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Exploration of the Sea

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Demersal Fish Committee

Ref.: Pelagic Fish Cttee and
Baltic Fish Cttee

REPORT OF THE ACFM STUDY GROUP ON STANDARD ICES ASSESSMENT COMPUTER PROGRAMS

(ICES Headquarters, Copenhagen, 24-27/2 1981)

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REPORT OF THE ACFM STUDY GROUP ON STANDARD ICES ASSESSMENT COMPUTER PROGRAMS

1. INTRODUCTION

1.1 Participants

K Hoydal (Chairman)	Chairman of the ACFM
B W Jones	UK (England and Wales)
H Lassen	Denmark
W Panhorst	ICES Systems Analyst
C J Rørvik	Norway

In addition, the ICES Secretariat was represented by V Nikolaev.

1.2 Terms of Reference

At the 68th Statutory Meeting it was decided (C.Res.1980/2:6/18) that the ACFM Study Group on Standard ICES Assessment Computer Programs should meet at ICES headquarters under the chairmanship of Mr K Hoydal, from 24 to 27 February 1981 "to test the new suite of programs prepared by the ICES Systems Analyst and put in hand any necessary modifications of these programs".

2. STUDY OF PROGRESS

2.1 General

The Study Group outlined in its report (C.M.1980/D:11) specifications for standard assessment programs and requirements for the data to be accessed by such programs. Programs considered to have a high priority in development were: virtual population analysis, yield per recruit, catch prediction and mesh assessment. Also in the construction of the data bank a corresponding priority system was adopted. The Systems Analyst reported on the status of the progress of the data bank and the analysis programs.

2.2 Data Files Lay-Out

The Systems Analyst studied the software packages supplied with the NORD computer for file handling. In view of the staff and time resources available the only feasible approach was to establish the ICES FISHDAT Assessment Data Bank (FAD) using these facilities, accepting that the editing facility limited the number of categories to four.

Two program packages are available in the NORD for input and file maintenance, viz.

- QED (an editor)
- File-Extract processor, mainly developed to extract data from files and convert them to user-defined formats.

Although the File-Extract processor can work on both sequential files and random files, the constraint that input and updating of data is done through the QED which works only on sequential files, implied that the majority of the data should be stored in sequentially structured files.

The Systems Analyst has designed and implemented a sub-routine package FADLAN through which access is made to the FAD, thereby enabling users to access the FAD without any knowledge of the file structure.

For each fish stock a "user" is created, and all data coming from this stock are catalogued with this user as owner. A Working Group member intending to run an analysis for a certain stock will then log in under the user name assigned to this stock, and he will be ensured of getting the relevant data. For reasons of convenience it was furthermore decided that one file will contain only one type of data.

Three system files were outlined and constructed, containing the following information:

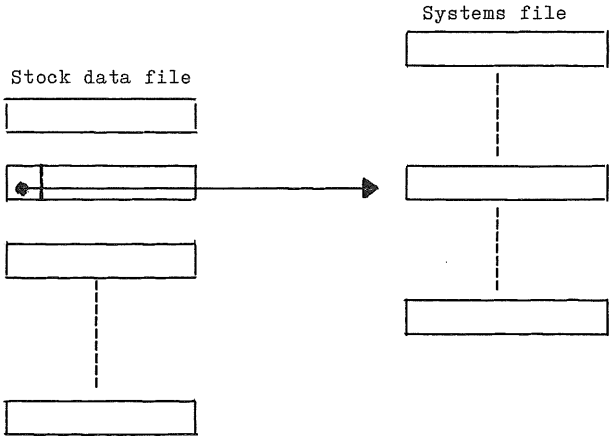
- stock description by user name
- definition of categories
- definition of units in which the data are reported.

These files are common for all stocks, and the last two are randomly organised.

For each stock a set of data files will be created. Their common feature is that data are recorded in free-format, and that the first two or three records contain general characteristics of the data, such as:

- user name of the stock to which they belong
- comment
- range of years, age groups or length groups covered by the data
- (if relevant) the unit in which the data are stored and the number of categories reported.

