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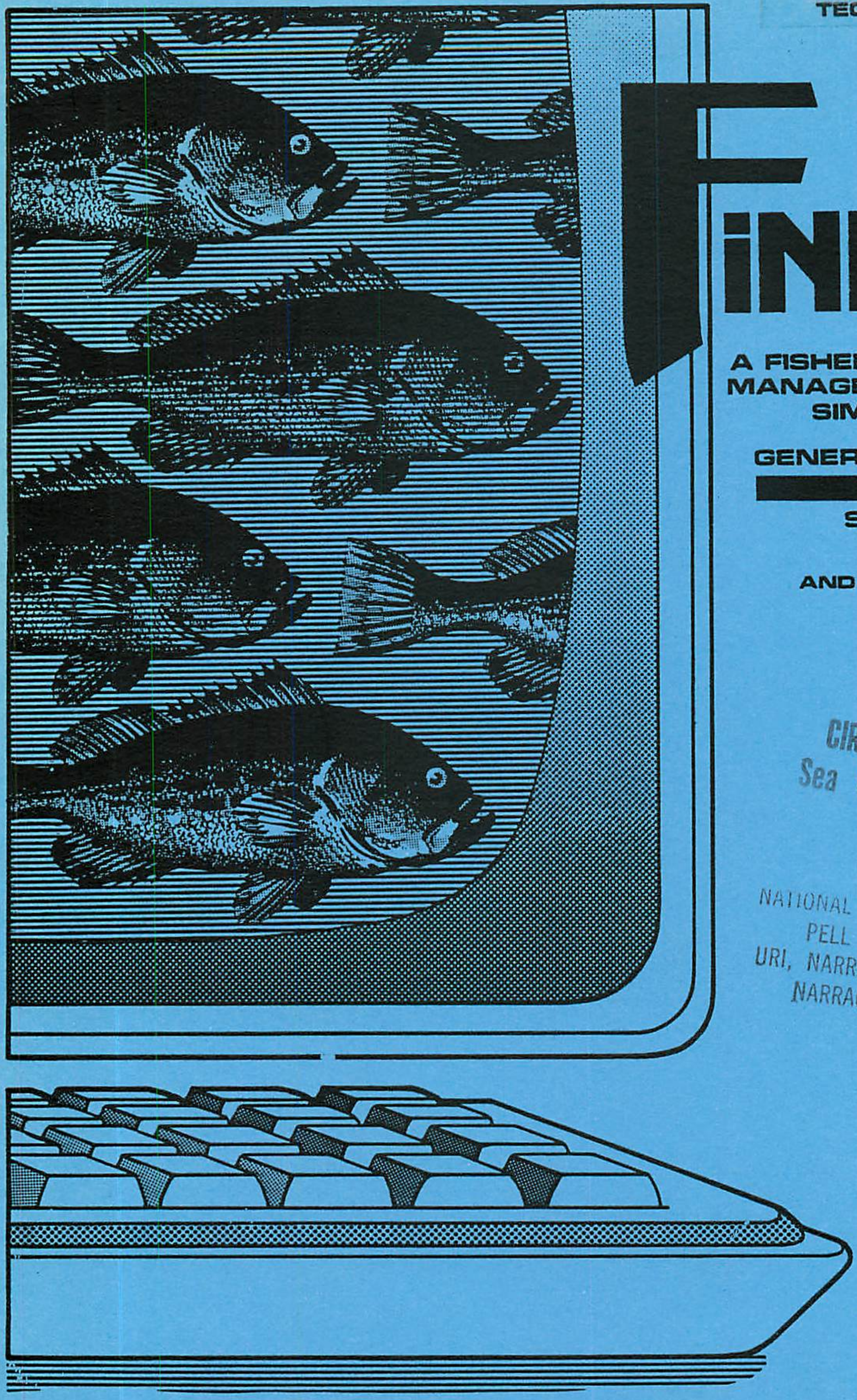

FINMAN

A FISHERIES INSTITUTION MANAGEMENT-TRAINING SIMULATION MODEL

GENERAL USER'S GUIDE

SEPTEMBER 1986

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SEA GRANT

FLORIDA SEA GRANT COLLEGE

FINMAN
A Fisheries Institution Management-Training Simulation Model

GENERAL USER'S GUIDE

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ABSTRACT

FINMAN (Fishery INstitutional MANagement-Training Simulation Model) is a microcomputer-based program which simulates decision-making responses at three levels within the fishery management institution: (1) fishery management rules, (2) fishery agency general budget allocations, and (3) research budget allocations. The program also allows for a variety of fishery types, rule development structures, and levels of authority over the fishery. FINMAN serves as (1) an analysis program for investigating system responses, and (2) an educational program for demonstrating system responses under a variety of situations. The program is written in BASIC with versions available for the Apple IIe, Apple IIc and IBM-PC microcomputers.

