Universiteit Antwerpen

CMRINPUT in EXCEL

DATA-INPUT FOR SMALL MAMMALS CAPTURE-MARK-RECAPTURE STUDIES

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Installation: Copy *CMRINPUTempty.xlsm* file to the hard disk, rename it with a meaningful name, open it with macros allowed/content enabled, complete information in worksheet "setup"

QUICK GUIDE FOR ENTERING NEW CAPTURE DATA

1. Open the file, if asked allow macros/ enable contents, select worksheet CMRALL3
2. On a new trapping day, first click the button New day, complete the information, click New Day OK
3. Then add new captures line by line:
   - Click New capture, complete the information in the light blue cells; use pull-down menus to select valid data entries
   - Click Check capture; if any red cells appear, correct them or check TOE-ID, repeat this until you are confident that data are OK; if necessary add remarks for new capture or comments for earlier capture(s)
   - Click Capture OK to confirm data

   Repeat this for every new capture
4. When done, save the file and quit Excel

Remember:
- Enter a New day for every day when traps were placed, **even if no animals were caught**!
- All trapped small mammals of **all species must be entered** in the database!
- Also animals that are found **dead in the trap must be entered** in the database!
- Treat captured animals **gently and with care**, release them at site of capture!

1 INTRODUCTION

1.1 General program description

CMRINPUT is an MS Excel-based program to facilitate the computer storage of CMR-data. The data are stored as "capture records", each capture record being the information collected during a single capture occasion of a given individual. The program provides easy input screens and has several routines to verify the validity of the entered data and intercept erroneous input, based on the characteristics of the study area and its species composition.

Note that the program does not perform any analysis of the recorded data and that it cannot be used to select or manipulate the stored information: the program is aimed at ensuring the quality of the routine data-input. However, the data are stored as a normal Excel-file, the data can easily be copied to another Excel-file and manipulated there.

This software was developed for entering the data that are collected during the routine capture-recapture studies in Morogoro, Tanzania. These studies are based on permanent study grids with trapping stations at regular intervals. Capture sessions are organised at regular intervals, and captured animals are marked and weighed and their sexual condition is noted before they are being released. The program was designed according to the usual working procedure followed in Morogoro but is easily adapted for working at other sites.

The program was written for studies in which animals are marked by toe clipping and it has several special functions for that purpose. However, the program can equally well be used with other means of identification (PIT-tag numbers, names,…).

1.2 Technical issues

CMRINPUT basically is a simple MS Excel file with three work sheets and some programmed macros in the file. Excel must be installed on the computer in order to use the program. The CMRINPUT file can be stored anywhere on the computer.

Depending on the security settings of your Excel-version, it may be necessary to choose “Allow macros” or “Enable content” when Excel asks for it upon opening the file. When macros are disabled in Excel, the program will not work. If the Excel security settings are so high that it does not even ask whether macros can be used, you will need to change the Excel settings (or ask your system administrator to do so).

In order to ensure the validity of the input data, the files are protected against changes. Data can only be entered using the program buttons (see below) and cannot be changed by just typing them somewhere. Also the structure and format of the worksheets and the program itself cannot be changed. If you are confident about you Excel-skills you can remove the protection (no password needed) for making specific changes, but this is not advisable.

If there is a need for additional copies of the program (e.g. for different studies), copy the empty CMRINPUT file and give it a different name or place it in a different directory.

The file contains three work sheets:

