

THE MATRIX - primary data

Q18													
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Date	Marking	Area	Group_coverage	ID								
2	14/04/2014	3	A	1.0	BB9172								
3	17/05/2014	2	A	0.7	B50A152								
4	17/05/2014	2	B	0.7	B810261								
5	24/05/2014	3	A	0.8	B810261								
6	24/05/2014	3	B	0.8	A1B8122								
7	25/05/2014	3	A	0.3	BB9B1								
8	25/05/2014	4	B	0.3	B506171								
9	25/05/2014	3	B	0.3	B506241								
10	25/05/2014	3	B	0.3	B604211								
11	09/06/2014	3	A	0.9	BB9001								
12	09/06/2014	2	B	0.9	B7071A2								
13	11/06/2014	3	A	0.3	BB9B1								
14	11/06/2014	3	B	0.3	B506241								
15	11/06/2014	2	B	0.3	B606262								
16	11/06/2014	3	B	0.3	A11082A2								
17	11/06/2014	0	B	0.3	AAB06111								
18	11/06/2014	2	B	0.3	AAB06112								
19	11/06/2014	3	B	0.3	A98082AB								
20	22/06/2014	2	A	0.7	BB9001								
21	22/06/2014	3	B	0.7	BB9171								
22	22/06/2014	1	B	0.7	AAB06221								
23	02/07/2014	3	A	1.0	B406082								
24	02/07/2014	3	B	1.0	A1206092								
25	02/07/2014	2	B	1.0	A1B7155								
26	13/07/2014	2	A	0.5	B7071A2								
27	13/07/2014	2	B	0.5	B810261								

THE MATRIX - primary data

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22	22/06/2014	1	B	0.7	AAB06221								
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25	02/07/2014	2	B	1.0	A1B7155								
26	13/07/2014	2	A	0.5	B7071A2								
27	13/07/2014	2	B	0.5	B810261								

Column names always start with CAPITOL letters

Never spaces between words

Date always as FIRST column
ID always as LAST column

THE MATRIX - supplemental data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID	Sex												
2	21506271	M												
3	21508091	M												
4	21607191	F												
5	21607221	F												
6	21706211	F												
7	21707051	F												
8	21710111	F												
9	21710112	F												
10	21808221	F												
11	21809161	M												
12	216092A1	F												
13	218060A1	F												
14	2AB0801A	F												
15	2AB08081	F												
16	2AB080A1	M												
17	2AB10051	M												
18	A1008261	F												
19	A11082A2	F												
20	A1206091	M												
21	A1206092	F												
22	A1206191	F												
23	A1206192	F												
24	A12062A1	M												
25	A1208122	F												
26	A120812A	M												
27	A120812B	M												

THE MATRIX - supplemental data

ID always as FIRST column

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1	ID	Sex												
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3	21508091	M												
4	21607191	F												
5	21607221	F												
6	21706211	F												
7	21707051	F												
8	21710111	F												
9	21710112	F												
10	21808221	F												
11	21809161	M												
12	216092A1	F												
13	218060A1	F												
14	2AB0801A	F												
15	2AB08081	F												
16	2AB080A1	M												
17	2AB10051	M												
18	A1008261	F												
19	A11082A2	F												
20	A1206091	M												
21	A1206092	F												
22	A1206191	F												
23	A1206192	F												
24	A12062A1	M												
25	A1208122	F												
26	A120812A	M												
27	A120812B	M												

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27	13/07/2014	2	B	0.5	B810261								

The individual called '**BB9172**' has been captured on **April the 4th 2014**, it has been captured in the study area '**A**' and it was pretty marked (**Marking 3**). **All the animals in the group have been photographed** (only 1 individual)

The individual called 'BB9172' has been captured on **April the 4th 2014**, it has been captured in the study area 'A' and it was pretty marked (**Marking 3**). **All the animals in the group have been photographed (only 1 individual)**

Home Insert Page Layout Formulas Data Review View Add-Ins

Cut Copy Paste Format Painter Clipboard

Arial 10 Bold Italic Underline Font

Wrap Text Merge & Center Alignment

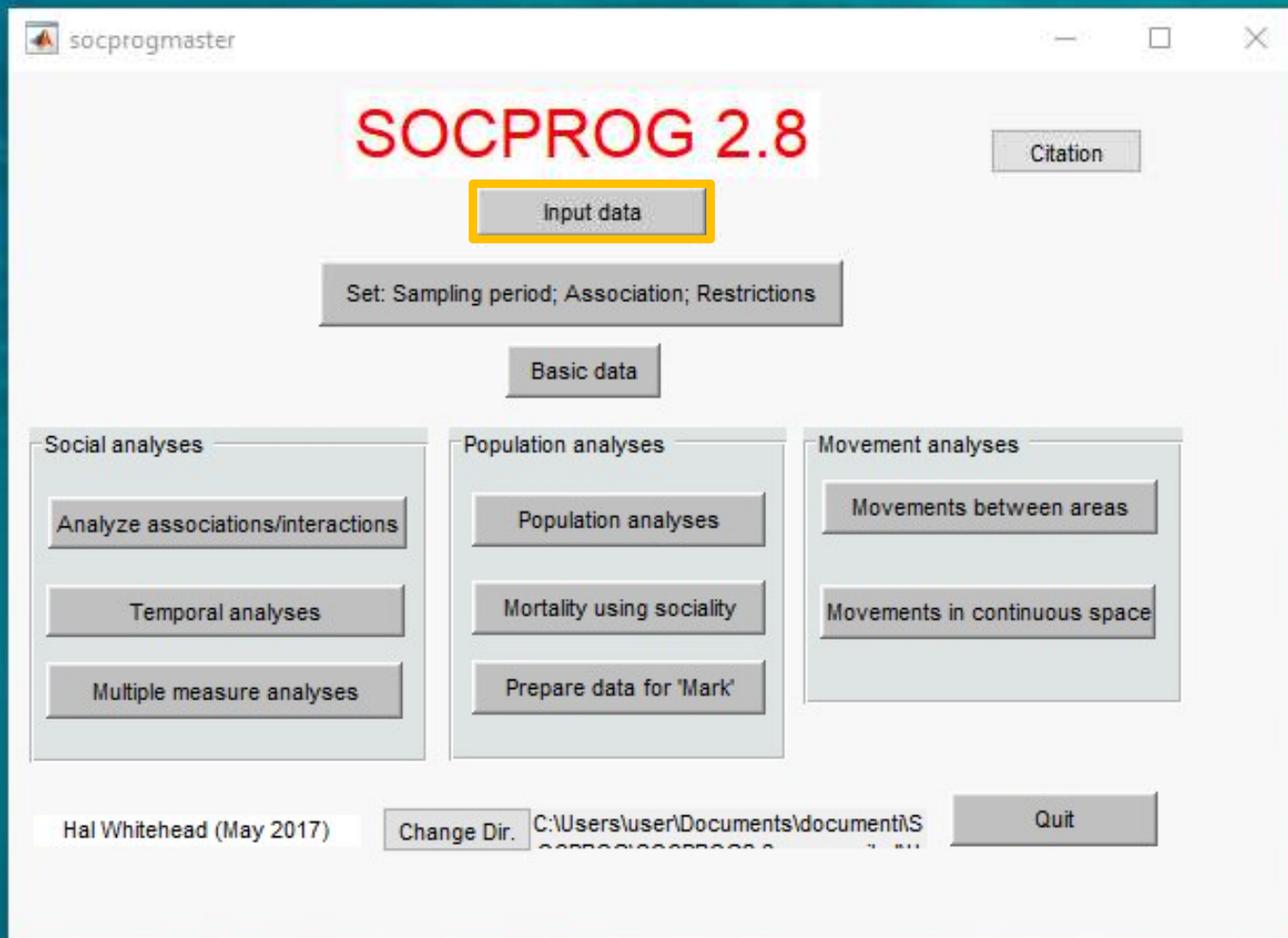
Date Number

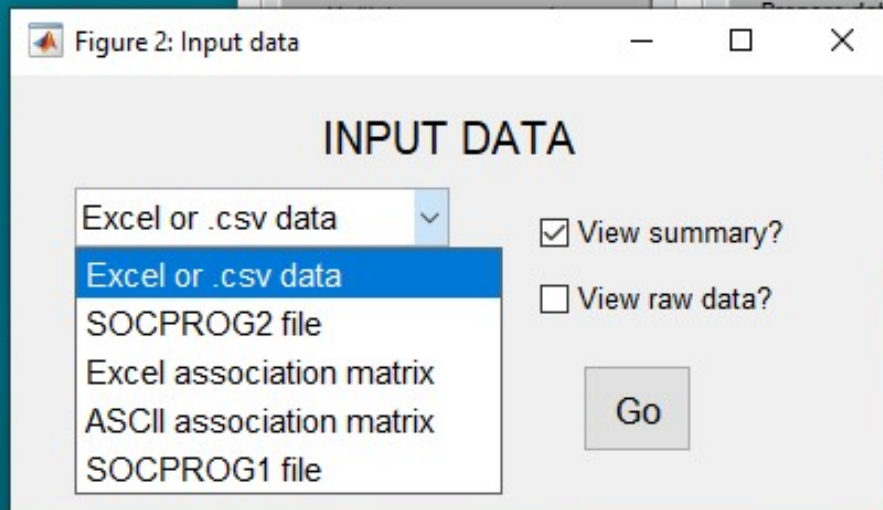
Conditional Formatting as Table Cell Styles Styles

