

The resulting F-array can be saved as a Species Table that can be accessed directly when creating Scenario Files for the Thompson and Bell routine of FiSAT II.

<i>Remarks</i>	The "length-frequency" file used here must in fact consist of total annual catch-at-length data, in numbers. It may be the average total catch of several years.
<i>Reading</i>	Pauly (1984a)

Predictions

While the previous routines of ASSESS are used to estimate the value of certain parameters, the routines below, which *require* these inputs, are meant to be used for yield and stock predictions, and hence, to identify appropriate management regimes.

Relative Y/R and B/R analysis: Knife-edge selection

The relative yield-per-recruit model based on the Beverton and Holt model of 1966.

<i>Required file</i>	None
<i>Input parameters</i>	L_c/L_∞ ratio (from 0.05 to 0.95) and M/K ratio (from 0.10 to 9.99)

Functions Relative yield-per-recruit (Y'/R) is computed from:

$$Y'/R = E \cdot U^{M/K} \left\{ 1 - \frac{3U}{(1+m)} + \frac{3U^2}{(1+2m)} - \frac{U^3}{(1+3m)} \right\}$$

where

$$U = 1 - (L_c/L_\infty)$$

$$m = (1-E)/(M/K) = (K/Z)$$

$$E = F/Z$$

Relative biomass-per-recruit (B'/R) is estimated from the relationship

$$B'/R = (Y'/R)/F, \text{ while}$$

E_{\max} , $E_{0.1}$ and $E_{0.5}$ are estimated by using the first derivative of this function.

Outputs Plots of Y'/R vs E ($=F/Z$) and of B'/R vs E , from which E_{\max} (exploitation rate which produces maximum yield), $E_{0.1}$ (exploitation rate at which the marginal increase of relative yield-per-recruit is $1/10^{\text{th}}$ of its value at $E=0$) and $E_{0.5}$ (value of E under which the stock has been reduced to 50% of its unexploited biomass) are also estimated.

User interface FiSAT II automatically plots the Y'/R isopleths diagram with M/K set to 1.00. If the user changes the M/K value (red circle in Fig. 4.40), a new isopleths diagram will be plotted automatically.

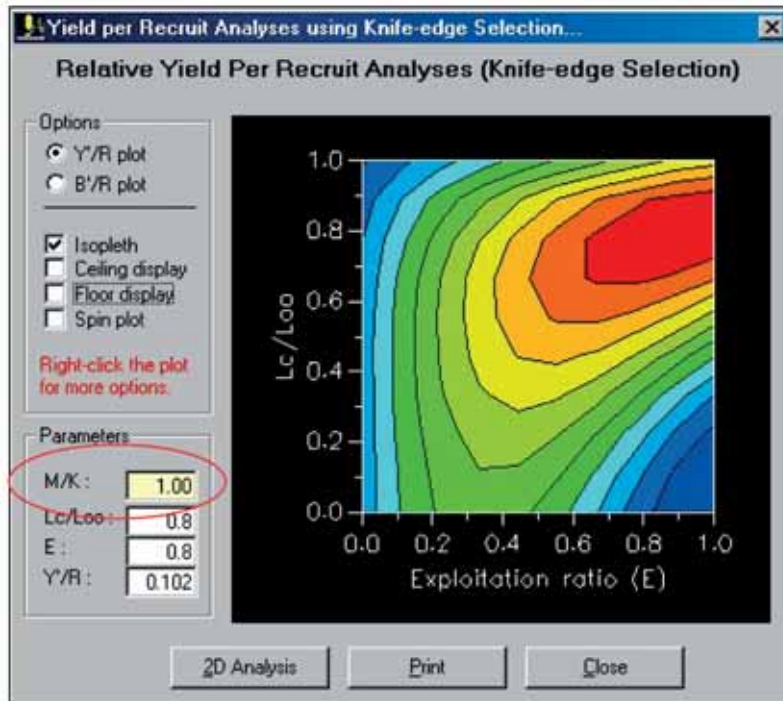


Fig. 4.40. Y'/R isopleths diagram with M/K value set to 1.0 (see figures 4.41 and 4.44 for facsimile presentations of other possible options in the presentation of the results).

The user interface also provides other options for viewing the results. Fig. 4.41 is an example of a 3D presentation of results for B'/R using the same M/K value. Note that the ceiling display, floor display and spin plot options are applicable only when the plot is presented in 3D.

To manually spin the plot in all axes, click both buttons of the mouse and drag the plot to the desired viewing angle.

Whether the results are presented as isopleths or in 3D, moving the mouse over the plot identifies the numeric values of the plot.

