APPENDIX E | SPATIAL ANALYSIS PROCESSING STEPS

APPENDIX E1 | STANDARD DATA PROCESSING

Protocol for Projecting Data

All files are in datum NAD 1983 (D_North_American_1983) and projected coordinate system UTM 11N (NAD_1983_UTM_Zone_11N). If files were not received in these formats, we used a geographic transformation and/or projection.

For vector data:

1. In ArcToolbox, select "**Project**" under Data Management Tools > Projections and Transformations > Feature > **Project**.
2. In the "Project" dialogue box:
    - A. Under "Input Dataset or Feature Class", select the layer you want to project from the dropdown menu.
    - B. Under "Output Dataset or Feature Class", rename the layer (if necessary) and make sure that it will be saved in the desired folder.
    - C. Under "Output Coordinate System", click the button to the right of the field.
        - i. Under the "Spatial Reference Properties" dialogue box, click "**Select**".
        - ii. Click the "Projected Coordinate Systems" folder, then the "UTM" folder, then the "NAD 1983" folder.
        - iii. Select the "NAD 1983 UTM Zone 11N.prj" file, and click "**Add**".
        - iv. Click "**OK**" in the Spatial Reference Properties" dialogue box.
    - D. If the original datum was NAD 1983, click "**OK**".
    - E. If the original datum was not NAD 1983, a drop-down arrow will appear on the right of the "Geographic Transformation" field. In that menu, select the top transformation between the original datum and NAD 1983. Then click "**OK**".

For raster data:

1. In ArcToolbox, select "**Project Raster**" under Data Management Tools > Projections and Transformations > Raster > **Project Raster**.
2. In the "Project Raster" dialogue box:
    - F. Under "Input Raster", select the raster you want to project from the dropdown menu.
    - G. Under "Output Raster Dataset", rename the layer (if necessary) and make sure that it will be saved in the desired folder.
    - H. Under "Output Coordinate System", click the button to the right of the field.
        - i. Under the "Spatial Reference Properties" dialogue box, click "**Select**".

ii. Click the "Projected Coordinate Systems" folder, then the "UTM" folder, then the "NAD 1983" folder.

iii. Select the "NAD 1983 UTM Zone 11N.prj" file, and click "**Add**".

iv. Click "**OK**" in the Spatial Reference Properties" dialogue box.

I. If the original datum was NAD 1983, proceed to step F.

J. If the original datum was not NAD 1983, a drop-down arrow will appear on the right of the "Geographic Transformation" field. In that menu, select the top transformation between the original datum and NAD 1983.

K. If the data is categorical, under the field "Resampling Technique", select "NEAREST" from the drop-down menu. Note: CUBIC was used for continuous data.

L. The field "Output Cell Size" should equal 30m.

M. Click "**OK**" in the "Project Raster" dialogue box.

Protocol for Clipping Data

Most files are clipped to either the boundaries of the California Desert District (CDD) or the California Desert Conservation Area (CDCA).

For vector data:

1. Add the file you wish to clip to an ArcMap session.
2. Add the desired boundary file (e.g. CDD or CDCA) to the ArcMap session.
3. In ArcToolbox, select "**Clip**" under Analysis Tools > Extract > **Clip**.
4. In the "Clip" dialogue box:
   A. Under "Input Features", select the layer you want to clip from the drop-down menu.
   B. Under "Clip Features", select the boundary file you want to clip to (e.g. CDD, CDCA).
   C. Under "Output Feature Class", rename the layer (if necessary) and make sure that it will be saved in the desired folder.
   D. Leave "XY Tolerance (Optional)" field blank.
   E. Click "**OK**".
5. The new clipped layer will be added to your map.

For raster data:

1. Add the file you wish to clip to a blank or existing ArcMap session.
2. Add the desired boundary file (e.g. CDD or CDCA) to the ArcMap session. For this example, we will use the file name "DEM_CDD_30".
3. Turn on "**Spatial Analyst**" tool. Select "Spatial Analyst" under Tools > Extensions > **Spatial Analyst**.
4. Open up the "**Spatial Analyst Toolbar**". Under View > Toolbars > **Spatial Analyst**.
5. Click on the Spatial Analyst Toolbar and select "Options".

A. Under the "General" tab:
    i. Working directory: specify where you want to hold the working version of the map.
    ii. Analysis Mask: Insert "DEM_CDD_30".
B. Under the "Extent" tab: select "same layer as DEM_CDD_30".
C. Under the "Cell Size" tab:
    i. Analysis cell size: select "Same as layer DEM_CDD_30". Note: 30 meter cell size is used for all rasters in this project.
    ii. Cell size: 30

6. To perform the mask/clip, click on the Spatial Analyst Toolbar and select "**Raster Calculator**". Double click the layer that you want to clip so that it appears in the blank space in the Raster Calculator field. Click "**EVALUATE**".

APPENDIX E2 | DEFINING THE SCOPE

For Steps 1 and 2, See Appendix E1

The following Steps 3 to 7 describe the processing involved to create a file that will later be used as the mask and extent. The file is used as the mask and extent in any geoprocessing involving species (Steps 6, 7, 8 of Appendix E4 | Ecology Processing).

Step 3: Convert Land Management Designation File from Vector to Raster[a]

A. ArcToolbox > Conversion Tools > To Raster > **Polygon to Raster**

B. Setting the "**Environments**" in the dialogue box**:** In the environments window, set the extent, cell size and mask equal to DEM_CDD_30:

   1. General Settings: Extent= DEM_CDD_30.
   2. Raster Analysis Settings: Cell Size, Extent= DEM_CDD_30.
   3. Select **OK.**

C. Once the environments are set, fill in the rest of the dialogue box.

   1. Input Features: Select a land management vector file.
   2. VALUE FIELD: See Table E.1.

Table E.1 Value Fields Used in Processing Land Management Vector Files

Vector File	VALUE Field
Wilderness	WLDPCA_ID
WSA	WSA_Suitab
ACEC	ACCPCA_
National Monument	FID
Flat-tailed Horned Lizard Management Area	HMPPTHL_
Land Ownership	Agency_NUM*

***Note: We created Agency_NUM, and the following numbers were assigned: 0=Unclassified, 1=BLM, 2= Bureau of Reclamation, 3=Military, 4=NPS, 5=FWS, 6=US Forest Service, 7=State, 8= Other Federal, 9=Local Government**

   3. Output Raster: In the "output feature class", locate the output location and name the file.
   4. All other boxes should be automatically filled in by setting the environments in the previous step.
   5. Click **OK**. A new raster file is created.

Step 4: Reclassify the raster file in ArcMap

A. Open the "Reclassify" tool:

[a] Note: For critical habitat, complete processing steps described below under "FWS Critical Habitat Processing" in place of steps 3-5.

1. ArcToolbox > Spatial Analyst > Reclass > **Reclassify**

B. In the dialogue box:
   1. Input raster: Select the land management raster that was just created.
   2. Reclass Field : VALUE.

C. Setting the "**Environments**" in the dialogue box: In the environments window, set the extent, cell size and mask equal to DEM_CDD_30:
   1. General Settings: Extent= DEM_CDD_30.
   2. Raster Analysis Settings: Cell Size, Extent= DEM_CDD_30.
   3. Select **"OK".**

D. Click under the "New Values" column and change:
   1. ACECs, Wilderness Areas, WSAs, National Monument, Flat-tail Horned Lizard Management Areas: 0 and NoData = 0, All other values = 1000.
   2. Land Ownership: NPS, FWS, BOR, and DOD were reclassified as 1000 and all others were reclassified as 0 (BLM, USFS, State, Local Govt., Private, Unclassified).

E. Output Raster: In the "**Output raster**", locate the output location and name the raster.

F. Click **OK**. This creates a new raster with high conflict areas scored at 1000 and all other areas scored at 0.

Step 5: Repeat Steps 3 and 4 for all land management vector files

Step 6: Overlay all land management raster files by adding all files using Raster Calculator in the Spatial Analyst Toolbar

Step 7: Reclassify resulting land management raster with 0 and NoData as 0 and all other values as 1000

FWS Critical Habitat Data Processing

Use these steps in place of Steps 3 to 5 above for U.S. Fish and Wildlife Service critical habitat areas.

Step 1: Union all [37] FWS critical habitat files in ArcMap

A. Open ArcMap, then open the union tool: ArcToolbox > Analysis Tools > Overlay > **Union.**

B. Once the dialogue box opens, locate and select all of the critical habitat files from the catalog tree, then drag them under the "**Features**" heading in the dialogue box.

C. In the "**Output feature class**", locate the output location and name the file.

D. Leave all other options as they are, click "**OK**"**.** This creates a single shapefile consisting of all 37 critical habitat files.