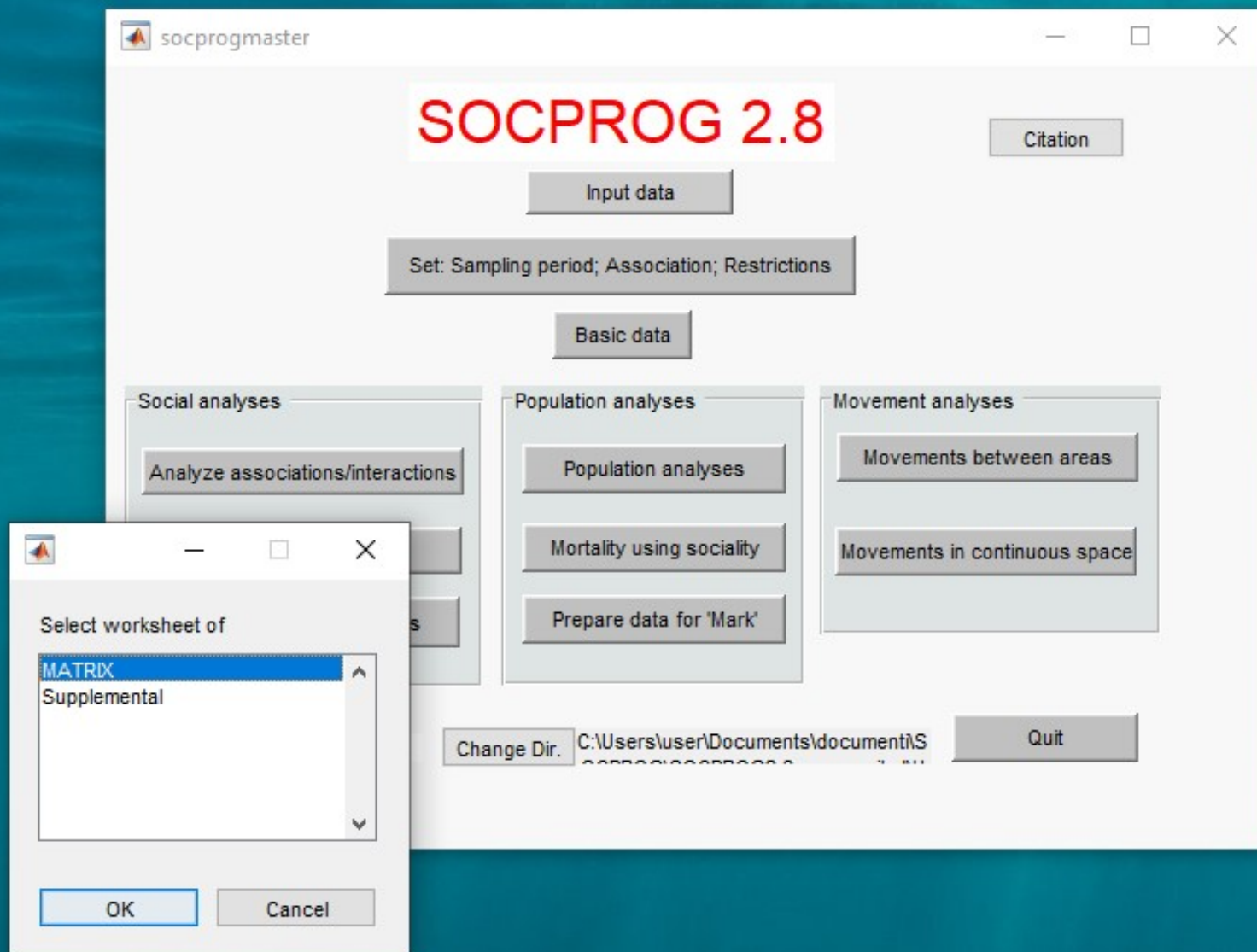
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25	02/07/2014	2	B	1.0	A1B7155								
26	13/07/2014	2	A	0.5	B7071A2								

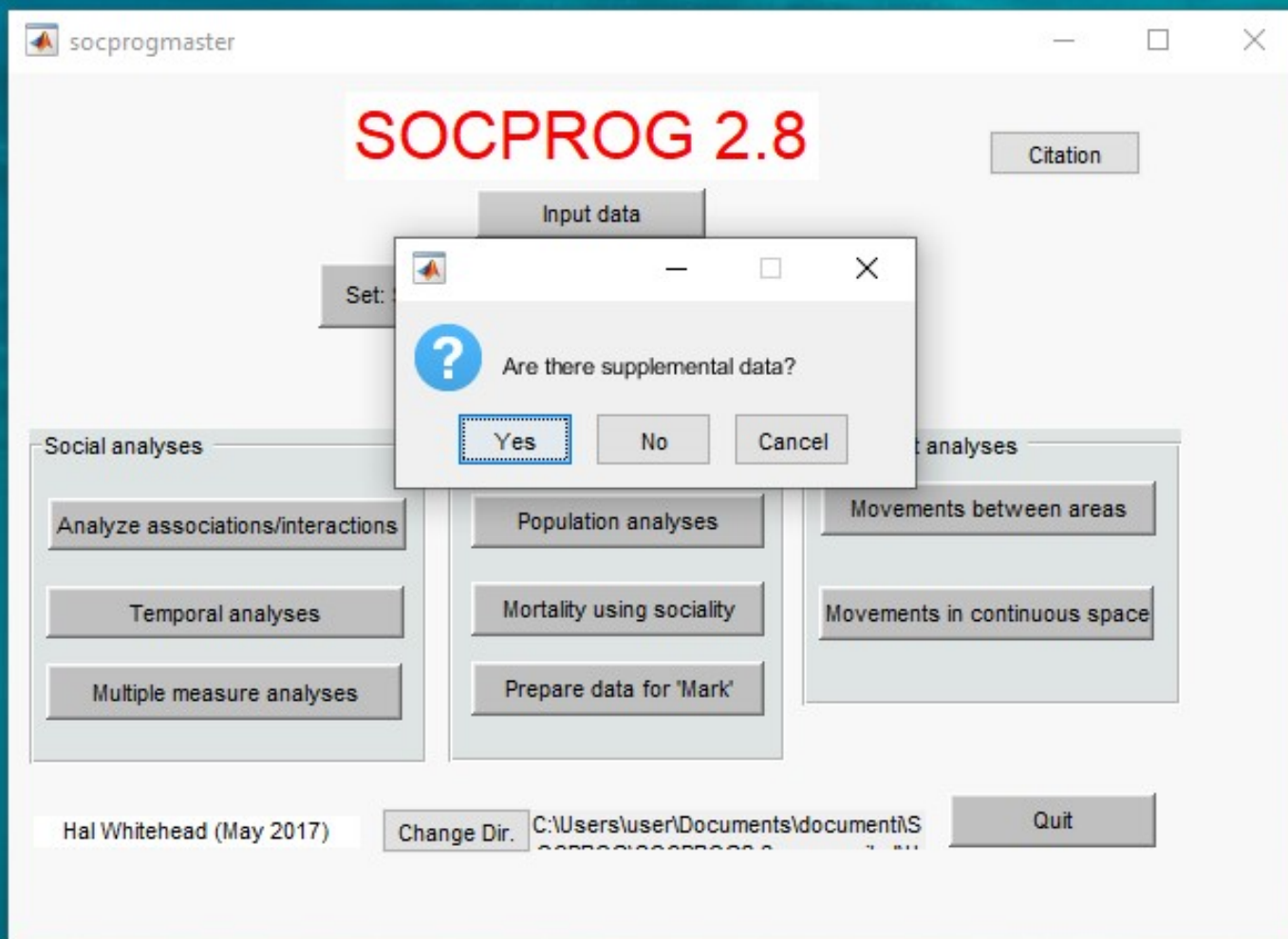
The individual called '**B506171**' has been captured on **May the 25th 2014**, it has been captured in the study area '**B**' and it was very well marked (**Marking 4**). **Only the 30% of the animals in the group have been photographed** (3 out of 9 individuals)

