

ABSTRACT

The development and structure of FiSAT (FAO-ICLARM Stock Assessment Tools) are presented; this software stems from the need to standardize common length-based methodologies for research in fish stock assessment, FiSAT includes all rou-

FISAT AND STOCK ASSESSMENT

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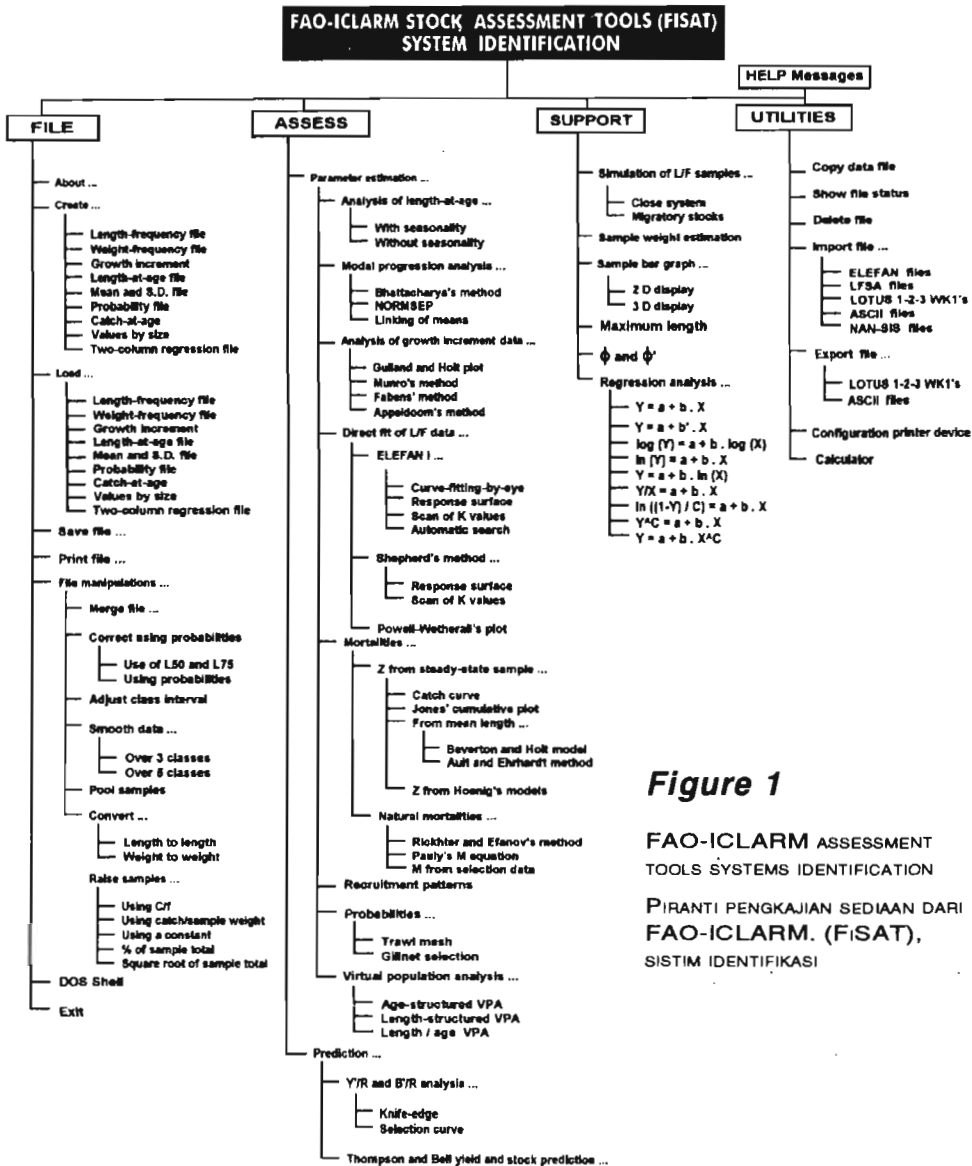


Figure 1
 FAO-ICLARM ASSESSMENT TOOLS SYSTEMS IDENTIFICATION
 PIRANTI PENGKAJIAN SEDIAAN DARI FAO-ICLARM. (FISAT), SISTIM IDENTIFIKASI



tines of the complete ELEFAN (Electronic Length Frequency Analysis) package developed by ICLARM and of the LFSA (Length-based Fish Stock Assessment) package developed by FAO, along with some new routines also found useful for analysis of length frequencies.

