Data Analysis for Knight GPS collars & Mobile Action i-gotU GPS units

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Version 2

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Chapter 1 – Creating a low-cost GPS collars utilizing Mobile Action igot-U 120 travel and sports loggers and traditional leather working tools.

https://search-proquest-com.prxy4.ursus.maine.edu/docview/2053259317?pq-origsite=summon

Chapter 2 - Setting up Mobile Action i-gotU 120 travel and sports loggers for data collection

Step 1. Download the Mobile Action igot-U software @TRIP PC (97 MB) from

http://global.mobileaction.com/download/i-gotU_download1.jsp

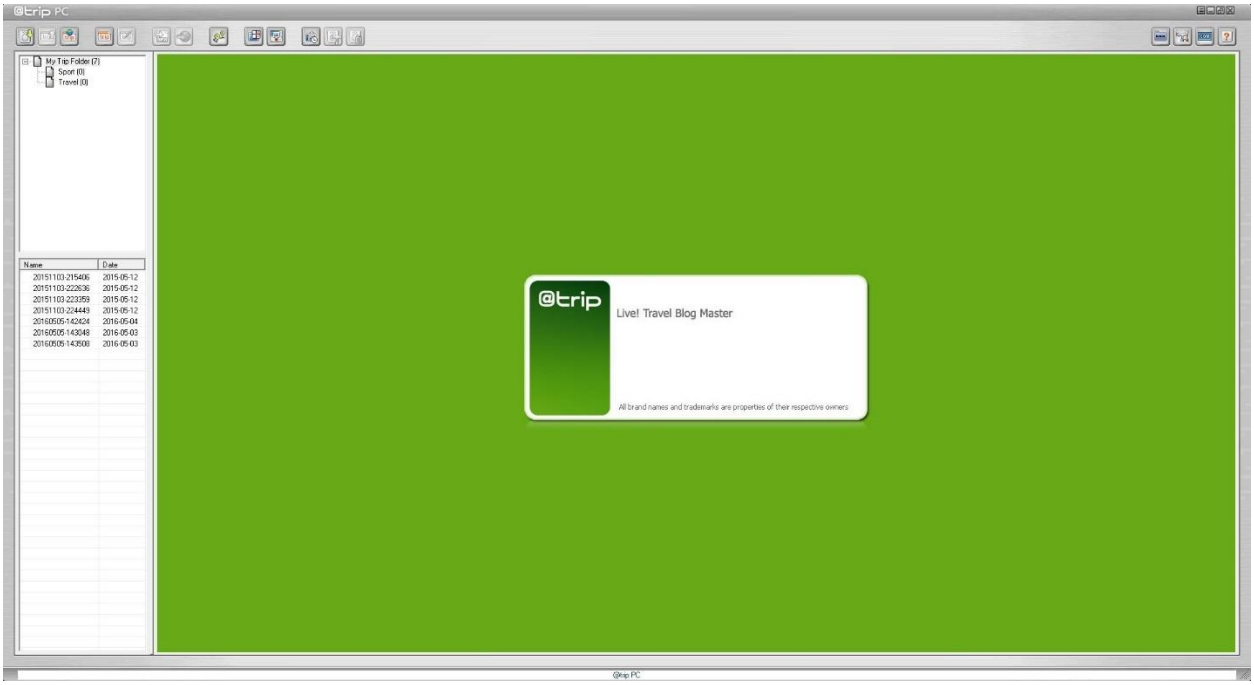
Step 2. Install the Travel & Sport Suite software (Typical)

Step 3. Create the following folder on your C drive :

C:\GT_DATA_LOG

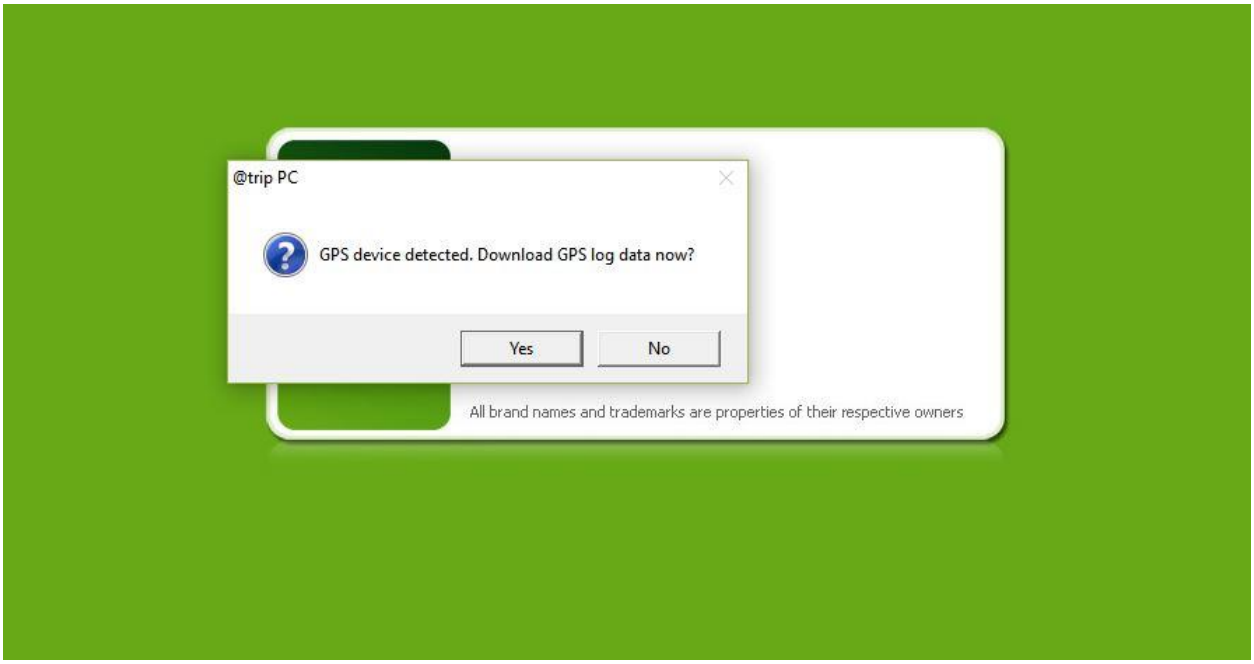
Step 4. Open the software by clicking on the @Trip PC icon

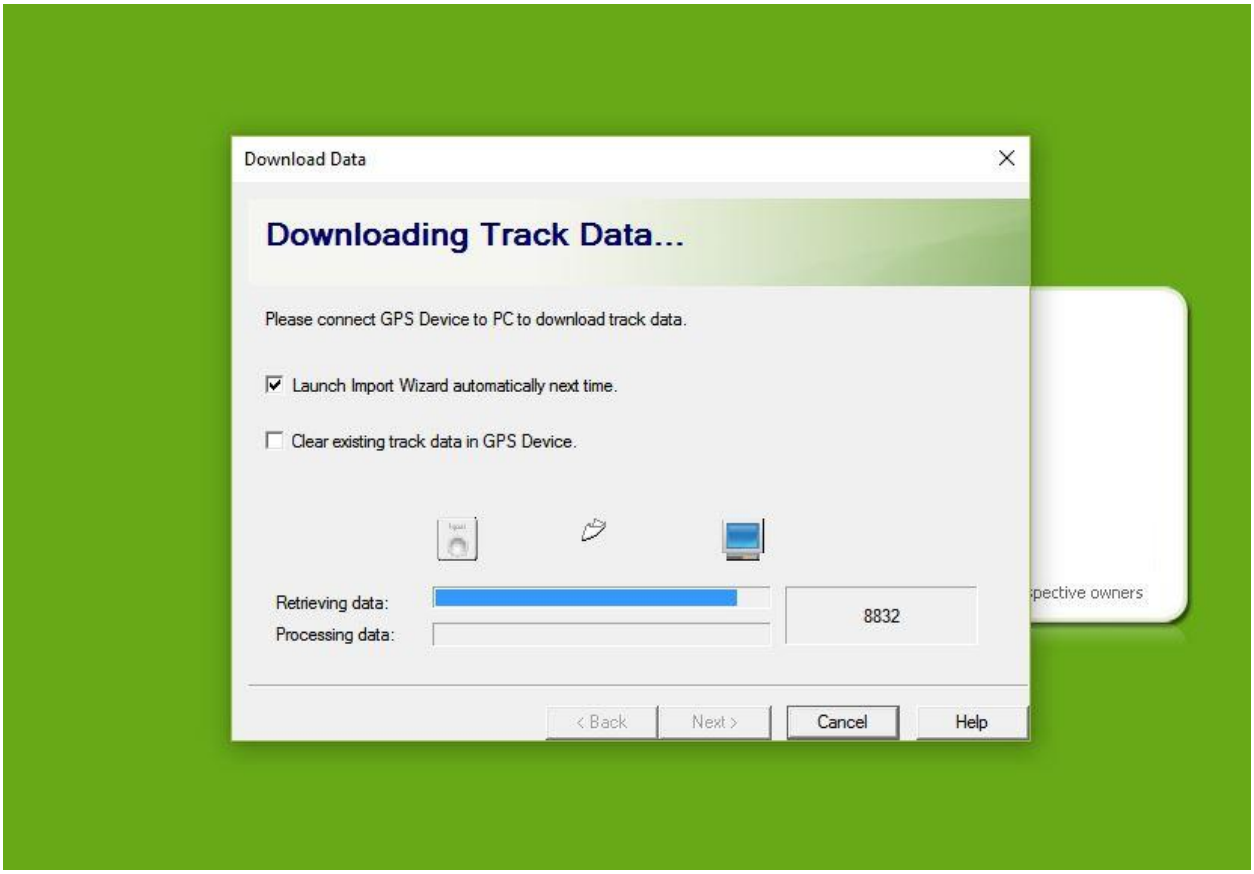
The home screen will look like this



Step 5. Plug the included USB cord into the computer and attach the i-gotU GPS device. You will be prompted with the following pop up box to log GPS data, click YES.

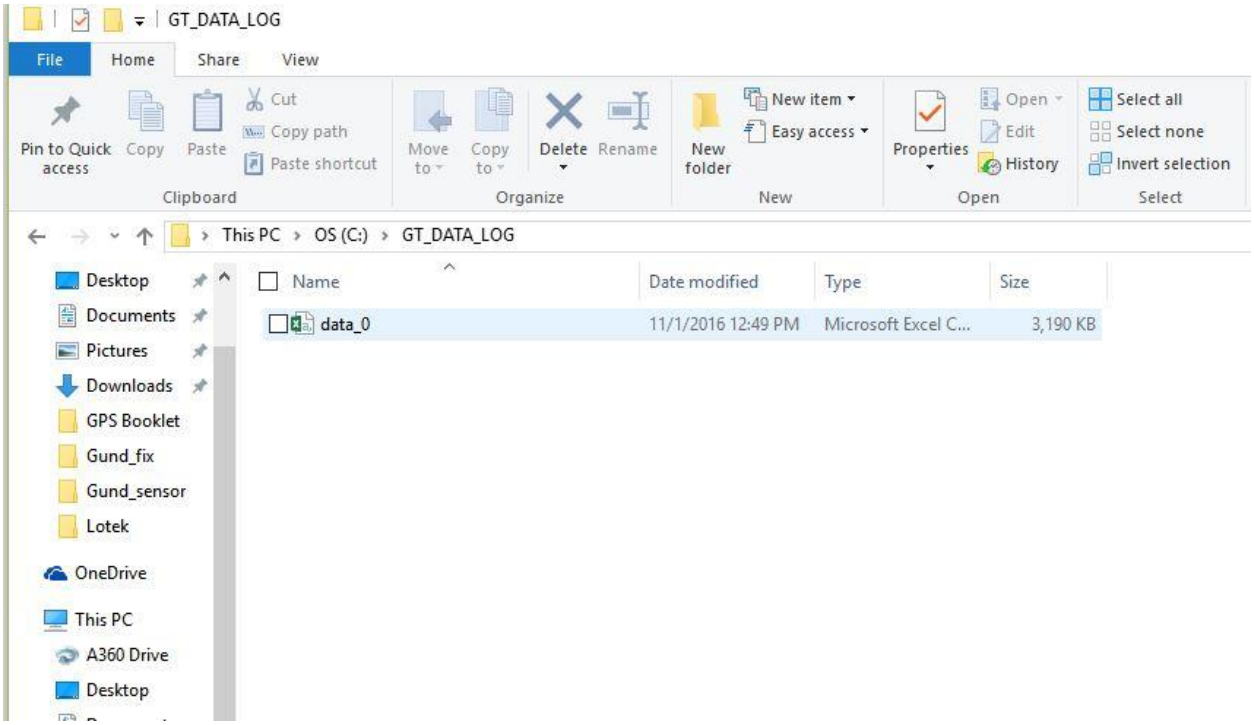
Note – the metal connection pins on the device can build up a level of corrosion when left on range for extended period of time and this will cause a poor connection. Take a pocket knife or fine sandpaper and clean the connections if the computer fails to recognize the device.


@trip PC
GPS device detected. Download GPS log data now?
Yes
No
All brand names and trademarks are properties of their respective owners


Download Data
Downloading Track Data...
Please connect GPS Device to PC to download track data.
Launch Import Wizard automatically next time.
Clear existing track data in GPS Device.
Retrieving data:
Processing data:
8832
< Back
Next >
Cancel
Help

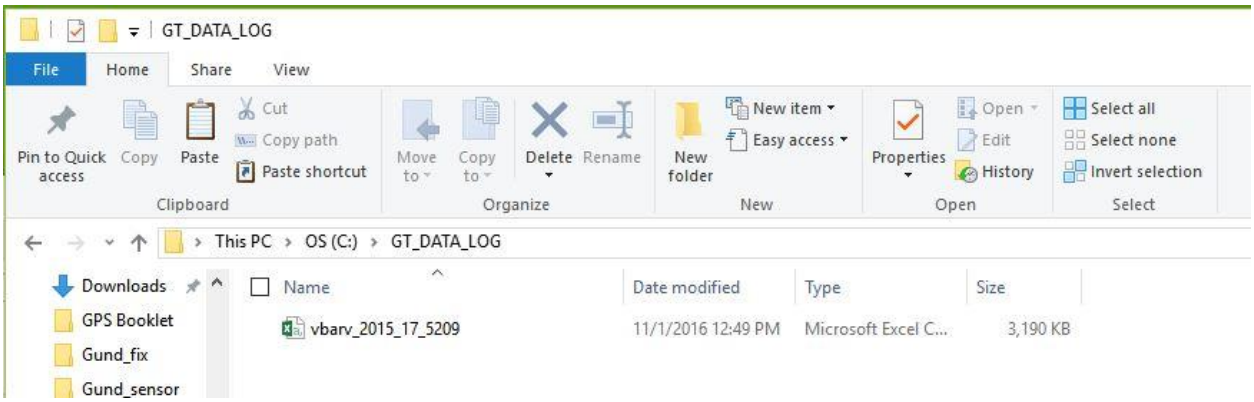
Data is now saved as a .csv file in

C:\GT_DATA_LOG



Rename the file – Processing GPS data creates a lot of folders and files. Take this opportunity to begin storing information in an organized fashion.

I suggest naming the file by (Location_timeperiod_collarnumber_animalID) for example, this example is from a research study at the University of Arizona's V-bar-V ranch in 2015 from GPS collar #17 placed on cow 5209. ArcMap (a program to be used later for further data processing) does not like spaces or exceptionally long file names, so use underscores.

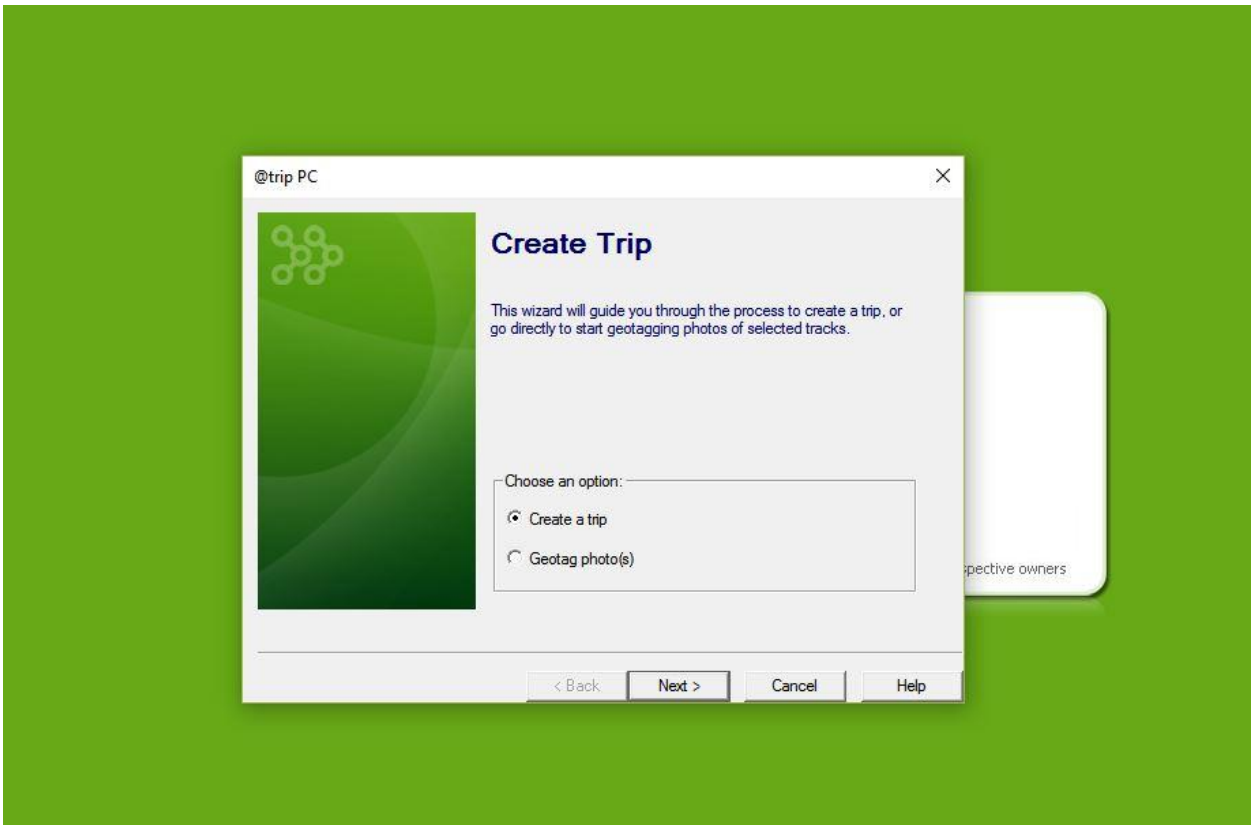


Once you have downloaded data from all collars and renamed the files, move them to a new folder location.

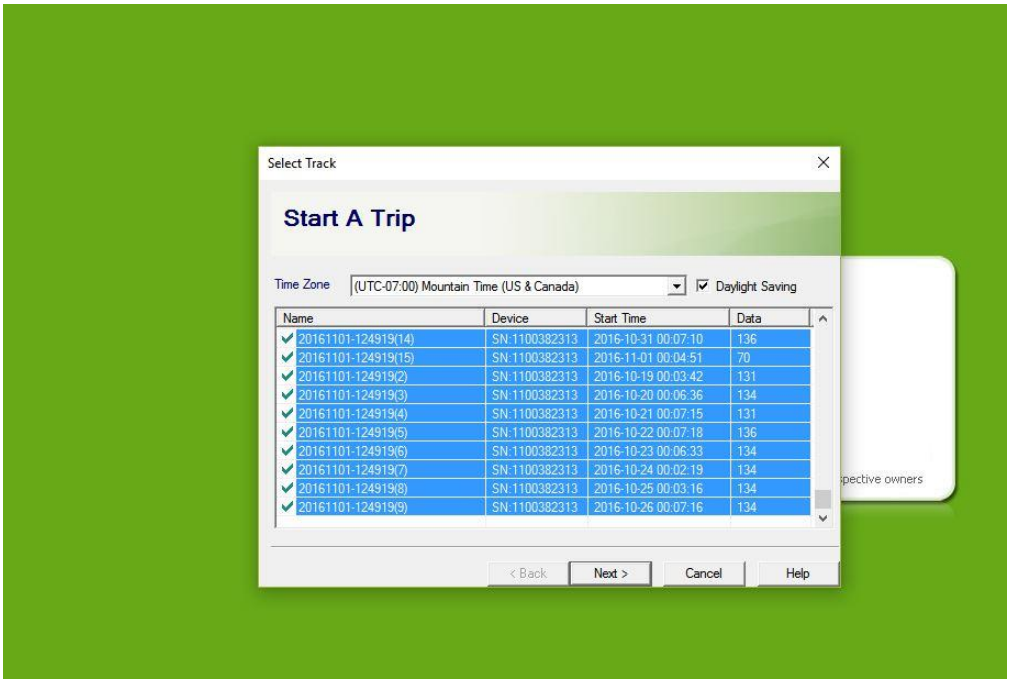
(Optional)

Utilizing @trip PC to look at individual animal data

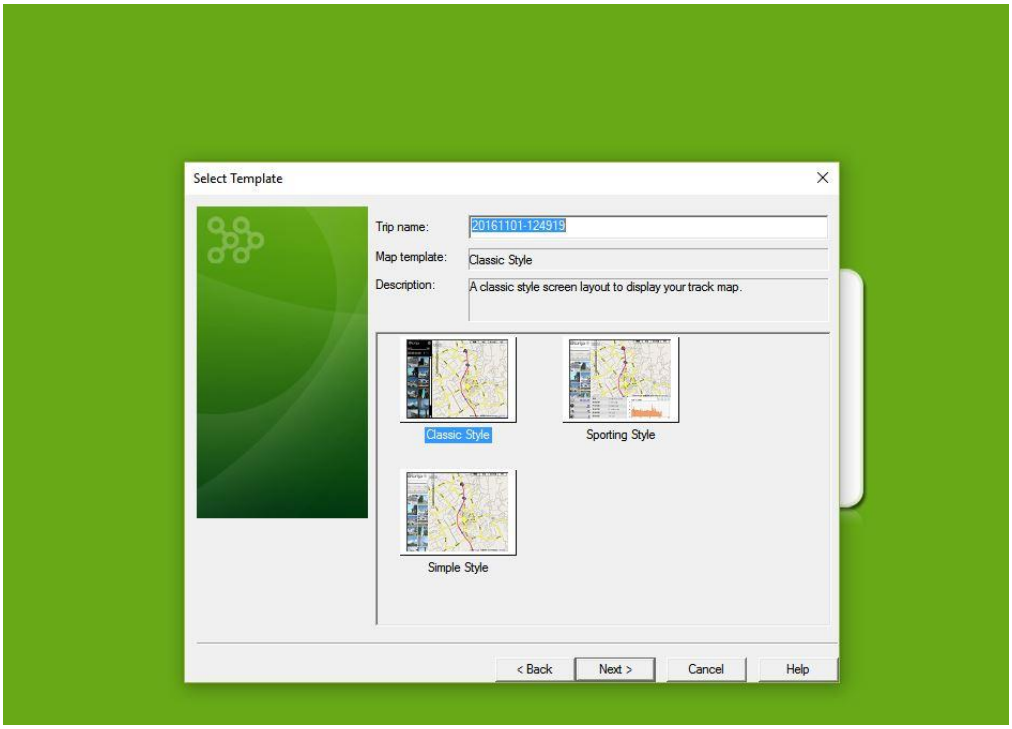
Plug the included USB cord into the computer and attach the i-gotU GPS device. You will be prompted with the following pop up box to log GPS data, click YES. When you are prompted to create a trip, select “Create a trip” and click Next>



The following screen will appear. Do not click or de highlight any selected data, simply press Next>

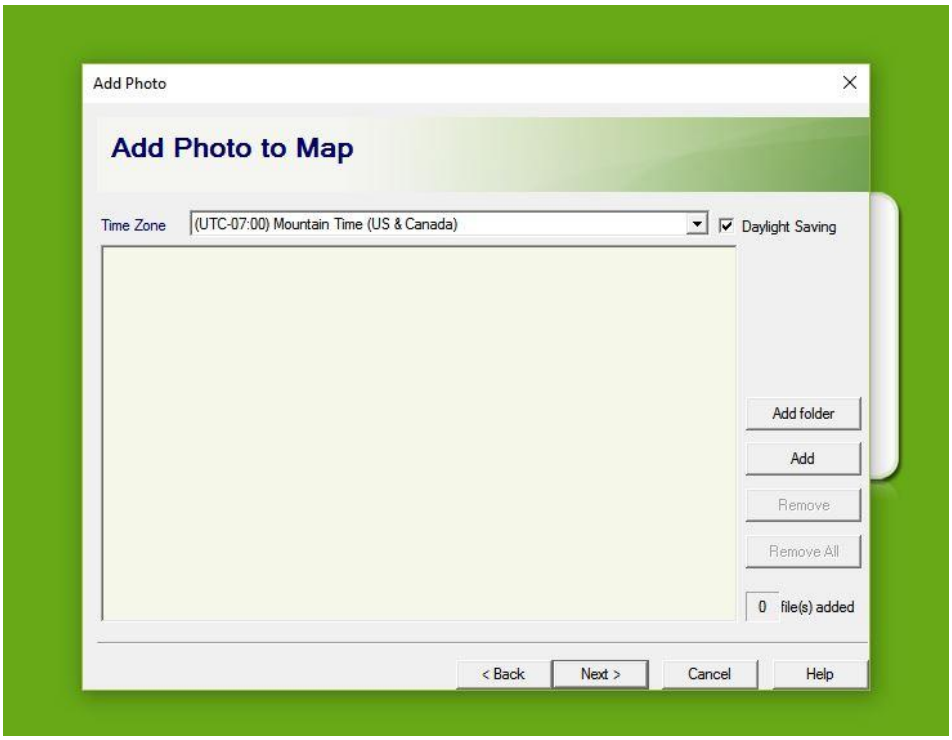


The following screen will appear. Rename the trip to easily identify it later. Once you download more than one trip, the number ID generated by the program will easily be confused the following trips.



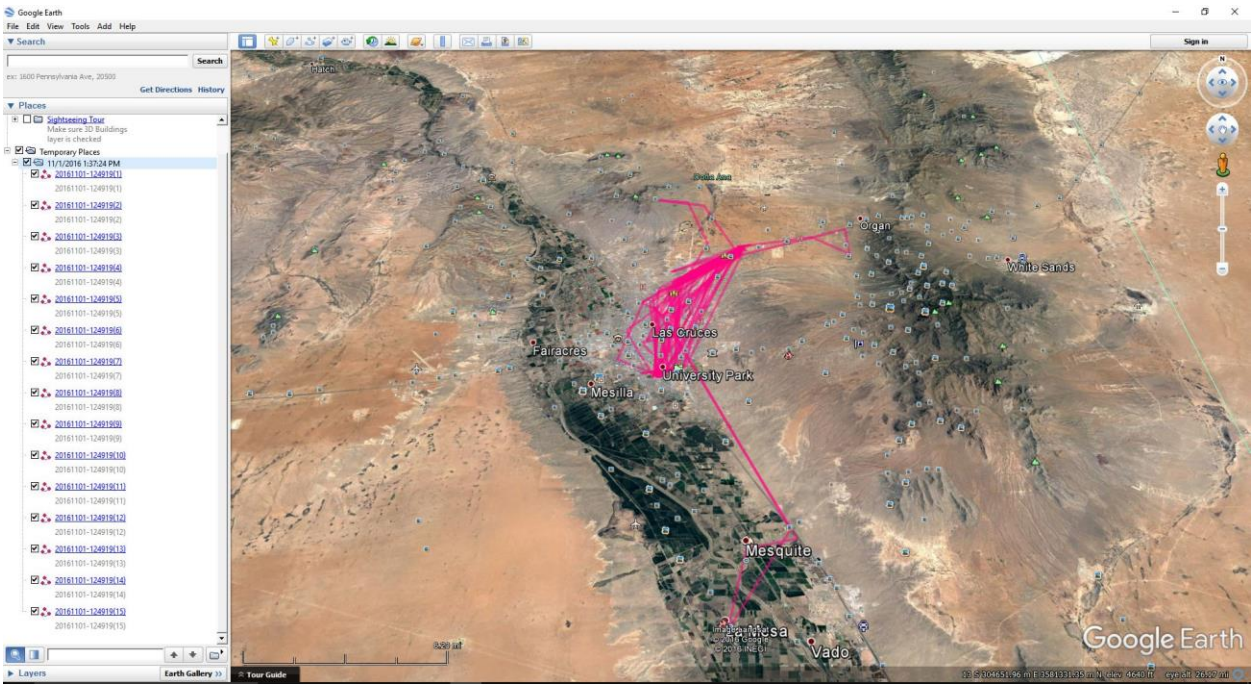
Select which ever template style you prefer. I generally utilize classic style. Sporting style will show extra information such as elevation and speed.

The following screen will appear. Select the appropriate time zone and click Next> following by Finish

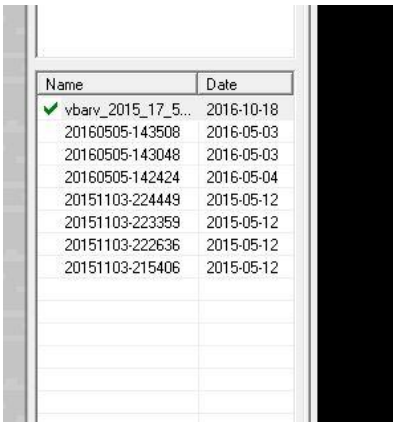


You can now view your trip on Google Maps.