Step 2: Convert the critical habitat union vector to a raster using ArcMap

A. ArcToolbox > Conversion Tools > To Raster > **Polygon to Raster.**

B. Setting the "**Environments**" in the dialogue box**:** In the environments window, set the extent, cell size and mask equal to DEM_CDD_30:
   1. General Settings: Extent = DEM_CDD_30.
   2. Raster Analysis Settings: Cell Size, Extent = DEM_CDD_30.
   3. Select "**OK**"**.**

C. Once the environments are set, fill in the rest of the dialogue box:
   1. Input Features: Select the critical habitat union shapefile.
   2. VALUE FIELD: Inspect the attribute table of the habitat union shapefile. Find the value field with the fewest number of different variables. In this case, "FID_caenot" has only values of -1 and 0 so it is chosen as the Value Field.
   3. Output Raster: In the "Output feature class", locate the output location and name the file.
   4. All other boxes should be automatically filled in by setting the environments in the previous step.
   5. Click "**OK**". A new raster file is created.

Step 3: Reclassify the new raster in ArcMap

A. ArcToolbox > Spatial Analyst > Reclass > **Reclassify.**

B. Input raster: select the raster that was just created.

C. Reclass Field : VALUE.

D. Setting the **Environments** in the dialogue box**:** In the environments window, set the extent, cell size and mask equal to DEM_CDD_30:
   1. General Settings: Extent= DEM_CDD_30.
   2. Raster Analysis Settings: Cell Size, Extent= DEM_CDD_30.
   3. Select "**OK**"**.**

E. Click under the "**New Values**" column and change NoData to 0 and all other values to 1000.

F. Output Raster: In the "Output raster", locate the output location and name the raster.

G. Click **OK**. This creates a new raster with cell values of only 1000 or 0.

APPENDIX E3 | ECOLOGY NUMERICAL SCORES

Global Rank

We assigned the NatureServe Global Rank (GRank) classification system with scores between 0 and 60. In order to distribute scores evenly between all possible classifications, we used increments of 10. Special classifications include:

- GH = Historical occurrence (element has not been seen in at least 20 years but suitable habitat exists)
- GX = Species is extirpated in the wild
- G? = Global Rank has not been established or is unknown

GH was given a score of 10 because suitable habitat might still exist for that species and there is potential for the species to reoccupy the area. GX was given a score of 0 because the species is extirpated from the wild and would not be able to reoccupy an area even if suitable habitat remained. G? was given a score of 0 because no rank has been provided.

G Rank	Score
G1	60
G2	50
G3	40
G4	30
G5	20
GH	10
GX	0
G?	0
GnTn	Gn + Tn
GnT1	9
GnT2	7
GnT3	5
GnT4	3
GnT5	1

Examples:

The Desert pincushion (*Coryphantha chlorantha*) has a GRank of G2G3. The numerical score is:

G2G3 = (50 + 40) / 2 = 45

The Cima milk-vetch (*Astragalus cimae* var. *cimae*) subspecies has a GRank of G2T2. The numerical score is:

G2T2 = 50 + 7 = 57

Peirson's milk-vetch (*Astragalus magdalenae* var. *peirsonii*) subspecies has a GRank of G3G4T2. The numerical score is:

G3G4T2 = (40 + 30)/2 + 7 = 35 + 7 = 42

The Curved-pod milk-vetch (*Astragalus mohavensis* var. *hemigyrus*) subspecies has a GRank of G3G4T2T3. The numerical score is:

G3G4T2T3 = (40 + 30)/2 + (7 + 5)/2 = 35 + 6 = 41

NatureServe sometimes uses "T" to indicate the score for a particular subspecies or variety, following the same categories as "G" (i.e. T1 = critically imperiled, T2 = imperiled, etc.). We wanted to distinguish between subspecies because rarity/endangerment can vary between subspecies, and therefore provided scores between 0 and 10 to be added to the "G" score.

State Rank

We assigned the NatureServe State Rank (SRank) classification system with scores between 0-60. In order to distribute scores evenly between all possible classifications, we used increments of five. Special classifications include:

- SH = Historical occurrence in California (suitable habitat exists)
- SX = Species is extirpated from California
- SNR = No SRank

SH was given a score of five because we thought if a species was able to persist in that area historically, then suitable habitat might still exist for that species. SX was given a score of 0 because an extinct species would not be able to reoccupy an area even if suitable habitat remained. SNR was given a score of 0 because no rank has been provided. Scores were not assigned in a linear fashion because we felt that the level of threat to the species warranted a greater score than the number of element occurrences, individuals, or acres. Species that were given ranks of S1, S2, or S3 were assumed to not have an associated threat ranking and therefore were assigned the same value as a ranking with 0.3 attached (no current threats known).

S Rank	Score
S1.0	30
S1.1	60
S1.2	45
S1.3	30
S2.0	25
S2.1	55
S2.2	40
S2.3	25
S3.0	20
S3.1	50
S3.2	35
S3.3	20
S4	15
S5	10
SH	5
SX	0
SNR	0

Examples:

The Algodones Dunes sunflower (*Helianthus niveus* ssp. *tephrodes*) has an SRank of S1.2. The numerical score is:

S1.2 = 45

Townsend's big-eared bat (*Corynorhinus townsendii*) has an SRank of S2S3. The numerical score is:

S2S3 = (25 + 20)/2 = 22.5

Because reclassifying in ArcGIS does not allow for decimals, we rounded up to 23.

Endangered Species Act

We assigned the Federal Endangered Species Act classification system with scores between 0 and 60. In order to distribute scores evenly between all possible classifications, we used increments of 10.

ESA	Score
Endangered	60
Threatened	50
Proposed Endangered	40
Proposed Threatened	30
Candidate	20
Spp of Concern	10
Delisted	0
None	0

Examples:

The Amargosa vole (*Microtus californicus scirpensis*) is listed as endangered and received a score of 60.

The San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*) is listed as a candidate and received a score of 20.

California Endangered Species Act

We assigned the California Endangered Species Act classification system with scores between 0 and 60. In order to distribute scores evenly between all possible classifications, we used increments of 15.

CESA	Score
Endangered	60
Threatened	45
Rare	30
Candidate	15
Delisted	0
None	0

Examples:

The Coachella Valley fringe-toed lizard (*Uma inornata*) is listed as endangered and received a score of 60.

The Mojave ground squirrel (*Xerospermophilus mohavensis*) is listed as threatened and received a score of 45.

California Native Plant Society

We assigned the California Native Plant Society classification system with scores between 0 and 60. In order to distribute scores evenly between all possible classifications, we used increments of five. Plants without rankings and non-plant element occurrences were given scores of 0.

CNPS	Score
1B.1	60
1B.2	55
1B.3	50
2.1	45
2.2	40
2.3	35
3.1	30
3.2	25
3.3	20
4.1	15
4.2	10
4.3	5
1A	0

Examples:

The Algodones Dunes Sunflower (*Helianthus niveus* ssp. *tephrodes*) was listed as 1B.2 (rare, threatened, or endangered in California and elsewhere AND fairly threatened in California). It was given a score of 55.

Booth's evening-primrose (*Camissonia boothii* ssp. *boothii*) was listed as 2.3 (rare, threatened, or endangered in California, but more common elsewhere; not very threatened in California). It was given a score of 35.

APPENDIX E4 | SENSITIVE HABITAT PROCESSING

Step 1: Download Data

A. Install the CNDDB RareFind 3 CD. RareFind 3 was provided to this project as an academic subscription. To obtain a copy of this database, go to <http://www.dfg.ca.gov/biogeodata/cnddb/>.

B. Download Element Occurrence data (vector) from CNDDB RareFind 3 into ArcMap.

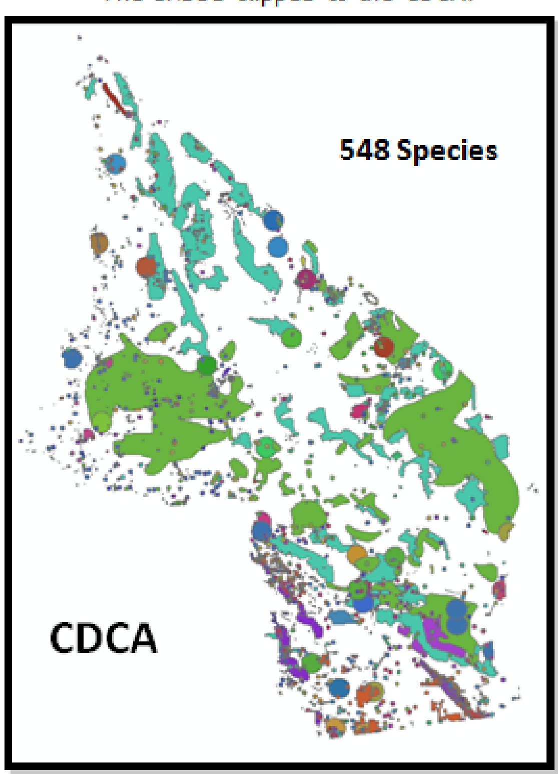
Step 2: Clip the CNDDB species data to the CDCA in ArcMap

A. Open ArcMap and add the CNDDB file (ECO_cnddb) and the outline of the CDCA (GEN_CDCA_Outline) to a blank or existing ArcMap session.