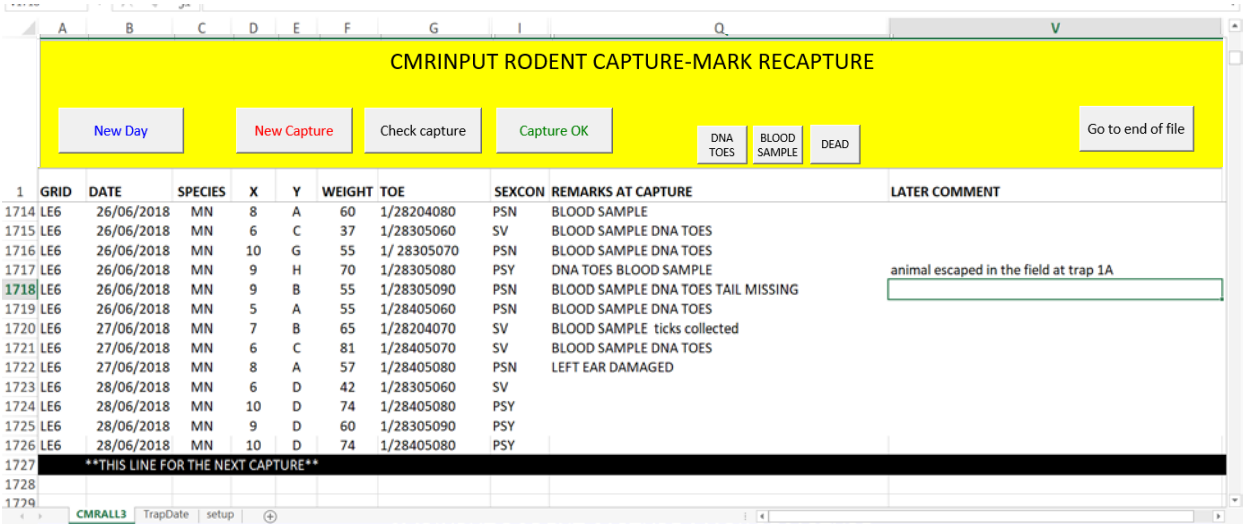
- **CMRALL3**: this is the worksheet where the capture data are stored and is the place where the different buttons are available for the different steps in the program.
- **TrapDate**: in this worksheet a list is kept of the trapping dates
- **setup**: this worksheet contains list of possible values for some of the columns; when entering data in CMRALL3, only values conforming to these lists are accepted, in order to avoid typing errors etc. The acceptable values may differ between studies (e.g. grid names and sizes, species abbreviations,…). The values are usually set at the start of a study and are only rarely changed.

While entering data, it is advisable to regularly save the file.

2 THE DIFFERENT WORKSHEETS

2.1 The main worksheet "CMRALL3"

The worksheet CMRALL3 is normally the one that is displayed when starting the program. In this worksheet, you can see the previously entered data, add comments to earlier captures and add new captures. Below is an example of this worksheet.



	GRID	DATE	SPECIES	X	Y	WEIGHT	TOE	SEXCON	REMARKS AT CAPTURE	LATER COMMENT
1714	LE6	26/06/2018	MN	8	A	60	1/28204080	PSN	BLOOD SAMPLE	
1715	LE6	26/06/2018	MN	6	C	37	1/28305060	SV	BLOOD SAMPLE DNA TOES	
1716	LE6	26/06/2018	MN	10	G	55	1/ 28305070	PSN	BLOOD SAMPLE DNA TOES	
1717	LE6	26/06/2018	MN	9	H	70	1/28305080	PSY	DNA TOES BLOOD SAMPLE	animal escaped in the field at trap 1A
1718	LE6	26/06/2018	MN	9	B	55	1/28305090	PSN	BLOOD SAMPLE DNA TOES TAIL MISSING	
1719	LE6	26/06/2018	MN	5	A	55	1/28405060	PSN	BLOOD SAMPLE DNA TOES	
1720	LE6	27/06/2018	MN	7	B	65	1/28204070	SV	BLOOD SAMPLE ticks collected	
1721	LE6	27/06/2018	MN	6	C	81	1/28405070	SV	BLOOD SAMPLE DNA TOES	
1722	LE6	27/06/2018	MN	8	A	57	1/28405080	PSN	LEFT EAR DAMAGED	
1723	LE6	28/06/2018	MN	6	D	42	1/28305060	SV		
1724	LE6	28/06/2018	MN	10	D	74	1/28405080	PSY		
1725	LE6	28/06/2018	MN	9	D	60	1/28305090	PSY		
1726	LE6	28/06/2018	MN	10	D	74	1/28405080	PSY		
1727	**THIS LINE FOR THE NEXT CAPTURE**									
1728										
1729										

