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International Council for the  
Exploration of the Sea

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REPORT OF THE WORKING GROUP FOR THE EVENTUAL ESTABLISHMENT  
OF AN ICES ADP SYSTEM FOR FISHERY STATISTICS

Copenhagen, 21-23 May 1980

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Report of the Working Group for the Eventual  
Establishment of an ICES ADP System  
for Fishery Statistics

ICES Headquarters Copenhagen, 21-23 May 1980

1. Participants

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J Y Le Gall	France
H Lassen	Denmark
K Laumann	Denmark
J A Pope (Chairman)	United Kingdom
C J Rørvik	Norway
C de Verdelhan	France

In addition, the ICES Secretariat was represented by Dr V Nikolaev and W Panhorst.

2. Terms of Reference

The Working Group's terms of reference, as set out in Council Resolution C. Res. 1979/2:19 were to:

"(a) prepare instructions for the submission of fish stock biological data to the ICES Data Bank through the FISHDAT System and to define appropriate checking and vetting procedures for the input of these data.

(b) further examine, in coordination with the ACFM Study Group, the question of building up the ICES program library

(c) to consider the preparation of an inventory of analysis programs available in National laboratories."

The work of the Group was organised under the following main headings

1. Review of ADP progress in 1979/80
2. Computer programs
3. Inventory of analysis programs
4. Courses for computer users
5. Input of biological data
6. Review of FISHDAT System

During one day of the meeting the members of the ACFM Study Group met separately in order to specify certain standard programs for use by Assessment Working Groups. Their report appears as an appendix to the Report of the ADP Working Group.

### 3. Review of ADP Progress in 1979/80

The Working Group reviewed progress in 1979/80 in two main areas, the production of the Bulletin Statistique and the acquisition by the Council of a mini-computer system

3.1 Bulletin Statistique. One of the first matters ever to be considered by the ADP Working Group was the possible use of computing facilities to improve the handling of material destined for publication in the Bulletin Statistique. Apart from ensuring that the introduction of ADP methods for this purpose should result in a considerable speeding up of publication, the Working Group, in the course of several meetings, made a detailed study of the contents and layout of the entire Bulletin, taking into account at the same time the material which had, up till then, been published in the ICES Statistical Newsletter.

A decision was made by the Council that a start should be made to producing at least part of the Bulletin by computer methods, beginning with Volume 58 (1973 data). Later it was decided that statistics of nominal catches and fishing effort by months, which had previously been published in an issue of the Statistical Newsletters, should be included in the Bulletin Statistique in a new table which would be numbered Table 7. Thus, for these data at least, the possibility that their submission would be adversely affected by the discontinuation of publication of the Newsletters was obviated.

The Group was pleased to note that all the main tables in the Bulletin are now prepared by computer. Each table currently involves a separate program although much of the coding in these programs is common. The Systems Analyst needs to do a certain amount of work to improve the efficiency of this suite of programs.

On the other hand the Group was worried by the fact that the cost of producing the larger Bulletin, which had resulted from the introduction of Table 7 and an expanded Table 10, the latter also having been introduced on the recommendation of the ADP Working Group, was causing concern to the Council. The ADP Working Group felt very strongly that to drop Table 7 and 10, which is one possible way in which publication costs might be reduced, would be a retrograde step as the data they contain are of value to both scientists and administrators. The submission of these data might also be threatened if National reporting offices could see no end product to their efforts. Countries which presently do not submit such data would hardly be encouraged to do so if these tables were omitted. Another possibility, namely to publish Table 7 in less detail was also not favoured.

The Group was of the opinion that (a) the statistical information from which Tables 7 and 10 are compiled should continue to be requested as

high priority from all member countries, (b) the information currently published in the Tables should continue to be made available and (c) that alternative ways of providing the information should be fully investigated.

The Group was sure that possible changes in printing procedures which might lower costs would be studied by the Secretariat and no useful purpose would be served by these being discussed by the ADP Working Group. However, ways by which computer methods might be brought to bear on the problem were considered. Two possibilities in particular were discussed. These were

(a) instead of publishing Tables 7 and 10 as at present they could be made available separately (i) as computer printout or (ii) on magnetic tape.

(b) Table 7 could be produced on microfiche to be placed in an envelope at the end of the Bulletin.

Neither of these methods are without their drawbacks. In the first place the cost of producing data as computer printout, in the quantity necessary, could be as much as producing the data as at present while magnetic tapes can only be read by those with access to a computer in their own country, although the laboratories in most countries either have their own in-house computers or have easy access to computers elsewhere.

