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

By

*Per J. Sparre Technical University of Denmark National Institute of Aquatic Resources* 





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

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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 VBprogram 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.

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			Baltistan -	Baltistan -	Baltistan -	Baltistan -	Scandinavia				
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17       NPV cash Flow ECC         18       Total Landings         19       Total Value         14       ▲       ►I       Tunin         17       TEMAS_INPUT       A         1       DIMENSIONS       2         2       TEMAS       S         3       Evaluation Fram.         4       Version. EXCEL       5         5       Marine Fisheries       6         6       DIFRES (Danish       7         7       8       Note: Do not ins         9       Hote: INPUT III Y       10         11       12       13         13       Table 1.1.       14         15       Number of periods       16         16       Number of Stocks       17	DNOMIC ANALYSIS.	tra1 / Fleet	790100.9 45541.78 102497 Output /	E COO7 Colored	E 112387 51638.31 123618.4 put / Econ F F STOCKS Age groups	G BUN INFO Date of thi Name of R Param. Crt File Name:	84086. 189277 Dut / TES H BMATION \$ run: eated:				
17       NPV cash Flow ECC         18       Total Landings         19       Total Value         14       ▲         17       TEMAS_INPUT         17       A         1       DIMENSIONS         2       TEMAS         3       Evaluation Frame         4       Version, EXCEL         5       Marine Fisheries         6       DIFRES (Danish         7       8         8       Note: Do not ins         9       Hote: INPUT III Y         10       11         12       13         13       Table 1.1.         14       15         15       Number of periods         16       Number of Stocks         17       Number of Countries	DNOMIC ANALYSIS.	tra1 / Fleet	790100.9 45541.78 102497 Output /	E Colls Coll Coll Coll Coll Coll Coll Coll Coll	E 112387 51638.31 123618.4 put / Econ F STOCKS Age groups	G BUN INFO Date of thi Name of R Param. Cro File Name:	84086. 189277 Dut / TES H RMATION \$ run: eated:				
17       NPV cash Flow ECC         18       Total Landings         19       Total Value         14       ▲         17       NRAS_INPUT         18       TEMAS_INPUT         19       TEMAS_INPUT         10       A         11       DIMENSIONS         2       TEMAS         3       Evaluation Fram         4       Version, EXCEL         5       Marine Fisheries         6       DIFRES (Danish         7       8         8       Note: Do not ins         9       Hote: IIIPUT III Y         10       11         12       13         13       Table 1.1.         14       15         15       Number of periods         16       Number of Areas         17       Number of Areas	DNOMIC ANALYSIS.	tra1 / Fleet	79010.9 45541.78 102497 Output /	E Table 1.2 Vest Cod East cod	E 112387 51638.31 123618.4 put / Ecor F STOCKS Age groups	G RUN INFO Date of thi Name of R Param. Cro File Name:	B4086, 189277 Dut / TES H RMATION S FUN: un: Pated:				

#### 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).

🔄 TEMAS_DEMO				
Filer Rediger Vis Foretrukne Funktioner	Hjælp			
🌀 Tilbage 🝷 🕥 🕤 🏂 🔎 Søg 🞼	Mapper			
Adresse 🖾 C:\TEMAS_DEMO				
Mapper ×	Navn 🔺	Størrelse	Туре	Ændret den
<ul> <li>Skrivebord</li> <li>Dokumenter</li> <li>Dome computer</li> <li>Documents and Settings</li> <li>TEMAS</li> <li>TEMAS_DEMO</li> <li>Dota</li> <li>Demon_5_Mig3</li> <li>Multiple_Output</li> <li>Help</li> <li>Help</li> <li>Help_INPUT</li> <li>EXTRAS</li> <li>Nonows</li> <li>Nundows</li> <li>Nundows</li> </ul>	<ul> <li>Data</li> <li>EXTRAS</li> <li>Kopi af Data</li> <li>READ_ME_FIRST_27Mar07.doc</li> <li>TEMAS_CALC_27Mar07.xls</li> <li>TEMAS_DEMON_27Mar07.xls</li> <li>TEMAS_INPUT_27Mar07.xls</li> <li>TEMAS_STO_OUT_27Mar07.xls</li> <li>TEMAS_USERS_MANUAL_27Mar07.doc</li> </ul>	1661 KB 5353 KB 3023 KB 5093 KB 762 KB 5583 KB	File Folder File Folder File Folder Microsoft Word Doc Microsoft Excel Wor Microsoft Excel Wor Microsoft Excel Wor Microsoft Word Doc	28-03-2007 20:13 28-03-2007 18:27 28-03-2007 18:26 27-03-2007 20:37 28-03-2007 18:29 27-03-2007 13:34 28-03-2007 19:03 27-03-2007 13:55 28-03-2007 20:11

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):

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<sup>1</sup> 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.

<sup>&</sup>lt;sup>1</sup> 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".

×



	MAIN	IN	PUT	MENU	
Time of last run: 27-03	3-2007 - 13:14:24		File Name	of last run : DEMON_5_Mig3	
Title of last run: DEMONSTR Stock(s).	ATION EXAMPLE No. 5 - 5 Area(s). 10 Year(s).	WITH FA	AKE DATA (20 (4 vears) . Circ	ountries, (Number of fleets: Ct 1: 2 Ct 2: ular movement (minimum 3 areas)	2) 2
Select Table				•	
Select Menu				•	?
Select Worksheet				•	
About	Options	?		Write list of all tables	?
Clear all sheets			C	reate Demonstration data	?
Backup File			Read	existing case study from disk	?
Delete	File(s)	?		Check input parameters	?

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.

MAIN MENU			×						
Evaluation Frame for fisheries management systems MAIN INPUT MENU									
Time of last run: 27-03-2007 - 13:14:24		File Name of last run : DEMON_5_Mig3							
Title of last run: DEMONSTRATION EXAMPLE No. 5 - 5 Stock(s). 5 Area(s). 10 Year(s).	WITH F. dt = 1	AKE DATA(2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) /4 years). Circular movement (minimum 3 areas)	2						
Select Table		•							
073 - Table5.2. NAMES OF FLEET CHARACTERISTICS 074 - Table5.3. OVERALL MULTIPLIER FOR NUMBER OF BOATS AND EFFORT - ALL FLEETS (ALL COUNTR 075 - Table5.4.1. Baltistan : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSELS) 076 - Table5.4.2. Baltistan : NUMBER OF NEW BOATS MultS									
077 - Table 5.4.3. Baltistan : CREW PER VESSEL 078 - Table 5.4.4. Baltistan : MAX DAYS/PERIOD 079 - Table 5.4.5. Baltistan : NUMBER OF DIS-INVESTMENT (WITHDRAWAL) VESSELS 080 - Table 5.4.6. Baltistan : NUMBER OF ATTRITION VESSELS									
Clear all sheets	?	Create Demonstration data	?						
Backup File	?	Read existing case study from disk	?						
Delete File(s)	?	Check input parameters ?	?						

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

READ STOCK INPUT FROM SHEET	×
STOCK TNPUT	?
EXCEL 2003, MS Visual Basis 6.3 TEMAS: 27 Mar 2007	
Options for Preprocessing of data	?
Goto Main Menu	
Read stock parameters from diskfile	?
Read stock parameters from 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

TEMAS	1
Oplaulation modula	
Galculation mouule	
Evaluation Frame for fisheries management	
EXCEL 2003, MS Visual Basis 6.3	
Simulation	]
Simulation	
Main Menu	
File Name of last run : DEMON_5_Mig3	
Time of last run: 27-03-2007 - 13:14:24	
Title of last run:	
DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA ( 2 Countries,	
(Number of needs: LC 1: 2 LC 2: 2) 2 Stock(s), 5 Area(s), 10 Year(s), dt = 1/4 years) , Circular movement (minimum 3 areas)	

time to time clear the sheets by the outton "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 heets" only applies to the tandard 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.

Ν	SO1_DIM (SO	02_STOCK /	(SO3_FLEET	г / SO4_EFF	ORT / SO5_B	DATS / SO6_	PRICES / SO7	_ECONOMY
_								
1	′SO8 TRIP RU 🖊	'SO9 STRUC	RU / S10 T	IUNING 🖌 S11	OBS / S12 DE	MON 🗸 S13 TJ	ABLES 🖌 S14 TI	EMAS 🖌 S15 HCB

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.

#### 1

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	A	В	C	D	E	F	G	H		J	K	L	M	N	
1	FLEET (FLEET/	STOC		UCTUR	ED INP	UT									
2	TEMAS	RUN INFO	RMATION	l:											
3	<b>Evaluation Frame for f</b>	isheries m	anageme	nt systems	5										
4	Version. EXCEL 2003, I	MS Visual	Basis 6.3.	TEMAS	20 Mar 20	07	Date of th	nis run:	26-03-2007	09:04					
5	Marine Fisheries Depa	rtment		3334			Name of	Run:							
6	<b>DIFRES</b> (Danish Institut	te of Marii	ne Reserci				Param. C	reated:	12:00:00 AM	00:00					
7							File Nam	e:	DEMON_5_N	lig3					L
8	Note: Do not insert or o	lelete row	/s or colur	nns betwe	en yellow	cells									
9	Note: INPUT IN YEL	LOW CEL	LS ONL	Y											
10															L
11	Table 3.1.1.	Baltista	n : ABS		сатсна	BILITY -	(Species	s, Area) t	by (Fleet, V	Size, Co	puntry, R	(igging)			L
		OB	ОВ	ОВ	ОВ	ОВ	ОВ								
		Trawler-	Trawler-	Trawler-	Trawler-	Trawler-	Trawler-	Gillnett-	Gillnett-	Gillnett-	Gillnett-	Gillnett-	Gillnett-		
		Baltistan -	Baltistan ·	Baltistan ·	Baltistan ·	Baltistan -	Baltistan -	Baltistan -	Baltistan -	Baltistan -	Baltistan -	Baltistan -	Baltistan -		
		Small -	Small -	Medium -	Medium -	Large -	Large -	Small -	Small -	Medium -	Medium -	Large -	Large -		
12		<110mm	>110mm	<110mm	>110mm	<110mm	>110mm	<110mm	>110mm	<110mm	>110mm	<110mm	>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	L
24		Catchabi	lity(FI, V.S	ize, Rig, Cl	ry, Spec, `	r', Per, Are	a) Absolute	e Catchabil	ity(FI, V.Size,	Rig, Ctry,	Spec, Area	a) * Relative	e Catchabil	ity(FI, \	¥.
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	В	С	D	E	F	G	Н		J	K
	1	DIMENSIONS	3									
1	2	TEMAS						RUN IN	FORMATION:			
1	3	Evaluation Frame	for fisherie	s manageme	nt systems							
4	4	Version. EXCEL 20	03, MS Visi	ial Basis 6.3.	- TEMAS: 20 Ma	ar 2007 -	-	Date o	f this run:	22-03-2007	19:31	
Ę	5	Marine Fisheries Department					Name	of Run:	DEMONSTRAT	DEMONSTRATION EXAMPLE No		
6	6	DIFRES (Danish Ins	stitute of M	arine Reserct	n)			Param	. Created:	12:00:00 AM	00:00	
7	7							File Na	ame:	DEMON_5_Mig	3	
8	В	Note: Do not insert	or delete i	rows or colun	nns between ye	llow cel	ls					
Ş	9	Note: INPUT IN \	ELLOW C	ELLS ONL	Y							
1	0											
4	4											

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.

<b>N</b>	Microsoft Excel - TEN	AS_INPUT_	27Mar07.xls												×
	A	В	С	D	E	F	G	H	J	K	L	M	N	0	~
1	DIMENSIONS														F
2	TEMAS						RUN	INFORMATION:							
3	Evaluation Frame f	or fisheries	management s	ystems											-
4	Version. EXCEL 200	3, MS Visu	al Basis 6.3 Th	EMAS: 2	20 Mar 200	7	Date	c 22-03-2007	19:31						
5	Marine Fisheries D	epartment					Nam	e DEMONSTRAT	ION EXAMP	LE No	.5-	WITH FAKE [	ATA	(2	
6	DIFRES (Danish Ins	titute of Ma	rine Reserch)				Para	n 12:00:00 AM	00:00						
7							File	N DEMON_5_Mig	3						
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9	Note: INPUT IN Y	ELLOWC	ELLS ONLY												
10															
11															r
13	Table 1.1.	BASIC D	IMENSIONS	т	able 1.2.	STOCKS	3	Table 1.3.	COUNTR	RIES		Table 1.4.	ARE	AS	
14		Number				Age groups			Number of F	Fleets					i i
15	Number of periods	4			West Cod	5		Baltistan	2			West Baltic			
16	Number of Stocks	2			East cod	5		Scandinavia	2			East Baltic			
17	Number of Countries	2										Not Baltic			
18	Number of Areas	5										Bornholm			
19	Number of Years	10										Gotland			
20	Fist Years	2000													
21	L		,												~
<b>H</b> •	$\rightarrow$ $\mathbb{N} \setminus SO1_DIM / $	502_STOCK	<u>/ SO3_FLEET / S</u>	D4_EFFC	DRT ( SO5_I	BOATS / SC	16_PR							>	1
Klar															:

Figure 2.2.1. Example of system dimensions of a case study

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research												

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



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 additon 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	В	C	D	E	F	G	Н
68								
69		File name:	DEMONSTRATION EXAM	IPLE No. 4	- WITH FAK	EDATA (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 ye	ears), No migration (D	efault)	
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								
an				OIA TEMA				
14 4	• • •K_SU9_STRUC_RU /	STOTIONING & STITORS / SIS	LIEMUN ( S13_TABLES (	SI4_TEMA	5 ( 51 <	Ш	J	>

Figure 2.3.1. Dimensions of Demonstration example No.4.

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	A		B	С		D		E	F		G				
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2	TEMAS									RUN INFO	RMATION				
3	Evaluation Frame for	fisheries	manade	ment syst	ems										
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11												-			
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13	Table	Num			10							-			
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10	Number of Steelee							East and	u J			-			
10	Number of Stocks		2					East cou	3	<mark>.</mark>		-			
17	Number of Countries		2									-			
10	Number of Areas											-			
19	Number of Years		2000									-			
20	FIST Years		2000					_				-			
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23		Age	groups					Vessel s	zeRiggings			-			
24	OB Trawler-Baltistan		1_			UB Trawler-Ba	altistan	_	3 2			_			
25	Gillnett-Baltistan		1			Gillnett-Baltist	an		<u> </u>			_			
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27	Table 1.5.2	2.1. 30	anumav		EIS	Table	1.5.2.2	. Scanu	navia . FLE		1210112	-			
28		Age .	groups					Vessel s	zeRiggings			-			
29	OB Trawler-Scandina	ivia	1_			OB Trawler-So	andinavi	a	3 2			_			
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SI           Klar           Fig           1           2           3           4           5           6           7           8           9           101           112           13           14           15           16           17           18           19          20	▶ ► N SO1_DIM ( S02 <i>SUIPE 2.3.2.a. Ps</i> H     22.0     DEN     12:0     DEN     Sca     Sca	2_STOCK , setudo , i 33.2007 MONSTRAT 00:00 AM MON_5_Mig able 1.3. 'able 1.3.	( S03_FLE <b>Baltic</b> J 19:31 10N EXAM 00:00 3 COUNT Number of	ET / S04_ demon K PLE No. 5 PLE No. 5 RIES Fleets 2	EFFORT	Cost Subsection Sector Cost Sector Se	S ( ) mple N Countri AREAS	0	P	Ct 2: 2) 2	R           Stock(s),	5 Area	(s), 10	Year(s),	
SI           Klar           Fig           1           2           3           4           5           6           7           8           9           10           11           12           13           14           15           16           17           18           90           20           21	► H\SO1_DIM (SO2 Fure 2.3.2.a. Ps Н 22.0 DEN 12:0 DEN 12:0 DEN 12:0 DEN 5ca Sca	2_STOCK , seudo , i 03-2007 MONSTRAT 00:00 AM MON_5_Mig Table 1.3. tistan undinavia	( S03_FLE Baltic J 19:31 10:01 EXAM 00:00 3 COUNT Number of	ET / S04_ <i>demoi</i> K PLE No. 5 PLE No. 5 RIES Fleets 2 2	EFFORT	A SOS_BOAT tion exa M FAKE DATA ( 2 Table 1.4. West Baltic Bernholm Gotland	S / Countri	0	P of fleets: Ct 1: 2	Ct 2: 2) 2	R      Stock(s), ::	5 Area	(s). 10	Year(s),	
SI           Klar           Fig           1           2           3           4           5           6           7           8           9           10           11           12           13           14           15           16           177           18           19           20           21           22	► H\SO1_DIM (SO2 FUITE 2.3.2.a. Ps Н 22.0 DEN 12:0 DEN 10 DEN 12:0 DEN 12:0 DEN	2_STOCK , seudo , i p3-2007 MONSTRAT D0:00 AM MON 5_Mig able 1.3. tistan mdinavia	SO3_FLE	ET / S04_ demoi K PLE No. 5 PLE No. 5 RIES Fleets 2 VESSEL	EFFORT	FAKE DATA ( 2 FAKE DATA ( 2 FA	S / Countri	0 es, (Number 	P of fleets: Ct 1: 2	Ct 2: 2) 2	Stock(s),	5 Area	(s). 10	V Year(s),	
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SI           Klar           Fig           1           2           3           4           5           6           7           8           9           101           112           13           14           15           16           17           18           19           201           21           22           23           24           25           76	► H SO1_DIM ( SO2 FUITE 2.3.2.a. PS H 22.0 DEN 12:0 12:0 DEN 12:0 DE	2_STOCK , seudo , i 03-2007 MONSTRAT 00:00 AM MON 5 Mig able 1.3. tistan mdinavia	A SO3_FLE	ET / S04_ demoi K PLE No. 5 PLE No. 5 PLE S PLE S P	EFFORT	Control Contro	S / Countri RREAS	0	P of fleets: Ct 1: 2 Table 1.5.1.4. rawler-Baltistan tt-Baltistan	Ct 2: 2) 2 Ct 2: 2) 2 Ct 2: 2) 2 Baltistan Rig 1 <110mm <110mm	R Stock(s), 2 	5 Area	(s), 10 GGING Rig 4	U Year(s).	
31           Klar           Klar           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           26           27	► H SO1_DIM ( SO2 FUITE 2.3.2.a. PS H 22.0 DEN 12:0 12:0	2_STOCK , seudo , i 33-2007 MONSTRAT 00:00 AM MON 5_Mig able 1.3. tistan mdinavia itistan : N s.siz. 1 all all andinavia	A SO3_FLE Baltic J 19:31 10N EXAM 00:00 13 COUNT Number of Ves.siz. 2 Medium Medium a : NAME	ET / S04_ demoi K PLE No. 5 PLE No. 5 PLE No. 5 PLE No. 5 VESSEL VESSEL VESSEL Large Large COF VES	SIZES	SOS_BOAT Ition exa M FAKE DATA ( 3) FAKE DATA ( 3) FAKE DATA ( 4) <pfake (="" 4)<="" data="" p=""> FAKE DATA ( 4) <pf< th=""><th>S / Countri AREAS</th><th>O Control Cont</th><th>P of fleets: Ct 1: 2 Table 1.5.1.4. rawler-Baltistan tt-Baltistan Table 1.5.2.4.</th><th>Q Ct 2: 2) 2 Ct 2: 2) 2 Baltistan Rig 1 &lt;110mm Scandin Scandin</th><th>R Stock(s), : : NAME ( Rig 2 &gt;110mm &gt;110mm</th><th>5 Area</th><th>(s). 10 GGING Rig 4</th><th>V Year(s). S Rig 5</th><th></th></pf<></pfake>	S / Countri AREAS	O Control Cont	P of fleets: Ct 1: 2 Table 1.5.1.4. rawler-Baltistan tt-Baltistan Table 1.5.2.4.	Q Ct 2: 2) 2 Ct 2: 2) 2 Baltistan Rig 1 <110mm Scandin Scandin	R Stock(s), : : NAME ( Rig 2 >110mm >110mm	5 Area	(s). 10 GGING Rig 4	V Year(s). S Rig 5	
31           Klar           Klar           1           2           3           4           5           6           7           8           9           10           111           12           13           14           15           16           17           18           19           20           21           22           23           24           25           26           27           28	► H SO1_DIM ( SO2 FUITE 2.3.2.a. PS H 22.0 DEN 12:0 D	2_STOCK , seudo , i u u u u u u u u u u u u u u u u u u	S03_FLE	ET / S04_ demoi K PLE No. 5 PLE No. 5 PLE No. 5 PLE No. 5 VESSEL VESSEL VESSEL Large Large COF VES Ves.siz. 3 Ves.siz. 3	SIZES	SOS_BOAT       Ition exa       M       FAKE DATA ( 3       FAKE DATA ( 3       East Baltic       Not Baltic       Bornholm       Gotland       S.       AVes. siz. 5	S / Countri REAS AREAS Ves. siz. 6 Ves. siz. 6	O Control Cont	P of fleets: Ct 1: 2 Table 1.5.1.4. rawler-Baltistan tt-Baltistan Table 1.5.2.4.	Q Ct 2: 2) 2 Ct 2: 2) 2 Baltistan Rig 1 <10mm <110mm Rig 1 Scandin: Rig 1	R Stock(s), 5 Stock(s), 5 Stoc	5 Area	(s). 10 GGING Rig 4	V Year(s). S Rig 5	
31           Klar           Klar           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           26           27           28           29	► H SO1_DIM ( SO2 FUITE 2.3.2.a. PS H 22.0 DEN 12:0 D	2_STOCK , seudo , i )3-2007 MONSTRAT 00:00 AM MON 5_Mig rable 1.3. tistan indinavia litistan : N s siz 1 all all all siz 1 all	A SO3_FLE Baltic J 19:31 10N EXAM 00:00 3 COUNTI Number of COUNTI Number of COUNTI NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NU	ET / SD4_ demoi K PLE No. 5 PLE No. 5 PLE No. 5 PLE No. 5 VESSEL VESSEL Ves.siz.3 Large Large SOF VES Ves.siz.3 Large	SIZES SEL SI	Sos_BOAT       Ition exa       M       FAKE DATA ( 3       FAKE DATA ( 3       Table 1.4.       West Baltic       Bornholm       Gotland       S       4Ves.siz. 5       ZES       4Ves.siz. 5	S ( ) mple N Countri AREAS Ves.siz. (	O Control Cont	P of fleets: Ct 1: 2 Table 1.5.1.4. rawler-Baltistan tt-Baltistan Table 1.5.2.4. rawler-Scandinavia	Q Ct 2: 2) 2 Ct 2: 2) 2 Baltistan Rig 1 <10mm Scandin Rig 1 <10mm	R Stock(s), : : NAME ( Rig 2 >110mm >110mm avia : NAM	5 Area	(s). 10 GGING Rig 4 FRIGG Rig 4	Vear(s), Year(s), S Rig 5	
Image: state	► H SO1_DIM ( SO2 FURE 2.3.2.a. Ps H 22.0 DEN 12:0 DE	2_STOCK , setudo 1 33-2007 MONSTRAT 00:00 AM MON 5_Mic able 1.3. tistan mdinavia s.siz. 1 all all all all all	A SO3_FLE Baltic J 19:31 10N EXAM 00:00 3 COUNTI Number of COUNTI Number of Ves.siz 2 Medium Medium A : NAME	ET / S04_ demoi k PLE No. 5 PLE No. 5 RIES Fleets 2 VESSEL Vessel Large Large Large	SIZES SEL SI	Aves. siz. 5	S ( ) mple N Countri AREAS Ves.siz.6	O es, (Number es, (Number es, O es, O e	P of fleets: Ct 1: 3 Table 1.5.1.4. rawler-Baltistan tt-Baltistan Table 1.5.2.4. rawler-Scandinavia	Ct 2: 2) 2 Ct 2: 2	R           Stock(s), 1           Image: Stock (s), 1 <th>5 Area</th> <th>(s), 10 GGING Rig 4 F RIGG Rig 4</th> <th>V Year(s), S Rig 5 Rig 5 Rig 5</th> <th></th>	5 Area	(s), 10 GGING Rig 4 F RIGG Rig 4	V Year(s), S Rig 5 Rig 5 Rig 5	
SI           Klar           Klar           Fig           S           6           7           8           9           10           11           12           13           14           15           16           177           18           90           20           21           22           23           24           25           26           27           28           30           31	► H SO1_DIM ( SO2 FURE 2.3.2.a. Ps H 22.0 DEN 12:0 DE	2_STOCK , seudo i b3-2007 MONSTRAT D0:00 AM MON_5_Mig able 1.3. tistan  tistan  tistan  tistan  tistan  all all all	SO3_FLE Baltic J 19:31 100 EXAM 00:00 3 COUNTI Number of COUNTI Number of Ves.siz. 2 Medium Medium	ET / SO4_ demoi k PLE No. 5 PLE No. 5 RIES Fleets 2 VESSEL Vessiz. 3 Large Large Large	SIZES SEL SI	AVES. Siz. 5	S ( ) mple N Countri AREAS Ves.siz.6	O es, (Number es, (Number G G G G G G G G G G G G G	P of fleets: Ct 1: 3 Table 1.5.1.4. rawler-Baltistan tt-Baltistan Table 1.5.2.4. rawler-Scandinavia	Ct 2: 2) 2 Ct 2:	R Stock(s), S Stock(s), S Stoc	S 5 Area DF RI Rig 3	(s), 10 GGING Rig 4	V Year(s). S Rig 5 Rig 5 Rig 5	

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.

🛅 C:\TEMAS\Data\Baltic\_Cod2 🚞 Multiple\_Output Baltic\_Cod2\_PARAM\_CONSTANT.TXT Baltic\_Cod2\_PARAM\_Y1\_Per1.TXT Baltic\_Cod2\_PARAM\_Y1\_Per2.TXT Baltic\_Cod2\_PARAM\_Y1\_Per3.TXT Baltic\_Cod2\_PARAM\_Y1\_Per4.TXT Baltic\_Cod2\_PARAM\_Y1\_Per5.TXT 🗐 Baltic Cod2 PARAM Y1 Per6.TXT Baltic\_Cod2\_PARAM\_Y2\_Per1.TXT Baltic\_Cod2\_PARAM\_Y2\_Per2.TXT Baltic\_Cod2\_PARAM\_Y2\_Per3.TXT Baltic\_Cod2\_PARAM\_Y2\_Per4.TXT Baltic\_Cod2\_PARAM\_Y2\_Per5.TXT Baltic\_Cod2\_PARAM\_Y2\_Per6.TXT Baltic\_Cod2\_PARAM\_Y3\_Per1.TXT Baltic\_Cod2\_PARAM\_Y3\_Per2.TXT Baltic\_Cod2\_PARAM\_Y3\_Per3.TXT Baltic\_Cod2\_PARAM\_Y3\_Per4.TXT 🖺 Baltic Cod2 PARAM V3 PerS TXT

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.

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ENTRY OF NEW	CASE SYSTEM DIMENSIONS	X
	W CASE DIMENSTONS	2
Versio	on: EXCEL 2003, MS Visual Basis 6.3 TEMAS; 27 Mar 2007	
File list	Main Menu ?	
STEP 1	Give name to new case study ?	Not Done
STEP 2	Read basic dimensions ?	Not Done
STEP 3	CREATE NEW CASE STUDY, STEP 1	Not Done
STEP 4	Give new name of data file - STEP 1	Not Done
STEP 5	Cancel	Not Done
STEP 6	BalticCod1	Not Done
QUIT	Go Back (Cancel entry of new case study) ?	

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.

11.



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.

1       DIMENSIONS       RUN INFORMATION:         2       TEMAS       RUN INFORMATION:         3       Evaluation Frame for fisheries management systems       Jate of this run: 29-03-2007 11:32         4       Version, EXCEL 2003, MS Yisual Basis 6.3 TEMAS: Marine Fisheries Department       NEXT STEP         5       Marine Fisheries Department       Jate of this run: 29-03-2007 11:32         6       DIFRES (Danish Institute of Marine Reserch)       Param. Created: 29-03-2007 11:32         7       STEP 1       File Name:       Baltic Cod1         8       Note: Do not insert or delete rows or columns between gellow cells       Param. Created: 29-03-2007 11:32         9       Hote: INPUT IN YELLOW CELLS ONLY       Note: The values given in the templets (tables) are the maximum allower         10       Note: STEP 3       Note: Fill in the above tables and click on on the button NEW CASE (Delet 11)         12       STEP 2       STEP 3         13       Table 1.1. BASIC DIMENSIONS       Table 1.2. STOCKS       Table 1.3. COUNTRIES       Table 1.4	M
2       TEMAS       RUN INFORMATION:         3       Evaluation Frame for fisheries management systems       A         4       Version. EXCEL 2003, MS Yisual Basis 6.3 TEMAS:       NEXT STEP         5       Marine Fisheries Department       Date of this run:       29-03-2007       11:32         6       DIFRES (Danish Institute of Marine Reserch)       Param. Created:       29-03-2007       11:32         7       STEP 1       File Name:       Baltic Cod1         8       Note: Do not insert or delete rows or columns between yellow cells       File Name:       Baltic Cod1         9       Hote: INPUT III YELLOW CELLS OILLY       Note: The values given in the templets (tables) are the maximum allower         10       Note: STEP 3       Table 1.1. BASIC DIMENSIONS       Table 1.2. STOCKS       Table 1.3. COUNTRIES       Table 1.4	
3       Evaluation Frame for fisheries management systems         4       Version. EXCEL 2003, MS Visual Basis 6.3 TEMAS:       NEXT STEP         5       Marine Fisheries Department       Jate of this run: 29-03-2007       11:32         6       DIFRES (Danish Institute of Marine Reserch)       Param. Created: 29-03-2007       11:32         7       STEP 1       File Name:       BalticCodI         8       Note: Do not insert or delete rows or columns between gellow cells       Param. Created: 29-03-2007       11:32         9       Note: INPUT IN YELLOW CELLS ONLY       Note: The values given in the templets (tables) are the maximum allower         10       Note: Fill in the above tables and click on on the button NEW CASE (Delet         11       STEP 2       STEP 3         12       STEP 1       Table 1.1. BASIC DIMENSIONS         13       Table 1.1. BASIC DIMENSIONS       Table 1.2. STOCKS       Table 1.3. COUNTRIES       Table 1.4	
4       Version. EXCEL 2003, MS Yisual Basis 6.3 TEMAS: Marine Fisheries Department       NEXT STEP uame of Run:       Date of this run: Uame of Run:       29-03-2007       11:32         5       Marine Fisheries Department       DEMONSTRATION EXAMPLE No. 4 - VITH FAKE         6       DIFRES (Danish Institute of Marine Reserch)       Param. Created:       29-03-2007       11:32         7       STEP 1       File Name:       BalticCod1         8       Note: Do not insert or delete rows or columns between gellow cells       BalticCod1         9       Hote: INPUT IN YELLOW CELLS ONLY       Note: The values given in the templets (tables) are the maximum allower not the button NEW CASE (Delet 10)         10       Note: STEP 3       Table 1.1. BASIC DIMENSIONS       Table 1.2. STOCKS       Table 1.3. COUNTRIES       Table 1.4	
5     Marine Fisheries Department     Jame of Bun:     DEMONSTRATION EXAMPLE No. 4 - VITH FAKE       6     DIFRES (Danish Institute of Marine Reserch)     Param. Created:     29-03-2007     11:32       7     File Name:     BalkieCod1     BalkieCod1     BalkieCod1       8     Note: Do not insert or delete rows or columns between gellow cells     Hote: INPUT IN YELLOW CELLS ONLY     Note: The values given in the templets (tables) are the maximum allowed tables and click on on the button NEW CASE (Delet 10)       10     Note: Fill in the above tables and click on on the button NEW CASE (Delet 11)       12     STEP 2     STEP 3       13     Table 1.1. BASIC DIMENSIONS     Table 1.2. STOCKS     Table 1.3. COUNTRIES     Table 1.4	
6       DIFRES (Danish Institute of Marine Reserch)       Param. Created:       29-03-2007       11:32         7       STEP 1       File Name:       BalticCodl         8       Note: Do not insert or delete rows or columns between gellow cells       Hote: IIIPUT III YELLOW CELLS OILLY       Note: The values given in the templets (tables) are the maximum allowe         10       Note: STEP 1       Note: Fill in the above tables and click on on the button NEW CASE (Deleted in the templets) of tables in the tables         11       STEP 2       STEP 3         13       Table 1.1. BASIC DIMENSIONS       Table 1.2. STOCKS       Table 1.3. COUNTRIES       Table 1.4	JATA (2
7       STEP 1       File Name:       BalticCodi         8       Note: Do not insert or delete rows or columns between gellow cells	
8       Note: Do not insert or delete rows or columns between geliow cells         9       Note: INPUT III YELLOW CELLS ONLY       Note: The values given in the templets (tables) are the maximum allowed not in the button NEW CASE (Deleted in the above tables and click on on the button NEW CASE (Deleted in the templets) are the maximum allowed in the templets (tables) are the maximum allowed in the templets (tables) are the maximum allowed in the above tables and click on on the button NEW CASE (Deleted in the templets) are the maximum allowed in the templets (tables) are templets (tables) are the templets (tables) are the	
3     Note: Inevalues given in the templets (tables) are the maximum allower (tables) are the maximum allo	
10     Note: Hill in the above tables and click on on the button NEW CASE (Deleter the remaining system input tables)       11     This will create the remaining system input tables       12     STEP 2       13     Table 1.1. BASIC DIMENSIONS       13     Table 1.1. BASIC DIMENSIONS	l dimensi
Instantial     This will create the remaining system input tables       12     STEP 2       13     Table 1.1. BASIC DIMENSIONS       13     Table 1.1. BASIC DIMENSIONS	e current
12     STEP 2     STEP 3       13     Table 1.1. BASIC DIMENSIONS     Table 1.2. STOCKS     Table 1.3. COUNTRIES	
13 TADIE 1.1. BASIC DIMENSIONS TADIE 1.2. STOCKS TADIE 1.3. COUNTRIES TADIE 1.4	
	. AREAS
Number	
14 Number Name of stock Age groups Name of Country of Heets Name of A	ea
15         Number of periods         12         1         Stock name 1         15         1         Country name 1         3         1         Area Name	ie 1
16         Number of Stocks         5         2         Stock name 2         15         2         Country name 2         3         2         Area Name 2	ie 2
17 Number of Countries 6 3 Stock name 3 15 3 Country name 3 3 3 Area Name	ie 3
18 Number of Areas 5 4 Stock name 4 15 4 Country name 4 3 4 Area Nar	ie 4
19 Number of Years 10 5 Stock name 5 15 5 Country name 5 3 5 Area Name	ie 5
20 Fist Years 1995 Max 6 Country name 6 3 Max	
21 Max	
22 DIMENSIONS - NEW CASE STUDY - STED 3	
20 Please enter names of stocks, countries and areas	
27 STEP 4	
28	
23 Name of Fleet OK Cancel Name of Fleet	eet
31 2 2 2	
32 3 3 3	

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.

ST	EP 3	Table 1.2.	STOCKS		Table 1.	3. COUNTRIE	s	Table 1.4.	AREAS
		Name of stock	Age groups		Name of Country	Number of fleets		Name of Area	
	1	Vestern Cod	10	1	Denmark	3	1	Baltic Vest	
	2	Eastern Cod	10	2	Germany	3	2	Balic East	
	3	Sprat	7	3	Latvia	3	3	Bornholm	
	4	Plaice	10	4	Poland	3	4	Gotland	
	5	Other species	10	5	Sweden	3	5	Not Baltic	
Ma	X			6	Other	1	Max		

1

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

1	DIMENSIONS								
2	TEMAS			B	UN INF	FORMATION:			
3	<b>Evaluation Frame for fis</b>	heries management sy	stems						
4	Version, EXCEL 2003, M	S Visual Basis 6.3 T	emas:	(T STEP	e of	29-03-2007	12:00		
5	Marine Fisheries Depart	ment			ne o	DEMONSTR	ATION EXAMP	LE No. 4 - VITH	FAKE I
6	DIFRES (Danish Institut)	e of Marine Reserch)		P	aram. I	29-03-2007	11:32		
7				F	ile Nar	I BalticCod1			
8	Note: Do not insert or d	elete rows or columns	between yellow	cells					
9	Note: INPUT IN YELLOW	CELLS ONLY							
10									
11									
12	T-LL- 4.4		Table 4.0	otoovo		Table 4.0	COUNTRIES		DEAG
13	Table 1.1.	BASIC DIMENSIONS	Table 1.2.	STOCKS		Table 1.3.	COUNTRIES	Table 1.4.	REAS
14		Number		Age groups		_	Number of Fleets		
15	Number of periods	12	Vestern Cod	10		Denmark	3	Baltic Vest	
16	Number of Stocks	5	Eastern Cod	10		Germany	3	Balic East	
17	Number of Countries	<b>b</b>	Sprat			Latvia	3	Bornholm	_
10	Number of Xears	10	Plaice Other creation	10	_	Poland	3 2	Not Paltie	_
20	Fist Years	1995	Other species			Other	1	NOCDARC	
20		1333				Other	· · · · ·		
22	Table 1.5.1.1.	Denmark : FLEETS							
23		Vessel Age gr.							
24		15							
25		15							
26		15							
27									
28	Table 1.5.2.1.	Germany : FLEETS							
29		Vessel Age gr.							
30		15	DIMENS	ions - Ne	W CA	SE STUDY -	STEP 4		
31		10							
32		CI C		Diance on	tor por	noc of floots o	nd number of us	scol pao aroupo	
34	Table 1.5.3.1.	Latvia : FLEETS		FICASE CIT	ter nai	nes or needs a	ind number of ve	ssei age groups	
35		Vessel Age gr.							
36		15			(	эк	Cancel		
37		15			`		Cancer		
38		15							1
39									
40	Table 1.5.4.1.	Poland : FLEETS							
41		Vessel Age gr.							
42		15							
43		15							
44		15							
45	Table 1551	Sweden · ELEETS							
40	Тале п.э.э.т.	Vessel Age at			_				_
48		15							
49		15							
50		15							
51									
52	Table 1.5.6.1.	Other : FLEETS							
53		Vessel Age gr.							
54		15							
EE									

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.

	A	В	С	D	E	F	G	Н	
12	Table 4.4		NCIONC		Table 4.0	CTOCKC			T-1
13	Table 1.1.	BASIC DIME	NSIONS		Table 1.2.	STOCKS			
14		Number				Age groups			_
15	Number of periods	12			Vestern Cod	10			Denn
16	Number of Stocks	5			Eastern Cod	10			Gern
1/	Number of Countries	. 6			Sprat				Latvi
10	Number of Areas				Plaice	10			Pola
20	Number of Years	1005			Uther species	10			Othe
20	riscieais	1999							Othe
22	Table 1.5.1.1.	Denmark : F	I FETS Table	1.5.1.2.	Denmark : ELEET	DIMENSIONS			
22	Tuble north	Age groups			Number of Vessel sizes	Number of Biggings			
24	Gilla	nge groups 1		Gillo	ridinber of vessersizes	a reamber of Fliggings			
25	Travi			Trawl	3	3			
26	Other			Other	3	3			
27				Other	v				
28	Table 1.5.2.1.	Germany : F	LEETS Table	1.5.2.2.	Germany : FLEET	DIMENSIONS			
29		Age groups			Number of Vessel sizes	Number of Riggings			+
30	Gilln	1		Gilln	3	3			
31	Travi	1		Trawl	3	3			
32	Other	1		Other	3	3			
33									
34	Table 1.5.3.1.	Latvia : FLE	ETS Table	1.5.3.2.	Latvia : FLEET DIN	IENSIONS			
35		Age groups			Number of Vessel sizes	Number of Riggings			
36	Gilln	1		Gilln	3	3			
37	Travi	1		Trawl	3	3			
38	Other	1		Other	3	3			
39									
40	Table 1.5.4.1.	Poland : FLE	ETS Table	1.5.4.2.	Poland : FLEET DI	MENSIONS			
41		Age groups			Number of Vessel sizes	Number of Riggings			
42	Gilln	1	DIMENSIO			етер 5			
43	Travi	1	DIMENSIO	ND - INE	W CASE STODT -	SILP J			
44	Other	1	- <u> </u>						
45	Table 1551	Sweden	ER 🔥 F	Please en	ter fleet dimensions (	number of vessel siz	e clas	ses and ric	ainas)
46	Table 1.5.5.1.	Sweden . FL							,
4/	0.11	Age groups							
48	Gilin				ок	Cancel			
43	Trawi Orber								
50	Utilei								
52	Table 1.5.6.1	Other : ELEE	TS Table	1.5.6.2	Other : ELEET DIM	ENSIONS			
53		Age groups			Number of Vessel sizes	Number of Biggings			
54	Other	nige groups 1		Other	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 somer or nggings			
EE		·		arsing 1					-
H -	🗘 🕨 🕨 🗎 🚺 🚺 🚺	[M / Old_Sta	ock / SO2_ST	OCK 🏑 :	SO2_STOCK_C / S	503 <b>_                                     </b>			

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.

