selected. When using larvae smaller than 10 mm the optimum choice for minimum sampling effort appears to be given when surveying the units C1, B2 and E6 or the units C1, B2 and E8. This suggests that the surveys in CNS are of less importance and thus may be omitted if necessary. It has to be considered, however, that these results are based on a data set obtained from complete coverage over a limited period of time. In future periods the variation in spawning time and area may differ from variations so far observed. Thus, the survey strategy should aim for at least occasional, exploratory coverages to allow the identification of possible general trends in the spawning behaviour and success of the herring groups in the North Sea.

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Table 1: IHLS time series database (1972 - 1997) with calculated LAI unit coverages and coefficients of variation (cv)

Year	LAIUnit	Area	Fortnight	Coverage	AbSmall	cvL<=9	cv9<L<=15	cvL<=15	cv9<L<=24	cvL<=24	L<=9	9<L<=15	L<=15	9<L<=24	L<=24
72	B1	Or/Sh	01-15Sep	93.81	1035	398.60	257.90	318.04	257.90	318.04	1133	492	1626	492	1626
72	B2	Or/Sh	16-30Sep	83.16	4104	267.04	134.61	204.07	132.26	202.94	4583	1734	6313	1764	6345
72	C1	Buchan	01-15Sep	70.15	25	572.77	448.42	492.58	448.42	492.58	30	5	35	5	35
72	C2	Buchan	16-30Sep	56.72	.	.	334.20	334.20	245.35	245.35	.	8	8	12	12
72	D1	CNS	01-15Sep	76.56	165	619.99	297.44	577.11	297.44	577.11	165	21	187	21	187
72	D2	CNS	16-30Sep	89.55	87	348.90	245.86	244.95	245.86	244.95	88	109	197	109	197
72	D3	CNS	01-15Oct	82.88	133	591.87	336.80	321.06	331.68	315.50	134	368	501	376	512
72	D4	CNS	16-31Oct	93.69	23	569.23	356.19	373.69	214.04	232.80	22	23	47	67	91
72	E6	SNS	16-31Dec	12.07	2	264.58	137.69	170.78	137.69	170.78	2	4	6	4	6
72	E7	SNS	01-15Jan	95.95	46	202.25	191.68	156.23	194.10	155.64	46	48	95	50	97
72	E8	SNS	16-31Jan	88.10	.	.	234.36	234.36	149.87	149.51	.	28	28	64	65
73	B1	Or/Sh	01-15Sep	96.91	1901	233.30	184.27	202.54	183.39	202.45	2029	498	2532	501	2533
73	B2	Or/Sh	16-30Sep	62.11	702	228.34	96.97	130.84	90.04	123.98	822	822	1646	909	1730
73	C1	Buchan	01-15Sep	91.04	3	443.35	.	443.35	.	443.35	3	.	3	.	3
73	C2	Buchan	16-30Sep	37.31	3	390.31	364.80	263.09	311.80	255.59	4	7	11	15	19
73	D1	CNS	01-15Sep	92.19	492	348.42	297.41	318.11	297.41	318.11	492	47	540	47	540
73	D2	CNS	16-30Sep	89.55	847	282.05	177.36	226.12	174.66	224.40	830	396	1222	404	1232
73	D3	CNS	01-15Oct	65.77	1395	210.95	157.37	172.89	153.10	171.65	1213	430	1641	444	1658
73	D4	CNS	16-31Oct	88.29	169	815.23	285.23	489.88	221.15	347.90	152	197	349	383	536
73	E6	SNS	16-31Dec	29.31	.	.	.	.	.	.	.	.	.	.	.
73	E8	SNS	16-31Jan	90.48	1	871.78	343.83	303.56	299.97	290.68	1	12	16	20	23
74	B1	Or/Sh	01-15Sep	97.94	736	322.12	150.56	214.79	145.23	204.96	758	555	1312	625	1385
74	B2	Or/Sh	16-30Sep	82.11	381	323.37	118.84	141.50	117.90	130.77	421	711	1132	878	1299
74	C1	Buchan	01-15Sep	97.01	88	487.61	314.09	379.79	305.71	373.59	101	53	155	58	158
74	C2	Buchan	16-30Sep	49.25	241	472.51	241.81	355.27	194.85	333.42	284	94	378	119	402
74	D1	CNS	01-15Sep	93.75	74	351.91	334.46	314.83	309.40	311.21	81	10	92	11	93
74	D3	CNS	01-15Oct	69.37	1182	319.64	174.49	275.51	174.53	274.32	1184	342	1524	364	1547
74	E7	SNS	01-15Jan	97.30	9	387.93	848.53	333.99	595.76	312.84	10	1	12	2	13
74	E8	SNS	16-31Jan	33.33	.	.	.	.	.	.	.	.	.	.	.
75	B1	Or/Sh	01-15Sep	82.47	337	198.38	194.84	180.78	196.16	181.29	371	351	728	352	729
75	B2	Or/Sh	16-30Sep	95.79	46	368.29	196.53	188.95	186.04	179.70	50	581	629	624	671
75	C1	Buchan	01-15Sep	61.19	270	402.92	360.32	387.10	360.32	387.10	312	15	327	15	327
75	D2	CNS	16-30Sep	100.00	140	299.90	249.43	239.72	249.43	239.72	90	83	171	83	171

75	D3	CNS	01-15Oct	89.19	77	443.70	597.75	545.55	570.86	522.97	77	705	785	742	823
75	D4	CNS	16-31Oct	92.79	12	1014.89	426.67	415.33	386.55	378.32	6	203	214	260	271
75	E6	SNS	16-31Dec	27.59	1	400.00	290.08	253.82	290.08	253.82	1	3	5	3	5
75	E7	SNS	01-15Jan	41.89	2	556.78	556.78	556.78	387.08	435.75	2	1	3	2	4
75	E8	SNS	16-31Jan	72.62	.	.	781.02	547.65	781.02	547.65	.	4	6	4	6
76	B1	Or/Sh	01-15Sep	87.63	544	290.06	128.92	231.95	132.52	230.35	545	167	710	171	715
76	B2	Or/Sh	16-30Sep	80.00	69	311.88	111.67	143.81	109.23	139.62	81	192	274	200	283
76	C1	Buchan	01-15Sep	65.67	.	.	663.32	663.32	574.23	574.23	.	5	5	7	7
76	C2	Buchan	16-30Sep	83.58	1	748.33	313.37	284.45	225.79	212.37	1	11	13	17	19
76	D1	CNS	01-15Sep	98.44	69	324.32	317.63	281.19	317.63	281.19	64	14	78	14	78
76	D2	CNS	16-30Sep	95.52	215	266.46	251.34	243.99	243.01	238.91	108	249	362	257	369
76	D3	CNS	01-15Oct	67.57	4	.	263.45	263.45	232.80	232.80	.	58	58	73	73
76	D4	CNS	16-31Oct	90.99	12	646.79	1004.99	735.93	549.39	543.99	10	4	14	11	20
76	E7	SNS	01-15Jan	72.97	2	543.57	543.57	397.79	543.57	397.79	3	3	7	3	7
77	B1	Or/Sh	01-15Sep	98.97	1096	202.50	232.14	190.22	227.66	187.93	1133	1028	2161	1067	2203
77	B2	Or/Sh	16-30Sep	93.68	201	346.81	135.55	128.60	120.08	113.50	221	1229	1450	1727	1946
77	C1	Buchan	01-15Sep	34.33	108	421.59	198.75	363.22	198.75	363.22	124	19	143	19	143
77	C2	Buchan	16-30Sep	100.00	28	355.92	206.39	241.04	169.75	206.43	32	35	68	48	81
77	D1	CNS	01-15Sep	84.38	520	349.64	179.56	280.52	179.31	280.38	520	186	709	188	711
77	D2	CNS	16-30Sep	86.57	287	394.34	190.96	196.85	179.47	187.72	262	323	587	356	621
77	D3	CNS	01-15Oct	91.89	89	710.46	305.40	316.44	261.14	278.17	89	187	275	253	343
77	D4	CNS	16-31Oct	65.77	2	854.40	289.92	293.52	259.04	262.82	3	113	117	221	224
77	E6	SNS	16-31Dec	81.03	1	685.57	.	685.57	.	685.57	1	.	2	.	2
77	E7	SNS	01-15Jan	62.16	.	.	532.60	532.60	532.60	532.60	.	8	8	8	8
77	E8	SNS	16-31Jan	42.86	.	.	.	.	.	.	.	.	.	.	.
78	B1	Or/Sh	01-15Sep	100.00	2904	471.24	356.89	459.54	346.30	457.82	3047	132	3179	146	3191
78	B2	Or/Sh	16-30Sep	38.95	43	140.86	133.29	129.86	117.02	115.50	50	293	343	348	398
78	C2	Buchan	16-30Sep	91.04	138	322.44	236.57	242.00	234.65	241.07	162	140	301	141	302
78	D1	CNS	01-15Sep	84.38	1405	308.89	278.73	304.89	278.73	304.89	1406	24	1429	24	1429
78	D2	CNS	16-30Sep	100.00	131	409.69	227.65	218.60	223.54	214.75	81	395	475	413	493
78	D3	CNS	01-15Oct	94.59	297	563.67	291.90	368.46	260.99	316.66	269	267	536	390	658
78	D4	CNS	16-31Oct	87.39	1	984.89	336.46	342.53	279.98	282.32	2	69	72	152	153
78	E6	SNS	16-31Dec	82.76	33	650.60	692.82	663.65	692.82	663.65	33	15	48	15	48
78	E7	SNS	01-15Jan	51.35	3	454.47	429.96	438.94	429.96	438.94	3	2	5	2	5
79	B1	Or/Sh	01-15Sep	96.91	2860	249.71	245.32	222.44	236.34	220.39	2882	1659	4540	1795	4676
79	B2	Or/Sh	16-30Sep	97.89	2361	579.11	112.98	239.18	111.17	218.82	2362	3512	5878	4112	6474
79	C1	Buchan	01-15Sep	62.69	170	394.09	309.32	313.05	323.59	311.45	197	76	274	80	278
79	C2	Buchan	16-30Sep	52.24	9	248.53	159.61	157.41	152.10	150.04	10	898	908	1093	1105
79	D1	CNS	01-15Sep	96.88	662	660.02	357.41	642.55	357.41	642.55	662	19	680	19	680
79	D2	CNS	16-30Sep	95.52	131	340.09	252.29	284.08	249.27	282.04	131	135	266	137	268
79	D3	CNS	01-15Oct	90.99	504	464.97	301.54	354.92	259.68	327.27	507	369	882	453	965