Or Google Earth by clicking the following button



To save the GPS data from @trip PC, right click the file name on the left side of the screen, and select Export to CSV. Please note, you only get the basic tracking data using this method, and you will not get any satellite or error information like the data set saved in C:\GT_DATA_LOG, and this data cannot be recovered unless the file is saved from the device to folder C:\GT_DATA_LOG

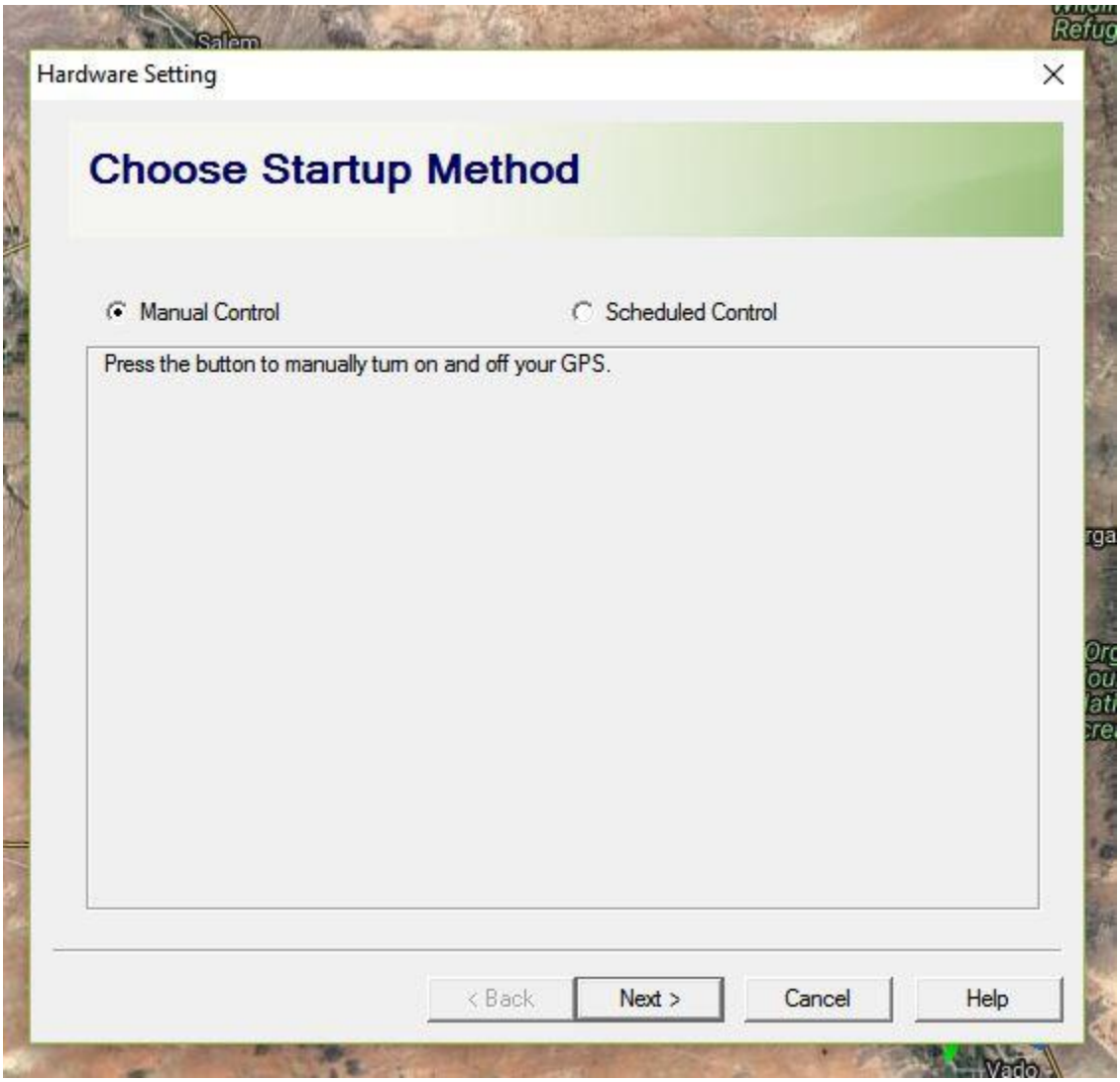


Data can be deleted using this button

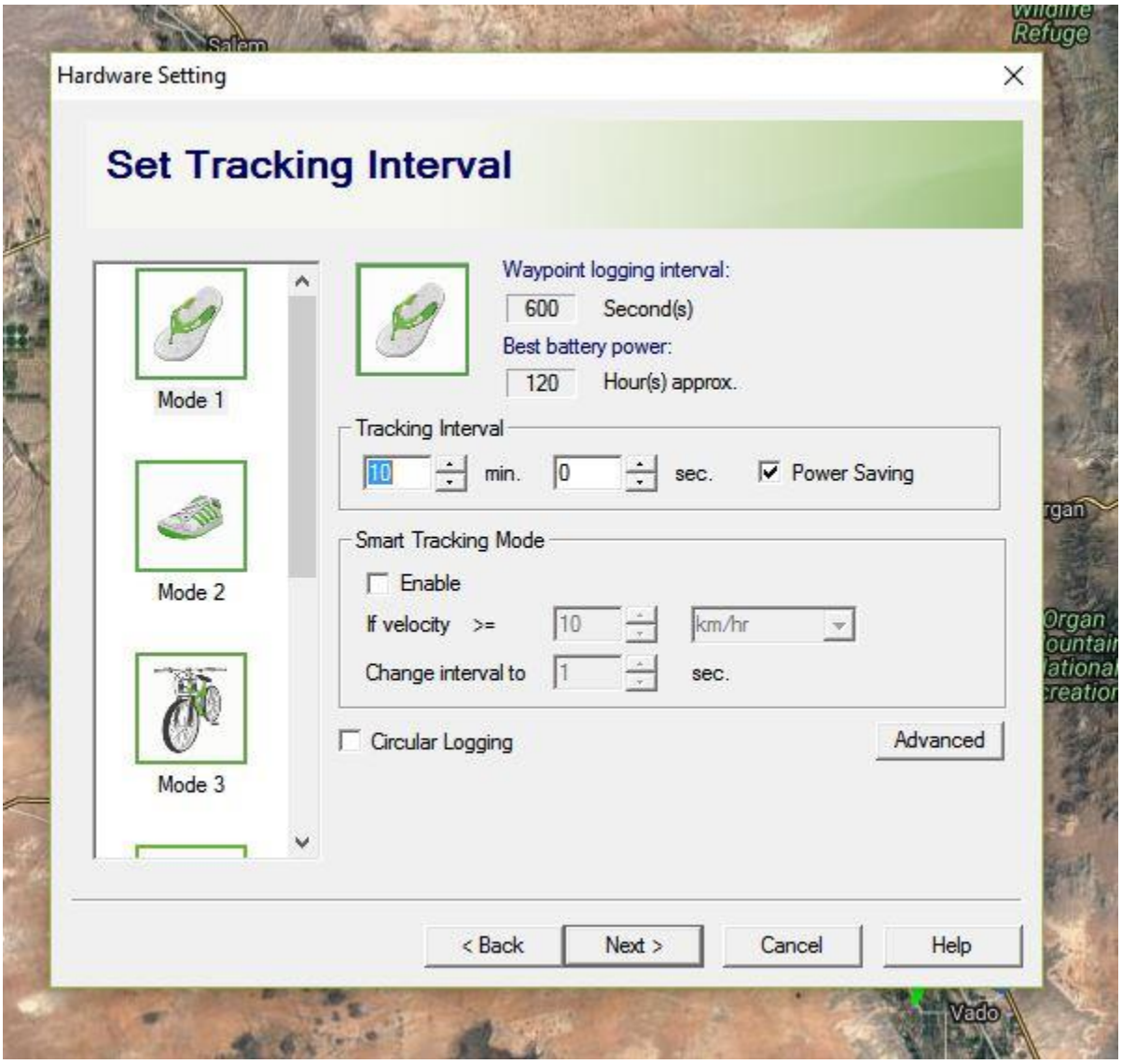
The GPS unit can be reconfigured or Setup using the following button

Screen 1 – Use this screen if you wish to setup password protection or Reset settings. Click Next to advance to screen 2

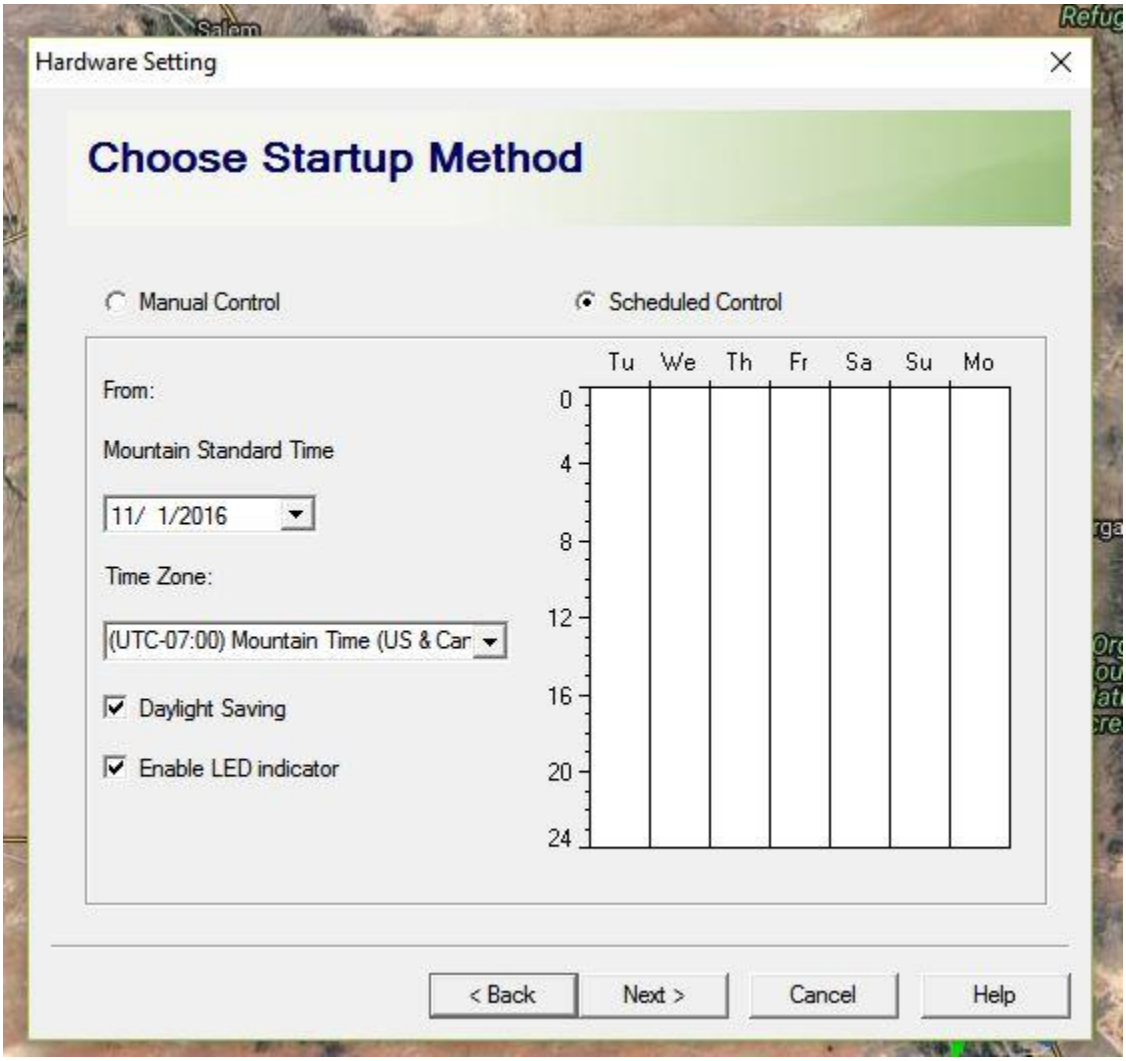
Screen 2 – Utilize this screen to setup manual control (push the button to turn GPS on) or Scheduled control (use the software to schedule the device to turn on at precise times of day, only record data on certain days or during certain times of day). Click next to advance to the manual or scheduled control Screens



Manual Control Screen – Select your interval between points. Be sure to DESELECT Power Saving mode. Power saving mode puts the device into sleep mode between points and has to reacquire satellite signal for every fix. This results in a reduced fix rate which intern leads to lost data. Smart Tracking mode allows you to put the GPS into sleep mode if the unit is traveling at an increased velocity. For example, it was designed to shut the unit off and save battery when you are driving in a car, as opposed to just walking around. I do not use this feature tracking livestock, however, it could useful if you wanted to exclude data from livestock being trailered, herded, or not at rest.



Scheduled Control Screen – Use this screen to schedule on/off times for the device. You could use it to turn on the devices after the collars have been placed on the livestock, or use this mode to only record data during the day/night/morning/noon/evening time. I could see this being useful if you would like to prepare/pack up your GPS tracking collars in the lab so when you arrive at the working facility you only have to place the collars on the animals to save time. Or, this would be useful in a situation like monitoring sheep behavior when animals are herded inside every night and you are only interested in the animals grazing behavior. This data could be sorted in excel later, but it would be a cumbersome task.



Chapter 3 – Sorting bad data from Mobile Action i-gotU 120 travel and sports loggers

This is a reply I received when I contacted Mobile Action to request more information about the data logged by the GPS unit

Dear Sir,

Thank you for using ***Mobile Action*** products.

We are sorry, we can only export the data from the GPS device(GT-120), and all the calculations are from the GPS chipset itself, we don't understand how it calculate.

Please see the following information we can only explain.

Please refer to the following steps to get data.
1. Add a new folder in C disk, folder name is GT_DATA_LOG, then run @trip PC program and download trip from i-gotU hardware again.
2. Please run the Microsoft Excel program to open the data file on C:\GT_DATA_LOG, you can see the whole GPS data that we recorded.

. Date: GPS date

. Time: GPS time, it is local time.

. Latitude: Please refer to wiki website http://en.wikipedia.org/wiki/Latitude

. Longitude: Please refer to wiki website http://en.wikipedia.org/wiki/Longitude

. Altitude: GPS Altitude, the unit is meter.

. Speed: The unit is meter/hour, This maximum speed of waypoint.

.Type: -1 is POI point, -2 is start point, -4 is end point.

. Distance: The unit is meter.

. Sleep Time: GPS Logger device sleep time. The unit is second.

. EHPE: Estimated Horizontal Position Error: The unit is cm.

Essential:
'1' – the waypoint is displayed on the map
' ' – Blank means waypoint is not displayed on the map.
If 'Optimize track' is enabled in the setting, waypoint filtered out will not be displayed on the map, and thus the blank (no value).

Sincerely yours

Mark Liang
Mobile Action Service Center also provides customers with easy access to online product **FAQ** that contain answers to commonly asked questions. Should you require further assistance, please do not hesitate to contact us via our website contact us page within your detail of question and product information please.
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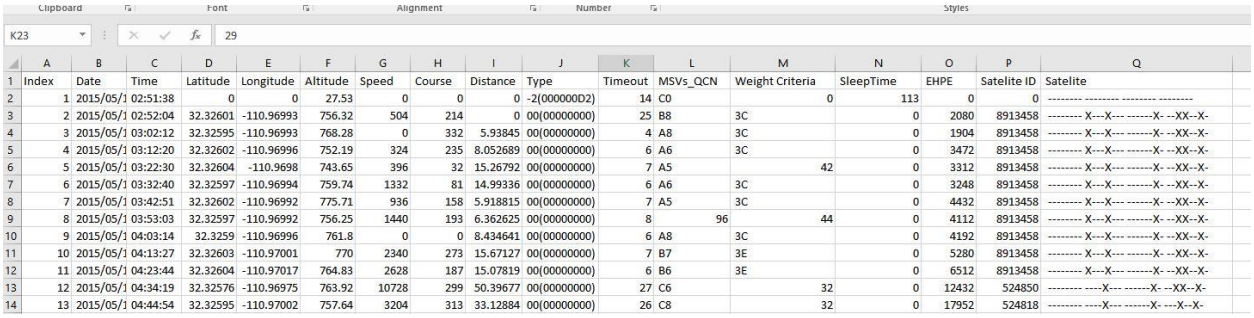
Mobile Action Technology Inc.
Web URL: www.mobileaction.com
Tel: 886-2-8913-1666 ext 678
Fax: 886-2-8913-1667

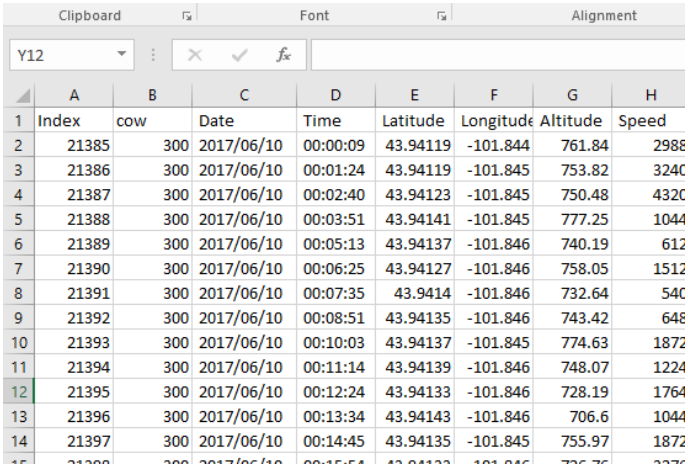
Step 1 – Open the csv file with raw GPS data



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Index	Date	Time	Latitude	Longitude	Altitude	Speed	Course	Distance	Type	Timeout	MSVs_QCN	Weight Criteria	SleepTime	EHPE	Satelite ID	Satelite
2	1	2015/05/1	02:51:38	0	0	27.53	0	0	0	-2(000000D2)	14	C0	0	113	0	0	-------- -------- -------- --------
3	2	2015/05/1	02:52:04	32.32601	-110.96993	756.32	504	214	0	00(00000000)	25	B8	3C	0	2080	8913458	-------- X---X--- ------X- --XX--X-
4	3	2015/05/1	03:02:12	32.32595	-110.96993	768.28	0	332	5.93845	00(00000000)	4	A8	3C	0	1904	8913458	-------- X---X--- ------X- --XX--X-
5	4	2015/05/1	03:12:20	32.32602	-110.96996	752.19	324	235	8.052689	00(00000000)	6	A6	3C	0	3472	8913458	-------- X---X--- ------X- --XX--X-
6	5	2015/05/1	03:22:30	32.32604	-110.9698	743.65	396	32	15.26792	00(00000000)	7	A5	42	0	3312	8913458	-------- X---X--- ------X- --XX--X-
7	6	2015/05/1	03:32:40	32.32597	-110.96994	759.74	1332	81	14.99336	00(00000000)	6	A6	3C	0	3248	8913458	-------- X---X--- ------X- --XX--X-
8	7	2015/05/1	03:42:51	32.32602	-110.96992	775.71	936	158	5.918815	00(00000000)	7	A5	3C	0	4432	8913458	-------- X---X--- ------X- --XX--X-
9	8	2015/05/1	03:53:03	32.32597	-110.96992	756.25	1440	193	6.362625	00(00000000)	8	96	44	0	4112	8913458	-------- X---X--- ------X- --XX--X-
10	9	2015/05/1	04:03:14	32.3259	-110.96996	761.8	0	0	8.434641	00(00000000)	6	A8	3C	0	4192	8913458	-------- X---X--- ------X- --XX--X-
11	10	2015/05/1	04:13:27	32.32603	-110.97001	770	2340	273	15.67127	00(00000000)	7	B7	3E	0	5280	8913458	-------- X---X--- ------X- --XX--X-
12	11	2015/05/1	04:23:44	32.32604	-110.97017	764.83	2628	187	15.07819	00(00000000)	6	B6	3E	0	6512	8913458	-------- X---X--- ------X- --XX--X-
13	12	2015/05/1	04:34:19	32.32576	-110.96975	763.92	10728	299	50.39677	00(00000000)	27	C6	32	0	12432	524850	-------- ----X--- ------X- --XX--X-
14	13	2015/05/1	04:44:54	32.32595	-110.97002	757.64	3204	313	33.12884	00(00000000)	26	C8	32	0	17952	524818	-------- ----X--- ------X- ---X--X-

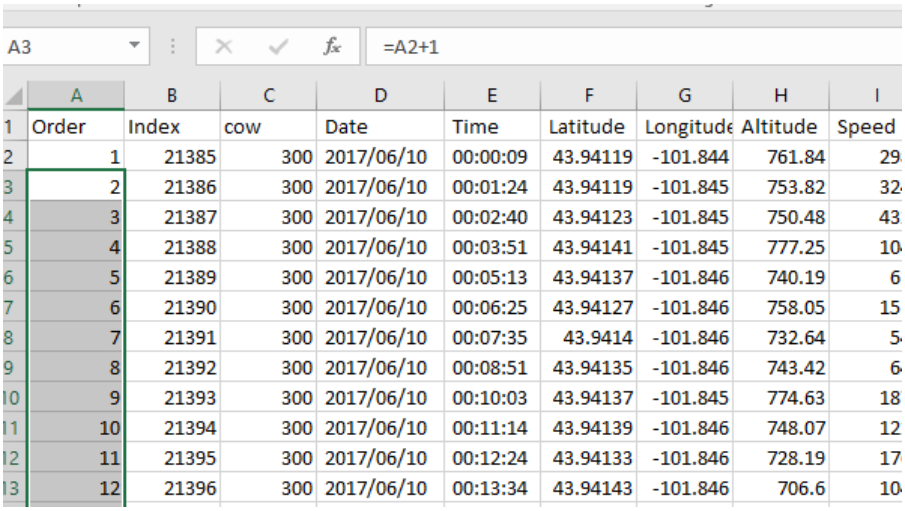
You should have the following columns: Index, Date, Time, Latitude, Longitude, Altitude, Speed, Course, Distance, Type, Timeout, MSVs_QCN, Weight Criteria, Sleep Time, EHPE, Satellite ID and Satellite.

Step 2 – Insert a new column between column A and B, label (cow, animal, bull, lamb etc.) Then add the animal's ID number to each row. Now combine all animals' data into this spread sheet (that way you can do the calculations for every animal at once instead of repeating this process for every time.) Leave a blank row between every animal (With this blank row, you can use Ctrl+Shift+the down arrow key to quickly navigate between animals).



	A	B	C	D	E	F	G	H
1	Index	cow	Date	Time	Latitude	Longitude	Altitude	Speed
2	21385	300	2017/06/10	00:00:09	43.94119	-101.844	761.84	2988
3	21386	300	2017/06/10	00:01:24	43.94119	-101.845	753.82	3240
4	21387	300	2017/06/10	00:02:40	43.94123	-101.845	750.48	4320
5	21388	300	2017/06/10	00:03:51	43.94141	-101.845	777.25	1044
6	21389	300	2017/06/10	00:05:13	43.94137	-101.846	740.19	612
7	21390	300	2017/06/10	00:06:25	43.94127	-101.846	758.05	1512
8	21391	300	2017/06/10	00:07:35	43.9414	-101.846	732.64	540
9	21392	300	2017/06/10	00:08:51	43.94135	-101.846	743.42	648
10	21393	300	2017/06/10	00:10:03	43.94137	-101.845	774.63	1872
11	21394	300	2017/06/10	00:11:14	43.94139	-101.846	748.07	1224
12	21395	300	2017/06/10	00:12:24	43.94133	-101.846	728.19	1764
13	21396	300	2017/06/10	00:13:34	43.94143	-101.846	706.6	1044
14	21397	300	2017/06/10	00:14:45	43.94135	-101.845	755.97	1872

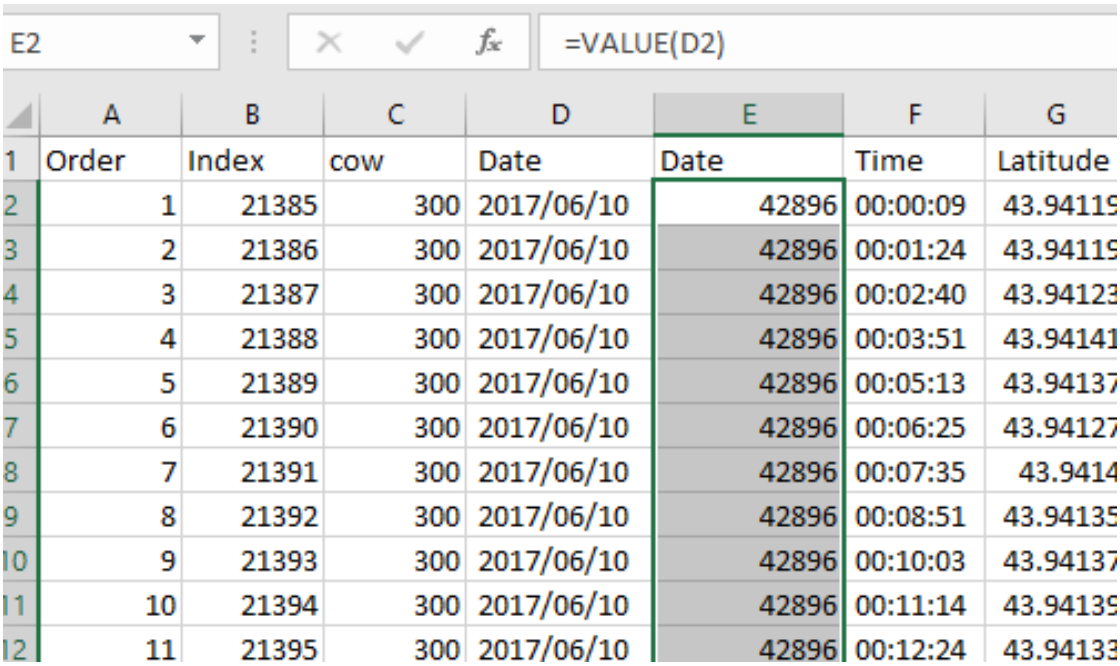
Step 3 – To the left of Column A, add a column, and rename this column, ORDER, and number each row. Be sure to copy and paste this row as numbers. This column allows you to list every cow in order and double check for mistakes when sorting by different columns.



A3 =A2+1

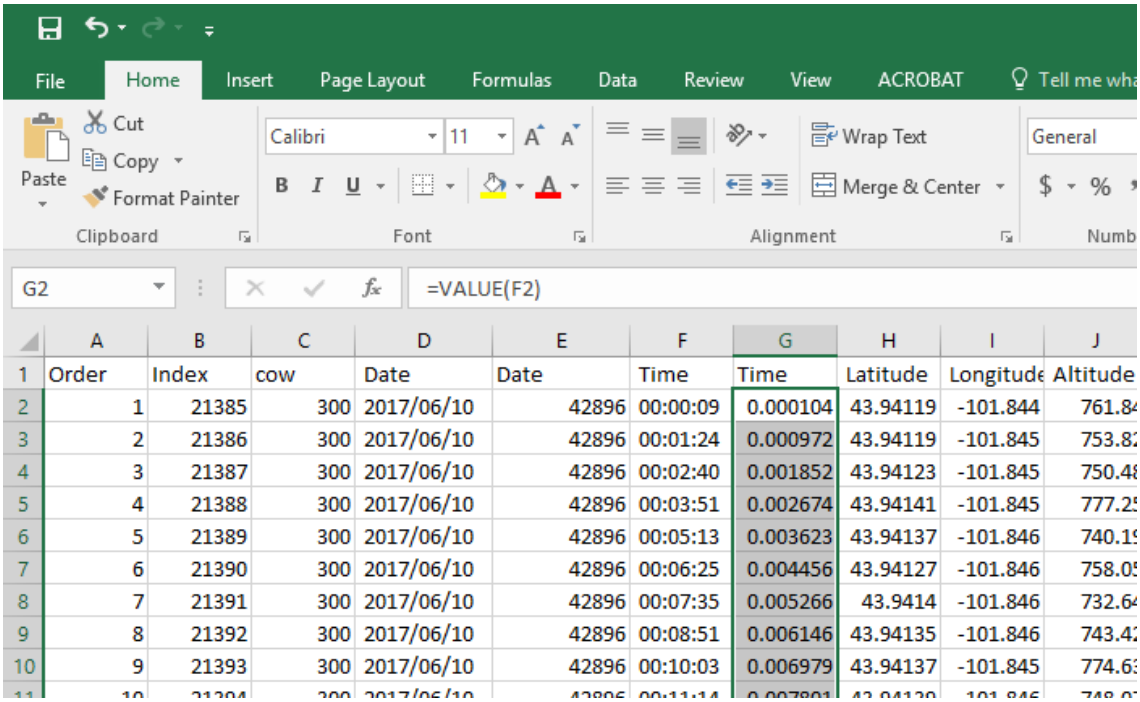
	A	B	C	D	E	F	G	H	I
1	Order	Index	cow	Date	Time	Latitude	Longitude	Altitude	Speed
2	1	21385	300	2017/06/10	00:00:09	43.94119	-101.844	761.84	29
3	2	21386	300	2017/06/10	00:01:24	43.94119	-101.845	753.82	32
4	3	21387	300	2017/06/10	00:02:40	43.94123	-101.845	750.48	43
5	4	21388	300	2017/06/10	00:03:51	43.94141	-101.845	777.25	10
6	5	21389	300	2017/06/10	00:05:13	43.94137	-101.846	740.19	6
7	6	21390	300	2017/06/10	00:06:25	43.94127	-101.846	758.05	15
8	7	21391	300	2017/06/10	00:07:35	43.9414	-101.846	732.64	5
9	8	21392	300	2017/06/10	00:08:51	43.94135	-101.846	743.42	6
10	9	21393	300	2017/06/10	00:10:03	43.94137	-101.845	774.63	18
11	10	21394	300	2017/06/10	00:11:14	43.94139	-101.846	748.07	12
12	11	21395	300	2017/06/10	00:12:24	43.94133	-101.846	728.19	17
13	12	21396	300	2017/06/10	00:13:34	43.94143	-101.846	706.6	10

Step 4 - Beside the Date and Time columns add an extra column and name them Date and Time respectively. The original Date and Time columns are in Text format. In the new columns, convert them to values.



