Measuring Biodiversity: Microsoft Excel Tutorial

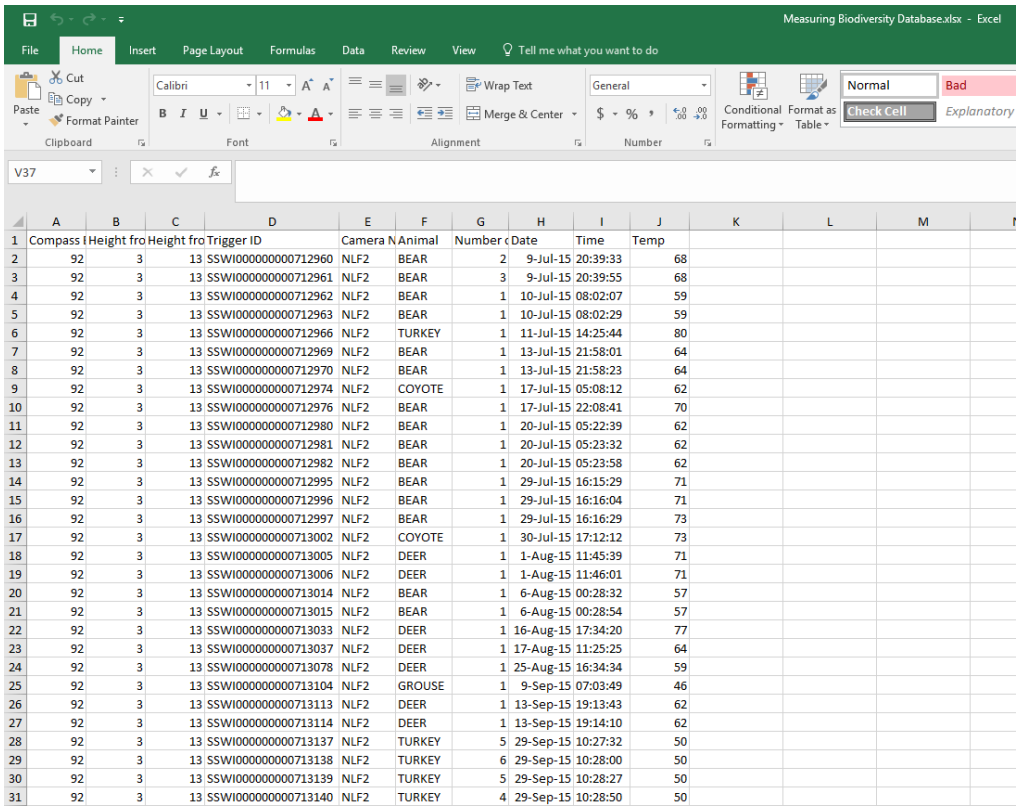
INTRODUCTION

This database contains a subset of data from Snapshot Wisconsin cameras deployed in two different Wisconsin ecoregions: Southern Wisconsin Till Plains (SWTP) and Northern Lakes and Forests (NLF). The columns of the spreadsheet refer to different pieces of metadata, metadata is defined as a set of data describing and giving information about other data (in this case the trail camera photos). The metadata describes the compass bearing of the trail camera, height from the ground, height from the trail, trigger ID (the name that the photo is stored as), camera number, animal, number of animals, data the photo was taken, time, and temperature.

These step-by-step instructions are designed to help students take a raw dataset and convert it into a series of Pivot Tables. The Pivot Tables will allow students to view the abundance of species for specific ecoregions, and calculate biodiversity indices.

