

Bison GIS Data Analysis Protocol – Fall Semester 2008

Updated 9/30/08

Goals and Rationale for Study

Each refuge in the US Fish & Wildlife system with a bison herd has been asked to “assess its natural resources and priorities, and identify a long-term carrying capacity for bison in the context of meeting all refuge purposes.” The bison herd at FTN is rotated through 11 grazing units from April through September on the ‘summer range’. Identification of long-term carrying capacity of the bison herd will require a consideration of grazing unit size, rotation schedule, and time in each unit because these factors may impact abundance of key grass species and range types (vegetation community). Ultimately, many other range factors will have to be taken into consideration, such as temperature, soil type, hydrology, and elevation. Anecdotal observations suggest that the bison herd shifts their grazing and movement patterns during the rut in July and August. If herd grazing and movements are significantly different during rut, this will imply the need to manage the herd differently during the rut months. This study has the potential to address two important points in bison conservation. Can we assume that bison (1) behave like cattle terms of their feeding ecology, and (2) behave the same as historical bison that migrated hundreds of miles each year? Overall, this research will increase our current understanding of bison habitat use and carrying capacity in the national wildlife refuge system.

Field Methodology

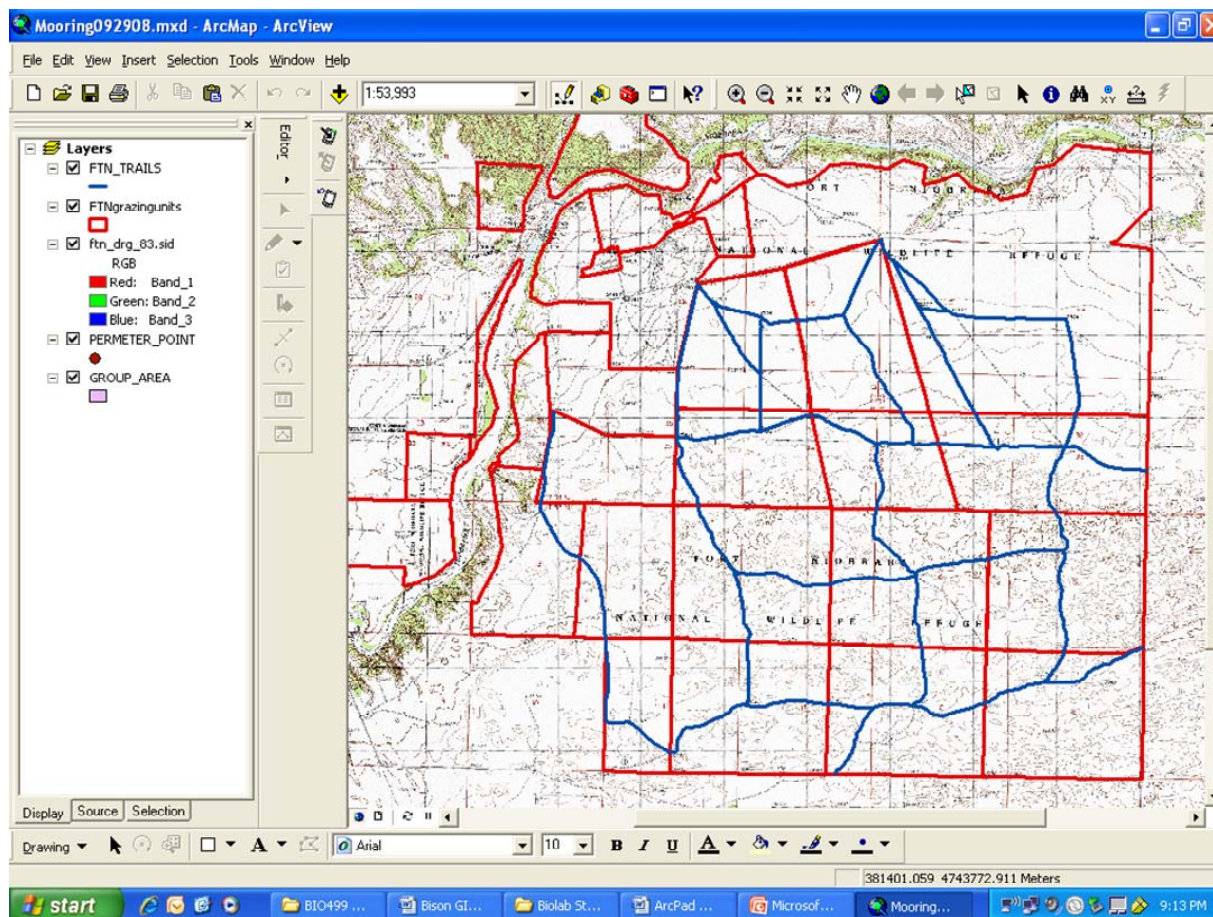
The field data collection for this pilot study was completed over summer 2008 at Fort Niobrara National Wildlife Refuge in the Sandhills of Nebraska. Between June 9 and August 7, we collected data on the compass bearings and distance of animals on the perimeter of the groups in relation to a GPS reference point, and sketched the approximate locations of the herd subgroups at various times of day on paper maps. At the time that we characterized the location of each group on the map, we collected data on group size, composition, and activity budgets. These variables can later be analyzed in relation to habitat factors such as vegetation, soil, slope, and so forth. In total, we produced 186 maps (herd sweeps) on 44 days in 9 grazing units. The next step will be to enter these data into the GIS mapping software in preparation for detailed analysis.

Computer Methodology

STEP 1: Checking out data layers for use in ArcPad and field data collection

The purpose of this procedure is to “check out” a version (called a ‘schema’) of the geodatabase project file (master file containing all the data) in ArcPad and bring it into ArcPad, where it can be edited (i.e. space data in the form of points and polygons can be added). The reason for doing this is that the geodatabase project file has tons of data entered (points and polygons from all the data that have been entered already) which make it very difficult to enter new data. The ‘schema’ is a version of the file that does not contain any data (e.g., no points/polygons), and thus is much more tractable to work with. The ‘schema’ files are then brought back to ArcMap and “checked in” to the geodatabase project file (essentially added in with all the other data). Thus, the master file with all the data is never moved between ArcMap and ArcPad, only the schema files containing the data entered in one session.