79	D4	CNS	16-31Oct	45.95	6	326.47	362.43	356.25	291.19	288.15	7	198	205	252	261
79	E6	SNS	16-31Dec	32.76	.	.	.	.	.	.	.	.	.	.	.
79	E7	SNS	01-15Jan	63.51	143	600.14	675.73	639.38	675.73	639.38	111	142	254	142	254
79	E8	SNS	16-31Jan	84.52	89	294.42	306.07	271.40	306.07	271.40	89	33	122	33	122
80	B1	Or/Sh	01-15Sep	100.00	3333	313.14	179.23	212.18	174.18	208.28	3534	4293	7823	4438	7976
80	B2	Or/Sh	16-30Sep	88.42	619	312.14	123.78	121.40	115.17	113.27	720	4005	4722	4738	5457
80	C1	Buchan	01-15Sep	85.07	18	454.86	153.93	163.73	146.54	153.12	21	287	309	356	377
80	C2	Buchan	16-30Sep	40.30	1	519.62	169.78	167.78	110.92	110.03	1	111	112	224	225
80	D1	CNS	01-15Sep	82.81	317	455.87	174.76	280.54	174.76	280.54	317	221	541	221	541
80	D2	CNS	16-30Sep	100.00	188	523.45	203.85	231.06	179.36	208.30	188	361	552	442	630
80	D3	CNS	01-15Oct	3.60	9	127.66	27.25	25.24	21.24	22.76	9	94	103	129	138
80	D4	CNS	16-31Oct	94.59	12	650.17	371.91	438.52	194.08	193.40	13	10	23	206	219
80	E6	SNS	16-31Dec	72.41	247	401.09	262.45	356.68	262.45	356.68	247	65	313	65	313
80	E7	SNS	01-15Jan	79.73	129	348.78	177.30	186.85	176.27	186.00	129	301	435	303	437
80	E8	SNS	16-31Jan	96.43	40	332.93	260.97	243.22	258.42	239.92	40	313	354	316	359
81	B1	Or/Sh	01-15Sep	96.91	3668	256.63	143.20	208.12	134.95	201.90	3667	1826	5499	2031	5712
81	B2	Or/Sh	16-30Sep	96.84	279	455.46	118.74	153.84	94.59	117.38	277	927	1208	1447	1728
81	C1	Buchan	01-15Sep	67.16	3	495.43	186.73	183.93	156.82	154.71	3	83	86	198	201
81	C2	Buchan	16-30Sep	44.78	12	344.91	201.47	208.39	125.31	126.91	12	176	187	469	480
81	D1	CNS	01-15Sep	81.25	903	387.10	135.57	291.62	129.45	282.35	903	357	1259	396	1299
81	D2	CNS	16-30Sep	92.54	238	408.25	137.91	169.06	123.72	150.41	235	590	825	727	961
81	D3	CNS	01-15Oct	70.27	121	371.50	192.35	176.27	173.75	161.30	119	819	939	1026	1147
81	D4	CNS	16-31Oct	94.59	.	.	329.99	329.99	122.05	122.05	.	14	14	366	366
81	E6	SNS	16-31Dec	55.17	1456	211.85	258.69	213.27	258.69	213.27	1456	1367	2821	1367	2821
81	E8	SNS	16-31Jan	98.81	70	210.71	138.34	141.05	134.57	138.57	70	295	362	307	372
82	B1	Or/Sh	01-15Sep	95.88	2344	158.96	124.96	119.32	118.30	115.87	2353	1812	4172	1947	4303
82	B2	Or/Sh	16-30Sep	100.00	1129	193.81	117.74	113.80	104.30	103.50	1116	2146	3254	2740	3852
82	C1	Buchan	01-15Sep	97.01	347	250.67	256.20	218.44	200.32	189.65	340	233	574	344	685
82	C2	Buchan	16-30Sep	56.72	259	346.50	144.74	150.65	119.46	122.74	257	452	710	662	922
82	D1	CNS	01-15Sep	75.00	86	291.03	222.11	196.58	217.44	192.26	86	156	243	162	251
82	D2	CNS	16-30Sep	74.63	64	427.05	141.03	193.45	139.99	192.06	64	160	224	170	233
82	D3	CNS	01-15Oct	67.57	1078	410.99	265.82	380.22	192.86	357.13	1077	132	1210	221	1300
82	D4	CNS	16-31Oct	14.41	23	166.51	194.52	195.37	170.08	172.24	23	66	82	76	96
82	E6	SNS	16-31Dec	56.90	710	205.95	165.93	169.43	165.93	169.43	710	484	1198	484	1198
82	E7	SNS	01-15Jan	98.65	276	176.61	141.46	133.18	139.96	131.76	275	431	710	444	722
82	E8	SNS	16-31Jan	51.19	54	178.14	157.34	152.41	151.64	149.31	54	113	171	119	177
83	B1	Or/Sh	01-15Sep	96.91	2579	196.22	112.48	135.48	111.21	130.85	2579	2527	5105	3021	5602
83	B2	Or/Sh	16-30Sep	97.89	809	290.97	97.74	114.99	90.71	104.88	812	2186	2991	2533	3347
83	C1	Buchan	01-15Sep	98.51	3662	568.83	205.50	498.48	178.03	485.00	3647	505	4154	623	4267
83	C2	Buchan	16-30Sep	86.57	770	244.48	96.65	117.17	93.55	112.69	768	1915	2684	2077	2842
83	D1	CNS	01-15Sep	62.50	1459	256.24	179.67	209.31	179.05	209.11	1459	655	2121	657	2123

83	D2	CNS	16-30Sep	91.04	281	460.21	156.40	235.59	144.51	213.05	281	310	590	378	660
83	D3	CNS	01-15Oct	85.59	63	287.30	271.28	237.70	207.52	192.29	63	212	271	297	362
83	E6	SNS	16-31Dec	10.34	71	132.27	153.01	130.88	153.01	130.88	71	262	332	262	332
83	E7	SNS	01-15Jan	83.78	243	143.24	128.09	121.76	127.42	121.27	243	813	1060	822	1066
83	E8	SNS	16-31Jan	66.67	58	234.32	224.29	223.75	224.38	222.96	58	182	240	183	241
84	B1	Or/Sh	01-15Sep	95.88	1795	223.50	104.66	140.93	99.90	134.55	1795	1365	3161	1551	3345
84	B2	Or/Sh	16-30Sep	100.00	1904	313.16	213.88	260.66	172.42	231.64	1912	1690	3601	2147	4061
84	C1	Buchan	01-15Sep	70.15	2327	241.10	192.75	199.45	183.29	196.16	2327	1025	3352	1114	3440
84	C2	Buchan	16-30Sep	95.52	1853	212.04	171.85	169.81	151.62	159.91	1853	1455	3311	1696	3550
84	D1	CNS	01-15Sep	68.75	684	236.88	139.24	144.78	138.30	143.00	688	480	1163	506	1190
84	D2	CNS	16-30Sep	83.58	2404	402.57	153.17	345.64	142.86	340.26	2404	455	2860	512	2913
84	D3	CNS	01-15Oct	86.49	821	496.56	188.65	214.00	158.20	180.86	824	2167	2991	3049	3876
84	D4	CNS	16-31Oct	36.94	433	161.50	98.35	92.93	76.09	75.41	433	1029	1462	1603	2041
84	E6	SNS	16-31Dec	91.38	523	238.62	207.69	214.79	207.69	214.79	523	687	1213	687	1213
84	E7	SNS	01-15Jan	100.00	184	212.72	154.66	150.54	152.26	148.84	185	561	750	578	763
84	E8	SNS	16-31Jan	92.86	39	271.12	149.99	151.74	147.25	148.55	39	345	383	398	439
85	B1	Or/Sh	01-15Sep	96.91	5627	211.58	97.85	169.80	89.30	163.94	5632	1726	7367	1962	7602
85	B2	Or/Sh	16-30Sep	100.00	3420	259.35	100.12	172.09	97.61	157.08	3432	2336	5766	2971	6397
85	C1	Buchan	01-15Sep	100.00	2521	252.48	134.59	156.34	128.82	148.80	2521	2177	4695	2475	4996
85	C2	Buchan	16-30Sep	98.51	1812	191.43	98.19	108.28	81.92	96.07	1812	2686	4501	3421	5242
85	D1	CNS	01-15Sep	95.31	130	234.38	168.83	162.01	161.09	156.19	130	399	527	424	553
85	D2	CNS	16-30Sep	97.01	13039	254.89	130.35	224.27	121.51	220.16	13039	2345	15379	2648	15681
85	D3	CNS	01-15Oct	90.99	1794	252.21	125.06	146.73	112.94	134.67	1794	3265	5058	3714	5513
85	D4	CNS	16-31Oct	90.99	215	292.97	146.62	153.85	112.57	118.89	215	1232	1448	1741	1956
85	E6	SNS	16-31Dec	96.55	1851	289.79	228.90	251.26	228.90	251.13	1851	425	2282	425	2283
85	E7	SNS	01-15Jan	77.03	407	158.55	134.84	131.56	135.63	131.87	407	415	825	421	830
85	E8	SNS	16-31Jan	90.48	38	197.32	117.43	114.44	118.03	115.16	38	634	679	677	720
86	B1	Or/Sh	01-15Sep	96.91	3529	312.11	134.23	229.29	131.75	225.78	3529	1370	4902	1449	4987
86	B2	Or/Sh	16-30Sep	97.89	1852	238.76	151.35	169.24	142.26	159.62	1842	2429	4270	2818	4658
86	C1	Buchan	01-15Sep	95.52	3366	269.02	151.20	185.39	149.44	184.16	3278	2958	6236	3054	6333
86	C2	Buchan	16-30Sep	91.04	343	214.70	145.97	143.59	125.36	124.68	341	2704	3043	3442	3782
86	D1	CNS	01-15Sep	93.75	1611	545.54	204.13	467.22	197.52	463.23	1611	433	2042	449	2059
86	D2	CNS	16-30Sep	100.00	6112	281.52	210.64	239.61	189.80	234.17	6112	1798	7913	2000	8110
86	D3	CNS	01-15Oct	63.96	188	311.56	124.22	118.10	113.30	107.83	188	1268	1459	1752	1946
86	D4	CNS	16-31Oct	54.95	36	250.14	107.26	108.96	91.48	91.19	36	558	593	1214	1247
86	E6	SNS	16-31Dec	82.76	780	279.68	220.09	238.17	220.09	238.17	780	1224	2005	1224	2005
86	E7	SNS	01-15Jan	100.00	123	171.70	148.85	147.11	145.73	143.60	123	1105	1228	1144	1268
86	E8	SNS	16-31Jan	89.29	18	297.32	192.58	191.63	183.15	181.51	18	1249	1265	1426	1450
87	B1	Or/Sh	01-15Sep	95.88	7409	185.91	132.36	172.98	124.82	171.56	7409	1075	8483	1151	8558
87	B2	Or/Sh	16-30Sep	96.84	1830	144.16	94.89	98.10	94.36	97.25	1848	4776	6631	5153	7007
87	C1	Buchan	01-15Sep	86.57	2578	302.08	281.12	283.79	279.39	283.28	2551	788	3346	794	3352