PART I: ACCESSING THE DATABASE

1. Download “Measuring Biodiversity Database.xlsx” file and open on your computer in Microsoft Excel.

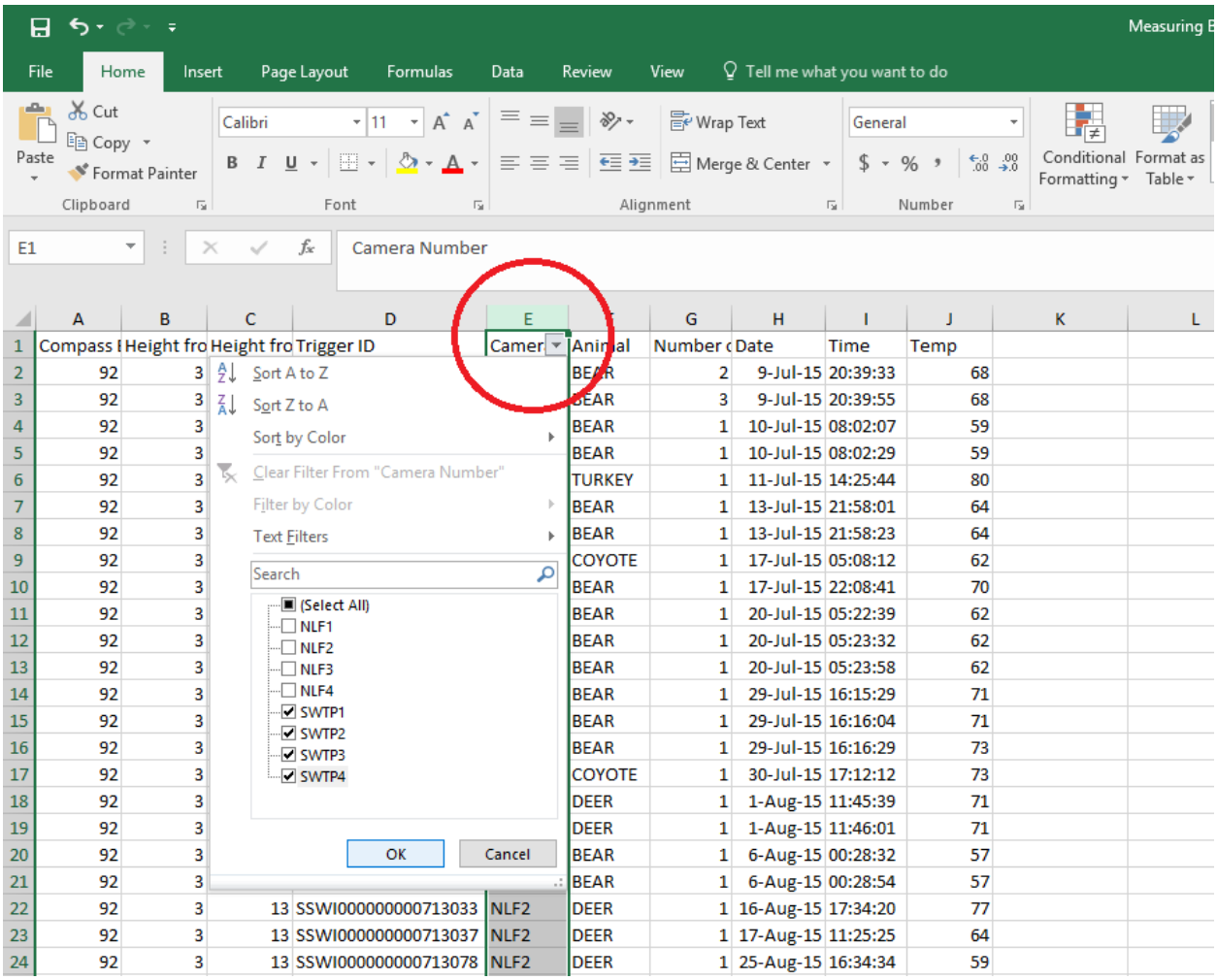


	A	B	C	D	E	F	G	H	I	J
1	Compass I	Height fro	Height fro	Trigger ID	Camera N	Animal	Number c	Date	Time	Temp
2	92	3	13	SSWI000000000712960	NLF2	BEAR	2	9-Jul-15	20:39:33	68
3	92	3	13	SSWI000000000712961	NLF2	BEAR	3	9-Jul-15	20:39:55	68
4	92	3	13	SSWI000000000712962	NLF2	BEAR	1	10-Jul-15	08:02:07	59
5	92	3	13	SSWI000000000712963	NLF2	BEAR	1	10-Jul-15	08:02:29	59
6	92	3	13	SSWI000000000712966	NLF2	TURKEY	1	11-Jul-15	14:25:44	80
7	92	3	13	SSWI000000000712969	NLF2	BEAR	1	13-Jul-15	21:58:01	64
8	92	3	13	SSWI000000000712970	NLF2	BEAR	1	13-Jul-15	21:58:23	64
9	92	3	13	SSWI000000000712974	NLF2	COYOTE	1	17-Jul-15	05:08:12	62
10	92	3	13	SSWI000000000712976	NLF2	BEAR	1	17-Jul-15	22:08:41	70
11	92	3	13	SSWI000000000712980	NLF2	BEAR	1	20-Jul-15	05:22:39	62
12	92	3	13	SSWI000000000712981	NLF2	BEAR	1	20-Jul-15	05:23:32	62
13	92	3	13	SSWI000000000712982	NLF2	BEAR	1	20-Jul-15	05:23:58	62
14	92	3	13	SSWI000000000712995	NLF2	BEAR	1	29-Jul-15	16:15:29	71
15	92	3	13	SSWI000000000712996	NLF2	BEAR	1	29-Jul-15	16:16:04	71
16	92	3	13	SSWI000000000712997	NLF2	BEAR	1	29-Jul-15	16:16:29	73
17	92	3	13	SSWI000000000713002	NLF2	COYOTE	1	30-Jul-15	17:12:12	73
18	92	3	13	SSWI000000000713005	NLF2	DEER	1	1-Aug-15	11:45:39	71
19	92	3	13	SSWI000000000713006	NLF2	DEER	1	1-Aug-15	11:46:01	71
20	92	3	13	SSWI000000000713014	NLF2	BEAR	1	6-Aug-15	00:28:32	57
21	92	3	13	SSWI000000000713015	NLF2	BEAR	1	6-Aug-15	00:28:54	57
22	92	3	13	SSWI000000000713033	NLF2	DEER	1	16-Aug-15	17:34:20	77
23	92	3	13	SSWI000000000713037	NLF2	DEER	1	17-Aug-15	11:25:25	64
24	92	3	13	SSWI000000000713078	NLF2	DEER	1	25-Aug-15	16:34:34	59
25	92	3	13	SSWI000000000713104	NLF2	GROUSE	1	9-Sep-15	07:03:49	46
26	92	3	13	SSWI000000000713113	NLF2	DEER	1	13-Sep-15	19:13:43	62
27	92	3	13	SSWI000000000713114	NLF2	DEER	1	13-Sep-15	19:14:10	62
28	92	3	13	SSWI000000000713137	NLF2	TURKEY	5	29-Sep-15	10:27:32	50
29	92	3	13	SSWI000000000713138	NLF2	TURKEY	6	29-Sep-15	10:28:00	50
30	92	3	13	SSWI000000000713139	NLF2	TURKEY	5	29-Sep-15	10:28:27	50
31	92	3	13	SSWI000000000713140	NLF2	TURKEY	4	29-Sep-15	10:28:50	50

Step 1. View of Measuring Biodiversity Database in Microsoft Excel.