1. Launch ArcMap.
2. The default view should be the Fort Niobrara map, with the last checked-in file being the one that displays. (Be sure that the view includes all the bison units.)



3. If the proper map does not appear when you launch ArcMap (highly unlikely), follow the following procedure:

- a. If there is an existing map, right-click on **Layers** in the top of the Display window on the right of the screen. Choose **Select All Layers**, then right-click on one of the layers and select **Remove**.
- b. Go to **File**, then **Open**, and browse to the Shared drive by the following path: **H:/Biology Shared Folder > Biolab Students > MOORING BISON > BISON GIS PROJECT** and select one of the .mxd files (they take the form of "YournameDate", e.g., Mooring092908.mxd).

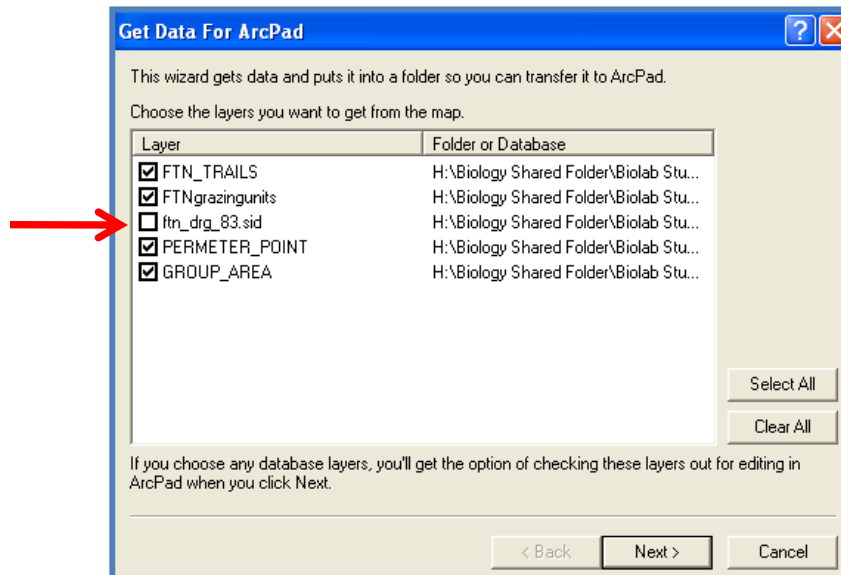
*Note. If no .mxd files are present, you must start from scratch! Click on the **Add Data** button. Go to the geodatabase on the Shared drive by the following path: **H:/Biology Shared Folder > Biolab Students > MOORING BISON > BISON GIS PROJECT > GEODATABASE > BISON GEODATABASE.gdb**. With the shift key down, highlight all the feature classes listed (FTN_trails, FTM_grazingunits, GROUP_AREA, PERIMETER_POINT) and hit **Add**. You will now need to adjust the symbology of the layers (how they appear) by left-clicking on the symbol below the name of each layer in the Display window on the left of the screen. For **FTN trails**, you will select dark blue color at width 2; for **FTN grazingunits**, choose red color at width 2. In the same way, you can select the size and color of the points created by **PERIMETER_POINTS** and the polygons created by **GROUP_AREA**.*

4. Activate the ArcPad menu if is not already. To do this select **View** from the main menu and **Toolbars** from the dropdown menu that appears. Place a check next to **ArcPad**. This loads

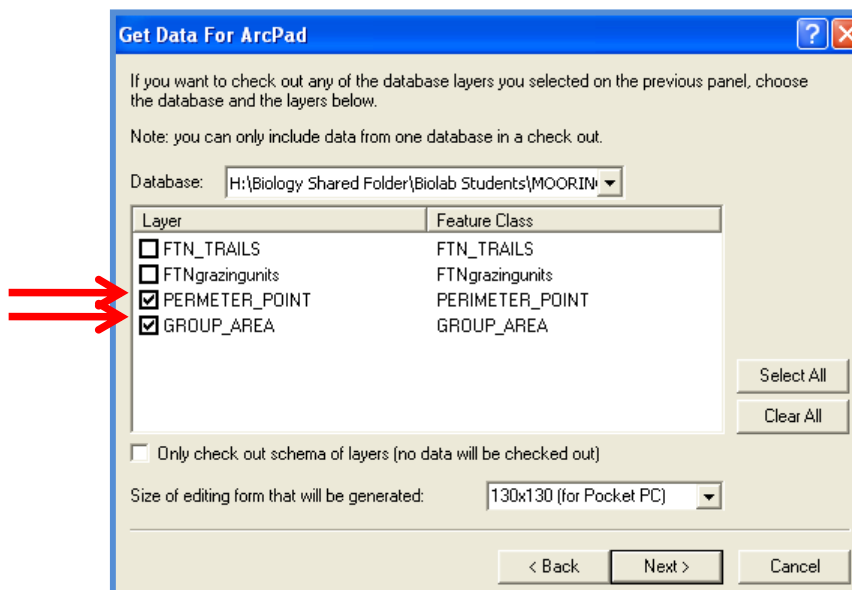
the ArcPad Tools for ArcMap toolbar . Dock or move the toolbar if desired.

5. Select the **Get Data for ArcPad** button from the ArcPad menu . This will open the **Get Data For ArcPad** dialog box. On the first page of the dialog box click on the **Select All** button at the lower right side of the box to check all the feature classes (layers), then **UNCHECK ftn_drg_83.sid** in the box to the left (alternatively, you could individually check all the boxes except ftn_drg_83.sid). The feature class ftn_drg_83.sid is the topo map and it is too big to check out.) Once complete select **Next >**.