To see the most recent data, click the grey button Go to end of file to see the latest captures, scroll up to see the earlier ones. The information in the worksheet is write-protected, you cannot overwrite the cells. Indeed, once the information about a capture is added and confirmed, it can no longer be changed. If at a later stage, the same day or later, you need to add or correct information, you can do this in the **Later comment** column, which has the only cells that you can write in. This is done to ensure that one always can go back to the original capture data, even if for some reason someone later thinks they were wrong .

In order to add a new capture, you will use the four grey buttons that each will initiate an action:

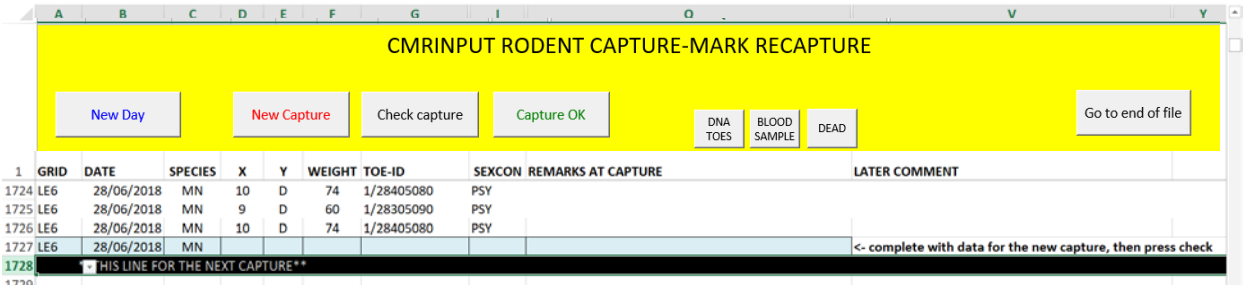
New day

This button must be clicked for a new trapping date, i.e. a date for which no capture data have been entered before, it will take you to the worksheet TrapDate (see below) where you will enter information about the trapping day, the number of traps placed etc… You need to do this only once for any given trapping day. The entered date must be later than 1/1/1994 and cannot be in the future.

If you placed traps, but nothing was caught, you still need to click this button and add the trapping day, so that it always remains possible to see that you did trap, but did not caught anything.

New capture

This button must be clicked for a new capture. The program will then add one empty line to the file (with a light blue background), where you can fill in the data for the new capture. Some information is copied from the previous line but can be overwritten if needed.



	GRID	DATE	SPECIES	X	Y	WEIGHT	TOE-ID	SEXCON	REMARKS AT CAPTURE	LATER COMMENT
1724	LE6	28/06/2018	MN	10	D	74	1/28405080	PSY		
1725	LE6	28/06/2018	MN	9	D	60	1/28305090	PSY		
1726	LE6	28/06/2018	MN	10	D	74	1/28405080	PSY		
1727	LE6	28/06/2018	MN							<- complete with data for the new capture, then press check
1728	HIS LINE FOR THE NEXT CAPTURE**									

For most columns, the data entry is restricted to specific values, that have been listed in the worksheet "setup". Entering an invalid value will cause an error message. Clicking on the small arrow next to the cell opens a small pull down menu where you can move up or down to select among the acceptable values. The weight is limited to a range defined in the "setup" worksheet.

GRID Can be any of the accepted grid names defined in worksheet "setup", e.g. MOR1, MOR2, ...

DATE The date of the capture, usually automatically filled in as the latest date entered as described above under the New day button. Only dates that have been defined before in the worksheet "setup" are accepted.

SPECIES Should be any of the accepted species name abbreviations defined in worksheet "setup", e.g. MN, LR, XX ...

X X-coordinate of the trap. Traps are assumed to be laid out in a square grid form, with the situation of each trap indicated with a row (x-coordinate) and column (y-coordinate) number.