Table	1.5.1.2.	Denmark : FLEET	DIMENSIONS								
		Number of Vessel sizes	Number of Riggings	ENTRY OF	NEW CASE						
	Gilln	3	3	LINIKT OF	NEW CASE :	STSTEM DIMEN	SIGNS				
	Trawl	3	3								
	Other	1	1								
					$N \vdash W$	I CASH	- 1	IMENIS	SION	15	?
Table	1.5.2.2.	Germany : FLEET	DIMENSIONS	1			- U				
		Number of Vessel sizes	Number of Riggings			Version: EXCE	L 2003	. MS Visual Basis 6.3.	TEMAS: 2	7	
	Gilln	3	3					,			
	Trawl	3	3								
	Other	1	1	File lis	st		Main	Menu		?	
Table	1.5.3.2.	Latvia : FLEET DIN	AENSIONS	CTED	4						
		Number of Vessel sizes	Number of Riggings	SIEP	<u> </u>	– Give nam	e to	new case stud	dy 🛛	?	Done
	Gilln	3	3								
	Trawl	3	3	CTED	<u> </u>	n/	L ? .				_
	Other	1	1	JILF	<u> </u>	кеаал	oasiu	: aimensions		17	Done
Table	1512	Deland - ELEET DI	MENCIONE								
Table	1.5.4.2.	Poland : FLEET DI	MENSIONS	STEP	3 200	od opmog of	ctock	a countrías an	daraar	2	Dope
		Number of Vessel sizes	Number of Riggings				SIUCA	s, count ies an	u ai cas	÷	Done
	Gilln	3	3								
	Trawl	3	3	STEP	4 ,	Read fleet-	nami	es and age gro	าเมาร	2	Done
	Uther										
Table	1552	Sweden : ELEET [	DIMENSIONS	CTED	<b>P</b>						
		Number of Vessel sizes	Number of Biggings	SIEP	5	Read	fleet	-dimensions		?	Not Done
	Gillo	Tidifiber of Yessel sizes	3								
	Trawl	3	3	CTED	6	0					
	Other	1	1	JILF	<b>·</b> ·	кеаа пате	s og	sizes and rigg	ings	1	Not Done
Table	1.5.6.2.	Other : FLEET DIN	IENSIONS	OUT		Back (Cance	al ani	tru of new case	stucke)	2	
		Number of Vessel sizes	Number of Riggings		00	Dack (Calle	a can	ry or new case	Study		
	Other	1	1								

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

111-

Table 1513	Denmark • NA	ME OF VESSEL SIZ	7ES	Tab	4 1 5 1 4	Denmark • NA	ME OF RIGGIN	6S	
Table 1.5.1.5.	Versie 1	Weards 2	Vec de 0	Tab	16 1.3.1.4.	Denmark . NA	Die 0	Dia 0	
C2le	Ves.siz. I	Vesisia, 2	Vesisia 3		Cille	Fig I	Fig 2	Fig 3	
Gilin	V.Siz.name I	V.Siz.name Z	V.Siz.name 3		Gilin	Rig Name 1	Rig Name 2	Rig Name 3	
Travi	¥.Siz.name 1	V.Stz.name Z	¥.Siz.name 3		Trave	Rig Name 1	Fig Name 2	Fig Name 3	
Uther	T.SIZ.name I				Uther	Rig Name 1			
Table 1.5.2.3.	Germany : NA	ME OF VESSEL SIZ	ZES .	Tab	le 1.5.2.4.	Germany : NA	ME OF RIGGIN	GS	
	Ves siz 1	Ves siz 2	Ves siz 3	1 410	io noizin	Big 1	Big 2	Big 3	
Gille	V Siz name 1	V Siz name 2	V Siz name 3		Gillo	Big Name 1	Big Name 2	Big Name 3	
Traul	V Siz name 1	V Siz name 2	V Siz name 3		Traul	Rig Name 1	Rig Name 2	Rig Name 3	
Other	V Siz name 1	T.OIL.IIGHIC L	T.OIL.Huile U		Other	Rig Name 1	ring reality 2	ring realize o	
Other	T.SIZ.Rune I				Other	rig wante 1			
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			Ria 1	Ria 2	Ria 3	
Gilln	¥.Siz.name 1	V.Siz.name 2	¥.Siz.name 3	-	Gilln	Big Name 1	Big Name 2	Big Name 3	
Trawl	¥.Siz.name 1	V.S.		بالانتخاب الل		with the second s	Rig Name 2	Rig Name 3	
Other	¥.Siz.name 1	DIMENSION	IS - NEW CAS	ESTUL	DY - STEP	6 🔼			
		1. A.	and the second			and the second			
Table 1.5.4.3.	Poland : NAME	EOFV 🔥 ,	la sca antar nam	ar of you	scal ciza clas	ces and ringings	OF RIGGINGS	3	
	Ves.siz.1	Ves 🌙 🏅	lease enter name	es ui ve:	5561 5126 Clas	ses and nggings	Rig 2	Rig 3	
Gilln	¥.Siz.name 1	V.S					Rig Name 2	Rig Name 3	
Travi	¥.Siz.name 1	V.S	22 D 22 OK				<b>Big Name 2</b>	<b>Big Name 3</b>	
Other	¥.Siz.name 1		OK		Cancel				
			atan <mark>atan atan atan atan atan atan atan</mark>	10					
Table 1.5.5.3.	Sweden: NAM	IE OF VESSEL SIZE	ES	Tab	le 1.5.5.4.	Sweden: NAM	AE OF RIGGING	iS	
	Ves.siz.1	Ves.siz. 2	Ves.siz. 3			Rig 1	Rig 2	Rig 3	
Gilln	¥.Siz.name 1	V.Siz.name 2	V.Siz.name 3		Gilln	Rig Name 1	Rig Name 2	Rig Name 3	
Travel	V.Siz.name 1	V.Siz.name 2	V.Siz.name 3		Travel	Rig Name 1	Rig Name 2	Rig Name 3	
Other	V.Siz.name 1				Other	Rig Name 1			
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	
Other	¥.Siz.name 1				Other	Big Name 1			

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.

1844

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.	Denmar	k:NAME	OF VESSEL	SIZE51e 1.5.1.4.	Denmark :	NAME OF R	GGINGS	
	Ves.siz.1	Ves.siz. 2	Ves.siz. 3		Big 1	Big 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.	German	y:NAME	OF VESSEL	SIZESIe 1.5.2.4.	Germany :	NAME OF RI	GGINGS	
	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 SIZ	ZESTable 1.5.3.4.	Latvia : NA	ME OF RIGG	NGS	
	Ves.siz.1	Ves.siz. 2	Ves.siz. 3		Big 1	Big 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 S	IZ <b>ES</b> able 1.5.4.4.	Poland : N/	AME OF RIGO	GINGS	
	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	-c12m	12-24m	>24m	Trawl	<110mm	>110mm	Other	
Other				Other				
Table 1.5.5.3.	Sweder	: NAME C	F VESSEL	SIZE8ble 1.5.5.4.	Sweden: N	AME OF RIG	GINGS	
	Ves.siz.1	Ves.siz. 2	Ves.siz. 3		Rig 1	Rig 2	Rig 3	Rig 4
Gilln	-c12m	12-24m	>24m	Gilln	<110mm	>110mm	Other	
Trawl	-c12m	12-24m	>24m	Trawl	<110mm	>110mm	Other	
Other				Other				
Table 1.5.6.3.	Other:	NAME OF	VESSEL SIZ	ESTable 1.5.6.4.	Other : NA	ME OF RIGGI	NGS	
	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.

Table 1.5.1.1.	Table 1.5.1.1. Denmark : FLEETS		Table 1.5.1.2.	Table 1.5.1.2. Denmark : FLEET DIMENSIONS			Table 1.5.1.3.	Denmark : NAME C
	Age groups		Vessel sizes Riggings		Riggings			Ves.siz.1
	1		Gilln	3	3		Gilln	<12m
	1		Traul	Traul 2 2				<12m
	1	ENTRY O	E DIMENSIONS CO	NCLUDED			Other	
Table 1.5.2.1.	Germany : F		Entry of dimensions cor	adudad			Table 1.5.2.3.	Germany : NAME O
	Age groups		chury or dimesions cor	iciadea				Ves.siz.1
	1	<u> </u>	PLEASE WATT WHILE		ΕΔΤΕς ΤΔΒΙ Ε ΤΕ	MPLETS	Gilln	<12m
	1			THE STOTEMER			Trawl	<12m
	1			<b>-</b> .			Other	
			OK	Cancel				
Table 1.5.3.1.	Latvia : FLE						Table 1.5.3.3.	Latvia : NAME OF V
	Age groups			Vessel sizes	Riggings			Ves.siz.1
	1		Gilln	3	3		Gilln	<12m
	1		Trawl	3	3		Trawl	<12m

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.

	A	В	С	D						
1	OBSERVED LANDINGS USED FOR TUNING									
2	TEMAS									
3	Evaluation Frame for fisheries management systems									
4	Version. EXCEL 2003, MS Visual Basis 6.3 TEMAS: 27 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 11.1.1.	Denmark -	Western Cod:	OBSERVED L						
12		1995 Per.1	1995 Per.2	1995 Per.3	199					
-13	Gilln - < 12m - < 110mm - Baltic West	No Value	No Value	No Value	No					
14	Gilln - < 12m - < 110mm - Balic East	No Value	No Value	No Value	No					
15	Gilln - < 12m - < 110mm - Bornholm		📫 Value 👘	No Value	No					
16	Gilln - <12m - <110mm - Gotland SYSTEM READY FOR DATA EN	TRY	X Value	No Value	No					
17	Gilln - < 12m - < 110mm - Not Balt		Value	No Value	No					
18	Gilln - <12m - >110mm - Baltic Vi 💦 Creation of templets cond	cluded	Value	No Value	No					
19	Gilln - < 12m - > 110mm - Balic Ea:		Value	No Value	No					
20	Gilln - <12m - >110mm - Bornholt You may now start to fill i	in the yellow c	ells Value	No Value	No					
-21	Gilln - < 12m - > 110mm - Gotland		Value	No Value	No					
22	Gilln - <12m - >110mm - Not Balt OK Cano	el	Value	No Value	No					
23	Gilln - <12m - Other - Baltic Ves		Value	No Value	No					
-24	Gilln - < 12m - Other - Balic East		Value	No Value	No					
25	Gilln - <12m - Other - Bornholm	No Value	No Value	No Value	No					
26	Gilln - < 12m - Other - Gotland	No Value	No Value	No Value	No					
27	Gilln - <12m - Other - Not Baltic	No Value	No Value	No Value	No					
28	Gilln - 12-24m - <110mm - Baltic West	No Value	No Value	No Value	No					

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

-	Microsoft Excel - T	EMAS_INPU	T_BALTIC_2	9Mar07.xls							×
	A	В	С	D	E	F	G	Н		J	
1	STOCK STRUCT	URED INPL	Л								^
2	TEMAS						BUN INFORM	ATION:			
3	Evaluation Frame for	r fisheries man	agement suste	ms							
4	Version. EXCEL 2003	, MS Visual Ba	asis 6.3 TEM	AS: 27 Mar 200	07		Date of this ru	IN:	29-03-2007	20:22	
5	Marine Fisheries Dep	partment					Name of Run:				
6	<b>DIFRES (Danish Insti</b>	itute of Marine	Reserch)				Param. Create	ed:	29-03-2007	20:20	
7							File Name:		BaticCod2		
8	Note: Do not insert o	or delete rows	or columns bet	tween yellow ce	lls						
9	Note: INPUT IN YELL	OW CELLS ON	LY								
10	Table 2.4.4	CDOM/TH AN									-
11	Table 2.1.1.	GROWTHAN		PARAMETERS	<b>&gt;</b>						-
12	Marker Ord	Loo	K	t-zero	Cond. Exp.	Maturity L50%	Maturity L75%	RelStDev.(K)	ReiStDev(C.Fac)		-
13	Western Loa	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value		-
15	Eastern Cou Corest	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 F	ACTOR								-
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 Yalue	No Value	No Value	No Value	No Value	No Yalue	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 ¥alue	No Value	No Value	No Value	No Value	
24	Plaice	No Yalue	No Value	No Value	No Yalue	No Value	No Value	No Yalue	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	Table 2.2.4	DECOLUTAR		De							-
27	Table 2.2.1.	RECRUITMEN	ПРАКАМЕН	EKS							
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 ¥alue	No Value	No Value	No Value	No Value	
30	Eastern Cod	No Yalue	No Value	No Value	No Yalue	No Value	No Yalue	No Yalue	No Yalue	No Value	
31	Sprat	No Value	No ¥alue	No ¥alue	No Value	No Value	No Value	No Value	No Value	No Value	
32	Plaice Other encodes	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	
24	Other species	NO Value	NO Value	NO Falue	NO Value	NO Talue	NO Value	NO Value	NO Talue	NO Value	
35	Table 2.2.2.	RECRUITMEN	IT DISTRIBUT	ION ON PERIC	DDS						-
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 Yalue	No Value	No Value	No Yalue	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 Yalue	No Value	No Value	No Yalue	No Value	No Value	
42	Table 2.2.2	DECOLUTION			6						-
43	Table 2.2.5.	RECROITMEN	TDISTRIBUT	ION ON AREA	5						-
44	Ventue Cert	Baltic West	Balic East	Bornholm	Gotland	Not Baltic					
40	Western Loa	No Value	No Value	No Value	No Value	No Value					-
40	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 Yalue	No Yalue	No Yalue	No Value	No Yalue					
50											-
51	Table 2.2.4.	LOW SPAW	VING SUCCES	S 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					~
H	♦ ► ► \ Old_Dim ↓	( SO1_DIM λ	SO2_STOCK	: <u>/</u> so2_sтос	K_C / SO3, FLE	ET 🖌 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.

	A	В	С	D	E	F	G	Н —		
1	INPUT	TABLES						<u> </u>		
2	TEMAS						RUN INFORMATION:			
3	fisheries	management sys	stems							
4	sual Bas	is 6.3 TEMAS:	27 Mar 20				Date of this run:	18-04-2007		
5	sheries D	epartment			4		Name of Run:	No Value		
6	nstitute c	of Marine Reserc	h)				Param. Created:	18-04-2007		
7							File Name:	BalticCod1		
8	rows or	columns betweer	n yellow c	ells						
9	YELLOW	V CELLS ONLY								
10	Indez	Table Number	Indez	Sheet Name	Start Row	Start Col	Caption	mm		
11	1	Table1.1.	1	S01_DIM	13	1	BASIC DIMENSIONS	The Dimensions of a ca:		
12	2	Table1.2.	1	S01_DIM	13	5	STOCKS	A 'Stocks' here means a		
13	3	Table1.3.	1	S01_DIM	13	9	COUNTRIES	Fleets can be grouped by		
14	4	Table1.4.	1	S01_DIM	13	13	AREAS	Areas are 'fishing ground		
15	5	Table1.5.1.1.	1	S01_DIM	22 1 Denmark : FLEETS A		A 'Fleet' is a group of fai			
16	6	Table1.5.1.2.	1	S01_DIM	22	4	Denmark : FLEET DIMENSIONS	Vessel size groups can t		
17	7	Table1.5.1.3.	1	S01_DIM	22	8	Denmark : NAME OF VESSEL SIZES	Vessel size groups can t		
18	8	Table1.5.1.4.	1	S01_DIM	22	13	Denmark : NAME OF RIGGINGS	Riggings means a subdiv		
19	9	Table1.5.2.1.	1	S01_DIM	28	1	Germany : FLEETS	A 'Fleet' is a group of fai		
20	10	Table1.5.2.2.	1	S01_DIM	28	4	Germany : FLEET DIMENSIONS	Vessel size groups can t		
21	11	Table1.5.2.3.	1	S01_DIM	28	8	Germany: NAME OF VESSEL SIZES	Vessel size groups can t		
22	12	Table1.5.2.4.	1	S01_DIM	28	13	Germany : NAME OF RIGGINGS	Riggings means a subdiv		
23	13	Table1.5.3.1.	1	S01_DIM	34	1	Latvia : FLEETS	A 'Fleet' is a group of fai		
24	14	Table1.5.3.2.	1	S01_DIM	34	4	Latvia : FLEET DIMENSIONS	Vessel size groups can b		
25	15	Table1.5.3.3.	1	S01 DIM	34	8	Latvia : NAME OF VESSEL SIZES	Vessel size groups can b		
536	526	Table 15.3.2.5.	15	S15_HCR	335	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
537	527	Table15.3.3.5.	15	S15_HCR	344	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
538	528	Table 15.3.4.5.	15	S15_HCR	353	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
539	529	Table15.3.5.5.	15	S15_HCR	362	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
540	530	Table 15.4.1.5.	15	S15_HCR	371	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
541	531	Table15.4.2.5.	15	S15_HCR	380	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
542	532	Table 15.4.3.5.	15	S15_HCR	389	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
543	533	Table 15.4.4.5.	15	S15_HCR	398	1	RELATIVE STABILITY (HARVEST CONTR	C Relative stability for TAC		
544	534	Table 15.4.5.5.	15	S15_HCR	407	1	RELATIVE STABILITY (HARVEST CONTR	CRelative stability for TAC 🚽		
- 1 P		2			1					

 Image: A start of tables in TEMAS\_INPUT.

	А	В	С	D	E —
58					<u> </u>
59	Table 1.6.1.	STOCK TAB	LES FOR O	UTPUT (1: The table	is displa
60		Number			
61	Western Cod	1			
62	Eastern Cod	1			
63	Sprat	1			
64	Plaice	1			
65	Other species	0			
66					
67					
68	Table 1.6.2.	AREAS TAB	LES FOR O	UTPUT (1: The table	is displa
69		Number			
70	Baltic West	1			
71	Balic East	1			
72	Bornholm	1			
73	Gotland	1			
74	Not Baltic	0			
75					
H -	♦ ► ► Old_Dim \ S01_E	DIM / Old_S	tock 🖌 SO2	2	•

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.

	Α	В	C	D	E	F	G	_
1	DIMENSIONS							-
2	TEMAS						RUN INFORMATION:	
3	<b>Evaluation Frame for fisher</b>	ries mana	gement systems					
4	Version. EXCEL 2003, MS V	lisual Bas	sis 6.3 TEMAS: 2	0 Mar 2007			Date of this run:	
5	Marine Fisheries Departme	nt				14	Name of Run:	
6	<b>DIFRES (Danish Institute o</b>	f Marine I	Reserch)			14	Param. Created:	
7							File Name:	
8	Note: Do not insert or delet	te rows o	r columns between	yellow cells				
9	Note: INPUT IN YELLOW CE	LLS ONL	Y					
12								
13	Table 1.1.	BASIC E	DIMENSIONS		Table 1.2.	STOCKS	S	
14		Number				Age group	s	_
15	Number of periods	- 4			Vest 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	l able 1.5.1.1.	Baltista	n:FLEETS	l able 1.5.1.2.	Baltistan : F	MENSIONS	_	
23		Age group	)s		Vessel sizes	Riggings		_
24	OB Trawler-Baltistan	1		OB Trawler-Baltistan	3	2		_
25	Gillnett-Baltistan	1	1	Gillnett-Baltistan	3	2	1	_
26	T-11-4504			T-11-4500	o	EL FET	DINENGLONG	_
27	Table 1.5.2.1.	Scandii	navia : FLEETS	Table 1.5.2.2.	Scandinavi	a:FLEET	DIMENSIONS	_
28		Age group	)S		Vessel sizes	Riggings		_
29	OB Trawler-Scandinavia	1		OB Trawler-Scandinavia	3	2		_
30	Gillnett-Scandinavia	1	1	Gillnett-Scandinavia	3	2	1	
31	( ) VI COL DIM ( COC			COA EFFORT /		I		Ě
14 4	INVESTIGATION ( 202)	2_STOCK	. <u>K SU3_FLEET K</u>	SU4_EFFORT / ] • ]			• •	

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

	Н	1	J	К	L	M	N	0	P	Q	R	S	T	U
1														
2														
3														
4		22-03-2007	19:31											
5		DEMONSTRA	TION EX		lo. 5 - ¥	ITH FAKE D		2 0	ountries, (Number of	fleets: Ct	1: 2 Ct 2:	2) 2	Stock[:	s), 5,
6		12:00:00 AM	00:00											
7		DEMON_5_M	ig3											
8														
9														
12														
13		Table 1.3.	COUNT	RIES		Table 1.4.	ARE	AS						
14			Number o	f Fleets										
15		Baltistan	2			Vest Baltic								
16		Scandinavia	2			East Baltic								
17						Not Baltic								
18						Bornholm								
19						Gotland								
20														
21				FOOT	0.750							E DIG		
22	Table 1.5.1.3.	Baltistan : N/	AME OF V	/ESSEL	SIZES				Table 1.5.1.4.	Baltistan	: NAME O	FRIGO	JINGS	
23		Ves.siz.1	Ves.siz. 2	Ves.siz. 3	Ves.siz. 4	Ves.siz. 5	Ves.s	iz. 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	T-1-1-00	C K								C			NCON	<u> </u>
27	Table 1.5.2.3.	Scandinavia	: NAME	OF VESS	EL SIZE	5			Table 1.5.2.4.	Scandina	Ma : NAM	EOFF	aggin	65
28		Ves.siz.1	Ves.siz. 2	Ves.siz. 3	Ves.siz. 4	Ves.siz. 5	Ves.s	iz. 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					1004 5	FEORT / CO		0.0				1	1	
14 4		<u>X SUZ_STUU</u>	K <u>K SU</u> B,	_FLEET,	<u>(</u> 504_Ε	нокт д ы	no R	UAT	<u> </u>					

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.

	EXCEL	
Index	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:

$$Lgt(St, y, a, q) = Loo(St) * (1 - exp[ -K (St) * (Age(a, q, qa) - Tzero(St))])$$

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

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

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



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	В	С	D	E	F	G	н	I	J	-
1	<b>STOCK ST</b>	RUCTUR	ED INPU	т							^
2	TEMAS						RUN INFORM	IATION:			_
3	<b>Evaluation Fr</b>	ame for fis	heries mana	gement sys	tems						
4	Version, EXC	EL 2003, M	S Visual Bas	sis 6.3 TE	MAS: 27 Mar 2	2007	Date of this r	un:	17-04-2007	16:24	
5	Marine Fisher	ies Depart	ment				Name of Run			TION EXA	
6	DIFRES (Dani	ish Institute	e of Marine I	Reserch)			Param. Creat	ed:	12:00:00 AM	00:00	
7							File Name:		DEMON_5_M	ig3	
8	Note: Do not	insert or d	elete rows o	r columns b	etween yellow	cells					
9	Note: INPUT I	I YELLOW	CELLS ONL	.Υ							
10	Table 0.4.4	opolartu									
11	Table 2.1.1.	GROWTH	AND MAT	JEILY PAR	AMETERS						
12		Loo	К	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	Table 0.4.0	CONDITIC	NEACTOR								
16	Table 2.1.2.	CONDITIC	DNFACTOR	٤							
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			02 стось			EEORT / CO					-
	• • • • [\ 501	CDIM Ya	02_3100	X 303_FL	CC 1 X 304_C	FORT & SU					

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

 $\begin{array}{l} \operatorname{Mat}(\operatorname{St}, \operatorname{y}, \operatorname{a}, \operatorname{q}) = \frac{1}{1 + \exp(\operatorname{Mat}1(\operatorname{St}) - \operatorname{Mat}2(\operatorname{St}) * \operatorname{Lgt}(\operatorname{St}, \operatorname{a}, \operatorname{y}, \operatorname{q}))} \\ \text{where} \\ \operatorname{Mat}1(\operatorname{St}) = \ln(3) * \operatorname{L}_{50\% \operatorname{Mat}}(\operatorname{St}) / (\operatorname{L}_{75\% \operatorname{Mat}}(\operatorname{St}) - \operatorname{L}_{50\% \operatorname{Mat}}(\operatorname{St})), \\ \operatorname{L}_{50\% \operatorname{Mat}}(\operatorname{St})) \text{ and} \\ \operatorname{L}_{X\% \operatorname{DMat}}(\operatorname{St}) = \operatorname{Length} \text{ at which } X \% \text{ are mature.} \end{array}$ 

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,  $\varepsilon_K$ 

 $\begin{aligned} & \operatorname{Lgt} \left( \operatorname{St}, \, \operatorname{y}, \operatorname{a}, \operatorname{q} \right) = \\ & \operatorname{L}_{\infty}(St)^* \left( 1 - \exp\left[ -K \, \left( \operatorname{St} \right)^* \varepsilon_K(St, \, y)^* \left( \operatorname{Age}(a, q) - T_0(St) \right) \right] \right) & \text{if } a \ge 2 \\ & \operatorname{Lgt} \left( \operatorname{St}, \, \operatorname{y}, \operatorname{a}, \operatorname{q}, \operatorname{qa} \right) = \\ & \operatorname{L}_{\infty}(St)^* \left( 1 - \exp\left[ -K \, \left( \operatorname{St} \right)^* \varepsilon_K(St, \, y)^* \left( \operatorname{Age}(a, q, aq) - T_0(St) \right) \right] \right) & \text{if } a \le 2 \end{aligned}$ 

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,  $\varepsilon_{OF}$ 

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

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.



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 $STR_2(SSB(St, y-1, \bullet, \bullet)) = HSCon \operatorname{Re} c(St)$

#### 1

	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
	HSSlope(St) = HSConstRec(St) / HSBiom(St).
3.	
Ricker	$STR_3(SSB(St, y-1, \bullet, \bullet)) =$
model	$Ric \ker Coeff(St) * SSB(St, y-1, \bullet, \bullet) * \exp(-Ric \ker Exp(St) * SSB(St, y-1, \bullet, \bullet))$
	where the parameters are RickerCoeff(St) and RickerExp(St)
4.	
Deriso-Schnute stock / recruitment model	$STR_4(SSB(St, y-1, \bullet, \bullet)) = DSCoeff1(St) * SSB(St, y-1, \bullet, \bullet)$
	* { $1 - DSCoeff 2(St) * SSB(St, y-1, \bullet, \bullet)$ } <sup><math>DSExp(St)</math></sup>
	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	t 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

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

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

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,  $RecDist_{Area}(St,Ar)$  and  $RecDist_{Period}(St,q)$ , the relative distribution of recruitment on areas and time periods.

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

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

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

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

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

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

where the "Spawning success factor" is defined as

$$rsf_{NotMPA}(St, Ar, \varepsilon_{SR2}(St)) = \begin{cases} rsf_{NotMPA}^{High}(St, Ar, \varepsilon_{SR2}(St)) & \text{if } \varepsilon_{SR2}(St) \leq IF \operatorname{Pr}(St, y) \\ rsf_{NotMPA}^{Low}(St, Ar, \varepsilon_{SR2}(St)) & \text{if } \varepsilon_{SR2}(St) > IF \operatorname{Pr}(St, y) \end{cases}$$
  
where  $0 \leq rsf_{NotMPA}^{Low}(St, Ar, \varepsilon_{SR2}(St)) \leq rsf_{NotMPA}^{High}(St, Ar, \varepsilon_{SR2}(St)) \leq 1$ 

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.  $\operatorname{Re} c(St, y, q, Ar) =$ (A.9.2.3)

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



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	В	С	D	E	F	G	н	<b>I</b>	J	K	L	M	N	-	7
50																L
51	Table 2.3.1.	STOCK	UMBERS	5 FIRST P	ERIOD OF	FIRST Y	EAR - Age	e 0- 1								
		West Cod -					East cod -									
		West	West Cod -	West Cod -	West Cod -	West Cod-	West	East cod -	East cod -	East cod -	East cod -					
52		Baltic	East Baltic	Not Baltic	Bornholm	Gotland	Baltic	East Baltic	Not Baltic	Bornholm	Gotland					
53	Age 0 - Per. 1	7500	0	0	0	0	0	800	0	2400	800	Enter O-group, p	eriod 1, here for c	alculation of initial	N	Ĩ
54	Age 0 - Per. 2	0	0	0	0	0	0	0	0	0	0	Enter O-group, p	eriod 2, here for c	alculation of initial	IN	
55	Age 0 - Per. 3	0	0	0	0	0	0	0	0	0	0	Enter O-group, p	eriod 3, here for c	alculation of initial	IN	
56	Age 0 - Per. 4	1372.03	0	0	0	0	0	658.574	0	1975.72	658.574	Enter O-group, p	eriod 4, here for c	alculation of initial	IN	
57	Age 1-Per. 1	3369.97	0	0	0	0	0	359.463	0	1078.39	359.463	Enter constant F	s here for calcula	tion 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	UMBERS	5 FIRST P	ERIOD OF	FIRST Y	EAR - Age	2+								
		West Cod -					East cod -									
		West	Vest Cod -	West Cod -	West Cod -	West Cod	Vest	East cod -	East cod -	East cod -	East cod -					
63		Baltic	East Baltic	Not Baltic	Bornholm	Gotland	Baltic	East Baltic	Not Baltic	Bornholm	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																L
H ·	• • • N \ SO1	_DIM / A	$\operatorname{rk1}\lambda SO$	2_STOCI	<td>FLEET / S</td> <td>SO4_EFFC</td> <td>DRT / SO</td> <td>5_BOATS</td> <td>&lt;</td> <td></td> <td></td> <td></td> <td>1</td> <td>&gt;</td> <td></td>	FLEET / S	SO4_EFFC	DRT / SO	5_BOATS	<				1	>	
Klar																

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

Table 2.3.1.	STOCK	NUMBER:	S FIRST P	PERIOD 0	F FIRST \	ÆAR - Ag	je 0-1					
	West Cod-	Vest Cod-	-			East cod -	East cod -					
	West	East	Vest Cod-	West Cod-	West Cod-	West	East	East cod -	East cod -	East cod -		
	Baltic	Baltic	Not Baltic	Bornholm	Gotland	Baltic	Baltic	Not Baltic	Bornholm	Gotland		
Age 0 - Per. 1	75000	0	0	0	0	0	5000	0	15000	5000	Enter O-group, p	eriod 1, here for calcu
Age 0 - Per. 2	0	0	0	0	0	0	0	0	0	0	Enter O-group, p	eriod 2, here for calc
Age 0 - Per. 3	0	0	0	0	0	0	0	0	0	0	Enter O-group, p	eriod 3, here for calc
Age 0 - Per. 4	20000	0	0	0	0	0	5000	0	15000	5000	Enter O-group, p	eriod 4, here for calc
Age 1-Per. 1	0.5	0	0	0	0	0	0.5	0	0.5	0.5	Enter constant F	s 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	NUMBER:	S FIRST P	PERIOD 0	F FIRST \	ÆAR - Ag	je 2+					
	West Cod-	West Cod	-			East cod -	East cod -					
	West	East	Vest Cod-	West Cod-	West Cod-	West	East	East cod -	East cod -	East cod -		
	Baltic	Baltic	Not Baltic	Bornholm	Gotland	Baltic	Baltic	Not Baltic	Bornholm	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	IUMBERS	FIRST PE	RIOD OF	FIRST YE	AR - Age	0-1					
	West Cod -					East cod -						
	West	West Cod -	West Cod -	West Cod -	West Cod -	West	East cod -	East cod -	East cod -	East cod -		
	Baltic	East Baltic	Not Baltic	Bornholm	Gotland	Baltic	East Baltic	Not Baltic	Bornholm	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, p	eriod 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, p	eriod 2, here
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, p	eriod 3, here
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, p	eriod 4, here
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 F	's 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	UMBERS	FIRST PE	RIOD OF	FIRST YE	AR - Age	2+					
	West Cod -					East cod -						
	West	West Cod -	West Cod -	West Cod -	West Cod -	West	East cod -	East cod -	East cod -	East cod -		
	Baltic	East Baltic	Not Baltic	Bornholm	Gotland	Baltic	East Baltic	Not Baltic	Bornholm	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	В	С	D	E	F	G
68	Table 2.4.1.	WEIGHTIN	G FACTORS	S FOR MEA	N F CALCU	LATION - A	ge 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.	WEIGHTIN	G FACTORS	S FOR MEA	N F CALCU	LATION - A	ge 2+
80		West Cod	East cod				
81	Age 2	1	1				
82	Age 3	1	1				
83	Age 4	1	1				
84							
H -	• • • <u>• \</u> \_SO1	DIM ∖SC	12_STOCK	(SO3_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  $F_{Mean}(2-4)$ 

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<sub>Max</sub> .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)

	PER	IOD 1	PEF	RIOD 2	PER	RIOD 3	PERIOD 4	
Table 2.5.1.	West Cod: MIG	RATION - AGE G	R.0-1					
14-14] 14-141 14-141 14-141 14-114] 14-114] 14-1141 14-1141 14-1141								
Table 2.5.2.	West Cod: MIG	RATION - AGE G	R.2+					
19-1 19-1 19-1								
Table 2.5.3.	East cod: MIGR	ATION - AGE GF	2.0-1					
14-14 14-14 14-14 14-14 14-14 14-14 14-14 14-14 14-14 14-14								
Table 2.5.4.	East cod: MIGR	ATION - AGE GF	<b>₹.2</b> +					
1,-1 1,-1								

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:	MIGF	RATIO	N - A	GE GF	R.0-1																		
		FRO	M W	/EST		FRO	M EA	AST	BALT	IC	FRO	M N	от в	ALTI	с	FRO	мв	ORNI	IOLN	1	FRO	MG	OTLA	AND	
Aqo O-Por. 1 Aqo O-Por. 2 Aqo O-Por. 3	Por. 1- From Wort Baltic to Wort Baltic	Por. 1- From Wart Baltic toEart Baltic	Por. 1- From Wort Baltic to Not Baltic	From Wast Baltic to Bornho m	Por. 1- From Wort Baltic to Gotland	Por. 1- From Eart Baltic to Wort Baltic	Per. 1- From Eart Baltic to Eart Baltic	Por. 1- Fram Eart Baltic ta Nat Baltic	From Eart Baltic to Bornhol m	Por. 1- From Eart Baltic to Gotland	Por. 1- Fram Nat Baltic to Wort Baltic	Por. 1- Fram Not Baltic toEart Baltic	Por. 1- Fram Not Baltic to Not Baltic	From Not Baltic to Bornhol m	Por. 1- Fram Nat Baltic to Gotland	Por. 1- Fram Barnha Mart Baltic	Por. 1- Fram I Barnha Eart Baltic	Por. 1- Fram I Barnhal Mat Baltic	Por. 1- Fram Barnhal Barnhal M 1 1	Por. 1- From Bornho Gotland	Por. 1- From Gotland to Wort Baltic	Por. 1- From Gotland toEart Baltic	Por. 1- From Gotland to Not Baltic	Por. 1- From Gotland to Bornhol m	Por. 1- From Gotland to Gotland 1 1
Ago 0-Por. 4 Ago 1-Por. 1 Ago 1-Por. 2 Ago 1-Por. 3 Ago 1-Por. 4	1						1 0.9 0.8 0.7		• •.1 •.2 •.3																1
Table 2.5.4.	East	FR0	MIGE M W	ATIO EST	N - A	GE GF FRO	8.2+ M E/	AST	BALT	TIC	FRO	M N	от в	ALTI	с	FRC	)M B	ORNI	HOLN	1	FRO	MG	OTLA	AND	
	Por. 1- From Wort Baltic to Wort Baltic	Por. 1- From Wort Baltic toEart Baltic	Por. 1- From Wort Baltic to Not Baltic	From Wort Baltic to Bornho m	Por. 1- From Wort Baltic to Gotland	Por. 1- From Eart Baltic to Wort Baltic	Por. 1- From Eart Baltic toEart Baltic	Por. 1- From Eart Baltic to Not Baltic	From Eart Baltic to Bornhol m	Por. 1- From Eart Baltic to Gotland	Por. 1- From Not Baltic to Wort Baltic	Por. 1- From Not Baltic toEart Baltic	Por. 1- From Not Baltic to Not Baltic	From Not Baltic to Bornhol m	Por. 1- From Not Baltic to Gotland	Por. 1- From Bornho mto Wort Baltic	Por. 1- From I Bornho mto Eart Baltic	Por. 1- Fram I Barnhal Mta Nat Baltic	Por. 1- Fram Barnhal mta Barnhal m	Por. 1- From Bornhol M to Gotland	Por. 1- From Gotland to Wort Baltic	Por. 1- From Gotland toEart Baltic	Per. 1- From Gotland to Not Baltic	Per. 1- From Gotland to Bornhol m	Por. 1- From Gotland to Gotland
Aqo 2 Aqo 3 Aqo 4							0.5 0.4 0.3		0.4 0.45 0.5	0.1 0.15 0.2			1					:		:		:			1

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.

	A	В	С	D	E	F	G	н	1	J	К	L	M	N	0	P	Q
101																	<b>_</b>
102	Table 2.5.3.	East c	od: MIG	RATIO	N - AGE	GR.0-1											
					Per. 1-					Per. 1-					Per. 1-		
		Per. 1-	Per. 1-	Per. 1-	From	Per. 1-	Per. 1-	Per. 1-	Per. 1-	From	Per. 1-	Per. 1-	Per. 1-	Per. 1-	From	Per. 1-	Per.
		From	From	From	West	From	From	From	From	East	From	From	From	From	Not	From	From
		West	West	West	Baltic	West	East	East	East	Baltic	East	Not	Not	Not	Baltic	Not	Born
		Baltic	Baltic	Baltic	to	Baltic	Baltic	Baltic	Baltic	to	Baltic	Baltic	Baltic	Baltic	to	Baltic	m to
		to Vest	to East	to Not	Bornhol	to	to West	to East	to Not	Bornhol	to	to Vest	to East	to Not	Bornhol	to	West
103		Baltic	Baltic	Baltic	m	Gotland	Baltic	Baltic	Baltic	m	Gotland	Baltic	Baltic	Baltic	m	Gotland	Balti
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	
112																	
113	Table 2.5.4.	East c	od: MIG	RATIO	N - AGE	GR.2+											
					Per. 1-					Per. 1-					Per. 1-		
		Per. 1-	Per. 1-	Per. 1-	From	Per. 1-	Per. 1-	Per. 1-	Per. 1-	From	Per. 1-	Per. 1-	Per. 1-	Per. 1-	From	Per. 1-	Per.
		From	From	From	West	From	From	From	From	East	From	From	From	From	Not	From	From
		West	West	West	Baltic	West	East	East	East	Baltic	East	Not	Not	Not	Baltic	Not	Born
		Baltic	Baltic	Baltic	to	Baltic	Baltic	Baltic	Baltic	to	Baltic	Baltic	Baltic	Baltic	to	Baltic	m to
		to Vest	to East	to Not	Bornhol	to	to West	to East	to Not	Bornhol	to	to West	to East	to Not	Bornhol	to	West
114		Baltic	Baltic	Baltic	m	Gotland	Baltic	Baltic	Baltic	m	Gotland	Baltic	Baltic	Baltic	m	Gotland	Balti
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	
110	A N NA COT	L DIM		етоеи			1 004	EEEOP	T / CC			I			1		ЪĊ
ha .	• • • • ( <u>\ 50</u> 1		λουz_	SIUCK	K 303,	_FLEE I	<u></u>	_EFFOR	i <u>k</u> su								

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

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							Q1																		
From:		Ţ	Wes	t				East	t			Not	Ba	tlic			Bo	rnho	olm			G	otlai	nd	
to:	W	Е	Ν	В	G	W	Е	Ν	В	G	W	Е	Ν	В	G	W	Е	Ν	В	G	W	Е	Ν	В	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
A4	1	0	0	0	0	0	0.3	0	0.5	0.2	0	$\frac{0}{2}$	I	0	0	0	0	0	1	0	0	0	0	0	1
Erom:			Wos	4				Fact	ŀ			<u>24</u> Not	Ba	flia			Bo	rnha	Jm			C	otlar	nd	
FIOIII.	W	E	N	L R	G	w	F	L'asi	L R	G	W	F	M	B	G	W	E E	N	R	G	W	E G	N	B	G
	1	E 0	IN O	0	0	w	Е 1	N	Б	0	Ŵ	С 0	1	D	0	w	Е 0.6	N O	0.2	02	w	L 0.5	N	0.2	0.2
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 - 0 3	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0.0	0	0.2	0.2	0	0.5	0	0.2	0.3
A0-04	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
A1-01	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
A1-02	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
								_				23	_						_			~			
From:		1	Wes	t				East	t	[	(	Q3 Not	Ba	tlic			Bo	rnho	olm			G	otlai	nd	
From: to:	W	E	Wes N	t B	G	W	E	East N	B	G	W	Q3 Not E	<b>Ba</b> N	tlic B	G	W	Bo E	rnho N	olm B	G	W	<b>G</b> E	o <b>tla</b> i N	nd B	G
From: to: A 0 - Q 1	W 1	E 0	West N 0	<b>t</b> В 0	G 0	W 0	E 0.67	East N 0	B 0.2	G 0.13	W 0	<b>Not</b> E 0	<b>Ba</b> <sup>1</sup>	tlic B 0	G 0	W 0	<b>Bo</b> E 0.6	nnho N 0	B 0.2	G 0.2	W 0	<b>G</b> E 0.5	otla N 0	nd B 0.2	G 0.3
From: to: A 0 - Q 1 A 0 - Q 2	W 1 1	E 0 0	Wess N 0 0	t B 0 0	G 0 0	W 0 0	E 0.67 0.67	East N 0 0	B 0.2 0.2	G 0.13 0.13	W 0 0	<b>Not</b> E 0 0	<b>Ba</b> N 1	tlic B 0 0	G 0 0	W 0 0	<b>Bo</b> E 0.6 0.6	<b>rnh</b> ( N 0 0	B 0.2 0.2	G 0.2 0.2	W 0 0	<b>G</b> E 0.5 0.5	N 0 0	nd B 0.2 0.2	G 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3	W 1 1	E 0 0 0	Wes N 0 0 0	t B 0 0 0	G 0 0 0	W 0 0 0	E 0.67 0.67 0.67	East N 0 0 0	B 0.2 0.2 0.2	G 0.13 0.13 0.13	W 0 0 0	23 Not E 0 0 0	<b>Ba</b> N 1 1	tlic B 0 0 0	G 0 0 0	W 0 0 0	<b>Bo</b> E 0.6 0.6 0.6	<b>rnh</b> ( N 0 0	B 0.2 0.2 0.2	G 0.2 0.2 0.2	W 0 0 0	E 0.5 0.5 0.5	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	nd B 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3
From: to: $A 0 - Q 1$ $A 0 - Q 2$ $A 0 - Q 3$ $A 0 - Q 4$	W 1 1 1 1	E 0 0 0 0	Wes N 0 0 0 0 0	t B 0 0 0 0 0	G 0 0 0 0	W 0 0 0 0	E 0.67 0.67 0.67 0.67	East N 0 0 0 0 0 0	B 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0	<b>Not</b> E 0 0 0 0 0	<b>Ba</b> N 1 1 1 1	tlic B 0 0 0 0 0	G 0 0 0 0	W 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6	<b>rnho</b> N 0 0 0 0	B           0.2           0.2           0.2           0.2           0.2	G 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0	<b>G</b> E 0.5 0.5 0.5 0.5	0 N 0 0 0 0 0 0 0	nd B 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2	W 1 1 1 1 1 1	E 0 0 0 0 0 0	Wess N 0 0 0 0 0 0	t B 0 0 0 0 0 0 0	G 0 0 0 0 0 0	W 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67	East N 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0	Q3           Not           E           0           0           0           0           0           0           0           0           0           0           0           0	<b>Ba</b> N 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0	G 0 0 0 0 0	W 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0	B           0.2           0.2           0.2           0.2           0.2           0.2           0.2           0.2           0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5	0 N 0 0 0 0 0 0 0 0 0 0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3	W 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0	Wess N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0	Q3           Not           E           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0	<b>Ba</b> N 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0	B           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	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0	E 0.5 0.5 0.5 0.5 0.5 0.5 0.5	N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4	W 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0	Wes N 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0	D3           Not           E           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0	<b>Ba</b> N 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0	B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0	E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2	W 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 0.67	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0	23 Not E 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Ba</b> N 1 1 1 1 1 1 1 1 1 1 1 1	tlic           B           0	G 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0	E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3	W 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wess N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 0.67	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E           0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic           B           0	G 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	N           0	B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0	Ge           E           0.5	N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Q3           Not           E           0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic           B           0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	N           0	B           0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes           N           0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	B           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           0.2           0.2           0.2           0           0	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0	Q3           Not           E           0      0           0           0           0           0           0           0           0           0           0           0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	N           0	B       0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From:	W 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes           N           0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1	East N 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E           0      0           0           0           0           0           0           0           0           0           0           0           0           0           0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to:	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 E	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E           0      0      0      0      0      0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnh( N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlar           N           0 <td>nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2</td> <td>G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3</td>	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 E E	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E           0      0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 E E	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23 Not E 0 0 0 0 0 0 0 0 0 0 0 0 0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           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           0.2           0.2           0.2           0.2           0.2           0.1           0.2	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
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From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 5	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 1 1	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnha N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2           0.1           1           1           1           1	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 E E 1 1 1 1 1 1 1 1 1 1 1 1	East N 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E           0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic           B           0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           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           0.2           0.2           0.2           0.2           0.2           0.1           0.2           0.2           0.2           0.1           1           1           1           1	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 1 A 0 - Q 2 A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 2 A 1 - Q 2	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0.87 0.85	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23 Not E 0 0 0 0 0 0 0 0 0 0 0 0 0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Bo E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2           0.1           1           1           1           1           1	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 3 A 1 - Q 4	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 1 1 1 1 1 1 1 1 0.87 0.85 0.7	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23 Not E 0 0 0 0 0 0 0 0 0 0 0 0 0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic B 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Bo E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           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           0.2           0.1           1           1           1           1           1           1           1	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 4 A 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 4 A 2 A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 -	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 1 1 1 1 1 1 0.87 0.85 0.7 0.4	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E         0           0         0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic           B           0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b>Bo</b> E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnho N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2           0.1           1           1           1           1	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3
From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 A 3 A 4 From: to: A 0 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 0 - Q 2 A 0 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 - Q 3 A 0 - Q 4 A 1 - Q 1 A 1 - Q 2 A 1 - Q 3 A 1 - Q 4 A 2 - Q 4 A 2 - Q 3 A 1 - Q 4 A 2 - Q 4 A 3 -	W 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Wes: N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E 0.67 0.67 0.67 0.67 0.67 0.67 1 1 1 1 1 1 1 1 1 1 1 1 0.87 0.85 0.7 0.4 0 3	East N 0 0 0 0 0 0 0 0 0 0 0 0 0	t B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	23           Not           E         0           0         0	Ba N 1 1 1 1 1 1 1 1 1 1 1 1 1	tlic           B           0      0	G 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Bo E 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6	rnha N 0 0 0 0 0 0 0 0 0 0 0 0 0	DIm           B           0.2           1	G 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	W 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	G E 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	otlan           N           0	nd B 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	G 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3

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 Bornholm50% 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

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

1

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	В	С	D	E	F	G	Н		J	K	L	M	N	0	—
118																-
119	Table 2.6.1.	NATUF	₹AL MO	RTALIT	Y-We	st Cod										7
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	0.3	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	0.3	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	0.3	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	0.3	2
125	Age 1Per. 1Area: 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	0.3	2
126	Age 1Per. 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	0.3	2
127	Age 1Per. 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	0.3	2
128	Age 1Per. 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	0.3	2
129	Age 2 Per. 1 Area: West Baltic	0.2	No Val	No Val	No Yal	0.2	No Yal	No Yal	No Yal	0.2	No Val	No Val	No Val	0.2	No Va	<mark>a</mark>
130	Age 2 Per. 2 Area: West Baltic	No Val	0.2	No Val	No Yal	No Val	0.2	No Val	No Yal	No Yal	0.2	No Val	No Val	No Val	0.3	2
131	Age 2 Per. 3 Area: West Baltic	No Val	No Val	0.2	No Val	No Val	No Yal	0.2	No Val	No Yal	No Val	0.2	No Val	No Val	No Va	a
132	Age 2 Per. 4 Area: West Baltic	No Val	No Val	No Val	0.2	No Val	No Yal	No Val	0.2	No Val	No Val	No Val	0.2	No Val	No Va	a
133	Age 3 Per. 1 Area: West Baltic	0.2	No Val	No Val	No Yal	0.2	No Val	No Val	No Val	0.2	No Val	No Val	No Val	0.2	No Va	a
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	0.3	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	a
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 Yal	No Val	0.2	No Val	No Va	a
137	Age 4 Per. 1 Area: West Baltic	0.2	No Val	No Val	No Yal	0.2	No Val	No Val	No Val	0.2	No Yal	No Val	No Val	0.2	No Va	a
138	Age 4 Per. 2 Area: West Baltic	No Val	0.2	No Val	No Yal	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 Yal	No Val	No Yal	0.2	No Val	No Yal	No Yal	0.2	No Val	No Val	No Ya	a
140	Age 4 Per. 4 Area: West Baltic	No Val	No Val	No Val	0.2	No Val	No Yal	No Yal	0.2	No Val	No Yal	No Yal	0.2	No Val	No Ya	a
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	0.3	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	0.3	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	0.3	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	0.3	2
145	Ane 1Per 1Area Fact Baltic	0.2	0.2	0.2	<u>02</u>	0.2	02	<b>م م</b>	0.2	0.2	0.2	0.2	0.2	0.2	0	<u> </u>

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

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PREPROCESSING OF STOCK INPUT		X
C Assign "No Migration" to migration coefficients	Not done	?
Compute initial stock numbers	Not done	?
C Assign same M to all age groups, times and areas	Not done	?
C Assign standard values to Stock Rel.Std.Dev (Stochastic simulation)	Not done	?
? Execute B	ack	

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.