A similar problem arises in the use of microfiche which, although cheap, require the use of a microfiche reader. Not all users of the Bulletin have microfiche readers.

While some users might prefer to receive much, if not all, of the contents of the Bulletin Statistique on magnetic tape, quite obviously

many others will want to continue to receive these statistics in the present printed form. At the present time, therefore, the ADP Group hopes that funds will be available to continue printing Tables 7 and 10 but that the usefulness of these tables and ways of reducing publication costs will be kept under review.

3.2 Acquisition of ICES Mini-computer. At its meeting in March 1979 the ADP Working Group drew up a detailed specification for both the hardware and software requirements of a mini-computer system for ICES. Using the very detailed information about the products of some 20 suppliers which had been compiled by the Systems Analyst, the ADP Working Group drew up a short list of 5 suppliers who, in their opinion, could best provide systems likely to satisfy the needs of ICES. The final choice had to be made by the ICES Secretariat on the basis of further information which the ADP Working Group recommended the Secretariat to elicit.

After further detailed study by the Systems Analyst, the Secretariat, on behalf of the Council, placed an order for a system based on a NORD-100 computer. This system was installed at ICES Headquarters in the Spring of 1980. It consists of the following

- 1) central processor: 128 Kword (one word = 16 bits)
- 2) cartridge disks: 15 Mb fixed and 15 Mb removable
- 3) terminals: 4 VDU (plus system console)
- 4) peripherals: floppy disk (308 Kb)  
Terminet-line printer (250 lpm, upper/lower ASCII)

The central processor is expandable up to a maximum of 16M words and up to 64 terminals may be supported.

The operating system is SINTRAN III/VS and both BASIC and FORTRAN are available.

In addition to these facilities there is also connection to the RECKU Univac 1100 computer by

- (a) RJE (batch) - 2400 baud, full duplex, synchronous leased line
- (b) dial-up telephone line - 300 baud, full/half duplex, asynchronous

#### 4. Computer Programs for Assessments and Data Analysis

Throughout all its discussions on computer programs designed for use by Assessment Working Groups, the ADP Working Group has always held the view that its function is limited to defining standards for the specification and documentation of programs, while program content must be the responsibility of the working groups themselves. At its meeting in March 1979 the ADP Working Group identified various classes of program and suggested where the responsibilities for these programs should lie. The first class contained the standard assessment programs, covering such topics as VPA, yield per recruit and catch prediction, which would be used by almost all assessment working groups. The ADP Working Group recommended that the ACFM should specify the programs in this class. A small study group was appointed by the Chairman of the ACFM (Mr A Saville) and it met during the ADP Working Group meeting. The study group was chaired by K Hoydal. Its report is given as an appendix to this report.

The ADP Working Group, in discussing documentation standards, drew a distinction between user documentation and maintenance documentation. The former is concerned essentially with providing enough information for any user to be able to (a) run the program using his own data, and (b) understand precisely what calculations are being performed on the data and what the various items of output refer to. Maintenance documentation should describe fully the structure of the program and what the program statements are doing. This documentation must be written in such a way as to allow proper maintenance of and alteration to the program.

The ADP Working Group concerned itself mainly with user documentation for the standard programs for assessment working groups which would be



written by the Systems Analyst and non-standard programs written by others. In view of the fact that many programs would be required for use both at ICES and at National laboratories, the need for transportability was emphasised. To achieve this, programs should be modular in design with those parts which are machine specific (essentially the input and output routines) kept separate from those which are not (essentially the various calculations). Each module should perform a specific identifiable set of procedures. Any errors encountered during the running of a program should be signalled by error messages which should identify the module in which the error occurred. The writing of interactive, "conversational" programs should be encouraged to assist the user in the running of a program.

In addition to programs for carrying out assessment calculations there is also a need for programs for certain mathematical procedures and for statistical analyses. In this connection the ADP Working Group noted that it is the intention of ICES to subscribe to the Numerical Algorithms Group (NAG) Library of mathematical and statistical routines. Whilst this will be a potentially valuable asset, the Group expressed its awareness of the inherent dangers in the use of such facilities, particularly the statistical routines, by persons without a thorough and up-to-date knowledge of statistical theory and practice.

After a very full discussion of this subject the ADP Working Group made the following recommendations relating to the writing and documentation of programs.