PART II: CONDENSING THE DATA

2. Highlight the “Camera Number” column by clicking on the “E” button above the heading. Under the Data tab, click the Filter tool. A downward facing arrow will now appear on the “Camera Number” heading. Click on the downward facing arrow, click “Clear” and then select the cameras appropriate for the ecoregion of interest (Southern Wisconsin Till Plains or Northern Lakes and Forests, whichever you start with – you will calculate the other later). Click “OK”.

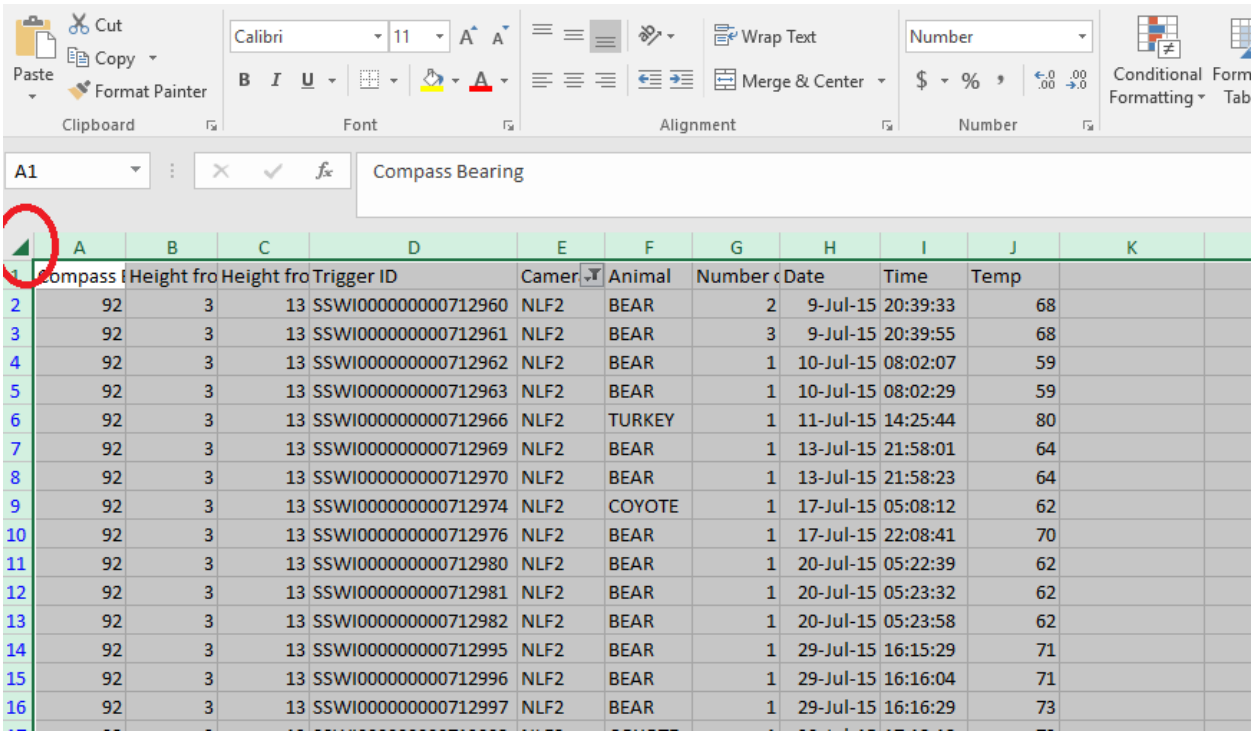


	A	B	C	D	E	F	G	H	I	J	K	L
1	Compass I	Height fro	Height fro	Trigger ID	Camer	Animal	Number o	Date	Time	Temp		
2	92	3				BEAR	2	9-Jul-15	20:39:33	68		
3	92	3				BEAR	3	9-Jul-15	20:39:55	68		
4	92	3				BEAR	1	10-Jul-15	08:02:07	59		
5	92	3				BEAR	1	10-Jul-15	08:02:29	59		
6	92	3				TURKEY	1	11-Jul-15	14:25:44	80		
7	92	3				BEAR	1	13-Jul-15	21:58:01	64		
8	92	3				BEAR	1	13-Jul-15	21:58:23	64		
9	92	3				COYOTE	1	17-Jul-15	05:08:12	62		
10	92	3				BEAR	1	17-Jul-15	22:08:41	70		
11	92	3				BEAR	1	20-Jul-15	05:22:39	62		
12	92	3				BEAR	1	20-Jul-15	05:23:32	62		
13	92	3				BEAR	1	20-Jul-15	05:23:58	62		
14	92	3				BEAR	1	29-Jul-15	16:15:29	71		
15	92	3				BEAR	1	29-Jul-15	16:16:04	71		
16	92	3				BEAR	1	29-Jul-15	16:16:29	73		
17	92	3				COYOTE	1	30-Jul-15	17:12:12	73		
18	92	3				DEER	1	1-Aug-15	11:45:39	71		
19	92	3				DEER	1	1-Aug-15	11:46:01	71		
20	92	3				BEAR	1	6-Aug-15	00:28:32	57		
21	92	3				BEAR	1	6-Aug-15	00:28:54	57		
22	92	3	13	SSWI000000000713033	NLF2	DEER	1	16-Aug-15	17:34:20	77		
23	92	3	13	SSWI000000000713037	NLF2	DEER	1	17-Jul-15	11:25:25	64		
24	92	3	13	SSWI000000000713078	NLF2	DEER	1	25-Aug-15	16:34:34	59		

Step 2. Filtering the data for only cameras from ecoregion of interest, in this case Southern Wisconsin Till Plains.