1.0 Identification:

Program Name: **FINMAN** - Version 1.0*

Language: **BASIC**

General User's Guide for the University of Miami Fishery Institution Management-Training and Research Simulation Project: William W. Fox, Jr., Principal Investigator. By Jerald S. Ault and William W. Fox, Jr., CIMAS, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida. This work is a result of research sponsored by NOAA Office of Sea Grant, Department of Commerce, Florida Sea Grant College Program, under Grant No. E/C-8.

Designed for the **Apple IIe, IIc,** and the **IBM/PC** microcomputer systems. Program storage requirements are 128K in RAM (64K in ROM) and one disk drive; output is arranged for an 80-column display. Available versions are written in Applesoft BASIC (Apple computers) and Microsoft BASIC (IBM/PC's), and are user-interactive with specialized data base file manipulation features.

*To obtain a copy of the program send one (1) blank two-sided 5 1/4" diskette or two (2) blank single-sided 5 1/4" diskettes, specifying the type of microcomputer you have, along with a prepaid return mailer, to the **authors** at Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149.

1.0 FINMAN Initial Conditions

Section I: Program Startup

1.1 Hardware/Software Operation Specifications and Program Execution

1.1.1 Instruction for Apple IIe and IIc microcomputers

1. Insert ProDOS Based system disk in Drive #1

2. To "boot" disk:

   A) Turn the computer power ON and the monitor screen on, or

   B) If the power is already ON and/or if you want to initiate another run, type:

   PR#6

   System will reboot while the power remains on.

3. The ProDOS User's Disk **prompt** will appear on the screen:

   A) Make sure the Caps Lock key is down.

   B) Type B to obtain the Applesoft BASIC programming mode.

4. The prompt] and a blinking cursor will appear in the lower left-hand corner of the screen. Now type:

   PR#3

   The screen will clear, and the 80-column prompt and a non-blinking cursor will appear in the upper left-hand corner of the screen.

5. The program FINMAN consists of over 30 discrete modules. To see the modular contents of the disk type:

   CATALOG

6. To begin execution of the program type:

   RUN FINMAN

1.1.2 Instruction for the IBM PC

1. Insert the IBM Personal Computer Disk Operating System (DOS) in Drive A.

2. To boot disk, turn power ON and monitor screen ON.

   From this point the machine will take about 30 seconds to a minute to warm up and load the system disk. You will hear a beep , followed by a whirring of the disk drive.

3. The IBM Personal Computer DOS - Version 2.10 **prompt** will appear on the screen, followed by the A drive **prompt.**

   A) Make sure the Caps Lock key is down.

   B) Type: **BASICA,** to obtain the Microsoft Advanced version of BASIC, the **prompt READY** will appear.

4. Replace the system disk with the IBM version of FINMAN in Drive A.

5. The program FINMAN consists of over 30 discrete modules. To see the modular contents of the disk type:

   FILES

6. To begin execution of the program FINMAN type:

   RUN "FINMAN

The **FINMAN** simulation program was designed menu driven to assist the user. The following narratives explain the management structure setup and the decisions option sequence. For detailed program description and further questions the reader should refer to the **FINMAN** Model Description and Operations Manual.*

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*FINMAN Model Description and Operations Manual (127 pages) is available as Technical Paper 47-A (Appendix), at a cost of $8.00. Checks should be made payable to the **University of Florida.** Mail to Florida Sea Grant Extension Program, GO22 McCarty Hall, University of Florida, Gainesville, FL 32611.

Section II: Option Selections for Management Scenario

To initialize the constraints placed on your abilities and management authority within a particular fishery system, you will be shown a series of options screens so that an information base can be generated. The information base guides basic decision processes regarding management measures and institutional budget allocations.