A 2D plot of the results (see a similar plot in Fig. 4.44) may also be plotted by clicking on the “2D Analysis” command button.

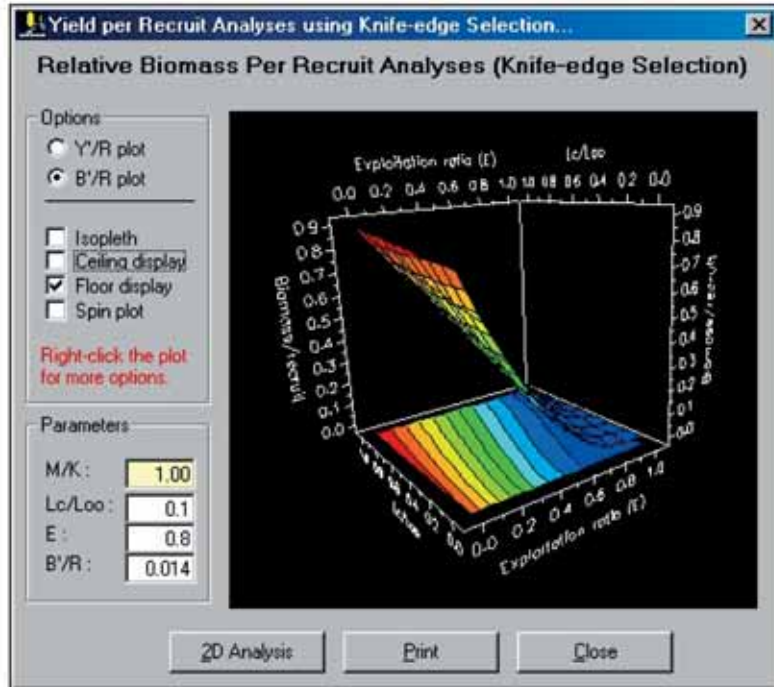


Fig. 4.41. 3D presentation of the B/R plot with a floor display of the results.

Remarks An example of the 2D graph is given in Fig. 4.44.

Readings Beverton and Holt (1966)

Relative Y/R and B/R analysis: Using selection ogive

The relative yield-per-recruit model presented in the following is based on the Beverton and Holt model of 1966, modified by Pauly and Soriano (1986).

Required file Probabilities of capture data

Input parameters L_{∞} , K and M

Functions Relative yield-per-recruit (Y'/R) is computed from

$$Y'/R = \sum P_i \cdot ((Y'/R)_i \cdot G_{i-1}) - ((Y'/R)_{i+1} \cdot G_i)$$

where

$(Y'/R)_i$ refers to the relative yield-per-recruit computed from the lower limit of class i using

$$(Y'/R)_i = E \cdot U^{M/K} \left\{ 1 - \frac{3U}{(1+m)} + \frac{3U^2}{(1+2m)} - \frac{U^3}{(1+3m)} \right\}$$

where U and m are defined as above,

P_i is the probability of capture between L_i and L_{i+1} , while G_i is defined by

$$G_i = \prod r_j$$

where

$$r_j = (1-c_j)^{S_j} / (1-c_{j-1})^{S_j}, \text{ and}$$

$$S_i = (M/K)(E/(1-E))P_i.$$

Here, B'/R is estimated from

$$(B'/R)_i = (1-E) \cdot A/B$$

where

$$A = \left\{ 1 - \frac{3U}{(1+m)} + \frac{3U^2}{(1+2m)} - \frac{U^3}{(1+3m)} \right\}$$

$$B = \left\{ 1 - \frac{3U}{(1+m')} + \frac{3U^2}{(1+2m')} - \frac{U^3}{(1+3m')} \right\}$$

and where $m' = 1/(M/K) = m/(1-E)$.

E_{\max} , $E_{0.1}$ and $E_{0.5}$ are estimated by using the first derivative of the function.

Outputs

Plots of Y'/R vs E ($=F/Z$) and of B'/R vs E , from which the E_{\max} , $E_{0.1}$ and $E_{0.5}$ (as defined above) are also estimated.

In addition to these two-dimensional outputs, the user has the option to plot yield-isopleths diagrams, which can be used to assess the impacts on yields of changes of E (corresponding to the level of exploitation) and of c ($= L_{50}/L_{\infty}$, corresponding to a change of mesh size).

User interface

The user interface of this module is very similar to the presentation of the results using the knife-edge assumption. The display options are the same. However, a selection data (probability file) has to be loaded before any calculations are done by the routine (Fig. 4.42).