87	C2	Buchan	16-30Sep	97.01	670	240.91	107.56	130.91	100.33	126.17	670	1237	1911	1383	2054
87	D1	CNS	01-15Sep	96.88	799	535.09	694.37	529.70	694.37	529.70	799	8	807	8	807
87	D2	CNS	16-30Sep	100.00	4922	427.76	102.16	374.51	96.09	371.87	4927	697	5634	741	5674
87	D3	CNS	01-15Oct	72.07	1987	167.06	107.10	103.59	95.30	96.70	1992	2383	4382	2686	4684
87	D4	CNS	16-31Oct	100.00	113	595.30	133.97	138.66	105.28	108.40	113	904	1019	1318	1428
87	E6	SNS	16-31Dec	62.07	934	388.82	403.73	394.31	403.73	394.31	934	885	1822	885	1822
87	E7	SNS	01-15Jan	81.08	297	142.43	128.09	119.29	126.59	117.82	297	593	889	610	910
87	E8	SNS	16-31Jan	64.29	146	204.44	177.34	166.28	175.29	165.23	146	255	399	272	416
88	B1	Or/Sh	01-15Sep	95.88	7538	285.87	288.69	259.76	281.34	257.66	7538	2438	9974	2526	10063
88	B2	Or/Sh	16-30Sep	100.00	8824	144.83	87.18	119.09	87.44	118.09	8832	2394	11222	2494	11322
88	C1	Buchan	01-15Sep	98.51	6801	294.20	204.42	256.25	198.38	253.93	6812	2558	9374	2660	9470
88	C2	Buchan	16-30Sep	89.55	5244	143.42	116.20	116.32	108.44	111.80	5248	5088	10336	5556	10804
88	D1	CNS	01-15Sep	87.50	5533	508.12	102.20	469.51	98.02	466.72	5533	469	6000	503	6037
88	D2	CNS	16-30Sep	85.07	3808	191.81	140.94	165.31	131.30	160.52	3808	2083	5895	2263	6072
88	D3	CNS	01-15Oct	88.29	1960	208.80	139.32	143.22	127.84	132.09	1960	3518	5486	4180	6146
88	D4	CNS	16-31Oct	73.87	206	295.12	131.10	129.68	118.41	117.18	206	1785	1989	2282	2492
88	E6	SNS	16-31Dec	87.93	1679	290.77	196.95	240.32	196.95	240.32	1679	743	2425	743	2425
88	E7	SNS	01-15Jan	94.59	162	187.35	132.81	123.18	130.36	121.89	162	569	731	603	759
88	E8	SNS	16-31Jan	67.86	112	158.90	113.29	101.78	108.38	98.79	112	324	442	366	480
89	B1	Or/Sh	01-15Sep	95.88	11476	261.21	127.81	202.60	125.18	200.76	11477	5279	16751	5430	16906
89	B2	Or/Sh	16-30Sep	98.95	5726	131.88	70.32	85.50	68.79	83.01	5725	6012	11745	6611	12336
89	C1	Buchan	01-15Sep	97.01	5875	404.87	232.18	279.05	203.41	260.25	5879	3639	9516	4471	10344
89	C2	Buchan	16-30Sep	98.51	692	247.95	148.41	145.89	127.82	127.86	692	2540	3230	3193	3885
89	D1	CNS	01-15Sep	96.88	1442	381.43	239.38	346.63	236.61	346.17	1442	197	1642	199	1644
89	D2	CNS	16-30Sep	100.00	5010	192.18	111.66	160.78	111.02	160.72	5010	1173	6180	1189	6195
89	D3	CNS	01-15Oct	90.09	2364	339.23	144.46	203.56	143.42	201.61	2364	2171	4534	2222	4588
89	D4	CNS	16-31Oct	38.74	2	458.13	160.91	160.56	121.53	120.89	2	432	433	733	736
89	E6	SNS	16-31Dec	68.97	1514	258.74	335.26	259.51	335.26	259.51	1514	537	2055	537	2055
89	E7	SNS	01-15Jan	93.24	2120	221.51	187.71	200.23	187.22	199.97	2120	1517	3639	1522	3643
89	E8	SNS	16-31Jan	50.00	512	164.92	135.48	133.38	134.18	132.74	512	1055	1570	1066	1580
90	B2	Or/Sh	16-30Sep	91.58	10145	118.71	112.22	105.14	111.46	104.00	10144	7385	17528	7950	18093
90	C1	Buchan	01-15Sep	76.12	4590	224.83	110.38	142.24	106.25	138.89	4590	3704	8293	3865	8457
90	C2	Buchan	16-30Sep	25.37	2045	122.28	49.41	75.96	47.88	74.77	2045	1905	3947	1975	4019
90	D1	CNS	01-15Sep	73.44	19965	335.39	161.44	327.39	160.95	327.33	19965	583	20553	585	20556
90	D2	CNS	16-30Sep	70.15	1239	204.66	97.63	129.52	95.18	127.70	1239	1108	2347	1144	2385
90	D3	CNS	01-15Oct	87.39	975	259.11	111.00	131.19	105.96	120.86	975	1488	2461	1798	2774
90	E6	SNS	16-31Dec	96.55	2552	365.53	236.33	315.66	235.14	314.91	2552	813	3367	820	3375
90	E7	SNS	01-15Jan	87.84	1204	131.53	192.96	147.20	190.28	146.21	1204	1257	2461	1275	2480
91	B1	Or/Sh	01-15Sep	39.18	1021	147.58	99.15	90.02	97.31	87.42	1021	943	1962	1013	2030
91	B2	Or/Sh	16-30Sep	44.21	2398	125.05	57.33	89.45	56.48	87.90	2397	1590	3988	1655	4055
91	C2	Buchan	16-30Sep	70.15	2032	186.97	113.25	129.78	104.20	122.04	2032	1953	3984	2270	4302