*Note: the layers that should be checked are: **FTN_trails**, **FTN_grazingunits**, **PERIMETER_POINT**, and **GROUP_AREA**.*

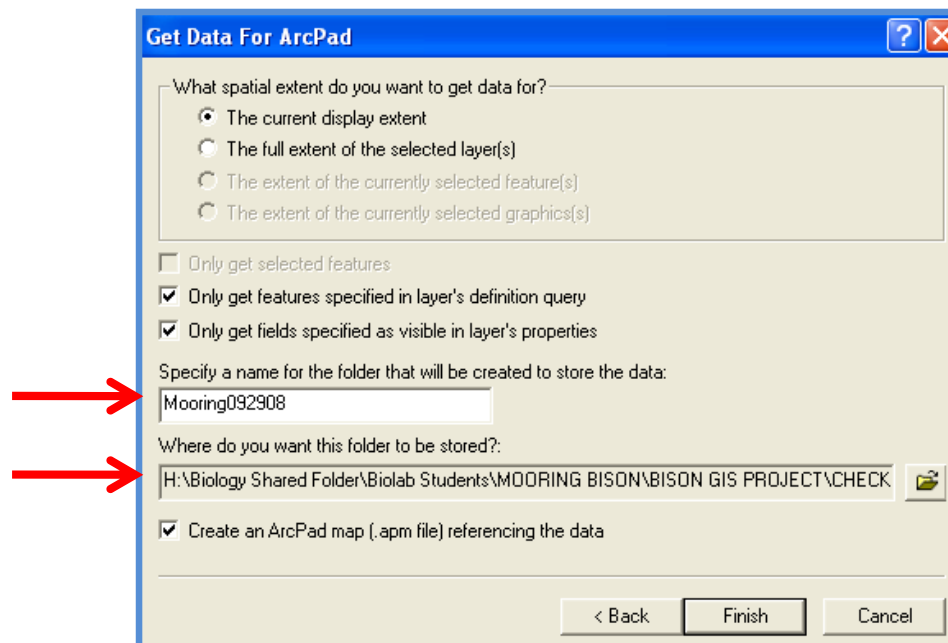


6. Select the feature classes you intend to edit (PERIMETER_POINT, GROUP_AREA) by placing a check in the box to their left. Since data already exist in these files and we do not wish to check out the existing data, check the **Only check out schema of layers** box. With this box selected, you will only check out the schema databases and none of the geometry (points and polygons). Once complete select **Next >**.



7. Select **The Current Display Extent** button. This will set the extent of your project to the current display of the ArcMap project. You may zoom in or out to change the display extent as necessary. Take the checked defaults for **Only get features specified in layer's definition query** and **Only get fields specified as visible in layer's properties**. Next, in the pane under **Specify a name for the folder that will be created to store the data:** name the folder using your last name and the date that you checked out the data, using 6 digits for the current month, day, and year (e.g., Mooring092908). You will create a unique folder using this formula every time you check out data (Note: if you check out/check in data more than once in the same day, add a letter extension to the filename to distinguish the different sessions, e.g., Mooring092908A.) Next, in the pane under **Where do you want this folder to be stored?**, specify the appropriate location on the shared drive by browsing for: Shared on 'Socrates' (H:) > Biology Shared Folder > Biolab Students > MOORING BISON > BISON GIS PROJECT > CHECKOUT. Check the box next to **Create an ArcPad map (.apm file) referencing the data**. Once complete select **Finish**.

*Note: the path in the **Where do you want this folder to be stored?** should be H:\Biology Shared Folder\Biolab Students\MOORING BISON\BISON GIS PROJECT\CHECKOUT*



8. After a couple of seconds you will be notified if the operation was successful. Select **OK** to complete the check out process.
9. Save the ArcMap project file (.mxd file) you just checked out by selecting **File**, then **Save As**, and going to the BISON GIS PROJECT folder on the Shared Drive (the same subfolder that contains the CHECKOUT folder). Save the file you just checked out (it will have an mxd extension). For this example, you would enter Mooring092908.mxd and hit **Save**.
10. Minimize or close ArcMap.

STEP 2: Editing data in ArcPad

1. Launch ArcPad 7.1; the **Start ArcPad with** dialogue box will appear. Select **An existing map or data**. Browse the window until you find the data folder you just created to store your checked out data. For the example above, this would be **H:\Biology Shared Folder\Biolab Students\MOORING BISON\BISON GIS PROJECT\CHECKOUT\ Mooring092908\ArcPad.apm**. Select

the green **OK** button  at the bottom of the dialogue box. The topo map will appear with the checked out schema.

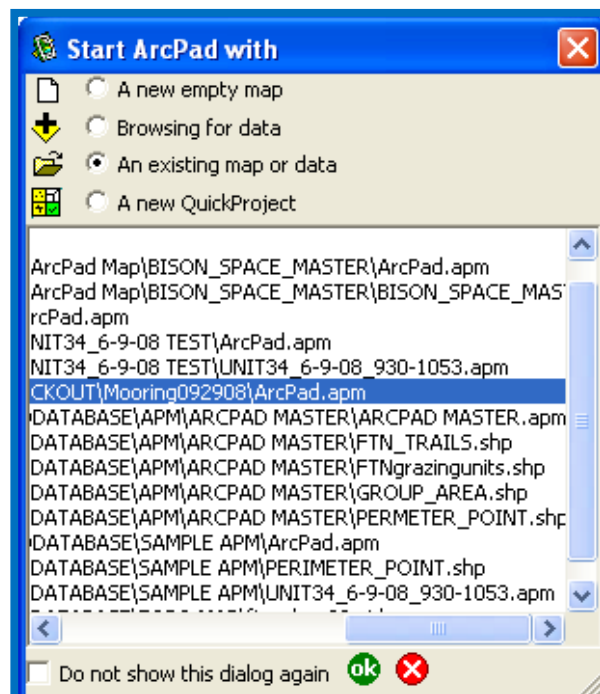


Open Map

Table of Contents

Add Layer

Alternatively, you may select **Browsing for data** in the dialogue box and follow the same path listed above to locate the ArcPad.apm file in the appropriate folder, then check the ArcPad.apm file and select **OK**.



