USER'S MANUAL FOR THE EXCEL APPLICATION "TEMAS" or "Evaluation Frame"

By

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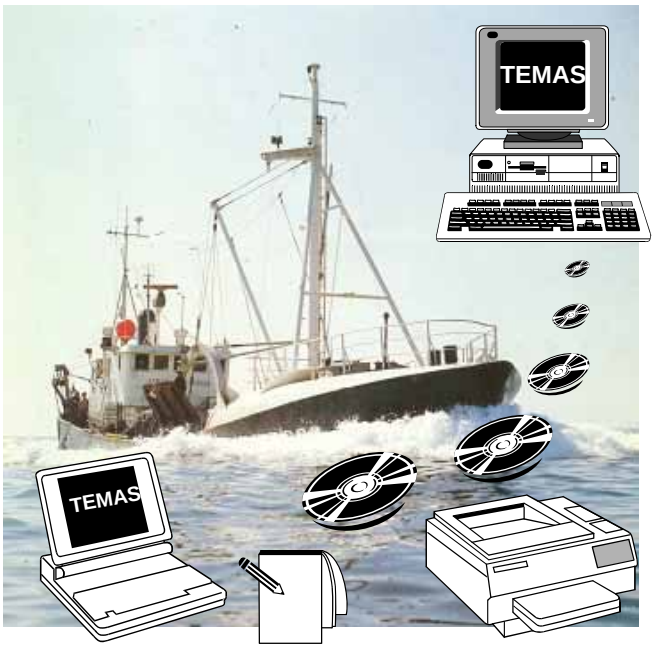

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Abstract.

This DTU-Aqua report contains an user's manual and a reference manual for the EXCEL/Visual Basic implementation of the TEMAS model (Technical measures – Development of evaluation model and application in Danish fisheries) or the Evaluation Frame (EF). The implementation is based on EXCEL/Visual Basic, because of the wide use of this software in fisheries institutes and elsewhere. Microsoft Office is chosen only because of its abundance, not because it is considered suitable for fisheries modelling. The source code is open, and the coding has been prepared with the intension that the users should be able to check it and if needed to modify it. The highest level of user-friendliness has been attempted in the implementation. The report also contains a "demonstration" of the software with a set of hypothetical data.

The present application of TEMAS is for the analysis of the effect of closed seasons and areas in the Baltic, for the recovery of the Baltic cod stocks. These applications are contributions (case studies) to the EU-FP6-Projects EFIMAS (mainly Closed seasons) and PROTECT (mainly Closed areas, Marine Protected Areas, MPAs).

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1. INTRODUCTION

1.1. WHAT IS TEMAS OR THE EVALUATION FRAME?

The software package presented here is named "TEMAS" (Technical Measures) because it was originally developed to assess the effect of mainly technical management measures. A broader broad descriptive name is Evaluation Frame (EF). (The first version of the package for technical management measures was presented in Ulrich *et al*, 2002 and a more comprehensive version is presented in Ulrich *et al*., 2007, while the present manual represents the latest version). The TEMAS software is implemented in EXCEL with extensive use of macros written in Visual Basic. In the context of the EU-FP6 EFIMAS and PROTECT projects it should be noted that closed seasons and MPAs in the terminology of TEMAS is technical management measures. Therefore, this latest version of TEMAS reported here contains components to evaluate closed seasons and MPAs. The case study of this application is the Baltic fisheries with focus on the cod fisheries and the areas and seasons closed to protect the cod spawners.

The overall contents of TEMAS are illustrated by the data-flowchart in Figure 1.1.1. The system compares two management regimes, A and B, by simulating the fisheries system over a series of years for both regimes, and eventually it compares the performance of the two regimes during the time period. Thus the figure illustrates a dynamic system, where the arrows indicate the processes of one single time period (month, quarter or year). The "operating system" (Figure 1.1.1) is a model simulation of the eco-system and the fisheries system. The boxes "Management regime A" and "Management regime B" indicates two models which can simulate the management processes (which may include simulation of ICES WG, setting of TACs, etc.). The operating system generates ("fake" or "hypothetical") input data to the management models, and it predicts the effect of the management regulations on the eco-system and the fisheries. Thus, you may consider TEMAS as a triple, model. Firstly, it executes the simulation of management regime A, using the operational model to produce input to the management simulation. Secondly, it does the same of management regime B, and thirdly it compares the two simulations.

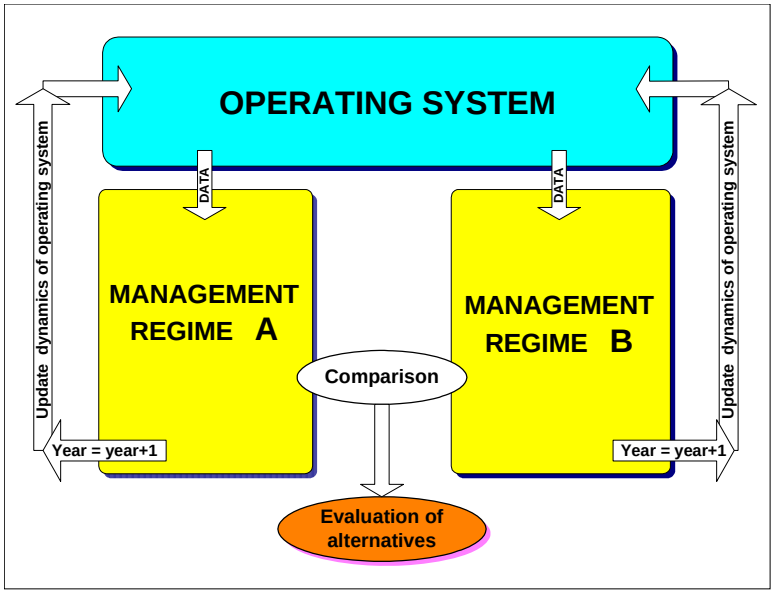


Figure 1.1.1 The principal components of TEMAS for one time period of a dynamic process.

The operating model produces input to the management model for year "y"
The management produces management regulations for year "y+1"
The management regulations for year "y+1" is used as input to the operational model, to produce input to the management model in year y+1, …. Etc.

In the context of evaluation of MPAs and closed seasons, the alternative management regimes could be:

- The current management regime with no closed seasons and MPAs. (The current regime could be Eg. TAC and maximum number of sea days, mesh size regulations etc.)
- The current management regime with closed seasons and MPAs

In the standard implementation of TEMAS, five pairs of alternative management regimes are considered Table 1.1.1). The six pairs or regime comparisons suggested here may not be the most relevant examples one could think of, and should be considered illustrations of the concepts, rather than the only examples for TEMAS.

	Regime Comparisons	Regime A	Regime B
1	Scientific advice / No scientific advice	ACFM Advice (TAC based on harvest control rule)	No ACFM Advice (TAC based on last years landings, and selected CPUE trends)
2	TAC regime with No misreporting / With Misreporting	ACFM Advice (TAC based on harvest control rule) No misreporting	Misreporting (Various assumptions, effect of regulations on misreporting)
3	With / without new Technical manage-ment measures. E.g. closed seasons and/or closed areas (MPA).	TAC (With current, Technical management measures, except for closed areas and seasons)	TAC with NEW Technical management measures. E.g. closed seasons and/or closed areas (MPA).
4	TAC / Effort regimes with ACFM's harvest control rule.	TAC (based on the current HCR of ACFM)	Effort, An alternative regime, management by effort regulations. Both regimes based on the current HCR of ACFM"
5	TAC / Effort regimes with NEW harvest control rule.	TAC (based on the current HCR of ACFM)	Effort, An alternative regime, management by effort regulations. Based on an alternative HCR, (mixed fisheries, - fleet based …)
6	Two alternatives for definition of MPAs and closed seasons	TAC, with first option for closed season and MPA	TAC, with second option for closed season and MPA

Table 1.1.1. The five pairs of regime comparisons of the current TEMAS program.

The operational model is the same in all regime comparisons. The operational model simulates fish stocks, fishing fleets etc,. and from the simulates quantities it simulates input data to the pair of management models.

The TEMAS model can do single deterministic simulations or multiple stochastic simulations. The multiple stochastic simulations executes a number of single deterministic simulations (say 1000 simulations), each of which based on parameters drawn by a random number generator. We shall forget about multiple stochastic simulations for the time being, and concentrate on single deterministic simulations.
In the present context of MPA and closed seasons of Baltic fisheries, focus will be on case study 3, but also the other cases are more or less relevant. Misreporting, for example, is considered a major problem in the Baltic cod fisheries (ICES, 2006).

TEMAS accounts for a number of different types of “errors” in the system. An error means a “deviation from the model”, or “something that can go wrong” .

1. Measurement error. Errors in input data, such as catch at age data, caused by data being estimated from samples, and not from complete enumeration.
2. Estimation error. Errors caused by the method used to estimate parameters, or erroneous assumption about the data.
3. Model misspecification error. Errors caused by incomplete or wrong understandings of the mechanism behind the system dynamics. The assumed Stock/recruitment relationships may be candidates for model misspecifications.
4. Implementation error. The errors caused by regulations not being reacted to as assumed. The fishers may find ways to implement regulations, which do not lead to the achievements of the intensions of regulations.

The software will be able to simulate the effect of errors and bias, by stochastic simulations. Stochastic simulation is simple to repeat the same calculations a large number of times, each time with new parameter-values drawn by a random number generator. The stochastic simulation requires specifications of probability distributions of those parameters which are considered stochastic variables.

The stochastic simulation module simply executes TEMAS a large number of times (say, 1000 times), and each time it draws parameters and initial condition variables by random number generators, executes a simulation over a series of years. At the end it retrieves the results of all 1000 simulations and converts them into, for example, frequency diagrams.

Finally it should be noted that the operational model of TEMAS contains many parameters which cannot be estimated by the data currently available. Therefore a large number of parameters will have be assigned “plausible” values, that is, values not estimated by statistical methods and observations but values which are believed to be “reasonable”. Likewise, TEMAS will contain a number of sub-models which has not been verified by recognized statistical tests. Therefore, the concept of “prediction power” may not be applicable to TEMAS.

We will simply not be in a position to say anything about the prediction power. The output of the model is in the best case of the nature: “It is likely that management regime A gives a better performance than management regime B” with respect of a selected measure of performance. TEMAS should not be used to quantify, for example, the expected spawning stock biomasses.

There is no alternative to this approach, when it comes to test alternative management regimes, which has not been tested earlier. A real statistical experimental design would require that the two alternative management regimes were test on two identical ecosystems, and such an experiment will never become possible in practice.

WHAT IS THE NATURE A FISHERIES EVALUATION FRAME?

Perhaps the best presentation of an evaluation frame is to compare it to a flight-simulator. Figure 1.1.2 shows a flight-simulator from the outside. From the outside you can see that it is not an aeroplane and it cannot fly.

However, stepping inside (Figure 1.1.3) you will get the illusion that you are in the cockpit of an aeroplane. What you see in the windows of the cockpit are produced by a Video film, and what the video film shows depends on how you operate the navigation instruments.
Thus everything is fake and has no relationship to the real world. However, despite its illusion-features, the flight simulator is a very useful tool, because it is almost the same as the real world, and the pilot-trainees achieve experiences in a safer way than in real aeroplanes. They can actually see what happens when they break rules, without making any damage.

Figure 1.1.2. Look at a flight simulator from the outside.

Hitting the virtual control tower of the virtual airport is (kind of) ok in a flight simulator. Nobody get killed or anything damaged in a flight simulator.

The Evaluation Frame is like a flight simulator. The simulated management system, is like the fake cockpit of the flight simulator. The operational model of TEMAS is like the video-film you see on the windows of the flight simulator.

The principles in this comparison are correct, but when it comes to the details you may claim that the operational model cannot mimic the ecosystem to the same degree as the flight simulator can mimic, say, the run-way and the airport.

Figure 1.1.3. Look at a flight simulator from the inside.

The simulation of the cockpit is almost perfect in the flight simulator, and although it is easier for us to simulate the management procedure than the eco-system, it is still a lot more difficult than simulation a cockpit.
The physical flight simulator (Figure 1.1.2) may be considered the parallel to the source code of the Evaluation Frame. If you are a designer of the flight simulator or the evaluation frame, you must master the "bricks" from which the thing is build.

But the features that there is no relationship to the real world, and all input and output is created inside the simulator are the same for Evaluation Frame and Flight Simulator.
The idea with the Evaluation Frame is to give the managers the opportunity to test alternative management strategies, which may or may not lead to a catastrophe (Figure 1.1.4). The philosophy is that "one should never test anything for the first time in the real world".
If you cannot simulate it, you should not implement it in the real world!

Figure 1.1.4. Running the Evaluation Frame

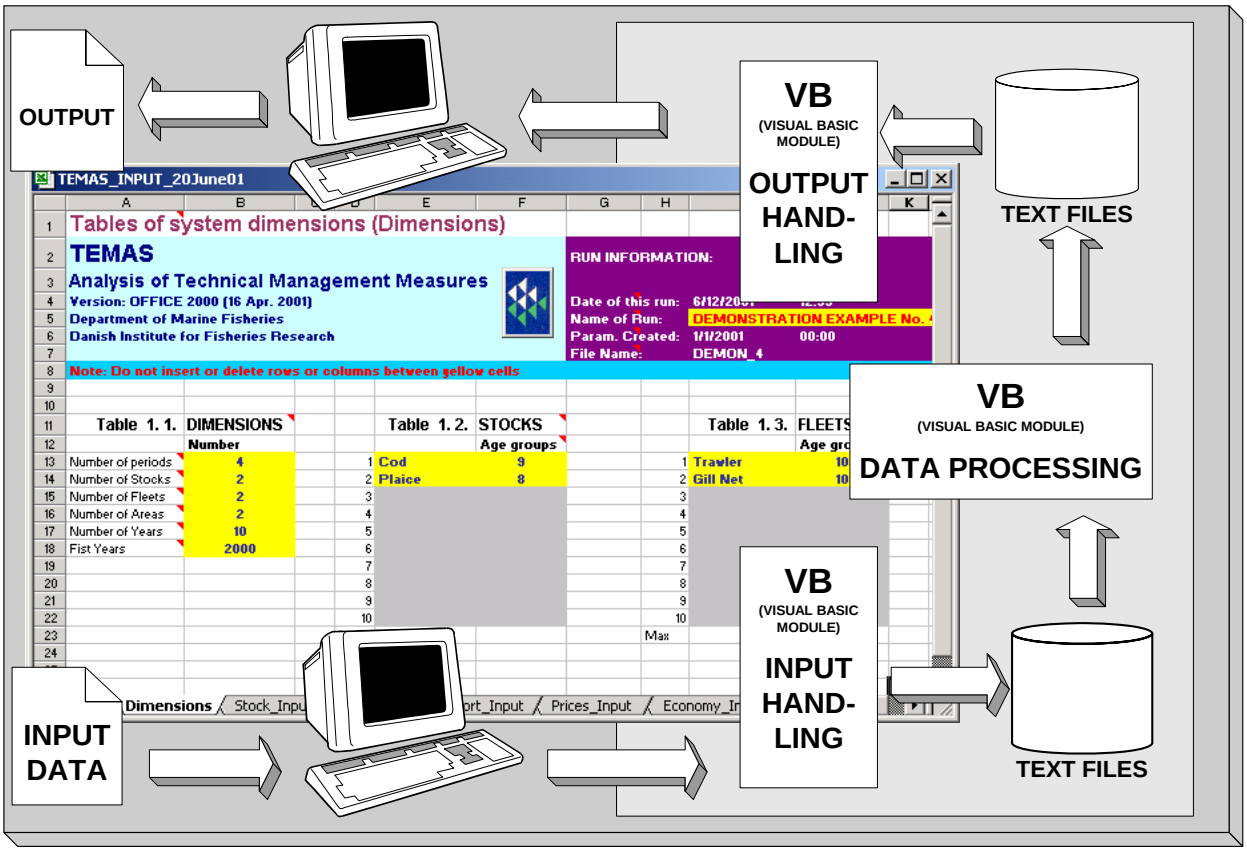


Figure 1.2.1. Flowchart for data and results of the TEMAS software.

1.2. HOW IS TEMAS IMPLEMENTED?

The software implementation of TEMAS is intended to become a public software package. That is, to become of a professional standard, with extensive documentation and user-friendly design.

As DIFRES (like most other fisheries research institutes associated with ICES) use Microsoft Office as their standard package, and most fisheries scientists are familiar with EXCEL, this commercial software was considered suitable as user-interface. However, this choice does not imply any validation or recommendation as to the qualities of MS Office. Once EXCEL is selected, the obvious choice for computer language is VISUAL BASIC (VB), the macro language of EXCEL (and other MS Office components).

The present version of TEMAS is implemented in EXCEL 2003.

Actually, the developer of TEMAS encountered many programming problems in implementing TEMAS. Often the VB-program broke down, for no obvious reason, and when restarted it appeared to be functioning perfect. Thus, the problems appeared not to be caused only by the "programming bugs" of the TEMAS-developers, but also but bugs in the Microsoft Office package.

The present TEMAS implementation uses the EXCEL worksheets for input and output only.

The cells of the worksheets do not contain any formulas, such as "A3 = A1 + A2". All calculations are made by VB-code, in the so-called VB-modules, which you can inspect, by clicking on the icon for the "VB-editor".

Thus TEMAS is 100% open source software. It is an experience that complicated models should not be coded as EXCEL-formulas (although this is possible), because the documentation and maintenance of large spreadsheet application becomes very cumbersome. Therefore, VB modules make all data manipulation in TEMAS. The advantage of using EXCEL is that the user is in a well-known environment and can use all the facilities of EXCEL for entry of input, pre-processing, further processing and presentation of results from TEMAS.

It is furthermore the idea that the implementation TEMAS should be so that model and VB-program can be modified by the users to meet special request from users. Thus, the user should also consider her/himself a developer of TEMAS, and with some knowledge of the EXCEL macro language the user can change the model behind TEMAS. However, once the user starts to modify the source code (the Visual Basic module of TEMAS) he/she should assume the full responsibility for the version of TEMAS he/she has created.

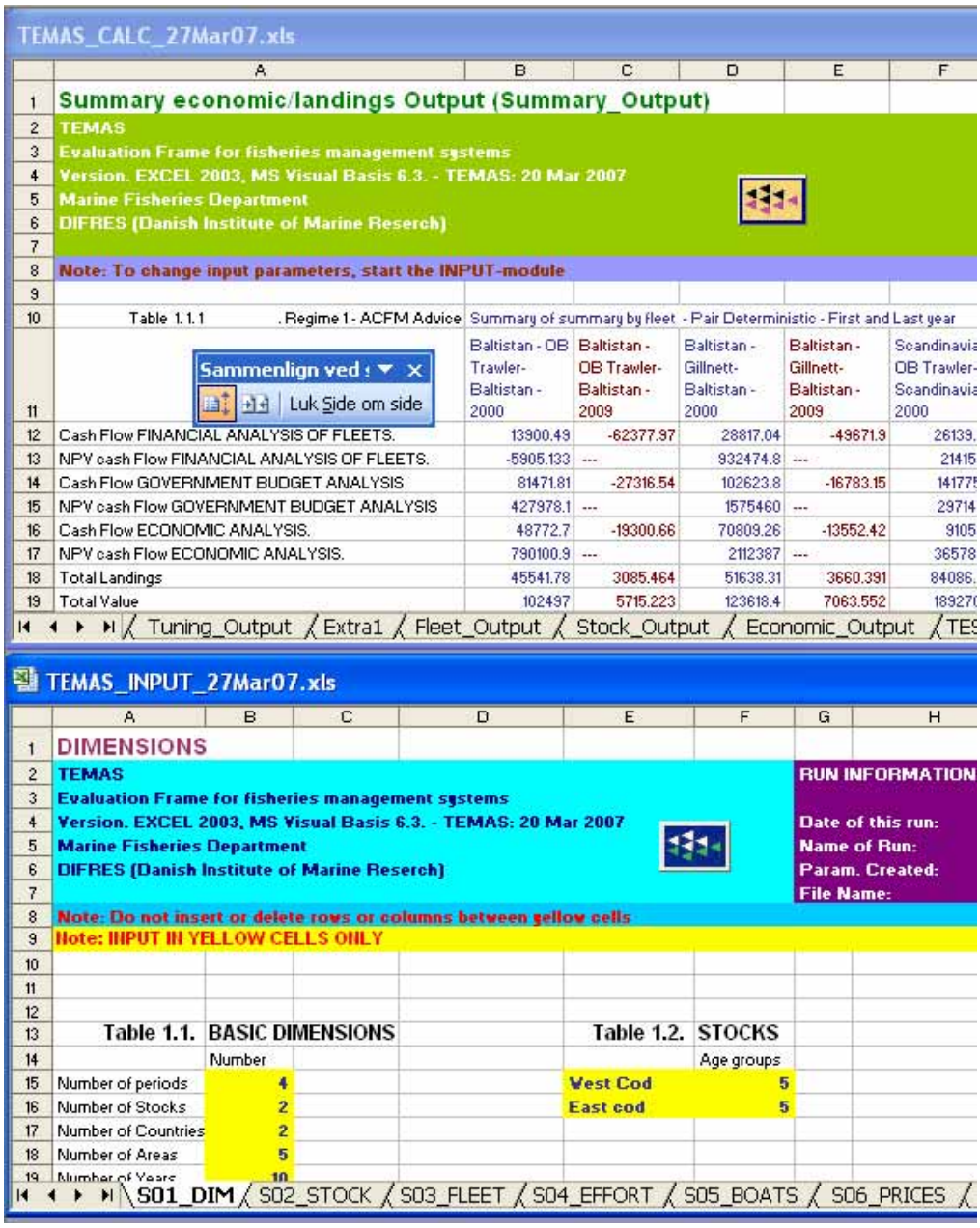


Figure 1.2.1. Screen image of TEMAS_INPUT and TEMAS_CALC run in parallel.

It is the experience, that running TEMAS, requires the participation of one or more people who can program in VISUAL BASIC. Sometimes, the program crashes, because of tiny problems for a VB-programmer. Most often, these problems are associated with reading the data files from the hard disk. An experienced VB-programmer can fix such problems in short time. The Visual Basic system has powerful debugging facilities, but if you do not know how to use it, even tiny VB-problems may prevent you from operating TEMAS.

Thus, operating TEMAS does not formerly require any knowledge of VISUAL BASIC, but practice has shown that some knowledge of VB-programming is very useful, or rather, it is almost a prerequisite for a successful execution of TEMAS.

TEMAS is implemented in the form of 4 independent workbooks:

1) TEMAS_INPUT (entry of input to TEMAS)
2) TEMAS_CALC (Simulations and output from TEMAS)
3) TEMAS_STO_OUT (Stochastic simulation output)
4) TEMAS_TUNING (calibration of parameters)

TEMAS_INPUT must be executed before TEMAS_CALC as will be further explained in Section 4. Most often you will run the two workbooks in parallel (Figure 1.2.1). You will make changes to the input parameters by TEMAS_INPUT and then you will move to TEMAS_CALC to make a simulation with the modified parameters. The module "TEMAS_TUNING" is optional, and may be used to condition the model (the parameters) on a suite of observations.

1.3. INSTALLATION AND START UP OF TEMAS

As TEMAS is implemented in EXCEL 2003 (MS Office 2003), you need MS Office 2003 (or later) on your PC to run TEMAS. You may downgrade TEMAS, to MS Office 97-8, and it appears that the workbooks are still working properly (however, this has not been thoroughly tested).

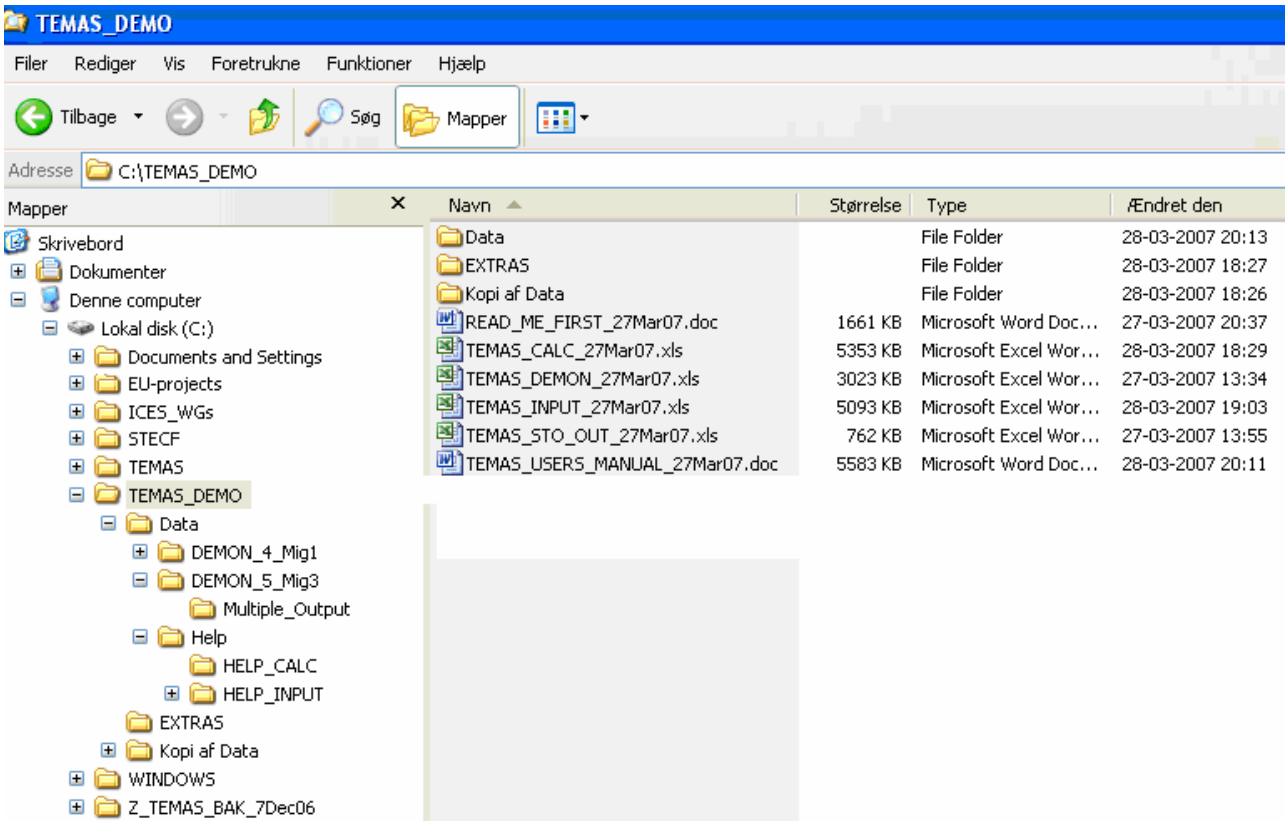


Figure 1.3.1. Location of the directories and subdirectories of TEMAS, as shown by the WINDOWS explorer.

It is difficult to predict the size of the TEMAS package, but for most applications 20 Mb of hard disk should be sufficient. Often you will need less space. As TEMAS consists of three EXCEL workbooks, their size depends on how much is contained in the cells of the worksheets.

The TEMAS package can be delivered in three ZIP-files by email, or you may get the original files (not zipped) on CD or TEMAS may be downloaded from PROTECT of EFIMAS website. There is no installation procedure as such for TEMAS. You just copy the directorates and put them on the C-drives as shown in figure 1.3.1. Note that the location is in the first level: C:\TEMAS\ or C:\TEMAS_DEMO\ in case you install the demonstration version of TEMAS. In the following, we shall use the demonstration version of TEMAS to explain the software.

The location of directories must be as shown in Figure 1.3.1, as TEMAS otherwise will not function. The important thing is the location of the data files as the TEMAS programs, TEMAS_CALC and TEMAS_INPUT must know where data-files are located. Note that the date "27Mar07" has been added to the names of the TEMAS excel files. Actually, you may change the names of the TEMAS EXCEL files as you like. But you should **not** change the names of the standard directories of TEMAS, and these are (See Figure 1.3.1):

C:\TEMAS

C:\TEMAS\DATA\
C:\TEMAS\DATA\Help
C:\TEMAS\DATA\Help\HELP_CALC
C:\TEMAS\DATA\Help\HELP_INPUT

There are two non-standard directories shown in Figure 1.3.1, namely "Copy of Data" and "EXTRAS". You are free to add any new subdirectories to the standard directories of TEMAS. It is recommended always to have a backup copy of both data and EXCEL files.

Actually, it is rather easy to change the name and location of the main directory "C:\TEMAS\" by changing one single line[1] in the declaration modules of the VIRTUAL BASIC, but the other standard directories cannot be changed, relative to the main directory.

TEMAS is ready to run without any further preparation. The programs are ordinary EXCEL workbooks. You start TEMAS by clicking on TEMAS_INPUT (see figure 1.3.1). Actually, you may also start by TEMAS_CALC, if your input data has already been prepared, but the first time you run TEMAS, you should start with clicking on "TEMAS_INPUT".
When activated, the first image you should see is shown on figure 1.3.2. You click on "Enable Macros" (there are no viruses or "worms" in the macros of TEMAS, if they come in the original form from the author) TEMAS
cannot run without the macros.

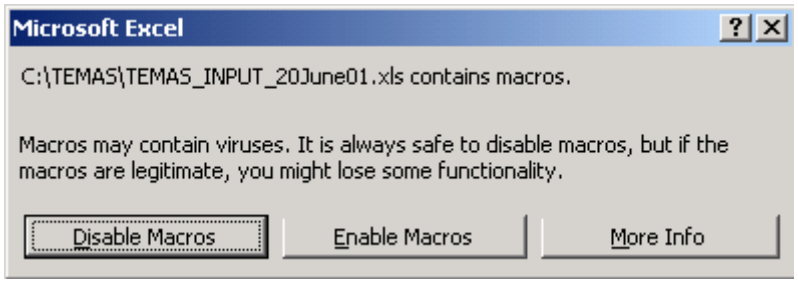


Figure 1.3.2. The first form shown when starting up TEMAS.

The next form appearing on the screen is the opening form of TEMAS as shown in figure 1.3.3

The purpose of the opening form is primarily to inform you that TEMAS has been started up properly. It also gives you some information of the data set currently in use (if any) Clicking on "main menu" takes you to the main menu for data entry (Figure 1.3.4).

Clicking the question-mark-buttons, displays some textbox with additional information about the button next to the question mark.

[1] In "TEMAS_INPUT" module "M01_DECLARATIONS", change the line (at the beginning of the module): "Public Const DirNm As String = "C:\TEMAS\"", and similarly in "TEMAS_CALC".

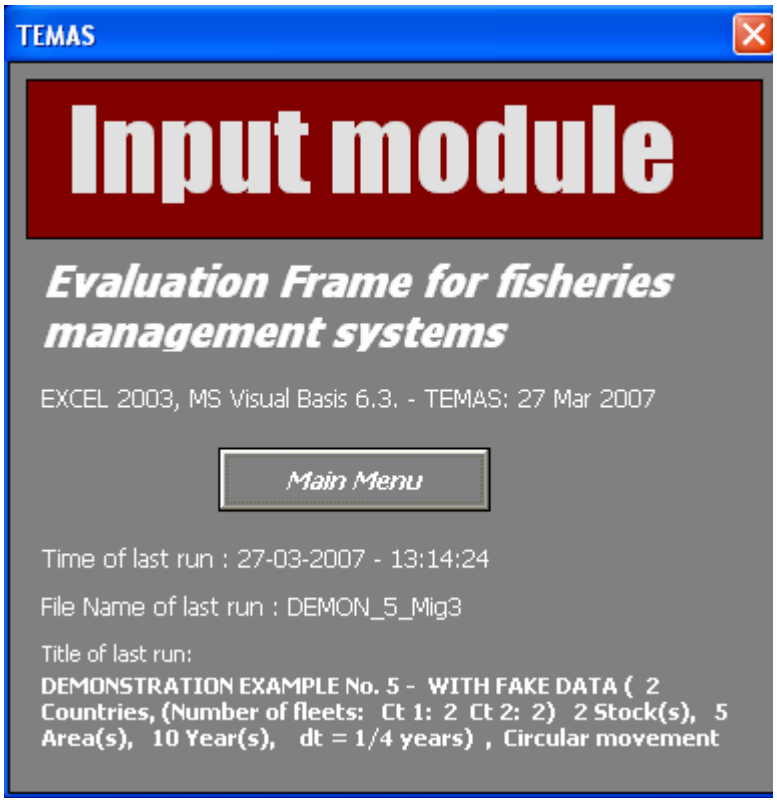


Figure 1.3.4. The opening form of TEMAS_INPUT

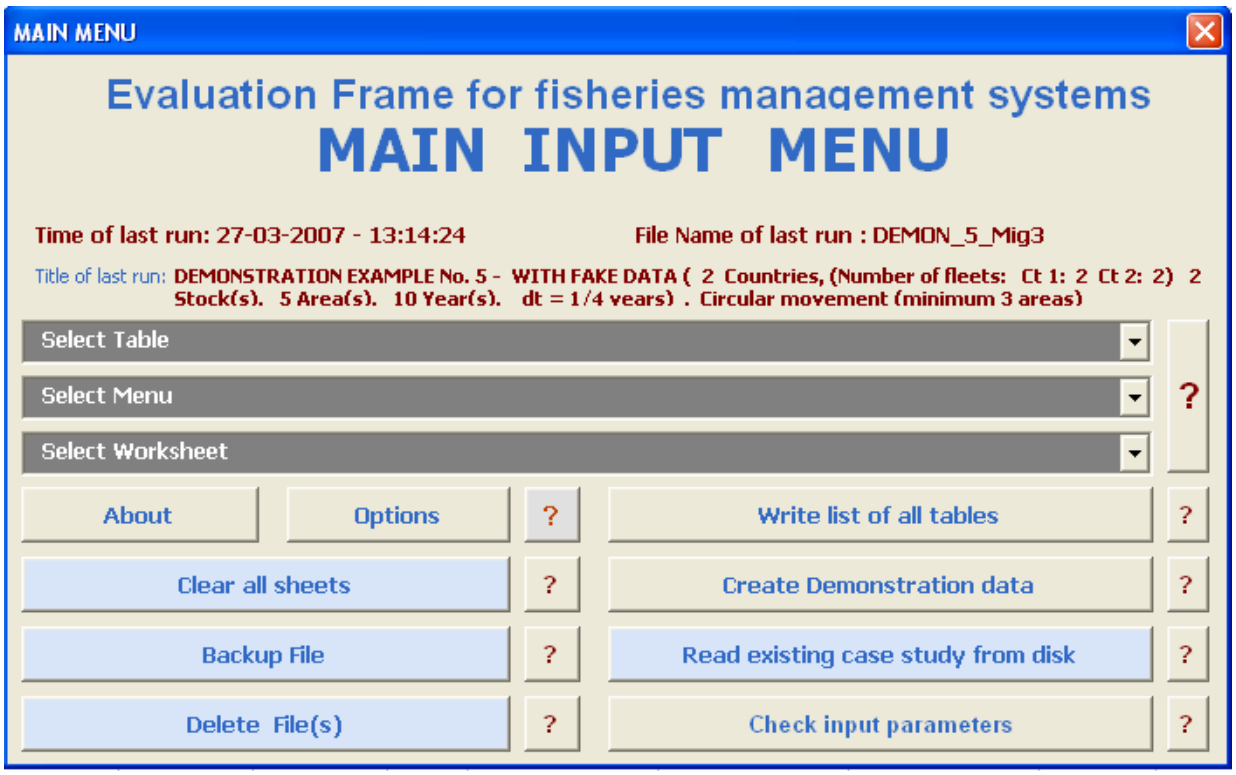


Figure 1.3.4. Main menu of TEMAS_INPUT.).

The "Main-menu" button takes you to the menu shown in Figure 1.3.4. The main purpose of the main menu is to let you easily navigate between the component of the workbook, that is, the table, the worksheets and the menus (the user-forms). This is done by aid of the three pull-down lists (see Figure 1.3.5

When clicking on one of the items in the list, you will be moved to that element (table, worksheet or user-form). The main menu also contains a number of auxiliary functions, the eight buttons under the pull-down lists.

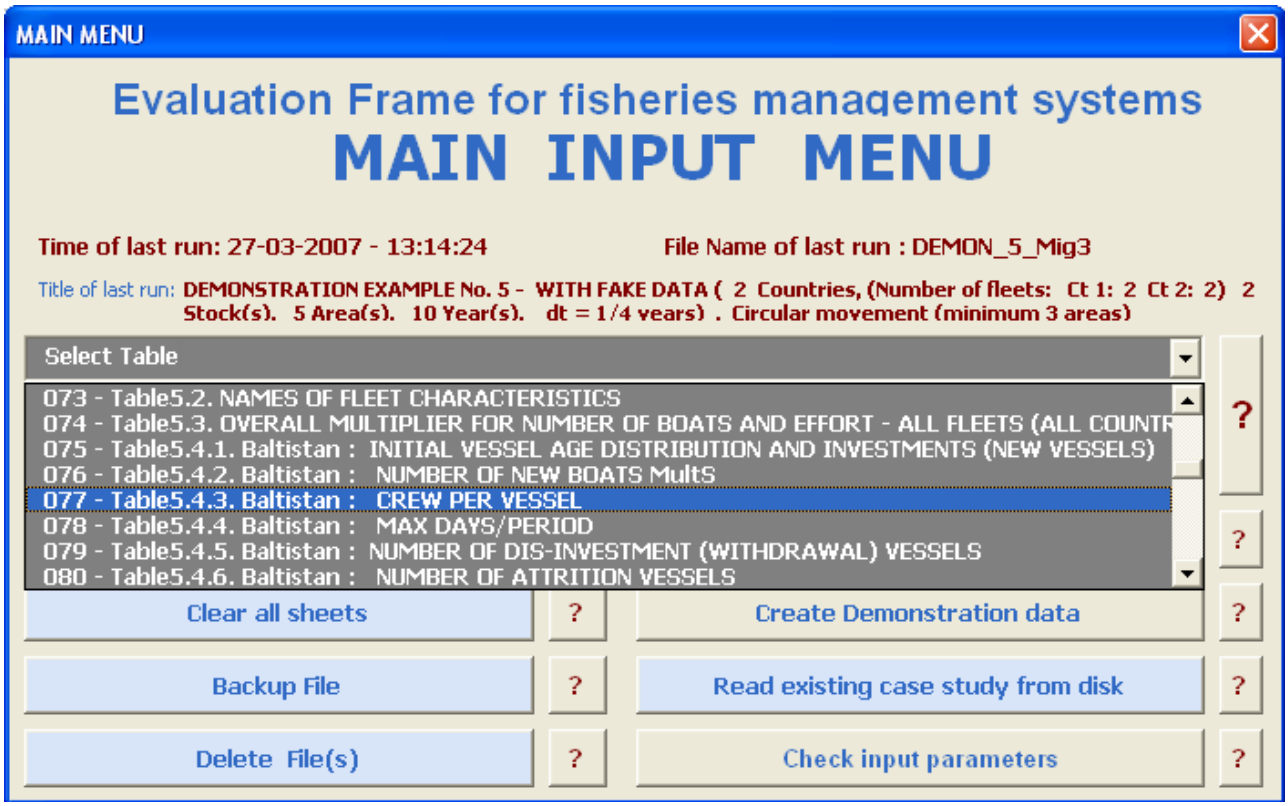


Figure 1.3.5. Pull-down list (for "finding table") of the main menu of TEMAS_INPUT.

The explanations of the other buttons on the main menu will be given in Section 4. Here the main menu is shown just to illustrate how a successful start up of TEMAS should be. To each worksheet of TEMAS is linked a user-form. All these user-forms have the same basic layout. As an example is shown the user-form of work-sheet "Stock_Input" in Figure 1.3.6. Each worksheet has a button with the TEMAS-logo, and clicking on that button activates the user-form. The start up of the TEMAS_CALC workbook follows a similar pattern (see Figure 1.3.7). TEMAS_CALC also has a main menu, which has the same basic features as that of TEMAS_INPUT.

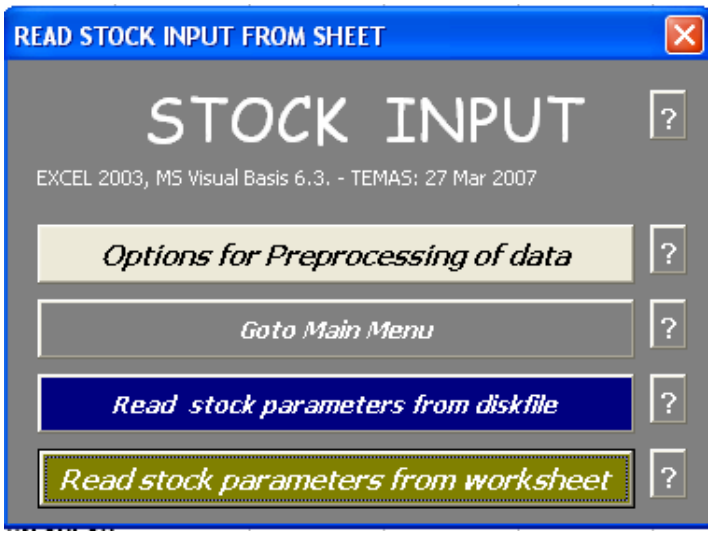
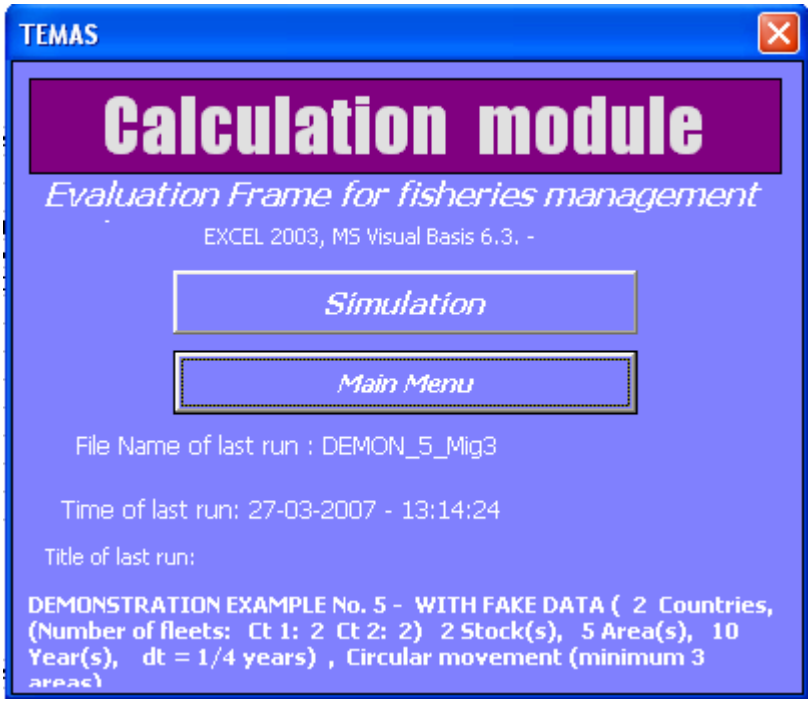


Figure 1.3.6. The menu for stock data entry of TEMAS (workbook TEMAS_INPUT)

If you are a new user of TEMAS and just want a demonstration of if, you don't need to prepare a set of input data. TEMAS_INPUT offers a suite of already made demonstration examples (click on button "Create demonstration example"), as will be explained in Section 2.3.
Thus, within a few minutes you should be able to run TEMAS with the pre-prepared input data sets.

The sizes of the TEMAS workbooks given in Figure 1.3.1 are 2560 Kb and 2850 Kb. These sizes however, changes with the case study. TEMAS has a tendency to grow in size, if you do not from time to time clear the sheets by the button "Clear all sheets" (in the main menu, Figure 1.3.5). This will not delete input data (which are stored in text files on the hard disk). Only output and cells prepared by the user will be deleted. Output can easily be regenerated. If you don't want your additional calculations to be deleted, write then on an additional worksheet. "Clear all sheets" only applies to the standard sheets of TEMAS.



Several of the topics dealt with in this section will be further elaborated in the following sections.

Figure 1.3.7. The opening form of TEMAS_CALC.

When running the program, you may do any calculation or manipulation of the input tables and output tables by aid of the facilities in EXCEL. With the output produced by the calculation workbook, there is no special instruction on things you should not do. You can do anything you like with the output workbooks, except for deleting the sheets or renaming them. There are five general warnings on thing you should not when running the package

WARNING 1: Do NOT delete any of the standard spreadsheets of the workbook, as that action will cause the program to crash.
WARNING 2: Do NOT insert or delete rows or columns between the input cells (cells indicated by colours, predominantly yellow colour). The yellow cell occur only in the data entry workbook.
WARNING 3: Do NOT change the names of the standard worksheets. If you do, the package will not function.
WARNING 4: Do NOT change the location of the standard directories.
WARNING 5: Do NOT delete files or folders in the directory "C:\TEMAS\Data\" by aid of Windows explorer: (where "TEMAS" is a generic name of the main directory of the system, as chosen by the user)

The data files can be deleted from main input menu, and when you want to delete data files, do it with the button "Delete File(s)" in the menu of the main menu.

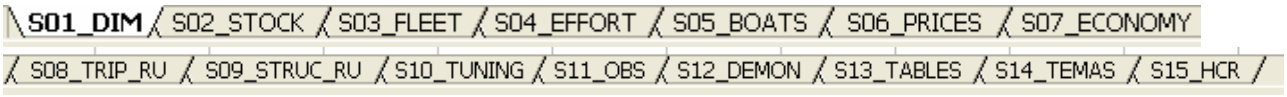
RECOMMENDATION 1: Do always keep a Backup file of your original data set. To be on the safe side you may from time to time make a copy of the entire data subdirectory.
Make also a backup of the entire system, so that in case everything goes wrong you can start up with a fresh version of system and your input data.
Making these backups takes very short time (seconds), whereas you may loose days of work if you loose your original data.

RECOMMENDATION 2: Use the ”Clear All sheets” button from time to time, as the workbook otherwise will grow in size. Without any data in the work sheets, each of the workbooks takes up about 2 Mb, but they may easily grow to 10 Mb after a number of applications.

2. INPUT TO TEMAS

2.1. WORKSHEETS OF THE INPUT-MODULE OF TEMAS

Input to TEMAS is entered by ten EXCEL worksheets, of the TEMAS_INPUT workbook.



There is in addition a worksheet “Table-list” which gives only information (generated by the program) about the contents of the input sheets. Thus, the TEMAS_INPUT workbook consists of 11 spreadsheets.

Input to TEMAS is partitioned into ten main groups (as structured by the worksheets of TEMAS_INPUT):

S01_DIM	Dimensions of case study
S02_STOCK	Stock input (input independent of the fleet structure)
S03_FLEET	Fleet input (which may or may not be fleet structured)
S04_EFFORT	Effort input (optional)
S05_BOATS	Boats input
S06_PRICES	Prices input
S07_ECONOMY	Economic input
S08_ TRIP_RU	Trip rules input (Parameters of the short term behaviour algorithms)
S09_ STRUC_RU	Structural rules input (Parameters of the long term behaviour algorithms)
S10_TUNING	Tuning data, for fish stock assessment
S11_OBS	Observation used for model calibration
S12_DEMON	List of demonstration examples
S13_TABLES	List of all tables in TEMAS_INPUT
S14_TEMAS	Parameters of technical management measures
S15_HCR	Parameters of harvest control rule

The input parameters are organized in tables. All tables of TEMAS_INPUT (and TEMAS_CALC) have exactly the same layout, exemplified by Table 2.1.1. (They are all produced by the same VB subroutine).

The cells used to enter input parameters have yellow background-colour. Thus, you should enter input values only in yellow cells. Tables without yellow cells in the worksheets of TEMAS_INPUT, are tables derived from the input tables, for the information of the user. Such information tables are made for checking purposes.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	FLEET (FLEET/STOCK) STRUCTURED INPUT													
2	TEMAS						RUN INFORMATION:							
3	Evaluation Frame for fisheries management systems													
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007						Date of this run:	26-03-2007	09:04					
5	Marine Fisheries Department						Name of Run:	DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA (2						
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:	12:00:00 AM	00:00					
7							File Name:	DEMON_5_Mig3						
8	Note: Do not insert or delete rows or columns between yellow cells													
9	Note: INPUT IN YELLOW CELLS ONLY													
10														
11	Table 3.1.1.	Baltistan : ABSOLUTE CATCHABILITY - (Species, Area) by (Fleet, V.Size, Country, Rigging)												
12		OB Trawler-Baltistan - Small - <110mm	OB Trawler-Baltistan - Small - >110mm	OB Trawler-Baltistan - Medium - <110mm	OB Trawler-Baltistan - Medium - >110mm	OB Trawler-Baltistan - Large - <110mm	OB Trawler-Baltistan - Large - >110mm	Gillnett-Baltistan - Small - <110mm	Gillnett-Baltistan - Small - >110mm	Gillnett-Baltistan - Medium - <110mm	Gillnett-Baltistan - Medium - >110mm	Gillnett-Baltistan - Large - <110mm	Gillnett-Baltistan - Large - >110mm	Mult
13	West Cod - West Baltic	9.82E-05	0.000106	1.79E-04	0.000192	3.75E-04	0.000403	8.35E-05	8.98E-05	1.52E-04	0.000163	3.19E-04	3.43E-04	1
14	West Cod - East Baltic	9.72E-05	0.000105	0.000177	0.00019	3.71E-04	0.000399	8.26E-05	8.88E-05	1.50E-04	0.000162	3.15E-04	3.39E-04	1
15	West Cod - Not Baltic	9.21E-05	0.000099	0.000167	0.00018	3.52E-04	0.000378	7.83E-05	8.41E-05	1.42E-04	0.000153	2.99E-04	0.000321	1
16	West Cod - Bornholm	1.16E-04	0.000124	2.10E-04	0.000226	4.41E-04	0.000475	9.83E-05	1.06E-04	1.79E-04	0.000192	3.75E-04	4.03E-04	1
17	West Cod - Gotland	1.14E-04	0.000122	2.06E-04	0.000222	4.34E-04	0.000466	9.65E-05	1.04E-04	1.75E-04	0.000189	3.69E-04	3.96E-04	1
18	East cod - West Baltic	1.08E-04	1.16E-04	1.96E-04	0.000211	4.12E-04	4.44E-04	9.18E-05	9.87E-05	1.67E-04	1.80E-04	3.51E-04	3.77E-04	1
19	East cod - East Baltic	1.07E-04	1.15E-04	1.94E-04	0.000209	4.08E-04	0.000439	9.09E-05	9.77E-05	1.65E-04	1.78E-04	3.47E-04	3.73E-04	1
20	East cod - Not Baltic	1.01E-04	0.000109	1.84E-04	0.000198	3.87E-04	0.000416	8.61E-05	9.26E-05	1.57E-04	0.000168	3.29E-04	3.53E-04	1
21	East cod - Bornholm	1.27E-04	1.37E-04	2.31E-04	0.000249	4.86E-04	5.22E-04	1.08E-04	1.16E-04	1.97E-04	2.11E-04	4.13E-04	4.44E-04	1
22	East cod - Gotland	1.25E-04	1.34E-04	2.27E-04	0.000244	4.77E-04	5.13E-04	1.06E-04	1.14E-04	1.93E-04	2.08E-04	4.05E-04	4.36E-04	1
23	Mult	1	1	1	1	1	1	1	1	1	1	1	1	1
24		Catchability(Fl, V.Size, Rig, Ctry, Spec, Y, Per, Area) Absolute Catchability(Fl, V.Size, Rig, Ctry, Spec, Area) * Relative Catchability(Fl, V.												
25														

Table 2.1.1. Example of the standard table layout of TEMAS_INPUT (and TEMAS_CALC).

All tables have got assigned a unique number, with a hierarchical structure, such as "Table 3.4.2.1" for "Work sheet no. 3", "Fleet No. 4", "Stock No, 2" and "Area No. 1"

The first 8 rows of the worksheet is the "heading" for the worksheet (see example in Figure 2.2.2). All worksheets of TEMAS has a similar heading. The first line is the title of the worksheet. Cells A2-A6 contains the program-identification. The most interesting part for you is probably cell A4, which contains the version number of TEMAS. Versions are simply indicated by the data of release.

	A	B	C	D	E	F	G	H	I	J	K
1	DIMENSIONS										
2	TEMAS						RUN INFORMATION:				
3	Evaluation Frame for fisheries management systems										
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007						Date of this run:	22-03-2007	19:31		
5	Marine Fisheries Department						Name of Run:	DEMONSTRATION EXAMPLE No. 5 -			
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:	12:00:00 AM	00:00		
7							File Name:	DEMON_5_Mig3			
8	Note: Do not insert or delete rows or columns between yellow cells										
9	Note: INPUT IN YELLOW CELLS ONLY										
10											

Figure 2.1.2. Example of the worksheet heading (heading for worksheet "Dimensions").

Cells G2-J7 contains information on the current case.
Cell I5 contains the "Name of Run", which can be any text-string on the user choice, which may help her/him identifying the case study. In TEMAS_CALC the "Name of Run" can also be used to lable alternative runs with the model. In this example only a part of the "Name of Run" is shown in Figure 2.1.2.
The file name (Cell I7) is the name of the text-file in subdirectory "Data", which contains the input parameter values. Her the name is "DEMON_5_Mig3", which is a set of fake data prepared by the program for demonstration-purposes only.
The heading gives the date and time the worksheet was created or modified last time (Cell I2), and the date the parameters (under the given File name) were created for the first time (Cell I6). In this case the date of creation is also fake.

2.2. SYSTEM DIMEMSIONS OF TEMAS (S01_DIM)

The "system-specification". inputs are stored in the work sheet "S01_DIM "

By the "dimensions of a case study" in TEMAS is meant (see example in Figure 2.2.1).

1) The number of stocks and the name of each stock
2) The number of age groups of each stock
3) The number of fleets and the name of each fleet
4) The number of vessel age groups of each fleet
5) The number of areas and the name of each area
6) The number of time steps per year, (or the basic time step, dt, of the simulation).
7) The first year and the number of years simulated.

"The basic time step" is the optional division of the year. Examples are "dt = 1.0 ", "dt = 0.25" and "dt = 1/12", which corresponds to using a time step of one year, a time step of a quarter of the year and one month, respectively.

The "first year" is the year (say 1999, 2001 or 2002), which you want it to appear in the output tables. Its value has no significance for the simulation outputs. The "number of years" determines the length of the time series of simulation results. There will be a results for each (Number of years) * (Number of time steps per year).

The cells of the tables are either yellow or grey. The yellow cells are the cells containing input values, whereas the grey cells are empty. The grey cells indicate the maximum dimensions of the current version of TEMAS. As can be seen, the maximum numbers of stocks, fleets and areas all have the same value, namely 10. These limits, however, can be changed by changing a few lines on the Visual Basic code.

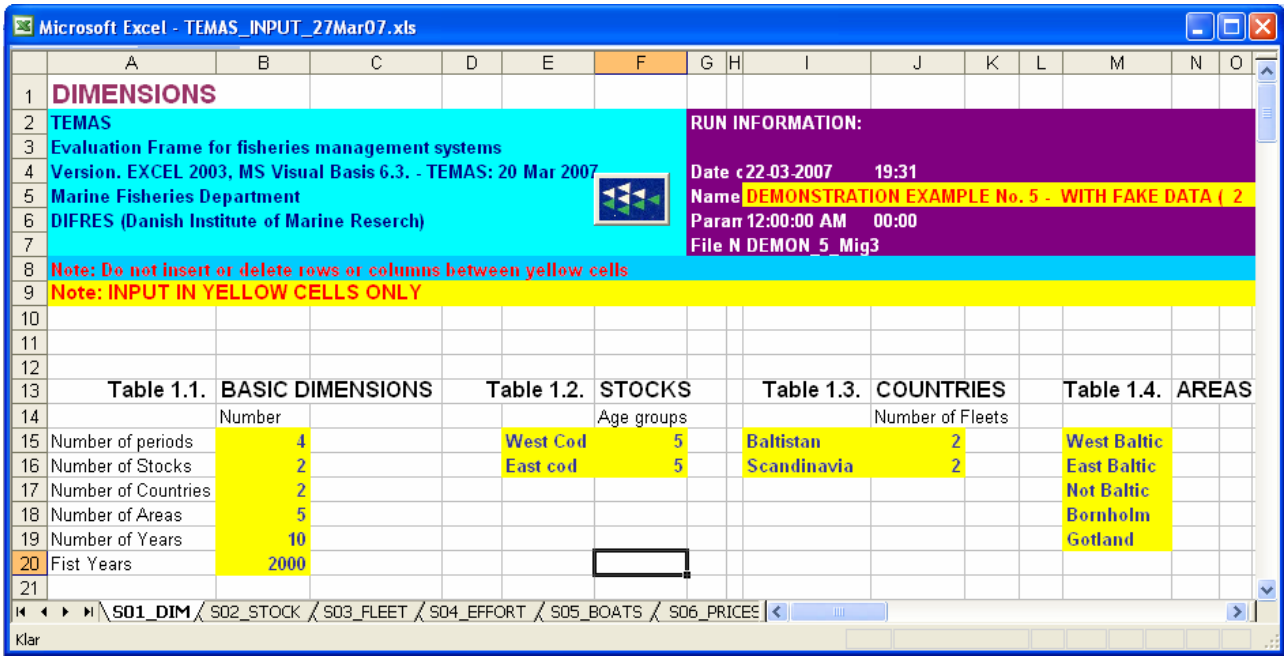


Figure 2.2.1. Example of system dimensions of a case study

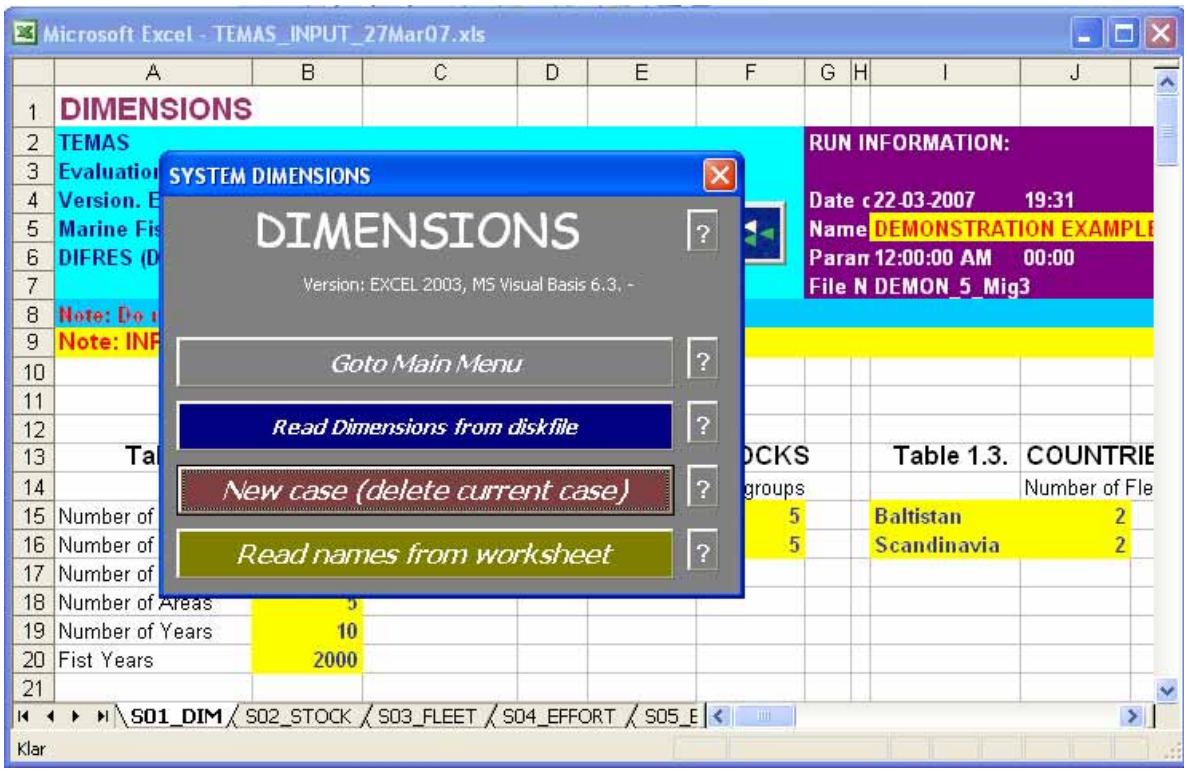


Figure 2.2.3. The menu of the worksheet,

The yellow cells are not easily reproduced in a black and white copy of this report, so in case you cannot spot the yellow cells, you are told that they are B13-18, E13-F14, I13-J14 and M13-M14, altogether 12 cells. You activate the menu of the worksheet by clicking on the button with the idealised fish school (the logo of TEMAS).

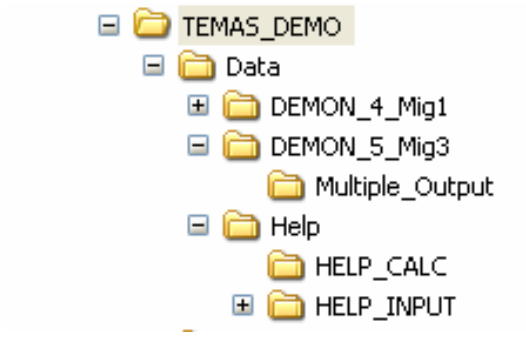
The menu for the "dimensions" worksheet (S01_DIM) is shown in Figure 2.2.3. Once you have activated the user-form, you cannot access the worksheet. The get out of the user-form, click on the "X" in the upper right corner of the user-form
The menus of the worksheets all have the same basic design. They all contain the tree buttons: a blue one: "Read XXXX from disk-file", a yellow one: "Read XXXX from worksheet" and a grey one: "Goto Main Menu", where "XXXX" is the name of the content of the worksheet.

The menu for dimensions, has in addtion a button which are not in other userforms.
"Read dimensions from disk-file" (Figure 2.2.3) will delete the content of the worksheet, read the dimensions from the disk-file and display a new set of Tables. "Read names from worksheet" will do the opposite, it will read the names from the worksheet and store the results in the disk-file. Thus, if you want to change the name of, say, one of the fleets, you overwrite the old fleet name and click on "Read names from worksheet". To change the dimensions, you need to click on "New case". All other worksheets will have only one button to read the content of the worksheet, and that option will read all input values of the worksheet. The dimensions, however, have a different status, compared to other input. The dimensions will change the format of all input tables; so changing the dimensions is a different concept compared to changing the non-dimension parameters, which you can modify without influencing the values of other parameters,

Which units to use for numbers, length and weight are entirely up to the user of TEMAS. It is not essential for the calculations which units are used (cm, mm, gram, kilo, tons, thousands, millions, etc.). It is the users responsibility to secure that the units are matching each other. This applies to input as well to output. As will appear, TEMAS never assigns units to variables or parameters. The only unit, which is fixed, is that of time. Here is used the unit of "one year", as is the tradition in

fish stock assessment. Thus all mortality rates as well as discount rates are given in the unit "per year".

2.3. DEMONSTRATION EXAMPLES OF TEMAS

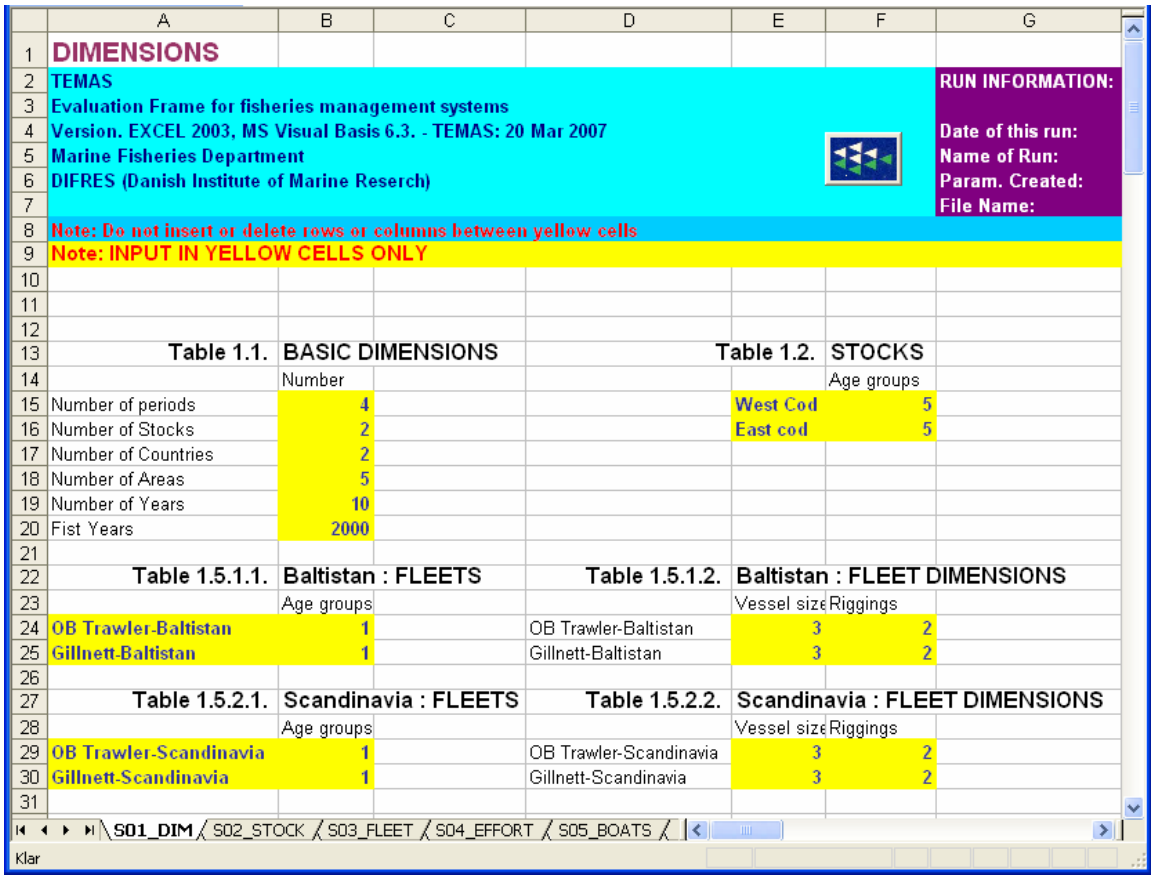


The TEMAS program contains two pre-prepared (fake) demonstration examples:
DEMON_4_Mig1 and DEMON_5_Mig3. Each demonstration data set is stored in sub directory in the "DATA"-directory. DEMON_4_Mig1 is the all-purpose demonstration example, whereas DEMON_5_Mig3 is an example with a number of features that resembles the Baltic cod case study. This manual uses the DEMON_5_Mig3 demonstration example to illustrate the TEMAS software.

	A	B	C	D	E	F	G	H
68								
69		File name:	DEMONSTRATION EXAMPLE No. 4 - WITH FAKE DATA (2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2)					
70	EXAMPLE No. 4	DEMON_4_Mig1	2 Stock(s), 2 Area(s), 10 Year(s), dt = 1/4 years) , No migration (Default)					
71	Number of Countries	2	Max: 6		1: Denmark	2: Norway		
72	Number of Stocks	2	Max: 3		1: Plaice	2: Cod		
73	Number of Areas	2	Max: 5		1: In-shore	2: Off-Shore		
74	Number of Quarters	4	Max: 12					
75	Country 1: Denmark	Number of Fleets	2	Max: 5		1: OB Trawler-Denmark	2: Gillnett-Denmark	
76		Fleet 1: OB Trawler-Denmark	Number of Vessel Ages	13	Max: 15			
77		Fleet 1	Number of Vessel Sizes	2	Max: 6		1: Small	2: Large
78		Fleet 1	Number of Rigs	2	Max: 5		1: Cod-Trawl	2: Lobster-Trawl
79		Fleet 2: Gillnett-Denmark	Number of Vessel Ages	12	Max: 15			
80		Fleet 2	Number of Vessel Sizes	2	Max: 6		1: Small	2: Large
81		Fleet 2	Number of Rigs	2	Max: 5		1: Cod-net	2: Sole-net
82	Country 2: Norway	Number of Fleets	2	Max: 5		1: OB Trawler-Norway	2: Gillnett-Norway	
83		Fleet 1: OB Trawler-Norway	Number of Vessel Ages	12	Max: 15			
84		Fleet 1	Number of Vessel Sizes	2	Max: 6		1: Small	2: Large
85		Fleet 1	Number of Rigs	2	Max: 5		1: Cod-Trawl	2: Lobster-Trawl
86		Fleet 2: Gillnett-Norway	Number of Vessel Ages	11	Max: 15			
87		Fleet 2	Number of Vessel Sizes	2	Max: 6		1: Small	2: Large
88		Fleet 2	Number of Rigs	2	Max: 5		1: Cod-net	2: Sole-net
89								
90								

S09_STRUC_RU / S10_TUNING / S11_OBS / S12_DEMON / S13_TABLES / S14_TEMAS / S1

Figure 2.3.1. Dimensions of Demonstration example No.4.

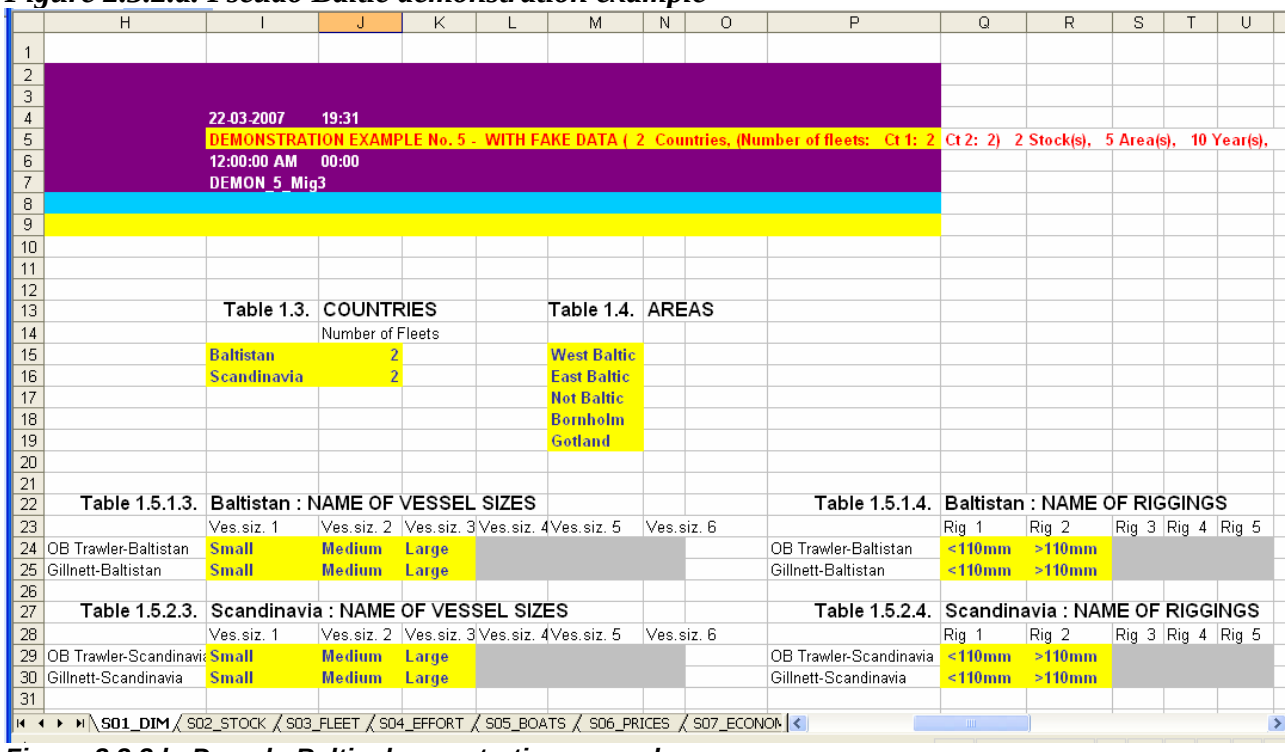


	A	B	C	D	E	F	G
1	DIMENSIONS						
2	TEMAS						RUN INFORMATION:
3	Evaluation Frame for fisheries management systems						
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007						Date of this run:
5	Marine Fisheries Department						Name of Run:
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:
7							File Name:
8	Note: Do not insert or delete rows or columns between yellow cells						
9	Note: INPUT IN YELLOW CELLS ONLY						
10							
11							
12							
13	Table 1.1.	BASIC DIMENSIONS		Table 1.2.	STOCKS		
14		Number				Age groups	
15	Number of periods	4			West Cod	5	
16	Number of Stocks	2			East cod	5	
17	Number of Countries	2					
18	Number of Areas	5					
19	Number of Years	10					
20	Fist Years	2000					
21							
22	Table 1.5.1.1.	Baltistan : FLEETS		Table 1.5.1.2.	Baltistan : FLEET DIMENSIONS		
23		Age groups			Vessel size	Riggings	
24	OB Trawler-Baltistan	1		OB Trawler-Baltistan	3	2	
25	Gillnett-Baltistan	1		Gillnett-Baltistan	3	2	
26							
27	Table 1.5.2.1.	Scandinavia : FLEETS		Table 1.5.2.2.	Scandinavia : FLEET DIMENSIONS		
28		Age groups			Vessel size	Riggings	
29	OB Trawler-Scandinavia	1		OB Trawler-Scandinavia	3	2	
30	Gillnett-Scandinavia	1		Gillnett-Scandinavia	3	2	
31							

S01_DIM / S02_STOCK / S03_FLEET / S04_EFFORT / S05_BOATS /

Klar

Figure 2.3.2.a. Pseudo Baltic demonstration example



	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1														
2														
3														
4		22-03-2007 19:31												
5		DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA (2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) 2 Stock(s), 5 Area(s), 10 Year(s),												
6		12:00:00 AM 00:00												
7		DEMON_5_Mig3												
8														
9														
10														
11														
12														
13		Table 1.3.	COUNTRIES			Table 1.4.	AREAS							
14			Number of Fleets											
15		Baltistan	2			West Baltic								
16		Scandinavia	2			East Baltic								
17						Not Baltic								
18						Bornholm								
19						Gotland								
20														
21														
22	Table 1.5.1.3.	Baltistan : NAME OF VESSEL SIZES							Table 1.5.1.4.	Baltistan : NAME OF RIGGINGS				
23		Ves.siz. 1	Ves.siz. 2	Ves.siz. 3	Ves.siz. 4	Ves.siz. 5	Ves.siz. 6			Rig 1	Rig 2	Rig 3	Rig 4	Rig 5
24	OB Trawler-Baltistan	Small	Medium	Large					OB Trawler-Baltistan	<110mm	>110mm			
25	Gillnett-Baltistan	Small	Medium	Large					Gillnett-Baltistan	<110mm	>110mm			
26														
27	Table 1.5.2.3.	Scandinavia : NAME OF VESSEL SIZES							Table 1.5.2.4.	Scandinavia : NAME OF RIGGINGS				
28		Ves.siz. 1	Ves.siz. 2	Ves.siz. 3	Ves.siz. 4	Ves.siz. 5	Ves.siz. 6			Rig 1	Rig 2	Rig 3	Rig 4	Rig 5
29	OB Trawler-Scandinavia	Small	Medium	Large					OB Trawler-Scandinavia	<110mm	>110mm			
30	Gillnett-Scandinavia	Small	Medium	Large					Gillnett-Scandinavia	<110mm	>110mm			
31														

S01_DIM / S02_STOCK / S03_FLEET / S04_EFFORT / S05_BOATS / S06_PRICES / S07_ECONOM

Figure 2.3.2.b. Pseudo Baltic demonstration example

2.4. STARTING UP A NEW CASE STUDY WITH TEMAS, S01_DIM

To start up a new case study, the first thing to do is to enter the system dimensions (see example in Figure 2.2.1) and then click on “New case (Delete current case)” in the menu (Figure 2.4.1).

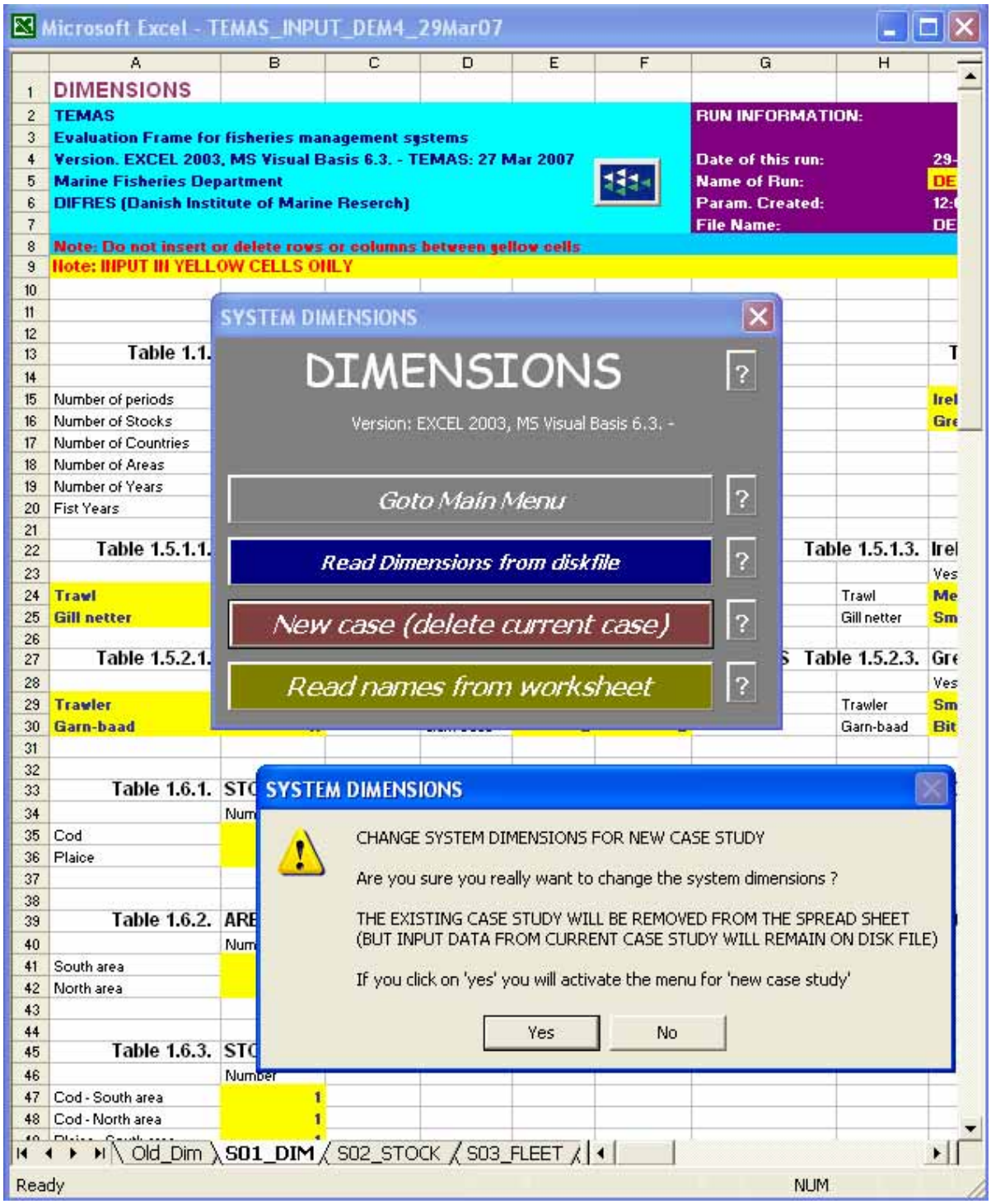


Figure 2.4.1.Starting up a new case study with TEMAS.

Clicking on “Yes” gives you the menu for “New case study” and the “Next Step”-button (Figure 2.4.2). As appears, the procedure for starting up a new case study is organized in steps. What happens in each step, is that TEMAS creates the data-files on the hard disk that will contain the parameters, variables and results. It is important that the steps are executed in the given order, as TEMAS will otherwise not be able organize the data-files. E.g. it must know the number of fleets in each country, before it can add further details to the fleets, such as gear riggings, vessel size classes etc.

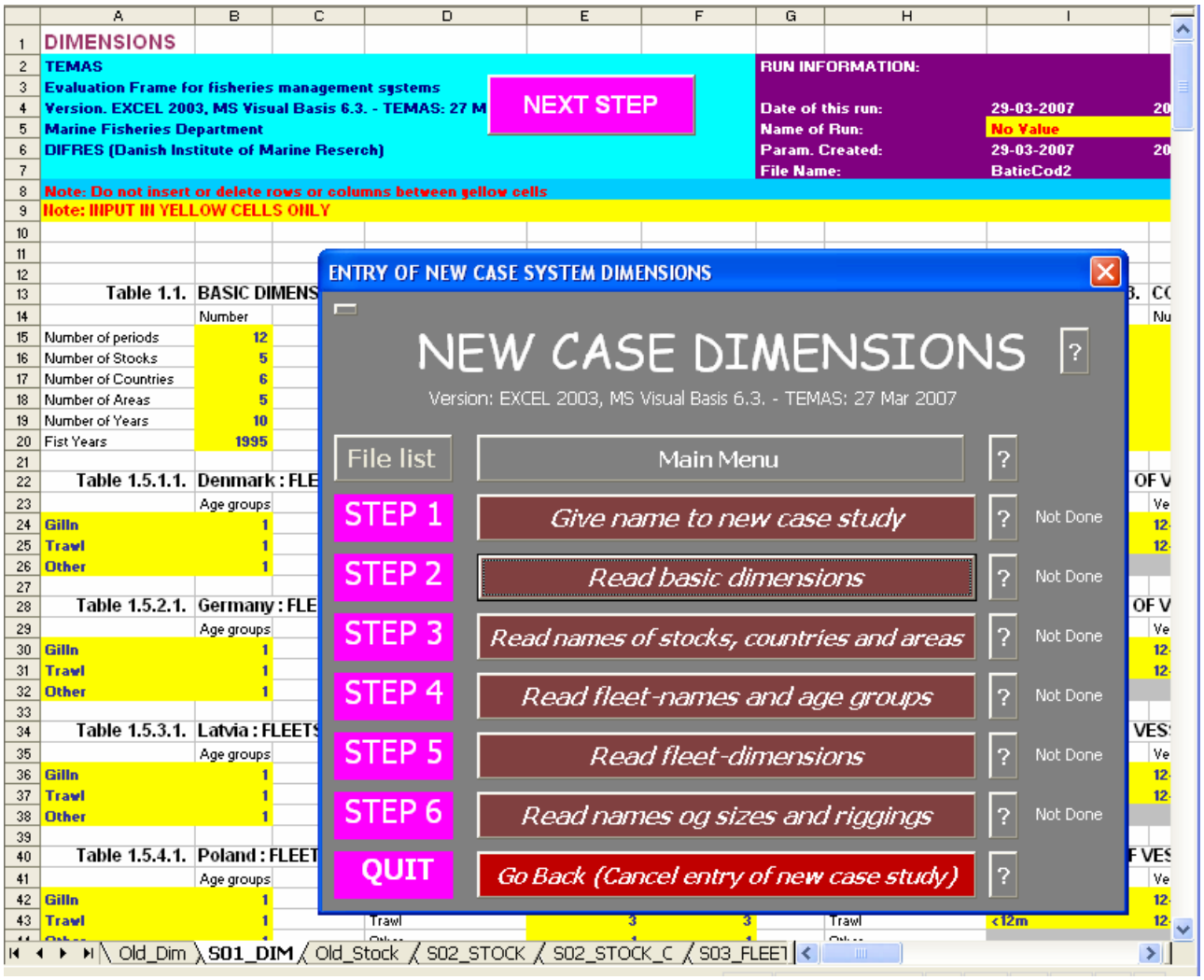
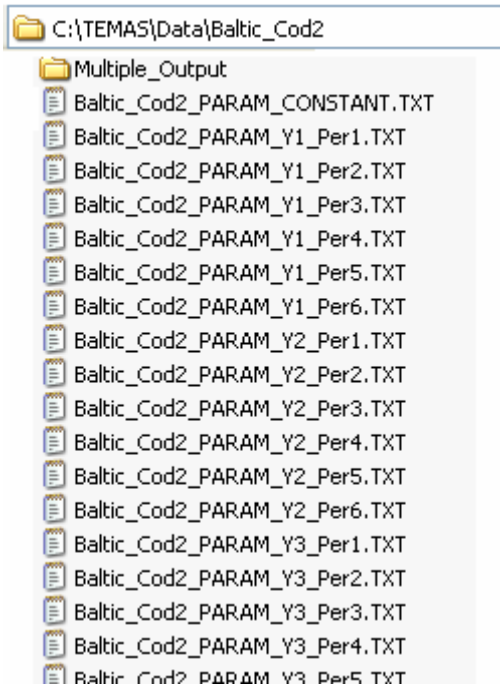


Figure 2.4.2. Menu for Starting up a new case study with TEMAS.



There are 6 steps in the procedure, and the user form will keep track of where you are in the process, as indicated in the right hand side column with "Not Done". As you proceed "Not done" will be replaced by "Done". Clicking on the question mark next to STEP 1: "Give name to new case study" gives an explanation of what a "name" means in the context of TEMAS (Figure 2.4.3), as well as the conventions for names used in TEMAS. It is important to choose names that makes sense and are explanatory, so that at a later state you will be able to remember the particulars about the case study.

Note that the name of the case study will also become is a part of the names of data files and data-directories cerated by TEMAS. If the name "BalticCod2" was given the names given to files would be those shown in the picture to the left. This time series of files contains the set of parameter-files, that all have "BalticCod2" as a part of their name.

These files and their names are created automatically by the TEMAS, and the user should never modify the names.

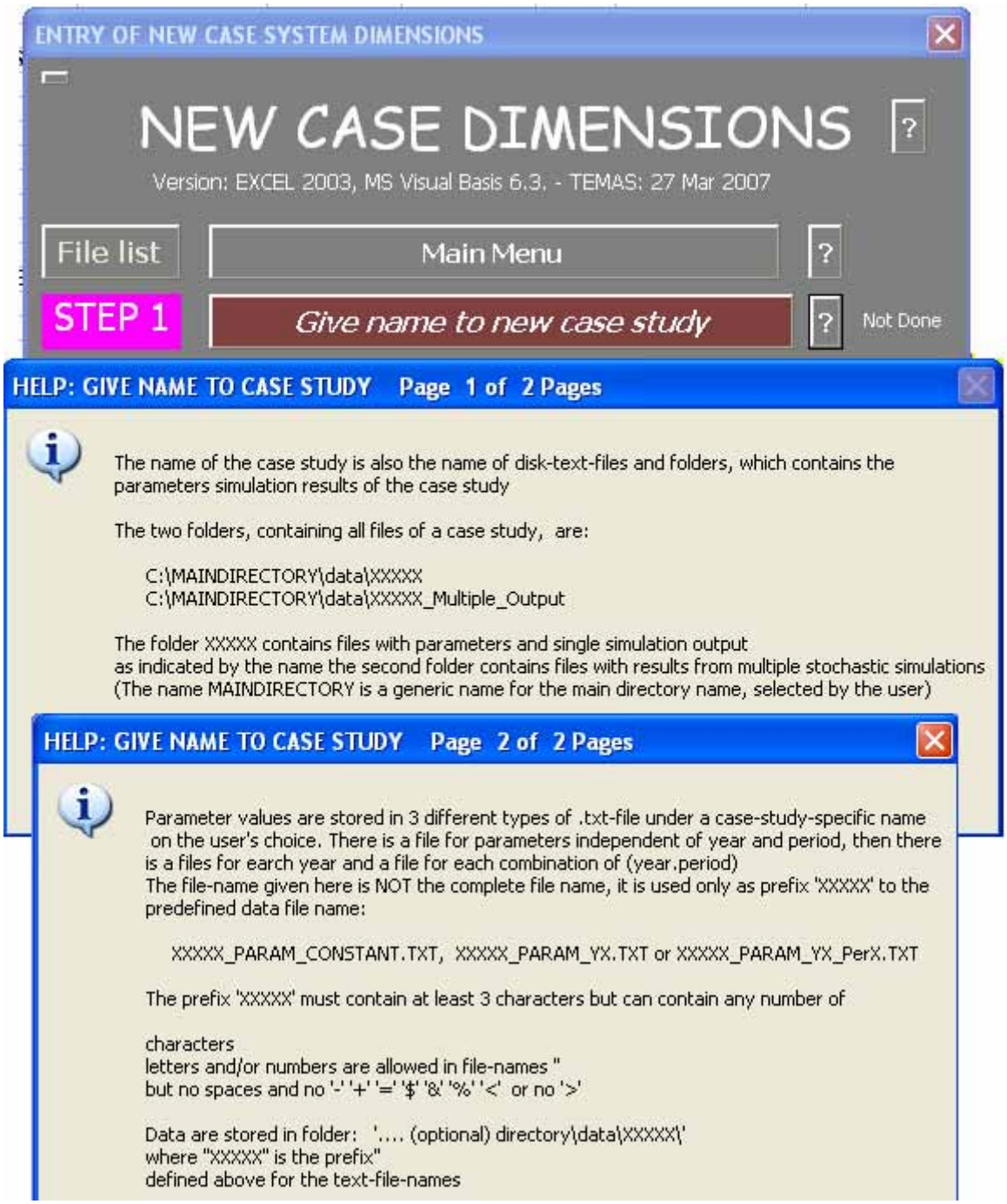


Figure 2.4.3. Name of case study explanation . (Click on the "?"-button). Starting up a new case study with TEMAS. Step 1

Clicking on "Give name to new case study" gives the input form shown in Figure 2.4.4. The name given here is "BalticCod1". "BalticCod" indicates that the TEMAS simulation focuses on the cod fisheris in the Baltic. The meaning of the number "1" is more cryptic, but it might refer to the first simulation in as series of alternative simulations.

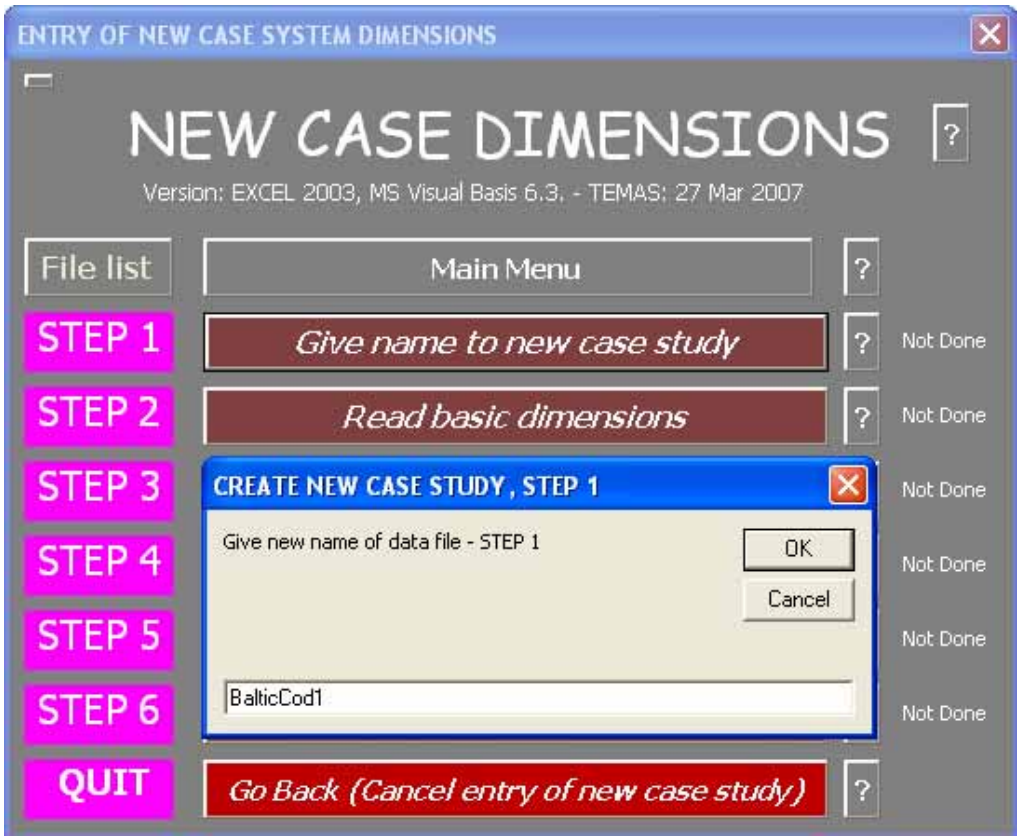


Figure 2.4.4. Giving name to new case study. Starting up a new case study with TEMAS. Step 1

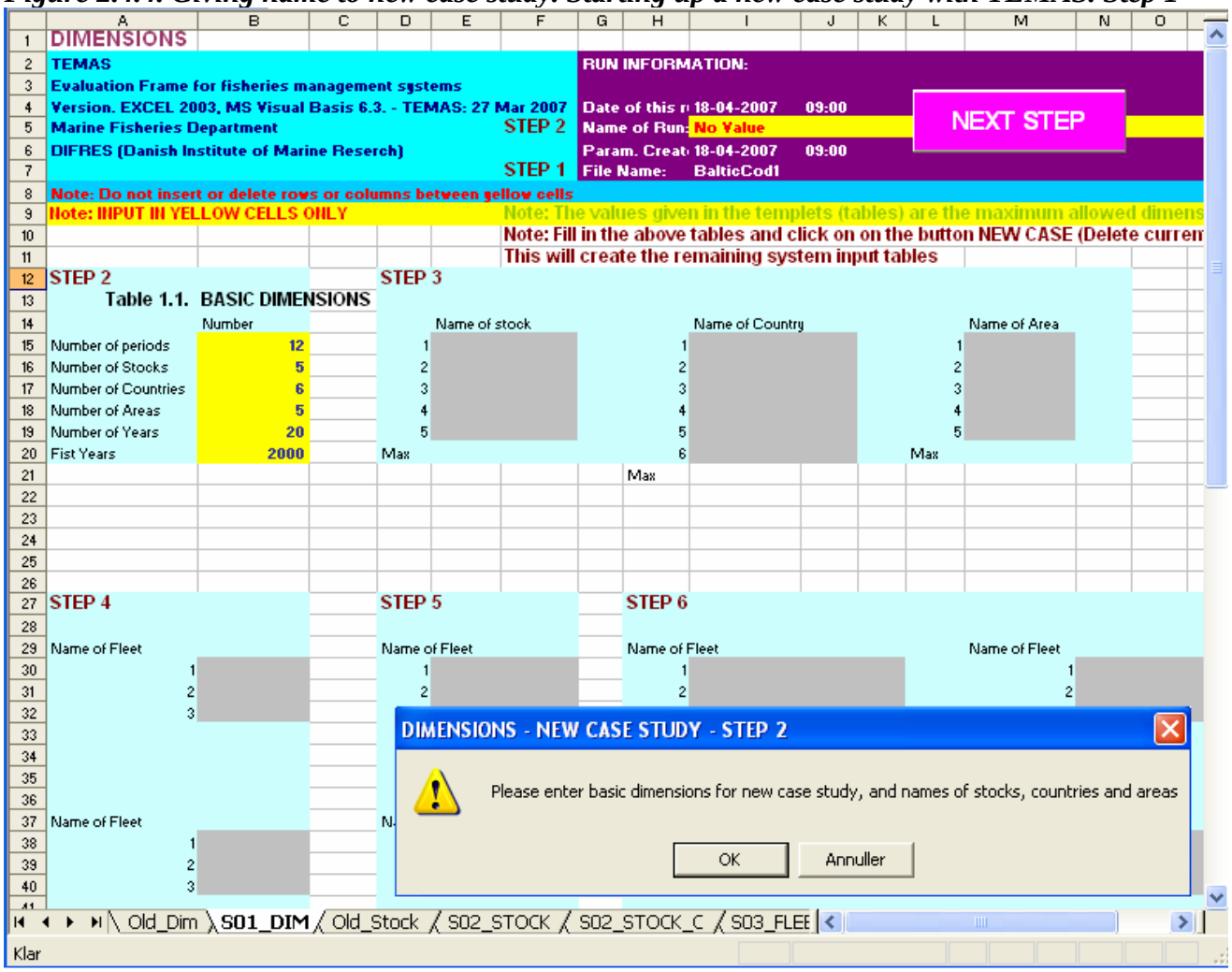


Figure 2.4.5.Starting up a new case study with TEMAS. Step 2

After "OK" the screen will turn into Figure 2.4.5. You are now ready to enter the dimensions of the new case study. The "basic dimensions" (12, 5, 6, 5) shown in Figure 2.4.5 are the maximum values allowed in the current implementation of TEMAS. (These maximum values of dimensions can easily be changed in the Visual Basic code). The number of years, ("20" in Figure 2.4.5) is a default value, not a maximum value, as TEMAS can handle a time series of any length.

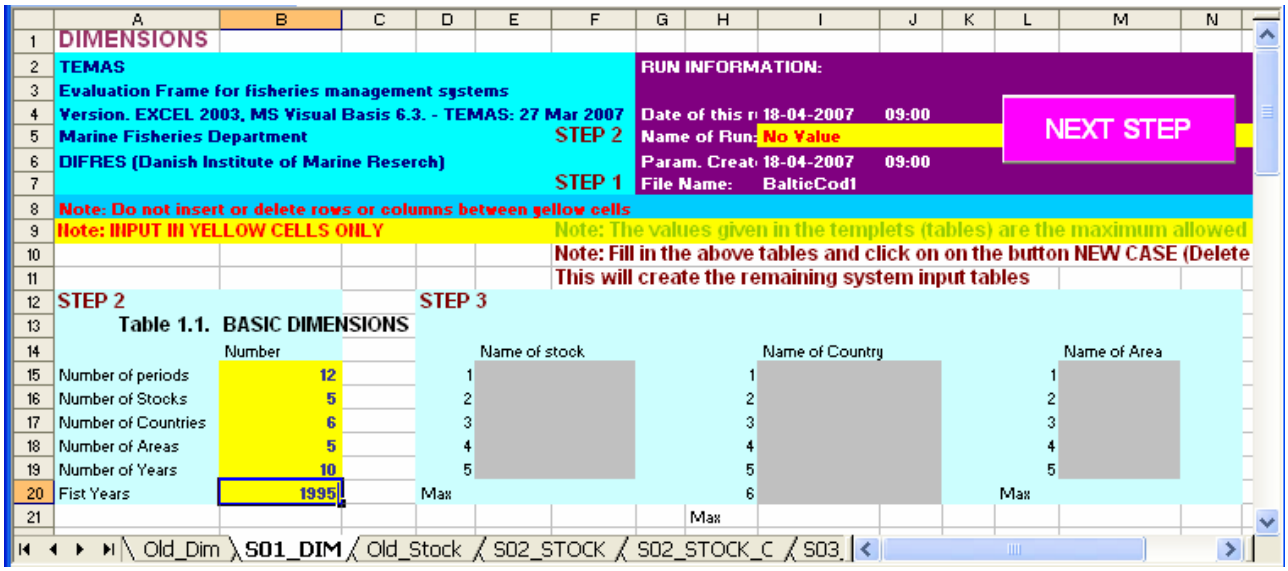


Figure 2.4.6. Entry of basic dimensions Starting up a new case study with TEMAS. Step 2

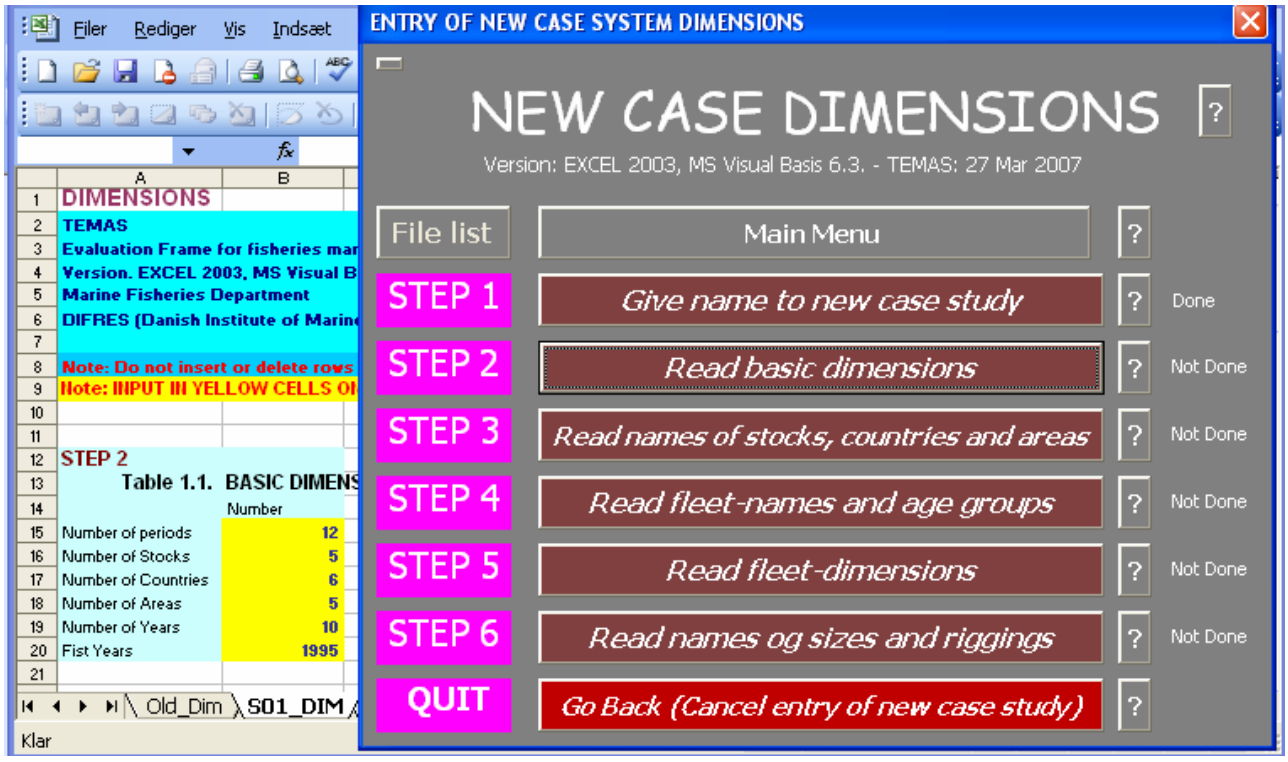


Figure 2.4.7.End of step 2. Starting up a new case study with TEMAS.