3. Google Sheets will now show a condensed version of the data only displaying the ecoregion of interest. Highlight the filtered data by clicking in the upper left corner of the Microsoft Excel (to the left of the A column, above row 1). Use Ctrl + C to copy the data. Navigate to the Workspace sheet, click in the upper left corner (to the left of the A column, above row 1) and paste the data in the Workspace sheet using Ctrl + V.
   This will allow you to manipulate the data that you want, while leaving the original dataset intact. In the original Database sheet, select the Data tab and select the Filter tool again (*which should be grayed out*) to restore the original dataset.

SNAPSHOT WISCONSIN



Cut
Copy
Format Painter
Paste
Clipboard
Calibri
11
Font
Wrap Text
Merge & Center
Alignment
Number
Conditional Formatting
Form Tab
A1
Compass Bearing

	A	B	C	D	E	F	G	H	I	J	K
1	Compass I	Height fro	Height fro	Trigger ID	Camer	Animal	Number c	Date	Time	Temp	
2	92	3	13	SSWI000000000712960	NLF2	BEAR	2	9-Jul-15	20:39:33	68	
3	92	3	13	SSWI000000000712961	NLF2	BEAR	3	9-Jul-15	20:39:55	68	
4	92	3	13	SSWI000000000712962	NLF2	BEAR	1	10-Jul-15	08:02:07	59	
5	92	3	13	SSWI000000000712963	NLF2	BEAR	1	10-Jul-15	08:02:29	59	
6	92	3	13	SSWI000000000712966	NLF2	TURKEY	1	11-Jul-15	14:25:44	80	
7	92	3	13	SSWI000000000712969	NLF2	BEAR	1	13-Jul-15	21:58:01	64	
8	92	3	13	SSWI000000000712970	NLF2	BEAR	1	13-Jul-15	21:58:23	64	
9	92	3	13	SSWI000000000712974	NLF2	COYOTE	1	17-Jul-15	05:08:12	62	
10	92	3	13	SSWI000000000712976	NLF2	BEAR	1	17-Jul-15	22:08:41	70	
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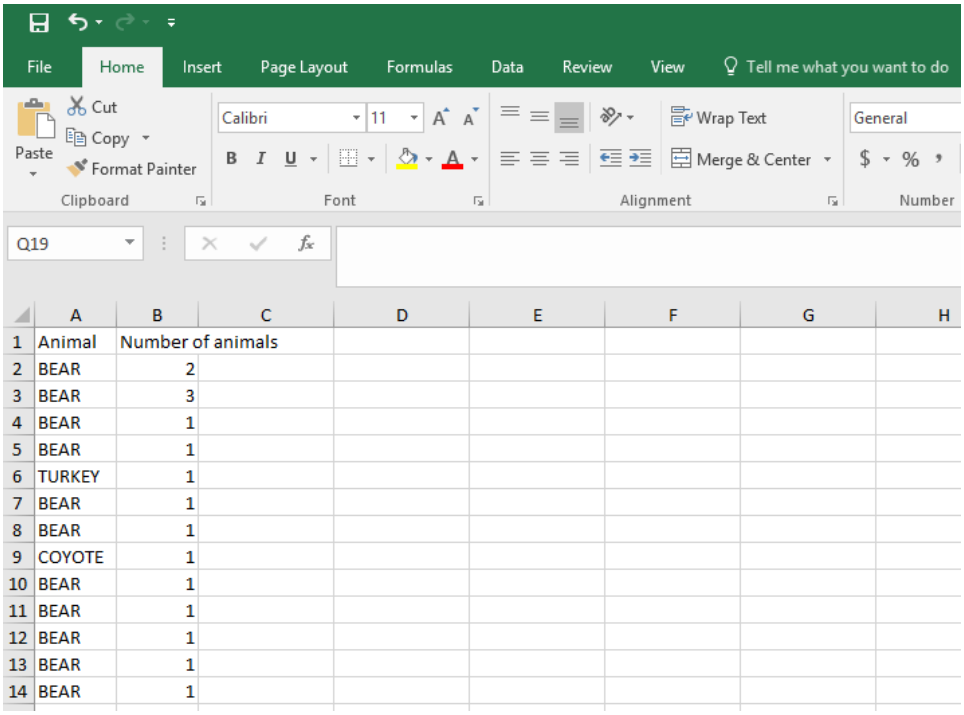
13	92	3	13	SSWI000000000712982	NLF2	BEAR	1	20-Jul-15	05:23:58	62	
14	92	3	13	SSWI000000000712995	NLF2	BEAR	1	29-Jul-15	16:15:29	71	
15	92	3	13	SSWI000000000712996	NLF2	BEAR	1	29-Jul-15	16:16:04	71	
16	92	3	13	SSWI000000000712997	NLF2	BEAR	1	29-Jul-15	16:16:29	73	

Step 3. Where to click in upper left corner to highlight entire sheet of data, and to paste in Workspace sheet.