Or, you may select **A new empty map** and select the **Add Layer** button  from the main toolbar. Browse to ArcPad.apm file in the appropriate folder using the above path, check ArcPad.apm and select **OK**.

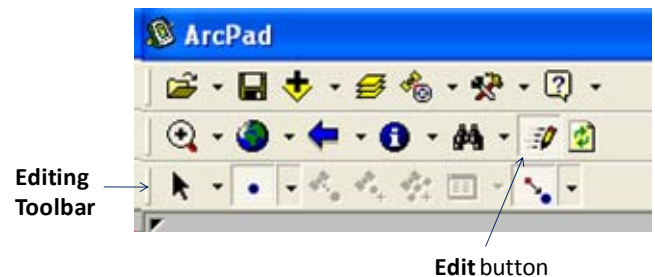
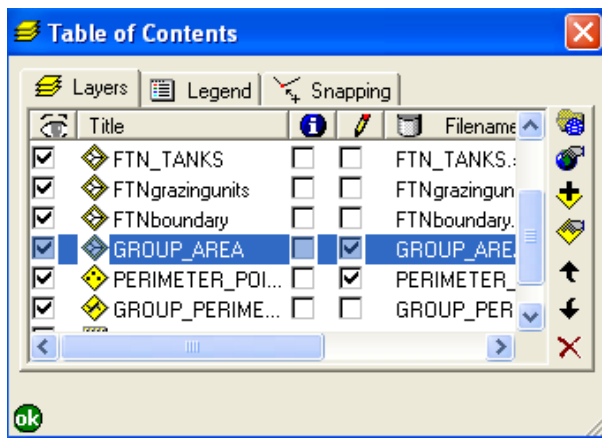
Or, you may select **A new empty map** and select the **Open Map** button  from the main toolbar. Browse in Windows to ArcPad.apm file in the appropriate folder using the above path, highlight ArcPad.apm and select **OK**.

There are many ways to open your checked out data, so use whatever works best for you.

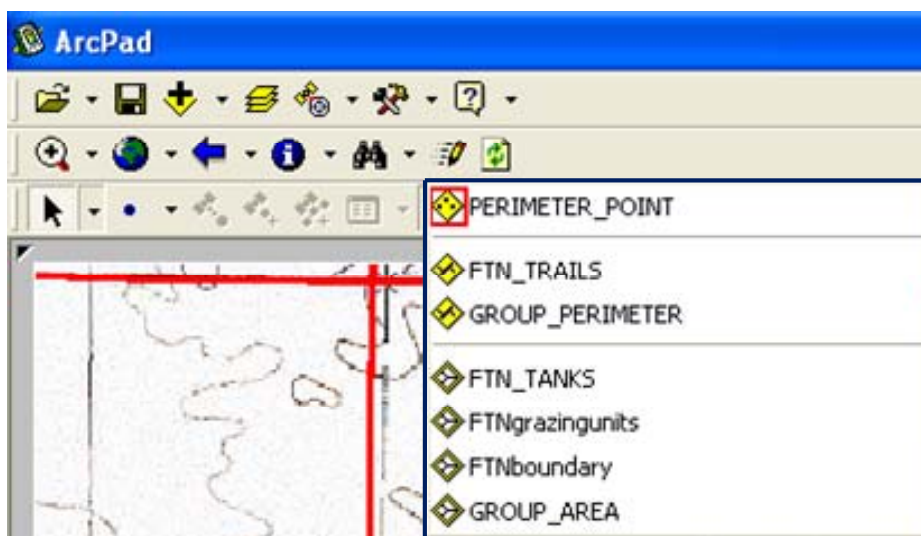
2. If the topo map did not open with the ArcPad.apm file, you will need to add it in separately.

Select the **Add Layer** button  from the main toolbar. Browse through the following path: **H:\Biology Shared Folder\Biolab Students\ MOORING BISON\BISON GIS PROJECT\GEODATABASE\TOPO MAP\ftn_drg_83.sid**. Check the **ftn_drg_83.sid** file and select **OK**. The topo map should now open.

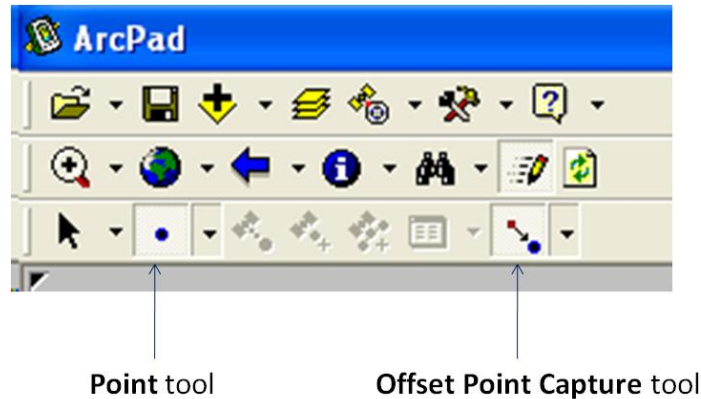
3. Select the **Table of Contents**  button (the “pancakes”) from the main toolbar. This will open the **Table of Contents** dialogue box, which lists all the layers currently loaded on ArcPad. This dialogue box also controls which layers are active for editing. The layers that you can edit are PERIMETER_POINT (point features) and GROUP_AREA (polygon features). Select the box in the edit column  next to the layers you wish to edit (you can only edit one layer at a time). You will start by selecting the PERIMETER_POINT layer to lay down points on the perimeter of each bison group. Select the **OK** button in the lower left corner of the **Table of Contents** dialog when done . The **Editing Toolbar** will now appear in your ArcPad session.