Also the "First year" ("2000" is Figure 2.4.5) is a default value, and any positive value will be accepted.

Next to the table with basic dimensions (Figure 2.4.5) are grey table templates, which indicate the current maximum allowed dimensions. If you exceed the limits, TEMAS will give an error message and stop. Clicking on "OK" allows you to enter the new "basic dimensions" (Figure 2.4.6), and

after clicking on the "NEXT STEP"-button, you get Figure 2.4.7. Note that step 1 is "Done", but step 2 is not. Only after clicking on "Read basic dimensions", will step 2 be completed.

In the example in Figure 2.4.6 is chosen the maximum dimensions as input (12 time period per year, months, 5 stocks, 6 counties, and 5 areas). The number of years in the simulated time series is reduced from the defaults value of 20 to 10 and the starting year is chosen to be 1995.

Clicking on "Read basic dimensions" will make TEMAS read the values of Table 1.1 and store the values on the hard disk. It will also produce the yellow tables shown in Figure 2.4.8. The yellow tables has changed colour from grey, because TEMAS now knows the number of names to be expected. Figure 2.4.8 shows the table templates for entry of names of stocks, countries and areas. Note that the tables has the dimensions given in step 2, the basic dimensions. These dimensions need not be equal to the maximum values as is the case for Table 2.4.6-8. , but could have been smaller. The names given in Figure 2.4.8 are the standard names given by TEMAS.

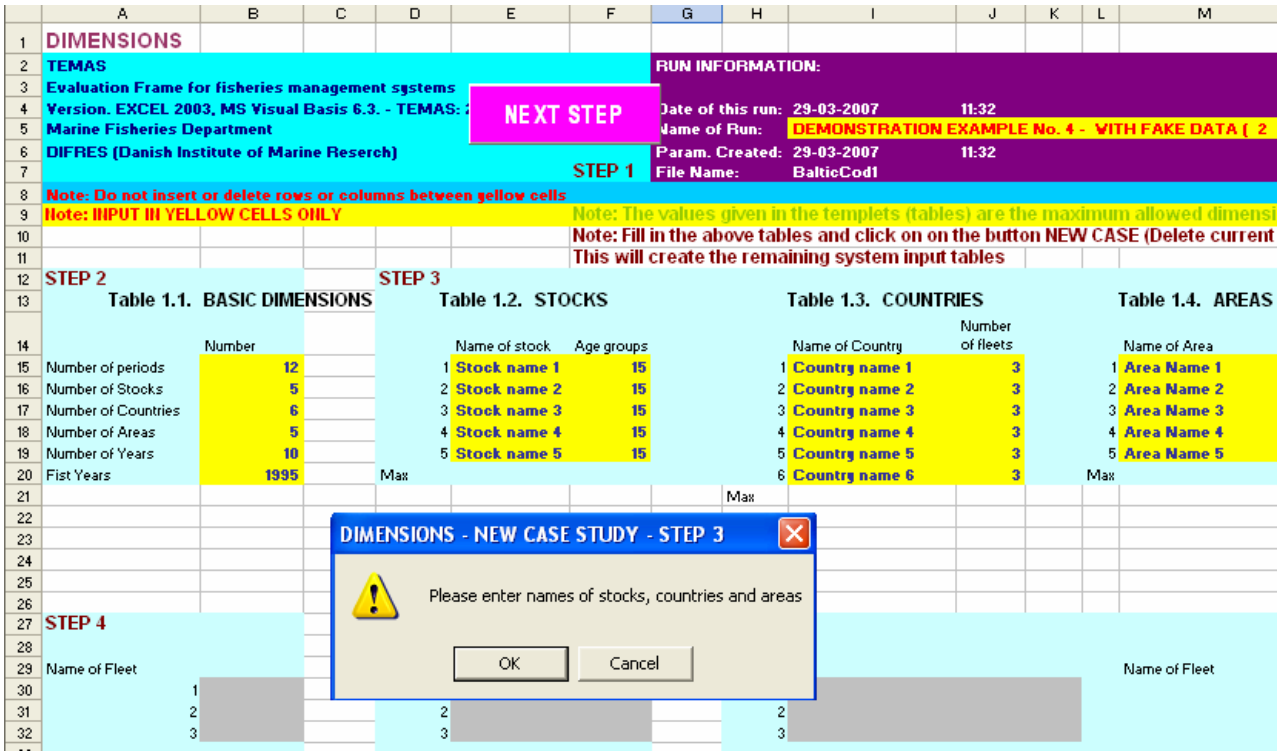


Figure 2.4.8.Starting up a new case study with TEMAS. Step 3: Entry of names of stocks, countries and areas.

You are now expected to overwrite the standard names as illustrated by Figure 2.4.9. This is step 3 in the procedure. Together with the names of stocks you must specify the number of age groups, and together with the names of countries you must specify the number of fleets in each country. Note that the last name in each Table represents "Other". Thereby we include "all species", all countries" and all "areas (of the world)" in the groupings. This inclusion of all landings in all areas by all countries is appropriate when modelling the economics and the behaviour of fishing fleets.

STEP 3

Table 1.2. STOCKS

	Name of stock	Age groups
1	Western Cod	10
2	Eastern Cod	10
3	Sprat	7
4	Plaice	10
5	Other species	10
Max		

Table 1.3. COUNTRIES

	Name of Country	Number of fleets
1	Denmark	3
2	Germany	3
3	Latvia	3
4	Poland	3
5	Sweden	3
6	Other	1

Table 1.4. AREAS

	Name of Area
1	Baltic West
2	Balic East
3	Bornholm
4	Gotland
5	Not Baltic
Max	

Figure 2.4.9. Names of stocks, countries and areas.Starting up a new case study with TEMAS. Step 3

DIMENSIONS

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS:
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

NEXT STEP

RUN INFORMATION:
e of 29-03-2007 12:00
ne of DEMONSTRATION EXAMPLE No. 4 - WITH FAKE D
Param. (29-03-2007 11:32
File Nan BalticCod1

Note: Do not insert or delete rows or columns between gellow cells
Note: INPUT IN YELLOW CELLS ONLY

Table 1.1. BASIC DIMENSIONS

	Number
Number of periods	12
Number of Stocks	5
Number of Countries	6
Number of Areas	5
Number of Years	10
Fist Years	1995

Table 1.2. STOCKS

	Age groups
Western Cod	10
Eastern Cod	10
Sprat	7
Plaice	10
Other species	10

Table 1.3. COUNTRIES

	Number of Fleets
Denmark	3
Germany	3
Latvia	3
Poland	3
Sweden	3
Other	1

Table 1.4. AREAS

Baltic West
Balic East
Bornholm
Gotland
Not Baltic

Table 1.5.1.1. Denmark : FLEETS

Vessel Age gr.
15
15
15

Table 1.5.2.1. Germany : FLEETS

Vessel Age gr.
15
15
15

Table 1.5.3.1. Latvia : FLEETS

Vessel Age gr.
15
15
15

Table 1.5.4.1. Poland : FLEETS

Vessel Age gr.
15
15
15

Table 1.5.5.1. Sweden : FLEETS

Vessel Age gr.
15
15
15

Table 1.5.6.1. Other : FLEETS

Vessel Age gr.
15

DIMENSIONS - NEW CASE STUDY - STEP 4

Please enter names of fleets and number of vessel age groups

OK Cancel

Figure 2.4.10.Starting up a new case study with TEMAS. Step 4

With the information on the number of fleets, TEMAS is now able to create the table templates shown in Figure 2.4.10. These tables are for the entry of country specific names of fleets, and the number of vessel-age groups. TEMAS allows for an account of vessel-ages (e.g. in connection with decommission). The value "15" is the maximum allowed number of vessel groups in the current implementation of TEMAS.

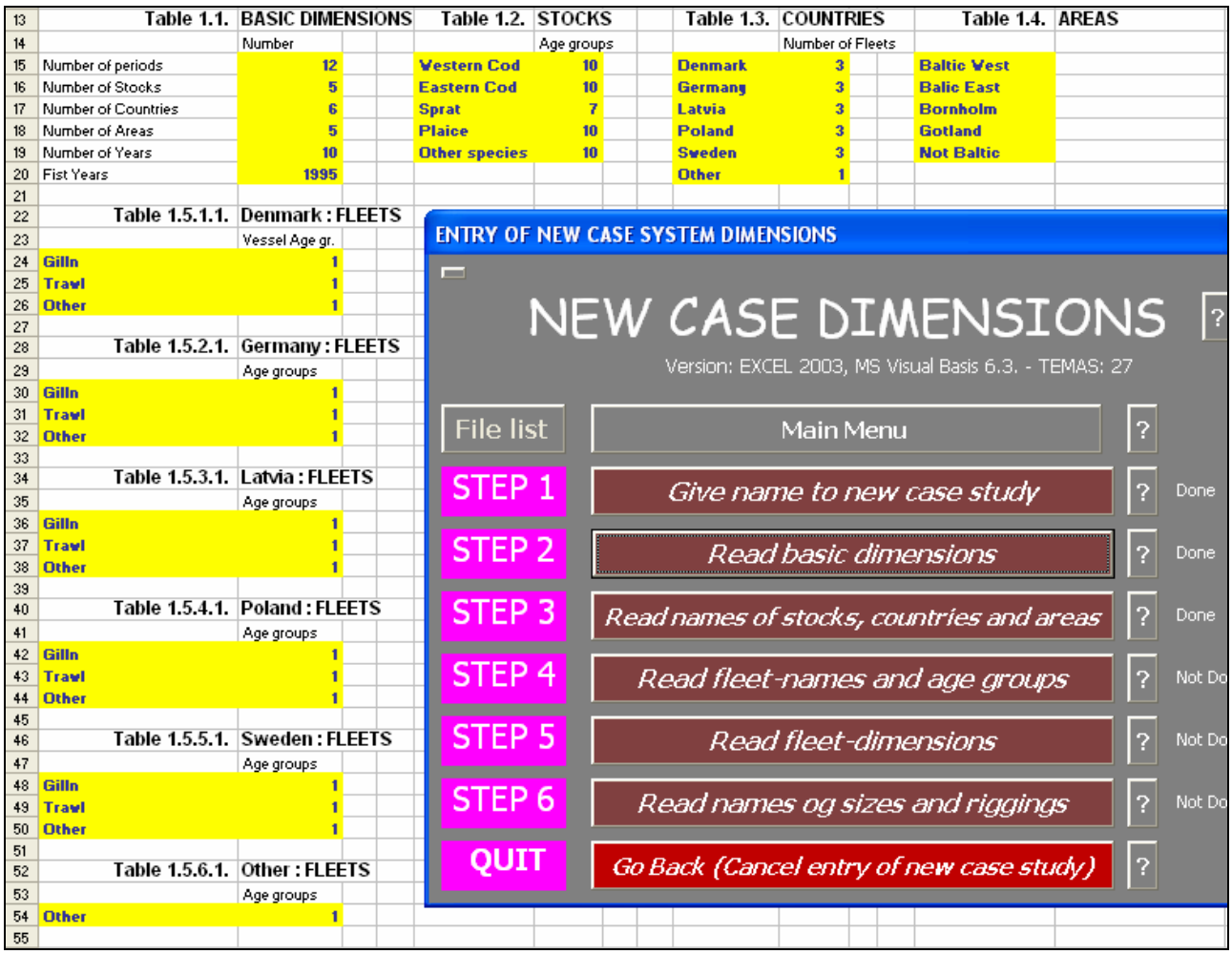


Figure 2.4.11.Starting up a new case study with TEMAS. Step 4

In table 2.4.11, the names of fleets have been given for all countries. In this case (see Table 2.4.12), we use the same 3 fleet names for all countries (Gill netters, trawlers and "other fleets"), but any country specific fleet definition would be accepted. In this case, the option to account for vessel ages is not used, that is only one vessel age group is chosen. One vessel age group does not mean that vessels are scrapped after one year, but that all vessels are in a plus group (1+). The option to account for vessel ages is mainly relevant when decommission programs are being investigated. Usually, it is easy to get the age distribution of vessels from vessel registers.

Table 2.4.12 creates templates for entry of fleet-dimensions, that is, the number of fleet specific vessel size groups and number of gear riggings. The number shown in Figure 2.4.12 are the maximum allowed values (3 vessel size groups and 3 riggings), with the current TEMAS configuration.

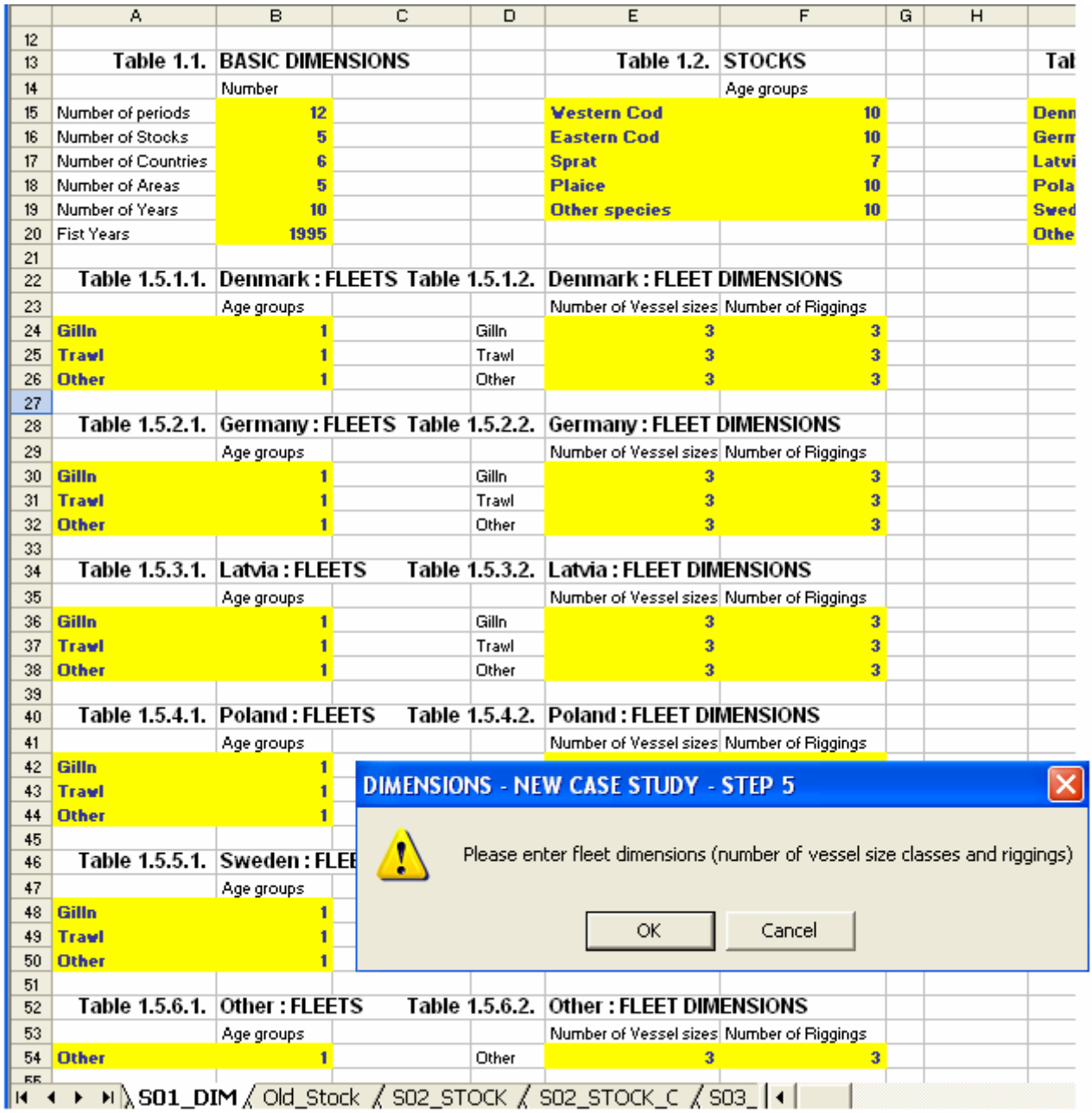


Figure 2.4.12.Starting up a new case study with TEMAS. Step 5

Again note that there is an "other"-group in each country, and that there is an "other" vessel group accounting for "other countries". The groups should always be chosen so that the "other"-groups are relatively small, as it will usually be difficult to get parameters for other groups. Therefore, it is desirably that "other"-groups are small so that the approximations they usually represent will not influence too much on the overall simulation results.

Figure 2.4.13 shows that the same dimensions are chosen for all countries, but other options are available. It is, however, desirable to homogenize the fleets and their particulars across countries as far as possible, for the purpose of presenting and surveying simulation results.

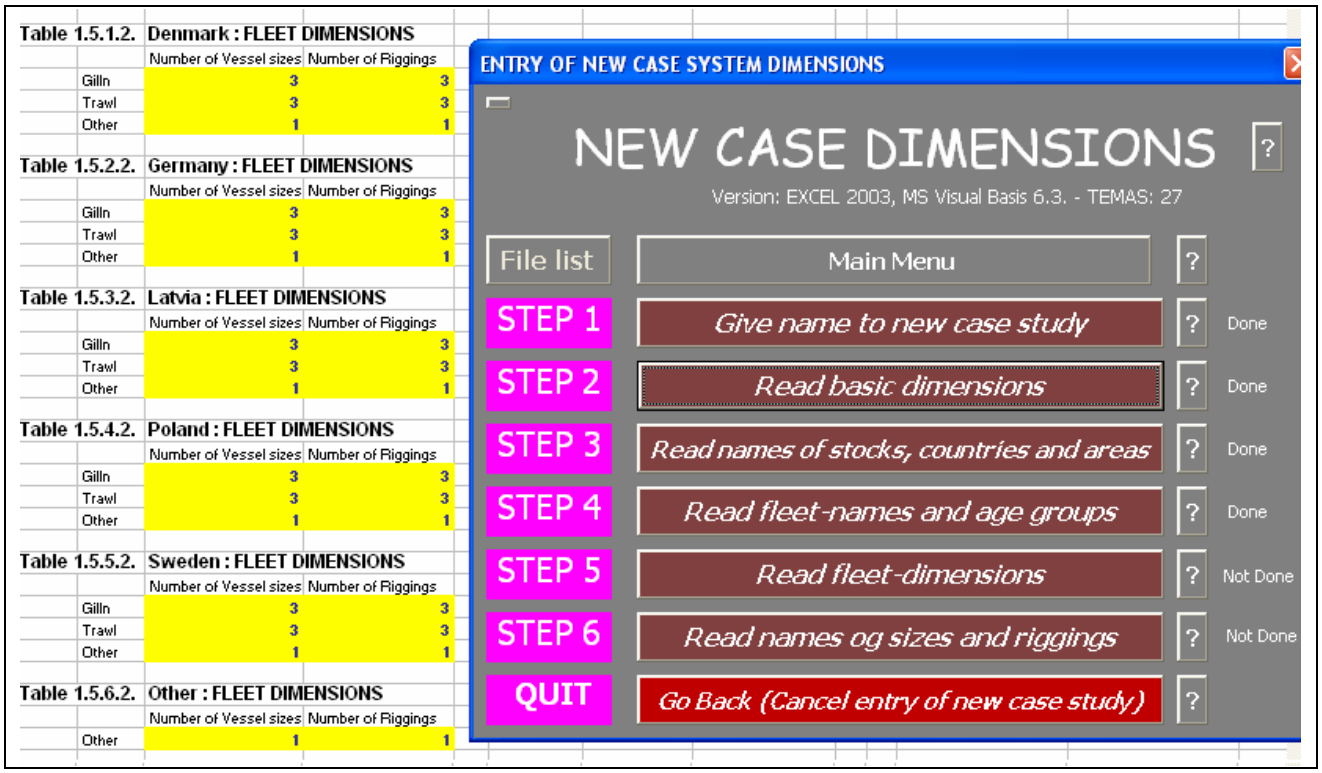


Figure 2.4.13.Starting up a new case study with TEMAS. Step 5

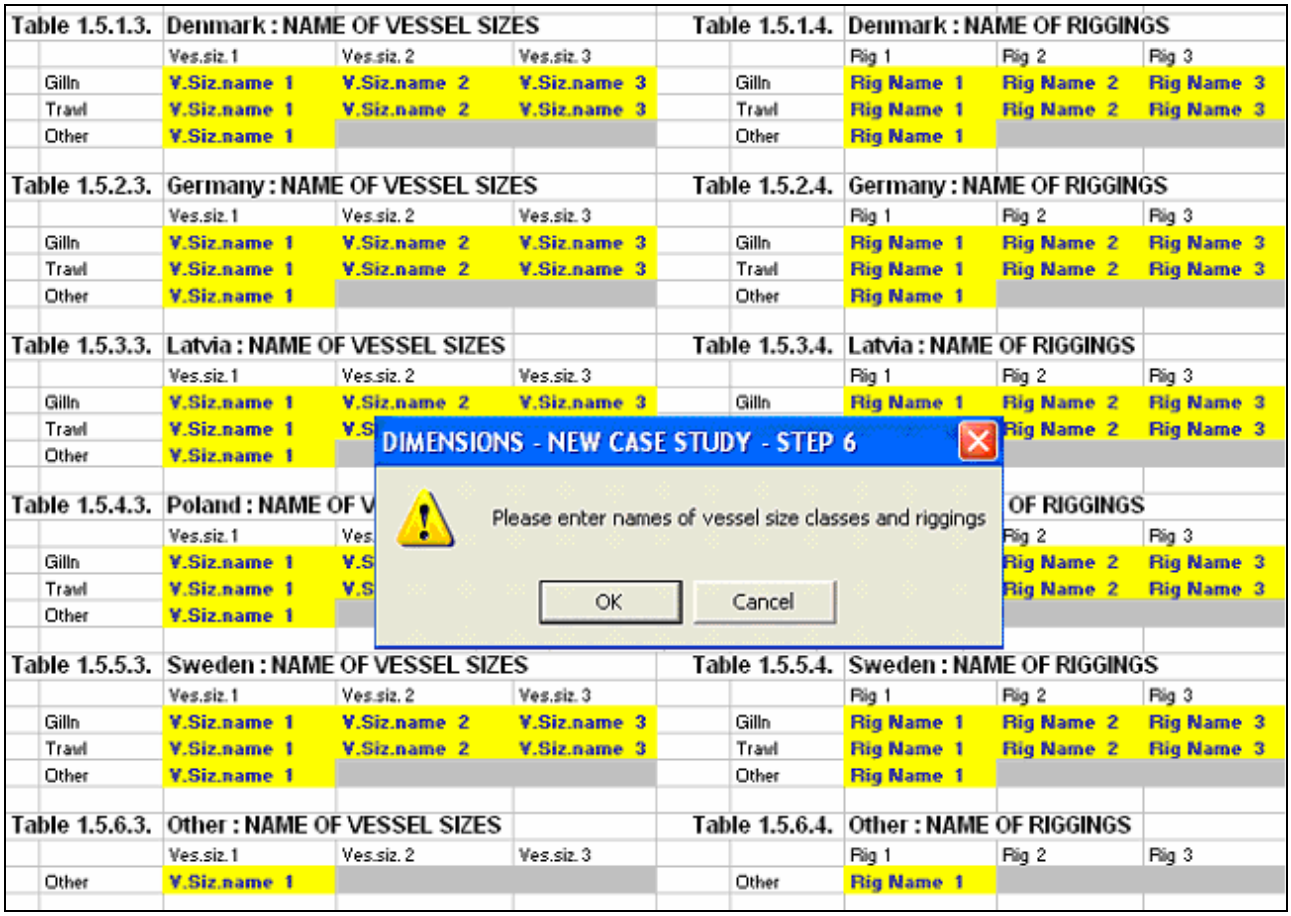


Figure 2.4.14.Starting up a new case study with TEMAS. Step 6

After Table 2.4.13 TEMAS is ready to take the number of vessel sizes and gear riggings as input. In this case we choose 3 vessel sizes and 3 riggings for gillnet and trawlers, where as for "other gears" there is only one vessel size group and one rigging.

Table 2.4.14 shows the templates for entry of names of vessel size classes and gear rigging names. The names shown in Table 2.4.14 are the standard names given by TEMAS, which you are supposed to overwrite. The names given of vessel size classes and gear riggings are shown in Figure 2.4.15. Again, the same vessel size names and gear rigging names are chosen for all fleets in all countries. That is, vessel sizes are small vessels less than 12 meters, medium size vessels between 12 and 24 meters and large vessels over 24 meters. The names "Small", "Medium" and "Large" might have been chosen as well.

Table 1.5.1.3.	Denmark : NAME OF VESSEL SIZES				Table 1.5.1.4.	Denmark : NAME OF RIGGINGS			
	Ves.siz.1	Ves.siz.2	Ves.siz.3			Rig 1	Rig 2	Rig 3	
Gilln	<12m	12-24m	>24m		Gilln	<110mm	>110mm	Other	
Trawl	<12m	12-24m	>24m		Trawl	<110mm	>110mm	Other	
Other					Other				
Table 1.5.2.3.	Germany : NAME OF VESSEL SIZES				Table 1.5.2.4.	Germany : NAME OF RIGGINGS			
	Ves.siz.1	Ves.siz.2	Ves.siz.3			Rig 1	Rig 2	Rig 3	Rig 4
Gilln	<12m	12-24m	>24m		Gilln	<110mm	>110mm	Other	
Trawl	<12m	12-24m	>24m		Trawl	<110mm	>110mm	Other	
Other					Other				
Table 1.5.3.3.	Latvia : NAME OF VESSEL SIZES				Table 1.5.3.4.	Latvia : NAME OF RIGGINGS			
	Ves.siz.1	Ves.siz.2	Ves.siz.3			Rig 1	Rig 2	Rig 3	Rig 4
Gilln	<12m	12-24m	>24m		Gilln	<110mm	>110mm	Other	
Trawl	<12m	12-24m	>24m		Trawl	<110mm	>110mm	Other	
Other					Other				
Table 1.5.4.3.	Poland : NAME OF VESSEL SIZES				Table 1.5.4.4.	Poland : NAME OF RIGGINGS			
	Ves.siz.1	Ves.siz.2	Ves.siz.3			Rig 1	Rig 2	Rig 3	Rig 4
Gilln	<12m	12-24m	>24m		Gilln	<110mm	>110mm	Other	
Trawl	<12m	12-24m	>24m		Trawl	<110mm	>110mm	Other	
Other					Other				
Table 1.5.5.3.	Sweden : NAME OF VESSEL SIZES				Table 1.5.5.4.	Sweden : NAME OF RIGGINGS			
	Ves.siz.1	Ves.siz.2	Ves.siz.3			Rig 1	Rig 2	Rig 3	Rig 4
Gilln	<12m	12-24m	>24m		Gilln	<110mm	>110mm	Other	
Trawl	<12m	12-24m	>24m		Trawl	<110mm	>110mm	Other	
Other					Other				
Table 1.5.6.3.	Other : NAME OF VESSEL SIZES				Table 1.5.6.4.	Other : NAME OF RIGGINGS			
	Ves.siz.1	Ves.siz.2	Ves.siz.3			Rig 1	Rig 2	Rig 3	Rig 4
Other					Other				

Figure 2.4.15.Starting up a new case study with TEMAS. Step 6

This brings us to the end of definition of dimensions of a new case study (Table 2.4.16). At this point TEMAS will start creating the data structured matching the dimensions just entered. That may take a while, depending on the magnitudes of dimensions. TEMAS will create table templates in all the standard input worksheets according to the dimensions and names given as input (S01_DIM, S02_STOCK, S03_FLEET, S04_EFFORT, S05_BOATS, S06_PRICES, S07_ECONOMY, S08_ TRIP_RU, S09_ STRUC_RU, S10_TUNING, S11_OBS, S14_TEMAS and S15_HCR).

Once this is done, it is relatively difficult to change the case study set up, although it is possible. The names, however, can easily be changed, as the "Dimensions" user form contains an option "Read names from worksheet" (Figure 2.2.3). This option allows for modifications of all names, but not dimensions. If dimensions are to be changed, you will have to repeat the six step procedure.

Furthermore, all input parameters will have to be re-entered. With a copy of the original input sheets, this may be done quickly, if only few dimensions are changed.

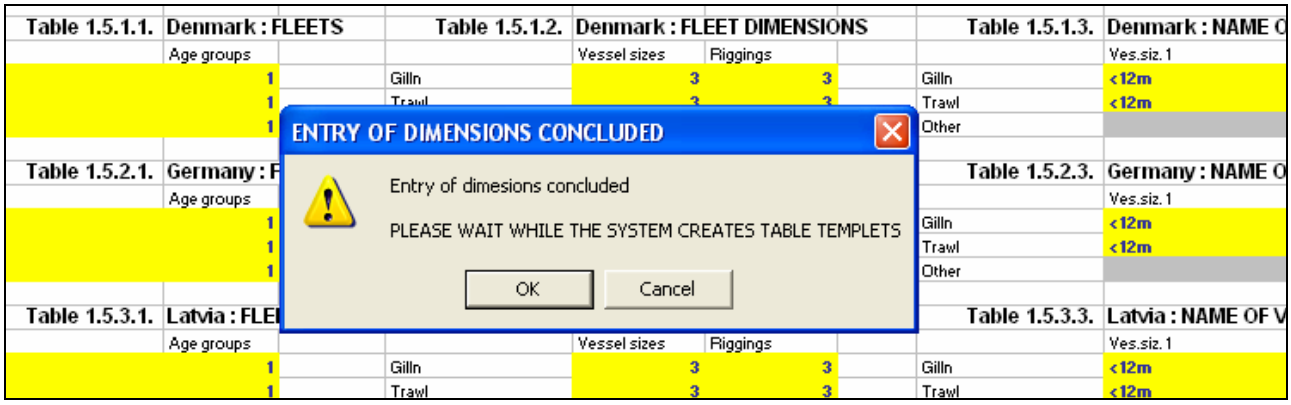


Figure 2.4.16. End of entry of data for Starting up a new case study with TEMAS.

Eventually, Figure 2.4.17 shows the last message from TEMAS concerning start of new case study. The tables created at this point will have all field filled in with "No Value", as indicated in Figure 2.4.17. Table 2.4.18 shows the table templates for entry of biological stock parameters. Whenever you try to start a simulation, TEMAS will check that all cells with "No Value" has been changed to contain a numerical value. If that is not the case, TEMAS will refuse to carry out the simulations.

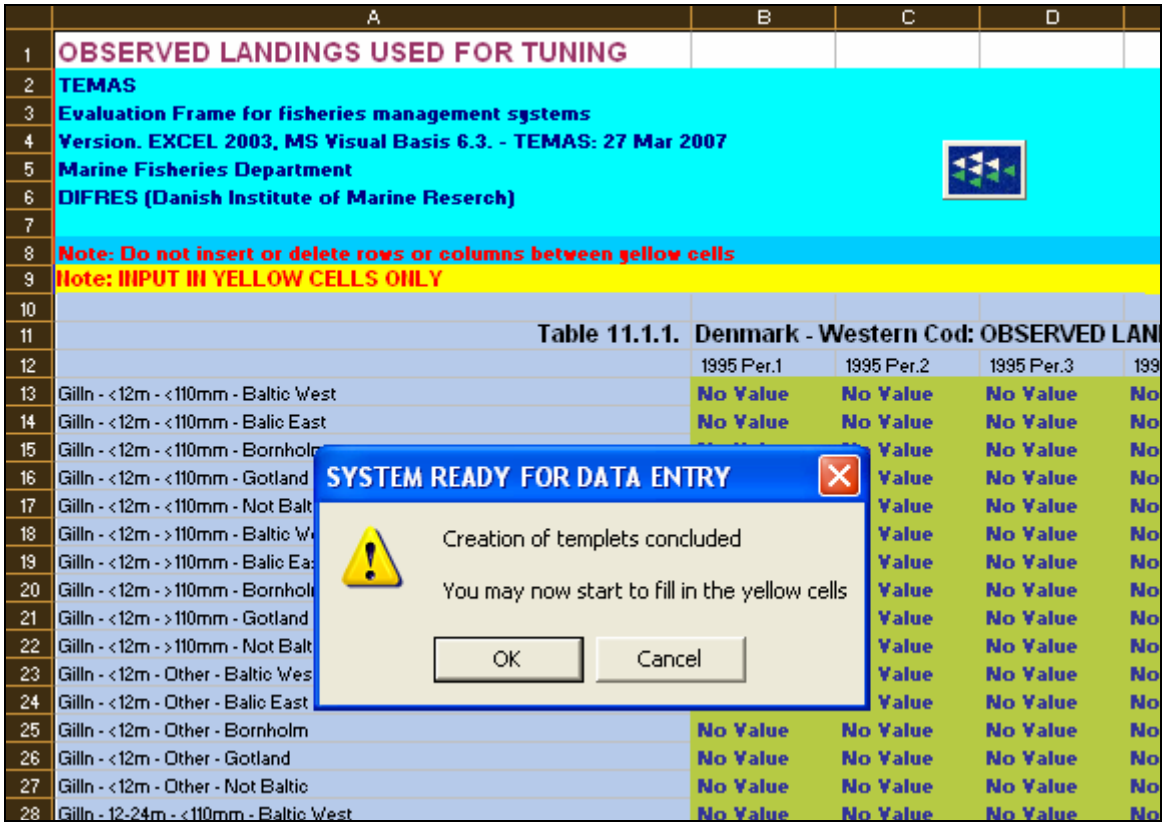
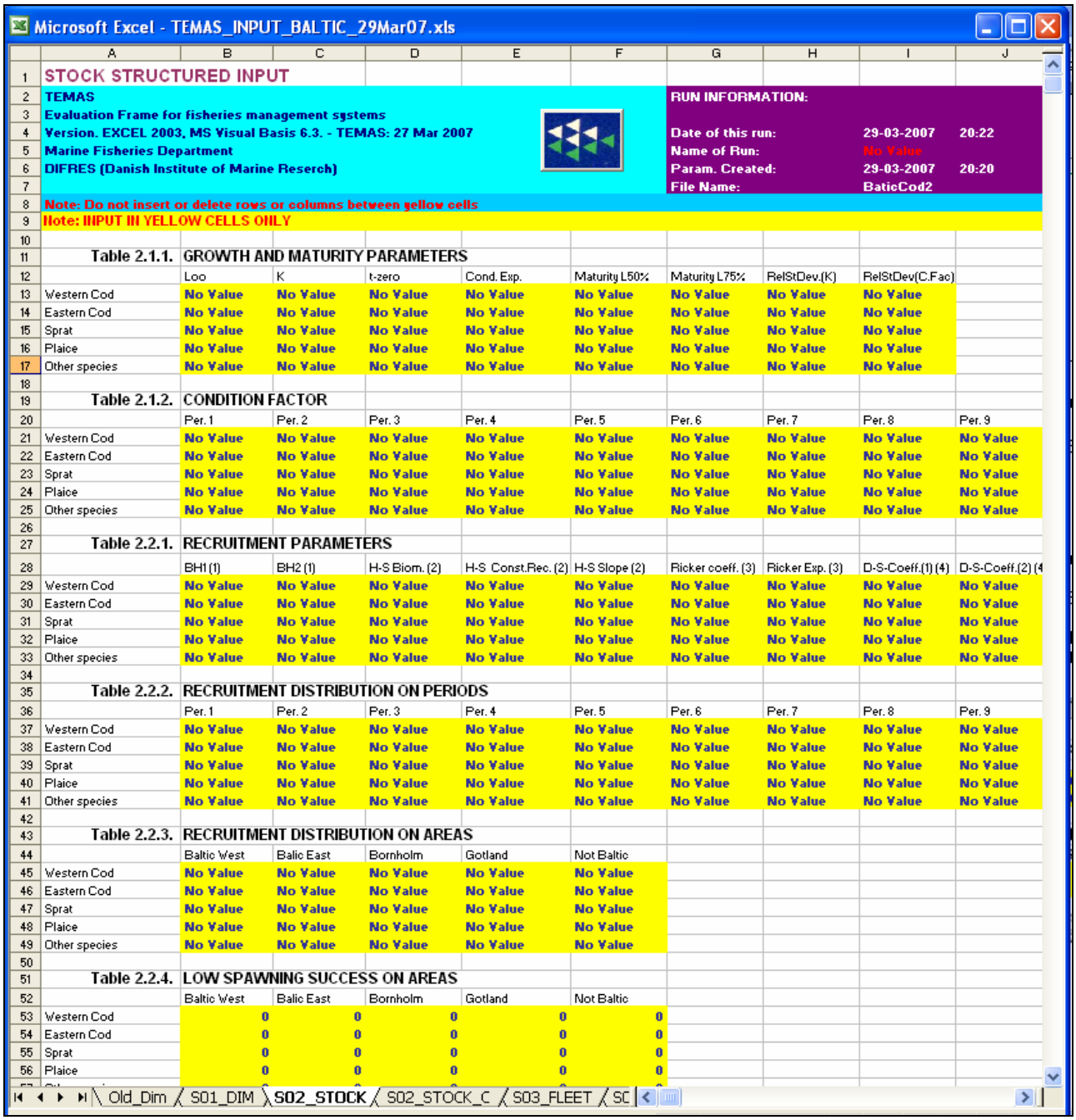


Figure 2.4.17. End of Starting up a new case study with TEMAS.



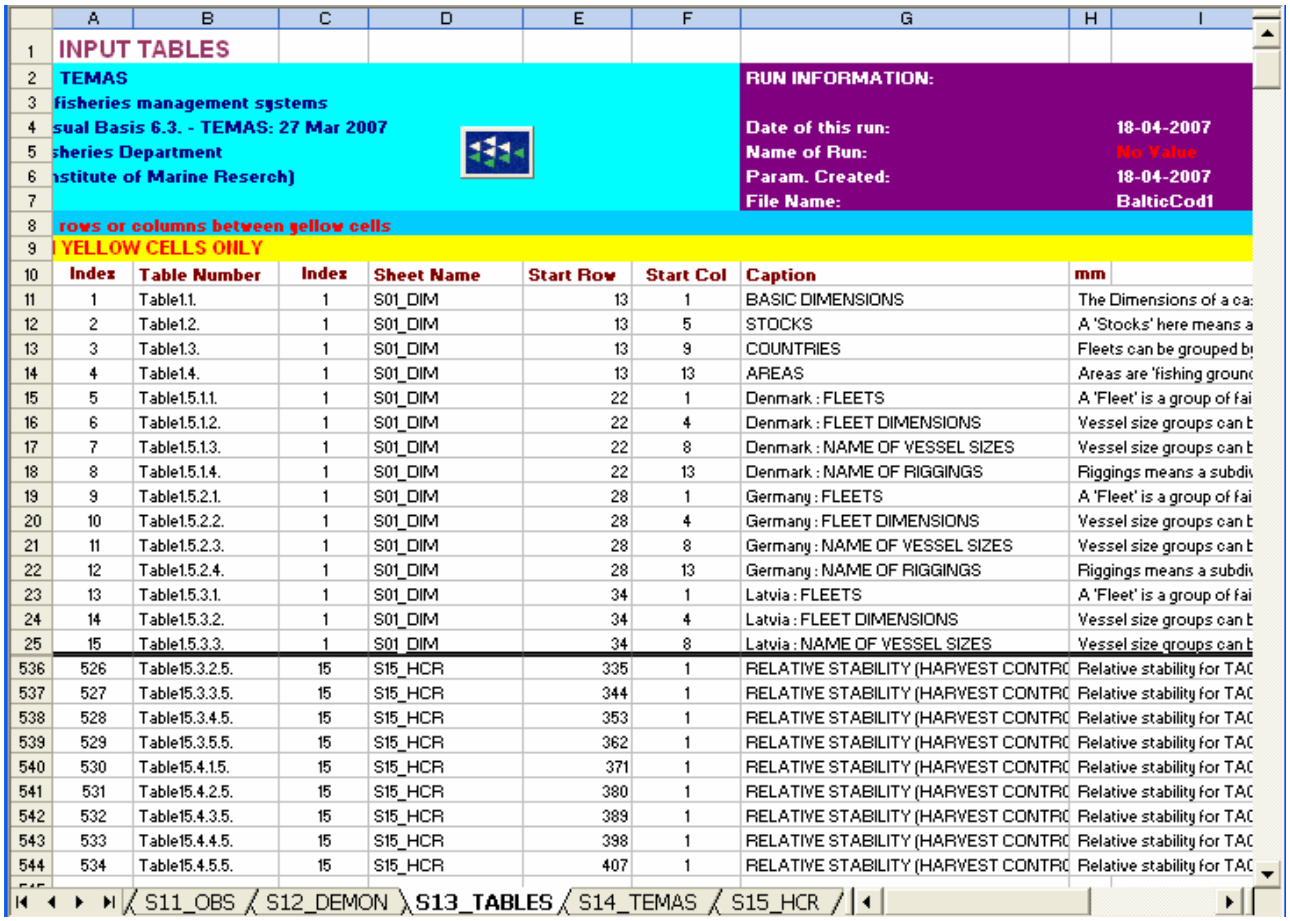
Microsoft Excel - TEMAS_INPUT_BALTIC_29Mar07.xls

	A	B	C	D	E	F	G	H	I	J
1	STOCK STRUCTURED INPUT									
2	TEMAS						RUN INFORMATION:			
3	Evaluation Frame for fisheries management systems									
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007						Date of this run:		29-03-2007	20:22
5	Marine Fisheries Department						Name of Run:		No Value	
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:		29-03-2007	20:20
7							File Name:		BaticCod2	
8	Note: Do not insert or delete rows or columns between yellow cells									
9	Note: INPUT IN YELLOW CELLS ONLY									
10										
11	Table 2.1.1.	GROWTH AND MATURITY PARAMETERS								
12		Loo	K	t-zero	Cond. Exp.	Maturity L50%	Maturity L75%	RelStDev.(K)	RelStDev(C.Fac)	
13	Western Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	
14	Eastern Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	
15	Sprat	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	
16	Plaice	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	
17	Other species	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	
18										
19	Table 2.1.2.	CONDITION FACTOR								
20		Per. 1	Per. 2	Per. 3	Per. 4	Per. 5	Per. 6	Per. 7	Per. 8	Per. 9
21	Western Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
22	Eastern Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
23	Sprat	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
24	Plaice	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
25	Other species	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
26										
27	Table 2.2.1.	RECRUITMENT PARAMETERS								
28		BH1 (1)	BH2 (1)	H-S Biom. (2)	H-S Const.Rec. (2)	H-S Slope (2)	Ricker coeff. (3)	Ricker Exp. (3)	D-S-Coeff.(1) (4)	D-S-Coeff.(2) (4
29	Western Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
30	Eastern Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
31	Sprat	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
32	Plaice	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
33	Other species	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
34										
35	Table 2.2.2.	RECRUITMENT DISTRIBUTION ON PERIODS								
36		Per. 1	Per. 2	Per. 3	Per. 4	Per. 5	Per. 6	Per. 7	Per. 8	Per. 9
37	Western Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
38	Eastern Cod	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
39	Sprat	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
40	Plaice	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
41	Other species	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
42										
43	Table 2.2.3.	RECRUITMENT DISTRIBUTION ON AREAS								
44		Baltic West	Balic East	Bornholm	Gotland	Not Baltic				
45	Western Cod	No Value	No Value	No Value	No Value	No Value				
46	Eastern Cod	No Value	No Value	No Value	No Value	No Value				
47	Sprat	No Value	No Value	No Value	No Value	No Value				
48	Plaice	No Value	No Value	No Value	No Value	No Value				
49	Other species	No Value	No Value	No Value	No Value	No Value				
50										
51	Table 2.2.4.	LOW SPAWNING SUCCESS ON AREAS								
52		Baltic West	Balic East	Bornholm	Gotland	Not Baltic				
53	Western Cod	0	0	0	0	0				
54	Eastern Cod	0	0	0	0	0				
55	Sprat	0	0	0	0	0				
56	Plaice	0	0	0	0	0				

Old_Dim | S01_DIM | S02_STOCK | S02_STOCK_C | S03_FLEET | SC

Figure 2.4.18. Table templates for new case study.

Depending on the dimensions, TEMAS can produce a number of output tables. A complete list of all tables can be achieved through the main menu (Figure 1.3.4) by option "Write list of all tables). The list is long and a part of it is shown in Figure 2.4.19. In the present case there is a total of 534 Input tables. When it comes to simulation results (output from TEMAS_CALC) the list is a lot longer. The total output is so large that it becomes more or less inaccessible. In most practical applications, only a subset of the potential output tables will be used. TEMAS offers options to exclude certain combinations of output tables. Table 2.4.20 shows some of the tables to select output options. Worksheet Table 1.6.1 (in Table 2.4.20), for example, specifies, that tables shall be made for Western cod, Eastern cod, sprat and plaice, but no tables shall be printed for "other species". Worksheet Table 1.6.2 exclude "Not Baltic" area from printing.



INPUT TABLES

TEMAS
fisheries management systems
sual Basis 6.3. - TEMAS: 27 Mar 2007
sheries Department
stitute of Marine Reserch)

RUN INFORMATION:

Date of this run: 18-04-2007
Name of Run: No Value
Param. Created: 18-04-2007
File Name: BalticCod1

rows or columns between yellow cells
YELLOW CELLS ONLY

Index	Table Number	Index	Sheet Name	Start Row	Start Col	Caption	mm
1	Table1.1.	1	S01_DIM	13	1	BASIC DIMENSIONS	The Dimensions of a ca:
2	Table1.2.	1	S01_DIM	13	5	STOCKS	A 'Stocks' here means a
3	Table1.3.	1	S01_DIM	13	9	COUNTRIES	Fleets can be grouped b
4	Table1.4.	1	S01_DIM	13	13	AREAS	Areas are 'fishing grounc
5	Table1.5.1.1.	1	S01_DIM	22	1	Denmark : FLEETS	A 'Fleet' is a group of fai
6	Table1.5.1.2.	1	S01_DIM	22	4	Denmark : FLEET DIMENSIONS	Vessel size groups can b
7	Table1.5.1.3.	1	S01_DIM	22	8	Denmark : NAME OF VESSEL SIZES	Vessel size groups can b
8	Table1.5.1.4.	1	S01_DIM	22	13	Denmark : NAME OF RIGGINGS	Riggings means a subdiv
9	Table1.5.2.1.	1	S01_DIM	28	1	Germany : FLEETS	A 'Fleet' is a group of fai
10	Table1.5.2.2.	1	S01_DIM	28	4	Germany : FLEET DIMENSIONS	Vessel size groups can b
11	Table1.5.2.3.	1	S01_DIM	28	8	Germany : NAME OF VESSEL SIZES	Vessel size groups can b
12	Table1.5.2.4.	1	S01_DIM	28	13	Germany : NAME OF RIGGINGS	Riggings means a subdiv
13	Table1.5.3.1.	1	S01_DIM	34	1	Latvia : FLEETS	A 'Fleet' is a group of fai
14	Table1.5.3.2.	1	S01_DIM	34	4	Latvia : FLEET DIMENSIONS	Vessel size groups can b
15	Table1.5.3.3.	1	S01_DIM	34	8	Latvia : NAME OF VESSEL SIZES	Vessel size groups can b
526	Table15.3.2.5.	15	S15_HCR	335	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
527	Table15.3.3.5.	15	S15_HCR	344	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
528	Table15.3.4.5.	15	S15_HCR	353	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
529	Table15.3.5.5.	15	S15_HCR	362	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
530	Table15.4.1.5.	15	S15_HCR	371	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
531	Table15.4.2.5.	15	S15_HCR	380	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
532	Table15.4.3.5.	15	S15_HCR	389	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
533	Table15.4.4.5.	15	S15_HCR	398	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC
534	Table15.4.5.5.	15	S15_HCR	407	1	RELATIVE STABILITY (HARVEST CONTRC	Relative stability for TAC

S11_OBS | S12_DEMON | S13_TABLES | S14_TEMAS | S15_HCR

Figure 2.4.19. List of tables in TEMAS_INPUT.

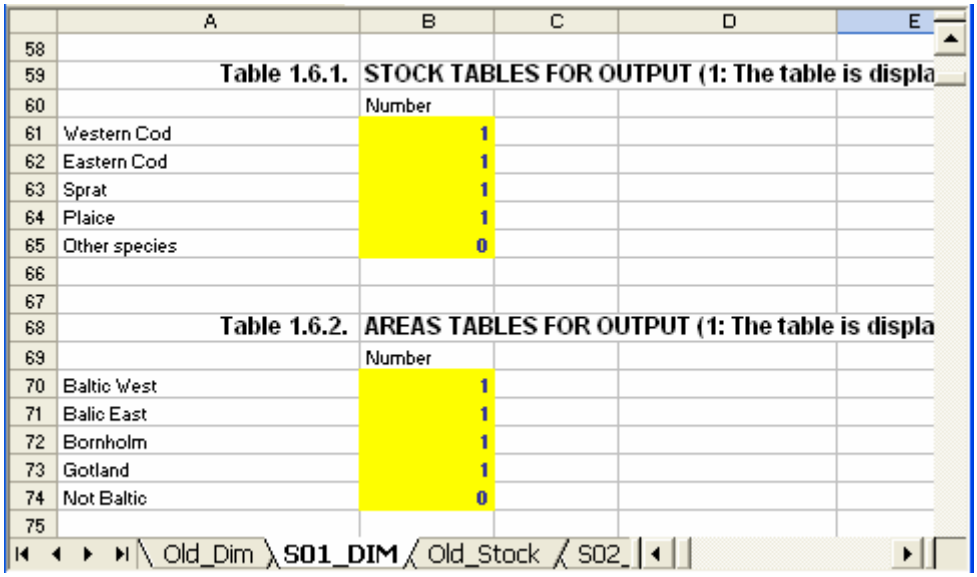


Table 1.6.1.	STOCK TABLES FOR OUTPUT (1: The table is displa	
	Number	
Western Cod	1	
Eastern Cod	1	
Sprat	1	
Plaice	1	
Other species	0	
Table 1.6.2.	AREAS TABLES FOR OUTPUT (1: The table is displa	
	Number	
Baltic West	1	
Balic East	1	
Bornholm	1	
Gotland	1	
Not Baltic	0	

Old_Dim | S01_DIM | Old_Stock | S02_

Figure 2.4.20. Output table options.

2.5. STOCK INPUT, S02_STOCK

This section and the following section will introduce the formats of TEMAS input by a hypothetical example, which has some resemblance with the Baltic cod fisheries. The dimensions of this demonstration example are shown in Figure 2.5.1.a-b.

	A	B	C	D	E	F	G
1	DIMENSIONS						
2	TEMAS						RUN INFORMATION:
3	Evaluation Frame for fisheries management systems						
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007						Date of this run:
5	Marine Fisheries Department						Name of Run:
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:
7							File Name:
8	Note: Do not insert or delete rows or columns between gellow cells						
9	Note: INPUT IN YELLOW CELLS ONLY						
12							
13	Table 1.1.	BASIC DIMENSIONS			Table 1.2.	STOCKS	
14		Number				Age groups	
15	Number of periods	4			West Cod	5	
16	Number of Stocks	2			East cod	5	
17	Number of Countries	2					
18	Number of Areas	5					
19	Number of Years	10					
20	Fist Years	2000					
21							
22	Table 1.5.1.1.	Baltistan : FLEETS		Table 1.5.1.2.	Baltistan : FLEET DIMENSIONS		
23		Age groups			Vessel sizes	Riggings	
24	OB Trawler-Baltistan	1		OB Trawler-Baltistan	3	2	
25	Gillnett-Baltistan	1		Gillnett-Baltistan	3	2	
26							
27	Table 1.5.2.1.	Scandinavia : FLEETS		Table 1.5.2.2.	Scandinavia : FLEET DIMENSIONS		
28		Age groups			Vessel sizes	Riggings	
29	OB Trawler-Scandinavia	1		OB Trawler-Scandinavia	3	2	
30	Gillnett-Scandinavia	1		Gillnett-Scandinavia	3	2	
31							

S01_DIM | S02_STOCK | S03_FLEET | S04_EFFORT

Figure 2.5.1.a. Dimensions of Demonstration example used to illustrate input formats

	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1														
2														
3														
4		22-03-2007 19:31												
5		DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA (2 Countries, (Number of Fleets: Ct 1: 2 Ct 2: 2) 2 Stock(s), 5 A												
6		12:00:00 AM 00:00												
7		DEMON_5_Mig3												
8														
9														
12														
13		Table 1.3.	COUNTRIES			Table 1.4.	AREAS							
14			Number of Fleets											
15		Baltistan	2			West Baltic								
16		Scandinavia	2			East Baltic								
17						Not Baltic								
18						Bornholm								
19						Gotland								
20														
21														
22	Table 1.5.1.3.	Baltistan : NAME OF VESSEL SIZES							Table 1.5.1.4.	Baltistan : NAME OF RIGGINGS				
23		Ves.siz. 1	Ves.siz. 2	Ves.siz. 3	Ves.siz. 4	Ves.siz. 5	Ves.siz. 6			Rig 1	Rig 2	Rig 3	Rig 4	Rig 5
24	OB Trawler-Baltistan	Small	Medium	Large					OB Trawler-Baltistan	<110mm	>110mm			
25	Gillnett-Baltistan	Small	Medium	Large					Gillnett-Baltistan	<110mm	>110mm			
26														
27	Table 1.5.2.3.	Scandinavia : NAME OF VESSEL SIZES							Table 1.5.2.4.	Scandinavia : NAME OF RIGGINGS				
28		Ves.siz. 1	Ves.siz. 2	Ves.siz. 3	Ves.siz. 4	Ves.siz. 5	Ves.siz. 6			Rig 1	Rig 2	Rig 3	Rig 4	Rig 5
29	OB Trawler-Scandinavia	Small	Medium	Large					OB Trawler-Scandinavia	<110mm	>110mm			
30	Gillnett-Scandinavia	Small	Medium	Large					Gillnett-Scandinavia	<110mm	>110mm			
31														

S01_DIM | S02_STOCK | S03_FLEET | S04_EFFORT | S05_BOATS

Figure 2.5.1.b. Dimensions of Demonstration example used to illustrate input formats

There are two hypothetical countries, “Scandinavia” and “Baltistan”, two stocks “Western cod” and “Eastern cod”. The dimensions are smaller than the real case as the input tables otherwise would become rather big. The time step is a quarter of the year. The number of areas is 5. This number is chosen to allow for more realistic demonstration of spatial aspects in connection with MPA’s. The number of fleets per country is 2, each with 3 vessel size classes and 2 gear riggings. The number of age groups of fish stocks is 5 for both stocks (to reduce size of tables), and the number of vessel size classes is 1, that is, the age structure of fleets is ignored.

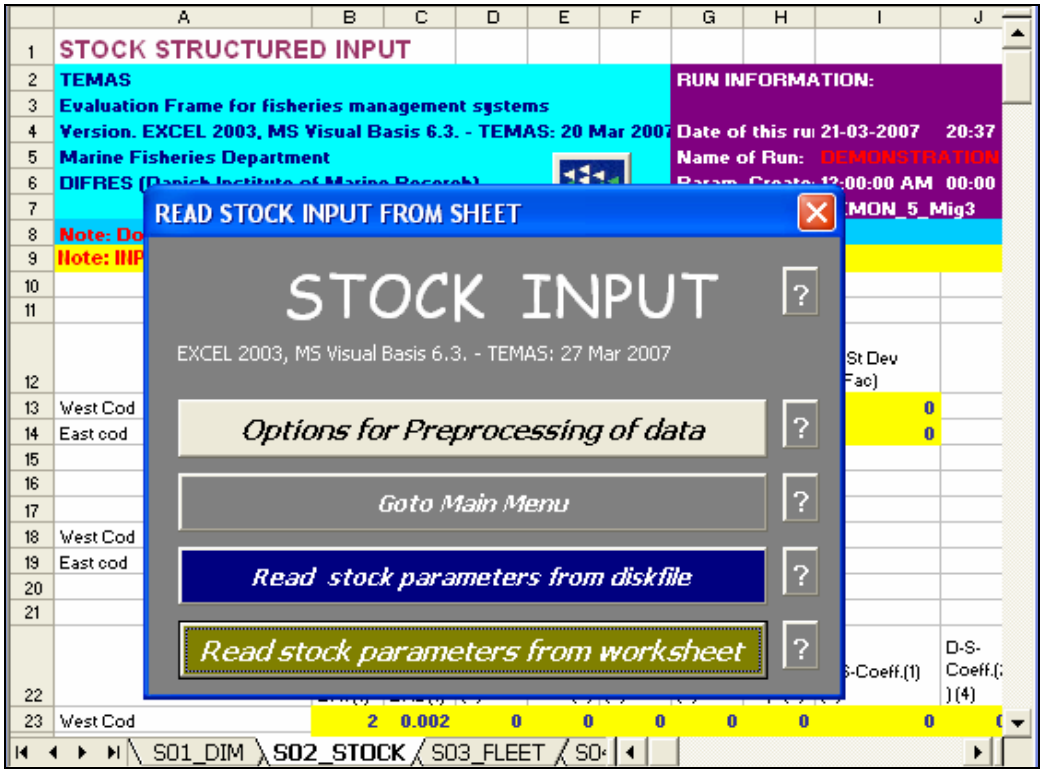


Figure 2.5.2. User-form for entry of stock related parameters.

Index	EXCEL Table	Caption
23	Table 2.1.1.	GROWTH AND MATURITY PARAMETERS
24	Table 2.1.2.	CONDITION FACTOR
25	Table 2.2.1.	RECRUITMENT PARAMETERS
26	Table 2.2.2.	RECRUITMENT DISTRIBUTION ON PERIODS
27	Table 2.2.3.	RECRUITMENT DISTRIBUTION ON AREAS
28	Table 2.2.4.	LOW SPAWNING SUCCESS ON AREAS
29	Table 2.2.5.	HIGH SPAWNING SUCCESS ON AREAS
30	Table 2.2.6.	RECRUITMENT TREND OVER YEARS
31	Table 2.3.1.	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 0- 1
32	Table 2.3.2.	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 2+
33	Table 2.4.1.	WEIGHTING FACTORS FOR MEAN F CALCULATION - Age 0- 1
34	Table 2.4.2.	WEIGHTING FACTORS FOR MEAN F CALCULATION - Age 2+
35	Table 2.5.1.	West Cod: MIGRATION - AGE GR.0-1
36	Table 2.5.2.	West Cod: MIGRATION - AGE GR.2+
37	Table 2.5.3.	East cod: MIGRATION - AGE GR.0-1
38	Table 2.5.4.	East cod: MIGRATION - AGE GR.2+
39	Table 2.6.1.	NATURAL MORTALITY - West Cod
40	Table 2.6.2.	NATURAL MORTALITY - East cod

Table 2.5.1. Tables in the Stock input sheet, S02_STOCK.

Figure 2.5.2 shows the input user-form for worksheet "S02_STOCK". As you will see, the layout of this userform is repeated for all other input sheets. Only the text on the command buttons are slightly modified, to reflect the type of input of the worksheet in question. Then four command buttons are

1) Options for pre-processing of data
2) Go to Main menu
3) Read Stock Parameters from disk file
4) Read Stock parameters from works sheet

Option 1 for pre-processing of data takes you to a new user-form, which will offer you a number of options for pre-processing of data. "Pre-processing" essentially means to assign values to parameters according to some rules, for example:"

. 1) Assign the same value to all years
2) Assign the same value to all time periods
3) Assign zero to all parameters of a certain type
..... etc.

You might have got the same explanation by clicking on the question mark next to the command button.

Option 4 reads the values currently in the worksheet and store them in text file on the hard disk. Thus, there is always a backup of your parameter values on the hard disk. They remain unchanged until next time you click on the yellow button, "Read stock parameters from worksheet". You can always refresh the worksheet values with the values from the text file by clicking on the blue button "Read stock parameters from disk file". Al parameters are stores in one single subdirectory, and you may take a copy of that subdirectory, to get a second backup of parameter values.

Table 2.5.1 shows a list of the "EXCEL Tables" of S02_STOCK, the tables you will have to fill in with parameter values. We shall use the name "EXCEL Tables" to separate the Tables shown in the figures (the worksheet examples) from the Tables of the manual. Recall that the yellow cells are those to fill in with numerical values. The column "index" in Table 2.5.1 is simply to count the number of tables in the input module of TEMAS. As will appear, there is a total of 204 input tables in this demonstration example. With more dimensions the number and the size of Tables will increase. That is one reason why the full data set for the Baltic is not used for demonstration.

The first item in Table 2.5.1 is the table for input of growth and maturity parameters (EXCEL table 2.1.1 in Figure 2.5.3). The first three columns in WXCEL Table 2.1.1 contain the three von Bertalanffy growth parameters by species. Mean Body length of stock "St", in the middle of time period q of year "y" of age group "a", LGT(St,a,y) is given by:

$$\mathrm{Lgt(St,\ y,a,q)} = \mathrm{Loo}(St) * \left(1 - \exp\left[\ -K\ (St) * (Age(a,q,qa) - Tzero(St)) \right] \right)$$

The age of the fish (or cohort) in units of years is defined:

$$Age(a,q,qa) = \begin{cases} a + (q - qa + 0.5) * dt & if\ a < 2 \\ a - da_{Mean}(St) + (q - 0.5) * dt & if\ \ a \geq 2 \end{cases}$$

$$where \quad da_{Mean}(St) = \sum_{qa=1}^{q_{max}} (qa - 1)\ \ * \ \mathrm{RecDistPeriod(St,\ qa)}$$

RecDistPeriod(St,qa) is the fraction of the annual recruitment which occurs in period qa, from which the mean time at recruitment, $da_{Mean}(st)$, is derived (to be defined in connection with EXCEL Table 2.2.2). This is the basis of age allocated to fish at age 2 and older.

For details behind the definition of growth parameters and all other parameters, the reader is referred to the report on the TEMAS model.

	A	B	C	D	E	F	G	H	I	J
1	STOCK STRUCTURED INPUT									
2	TEMAS						RUN INFORMATION:			
3	Evaluation Frame for fisheries management systems									
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007						Date of this run:		17-04-2007	16:24
5	Marine Fisheries Department						Name of Run:		DEMONSTRATION EXA	
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:		12:00:00 AM	00:00
7							File Name:		DEMON_5_Mig3	
8	Note: Do not insert or delete rows or columns between yellow cells									
9	Note: INPUT IN YELLOW CELLS ONLY									
10										
11	Table 2.1.1.	GROWTH AND MATURITY PARAMETERS								
12		Loo	K	t-zero	Cond. Exp.	Maturity L50%	Maturity L75%	RelStDev.(K)	RelStDev(C.Fac)	
13	West Cod	148	0.103	0	3	40.2	46.2	0	0	
14	East cod	131	0.11	-0.384	3	38	44.9	0	0	
15										
16	Table 2.1.2.	CONDITION FACTOR								
17		Per. 1	Per. 2	Per. 3	Per. 4					
18	West Cod	0.00001	0.00001	0.00001	0.00001					
19	East cod	0.00001	0.00001	0.00001	0.00001					
20										

S01_DIM | S02_STOCK | S03_FLEET | S04_EFFORT | S0

Figure 2.5.3. First part of stock parameters, growth parameters.

The fourth column "Cond. Exp." Refers to the exponent in the model for relationship between length and weight. The other parameter in the length/weight relationship is the "condition factor", which is period specific, and therefore has been given a separate table (EXCEL Table 2.1.2)

Mean Body weight is derived from the body length

$$Wgt\ (St, y, a, q) = ConditionFactor\ (St, q) * Lgt(St, y, a, q)^{CondExp\ (St)}$$

The condition factors is assumed to depend on the time of the year, q. That means that the user has the option to let the condition factor vary over seasons of the year. The condition exponent is assumed to remain constant during the year.

The columns "Maturity L50%" and "Maturity L75%" are the parameters in the logistic model of maturity as a function of body length. Maturity ogive, that is the fraction of mature fish as a function of body length is

$$\mathrm{Mat(St, y, a, q)} = \frac{1}{1 + \exp(\mathrm{Mat1(St)} - \mathrm{Mat2(St)} * \mathrm{Lgt}(St, a, y, q))}$$

where

$Mat1(St) = \ln(3) * L_{50\%Mat}(St) / (L_{75\%Mat}(St) - L_{50\%Mat}(St))$, $Mat2(St) = \ln(3) / (L_{75\%Mat}(St) - L_{50\%Mat}(St))$ and

$L_{X\%DMat}(St)$ = Length at which X % are mature.

The columns RelStDev(K) and RelStDev(C.Fac) are parameters in the stochastic model of growth. The body length at age can be made a stochastic variable in TEMAS, by introduction of the stochastic factor, ε_K

$$Lgt\ (St,\ y,a,q) =$$

$$L_{\infty}(St) * \left(1 - \exp\left[-K\ (St) * \varepsilon_K(St,y) * (Age(a,q) - T_0(St)) \right] \right)\ if\ \ a \geq 2$$

$$Lgt\ (St,\ y,a,q,qa) =$$

$$L_{\infty}(St) * \left(1 - \exp\left[-K\ (St) * \varepsilon_K(St,y) * (Age(a,q,aq) - T_0(St)) \right] \right)\ if\ \ a \leq 2$$

where $\varepsilon_K(St,\ y)$ is a year and stock dependent normally distributed stochastic variable with mean value 1.0 and standard deviation RelStDev(K). The length/weight relationship can be made stochastic in TEMAS through the stochastic factor, ε_{QF}

$$Wgt\ (St,y,a,q) = QF\ (St,q) * \varepsilon_{QF}(St,y) * Lgt(St,y,a,q)^{QE\ (St)}$$

where $\varepsilon_{QF}(St,\ y) = (\varepsilon_K(St,\ y) + \varepsilon'_{QF}(St,\ y))/2$ and where $\varepsilon'_{QF}(St,\ y))$ is a year and stock dependent normally distributed stochastic variable with mean value 1.0 and standard deviation RelStDev(C.Fac). Body weight is assumed to be the same for stock, landings and discards in the operational model.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
21	**Table 2.2.1.**	**RECRUITMENT PARAMETERS**														
22		BH1 (1)	BH2 (1)	H-S Biom. (2)	H-S Const.Rec. (2)	H-S Slope (2)	Ricker coeff. (3)	Ricker Exp. (3)	D-S-Coeff.(1) (4)	D-S-Coeff.(2) (4)	D-S-Exp. (4)	RelStDev (R)	Freq.Outst. Yrs	Mag.Outst. Yrs	Autocorr.Outst.Yrs	Model Choice
23	West Cod	2	0.002	0	0	0	0	0	0	0	0	0	1	1	0	1
24	East cod	2	0.002	0	0	0	0	0	0	0	0	0	10	3	0	1
25																
26	**Table 2.2.2.**	**RECRUITMENT DISTRIBUTION ON PERIODS**														
27		Per. 1	Per. 2	Per. 3	Per. 4											
28	West Cod	0.75	0.25	0	0											
29	East cod	0.4	0.6	0	0											
30																
31	**Table 2.2.3.**	**RECRUITMENT DISTRIBUTION ON AREAS**														
32		West Baltic	East Baltic	Not Baltic	Bornholm	Gotland										
33	West Cod	1	0	0	0	0										
34	East cod	0	0.2	0	0.6	0.2										
35																
36	**Table 2.2.4.**	**LOW SPAWNING SUCCESS ON AREAS**														
37		West Baltic	East Baltic	Not Baltic	Bornholm	Gotland										
38	West Cod	1	1	1	1	1										
39	East cod	1	1	0.1	1	0.1										
40																
41	**Table 2.2.5.**	**HIGH SPAWNING SUCCESS ON AREAS**														
42		West Baltic	East Baltic	Not Baltic	Bornholm	Gotland										
43	West Cod	2	2	2	2	2										
44	East cod	1.5	1.5	0.1	2	2										
45																
46	**Table 2.2.6.**	**RECRUITMENT TREND OVER YEARS**														
47		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009					
48	West Cod	1	1	1	1	1	1	1	1	1	1					
49	East cod	1	1	1	1	1	1	1	1	1	1					
50																

S01_DIM | S02_STOCK | S03_FLEET | S04_EFFORT | S05_BOATS | S06_P

Figure 2.5.4. Second part of stock parameters, stock/recruitment parameters.

EXCEL Table 2.2.1 (Figure 2.5.4) contains the parameters of the chosen stock and recruitment model. There are four options, and the last column "Model Choice" points at the selected model. The four S/R-model options are:

1. Beverton and Holt stock/recruitment model	$$STR_1(SSB(St,y-1,\bullet,\bullet)) = \frac{BH1(St) * SSB(St,y-1,\bullet,\bullet)}{1 + BH2(St) * SSB(St,y-1,\bullet,\bullet)}$$ where BH1(St) and BH2(St) are the parameters. .
2. "Hockey stick" stock/recruitment model	If SSB > HSBiom(St) then $$STR_2(SSB(St,y-1,\bullet,\bullet)) = HSCon\,\mathrm{Re}\,c(St)$$

	If SSB < HSBiom(St) then $STR_2(SSB(St, y-1,\bullet,\bullet)) = HSSlope(St) * SSB(St, y-1,\bullet,\bullet)$ where the parameters are HSBiom(St) and HSConstRec(St).The slope is not a parameter as it is defined by the two parameters: HSSlope(St) = HSConstRec(St) / HSBiom(St).
3. Ricker stock/recruitment model	$STR_3(SSB(St, y-1,\bullet,\bullet)) =$ $Ric\ker Coeff(St) * SSB(St, y-1,\bullet,\bullet) * \exp(-Ric\ker Exp(St) * SSB(St, y-1,\bullet,\bullet))$ where the parameters are RickerCoeff(St) and RickerExp(St)
4. Deriso-Schnute stock / recruitment model	$STR_4(SSB(St, y-1,\bullet,\bullet)) = DSCoeff1(St) * SSB(St, y-1,\bullet,\bullet)$ $* \{ 1 - DSCoeff2(St) * SSB(St, y-1,\bullet,\bullet) \}^{DSExp(St)}$ where the parameters are: DSCoeff1(St), DSCoeff2(St) and DSExp(St)

It is only required to fill the parameters matching the choice of model. Parameters of other model can be assigned any values as they are ignored by the program. In the example of EXCEL Table 2.2.1, the Beverton and Holt model (Model no. 1) is chosen. Parameters of other models are zero.

The names of stock and recruitment parameters are explained in Table 2.5.2.

	Column name	Explanation
1	BH1 (1)	Beverton & Holt
2	BH2 (1)	Beverton & Holt
3	H-S Biom. (2)	Critical biomass in Hockey stick model
4	H-S Const.Rec. (2)	Constant recruitment in Hockey stick model
5	H-S Slope (2)	Slope of line in Hockey stick model
6	Ricker coeff. (3)	Coefficient in Ricker model
7	Ricker Exp. (3)	Exponent in Ricker Model
8	D-S-Coeff.(1) (4)	First coefficient in Deriso-schnute model
9	D-S-Coeff.(2) (4)	Second coefficient in Deriso-schnute model
10	D-S-Exp. (4)	Exponent in Deriso-schnute model
11	RelStDev(R)	Relative standard deviation of recruitment
12	Freq.Outst.Yrs	Frequency of outstanding years
13	Mag.Outst.Yrs	Magnitude of outstanding years
14	Autocorr.Outst.Yrs	Autocorrelation of outstanding years
15	Model Choice	1,2,3 or 4 (B&H, Hockey Stick, Ricker, Deriso-Schnute)

Table 2.5.2. Names of Stock recruitment parameters (EXCEL Table 2.2.1).

The parameter "RelStDev(R)" is a parameter in stochastic model of recruitment

$$Rec(St, y,\bullet,\bullet) = STR_X(SSB_{RV}(St, y-1,\bullet,\bullet)) * \varepsilon_{SR}(St)$$

Where $\varepsilon_{SR}(St) = \varepsilon_{SR1}(St) * R_{RepVol}(St)$

is the product of two stochastic factors of stock/recruitment relationship, of stock "St". The factor $\varepsilon_{SR1}(St)$ is a stock dependent log-normally distributed stochastic variable with mean value 1.0 and standard deviation RelStDev(R).

The factor $R_{RepVol}(St)$, the "reproductive volume factor", is specially designed to accommodate the dynamics of Baltic cod, where the recruitment is believed to be enhanced by large reproductive

volumes (outstanding years). This happens only in certain years, and $\varepsilon_{SR2}(St)$ is a uniformly distributed stochastic variable controlling a reproductive volume factor, $R_{RepVol}(St)$

$$R_{\mathrm{Re}\,pVol}(St)=\begin{cases} MagOutstYrs(St) \;\; if \;\; \varepsilon_{SR2}(st) \le IF\,\Pr(St,y) \\ 1 \;\; if \;\; \varepsilon_{SR2}(St) > IF\,\Pr(St,y) \end{cases}$$

Where the "Inflow probability" is given by the model

IFPr(Sy,y)=(1+AutocorrOutstYrs(St)*Inflow(y-1))/FreqOutstYrs(St)

Where AutocorrOutstYrs(St) is the autocorrelation parameter of inflow years. and FreqOutstYrs(St) is the average number of years between occurrences of large reproductive volumes. "MagOutstYrs(St)" is the average relative magnitude of recruitment in years of high reproductive volume.

Hereby all S/R parameter in EXCEL Table 2.2.1 have been explained.

EXCEL Tables 2.2.2 and 3 keeps the distribution of recruitment on periods and areas respectively. After the total stock recruitment is derived, it is subsequently distributed on areas and time periods by the input parameters, $\mathrm{RecDist}_{\mathrm{Area}}(St,Ar)$ and $\mathrm{RecDist}_{\mathrm{Period}}(St,q)$, the relative distribution of recruitment on areas and time periods.

$$\mathrm{Re}c(St,y,q,Ar)=\mathrm{Re}cDist_{Area}(St,Ar)*\mathrm{Re}cDist_{Period}(St,q)*STR_{X}(SSB_{RV}(St,y-1,\bullet,\bullet))$$

$$\mathrm{Re}cDist_{Area}(St,Ar)=\frac{\mathrm{Re}cruitment\;\; number\;\; in\;\; area\;\; "ar"}{Total\;\;\mathrm{Re}cruitment\;\; Number}=\frac{N(St,y,0,q,Ar)}{\sum_{i=1}^{Ar_{Max}}N(St,y,0,q,i)}$$

Thus, $\mathrm{RecDist}_{\mathrm{Area}}(St, Ar)$ is assumed to be independent of time period, "q". The distribution on time periods is defined the same way, $\mathrm{RecDist}_{\mathrm{Period}}(St, q)$ is assumed to be independent of area, "Ar".

EXCEL Tables 2.2.4 and 5 contain the spawning success parameters, rfs, for low success and high success respectively. These parameters are used to define the SSB (Spawning stock biomass) in two aleternative cases, namely when the year is an inflow year and when it is not an inflow year.

$$SSB_{RV}(St,y,\bullet,\bullet)=\sum_{q=1}^{q_{Max}}\sum_{Ar=1}^{Ar_{Max}}\sum_{a=0}^{a_{Max}(St)}N_{Mean}(St,y,a,q,Ar)*$$

$$Wgt(St,y,a,q)*Mat(St,a,q)*RDist_{Period}(St,q)*RSF_{MPA}(St,Ar)$$

$$RSF_{MPA}(St,Ar,\varepsilon_{SR2}(St))=\begin{cases} rsf_{NotMPA}(St,Ar,\varepsilon_{SR2}(St)) \;\; if \;\; Ar \ne MPA \\ 1 \;\; if \;\; Ar = MPA \end{cases}$$

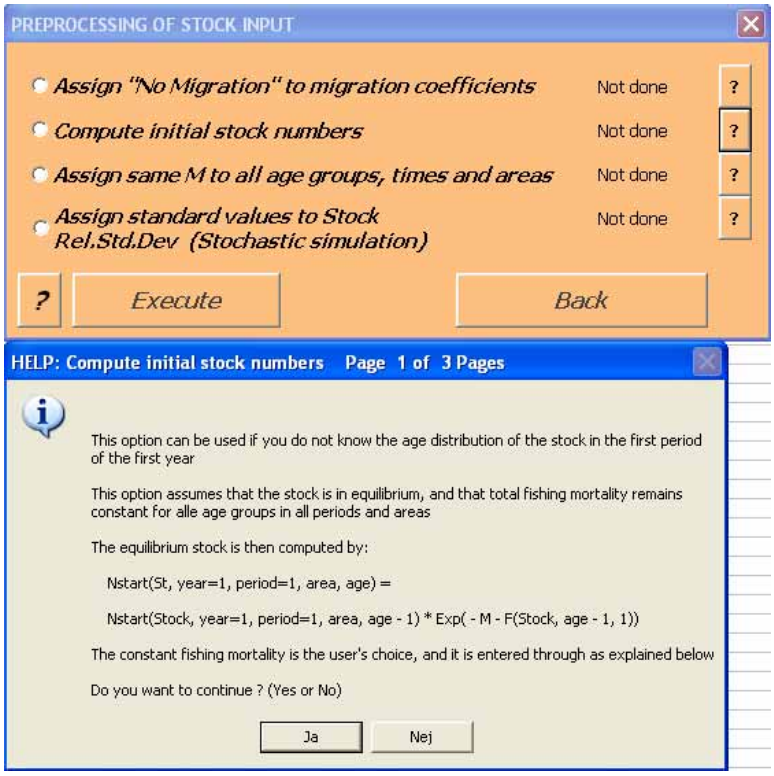
where the "Spawning success factor" is defined as

$$rsf_{NotMPA}(St,Ar,\varepsilon_{SR2}(St))=\begin{cases} rsf^{High}_{NotMPA}(St,Ar,\varepsilon_{SR2}(St)) \;\; if \;\; \varepsilon_{SR2}(St) \le IF\,\Pr(St,y) \\ rsf^{Low}_{NotMPA}(St,Ar,\varepsilon_{SR2}(St)) \;\; if \;\; \varepsilon_{SR2}(St) > IF\,\Pr(St,y) \end{cases}$$

where $0 \le rsf^{Low}_{NotMPA}(St,Ar,\varepsilon_{SR2}(St)) \le rsf^{High}_{NotMPA}(St,Ar,\varepsilon_{SR2}(St)) \le 1$

EXCEL Table 2.2.6 is the last recruitment parameter table. It contains the exogenous recruitment trend parameters. TEMAS allows for analysing the effect of a "recruitment trend", that is, analysing the effect of average recruitment slowly going downwards or going upwards.

$$Rec(St, y, q, Ar) = RecDist_{Area}(St, Ar) * RecDist_{Period}(St, q) * STR_X(SSB_{RV}(St, y-1, \bullet, \bullet)) * RecTrend(St, y) \quad (A.9.2.3)$$



RecTrend(St,y) can be any function of y (year). Recruitment sometimes shows such a trend over a long series of years, for reasons which are not understood by science. As such phenomena do occur in reality, and sometimes with catastrophic consequences for fisheries and ecosystem, they are accounted for as exogenous impacts.
Thus RecTrend(St,y) can take any value (based on any assumption) the user of TEMAS want to test.

EXCEL Table 2.3.1and 2 (Figure 2.5.5.a) contain the initial stock numbers in each area for juveniles and adults respectively. The initial stock numbers can be given as input, or they can be computed by the program under the assumption of equilibrium and constant fishing mortality (constant over age groups). This is an option in the userform "PRE-PROCES-SING OF STOCK INPUT", which will be discussed below Figures 2.5.5.b shows the input to a calculation of initial stock numbers, and Figure 2.5.5.c shows the result of the calculation.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
50														
51	**Table 2.3.1.**	**STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 0- 1**												
52		West Cod - West Baltic	West Cod - East Baltic	West Cod - Not Baltic	West Cod - Bornholm	West Cod - Gotland	East cod - West Baltic	East cod - East Baltic	East cod - Not Baltic	East cod - Bornholm	East cod - Gotland			
53	Age 0 - Per. 1	7500	0	0	0	0	0	800	0	2400	800	Enter O-group, period 1, here for calculation of initial N		
54	Age 0 - Per. 2	0	0	0	0	0	0	0	0	0	0	Enter O-group, period 2, here for calculation of initial N		
55	Age 0 - Per. 3	0	0	0	0	0	0	0	0	0	0	Enter O-group, period 3, here for calculation of initial N		
56	Age 0 - Per. 4	1372.03	0	0	0	0	0	658.574	0	1975.72	658.574	Enter O-group, period 4, here for calculation of initial N		
57	Age 1 - Per. 1	3369.97	0	0	0	0	0	359.463	0	1078.39	359.463	Enter constant Fs here for calculation of initial N		
58	Age 1 - Per. 2	0	0	0	0	0	0	0	0	0	0			
59	Age 1 - Per. 3	0	0	0	0	0	0	0	0	0	0			
60	Age 1 - Per. 4	616.492	0	0	0	0	0	295.916	0	887.749	295.916			
61														
62	**Table 2.3.2.**	**STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 2+**												
63		West Cod - West Baltic	West Cod - East Baltic	West Cod - Not Baltic	West Cod - Bornholm	West Cod - Gotland	East cod - West Baltic	East cod - East Baltic	East cod - Not Baltic	East cod - Bornholm	East cod - Gotland			
64	Age 2	1108.03	0	0	0	0	0	221.606	0	664.819	221.606			
65	Age 3	497.871	0	0	0	0	0	99.5741	0	298.722	99.5741			
66	Age 4	223.708	0	0	0	0	0	44.7415	0	134.225	44.7415			
67														

S01_DIM / Ark1 \ S02_STOCK / S03_FLEET / S04_EFFORT / S05_BOATS

Klar

Figure 2.5.5.a. Third part of stock parameters, stock numbers first period of first year.

Table 2.3.1.	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 0- 1										
	West Cod - West Baltic	West Cod - East Baltic	West Cod - Not Baltic	West Cod - Bornholm	West Cod - Gotland	East cod - West Baltic	East cod - East Baltic	East cod - Not Baltic	East cod - Bornholm	East cod - Gotland	
Age 0 - Per. 1	75000	0	0	0	0	0	5000	0	15000	5000	Enter O-group, period 1, here for calcu
Age 0 - Per. 2	0	0	0	0	0	0	0	0	0	0	Enter O-group, period 2, here for calcu
Age 0 - Per. 3	0	0	0	0	0	0	0	0	0	0	Enter O-group, period 3, here for calcu
Age 0 - Per. 4	20000	0	0	0	0	0	5000	0	15000	5000	Enter O-group, period 4, here for calcu
Age 1 - Per. 1	0.5	0	0	0	0	0	0.5	0	0.5	0.5	Enter constant Fs here for calculation
Age 1 - Per. 2	0	0	0	0	0	0	0	0	0	0	
Age 1 - Per. 3	0	0	0	0	0	0	0	0	0	0	
Age 1 - Per. 4	0	0	0	0	0	0	0	0	0	0	

Table 2.3.2.	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 2+									
	West Cod - West Baltic	West Cod - East Baltic	West Cod - Not Baltic	West Cod - Bornholm	West Cod - Gotland	East cod - West Baltic	East cod - East Baltic	East cod - Not Baltic	East cod - Bornholm	East cod - Gotland
Age 2	0	0	0	0	0	0	0	0	0	0
Age 3	0	0	0	0	0	0	0	0	0	0
Age 4	0	0	0	0	0	0	0	0	0	0

Figure 2.5.5.b. Input for calculation of initial stock numbers. Input data are in the gray and orange coloured cells. Note that the constant fishing mortality is given in the row for period 1 age group 1. The yellow cells are used for input in this special case.

Table 2.3.1.	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 0- 1										
	West Cod - West Baltic	West Cod - East Baltic	West Cod - Not Baltic	West Cod - Bornholm	West Cod - Gotland	East cod - West Baltic	East cod - East Baltic	East cod - Not Baltic	East cod - Bornholm	East cod - Gotland	
Age 0 - Per. 1	56250.0	0.0	0.0	0.0	0.0	0.0	2000.0	0.0	6000.0	2000.0	Enter O-group, period 1, here f
Age 0 - Per. 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Enter O-group, period 2, here f
Age 0 - Per. 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Enter O-group, period 3, here f
Age 0 - Per. 4	16091.7	0.0	0.0	0.0	0.0	0.0	4709.3	0.0	14128.1	4709.3	Enter O-group, period 4, here f
Age 1 - Per. 1	40524.8	0.0	0.0	0.0	0.0	0.0	2602.8	0.0	7808.4	2602.8	Enter constant Fs here for cal
Age 1 - Per. 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Age 1 - Per. 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Age 1 - Per. 4	7990.9	0.0	0.0	0.0	0.0	0.0	2224.5	0.0	6673.6	2224.5	

Table 2.3.2.	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 2+									
	West Cod - West Baltic	West Cod - East Baltic	West Cod - Not Baltic	West Cod - Bornholm	West Cod - Gotland	East cod - West Baltic	East cod - East Baltic	East cod - Not Baltic	East cod - Bornholm	East cod - Gotland
Age 2	40726.8	0.0	0.0	0.0	0.0	0.0	4002.0	0.0	12006.0	4002.0
Age 3	20224.3	0.0	0.0	0.0	0.0	0.0	1890.4	0.0	5671.2	1890.4
Age 4	10043.1	0.0	0.0	0.0	0.0	0.0	893.0	0.0	2678.9	893.0

Figure 2.5.5.c. Result of the calculation with input from Figure 2.5.5.b.

The calculations are straight forward, and are done in first quarter of first year, as if it was over a time span of a_{Max}(St) years.

	A	B	C	D	E	F	G
68	Table 2.4.1.	WEIGHTING FACTORS FOR MEAN F CALCULATION - Age 0- 1					
69		West Cod	East cod				
70	Age 0 - Per. 1	0	0				
71	Age 0 - Per. 2	0	0				
72	Age 0 - Per. 3	0	0				
73	Age 0 - Per. 4	0	0				
74	Age 1 - Per. 1	0	0				
75	Age 1 - Per. 2	0	0				
76	Age 1 - Per. 3	0	0				
77	Age 1 - Per. 4	0	0				
78							
79	Table 2.4.2.	WEIGHTING FACTORS FOR MEAN F CALCULATION - Age 2+					
80		West Cod	East cod				
81	Age 2	1	1				
82	Age 3	1	1				
83	Age 4	1	1				
84							

S01_DIM | S02_STOCK | S03_FLE

Figure 2.5.6. Sixth part of stock parameters, Weighting factors for calculation of mean F.

Figure 2.5.6 (EXCEL Tables 2.4.1 and 2) show the weighting factors (WF) in the calculation of stock mean F.

$$F_{Mean}(St) = \frac{\sum_{a=0}^{a_{Max}(St)} F(St,a) * WF(St,a)}{\sum_{a=0}^{a_{Max}(St)} WF(St,a)}$$

These weighting factors can be used to compute the traditional mean F as presented by ICES Working Groups, with WF(St,a) = 1 or 0. The example above corresponds to the ICES concept of $F_{Mean}(2\text{-}4)$

Figures 2.5.7.a-c. (EXCEL Tables 2.5.1-4) show the migration coefficients. The full set of migration coefficients for one species (Eastern cod) is presented in Table 2.5.3 as an example.

The migration is modelled in a time discrete manner:

a) Migration takes place at the end of each time period and the process of migration takes zero time.
b) During a time period the fish/shrimps are assumed to be homogeneously distributed within the area.

The "Migration Coefficient", MC, from area A to area B is defined as the fraction of the animals in area A which moves to area B. In this definition, the "movements" include the "move" from area A to area A, i.e., the event that the animal does not move. The migration coefficient depends on (or has the indices):
FAr: Starting area TAr: Destination area
Note that the sum of migration coefficients over destination areas always becomes 1.0, as the starting area is also considered a destination area: $1.0 = \sum_{TAr} MC(FAr, TAr, q, a)$ where a = age group and q = time period (division of year).

Note that there are two tables for each species

1) Migration coefficients for age groups 0 and 1 (each year with Q_{Max} .period cohorts)
2) Migration coefficient for age groups 2 to $a_{Max}(St)$ with one (combined) age group each year.

Each of these tables are organised so that columns comes in period groups (Figure 2.5.7.a)

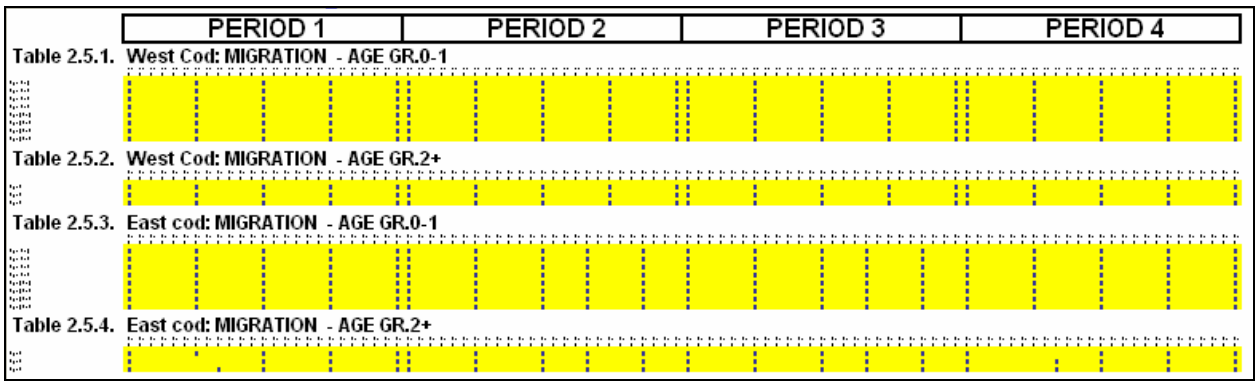


Figure 2.5.7.a. Third part of stock parameters. Migration coefficient for Eastern Cod. The EXCEL sheet is reduced to a size so that all periods are displayed. Details are not detectable.

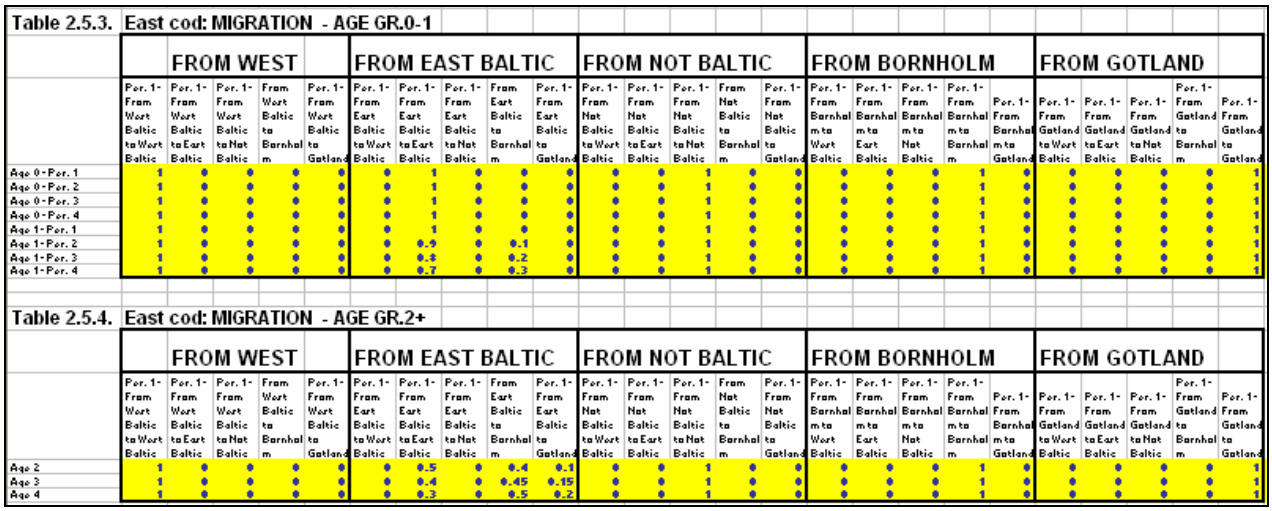


Table 2.5.3. East cod: MIGRATION - AGE GR.0-1

	FROM WEST					FROM EAST BALTIC					FROM NOT BALTIC					FROM BORNHOLM					FROM GOTLAND				
	Per. 1-From West Baltic to West Baltic	Per. 1-From West Baltic to East Baltic	Per. 1-From West Baltic to Not Baltic	From West Baltic to Bornholm	Per. 1-From West Baltic to Gotland	Per. 1-From East Baltic to West Baltic	Per. 1-From East Baltic to East Baltic	Per. 1-From East Baltic to Not Baltic	From East Baltic to Bornholm	Per. 1-From East Baltic to Gotland	Per. 1-From Not Baltic to West Baltic	Per. 1-From Not Baltic to East Baltic	Per. 1-From Not Baltic to Not Baltic	From Not Baltic to Bornholm	Per. 1-From Not Baltic to Gotland	Per. 1-From Bornholm to West Baltic	Per. 1-From Bornholm to East Baltic	Per. 1-From Bornholm to Not Baltic	From Bornholm to Bornholm	Per. 1-From Bornholm to Gotland	Per. 1-From Gotland to West Baltic	Per. 1-From Gotland to East Baltic	Per. 1-From Gotland to Not Baltic	Per. 1-From Gotland to Bornholm	Per. 1-From Gotland to Gotland
Age 0 - Per. 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 0 - Per. 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 0 - Per. 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 0 - Per. 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 1 - Per. 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 1 - Per. 2	1	0	0	0	0	0	0.9	0	0.1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 1 - Per. 3	1	0	0	0	0	0	0.8	0	0.2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 1 - Per. 4	1	0	0	0	0	0	0.7	0	0.3	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0

Table 2.5.4. East cod: MIGRATION - AGE GR.2+

	FROM WEST					FROM EAST BALTIC					FROM NOT BALTIC					FROM BORNHOLM					FROM GOTLAND				
	Per. 1-From West Baltic to West Baltic	Per. 1-From West Baltic to East Baltic	Per. 1-From West Baltic to Not Baltic	From West Baltic to Bornholm	Per. 1-From West Baltic to Gotland	Per. 1-From East Baltic to West Baltic	Per. 1-From East Baltic to East Baltic	Per. 1-From East Baltic to Not Baltic	From East Baltic to Bornholm	Per. 1-From East Baltic to Gotland	Per. 1-From Not Baltic to West Baltic	Per. 1-From Not Baltic to East Baltic	Per. 1-From Not Baltic to Not Baltic	From Not Baltic to Bornholm	Per. 1-From Not Baltic to Gotland	Per. 1-From Bornholm to West Baltic	Per. 1-From Bornholm to East Baltic	Per. 1-From Bornholm to Not Baltic	From Bornholm to Bornholm	Per. 1-From Bornholm to Gotland	Per. 1-From Gotland to West Baltic	Per. 1-From Gotland to East Baltic	Per. 1-From Gotland to Not Baltic	Per. 1-From Gotland to Bornholm	Per. 1-From Gotland to Gotland
Age 2	1	0	0	0	0	0	0.5	0	0.4	0.1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 3	1	0	0	0	0	0	0.4	0	0.45	0.15	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
Age 4	1	0	0	0	0	0	0.3	0	0.5	0.2	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0

Figure 2.5.7.b. Third part of stock parameters. Migration coefficient for Eastern Cod, first period. The EXCEL sheet is reduced to a size so that all "From area"'s are displayed. Details are not detectable.

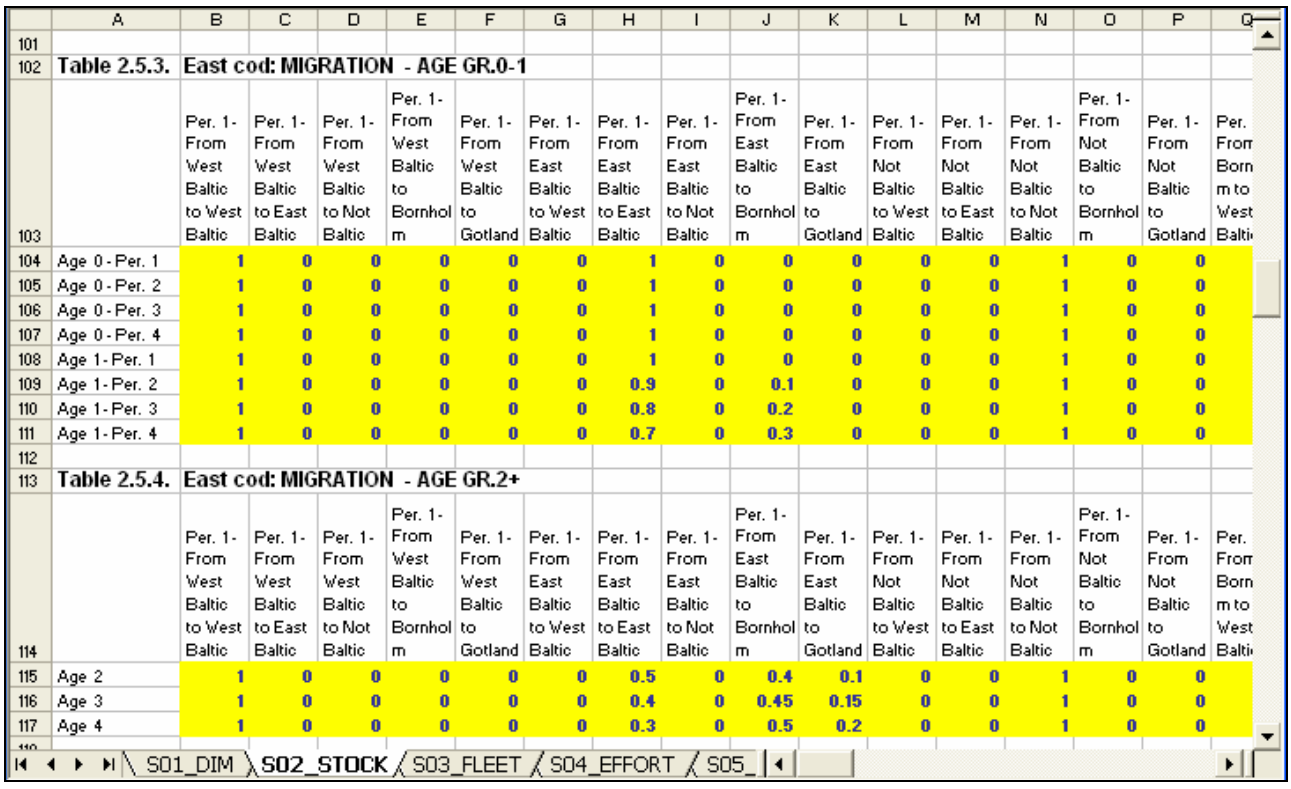


Table 2.5.3. East cod: MIGRATION - AGE GR.0-1

		Per. 1-From West Baltic to West Baltic	Per. 1-From West Baltic to East Baltic	Per. 1-From West Baltic to Not Baltic	Per. 1-From West Baltic to Bornholm	Per. 1-From West Baltic to Gotland	Per. 1-From East Baltic to West Baltic	Per. 1-From East Baltic to East Baltic	Per. 1-From East Baltic to Not Baltic	Per. 1-From East Baltic to Bornholm	Per. 1-From East Baltic to Gotland	Per. 1-From Not Baltic to West Baltic	Per. 1-From Not Baltic to East Baltic	Per. 1-From Not Baltic to Not Baltic	Per. 1-From Not Baltic to Bornholm	Per. 1-From Not Baltic to Gotland	Per. From Bornholm to West Baltic
104	Age 0 - Per. 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	
105	Age 0 - Per. 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	
106	Age 0 - Per. 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	
107	Age 0 - Per. 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	
108	Age 1 - Per. 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	
109	Age 1 - Per. 2	1	0	0	0	0	0	0.9	0	0.1	0	0	0	1	0	0	
110	Age 1 - Per. 3	1	0	0	0	0	0	0.8	0	0.2	0	0	0	1	0	0	
111	Age 1 - Per. 4	1	0	0	0	0	0	0.7	0	0.3	0	0	0	1	0	0	

Table 2.5.4. East cod: MIGRATION - AGE GR.2+

		Per. 1-From West Baltic to West Baltic	Per. 1-From West Baltic to East Baltic	Per. 1-From West Baltic to Not Baltic	Per. 1-From West Baltic to Bornholm	Per. 1-From West Baltic to Gotland	Per. 1-From East Baltic to West Baltic	Per. 1-From East Baltic to East Baltic	Per. 1-From East Baltic to Not Baltic	Per. 1-From East Baltic to Bornholm	Per. 1-From East Baltic to Gotland	Per. 1-From Not Baltic to West Baltic	Per. 1-From Not Baltic to East Baltic	Per. 1-From Not Baltic to Not Baltic	Per. 1-From Not Baltic to Bornholm	Per. 1-From Not Baltic to Gotland	Per. From Bornholm to West Baltic
115	Age 2	1	0	0	0	0	0	0.5	0	0.4	0.1	0	0	1	0	0	
116	Age 3	1	0	0	0	0	0	0.4	0	0.45	0.15	0	0	1	0	0	
117	Age 4	1	0	0	0	0	0	0.3	0	0.5	0.2	0	0	1	0	0	

S01_DIM | S02_STOCK | S03_FLEET | S04_EFFORT | S05_

Figure 2.5.7.c. Third part of stock parameters. Some Migration coefficient for Eastern Cod. Only in Figure c are details visible.