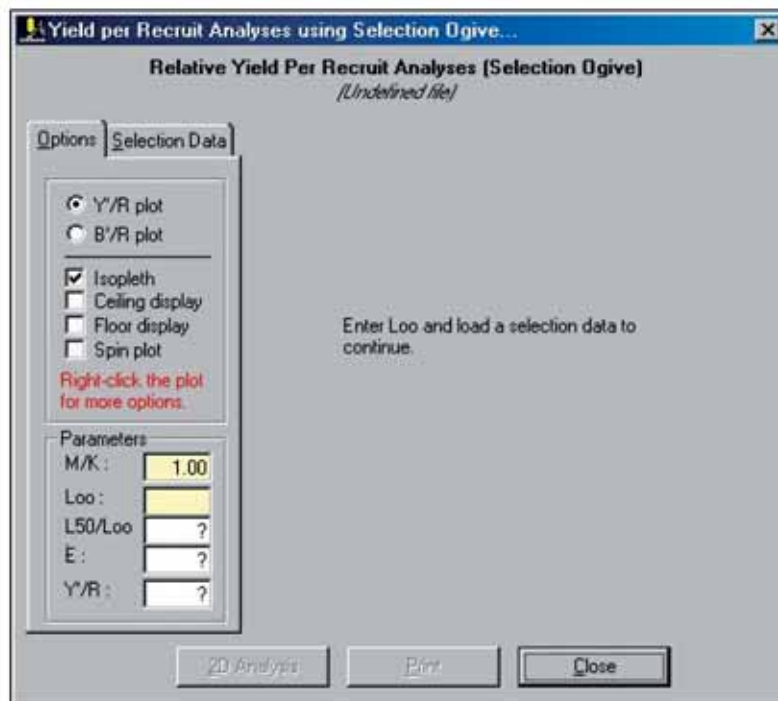


Fig. 4.42. Initial display of FISAT II when the Beverton and Holt Y/R model using selection ogive routine is accessed. A probability of capture file is required by the routine.

The L_{∞} used in previous calculations using the file or associated files are used as defaults. The user may change the value to compute new points of the plot.

As in the previous routine, the results may be plotted in three dimensions (Fig. 4.43) with options to also plot the ceiling and floor displays.

The 2D plot (Fig. 4.44) is the graphical representation of the results for a specific c ($= L_{50}/L_{\infty}$) value. The user has the option to change the value or may slide the scroll bar to examine changes of the c value (simulating a change of the mesh size).

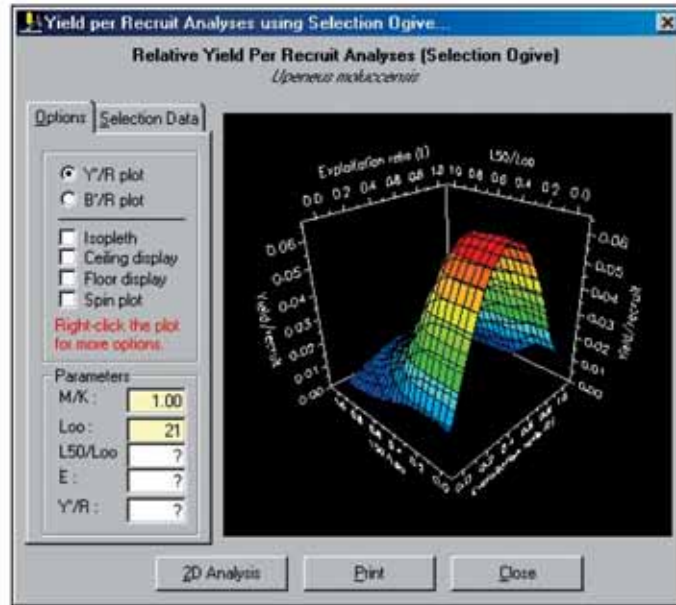


Fig. 4.43. A 3D presentation of the Y/R plot using the selection data.