B. Use the "Clip" tool: Arc Toolbox > Analysis tools > Extract > **Clip:**

1. In the dialogue box:
    a. Input Features: ECO_cnddb.
    b. Clip Features: GEN_CDCA_Outline.
    c. Leave the XY Tolerance field blank.
    d. Click "**OK**".

The CNDDB clipped to the CDCA:

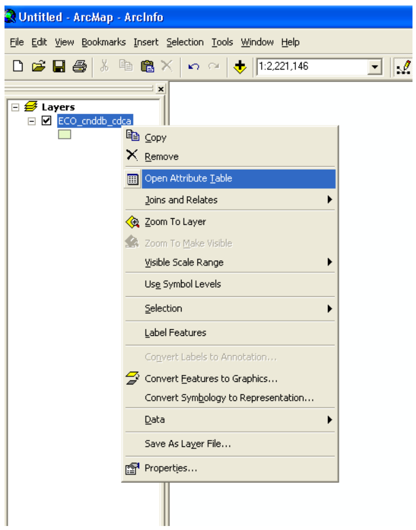


Step 3: Add numerical scores to the species attribute table

In this step, the calculated numerical scores for each species are entered into the CNDDB attribute table so that the scores can be used later for reclassification. The five categories of numerical values will be entered based on GRANK, SRANK, ESA, CESA, and CNPS. To see the scores and how they were calculated, refer to Appendix E3. ECO_cnddb_cdca is the layer created in Step 2.

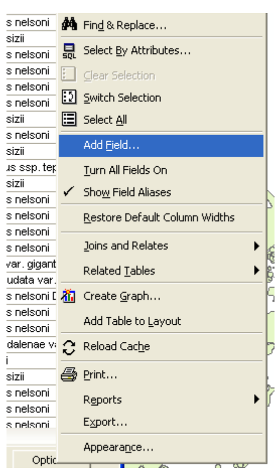
A. Add the ECO_cnddb_cdca layer to a new or existing ArcMap Session.

B. In the table of contents, right click on the layer and click “Open Attributes Table”.

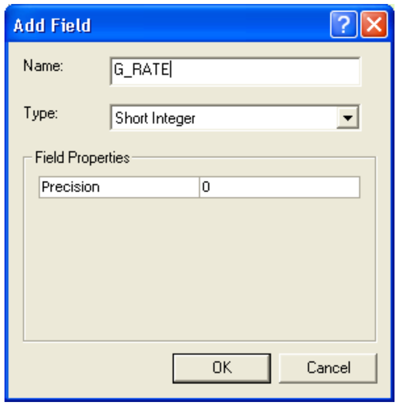


C. Add a new field to the attributes table:

1. Click Options > **Add Field.**

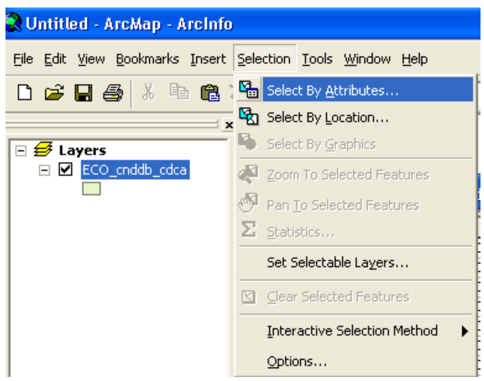


2. In the “Name” field of the “Add Field” dialogue box, type **“G_RATE”.**
3. Set the “Type” field to **“Short Integer”.**
4. Click **“OK”.**

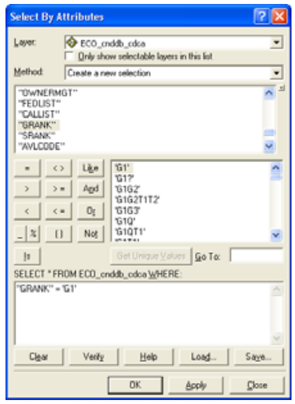


D. Create a selection of one category of GRANK (e.g. G1):

1. In the main window of ArcMap, click Selection > **Select by Attributes.**

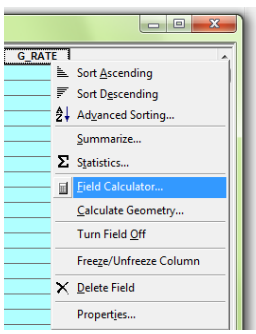


2. In the "**Select by Attributes**" dialogue box:
   a. Set the "Layer" to **"ECO_cnddb_cdca".**
   b. Leave "Only show selectable layers in this list" **unchecked.**
   c. Set the "Method" to **"Create new selection"**.
   d. DOUBLE CLICK **"GRANK"** from the list of fields. GRANK should now be added to the blank box at the bottom of the dialogue box.
   e. Click the **equal** button .
   f. Click **"Get Unique Values".**
   g. DOUBLE CLICK the first result from the list of unique values to add it after the **equal** sign.
   h. The dialogue box should look like the one below.
   i. Click **"Apply".**

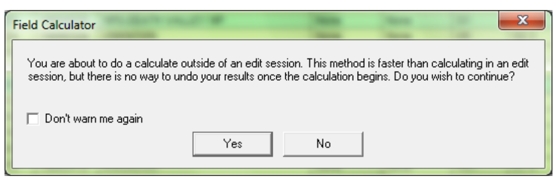


E. Use the field calculator to add records to G_RATE:

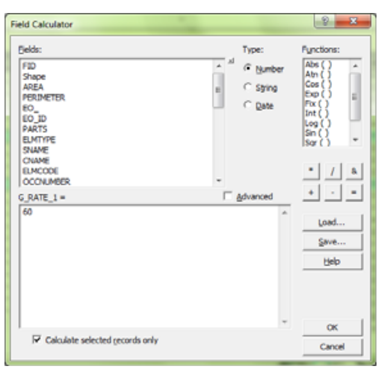
1. With the selection made, open the attributes table of **"ECO_cnddb_cdca".**
2. Right click the heading **"G_RATE".**
3. Click **"Field Calculator…"**



4. A warning message will appear. Click **"Yes"**



5. Click in the blank space and type the code for the GRATE that was selected. In this case, the GRATE G1 is selected. Type **60**. Click **"OK"**.



6. Now, only the GRANKS equal to G1 are calculated.

7. Repeat Steps D and E for every different GRATE.

F. Repeat Steps C to E for each of the remaining categories.

Step 4: Create a new file for each species

In order to analyze individual species, they each need to be separated from the larger ECO_cnddb_cdca file and made into their own shapefile. There are several hundred species in the file, which could become time consuming if it is done manually in ArcGIS, but there is a faster and more efficient way to do it through the use of Microsoft Excel and the ArcGIS Command Line.

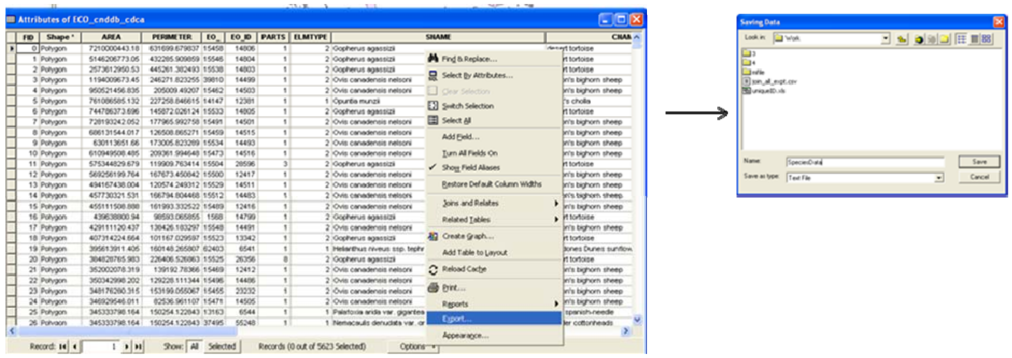
Excel can be used to automate the creation of a command line text. Excel can automatically fill out multiple cells, and by using the "&" sign, one cell can be filled with the contents of several cells. For example, the contents in cells A1, B1 and C1 can be pieced together and placed in the cell D1 using the formula: **D1= A1&B1&C1**

Then, this cell's content is copied and pasted into the command line of ArcGIS. The command line can perform any task in ArcGIS that is normally done through the use of dialogue boxes. For example, the species named "Mimulus mohavensis" can be selected from a list of species and made into its own shapefile using the dialogue box "Select by Attribute". The command line behind this task is:

SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\172.shp ("SNAME" = 'Mimulus mohavensis?')