Q1																									
From:	West					East					Not Batlic					Bornholm					Gotland				
to:	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G
A 0 - Q 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 0 - Q 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 0 - Q 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 0 - Q 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 2	1	0	0	0	0	0	**0.9**	0	**0.1**	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 3	1	0	0	0	0	0	**0.8**	0	**0.2**	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 4	1	0	0	0	0	0	**0.7**	0	**0.3**	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 2	1	0	0	0	0	0	**0.5**	0	**0.4**	**0.1**	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 3	1	0	0	0	0	0	**0.4**	0	**0.5**	**0.15**	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 4	1	0	0	0	0	0	**0.3**	0	**0.5**	**0.2**	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1

Q2																									
From:	West					East					Not Batlic					Bornholm					Gotland				
to:	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G
A 0 - Q 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 0 - Q 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 0 - Q 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 0 - Q 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3

Q3																									
From:	West					East					Not Batlic					Bornholm					Gotland				
to:	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G
A 0 - Q 1	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 0 - Q 2	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 0 - Q 3	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 0 - Q 4	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 1	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 2	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 3	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 1 - Q 4	1	0	0	0	0	0	0.67	0	0.2	0.13	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3
A 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.6	0	0.2	0.2	0	0.5	0	0.2	0.3

Q4																									
From:	West					East					Not Batlic					Bornholm					Gotland				
to:	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G	W	E	N	B	G
A 0 - Q 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 0 - Q 2	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 0 - Q 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 0 - Q 4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 2	1	0	0	0	0	0	0.87	0	0.1	0.03	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 3	1	0	0	0	0	0	0.85	0	0.2	0.05	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 1 - Q 4	1	0	0	0	0	0	0.7	0	0.2	0.1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 2	1	0	0	0	0	0	0.4	0	0.4	0.2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 3	1	0	0	0	0	0	0.3	0	0.6	0.15	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
A 4	1	0	0	0	0	0	0.2	0	0.7	0.15	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1

Table 2.5.3. Migration coefficients for Eastern cod.(W:West, E:East, N:Not Baltic, B:Bornholm, G:Gotland)

Within each period, the columns are organised in groups according to where the migration starts, that from which area the migration starts (Figure 2.5.7.b). In the present case there are five areas. From each of these five areas the migration can go to 5 areas (as staying in the area is also an option for migration, i.e. no migration). As appears it is not possible to make a readable version of the EXCEL table, and therefore, Table2.5.3 was made. Table 2.5.7.c shows a part of the EXCEL table with all details visible.

Table 2.5.2 is reorganized to match the A4 format, so that period groups are placed on top of each other.

There are no movements in the two areas "West" and "Not Baltic" in the hypothetical example of Table 2.5.3. This is because "From West to West" is 1 and other cells 0. And from "Not Baltic to Not Baltic" is 1 and other cells 0. Thus is this example the movements are only between East, Bornholm and Gotland.

To explain the nature of "migration coefficients" the text below translate to migration matrix in Table 2.5.3 into words:

Movements in Quarter 1:

Ages 0-1: Movements from East to Bornholm, but only age gr 1.
No movements out of Bornholm or Gotland

Ages 2-4: Movements from East to Bornholm and Gotland.
No movements out of Bornholm or Gotland

Movements in Quarter 2:

Ages 0-4: 60% moves from Bornholm to East, 20% to Gotland, 20% remain in Bornholm
50% moves Gotland to East, 20% tol Bornholm and 30% remain in Gotland
No movements out of East Baltic

Movements in Quarter 3:

Ages 0-1: 20% moves from East to Bornholm, 13% moves to Gotland and 67% remain in East
60% moves from Bornholm to East, 20% to Gotland and 20% remain in Bornholm
50% moves from Gotland to East, 20% to Gotland and 30% remain in Gotland.

Ages 2-4: No movements out of East.
60% moves from Bornholm to East, 20% to Gotland and 20% remain in Bornholm
50% moves from Gotland to East, 20% to Gotland and 30% remain in Gotland.

Movements in Quarter 4:

Ages 0-4: No movements in age group 0. No movements out of Bornholm and Gotland.
Some movements from East to Bornholm and Gotland.

The last stock-table (EXCEL Table 2.6.1) is shown in Figure 2.5.8.a-b. It contains the natural mortality (M).
Here it is possible to let natural mortality depend on area, time and age. Figure 2.5.8 shows the organization of the EXCEL table for one stock. The columns are the years divided into periods, and the rows are the areas and the age/period groups. In this case, however, the traditional "ICES approach" to let M = 0.2 for all ages to all times in all areas. In that case you may either use the facilities of EXCEL to fill in the table with 0.2 everywhere (you may here ignore that some cells contain the text "No value"), or you use the "pre-processing of stock-data" (Figure 2.5.9). The option "Assign same "M to all age groups, times and areas" will take the value in the upper left corner of the table (indicated with a red frame in Figure 2.5.9) and use that value elsewhere in the table.

The option for calculation of initial stock size has already been discussed. The option for "no migration" assigns 0 and 1 to all migration coefficients

$$MC(\ from\ \ Area\ \ A,\quad to\ \ Area\ \ B) = \begin{cases} 1\ \ if\ \ A = B \\ 0\ \ otherwise \end{cases}$$

The standard values of relative standard deviations for stochastic simulation are

Rel. Std.Dev. Von Bertalanffy parameter, K, = 0.1 (normally distributed)
Rel. Std.Dev. of Condition Factor = 0.1 (normally distributed)
Rel. Std.Dev. of Recruitment = 0.5 (log-normally distributed)
Rel. Std.Dev. of Catchability, Q, = 0.1 (normally distributed)

Figure 2.5.8.b. Fourth part of stock parameters. Natural mortalities.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
118															
119	Table 2.6.1.	NATURAL MORTALITY - West Cod													
120		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2
121	Age 0 Per. 1 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
122	Age 0 Per. 2 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
123	Age 0 Per. 3 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
124	Age 0 Per. 4 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
125	Age 1 Per. 1 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
126	Age 1 Per. 2 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
127	Age 1 Per. 3 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
128	Age 1 Per. 4 Area: West Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
129	Age 2 Per. 1 Area: West Baltic	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Va
130	Age 2 Per. 2 Area: West Baltic	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2
131	Age 2 Per. 3 Area: West Baltic	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Va
132	Age 2 Per. 4 Area: West Baltic	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Va
133	Age 3 Per. 1 Area: West Baltic	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Va
134	Age 3 Per. 2 Area: West Baltic	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2
135	Age 3 Per. 3 Area: West Baltic	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Va
136	Age 3 Per. 4 Area: West Baltic	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Va
137	Age 4 Per. 1 Area: West Baltic	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Va
138	Age 4 Per. 2 Area: West Baltic	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2
139	Age 4 Per. 3 Area: West Baltic	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Va
140	Age 4 Per. 4 Area: West Baltic	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Va
141	Age 0 Per. 1 Area: East Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
142	Age 0 Per. 2 Area: East Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
143	Age 0 Per. 3 Area: East Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
144	Age 0 Per. 4 Area: East Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
145	Age 1 Per. 1 Area: East Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

S01 DIM | S02 STOCK | S03 FLEET | S04 EFFORT | S05

Figure 2.5.8.b. Fourth part of stock parameters. Some Natural mortalities.

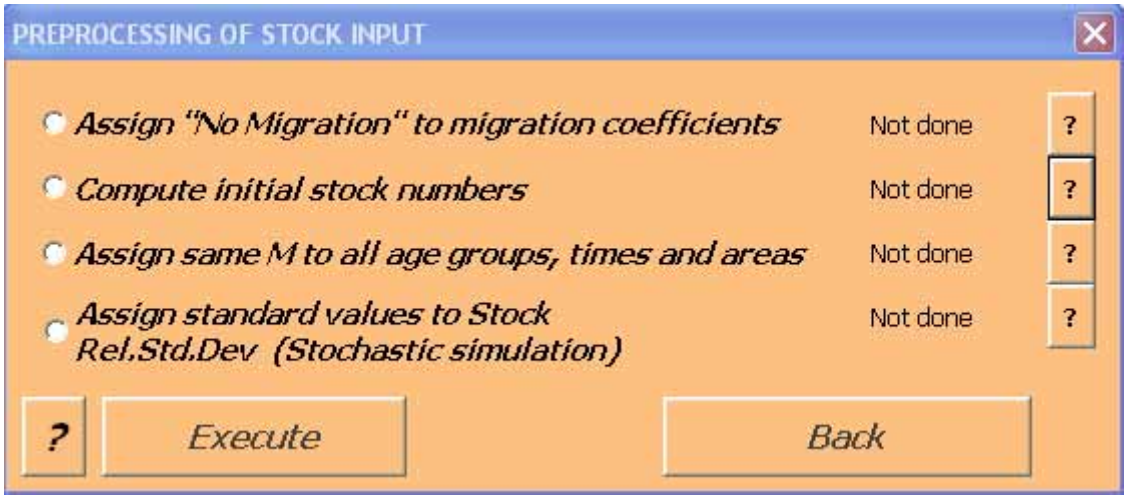


Figure 2.5.9. Options for pre-processing of stock parameters.

2.6. FLEET INPUT, S03_FLEET

Figure 2.6.1 shows the input user-form for worksheet "S03_FLEET", fleet structured input. The layout of the userform is the same as the userform for the stock-structured input, S02_STOCK .

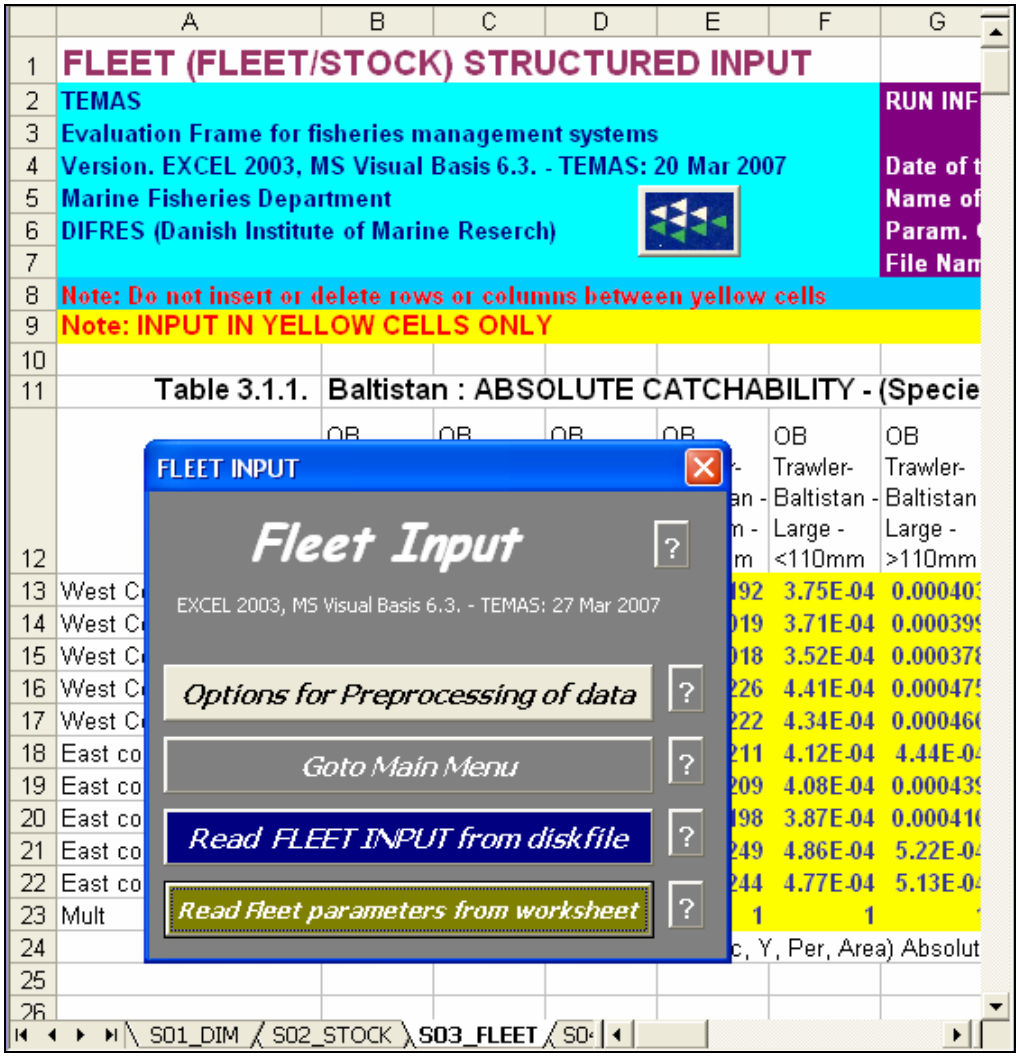


Figure 2.6.1. User-form for entry of fleet related parameters.

Table 2.6.1 lists the tables in userform S03_FLEET. Note that all tables in S03_FLEETS are country-specific. The parameters in the fleet-structured tables are all related to the relationship between effort and area fishing mortality. Area-Fishing mortality is the sum of area-landing mortality and area-discard mortality:

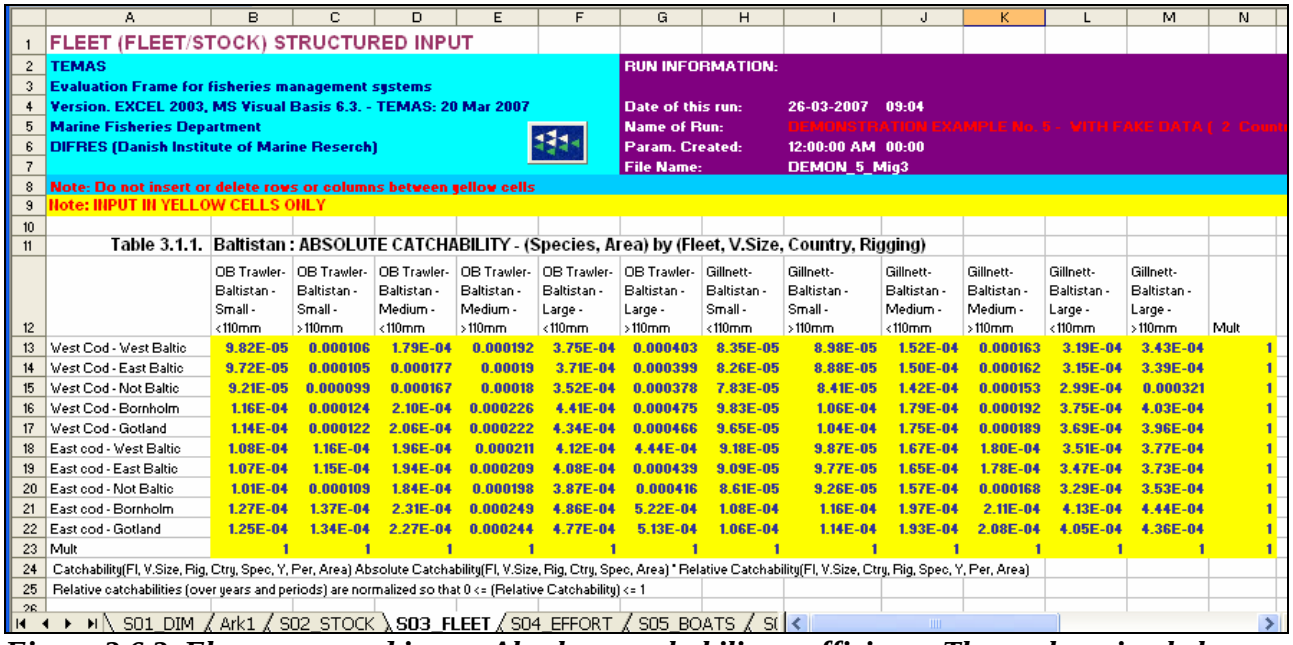
$F(Fl, Vs, Rg, Ct, St, y, a, q, Ar) = F_{land}(-) + F_{disc}(-)$

Where "(-)" indicates the full set of indices "(Fl, Vs, Rg, Ct, St, y, a, q, Ar)" and
$F_{land}(-)$ = Area-landing mortality, $F_{disc}(-)$ = Area-discard mortality and
$F(-)$ = Area-Fishing mortality.

They are defined by: $F_{land}(-) = F(-) * (1 - DIS(-))$ and $F_{disc}(-) = F(-) * DIS(-)$,
where DIS = fraction of fish caught, which are discarded. The discard ogive gives the fraction of fish discarded (for any reason) as a function of body length, is modelled by "one minus the logistic curve":

Index	EXCEL Table	Caption
41	Table3.1.1.	Baltistan : ABSOLUTE CATCHABILITY
42	Table3.1.2.	Baltistan : PARAMETERS IN MODEL FOR CATCHABILITY
43	Table3.1.3.	Scandinavia : ABSOLUTE CATCHABILITY
44	Table3.1.4.	Scandinavia : PARAMETERS IN MODEL FOR CATCHABILITY
45	Table3.2.1.	Baltistan : MESH SIZE (generalized concept)
46	Table3.2.2.	Baltistan : GEAR SELECTION FACTOR
47	Table3.2.3.	Baltistan : GEAR SELECTION RANGE
48	Table3.2.4.	Baltistan : DISCARDS L50%
49	Table3.2.5.	Baltistan : DISCARDS L75%
50	Table3.2.6.1.	Baltistan : West Baltic RELATIVE (PERIOD) CATCHABILITY
51	Table3.2.6.2.	Baltistan : East Baltic RELATIVE (PERIOD) CATCHABILITY
52	Table3.2.6.3.	Baltistan : Not Baltic RELATIVE (PERIOD) CATCHABILITY
53	Table3.2.6.4.	Baltistan : Bornholm RELATIVE (PERIOD) CATCHABILITY
54	Table3.2.6.5.	Baltistan : Gotland RELATIVE (PERIOD) CATCHABILITY
55	Table3.2.7	Scandinavia : MESH SIZE (generalized concept)
56	Table3.2.8	Scandinavia : GEAR SELECTION FACTOR
57	Table3.2.9	Scandinavia : GEAR SELECTION RANGE
58	Table3.2.10	Scandinavia : DISCARDS L50%
59	Table3.2.11.	Scandinavia : DISCARDS L75%
60	Table3.2.12.1.	Scandinavia : West Baltic RELATIVE (PERIOD) CATCHABILITY
61	Table3.2.12.2.	Scandinavia : East Baltic RELATIVE (PERIOD) CATCHABILITY
62	Table3.2.12.3.	Scandinavia : Not Baltic RELATIVE (PERIOD) CATCHABILITY
63	Table3.2.12.4.	Scandinavia : Bornholm RELATIVE (PERIOD) CATCHABILITY
64	Table3.2.12.5.	Scandinavia : Gotland RELATIVE (PERIOD) CATCHABILITY

Table 2.6.1. Tables in the Fleet input sheet, S03_FLEET.



FLEET (FLEET/STOCK) STRUCTURED INPUT

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

RUN INFORMATION:
Date of this run: 26-03-2007 09:04
Name of Run: DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA (2 Countr
Param. Created: 12:00:00 AM 00:00
File Name: DEMON_5_Mig3

Note: Do not insert or delete rows or columns between yellow cells
Note: INPUT IN YELLOW CELLS ONLY

Table 3.1.1. Baltistan : ABSOLUTE CATCHABILITY - (Species, Area) by (Fleet, V.Size, Country, Rigging)

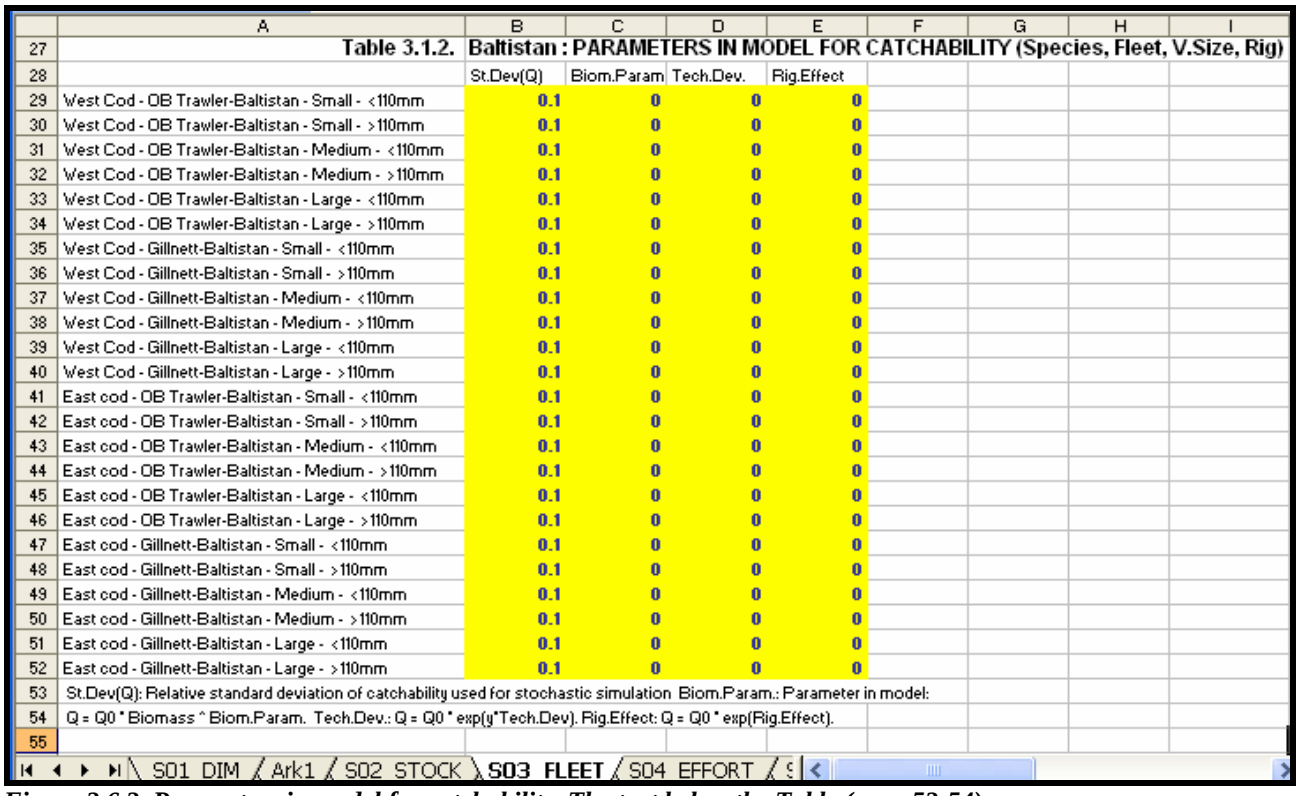
	OB Trawler-Baltistan - Small - <110mm	OB Trawler-Baltistan - Small - >110mm	OB Trawler-Baltistan - Medium - <110mm	OB Trawler-Baltistan - Medium - >110mm	OB Trawler-Baltistan - Large - <110mm	OB Trawler-Baltistan - Large - >110mm	Gillnett-Baltistan - Small - <110mm	Gillnett-Baltistan - Small - >110mm	Gillnett-Baltistan - Medium - <110mm	Gillnett-Baltistan - Medium - >110mm	Gillnett-Baltistan - Large - <110mm	Gillnett-Baltistan - Large - >110mm	Mult
West Cod - West Baltic	9.82E-05	0.000106	1.79E-04	0.000192	3.75E-04	0.000403	8.35E-05	8.98E-05	1.52E-04	0.000163	3.19E-04	3.43E-04	1
West Cod - East Baltic	9.72E-05	0.000105	0.000177	0.00019	3.71E-04	0.000399	8.26E-05	8.88E-05	1.50E-04	0.000162	3.15E-04	3.39E-04	1
West Cod - Not Baltic	9.21E-05	0.000099	0.000167	0.00018	3.52E-04	0.000378	7.83E-05	8.41E-05	1.42E-04	0.000153	2.99E-04	0.000321	1
West Cod - Bornholm	1.16E-04	0.000124	2.10E-04	0.000226	4.41E-04	0.000475	9.83E-05	1.06E-04	1.79E-04	0.000192	3.75E-04	4.03E-04	1
West Cod - Gotland	1.14E-04	0.000122	2.06E-04	0.000222	4.34E-04	0.000466	9.65E-05	1.04E-04	1.75E-04	0.000189	3.69E-04	3.96E-04	1
East cod - West Baltic	1.08E-04	1.16E-04	1.96E-04	0.000211	4.12E-04	4.44E-04	9.18E-05	9.87E-05	1.67E-04	1.80E-04	3.51E-04	3.77E-04	1
East cod - East Baltic	1.07E-04	1.15E-04	1.94E-04	0.000209	4.08E-04	0.000439	9.09E-05	9.77E-05	1.65E-04	1.78E-04	3.47E-04	3.73E-04	1
East cod - Not Baltic	1.01E-04	0.000109	1.84E-04	0.000198	3.87E-04	0.000416	8.61E-05	9.26E-05	1.57E-04	0.000168	3.29E-04	3.53E-04	1
East cod - Bornholm	1.27E-04	1.37E-04	2.31E-04	0.000249	4.86E-04	5.22E-04	1.08E-04	1.16E-04	1.97E-04	2.11E-04	4.13E-04	4.44E-04	1
East cod - Gotland	1.25E-04	1.34E-04	2.27E-04	0.000244	4.77E-04	5.13E-04	1.06E-04	1.14E-04	1.93E-04	2.08E-04	4.05E-04	4.36E-04	1
Mult	1	1	1	1	1	1	1	1	1	1	1	1	1

Catchability(Fl, V.Size, Rig, Ctry, Spec, Y, Per, Area) Absolute Catchability(Fl, V.Size, Rig, Ctry, Spec, Area) * Relative Catchability(Fl, V.Size, Ctry, Rig, Spec, Y, Per, Area)

Relative catchabilities (over years and periods) are normalized so that 0 <= (Relative Catchability) <= 1

S01_DIM / Ark1 / S02_STOCK / S03_FLEET / S04_EFFORT / S05_BOATS / S(

Figure 2.6.2. Fleet structured input: Absolute catchability coefficients. The explanation below the table (row 24-25) says: Catchability(Fl, V.Size, Rig, Ctry, Spec, Y, Per, Area) = Absolute Catchability(Fl, V.Size, Rig, Ctry, Spec, Area) * Relative Catchability(Fl, V.Size, Ctry, Rig, Spec, Y, Per, Area). Relative catchabilities (over years and periods) are normalized so that 0 <= (Relative Catchability) <= 1



	A	B	C	D	E	F	G	H	I
27	Table 3.1.2.	Baltistan : PARAMETERS IN MODEL FOR CATCHABILITY (Species, Fleet, V.Size, Rig)							
28		St.Dev(Q)	Biom.Param	Tech.Dev.	Rig.Effect				
29	West Cod - OB Trawler-Baltistan - Small - <110mm	0.1	0	0	0				
30	West Cod - OB Trawler-Baltistan - Small - >110mm	0.1	0	0	0				
31	West Cod - OB Trawler-Baltistan - Medium - <110mm	0.1	0	0	0				
32	West Cod - OB Trawler-Baltistan - Medium - >110mm	0.1	0	0	0				
33	West Cod - OB Trawler-Baltistan - Large - <110mm	0.1	0	0	0				
34	West Cod - OB Trawler-Baltistan - Large - >110mm	0.1	0	0	0				
35	West Cod - Gillnett-Baltistan - Small - <110mm	0.1	0	0	0				
36	West Cod - Gillnett-Baltistan - Small - >110mm	0.1	0	0	0				
37	West Cod - Gillnett-Baltistan - Medium - <110mm	0.1	0	0	0				
38	West Cod - Gillnett-Baltistan - Medium - >110mm	0.1	0	0	0				
39	West Cod - Gillnett-Baltistan - Large - <110mm	0.1	0	0	0				
40	West Cod - Gillnett-Baltistan - Large - >110mm	0.1	0	0	0				
41	East cod - OB Trawler-Baltistan - Small - <110mm	0.1	0	0	0				
42	East cod - OB Trawler-Baltistan - Small - >110mm	0.1	0	0	0				
43	East cod - OB Trawler-Baltistan - Medium - <110mm	0.1	0	0	0				
44	East cod - OB Trawler-Baltistan - Medium - >110mm	0.1	0	0	0				
45	East cod - OB Trawler-Baltistan - Large - <110mm	0.1	0	0	0				
46	East cod - OB Trawler-Baltistan - Large - >110mm	0.1	0	0	0				
47	East cod - Gillnett-Baltistan - Small - <110mm	0.1	0	0	0				
48	East cod - Gillnett-Baltistan - Small - >110mm	0.1	0	0	0				
49	East cod - Gillnett-Baltistan - Medium - <110mm	0.1	0	0	0				
50	East cod - Gillnett-Baltistan - Medium - >110mm	0.1	0	0	0				
51	East cod - Gillnett-Baltistan - Large - <110mm	0.1	0	0	0				
52	East cod - Gillnett-Baltistan - Large - >110mm	0.1	0	0	0				
53	St.Dev(Q): Relative standard deviation of catchability used for stochastic simulation Biom.Param.: Parameter in model:								
54	Q = Q0 * Biomass ^ Biom.Param. Tech.Dev.: Q = Q0 * exp(y*Tech.Dev). Rig.Effect: Q = Q0 * exp(Rig.Effect).								
55									

SO1 DIM / Ark1 / SO2 STOCK / SO3 FLEET / SO4 EFFORT /

Figure 2.6.3. Parameters in model for catchability. The text below the Table (rows 53-54) says: St.Dev(Q): Relative standard deviation of catchability used for stochastic simulation Biom.Param.: Parameter in model: Q = Q0 * Biomass ^ Biom.Param. Tech.Dev.: Q = Q0 * exp(y*Tech.Dev). Rig.Effect: Q = Q0 * exp(Rig.Effect).

$$DIS(Fl,Vs,Rg,Ct,St,y,a,q) =$$

$$1 - \frac{1}{1+\exp(Dis1(Fl,Vs,Rg,Ct,St,y,q) - Dis2(Fl,Vs,Rg,Ct,St,y,q) * Lgt(St,a,q))}$$

where parameters of the logistic ogive are defined as those of the maturity ogive.
Thus,

$Dis1(Fl,Vs,Rg,Ct,St,y,q) =$
$\ln(3) * LGT_{50\%Discards}(Fl,Vs,Rg,Ct,St,y,q,St) / (LGT_{25\%Discards}(-) - LGT_{50\%Discards}(-))$,
$Dis2(Fl,Vs,Rg,Ct,St,y,q) = \ln(3) / (LGT_{25\%Discards}(Fl,Vs,Rg,Ct,St,y,q,St) - LGT_{50\%Discards}(-))$ and
$LGT_{X\%Discards}(Fl,Vs,Rg,Ct,St,y,q,St)$ = Length at which X % are retained.

EXCEL Tables 3.2.4-5 and EXCEL Table 3.2.10-11 contain the discard parameters $LGT_{25\%Discards}$ and $LGT_{50\%Discards}$ (Figure 2.6.5). The discard parameters can be modified in any time period of any year.
The remaining tables gives the parameters in the model that links effort (E) to total area fishing mortality (F):

$$F(Fl,Vs,Rg,Ct,St,y,a,q,Ar) = E(Fl,Vs,Rg,Ct,y,q,Ar) *$$
$$Q_1^{Absolute}(Fl,Vs,Rg,Ct,St,Ar) * Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y,q,Ar) *$$
$$B(St,Ar,y,q-1)^{QB_{Exp}(Fl,Vs,Rg,St)} *$$
$$\exp(y * Q_{Tech-Dev}(Fl,Vs,Rg,St,y)) * \exp(RE(Fl,Vs,Rg,St)) *$$
$$SEL(Fl,Vs,Rg,Ct,St,y,a,q) * \varepsilon_Q(Fl,St,y)$$

	A	B	C	D	E	F	G	H	I
104	Table 3.2.1.	Baltistan : MESH SIZE (generalized concept) (Species, Fleet, V.Size, Rig)							
105		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
106	OB Trawler-Baltistan - Small - <110mm	100	100	100	100	100	100	100	100
107	OB Trawler-Baltistan - Small - >110mm	120	120	120	120	120	120	120	120
108	OB Trawler-Baltistan - Medium - <110mm	100	100	100	100	100	100	100	100
109	OB Trawler-Baltistan - Medium - >110mm	120	120	120	120	120	120	120	120
110	OB Trawler-Baltistan - Large - <110mm	100	100	100	100	100	100	100	100
111	OB Trawler-Baltistan - Large - >110mm	120	120	120	120	120	120	120	120
112	Gillnett-Baltistan - Small - <110mm	110	110	110	110	110	110	110	110
113	Gillnett-Baltistan - Small - >110mm	130	130	130	130	130	130	130	130
114	Gillnett-Baltistan - Medium - <110mm	110	110	110	110	110	110	110	110
115	Gillnett-Baltistan - Medium - >110mm	130	130	130	130	130	130	130	130
116	Gillnett-Baltistan - Large - <110mm	110	110	110	110	110	110	110	110
117	Gillnett-Baltistan - Large - >110mm	130	130	130	130	130	130	130	130
118	Mesh sizes (in a user-defined unit) of the gear-riggings by fleet and country. Gear selection is modelled by the logistic curve, with L50%/ = (Gear selection factor) * (M								
119									
121	Table 3.2.2.	Baltistan : GEAR SELECTION FACTOR (=L50%/MeshSize) (Species, Fleet, V.Size, Rig)							
122		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
123	West Cod - OB Trawler-Baltistan - <110mm	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
124	West Cod - OB Trawler-Baltistan - >110mm	0.208	0.208	0.208	0.208	0.208	0.208	0.208	0.208
125	West Cod - Gillnett-Baltistan - <110mm	0.273	0.273	0.273	0.273	0.273	0.273	0.273	0.273
126	West Cod - Gillnett-Baltistan - >110mm	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231
127	East cod - OB Trawler-Baltistan - <110mm	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275
128	East cod - OB Trawler-Baltistan - >110mm	0.229	0.229	0.229	0.229	0.229	0.229	0.229	0.229
129	East cod - Gillnett-Baltistan - <110mm	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
130	East cod - Gillnett-Baltistan - >110mm	0.254	0.254	0.254	0.254	0.254	0.254	0.254	0.254
131		Gear selection factor = L50%/(Mesh size), L50% = Body length at which 50% of the fish entering the gear are retained.							
132									
135	Table 3.2.3.	Baltistan : GEAR SELECTION RANGE (=L75%-L25%) (Species, Fleet, V.Size, Rig)							
136		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
137	West Cod - OB Trawler-Baltistan - <110mm	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
138	West Cod - OB Trawler-Baltistan - >110mm	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
139	West Cod - Gillnett-Baltistan - <110mm	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
140	West Cod - Gillnett-Baltistan - >110mm	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
141	East cod - OB Trawler-Baltistan - <110mm	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
142	East cod - OB Trawler-Baltistan - >110mm	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
143	East cod - Gillnett-Baltistan - <110mm	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
144	East cod - Gillnett-Baltistan - >110mm	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
145		Gear selection range (=L75%-L25%), L75%,L50%,L25% = Body length at which 75%,50%,25% of the fish entering the ge							
146									

S01_DIM | Ark1 | S02_STOCK | S03_FLEET | S04_EFFORT

Figure 2.6.4. Gear selection parameters.

The absolute catchability coefficient is EXCEL Table 3.1.1 (Baltistan) $Q_1^{Absolute}(Fl,Vs,Rg,Ct,St,Ar)$ and 3.1.3 (Scandinavia) The absolute catchability for Baltistan is shown in Figure 2.6.2. EXCEL Tables 3.2.6.1-5 (Baltistan) and EXCEL Tables 3.2.12.1-5 (Scandinavia) contain the area specific relative catchability $Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y,q,Ar)$,.(Figure 2.6.6). The relative catchability can take only values between 0 and 1, and is used to model changes in fishing efficiency over time. The table for absolute catchability, contains a row and a column for multipliers (Figure 2.6.2). The multipliers in the row (line 23) are applied to the column above, and the column of multiplier (column N) is applied to the row. The multiplier in rightmost corner is applied to the entire table.

The relative standard deviation of catchability, $\varepsilon_Q(Fl,St,y)$, the parameters in the model biomass dependence $B(St,Ar,y,q-1)^{QB_{Exp}(Fl,Vs,Rg,St)}$, the model of technical creeping $\exp(y*Q_{Tech-Dev}(Fl,Vs,Rg,St,y))$ and the rigging effect $\exp(RE(Fl,Vs,Rg,St))$ are contained in EXCEL Tables 3.1.2 and 3.1.4. (Figure 2.6.3).

	A	B	C	D	E	F	G	H	I
149	**Table 3.2.4.**	**Baltistan : DISCARDS L50% (Species, Fleet, V.Size, Rig)**							
150		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
151	West Cod - OB Trawler-Baltistan - Small - <110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
152	West Cod - OB Trawler-Baltistan - Small - >110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
153	West Cod - OB Trawler-Baltistan - Medium - <110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
154	West Cod - OB Trawler-Baltistan - Medium - >110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
155	West Cod - OB Trawler-Baltistan - Large - <110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
156	West Cod - OB Trawler-Baltistan - Large - >110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
157	West Cod - Gillnett-Baltistan - Small - <110mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
158	West Cod - Gillnett-Baltistan - Small - >110mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
159	West Cod - Gillnett-Baltistan - Medium - <110mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
160	West Cod - Gillnett-Baltistan - Medium - >110mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
161	West Cod - Gillnett-Baltistan - Large - <110mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
162	West Cod - Gillnett-Baltistan - Large - >110mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
163	East cod - OB Trawler-Baltistan - Small - <110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
164	East cod - OB Trawler-Baltistan - Small - >110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
165	East cod - OB Trawler-Baltistan - Medium - <110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
166	East cod - OB Trawler-Baltistan - Medium - >110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
167	East cod - OB Trawler-Baltistan - Large - <110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
168	East cod - OB Trawler-Baltistan - Large - >110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
169	East cod - Gillnett-Baltistan - Small - <110mm	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
170	East cod - Gillnett-Baltistan - Small - >110mm	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
171	East cod - Gillnett-Baltistan - Medium - <110mm	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
172	East cod - Gillnett-Baltistan - Medium - >110mm	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
173	East cod - Gillnett-Baltistan - Large - <110mm	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
174	East cod - Gillnett-Baltistan - Large - >110mm	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
175		L50% = Body length at which 50 % of the fish caught are discarded. Discarding is modelled by the logistic curve							
176									
179	**Table 3.2.5.**	**Baltistan : DISCARDS L75% (Species, Fleet, V.Size, Rig)**							
180		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
181	West Cod - OB Trawler-Baltistan - Small - <110mm	17.25	17.25	17.25	17.25	17.25	17.25	17.25	17.25
182	West Cod - OB Trawler-Baltistan - Small - >110mm	17.25	17.25	17.25	17.25	17.25	17.25	17.25	17.25
183	West Cod - OB Trawler-Baltistan - Medium - <110mm	17.25	17.25	17.25	17.25	17.25	17.25	17.25	17.25
184	West Cod - OB Trawler-Baltistan - Medium - >110mm	17.25	17.25	17.25	17.25	17.25	17.25	17.25	17.25
185	West Cod - OB Trawler-Baltistan - Large - <110mm	17.25	17.25	17.25	17.25	17.25	17.25	17.25	17.25
186	West Cod - OB Trawler-Baltistan - Large - >110mm	17.25	17.25	17.25	17.25	17.25	17.25	17.25	17.25
187	West Cod - Gillnett-Baltistan - Small - <110mm	20.70	20.70	20.70	20.70	20.70	20.70	20.70	20.70
188	West Cod - Gillnett-Baltistan - Small - >110mm	20.70	20.70	20.70	20.70	20.70	20.70	20.70	20.70
189	West Cod - Gillnett-Baltistan - Medium - <110mm	20.70	20.70	20.70	20.70	20.70	20.70	20.70	20.70
190	West Cod - Gillnett-Baltistan - Medium - >110mm	20.70	20.70	20.70	20.70	20.70	20.70	20.70	20.70
191	West Cod - Gillnett-Baltistan - Large - <110mm	20.70	20.70	20.70	20.70	20.70	20.70	20.70	20.70
192	West Cod - Gillnett-Baltistan - Large - >110mm	20.70	20.70	20.70	20.70	20.70	20.70	20.70	20.70
193	East cod - OB Trawler-Baltistan - Small - <110mm	18.98	18.98	18.98	18.98	18.98	18.98	18.98	18.98
194	East cod - OB Trawler-Baltistan - Small - >110mm	18.98	18.98	18.98	18.98	18.98	18.98	18.98	18.98
195	East cod - OB Trawler-Baltistan - Medium - <110mm	18.98	18.98	18.98	18.98	18.98	18.98	18.98	18.98
196	East cod - OB Trawler-Baltistan - Medium - >110mm	18.98	18.98	18.98	18.98	18.98	18.98	18.98	18.98
197	East cod - OB Trawler-Baltistan - Large - <110mm	18.98	18.98	18.98	18.98	18.98	18.98	18.98	18.98
198	East cod - OB Trawler-Baltistan - Large - >110mm	18.98	18.98	18.98	18.98	18.98	18.98	18.98	18.98
199	East cod - Gillnett-Baltistan - Small - <110mm	22.77	22.77	22.77	22.77	22.77	22.77	22.77	22.77
200	East cod - Gillnett-Baltistan - Small - >110mm	22.77	22.77	22.77	22.77	22.77	22.77	22.77	22.77
201	East cod - Gillnett-Baltistan - Medium - <110mm	22.77	22.77	22.77	22.77	22.77	22.77	22.77	22.77
202	East cod - Gillnett-Baltistan - Medium - >110mm	22.77	22.77	22.77	22.77	22.77	22.77	22.77	22.77
203	East cod - Gillnett-Baltistan - Large - <110mm	22.77	22.77	22.77	22.77	22.77	22.77	22.77	22.77
204	East cod - Gillnett-Baltistan - Large - >110mm	22.77	22.77	22.77	22.77	22.77	22.77	22.77	22.77
205		L75% = Body length at which 75 % of the fish caught are discarded. Discarding is modelled by the logistic curve							
206									

S01_DIM / Ark1 / S02_STOCK / **S03_FLEET** / S04_EFFORT /

Figure 2.6.5. Discard selection parameters.

209	Table 3.2.5.1.	Baltistan : - West Baltic RELATIVE (PERIOD) CATCHABILITY (max value = 1) - (Species							
210		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
211	West Cod - OB Trawler-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
212	West Cod - OB Trawler-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
213	West Cod - OB Trawler-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
214	West Cod - OB Trawler-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
215	West Cod - OB Trawler-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
216	West Cod - OB Trawler-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
217	West Cod - Gillnett-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
218	West Cod - Gillnett-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
219	West Cod - Gillnett-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
220	West Cod - Gillnett-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
221	West Cod - Gillnett-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
222	West Cod - Gillnett-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
223	East cod - OB Trawler-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
224	East cod - OB Trawler-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
225	East cod - OB Trawler-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
226	East cod - OB Trawler-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
227	East cod - OB Trawler-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
228	East cod - OB Trawler-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
229	East cod - Gillnett-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
230	East cod - Gillnett-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
231	East cod - Gillnett-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
232	East cod - Gillnett-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
233	East cod - Gillnett-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
234	East cod - Gillnett-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
235	Relative distribution of Catchability on periods. Catchability(Fleet, V.Size, Rig, Ctry, Species, Year, Period, Area) =								
236	Absolute Catchability(Fleet, Rig, Species, Area)* Relative Catchability(Fleet, Rig, Species, Area, Year, Period) where 0 <=								
237	(Relative Catchability) <= 1, relative to variations within years and period. Relative catchabilities (over years and periods) are normalized so that the maximum value is one								
238									
239	Table 3.2.5.2.	Baltistan : - East Baltic RELATIVE (PERIOD) CATCHABILITY (max value = 1) - (Species,							
240		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
241	West Cod - OB Trawler-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
242	West Cod - OB Trawler-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
243	West Cod - OB Trawler-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
244	West Cod - OB Trawler-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
245	West Cod - OB Trawler-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
246	West Cod - OB Trawler-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
247	West Cod - Gillnett-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
248	West Cod - Gillnett-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
249	West Cod - Gillnett-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
250	West Cod - Gillnett-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
251	West Cod - Gillnett-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
252	West Cod - Gillnett-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
253	East cod - OB Trawler-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
254	East cod - OB Trawler-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
255	East cod - OB Trawler-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
256	East cod - OB Trawler-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
257	East cod - OB Trawler-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
258	East cod - OB Trawler-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
259	East cod - Gillnett-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
260	East cod - Gillnett-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
261	East cod - Gillnett-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
262	East cod - Gillnett-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
263	East cod - Gillnett-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
264	East cod - Gillnett-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85
265		Relative distribution of Catchability on periods. Catchability(Fleet, V.Size, Rig, Ctry, Species, Year, Period, Area) = Abs							

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Figure 2.6.6. Relative (Period) catchability coefficients. The explanation below the table says:
Relative distribution of Catchability on periods.
Catchability(Fleet, V.Size, Rig, Ctry, Species, Year, Period, Area) =
Absolute Catchability(Fleet, Rig, Species, Area)*
Relative Catchability(Fleet, Rig, Species, Area, Year, Period)
where 0 <= (Relative Catchability) <= 1, relative to variations within years and period.
Relative catchabilities (over years and periods) are normalized so that the maximum value is one

The parameters of the gear selction ogive $SEL(Fl,Vs,Rg,Ct,St,y,a,q)$ are in EXCEL Tables 3.2.1-3 (Baltistan) and EXCEL Tables 3.2.7-9 (Scandinavia). (Figure 2.6.4). The logistic curve is used to model the selection of fishing gears

$$SEL(Fl, Vs, Rg, Ct, St, y, a, q) = \frac{1}{1 + \exp(Sel1(Fl, Vs, Rg, Ct, St, y) - Sel2(Fl, Vs, Rg, Ct, St, y) * Lgt(St, y, a, q))}$$

where parameters of the logistic ogive are defined
Sel1(Fl, Vs, Rg, Ct, St, y) = ln(3)* $LGT_{50\%}$(Fl, Vs, Rg, Ct, St, y) /($LGT_{75\%}$(-) - $LGT_{50\%Mat}$(-)),
Sel2(Fl, Vs, Rg, Ct, St, y) = ln(3)/($LGT_{75\%}$(Fl, Vs, Rg, Ct, St, y) - $LGT_{50\%}$(-)) and
$LGT_{50\%}$(Fl, Vs, Rg, Ct, St, y) = MS(Fl, Vs, Rg, Ct, y) * SF(Fl, Vs,. Rg, Ct, St, y),
$LGT_{75\%}$(Fl, Vs, Rg, Ct, St, y) = $LGT_{50\%}$(Fl, Vs, Rg, Ct, St, y) + SR(Fl, Vs, Rg, Ct, St, y)/2
MS(Fl, Vs, Rg, Ct, y) = Mesh size of fleet Fl in year y,
SF(Fl, Vs, Rg, Ct, St, y) = Selection factor and
SR(Fl, Vs, Rg, Ct, St, y) = Selection range (=$LGT_{75\%}$-$LGT_{25\%}$)

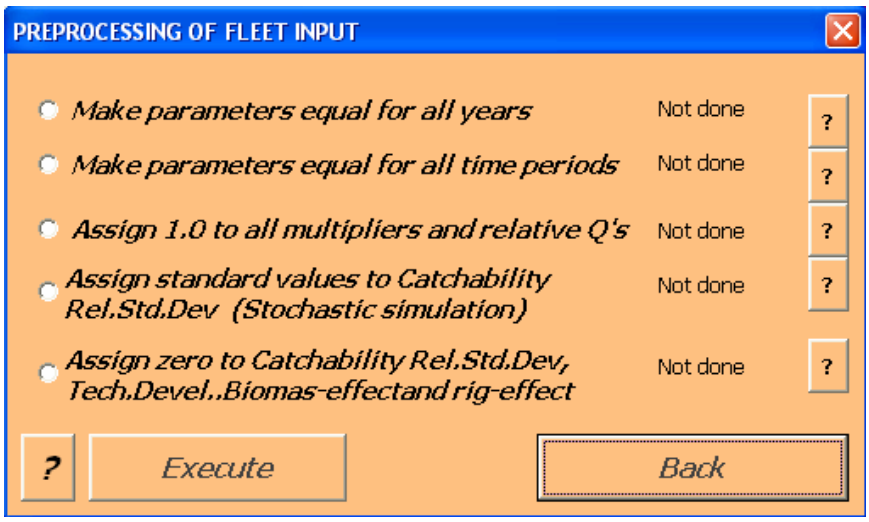


Figure 2.6.7. Options for pre-processing of fleet parameters.

The menu for pre-processing of fleet data is shown in Figure 2.6.7. There are five options for pre-processing:

1) Make parameters equal for all years. This option will take the value for first year and apply it to all other years, for all y-dependent parameters:
MS(Fl, Vs, Rg, Ct, y) = MS(Fl, Vs, Rg, Ct, y_{first})
SF(Fl, Vs, Rg, Ct, St, y) = SF(Fl, Vs, Rg, Ct, St, y_{first})
SR(Fl, Vs, Rg, Ct, St, y) = SR(Fl, Vs, Rg, Ct, St, y_{first})

$$Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y,q,Ar) = Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y_{first},q,Ar)$$

$$Q_{Tech-Dev}(Fl,Vs,Rg,St,y) = Q_{Tech-Dev}(Fl,Vs,Rg,St,y_{first})$$

2) Make parameters equal for all time periods This option will take the value for first year and apply it to all other years, for all y-dependent parameters:

$$Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y,q,Ar) = Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y,1,Ar)$$

3) Assign 1.0 to all multipliers and relative Q's $Q_1^{Relative}(Fl,Vs,Rg,Ct,St,y,q,Ar) = 1.0$

4) Assign standard values to catchabilityRel.Std.Dev (Stochastic simulation)
The relative Standard deviation of $\varepsilon_Q(Fl,St,y)$ is given the value 0.1

5) Assign zero to catchability std dev, Tech.devel..Biomass effect and rig effect.

$$\varepsilon_Q(Fl,St,y) = 0, \quad QB_{Exp}(Fl,Vs,Rg,St) = 0, \quad Q_{Tech-Dev}(Fl,Vs,Rg,St,y) = 0$$

$$RE(Fl,Vs,Rg,St) = 0$$

2.7. EFFORT INPUT (OPTIONAL), S04_EFFORT

Figure 2.7.1 shows the input user-form for worksheet "S04_EFFORT", fleet structured input.

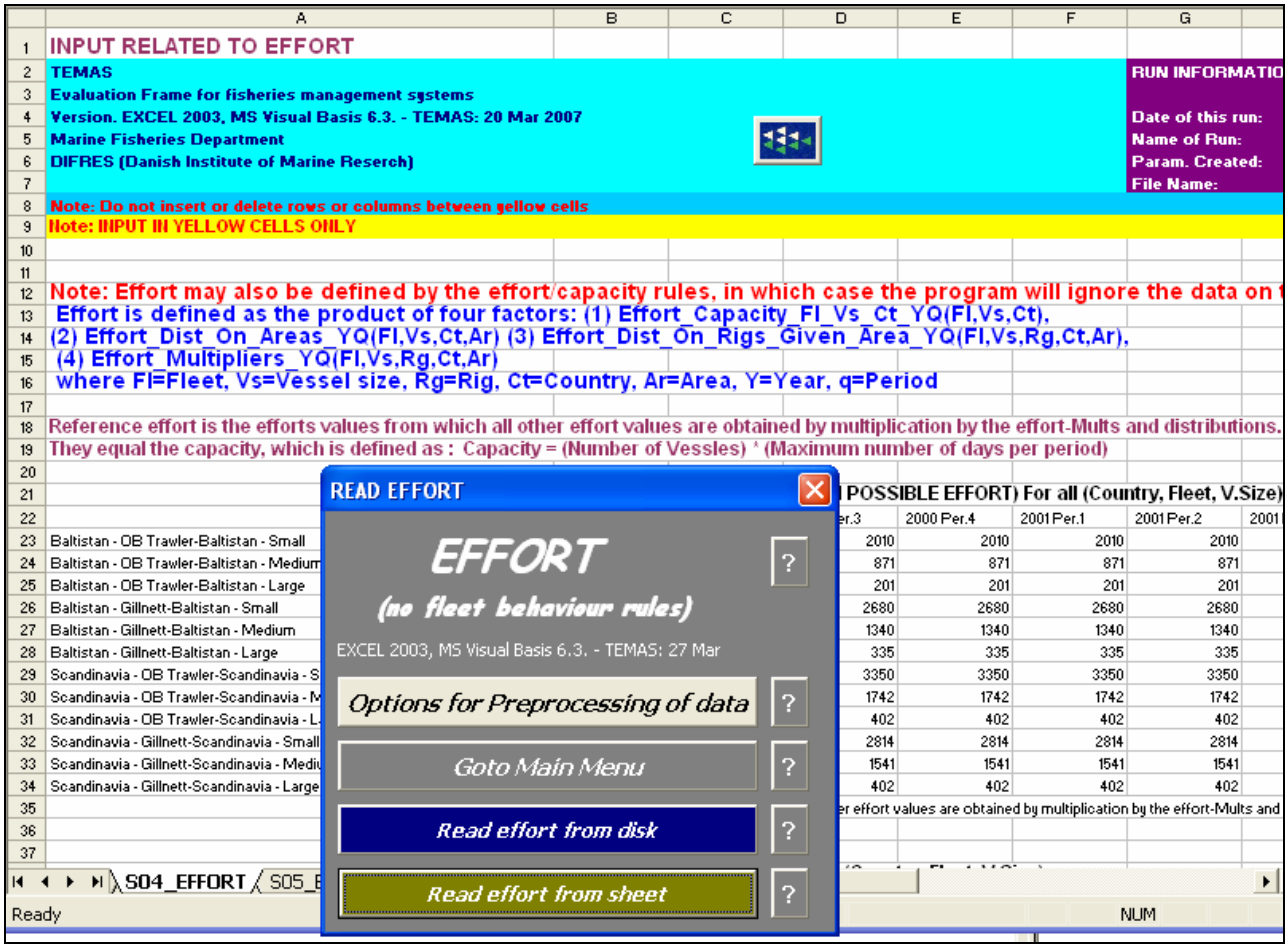


Figure 2.7.1. User-form for entry of effort related data and parameters, worksheet S04_EFFORT. The text in rows 12-19 reads: Note: Effort may also be defined by the effort/capacity rules, in which case the program will ignore the data on this sheet. Effort is defined as the product of four factors: (1) Effort_Capacity_Fl_Vs_Ct_YQ(Fl, Vs, Ct), (2) Effort_Dist_On_Areas_YQ(Fl, Vs, Ct, Ar) (3) Effort_Dist_On_Rigs_Given_Area_YQ(Fl, Vs, Rg, Ct, Ar), (4) Effort_Multipliers_YQ(Fl, Vs, Rg, Ct, Ar) where Fl=Fleet, Vs=Vessel size, Rg=Rig, Ct=Country, Ar=Area, Y=Year, q=Period Reference effort is the efforts values from which all other effort values are obtained by multiplication by the effort-Mults and distributions. They equal the capacity, which is defined as : Capacity = (Number of Vessels) * (Maximum number of days per period)

The EXCEL Tables of worksheet S04_EFFORT are listed in Table 2.7.1. Only three out of seven EXCEL tables are yellow input tables. The remaining four (white) tables are so-called "resulting tables", that is, tables derived from input tables, as information and check-options for the user.

Index	EXCEL Table	Caption
65	Table4.1.	REFERENCE EFFORT (MAXIMUM POSSIBLE EFFORT) Not input
66	Table4.2.	EFFORT DISTRIBUTION ON AREAS
67	Table4.3.	RESULTING EFFORT AFTER DISTRIBUTION ON AREAS Not input
68	Table4.4.	EFFORT DISTRIBUTION ON RIGS (AFTER DISTRIBUTION ON AREAS)
69	Table4.5.	RESULTING EFFORT AFTER DISTRIBUTION ON RIGS AND AREAS Not input
70	Table4.6.	EFFORT MULTIPLIERS
71	Table4.7.	RESULTING EFFORT DISTRIBUTION ON RIGS (AFTER DISTRIBUTION ON AREAS)

Table 2.7.1. Tables in the effort input sheet, S04_EFFORT.

Effort can be controlled in TEMAS in two ways:

(1) Giving effort as input
(2) Let the "Effort-rule" decide the effort (see Section 5).

Worksheet S04-EFFORT deals with only the first way of entering effort in the TEMAS model. This feature of effort input in the context of TEMAS is why the data are said to be optional. In case you chose the option to let the effort be determined by the effort rules (the short term and long term behaviour models also called "trip-behaviour" and "structural behaviour") you do not need to give effort as input.

The effort exerted (the actual number of days at sea) is a function of the effort entered in worksheet S04-EFFORT as well as the number of vessels (boats) entered in worksheet S05_BOATS. The number of vessels defines an upper limit for the number sea days that can be exerted. The effort capacity of a vessel, EY_{MAX} ,is the maximum number of fishing effort units (fishing days or sea days) that a fleet can exert in a time period. It is given by the variable:

EY_{MAX}(Fl, Vs, Ct, y, q, Ar) = The maximum physical number of effort units per vessel per time unit in Area Ar (in worksheet S05_BOATS).

The total effort exerted by fleet (Fl,Vs,Ct) during time period q is the sum over riggings and areas

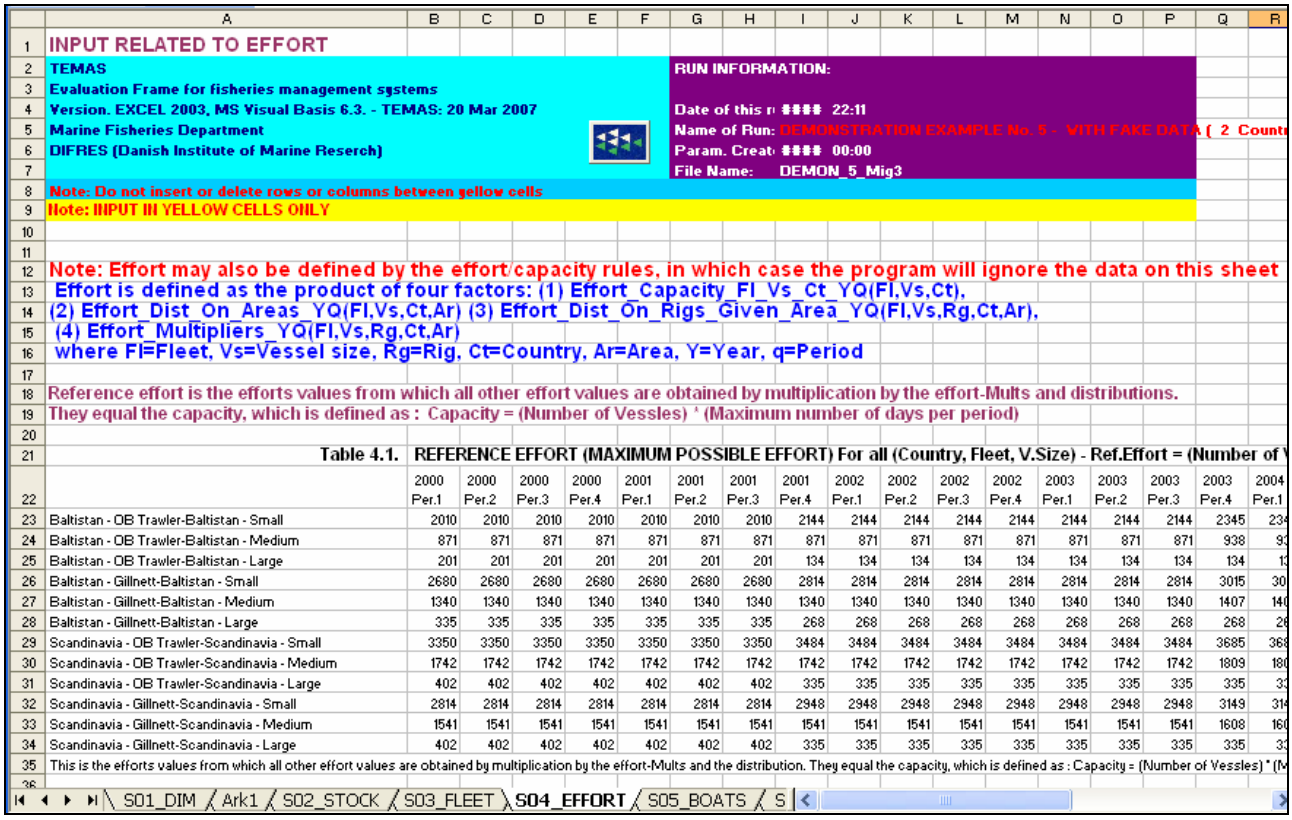
$$E(Fl,Vs,\bullet,Ct,y,q,\bullet) = \sum_{Ar=1}^{NU_{Area}} \sum_{Rg=1}^{Rg(Fl)} E(Fl,Vs,Rg,Ct.y,q,Ar)$$

According to the definition of, EY_{MAX}, it is not dependent on the rigging. We define the "reference effort" or the "maximum effort" by

$$E_{REF}(Fl,Vs,Ct,y,q,Ar) = NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * EY_{Max}(Fl,Vs,Ct,y,q,Ar)$$

The number of vessels, $NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet)$, are contained in worksheet S05_BOATS.

The reference effort is shown in EXCEL Table 4.1 (Figure 2.7.2). The cell background in this table is white indicating that the values are not input, but are the results of a calculation. They are the product (Number of Vessels) * (Maximum number of days per period) which are given in two tables in worksheet S05_BOATS (see next section).



INPUT RELATED TO EFFORT

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

RUN INFORMATION:
Date of this r #### 22:11
Name of Run: DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA (2 Countr
Param. Creat #### 00:00
File Name: DEMON_5_Mig3

Note: Do not insert or delete rows or columns between yellow cells
Note: INPUT IN YELLOW CELLS ONLY

Note: Effort may also be defined by the effort capacity rules, in which case the program will ignore the data on this sheet
Effort is defined as the product of four factors: (1) Effort_Capacity_Fl_Vs_Ct_YQ(Fl,Vs,Ct),
(2) Effort_Dist_On_Areas_YQ(Fl,Vs,Ct,Ar) (3) Effort_Dist_On_Rigs_Given_Area_YQ(Fl,Vs,Rg,Ct,Ar),
(4) Effort_Multipliers_YQ(Fl,Vs,Rg,Ct,Ar)
where Fl=Fleet, Vs=Vessel size, Rg=Rig, Ct=Country, Ar=Area, Y=Year, q=Period

Reference effort is the efforts values from which all other effort values are obtained by multiplication by the effort-Mults and distributions.
They equal the capacity, which is defined as : Capacity = (Number of Vessles) * (Maximum number of days per period)

Table 4.1. REFERENCE EFFORT (MAXIMUM POSSIBLE EFFORT) For all (Country, Fleet, V.Size) - Ref.Effort = (Number of V

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	2004 Per.1
Baltistan - OB Trawler-Baltistan - Small	2010	2010	2010	2010	2010	2010	2010	2144	2144	2144	2144	2144	2144	2144	2144	2345	234
Baltistan - OB Trawler-Baltistan - Medium	871	871	871	871	871	871	871	871	871	871	871	871	871	871	871	938	93
Baltistan - OB Trawler-Baltistan - Large	201	201	201	201	201	201	201	134	134	134	134	134	134	134	134	134	13
Baltistan - Gillnett-Baltistan - Small	2680	2680	2680	2680	2680	2680	2680	2814	2814	2814	2814	2814	2814	2814	2814	3015	30
Baltistan - Gillnett-Baltistan - Medium	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1407	140
Baltistan - Gillnett-Baltistan - Large	335	335	335	335	335	335	335	268	268	268	268	268	268	268	268	268	26
Scandinavia - OB Trawler-Scandinavia - Small	3350	3350	3350	3350	3350	3350	3350	3484	3484	3484	3484	3484	3484	3484	3484	3685	368
Scandinavia - OB Trawler-Scandinavia - Medium	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1809	180
Scandinavia - OB Trawler-Scandinavia - Large	402	402	402	402	402	402	402	335	335	335	335	335	335	335	335	335	33
Scandinavia - Gillnett-Scandinavia - Small	2814	2814	2814	2814	2814	2814	2814	2948	2948	2948	2948	2948	2948	2948	2948	3149	314
Scandinavia - Gillnett-Scandinavia - Medium	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1608	160
Scandinavia - Gillnett-Scandinavia - Large	402	402	402	402	402	402	402	335	335	335	335	335	335	335	335	335	33

This is the efforts values from which all other effort values are obtained by multiplication by the effort-Mults and the distribution. They equal the capacity, which is defined as : Capacity = (Number of Vessles) * (M

S01_DIM | Ark1 | S02_STOCK | S03_FLEET | S04_EFFORT | S05_BOATS | S

Figure 2.7.2. Reference effort. The explanation below the tables says: This is the efforts values from which all other effort values are obtained by multiplication by the effort-multipliers and the distribution. They equal the capacity, which is defined as :
*Capacity = (Number of Vessels) * (Maximum number of days per period)*

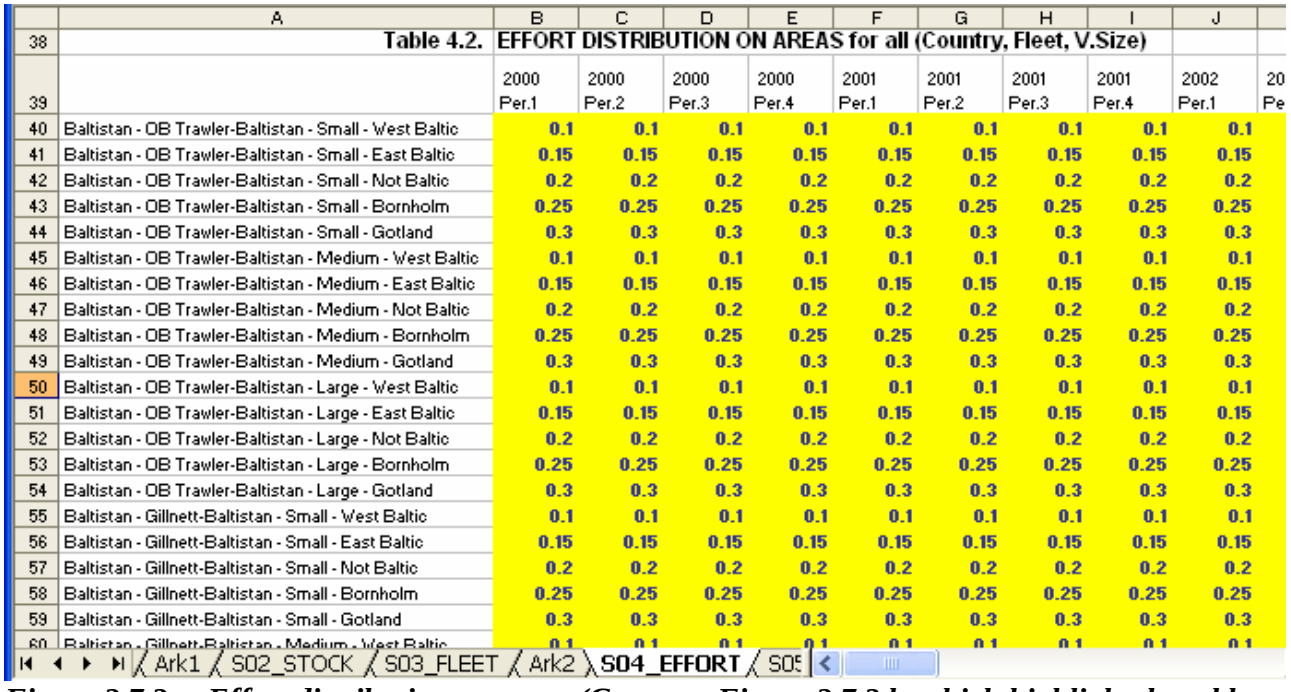


Table 4.2. EFFORT DISTRIBUTION ON AREAS for all (Country, Fleet, V.Size)

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	20 Pe
Baltistan - OB Trawler-Baltistan - Small - West Baltic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Baltistan - OB Trawler-Baltistan - Small - East Baltic	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Baltistan - OB Trawler-Baltistan - Small - Not Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Baltistan - OB Trawler-Baltistan - Small - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Baltistan - OB Trawler-Baltistan - Small - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Baltistan - OB Trawler-Baltistan - Medium - West Baltic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Baltistan - OB Trawler-Baltistan - Medium - East Baltic	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Baltistan - OB Trawler-Baltistan - Medium - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Baltistan - OB Trawler-Baltistan - Medium - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Baltistan - OB Trawler-Baltistan - Large - West Baltic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Baltistan - OB Trawler-Baltistan - Large - East Baltic	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Baltistan - OB Trawler-Baltistan - Large - Not Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Baltistan - OB Trawler-Baltistan - Large - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Baltistan - OB Trawler-Baltistan - Large - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Baltistan - Gillnett-Baltistan - Small - West Baltic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Baltistan - Gillnett-Baltistan - Small - East Baltic	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Baltistan - Gillnett-Baltistan - Small - Not Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Baltistan - Gillnett-Baltistan - Small - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Baltistan - Gillnett-Baltistan - Small - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Baltistan - Gillnett-Baltistan - Medium - West Baltic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	

Ark1 | S02_STOCK | S03_FLEET | Ark2 | S04_EFFORT | S05

Figure 2.7.3.a. Effort distribution on areas (Compare Figure 2.7.3.b, which highlight the table structure). The explanation below the table says: Distribution of effort on areas for each combination of (Country, Fleet, V. Size). For given (Country, Fleet, V. Size) they sum up to 1 over areas.

The input effort in the present version of TEMAS is E(Fl, Vs, Ct, y, q,•), that is, the total effort summed over areas, together with the relative distribution of effort over areas:

$$E_{Area-Dist}(Fl,Vs,\bullet,Ct,y,q,Ar)=\frac{E(Fl,Vs,\bullet,Ct,y,q,Ar)}{E(Fl,Vs,\bullet,Ct,y,q,\bullet)}$$

The effort distribution can be given as input each period each year, in the case where the behaviour rules are not applied. Thus, effort is derived from the product of the two input parameters,

E(Fl, Vs, •, Ct, y, q,•) and $E_{Area-Dist}$(Fl, Vs, • ,Ct, y, q, Ar)

Which in turn gives the effort distribution on fleets, vessels sizes and countries:

E(Fl, Vs, • , Ct, y, q, Ar) = E(Fl, Vs, •, Ct, y, q, •)* $E_{Area-Dist}$ (Fl, Vs, •, Ct, y, q, Ar)

The next step in the distribution of effort is the distribution on riggings for given area:

E(Fl, Vs, Rg, Ct, y, q, Ar) = E(Fl, Vs, • ,Ct, y, q, Ar)* $E_{Rig-Dist}$(Fl, Vs, Rg, Ct, y, q, Ar)

The definition of effort distribution on riggings for given area, Ar is

$$E_{Rig-Dist}(Fl,Vs,Rg,Ct,y,q,Ar)=\frac{E(Fl,Vs,Rg,Ct,y,q,Ar)}{E(Fl,Vs,\bullet,Ct,y,q,Ar)}$$

To summarize the distribution, the complete model of effort distribution on areas, and on rigs for given area read:

$$E(Fl,Vs,Rg,Ct,y,q,Ar)=E_{REF}(Fl,Vs,\bullet,Ct,y,q,\bullet)*$$
$$E_{Rig-dist}(Fl,Vs,Rg,y,q,Ar)*E_{Area-dist}(Fl,Vs,\bullet,Ct,y,q,Ar)$$

EXCEL Table 4.2 (Figure 2.7.3.a) shows the distribution of effort on areas. Figure 2.7.3.a shows only a part of the table. Figure 2.7.3.b shows the complete tables, with an indication of the table hierarchical structure: Country, Gear, Vessel size, area.

Thus, each group of five cells (one for each area) sums up to 1.0. E.g. the sum of cells B40, B41, B42, B43 and B44 is 1.0.

In case you enter numbers that do not sum up to 1.0, the program will normalize the values so that the sum becomes 1.0, as illustrated in Figure 2.7.3.c. In this case cells B40,…,B44 contain the numbers 20, 30, 40, 50 and 60 which normalized become 0.10,0.15,0.20,0.25 and 0.30

In case you enter only zeroes, the program cannot normalize, and the values “no value” will appear in the EXCEL table.

The resulting effort (summed over riggings) after distribution on areas

$$E(Fl,Vs,\bullet,Ct,y,q,Ar)=E_{REF}(Fl,Vs,\bullet,Ct,y,q,\bullet)*E_{Area-dist}(Fl,Vs,\bullet,Ct,y,q,Ar)$$

are shown in EXCEL table 4.3 (Figure 2.7.4).

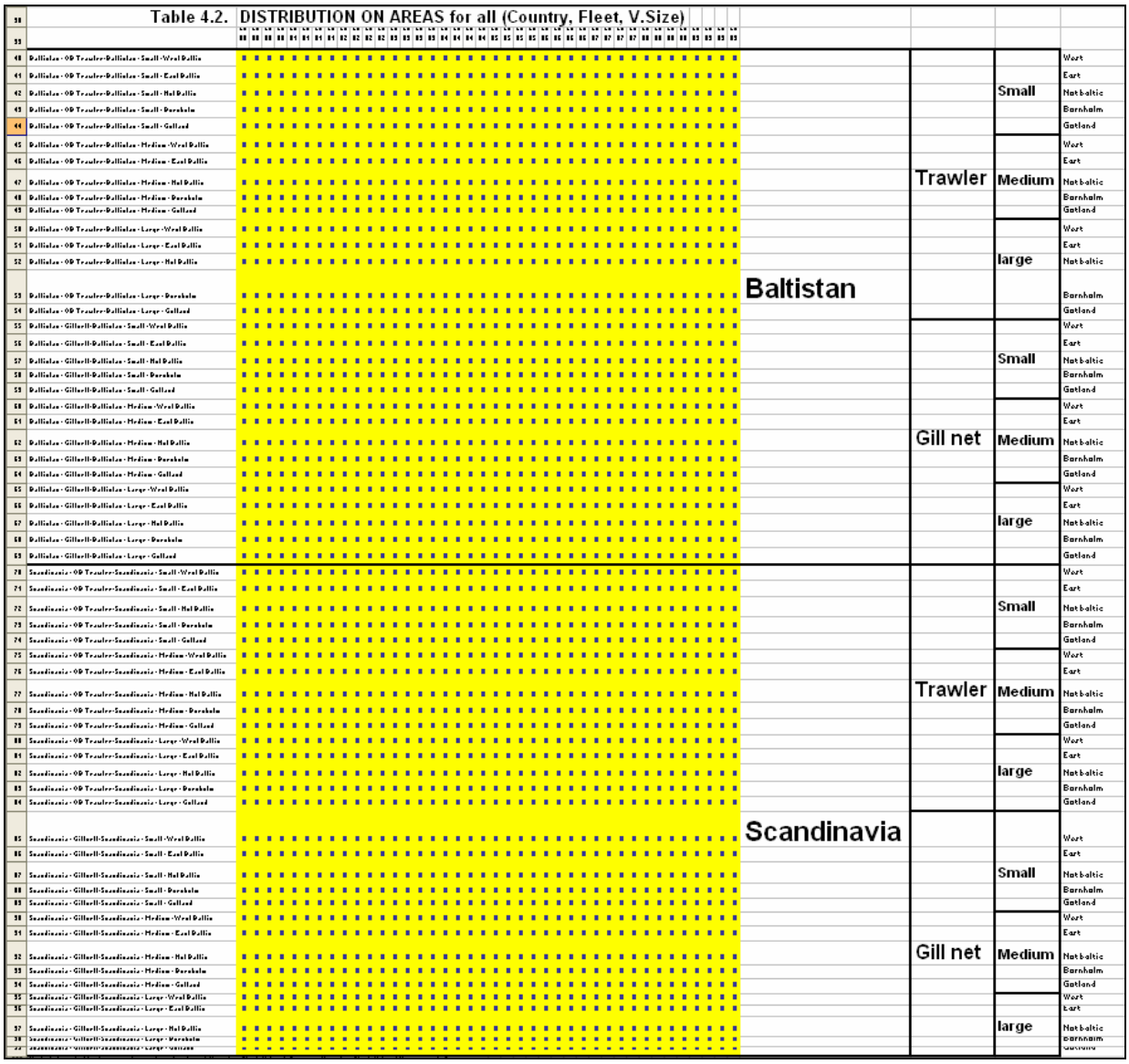


Figure 2.7.3.b. Effort distribution on areas with focus on the table structure. This version shows the entire table, the cells of which are hardly readable. The last column (hardly readable) contains the area names "West","East","Not Baltic","Bornhol" and "Gotland", for each vessel size.

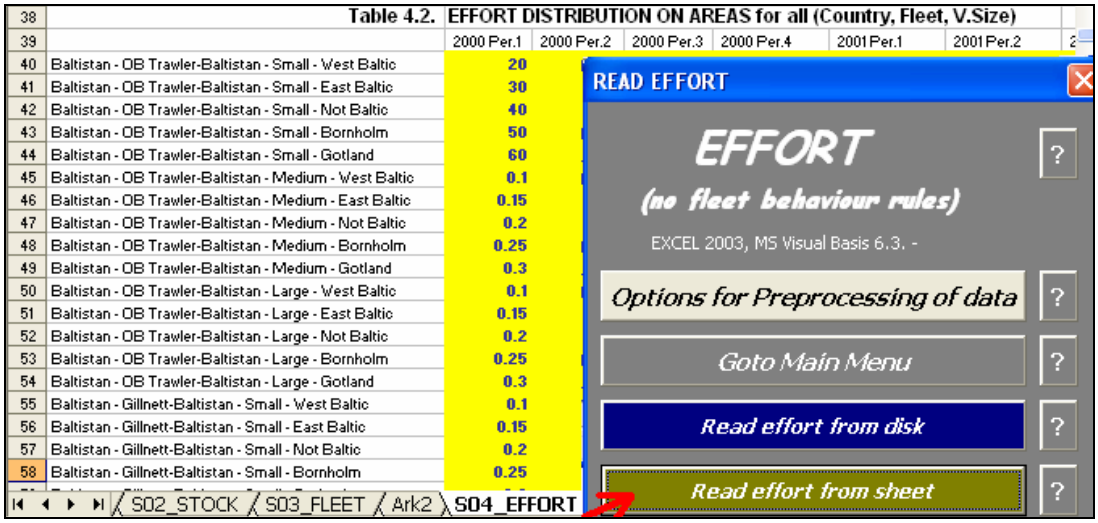


Figure 2.7.3.c. Effort distribution on areas. Example to illustrate the normalization of input. After clicking on "Read effort from sheet", cells B40,…,B44 will sum up to 1.0.

	A	B	C	D	E	F	G	H	I	J
103	Table 4.3.	RESULTING EFFORT AFTER DISTRIBUTION ON AREAS (Country, Fleet, V.Si								
104		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1
105	Baltistan - OB Trawler-Baltistan - Small - West Baltic	201	201	201	201	201	201	201	214.4	214.4
106	Baltistan - OB Trawler-Baltistan - Small - East Baltic	301.5	301.5	301.5	301.5	301.5	301.5	301.5	321.6	321.6
107	Baltistan - OB Trawler-Baltistan - Small - Not Baltic	402	402	402	402	402	402	402	428.8	428.8
108	Baltistan - OB Trawler-Baltistan - Small - Bornholm	502.5	502.5	502.5	502.5	502.5	502.5	502.5	536	536
109	Baltistan - OB Trawler-Baltistan - Small - Gotland	603	603	603	603	603	603	603	643.2	643.2
110	Baltistan - OB Trawler-Baltistan - Medium - West Baltic	87.1	87.1	87.1	87.1	87.1	87.1	87.1	87.1	87.1
111	Baltistan - OB Trawler-Baltistan - Medium - East Baltic	130.65	130.65	130.65	130.65	130.65	130.65	130.65	130.65	130.65
112	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	174.2	174.2	174.2	174.2	174.2	174.2	174.2	174.2	174.2
113	Baltistan - OB Trawler-Baltistan - Medium - Bornholm	217.75	217.75	217.75	217.75	217.75	217.75	217.75	217.75	217.75
114	Baltistan - OB Trawler-Baltistan - Medium - Gotland	261.3	261.3	261.3	261.3	261.3	261.3	261.3	261.3	261.3
115	Baltistan - OB Trawler-Baltistan - Large - West Baltic	20.1	20.1	20.1	20.1	20.1	20.1	20.1	13.4	13.4
116	Baltistan - OB Trawler-Baltistan - Large - East Baltic	30.15	30.15	30.15	30.15	30.15	30.15	30.15	20.1	20.1
117	Baltistan - OB Trawler-Baltistan - Large - Not Baltic	40.2	40.2	40.2	40.2	40.2	40.2	40.2	26.8	26.8
118	Baltistan - OB Trawler-Baltistan - Large - Bornholm	50.25	50.25	50.25	50.25	50.25	50.25	50.25	33.5	33.5
119	Baltistan - OB Trawler-Baltistan - Large - Gotland	60.3	60.3	60.3	60.3	60.3	60.3	60.3	40.2	40.2
120	Baltistan - Gillnett-Baltistan - Small - West Baltic	268	268	268	268	268	268	268	281.4	281.4
121	Baltistan - Gillnett-Baltistan - Small - East Baltic	402	402	402	402	402	402	402	422.1	422.1
122	Baltistan - Gillnett-Baltistan - Small - Not Baltic	536	536	536	536	536	536	536	562.8	562.8
123	Baltistan - Gillnett-Baltistan - Small - Bornholm	670	670	670	670	670	670	670	703.5	703.5
124	Baltistan - Gillnett-Baltistan - Small - Gotland	804.0001	804.0001	804.0001	804.0001	804.0001	804.0001	804.0001	844.2	844.2
125	Baltistan - Gillnett-Baltistan - Medium - West Baltic	134	134	134	134	134	134	134	134	134

S03_FLEET | Ark2 | S04_EFFORT | S05_BOATS | S06_PRICE

Figure 2.7.4. Resulting effort after distribution on areas. These data are derived from EXCEL Table 4.1 and 4.2 by multiplications (Figure 2.7.2 and Figure 2.7.3).

	A	B	C	D	E	F	G	H	I	J	K
168	Table 4.4.	EFFORT DISTRIBUTION ON RIGS (AFTER DISTRIBUTION ON AREAS) (Country, Fleet,									
169		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2
170	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375
171	Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625
172	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545
173	Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455
174	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643
175	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357
176	Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706
177	Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294
178	Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475
179	Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525
180	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - <110mm	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375
181	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - >110mm	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625	0.5625
182	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - <110mm	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545	0.4545
183	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - >110mm	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455	0.5455
184	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - <110mm	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643	0.4643
185	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - >110mm	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357	0.5357
186	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - <110mm	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706	0.4706
187	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - >110mm	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294	0.5294
188	Baltistan - OB Trawler-Baltistan - Medium - Gotland - <110mm	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475
189	Baltistan - OB Trawler-Baltistan - Medium - Gotland - >110mm	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525
190	Baltistan - OB Trawler-Baltistan - Large - West Baltic - <110mm	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375	0.4375

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Figure 2.7.5.a Effort distribution on riggings (after distribution on areas). The structure of EXCEL Table 4.4 is illustrated in Figure 2.7.5.b..

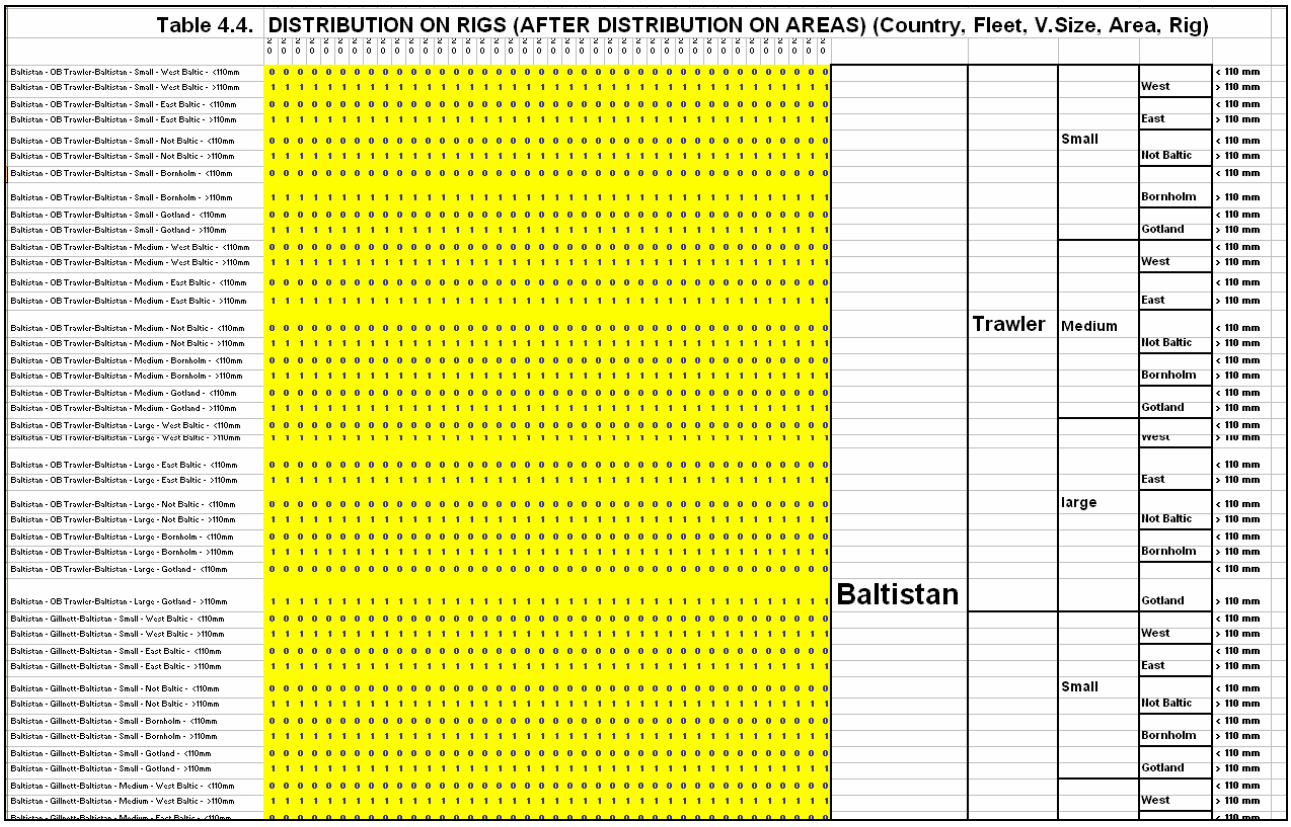

Table 4.4.	DISTRIBUTION ON RIGS (AFTER DISTRIBUTION ON AREAS) (Country, Fleet, V.Size, Area, Rig)				
Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm				West	> 110 mm
Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm				East	> 110 mm
Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm			Small		< 110 mm
Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm				Not Baltic	> 110 mm
Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm				Bornholm	> 110 mm
Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm				Gotland	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - West Baltic - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - West Baltic - >110mm				West	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - East Baltic - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - East Baltic - >110mm				East	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - <110mm		Trawler	Medium		< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - >110mm				Not Baltic	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Bornholm - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Bornholm - >110mm				Bornholm	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Gotland - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Gotland - >110mm				Gotland	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - West Baltic - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Large - West Baltic - >110mm				West	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - East Baltic - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Large - East Baltic - >110mm				East	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - Not Baltic - <110mm			large		< 110 mm
Baltistan - OB Trawler-Baltistan - Large - Not Baltic - >110mm				Not Baltic	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - Bornholm - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Large - Bornholm - >110mm				Bornholm	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - Gotland - <110mm					< 110 mm
Baltistan - OB Trawler-Baltistan - Large - Gotland - >110mm		Baltistan		Gotland	> 110 mm
Baltistan - Gillnett-Baltistan - Small - West Baltic - <110mm					< 110 mm
Baltistan - Gillnett-Baltistan - Small - West Baltic - >110mm				West	> 110 mm
Baltistan - Gillnett-Baltistan - Small - East Baltic - <110mm					< 110 mm
Baltistan - Gillnett-Baltistan - Small - East Baltic - >110mm				East	> 110 mm
Baltistan - Gillnett-Baltistan - Small - Not Baltic - <110mm			Small		< 110 mm
Baltistan - Gillnett-Baltistan - Small - Not Baltic - >110mm				Not Baltic	> 110 mm
Baltistan - Gillnett-Baltistan - Small - Bornholm - <110mm					< 110 mm
Baltistan - Gillnett-Baltistan - Small - Bornholm - >110mm				Bornholm	> 110 mm
Baltistan - Gillnett-Baltistan - Small - Gotland - <110mm					< 110 mm
Baltistan - Gillnett-Baltistan - Small - Gotland - >110mm				Gotland	> 110 mm
Baltistan - Gillnett-Baltistan - Medium - West Baltic - <110mm					< 110 mm
Baltistan - Gillnett-Baltistan - Medium - West Baltic - >110mm				West	> 110 mm

Figure 2.7.5.b. Effort distribution on riggings (after distribution on areas) with focus on the structure of EXCEL Table 4.4. The table shown here represents about 40% of EXCEL Table 4.4.

Figure 2.7.5.a and b shows the effort distribution on riggings (after distribution on areas). In this case there are only two riggings ">110mm" and ">110mm". There fore each of the two cells for given (Country, Fleet, Vessel Size, Area) sum up to 1.0. E.g. cells B170 and B171 sum up to 1.0.

Figure 2.7.5.a. shows only a minor part of EXCEL Table 4.4. Figure 2.7.5.b shows a larger part, but not all of EXCEL Table 4.4. Figure 2.7.5.b shows some 40% of EXCEL Table 4.4, which is considered enough to reveal the table structure.

Figure 2.7.6 (EXCEL Table 4.5) shows the resulting effort after multiplication with the distribution on riggings.

$$E(Fl,Vs,Rg,Ct,y,q,Ar) = E_{REF}(Fl,Vs,\bullet,Ct,y,q,\bullet) *$$
$$E_{Area-dist}(Fl,Vs,\bullet,Ct,y,q,Ar) * E_{Rig-Dist}(Fl,Vs,Rg,Ct,y,q,Ar)$$

Assessing the effect of changing effort by fleet, rigging, area and season is the key-exercise of TEMAS. Therefore, a "multiplier" ("X_E") to facilitate the manipulation of effort has been introduced. Actual effort used in the simulation is thus defined as the product of a "Reference-effort", E_{Ref}(Fl , y, q, Ar), and the multipliers (X_E):

$$E(Fl,Vs,Rg,Ct,y,q,Ar) = E_{Ref}(Fl,Vs,Rg,Ct,y,q,Ar) * X_E(Fl,Vs,Rg,Ct,y,q,Ar)$$

Using only multipliers less than or equal to one will guarantee that the effort never will exceed the physical upper limit of possible number of sea days.

	A	B	C	D	E	F	G	H	I	J
293	Table 4.5.	RESULTING EFFORT AFTER DISTRIBUTION ON RIGS AND AREAS (Country, Flee								
294		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1
295	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	87.9375	87.9375	87.9375	87.9375	87.9375	87.9375	87.9375	93.8	93.8
296	Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	113.0625	113.0625	113.0625	113.0625	113.0625	113.0625	113.0625	120.6	120.6
297	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	137.0454	137.0454	137.0454	137.0454	137.0454	137.0454	137.0454	146.1818	146.1818
298	Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	175.4182	175.4182
299	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	186.6429	186.6429	186.6429	186.6429	186.6429	186.6429	186.6429	199.0857	199.0857
300	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	215.3572	215.3572	215.3572	215.3572	215.3572	215.3572	215.3572	229.7143	229.7143
301	Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	236.4706	236.4706	236.4706	236.4706	236.4706	236.4706	236.4706	252.2353	252.2353
302	Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	266.0294	266.0294	266.0294	266.0294	266.0294	266.0294	266.0294	283.7647	283.7647
303	Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	286.425	286.425	286.425	286.425	286.425	286.425	286.425	305.52	305.52
304	Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	316.575	316.575	316.575	316.575	316.575	316.575	316.575	337.68	337.68
305	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - <110mm	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625
306	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - >110mm	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375
307	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - <110mm	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636
308	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - >110mm	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365
309	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - <110mm	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857
310	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - >110mm	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143
311	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - <110mm	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706
312	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - >110mm	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794
313	Baltistan - OB Trawler-Baltistan - Medium - Gotland - <110mm	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175
314	Baltistan - OB Trawler-Baltistan - Medium - Gotland - >110mm	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825
315	Baltistan - OB Trawler-Baltistan - Large - West Baltic - <110mm	8.79375	8.79375	8.79375	8.79375	8.79375	8.79375	8.79375	5.8625	5.8625
316	Baltistan - OB Trawler-Baltistan - Large - West Baltic - >110mm	11.30625	11.30625	11.30625	11.30625	11.30625	11.30625	11.30625	7.5375	7.5375

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Figure 2.7.6. Resulting effort distribution on riggings and areas. Explanation below EXCEL table: Calculated from the effort by area by: Ref.Effort(Ct,Fl,Vs,Ar,Rig) = Rig_Distribution(Ct,Fl,Vs,Area,Rig) *Ref.Effort(Ct,Fl,Vs,Ar)

A

	A	B	C	D	E	F	G	H	I
418	Table 4.6.	EFFORT MULTIPLIERS (Country, Fleet, V.Size, Area, Rig)							
419		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
420	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	1	1	1	1	1	1	1	1
421	Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	1	1	1	1	1	1	1	1
422	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	2	1	1	1	1	1	1	1
423	Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	1	1	1	1	1	1	1	1
424	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	1	1	1	1	1	1	1	1
425	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	1	1	1	1	1	1	1	1
426	Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	1	1	1	1	1	1	1	1
427	Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	1	1	1	1	1	1	1	1
428	Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	1	1	1	1	1	1	1	1
429	Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	1	1	1	1	1	1	1	1

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B

	A	B	C	D	E	F	G	H	I
418	Table 4.6.	EFFORT MULTIPLIERS (Country, Fleet, V.Size, Area, Rig)							
419		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4
420	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	0.5	1	1	1	1	1	1	1
421	Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	0.5	1	1	1	1	1	1	1
422	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	1	1	1	1	1	1	1	1
423	Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	0.5	1	1	1	1	1	1	1
424	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	0.5	1	1	1	1	1	1	1
425	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	0.5	1	1	1	1	1	1	1
426	Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	0.5	1	1	1	1	1	1	1
427	Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	0.5	1	1	1	1	1	1	1
428	Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	0.5	1	1	1	1	1	1	1
429	Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	0.5	1	1	1	1	1	1	1

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Figure 2.7.7. Effort multipliers. A: Before clicking on "Read effort from sheet", B: After clicking on "Read effort from sheet". Explanation below EXCEL table: Effort Mults by Country, Fleet, V.Size, Area and Rig, by which you can change effort Effort(Ct,Fl,Vs,Ar,Rig)= Mult(Ct,Fl,Vs,Ar,Rig) * Ref.Effort(Ct,Fl,Vs,Ar,Rig). NOTE That 0 <= Mult <= 1

Figure 2.7.7 (EXCEL Table 4.6) contains effort multipliers. In this case they have all got the maximum value of 1 except for cell B422, which has got value 2 (Figure A). Figure B shows the results after clicking on "read effort from sheet". The program will normalize the multipliers within the period in question, so that the maximum value becomes one. Any multiplier value above 1 is absurd, as the multiplier is applied to the maximum possible effort.

	A	B	C	D	E	F	G	H	I	J	K
543	Table 4.7.	RESULTING EFFORT DISTRIBUTION ON RIGS (AFTER DISTRIBUTION ON AREAS) (									
544		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2
545	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	87.9375	87.9375	87.9375	87.9375	87.9375	87.9375	87.9375	93.8	93.8	
546	Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	113.0625	113.0625	113.0625	113.0625	113.0625	113.0625	113.0625	120.6	120.6	1
547	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	137.0454	137.0454	137.0454	137.0454	137.0454	137.0454	137.0454	146.1818	146.1818	146.
548	Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	164.4546	175.4182	175.4182	175.
549	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	186.6429	186.6429	186.6429	186.6429	186.6429	186.6429	186.6429	199.0857	199.0857	199.0
550	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	215.3572	215.3572	215.3572	215.3572	215.3572	215.3572	215.3572	229.7143	229.7143	229.
551	Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	236.4706	236.4706	236.4706	236.4706	236.4706	236.4706	236.4706	252.2353	252.2353	252.2
552	Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	266.0294	266.0294	266.0294	266.0294	266.0294	266.0294	266.0294	283.7647	283.7647	283.7
553	Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	286.425	286.425	286.425	286.425	286.425	286.425	286.425	305.52	305.52	30
554	Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	316.575	316.575	316.575	316.575	316.575	316.575	316.575	337.68	337.68	33
555	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - <110mm	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10625	38.10
556	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - >110mm	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99375	48.99
557	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - <110mm	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38636	59.38
558	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - >110mm	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26365	71.26
559	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - <110mm	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87857	80.87
560	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - >110mm	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32143	93.32
561	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - <110mm	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4706	102.4
562	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - >110mm	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2794	115.2
563	Baltistan - OB Trawler-Baltistan - Medium - Gotland - <110mm	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.1175	124.
564	Baltistan - OB Trawler-Baltistan - Medium - Gotland - >110mm	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1825	137.1
565	Baltistan - OB Trawler-Baltistan - Large - West Baltic - <110mm	8.79375	8.79375	8.79375	8.79375	8.79375	8.79375	8.79375	5.8625	5.8625	5.8

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Figure 2.7.8. Resulting effort after application of effort multipliers. Explanation below EXCEL table: Calculated by:
Effort(Ct,Fl,Vs,Ar,Rig)= Mult(Ct,Fl,Vs,Ar,Rig) * Ref.Effort(Ct,Fl,Vs,Ar,Rig)

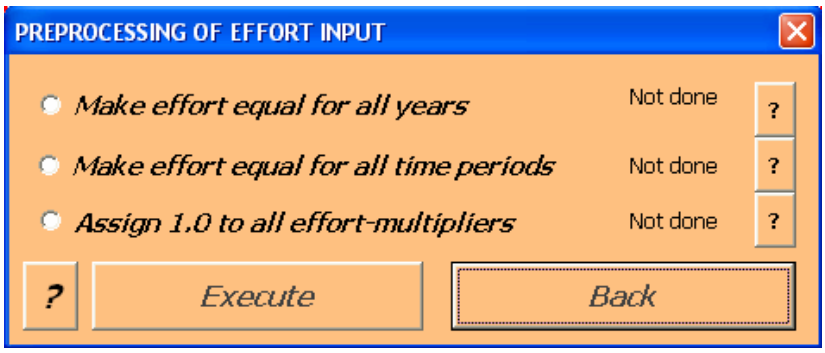


Figure 2.7.9.a. Options for pre-processing of effort data and parameters.

Figure 2.7.9.a shows the user form for pre-processing of effort input. Figure 2.7.9.b shows examples of the three options for pre-processing. Option 1 makes the data equal from year to year, but allow for variations between periods. Option 2 makes data equal for all periods, but allow for variations between years. Option 3 makes the multipliers equal and 1.0 for all periods and years.