E2 =VALUE(D2)

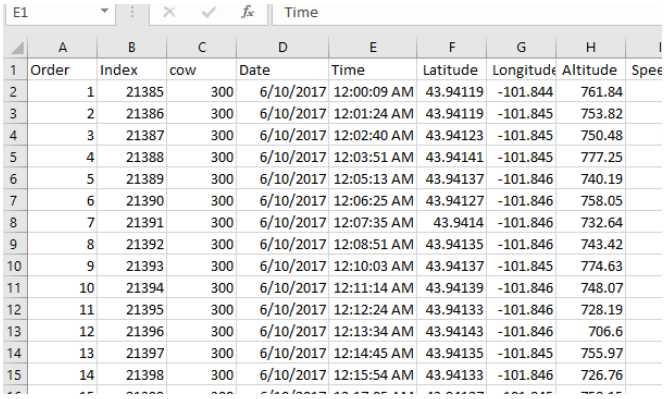
	A	B	C	D	E	F	G
1	Order	Index	cow	Date	Date	Time	Latitude
2	1	21385	300	2017/06/10	42896	00:00:09	43.94119
3	2	21386	300	2017/06/10	42896	00:01:24	43.94119
4	3	21387	300	2017/06/10	42896	00:02:40	43.94123
5	4	21388	300	2017/06/10	42896	00:03:51	43.94141
6	5	21389	300	2017/06/10	42896	00:05:13	43.94137
7	6	21390	300	2017/06/10	42896	00:06:25	43.94127
8	7	21391	300	2017/06/10	42896	00:07:35	43.9414
9	8	21392	300	2017/06/10	42896	00:08:51	43.94135
10	9	21393	300	2017/06/10	42896	00:10:03	43.94137
11	10	21394	300	2017/06/10	42896	00:11:14	43.94139
12	11	21395	300	2017/06/10	42896	00:12:24	43.94133



	A	B	C	D	E	F	G	H	I	J
1	Order	Index	cow	Date	Date	Time	Time	Latitude	Longitude	Altitude
2	1	21385	300	2017/06/10	42896	00:00:09	0.000104	43.94119	-101.844	761.84
3	2	21386	300	2017/06/10	42896	00:01:24	0.000972	43.94119	-101.845	753.82
4	3	21387	300	2017/06/10	42896	00:02:40	0.001852	43.94123	-101.845	750.48
5	4	21388	300	2017/06/10	42896	00:03:51	0.002674	43.94141	-101.845	777.25
6	5	21389	300	2017/06/10	42896	00:05:13	0.003623	43.94137	-101.846	740.19
7	6	21390	300	2017/06/10	42896	00:06:25	0.004456	43.94127	-101.846	758.05
8	7	21391	300	2017/06/10	42896	00:07:35	0.005266	43.9414	-101.846	732.64
9	8	21392	300	2017/06/10	42896	00:08:51	0.006146	43.94135	-101.846	743.42
10	9	21393	300	2017/06/10	42896	00:10:03	0.006979	43.94137	-101.845	774.63

Then format the new Date column to show the date however you prefer and format the time column to military time. Once completed, highlight each column, copy and paste it as numbers to remove the formulas.

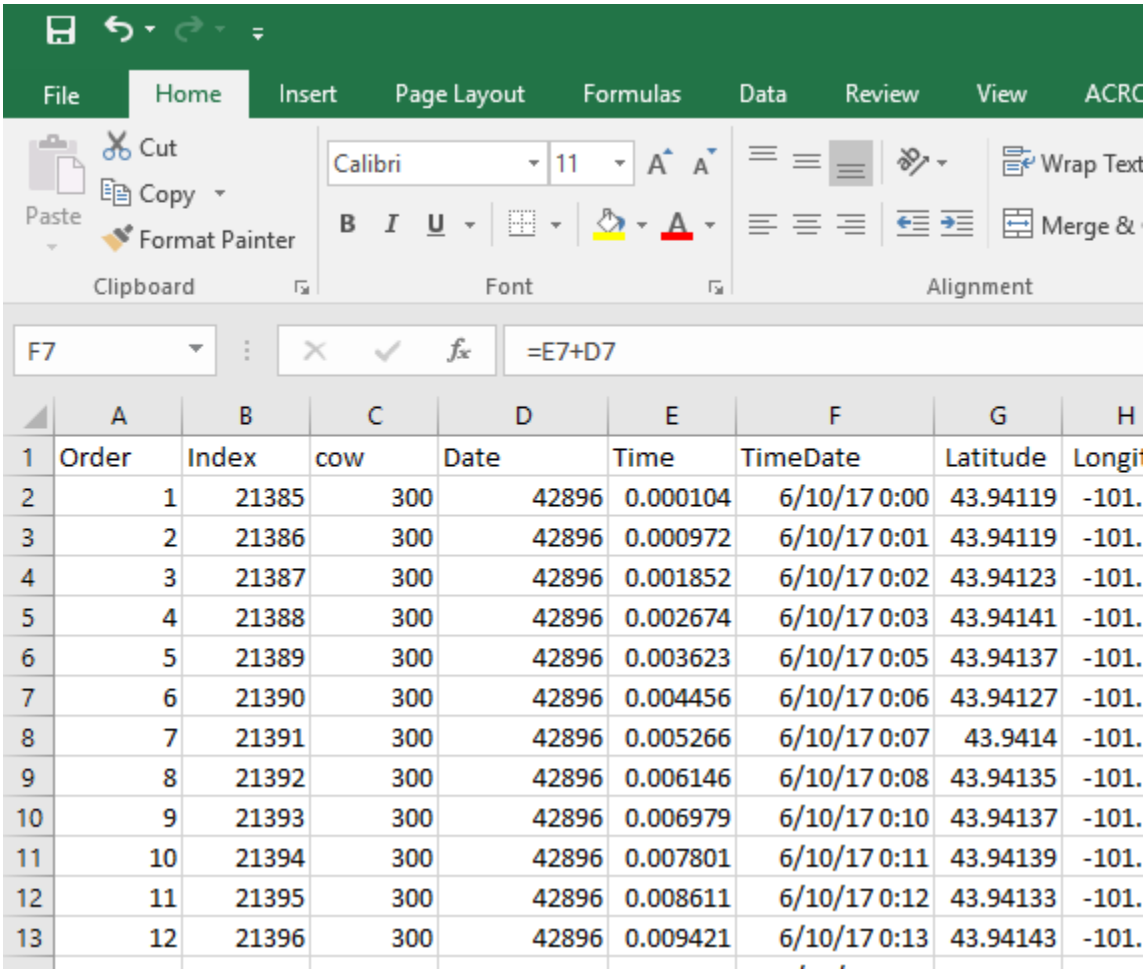
Then delete the “text” Date and Time columns.



	A	B	C	D	E	F	G	H
1	Order	Index	cow	Date	Time	Latitude	Longitude	Altitude
2	1	21385	300	6/10/2017	12:00:09 AM	43.94119	-101.844	761.84
3	2	21386	300	6/10/2017	12:01:24 AM	43.94119	-101.845	753.82
4	3	21387	300	6/10/2017	12:02:40 AM	43.94123	-101.845	750.48
5	4	21388	300	6/10/2017	12:03:51 AM	43.94141	-101.845	777.25
6	5	21389	300	6/10/2017	12:05:13 AM	43.94137	-101.846	740.19
7	6	21390	300	6/10/2017	12:06:25 AM	43.94127	-101.846	758.05
8	7	21391	300	6/10/2017	12:07:35 AM	43.9414	-101.846	732.64
9	8	21392	300	6/10/2017	12:08:51 AM	43.94135	-101.846	743.42
10	9	21393	300	6/10/2017	12:10:03 AM	43.94137	-101.845	774.63
11	10	21394	300	6/10/2017	12:11:14 AM	43.94139	-101.846	748.07
12	11	21395	300	6/10/2017	12:12:24 AM	43.94133	-101.846	728.19
13	12	21396	300	6/10/2017	12:13:34 AM	43.94143	-101.846	706.6
14	13	21397	300	6/10/2017	12:14:45 AM	43.94135	-101.845	755.97
15	14	21398	300	6/10/2017	12:15:54 AM	43.94133	-101.846	726.76

Highlight all rows, and use the sort function under the data tab to sort the dataset by date. Remove dates that are not included on the study. Re-sort using the Order column.

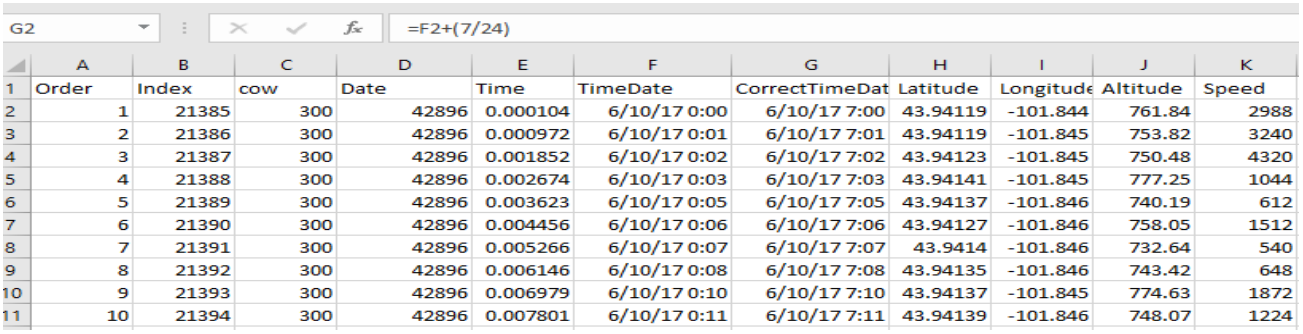
Step 5. Unfortunately, this raw data file does not correct for time zones. In order to correct for this, we must combine the date and time. Insert a column to the right of Time labeled TimeDate and add the Date and Time columns together. Save the new column as a value



	A	B	C	D	E	F	G	H
1	Order	Index	cow	Date	Time	TimeDate	Latitude	Longi
2	1	21385	300	42896	0.000104	6/10/17 0:00	43.94119	-101.
3	2	21386	300	42896	0.000972	6/10/17 0:01	43.94119	-101.
4	3	21387	300	42896	0.001852	6/10/17 0:02	43.94123	-101.
5	4	21388	300	42896	0.002674	6/10/17 0:03	43.94141	-101.
6	5	21389	300	42896	0.003623	6/10/17 0:05	43.94137	-101.
7	6	21390	300	42896	0.004456	6/10/17 0:06	43.94127	-101.
8	7	21391	300	42896	0.005266	6/10/17 0:07	43.9414	-101.
9	8	21392	300	42896	0.006146	6/10/17 0:08	43.94135	-101.
10	9	21393	300	42896	0.006979	6/10/17 0:10	43.94137	-101.
11	10	21394	300	42896	0.007801	6/10/17 0:11	43.94139	-101.
12	11	21395	300	42896	0.008611	6/10/17 0:12	43.94133	-101.
13	12	21396	300	42896	0.009421	6/10/17 0:13	43.94143	-101.

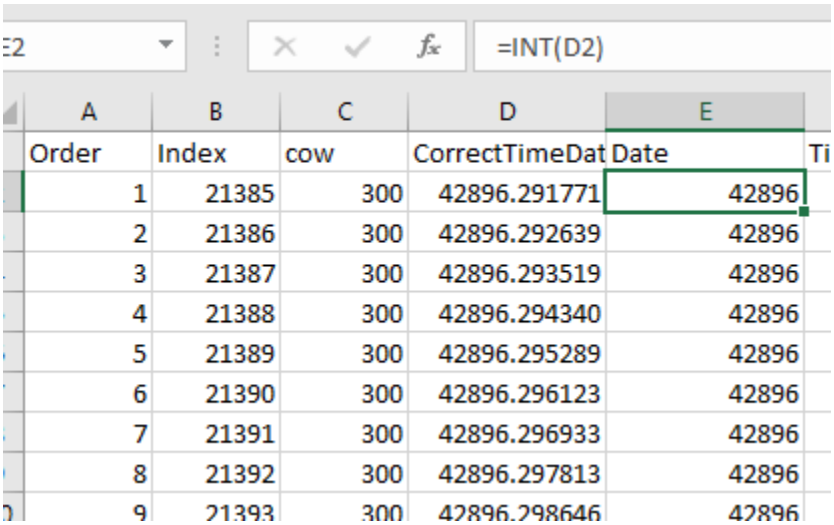
To the right of the new column add column CorrectTimeDate. In this example, we need to add 7 hours to the time/date in order to get the correct time and date. Use the following formula. This will correct the time of day, and make sure the date is also correct. = “TimeDate” + (hours/24)

=F2+(7/24)



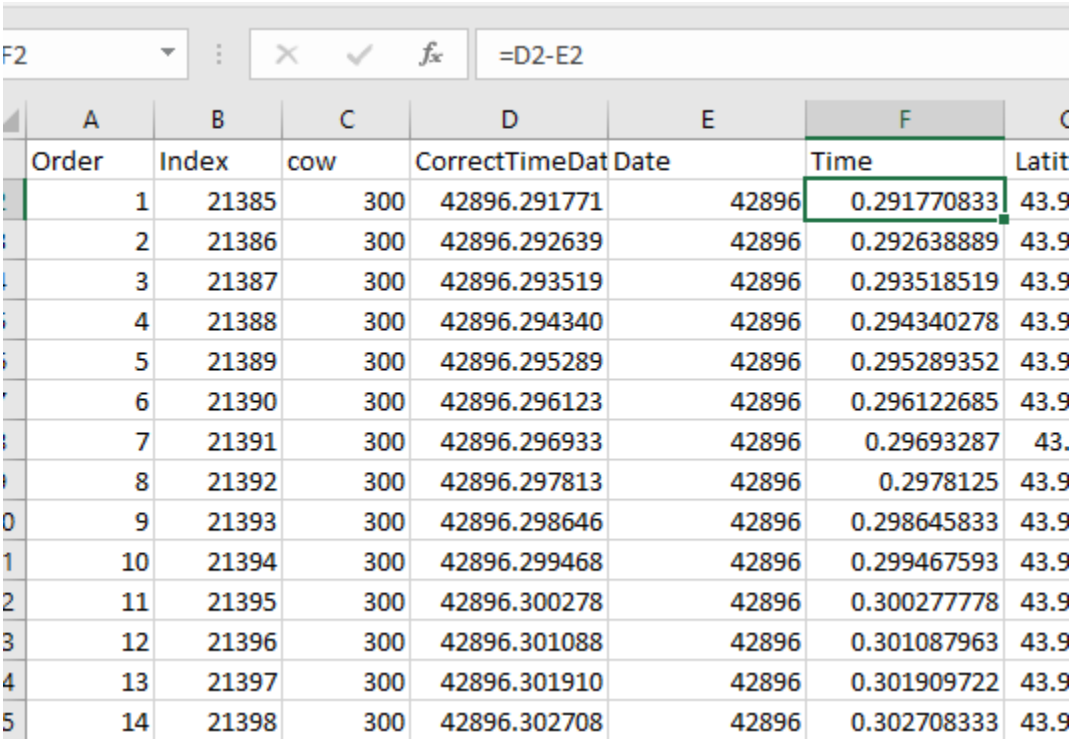
	A	B	C	D	E	F	G	H	I	J	K
1	Order	Index	cow	Date	Time	TimeDate	CorrectTimeDat	Latitude	Longitude	Altitude	Speed
2	1	21385	300	42896	0.000104	6/10/17 0:00	6/10/17 7:00	43.94119	-101.844	761.84	2988
3	2	21386	300	42896	0.000972	6/10/17 0:01	6/10/17 7:01	43.94119	-101.845	753.82	3240
4	3	21387	300	42896	0.001852	6/10/17 0:02	6/10/17 7:02	43.94123	-101.845	750.48	4320
5	4	21388	300	42896	0.002674	6/10/17 0:03	6/10/17 7:03	43.94141	-101.845	777.25	1044
6	5	21389	300	42896	0.003623	6/10/17 0:05	6/10/17 7:05	43.94137	-101.846	740.19	612
7	6	21390	300	42896	0.004456	6/10/17 0:06	6/10/17 7:06	43.94127	-101.846	758.05	1512
8	7	21391	300	42896	0.005266	6/10/17 0:07	6/10/17 7:07	43.9414	-101.846	732.64	540
9	8	21392	300	42896	0.006146	6/10/17 0:08	6/10/17 7:08	43.94135	-101.846	743.42	648
10	9	21393	300	42896	0.006979	6/10/17 0:10	6/10/17 7:10	43.94137	-101.845	774.63	1872
11	10	21394	300	42896	0.007801	6/10/17 0:11	6/10/17 7:11	43.94139	-101.846	748.07	1224

Save the new column as values, and delete the incorrect date and time columns. Add two new Date and Time Columns. Under Date use the formula = INT("CorrectTimeDate") to remove the time from the date stamp. Under the new Time column subtract the new "Date" column from "CorrectTimeDate" to separate out the time. Then Save both as values and delete TimeDate column =INT(D2)



E2 | =INT(D2)

	A	B	C	D	E
	Order	Index	cow	CorrectTimeDat	Date
1	1	21385	300	42896.291771	42896
2	2	21386	300	42896.292639	42896
3	3	21387	300	42896.293519	42896
4	4	21388	300	42896.294340	42896
5	5	21389	300	42896.295289	42896
6	6	21390	300	42896.296123	42896
7	7	21391	300	42896.296933	42896
8	8	21392	300	42896.297813	42896
9	9	21393	300	42896.298646	42896

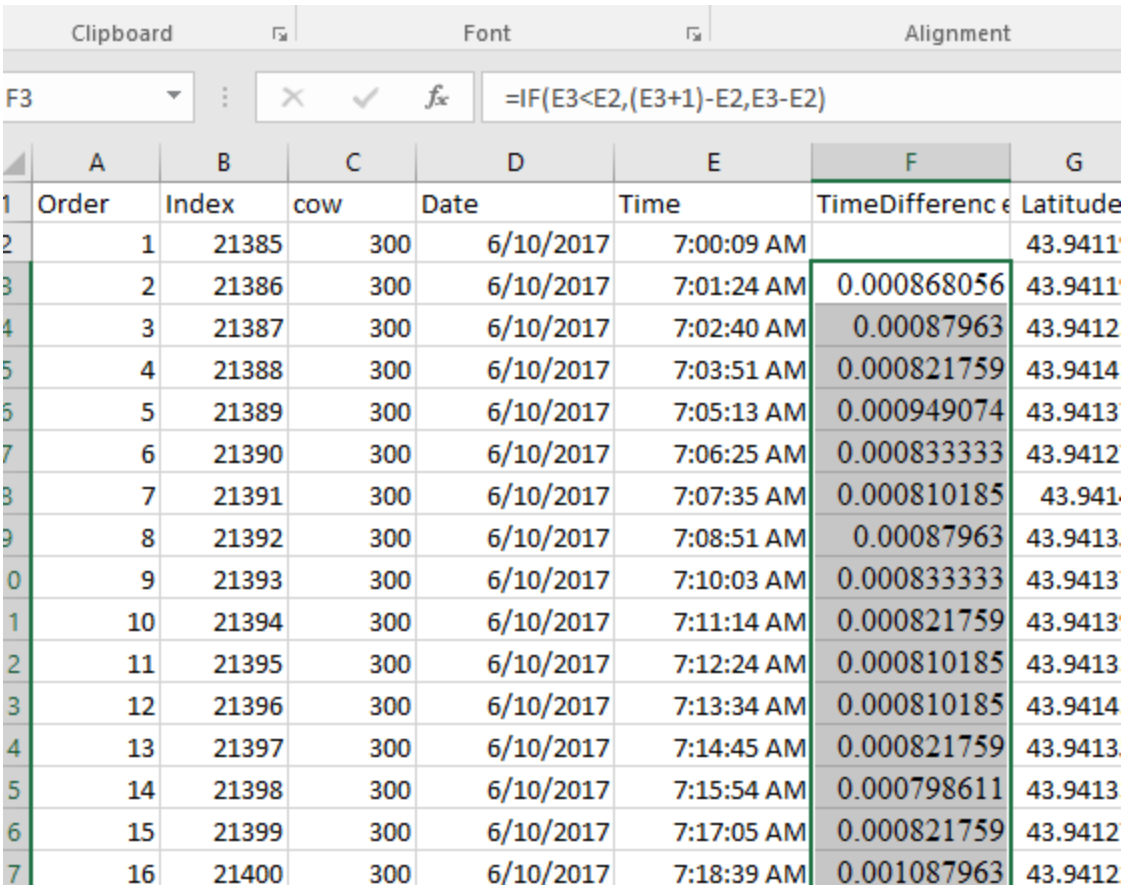


F2 | =D2-E2

	A	B	C	D	E	F
	Order	Index	cow	CorrectTimeDat	Date	Time
1	1	21385	300	42896.291771	42896	0.291770833
2	2	21386	300	42896.292639	42896	0.292638889
3	3	21387	300	42896.293519	42896	0.293518519
4	4	21388	300	42896.294340	42896	0.294340278
5	5	21389	300	42896.295289	42896	0.295289352
6	6	21390	300	42896.296123	42896	0.296122685
7	7	21391	300	42896.296933	42896	0.29693287
8	8	21392	300	42896.297813	42896	0.2978125
9	9	21393	300	42896.298646	42896	0.298645833
10	10	21394	300	42896.299468	42896	0.299467593
11	11	21395	300	42896.300278	42896	0.300277778
12	12	21396	300	42896.301088	42896	0.301087963
13	13	21397	300	42896.301910	42896	0.301909722
14	14	21398	300	42896.302708	42896	0.302708333

Step 6. Insert a column to the right of Time, and label it Time Difference and subtract the previous time to get the time difference between points. *Correction. Use formula

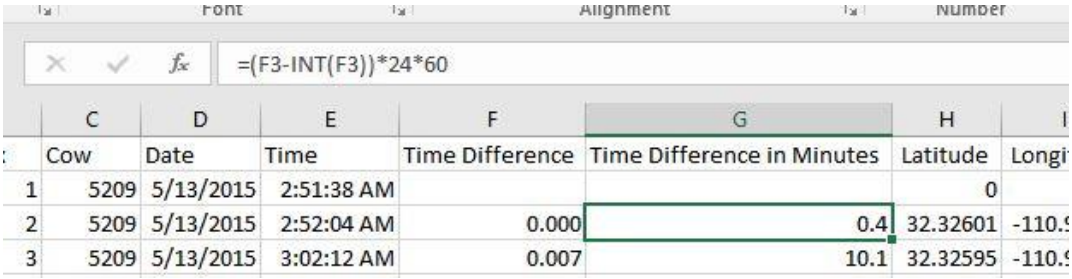
=IF(E3<E2,(E3+1)-E2,E3-E2) to allow for multiple day time differences



	A	B	C	D	E	F	G
1	Order	Index	cow	Date	Time	TimeDifferenc e	Latitude
2	1	21385	300	6/10/2017	7:00:09 AM		43.9411
3	2	21386	300	6/10/2017	7:01:24 AM	0.000868056	43.9411
4	3	21387	300	6/10/2017	7:02:40 AM	0.00087963	43.9412
5	4	21388	300	6/10/2017	7:03:51 AM	0.000821759	43.9414
6	5	21389	300	6/10/2017	7:05:13 AM	0.000949074	43.9413
7	6	21390	300	6/10/2017	7:06:25 AM	0.000833333	43.9412
8	7	21391	300	6/10/2017	7:07:35 AM	0.000810185	43.941
9	8	21392	300	6/10/2017	7:08:51 AM	0.00087963	43.9413
10	9	21393	300	6/10/2017	7:10:03 AM	0.000833333	43.9413
11	10	21394	300	6/10/2017	7:11:14 AM	0.000821759	43.9413
12	11	21395	300	6/10/2017	7:12:24 AM	0.000810185	43.9413
13	12	21396	300	6/10/2017	7:13:34 AM	0.000810185	43.9414
14	13	21397	300	6/10/2017	7:14:45 AM	0.000821759	43.9413
15	14	21398	300	6/10/2017	7:15:54 AM	0.000798611	43.9413
16	15	21399	300	6/10/2017	7:17:05 AM	0.000821759	43.9412
17	16	21400	300	6/10/2017	7:18:39 AM	0.001087963	43.9412

Step 7. Insert a new column to the right of Time Difference and label it Difference in Minutes, and insert the following formula to calculate the difference in time (unit minutes)

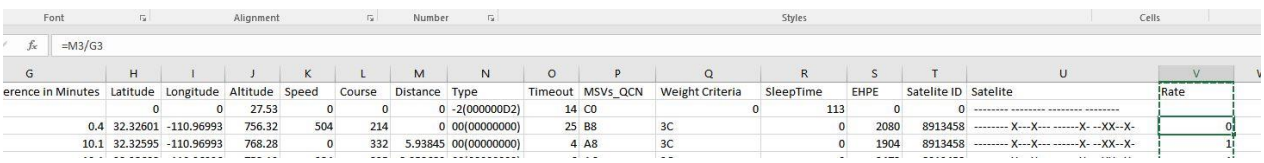
=(F3-INT(F3))*24*60



	C	D	E	F	G	H	I
	Cow	Date	Time	Time Difference	Time Difference in Minutes	Latitude	Longi
1	5209	5/13/2015	2:51:38 AM			0	
2	5209	5/13/2015	2:52:04 AM	0.000	0.4	32.32601	-110.9
3	5209	5/13/2015	3:02:12 AM	0.007	10.1	32.32595	-110.9

Step 8. Copy and paste both new columns as numbers to remove formulas.

Step 9. Rename column V to “rate” and divide the Distance column by the Time Difference in Minutes column to get rate of travel in meters per minute. Then copy and paste the column as numbers to remove the formulas. = M3/G3



G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
erence in Minutes	Latitude	Longitude	Altitude	Speed	Course	Distance	Type	Timeout	MSVs_QCN	Weight Criteria	SleepTime	EHPE	Satelite ID	Satelite	Rate
	0	0	27.53	0	0	0	-2(000000D2)	14	C0	0	113	0	0	-------- -------- -------- --------	
0.4	32.32601	-110.96993	756.32	504	214	0	00(00000000)	25	B8	3C	0	2080	8913458	-------- X---X--- ------X- --XX--X-	0
10.1	32.32595	-110.96993	768.28	0	332	5.93845	00(00000000)	4	A8	3C	0	1904	8913458	-------- X---X--- ------X- --XX--X-	1

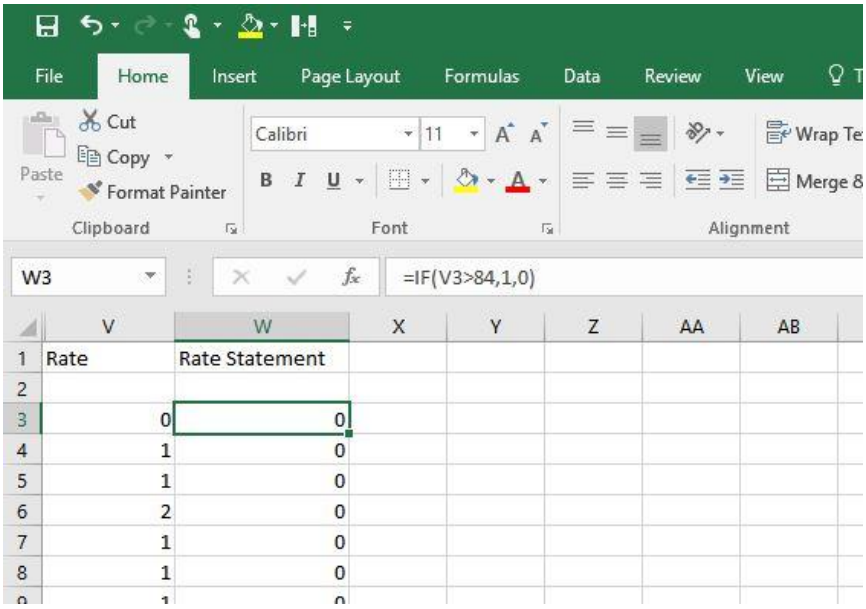
Note from Dr. Jim Sprinkle

When you save the GPS data as a shapefile in Arcmap, it scrubs the unique numbers for time difference etc. That's because they need to be saved as text to retain their uniqueness. Here is what I did to correct the problem. I added 3 new time columns to the csv file that I saved as Excel. Two of the columns were identical to your time difference and time difference in minutes column. The other column was a column I called time calc where I copied only the time with your formula =value(cells with text time). There was no need to copy date as a value. After doing my calculations and getting the rate, converting to values, I exported the time difference to Notepad, saved as text, and paste special back into Excel as text. I also had to format that time diff column as text in Excel. When I brought the file into Arcmap and saved as a layer it retained the time difference and date and time points unique characteristics since they are formatted in text. It was very helpful to me when I was deleting points in Arcmap to have unique time values.