4. For this exercise, we are only interested in the abundance of animals in each ecoregion. In the Workspace sheet delete all columns, except for “Animal” and “Number of animal”, by right clicking on the column heading letter and selecting “Delete.” You can select multiple columns to delete by using the Ctrl button while you select columns.



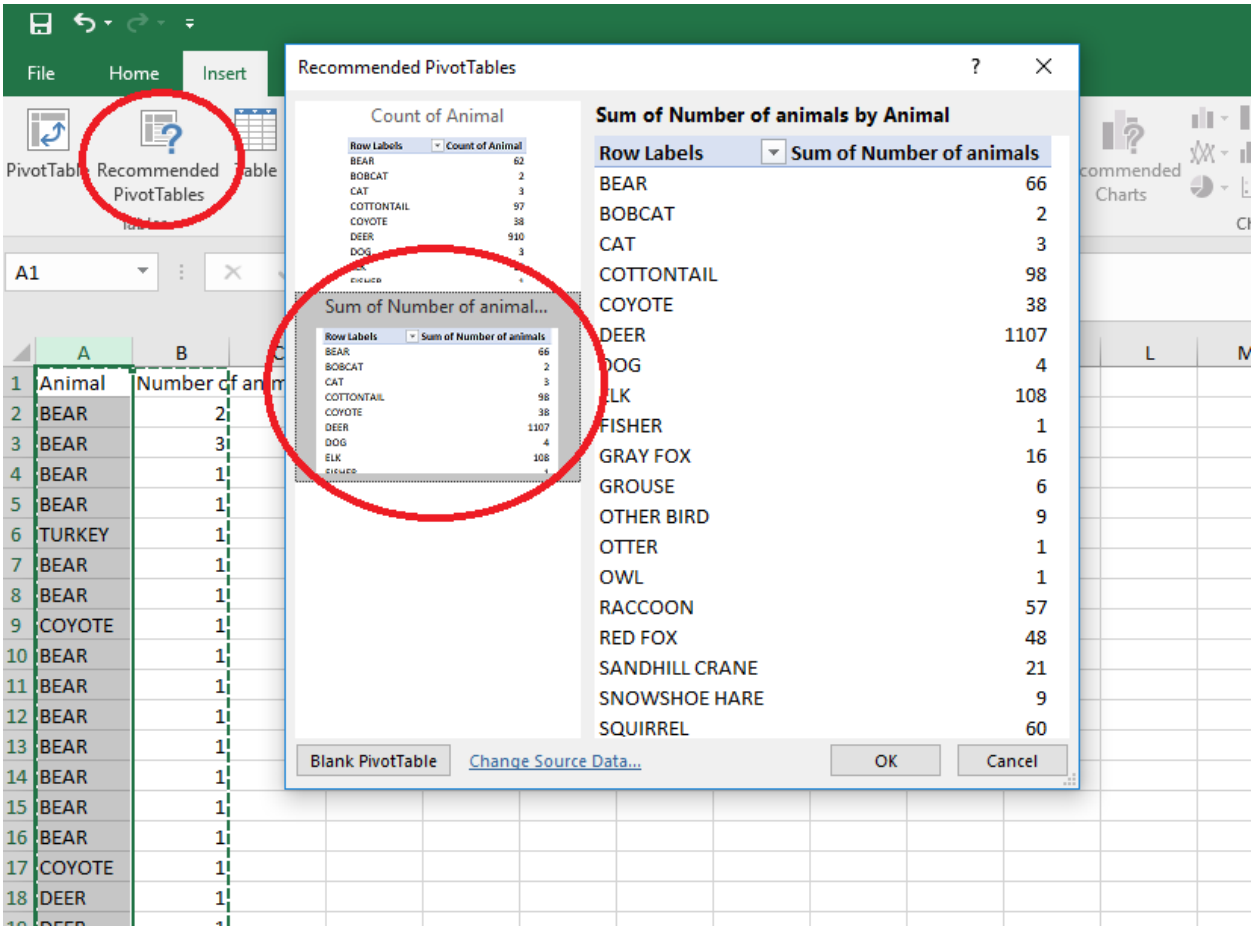
	A	B	C	D	E	F	G	H
1	Animal	Number of animals						
2	BEAR	2						
3	BEAR	3						
4	BEAR	1						
5	BEAR	1						
6	TURKEY	1						
7	BEAR	1						
8	BEAR	1						
9	COYOTE	1						
10	BEAR	1						
11	BEAR	1						
12	BEAR	1						
13	BEAR	1						
14	BEAR	1						

Step 4. View of condensed data of interest in Workspace sheet.

PART III: CREATING A PIVOT TABLE

5. The next step is to create a Pivot Table to summarize the data. Highlight the “Animal” column by clicking on the “A” column heading. While these column is highlighted, click on the Insert tab and select “Recommended Pivot Tables.” Choose the second option, “Sum of Number of animals by Animal.” (*if you select the first option, “Count of Animal” this will not take into consideration if a camera trigger has multiple individuals for example, if a trail camera shows three deer will only appear as one under these settings*).