91	D1	CNS	01-15Sep	79.69	4823	457.03	235.59	418.89	235.45	418.36	4823	735	5560	741	5567
91	D2	CNS	16-30Sep	100.00	2110	345.26	238.02	240.31	233.92	238.04	2110	1111	3226	1146	3259
91	D3	CNS	01-15Oct	86.49	1249	391.83	192.21	249.31	195.84	229.48	1249	1222	2482	1675	2931
91	E6	SNS	16-31Dec	89.66	4400	696.02	305.35	682.05	305.35	682.05	4400	133	4533	133	4533
91	E7	SNS	01-15Jan	97.30	873	287.64	218.79	231.40	217.54	230.20	873	1469	2342	1484	2359
92	B1	Or/Sh	01-15Sep	13.40	189	187.96	81.27	92.34	73.10	84.26	189	421	610	469	660
92	B2	Or/Sh	16-30Sep	82.11	4917	193.21	102.84	140.91	101.63	139.69	4917	2660	7589	2751	7670
92	C2	Buchan	16-30Sep	59.70	822	320.97	87.51	167.82	71.75	142.87	822	701	1526	934	1758
92	D1	CNS	01-15Sep	42.19	10	375.53	199.99	216.62	199.99	216.62	10	16	27	16	27
92	D2	CNS	16-30Sep	59.70	165	318.37	260.80	262.58	238.47	247.80	165	311	478	345	510
92	D3	CNS	01-15Oct	52.25	163	291.48	151.50	174.03	146.53	151.78	163	306	471	474	639
92	E6	SNS	16-31Dec	10.34	176	244.95	244.95	244.95	244.95	244.95	176	50	226	50	226
92	E7	SNS	01-15Jan	85.14	1616	169.03	155.82	151.48	153.81	150.39	1616	1707	3325	1728	3349
93	B2	Or/Sh	16-30Sep	40.00	66	266.95	140.10	165.16	91.25	100.59	66	125	196	276	346
93	C2	Buchan	16-30Sep	68.66	174	290.72	329.21	293.24	273.85	265.95	174	302	475	555	726
93	D2	CNS	16-30Sep	98.51	685	218.93	211.56	200.67	211.56	200.67	685	253	936	253	936
93	D3	CNS	01-15Oct	59.46	85	184.13	132.09	116.42	127.02	112.14	85	398	489	419	510
93	E6	SNS	16-31Dec	89.66	1358	221.04	381.07	265.39	381.07	265.39	1358	635	1995	635	1995
93	E7	SNS	01-15Jan	87.84	1101	208.78	191.70	189.06	186.85	187.89	1103	347	1454	357	1462
94	B1	Or/Sh	01-15Sep	15.46	26	140.42	82.15	83.05	80.09	80.08	26	163	190	230	260
94	B2	Or/Sh	16-30Sep	80.00	1179	161.57	90.78	108.47	82.86	96.63	1179	1792	2974	2359	3537
94	D2	CNS	16-30Sep	100.00	1464	555.64	221.42	507.21	221.42	507.21	1464	137	1602	137	1602
94	D3	CNS	01-15Oct	63.06	44	269.73	180.44	161.02	165.87	148.95	44	413	460	454	500
94	E6	SNS	16-31Dec	46.55	537	393.37	261.67	380.21	261.67	380.21	537	16	555	16	555
94	E7	SNS	01-15Jan	87.84	595	195.34	154.73	168.25	152.96	167.64	595	514	1116	519	1119
95	B2	Or/Sh	16-30Sep	95.79	8689	278.14	115.80	226.63	115.11	223.52	8688	2311	10996	2470	11156
95	D3	CNS	01-15Oct	34.23	43	182.82	105.90	102.49	100.85	97.62	43	693	735	779	820
95	E6	SNS	16-31Dec	98.28	74	255.87	338.44	286.58	338.44	286.58	74	67	141	67	141
95	E7	SNS	01-15Jan	100.00	230	165.48	134.04	126.39	134.56	126.56	230	417	646	421	649
95	E8	SNS	16-31Jan	34.52	164	181.64	182.17	177.36	181.51	177.48	164	336	499	340	502
96	B2	Or/Sh	16-30Sep	49.47	809	264.19	140.35	196.52	123.57	174.63	809	641	1450	930	1736
96	C2	Buchan	16-30Sep	95.52	184	377.71	242.95	246.65	214.40	223.79	184	424	611	492	679
96	D2	CNS	16-30Sep	47.76	564	402.23	299.23	379.68	295.22	379.04	564	73	636	74	637
96	E6	SNS	16-31Dec	91.38	337	375.87	305.45	327.66	305.45	327.66	337	133	470	133	470
96	E7	SNS	01-15Jan	87.84	675	249.39	272.02	249.39	270.42	248.28	675	733	1409	741	1418
96	E8	SNS	16-31Jan	61.90	691	238.95	181.84	178.19	179.31	176.29	691	772	1468	790	1486
97	B2	Or/Sh	16-30Sep	95.79	[illegible]	289.00	191.22	238.54	178.67	232.41	6717	3046	9765	3342	10057
97	C2	Buchan	16-30Sep	70.15	.	219.41	160.53	156.52	126.99	125.51	24	483	508	862	888
97	E6	SNS	16-31Dec	82.76	.	689.99	503.52	689.92	503.52	689.92	2898390	299	2898690	299	2898690
97	E7	SNS	01-15Jan	87.84	.	205.29	327.52	231.93	323.10	230.71	1033	460	1492	466	1499
97	E8	SNS	16-31Jan	94.05	.	473.00	374.53	353.07	374.33	352.88	2164	1748	3918	1749	3920

Table 2: Output of regression of MLAI vs SSB for larvae LFD 5 to 9, Period 1972 to 1997, unweighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	LAI unit election										
La5to9	-0.90	0.0000032	0.822	0.814	0.58	517814.58	180495.33	81	B1	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La5to9	-1.01	0.0000037	0.776	0.766	0.78	517814.58	208587.53	81	B1	C1	C2	B1	B2	E6	E7	E8				
La5to9	-1.78	0.0000036	0.743	0.731	0.83	517814.58	228583.27	81	B1	C2	B1	B2	E6	E7	E8					
La5to9	-1.21	0.0000035	0.743	0.731	0.80	517814.58	228641.49	81	B1	C1	B1	B2	E6	E7	E8					
La5to9	-1.18	0.0000039	0.710	0.697	0.97	517814.58	248274.97	81	B1	C1	C2	B1	E6	E7	E8					
La5to9	-0.95	0.0000043	0.757	0.746	0.93	517814.58	220049.32	81	B2	C1	C2	B2	E6	E7	E8					
La5to9	-1.44	0.0000036	0.645	0.629	1.05	517814.58	288742.39	81	B1	C1	B1	E6	E7	E8						
La5to9	-1.21	0.0000041	0.730	0.717	0.97	517814.58	236787.07	81	B2	C1	B2	E6	E7	E8						
La5to9	-2.22	0.0000038	0.683	0.669	1.01	517814.58	264997.45	81	B1	C2	B1	E6	E7	E8						
La5to9	-1.90	0.0000042	0.723	0.711	1.01	517814.58	240541.29	81	B2	C2	B2	E6	E7	E8						
La5to9	-0.91	0.0000035	0.784	0.775	0.72	517814.58	203898.21	81	B1	C1	B1	B2	E6	E7						
La5to9	-1.14	0.0000033	0.720	0.707	0.79	517814.58	242899.28	81	B1	C1	B1	B2	E6	E8						
La5to9	-0.35	0.0000032	0.695	0.681	0.81	517814.58	257869.03	81	B1	C1	B1	B2	E7	E8						
La5to9	-0.86	0.0000033	0.766	0.755	0.71	517814.58	215221.93	81	B1	C1	B1	B2	E6							
La5to9	0.21	0.0000032	0.745	0.733	0.72	517814.58	227924.89	81	B1	C1	B1	B2	E7							
La5to9	-0.29	0.0000028	0.505	0.482	1.08	517814.58	386046.85	81	B1	C1	B1	B2	E8							
La5to9	-1.58	0.0000036	0.754	0.743	0.79	517814.58	222439.27	81	B1	C2	B1	B2	E6							
La5to9	-0.64	0.0000033	0.741	0.730	0.76	517814.58	229925.48	81	B1	C2	B1	B2	E7							
La5to9	-0.86	0.0000030	0.605	0.587	0.94	517814.58	314953.92	81	B1	C2	B1	B2	E8							
La5to9	-1.03	0.0000034	0.597	0.579	1.07	517814.58	320624.70	81	B1	C1	B1	E6								
La5to9	0.58	0.0000032	0.609	0.591	1.00	517814.58	312795.49	81	B1	C1	B1	E7								
La5to9	-0.01	0.0000026	0.226	0.191	1.83	517814.58	722657.75	81	B1	C1	B1	E8								
La5to9	-0.73	0.0000041	0.809	0.800	0.77	517814.58	189646.93	81	B2	C1	B2	E6								
La5to9	1.16	0.0000039	0.734	0.721	0.92	517814.58	235109.03	81	B2	C1	B2	E7								
La5to9	0.04	0.0000036	0.631	0.615	1.05	517814.58	298364.69	81	B2	C1	B2	E8								
La5to9	-2.15	0.0000038	0.637	0.621	1.12	517814.58	294480.55	81	B1	C2	B1	E6								
La5to9	-0.87	0.0000034	0.699	0.685	0.88	517814.58	256039.67	81	B1	C2	B1	E7								
La5to9	-1.06	0.0000030	0.426	0.400	1.33	517814.58	453340.95	81	B1	C2	B1	E8								
La5to9	-1.68	0.0000043	0.753	0.742	0.96	517814.58	223064.85	81	B2	C2	B2	E6								
La5to9	-0.08	0.0000040	0.726	0.714	0.95	517814.58	239546.62	81	B2	C2	B2	E7								
La5to9	-0.61	0.0000036	0.626	0.609	1.08	517814.58	301499.85	81	B2	C2	B2	E8								