Step 10. To the right of the rate column, create a "rate statement",

=IF("rate">84,1,0)

Copy and paste the column as numbers to remove the formula



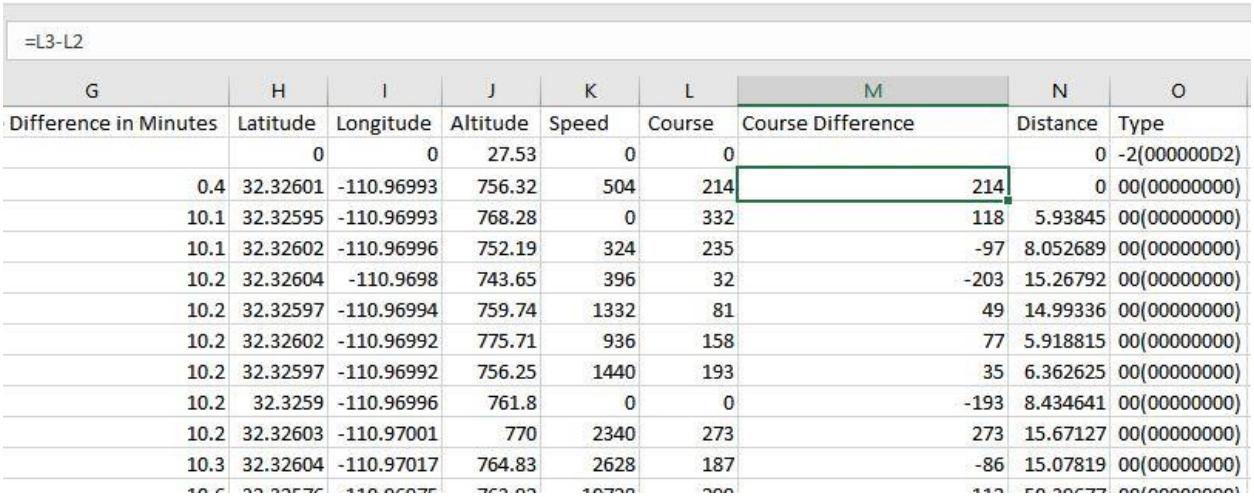
	V	W	X	Y	Z	AA	AB
1	Rate	Rate Statement					
2							
3	0	0					
4	1	0					
5	1	0					
6	2	0					
7	1	0					
8	1	0					

This flags fixes that are traveling greater than 84 meters per minute, the average walking speed of a bovine animal. (If you are working with a different species, you will need to find and substitute in the appropriate velocity).

N. Chapinal, A. M. de Passille, D. M. Weary, M. A. G. von Keyserlingk and J. Rushen. 2009. Using gait score, walking speed, and lying behavior to detect hoof lesions in dairy cows. J. Dairy Sci. 92:4365-4374, Doi:10:3168/jds.2009-2115.

Step 11. To the right of the "course" column add a new column labeled Course Difference, and calculate the difference in course between each fix absolute values using

=ABS(L3-L2)



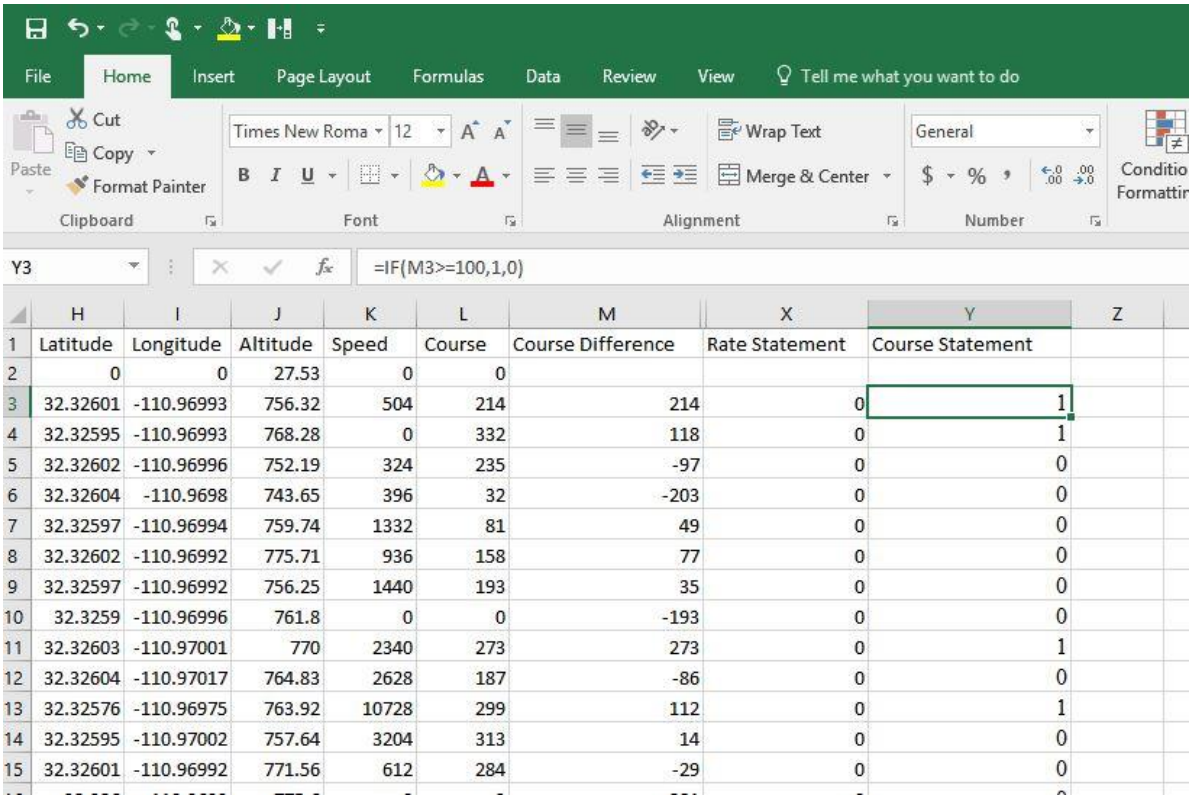
=L3-L2

G	H	I	J	K	L	M	N	O
Difference in Minutes	Latitude	Longitude	Altitude	Speed	Course	Course Difference	Distance	Type
	0	0	27.53	0	0		0	-2(000000D2)
0.4	32.32601	-110.96993	756.32	504	214	214	0	00(00000000)
10.1	32.32595	-110.96993	768.28	0	332	118	5.93845	00(00000000)
10.1	32.32602	-110.96996	752.19	324	235	-97	8.052689	00(00000000)
10.2	32.32604	-110.9698	743.65	396	32	-203	15.26792	00(00000000)
10.2	32.32597	-110.96994	759.74	1332	81	49	14.99336	00(00000000)
10.2	32.32602	-110.96992	775.71	936	158	77	5.918815	00(00000000)
10.2	32.32597	-110.96992	756.25	1440	193	35	6.362625	00(00000000)
10.2	32.3259	-110.96996	761.8	0	0	-193	8.434641	00(00000000)
10.2	32.32603	-110.97001	770	2340	273	273	15.67127	00(00000000)
10.3	32.32604	-110.97017	764.83	2628	187	-86	15.07819	00(00000000)

Step 12. To the right of "rate statement" column rename the column to Course Statement, and type in the following statement:

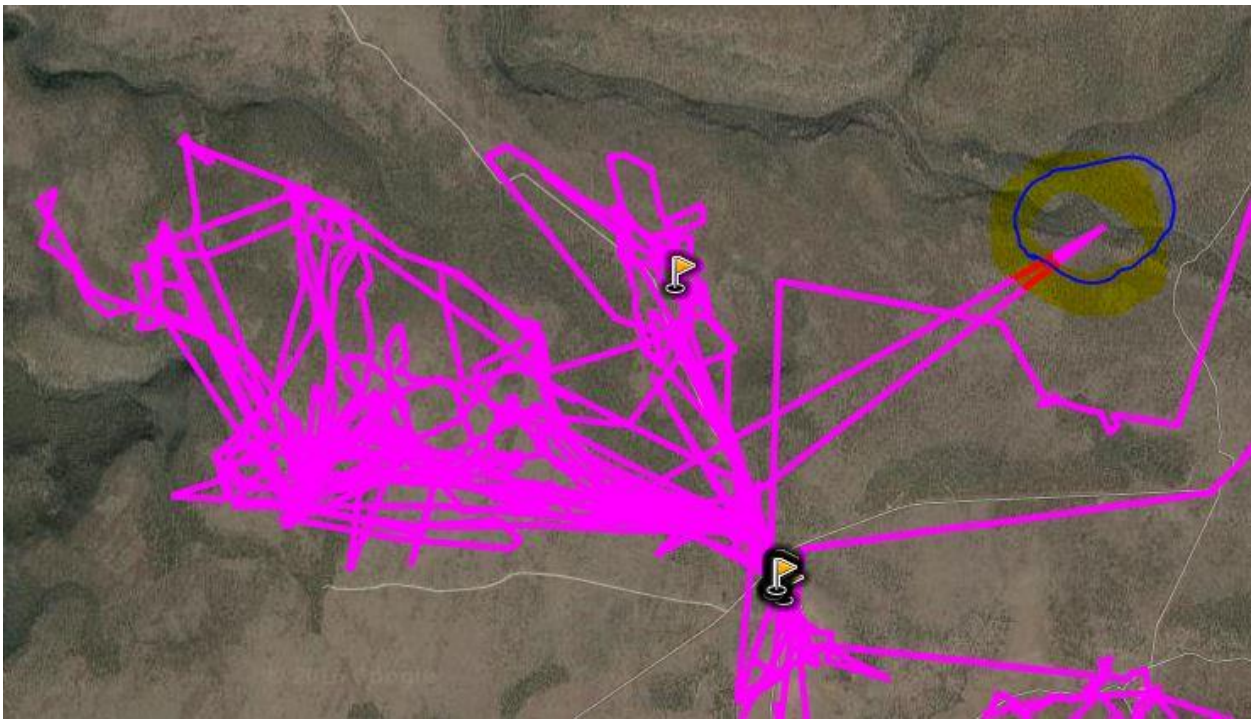
=IF("course difference" >=100,1,0)

Copy and paste into numbers to eliminate formulas.



	H	I	J	K	L	M	X	Y	Z
1	Latitude	Longitude	Altitude	Speed	Course	Course Difference	Rate Statement	Course Statement	
2	0	0	27.53	0	0				
3	32.32601	-110.96993	756.32	504	214	214	0	1	
4	32.32595	-110.96993	768.28	0	332	118	0	1	
5	32.32602	-110.96996	752.19	324	235	-97	0	0	
6	32.32604	-110.9698	743.65	396	32	-203	0	0	
7	32.32597	-110.96994	759.74	1332	81	49	0	0	
8	32.32602	-110.96992	775.71	936	158	77	0	0	
9	32.32597	-110.96992	756.25	1440	193	35	0	0	
10	32.3259	-110.96996	761.8	0	0	-193	0	0	
11	32.32603	-110.97001	770	2340	273	273	0	1	
12	32.32604	-110.97017	764.83	2628	187	-86	0	0	
13	32.32576	-110.96975	763.92	10728	299	112	0	1	
14	32.32595	-110.97002	757.64	3204	313	14	0	0	
15	32.32601	-110.96992	771.56	612	284	-29	0	0	

This flags fixes that have drastic course changes. You can see bad positions on the @trip PC google map view, they look like this. However, there is no good way to identify which point that is, or if it is actually good data or the result of a lot of time between fixes.



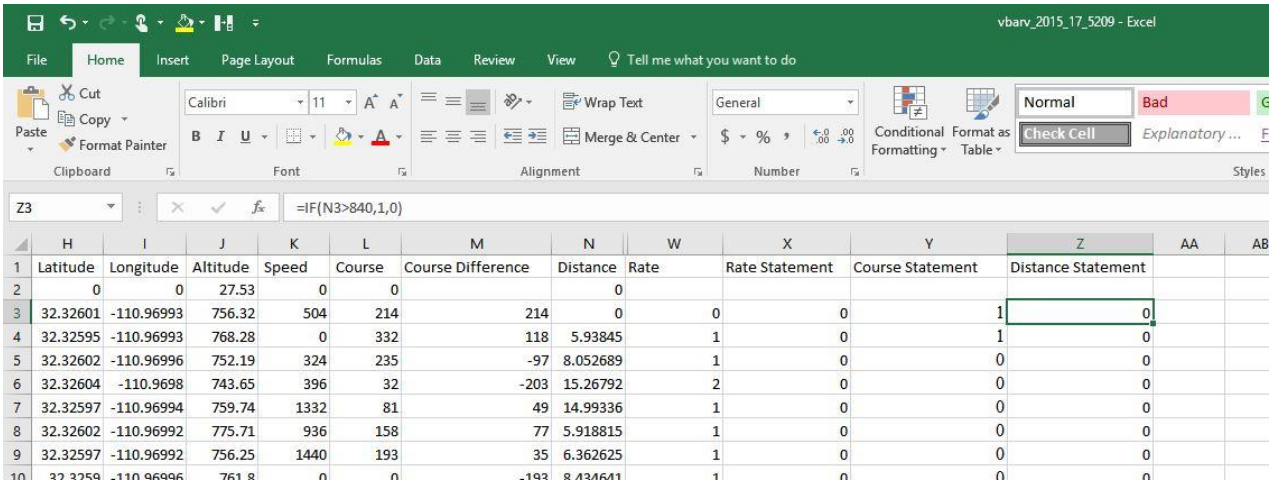
Step 13 - Rename Column Z to “Distance statement”. You now have to determine what distance you would find suspect. In this example, I am tracking a cow at 10 minute intervals. So…

84 m/min * 10 min = 840 meters

Anything greater than 840 meters is suspect, and I want to flag that data

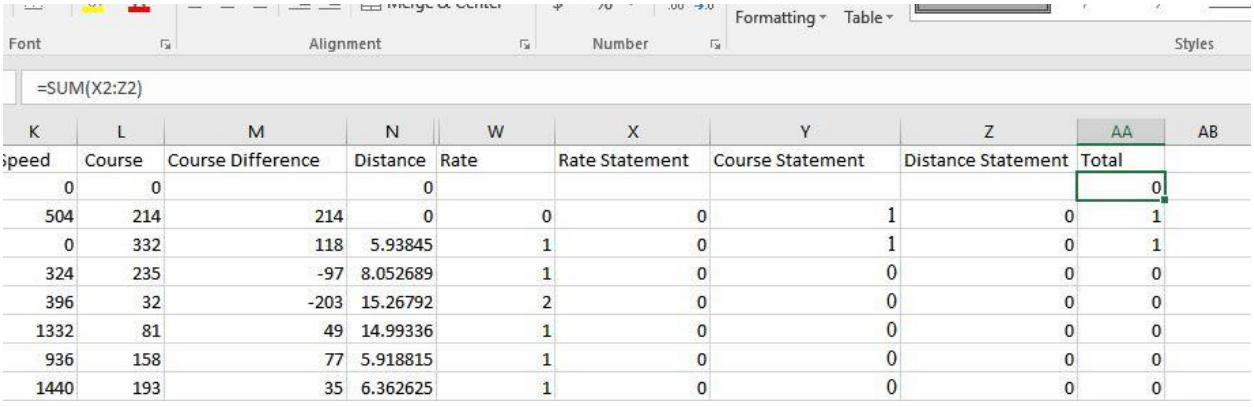
=IF(“distance” >840,1,0)

Be sure to copy and paste as numbers to eliminate formula



	H	I	J	K	L	M	N	W	X	Y	Z	AA	AB
1	Latitude	Longitude	Altitude	Speed	Course	Course Difference	Distance	Rate	Rate Statement	Course Statement	Distance Statement		
2	0	0	27.53	0	0		0						
3	32.32601	-110.96993	756.32	504	214	214	0	0	0	1	0		
4	32.32595	-110.96993	768.28	0	332	118	5.93845	1	0	1	0		
5	32.32602	-110.96996	752.19	324	235	-97	8.052689	1	0	0	0		
6	32.32604	-110.9698	743.65	396	32	-203	15.26792	2	0	0	0		
7	32.32597	-110.96994	759.74	1332	81	49	14.99336	1	0	0	0		
8	32.32602	-110.96992	775.71	936	158	77	5.918815	1	0	0	0		
9	32.32597	-110.96992	756.25	1440	193	35	6.362625	1	0	0	0		

Step 14 – Label column AA, “Total”, and sum the previous 3 columns. Be sure to copy and paste as numbers to eliminate formula.



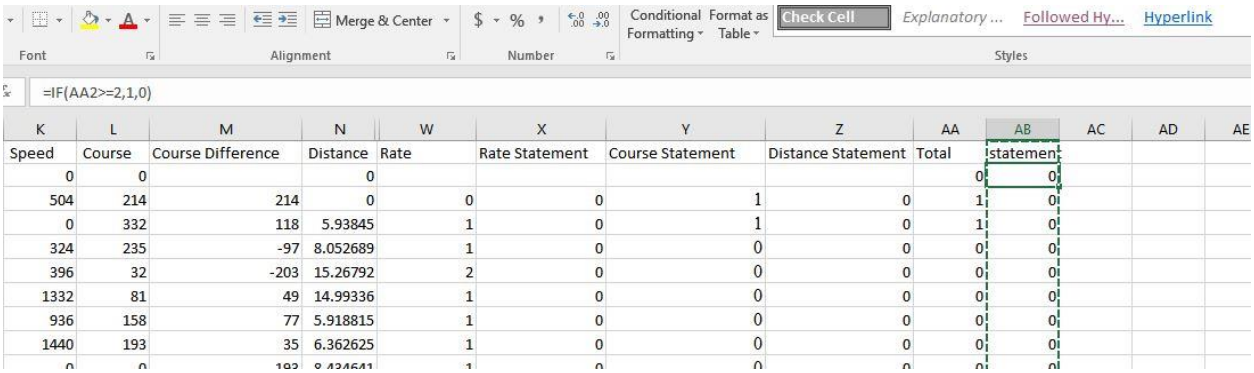
K	L	M	N	W	X	Y	Z	AA	AB
Speed	Course	Course Difference	Distance	Rate	Rate Statement	Course Statement	Distance Statement	Total	
0	0		0					0	
504	214	214	0	0	0	1	0	1	
0	332	118	5.93845	1	0	1	0	1	
324	235	-97	8.052689	1	0	0	0	0	
396	32	-203	15.26792	2	0	0	0	0	
1332	81	49	14.99336	1	0	0	0	0	
936	158	77	5.918815	1	0	0	0	0	
1440	193	35	6.362625	1	0	0	0	0	

Step 15. Label column AB, “Statement” and utilize the following formula

=IF(“total”>=2,1,0)

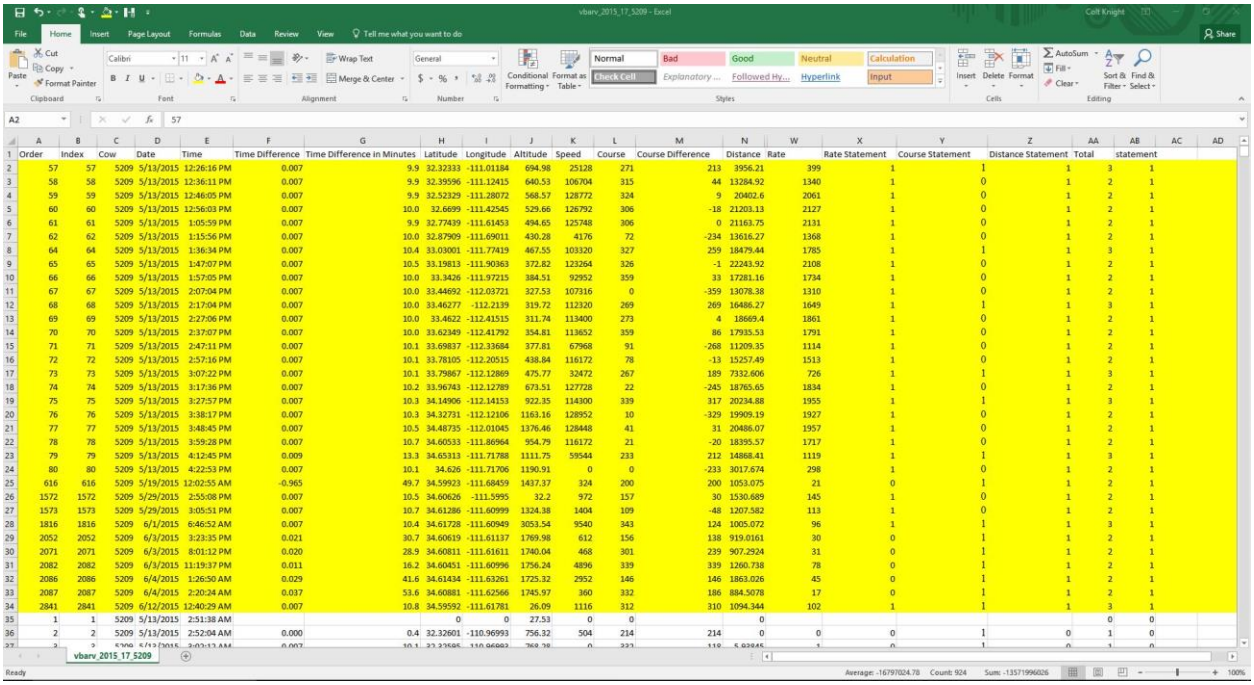
This looks at rate, course change, and distance traveled between points and flags them as bad data by finding the points that are way off course as shown previously.

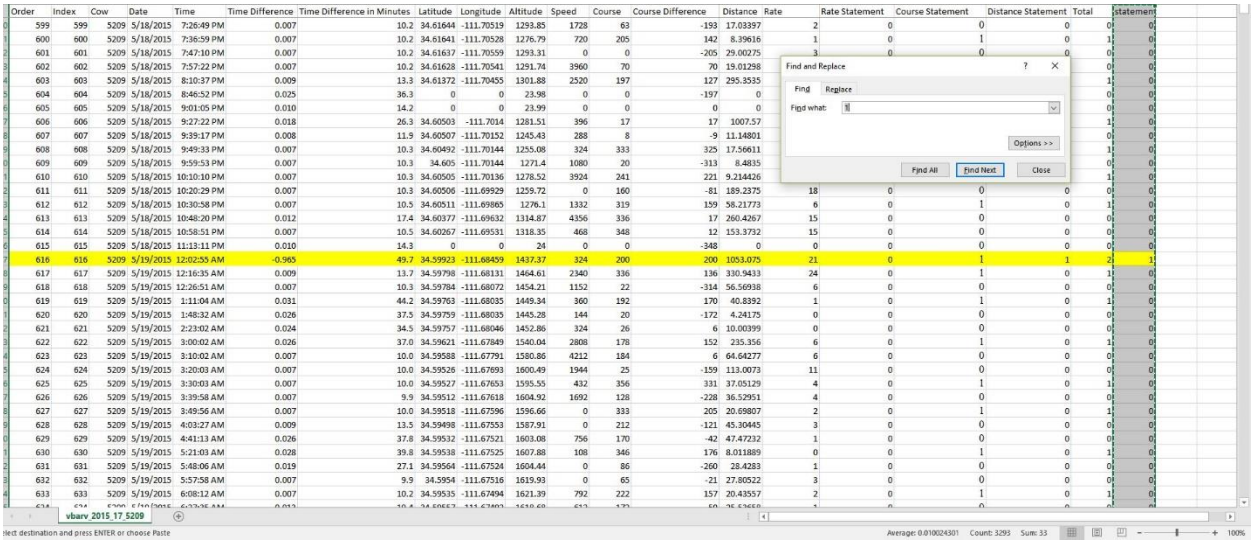
Be sure to copy and paste as numbers to eliminate formula.



K	L	M	N	W	X	Y	Z	AA	AB	AC	AD	AE
Speed	Course	Course Difference	Distance	Rate	Rate Statement	Course Statement	Distance Statement	Total	statement			
0	0		0					0	0			
504	214	214	0	0	0	1	0	1	0			
0	332	118	5.93845	1	0	1	0	1	0			
324	235	-97	8.052689	1	0	0	0	0	0			
396	32	-203	15.26792	2	0	0	0	0	0			
1332	81	49	14.99336	1	0	0	0	0	0			
936	158	77	5.918815	1	0	0	0	0	0			
1440	193	35	6.362625	1	0	0	0	0	0			
0	0	193	8.434641	1	0	0	0	0	0			

Step 16. Highlight all columns, and under the data tab select Sort, sort by statement. You now have all the data points listed in order. If you would like to double check them to see if they are really bad data, highlight the rows in yellow. Resort by the order column. Then highlight the Statement column and use the Find and Select tool under the Home tab to search for 1s. You can then look at each flagged data point and determine if you think it is good/bad data based on the animals speed, distance traveled between points, and time between points. In the interest of time on large data sets, I would simply eliminate all flagged data. Later data analysis will make up for distance traveled.





Step 17. Save data with appropriate file name so that you can tell the difference between raw and clean data.

Additional data cleanup- In most cases, the above calculations will clean up most of the bad data. However, in some circumstances, not all bad data has been removed. Typically, you will see high estimates for distance traveled or strange elevation/altitude measurements. Also, you may see points on ArcMap that are clearly out of boundaries for cattle to utilize.

One method is to order your spreadsheet based on distance traveled, rate, or altitude to find suspect points. Additionally, you could use the ArcMap to find and remove obviously bad data points (points outside of the acceptable boundaries.)

I am including a few notes from Dr. Jim Sprinkle on his additional data cleanup

I deleted points from the raw csv file by finding those points with altitudes that were way off. For my data set, it was altitude <1400 and >1900 meters. This let me eliminate about 50 or 60 data points over 30 days (taken every 5 minutes).

I added an extra step in data cleanup. I cleaned up the GPS shape file in Arcmap with the edit function. The way I did this was to overlay the points over the World Imagery file I downloaded from Esri. With this file, I was able to eliminate waypoints that were clearly outside the pasture boundaries. After doing this, I went through each day's data and eliminated waypoints that bounced outside the normal travel rate. I did this by the Selection/Select by Attributes menu function. I chose Date = Get Unique Value and chose the date. I then looked at the highlighted points and with the identify function was able to identify when the respective point was recorded along with its values. Often, there were two points close together in time as they bounced off the path. Using the edit function, I then highlighted the point I wanted to delete. You do have to make sure to only have one point showing up in blue when you select it to delete or you will delete the entire day. After getting rid of the bad waypoints I saved the file, then cleared selected features and chose the next day for evaluation.

After cleaning up the file in Arcmap, I exported the cleaned up file using the Conversion Tools\Excel\Table to Excel function when the layer was selected. This new file became the file that I used for the Pivot Table summary to prepare my SAS file.

I added one more calculation to my final Excel file. I added a column called "15 Slope" that was populated with =IF(N2 > 15, 1, "") . This allowed me to call up the sum of 15 slope in the pivot table for each day. I then divided this number by the GPS count for each day and multiplied by 100 to get the percentage of time the cows accessed slopes greater than 15%.

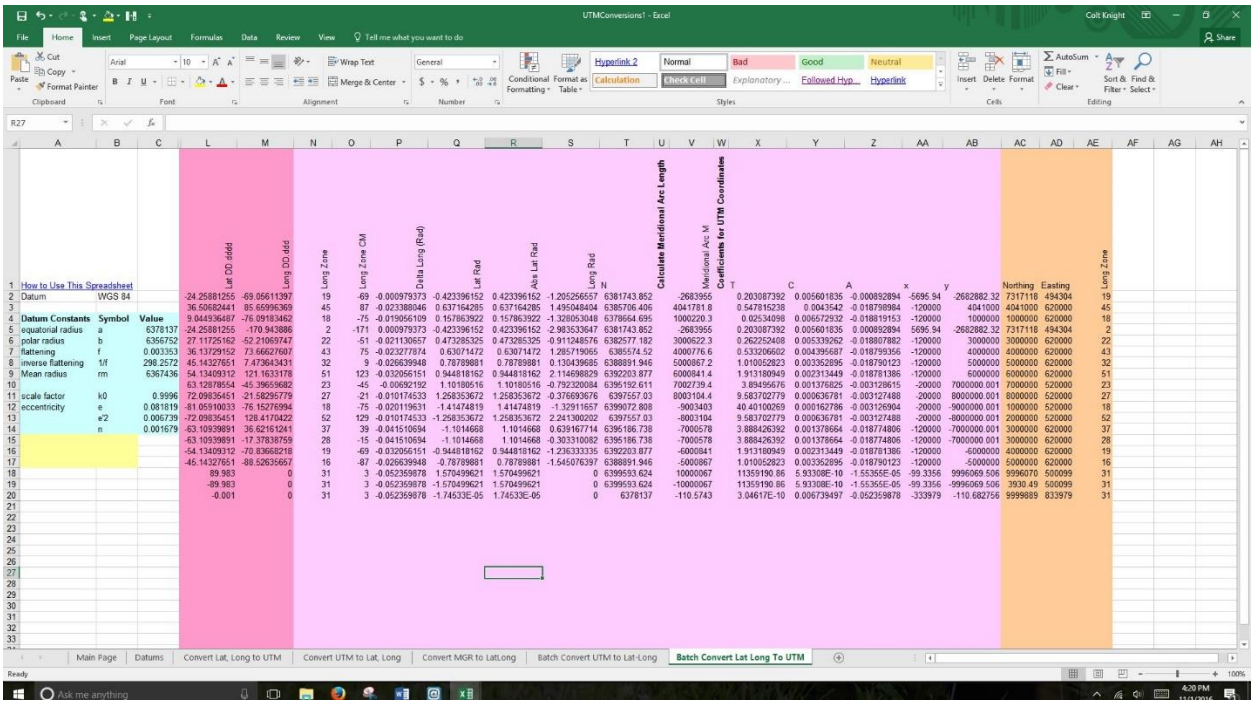
The above calculation could prove extremely useful, and the methodology could apply to any number of calculations, such as high/low elevation usage, time spent traveling throughout the day, etc.

Chapter 4 – Converting Longitude and Latitude to UTM (Northing and Easting)

To be able to estimate distance traveled for livestock, we need to calculate the distance between two points which we can do easily using Pythagoras's theorem if we have positions in UTM (Northing and Easting). In addition, to utilize Arc Map more accurately, using UTMs instead of Longitude and Latitude will result in less error because ArcMap will not have to convert between extreme units like minutes and degrees to meters.