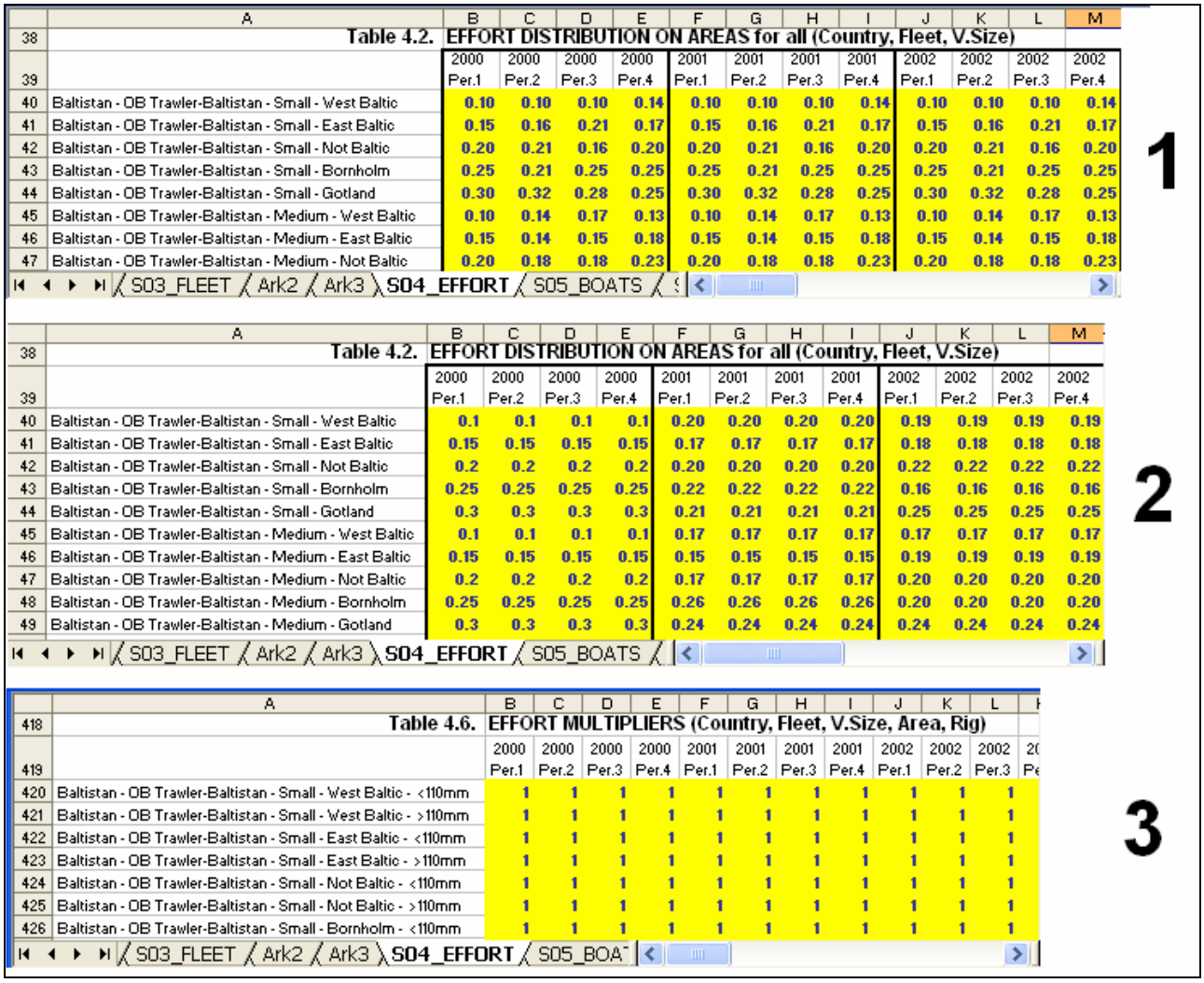


Table 4.2. EFFORT DISTRIBUTION ON AREAS for all (Country, Fleet, V.Size)

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
Baltistan - OB Trawler-Baltistan - Small - West Baltic	0.10	0.10	0.10	0.14	0.10	0.10	0.10	0.14	0.10	0.10	0.10	0.14
Baltistan - OB Trawler-Baltistan - Small - East Baltic	0.15	0.16	0.21	0.17	0.15	0.16	0.21	0.17	0.15	0.16	0.21	0.17
Baltistan - OB Trawler-Baltistan - Small - Not Baltic	0.20	0.21	0.16	0.20	0.20	0.21	0.16	0.20	0.20	0.21	0.16	0.20
Baltistan - OB Trawler-Baltistan - Small - Bornholm	0.25	0.21	0.25	0.25	0.25	0.21	0.25	0.25	0.25	0.21	0.25	0.25
Baltistan - OB Trawler-Baltistan - Small - Gotland	0.30	0.32	0.28	0.25	0.30	0.32	0.28	0.25	0.30	0.32	0.28	0.25
Baltistan - OB Trawler-Baltistan - Medium - West Baltic	0.10	0.14	0.17	0.13	0.10	0.14	0.17	0.13	0.10	0.14	0.17	0.13
Baltistan - OB Trawler-Baltistan - Medium - East Baltic	0.15	0.14	0.15	0.18	0.15	0.14	0.15	0.18	0.15	0.14	0.15	0.18
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	0.20	0.18	0.18	0.23	0.20	0.18	0.18	0.23	0.20	0.18	0.18	0.23

1

Table 4.2. EFFORT DISTRIBUTION ON AREAS for all (Country, Fleet, V.Size)

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
Baltistan - OB Trawler-Baltistan - Small - West Baltic	0.1	0.1	0.1	0.1	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.19
Baltistan - OB Trawler-Baltistan - Small - East Baltic	0.15	0.15	0.15	0.15	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18
Baltistan - OB Trawler-Baltistan - Small - Not Baltic	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.20	0.22	0.22	0.22	0.22
Baltistan - OB Trawler-Baltistan - Small - Bornholm	0.25	0.25	0.25	0.25	0.22	0.22	0.22	0.22	0.16	0.16	0.16	0.16
Baltistan - OB Trawler-Baltistan - Small - Gotland	0.3	0.3	0.3	0.3	0.21	0.21	0.21	0.21	0.25	0.25	0.25	0.25
Baltistan - OB Trawler-Baltistan - Medium - West Baltic	0.1	0.1	0.1	0.1	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Baltistan - OB Trawler-Baltistan - Medium - East Baltic	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.19	0.19	0.19	0.19
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	0.2	0.2	0.2	0.2	0.17	0.17	0.17	0.17	0.20	0.20	0.20	0.20
Baltistan - OB Trawler-Baltistan - Medium - Bornholm	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.20	0.20	0.20	0.20
Baltistan - OB Trawler-Baltistan - Medium - Gotland	0.3	0.3	0.3	0.3	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24

2

Table 4.6. EFFORT MULTIPLIERS (Country, Fleet, V.Size, Area, Rig)

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	1	1	1	1	1	1	1	1	1	1	1	1
Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	1	1	1	1	1	1	1	1	1	1	1	1
Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	1	1	1	1	1	1	1	1	1	1	1	1
Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	1	1	1	1	1	1	1	1	1	1	1	1
Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	1	1	1	1	1	1	1	1	1	1	1	1
Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	1	1	1	1	1	1	1	1	1	1	1	1
Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	1	1	1	1	1	1	1	1	1	1	1	1

3

Figure 2.7.9.b. Examples of applications of options for pre-processing of effort data and parameters (compare figure 2.7.9.b). (1) Make effort equal for all years (2) Make effort equal for all periods (3)Assign 1 to all effort multipliers.

2.8. BOATS INPUT, S05_BOATS

Figure 2.8.1 shows the user form for entry of boats (or number of vessel) input data in worksheet S05_BOATS.

Table 2.8.1.a shows a list of the EXCEL tables in worksheet B05_BOATS used in the present demonstration example. Worksheet S05_BOATS offers a suite of options for definition of the so-called "fleet characteristics", and if an option is not utilized, the table is not deleted, but displayed as a "blue template" filled in vith "no value". This is done to facilitate the comprehension of data data structure. Table 2.8.1.b lists the tables of "fleet characteristics" that are deselected in the present demonstration example.

Note that except for the three first EXCEL tables, all EXCEL tables are country specific.

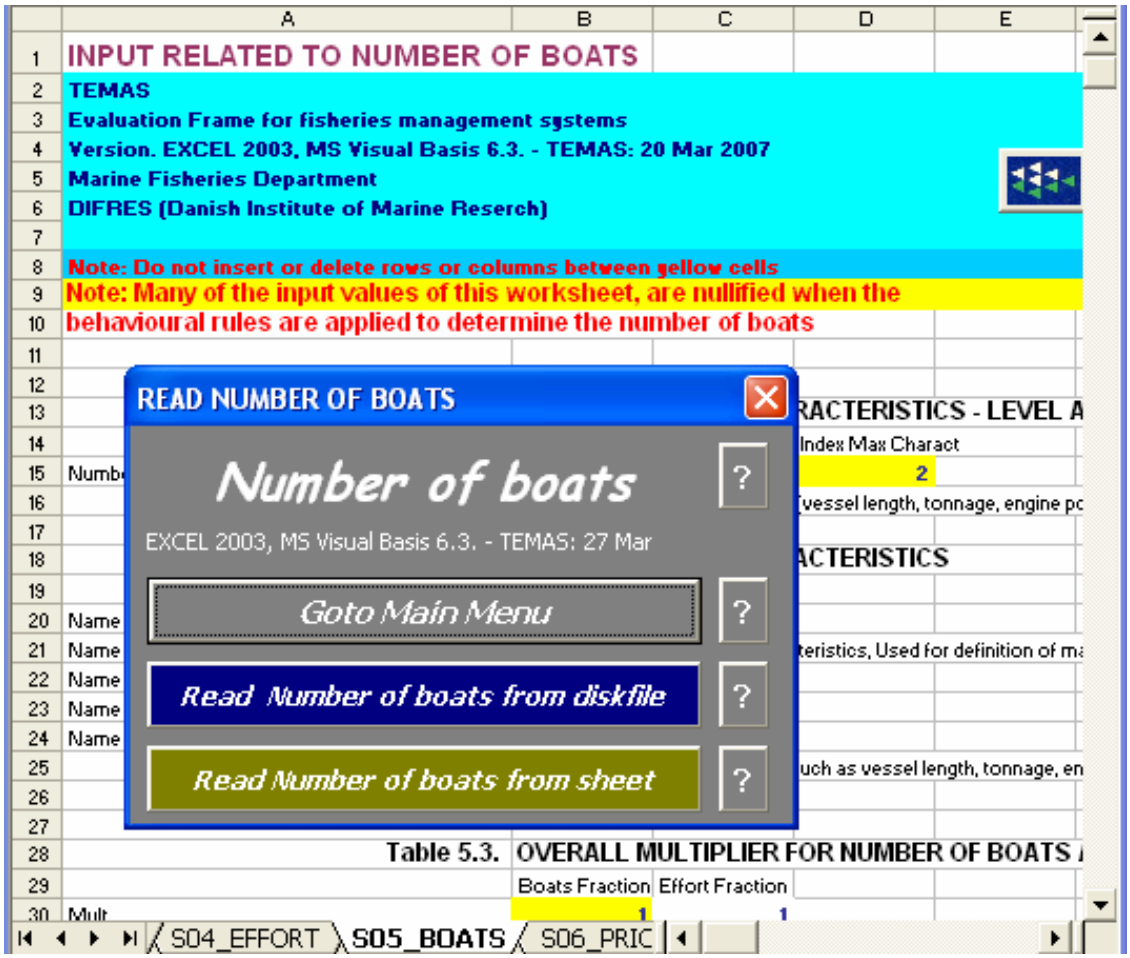


Figure 2.8.1. Userform for entry of boat-related data and parameters.

Index	EXCEL Table	Caption
72	Table5.1.	NUMBER OF FLEET CHARACTERISTICS - LEVEL AND INDEX OF MAX TOTAL CHARACTERISTICS
73	Table5.2.	NAMES OF FLEET CHARACTERISTICS
74	Table5.3.	OVERALL MULTIPLIER FOR NUMBER OF BOATS AND EFFORT
75	Table5.4.1.	Baltistan : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSELS)
76	Table5.4.2.	Baltistan : NUMBER OF NEW BOATS MultS
77	Table5.4.3.	Baltistan : CREW PER VESSEL
78	Table5.4.4.	Baltistan : MAX DAYS/PERIOD
79	Table5.4.5.	Baltistan : NUMBER OF DIS-INVESTMENT (WITHDRAWAL) VESSELS
80	Table5.4.6.	Baltistan : NUMBER OF ATTRITION VESSELS
81	Table5.4.7.	Baltistan : NUMBER OF DECOMMISIONED VESSELS
82	Table5.4.8.	Baltistan : RESULTING VESSEL AGE DISTRIBUTION
83	Table5.4.9.	Baltistan : RESULTING NUMBER OF DECOMMISIONED VESSELS
84	Table5.4.10.	Baltistan : NUMBER OF VESSESLS (SUMMARY)
85	Table5.4.11.	Scandinavia : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSELS)
86	Table5.4.12.	Scandinavia : NUMBER OF NEW BOATS MultS
87	Table5.4.13.	Scandinavia : CREW PER VESSEL
88	Table5.4.14.	Scandinavia : MAX DAYS/PERIOD
89	Table5.4.15.	Scandinavia : NUMBER OF DIS-INVESTMENT (WITHDRAWAL) VESSELS
90	Table5.4.16.	Scandinavia : NUMBER OF ATTRITION VESSELS
91	Table5.4.17.	Scandinavia : NUMBER OF DECOMMISIONED VESSELS
92	Table5.4.18.	Scandinavia : RESULTING VESSEL AGE DISTRIBUTION
93	Table5.4.19.	Scandinavia : RESULTING NUMBER OF DECOMMISIONED VESSELS
94	Table5.4.20.	Scandinavia : NUMBER OF VESSESLS (SUMMARY)
95	Table5.5.1.	Baltistan : FLEET CHARACTERISTICS: Length
96	Table5.5.2.	Baltistan : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Length
100	Table5.5.6.	Baltistan : FLEET CHARACTERISTICS: Tonnage

101	Table5.5.7.	Baltistan : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Tonnage
102	Table5.5.8.	Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Tonnage
105	Table5.5.11.	Baltistan : FLEET CHARACTERISTICS: KgWat
106	Table5.5.12.	Baltistan : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): KgWat
120	Table5.5.26.	Scandinavia : FLEET CHARACTERISTICS: Length
121	Table5.5.27.	Scandinavia : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Length
125	Table5.5.31.	Scandinavia : FLEET CHARACTERISTICS: Tonnage
126	Table5.5.32.	Scandinavia : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Tonnage
127	Table5.5.33.	Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY CTRY): Tonnage
130	Table5.5.36.	Scandinavia : FLEET CHARACTERISTICS: KgWat
131	Table5.5.37.	Scandinavia : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): KgWat

Table 2.8.1.a. Tables in the boats input sheet, which are actually used, S05_BOATS.

Index	EXCEL Table	Caption
97	*Table5.5.3.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Length - Not Used*
98	*Table5.5.4.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Length - Not Used*
99	*Table5.5.5.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): Length - Not Used*
103	*Table5.5.9.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Tonnage - Not Used*
104	*Table5.5.10.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): Tonnage - Not Used*
107	*Table5.5.13.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): KgWat - Not Used*
108	*Table5.5.14.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): KgWat - Not Used*
109	*Table5.5.15.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): KgWat - Not Used*
110	*Table5.5.16.*	*Baltistan : FLEET CHARACTERISTICS: Not Used*
111	*Table5.5.17.*	*Baltistan : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Not Used*
112	*Table5.5.18.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Not Used - Not Used*
113	*Table5.5.19.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Not Used - Not Used*
114	*Table5.5.20.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): Not Used - Not Used*
115	*Table5.5.21.*	*Baltistan : FLEET CHARACTERISTICS: Not Used*
116	*Table5.5.22.*	*Baltistan : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Not Used*
117	*Table5.5.23.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Not Used - Not Used*
118	*Table5.5.24.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Not Used - Not Used*
119	*Table5.5.25.*	*Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): Not Used - Not Used*
122	*Table5.5.28.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Length - Not Used*
123	*Table5.5.29.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Length - Not Used*
124	*Table5.5.30.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): Length - Not Used*
128	*Table5.5.34.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Tonnage - Not Used*
129	*Table5.5.35.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY CTRY, FLEET AND VESSEL SIZE): Tonnage - Not Used*
132	*Table5.5.38.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): KgWat - Not Used*
133	*Table5.5.39.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): KgWat - Not Used*
134	*Table5.5.40.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZE): KgWat - Not Used*
135	*Table5.5.41.*	*Scandinavia : FLEET CHARACTERISTICS: Not Used*
136	*Table5.5.42.*	*Scandinavia : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Not Used*
137	*Table5.5.43.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Not Used - Not Used*
138	*Table5.5.44.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Not Used - Not Used*
139	*Table5.5.45.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY CTRY, FLEET AND VESSEL SIZE): Not Used - Not Used*
140	*Table5.5.46.*	*Scandinavia : FLEET CHARACTERISTICS: Not Used*
141	*Table5.5.47.*	*Scandinavia : (START NUMBER OF VESSELS)* (FLEET CHARACTERISTICS): Not Used*
142	*Table5.5.48.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Not Used - Not Used*
143	*Table5.5.49.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Not Used - Not Used*
144	*Table5.5.50.*	*Scandinavia : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY CTRY, FLEET AND VESSEL SIZE): Not Used - Not Used*

Table 2.8.1.b. Tables in the boats input sheet, which are not used, S05_BOATS.

The number of boats or vessels is in TEMAS composed of "vessel age groups" (Index "Va"), that is.

$$NU_{Vessel}(Fl, Vs, Ct, y, q, \bullet) = \sum_{Va=1}^{Va_{Max}} NU_{Nessel}(Fl, Vs, Ct, y, q, Va)$$

where NU_{Vessel}(Fl, Vs, Ct, y, q, Va) = Number of vessels which has age "Va".

The number of vessels, NU_{Vessel}(Fl, Vs, Ct, y, q,Va), is defined by iteration:

	q > 1	q = 1
Va = 0	$NU_{Vessel}(Fl, Vs, Ct, y, q, 0) = NU_{New\text{-}Vessel}(Fl, Vs, Ct, y,q)$	$NU_{Vessel}(Fl, Vs, Ct, y,1,0) = NU_{New\text{-}Vessel}(Fl, Vs, Ct, y,q)$
Va = $1,2,\ldots,Va_{max}$-1	$NU_{Vessel}(Fl, Vs, Ct, y, q,Va) = NU_{vessel}(Fl, y , q-1,Va) - NU_{Decomm}(Fl, Vs, Ct, y, q,Va) - NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va) - NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$	$NU_{Vessel}(Fl, Vs, Ct, y,Va) = NU_{vessel}(Fl, y-1, q_{Max},Va) - NU_{Decomm}(Fl, Vs, Ct, y, 1,Va) - NU_{Withdrawal}(Fl, Vs, Ct, y, 1, Va) - NU_{Attrition}(Fl, Vs, Ct, y, 1, Va)$
Va = Va_{Max} (plus group)	$NU_{vessel}(Fl, Vs, Ct, y, q,Va) = NU_{vessel}(Fl, Vs, Ct, y, q-1, Va_{Max}) + NU_{Decomm}(Fl, Vs, Ct, y, q, Va_{Max}) - NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va_{Max}) - NU_{Attrition}(Fl, Vs, Ct, y, q, Va_{Max})$	$NU_{vessel}(Fl, Vs, Ct, y, 1,Va) = NU_{vessel}(Fl, y-1, q_{Max}, Va_{Max}) + NU_{vessel}(Fl, y-1, q_{Max}, Va_{Max} -1) - NU_{Decomm}(Fl, Vs, Ct, y, 1, Va_{Max}) - NU_{Withdrawal}(Fl, Vs, Ct, y, 1, Va_{Max}) - NU_{Attrition}(Fl, Vs, Ct, y, 1, Va_{Max})$

Where NU_{Decomm}, $NU_{Attrition}$ and $NU_{Withdrawal}$ are the numbers of vessels withdrawn due to a vessel decommissioning, retired vessels having reached the end of their techno-economic lifetime and withdrawal. $NU_{New\text{-}Vessel}(Fl, Vs, Ct, y, q)$ is the (simulated or predicted) number of new vessels (number of investments in new vessels).

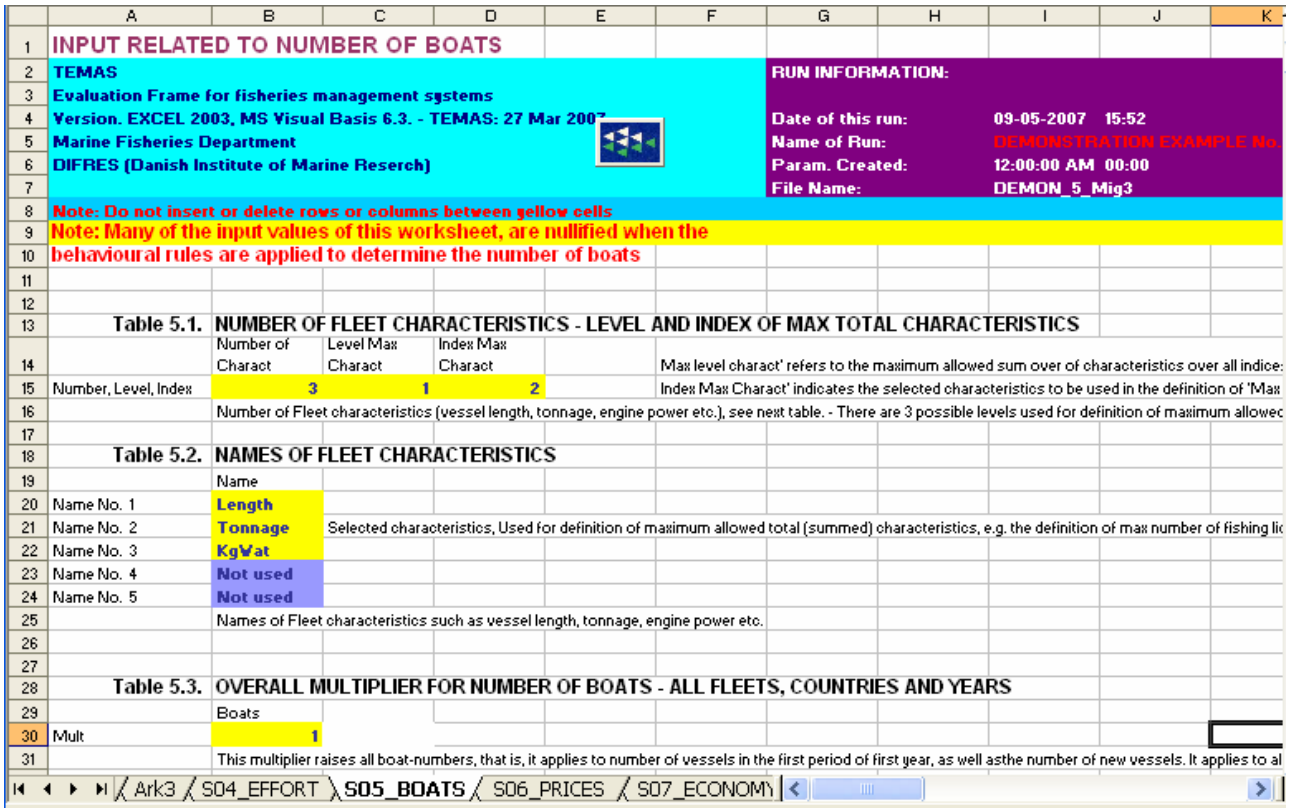
The (simulated or predicted) numbers may be either given as input parameters or be determined by the "Structural or long term Fleet behaviour rules". When the number of vessels are computed according to the so-called "structural behaviour rules", they are computed as a fraction of the existing number of vessels and it becomes essential in which sequence numbers are computed. The sequence of events is (1) Decommission (2) Disinvestments (3) Attritions (4) Recruitments (Investments).

EXCEL Tables 5.1 and 2. (Figure 2.8.2) contain the number and names of the fleet characteristics. The values of the fleet characteristics are given in subsequent EXCEL tables.

Examples of fleet characteristics are "Vessel tonnage", "Length of vessel" and "KgW of engine". The TEMAS model allow for a user selected number of fleet characteristics to be accounted for. These fleet characteristics may be used in two ways:

1) The definition of fisheries regulations (as in the example with tonnage above)
2) Measures of fleet features used in output tables, as additional information and explanation.

EXCEL table 5.1 contains the number of fleet characteristics, and indicates which of them are used for definition of fisheries regulations. As appear from EXCEL table 5.1. are three fleet characteristics. The names of the three fleet characteristics are given in EXCEL Table 5.2 (Figure 2.8.2): "Length","Tonnage" and "KgWat". The column "Index Max Charact" indcates the it is characteristics no 2, that is, "tonnage" which is used to define the "Maximum regulation". Only one choice is available.



	A	B	C	D	E	F	G	H	I	J	K
1	INPUT RELATED TO NUMBER OF BOATS										
2	TEMAS						RUN INFORMATION:				
3	Evaluation Frame for fisheries management systems										
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007						Date of this run:		09-05-2007 15:52		
5	Marine Fisheries Department						Name of Run:		DEMONSTRATION EXAMPLE No.		
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:		12:00:00 AM 00:00		
7							File Name:		DEMON_5_Mig3		
8	Note: Do not insert or delete rows or columns between yellow cells										
9	Note: Many of the input values of this worksheet, are nullified when the										
10	behavioural rules are applied to determine the number of boats										
11											
12											
13	Table 5.1.	NUMBER OF FLEET CHARACTERISTICS - LEVEL AND INDEX OF MAX TOTAL CHARACTERISTICS									
14		Number of Charact	Level Max Charact	Index Max Charact		Max level charact' refers to the maximum allowed sum over of characteristics over all indice:					
15	Number, Level, Index	3	1	2		Index Max Charact' indicates the selected characteristics to be used in the definition of 'Max					
16		Number of Fleet characteristics (vessel length, tonnage, engine power etc.), see next table. - There are 3 possible levels used for definition of maximum allowec									
17											
18	Table 5.2.	NAMES OF FLEET CHARACTERISTICS									
19		Name									
20	Name No. 1	Length									
21	Name No. 2	Tonnage	Selected characteristics, Used for definition of maximum allowed total (summed) characteristics, e.g. the definition of max number of fishing lic								
22	Name No. 3	KgWat									
23	Name No. 4	Not used									
24	Name No. 5	Not used									
25		Names of Fleet characteristics such as vessel length, tonnage, engine power etc.									
26											
27											
28	Table 5.3.	OVERALL MULTIPLIER FOR NUMBER OF BOATS - ALL FLEETS, COUNTRIES AND YEARS									
29		Boats									
30	Mult	1									
31		This multiplier raises all boat-numbers, that is, it applies to number of vessels in the first period of first year, as well asthe number of new vessels. It applies to al									

Ark3 | S04_EFFORT | S05_BOATS | S06_PRICES | S07_ECONOM

Figure 2.8.2. EXCEL Tables 5.1-2. Fleet characteristics and EXCEL Table 5.3: Overall multiplier for number of boats and effort.

The explanations to EXCEL Table 5.1 . say:

Row 14: 'Max level charact' refers to the maximum allowed sum over of characteristics over all indices in the Aggregation level: Level 1: Ct Level 2: (Fl,Ct) Level 3: (Fl,Vs,Ct)

Row 15: 'Index Max Charact' indicates the selected characteristics to be used in the definition of 'Max level charactert' , e.g. If levet is 1, then it could be the maximum allowed total KgWat of all fleets in a country

Row 16: Number of Fleet characteristics (vessel length, tonnage, engine power etc.), see next table. - There are 3 possible levels used for definition of maximum allowed characteristics: (Level 1:by Country),(Level 2:by Fleet and Country), (Level 3: by Fleet, Vessel size and Country). - 'Index' means 'index of fleet characteristics' used for definition of maximum allowed characteristics (note: only one choice possible)

The explanations to EXCEL Table 5.2 . say:

Row 21: Selected characteristics, Used for definition of maximum allowed total (summed) characteristics, e.g. the definition of max number of fishing licenses

Row 25: Names of Fleet characteristics such as vessel length, tonnage, engine power etc.

The explanations to EXCEL Table 5.3 . say:

Row 30: This multiplier raises all boat-numbers, that is, it applies to number of vessels in the first period of first year, as well as the number of new vessels. It applies to all fleets of all counties in all years.

The "maximum regulation" is an upper limit, MAL (Maximum allowed level) of the characteristics summed over vessels. TEMAS allows for limitations of total characteristics of three levels Country, Fleet and Vessel Size:

Level 1: Country level

$$\sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y,\bullet) * CHARACT(Fl,Vs,Ct) \le MAL_{Charact}^{Level\ 1}(Ct)$$

Level 2: Fleet level:

$$\sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y,\bullet) * CHARACT(Fl,Vs,Ct) \le MAL_{Charact}^{Level\ 2}(Fl,Ct)$$

Level 3: Vessel size level:

$$NU_{Vessel}(Fl,Vs,Ct,y,\bullet) * CHARACT(Fl,Vs,Ct) \le MAL_{Charact}^{Level\ 3}(Fl,Vs,Ct)$$

The column "Level Max Charact" in EXCEL Table 5.1 indicates "Level 1", that it, the country level. Thus there is an upper limit for the total tonnage of all vessels of each country in this example. EXCEL Table 5.2 shows that there are options for up to 5 different fleet characteristics in the present version of TEMAS, but only three of them are used.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
32																
33	**Table 5.4.1.**	**Baltistan : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSELS)**														
34		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	200 Per
35	OB Trawler-Baltistan - Small - Age 1 - New boats	5	0	0	0	0	0	0	5	0	0	0	0	0	0	
36	OB Trawler-Baltistan - Medium - Age 1 - New boats	3	0	0	0	0	0	0	3	0	0	0	0	0	0	
37	OB Trawler-Baltistan - Large - Age 1 - New boats	2	0	0	0	0	0	0	2	0	0	0	0	0	0	
38	Gillnett-Baltistan - Small - Age 1 - New boats	5	0	0	0	0	0	0	5	0	0	0	0	0	0	
39	Gillnett-Baltistan - Medium - Age 1 - New boats	3	0	0	0	0	0	0	3	0	0	0	0	0	0	
40	Gillnett-Baltistan - Large - Age 1 - New boats	2	0	0	0	0	0	0	2	0	0	0	0	0	0	
41		The number of vessels by vessel age group in first period of first year and number of investments (number of recruiting														
42																
43																
44	**Table 5.4.2.**	**Baltistan : NUMBER OF NEW BOATS MULTIPLIER**														
45		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	200 Per
46	OB Trawler-Baltistan - Small	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
47	OB Trawler-Baltistan - Medium	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
48	OB Trawler-Baltistan - Large	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
49	Gillnett-Baltistan - Small	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
50	Gillnett-Baltistan - Medium	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
51	Gillnett-Baltistan - Large	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
52		Multiplier to raise the number of new boats (number of investments). There is a multiplier for each period of each year														
53																

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Figure 2.8.2.a. Initial number of vessels and number of new vessels in the case where the vessel age distribution is ignored. Figure 2.8.2.b shows an example woth vessel age distribution.
The explanation below EXCEL Table 5.4.1. says: The number of vessels by vessel age group in first period of first year and number of investments (number of recruiting vessels in first age group). This is the input number of vessels. Other table-entries are labeled 'No value' because they are derived from the input numbers. Recall that fishing vessels are treated as fish stocks, so that the input is sufficient to fill in the entire tables. (See the table 'Resulting number of vessels')
The explanation below EXCEL Table 5.4.2. says: Multiplier to raise the number of new boats (number of investments). There is a multiplier for each period of each year

	A	B	C	D	E	F	G	H	I	J
32										
33	Table 5.4.1.	Ireland : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSELS)								
34		2000 Per.1 - Init	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1
35	Trawl - Medium - Age 1 - New boats	0	42	0	46	0	0	0	0	
36	Trawl - Medium - Age 2 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
37	Trawl - Medium - Age 3 - New boats	70	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
38	Trawl - Medium - Age 4 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
39	Trawl - Medium - Age 5 - New boats	66	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
40	Trawl - Medium - Age 6 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
41	Trawl - Medium - Age 7 - New boats	62	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
42	Trawl - Medium - Age 8 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
43	Trawl - Medium - Age 9 - New boats	58	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
44	Trawl - Medium - Age 10 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
45	Trawl - Medium - Age 11 - New boats	54	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
46	Trawl - Medium - Age 12 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
47	Trawl - Medium - Age 13 - New boats	50	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
48	Trawl - Large - Age 1 - New boats	34	0	38	0	0	0	0	0	
49	Trawl - Large - Age 2 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
50	Trawl - Large - Age 3 - New boats	46	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
51	Trawl - Large - Age 4 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
52	Trawl - Large - Age 5 - New boats	42	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
53	Trawl - Large - Age 6 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
54	Trawl - Large - Age 7 - New boats	38	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
55	Trawl - Large - Age 8 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
56	Trawl - Large - Age 9 - New boats	34	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
57	Trawl - Large - Age 10 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
58	Trawl - Large - Age 11 - New boats	30	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
59	Trawl - Large - Age 12 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
60	Trawl - Large - Age 13 - New boats	26	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
61	Gill netter - Small - Age 1 - New boats	44	0	48	0	0	0	0	0	
62	Gill netter - Small - Age 2 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
63	Gill netter - Small - Age 3 - New boats	44	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
64	Gill netter - Small - Age 4 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
65	Gill netter - Small - Age 5 - New boats	40	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value
66	Gill netter - Small - Age 6 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value

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Figure 2.8.2.b. Initial number of vessels and number of new vessels in with vessel age distribution.

EXCEL Table 5.3 contains the overall multiplier for new boats. The number of new vessels (investments) is created from a "reference number" multiplied by a "Multiplier":

$$NU_{Vessel}(Fl,Vs,Ct,y,q,0) = X_0^{Vessels} * X_1^{Vessels}(Fl,Vs,Ct,y) * NU^{Re\,ference}_{New\ Vessels}(Fl,Vs,Ct,y)$$

The multiplier is composed of two factors, where the first factor is independent $X_0^{Vessels}$ (EXCEL Table 5.3), and applies to all fleets in all time periods, whereas the second factor depends on fleet and time period. $X_1^{Vessels}(Fl,Vs,Ct,y)$ (EXCEL Table 5.4.2)

Figure 2.8.2.a (EXCEL Table 5.4.1) shows the initial number of vessels, i.e. the number of vessels in first period of first year, NU_{Vessel}(Fl, Vs, Ct, y=1, q=1, Va) and number of new vessels, i.e. the number of "recruiting vessels" or "vessel investments" in all years (and all periods) NU_{Vessel}(Fl, Vs, Ct, y, q, 0) = $NU_{New\text{-}Vessel}$(Fl, Vs, Ct, y,q). The example in Figure 2.8.2.a deals with only one vessel age group. Figure 2.8.2.b shows an example with 13 vessel age groups. In this example it becomes clearer that the new vessels are "recruits" i.e. belong to age group 0. As new vessels can enter only age group 0, the values for age group 1+ are not detfines, which is indicated by "No Value". Only the first period in first year can contain the 1+ vessel age group.

EXCEL Table 5.4.2 (Figure 2.8.2.a) contains the multipliers for the initial vessels numbers and the numbers of new vessels, $X_1^{Vessels}(Fl,Vs,Ct,y)$. The resulting number of vessels will become the product of EXCEL tables 5.4.1. and EXCEL Table 5.4.2. This multiplier will also be applied to the initial number of vessels in first period of first year. For the initial fleet, the multiplier applies to all vessel age groups.

Figure 2.8.3 shows the number of crew per vessel (EXCEL Table 5.4.3) and the maximum number of days per months (EXCEL Table 5.4.4). The "crew per vessel" is used to compute the employment by multiplication with number of vessels, and to compute other indicators of performance in the economic model.

The maximum number of sea days, $EY_{MAX}(Fl, Vs, Ct, y, q, Ar)$, multiplied by the number of vessels, gives the upper limit of the effort (sea days) that can be exerted. We define the "reference effort" or the "maximum effort" by

$$E_{REF}(Fl,Vs,Ct,y,q,Ar) \;=\; NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * EY_{Max}(Fl,Vs,Ct,y,q,Ar)$$

As the time periods are quarters of the year in this example, the upper limit of maximum number of days becomes 90-92 days. Here the values 65-67 are given, so that vessels stay 33-35 days in port every time period.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
55	**Table 5.4.3.**	**Baltistan : CREW PER VESSEL**																
56		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	200 Per
57	OB Trawler-Baltistan - Small	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
58	OB Trawler-Baltistan - Medium	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	
59	OB Trawler-Baltistan - Large	9	9	9	9	9	9	9	9	9	9	8	8	8	8	8	8	
60	Gillnett-Baltistan - Small	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
61	Gillnett-Baltistan - Medium	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	
62	Gillnett-Baltistan - Large	9	9	9	9	9	9	9	9	9	9	8	8	8	8	8	8	
63		Number of crew members per vessel, used to define employment. There is a crew-number for each period of each year																
64																		
65																		
66	**Table 5.4.4.**	**Baltistan : MAX DAYS/PERIOD**																
67		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	200 Per
68	OB Trawler-Baltistan - Small	67	67	67	67	66	66	66	66	65	65	65	65	67	67	67	67	
69	OB Trawler-Baltistan - Medium	67	67	67	67	66	66	66	66	65	65	65	65	67	67	67	67	
70	OB Trawler-Baltistan - Large	67	67	67	67	66	66	66	66	65	65	65	65	67	67	67	67	
71	Gillnett-Baltistan - Small	67	67	67	67	66	66	66	66	65	65	65	65	67	67	67	67	
72	Gillnett-Baltistan - Medium	67	67	67	67	66	66	66	66	65	65	65	65	67	67	67	67	
73	Gillnett-Baltistan - Large	67	67	67	67	66	66	66	66	65	65	65	65	67	67	67	67	
74		The maximum number of effort units (say days) per time unit a vessel of the fleet can exert. This parameter defines the effort-capacityTh																
75																		

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Figure 2.8.3. Crew per vessel and maximum number of sea days per period.
Explanation below EXCEL Table 5.4.3: Number of crew members per vessel, used to define employment. There is a crew-number for each period of each year.
Explanation below EXCEL Table 5.4.4: The maximum number of effort units (say days) per time unit a vessel of the fleet can exert. This parameter defines the effort-capacity. There is a value of this parameter for each period of each year.

Figure 2.8.4. shows the Number of disinvestments (or vessel withdrawals), $NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va)$ (EXCEL Table 5.4.5), number of attritions, $NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$ (EXCEL Table 5.4.6) and number of decommissioned vessels $NU_{Decomm}(Fl, Vs, Ct, y, q,Va)$ (EXCEL Table 5.4.7).

The input values of removals, $NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va)$, $NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$, and $NU_{Decomm}(Fl, Vs, Ct, y, q,Va)$ should match the number af vessels, in the sense that the number of removal connot exceed the current number of vessel, $NU_{Vessel}(Fl, Vs, Ct, y, q, Va)$.

When calculation the resulting number of vessels, the chronological order is (1) Decommission (2) Attrition (3) Dis-investment. If it is attepted to remove more vessels than there are, the input values are changed, so that the removals become feasible, as described in the 3-steps algorithm. (We use the sign " ← " to denote assignment). The fourth step, the recruitment of new vessels, will never create inconsistencies. Step 4 is included to show that vessel recruitment is the last step in the calculation of "resulting number of vessels".

Step 1: Decommission

If
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \geq NU_{Decomm}(Fl, Vs, Ct, y, q, Va)$
Then
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \leftarrow NU_{Vessel}(Fl, Vs, Ct, y, q, Va) - NU_{Decomm}(Fl, Vs, Ct, y, q, Va)$
Else
$NU_{Decomm}(Fl, Vs, Ct, y, q, Va) \leftarrow NU_{Vessel}(Fl, Vs, Ct, y, q, Va)$
and
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \leftarrow 0$

Step 2: Attrition

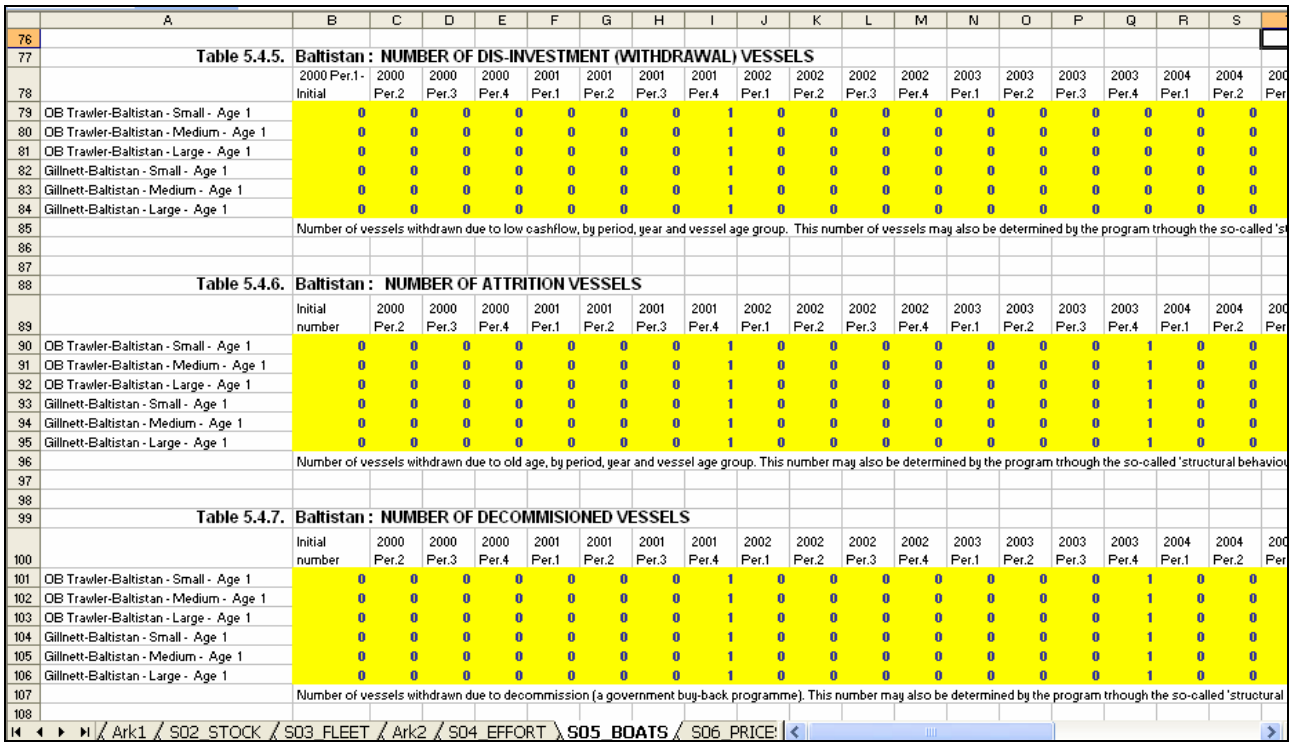
If
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \geq NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$
Then
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \leftarrow NU_{Vessel}(Fl, Vs, Ct, y, q, Va) - NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$
Else
$NU_{Attrition}(Fl, Vs, Ct, y, q, Va) \leftarrow NU_{Vessel}(Fl, Vs, Ct, y, q, Va)$
and
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \leftarrow 0$

Step 3: Disinvestment (Withdrawal)

If
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \geq NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va)$
Then
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \leftarrow NU_{Vessel}(Fl, Vs, Ct, y, q, Va) - NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va)$
Else
$NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va) \leftarrow NU_{Vessel}(Fl, Vs, Ct, y, q, Va)$
and
$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \leftarrow 0$

Step 4: Recruitment

$NU_{Vessel}(Fl, Vs, Ct, y, q, 0) = NU_{New\text{-}Vessel}(Fl, Vs, Ct, y, q) * Multiplier$



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
76																			
77	**Table 5.4.5.**	**Baltistan : NUMBER OF DIS-INVESTMENT (WITHDRAWAL) VESSELS**																	
78		2000 Per.1 - Initial	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	2004 Per.1	2004 Per.2	200 Per
79	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
80	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
81	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
82	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
83	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
84	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
85		Number of vessels withdrawn due to low cashflow, by period, year and vessel age group. This number of vessels may also be determined by the program trhough the so-called 'st																	
86																			
87																			
88	**Table 5.4.6.**	**Baltistan : NUMBER OF ATTRITION VESSELS**																	
89		Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	2004 Per.1	2004 Per.2	200 Per
90	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
91	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
92	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
93	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
94	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
95	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
96		Number of vessels withdrawn due to old age, by period, year and vessel age group. This number may also be determined by the program trhough the so-called 'structural behaviou																	
97																			
98																			
99	**Table 5.4.7.**	**Baltistan : NUMBER OF DECOMMISIONED VESSELS**																	
100		Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	2004 Per.1	2004 Per.2	200 Per
101	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
102	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
103	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
104	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
105	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
106	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	
107		Number of vessels withdrawn due to decommission (a government buy-back programme). This number may also be determined by the program trhough the so-called 'structural																	
108																			

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Figure 2.8.4. Number of disinvestments, number of attritions and decommissioned vessels.
Explanation below EXCEL Table 5.4.5: Number of vessels withdrawn due to low cash flow, by period, year and vessel age group. This number of vessels may also be determined by the program trough the so-called 'structural behaviour rules'
Explanation below EXCEL Table 5.4.6: Number of vessels withdrawn due to old age, by period, year and vessel age group. This number may also be determined by the program trough the so-called 'structural behaviour rules'
Explanation below EXCEL Table 5.4.7: Number of vessels withdrawn due to decommission (a government buy-back programme). This number may also be determined by the program trough the so-called 'structural behaviour rules'

Figure 2.8.5 (EXCEL Table 5.4.8) shows the resulting number of vessels after vessel recruitment (Investment) the execution of the algorithm above, and after application of multipliers to number of new vessels (EXCEL Table 5.4.2).
EXCEL Table 5.4.9 (Figure 2.8.5) shows the resulting number of decommissions

Figure 2.8.6 (EXCEL Table 5.4.10, summarises the resulting number of vessels, in that it gives results (new vessels, decommissions, attritions and dis-investments) summed over vessel age groups. In the present case of only one vessel age group, this table may not be so interesting. The purpose is to illustrate the vessel number manipulations and to produce a table for presentation in reports.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
110	**Table 5.4.8. Baltistan : RESULTING VESSEL AGE DISTRIBUTION**																	
111		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	2004 Per.1	20 Pe
112	OB Trawler-Baltistan - Small - Age 1	30	30	30	30	30	30	30	32	32	32	32	32	32	32	32	35	35	
113	OB Trawler-Baltistan - Medium - Age 1	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	14	14	
114	OB Trawler-Baltistan - Large - Age 1	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	
115	Gillnett-Baltistan - Small - Age 1	40	40	40	40	40	40	40	42	42	42	42	42	42	42	42	45	45	
116	Gillnett-Baltistan - Medium - Age 1	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	21	21	
117	Gillnett-Baltistan - Large - Age 1	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	
118	The resulting number of vessels by vessel age group at beginning and during the year. Number of vessels(Period,Age) = Number of vessels (Period-1, Age) - Number																		
119																			
120																			
121	**Table 5.4.9. Baltistan : RESULTING NUMBER OF DECOMMISIONED VESSELS**																		
122		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3	2003 Per.4	2004 Per.1	20 Pe
123	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
124	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
125	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
126	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
127	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
128	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
129	Resulting number of decomissions. Results derived from application of multipliers (if applied), otherwise a copy of foregoing table with number of decomissions.																		
130																			

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Figure 2.8.5. Resulting number of vessels and resulting numbers of decommissions.

Explanation below EXCEL Table 5.4.8: The resulting number of vessels by vessel age group at beginning and during the year. Number of vessels (Period, Age) = Number of vessels (Period-1 , Age) - Number of decommissioned vessels (Period , Age) - Number of attrition vessels (Period , Age) - Number of disinvestment vessels (Period , Age) + Number of investment(Period,1). The last term is non-zero only if age = 1

Explanation below EXCEL Table 5.4.9: Resulting number of decommissions. Results derived from application of multipliers (if applied), otherwise a copy of foregoing table with number of decommissions.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
132	**Table 5.4.10. Baltistan : NUMBER OF VESSESLS (SUMMARY)**													
133		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2 P
134	OB Trawler-Baltistan - Small - New vessels	0	0	0	0	0	0	0	5	0	0	0	0	0	
135	OB Trawler-Baltistan - Small - Decommissions	0	0	0	0	0	0	0	1	0	0	0	0	0	
136	OB Trawler-Baltistan - Small - Attritions	0	0	0	0	0	0	0	1	0	0	0	0	0	
137	OB Trawler-Baltistan - Small - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	
138	OB Trawler-Baltistan - Small - Total	30	30	30	30	30	30	30	32	32	32	32	32	32	
139	OB Trawler-Baltistan - Medium - New vessels	0	0	0	0	0	0	0	3	0	0	0	0	0	
140	OB Trawler-Baltistan - Medium - Decommissions	0	0	0	0	0	0	0	1	0	0	0	0	0	
141	OB Trawler-Baltistan - Medium - Attritions	0	0	0	0	0	0	0	1	0	0	0	0	0	
142	OB Trawler-Baltistan - Medium - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	
143	OB Trawler-Baltistan - Medium - Total	13	13	13	13	13	13	13	13	13	13	13	13	13	
144	OB Trawler-Baltistan - Large - New vessels	0	0	0	0	0	0	0	2	0	0	0	0	0	
145	OB Trawler-Baltistan - Large - Decommissions	0	0	0	0	0	0	0	1	0	0	0	0	0	
146	OB Trawler-Baltistan - Large - Attritions	0	0	0	0	0	0	0	1	0	0	0	0	0	
147	OB Trawler-Baltistan - Large - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	
148	OB Trawler-Baltistan - Large - Total	3	3	3	3	3	3	3	2	2	2	2	2	2	
149	Gillnett-Baltistan - Small - New vessels	0	0	0	0	0	0	0	5	0	0	0	0	0	
150	Gillnett-Baltistan - Small - Decommissions	0	0	0	0	0	0	0	1	0	0	0	0	0	
151	Gillnett-Baltistan - Small - Attritions	0	0	0	0	0	0	0	1	0	0	0	0	0	
152	Gillnett-Baltistan - Small - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	
153	Gillnett-Baltistan - Small - Total	40	40	40	40	40	40	40	42	42	42	42	42	42	
154	Gillnett-Baltistan - Medium - New vessels	0	0	0	0	0	0	0	3	0	0	0	0	0	
155	Gillnett-Baltistan - Medium - Decommissions	0	0	0	0	0	0	0	1	0	0	0	0	0	
156	Gillnett-Baltistan - Medium - Attritions	0	0	0	0	0	0	0	1	0	0	0	0	0	
157	Gillnett-Baltistan - Medium - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	
158	Gillnett-Baltistan - Medium - Total	20	20	20	20	20	20	20	20	20	20	20	20	20	
159	Gillnett-Baltistan - Large - New vessels	0	0	0	0	0	0	0	2	0	0	0	0	0	
160	Gillnett-Baltistan - Large - Decommissions	0	0	0	0	0	0	0	1	0	0	0	0	0	
161	Gillnett-Baltistan - Large - Attritions	0	0	0	0	0	0	0	1	0	0	0	0	0	
162	Gillnett-Baltistan - Large - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	
163	Gillnett-Baltistan - Large - Total	5	5	5	5	5	5	5	4	4	4	4	4	4	
164	These summary values are derived from the other tables for checking and presentation purposes														

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Figure 2.8.6. Summary of number of vessels, showing New vessels, Decommissions, Attritions and Withdrawals. Explanation below EXCEL Table 5.4.10: These summary values are derived from the other tables for checking and presentation purposes

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
300																
301	**Table 5.5.1.**	**Baltistan : FLEET CHARACTERISTICS: Length**														
302		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3
303	OB Trawler-Baltistan - Small	10	10	10	10	10	10	10	10	10	10	10	10	10	10	1
304	OB Trawler-Baltistan - Medium	20	20	20	20	20	20	20	20	20	20	20	20	20	20	2
305	OB Trawler-Baltistan - Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
306	Gillnett-Baltistan - Small	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
307	Gillnett-Baltistan - Medium	16	16	16	16	16	16	16	16	16	16	16	16	16	16	1
308	Gillnett-Baltistan - Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
309		Fleet characteristics: Length														
310																
311																
312	**Table 5.5.2.**	**Baltistan : (START NUMBER OF VESSELS)' (FLEET CHARACTERISTICS): Length**														
313		2000 Per.1 - Initial number	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3
314	OB Trawler-Baltistan - Small	600	600	600	600	600	600	600	700	640	640	640	640	640	640	64
315	OB Trawler-Baltistan - Medium	650	650	650	650	650	650	650	800	650	650	650	650	650	650	65
316	OB Trawler-Baltistan - Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
317	Gillnett-Baltistan - Small	720	720	720	720	720	720	720	810	756	756	756	756	756	756	75
318	Gillnett-Baltistan - Medium	980	980	980	980	980	980	980	1127	980	980	980	980	980	980	98
319	Gillnett-Baltistan - Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
320		Fleet characteristics: Length														
321																
322																
323	**Table 5.5.3.**	**Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Length - Not Used**														
324		2000 Per.1 - Initial	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3
325	OB Trawler-Baltistan - Small	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
326		Maximum allowable total value of characteritics Length - Not Used														
327																
328																
329	**Table 5.5.4.**	**Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET): Length - No**														
330		2000 Per.1 - Initial	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3
331	OB Trawler-Baltistan	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
332	Gillnett-Baltistan	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
333		Maximum allowable total value of characteristics Length														
334																
335																
336	**Table 5.5.5.**	**Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND VESSEL SIZ**														
337		2000 Per.1 - Initial	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Per.2	2003 Per.3
338	OB Trawler-Baltistan - Small	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
339	OB Trawler-Baltistan - Medium	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
340	OB Trawler-Baltistan - Large	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
341	Gillnett-Baltistan - Small	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
342	Gillnett-Baltistan - Medium	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
343	Gillnett-Baltistan - Large	No Value	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Val	No Va
344		Maximum allowable total value of characteristics Length - Not Used														
345																

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Figure 2.8.7.a. First fleet characteristics, vessel length, ("used" or "not used").

Figures 2.8.7.a and b show the vessel characteristics. Recall EXCEL Tables 5.1-2, that specifies 3 fleet characteristics,

1	Vessel length
2	Vessel tonnage
3	Engine KgWat

of which the second characteristics, vessel tonnage, is used for regulation on the country-level. EXCEL Table 5.5.1 (Figure 2.8.7.a) contains the vessel lengths and EXCEL Table 5.5.2 contain the total characteristics for the fleets. EXCEL Tables 5.5.3-5 are the tables for regulations, that is, the maximum level of the total characteristics. There are three possible levels for the regulation (1) By Country (2) By (Fleet, Country) (3) by (Fleet, Vessel size, Country). Nome of the three options (EXCEL Tables 5.5.3-5 are used). In figure 2.8.7.b, containing the tables with vessel tonnage, it can be seen that this characteristics on country level is used for regulation, i.e. there is an upper limit for the total vessel tonnage of the country (EXCEL Table 5.5.8).

	A	B	C	D	E	F	G	H	I	J
346										
347	**Table 5.5.6.**	**Baltistan : FLEET CHARACTERISTICS: Tonnage**								
348		2000 Per.1 - Ir	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.
349	OB Trawler-Baltistan - Small	20	20	20	20	20	20	20	20	
350	OB Trawler-Baltistan - Medium	50	50	50	50	50	50	50	50	
351	OB Trawler-Baltistan - Large	0	0	0	0	0	0	0	0	
352	Gillnett-Baltistan - Small	18	18	18	18	18	18	18	18	
353	Gillnett-Baltistan - Medium	49	49	49	49	49	49	49	49	
354	Gillnett-Baltistan - Large	0	0	0	0	0	0	0	0	
355		Fleet characteristics: Tonnage								
356										
357										
358	**Table 5.5.7.**	**Baltistan : (START NUMBER OF VESSELS) * (FLEET CHARACTERISTICS): Tonnage**								
359		2000 Per.1 - Ir	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.
360	OB Trawler-Baltistan - Small	600	600	600	600	600	600	600	700	
361	OB Trawler-Baltistan - Medium	650	650	650	650	650	650	650	800	
362	OB Trawler-Baltistan - Large	0	0	0	0	0	0	0	0	
363	Gillnett-Baltistan - Small	720	720	720	720	720	720	720	810	
364	Gillnett-Baltistan - Medium	980	980	980	980	980	980	980	1127	
365	Gillnett-Baltistan - Large	0	0	0	0	0	0	0	0	
366		Fleet characteristics: Tonnage								
367										
368										
369	**Table 5.5.8.**	**Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY): Tonnage**								
370		2000 Per.1 - Ir	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.
371	OB Trawler-Baltistan - Small	1000	1000	1000	1000	1000	1000	1000	1000	10
372		Maximum allowable total value of characteritics Tonnage								
373										
374										
375	**Table 5.5.9.**	**Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY AND FLEET)**								
376		2000 Per.1 - Ir	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.
377	OB Trawler-Baltistan	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
378	Gillnett-Baltistan	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
379		Maximum allowable total value of characteristics Tonnage								
380										
381										
382	**Table 5.5.10.**	**Baltistan : MAXIMUM TOTAL ALLOWED FLEET CHARACTERISTICS (BY COUNTRY, FLEET AND**								
383		2000 Per.1 - Ir	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.
384	OB Trawler-Baltistan - Small	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
385	OB Trawler-Baltistan - Medium	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
386	OB Trawler-Baltistan - Large	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
387	Gillnett-Baltistan - Small	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
388	Gillnett-Baltistan - Medium	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
389	Gillnett-Baltistan - Large	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
390		Maximum allowable total value of characteristics Tonnage - Not Used								

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Figure 2.8.7.a. Second fleet characteristics, vessel tonnage, ("used" or "not used").

Note that there are no options for pre-processing of boats data (Figure 2.8.1)

2.9. PRICES INPUT. S06_PRICES

The userform for entry of price-data in worksheet S06_PRICES, is shown in Figure 2.9.1, and Table 2.9.1 shows the list of EXCEL tables in S06_PRICES.

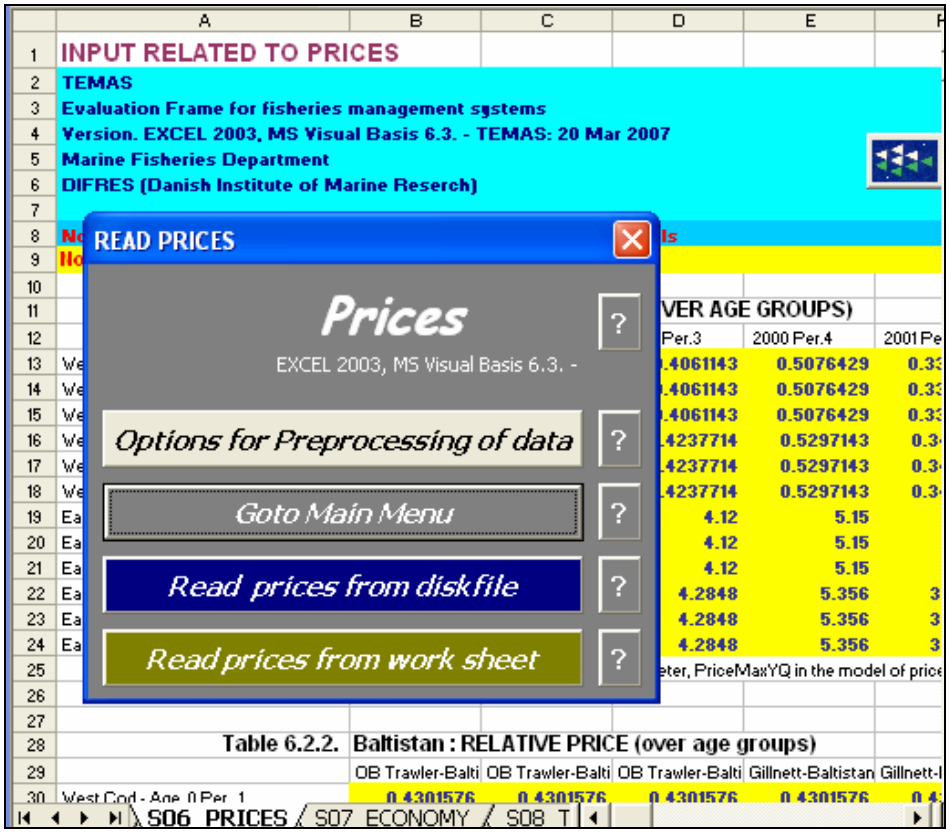


Figure 2.9.1. User-form for entry of prices related data and parameters.

Index	EXCEL Table	Caption
145	Table6.2.1.	Baltistan : MAXIMUM PRICE (over age groups)
146	Table6.2.2.	Baltistan : RELATIVE PRICE (over age groups)
147	Table6.2.3.	Baltistan : PRICE FLEXIBILITY
148	Table6.3.1.	Scandinavia : MAXIMUM PRICE (over age groups)
149	Table6.3.2.	Scandinavia : RELATIVE PRICE (over age groups)
150	Table6.3.3.	Scandinavia : PRICE FLEXIBILITY

Table 2.9.1. Tables in the prices input sheet, S06_PRICES.

The price concept used in TEMAS is the "Ex-vessel price", that is the price of the landings given to the vessel (the vessel owner). They are given as a maximum price over age groups and a relative price by age:

$P_{Max}(Fl,Vs,Rg,Ct, St, y, q)$ = Maximum Price (over age groups)

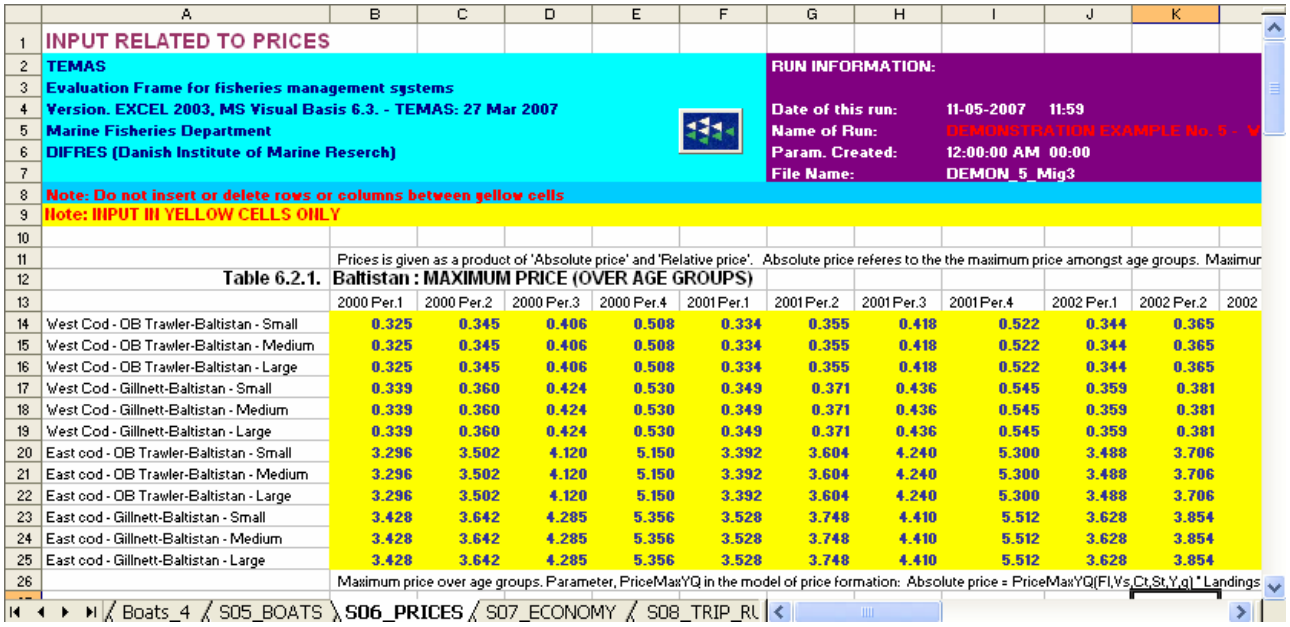
and

$P_{Rel}(Fl,Vs, Rg, Ct, St, a, q)$ is the relative price of age group "a".

Note that P_{Max} depends on the year and the period, but not the age group, whereas P_{Rel} depends on the age group of the animals but not the year. The product becomes the age-dependent absolute price:

$$P(Fl,Vs,Rg,Ct,St,y,a,q) = P_{Max}(Fl,Vs,Rg,Ct,St,y,q) * P_{Rel}(Fl,Vs,Rg,Ct,St,q,a)$$

The maximum prices are shown in Table 2.9.2 (EXCEL Table 6.2.1) and the relative price is shown in Figure 2.9.3 (EXCEL Table 6.2.2).



	A	B	C	D	E	F	G	H	I	J	K
1	INPUT RELATED TO PRICES										
2	TEMAS						RUN INFORMATION:				
3	Evaluation Frame for fisheries management systems										
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007						Date of this run:	11-05-2007	11:59		
5	Marine Fisheries Department						Name of Run:	DEMONSTRATION EXAMPLE No. 5 - V			
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:	12:00:00 AM	00:00		
7							File Name:	DEMON_5_Mig3			
8	Note: Do not insert or delete rows or columns between yellow cells										
9	Note: INPUT IN YELLOW CELLS ONLY										
10											
11		Prices is given as a product of 'Absolute price' and 'Relative price'. Absolute price referes to the the maximum price amongst age groups. Maximur									
12	Table 6.2.1. Baltistan : MAXIMUM PRICE (OVER AGE GROUPS)										
13		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002
14	West Cod - OB Trawler-Baltistan - Small	0.325	0.345	0.406	0.508	0.334	0.355	0.418	0.522	0.344	0.365	
15	West Cod - OB Trawler-Baltistan - Medium	0.325	0.345	0.406	0.508	0.334	0.355	0.418	0.522	0.344	0.365	
16	West Cod - OB Trawler-Baltistan - Large	0.325	0.345	0.406	0.508	0.334	0.355	0.418	0.522	0.344	0.365	
17	West Cod - Gillnett-Baltistan - Small	0.339	0.360	0.424	0.530	0.349	0.371	0.436	0.545	0.359	0.381	
18	West Cod - Gillnett-Baltistan - Medium	0.339	0.360	0.424	0.530	0.349	0.371	0.436	0.545	0.359	0.381	
19	West Cod - Gillnett-Baltistan - Large	0.339	0.360	0.424	0.530	0.349	0.371	0.436	0.545	0.359	0.381	
20	East cod - OB Trawler-Baltistan - Small	3.296	3.502	4.120	5.150	3.392	3.604	4.240	5.300	3.488	3.706	
21	East cod - OB Trawler-Baltistan - Medium	3.296	3.502	4.120	5.150	3.392	3.604	4.240	5.300	3.488	3.706	
22	East cod - OB Trawler-Baltistan - Large	3.296	3.502	4.120	5.150	3.392	3.604	4.240	5.300	3.488	3.706	
23	East cod - Gillnett-Baltistan - Small	3.428	3.642	4.285	5.356	3.528	3.748	4.410	5.512	3.628	3.854	
24	East cod - Gillnett-Baltistan - Medium	3.428	3.642	4.285	5.356	3.528	3.748	4.410	5.512	3.628	3.854	
25	East cod - Gillnett-Baltistan - Large	3.428	3.642	4.285	5.356	3.528	3.748	4.410	5.512	3.628	3.854	
26		Maximum price over age groups. Parameter, PriceMaxYQ in the model of price formation: Absolute price = PriceMaxYQ(Fl,Vs,Ct,St,Y,q) * Landings									

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Figure 2.9.2. Maximum price over age groups.
The explanation above the EXCEL table says:
Prices are given as a product of 'Absolute price' and 'Relative price'.
Absolute price refers to the maximum price amongst age groups. "
Maximum prices can either be given as input (for all years) or be calculated by the model:
PriceMax(Y+1) = PriceMax0(Y) * LandingsWeight_Y(Y) ^ PriceFlex(Y).
The relative values are between zero and one and defines the relative value over age of fish (ages, period), and over periods during the year. All together the price model reads:
Price(Fl,Vs,Ct,St,q,a,Y,q) = PriceMaxYQ(Fl,Vs,Ct,St,Y,q) * LandingsWeight(St,y,q) ^ PriceFlex(Fl,Vs,Ct) * PriceRelbyAge(Fl,Vs,Ct,St,q,a).
Where Fl = Fleet, Vs = Vessel size, Ct = Country, St = Stock, y = year, q = Period, a = age group.
The explanation below the EXCEL table says:
Maximum price over age groups. Parameter, PriceMaxYQ in the model of price formation:
Absolute price = PriceMaxYQ(Fl,Vs,Ct,St,Y,q) * LandingsWeight(St,y,q) ^ PriceFlex(Fl,Vs,Ct)

In the current version of TEMAS, prices are given as input parameters. They can either be assumed to remain constant (i.e. no changes in response to changes in supply) or to vary as a result of changes in supply (i.e. in landings). Where variations in supply are assumed to have an effect on prices, TEMAS provides a simple price formation function that, however, disregards changes in demand. In the simple version, price flexibility is only related to changes in the supply (i.e. landings of the fishery) of the same species:

$$P_{Max}(Fl,Vs,Rg,Ct,St,y,q) =$$

$$P_{Max,0}(Fl,Vs,Rg,Ct,St,q) * Y_{Land}(\bullet,St,y-1,\bullet,\bullet,\bullet)^{PFlex(Fl,St)}$$

where PFlex(Fl, Vs, Rg, Ct, St), is the price flexibility and $P_{max,0}$ (Fl, Vs, Rg, Ct, St, y) is a constant coefficient

The price flexibility is shown in Figure 2.9.3 (EXCEL Table 6.2.3).

	A	B	C	D	E	F	G	H
28	**Table 6.2.2.**	**Baltistan : RELATIVE PRICE (over age groups)**						
29		OB Trawler-Baltistan Small	OB Trawler-Baltistan Medium	OB Trawler-Baltistan Large	Gillnett-Baltistan Small	Gillnett-Baltistan Medium	Gillnett-Baltistan Large	
30	West Cod - Age 0 Per. 1	**0.430**	**0.430**	**0.430**	**0.430**	**0.430**	**0.430**	
31	West Cod - Age 0 Per. 2	**0.490**	**0.490**	**0.490**	**0.490**	**0.490**	**0.490**	
32	West Cod - Age 0 Per. 3	**0.567**	**0.567**	**0.567**	**0.567**	**0.567**	**0.567**	
33	West Cod - Age 0 Per. 4	**0.667**	**0.667**	**0.667**	**0.667**	**0.667**	**0.667**	
34	West Cod - Age 1 Per. 1	**0.611**	**0.611**	**0.611**	**0.611**	**0.611**	**0.611**	
35	West Cod - Age 1 Per. 2	**0.653**	**0.653**	**0.653**	**0.653**	**0.653**	**0.653**	
36	West Cod - Age 1 Per. 3	**0.721**	**0.721**	**0.721**	**0.721**	**0.721**	**0.721**	
37	West Cod - Age 1 Per. 4	**0.818**	**0.818**	**0.818**	**0.818**	**0.818**	**0.818**	
38	West Cod - Age 2 Per. 1	**0.704**	**0.704**	**0.704**	**0.704**	**0.704**	**0.704**	
39	West Cod - Age 2 Per. 2	**0.713**	**0.713**	**0.713**	**0.713**	**0.713**	**0.713**	
40	West Cod - Age 2 Per. 3	**0.751**	**0.751**	**0.751**	**0.751**	**0.751**	**0.751**	
41	West Cod - Age 2 Per. 4	**0.818**	**0.818**	**0.818**	**0.818**	**0.818**	**0.818**	
42	West Cod - Age 3 Per. 1	**0.794**	**0.794**	**0.794**	**0.794**	**0.794**	**0.794**	
43	West Cod - Age 3 Per. 2	**0.804**	**0.804**	**0.804**	**0.804**	**0.804**	**0.804**	
44	West Cod - Age 3 Per. 3	**0.847**	**0.847**	**0.847**	**0.847**	**0.847**	**0.847**	
45	West Cod - Age 3 Per. 4	**0.923**	**0.923**	**0.923**	**0.923**	**0.923**	**0.923**	
46	West Cod - Age 4 Per. 1	**0.860**	**0.860**	**0.860**	**0.860**	**0.860**	**0.860**	
47	West Cod - Age 4 Per. 2	**0.871**	**0.871**	**0.871**	**0.871**	**0.871**	**0.871**	
48	West Cod - Age 4 Per. 3	**0.918**	**0.918**	**0.918**	**0.918**	**0.918**	**0.918**	
49	West Cod - Age 4 Per. 4	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	
50	East cod - Age 0 Per. 1	**0.355**	**0.355**	**0.355**	**0.355**	**0.355**	**0.355**	
51	East cod - Age 0 Per. 2	**0.414**	**0.414**	**0.414**	**0.414**	**0.414**	**0.414**	
52	East cod - Age 0 Per. 3	**0.488**	**0.488**	**0.488**	**0.488**	**0.488**	**0.488**	
53	East cod - Age 0 Per. 4	**0.585**	**0.585**	**0.585**	**0.585**	**0.585**	**0.585**	
54	East cod - Age 1 Per. 1	**0.545**	**0.545**	**0.545**	**0.545**	**0.545**	**0.545**	
55	East cod - Age 1 Per. 2	**0.591**	**0.591**	**0.591**	**0.591**	**0.591**	**0.591**	
56	East cod - Age 1 Per. 3	**0.661**	**0.661**	**0.661**	**0.661**	**0.661**	**0.661**	
57	East cod - Age 1 Per. 4	**0.760**	**0.760**	**0.760**	**0.760**	**0.760**	**0.760**	
58	East cod - Age 2 Per. 1	**0.654**	**0.654**	**0.654**	**0.654**	**0.654**	**0.654**	
59	East cod - Age 2 Per. 2	**0.662**	**0.662**	**0.662**	**0.662**	**0.662**	**0.662**	
60	East cod - Age 2 Per. 3	**0.697**	**0.697**	**0.697**	**0.697**	**0.697**	**0.697**	
61	East cod - Age 2 Per. 4	**0.760**	**0.760**	**0.760**	**0.760**	**0.760**	**0.760**	
62	East cod - Age 3 Per. 1	**0.769**	**0.769**	**0.769**	**0.769**	**0.769**	**0.769**	
63	East cod - Age 3 Per. 2	**0.779**	**0.779**	**0.779**	**0.779**	**0.779**	**0.779**	
64	East cod - Age 3 Per. 3	**0.820**	**0.820**	**0.820**	**0.820**	**0.820**	**0.820**	
65	East cod - Age 3 Per. 4	**0.894**	**0.894**	**0.894**	**0.894**	**0.894**	**0.894**	
66	East cod - Age 4 Per. 1	**0.860**	**0.860**	**0.860**	**0.860**	**0.860**	**0.860**	
67	East cod - Age 4 Per. 2	**0.871**	**0.871**	**0.871**	**0.871**	**0.871**	**0.871**	
68	East cod - Age 4 Per. 3	**0.918**	**0.918**	**0.918**	**0.918**	**0.918**	**0.918**	
69	East cod - Age 4 Per. 4	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	
70		Relative price = Price / Maximum price over age groups. Note that the program will normalize t						
71								
72								
73	**Table 6.2.3.**	**Baltistan : PRICE FLEXIBILITY**						
74		OB Trawler-Ba	Gillnett-Baltistan					
75	West Cod	**0.0001**	**0.0001**					
76	East cod	**0.0001**	**0.0001**					
77		The parameter 'Flexibility' in the model: Maximum Price = P0 * Landings ^ Flexibility, where P0 is						

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Figure 2.9.3. Relative prices.

The explanation below the EXCEL table 6.2.2. says:

Relative price = Price / Maximum price over age groups. Note that the program will normalize the values you give as input, so that maximum becomes 1.0

The explanation below the EXCEL table 6.2.3. says:

The parameter 'Flexibility' in the model: Maximum Price = P0 * Landings ^ Flexibility, where P0 is a constant

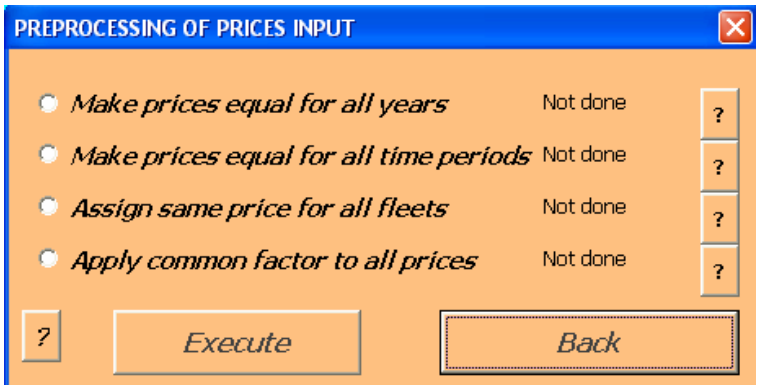

Figure 2.9.4. Options for pre-processing of prices data and parameters.

Figure 2.9.4 shows the user form for four options for pre-processing of price input.

1) "Make prices equal for all years"

This option applies to the maximum price only (the relative price is not dependent on year). It takes price for the first year and assigns that value to all the later years.

$P_{Max}(Fl,Vs,Rg,Ct, St, y,q) = P_{Max}(Fl,Vs,Rg,Ct, St, 1,q)$

If you select that option the content of the cells for years after first year becomes irrelevant

2) "Make prices equal for all time periods"

This applies to the relative price only (the maximum price is not dependent on period). It takes price for the first period and assigns that value to all the later periods:"

$P_{Rel}(Fl,Vs, Rg, Ct, St, a, q) = P_{Rel}(Fl,Vs, Rg, Ct, St, a, 1)$

If you select that option the content of the cells for periods after first period becomes irrelevant

3) "Make prices equal for all fleets"

This option applies to the relative price and the maximum price. It takes price for the fleet first year and assigns that value to all the later periods:

$P_{Max}(Fl,Vs,Rg,Ct, St, y,q) = P_{Max}(1, 1, 1, Ct, St, y, q)$
$P_{Rel}(Fl,Vs, Rg, Ct, St, a, q) = P_{Rel}(1, 1, 1, Ct, St, a, q)$

Note that between (year,period)- variation is maintained
If you select that option the content of the cells for fleets after first fleet becomes irrelevant

4) "Apply common factor to all prices"

This option lets you read a common price multiplier, X, by an 'input-box'. Then the multiplier is then applie to the maximum price:

$P_{Max}(Fl,Vs,Rg,Ct, St, y,q) = X * P_{Max}(Fl, Vs, Rg, Ct, St, y, q)$

2.10. ECONOMIC INPUT, S07_ECONOMY

There are 3 economic models in the current version of TEMAS, reflecting the views of three groups of stakeholders

A) FINANCIAL ANALYSIS OF FLEETS: From the point of view of vessel owners.
B) GOVERNMENT BUDGET: The impact of the fleets on the government budget
C) ECONOMIC ANALYSIS: The economic performance from of the economy as a whole.

Figure 2.10.1 shows the user form for entry of economy related input.

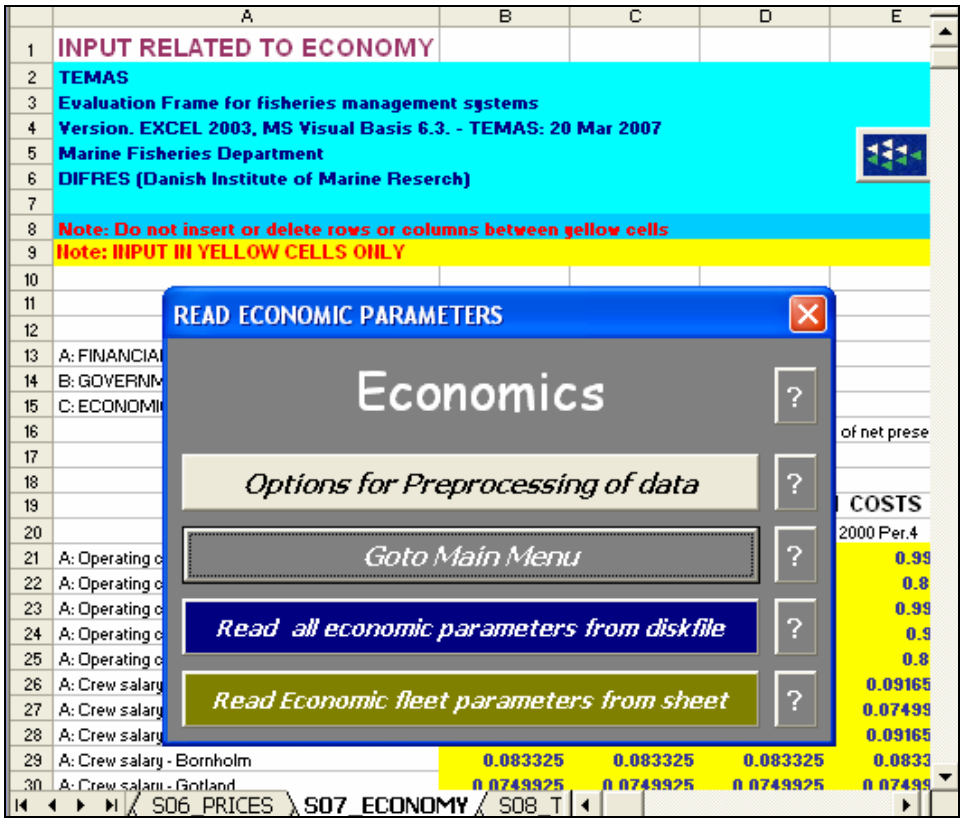

Figure 2.10.1 User-form for entry of economy related parameters.

Index	EXCEL Table	Caption
151	Table7.1.	Rate of discount
152	Table7.2.1.1.1.	Baltistan : OB Trawler-Baltistan - Small COSTS
153	Table7.2.1.1.2.	Baltistan : OB Trawler-Baltistan - Medium COSTS
154	Table7.2.1.1.3.	Baltistan : OB Trawler-Baltistan - Large COSTS
155	Table7.2.1.2.1.	Baltistan : Gillnett-Baltistan - Small COSTS
156	Table7.2.1.2.2.	Baltistan : Gillnett-Baltistan - Medium COSTS
157	Table7.2.1.2.3.	Baltistan : Gillnett-Baltistan - Large COSTS
158	Table7.2.2.1.1.	Scandinavia : OB Trawler-Scandinavia - Small COSTS
159	Table7.2.2.1.2.	Scandinavia : OB Trawler-Scandinavia - Medium COSTS
160	Table7.2.2.1.3.	Scandinavia : OB Trawler-Scandinavia - Large COSTS
161	Table7.2.2.2.1.	Scandinavia : Gillnett-Scandinavia - Small COSTS
162	Table7.2.2.2.2.	Scandinavia : Gillnett-Scandinavia - Medium COSTS
163	Table7.2.2.2.3.	Scandinavia : Gillnett-Scandinavia - Large COSTS
164	Table7.2.2.2.3.1.	Revenue from other species

Table 2.10.1. Tables in the economy input sheet, S07_ECONOMY.

The Visual Basic code of the TEMAS program for the economy has been constructed so that it is flexible. That means that the economic model can be modified, extended or reduced, should a special application required it. The tables shown as examples below are slightly simpler than the theory explaned in Annex C of the TEMAS report. For example, it is a relatively simple thing for the programmer to change the number of economic models.

Whenever a feature from Annex C is not in the current version of TEMAS, this is explained.

All three models operate with the same concepts of costs, earnings and investments, but (possibly) with different parameters.

The economic model calculates the cash flow (revenue – costs) for each time period and eventual it computes the net present value over the time horizon simulated. The economic model was designed by Mr. Rolf Willmann, of the fisheries department of FAO, Rome (Sparre and Willmann, 1993).

The key performance measures of project analysis are the net present value (NPV), equal to the discounted net cash flow. The NPV is defined:

$$NPV(r) = \sum_{y=y_{first}}^{y_{last}} \frac{Value_y}{(1+r)^{y-y_{first}}}$$

where "r" is a user defined input parameter, the "discount rate". The discount rate is country specific and model-specific, as appears from Figure 2.10.2, which shows the input table for Discount rates.

	A	B	C	D	E
1	INPUT RELATED TO ECONOMY				
2	TEMAS				
3	Evaluation Frame for fisheries management systems				
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 20 Mar 2007				
5	Marine Fisheries Department				
6	DIFRES (Danish Institute of Marine Reserch)				
7					
8	Note: Do not insert or delete rows or columns between yellow cells				
9	Note: INPUT IN YELLOW CELLS ONLY				
10					
11	Table 7.1.	RATE OF DISCOUNT			
12		Baltistan	Scandinavia		
13	A: FINANCIAL ANALYSIS OF FLEETS.	0.031	0.032		
14	B: GOVERNMENT BUDGET ANALYSIS	0.031	0.032		
15	C: ECONOMIC ANALYSIS.	0.031	0.032		
16		Discount rate of 3 economic analyses for calculation of net present value. Ur			
17					

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Figure 2.10.2. Rate of discount

The explanation below EXCEL Table 7.1 says: Discount rate of 3 economic analyses for calculation of net present value. Unit: Per year (absolute number, not percent) There are 3 economic analyses: (A) FINANCIAL ANALYSIS OF FLEETS: The financial input parameters to analyse the finacial performance of fishing fleets (i.e. from the point of view of vessel owners), (B): GOVERNMENT BUDGET ANALYSIS: The financial input parameters to analyse the impact of the fleets on the government budget. (B): ECONOMIC ANALYSIS: The economic input arameters to analyse the economic performance of fishing fleet(s) and the entire fishery (i.e. from the point of view of the economy as a whole)

Figures 2.10.3.a-b contain the rates of costs, investment and decommission of the three models (A) FINANCIAL ANALYSIS OF FLEETS (B) GOVERNMENT BUDGET (C) ECONOMIC ANALYSIS, where the models are indicated by A,B and C. The table is country, fleet and vessel size specific. Some of the costs are area-specific

	A	B	C	D	E	
18						
19	Table 7.2.1.1.1.	Baltistan : OB Trawler-Baltistan - Small COSTS				
20		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 F
21	A: Operating cost - West Baltic	1.00	1.00	1.00	1.00	
22	A: Operating cost - East Baltic	0.82	0.82	0.82	0.82	
23	A: Operating cost - Not Baltic	1.00	1.00	1.00	1.00	
24	A: Operating cost - Bornholm	0.91	0.91	0.91	0.91	
25	A: Operating cost - Gotland	0.82	0.82	0.82	0.82	
26	A: Crew salary - West Baltic	0.09	0.09	0.09	0.09	
27	A: Crew salary - East Baltic	0.07	0.07	0.07	0.07	
28	A: Crew salary - Not Baltic	0.09	0.09	0.09	0.09	
29	A: Crew salary - Bornholm	0.08	0.08	0.08	0.08	
30	A: Crew salary - Gotland	0.07	0.07	0.07	0.07	
31	A: Handling cost - West Baltic	0.06	0.06	0.06	0.06	
32	A: Handling cost - East Baltic	0.05	0.05	0.05	0.05	
33	A: Handling cost - Not Baltic	0.06	0.06	0.06	0.06	
34	A: Handling cost - Bornholm	0.06	0.06	0.06	0.06	
35	A: Handling cost - Gotland	0.05	0.05	0.05	0.05	
36	A: Sale cost - West Baltic	0.05	0.05	0.05	0.05	
37	A: Sale cost - East Baltic	0.04	0.04	0.04	0.04	
38	A: Sale cost - Not Baltic	0.05	0.05	0.05	0.05	
39	A: Sale cost - Bornholm	0.04	0.04	0.04	0.04	
40	A: Sale cost - Gotland	0.04	0.04	0.04	0.04	
41	A: Crew share	0.30	0.30	0.30	0.30	
42	A: License fee	9.09	9.09	9.09	9.09	
43	A: Insurance	11.11	11.11	11.11	11.11	
44	A: Other fixed costs	25.25	25.25	25.25	25.25	
45	A: Investment per new vessel	1010.00	1010.00	1010.00	1010.00	
46	A: Vessel Decommission Age 1	680.07	680.07	680.07	680.07	
47	B: Tax on operating cost - West Baltic	0.19	0.19	0.19	0.19	
48	B: Tax on operating cost - East Baltic	0.15	0.15	0.15	0.15	
49	B: Tax on operating cost - Not Baltic	0.19	0.19	0.19	0.19	
50	B: Tax on operating cost - Bornholm	0.17	0.17	0.17	0.17	
51	B: Tax on operating cost - Gotland	0.15	0.15	0.15	0.15	
52	B: Subsidy on operating cost - West Baltic	0.09	0.09	0.09	0.09	
53	B: Subsidy on operating cost - East Baltic	0.07	0.07	0.07	0.07	
54	B: Subsidy on operating cost - Not Baltic	0.09	0.09	0.09	0.09	
55	B: Subsidy on operating cost - Bornholm	0.08	0.08	0.08	0.08	
56	B: Subsidy on operating cost - Gotland	0.07	0.07	0.07	0.07	
57	B: Revenue tax rate - West Baltic	0.05	0.05	0.05	0.05	
58	B: Revenue tax rate - East Baltic	0.04	0.04	0.04	0.04	
59	B: Revenue tax rate - Not Baltic	0.05	0.05	0.05	0.05	
60	B: Revenue tax rate - Bornholm	0.04	0.04	0.04	0.04	
61	B: Revenue tax rate - Gotland	0.04	0.04	0.04	0.04	
62	B: License fee	9.09	9.09	9.09	9.09	
63	B: Decommission crew	101.00	101.00	101.00	101.00	
64	B: Total vessel decommission Age 1	17.17	17.17	17.17	17.17	

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Figure ***2.10.3.a. Variable costs and fixed costs of three economic models (continued).***

The parameters in EXCEL Table 7.2.1.1.1 are:

Economic model A: Financial analysis of fleets:

Financial operating costs of handling (Figure 2.10.3.a)

$COR^{i}_{Yield}(Fl,Vs,Rg,Ct,y,q,Ar)$ Cost rate (cost per weight unit) depending on the yield.

Financial crew salary: (Figure 2.10.3.a)

$COR^{Salary}_{Crew}(Fl,Vs,Rg,Ct,y,q,Ar)$: salary per unit of effort.

Financial operating costs of harvesting: (Figure 2.10.3.a)

$COR^{i}_{E}(Fl,Vs,Rg,Ct,y,q,Ar)$ Cost rate (cost per effort unit) depending on the effort in area Ar.

Financial operating costs of landings: (Figure 2.10.3.a)

$COR^{i}_{VAL}(Fl,Vs,Rg,Ct,y,q,Ar)$ Cost rate (cost per value unit) depending on the value of landings.

Crew share income (Figure 2.10.3.a)

$COF^{Share}_{Crew}(Fl,Vs,Ct,y,q)$ Relative crew share, Fraction of divisible earnings

Financial Fixed costs (Figure 2.10.3.a)

$COR^{1}_{Fix}(Fl,Vs,Ct,y,q)$: Period Licence fee per vessel

$COR^{2}_{Fix}(Fl,Vs,Ct,y,q)$: Period Insurance per vessels

$COR^{3}_{Fix}(Fl,Vs,Ct,y,q)$: Other fixed costs per vessel per period

Financial investment cost in harvesting capacity (Figure 2.10.3.a)

	A	B	C	D	E
65	C: Economic operating cost - West Baltic	680.07	680.07	680.07	680.07
66	C: Economic operating cost - East Baltic	1.00	1.00	1.00	1.00
67	C: Economic operating cost - Not Baltic	0.82	0.82	0.82	0.82
68	C: Economic operating cost - Bornholm	1.00	1.00	1.00	1.00
69	C: Economic operating cost - Gotland	0.91	0.91	0.91	0.91
70	C: Crew opportunity costs - West Baltic	0.82	0.82	0.82	0.82
71	C: Crew opportunity costs - East Baltic	0.09	0.09	0.09	0.09
72	C: Crew opportunity costs - Not Baltic	0.07	0.07	0.07	0.07
73	C: Crew opportunity costs - Bornholm	0.09	0.09	0.09	0.09
74	C: Crew opportunity costs - Gotland	0.08	0.08	0.08	0.08
75	C: Economic handling cost - West Baltic	0.07	0.07	0.07	0.07
76	C: Economic handling cost - East Baltic	0.06	0.06	0.06	0.06
77	C: Economic handling cost - Not Baltic	0.05	0.05	0.05	0.05
78	C: Economic handling cost - Bornholm	0.06	0.06	0.06	0.06
79	C: Economic handling cost - Gotland	0.06	0.06	0.06	0.06
80	C: Economic sale cost - West Baltic	0.05	0.05	0.05	0.05
81	C: Economic sale cost - East Baltic	0.05	0.05	0.05	0.05
82	C: Economic sale cost - Not Baltic	0.04	0.04	0.04	0.04
83	C: Economic sale cost - Bornholm	0.05	0.05	0.05	0.05
84	C: Economic sale cost - Gotland	0.04	0.04	0.04	0.04
85	C: Investment per new vessel	0.04	0.04	0.04	0.04
86		Costs and investments of the 3 economic models. There are 3 economic an			
87					

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Figure 2.10.3.b. Continued from Figure 2.10.3.a.Variable costs and fixed costs of three economic models). ***The explanation below the EXCEL table says:***

Costs and investments of the 3 economic models. There are 3 economic analyses: (A) FINANCIAL ANALYSIS OF FLEETS: The financial input parameters to analyse the finacial performance of fishing fleets (i.e. from the point of view of vessel owners), (B): GOVERNMENT BUDGET ANALYSIS: The financial input parameters to analyse the impact of the fleets on the government budget. (C): ECONOMIC ANALYSIS: The economic input arameters to analyse the economic performance of fishing fleet(s) and the entire fishery (i.e. from the point of view of the economy as a whole)

$INVR^{Total}(Fl,Vs,Ct,y,q)$: Cost of one new vessel

Vessel decommission payment: (Figure 2.10.3.a and c)

$DECVR(Fl,Vs,Ct,y,q,Va)$: Decommission fee of one vessel of age Va. In Figure 2.10.3.a, only one vessel age is considered. See example in Figure 2.10.3.c with 13 vessel age groups

Economic model B: Government treasury

The cost rates are the same in model A, B and C, and therefore they do not appear under model B. The taxes are also the same. Taxes however, are given under model B in EXCEL table 7.2.1.1

Tax on Operating Costs (Figure 2.10.3.a)

$TAXR_{Operation}(Fl,Vs,Rg,Ct,y,q)$ = Tax rate of operation costs (tax per value unit)

Tax on gross revenue (Figure 2.10.3.a):

$TAXR_{REV}(Fl,Vs,Ct,y,q)$:Tax rate of revenue (tax per value unit)

Subsidy on Operating Costs and prices

$SUBR_{Yield}(Fl,Vs,Rg,Ct,y,q)$:Subsidy rate on landings (not used in current version of TEMAS)

$SUBR_{E}(Fl,Vs,Rg,Ct,y,q)$:Subsidy rate on effort (called operation costs in current version of TEMAS)

$SUBR_{VAL}(Fl,Vs,Rg,Ct,y,q)$:Subsidy rate on value of landings (not used in current version of TEMAS)

P_{MinPO}(Fl,Vs,Rg,Ct,St,y,a,q): Intervention price (the PO-price) is not used in the present version of TEMAS

$LICR(Fl,Vs,Ct,y)$: Annual license fee of one vessel

$DECCR(Fl,Vs,Ct,y,q)$: Decommission fee of one crew member

$DECVR(Fl,Vs,Ct,y,q,Va)$: Decommission fee of one vessel

$CO_{Management}(Ct,y,q)$: Cost of fisheries management is not in the current version of TEMAS

	A	B	C	D	E	F
79						
80	Table 7.2.1.1.2.	Ireland : Trawl - Large COSTS				
81		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1
82	A: Operating cost - South area	1.951	1.951	1.951	1.951	1.970
83	A: Operating cost - North area	1.955	1.955	1.955	1.955	1.974
84	A: Crew salary - South area	0.179	0.179	0.179	0.179	0.181
85	A: Crew salary - North area	0.179	0.179	0.179	0.179	0.181
86	A: Handling cost - South area	0.125	0.125	0.125	0.125	0.126
87	A: Handling cost - North area	0.125	0.125	0.125	0.125	0.126
88	A: Sale cost - South area	0.0908	0.0908	0.0908	0.0908	0.0917
89	A: Sale cost - North area	0.0910	0.0910	0.0910	0.0910	0.0919
90	A: Crew share	0.30	0.30	0.30	0.30	0.30
91	A: License fee	19.5	19.5	19.5	19.5	19.7
92	A: Insurance	23.8	23.8	23.8	23.8	24.0
93	A: Other fixed costs	54.1	54.1	54.1	54.1	54.6
94	A: Investment per new vessel	2163	2163	2163	2163	2185
95	A: Vessel Decommission Age 1	4325	4325	4325	4325	4368
96	A: Vessel Decommission Age 2	4016	4016	4016	4016	4056
97	A: Vessel Decommission Age 3	3707	3707	3707	3707	3744
98	A: Vessel Decommission Age 4	3398	3398	3398	3398	3432
99	A: Vessel Decommission Age 5	3089	3089	3089	3089	3120
100	A: Vessel Decommission Age 6	2780	2780	2780	2780	2808
101	A: Vessel Decommission Age 7	2471	2471	2471	2471	2496
102	A: Vessel Decommission Age 8	2163	2163	2163	2163	2184
103	A: Vessel Decommission Age 9	1854	1854	1854	1854	1872
104	A: Vessel Decommission Age 10	1545	1545	1545	1545	1560
105	A: Vessel Decommission Age 11	1236	1236	1236	1236	1248
106	A: Vessel Decommission Age 12	927	927	927	927	936
107	A: Vessel Decommission Age 13	618	618	618	618	624
108	B: Tax on operating cost - South area	0.369	0.369	0.369	0.369	0.372
109	B: Tax on operating cost - North area	0.369	0.369	0.369	0.369	0.373
110	B: Subsidy on operating cost - South area	0.173	0.173	0.173	0.173	0.175
111	B: Subsidy on operating cost - North area	0.174	0.174	0.174	0.174	0.175

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Figure 2.10.3.c. Example with vessel age specific decommission fee. The decommission in Figure 2.10.3.a (line 46) is for only one vessel age group, because vessel age are ignored in that example.

Economic model C: Economic model (for the Society)

$COR^{i}_{Yield}(Fl,Vs,Rg,Ct,y,q,Ar)$ Economic Cost rate (cost per weight unit) depending on the yield.

Financial crew salary: (Figure 2.10.3.b)

$COR^{Salary}_{Crew}(Fl,Vs,Rg,Ct,y,q,Ar)$: salary per unit of effort.

Financial operating costs of harvesting: (Figure 2.10.3.b)

$COR^{i}_{E}(Fl,Vs,Rg,Ct,y,q,Ar)$: Economic Cost rate depending on the effort in area Ar.

Financial operating costs of landings: (Figure 2.10.3.b)

$COR^{i}_{VAL}(Fl,Vs,Rg,Ct,y,q,Ar)$: Economic Cost rate depending on the value of landings.

$COR_{Oprtunity}(Fl,Vs,Ct,y,q)$: Opportunity cost rate (per crew member per period)

$INVR^{Total}(Fl, Vs, Ct, y, q)$: Cost of one new vessel

	A	B	C	D	E	F	G	H	I	J	K	L	M
864													
865	Table 7.2.2.2.3.1.	REVENUE FROM OTHER STOCKS											
866		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
867	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
868	Baltistan - OB Trawler-Baltistan - Small - West Baltic - >110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
869	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
870	Baltistan - OB Trawler-Baltistan - Small - East Baltic - >110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
871	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
872	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
873	Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
874	Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
875	Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
876	Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.3	10.3	10.3	10.3
877	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - <110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
878	Baltistan - OB Trawler-Baltistan - Medium - West Baltic - >110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
879	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - <110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
880	Baltistan - OB Trawler-Baltistan - Medium - East Baltic - >110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
881	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - <110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
882	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - >110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
883	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - <110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
884	Baltistan - OB Trawler-Baltistan - Medium - Bornholm - >110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
885	Baltistan - OB Trawler-Baltistan - Medium - Gotland - <110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
886	Baltistan - OB Trawler-Baltistan - Medium - Gotland - >110mm	20.2	20.2	20.2	20.2	20.4	20.4	20.4	20.4	20.6	20.6	20.6	20.6
887	Baltistan - OB Trawler-Baltistan - Large - West Baltic - <110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
888	Baltistan - OB Trawler-Baltistan - Large - West Baltic - >110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
889	Baltistan - OB Trawler-Baltistan - Large - East Baltic - <110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
890	Baltistan - OB Trawler-Baltistan - Large - East Baltic - >110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
891	Baltistan - OB Trawler-Baltistan - Large - Not Baltic - <110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
892	Baltistan - OB Trawler-Baltistan - Large - Not Baltic - >110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
893	Baltistan - OB Trawler-Baltistan - Large - Bornholm - <110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
894	Baltistan - OB Trawler-Baltistan - Large - Bornholm - >110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
895	Baltistan - OB Trawler-Baltistan - Large - Gotland - <110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
896	Baltistan - OB Trawler-Baltistan - Large - Gotland - >110mm	50.5	50.5	50.5	50.5	51	51	51	51	51.5	51.5	51.5	51.5
897	Baltistan - Gillnett-Baltistan - Small - West Baltic - <110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
898	Baltistan - Gillnett-Baltistan - Small - West Baltic - >110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
899	Baltistan - Gillnett-Baltistan - Small - East Baltic - <110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
900	Baltistan - Gillnett-Baltistan - Small - East Baltic - >110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
901	Baltistan - Gillnett-Baltistan - Small - Not Baltic - <110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
902	Baltistan - Gillnett-Baltistan - Small - Not Baltic - >110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
903	Baltistan - Gillnett-Baltistan - Small - Bornholm - <110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
904	Baltistan - Gillnett-Baltistan - Small - Bornholm - >110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
905	Baltistan - Gillnett-Baltistan - Small - Gotland - <110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
906	Baltistan - Gillnett-Baltistan - Small - Gotland - >110mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12
907	Baltistan - Gillnett-Baltistan - Medium - West Baltic - <110mm	8.08	8.08	8.08	8.08	8.16	8.16	8.16	8.16	8.24	8.24	8.24	8.24

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Figure 2.10.4. Constant revenue from "Other stocks". ***Explanation below table says: Revenue from other stocks is a lump sum accounting for the revenue generated by landings of species which are not modelled explicitly in TEMAS. Note, this is a (Year, period, Fl, Vs, Rg, Ct, Ar)-specific constant***

Figure 2.10.4 (EXCEL Table 7.2.2.2.3.1) shows the "Revenue from other stocks". The revenue from other stocks is a lump sum accounting for the revenue generated by landings of species which are not modelled explicitly in TEMAS. The revenue from other stocks is a (Year, period, Fleet, Vessel size, Rigging, Country, Area)-specific constant.