Table 3: Output of regression of MLAI vs SSB for larvae LFD 5 to 9, Period 1972 to 1997, weighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	eight LAI unit election										
La5to9	-1.07	0.0000030	0.872	0.866	0.44	517814.58	148962.02	81	B1	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La5to9	-1.26	0.0000033	0.785	0.775	0.67	517814.58	203416.48	81	B1	C1	C2	B1	B2	E6	E7	E8				
La5to9	-1.62	0.0000031	0.748	0.737	0.71	517814.58	225431.26	81	B1	C2	B1	B2	E6	E7	E8					
La5to9	-1.39	0.0000031	0.725	0.712	0.74	517814.58	239601.78	81	B1	C1	B1	B2	E6	E7	E8					
La5to9	-1.47	0.0000034	0.738	0.726	0.78	517814.58	231480.87	81	B1	C1	C2	B1	E6	E7	E8					
La5to9	-1.37	0.0000039	0.745	0.733	0.88	517814.58	227665.18	81	B2	C1	C2	B2	E6	E7	E8					
La5to9	-1.61	0.0000031	0.663	0.648	0.86	517814.58	277258.91	81	B1	C1	B1	E6	E7	E8						
La5to9	-1.62	0.0000038	0.692	0.678	0.97	517814.58	259837.74	81	B2	C1	B2	E6	E7	E8						
La5to9	-1.91	0.0000032	0.715	0.702	0.78	517814.58	245912.51	81	B1	C2	B1	E6	E7	E8						
La5to9	-1.90	0.0000038	0.708	0.694	0.93	517814.58	250052.83	81	B2	C2	B2	E6	E7	E8						
La5to9	-1.13	0.0000032	0.763	0.752	0.68	517814.58	216853.55	81	B1	C1	B1	B2	E6	E7						
La5to9	-1.35	0.0000029	0.770	0.760	0.62	517814.58	212605.54	81	B1	C1	B1	B2	E6	E8						
La5to9	-0.88	0.0000030	0.693	0.679	0.76	517814.58	259224.69	81	B1	C1	B1	B2	E7	E8						
La5to9	-1.10	0.0000030	0.812	0.803	0.55	517814.58	187542.51	81	B1	C1	B1	B2	E6							
La5to9	-0.30	0.0000030	0.742	0.730	0.69	517814.58	229517.42	81	B1	C1	B1	B2	E7							
La5to9	-0.95	0.0000028	0.561	0.541	0.95	517814.58	344769.03	81	B1	C1	B1	B2	E8							
La5to9	-1.41	0.0000030	0.793	0.783	0.60	517814.58	199136.41	81	B1	C2	B1	B2	E6							
La5to9	-0.76	0.0000031	0.767	0.757	0.65	517814.58	214320.25	81	B1	C2	B1	B2	E7							
La5to9	-1.11	0.0000028	0.673	0.658	0.76	517814.58	271654.76	81	B1	C2	B1	B2	E8							
La5to9	-1.44	0.0000028	0.542	0.521	0.98	517814.58	358762.12	81	B1	C1	B1	E6								
La5to9	-0.25	0.0000029	0.644	0.628	0.84	517814.58	290300.34	81	B1	C1	B1	E7								
La5to9	-0.95	0.0000024	0.212	0.176	1.76	517814.58	753226.25	81	B1	C1	B1	E8								
La5to9	-1.01	0.0000037	0.794	0.785	0.73	517814.58	198748.81	81	B2	C1	B2	E6								
La5to9	0.98	0.0000037	0.714	0.701	0.90	517814.58	246890.83	81	B2	C1	B2	E7								
La5to9	-0.87	0.0000034	0.605	0.587	1.07	517814.58	315710.30	81	B2	C1	B2	E8								
La5to9	-1.86	0.0000030	0.654	0.638	0.85	517814.58	284070.01	81	B1	C2	B1	E6								
La5to9	-1.04	0.0000030	0.744	0.732	0.69	517814.58	229084.81	81	B1	C2	B1	E7								
La5to9	-1.40	0.0000027	0.431	0.405	1.19	517814.58	448717.54	81	B1	C2	B1	E8								
La5to9	-1.50	0.0000038	0.747	0.735	0.85	517814.58	227223.21	81	B2	C2	B2	E6								
La5to9	0.07	0.0000037	0.742	0.731	0.85	517814.58	229761.99	81	B2	C2	B2	E7								
La5to9	-1.06	0.0000034	0.640	0.623	0.98	517814.58	293003.12	81	B2	C2	B2	E8								

Table 4: Output of regression of MLAI vs SSB for larvae LFD 5 to 9, Period 1981 to 1991, unweighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	LAI unit election										
La5to9	0.26	0.0000021	0.859	0.841	0.28	840379.80	133902.39	81	B1	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La5to9	0.59	0.0000020	0.857	0.840	0.27	840379.80	134958.74	81	B1	C1	C2	B1	B2	E6	E7	E8				
La5to9	-0.32	0.0000020	0.775	0.747	0.35	840379.80	178336.18	81	B1	C2	B1	B2	E6	E7	E8					
La5to9	0.09	0.0000021	0.833	0.812	0.30	840379.80	148380.60	81	B1	C1	B1	B2	E6	E7	E8					
La5to9	0.64	0.0000019	0.847	0.828	0.27	840379.80	140748.55	81	B1	C1	C2	B1	E6	E7	E8					
La5to9	0.96	0.0000021	0.820	0.798	0.32	840379.80	155119.54	81	B2	C1	C2	B2	E6	E7	E8					
La5to9	0.03	0.0000020	0.804	0.780	0.32	840379.80	163806.18	81	B1	C1	B1	E6	E7	E8						
La5to9	0.44	0.0000022	0.816	0.793	0.34	840379.80	157618.27	81	B2	C1	B2	E6	E7	E8						
La5to9	-0.48	0.0000019	0.741	0.708	0.37	840379.80	196460.79	81	B1	C2	B1	E6	E7	E8						
La5to9	-0.07	0.0000021	0.723	0.688	0.42	840379.80	205548.21	81	B2	C2	B2	E6	E7	E8						
La5to9	0.52	0.0000020	0.854	0.836	0.28	840379.80	137286.40	81	B1	C1	B1	B2	E6	E7						
La5to9	0.02	0.0000021	0.866	0.849	0.27	840379.80	130527.40	81	B1	C1	B1	B2	E6	E8						
La5to9	0.67	0.0000020	0.734	0.700	0.40	840379.80	200026.10	81	B1	C1	B1	B2	E7	E8						
La5to9	0.44	0.0000021	0.853	0.835	0.29	840379.80	137833.13	81	B1	C1	B1	B2	E6							
La5to9	1.45	0.0000019	0.766	0.737	0.35	840379.80	183725.90	81	B1	C1	B1	B2	E7							
La5to9	0.60	0.0000020	0.646	0.601	0.50	840379.80	246583.27	81	B1	C1	B1	B2	E8							
La5to9	-0.05	0.0000020	0.745	0.714	0.39	840379.80	194326.78	81	B1	C2	B1	B2	E6							
La5to9	0.77	0.0000018	0.749	0.718	0.35	840379.80	192330.24	81	B1	C2	B1	B2	E7							
La5to9	0.11	0.0000020	0.737	0.704	0.39	840379.80	198710.11	81	B1	C2	B1	B2	E8							
La5to9	0.50	0.0000020	0.860	0.842	0.26	840379.80	134780.36	81	B1	C1	B1	E6								
La5to9	1.96	0.0000018	0.662	0.620	0.42	840379.80	238539.69	81	B1	C1	B1	E7								
La5to9	0.72	0.0000018	0.384	0.307	0.76	840379.80	423804.53	81	B1	C1	B1	E8								
La5to9	1.00	0.0000023	0.874	0.859	0.29	840379.80	126481.81	81	B2	C1	B2	E6								
La5to9	2.86	0.0000020	0.851	0.832	0.28	840379.80	139701.87	81	B2	C1	B2	E7								
La5to9	1.23	0.0000022	0.839	0.819	0.32	840379.80	146117.59	81	B2	C1	B2	E8								
La5to9	-0.15	0.0000019	0.714	0.679	0.39	840379.80	211102.58	81	B1	C2	B1	E6								
La5to9	0.94	0.0000017	0.691	0.652	0.36	840379.80	223360.99	81	B1	C2	B1	E7								
La5to9	0.09	0.0000018	0.669	0.628	0.41	840379.80	234826.92	81	B1	C2	B1	E8								
La5to9	0.35	0.0000021	0.653	0.610	0.51	840379.80	243268.95	81	B2	C2	B2	E6								
La5to9	1.81	0.0000019	0.706	0.669	0.40	840379.80	215544.01	81	B2	C2	B2	E7								
La5to9	0.57	0.0000021	0.744	0.712	0.41	840379.80	195934.30	81	B2	C2	B2	E8								