- 1) programs should be written in standard FORTRAN IV
- 2) programs should be of modular structure
- 3) realistic test data should be made available along with the set of correct output
- 4) liberal use of error codes should be made to pinpoint and explain errors occurring at run-time

- 5) user documentation should follow a standard pattern and should contain
  - (a) program title with keywords
  - (b) purpose of program
  - (c) description of input file
  - (d) description of all routines used
  - (e) example of output file
  - (f) a list of parameters, constants and variable names
  - (g) author's name
  - (h) date of last revision to the program
- 6) documentation should be contained in a loose-leaf folder to facilitate changes. Each page should be headed with a title, creation date, version number and a document page numbering system (eg page 3 of 4).

The ADP Working Group reiterated its view, expressed in last year's report, that the original versions of standard assessment programs should not be altered in any way without the express authority of the Chairman of the ACFM. Copies of these programs might, however, be altered. The ADP Working Group recommended that the same procedure should apply to all other programs. Any changes made should be properly described and recorded in appropriate documentation.

The ADP Working Group recognised that a proliferation of original and modified programs and also data files could very quickly arise with consequent disk saturation. Stringent management procedures would eventually have to be applied in order to control which files should be disk resident, which should be archived and how, and which should be destroyed. This is a matter for the Systems Analyst. He should, however, always consult with Assessment Working Group chairmen where appropriate and should bear in mind the necessity for every file used in a given year's assessments to remain available until at least after the ACFM meeting which considered these assessments.

The ADP Working Group was of the opinion that a newsletter giving information on such matters as the current availability of programs, proposed new programs, new computing facilities, etc., to be distributed to users and other interested parties would be extremely valuable.

#### 5. Inventory of Analysis Programs

The ADP Working Group was made aware that FAO had already begun a study of the feasibility of compiling an inventory of assessment programs. The Working Group therefore felt that for ICES to do so too would be an unnecessary duplication of effort and that, at the present time, ICES should not pursue this matter further.

However, the Working Group did consider that it would be of value to many workers to know the details of the algorithms and procedures in programs used in research work described in contributions to Statutory Meetings and in scientific publications. In fact there is a great deal of value in publishing algorithms on their own provided they are in a form which makes them easily usable on any, or at least most, computers. The ADP Working Group therefore recommends that the Council should, through its appropriate governing bodies, consider the possibility of publishing algorithms in Journal du Conseil.

#### 6. Course for Computer Users

Besides being used throughout the year in relation to the work of the Secretariat, the new computer is intended to provide a facility for members of working groups, especially assessment working groups, for undertaking their own computing when they meet at ICES Headquarters. It will, therefore, be both necessary and desirable, that those who have need to, will take advantage of the multi-user facilities to run specially prepared programs themselves and to write, test and run their own programs.

Whilst some assistance may be reasonably expected from the Systems Analyst during meetings, clearly this has to be of a limited nature and the most satisfactory procedure from the working groups' point of view is that at least some of their members be capable of using the computing facilities themselves.

Recognising this need for training, the ICES Secretariat, in consultation with the chairman of the ADP Working Group, proposed that a short course could be given at ICES Headquarters if sufficient interest was expressed. The Systems Analyst reported that, to date, only three positive responses had been received.

The ADP Working Group felt that the poor response was in large part due to two factors. In the first place the course dates had been chosen to coincide with the Statutory Meeting and many regular members of working groups never, or only rarely, attended the Council's Statutory Meetings. Secondly, most Governments would be unlikely to provide funds for their scientists to attend such a course. Thus, whilst the ADP Working Group did not wish to discourage the holding of a course in October, 1980, for any who wished to attend, it was strongly of the opinion that alternative means should be sought for providing the necessary instruction for potential users.

The ADP Working Group is of the firm opinion that the most satisfactory solution for most users would be for the Systems Analyst to prepare a carefully written set of users instructions to be made available to all who require them. The ADP Working Group considered that whilst such instructions would obviously draw heavily on the manuals provided by the suppliers of the computer, the latter were not themselves suitable for the sort of instruction required. The users guide should be aimed very precisely at the known needs of working group members and should include such topics as (a) file creation, (b) editing and (c) program running.

The possibility of using the ICES computer by means of a remote terminal was also discussed. At present the necessary communications interface does not exist on the ICES equipment but it is likely that this could be provided relatively cheaply. It was recommended that the Systems Analyst, in collaboration with another member of the ADP Working Group (Keld Laumann) should investigate this possibility. If such a connection could be made easily and at relatively little cost, it could be tested by the Laboratories at Lowestoft and Aberdeen. If successful, this facility could provide a means both for learning how to use the computer and for program testing and data analysis at National laboratories prior to working group meetings.