	A	В	С	D	E	F	G	Н	1	J	К	L	M	N
1	FLEET (FLEET/S	TOCK) S	TRUCTU	RED INPU	л									
2	TEMAS						RUN INFO	RMATION:						
3	<b>Evaluation Frame for</b>	fisheries m	anagement	systems										
4	Version. EXCEL 2003,	MS Visual	Basis 6.3	TEMAS: 20	) Mar 2007		Date of th	Date of this run: 26-03-2007 09:04						
5	Marine Fisheries Dep	artment				44	Name of <b>H</b>	lun:						
6	DIFRES (Danish Instit	tute of Mari	ne Reserch	)		1212	Param, Cr	eated:	12:00:00 AM	00:00				
7					-		File Name		DEMON_5_N	4ig3				
8	Note: Do not insert or delete rows or columns between yellow cells													
9	Note: INPUT IN TELLU	WUCELLS	ліст											
11	Table 3.1.1.	Baltistan	ABSOLUT	E CATCH	BILITY . (S	Species, A	rea) by (Ele	et. V.Size	Country, Rid	adina)				
<u> </u>	14010 01111	OD Touris	ODT	ODT	OD Turk			0		0	0.00	Cille ett	031	
		OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	Gillnett-	Gillnett-	Gillnett-	Gillnett- Rolfictory	Gillnett-	Gillnett- Raltistan	
		Small -	Small -	Medium -	Medium -	Large -	Large -	Small -	Small -	Medium -	Medium -	Large -	Large -	
12		<110mm	>110mm	<110mm	>110mm	<110mm	>110mm	<110mm	>110mm	<110mm	>110mm	<110mm	>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	-
22	East cod - Gotiand	1.20E-04	1.34E-04	2.27E-04	0.000244	4.77E-04	0.13E-04	1.06E-04	1.14E-04	1.33E-04	2.08E-04	4.00E-04	4.36E-04	
23	Catokabilitu(ELV Size, Pig	Ctru Spec V	Por éres) éb	colute Catoba	hilitu(ELV Size	Pia Ctru So	ao Araa)*Bal	atiue Catokab	ilitu(ELV Size, Ch	u Pia Spec V	Por Area)			
25	Belative catchabilities (our	er liears and pe	rier, Areaj Au ariods) are por	malized so the	t0 (a (Belatio	e Catchabilitei	ev, niedji nel 17:el	auve Catoriau	intgiji i, v.Size, Cti	g, ring, opec, r	, r ei, Aleaj			
26	Theracive caronabilities (ov	er gears and pe	l are not		i i elada	e Gatoriabilityj								
H ·	<ul> <li>N SO1_DIM ,</li> </ul>	(Ark1 / S	02_STOCK	🔾 SO3_FI	LEET / SO4	LEFFORT	/ SO5_BC	ATS / SI	<					>

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  $0 \le (Relative Catchability) \le 1$ 

	A	В	С	D	E	F	G	Н	
27	Table 3.1.2.	Baltistan	PARAMET	FERS IN M	ODEL FOR	CATCHAB	LITY (Spec	cies, 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 u	sed for stocha	stic simulation	n Biom.Paran	n.: Parameter	in model:			
54	Q = Q0 * Biomass * Biom.Param. Tech.Dev.: Q = Q0 * e	xp(y*Tech.De	y). Rig.Effect: (	Q = Q0 * exp(R	lig.Effect).				
55									
H -	🕩 📕 SO1 DIM 🖉 Ark1 🖉 SO2 STOCK	\ SO3 FL	.EET / SO4	EFFORT	15 <				3

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 - -

 $1 - \frac{1}{1 + \exp(\text{Dis1}(\text{Fl}, \text{Vs}, \text{Rg}, \text{Ct}, \text{St}, \text{y}, q) - \text{Dis2}(\text{Fl}, \text{Vs}, \text{Rg}, \text{Ct}, \text{St}, \text{y}, q) * \text{Lgt}(St, a, q))}$ where parameters of the logistic ogive are defined as those of the maturity ogive.

1

Thus,  $Dis1(Fl,Vs,Rg,Ct,St,y,q) = \frac{(Fl,Vs,Rg,Ct,St,y,q)}{(Fl,Vs,Rg,Ct,St,y,q)}$ 

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

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):

$$F(Fl,Vs,Rg,Ct,St,y,a,q,Ar) = E(Fl,Vs,Rg,Ct,y,q,Ar)^{*}$$

$$Q_{1}^{Absolute}(Fl,Vs,Rg,Ct,St,Ar)^{*}Q_{1}^{Relative}(Fl,Vs,Rg,Ct,St,y,q,Ar)^{*}$$

$$B(St,Ar,y,q-1)^{QB_{Exp}(Fl,Vs,Rg,St)}^{*}$$

$$\exp(y^{*}Q_{Tech-Dev}(Fl,Vs,Rg,St,y))^{*}\exp(RE(Fl,Vs,Rg,St))^{*}$$

$$SEL(Fl,Vs,Rg,Ct,St,y,a,q)^{*}\varepsilon_{O}(Fl,St,y)$$

	A	В	C (	D	E	F	G	H		
104	Table 3.2.1.	Baltistan	MESH SIZ	E (genera	lized conc	ept) (Spec	ies, 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	20
106	OB Trawler-Baltistan - Small - <110mm	100	100	100	100	100	100	100	100	
107	UB 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	UB 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 gea	r-riggings by fle	eet and countr	y. Gear select	ion is modelle	d by the logisti	ic curve, with L	50%/ = (Gear s	election factor)	°(M
119		-								
121	Table 3.2.2.	Baltistan	GEAR SEL	ECTION F	ACTOR (=L	50%/Mesh	(Spe) (Spe	cies, 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	20
123	Vest Cod - OB Trawler-Baltistan - <110mm	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	
124	Vest 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	on factor = L50	)%/(Meshisize	), L50% = Bod	y length at whi	ch 50% of the I	fish entering th	e gear are retain	ed.
132								_	-	
135	Table 3.2.3.	Baltistan	GEAR SEL	ECTION R	ANGE (=L7	5%-L25%)	(Species,	Fleet, V.Siz	ze, 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	20
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	Vest Cod - Gillnett-Baltistan - <110mm	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
140	Vest 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 - >10mm	3 30	3 30	3 30	3 30	3 30	3 30	3 30	3 30	
145		Gear selection	on range (=1.78	25%) 175	215021252	= Bodulenath	at which 75% P	0% 25% of the	fish entering the	ne
146		Gear Selection	an ange (- Er e		,	- Dogrenger	as amon rozaje	iona,eona or the	now envening the	900
H -	🔹 🕨 📐 SO1_DIM 📈 Ark1 🖉 SO2	STOCK )	SO3_FLEE	T / SO4_E	FFORT <	Ш				>

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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

 $Q_1^{\text{Relative}}(Fl, Vs, Rg, Ct, St, y, q, Ar)$ , .(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,  $\mathcal{E}_{Q}(Fl, St, y)$ , 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	В	С	D	E	F	G	Н	I -
149	Table 3.2.4.	Baltistan	DISCARD	SL50% (S	pecies, Fle	eet, 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 Travier 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 - 2 Monim	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
153	West Cod - OB Trawler-Dakistan - Medium - \ 110mm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
154	West Cod - OB Trawler-Bakistan - Medium - 2 Homm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
100	West Cod - OB Travilar Baltistan - Large - Khomm	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
100	West Cod - OB Hawler-Bakistan - Large - Shohim	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
107	West Cod - Gillaett Dabistan - Small - Kilomm	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
100	West Cod - Gillerte Dakistan - Smail - Shohim	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
103	West Cod - Gillnett-Baltistan - Medium - Kilomm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
160	West Cod - Gillnett-Baltistan - Medium - > Homm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
161	West Cod - Gillnett-Baltistan - Large - < 10mm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
162	west Cod - Gillnett-Baltistan - Large - > Ilumm	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
163	East cod - UB Trawler-Baltistan - Small - < 110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
104	East cod - OB Trawier-Baitistan - Small - > 10mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
160	East cod - OB Travier-Baltistan - Medium - <110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
166	East cod - OB Travier-Baltistan - Medium - >110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
167	East cod - OB Trawier-Baitistan - Large - <110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
168	East cod - UB Trawler-Baltistan - Large - >110mm	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
169	East cod - Gilleett-Baltistan - Small - K110mm	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
1/1	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 whic	h 50 % of the f	fish caught are	e discarded. D	iscarding is m	odelled by the	logistic curve
176	Table 2.2.5	Deltisten	DICCADD	CI ZEN /C	nacios Fl	at V Cine	Dia		
179	Table 5.2.5.	Balustan	DISCARD	SL15% (S	pecies, Fie	eet, v.size	, Kig)		
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 whic	h 75 % of the f	fish caught are	e discarded. D	iscarding is m	odelled by the	logistic curve
206	oor pris ( all a ( coo coo c								
14 4	I ▶ ▶I <u>  SU1_DIM ( Ark1 ( SU2_</u> STOC	κ <u>λ</u> SU3_I	-LEET <u>( S</u> C	14_EFFORT	15	111			>

Figure 2.6.5. Discard selection parameters.

209	Table 3.2.5.1.	Baltistan	- West B	altic REL/	ATIVE (PER	IOD) CATO	HABILITY	(max value	e = 1) - (Spe	cies
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	20
211	West Cod - OB Trawler-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
212	West Cod - OB Trawler-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
213	West Cod - OB Trawler-Baltistan - Medium - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
214	West Cod - OB Trawler-Baltistan - Medium - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
215	West Cod - OB Trawler-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
216	West Cod - OB Trawler-Baltistan - Large - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
217	West Cod - Gillnett-Baltistan - Small - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
218	West Cod - Gillnett-Baltistan - Small - >110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
219	West Cod - Gillnett-Baltistan - Medium - <110mm		0.9	0.6	0.85		0.9	0.6	0.8	5
220	Vest Cod - Gillnett-Baltistan - Medium - >110mm		0.9	0.6	0.85	1	0.9	0.6	0.85	5
221	West Cod - Gillnett-Baltistan - Large - <110mm	1	0.9	0.6	0.85	1	0.9	0.6	0.85	5
222	West Cod - Gillnett-Baltistan - Large - >110mm		0.9	0.6	0.85	1	0.9	0.6	0.85	5
223	East cod - UB Trawler-Baltistan - Small - <110mm		0.9	0.6	0.85		0.9	0.6	0.8	5
224	East cod - OB Trawler-Baltistan - Small - >110mm		0.9	0.6	0.85	1	0.9	0.6	0.85	5
225	East cod - UB Trawler-Baltistan - Medium - <110mm		0.9	0.6	0.85		0.9	0.6	0.8	5
226	East cod - OB Trawler-Baltistan - Medium - >110mm		0.9	0.6	0.85	1	0.9	0.6	0.85	5
227	East cod - UB Trawler-Baltistan - Large - <110mm		0.9	0.6	0.85		0.9	0.6	0.8	5
228	East cod - UB Trawler-Baltistan - Large - >110mm		0.9	0.6	0.85		0.9	0.6	0.85	0 -
229	East cod - Gillnett-Baltistan - Small - <110mm		0.9	0.6	0.85		0.9	0.6	0.85	0
230	East cod - Gillnett-Baltistan - Small - >110mm		0.9	0.6	0.85		0.9	0.6	0.85	0 -
231	East cod - Gillnett-Baltistan - Medium - <110mm		0.9	0.6	0.85		0.9	0.6	0.85	0
232	East cod - Gillnett-Baltistan - Medium - >110mm		0.9	0.6	0.85		0.9	0.6	0.85	0 -
233	East cod - Gillnett-Baltistan - Large - <110mm		0.9	0.6	0.85		0.9	0.6	0.85	0
234	East cod - Gillnett-Baltistan - Large - >110mm		0.9	0.6	0.85	<b>ا</b>	0.9	0.6	0.85	0
235	Relative distribution of Catchability on periods. Catch	hability[Fleet, v	Size, Rig, Utrj National Dia	, species, re	ar, Period, Are	aj=				
236	Absolute Catchability(Fleet, Rig, Species, Area) Rei- (Deleting Catchability) - 1 seleting to reside a site	ative Catchabi	iity(Fieet, Hig, da Datasiwa	Species, Area	a, rear, Periodj (	where U <=		No a Na a maria		
237	[Relative Catchability] <= 1, relative to variations within	n years and pei	100. Helative (	catonabilities	(over years and	o periods j are	normalized so	that the maxir	num value is on	ie
238	Table 3 2 5 2	Baltistan	- Fast Ba	itic RELA	TIVE (DERI	OD) CATCI	HARILITY (I	nav value	= 1) . (Spec	ies
200	Таме 5/2/5/2/	2000 Ber 1	2000 Bar 2	2000 Ber 2	2000 Ber 4	2001 Ber 1	2001 Ber 2	2001 Der 2	- 1) - (Spec	20
240	West Cod - OR Trauler-Rabistan - Small - 7110mm	2000 Fel.i	2000 F el.2	2000 P et.3	0.95	20011-01.1	20011-01.2	2001-141.5	2001Fel.4	5
242	West Cod - OB Trawler-Baltistan - Small - N10mm		0.0	0.0	0.05		0.5	0.0	0.0	5
242	West Cod - OB Trawler-Bakistan - Smail - 2 Homm		0.0	0.0	0.05		0.9	0.0	0.0	5
243	West Cod - OB Trawler-Baltistan - Medium - 110mm		0.0	0.0	0.05		0.5	0.0	0.0	5
245	West Cod - OB Trawler-Bakistan - Heddin - 2 Homm		0.0	0.0	0.05		0.9	0.0	0.0	5
246	West Cod - OB Trawler-Baltistan - Large - \110mm		0.0	0.0	0.05		0.5	0.0	0.0	5
240	West Cod - Gillnett-Baltistan - Small - 2110mm		0.0	0.0	0.05		0.9	0.0	0.0	5
249	West Cod - Gillnett-Baltistan - Small - \110mm		0.0	0.0	0.05		0.5	0.0	0.0	5
249	West Cod - Gillnett-Baltistan - Onair - 7 nomin		0.0	0.0	0.05		0.9	0.0	0.0	5
250	West Cod - Gillnett-Baltistan - Medium - \110mm		0.0	0.0	0.05		0.5	0.0	0.0	5
250	West Cod - Gillnett-Baltistan - Medidin - Zhomm		0.0	0.0	0.05		0.9	0.0	0.0	5
252	West Cod - Gillnett-Baltisten - Large - V 10mm		0.0	0.0	0.00		0.0	0.0	0.03	5
252	Fast cod - OB Trawler-Baltistan - Small - 210mm		0.5	0.0	0.00		0.9	0.0	0.03	5
254	East cod - OB Trawler-Bakistan - Small - Minim		0.0	0.0	0.05		0.5	0.0	0.0	5
254	East cod - OB Traular Babistan - Medium - 210mm		0.0	0.0	0.00		0.0	0.0	0.03	5
256	East cod - OB Trawler-Baltistan - Medium - × 110mm		0.0	0.0	0.00		0.3	0.0	0.03	5
250	East cod - OB Trawler-Baltistan - Medium - 7 Ionim		0.0	0.0	0.05		0.3	0.0	0.00	5
259	East cod - OB Trawler-Baltistan - Large - < 10mm		0.9	0.0	0.00		0.9	0.0	0.03	5
259	East cod - Gillpett-Baltistan - Small - 210mm		0.5	0.0	0.00		0.0	0.0	0.03	5
260	East cod - Gilloett-Baltistan - Small - \100mm		0.9	0.0	0.00		0.9	0.0	0.03	5
260	East cod - Gilloett-Baltistan - Medium - 210mm		0.0	0.0	0.00		0.0	0.0	0.03	5
262	East cod - Gilloett-Baltistan - Medium - × 10mm		0.9	0.0	0.00		0.9	0.0	0.03	5
262	East cod - Gillnett-Baltistan - Large - / 10mm		0.5	0.0	0.00		0.0	0.0	0.03	5
264	East ond - Gillnett-Baltistan - Large - \100mm		0.0	0.0	0.00		0.0	0.0	0.03	5
265	Last ood - omnett-bardstaff - Large - 2 Hornin	Belative dist	ribution of Ca	tehability on n	eriods Catoba	hilitu(Fleet V	Size Big Otra	Species Yes	r Period Ares)	- Ah-
		, relative dist	action or ca	condointy on p	chous, catoria	isangir reet, v.	olee, ring, ody,	opeoles, rea	, rienoa, Areaj	- 103
H 4	I ► N \ S01_DIM / Ark1 / S02_STOC	<u>к λ</u> SO3_F	LEET	14_EFFORT	「 <u> </u>					3

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  $0 \le (Relative Catchability) \le 1$ , 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 selection 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

1

2

Execute

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

1  $1 + \exp(\text{Sel1}(\text{Fl}, \text{Vs}, \text{Rg}, \text{Ct}, \text{St}, y) - \text{Sel2}(\text{Fl}, \text{Vs}, \text{Rg}, \text{Ct}, \text{St}, y) * \text{Lgt}(St, y, a, q))$ where parameters of the logistic ogive are defined Sel1(Fl, Vs, Rg, Ct, St, y) =  $\ln(3)$ \* LGT<sub>50%</sub>(Fl, Vs, Rg, Ct, St, y) /(LGT<sub>75%</sub>(-) - LGT<sub>50%Mat</sub>(-)), 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 $SR(Fl, Vs, Rg, Ct, St, y) = Selection range (=LGT_{75\%}-LGT_{25\%})$ PREPROCESSING OF FLEET INPUT Make parameters equal for all years Not done Make parameters equal for all time periods Not done ? ? • Assign 1.0 to all multipliers and relative Q's Not done Assign standard values to Catchability Not done Rel.Std.Dev (Stochastic simulation) Assign zero to Catchability Rel.Std.Dev, Not done ? Tech.Devel..Biomas-effectand rig-effect

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:

Back

$$\begin{split} & \mathrm{MS}(\mathrm{Fl},\mathrm{Vs},\mathrm{Rg},\mathrm{Ct},\mathrm{y}) = \mathrm{MS}(\mathrm{Fl},\mathrm{Vs},\mathrm{Rg},\mathrm{Ct},\mathrm{y}_{\mathrm{first}}) \\ & \mathrm{SF}(\mathrm{Fl},\mathrm{Vs},\mathrm{Rg},\mathrm{Ct},\mathrm{St},\mathrm{y}) = \mathrm{SF}(\mathrm{Fl},\mathrm{Vs},\mathrm{Rg},\mathrm{Ct},\mathrm{St},\mathrm{y}_{\mathrm{first}}) \\ & \mathrm{SR}(\mathrm{Fl},\mathrm{Vs},\mathrm{Rg},\mathrm{Ct},\mathrm{St},\mathrm{y}) = \mathrm{SR}(\mathrm{Fl},\mathrm{Vs},\mathrm{Rg},\mathrm{Ct},\mathrm{St},\mathrm{y}_{\mathrm{first}}) \\ & Q_1^{\mathrm{Re\,lative}}(Fl,\!Vs,\!Rg,\!Ct,\!St,y,\!q,\!Ar) = Q_1^{\mathrm{Re\,lative}}(Fl,\!Vs,\!Rg,\!Ct,\!St,y_{first},\!q,\!Ar) \\ & Q_{Tech-Dev}(Fl,\!Vs,\!Rg,\!St,y) = Q_{Tech-Dev}(Fl,\!Vs,\!Rg,\!St,y_{first}) \end{split}$$

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:

$$Q_{l}^{\text{Relative}}(Fl, Vs, Rg, Ct, St, y, q, Ar) = Q_{l}^{\text{Relative}}(Fl, Vs, Rg, Ct, St, y, l, Ar)$$

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

4) Assign standard values to catchabilityRel.Std.Dev (Stochastic simulation)

The relative Standard deviation of  $\mathcal{E}_{O}(Fl, St, y)$  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.

	0		P	C		n	F	F	G		
	INDUT DELATED TO EFEO	DT				0			4	-	
1	INPUT RELATED TO EFFO	RI									
2	TEMAS								RUNINFUR	MATIU	
- 3	Version EXCEL 2003 MS Visual E	nagement systems Racie 6 2 - TEMAS: 20 Mar 2	007						Date of this	F110-	
7	Marine Ficheries Department	54515 0.5 TEMA5: 20 Mai 2	.007	-	14				Name of Ru	nun: n-	
6	DIEBES (Danish Institute of Marin	e Beserch)		1	442				Param. Created:		
7		,							File Name:		
8	Note: Do not insert or delete rows	or columns between gellow	cells								
9	Note: INPUT IN YELLOW CELLS 0	NLY									
10											
11				L <u></u>					L		
12	Note: Effort may also be	defined by the effort	/capacity r	ules, in wr	nich c	ase tr	ne progran	n will ignor	e the data	a on	
13	Effort is defined as the p	broduct of four facto	rs: (1) Eno	rt_Capacit	<u>V_FI_</u>	vs_ct		CT),			
14	(2) Effort Multipliars VG	VELVe Ba Ct Ar	non_Dist	OIL RIGS	Giver	I_Are	a_10(FI,V)	s,Rg,Ct,Ar)			
10	where El=Eleet Vs=Ves	al size Pa=Pia Ct=(	Country Ar	=Area V=	Vear	a=Pe	riod				
10	where ri-rieet, vo-vest	set size, kg-kig, ct-	Journary, Al	-Area, r-	rear,	q-re	livu				
17	Reference effort is the efforts	values from which all oth	er effort value	es are obtain	ed by r	nultipli	cation by the	effort.Mults	and distribu	tions	
19	They equal the capacity, which	is defined as : Capacity	= (Number of	Vessles) * (I	Maxim	im nun	nber of days	per period)		dons.	
20											
21		READ EFFORT			×	POSS	BLE EFFORT	) For all (Cou	ntry, Fleet, V	/.Size)	
22						er.3	2000 Per.4	2001 Per.1	2001 Per.2	2001	
23	Baltistan - OB Trawler-Baltistan - Small	FFFO	o T			2010	2010	2010	201	0	
24	Baltistan - OB Trawler-Baltistan - Medium	EFFOI	</td <td></td> <td>?</td> <td>871</td> <td>871</td> <td>871</td> <td>87</td> <td>71</td>		?	871	871	871	87	71	
25	Baltistan - OB Trawler-Baltistan - Large					201	201	201	20	л	
26	Baltistan - Gillnett-Baltistan - Small	(no fleet beha	viour rule	!s)		2680	2680	2680	268	0	
27	Baltistan - Gillnett-Baltistan - Medium					1340	1340	1340	134	0	
28	Baltistan - Gillnett-Baltistan - Large	EXCEL 2003, MS Visual Basis	: 6.3 TEMAS:	27 Mar		335	335	335	33	5	
29	Scandinavia - OB Trawler-Scandinavia - S					3350	3350	3350	335	0	
30	Scandinavia - UB Trawler-Scandinavia - M	Options for Prepi	ocessing	of data 📗	?	1/42	1/42	1/42	1/4	2	
31	Scandinavia - UB Travier-Scandinavia - L					402	402	402	40	2	
22	Scandinavia - Gillnett Scandinavia - Smail Scandinavia - Gillnett Scandinavia - Mediu	C-1-14-			2	2014	2014	2014	201	4	
33	Scandinavia - Gillnett-Scandinavia - Hedu	GOTO Ma	in menu		<i>:</i>	402	402	402	40	2	
35	Scandinavia - cilmett-Scandinavia - Large					er effort v	alues are obtaine	d bu multiplication	buthe effort-Mi	≏ ults and	
36		Read effor	t from disk		2	er en ore		a by manphoador			
37		inclusion and a second									
14		·				· ^					
		Read effort	from sheet		?					-	
Rea	idy							I	NUM		

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=PeriodReference 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.

	EXCEL	
Index	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).

	A	В	С	D	E	F	G	н		J	К	L	M	N	0	P	Q	B
1	INPUT RELATED TO EFFORT																	
2	TEMAS						RUN I	NFORM	ATION									
3	Evaluation Frame for fisheries management syst	ems																
4	Version. EXCEL 2003, MS Visual Basis 6.3 TEI	MAS: 2	0 Mar 2	007			Date o	of this r		22:11								
5	Marine Fisheries Department						Name	of Run:									(20	ount
6	DIFRES (Danish Institute of Marine Reserch)						Param	. Creat		00:00								
7					_		File N	ame:	DEMO	N_5_M	ig3							
8	Note: Do not insert or delete rows or columns be	etween	gellow (	cells														
9	Note: INPUT IN YELLOW CELLS ONLY																	
10																		
11																		
12	Note: Effort may also be defined by	the e	effort/	capa	city ru	iles, i	n wh	ich ca	ase th	ie pro	ogram	n will i	ignor	e the	data	on th	is sh	eet
13	Effort is defined as the product of	four	factor	ʻs: (1)	Effor	t_Ca	pacity	/_FI_\	/s_Ct	_YQ(I	FI,Vs,	Ct),						
14	(2) Effort_Dist_On_Areas_YQ(FI,Vs,	Ct,Ar	) (3) E	ffort_	Dist_	On_F	tigs_	Giver	_Are	a_YQ	(FI,Vs	s,Rg,C	:t,Ar),					
15	(4) Effort_Multipliers_YQ(FI,Vs,Rg,	Ct,Ar)																
16	where FI=Fleet, Vs=Vessel size, Rg	J=Rig	, ct=c	ount	ry, Ar	=Area	ι, Υ=١	(ear,	q=Pei	iod								
17																		
18	Reference effort is the efforts values from v	which a	all othe	er effor	t value	s are (	obtain	ed by n	nultipli	cation	by the	effort-	Mults	and dis	stributi	ons.		
19	They equal the capacity, which is defined as	s: Cap	acity =	(Num	ber of	Vessle	s) ^ (N	laximu	im nun	nber of	days	per per	iod)					
20																		
21	Table 4.1.	REFE	RENCE	FFFOF	CI (MA)	XIMUM	POSS	SIBLE E	FFORT	) For a	ll (Cou	ntry, Fl	eet, V.	Size) -	Ref.Eff	ort = (I	Numbe	er of
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	2004
22		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1
23	Baltistan - OB Trawler-Baltistan - Small	2010	2010	2010	2010	2010	2010	2010	2144	2144	2144	2144	2144	2144	2144	2144	2345	23
24	Baltistan - OB Trawler-Baltistan - Medium	871	871	871	871	871	871	871	871	871	871	871	871	871	871	871	938	9
25	Baltistan - OB Trawler-Baltistan - Large	201	201	201	201	201	201	201	134	134	134	134	134	134	134	134	134	1
26	Baltistan - Gillnett-Baltistan - Small	2680	2680	2680	2680	2680	2680	2680	2814	2814	2814	2814	2814	2814	2814	2814	3015	- 30
27	Baltistan - Gillnett-Baltistan - Medium	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1407	14
28	Baltistan - Gillnett-Baltistan - Large	335	335	335	335	335	335	335	268	268	268	268	268	268	268	268	268	2
29	Scandinavia - OB Trawler-Scandinavia - Small	3350	3350	3350	3350	3350	3350	3350	3484	3484	3484	3484	3484	3484	3484	3484	3685	36
30	Scandinavia - OB Trawler-Scandinavia - Medium	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1742	1809	18
31	Coopdinauja - OP Trawler-Coopdinauja - Large	402	402	402	402	402	402	402	335	335	335	335	335	335	335	335	335	3
32	ocandinavia - OD Trawier-ocandinavia - Large				2014	2014	2814	2814	2948	2948	2948	2948	2948	2948	2948	2949	314.9	31
22	Scandinavia - OB Trawer Scandinavia - Carge Scandinavia - Gillnett-Scandinavia - Small	2814	2814	2814	2014	2014	2011		2010	2010			2010			2040	0110	
	Scandinavia - GB Frawier-Scandinavia - Large Scandinavia - Gillnett-Scandinavia - Small Scandinavia - Gillnett-Scandinavia - Medium	2814 1541	2814 1541	2814 1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1541	1608	16
34	Scandinavia - Gilhett-Scandinavia - Karge Scandinavia - Gilhett-Scandinavia - Medium Scandinavia - Gilhett-Scandinavia - Medium Scandinavia - Gilhett-Scandinavia - Large	2814 1541 402	2814 1541 402	2814 1541 402	2014 1541 402	1541 402	1541	1541 402	1541 335	1541 335	1541 335	1541 335	1541 335	1541 335	1541 335	1541 335	1608 335	16
34 35	Scandinavia - Girlawer Scandinavia - Eage Scandinavia - Gillnett-Scandinavia - Small Scandinavia - Gillnett-Scandinavia - Medium Scandinavia - Gillnett-Scandinavia - Large This is the efforts values from which all other effort values a	2814 1541 402 re obtain	2814 1541 402 ed by mu	2814 1541 402 Itiplicatio	2014 1541 402 n by the e	1541 402 effort-Mu	1541 402 Its and t	1541 402 he distrib	1541 335 ution. The	1541 335 ey equal t	1541 335 he capac	1541 335 sity, whick	1541 335 is define	1541 335 d as : Ca	1541 335 pacity = (	1541 335 Number (	1608 335 of Vessle	16 3 es)*(N

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)

	A	В	С	D	E	F	G	н	I	J	
38	Table 4.2.	EFFORT	DISTRIE	UTION C	IN AREA	S for all	(Country	, Fleet, V	.Size)		
		2000	2000	2000	2000	2001	2001	2001	2001	2002	20
39		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Pe
40	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	
41	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	
42	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	
43	Baltistan - OB Trawler-Baltistan - Small - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
44	Baltistan - OB Trawler-Baltistan - Small - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
45	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	
46	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	
47	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	
48	Baltistan - OB Trawler-Baltistan - Medium - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
49	Baltistan - OB Trawler-Baltistan - Medium - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
50	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	
51	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	
52	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	
53	Baltistan - OB Trawler-Baltistan - Large - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
54	Baltistan - OB Trawler-Baltistan - Large - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
55	Baltistan - Gillnett-Baltistan - Small - West Baltic	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
56	Baltistan - Gillnett-Baltistan - Small - East Baltic	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
57	Baltistan - Gillnett-Baltistan - Small - Not Baltic	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
58	Baltistan - Gillnett-Baltistan - Small - Bornholm	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
59	Baltistan - Gillnett-Baltistan - Small - Gotland	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
03	Baltistan - Gillnett-Baltistan - Medium - Mest Baltic	0.1	0.1	0.1	<u></u> 91	0.1	0.1	0.1	0.1	0.1	
H ·	♦ ▶ ▶ // Ark1 /_S02_STOCK // S03_FLEE <sup>-</sup>	Γ / Ark2	$\lambda$ SO4_	EFFORT	🖌 SO5 🔀						

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  $E(Fl, Vs, Ct, y, q, \bullet)$ , 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,

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

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

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

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

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

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).

	Table 4.2	DISTRIBUTION ON AREAS for all (Country Eleast V Size)			
	Table 4.2.	υτοι παιο πραγοματικά τη ματαγραφική ματαγραφική τη			
33		<b>0 0 0 0 0 0 0 0 0 0</b>			
a	Pallislas - OP Trauler-Pallislas - Small - West Pallis				Wast
41	Pallislas · OP Trauler·Pallislas · Small · East Pallis				Eart
42	Ballislas : OB Trauler: Ballislas : Small : Hel Ballis			Small	Nothaltic
-	Bullial as a OB Taurian Bullial as Smull - Baashala				Barobala
					Gastan d
					Gaciana
45	Pallislas · OP Trauler·Pallislas · Hediss · West Pallis				Wast
-6	Pallislas · OP Trauler·Pallislas · Hediss · East Pallis				Eart
a	Pallislas · OP Trauler·Pallislas · Hedius · Hel Pallis		Trawler	Medium	Notbaltic
a	Pallislas · OP Trauler·Pallislas · Hedius · Perskels				Bornholm
-13	Pallislas · OP Trauler·Pallislas · Hedius · Golland				Gotland
51	Pallislas · OP Trauler-Pallislas · Lorge · West Pallis				Wort
51	Pallislas · OP Trauler·Pallislas · Large · East Pallis				Eart
52	Pallislas : OP Trauler: Pallislas : Larer : Hel Pallis			large	Notbaltic
-				-	
		Baltistan			Barrahala
	Pallislas · OP Tradice Pallislas · Carge · Persons	Partocali			Catland
	b Malas - Charles Malas - Cargo - Galas				Gatrana Musek
56	Pallielae - Giller II-Pallielae - Small - Eael Pallie			· · · ·	Eart
57	Pallielae - Giller II-Pallielae - Seall - Hel Pallie			small	Notbaltic
58	Pallielae - Giller II-Pallielae - Small - Perekele				Barnhalm
59	Pallislas - Giller II-Pallislas - Small - Gelland				Gotland
- 61	Pallislas - Giller II-Pallislas - Hediss - West Pallis				Wast
61	Pallislas - Giller II-Pallislas - Hedise - East Pallis				Eart
62	Pallislas - Giller II-Pallislas - Medice - Hel Pallis		Gill net	Medium	Notbaltic
63	Pallislas - Gillerll-Pallislas - Hedius - Perskels				Barnhalm
54	Pallislas - Giller II-Pallislas - Hedius - Gelland				Gotland
65	Pallislas - Giller II-Pallislas - Large - West Pallis				Work
	Pallislas - Giller II-Pallislas - Larer - Casl Pallis				Eart
	Bullister Giller II. Bullister Lange Hall Bullis			large	Nethaltic
					Parakala
					Gastan d
	Patholae - Gillerit-Patholae - Carge - Golland				Gotiana
					ware
- 71	Sepadieseis - OP Trauler-Sepadieseis - Seall - East Pallie				Lart
72	Secedieceis - OD Trauler-Secedieceis - SecII - Hel Dallie			small	Notbaltic
73	Secondinania - OD Trauler-Secondinania - Small - Derobelm				Bernheim
74	Secondinania - OD Trauler-Secondinania - Small - Gelland				Gotland
75	Seandinania - OB Trauler-Seandinania - Hedine - Went Pallin				Wast
75	Secedieceis · OD Trauler·Secedieceis · Hedien · Eael Dallie				Eart
"	Suandinania - OP Trauler-Suandinania - Medium - Hul Pallin		Trawler	Medium	Notbaltic
78	Saundiaunia · OB Trauler-Saundiaunia · Mediam · Barabala				Bernheim
73	Suandinania - OB Trauler-Suandinania - Hedium - Gulland				Gotland
	Secondinania - OD Trauler-Secondinania - Large - West Pallin				Wast
н	Saundinania - OD Trauler-Saundinania - Large - East Dallin				Eart
12	Secondinania - OB Transfer-Secondinania - Large - Hal Pallin			large	Notbaltic
13	Seandinania - OP Trauler-Seandinania - Larer - Persbelm				Barnhalm
н	Suandinania - OB Trauler-Suandinania - Large - Galland				Gotland
		Scandinavia			lil s
-		ocurranteria			West.
				o	
17	Suandinania - Giller II-Suandinania - Suall - Hel Dallin			small	Notbaltic
н	Saudiausia - Gillarll-Saudiausia - Saull - Parabala				Bornholm
	Search and State of Search and Search and Search and				untiand Muse
	Seandingerige Gillerill-Seandingerige Hindine -Went Pallin				Wart
31	ananana - Giller II-Suandinania - Medium - East Pallin		0.11		- 474
52	Saundiaunia - Gillar II-Saundiaunia - Hedium - Hal Pullia		Gill net	Medium	Natbaltic
33	Seandinania - Giller II-Seandinania - Medine - Perskele				Barnhalm
34	Secondinania - Giller II-Secondinania - Medium - Gelland				Gotland
35	Saundinania - Gillarll-Saundinania - Large - Went Pallin Saundinania - Gillarll-Saundinania - Large - Bast Battin				wort Lart
<b>—</b>				large	
37	Sasadinania - Gillerll-Sasadinania - Large - Hal Dallin Sasadinanya - Kullerll-Sasadinanya - Large - Manbala			arge	Not baltic
- 11					Garrana

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.

~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~								
38	Table 4.2.	EFFORT	DISTRIBU	TION ON AF	REAS for all	(Country, Flee	et, V.Size)	
- 39		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 Per.2	2
40	Baltistan - OB Trawler-Baltistan - Small - West Baltic	20						
41	Baltistan - OB Trawler-Baltistan - Small - East Baltic	30	R	AD EFFOR	{[]			
42	Baltistan - OB Trawler-Baltistan - Small - Not Baltic	40						
43	Baltistan - OB Trawler-Baltistan - Small - Bornholm	50				DT.		
44	Baltistan - OB Trawler-Baltistan - Small - Gotland	60		4	:FF0	K/		?
45	Baltistan - OB Trawler-Baltistan - Medium - West Baltic	0.1						
46	Baltistan - OB Trawler-Baltistan - Medium - East Baltic	0.15		(no fl	eet beha	aviour rule	25)	
47	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	0.2					-	
48	Baltistan - OB Trawler-Baltistan - Medium - Bornholm	0.25		EXCEL 2	2003, MS Visu	al Basis 6.3		
49	Baltistan - OB Trawler-Baltistan - Medium - Gotland	0.3						
50	Baltistan - OB Trawler-Baltistan - Large - West Baltic	0.1		Ontions	for Pren	rocession	of data	2
51	Baltistan - OB Trawler-Baltistan - Large - East Baltic	0.15		options	ios i reps	occosing	0, 0010	•
52	Baltistan - OB Trawler-Baltistan - Large - Not Baltic	0.2						
53	Baltistan - OB Trawler-Baltistan - Large - Bornholm	0.25			Goto Ma	in Menu		?
54	Baltistan - OB Trawler-Baltistan - Large - Gotland	0.3			00107.00			
55	Baltistan - Gillnett-Baltistan - Small - West Baltic	0.1						
56	Baltistan - Gillnett-Baltistan - Small - East Baltic	0.15		F	tead effor	t from disk		?
57	Baltistan - Gillnett-Baltistan - Small - Not Baltic	0.2						
58	Baltistan - Gillnett-Baltistan - Small - Bornholm	0.25						
14	A N N / SOD STOCK / SOD FLEET / AV2			R	ead effort	from sheet		?
1.4	M M SUZ_STOCK & SUS_FLEET & AIKZ	YOO4_EL	Γυκί 🗾	·				

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	В	С	D	E	F	G	Н		J
103	Table 4.3.	RESULT	ING EFF	ORT AFT	ER DISTE	RIBUTION	ON AR	EAS (Cou	intry, Fle	et, V.Siz
		2000	2000	2000	2000	2001	2001	2001	2001	2002
104		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	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
H	Image: So3_FLEET ( Ark2 ) SO4_EFFOF	RT / SO5	_BOATS	<u>(</u> SO6_	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).

