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International Council for the Exploration of the Sea

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REPORT OF THE PLANNING GROUP FOR HERRING SURVEYS IN THE NORTH SEA AND ADJACENT AREAS

Aberdeen, Scotland, 2, 4,5 February 1993

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1 TERMS OF REFERENCE

ICES Resolution C.Res. 1992/2:17 - A planning group for Herring surveys will be established to replace the Working group on Herring Larval Surveys South of 62N and the Planning group for Acoustic Surveys in Sub-area IV and Division IIIa and will meet in Aberdeen, Scotland UK from 2-5 February 1993 to:

a) coordinate herring acoustics and larval surveys in the North Sea and adjacent areas;

b) evaluate the reliability and usefulness of both survey methods;

c) submit a report to the herring Assessment Working Group for the Area South of 62N.

2 PARTICIPANTS

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3 SURVEYS FOR 1993 HERRING ASSESSMENT

3.1 Acoustic Surveys

A total of 5 surveys were carried out in ICES areas IVa , IVb VIa North and the Kattegat and Skagerrak. Table 1 shows the dates for the acoustic survey programme carried out in 1992

Table 1 1992 Acoustic Surveys

Country/Vessel	Dates	Area
Norway / *JOHAN HJORT*	24 June - 11 July	57 to 62 N 1E to Norway
Netherlands / *TRIDENS*	6 - 23 July	54 to 59 N 2E to UK coast
Scotland / *SCOTIA*	13 - 31 July	58 to 62 N 2E to 4W
Scotland / *AZALEA*	16 - 31 July	56 30 to 60N 4W to 7W
Denmark / *DANA*	7 - 23 July	57 N 5 E to Kattegat

3.2 Larval Surveys

Table 2 shows the programme of larval surveys carried out in 1992/93 for the 1993 assessment of herring stocks.

Table 2 1992 Programme of Herring Larval Survey Cruises.

Country/ Vessel	Dates	Area
Germany / *POSEIDON*	3 - 21 January 1993	Channel IVc, VIId
Germany / *POSEIDON*	13 Sept to 7 Oct	Orkney Shetland
Scotland / *BON ESPPRIT*	1 - 11 September	VIa North
Scotland / *SCOTIA*	5 days September	VIa North
Scotland / *SCOTIA*	12 - 24 October	VIa North
Netherlands / *TRIDENS*	15 - 22 September	Central N.S., Buchan
Netherlands / *KW 34*	28 Sept to 8 Oct	Central North Sea
Netherlands / *TRIDENS*	14 - 18 December	Channel

3.3 Discussion

The survey results were presented and discussed at the planning group meeting, however, the results are not included here, they will be presented in separate survey reports. A brief report on discussions is included here.

3.3.1 Acoustic Surveys

The analysis of the acoustic surveys was largely completed for ICES areas VIa North, IVa and IVb. The surveys were carried out almost without problems, with the exception of the *SCOTIA* survey of Orkney Shetland where problems with fishing were experienced. This was due mainly to the inexperience of the fishing mates in the deployment of pelagic fishing gear. When deployed correctly catches were as expected. The planning group discussed the sources of error in the surveys. The largest potential errors were identified as species allocation of integrator records and spatial sampling errors. In addition there are differences among participating countries in the procedures for using length and age data derived from trawl hauls in order to obtain both conversion factors for areas with different sizes of fish and to disaggregate the abundance between age groups. One further source of error was noted, the possible yearly changes in mean target strength due to the changes in fish behaviour. In some years, particularly 1988 to 90, significant numbers of small dense herring schools were found in the top 50m. However in 1991 and 92 this proportion seems to have diminished.

In 1993 the area coverage appeared to be largely complete for the assessment of the 2+ age groups of herring. With the exception of one statistical rectangle in the central North Sea and one in the south of VIa North no high densities were recorded near the boundaries of the survey area. The eastern central North Sea however was not surveyed due to the limited vessel resources and thus no estimate of 1 ring fish could be made.

Some differences between the estimates by *JOHAN HJORT* and *SCOTIA* were observed in the overlapping area between 1° to 2°E. This difference does not give rise to large changes in the total stock estimates but they illustrate the need for careful selection of survey strategy and timing.

3.3.2 Larval Surveys

Most of the analysis of the larval survey data remains to be carried out. Discussions in the planning group were limited to the results from the VIa North surveys which were available. Problems were encountered with interpolation because of poor area coverage due to the loss of survey time caused by bad weather. The problem was compounded by the presence of one station south of the Hebrides which contributed 55% of the Larval Abundance Index (LAI). This type of problem has been encountered in previous years, and although procedures for collecting 3 or 4 additional stations are included in the standard method, these survey based methods were not possible due to a shortage of resources. It was pointed out that, with the current level of effort, sampling problems of this type could occur more frequently in the future. The correct approach to this type of data analysis problem was discussed in some detail. It was concluded that for the long term use of the LAI the data should be included uncorrected in the series. However, the assessment requirements from the VIa North data are for the best estimate of stock size in 1993. In this case some indication of the likely error in the current years estimate of the LAI would be helpful. An investigation of the frequency of occurrence of single large values and their relation to the mean in each year in the historical data base might be helpful.