#### 7. Input of Biological Data

As originally conceived, the biological data files in the ICES FISHDAT System would contain basic information at the lowest level of aggregation. Assessment working groups would then be able, by means of suitable software, to combine material from different sources and aggregate these in the way most suitable for their purposes. A draft proposal for the contents of such biological data files was made by the ADP Working Group in the report of its meeting in 1977. At that time many working group members were bringing their basic biological data to assessment meetings and much time and effort was being spent by the working groups in the laborious and error-prone calculations required to process these data into a form suitable for carrying out assessment studies.

To-day the position is different. In the first place many assessment procedures have become standardised and formalised to the extent that very precise requirements for input data have been defined. In the second place, many national laboratories now have their own computing facilities and can, relatively easily, produce these data in the required form. The burden on the assessment working groups to aggregate and combine considerable amounts of heterogeneous basic material is now considerably less than it was

and there is no immediate need to create the basic biological data files as originally envisaged.

The input data files currently required by the assessment working groups for use with the standard assessment programs were discussed by the ACFM Study Group and these requirements are contained in their appendix to this report.

The input of basic biological data on a statistical square basis still remains a worthwhile objective. At the present time there are some countries which find it difficult to provide data in any form other than as basic records and a fully integrated system for handling basic biological data in conjunction with basic catch and effort information, as envisaged in the original FISHDAT specification, would still seem to be well worth pursuing. However, the highest priority should be given to establishing the assessment working group files described in the appendix and to providing sufficient computing facilities for (a) aggregating national data into international files and (b) recording the procedures used in combining the national data.

The ADP Working Group agreed that it would be helpful to users if examples of the data files described in the appendix were given in the users manuals for the standard assessment programs. The Working Group recommends that the Systems Analyst should also define the form in which national data are to be presented as well as giving appropriate checking and vetting procedures.

## 8. Review of FISHDAT System

The ADP Working Group first met in June 1972. In its eight years of existence it has been instrumental in the setting up of a computerised system for handling much of the Council's statistical work, particularly in relation to the Bulletin Statistique which is now largely produced by ADP methods. It has proposed and made trials of several procedures for

handling biological data and for combining such data with statistics of commercial catches and effort to facilitate the Council's role in providing, through its assessment working groups, advice on the scientific management of fish stocks. Guidelines for the writing and documentation of programs for assessment and statistical purposes have been laid down.

During its existence it has seen the creation and filling of a new post in the Secretariat, namely that of ICES Systems Analyst, a post with specific responsibility for computer matters. The ADP Working Group drew up the detailed specification for a computer system for the Council. As already noted, this system is now installed and operational.

The ADP Working Group now feels that its original terms of reference have been satisfactorily fulfilled and it recommends that the Working Group for the Eventual Establishment of an ICES ADP System for Fishery Statistics be wound up.

In making this recommendation, the ADP Working Group recognised that there is a very real need for an advisory group to be set up to review and give guidance on the needs of the users of the Council's computing facilities, and to provide advice to the Council, on a continuing basis, on the general administration of its computing facilities. Such matters as the upgrading of the mini-computer system must be kept under constant review as otherwise there may be great delays in implementing the Council's needs. For example, taking into account the Council's budgetary procedures, the time interval between making the decision to acquire a particular item of hardware, say, and its actual installation could well be of the order of two years. In discussing this, the ADP Working Group has already identified several areas where enhancements must soon be seriously considered and budgeted for. These include

- (1) a graphics plotter
- (2) a good quality printer to provide tables for direct reproduction in reports

(3) additional wiring to provide terminal access from meeting and other rooms in ICES Headquarters

(4) a second disk drive

(5) additional on-line terminals

In addition it is essential that the Council recognise the limited life expectancy of its computer system and the consequent need to budget for its eventual replacement.

Accordingly, the ADP Working Group recommends that an ICES ADP Systems Users Working Group be set up to

(a) identify, coordinate and advise on the ADP requirements of the Council's Standing Committees, Advisory Committees, Working Groups and Secretariat

(b) advise the Council on the appropriate actions, including estimated costings, to meet these requirements

This Working Group should report to the Council through the Statistics Committee and the Consultative Committee. It will be essential that a wide range of user interests be represented on this Working Group and that it will include computer experts from National laboratories.