1.2 Management Structure Settings

The program initializes with the **FINMAN** Version 1.0 title screen. All subsequent screens are management setting designed with prompts.

First Prompt: Management System Type screen

1.2.1 Management System Type

Option allows you to choose among 3 types of fishery management system structures. These management system types are ordered in ascending levels of difficulty for achieving optimum fishery management policy.

1.2.1.1 Autocratic

Decisions by management are 100% implemented. Decisions can be additionally filtered depending upon other budget and policy decisions you make and their relationship to optimum.

1.2.1.2. Commission

You make recommendations on fishery institution decisions. Your policy power is limited to having one vote on a board of seven members.

1.2.1.3. Legislature

You strictly make recommendations. Implementation of your recommendation(s) is based upon the strength of your constituency support.

<u>**Second Prompt:**</u> Scope of Management Authority Over the Stock screen.

1.2.2 Scope of Management Authority Over Stock

Allows you to set the level of your control over the unit stock of interest.

1.2.2.1. 100% Authority

A unilateral fishery management institution. One policy body for the stock management.

1.2.2.2. 67% Authority

The case of bilateral policy on a stock with overlapping distributional boundaries. Unit stock is shared with one other entity; you have complete control over 67% of the unit stock. The remaining 33% control is computed as a stochastic variable at each iteration to determine your overall level of control.

1.2.2.3. 33% Authority

Multilateral policy case. Unit stock is shared with two other management entities; you have total control of only 33% of the unit stock.

Third Prompt: Species Profile screen.

1.2.3 Selection of Species Profiles

A given simulation exercise of FINMAN is characterized by user selection of one of six species-types available for management strategy simulation. The user is referred to Section 4.0 of the Model Description and Operations Manual for complete background information on the species. The following **prompt** will appear:

SELECT SPECIES-TYPE FOR MANAGEMENT STRATEGY SIMULATION

1. Grouper
2. Tuna
3. Anchovy
4. Shrimp
5. Seatrout
6. Snapper

PLEASE MAKE THE SELECTION (1-6):

For the Apple IIe and Apple IIc versions only:

Upon making the species selection the program returns the **prompt,**

PLEASE PLACE THE SPECIES DISK IN DRIVE #1

Take the FINMAN diskette out of Drive #1 and replace it with the SPECIES diskette in Drive #1, then press RETURN. The program returns the prompt — **Searching Out and Loading Requested Data Files** — while writing the necessary simulation variable data to the RAM area of memory. When this process is completed, the program will return the prompt — **Data file for species x completed, Return the finman diskette to drive #1.** Take the SPECIES diskette out of Drive #1 and replace it with the FINMAN diskette in Drive #1, then press RETURN.

For the IBM PC version, selection of the SPECIES profile will forward you to the fourth prompt.

Fourth Prompt: Fishery Exploitation Type

1.2.4 Fishery Exploitation Type

The fishery exploitation type to be managed includes an array of choices ranging from:

1.2.4.1 Commercial (1 Gear Type)

One-gear fishery with constant (i.e., "knife-edged") gear selectivity properties for all ages past t_c.

1.2.4.2 Commercial (2 Gear Types)

Sequential competition (i.e., one segment of the fishery operates on a younger portion of the stock than another).

1.2.4.3 Commercial and Recreational In Sequence

Recreational interests compete with Commercial interests or values.

1.2.4.4 Selection for Targeted Ages by Either Two Fleet Fishery

If one selects either of the two-gear functions (i.e. Fishery Type = 2 or 3), then one can select the degree of gear selectivity overlap for the targeted ages exploited by the two gear types. This choice allows for simulation of the effects of overlapping gear selectivity. Otherwise the default conditions listed in Sections 15.1-15.6 will be applied. Default conditions cause the effect of discrete non-overlapping selection of gears. If the user chooses to set ages of selection then he/she must: (1) enter the **maximum age** to be fished by Fleet 1, which cannot be less than 1 (= time of birth), and then has the gear fishing from ages 1 to this maximum age, and (2) enter the **minimum age** fished by Fleet 2, which cannot exceed t_λ, which then allows Fleet 2 to fish from this minimum age to the oldest age in the stock. Ages of overlap receive summed fishing mortality effects.