Y Y-coordinate of the trap.

WEIGHT Body weight in g (no decimals needed); should be within the range defined in the "setup" worksheet. To minimise rounding errors, data can be entered to the nearest 0.1 g although the program itself will round the values to the nearest 1 g.

TOE-ID The toe clipping code or other unique identification for the captured individual. If it is an animal that you never trapped before, give it new toe clipping code (or other identification, e.g. a PIT tag)

SEXCON A code for the reproductive condition of the animal. This a is a two-letter code for males, a three-letter code for females. Based on this code, the program will recognise the individual's sex. The codes should be formed as follows:

males :	1st letter:	**A** (abdominal testes)	or	**S** (scrotal testes)
	2nd letter:	**N** (no swollen epidiymis)	or	**V** (swollen epididymis visible)
females :	1st letter:	**C** (closed vagina)	or	**P** (perforate vagina)
	2nd letter:	**S** (small nipples)	or	**L** (lactating)
	3rd letter:	**N** (not visibly pregnant)	or	**Y** (visibly pregnant)

Normally, the accepted combinations are defined in the worksheet "setup" and can selected from the pulldown menu next to this cell.

REMARKS AT CAPTURE any remarks, in plain English, that report something unusual or particular:

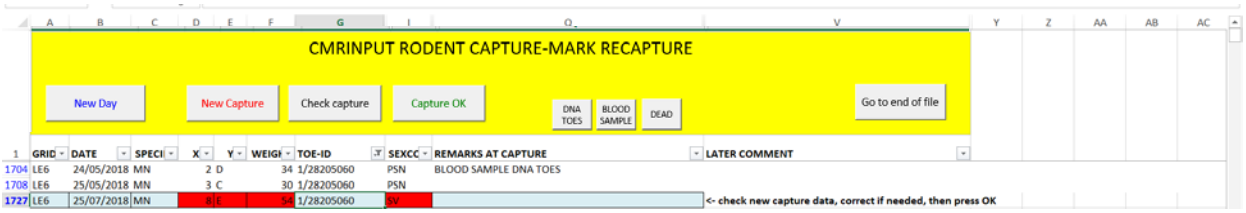
- characteristics useful for future identification of the animal (*e.g.* "tail tip lost", "toe 20 damaged",...)
- signs of disease, wounds or parasites (*e.g.* "fly maggot in abdomen", "left hind foot swollen", "right ear torn",...)
- information on multiple captures (see section 3.4)
- special manipulations (*e.g.* "toes kept for DNA", "radiotagged 151.457 MHz",...)
- anything else you think is worth reporting

Three frequently used remarks have been assigned to a grey buttons in the yellow screen top : DNA TOES, BLOOD SAMPLE and DEAD. Clicking the button inserts that remark.

After entering the capture data, these should be verified by clicking the Check Capture button;

Check Capture

Clicking this button lets the program check whether an animal with the same TOE-ID has been captured before, and if so, it will verify whether the time since that previous capture is not unusually long, whether there is an unusually large distance to the previous trapping station, whether there was an unusual weight change, or whether the animal was recorded as a different sex at the previous capture. The program lists the previous captures with the same TOE-ID and if it finds such suspicious data, it indicates in red the field where something may be wrong.



If cells are coloured red, double check that no errors were made, either in the red cells, or in the **TOE-ID** field. If something was entered wrongly, correct it and click again Check Capture. If necessary, repeat this until there are no more red cells, or until you are confident that despite any red cells, the information for this capture is correct.

Notice that you can only change data for the current capture. Even if you are convinced that an error was made at an earlier capture, you can no longer correct that error. Instead, you can add a comment in the **LATER COMMENT** cell for that previous capture.

Once you are convinced that the current capture data are correct, click Capture OK.

Capture OK

Click this button only after you have checked that the current capture data are OK. Once you have clicked this button, the capture are confirmed and stored in the file and can no longer be changed. If you later discover an error anyhow for this capture, you can add a remark in the **LATER COMMENT** cell.