You can easily batch convert Longitude and Latitude to UTM using a spread sheet provided by University of Wisconsin located here

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=0ahUKEwiasvuwy4jQAhWmwVQKHT2YDc8QFggwMAM&url=http%3A%2F%2Fwww.uwgb.edu%2Fdutchs%2FUsefulData%2FUTMConversions1.xls&usg=AFQjCNE5gDT3aToy0F3g1A4vGIiKamHc6g&sig2=0aoZK6A-4qIYEAio5ae2QQ&cad=rja



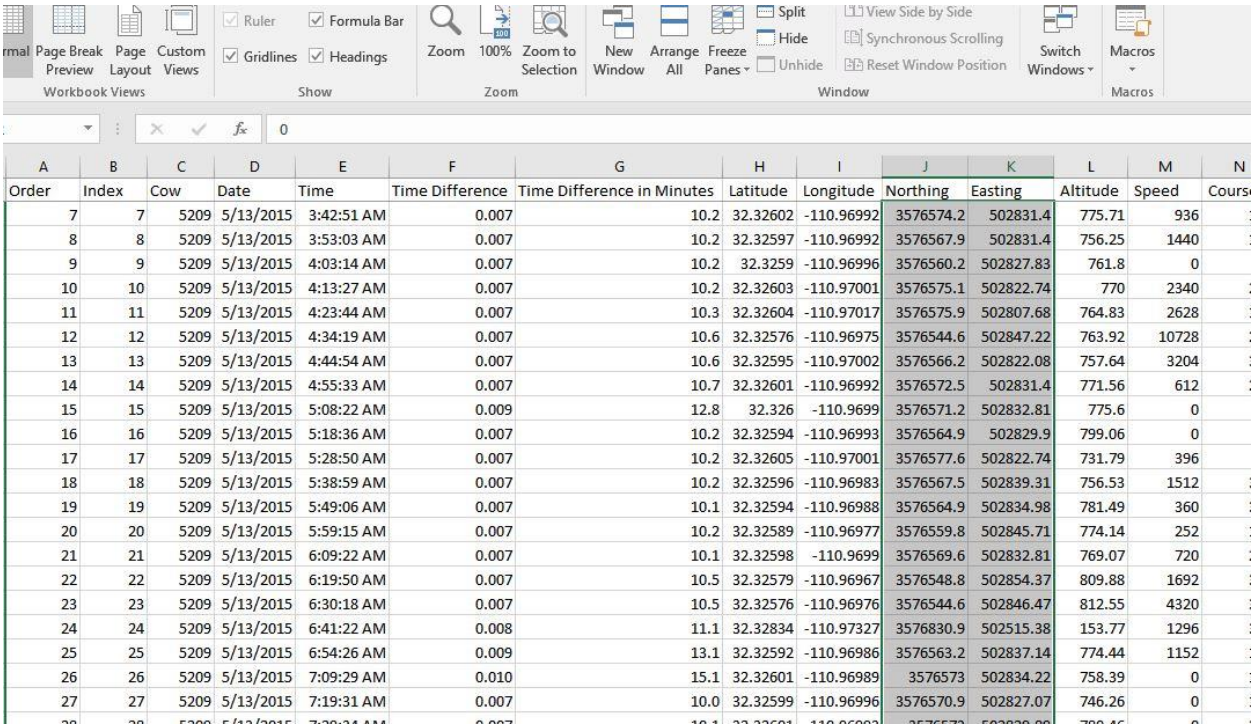
Open the spreadsheet and select Batch Convert Lat Long to UTM

Paste your Latitude and Longitude coordinates into L2 and M2 cells.

Be sure to highlight the row N2:AE2 and copy the formulas all the way down through the example formulas, and then again till the end of your dataset.

Take note of Column AE (You will need this number later to import your data into ArcMap)

Copy and Paste as values the Northing and Easting columns next to the Longitude and Latitude columns in your data spread sheet.



A	B	C	D	E	F	G	H	I	J	K	L	M	N
Order	Index	Cow	Date	Time	Time Difference	Time Difference in Minutes	Latitude	Longitude	Northing	Easting	Altitude	Speed	Cours
7	7	5209	5/13/2015	3:42:51 AM	0.007	10.2	32.32602	-110.96992	3576574.2	502831.4	775.71	936	
8	8	5209	5/13/2015	3:53:03 AM	0.007	10.2	32.32597	-110.96992	3576567.9	502831.4	756.25	1440	
9	9	5209	5/13/2015	4:03:14 AM	0.007	10.2	32.3259	-110.96996	3576560.2	502827.83	761.8	0	
10	10	5209	5/13/2015	4:13:27 AM	0.007	10.2	32.32603	-110.97001	3576575.1	502822.74	770	2340	
11	11	5209	5/13/2015	4:23:44 AM	0.007	10.3	32.32604	-110.97017	3576575.9	502807.68	764.83	2628	
12	12	5209	5/13/2015	4:34:19 AM	0.007	10.6	32.32576	-110.96975	3576544.6	502847.22	763.92	10728	
13	13	5209	5/13/2015	4:44:54 AM	0.007	10.6	32.32595	-110.97002	3576566.2	502822.08	757.64	3204	
14	14	5209	5/13/2015	4:55:33 AM	0.007	10.7	32.32601	-110.96992	3576572.5	502831.4	771.56	612	
15	15	5209	5/13/2015	5:08:22 AM	0.009	12.8	32.326	-110.9699	3576571.2	502832.81	775.6	0	
16	16	5209	5/13/2015	5:18:36 AM	0.007	10.2	32.32594	-110.96993	3576564.9	502829.9	799.06	0	
17	17	5209	5/13/2015	5:28:50 AM	0.007	10.2	32.32605	-110.97001	3576577.6	502822.74	731.79	396	
18	18	5209	5/13/2015	5:38:59 AM	0.007	10.2	32.32596	-110.96983	3576567.5	502839.31	756.53	1512	
19	19	5209	5/13/2015	5:49:06 AM	0.007	10.1	32.32594	-110.96988	3576564.9	502834.98	781.49	360	
20	20	5209	5/13/2015	5:59:15 AM	0.007	10.2	32.32589	-110.96977	3576559.8	502845.71	774.14	252	
21	21	5209	5/13/2015	6:09:22 AM	0.007	10.1	32.32598	-110.9699	3576569.6	502832.81	769.07	720	
22	22	5209	5/13/2015	6:19:50 AM	0.007	10.5	32.32579	-110.96967	3576548.8	502854.37	809.88	1692	
23	23	5209	5/13/2015	6:30:18 AM	0.007	10.5	32.32576	-110.96976	3576544.6	502846.47	812.55	4320	
24	24	5209	5/13/2015	6:41:22 AM	0.008	11.1	32.32834	-110.97327	3576830.9	502515.38	153.77	1296	
25	25	5209	5/13/2015	6:54:26 AM	0.009	13.1	32.32592	-110.96986	3576563.2	502837.14	774.44	1152	
26	26	5209	5/13/2015	7:09:29 AM	0.010	15.1	32.32601	-110.96989	3576573	502834.22	758.39	0	
27	27	5209	5/13/2015	7:19:31 AM	0.007	10.0	32.32599	-110.96996	3576570.9	502827.07	746.26	0	

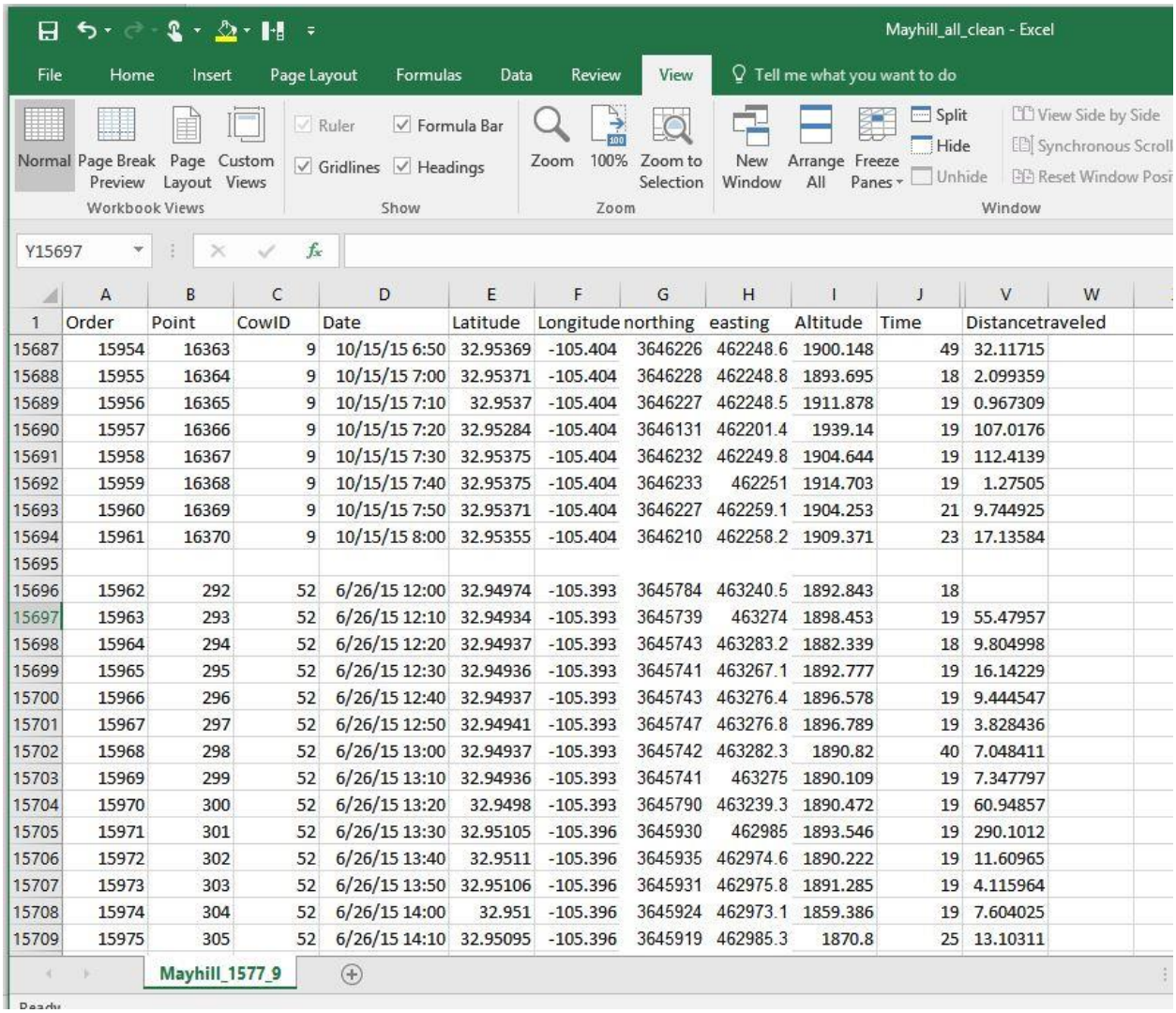
Chapter 5 – Estimating Distance traveled

Now add a distance traveled column and utilize this formula to calculate the distance traveled in meters between points:

Northing 1=" N1" Easting 1="E1" Northing 2="N2" Easting 2="E2"

=SQRT((N2-N1) ^2+(E2-E1) ^2)

Select the cow number in the first column and press Ctrl+Shift+down arrow, and this will take you to the next cow in your list. Clear the contents in the blank space between each cow and the first row for Distance Travelled. Since we performed the formula for distance travelled for all animals, the first distance travelled measure for each cow is actually the distance between where the previous cow finished the study and next cow started the study, so we need to clear the contents of those cells.



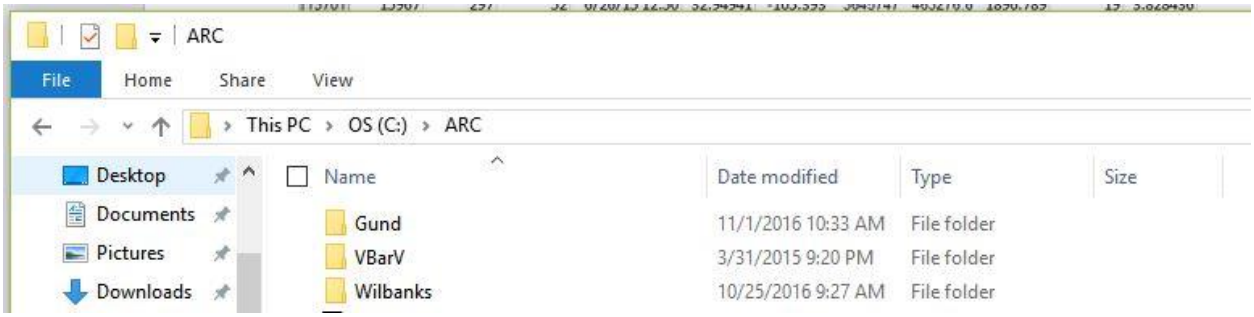
	A	B	C	D	E	F	G	H	I	J	V	W
1	Order	Point	CowID	Date	Latitude	Longitude	northing	easting	Altitude	Time	Distancetraveled	
15687	15954	16363	9	10/15/15 6:50	32.95369	-105.404	3646226	462248.6	1900.148	49	32.11715	
15688	15955	16364	9	10/15/15 7:00	32.95371	-105.404	3646228	462248.8	1893.695	18	2.099359	
15689	15956	16365	9	10/15/15 7:10	32.9537	-105.404	3646227	462248.5	1911.878	19	0.967309	
15690	15957	16366	9	10/15/15 7:20	32.95284	-105.404	3646131	462201.4	1939.14	19	107.0176	
15691	15958	16367	9	10/15/15 7:30	32.95375	-105.404	3646232	462249.8	1904.644	19	112.4139	
15692	15959	16368	9	10/15/15 7:40	32.95375	-105.404	3646233	462251	1914.703	19	1.27505	
15693	15960	16369	9	10/15/15 7:50	32.95371	-105.404	3646227	462259.1	1904.253	21	9.744925	
15694	15961	16370	9	10/15/15 8:00	32.95355	-105.404	3646210	462258.2	1909.371	23	17.13584	
15695												
15696	15962	292	52	6/26/15 12:00	32.94974	-105.393	3645784	463240.5	1892.843	18		
15697	15963	293	52	6/26/15 12:10	32.94934	-105.393	3645739	463274	1898.453	19	55.47957	
15698	15964	294	52	6/26/15 12:20	32.94937	-105.393	3645743	463283.2	1882.339	18	9.804998	
15699	15965	295	52	6/26/15 12:30	32.94936	-105.393	3645741	463267.1	1892.777	19	16.14229	
15700	15966	296	52	6/26/15 12:40	32.94937	-105.393	3645743	463276.4	1896.578	19	9.444547	
15701	15967	297	52	6/26/15 12:50	32.94941	-105.393	3645747	463276.8	1896.789	19	3.828436	
15702	15968	298	52	6/26/15 13:00	32.94937	-105.393	3645742	463282.3	1890.82	40	7.048411	
15703	15969	299	52	6/26/15 13:10	32.94936	-105.393	3645741	463275	1890.109	19	7.347797	
15704	15970	300	52	6/26/15 13:20	32.9498	-105.393	3645790	463239.3	1890.472	19	60.94857	
15705	15971	301	52	6/26/15 13:30	32.95105	-105.396	3645930	462985	1893.546	19	290.1012	
15706	15972	302	52	6/26/15 13:40	32.9511	-105.396	3645935	462974.6	1890.222	19	11.60965	
15707	15973	303	52	6/26/15 13:50	32.95106	-105.396	3645931	462975.8	1891.285	19	4.115964	
15708	15974	304	52	6/26/15 14:00	32.951	-105.396	3645924	462973.1	1859.386	19	7.604025	
15709	15975	305	52	6/26/15 14:10	32.95095	-105.396	3645919	462985.3	1870.8	25	13.10311	

Chapter 6 – Generating Accurate Elevation measurements

Step 1 – Format spreadsheet for importation into ArcMap. Remove all spaces and symbols in column headings. Utilize underscores if needed. Save as a .CSV file.

Order	Point	Month	Day	Year	Hour	Minute	Latitude	Longitude	Nothing	Easting	Altitude	Time	Temp	Fix_Status	Stats	DOP	Date_Time	X_Act_av	Y_Act_av	Hd_Dn_av	cow	Distance
896	896	8	26	2012	0	0	32.4974556	-108.55257	3601141.702	166174.054	1668.691	26	23	"3D Fix-F1"	9	2	8/26/12 0:00	1	35.5	22	256	
897	897	8	26	2012	0	10	32.4974453	-108.55257	3601140.559	166174.016	1667.953	26	23	"3D Fix-F1"	9	2	8/26/12 0:10	0	38.5	20	256	1.1436315
898	898	8	26	2012	0	20	32.4974728	-108.5525883	3601143.668	166172.398	1666.813	26	23	"3D Fix-F2"	10	1.7	8/26/12 0:20	2	13.5	30.65	256	3.504826
899	899	8	26	2012	0	30	32.4975156	-108.5526019	3601148.459	166171.277	1651.375	27	23	"3D Fix-F2"	9	2.2	8/26/12 0:30	0	0	100	256	4.9203986
900	900	8	26	2012	0	40	32.4974483	-108.5525756	3601140.91	166173.501	1666.023	26	22.5	"3D Fix-F1"	9	2.3	8/26/12 0:40	0	2.5	20.65	256	7.8697889
901	901	8	26	2012	0	50	32.4974356	-108.5525661	3601139.471	166174.347	1663.277	26	23	"3D Fix-F1"	9	2.3	8/26/12 0:50	1	56	8	256	1.6692624
902	902	8	26	2012	1	0	32.4974506	-108.5525886	3601141.206	166172.287	1660.617	26	23.5	"3D Fix-F2"	9	2.2	8/26/12 1:00	0	13	0.35	256	2.6932926
903	903	8	26	2012	1	10	32.4974683	-108.5525842	3601143.155	166172.766	1664.063	38	23.5	"3D Fix-F1"	9	2.2	8/26/12 1:10	10	6.5	9.35	256	2.0069983
904	904	8	26	2012	1	20	32.4976483	-108.5523083	3601162.26	166199.372	1666.242	26	23	"3D Fix-F1"	9	2	8/26/12 1:20	24	11	89	256	32.754851
905	905	8	26	2012	1	30	32.4978631	-108.5519981	3601185.117	166229.332	1672.113	26	23	"3D Fix-F1"	8	2.2	8/26/12 1:30	4	11	99	256	37.683472

To avoid any trouble importing files into ArcMap, create a new folder directly on your c drive and name it ARC. I use subfolders within ARC to separate locations/ranches. (Once you have several studies on your computer, the files become confusing without good organization.)

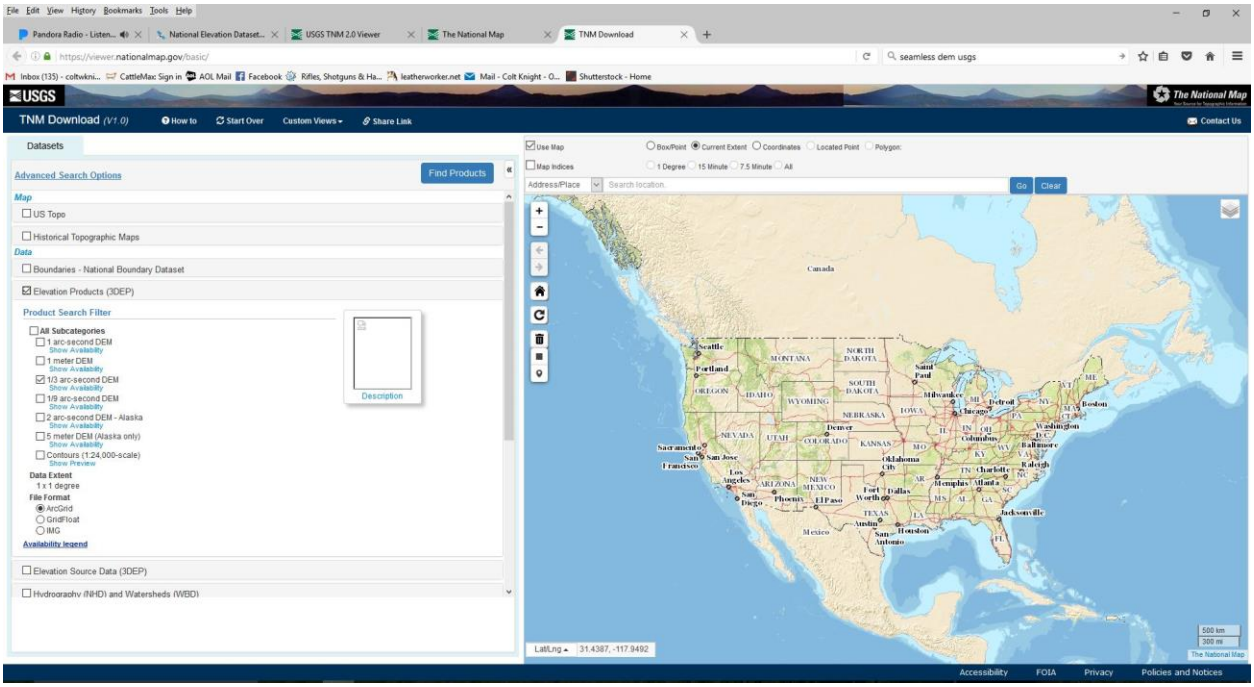


Step 2. Find a Seamless DEM

Go to

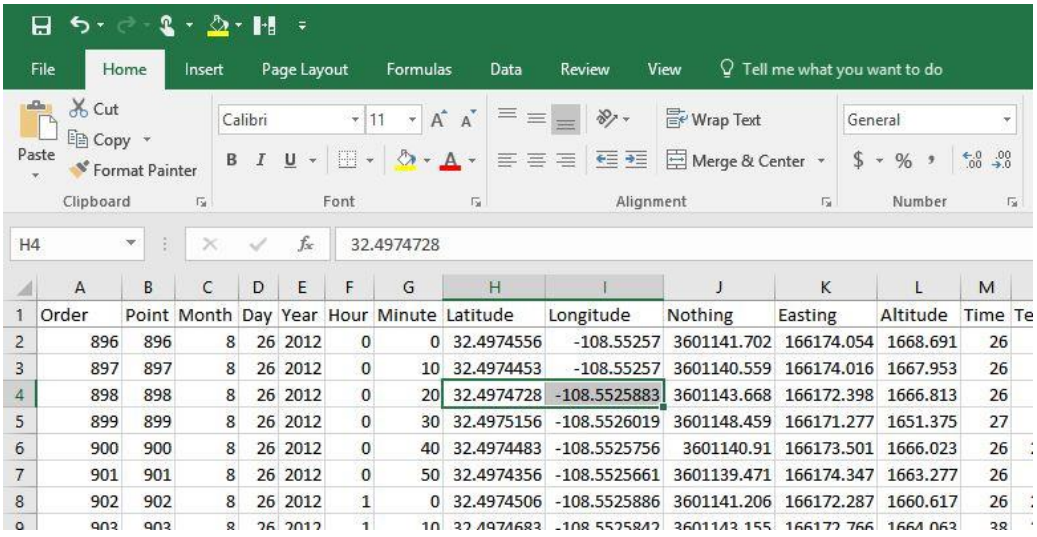
https://viewer.nationalmap.gov/basic/

Select Elevation Products (3DEP), search availability and select the finest resolution



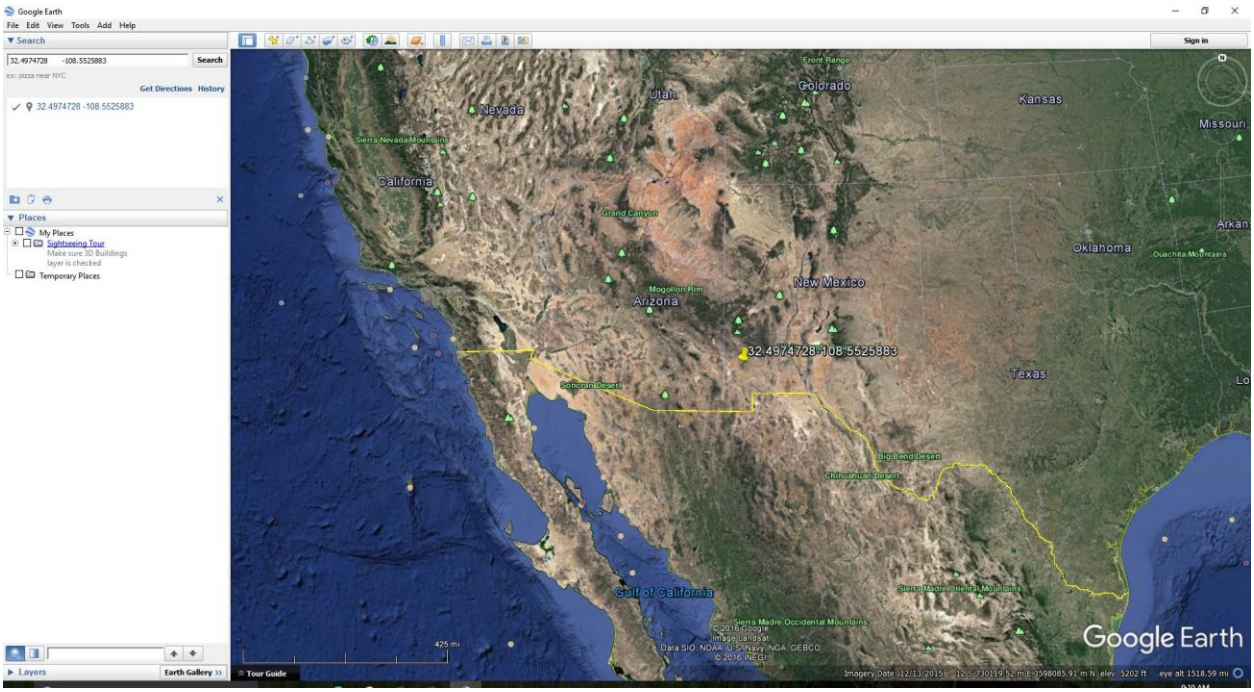
Zoom in on the location using the map to the right, and select the area you need for your study. If you are unfamiliar with the location, you can use your data set and Google Earth to find the spatial location of the ranch.