Fifth Prompt: Current Fishery Status screen

1.2.5. Current Fishery Status

1.2.5.1 Developing

Fishery where the unit stock is in essentially the virgin state.

1.2.5.2 Fully Exploited

Fishery is roughly at the maximum sustainable yield (MSY) for the selection pattern.

1.2.5.3 Recruitment Overfished

Fishery is well past MSY; the spawning stock has been severely reduced.

1.2.5.4 Unknown

Program generates a prompt which asks the user to enter a integer number of any size. Upon entry of this integer, the program randomly selects one of the three fishery cases mentioned above.

Sixth Prompt: Historical Data Availability screen.

1.2.6. Historical Data Availability

1.2.6.1 Complete

Program provides all data and complete analyses.

1.2.6.2 Sketchy

Program provides catch and effort statistics, economic data, and a production model estimate.

1.2.6.3 Very Sketchy

Program provides a statement of the fishery status.

1.2.6.4 None

No data available.

For the IBM PC version only:

At this point the program requests that you **"Please place the SPECIES diskette in Drive A"**. Take the FINMAN diskette out of Drive A and replace it with the SPECIES diskette, then press any key to continue. The program will then read the necessary variable data from the SPECIES diskette and write it to the RAM area of memory. When this process is completed, the program will return the prompt — **Data file for SPECIES X completed, Return the FINMAN diskette to Drive A.** Take the SPECIES diskette out of Drive A and replace it with the FINMAN diskette in Drive A, then press any key to continue.

For the Apple IIe and Apple IIc:

The program then accesses the RAM area of memory to bring the desired information into active memory. This process takes about 15 seconds for an Apple IIe with a Titan Accelerator peripheral board. During this time you will see the **prompt — Accessing Data File For Input From Internal Drive.** When this is completed the **prompt — Data File Input Is Now Completed** — will appear. After pressing RETURN the program produces the display **prompt — HERE COMES THE CATCH HISTORY**, meanwhile the necessary historical data is being loaded from memory and filtered by an algorithm influenced according to the user's initial choices.

From this point on in the User's Guide the information presented is identical for all computer types utilized. Depending upon the option selections for the management scenario by the user, the program will produce up to two complete time series of historical data for the selected fishery including: (1) a fishery catch and effort record, and (2) a fishery economic history. Both of these time series can be printed if so desired. After this output is completed, and the necessary RETURN's entered, the **prompt --NOW COMPUTING THE**

YIELD ISOPLETHS WITH BEST AVAILABLE INFORMATION will appear. Computation of this feature requires about 1 minute for the IBM PC and Apple IIe mentioned above, and about three minutes for the Apple IIc.

Section III: Decisons Sequence

Program displays a tabular form equilibrium yield per recruit analysis. At the bottom of the table the management settings for the present year are shown; i.e., the estimated t_c and F for the previous year, and the selected adjustments (if any) in t_c and F for the present year. This table can be printed out if so desired.

1.3.0 Management Measures To Be Implemented

The program displays the scope of your management authority over the stock, and begins the management measures sequence. Four major groupings of fishery management measures are available as detailed in the following sections, (1.3.1) effort limits, (1.3.2) size limits, (1.3.3) season limits, and (1.3.4) catch limits and allocations.

1.3.1 Fishing Effort Strategy

Presently the user defines the fishing mortality rate, which is then modified to units of gear effort by the appropriate operation of the catchability coefficient(s). All mortality rates are age-specific and constant across ages in the single gear fishery. You will be shown a **prompt** which indicates your management authority over the stock, the last season's estimate of F, and asks:

"Do you want to change the fishing effort strategy for the present year?"

You must decide whether you would like to alter the fishing effort strategy for the present year of simulation relative to the last season's value. If the decision is **YES**, the input constant value represents potential fishing mortality. If two fleets have been selected for, then the user must decide whether he wants to regulate the fishing effort strategy in the present year for either of the two fleets separately. Last season's estimate of F is shown in both cases. Your choices in the present year (iteration) are: (1) no regulated change in F for both fleets, (2) change in regulated F for Fleet 1 and no change for Fleet 2, (3) no change in F for Fleet 1 and change in regulated F for Fleet 2, and (4) change in regualted F for both fleets. A NO decision means that the last presumed regulated F remains in effect. If the decision is **YES** for either or both Fleet 1 and/or Fleet 2, then a prompt appears asking you to input the value of F recommended for the respective Fleet(s). The input value of F will then be applied against the segment of the age distribution selected for in the initial options sequence.

