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A Punch-Card System for Compiling ICNAF's Statistics

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Every year the amount of statistical data received in the Secretariat for compilation in the Statistical Bulletin increases. There were almost twice as many figures to compile for Statistical Bulletin Vol.4 as for Vol.3. This is an excellent indication of the increased detail in which the Commission statistics are now collected and will be most gratifying to the Commission. However, as neither the number of the staff of the Secretariat nor the amount of mechanical aid has increased, there is a danger of a bottleneck forming which will delay the publication of the Statistical Bulletin and prevent the Secretariat carrying out its proper duties in respect to the compiling of such other data such as that on mesh sizes, length measurements of fish, etc. As pointed out in Document No.9 (Serial No.368), the first statistical submissions for the 1955 fishery arrived in the Secretariat on the day after the tables of Statistical Bulletin Vol.4 were sent to the printer, and before Part I had been finally prepared or any proof-reading done.

More mechanical aid is now required to aid with the processing of the statistical data received by the Commission. This is also a natural consequence of the accumulation over the years of statistical data.

An IBM punch-card system, using tabulating and computing machines, is ideally suited to ICNAF's needs. It would assist with much of the routine work in preparing the Statistical Bulletin and in other operations where the amount of arithmetic is excessive and time consuming.

It is proposed therefore that the Secretariat should continue with its preparation of a suitable IBM system for ICNAF's statistical work and introduce it when it has been finally prepared, and that a sum of money be appropriated for that purpose. The details of the cost of using an IBM system are given on page 8.

In the following appendices, ICNAF's statistical requirements are described (page 2), the procedure and compilation carried out in the Secretariat outlined (page 5) and the technical details and applications of a suitable IBM system discussed (page 6).

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Appendix 1 - ICNAF Statistical Requirements

The collection and publication of ICNAF statistics are to provide factual information on the extent and intensity of the fisheries in the ICNAF area and to permit observation of any changes in the extent or intensity of the fisheries or the species composition of the catches in any area, month or year.

They are especially designed to assist fishery scientists or administrators to calculate the maximum (or optimum) sustained yield possible from the various fisheries.

The data compiled by ICNAF are in two parts:

- Part A - Detailed data on the major groundfish fisheries
- Part B - Summary data on the landings of all other fisheries.

Part A - Groundfish

(1) The statistical submissions on groundfish from the countries fishing in the Northwest Atlantic give the catch and effort statistics for each size class of each kind of vessel in each month in each ICNAF subarea and subdivision. The landings of each species are given separately in terms of the condition first weighed.

(2) The countries which submit statistics are as follows (Three of them are divided into two parts, each of which submits separate statistics):

- | | | |
|---------|---------------------------|---------------------|
| Canada | - (1) Maritimes & Quebec | (7) Germany |
| | (2) Newfoundland | (8) Iceland |
| Denmark | - (3) Faroes | (9) Italy |
| | (4) Greenland | (10) Norway |
| France | - (5) Home Ports | (11) Portugal |
| | (6) St. Pierre & Miquelon | (12) Spain |
| | | (13) United Kingdom |
| | | (14) United States |

There are therefore fourteen statistical submissions.

(3) Statistics are reported from vessels of the following types:

- (1) Otter Trawlers
 - (2) Pair Trawlers
 - (3) Dory Vessels
 - (4) Danish Seiners
 - (5) Long Liners
 - (6) Trap boats
 - (7) Sink Gill net boats
 - (8) Small hook and line boats
-) Miscellaneous

(4) Vessels may be classified as:

0-50	gross tons
51-150	" "
151-500	" "
500-900	" "
over 900	" "

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Canadian dory vessels and long liners are also classified as:

- A. Halibut Fishing
- B. Salt Fishing
- C. Fresh Fishing

Portuguese dory vessels are classified as:

- (1) Sailing Vessels without refrigeration
- (2) Motor Vessels without refrigeration
- (3) Motor Vessels with refrigeration

(5) The ICNAF area is divided into five subareas each of which is subdivided into a number of subdivisions as follows:

<u>Subarea</u>	<u>Subdivision</u>
1	A, B, C, D, E, F
2	G, H, J
3	K, L, M, N, O, P
4	R, S, T, V, W, X
5	Y, Z

A total of twenty-three subdivisions.

(6) The species are grouped as:

- (A) The species
 - (1) Cod
 - (2) Haddock
 - (3) Redfish
 - (4) Halibut
- (B) The groups
 - (5) Flounders
 - (6) Other Groundfish
 - (7) Pelagic Fish
 - (8) Other Fish
 - (9) Shellfish

The species included in the groups are given on pp.20-22 of ICNAF Statistical Bulletin Vol.4 for the year 1954. (Halifax 1956).