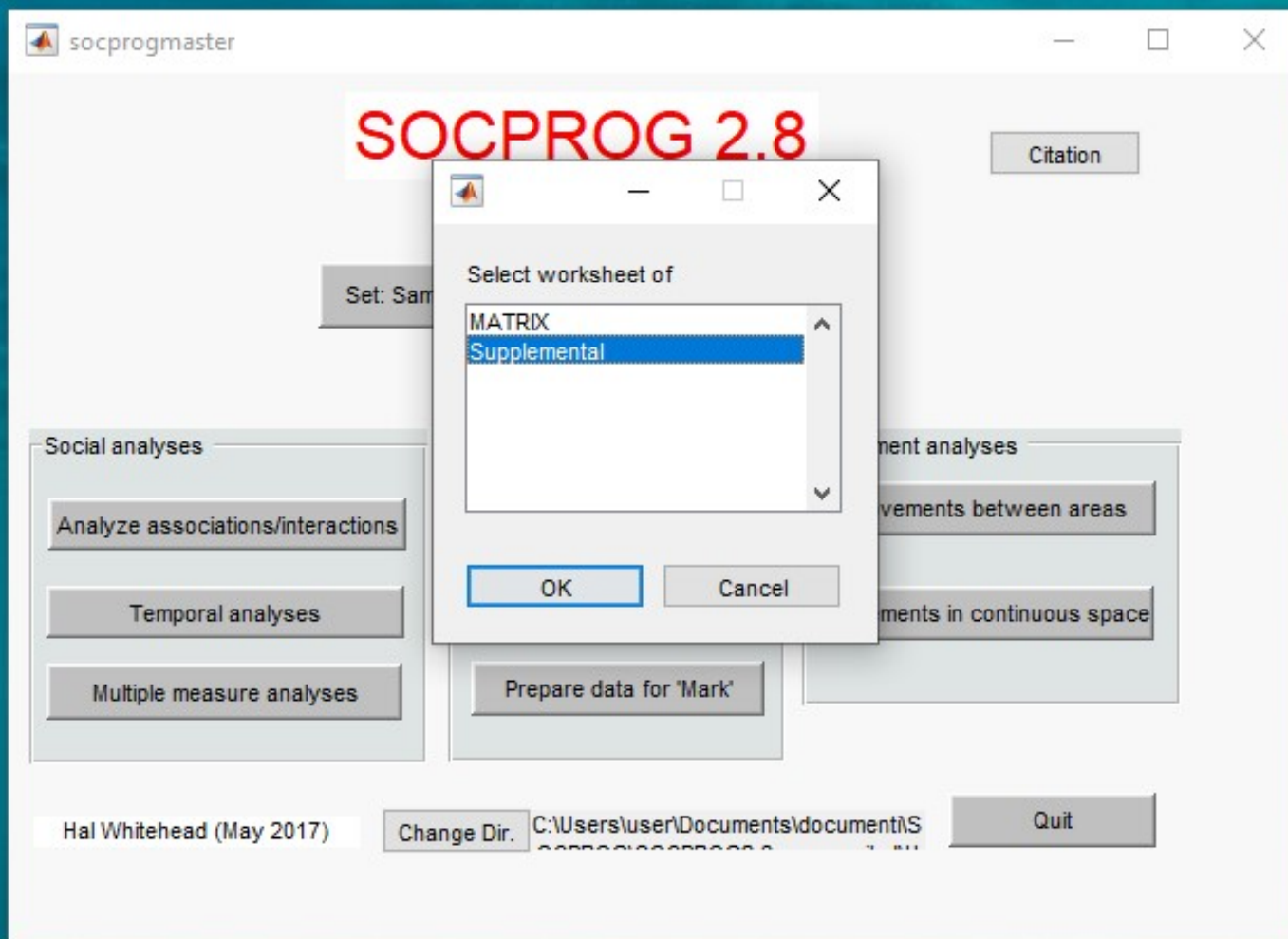
DATASET INPUT

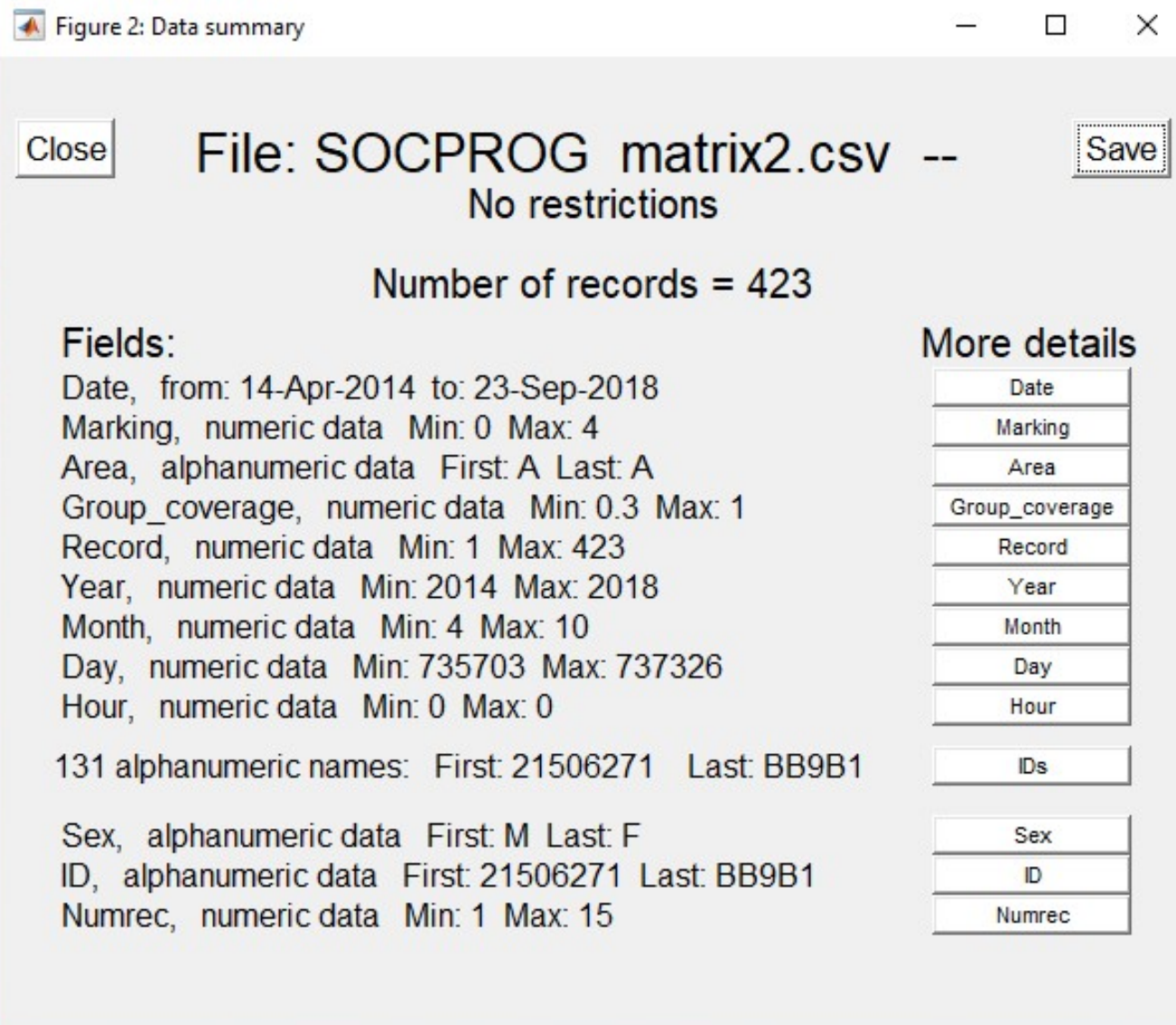


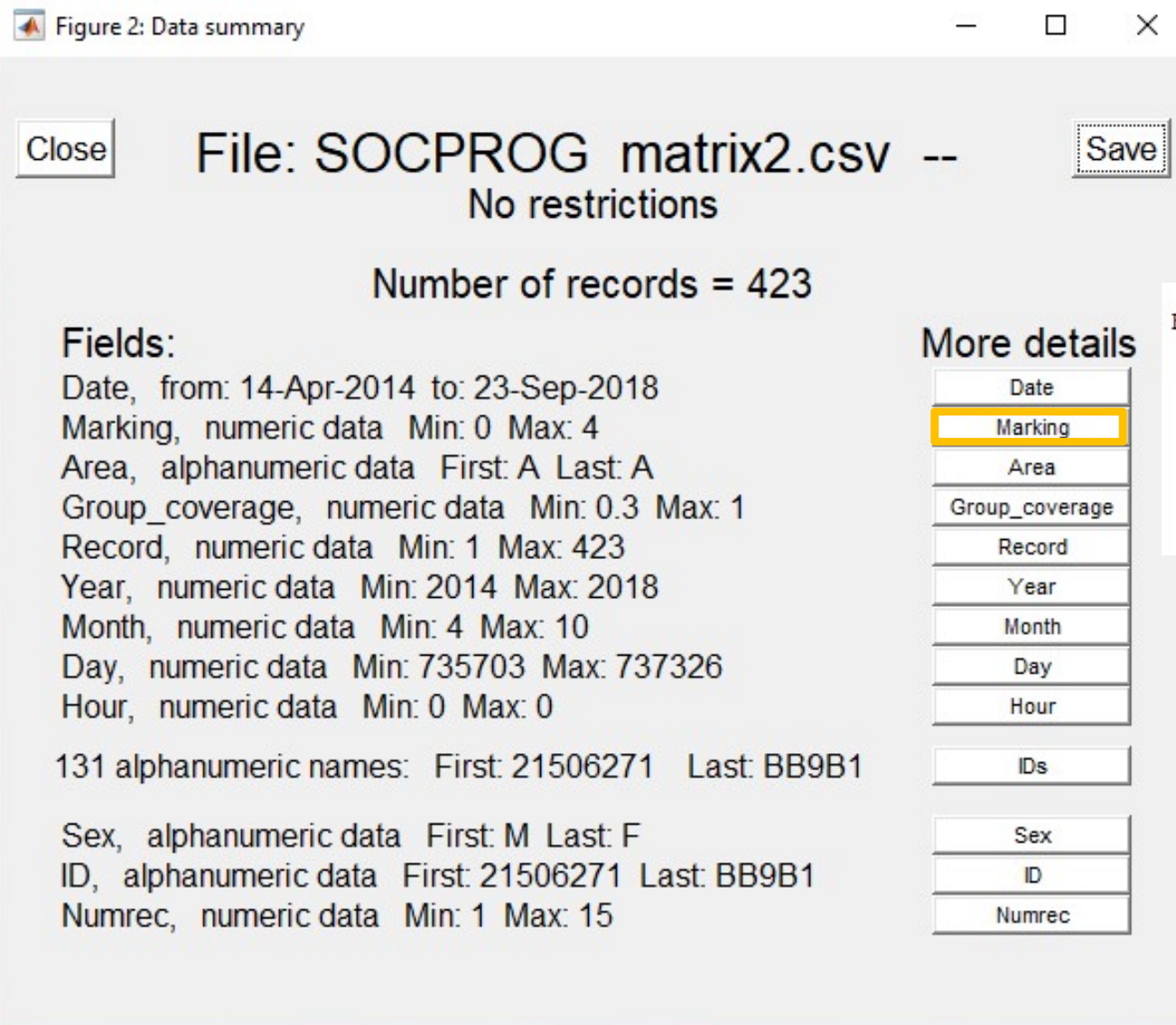






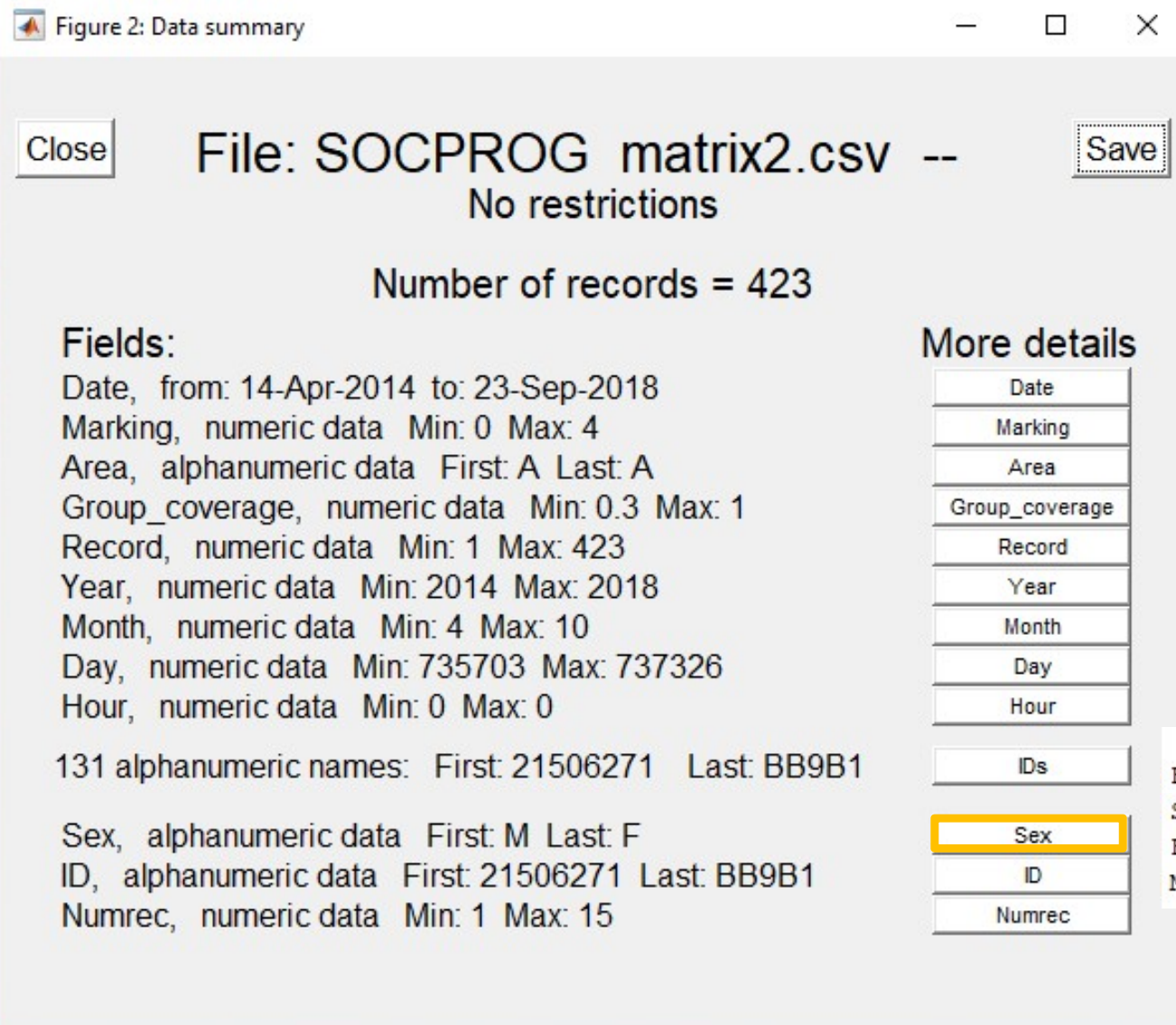






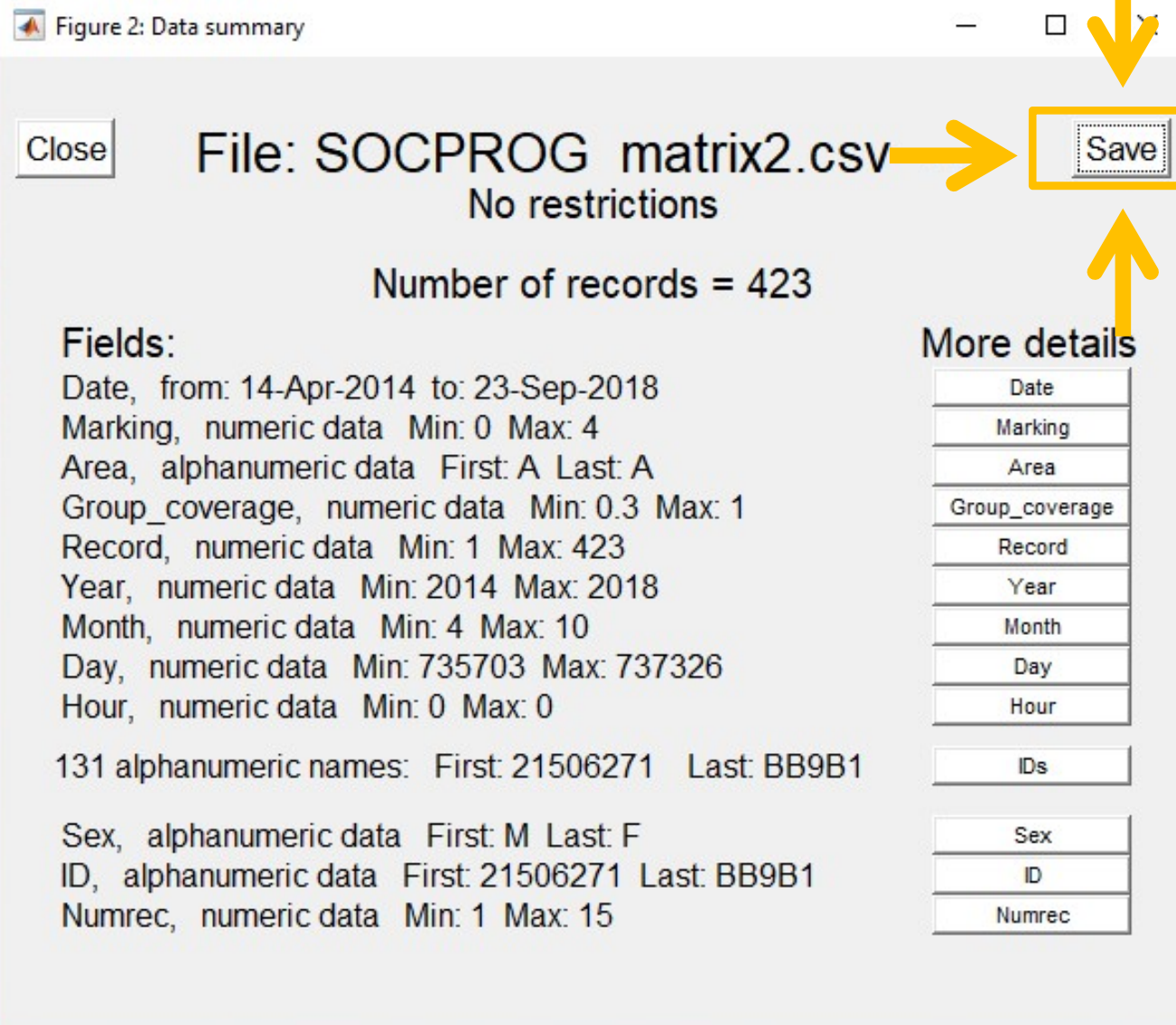
File: SOCPROG_matrix2.csv -- No restr

Marking	Records
0	34
1	32
2	203
3	152
4	2

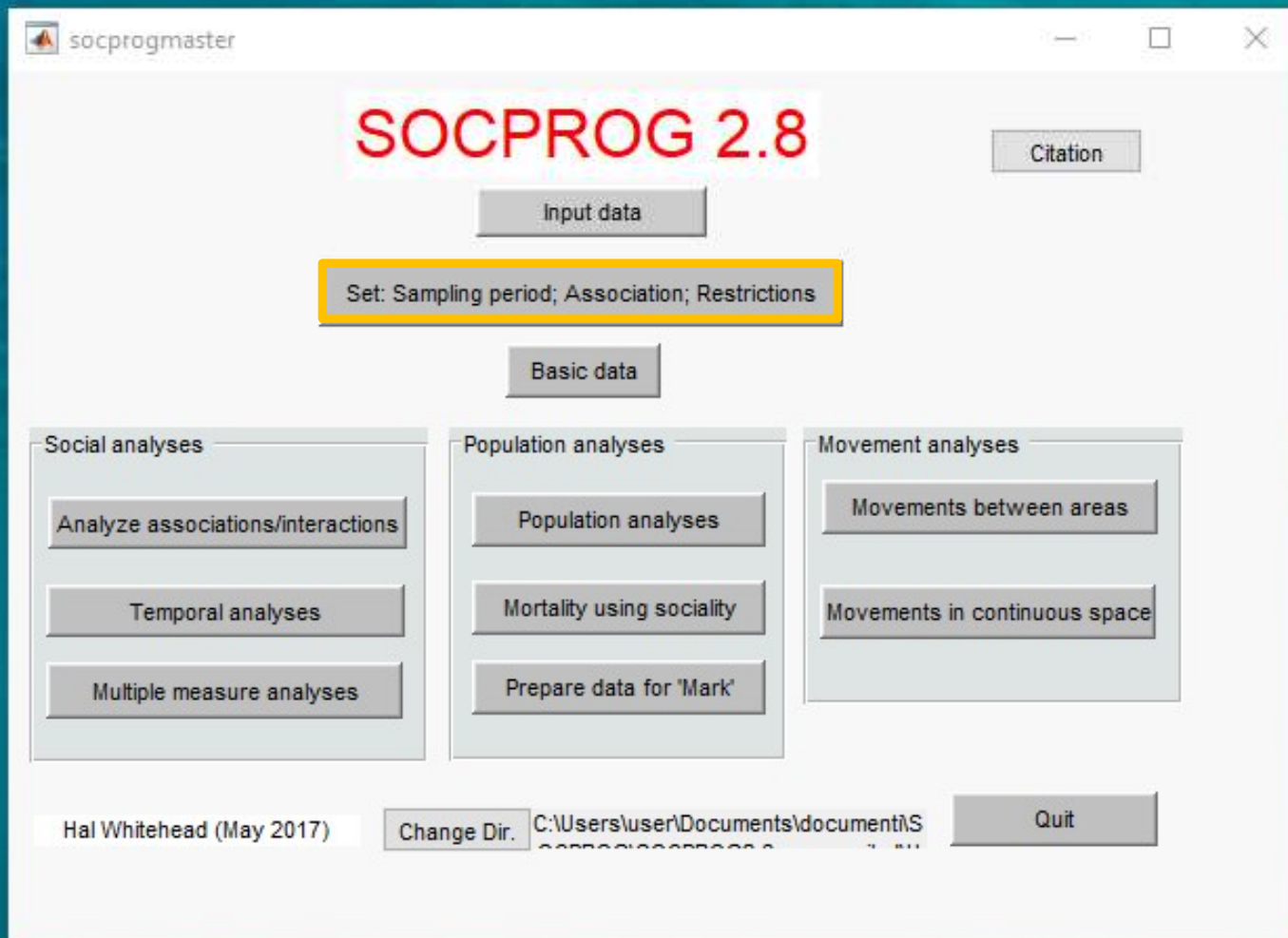


File: SOCPROG_matrix2.csv -- No restr

Sex Individuals	
F	73
M	58



SET DATA RESTRICTIONS





Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec

Sampling period (none set)

Day

Set

Define association:

Group variable

Set

Group variable:

Date

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Set

Figure 2

File Edit View Insert Tools Desktop Window Help



Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec

Sampling period (none set)

Day

Set

Define association:

Set

Group variable

Group variable:

Date

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Set

Figure 2

File Edit View Insert Tools Desktop Window Help



Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour
Sample

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec
Numsamp

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Set

Figure 2

File Edit View Insert Tools Desktop Window Help



Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour
Sample

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec
Numsamp

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Set

s

s

Figure 2

File Edit View Insert Tools Desktop Window Help



See the Manual @page 19

Year<1992

<- 1992 and subsequent years are omitted

(Month>4)&***(Month***<8)

<- May-July only

~((Sample>1)&***(Sample***<8))

<- just sample 1, and from 8 on

strcmp(Behaviour,'G')

<- just when *Behaviour* is 'G'

Record>100

<- just records 101 and on

Similarly, on the right you can make restrictions using the supplemental fields (attributes of individuals) which restricts the individuals that are used in subsequent analyses. e.g. enter:

~strcmp(Sex,'F')

<- no females

strncmp(ID,'Q',1)

<- just individuals for whom the first character of the ID is 'Q'

(Numrec>20)'&***strcmp(Sex,'M')***

<- males with at least 21 records