1.3.2 Size and Age of Capture

The user selects the age at first capture (= age and/or size of 100% vulnerability) to be used by the particular gear-type operating. The age of capture is set as a minimum size available to the fleet(s) as a whole. A **prompt** appears showing the estimated value for t_c in the previous year and asks:

Do you want to regulate the size limit (=age of first capture) strategy for the present year?

You must decide if regulation of size is what you want, and if so, what will be the minimum age of capture. Selection is assigned with "knife-edged" properties such that all fishes less than t_c have an availabiltiy of 0.0 to the fishing process, and all fishes greater than or equal to t_c have an availability of 1.0 to the gear. Your decision then sets the minimum age (size) of vulnerability which then may be altered depending upon the filters operating during the present loop.

1.3.2.1 Review of the Yield Per Recruit Table

At this point the program returns the prompt -- **DO YOU WANT TO REVIEW THE YIELD PER RECRUIT TABLE?** If you want to review the table and /or you intend to alter your management selections for F and/or t_c, then enter **YES**. If **YES** is selected your adjustments to t_c and F in year t will appear in the lower right-hand side of the table, along with the original estimates to t_c and F in year t-1 in the lower left-hand side of the table. A print out of the table is possible if so desired. If you have made further changes to F and/or t_c, the program will then ask if there are any further changes to these parameters desired. If you answer **NO**, then you are advanced to the next section. If the answer is **YES**, then you are then passed back through the decisons sequence for fishing mortality and age of capture to enter any further adjustments, and can continue doing so as long as deemed necessary.

1.3.3 Seasonal Closures

Closed seasons (i.e., specific months of the year) can be selected to achieve specific mortality rates, and are set for the fleet(s) as a whole. The following **prompt** will appear:

Do you want to set season (i.e., months) closures for the present year?

Months are designated by the numerical analogs in the simulation model (i.e., July = 7), and thus the prompts requires a numerical input, e.g.,

Input the starting month of closure = (integer month), and

Input the ending month of closure = (integer month).

Closures are operable from day one of the starting month to day one of the ending month. That is, a closure that runs from March (=3) to June (=6) would run from March 1 to June 1, a total of 3 months. A closure for the entire year would run from January (=1) to January (=13). A closure from December (=12) to December (=12) gives no closure. For every management year t, the program produces a historical time series ordered by effort and has the associated catches up to management year (t-1). A print-out of this stock production information is possible is so desired by the user.

1.3.4 Catch Limits and Allocations

Catch quotas, by individual fleets, can be instituted in order to adjust the age-specific instantaneous fishing mortality rates upwards or downwards to achieve yields or catch rates within a particular tolerance. The following prompts appear showing the catch for fleet x last year (t-1) was y units of weight, and asks:

Do you want to set a catch quota for the present year?

Positive response to this input means that you must then input the recommended upper limit for catch for the present year t. The tolerance for the catch quota set by default is 0.5% over the recommended upper limit for catch in the present year of simulation. The type of catch quota available to the user is dependent upon the selection of the fishery type.

1.3.4.1. Overall Catch Limit (Fishery Type 1)

Catch quota for the single gear-type fishery. The user sets the catch limit for the single fleet in weight, which is entered in terms of the units of W_∞ (i.e., ultimate weight from the von Bertalanffy formulation).

1.3.4.2. Catch Limit Subdivided by Fleets (Fishery Type 2)

Catch quota sequence for the two commercial gear-types fishery. The catch limits can be set for either or both fleets in the same year, the program will solve the exact solution of the catch equation, even when the gears have overlapping selective properties. Quotas for both fleets are set in weight, in units of W_∞ (found in Section 13.0 of the Model Description and Operations Manual) allowable for the respective fleets. A 0.5% tolerance at solution is considered acceptable.

1.3.4.3. Boat Quotas and/or Bag Limits (Fishery Type 3)

Sequence of catch restrictions for commercial and recreational fleets operating jointly. Catch limits for the commercial fleet(s) are set in terms of weight of the catch, while catch limits for the recreational fleet are set in terms of maximum number of fish per angler allowable (i.e., bag limit). If the recommended bag limit is not exceeded on the first iteration, then the program provides a solution to the catch equation; however, if the bag limit is exceeded by virtue of the present level of fishing effort, the program minimizes the catch equation within the specified constraints to achieve the recommended number of fish per angler for the entire recreational segment.