The directions for setting up the excel sheet and executing hundreds of commands at once is described below.

A. Export the data from the species attribute table in .txt format (in ArcGIS):
    1. Add the file "ECO_cnddb_cdca" to the table of contents.
    2. Open the "ECO_cnddb_cdca" attribute table.
    3. Click Options > **Export.**
    4. Export the data from the species attribute table in .txt format:
        a. In the "Export Data" dialogue box:
            i. Export: All records
            ii. Make sure to change the file format from ".dbf" to ".txt".



B. In Excel:

1. Import the .txt file into Excel

   b. Click the **"Data"** tab in the Excel ribbon.

   c. Click **"From Text".**

   d. In the **"Import Text File"** dialogue box, select the .txt file.

   e. Click **"Import".**

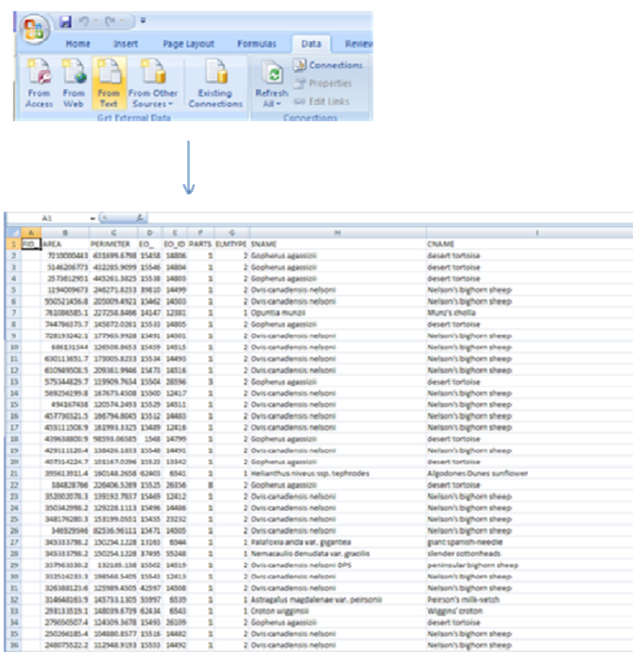
   f. In the **"Text Import Wizard"** dialogue box:

      i. Make sure the radio button **"Delimited"** is clicked.

      ii. Click **"Next".**

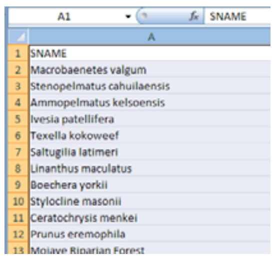
      iii. In Step 2, make sure the box next to **"Comma"** is checked.

      iv. Click **"Finish"**.



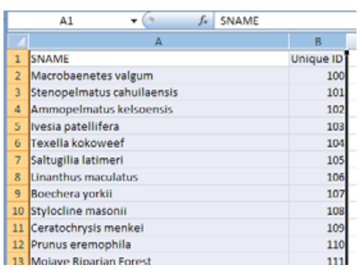
2. Delete all columns but SNAME, this is the species scientific name. The field CNAME is the species common name and was not used because some of the names contain apostrophes. This type of symbol is not accepted in the command line window.

3. Delete duplicate rows:
    a. Select the entire column that contains “SNAME”.
    b. In the **Data** tab, click **“Remove Duplicates”.**
    c. A warning box appears: Make sure the radio button next to **Expand the selection** is clicked.
    d. Click **“Remove Duplicates…”**
    e. Click **“Unselect All”.**
    f. Click the box next to **“SNAME”.**
    g. Click **“OK”.**



	A
1	SNAME
2	Macrobaenetes valgum
3	Stenopelmatus cahuilaensis
4	Ammopelmatus kelsoensis
5	Ivesia patellifera
6	Texella kokoweef
7	Saltugilia latimeri
8	Linanthus maculatus
9	Boechera yorkii
10	Stylocline masonii
11	Ceratochrysis menkei
12	Prunus eremophila
13	Mojave Riparian Forest

4. Create a new column for unique ID’s. When saving the new file, ArcGIS does not accept file names of more than 13 characters. For this reason, each species is assigned a unique ID number to be used as the new filename. The species unqiue ID will be used as the filename when the selection is exported into a shapefile. For example, “Macrobaenetes valgum” will be “100.shp”.

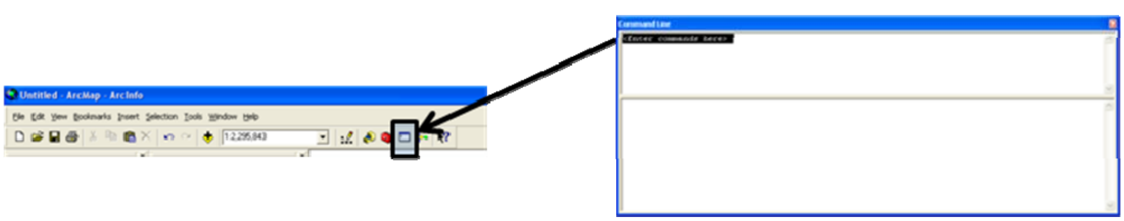


	A	B
1	SNAME	Unique ID
2	Macrobaenetes valgum	100
3	Stenopelmatus cahuilaensis	101
4	Ammopelmatus kelsoensis	102
5	Ivesia patellifera	103
6	Texella kokoweef	104
7	Saltugilia latimeri	105
8	Linanthus maculatus	106
9	Boechera yorkii	107
10	Stylocline masonii	108
11	Ceratochrysis menkei	109
12	Prunus eremophila	110
13	Mojave Riparian Forest	111

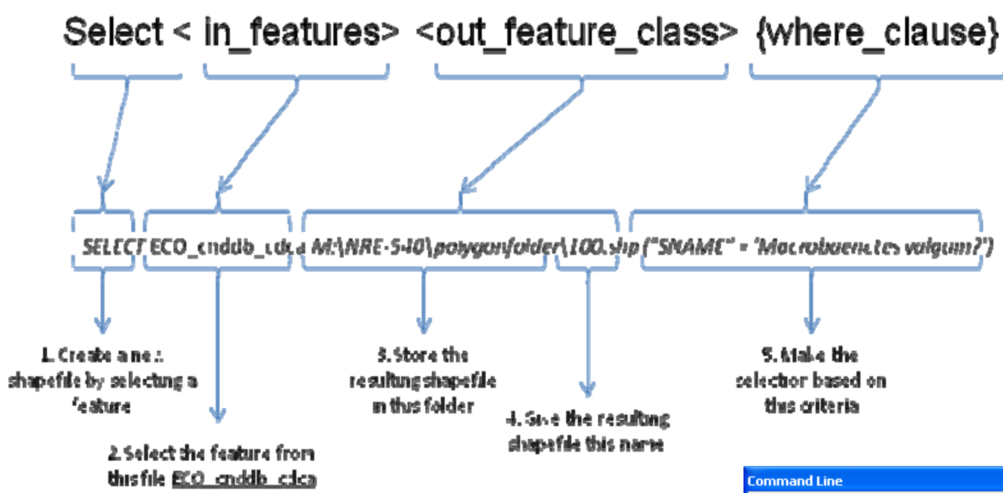
5. Fill in the rest of the columns in Excel based on the command line script format. The format of the command line is:

    Select < in_features> <out_feature_class> {where_clause}

C. Understanding Command Line:
    1. Add the file “ECO_cnddb_cdca” to a new or existing ArcMap session. Note the Command Line Window:



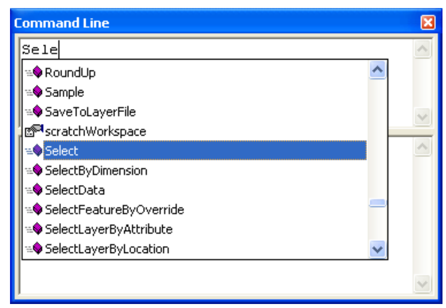
The command for selecting a piece of a shapefile and creating a new shapefile from it is:



Each of the pieces are described below:

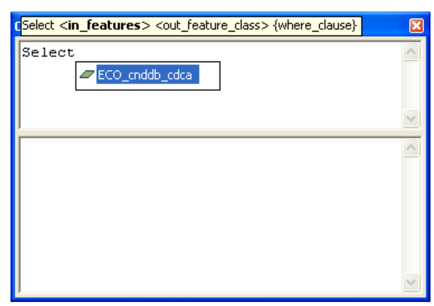
1. SELECT <command>.