It was noted that the coverage in 1992 for the central and northern North Sea was insufficient for the estimation of a larval mortality rate. The long term mean mortality estimate, obtained from years when mortality estimates were available, will be used to analyze the data.

4 PLANS FOR 1993 SURVEYS

4.1 Acoustic Surveys

Table 3 shows the provisional vessels dates and areas for the 1993 acoustic survey programme for herring stocks in IVa, IVb and VIa North.

Table 3 1993 Acoustic Survey Programme

Country/Vessel	Dates	Area
Norway / *G O SARS*	1 to 22 July	57 to 62 N 1E to Norway
Netherlands / *TRIDENS*	28 June to 16 July	54 to 59 N 2E to UK coast
Scotland / *SCOTIA*	10 July to 30 August	58 to 62 N 2E to 4W
Scotland / Charter	16 days July	56 30 to 60N 4W to 7W
Denmark / *DANA*	8 to 23 July	57 N 5 E to Kattegat

The survey grids must be organised to minimise the time between vessel change over at the boundaries of individual areas. *TRIDENS* will survey the Western Central North Sea so that the survey is approximately continuous with *SCOTIA* in the North Western North Sea. The Scottish Charter in VIa will be organised so that the survey is completed at the north eastern limit of this area at the same time as *SCOTIA* completes the area east of Orkney and Shetland. The G.O. Sars will survey the southern part of the North Eastern North Sea to match with *TRIDENS* and the Northern part of the area to match with *SCOTIA*. *DANA* will start the survey in the North Sea to coincide with the timing of *G O SARS*. The individual survey areas for each vessel are shown in Figure 1.

The current survey plan will exclude the Moray Firth and Firth of Forth on the Scottish coast and the Eastern Central North Sea off Denmark and Germany. This means that estimates of 1 ring fish will not be possible for the 1993 survey. Additional resources would allow surveys of the eastern central North Sea, and the possibility of slightly larger area overlap. In this case an estimate of 1 ring fish would be possible, allowing extra information on year class mortality and a more complete stock assessment.

Coordination of North Sea acoustic surveys with the Baltic acoustic surveys would also help with better assessment of stocks in the North Sea, Kattegat, Skagerrak and the Baltic.

The survey planning group has been asked to include sampling for *Ichthyophonus* infection rate within the standard survey sampling programme. Macroscopic examination of hearts should be included in with the normal sampling programme for age sex maturity and race. This data will be used to obtain current levels of infection in the stock. In addition hearts from these fish should be taken and frozen in trays to match the otolith sampling. These frozen samples will be used to estimate the success rate of macroscopic examination for estimating prevalence rates.

Standardisation of acoustic survey and analysis procedures was discussed and its importance recognised by the planning group. Some work is required before the current use of trawl data can be assured and an examination of the procedures for use of trawl data is required. However, some equipment setting standardisation is also required. Threshold on the Simrad EK500 sounder can be chosen as -70dB, this figure should be adopted for future analysis of herring surveys.

4.2 Larval Surveys

Table 4 shows the provisional programme, dates and vessels allocated for the 1993 larval surveys.

There are sufficient resources to obtain surveys of VIa North and the Channel. However, at present this survey programme for 1993 is not sufficient to provide even a single survey coverage of the Orkney, Shetland Buchan and Central North Sea spawning grounds. If this situation continues it will not be possible to calculate the larval production estimate (LPE) for the 1994 Herring Assessment WG. The redeployment of resources was discussed, both between larval surveys and from acoustic surveys. It was felt that this effort was unlikely to be particularly helpful to the other larval surveys, and that research vessels would not be made available for work in different areas from those already selected. The implication is that there is a requirement for greater resources if the LPE index of herring abundance for IVa and IVb is required.

Table 4 Provisional 1993 Larval Survey Programme

Country/ Vessel	Dates	Area
Scotland/ Charter	10 days September	VIa North
Scotland / *SCOTIA*	14 days October	VIa North
Netherlands / *TRIDENS*	20 - 24 September	Central North Sea
Netherlands / *TRIDENS*	4- 8 October	Central North Sea
Netherlands / *TRIDENS*	20 - 24 December	Channel
Germany / *POSEIDON*	15 - 30 September	Orkney Shetland
Germany / *POSEIDON*	5- 25 January 1994 (Provisional)	Channel

5 EVALUATION OF SURVEYS

In order to evaluate the surveys and their usefulness, the surveys were considered in several ways and the results discussed. The survey methodology has been examined and where information is available an intrinsic error analysis is included. The performance of the methods in the assessment was evaluated by comparison of the different indices with VPA. In addition the historical cost and use of the surveys has been documented to provide a measure of the cost benefit actually obtained in the last few years.

5.1 Sources of error in survey methods

The methodology of both survey techniques have been examined for sources of error.