Go to your spread sheet and pick a longitude and latitude from the data set

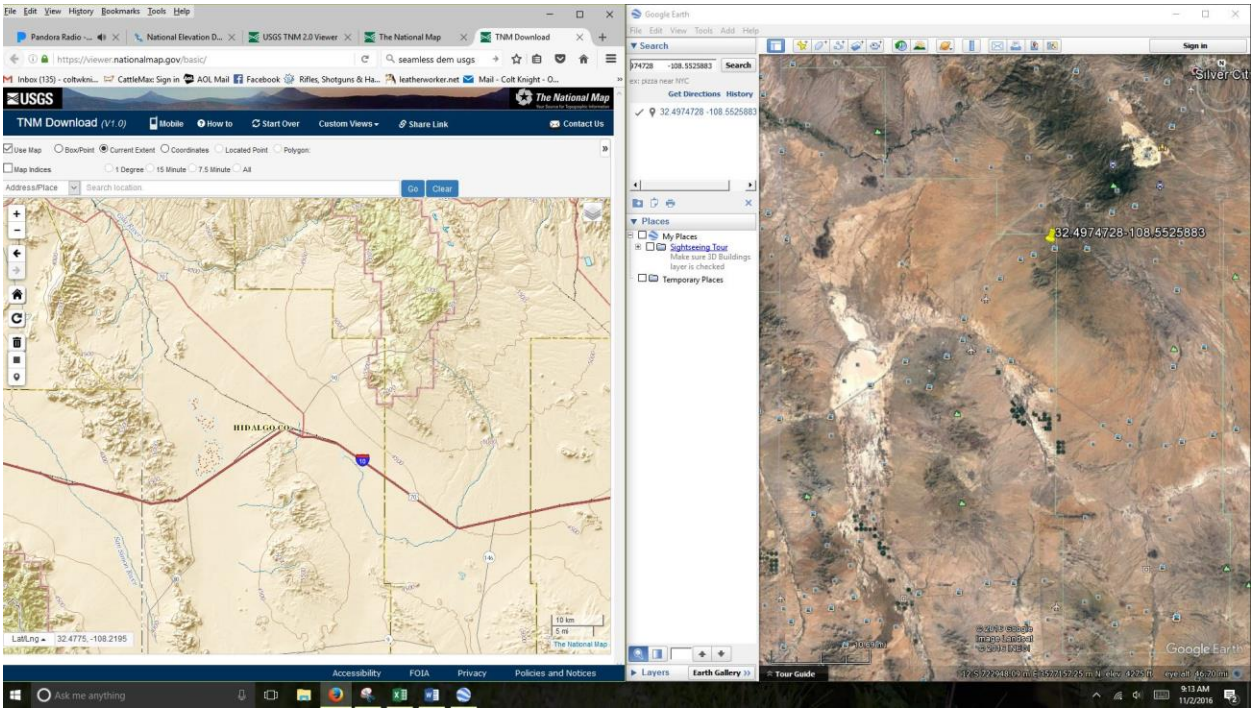


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Order	Point	Month	Day	Year	Hour	Minute	Latitude	Longitude	Nothing	Easting	Altitude	Time
2	896	896	8	26	2012	0	0	32.4974556	-108.55257	3601141.702	166174.054	1668.691	26
3	897	897	8	26	2012	0	10	32.4974453	-108.55257	3601140.559	166174.016	1667.953	26
4	898	898	8	26	2012	0	20	32.4974728	-108.5525883	3601143.668	166172.398	1666.813	26
5	899	899	8	26	2012	0	30	32.4975156	-108.5526019	3601148.459	166171.277	1651.375	27
6	900	900	8	26	2012	0	40	32.4974483	-108.5525756	3601140.91	166173.501	1666.023	26
7	901	901	8	26	2012	0	50	32.4974356	-108.5525661	3601139.471	166174.347	1663.277	26
8	902	902	8	26	2012	1	0	32.4974506	-108.5525886	3601141.206	166172.287	1660.617	26

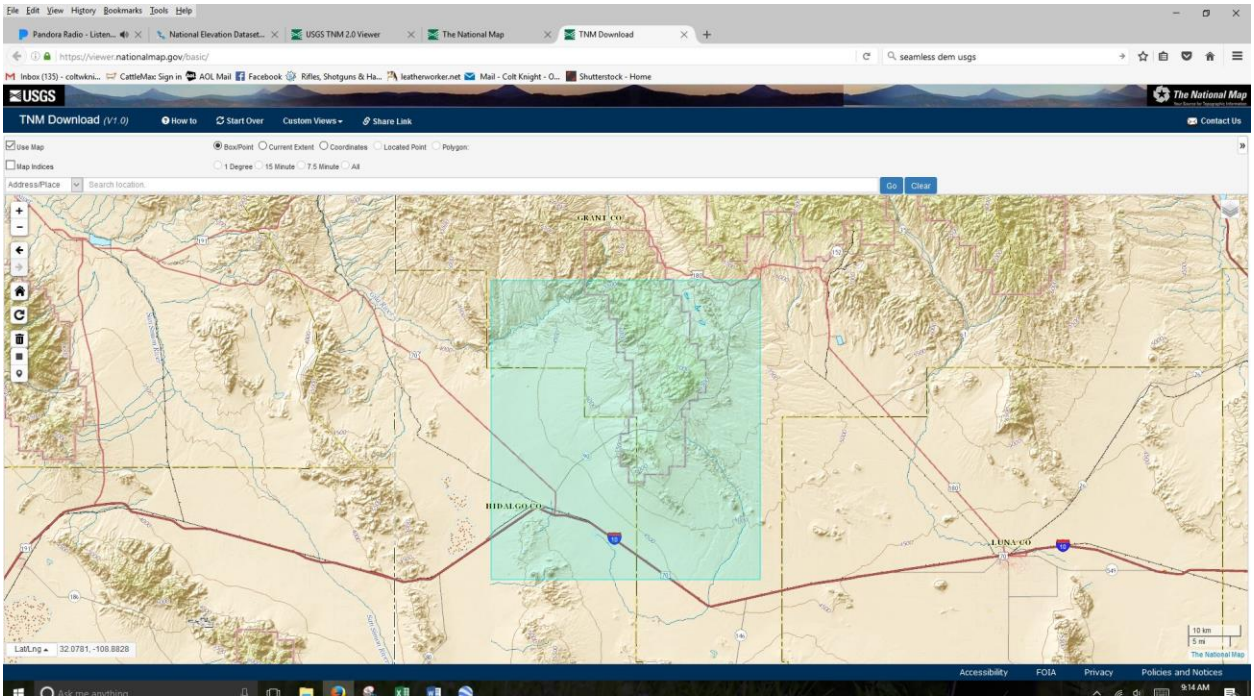
Search for that location on Google Earth



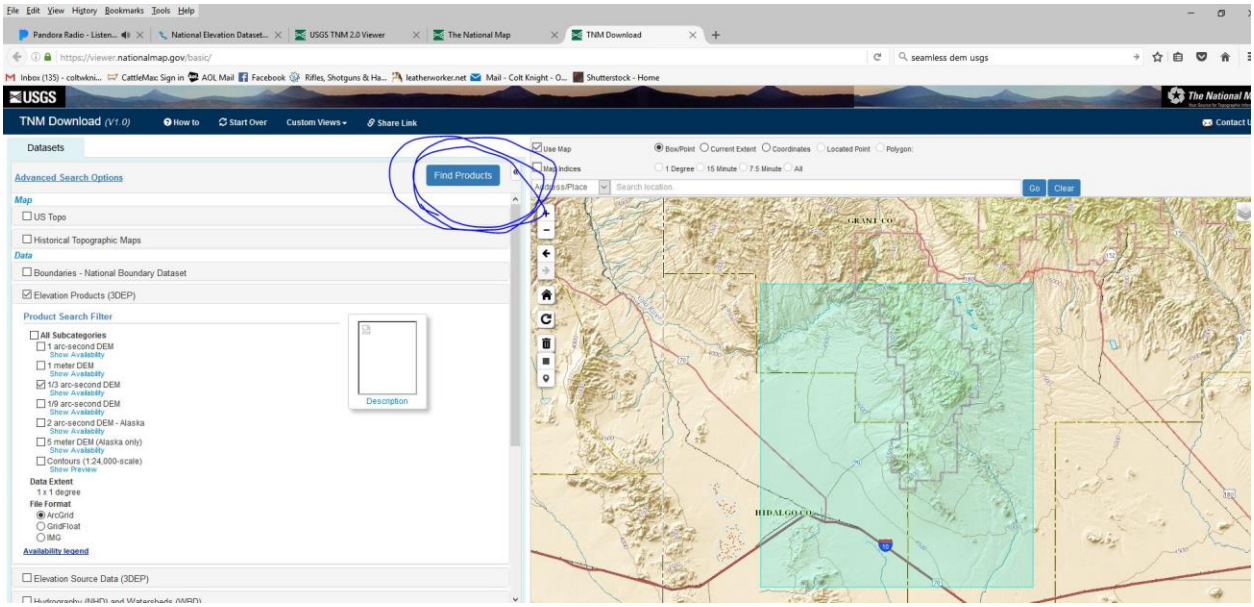
You now have a pinpoint location of the ranch, and you can use this as a reference to find the DEM map on The National Map from the USGS.



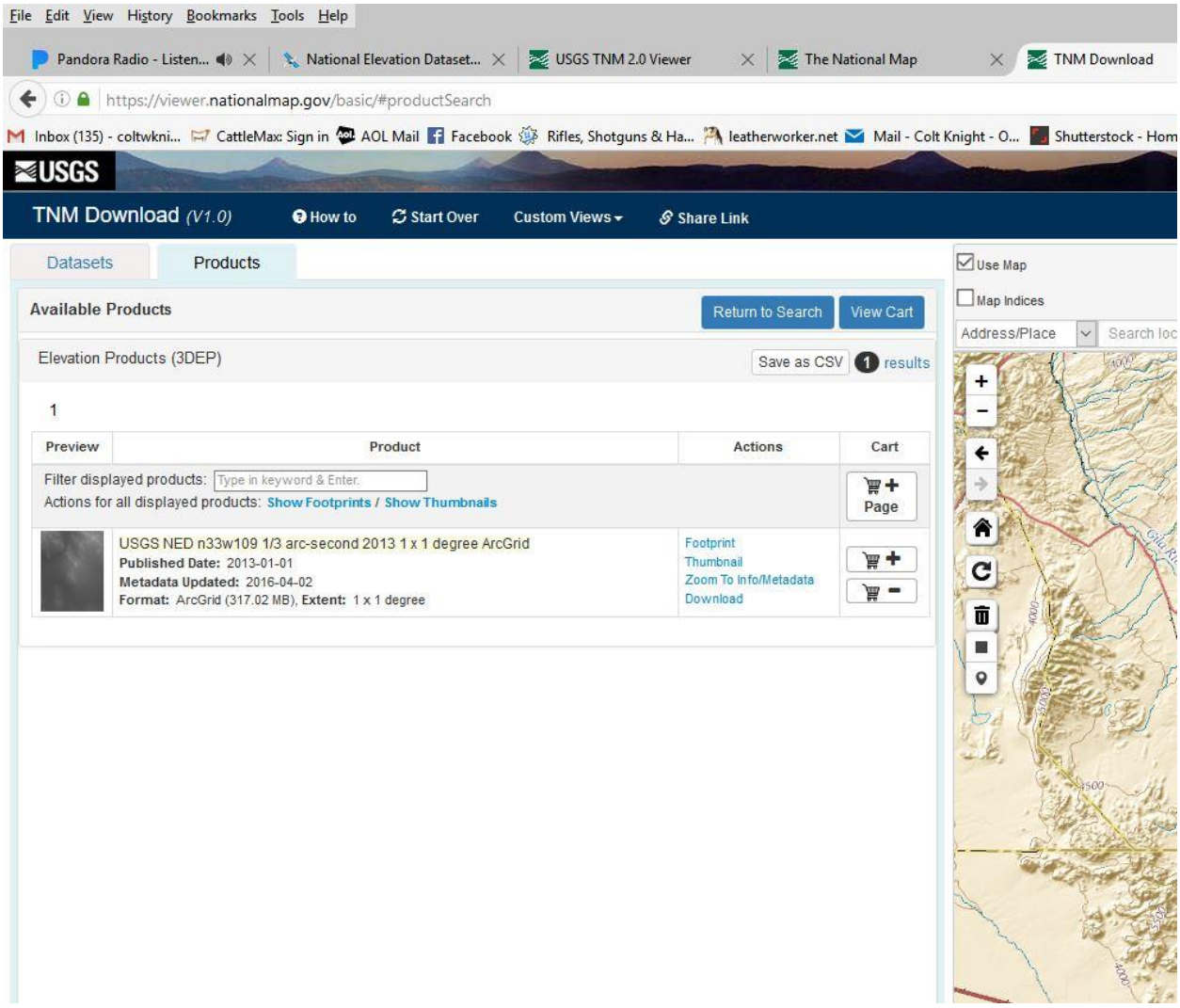
Use the square button selection tool to highlight the area surrounding the ranch



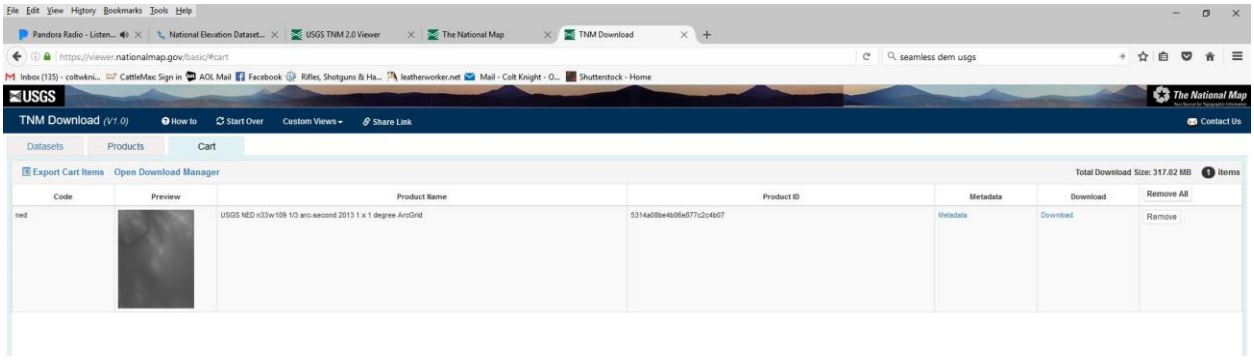
Then click the find products button



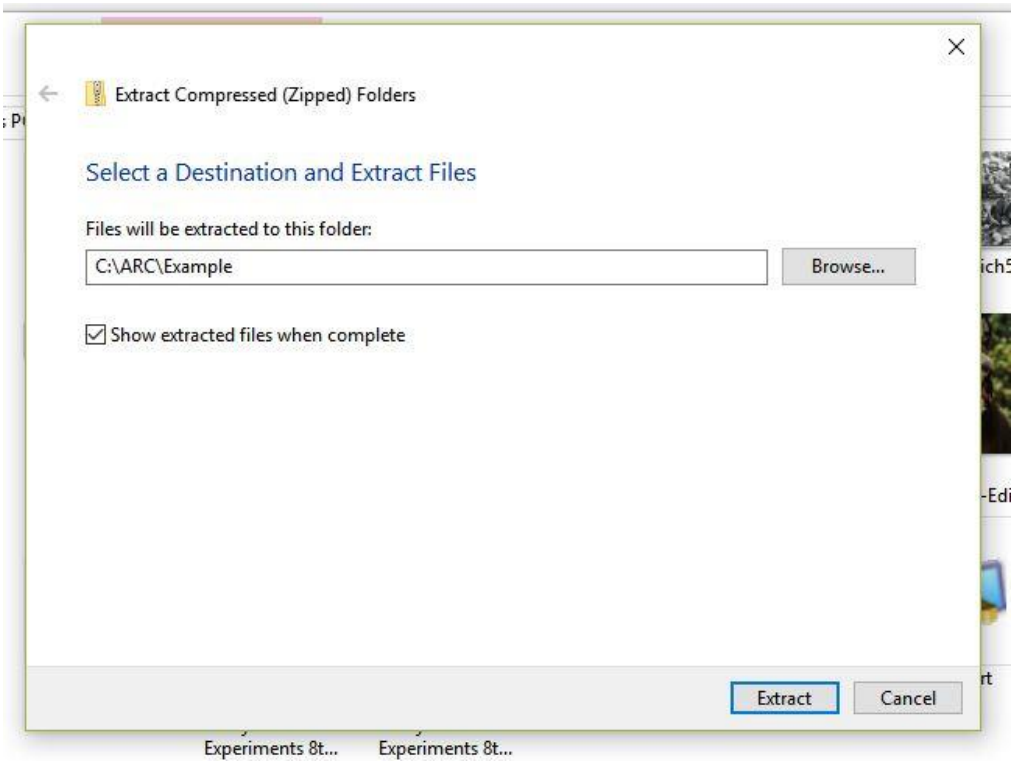
The next screen will then generate an elevation map, add it to your cart

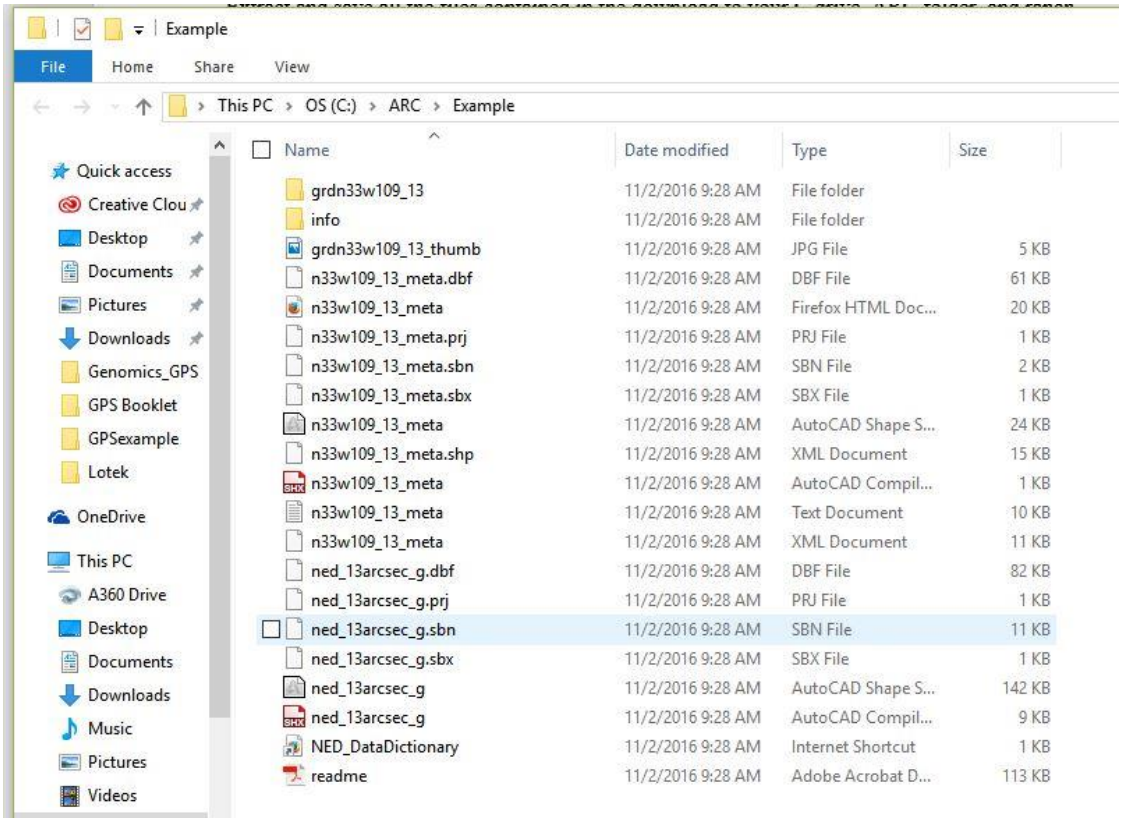


Then view your cart, and download the data



Extract and save all the files contained in the download to your C drive, ARC folder, and ranch sub folder





Open ArcMap, and create a new blank map

Under File, click Add Data and select Add XY data

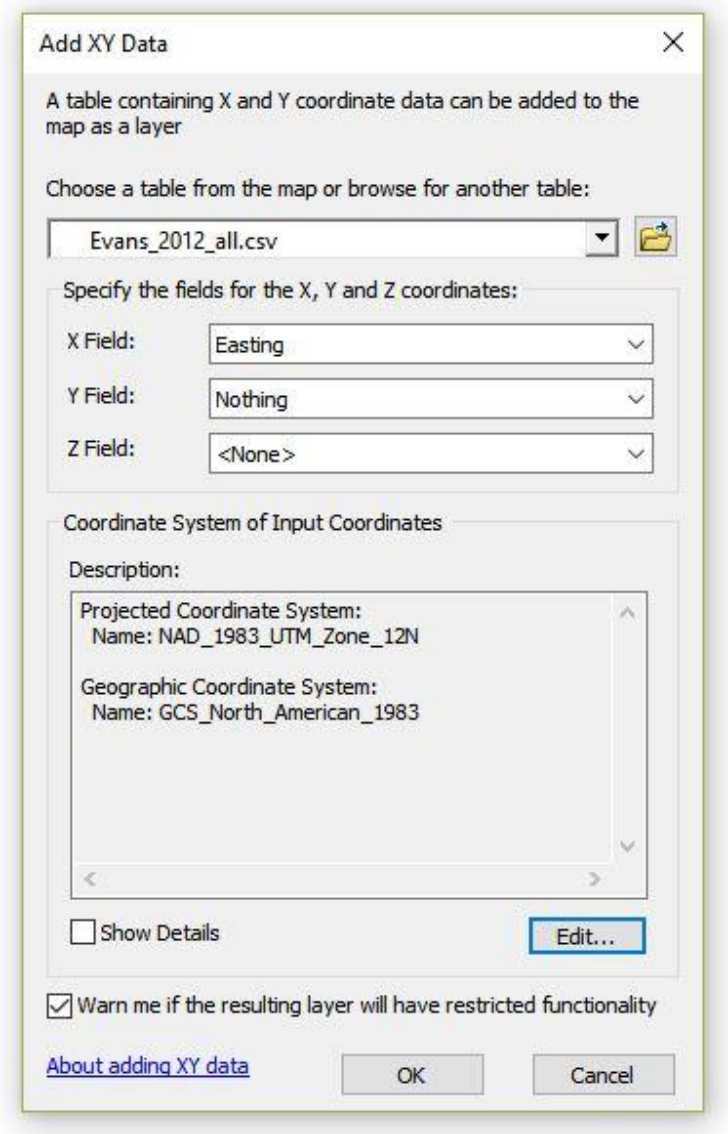
Select the CSV spread sheet you created earlier

Set X to Easting

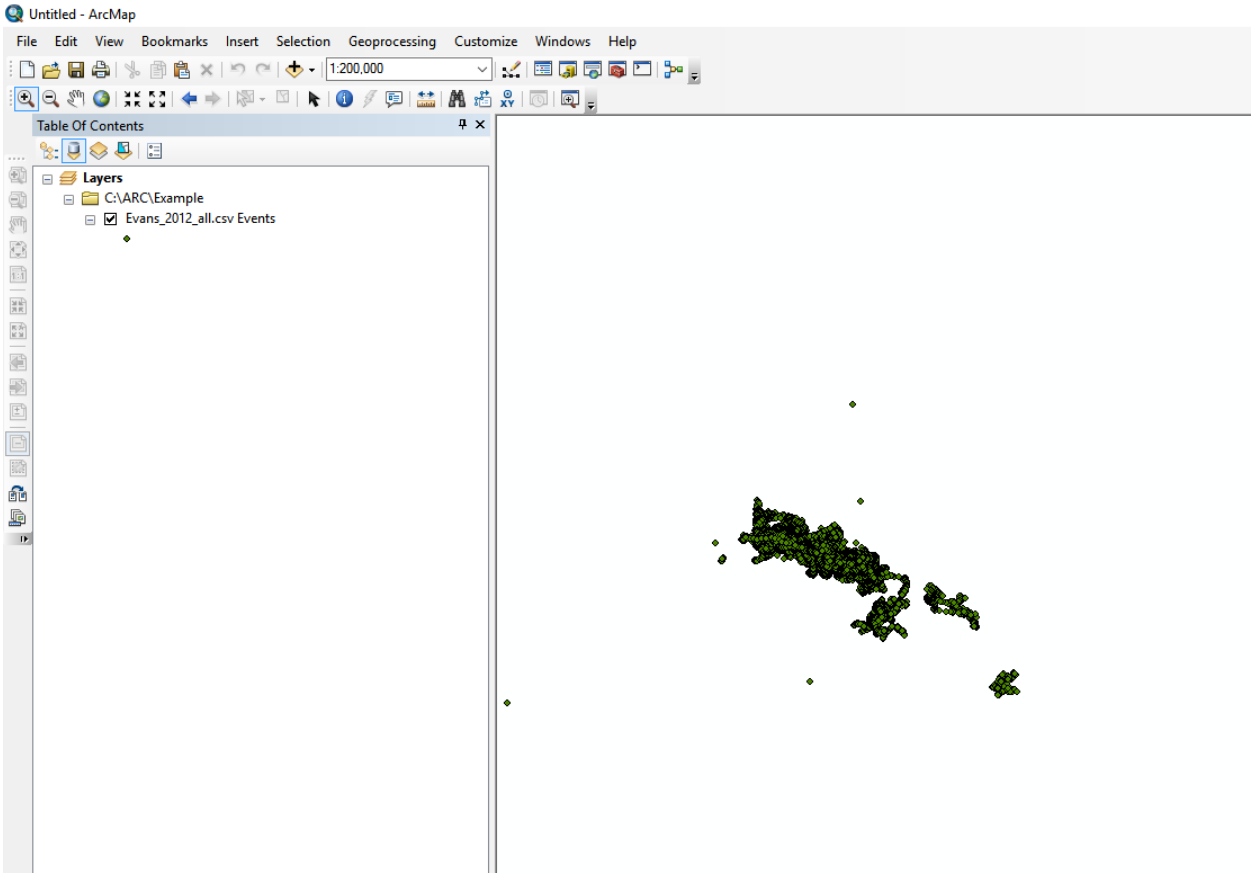
Set Y to Northing

Leave Z blank

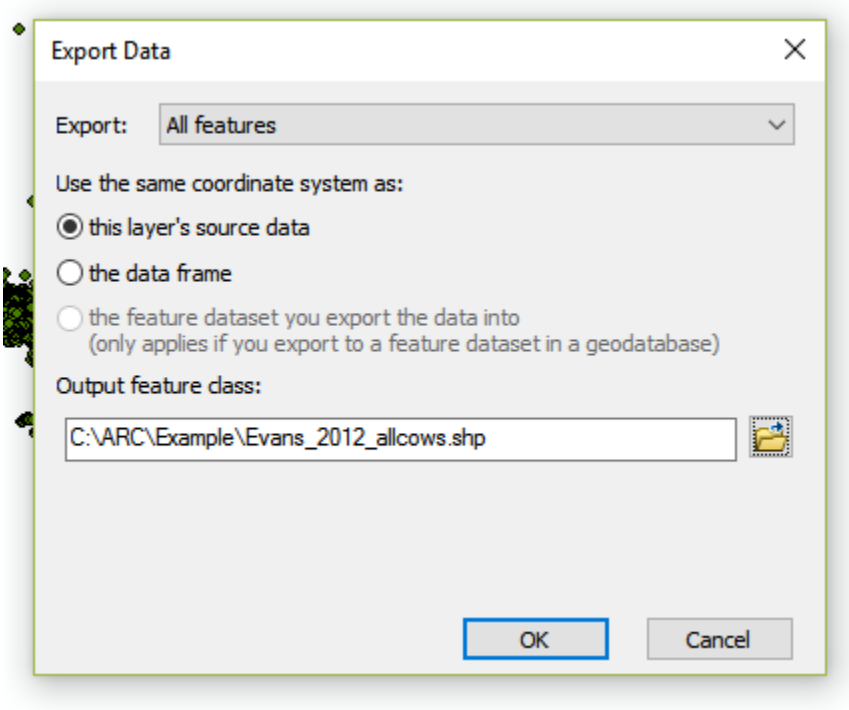
Then click EDIT, under Projected Coordinate system, Select UTM, then select NAD 1983, and finally, select the appropriate UTM zone. In this example, which is in New Mexico, 12N is the appropriate zone. If you are unsure which zone, utilize the batch convert long lat to UTM spreadsheet from the University of Wisconsin to identify the zone you will need. Click OK



Now the CSV has been added to ArcMap, but it needs to be converted to a shape file to be useful.

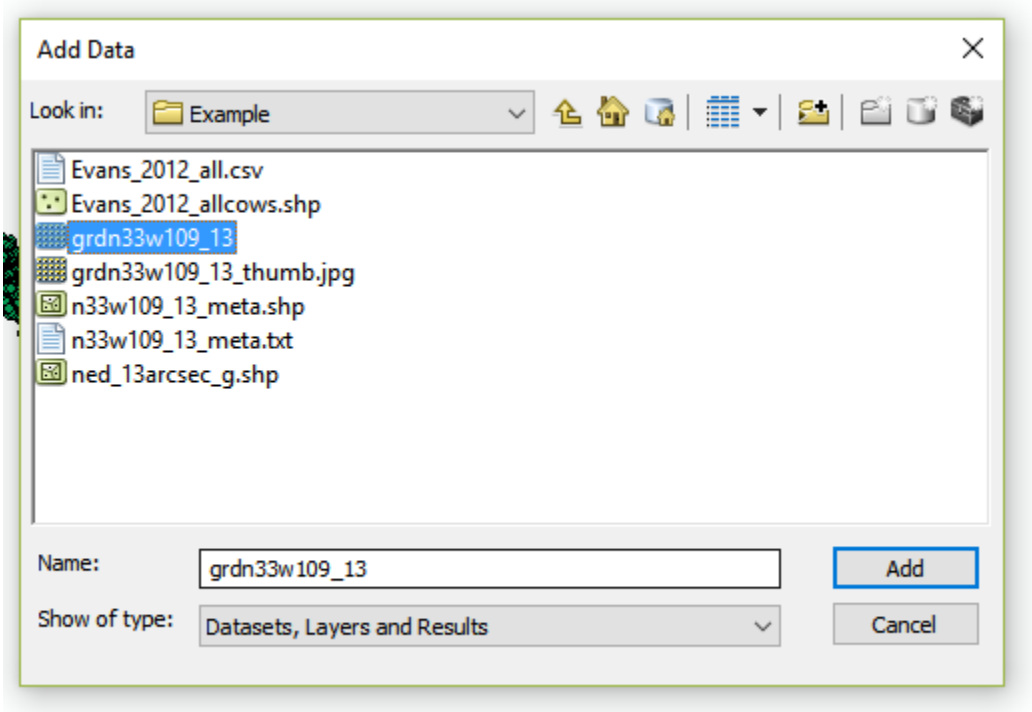


Right click the csv file, click data, click export data, and save the file in the appropriate location with a name you can easily recognize

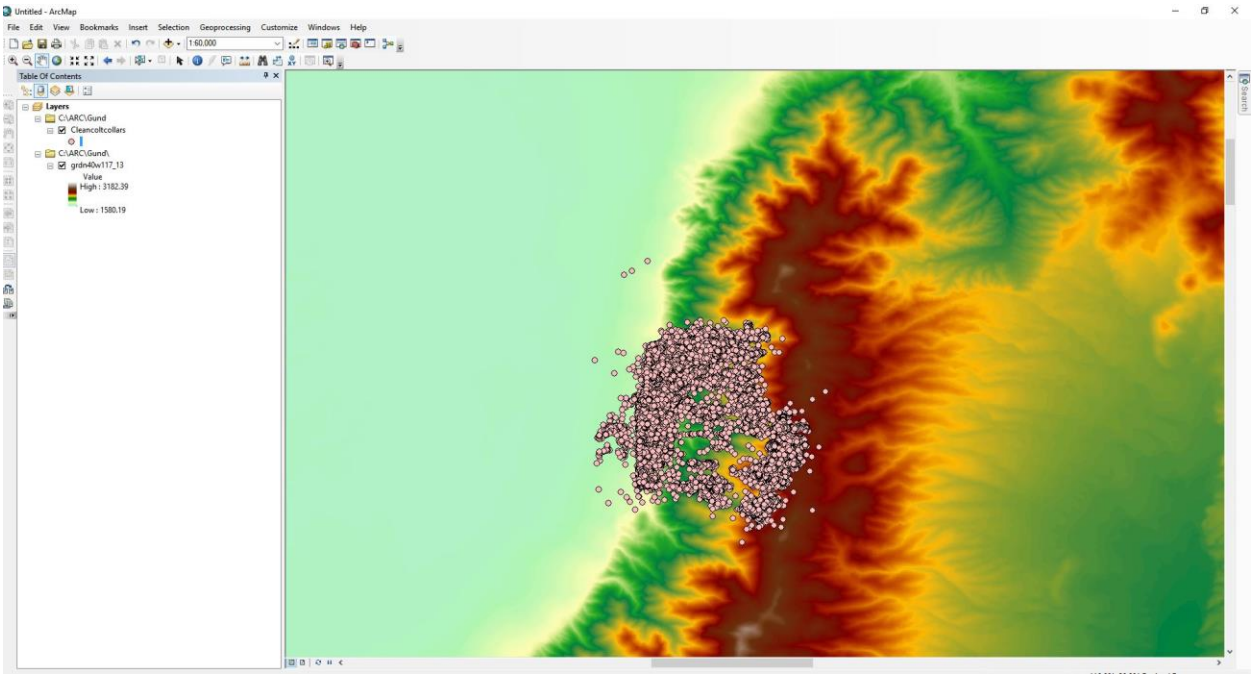


Once the shape file has been added to the map, you can remove the CSV to reduce clutter.