By means of pointers to the systems files information about the stock, categories and data units will be retrieved, as is illustrated in the following figure:



In all files unknown values should be indicated by the value -1.

File and record descriptions were proposed for the following stock data files:

a) total annual catches from the stock in tonnes by year and category

b) total international catch in numbers by year, age group and category

c) total international catch in numbers by year, length group and category

d) mean values for the weight of the catch by year, age group and category

e) mean values for the weight of the stock by year and by age group

f) proportions of the stock being mature at the start of a year, by year and by age group, including also the proportion of annual fishing and natural mortality to which the stock is subjected before it spawns

g) natural mortality by year and by age group

h) fishing mortality for the oldest true age group (i.e. not a plus-group) in a VPA

i) fishing mortality for the last year handled by a VPA.

2.3 Input of Data to the Files

Input of data to the files is presently in progress. Catches in numbers are derived from the files originally stored at RECKU, other data are taken from the Working Group reports. This data transfer will be completed before the meeting of each Working Group. The ICES Secretariat has taken responsibility for the maintenance of the data files.

2.4 Sub-Routines Accessing the Data (FADLAN)

For each of the stock files two routines were constructed: one retrieving the general information stored in the first two or three records, and another reading the actual data. In general, data can be accessed for a variable range of age groups (length groups) and years, and, if relevant, by category or all categories combined. Where possible, extensive checking procedures have been included to ensure that the user passes the correct parameters in the call to the routines, and eventual error messages and error codes are directed to the terminal.

Since the use of QED imposes restrictions on a maximum record size of 132 bytes, it was originally feared that allowing an unlimited number of categories should ask for some chaining techniques in the data files, which, with the limited time available, would be difficult to implement. In addition, in relation to an unlimited number of categories, some problems were expected to arise with regard to the maximum logical address space available for a program. The sub-routines accessing the data do therefore presently not allow for a number of categories greater than four. During programming the VPA, however, methods were found to overcome these problems, so there are no restrictions remaining to limit the number of categories to four, and thus the sub-routines accessing the data must be revised accordingly. One should, however, keep in mind that QED is not the ideal tool to handle data files with many categories, since it operates on characters and not on user-defined groups of

characters. If therefore many files containing a high number of categories are likely to be considered, it may well turn out that we should give a high priority to developing an editor for the data files, operating on a category level rather than a character level.

All the access routines are stored on a library file called ICESLIB. During programming the VPA, it was found that for certain procedures needed by VPA it would be advantageous to have them available as routines for other programs too. Therefore such routines were appended to ICESLIB.

2.5 Main Assessment Programs

When the meeting started, no program was completed. The construction of a VPA, however, was almost finalised, and the members of the Study Group had an opportunity to run a restricted part of the program to judge whether it worked according to the specifications. It was concluded from the program part available, that there was no reason to change its design,and the Systems Analyst was given the opportunity to finalise the programming during the first two days of the meeting.

The VPA can handle up to 30 years and 30 age groups, and it permits the user to specify which categories have to be excluded from the analysis. A sum-of-products check is incorporated, and is applied to all categories reported in the file containing catch in numbers plus, in addition, to the total catch. It calls routines from the NAG library wherever possible, and accesses the data files by the routines in ICESLIB.

Programs for yield per recruit and prediction are presently not developed, but old versions originally developed at RECKU have been converted to the NORD and are available for the Assessment Groups. A mesh assessment program developed by K Hoydal, C J Rørvik and P Sparre (Ref. C.M.1980/G:28) is installed and adapted with a routine from the NAG library.

These programs are not yet fully developed and documented to the standard required for inclusion in the ACFM Standard Program Package.

2.6 Documentation

The documentation presently available is incomplete, and to allow for efficient use of the programs and sub-routines developed so far, a lot of effort needs to be given to bring the documentation to a higher standard. This may delay further program developments, until the documentation of existent software has been raised to an acceptable level.