	А	В	С	D	E	F	G	Н	1	J	К
168	Table 4.4.	EFFORT	DISTRIB	UTION C	N RIGS	AFTER D	ISTRIBU	TION ON	AREAS	) (Countr	y, Fleet,
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002
169		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	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
H	H / S03_FLEET / Ark2 , S04_EFFORT / S05	BOATS	/ SO6_P	RICES ,	/ S07_	<					

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.	. DI	STI	RIB	UTI	ON	ON	RIG	is (	AF	TER	۲D	ST	RIE	BUT	гю	N (	ON	A	RE	AS) (Country	, Fleet, V	Size, Ar	ea, Rig)	
	2 2	2 2	2 2 3	2 2 2		2 2 2		2 2	2 2 3		2 2	2 2	2 2	0 0	2 2	0 0		2 2	2 2					
Debine OBTable Believe And Marshie WAR																								. 110
Baltistan - UD Trawler-Daltistan - Small - West Baltic - Kilumm Baltistan - OB Trawler-Baltistan - Small - West Baltic - Million	- 1 1	1 1	1 1	1 1	1 1 1	1 1	1 1 1	1 1	1 1	1 1 1		1 1	1 1	1 1		1 1	1 1	1 1	1 1				West	< 110 mm
Publisher OP Trunks Publisher Smith Fred Public (110an	-																							/ 110 mm
Baltisten - OB Trawler-Baltisten - Small - East Baltic - Villom	- 1 1	1 1	1 1	1 1			1 1 1	1 1	1 1	1 1 1			1 1				1 1		1 1		_	_	Fast	< 110 mm
Datastan - OD Hawki-Datastan - Jinan - East Datas - Jinani		1.1	с÷,	11				11	11						· · ·		11		11			0	Luot	/
Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0			small		< 110 mm
Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110mm	1 1	1 1	1.1	1 1	1 1 1	1 1	1 1 1	1 1	1 1	1 1 1	1 1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1				Not Baltic	> 110 mm
Baltistan - OB Trawler-Baltistan - Small - Bornholm - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	00	0 0	0 0	0 0	0 0	9 0 1	0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Small - Bornholm - >110mm	1.1	1.1	1.1	1.1	1.1.1	1.1	1.1.1	1.1	1.1	1 1 1		1.1	1 1	1.1	1.1	1 1	1-1	1 1	1 1				Bornholm	> 110 mm
Baltistan - OB Trawler-Baltistan - Small - Gotland - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Small - Gotland - >110mm	1 1	1 1	1.1	1 1	1 1 1	1.1	1 1 1	1 1	1 1	1 1 1	1 1 1	1 1	1 1	1.1.1	1.1.1	1 1	1 1	1 1	1 1				Gotland	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - West Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0.0	0 0	0 0	0.0		0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - West Baltic - >110mm	<mark>11</mark>	1 1	1.1	1.1	1.1.1	1.1	1 1 1	1.1	1.1	1 1 1	1 1 1	1.1	1 1	1.1	1.1.1	1 1	1 1	1 1	1 1				West	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - East Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - East Baltic - >110mm	1.1	1.1	1.1	1.1	1.1.1	1.1	1 1 1	1 1	1 1	1 1 1	1.1.1	1 1	1 1	1.1	1.1	1.1	1-1	1 1	1 1				East	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0.0	0 0	0 0	0.0		0 0	0 0	0 0		Trawler	Medium		< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Not Baltic - >110mm	- <u>1 1</u>	1.1	1.1	1.1	1.1.1	1.1	1 1 1	1.1	1.1	1 1 1	1 1 1	1.1	1 1	1.1	1.1	1 1	1.1	1 1	1 1				Not Baltic	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Bornholm - <110mm	o o	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0		0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Bornholm - >110mm	1.1	1.1	1.1	1.1	1 1 1	1.1	1 1 1	1.1	1.1	1.1.1	1 1 1	1.1	1.1	1 1	1.1	1 1	1.1	1.1	1.1				Bornholm	> 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Gotland - <110mm	- o o	0 0	0.0	0 0		0 0	0 0 0	0 0	0 0	0 0 0	0 0	0.0	0 0	0.0			0 0	0 0	0 0			-		< 110 mm
Baltistan - OB Trawler-Baltistan - Medium - Gotland - >110mm	1 1	1.1	1.1	1.1	1 1 1	1.1	1 1 1	1.1	1.1	1.1.1	1 1 1	1 1	1 1	1 1	1.1	1 1	1.1	1.1	1 1				Gotland	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - West Baltic - <110mm	- o o	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0.0	0 0	0 0	0.0		0 0	0 0	0 0					< 110 mm
Baltistan - UB I rawler-Baltistan - Large - West Baltic - >110mm	1.1	1.1	1.1	1.1	1.1.1	1.1	1.1.1	1.1	1.1	1.1.1	1.1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1				west	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - East Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Large - East Baltic - >110mm	1.1	1 1	1.1	1.1	1 1 1	1.1	1 1 1	1.1	1.1	1 1 1	1 1 1	1 1	1 1	1 1	1 1	1 1	1.1	1 1	1 1				East	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - Not Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0		0 0	0 0	0 0			large		< 110 mm
Baltistan - OB Trawler-Baltistan - Large - Not Baltic - >110mm	- <u>1 1</u>	1 1	1.1	1.1	1.1.1	1.1	1 1 1	1.1	1.1	1 1 1	1 1 1	1.1	1 1	1.1.1	1.1.1	1 1	1.1	1 1	1 1				Not Baltic	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - Bornholm - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0		0 0	0 0	0 0					< 110 mm
Baltistan - OB Trawler-Baltistan - Large - Bornholm - >110mm	1.1	1 1	1.1	1.1	1.1.1	1.1	1 1 1	1.1	1.1	1 1 1	1 1 1	1 1	1 1	1.1	1.1.1	1 1	1 1	1 1	1 1				Bornholm	> 110 mm
Baltistan - OB Trawler-Baltistan - Large - Gotland - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0		0 0	0 0	0 0					< 110 mm
																				Daltistan				
Baltistan - OB Trawler-Baltistan - Large - Gotland - >110mm	1 1	1 1	1.1	1.1	1 1 1	1.1	1 1 1	1 1	1.1	1 1 1	1 1 1	1.1	1 1	1.1	1.1.1	1 1	1 1	1 1	1 1	Daitistan			Gotland	> 110 mm
Baltistan - Gillnett-Baltistan - Small - West Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0					< 110 mm
Baltistan - Gillnett-Baltistan - Small - West Baltic - >110mm	1 1	1 1	1.1	1 1	1 1 1	1.1	1 1 1	1 1	1.1	1 1 1	1 1 1	1.1	1 1	1.1.1	1.1.1	1 1	1 1	1 1	1 1				West	> 110 mm
Baltistan - Gillnett-Baltistan - Small - East Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0.0	0 0	0 0	0.0		0 0	0 0	0 0					< 110 mm
Baltistan - Gillnett-Baltistan - Small - East Baltic - >110mm	11	1.1	1.1	1.1	1 1 1	1.1	1 1 1	1.1	1.1	1 1 1	1 1 1	1.1	1 1	1.1	1.1	1 1	1.1	1 1	1 1				East	> 110 mm
Baltistan - Gillnett-Baltistan - Small - Not Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0			Small		< 110 mm
Baltistan - Gillnett-Baltistan - Small - Not Baltic - >110mm	1.1	1 1	1.1	1 1	1 1 1	1 1	1 1 1	1 1	1 1	1 1 1	1 1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1				Not Baltic	> 110 mm
Baltistan - Gillnett-Baltistan - Small - Bornholm - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0				1	< 110 mm
Baltistan - Gillnett-Baltistan - Small - Bornholm - >110mm	1 1	1 1	1.1	1 1	1 1 1	1.1	1 1 1	1 1	1 1	1 1 1	1 1 1	1 1	1 1	1 1	1.1	1 1	1 1	1 1	1 1			1	Bornholm	> 110 mm
Baltistan - Gillnett-Baltistan - Small - Gotland - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0 0		0 0	0 0	0 0					< 110 mm
Baltistan - Gillnett-Baltistan - Small - Gotland - >110mm	1 1	1 1	1.1	1.1	1 1 1	1.1	1 1 1	1 1	1.1	1 1 1	1 1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1				Gotland	> 110 mm
Baltistan - Gillnett-Baltistan - Medium - West Baltic - <110mm	0 0	0 0	0 0	0 0	0 0 0	0 0	0 0 0	0 0	0 0	0 0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0					< 110 mm
Baltistan - Gillnett-Baltistan - Medium - West Baltic - >110mm	1 1	1 1	1 1	1 1	1 1 1	1 1	1 1 1	1 1	1.1	1 1 1	1 1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 1				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	В	С	D	E	F	G	Н	I	J	
293	Table 4.5.	RESULT	ING EFF	ORT AFT	ER DISTI	RIBUTIO	I ON RIG	S AND A	REAS (C	ountry, F	lee
294		2000 Per.*	2000 Per.:	2000 Per.3	2000 Per.	2001 Per.1	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.*	200
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	1
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	17
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	19
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	22
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	25
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	28
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	38
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	48
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	59
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	- 71
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	80
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	93
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	10
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	11
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	1
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	13
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	
H -	♦ ► ► K SO3 FLEET / Ark2 SO4 EFFORT / SO5	BOATS	/ SO6 P	PRICES	1 <						>

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	B	C		E	F	G	Н	
418	Table 4.6.	FFOR	MULTI	PLIERS	(Country	y, Fleet,	v.size,	Area, Ri	g)
		2000	2000	2000	2000	2001	2001	2001	2001
419		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4
420	Baltistan - OB Trawler-Baltistan - Small - Vest 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
H -	S03_FLEET / Ark2 S04_EFFORT / S05_BOAT	rs / so	6_PRICE	<					

	A	В	С	D	E	F	G	Н		
418	Table 4.6.	EFFORT	I MULTI	PLIERS	(Countr	y, Fleet,	V.Size,	Area, Ri	g)	
		2000	2000	2000	2000	2001	2001	2001	2001	
419		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	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 - Vest 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	
14	$\mathbf{A} \times \mathbf{N} / (202) = EET / Arb2 (204) = EEODT / 205 EOAT$	re / en		1						

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	В	С	D	E	F	G	Н		J	K
543	Table 4.7.	RESULT	ING EFF	ORT DIST	RIBUTIC	ON ON RI	GS (AFT	ER DISTF	RIBUTION	I ON ARE	AS) (
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002
544		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	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	175.4
549	Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <10mm	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	229.7
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
H ·	I > M / S03_FLEET / Ark2 S04_EFFORT / S05_	BOATS	/ SO6_P	PRICES ,	( <	Ш					>

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.

	A	B	C		)	Е	F	G	Н		J	k		L	M
38	Table 4.2.		DRT D	ISTRI	BUTIC	ONC	N ARE	AS fo	r all (C	Country	y, Flee	et, V.S	ize)		
		2000	2000	0 200	0 2	.000	2001	2001	2001	2001	2002	2 200	12 2	2002	2002
39		Per.1	Per.2	2 Per	.3  P	er.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.	.2 F	er.3	Per.4
40	Baltistan - OB Trawler-Baltistan - Small - West Baltic	0.1	0 0.	10 0	.10	0.14	0.10	0.10	0 0.1	0 0.1	4 0.	10 0	.10	0.10	0.14
41	Baltistan - OB Trawler-Baltistan - Small - East Baltic	0.1	5 0.	16 0	.21	0.17	0.15	0.10	6 0.2	1 0.1	7 0.	15 0	.16	0.21	0.17
42	Baltistan - OB Trawler-Baltistan - Small - Not Baltic	0.2	0 0.	21 0	.16	0.20	0.20	0.2	1 0.1	6 0.2	0 0.2	20 0	.21	0.16	0.20
43	Baltistan - OB Trawler-Baltistan - Small - Bornholm	0.2	5 0.	21 0.	.25	0.25	0.25	0.2	1 0.2	5 0.2	5 0.2	25 0	.21	0.25	0.25
44	Baltistan - OB Trawler-Baltistan - Small - Gotland	0.3	0 0.3	32 0.	.28	0.25	0.30	0.32	2 0.2	8 0.2	5 0.3	30 0.	.32	0.28	0.25
45	Baltistan - UB Trawler-Baltistan - Medium - West Baltic	0.1	U U.	14 0	.17	0.13	0.10	0.14	F 0.1	7 0.1	3 0.	10 0	.14	0.17	0.13
46	Baltistan - OB Trawler-Baltistan - Medium - East Baltic	0.1	5 0.	14 0	.15	0.18	0.15	0.14	F 0.1	5 0.1	8 0.	15 0	.14	0.15	0.18
4/	Baltistan - UB Trawler-Baltistan - Medium - Not Baltic	0.2	<b>U U</b> .	18 0	.18	0.23	0.20	0.18	8 U.1	8 0.2	3 0.2	20 0	.18	0.18	0.23
H 1	I SU3_FLEET / Ark2 / Ark3 / SU4_	_EFFU	RI	SU5_E	<u>30a i</u>	57	5								>
	A 7-11- 4 0	B	C		E		F	G	H	1	J	K		-	M
38	Table 4.2.	EFFOR	(I DIS	TRIBU	TION	101	AREA	STOP	ali (Co	untry,	⊦leet,	v.siz	e)	_	
		2000	2000	2000	200	0 2	001 2	2001	2001	2001	2002	2002	200	)2 2	2002
39	Delivery OD Trades Delivery Const. March 19	Per.1	Per.2	Per.3	Per.	<sup>4</sup> P	er.1 F	rer.2	Per.3	Per.4	Per.1	Per.2	Per	.3  F	rer.4
40	Baltistan - OB Trawler-Baltistan - Small - West Baltic	0.1	0.1	U.		0.1	0.20	0.20	0.20	0.20	0.19	0.1		.19	0.19
41	Baltistan - UB Trawler-Baltistan - Small - East Baltic	0.15	0.15	0.1	5 U	.15	0.17	0.17	0.17	0.17	0.18	0.18	5 U	.18	0.18
42	Baltistan - UB Trawler-Baltistan - Small - Not Baltic	0.2	0.2	0.2	2 1	J.Z	0.20	0.20	0.20	0.20	0.22	0.22	2 0	.22	0.22
43	Baltistan - UB Trawler-Baltistan - Small - Bornholm	0.25	0.25	0.2	5 U.	25	0.22	0.22	0.22	0.22	0.16	0.16	5 U	.16	0.16
44	Baltistan - OB Trawler-Baltistan - Small - Gotland	0.3	0.3	0.;	3 (	J.3	0.21	0.21	0.21	0.21	0.25	0.2	<b>)</b> 0	.25	0.25
45	Baltistan - UB Trawler-Baltistan - Medium - West Baltic	0.1	0.1	U.		0.1	0.17	0.17	0.17	0.17	0.17	0.1/		.17	0.17
46	Baltistan - UB Trawler-Baltistan - Medium - East Baltic	0.15	0.15	0.1	5 U	.15	0.15	0.15	0.15	0.15	0.19	0.1		.19	0.19
47	Baltistan - OB Trawler-Baltistan - Medium - Not Baltic	0.2	0.2	0.0	2 1	J.Z	0.17	0.17	0.17	0.17	0.20	0.20	J U	.20	0.20
48	Baltistan - UB Travier-Baltistan - Medium - Bornholm	0.25	0.25	0.2	5 U.	25	0.26	0.26	0.26	0.26	0.20	0.20	) U	.20	0.20
49	Baltistan - UB Trawler-Baltistan - Medium - Gotland	0.3	0.3	U.,	3 (	1.3	0.24	0.24	0.24	0.24	0.24	0.24	+ U	.24	0.24
• •	Image: Market Arks Arks Arks Arks Arks Arks Arks Arks	_EFFO	RT 🆯	505_E	BOAT	s (	<								>
	A		В	С	D	E	F	G	н	1	J	K	L	ŀ	
418	Table	e 4.6.	EFFO	RT MU	JLTIP	LIEF	8S (Co	untry,	Fleet,	V.Size	e, Area	a, Rig)	)		
			2000	2000	2000	2000	2001	2001	2001	2001 ;	2002 2	2002 2	2002	20	
419			Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4 F	Per.1 F	Per.2 F	er.3	Pe	
420	Baltistan - OB Trawler-Baltistan - Small - West Baltic - <110mm			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		
421		Baltistan - OB Trawler-Baltistan - Small - East Baltic - <110mm			1		1 1	1	1	1	1	1	1		
421 422	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <11	10mm	1												
421 422 423	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <11 Baltistan - OB Trawler-Baltistan - Small - East Baltic - >11	10mm 10mm	1	1	1		1 1	1	1	1	1	1	1		
421 422 423 424	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <11 Baltistan - OB Trawler-Baltistan - Small - East Baltic - >11 Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110	10mm 10mm 0mm	1	1	1		1 1 1 1	1	1	1	1	1	1		
421 422 423 424 425	Baltistan - OB Trawler-Baltistan - Small - East Baltic - <11 Baltistan - OB Trawler-Baltistan - Small - East Baltic - >11 Baltistan - OB Trawler-Baltistan - Small - Not Baltic - <110 Baltistan - OB Trawler-Baltistan - Small - Not Baltic - >110	10mm 10mm 0mm 0mm	1	1	1		1 1 1 1 1 1	1   1   1	1	1 1 1	1 1 1	1 1 1	1 1 1		
421 422 423 424 425 426	Baltistan - OB Trawler-Baltistan - Small - East Baltic - < 11 Baltistan - OB Trawler-Baltistan - Small - East Baltic - > 11 Baltistan - OB Trawler-Baltistan - Small - Not Baltic - < 110 Baltistan - OB Trawler-Baltistan - Small - Not Baltic - > 110 Baltistan - OB Trawler-Baltistan - Small - Bornholm - < 110	IOmm IOmm Omm Omm Omm	1		1		1 1 1 1 1 1	1	1 1 1	1	1 1 1	1 1 1	1 1 1		

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.



		A	В	С	D	E								
1	INPU	JT RELATED TO NUMBER O	OF BOATS			-								
2	TEM/	15												
3	Evalu	ation Frame for fisheries manageme	ent systems											
4	Versi	on. EXCEL 2003, MS Visual Basis 6.	3 TEMAS: 2	0 Mar 2007										
5	Marin	e Fisheries Department				2324								
6	DIFRES (Danish Institute of Marine Reserch)													
7														
8	Note: Do not insert or delete rows or columns between yellow cells													
9	Note:	Many of the input values of this	worksheet, a	ne numned wher of her	when the									
10	Dena	viou ai rules are applied to deter	mine the fitt	incer of boa	15									
12														
13		READ NUMBER OF BOATS			RACTERISTI	CS - LEVEL A								
14				_	Index Max Char	act								
15	Numb	Number of	haata	2	2									
16		Number 01	Doars		vessel length, t	onnage, engine pc								
17		EVCEL 2003 MS Vieual Basis 6-3 - 1	TEMAS: 27 Mar											
18		EXCEE 2003, MD VISUAI BASIS 0.3 1			ACTERISTIC	S								
19														
20	Name	Goto Main Me	ะกน											
21	Name				teristics, Used f	or definition of ma								
22	Name	Read Number of hoats	from dickfil	. 2										
23	Name	ACCES MEMORY OF DOULS												
24	Name													
25		Read Number of boats	from sheet	?	uch as vessel le	ength, tonnage, en								
26														
27		Table 5.3	OVERALL M	UI TIPLIER E		ROFBOATS								
29		Tuble 5.5.	Boats Eraction	Effort Eraction										
30	Mult		Loads Fraction	Enorceraction										
14 -	• • •	SO4_EFFORT \ SO5_BOATS	SO6 PRIC											
		<u></u>												

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

	EXCEL	
Index	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<sub>Vessel</sub>(Fl, Vs, Ct, y, q,Va), is defined by iteration:

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

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.  $NU_{New-Vessel}(Fl, Vs, Ct, y, q)$  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" indicates the it is characteristics no 2, that is, "tonnage" which is used to define the "Maximum regulation". Only one choice is available.

1

	A	В	С	D	E	F	G	Н		J	К				
1	INPUT RELATE		BER OF	BOATS											
2	TEMAS					BUN INFORMATION:									
3	<b>Evaluation Frame</b>	for fisheries n	nanagement s												
4	Version. EXCEL 20	03, MS Visua	l Basis 6.3	TEMAS: 27 M	-	Date of this	run:	09-05-2007	15:52						
5	Marine Fisheries D	lepartment				Name of Ru	n:			<b>IPLE No.</b>					
6	<b>DIFRES (Danish In</b>	stitute of Ma	rine Reserch)	l i i i i i i i i i i i i i i i i i i i		Param. Crea	ited:	12:00:00 AM	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	s are applied	l to determii	ie the numb	er of boats										
11															
12															
13	Table 5.1.	NUMBER O	F FLEET CHA	RACTERIST	CS - LEVEL	AND INDEX (	OF MAX TOT	AL CHARAC	TERISTICS						
14		Number of	Charaot	Index Max		Man lovel abor	ant' rafare to the	manimum alleure	d cum quar of al	aractoristics of	uar all indiaa				
19	Number Level Index	Charact	Charact	Charact		Index Max Char	act refers to the	maximum allowe	a sum over or cr	raracteristics ov	ion of Mar				
10	Number, Level, Index	a Number of Elec	at obstractoristics	z (uoccol lopath t		Tinues Mas Chai	ract indicates tri sout table – Thore	e selecteu chara a vo 2 possible k	otensuos to be u	Sed in the dennic	DUT OF Max				
17		Number of Free	conaracteristics	(vesseriengen, e	onnage, engine	power etc.j, see i	leat table There	are o possible i	evers asea for de	rinidon or maxin	ium allowed				
18	Table 5.2.	NAMES OF	FLEET CHAR	ACTERISTIC	s										
19		Name			-										
20	Name No. 1	Length													
21	Name No. 2	Tonnage	Selected chara	cteristics. Used f	or definition of r	naximum allowed	d total (summed)	characteristics.	e.a. the definition	of max number	of fishing lie				
22	Name No. 3	KgWat					<i>`</i>		1		<b>_</b>				
23	Name No. 4	Not used													
24	Name No. 5	Not used													
25		Names of Flee	t characteristics	such as vessel l	ength, tonnage, e	engine power etc.									
26															
27															
28	Table 5.3.	OVERALL M	IULTIPLIER	FOR NUMBER	R OF BOATS	- ALL FLEET	rs, countri	ES AND YEA	RS						
29		Boats													
30	Mult	1													
31		This multiplier r	aises all boat-nu	mbers, that is, it	applies to numb	er of vessels in th	he first period of	first year, as well	asthe number of	new vessels. It a	applies to al				
H ·	🔹 🕨 🖌 Ark3 🔏 S	604 EFFORT	<b>3</b> SO5 BO	ATS / SO6	PRICES 🖌 S	07 ECONOM	n < 🗉				>				

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  

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

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	В	C		E	F	G	Н		J	K	L	M	N	0	F
32																
- 33	Table 5.4.1.	Baltistan	: INN	IAL V	ESSE	L AGE	DIST	RIBUTI	ON A	ND INV	/ESTN	<b>MENTS</b>	(NEW	/ VES	SELS)	
		2000 Per.1 Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	200
34		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	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 ves:	sels by v	essel ag	ge group	o in first	period o	f first ye	ar and n	umber	of invest	tments (	number	of recru	uiting
42																
43																
44	Table 5.4.2.	Baltistan	I: NU	MBEF	OF N	EW B(	OATS	MULT	IPLIEF	۲.						
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 tł	ne numb	er of ne	w boats	(numbe	r of inve	stments	s). There	eisamu	ultiplier f	or each	period c	if each y	jear
53																
H.	I · · · · / Ark2 / Ark3 / S04_EFFORT S05_BOATS / S06_PRICES / S07										>					

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	В	С	D	E	F	G	Н	1	J
32										
33	Table 5.4.1.	Ireland : IN	TIAL VESSE	L AGE DISTR	RIBUTION AN	ID INVESTM	ENTS (NEW )	/ESSELS)		
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.
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 Valu
37	Trawl - Medium - Age 3 - New boats	70	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
38	Trawl - Medium - Age 4 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
- 39	Trawl - Medium - Age 5 - New boats	66	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
40	Trawl - Medium - Age 6 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
41	Trawl - Medium - Age 7 - New boats	62	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
42	Trawl - Medium - Age 8 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
43	Trawl - Medium - Age 9 - New boats	58	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
44	Trawl - Medium - Age 10 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
45	Trawl - Medium - Age 11 - New boats	54	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
46	Trawl - Medium - Age 12 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
47	Trawl - Medium - Age 13 - New boats	50	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
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 Valu
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 Valu
52	Trawl - Large - Age 5 - New boats	42	No Value	No Value	No Value	No ¥alue	No Value	No Value	No Value	No Valu
53	Trawl - Large - Age 6 - New boats	0	No Value	No Value	No Value	No ¥alue	No Value	No Value	No Value	No Valu
54	Trawl - Large - Age 7 - New boats	38	No Value	No Value	No Value	No ¥alue	No Value	No Value	No Value	No Valu
55	Trawl - Large - Age 8 - New boats	0	No Value	No Value	No Value	No ¥alue	No Value	No Value	No Value	No Valu
56	Trawl - Large - Age 9 - New boats	34	No Value	No Value	No Value	No ¥alue	No Value	No Value	No Value	No Valu
57	Trawl - Large - Age 10 - New boats	0	No Value	No Value	No Value	No ¥alue	No Value	No Value	No Value	No Valu
58	Trawl - Large - Age 11 - New boats	30	No Value	No Value	No Yalue	No Yalue	No Value	No Yalue	No Value	No Value
59	Trawl - Large - Age 12 - New boats	0	No Value	No Value	No Yalue	No Yalue	No Value	No Yalue	No Value	No Value
60	Trawl - Large - Age 13 - New boats	26	No Value	No Value	No Yalue	No Yalue	No Value	No Yalue	No Value	No Yalu
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 Yalue	No Value	No Value	No Yalue	No Value	No Yalu
63	Gill netter - Small - Age 3 - New boats	44	No Value	No Value	No Yalue	No Value	No Value	No Value	No Value	No Valu
64	Gill netter - Small - Age 4 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
65	Gill netter - Small - Age 5 - New boats	40	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
66	Gill netter - Small - Age 6 - New boats	0	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Valu
07	Gilloottor Small Ago 7 Nowboate		D / COC DD	Ma Malua	No Volue	Ale Malue	No Value	No Value	No Value	Ma Value
14	P P K ATKZ ζ SU4_EFFURT χ	5U3_BUAT	а <u>д 500_</u> РК	ICES & SU/	_ECONOMIA	615				3

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":

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

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)  $NU_{Vessel}(Fl, Vs, Ct, y, q, 0) = NU_{New-Vessel}(Fl, Vs, Ct, y,q)$ . 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.

1.1

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	В	С	D	E	F	G	Н		J	K	L	M	N	0	P	Q	B
55	Table 5.4.3.	Baltistan	: CR	EW P	ER VE	SSEL												
		2000 Per.1-																
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	200
56		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	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 (	rew me	mbers p	er vess	el, used	to defin	e emplo	yment. 1	There is	a crew-r	humber I	or each	period	ofeach	year		
64																		
65																		
66	Table 5.4.4.	Baltistan	: MA	X DA	/S/PE	RIOD												
		2000 Per.1-																
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	200
67		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	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 maximu	ım numl	ber of ef	fort unit	s (say d	ays) per	time un	it a vess	el of the	e fleet da	an exert.	This pa	rameter	defines	the effo	rt-capac	sityTl
75																		
H -	🔹 🕨 🖊 Ark2 🖉 Ark3 🏒	SO4_EFFC	RT λ	SO5_	BOAT	s/ s	06_PF	RICES	/s	<				]				>
-									-									

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<sub>Withdrawal</sub>(Fl, Vs, Ct, y, q, Va) (EXCEL Table 5.4.5), number of attritions, NU<sub>Attrition</sub>(Fl, Vs, Ct, y, q, Va) (EXCEL Table 5.4.6) and number of decommissioned vessels NU<sub>Decomm</sub>(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 of 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 "  $\leftarrow$  " 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  $NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \ge NU_{Decomm}(Fl, Vs, Ct, y, q, Va)$ 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  $NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \ge NU_{Attrition}(Fl, Vs, Ct, y, q, Va)$ 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  $NU_{Vessel}(Fl, Vs, Ct, y, q, Va) \ge NU_{Withdrawal}(Fl, Vs, Ct, y, q, Va)$ 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

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

	A	В	С		E	F	G	Н		J	К	L	M	N		P	Q	В	S	
76		_	_							-		-			_				-	$\square$
77	Table 5.4.5.	Baltistan	: NUM	BER OF	DIS-IN	VESTA	ΛΈΝΤ (N	NITHDE	RAWAL	) VESS	ÉLS									
		2000 Per.1-	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	2004	2004	200
78		Initial	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per
79	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	) (	) 0	· 1	I 0	0	) 0	0	0	0	0	0	0	0	1
80	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	) (	) 0	· 1	I 0	0	) 0	0	0	0	0	0	0	0	1
81	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	) (	) 0	· 1	I 0	0	) 0	0	0	0	0	0	0	0	1
82	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	) (	) 0	· 1	I 0	0	) 0	0	0	0	0	0	0	0	1
83	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	) (	) ()	· 1	I 0	0	) 0	0	0	0	0	0	0	0	1
84	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	) (	) 0	· 1	I 0	0	) 0	0	0	0	0	0	0	0	(
85		Number of v	essels wi	ithdrawn d	ue to low	cashflov	, by peric	d, year an	d vessel a	age group	. This nu	mber of v	essels m	ay also be	determin	ied by the	program	trhough t	he so-cal	led 's
86																				
87																				
88	Table 5.4.6.	Baltistan	: NUN	BER 0	ATTR	ITION V	/ESSE	_S												
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	2004	2004	200
89		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per
90	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
91	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	) (	) 0	· 1	I 0	0	) 0	0	0	0	0	1	0	0	1
92	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
93	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
94	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
95	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
96		Number of v	essels wi	ithdrawn d	ue to old	age, by p	eriod, yea	r and ves	sel age gr	oup. This	number r	may also <b>t</b>	oe determ	ined by th	e progran	n trhough	the so-ca	alled 'stru	ctural bek	avio
97																				
98																				
- 99	Table 5.4.7.	Baltistan	: NUM	BER OF	DECO	MMISI	DNED V	ESSEL	s											
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	2004	2004	200
100		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per
101	OB Trawler-Baltistan - Small - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
102	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
103	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
104	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
105	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	) (	) 0	i 1	I 0	0	) 0	0	0	0	0	1	0	0	1
106	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	) (	) 0	1	I 0	0	) 0	0	0	0	0	1	0	0	
107		Number of v	essels wi	ithdrawn d	ue to dec	ommissi	ion (a gov	/ernment	buy-back	program	ne). This	number m	ay also b	e determi	ned by the	e program	trhough I	the so-ca	lled 'struc	stural
108						<u> </u>				L										
H ·	🔹 🕨 🖌 Ark1 🖉 SO2_STOCK 🔏 S	503_FLEET	🖌 Ark	2 <u>/</u> SO4	4_EFFC	RTλS	605_B	DATS 🔬	S06_	PRICE:	<		Ш							>

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	В	С	D	E	F	G	н	1	J	K	L	M	N	0	P	Q	B	
110	Table 5.4.8.	Baltistan	: RES	ULTING	VESS	EL AGE	DISTR	BUTIO	Ň										
		2000 Per.1 - Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003	2003	2004	20
111		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Pe
112	UB Trawler-Baltistan - Small - Age 1	30	30	30	30	30	30	30	32	32	32	32	32	32	32	32	35	35	-
113	UB 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	1
117	Gillnett-Baltistan - Large - Age 1	5	5	5	5	5	i 5	5	4	4	4	4	4	4	4	4	4	4	·
118		The resulting	number	of vessels	s by vess	el age gro	oup at beg	inning and	d during th	heyear. N	Jumber of	fvessels(	Period,A	ge)= Nu	mber of v	essels (F	eriod-1, /	λge) - Nur	mbe
119																			
120																			
121	Table 5.4.9.	Baltistan	: RES	ULTING	NUMB	ER OF	DECON	MISIO	NED VE	SSELS									
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. <b>4</b>	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	1 0	0	0	0	0	0	0	1	0	1
124	OB Trawler-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	1 0	0	0	0	0	0	0	1	0	1
125	OB Trawler-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	1 0	0	0	0	0	0	0	1	0	1
126	Gillnett-Baltistan - Small - Age 1	0	0	0	0	0	0	0	1	1 0	0	0	0	0	0	0	1	0	1
127	Gillnett-Baltistan - Medium - Age 1	0	0	0	0	0	0	0	1	1 0	0	0	0	0	0	0	1	0	1
128	Gillnett-Baltistan - Large - Age 1	0	0	0	0	0	0	0	1	1 0	0	0	0	0	0	0	1	0	1
129		Resulting nu	mber of d	lecomissi	ons. Res	ults deriv	ed from a	pplication	of multip	pliers (if ap	pplied), ot	herwise a	copy of f	oregoing	table with	number o	of decom	issions.	
130																			
N	Ark1 / S02 STOCK / S03 FLEE	T / Ark2	/ SO4	EFFOR	r ∖ so	5 BOA	TS /	506 PR	ICES	<								1	>

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	В	С	D	E	F	G	Н	- 1	J	K	L	M	N	
132	Table 5.4.10.	Baltistan	: NUME	BER OF	VESSE	SLS (S	SUMMA	RY)							1
		2000 Per.1-													
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2
133		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	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	J
142	OB Trawler-Baltistan - Medium - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	J
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	J
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	J
152	Gillnett-Baltistan - Small - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	J
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	J
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	J
162	Gillnett-Baltistan - Large - Withdrawals	0	0	0	0	0	0	0	1	0	0	0	0	0	1
163	Gillnett-Baltistan - Large - Total	5	5	5	5	5	5	5	4	4	4	4	4	4	
164		These summ	hary value	s are deri	ved from	the other	tables for	checking	) and pres	sentation	purposes	5			
AGE.		T / AND	7 спи			5 00/								3	

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	В	С	D	E	F	G	н	1	J	K	L	M	N	0	P
300																
301	Table 5.5.1.	Baltistan	: FLEET	CHAR	ACTERI	STICS:	Lengt	h								
		2000 Per.1 -														
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003
302		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3
303	OB Trawler-Baltistan - Small	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
304	OB Trawler-Baltistan - Medium	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
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	4
307	Gillnett-Baltistan - Medium	16	16	16	16	16	16	16	16	16	16	16	16	16	16	10
308	Gillnett-Baltistan - Large	0	0	0	0	0	0	0	0	0	0	0	0	0	0	_
309		Fleet charac	teristics: l	ength												
310																
311		_														
312	Table 5.5.2.	Baltistan	: (STAF	RT NUM	BER OF	VESS	ELS)* (	FLEET	CHARA	CTERIS	STICS):	Length	1			
		2000 Per.1-														
		Initial	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003
313		number	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	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 charac	teristics: l	ength												
321																
322																
323	Table 5.5.3.	Baltistan	: MAXI	NUM TO	DTAL A	LLOW	ED FLEI	ET CHA	RACTE	RISTIC	S (BY C	OUNT	RY): Lei	ngth - N	lot Use	d
		2000 Per.1 -	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003
324		Initial	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	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 all	owable to	tal value	of charac	teritics Le	ength - No	ot Used								
327																
328																
329	Table 5.5.4.	Baltistan	: MAXII	NOW TO	DTAL A	LLOW	ED FLE	ET CHA	RACTE	RISTIC	S (BY C	COUNTI	RY AND	FLEET	): Leng	<u>th - No</u>
		2000 Per.1 -	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003
330		Initial	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	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 ¥al	No Val	No ¥al	No ¥al	No Val	No ¥al	No ¥al	No ¥al	No ¥al	No ¥al	No ¥al	No Val	No ¥al	No ¥a
333		Maximum all	owable to	tal value	of charac	teristics l	length									
334																
335	7-11-555	D. N.							DACT	DIGTIC	0.000	COLUMN T			LIF-CO	<b>FL 017</b>
336	Table 5.5.5.	Baltistan	: MAXI	NOM TO	JIAL A	LLOW	ED FLEI	ET CHA	RACTE	RISTIC	S (BY C	JOUNTI	RY, FLE	ET ANL	VESS	EL SIZ
		2000 Per.1-	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	2003	2003
337		Initial	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3
338	OB Trawler-Baltistan - Small	No Yalue	No Yal	No Yal	No Yal	No Yal	No ¥al	No Yal	No Yal	No Yal	No ¥al	No Yal	No Yal	No Yal	No ¥al	No ¥a
339	OB Trawler-Baltistan - Medium	No Value	No Yal	No Yal	No Yal	No Yal	No ¥al	No Yal	No Yal	No Yal	No Yal	No Yal	No Yal	No ¥al	No ¥al	No ¥a
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 ¥a
341	Gillnett-Baltistan - Small	No Value	No Yal	No Yal	No Val	No Yal	No Yal	No Val	No Yal	No Yal	No Yal	No Yal	No Val	No Val	No Yal	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 ¥al	No Va
343	Gillnett-Baltistan - Large	No Value	No Val	No Val	No Val	No Val	No Val	No Yal	No Yal	No Yai	No Yal	No Yal	No Yai	No Val	No Yai	No ¥a
344		Maximum all	owable to	tal value	of charac	teristics l	Length - N	lot Used								
345				1	1-		= \									
H -	Ark1 / S02 STOC	K 🖌 SO3	FLEET	/ Ark2	/ S04	EFFOR	$T \ge S0$	15 BO	<							>

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	В	С	D	E	F	G	Н	- 1	J
346										
347	Table 5.5.6.	Baltistan :	FLEET CH/	ARACTERIS	STICS: Toni	nage				
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 characte	eristics: Tonna	ige						
356										
357										
358	Table 5.5.7.	Baltistan :	(START NU	JMBER OF	VESSELS)	(FLEET CH	IARACTER	ISTICS): To	nnage	
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 characte	eristics: Tonna	ige						
367										
368				TOTAL		FFT OLLAR	ATERIATI		NITES O T	
369	Table 5.5.8.	Baltistan :	MAXIMUM	TOTAL AL	LOWED FL	EET CHAR	ACTERISTI	CS (BY COL	JNTRY): TO	nnage
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 allo	owable total va	lue of characte	ritics Tonnage	•				
373										
374	Table 5.5.0	Daltietan :	MAYIMUM	TOTAL AL				CS (PV COL		
375	Table 5.5.9.	Dalustan.		101AL AL		CET CHAN	ACTENISTI 2001 Dec 0	DOM Dave 2	DITET AND	PLEET /
376	OD Taxadas Dalkistas	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	Cille att Dahistee	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Value	No Yalu
270	Gillinett-Baittstan	Maximum alle	NO Falue	NO Falue	NO Talue	NO Talue	NU Talue	NO Talue	NO Talue	NO Talu
200		Maximum and	wabie (otal va	ide of characte	ansties ronnag	le				
291										
382	Table 5.5.10.	Baltistan :	MAXIMUM	TOTAL AL	LOWED FL	EET CHAR	ACTERISTI	CS (BY COL	JNTRY, ELE	ET 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 Yalue	No Yalue	No Yalue	No Yalue	No Yalue	No Yalue	No Yalue	No Yalu
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 Travler-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 allo	wable total va	lue of characte	ristics Tonnac	e - Not Used	NO FUIC	into Funde	NO FUILL	NO TOO
201				ide of characte	instics ronnag	ie - Not Obed	-			
14 4	A N N / Roots 4 \ SOS	; <b>DOAT</b> Q /	CO6 DD10	EC / CN7.	ECONOM	( ) <b>(</b> ) (				N 1

**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<sub>Rel</sub>(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	В	С	D	E	F	G	Н	I	J	К	-
1 INPUT RELATED TO PRICES	5										
2 TEMAS						RUN INFO	RMATION:				
3 Evaluation Frame for fisheries mana	igement sys	tems									
4 Version. EXCEL 2003, MS Visual Ba	sis 6.3 TE	MAS: 27 M	ar 2007		-	Date of thi	s run:	11-05-2007	11:59		
5 Marine Fisheries Department						Name of <b>R</b>	un:				5 - V
6 DIFRES (Danish Institute of Marine	Reserch)					Param. Cr	eated:	12:00:00 AM	00:00		
7						File Name:		DEMON_5_P	Mig3		
8 Note: Do not insert or delete rows o	r columns l	etween yell	ow cells 👘								
9 Note: INPUT IN YELLOW CELLS ONL	.Y										
10											
11 Table 0.0.1	Prices is give	en as a produc	t of 'Absolute	price' and 'Re	lative price'.	Absolute price	referes to the	the maximum p	rice amongst a	age groups. M	laximur
12 Table 6.2.1.	Baltistan	: MAXIMUN	I PRICE (O	VER 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	i Maximum p	rice over age g	roups. Param	eter, PriceMa:	rrul in the mo	aei of price for	mation: Abso	iute price = Price	aviaxYQ(FI,Vs	.ut,St,Y,q]"La	ndings
I	<u>)</u> , SO6_PF	RICES / SC	7_ECONO	MY 🖌 SO8	TRIP_RU	<					>

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 Table 6.2.2	Baltistan (		D DDICE (m #	E	F	G	Н
28	Table 6.2.2.	Baltistan :	RELATIVE	PRICE (OVE	er age grou	ups)		
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 1Per. 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 1Per. 1	0.545	0.545	0.545	0.545	0.545	0.545	
55	East cod - Age 1Per. 2	0.591	0.591	0.591	0.591	0.591	0.591	
56	East cod - Age 1Per. 3	0.661	0.661	0.661	0.661	0.661	0.661	
57	East cod - Age 1Per. 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∤Max	imum price ov	er age groups.	Note that th	ie program wil	l normalize I
71								
72	Table 6.3.2	Deltister d						
73	Table 6.2.3.	Baitistan :		XIBILITY				
74		UB Trawler-Ba	Gillnett-Balt	istan				
75	West Cod	0.0001	0.0001					
76	Eastcod	0.0001	0.0001			DOM: N	A E1	
- 77		The parameter	r 'Flexibility' in	the model: Ma	aximum Price :	: P0 " Landing L	gs " Flexibility,	where P0 is
I4 - •	N N S04 EEEORT	7 X SO5, BO	ATS \ SO	6 PRICES				

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 =  $P0 * Landings \wedge Flexibility$ , 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.