(7) The ICNAF statistical unit for groundfish consists of five parts (see Table 1)

- (a) Identification: - identifies the country, type of vessel or gear, size class of vessel, ICNAF subarea and subdivisions, and month when fishing took place.
- (b) Effort data: - Includes the number of vessels fishing. The other effort data is divided into two parts:
 - (i) Descriptive, i.e. fishing power data which may include average gross tonnage, average horse power, average number of crew, average number of dories, average number of lines per set, average number of hooks per line, size of otter trawl, size of meshes in nets, etc.

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(ii) Applied. This may include various measures of fishing time such as days absent from port, days on fishing grounds, days fished or hours fished and/or it may include such measures of the effort as number of drags, sets, lines or hooks fished. The type of applied effort data given depends to some extent on the type of fishing operations being carried out, especially whether otter trawling or hook and line fishing.

- (c) Landings: - given by separate species. They may be given by size categories. The landings are given in the condition in which they are first weighed, e.g. green salted, gutted, round, etc. They are usually - although not always - given in the unit of weight used in the country of origin.
- (d) Catches Discarded at Sea - This data should be given by separate species. So far no country has attempted to report full statistics on this item.
- (e) Yields per Unit of Effort

(8) Additional descriptive data on the vessels operating in the ICNAF area are submitted every three years (for 1956 - the current year - these data will be submitted). Such information as type of vessel, gross tonnage, horsepower, type of engine or motor; type and size of gear, size of crew, whether radar, W/T, echo-sounder, etc. are carried are given for each vessel.

Part B - All Other Species

Data on these species are obtained separately for each species where possible. They are usually given by subdivision of capture but not by kind or size of vessel. No effort data is submitted to ICNAF. They are classed as part of the Other Groundfish group or as Pelagic Fish, Other Fish or Shellfish.

The statistics of Part A submitted to the Commission comprise about 2,114 ICNAF units. The distribution of these ICNAF units according to countries is shown in Table 3. The varying number of units reported by the countries reflects the varying complexity of the various fisheries and the detail in which the data is recorded rather than the size of the fisheries. The ICNAF units are submitted by member countries in national tables. A skeleton national table is shown in Table 2.

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Appendix 2 - Procedure of Compilation of ICNAF's Statistical Data

A. First Stage:

(1) Landings are converted to metric tons round fresh weight by multiplying by appropriate conversion factors, and the separate conditions (green, salt, fillets, etc.) are brought together to give one weight for each size category of each species landed for each ICNAF statistical unit.

(2) Weights for each size category are added to give a total for each species.

(3) The weights for the separate species of flounder, other groundfish, etc. may be added to give totals for these groups.

(4) The weights of the separate species are added to give the total catch for each ICNAF unit.

(5) One or more yields per unit of effort are calculated.

B. Second Stage:

(1) National totals are obtained for each of the efforts and species for each type and size of vessel, subdivision and subarea.

(2) Cross tabulated national totals are obtained for each of the efforts and species for each month for each size and type of vessel, subdivision, etc.

(3) International totals of the landings classified by type of vessel, subdivision, month and country are obtained.

C. Third Stage:

(1) The basic national tables are prepared for printing. They include the totals of type B1 but not B2.

(2) Tables giving the B2 totals are prepared as summaries. These may be used for drawing the figures of Part I (see Statistical Bulletin Vol.4).

(3) International tables are prepared from B3 totals (see Tables 1-7, Statistical Bulletin Vol.4).

D. Fourth Stage:

(1) Selected landings and yields per unit of effort are summarized over a series of years according to need.

(2) Additional data is obtained from some countries giving the basic ICNAF unit of data for individual vessels instead of the usual group of vessels. This data is particularly useful for analyzing the variation in the catch per unit of effort between vessels.

- (a) To show the relation of the variations to the characteristics of the vessels, e.g. gross tonnage, etc.
- (b) To measure the variance of the individual estimates of the yield per unit of effort.
- (c) This last permits the significance of any difference in the catch per unit of effort by subareas, months or years to be tested.

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(3) The effort data are to be related to a standard fishing effort and the individual efforts are then to be calculated in terms of this standard effort.

(4) The now standardized efforts of the various sizes and kinds of fishing vessels are to be summarized and the average yield per unit of standard effort for each month/subdivision calculated.

(5) Yields per standard unit of effort are then to be analyzed for one year or over a series of years to investigate differences, changes or anomalies between seasons, areas or years.

Appendix 3 - Outline of a Punch-Card System

1. General

(i) A punch-card system using tabulating and computing machines has been described by J. leG. Lacy in "Purposes and Methods in Fishery Statistics", Report of First International Meeting on Fishery Statistics, May 1952 (mimeographed FAO, Rome, 1955).