2.7 Conclusion

The Study Group expressed appreciation of the work done by the Systems Analyst of ICES.

Although not all programs in the Package were finalised, it was thought that a very thorough job had been done in designing the input files, the call routines and the VPA, and this was the most effective use of the limited time which had been available before the round of Working Group meetings in 1981.

The very user-oriented design of the VPA program was felt to offer an approach which fulfilled the intentions of the Study Group for the Standard Program Package.

3. SELECTION OF A SUITABLE MEASURE OF FISHING MORTALITY

3.1 General

The Group studied the problem of selection of a suitable measure of fishing mortality which could be expressed as a single figure. Within a single Working Group report, and from year to year, it is desirable, whenever a single figure index of fishing mortality is quoted, that it should be determined in a consistent manner throughout the various stages of assessment, prediction, and statement of management objectives. There could also be advantages if a comparable method was used for expressing fishing mortality between the various Working Group reports. Furthermore, stock managers at the recent ICES Dialogue Meeting specifically requested that in advice given by ICES a single figure should be used when referring to fishing mortality. However, fishing mortality in any one year is calculated as a set of values of fishing mortality each relating to a particular age group. No single figure can fully represent the data contained in an array. The problem is to decide which single figure index of fishing mortality can best fulfil the requirement of ACFM to provide management advice to fisheries administrators in a comprehensible form.

3.2 Possible Single Figure Measures of Fishing Mortality

A number of different measures of F have been suggested including:

(i) The value of F on the age group(s) subject to maximum exploitation;

(ii) The average weighted (by stock numbers) F on fully recruited age groups. This was recommended by the ICES ad hoc Meeting on the Provision of Advice on the Biological Basis for Fisheries Management (Coop. Res.Rep., No.62);

(iii) The average weighted F on all exploited age groups;

(iv) The arithmetic average F on a specified range of age groups.

In considering the various possibilities, the following points were considered:

The index F should be directly proportional to fishing effort so that a recommended change in F will imply the same proportional change in effort, and also that F on effort correlations can be examined.

It should be as free as possible from bias.

It should be as free as possible from error.

It should be applicable to all stages of assessment, e.g., VPA, yield per recruit, predictions, etc.

The definition of the method of determining the index of F should be unambiguous.

Perhaps the most difficult situation to deal with is where there is a change in the exploitation pattern such as might be expected to result from an increase in minimum mesh size. There is probably no entirely satisfactory solution to this problem other than by the use of an array. Management measures designed to change an exploitation pattern are usually aimed at selectively reducing fishing mortality on the youngest age groups and thereby reducing

the total F that a year class can expect to experience during its exploited life span. If this reduction in fishing mortality is reflected in the index of F then the F index determined after the change in exploitation pattern will not have the same relationship to fishing effort as the F index determined before the change.

The main disadvantages of the various measures of F listed above were considered to be:

(i) F on the age group(s) subject to maximim exploitation. Difficulties can occur if the age group(s) which are subject to maximum exploitation are within the age range affected by a change in exploitation pattern when the age group subject to maximum exploitation after the change in exploitation pattern may be different from the one before the change. Also the age of age groups subject to maximum exploitation can vary in different annual estimates of fishing mortality.

(ii) Average weighted F on fully recruited age groups. There may be difficulties in defining which are the fully recruited age groups. It may be subject to bias due to variations in year class strengths in the stock, but this measure of F can have advantages in reducing error due to variability of individual F estimates in the circumstances when F on the fully recruited age groups is approximately constant with age. There is no direct proportional relationship with effort. There are difficulties in interpolation of predicted catches associated with F indices between those specifically calculated. It is difficult to determine the actual F at age array from a specified index of F.

(iii) Average weighted F on all exploited age groups. There could be difficulties in defining the lower end of the exploited age range if the youngest age group appears in the catches in some years, but not in others. All the disadvantages given for (ii) above, except the first, also apply to this measure of F. In addition, changes in exploitation pattern are likely to truncate the exploited age range at the lower end.