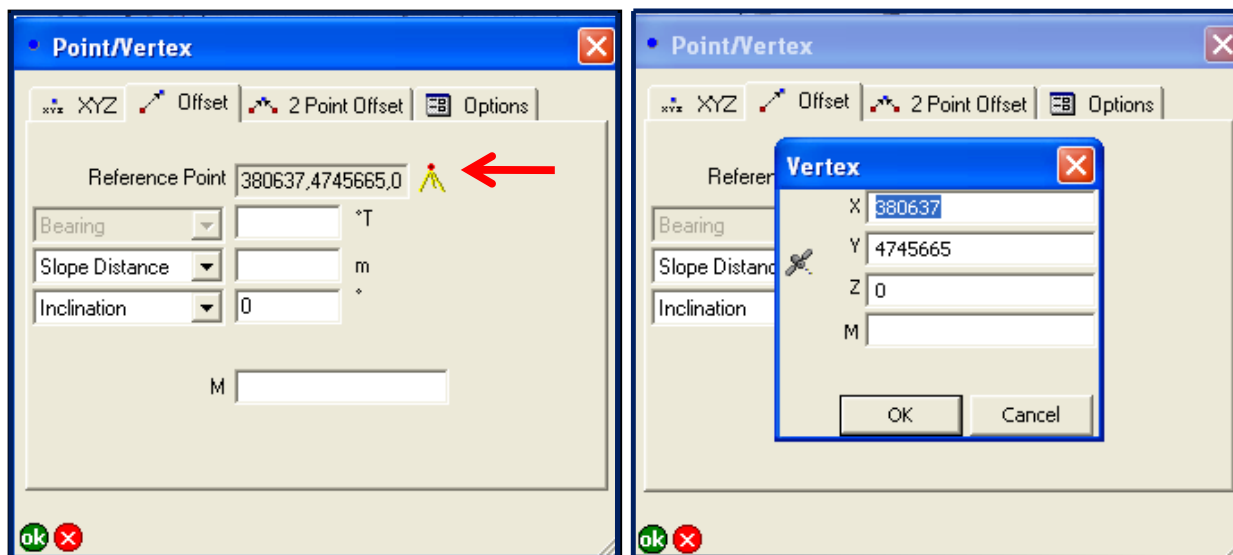
4. Alternatively, instead of using the **Table of Contents** dialogue box to choose the layer to edit, click on the **Edit** (“pencil”) button  and enable editing of the appropriate layer. Again, start by selecting the PERIMETER_POINT layer to lay down points on the perimeter of each bison group.



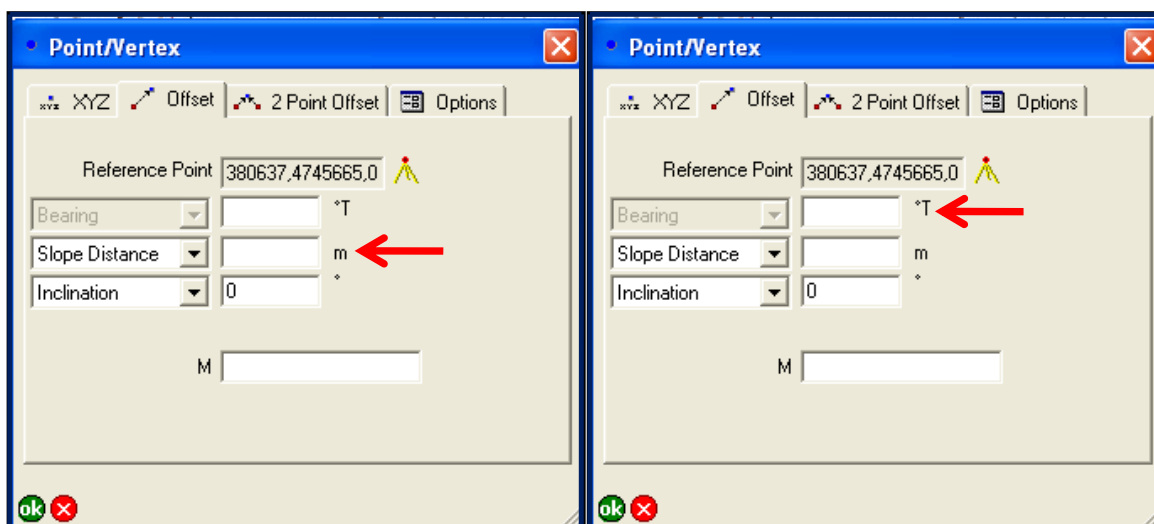
5. Once you select the PERIMETER_POINT layer for editing, the **Editing Toolbar** will appear. If it is not already visible, select the **Point tool** button  on the left of the toolbar, and the **Offset Point Capture tool**  on the right of the toolbar.



6. Now you are ready to begin laying down the points on the perimeter of each bison group for the 'sweep' (time) you are working on. With the **Point** and **Offset Point Capture** buttons depressed, use the mouse to click on the area of the topographic map where the reference coordinates were established for the first group (group A) mapped on the paper map in the field (where the 'X' is). The mouse position will appear as a small crosshair; when you click, it will open the **Point/Vertex** dialogue box.