REPORT OF THE ACFM STUDY GROUP ON STANDARD COMPUTER PROGRAMS FOR ASSESSMENT  
WORKING GROUPS

1. INTRODUCTION

The Group, consisting of K. Hoydal (Chairman), W. Panhorst (ICES Systems Analyst), B.W. Jones, H. Lassen and C.J. Rørvik, met at ICES Headquarters on 22 May 1980 to prepare outline specifications for standard assessment computer programs.

In view of the limited time available before the 1981 round of Assessment Working Group Meetings, the Study Group considered it advisable to limit the scope of its work to a few basic programs with the hope that these can be implemented on the NORD 100 computer by early 1981. At this meeting, the Group prepared outline specification for basic input data files, which would be required for each stock and which could be accessed by the programs, and programs for Virtual Population Analysis (VPA), Catch Prediction, Yield per Recruit, and Mesh Assessment. These, of course, represent only a basic set of programs and it is anticipated that additional standard programs will be added in the future. There will also be a need for more specialised programs to meet the specific needs of particular Working Groups.

2. INPUT DATA FILES

The Group proposed that the following data files would be required for each stock :

- A) Working Group data of catches (tonnes) x country x year x area. Total annual catch from the stock.
- B) Total international catch numbers x age groups x category x year and total international annual catch all categories combined. (Category can be used for sex, gear, fishery (e.g. human consumption, industrial by-catch, discards) country, etc. as required for the stock).
- C) Numbers caught x length group x category x area unit.
- D) Mean weight x age group x year x category in (I) catch  
(II) stock
- E) Proportion mature x age group x year.
- F) Proportion of annual F and annual M before spawning season (not available by year or by age).

- G) Natural mortality x age group x year.
- H) Exploitation pattern (relative F on each age group) x year x category.
- I) Selection factor and selection range.  
Lower priority files which could be considered are
- J) Recruitment index x year.
- K) Fishing effort and/or catch per unit effort x year x category.
- L) Fishery independent stock biomass estimate x year (e.g. from acoustic, egg or larval surveys).
- M) Food preference matrix (for multi-species assessment)
- N) Migration parameters.

It is suggested that irrespective of how files are structured within the computer, the file format as it appears to the user should be as simple as possible. There should be provision for file contents to be tabulated suitably formatted and labelled for direct reproduction in a Working Group report.

### 3. PROGRAMS

#### 3.1 Virtual Population Analysis (VPA)

The program should be the true VPA and not a cohort analysis. There should be provision to handle 30 age groups x 30 years.

Data requirements are :

- a) Total international catch number x age x year (FILE B).
- b) Nominal international catch weight x year (FILE A).
- c) Average weight in catch and stock x age group x year (FILE D).
- d) For each age group in latest year and on oldest age group in all years (Manual input).
- e) M x age group x year (File G or option of manual input if constant for all years and/or age groups.)

The program would call data automatically from computer file where appropriate. The catch age composition data would include a 'plus-group', e.g. the age group 15+ would include the catch in each year of ages 15 and older. This plus-group would not be used in the VPA proper which would commence on the oldest true age group. However, the input of F assumed for the oldest true age group would also be assumed for the 'plus-group' and this would be used to calculate the corresponding stock size (plus-group stock = plus-group catch x  $\frac{Z}{F(1-e^{-Z})}$  )

Output : -

- a) Table of input catch age composition data as at present but with three extra lines giving for each year the nominal catch weight, sums of products numbers x average weight in catch, ratio nominal catch : SOPS. SOPS to include the plus-group.
- b) Fishing mortality table as at present but with average  $F$  (option of weighted or unweighted by stock number) in each year calculated for two separate user specified age ranges and also average  $F$  (unweighted) on each age-group for a range of years to be specified by the user. Format to allow for 3 decimal places with option to suppress third decimal place.
- c) Table of stock size (numbers) as at present. Output rounded to nearest integer. Additional columns to give stock size at the beginning of the year after the last one used in VPA, (this to be stored in file for use in catch prediction), and average stock number of each age-group for a range of years specified by user.
- d) Stock biomass table as at present. No decimal places. Total stock biomass and spawning stock biomass to be given for each year. Spawning stock to be determined from maturity ogive (FILE E).
- e) There should be an option for both (c) and (d) to be estimated either at 1 January in each year or at time of commencement of spawning. In the latter case, the proportion of  $F$  and  $M$  sustained in the year prior to the spawning season is determined by data in FILE F. Estimates of total and spawning stock biomass should include plus-group.