Table 5: Output of regression of MLAI vs SSB for larvae LFD 5 to 9, Period 1981 to 1991, weighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	Cover	eight LAI unit election										
La5to9	-0.34	0.0000021	0.907	0.896	0.22	840379.80	105535.73	81	B1	0	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La5to9	-0.24	0.0000019	0.806	0.782	0.31	840379.80	162485.58	81	B1	0	C1	C2	B1	B2	E6	E7	E8				
La5to9	-0.72	0.0000019	0.723	0.688	0.38	840379.80	205121.38	81	B1	0	C2	B1	B2	E6	E7	E8					
La5to9	-0.60	0.0000020	0.786	0.759	0.34	840379.80	172932.26	81	B1	0	C1	B1	B2	E6	E7	E8					
La5to9	-0.29	0.0000018	0.790	0.763	0.31	840379.80	171000.35	81	B1	0	C1	C2	B1	E6	E7	E8					
La5to9	0.11	0.0000020	0.786	0.759	0.34	840379.80	172804.56	81	B2	0	C1	C2	B2	E6	E7	E8					
La5to9	-0.72	0.0000019	0.722	0.687	0.38	840379.80	206007.89	81	B1	0	C1	B1	E6	E7	E8						
La5to9	-0.32	0.0000021	0.792	0.766	0.35	840379.80	170195.93	81	B2	0	C1	B2	E6	E7	E8						
La5to9	-0.85	0.0000017	0.670	0.628	0.39	840379.80	233175.71	81	B1	0	C2	B1	E6	E7	E8						
La5to9	-0.50	0.0000019	0.688	0.649	0.42	840379.80	223319.26	81	B2	0	C2	B2	E6	E7	E8						
La5to9	-0.15	0.0000019	0.799	0.774	0.32	840379.80	166632.70	81	B1	0	C1	B1	B2	E6	E7						
La5to9	-0.70	0.0000021	0.798	0.773	0.34	840379.80	166921.95	81	B1	0	C1	B1	B2	E6	E8						
La5to9	-0.34	0.0000020	0.758	0.728	0.38	840379.80	187671.94	81	B1	0	C1	B1	B2	E7	E8						
La5to9	-0.27	0.0000021	0.781	0.754	0.36	840379.80	176064.83	81	B1	0	C1	B1	B2	E6							
La5to9	0.43	0.0000020	0.780	0.752	0.35	840379.80	176896.92	81	B1	0	C1	B1	B2	E7							
La5to9	-0.47	0.0000021	0.711	0.675	0.44	840379.80	212315.20	81	B1	0	C1	B1	B2	E8							
La5to9	-0.46	0.0000019	0.711	0.675	0.40	840379.80	212041.43	81	B1	0	C2	B1	B2	E6							
La5to9	0.12	0.0000019	0.705	0.668	0.39	840379.80	215242.55	81	B1	0	C2	B1	B2	E7							
La5to9	-0.61	0.0000020	0.715	0.680	0.42	840379.80	209864.30	81	B1	0	C2	B1	B2	E8							
La5to9	-0.29	0.0000018	0.698	0.660	0.38	840379.80	219659.51	81	B1	0	C1	B1	E6								
La5to9	0.45	0.0000018	0.684	0.644	0.41	840379.80	227197.56	81	B1	0	C1	B1	E7								
La5to9	-0.56	0.0000019	0.434	0.363	0.70	840379.80	382155.64	81	B1	0	C1	B1	E8								
La5to9	0.36	0.0000022	0.872	0.856	0.28	840379.80	127782.42	81	B2	0	C1	B2	E6								
La5to9	2.36	0.0000020	0.823	0.801	0.31	840379.80	154749.52	81	B2	0	C1	B2	E7								
La5to9	-0.04	0.0000023	0.874	0.858	0.29	840379.80	127055.86	81	B2	0	C1	B2	E8								
La5to9	-0.52	0.0000016	0.638	0.593	0.39	840379.80	251390.28	81	B1	0	C2	B1	E6								
La5to9	0.01	0.0000016	0.639	0.594	0.40	840379.80	251021.06	81	B1	0	C2	B1	E7								
La5to9	-0.65	0.0000016	0.640	0.595	0.40	840379.80	250744.81	81	B1	0	C2	B1	E8								
La5to9	0.03	0.0000020	0.660	0.618	0.48	840379.80	239495.71	81	B2	0	C2	B2	E6								
La5to9	1.68	0.0000018	0.654	0.611	0.44	840379.80	242898.85	81	B2	0	C2	B2	E7								
La5to9	-0.26	0.0000021	0.713	0.678	0.44	840379.80	211654.58	81	B2	0	C2	B2	E8								

Table 6: Output of regression of MLAI vs SSB for larvae LFD 10 to 24, Period 1981 to 1991, unweighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	Cover	LAI unit election										
La10to24	-0.57	0.0000013	0.623	0.576	0.33	840379.80	256743.27	81	B1	0	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La10to24	-0.30	0.0000011	0.572	0.518	0.32	840379.80	286555.94	81	B1	0	C1	C2	B1	B2	E6	E7	E8				
La10to24	-0.41	0.0000009	0.526	0.467	0.28	840379.80	314506.92	81	B1	0	C2	B1	B2	E6	E7	E8					
La10to24	-0.48	0.0000011	0.497	0.434	0.37	840379.80	333502.69	81	B1	0	C1	B1	B2	E6	E7	E8					
La10to24	-0.37	0.0000011	0.561	0.506	0.33	840379.80	293013.34	81	B1	0	C1	C2	B1	E6	E7	E8					
La10to24	-0.25	0.0000012	0.600	0.550	0.32	840379.80	270686.79	81	B2	0	C1	C2	B2	E6	E7	E8					
La10to24	-0.61	0.0000012	0.497	0.434	0.38	840379.80	333846.69	81	B1	0	C1	B1	E6	E7	E8						
La10to24	-0.46	0.0000012	0.523	0.464	0.38	840379.80	316895.21	81	B2	0	C1	B2	E6	E7	E8						
La10to24	-0.52	0.0000009	0.493	0.429	0.30	840379.80	336886.26	81	B1	0	C2	B1	E6	E7	E8						
La10to24	-0.39	0.0000010	0.552	0.496	0.29	840379.80	298749.49	81	B2	0	C2	B2	E6	E7	E8						
La10to24	-0.36	0.0000010	0.490	0.427	0.34	840379.80	338374.67	81	B1	0	C1	B1	B2	E6	E7						
La10to24	-0.52	0.0000011	0.371	0.293	0.49	840379.80	431973.22	81	B1	0	C1	B1	B2	E6	E8						
La10to24	-0.25	0.0000013	0.591	0.540	0.35	840379.80	276177.00	81	B1	0	C1	B1	B2	E7	E8						
La10to24	-0.39	0.0000010	0.353	0.272	0.46	840379.80	450035.39	81	B1	0	C1	B1	B2	E6							
La10to24	-0.01	0.0000012	0.580	0.527	0.33	840379.80	283212.71	81	B1	0	C1	B1	B2	E7							
La10to24	-0.35	0.0000014	0.475	0.409	0.48	840379.80	350130.95	81	B1	0	C1	B1	B2	E8							
La10to24	-0.26	0.0000007	0.384	0.307	0.31	840379.80	421511.15	81	B1	0	C2	B1	B2	E6							
La10to24	0.08	0.0000009	0.569	0.516	0.25	840379.80	289222.06	81	B1	0	C2	B1	B2	E7							
La10to24	-0.19	0.0000010	0.528	0.469	0.32	840379.80	314647.96	81	B1	0	C2	B1	B2	E8							
La10to24	-0.56	0.0000011	0.318	0.233	0.52	840379.80	489260.87	81	B1	0	C1	B1	E6								
La10to24	-0.02	0.0000013	0.609	0.560	0.34	840379.80	267680.14	81	B1	0	C1	B1	E7								
La10to24	-0.53	0.0000016	0.457	0.389	0.57	840379.80	364699.06	81	B1	0	C1	B1	E8								
La10to24	-0.35	0.0000011	0.350	0.269	0.51	840379.80	454908.81	81	B2	0	C1	B2	E6								
La10to24	0.32	0.0000013	0.708	0.671	0.28	840379.80	214642.24	81	B2	0	C1	B2	E7								
La10to24	-0.28	0.0000016	0.526	0.467	0.50	840379.80	317163.17	81	B2	0	C1	B2	E8								
La10to24	-0.37	0.0000007	0.309	0.222	0.34	840379.80	499778.04	81	B1	0	C2	B1	E6								
La10to24	0.07	0.0000008	0.487	0.423	0.28	840379.80	342685.46	81	B1	0	C2	B1	E7								
La10to24	-0.22	0.0000010	0.392	0.316	0.40	840379.80	416193.22	81	B1	0	C2	B1	E8								
La10to24	-0.21	0.0000008	0.408	0.334	0.32	840379.80	401610.81	81	B2	0	C2	B2	E6								
La10to24	0.38	0.0000010	0.711	0.675	0.20	840379.80	212869.69	81	B2	0	C2	B2	E7								
La10to24	-0.11	0.0000012	0.597	0.547	0.32	840379.80	274140.70	81	B2	0	C2	B2	E8								