Figure 2.10.5 shows the userform for pre-processing of economic data. The options are

1) Make all parameters equal for all years. This potion will take the values for first year and apply it to all years.
2) Multiply all costs with a common multiplier. This option will present a form where the common factor can be entered. And then all costs will be multiplied by that factor.

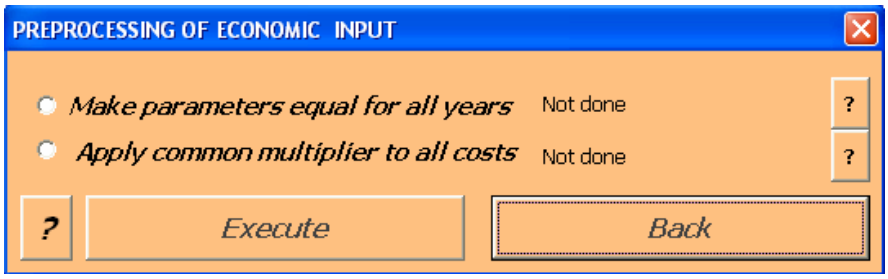


Figure 2.10.5. Options for pre-processing of economy data and parameters.

2.11. TRIP RULES INPUT, S08_ TRIP_RU

The sheet, "S08_TRIP_RU" (Trip Rules), contains the input parameters in the RUM (Random Utility Model) for short term behaviour (or "trip-related" behaviour). The RUM is also named a "discrete choice model", because it operates with a finite number of choices. The model is mathematically equal to that for long term behaviour.

TEMAS offers two alternative ways of setting effort and capacity, namely to let it be determined by the behaviour rules, or to let it be given as input from the worksheet. If the effort/capacity is determined by the behaviour rules, then the age distributions of vessels given as input data are not used by TEMAS. The initial age distribution of vessels however, is used in both options for effort input. We shall comment further on this issue at the end of this section.

The probability that choice maker "i" will select choice "j" is designated

p_{ij} = The probability that choice-maker "i" will select choice "j". A choice maker is in the present context a "fleet", (Fl,Vs,Ct). A choice can be, for example, an "area" or a "rigging".

RUM uses the "logit model" for the finite number of choices: $p_{i,Choice} = \frac{\exp(U_{i,Choice})}{\sum_{j=1}^{M} \exp(U_{i,j})}$

The utility, $U_{i,j}$, is defined by the linear model in "Characteristics" and "Attributes":

$$U_{i,j} = \sum_{r=1(Characteristics)}^{R} \beta_{ij,r} * X_{i,r} + \sum_{s=1(Attributes)}^{S} \gamma_{i,s} * W_{ij,s}$$

Thus, there are two types of independent variables to model U:

Independent variable	Features of variable	Symbol	Associated Parameter
Characteristics	Dependent of choice-maker Independent of choice	$X_{i,r}$	$\beta_{ij,r}$
Attributes	Independent of choice-maker Dependent of choice	$W_{ij,s}$	$\gamma_{i,s}$

Note that $\gamma_{i,s}$ and $X_{i,r}$ are independent of choice ("j") .

There are four trip related behaviour models in the current version of the TEMAS model:

1) Model for fishing/not fishing (Effort rule)
2) Model for choice of area (fishing grounds)
3) Model for choice of rigging
4) Model for discarding

Figure 2.11.1 shows the user-form for sheet S08_TRIP_RU and Table 2.11.1 lists the tables in sheet S08_TRIP_RU. The first table (Figure 2.11.2, EXCEL Table 8.1) allows for definition of rules, by entry of names of rules. This is possible, because any rule is represented by the same basic mathematical model, so it is only the number of parameters and their values that makes rules different. The Table is white, however, so that it is not an input table. This is simply because the TEMAS program is under development, and the option to define rules is not yet implemented. For the time being, there is only the fixed options given in EXCEL table 8.1)

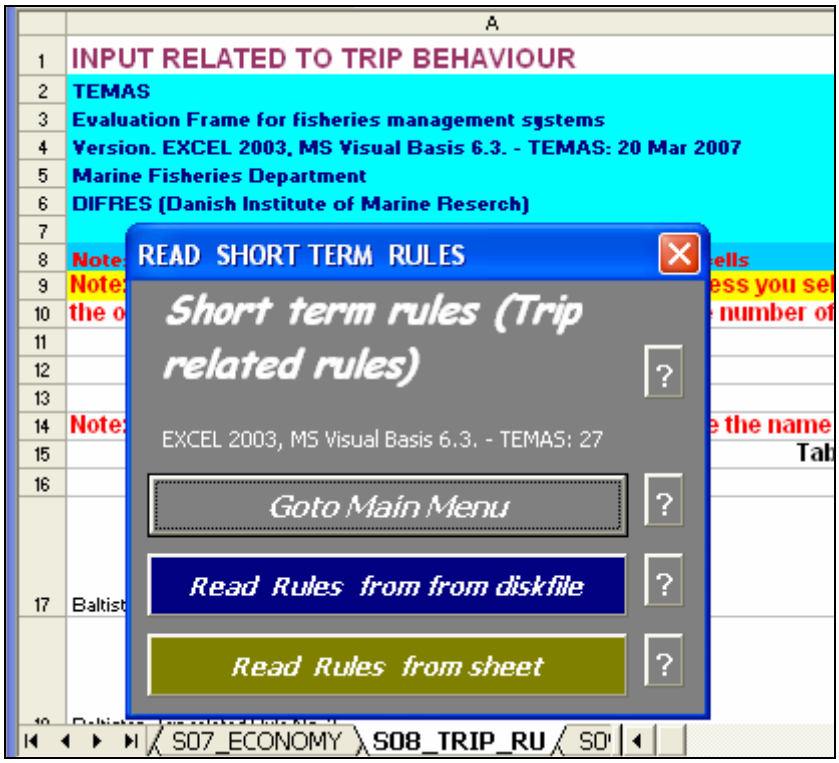
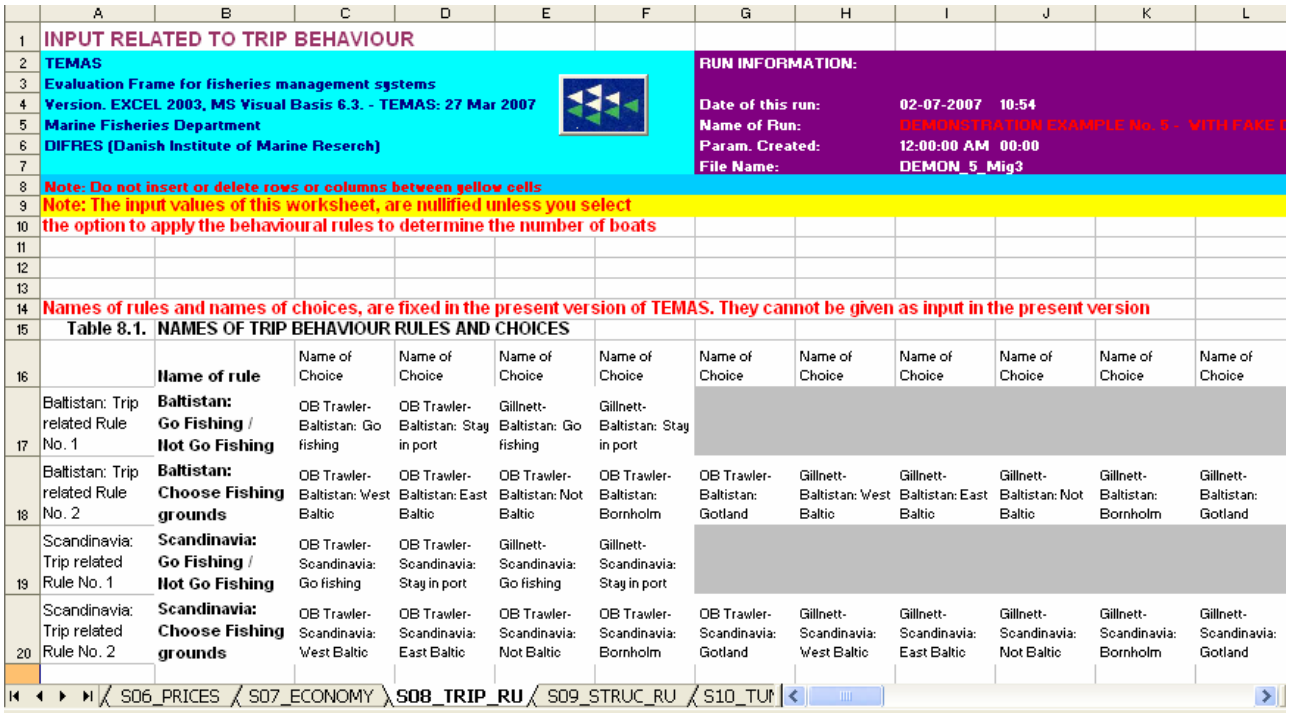


Figure 2.11.1. User-form for entry of trip behaviour related parameters.

Index	EXCEL Table	Caption
165	Table 8.1.	NAMES OF TRIP BEHAVIOUR RULES AND CHOICES
166	Table 8.2.	Baltistan : TRIP BEHAVIOUR COEFFICIENTS OF R.U.M.
167	Table 8.3.	Scandinavia : TRIP BEHAVIOUR COEFFICIENTS OF R.U.M.

Table C.2.11.1. Tables in the trip behaviour input sheet, S08_TRIP_RU.



	A	B	C	D	E	F	G	H	I	J	K	L
1	INPUT RELATED TO TRIP BEHAVIOUR											
2	TEMAS						RUN INFORMATION:					
3	Evaluation Frame for fisheries management systems											
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007						Date of this run:	02-07-2007 10:54				
5	Marine Fisheries Department						Name of Run:	DEMONSTRATION EXAMPLE No. 5 - WITH FAKE				
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created:	12:00:00 AM 00:00				
7							File Name:	DEMON_5_Mig3				
8	Note: Do not insert or delete rows or columns between yellow cells											
9	Note: The input values of this worksheet, are nullified unless you select											
10	the option to apply the behavioural rules to determine the number of boats											
11												
12												
13												
14	Names of rules and names of choices, are fixed in the present version of TEMAS. They cannot be given as input in the present version											
15	Table 8.1.	NAMES OF TRIP BEHAVIOUR RULES AND CHOICES										
16		Name of rule	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice
17	Baltistan: Trip related Rule No. 1	Baltistan: Go Fishing / Not Go Fishing	OB Trawler-Baltistan: Go fishing	OB Trawler-Baltistan: Stay in port	Gillnett-Baltistan: Go fishing	Gillnett-Baltistan: Stay in port						
18	Baltistan: Trip related Rule No. 2	Baltistan: Choose Fishing grounds	OB Trawler-Baltistan: West Baltic	OB Trawler-Baltistan: East Baltic	OB Trawler-Baltistan: Not Baltic	OB Trawler-Baltistan: Bornholm	OB Trawler-Baltistan: Gotland	Gillnett-Baltistan: West Baltic	Gillnett-Baltistan: East Baltic	Gillnett-Baltistan: Not Baltic	Gillnett-Baltistan: Bornholm	Gillnett-Baltistan: Gotland
19	Scandinavia: Trip related Rule No. 1	Scandinavia: Go Fishing / Not Go Fishing	OB Trawler-Scandinavia: Go fishing	OB Trawler-Scandinavia: Stay in port	Gillnett-Scandinavia: Go fishing	Gillnett-Scandinavia: Stay in port						
20	Scandinavia: Trip related Rule No. 2	Scandinavia: Choose Fishing grounds	OB Trawler-Scandinavia: West Baltic	OB Trawler-Scandinavia: East Baltic	OB Trawler-Scandinavia: Not Baltic	OB Trawler-Scandinavia: Bornholm	OB Trawler-Scandinavia: Gotland	Gillnett-Scandinavia: West Baltic	Gillnett-Scandinavia: East Baltic	Gillnett-Scandinavia: Not Baltic	Gillnett-Scandinavia: Bornholm	Gillnett-Scandinavia: Gotland

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Figure 2.11.2 Names of rules and choices in short term behaviour model.

Furthermore, the present version of TEMAS does not implement the "Ad Hoc" rules as introduced in Annex C of the TEMAS report. The reason for this is that the philosophy behind the RUM essentially is the same as the Ad Hoc models, but the RUM has "nicer" mathematically properties. It was not considered necessary to have two almost equal options for behaviour models in TEMAS.

EXCEL Table 8.1 (Figure 2.11.2) shows that names of rules are organized by country, four rules for country "Baltistan" followed by four rules for country "Scandinavia". Column "B" in EXCEL Table 8.1, contains the name of the rule, for example "Choose fishing ground" in cell "B18". The rest of the line contains the available choises, which in the case of fishing grounds are the 5 areas "West Baltic","East Baltic","Not Baltic","Bornholm" and "Gotland". There is a set for each fleet ("Trawlers" and "Gill netters").

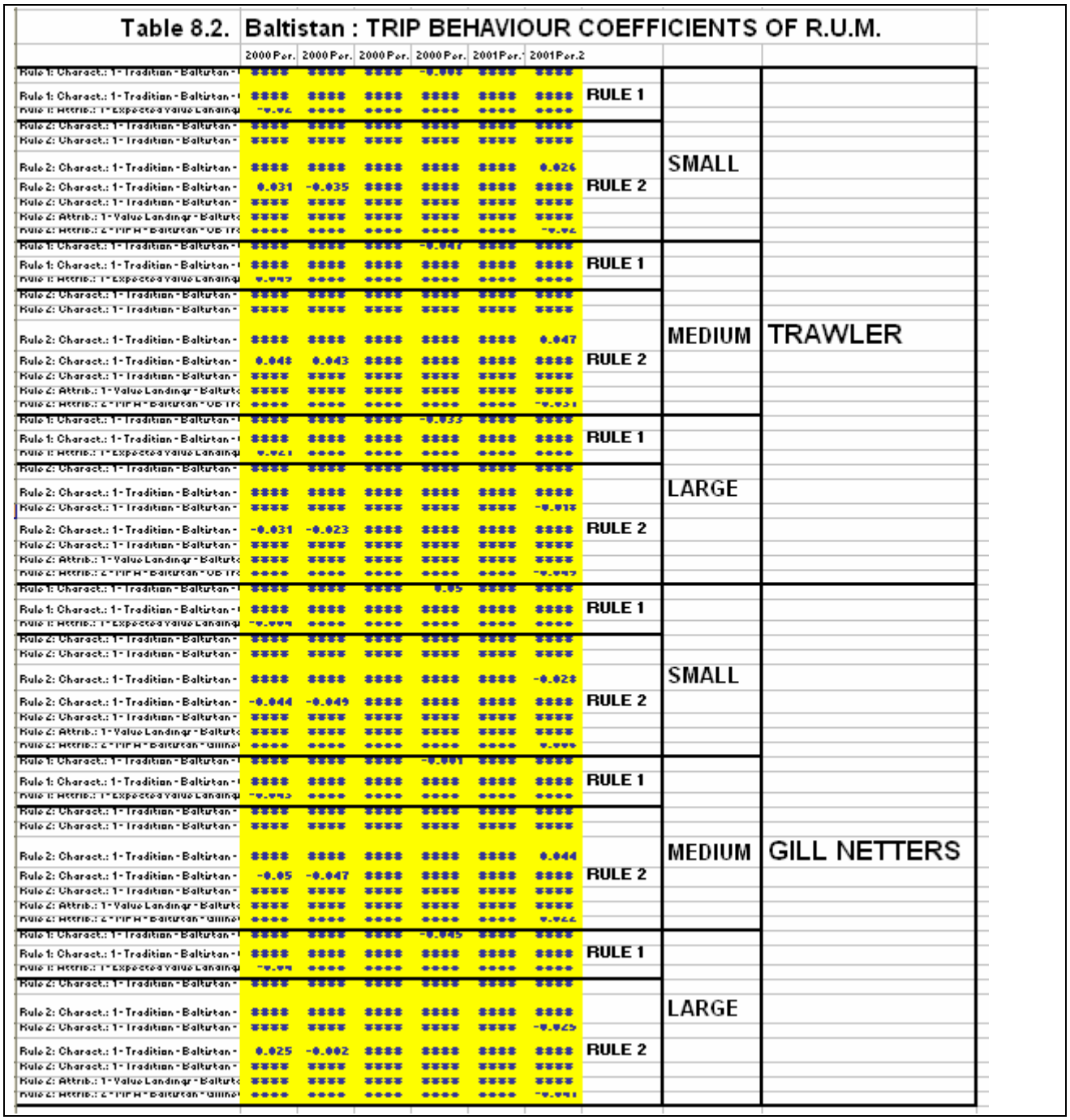


Table 8.2.	Baltistan : TRIP BEHAVIOUR COEFFICIENTS OF R.U.M.								
	2000 Por.	2000 Por.	2000 Por.	2000 Por.	2001 Por.	2001 Por.2			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****	RULE 1		
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 1: Attrib.: 1 - Expected Value Landing	-0.02	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	0.026		SMALL	
Rule 2: Charact.: 1 - Tradition - Baltistan -	0.031	-0.035	****	****	****	****	RULE 2		
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1 - Value Landing r - Baltista	****	****	****	****	****	****			
Rule 2: Attrib.: 2 - TIP H - Baltistan - OB Tra	****	****	****	****	****	-0.02			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	-0.047	****	****			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****	RULE 1		
Rule 1: Attrib.: 1 - Expected Value Landing	0.042	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	0.047		MEDIUM	TRAWLER
Rule 2: Charact.: 1 - Tradition - Baltistan -	0.048	0.043	****	****	****	****	RULE 2		
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1 - Value Landing r - Baltista	****	****	****	****	****	****			
Rule 2: Attrib.: 2 - TIP H - Baltistan - OB Tra	****	****	****	****	****	-0.03			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	-0.033	****	****			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****	RULE 1		
Rule 1: Attrib.: 1 - Expected Value Landing	0.021	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****		LARGE	
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	-0.01			
Rule 2: Charact.: 1 - Tradition - Baltistan -	-0.031	-0.023	****	****	****	****	RULE 2		
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1 - Value Landing r - Baltista	****	****	****	****	****	****			
Rule 2: Attrib.: 2 - TIP H - Baltistan - OB Tra	****	****	****	****	****	-0.04			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	0.05	****	****			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****	RULE 1		
Rule 1: Attrib.: 1 - Expected Value Landing	-0.04	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	-0.02		SMALL	
Rule 2: Charact.: 1 - Tradition - Baltistan -	-0.044	-0.049	****	****	****	****	RULE 2		
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1 - Value Landing r - Baltista	****	****	****	****	****	****			
Rule 2: Attrib.: 2 - TIP H - Baltistan - Gillnet	****	****	****	****	****	0.009			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	-0.001	****	****			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****	RULE 1		
Rule 1: Attrib.: 1 - Expected Value Landing	-0.043	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	0.044		MEDIUM	GILL NETTERS
Rule 2: Charact.: 1 - Tradition - Baltistan -	-0.05	-0.047	****	****	****	****	RULE 2		
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1 - Value Landing r - Baltista	****	****	****	****	****	****			
Rule 2: Attrib.: 2 - TIP H - Baltistan - Gillnet	****	****	****	****	****	0.022			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	-0.045	****	****			
Rule 1: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****	RULE 1		
Rule 1: Attrib.: 1 - Expected Value Landing	-0.04	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****		LARGE	
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	-0.02			
Rule 2: Charact.: 1 - Tradition - Baltistan -	0.025	-0.002	****	****	****	****	RULE 2		
Rule 2: Charact.: 1 - Tradition - Baltistan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1 - Value Landing r - Baltista	****	****	****	****	****	****			
Rule 2: Attrib.: 2 - TIP H - Baltistan - Gillnet	****	****	****	****	****	-0.04			

Figure2.11.3.a. The RUM table structure for trip behaviour of one country.

22	Table 8.2.	Baltistan : TRIP BEHAVIOUR COEFFICIENTS OF R.U.M.						
23		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 F
24	Rule 1: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - Go fishing	2.06E-02	-2.81E-02	2.34E-02	-0.00791	7.01E-03	-2.68E-02	-1.44
25	Rule 1: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - Stay in port	3.34E-03	3.73E-02	4.66E-02	9.06E-03	1.77E-02	-2.23E-02	-1.62
26	Rule 1: Attrib.: 1 - Expected Value Landings - Baltistan - OB Trawler-Baltistan - Small	-0.01981	-2.84E-02	2.42E-02	2.85E-02	1.98E-02	1.54E-02	-1.85
27	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - West Baltic	2.75E-02	-5.72E-03	-1.62E-02	3.00E-02	-1.92E-02	3.02E-02	-0
28	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - East Baltic	-4.86E-02	3.32E-03	-3.29E-02	2.71E-02	-2.52E-02	-6.77E-03	-5.60
29	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - Not Baltic	2.61E-02	-1.16E-02	-2.53E-02	-2.53E-02	5.45E-03	0.02595	-0.0
30	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - Bornholm	0.031449	-0.03456	4.79E-02	-1.62E-02	4.48E-02	3.07E-02	4.16
31	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - Gotland	2.09E-02	3.13E-02	3.43E-02	-5.79E-03	2.65E-02	1.39E-03	4.86
32	Rule 2: Attrib.: 1 - Value Landings - Baltistan - OB Trawler-Baltistan - Small	4.62E-02	4.13E-02	4.54E-02	-1.23E-02	2.41E-02	-3.76E-02	-5.13
33	Rule 2: Attrib.: 2 - MPA - Baltistan - OB Trawler-Baltistan - Small	3.71E-02	6.16E-03	-1.82E-02	-8.67E-04	-3.56E-02	-0.01971	4.41
34	Rule 1: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - Go fishing	-2.21E-02	-1.39E-02	-3.63E-02	-4.68E-02	-5.95E-03	-4.89E-02	-4.03
35	Rule 1: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - Stay in port	3.30E-02	3.02E-02	3.69E-02	-3.85E-02	-0.02876	-1.41E-02	-1.43
36	Rule 1: Attrib.: 1 - Expected Value Landings - Baltistan - OB Trawler-Baltistan - Medium	4.86E-02	4.09E-03	-0.02175	3.56E-02	-7.45E-04	-5.84E-03	-4.55
37	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - West Baltic	4.11E-02	4.45E-02	1.58E-02	-2.76E-02	5.47E-03	-0.02028	3.05
38	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - East Baltic	-0.02731	0.027658	7.69E-03	0.027539	3.07E-02	6.01E-03	-3.54
39	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	1.95E-02	0.033675	-1.29E-02	3.40E-02	-7.60E-03	4.70E-02	1.31
40	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - Bornholm	4.80E-02	4.33E-02	-2.27E-02	-7.49E-03	-1.10E-02	-4.16E-02	9.13
41	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Medium - Gotland	-2.56E-02	-4.97E-02	3.98E-02	2.13E-03	-2.76E-02	4.00E-02	1.55
42	Rule 2: Attrib.: 1 - Value Landings - Baltistan - OB Trawler-Baltistan - Medium	7.52E-03	3.79E-02	1.71E-02	-0.01677	-3.20E-02	-2.02E-02	1.04
43	Rule 2: Attrib.: 2 - MPA - Baltistan - OB Trawler-Baltistan - Medium	-4.00E-02	-3.17E-02	4.93E-02	4.34E-02	-3.98E-02	-3.06E-02	1.16
44	Rule 1: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - Go fishing	-3.37E-02	1.62E-02	-2.84E-02	-3.30E-02	3.73E-02	1.59E-02	-3.05
45	Rule 1: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - Stay in port	1.47E-02	9.18E-03	3.21E-03	1.04E-02	-6.65E-03	-1.56E-02	-4.88
46	Rule 1: Attrib.: 1 - Expected Value Landings - Baltistan - OB Trawler-Baltistan - Large	2.13E-02	3.78E-02	-0.02956	-4.16E-02	-3.11E-02	-2.81E-02	-2.69
47	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - West Baltic	-1.74E-02	1.42E-02	-4.95E-03	-9.12E-04	-3.26E-02	4.76E-02	-7.93
48	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - East Baltic	1.33E-02	4.95E-02	4.63E-02	5.05E-03	-2.39E-02	4.31E-02	0.02
49	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - Not Baltic	-2.92E-02	0.044218	1.10E-02	-2.86E-03	3.11E-02	-0.01754	-1.83
50	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - Bornholm	-3.14E-02	-2.25E-02	-1.98E-02	9.70E-03	4.14E-02	5.62E-03	-0.0
51	Rule 2: Charact.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Large - Gotland	0.008336	-3.11E-02	2.64E-02	4.93E-02	2.86E-02	-4.42E-02	3.94
52	Rule 2: Attrib.: 1 - Value Landings - Baltistan - OB Trawler-Baltistan - Large	-1.21E-02	2.04E-02	-2.09E-02	-3.59E-02	1.37E-02	-2.49E-02	1.16
53	Rule 2: Attrib.: 2 - MPA - Baltistan - OB Trawler-Baltistan - Large	-0.02103	3.81E-02	4.87E-03	4.02E-02	3.97E-02	-4.88E-02	2.69
54	Rule 1: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - Go fishing	-6.97E-03	2.19E-02	3.86E-02	4.97E-02	2.41E-02	4.40E-02	2.72
55	Rule 1: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - Stay in port	1.78E-02	-3.69E-02	-9.51E-03	-4.63E-02	-3.01E-02	-3.16E-02	1.99
56	Rule 1: Attrib.: 1 - Expected Value Landings - Baltistan - Gillnett-Baltistan - Small	-3.70E-03	4.61E-02	-0.02177	-8.65E-03	0.026787	-1.19E-02	-0.0
57	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - West Baltic	-1.47E-02	0.012738	-5.02E-03	-1.53E-02	-4.37E-02	5.89E-04	2.68
58	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - East Baltic	-9.52E-03	-4.69E-02	4.53E-02	-0.036	-9.53E-03	4.77E-02	1.27
59	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - Not Baltic	-2.30E-02	2.97E-02	0.011188	-3.31E-02	3.86E-02	-2.83E-02	2.09
60	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - Bornholm	-4.44E-02	-4.94E-02	6.58E-03	-2.06E-02	-0.01433	4.75E-02	4.27
61	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Small - Gotland	-2.56E-02	4.67E-03	1.03E-02	0.047117	3.86E-02	4.52E-02	6.57
62	Rule 2: Attrib.: 1 - Value Landings - Baltistan - Gillnett-Baltistan - Small	-3.44E-02	2.21E-03	-2.51E-02	1.74E-02	-2.32E-02	3.06E-02	1.34
63	Rule 2: Attrib.: 2 - MPA - Baltistan - Gillnett-Baltistan - Small	-2.55E-03	2.12E-02	4.65E-02	0.014552	-2.42E-02	5.93E-03	2.92
64	Rule 1: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - Go fishing	9.61E-03	3.67E-02	4.41E-02	-1.29E-03	-2.16E-02	-1.69E-02	1.28
65	Rule 1: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - Stay in port	3.33E-02	-1.80E-02	-2.86E-02	5.43E-03	5.28E-03	0.016512	-6.42
66	Rule 1: Attrib.: 1 - Expected Value Landings - Baltistan - Gillnett-Baltistan - Medium	-4.26E-02	-0.03509	-3.86E-02	-3.87E-02	-3.86E-02	-3.87E-02	-3.86
67	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - West Baltic	-3.95E-02	-3.56E-02	0.014366	4.64E-02	5.25E-04	4.73E-02	1.62
68	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - East Baltic	-1.68E-02	-3.28E-02	-2.56E-02	-4.24E-02	7.66E-03	2.09E-03	-3.67
69	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - Not Baltic	-3.72E-02	-1.28E-03	-1.89E-02	-3.15E-02	-4.40E-02	4.35E-02	3.11
70	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - Bornholm	-5.00E-02	-0.04656	-3.06E-02	-2.95E-02	-2.97E-02	-2.95E-02	-0.0
71	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - Gotland	3.68E-03	0.035114	-2.68E-02	-4.57E-02	4.32E-02	2.96E-02	2.38
72	Rule 2: Attrib.: 1 - Value Landings - Baltistan - Gillnett-Baltistan - Medium	1.79E-02	-5.41E-03	-4.41E-02	2.64E-03	4.57E-02	-4.34E-02	-3.61
73	Rule 2: Attrib.: 2 - MPA - Baltistan - Gillnett-Baltistan - Medium	-4.58E-03	4.75E-02	1.03E-02	-2.04E-02	-2.87E-02	2.22E-02	-4.47
74	Rule 1: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - Go fishing	-4.05E-02	-0.00306	3.85E-02	-4.52E-02	2.79E-02	4.88E-02	2.66
75	Rule 1: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - Stay in port	8.98E-03	-2.55E-02	2.62E-02	-3.61E-02	1.33E-03	5.52E-03	9.57
76	Rule 1: Attrib.: 1 - Expected Value Landings - Baltistan - Gillnett-Baltistan - Large	-4.02E-02	4.66E-02	-5.18E-04	4.33E-02	-0.03603	-7.66E-03	-2.45
77	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - West Baltic	-5.61E-03	2.85E-02	-3.06E-02	2.85E-02	-1.59E-02	7.55E-03	2.74
78	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - East Baltic	-2.27E-02	-3.36E-02	1.99E-02	4.58E-02	1.37E-03	-1.96E-02	-1.09
79	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - Not Baltic	3.73E-02	-2.94E-02	-4.39E-02	4.40E-02	-1.48E-02	-2.46E-02	1.89
80	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - Bornholm	2.51E-02	-1.80E-03	-2.20E-02	-6.80E-03	2.05E-02	4.37E-02	-2.10
81	Rule 2: Charact.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Large - Gotland	-2.27E-02	1.29E-02	4.00E-02	3.30E-02	-2.69E-02	-2.55E-03	-3.11
82	Rule 2: Attrib.: 1 - Value Landings - Baltistan - Gillnett-Baltistan - Large	2.90E-02	1.09E-03	4.67E-02	-4.45E-02	2.27E-02	0.037133	9.89
83	Rule 2: Attrib.: 2 - MPA - Baltistan - Gillnett-Baltistan - Large	-0.02027	-1.40E-02	-2.87E-03	-2.64E-02	9.82E-03	-4.06E-02	-3.12

Figure2.11.3.b. The RUM table for one trip-behaviour of one country.

Table 2.11.1 shows that there is a table for each country. Table 2.11.3.a shows the structure of each country-table, which is structured by fleet and vessel size (Fl,Vs), and for each (Fl,Vs) input parameters are organice by "rule". Table 2.11.3.b shows that for each (Fl,Vs), the input data (coefficient in the utility fubction) for each rule are organized by characteristics ($\beta_{ij,r}$) and attributes ($\gamma_{i,s}$)

As already explained, TEMAS offers two alternative ways of setting effort and capacity, namely to let it be determined by the behaviour rules, or to let it be given as input from the worksheet. If the effort/capacity is determined by the behaviour rules, then the age distribution of vessels (input data) is not used by TEMAS. The initial age distribution (first line in Table 5.2.1 in Figure 2.8.2) however, is used in both options for effort input.

Figure 2.11.4 shows the form used to start up the simulation (in workbook "TEMAS_CALC"). This user form contains a toggle-button, which allows the use to toggle between the two options for input of effort and fleet capacity:

"***Use Effort/Capacity rules to generate effort***" and
"***Use Effort and Capacity read from worksheet as input.***"

The remaining options offered in the user form of Figure 2.11.4 will be further discussed below.

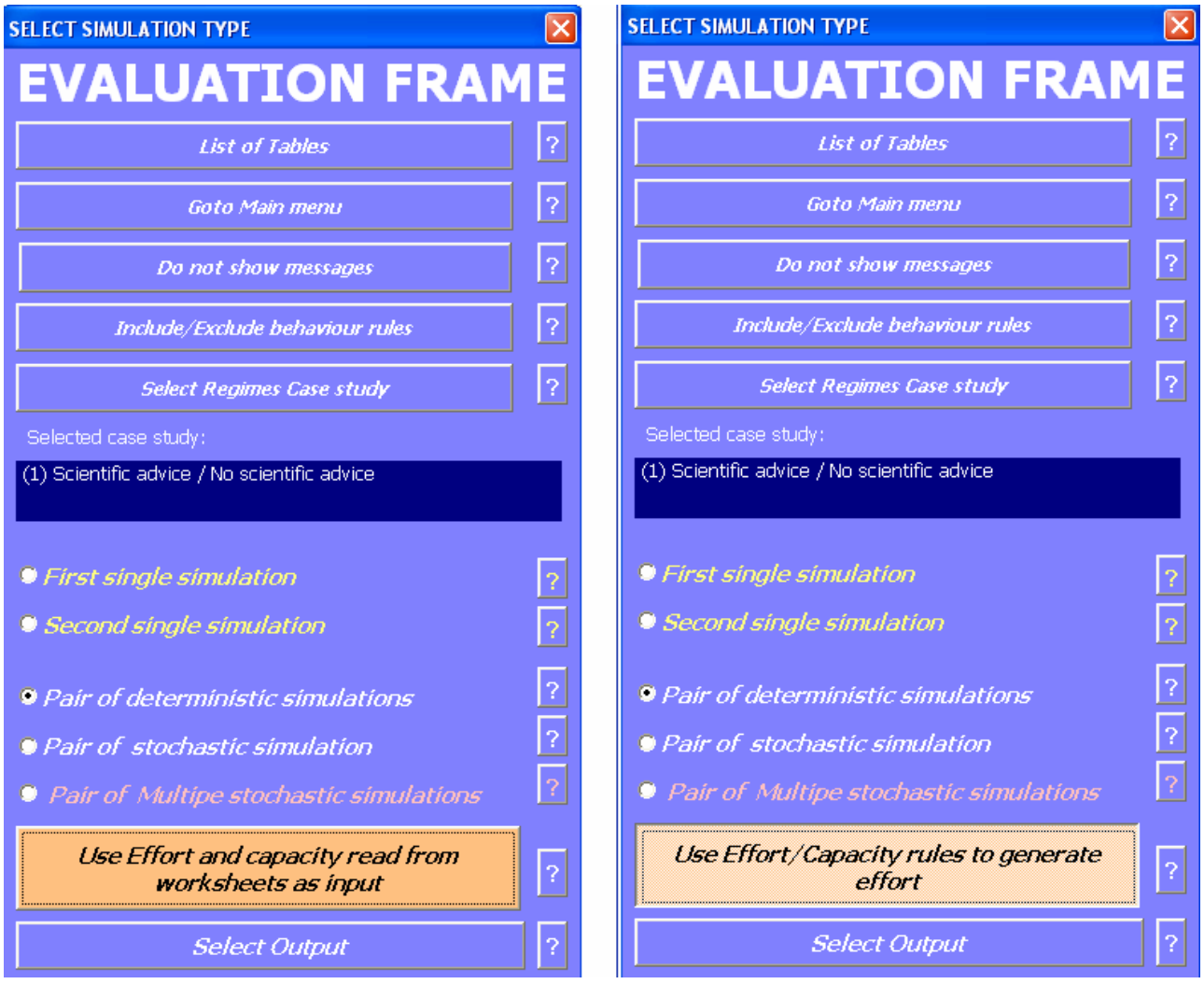


Figure 2.11.4. The user form for selection of type of simulation, including the toggle-button to select between the two effort/capacity options.

2.12. STRUCTURAL RULES INPUT, S09_ STRUC_RU

The sheet, "S09_STRUC_RU", contains the input parameters in the RUM (Random Utility Model) for long term (or "structural") behaviour. This model is mathematically the same as that for short term behaviour. For a definition of the RUM model, see foregoing section (Section 2.11).

The four structural rules currently in the TEMAS package are:

1) Decommission (Rule). This (and the three following rules) are the so-called long term rules, which determines the capacity of the fishing fleets. The decommission rules takes the decision on accept of a decommission compensation based on the recent economic performance of the fleet and the age structure of the fleet.
2) Dis-investment rule. This rule decides on the bankruptcy of a vessel based on the recent economic performance of the fleet.
3) Attrition rule: The attrition rule takes the decision on scrapping a vessel due to old age based on the age structure of the fleet (not implemented in the Baltic case).
4) Investment rule: This rule decides on the investment in a new vessel based on the recent economic performance of the fleet.

The probabilities of accepting, p^{Accept}_{Decomm}, $p^{Accept}_{Withdrawal}$, $p^{Accept}_{Attrition}$, $p^{Accept}_{New-Vessel}$ thus determines the exit/entry model.

They can be modelled by the RUM, (Random Utility Model). For a more comprehensive explanation of the RUM applied to fisheries, see Annex A. The decommision rule is presented here as an example of the structural rules. The mathematical formulations is similar for all 4 structural rules.

$$p^{Accept}_{Decomm} = \frac{\exp(U^{Accept}_{Decomm})}{\exp(U^{Reject}_{Decomm}) + \exp(U^{Accept}_{Decomm})} \quad \text{and} \quad p^{Reject}_{Decomm} = 1 - p^{Accept}_{Decom}$$

U^{Accept}_{Decomm} is the "utility" of accepting decommission and U^{Reject}_{Decomm} is the utility of rejecting decommission. The general expression for utility fransformed to the vessel exit/entry model reads

$$U^{Accept}_{Decomm}(Fl,Vs,Ct,y,q) =$$

$$\sum_{r=1(Characteristics)}^{R_{Decomm}} \beta^{Accept}_{Decomm.\ r} * X_{Decomm,\ r}(Fl,Vs,Ct,y,q)$$

$$+ \sum_{s=1(Attributes)}^{S_{Decomm}} \gamma_{Decomm,\ s} * W^{Accept}_{Decomm,\ s}(Fl,Vs,Ct,y,q)$$

The RUM applied in the Baltic case is summarized in the Table 2.12.1. The idea is that if the "historical cash flow" is low during a certain period, then decommission is accepted, if it exists, and if no decommission is available, dis-investment (withdrawal from fishing industry) applies. If cash flow has been high for a while, and there are free licenses available, then investments are made. If no free licenses are available, investments may be preceded by scrapping (dis-investment) of old vessels. For example, small vessels may be replaced by large vessels if large vessels give higher cash flow. Also move of investments from one fleet to another fleet can occur.

Coefficient	Structural rule		
	Decommission	**Dis-Investment**	**Investment**
Characteristics (1)	Historical cash flow	Historical cash flow	Historical cash flow
Characteristics (2)		Maximum Allowed capacity	Maximum Allowed capacity
Attributes (1)	Decommission fee		

Table 2.12.1. Characteristics and attributes for three RUM models of fleet capacity dynamics applied to the Baltic Case study.

Characteristics in the three rules are

$$X_{Decomm,\ 1}(Fl,Vs,Ct,y,q) = CF_{RUM}(Fl,Vs,Ct,y,q)$$

$$X_{Dis-Invest,\ 1}(Fl,Vs,Ct,y,q) = CF_{RUM}(Fl,Vs,Ct,y,q)$$

$$X_{Dis-Invest,\ 2}(Fl,Vs,Ct,y,q) = \text{ Vacant Licenses}$$

$$X_{Invest,\ 1}(Fl,Vs,Ct,y,q) = CF_{RUM}(Fl,Vs,Ct,y,q)$$

$$X_{Invest,\ 2}(Fl,Vs,Ct,y,q) = \text{Vacant Licencses}$$

and the single attribute considered in the decommission rule is

$$W^{Accept}_{Decomm,1}(Fl,Vs,Ct,y,q) = \text{Decommission fee for one vessel}$$

The cash flow concept, $CF_{RUM}(Fl,Vs,Ct,y,q)$, used in the present RUM is the average cashflow per period during the period $y - dy_{RUM}, y - dy_{RUM} + 1,..., y - 1$ and the periods for year y: 1,2,…,q-1.

The cash flows of hesorical years are weighted by a factor, Fac_u^{RUM}, which could be $Fac_u^{RUM} = (Fac^{RUM})^{-(y-u)}$ where Fac^{RUM} is a constant $0 < Fac^{RUM} \le 1$.

$$CF_{RUM}(Fl,Vs,Ct,y,q) = \frac{1}{dy_{RUM} * q_{Max}} \sum_{u=y-dy_{RUM}}^{y-1} \sum_{q=1}^{q_{Max}} FNCF_{RUM}(Fl,Vs,Ct,u,q,\bullet) * Fac_u^{RUM}$$

$$+ \frac{1}{q-1} \sum_{v=1}^{q-1} FNCF_{RUM}(Fl,Vs,Ct,y,q,\bullet)$$ and the net cash flow summed over areas is defined

$$FNCF_{RUM}(Fl,Vs,Ct,y,q,\bullet) = REV(Fl,Vs,Ct,y,q,\bullet) - VCO(Fl,Vs,Ct,y,q,\bullet) - CO_{Fix}^{Total}(Fl,Vs,Ct,y,q)$$

where REV is the revenue from landings, VCO is the total variable costs, and CO_{Fix}^{Total} is the total fixed costs.

The number of vessels is usually limited. The usual condition for introduction of a new vessel is that a vessel of similar size is removed from fishery. These conditions are often linked to capacity rather than the number of vessels, so that, for example, one big vessel, can be replacement three small vessel, if the total fishing capacity of the small vessels equals that of the new big vessel. Let TON(Fl, Vs, Ct) be the tonnage of an average vessel in vessel size Vs in Fleet Fl country Ct. If the entry of new vessels is conditions of removal of old vessels with the same tonnage, this would lead to lead to the country specific constraint:

$$\sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{New-Vessel}(Fl,Vs,Ct,y,q,\bullet) * TON(Fl,Vs,Ct) \leq$$

$$\sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Decomm}(Fl,Vs,Ct,y,q,\bullet) * TON(Fl,Vs,Ct) +$$

$$\sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Withdrawal}(Fl,Vs,Ct,y,q,\bullet) * TON(Fl,Vs,Ct) +$$

$$\sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Attrition}(Fl,Vs,Ct,y,q.\bullet) * TON(Fl,Vs,Ct)$$

If furthermore, decommisioned vessels cannot be replaced the term

$\sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Decomm}(Fl,Vs,Ct,y,q,\bullet) * TON(Fl,Vs,Ct)$ should be removed from the inequality

above. The vessel tonnage is just one example of a "fleet characteristics". Other examples of fleet characteristics are "Length of vessel" and "KgW of engine".

The "maximum regulations" are thought of as an upper limit, MAL (Maximum allowed level) of the characteristics summed over vessels. TEMAS allows for limitations of total characteristics of three levels Country, Fleet and Vessel Size:

Level 1: Country level

$$\sum_{Fl=}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * TON(Fl,Vs,Ct) \leq MAL_{Ton}^{Level\ 1}(Ct,y)$$

Level 2: Fleet level:

$$\sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * TON(Fl,Vs,Ct) \leq MAL_{Ton}^{Level\ 2}(Fl,Ct,y)$$

Level 3: Vessel size level:

$$NU_{Vessel}(Fl,Vs,Ct,y,\bullet) * TON(Fl,Vs,Ct) \leq MAL_{Ton}^{Level\ 3}(Fl,Vs,Ct)$$

To indicate a maximum regulation defined by a fleet characteristics, is thus required a specification of the characteristics (tonnage, vessel length, KWat etc.) and the level at which the MAL shall be applied. As illustrated by the example above on investment/replace above, the characteristics may be used for other types of regulations than maximum regulations.

$X_{Dis-Invest,\ 2}(Fl,Vs,Ct,y,q) = X_{Invest,\ 2}(Fl,Vs,Ct,y,q)$ = Max Capacity - Actual capacity

is not (Fl,Vs)-specific, it depends only on the country in the present TEMAS version for the Baltic

(Max Capacity - Actual capacity) =

$$MAL_{Ton}^{Level\ 1}(Ct) - \sum_{Fl=}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y.q,\bullet) * TON(Fl,Vs,Ct,y)$$

The variable "vacant licenses" is defined to prevent investment when no licenses are vacant, that is

$$Vacant\ \ Licenses =$$

$$\begin{cases} 0 \ \ if \ \ MAL_{Ton}^{Level\ 1}(Ct) > \sum_{Fl=}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y.q,\bullet) * TON(Fl,Vs,Ct,y) \\ -\infty \ \ if \ \ MAL_{Ton}^{Level\ 1}(Ct) \le \sum_{Fl=}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Vessel}(Fl,Vs,Ct,y.q,\bullet) * TON(Fl,Vs,Ct,y) \end{cases}$$

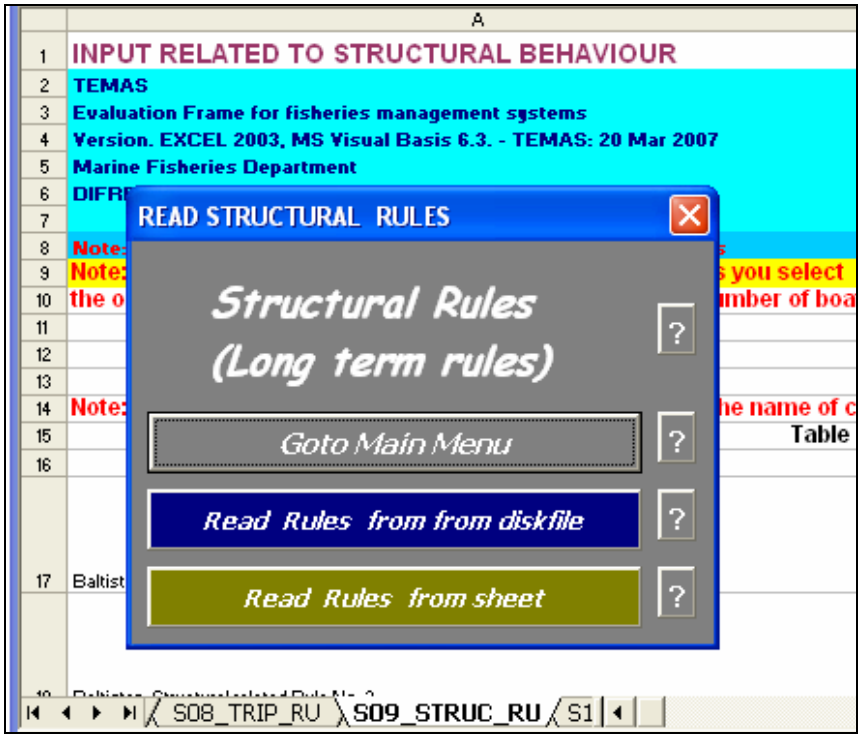
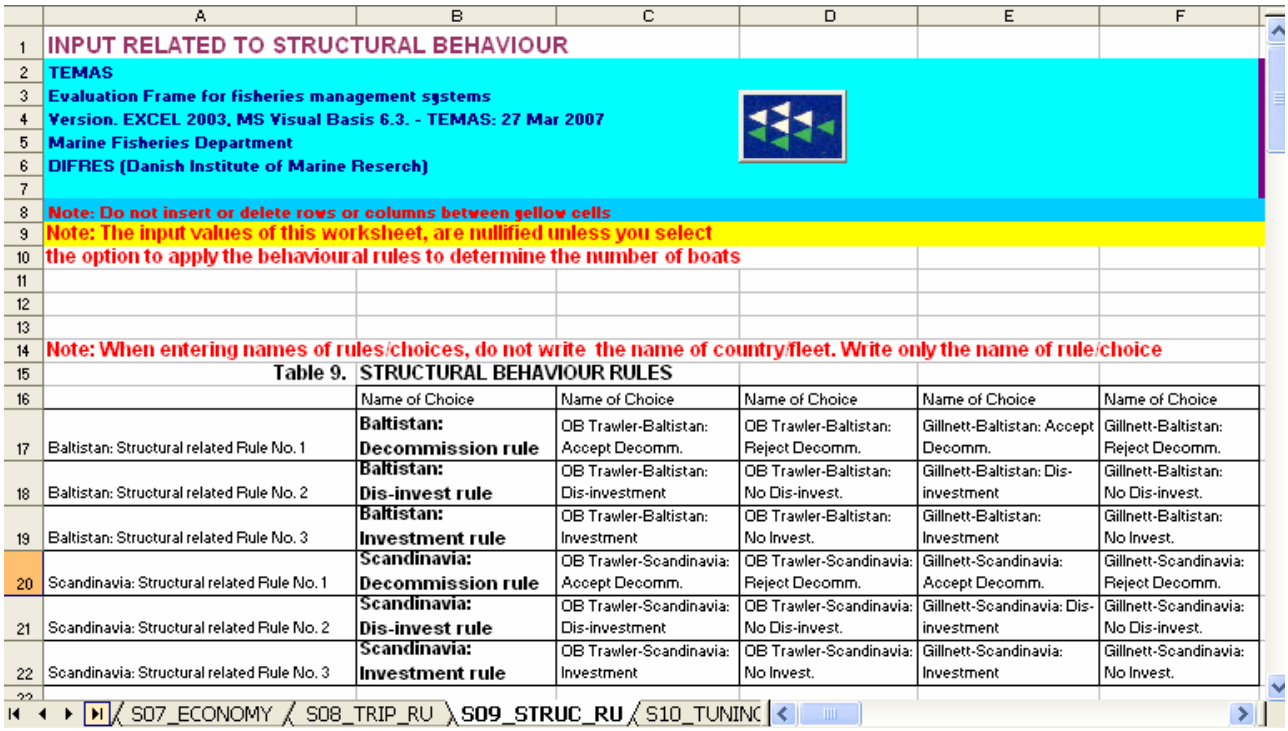


Figure 2.12.1. User-form for entry of structural behaviour related parameters.

Index	EXCEL Table	Caption
168	Table9.	STRUCTURAL BEHAVIOUR RULES
169	Table9.1.1.	Baltistan : STRUCTURAL BEHAVIOUR COEFFICIENTS OF R.U.M.
170	Table9.1.2.	Scandinavia : STRUCTURAL BEHAVIOUR COEFFICIENTS OF R.U.M.

Table 2.12.2. Tables in the structural behaviour input sheet, S09_STRUC_RU.



INPUT RELATED TO STRUCTURAL BEHAVIOUR

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

Note: Do not insert or delete rows or columns between yellow cells
Note: The input values of this worksheet, are nullified unless you select
the option to apply the behavioural rules to determine the number of boats

Note: When entering names of rules/choices, do not write the name of country/fleet. Write only the name of rule/choice

Table 9. STRUCTURAL BEHAVIOUR RULES

	Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice
Baltistan: Structural related Rule No. 1	**Baltistan: Decommission rule**	OB Trawler-Baltistan: Accept Decomm.	OB Trawler-Baltistan: Reject Decomm.	Gillnett-Baltistan: Accept Decomm.	Gillnett-Baltistan: Reject Decomm.
Baltistan: Structural related Rule No. 2	**Baltistan: Dis-invest rule**	OB Trawler-Baltistan: Dis-investment	OB Trawler-Baltistan: No Dis-invest.	Gillnett-Baltistan: Dis-investment	Gillnett-Baltistan: No Dis-invest.
Baltistan: Structural related Rule No. 3	**Baltistan: Investment rule**	OB Trawler-Baltistan: Investment	OB Trawler-Baltistan: No Invest.	Gillnett-Baltistan: Investment	Gillnett-Baltistan: No Invest.
Scandinavia: Structural related Rule No. 1	**Scandinavia: Decommission rule**	OB Trawler-Scandinavia: Accept Decomm.	OB Trawler-Scandinavia: Reject Decomm.	Gillnett-Scandinavia: Accept Decomm.	Gillnett-Scandinavia: Reject Decomm.
Scandinavia: Structural related Rule No. 2	**Scandinavia: Dis-invest rule**	OB Trawler-Scandinavia: Dis-investment	OB Trawler-Scandinavia: No Dis-invest.	Gillnett-Scandinavia: Dis-investment	Gillnett-Scandinavia: No Dis-invest.
Scandinavia: Structural related Rule No. 3	**Scandinavia: Investment rule**	OB Trawler-Scandinavia: Investment	OB Trawler-Scandinavia: No Invest.	Gillnett-Scandinavia: Investment	Gillnett-Scandinavia: No Invest.

S07_ECONOMY | S08_TRIP_RU | S09_STRUC_RU | S10_TUNING

Figure 2.12.2. Names of structural behaviour rules and choices

Figure 2.12.1 shows the userform of sheet S09_STRUC_RU, and Table 2.12.2 lists the three tables of the sheet. The structure is exactly the same as for sheet "S08_TRIP_RU"

Figure 2.12.2 shows the names of rules (EXCEL Table 9), and is exactly the same format as that for the trip related RUM (Figure 2.11.2).
Figure 2.12.3 shows the parameters of the RUM for structural behaviour, (in the Baltic case). The structure of this table is the same as that for the trip related RUM (Figures 2.11.3.a-b)

24	Table 9.1.1. Baltistan : STRUCTURAL BEHAVIOUR COEFFICIENTS OF R.U.M.				
25		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per
26	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Small - Accept Decomm.	-2.25E-02	3.62E-02	-2.74E-02	4.54E-
27	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Small - Reject Decomm.	-2.66E-02	-3.66E-02	-0.04867	-1.82E-
28	Rule 1: Attrib.: 1: Decommission fee - Baltistan - OB Trawler-Baltistan - Small	-4.36E-02	3.85E-02	3.30E-02	4.53E-
29	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Small - Dis-investment	1.42E-02	-3.84E-02	-4.69E-02	-0.0447
30	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Small - No Dis-invest.	-3.61E-02	-9.39E-03	4.13E-02	-3.21E-
31	Rule 2: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Small - Dis-investment	1.42E-02	-0.022587	-3.28E-05	-2.87E-
32	Rule 2: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Small - No Dis-invest.	-4.13E-02	-1.07E-02	4.79E-02	3.06E-
33	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Small - Investment	-4.26E-02	-4.44E-02	-4.94E-02	-3.72E-
34	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Small - No Invest.	8.63E-03	-5.21E-03	4.64E-02	-2.04E-
35	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Small - Investment	-1.80E-02	3.17E-02	0.016219	-4.22E-
36	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Small - No Invest.	-2.55E-02	-4.90E-02	2.92E-02	3.17E-
37	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Medium - Accept Decomm.	2.29E-02	-1.38E-02	2.34E-02	-4.74E-
38	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Medium - Reject Decomm.	4.79E-03	-2.40E-03	0.04994	4.04E-
39	Rule 1: Attrib.: 1: Decommission fee - Baltistan - OB Trawler-Baltistan - Medium	-2.78E-02	-4.54E-03	-3.60E-03	4.08E-
40	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Medium - Dis-investment	-7.27E-04	-2.57E-02	4.76E-02	1.71E-
41	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Medium - No Dis-invest.	2.39E-02	1.41E-02	1.58E-02	4.93E-
42	Rule 2: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Medium - Dis-investment	-4.89E-02	-1.56E-02	-3.57E-02	-1.19E-
43	Rule 2: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Medium - No Dis-invest.	9.85E-03	4.86E-02	3.30E-03	9.44E-
44	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Medium - Investment	-1.88E-02	-1.49E-04	1.57E-03	6.70E-
45	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Medium - No Invest.	1.81E-02	8.18E-03	-4.49E-02	-4.48E-
46	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Medium - Investment	-2.71E-02	1.53E-02	-3.19E-02	0.0255
47	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Medium - No Invest.	-4.41E-02	4.15E-02	-4.82E-02	-4.38E-
48	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Large - Accept Decomm.	-1.18E-02	4.66E-02	-3.23E-02	2.64E-
49	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Large - Reject Decomm.	-0.018512	2.56E-03	-3.30E-02	-4.65E-
50	Rule 1: Attrib.: 1: Decommission fee - Baltistan - OB Trawler-Baltistan - Large	0.036584	3.41E-02	7.68E-03	-4.01E-
51	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Large - Dis-investment	-1.49E-02	-3.94E-02	-1.11E-02	-2.95E-
52	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Large - No Dis-invest.	4.18E-02	-3.84E-02	-2.08E-02	-3.04E-
53	Rule 2: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Large - Dis-investment	3.34E-02	-0.014414	-2.47E-02	4.82E-
54	Rule 2: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Large - No Dis-invest.	-0.033016	2.67E-02	-0.020133	-2.09E-
55	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Large - Investment	-3.99E-02	-0.01751	5.77E-03	4.87E-
56	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - OB Trawler-Baltistan - Large - No Invest.	4.30E-02	2.15E-02	-4.67E-02	1.56E-
57	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Large - Investment	-2.40E-02	-4.56E-02	3.64E-03	-1.16E-
58	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Large - No Invest.	2.60E-02	2.94E-06	-3.24E-02	4.91E-
59	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Small - Accept Decomm.	3.76E-02	-4.60E-02	-7.59E-03	4.53E-
60	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Small - Reject Decomm.	-1.30E-02	0.019801	-3.23E-02	0.011
61	Rule 1: Attrib.: 1: Decommission fee - Baltistan - Gillnett-Baltistan - Small	-0.028428	-2.27E-02	-5.96E-03	6.58E-
62	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Small - Dis-investment	-1.22E-02	8.37E-03	2.73E-02	1.03E-
63	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Small - No Dis-invest.	2.35E-02	-1.85E-03	-1.60E-02	2.30E-
64	Rule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Small - Dis-investment	-1.78E-02	-1.22E-03	-3.71E-02	0.0319
65	Rule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Small - No Dis-invest.	-4.79E-02	3.07E-02	2.28E-02	8.05E-
66	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Small - Investment	-2.72E-02	2.04E-03	2.23E-02	3.95E-
67	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Small - No Invest.	1.37E-02	-0.019657	-0.019843	-4.05E-
68	Rule 3: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Small - Investment	7.88E-04	-1.24E-02	-4.40E-02	-2.51E-
69	Rule 3: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Small - No Invest.	-4.64E-02	-1.68E-02	2.40E-02	4.65E-
70	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Medium - Accept Decomm.	-3.87E-02	-1.53E-02	-3.67E-02	0.012
71	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Medium - Reject Decomm.	7.47E-03	-4.83E-02	-3.86E-02	-3.86E-
72	Rule 1: Attrib.: 1: Decommission fee - Baltistan - Gillnett-Baltistan - Medium	4.79E-02	2.19E-02	6.06E-03	0.0143
73	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Medium - Dis-investment	8.28E-03	1.60E-02	-2.56E-02	-2.56E-
74	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Medium - No Dis-invest.	0.025858	-3.63E-02	6.07E-03	-1.89E-
75	Rule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - Dis-investment	4.58E-02	-8.48E-04	-3.01E-02	-3.06E-
76	Rule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - No Dis-invest.	-0.038203	-4.85E-02	-4.79E-03	-2.68E-
77	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Medium - Investment	5.12E-03	3.69E-02	-0.012403	-2.52E-
78	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Medium - No Invest.	4.48E-02	-2.57E-03	4.93E-02	-2.55E-
79	Rule 3: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - Investment	-1.47E-02	3.42E-02	1.65E-02	3.03E-
80	Rule 3: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - No Invest.	-2.14E-02	-3.76E-02	-4.81E-02	-7.67E-
81	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Large - Accept Decomm.	8.41E-03	-4.50E-02	-7.82E-03	3.85E-
82	Rule 1: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Large - Reject Decomm.	-1.61E-02	1.28E-02	-4.87E-02	2.62E-
83	Rule 1: Attrib.: 1: Decommission fee - Baltistan - Gillnett-Baltistan - Large	-2.27E-02	3.48E-02	1.93E-02	2.44E-
84	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Large - Dis-investment	5.93E-03	-4.81E-02	4.79E-02	2.46E-
85	Rule 2: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Large - No Dis-invest.	-1.24E-02	4.48E-02	-4.18E-02	-5.18E-
86	Rule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Large - Dis-investment	-4.08E-02	-4.76E-02	-4.18E-02	-3.06E-
87	Rule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Large - No Dis-invest.	3.84E-02	1.43E-02	8.80E-03	1.99E-
88	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Large - Investment	-1.29E-02	4.26E-02	-2.64E-02	-4.39E-
89	Rule 3: Charact.: 1: Hist. Cashflow - Baltistan - Gillnett-Baltistan - Large - No Invest.	-2.44E-02	9.66E-03	2.35E-02	-2.20E-
90	Rule 3: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Large - Investment	2.53E-02	-2.84E-02	-4.02E-02	4.00E-
91	Rule 3: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Large - No Invest.	-2.58E-02	4.01E-02	3.65E-02	1.50E-

Figure 2.12.3. Parameters in structural behaviour model (RUM)

2.13 TUNING INPUT, S_10_TUNING

By "tuning" is meant the processes of finding the "reference simulation" of TEMAS. The reference simulation is the situation (scenario) relative to which all the other simulations are made, and are compared to, when addressing the "'What-if-then-questions'.

The reference simulation will usually be chosen to be a simulation in equilibrium, that is, a simulation where all results are equal in all years of the time series under study. The reference simulation will usually be chosen to be the fisheries situation of the current situation (current year). TEMAS is said to reproduce the current situation when it can reproduce the landings (in weight) observed the last data year for each combination of fleet, stock, time period and.

The idea of "calibration" is closely related to "tuning". Calibration means to adjust certain parameters of TEMAS, so that TEMAS can make a simulated prediction for a historical period, that does not "deviate too much" from the observed fisheries. For example, TEMAS should be able to simulate predicted catches from 1995 to 2005 that do not deviate too much from the actual (observed) catches 1995-2005. TEMAS calibrates some of its parameters by aid of the so-called modified χ^2-criterion (Sokal and Rohlf, 1981)

$$\chi^2_X = \sum_{Indices} \frac{(X_{Observed} - X_{Calculated})^2}{X_{Calculated}}$$

where "$X_{calculated}$" symbolises a prediction-variable of the model, for example, the weight of cod, caught by a certain gear rigging of a fleet fleet, at a certain time, in a certain area. "$X_{observed}$" indicates the value of X observed from a historical period. The variables "X" are selected so that they are easy to access.

The options for calibration data are:

1) Catches, (Landings and discards) on various dis-aggregation levels. From (Fl, Vs, Rg, Ct, St, y, a, q, Va, Ar) to (•,•,•,•, St, y,•,•,•,•) . These data are entered through worksheet "S11_OBS".
2) Index of stock numbers from research vessel survey or from catch per unit of effort of commercial vessels.
3) Index of stock biomass or SSB from research vessel survey or from catch per unit of effort of commercial vessels.
4) Mean stock F (Fishing mortality) from (for example) fish stock assessment of ICES working groups.

The χ^2 for landings summed over age groups is:

$$\chi^2_{Yield} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{Ar=1}^{Ar_{Max}} \frac{(Y^{Obs}_{Landings}(Fl,Vs,Rg,Ct,St,y,\bullet,q,\bullet,Ar) - Y^{Calc}_{Landings}(Fl,Vs,Rg,Ct,St,y,\bullet,q,\bullet,Ar))^2}{Y^{Calc}(Fl,Vs,Rg,Ct,St,y,\bullet,q,\bullet,Ar)}$$

Landings summed over vessel age groups and fish age groups, are the "observations" expected in the current version of TEMAS. These data are entered in worksheet "S11_OBS"

The index of stock numbers can be catch per day by age group, converted into relative numbers, to make them compatible with relative numbers predicted by TEMAS.

$$\chi^2_N = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{a=1}^{a_{Max}(St)} \frac{(N^{Obs}_{Index}(St,y,q,a,Ar) - N^{Calc}_{Index}(St,y,q,a,A))^2}{N^{Calc}_{Index}(St,y,q,a)}$$

Where, for example, $N^{Calc}_{Index}(St,y,q,a,Ar) = \frac{N(St,y,q,a,Ar)}{\sum_{i=1}^{a_{Max}(St)} N(St,y,q,i,Ar)}$ and the survey index is derived from, say, catch per hour, $CPUE_{Survey}$, $N^{Obs}_{Index}(St,y,q,a,Ar) = \frac{CPUE_{Survey}(St,y,q,a,Ar)}{\sum_{i=1}^{a_{Max}(St)} CPUE_{Survey}(St,y,q,i,Ar)}$

Also indices of biomass (or SSB) can be made relative and compared to indices predicted by TEMAS.

$$\chi^2_{SSB} = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \frac{(SSB^{Obs}_{Index}(St,y,q) - SSB^{Calc}_{Index}(St,y,q))^2}{SSB^{Calc}_{Index}(St,y,q)}$$

Fishing mortality can be compared to fishing mortalities estimated by persons independent of TEMAS (e.g. ICES WGs).

$$\chi^2_{F_{MEAN}} = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \frac{(F^{Obs}_{Mean}(St,y,q) - F^{Calc}_{Mean}(St,y,q))^2}{F^{Calc}_{Mean}(St,y,q)}$$

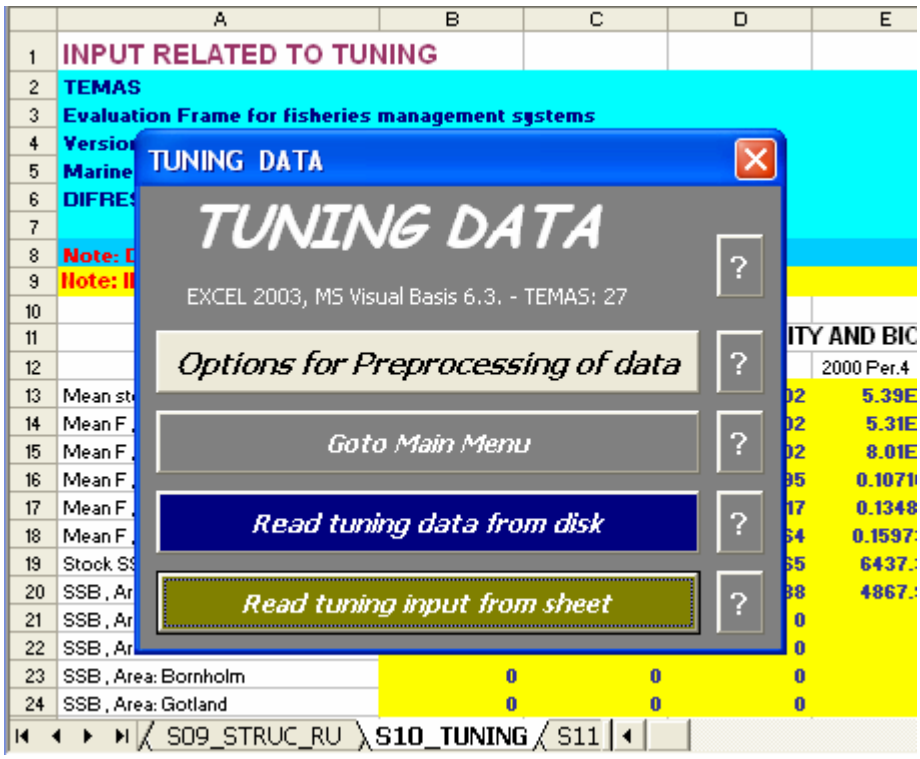
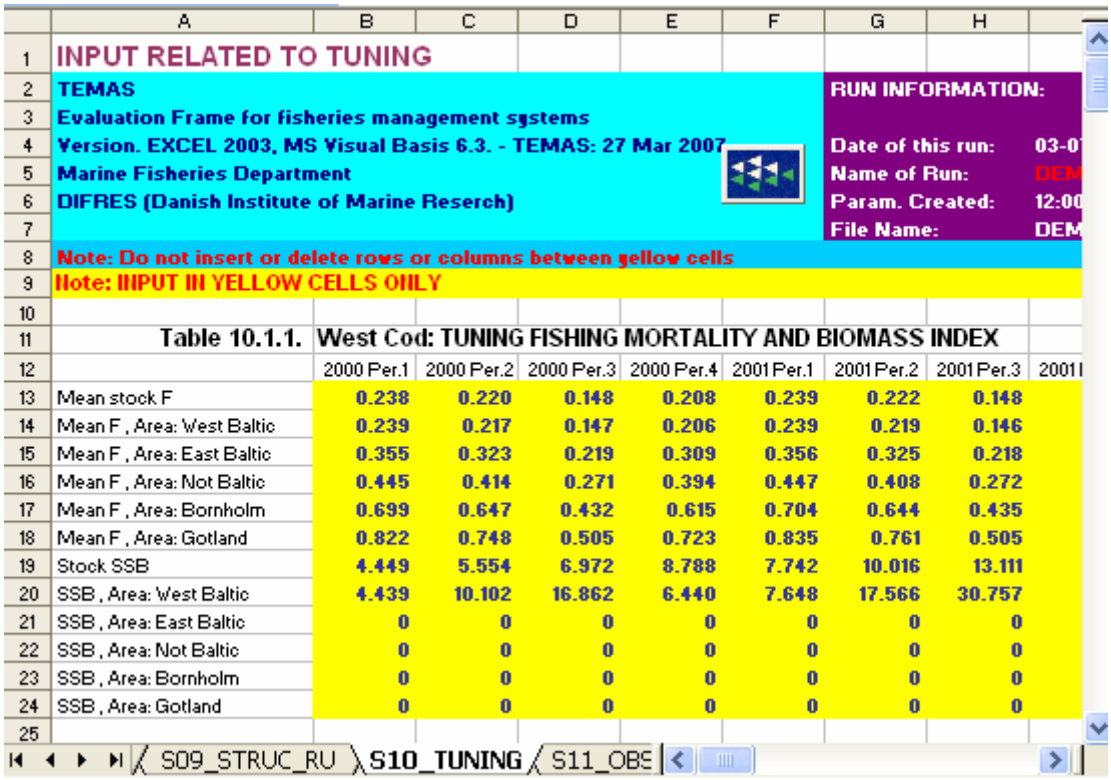


Figure 2.13.1. User-form for entry of tuning data.

Index	EXCEL Table	Caption
171	Table10.1.1.	West Cod: TUNING FISHING MORTALITY AND BIOMASS INDEX
172	Table10.1.2.	West Cod: INDEX OF ABUNDANCE (Numbers at age)
173	Table10.2.1.	East cod: TUNING FISHING MORTALITY AND BIOMASS INDEX
174	Table10.2.2.	East cod: INDEX OF ABUNDANCE (Numbers at age)

Table 2.13.1. Tables in the tuning input sheet, S010_TUNING.



INPUT RELATED TO TUNING

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

RUN INFORMATION:
Date of this run: 03-0
Name of Run: DEM
Param. Created: 12:00
File Name: DEM

Note: Do not insert or delete rows or columns between gellow cells
Note: INPUT IN YELLOW CELLS ONLY

Table 10.1.1. West Cod: TUNING FISHING MORTALITY AND BIOMASS INDEX

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001
Mean stock F	0.238	0.220	0.148	0.208	0.239	0.222	0.148	
Mean F , Area: West Baltic	0.239	0.217	0.147	0.206	0.239	0.219	0.146	
Mean F , Area: East Baltic	0.355	0.323	0.219	0.309	0.356	0.325	0.218	
Mean F , Area: Not Baltic	0.445	0.414	0.271	0.394	0.447	0.408	0.272	
Mean F , Area: Bornholm	0.699	0.647	0.432	0.615	0.704	0.644	0.435	
Mean F , Area: Gotland	0.822	0.748	0.505	0.723	0.835	0.761	0.505	
Stock SSB	4.449	5.554	6.972	8.788	7.742	10.016	13.111	
SSB , Area: West Baltic	4.439	10.102	16.862	6.440	7.648	17.566	30.757	
SSB , Area: East Baltic	0	0	0	0	0	0	0	
SSB , Area: Not Baltic	0	0	0	0	0	0	0	
SSB , Area: Bornholm	0	0	0	0	0	0	0	
SSB , Area: Gotland	0	0	0	0	0	0	0	

Figure 2.13.2. From worksheet Tuning_Input.

Figure 2.13.2 contains the index of stock biomass or SSB from research vessel survey or from catch per unit of effort of commercial vessels and mean stock F (Fishing mortality) from (for example) fish stock assessment of ICES working groups. Mean F and SSB can be given for the stock (in all areas) and by area.

Figure 2.13.3 .a and b contain the indices of stock numbers, from research vessel survey or from commercial vessels. TEMAS offers the option for one index only. Should more indices be available (as is often the case for ICES WG assessments), the user of TEMAS must combine into one index before entry in TEMAS. Figure 2.13.3.a shows the structure of the index-table, which starts with the index for all area combined and then gives the data by area. Figure 2.13.3.b shows that individual index-data must be structured as the stock numbers are structured in TEMAS. That is with period groups in ages 0 and 1, period groups merged into age groups for age 2 and older.

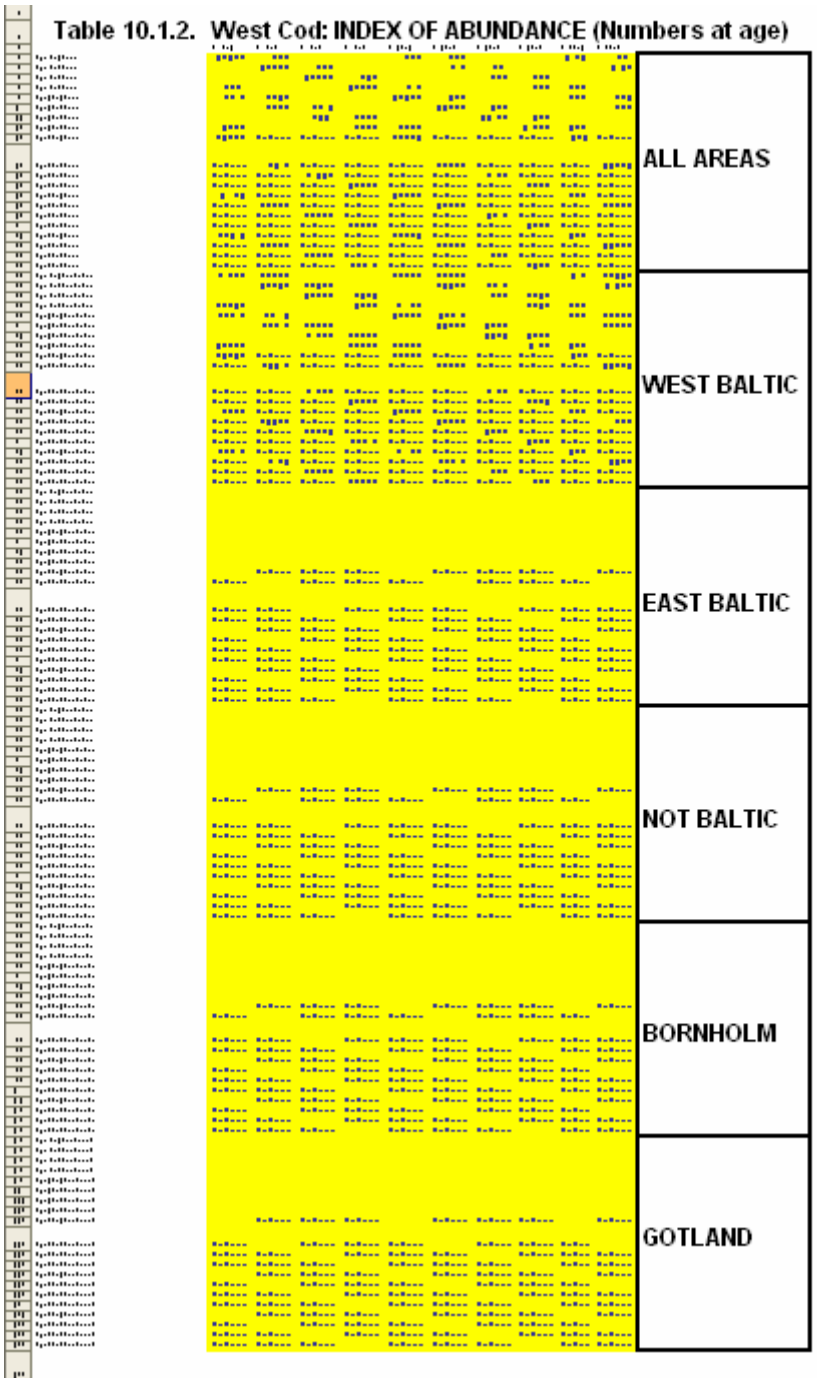


Figure 2.13.3.a. Structure of table for Research survey (or commercial fisheries) indices of stock numbers

	A	B	C	D	E	F	G	H	I	J	K	L	M
28	Table 10.1.2.	West Cod: INDEX OF ABUNDANCE (Numbers at age)											
29		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
30	Age 0 Per. 1 All areas	151.49	2.38	0.00	0.00	8.52	2.84	0.00	0.00	10.71	3.50	0.00	0.00
31	Age 0 Per. 2 All areas	0.00	143.37	2.22	0.00	0.00	8.03	2.70	0.00	0.00	10.18	3.38	0.00
32	Age 0 Per. 3 All areas	0.00	0.00	135.94	2.13	0.00	0.00	7.68	2.52	0.00	0.00	9.60	3.20
33	Age 0 Per. 4 All areas	27.20	0.00	0.00	127.53	2.02	0.00	0.00	7.24	2.42	0.00	0.00	9.14
34	Age 1 Per. 1 All areas	67.07	26.18	0.00	0.00	121.56	1.93	0.00	0.00	6.89	2.31	0.00	0.00
35	Age 1 Per. 2 All areas	0.00	64.24	25.01	0.00	0.00	115.55	1.85	0.00	0.00	6.57	2.22	0.00
36	Age 1 Per. 3 All areas	0.00	0.00	61.10	23.39	0.00	0.00	110.35	1.73	0.00	0.00	6.28	2.09
37	Age 1 Per. 4 All areas	12.27	0.00	0.00	58.44	22.65	0.00	0.00	106.34	1.64	0.00	0.00	5.98
38	Age 2 Per. 1 All areas	22.00	No Value	No Value	No Value	67.98	No Value	No Value	No Value	121.29	No Value	No Valu	No Value
39	Age 2 Per. 2 All areas	No Value	21.06	No Value	No Value	No Value	63.46	No Value	No Value	No Value	115.41	No Valu	No Value
40	Age 2 Per. 3 All areas	No Value	No Value	20.12	No Value	No Value	No Value	60.72	No Value	No Value	No Value	109.78	No Value
41	Age 2 Per. 4 All areas	No Value	No Value	No Value	18.96	No Value	No Value	No Value	58.32	No Value	No Value	No Valu	104.89
42	Age 3 Per. 1 All areas	10.05	No Value	No Value	No Value	17.93	No Value	No Value	No Value	54.52	No Value	No Valu	No Value
43	Age 3 Per. 2 All areas	No Value	9.23	No Value	No Value	No Value	16.35	No Value	No Value	No Value	49.64	No Valu	No Value
44	Age 3 Per. 3 All areas	No Value	No Value	8.46	No Value	No Value	No Value	15.06	No Value	No Value	No Value	46.45	No Value
45	Age 3 Per. 4 All areas	No Value	No Value	No Value	7.78	No Value	No Value	No Value	13.97	No Value	No Value	No Valu	42.85
46	Age 4 Per. 1 All areas	4.51	No Value	No Value	No Value	6.98	No Value	No Value	No Value	12.74	No Value	No Valu	No Value
47	Age 4 Per. 2 All areas	No Value	4.00	No Value	No Value	No Value	6.28	No Value	No Value	No Value	11.38	No Valu	No Value
48	Age 4 Per. 3 All areas	No Value	No Value	3.60	No Value	No Value	No Value	5.69	No Value	No Value	No Value	10.19	No Value
49	Age 4 Per. 4 All areas	No Value	No Value	No Value	3.33	No Value	No Value	No Value	5.17	No Value	No Value	No Valu	9.39
50	Age 0 Per. 1 Area: West E	7.03	2.33	0	0	8.44	2.824153	0	0	10.49	3.51	0	0

S09_STRUC_RU | S10_TUNING | S11_OBS | S12_DEMON | S13_TABLES | S14_TEMAS

Figure 2.13.3.b. Research survey (or commercial fisheries) indices of stock numbers

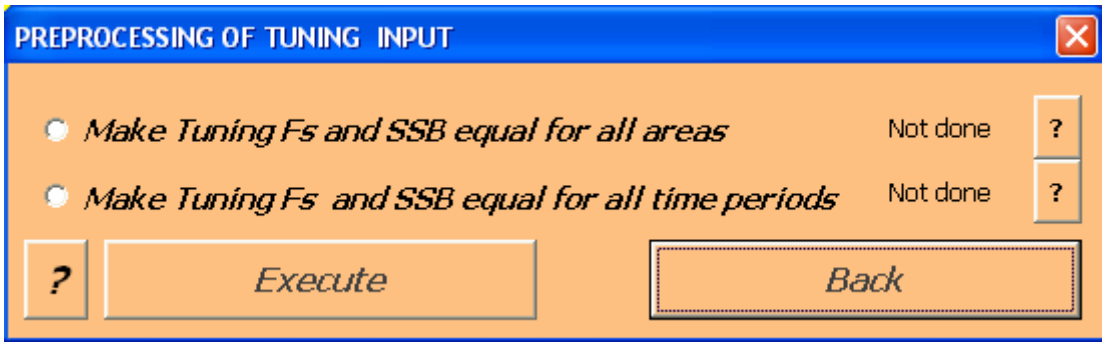


Figure 2.13.3. Options for pre-processing of tuning data.

The option "Make Tuning Fs equal for all areas" takes the tuning F of first area, and assigns that value to all other areas $F^{Obs}_{Mean}(St, y, q, Ar) = F^{Obs}_{Mean}(St, y, q, 1)$. If you select that option the value in the cells for other areas than the first areas will become irrelevant.

The option "Make Tuning Fs equal for all time periods" takes the tuning F of first time period, and assigns that value to all other periods

$F^{Obs}_{Mean}(St, y, q, Ar) = F^{Obs}_{Mean}(St, y, 1, Ar)$ and $F^{Obs}_{Stock,Mean}(St, y, q) = F^{Obs}_{Stock,Mean}(St, y, 1)$

If you select that option the value in the cells for periods later than first period will become irrelevant

2.14. OBSERVATIONS INPUT, S11_OBS

"Observations" plays the same role in TEMAS as "tuning data", actually "Observations! are tuning or calibration data in the context of TEMAS. The concepts "tuning" and "calibrations" (which are almost the same) are explained in Section 2.13. Observations mean "observed landings" in the present version of TEMAS. Figure 2.14.1 shows the user-form for sheet "S11_OBS", and Table 2.14.1 shows the tables of "S11_OBS". There is a table for each combination of stock and country.

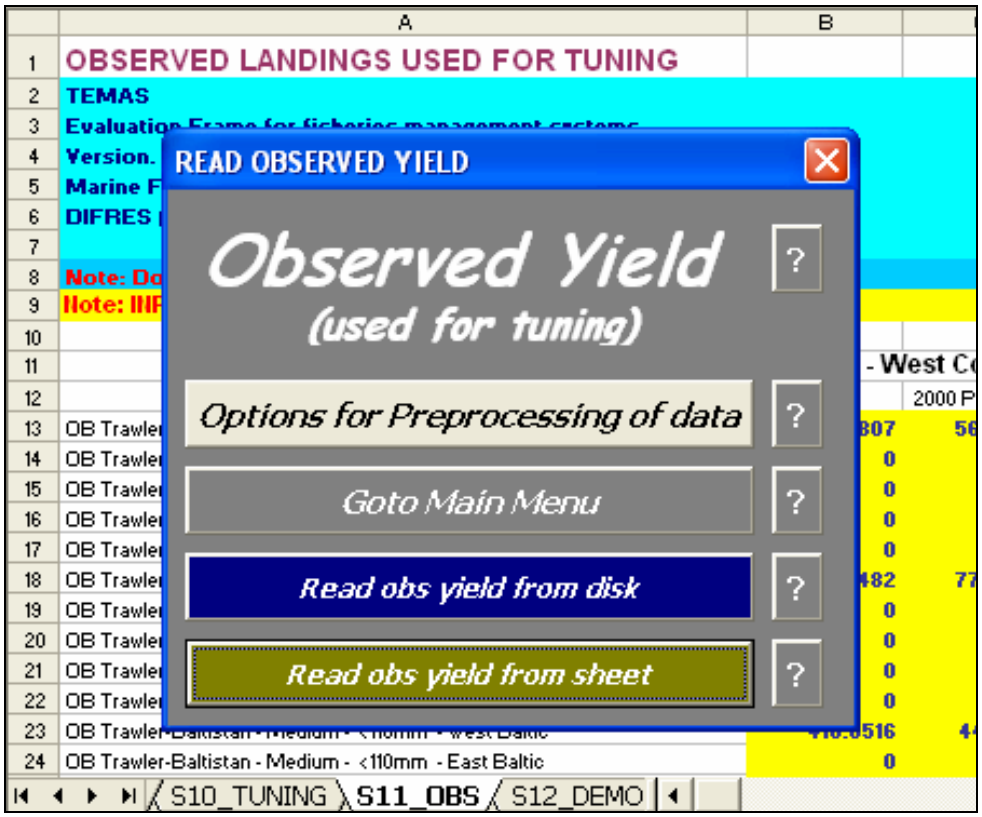


Figure 2.14.1. . User-form for entry of observations.

Index	EXCEL Table	Caption
175	Table 11.1.	Time series of observed landings
176	Table 11.2.1.	Baltistan - West Cod: OBSERVED LANDINGS
177	Table 11.2.2.	Baltistan - East cod: OBSERVED LANDINGS
178	Table 11.3.1.	Scandinavia - West Cod: OBSERVED LANDINGS
179	Table 11.3.2.	Scandinavia - East cod: OBSERVED LANDINGS

Table 2.14.1. Tables in the observations input sheet, S011_OBS.

Figure 2.14.3. shows EXCEL Table 11.1, giving the length of time series of observations. This range, from (First period of first year) to (Last period of last year) may be equal to or shorter than the time span of the simulation. In this example the observation runs from (second quarter of 2001) to (third quarter of 2007) whereas the simulation runs from (first quarter of 2000) to (last qyarter of 2009). EXCEL Table 11.2.1 shows the actual observations for West cod landed by one country (Baltistan). The periods for which data are not available will automatically be filled in with "No Value", and need not be filled in by you. Figure 2.14.2 shows the entire table for West cod landed by Baltistan.

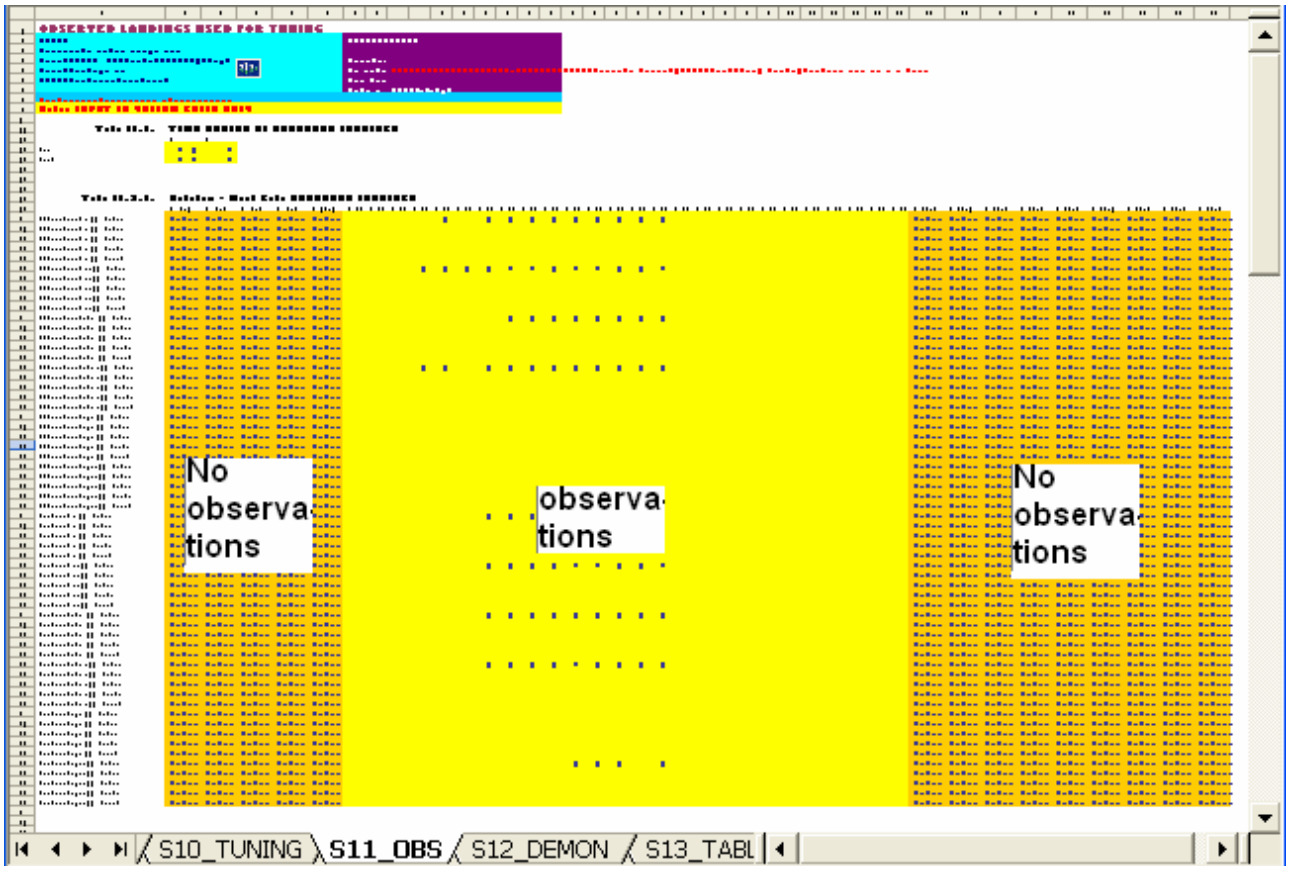
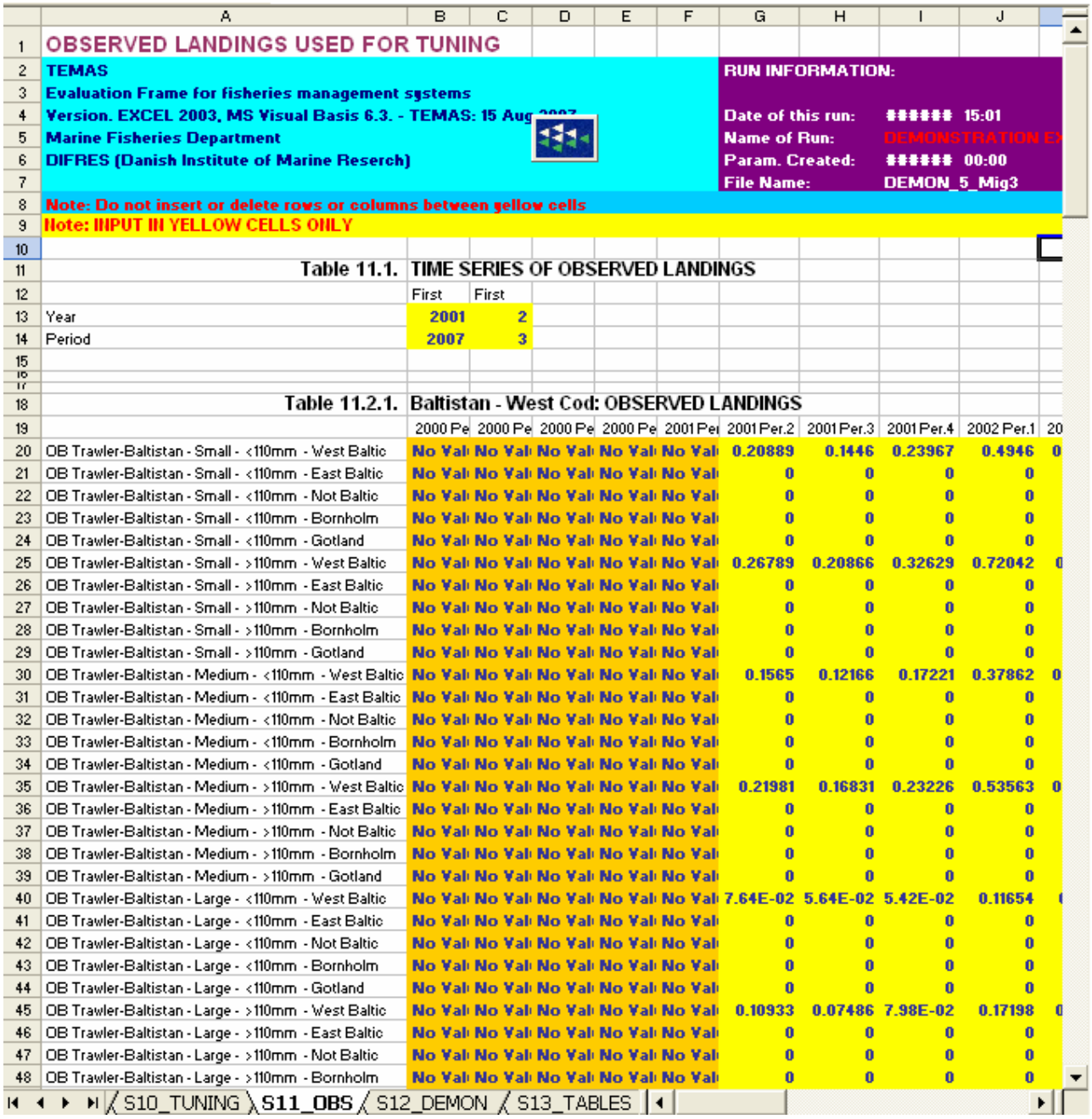


Figure 2.14.2. Observatins. Landings by fleet, vessel size, rigging and area (Fl,Vs,Rg,Ar) and area by one country (Scandinavia). Illustration of time series of observations.

Frequency	Aggregation level of landings used for tuning				
Data per period	Area	Country	Fleet	Vessel size	Rigging
	Area	Country	Fleet	Vessel size	
	Area	Country	Fleet		
	Area				
	Country		Fleet	Vessel size	Rigging
	Country		Fleet	Vessel size	
	Country		Fleet		
	Country				
	Total stock				
Annual data	Area	Country	Fleet	Vessel size	Rigging
	Area	Country	Fleet	Vessel size	
	Area	Country	Fleet		
	Area				
	Country		Fleet	Vessel size	Rigging
	Country		Fleet	Vessel size	
	Country		Fleet		
	Country				
	Total stock				

Table 2.14.2. Options for aggregation levels when tuning TEMAS with observations of stock specific landings.

In the present case the West cod is caught only in the Western Baltic. The observations can be aggregated in various ways, before they are used in the calibration, as illustrated in Table 2.14.2. It may also well happen that observation data are not available in the highest aggregation level (Area, Country, Fleet, Vessel size, Rigging). EXCEL Table 11.2.1, however, only offers data entry at the highest aggregation level.



OBSERVED LANDINGS USED FOR TUNING

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 15 Aug 2007
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

RUN INFORMATION:
Date of this run: ###### 15:01
Name of Run: DEMONSTRATION EX
Param. Created: ###### 00:00
File Name: DEMON_5_Mig3

Note: Do not insert or delete rows or columns between gellow cells
Note: IINPUT IN YELLOW CELLS ONLY

Table 11.1. TIME SERIES OF OBSERVED LANDINGS

	First	First
Year	2001	2
Period	2007	3

Table 11.2.1. Baltistan - West Cod: OBSERVED LANDINGS

	2000 Pe	2000 Pe	2000 Pe	2000 Pe	2001 Per	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	20
OB Trawler-Baltistan - Small - <110mm - West Baltic	No Val	No Val	No Val	No Val	No Val	0.20889	0.1446	0.23967	0.4946	0
OB Trawler-Baltistan - Small - <110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - <110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - <110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - <110mm - Gotland	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - >110mm - West Baltic	No Val	No Val	No Val	No Val	No Val	0.26789	0.20866	0.32629	0.72042	0
OB Trawler-Baltistan - Small - >110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - >110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - >110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Small - >110mm - Gotland	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - <110mm - West Baltic	No Val	No Val	No Val	No Val	No Val	0.1565	0.12166	0.17221	0.37862	0
OB Trawler-Baltistan - Medium - <110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - <110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - <110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - <110mm - Gotland	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - >110mm - West Baltic	No Val	No Val	No Val	No Val	No Val	0.21981	0.16831	0.23226	0.53563	0
OB Trawler-Baltistan - Medium - >110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - >110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - >110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Medium - >110mm - Gotland	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - <110mm - West Baltic	No Val	No Val	No Val	No Val	No Val	7.64E-02	5.64E-02	5.42E-02	0.11654	
OB Trawler-Baltistan - Large - <110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - <110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - <110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - <110mm - Gotland	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - >110mm - West Baltic	No Val	No Val	No Val	No Val	No Val	0.10933	0.07486	7.98E-02	0.17198	0
OB Trawler-Baltistan - Large - >110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - >110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
OB Trawler-Baltistan - Large - >110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	

S10_TUNING | S11_OBS | S12_DEMON | S13_TABLES

Figure 2.14.3. Observatins. Landings by fleet, vessel size, rigging and area (Fl,Vs,Rg,Ar) and area by one country (Scandinavia).

If the data are available on an aggregated level, the disaggregated table can still be used for data entry. The aggregated data just have to be filled in cells representing the aggregation as illustrated in Table. Which cell is chosen to represent an aggregation is irrelevant. When the data subsequently ae used in the calibration process, the user must choose the aggregation level of the input data, or data further disaggregated. The tuning module, will then automatically aggregate the data before using them.

The same procedure applies if only annual data are available. In that case the annual data are entered in one period (any period) of the year in question. Before applied, the program will convert the data into annual data, by summation over periods.

Area, Country, Fleet, Vessel size, Rig	Ctry, Fleet, V.size, Rig	Ctry, Fleet, V.size	Country, Fleet	Country	Total stock
OB Trawler-Baltistan - Small - <110mm - West Baltic	OB Trawler-Baltistan - Small - <110mm	OB Trawler-Baltistan - Small -	OB Trawler-Baltistan	Baltistan	Total stock
OB Trawler-Baltistan - Small - <110mm - East Baltic					
OB Trawler-Baltistan - Small - <110mm - Not Baltic					
OB Trawler-Baltistan - Small - <110mm - Bornholm					
OB Trawler-Baltistan - Small - <110mm - Gotland					
OB Trawler-Baltistan - Small - >110mm - West Baltic	OB Trawler-Baltistan - Small - >110mm				
OB Trawler-Baltistan - Small - >110mm - East Baltic					
OB Trawler-Baltistan - Small - >110mm - Not Baltic					
OB Trawler-Baltistan - Small - >110mm - Bornholm					
OB Trawler-Baltistan - Small - >110mm - Gotland					
OB Trawler-Baltistan - Medium - <110mm - West Baltic	OB Trawler-Baltistan - Medium - <110mm	OB Trawler-Baltistan - Medium			
OB Trawler-Baltistan - Medium - <110mm - East Baltic					
OB Trawler-Baltistan - Medium - <110mm - Not Baltic					
OB Trawler-Baltistan - Medium - <110mm - Bornholm					
OB Trawler-Baltistan - Medium - <110mm - Gotland					
OB Trawler-Baltistan - Medium - >110mm - West Baltic	OB Trawler-Baltistan - Medium - >110mm				
OB Trawler-Baltistan - Medium - >110mm - East Baltic					
OB Trawler-Baltistan - Medium - >110mm - Not Baltic					
OB Trawler-Baltistan - Medium - >110mm - Bornholm					
OB Trawler-Baltistan - Medium - >110mm - Gotland					
OB Trawler-Baltistan - Large - <110mm - West Baltic	OB Trawler-Baltistan - Large - <110mm	OB Trawler-Baltistan - Large			
OB Trawler-Baltistan - Large - <110mm - East Baltic					
OB Trawler-Baltistan - Large - <110mm - Not Baltic					
OB Trawler-Baltistan - Large - <110mm - Bornholm					
OB Trawler-Baltistan - Large - <110mm - Gotland					
OB Trawler-Baltistan - Large - >110mm - West Baltic	OB Trawler-Baltistan - Large - >110mm				
OB Trawler-Baltistan - Large - >110mm - East Baltic					
OB Trawler-Baltistan - Large - >110mm - Not Baltic					
OB Trawler-Baltistan - Large - >110mm - Bornholm					
OB Trawler-Baltistan - Large - >110mm - Gotland					
Gillnett-Baltistan - Small - <110mm - West Baltic	Gillnett-Baltistan - Small - <110mm	Gillnett-Baltistan - Small	Gillnett-Baltistan		
Gillnett-Baltistan - Small - <110mm - East Baltic					
Gillnett-Baltistan - Small - <110mm - Not Baltic					
Gillnett-Baltistan - Small - <110mm - Bornholm					
Gillnett-Baltistan - Small - <110mm - Gotland					
Gillnett-Baltistan - Small - >110mm - West Baltic	Gillnett-Baltistan - Small - >110mm				
Gillnett-Baltistan - Small - >110mm - East Baltic					
Gillnett-Baltistan - Small - >110mm - Not Baltic					
Gillnett-Baltistan - Small - >110mm - Bornholm					
Gillnett-Baltistan - Small - >110mm - Gotland					
Gillnett-Baltistan - Medium - <110mm - West Baltic	Gillnett-Baltistan - Medium - <110mm	Gillnett-Baltistan - Medium			
Gillnett-Baltistan - Medium - <110mm - East Baltic					
Gillnett-Baltistan - Medium - <110mm - Not Baltic					
Gillnett-Baltistan - Medium - <110mm - Bornholm					
Gillnett-Baltistan - Medium - <110mm - Gotland					
Gillnett-Baltistan - Medium - >110mm - West Baltic	Gillnett-Baltistan - Medium - >110mm				
Gillnett-Baltistan - Medium - >110mm - East Baltic					
Gillnett-Baltistan - Medium - >110mm - Not Baltic					
Gillnett-Baltistan - Medium - >110mm - Bornholm					
Gillnett-Baltistan - Medium - >110mm - Gotland					
Gillnett-Baltistan - Large - <110mm - West Baltic	Gillnett-Baltistan - Large - <110mm	Gillnett-Baltistan - Large			
Gillnett-Baltistan - Large - <110mm - East Baltic					
Gillnett-Baltistan - Large - <110mm - Not Baltic					
Gillnett-Baltistan - Large - <110mm - Bornholm					
Gillnett-Baltistan - Large - <110mm - Gotland					
Gillnett-Baltistan - Large - >110mm - West Baltic	Gillnett-Baltistan - Large - >110mm				
Gillnett-Baltistan - Large - >110mm - East Baltic					
Gillnett-Baltistan - Large - >110mm - Not Baltic					
Gillnett-Baltistan - Large - >110mm - Bornholm					
Gillnett-Baltistan - Large - >110mm - Gotland					
……				**Scandinavia**	

Table 2.14.3. Examples of aggrecation levels of observations. When data are aggregated, they must be filled in cells belonging to the aggregation.