(iv) Arithmetic average on a specified range of age groups. In many fisheries this measure of F probably suffers from the fewer disadvantages, especially if the age range is carefully selected. If possible, the lower age should be high enough to be above the age range likely to be affected by changes in the exploitation pattern, and the higher age should be low enough to be outside the range of ages for which estimates of fishing mortality are subject to error, resulting from incorrect input F values on the oldest age group in a VPA. The resultant age range chosen according to these criteria is likely to encompass mainly the older age groups for which estimates of fishing mortality are subject to more variability due to the lower abundance of older fish in the catches.

3.3 Measure of Fishing Pressure

As stated already the problem is to give a measure of fishing pressure which combines the effect of changes in exploitation pattern and changes in fishing effort (changes in age of entry and changes in level of F).

For assessment purposes any measure well specified and suitable for different analyses could be calculated, and there should be no reason for restricting Working Groups in this.

Translating this into a figure which is meaningful in management is quite another problem and might not be possible if no definite managerial targets for either fishable biomass or spawning stock biomass are set.

Assuming that there is a target value for fishable biomass, the following procedure could be suggested:

1. The target value of fishable biomass is evaluated.
2. The age of entry to the fishery is estimated from the number at age data
3. The F necessary to produce this target is determined from yield per recruit considerations.

From this reasoning the measure of F to go into this is a mean over the age groups where F is constant, and in this case it is irrelevant if it is weighted or unweighted.

3.4 North-East Arctic Saithe - A Fishing Mortality Case Study

To illustrate some of the problems associated with the choice of a single figure measure of F, the Study Group took as a case study a specific situation in the North-east Arctic Saithe Fishery. In this fishery, in recent years fishing mortality levels have been well above F_{max}. This is due, not so much to the overall level of fishing being too high, but more to an unsatisfactory exploitation pattern with high levels of fishing mortality on the younger age groups. The main cause of the unsatisfactory exploitation pattern is the purse seine fishery which exploits the younger age groups in the inshore areas. This problem was analysed during the 1980 meeting of the Saithe Working Group (Doc. C.M.1980/G:11).

The estimates of fishing mortality on each age group in 1979 are given in Table 1 for the total fishery and also for the purse seine and 'other gears' separately. The 'other gears' fishing mortality estimates are those which would apply to the stock if purse seining was to be prohibited. The fishing mortality arrays have been normalised to the age group subject to maximum exploitation (age group 3 in the existing fishery, but age group 5 for the fishery without purse seine fishing) as would be done if this value was used as an index of fishing mortality. Yield per recruit curves were calculated to illustrate the equilibrium conditions for fisheries with and without fishing by purse seiners. In each case, five different indices of fishing mortality were calculated for each value of the yield per recruit:

(i) For the age group subject to maximum exploitation

(ii) Average weighted F on age groups 2-11 (i.e., the whole exploited age range except the oldest which are subject to error in VPA)

(iii) Arithmetic average F on age groups 2-11

(iv) Average weighted F on age groups 8-11 (age range as for (ii) and (iii) but excluding younger age groups affected by the change in exploitation pattern)

(v) Arithmetic average F on age groups 8-11.

These data and the corresponding yields per recruit are given in Tables 2 and 3. In this particular example, F indices (iv) and (v) have identical values because the actual F at age values are constant from ages 8-14. Also given in the tables are the 1979 levels of F as represented by each of the F indices. In the case of the 1979 values weighting, where appropriate, is by numbers in the stock in 1979. For the weighted index for the situation without purse seine fishing it is not possible to estimate the 1979 weighted average F value because the numbers in the stock in 1979 are not available for a fishery excluding purse seiners.

For the situations with and without fishing by purse seiners, yield per recruit curves are plotted in Figures 1 and 2 using the different indices of F as abscissa.