Then click the add data button and upload the DEM map from National Maps

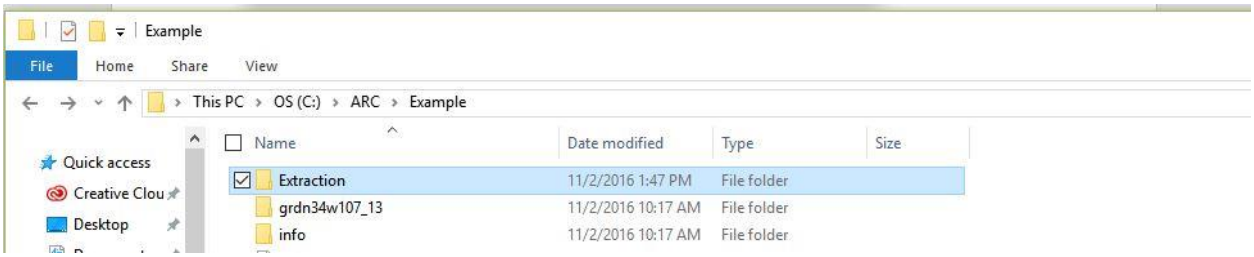


Here is an example of cow data (cleancoltcollars) plotted against the elevation map in ArcMap

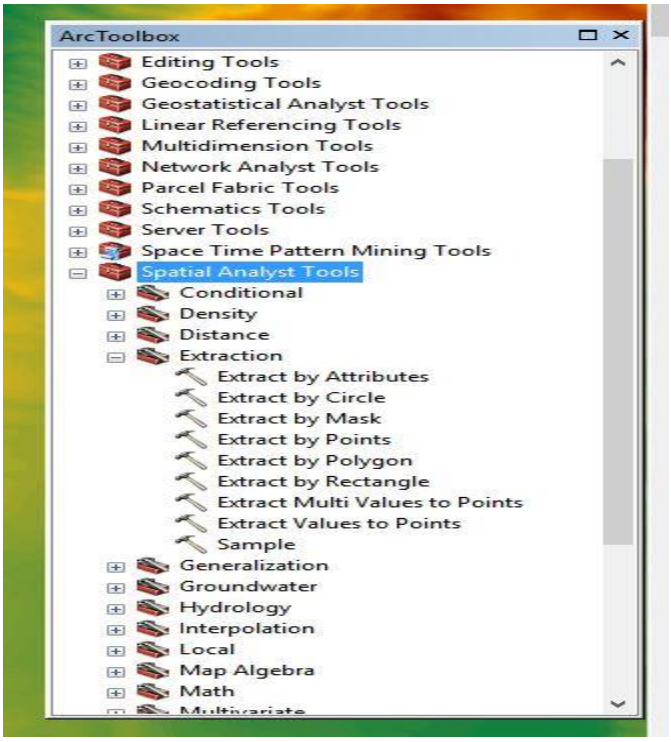


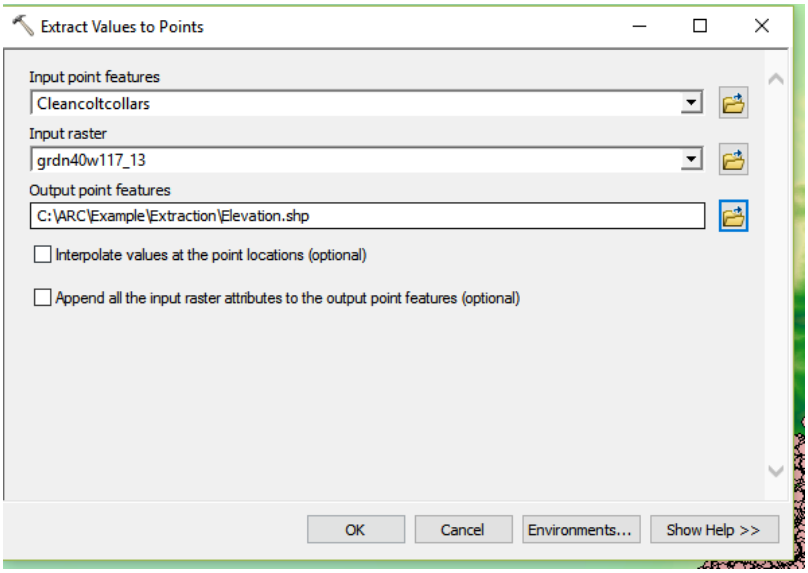
Once the shape files and DEM map are in place, elevation can be extracted for all points and all animals at once.

Step 1. Create a new folder within the Ranch and ARC folders named Extraction



Step 2. Open Arc Tool Box > Spatial Analyst Tools > Extraction>Extract Values to Points





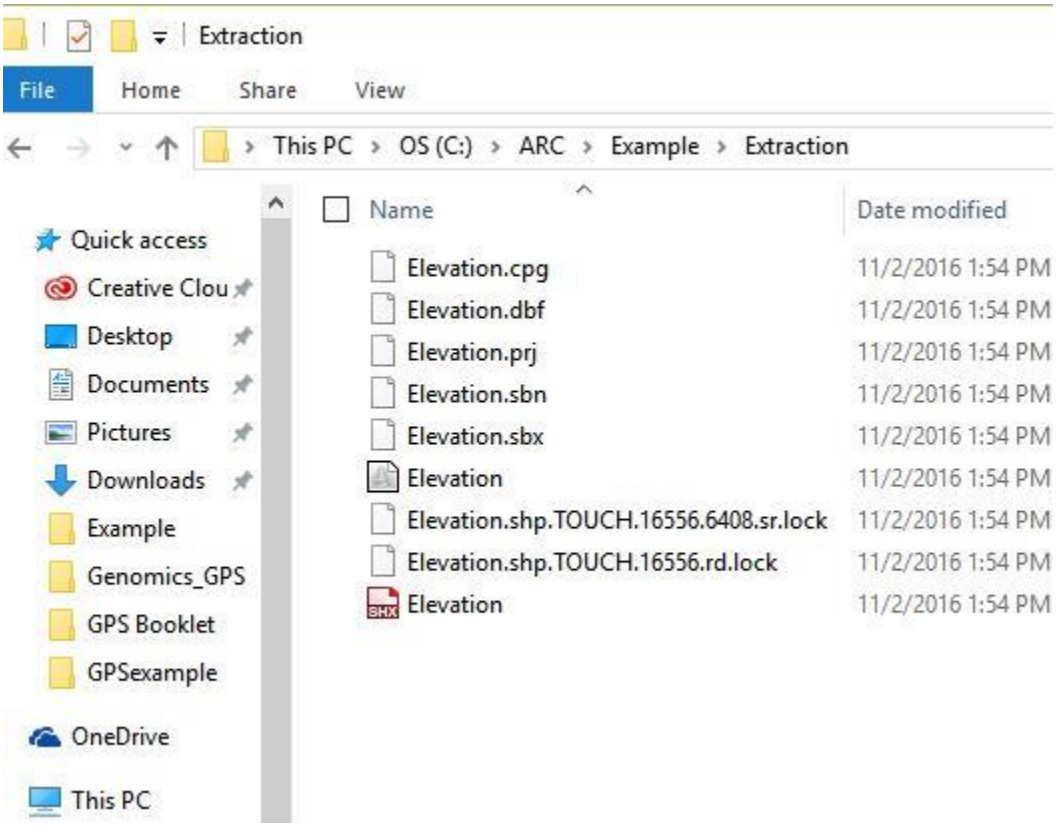
Input Point Features – animal shape file

Input Raster – Elevation file

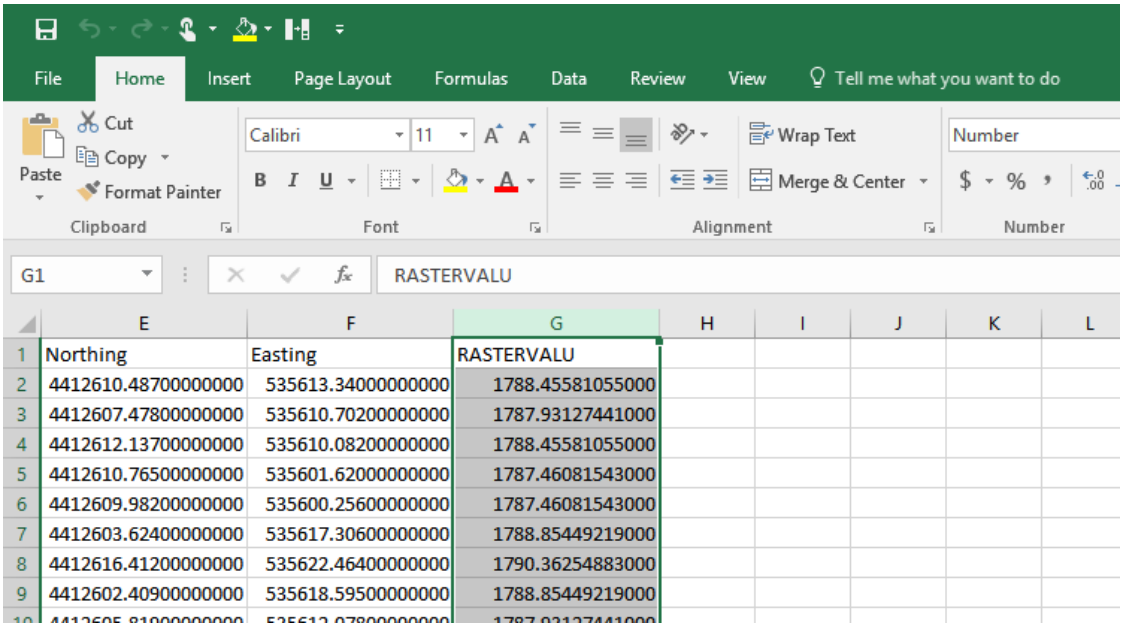
Output Point features – name this file “Elevation” in the newly created extraction folder

Click >Environments> Processing Extent> change default to Same As Display (make sure you zoom in and include all points on your map) then press OK

You have now generated elevation values for your points.



Open the "Elevation.dbf" file in Excel – The column labeled RASTERVALU is elevation values in meters. Simply copy this column and paste it into your data spreadsheet. Rename the column elevation.

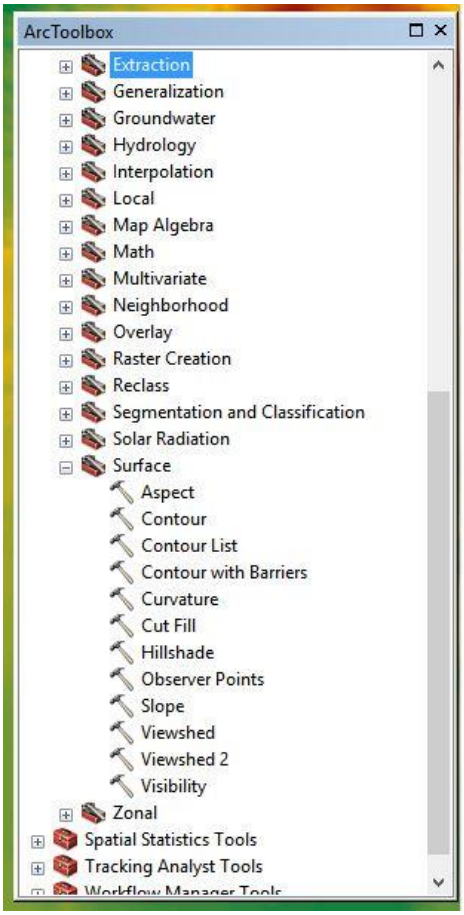


	E	F	G	H	I	J	K	L
1	Northing	Easting	RASTERVALU					
2	4412610.48700000000	535613.34000000000	1788.45581055000					
3	4412607.47800000000	535610.70200000000	1787.93127441000					
4	4412612.13700000000	535610.08200000000	1788.45581055000					
5	4412610.76500000000	535601.62000000000	1787.46081543000					
6	4412609.98200000000	535600.25600000000	1787.46081543000					
7	4412603.62400000000	535617.30600000000	1788.85449219000					
8	4412616.41200000000	535622.46400000000	1790.36254883000					
9	4412602.40900000000	535618.59500000000	1788.85449219000					

Chapter 7 – Generating Slope utilization data

Once the animal shape file and elevation files are in place on ArcMap, generating slope data is relatively easy.

Step 1. Open Arc Toolbox>Spatial Analyst Tools>Surface>Slope



Input Raster = elevation map

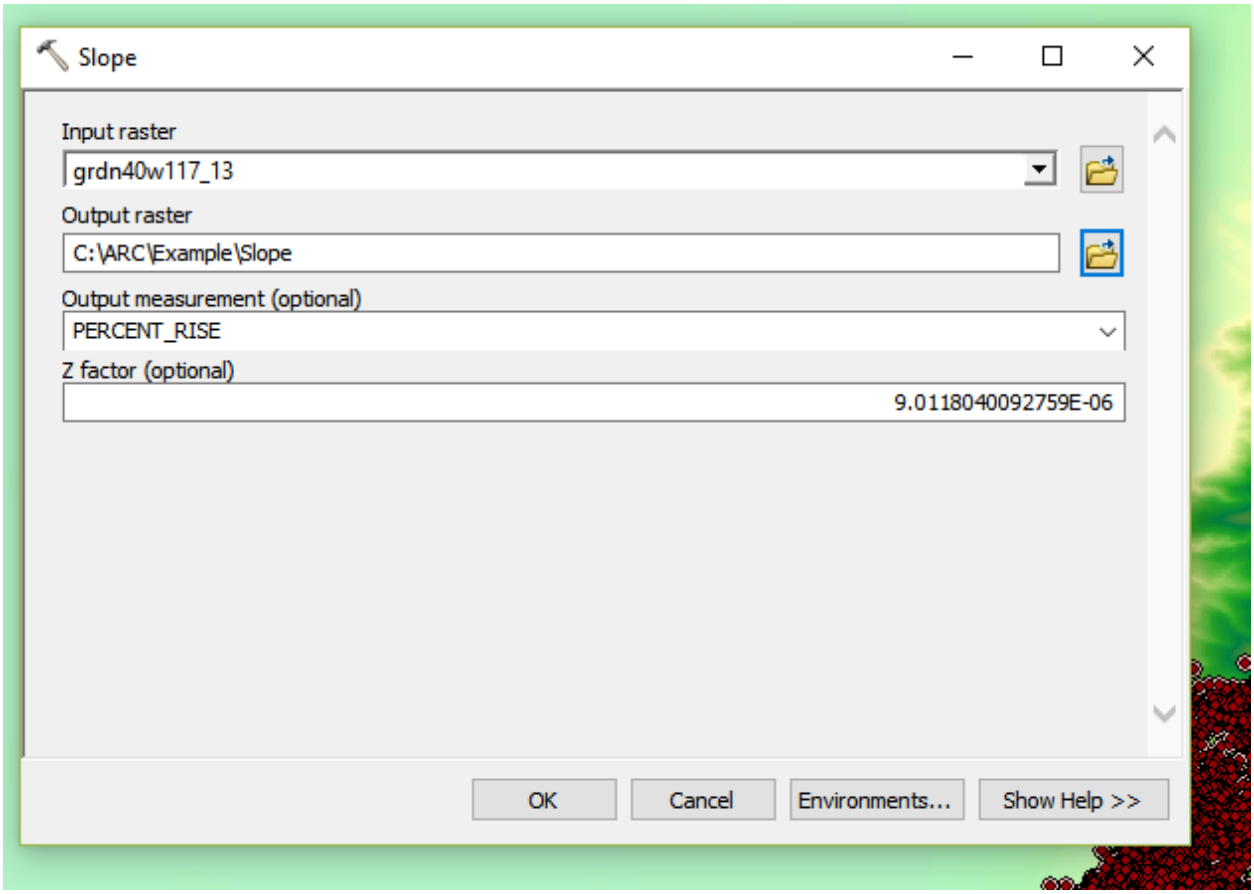
Output Raster – name the file “Slope” in the ranch folder

Click Environment>Processing Extent>change default to same as display (make sure your map is zoomed in on your points and includes all points).

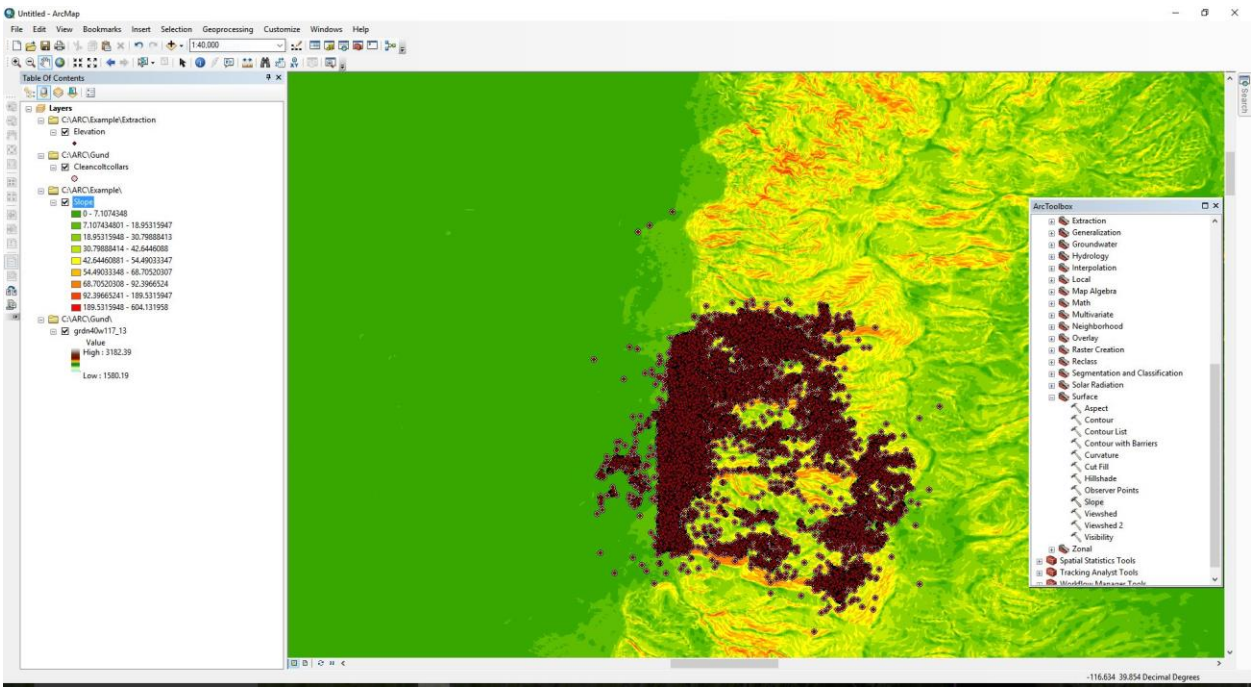
Change output measure to percent-rise

Leave Z-factor as it is

Press OK



A slope file has now been generated



Open Arc Toolbox>Spatial Analyst>Extraction>Extract Values to Points

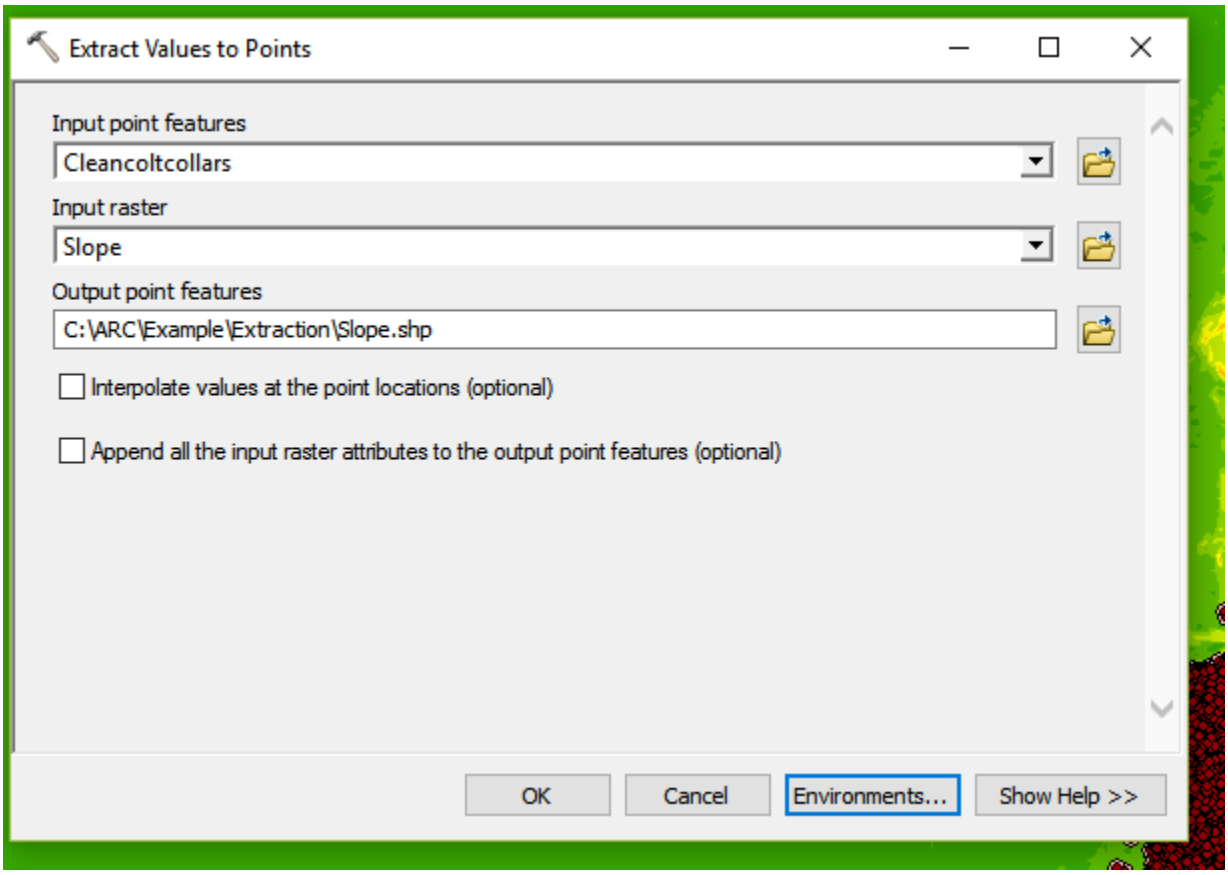
Input Point features = animal shape file

Input Raster = slope file

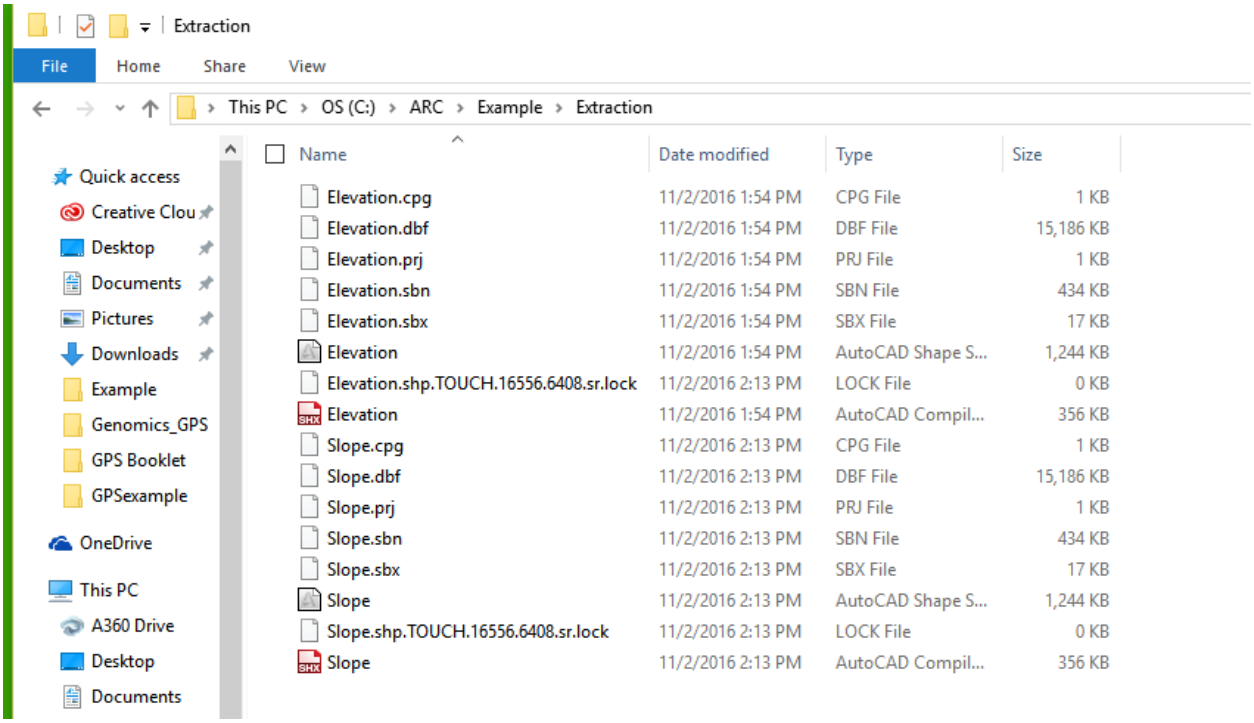
Save the file as “Slope” in the extraction folder

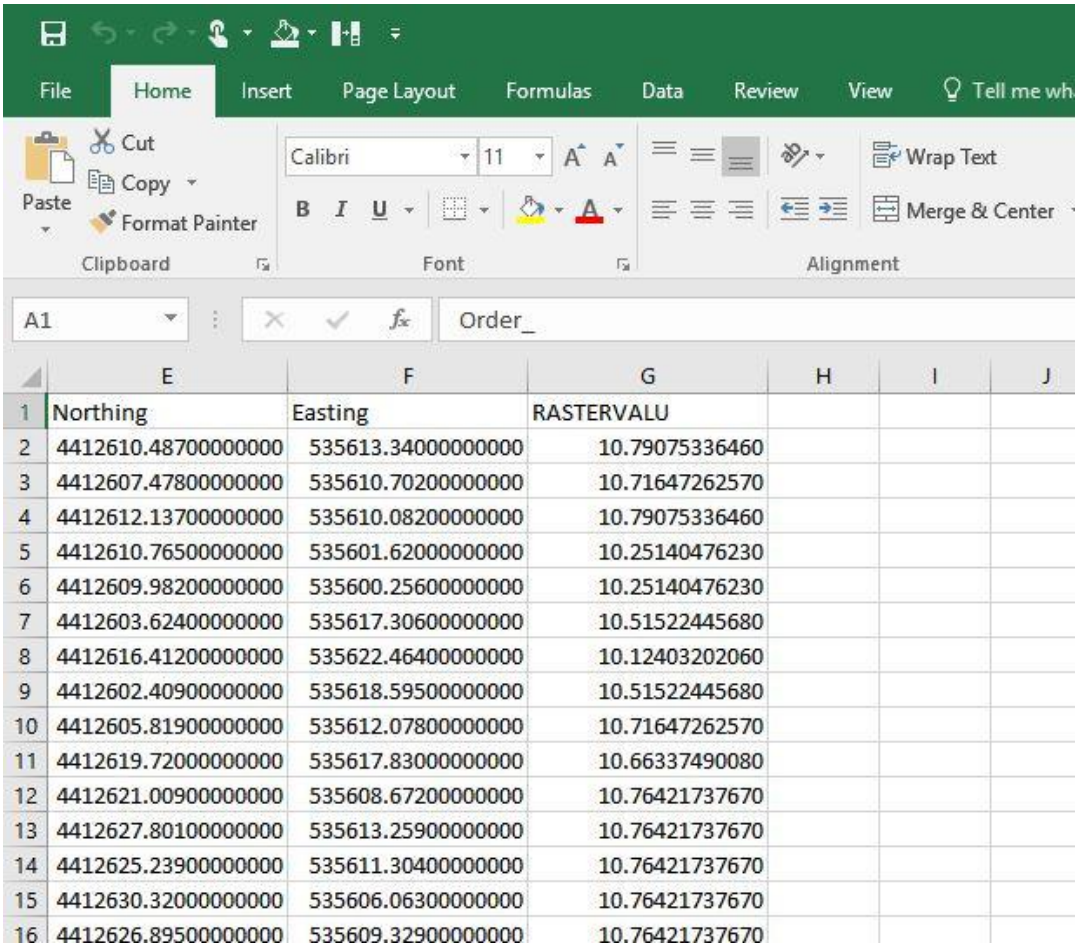
Click Environments>Processing Extent and change default to Same As Display

Press Ok



The slope files have now been generated. Open the “Slope.dbf” file in Excel – The column labeled RASTERVALU is slope values in percent rise. Simply copy this column and paste it into your data spreadsheet. Rename the column slope.