The "observation" in question is the "Total landings" by stock, fleet, area, year and time period (Figure 2.14.2). Total landings means landings in units of (whole body wet) weight summed over age groups. This kind of data is often available from the annual statistics of fisheries.

Such data may be used to tune TEMAS, that is, to modify selected parameters of TEMAS so that TEMAS becomes able to reproduce the observed landings as output from the simulation. How this tuning of TEMAS is made will be discussed in Appendix E.

The tuning can be made in many ways. The main techniques suggested by TEMAS is to "tune the recruitment" to produce the observed catches. Ignoring a suite of details, it is essentially true that:

Weight of landings = ("Almost" constant Factor) * (Number of recruits)

Thus when you raise the recruitment you raise the landings, and when you reduce the recruits you reduce the landings. It is also essentially true that

Weight of landings = ("Almost" constant Factor) * Catchability* Effort

if the effort is not given very high or very low values. The equation above is valid only in a limited range of stock biomasses. Anyway, essentially, we can tune the catchability to reproduce an observed landings.

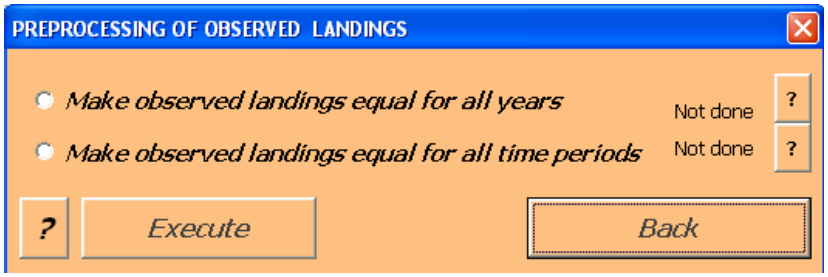


Figure 2.14.4. Options for pre-processing of observation data.

Table 2.14.4 shows the Pre-processing menu of worksheet "S11_OBS"
The option "Make observed landings equal for all years" takes the observed landings from the first year and assigns that value to all other years:"

$$Y_{Land}^{Obs}(Fl,Vs,Rg,Ct,St,y,q,Ar) = Y_{Land}^{Obs}(Fl,Vs,Rg,Ct,St,1,q,Ar)$$

If you select that option, the values of the cells of years later than first year become irrelevant.

The option "Make observed landings equal for all time periods" takes the observed landings from the first period and assigns that value to all other periods:"

$$Y_{Land}^{Obs}(Fl,Vs,Rg,Ct,St,y,q,Ar) = Y_{Land}^{Obs}(Fl,Vs,Rg,Ct,St,y,1,Ar)$$

If you select that option, the values of the cells of periods later than first period become irrelevant.

2.15. INPUT OF TECHNICAL MANAGEMENT MEASURES, S14_TEMAS

Technical management measures (TEMAS) are measures which are not catch quotas in the terminology of the TEMAS model. In the present version of TEMAS there are considered only four technical management measures, namely

1) Minimum landing size
2) MPA (Marine Protected Areas)
3) Maximum number of sea days
4) Closed seasons

Other technical measures are e.g. mesh size regulations. These measures are indirectly covered by the selection of parameters in gear selection ogives.

Also MPAs are indirectly covered by the input effort (effort is zero in MPAs) or by the RUM (Random Utility Model) for the behaviour of fishers. The utility of selecting an MPA as fishing ground is assigned the value of "-∞".
Sheet S14_TEMAS, however also contains options for direct handling of MPAs and closed seasons, which makes it simple to compare two alternative management regimes, which differ in terms of closed areas and closed seasons. This is "regime comparison" No 6 in Table 1.1.1

	Regime Comparisons	Regime A	Regime B
6	Two alternatives for definition of MPAs and closed seasons	TAC, with first option for closed season and MPA	TAC, with second option for closed season and MPA

Figure 2.15.1 shows the user-form of sheet "S14_TEMAS", and Table 2.15.1 lists the EXCEL tables in the sheet. There is one table for the minimum landing sizes, and one table with maximum number of sea days for each combination of country and area.

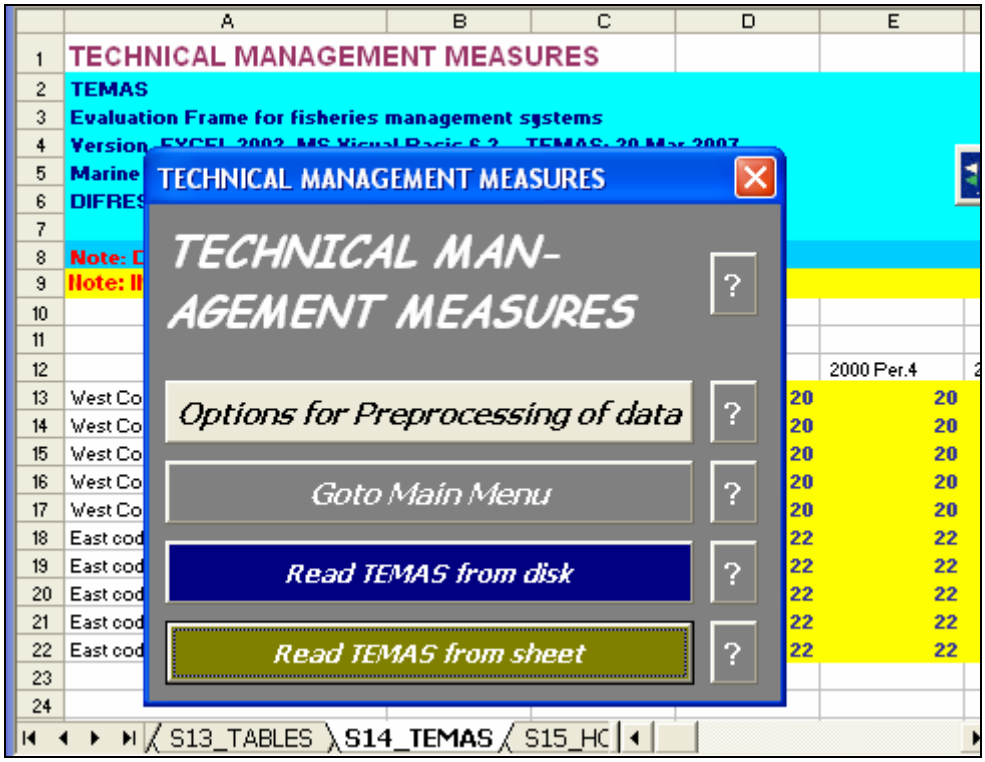


Figure 2.15.1. User-form for entry of parameters for technical management measures.

Index	EXCEL Table	Caption
177	Table14.2.1.1.1.1.	Baltistan - West Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
178	Table14.2.1.1.1.2.	Baltistan - West Baltic SEASONAL CLOSURE Regime 1
179	Table14.2.1.1.2.1.	Baltistan - East Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
180	Table14.2.1.1.2.2.	Baltistan - East Baltic SEASONAL CLOSURE Regime 1
181	Table14.2.1.1.3.1.	Baltistan - Bornholm MAXIMUM NUMBER OF SEA DAYS Regime 1
182	Table14.2.1.1.3.2.	Baltistan - Bornholm SEASONAL CLOSURE Regime 1
183	Table14.2.1.1.4.1.	Baltistan - Gotland MAXIMUM NUMBER OF SEA DAYS Regime 1
184	Table14.2.1.1.4.2.	Baltistan - Gotland SEASONAL CLOSURE Regime 1
185	Table14.2.1.1.5.1.	Baltistan - Not Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
186	Table14.2.1.1.5.2.	Baltistan - Not Baltic SEASONAL CLOSURE Regime 1
187	Table14.2.1.2.1.1.	Scandinavia - West Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
188	Table14.2.1.2.1.2.	Scandinavia - West Baltic SEASONAL CLOSURE Regime 1
189	Table14.2.1.2.2.1.	Scandinavia - East Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
190	Table14.2.1.2.2.2.	Scandinavia - East Baltic SEASONAL CLOSURE Regime 1
191	Table14.2.1.2.3.1.	Scandinavia - Bornholm MAXIMUM NUMBER OF SEA DAYS Regime 1
192	Table14.2.1.2.3.2.	Scandinavia - Bornholm SEASONAL CLOSURE Regime 1
193	Table14.2.1.2.4.1.	Scandinavia - Gotland MAXIMUM NUMBER OF SEA DAYS Regime 1
194	Table14.2.1.2.4.2.	Scandinavia - Gotland SEASONAL CLOSURE Regime 1
195	Table14.2.1.2.5.1.	Scandinavia - Not Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
196	Table14.2.1.2.5.2.	Scandinavia - Not Baltic SEASONAL CLOSURE Regime 1
197	Table14.2.2.1.1.1.	Baltistan - West Baltic MAXIMUM NUMBER OF SEA DAYS Regime 2
198	Table14.2.2.1.1.2.	Baltistan - West Baltic SEASONAL CLOSURE Regime 2
199	Table14.2.2.1.2.1.	Baltistan - East Baltic MAXIMUM NUMBER OF SEA DAYS Regime 2
200	Table14.2.2.1.2.2.	Baltistan - East Baltic SEASONAL CLOSURE Regime 2
201	Table14.2.2.1.3.1.	Baltistan - Bornholm MAXIMUM NUMBER OF SEA DAYS Regime 2
202	Table14.2.2.1.3.2.	Baltistan - Bornholm SEASONAL CLOSURE Regime 2
203	Table14.2.2.1.4.1.	Baltistan - Gotland MAXIMUM NUMBER OF SEA DAYS Regime 2
204	Table14.2.2.1.4.2.	Baltistan - Gotland SEASONAL CLOSURE Regime 2
205	Table14.2.2.1.5.1.	Baltistan - Not Baltic MAXIMUM NUMBER OF SEA DAYS Regime 2
206	Table14.2.2.1.5.2.	Baltistan - Not Baltic SEASONAL CLOSURE Regime 2
207	Table14.2.2.2.1.1.	Scandinavia - West Baltic MAXIMUM NUMBER OF SEA DAYS Regime 2
208	Table14.2.2.2.1.2.	Scandinavia - West Baltic SEASONAL CLOSURE Regime 2
209	Table14.2.2.2.2.1.	Scandinavia - East Baltic MAXIMUM NUMBER OF SEA DAYS Regime 2
210	Table14.2.2.2.2.2.	Scandinavia - East Baltic SEASONAL CLOSURE Regime 2
211	Table14.2.2.2.3.1.	Scandinavia - Bornholm MAXIMUM NUMBER OF SEA DAYS Regime 2
212	Table14.2.2.2.3.2.	Scandinavia - Bornholm SEASONAL CLOSURE Regime 2
213	Table14.2.2.2.4.1.	Scandinavia - Gotland MAXIMUM NUMBER OF SEA DAYS Regime 2
214	Table14.2.2.2.4.2.	Scandinavia - Gotland SEASONAL CLOSURE Regime 2
215	Table14.2.2.2.5.1.	Scandinavia - Not Baltic MAXIMUM NUMBER OF SEA DAYS Regime 2

Table 2.15.1. Tables in the technical management measures input sheet, S014_TEMAS.

	A	B	C	D	E	F	G	H	I	J	K
1	TECHNICAL MANAGEMENT MEASURES										
2	TEMAS						RUN INFORMATION:				
3	Evaluation Frame for fisheries management systems										
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 200						Date of this run: #### 16:47				
5	Marine Fisheries Department						Name of Run: DEMONSTRATION E				
6	DIFRES (Danish Institute of Marine Reserch)						Param. Created: #### 00:00				
7							File Name: DEMON_5_Mig3				
8	Note: Do not insert or delete rows or columns between yellow cells										
9	Note: INPUT IN YELLOW CELLS ONLY										
10											
11	Table 14.1.	MINIMUM LANDING SIZE									
12		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2
13	West Cod - West Baltic	38	38	38	38	38	38	38	38	38	
14	West Cod - East Baltic	40	40	40	40	40	40	40	40	40	
15	West Cod - Not Baltic	35	35	35	35	35	35	35	35	35	
16	West Cod - Bornholm	40	40	40	40	40	40	40	40	40	
17	West Cod - Gotland	40	40	40	40	40	40	40	40	40	
18	East cod - West Baltic	38	38	38	38	38	38	38	38	38	
19	East cod - East Baltic	40	40	40	40	40	40	40	40	40	
20	East cod - Not Baltic	35	35	35	35	35	35	35	35	35	
21	East cod - Bornholm	40	40	40	40	40	40	40	40	40	
22	East cod - Gotland	40	40	40	40	40	40	40	40	40	
23											

S12_DEMON | S13_TABLES | S14_TEMAS | S1

Figure 2.15.2. Minimum landing sizes, $Lgt_{Min}^{Land}(St, y, q, Ar)$

Figure 2.15.2 (EXCEL Table 2.15.2) shows the minimum landing sizes, $Lgt_{Min}^{Land}(St, y, q, Ar)$. The fish below the minimum allowed landing length is named "undersized fish". The influence of minimum legal landing $Lgt_{Min}^{Land}(St, y, q, Ar)$ size is accounted for in TEMAS in two ways

1) The choice of mesh size and thereby the choice of gear selection parameters,
2) The discard-model practice.

If the minimum landing size is smaller than $LGT_{25\%}$, the length at which 25% are retained by the gear if encountered $Lgt_{Min}^{Land}(St, y, q, Ar) \geq LGT_{25\%}(Fl, Vs, Rg, St, Ct, y, q)$, then few undersized fish will be caught.

The discard practice in TEMAS can be determined in two ways

1) Using the behaviour model (RUM) for discard practice
2) Not using the behaviour model for discard practice, i.e. use a fixed assumption for discard practice.

The model of option 2, lets all undersized fish be discarded, in case the behaviour model for discard practice is turned off. One of the choices available for discard practice is to let all undersized fish be discarded. The model reads (Section A.3.2)

$$DIS(St, Fl, Vs, Rg, y, a, q, Ar) =$$

$$\begin{cases} 1 - \dfrac{1}{1 + \exp(Dis1(Fl, Vs, Rg, St, y) - Dis2(Fl, Vs, Rg, St, y) * Lgt(St, a, q))} \\ \qquad if \quad Lgt(St, a, .q) > Lgt_{Min}^{Land}(St, y, q, Ar) \\ 1 \quad if \quad Lgt(St, a, q) \le Lgt_{Min}^{Land}(St, y, q, Ar) \end{cases}$$

Dis1(St) = $\ln(3) * LGT_{50\%Discards}(St) / (LGT_{25\%Discards}(St) - LGT_{50\%Discards}(St))$,
Dis2(St) = $\ln(3) / (LGT_{25\%Discards}(St) - LGT_{50\%Discards}(St))$ and
$LGT_{X\%Discards}(St)$ = Length at which X % are retained.

	A	B	C	D	E	F	G	H	I	J	K	L	M
25													
26	Table 14.2.1.1.1.1.	Baltistan - West Baltic MAXIMUM NUMBER OF SEA DAYS (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 1											
27		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
28	Trawl - Small - <110mm	60	60	59	59	58	58	57	57	56	56	55	55
29	Trawl - Small - >110mm	56	55	55	54	54	53	53	52	52	51	51	50
30	Trawl - Large - <110mm	54	53	52	52	52	51	50	50	50	49	48	48
31	Trawl - Large - >110mm	49	49	48	47	47	47	46	45	45	45	44	43
32	Gill net - Small - <120mm	47	46	46	45	45	44	44	43	43	42	42	41
33	Gill net - Small - >120mm	42	42	41	41	40	40	39	39	38	38	37	37
34	Gill net - Large - <120mm	40	40	39	38	38	38	37	36	36	36	35	34
35	Gill net - Large - >120mm	36	35	35	34	34	33	33	32	32	31	31	30
36		Maximum number of sea days given by regulation											
37													
38	Table 14.2.1.1.1.2.	Baltistan - West Baltic SEASONAL CLOSURE (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 1											
39		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4
40	Trawl - Small - <110mm	1	1	1	1	1	1	1	1	1	1	1	1
41	Trawl - Small - >110mm	1	1	1	1	1	1	1	1	1	1	1	1
42	Trawl - Large - <110mm	1	1	1	1	1	1	1	1	1	1	1	1
43	Trawl - Large - >110mm	1	1	1	1	1	1	1	1	1	1	1	1
44	Gill net - Small - <120mm	1	1	1	1	1	1	1	1	1	1	1	1
45	Gill net - Small - >120mm	1	1	1	1	1	1	1	1	1	1	1	1
46	Gill net - Large - <120mm	1	1	1	1	1	1	1	1	1	1	1	1
47	Gill net - Large - >120mm	1	1	1	1	1	1	1	1	1	1	1	1
48		Fraction of sea days given by regulation, Must be in interval [0,1] 1:Total closure of entire period, 0:No closure, x (0<x<1) closed in the X*(Ref.Effort) where (Refere											
49													

Figure 2.15.3. Maximum number of sea days and seasonal closure (MPA), given by regulations. $EY_{Reg}(Fl, Vs, Rg, Ct, y, q, Ar)$ ***and*** $X^{MPA-Closure}(Fl, Vs, Rg, Ct, y, q, Ar)$, $0 \le X^{MPA-Closure} \le 1$ ***for one country (Baltistan) in one area (West Baltic). The text under EXCEL Table 14.2.1.1.1.2 reads: Fraction of sea days given by regulation, Must be in interval [0,1] 1:Total closure of entire period, 0:No closure, x (0<x<1) closed in the X*(Ref.Effort) where (Reference Effort) = (Maximum Possible Effort in units of fishing days)***

Figure 2.15.3 shows the maximum number of allowed sea days per time period (Section D.5.3), $EY_{Reg}(Fl, Vs, Rg, Ct, y, q, Ar)$ and the MPA-closure reduction factor, $X^{MPA-Closure}(Fl, Vs, Rg, Ct, y, q, Ar)$, for one combination of country and area (in this example: Per quarter of the year).

Area specific effort can be reduced in three major different ways

1) Reduction of overall capacity (reduce upper limit of total sea days for all areas)
2) Area specific reduction of maximum number of sea days
3) MPA, - seasonal closure of selected areas.

We shall combine the three effort reduction methods in one combined model.

Recall the definitions of the concepts $F_{HCR}^{Before}(St,y,q,Ar)$, $E^{Before}(Fl,Vs,Rg,Ct,St,y,q,Ar)$ and $E^{After}(Fl,Vs,Rg,Ct,y,q,Ar)$ given in Section 5.1. For each stock one can then set the efforts of fleets to match each stock specific F (Eq, D.5.1.1):

$$F_{HCR}^{Before}(St,y,Ar) =$$

$$\sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} E^{Before}(Fl,Vs,Rg,Ct,St,y,q,Ar) * Q(Fl,Vs,Rg,Ct,St,y,q,Ar)$$

The relative distribution of efforts on (Fl, Vs, Rg, Ct) is assume to be given, for example by the relative stability and a common factor is applied to all (Fl, Vs, Rg, Ct) to achieve it. The suffix "Before" refers to "Before the modifications of efforts to match the set of HCRs for all stocks combined". The E^{Before} has "St" index, so this (artificial) effort concept is stock specific. The "after modification" effort concept E^{After} has no "St"-index, and the equal sign is replaced by an "smaller than" sign.

$$F_{HCR}^{Before}(St,y,Ar) \geq$$

$$\sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} E^{After}(Fl,Vs,Rg,Ct,y,q,Ar) * Q(Fl,Vs,Rg,Ct,St,y,q,Ar)$$

The effort after modification of fleet specific effort can be expressed as the product of the effort before modification multiplied with the reduction factors $X^{SeaDays}$ and $X^{MPA-Closure}$

$$E^{After}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar) = \sum_{Ct=1}\sum_{Fl=1}\sum_{Vs=1}\sum_{Rg=1} X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar) *$$

$$X^{MPA-Closure}(Fl,Vs,Rg,Ct,y,q,Ar) * E^{Before}(Fl,Vs,Rg,Ct,St,y,q,Ar)$$

where the factor, $X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar)$, is defined by the management regulation, combined with some harvest control rule and the upper limit for sea days (the "maximum possible number of sea days per period" (Eqs. D.5.3.2.a and b)

$X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar) = \dfrac{EY_{Reg}(Fl,Vs,Rg,Ct,y,q,Ar)}{EY_{Max}(Fl,Vs,Ct,y,q,Ar)}$ where EY_{MAX} is The maximum physical number of effort units per vessel per time unit and $EY_{Reg}(Fl,Vs,Rg,Ct,y,q,Ar)$ is the maximum number of sea days per time period dictated by the regulation,

and the "MPA-factor", $X^{MPA-Closure}(Fl,Vs,Rg,Ct,y,q,Ar)$, is the fraction of time period (y,q) which is closed for fishing. Thus

$$0 \leq X^{MPA-Closure}(Fl,Vs,Rg,Ct,y,q,Ar) \leq 1$$

Effort cannot exceed a physical upper limit (Eq. A.4.4.1)

$$E(Fl,Vs,\bullet,Ct,y,q,Ar) \leq NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * EY_{Max}(Fl,Vs,Ct,y,q,Ar)$$

Table 14.2.1.1.2.1.	Baltistan - East Baltic MAXIMUM NUMBER OF SEA DAYS (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 1												
	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 P
Trawl - Small - <110mm	59	58	58	57	57	56	56	55	55	54	54	53	53	
Trawl - Small - >110mm	55	54	53	53	53	52	51	51	51	50	49	49	49	
Trawl - Large - <110mm	52	52	51	50	50	50	49	48	48	48	47	46	46	
Trawl - Large - >110mm	48	47	47	46	46	45	45	44	44	43	43	42	42	
Gill net - Small - <120mm	46	45	44	44	44	43	42	42	42	41	40	40	40	
Gill net - Small - >120mm	41	41	40	39	39	39	38	37	37	37	36	35	35	
Gill net - Large - <120mm	39	38	38	37	37	36	36	35	35	34	34	33	33	
Gill net - Large - >120mm	34	34	33	33	32	32	31	31	30	30	29	29	28	
	Maximum number of sea days given by regulation													

Table 14.2.1.1.2.2.	Baltistan - East Baltic SEASONAL CLOSURE (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 1												
	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 P
Trawl - Small - <110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Small - >110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Large - <110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Large - >110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Small - <120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Small - >120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Large - <120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Large - >120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Fraction of sea days given by regulation, Must be in interval [0,1] 1:Total closure of entire period, 0:No closure, x (0<x<1) closed in the X*(Ref.Effort) where (Reference Effort												

Table 14.2.1.1.3.1.	Baltistan - Bornholm MAXIMUM NUMBER OF SEA DAYS (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 1												
	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 P
Trawl - Small - <110mm	58	57	56	56	56	55	54	54	54	53	52	52	52	
Trawl - Small - >110mm	53	53	52	51	51	51	50	49	49	49	48	47	47	
Trawl - Large - <110mm	51	50	50	49	49	48	48	47	47	46	46	45	45	
Trawl - Large - >110mm	46	46	45	45	44	44	43	43	42	42	41	41	40	
Gill net - Small - <120mm	44	44	43	42	42	42	41	40	40	40	39	38	38	
Gill net - Small - >120mm	40	39	39	38	38	37	37	36	36	35	35	34	34	
Gill net - Large - <120mm	38	37	36	36	36	35	34	34	34	33	32	32	32	
Gill net - Large - >120mm	33	32	32	31	31	30	30	29	29	28	28	27	27	
	Maximum number of sea days given by regulation													

Table 14.2.1.1.3.2.	Baltistan - Bornholm SEASONAL CLOSURE (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 1												
	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 P
Trawl - Small - <110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Small - >110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Large - <110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Large - >110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Small - <120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Small - >120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Large - <120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Large - >120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Fraction of sea days given by regulation, Must be in interval [0,1] 1:Total closure of entire period, 0:No closure, x (0<x<1) closed in the X*(Ref.Effort) where (Reference Effort												

Figure 2.15.4.a Maximum number of sea days and seasonal closure (MPA), for one country (Baltistan) and two areas (East Baltic and Bornholm) in REGIME 1, with no MPA and no closed season.

Combining maximum number of sea days, capacity and MPA gives the effort expression after modification of stock specific effort.

$$E^{After}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar) =$$

$$\sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} MAX\{ X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar) *$$

$$X^{MPA-Closure}(Fl,Vs,Rg,Ct,y,q,Ar) * E^{Before}(Fl,Vs,Rg,Ct,St,y,q,Ar),$$

$$NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * EY_{Max}(Fl,Vs.Ct,y,q,Ar) \}$$

The modification of stock specific effort is contained in the factor $X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar)$

The number of vessels was introduced in Section A.4.1. Omitting all special cases the general equations

Vessel age	Number of vessels in period q where q > 1
Va = 0	$NU_{Vessel}(Fl, Vs, Ct, y, q, 0) = NU_{New\text{-}Vessel}(Fl, Vs, Ct, y, q)$
Va = 1,2,…,Va_{max}-1	$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) = NU_{vessel}(Fl, y, q-1, Va) - NU_{Decomm}(Fl, Vs, Ct, y, q, Va) - NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va) - NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$

The dynamics of the number of vessels, that is what creates an investment in a new vessel or withdrawal of a vessel is covered in the economic part of the TEMAS model.

Table 14.2.2.1.2.1. Baltistan - East Baltic MAXIMUM NUMBER OF SEA DAYS (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 2

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Pe
Trawl - Small - <110mm	59	58	58	57	57	56	56	55	55	54	54	53	53	
Trawl - Small - >110mm	55	54	53	53	53	52	51	51	51	50	49	49	49	
Trawl - Large - <110mm	52	52	51	50	50	50	49	48	48	48	47	46	46	
Trawl - Large - >110mm	48	47	47	46	46	45	45	44	44	43	43	42	42	
Gill net - Small - <120mm	46	45	44	44	44	43	42	42	42	41	40	40	40	
Gill net - Small - >120mm	41	41	40	39	39	39	38	37	37	37	36	35	35	
Gill net - Large - <120mm	39	38	38	37	37	36	36	35	35	34	34	33	33	
Gill net - Large - >120mm	34	34	33	33	32	32	31	31	30	30	29	29	28	
	Maximum number of sea days given by regulation													

Table 14.2.2.1.2.2. Baltistan - East Baltic SEASONAL CLOSURE (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 2

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Pe
Trawl - Small - <110mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Trawl - Small - >110mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Trawl - Large - <110mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Trawl - Large - >110mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Gill net - Small - <120mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Gill net - Small - >120mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Gill net - Large - <120mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
Gill net - Large - >120mm	1	0.25	0.25	1	1	0.25	0.25	1	1	0.25	0.25	1	1	0.
	Fraction of sea days given by regulation, Must be in interval [0,1] 1:Total closure of entire period, 0:No closure, x (0<x<1) closed in the X*(Ref.Effort) where (Reference Effort)													

Table 14.2.2.1.3.1. Baltistan - Bornholm MAXIMUM NUMBER OF SEA DAYS (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 2

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Pe
Trawl - Small - <110mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Trawl - Small - >110mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Trawl - Large - <110mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Trawl - Large - >110mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gill net - Small - <120mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gill net - Small - >120mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gill net - Large - <120mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gill net - Large - >120mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Maximum number of sea days given by regulation													

Table 14.2.2.1.3.2. Baltistan - Bornholm SEASONAL CLOSURE (BY REGULATION) - (Fleet, V.Size, Rig, Country, Area) Regime 2

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	2003 Pe
Trawl - Small - <110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Small - >110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Large - <110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Trawl - Large - >110mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Small - <120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Small - >120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Large - <120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gill net - Large - >120mm	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Fraction of sea days given by regulation, Must be in interval [0,1] 1:Total closure of entire period, 0:No closure, x (0<x<1) closed in the X*(Ref.Effort) where (Reference Effort)													

Figure 2.15.4.b Maximum number of sea days and seasonal closure (MPA), for one country (Baltistan) and two areas (East Baltic and Bornholm) in REGIME 2 with MPA (Bornholm) and closed season (2nd and 3rd quarter) in area East Baltic.

Tables 2.15.4 a and b illustrate the data structure by management regimes. Figure a) represents a strategy with no closed areas (no MPA) and with no closed season.

EXEL Table 14.2.1.1.2.2 has "1" everywhere, indicating that fishing is allowed through out all periods, whereas EXEL Table 14.2.2.1.2.2 shows that for Regime 2 only 25% of time period 2 and 3 are open for fishing. Thus in Regime 2, periods 2 and 3 are 75% closed seasons.

EXCEL Table 14.2.1.1.3.1 has maximum number of sea days larger than zero, so the Bornholm area is not a MPA in Regime 1, where EXCEL Table 14.2.2.1.3.1 has zero's everywhere indicating that fishing is prohibited throughout the year. Thus the Bornholm area is an MPA in Regime 2. The

MPA needs not to be in action all year round. It might, for example, be active only in period 2 and 3.

Figure 2.15.5.a. shows the overall structure of all MPA and all closed season parameters for all countries and two alternative rimes. Figure 2.15.5.b shows the upper 25 % of Figure 2.15.5.a, namely the complete set of parameters for one regime (no 1) , one country (Baltistan) and all areas.

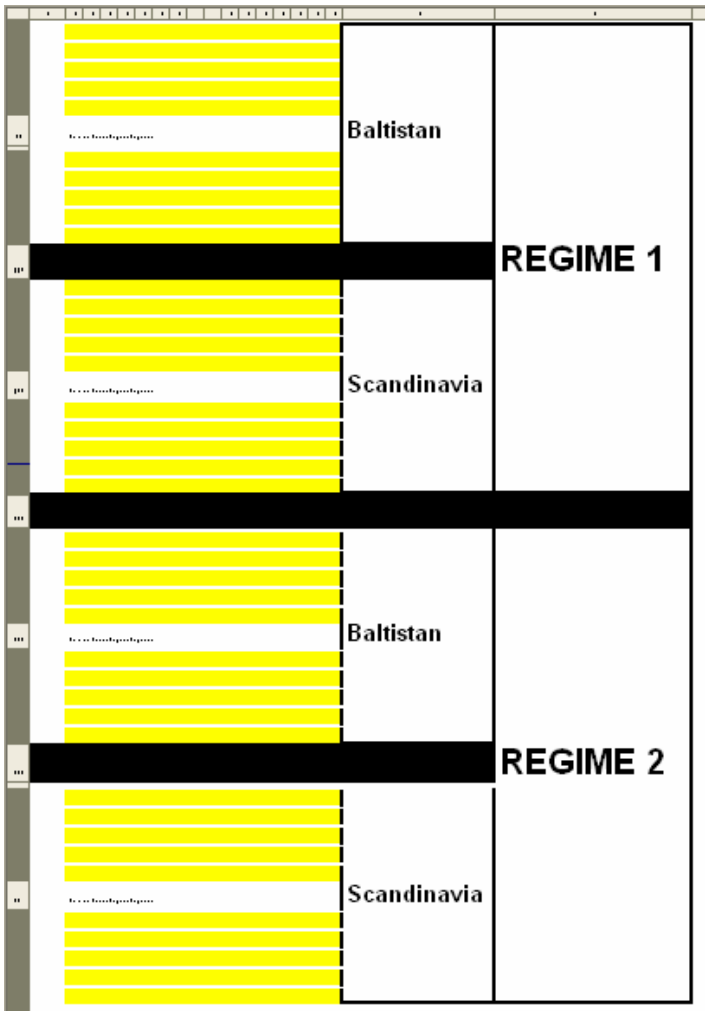


Figure 2.15.5.a. The overall structure of MPA and closed season parameters.

Figure 2.15.6 shows the 6 options for pre-processing of minimum landing size and maximum sea days/seasonal closure parameters.

Option 1 ”Make minimum landing size equal for all areas" copies the parameter values for the first area to all other areas.

Option 2 "Make maximum regulation sea days and closed seasons equal for all areas "copies the parameter values for the first area to all other areas.

Option 3 "Make minimum landing size equal for all years and time periods "copies the parameter values for the first period in the first year to all other periods in all other years.

Option 4 " Make maximum regulation sea days and closed seasons equal for all years and time periods " copies the parameter values for the first period in the first year to all other periods in all other years

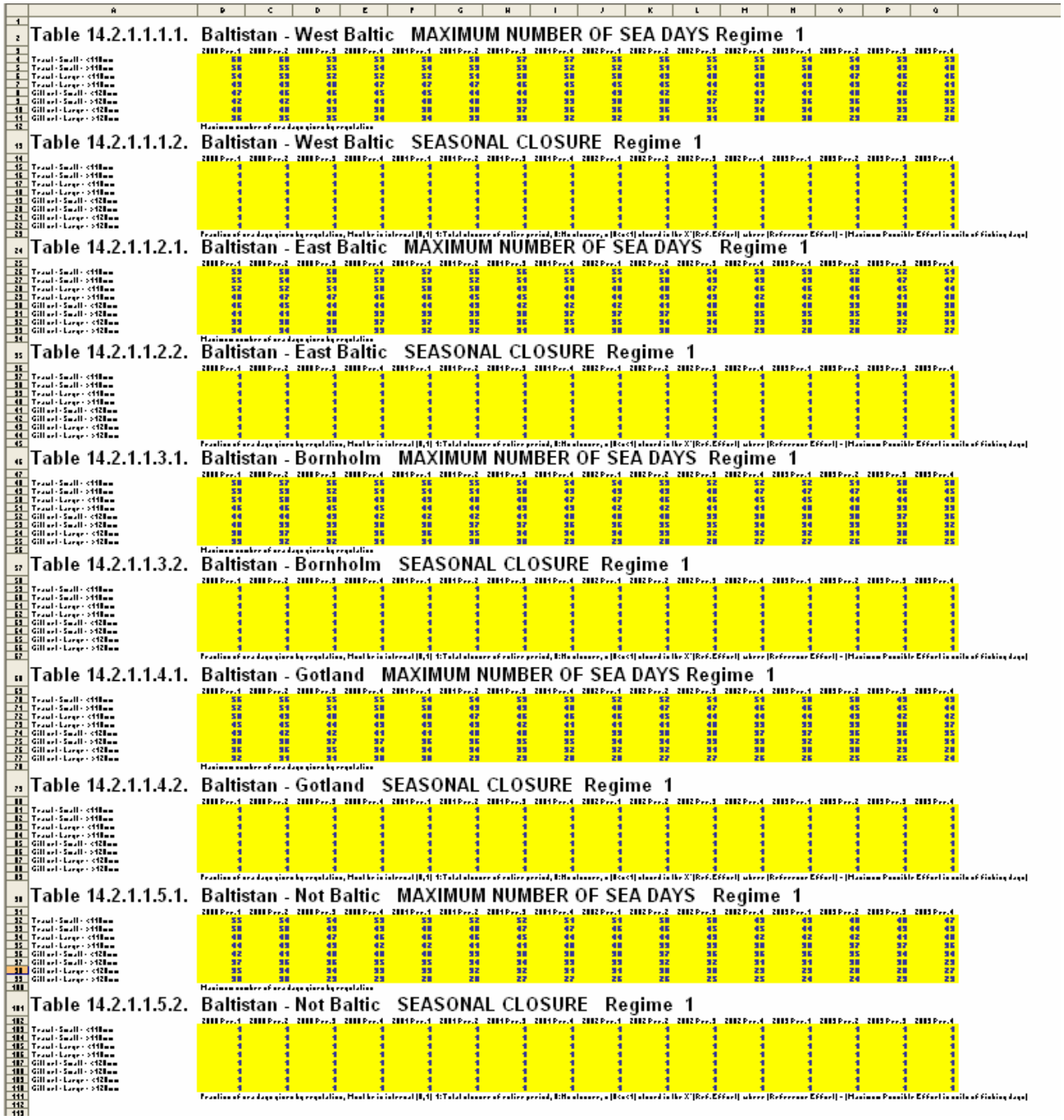


Figure 2.15.5.b. The overall structure of MPA and closed season parameters for one regime (the upper part of Figure 2.15.5.a.). One country and all areas.

Option 5 "Make maximum regulation sea days and closed seasons equal for regimes 1 and 2 " can be used in case you don't want to assess the effect of closed seasons and MPAs. It simply copies the parameter values for regime 1 to regime 2"

Option 6 "Remove maximum regulation sea days and closed seasons for regimes 1 and 2" assigns the maximum possible number of sea days (entered in work sheet S05_BOATS) to the parameter for maximum regulation sea days. It opens all closed areas for fishery, by assigning the value 1 the closed area factor

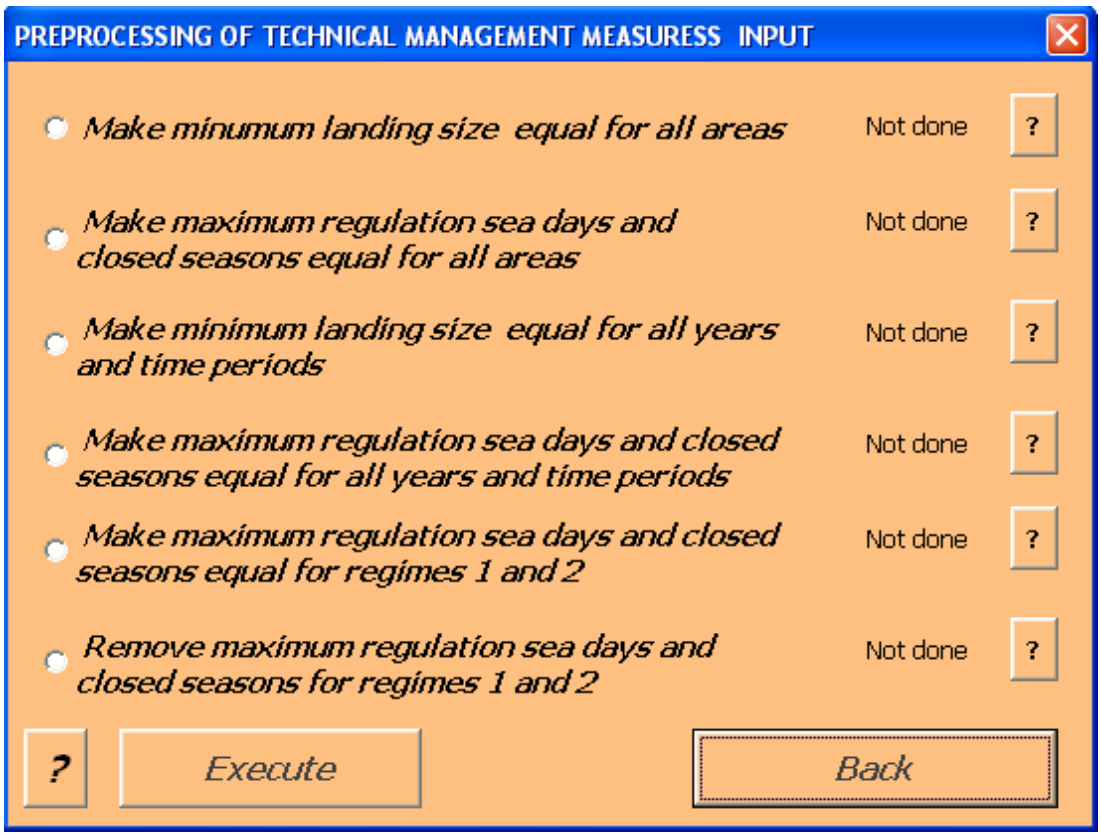


Figure 2.15.6. Options for pre-processing of parameters of technical management measures (TEMAS).

2.16. INPUT OF HARVEST CONTROL RULES, S15_HCR

Figure 2.15.1 shows the user-form of sheet "S15_HCR", and Table 2.16.1 lists the EXCEL tables in the sheet. There is one table for for the HCR of the precautionary approach (the HCR of ICES), and one table with relative stability for each combination of stock and area.

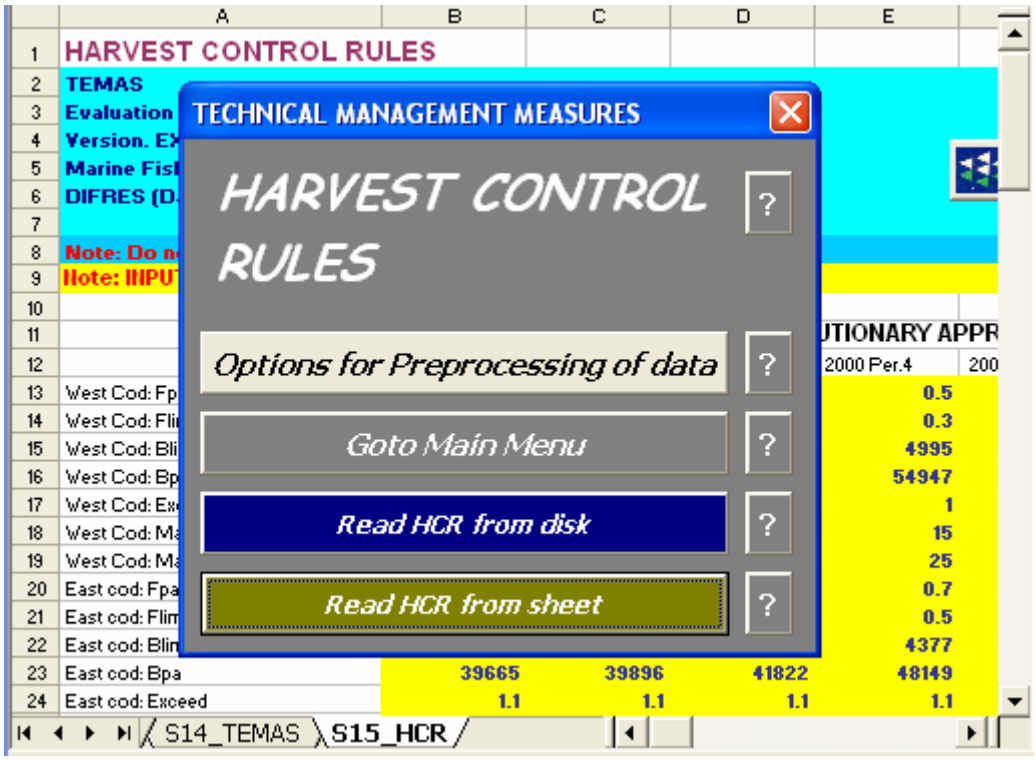
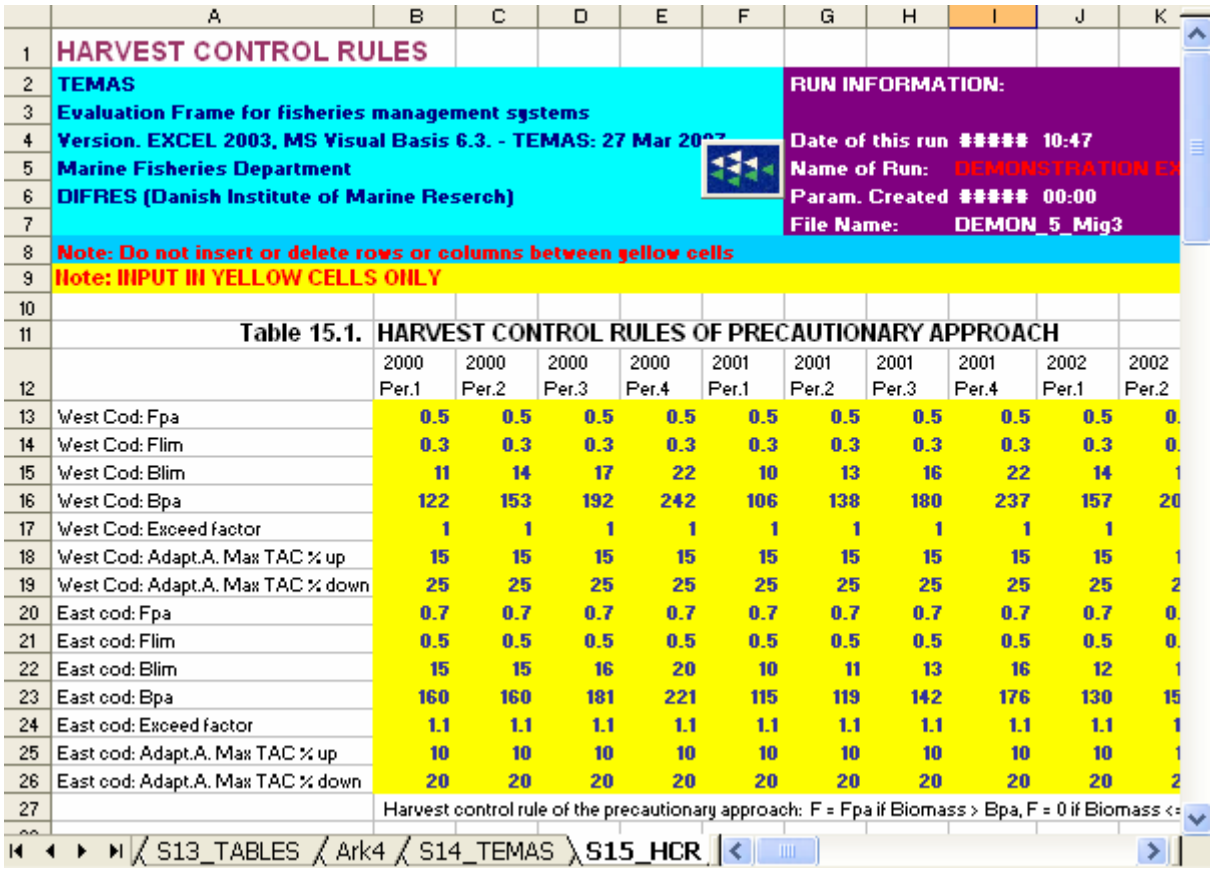


Figure 2.16.1. User-form for entry of parameters for harvest control rules.

Index	EXCEL Table	Caption
190	Table15.1.	HARVEST CONTROL RULES OF PRECAUTIONARY APPROACH
191	Table15.2.1.1.	RELATIVE STABILITY (HARVEST CONTROL RULES) - West Cod - West Baltic
192	Table15.2.1.2.	RELATIVE STABILITY (HARVEST CONTROL RULES) - West Cod - East Baltic
193	Table15.2.1.3.	RELATIVE STABILITY (HARVEST CONTROL RULES) - West Cod - Not Baltic
194	Table15.2.1.4.	RELATIVE STABILITY (HARVEST CONTROL RULES) - West Cod - Bornholm
195	Table15.2.1.5.	RELATIVE STABILITY (HARVEST CONTROL RULES) - West Cod - Gotland
196	Table15.2.2.1.	RELATIVE STABILITY (HARVEST CONTROL RULES) - East cod - West Baltic
197	Table15.2.2.2.	RELATIVE STABILITY (HARVEST CONTROL RULES) - East cod - East Baltic
198	Table15.2.2.3.	RELATIVE STABILITY (HARVEST CONTROL RULES) - East cod - Not Baltic
199	Table15.2.2.4.	RELATIVE STABILITY (HARVEST CONTROL RULES) - East cod - Bornholm
200	Table15.2.2.5.	RELATIVE STABILITY (HARVEST CONTROL RULES) - East cod - Gotland
201	Table15.3.1.5.	RELATIVE STABILITY (HARVEST CONTROL RULES, summed over areas) - West Cod
202	Table15.3.2.5.	RELATIVE STABILITY (HARVEST CONTROL RULES, summed over areas) - East cod
203	Table15.4.1.5.	RELATIVE STABILITY (HARVEST CONTROL RULES, by country) - West Cod
204	Table15.4.2.5.	RELATIVE STABILITY (HARVEST CONTROL RULES, by country) - East cod

Table 2.16.1. Tables in the harvest control rule input sheet, S015_HCR.



HARVEST CONTROL RULES

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

RUN INFORMATION:
Date of this run ##### 10:47
Name of Run: DEMONSTRATION EX
Param. Created ##### 00:00
File Name: DEMON_5_Mig3

Note: Do not insert or delete rows or columns between gellow cells
Note: INPUT IN YELLOW CELLS ONLY

Table 15.1. HARVEST CONTROL RULES OF PRECAUTIONARY APPROACH

	2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2
West Cod: Fpa	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.
West Cod: Flim	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.
West Cod: Blim	11	14	17	22	10	13	16	22	14	1
West Cod: Bpa	122	153	192	242	106	138	180	237	157	20
West Cod: Exceed factor	1	1	1	1	1	1	1	1	1	
West Cod: Adapt.A. Max TAC % up	15	15	15	15	15	15	15	15	15	1
West Cod: Adapt.A. Max TAC % down	25	25	25	25	25	25	25	25	25	2
East cod: Fpa	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.
East cod: Flim	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.
East cod: Blim	15	15	16	20	10	11	13	16	12	1
East cod: Bpa	160	160	181	221	115	119	142	176	130	15
East cod: Exceed factor	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1
East cod: Adapt.A. Max TAC % up	10	10	10	10	10	10	10	10	10	1
East cod: Adapt.A. Max TAC % down	20	20	20	20	20	20	20	20	20	2

Harvest control rule of the precautionary approach: F = Fpa if Biomass > Bpa, F = 0 if Biomass <=

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Figure 2.16.2.
The comment below the table says: Harvest control rule of the precautionary approach:
$F = F_{pa}$ if Biomass > B_{pa},
$F = 0$ if Biomass <= B_{lim},
if B_{lim} < Biomass < B_{pa} then $F = F_{pa}*(Biomass-B_{lim})/(B_{pa}-B_{lim})$
F_{pa}: Fishing mortality of the precautionary approach
F_{lim}: Critical lower limit of Fishing mortality
B_{lim}: Lower biomass-limit of the precautionary approach
B_{pa}: Biomass of the precautionary approach
The amount af HCR-excess accepted, here given as a factor (Exceed factor).
That is: Landings <= Exceed Factor * TAC.
The adaptive appraoch maximum changes in TAC is defined :
Maximum change up (%) of TAC in two consecutive years, when $F > F_{pa}$ or $B < B_{pa}$
Maximum change down (%) of TAC when $F <= F_{pa}$ or $B <= B_{pa}$

Figure 2.16.2 (EXCEL Table 15.1) contains the parameters of the ICES harvest control rule F_{pa}: (fishing mortality of the precautionary approach), F_{lim}, (Critical lower limit of Fishing mortality). B_{lim} (lower biomass-limit of the precautionary approach) and B_{pa} (Biomass of the precautionary approach). Figure 2.16.2 also contains "acceptable exceed factor", $X_{TAX}^{Exceed}(St,y)$, for TAC and the maximum relative change of TAC between consecutive years of the adaptive approach., that is, if the TAC increases, $TAC_{CH}^{UP}(St,y)$ and if TAC decreases $TAC_{CH}^{Down}(St,y)$.

The Harvest control rule of ICES is implemented by assigning a value, F_{HCR},to the mean fishing mortality in the forecast, $F_{FOR\text{-}Mean}(St,y+2)$, The forecast is made in year y+1 (this year) , based on data in last data year, y, for next year, "y+2" : $F_{HCR}(St,y+2) = F_{FOR\text{-}Mean}(St,y+2)$. The mathematical expression for the ICES harvest control rule, with all indices, reads.

$$F_{HCR}(St, y+2) = \begin{cases} 0 \;\; if \;\; SSB(St.y) \le B_{\lim}(St) \\ F_{pa}(St)\dfrac{SSB(St,y) - B_{\lim}}{B_{pa}(St) - B_{\lim}(St)} \;\; if \;\; B_{\lim}(St) \le SSB(St,y) \le B_{pa}(St) \\ F_{pa}(St) \;\; if \;\; SSB(St,y) > B_{pa} \end{cases} \qquad \text{(D.4.3.2.1)}$$

That means that the F dictated by the HCR is used in the catch prediction "next year" relative to the assessment year, y+1. Year y is the last "data-year". The same HCR dictated fishing mortality derived foregoing year is used in the simulation model for the "current" year - that is the year of the ICES assessment (y+1).

The F_{HCR} of the HCR is converted into a TAC for the quota management regime (Eq. D.4.3.3.1.a)

$$TAC(St,y) = \sum_{a=o}^{a_{Max}(St)} C_{FOR}(St,y,a) * w(St,y,a)$$

which will be applied in the simulation model to stop the fishery under quota regime, if the TAC is exceeded. In practice, however, the TAC is often counted against the landings The catch is divided into landings and discards, and the condition for quota management now becomes (Eq. D.4.3.3.2).

$$TAC(St,y) \ge \sum_{a=o}^{a_{Max}(St)} \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{Ar=1}^{Ar_{Max}} C_{Land}(Fl,Vs,Rg,Ct,St,y,a,q,Ar) * w(St,y,a,q)$$

Technically, the TEMAS program does not search for the F that produces a given TAC. It starts with the F_{PA} and from that it produces the "right" TAC. The overall F_{PA}, is subsequently distributed on countries, fleets, riggings and areas, and the combined landings will automatically sum up to the desired TAC.

If the effort corresponding to F_{PA} exceeds the capacity of the fleets,

$$E(Fl,Vs,\bullet,Ct,y,q,\bullet) \le NU_{Vessel}(Fl,Vs,Ct,y,q) * EY_{Max}(Fl,Vs,Ct,y,q)$$

then fishing mortality is reduced below F_{PA}, with the reduction factor

$$\frac{E(Fl,Vs,\bullet,Ct,y,q,\bullet)}{NU_{Vessel}(Fl,Vs,Ct,y,q) * EY_{Max}(Fl,Vs,Ct,y,q)}$$

That is, no F can be bigger than the maximum capacity allows for.

TEMAS contains an option to distribute effort according to the relative stability, that is the distribution of effort is in the same proportions as the historical rights (see Section D.6).

One feature of the adaptive approach, as implemented by the EU is that the change of TAC from year to year, TAC(St, y)-TAC(St, y-1) is not allowed to exceed a certain percentage of TAC(St,y-1) if the TAC increases, $TAC_{CH}^{UP}(St,y)$ and if TAC decreases $TAC_{CH}^{Down}(St,y)$.

$$\frac{TAC(St,y-1)-TAC(St,y)}{TAC(St,y-1)} \quad \leq \quad TAC_{CH}^{Down}(St,y) \quad if \quad TAC(St,y-1) \geq TAC(St,y)$$

$$\frac{TAC(St,y)-TAC(St,y-1)}{TAC(St,y-1)} \quad \leq \quad TAC_{CH}^{Up}(St,y) \quad if \quad TAC(St,y-1) < TAC(St,y)$$

This lead to the definition of a TAC concept, we call "TAC of the adaptive approach": (Eq. D.7.1.2)

$$TAC_{ADapt}(St,y) =$$
$$\begin{cases} Min\left\{ TAC(St,y),\ TAC(St,y-1)*(1-TAC_{CH}^{Down}(St,y))\right\} & if \quad TAC(St,y) < TAC(St,y-1) \\ Max\left\{ TAC(St,y),\ TAC(St,y-1)*(1+TAC_{CH}^{Up}(St,y))\right\} & if \quad TAC(St,y) > TAC(St,y-1) \end{cases}$$

The F_{HCR} of the HCR is converted into a TAC for the quota management regime by Eq D.4.3.3.1.a. In practice, it is often accepted that the TAC advised by ICES is exceeded. With the acceptable exceed factor $X_{TAX}^{Exceed}(St,y)$, the inequality of Eq D.4.3.3.1.a becomes replaced by the weaker inequality (because $X_{TAX}^{Exceed}(St,y) \geq 1.0$).

$$TAC(St,y) < X_{TAX}^{Exceed}(St,y) * \sum_{a=o}^{a_{Max}(St)} C_{FOR}(St,y,a) * w(St,y,a)$$

The historical right relative to landings is defined as the historical overage shares of landings

$$RELHRgt_{Land}(Fl,Vs,Rg,Ct,St,y,q,Ar) = \frac{HRgt_{Land}(Fl,Vs,Rg,Ct,St,y,q,Ar)}{HRgt_{Land}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar)}$$

where

$$HRgt_{Land}(Fl,Vs,Rg,Ct,St,y,q,Ar) = \sum_{u=y-Ny_{Hist}}^{y-1} Y_{Land}(Fl,Vs,Rg,Ct,St,y,q,Ar) * HFac^{u-y}$$

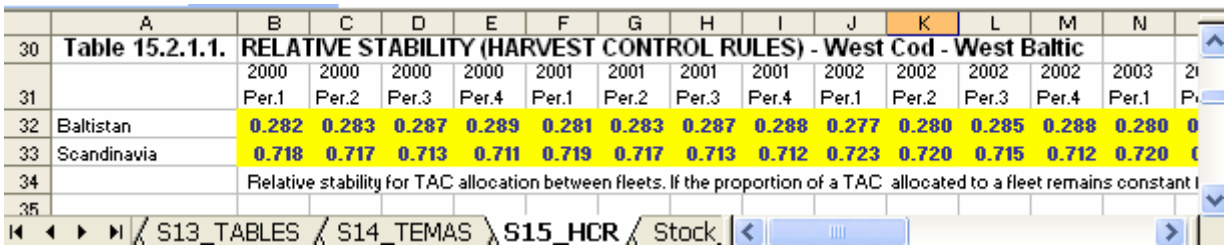
Where HFac is a discount factor, assigning lower values to years the longer in the past. Therefore, HFac $\leq$1.0. When HFac = 1.0, all years have assigned the same importance.
Note that $RELHRgt_{Land}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar) = 1$

The general historical right with respect of measure "X" is

$$RELHRgt_{X}(Fl,Vs,Rg,Ct,St,y,q,Ar) = \frac{HRgt_{X}(Fl,Vs,Rg,Ct,St,y,q,Ar)}{HRgt_{X}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar)}$$

$$HRgt_{X}(Fl,Vs,Rg,Ct,St,y,q,Ar) = \sum_{u=y-Ny_{Hist}}^{y-1} X(Fl,Vs,Rg,Ct,St,y,q,Ar) * HFac^{u-y}$$

Note that $RELHRgt_{X}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar) = 1$



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
30	Table 15.2.1.1.	RELATIVE STABILITY (HARVEST CONTROL RULES) - West Cod - West Baltic												
31		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1
32	Baltistan	0.282	0.283	0.287	0.289	0.281	0.283	0.287	0.288	0.277	0.280	0.285	0.288	0.280
33	Scandinavia	0.718	0.717	0.713	0.711	0.719	0.717	0.713	0.712	0.723	0.720	0.715	0.712	0.720
34	Relative stability for TAC allocation between fleets. If the proportion of a TAC allocated to a fleet remains constant													
35														

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Figure 2.16.2. Relative stability for one combination of stock and area.

The comment below the table says: Relative stability for TAC allocation between fleets. If the proportion of a TAC allocated to a fleet remains constant from year to year, it is called relative stability. The parameters of this tables gives the proportions of an area specific TAC for a given stock. A TAC share is given by a vessel size of a fleet of a country. Thus the index of relative stability is (Fleet, vessel size, country, stock, area).

The current version of TEMAS has three X- From the basic definition with all indices in use, options

1) X = Landings
2) X = Value of landings
3) X = Effort (in this case index "St" is omitted)

various aggregated historical rights can be defined. The present version of TEMAS contains the following options aggregated historical rights:

X=Landings and Value of landings:	X=Effort:
$RELHRgt_X(Fl,Vs,Rg,Ct,St,y,q,\bullet)$	$RELHRgt_X(Fl,Vs,Rg,Ct,y,q,\bullet)$
$RELHRgt_X(Fl,Vs,\bullet,Ct,St,y,q,\bullet)$	$RELHRgt_X(Fl,Vs,\bullet,Ct,y,q,\bullet)$
$RELHRgt_X(\bullet,\bullet,\bullet,Ct,St,y,q,\bullet)$	
$RELHRgt_X(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar)$	
$RELHRgt_X(\bullet,\bullet,\bullet,\bullet,St,y,q,\bullet)$	

One traditional use of historical rights concerns distribution of a total TAC on countries. The TAC of a country in time period q of year y is

$$TAC(Ct,St,y,q) = TAC(\bullet,St,y,q) * RELHRgt_{Land}(\bullet,\bullet,\bullet,Ct,y,q,\bullet)$$

If the TAC is annual, and we assign the same value, $RELHRgt_{Land}^{Annual}(\bullet,\bullet,\bullet,Ct,y,\bullet)$, of the historical right to all time periods, then the annual TAC share of country Ct becomes

$$TAC(Ct,St,y,\bullet) = TAC(\bullet,St,y,\bullet) * RELHRgt_{Land}^{Annual}(\bullet,\bullet,\bullet,Ct,y,\bullet)$$

This is the basic principle behind the TAC sharing between counties as is has been executed by the EU (and other management bodies) for decades.

The relative stability could be extended to effort quotas, but this option has not yet been implemented in TEMAS, because the actual legislation (the EU regulations) has not been formulated along that line. Effort based management in the EU is introduced in the form of "structural policy for fishing capacity", "Maximum number of sea days" (Section D.7.2) and closed areas (Section D.8).

TEMAS offers options to use the principle of relative stability on various disaggregated levels and based on various different measures (landings, value of landings and effort).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
100	Table 15.3.1.5.	RELATIVE STABILITY (HARVEST CONTROL RULES, summed over areas) - West Cod												
101		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2002 Per.2	2002 Per.3	2002 Per.4	2003 Per.1	
102	Baltistan	0.2816	0.2835	0.2869	0.2892	0.2809	0.283	0.2867	0.2882	0.2766	0.2798	0.2849	0.288	0.2797	
103	Scandinavia	0.7184	0.7165	0.7131	0.7108	0.7191	0.717	0.7133	0.7118	0.7234	0.7202	0.7151	0.712	0.7203	

S13_TABLES | S14_TEMAS | S15_HCR | Stock

Figure 2.16.3. Relative stability for one stock summed over areas (Information table).

2.17. LIST OF TABLES, S13_TABLES

H11

The Dimensions of a case study, has a spcial status as input parameters, as it determines the numbers of the other parameters, as well as the number of variables in the model. Thus if you change the dimensions, all other parameters must also be changed. Some (sometimes all) table dimensionss will be changed when dimensions are changed

INPUT TABLES
TEMAS
fisheries management syste
sual Basis 6.3. - TEMAS: 27
sheries Department
stitute of Marine Reserch)
Name of Run:
Param. Created:
File Name:
rows or columns between gellow cells
YELLOW CELLS ONLY

Table Index	Table Number	Sheet Index	Sheet Name	Start Row	Start Col	Caption	Comment
1	Table1.1.	1	S01_DIM	13	1	BASIC DIMENSIONS	The Dimensions of
2	Table1.2.	1	S01_DIM	13	5	STOCKS	A 'Stocks' here mea
3	Table1.3.	1	S01_DIM	13	9	COUNTRIES	Fleets can be group
4	Table1.4.	1	S01_DIM	13	13	AREAS	Areas are 'fishing gr
5	Table1.5.1.1.	1	S01_DIM	22	1	Baltistan : FLEETS	A 'Fleet' is a group c
6	Table1.5.1.2.	1	S01_DIM	22	4	Baltistan : FLEET DIMENSIONS	Vessel size groups c
7	Table1.5.1.3.	1	S01_DIM	22	8	Baltistan : NAME OF VESSEL SIZES	Vessel size groups c
8	Table1.5.1.4.	1	S01_DIM	22	16	Baltistan : NAME OF RIGGINGS	Riggings means a s
9	Table1.5.2.1.	1	S01_DIM	27	1	Scandinavia : FLEETS	A 'Fleet' is a group c
10	Table1.5.2.2.	1	S01_DIM	27	4	Scandinavia : FLEET DIMENSIONS	Vessel size groups c
11	Table1.5.2.3.	1	S01_DIM	27	8	Scandinavia : NAME OF VESSEL SIZES	Vessel size groups c
12	Table1.5.2.4.	1	S01_DIM	27	16	Scandinavia : NAME OF RIGGINGS	Riggings means a s
13	Table1.6.1.	1	S01_DIM	33	1	STOCK TABLES FOR OUTPUT (1: The table is di	Zero indicates that n
14	Table1.6.2.	1	S01_DIM	39	1	AREAS TABLES FOR OUTPUT (1: The table is di	Zero indicates that n
15	Table1.6.3.	1	S01_DIM	48	1	STOCK/AREAS TABLES FOR OUTPUT (1: Table	Zero indicates that n
16	Table1.6.4.	1	S01_DIM	62	1	COUNTRY TABLES FOR OUTPUT (1: Table disp	Zero indicates that n
17	Table1.6.5.	1	S01_DIM	68	1	COUNTRY/FLEET TABLES FOR OUTPUT (1: Ta	Zero indicates that n
18	Table1.6.6.	1	S01_DIM	76	1	COUNTRY/FLEET/VESSEL SIZE TABLES FOR	Zero indicates that n
19	Table1.6.7.	1	S01_DIM	92	1	COUNTRY/FLEET/RIG TABLES FOR OUTPUT (	Zero indicates that n
20	Table1.6.8.	1	S01_DIM	104	1	RESULTING TABLES FOR OUTPUT (1: Table dis	This table contains t
21	Table1.6.9.	1	S01_DIM	133	1	MAXIMUM NUMBER OF TABLES FOR OUTPU	The number of table:
22	Table1.7.	1	S01_DIM	141	1	COMMENTS TO NAMES	Comments (explana
23	Table2.1.1.	2	S02_STOCK	11	1	GROWTH AND MATURITY PARAMETERS	Von Bertalanffy gro
24	Table2.1.2.	2	S02_STOCK	16	1	CONDITION FACTOR	Condition Factor is
25	Table2.2.1.	2	S02_STOCK	21	1	RECRUITMENT PARAMETERS	Parameters in four a
26	Table2.2.2.	2	S02_STOCK	26	1	RECRUITMENT DISTRIBUTION ON PERIODS	Distribution of recru
27	Table2.2.3.	2	S02_STOCK	31	1	RECRUITMENT DISTRIBUTION ON AREAS	Distribution of recru
28	Table2.2.4.	2	S02_STOCK	36	1	LOW SPAWNING SUCCESS ON AREAS	The weighting factor
29	Table2.2.5.	2	S02_STOCK	41	1	HIGH SPAWNING SUCCESS ON AREAS	The weighting factor
30	Table2.2.6.	2	S02_STOCK	46	1	RECRUITMENT TREND OVER YEARS	If we assume, e.g., a :
31	Table2.3.1.	2	S02_STOCK	51	1	STOCK NUMBERS FIRST PERIOD OF FIRST Y	Initial number of juve
32	Table2.3.2.	2	S02_STOCK	62	1	STOCK NUMBERS FIRST PERIOD OF FIRST Y	Initial number of age
33	Table2.4.1.	2	S02_STOCK	68	1	WEIGHTING FACTORS FOR MEAN F CALCUL	MeanF over a range
34	Table2.4.2.	2	S02_STOCK	79	1	WEIGHTING FACTORS FOR MEAN F CALCUL	MeanF over a range
35	Table2.5.1	2	S02_STOCK	85	1	West Cod: MIGRATION - AGE GR 0-1	Migration coefficier

S12_DEMON | S13_TABLES | Ark4 | S14_TEMAS | S:

Figure 2.17.2. Complete list of tables.

Figure 2.17.1 shows the user-form of sheet "S13_TABLES". This is different from the menus ofthe input sheets. The user form of S13_TABLES, is the main menu of TEMAS_INPUT.
Clicking on "write list of all tables" gives you two tables. One table (Figure 2.17.2) is a complete list of all tables produced by the current case study. Figure 2.17.3 shows a summary list of tables,

i.e. a list which shows on the first tables in each group of tables. “A group of tables” for example can be a group of “stock-tables” or “country-tables”.

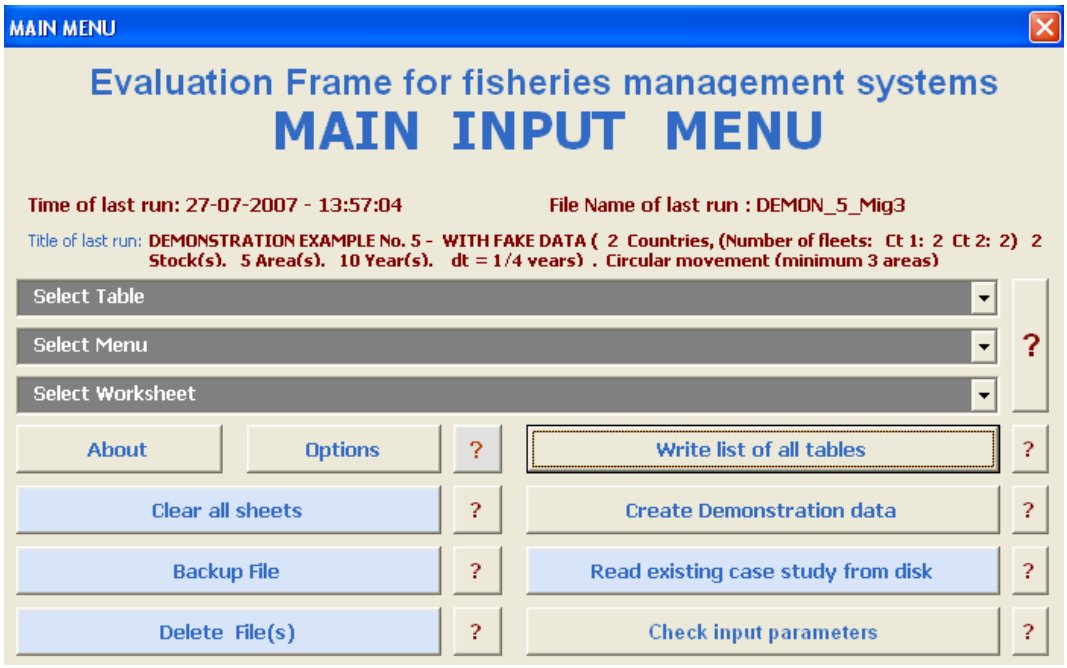
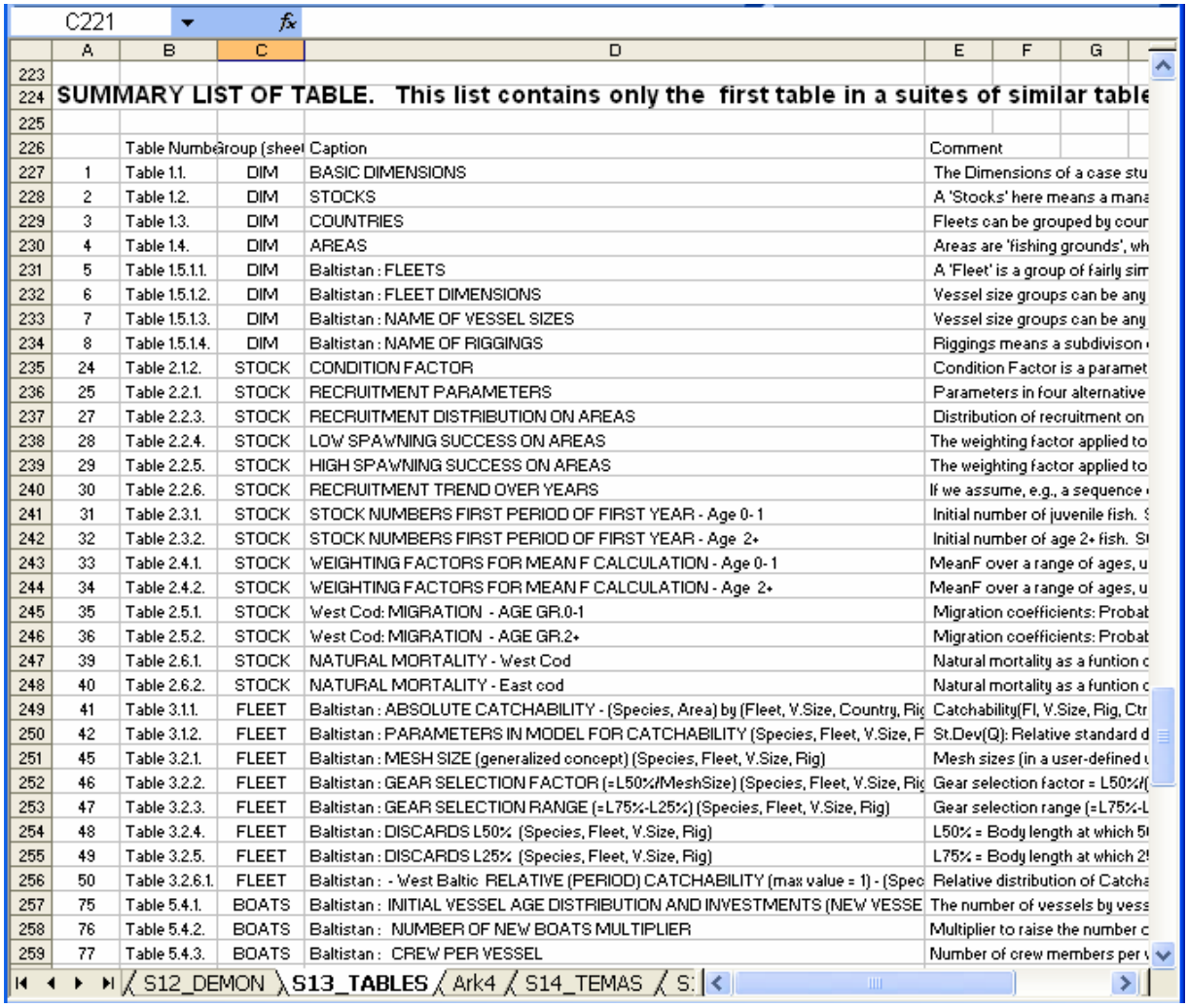


Figure 2.17.1. Main menu of TEMAS input.



C221

	A	B	C	D	E	F	G
223							
224	SUMMARY LIST OF TABLE. This list contains only the first table in a suites of similar table						
225							
226		Table Numbe	Group (sheet	Caption	Comment		
227	1	Table 1.1.	DIM	BASIC DIMENSIONS	The Dimensions of a case stu		
228	2	Table 1.2.	DIM	STOCKS	A 'Stocks' here means a mana		
229	3	Table 1.3.	DIM	COUNTRIES	Fleets can be grouped by cour		
230	4	Table 1.4.	DIM	AREAS	Areas are 'fishing grounds', wh		
231	5	Table 1.5.1.1.	DIM	Baltistan : FLEETS	A 'Fleet' is a group of fairly sim		
232	6	Table 1.5.1.2.	DIM	Baltistan : FLEET DIMENSIONS	Vessel size groups can be any		
233	7	Table 1.5.1.3.	DIM	Baltistan : NAME OF VESSEL SIZES	Vessel size groups can be any		
234	8	Table 1.5.1.4.	DIM	Baltistan : NAME OF RIGGINGS	Riggings means a subdivison		
235	24	Table 2.1.2.	STOCK	CONDITION FACTOR	Condition Factor is a paramet		
236	25	Table 2.2.1.	STOCK	RECRUITMENT PARAMETERS	Parameters in four alternative		
237	27	Table 2.2.3.	STOCK	RECRUITMENT DISTRIBUTION ON AREAS	Distribution of recruitment on		
238	28	Table 2.2.4.	STOCK	LOW SPAWNING SUCCESS ON AREAS	The weighting factor applied to		
239	29	Table 2.2.5.	STOCK	HIGH SPAWNING SUCCESS ON AREAS	The weighting factor applied to		
240	30	Table 2.2.6.	STOCK	RECRUITMENT TREND OVER YEARS	If we assume, e.g., a sequence		
241	31	Table 2.3.1.	STOCK	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 0-1	Initial number of juvenile fish. S		
242	32	Table 2.3.2.	STOCK	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 2+	Initial number of age 2+ fish. St		
243	33	Table 2.4.1.	STOCK	WEIGHTING FACTORS FOR MEAN F CALCULATION - Age 0-1	MeanF over a range of ages, u		
244	34	Table 2.4.2.	STOCK	WEIGHTING FACTORS FOR MEAN F CALCULATION - Age 2+	MeanF over a range of ages, u		
245	35	Table 2.5.1.	STOCK	West Cod: MIGRATION - AGE GR.0-1	Migration coefficients: Probat		
246	36	Table 2.5.2.	STOCK	West Cod: MIGRATION - AGE GR.2+	Migration coefficients: Probat		
247	39	Table 2.6.1.	STOCK	NATURAL MORTALITY - West Cod	Natural mortality as a funtion c		
248	40	Table 2.6.2.	STOCK	NATURAL MORTALITY - East cod	Natural mortality as a funtion c		
249	41	Table 3.1.1.	FLEET	Baltistan : ABSOLUTE CATCHABILITY - (Species, Area) by (Fleet, V.Size, Country, Rig	Catchability(Fl, V.Size, Rig, Ctr		
250	42	Table 3.1.2.	FLEET	Baltistan : PARAMETERS IN MODEL FOR CATCHABILITY (Species, Fleet, V.Size, F	St.Dev(Q): Relative standard d		
251	45	Table 3.2.1.	FLEET	Baltistan : MESH SIZE (generalized concept) (Species, Fleet, V.Size, Rig)	Mesh sizes (in a user-defined u		
252	46	Table 3.2.2.	FLEET	Baltistan : GEAR SELECTION FACTOR (=L50%/MeshSize) (Species, Fleet, V.Size, Rig	Gear selection factor = L50%/(		
253	47	Table 3.2.3.	FLEET	Baltistan : GEAR SELECTION RANGE (=L75%-L25%) (Species, Fleet, V.Size, Rig)	Gear selection range (=L75%-L		
254	48	Table 3.2.4.	FLEET	Baltistan : DISCARDS L50% (Species, Fleet, V.Size, Rig)	L50% = Body length at which 5		
255	49	Table 3.2.5.	FLEET	Baltistan : DISCARDS L25% (Species, Fleet, V.Size, Rig)	L75% = Body length at which 2		
256	50	Table 3.2.6.1.	FLEET	Baltistan : - West Baltic RELATIVE (PERIOD) CATCHABILITY (max value = 1) - (Spec	Relative distribution of Catcha		
257	75	Table 5.4.1.	BOATS	Baltistan : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSE	The number of vessels by vess		
258	76	Table 5.4.2.	BOATS	Baltistan : NUMBER OF NEW BOATS MULTIPLIER	Multiplier to raise the number c		
259	77	Table 5.4.3.	BOATS	Baltistan : CREW PER VESSEL	Number of crew members per		

S12_DEMON | S13_TABLES | Ark4 | S14_TEMAS | S:

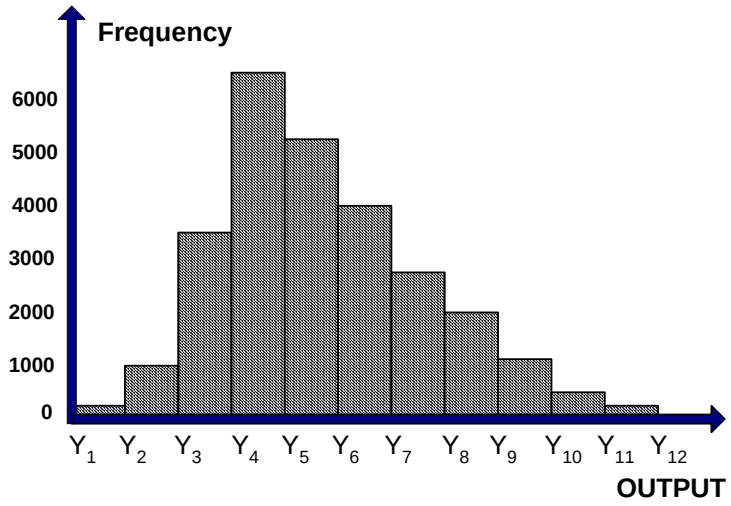
Figure 2.17.3 Summary list of tables.

2.18. PARAMETERS USED TO CREATE STOCHASTIC FACTORS.

No model in fisheries can predict the exact value of any predictor. To the simple model one should ideally add a stochastic term, ε, (or multiply a stochastic factor) so a general stochastic model reads

Model(**Input**,**Parameters**) = **Output** **+** **ε.** Or
Model(**Input**,**Parameters**) = **Output** ***** **ε.**

The stochastic term, ε , takes an unpredictable value from a probability distribution which we may have some knowledge about. Usually, ε, is assumed to be normally (symmetric) or log-normally (skewed to the left) distributed in fisheries models. The stochastic term accounts for all the elements not accounted for in the conceptual model. If the model actually reflects the true relationship between input and output (that is rarely the case in any fisheries model), the stochastic term has a known mean value (usually zero). However, the fisheries models are always incomplete with an unknown bias.



The deterministic model predicts a single value, whereas the stochastic model predicts a probability distribution of the output, $:\Pr\left\{ Y_i \le Output < Y_{i+1} \right\}$ where Y_i and Y_{i+1} are limits defining some intervals of output (Figure 2.18.1). The probability distribution depends on the stochastic term **ε,** which may have an assumed distribution or a distribution estimated from time series of observation of (Input,Output).

Figure 2.18.1. Output from stochastic simulation.

When using a stochastic model for prediction, the standard procedure is to let a computer program repeat the same prediction (or simulations) many times, say 1000 times or 10000 times. In each simulation the computer program draws the values of parameters from a random number generator. Eventually, the probability distribution is estimated by the frequency distribution of output (see Figure 2.18.1). That means that a stochastic model requires the parameters of the probability distribution of parameter estimates as input. (For a general introduction see for example Manly, 1998).

TEMAS uses a stochastic factor. The value of the stochastic factor is in TEMAS drawn from a random number generator, which assumes either

a) A normally distributed stochastic variable with mean value 1.0
b) A log normally distributed stochastic variable with mean value 1.0

In addition to the man value, these distributions need the variance as parameter, which in TEMAS is derived from the “relative standard deviation” (Standard deviation / mean value), which in this case is the same as standard deviation since the mean value is one.

The parameters, which can be made stochastic variable in TEMAS, are indicated by light blue cells in the work sheet. These are:

1) Bertalanffy growth parameter, K (normally distributed) (EXCEL Table 2.1.1, Figure 2.18.2)
2) Condition factor (normally distributed)) (EXCEL Table 2.1.1, Figure 2.18.2)
3) The stock recruitment relationship (log-normally distributed) (EXCEL Table 2.2.1, Figyre 2.1.8.2)
4) Catchability coefficient (EXCEL Table 3.1.2, Figure 2.18.3)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
11	Table 2.1.1.	GROWTH AND MATURITY PARAMETERS														
12		Loo	K	t-zero	Cond. Exp.	Maturity L50%	Maturity L75%	RelStDev.(K)	RelStDev(C.Fac)							
13	West Cod	148	0.103	0	3	40.2	46.2	0.1	0.1							
14	East cod	131	0.11	-0.384	3	38	44.9	0.1	0.1							
15																
16	Table 2.1.2.	CONDITION FACTOR														
17		Per. 1	Per. 2	Per. 3	Per. 4											
18	West Cod	1E-05	1E-05	1E-05	1E-05											
19	East cod	1E-05	1E-05	1E-05	1E-05											
20																
21	Table 2.2.1.	RECRUITMENT PARAMETERS														
22		BH1 (1)	BH2 (1)	H-S Biom. (2)	H-S Const.Rec. (2)	H-S Slope (2)	Ricker coeff. (3)	Ricker Exp. (3)	D-S-Coeff.(1) (4)	D-S-Coeff.(2) (4)	D-S-Exp. (4)	RelStDev(R)	Freq.Outst.Yrs	Mag.Outst.Yrs	Autocorr. Outst.Yrs	Model Choice
23	West Cod	2	0.002	0	0	0	0	0	0	0	0	0.5	1	1	0	1
24	East cod	2	0.002	0	0	0	0	0	0	0	0	0.5	10	3	0	1
25																

S01 DIM / Ark1 \ S02 STOCK / S03 FLEET / Ark2 / Ark3 / S04 EF

Figure 2.18.2. Relative standard deviations of Bertalanffy growth parameter, K (normally distributed) and Condition factor (normally distributed)

	A	B	C	D	E	F	G	H
26								
27	Table 3.1.2.	Baltistan : PARAMETERS IN MODEL FOR CATCHABILITY (Species, Fleet, V.Size, Rig)						
28		St.Dev(Q)	Biom.Param.	Tech.Dev.	Rig.Effect			
29	West Cod - OB Trawler-Baltistan - Small - <110mm	0.1	3.81E-06	0	0			
30	West Cod - OB Trawler-Baltistan - Small - >110mm	0.1	8.80E-07	0	0			
31	West Cod - OB Trawler-Baltistan - Medium - <110mm	0.1	2.40E-06	0	0			
32	West Cod - OB Trawler-Baltistan - Medium - >110mm	0.1	3.41E-06	0	0			
33	West Cod - OB Trawler-Baltistan - Large - <110mm	0.1	8.61E-06	0	0			
34	West Cod - OB Trawler-Baltistan - Large - >110mm	0.1	5.18E-06	0	0			
35	West Cod - Gillnett-Baltistan - Small - <110mm	0.1	8.29E-06	0	0			
36	West Cod - Gillnett-Baltistan - Small - >110mm	0.1	2.41E-06	0	0			
37	West Cod - Gillnett-Baltistan - Medium - <110mm	0.1	4.14E-06	0	0			
38	West Cod - Gillnett-Baltistan - Medium - >110mm	0.1	3.58E-06	0	0			
39	West Cod - Gillnett-Baltistan - Large - <110mm	0.1	3.58E-06	0	0			
40	West Cod - Gillnett-Baltistan - Large - >110mm	0.1	3.58E-06	0	0			
41	East cod - OB Trawler-Baltistan - Small - <110mm	0.1	3.58E-06	0	0			
42	East cod - OB Trawler-Baltistan - Small - >110mm	0.1	3.58E-06	0	0			
43	East cod - OB Trawler-Baltistan - Medium - <110mm	0.1	3.58E-06	0	0			
44	East cod - OB Trawler-Baltistan - Medium - >110mm	0.1	4.45E-07	0	0			
45	East cod - OB Trawler-Baltistan - Large - <110mm	0.1	2.42E-07	0	0			
46	East cod - OB Trawler-Baltistan - Large - >110mm	0.1	1.42E-06	0	0			
47	East cod - Gillnett-Baltistan - Small - <110mm	0.1	1.21E-06	0	0			
48	East cod - Gillnett-Baltistan - Small - >110mm	0.1	1.21E-06	0	0			
49	East cod - Gillnett-Baltistan - Medium - <110mm	0.1	1.21E-06	0	0			
50	East cod - Gillnett-Baltistan - Medium - >110mm	0.1	1.21E-06	0	0			
51	East cod - Gillnett-Baltistan - Large - <110mm	0.1	1.21E-06	0	0			
52	East cod - Gillnett-Baltistan - Large - >110mm	0.1	1.21E-06	0	0			
53		St.Dev(Q): Relative standard deviation of catchability used for stochastic simulation Biom.Param.: Parameter in mode						

S01_DIM / Ark1 / S02_STOCK \ S03_FLEET / Ark2 / Ark3 / S0

Figure 2.18.3. Relative standard deviation of catchability coefficients for one country, Baltistan. The explanation below the table says:
St.Dev(Q): Relative standard deviation of catchability used for stochastic simulation
Biom.Param.: Parameter in model: $Q = Q_0 * Biomass \wedge Biom.Param.$
Tech.Dev.: $Q = Q_0 * exp(y*Tech.Dev)$. Rig.Effect: $Q = Q_0 * exp(Rig.Effect)$.

3. EXECUTION OF A SIMULATION

TEMAS is implemented in the form of 4 independent workbooks:

5) TEMAS_INPUT (entry of input to TEMAS)
6) TEMAS_CALC (Simulations and output from TEMAS)
7) TEMAS_STO_OUT (Stochastic simulation output)
8) TEMAS_TUNING (calibration of parameters)

Chapter 3 deals with the worksheet TEMAS_CALC, which executes the simulations and produces the output from single simulations. Output from stochastic multiple simulations is handled by the worksheet TEMAS_STO_OUT. Worksheet TEMAS_CALC appears very much as TEMAS_INPUT. Menus are activated by a "fish school" command button. The following sections will explain the menus of TEMAS_CALC.

When running the program, you may do any calculation or manipulation of the input tables and output tables by aid of the facilities in EXCEL.

With the output produced by the calculation workbook, there is no special instruction on things you should not do. You can do anything you like with the output workbooks, except for deleting the sheets or renaming them.

There are five general warnings on thing you should not when running the package

WARNING 1: Do NOT delete any of the standard spreadsheets of the workbook, as that action will cause the program to crash.

WARNING 2: Do NOT insert or delete rows or columns between the input cells (cells indicated by colours, predominantly yellow colour). The yellow cell occur only in the data entry workbook.

WARNING 3: Do NOT change the names of the standard worksheets. If you do, the package will not function.

WARNING 4: Do NOT change the location of the standard directories.

WARNING 5: Do NOT delete files or folders in the directory "C:\TEMAS\Data\" by aid of Windows explorer: (where "TEMAS" is a generic name of the main directory of the system, as chosen by the user)

The data files can be deleted from main input menu, and when you want to delete data files, do it with the button "Delete File(s)" in the menu of the main menu.

RECOMMENDATION 1: Do always keep a Backup file of your original data set. To be on the safe side you may from time to time make a copy of the entire data subdirectory.
Make also a backup of the entire system, so that in case everything goes wrong you can start up with a fresh version of system and your input data.
Making these backups takes very short time (seconds), whereas you may loose days of work if you loose your original data.

RECOMMENDATION 2: Use the "Clear All sheets" button from time to time, as the workbook otherwise will grow in size. Without any data in the work sheets, each of the workbooks takes up about 2 Mb, but they may easily grow to 10 Mb after a number of applications.

In general: The package consists of two EXCEL workbooks. Follow the normal precautionary approaches when running EXCEL workbooks.

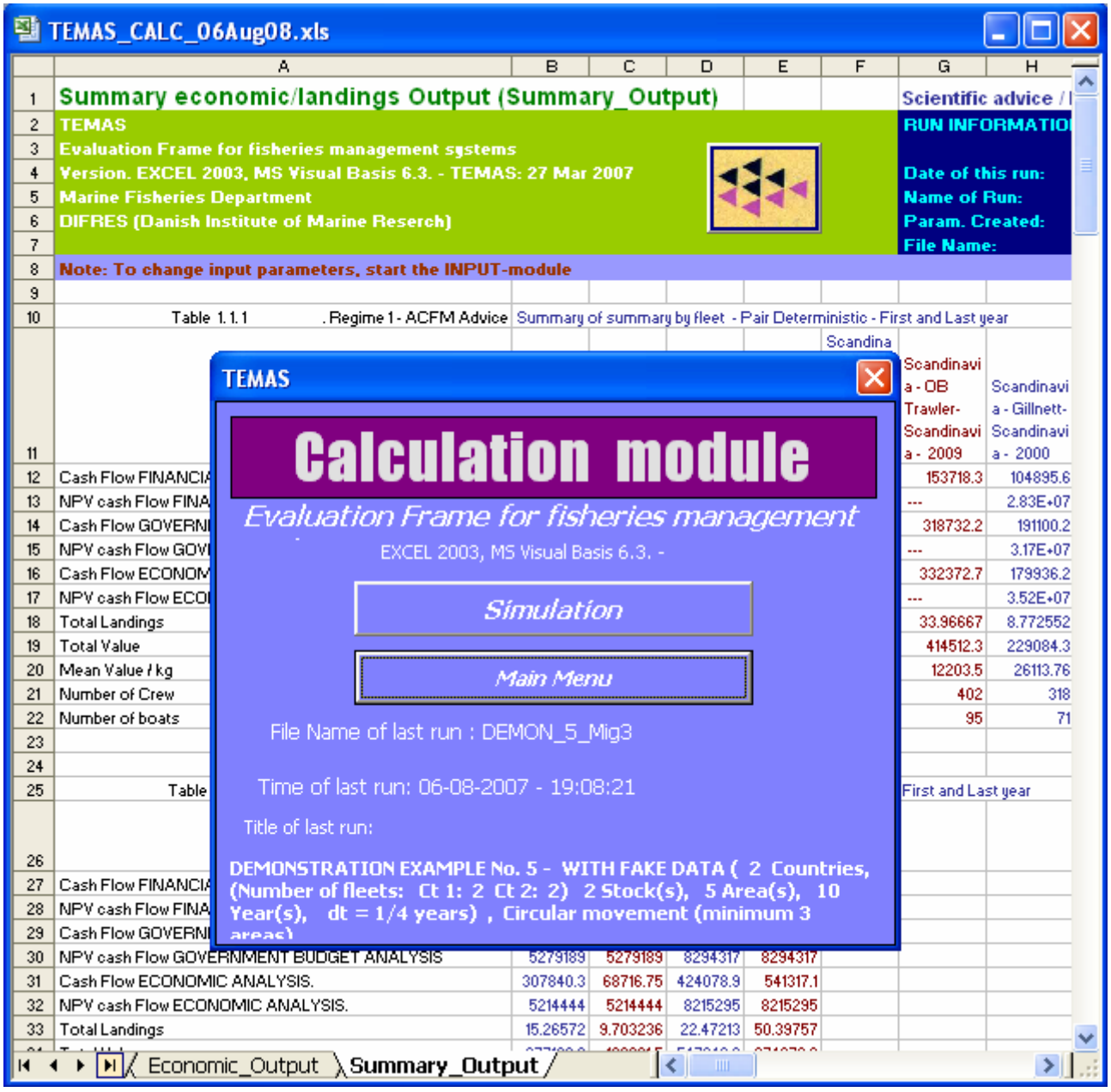


Figure 3.1.1. Opening of calculation module.

3.1. START UP

Figure 3.1.1 shows the opening form appearing after activating the workbook, "TEMAS_CALC_Date". To start the calculations (the simulation) click on "simulations". That will activate the userform for selection of type of simulation you want to execute (see the following section). Commandbutton "Main frame" allows you to make various types of file manipulation, and it offers the option for tuning of model, which is executed by a new userform (see Section 3.6).

3.2. SELECT SIMULATION

Figure 3.2.1 shows the user form for selection of type of simulation. Recall that TEMAS executes two alternative simulations (two alternative scenarios) and makes a comparison. We call the alternatives "first simulation" and "second simulation". You may execute the simulations as a single simulation or as a pair of comparative simulations. You may execute the simulation in deterministic mode or stochastic mode. In stochastic mode there is the option to make many simulations of pairs of alternative scenarios, in order to estimate probability distributions of outputs. These options lead to 5 different types of simulations (five option buttons)

Type	Num-ber of scena-rios	Sto-chas-tic	Number of Simu-lations	Explanation
1	1	No	1	First deterministic single simulation.
2	1	No	1	Second deterministic single simulation.
3	2	No	2	Two deterministic (alternatives) simulations
4	2	Yes	2	Two stochastic (alternatives) simulations
5	2	yes	Many	Many repetitions of two stochastic (alternatives) simulations

Figure 3.2.1. Userform for selection of case study, behaviour models and run-type.

The option to select a single deterministic simulation allocates the constant value ”1.0” to all stochastic factors. That is, the input values of parameters as they appear on the spreadsheet are used It produces output distributed over 16 (optional) worksheets. The details about the output sheets are presented in chapter 4.

1	Summary_Output	Summary Output
2	Economic_Output	Economic Output
3	Stock_Output	Annual Stock Output
4	Fleet_Output	Annual Fleet Output
7	Tuning_Output	Tuning Output
8	Rules	Behaviour Rules Output
10	St_Out_Period	Stock output by time period
11	St_Out_Area	Annual Stock output by area
12	St_Out_Per_Ar	Stock output by time period and area
13	Fl_Out_Period	Fleet output by time period
14	Fl_Out_Area	Annual Fleet output by area
15	Fl_Out_Per_Ar	Fleet output by time period and area
16	ICES_Output	Output from simulation of ICES assessment/advice

The single simulation can be of the first or the second alternative.
The pair of deterministic simulations executes both alternative scenarios and makes a comparison.

This option “pair of stochastic simulations” draws the stochastic factors from random number generators. Parameters in the model which are modified by the so-called stochastic factors

(Modified Parameter) = (Reference Parameter) * (Stochastic Factor)

The stochastic parameters are described in Section 2.18.

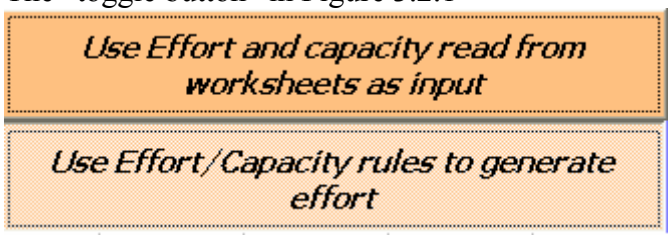
It makes two comparative simulations and displays detailed results in the work sheets
It also compares the two simulations. The format of output is exactly the same as that for the single stochastic simulation.

The last option “pair of multiple stochastic simulations” uses stochastic input described above.

It makes a number of simulations (the number on the user’s choice) and displays distributions of selected output variables in the work book “TEMAS_STO_OUT”.

Thus the multiple stochastic simulation repeats the calculations a large number of times (say, 1000 times), and each time with a new set of input parameters. The outputs are frequency diagrams of selected key output values

The “toggle button” in Figure 3.2.1



lets you choose the between two options for the creation of effort by fleet, area and time period:

1) Give all efforts as input parameters (in module TEMAS_INPUT).
2) Let the effort be determined by the behaviour rules (structural and trip-behaviour rules).