Table 7: Output of regression of MLAI vs SSB for larvae LFD 10 to 24, Period 1981 to 1991, weighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	Cover	eight LAI unit	election									
La10to24	-0.32	0.0000011	0.688	0.650	0.25	840379.80	222120.89	81	B1	0	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La10to24	-0.12	0.0000010	0.537	0.479	0.31	840379.80	307649.79	81	B1	0	C1	C2	B1	B2	E6	E7	E8				
La10to24	-0.16	0.0000008	0.472	0.406	0.28	840379.80	350415.08	81	B1	0	C2	B1	B2	E6	E7	E8					
La10to24	-0.22	0.0000010	0.443	0.373	0.37	840379.80	371988.48	81	B1	0	C1	B1	B2	E6	E7	E8					
La10to24	-0.23	0.0000011	0.534	0.476	0.33	840379.80	309569.85	81	B1	0	C1	C2	B1	E6	E7	E8					
La10to24	-0.03	0.0000011	0.584	0.532	0.31	840379.80	279454.56	81	B2	0	C1	C2	B2	E6	E7	E8					
La10to24	-0.40	0.0000011	0.459	0.392	0.38	840379.80	360142.94	81	B1	0	C1	B1	E6	E7	E8						
La10to24	-0.14	0.0000011	0.499	0.437	0.37	840379.80	332461.23	81	B2	0	C1	B2	E6	E7	E8						
La10to24	-0.30	0.0000008	0.413	0.340	0.30	840379.80	395828.17	81	B1	0	C2	B1	E6	E7	E8						
La10to24	-0.08	0.0000009	0.533	0.475	0.27	840379.80	310435.11	81	B2	0	C2	B2	E6	E7	E8						
La10to24	-0.12	0.0000009	0.437	0.367	0.35	840379.80	376791.03	81	B1	0	C1	B1	B2	E6	E7						
La10to24	-0.25	0.0000010	0.344	0.262	0.46	840379.80	458170.21	81	B1	0	C1	B1	B2	E6	E8						
La10to24	-0.17	0.0000011	0.498	0.435	0.36	840379.80	333377.85	81	B1	0	C1	B1	B2	E7	E8						
La10to24	-0.14	0.0000009	0.333	0.250	0.44	840379.80	470640.48	81	B1	0	C1	B1	B2	E6							
La10to24	-0.04	0.0000010	0.494	0.431	0.34	840379.80	336459.33	81	B1	0	C1	B1	B2	E7							
La10to24	-0.23	0.0000011	0.405	0.330	0.45	840379.80	403823.43	81	B1	0	C1	B1	B2	E8							
La10to24	-0.07	0.0000007	0.376	0.299	0.31	840379.80	427946.33	81	B1	0	C2	B1	B2	E6							
La10to24	0.02	0.0000008	0.529	0.470	0.25	840379.80	314071.38	81	B1	0	C2	B1	B2	E7							
La10to24	-0.11	0.0000009	0.475	0.410	0.30	840379.80	349638.39	81	B1	0	C2	B1	B2	E8							
La10to24	-0.38	0.0000011	0.289	0.200	0.55	840379.80	523664.81	81	B1	0	C1	B1	E6								
La10to24	-0.14	0.0000012	0.551	0.494	0.35	840379.80	301888.74	81	B1	0	C1	B1	E7								
La10to24	-0.50	0.0000014	0.395	0.320	0.56	840379.80	413705.45	81	B1	0	C1	B1	E8								
La10to24	0.00	0.0000011	0.375	0.297	0.46	840379.80	430991.57	81	B2	0	C1	B2	E6								
La10to24	0.24	0.0000012	0.599	0.549	0.31	840379.80	273241.14	81	B2	0	C1	B2	E7								
La10to24	-0.17	0.0000013	0.463	0.396	0.47	840379.80	359618.87	81	B2	0	C1	B2	E8								
La10to24	-0.22	0.0000006	0.249	0.155	0.36	840379.80	579744.29	81	B1	0	C2	B1	E6								
La10to24	-0.08	0.0000008	0.454	0.385	0.28	840379.80	366552.44	81	B1	0	C2	B1	E7								
La10to24	-0.21	0.0000008	0.321	0.236	0.38	840379.80	485872.32	81	B1	0	C2	B1	E8								
La10to24	0.10	0.0000008	0.469	0.403	0.28	840379.80	354795.13	81	B2	0	C2	B2	E6								
La10to24	0.29	0.0000009	0.653	0.610	0.22	840379.80	243321.40	81	B2	0	C2	B2	E7								
La10to24	-0.03	0.0000010	0.557	0.501	0.30	840379.80	297946.83	81	B2	0	C2	B2	E8								

Table 8: Output of regression of MLAI vs SSB for larvae LFD 10 to 15, Period 1981 to 1991, unweighted MLAIs

Larvae	a	b	r	a r	rm e	meanSSB	inv re Err	elYear	elUnit	Cover	LAI unit election										
La10to15	-0.18	0.0000014	0.674	0.633	0.32	840379.80	229726.87	81	B1	0	C1	C2	B1	B2	D1	D2	D3	D4	E6	E7	E8
La10to15	-0.07	0.0000012	0.621	0.574	0.31	840379.80	258546.02	81	B1	0	C1	C2	B1	B2	E6	E7	E8				
La10to15	-0.25	0.0000010	0.580	0.528	0.27	840379.80	281929.69	81	B1	0	C2	B1	B2	E6	E7	E8					
La10to15	-0.34	0.0000012	0.538	0.481	0.36	840379.80	306902.44	81	B1	0	C1	B1	B2	E6	E7	E8					
La10to15	-0.13	0.0000012	0.599	0.549	0.33	840379.80	270920.24	81	B1	0	C1	C2	B1	E6	E7	E8					
La10to15	0.03	0.0000013	0.645	0.601	0.32	840379.80	245759.25	81	B2	0	C1	C2	B2	E6	E7	E8					
La10to15	-0.49	0.0000012	0.520	0.460	0.38	840379.80	319009.01	81	B1	0	C1	B1	E6	E7	E8						
La10to15	-0.27	0.0000013	0.562	0.507	0.37	840379.80	293317.35	81	B2	0	C1	B2	E6	E7	E8						
La10to15	-0.37	0.0000009	0.536	0.478	0.29	840379.80	308642.21	81	B1	0	C2	B1	E6	E7	E8						
La10to15	-0.17	0.0000011	0.606	0.557	0.28	840379.80	267653.67	81	B2	0	C2	B2	E6	E7	E8						
La10to15	-0.18	0.0000011	0.543	0.485	0.33	840379.80	304728.44	81	B1	0	C1	B1	B2	E6	E7						
La10to15	-0.40	0.0000012	0.419	0.346	0.48	840379.80	391116.17	81	B1	0	C1	B1	B2	E6	E8						
La10to15	-0.08	0.0000014	0.632	0.586	0.35	840379.80	253418.84	81	B1	0	C1	B1	B2	E7	E8						
La10to15	-0.23	0.0000012	0.413	0.339	0.45	840379.80	396779.47	81	B1	0	C1	B1	B2	E6							
La10to15	0.24	0.0000013	0.640	0.595	0.32	840379.80	249408.85	81	B1	0	C1	B1	B2	E7							
La10to15	-0.21	0.0000015	0.529	0.470	0.47	840379.80	313964.71	81	B1	0	C1	B1	B2	E8							
La10to15	-0.08	0.0000009	0.462	0.395	0.30	840379.80	358850.30	81	B1	0	C2	B1	B2	E6							
La10to15	0.36	0.0000010	0.625	0.578	0.25	840379.80	257573.27	81	B1	0	C2	B1	B2	E7							
La10to15	-0.01	0.0000012	0.605	0.556	0.31	840379.80	268746.51	81	B1	0	C2	B1	B2	E8							
La10to15	-0.40	0.0000012	0.351	0.270	0.53	840379.80	453719.92	81	B1	0	C1	B1	E6								
La10to15	0.27	0.0000014	0.655	0.612	0.33	840379.80	242609.89	81	B1	0	C1	B1	E7								
La10to15	-0.39	0.0000017	0.483	0.418	0.59	840379.80	346020.87	81	B1	0	C1	B1	E8								
La10to15	-0.11	0.0000013	0.405	0.331	0.51	840379.80	404607.59	81	B2	0	C1	B2	E6								
La10to15	0.73	0.0000015	0.752	0.721	0.28	840379.80	191805.73	81	B2	0	C1	B2	E7								
La10to15	-0.07	0.0000018	0.589	0.538	0.48	840379.80	279057.50	81	B2	0	C1	B2	E8								
La10to15	-0.17	0.0000008	0.370	0.291	0.33	840379.80	435780.10	81	B1	0	C2	B1	E6								
La10to15	0.41	0.0000009	0.544	0.487	0.28	840379.80	305818.81	81	B1	0	C2	B1	E7								
La10to15	-0.05	0.0000011	0.490	0.426	0.37	840379.80	340957.23	81	B1	0	C2	B1	E8								
La10to15	0.07	0.0000009	0.483	0.418	0.32	840379.80	345525.91	81	B2	0	C2	B2	E6								
La10to15	0.84	0.0000011	0.735	0.702	0.21	840379.80	200614.67	81	B2	0	C2	B2	E7								
La10to15	0.15	0.0000013	0.676	0.636	0.30	840379.80	231209.84	81	B2	0	C2	B2	E8								

Table 9: Standard Area Definition (Area Definition File)

A = Stan ar Area Buchan Or ne /Shetlan Central North Sea Southern North Sea
B = Surve /Fortnight
C = 10 20 ectangle
D = 10 10 nm ectangle = 1/9th o 10 20 ectangle
E = o ition
F = Area o 10 10 nm ectangle
= riorit 0 1 2 = tan ar po ition -1 -2 = e tra po ition