Readers are invited to send to the Chairman of ACFM their reasoned comments and observations on which index of F might be the best one to use in a summary of this assessment such as might be prepared by ACFM for consideration by the stock managers. All comments will be taken into account when this matter is further considered at the next meeting of ACFM. Until that time, the Study Group would recommend to Working Groups meeting before July 1981 that they carefully consider, in the light of the above discussion, which index of F would be best suited to their particular needs and also to comment on why alternative indices would not be satisfactory. Having adopted a particular F index, a Working Group should endeavour to avoid using different indices in different parts of their report.

4. PROPOSED RULES FOR IMPLEMENTING PROGRAMS AT THE ICES COMPUTER SYSTEM

The former ADP Working Group at its 1979 meeting (Doc. C.M.1979/D:3) recognised three levels of assessment programs:

1. Standard programs generally applicable (ACFM programs)
2. Standard programs specific for an Assessment Working Group
3. Ad hoc programs.

The ADP report discusses the responsibilities on the functioning of these programs and Table 4 (i.e., Table 1 in C.M.1979/D:3) summarised these considerations.

The ACFM Study Group endorsed this dinstinction into the three classes of programs and continued specifying together with the ICES Systems Analyst, which constraints the Group sees fit for each program category.

The ICES computer system at present offers the following software facilities languages

FORTRAN

BASIC

Standard package for numerical and statistical analyses

NAG Currently Mark 6, see ref. 1

Standard package for assessing and maintaining the FISHDAT Assessment Databank (FAD)

FADLAN

The ICES computer system offers the FISHDAT Assessment Databank (FAD).

The Study Group has laid down the following guidelines:

4.1 FORTRAN is preferable to BASIC, and FORTRAN is obligatory for ACFM Standard Programs. However, the Group recognises the occasional need for fast processing of small ad hoc programs where BASIC in many cases is superior. Also transfer of programs from outside agencies to the ICES computer may call for applying BASIC.

4.2 The NAG Library offers a spectrum of sub-routines for numerical calculations and a selection of statistical routines. These routines should be used for ACFM standard programs and this rule should be strictly observed. When transferring programs this rule would be impracticable but any new program should if at all possible observe this rule as this will reduce the probability of errors in the numerical calculations.

4.3 The ICES computer system offers the FAD through the FADLAN package. It should be observed that FAD is only accessible through FADLAN and no program is allowed access through other means except with the Systems Analyst's permission.

4.4 The ACFM Standard Programs will be accessible at the ICES computer at any time while programs of other categories may be stored off-line. The Chairmen of Assessment Working Groups are responsible for informing the Systems Analyst of the files which are considered of permanent value. These files (data or programs) will be provided with back-up services and will be available at the next session of the Assessment Working Group, while all other files (see also 5) will be scratched 7 days after the session of the Working Group has come to a close.

4.5 The Systems Analyst will assign program names and file names to the ACFM Standard Assessment Package. He will furthermore assign an acronym to each Assessment Working Group and only files having names beginning with these acronyms can be made permanent and thus available during the entire Working Group session. The Working Group members may assign files under other names but these files will be considered as temporary and may without warning be erased at any time after computer session log off.

4.6 Programs and sub-routines of all categories should observe the name convention of the NAG and FADLAN packages and these other routines must not have names which might cause conflicts. The name conventions are

NAG Sub-routines begin with an alphabetic character followed by 2 digits

FADLAN Sub-routines begin with the two characters IF.

4.7 The documentation standards laid down by the ADP Working Group (C.M.1979/D:3) apply. These standards operate with 5 categories of documentation

- User's guide
- Method description
- Code documentation
- Test data
- Code listings

and the requirement for each program category is given in Table 4.

4.8 The responsibilities for maintenance of the programs are also referred to in C.M.1979/D:3. Table 4 summarises the findings which the Study Group endorses.

4.9 The standard ACFM programs together with all available documentation should be made generally available.

The standard and ad hoc Assessment Working Group programs should be available under the same restrictions as other internal Assessment Working Group data material.

4.10 The ICES Secretariat is not responsible for the proper functioning of its programs running outside ICES Headquarters, nor should the ICES Secretariat take responsibility for updating and maintaining these programs outside the ICES computer system.