   This tells the program to create a new selection from a layer.



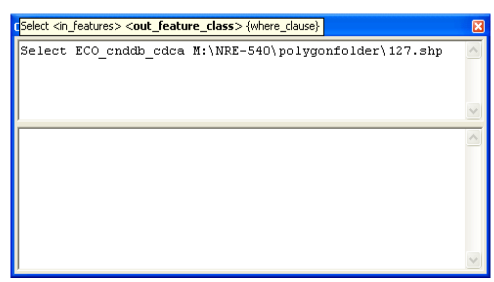
2. ECO_cnddb_cdca <in_features>

   The feature to create the selection from is the layer called “ECO_cnddb_cdca”. It is the only layer displayed in the map so it is the only option to choose from.

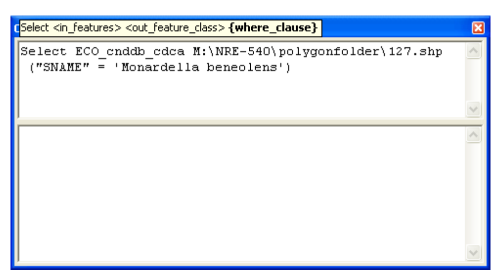


3. C:\FileLocation\127.shp <out_feature_class>

   There are two parts to this. The first part is the destination for the file.



4. The second part is the new file name, 127.shp. This is the unique ID for the species “Monardella beneolens”.



5. (“SNAME”= ‘Monardella beneolens’) {where_clause}

   This line specifies which species to select from the list of species in the shapefile attribute table. In this case, the species with the scientific name “Monardella beneolens” will be selected.

   This completes the command line. Once executed, a new shapefile is created called “127.shp” and contains only habitat for the species “Mandardellla beneolens”.

D. Creating Command Line using Excel

1. Creating pieces 1 through 5 in Excel: Add these columns to the spreadsheet that was created from the “ECO_cnddb_cdca” attribute table. Note: All of this is case sensitive.
2. To create pieces 1, 2, and 3 in Excel, simply type it once. The same line can be repeated for all files.
3. The column containing piece 1 (Column C) should say “SELECT” all the way down to the last row of species. This is the same for the column containing piece 2 (Column D), the “in” feature: “ECO_cnddb_cdca”, and the same for the column containing piece 3 (Column E), the “out” feature: “M:\NRE-540\polygonfolder\”. This is the location to store the output file however it may be different depending on the user’s preference.

E1 fx M:\NRE-540\polygonfolder\

	A	B	C	D	E
1	SNAME	Unique ID	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\
2	Macrobaenetes valgum	100	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\
3	Stenopelmatus cahuilaensis	101	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\
4	Ammopelmatus kelsoensis	102	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\
5	Ivesia patellifera	103	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\
6	Texella kokoweef	104	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\
7	Saltugilia latimeri	105	SELECT	ECO_cnddb_cdca	M:\NRE-540\polygonfolder\

4. Create a new column to contain the second part of the out feature, which is the output filename. In this case, it is Column F. In cell F2, insert an equation that references Column B (=B2), the column containing “Unique ID”. The rest of this column can be filled in by using “autofill” in Excel.

F2 fx =B2

	A	B	C	D	E	F
1	SNAME	Unique ID				
2	Macrobaenetes valgum	100	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	100
3	Stenopelmatus cahuilaensis	101	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	101
4	Ammopelmatus kelsoensis	102	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	102
5	Ivesia patellifera	103	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	103
6	Texella kokoweef	104	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	104
7	Saltugilia latimeri	105	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	105

5. Create a new column to complete the out feature class portion of the command line, in this case Column G. This column is filled with “.shp” for every row that contains the species. Later, these two columns (F and G) will be merged together to form one. For example, 100.shp. This avoids the process of needing to type in 100.shp.

F2 fx =B2

	A	B	C	D	E	F	G
1	SNAME	Unique ID					
2	Macrobaenetes valgum	100	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	100	.shp
3	Stenopelmatus cahuilaensis	101	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	101	.shp
4	Ammopelmatus kelsoensis	102	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	102	.shp
5	Ivesia patellifera	103	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	103	.shp
6	Texella kokoweef	104	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	104	.shp
7	Saltugilia latimeri	105	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	105	.shp

6. Piece 5 is the "where clause": ("SNAME"='Mandardella beneolens').
7. The first part of the where clause is the SNAME. Create a new column (H) filled with "SNAME". This is the same for all lines. The exact text to type is:

("SNAME='

F2 fx =B2

	A	B	C	D	E	F	G	H
1	SNAME	Unique ID						
2	Macrobaenetes valgum	100	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	100	.shp	("SNAME" = '
3	Stenopelmatus cahuilaensis	101	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	101	.shp	("SNAME" = '
4	Ammopelmatus kelsoensis	102	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	102	.shp	("SNAME" = '
5	Ivesia patellifera	103	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	103	.shp	("SNAME" = '
6	Texella kokoweef	104	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	104	.shp	("SNAME" = '
7	Saltugilia latimeri	105	SELECT	ECO_cndd	M:\NRE-540\polygonfolder\	105	.shp	("SNAME" = '

8. The second part is the species name 'Mandardella beneolens'. Create a new column (I) that references the column that holds the species name (A). Later, these two columns will be merged together to form one. For example, "SNAME=Mandardella beneolens".

I2 fx =A2

	E	F	G	H	I
1					
2	M:\NRE-540\polygonfolder\	100	.shp	("SNAME" = '	Macrobaenetes valgum
3	M:\NRE-540\polygonfolder\	101	.shp	("SNAME" = '	Stenopelmatus cahuilae
4	M:\NRE-540\polygonfolder\	102	.shp	("SNAME" = '	Ammopelmatus kelsoen
5	M:\NRE-540\polygonfolder\	103	.shp	("SNAME" = '	Ivesia patellifera
6	M:\NRE-540\polygonfolder\	104	.shp	("SNAME" = '	Texella kokoweef
7	M:\NRE-540\polygonfolder\	105	.shp	("SNAME" = '	Saltugilia latimeri

9. Creating the pieces in-between the bulk. Column J contains a single quote that surrounds the scientific name. Since Excel won't allow just **'**), a question mark needs to be added: **?')** Later, the question mark will be removed.

I2 fx =A2

	E	F	G	H	I	J
1						
2	M:\NRE-540\polygonfolder\	100	.shp	("SNAME" = '	Macrobaenetes valgum	?')
3	M:\NRE-540\polygonfolder\	101	.shp	("SNAME" = '	Stenopelmatus cahuilae	?')
4	M:\NRE-540\polygonfolder\	102	.shp	("SNAME" = '	Ammopelmatus kelsoen	?')
5	M:\NRE-540\polygonfolder\	103	.shp	("SNAME" = '	Ivesia patellifera	?')
6	M:\NRE-540\polygonfolder\	104	.shp	("SNAME" = '	Texella kokoweef	?')
7	M:\NRE-540\polygonfolder\	105	.shp	("SNAME" = '	Saltugilia latimeri	?')

10. Column K: Columns C through J are combined. The formula bar shows this, and the cell shows the actual text.

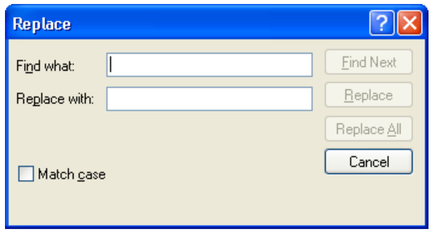
K2 fx =C2&D2&E2&F2&G2&H2&I2&J2

	G	H	I	J	K
1					
2	.shp	("SNAME" = '	Macrobaenetes valgum	?')	SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\100.shp ("SNAME" = 'Macrobaenetes valgum?')
3	.shp	("SNAME" = '	Stenopelmatus cahuilae	?')	SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\101.shp ("SNAME" = 'Stenopelmatus cahuilaensi
4	.shp	("SNAME" = '	Ammopelmatus kelsoen	?')	SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\102.shp ("SNAME" = 'Ammopelmatus kelsoensis
5	.shp	("SNAME" = '	Ivesia patellifera	?')	SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\103.shp ("SNAME" = 'Ivesia patellifera?')
6	.shp	("SNAME" = '	Texella kokoweef	?')	SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\104.shp ("SNAME" = 'Texella kokoweef?')
7	.shp	("SNAME" = '	Saltugilia latimeri	?')	SELECT ECO_cnddb_cdca M:\NRE-540\polygonfolder\105.shp ("SNAME" = 'Saltugilia latimeri?')