A	B	C	D	E	F	
1	1	1	1	59550350	.344295	0
1	1	1	2	59550330	.344295	0
1	1	1	3	59550310	.344295	1
1	1	1	4	59550250	.344295	1
1	1	1	5	59550230	.344295	2
1	1	1	6	59550210	.344295	2
1	1	1	7	59550150	.344295	2
1	1	1	8	59550130	.322571	2
1	1	1	9	59550110	.284102	0
1	1	2	1	59450350	.346023	0
1	1	2	2	59450330	.346023	1
1	1	2	3	59450310	.346023	1
1	1	2	4	59450250	.346023	2
1	1	2	5	59450230	.346023	2
1	1	2	6	59450210	.346023	2
1	1	2	7	59450150	.346023	2
1	1	2	8	59450130	.346023	2
1	1	2	9	59450110	.346023	2
1	1	3	1	59350350	.347747	0
1	1	3	2	59350330	.347747	1
1	1	3	3	59350310	.347747	2
1	1	3	4	59350250	.347747	2
1	1	3	5	59350230	.347747	2
1	1	3	6	59350210	.347747	2
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1	1	3	8	59350130	.338479	2
1	1	3	9	59350110	.347747	1
1	1	4	1	59250350	.349469	0
1	1	4	2	59250330	.349469	1
1	1	4	3	59250310	.349469	2
1	1	4	4	59250250	.322535	0
1	1	4	5	59250230	.302918	2
1	1	4	6	59250210	.349469	2
1	1	4	7	59250150	.349469	2
1	1	4	8	59250130	.349469	2
1	1	4	9	59250110	.349469	2
1	1	5	1	59150350	.351187	0
1	1	5	2	59150330	.351187	0
1	1	5	3	59150310	.325081	0
1	1	5	5	59150230	.18979	0
1	1	5	6	59150210	.351187	2
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1	1	5	8	59150130	.351187	2
1	1	5	9	59150110	.351187	1
1	1	6	1	59050350	.352903	0
1	1	6	2	59050330	.32915	1
1	1	6	5	59050230	.290577	2
1	1	6	6	59050210	.352903	2
1	1	6	7	59050150	.352903	2
1	1	6	8	59050130	.352903	1
1	1	6	9	59050110	.352903	1
1	1	7	1	58550350	.354616	0
1	1	7	2	58550330	.304134	2
1	1	7	5	58550230	.354616	1
1	1	7	6	58550210	.354616	2
1	1	7	7	58550150	.354616	2
1	1	7	8	58550130	.354616	2
1	1	7	9	58550110	.354616	1
1	1	8	1	58450350	.356325	2
1	1	8	2	58450330	.346514	2
1	1	8	4	58450250	.29111	2
1	1	8	5	58450230	.356325	2
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1	1	8	8	58450130	.356325	2
1	1	8	9	58450110	.356325	2
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1	1	9	3	58350310	.082156	2
1	1	9	4	58350250	.358032	2
1	1	9	5	58350230	.358032	0
1	1	9	6	58350210	.358032	2
1	1	9	7	58350150	.358032	2
1	1	9	8	58350130	.358032	1
1	1	9	9	58350110	.358032	1
1	1	10	3	58250310	.10143	0
1	1	10	4	58250250	.359735	1
1	1	10	5	58250230	.359735	1
1	1	10	6	58250210	.359735	2
1	1	10	7	58250150	.359735	2
1	1	10	8	58250130	.359735	2
1	1	10	9	58250110	.359735	0
1	1	11	3	58150310	.329278	1
1	1	11	4	58150250	.361436	1
1	1	11	5	58150230	.361436	0
1	1	11	6	58150210	.361436	2
1	1	11	7	58150150	.361436	2
1	1	11	8	58150130	.361436	1

1	1	11	9	58150110	.361436	1
1	1	12	2	58050330	.340309	1
1	1	12	3	58050310	.363133	1
1	1	12	4	58050250	.363133	1
1	1	12	5	58050230	.363133	0
1	1	12	6	58050210	.363133	2
1	1	12	7	58050150	.363133	2
1	1	12	8	58050130	.363133	1
1	1	12	9	58050110	.363133	0
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1	2	1	3	59550310	.344295	0
1	2	1	4	59550250	.344295	1
1	2	1	5	59550230	.344295	0
1	2	1	6	59550210	.344295	2
1	2	1	7	59550150	.344295	1
1	2	1	8	59550130	.322571	1
1	2	1	9	59550110	.284102	0
1	2	2	2	59450330	.346023	0
1	2	2	3	59450310	.346023	0
1	2	2	4	59450250	.346023	0
1	2	2	5	59450230	.346023	0
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1	2	3	4	59350250	.347747	1
1	2	3	5	59350230	.347747	1
1	2	3	6	59350210	.347747	1
1	2	3	7	59350150	.347747	1
1	2	3	8	59350130	.338479	1
1	2	3	9	59350110	.347747	0
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1	2	4	2	59250330	.349469	0
1	2	4	3	59250310	.349469	1
1	2	4	4	59250250	.322535	1
1	2	4	5	59250230	.302918	0
1	2	4	6	59250210	.349469	1
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1	2	4	8	59250130	.349469	1
1	2	4	9	59250110	.349469	0
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1	2	5	2	59150330	.351187	1
1	2	5	3	59150310	.325081	0
1	2	5	5	59150230	.18979	0
1	2	5	6	59150210	.351187	0
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1	2	5	8	59150130	.351187	1
1	2	5	9	59150110	.351187	0
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1	2	6	2	59050330	.32915	1
1	2	6	5	59050230	.290577	0
1	2	6	6	59050210	.352903	1
1	2	6	7	59050150	.352903	1
1	2	6	8	59050130	.352903	0
1	2	6	9	59050110	.352903	1
1	2	7	1	58550350	.354616	1
1	2	7	2	58550330	.304134	1
1	2	7	5	58550230	.354616	1
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1	2	7	7	58550150	.354616	1
1	2	7	8	58550130	.354616	1
1	2	7	9	58550110	.354616	0
1	2	8	1	58450350	.356325	1
1	2	8	2	58450330	.346514	1
1	2	8	4	58450250	.29111	1
1	2	8	5	58450230	.356325	1
1	2	8	6	58450210	.356325	1
1	2	8	7	58450150	.356325	1
1	2	8	8	58450130	.356325	0
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1	2	9	1	58350350	.196459	0
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1	2	9	9	58350110	.358032	1
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1	2	10	6	58250210	.359735	1
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1	2	11	6	58150210	.361436	1
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1	2	12	3	58050310	.363133	2
1	2	12	4	58050250	.363133	0
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2	1	1	6	57550210	.364828	1
2	1	1	7	57550150	.364828	1
2	1	1	8	57550130	.364828	1
2	1	1	9	57550110	.364828	1
2	1	1	10	57550050	.364828	-1
2	1	2	4	57450250	.307694	0
2	1	2	5	57450230	.355288	0
2	1	2	6	57450210	.322724	0
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2	1	2	8	57450130	.366519	2
2	1	2	9	57450110	.366519	1
2	1	2	10	57450050	.366519	-1
2	1	3	7	57350150	.164057	1
2	1	3	8	57350130	.368207	2
2	1	3	9	57350110	.368207	1
2	1	3	10	57350050	.368207	-1
2	1	4	7	57250150	.199564	2

2	1	4	8	57250130	.369892	2
2	1	4	9	57250110	.369892	1
2	1	4	10	57250050	.369892	1
2	1	4	11	57250030	.369892	0
2	1	4	12	57250010	.369892	0
2	1	5	7	57150150	.371574	2
2	1	5	8	57150130	.371574	2
2	1	5	9	57150110	.371574	1
2	1	5	10	57150050	.371574	2
2	1	5	11	57150030	.371574	0
2	1	5	12	57150010	.371574	0
2	1	6	7	57050150	.373253	1
2	1	6	8	57050130	.373253	1
2	1	6	9	57050110	.373253	1
2	1	6	10	57050050	.373253	2
2	1	6	11	57050030	.373253	0
2	1	6	12	57050010	.373253	0
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2	1	7	9	56550110	.374929	2
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2	1	7	11	56550030	.374929	0
2	1	7	12	56550010	.374929	0
2	1	8	6	56450210	.376601	0
2	1	8	7	56450150	.376601	0
2	1	8	8	56450130	.376601	1
2	1	8	9	56450110	.376601	2
2	1	8	10	56450050	.376601	1
2	1	8	11	56450030	.376601	0
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2	1	9	12	56350010	.378271	0
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2	1	10	7	56250150	.379937	0
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2	1	10	9	56250110	.379937	0
2	1	10	10	56250050	.379937	-1
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2	1	11	7	56150150	.3816	0
2	1	11	8	56150130	.3816	0
2	1	11	9	56150110	.3816	0
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2	1	12	6	56050210	.383259	0
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2	1	12	8	56050130	.383259	0
2	1	12	9	56050110	.383259	0
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2	2	2	8	57450130	.366519	0
2	2	2	9	57450110	.366519	1
2	2	2	10	57450050	.366519	-1
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2	2	5	9	57150110	.371574	1
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2	2	6	8	57050130	.373253	1
2	2	6	9	57050110	.373253	1
2	2	6	10	57050050	.373253	2
2	2	6	11	57050030	.373253	2
2	2	6	12	57050010	.373253	0
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2	2	7	8	56550130	.374929	1
2	2	7	9	56550110	.374929	2
2	2	7	10	56550050	.374929	1
2	2	7	11	56550030	.374929	2
2	2	7	12	56550010	.374929	0
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2	2	8	9	56450110	.376601	1
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2	2	8	11	56450030	.376601	1
2	2	8	12	56450010	.376601	0
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2	2	9	7	56350150	.378271	0
2	2	9	8	56350130	.378271	0
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2	2	9	10	56350050	.378271	1
2	2	9	11	56350030	.378271	0
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2	2	10	6	56250210	.379937	0
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2	2	10	8	56250130	.379937	0
2	2	10	9	56250110	.379937	0
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2	2	11	7	56150150	.3816	0
2	2	11	8	56150130	.3816	0
2	2	11	9	56150110	.3816	0
2	2	11	10	56150050	.3816	-1
2	2	12	6	56050210	.383259	0

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2	2	12	8	56050130	.383259	0
2	2	12	9	56050110	.383259	0
2	2	12	10	56050050	.383259	-1
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2	1			57550330		-2
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2	1			57450310		-2
2	1			57550350		-2
2	1			57550330		-2
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3	1	1	3	55550130	.384916	1
3	1	1	4	55550110	.384916	0
3	1	1	5	55550050	.384916	0
3	1	2	2	55450150	.316202	2
3	1	2	3	55450130	.386569	2
3	1	2	4	55450110	.386569	0
3	1	2	5	55450050	.386569	0
3	1	3	3	55350130	.354619	2
3	1	3	4	55350110	.388219	0
3	1	3	5	55350050	.388219	1
3	1	3	6	55350030	.388219	0
3	1	4	3	55250130	.293314	2
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