(ii) The system described by Lacy which is used for the fisheries statistics of England and Wales, is very similar to the one proposed for ICNAF. The same kind of data is punched, e.g. locality of fishing, types of gear, effort data and landings, and in both systems one card is punched for each size category of each condition of each species landed (ICNAF's system would also include fish discarded at sea). However, a major difference between the system described by Lacy and the one proposed for ICNAF is that for the former the punched cards are based on the individual trips made by a fishing vessel and requires over 300,000 cards per year; whereas for the ICNAF system the punched cards would be based on the ICNAF unit (see Table 1) which may include the trips or parts of the trips of several vessels, and requires about 8,000-10,000 cards per year.

(iii) The number of ICNAF units, the average number of landings' cyphers per ICNAF unit (cyphers may be for separate conditions, size categories or species) and the number of IBM cards required for ICNAF's statistical data are given for each country in Table 3.

2. Applications

A. The IBM punch-card system will:-

- (1) Record all original data for permanent filing and re-use, e.g. for revision of conversion factors;
- (2) Retain all past data in a form suitable for compilation over a number of years, i.e. the data will be easily available for further processing.

B. It will carry out many processes mechanically, such as

- (1) Converting landed weights to round fresh weights in metric tons;
- (2) Sorting and tabulating the data for making up the tables and summaries required for the Statistical Bulletin;
- (3) Calculating the yield per unit of effort;/7.

- (4) Calculating standard efforts and yields per unit of standard effort when the formula for converting particular efforts to standard efforts is established;
- (5) The arithmetic required in employing statistical tests or analyses, e.g. in the calculations for analysis of various or multiple correlation coefficients.

C. Once the system is in use it can be used for the relatively small jobs, including:-

- (1) The analysis of the individual vessel data from France and Spain;
- (2) The analysis of conversion factor data;
- (3) The analysis of any other experimental or observational data which is bulky and when the arithmetic is onerous;
- (4) The integration of length measurement data with the statistics;
- (5) The integration of tagging data with the statistics.

D.

- (1) Type all data required in the tables of the Statistical Bulletin in a form suitable for publication;
- (2) Perhaps type tables in such a manner that copies could be made by means of photo-lithography, thus cutting down on printing expenses.

3. The IBM Card

An example of an IBM card is attached.

(i) There are 80 columns on the standard IBM card. Each column can be punched with a hole to represent a number 0 to 9 or a letter of the alphabet (two holes). About 8,000-10,000 cards are required for ICNAF's statistics (Table 3)

(ii) Coding is used to translate names, etc. into a form that can be punched on a card, e.g.

Types of vessels may be coded thus:-

	<u>Code</u>
Otter Trawlers	1
Dory Vessels	2
Long Liners	3
Etc./8.

The exact coding to be used for the various items is not yet decided but would probably follow one already in use by another international organization (if suitable) or by a member country (e.g. U.K.). In general there is advantage to be had from using a standardized method of coding, especially for an international organization. However, the coding to be used would be decided only after exhaustive studies have been made and expert advice consulted as to the most efficient codes for punching and sorting.

(iii) Fields: The IBM card is divided into fields which consist of a group of columns used for the same kind of data, e.g. the field for average gross tonnage might contain four columns, the first for thousands, the second for hundreds, the third for tens and the fourth for units.

An outline of the fields and the number of columns for each which could be used for ICNAF's statistics are given in Table 4 (compare with the basic ICNAF unit, Table 10.

4. Procedure and Cost

If a punch-card system is introduced, the cards will be punched at headquarters but the computing and tabulating will be done at a service office or at some larger centre which has the necessary machines. These machines are expensive and it would not be practicable for ICNAF to obtain them.

The cards themselves are relatively inexpensive costing about \$1.50 per thousand. In addition, there would be the initial cost of having a plate made to print ICNAF's fields or other details on the cards. This would cost about \$40.00.

The punches which might be considered for ICNAF's use vary in price from about \$8.00 to \$25.00 per month. The more expensive punches do much more, automatically, than the cheaper punches and save a corresponding amount of time. A punch would be required for about six months in the year, or less with a fully automatic punch.

The cost of processing the cards is based on the length of time that the tabulating and other machines are used. They carry out a great deal of work in a very short time. An estimate of this cost will be available at the Annual Meeting.