Further requirements which should be considered are a program to do quarterly VPAs and also for provision for male and female stock numbers and stock weight to be summed where VPAs are done for each sex separately.

### 3.2 Catch Prediction

The basic requirement is to make a prediction, for specified assumptions of the catch in the current year ( $t$ ), and for each set of assumptions for year  $t$  to calculate catches in year  $t + 1$  for a range of  $F$  options. Provision should be made, however, for predictions over a longer period of years. Provision should be made for the option of predictions with a TAC constraint in any (or all) of the years. For each catch prediction run, the computer should also print a table of the input data used in the prediction, suitably labelled and formatted for direct reproduction in the Working Group Report. Provision should be made for separate components (categories) of the fishery to be handled separately in the prediction and the category catches summed for the total catch prediction. An example of the use of this facility are the North Sea Roundfish fisheries,

where there are three components: Human consumption landings, discards and industrial fishery by-catches. In such cases, each category will have separate weight-at-age data and exploitation pattern and it should be possible to vary overall F on each category separately in the prediction years.

The program will call weight-at-age data from the basic files. These data will be displayed and the possibility for manual amendment should be provided. The stock size at beginning of the first year of prediction (t) would be that stored from the most recent run of the VPA. The exploitation pattern would be derived from the F-at-age data input for the latest year in the VPA and stored in FILE H.

This would be displayed with the option of manual amendment for any year of the prediction period. Levels of F (or TAC) for first year of prediction will be specified by the user. For the following year catches and spawning stock biomass (at beginning of year after or at beginning of spawning season in following year) for a fixed range of F ratios compared with the F in last year of VPA. Recruitment data would be input manually by the user. If possible, a summary of the catch prediction should be displayed on VDU before the full output is printed. Where required, catch predictions should be possible for sexes separately and the results summed.

### 3.3 Yield per Recruit

A yield per recruit program will be required based on the analytical model in which F varies with age. For the North Sea situation, where there are human consumption landings, discards and industrial fishery by-catches, these components should be handled separately with weight-at-age data and exploitation patterns appropriate to each component. The yield in such a case would not include discards which are not landed.

The program would use weight-at-age data from the basic file (FILE D) and the exploitation pattern from FILE H.

The user would specify the increments of F for which yield per recruit, total biomass per recruit, and spawning stock biomass per recruit would be calculated. F could be defined as the fishing mortality on the age-group subject to maximum exploitation or as F relative to a reference year. For each curve the program would determine  $F_{\max}$  and  $F_{0.1}$ .

The possibility of varying the exploitation pattern should be provided which would enable, for example, the simulation of the long term effects of a mesh change. However, problems can arise because with a change in exploitation pattern, this can result in a change in the age group(s) which is (are) subject to maximum exploitation and in this case the F axes of the yield curves may not be comparable.

### 3.4 Mesh Assessment

The Study Group did not have a chance to discuss mesh assessment programs in any detail, but it was thought likely that two programs would be required, one to do the Gulland type of assessment, and the other method developed by Andersen, Hoydal, Rørvik and Sparre which, in addition to a mesh assessment, can provide an estimate of the effective mesh size actually in use. Basic input FILE C would contain length composition data which would have to be compatible with the data requirements of the mesh assessment programs.

The programs would have to make provisions for discards.

It would also be possible to use the catch prediction program to assess short or long-term effects of mesh changes by changing the exploitation pattern to simulate the effects of a mesh change.

## 4. CONCLUDING REMARKS

It is probable that the Study Group has not anticipated all requirements that will be demanded of the basic programs. Nor can the Group exclude the possibility that there will be some initial problems in the use of the programs.

It is probable that in the light of experience gained in the early use of these programs, that it will become apparent that amendments and/or enhancements will be needed. It is a requirement that all programs will be fully documented and that shorter user guides will also be provided .

It is clear that the programs and the associated files will need to be thoroughly tested before use in any Working Group. It is hoped that it will be possible to run test data at ICES Headquarters and perhaps transfer the programs to other institutions where additional testing might be undertaken. In addition, arrangements should be made for the same assessments to be made with the test data with alternative programs either at ICES Headquarters or at national Institutions

The Study Group recommends that arrangements should be made for it to meet again, perhaps at the time of the Statutory Meeting (1980), to discuss more detailed program specifications which will be prepared by the ICES System Analyst.