11. Add the contents from Excel to Notepad:
    a. In Excel, right click on cell K2 > **Copy.**
    b. Open Microsoft Notepad.

c. Right click > **Paste.**

d. Click Edit > **Replace…**



e. In **"Find what"** type: **?.**

f. In **"Replace with:"** type a blank (spacebar).

g. Click **"Replace All".**

12. Now, the **?** should be gone from the text.Add Contents from Notepad to ArcGIS Command Line:

a. In Notepad, select all the text, right click > **copy.**

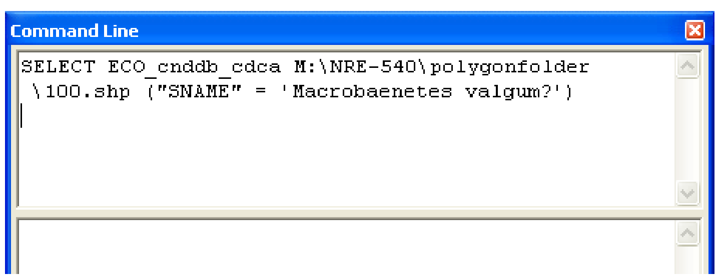
b. Add the file **ECO_cnddb_cdca** to a new or existing ArcMap session.

c. Open the Command Line Window.

d. Where it says "Enter commands here", right click > **paste.**

e. Hit the **"enter"** key on the keyboard.

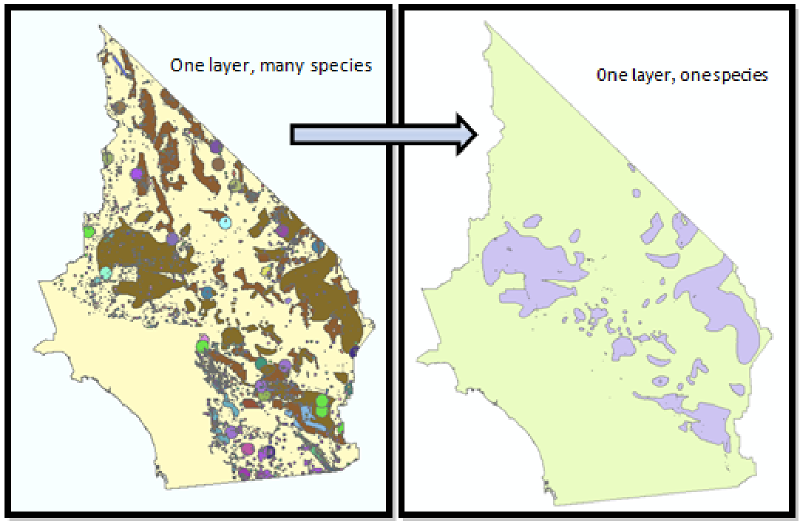
f. ArcGIS will run the command which creates a new shapefile for the species "Macrobaenetes valgum".



E. Using Command Line to speed up processing:

1. To make the best use of the Command Line, the user may copy and paste several hundred commands at once into the window and run it at one time. Depending on the speed of the machine, running several hundred at once may take too long, so the user also has the option to run the process in batches of a more manageable size.

Final result: one layer per species



Step 5: Convert species files from vector to raster

The next step is to rasterize the vector. A raster format is preferred over a vector for this type of analysis because it allows us to perform raster calculations. With a raster, every cell of an element occurrence has one value, and where different shapes overlap, those different values are added together.

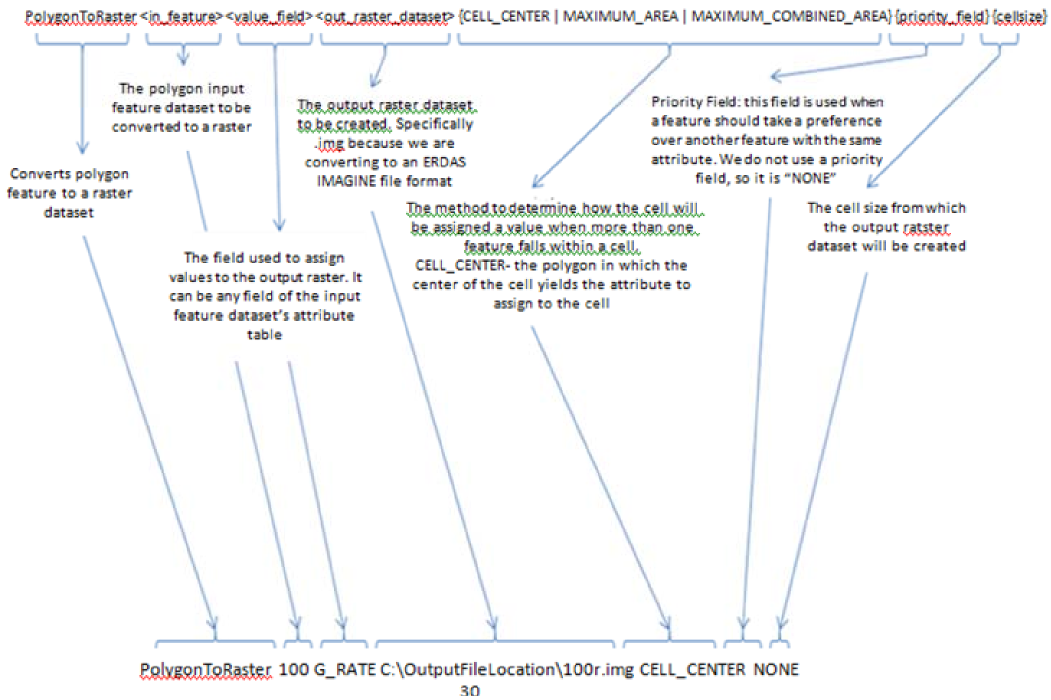
Excel is used to expedite the process of rasterizing all of the vectors. The command line behind this task is:

PolygonToRaster 100 G_RATE M:\NRE-540\rasterfolder\100r.img CELL_CENTER NONE 30

The directions for setting up the Excel sheet and executing multiple commands at once is described below. This step uses the vectors that were created in Step 4, Appendix E4:

A. Open ArcGIS and add the polygons to the map. Multiple polygons can be added, depending on your computer's speed. It is a good idea to start with a batch of 10 to see how fast the process works.
B. Open Excel to start creating the command line used for executing "Polygon to Raster".

The graphic below describes the purpose behind each piece of the command line, along with the appropriate fields to fill it in for our purpose.



C. In Excel, start with three columns: "Unique ID", "filename extension" and the command "Polygon to Raster":
   1. Column B is the beginning of the command line.
   2. Column C is the unique ID and is used as the input feature.
   3. Column D is the file extension. It will be used later in the command line in "out_raster_dataset". The output raster will have the same unique ID as the input feature, only with "r" added to the end to signify it is a raster, and ".img" as the filename extension because it is now an ERDAS IMAGINE file.

B2 fx PolygonToRast

	A	B	C	D
1			Unique ID	extension
2		PolygonToRaster	100	r.img
3		PolygonToRaster	101	r.img
4		PolygonToRaster	102	r.img
5		PolygonToRaster	103	r.img
6		PolygonToRaster	104	r.img
7		PolygonToRaster	105	r.img

D. In **Column E**, type in the value_field, which is the field used to assign values to the output raster. In this case, we use "G_RATE". In the same column, type the beginning of the file location. End this line with "\" so that the next column (which contains the new filename) can be appended.

E2 — *fx* G_RATE M:\NRE-540\rasterfolder\

	A	B	C	D	E	F
1			Unique ID	extension		
2		PolygonToRaster	100	r.img	G_RATE M:\NRE-540\rasterfolder\	
3		PolygonToRaster	101	r.img	G_RATE M:\NRE-540\rasterfolder\	
4		PolygonToRaster	102	r.img	G_RATE M:\NRE-540\rasterfolder\	
5		PolygonToRaster	103	r.img	G_RATE M:\NRE-540\rasterfolder\	
6		PolygonToRaster	104	r.img	G_RATE M:\NRE-540\rasterfolder\	
7		PolygonToRaster	105	r.img	G_RATE M:\NRE-540\rasterfolder\	

E. In **Column F**, prepare the output filename by combining column C&D as shown below:

F2 — *fx* =C2&D2

	B	C	D	E	F
1		Unique ID	extension		
2	PolygonToRaster	100	r.img	G_RATE M:\NRE-540\rasterfolder\	100r.img
3	PolygonToRaster	101	r.img	G_RATE M:\NRE-540\rasterfolder\	101r.img
4	PolygonToRaster	102	r.img	G_RATE M:\NRE-540\rasterfolder\	102r.img
5	PolygonToRaster	103	r.img	G_RATE M:\NRE-540\rasterfolder\	103r.img
6	PolygonToRaster	104	r.img	G_RATE M:\NRE-540\rasterfolder\	104r.img
7	PolygonToRaster	105	r.img	G_RATE M:\NRE-540\rasterfolder\	105r.img

F. In **Column G**, type both the cell assignment type, and priority field. Here, the cell assignment type is "CELL_CENTER" and the priority field is "NONE".