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Table 1 - Unit of ICHAF Statistical Data

<u>Generalized Example</u>			
Country))	
Type of Vessel))	
Vessel size class)	Gear)
Subarea))	Identification
Subdivision)	Locality)
Year))	
Month)	Season)
No. of Vessels))	
Average Gross Tonnage))	
Average Horsepower))	
Average No. in Crew)	Description)
Length of Footrope (Otter Trawl)))	
Etc.))	
Days absent from port))	
Days on grounds))	Efforts
Days fished))	
No. of Drags)	Applied)
Hours fished))	
No. of Hooks))	
No. of dory hours))	
Etc.))	
<u>Species</u>	<u>Condition</u>	<u>Culling</u>)
Cod	Green Salted	Large)
		Medium)
		Small)
	Gutted Head On	Large)
		Medium)
		Small)
	Fillets	Unsorted)
<u>Haddock</u>	Green Salted	Large)
		Medium)
		Small)
	Gutted Head On	Large)
		Medium)
		Small)
<u>Redfish</u>	etc.	etc.)
<u>Halibut</u>	etc.	etc.)
<u>Am. Plaice</u>	etc.)
<u>Pollock</u>	etc.)
Etc.	etc.)
Etc.	etc.	etc.)
Cod)
Haddock)
Redfish)
American Plaice)
Etc.)
Total Yield per Day Absent)
Cost Yield per Hour Fished)
Etc.)
Etc.)

Table 2 - Skeleton National Table of ICRAF Statistical Data

Generalized Example

Country	EFFORTS				LANDINGS				DISCARDS		ITEMS PER UNIT OF EFFORT	
	No. of Vessels Tonnage	Days	Applied	Days	Headlock	Headlock	Headlock	Headlock	Headlock	Headlock	Total Per	Day Absent

each complete row represents an ICRAF unit

Type of Vessel:
 Size Class (1)
 Subdivision 1A

- Jan.
- Feb.
- Mar.
- Apr.
- May
- June
- July
- Aug.
- Sept.
- Oct.
- Nov.
- Dec.
- Year

Subdivision 1B

- Jan.
- Feb.
- Mar.
- Apr.
- May
- June
- July
- Aug.
- Sept.
- Oct.
- Nov.
- Dec.
- Year

Size Class (11)
 Etc.

Table 3 - No. of ICNAF Units and Estimated No. of Punched Cards Required (with average no. of landings cyphers per ICNAF unit)¹⁾

	<u>ICNAF units</u>	<u>Average No. of Landings Cyphers</u> ¹⁾	<u>Est. No. of Punched Cards Req'd</u>
<u>Canada</u> (Mar. & Que.)	452	3.7	1,658
(Hfld.) standard	166	4.9	809
special ²⁾	224	1.2	279
<u>Denmark</u> (Faroes)	6	1.3	8
(Greenland)	6	2.3	14
<u>France</u> standard	73	2.7	198
special ³⁾	58	1.0	58
<u>Germany</u>	5	9.2	46
<u>Iceland</u>	6	5.5	33
<u>Italy</u>	1	1.0	1
<u>Norway</u>	50	1.5	76
<u>Portugal</u>	101	1.2	126
<u>Spain</u> standard	74	5.6	418
special ⁴⁾	732	3.5	2,527
<u>U.K.</u>	15	5.7	86
<u>U.S.A.</u>	220	11.7	2,577
	2,114	4.0	8,496

- 1) A landings cypher may be for a size category, condition or species.
- 2) Hfld. special data gives fishing efforts and catches where the fishing effort was applied to one species only.
- 3) French special data gives efforts and landings by individual vessels for each subarea.
- 4) Spanish special effort data gives efforts and landings by individual vessels for each month/subdivision. This data includes the Spanish standard data.

Table 4 - Outline of Fields and Number of Columns in Each Field of IEM Card

<u>Field No.</u>	<u>Subject</u>	<u>Coded or not</u>	<u>No. of Columns</u>	
1	Date	No	2	
2	Country	Yes	2	
3	Type of Vessel	Yes	2	} Possibly coded together
4	Size Class	Yes	1	
5	Subarea Fished	No	1	
6	Subdivision Fished	Yes	1	
7	Month	Yes	2	
8	No. of Vessels	No	3	
9	Average Gross Tonnage	No	4	Perhaps given to nearest 10 tons.
10	No. of Trips	Yes	4	} In general decimal fraction would not be given, although in particular cases, e.g. no. of trips, decimals could be given
11	No. of Days Absent	No	4	
12	No. of Days on Grounds	No	4	
13	No. of Days Fished	No	4	
14	No. of Hours Fished (Otter Trawl) }	No	4	
	" " Hooks (1000s) (Long Lines) }			
15	No. of Drags (Otter Trawl) }	No	4	
	" " Seta (Long Lines) }			
16	No. of Lines Fished (100s) }	No	5	
	" " Dory Hours (Dory Vessels) }			
17	Species identification	Yes	3	2 columns might be sufficient
18	Condition landed	Yes	2	
19	Size category	Yes	1	
20	Unit of weight	Yes	1	
21	Weight	No	6	Fewer columns might be sufficient
22	Conversion factor	No	5	May not be necessary to punch this
23	Round fresh wt. in metric tons	No	6	Fewer columns might be sufficient. (No decimal fraction recorded.)
<hr/> Total		-	71	-

The order of the fields is relatively arbitrary and is provisional only