2.2 Worksheet "TrapDate"

This worksheet is opened when the New Day button was clicked. Add the data of the new trapping day, indicate whether the trapping day is part of a regular trapping session (type "yes") or whether it is part of an occasional additional trapping effort (type "no"), add the number of traps and in the last column enter some information about the weather during the past night (e.g. "dry", "open sky, full moon",…) or additional remarks about the trapping day.

When done, click the button New Day OK

2.3 Worksheet "setup"

The CMRINPUT program uses information about the study grids and the species composition in the area to make sure that the data that are typed in are possible and that typing errors are reduced to a minimum. The program reads all necessary information for a study from the worksheet "**setup**". The settings can be changed in this worksheet, this is something that is usually done in the beginning of the study and should only be done by the Principal Investigator of the study.

SPEC A list of all allowed species abbreviations. Empty fields will be ignored. Species abbreviations are two characters wide and always capitals. During normal operation, the program will only accept abbreviations that are defined here. Often, an abbreviation "XX" is included as a species name for unusual species (which then can be further specified in the Remarks field).

X The allowed X-coordinates. Traps are assumed to be laid out in a square grid form, with the situation of each trap indicated with a row (x-coordinate) and column (y-coordinate) number.

Y The allowed Y-coordinates.

WE In the first line the minimum value for a valid body weight input, in the second line the maximum value

3 HOW DO I...

3.1 Correct earlier data

If you discover errors in a capture line that was entered and confirmed earlier, you can no longer correct the data files; However, you can always add something in the last column **LATER COMMENT**. Write a comment there about what you think is wrong, maybe why you think it is wrong and add your name or initials and a date so that one later still can see who added the comment. Date.

Indeed, the CMRINPUT philosophy is that data cannot be changed anymore once they have been entered and confirmed. This is so.to avoid accidental correction of capture records with no trace of what the original entry was. Of course, all data can be changed by removing the protection of the file, but that is something to be done only very cautiously by the researcher at the time of the data analysis, not during data entry.

3.2 Enter multiple captures

A multiple capture occurs when two or more individuals are trapped together in one trap. On such occasion, add a separate capture record for each animal as usual but add in the **REMARKS** field: "Together in trap with..." followed by the toe clipping codes of the animals that were together in the trap.

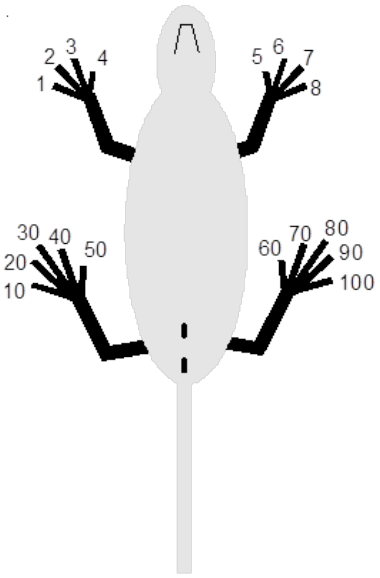
3.3 Enter a dead animal

If an animal dies in the trap or during manipulation, it can of course not be released. However, it is necessary to record it in the file anyhow, because it was present in the population before the capture, and it is also certain that it will never be recaptured again, something that is useful to know when estimating survival in the population.

Enter all capture data like for any other animal, but add “DEAD” in the **REMARKS** (or click the DEAD button). If the animal was not yet marked, give a TOE-ID anyhow and collect toe clippings like for other new individuals. If the animal was returned to the trap alive, but turned out to have died when releasing it in the field, find the record in the CMRALL3 worksheet and add “DEAD upon release” in the **LATER COMMENT**.

3.4 Construct toe clipping codes

The toes are numbered 1-4 and 5-8 on the right and left front feet respectively and 10-50 and 60-100 on the right and left hind feet respectively, always counted from left to right when the animal is held on its back (see figure). The clipped toes are always read in the same sequence and are typed without any spaces or symbols between the toes, *e.g.* 26106090. If an animal is very peculiar, *e.g.* and leg is absent, then the toe clipping code may be some words, *e.g.* "no left front leg".