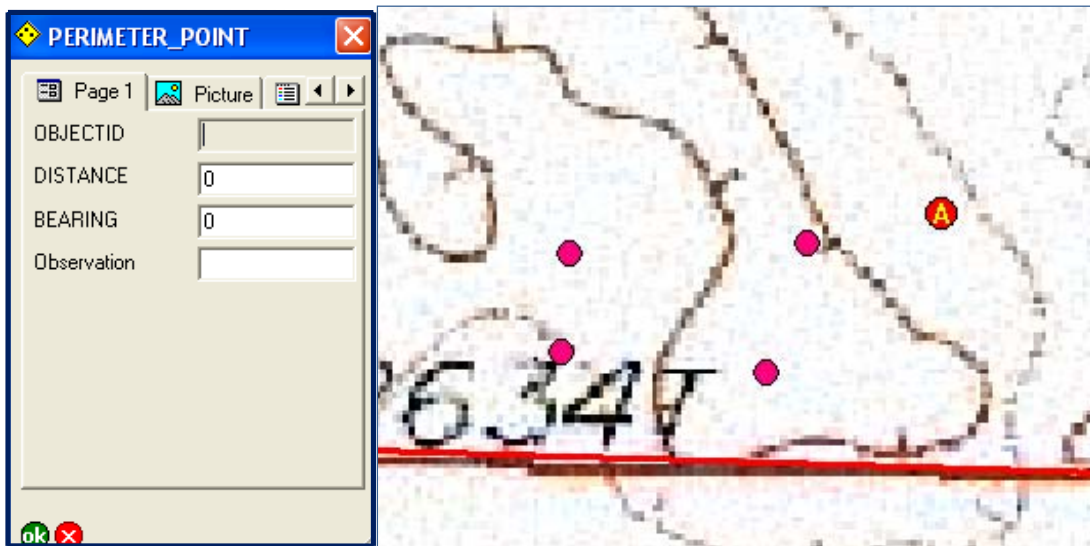


- From the **Point/Vertex** dialogue, you will first enter the GPS coordinates of the reference point by going to the **Reference Point** window and clicking on the tripod icon to the right. This will open up the **Vertex** dialogue box, where you will enter the GPS coordinates for that bison group (in this case, group A). Enter the coordinates from the Excel spreadsheet 'Bison Space Use 2008 MASTER', which is located in the BISON GIS PROJECT folder on the Shared drive (simply copy and paste using the Control-C and Control-V commands). The GPS position is recorded in **UTM** format (Universal Transverse Mercator), which is the standard GPS format used by most government agencies. (In the UTM format, the numbers actually mean something on the ground; they refer to the number of meters from a reference point – see Wikipedia). The X-value (the top value reported on a GPS unit) is known as the **easting** (distance east of the central meridian) and the Y-value (bottom value on a GPS unit) is known as the **northing** (distance north of the equator). Enter the first (easting) value in the **X** box and the second (northing) value in the **Y** box and click **OK**.



- Next, enter the distance to the first perimeter point into the **Slope Distance** box (make sure that it is set to meters). Then, enter the bearing to the first perimeter point into the **Bearing** box (this box will be shaded because it cannot be changed). Now click **OK**. The **PERIMETER_POINT** dialogue box will open, giving you the opportunity to enter the point data (distance, bearing, and observation number) for the attribute table linked to the PERIMETER_POINT layer. Because the points are only needed to guide the drawing of the bison group polygon, we will not record any data in this box. Close the box by clicking **OK**. A red circle with a yellow letter 'A' will now appear on the map – this is the location of the GPS reference coordinates. Also, a point will appear on the map at the distance and bearing from the GPS coordinates specified by the values you just entered.

*Note: If for some reason the symbology settings get changed, you can adjust the size and color of the displayed point feature in the PERIMETER_POINT dialogue box. Scroll to the right by clicking the right arrow, select the **Symbology** tab, highlight the symbol and then select the **Point Style** tab, and adjust the size and color of the point.*



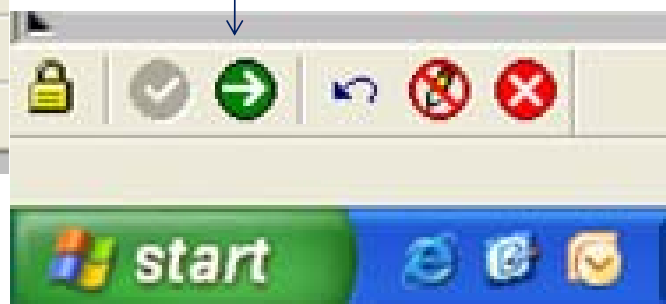
9. Repeat this procedure until all the points for the particular bison group have been entered and appear on the map. Note that you only need to enter the UTM coordinates the first time; thereafter, the dialogue box will retain the same coordinates as the default and you only need enter the new distance and bearing values.

10. Once all the points for the group have been laid down, click the **Edit** button  and deactivate the PERIMETER_POINT layer by clicking on it. Now, activate the GROUP_AREA layer by clicking on that layer in the **Edit** box. Note that the **Point** button is now replaced by the **Polygon** button on the left side of the **Edit** toolbar. Click on the Polygon button to depress it, then move the crosshairs with the mouse to the perimeter points, clicking on each point until you have created a polygon enclosing all the points. After clicking on the last point, move the cursor to the bottom left of the screen and click on the green arrow button to complete the polygon.