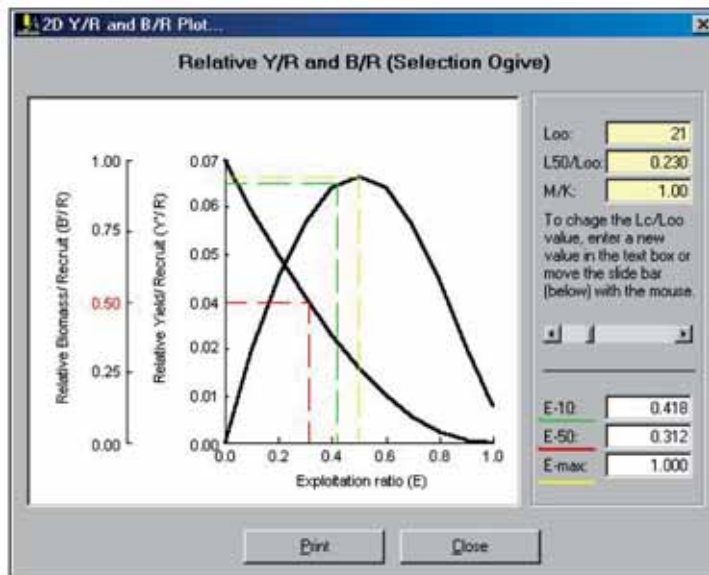


Fig. 4.44. 2D presentation of the results for specific L_{50}/L_{∞} value. The scroll bar may be used to examine changes of the L_{50}/L_{∞} values.

Remarks Using probabilities of capture which abruptly change from zero to 1 at $L_{50}(=L_c)$ enables this model to simulate the behaviour of the same model assuming a knife-edge selection, and thus allows comparison between the two approaches.

Readings Pauly (1984a)
 Pauly and Soriano (1986)
 Beverton and Holt (1966)
 Silvestre *et al.* (1991)

Thompson and Bell yield and stock prediction

This model combines features of Beverton and Holt's Y/R model with those of VPA, which it inverts. The version presented here can be used to analyse either a single species, exploited by a single gear, or several species, exploited by several fleets. Naturally, the data requirements increase with the complexity of the analysis required. It is for this reason that this routine is presented through a series of "options".

Five options are provided: (1) Create, edit, save or print a Species Table, containing population parameters, value by length groups and the F-array associated with one species, (2) Create, edit, save or print a Fleet Table, containing a text description of the fleet, (3) Create, edit, save or print a Relations Table linking the Species and Fleet Tables, data on selection and catch indexes used, to split the F-array if the species is (are) exploited by several fleets, (4) Run a Predict routine, which executes the model and outputs the graphical and numeric results, (5) Help, which contains a short description of the procedure and data requirements.

Required file Scenario File

Input parameters Species Table(s), Fleet Table(s), and relations between the species and the fleets.

Functions The sum of the yields ($Y = \Sigma Y_i$) is computed from

$$Y_i = C_i \cdot \bar{w}_i$$

where the mean body weight

$$\bar{w}_i = \left(\frac{1}{L_{i+1} - L_i} \right) \cdot \left(\frac{a}{b+1} \right) \cdot \left(L_{i+1}^{b+1} \cdot L_i^{-b+1} \right)$$

and where a and b are the coefficients of the length-weight relationship and L_i and L_{i+1} are the lower limit and upper limit of the length class, respectively; also we have

$$C_i = (N_i - N_{i+1}) / (M + F_i)$$

where the predicted population (N_i) is given by

$$N_{i+1} = N_i \cdot \text{EXP}(-(M + F_i) \cdot \Delta t_i), \text{ and}$$

$$\Delta t_i = (1/K) \cdot \ln((L_\infty - L_i) / (L_\infty - L_{i+1}))$$

The biomass is computed from

$$B_i = ((N_i - N_{i+1}) / (M + F_i)) \cdot \Delta t_i \cdot \bar{w}_i$$

and

the value (V_i) is computed by

$$V_i = Y_i \cdot v_i$$

where v_i is the unit value for class i .

In the multi-species/multi-fleet scenario, an F-array has to be generated (based on the ratio of catches of the different gears) before any yield predictions can be made. The yields, computed on a per species and per fleet basis, are then added.

Outputs

Plots of yields, values and biomass estimates for a range of f-factors for each species-fleet combination as well as the cumulative curve. An option is provided to examine the effect of changes of selection parameters.

User interface

The user interface of this routine has three tabs. The first tab (Fig. 4.45) opens the scenario file (*.SCE) that identifies the list of species and fleets included for analysis.