		A	В	С	D	Е —					
1	INPUT RE	LATED TO ECONOMY				<b>^</b>					
2	TEMAS										
3	<b>Evaluation</b>	Frame for fisheries manageme	nt systems								
4	Version. EX	CEL 2003, MS Visual Basis 6.3	3 TEMAS: 20	) Mar 2007							
5	Marine Fish	eries Department				3334					
6	DIFRES (Da	nish Institute of Marine Reser	ch)								
7											
8	Note: Do no	ot insert or delete rows or colu	mns between y	jellow cells 👘							
9	Note: INPUT	IN YELLOW CELLS ONLY									
10											
11		READ ECONOMIC PARAM	FTFRS								
12											
13	A: FINANCIA										
14	B: GOVERNM	BEGOVERNIN Economics 2									
15											
16						of net prese					
17				<i></i>							
18		Options for Pro	eprocessii	ng of data	?	LCOSTS					
19											
20		Coto			5	2000 Per.4					
21	A: Uperating c	Golo	viali i Merik	<u></u>		0.93					
22	A: Operating c					0.8					
23	A: Operating o	Read all economic	parameter	s from diskt	<i>ile</i> 2	0.35					
25	A: Operating o					0.3					
26	A: Crew salaru					0.09165					
27	A: Crew salary	Read Economic flee	t paramete	rs from she	et ?	0.07499					
28	A: Crew salaru					0.09165					
29	A: Crew salary	- Bornholm	0.083325	0.083325	0.083325	0.0833					
30	A-Crew salaru	- Gotland	0.0749925	0 0749925	0.0749925	0.07499					
H ·	• • • / S	06_PRICES \ S07_ECONO	MY / SO8_T	•		•					

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
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155	Table7.2.1.2.1.	Baltistan : Gillnett-Baltistan - Small COSTS
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163	Table7.2.2.3.	Scandinavia : Gillnett-Scandinavia - Large COSTS
164	Table7.2.2.3.1.	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	В	С	D	E						
1	INPUT RELATED TO ECONOM	Y									
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 DIS	COUNT								
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 analy	ses for calculatio	n of net present v	alue. Ur					
17						-					
H -	SO7_ECON	omy / [so8_]	TRIP								

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

D

19	Table 7.2.1.1.1.	Baltistan : O	B Trawler-Ba	ltistan - Sma	I 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	
H I	I > N / SO6_PRICES \SO7_ECON	<b>DMY</b> / SO8_1	TRIP_   •			
2.10	3.a. Variable costs and fixed co	osts of three	e economic	models (co	ntinued).	
The	parameters in EXCEL Table 7.2.1.	1.1 are:				

в

### 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)

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

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

 $COR_E^i(Fl, Vs, Rg, Ct, y, q, Ar)$  Cost rate (cost per effort unit) depending on the effort in area Ar. Financial operating costs of landings: (Figure 2.10.3.a)

A

Figure

 $COR_{VAI}^{i}$  (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)

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

Financial Fixed costs (Figure 2.10.3.a)

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

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

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

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

	A	В	С	D	E	
65	C: Economic operating cost - West Baltic	680.07	680.07	680.07	680.07	<u></u>
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 invest	ments of the 3 ec	onomic models.	There are 3 econo	omic an
87						
R.	( ) N / SO6 PRICES \ SO7 ECON					►LĖ

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

	Α	В	С	D	E	F		
79								<u></u>
80	Table 7.2.1.1.2.	Ireland : Trav	wl-Large CC	OSTS				
81		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per.4	2001 Per.1	2001 F	:
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		*
H -	♦ ▶ ▶ \\ SO7_ECONOMY / SO8_TI	RIP_RU / SO	9_STRUC_RU	<			>	

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)**

 $COR_{Yield}^{i}(Fl,Vs,Rg,Ct,y,q,Ar)$  Economic Cost rate (cost per weight unit) depending on the yield. Financial crew salary: (Figure 2.10.3.b)

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

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

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

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

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

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



864 865											15	-	141	-
865	7 11 700004													_
	Table 7.2.2.3.1.	REVER	NUE FR	омот	HERS	TOCKS								_
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2
866		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	P
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	Baitistan - UB 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 - UB 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 - UB 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 - UB 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 - UB 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 - UB 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 - UB 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 - UB 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 - UB 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 - UB 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 - K110mm	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 - > Humm	50.5	50.5	50.5	50.5	100	51	51	100	01.0	51.5	51.5	51.5	
897	Baltistan - Gillinett-Baltistan - Small - West Baltic - < 10mm Dekisten - Gillertt Bekisten - Small - Meet Bekis - + 10mm	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 - Gillinett-Baltistan - Small - West Baltis - >10mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	4.12	4.12	4.12	
833	Baitistan - Gillinett-Baitistan - Small - East Baitis - Kilumm	4.04	9.09	4.04	4.04	4.08	4.08	4.08	4.08	9.12	9.12	9.12	9.12	
900	Baltistan - Gillinett-Baltistan - Small - East Baltic - > Ilumm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	9.12	4.12	9.12	9.12	
901	Dakistan - Gilleett Dakistan - Small - Not Baltic - K110mm Dakistan - Gilleett Dakistan - Small - Not Dakis - 140mm	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.08	4.12	9.12	4.12	9.12	
902	Baitistan - Gillinett-Baltistan - Small - Not Baltic - >110mm Baltistan - Gillinett Baltistan - Small - Berekelm - (490	4.04	4.04	4.04	4.04	4.08	4.08	4.08	4.00	4.12	4.12	4.12	9.12	
903	Dakistan - Gilloott Dakistan - Small - Bornholm - Killumm	1.04	1.04	1.04	1.04	4.00	4.00	4.00	1.08	9.12	9.12	9.12	9.12	
905	Dakistan - Gilinett-Baltistan - Small - Bornholm - >110mm Pakistan - Gilinett Pakistan Small - Gotland - /110mm	1.04	4.04	4.04	1.04	4.00	4.00	4.00	4.00	9.12	9.12	9.12	9.12	
905	Dakistan - Gilinett Paltistan - Small - Gotland - Kilumm Paltistan - Gilinett Paltistan - Small - Gotland - 110	4.04	4.04	4.04	4.04	4.00	4.08	4.08	4.00	9.12	9.12	9.12	9.12	
907	Darustan - Camett-Darustan - Smail - Ciottanu - Shuffim Paltistan - Gilloott-Daltistan - Medium - Mest Paltis - 410mm	9.09	9.09	9.09	9.09	9.10	9.10	9.10	9.10	9.12	9.12	9.12	9.12	~
14 4	Bardstan - Gimmett-Bardstan - Medium - West Bards - Churm N SO7 ECONOMY / SO8 TRIP RU / SO9	STRU	C RU	/ S10	TUNIN	IC C	0.10	0.16	0.16	0.24	0.24	0.24	0.24	

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 7.2.2.3.1) 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".

"fleet", (Fl,Vs,Ct). A choice can be, for example, an and  $p_{i,Choice} = \frac{\exp(U_{i,Choice})}{\sum_{j=1}^{M} \exp(U_{i,j})}$ 

The utility,  $U_{i,i}$  , 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	$X_{i,r}$	$eta_{_{ij,r}}$
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 (	Table C 2 11 1 Tables in the tain 1 demission inner the st COO TDID DI								

Table C.2.11.1. Tables in the trip behaviour input sheet, S08\_TRIP\_RU.

	A	В	C	D	E	F	G	Н	<u> </u>	J	К	L
1	INPUT REL	ATED TO TRIP	BEHAVIOU	JR								
2	TEMAS						<b>RUN INFOR</b>	MATION:				
3	<b>Evaluation Fra</b>	me for fisheries m	anagement sy	stems								
4	Version. EXCE	L 2003, MS Visual	Basis 6.3 T	EMAS: 27 Ma	r 2007 🛛 💽		Date of this	run:	02-07-2007	10:54		
5	Marine Fisheri	es Department					Name of Ru	n:				
6	DIFRES (Danish Institute of Marine Reserch)							ated:	12:00:00 AM	00:00		
(	Note De cati						File Name:		DEMUN_5_	Mig3		
9	Note: The inp	ut values of this i	worksheet, a	re nullified i	w cens inless vou s	elect						
10	the option to	apply the behavid	oural rules to	determine t	the number	of boats						
11												
12												
13												
14	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							
			Name of	Name of	Name of	Name of	Name of	Name of	Name of	Name of	Name of	Name of
16		Name of rule	Choice	Choice	Choice	Choice	Choice	Choice	Choice	Choice	Choice	Choice
	Baltistan: Trip	Baltistan:	OB Trawler-	OB Trawler-	Gillnett-	Gillnett-						
	related Rule	Go Fishing /	Baltistan: Go	Baltistan: Stay	Baltistan: Go	Baltistan: Stay						
17	INO. 1	Not Go Fishing	hshing	in port	hshing	in port						
	Baltistan: Trip	Baltistan:	OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	Gillnett-	Gillnett-	Gillnett-	Gillnett-	Gillnett-
	related Rule	Choose Fishing	Baltistan: West	Baltistan: East	Baltistan: Not	Baltistan:	Baltistan:	Baltistan: West	Baltistan: East	Baltistan: Not	Baltistan:	Baltistan:
18	NO. 2	grounds	Baltic	Baltic	Baltic	Bornholm	Gotland	Baltic	Baltic	Baltic	Bornholm	Gotland
	Scandinavia:	Scandinavia:	OB Trawler-	OB Trawler-	Gillnett-	Gillnett-						
	Trip related	Go Fishing /	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:						
19	Rule No. 1	Not Go Fishing	Golishing	Stay in port	Golishing	Stay in port						
	Scandinavia:	Scandinavia:	OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	OB Trawler-	Gillnett-	Gillnett-	Gillnett-	Gillnett-	Gillnett-
	Trip related	Choose Fishing	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:	Scandinavia:
20	Rule NO. 2	grounas	west Baltic	East Baltic	NOT Baltic	Bornnölm	Gotiand	west Baltic	East Baltic	NOT Baltic	Bornnolm	Gotiand
14		DRICES / SOT	ECONOMY \			CTDUC DU	/ S10 TLM					
P.	K 200	THUCES Y SONT	ECONOMIT A	JUO_IRIP	_KO \ 209_	arkoc_ku j	( <u>210 10</u> [	• J				

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.	Balti	stan :	TRI	P BE	HAVIO	DUR	COEFF	ICIENTS	OF R.U.M.
	2000 Por.	2000 Por.	2000 Por.	2000 Por.	2001Por.	2001Por.	2		
Kulo 1: Charact.: 1 - Iradition - Balturtan -				-0.003					
Rule 1: Charact.: 1-Tradition-Baltistan-	****	****	****	****	****	****	RULE 1		
nulo I: Httrib.: I-Expected value Landing	14.45	****	****	****	****	****			
Kulo 2: Charact.: 1- Iradition - Balturtan -									
Nule 2: Charact.: 1- Tradition - Balturtan -		****	****	****		****			
Rule 2: Charact.: 1-Tradition-Baltistan-	****	****	****	****	****	0.026		SMALL	
Pull 2: Charact - 1: Teadition - Palticture	0.021						BIILE 2		
Sulo 2: Charact : 1- Iradition - Baltistan -							HOLL E		
Rule 2: Attrib.: 1- Value Landinar - Baltirte	****	****	****	****	****	****			
nule 2: Httrib.: 2 - Pir H - Baltistan - OB 114	****	****	****	****		-9.94			
Kulo 1: Charact.: 1- Iradition - Baltistan - I				-0.047					
Rule 1: Charact.: 1 - Tradition - Baltistan - P	****	****	****	****	****	****	RULE 1		
mulo I: Httrib.: I * Expected value Landing	9.997	****	****	****	****	****			
Kulo 2: Charact.: 1- Iradition-Balturtan-									
Kule 2: Charact.: 1- Iradition-Baltutan-	****	****	****	****	****	****			
								MEDIUM	TRAWLER
Kule 2: Charact.: 1- Tradition - Baltirtan -	****	****	****	****		0.047		MEDIOW	
Rule 2: Charact.: 1-Tradition-Baltirtan-	0.041	0.043	****	****	****	****	RULE 2		
Kule 2: Charact.: 1- Iradition - Balturtan -	****	****	****	****	****	****			
Kulo 2: Attrib.: 1-Value Landingr - Baltirte	****	****	****	****	****	****			
naio 2: Attrib.: 2 - Mir A - Baltutan - OB 114									
nule II Unaract.: I - Iradition - Baiturtan - I									
Rulo 1: Charact.: 1 - Tradition - Baltistan - I	****	****	****	****	****	****	RULE I		
nale I: Accris.: 1-Expected value Landing									
nalez: ondract.: 1- Tradition - Daitoran -								LADOF	
Rule 2: Charact.: 1-Tradition-Baltirtan-	****	****	****	****	****	****		LARGE	
Kule 2: Charact.: 1- Iradition-Baltutan-	****	****	****	****	****	-9.917			
Rulo 2: Charact.: 1-Tradition-Baltirtan-	-0.031	-0.023	****	****	****	****	RULE 2		
Kulo 2: Charact.: 1- Iradition-Baltistan-	****	****	****	****	****	****			
Kulo Z: Attrib.: 1-Yaluo Landingr-Baltirto	****	****	****	****	****	****			
nulo 2: Histrib.: 2 Thin Hin Dalsustan TOD Tre	****	****	****	****	****	79.997			
Rule 1: Charact.: 1- Iradition-Balturtan-I				0.05					
Rule 1: Charact.: 1-Tradition-Baltirtan-I	****	****	****	****	****	****	RULE 1		
nulo I: Httrib.: I * Expected value Landing		****	****	****	****	****			
Rule 2: Charact.: 1- Iradition - Balturtan -									
Kule 2: Charact.: 1- Iradition - Balturtan -	****	****	****	****	****	****			
Rule 2: Charact.: 1-Tradition-Baltistan-	****	****	****	****	****	-0.022		SMALL	
Nulo 2: Charact.: 1-Tradition - Baltirtan -	-0.044	-0.049	****	****	****	****	HULE Z		
nule 2: Undract.: 1- Fradition - Baltutan - Kula /: Akkuk : 1- Value I as do as e Policet.	2222								
nule 2: Httrip.; 2 - Mir H - Daltutan - Galtute									
Kulo 1: Charact.: 1 - Iradition - Baltistan -				-0.001					
Rula 1. Charach - 1. To divise - Polyint							BIILE 1		
nule I: Undract.: 1- Iradition - Baltutan - I Nule I: Httrip.: 1- Expected Value Landing							HOLE I		
Rule 2: Charact.: 1- Iradition - Balturtan -									
Kule 2: Charact.: 1- Iradition - Baltutan -	****	****	****	****	****	****			
								MEDUNA	
Rule 2: Charact.: 1-Tradition-Baltistan-	****	****	****	****	****	0.044		MEDIUM	GILLINETTERS
Rule 2: Charact.: 1-Tradition-Baltistan-	-0.05	-0.047	****	****	****	****	RULE 2		
Kule 2: Charact.: 1- Iradition - Balturtan -	****	****	****	****	****	****			
Rule 2: Attrib.: 1-Value Landingr - Baltirte	****	****	****	****	****	****			
NUI2 2: HEEFID.: 2 THINH T DAILUSAN T AIIINE		****	****	****	****	9.944			
Kule 1: Charact.: 1 - Iradition - Baltutan - I				-0.045					
Rule 1: Charact.: 1-Tradition-Baltistan-	****	****	****	****	****	****	RULE 1		
nulo I: Httrib.: I * Expected value Landing		****	****	****	****	****			
Rule 2: Charact.: 1- Iradition - Balturtan -									
								LARGE	
Rule 2. Observation of Transferration - District								LANOL	
Rule 2: Charact.: 1-Tradition-Baltistan-	****								
Rule 2: Charact.: 1- Tradition - Baltirtan - Kule 2: Charact.: 1- Iradition - Baltirtan -	****	****	****	****	****	-9.925			
Rulo 2: Charact.: 1- Tradition - Baltirtan - Kulo 2: Charact.: 1- Iradition - Baltirtan - Rulo 2: Charact.: 1- Tradition - Baltirtan -	**** **** •.•25	-0.002	****	****	****	-9.925	RULE 2		
Rulo 2: Charact.: 1-Tradition - Baltirtan - Kulo 2: Charact.: 1-Tradition - Baltirtan - Rulo 2: Charact.: 1-Tradition - Baltirtan - Rulo 2: Charact.: 1-Tradition - Baltirtan -	0.025	-0.002 -112	****	****	****	-0.025 2222	RULE 2		
Rule 2: Charaet.: 1- Tradition - Baltirtan Kule 2: Charaet.: 1- Iradition - Baltirtan Rule 2: Charaet.: 1- Tradition - Baltirtan Kule 2: Charaet.: 1- Iradition - Baltirtan Kule 2: Attrib.: 1-Value Landingr - Balturta	**** **** •.•25 ****	-0.002 3333 3333	****			-0.025	RULE 2		

1

Figure 2.11.3.a. The RUM table structure for trip behaviour of one country.

22	Table 8.2.	Baltistan	: TRIP BE	HAVIOUR	COEFFICIE	NTS 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: Charaot.: 1 - Tradition - Baltistan - OB Trawler-Baltistan - Small - Not Baltio	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: Charaot.: 1 - Tradition - Baltistan - Gillnett-Baltistan - Medium - Not Baltio	-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
04	-							

Figure 2.11.3.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.

SELECT SIMULATION TYPE	SELECT SIMULATION TYPE
<b>EVALUATION FRAME</b>	<b>EVALUATION FRAME</b>
List of Tables ?	List of Tables
Goto Main menu	Goto Main menu
Do not show messages	Do not show messages
Include/Exclude behaviour rules ?	Include/Exclude behaviour rules ?
Select Regimes Case study ?	Select Regimes Case study ?
Selected case study:	Selected case study:
(1) Scientific advice / No scientific advice	(1) Scientific advice / No scientific advice
© First single simulation ?	• First single simulation ?
© Second single simulation ?	• Second single simulation ?
• Pair of deterministic simulations	Pair of deterministic simulations
Pair of stochastic simulation	• Pair of stochastic simulation ?
Pair of Multipe stochastic simulations	Pair of Multipe stochastic simulations
Use Effort and capacity read from worksheets as input	Use Effort/Capacity rules to generate effort ?
Select Output ?	Select Output ?

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,  $p_{Decomm}^{Accept}$ ,  $p_{Withdrawal}^{Accept}$ ,  $p_{Attrition}^{Accept}$ ,  $p_{New-Vessel}^{Accept}$  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 decommission rule is presented here as an example of the structural rules. The mathematical formulations is similar for all 4 structural rules.

$$p_{Decomm}^{Accept} = \frac{\exp(U_{Decomm}^{Accept})}{\exp(U_{Decomm}^{Re ject}) + \exp(U_{Decomm}^{Accept})} \quad \text{and} \quad p_{Decomm}^{Re ject} = 1 - p_{Decom}^{Accept}$$

 $U_{Decomm}^{Accept}$  is the "utility" of accepting decommission and  $U_{Decomm}^{\text{Re ject}}$  is the utility of rejecting decommission. The general expression for utility fransformed to the vessel exit/entry model reads

$$U_{Decomm}^{Accept}(Fl,Vs,Ct,y,q) = \sum_{r=1(Characteristics)}^{R_{Decomm}} \beta_{Decomm,r}^{Accept} * X_{Decomm,r}(Fl,Vs,Ct,y,q) + \sum_{s=1(Attributes)}^{S_{Decomm}} \gamma_{Decomm,s} * W_{Decomm,s}^{Accept}(Fl,Vs,Ct,y,q)$$

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

$$\begin{split} &X_{Decomm, 1}(Fl, Vs, Ct, y, q) = CF_{RUM}(Fl, Vs, Ct, y, q) \\ &X_{Dis-Invest, 1}(Fl, Vs, Ct, y, q) = CF_{RUM}(Fl, Vs, Ct, y, q) \\ &X_{Dis-Invest, 2}(Fl, Vs, Ct, y, q) = \text{Vacant Licenses} \\ &X_{Invest, 1}(Fl, Vs, Ct, y, q) = CF_{RUM}(Fl, Vs, Ct, y, q) \\ &X_{Invest, 2}(Fl, Vs, Ct, y, q) = \text{Vacant Licenses} \end{split}$$

and the single attribute considered in the decommission rule is

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

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  $0 < Fac^{RUM} \le 1$ .

$$CF_{RUM}(Fl,Vs,Ct,y,q) = \frac{1}{dy_{RUM}} \sum_{u=y-dy_{RUM}}^{y-1} \sum_{q=1}^{q_{Max}} \sum_{u=y-dy_{RUM}}^{q_{Max}} FNCF_{RUM}(Fl,Vs,Ct,u,q,\bullet) * Fac_{u}^{RUM}$$
  
+  $\frac{1}{q-1}\sum_{v=1}^{q-1} FNCF_{RUM}(Fl,Vs,Ct,y,q,\bullet)$  and the net cash flow summed over areas is defined  
 $FNCF_{RUM}(Fl,Vs,Ct,y,q,\bullet) = REV(Fl,Vs,Ct,y,q,\bullet) - VCO(Fl,Vs,Ct,y,q,\bullet) - CO_{Fix}^{Total}(Fl,Vs,Ct,y,q,\bullet)$ 

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:

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$$\begin{split} & \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{New-Vessel}(Fl,Vs,Ct,y,q,\bullet) *TON(Fl,Vs,Ct) \leq \\ & \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Decomm}(Fl,Vs,Ct,y,q,\bullet) *TON(Fl,Vs,Ct) + \\ & \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Withdrawal}(Fl,Vs,Ct,y,q,\bullet) *TON(Fl,Vs,Ct) + \\ & \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} NU_{Attrition}(Fl,Vs,Ct,y,q,\bullet) *TON(Fl,Vs,Ct) \\ \end{split}$$

If furthermore, decommissioned vessels cannot be replaced the term

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

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

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

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

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) =

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

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

Vacant Licenses =

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



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.

	A	В	C	D	E	F	-
1	INPUT RELATED TO STRUC	TURAL BEHAVIOU	R				74
2	TEMAS						
3	Evaluation Frame for fisheries mana	aement sustems					
4	Version, EXCEL 2003, MS Visual Bas	sis 6.3 TEMAS: 27 Ma	r 2007				
5	Marine Fisheries Department						
6	DIFRES (Danish Institute of Marine I	Reserch)					
7		· ·					
8	Note: Do not insert or delete rows o	r columns between yello	w cells				
9	Note: The input values of this wor	ksheet, are nullified u	inless you select 👘				
10	the option to apply the behavioura	al rules to determine t	the number of boats	<b>i</b>			
11							
12							
13							
14	Note: When entering names of ru	les/choices, do not w	rite the name of co	untry/fleet. Write or	ly the name of rule/	choice	
15	Table 9.	STRUCTURAL BEHAV	IOUR RULES				-
16		Name of Choice	Name of Choice	Name of Choice	Name of Choice	Name of Choice	_
		Baltistan:	OB Trawler-Baltistan:	OB Trawler-Baltistan:	Gillnett-Baltistan: Accept	Gillnett-Baltistan:	
17	Baltistan: Structural related Rule No. 1	Decommission rule	Accept Decomm.	Reject Decomm.	Decomm.	Reject Decomm.	
		Baltistan:	OB Trawler-Baltistan:	OB Trawler-Baltistan:	Gillnett-Baltistan: Dis-	Gillnett-Baltistan:	
18	Baltistan: Structural related Rule No. 2	Dis-invest rule	Dis-investment	No Dis-invest.	investment	No Dis-invest.	
		Baltistan:	OB Trawler-Baltistan:	OB Trawler-Baltistan:	Gillnett-Baltistan:	Gillnett-Baltistan:	
19	Baltistan: Structural related Rule No. 3	Investment rule	Investment	No Invest.	Investment	No Invest.	4
		scandinavia:	OB Trawler-Scandinavia:	OB Trawler-Scandinavia:	Gillnett-Scandinavia:	Gillnett-Scandinavia:	
20	Scandinavia: Structural related Hule No. 1	Decommission rule	Accept Decomm.	Reject Decomm.	Accept Decomm.	Reject Decomm.	4
~	Constitution Characteristics of Date Mar 2	Scandinavia:	OB Trawler-Scandinavia:	UB Trawler-Scandinavia:	Gillnett-Scandinavia: Dis-	Gillnett-Scandinavia:	
21	ocanumavia: otructural related Hule NO. 2	Scandinavia	OB Travlar Seandinavia	NO DIS-INVEST. OR Travilar Sapadia suisu	nives(ment Gilloott Soondiopuis:	NO DIS-INVEST.	+
22	Scandinauia: Structural related Bule No. 3	Invectment rule	DD Trawier-Scandinavia:	No Invest	cilinett-ocaridinavia:	No louest	
22	ooanamasia; or dotara related Fidle NU. 5	investment rule	nives(nen)	NO INVESC	investment	NO HIVESU	
II ·	♦ ▶ ▶ / S07_ECONOMY / S08_	TRIP_RU SO9_STR	UC_RU/S10_TUN	INC < 📖		>	

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 BE	AVIOUR C	OEFFICIEN	IS OF R.U.I	Л.
25		2000 Per.1	2000 Per.2	2000 Per.3	2000 Per
26	Rule 1: Charaot.: 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 Travier-Baltistan - Small - Dis-investment Dule 2: Charact.: 1: Hist, Cashflow, Dahiston, OB Travier Baltistan - Small - Na Dis-investment	1.4ZE-02	-3.84E-02	-4.69E-02	-0.0447
30	Rule 2: Charact.: 1: Hist, Cashriow - Baltistan - OB Trawler-Baltistan - Small - No Dis-Invest. Pule 2: Charact.: 2: May Cashaity, Pakistan, OP Trawler Pakistan, Small, Dis investment	-3.61E-02	-3.33E-03	4.13E-02	-3.21E-
32	Rule 2: Charact - 2: Max Capacity - Datistan - OD Trawler-Datistan - Small - No Distingest	.4 13E-02	-0.022307	-3.20E-03	-2.07E-
33	Rule 3: Charact - 1: Hist, Cashflow - Baltistan - OB Trawler-Baltistan - Small - Investment	-4.26E-02	-1.07E-02	-4 94F-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: Charaot.: 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: Charaot.: 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	mue 3: Unaraot.: 2: Max Capacity - Baltistan - UB Trawler-Baltistan - Medium - Investment Pula 3: Chapacht, 3: Max Capacity, Baltistan - OB Travity Delvictor, Marilian, Marilian, Marilian	-2.71E-02	1.53E-02	-3.19E-02	0.0255
4/	Rule 3: Charact.: 2: Max Capacity - Baltistan - OB Trawler-Baltistan - Medium - No Invest. Bule 1: Charact.: 1: Uist, Cash Cau, Baltistan, OB Trawler Baltistan - Invest, Assest Bacamer	-4.41E-02	4.19E-02	-4.82E-02	-4.38E-
69 A Q	Rule I: Charact, II: Hist, Cashflow - Baltistan - OB Trawler-Baltistan - Large - Accept Decomm.	-1.18E-02	4.00E-02	-3.23E-02	2.04E-
43 50	Nule I: Charact.: I: Hist. Cashnow - Dattistan - OD Trawel-Dattistan - Large - Neject Decomm.	-0.010312	2.30E-03	-3.30E-02	-1.03E-
51	Rule 2: Charact - 1: Decommission ree - Baltistan - OB Trawler-Baltistan - Large Bule 2: Charact - 1: Hist, Cashflow - Baltistan - OB Trawler-Baltistan - Large - Dis-investment	-149E-02	-3 94F-02	-1 11E-02	-7.01E
52	Rule 2: Charact - 1 Hist, Cashflow - Baltistan - OB Trawler-Baltistan - Large - No Discinvest	4 18E-02	-3.84E-02	-2 08E-02	-3.04E
53	Bule 2: Charact :: 2: Max Capacitu - Baltistan - OB Trawler-Baltistan - Large - Dis-investment	3.34E-02	-0.014414	-2.47E-02	4.82E-
54	Rule 2: Charaot.: 2: Max Capacitu - 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	0.0111
61	Rule 1: Attrib.: 1: Decommission fee - Baltistan - Gillnett-Baltistan - Small	-0.028428	-2.27E-02	-5.96E-03	6.58E-
62	Rule 2: Charaot.: 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 Dule 2: Charact.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Small - Na Disiowert	-1.78E-02	-1.22E-03	-3.71E-02	0.0319
65	Rule 2: Charaotti: 2: Max Capacity - Baltistan - Gilliott-Baltistan - Small - No Dis-Invest. Dule 2: Charaotti: 1 List Capitiliaus, Dabiatan - Cilliotti - Dabiatan - Small - No Dis-Invest.	-4.79E-02	3.07E-02	2.28E-02	8.05E-
65	Rule 3: Charact.: 1: Hist, Cashflow - Baltistan - Gilleatt-Baltistan - Small - Investment Rule 3: Charact.: 1: Hist, Cashflow, Rakistan - Gilleatt Rakistan - Small - Ne Isvest	-Z.72E-02	2.04E-03	Z.Z3E-UZ	3.35E-
10	Rule 3: Charaot - 2: May Canacity - Baltistan - Gilinett-Baltistan - Small - Invest. Bule 3: Charaot - 2: May Canacity - Baltistan - Gillnett-Baltistan - Small - Investment	7.99E-04	-0.015057	-0.015045	-1.03E
60	Rule 3: Charact - 2: Max Capacity - Baltistan - Gilnett-Baltistan - Small - Molectinett	-4 64E-02	-1.24E-02	2 40F-02	4.65E
70	Bule 1: Charact : 1: Hist, Cashflow - Baltistan - Gillnett-Baltistan - Orian - No Invest.	-3.87E-02	-1.53E-02	-3.67E-02	0.0124
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: Charaot.: 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: Charaot.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - No Dis-invest.	-0.038203	-4.85E-02	-4.79E-03	-2.68E-
77	Rule 3: Charaot.: 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: Charaot.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - Investment	-1.47E-02	3.42E-02	1.65E-02	3.03E-
80	Rule 3: Charaot.: 2: Max Capacity - Baltistan - Gillnett-Baltistan - Medium - No Invest.	-2.14E-02	-3.76E-02	-4.81E-02	-7.67E-
81	Hule I: Charaot.: 1: Hist, Cashflow - Baltistan - Gillent-Baltistan - Large - Accept Decomm.	8.41E-03	-4.50E-02	-7.82E-03	3.85E-
82	mule I: Unaraotti I: Hist. Uashnow - Baltistan - Ullinett-Baltistan - Large - Hejeot Decomm. Dule 1. Atvik, 1. Decommission (co. Dalkistan, Cillery, Delvictor, Large	-1.61E-02	1.28E-02	-4.87E-02	2.62E-
83	nue :: Auto:: :: Decommission ree - Battistan - Gillnett-Battistan - Large Dule 2: Charaot, 1: Hist, Cachtlow, Baltistan - Gillnett Daltistan - Large - Dis investment	-2.27E-02	3.46E-02	1.33E-02	2.44E
99	n are 2. Gharaot. 1: Hist, Gashnow - Balustan - Gilmett-Balustan - Large - Dis-Investment Bule 2: Charaot - 1: Hist, Cashflow , Baltistan , Gilmett-Baltistan , Large - No Dis-invest	-1 24E-02	4 485-02	-4 18E-02	-5 195
88	Rule 2: Charact - 2: Max Canacity - Baltistan - Gillnett-Baltistan - Large - NO Dis-INVest.	-4 08E-02	-4 76E-02	-4 18E-02	-3 06E
87	Bule 2: Charact : 2: Max Canacitu - Baltistan - Gillnett-Baltistan - Large - Dis-Investment	3.84E-02	1.43E-02	8.80E-02	1.99E
88	Bule 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  $\chi^2$ -criterion (Sokal and Rohlf, 1981)

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

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:

- 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  $\chi^2$  for landings summed over age groups is:

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

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.

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

Where, for example,  $N_{Index}^{Calc}(St, y, q, a, Ar) = \frac{N(St, y, q, a, Ar)}{\sum_{i=1}^{a_{Max}(St)} N(St, y, q, i, Ar)}$  and the survey index is derived

from, say, catch per hour, CPUE<sub>Survey</sub>,  $N_{Index}^{Obs}(St, y, q, a, Ar) = \frac{CPUE_{Survey}(St, y, q, a, Ar)}{\sum_{i=1}^{a_{Max}(St)} CPUE_{Survey}(St, y, q, i, Ar)}$ 

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

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

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.

1

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	2.13.1. Tables in th	he tuning input sheet, S010_TUNING.

С D A в E F G н INPUT RELATED TO TUNING 1 2 **RUN INFORMATION:** TEMAS 3 Evaluation Frame for fisheries management systems Version, EXCEL 2003, MS Visual Basis 6.3. - TEMAS: 27 Mar 2007 Date of this run: 03-0 Marine Fisheries Department Name of Run: 5 **DIFRES (Danish Institute of Marine Reserch)** Param. Created: 12-00 6 7 File Name: DEN Note: Do not insert or delete rows or columns between yellow cells 8 9 Note: INPUT IN YELLOW CELLS ONL 10 Table 10.1.1. West Cod: TUNING FISHING MORTALITY AND BIOMASS INDEX 11 12 2000 Per.1 2000 Per.2 2000 Per.3 2000 Per.4 2001 Per.1 2001 Per.2 2001 Per.3 20011 13 Mean stock F 0 208 0 222 0 238 0 220 0 148 0 239 0 148 14 Mean F , Area: West Baltic 0.239 0.217 0.147 0.206 0.239 0.219 0.146 0.355 0.219 0.309 0.356 0.325 15 Mean F , Area: East Baltic 0.323 0.218 16 Mean F , Area: Not Baltic 0.445 0.414 0.271 0.394 0.447 0 408 0.272 0.699 0 432 0.615 0 704 0.644 17 Mean F , Area: Bornholm 0.647 0 435 18 Mean F , Area: Gotland 0.822 0.748 0.505 0.723 0.835 0.761 0.505 19 Stock SSB 4.449 5.554 6.972 8.788 7.742 10.016 13.111 20 SSB, Area: West Baltic 4.439 10,102 16 862 6.440 7.648 17.566 30.757 21 SSB . Area: East Baltic n n **n** n n n n 22 SSB, Area: Not Baltic n n n n 0 n n 0 0 23 SSB . Area: Bornholm 0 0 0 0 0 24 SSB . Area: Gotland n n n 0 n 0 n 25 K < > H / S09\_STRUC\_RU S10\_TUNING / S11\_OBS < >

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 2.13.2. From worksheet Tuning\_Input.

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Table 10.1.2. West Cod: INDEX OF ABUNDANCE (Numbers at age)

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

	Α	В	С	D	E	F	G	H		J	K	L	M	7
28	Table 10.1.2.	West Co	d: INDEX	OF ABU	NDANCE	(Numbe	rs at age)							1
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	
29		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	
30	Age OPer. 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	1
31	Age O 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 OPer. 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 OPer. 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 1	
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 I	
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 1	
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 1	
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 1	
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 I	
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 1	
50	Age O Per. 1 Area: West B	7.03	2.33	0	0	8.44	2.824153	0	0	10.49	3.51	0	0	
	I ► NIZ SO9 STRUC RU \S		3 / S11 OBS	S / S12 DEM	40N / 513	TABLES / S	14 TEMAS	1	•	0	40 44400	0.0700	ŝ	ſ

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  $F_{Mean}^{Obs}(St, y, q, Ar) = F_{Mean}^{Obs}(St, y, q, 1)$ . 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

 $F_{Mean}^{Obs}(St, y, q, Ar) = F_{Mean}^{Obs}(St, y, l, Ar) \text{ and } F_{Stock, Mean}^{Obs}(St, y, q) = F_{Stock, Mean}^{Obs}(St, y, l)$ 

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
T-11. )	141 T-11 41	La sur d'anna innert al set CO11 ODC

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

	<u> </u>	D		0	E	F	a			J	
1	OBSERVED LANDINGS USED FOR	TUNI	NG								
2	TEMAS						BUN INFO	DRMATIO	N:		
3	Evaluation Frame for fisheries management	sestems									
4	Version, EXCEL 2003, MS Visual Basis 6.3	TEMAS	: 15 Aug	2007			Date of t	his run:		15:01	
5	Marine Fisheries Department			1.14			Name of	Run:			
6	DIFRES (Danish Institute of Marine Reserch)			1400			Param. C	reated:		00:00	
7	· · · · · · · · · · · · · · · · · · ·						File Nam	e:	DEMON	5 Mia3	
8	Note: Do not insert or delete rows or column	s betwe	en <b>s</b> ello	w cells							
9	Note: INPUT IN YELLOW CELLS ONLY										
10											Г
11	Table 11.1.	TIME S	ERIES	OF OBS	ERVED	LAND	NGS				
12		First	First								
13	Year	2001	2								
14	Period	2007	3								
15											
10											F
18	Table 11.2.1.	Baltist	an - We	est Cod	: OBSE	RVED L	ANDINGS	5			
19		2000 Pe	2000 Pe	2000 Pe	2000 Pe	2001 Per	2001 Per.2	2001 Per.3	2001 Per.4	2002 Per.1	2
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	
21	OB Trawler-Baltistan - Small - <110mm - East Baltic	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
22	OB Trawler-Baltistan - Small - <110mm - Not Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
23	OB Trawler-Baltistan - Small - <110mm - Bornholm	No Val	No Yal	No Yal	No Val	No Val	0	0	0	0	
24	OB Trawler-Baltistan - Small - <110mm - Gotland	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
25	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	
26	OB Trawler-Baltistan - Small - >110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
27	OB Trawler-Baltistan - Small - >110mm - Not Baltic	No Val	No Yal	No Yal	No Val	No Val	0	0	0	0	
28	OB Trawler-Baltistan - Small - >110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
29	OB Trawler-Baltistan - Small - >110mm - Gotland	No Val	No Val	No Yal	No Yal	No Val	0	0	0	0	
30	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	
31	OB Trawler-Baltistan - Medium - <110mm - East Baltic	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
32	OB Trawler-Baltistan - Medium - <110mm - Not Baltic	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
33	OB Trawler-Baltistan - Medium - <110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
34	OB Trawler-Baltistan - Medium - <110mm - Gotland	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
35	OB Trawler-Baltistan - Medium - >110mm - West Baltic	No Val	No Yal	No Yal	No Yal	No Val	0.21981	0.16831	0.23226	0.53563	
36	OB Trawler-Baltistan - Medium - >110mm - East Baltic	No Val	No Val	No Yal	No Yal	No Val	0	0	0	0	
37	OB Trawler-Baltistan - Medium - >110mm - Not Baltic	No Val	No Yal	No Yal	No Yal	No Val	0	0	0	0	
38	OB Trawler-Baltistan - Medium - >110mm - Bornholm	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
39	OB Trawler-Baltistan - Medium - >110mm - Gotland	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
40	OB Trawler-Baltistan - Large - <110mm - West Baltic	No Val	No Val	No Val	No Yal	No Val	7.64E-02	5.64E-02	5.42E-02	0.11654	
41	OB Trawler-Baltistan - Large - <110mm - East Baltic	No Val	No Yal	No Yal	No Yal	No Val	0	0	0	0	
42	OB Trawler-Baltistan - Large - <110mm - Not Baltic	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
43	OB Trawler-Baltistan - Large - <110mm - Bornholm	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
44	OB Trawler-Baltistan - Large - <110mm - Gotland	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
45	OB Trawler-Baltistan - Large - >110mm - West Baltic	No Val	No Val	No Val	No Yal	No Val	0.10933	0.07486	7.98E-02	0.17198	
46	OB Trawler-Baltistan - Large - >110mm - East Baltic	No Val	No Val	No Val	No Val	No Val	0	0	0	0	
47	OB Trawler-Baltistan - Large - >110mm - Not Baltic	No Val	No Val	No Val	No Yal	No Val	0	0	0	0	
40	OB Trawler-Baltistan - Large - >110mm - Bornholm	No Val	Mo Val	Man Male	Man Male	Mo Val	0	0	0	0	

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.
	Ctry, Fleet,	Ctry, Fleet,	Country,	Country	Total stock
Area, Country, Fleet, Vessel size, Rig	V.size, Rig	V.size	Fleet	-	
OB Trawler-Baltistan - Small - <110mm - West Baltic	OB Trawler-	-		1	İ
OB Trawler-Baltistan - Small - <110mm - Fast Baltic	Baltistan - Small				
OB Trawler-Baltistan - Small - <110mm - Not Baltic	- <110mm				
OB Trawler-Baltistan Small <110mm Barnhalm					
OD Hawler-Dalusian - Shidii - <110/////11 - D0/////0////	-	OB Trawler-			
OB Trawier-Baitistan - Small - <110mm - Gotland		Baltistan -			
OB Trawler-Baltistan - Small - >110mm - West Baltic	OB I rawler-	Small -			
OB Trawler-Baltistan - Small - >110mm - East Baltic	Baltistan - Small	Smail -			
OB Trawler-Baltistan - Small - >110mm - Not Baltic	- >110mm				
OB Trawler-Baltistan - Small - >110mm - Bornholm					
OB Trawler-Baltistan - Small - >110mm - Gotland					
OB Trawler-Baltistan - Medium - <110mm - West Baltic	OB Trawler-				
OB Trawler-Baltistan - Medium - <110mm - East Baltic	Baltistan -				
OB Trawler-Baltistan - Medium - <110mm - Not Baltic	Medium -				
OB Trawler-Baltistan - Medium - <110mm - Bornholm	<110mm				
OB Trawler-Baltistan - Medium - <110mm - Gotland	-	OB Trawler-	OB .		
OB Trawler-Baltistan - Medium - <110mm - West Baltis	OP Trouder	Baltistan -	I rawler-		
OB Trawler-Ballistan - Medium - >11011111 - West Ballic	DB Hawler-	Medium	Baltistan		
OB Trawler-Baltistan - Medium - >110mm - East Baltic	Dailisian -				
OB Trawler-Baltistan - Medium - >110mm - Not Baltic					
OB Trawler-Baltistan - Medium - >110mm - Bornholm	>110mm				
OB Trawler-Baltistan - Medium - >110mm - Gotland		ļ	4		
OB Trawler-Baltistan - Large - <110mm - West Baltic	OB Trawler-				
OB Trawler-Baltistan - Large - <110mm - East Baltic	Baltistan - Large				
OB Trawler-Baltistan - Large - <110mm - Not Baltic	- <110mm				
OB Trawler-Baltistan - Large - <110mm - Bornholm					
OB Trawler-Baltistan - Large - <110mm - Gotland		OB Trawler-			
OB Trawler-Baltistan - Large - >110mm - West Baltic	OB Trawler-	Baltistan -			
OB Trawler-Baltistan - Large - >110mm - East Baltic	Baltistan - Large	Large			
OB Trawler-Baltistan - Large - >110mm - Not Baltic	- >110mm	0			
OB Trawler-Dalitistan - Large - >110mm - Not Dalit				Baltistan	
OB Trawler-Dalitstan - Large - >110mm - Bornholm	-				Total stock
OB Hawler-Ballistan - Large - >110mm - Golland				_	
Gilinett-Baltistan - Small - <110mm - West Baltic	Gilinett-Baitistan				
Gillnett-Baltistan - Small - <110mm - East Baltic	- Small -				
Gillnett-Baltistan - Small - <110mm - Not Baltic	<110mm				
Gillnett-Baltistan - Small - <110mm - Bornholm					
Gillnett-Baltistan - Small - <110mm - Gotland		Gillnett-			
Gillnett-Baltistan - Small - >110mm - West Baltic	Gillnett-Baltistan	Baltistan -			
Gillnett-Baltistan - Small - >110mm - East Baltic	- Small -	Small			
Gillnett-Baltistan - Small - >110mm - Not Baltic	>110mm				
Gillnett-Baltistan - Small - >110mm - Bornholm					
Gillnett-Baltistan - Small - >110mm - Gotland	-				
Gillnett-Baltistan - Medium - <110mm - West Baltic	Gillnett-Baltistan	1	1		
Gillnett-Baltistan - Medium - <110mm East Baltic	- Medium -				
Gillnott-Baltistan - Medium - <110mm Not Baltia	<110mm				
Cillpott Poltioton Modium (440mm Dombolis					
Cilleatt Dakistan - Medium - <110mm - Bornholm	4	Gillnett	Gillnett-		
Gillinett-Baltistan - Medium - <110mm - Gotland		Baltistan -	Baltistan		
Gilinett-Baltistan - Medium - >110mm - West Baltic	Gillnett-Baltistan	Medium			
Gillnett-Baltistan - Medium - >110mm - East Baltic	- Medium -				
Gillnett-Baltistan - Medium - >110mm - Not Baltic	>110mm				
Gillnett-Baltistan - Medium - >110mm - Bornholm					
Gillnett-Baltistan - Medium - >110mm - Gotland					
Gillnett-Baltistan - Large - <110mm - West Baltic	Gillnett-Baltistan		]		
Gillnett-Baltistan - Large - <110mm - East Baltic	- Large -				
Gillnett-Baltistan - Large - <110mm - Not Baltic	<110mm				
Gillnett-Baltistan - Large - <110mm - Bornholm	1				
Gillnott-Baltistan - Large - <110mm Gotland	4	Gillnett-			
Cillpott Politioton Lorgo \$110mm West Politic	Cillpott Doltister	Baltistan -			
Gillinett-Baltistan - Large - >110mm - West Baltic		Large			
Gilinett-Baltistan - Large - >110mm - East Baltic	- Large -	Laigo			
Gillnett-Baltistan - Large - >110mm - Not Baltic	. 110				
	>110mm				
Gillnett-Baltistan - Large - >110mm - Bornholm	>110mm				
Gillnett-Baltistan - Large - >110mm - Bornholm Gillnett-Baltistan - Large - >110mm - Gotland	>110mm				

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:"

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

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 "- $\infty$ ".