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Set

Figure 2

File Edit View Insert Tools Desktop Window Help



Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour
Sample

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec
Numsamp

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Marking>1

s

Individuals (Supplemental fields)

strcmp(Sex,'M')

s

Set

Figure 2

File Edit View Insert Tools Desktop Window Help



Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour
Sample

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec
Numsamp

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Marking>1

s

strcmp(Sex,'M')

s

Set

Figure 3: Data summary

Close

File: SOCPROG matrix2.csv -- Save

Marking>1 & strcmp(Sex,'M')

Number of records = 145

Fields:

Date, from: 25-May-2014 to: 16-Sep-2018

Marking, numeric data Min: 2 Max: 4

Area, alphanumeric data First: B Last: B

Group_coverage, numeric data Min: 0.3 Max: 1

Record, numeric data Min: 7 Max: 422

Year, numeric data Min: 2014 Max: 2018

Month, numeric data Min: 5 Max: 10

Day, numeric data Min: 735744 Max: 737319

Hour, numeric data Min: 0 Max: 0

Sample, numeric data Min: 2014 Max: 2018

40 alphanumeric names: First: A1206091 Last: BB9174

Sex, alphanumeric data First: M Last: M

ID, alphanumeric data First: A1206091 Last: BB9174

Numrec, numeric data Min: 1 Max: 15

Numsamp, numeric data Min: 1 Max: 5

More details

Date

Marking

Area

Group_coverage

Record

Year

Month

Day

Hour

Sample

IDs

Sex

ID

Numrec

Numsamp

View data

Restricted

Summary

Save

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Marking>1

s

strcmp(Sex,'M')

s

Set

Figure 3: Data summary

Close

File: SOCPROG matrix2.csv --

Save

Marking>1 & strcmp(Sex,'M')

Number of records = 145

File: SOCPROG_matrix2.csv -- Marking>1 & strcmp(Sex,'M')

Marking	Records
2	84
3	60
4	1

Record, numeric data Min: 7 Max: 422

Year, numeric data Min: 2014 Max: 2018

Month, numeric data Min: 5 Max: 10

Day, numeric data Min: 735744 Max: 737319

Hour, numeric data Min: 0 Max: 0

Sample, numeric data Min: 2014 Max: 2018

40 alphanumeric names: First: A1206091 Last: BB9174

Sex, alphanumeric data First: M Last: M