5.1.1 Acoustic Surveys (Error of an acoustic index)

This section is derived from an error analysis presented in an ICES Cooperative Research Report (No 187 Simmonds et al 1992) which was prepared under the ICES FAST Working

Group. The values presented in this report have been modified to suite the particular circumstances for the North Sea herring surveys. It is difficult to estimate the absolute abundance of the North Sea herring stock. For example target strength information on North Sea herring in July is limited. However for fisheries management purposes an index of abundance may be used to estimate changes in stock from year to year or season to season. Table 5 shows the sources of uncertainty that effect the overall error in the relative estimate. In producing these estimates of error we are assuming that the survey is conducted competently and that care has been taken to ensure that where possible the sources of error have been identified and some attempt has been made to minimise them. The numerical values for each source of error have been derived from published information. The detailed references for each source of error can be found in Simmonds et al 1992.

TABLE 5. Sources of error in acoustic estimates of relative abundance. The error values are approximate confidence intervals for typical survey conditions using a 38kHz echo sounder for North Sea herring and where appropriate attempting to correct for the known sources of error.

Source of error	Random Error	Systematic Error (Bias)	Notes
Physical Calibration	2%	5%	
Transducer Motion	-	0 to 10%	(1)
Bubble Attenuation	-	0 to 10%	(1)
Hydrographic Conditions	3%	-	(2)
Target Strength	10%	-	(3)
Species Identification	-	10% to 20%	
Spatial Sampling	4 to 20%	-	
Fish Migration	-	0 to 5%	
Diel Behaviour	0 to 10%	-	(4)
Totals	11% to 25%	11% to 29%	(5)
Over all Total	15% to 38%		
Typical Precision	**26%**		

Notes:
(1) Worst in bad weather.
(2) Worst at long range.
(3) assuming species or size composition does not alter significantly.
(4) Only considered random if the survey does preferentially sample at different times of day.
(5) Assuming independent errors for all parameters except for transducer motion and bubble attenuation which may be correlated and are therefore treated as dependant errors.

5.1.2 Larval Surveys

There is no equivalent numerical analysis of errors for the larval surveys. Some work in the sources of error has been carried out and reported in Anon 1990 the Report of the Working Group on Herring Larval Surveys South of 62°N.

The major assumptions in the LPE as an index of herring abundance are:

a) Growth in length of larvae is linear in time and the length at hatching is constant.
b) Daily mortality rate is independent of length and time.
c) Average production of larvae is constant over time for each size group analyzed. In other words the average production over the range of back calculated hatch dates for all 10mm larvae caught in a sampling season is the same as the average production over the corresponding period for any other size group.
d) There is no immigration of larvae into the survey area. (Emigration can be interpreted as an increase in mortality rate.)
e) Egg mortality does not vary among years.

Currently the survey effort is insufficient for the calculation of the mortality rate separately for each year. The mean value of mortality is used and the larval mortality is assumed constant.

This procedure results in an estimate of larval numbers based on a weighted average of numbers at length and thus currently the weights are constant among years.

In addition to the assumptions and associated errors in the LPE calculations, the surveys also suffer from spatial sampling errors in the same manner as acoustic surveys. The 1992 VIa North data indicates very highly skewed distribution of abundance values, in this case one station contributed 55% of the index. This value was unusually high, but high values have been observed on other occasions. A comparison with several years of acoustic surveys indicated that this type of problem was more extreme on larval surveys. This sampling problem is of less importance for the LPE than the LAI. For the LPE, where larger larvae which are more evenly distributed in space are incorporated in the estimate with higher weighting factors, the impact of this type of encounter is diminished. Superficially the spatial sampling per unit of research vessel time appears worse for larval surveys than for acoustic surveys. However, a more detailed analysis needs to be carried out and substantially more work is required if an intrinsic error analysis for larval surveys is to be obtained.

5.2 Comparison with other methods.

Section 5.1 above describes the sources of errors but provides only limited information on the performance of the survey methods. Here we examine first the performance of the survey methods, and secondly the recent historical use of the survey data.

5.2.1 Analytical Comparison

This section is derived from a paper presented by K. Patterson, this paper will also be presented at the Herring Assessment WG. It addresses the problem of quantifying the performance of three indices of herring biomass: the larval production estimate (LPE); the acoustic stock size estimate (acoustic index) and the IYFS 3+ index of stock size. Three methods have been used: calibration regression, factor analysis, and an integrated catch-at-age analysis method. For each method, residual plots for predicted and observed index values have been calculated, and measures of goodness of fit for the different indices have been compared.

5.2.1.1 Comparison of three indexes

There is some evidence that the comparative performance of the indices may have changed over time. Consequently some comparisons have been repeated excluding some recent data for which the VPA is not converged and the residuals cannot be accurately defined and where these appear to yield anomalous results.
The three methods differ. In the calibration regression method historical VPA estimates of biomass are treated as precise and the indices are calibrated against these values. Data in the last years where the VPA is not converged are omitted, this is also the case when using the factor analysis method. In the latter method however the VPA estimates are not assumed *a priori* to be more precise than the other indices of biomass. Lastly, the integrated analysis method allows inclusion of all catch at age data up to the final year and includes a consideration of the dependence of the VPA estimates of stock size on the indices. Figure 2 shows the pattern of residuals for each index using the integrated method.