Requiring only a minimum of 512K of RAM, 7.5 MBytes of free disk space for the programs and EGA or VGA graphic displays for high-resolution graphic outputs on an IBM PC (or its compatibles), FiSAT now includes 90 different routines for fish stock assessment and supports data types other than length frequencies. It is envisioned that both ICLARM and FAO will distribute FiSAT in the form of three 3.5" disks with a User's Guide in the second half of 1994 to over 800 registered users of both ELEFAN and LFSA. An edited detailed Reference Manual, outlining the theory behind each routine, will also be made available by late 1994.

Perkembangan dan struktur dari pada FiSAT (FAO-ICLARM Stock Assessment Tools) disajikan; piranti lunak ini disesuaikan menurut kebutuhan untuk menstandisasi metodologi berdasarkan ukuran panjang yang biasa untuk penelitian didalam pengkajian sediaan. Didalam FiSAT terdapat semua rutin dalam Compleat ELEFAN yang dikembangkan masing-masing oleh ICLARM dan LFSA yang dikembangkan oleh FAO, bersama-sama dengan rutin yang baru yang berguna untuk analisis frekuensi panjang.

Program ini hanya memerlukan RAM 512 K, 7,5 MBytes dari hard disk dan untuk penyajian grafik resolusi tinggi diperlukan monitor EGA dan VGA pada IBM PC atau yang kompatibel, sekarang FiSAT mencakup 90 rutin yang berbeda untuk pengkajian suatu sediaan dan dapat mendukung penggunaan jenis data yang lain selain frekuensi panjang. Telah dipertimbangkan bahwa ICLARM dan FAO akan menyebar luaskan FiSAT dalam bentuk tiga disket 3,5 inci yang dilengkapi dengan buku petunjuk menjelang akhir tahun 1994 kepada lebih dari 800 pengguna ELEFAN dan LFSA. Reference Manual yang lengkap, yang menjelaskan teori dari masing-masing rutin akan tersedia pada akhir tahun 1994.

INTRODUCTION

"Future life scientist may be characterized more by their ability to use the computer for data analysis and simulation than by their ability to use the traditional microscope" (Spain 1982). Indeed, it has become apparent in recent times that more and more fisheries scientists are knowledgeable in using microcomputers, and to a certain degree, in programming as well.

A fishery stock assessment should provide scientific advice about the state of the fish stock which ultimately should be managed for the benefit of the fishermen. This, however, is not the direct procedure as it would be for a farmer to manage a domestic stock or for a forester to manage a forest. The major difference is that fishes are usually not seen, counted or weighed before they are caught, thus the need to assess fish stocks through mathematical inferences. However, as noted by the late John Gulland, classical methods are inappropriate for two reasons; (i) fisheries have the capacity to develop and reach a critical level in a much shorter time than required for their scientific assessment, which leads to *post mortem* results rather than useful advice and (ii) a much greater accuracy is more often expected than obtained when computational difficulties are circumvented through approximation (Gayanilo, 1993; Garcia *et al.*, 1993).

Recent developments in the microcomputer industry have brought powerful number-crunch-

ing abilities to the desks of most researchers which may, in some ways, diminish the 'inappropriateness' of the classical procedures. The renewed interest in biomathematics resulted in the development of new algorithms being implemented on microcomputers, improving the accuracy and speed of the assessment procedures.