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.

		A	В	С	D	E
1	TECHI	NICAL MANAGEM	ENT MEAS	URES		
2	TEMAS					
3	Evaluati	ion Frame for fisheries	management s	ystems		
4	Version	EVEL 2002 MC View	A Dacie 6.2	TEMAC. 20 M-	- 2007	
5	Marine	TECHNICAL MANAG	EMENT MEA	SURES		
6	DIFRE					
7		TECHAITC		,		
8	Note: E	IECHINICA	IL MAN	/-		
9	Note: II	ACEMENT	MEAG	IDEE	?	
10		AGEMENI	MEAS	UKES		
11						0000 0 4
12	V					2000 Per.4
13	West Co	Options for Pr	eprocessi	ína of data	2 2	20 20
19	West Co			<b>,</b>		20 20
10	West Co	-				20 20
17	West Co	Goto	Main Men	LI	?	20 20
18	East cod					22 22
19	Eastcod	Road T	MAC from	dick	2	22 22
20	East cod	Read It		JISK		22 22
21	East cod					22 22
22	East cod	Read TE	MAS from si	heet	?	22 22
23						
24						
<b>I</b> •	с ► Ы,	(S13_TABLES $\mathbf{S1}^{4}$	4_TEMAS	S15_HC 🔳		

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	В	С	D	E	F	G	н	1	J	K ·
1	TECHNICAL MANAGEM	ENT M	EASU	RES							
2	TEMAS						<b>BUN IN</b>	FORMA	TION:		
3	<b>Evaluation Frame for fisheries</b>	managei	ment sys	tems							
4	Version. EXCEL 2003, MS Visu	al Basis	6.3 TE	MAS: 27	Mar 200		Date of	this run		16:47	
5	Marine Fisheries Department						Name o	f Bun:			ION E
6	DIFRES (Danish Institute of Ma	arine Re:	serch) 👘				Param.	Created		00:00	
7							File Na	me:	DEMO	N_5_Mig	3
8	Note: Do not insert or delete ro	ows or ce	olumns b	etween y	jellow ce	lls					
9	Note: INPUT IN YELLOW CELLS	SONLY									
10											
11	l able 14.1.	MINIMU		DING SIZ	۲F	0004	0004	0004	0004	0000	0000
12		2000 Por 1	2000 Por 2	2000 Por 2	2000 Por 4	2001 Dor 1	2001 Por 2	2001 Por 2	2001 Bor 4	2002 Por 1	2002 Dor 2
12	Vest Cod - Vest Baltic	20	20	20	20	20	20	20	20	20	F el.2
14	West Cod - Fast 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	Vest 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											
H -	♦ ♦   / S12_DEMON / S13	TABLE	s <b>∖sı</b>	4_TEM	AS / S:	<		j	i	i	>

**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  $Lgt_{Min}^{Land}(St, y, q, Ar) \ge LGT_{25\%}(Fl, Vs, Rg, St, Ct, y, q)$ , 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) =

$$\begin{cases} 1 - \frac{1}{1 + \exp(\text{Disl}(\text{Fl}, \text{Vs}, \text{Rg}, \text{St}, y) - \text{Dis2}(\text{Fl}, \text{Vs}, \text{Rg}, \text{St}, y) * \text{Lgt}(St, a, q))} \\ if \quad Lgt(St, a, q) > Lgt_{Min}^{Land}(St, y, q, Ar) \\ 1 \quad if \quad Lgt(St, a, q) \leq Lgt_{Min}^{Land}(St, y, q, Ar) \end{cases}$$

 $LGT_{X\%Discards}(St) = Length at which X \% are retained.$ 

	A	B	с	D	E	F	G	н	1	J	к	L	M	
25														_
26	Table 14.2.1.1.1.1.	Baltistan	- West Bal	tic MAXI	MUM NUM	BER OF S	EA DAYS	(BY REGU	ILATION) - (F	leet, V.Siz	e, Rig, Co	untry, Are	a) 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	200
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 nu	umber of sea	days given by	y regulation									
37														
38	Table 14.2.1.1.1.2.	Baltistan	- West Bal	tic SEAS	ONAL CL	OSURE (B	Y REGUL	ATION) - (F	leet, V.Size,	Rig, Cour	ntry, 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	200
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 s	ea days giver	n by regulatio	n, Must be in	interval [0,1]	1:Total clos	sure of entire	period, D:No clo	sure, x (0 <x<< td=""><td>1) closed in t</td><td>he X*(Ref.Eff</td><td>nt) where (Re</td><td>efere</td></x<<>	1) closed in t	he X*(Ref.Eff	nt) where (Re	efere
49														

Figure 2.15.3. Maximum number of sea days and seasonal closure (MPA), given by regulations.  $EY_{\text{Reg}}(Fl,Vs,Rg,Ct,y,q,Ar)$  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),  $EY_{\text{Reg}}(Fl, Vs, Rg, Ct, y, q, Ar)$  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):

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

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<sup>Before</sup> has "St" index, so this (artificial) effort concept is stock specific. The "after modification" effort concept E<sup>After</sup> has no "St"-index, and the equal sign is replaced by an "smaller than" sign.

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

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)

$$X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar) = \frac{EY_{Reg}(Fl,Vs,Rg,Ct,y,q,Ar)}{EY_{Max}(Fl,Vs,Ct,y,q,Ar)} \quad \text{where EY}_{MAX} \text{ is The maximum}$$

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 Ba	altic MAX	XIMUM NU	JMBER O	F SEA DA	YS (BY RE	GULATIC	N) - (Flee	t, V.Size,	Rig, Cour	try, 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 n	umber of se	a days given	by regulation										
Table 14.2.1.1.2.2.	Baltistan	- East Ba	altic SE/	SONAL C	LOSURE	(BY REGU	JLATION)	- (Fleet, \	/.Size, Rig	i, Country	, Area) F	tegime 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 giv	en by regula	ion, Must be	in interval [0	,1] 1:Total cl	osure of enti	re period, 0:N	lo closure, x	(0 <x<1) close<="" td=""><td>ed in the X*(F</td><td>ef.Effort) wh</td><td>ere (Referen</td><td>ice Effor</td></x<1)>	ed in the X*(F	ef.Effort) wh	ere (Referen	ice Effor
Table 14.2.1.1.3.1.	Baltistan	- Bornho	olm MAX	IMUM NU	MBER OF	SEA DAY	S (BY RE	GULATIO	N) - (Fleet,	V.Size, F	kig, Count	ry, 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 n	umber of se	a days given	by regulation	I									
Table 11 3 1 1 2 3	Deltistan	Dornha		COMAL CI	OCUDE (	DVDECU	ATION	(Floot V	Cizo Dia	Country	Area) D	aime 4		
Table 14.2.1.1.5.2.	Balustan	- Bornno	JIIII SEA	SUNAL CI	_050RE (	BT REGU	LATION) -	(Fleet, V	Size, Rig,	country,	Area) Re	egime i		
	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					
Trawl - Small - >110mm		1		1	1		1		1					
Trawl-Large- <110mm		1		1	1		1		1					
Trawi - 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 giv	ien by regulal	ion, Must be	in interval [0	(1) 1: Total cl	osure of enti	re period, 0:N	IO CIOSUIE, X	(U <x<1) close<="" td=""><td>ea in the X"(A</td><td>iet.Effort] wh</td><td>ere (Referen</td><td>ice Effort</td></x<1)>	ea in the X"(A	iet.Effort] wh	ere (Referen	ice Effort

1.14

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.

$$\begin{split} E^{After}(\bullet,\bullet,\bullet,\bullet,St, y, q, Ar) &= \\ \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{Rg=1}^{MAX} \left\{ X^{SeaDays}(Fl,Vs,Rg,Ct,y,q,Ar)^{*} X^{MPA-Closure}(Fl,Vs,Rg,Ct,y,q,Ar) * E^{Before}(Fl,Vs,Rg,Ct,St,y,q,Ar), NU_{Vessel}(Fl,Vs,Ct,y,q,\bullet) * EY_{Max}(Fl,Vs.Ct,y,q,Ar) \right\} \end{split}$$

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	$NU_{Vessel}(Fl, Vs, Ct, y, q, 0) = NU_{New-Vessel}(Fl, Vs, Ct, y, q)$
$Va = 1, 2,, Va_{max}$ -	$NU_{Vessel}(Fl, Vs, Ct, y, q, Va) = NU_{vessel}(Fl, y, q-1, Va) -$
1	NU <sub>Decomm</sub> (Fl, Vs, Ct, y, q, Va) – NU <sub>Withdrawal</sub> (Fl, Vs, Ct, y, q, Va) –
	NU <sub>Attrition</sub> (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 44.2.2.4.2.4	Deltister	East D	His MAN	VIRAL IRA KI				CLIL A TIO	Al) (Floor	Veine	Dia Com	true Areas	Degime	
Table 14.2.2.1.2.1.	Baltistar	i - East Ba	апіс мал		DIMBER O	F SEA DA	YS (BY RE	GULATIO	N) - (Flee	t, v.Size,	Rig, Cour	try, 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	
	Maximumin	umber of se	a days given	by regulation	1									
T-11- 4400 400	D - Minter	E	N: 05.	CONNER			U. ATLOND	(Fland)	( C) D)	<b>C</b>				
Table 14.2.2.1.2.2.	Bartistal	i - East Ba	aπic SEA	SONAL C	LOSURE	(BA KEO	JEATION)	- (Fleet, ν	/.Size, Rig	, Country	, Area) H	egime z		
	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 giv	en by regulat	ion, Must be	in interval [0	(1] 1:Total ele	osure of enti	re period, 0:N	lo closure, x	(0 <x<1) close<="" td=""><td>d in the X*(R</td><td>ef.Effort) wh</td><td>ere (Referer</td><td>ice Effort)</td></x<1)>	d in the X*(R	ef.Effort) wh	ere (Referer	ice Effort)
Table 14.2.2.1.3.1.	Baltistan	i - Bornho	IM MAX	IMUM NU	MBER OF	SEA DAY	S (BY RE	GULATION	N) - (Fleet,	V.Size, F	tig, Count	ry, 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	
	Maximumin	umber of se	a days given	by regulation	1									
Table 14.2.2.1.3.2.	Baltistan	i - Bornho	olm SEAS	SONAL C	LOSURE	BY REGU	LATION) -	(Fleet, V	Size, Rig,	Country,	Area) Re	egime 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 daus giv	en bu regulat	ion. Must be	in interval [0	.11 1:Total cl	osure of enti	re period. 0:N	lo closure, x	(0 <x<1) close<="" td=""><td>d in the X*(B</td><td>ef.Effort) wh</td><td>ere (Referer</td><td>ice Effort</td></x<1)>	d in the X*(B	ef.Effort) wh	ere (Referer	ice 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 (2<sup>nd</sup> and 3<sup>rd</sup> 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

A	<b>P</b> C <b>D</b> E <b>F</b> G <b>H</b> IJ K L <b>HH</b> 0 <b>P</b> 0
Table 14.2.1.1.1.1.	Baltistan - West Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
1         Tradi-Sull + 411ms           2         Tradi-Sull + 411ms           8         Tradi-Large + 411ms           9         Tradi-Large + 411ms           1         Gill ad-Sudl + 421ms           1         Gill ad-Sudl + 421ms           1         Gill ad-Large + 421ms           10         Gill ad-Large + 421ms           11         Gill ad-Large + 421ms           12         Gill ad-Large + 421ms	
<sup>19</sup> Table 14.2.1.1.1.2.	Baltistan - West Baltic SEASONAL CLOSURE Regime 1
3         Total - Sail - Allan           35         Total - Sail - Allan           36         Total - Large - Allan           37         Sail - Allan           38         Gillari - Sail - Allan           39         Gillari - Sail - Allan           31         Gillari - Large - Allan           32         Gillari - Large - Allan           33         Gillari - Large - Allan           34         Gillari - Large - Allan	
Table 14.2.1.1.2.1.	Baltistan - East Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
25         Trank-Smill-Stillme           25         Trank-Smill-Stillme           26         Trank-Large-Stillme           27         Trank-Large-Stillme           28         Trank-Smill-Stillme           29         Trank-Smill-Stillme           21         Trank-Smill-Stillme           23         Trank-Smill-Stillme           24         Gillard-Smill-Stillme           25         Gillard-Large-Stillme           26         Gillard-Large-Stillme           26         Gillard-Large-Stillme           26         Gillard-Large-Stillme	CHIPPerA         CHIPERA         CHIPERA         CHIPERA         CHIPERA         CHIPERA         CHIPERA         C
5 Table 14.2.1.1.2.2.	Baltistan - East Baltic SEASONAL CLOSURE Regime 1
35         Trand-Smill-Stillen           31         Trand-Smill-Stillen           32         Trand-Large-Stillen           34         Trand-Large-Stillen           45         Gilled-Smill-Stillen           46         Gilled-Smill-Stillen           47         Gilled-Large-Stillen           48         Gilled-Large-Stillen           49         Gilled-Large-Stillen           49         Gilled-Large-Stillen           49         Gilled-Large-Stillen	
Table 14.2.1.1.3.1.	Baltistan - Bornholm MAXIMUM NUMBER OF SEA DAYS Regime 1
47         Trant-Sailt-Stilling           18         Trant-Large-Stilling           18         Trant-Large-Stilling           18         Trant-Large-Stilling           18         Trant-Large-Stilling           18         Gilling-Large-Stilling           18         Gilling-Large-Stilling           18         Gilling-Large-Stilling           18         Gilling-Large-Stilling           19         Gilling-Large-Stilling           19         Gilling-Large-Stilling           19         Gilling-Large-Stilling           19         Gilling-Large-Stilling	
Table 14.2.1.1.3.2.	Baltistan - Bornholm SEASONAL CLOSURE Regime 1
32         Trank: Smill: 4988m           35         Trank: Smill: 5988m           36         Trank: Smill: 5988m           37         Smill: Smill: 5988m           36         Gilliani: Smill: 5988m           36         Gilliani: Smill: 5988m           37         Gilliani: Smill: 5988m           38         Gilliani: Smill: 5988m           39         Gilliani: Large + 5188m           36         Gilliani: Large + 5188m           37         Smill: Smill: 5988m	all Prod. all Pr
u Table 14.2.1.1.4.1.	Baltistan - Gotland MAXIMUM NUMBER OF SEA DAYS Regime 1
21         Traul - Sull - Stillen           23         Traul - Sull - Stillen           24         Traul - Large - Stillen           25         Traul - Sull - Stillen           26         Gillen - Sull - Stillen           26         Gillen - Sull - Stillen           26         Gillen - Sull - Stillen           27         Gillen - Large - Stillen           28         Gillen - Large - Stillen           29         Gillen - Large - Stillen	35         35         35         34         35         35         36         37         37         37         37         36         48         47         48         47         48         47         48         47         48         47         48         47         48         48         47         48         46         47         48         46         46         46         46         46         46         46         47         48         47         48         48         47         48         46         46         46         46         46         46         46         47         48         47         48         47         48         46         46         46         46         46         46         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48         47         48<
<sup>11</sup> Table 14.2.1.1.4.2.	Baltistan - Gotland SEASONAL CLOSURE Regime 1
10         Trank-Smith efficient           20         Trank-Smith efficient           21         Trank-Smith efficient           22         Trank-Smith efficient           24         Trank-Smith efficient           25         Gillard-Smith efficient           26         Gillard-Smith efficient           27         Gillard-Smith efficient           28         Gillard-Larger efficient           29         Gillard-Larger efficient           20         Gillard-Larger efficient           28         Gillard-Larger efficient	
" Table 14.2.1.1.5.1.	Baltistan - Not Baltic MAXIMUM NUMBER OF SEA DAYS Regime 1
13 33 Traul - Suill - Stilling 33 Traul - Suill - Stilling 34 Traul - Suill - Stilling 35 Traul - Larger - Stilling 36 Gilling - Larger - Stilling 36 Gilling - Larger - Stilling 31 Gilling - Larger - Stilling 31 Gilling - Larger - Stilling 33 Gilling - Larger - Stilling 34 Gilling - Larger - Stilling 35 Gilling - Larger - Stilling 36 Gilling - Larger - Stilling 36 Gilling - Larger - Stilling 36 Gilling - Larger - Stilling 37 Gilling - Larger - Stilling 38 Gilling - Larger - Stilling 39 Gilling - Larger - Stilling 30 Gi	JULPERAL
111 Table 14.2.1.1.5.2.	Baltistan - Not Baltic SEASONAL CLOSURE Regime 1
100         Transi Sandi - ettilaa           101         Transi Sandi - ettilaa           102         Transi Sandi - ettilaa           103         Transi Sandi - ettilaa           104         Transi Sandi - ettilaa           105         Transi Sandi - ettilaa           108         Gillaati Sandi - ettilaa           109         Gillaati Sandi - ettilaa           101         Gillaati Sandi - ettilaa           102         Gillaati Sandi - ettilaa           103         Gillaati Sandi - ettilaa           104         Gillaati Sandi - ettilaa           105         Gillaati Sandi - ettilaa           101         Gillaati Sandi - ettilaa	renteren anderen

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	2.16.1. Tables in	the harvest control rule input sheet, S015_HCR.

	A	В	С	D	E	F	G	н	<u> </u>	J	К —
1	HARVEST CONTROL RU	LES									-
2	TEMAS						<b>RUN IN</b>	FORMA	TION:		
3	<b>Evaluation Frame for fisheries</b>	managei	ment sys	tems							
4	Version. EXCEL 2003, MS Visu	al Basis	6.3 TE	MAS: 2	7 Mar 20	07	Date of	this run		10:47	
5	Marine Fisheries Department						Name o	f Bun:			ON EX
6	DIFRES (Danish Institute of Ma	arine Res	serch)				Param.	Created		00:00	
7							File Na	me:	DEMON	5_Mig	
8	Note: Do not insert or delete ro	ws or c	olumns l	between	jellov c	ells					-
9	Note: INPUT IN YELLOW CELLS	5 ONLY									
10											
11	Table 15.1.	HARVE	ST CON	ITROL F	RULES	OF PREC	CAUTIO	NARY A	PPROAG	CH	
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002
12		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2
13	West Cod: Fpa	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	<b>0</b> .
14	West Cod: Flim	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	<b>0</b> .
15	West Cod: Blim	11	14	17	22	10	13	16	22	14	1
16	West Cod: Bpa	122	153	192	242	106	138	180	237	157	20
17	West Cod: Exceed factor	1	1	1	1	1	1	1	1	1	
18	West Cod: Adapt.A. Max TAC % up	15	15	15	15	15	15	15	15	15	1
19	West Cod: Adapt.A. Max TAC % down	25	25	25	25	25	25	25	25	25	2
20	East cod: Fpa	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.
21	East cod: Flim	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.
22	East cod: Blim	15	15	16	20	10	- 11	13	16	12	1
23	East cod: Bpa	160	160	181	221	115	119	142	176	130	15
24	East cod: Exceed factor	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1
25	East cod: Adapt.A. Max TAC ½ up	10	10	10	10	10	10	10	10	10	1
26	East cod: Adapt.A. Max TAC % down	20	20	20	20	20	20	20	20	20	2
27		Harvest	control ru	le of the pr	ecautiona	ary approa	ph:F=Fp	a if Bioma	ss > Bpa, F	= 0 if Bio	mass <= 🔍
14	N N / C12 TADLES / AVA	4/01/		c \ c1	5 000						

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,  $F_{FOR-Mean}(St,y+2)$ , The forecast is made in year y+1 (this year), based on data in last data year, y, for next year, "y+2" :  $F_{HCR}(St,y+2) = F_{FOR-Mean}(St,y+2)$ . The mathematical expression for the ICES harvest control rule, with all indices, reads.

$$F_{HCR}(St, y+2) = \begin{cases} 0 \quad if \quad SSB(St, y) \le B_{\lim}(St) \\ F_{pa}(St) \frac{SSB(St, y) - B_{\lim}}{B_{pa}(St) - B_{\lim}(St)} \quad if \quad B_{\lim}(St) \le SSB(St, y) \le B_{pa}(St) \\ F_{pa}(St) \quad if \quad SSB(St, y) > B_{pa} \end{cases}$$
(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<sub>HCR</sub> of the HCR is converted into a TAC for the quota management regime (Eq. D.4.3.3.1.a)

$$TAC(St, y) = \sum_{a=0}^{a_{Max}(St)} C_{FOR}(St, y, a) * w(St, y, a)$$

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<sub>PA</sub>, 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  $TAC_{CH}^{Down}(St, y)$ .

$$\frac{TAC(St, y-1) - TAC(St, y)}{TAC(St, y-1)} \leq TAC_{CH}^{Down}(St, y) \quad if \quad TAC(St, y-1) \geq TAC(St, y)$$

$$\frac{TAC(St, y) - TAC(St, y-1)}{TAC(St, y-1)} \leq TAC_{CH}^{Up}(St, y) \quad if \quad TAC(St, y-1) < TAC(St, y)$$

This lead to the definition of a TAC concept, we call "TAC of the adaptive approach": (Eq. D.7.1.2)

$$\begin{aligned} TAC_{ADapt}(St, y) &= \\ & \left\{ Min\left\{ TAC(St, y), TAC(St, y-1) * (1 - TAC_{CH}^{Down}(St, y)) \right\} \text{ if } TAC(St, y) < TAC(St, y-1) \\ & \left\{ Max\left\{ TAC(St, y), TAC(St, y-1) * (1 + TAC_{CH}^{Up}(St, y)) \right\} \text{ if } TAC(St, y) > TAC(St, y-1) \\ & \left\{ TAC(St, y), TAC(St, y-1) * (1 + TAC_{CH}^{Up}(St, y)) \right\} \text{ if } TAC(St, y) > TAC(St, y-1) \end{aligned} \end{aligned}$$

The F<sub>HCR</sub> 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  $X_{TAX}^{Exceed}(St, y) \ge 1.0$ ).

$$TAC(St, y) < X_{TAX}^{Exceed}(St, y) * \sum_{a=o}^{a_{Max}(St)} C_{FOR}(St, y, a) * w(St, y, a)$$

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

$$\begin{aligned} RELHRgt_{X}(Fl,Vs,Rg,Ct,St,y,q,Ar) &= \frac{HRgt_{X}(Fl,Vs,Rg,Ct,St,y,q,Ar)}{HRgt_{X}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar)} \\ HRgt_{X}(Fl,Vs,Rg,Ct,St,y,q,Ar) &= \sum_{u=y-Ny_{Hist}}^{y-1} X(Fl,Vs,Rg,Ct,St,y,q,Ar) * HFac^{u-y} \\ \text{Note that } RELHRgt_{X}(\bullet,\bullet,\bullet,\bullet,St,y,q,Ar) = 1 \end{aligned}$$



	A	В	С	D	E	F	G	Н	I	J	K	L	M	N	_
30	Table 15.2.1.1.	RELA	TIVE ST	<b>ABILI</b>	TY (HAI	RVEST	CONT	ROL R	ULES)	West	Cod -	WestE	Baltic		^
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	21
- 31		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	P-
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	0
-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	C
-34		Relativ	e stability	for TAC	allocatio	on betwee	en fleets.	lf the pro	portion o	of a TAC	allocate	d to a fle	et remain	s consta	int I 🚽
35															~
H -	🗘 🕨 🖌 S13_T/	ABLES	/ S14	_TEMA	sλs:	15_HC	R / S	tock_	<					>	

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	В	С	D	E	F	G	н	<b>I</b>	J	К	L	M	N	-
100	Table 15.3.1.5.	RELAT	TIVE ST	TABILIT	TY (HAI	RVEST	CONT	ROL R	JLES, 9	summ	ed ove	r areas	s) - We	st Cod	
		2000	2000	2000	2000	2001	2001	2001	2001	2002	2002	2002	2002	2003	21
101		Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	Per.2	Per.3	Per.4	Per.1	P
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	
40.4	L		_												
∎ -	< ▶ ▶  <u>/</u> S13_T/	ABLES	<u>/</u> S14	_TEMA	lS λS:	15_HC	R/S	tock	<					>	

Figure 2.16.3. Relative stability for one stock summed over areas (Information table).

## 2.17. LIST OF TABLES, S13\_TABLES

	H11	-	<i>f</i> ∗ Th	e Dimension	sofac	ase study	, has a spcial status as input	parameters, as it
	A	В	🔲 det	ermines the	numbei	rs of the o	ther parameters, as well as the	e number of variables
1	INPUT	TABLES	in t	he model. Ti	hus if vo	ou chande	the dimensions, all other para	ameters must also be
2	TEMAS		cha	unded Some	) (some	times all)	table dimensionss will be cha	nged when
3	fisheries	management su	ste alian	ingea. Some	- (301116 	unico any M	table unitensionss will be cha	ngeu when
4	sual Basi	s 6.3 TEMAS:	27	iensions are	change	90	Date of this run.	
5	sheries D	epartment					Name of Run:	
6	nstitute o	f Marine Reserc	:h)				Param. Created:	
7			-				File Name:	
8	rows or	columns betwee	n yellow	cells				
9	YELLOW	V CELLS ONLY						
	Table		Sheet		Start			
10	Indez	Table Number	Index	Sheet Name	Row	Start Col	Caption	Comment
11	1	Table1.1.	1	S01_DIM	13	1	BASIC DIMENSIONS	The Dimensions of
12	2	Table1.2.	1	S01_DIM	13	5	STOCKS	A 'Stocks' here mea
13	3	Table1.3.	1	S01_DIM	13	9	COUNTRIES	Fleets can be group
14	4	Table1.4.	1	S01_DIM	13	13	AREAS	Areas are 'fishing gr
15	5	Table1.5.1.1.	1	S01_DIM	22	1	Baltistan : FLEETS	A 'Fleet' is a group c
16	6	Table1.5.1.2.	1	S01_DIM	22	4	Baltistan : FLEET DIMENSIONS	Vessel size groups (
17	7	Table1.5.1.3.	1	S01_DIM	22	8	Baltistan : NAME OF VESSEL SIZES	Vessel size groups (
18	8	Table1.5.1.4.	1	S01_DIM	22	16	Baltistan : NAME OF RIGGINGS	Riggings means a si
19	9	Table1.5.2.1.	1	SULDIM	27	1	Scandinavia : FLEETS	A 'Fleet' is a group c
20	10	Table1.5.2.2.	1	S01_DIM	27	4	Scandinavia : FLEET DIMENSIONS	Vessel size groups (
21	11	Table1.5.2.3.	1	S01_DIM	27	8	Scandinavia : NAME OF VESSEL SIZES	Vessel size groups (
22	12	Table1.5.2.4.	1	S01_DIM	27	16	Scandinavia : NAME OF RIGGINGS	Riggings means a si
23	13	Table1.6.1.	1	SUI_DIM	33	1	STUCK TABLESFUR OUTPUT (1: The ta	ble is di Zero indicates that n
24	14	Table1.6.2.	1	SUI_DIM	39	1	AREAS TABLES FOR OUTPUT (1: The ta	ble is di Zero indicates that n
20	CI 0	Table1.6.3.	1	SULDIM COLDINA	48	1	STUCK/AREAS TABLES FOR OUTPUT	Lis l'able Zero Indicates that h
20	10	Table1.6.4.	1	SOL DIM	62	1	COUNTRY TABLES FOR OUTFOIL II TA	IT (1. To Zero indicates that h
21	10	Table10.0.	1	SOL DIM	70	1		SECR. Zero indicates that a
20	19	Table16.7	1	S01_DIM	92	1	COUNTRY ELECTRESSEE SIZE TABLE	ITPUT I Zero indicates that n
30	20	Table16.8	1	S01_DIM	104	1	BESULTING TABLES FOR OUTPUT () T	able dis This table contains t
31	21	Table16.9	1	S01_DIM	133	1	MAXIMUM NUMBER OF TABLES FOR	OUTPUT The number of table
32	22	Table1.7.	1	S01 DIM	141	1	COMMENTS TO NAMES	Comments (explana
33	23	Table2.1.1	2	S02 STOCK	11	1	GROWTH AND MATURITY PARAMETE	RS Von Bertalanffu grov
34	24	Table2.1.2.	2	S02 STOCK	16	1	CONDITION FACTOR	Condition Factor is
35	25	Table2.2.1.	2	S02 STOCK	21	1	RECRUITMENT PARAMETERS	Parameters in four a
36	26	Table2.2.2.	2	S02_STOCK	26	1	RECRUITMENT DISTRIBUTION ON PER	RIODS Distribution of recru
37	27	Table2.2.3.	2	S02_STOCK	31	1	RECRUITMENT DISTRIBUTION ON ARE	EAS Distribution of recru
38	28	Table2.2.4.	2	S02_STOCK	36	1	LOW SPAWNING SUCCESS ON AREAS	The weighting factor
39	29	Table2.2.5.	2	S02_STOCK	41	1	HIGH SPAWNING SUCCESS ON AREAS	6 The weighting factor
40	30	Table2.2.6.	2	S02_STOCK	46	1	RECRUITMENT TREND OVER YEARS	If we assume, e.g., a
41	31	Table2.3.1.	2	S02_STOCK	51	1	STOCK NUMBERS FIRST PERIOD OF F	IRST Y Initial number of juve
42	32	Table2.3.2.	2	S02_STOCK	62	1	STOCK NUMBERS FIRST PERIOD OF F	IRST Y Initial number of age
43	33	Table2.4.1.	2	S02_STOCK	68	1	VEIGHTING FACTORS FOR MEAN F.C.	ALCUL, MeanF over a range
44	34	Table2.4.2.	2	S02_STOCK	79	1	VEIGHTING FACTORS FOR MEAN F.C.	ALCUL, MeanF over a range
45	35	Table2.5.1	2	S02 STOCK	85	1	Vest Cod MIGBATION - AGE GB 0-1	Migration coefficier ≚
I4 ·	( ) <u>) (</u>	S12_DEMON	$\lambda$ S13_	TABLES / A	rk4 ( S	14_TEMAS	S ( 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 of the 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".

MAIN MENU		×
Evaluation Frame fo	r fis	heries management systems
MAIN	IN	IPUT MENU
Time of last run: 27-07-2007 - 13:57:04		File Name of last run : DEMON_5_Mig3
Title of last run: DEMONSTRATION EXAMPLE No. 5 - Stock(s). 5 Area(s). 10 Year(s).	WITH Fa	AKE DATA (2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) 2 /4 vears). Circular movement (minimum 3 areas)
Select Table		
Select Menu		• ?
Select Worksheet		■
About Options	?	Write list of all tables ?
Clear all sheets	?	Create Demonstration data ?
Backup File	?	Read existing case study from disk ?
Delete File(s)	?	Check input parameters ?

Figure 2.17.1. Main menu of TEMAS input.

	C221	-	fx					
	A	В	С	D	E	F	G	
223								
224	SUMI	MARY L	IST OF T	ABLE. This list contains only the first table in a su	ites o	fsimi	lar tak	≥l∈
225								
226		Table Num	bĠroup (shee	Caption	Comme	nt		
227	1	Table 1.1.	DIM	BASIC DIMENSIONS	The Dirr	nensions	of a case	stu
228	2	Table 1.2.	DIM	STOCKS	A 'Stoc	ks' here π	neans a m	ana
229	3	Table 1.3.	DIM	COUNTRIES	Fleets o	an be gro	uped by co	our
230	4	Table 1.4.	DIM	AREAS	Areas a	re 'fishing	grounds',	wh
231	5	Table 1.5.1.1	DIM	Baltistan : FLEETS	A 'Fleet	' is a grou	p of fairly	sim
232	6	Table 1.5.1.2	DIM	Baltistan : FLEET DIMENSIONS	Vessel:	size group	is can be a	any
233	7	Table 1.5.1.3	DIM	Baltistan : NAME OF VESSEL SIZES	Vessel:	size group	is can be a	any
234	8	Table 1.5.1.4	DIM	Baltistan : NAME OF RIGGINGS	Rigging	s means a	a subdivis:	oni
235	24	Table 2.1.2.	STOCK	CONDITION FACTOR	Conditie	on Factor	is a paran	net
236	25	Table 2.2.1.	STOCK	RECRUITMENT PARAMETERS	Parame	ters in fou	ur alternat	ive
237	27	Table 2.2.3.	STOCK	RECRUITMENT DISTRIBUTION ON AREAS	Distribu	tion of rea	pruitment	on
238	28	Table 2.2.4.	STOCK	LOW SPAWNING SUCCESS ON AREAS	The weig	phting fact	or applied	Ito
239	29	Table 2.2.5.	STOCK	HIGH SPAWNING SUCCESS ON AREAS	The weig	phting fact	or applied	Ito
240	30	Table 2.2.6.	STOCK	RECRUITMENT TREND OVER YEARS	If we ass	ume, e.g.,	a sequen	ce
241	31	Table 2.3.1.	STOCK	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 0-1	Initial nu	imber of ju	uvenile fis	h. S
242	32	Table 2.3.2.	STOCK	STOCK NUMBERS FIRST PERIOD OF FIRST YEAR - Age 2+	Initial nu	imber of a	ige 2+ fish	. SI
243	33	Table 2.4.1.	STOCK	WEIGHTING FACTORS FOR MEAN FICALCULATION - Age 0-1	MeanF	over a ran	ge of age:	s, u
244	34	Table 2.4.2.	STOCK	WEIGHTING FACTORS FOR MEAN FICALCULATION - Age 2+	MeanEx	over a ran	ge of age:	s, u
245	35	Table 2.5.1.	STOCK	West Cod: MIGRATION - AGE GR.0-1	Migratic	on coeffic	ients: Pro	bat
246	36	Table 2.5.2.	STOCK	West Cod: MIGRATION - AGE GR.2+	Migratic	on coeffic	ients: Pro	bat
247	39	Table 2.6.1.	STOCK	NATURAL MORTALITY - Vest Cod	Natural	mortality.	as a funtic	onic
248	40	Table 2.6.2.	STOCK	NATURAL MORTALITY - East cod	Natural	mortality.	as a funtic	on c 🔛
249	41	Table 3.1.1.	FLEET	Baltistan : ABSOLUTE CATCHABILITY - (Species, Area) by (Fleet, V.Size, Country, Rig	Catchal	oility(FI, 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): Relativ	ve standar	rd d 📄
251	45	Table 3.2.1.	FLEET	Baltistan : MESH SIZE (generalized concept) (Species, Fleet, V.Size, Rig)	Meshis	izes (in a u	user-defin	edit
252	46	Table 3.2.2	FLEET	Baltistan : GEAR SELECTION FACTOR (=L50%/MeshSize) (Species, Fleet, V.Size, Rig	Gear se	lection fa	ctor = L50	×I(
253	47	Table 3.2.3	FLEET	Baltistan : GEAR SELECTION RANGE (=L75%-L25%) (Species, Fleet, V.Size, Rig)	Gear se	lection rai	nge (=175	7-L
254	48	Table 3.2.4	FLEET	Baltistan : DISCARDS L50% (Species, Fleet, V.Size, Rig)	L50% =	Body leng	th at whic	h 51
255	49	Table 3.2.5.	FLEET	Baltistan : DISCARDS L25% (Species, Fleet, V.Size, Rig)	L75% =	Body leng	th at whic	h 2!
256	50	Table 3.2.6.	1. FLEET	Baltistan : - Vest Baltic RELATIVE (PERIOD) CATCHABILITY (max value = 1) - (Spec	Relative	e distributi	on of Cat	cha
257	75	75 Table 5.4.1. BOATS		Baltistan : INITIAL VESSEL AGE DISTRIBUTION AND INVESTMENTS (NEW VESSE	The num	ber of ve	ssels by v	ess
258	76	76 Table 5.4.2. BOATS		Baltistan : NUMBER OF NEW BOATS MULTIPLIER	Multiplie	r to raise	the numb	eric
259	77	Table 5.4.3	BOATS	Baltistan : CREW PER VESSEL	Number	of crew m	embers p	er 🗸 🗸
H -	• • •	,∕ S12_D	ÉMON λs	13_TABLES / Ark4 / S14_TEMAS / S:			3	

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,  $\varepsilon$ , (or multiply a stochastic factor) so a general stochastic model reads

Model(Input,Parameters) = Output +  $\epsilon$ . Or Model(Input,Parameters) = Output \*  $\epsilon$ .

The stochastic term,  $\varepsilon$ , takes an unpredictable value from a probability distribution which we may have some knowledge about. Usually,  $\varepsilon$ , 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, :  $\Pr\left\{ Y_i \leq Output < Y_{i+1} \right\}$  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  $\varepsilon$ , 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, Figure 2.1.8.2)
- 4) Catchability coefficient (EXCEL Table 3.1.2, Figure 2.18.3)

	A	В	С	D	E	F	G	Н		J	K	L	M	N	0	Р	
11	Fable 2.1.1.	GROWT	'H AND N	ATURIT	Y PARA	METERS											L
12		Loo	к	t-zero	Cond. Exp.	Maturity L50%	Maturity L75%	ReIStD ev.(K)	RelStDe v(C.Fac)								
13	West Cod	148	0.103	0	3	40.2	46.2	0.1	0.1								Г
14	East cod	131	0.11	-0.384	3	38	44.9	0.1	0.1								Г
15																	Γ
16	Fable 2.1.2.	CONDIT	ION FAC	TOR													
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	Fable 2.2.1.	RECRU	TMENT F	PARAME	TERS												
				H-S	H-S Const.Re	H-S	Ricker	Ricker	D-S-	D-S- Coeff.(2)	D-S-Exp.	RelStD	Freq.Out	Mag.Out	Autocorr.	Model	
22		BH1(1)	BH2 (1)	Biom. (2)	o. (2)	Slope (2)	coeff. (3)	Exp. (3)	Coeff.(1) (4)	(4)	(4)	ev(R)	st.Yrs	st.Yrs	Outst.Yrs	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			( aulist )	000 0	TOOK (		ET LAN	10104	0 / 004 1								

Figure 2.18.2. Relative standard deviations of Bertalanffy growth parameter, K (normally distributed) and Condition factor (normally distributed)

	A	В	С	D	E	F	G	Н	-
26									
27	Table 3.1.2.	Baltistan : P	ARAMETERS	IN MODEL FO	R CATCHABI	LITY (Species	s, Fleet, V.Size	e, Rig)	
28		St.Dev(Q)	Biom.Param.	Tech.Dev.	Rig.Effect				
29	Vest Cod - OB Trawler-Baltistan - Small - <110mm	0.1	3.81E-06	0	0				
- 30	Vest Cod - OB Trawler-Baltistan - Small - >110mm	0.1	8.80E-07	0	0				
31	Vest Cod - OB Trawler-Baltistan - Medium - <110mm	0.1	2.40E-06	0	0				
32	Vest Cod - OB Trawler-Baltistan - Medium - >110mm	0.1	3.41E-06	0	0				
33	Vest Cod - OB Trawler-Baltistan - Large - <110mm	0.1	8.61E-06	0	0				
34	Vest Cod - OB Trawler-Baltistan - Large - >110mm	0.1	5.18E-06	0	0				
35	Vest Cod - Gillnett-Baltistan - Small - <110mm	0.1	8.29E-06	0	0				
36	Vest Cod - Gillnett-Baltistan - Small - >110mm	0.1	2.41E-06	0	0				
37	Vest Cod - Gillnett-Baltistan - Medium - <110mm	0.1	4.14E-06	0	0				
38	Vest Cod - Gillnett-Baltistan - Medium - >110mm	0.1	3.58E-06	0	0				
39	Vest Cod - Gillnett-Baltistan - Large - <110mm	0.1	3.58E-06	0	0				-
40	Vest 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				1
53		St.Dev(Q): Rela	tive standard devi	ation of catchabili	ity used for stocha	stic simulation B	iom.Param.: Para	meter in mod	le 👡
	A N N COL DIM / Ark1 / SO2 STOCK		TLANDIA	v / co.					1

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 ^ Biom.Param. Tech.Dev.:  $Q = Q_0 * \exp(y*Tech.Dev)$ . Rig.Effect:  $Q = Q_0 * \exp(\text{Rig.Effect})$ .