ID, alphanumeric data First: A1206091 Last: BB9174

Numrec, numeric data Min: 1 Max: 15

Numsamp, numeric data Min: 1 Max: 5

More details

Date

Marking

Area

Group_coverage

Record

Year

Month

Day

Hour

Sample

IDs

Sex

ID

Numrec

Numsamp

View data

Restricted

Summary

Save

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Marking>1

s

strcmp(Sex,'M')

s

Set

Figure 3: Data summary

Close

File: SOCPROG_matrix2.csv --
Marking>1 & strcmp(Sex,'M')

Save

Number of records = 145

File: SOCPROG_matrix2.csv -- Marking>1 & strcmp(Sex,'M')

Marking	Records
2	84
3	60
4	1

PLAY WITH THE RESTRICTIONS:

**Area 'A' only and marking >0
and only Females**

Record, numeric data Min: 7 Max: 422

Year, numeric data Min: 2014 Max: 2018

Month, numeric data Min: 5 Max: 10

Day, numeric data Min: 735744 Max: 737319

Hour, numeric data Min: 0 Max: 0

Sample, numeric data Min: 2014 Max: 2018

40 alphanumeric names: First: A1206091 Last: BB9174

Sex, alphanumeric data First: M Last: M

ID, alphanumeric data First: A1206091 Last: BB9174

Numrec, numeric data Min: 1 Max: 15

Numsamp, numeric data Min: 1 Max: 5

More details

Marking

Area

Group_coverage

Record

Month

Day

Sample

IDs

Sex

ID

Numrec

Numsamp

View data

Restricted

Summary

Save

Sampling period (Year)

Reset

Define association:

Reset

Group variable:

Date

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

Individuals (Supplemental fields)

Set

Marking>1

strcmp(Sex,'M')

SOLUTION

Close

File: SOCPROG matrix2.csv --
(Marking>0)&strcmp(Area,'A') & strcmp(Sex,'F')

Save

Number of records = 91

Fields:

Date, from: 14-Apr-2014 to: 23-Sep-2018
Marking, numeric data Min: 1 Max: 4
Area, alphanumeric data First: A Last: A
Group_coverage, numeric data Min: 0.3 Max: 1
Record, numeric data Min: 1 Max: 423
Year, numeric data Min: 2014 Max: 2018
Month, numeric data Min: 4 Max: 10
Day, numeric data Min: 735703 Max: 737326
Hour, numeric data Min: 0 Max: 0
Sample, numeric data Min: 2014 Max: 2018

37 alphanumeric names: First: 21607191 Last: BB9B1

Sex, alphanumeric data First: F Last: F
ID, alphanumeric data First: 21607191 Last: BB9B1
Numrec, numeric data Min: 1 Max: 8
Numsamp, numeric data Min: 1 Max: 5