The three methods have been used to compare the goodness of fit of three index series to the stock assessment information. A simple correlation coefficient (*r*) was used as the goodness of fit criterion. A double logarithmic catchability relationship was used for consistency throughout.

The calibration regression method was used to calculate *r* for each of the indices in comparison with the 'converged' VPA as estimated in the ICES HAWG. In the case of the factor analysis method, the *r* is a loading factor: the measure of the correlation of each index with the estimated biomass, estimated from all the available indices including the VPA. Lastly in the case of the integrated analysis method the fit of the index data to the predicted index data is calculated from the integrated analysis using the information from that index and the catch at age information only.

To deal with unusual residuals in 1990 and 1991 and the uncertainty in the accuracy of establishing recent residuals, the comparison was repeated using data up to 1989 only. Results are given in Table 5. These show that the IYFS index consistently appears to give the highest correlation, independently of the method used, followed by the acoustic index and lastly the LPE index.

The IYFS index based on 2+ age groups has provided a poor index for spawning stock biomass in 1988 to 1990. For the 1991 assessment the 3+ index was discovered to give a substantially better fit to the VPA and this was adopted in preference. There is no obvious reason why exclusion of a year class and thus a fluctuating part of the potential spawning stock biomass should give better results. Bearing in mind that this index has been chosen this year on the basis of the degree of fit for recent years it is unclear how we should expect this index to behave in the future.

a

b

c

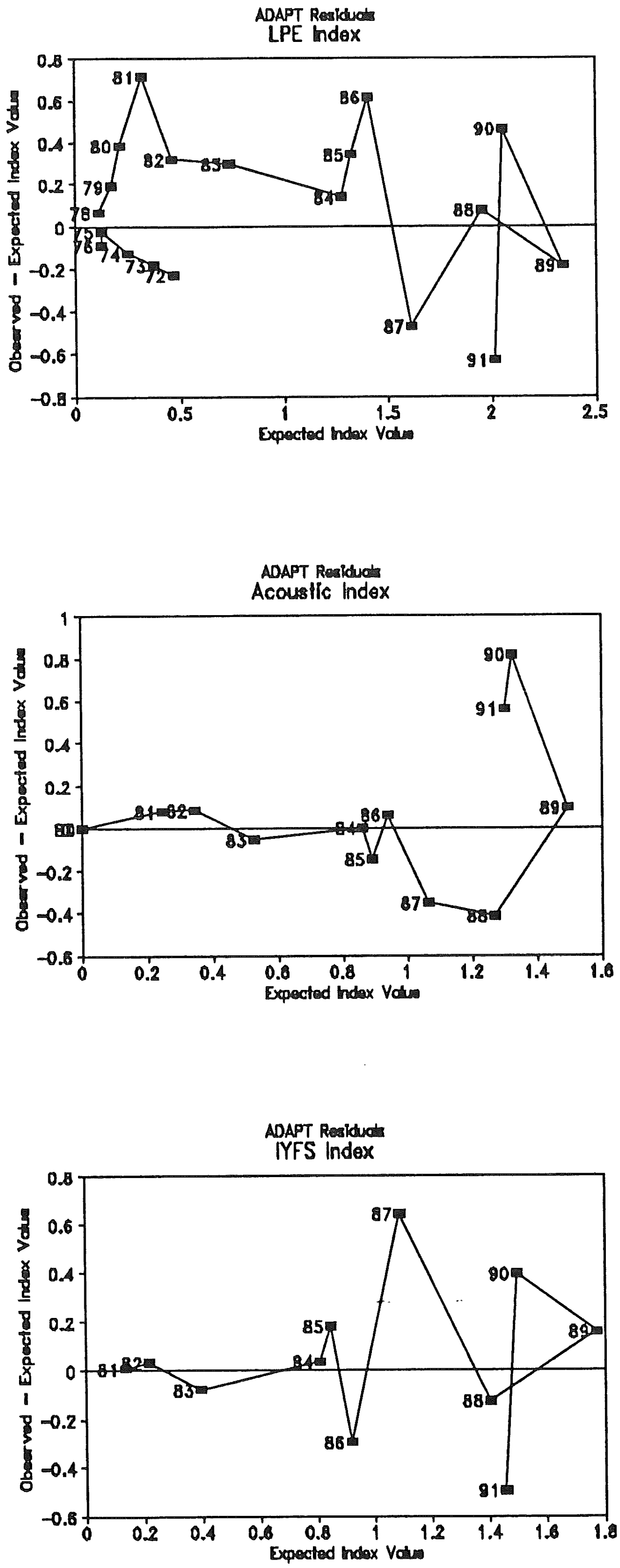


Figure 2a-c. Residuals and predicted index data from the integrated analyses. a, LPE index; b, Acoustic index; c, IYFS 3+ index.