## **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 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.

-	TEMAS_CALC_O	6Aug08.xls									
		A B C D E F	G	н —							
1	Summary eco	nomic/landings Output (Summary, Output)	Scientific	advice /							
2	TEMAS	all all go output (output)	BUN INFO	RMATIO							
3	Fualuation Frame	for fisheries management sustems	THOM IN THE								
4	Version EXCEL 2003 MS Visual Basis 6.3 . TEM0S: 27 Mar 2007										
5	Marine Eisberies Denartment										
6	DIFRES (Danish Institute of Marine Reserch)										
7			File Name	e:							
8	Note: To change i	input parameters, start the INPUT-module									
9											
10	Table	1.1.1 . Regime 1 - ACFM Advice Summary of summary by fleet - Pair Deterministic - Fir:	st and Last y	ear							
		Scandina									
		TEMAS	Scandinavi	Our discust							
			a - OB Traular	Scandinavi s. Gillsott							
			Scandinavi	Scandinavi							
11		Colculation modulo	a - 2009	a - 2000							
12	Cash Flow FINANCIA	valvulativii ilivuulu	153718.3	104895.6							
13	NPV cash Flow FINA	The bar the Transford (the star second second		2.83E+07							
14	Cash Flow GOVERN	Evaluation Frame for fisheries management	318732.2	191100.2							
15	NPV cash Flow GOV	EXCEL 2003, MS Visual Basis 6.3		3.17E+07							
16	Cash Flow ECONOM		332372.7	179936.2							
17	NPV cash Flow ECO	Simulation		3.52E+07							
18	Total Landings	Connection	33.96667	8.772552							
19	Total Value		414512.3	229084.3							
20	Mean Value rikg	Main Menu	12203.5	26113.76							
21	Number of Crew		902	310							
22	Number or boats	File Name of last run : DEMON_5_Mig3	30								
24											
25	Table	Time of last run: 06-08-2007 - 19:08:21	First and La	styear							
		mail of the second s									
		litie of last run:									
26		DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA ( 2 Countries,									
27	Cash Flow FINANCIA	(Number of fleets: Ct 1: 2 Ct 2: 2) 2 Stock(s), 5 Area(s), 10									
28	NPV cash Flow FINA	Year(s), dt = 1/4 years) , Circular movement (minimum 3									
29	Cash Flow GOVERN										
30	Dark Flow FCONOM	CANALYSIS 0279189 5279189 8294317 8294317									
31	32 NPV cash Flow ECONOMIC ANALYSIS 5214444 5214444 5215295 8215295										
32	33 Total Landings 15 26572 9 703236 22 47213 50 39757										
- 0.0											
l∎ -	🕩 🕨 ( Econor	nic_Output \Summary_Output /									

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 <sup>(c)</sup>)

Ту	Num-ber	Sto-	Number	Explanation
pe	of	chas-	of	
-	scena-	tic	Simu-	
	rios		lations	
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	FI_Out_Period	Fleet output by time period
14	FI_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

SELECT OUTPUT FORMAT	
Select output for single simu Note that printing in worksheets by Visual Basic is very slow. Selecting all output may an hour, depending on the dimensions). Advice: Select only the output you need! The total number of output tables of the present case study is 2673	take long time (up to
	Back
🗐 Rules 🔹	Goto Main Menu ?
<ul> <li>Octores (providences, per redection, discard, etc.)</li> <li>Period - Area - Fleet Output</li> <li>Area - Fleet Output (Summed over periods)</li> <li>Period - Fleet Output (Summed over areas)</li> <li>Annual Fleet Output (Summed over areas and periods)</li> <li>Period - Area - Stock Output</li> <li>Area - Stock Output (summed over periods)</li> <li>Period - Stock Output (summed over areas)</li> <li>Annual Stock Output (summed over areas and periods)</li> <li>Economic Output</li> <li>Number of vessels and effort</li> <li>Summary Output</li> </ul>	<ul> <li>Select Fleet (s) ?</li> <li>All fleets selected</li> <li>Select Stock (s) ?</li> <li>All stocks selected</li> </ul>
Compute	?

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

Behaviour Rules								
<b>In</b> Select	the rules to be applied in sthe simulation.	2						
<b>&gt;</b>	Apply Attrition rules							
	Apply Dis-investment rules							
	Apply Investment rules	?						
	Apply Decommission rules	?						
	Apply discard practice rule	?						
	Apply Effort rigging allocation rule	?						
	Apply Effort area allocation rule	?						
<b>V</b>	Apply Effort level rule	?						
	Back (Select simulation)	?						

Figure 3.4.1. Selection of behaviour rules for inclusion/exclusion.

# 3.5. SELECT CASE STUDY

## Select case study

Select Case-study for Evaluation	?
A "case study" means a comparison of two alternative management regimes. The six options given here can be extended by adding new subroutines to the program	
Scientific advice / No scientific advice	?
• TAC regime with No misreporting / with Misreporting	?
• With / without new Technical management measures	?
TAC / Effort regimes with ACFMs harvest control rule	?
• TAC / Effort regimes with NEW harvest control rule	?
• With MPA/Season Option 1 / With MPA/Season Option 2	?
Go Back (select simulation)	

Figure 3.5.1. Selection of case study.

## 3.6. MAIN MENU FOR CALCULATION MODULE

AIN MENU
Evaluation Frame for fishereis management systems
MAIN CALCULATION MENU
Time of last run: 06-08-2007 - 19:08:21
File Name of last run : DEMON_5_Mig3 EMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA ( 2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) 2 tock(s), 5 Area(s), 10 Year(s), dt = 1/4 years) , Circular movement (minimum 3 areas)
Select Table
Select Menu
Select Worksheet
Clear all sheets ? Select simulation ? Options ? Write list of all tables ?
Tuning ?

Figure 3.6.1.a. Main menu of calculation module.

Evaluation Frame for fishereis management systems
MAIN CALCULATION MENU
Time of last run: 06-08-2007 - 19:08:21
File Name of last run : DEMON_5_Mig3
$\begin{array}{l} \mbox{DEMONSTRATION EXAMPLE No. 5 - WITH FAKE DATA ( 2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) 2 \\ \mbox{Stock(s), 5 Area(s), 10 Year(s), dt = 1/4 years), Circular movement (minimum 3 areas)} \end{array}$
Select Table
Select Menu ?
001 Start Up form
003 Select simulation
004 Select Multiple simulation output ?
005 Select Case study 006 Select Single simulation output
007 Main menu
UU8 Select rules

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".

OPTIONS	
Show cell comments	
	Go Back

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"

	A	В	C	D	E	F	G					
1	1 List of tables produced by the calculaton module (Table List)											
2	TEMAS						RUN INFORMATION.					
2	Enal	no Nation Frame for	fichari	ec management d	ectomo							
Å	4 Version EXCEL 2003 MS Visual Basis 6.3 - TEMAS- 27 Ma				TEMAG	. 27 84	Date of this run.					
5	<ul> <li>Fersion, EACEL 2003, M3 Fisual Dasis 0.3 TEMA3: 27 Ma</li> <li>Maxina Eicharias Danastmant</li> </ul>						Date of this fun:					
6	DIEDES (Danich Institute of Marine Pasarah)						Name or roun:					
7			itute or	istantie rieserchy	4	442	File Name.					
- '	File Name:											
a a		. To onange mpo	it paran	leters, start the h		louure						
10												
11	Each	table appears twice .	one time	for each of the altern	atiue mar	Dagemer	t regimes					
12	Laon	(able appears (moe,	one ame	Tor each of the alterna	acive mai	lagemei	k regimes					
<u> </u>	Tab		Shee									
	le		t i		Start	Start						
13	Inde	Table Number	Indez	Sheet Name	Row	Col	Caption	Comment				
14	1	Table 1. 1. 1	1	Summary_Output	10	1	Summary of summary by fleet - First and Last year	Key economic indicators by flo				
15	2	Table 1. 1. 2	1	Summary_Output	25	1	Summary of summary by country - First and Last year	Key economic indicators by fl				
16	3	Table 1.2	1	Summary_Output	45	1	Summary of Summary by year for all fleets - All years	Key economic indicators for a				
17	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				
18	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				
19	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				
20	7	Table 1. 3. 2. 2	1	Summary_Output	107	1	GOVERNMENT BUDGET ANALYSIS - by Country - All years	These are the financial input p				
21	8	Table 1. 3. 3. 1	1	Summary_Output	121	1	ECONOMIC ANALYSIS by fleet - First and Last year	These are the economic input				
22	9	Table 1. 3. 3. 2	1	Summary_Output	136	1	ECONOMIC ANALYSIS by Country - All years	These are the economic input				
23	10	Table 1. 3. 4. 1	1	Summary_Output	151	1	ADDITIONAL INFORMATION - by fleet First and Last year	Additional information by cou				
24	11	Table 1. 3. 4. 2	1	Summary_Output	176	1	ADDITIONAL INFORMATION - by country - All years	Additional information by cou				
25	12	Table 1. 4. 1	1	Summary_Output	205	1	FINANCIAL ANALYSIS OF FLEETS ALL FLEETS (COUNTRIES AND	These are the financial input p				
26	13	Table 1. 4. 2	1	Summary_Output	220		GOVERNMENT BUDGET ANALYSIS - ALL FLEETS (COUNTRIES AN	These are the financial input p				
27	14	Table 1. 4. 3	1	Summary_Output	234		ECONOMIC ANALYSIS ALL FLEETS (COUNTRIES AND VESSEL SI	These are the economic input				
28	15	Table 1. 4. 4	1	Summary_Output	247		ADDITIONAL INFORMATION, - ALL FLEETS (COUNTRIES AND VES	Additional information East o				
29	16	Table 2, 1, 1, 1, 1, 1	2	Economic_Output	13		FINANCIAL ANALYSIS OF FLEETS Baltistan - OB Trawler-Baltistan -	These are the financial input p				
30	17	Table 2, 1, 1, 1, 1, 2	2	Economic_Output	32		Annual FINANCIAL ANALYSIS OF FLEETS Baltistan - OB Trawler-Ba	These are the financial input p				
31	18	Table 2, 1, 1, 1, 2, 1	2	Economic_Output	52	1	GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-Baltistan	These are the financial input p				
32	19	Table 2, 1, 1, 1, 2, 2	2	Economic_Output	72	1	Annual GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-B	These are the financial input p				
33	20	Table 2, 1, 1, 1, 3, 1	2	Economic_Output	89	1	ECONOMIC ANALYSIS Baltistan - OB Trawler-Baltistan - Small	These are the economic input				
34	21	Table 2, 1, 1, 1, 3, 2	2	Economic_Output	106		Annual ECONOMIC ANALYSIS Baltistan - OB Trawler-Baltistan - Sma	These are the economic input				
35	22	Table 2, 1, 1, 1, 4, 1	2	Economic_Output	121	1	ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltistan - Small	Additional information				
36	23	Table 2, 1, 1, 1, 4, 2	2	Economic_Output	154	1	ANNUAL ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltist	Annual Additional information				
37	24	Table 2, 1, 1, 2, 1, 1	2	Economic_Output	187	1	FINANCIAL ANALYSIS OF FLEETS Baltistan - OB Trawler-Baltistan -	These are the financial input p				
38	25	Table 2, 1, 1, 2, 1, 2	2	Economic_Output	220	1	Annual FINANCIAL ANALYSIS OF FLEETS Baltistan - OB Trawler-Ba	These are the financial input p				
39	26	Table 2, 1, 1, 2, 2, 1	2	Economic_Output	240		GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-Baltistan	These are the financial input p				
40	27	Table 2. 1. 1. 2. 2. 2	2	Economic_Output	260	1	Annual GOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-B	These are the financial input p				
41	28	Table 2. 1. 1. 2. 3. 1	2	Economic_Output	277	1	ECONOMIC ANALYSIS Baltistan - OB Trawler-Baltistan - Medium	These are the economic input				
42	29	Table 2, 1, 1, 2, 3, 2	2	Economic_Output	294	1	Annual ECONOMIC ANALYSIS Baltistan - OB Trawler-Baltistan - Med	These are the economic input				
43	30	Table 2. 1. 1. 2. 4. 1	2	Economic_Output	309	1	ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltistan - Mediu	Additional information				
44	31	Table 2. 1. 1. 2. 4. 2	2	Economic_Output	342	1	ANNUAL ADDITIONAL INFORMATION - Baltistan - OB Trawler-Baltist	Annual Additional information				
45	32	Table 2, 1, 1, 3, 1, 1	2	Economic_Output	375	1	FINANCIAL ANALYSIS OF FLEETS Baltistan - OB Trawler-Baltistan -	These are the financial input p				
46	33	Table 2. 1. 1. 3. 1. 2	2	Economic_Output	408	1	Annual FINANCIAL ANALYSIS OF FLEETS Baltistan - OB Trawler-Ba	These are the financial input p				
47	34	Table 2 1 1 3 2 1	2	Economic Output	428	- 66	LIGOVERNMENT BUDGET ANALYSIS - Baltistan - OB Trawler-Baltistan	These are the financial input n				
14	• •	M V Table_Fist	ч, н_	ouc_per_ar / I	ACYP	mont,	<u>Λ Message Λ H_Out_A S</u>	2				

Figure 3.6.4. List of tables produced by the "TEMAS\_CALC" workbook.



## 3.7. MULTIPLE STOCHASTIC SIMULATION

		A	B C D		E		F	-				
1	Summary ec	onomic/landings Output	ut (Summ	ary O	utput)							
2	TEMAS											
3	Evaluation Frame for fisheries management systems											
4	Version. EXCEL 2003, MS Visual Basis 6.3 TEMAS: 27 Mar 2007											
5	Marine Fisheries	Department										
6	DIFRES (Danish	SELECT MULTIPLE SIMULA	TION OUT	PUT								
7												
8	Note: To change	MULTIDLE CT			CTMH	LATTON						
9	T-L	MULTIPLE SIC	JUNAS		SIMU	LATION	2					
10	Tab	Note: Fixed out	nut format (only in two worksheets)					year OD Too	daa			
12	Cook Eleve ElMANC					<i>*</i>		0B 11a	/ler- 140020.2	-		
12	NEV oach Flow FIN							1.02	1665-07			
14	Cash Flow GOVER	? Goto Main Me	ยกบ 👘		Сотр	ute	?	7.83	2572421	-		
15	NPV cash Flow GO			_i	_				2.14E+07			
16	Cash Flow ECONO	To display the resu	llts of th	e mul	tiple stor	hastric		5.98	244142.7	~		
17	NPV cash Flow EC	ro display the resu	into or un	ie men	tiple stor	chusure			2.62E+07			
18	Total Landings	<ul> <li>simulations, please</li> </ul>	e use the	work	book:			0415	13.69957			
19	Total Value	"TEMAS STO OUT"						9.57	318159.6	Ĩ		
20	Mean Value / kg						_	9.13	23224.06			
21	Number of Crew			195	237	285		327	360			
22	Number of boats		STOCHASTIC SIMULATIONS						82			
23									-			
24			Give number of simulations (minimum 5)									
25	Table	e 1.1.2 . Regime 1 - ACFM A					L	UK	i			
26								Cancel				
27	NDV	ANCIAL ANALYSIS OF FLEETS.					_		I			
20	Cash Flow GOVERN	MINENT RUDGET ANALYSIS										
30	NPV cash Flow GOVERN	VERMMENT BUDGET ANALYSIS										
31	Cash Flow ECONOR	MIC ANALYSIS.	5									
32	32 NPV cash Flow ECONOMIC ANALYSIS.											
K ← ► ► K / Economic_Output / Summary_Output /												
i Tegning - 📐   Autofigurer - 🔪 🔪 🔿 🖓 🕼 👔 🖉   🔌 - 🥖 - 🗛 - 🚍 🛒 📮 🗐 📕												
Klar	Klar											

Figure 3.7.1. Userform to start the stochastic (multiple) simulations.
	A	В	С	D	E	F	G	
1	Stochastic	simulation m	essages (M	essage)			Scientific advic	e / No scie
2	TEMAS						RUN INFORMAT	TION:
3	<b>Evaluation Fra</b>	ne for fisheries n	nanagement syst	ems				
4	Version, EXCE	. 2003, MS Visua	Basis 6.3 TE	MAS: 27 Mar 200	7		Date of this run:	
5	Marine Fisherie	s Department					Name of Run:	
6	<b>DIFRES</b> (Danis	h Institute of Ma	rine Reserch)				Param. Created:	
7							File Name:	
8	Note: To chang	e input paramete	rs, start the INP	UT-module				
9								
10								
11							+	
12								
13						all 5 calculat	ions for	
14	MULTIPLE	STOCHASTIC	SIMULATION	N	{			
15						egine 1 coi	npietea	
16		Management	Regime 1 - ACF	M Advice				
17		Simulation No.	5					
18		% remaining	0					
19		Of total 5 simu	lations					
20								
21								
22	To display the	results of the	multiple stocha	astric simulatio	ns, please use	the workboo	k: TEMAS_STO_(	JUT
23								
24								
25								
26		Management	Regime 2 - No A	ACFM Advice	(	3 simulation	ıs for 💦 🗌	
27		Simulation No.	3			rogimo 2 co	mulated	
28		% remaining	40			regime 2 co		
29		Of total 5 simu	lations			· · · · ·		
30								
31								

Figure 3.7.2.a. Message from stochastic (multiple) simulations, during execution.

	A	В	С	D	E	F	G	н		
1	Stochastic	simulation m	iessages (l	Message)			Scientific advic	e / No sci	entific advice -	R
2	TEMAS						<b>BUN INFORMA</b>	TION:		
3	<b>Evaluation Fran</b>	ne for fisheries r	nanagement sy	stems						
4	Version, EXCEL	. 2003, MS Visua	l Basis 6.3 Ti	EMAS: 27 Mar 20	07		Date of this run		09-08-2007	11
5	Marine Fisherie	s Department					Name of Run:		DEMONSTRAT	0
6	<b>DIFRES</b> (Danis	h Institute of Ma	rine Reserch)				Param. Created		12:00:00 AM	0
7							File Name:		DEMON_5_Mig	3
8	Note: To chang	e input paramete	rs, start the IN	PUT-module						
9										
10										
11										
12					_					
13		TOCHASTIC	SIMULATIC							
14	WOLTIFLES	STUCHASTIC	SINULATIC							
15		Management	Degime 1 A/	CEM Advice						I
10		Management	Kegime I - A	5 M AUVICE						
10		Simulation No.		0						
10		A remaining	lations	•						
20		Or total 5 Silliu	lations							
20										-
22	To display the	results of the	multiple stoc	hastric simulati	ons, ple	ease t	ise the workbo	ok: TEMA	S STO OUT	
23							J.,			
24					FX	FCUT	ION TIME			
25						2001				
26		Management	Regime 2 - No	ACFM Advice	6	•	COMPUTATION C	OMPLETED		
27		Simulation No.		5		IJ.				
28		% remaining		0		V	Execution time =	32 Second	ls, or .53 minutes	
29		Of total 5 simu	lations							
30							0	ж I		
31										
32										~
H ·	Mess	age / Fl_Out_/	Area 🖌 Fl_Ou	t_Period 🖌 ST_	Out_Pe	<				2

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:

Summary\_Output / Economic\_Output / Stock\_Output / Fleet\_Output / Stochastic\_Output / NPV\_Output / Tuning\_Output / Rules / Ogives / St\_Out\_Period / St\_Out\_Area / St\_Out\_Per\_Ar / / Fl\_Out\_Period / Fl\_Out\_Area / Fl\_Out\_Per\_Ar / Table\_List / 

- 1) "Summary output" (Figure 3.1.1-2)
- "Stock Output" (stock structured output, Tables 3.3.1-2) 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)
- "NPV\_Output" (NPV = "Net Present Value"). 6)
- "Tuning\_Output" (Figure 4.6.2) 7)
- "Rules" 8)

- "Ogives" (gear selection ogive, discard ogives and growth curves, not shown here) 9)
- 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) "FI\_Out\_Area", "Annual Fleet output by area (summed over periods)"
- 15) "FI\_Out\_Per\_Ar", "Fleet output by time period and area"
- 16) "Table\_List", "List of all tables produced by TEMAS\_CALC"

	A	B C D E F	G H I	JK	ц м	N	0	P	Q	B	s	т	U	-
1	Summary economic/la	andings Output (Summary_Output)	Scientific eduice / Huscie	ntific advid	co - Rogimo 1: ACFM Advico Ro	eqime 2: H	ACFM A	dvice						-
3	Evaluation Frame for firm	eries management system <u>s</u>	NOR INFORMATION.											
4	Version, EXCEL 2003, MS V Marine Fisheries Departm	ireal Barir 6.3 TEMAS: 2007	Date of this run: \$\$\$\$\$ Name of Bun: DEMON	** 14:25 STRATION I	TAMPLE No. 5 - WITH FAKE DA	1A ( 2 C.	ntrier, f		ffleetr	Ct 1: 2	Ct 2: 21	2 Stuck(z).	5 Areals	ā
6	DIFRES (Denick Institute)	of Marino Rozorch)	Param. Graatad: \$\$\$\$\$											2
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9														
	Table 1. 1. 1				Table 1. 1. 1.									
	Pegime 1	Summary of summary b	v fleet - Pair		Pegime 2 - No	Sum	marv	ofer	imm	any b	v flag	+ D	air 👘	
	. Kegime i -	Summary of Summary D	yneet - ran		Regime 2 - No	Sum	inai y	01 51		aryb	y nee	at - F d		≡
10	ACFM Advice	Deterministic - First and	l Last year		ACFM Advice	Dete	rmini	stic -	- Firs	st and	d Las	t year		
		Baltirtan - Baltirtan - Baltirtan - Baltirtan - Scandinavi	Scandinavi Scandinavi Scandinav	via-		Baltistan -	Baltirtan -	Baltistan-	Baltirtan	Scandinav	Scandinav	Scandinavi S	candinavi	
		OB OB Gillnott- Gillnott- a-OB Trauler- Trauler- Baltirtan- Baltirtan- Trauler-	a-OB a-Gillnott- Gillnott- Traulor- Scandinavi Scandinav	via-		OB Traulor Baltistan -	OB Traulor Baltirtan -	Gillnott- Baltirtan-	Gillnett- Baltirtan	ia-OB Trauler-	ia-OB Trauler-	a-Gillnott- a Scandinavi S	- Gillnott- candinavi	
11	Cash Elay EINANCIAL ANALYSIS (	Baltirtan - Baltirtan - 2000 2009 Scandinavi	Scandinavi a-2000 2009	162	Cash Flavy FINANCIAL ANALYSIS OF FL	2000	2009	2000	2009	Scandinav 140954 2	Scandinav	a - 2000 a	- 2009	
13	NPV cark Flau FINANCIAL ANALY	1402058 7911787 1.66E+07	2.83E+07		NPV cark Flau FINANCIAL ANALYSIS C	1282649		7325970		1.50E+07		2.46E+07 -		_
14	Cark Flow GOVERNMENT BUDGET NPV cark Flow GOVERNMENT BUD	145431 22944.01 178176.6 34047.83 257242.1 3780739 1.08E+07 2.14E+07	318732.2 191100.2 20324	47.3	Cark Flau GOVERNMENT BUDGET ANA NPV cark Flau GOVERNMENT BUDGET	145447.6 3487362	-32159.72	178189.1 1.00E+07	-22929	257263.4 1.90E+07	-47287.61	191114 2.76E+07 -	-31728.05	-
16	Cark Flau ECONOMIC ANALYSIS.	139341.1 31110.78 168499.1 37605.98 244142.7	332372.7 179936.2 20894	44.3	Cark Flau ECONOMIC ANALYSIS.	139357.8	-23081.76	168511.7	-18461.6	244164.1	-27687.53	179950	-22155.81	
18	Tatal Landingr	7.419739 5.472821 7.845979 4.230415 13.69957	33.96667 8.772552 16.4	309	Tatal Landingr	7.419739	3.28E-03	7.845979	2.85E-03	13.69957	5.98E-03	8.772552	3.18E-03	
19	Tatal Value Mean Value / ka	172310.2 60751.95 204000 61929.57 310159.6 23223.22 11100.66 26113.76 14639.13 23224.06	414512.3 229084.3 26016 12203.5 26113.76 15834	57.3 4.03	Tatal Value Mean Value / ka	172328.1 23225.63	20.61915 6292.986	204901.6 26115.49	20.5232	318183.4 23225.79	37.72611 6304.621	229099.5	22.92978	-
21	Number of Crou	195 237 285 327 360	402 318	360	Number of Crou	195	237	285	327	360	402	318	360	-
23	Humber or boats	40 37 03 10 02	72 11	••	number of blady	40	27		1.	**	72		•••	-
24														-
	Table 1. 1. 2.				Table 1. 1. 2.	Sum	marv	of si	umm	arv b	V COL	untry	- 1	
	Denime 1				Denime 2 Me	Dain	Date			Fire		11.00		
	Regime 1 -	Summary of summary b	y country -		Regime 2 - No	Pair	Detei	rmini	STIC	- FIrs	t and	Last		
25	ACFM Advice	Pair Deterministic - Firs	t and Last vear		ACFM Advice	vear								
									e					
		Baltirtan- Baltirtan- Scandinav Scandina				Baltistan-	Baltirtan -	Scandina	via-					
26	Cark Flou FINANCIAL ANALYSIS	2000 2009 ia-2000 via-2009 185951.8 -40951 245834.9 245569			Cark Flou FINANCIAL ANALYSIS OF FL	2000 185972.2	-118133	245859.5	-168243					
28	NPV cark Flow FINANCIAL ANALY: Cark Flow GOVERNMENT BUDGET	3168697 3168697 4999620 4999620 323607.6 56991.34 dd83d2 3 521979.6			NPV cark Flau FINANCIAL ANALYSIS C Cark Flau GOVERNMENT BUDGET ANA	2927432	2927432	4026539 448377 4	4026539					
30	NPV cark Flau GOVERNMENT BUD	5279189 5279189 8294317 8294317			NPV cark Flau GOVERNMENT BUDGET	4927590	4927590	6876958	6876958					
31	NPV cark Figu ECONOMIC ANALYSIS.	501840.3 68116.75 424078.9 541317.1 5214444 5214444 8215295 8215295			NPV cark Flau ECONOMIC ANALYSIS.	4869779	4869779	6825177	6825177					
33	Total Landingr Total Value	15.26572 9.703236 22.47213 50.39757 377198.3 122681.5 547243.9 674679.6			Total Landingr Total Value	15.26572	6.12E-03 41.1424	22.47213	9.16E-03 60.6559					
35	Mean Value / kg	24708.84 12643.36 24352.12 13387.15			Mean Value / kg	24710.9	6720.488	24353.85	6622.4					
36	Number of boats	480 564 678 762 111 137 153 179			Number of boots	480	137	153	179					
38				_										
40														
41		DECIME	1			FC	TN/	TF.	2					
43		- KEGINIE .					TTA	117	4	)				
	Table 4 0				Table 4.0									
	Table 1.2.				Table 1.2.									
	Regime 1 -	Summary of Summary b	v vear for all fle	eets	Regime 2 - No	Sum	mar∨	of S	umm	arv t	ov ve	ar for	all	
	ACEM Advice	Bair Deterministic All	Veere		ACEM Adviso	floot	, Ď		otor	ninia	tio /		-	
45	ACFINI AUVICE		ycals 2005 2004 2	007 2000	ACFINI AUVICE	11661	3 - F	an D	2002	2004		All yea	2007	-
40	Carl Flau FINANCIAL ANALYSIS	431786.6 439175 1543995 3142845 2449920	276275.4 113957.3 122	924 4E+05	Cark Flou FINANCIAL ANALYSIS OF FL	431831.7	439175	1543995	3142845	2449920	276275.4	-38460.14	-269234.2	
48	NPV carh Flou FINANCIAL ANALY: Carh Flou GOVERNMENT BUDGET	8168317 771949.9 935894.4 2361203 4805008 3666295	724613.9 273002.1 4519	19.6 8E+05	<ul> <li>NPV carh Flau FINANCIAL ANALYSIS C Carh Flau GOVERNMENT BUDGET ANA</li> </ul>	6953970 772014.1	935894.4	2361203	4805008	3666295	724613.9	46294.38	-119920.2	-
50	NPV cark Flow GOVERNMENT BUD Cark Flow ECONOMIC ANALYSIS	1.36E+07 731919.1 898137.8 2319420 4767151 3424444	 685206.6 292340.7 474	 583 8F+05	- NPV cark Flau GOVERNMENT BUDGET Cark Flau ECONOMIC ANALYSIS	1.18E+07 731483 5	 898137 *	2319920	4767151	 3671664	 685206 4	74601.52		-
52	NPV cark Flau ECONOMIC ANALY	1.34E+07			NPV carh Flau ECONOMIC ANALYSIS.	1.17E+07								-
53	Total Value	sr.rsrep 51.78107 116.0598 241.288 194.998* 924442.2 1199817 2655466 5429641 408673*	44.59882 32.12971 55.17 976867.1 342980.5 64956	436 70.69 52.9 9E+05	Total Value	924512.6	51.78107 1199817	116.0598 2655466	241.288 5429641	194.9981 4086731	44.59882 976867.1	5.265861 86671.59	0.816081	-
55	Moan Valuotka	24496.42 23170.96 22880.15 22502.74 20957.6	21903.43 10674.87 1177	2.91 12461	Moan Valuo / kg	24498.29	23170.96	22880.15	22502.7	20957.8	21903.43	16459.15	12703.22	<b>*</b>
THE .	K Extral ( )	Heel_output & Stock_output &	Economic_Output )	Summa	iry_output/js				1			J	>	1
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	ALI	EKNAIIVE			AL	Η,	$\langle N \rangle$	A		( H,	2			
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Figure 4.1.1.a. First portion of Summary output with two alternatives.

5	TEMAS CALC DEA	ug08.xls					
	Genman economical	andings Datput (Summary, Datput Zalastilla séries / No. 41	n H milito adalas - Regime I-d	19 6 9 8 6 8 1 1 19755 MITH Adulta Raques I, Re ACTH Adulta	60 BC	at at all an at as	H N
a subset	Barrari Fridayan Barrari Barrari Barrian Barrari an	and a second sec		ing Careford Marinet Constant and Harris . On the S Co. 2	· ZJ J. Trankleh, Siderelleh,	WTento), W. Wissens) , Charles services	(
	Table 1.1.1. Regime 1 - ACFM Advice	Summary of summary by fleet - Pair Deterministic - First and Last year	Table 1.1.1. Regime 2 - No ACFM	Summary of summary by fleet • Pair Deterministic • First and Last year	Table 1.1.1. Camparison of regimes.	Summary of summary by f Pair Deterministic - First ar Last year	leet - nd
CURRENT STATE OFF	Cust Pau Protectos anto 100 1973 - es Pau Protectos anto 100 1975 - es Pau Protectos anto 1976 - es Pau Constructor 100 1976 - es Pau Constructor 100 1978 - es Pau Constructor 100 1984 - Pau Paul Prote Paul	Barton         Annual (Second Second Sec	C an figur (1999) A Bola THE MT 1 and Figur (1999) A Bola The Figur (1994) A Bola Figur (1994) Figur (1994) Figur (1994) Figur (1994) Figur (1994) Figur (1994) Figur (1994)	Description         Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	Control Type, Plantactic Adv. and A 1993 O 1997 - Levin Type, Plantactic Adv. and A 1993 Control Type, Control and A 1990 A 1997 - Levin Type, Control and A 1990 A 1997 - Theorem Control And A 1990 A 1990 - Theorem Control And A 1990 A Resolution of Yorks A	Bernards         Solations         Solations <th< td=""><td></td></th<>	
	Table 1.1.2. Regime 1 - ACFM Advice	Summary of summary by country - Pair Deterministic - First and Last year	Table 1.1.2. Regime 2 - No ACEM	Summary of summary by country - Pair Deterministic - First and Last year	Table 1.1.2. Camparison	Summary of summary by country - Pair Determinist	ic -
111111111111111111111111	Can Par Telepola Statement Will an Telepola Statement Telepola Statement Will age Telepola Par Telepola Par Statement Par Statement Stat	Annual An	Count Proc. (1988) Vol. Broke, 1997 Whith our Trans. (1989) Vol. Broke, 1997 Whith our Trans. (1997) Vol. Broke, 1997 Whith our Trans. (1997) Vol. Broke, 1997 Whith our Trans. (1997) Vol. Broke, 1997 Whith Order	Barlow Marcow Constraint         Barlow	East Part - Plantecki, and state of with a set Part - Plantecki, and state of the Plantecki - Plantecki - Plantecki Plantecki - Plantecki - Plantecki - Plantecki Plantecki - Plantecki - Plantecki - Plantecki - Plantecki -	Extrans Extension Extension Extension Extension     Y 2104-09 - 4-240 - 4-2     Participation Extension     Extension	
Transferrences and the	Availar 1-80755	Regime 1 relations and other back to the second state of the seco	Parameter Tra	egime 2	to 12 Susperior	omparison f regimes	(M) and 300 (M) 43 (4) 43 (4) (4) (4) (4) (4) (4) (4) (4) (4) (4)

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 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	В	С	D	E
43	Table 1.3.	FINANCIAL AN	ALYSIS OF HAF	VESTING - Dete	erministic
44		Tramler 2000		Gill Net 2000	Gill Net 2009
45	Gr. revenue before tax	24929	6707.0	24929	6707
40	concrevence before (as	1740 9	225.25	1740 9	225.25
40	Concernation of the term	1/40.3	00000	1740.3	00717
47	Gr. revenue after tax	33192	6371.6	33192	6371.7
48	Costs of effort	6161.5	/04.1/	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 subsidu	105	11 400	35	3 8000
59	N cash Flow	9519.6	3295.2	20034	4475.8
60	N P V oach Flow	5010.0	0200.2	20004	0
61	nur.v.cashriow	335.56	•	3304.3	0
01	Table 4.4				CUDY Determin
63	1 apie 1.4.	FINANCIAL AN	ALTSIS OF GUN	ERNMENT TREA	SURT - Determin
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 Subsidu	610 15	70 417	205.20	22 472
70		1000	10.417	203.30	20.972
72	Licence ree	1000	102.40	050	60.800
73	vessel subsidy	CUI	11.400	30	3.8000
74	Hevenue 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 AN	ALYSIS - Dete	rministic	
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		7.0500		
94	[ OOSt Of failangs	38 126	/ 3569	38 126	7 3569
04	Crew Oppurt C	38.126	7.3069	38.126	7.3569
OF	Crew Oppurt.C.	38.126 6300	684	38.126	7.3569
85	Crew Oppurt.C. Fixed costs	38.126 6300 5250	684	38.126 2800 2625	7.3569 304 285
85 86	Crew Oppurt.C. Fixed costs Investment	38.126 6300 5250 0	7.3569 684 570 0	38.126 2800 2625 0	7.3569 304 285 0
85 86 87	Crew Oppurt.C. Fixed costs Investment Management C.	38.126 6300 5250 0	7.3569 684 570 0 15	38.126 2800 2625 0 15	7.3569 304 285 0 15
85 86 87 88	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow	38.126 6300 5250 0 15 17174	7.3569 684 570 0 15 4726.5	38.126 2800 2625 0 15 26380	7.3569 304 285 0 15 5743.6
85 86 87 88 89	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow	38.126 6300 5250 0 15 17174 2481.4	7.3569 684 570 0 15 4726.5 0	38.126 2800 2625 0 15 26380 5332.4	7.3569 304 285 0 15 5743.6 0
85 86 87 88 89 91	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow	38.126 6300 5250 0 15 17174 2481.4	7.3569 684 570 0 15 4726.5 0	38.126 2800 2625 0 15 26380 5332.4	7.3569 304 285 0 15 5743.6 0
85 86 87 88 89 91 92	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b>	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN	7.3569 684 570 0 15 4726.5 0 IFORMATION -	38.126 2800 2625 0 15 26380 5332.4 Deterministic	7.3569 304 285 0 15 5743.6 0
85 86 87 88 89 91 92 92	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b>	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Travier 2000	7.3569 684 570 0 15 4726.5 0 IFORMATION - Travier 2009	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000	7.3569 304 285 0 15 5743.6 0 6ill Net 2009
85 86 87 88 89 91 92 93 94	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b>	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 2475.0	7.3569 684 570 0 15 4726.5 0 IFORMATION - Trawler 2009	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000	7.3569 304 285 0 15 5743.6 0 6ill Net 2009
85 86 87 88 89 91 92 93 93 94 95	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow Table 1. 6. Landings Cod	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0	7.3569 684 570 0 15 4726.5 0 IFORMATION - Trawler 2009 658.92	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0	7.3569 304 285 0 15 5743.6 0 Gill Net 2009 658.92 70.700
85 86 87 88 89 91 92 93 94 95 90	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60	7.3569 684 570 0 15 4726.5 0 <b>IFORMATION</b> - <b>Trawler 2009</b> 658.92 76.766	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60	7.3569 304 285 0 15 5743.6 0 Gill Net 2009 658.92 76.766
85 86 87 88 91 92 93 93 94 95 96	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice Total Landings	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 331.60	IFORMATION - Trawler 2009 75.76 76.766 735.69	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6	7.3569 304 285 0 15 5743.6 0 Gill Net 2009 658.92 76.766 735.69
85 86 87 88 91 92 93 93 94 95 95 95 97	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice Total Landings Value Cod	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3812.6 31816	IFORMATION - Trawler 2009 58921 59921	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816	7.3569 304 285 0 15 5743.6 0 Gill Net 2009 658.92 76.766 735.69 5992.1
85 86 87 88 91 92 93 93 95 95 96 97 98	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice Total Landings Value Cod Value Plaice	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3812.6 31816 3182.2	IFORMATION - Trawler 2009 58.92 76.766 735.69 5992.1 714.92	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816 31816 312.2	7.3569 304 285 285 304 304 305 304 305 305 305 305 305 305 305 305 305 305
85 86 87 88 91 91 92 93 93 94 95 96 97 98 98	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3812.6 31816 31816 3122.2 34939	IFORMATION - Trawler 2009 58.92 76.766 735.69 5992.1 714.92 6707.0	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816 31816 3182.2 34939	7.3569 304 285 285 304 304 305 304 305 305 305 305 305 305 305 305 305 305
85 86 87 88 91 92 93 93 94 95 96 97 98 99 99 99 99	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1. 6.</b> Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3312.6 31816 31816 3182.2 34939 9.1639	IFORMATION - Trawler 2009 58.92 76.766 735.69 5992.1 714.92 6707.0 9.1167	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816 31816 3182.2 34939 9.1639	7.3569 304 285 0 15 5743.6 0 Gill Net 2009 658.92 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167
85 86 87 88 91 92 93 94 95 95 95 95 95 95 95 98 99 100 101	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow Table 1.6. Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3812.6 31816 31816 3182.2 34939 9.1639 6300	IFORMATION - Trawler 2009 58.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 684	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816 3182.2 34939 9.1639 2800	7.3569 304 285 0 15 5743.6 0 658.92 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 304
85 86 87 88 91 92 93 94 95 96 97 98 99 90 100 101 102	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew Number of boats	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3812.6 31816 31816 3182.2 34939 9.1639 6300 2100	IFORMATION - Trawler 2009 58.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 684 228	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816 3182.2 34939 9.1639 2800 700	7.3569 304 285 0 15 5743.6 0 658.92 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 304 76
85 86 87 88 91 92 93 94 95 94 95 96 97 98 99 100 101 102 103	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1.6.</b> Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew Number of boats C.P.U.E Cod	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3812.6 31816 31816 3182.2 34939 9.1639 6300 2100	IFORMATION - Trawler 2009 58.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 684 228 .0093574	38.126 2800 2625 0 15 26380 5332.4 Deterministic Gill Net 2000 3476.0 336.60 3812.6 31816 31816 3182.2 34939 9.1639 2800 700	7.3569 304 285 0 15 5743.6 0 658.92 658.92 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 304 76 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
85 86 87 88 89 91 92 93 94 95 96 97 98 99 90 100 101 102 103 104	Crew Oppurt.C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1. 6.</b> Landings Cod Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew Number of boats C.P.U.E Cod C.P.U.E Cod C.P.U.E Cod	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3312.6 31816 31816 31816 3182.2 34939 9.1639 6300 2100 .0056415	IFORMATION - Trawler 2009 IFORMATION - Trawler 2009 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 684 228 .0093574 0010902	38.126 2800 2625 0 15 26380 5332.4 <b>Deterministic</b> <b>Gill Net 2000</b> 3476.0 336.60 3312.6 31816 31816 31816 3182.2 34939 9.1639 2800 700 .016925	7.3569 304 285 0 15 5743.6 0 658.92 658.92 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 304 76 0 028072 0022705
85 86 87 88 89 91 92 93 94 95 96 97 98 99 90 100 101 102 103 104	Crew Oppurt C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1. 6.</b> Landings Cod Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew Number of boats C.P.U.E Cod C.P.U.E Cod	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 3312.6 33812.6 31816 31816 31816 3182.2 34939 9.1639 6300 2100 .0056415 .00054630	IFORMATION - Trawler 2009 IFORMATION - Trawler 2009 058.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 684 228 .0093574 .0019902 .005044	38.126 2800 2625 0 15 26380 5332.4 <b>Deterministic</b> <b>Gill Net 2000</b> 3476.0 336.60 3312.6 31816 31816 31816 3182.2 34939 9.1639 9.1639 9.1639 9.16395 .0016389	7.3569 304 285 0 15 5743.6 0 658.92 658.92 658.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 304 76 0.028072 .0032705
85 86 87 88 89 91 92 93 94 93 94 95 94 93 94 95 94 95 97 98 99 100 101 102 103 104	Crew Oppurt C. Fixed costs Investment Management C. N.cash Flow N.P.V.cash Flow <b>Table 1. 6.</b> Landings Cod Landings Cod Landings Plaice Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew Number of boats C.P.U.E Cod C.P.U.E Plaice Val.P.U.E Cod	38.126 6300 5250 0 15 17174 2481.4 ADDITIONAL IN Trawler 2000 3476.0 336.60 336.60 3312.6 3381	IFORMATION - Trawler 2009 IFORMATION - Trawler 2009 058.92 76.766 735.69 5992.1 714.92 6707.0 9.1167 684 228 .0093574 .0019902 .005024	38.126 2800 2625 0 15 26380 5332.4 <b>Deterministic</b> <b>Gill Net 2000</b> 3476.0 336.60 3312.6 31816 31816 31816 3182.2 34939 9.1639 9.1639 9.1639 9.16395 0.016325 .0016389	7.3569 304 285 0 15 5743.6 0 <b>Gill Net 2009</b> 658.92 658.92 76.766 735.69 75.60 7

Figure 3.1.2. Second portion of Summary output.