1.4.0 Overall Budget Allocations Among Enforcement, Research and Influence with Constituents

You have a total resource management budget of one million dollars for the first year of management simulation. This budget can increase or decrease in subsequent years based on the level of constituency satisfaction. Each simulation year the general budget must be distributed as allocations among the following three (3) agencies. After the initial year of simulation you will be asked if you would like to retain your decisions in year t-1, showing the allocations. If this is the choice, then the decision will be implemented in present year of simulation.

1.4.1 Assessment and Monitoring

Sets the overall budget available to the five (5) component research and monitoring groups, descriptions of which can be found in Section 11.4.1 and 11.4.2 of the FINMAN Model Description and Operations Manual.

1.4.2 Enforcement

Generates the dollars for the necessary police action to maintain imposed regulations within their recommended levels.

1.4.3 Development

Allows the development of the fishery from an economic and effort prespective, and also feeds into the constituency function.

The dollar amounts allocated to each of the above agencies dictates the level of accuracy and precision observed in the external output, the degree of compliance with your recommended management measures, the rate of fishery development, and the level of constituency satisfaction. After responding to the general budget prompts with allocations you will be shown a screen with a summary of your decisions, which asks **"Is this the allocation scheme that you want?"** If not, you will be returned to the top of the sequence to reallocate these finds. The amount in the "unallocated" cell is considered fiscal surplus and feeds back in the "Influence with Constituency" function, and proportionalizes potential budget increases for the next program iteration.

1.5 Research Budget Allocations Among Data Collection and Analysis Projects

From the total dollar amount allocated to Assessment and Monitoring activities you must allocate funds to the following component research endeavors. Once again, the dollar amount allocated to each of the following component data collection and research activities dictates the level of accuracy and precision you will observe on the external output, tempered by the initial conditions selections and the internal modifying functions. These areas for allocation are:

1.5.1 Compilation of Basic Fishery Statistics

1.5.2 Catch Analysis

1.5.3 Resource Surveys

1.5.4 Economic Analysis

1.5.5 Environmental Trends and Effects on Fishing Activities

The specific component variables for these five assessment and monitoring allocation areas are detailed completely in Sections 11.4.1 and 11.4.2 in the Model Description and Operations Manual. As before, after the initial year of simulation you will be asked if you would like to retain your decisions made in year t-1, for the present year t, showing the allocations. If your choice is YES, then these allocations will be implemented in year t.

After you have allocated the assessment and monitoring budget, a screen will appear with a summary of your allocations. The amount in the unallocated cell is considered "misallocated" and as such has a negative impact on your "influence" on the constituency.

1.6 Calculation of a Simulation Sequence

Upon completion of all management, budget, and decisions input and bypassing the review sequence, FINMAN will then compute the present year's simulation. The program first passes through a decisions modification loop which adjusts the input values for decisions according to the present budget decisions; this influences the precision and/or accuracy of the output. After adjustments are made, if any, the program then calculates statistics for the present loop. This entire calculation process takes approximately about 20 seconds on an Apple IIe with an accelerator board and the IBM PC, and about 50 seconds on the Apple IIc.

If the user has chosen to implement a catch quota, the above calculations will undoubtedly take longer. Computation time for the catch quota loop is a function of: (1) the complexity of the fishing pattern (i.e. two gears more complex than a single gear), and (2) the segment of the yield curve on which the desired quota value lies. When the desired quota value is attained, the prompt **"Quota within tolerance"** will appear on the screen.

1.7 Destination for FINMAN Output

After completion of the present simulation sequence, a prompt is shown which asks: (1) Do you want the results sent to the printer?, or (2) Do you want the results to be displayed on the monitor screen? To print-out, your machine

must be interfaced with a printer. Otherwise, always enter **NO** when this prompt appears! If the results are to be sent to the printer, then the output contains all the present loops' statistics, plus complete time series information for the years of simulation to date, including the number of years of historical data provided orginally. If the results are displayed on the monitor screen, then the information presented includes all data available from the present loop, plus time series data equipment to the last t years in the fishery. After each loop the program makes an internal decision to boot the manager because of poor preformance or not. If another iteration is to be allowed, then the user must decide whether or not to go on. Successive iterations on the program follow the logic presented in Section III onward. Output for the IBM PC is generated by pressing the **Control** and **Print Screen** keys simultaneously. To discontinue the output simply repeat the procedure.