The behaviour model contains eight Effort/Capacity rules for the

1) Fishing effort rule
2) Dis-Investment rule
3) Investment rule
4) Attrition rule
5) Dis-investment rule

STOP

1) FISHING EFFORT RULE:

If during A time periods (e.g. one month):
Gross revenue < [F-operating cost + F-landing cost + crew share income + crew effort income]

Then a percentage X of the fleet will stop fishing for Y time periods

2) DIS-INVESTMENT RULE:

If for a continuous period of T years:
Financial net cash flow (excluding vessel decommission) <0
"Then a percentage Z of the fleet (round to integer) will withdraw from the fishery
T and Z are input variables

Withdrawal is either with or without decommission compensation

STOP
3) INVESTMENT RULE:

If for a continuous period of G years: Financial net cash flow > W
Then a percentage Q (round to integer) of the fleet will be added

4) ATTRITION RULE:

Every year a percentage B (round to integer) of the fleet retires due
to having reached the end of the technical life time of the vessels

3.3. SELECT OUTPUT FOR SINGLE SIMULATION

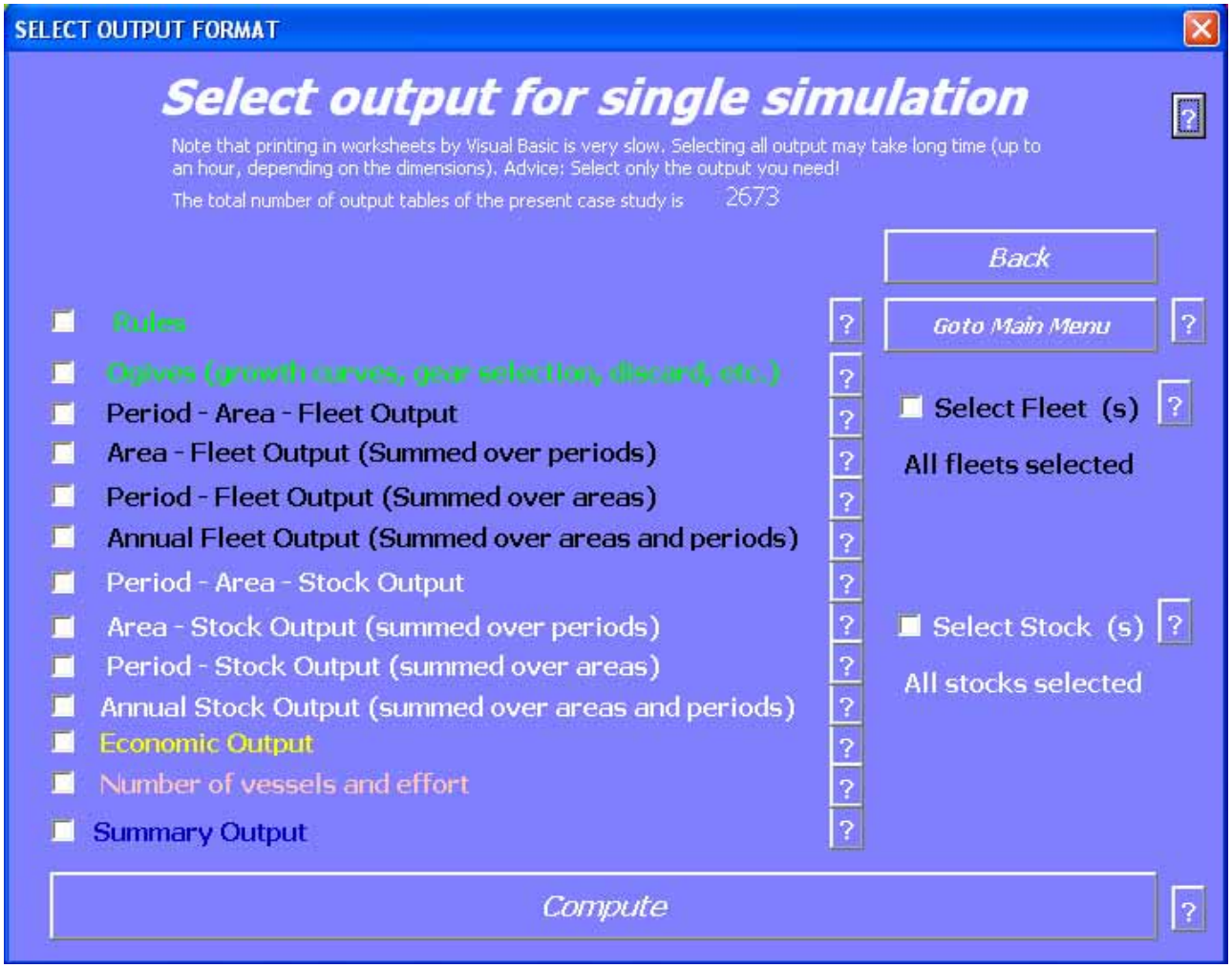


Figure 3.3.1. Userform for selection of output from the chosen simulation.

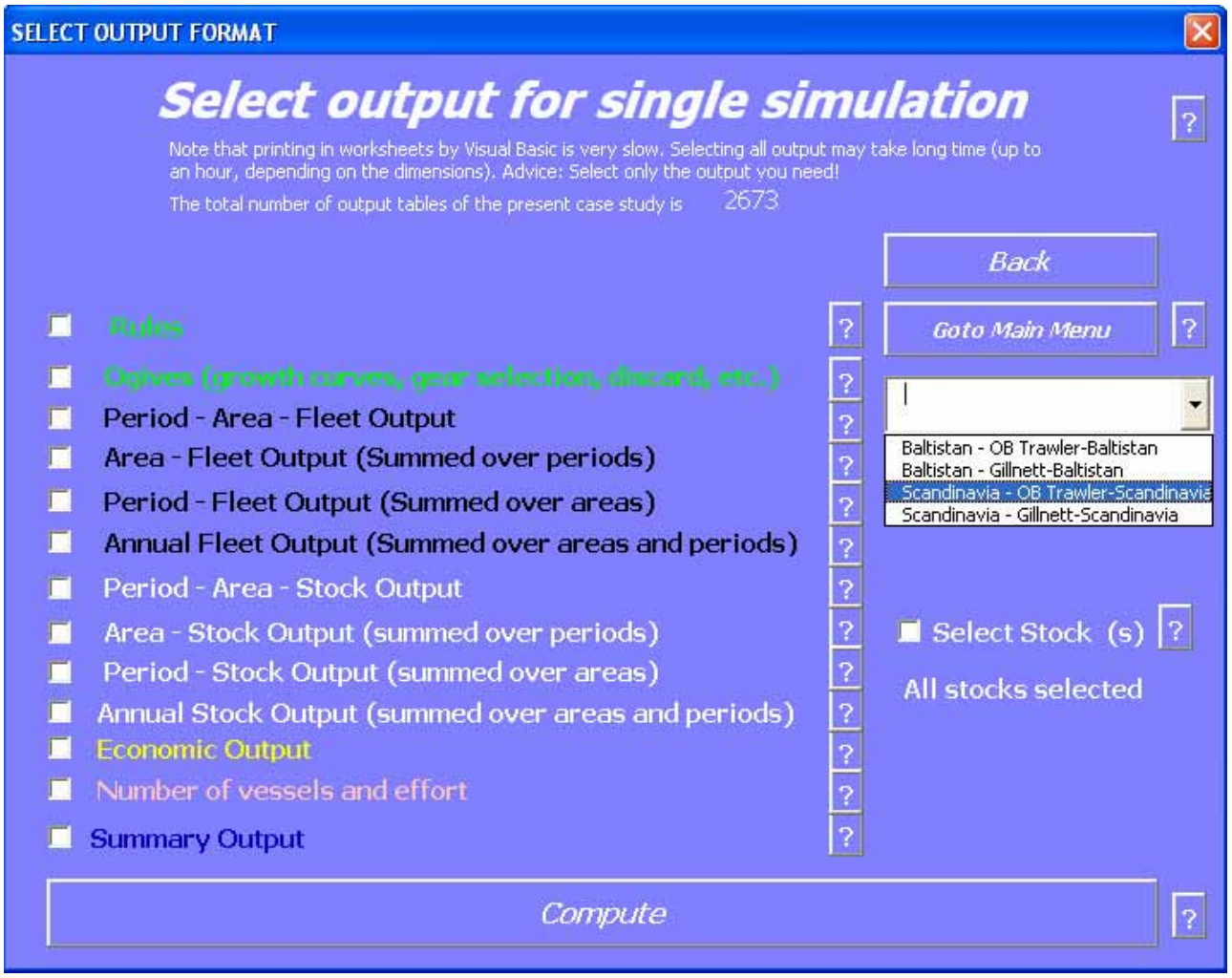


Figure 3.3.2 Userform for selection of output from the chosen simulation. Her illustration of selection of a single fleet, which will be the only one for which results are displayed.

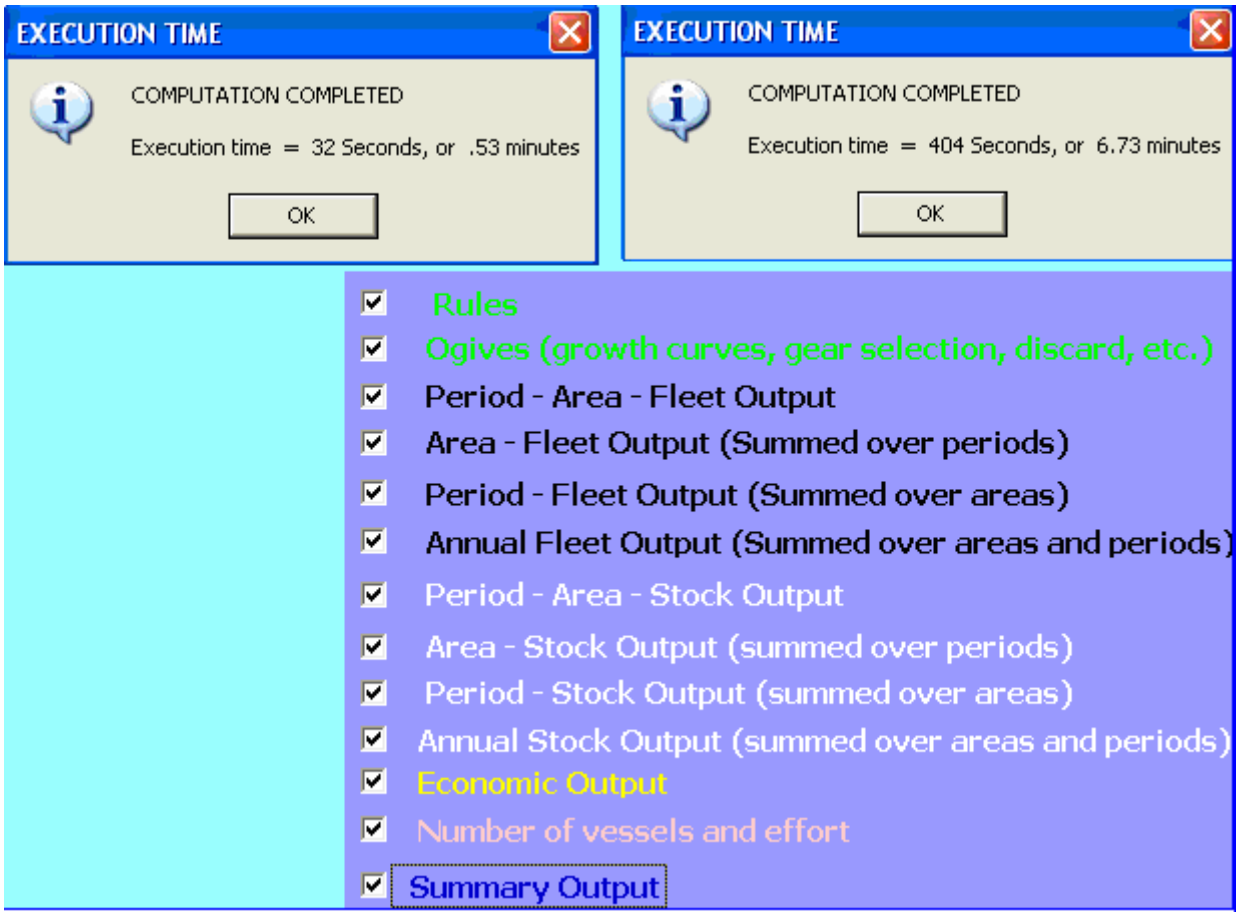


Figure 3.3.3. Message at the end of simulation. The left hand side completion message represents a run with no display of output, and the right hand side the maximum number of tables displayed (as indicated on the lower part of the picture)

3.4. INCLUDE/EXCLUDE BEHAVIOUR RULES

Figure 3.4.1. Selection of behaviour rules for inclusion/exclusion.

3.5. SELECT CASE STUDY

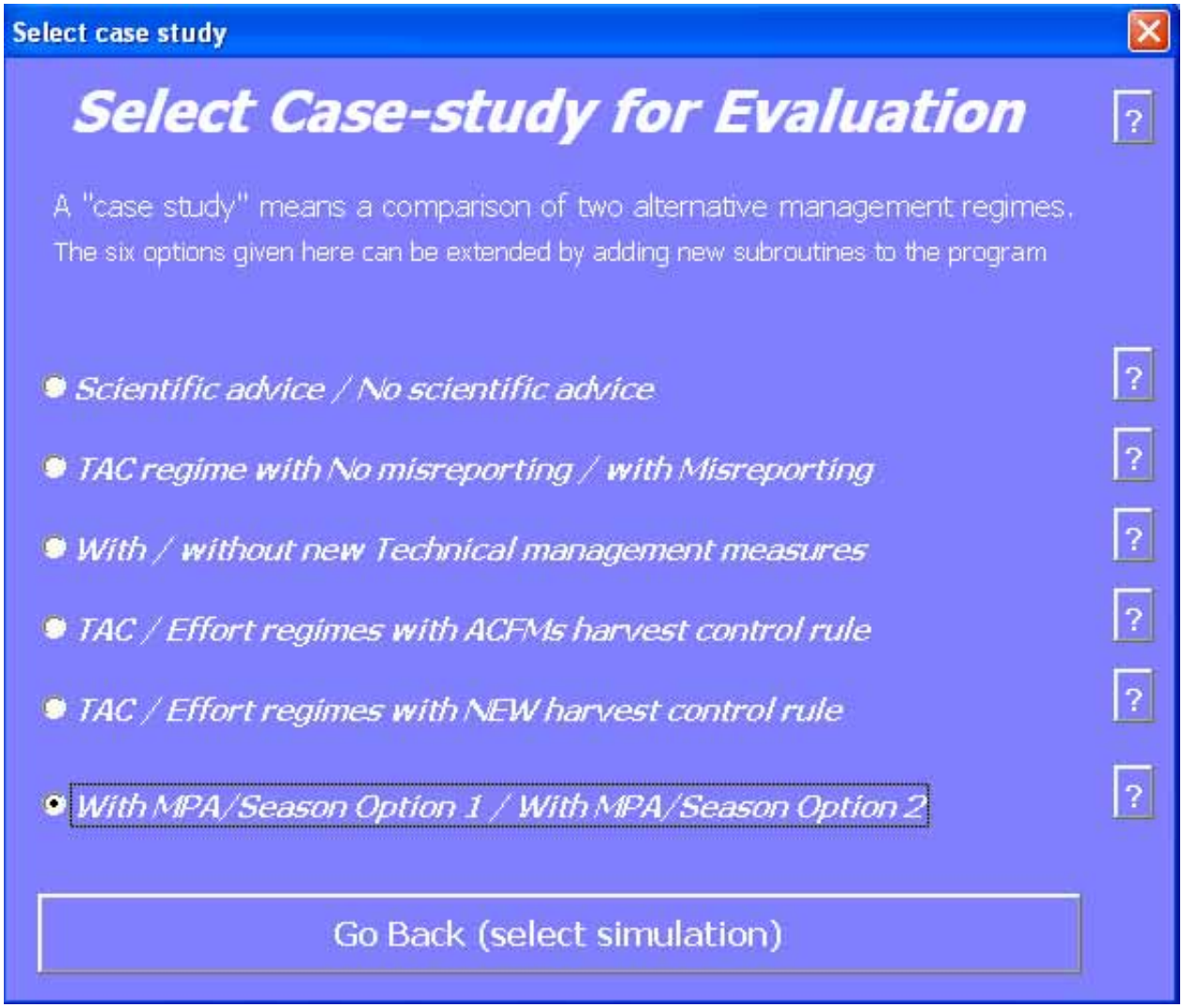


Figure 3.5.1. Selection of case study.

3.6. MAIN MENU FOR CALCULATION MODULE

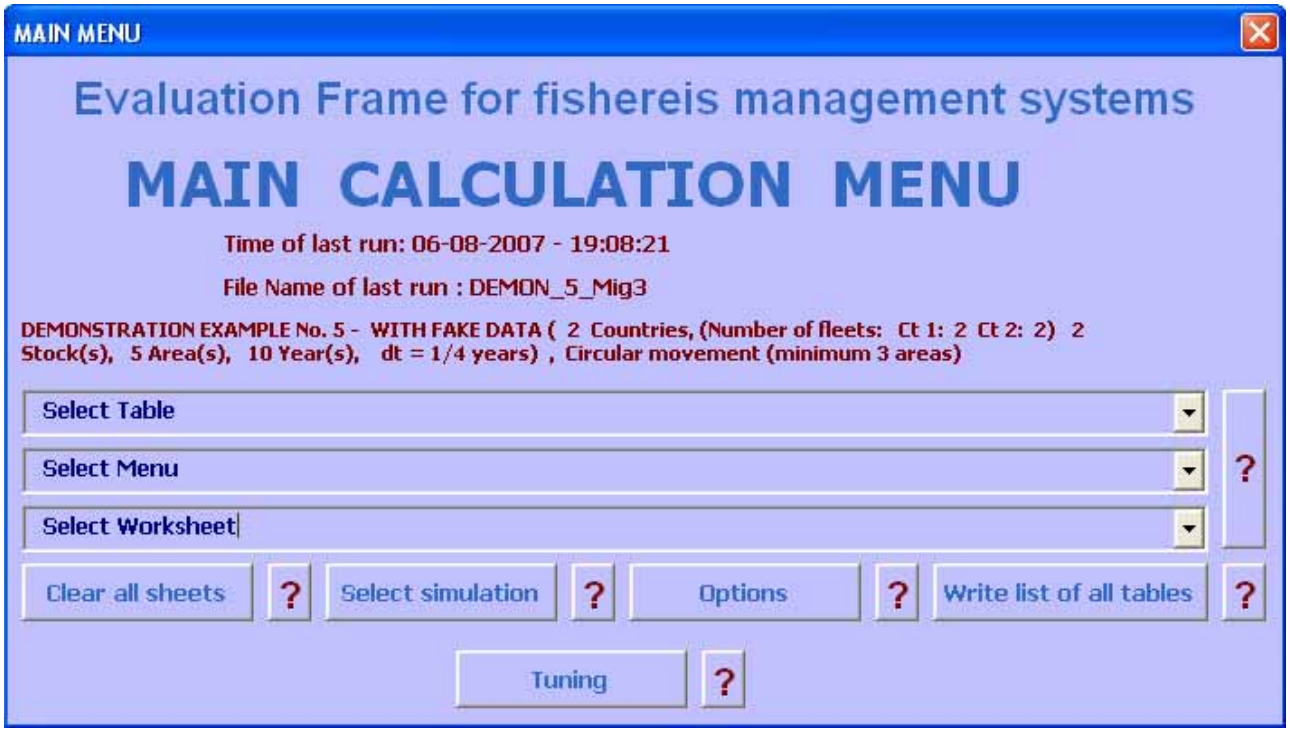


Figure 3.6.1.a. Main menu of calculation module.

…

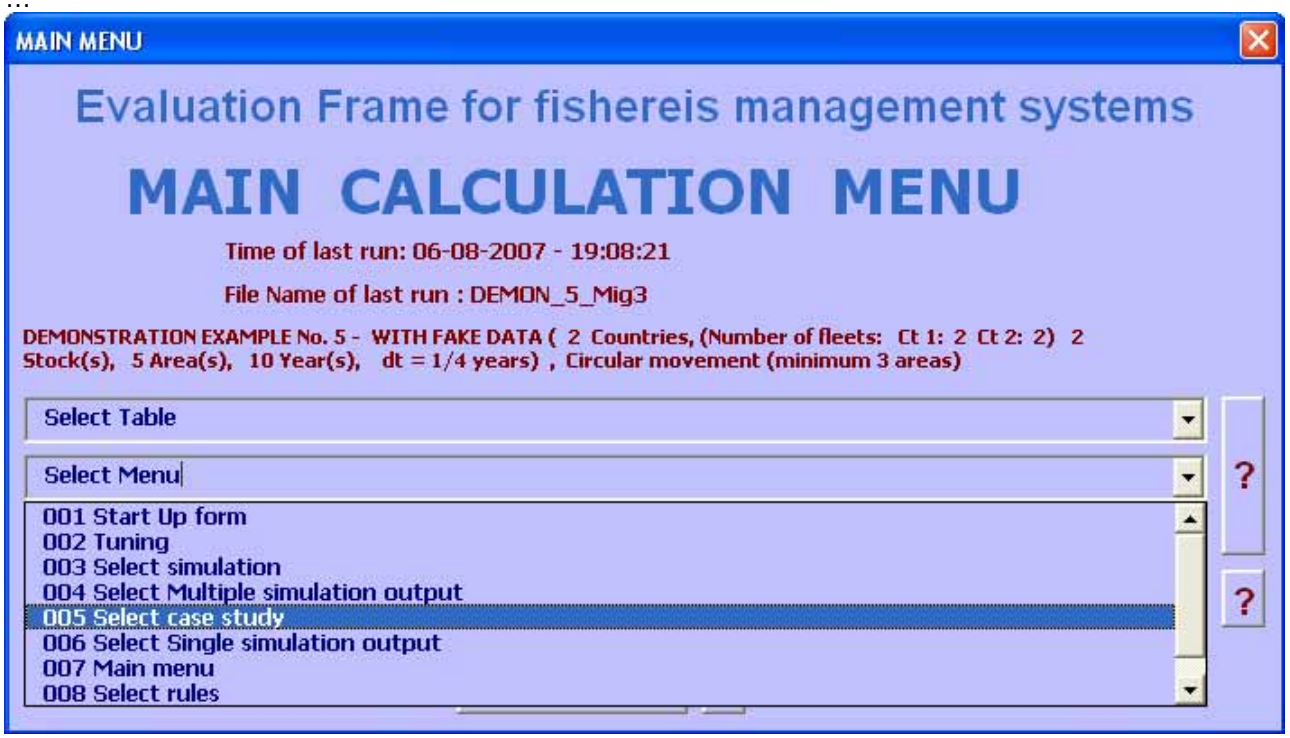


Figure 3.6.1.b. Main menu of calculation module, with illustration of selection of menu.

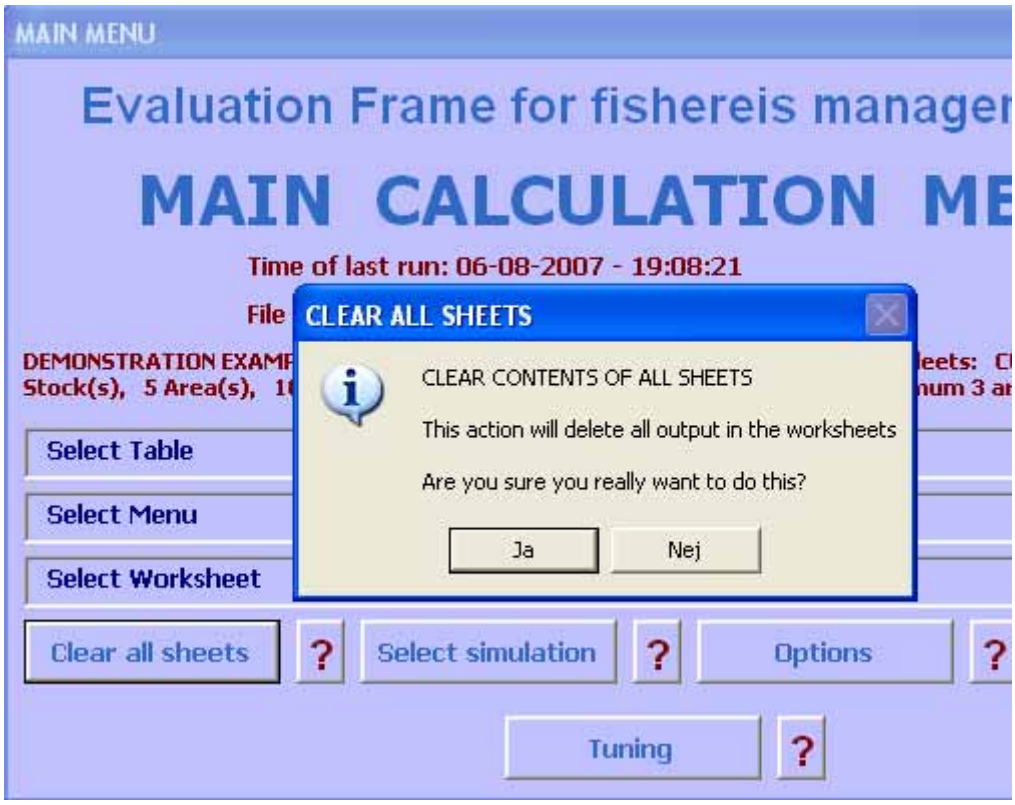


Figure 3.6.1.c. Main menu of calculation module, with illustration of"clear all sheets".

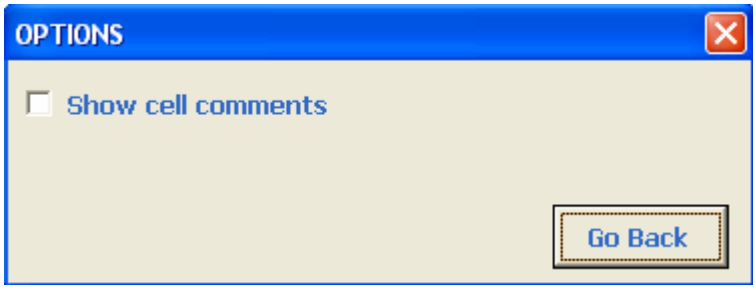


Figure 3.6.2. "Options in Main menu.

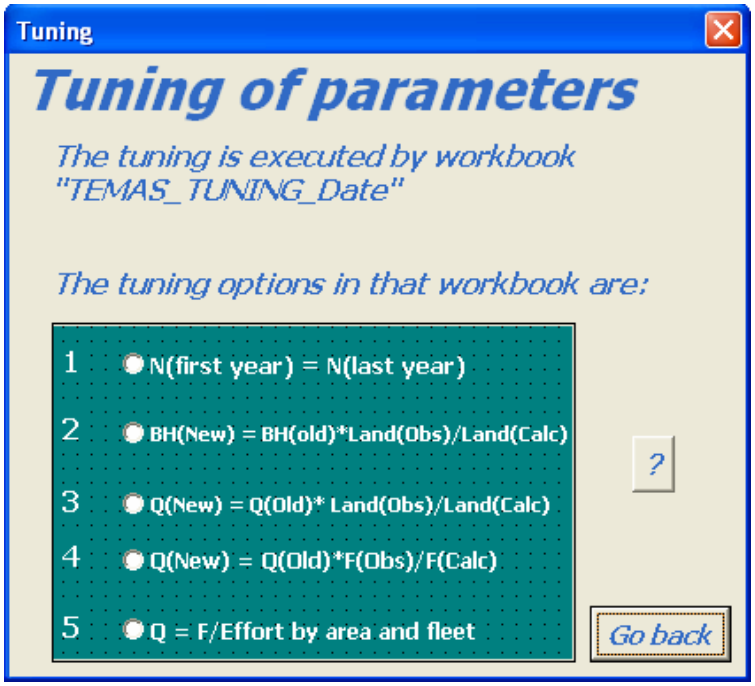
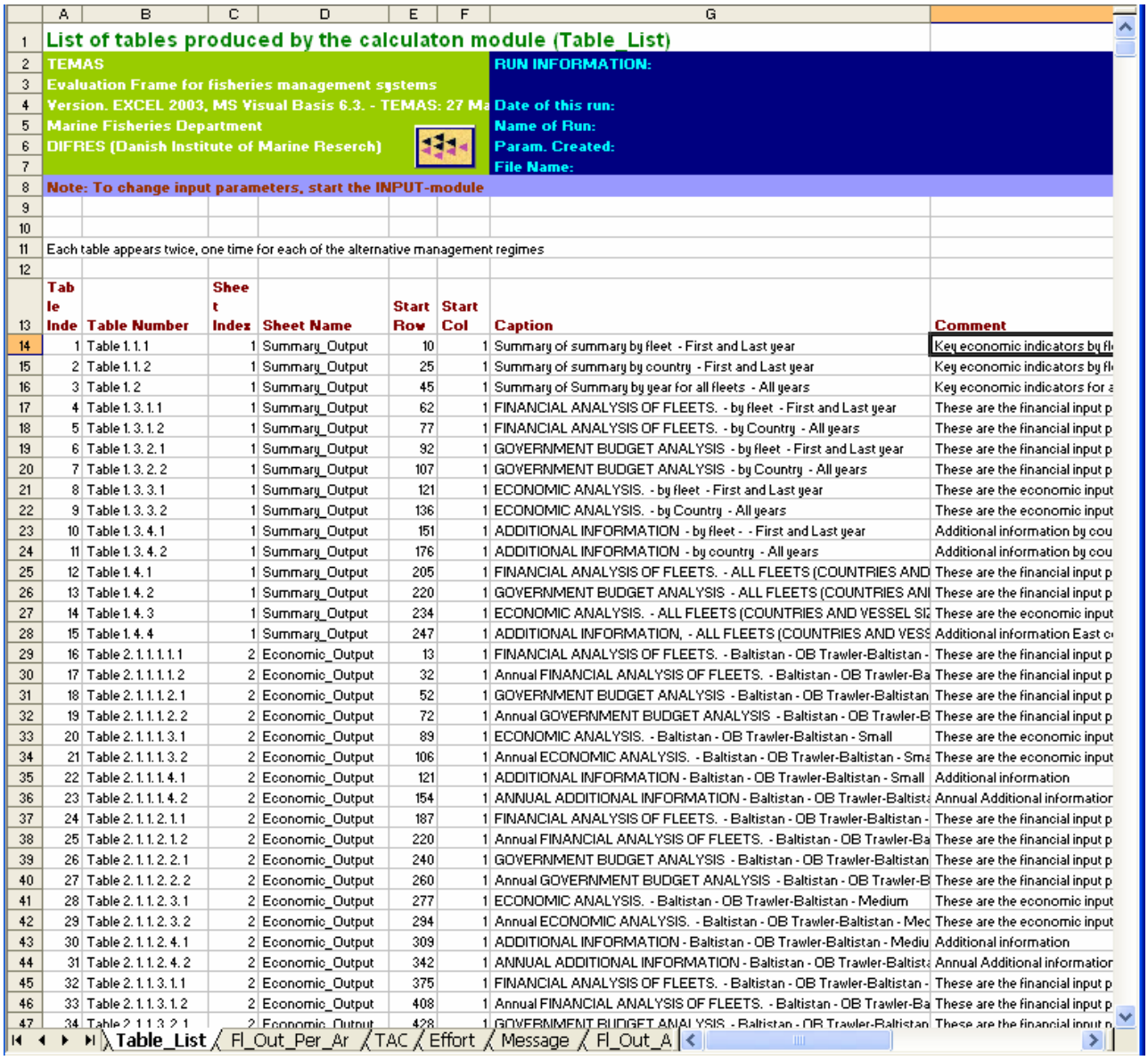


Figure 3.6.3. Message when clicking on "Tuning", which is executed by another workbook, "TEMAS_TUNING"



List of tables produced by the calculaton module (Table_List)

TEMAS
Evaluation Frame for fisheries management systems
Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Ma
Marine Fisheries Department
DIFRES (Danish Institute of Marine Reserch)

RUN INFORMATION:
Date of this run:
Name of Run:
Param. Created:
File Name:

Note: To change input parameters, start the INPUT-module

Each table appears twice, one time for each of the alternative management regimes

Table Index	Table Number	Sheet Index	Sheet Name	Start Row	Start Col	Caption	Comment
1	Table 1.1.1	1	Summary_Output	10	1	Summary of summary by fleet - First and Last year	Key economic indicators by fl
2	Table 1.1.2	1	Summary_Output	25	1	Summary of summary by country - First and Last year	Key economic indicators by fl
3	Table 1.2	1	Summary_Output	45	1	Summary of Summary by year for all fleets - All years	Key economic indicators for a
4	Table 1.3.1.1	1	Summary_Output	62	1	FINANCIAL ANALYSIS OF FLEETS. - by fleet - First and Last year	These are the financial input p
5	Table 1.3.1.2	1	Summary_Output	77	1	FINANCIAL ANALYSIS OF FLEETS. - by Country - All years	These are the financial input p
6	Table 1.3.2.1	1	Summary_Output	92	1	GOVERNMENT BUDGET ANALYSIS - by fleet - First and Last year	These are the financial input p
7	Table 1.3.2.2	1	Summary_Output	107	1	GOVERNMENT BUDGET ANALYSIS - by Country - All years	These are the financial input p
8	Table 1.3.3.1	1	Summary_Output	121	1	ECONOMIC ANALYSIS. - by fleet - First and Last year	These are the economic input
9	Table 1.3.3.2	1	Summary_Output	136	1	ECONOMIC ANALYSIS. - by Country - All years	These are the economic input
10	Table 1.3.4.1	1	Summary_Output	151	1	ADDITIONAL INFORMATION - by fleet - - First and Last year	Additional information by cou
11	Table 1.3.4.2	1	Summary_Output	176	1	ADDITIONAL INFORMATION - by country - All years	Additional information by cou
12	Table 1.4.1	1	Summary_Output	205	1	FINANCIAL ANALYSIS OF FLEETS. - ALL FLEETS (COUNTRIES AND	These are the financial input p
13	Table 1.4.2	1	Summary_Output	220	1	GOVERNMENT BUDGET ANALYSIS - ALL FLEETS (COUNTRIES ANI	These are the financial input p
14	Table 1.4.3	1	Summary_Output	234	1	ECONOMIC ANALYSIS. - ALL FLEETS (COUNTRIES AND VESSEL SI	These are the economic input
15	Table 1.4.4	1	Summary_Output	247	1	ADDITIONAL INFORMATION, - ALL FLEETS (COUNTRIES AND VESS	Additional information East c
16	Table 2.1.1.1.1.1	2	Economic_Output	13	1	FINANCIAL ANALYSIS OF FLEETS. - Baltistan - OB Trawler-Baltistan -	These are the financial input p
17	Table 2.1.1.1.1.2	2	Economic_Output	32	1	Annual FINANCIAL ANALYSIS OF FLEETS. - Baltistan - OB Trawler-Ba	These are the financial input p
18	Table 2.1.1.2.1	2	Economic_Output	52	1	GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-Baltistan	These are the financial input p
19	Table 2.1.1.2.2	2	Economic_Output	72	1	Annual GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-B	These are the financial input p
20	Table 2.1.1.3.1	2	Economic_Output	89	1	ECONOMIC ANALYSIS. - Baltistan - OB Trawler-Baltistan - Small	These are the economic input
21	Table 2.1.1.3.2	2	Economic_Output	106	1	Annual ECONOMIC ANALYSIS. - Baltistan - OB Trawler-Baltistan - Sma	These are the economic input
22	Table 2.1.1.4.1	2	Economic_Output	121	1	ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltistan - Small	Additional information
23	Table 2.1.1.4.2	2	Economic_Output	154	1	ANNUAL ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltista	Annual Additional informatior
24	Table 2.1.2.1.1	2	Economic_Output	187	1	FINANCIAL ANALYSIS OF FLEETS. - Baltistan - OB Trawler-Baltistan -	These are the financial input p
25	Table 2.1.2.1.2	2	Economic_Output	220	1	Annual FINANCIAL ANALYSIS OF FLEETS. - Baltistan - OB Trawler-Ba	These are the financial input p
26	Table 2.1.2.2.1	2	Economic_Output	240	1	GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-Baltistan	These are the financial input p
27	Table 2.1.2.2.2	2	Economic_Output	260	1	Annual GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-B	These are the financial input p
28	Table 2.1.2.3.1	2	Economic_Output	277	1	ECONOMIC ANALYSIS. - Baltistan - OB Trawler-Baltistan - Medium	These are the economic input
29	Table 2.1.2.3.2	2	Economic_Output	294	1	Annual ECONOMIC ANALYSIS. - Baltistan - OB Trawler-Baltistan - Mec	These are the economic input
30	Table 2.1.2.4.1	2	Economic_Output	309	1	ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltistan - Mediu	Additional information
31	Table 2.1.2.4.2	2	Economic_Output	342	1	ANNUAL ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltista	Annual Additional informatior
32	Table 2.1.3.1.1	2	Economic_Output	375	1	FINANCIAL ANALYSIS OF FLEETS. - Baltistan - OB Trawler-Baltistan -	These are the financial input p
33	Table 2.1.3.1.2	2	Economic_Output	408	1	Annual FINANCIAL ANALYSIS OF FLEETS. - Baltistan - OB Trawler-Ba	These are the financial input p
34	Table 2.1.3.2.1	2	Economic_Output	428	1	GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-Baltistan	These are the financial input p

Table_List | Fl_Out_Per_Ar | TAC | Effort | Message | Fl_Out_A

Figure 3.6.4. List of tables produced by the "TEMAS_CALC" workbook.

3.7. MULTIPLE STOCHASTIC SIMULATION

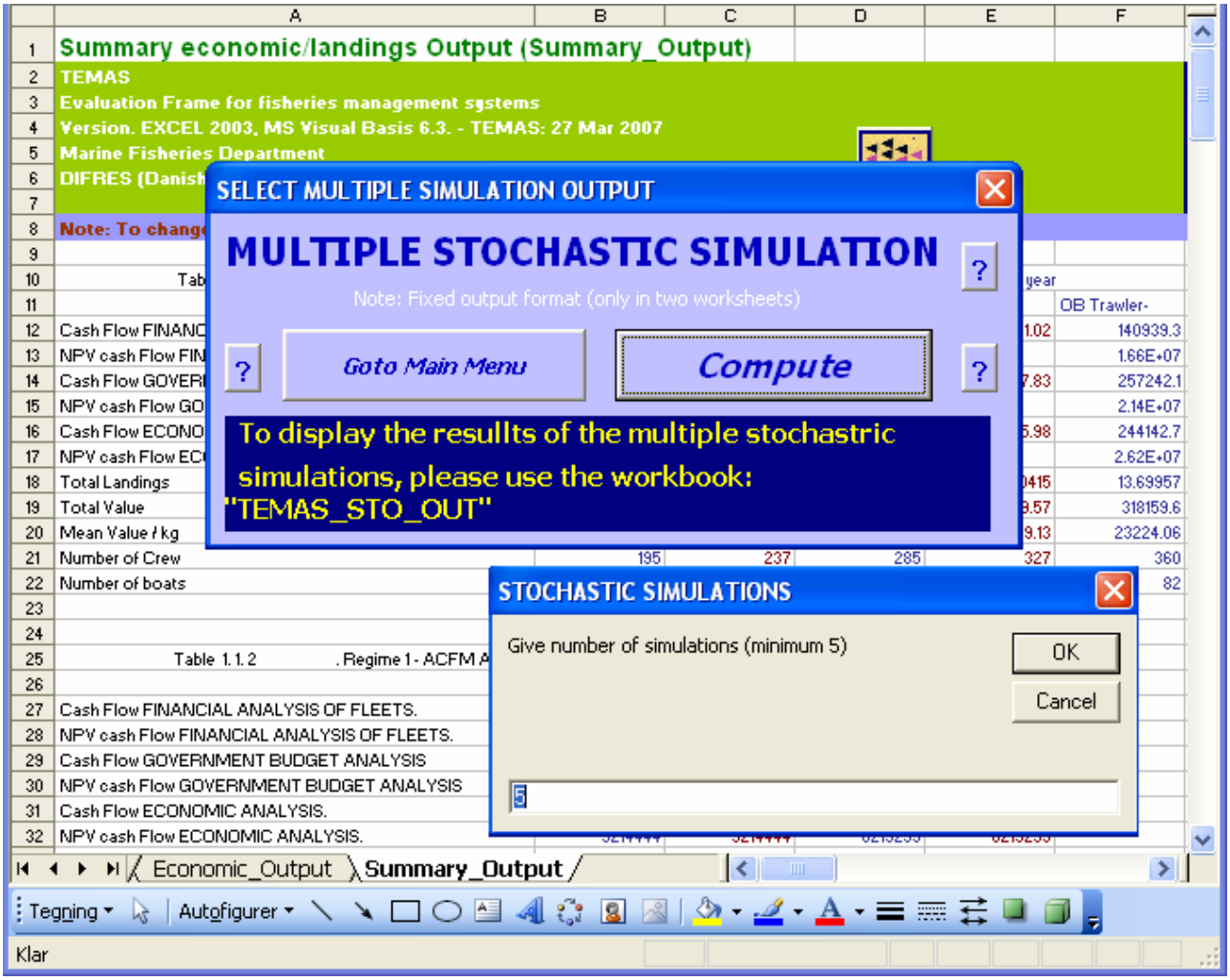


Figure 3.7.1. Userform to start the stochastic (multiple) simulations.

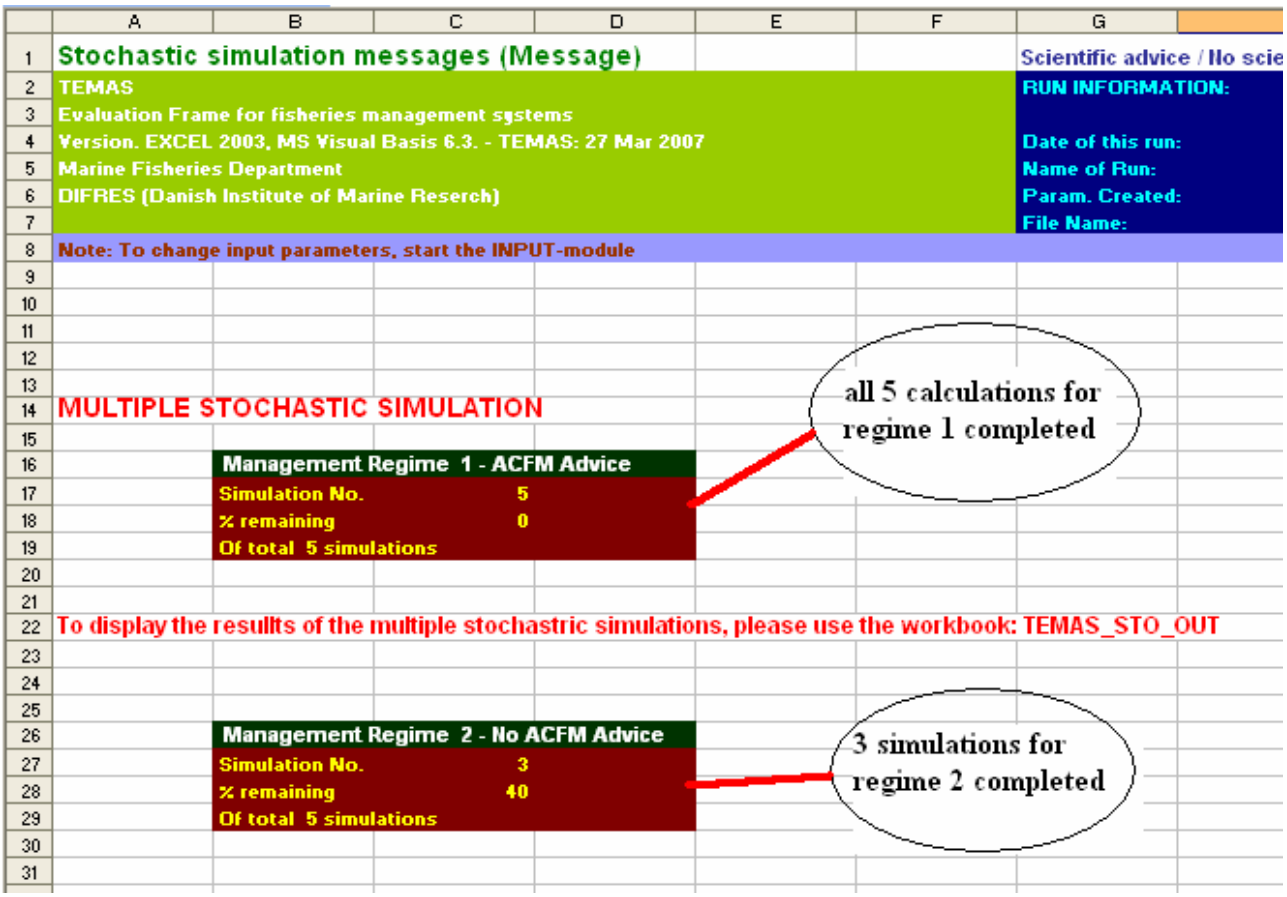


Figure 3.7.2.a. Message from stochastic (multiple) simulations, during execution.

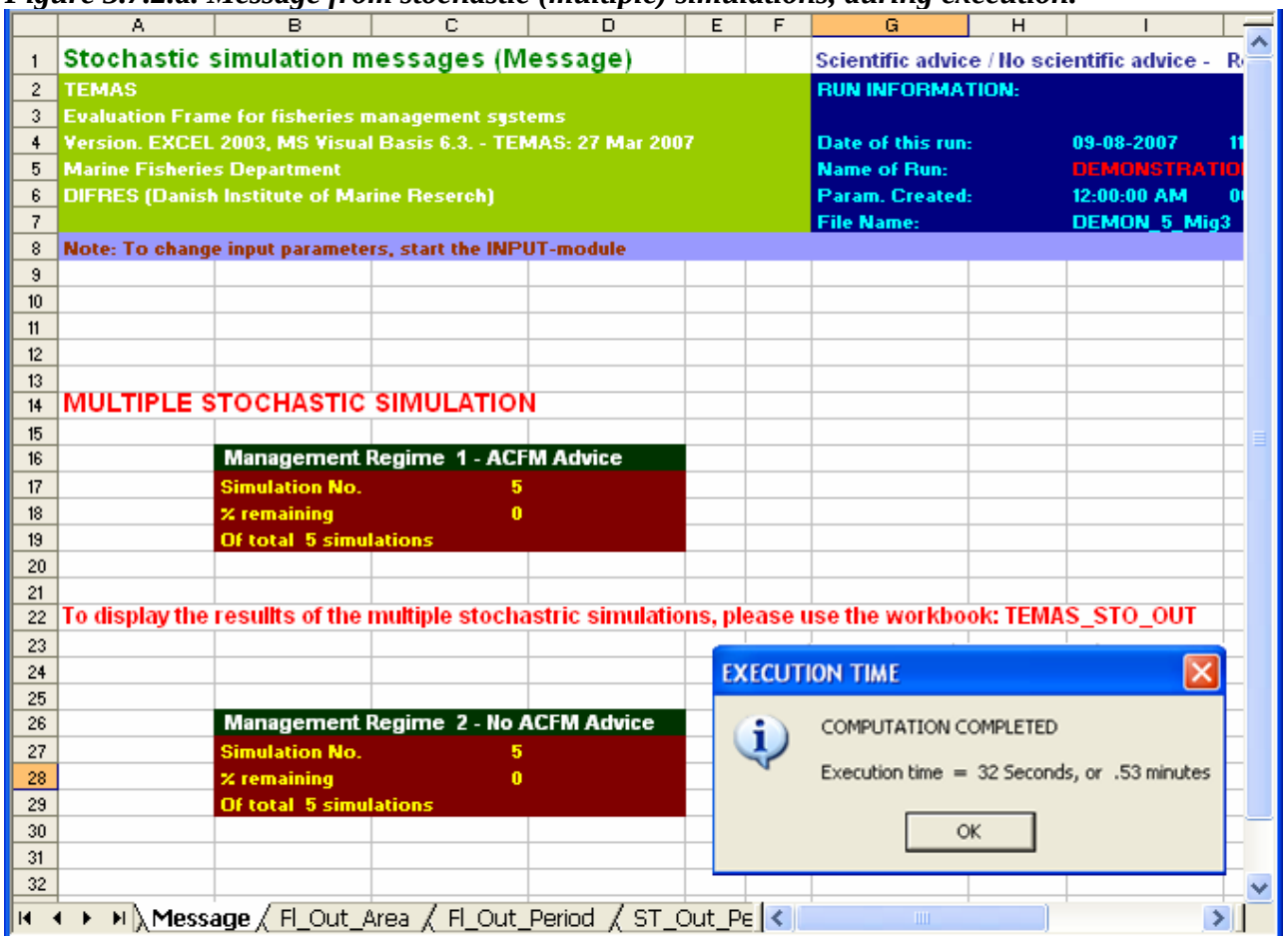


Figure 3.7.2.b. Message from stochastic (multiple) simulations when completed.

4. OUTPUT FROM TEMAS

As input to TEMAS, the Output is also separated into stock structured output and fleet structured output, as indicated by the names of the 16 output worksheets in workbook TEMAS_CALC:

1) “Summary_output” (Figure 3.1.1-2)
2) “Stock_Output” (stock structured output, Tables 3.3.1-2)
3) “Fleet_Output”, (Fleet and fleet/stock structured output, Tables 3.3.3-4)
4) “Economy_Output”, (Table 3.4.1-2)
5) “Stochastic_Output” (Figures 3.2.1 and 3.5.1, Tables 3.5.1-2)
6) “NPV_Output” (NPV = “Net Present Value”).
7) “Tuning_Output” (Figure 4.6.2)
8) “Rules”
9) “Ogives” (gear selection ogive, discard ogives and growth curves, not shown here)
10) "St_Out_Period", "Stock output by time period (summed over areas)"
11) "St_Out_Area", "Annual Stock output by area (summed over periods)"
12) "St_Out_Per_Ar", "Stock output by time period and area"
13) "Fl_Out_Period", "Fleet output by time period (summed over areas)"
14) "Fl_Out_Area", "Annual Fleet output by area (summed over periods)"
15) "Fl_Out_Per_Ar","Fleet output by time period and area"
16) "Table_List","List of all tables produced by TEMAS_CALC"

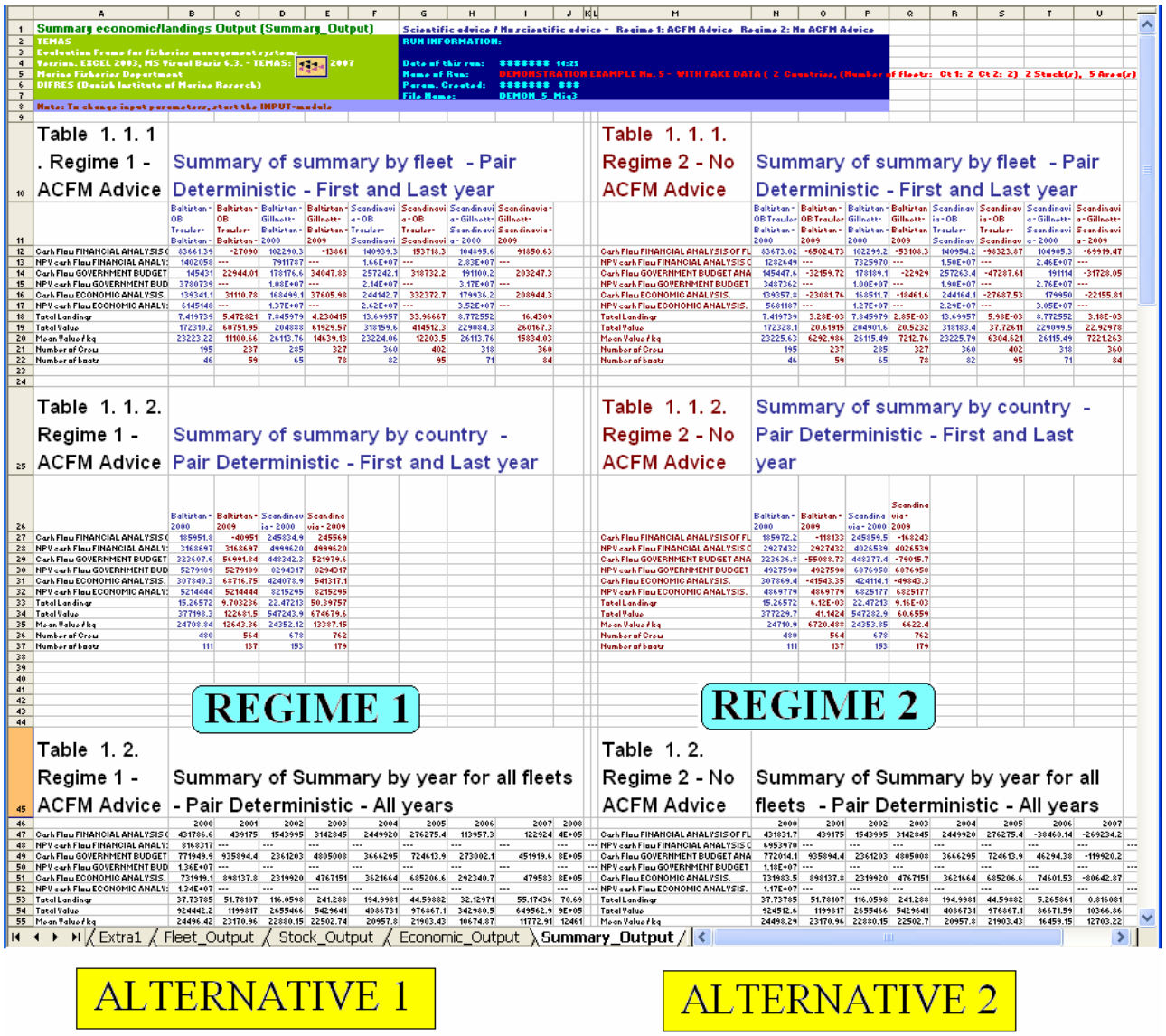


Figure 4.1.1.a. First portion of Summary output with two alternatives.

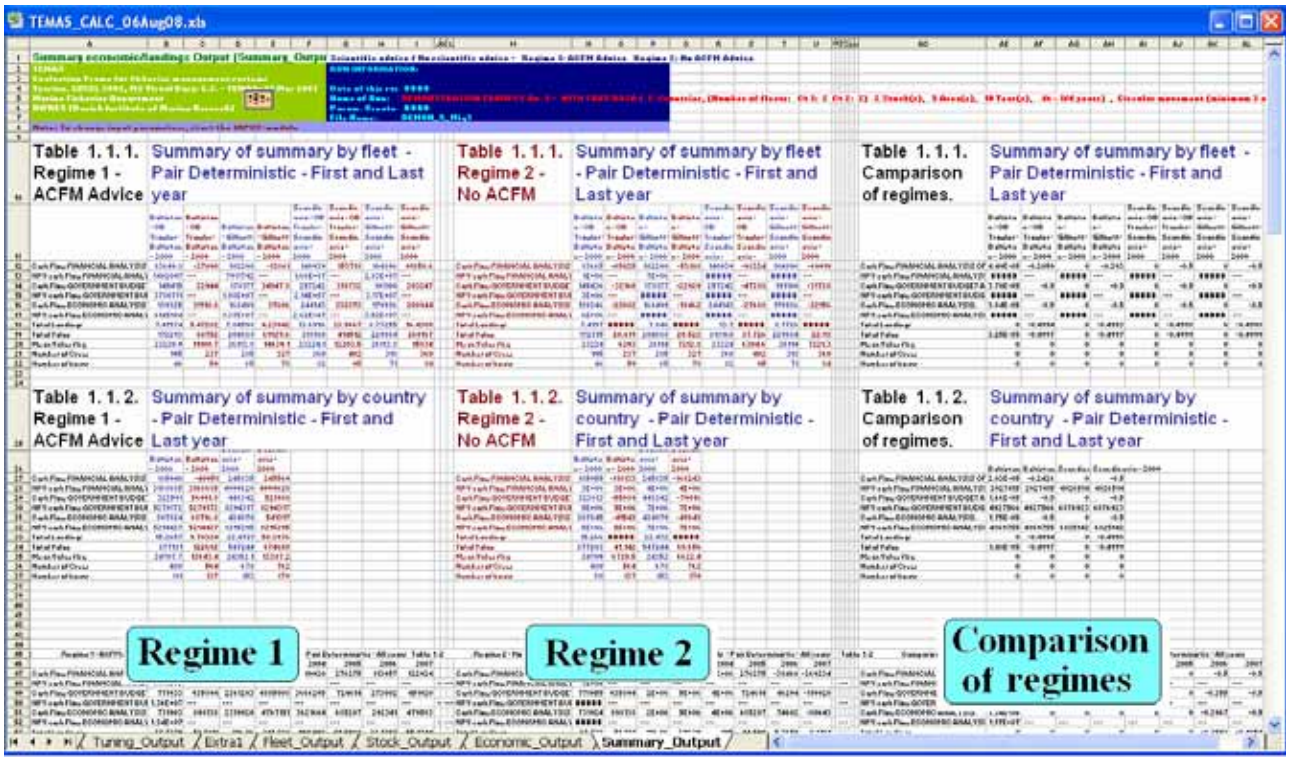


Figure 4.1.1.b. First portion of Summary output with two alternatives, and comparison of alternatives. Note that the left hand side is identical to Figure a.

The output for single simulations (deterministic or stochastic) provides many more details than the output from stochastic simulations. The output from stochastic simulations comprises a set of selected key-results only.

Output (produced by workbook TEMAS_CALC) is divided into the groups

1) Stock structured Output (Output independent of the fleet structure)
2) Fleet structured Output (which may or may not be fleet structured)
3) Economic output

Each output group is further divided into

1) Results from single deterministic simulation
2) Results from single stochastic simulation
3) Results from multiple stochastic simulation

TEMAS produces large amounts of output for single simulations. The total output for a single simulation is so voluminous that it is not likely ever to be used in full. The idea with the large amounts of output, is that the user should select whatever subset she/he considers useful in the context of the case study.

The detailed output from single simulations produced by the TEMAS is rather extensive, and the reader is referred to the demonstration example of TEMAS to see further details.

TEMAS, however, contains a suggestion for such a sub-set of output from a single simulation (Figures 3.1.1-3). To fully understand the content of the Tables in Figures 3.3.1-3, you should read Sections 5 and 6, but the titles of table entries should indicate the overall meaning of the table contents.

4.1. SUMMARY OUTPUT FROM SINGLE SIMULATION

The first part of the summary single simulation output contains two tables Table 3.3.1. One table summarising the results by fleet, by showing some key results for the first and the last year by fleet. The second table shows the same results for all fleets combined, and now for all years in the time series simulated. As appear all the key results given in the “Summary” of “Summary” are of an economic/technical nature. It also shows the total employment of the fleets. There is only one direct biological result, namely the total landings in weight units.

The output is divided into the three economic analyses:

1) Financial analysis of the harvesting (stakeholder: Fishing industry)
2) Financial analysis of the government treasury
3) Economic analysis (stakeholder: Society in general)

For each analysis is shown the Net cash flow, and the net present value of cash flow.

To that is added information on total landings, number of boats and crew.

This is a choice made by the authors, to emphasize on the economic/technical/employment aspects. TEMAS however, offers you the possibility to create your own summary of output, by aid of the facilities of EXCEL. If you master the VISUAL BASIC language, you can change the modules of TEMAS_CALC, but you can also manipulate the output by spreadsheet formulas.

Part two (Table 3.3.2) of the summary single simulation output extends the first table in Figure 3.3.1 with more details. It shows some details of the costs of fishing and it split the landings by stocks. The results are shown by fleet, for the first year and the last year of simulation.
In addition to first part of the summary, part two gives the CPUE (Catch Per Unit of Effort) by stock.

Part 3 , (Table 3.3.3) gives the single-simulation results for all fleets combined, but now for all years in the time series.

Behind these summary tables of single simulations are tables with more details about the single simulations, as will be exemplified in the following.

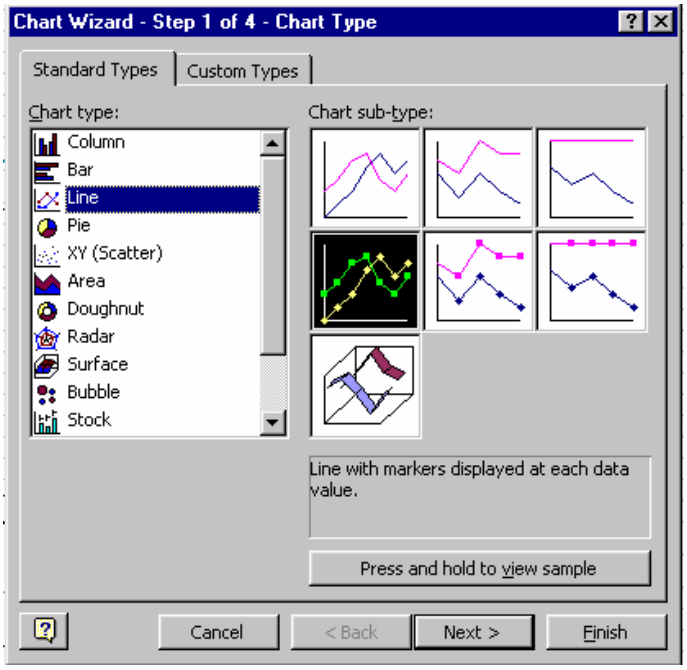
	A	B	C	D	E
43	**Table 1. 3.**	**FINANCIAL ANALYSIS OF HARVESTING - Deterministic**			
44		**Trawler 2000**	**Trawler 2009**	**Gill Net 2000**	**Gill Net 2009**
45	Gr. revenue before tax	34939	6707.0	34939	6707
46	revenue tax	1746.9	335.35	1746.9	335.35
47	Gr. revenue after tax	33192	6371.6	33192	6371.7
48	Costs of effort	6161.5	704.17	3080.7	352.08
49	Cost of landing	38.126	7.3569	38.126	7.3569
50	Crew share	4177.9	884.58	4732.5	947.96
51	Crew salary	6161.5	704.17	2053.8	234.72
52	Fixed Costs	5250	570	2625	285
53	Investment	0	0	0	0
54	Decommission	0	0	0	0
55	Effort tax	924.22	105.63	308.07	35.208
56	Effort subsidy	616.15	70.417	205.38	23.472
57	Licence fee	1680	182.40	560	60.800
58	Vessel subsidy	105	11.400	35	3.8000
59	N.cash Flow	9519.6	3295.2	20034	4475.8
60	N.P.V.cash Flow	595.58	0	3904.9	0
61					
63	**Table 1. 4.**	**FINANCIAL ANALYSIS OF GOVERNMENT TREASURY - Determinist**			
64		**Trawler 2000**	**Trawler 2009**	**Gill Net 2000**	**Gill Net 2009**
65	Tax/boat/yr	0	0	0	0
66	Subsidies/boats/yr	0	0	0	0
67	Vessel Decomm.	0	0	0	0
68	Crew Decomm.	0	0	0	0
69	Management C.	15	15	15	15
70	Effort tax	924.22	105.63	308.07	35.208
71	Effort Subsidy	616.15	70.417	205.38	23.472
72	Licence fee	1680	182.40	560	60.800
73	Vessel subsidy	105	11.400	35	3.8000
74	Revenue tax	1746.9	335.35	1746.9	335.35
75	N.cash Flow	3615.0	526.56	2359.6	389.09
76	N.P.V.cash Flow	972.18	0	586.88	0
77					
79	**Table 1. 5.**	**ECONOMIC ANALYSIS - Deterministic**			
80		**Trawler 2000**	**Trawler 2009**	**Gill Net 2000**	**Gill Net 2009**
81	Gross revenue	34939	6707.0	34939	6707
82	Cost of effort	6161.5	704.17	3080.7	352.08
83	Cost of landings	38.126	7.3569	38.126	7.3569
84	Crew Oppurt.C.	6300	684	2800	304
85	Fixed costs	5250	570	2625	285
86	Investment	0	0	0	0
87	Management C.	15	15	15	15
88	N.cash Flow	17174	4726.5	26380	5743.6
89	N.P.V.cash Flow	2481.4	0	5332.4	0
91					
92	**Table 1. 6.**	**ADDITIONAL INFORMATION - Deterministic**			
93		**Trawler 2000**	**Trawler 2009**	**Gill Net 2000**	**Gill Net 2009**
94	Landings Cod	3476.0	658.92	3476.0	658.92
95	Landings Plaice	336.60	76.766	336.60	76.766
96	Total Landings	3812.6	735.69	3812.6	735.69
97	Value Cod	31816	5992.1	31816	5992.1
98	Value Plaice	3122.2	714.92	3122.2	714.92
99	Total Value	34939	6707.0	34939	6707.0
100	Mean Value/kg	9.1639	9.1167	9.1639	9.1167
101	Number of Crew	6300	684	2800	304
102	Number of boats	2100	228	700	76
103	C.P.U.E Cod	.0056415	.0093574	.016925	.028072
104	C.P.U.E Plaice	.00054630	.0010902	.0016389	.0032705
105	Val.P.U.E Cod	.051638	.085094	.15491	.25528
106	Val.P.U.E Plaice	.0050673	.010153	.015202	.030458
107					

Figure 3.1.2. Second portion of Summary output.

109	Table 1. 7.	FINANCIAL ANALYSIS OF HARVESTING, ALL FLEETS - Determin									
110		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
111	Gr. revenue before tax	69877	50569	41359	36140	34697	34104	22919	19717	19700	13414
112	revenue tax	3493.9	2528.5	2067.9	1807.0	1734.9	1705.2	1146.0	985.85	985.00	670.70
113	Gr. revenue after tax	66384	48041	39291	34333	32962	32399	21773	18731	18715	12743
114	Costs of effort	9242.2	9033.8	8686.3	7821.5	7387.6	7168.3	4280.6	2835.2	2112.5	1056.3
115	Cost of landing	76.253	55.573	46.081	40.592	38.945	38.161	25.592	21.925	21.762	14.714
116	Crew share	8910.4	6049.7	4727.2	4091.4	3948.7	3897.0	2710.2	2475.6	2595.9	1832.5
117	Crew salary	8215.3	8030	7721.2	6952.1	6566.1	6371.5	3805.0	2520.2	1877.8	938.89
118	Fixed Costs	7875	7312.5	7031.3	6331.3	5980	5802.5	3465	2295	1710	855
119	Investment	0	0	0	0	0	0	0	0	0	0
120	Decommission	0	0	0	0	0	0	0	0	0	0
121	Effort tax	1232.3	1204.5	1158.2	1042.8	984.91	955.72	570.75	378.03	281.67	140.83
122	Effort subsidy	821.53	803	772.12	695.21	656.61	637.15	380.50	252.02	187.78	93.889
123	Licence fee	2240	2080	2000	1800.8	1700.8	1650.4	985.60	652.80	486.40	243.20
124	Vessel subsidy	140	130	125	112.55	106.30	103.15	61.600	40.800	30.400	15.200
125	N.cash Flow	29554	15208	8818.0	7060.5	7118.2	7255.4	6372.8	7845.3	9847.2	7771.0
126	N.P.V.cash Flow	4500.5	0	0	0	0	0	0	0	0	0
127											
129	Table 1. 8.	FINANCIAL ANALYSIS OF GOVERNMENT TREASURY, ALL FLEET									
130		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
131	Tax/boat/yr	0	0	0	0	0	0	0	0	0	0
132	Subsidies/boats/yr	0	0	0	0	0	0	0	0	0	0
133	Vessel Decomm.	0	0	0	0	0	0	0	0	0	0
134	Crew Decomm.	0	0	0	0	0	0	0	0	0	0
135	Management C.	30	30	30	30	30	30	30	30	30	30
136	Effort tax	1232.3	1204.5	1158.2	1042.8	984.91	955.72	570.75	378.03	281.67	140.83
137	Effort Subsidy	821.53	803	772.12	695.21	656.61	637.15	380.50	252.02	187.78	93.889
138	Licence fee	2240	2080	2000	1800.8	1700.8	1650.4	985.60	652.80	486.40	243.20
139	Vessel subsidy	140	130	125	112.55	106.30	103.15	61.600	40.800	30.400	15.200
140	Revenue tax	3493.9	2528.5	2067.9	1807.0	1734.9	1705.2	1146.0	985.85	985.00	670.70
141	N.cash Flow	5974.6	4850.0	4299.0	3812.9	3627.7	3541.0	2230.2	1693.9	1504.9	915.64
142	N.P.V.cash Flow	1559.1	0	0	0	0	0	0	0	0	0
143											
145	Table 1. 9.	ECONOMIC ANALYSIS, ALL FLEETS - Deterministic									
146		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
147	Gross revenue	69877	50569	41359	36140	34697	34104	22919	19717	19700	13414
148	Cost of effort	9242.2	9033.8	8686.3	7821.5	7387.6	7168.3	4280.6	2835.2	2112.5	1056.3
149	Cost of landings	76.253	55.573	46.081	40.592	38.945	38.161	25.592	21.925	21.762	14.714
150	Crew Oppurt.C.	9100	8450	8125	7316	6910	6705	4004	2652	1976	988
151	Fixed costs	7875	7312.5	7031.3	6331.3	5980	5802.5	3465	2295	1710	855
152	Investment	0	0	0	0	0	0	0	0	0	0
153	Management C.	30	30	30	30	30	30	30	30	30	30
154	N.cash Flow	43554	25687	17440	14601	14351	14360	11114	11883	13850	10470
155	N.P.V.cash Flow	7813.8	0	0	0	0	0	0	0	0	0
156											
158	Table 1. 10.	ADDITIONAL INFORMATION, ALL FLEETS - Deterministic									
159		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
160	Landings Cod	6952.0	4976.1	4086.4	3588.4	3430.9	3344.7	2243.0	1934.5	1934.3	1317.8
161	Landings Plaice	673.21	581.18	521.74	470.85	463.60	471.39	316.15	257.95	241.85	153.53
162	Total Landings	7625.3	5557.3	4608.1	4059.2	3894.5	3816.1	2559.2	2192.5	2176.2	1471.4
163	Value Cod	63633	45181	36552	31826	30453	29782	20015	17339	17459	11984
164	Value Plaice	6244.4	5388.1	4806.9	4314.7	4243.9	4321.9	2904.7	2378.3	2240.7	1429.8
165	Total Value	69877	50569	41359	36140	34697	34104	22919	19717	19700	13414
166	Mean Value/kg	9.1639	9.0997	8.9752	8.9032	8.9092	8.9369	8.9558	8.9930	9.0527	9.1167
167	Number of Crew	988	988	988	988	988	988	988	988	988	988
168	Number of boats	2800	2600	2500	2251	2126	2063	1232	816	608	304
169											

Figure 4.1.3. Third portion of Summary output.

3.2. GRAPHICAL OUTPUT FROM TEMAS



Except "NPV_Output", all output is structured as time series.

The output from TEMAS consists only of tables with numbers. TEMAS does not produce any graphs.

It is up to the user of TEMAS to apply the facilities of EXCEL to produce whatever graphs she/he considers useful.

Some tables are designed by TEMAS to make the transformation into a graph easy. Figure 3.2.1, for example, shows a typical output from 500 multiple stochastic simulations. In this case the graph shows the frequency distribution of present net value of financial net cash flow of the harvesting for two fleets (Trawlers and Gill-netters)

Financial NPV of Fleet		
	Trawler	Gill net
Mean	120492	61139
Std.dev.	36550	18789
Min	23346	5884
Max	267985	123501
Rel.Std. dev %	30	31
Class index	Trawler	Gill net
1	1	3
2	4	1
3	4	2
4	6	6
5	21	3
6	39	18
7	35	21
8	47	27
9	54	50
10	56	45
11	52	46
12	43	54
13	37	35
14	37	36
15	22	45
16	7	35
17	11	25
18	8	16
19	9	12
20	2	8
21	3	5
22	1	4
23	0	2
24	0	0
25	1	1

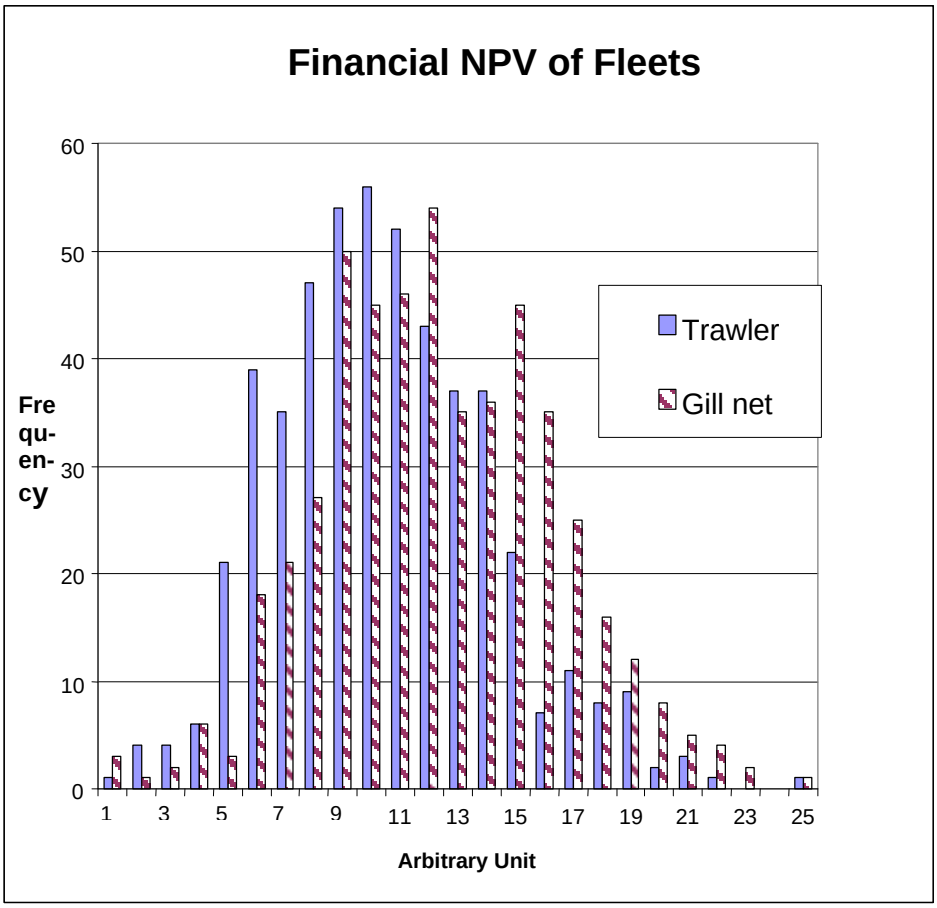


Figure 3.2.1. Example of graph produced from the output tables of TEMAS.

The unit on the x-axis is arbitrary. TEMAS finds the minimum and the maximum values simulated, and computes the "Range = Maximum – Minimum". Then for each simulated value, X, it assigns the

$$Class\ \ Index = INT\left[\ \frac{X - Minimum}{Range} + 0.5\ \right]$$

where "Int" is the integer part of a real number. The "Frequency" is then the number of times a "Class index" was simulated.

Other types of output graphs from multiple stochastic simulations are shown in Section 7.2.

The table left of the graph in Figure 3.2.1, is the table appearance on the work sheet "NPV_Output".

To get the graph, the user must on her/his own activate the "Chart wizard" of EXCEL. In this case, the production of the graph was straightforward. In other cases, the output of TEMAS may not match the wishes of the user, the user will then need to do some pre-processing of the output before the graph can be made. Alternatively, the user may modify the VISUAL BASIC code of TEMAS, to make it produce a suitable output table.

4.3. DETAILED BIOLOGICAL OUPUT FROM SINGLE SIMULATION

TEMAS does not provide any facilities on its own for printing hard copies of output. The user is supposed to manage on her/his own by aid of the print facilities of EXCEL. Table 3.3.1 shows an example of a table with annual stock structured output produced by TEMAS. In this case the output comes from a single simulation, which allows for very detailed output.

Species A : STOCK NUMBERS – Deterministic

Age/Year	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
0	2000.0	1300.0	1296.4	1296.0	1295.1	1293.6	1291.7	1289.6	1287.4	1285.3	1283.5	1281.8	1280.6
1	1637.5	1630.1	1063.1	1060.1	1059.8	1059.0	1057.9	1056.3	1054.6	1052.9	1051.2	1049.7	1048.3
2	1340.6	1237.4	1294.9	844.6	842.4	842.6	842.6	841.7	840.8	840.1	838.7	837.7	837.1
3	1097.6	902.0	924.9	968.5	632.3	631.3	632.9	632.9	632.7	633.6	633.0	632.5	633.3
4	898.7	717.0	662.8	680.9	713.7	466.4	466.9	468.0	468.5	469.7	470.3	470.3	471.3
5	735.8	584.6	525.6	487.2	501.5	525.9	344.6	345.0	346.2	347.5	348.4	349.1	350.1
6	602.4	478.3	428.4	386.3	359.1	370.1	389.2	255.0	255.5	257.0	258.0	258.9	260.1
7	493.2	391.5	350.4	314.8	284.7	265.3	274.3	288.4	189.1	190.0	191.1	192.0	193.1
8	403.8	320.5	286.8	257.5	232.0	210.3	196.8	203.7	214.2	140.8	141.5	142.4	143.4
9	330.6	477.3	584.5	640.3	661.7	660.3	646.1	626.4	618.1	621.8	570.2	532.8	506.9
Biomass	**142323**	**127434**	**125697**	**121980**	**116900**	**111223**	**105802**	**100766**	**96422**	**92936**	**89988**	**87877**	**86532**
SSB	**130086**	**116857**	**115657**	**112803**	**108507**	**103377**	**98296**	**93477**	**89271**	**85864**	**82970**	**80899**	**79574**

Species A : CATCH NUMBERS – Deterministic

Age/Year	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
0	33.7	6.3	6.2	6.1	6.0	5.9	5.9	5.8	5.6	5.6	5.5	5.4	5.4
1	477.4	189.6	122.7	121.4	119.5	116.6	116.5	114.4	111.4	111.2	109.2	106.2	106.0
2	909.7	420.8	436.9	282.2	278.7	271.8	271.8	268.7	261.4	261.2	258.0	250.7	250.5
3	845.7	360.9	364.0	378.0	244.8	238.2	238.9	236.8	230.5	230.9	228.6	222.2	222.5
4	704.0	292.8	264.3	267.0	278.2	177.2	177.5	176.5	172.0	172.6	171.3	166.7	167.1
5	578.0	239.6	210.0	190.0	192.8	197.6	129.6	128.7	125.8	126.3	125.6	122.5	122.9
6	473.6	196.1	171.3	150.5	136.9	136.7	144.2	93.8	91.5	92.2	91.8	89.6	90.1
7	387.8	160.6	140.1	122.7	108.4	97.1	99.9	104.5	66.7	67.1	67.0	65.5	66.0
8	317.5	131.5	114.7	100.4	88.4	76.9	71.0	72.5	74.4	49.0	48.9	47.9	48.3
9	260.0	195.8	233.8	249.6	252.0	241.4	232.8	220.7	209.5	209.3	189.0	170.8	162.1
YIELD	**114208**	**51207**	**49462**	**47034**	**44229**	**40599**	**38317**	**35967**	**33350**	**32065**	**30738**	**29165**	**28730**

Species A : FISHING MORTALITY - Deterministic

Age/Year	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
0	0.009	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
1	0.161	0.061	0.060	0.060	0.059	0.057	0.057	0.056	0.055	0.055	0.054	0.053	0.053
2	0.394	0.185	0.183	0.181	0.179	0.175	0.175	0.173	0.168	0.168	0.166	0.161	0.161
3	0.453	0.221	0.219	0.216	0.214	0.209	0.209	0.207	0.201	0.201	0.199	0.193	0.193
4	0.462	0.226	0.224	0.221	0.219	0.213	0.213	0.211	0.205	0.205	0.204	0.198	0.198
5	0.463	0.227	0.225	0.222	0.220	0.214	0.214	0.212	0.206	0.206	0.204	0.198	0.198
6	0.464	0.227	0.225	0.222	0.220	0.214	0.214	0.212	0.206	0.206	0.204	0.198	0.198
7	0.464	0.227	0.225	0.222	0.220	0.214	0.214	0.212	0.206	0.206	0.205	0.199	0.199
8	0.464	0.227	0.225	0.222	0.220	0.214	0.214	0.212	0.207	0.207	0.205	0.199	0.199
9	0.464	0.227	0.225	0.222	0.220	0.214	0.214	0.212	0.207	0.207	0.205	0.199	0.199

Table 3.3.1. Example of stock structured annual output from worksheet "Stock_Output"

Table 3.3.2 shows an example of finer details, namely results by time period (here by quarters). In this case the output tables has been transferred from EXCEL into MS WORD, and has been subject to various editing. In the present case, the table is very close to the table as it appears in the worksheet "Stock_Output", but the idea is that the user should define the final design of output.

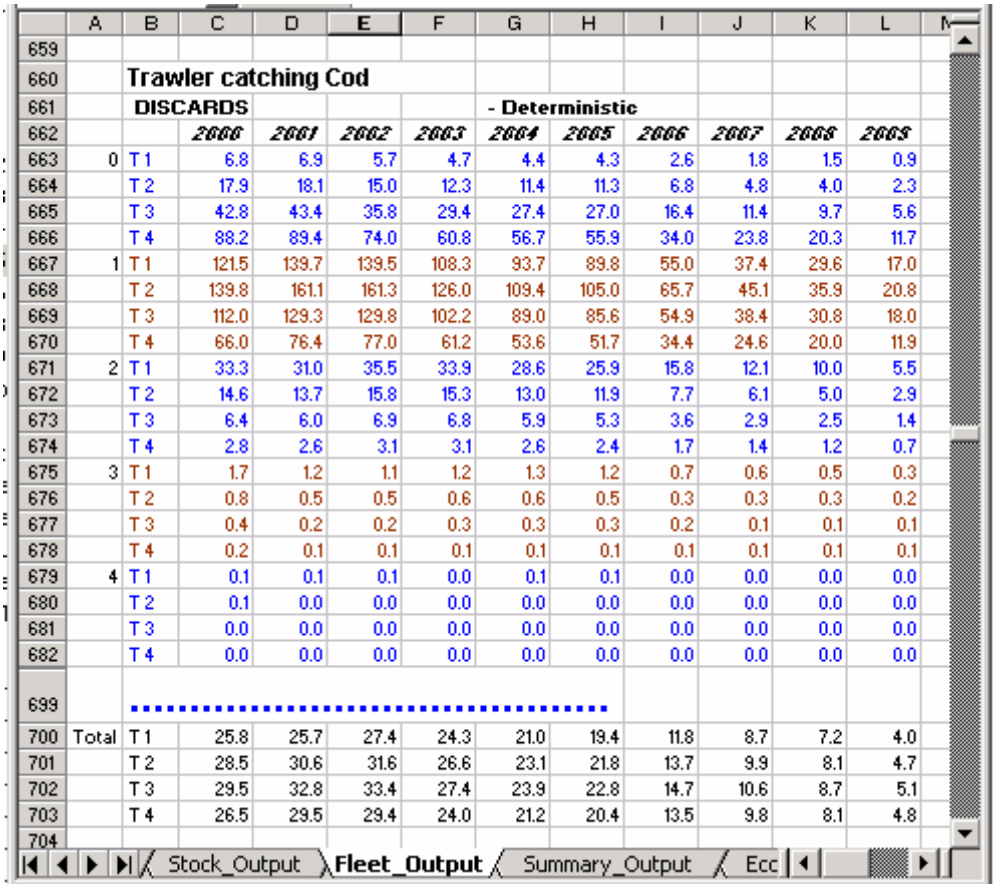
The results shown in Table 3.3.1and 3.3.2 represents only one species, accumulated over all fleets. Catch number and fishing mortality (Table 3.3.1) could be given for each fleet as well. In case there are several areas there will also be a Table for each combination of Fleet, Stock and Area. With several fleets and stocks and areas, the output from TEMAS will be overwhelming. In many cases, only a few selected, if any, tables like Tables 3.3.1-2 or more detailed tables, will be used in the report of the fisheries assessment made by TEMAS.

Age/Year		*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
0	Q 1	2000.0	1300.0	1296.4	1296.0	1295.1	1293.6	1291.7	1289.6	1287.4	1285.3	1283.5	1281.8	1280.6
	Q 2	1900.1	1235.1	1231.6	1231.3	1230.4	1229.1	1227.3	1225.3	1223.3	1221.3	1219.6	1218.0	1216.8
	Q 3	1801.6	1174.9	1171.6	1171.2	1170.4	1169.1	1167.4	1165.5	1163.6	1161.7	1160.1	1158.6	1157.5
	Q 4	1713.7	1117.6	1114.4	1114.1	1113.3	1112.1	1110.5	1108.7	1106.9	1105.1	1103.5	1102.1	1101.0
1	Q 1	1637.5	1630.1	1063.1	1060.1	1059.8	1059.0	1057.9	1056.3	1054.6	1052.9	1051.2	1049.7	1048.3
	Q 2	1510.4	1504.4	981.3	978.8	979.0	979.0	977.9	976.9	976.0	974.4	973.3	972.6	971.4
	Q 3	1367.6	1431.0	933.4	931.0	931.2	931.2	930.2	929.3	928.4	926.9	925.8	925.2	924.0
	Q 4	1300.9	1361.2	887.9	885.6	885.8	885.8	884.8	883.9	883.2	881.7	880.7	880.1	878.9
2	Q 1	1340.6	1237.4	1294.9	844.6	842.4	842.6	842.6	841.7	840.8	840.1	838.7	837.7	837.1
	Q 2	1162.3	1074.5	1125.2	734.6	733.4	735.3	735.3	735.1	736.1	735.4	734.9	735.8	735.2
	Q 3	996.9	1022.1	1070.3	698.8	697.7	699.4	699.4	699.3	700.2	699.6	699.1	699.9	699.4
	Q 4	948.3	972.3	1018.1	664.7	663.6	665.3	665.3	665.2	666.1	665.5	665.0	665.8	665.3
3	Q 1	1097.6	902.0	924.9	968.5	632.3	631.3	632.9	632.9	632.7	633.6	633.0	632.5	633.3
	Q 2	934.7	770.1	791.1	829.1	541.8	542.4	543.8	544.3	545.7	546.4	546.4	547.6	548.2
	Q 3	792.4	732.5	752.5	788.7	515.4	516.0	517.3	517.7	519.1	519.8	519.8	520.8	521.4
	Q 4	753.8	696.8	715.8	750.2	490.3	490.8	492.0	492.5	493.8	494.4	494.4	495.4	496.0
4	Q 1	898.7	717.0	662.8	680.9	713.7	466.4	466.9	468.0	468.5	469.7	470.3	470.3	471.3
	Q 2	763.3	610.7	566.1	582.6	611.1	400.4	400.9	402.2	403.7	404.7	405.6	406.8	407.6
	Q 3	646.0	580.9	538.5	554.2	581.3	380.9	381.3	382.6	384.0	385.0	385.8	386.9	387.7
	Q 4	614.5	552.6	512.2	527.2	552.9	362.3	362.7	363.9	365.3	366.2	367.0	368.1	368.8
5	Q 1	735.8	584.6	525.6	487.2	501.5	525.9	344.6	345.0	346.2	347.5	348.4	349.1	350.1
	Q 2	624.7	497.7	448.8	417.2	430.0	452.1	296.3	296.8	298.6	299.7	300.8	302.2	303.1
	Q 3	528.6	473.4	426.9	396.8	409.0	430.1	281.8	282.4	284.1	285.1	286.1	287.5	288.3
	Q 4	502.8	450.3	406.1	377.5	389.1	409.1	268.1	268.6	270.2	271.2	272.1	273.5	274.2
6	Q 1	602.4	478.3	428.4	386.3	359.1	370.1	389.2	255.0	255.5	257.0	258.0	258.9	260.1
	Q 2	511.4	407.1	365.7	330.8	308.2	318.7	335.0	219.7	220.7	222.0	223.0	224.4	225.5
	Q 3	432.7	387.3	347.9	314.6	293.1	303.2	318.7	209.0	210.0	211.2	212.2	213.5	214.5
	Q 4	411.6	368.4	330.9	299.3	278.9	288.4	303.2	198.8	199.7	200.9	201.8	203.1	204.0
7	Q 1	493.2	391.5	350.4	314.8	284.7	265.3	274.3	288.4	189.1	190.0	191.1	192.0	193.1
	Q 2	418.7	333.3	299.2	269.5	244.4	228.6	236.6	248.9	163.6	164.4	165.5	166.6	167.7
	Q 3	354.2	317.0	284.6	256.4	232.5	217.5	225.1	236.7	155.6	156.3	157.4	158.5	159.5
	Q 4	336.9	301.6	270.7	243.9	221.1	206.9	214.1	225.2	148.0	148.7	149.7	150.8	151.7
8	Q 1	403.8	320.5	286.8	257.5	232.0	210.3	196.8	203.7	214.2	140.8	141.5	142.4	143.4
	Q 2	342.8	272.8	244.9	220.5	199.2	181.3	169.9	176.1	185.6	122.0	122.6	123.8	124.7
	Q 3	290.0	259.5	233.0	209.7	189.4	172.5	161.6	167.5	176.5	116.1	116.7	117.8	118.6
	Q 4	275.9	246.9	221.6	199.5	180.2	164.1	153.7	159.3	167.9	110.4	111.0	112.0	112.8
9	Q 1	330.6	477.3	584.5	640.3	661.7	660.3	646.1	626.4	618.1	621.8	570.2	532.8	506.9
	Q 2	280.7	406.3	499.1	548.3	568.0	569.3	557.9	542.0	536.9	540.5	496.4	465.2	442.7
	Q 3	237.4	386.5	474.7	521.6	540.3	541.5	530.6	515.6	510.7	514.1	472.2	442.5	421.1
	Q 4	225.9	367.6	451.6	496.1	514.0	515.1	504.8	490.5	485.8	489.1	449.1	420.9	400.6
Bio-	Q 1	142323	127434	125697	121980	116900	111223	105802	100766	96422	92936	89988	87877	86532
mass	Q 2	131594	117819	116092	112560	107862	102911	97978	93524	89877	86771	84225	82564	81364
	Q 3	121207	121271	119070	115101	110087	104957	99950	95490	91880	88829	86347	84735	83567
	Q 4	125032	124639	121939	117540	112235	106951	101888	97437	93872	90880	88464	86901	85766
SSB	**Q 1**	130086	116857	115657	112803	108507	103377	98296	93477	89271	85864	82970	80899	79574
	Q 2	120418	108071	106952	104228	100197	95683	91031	86751	83204	80165	77660	76019	74836
	Q 3	110960	111393	109910	106760	102377	97650	92899	88600	85081	82093	79650	78057	76906
	Q 4	114618	114672	112779	109192	104478	99564	94737	90434	86952	84019	81641	80096	78977

Table 3.3.2. Example of stock structured output (Stock numbers, Biomass and SSB) from worksheet "Stock_Output", by time period (here by quarter).

Figures 3.3.3-4 shows examples of output tables which are less aggregated than Tables 3.3.1-2, which refers to all fleets and areas combined. Figures 3.3.3-4 are tables from worksheet "Fleet_Output".

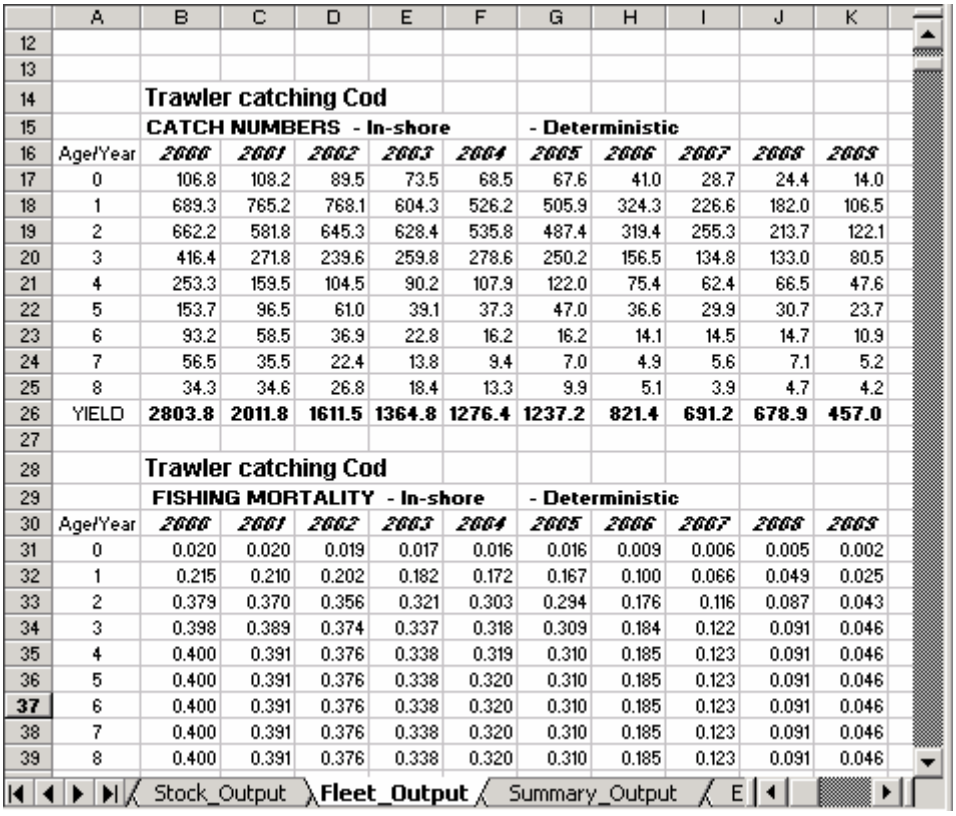
Figure 3.3.3 refers to one selected fleet, whereas Figure 3.3.4 refers to a combination of selected fleet and selected area. Figure 3.3.3 gives the results by time period, whereas Table 3.3.4 give result by year. The numbers caught from Table 3.3.4 are given a graphical presentation in Figure 3.3.1.



	A	B	C	D	E	F	G	H	I	J	K	L
659												
660		Trawler catching Cod										
661		DISCARDS					- Deterministic					
662			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
663	0	T 1	6.8	6.9	5.7	4.7	4.4	4.3	2.6	1.8	1.5	0.9
664		T 2	17.9	18.1	15.0	12.3	11.4	11.3	6.8	4.8	4.0	2.3
665		T 3	42.8	43.4	35.8	29.4	27.4	27.0	16.4	11.4	9.7	5.6
666		T 4	88.2	89.4	74.0	60.8	56.7	55.9	34.0	23.8	20.3	11.7
667	1	T 1	121.5	139.7	139.5	108.3	93.7	89.8	55.0	37.4	29.6	17.0
668		T 2	139.8	161.1	161.3	126.0	109.4	105.0	65.7	45.1	35.9	20.8
669		T 3	112.0	129.3	129.8	102.2	89.0	85.6	54.9	38.4	30.8	18.0
670		T 4	66.0	76.4	77.0	61.2	53.6	51.7	34.4	24.6	20.0	11.9
671	2	T 1	33.3	31.0	35.5	33.9	28.6	25.9	15.8	12.1	10.0	5.5
672		T 2	14.6	13.7	15.8	15.3	13.0	11.9	7.7	6.1	5.0	2.9
673		T 3	6.4	6.0	6.9	6.8	5.9	5.3	3.6	2.9	2.5	1.4
674		T 4	2.8	2.6	3.1	3.1	2.6	2.4	1.7	1.4	1.2	0.7
675	3	T 1	1.7	1.2	1.1	1.2	1.3	1.2	0.7	0.6	0.5	0.3
676		T 2	0.8	0.5	0.5	0.6	0.6	0.5	0.3	0.3	0.3	0.2
677		T 3	0.4	0.2	0.2	0.3	0.3	0.3	0.2	0.1	0.1	0.1
678		T 4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
679	4	T 1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
680		T 2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
681		T 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
682		T 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
699												
700	Total	T 1	25.8	25.7	27.4	24.3	21.0	19.4	11.8	8.7	7.2	4.0
701		T 2	28.5	30.6	31.6	26.6	23.1	21.8	13.7	9.9	8.1	4.7
702		T 3	29.5	32.8	33.4	27.4	23.9	22.8	14.7	10.6	8.7	5.1
703		T 4	26.5	29.5	29.4	24.0	21.2	20.4	13.5	9.8	8.1	4.8
704												

Stock_Output | Fleet_Output | Summary_Output | Ecc

Figure 3.3.3. Stock and Fleet specific output by time period (from worksheet "Fl_Out_Period")



	A	B	C	D	E	F	G	H	I	J	K
12											
13											
14		Trawler catching Cod									
15		CATCH NUMBERS - In-shore					- Deterministic				
16	Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
17	0	106.8	108.2	89.5	73.5	68.5	67.6	41.0	28.7	24.4	14.0
18	1	689.3	765.2	768.1	604.3	526.2	505.9	324.3	226.6	182.0	106.5
19	2	662.2	581.8	645.3	628.4	535.8	487.4	319.4	255.3	213.7	122.1
20	3	416.4	271.8	239.6	259.8	278.6	250.2	156.5	134.8	133.0	80.5
21	4	253.3	159.5	104.5	90.2	107.9	122.0	75.4	62.4	66.5	47.6
22	5	153.7	96.5	61.0	39.1	37.3	47.0	36.6	29.9	30.7	23.7
23	6	93.2	58.5	36.9	22.8	16.2	16.2	14.1	14.5	14.7	10.9
24	7	56.5	35.5	22.4	13.8	9.4	7.0	4.9	5.6	7.1	5.2
25	8	34.3	34.6	26.8	18.4	13.3	9.9	5.1	3.9	4.7	4.2
26	YIELD	**2803.8**	**2011.8**	**1611.5**	**1364.8**	**1276.4**	**1237.2**	**821.4**	**691.2**	**678.9**	**457.0**
27											
28		Trawler catching Cod									
29		FISHING MORTALITY - In-shore					- Deterministic				
30	Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
31	0	0.020	0.020	0.019	0.017	0.016	0.016	0.009	0.006	0.005	0.002
32	1	0.215	0.210	0.202	0.182	0.172	0.167	0.100	0.066	0.049	0.025
33	2	0.379	0.370	0.356	0.321	0.303	0.294	0.176	0.116	0.087	0.043
34	3	0.398	0.389	0.374	0.337	0.318	0.309	0.184	0.122	0.091	0.046
35	4	0.400	0.391	0.376	0.338	0.319	0.310	0.185	0.123	0.091	0.046
36	5	0.400	0.391	0.376	0.338	0.320	0.310	0.185	0.123	0.091	0.046
37	6	0.400	0.391	0.376	0.338	0.320	0.310	0.185	0.123	0.091	0.046
38	7	0.400	0.391	0.376	0.338	0.320	0.310	0.185	0.123	0.091	0.046
39	8	0.400	0.391	0.376	0.338	0.320	0.310	0.185	0.123	0.091	0.046

Stock_Output | Fleet_Output | Summary_Output | E

Figure 3.3.4. Stock, Fleet and area specific annual output. (from worksheet "Fl_Out_Area")

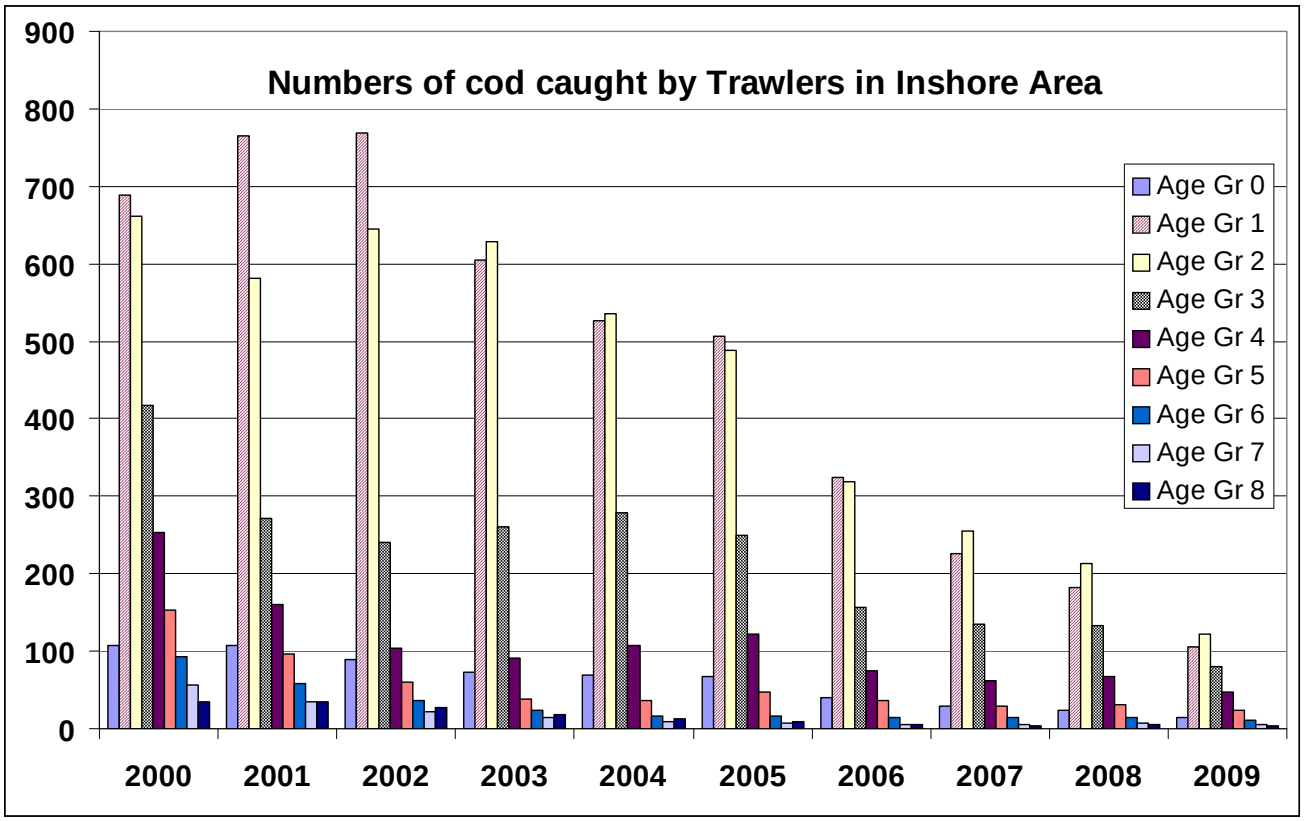


Figure 3.3.1. Example of graphical presentation of fleet structured output. Derived from Figure 3.3.4.

Figure 3.3.1 uses lines 16-25 of Table 3.3.4 as input to the EXCEL graph wizard, without any modifications of the data. Naturally, you must know how to operate the graph wizard of EXCEL, but once you master that technique, it takes little time to produce Figure 3.3.1. Once you have the graph, it will stay in the worksheet, and be modified every time you make a new simulation. Like that you can "customize" the graphical output of TEMAS.