SNAPSHOT WISCONSIN



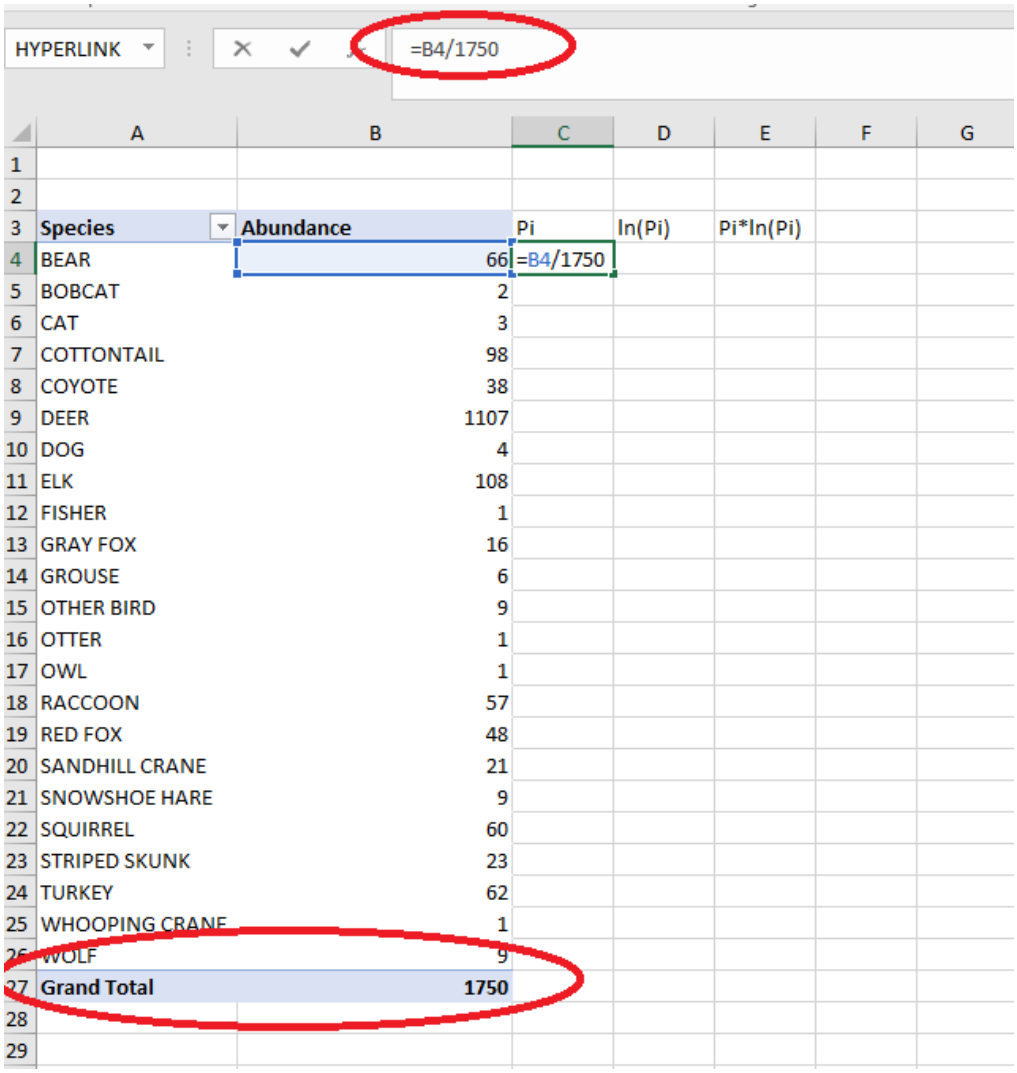
Step 5. Under "Recommended Pivot Tables" select the second option, "Sum of Number of animals by Animal."

Row Labels	Sum of Number of animals
BEAR	66
BOBCAT	2
CAT	3
COTTONTAIL	98
COYOTE	38
DEER	1107
DOG	4
ELK	108
FISHER	1
GRAY FOX	16
GROUSE	6
OTHER BIRD	9
OTTER	1
OWL	1
RACCOON	57
RED FOX	48
SANDHILL CRANE	21
SNOWSHOE HARE	9
SQUIRREL	60
STRIPED SKUNK	23
TURKEY	62
WHOOPING CRANE	1
WOLF	9
Grand Total	**1750**

Step 5. Example of what your Pivot Table should look like.