1.8 User Instruction for a Typical Exercise of FINMAN

It behooves the user to define goals and objectives with regards to the use of the resource, and further delineate the decision environment framework. The user's scope of fishery regulation should be conceived on a broad enough basis to embrace biological, economic and social factors a priori, on equal terms. The work sheet (Table 1.8) is provided so that the user may keep track of decisions and allocations made while working through the FINMAN network during successive "annual" iterations. Sections 5.0 - 5.5 of the User's Manual delineates the standards for program execution, the starting conditions, selection or a species profile, and options for management scenarios. At each successive iteration of FINMAN, managerial, research and budget allocation decisions must be made by the user. The user may want to record the appropriate information onto the flow sheet to document the initial management framework; and with each successive iteration record management measures implemented, and the respective magnitude of those measures. All budgetary enforcement, development, and research and monitoring decisions are carried on the FINMAN's output for user convenience. Initial system options and their analogs are listed below for transcription ease under Section II of the worksheet:

A. **Management System**

1. A = Autocratic
2. C = Commission
3. L = Legislative

B. **Management Authority Scope**

1. 100 = 100 Percent
2. 67 = 67 Percent
3. 33 = 33 Percent

C. **Species-Type Profiles**

1. G = Grouper
2. T = Tuna
3. A = Anchovy
4. SH = Shrimp
5. ST = Seatrout
6. SN = Snapper

D. **Fishery Exploitation Type(s)**

1. 1-C = One Commercial Gear
2. 2-C = Two Commercial Gear
3. R&C = Recreational and Commercial Gears

E. **Current Fishery Status**

1. D = Developing
2. FE = Fully Exploited
3. RO = Recruitment Overfished
4. U = Unknown

F. **Historical Data Availability**

1. C = Complete
2. S = Sketchy
3. VS = Very Sketchy
4. N = None

FINMAN SIMULATION #__________ Table 1.8

I) MANAGEMENT FRAMEWORK SELECTIONS

		TYPE
A.	Management System (A,C,L)	
B.	Management Authority Scope (100,67,33)	
C.	Species-type Profile (G,T,A,SH,ST,SN)	
D.	Fishery Exploitation Type(s) (1-C,2-C,R&C)	
E.	Current Fishery Status (D,FE,RO,U)	
F.	Historical Data Availability (C,S,VS,N)	

II) MANAGEMENT MEASURES IMPLEMENTED (IMPLEMENTED (I): YES = 1, NO = 0; ENTER RECOMMENDED VALUE IF 1)

Year of Simulation	Fishing Effort			Size of Capture		Seasonal Closures			Catch Limits			Utility
	I	1	2	I	TC	I	1	2	I	1	2	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Table 1.8 (cont.)

II) MANAGEMENT MEASURES IMPLEMENTED (continued)

Year of Simulation	Fishing Effort			Size of Capture		Seasonal Closures			Catch Limits			Utility
	I	1	2	I	TC	I	1	2	I	1	2	
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

1.9 Graphing the Output for Management Interpretation

The user can construct graphs for various kinds of plots as derived from (1) information which standard fishery sampling surveys are most likely to have collected, and (2) information that the particular manager in "real" situations may not have, but because of the completeness of the FINMAN simulator is able to view as time dependent variables replete with varying levels of sampling error depending upon previous budgetary allocations. User selection determines the amount and quality of historical fishery data available. For the initial information provided, the user may want to construct graphs for the several kinds of typical plots mentioned below. With each successive iteration of FINMAN the user can update these plots by adding the new data points. From the information supplied by the initial data set, the student can perform several standard analyses to determine and recommend a combination of time of capture (t_c) and fishing mortality (F) that move the fishery towards an "optimum" sustainable yield, and thus satisfy the several competing objectives of fishery management. From this approach the individual is able to develop strategies for regulations, basing decisions on these evaluations and feedback; in this way job security is likely to be as good as possible considering the prevailing conditions. As mentioned previously, the user can update plots with each iteration to improve one's look at the fishery, and then make minor tunings on management strategy in accordance with the trends derived from the plots. Rigorous analysis could be performed every loop, but a more reasonable approach might be every 5-6 years (loops) as the data stream becomes available.