The program maintains a database of all used toe clipping codes. If new animals are to be marked, refer to a list with toe clipping codes (or use the provided toe clipping labels). Normally, only one toe per fore paw and maximum two toes per hind foot are clipped. Only the upper one phalanx of a toe is to be clipped and all clippings of an individual are stored in an eppendorf tube with alcohol for later DNA work. A narrow paper label with the toe clipping code written in pencil (!) is also put in the tube; remember to write also the series number on the label (see below); at the back of the paper strip, write the grid name and the date.

Because of the large number of individuals in long-term studies, the same toe clipping codes must be used again after some time (after about 2300 individuals have been clipped). The program distinguishes between the different consecutive series of toe clipping codes by adding a series number in front of the toe clipping code, *e.g.* 1/4850 or 2/4850. The observer obviously cannot see on the individual to which series it belongs. However, animals marked with a toe clipping code have normally died when that toe clipping code is used again.

3.5 Solve unknown toe clipping codes

Unknown toe clipping codes occur when an animal (whether or not previously toe clipped) has lost additional toes. First of all, check again whether all seemingly clipped toes are really cut; if a toe is only wounded or the toenail is broken off, then try using an alternative toe clipping code, disregarding that one problematic toe. If the resulting toe clipping code exists and the capture history makes sense, then add a new capture record for this toe clipping code, mentioning in the *Remarks* field that "toe nr ... is damaged". Since wounds do heal and toenails do regrow, it is likely that next time you won't see anything special anymore on the animal.

If the toes are really cut, then check whether you see any differences between the toes. Maybe one of the cuttings is fresh while the others are old, maybe one of the toes is cut unusually high or low, etc.... If this is the case, then try using an alternative toe clipping code, disregarding that one suspicious toe. Alternatively, try different toe clipping codes, each time disregarding one of the clipped toes (*e.g.* if toe clipping code 2310307090 does not exist, try 23103070, 23103090, 23107090, 23307090,...); carefully verify the capture histories for each of these toe clipping codes until you find one with which you are really satisfied. If you are reasonably sure that you have found the original toe clipping code, then add a new capture record for that toe clipping code and mention in the *Remarks* field: "Was toe clipping code..." followed by the old toe clipping code. Also add a comment to the previous capture records for this toe clipping code, mentioning to what toe clipping code it has changed. From now on, the animal will be identified by its new toe clipping code.

If you cannot with certainty find the original toe clipping code for the animal, then act as if you are adding a first capture record for a new animal and enter the toe clipping code to the one that you actually see on the animal and mention "New toe clipping code; original unknown" in the *Remarks* field. Cut a piece of the tail (0.5 cm) and store it, with a label with the toe clipping code, in a tube with alcohol for later DNA work. From now on, the animal will be identified by its new toe clipping code.

3.6 Solve toe clipping code conflicts

A toe clipping code conflict occurs when two or more animals have the same toe clipping code simultaneously. You will notice this when you trap two such animals on the same day, or when you notice from the capture history that a certain toe clipping code is often changing sex, species, weight, home range,... The following is a list of suggestions on what you should do:

- Double-check the toe clipping code but also sex, trap co-ordinates, etc.: maybe the capture history does not make sense because you made a mistake looking at the animal. Also consider where the capture history does not correspond to your present observation of the animal. Maybe you made a mistake the previous time in recording the sex (especially in young animals) or you typed, by habit, for example 'MN' for the species while it should have been another species code. In such cases, there is no toe clipping code conflict. Just add the new capture record and make sure to store the right data this time; put a small note in the *Remarks* field in which you explicitly confirm the correct observation. Never change the previous capture record, unless you have proof that you made a mistake there (*e.g.* when the notes on your papers show that you made a mistake when entering the data).
- If you trap an animal with a toe clipping code that you have already seen that day, verify both animals, also the first one. If you misread the TOE-ID of the first one, then first correct that mistake: add a **LATER COMMENT** mentioning the correct TOE-ID. Then add, as usual, a new capture record for the second animal.
- If you are sure that there actually are two different animals with the same toe clipping code, there are two possible solutions:
    - If the two animals can be easily and permanently recognised (because they are different sexes or belong to different species), you can keep the toe clipping code for both animals. For one of them, however, you must from now on always add a letter "B" to the toe clipping code