One of ICLARM's early contributions to this emerging trend was the development of the ELEFAN (**E**lectronics **L**ength **F**requency **A**nalysis) (Pauly and David, 1981; Brey and Pauly 1986; Gayanilo *et al.*, 1989) suite of routines. This software package provided an alternative to fisheries scientists working in the tropics to assess fish stocks incorporating methods that could be used and for which data was available and/or readily collected (Pauly *et al.*, in press). The staff of FAO (**F**ood and **A**griculture **O**rganization) has also contributed to the development of methodologies applicable to the tropics and much of this effort is incorporated in the LFSA (**L**ength-based **F**ish **S**tock **A**ssessment) software package (Sparre, 1987).

ELEFAN and LFSA were developed in response to the same needs, hence, both packages included a number of similar routines. Things could have been left at that: FAO and ICLARM continue to maintain and distribute their respective software and the interested colleagues can choose. Practical experiences made during various training courses especially the FAO/DANIDA Training Courses in Tropical Fish Stock Assessment showed, however, that the simultaneous offering of "competing" software had an inhibiting effect on the course participants. Also, the costs of maintaining and documenting a complex software package are rather high, especially if one's mission is global and hence, involves producing documentation in languages other than English (Pauly and Sparre 1991).

For all these reasons, FAO and ICLARM have signed a Letter of Agreement covering the development of a joint software which will supersede FAO's LFSA and ICLARM's Complete ELEFAN. The new software is now called FiSAT (**F**AO-**I**CLARM **S**tock **A**ssessment **T**ools). It includes all routines of the Complete ELEFAN and LFSA as well as new promising models/methodologies.

THE FISAT SOFTWARE

The first version of FiSAT contains over 90 modules and supports several data types (but mainly length frequencies). Following some of the standards set by commercial software for its user interface, it will be distributed on three 3.5" disks, with a User's Guide to the software and Reference Manual, to be printed and distributed through FAO. The software package will require 7.5 Mbytes of free disk space for a minimum of 512K of RAM and a graphic adapter (EGA or VGA) for its high-resolution graphic displays. FiSAT has four main groups of routines, FILE, ASSESS, SUPPORT and UTILITIES (fig.1)

The FILE Menu

The FILE set of routines provides functions to :

- Create, edit, save and print (length or weight frequency, growth increment, length-at-age, mean and standard deviation, selection, catch-at-age, value by size and two-column regression) files;
- Manipulate the data files : merge different files, correct length frequencies using probabilities of capture, adjust the class interval of grouped frequencies, pool samples, convert data forms, raise samples, etc...



Most of these routines are for manipulating length frequencies, as the package as a whole emphasizes the analysis of for length frequency data, the key data (besides catches) in the tropical fisheries.

The ASSESS Menu

The routines in the ASSESS menu include procedures to (i) estimate growth parameters from length-at-age, growth increments and length frequencies, (ii) estimate mortalities and related parameters, (iii) identify seasonal pulses of recruitment (iv) compute fishing patterns (F. array) and recruitment using Virtual Population Analysis (VPA), and (v) predict yield and biomass per recruit (Y/R; B/R) from the Beverton and Holt and Thompson and Bell models for various fishing scenarios (single and multispecies).

The SUPPORT Menu

This set of routines includes various ancillary functions: estimating sample weights given length-weight relationships, plotting of length-frequency histograms, estimation of expected maximum size from observed extreme values, estimating growth indices (o) and performing linear regression analysis. This menu also offers a routine for the simulation of length frequencies from either a closed-system (where it is assumed that fish do not migrate to other areas) or from a system that allows sequential migration of fish from one area to the next (up to four areas can be linked by migrating fish).

The UTILITIES Menu

The set of routines included in the UTILITIES menu serve purposes such as copying of data files, deleting files, importing ELEFAN, LFSA, LOTUS 1-2-3, ASCII and NAN-SIS files, exporting length frequencies to LOTUS 1-2-3 or ASCII files and configuring printer devices. A calculator is also included for convenience.

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