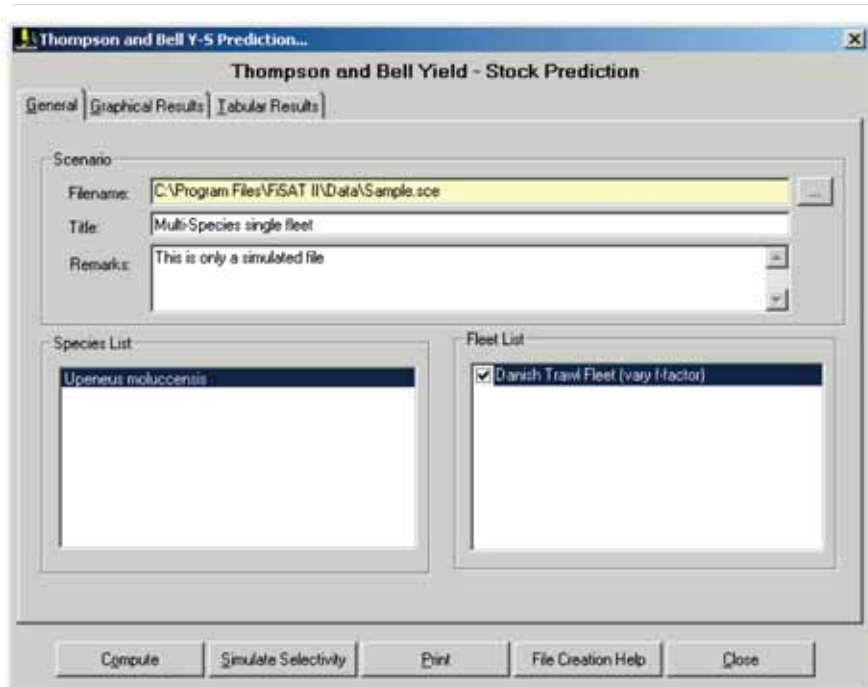


Fig. 4.45. User interface of the Thompson and Bell yield-stock prediction module that identifies the file and options to simulate changes in the f-factor for each fleet included in the scenario.

As an option, the user may also uncheck the box corresponding to the fleet label to simulate a fixed value for the f-factor. In which case, the user will be prompted on what value to use. If the box is checked, FiSAT II will present results with the f-factor of the fleet varying from 0 to 4.

When the “Compute” command button is clicked, the results will be plotted as shown in Fig. 4.46. The numeric equivalent of the result is given on the third tab.

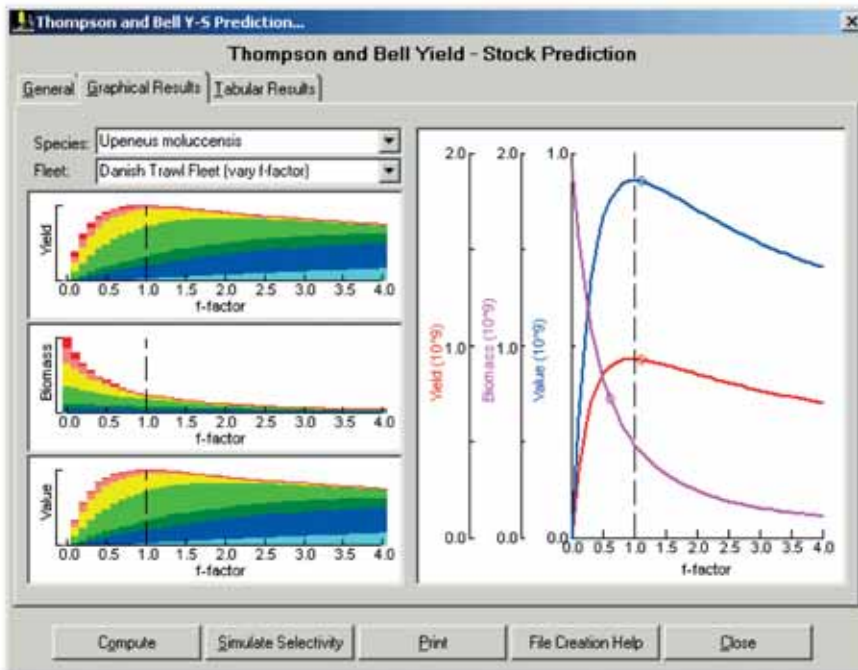


Fig. 4.46. The graphical result of the Thompson and Bell yield-stock prediction module of FiSAT II. The left panel with three graphs shows results specific to a fleet and a species while the right panel shows the cumulative results.

The three graphs in the left panel are the results of the simulation for a specific species as exploited by a fleet. Use the dropdown list in the upper left panel of the interface to view results of other combinations. The range of colours used (red to light blue; the blue band is not visible in Fig. 4.46) represents the age group distribution with red representing the oldest age group.

The right panel is the graphical representation of the cumulative results. The important points of the plotted lines are given by small circles. The small circle in the value and yield curves

represents the maximum point while that for the biomass curve, represents the point at which the biomass has reach 50% of the original biomass.

Remarks

When used here, the output of a length-structured VPA fulfils most of the data requirements (on a per-species basis). Thus, this form of VPA was programmed to automatically generate the appropriate file for transfer to this routine.

Readings

Sparre and Willmann (1993)
Thompson and Bell (1934)