More details

Date
Marking
Area
Group_coverage
Record
Year
Month
Day
Hour
Sample

IDs

Sex
ID
Numrec
Numsamp

Records (Primary fields)

(Marking>0)&strcmp(Area,'A')

s

Individuals (Supplemental fields)

strcmp(Sex,'F')

s

Reset

LET'S START THE ANALYSIS

Close

SET: Sampling Period; Association Type; Restrictions

Raw data

Restricted

Summary

Save

Primary Data Fields (s=string)

Date
Marking
Area (s)
Group_coverage (s)
Record
Year
Month
Day
Hour
Sample

Supplemental Data Fields (s=string)

Sex (s)
ID (s)
Numrec
Numsamp

Sampling period (Year)

Year

s

Reset

Define association:

Group variable

Reset

Group variable:

Date

s

Association type:

Grouped in sampling period

Restrictions on:

Records (Primary fields)

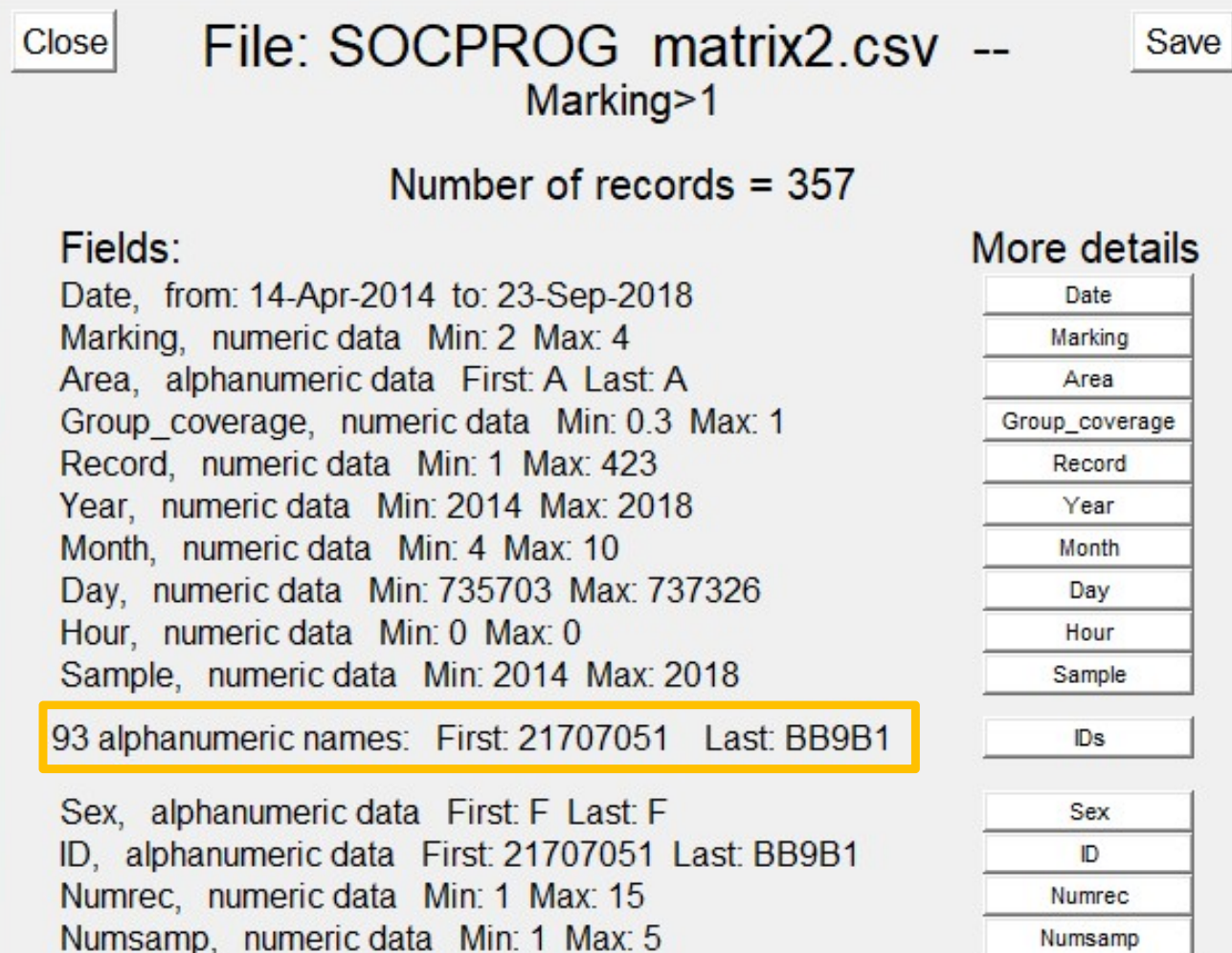
Marking>1

s

Individuals (Supplemental fields)

