Informational Leaflet 10

REPORT ON DATA PROCESSING SHORT COURSE UNIVERSITY OF WASHINGTON

By:

Donald B. Siniff
Division of Biological Research
Juneau, Alaska

March 27, 1962

STATE OF ALASKA
WILLIAM A. EGAN - GOVERNOR

DEPARTMENT OF
FISH AND GAME
WALTER KIRKNESS - COMMISSIONER
SUBPORT BUILDING, JUNEAU

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Report on Data Processing Short Course

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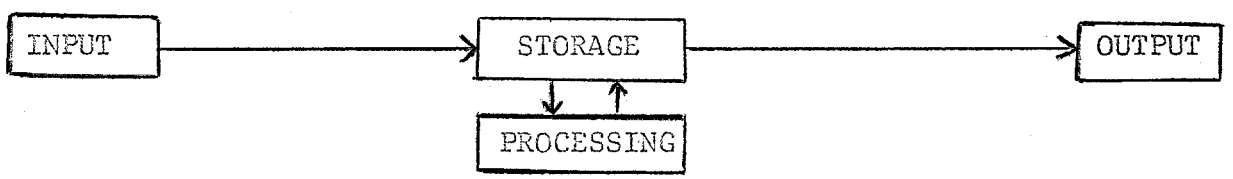
The University of Washington's College of Fisheries, the Pacific Northwest Research Computer Laboratory, and the International Business Machine Corporation sponsored a short course in the electronic processing of biological data from March 6-16, 1962. This course was designed to give fisheries personnel an introduction to computer problems and techniques, thus showing how computer systems may greatly facilitate the processing of biological data. This Department was able to send two representatives to this course, their biometrician and their statistician.

The emphasis of the Data Processing course was on teaching a basic course in FORTRAN (FORmula TRANslation) programming and acquiring some ability to write and get these written programs to accomplish their purpose (i.e., compute without error). In addition, some time was spent on the application of statistical methods to biological data, by using computer programs already written and applicable to the IBM 709 computer. The purpose of this brief memo is to acquaint the biologists of this Department with the basic mechanisms of such a computer and then point out a few applications of such a system in Research and Management of fish and game populations.

The basic components of a computer system can be described by the following block diagram.



A computer is only capable of carrying out instructions which are given to it by some outside source, usually an individual. For any given problem, a set of instructions must be constructed. This set of instructions is called the <u>program</u> and the person who constructs these instructions is the <u>programmer</u>.

With the advent of large computer systems, one of the major problems was to find a common mode of communication between the computer and the programmer. When using many of the earlier programming systems it was difficult for the programmer to correctly describe his problem to the computer, so that the correct result could be obtained. This problem has been greatly reduced because of modern programming systems, one of these being FORTRAN. FORTRAN makes it possible for instructions to be given to the computer by written statements which are punched on data processing cards. The following is a greatly simplified FORTRAN program, and is only for purposes of illustration.

In this example suppose we have x_1, x_2, and x_3 on punch cards and wish to obtain the sum for each set of these three variables. The program would contain these basic instructions and take the following form:

```
Read x1 x2 x3
x = x1 + x2 + x3
Print x
End
```

The computer takes these instructions and by using what could be called a FORTRAN processor converts these instructions to machine language and then carries out the calculations.

There are several types of programming systems which furnish the desired facility for easy communication with computers. Thus, FORTRAN is not the only method nor necessarily the best but it is in large use on most of the more recent IBM computer systems.

The application of these computer systems to fishery management problems could be one of the most progressive techniques which workers in this field will have at their disposal.

Two fields of application for computer systems to greatly assist in biological studies are: (a) the extremely fast analysis of complex problems which would take months to interpret via a desk calculator and (b) the construction of hypothetical fish populations so that the effects of different environmental factors and management techniques may be measured over a series of years.

An example of an analysis which would be very impractical to do on a desk calculator is multiple regression with a large number of independent variables. Suppose we have a dependent variable and we wish to determine whether or not it is affected by several independent variables. Say the dependent variable corresponds to a number of downstream migrants during a certain observation period and with each observation there exists a measure of the independent variables, such as turbidity, water temperature, a light index, etc. These data may take the form: $Y = b_0 + b_1x_1 + b_2x_2 + \ldots + b_ix_i + \ldots + b_nx_n$ where Y = number of smolts, and x_i = the independent variables. If the number of independent variables (n) is over 5, the amount of computations necessary to properly analyze these data are very cumbersome. However, by using a computer these data can be completely analyzed in several minutes of machine time, thus leaving much more time to study and interpret the results.

An excellent example of what can be done with a computer in problems involving population models is presently under study at the University of Washington. A model of the Bristol Bay fishery is being constructed with random variables to simulate the natural phenomenon, and past records to simulate fishery effects and management practices. By simulating collection of data corresponding to the present indices, an effort is being made to better understand how these measures can be used to obtain a more reliable prediction of the Bristol Bay run. If such a system can be established it will certainly be of great value to all who are concerned with this very important resource.

This has been a brief attempt to describe a computer system and mention a very few of the many applications which such a system has in biological work. The computer is only an aid to the biologists and the final interpretation of biological data and management techniques is still very much at the discretion of the biologists. However, these machines greatly increase the information that may be quickly realized from data; hence, the biologists will have a more complete picture of the fishery and a greater amount of time to study the results before any management decision is made.

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