	E	F	G	H	I	J
1	Northing	Easting	RASTERVALU			
2	4412610.48700000000	535613.34000000000	10.79075336460			
3	4412607.47800000000	535610.70200000000	10.71647262570			
4	4412612.13700000000	535610.08200000000	10.79075336460			
5	4412610.76500000000	535601.62000000000	10.25140476230			
6	4412609.98200000000	535600.25600000000	10.25140476230			
7	4412603.62400000000	535617.30600000000	10.51522445680			
8	4412616.41200000000	535622.46400000000	10.12403202060			
9	4412602.40900000000	535618.59500000000	10.51522445680			
10	4412605.81900000000	535612.07800000000	10.71647262570			
11	4412619.72000000000	535617.83000000000	10.66337490080			
12	4412621.00900000000	535608.67200000000	10.76421737670			
13	4412627.80100000000	535613.25900000000	10.76421737670			
14	4412625.23900000000	535611.30400000000	10.76421737670			
15	4412630.32000000000	535606.06300000000	10.76421737670			
16	4412626.89500000000	535609.32900000000	10.76421737670			

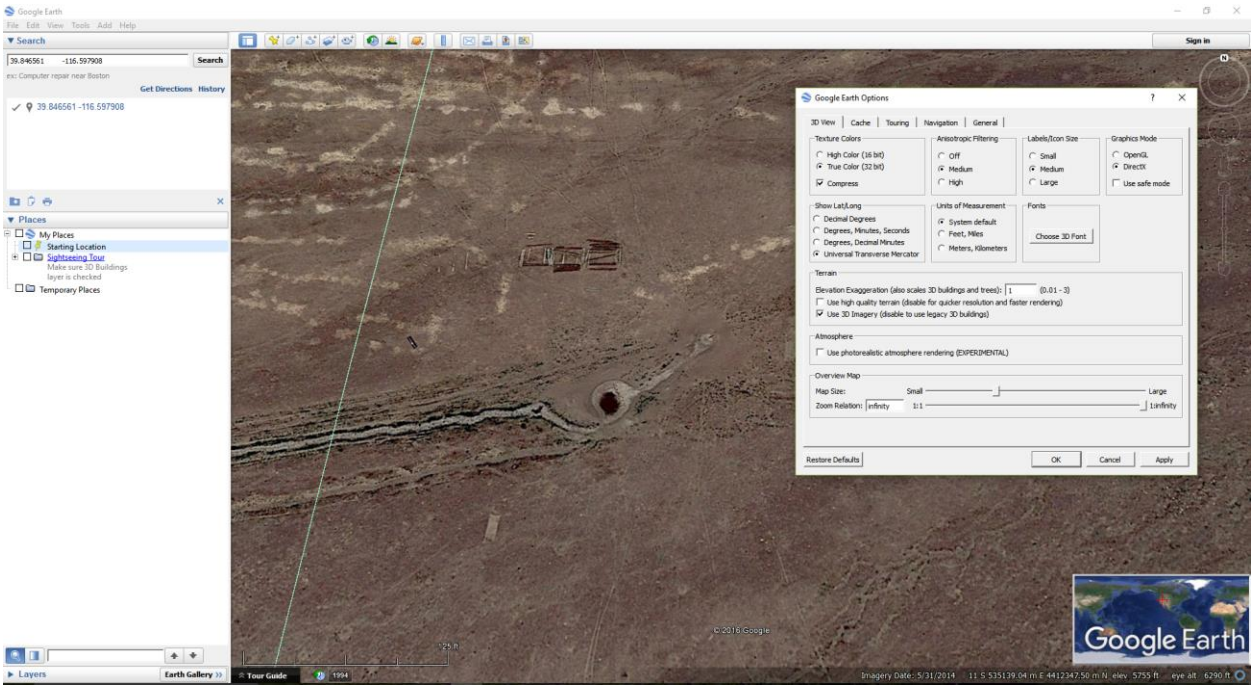
Chapter 8 – Generating Distance from Water measurements

Understanding animals' interaction with water, especially on arid rangelands, is important information for researchers. With the aid of Google Earth, ArcMap, and Excel, numerous inferences can be made with regards to animals' interaction with water. First, we can calculate how far an animal is from water for every GPS position. We can estimate how much time they spend close to water, and how far they travel from water. We can even determine how often an animal visits a water source. This tool also allows you to map out distances from supplement sources, riparian areas, barns, trails, etc.

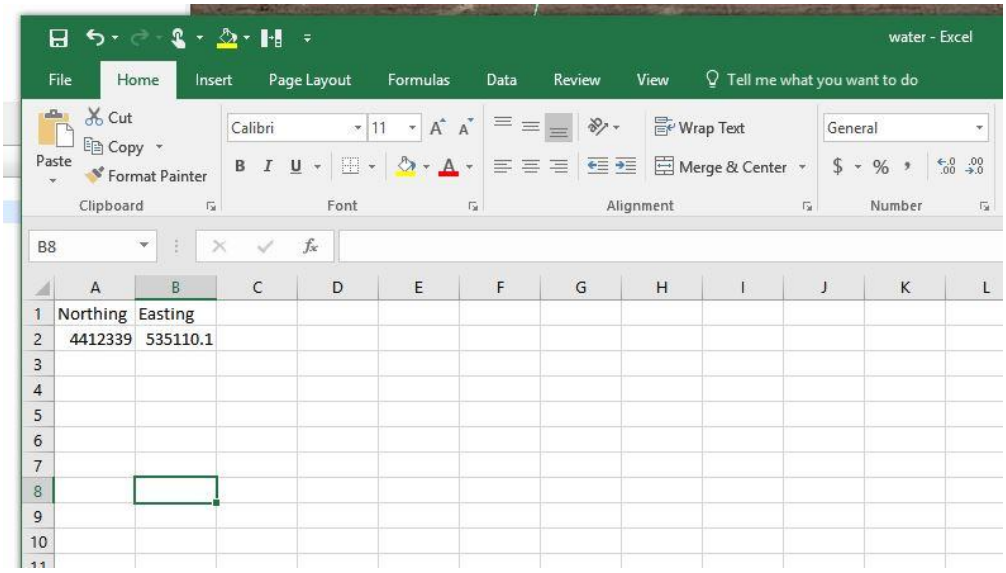
Step 1. Import a shape file of water sources from the ranch onto the ArcMap with the ranch borders, animals, elevation, and slope already open. If you do not have a shape file of water allotments, you can generate one easily using Google Earth, Excel, and ArcMap. See below

Step 2. Open Google Earth. Use a Longitude and Latitude point form your spreadsheet to locate the ranch. Search Google Earth for the known water sources. In this example, I have zoomed in on a stock tank/pond. Under the tools tab>Options>3D View make sure to select Universal Transverse Mercator under Show Lat/Long>OK

Now hover the cursor over the stock tank and write down the Northing and Easting points in the lower right hand corner.



Create a short Microsoft excel file with these coordinates and save as a CSV file



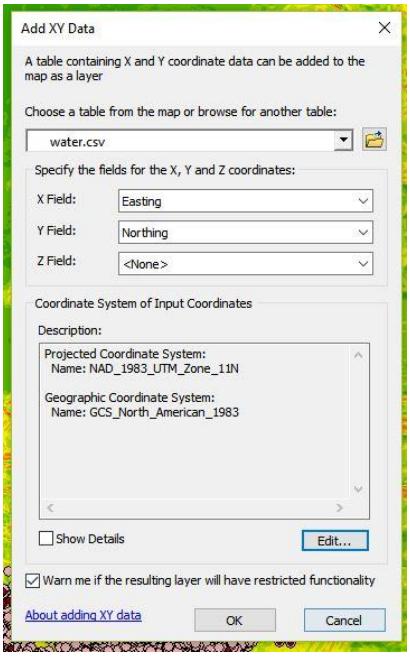
Import this into ArcMap File>Add Data>add XY data

X = easting

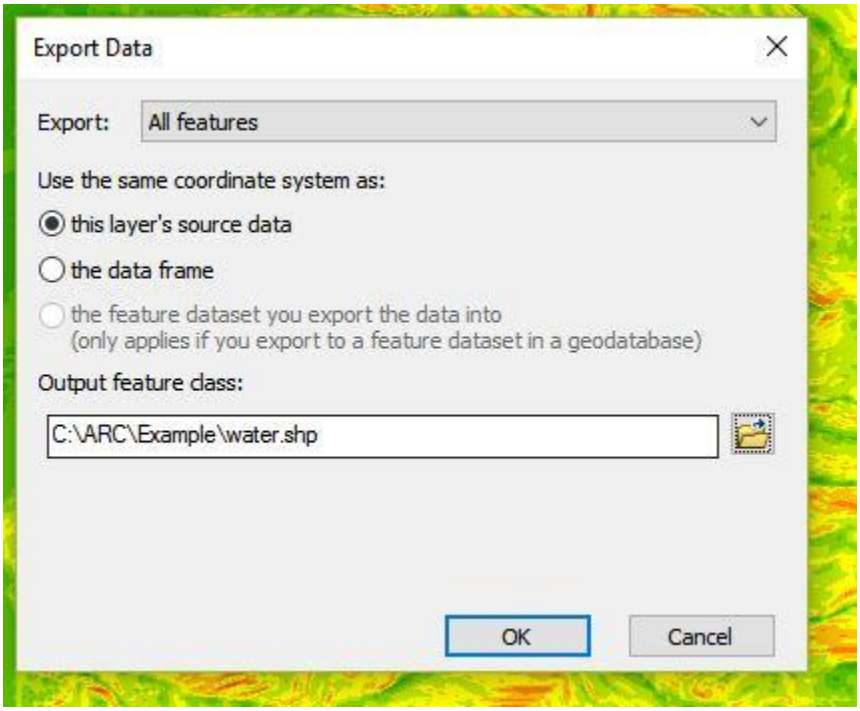
Y = northing

Z = default

Then click EDIT, under Projected Coordinate system, Select UTM, then select NAD 1983, and finally, select the appropriate UTM zone. In this example, which is in Nevada, 11N is the appropriate zone. If you are unsure which zone, utilize the batch convert long lat to UTM spreadsheet from the University of Wisconsin to identify the zone you will need. Click OK



Once the data has been added to ArcMap, right click the water.csv file, Data>Export Data save it as a shape file named water



Once the water shape file has been added, remove the csv file

Open Arc Toolbox>Spatial Analyst Tools>Distance>Euclidean Distance

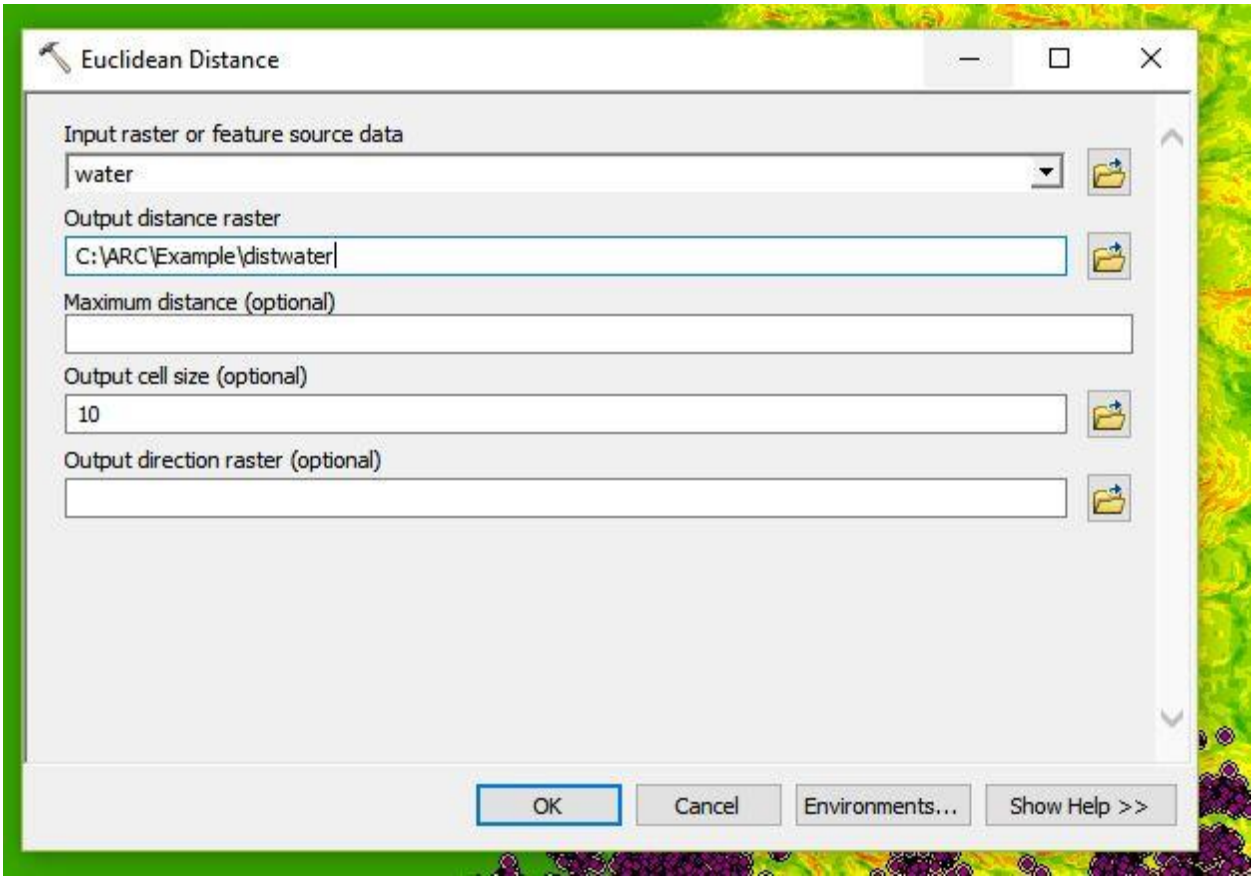
Input raster = water shape file

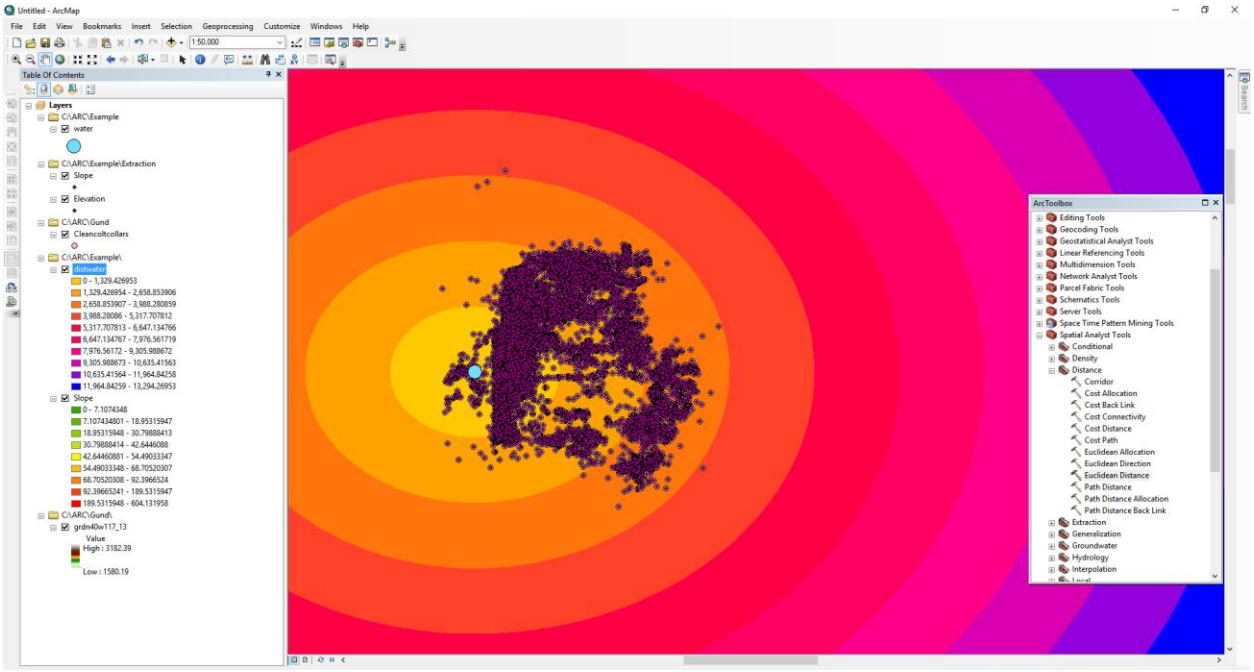
Output distance raster = save as “distwater” in the ranch folder

Output cell size = 5-10 meters

Environments>Processing Extent> change default to same as display

OK





Now the data must be extracted like Elevation and Slope

Go to Arc Toolbox>Spatial Analyst Tools>Extraction>Extract Values To Points

Input point features = animal shape file

Input raster = distwater file

Save it to the extraction folder as “dist2water”

Environments>Processing Extent>change default to same as display

OK

The dist2water files have now been generated. Open the “dist2water.dbf” file in Excel – The column labeled RASTERVALU is distance to water values in meters. Simply copy this column and paste it into your data spreadsheet. Rename the column dist2water.

Chapter 9 – Utilize Pivot Tables in Excel to easily calculate Means, Mins, Max, and Counts.

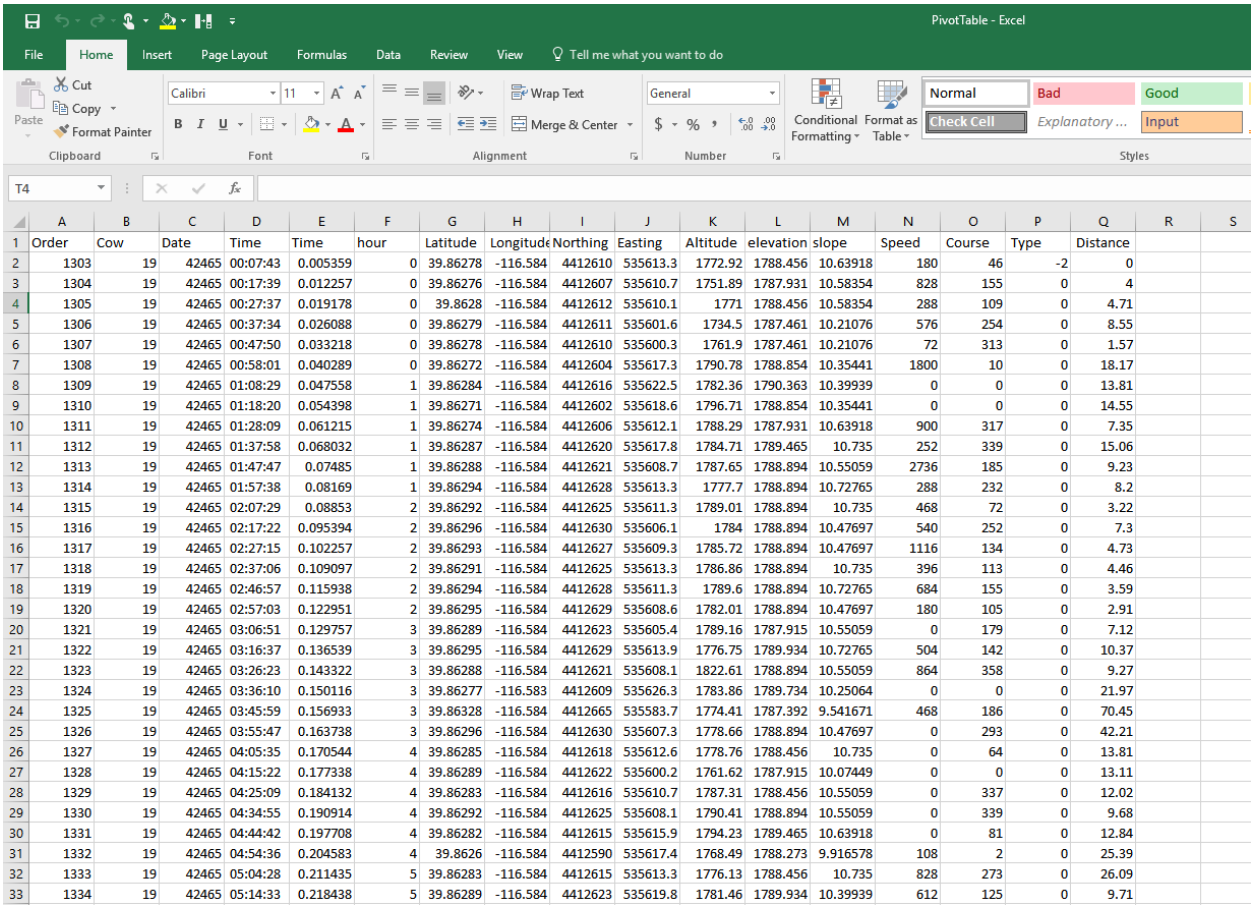
Tracking data spreadsheets can often exceed 100s of thousands of rows with countless columns. Interpreting this data becomes increasingly cumbersome when you cannot simply scroll through data. Using pivot tables in Excel easily allows researchers to orientate data in an easy to use fashion or make tables of averaged data to run through statistical programs.

The use of pivot tables is virtually limitless, so I will only go through some basic tracking uses

For those unfamiliar with Pivot Tables, a basic Microsoft Office primer can be found here:

https://support.office.com/en-us/article/Create-a-PivotTable-to-analyze-worksheet-data-a9a84538-bfe9-40a9-a8e9-f99134456576?ui=en-US&rs=en-US&ad=US

Here is a relatively small GPS dataset with 45796 observations



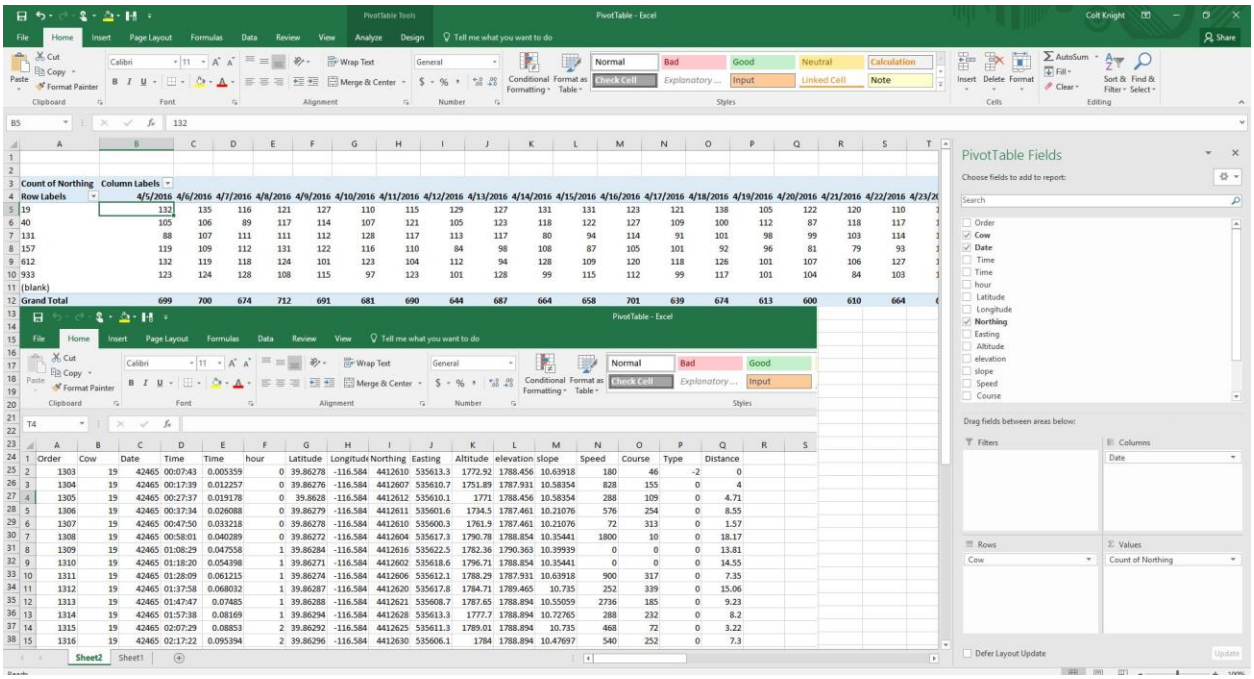
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Order	Cow	Date	Time	Time	hour	Latitude	Longitude	Northing	Easting	Altitude	elevation	slope	Speed	Course	Type	Distance
2	1303	19	42465	00:07:43	0.005359	0	39.86278	-116.584	4412610	535613.3	1772.92	1788.456	10.63918	180	46	-2	0
3	1304	19	42465	00:17:39	0.012257	0	39.86276	-116.584	4412607	535610.7	1751.89	1787.931	10.58354	828	155	0	4
4	1305	19	42465	00:27:37	0.019178	0	39.8628	-116.584	4412612	535610.1	1771	1788.456	10.58354	288	109	0	4.71
5	1306	19	42465	00:37:34	0.026088	0	39.86279	-116.584	4412611	535601.6	1734.5	1787.461	10.21076	576	254	0	8.55
6	1307	19	42465	00:47:50	0.033218	0	39.86278	-116.584	4412610	535600.3	1761.9	1787.461	10.21076	72	313	0	1.57
7	1308	19	42465	00:58:01	0.040289	0	39.86272	-116.584	4412604	535617.3	1790.78	1788.854	10.35441	1800	10	0	18.17
8	1309	19	42465	01:08:29	0.047558	1	39.86284	-116.584	4412616	535622.5	1782.36	1790.363	10.39939	0	0	0	13.81
9	1310	19	42465	01:18:20	0.054398	1	39.86271	-116.584	4412602	535618.6	1796.71	1788.854	10.35441	0	0	0	14.55
10	1311	19	42465	01:28:09	0.061215	1	39.86274	-116.584	4412606	535612.1	1788.29	1787.931	10.63918	900	317	0	7.35
11	1312	19	42465	01:37:58	0.068032	1	39.86287	-116.584	4412620	535617.8	1784.71	1789.465	10.735	252	339	0	15.06
12	1313	19	42465	01:47:47	0.07485	1	39.86288	-116.584	4412621	535608.7	1787.65	1788.894	10.55059	2736	185	0	9.23
13	1314	19	42465	01:57:38	0.08169	1	39.86294	-116.584	4412628	535613.3	1777.7	1788.894	10.72765	288	232	0	8.2
14	1315	19	42465	02:07:29	0.08853	2	39.86292	-116.584	4412625	535611.3	1789.01	1788.894	10.735	468	72	0	3.22
15	1316	19	42465	02:17:22	0.095394	2	39.86296	-116.584	4412630	535606.1	1784	1788.894	10.47697	540	252	0	7.3
16	1317	19	42465	02:27:15	0.102257	2	39.86293	-116.584	4412627	535609.3	1785.72	1788.894	10.47697	1116	134	0	4.73
17	1318	19	42465	02:37:06	0.109097	2	39.86291	-116.584	4412625	535613.3	1786.86	1788.894	10.735	396	113	0	4.46
18	1319	19	42465	02:46:57	0.115938	2	39.86294	-116.584	4412628	535611.3	1789.6	1788.894	10.72765	684	155	0	3.59
19	1320	19	42465	02:57:03	0.122951	2	39.86295	-116.584	4412629	535608.6	1782.01	1788.894	10.47697	180	105	0	2.91
20	1321	19	42465	03:06:51	0.129757	3	39.86289	-116.584	4412623	535605.4	1789.16	1787.915	10.55059	0	179	0	7.12
21	1322	19	42465	03:16:37	0.136539	3	39.86295	-116.584	4412629	535613.9	1776.75	1789.934	10.72765	504	142	0	10.37
22	1323	19	42465	03:26:23	0.143322	3	39.86288	-116.584	4412621	535608.1	1822.61	1788.894	10.55059	864	358	0	9.27
23	1324	19	42465	03:36:10	0.150116	3	39.86277	-116.583	4412609	535626.3	1783.86	1789.734	10.25064	0	0	0	21.97
24	1325	19	42465	03:45:59	0.156933	3	39.86328	-116.584	4412665	535583.7	1774.41	1787.392	9.541671	468	186	0	70.45
25	1326	19	42465	03:55:47	0.163738	3	39.86296	-116.584	4412630	535607.3	1778.66	1788.894	10.47697	0	293	0	42.21
26	1327	19	42465	04:05:35	0.170544	4	39.86285	-116.584	4412618	535612.6	1778.76	1788.456	10.735	0	64	0	13.81
27	1328	19	42465	04:15:22	0.177338	4	39.86289	-116.584	4412622	535600.2	1761.62	1787.915	10.07449	0	0	0	13.11
28	1329	19	42465	04:25:09	0.184132	4	39.86283	-116.584	4412616	535610.7	1787.31	1788.456	10.55059	0	337	0	12.02
29	1330	19	42465	04:34:55	0.190914	4	39.86292	-116.584	4412625	535608.1	1790.41	1788.894	10.55059	0	339	0	9.68
30	1331	19	42465	04:44:42	0.197708	4	39.86282	-116.584	4412615	535615.9	1794.23	1789.465	10.63918	0	81	0	12.84
31	1332	19	42465	04:54:36	0.204583	4	39.8626	-116.584	4412590	535617.4	1768.49	1788.273	9.916578	108	2	0	25.39
32	1333	19	42465	05:04:28	0.211435	5	39.86283	-116.584	4412615	535613.3	1776.13	1788.456	10.735	828	273	0	26.09
33	1334	19	42465	05:14:33	0.218438	5	39.86289	-116.584	4412623	535619.8	1781.46	1789.934	10.39939	612	125	0	9.71

I am going to highlight the dataset, select the insert tab and press insert Pivot Table

First, I want to check my fix rate

Row = cow, Column = date, values = count of northing

This quickly allows me to see how many positions each collar/cow had each day. In this circumstance, I took a position every 10 minutes, so a perfect fix rate would be 144 per day. I can divide the actual positions by 144 and get the fix rate for each cow for each day



Next I want to know how far an animal traveled each day

Row = cow, Column = date, values = Sum of Distance

Average elevation utilization

Row = cow, Column = date, values = average elevation

Min elevation

Row = cow, Column = date, values = Min elevation

Max elevation

Row = cow, Column = date, values = Max Elevation

These can be repeated for Slope and Distance from Water

Once you have all the information you need, copy and paste the pivot table as numbers, label the rows and columns properly and save as a .csv for importation into SAS.

You can also utilize If statements

For example, you want to estimate how much time is spent by water. Add a column besides the Dist2water column =IF("dist2water cell" <200,1,0) excel will flag every point where the cow was within 200 meters of water and mark it with a number 1, and any time the animal was further than 200 meters away, a number zero. Use the pivot table to quickly average that column

per animal per day, and it will give you a percent of time spent by water. You can do the same for elevation or slope. For example, percentage of time spent in high or low elevation, or time spent on/off challenging slopes.

If you would like to look at what happens throughout the day you can set the time column to military time and add 3 more columns beside time labeled Hour Minute and Second.

=Hour("time cell") will pull out the hour. You can then use the pivot table to summarize the animal's activity throughout the day, every day for all animals.