Set

Figure 3: Data summary



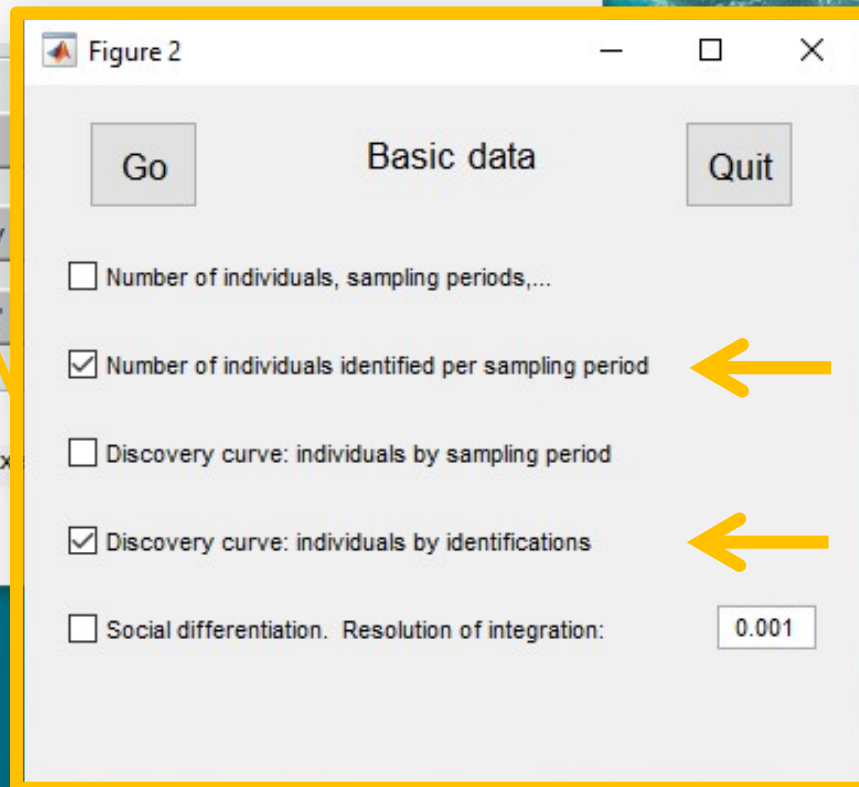
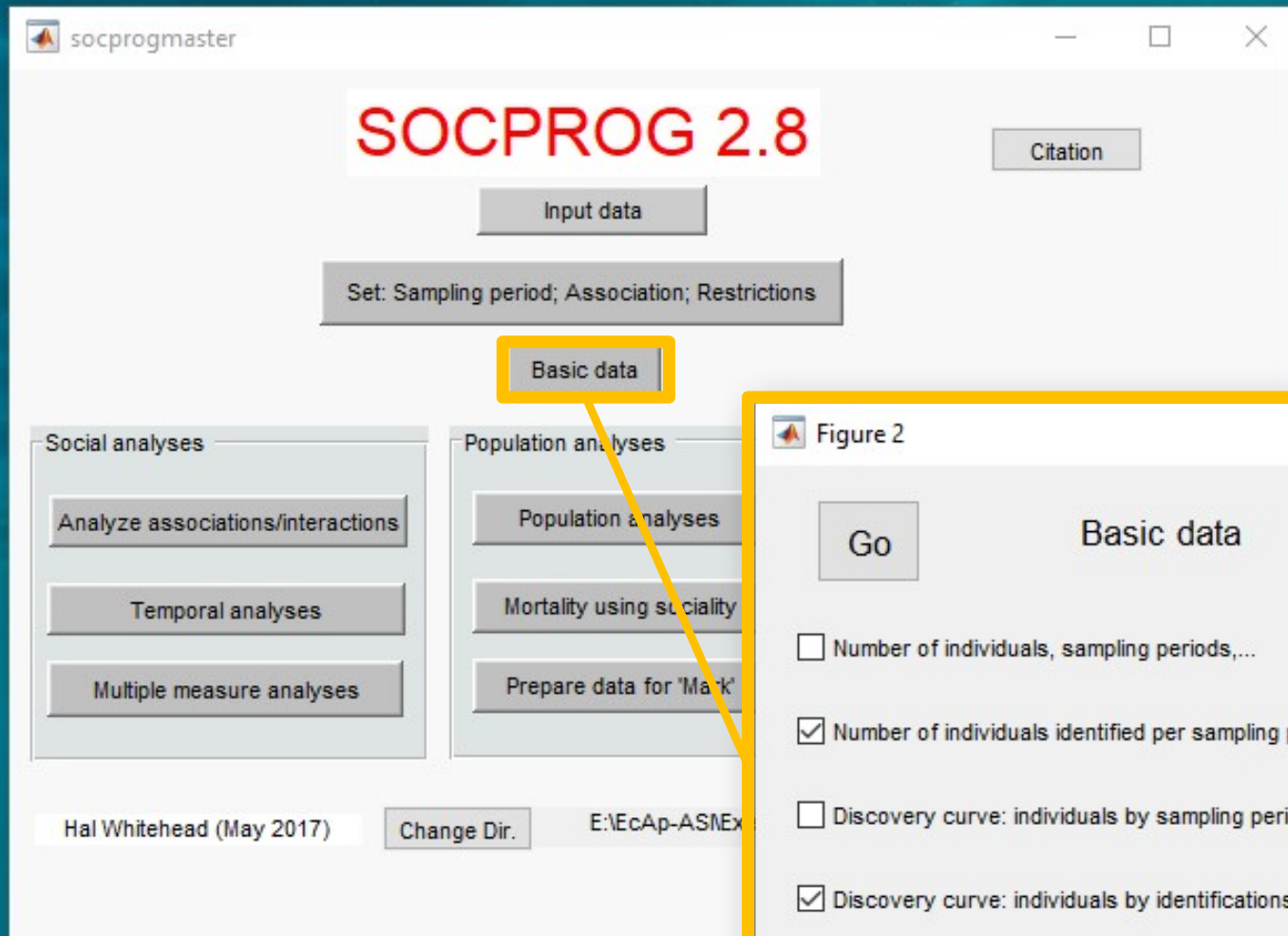
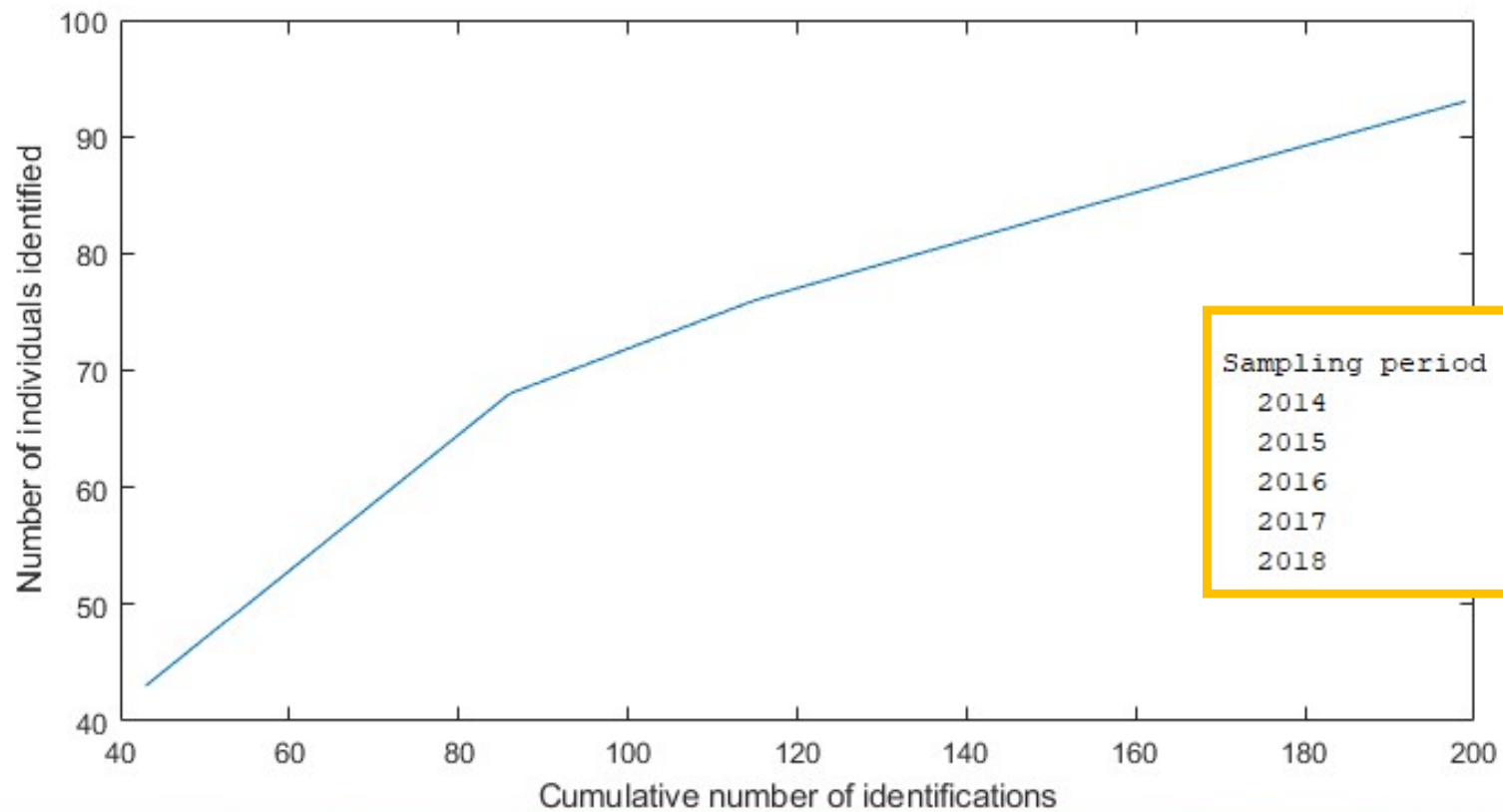
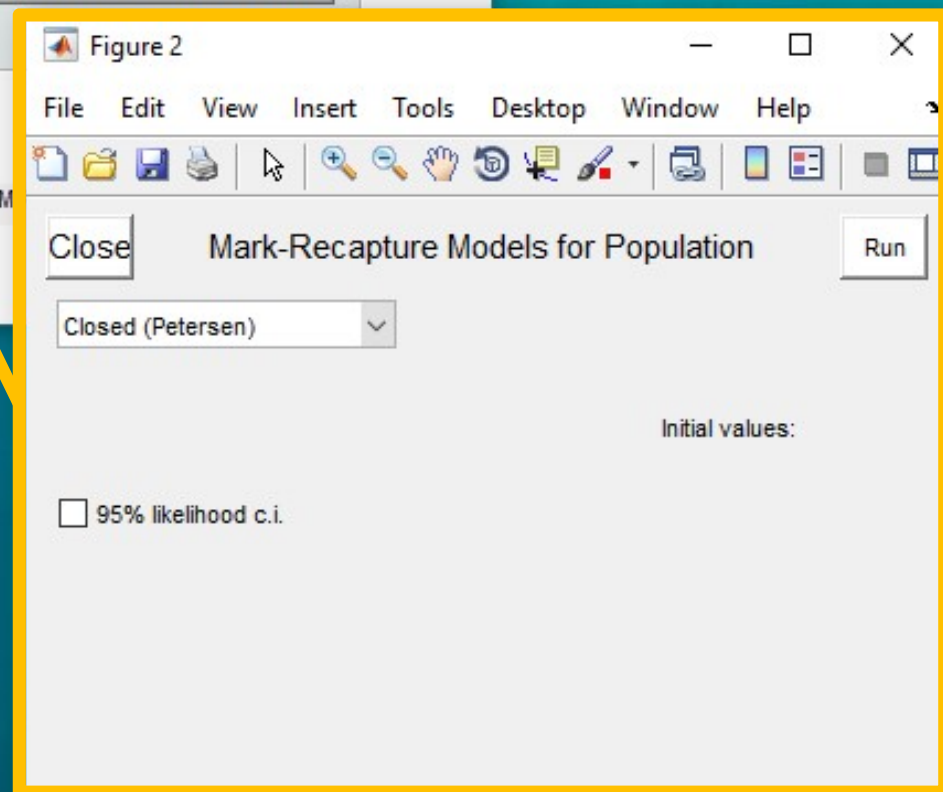
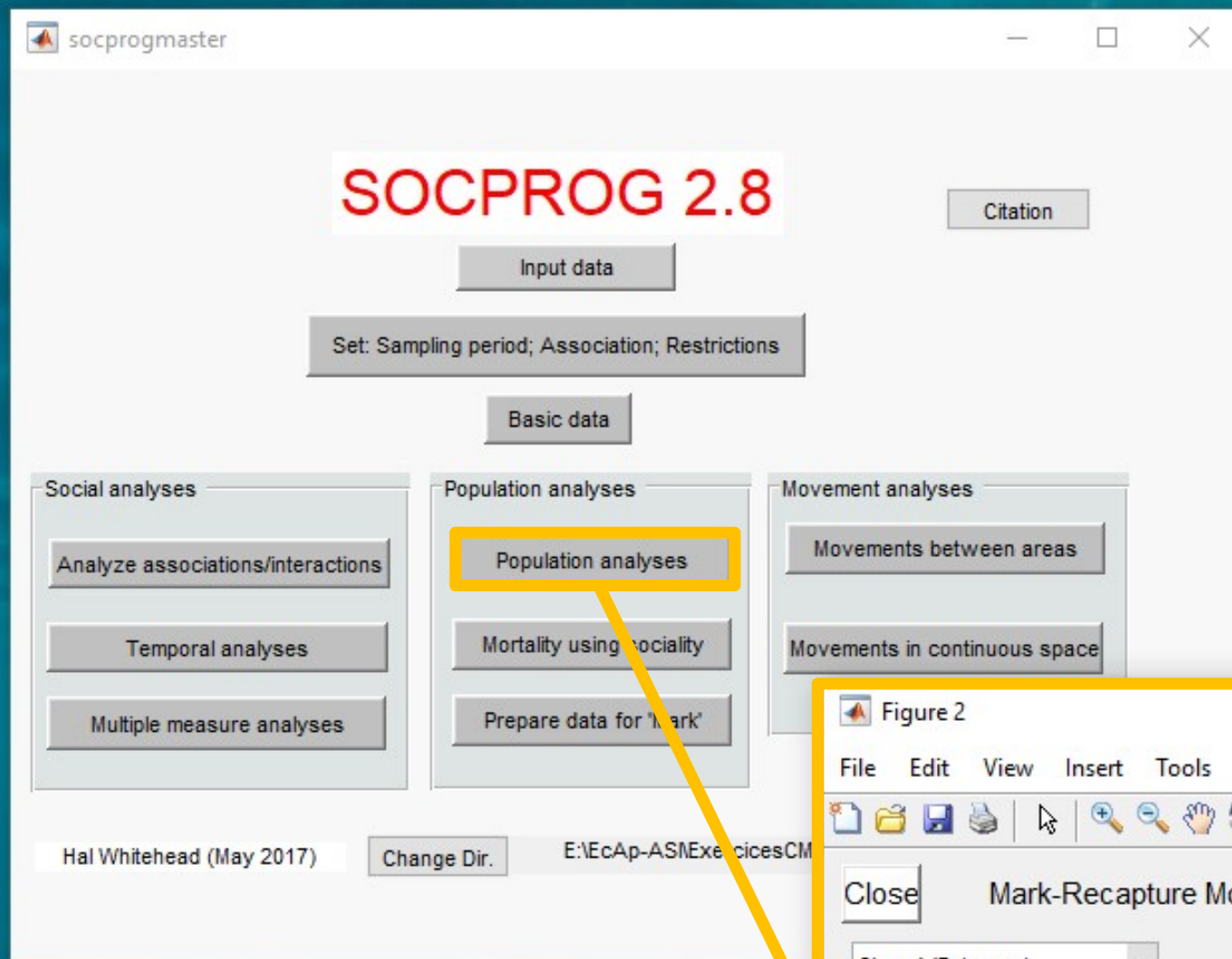