PART IV: PERFORMING CALCULATIONS IN MICROSOFT EXCEL

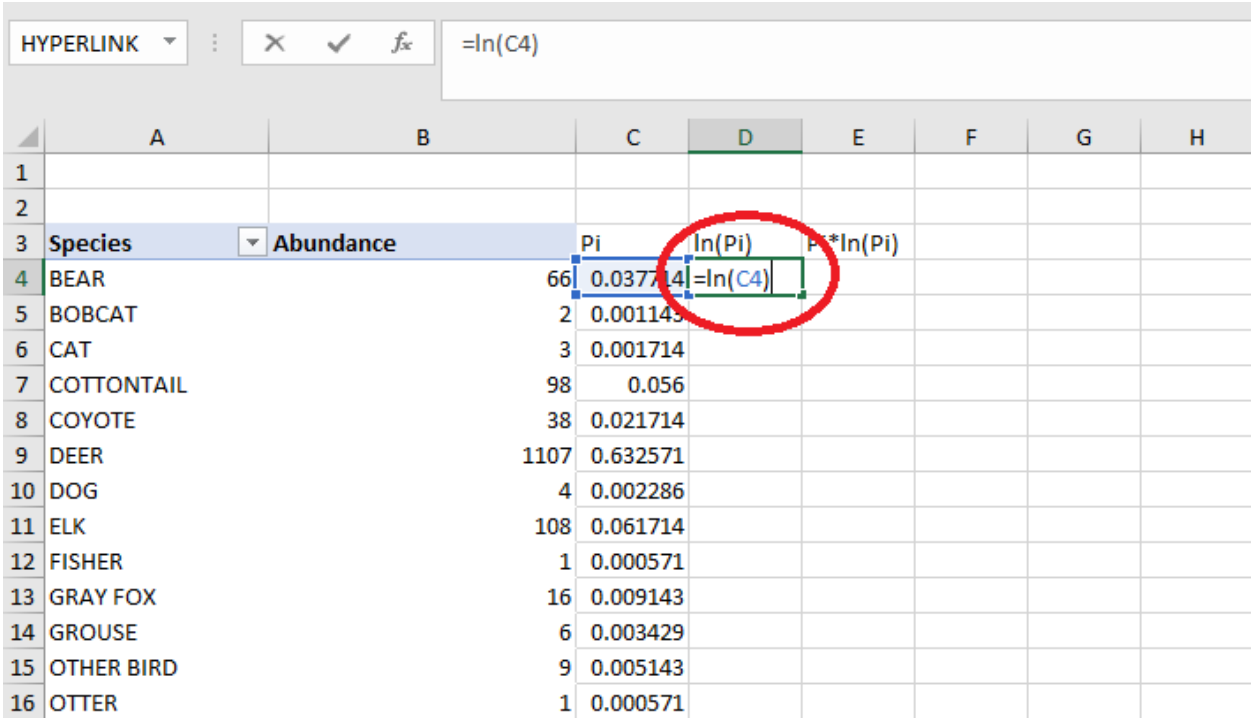
6. A Pivot Table will be created in a new sheet, your Pivot Table should display each species and the total number of sighting on the trail cameras. Rename the headings to “Species” and “Abundance”, and create new headings for P_i, $\ln(P_i)$, and $P_i * \ln(P_i)$ in the adjacent columns.
7. To have Microsoft Excel calculate the P_i value, enter in =(CELL_LOCATION / Total Abundance). For this exercise, the Grand Total value reflects the total number of individuals, do not reference the cell of the total abundance, or the following step will not work correctly. For example, enter =(B4/1750). (*Be aware of where Microsoft Excel has created the Pivot Table, this will impact what cell number you are using, for example B4*). To autofill the P_i value for each species, click on the calculated cell and drag down green square in the bottom right corner.



	A	B	C	D	E	F	G
1							
2							
3	**Species**	**Abundance**	Pi	ln(Pi)	Pi*ln(Pi)		
4	BEAR	66	=B4/1750				
5	BOBCAT	2					
6	CAT	3					
7	COTTONTAIL	98					
8	COYOTE	38					
9	DEER	1107					
10	DOG	4					
11	ELK	108					
12	FISHER	1					
13	GRAY FOX	16					
14	GROUSE	6					
15	OTHER BIRD	9					
16	OTTER	1					
17	OWL	1					
18	RACCOON	57					
19	RED FOX	48					
20	SANDHILL CRANE	21					
21	SNOWSHOE HARE	9					
22	SQUIRREL	60					
23	STRIPED SKUNK	23					
24	TURKEY	62					
25	WHOOPING CRANE	1					
26	WOLF	9					
27	**Grand Total**	**1750**					
28							
29							

Step 7. Example of what your Pivot Table should look like with added columns for Microsoft Excel to help organize calculations, the red circles show the total abundance and equation for calculating P_i.

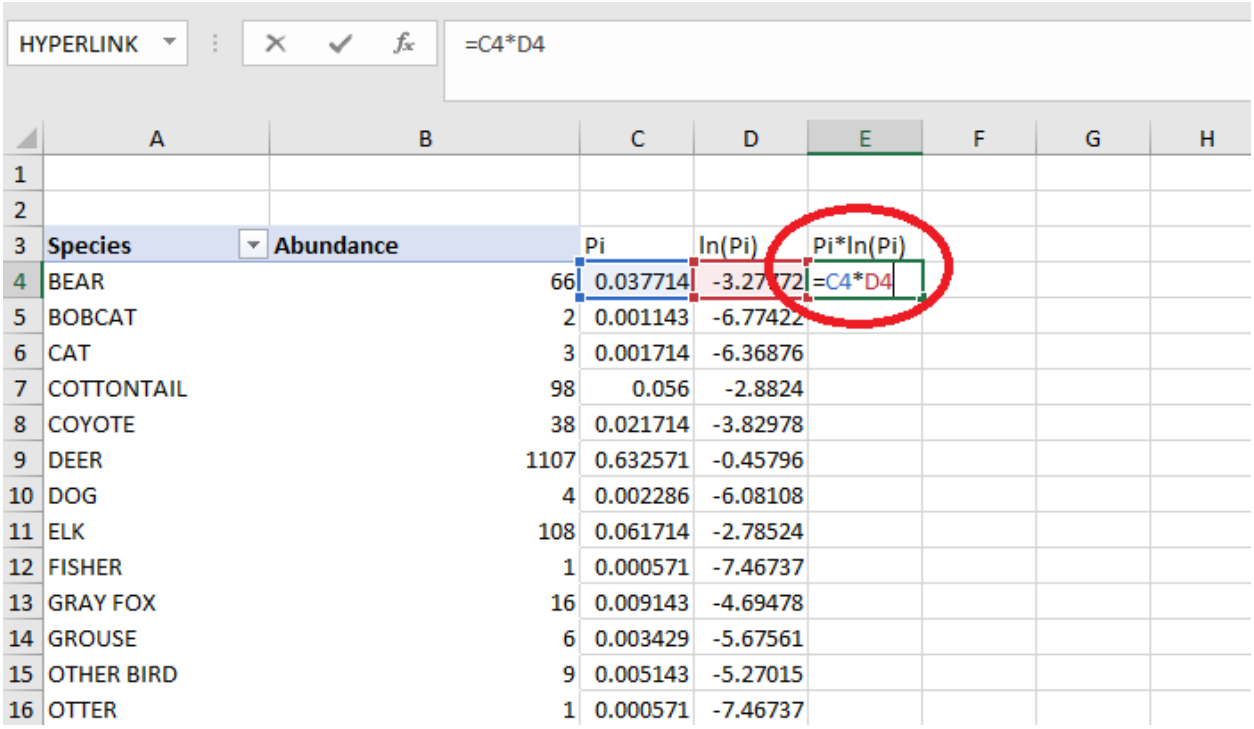
8. Use Microsoft Excel to calculate ln(P_i) by typing in the equation =ln(CELL_LOCATION) into the corresponding cell. For example, =ln(C4) (*these cell locations may vary based on your dataset*)