1.9.1 Typical plots

Routinely, some estimates of the total yield in weight of the catch, and the total number of effort units necessary to procure that catch, are made on an annual basis in most industrial fisheries. These estimates, like all sampling statistics, are subject to some amount of sampling error. In artisanal and/or weakly developed fisheries, information such as average length or weight of fish in the catch might be available. The following descriptions will indicate how to set up and scale the ordinate and abscissa (i.e. Y depedent upon X) of the plots for each species type, and will give some indication of the interpretation of the plots. Thus, five typical plots utilized for management evaluation are:

1.9.1.1 Total Yield on Time

Yield, from the inception of the fishery plotted against year of the fishery provides a look at the historical, present and potential trends for yields. In particular, it demonstrates the correlations between the allowable biological catch (ABC) and what is going on with the yield. The ABC should reflect the managerial strategy necessary to reach a maximum sustainable yield, which is in fact the total allowable catch (TAC). This TAC can be most efficiently approached by prudent percentage allocations of the ABC.

1.9.1.2 Total Fishing Effort on Time

Establishes the trends in fishing effort over the years in question.

1.9.1.3 Total Yield on Fishing Mortality

Establishes point of inflection from positive to negative changes in yield with respect to increasing F. If the ($\Delta Y/\Delta F$) ratio is very negative, then the population is running the chance of being driven to industrial extinction.

1.9.1.4 Catch per Unit Effort (CPUE) on Effort

CPUE is considered a proxy for population abundance, and as such gives an indication of the response of population abundance to increases in fishing effort.

1.9.1.4.1 CPUE on ABC

This plot allows examination of delay time between CPUE (t) and ABC (t + 1), and will also indicate the economic recuperation of a fishery.

1.9.1.4.2 CPUE on Time

Demonstrates time trends in population abundance.

1.9.1.5 Average Length and/or Weight on Time

Time changes in average length in the population demonstrates the severity of the changes in average length/weight. Further, the ratio between the average length today and the average length at MSY is important for economic considerations. Primarily, this plot is important for demonstrating relative impacts of management policy.

1.9.2 Accessory Plots

Typically, information for these plots does not become available until a fishery management project has become established, and a sampling survey system for fishery and resource statistics is initiated. Nonetheless, the FINMAN simulator makes this information available and the following plots are recommended.

1.9.2.1 Rate of Profit on Running Costs

There is a certain fishing intensity that will enable the industry to operate with the greatest margin of total profit, and it is necessary to examine the relevance of this to the requirements of optimum fishing.

1.9.2.2 Annual Profit on Fishing Mortality

The fishing intensity giving maximum profit is such that at any higher intensity the increased cost of fishing would outweigh the additional value of the catch, while at any lower intensity the reverse would happen. The maximum total profit offers the simplest objective compromise between maximizing the value of the yeild and minimizing the cost of fishing. From a vessel's or fleet operator's standpoint, it is the profit to each unit that is critical rather than the total profit to the industry as a whole. Only if the number of units remains constant and each receives a constant fraction of the total profit, will the profit to each unit reach a maximum when the total profit is maximal.

1.9.2.3 Spawning Biomass on Time

Spawning biomass is one of the most critical plots from a management standpoint. The decisionmaking process makers are typically looking for the most reasonable ABC; inexorably the ABC is constrained by the level of the spawning biomass. The spawning biomass today predicts or indicates the appropriate ABC next year. This plot is particularly revealing and important for species subject to recruitment overfishing.

1.9.2.4 Recruitment (t) / Spawning Biomass (t-1) on Time

This plot is instructive to show the correlated trends between the spawning biomass at time t and the subsequent recruitment at time t + 1. Points out recruitment overfishing.

1.9.2.5 Percent Recruits in Catch on Time

Plotting the fraction of this year's recruitment in the landings can provide a "red light" to demonstrate a serious condition of growth overfishing in the fishery.

Other plots like (1) Population Biomass on time, and (2) Population Biomass on Fishing Mortality are also convincing factors from a managerial standpoint to show positive or deleterious casual effects of the present and past trends in fishing activity.