The acoustic index used without a constraint to unit log slope in the integrated analysis returned a stock size of the order of 4 million t, thus widening further the discrepancy between the acoustic and the other indices that was noted previously.

Table 6. Comparison of index variability (correlation coefficients) using calibration regression, factor analysis or integrated catch-at-age analysis.

Index/Method	Calibration Regression	Factor Analysis	Integrated Analysis
Data to 1991			
LPE	0.927	0.845	0.923
Acoustic	0.931	0.878	0.952 (*)
IYFS	0.954	0.960	0.952
b. Data to 1989			
LPE	0.950	0.812	- 0.929
Acoustic	0.965	0.929	0.931
IYFS	0.959	0.963	0.964

(*) - Biomass estimate ≈ 4 000 000 t without constraint to linear catchability

5.2.1.2 Retrospective Analyses

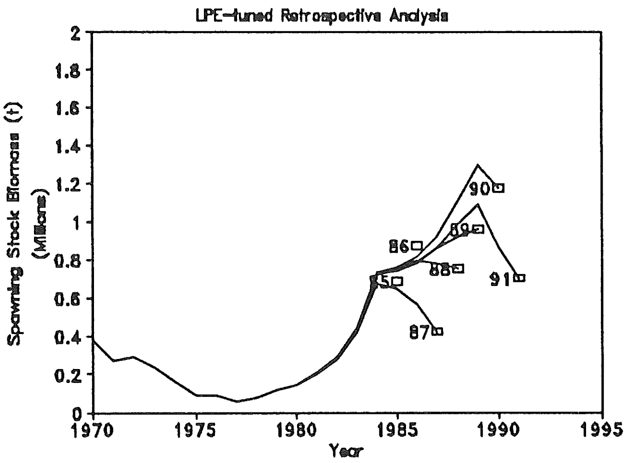
Some further insight into the reliability of stock assessments tuned on the various indices can be gained by calculating independent retrospective analyses on each index (Figure 3). The stock assessments tend to be strongly driven by the trend in the last few years' index data, so that a positive followed by a negative residual results in a low stock size estimate, and *vice versa*. This can be seen on comparing Figures 2 and 3.

The declining trend in acoustic series residuals from 1982 to 1988 led to low terminal-year stock size estimates in 1987 and 1988, and conversely the high residuals in 1991 and 1990 led to high values in these years.

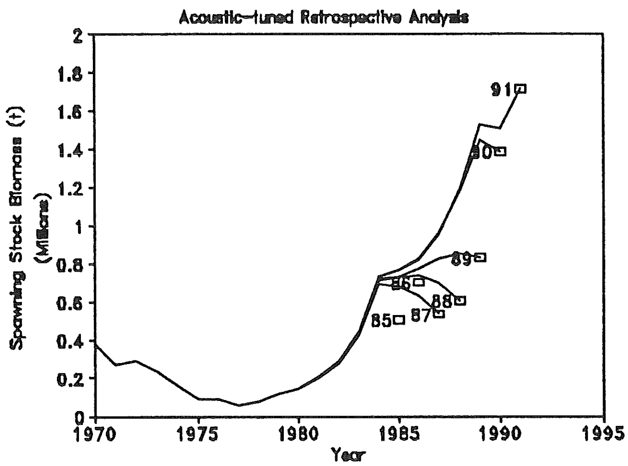
Similarly, the low IYFS residual in 1986 followed by the high residual in 1987 (Figure 2) resulted in a marked jump in the terminal populations tuned on this index from 1986 to 1987. A jump in the other direction in the LPE tuned retrospective from 1986 to 1987 can be attributed to a similar cause.

The retrospective analyses show that the stock assessment is particularly sensitive to the pattern of residuals as well as their actual magnitude. This implies that to forecast the accuracy of future assessments, it would be necessary to model the correlation in residuals as well as their magnitude; it is not immediately obvious how this could be done. For the moment it seems sufficient to deal with a consideration of index residuals than with retrospective analyses.

a



b



c

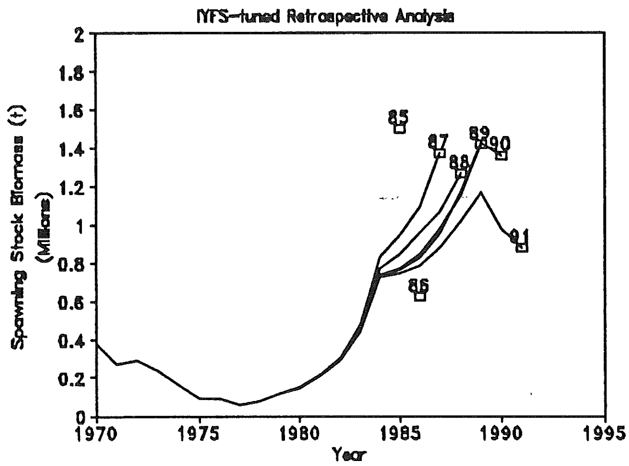


Figure 3a-c. Retrospective analyses using separate analyses tuned on different indices independently. a, LPE index; b, acoustic index; c, IYFS index.