G17 — *fx*

	C	D	E	F	G
1	Unique ID	extension			
2	100	r.img	G_RATE M:\NRE-540\rasterfolder\	100r.img	CELL_CENTER NONE
3	101	r.img	G_RATE M:\NRE-540\rasterfolder\	101r.img	CELL_CENTER NONE
4	102	r.img	G_RATE M:\NRE-540\rasterfolder\	102r.img	CELL_CENTER NONE
5	103	r.img	G_RATE M:\NRE-540\rasterfolder\	103r.img	CELL_CENTER NONE
6	104	r.img	G_RATE M:\NRE-540\rasterfolder\	104r.img	CELL_CENTER NONE
7	105	r.img	G_RATE M:\NRE-540\rasterfolder\	105r.img	CELL_CENTER NONE

G. In **Column H**, type the cell size of the output raster. Here the cell size is 30.

H12 — *fx*

	C	D	E	F	G	H
1	Unique ID	extension				
2	100	r.img	G_RATE M:\NRE-540\rasterfolder\	100r.img	CELL_CENTER NONE	30
3	101	r.img	G_RATE M:\NRE-540\rasterfolder\	101r.img	CELL_CENTER NONE	30
4	102	r.img	G_RATE M:\NRE-540\rasterfolder\	102r.img	CELL_CENTER NONE	30
5	103	r.img	G_RATE M:\NRE-540\rasterfolder\	103r.img	CELL_CENTER NONE	30
6	104	r.img	G_RATE M:\NRE-540\rasterfolder\	104r.img	CELL_CENTER NONE	30
7	105	r.img	G_RATE M:\NRE-540\rasterfolder\	105r.img	CELL_CENTER NONE	30

H. In **Column I**, piece together all of the columns that were just built. This forms the final command line. After this is entered **once**, drag the formula down to fill in the rest of the columns.

=B2&C2&E2&F2&G2&H2

E	F	G	H	I
IRE-540\rasterfolder\	100r.img	CELL_CENTER NONE	30	PolygonToRaster 100 G_RATE M:\NRE-540\rasterfolder\100r.img CELL_CENTER NONE 30
IRE-540\rasterfolder\	101r.img	CELL_CENTER NONE	30	PolygonToRaster 101 G_RATE M:\NRE-540\rasterfolder\101r.img CELL_CENTER NONE 30
IRE-540\rasterfolder\	102r.img	CELL_CENTER NONE	30	PolygonToRaster 102 G_RATE M:\NRE-540\rasterfolder\102r.img CELL_CENTER NONE 30
IRE-540\rasterfolder\	103r.img	CELL_CENTER NONE	30	PolygonToRaster 103 G_RATE M:\NRE-540\rasterfolder\103r.img CELL_CENTER NONE 30
IRE-540\rasterfolder\	104r.img	CELL_CENTER NONE	30	PolygonToRaster 104 G_RATE M:\NRE-540\rasterfolder\104r.img CELL_CENTER NONE 30
IRE-540\rasterfolder\	105r.img	CELL_CENTER NONE	30	PolygonToRaster 105 G_RATE M:\NRE-540\rasterfolder\105r.img CELL_CENTER NONE 30

I. The output from this process will be used in the next step.

Step 6: Reclassify raster files using command line

The next step is to reclassify the raster value created in the previous step. The purpose of the reclassify is to transform the "NoData" values contained in the attribute table of the raster to 0. This allows users to view the boundary of the study area. The raster value from the numerical score needs to remain unchanged, but is still included in the reclassify processes. There are only two values of the raster, 0 and GRANK (or SRANK, ESA, CESA, or CNPS), so only two values need to be reclassified.

As with the previous three tasks, the best way to do this is by using the command line in ArcGIS.

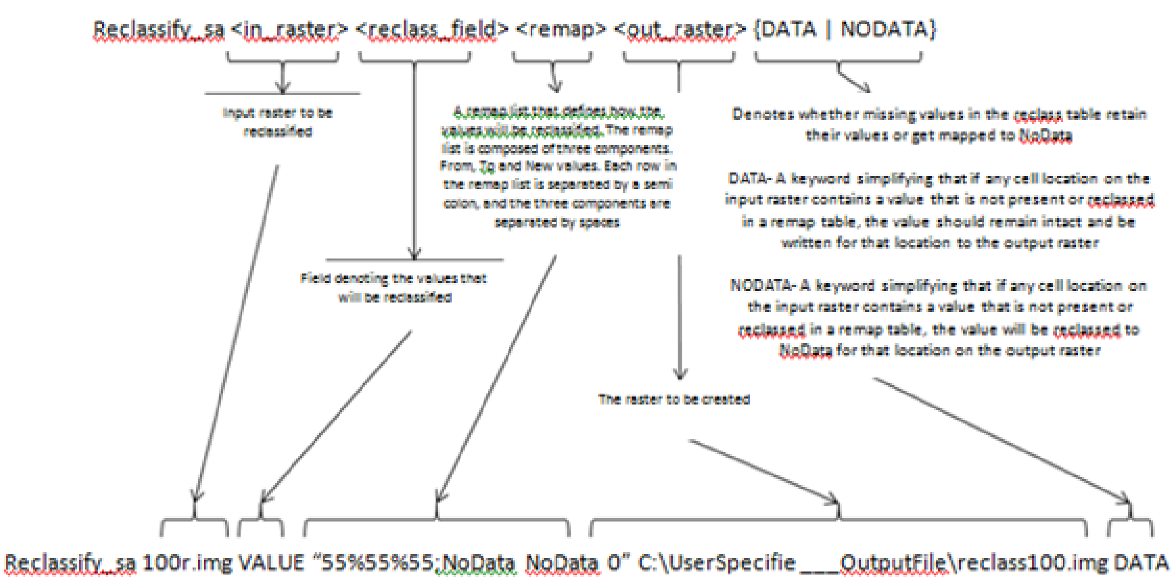
The command line syntax to reclassify the values of a raster:

Reclassify reclass100.img VALUE "old value old value new value;0 0 0 " reclass100_S.img

The directions for setting up the excel sheet and executing multiple commands at once is described below. This step uses the rasters that were created in Step 6.

A. Open ArcGIS and add the rasters to the map. Many can be added, depending on your computer's speed. It is a good idea to start with a batch of 10 to see how fast the process works.
B. Open Excel to start creating the command line used for executing "Reclassify".

   The graphic below describes the purpose behind each piece of the command line, along with the appropriate fields to fill it in for our purpose.



1. In excel, add a column that contains the species name (Column A).

2. Add a column that contains the species unique identifier (Column B).
3. Add a column that contains the species numerical score, in this case G_RATE (Column C).

	A	B	C
1	Species Scientific Name	Unique ID	G_RATE
2	Macrobaenetes valgum	100	55
3	Stenopelmatus cahuilaensis	101	55
4	Ammopelmatus kelsoensis	102	60
5	Ivesia patellifera	103	60
6	Texella kokoweef	104	60
7	Saltugilia latimeri	105	50

4. The next column (D) contains "r.img". This is the file extension that will be pieced together with the unique ID. Once pieced together it creates the input filename.

	A	B	C	D
1	Species Scientific Name	Unique ID	G_RATE	
2	Macrobaenetes valgum	100	55	r.img
3	Stenopelmatus cahuilaensis	101	55	
4	Ammopelmatus kelsoensis	102	60	
5	Ivesia patellifera	103	60	
6	Texella kokoweef	104	60	
7	Saltugilia latimeri	105	50	

5. Next, the contents of Columns B and D are put together to create the input raster in Column E.

E2 =B2&D2

	A	B	C	D	E
1	Species Scientific Name	Unique ID	G_RATE		in_raster
2	Macrobaenetes valgum	100	55	r.img	100r.img
3	Stenopelmatus cahuilaensis	101	55		
4	Ammopelmatus kelsoensis	102	60		
5	Ivesia patellifera	103	60		
6	Texella kokoweef	104	60		
7	Saltugilia latimeri	105	50		

6. Columns F and G begin the actual command line syntax. The command is "Reclassify_sa" and is the same for all of the rasters, as well as the reclass field "VALUE".

B	C	D	E	F	G
Unique ID	G_RATE		in_raster	command	reclass_field
100	55	r.img	100r.img	Reclassify_sa	VALUE
101	55				

7. Insert a new column (H) for a placeholder (%). Also, insert another column (I) called "remap". In Column I, combine the place holder and G_RATE.