5. FURTHER DEVELOPMENT IN THE STANDARD ASSESSMENT COMPUTER PACKAGE

5.1 The completion of the standard programs specified at the Study Group's meeting in May 1980 (C.M.1980/D:11) should be finalised before the 1982 round of Assessment Working Groups.

5.2 Documentation of the ACFM Standard Assessment Programs and an introduction to the ICES system should be made available to the 1981 round of the Assessment Working Groups, if only as drafts.

5.3 To facilitate the maintenance and updating of the FAD, the ICES Secretariat is asked to draw up a proposal for forms on which data for input to the FAD should be transmitted. These proposals should be presented to the 1981 Council Meeting for discussion and adoption.

5.4 The Systems Analyst should be urged to compile a review of the content of the FADLAN package, the NAG package and the various conventions on files names, etc. Such a review should be sent to this Study Group for comments and presented to the Council Meeting in 1981.

5.5 The Study Group recognises the need for a higher degree of flexibility within the file structure of FAD, see Section 2. This, however, requires also a specially designed editor to operate on the FAD. The Study Group advises that this task of enlarging the potential of the FAD be studied thoroughly by the Systems Analyst and that his proposal together with a description of an EDITOR be circulated among the Study Group members for comments. However, the tasks described in 5.1-5.4 will have higher priority subject to the ACFM findings on the use of effort data.

6. FUTURE OF THE ICES COMPUTER SYSTEM

The present computer system was designed in 1979 (C.M.1979/D:3) and consists of what the ADP Working Group considered essential for the Assessment Working Groups. The ADP Working Group furthermore listed a number of non-essential but desirable facilities, among which were

- graph plotting facilities
- magnetic tape station
- data base software
- data entry software.

The Study Group is aware of the limits of the ICES computer and recognises that access to the above-mentioned facilities would be advantageous to the work of the Assessment Working Groups. However, the Study Group has not made a thorough investigation of all the desired upgradings of the ICES computer system and did not discuss priorities. Such discussions would call for a wider scope of views than presented by this Study Group. The Group, however, emphasises the need for a continued modification and upgrading of the hardware and software available and therefore recommends that the Council considers the financial possibilities with the aim of introducing an account on the Council's annual budget for hardware and software modifications and upgradings.

The Study Group is aware that the programming staff resources available at ICES Secretariat represent a severe constraint on the rate of progress in the development of the ACFM package, but the Group has not ventured a detailed analysis of the problem.

The Study Group expects that numerous suggestions on enhancements and modifications will appear during the 1981 round of the Assessment Working Groups. Anticipating these proposals and the workload experienced during the 1981 Working Group sessions, the Study Group will at its next meeting initiate a proper evaluation of needs and availability of programming staff resources, taking into account the necessary wider scope of views than this Group represents.

7. FUTURE OF THE STUDY GROUP

The brief of this Study Group is to assist the Systems Analyst in specifying and implementing the ACFM Standard Assessment computer package. The Study Group feels that the outstanding problems within these terms of reference are those described in Section 5. Therefore, a further meeting of this Group is considered appropriate in early 1982. The Groups finds it premature to consider enlarging either the brief or the membership as work on all aspects of the terms of reference is all well underway but not completed.

Reference

NAG Library Manual (Mark 6)
NAG Central Office
7, Banbury Road
Oxford OX2 6NN
United Kingdom.