5.2.1.3 Conclusions to analytical comparison

The three models used here to describe the goodness of fit of index data to biomass estimates have returned generally similar results. With the exception of the calibration regression they are robust to the choice of 1991 or 1989 as the last year of the analysis. The IYFS index fitted all the models best, followed by the acoustic index and lastly the larval production index.

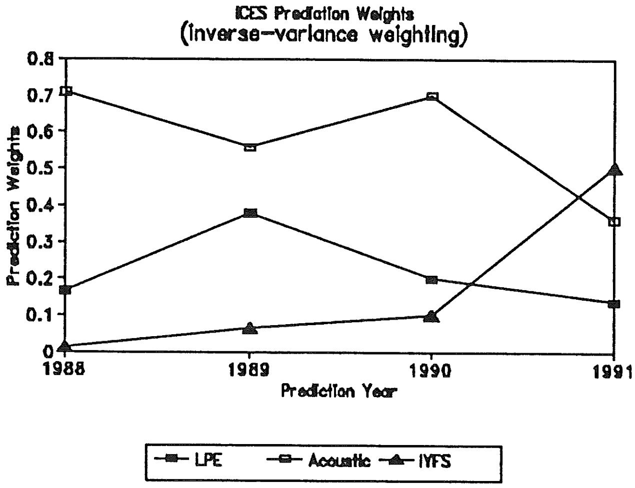


Figure 4. Use of the index series in the ICES herring assessment working group. Inverse-variance weights used in combining the predicted biomass estimates from each series. (Note that the ICES procedure differed somewhat between years: in 1988 the estimates were shrunk to the mean. In 1990 and 1991 the acoustic series regressions were constrained to unity slope. In the IYFS series the 2-ring herring were excluded in 1991 only. Years refer to the last year for which the prediction is made, *ie* the 1991 prediction was made by the herring assessment working group in 1992.)

5.2.2 Use by Herring Assessment WG

Since 1988 the herring assessment working group has used a combination of 3 survey indexes along with the catch at age data obtained from commercial vessel samples. The weighting factors for these survey methods were selected on the basis of calibration regressions based on the standard error for the regression. In all cases the last 4 years were omitted as the VPA had not converged sufficiently to obtain a reasonable estimate of the residuals. This method gives a preference in the selection to longer time series as the standard error is inversely proportional to root N the number of observations (years). This slightly enhances the selection of the Larval surveys which have a substantially longer time series. The weighting factors used are shown in Figure 4. In 1988-89 the acoustic survey was used with a log regression, and in 1990-91 a linear regression. In 1988-90 the IYFS index was derived from estimates of 2+ age group index, and in 1991 this was changed to 3+ age categories.

It is possible to obtain a simple use per unit cost comparison for the Acoustic and Larval surveys for the North Sea areas IVa and IVb by combining these weighting factors with the average number of annual vessel days required to give the calibration regression, ie. the average number of annual sea days up to 4 years before the current year. The number of sea days per year is shown in Figure 5 and 6 for the larval and acoustic surveys respectively.

The estimates of cost per unit benefit for 1988 to 1991 are shown in Table 6

Table 7. The weighting factors used by HAWG, the average sea days per year to obtain the indexes and the resulting use per unit cost (Weighting factor/average research vessel days *100) for Larval and Acoustic surveys from 1988 to 1991.

Year	Acoustic Weight	LPE Weight	IYS Weight	Acoustic Survey Days	Larval Survey Days	Acoustic Use/Unit Cost	Larval Use/Unit Cost
1988	0.71	0.17	0.02	48.8	95.1	1.45	0.18
1989	0.56	0.38	0.06	47.2	95.19	1.19	0.40
1990	0.70	0.20	0.10	48.6	94.3	1.44	0.21
1991	0.35	0.14	0.50	49.5	93.5	0.71	0.15
Mean	0.58	0.22	0.17	49.2	94.52	1.18	0.24

6 Other uses for Acoustic and Larval Surveys in addition to direct numerical use in the Assessment.

In addition to the direct numerical input to the annual assessment described above there are other uses for the data from both the larval and acoustic surveys.

6.1 Acoustic Surveys

i) Assessment of the prevalence of ichthyophonus from estimates of infected proportions in trawl samples and coincident density estimates from the survey system.

ii) Estimates of abundance of other species, particularly Norway Pout can be obtained from the acoustic survey.

iii) The survey is ideally suited to the collection of environmental parameters as well as fish abundance data.

iv) The acoustic survey provides age disaggregated estimates of herring stocks. This information could be incorporated in the assessment procedure directly or used to indicate the error in individual yearly survey values.