(*e.g.* 4630100 becomes 4630100 B) and add that information to the **REMARKS**. Of course, when an animal is captured again later, you won't be able to see whether this is the "B"-animal. However, when you look at the capture history for this toe clipping code after clicking Check Capture., the capture histories of both animals will be shown and a letter "B" will be in front of the appropriate capture records. You must then decide from that information whether the animal you have captured should get the "B" or not.

- In all other cases, you must clip one or more additional toes of one of the animals so that the animal will in the future be recognised by another toe clipping code: change the TOE-ID to the one that you now actually see on the animal. Make sure however that the new toe clipping code is not yet in use by another animal so that you don't create a new conflict.

- Whatever the solution you have used, you should try to find the original toe clipping code of the animal for which you added "B" to the code or cut additional toes. The conflict can have arisen because an animal has lost additional toes. The conflict can also have arisen because toes were wrongly clipped; try different toe clipping codes in which you change one of the toes at a time. If you find the original toe clipping code, then mention in the **REMARKS** field of the animal with the changed toe clipping code "Was toe clipping code..." followed by the old toe clipping code. Otherwise, then mention "New toe clipping code; original unknown", cut a piece of a tail (0.5 cm) and store it, with a label with the toe clipping code, in a tube with alcohol for later DNA work.

4 DATA STRUCTURE AND MANIPULATION

This section provides information for the researchers analysing the data. It involves removing the protection of the worksheets and **is not part of the normal CMRINPUT procedures.** Unless the researcher is well experienced in Excel and has at least basic knowledge of Excel macro-language, it is advisable to make a copy of the CMRINPUT xlsm file, work in that copy and leave the original file untouched.

The columns on the worksheet "CMRALL3" show the information entered for each capture. However, the program actually stores also some information calculated from the entered data. For example the program assigns a value for sex (M or F) depending on the information in the SEXCON column. The additional data is stored in the file in hidden columns, so that it is not normally visible. Of course the columns can be made visible when analysing the data: It is advisable to copy all data to another Excel-file, unhide all columns in that file.

Structure for CMR-data

Column	Field Name	Contents
A	GRID	grid name
B	DATE	capture date
C	SPECIES	species abbreviation
D	X	trap x-coordinate in grid
E	Y	trap y-coordinate in grid
F	WEIGHT	weight (g)
G	TOE/ID	individual code
H	SX	sex (M/F)
I	SEXCON	reproductive condition (
J	TE	testes (Abdominal/Scrotal)
K	GU	swollen epididymis (Visible/Non-visible)
L	VA	vagina (Closed/Open)
M	NI	nipples (Lactating/Small)
N	GR	pregnant (Yes/No)
O	TC	trapping code (1-4 – see footnote)
P	TAG	tag (tag number for dead animals, if they are kept)
Q	REMARKS AT CAPTURE	remarks at capture
R	HAB	not used at present
S	MONTH	month as yydd
T	WEEK	week number (starting from week 1 in January 1994)
U	AGE	reproductive stage (subadult/adult)
V	LATER COMMENT	comments that are added later, not at time of capture

TC, the "trapping code" is automatically assigned as follows:

1: unmarked animal, marked and released
2: marked animal, released
3: unmarked animal, not released
4: marked animal, not released

Cell W1 on the worksheet "CMRALL3" is a hidden cell, it contains the line number of the last capture record in the list. When lines with capture data are added or deleted manually in this worksheet, the value in cell W5 must be changed accordingly. Afterwards, column W should be hidden again and the worksheet protected again in order to run the macros correctly.