TABLE 1. NORTH-EAST ARCTIC SAITHE - DATA

AGE	FISHING MORTALITY 1979					
	TOTAL		PURSE SEINE (average 1974-1979)		OTHER GEARS	
	ACTUAL	NORMALIZED	ACTUAL	NORMALIZED	ACTUAL	NORMALIZED
2	.18	.333	.17		.01	.048
3	.54	1	.39		.15	.714
4	.29	.537	.13		.16	.762
5	.29	.537	.08		.21	1
6	.18	.333	.05		.13	.619
7	.18	.333	.02		.16	.762
8	.18	.333			.18	.857
9	.18	.333			.18	.857
10	.18	.333			.18	.857
11	.18	.333			.18	.857
12	.18	.333			.18	.857
13	.18	.333			.18	.857
14	.18	.333			.18	.857

TABLE 2 . NORTH-EAST ARCTIC SAITHE - WITH PURSE SEINE FISHERY

	INDEX OF FISHING MORTALITY					Yw/R
	F on AGE -GROUP 3*	AVERAGE WEIGHTED F		ARITHMETIC AVERAGE F		
		AGES 2-11	AGES 8-11	AGES 2-11	AGES 8-11	
	(i)	(ii)	(iv)	(iii)	(v)	kg
	.1	.040	.033	.044	.033	.376
	.2	.105	.067	.088	.067	.545
	.3	.161	.100	.132	.100	.615
	.4	.218	.133	.176	.133	.636
	.5	.276	.167	.220	.167	.632
	.6	.334	.200	.264	.200	.619
	.7	.392	.233	.308	.233	.600
	.8	.450	.267	.352	.267	.581
	.9	.506	.300	.396	.300	.563
	1.0	.562	.333	.441	.333	.546
F_{1979} from VPA	0.54	.312	.180	.238	.180	

* Age-group subject to maximum exploitation

TABLE 3. NORTH-EAST ARCTIC SAITHE - WITHOUT PURSE SEINE FISHERY

INDEX OF FISHING MORTALITY					
F ON AGE-GROUP 5[*]	AVERAGE WEIGHTED F		ARITHMETIC AVERAGE F		Yw/R
	AGES 2-11	AGES 8-11	AGES 2-11	AGES 8-11	
(i)	(ii)	(iv)	(iii)	(v)	kg
.1	.061	.086	.073	.086	.619
.2	.116	.171	.147	.171	.767
.3	.166	.257	.220	.257	.788
.4	.212	.343	.293	.343	.771
.5	.256	.429	.367	.429	.745
.6	.297	.514	.440	.514	.718
.7	.335	.600	.513	.600	.694
.8	.372	.686	.587	.686	.673
.9	.408	.771	.660	.771	.655
1.0	.442	.857	.733	.857	.639
F_{1979} from VPA .21	?	.180	.154	.180	

[*]Age-group subject to maximum exploitation

TABLE 4. DOCUMENTATION OF ANALYSIS PROGRAMS

Program Category *	Responsibility for changes	Maintenance	Changes to be executed by	Documentation					File updating by
				a	b	c	d	e	
1)	ACFM	ICES	ICES Secretariat	+	+	+	+	+	ICES
2)	WG Chairman	WG Chairman	WG member	+	+		+	+	ICES
3)	WG Chairman	WG Chairman	WG member		+**		+	+	-