6.2 Larval Surveys

i) Survey data on spawning grounds provides useful qualitative information on the use of particular historical spawning sites. This can be useful for stock management decisions.

ii) Information on the location of spawning grounds is used as an input to the impact assessment of seabed and sub-seabed utilisation proposals.

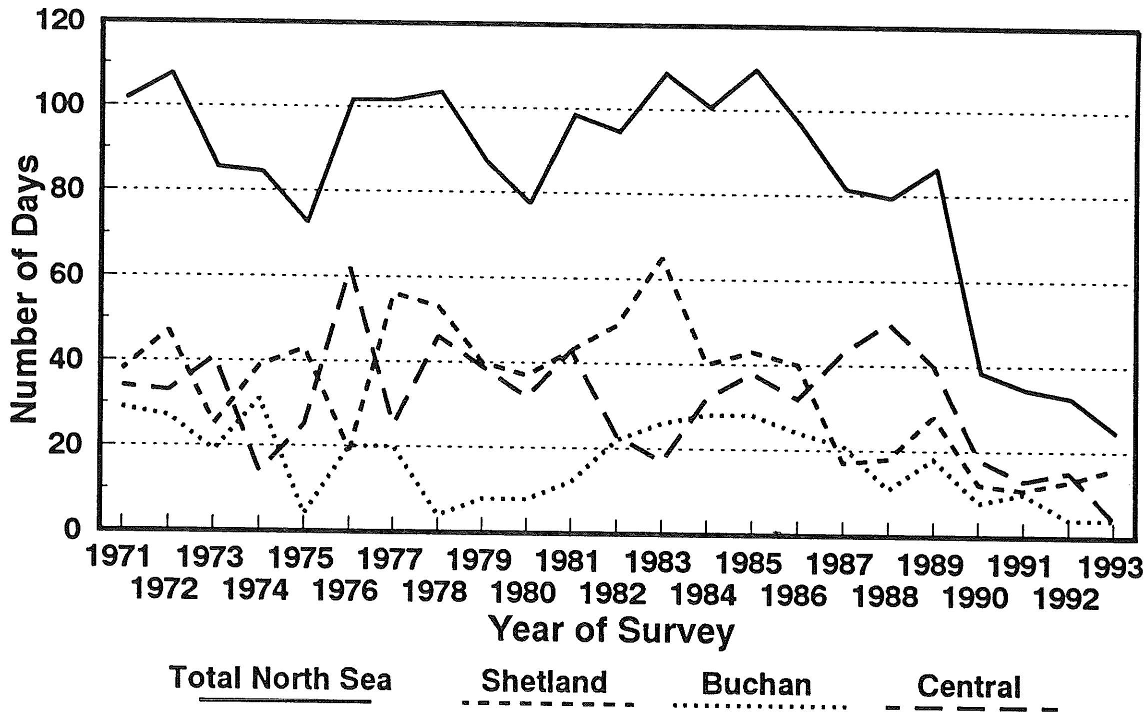


Figure 5. Reseach vessel days for North Sea Larval Surveys 1971-1992

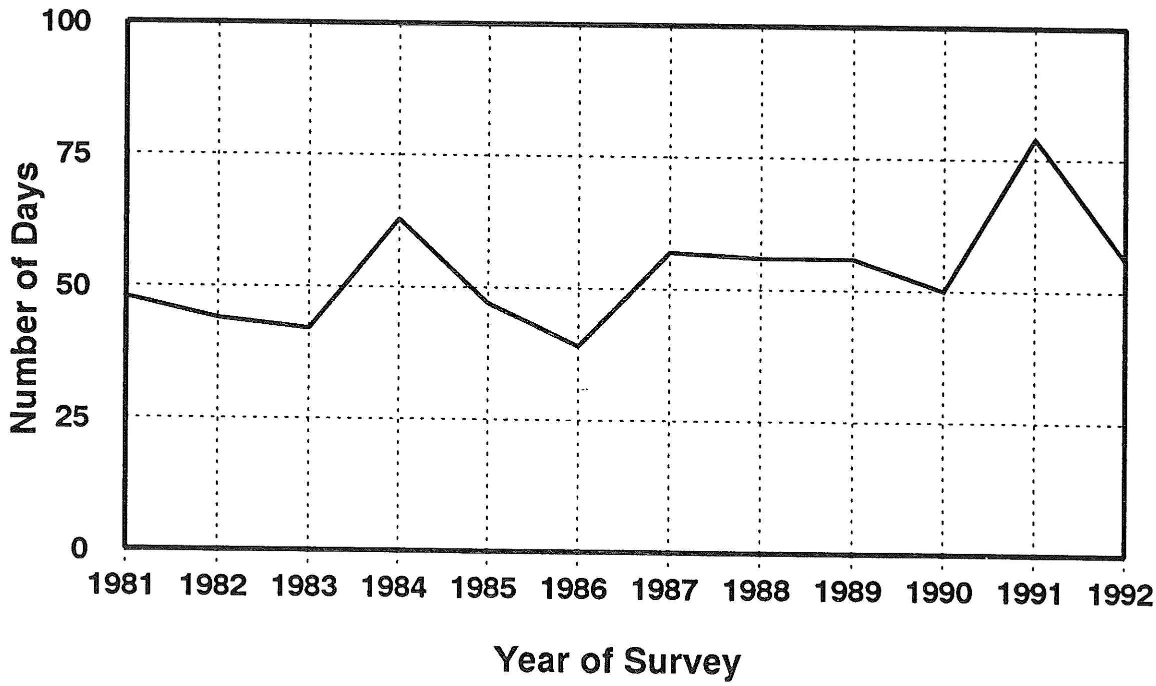


Figure 6. Research vessel days for North Sea Acoustic Surveys 1981-92

7 CONCLUSIONS

7.1 General

i) Cost Benefit analysis provides a historical statement of the Use per Unit Cost ratio for the Acoustic surveys and the LPE for the North Sea stocks of IVa and IVb. The Acoustic surveys have provided substantially greater use per unit cost over the period examined.

ii) The comparative analysis of the herring abundance indices for the period studied indicates that the acoustic surveys are providing a slightly better relationship to VPA estimates than the LPE for the North Sea. However the statistical significance of this difference is not known.

iii) It must be remembered in evaluating the surveys that two survey methods can provide independent complimentary estimates of herring abundance.

7.2 Acoustic Surveys

i) Survey grids are now at 15Nm spacing for the areas surveyed. This is regarded as the minimum sensible level for herring surveys. Some of the earlier surveys were conducted with grids of 7.5Nm over parts of the area. However the current resources are not sufficient for this higher level.

ii) The Area coverage is just sufficient for an estimate of 2 ring and older herring. The Eastern Central North Sea off the German and Danish coasts and the Moray Firth contains significant numbers of 1 ring fish. Surveys of this area in earlier years have given estimates of 1 ring fish which have been used by the Herring Assessment WG.

iii) The timing of survey cruises is very important. It is essential to organise survey cruises so that there is a minimum time difference between adjacent areas surveyed by different vessels. Overlap between survey areas is necessary to reduce the possibility of errors caused by fish migration.

7.3 Larval Surveys

i) The survey effort proposed in 1993 for Larval surveys for IVa and IVb is insufficient to give a single coverage of Orkney, Shetland, Buchan and Central North Sea spawning grounds. If this situation continues it will not be possible to obtain an LPE for the IVa and IVb herring stocks. An increase of resources of about 6 days is required to provide a single coverage. This level of coverage is, however, still insufficient for the estimation of an LAI for the North Sea.

ii) The overall level of effort proposed for 1993 appears to be sufficient to obtain LAIs for IVa North and Channel areas.