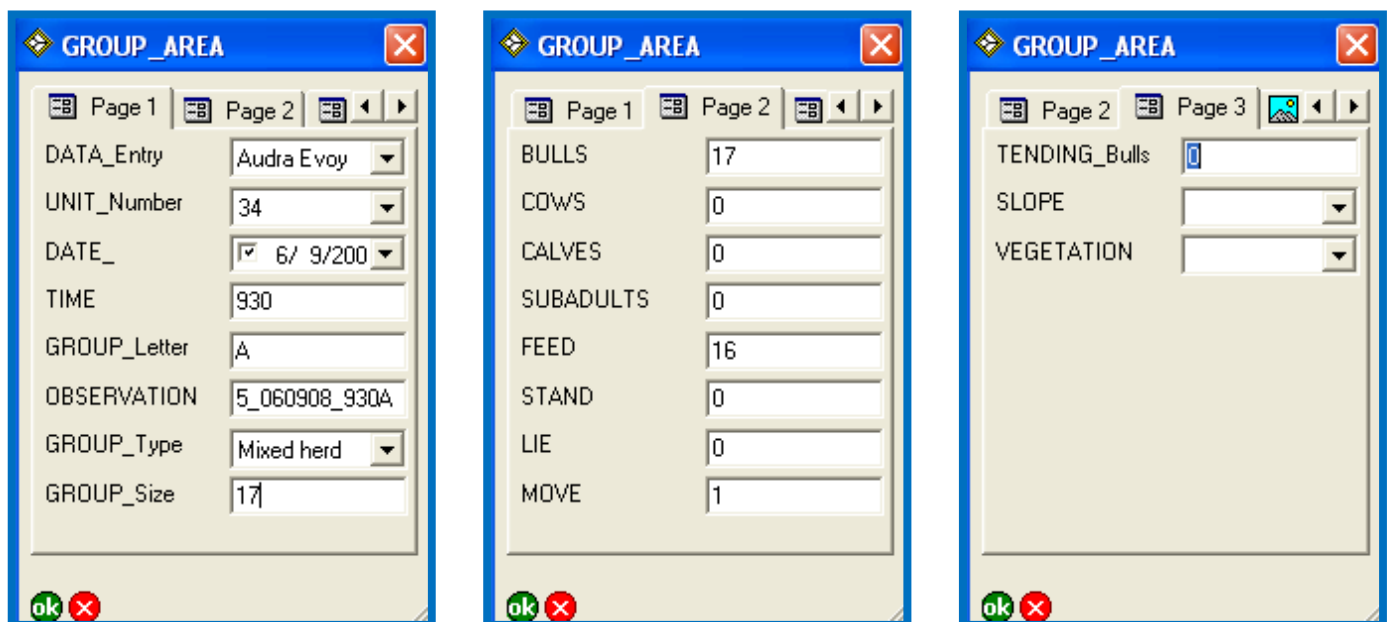


Polygon tool

Complete action tool



11. The **GROUP_AREA** dialogue box will appear, and you will enter the data on the bison group contained in the Excel spreadsheet. In **DATA_Entry** choose your name from the drop-down menu, in **UNIT_Number** enter the unit you are editing from the drop-down menu, in **DATE_** enter the date of the field data collection (when you click on the down-arrow, a calendar will appear and you will have to scroll back to the observation date.) Next enter the values into the windows for **Time** (using 24-hour time with no colons) and **Group_Letter** (A, B, C, etc.). For **Observation** you will enter the unit number, date, time, and group letter using the formula UNIT#_DATE_TIMELETTER (e.g., UNIT34_060908_930A). The purpose is to create a unique observation name for later searching. Next, in **Group_Type** choose from the drop-down menu whether the bison group is a **Mixed** or **Bull** group. In **Group_Size**, enter the total size of the group. On **Page 2**, enter the number of **BULLS**, **COWS**, **CALVES**, and **SUBADULTS** in the group, and the number of bison engaged in **FEED**, **STAND**, **LIE**, and **MOVE**. Scroll to the right using the right-arrow and select the **Page 3** tab, and enter the number of **TENDING_Bulls** (during the rut only). Ignore **SLOPE** and **VEGETATION**, since we did not collect data on those measures this year.



The image shows three sequential screenshots of the **GROUP_AREA** dialog box, illustrating the data entry process across three pages.

Page 1: Contains fields for **DATA_Entry** (Audra Evoy), **UNIT_Number** (34), **DATE_** (6/ 9/200), **TIME** (930), **GROUP_Letter** (A), **OBSERVATION** (5_060908_930A), **GROUP_Type** (Mixed herd), and **GROUP_Size** (17).

Page 2: Contains fields for **BULLS** (17), **COWS** (0), **CALVES** (0), **SUBADULTS** (0), **FEED** (16), **STAND** (0), **LIE** (0), and **MOVE** (1).

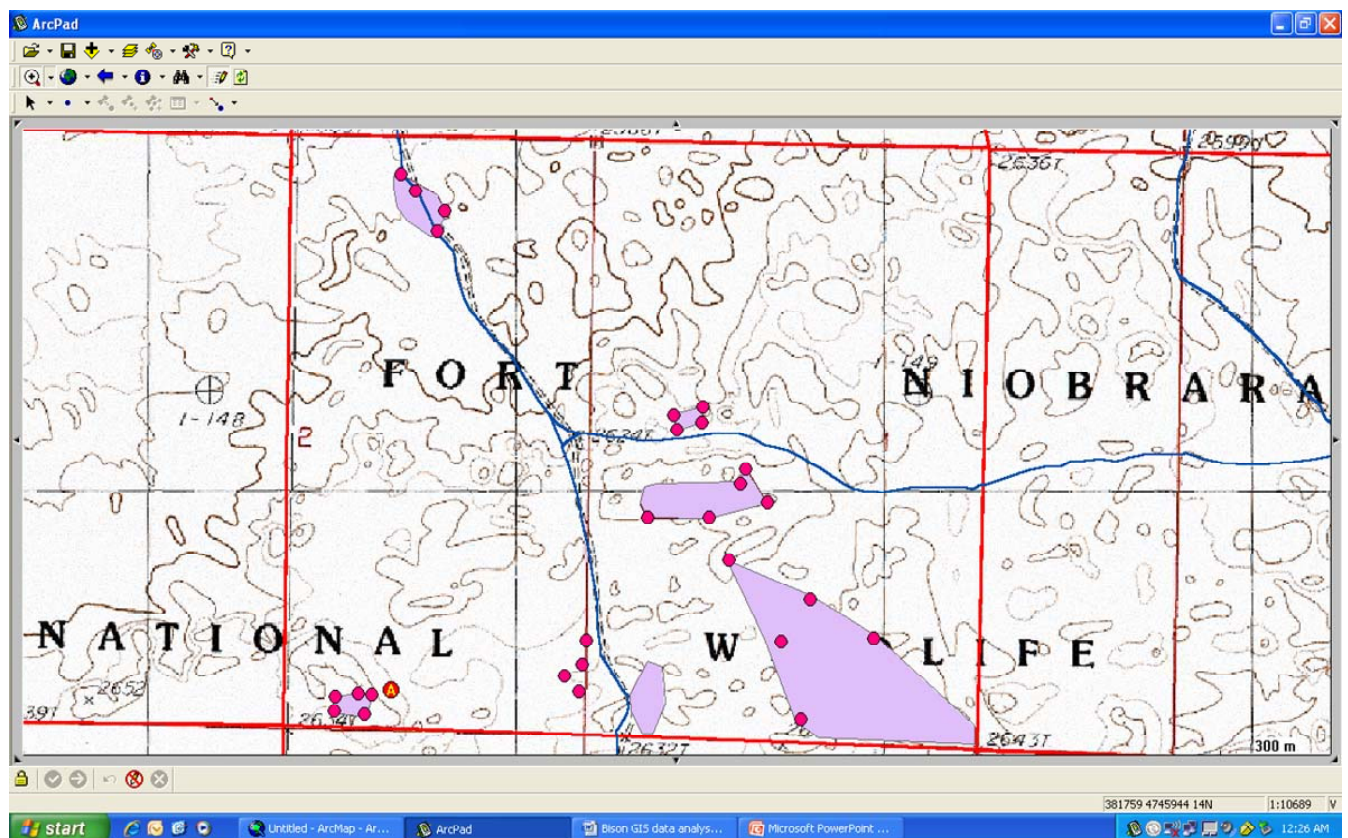
Page 3: Contains fields for **TENDING_Bulls** (0), **SLOPE**, and **VEGETATION**.