* See section 4 of this report

** To be given in Assessment Working Group report

a Users Guide

b Method used

c Code documentation

d Test data

e Code listings

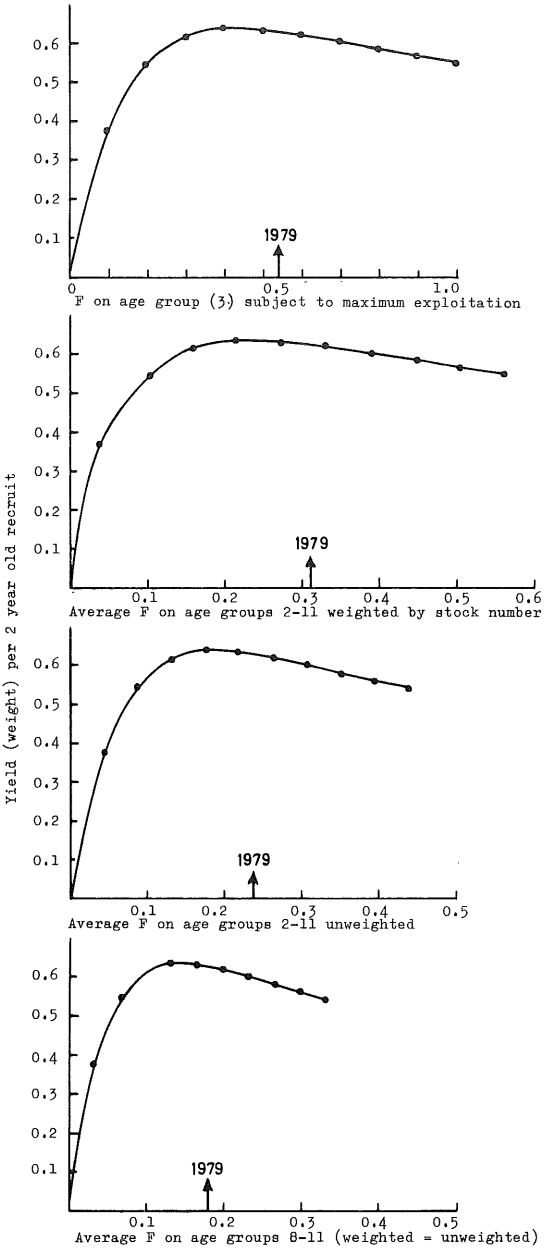


Figure 1. North-East Arctic SAITHE. Yield per recruit.
(With purse seine fishery)

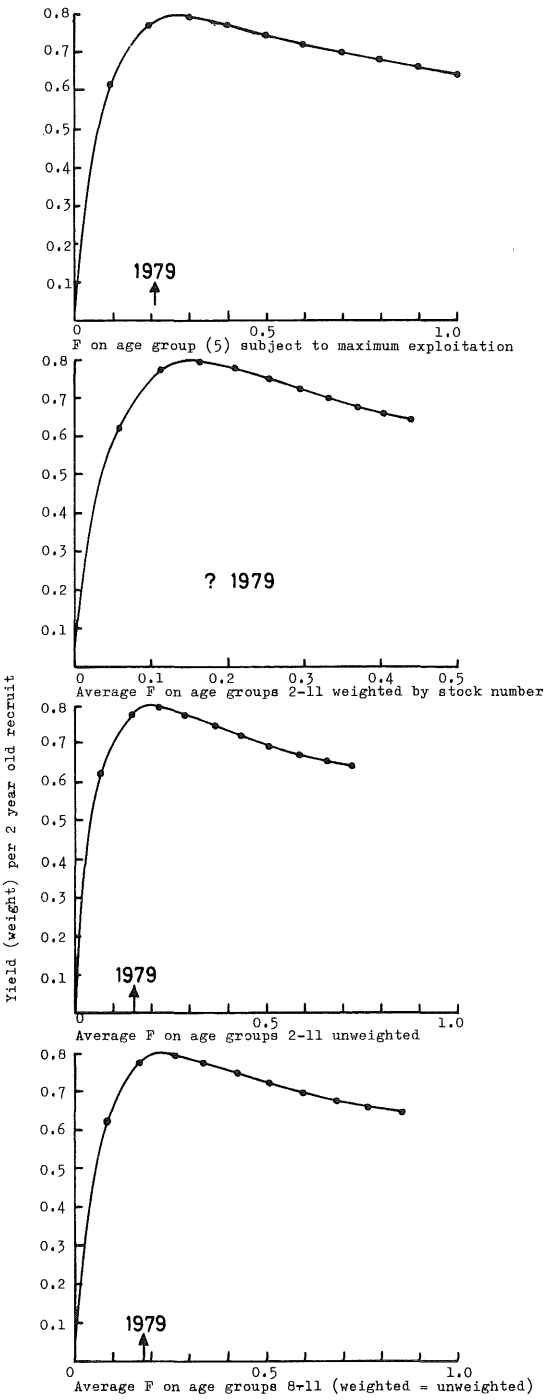


Figure 2. North-East Arctic SAITHE. Yield per recruit. (Without purse seine fishery)