iii) There is uncertainty about the quality of the IVa IVb LPE at the current level of effort. There is a need to use the Larval Data Base (held in Aberdeen) to investigate the consequences of a single coverage survey in the North Sea.

iv) A single coverage of the IVa and IVb areas is insufficient to provide annual estimates of larval mortality. The long term mean mortality will be required to give weighting factors for different sizes of larvae. Trends or changes in larval mortality will not be detected.

v) The planning group noted that timing of surveys for a single coverage will be critical to the success of this strategy.

8 RECOMMENDATIONS

i) There is an urgent need to investigate the possibility of additional resources being made available if a single coverage larval survey of the North Sea areas IVa and IVb is to be carried out in 1993. The extra requirement is for 6 days survey in September.

i) If the surveys of IVa and IVb are to continue at the single coverage level the planning group recommends that the impact on precision of the LPE of this level for larval surveys be investigated from the historical data base.

ii) Standard Calibration of GULF III plankton samplers and associated flow meters should be carried out to improve comparison of results from the different versions of Gulf III samplers used with all ICES coordinated ichthyoplankton surveys

iii) A new plankton sampler should be designed to reduce problems with measurement of volume filtered and the avoidance of larger larvae due to the visibility of the sampler. A series of inter-calibration exercises must be carried out before routinely deploying improved samplers.

iv) A Workshop on species allocation, size determination and age disaggregation procedures used in acoustic surveys for herring be held in Bergen in May 1994 under the chairmanship of Asgeir Aglen. Current methods for species allocation will be investigated and a set of standard procedures defined. Current methods and standard procedures will be examined for the analysis of length data from fishing stations to give length keys for abundance estimation and age keys for age disaggregation.

v) The planning group recommends that the Planning group for Hydroacoustic Surveys in the Baltic should examine possibilities for closer cooperation and coordination of acoustic surveys with North Sea surveys. The aim of cooperation would be to provide better estimation of herring in the North Sea, the Kattegat, the Skagerrak, and the Baltic.

vi) The 1992 LAI for VIa north should be examined for the magnitude and direction of error due to an exceptional data point.

vii) Extra resources for the Acoustic survey covering the area of the Eastern Central North Sea off the German and Danish coasts would ensure a better area coverage and an estimate of 1 ring fish. Provision of additional resources for this work should be encouraged.

REFERENCES

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