12. When you have completed entering all the data for the group, click the **OK** button .

13. Deactivate the **GROUP_AREA** layer for editing by selecting the **Layers**  button and un-checking the box in the edit column  and clicking **OK**  OR by selecting the **Edit** button  and de-selecting the **GROUP_AREA** layer.

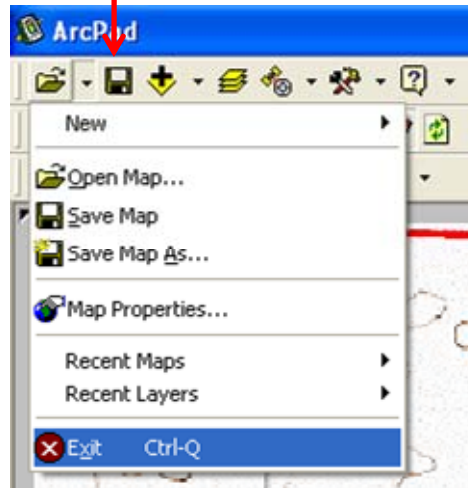


14. Repeat the procedure (2-12) for **Group B** by first laying down the perimeter points using the Offset Point Capture Tool while editing the PERIMETER_POINT layer, and then tracing the group polygon while editing the GROUP_AREA layer. Continue until you have mapped all of the groups for that particular sweep (time period). Your ArcPad map should now look something like this:



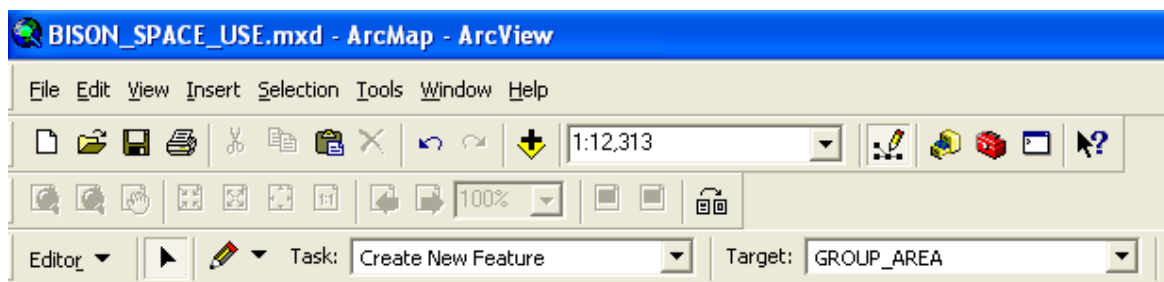
15. When you are finished mapping the sweep, select the **Save Project** button  and select **Save Map**, then exit from ArcPad. This can be done by selecting the dropdown menu next to the **Open Map** button. Select **Exit** from the menu that appears to close ArcPad.

Save Project button

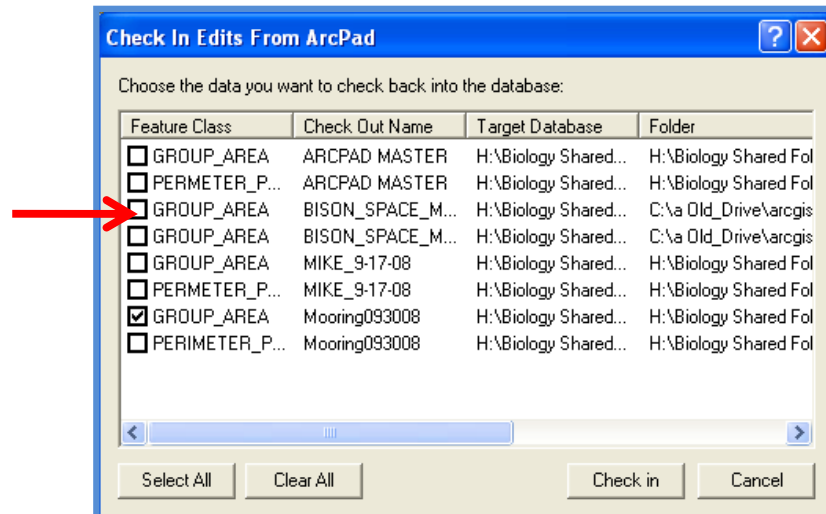


STEP 3: Checking in field data from ArcPad to ArcMap

1. Maximize ArcMap, or launch a new ArcMap session. Open up the .mxd project file which contains the data you originally checked out (this should usually open as the default, unless someone else is entering data at the same time as you). If your file does not open as the default, go to **File** and **Open**, and browse to your .mxd file (e.g., Mooring092908.mxd), select it and click **Open**.
2. Start an edit session by selecting the **Editor** button on the Editor Toolbar and select **Start Editing** from the drop down menu that appears. One at a time, select the feature classes (layers) that you intend to check in data to in the **Target** box (PERIMETER_POINT and GROUP_AREA).



3. Select the **Check In Edits** From ArcPad  button on the ArcPad Toolbar. This button is activated only when you are in an edit session.
4. The **Check In Edits** From ArcPad Dialog should now appear. Select the edits you would like to check in from ArcPad and select **Check in**. Select **Cancel** to close the dialogue box.



5. After the check in, your data should appear in your project. From the Edit Toolbar select the **Editor** button and select **Save Edits** from the drop down menu that appears. Next select **Stop Editing**. You have completed the check in check out process.