If you master the VISUAL BASIC language, you may add sub-routines, which produces tables for graphs on your own choice.

You may as well make your own tables derived from the standard output tables of TEMAS, but then you should remember that TEMAS clears the output sheets, when it restart the calculations. Thus, you should make a copy your private tables in a separate (non-standard) sheet in TEMAS_CALC. This is the main reason why EXCEL has been chosen for the implementation of TEMAS, namely to give the user the maximum freedom to customize input and output handling and presentation by aid of a well-known tool.

Section 4.3 describes an example of a user-defined table, to manipulate input data to TEMAS.

One problem with the TEMAS output is that the there is so much of it. It is necessary to be rather selective concerning the choice of results to present in the report on the TEMAS analysis. Probably one will not show age structured results in the final report, unless there is a request to address questions related to size distribution. A TEMAS analysis aiming at assessing the effect of mesh size changes may require the presentation of age/size structured data, whereas for other analyses if will suffice to present only total landings by weight and/or by value. Thus, there is no set of standard output tables of TEMAS. It all depends on the objectives of using TEMAS in the actual situation.

The detailed output is thought of as a options for the user, by which she/he can check and assess the simulations. The detailed results may reveal inconsistencies and questionable assumptions in the input parameters.

4.4. DETAILED ECONOMIC OUPUT FROM SINGLE SIMULATION

The economic output combined with a few biological summary results is considered the principal output of TEMAS, as explained in Section 3.1. This section present some detailed economic results as well as some results of a technical/employment/biological nature.

Table 3.4.1 shows an example of fleet specific economic output from a single deterministic simulation. In this case it shows the two financial analyses and the economic analysis for the trawler fleet, together with some "additional information". The economic analyses are explained in detail in the theoretical paper on TEMAS.

The economic results are shown for each fleet (Table 3.4.1), as well as for all fleets combined (in the summary outpt).

The additional information for the fleet-specific economic analysis (Table 3.4.1) shows the total landings, the value, the CPUE (Catch Per Unit of Effort) the Val.PUE (Value Per Unit of Effort) for each stock. In the example of Table 3.4.1, there are two species "Cod" and "Plaice". The additional information thus is a summary of the biological output related to the production of fleets. Furthermore, the additional information shows the capacity (the number of vessels) and the employment. All these results are key-results, and may be used as indicators for the performance of the fleets.

CPUE and Val.PUE represent the production in the economic model. But CPUE also indicates the stock biomass, so, somehow, these are central indicators of the system, of interest both to biologists and economists.

The "gross revenue" (Table 3.4.1) is derived as the product of Val.P.U.E and price. The gross revenue minus the costs of fishing and investments gives the "Cash flow" in the financial analysis of the harvesting sector. The cash flow represents the "profit" of the fleet (Table 3.4.1) or the industry (summary output). A similar concept is used in the economic analysis, where the stakeholder is considered to be the society. For the government treasury, the perspective is kind of turned around, with for example, tax being an income, not a cost.

Note that table 3.1.3 and 3.4.1 does not match in all lines. Table 3.1.3 shows results for all fleets combined, and then it does not make sense to give any results on effort, CPUE and Val.PUE., as these concepts are linked to individual fleets. Table 3.1.3 contains only output for which the units are fleet-independent, so that they can be summed over fleets.

Some output of the economic tables, can in a meaningful way be given by stock, area and by time period, but not all of them. From the (pure) economic point of view it is irrelevant where the landings come from in terms of stock and area, and therefore it may usually not make sense to make an economic analysis for a fish stock or a fishing area in isolation.

The NPVs (Net Present Values) of the net cash flows are shown below the column for the first year, but it refers to the entire time series by the formula, where "r" is either the discount rate for the financial analysis or the discount rate for the economic analysis (see discussion in the theoretical paper on TEMAS).

$$NPV(r) = \sum_{y=2000}^{2012} \frac{Net\_Value_y}{(1+r)^{y-2000}}$$

Table 2. 1. 1. **FINANCIAL ANALYSIS OF HARVESTING Trawler - Deterministic**

.	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Gr. revenue before tax	37444	26329	17037	12195	9730.5	9114.3	4509.0	3277.9	3585.1	1265.7
Revenue tax	1872.2	1316.5	851.83	609.77	486.53	455.71	225.45	163.89	179.25	63.287
Gr. revenue after tax	35572	25013	16185	11586	9244.0	8658.6	4283.6	3114.0	3405.8	1202.5
Costs of effort	6161.5	6141.8	5583.4	5054.6	4595.5	4671.9	2194.9	1260.7	1017.2	254.10
Cost of landing	38.524	25.887	16.405	11.585	9.1260	8.4157	4.0987	2.9368	3.1639	1.0994
Crew share	4411.5	2830.6	1590.2	979.64	697.27	598.00	313.31	277.99	358.29	142.25
Crew salary	6161.5	6141.8	5583.4	5054.7	4595.5	4671.9	2194.9	1260.7	1017.2	254.10
Fixed Costs	5250	4985.3	4532	4102.8	3730.1	3792.2	1781.6	1023.3	825.68	206.25
Investment	0	255	0	260	0	530	0	1350	272.50	0
Decommission	0	0	14.400	0	18.300	0	42.600	0	10.500	0
Effort tax	9.2422	9.2127	8.3751	7.5820	6.8933	7.0079	3.2923	1.8911	1.5258	.38115
Effort subsidy	6.1615	6.1418	5.5834	5.0547	4.5955	4.6719	2.1949	1.2607	1.0172	.25410
Licence fee	1680	1564	1408	1262.4	1136.8	1144.8	532.80	303.20	242.40	60
N.cash Flow	11866	3065.3	-2517.1	-5142.7	-5504.4	-6761.0	-2696.4	-2365.5	-320.66	284.53
N.P.V.cash Flow	-19042	0	0	0	0	0	0	0	0	0

Table 2. 1. 2. **FINANCIAL ANALYSIS OF GOVERNMENT TREASURY, Trawler - Deterministic**

.	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Subsidies/boats/yr	16800	15953	14502	13129	11936	12135	5701.0	3274.6	2642.2	660
Vessel Decomm.	0	0	48	0	61	0	142	0	35	0
Crew Decomm.	0	0	5487.8	0	7109.6	0	16865	0	4234.7	0
Management C.	15	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500
Effort tax	9.2422	9.2127	8.3751	7.5820	6.8933	7.0079	3.2923	1.8911	1.5258	.38115
Effort Subsidy	6.1615	6.1418	5.5834	5.0547	4.5955	4.6719	2.1949	1.2607	1.0172	.25410
Licence fee	1680	1564	1408	1262.4	1136.8	1144.8	532.80	303.20	242.40	60
Revenue tax	1872.2	1316.5	851.83	609.77	486.53	455.71	225.45	163.89	179.25	63.287
N.cash Flow	-13260	-13085	-17791	-11270	-17497	-10548	-21965	-2823.0	-6506.0	-553.09
N.P.V.cash Flow	-90682	0	0	0	0	0	0	0	0	0

Table 2. 1. 3. **ECONOMIC ANALYSIS - Trawler - Deterministic**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Gross revenue	37444	26329	17037	12195	9730.5	9114.3	4509.0	3277.9	3585.1	1265.7
Cost of effort	6161.5	6141.8	5583.4	5054.6	4595.5	4671.9	2194.9	1260.7	1017.2	254.10
Cost of landings	38.524	25.887	16.405	11.585	9.1260	8.4157	4.0987	2.9368	3.1639	1.0994
Crew Oppurt.C.	6300	5982.3	5438.4	4923.4	4476.2	4550.6	2137.9	1228.0	990.81	247.50
Fixed costs	5250	4985.3	4532	4102.8	3730.1	3792.2	1781.6	1023.3	825.68	206.25
Investment	0	255	0	260	0	530	0	1350	272.50	0
Management C.	15	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500
N.cash Flow	19679	8923.7	1450.9	-2172.6	-3096.2	-4454.7	-1625.4	-1603.2	459.37	540.29
N.P.V.cash Flow	-613.38	0	0	0	0	0	0	0	0	0

Table 2. 1. 4. **ADDITIONAL INFORMATION - Trawler - Deterministic**

.	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Landings Cod	3512.4	2258.8	1381.0	944.57	724.62	651.58	311.86	222.62	240.10	83.768
Landings Plaice	340.02	279.11	211.81	169.36	144.53	142.35	71.192	49.304	50.159	16.178
Total Landings	3852.4	2537.9	1592.8	1113.9	869.15	793.93	383.05	271.92	290.26	99.946
Value Cod	40012	29047	19924	15029	12383	11826	5704.7	3837.1	3878.0	1282.2
Value Plaice	8981.6	8250.0	7082.9	6192.2	5554.1	5631.4	2723.7	1692.0	1523.6	437.33
Total Value	37444	26329	17037	12195	9730.5	9114.3	4509.0	3277.9	3585.1	1265.7
Mean Value/kg	9.7196	10.374	10.696	10.948	11.195	11.480	11.771	12.054	12.351	12.664
Number of Crew	0	0	0	0	0	0	0	0	0	0
Number of boats	2100	1955	1760	1578	1421	1431	666	379	303	75
C.P.U.E Cod	.0057	.0038	.0025	.0019	.0017	.0015	.0015	.0019	.0026	.0036
C.P.U.E Plaice	.0006	.0005	.0004	.0003	.0003	.0003	.0003	.0004	.0005	.0007
Val.P.U.E Cod	.0547	.0383	.0267	.0208	.0181	.0165	.0174	.0224	.0309	.0448
Val.P.U.E Plaice	.0061	.0054	.0047	.0043	.0042	.0042	.0046	.0057	.0075	.0100

Table 3.4.1. Example of economic output. The three analyses for a selected fleet (From worksheet "Economic_Output")

4.5. OUTPUT FROM STOCHASTIC SIMULATIONS

The output from multiple simulations is in worksheets "Stochastic_Output" (Tables 3.5.1-2) and "NPV_Output" (NPV = Net Present Value", Table 3.5.3),.

The results in worksheet "NPV_Output" is derived from the results in worksheet "Stochastic Output", by the formula:

$$NPV(r) = \sum_{y=First\ Year}^{Lasty\ year} \frac{Net\_Value_y}{(1+r)^{y-First\ Year}}$$

Thus, the detailed results are shown in "Stochastic_Output" and the summary results in "NPV_Output"

The output from multiple stochastic simulations only shows time series of a few selected key results, and their net present values. (stochastic simulation is also discussed in Section 7)

The annual output is given in the form of a frequency distribution for each year, as illustrated by the example in Table 3.5.1, which shows the time series of frequencies of 500 simulations of the Cash Flow of Harvesting for a selected fleet.

The row "Class low.lim." (Lower limit of class interval) divides the range of output values in interval of equal length. The sum of the table entries in each "year-row" is 500. The number in each row gives the number of simulation where the result felt in the interval in question. For example, in year 2000, there were 54 simulations, which gave a "Total cash flow " in the interval from 165 to 192.

The graph shown in Figure 3.2.1 is derived from two tables like Table 3.5.1, one for each fleet. From table 3.5.1. one could make 13 graphs. In Figure 3.2.1, the 13 graphs has been combined into one single graph, by computing the net present value of all net cash flows of 13 years.

Table 3.5.2 presents a complete list of the key results from the multiple stochastic simulations, in the case where there are two stocks and two fleets. Figure 3.5.1 shows an example of a graph easily produced from the first sub-table of Table 3.5.2.

Class index	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Class low. Lim.	-76	-49	-22	5	31	58	85	112	138	165	192	219	245	272	299	326	353	379	406	433	460	486	513	540	567
2000	0	0	0	1	4	6	11	21	31	54	51	51	69	46	36	40	34	10	13	13	4	4	0	0	1
2001	0	0	0	0	1	6	19	32	51	76	66	77	50	51	31	17	11	6	2	1	2	1	0	0	0
2002	0	0	0	0	1	17	23	59	69	89	73	66	45	24	15	11	2	3	0	2	0	1	0	0	0
2003	0	0	0	0	2	14	29	73	92	89	93	55	34	7	7	3	1	0	0	1	0	0	0	0	0
2004	0	0	0	1	18	55	111	105	95	63	25	10	10	4	1	0	0	0	0	1	1	0	0	0	0
2005	0	0	0	17	53	120	132	98	38	18	12	4	3	2	0	2	1	0	0	0	0	0	0	0	0
2006	0	3	37	76	127	101	68	48	17	14	3	1	3	0	1	1	0	0	0	0	0	0	0	0	0
2007	9	30	101	127	100	66	26	19	9	6	3	1	1	1	0	0	0	0	1	0	0	0	0	0	0
2008	0	4	32	109	128	97	53	35	19	9	7	2	1	3	0	1	0	0	0	0	0	0	0	0	0
2009	33	82	123	103	76	36	22	11	7	4	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
2010	5	33	104	121	106	66	26	16	13	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	3	13	84	138	106	72	41	22	8	5	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0
2012	23	73	113	109	94	41	22	10	8	2	1	2	0	1	0	1	0	0	0	0	0	0	0	0	0

Table 3.5.1. Time series of Frequency in 500 simulations of Cash Flow of Financial analysis of Harvest for fleet: Trawler

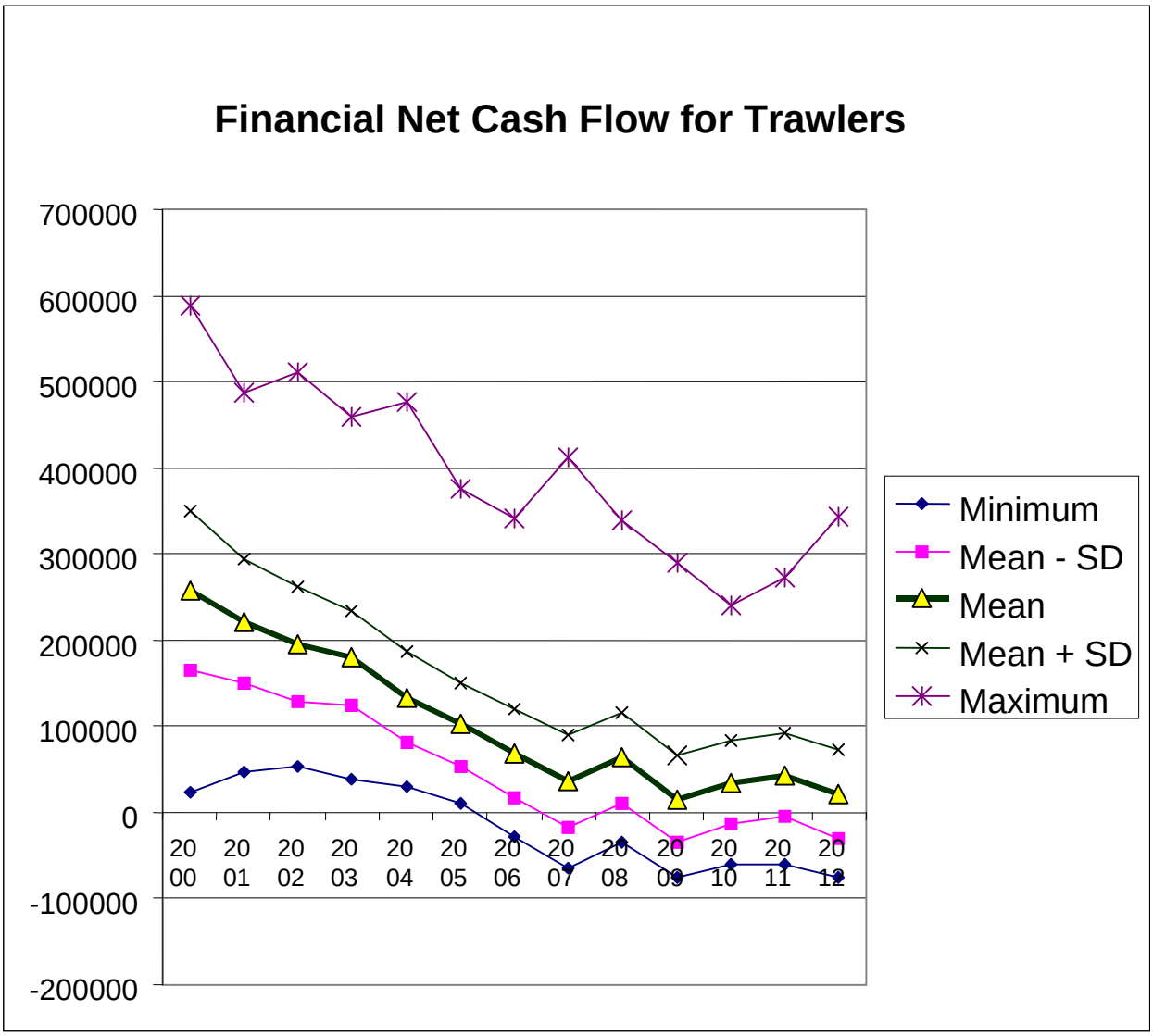


Figure 3.5.1. Graphical presentation of time series, produced by multiple stochastic simulations.

Figure 3.5.1 shows an alternative way of presenting distributions of net cash flow, compared to Figure 3.2.1 Figure 3.5.1 indicates the probability distributions for the cash flow every year in the time series. The probability distributions are indicated by the mean value of the distribution, and mean value plus/minus standard deviation (SD). The graph also shows the minimum and the maximum values among the simulations made.

Figure 3.5.1 is very easy to produce with the present version of TEMAS, as TEMAS produces the number shown in Table 3.5.2. These tables can easily be converted into graphs by aid of the EXCEL graph wizard. One does not need to make any modifications of the numbers in Table 3.5.2 to produce the graph 3.5.1.

Table 3.5.3 shows the complete content of sheet "NPV_Output", which gives estimated probability distribution the Net Present Values of the three analyses by fleets. The probability distributions are estimated by the frequencies, in this case, of only 100 simulations.

Somehow, one may claim that Table 3.5.3 represents the overall summary output of a TEMAS exercise, as it shows both the economic key results as well as their probability estimation. Actually, it is the **estimate of** the probability distribution, which Table 3.5.3 shows, and that estimate is based on the (questionable) assumption that TEMAS gives an unbiased reflection of the real world.

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Cash Flow Financial Harvest – Trawler

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum
2000	23241	165590	257635	349679	587675
2001	47711	149707	222028	294349	487046
2002	53439	128339	195438	262536	511103
2003	38095	125416	179472	233528	458392
2004	30880	81675	133833	185990	475772
2005	10716	54350	102182	150015	375716
2006	-27280	16267	67677	119086	341541
2007	-64380	-16984	36166	89315	412615
2008	-35454	10670	63394	116117	338330
2009	-74500	-35381	15398	66177	289954
2010	-60386	-13650	35137	83923	241085
2011	-60851	-5422	43758	92938	273627
2012	-75042	-30735	20785	72304	344137

Cash Flow Financial Harvest - Gill net

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum
2000	814	89875	137323	184772	263896
2001	-33039	47439	89822	132206	232303
2002	14159	69120	108069	147018	238287
2003	1770	59968	95593	131218	240079
2004	-15971	25358	60622	95885	219077
2005	-25115	11301	46766	82231	297860
2006	-59739	-18217	17858	53934	305817
2007	-63265	-20228	16318	52863	304579
2008	-69560	-37698	-1863	33972	175787
2009	-75000	-42083	-6182	29720	137661
2010	-94366	-58776	-25128	8520	99068
2011	-69533	-29577	2862	35302	155575
2012	-76635	-37965	-4330	29305	158348

Cash Flow Financial Government Treasury – Trawler

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Cash Flow Financial Government Treasury – Gill net

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Cash Flow Economic Analysis – Trawler

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Cash Flow Economic Analysis - Gill net

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Revenue – Trawler

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Revenue – Gill net

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

SSB – Shrimp

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

SSB – Squid

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Yield – Shrimp

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum

…… etc…..

Yield – Squid

Year	Minimum	Mean - SD	Mean	Mean + SD	Maximum
2000	12244	22805	28532	34258	44489
2001	17002	23367	28275	33182	45969
2002	17109	21618	25873	30128	42462
2003	14274	18651	22356	26061	39904
2004	11492	15514	19181	22847	38796
2005	9544	13114	16938	20763	51297
2006	9217	11762	15329	18897	48093
2007	7727	10932	14358	17784	45159
2008	6774	10184	13389	16594	32878
2009	6537	9373	12726	16080	32111
2010	5605	9044	12049	15054	27375
2011	6296	8902	11750	14599	25565
2012	5467	8287	11233	14179	22675

Table 3.5.2. Complete list of the key results from multiple stochastic simulations, in the case where there are two stocks and two fleets (the time series, however, are only shown for the two first key results and the last one).

Frequency in 100 simulations of Net Prevent Values						
	Trawler			**Gill Net**		
	Financial Harvest N.P.Val. Cash.Fl.	**Financial Govt. Tr. N.P.Val. Cash.Fl.**	**Economic Net Pre-sent Val. Cash.Fl.**	**Financial Harvest N.P.Val. Cash.Fl.**	**Financial Govt. Tr. N.P.Val. Cash.Fl.**	**Economic Net Pre-sent Val. Cash.Fl.**
Mean	1333.9	2274.6	3387.4	4619.4	1050.0	6221.3
Std.dev.	1185.8	77.7	1483.0	1139.7	72.0	1425.2
Min	-1397.5	2105.2	6.6	2049.1	889.1	3007.5
Max	4459.4	2514.3	7329.9	7624.4	1253.4	9987.5
Rel.Std.dev.	88.9	3.4	43.8	24.7	6.9	22.9
The simulated range is divided into 25 intervals, and frequencies refer to these intervals						
	Trawler			**Gill Net**		
Class index	**Financial Harvest N.P.Val. Cash.Fl.**	**Financial Govt. Tr. N.P.Val. Cash.Fl.**	**Economic Net Pre-sent Val. Cash.Fl.**	**Financial Harvest N.P.Val. Cash.Fl.**	**Financial Govt. Tr. N.P.Val. Cash.Fl.**	**Economic Net Pre-sent Val. Cash.Fl.**
1	**1**	**0**	**1**	**1**	**1**	**1**
2	**0**	**1**	**0**	**0**	**0**	**0**
3	**1**	**0**	**1**	**3**	**0**	**3**
4	**3**	**1**	**3**	**2**	**4**	**2**
5	**3**	**4**	**3**	**3**	**4**	**3**
6	**2**	**2**	**2**	**1**	**1**	**1**
7	**6**	**3**	**7**	**10**	**3**	**10**
8	**14**	**13**	**13**	**4**	**11**	**4**
9	**4**	**10**	**4**	**8**	**7**	**8**
10	**7**	**6**	**7**	**11**	**10**	**11**
11	**8**	**5**	**8**	**5**	**6**	**5**
12	**6**	**10**	**6**	**8**	**8**	**8**
13	**4**	**4**	**4**	**3**	**4**	**3**
14	**5**	**8**	**6**	**8**	**8**	**8**
15	**11**	**11**	**11**	**6**	**6**	**6**
16	**8**	**5**	**7**	**2**	**3**	**2**
17	**2**	**4**	**2**	**9**	**9**	**9**
18	**3**	**2**	**3**	**6**	**7**	**6**
19	**4**	**6**	**4**	**5**	**3**	**5**
20	**3**	**0**	**3**	**0**	**0**	**0**
21	**0**	**2**	**0**	**0**	**0**	**0**
22	**2**	**0**	**2**	**1**	**2**	**1**
23	**0**	**2**	**0**	**2**	**1**	**2**
24	**2**	**1**	**2**	**0**	**1**	**0**
25	**1**	**0**	**1**	**2**	**1**	**2**

TABLE 3.5.3. Summary output of stochastic simulations from work sheet "NPV_Output".

5. RUNNING THE TEMAS

5.1. DO'S AND DON'TS

When running TEMAS, you may do any calculation or manipulation of the TEMAS input tables and output tables by aid of the facilities in EXCEL. With the output tables, produced by workbook TEMAS_CALC, there is no special instruction on things you should not do. You can do anything you like with the output workbooks, except for deleting the sheets or renaming them. There are four general warnings on thing you should not when running TEMAS, in particular TEMAS_INPUT.

WARNING 1: Do NOT delete any of the standard spreadsheets of TEMAS, as that action will cause the TEMAS to crash.

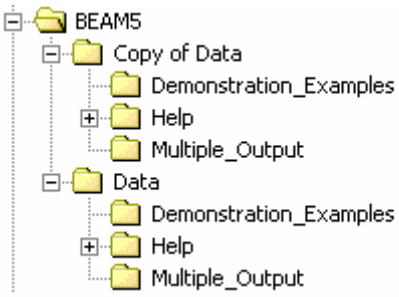
WARNING 2: Do NOT insert or delete rows or columns between the input cells (cells indicated by colours, predominantly yellow colour). The yellow cells occur only in workbook TEMAS_INPUT.

WARNING 3: Do NOT change the names of the standard worksheets of TEMAS. If you do, TEMAS will not function.

WARNING 4: Do NOT change the location of the TEMAS directories (as shown in Figure 1.3.1) (You may, however, change the location of C:\TEMAS\ if you make the corresponding change the to the "Declarations" -VB-modules.

WARNING 5: Do NOT delete files in the directories by aid of "Windows explorer":

C:\TEMAS\Data\
C:\TEMAS\Data\Demonstration_examples
C:\TEMAS\Data\Multiple_Output
C:\TEMAS\Data\Help



The data files can be deleted by options in the menu, and when you want to delete data files, do it with the button "Delete File(s)" in the main menu of the input module (Figures 1.3.5-6).

RECOMMENDATION 1: Do always keep a Backup file of your original data set. To be on the safe side you may from time to time make a copy of the entire data subdirectory.

Make also a backup of the entire TEMAS system, so that in case everything goes wrong you can start up with a fresh version of TEMAS system and your input data.

Making these backups takes very short time (seconds), whereas you may loose days of work if you loose your original data.

In general: TEMAS consists of two EXCEL workbooks. Follow the normal precautionary approaches when running EXCEL workbooks.

RECOMMENDATION 2: Use the "Clear All sheets" button from time to time , as TEMAS otherwise will grow in size. Without any data in the work sheets, each of the workbooks takes up about 2 Mb, but they may easily grow to 10 Mb after a number of applications. Both main menus (main menu of the input module, Figure 1.3.5-6 and the calculation module, Figure 4.4.1) contains the option to "Clear all sheets".

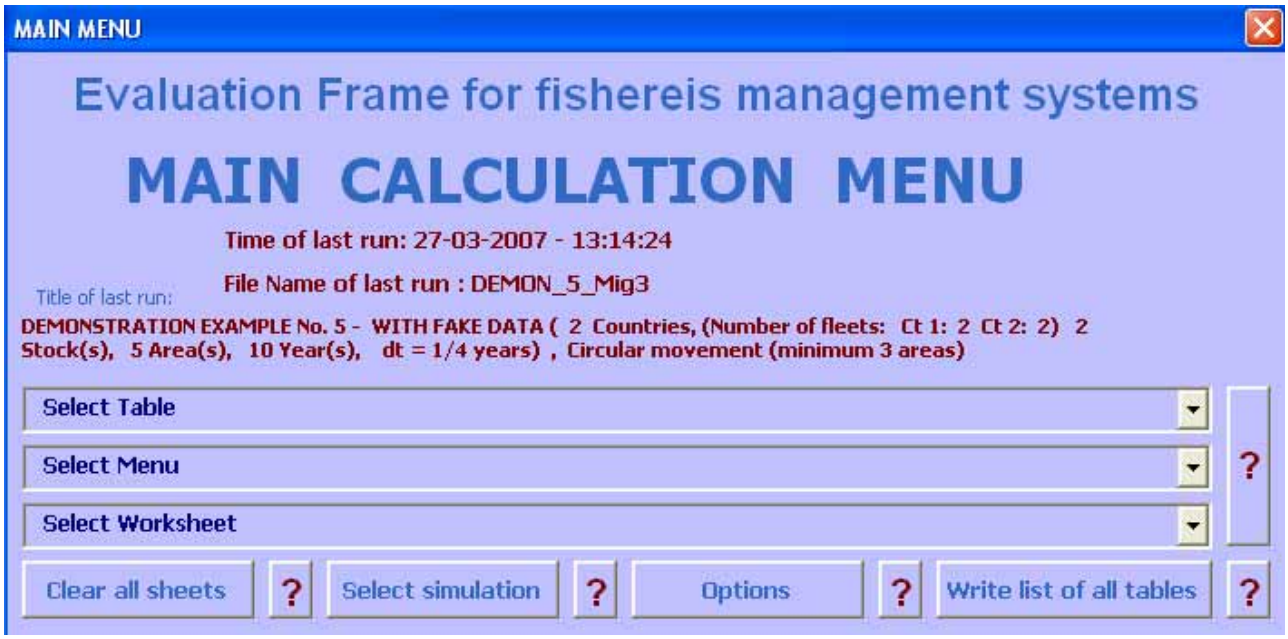
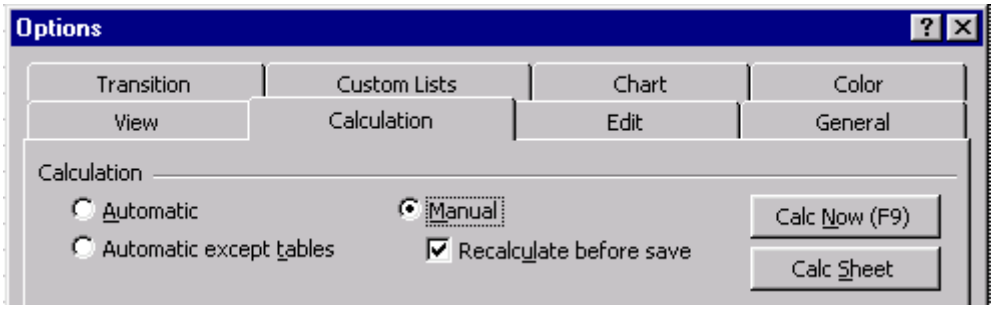


Figure 4.1.1. The main menu for the calculation module.

5.2. START CALCULATIONS



Calculation in TEMAS is executed by TEMAS_CALC. It should be kept in mind that TEMAS does not automatically execute the computations, when you modify the content of a cell, as in an ordinary spreadsheet. Actually, there is an option in EXCEL for "manual calculation". If you select this option, calculations will be made only when you press the "F9-key". Likewise, TEMAS 5 will only execute when you request it to do so, corresponding to pressing the "F9" key. You give the commands to TEMAS by clicking on buttons in the "User forms".

Like the input module, the calculation module contains a "main menu" (Figure 4.1.1). The main menus have the same basic layout, but the main menu for to input module (Figures 1.3.5-6) contains more option buttons than the main menu for calculations.

The calculation module contains only 6 menus (see Figure 4.2.1), compared to the input module containing 25 menus (see Table 4.2.1).

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Figure 4.2.1. List of menus on the calculation module (from the main menu for the calculation module, Figure 4.1.1).

1	Start Up Form
2	About (the software)
3	Particulars about the author (Per Sparre)
4	Particulars about the author (Rolf Willmann)
5	Main Menu
6	Input: Dimensions of case study
7	Input: Stocks structured input
8	Input: Fleet/Stock - structured input
9	Input: Effort
10	Input: No. of boats
11	Input: Price per kg
12	Input: Economic input
13	Input: Landings
14	Input: Estimate of F
15	Input: Behaivioral rules of the fishing industry
16	Select demonstration example
17	Select type of migration
18	Pre-processing of Stocks structured input
19	Pre-processing of Fleets and Fleet/Stock - structured input
20	Pre-processing of Effort
21	Pre-processing of Number of boats
22	Pre-processing of Price per kg
23	Pre-processing of Fleets structured oconomic input
24	Pre-processing of Observed landings used for tuning
25	Pre-processing of Fishing mortality as additional data used for tuning

Table 4.2.1. List of menus in the input module. (This can be achieved from the main menu of the input module, see Figure 1.3.5, option "Select menu")

Figure 4.2.2 shows the user forms by which you can start the simulation, by clicking on "compute". There are two user-forms from which the computations can be started in the calculation module. The first menu "SELECT SIMULATION TYPE" lets you choose between deterministic/stochastic simulation, and in case of stochastic simulation you can choose between "single simulation" and "multiple simulation".

The second menu "SELECT OUTPUT" in Figure 4.2.2 starts the computation of single simulations, which produces a suite of detailed output. The form is used to select output and to start the computations.

Once you are in the scope of user-forms, you loose access to the spreadsheet, but you can at any time easily toggle between user-forms and spreadsheets. You go from sheets to user-forms by clicking on the green button with the "Fish school" and "Start" on it. You leave the user forms by clicking on the "Go to Sheets" button, or the "X" in the upper right corner of the form. As an example of a user form, Figure 1.3.5 shows the form for entry of stock structured input.

Changing parameter values of the worksheet cells in TEMAS_INPUT will have an effect on the simulation results, only after the modified parameter values have been copied to the disk-files, from which the computation module of TEMAS takes its input.

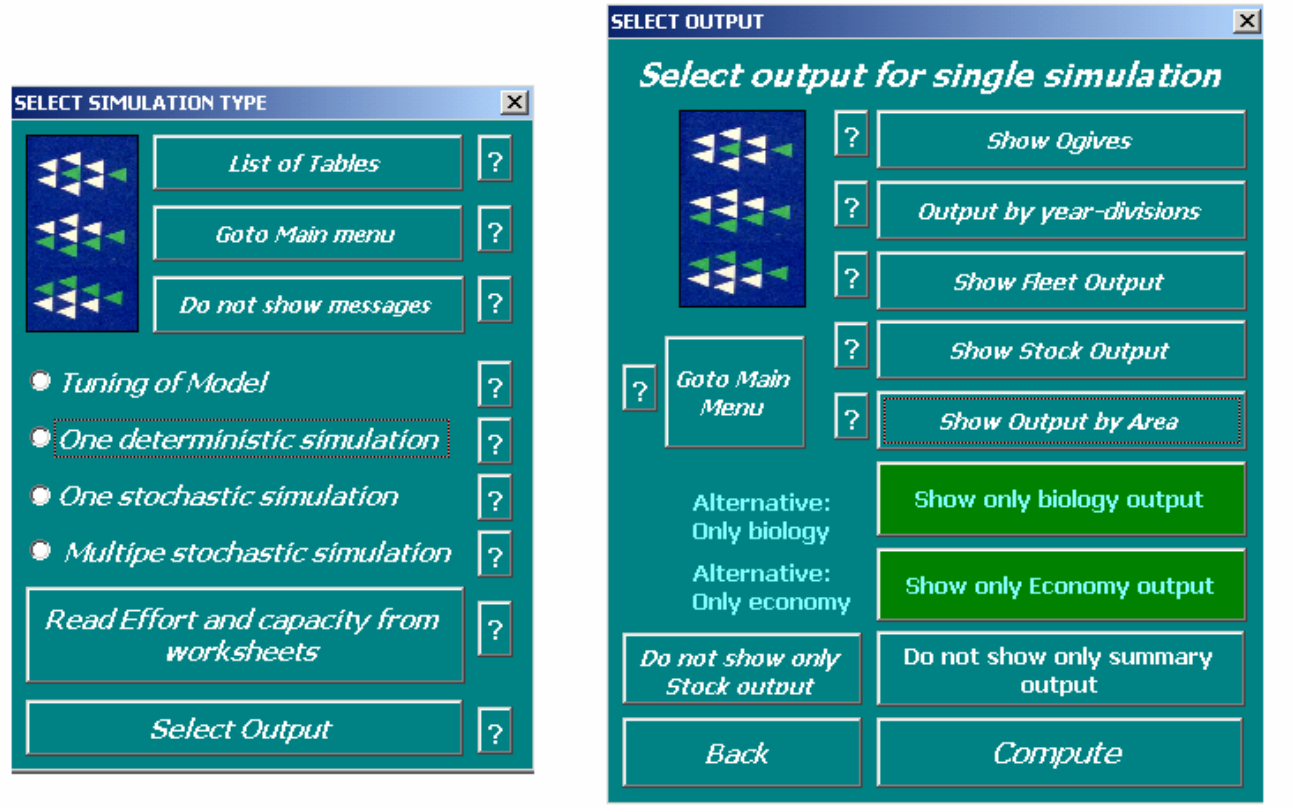


Figure 4.2.2. User-form to start up the computation.

5.4. RUN OPTIONS OF TEMAS AND RUN MESSAGES

Running TEMAS, that is, execute simulations is done with workbook TEMAS_CALC. The run option in workbook TEMAS_CALC relates to management regime and type of stochastic/ deterministic simulation.

The options for stochastic/deterministic simulation are (see Figure 2.7.2, and Figure 4.4.1).

1) Single deterministic simulation
2) Single stochastic simulation
3) Multiple stochastic simulations.

In case 3 you are also requested to enter the number of simulations you want TEMAS to execute.

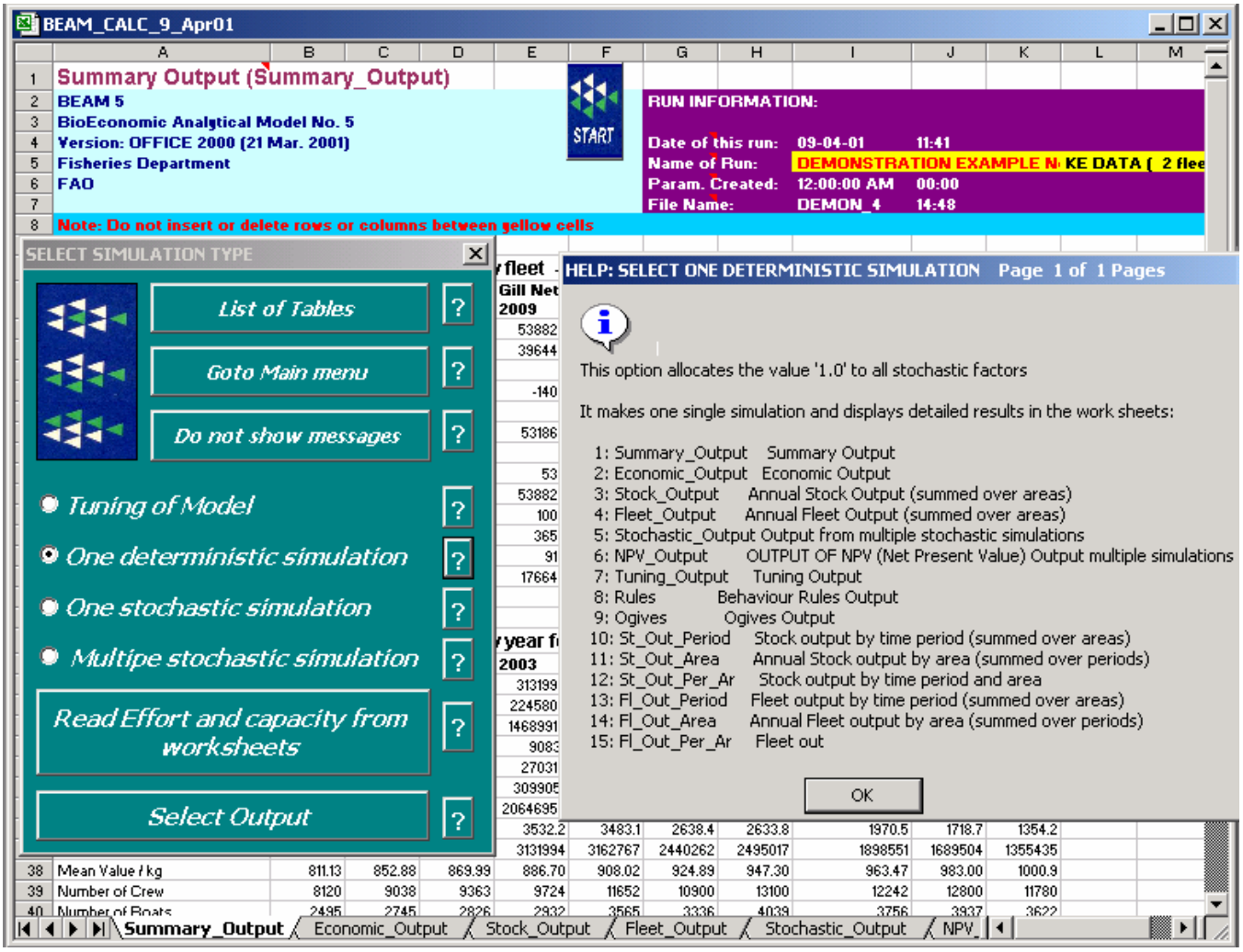


Figure 5.4.1. The menu for selection of simulation type, with an example of help-text-box. (compare Figure 2.7.2)

In addition, there are two options for creation of effort/capacity input (See Figure 4.4.1), which are:

1) Use the Effort/Capacity rules to let TEMAS determine the effort and number of vessels
2) Read effort and number of vessels from the worksheets.

After, you have selected the simulation type, you can proceed with the selection of output tables (As shown in Figure 4.2.1 in the case of single simulations).

5.5. RUN MESSAGES

When you start a simulation with TEMAS, it will sometimes produce messages on the screen as the calculations proceed. Figure 4.5.1 shows such an example. Here it tells you that the input effort exceeds the capacity for trawlers in first time period of year 2001. Then TEMAS will reduce the input effort to the capacity, by application of an effort reduction factor (in this case it will reduce effort with about 2.2 % (Reduction factor = 0.977). Now you may not want all these massages (there may be many of them) and you can suppress them by clicking on “Cancel”. That will suppress all the following messages.

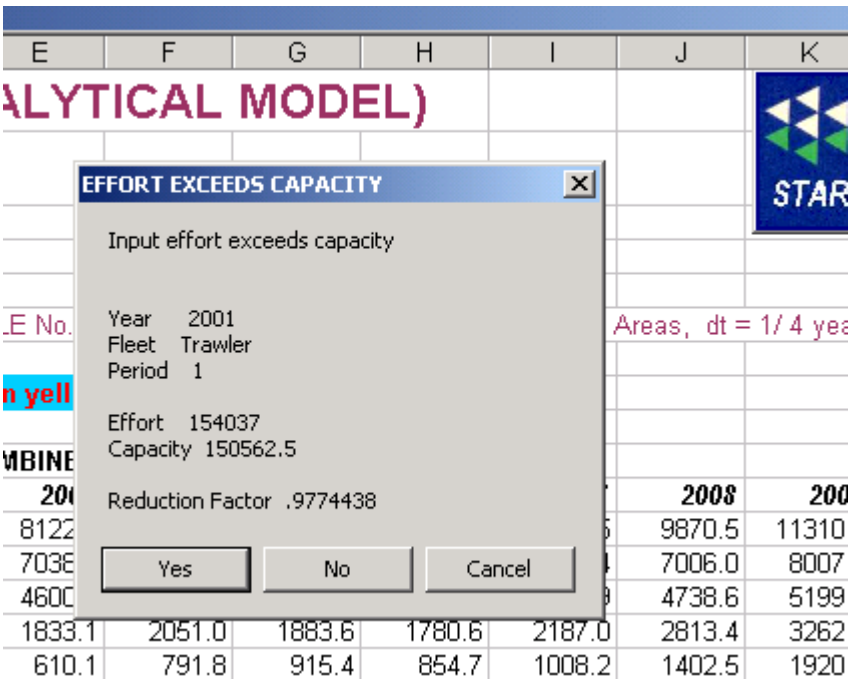


Figure 5.5.1. Run-message that input effort has exceeded the capacity of a fleet. (Compare Table 4.5.1)

Clicking on “cancel”, however, will only make the messages not appear on the screen. Messages will always be kept in two text files.:

“RULES_MESSAGES”
and
“RUN_MESSAGES”
in directory TEMAS. The file “RULES_MESSAGES” contains a message for each time a behavioural rule of the industry (Sections 2.11 and 6.6). The text file “RUN_MESSAGES” contains all other messages. The message shown in Figure 4.5.1 will go to text-file “RUN_MESSAGE”. Table 4.5.1 shows an example of the contents of “RUN_MESSAGES”. Whenever you start a simulation, these two text-files will be deleted and overwritten with the new messages.

```
EFFORT > CAPACITY  Trawler   2001   Per=  1  Eff=  154037   Capcty=   150563   ReducFct=   0.977444
EFFORT > CAPACITY Gill Net   2001   Per=  1  Eff=   51346   Capcty=    50188   ReducFct=   0.977444
EFFORT > CAPACITY  Trawler   2001   Per=  2  Eff=  154037   Capcty=   150563   ReducFct=   0.977444
EFFORT > CAPACITY Gill Net   2001   Per=  2  Eff=   51346   Capcty=    50188   ReducFct=   0.977444
EFFORT > CAPACITY  Trawler   2001   Per=  3  Eff=  154037   Capcty=   150563   ReducFct=   0.977444
EFFORT > CAPACITY  Trawler   2001   Per=  4  Eff=  154037   Capcty=   150563   ReducFct=   0.977444
EFFORT > CAPACITY Gill Net   2001   Per=  4  Eff=   51346   Capcty=    50188   ReducFct=   0.977444
EFFORT > CAPACITY  Trawler   2002   Per=  1  Eff=  154037   Capcty=   144772   ReducFct=   0.939850
EFFORT > CAPACITY Gill Net   2002   Per=  1  Eff=   51346   Capcty=    48257   ReducFct=   0.939850
EFFORT > CAPACITY  Trawler   2002   Per=  2  Eff=  154037   Capcty=   144772   ReducFct=   0.939850
EFFORT > CAPACITY Gill Net   2002   Per=  2  Eff=   51346   Capcty=    48257   ReducFct=   0.939850
EFFORT > CAPACITY  Trawler   2002   Per=  3  Eff=  154037   Capcty=   144772   ReducFct=   0.939850
EFFORT > CAPACITY  Trawler   2002   Per=  4  Eff=  154037   Capcty=   144772   ReducFct=   0.939850
EFFORT > CAPACITY Gill Net   2002   Per=  4  Eff=   51346   Capcty=    48257   ReducFct=   0.939850
EFFORT > CAPACITY  Trawler   2003   Per=  1  Eff=  154037   Capcty=   130333   ReducFct=   0.846115
EFFORT > CAPACITY Gill Net   2003   Per=  1  Eff=   51346   Capcty=    43470   ReducFct=   0.846616
EFFORT > CAPACITY  Trawler   2003   Per=  2  Eff=  154037   Capcty=   130333   ReducFct=   0.846115
EFFORT > CAPACITY Gill Net   2003   Per=  2  Eff=   51346   Capcty=    43470   ReducFct=   0.846616
EFFORT > CAPACITY  Trawler   2003   Per=  3  Eff=  154037   Capcty=   130333   ReducFct=   0.846115
 …… etc. ……..
```

Table 5.5.1. Run-messages that input effort has exceeded the capacity of a fleet in text file "RUN_MESSAGES". (Compare Figure 4.5.1)

6. CALIBRATION

6.1. INTRODUCTION

The statistical estimation of parameters in TEMAS, is more or less assumed to be a problem isolated from the simulations with TEMAS. Somehow, we assume that parameters are available from various (not specified, by "reliable" sources). Needless to say, this will never strictly be the case in any application of TEMAS. Actually, many of the crucial parameters of TEMAS cannot be estimated by robust statistical methods, involving estimation of variance and co-variances and all their derivatives in the form of statistical diagnostics. The general parameter estimation problem in fisheries is illustrated by the fact that most fish stock assessments in ICES are made by highly questionable non-standard methods like the XSA, that is methods that do not live up to the standards of textbooks in bio-statistical analysis (e.g. Sokal and Rohlf, 1981). ICES could have chosen to apply strict statistical methods, like those of the SAS, the S or the R system of methods, but have so far refrained from using the standard approach. The TEMAS is not in any better situation, than any other current model currently available to fisheries science. TEMAS perhaps differs from other approaches in that it accepts and fully accounts for its limited capability in parameter estimation. TEMAS lacks a proper methodology for parameter estimation, and many (most) parameters of TEMAS are "guesstimates" rather than "estimates" (as defined in standard textbooks of statistical inference). The reason for this is not that parameter estimation methodology is not available, but that available data are of a poor quality, but perhaps more important is, that the basic mechanism behind the system dynamics is not understood. The so-called "process errors" of TEMAS are not known. Thus, it is not possible to separate "process errors" and "measurement errors", but both are probably big

However, it is not satisfactory to make a complete separation between the "real world" and the simulations by TEMAS. One would like to maintain the humble illusion that TEMAS does indeed resemble to the real world, although we do not dare make statements about the "prediction power" of TEMAS. The calibration of TEMAS is a rather ad hoc attempt to make TEMAS not deviate "too much" from the reality.

6.2. CALIBRATION OF TEMAS

The idea of "calibration" means to adjust certain parameters of TEMAS, so that TEMAS can make a simulated prediction for a historical period, that does not "deviate too much" from the observed fisheries. For example, TEMAS should be able to simulate predicted catches from 1995 to 2005 that do not deviate too much from the actual (observed) catches 1995-2005.

TEMAS calibrates some of its parameters by aid of the so-called modified χ^2-criterion (Sokal and Rohlf, 1981)

$$\chi^2_X = \sum_{Indices} \frac{(X_{Observed} - X_{Calculated})^2}{X_{Calculated}} \qquad \text{(E.1.2.1)}$$

where "$X_{calculated}$" symbolises a prediction-variable of the model, for example, the weight of cod, caught by a certain gear rigging of a fleet fleet, at a certain time, in a certain area. "$X_{observed}$" indicates the value of X observed from a historical period. The variables "X" are selected so that they are easy to access. The example given above can be easily extracted from the logbooks. The same model is used for both prediction and estimation. $X_{calculated}$ depends on the indigenous parameters, and χ^2 is minimised with respect of the indigenous parameters. "Indices" is a subset of the indices available in TEMAS[1] The most detailed version of Eq E.1.2.1 is achieved with the

[1] 1.

	Index	*Explanation*	*Range*	Note that the sequence of indices will be (Fl, Vs, Rg, Ct, St, y, a, qa, Va, Ar) for all variables. Time variables in alphabetical order
1	a	Age group	a = 0,1,2,…,a_{max}(St)	
2	Ar	Area	Ar = 1,2,…,Ar_{max}	
3	Ct	Country	Ct = 1,…,Ct_{Max}	

complete set of all indices used in TEMAS, i.e. (Fl, Vs, Rg, Ct, St, y, a, q, Va, Ar) is given by Eq. E.1.2.2

$$\chi^2_{Yield} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{a=1}^{a_{Max}(St)} \sum_{q=1}^{q_{Max}} \sum_{Va=}^{Va_{Max}(Ct,Fl)} \sum_{Ar=1}^{Ar_{Max}}$$

$$\frac{(Y^{Obs}_{Landings}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar) - Y^{Calc}_{Landings}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar))^2}{Y^{Calc}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar)} + \quad \text{(E.1.2.2)}$$

$$\frac{(Y^{Obs}_{Discards}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar) - Y^{Calc}_{Discards}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar))^2}{Y^{Calc}_{Discards}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar)}$$

Eq. contains the sum of squares of deviation (SSD) for both landings and discards, for each vessel age group. Removing the discards, which are usually not (rather never) direct observations, as well as the vessel age group data, which will usually not be available, we come to Eq E.1.2.3 .

$$\chi^2_{Yield} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{a=1}^{a_{Max}(St)} \sum_{q=1}^{q_{Max}} \sum_{Ar=1}^{Ar_{Max}}$$

$$\frac{(Y^{Obs}_{Landings}(Fl,Vs,Rg,Ct,St,y,a,q,\bullet,Ar) - Y^{Calc}_{Landings}(Fl,Vs,Rg,Ct,St,y,a,q,\bullet,Ar))^2}{Y^{Calc}(Fl,Vs,Rg,Ct,St,y,a,q,\bullet,Ar)} + \quad \textbf{\textit{(E.1.2.3)}}$$

Eq. E.12.3 gives the SSD's by age group, which again will be "observations" estimated from samples. However, Eq, may be applicable in some cases, where a comprehensive biological/technical data collection program is being implemented.

The chi-squared expression for landings summed over age groups is given in Eq. E.1.2.4. This is the standard expression used in the current version of TEMAS.

$$\chi^2_{Yield} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{Ar=1}^{Ar_{Max}}$$

$$\frac{(Y^{Obs}_{Landings}(Fl,Vs,Rg,Ct,St,y,\bullet,q,\bullet,Ar) - Y^{Calc}_{Landings}(Fl,Vs,Rg,Ct,St,y,\bullet,q,\bullet,Ar))^2}{Y^{Calc}(Fl,Vs,Rg,Ct,St,y,\bullet,q,\bullet,Ar)} \quad \text{(E.1.2.4)}$$

Landings summed over vessel age groups and fish age groups, are the "observations" expected in the current version of TEMAS. This feature of the current TEMAS can easily be changed.

Eq. E.1.2.4 calculates SSD by rigging. In case rigging data are not available, the next version with landings aggregated over riggings is shown in Figure E.1.2.5.

$$\chi^2_{Yield} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{Ar=1}^{Ar_{Max}}$$

$$\frac{(Y^{Obs}_{Landings}(Fl,Vs,\bullet,Ct,St,y,\bullet,q,\bullet,Ar) - Y^{Calc}_{Landings}(Fl,Vs,\bullet,Ct,St,y,\bullet,q,\bullet,Ar))^2}{Y^{Calc}(Fl,Vs,\bullet,Ct,St,y,\bullet,q,\bullet,Ar)} \quad \text{(E.1.2.5)}$$

4	Fl	Fleet	Fl = 1,2,…,Fl_{max}(Ct)	
5	q	Time period (as time)	q = 1,..,q_{max}	
6	qa	Time period (as age)	qa = 1,..,q_{max},	
7	Rg	Rigging of gear	Rg = 1,…,Rg_{max}(Fl,Ct)	
8	y	Year	y = $y_{firSt,\ yfirst}$+1,…,y_{last}	
9	St	Stock	St = 1,…,St_{max}	
10	Va	Vessel age group	Va = 1,…Va_{max}(Fl,Ct)	
11	Vs	Vessel size group	Vs = 1,…Vs_{max}(Fl,Ct)	

From Eq. E.1.2.5 one may reduce the number of indices of SSD further, depending on the actual case study. E.g. one might consider only the total annual landings by stock:

$$\chi^2_{Yield} = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \frac{(Y^{Obs}_{Landings}(\bullet,\bullet,\bullet,\bullet,St,y,\bullet,\bullet,\bullet,\bullet) - Y^{Calc}_{Landings}(\bullet,\bullet,\bullet,\bullet,St,y,\bullet,\bullet,\bullet,\bullet))^2}{Y^{Calc}(\bullet,\bullet,\bullet,\bullet,St,y,\bullet,\bullet,\bullet,\bullet)} \qquad \text{(E.1.2.6)}$$

In addition to yield (landings and discards), the TEMAS software offers three more options for calibration to observations. The options for calibration data are:

5) Catches, (Landings and discards) on various dis-aggregation levels. From (Fl, Vs, Rg, Ct, St, y, a, q, Va, Ar) to (•,•,•,•, St, y,•,•,•,•)
6) Index of stock numbers from research vessel survey or from catch per unit of effort of commercial vessels.
7) Index of stock biomass or SSB from research vessel survey or from catch per unit of effort of commercial vessels.
8) Mean stock F (Fishing mortality) from (for example) fish stock assessment of ICES working groups.

The index of stock numbers can be catch per day by age group, converted into relative numbers, to make them compatible with relative numbers predicted by TEMAS.

$$\chi^2_N = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{a=1}^{a_{Max}(St)} \frac{(N^{Obs}_{Index}(St,y,q,a,Ar) - N^{Calc}_{Index}(St,y,q,a,A))^2}{N^{Calc}_{Index}(St,y,q,a)} \qquad \text{(E.1.2.7)}$$

Where, for example, $N^{Calc}_{Index}(St,y,q,a,Ar) = \frac{N(St,y,q,a,Ar)}{\sum_{i=1}^{a_{Max}(St)} N(St,y,q,i,Ar)}$ and the survey index is derived from, say, catch per hour, $CPUE_{Survey}$, $N^{Obs}_{Index}(St,y,q,a,Ar) = \frac{CPUE_{Survey}(St,y,q,a,Ar)}{\sum_{i=1}^{a_{Max}(St)} CPUE_{Survey}(St,y,q,i,Ar)}$

Also indices of biomass (or SSB) can be made relative and compared to indices predicted by TEMAS.

$$\chi^2_{SSB} = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \frac{(SSB^{Obs}_{Index}(St,y,q) - SSB^{Calc}_{Index}(St,y,q))^2}{SSB^{Calc}_{Index}(St,y,q)} \qquad \text{(E.1.2.8)}$$

Fishing mortality can be compared to fishing mortalities estimated by persons independent of TEMAS (e.g. ICES WGs).

$$\chi^2_{F_{MEAN}} = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \frac{(F^{Obs}_{Mean}(St,y,q) - F^{Calc}_{Mean}(St,y,q))^2}{F^{Calc}_{Mean}(St,y,q)} \qquad \text{(E.1.2.9)}$$

In theory, the χ^2 expression could make the basis for estimating the parameters, (designated "P" in Eq E.1.2.9), by minimization. Because of the large number of parameters, and the small number of degrees of freedom, this approach would be very problematic in practice.

$$\chi^2_X(X^{Obs},P) = \sum_{Indices} \frac{(X^{Obs} - X^{Calc}(P))^2}{X^{Calc}(P)} = Minimum \qquad \text{(E.1.2.10)}$$

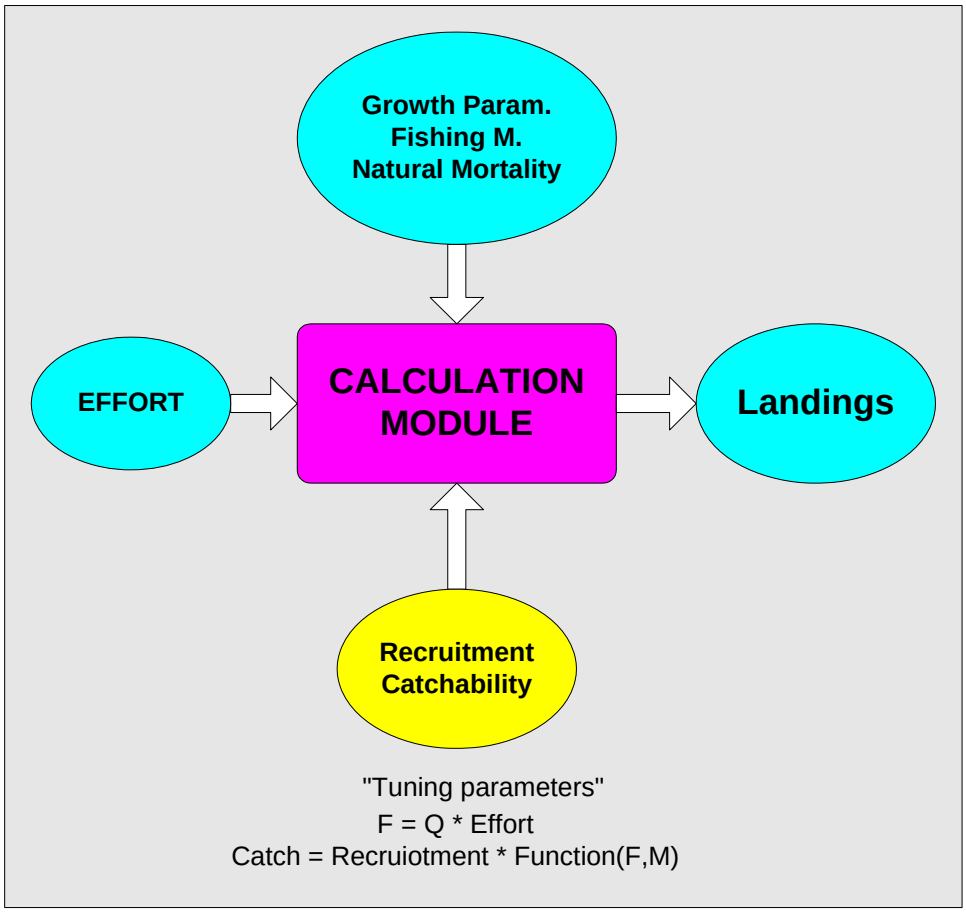
Some parameters (a subset of P), however, may be estimated that way. That could apply to the catchability coefficients.

Other “observations” than landings can be used to calibrate TEMAS. That could be CPUE observations from research surveys that are believed to be a proxy for SSB or recruitment.

6.3. TUNING OF TEMAS

By tuning is meant the processes of finding the reference simulation of TEMAS. The reference simulation is the situation (scenario) relative to which all the other simulations are made, and are compared to, when addressing the '"What-if-then-questions' " Tuning involves the calculation of certain parameters, as discussed Sections 2.12. It should be noted that tuning does not involve a proper statistical estimation of parameters.

The reference simulation will usually be chosen to be a simulation in equilibrium, that is, a simulation where all results are equal in all years of the time series under study. Furthermore, the reference simulation will usually be chosen to be the fisheries situation of the current situation (current year). TEMAS is said to reproduce the current situation when it can reproduce the landings (in weight) observed the last data year for each combination of fleet, stock, time period and area. To achieve this goal completely is usually impossible, so one can only hope for a reasonable approximation. Taking in to account all the sources of uncertainties involved in TEMAS, there is no reason to make too much effort in achieving a complete reproduction of observed catches.



The five types of tuning offered by TEMAS is (see also Figure 4.6.1 showing the tuning menu form)

1) N(first year) = N(last year). To achieve equilibrium
2) BH(New)=BH(old)*Land(Obs)/Land(Calc). Tune recruitment to observed landings
3) Q(New)=Q(old)*Land(Obs)/Land(Calc). Tune catchability to observed landings
4) Q(New)=Q(old)*F(Obs)/F(Calc). Tune catchability to observed total fishing mortality.
5) Q=F/Effort by area and fleet. Compute individual catchabilities to observed area fishing mortalities

The total landings from a stock is (almost) proportional to the parameters 'BH1' in the stock and recruitment model (Beverton & Holt model), with all other parameters kept constant. Thus, for a given fishing mortality, BH1 can be selected to give any landings you want. As the parameter 'BH1' is usually an unknown parameter, you may consider the tuning of TEMAS as a pseudo estimation of BH1 (it is not a proper estimation). You calibrate BH1 to produce the observed landings

The procedure of calibrating BH1 gives you the total landings for a given total fishing mortality. Next step in the tuning is then to distribute the landings from the stock in question on the fleets. This is achieved by assigning the values to catchability coefficients that produces the fishing mortalities, which in turn gives the observed landings by fleet, area and time period.

To summarize: Tuning means assigning values to:

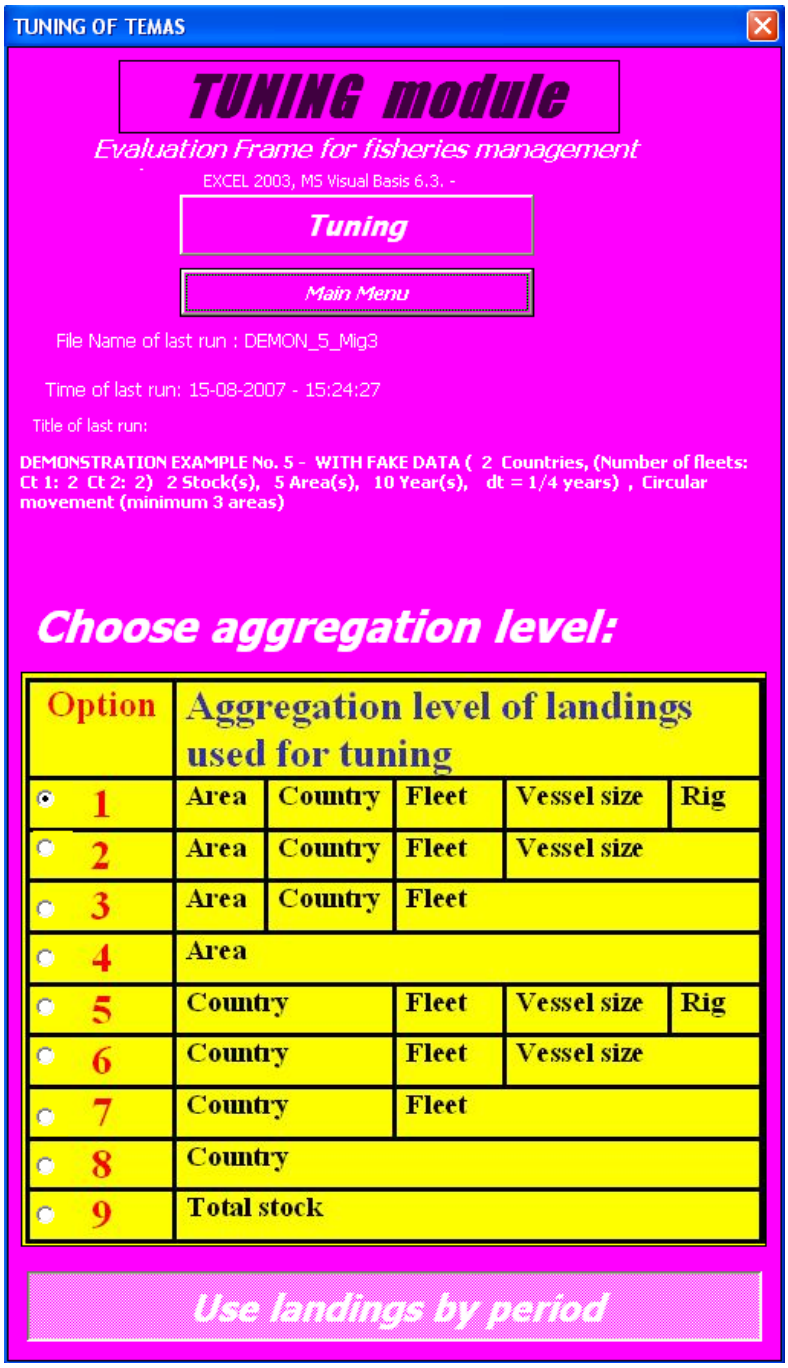
1) The Beverton and Holt parameter BH1(Stock)
2) Catchability coefficient, Q(Stock, Fleet, Area, Time period)

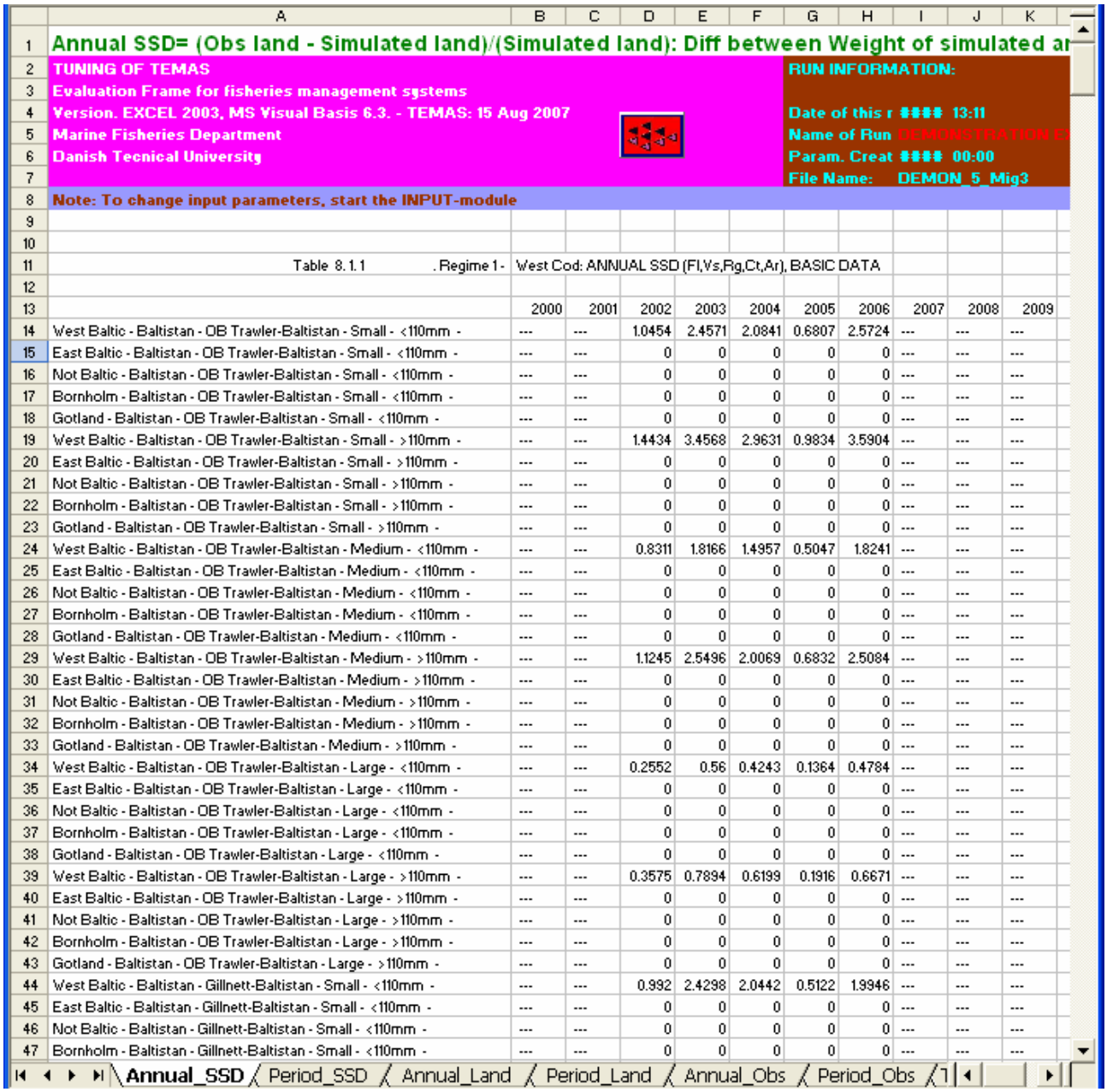
so that: Observed landings = Calculated landings for all combinations of Stock, Fleet, Area and Time period in a given year (which is usually the most recent data year) so that the system is in equilibrium (gives the same results in all years)

Recommendation: The tuning procedure changes the input files in the disk:

1) The stock input files are changed
2) The fleet input files are changed

Therefore: **MAKE A BACKUP OF THE DISKFILES BEFORE TUNING**. You may regret the tuning, and want to return to the starting point. Returning to the starting point is difficult unless you made a backup


TUNING OF TEMAS
TUNING module
Evaluation Frame for fisheries management
EXCEL 2003, MS Visual Basis 6.3. -
Tuning
Main Menu
File Name of last run : DEMON_5_Mig3
Time of last run: 15-08-2007 - 15:24:27
Title of last run:
DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA (2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) 2 Stock(s), 5 Area(s), 10 Year(s), dt = 1/4 years) , Circular movement (minimum 3 areas)
Choose aggregation level:
Option
Aggregation level of landings used for tuning
1 Area Country Fleet Vessel size Rig
2 Area Country Fleet Vessel size
3 Area Country Fleet
4 Area
5 Country Fleet Vessel size Rig
6 Country Fleet Vessel size
7 Country Fleet
8 Country
9 Total stock
Use landings by period



	A	B	C	D	E	F	G	H	I	J	K
1	Annual SSD= (Obs land - Simulated land)/(Simulated land): Diff between Weight of simulated ar										
2	TUNING OF TEMAS							RUN INFORMATION:			
3	Evaluation Frame for fisheries management systems										
4	Version. EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 15 Aug 2007							Date of this r #### 13:11			
5	Marine Fisheries Department							Name of Run DEMONSTRATION C			
6	Danish Tecnical University							Param. Creat #### 00:00			
7								File Name: DEMON_5_Mig3			
8	Note: To change input parameters, start the INPUT-module										
9											
10											
11	Table 8.1.1 . Regime 1 -	West Cod: ANNUAL SSD (Fl,Vs,Rg,Ct,Ar), BASIC DATA									
12											
13		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
14	West Baltic - Baltistan - OB Trawler-Baltistan - Small - <110mm -	---	---	1.0454	2.4571	2.0841	0.6807	2.5724	---	---	---
15	East Baltic - Baltistan - OB Trawler-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---
16	Not Baltic - Baltistan - OB Trawler-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---
17	Bornholm - Baltistan - OB Trawler-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---
18	Gotland - Baltistan - OB Trawler-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---
19	West Baltic - Baltistan - OB Trawler-Baltistan - Small - >110mm -	---	---	1.4434	3.4568	2.9631	0.9834	3.5904	---	---	---
20	East Baltic - Baltistan - OB Trawler-Baltistan - Small - >110mm -	---	---	0	0	0	0	0	---	---	---
21	Not Baltic - Baltistan - OB Trawler-Baltistan - Small - >110mm -	---	---	0	0	0	0	0	---	---	---
22	Bornholm - Baltistan - OB Trawler-Baltistan - Small - >110mm -	---	---	0	0	0	0	0	---	---	---
23	Gotland - Baltistan - OB Trawler-Baltistan - Small - >110mm -	---	---	0	0	0	0	0	---	---	---
24	West Baltic - Baltistan - OB Trawler-Baltistan - Medium - <110mm -	---	---	0.8311	1.8166	1.4957	0.5047	1.8241	---	---	---
25	East Baltic - Baltistan - OB Trawler-Baltistan - Medium - <110mm -	---	---	0	0	0	0	0	---	---	---
26	Not Baltic - Baltistan - OB Trawler-Baltistan - Medium - <110mm -	---	---	0	0	0	0	0	---	---	---
27	Bornholm - Baltistan - OB Trawler-Baltistan - Medium - <110mm -	---	---	0	0	0	0	0	---	---	---
28	Gotland - Baltistan - OB Trawler-Baltistan - Medium - <110mm -	---	---	0	0	0	0	0	---	---	---
29	West Baltic - Baltistan - OB Trawler-Baltistan - Medium - >110mm -	---	---	1.1245	2.5496	2.0069	0.6832	2.5084	---	---	---
30	East Baltic - Baltistan - OB Trawler-Baltistan - Medium - >110mm -	---	---	0	0	0	0	0	---	---	---
31	Not Baltic - Baltistan - OB Trawler-Baltistan - Medium - >110mm -	---	---	0	0	0	0	0	---	---	---
32	Bornholm - Baltistan - OB Trawler-Baltistan - Medium - >110mm -	---	---	0	0	0	0	0	---	---	---
33	Gotland - Baltistan - OB Trawler-Baltistan - Medium - >110mm -	---	---	0	0	0	0	0	---	---	---
34	West Baltic - Baltistan - OB Trawler-Baltistan - Large - <110mm -	---	---	0.2552	0.56	0.4243	0.1364	0.4784	---	---	---
35	East Baltic - Baltistan - OB Trawler-Baltistan - Large - <110mm -	---	---	0	0	0	0	0	---	---	---
36	Not Baltic - Baltistan - OB Trawler-Baltistan - Large - <110mm -	---	---	0	0	0	0	0	---	---	---
37	Bornholm - Baltistan - OB Trawler-Baltistan - Large - <110mm -	---	---	0	0	0	0	0	---	---	---
38	Gotland - Baltistan - OB Trawler-Baltistan - Large - <110mm -	---	---	0	0	0	0	0	---	---	---
39	West Baltic - Baltistan - OB Trawler-Baltistan - Large - >110mm -	---	---	0.3575	0.7894	0.6199	0.1916	0.6671	---	---	---
40	East Baltic - Baltistan - OB Trawler-Baltistan - Large - >110mm -	---	---	0	0	0	0	0	---	---	---
41	Not Baltic - Baltistan - OB Trawler-Baltistan - Large - >110mm -	---	---	0	0	0	0	0	---	---	---
42	Bornholm - Baltistan - OB Trawler-Baltistan - Large - >110mm -	---	---	0	0	0	0	0	---	---	---
43	Gotland - Baltistan - OB Trawler-Baltistan - Large - >110mm -	---	---	0	0	0	0	0	---	---	---
44	West Baltic - Baltistan - Gillnett-Baltistan - Small - <110mm -	---	---	0.992	2.4298	2.0442	0.5122	1.9946	---	---	---
45	East Baltic - Baltistan - Gillnett-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---
46	Not Baltic - Baltistan - Gillnett-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---
47	Bornholm - Baltistan - Gillnett-Baltistan - Small - <110mm -	---	---	0	0	0	0	0	---	---	---

Annual_SSD / Period_SSD / Annual_Land / Period_Land / Annual_Obs / Period_Obs / T

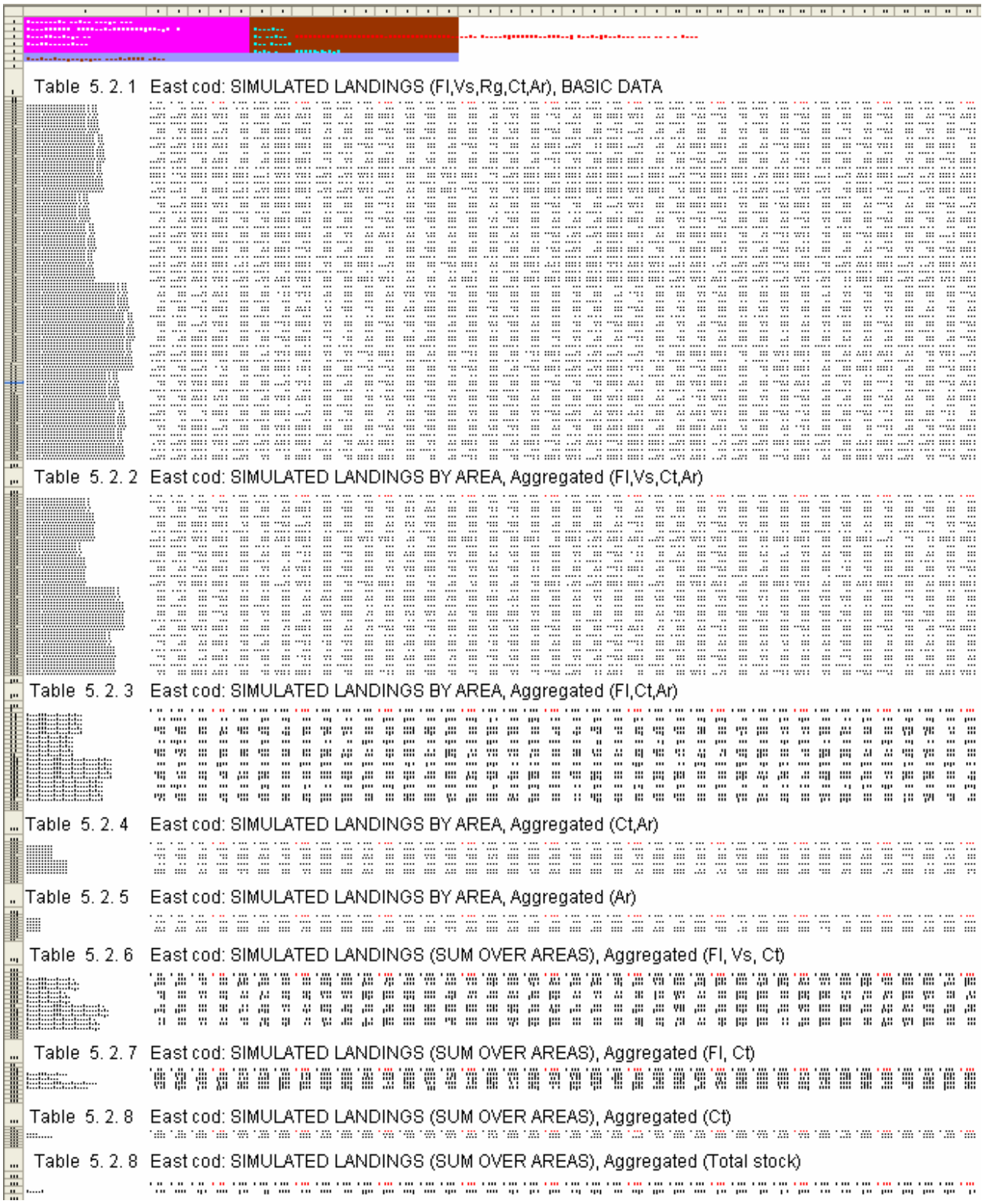


Table 5. 2. 1 East cod: SIMULATED LANDINGS (Fl,Vs,Rg,Ct,Ar), BASIC DATA
Table 5. 2. 2 East cod: SIMULATED LANDINGS BY AREA, Aggregated (Fl,Vs,Ct,Ar)
Table 5. 2. 3 East cod: SIMULATED LANDINGS BY AREA, Aggregated (Fl,Ct,Ar)
Table 5. 2. 4 East cod: SIMULATED LANDINGS BY AREA, Aggregated (Ct,Ar)
Table 5. 2. 5 East cod: SIMULATED LANDINGS BY AREA, Aggregated (Ar)
Table 5. 2. 6 East cod: SIMULATED LANDINGS (SUM OVER AREAS), Aggregated (Fl, Vs, Ct)
Table 5. 2. 7 East cod: SIMULATED LANDINGS (SUM OVER AREAS), Aggregated (Fl, Ct)
Table 5. 2. 8 East cod: SIMULATED LANDINGS (SUM OVER AREAS), Aggregated (Ct)
Table 5. 2. 8 East cod: SIMULATED LANDINGS (SUM OVER AREAS), Aggregated (Total stock)

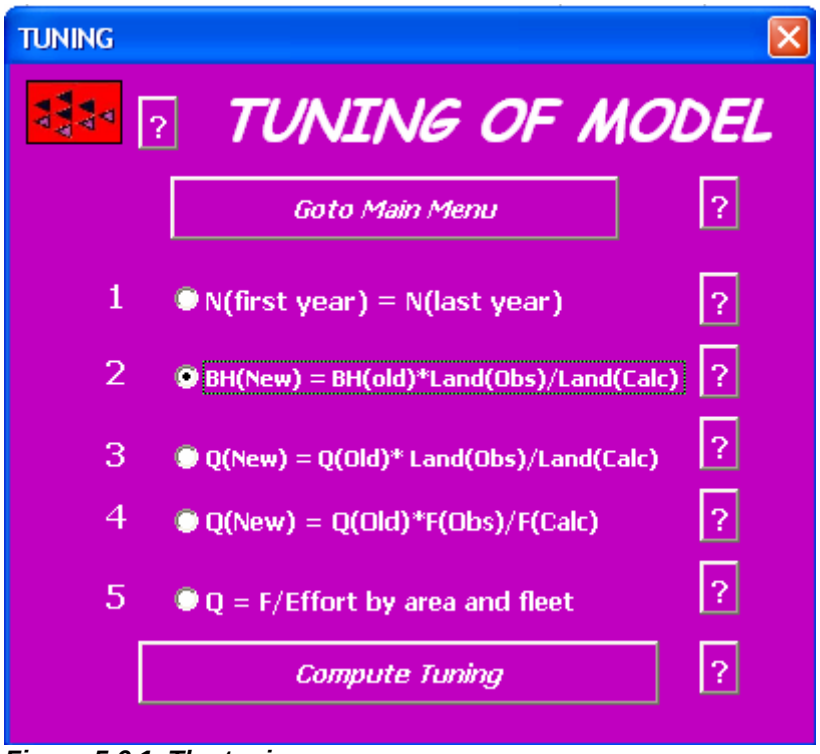
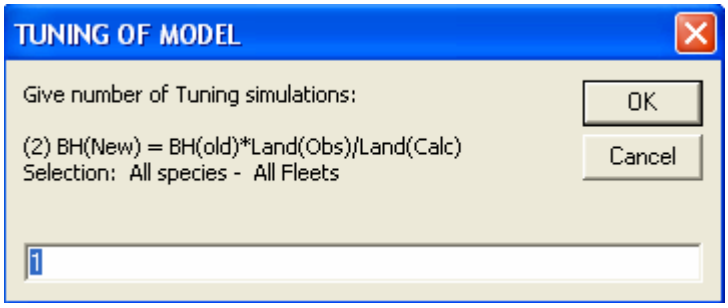


Figure 5.6.1. The tuning menu.



N(first year) = N(last year)

This tuning is used to make the reference simulation an equilibrium situation "After the completion of a simulation it assigns the calculated stock numbers of the last year, to the initial stock numbers (first years)

N(Stock, First year, age, period, area) := N(Stock, Last year, age, period, area)

BH(New)=BH(old)*Land(Obs)/Land(Calc)

This tuning changes the first stock/recruitment parameter, BH1, so that:

Total Observed Landings (Stock, First year) = Total Calculated Landings (Stock, First year)

Recall that:

$$\mathrm{Rec}(year, Period, Area) = \mathrm{Rec}Dist_{Area} * \mathrm{Rec}Dist_{Period} * \frac{BH1 * SSB(year-1)}{1 + BH2 * SSB(year-1)}$$

where SSB = Spawning Stock Biomass and Recruitment, Rec, is the number in the 0-group: "N(St, year, 0, period, area)

First step is to calculate the tuning factor:

$$TuningFactor = \frac{Total\ \ Observed\ \ Landings(Stock, First\ \ year)}{Total\ \ Calculated\ \ Landings(Stock, First\ \ year)}$$

Second step is to change the Beverton & Holt parameter, BH1, by the tuning factor:

BH1(Stock) is replaced by TuningFactor * BH1(Stock)

Q(New)=Q(old)*Land(Obs)/Land(Calc)

Tune Catchability to landings. This tuning uses the landings (by weight) for each combination of Stock, fleet area and time period as input. If modifies the catchabilities of each combination so that:

Observed landings = Calculate landings, for each combination.

The tuning factor is thus

$$TuningFactor = \frac{Observed\ \ Landings(Stock, Year, Period, Area, Fleet)}{Calculated\ \ Landings(Stock, Year, Period, Area, Fleet)}$$

And the computation of the tuning becomes (Q = catchability coefficient):

Q(Stock, Year, period, area, fleet) is replaced by (Tuning Factor) * Q(Stock, Year, period, area, fleet

Q(New)=Q(old)*F(Obs)/F(Calc)

This tuning uses the total (stock) fishing mortality given as input: 'F_{Tuning}'
The tuning changes the Reference catchability, so that:

$F_{Calculated}$(Stock, period) = F_{Tuning}(Stock, period)

"Recall that: $F_{Calculated}$ = Effort * (Reference catchability)* Selection

First step is to calculate the tuning factor:

TuningFactor = F_{Tuning}(Stock, period) / F_{Stock}(Stock, First Year, period, Oldest age)

Second step is to change the catchability, Q, by the tuning factor:

Q(Stock, Year, period, area, fleet) is replaced by TuningFactor * Q(Stock, First year, period, area, fleet)

Q=F/Effort by area and fleet

This tuning requires that fishing mortalities, F_{TUNING}, has been estimated (or can be assigned plausible values) by period, area and fleet, and that effort also have been been observed. Then the catchability is computed by

$$Q(Stock,\ first\ \ year, Period, Area, Fleet) = \frac{F_{TUNING}(Stock, Period, Area, Fleet)}{Effort(First\ \ year, Period, Area, Fleet)}$$

for the first year. Subsequently all years are assigned the same values:

$$Q(Stock, year, Period, Area, Fleet) = Q(Stock, First\ \ year, Period, Area, Fleet)$$

How to tune TEMAS

To tune TEMAS can somewhat be called an art, rather than a science. Basically, you find a satisfactory tuning by trial and error.

The worksheet, "Tuning_Output" in workbook "TEMAS_CALC" contains some diagnostic output, showing the relative deviation between observations and calculated values (see Figure 4.4.2)

BEAM_CALC

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	BEAM 5 (BIO-ECONOMIC ANALYTICAL MODEL)												
2	OUTPUT - TUNING								START				
3	FAO, Fisheries Department												
4	(Version 1.0 - 28 July 2000)												
5													
6	Name of Run:		DEMONSTRATION EXAMPLE No. 4 WITH FAKE DATA (2 fleets, 2 Stocks, 2 Areas, dt = 1/ 4 years)										
7	Parameters Created:		1/9/2001	21:32		File Name:	DEMON_4						
8	Note: Do not insert or delete rows or columns between yellow cells												
9													
25	TOTAL OBSERVED AND CALCULATED STOCK FISHING MORTALITY (Summed over fleets, areas and time periods)												
26													
28	Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
29	Cod	Observ.	.8000	.8000	.8000	.8000	.8000	.8000	.8000	.8000	.8000	.8000	
30		Calc.	.7750	.7432	.7017	.6692	.6238	.6316	.3765	.3153	.2523	.1783	
31	Plaice	Observ.	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	
32		Calc.	.4844	.4645	.4386	.4183	.3899	.3947	.2353	.1971	.1577	.1115	
33													
34	Differences : TOTAL OBSERVED AND CALCULATED STOCK FISHING MORTALITY (Summed over fleets, areas and time periods)												
35	Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
36	Cod	% Diff.	-3.1	-7.1	-12.3	-16.3	-22.0	-21.1	-52.9	-60.6	-68.5	-77.7	
37	Plaice	% Diff.	-3.1	-7.1	-12.3	-16.3	-22.0	-21.1	-52.9	-60.6	-68.5	-77.7	
38													
39	TOTAL OBSERVED AND CALCULATED LANDINGS (WEIGHT) (Summed over fleets, areas and time periods)												
40													
42	Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
43	Cod	Observ.	62430	62430	62430	62430	62430	62430	62430	62430	62430	62430	
44		Calc.	8001	5889	4798	4357	4005	4000	2617	2719	2725	2451	
45	Plaice	Observ.	61479	61479	61479	61479	61479	61479	61479	61479	61479	61479	
46		Calc.	656	574	535	519	498	521	343	343	330	283	
47													
48	Differences : TOTAL OBSERVED AND CALCULATED LANDINGS (WEIGHT) (Summed over fleets, areas and time periods)												
49	Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
50	Cod	% Diff.	-87.2	-90.6	-92.3	-93.0	-93.6	-93.6	-95.8	-95.6	-95.6	-96.1	
51	Plaice	% Diff.	-98.9	-99.1	-99.1	-99.2	-99.2	-99.2	-99.4	-99.4	-99.5	-99.5	
52													

Economic_Output | Stochastic_Output | NPV_Output | **Tuning_Output** | Rules | Ogives

Figure 4.6.2. Selected output from Tuning.

The "diagnostics" are the relative differences between observations and model-predicted values:

$$Difference = 100\frac{(Observed\ Value\ -\ Calculated\ Value)}{Calulated\ Value}\quad \%$$

which you by manipulation of parameter values tries to make as close as possible to zero. The example of Figure 4.4.2 refers to the entire stock and fishery.

There are other similar tables with area and fleet specific diagnostics in work sheet "Tuning". Usually, you will firstly, tune the overall results, and subsequently "fine-tune" to the detailed results.

7. BREAK DOWN OF TEMAS - ERROR MESSAGES

TEMAS may break down. TEMAS as any other program contains “bugs”. EXCEL contains “bugs”. You may make errors. There are many reasons why TEMAS may break down.

There is one general rule for the user not familiar with VISUAL BASIC:

“Close TEMAS and restart it”

In the example below an error was made on purpose to demonstrate a run-time-error message of EXCEL. In this case the message file “RUN_MESSAGES.TXT” (Section 4.6) was opened by EXCEL. Then no other EXCEL workbook can open RUN_MESSAGES. When you start TEMAS_CALC it will try to open the message file, and find out that it is already being used be another application. That will cause the error message shown in Figure 2.1.4.1. TEMAS will break down.

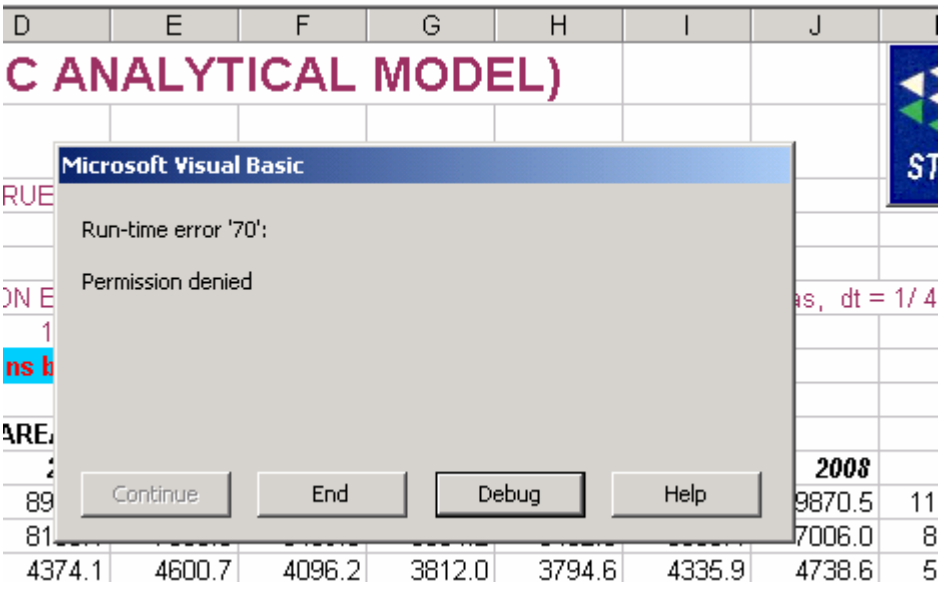


Figure 4.7.1. Example of error message from EXCEL.

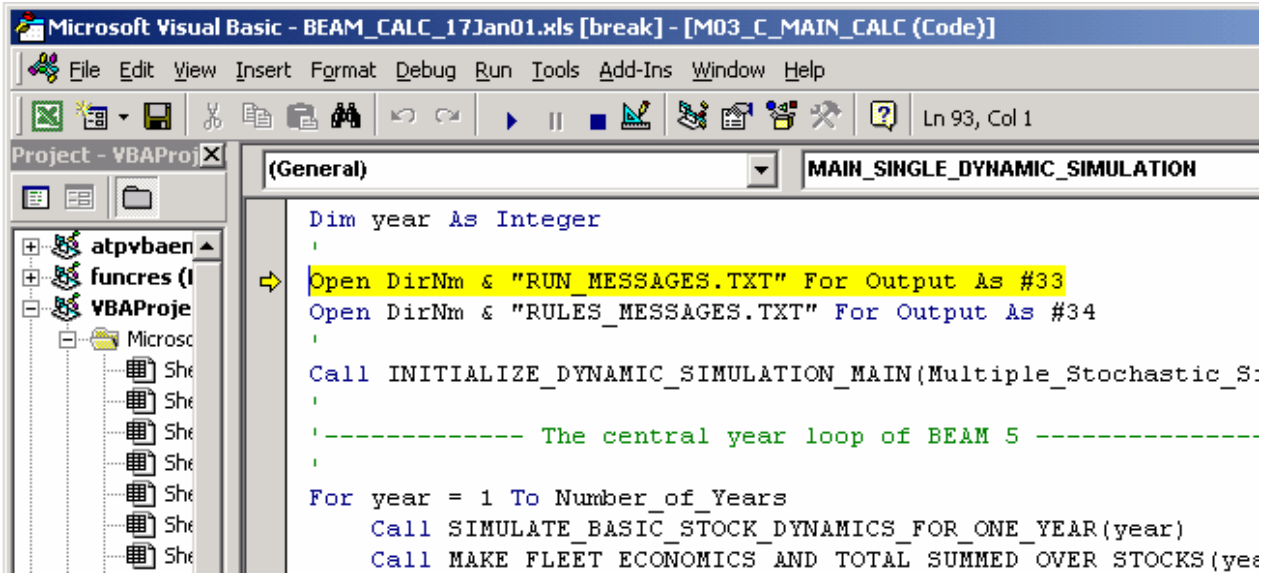


Figure 4.7.2. Example of EXCEL debugger.

At this stage you may close TEMAS_CALC and restart it. That will be the standard way of handling error messages from EXCEL. The problem may be caused by a bug in TEMAS, or it may be caused by you doing something you should not do. The latter explanation applies to Figure 4.7.1.

You may also try to handle the error message yourself. If you click on “debug”, EXCEL will take you to the VISUAL BASIC editor, and an arrow will point at the VISUAL BASIC line where the Run-Time-Error occurred, and the line will be highlighted by yellow background as shown in Figure 2.14.2.

As can be seen, this should give you an indication that something might be wrong with the file “RUN_MESSAGES.TXT”, and you may get the idea to close the EXCEL workbook, which uses the message file, and TEMAS will be running again.

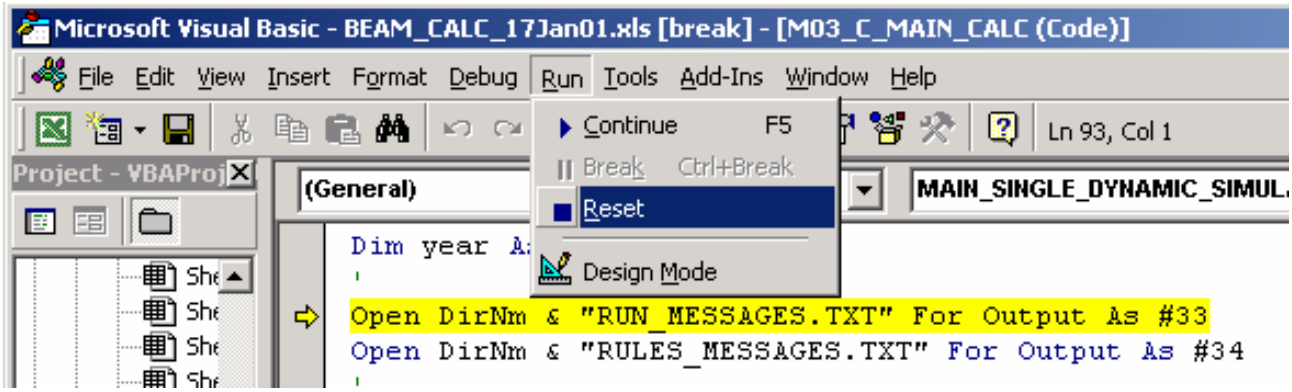


Figure 4.7.3. How to restart TEMAS.

However, to restart TEMAS you may either close it down and restart it, or you may restart it by clicking on “Reset” in the VISUAL BASIC editor, as shown in Figure 2.14.3.

DTU Aqua-rapportindex

Denne liste dækker rapporter udgivet i indeværende år samt de foregående to kalenderår. Hele listen kan ses på DTU Aquas hjemmeside www.aqua.dtu.dk, hvor de fleste nyere rapporter også findes som PDF-filer.

Nr. 158-06 Østers (*Ostrea edulis*) i Limfjorden. Per Sand Kristensen og Erik Hoffmann

Nr. 159-06 Optimering af fangstværdien for jomfruhummere (*Nephrops norvegicus*) – forsøg med fangst og opbevaring af levende jomfruhummere. Lars-Flemming Pedersen

Nr. 160-06 Undersøgelse af smoltudtrækket fra Skjern Å samt smoltdødelighed ved passage af Ringkøbing Fjord 2005. Anders Koed

Nr. 161-06 Udsætning af geddeyngel i danske søer: Effektvurdering og perspektivering. Christian Skov, Lene Jacobsen, Søren Berg, Jimmi Olsen og Dorte Bekkevold

Nr. 162-06 Avlsprogram for regnbueørred i Danmark. Alfred Jokumsen, Ivar Lund, Mark Henryon, Peer Berg, Torben Nielsen, Simon B. Madsen, Torben Filt Jensen og Peter Faber

Nr. 162a-06 Avlsprogram for regnbueørred i Danmark. Bilagsrapport. Alfred Jokumsen, Ivar Lund, Mark Henryon, Peer Berg, Torben Nielsen, Simon B. Madsen, Torben Filt Jensen og Peter Faber

Nr. 163-06 Skarven (*Phalacrocorax carbo sinensis* L.) og den spættede sæls (*Phoca vitulina* L.) indvirkning på fiskebestanden i Limfjorden: Ecopath modellering som redskab i økosystem beskrivelse. Rasmus Skoven

Nr. 164-06 Kongeåens Dambrug – et modeldambrug under forsøgsordningen. Statusrapport for første måleår af moniteringsprojektet. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

Nr. 165-06 A pilot-study: Evaluating the possibility that Atlantic Herring (*Clupea harengus* L.) exerts a negative effect on lesser sandeel (*Ammodytes marinus*) in the North Sea, using IBTS-and TBM-data. Mikael van Deurs

Nr. 166-06 Ejstrupholm Dambrug – et modeldambrug under forsøgsordningen. Statusrapport for første måleår af moniteringsprojektet. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

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Nr. 169-07 Produktion af blødskallede strandkrabber i Danmark - en ny marin akvakulturproduktion. Knud Fischer, Ulrik Cold, Kevin Jørgensen, Erling P. Larsen, Ole Saugmann Rasmussen og Jens J. Sloth.

Nr. 170-07 Den invasive stillehavsøsters, Crassostrea gigas, i Limfjorden - inddragelse af borgere og interessenter i forslag til en forvaltningsplan. Helle Torp Christensen og Ingrid Elmedal.

Nr. 171-07 Kystfodring og kystøkologi - Evaluering af revlefodring ud for Fjaltring. Josianne Støttrup, Per Dolmer, Maria Røjbek, Else Nielsen, Signe Ingvardsen, Per Sørensen og Sune Riis Sørensen.

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