	A	B	C	D	E	F	G	H
1								
2								
3	**Species**	**Abundance**	Pi	ln(Pi)	Pi*ln(Pi)			
4	BEAR	66	0.037714	=ln(C4)				
5	BOBCAT	2	0.001143					
6	CAT	3	0.001714					
7	COTTONTAIL	98	0.056					
8	COYOTE	38	0.021714					
9	DEER	1107	0.632571					
10	DOG	4	0.002286					
11	ELK	108	0.061714					
12	FISHER	1	0.000571					
13	GRAY FOX	16	0.009143					
14	GROUSE	6	0.003429					
15	OTHER BIRD	9	0.005143					
16	OTTER	1	0.000571					

Step 8. Calculation for ln(P_i).

9. Calculate P_i*ln(P_i) using the equation =(CELL_LOCATION * CELL_LOCATION). For example, =(C4*D4) (*these cell locations may vary based on your dataset)*



	A	B	C	D	E	F	G	H
1								
2								
3	**Species**	**Abundance**	Pi	ln(Pi)	Pi*ln(Pi)			
4	BEAR	66	0.037714	-3.27772	=C4*D4			
5	BOBCAT	2	0.001143	-6.77422				
6	CAT	3	0.001714	-6.36876				
7	COTTONTAIL	98	0.056	-2.8824				
8	COYOTE	38	0.021714	-3.82978				
9	DEER	1107	0.632571	-0.45796				
10	DOG	4	0.002286	-6.08108				
11	ELK	108	0.061714	-2.78524				
12	FISHER	1	0.000571	-7.46737				
13	GRAY FOX	16	0.009143	-4.69478				
14	GROUSE	6	0.003429	-5.67561				
15	OTHER BIRD	9	0.005143	-5.27015				
16	OTTER	1	0.000571	-7.46737				

*Step 9. Calculation for P_i * ln(P_i).*

10. Calculate the Shannon diversity index using the equation H = -SUM (P_i * ln(P_i)). You can perform this calculation in Microsoft Excel using the equation =-SUM(FIRST_CELL_LOCATION:LAST_CELL_LOCATION). For example, =-SUM(E4:E26) (*these cell locations may vary based on your dataset*).

	Species	Abundance	Pi	ln(Pi)	Pi*ln(Pi)
4	BEAR	66	0.037714	-3.27772	-0.12362
5	BOBCAT	2	0.001143	-6.77422	-0.00774
6	CAT	3	0.001714	-6.36876	-0.01092
7	COTTONTAIL	98	0.056	-2.8824	-0.16141
8	COYOTE	38	0.021714	-3.82978	-0.08316
9	DEER	1107	0.632571	-0.45796	-0.28969
10	DOG	4	0.002286	-6.08108	-0.0139
11	ELK	108	0.061714	-2.78524	-0.17189
12	FISHER	1	0.000571	-7.46737	-0.00427
13	GRAY FOX	16	0.009143	-4.69478	-0.04292
14	GROUSE	6	0.003429	-5.67561	-0.01946
15	OTHER BIRD	9	0.005143	-5.27015	-0.0271
16	OTTER	1	0.000571	-7.46737	-0.00427
17	OWL	1	0.000571	-7.46737	-0.00427
18	RACCOON	57	0.032571	-3.42432	-0.11153
19	RED FOX	48	0.027429	-3.59617	-0.09864
20	SANDHILL CRANE	21	0.012	-4.42285	-0.05307
21	SNOWSHOE HARE	9	0.005143	-5.27015	-0.0271
22	SQUIRREL	60	0.034286	-3.37303	-0.11565
23	STRIPED SKUNK	23	0.013143	-4.33188	-0.05693
24	TURKEY	62	0.035429	-3.34024	-0.11834
25	WHOOPING CRANE	1	0.000571	-7.46737	-0.00427
26	WOLF	9	0.005143	-5.27015	-0.0271
27	**Grand Total**	**1750**			=-SUM(E4:E26)

Step 10. Calculation for finding the Shannon diversity index.

11. You can use a calculator to calculate Evenness (E), or take advantage of Microsoft Excel to do this calculation for you! Use some of the techniques that you have learned in this tutorial.
12. Repeat these steps for the next ecoregion. Record your answers in your Student Worksheet.