109	Table 1.7.	FINAN	ICIAL I	ANALY	'SIS OF	F HAR	ÆSTIN	IG, AL	L FLEE	TS - [	)etermir
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 subsidu	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 subsidu	140	130	125	112 55	106.30	103 15	61600	40,800	30 400	15 200
125	Nicash Flow	29554	15208	8818.0	7060.5	7118.2	7255.4	6372.8	7845.3	9847.2	77710
120	N B V cash Flow	4500.5	10200	0010.0	1000.0	0	1200.4	0012.0	1045.5	0041.2	0
120	Tull 14.0dSill IOW	4000.0									-
121	Table 1 0	CINIAN	CIAL	ANIAI V		COM		INT TE	EACH		
129	Table 1. o.	FINAN		ANAL I	313 01	- 600			CA3U	RT, AL	
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.	ECON	OMIC	ANALY	rsis, a	ILL FL	EETS -	Deter	minist	tic	
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				Ť							
150	Table 1 10		IONAL	INEO	DMATI	ON AL		ETS	Dotorr	ninieti	c
100	Table 1. 10.	2000	2004	0000	2000	0004		- C I J - I	0007	2000	0000
103	Les de la Cel	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
	i Landings Plaice	673.21	581.18	521.74	470.85	463.60	471.39	316.15	257.95	241.85	153.53
161			EEE7.2	46081	4059.2	3894.5	3816.1	2559.2	2192.5	2176.2	1471.4
161	Total Landings	7625.3	0001.0				A 4 4 4 1 1				1 AZ = - 11
161 162 163	Total Landings Value Cod	7625.3 63633	45181	36552	31826	30453	29782	20015	17339	17459	11984
161 162 163 164	Total Landings Value Cod Value Plaice	7625.3 63633 6244.4	45181 5388.1	36552 4806.9	31826 4314.7	30453 4243.9	29782 4321.9	20015 2904.7	17339 2378.3	17459 2240.7	11984 1429.8
161 162 163 164 165	Total Landings Value Cod Value Plaice Total Value	7625.3 63633 6244.4 69877	45181 5388.1 50569	36552 4806.9 41359	31826 4314.7 36140	30453 4243.9 34697	29782 4321.9 34104	20015 2904.7 22919	17339 2378.3 19717	17459 2240.7 19700	11984 1429.8 13414
161 162 163 164 165 166	Total Landings Value Cod Value Plaice Total Value Mean Value/kg	7625.3 63633 6244.4 69877 9.1639	45181 5388.1 50569 9.0997	36552 4806.9 41359 8.9752	31826 4314.7 36140 8.9032	30453 4243.9 34697 8.9092	29782 4321.9 34104 8.9369	20015 2904.7 22919 8.9558	17339 2378.3 19717 8.9930	17459 2240.7 19700 9.0527	11984 1429.8 13414 9.1167
161 162 163 164 165 166 167	Total Landings Value Cod Value Plaice Total Value Mean Value/kg Number of Crew	7625.3 63633 6244.4 69877 9.1639 988	45181 5388.1 50569 9.0997 988	36552 4806.9 41359 8.9752 988	31826 4314.7 36140 8.9032 988	30453 4243.9 34697 8.9092 988	29782 4321.9 34104 8.9369 988	20015 2904.7 22919 8.9558 988	17339 2378.3 19717 8.9930 988	17459 2240.7 19700 9.0527 988	11984 1429.8 13414 9.1167 988

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 Gillnetters)



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.

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 : CATO		BERS – D	etermini	stic								

Species A : STOCK NUMBERS – Deterministic

Species A : CAICH 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	
YIEL D	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 3.3.1 and 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/Y	ear	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
	03	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
	$\tilde{0}4$	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	$\overline{0}$ 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
2	$\overline{0}_{2}$	1162.3	107/ 5	1125 2	734.6	722.4	725.2	725.2	725.1	726.1	735 /	73/ 0	735.8	735.2
	03	006.0	1074.5	1070.3	608 8	607 7	600 /	600 /	600 3	700.1	600 6	600 1	600 0	600 /
	$\overline{0}$	0/0.7	072.1	1010.0	664 7	663.6	665.3	665.3	665.2	666 1	665.5	665.0	665.8	665.3
2		1007.6	002.0	024.0	069.5	622.2	621.2	622.0	622.0	622.7	622.6	622.0	622.5	622.2
3		0247	902.0 770.1	724.7 701 1	900.0	032.3 5/1 0	5121	0JZ.9 5/2 0	0JZ.9 544.2	545.7	033.0 546.4	516 A	547.6	033.3 E10 2
		702 /	770.1	771.1	700 7	541.0 E1E /	542.4 E14.0	545.0 E17.2	544.5 E17.7	54J.7 E10 1	540.4 E10.0	540.4 510.0	547.0	540.Z
	01	792.4	132.3	702.0	750.7	010.4 400.2	100.0	102.0	102 E	019.1 402.0	019.0 404.4	019.0	JZU.0	JZ1.4
4	Q 4	700.7	090.0	/10.0	730.2	490.3	490.0	492.0	492.0	493.0 440 E	494.4	494.4	490.4	490.0
4	Q1	898.7	/1/.0	002.8	080.9	/13./	400.4	400.9	408.0	408.5	409.7	470.3	470.3	4/1.3
	QZ	/03.3	010.7	500. I	582.0	011.1	400.4	400.9	402.2	403.7	404.7	405.0	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
	<b>.</b>						27001	21101	20101	30702	31017	31011	30070	

# 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	в	С	D	E	F	G	Н		J	К	L	<u> N</u>
659													_
660		Тгаи	vler cat	ching	Cod								
661		DISC	CARDS				- Dete	rministi	c				
662			2000	2001	2002	2003	2004	2005	2006	2007	2008	2005	
663	0	T1	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		Т3	42.8	43.4	35.8	29.4	27.4	27.0	16.4	11.4	9.7	5.6	
666		Τ4	88.2	89.4	74.0	60.8	56.7	55.9	34.0	23.8	20.3	11.7	
667	1	T1	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		Т3	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	T1 -	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		Т3	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	T1	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		Т3	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	T1	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		Т3	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	T1	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		Т3	29.5	32.8	33.4	27.4	23.9	22.8	14.7	10.6	8.7	5.1	
703		Τ4	26.5	29.5	29.4	24.0	21.2	20.4	13.5	9.8	8.1	4.8	
704							_			,			
		비서 의	itock_Ou	utput )	Fleet_	Outpu	t/ Su	mmary_	Output	/ Eco	: •	)	•

Figure 3.3.3. Stock and Fleet specific output by time period (from worksheet "FI\_Out\_Period")

	A	В	С	D	E	F	G	Н	1	J	К	-
12												
13												_
14		Trawle	r catch	ning Ca	d							
15		CATCH	INUMB	ERS - I	In-shore	e	- Dete	rministi	C			
16	Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2005	
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		Trawle	r catch	ning Ca	d							
29		FISHIN	IG MOR	TALITY	′ - In-sl	hore	- Dete	rministi	C			
- 30	Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2005	
- 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	-
	I D DK	Stock_	Output	) Flee	t_Outp	ut 🦯 🤅	Summary	/_Outpu	t / E			

Figure 3.3.4. Stock, Fleet and area specific annual output. (from worksheet "FI\_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 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	2 0	0	C	C	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	C	142	0	35	0
Crew Decomm.	0	0	5487.8	0	7109.6	i C	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	C	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	C	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	8 C	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	5 11.480	11.771	12.054	12.351	12.664
Number of Crew	C	0 0	0	0	C	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	<u>165</u>	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	<u>54</u>	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.

-	p.,	
-	-	

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
2004	10716	54250	100000	150015	275716
2005	10710	16067	102102	1100015	3/3/10
2006	-27260	10207	0/0//	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 I	Harvest - C	Sill 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
2002	1770	50068	05503	131218	240070
2003	45074	03300	90093	101210	240079
2004	-159/1	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
2011	76625	27065	1220	20205	1592/9
	10000		1000	20000	100010
Year etc	Minimum	Mean - SD	Mean	Mean + SD	Maximum
<b>Cash Flow Fi</b> Year	nancial Gove	rnment Trea	sury – Gill net		Marian
- 4 -	Winning	iviean - 3D	wean	Mean + SD	waximum
Cash Flow Ed Year	conomic Analy Minimum	ysis – Trawle Mean - SD	mean r Mean	Mean + SD Mean + SD	Maximum
Cash Flow Ed Year Cash Flow Ed Cash Flow Ed	conomic Anal Minimum conomic Anal	ysis - Trawle Mean - SD ysis - Gill net	Mean Mean	Mean + SD Mean + SD	Maximum
Cash Flow Ed Year Cash Flow Ed Cash Flow Ed Year etc	Conomic Analy Minimum Conomic Analy Minimum	ysis – Trawle Mean - SD ysis - Gill net Mean - SD	r Mean t Mean	Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum
etc Cash Flow Ed Year Cash Flow Ed Year etc Revenue – Tr	conomic Analy Minimum conomic Analy Minimum rawler	ysis – Trawle Mean - SD ysis - Gill net Mean - SD	Mean Mean Mean	Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum
Cash Flow Ec Year Cash Flow Ec Year Cash Flow Ec Year Revenue – Tr Year	Aninimum Minimum Conomic Analy Minimum awler Minimum	ysis – Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum
etc Cash Flow Ec Year Cash Flow Ec Year Revenue – Tr Year etc	conomic Analy Minimum conomic Analy Minimum rawler Minimum	ysis – Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum
etc Cash Flow Ec Year Cash Flow Ec Year etc Revenue – Tr Year etc Revenue – G	Aninimum Minimum Conomic Analy Minimum awler Minimum	ysis – Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum
Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Revenue – Tr Year Revenue – G Year	Minimum Minimum Conomic Analı Minimum awler Minimum Minimum	ysis – Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum
Cash Flow Eq Year Cash Flow Eq Year etc Revenue – Tr Year etc Revenue – G Year Year	conomic Analy Minimum conomic Analy Minimum awler Minimum ill net Minimum	ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum
etc Cash Flow Eq Year Cash Flow Eq Year etc Revenue – Tr Year etc Revenue – G Year etc SSB – Shrim	conomic Analy Minimum conomic Analy Minimum awler Minimum ill net Minimum	ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum
etc Cash Flow Ed Year Cash Flow Ed Year Revenue – Tr Year Revenue – G Year SSB – Shrim Year	conomic Analy Minimum conomic Analy Minimum minimum ill net Minimum p Minimum	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum
etc Cash Flow Eq Year Cash Flow Eq Year etc Revenue – Tr Year etc Revenue – G Year SSB – Shrim Year Year	conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum	Mean - SD ysis - Trawle Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum
Cash Flow Eq Year Cash Flow Eq Year etc Revenue – Tr Year Revenue – G Year etc SSB – Shrim Year SSB – Shrim Year	conomic Analy Minimum conomic Analy Minimum awler Minimum ill net Minimum p Minimum	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum
etc         Cash Flow Eq         Year        etc         Revenue – Tr         Year        etc         Revenue – G         Year	conomic Analy Minimum conomic Analy Minimum inimum ill net Minimum inimum inimum Minimum	Mean - SD ysis - Trawle Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum
Cash Flow Eq Year Cash Flow Eq Year etc Revenue – Tr Year etc Revenue – G Year etc SSB – Shrim Year etc SSB – Squid Year etc	conomic Analy Minimum conomic Analy Minimum awler Minimum ill net Minimum p Minimum	Mean - SD ysis - Trawle Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum
Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Cash Flow Eq Cash Flow Eq Cash Flow Eq Cash Flow Eq Year Cash Flow Eq SSB – Shrim Yield – Shrim Yield – Shrim	Aminimum Minimum Conomic Analy Minimum awler Minimum ill net Minimum Minimum Minimum	Mean - SD ysis - Trawle Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum
Cash Flow Ed Year Cash Cash Flow Ed Year Cash Cash Cash Cash Cash Cash Cash Cash	Conomic Analy Minimum Conomic Analy Minimum Cawler Minimum Minimum Minimum Minimum Minimum	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum
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	Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum 12244 17002 17109 14274	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD 22805 23367 21618 1865	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904
Cash Flow Ed Year Cash Flow Ed Year Cash Flow Ed Year Revenue – Tr Year Revenue – G Year Cash Flow Ed Year Cash Flow Ed Cash Flow Ed Cash Flow Ed Cash Flow Ed Cash Flow Ed Year Cash Flow Ed Cash Flow Ed Year Cash Cash Cash Cash Cash Cash Cash Cash	Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum Minimum Minimum Minimum 12244 17109 14274 11492	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD 22800 2336 21618 1865 15514	Mean           Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 38796
Cash Flow Ed Year Cash Flow Ed Year Cash Flow Ed Year Cash Flow Ed Year Cash Flow Ed Year Cash Flow Ed Year Cash Flow Ed Cash Flow Ed Cash Flow Ed Cash Flow Ed Cash Flow Ed Year Cash Cash Cash Flow Ed Year Cash Cash Cash Cash Cash Cash Cash Cash	Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum 12244 17109 14274 1492 9544	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD 2380; 21618 1865; 15514 13114	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 38796 51297
Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Year Cash Flow Eq Cash Flow Eq Cash Flow Eq Cash Flow Eq Cash Flow Eq Year Cash Cash Flow Eq Year Cash Cash Flow Eq Year Cash Cash Cash Cash Cash Cash Cash Cash	Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum Minimum 12244 17109 14274 11492 9544 9217	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD 22803 23363 21618 1865 15514 13114 11762	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 38796 51297 48093
	Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum 12244 17002 17109 14274 11492 9544 9217 7727	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 42462 39904 45959
	Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Conomic Analy Minimum Minimum Conomic Analy Minimum Minimum Conomic Analy Minimum Minimum Conomic Analy Minimum Minimum Conomic Analy Minimum Minimum Conomic Analy Minimum Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Conomic	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD 22809 23367 21618 1865 <sup>-</sup> 15514 13114 11762 10932 1018-	Mean           Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 42462 39904 42462 39904 45159 32878
	Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum Minimum 12244 17002 17109 14274 11492 9544 9217 7727 6774 6537	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD Mean - SD 2280 2336 2336 21618 1865 15514 13114 1176 10932 1018 237	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 38796 51297 48093 45159 32878 32111
	Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum Minimum 12244 17109 14274 1492 9544 9217 7727 6774 6505	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD 22808 23361 21618 1865 <sup>-</sup> 15514 13114 1176 <sup>-</sup> 1093 <sup>-</sup> 1018 <sup>-</sup> 937 <sup>-</sup> 9	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Max
etc           Cash Flow Eq           Year           Cash Flow Eq           Year           Revenue – Tr           Year           Revenue – G           Year           SSB – Shrim           Year           SSB – Squid           Year           Yield – Shrim           Year           2000           2001           2002           2003           2004           2005           2006           2007           2008           2010           2010	Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum 12244 17002 17109 14274 11492 9544 9217 7727 6774 6537 5605 5005	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD 1618 1865 15514 13114 1176 10932 1018 937 907	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 38796 51297 48093 45159 32878 32711 27575
	Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Conomic Analy Minimum Minimum Minimum Minimum Minimum Minimum 12244 17002 17109 14274 11492 9544 9217 7727 6774 6537 5605 6296	Mean - SD ysis - Trawle Mean - SD ysis - Gill net Mean - SD Mean - SD 1651 1655 1551 13114 13114 13	Mean Mean Mean Mean Mean Mean Mean Mean	Mean + SD Mean + SD	Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum Maximum 44489 45969 42462 39904 44489 45969 42462 39904 45159 32878 32111 27375 25565

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).

4444
------

Trawler         Gill Net           Financial Harvest N.P.Val. Cash.Fl.         Financial Govt. Tr. N.P.Val. Cash.Fl.         Financial Net Pre- sent Val. Cash.Fl.         Financial Harvest N.P.Val. Cash.Fl.         Economic Govt. Tr. N.P.Val. Cash.Fl.         Financial Govt. Tr. N.P.Val. Cash.Fl.         Economic Govt. Tr. N.P.Val. Cash.Fl.         Economic Govt. Tr. N.P.Val. Cash.Fl.         Economic Cash.Fl.         Financial Govt. Tr. N.P.Val.         Economic Cash.Fl.         Sent Val. Cash.Fl.         Cash.Fl. Cash.Fl.         Economic Cash.Fl.           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           Max         4459.4         2514.3         7329.9         7624.4         1253.4         9987.5           Max         4459.4         2514.3         7329.9         7624.4         1253.4         9987.5           The simulated range is divided into 25 intervals, and frequencies refer to these intervals         Sent Val.         Cash.Fl.         Govt. Tr. N.P.Val.         N.P.Val.         Govt. Tr. N.P.Val.         N.P.Val.         Govt. Tr. N.P.Val.         Sent Val.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.	Frequency in	100 simula	tions of Ne	et Prevent \	/alues					
Financial Harvest N.P.Val. Cash.Fl.         Financial Govt. Tr. N.P.Val. Cash.Fl.         Financial Set Val. Cash.Fl. Cash.Fl.         Financial Harvest N.P.Val. Cash.Fl.         Financial Govt. Tr. N.P.Val. Cash.Fl.         Economic Govt. Tr. N.P.Val. Cash.Fl.         Financial Govt. Tr. N.P.Val. Cash.Fl.         Economic Govt. Tr. 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         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. N.P.Val.         Economic Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.         Cash.Fl.			Trawler		Gill Net					
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         Govt. Tr.         N.P.Val.         Financial Govt. Tr.         Financial Harvest         Financial Govt. Tr.         Financial Cash.FI.         <		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.			
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         Gill Net         Economic         Financial         Govt. Tr.         N.P.Val.         Cash.Fl.	Mean	1333.9	2274.6	3387.4	4619.4	1050.0	6221.3			
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         Gill Net         Economic         Financial Govt. Tr.         Financial Govt. Tr.         Financial Cash.Fl.	Std.dev.	1185.8	77.7	1483.0	1139.7	72.0	1425.2			
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           Financial Harvest         Financial Govt. Tr.         Financial Cash.Fl.         Economic Cash.Fl.         Financial Cash.Fl.         Economic Cash.Fl.         Financial Cash.Fl.         Cash.Fl. </th <th>Min</th> <th>-1397.5</th> <th>2105.2</th> <th>6.6</th> <th>2049.1</th> <th>889.1</th> <th>3007.5</th>	Min	-1397.5	2105.2	6.6	2049.1	889.1	3007.5			
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           Financial Harvest         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. Cash.Fl.         Financial Cash.Fl.         Economic Sent Val.         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. Cash.Fl.         Financial Cash.Fl.         Financial Ca	Max	4459.4	2514.3	7329.9	7624.4	1253.4	9987.5			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Rel.Std.dev.	88.9	3.4	43.8	24.7	6.9	22.9			
Financial Harvest N.P.Val.         Financial Govt. Tr. N.P.Val.         Financial Govt. Tr. N.P.Val.         Financial Sent Val.         Financial Harvest sent Val.         Financial Govt. Tr. N.P.Val.         Economic Net Pre- sent Val.           1         1         0         1         1         1         1           2         0         1         0         1         1         1         1           2         0         1         0         1         1         1         1           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     <	The simulated r	ange is divid	ded into 25 i	ntervals, an	d frequencies	s refer to the	ese intervals			
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			Trawler			Gill Net				
Class indexCash.Fl.Cash.Fl.Cash.Fl.Cash.Fl.Cash.Fl.Cash.Fl.111011112010000310130343132425343343622211176371031081413134114941048781076711101111858565126106888		Financial Harvest N.P.Val.	Financial Govt. Tr. N.P.Val.	Economic Net Pre- sent Val.	Financial Harvest N.P.Val.	Financial Govt. Tr. N.P.Val.	Economic Net Pre- sent Val.			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Class index	Cash.Fl.	Cash.Fl.	Cash.Fl.	Cash.Fl.	Cash.Fl.	Cash.Fl.			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1	1	0	1	1	1	1			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2	0	1	0	0	0	0			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	3	1	0	1	3	0	3			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	4	3	1	3	2	4	2			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5	3	4	3	3	4	3			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	6	2	2	2	1	1	1			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	7	6	3	7	10	3	10			
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	8	14	13	13	4	11	4			
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	9	4	10	4	8	7	8			
11         8         5         8         5         6         5           12         6         10         6         8         8         8           13         4         4         4         3         4         3	10	7	6	7	11	10	11			
12         6         10         6         8         8         8           13         4         4         4         3         4         3	11	8	5	8	5	6	5			
	12	6	10	6	8	8	8			
	13	4	4	4	3	4	3			
<u>14 5 8 6 8 8 8</u>	14	5	8	6	8	8	8			
15 11 11 11 6 6 6	15	11	11	11	6	6	6			
	16	8	5	7	2	3	2			
<u>17 2 4 2 9 9 9</u>	17	2	4	2	9	9	9			
	18	3	2	3	6	7	6			
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	19	4	6	4	5	3	5			
	20	3	0	3	Ű	U	U			
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	21	U	2	0	0	0	Ű			
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	22	2	0	2	1	2	1			
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	23	U	<u> </u>	U	2	1	2			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	<u>24</u> 25	<u> </u>	<u> </u>	<u> </u>	U 2	1	0			

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".

MAIN MENU	
Evaluation	Frame for fishereis management systems
MAIN	CALCULATION MENU
Time of	last run: 27-03-2007 - 13:14:24
File Nam	e of last run : DEMON_5_Mig3
DEMONSTRATION EXAMPLE No	o. 5 - WITH FAKE DATA ( 2 Countries, (Number of fleets: Ct 1: 2 Ct 2: 2) 2
Stock(s), 5 Area(s), 10 Yea	r(s), dt = 1/4 years) , Circular movement (minimum 3 areas)
Select Table	<b>•</b>
Select Menu	
Select Worksheet	

Figure 4.1.1. The main menu for the calculation module.

#### **5.2. START CALCULATIONS**

Options			? ×
Transition	Custom Lists	Chart	Color
View	Calculation	Edit	General
Calculation			
C <u>A</u> utomatic	• Manual		Calc Now (F9)
C Automatic exce	ept <u>t</u> ables 🔽 Recal	c <u>ul</u> ate before save	Calc <u>S</u> heet

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).

,

	Select Table		1
	Select Menu	?	
	001 Start Up (Appears only when starting) - 002 Select simulation -		
F	003 Select Single simulation output - 004 Tuning -	_	
	005 Select Multiple simulation output - 006 Main menu -		

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	Dro processing of Fishing mortality on additional data 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.

BEAM_CALC_9_Apr01										
A B C	D	E	F	G	н	1	J	К	L	M —
1 Summary Output (Summary Outpu	lt)		11							<b></b>
2 BEAM 5	1			<b>RUN INFO</b>	DRMAT	ION:				
3 BioEconomic Analytical Model No. 5			-							
4 Version: OFFICE 2000 (21 Mar. 2001)			STARU	Date of t	nis run:	09-04-01	11:41			
5 Fisheries Department				Name of	Run:	DEMONSTRA	TION EX/		KE DAT	A ( 2 flee
6 FAO				Param. C	reated:	12:00:00 AM	00:00			
/ Note: Do not incert or delete rows or columns	hotsoo		olle	File Name	2:	DEMON_4	14:48			
• Note: Do not insert of delete lows of coldinas	Detween	genow c	ens							
SELECT SIMULATION TYPE	×	rfleet .	HELD. SE		DETERN	ATNISTIC STMI	ILATION.	Dage	1 of 1 Pa	nes
		Gill Net			DETER		JERTION	ruge	101110	iges
List of Tables	?	2009								
		53882								
		39644								
Goto Main menu	2		This opt	ion allocate	is the va	alue '1.0' to all st	ochastic ha	actors		
		-140	Th make	- opo cipala		ion and displays	detailed v	veulte in t	ho work d	
		E2100	It make:	s one single	simulau	ion and displays	decalled re	suits in t	ne work si	ieets:
Do not snow messages	Ľ	55100	1: Sur	omary Out	out Su	immary Output				
	1	53	2: Ecc	nomic Out	put Eco	nomic Output				
		53882	3: Sto	ck_Output	Annu	ial Stock Output	(summed)	over area	as)	
I uning of Model	?	100	4: Fle	et_Output	Annu	al Fleet Output (	summed a	ver area:	s)	
		365	5: Sto	chastic_Ou	tput Oul	tput from multipl	e stochast	ic simulat	ions	
One deterministic simulation	?	91	6: NP\	/_Output	OUTE	PUT OF NPV (Net	: Present \	/alue) Ou	tput multip	ole simulations
		17664	7: Tur	ning_Outpu	t Tuni	ng Output				
One stochastic simulation	2		8: Rui	es t	Sehaviou	ir Rules Output				
		umar f.	9: Ugi 10: SE	Ves Out Pario	Ugives ( d. Stor	Jucpuc :k output by time	period (c	ummed o	uer areac)	
Multine stochastic simulation	5	ryearn	11:50	Out Area		ual Stock output	by area (/	ummed o summed o	ver areas; over nerior	'  <)
i	Ŀ	2003	12: St	Out Per 4	Ar Sto	ck output by tim	e period a	nd area	nor ponot	
		224580	13: Fl	Out Period	f Flee	t output by time	period (su	mmed ov	er areas)	
Read Effort and capacity from	2	1468991	14: Fl	Out_Area	Annu	ual Fleet output l	by area (s	ummed o <sup>.</sup>	ver period	s)
worksheets		9083	15: Fl_	Out_Per_A	r Flee	et out				
		27031								
		309905				ОК				
Select Output	2	2064695								
		3532.2	3483.1	2638.4	2633.0	3 1970.5	1718.7	1354.2	2	
20 Mass Value Like 011 12 053 00	000 000	006 70	3162767	2440262	249501	1898551	1689504	1355438		
So         Mean value r Kg         Still 3         892.88           39         Number of Crew         8120         9029	9353	9724	308.02	329.83	397.30	J 363.47	383.00	11790	י ו	
40 Number of Boats	2826	2932	3565	3336	4039	3756	3937	3622	>	<b>•</b>
Summary_Output / Economic_Outp	out / S	itock_Out	put / Fl	eet_Outpul	: / Sto	ochastic_Output	/ NPV	•		

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.

Е	F	G	Н		J	K
<b>ALY</b>	TICAL	MODE	EL)			
	EFFORT EXCEE	DS CAPACIT	Y	×		STAR
	Input effort e	xceeds capaci	ity			
.E No.	Year 2001 Fleet Trawle Period 1	er		-	Areas, dt =	= 1/ 4 yea
<mark>n yell</mark> Mbine	Effort 1540 Capacity 150	37 562.5		-		
20(	Reduction Fac	tor .9774438	3		2008	200
8122				5	9870.5	11310
7038	Yes	No	Ca	ncel	7006.0	8007
4600				þ	4738.6	5199
1833	.1 2051.0	1883.6	1780.6	2187.0	2813.4	3262
610	.1 791.8	915.4	854.7	1008.2	1402.5	1920

# 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

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
	. 6	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 "quesstimates" 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  $\chi^2$ -criterion (Sokal and Rohlf, 1981)

$$\chi_X^2 = \sum_{Indices} \frac{\left(X_{Observed} - X_{Calculated}\right)^2}{X_{Calculated}}$$
(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  $\chi^2$  is minimised with respect of the indigenous parameters. "Indices" is a subset of the indices available in TEMAS<sup>1</sup> The most detailed version of Eq E.1.2.1 is achieved with the

<sup>1</sup> <sup>1</sup> :				
	Index	Explanation	Range	Note that the sequence of indices will be
1	а	Age group	$a = 0, 1, 2,, a_{max}(St)$	(FI, Vs, Rg, Ct, St, y, a, qa, Va, Ar) for all variables.
2	Ar	Area	$Ar = 1, 2,, Ar_{max}$	
3	Ct	Country	$Ct = 1, \dots, Ct_{Max}$	Time variables in alphabetical order

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

$$\chi_{Yield}^{2} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg} \sum_{St=1}^{St=1} \sum_{y=y_{first}}^{y_{last}} \sum_{a=1}^{a_{Max}(St)} \sum_{q=1}^{q_{Max}} \sum_{Va=1}^{Va_{Max}(Ct,Fl)Ar_{Max}} \sum_{Ar=1}^{Ar=1} \frac{(Y_{Londings}^{Obs}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar) - Y_{Landings}^{Calc}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar))^{2}}{Y^{Calc}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar)} +$$
(E.1.2.2)  
$$\frac{(Y_{Discards}^{Obs}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar) - Y_{Discards}^{Calc}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar))^{2}}{Y_{Discards}^{Calc}(Fl,Vs,Rg,Ct,St,y,a,q,Va,Ar)}$$

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.

$$\chi_{Yield}^{2} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs_{Max}(Fl,Ct)} \sum_{Rg=1}^{Rg_{Max}(Fl,Ct)} \sum_{St=1}^{Rg_{Max}} \sum_{y=y_{first}}^{y_{last}} \sum_{a=1}^{a_{Max}(St)} \sum_{q=1}^{q_{Max}} \sum_{Ar=1}^{Ar_{Max}} \sum_{q=1}^{Vr_{Max}(Fl,Ct)} \sum_{Rg=1}^{Vr_{Max}(Fl,Ct)} \sum_{Vs=1}^{Vr_{Max}(Fl,Ct)} \sum_{Ys=1}^{Vr_{Max}(Fl,Ct)} \sum_{St=1}^{Vr_{Max}(Fl,Ct)} \sum_{y=y_{first}}^{a_{Max}(St)} \sum_{q=1}^{q_{Max}(Fl,Ct)} \sum_{q=1}^{Vr_{Max}(Fl,Ct)} \sum_{Rg=1}^{Vr_{Max}(Fl,Ct)} \sum_{Vs=1}^{Vr_{Max}(Fl,Ct)} \sum_{Ys=1}^{Vr_{Max}(Fl,Ct)} \sum_{q=1}^{Vr_{Max}(Fl,Ct)} \sum_{q=1}^{Vr_{Max}(Fl,Ct)} \sum_{q=1}^{Vr_{Max}(Fl,Ct)} \sum_{q=1}^{Vr_{Max}(Fl,Ct)} \sum_{Vs=1}^{Vr_{Max}(Fl,Ct)} \sum_{Vs=1}^{Vr_{Max}($$

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.

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

$$\chi_{Yield}^{2} = \sum_{Ct=1}^{Ct_{Max}} \sum_{Fl=1}^{Fl_{Max}(Ct)} \sum_{Vs=1}^{Vs} \sum_{St=1}^{St=1} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{Ar=1}^{Ar_{Max}} \sum_{q=1}^{Ar_{Max}} \sum_{Ar=1}^{Q} \frac{(Y_{Landings}^{Obs}(Fl,Vs,\bullet,Ct,St,y,\bullet,q,\bullet,Ar) - Y_{Landings}^{Calc}(Fl,Vs,\bullet,Ct,St,y,\bullet,q,\bullet,Ar))^{2}}{Y^{Calc}(Fl,Vs,\bullet,Ct,St,y,\bullet,q,\bullet,Ar)}$$
(E.1.2.5)

4	FI	FI	Fleet	$FI = 1, 2, \dots, FI_{max}(Ct)$
5	q	q	Time period (as	$q = 1,,q_{max}$
			time)	
6	qa	qa	Time period (as	$qa = 1,,q_{max},$
			age)	
7	Rg	Rg	Rigging of gear	$Rg = 1,, Rg_{max}(FI, Ct)$
8	У	У	Year	$y = y_{firSt, yfirst} + 1, \dots, y_{last}$
9	St	St	Stock	$St = 1,,St_{max}$
10	Va	Va	Vessel age group	$Va = 1,Va_{max}(FI,Ct)$
11	Vs	Vs	Vessel size group	$Vs = 1,Vs_{max}(FI,Ct)$

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:

$$\chi^{2}_{Yield} = \sum_{St=1}^{St_{Max}} \sum_{y=y_{first}}^{y_{last}} \frac{(Y_{Landings}^{Obs}(\bullet, \bullet, \bullet, \bullet, St, y, \bullet, \bullet, \bullet) - Y_{Landings}^{Calc}(\bullet, \bullet, \bullet, \bullet, St, y, \bullet, \bullet, \bullet))^{2}}{Y^{Calc}(\bullet, \bullet, \bullet, \bullet, St, y, \bullet, \bullet, \bullet)}$$
(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
- (FI, 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.
- 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.

$$\chi_{N}^{2} = \sum_{St=1}^{St} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \sum_{a=1}^{a_{Max}(St)} \frac{(N_{Index}^{Obs}(St, y, q, a, Ar) - N_{Index}^{Calc}(St, y, q, a, A))^{2}}{N_{Index}^{Calc}(St, y, q, a, A)}$$
(E.1.2.7)

Where, for example,  $N_{Index}^{Calc}(St, y, q, a, Ar) = \frac{N(St, y, q, a, Ar)}{\sum_{i=1}^{a_{Max}(St)} N(St, y, q, i, Ar)}$  and the survey index is derived from,

say, catch per hour, CPUE<sub>Survey</sub>, 
$$N_{Index}^{Obs}(St, y, q, a, Ar) = \frac{CPUE_{Survey}(St, y, q, a, Ar)}{\sum_{i=1}^{a_{Max}(St)} CPUE_{Survey}(St, y, q, i, Ar)}$$

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

$$\chi^{2}_{SSB} = \sum_{St=1}^{St} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \frac{(SSB_{Index}^{Obs}(St, y, q) - SSB_{Index}^{Calc}(St, y, q))^{2}}{SSB_{Index}^{Calc}(St, y, q)}$$
(E.1.2.8)

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

$$\chi_{F_{MEAN}}^{2} = \sum_{St=1}^{St} \sum_{y=y_{first}}^{y_{last}} \sum_{q=1}^{q_{Max}} \frac{(F_{Mean}^{Obs}(St, y, q) - F_{Mean}^{Calc}(St, y, q))^{2}}{F_{Mean}^{Calc}(St, y, q)}$$
(E.1.2.9)

In theory, the  $\chi^2$  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.

$$\chi_X^2(X^{Obs}, P) = \sum_{Indices} \frac{(X^{Obs} - X^{Calc}(P))^2}{X^{Calc}(P)} = Minimum$$
(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



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	Count	ry	Fleet	Vessel size	Rig				
• 6	Count	ry	Fleet	Vessel size					
• 7	Count	ry	Fleet						
• 8	Country								
o 9	Total stock								

Use landings by period

	A	в	С	D	E	F	G	Н	I	J	К
1	Annual SSD= (Obs land - Simulated land)/(§	Simula	ated I	and):	Diff	betw	een V	Veiah	t of s	imula	ated ar 🗕
2	TUNING OF TEMAS						BUN I	NEORM	ATION	-	
3	Fualuation Frame for fisheries management systems										
4	Version EXCEL 2003 MS Visual Basis 6.3 - TEMAS: 15 A	ua 2007	,		_		Date o	of this r		13-11	
5	Marine Fisheries Denartment	ug 2001		124.			Name	of Bun	DEMO		TIONES
- A	Danish Tecnical Universit			4 4 4 7			Param	Creat		00-00	
7							File N	ame-	DEMO	N 5 M	ia3
8	Note: To change input parameters, start the INPUT-modul	e									
9											
10											
11	Table 8.1.1 . Begime 1-	Vest Co	od: ANN	UAL SSE	) (FI.Vs.F	Ra.Ct.Ari	BASIC	DATA			
12						- <u>j</u> ,					
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			
H -	Annual_SSD / Period_SSD / Annual_Land	l / Pe	eriod_L	and /	Annu	al_Obs	; <u>(</u> Pe	riod_C	bs /1	•	

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	Table 5.2.1	East cod: SIMULATED LANDINGS (FLVs.Rg.Ct.Ar), BASIC DATA
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10	Table 5.2.2	East cod: SIMULATED LANDINGS BY AREA, Aggregated (FI,Vs,Ct,Ar)
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111	Table 5.2.3	
ų,		
	Table 5.2.4	East cod: SIMULATED LANDINGS BY AREA, Aggregated (Ct,Ar)
l		
	Table 5.2.5	East cod: SIMULATED LANDINGS BY AREA, Aggregated (Ar)
- 10-	Table 5 2 6	East cod: SIMULATED LANDINGS (SUM OVER AREAS), Addregated (FLVs, Cf)
- 88	Table 5 2 7	East cod: SIMULATED LANDINGS (SUM OVER AREAS) Addregated (FL Ct)
100		
	l	
	Table 5.2.8	East cod: SIMULATED LANDINGS (SUM OVER AREAS), Aggregated (Ct)
		an an an an an an an an an an an an an a
	Table 5.2.8	East cod: SIMULATED LANDINGS (SUM OVER AREAS), Aggregated (Total stock)
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Figure 5.6.1. The tuning menu.

TUNING OF MODEL	X
Give number of Tuning simulations: (2) BH(New) = BH(old)*Land(Obs)/Land(Calc) Selection: All species - All Fleets	OK Cancel
0	

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:

$$\operatorname{Re} c(year, Period, Area) = \operatorname{Re} cDist_{Area} * \operatorname{Re} cDist_{Period} * \frac{BH1 * SSB(year - 1)}{1 + BH2 * SSB(year - 1)}$$

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<sub>Calculated</sub> = Effort \* (Reference catchability)\* Selection

First step is to calculate the tuning factor:

TuningFactor = F<sub>Tuning</sub>(Stock, period) / F<sub>Stock</sub>(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<sub>TUNING</sub>, 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	В	С	D	E	F	G	Н	1	J	K	L	м —
1	BEAM 5 (	BIO-E	CON	DMIC AN	IALY1	<b>FICAL</b>	MOD	EL)					<b>^</b>
2	OUTPU	T - T	<b>UNIN</b>	IG									
3	FAO, Fisheries	Departme	ent										
4	(Version 1.0 - 28	3 July 200	0)						SIA	RI			
5													
6	Name of Run:		DEMONST	<b>FRATION EXAM</b>	PLE No. 41	VITH FAKE	DATA (2)	leets, 2 Sto	oks, 2 Area	s, dt = 174 y	ears)		
7	Parameters Create	d:	1/9/2001	21:32		File Name:	DEMON_4	•					
8	Note: Do not in	sert or de	elete rows	or columns b	etween ye	llow cells							
9													
25	TOTAL OBSER	VED AND	CALCULI	ATED STOCK	FISHING	MORTAL	ITY (Sum	med over	fleets, are	eas and tii	ne periods	5)	
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		Calo.	.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 : T(	DTAL OB	SERVED A	ND CALCUL/	<b>TED STO</b>	DCK FISH	ING MOR	TALITY (S	Summed a	ver fleets	, areas an	d time pe	riods)
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 OBSER	VED AND	CALCUL/	ATED LANDIN	IGS (VEI	GHT) (Sun	nmed ove	r fleets, a	reas and (	ime perio	ds)		
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		Calo.	8001	5889	4798	4357	4005	4000	2617	2719	2725	2451	
45	Plaice	Observ.	61479	61479	61479	61479	61479	61479	61479	61479	61479	61479	
46		Calo.	656	574	535	519	498	521	343	343	330	283	
47													
48	Differences : T(	DTAL OB	SERVED A	ND CALCUL/	TED LA	NDINGS (1	VEIGHT)	(Summed	over fleet	is, areas a	nd time pe	eriods)	
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													
<u>52</u>			A 1 C	-Laska Ast	· / unu	L Outerst	· •	<b>0</b>	( Dulas /	A-1-1-1			
<u>I</u> ∎I4	II▶ NK Econo	mic_Outp	ut 🔏 Sto	chastic_Outpu	t <u>(</u> NPV	Output	λ l'uning	_Output /	(Rules /	Ogives /			

Figure 4.6.2. Selected output from Tuning.

The "diagnostics" are the relative differences between observations and model-predicted values:

$$Difference = 100 \frac{(Observed Value - Calculated Value)}{Calulated Value}$$
%

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.

Microsoft Visual Basic - BEAM_CALC_17Jan01.xls [break] - [M03_C_MAIN_CALC (Code)]						
K Eile Edit View Insert Format Debug Run Tools Add-Ins Window Help						
📉 🛅 - 🔚   ½ 📭 💼 🚧 🗠 ⇔ → II 🔹 💒 😫 😭 😤 🏷 😰 Ln 93, Col 1						
Project - VBAProj X	(G	ieneral) MAIN_SINGLE_DYNAMIC_SIMULATION				
		Dim year As Integer				
ter ter ter ter ter ter ter ter ter ter						
I H S runcres (I	<>	Open DirNm & "RUN_MESSAGES.TXT" For Output As #33				
🛛 🖃 🦓 VBAProje		Open DirNm & "RULES_MESSAGES.TXT" For Output As #34				
📄 🖻 😁 Microse		_				
		Call INITIALIZE DYNAMIC SIMULATION MAIN(Multiple Stochastic S:				
■ She						
She She ' The central year loop of BEAM 5						
		For year = 1 To Number of Years				
		(all SIMULATE BASIC STOCK DYNAMICS FOR ONE VEAD(mean)				
		Call SINGLATE DASIC_STOCK_DIWANTCS_FOR_OWE_TEAR(YEAR)				
		CALL MAKE FLEEL ECONOMICS AND TOTAL SUMMED OVER STOCKS (YES				

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.

🚰 Microsoft Visual B	asic - BEAM_CALC_17	Jan01.xls [break] - [M03	_C_MAIN_CALC (Code)]
∫🥞 <u>E</u> ile <u>E</u> dit ⊻iew ;	Insert Format Debug	<u>Run</u> <u>T</u> ools <u>A</u> dd-Ins <u>W</u> ind	low <u>H</u> elp
) 🐹 🛅 • 🖬 🛛 🐰	🖻 🖪 🖊 🗠 🗠	▶ <u>C</u> ontinue F5	🎙 🚰 🛠 😰 🛯 Ln 93, Col 1
Project - VBAProjX	(General)	∏ Brea <u>k</u> Ctrl+Break ■ <u>R</u> eset	MAIN_SINGLE_DYNAMIC_SIMUL
She	Dim year A:	Mode	
She She	🖙 🖒 🖒 🖒 🖒	& "RUN_MESSAGES.T	XT" For Output As #33
	Open DirNm	<pre>« "RULES_MESSAGES</pre>	.TXT" For Output As #34

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.

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Nr. 159-06	Optimering af fangstværdien for jomfruhummere ( <i>Nephrops norvegicus</i> ) – 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
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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.
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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.
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