Figure 4

File Edit View Insert Tools Desktop Window Help



Sampling period	Number identified
2014	43
2015	43
2016	29
2017	39
2018	45



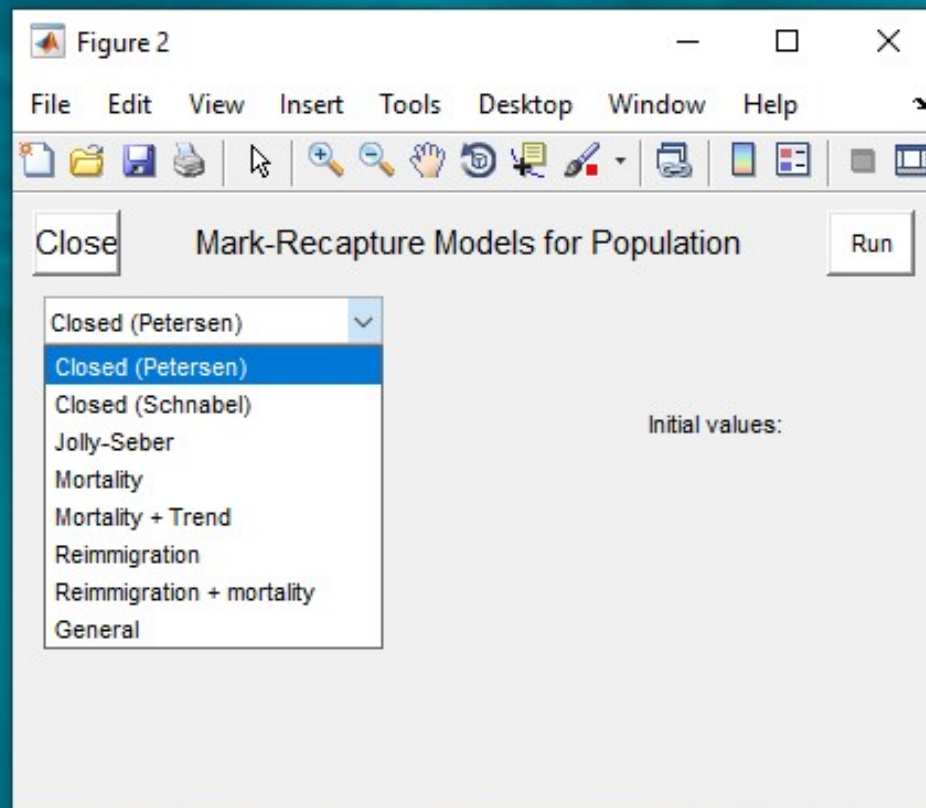


Figure 2

File Edit View Insert Tools Desktop Window Help

Close Mark-Recapture Models for Population Run

Closed (Schnabel) Tolerance: 0.0001

Max. iterations: 200

Initial values:

N = 93

☐ 95% likelihood c.i.

☒ Bootstrap 95% c.i. + s.e.; n = 100

☐ Jackknife s.e.

☐ Support function plot

☐ Residuals plot



Figure 2

File Edit View Insert Tools Desktop Window Help

Close Mark-Recapture Models for Population Run

Closed (Schnabel) Tolerance: 0.0001

Max. iterations: 200

Initial values:

☐ 95% likelihood c.i. N = 93

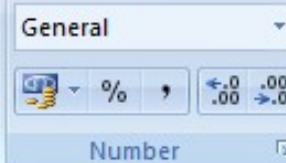
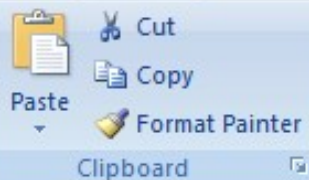
☒ Bootstrap 95% c.i. + s.e.; n = 100

☐ Jackknife s.e.

☐ Support function

☐ Residuals plot

```
File: SOCPROG_matrix2.csv
Sampling period: Year
Restrictions: Marking>1
Association: Group association; Date; grouped in sampling period
Number of sampling periods = 5  Number of individuals = 93
Model: Closed (Schnabel)
Estimated population size = 100.056
      (Bootstrap s.e. =      3.6  95%c.i. =      93.8 -      108.6)
Log-likelihood = -180.2125; Akaike Information Criterion (AIC)= 362.4249
```



M22

 f_x

	A	B	C	D	E	F	G	H
1	MODEL name	Estimated population size	SD	mortality	trend	re-immigration	AIC	
2		(this is about MARKED population only)						
3								
4	Closed (Schnabel)	100	4	-	-	-	362.42	
5	Mortality							
6	Mortality + trend							
7	Reimmigration							
8	Reimmigration + mortality							
9								
10								
11								

**Do the same for the OPEN POPULATION models
and then compare the AIC**

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General Number

Conditional Formatting as Table Cell Styles Styles

	A	B	C	D	E	F	G	H
1	MODEL name	Estimated population size	SD	mortality	trend	re-immigration	AIC	
2		(this is about MARKED population only)						
3								
4	Closed (Schnabel)	100	4	-	-	-	362.42	
5	Mortality	79	7	0.1	-	-	356.89	
6	Mortality + trend	79	8	0.11	-0.05	-	358.25	
7	Reimmigration	80	10	-	-	0.05	358.85	
8	Reimmigration + mortality	79	7	<0.001	-	0.09	360.88	
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Alignment: Wrap Text, Merge & Center

Number: General, %, .00, .00

Styles: Conditional Formatting, Format as Table, Cell Styles

	A	B	C	D	E	F	G	H
1	MODEL name	Estimated population size	SD	mortality	trend	re-immigration	AIC	
2		(this is about MARKED population only)						
3								
4	Closed (Schnabel)	100	4	-	-	-	362.42	
5	Mortality	79	7	0.1	-	-	356.89	
6	Mortality + trend	79	8	0.11	-0.05	-	358.25	
7	Reimmigration	80	10	-	-	0.05	358.85	
8	Reimmigration + mortality	79	7	<0.001	-	0.09	360.88	
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General Number

Conditional Formatting as Table Cell Styles Styles

	A	B	C	D	E	F	G	H
1	MODEL name	Estimated population size	SD	mortality	trend	re-immigration	AIC	
2		(this is about MARKED population only)						
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7	Reimmigration	80	10	-	-	0.05	358.85	
8	Reimmigration + mortality	79	7	<0.001	-	0.09	360.88	
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**Knowing that the proportion of marked individuals in the population (ϕ) is 0.76
WHAT IS THE TOTAL POPULATION SIZE?**

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General Number

Conditional Formatting as Table Cell Styles Styles

	A	B	C	D	E	F	G
1	MODEL name	Estimated population size	SD	ϕ	TOTAL POPULATION	VAR	SE
2		(this is about MARKED population only)					
3							
4							
5	Mortality	79	7	0.76	79/0.76 = 104	70	8
6	Mortality + trend	79	8	0.76	79/0.76 = 104	85	9
7	Reimmigration	80	10	0.76	80/0.76 = 105	122	11
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$$N_{total} = \frac{N_{marked}}{\theta}$$

$$Var(N_{total}) = N_{marked}^2 \left(\frac{Var(N_{marked})}{N^2} + \frac{1-\theta}{n\theta} \right)$$