D	E	F	G	H	I
	in_raster	command	reclass_field	place holder	remap
r.img	100r.img	Reclassify_sa	VALUE	%	55%

8. In a new Column (J), insert a double quote. Later, this will sandwich the line "remap".

D	E	F	G	H	I	J
	in_raster	command	reclass_field	place holder	remap	
r.img	100r.img	Reclassify_sa	VALUE	%	55%	"

9. In Column J, insert a semicolon. Later this will be put between the first and second parts of the remap line.

D	E	F	G	H	I	J
	in_raster	command	reclass_field	place holder	remap	
r.img	100r.img	Reclassify_sa	VALUE	%	55%	;

10. Insert a new column (K) called "remap2". In this column, type "**NoData NoData 0**". This ends the components of the remap portion of the command line.

D	E	F	G	H	I	J	K
	in_raster	command	reclass_field	place holder	remap		remap2
r.img	100r.img	Reclassify_sa	VALUE	%	55%	"	NoData NoData 0"

11. Title Column M "entire remap line". In Column M, combine Columns K, I, J and L using the formula: **=K2&I2&I2&J2&L2**. This step adds together the entire remap line, which is now ready to be added to the entire command line syntax.

G	H	I	J	K	L	M
reclass_field	place holder	remap			remap2	entire remap line
VALUE	%	55%	;	"	NoData NoData 0"	"55%55%55%;NoData NoData 0"

12. The next column (N) contains the file location. Here, enter the file location where you would like the resulting raster to be stored.

I	J	K	L	M	N
remap			remap2	entire remap line	file location
55%	;	"	NoData NoData 0"	"55%55%55%;NoData NoData 0"	D:\reclassified\

13. The next column (O) is for part of the filename for the reclassified raster. The new filename is the name of this input raster with **reclass.img** added onto it.

fx reclass.img

L	M	N	O
remap2	entire remap line	file location	
NoData NoData 0"	"55%55%55%;NoData NoData 0"	D:\reclassified\	reclass.img

14. Column P contains the new filename. To create this, use the formula: **=B2&O2**

L	M	N	O	P
remap2	entire remap line	file location		new filename
NoData NoData 0"	"55%55%55%;NoData NoData 0"	D:\reclassified\	reclass.img	100reclass.img

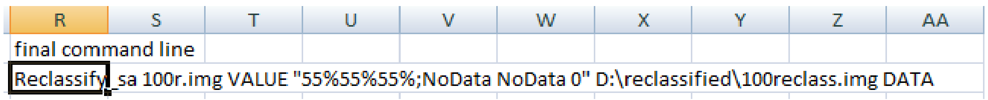
15. The last piece to be put together in the command line is **DATA**. Create a new column (Q) to hold the word DATA.

M	N	O	P	Q
entire remap line	file location		new filename	
"55%55%55%;NoData NoData 0"	D:\reclassified\	reclass.img	100reclass.img	DATA

16. Now the spreadsheet is set up with all of the necessary components to piece together the final command line. Create a new column (R) titled “final command line”. Use this formula:

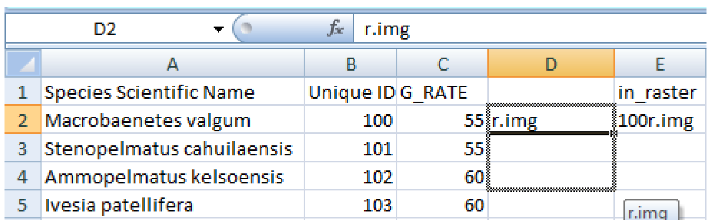
    =F2&G2&E2&M2&N2&P2&Q2

    The command should look like the one below. If there are not spaces in the command line where they should be, simply go back to the cell that contains the text and type a space before or after the text, depending on where it is needed.



C. Fill in the rows below Row 2:

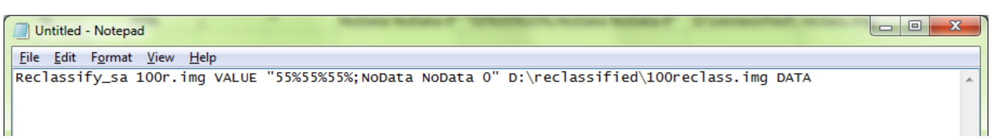
1. Click on Cell D2 and drag it down to fill in the rows below.



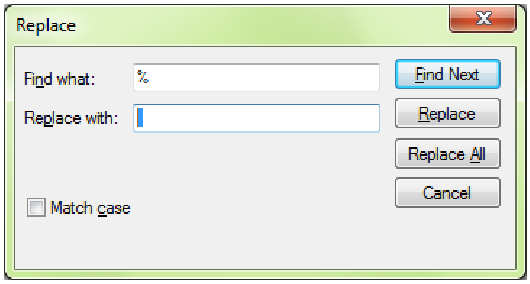
2. In the next cell (E2), double click on the lower right corner of the cell. This will automatically fill in all of the rows.
3. Repeat these steps for all of the remaining columns, including R.
4. Now, Column R can be selected and pasted into the command line window of ArcGIS.

D. Open ArcGIS and run a sample of the command line.

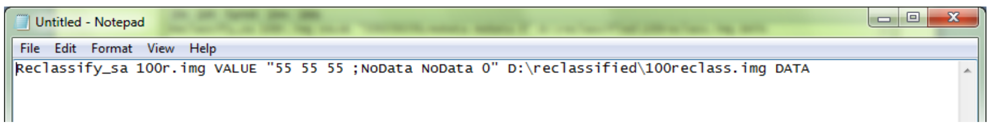
1. In ArcGIS, add a few rasters to the map to be reclassified using the command line from Excel.
2. Once the rasters are added to the map, open Excel and select the rows from Column R that match the rasters added to the map.
3. Once the cells are selected, click “Copy”.
4. Next, open NotePad.
5. Click “Paste”. The contents from excel are pasted into NotePad.



6. Next, erase % from the line:
    a. In NotePad, click Edit > **Replace…**
    b. In the dialogue box, type % in the first line, and a space in the next line.



c. Click “**Replace All**”. This will take out the % signs and replace them with spaces. The command line should look like the one below.



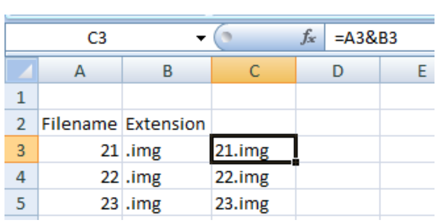
E. Run the command line in ArcGIS:
   1. In Notepad, highlight the command line and click **“Copy”.**
   2. Open ArcGIS, open the command line dialogue box and click **“Paste”.**
   3. Hit the **“Enter”** key on the keyboard.
   4. The command line is running. The input raster will be reclassified and saved in the specified location. Once this runs smoothly, many rasters can be reclassified at once.

Step 7: Overlaying raster files using single output map algebra

The final step overlays all the different species rasters using single output map algebra to create one map with all the scores added up. This will result in one map for GRank, one for SRank, one for ESA, and so on.

Create the command line in Microsoft Excel:

A. Open an Excel document that contains the filename of all the rasters to be added:
   1. If there is not a spreadsheet with the appropriate filenames, use Microsoft Excel to create them.
   2. Create a column with the filename (Column A).
   3. Create another column with the filename extension (.img).
   4. Use “**&**” to combine the two, creating one filename.



B. After creating a column that contains the filename, create a new column (D) to contain the file’s pathname (the location of the file).

	A	B	C	D
1				
2	Filename	Extension		
3	21	.img	21.img	C:\Rasters\
4	22	.img	22.img	C:\Rasters\
5	23	.img	23.img	C:\Rasters\

C. In the next column (E), combine the pathname and the filename. This creates the complete filename and path required from the tool "Single output map algebra".

E3 =D3&C3

	A	B	C	D	E
1					
2	Filename	Extension			
3	21	.img	21.img	C:\Rasters\	C:\Rasters\21.img
4	22	.img	22.img	C:\Rasters\	C:\Rasters\22.img
5	23	.img	23.img	C:\Rasters\	C:\Rasters\23.img

D. The next step is to add a **+** sign after the filename extension in column B. Leave a space between **.img** and **+**. This is done in the column containing the text "**.img**", not the column that references the text. The text in Columns C and E will automatically reflect the changes made in Column B since they both reference Column B.

B3 .img +

	A	B	C	D	E
1					
2	Filename	Extension			
3	21	.img +	21.img +	C:\Rasters\	C:\Rasters\21.img +
4	22	.img	22.img	C:\Rasters\	C:\Rasters\22.img
5	23	.img	23.img	C:\Rasters\	C:\Rasters\23.img

E. Drag the contents of Column B down to add **+** to every line in Column E.

F. Once complete, select the contents in Column E and click **"Copy"**.

Apply the command line from Excel to ArcGIS

A. Open ArcGIS.

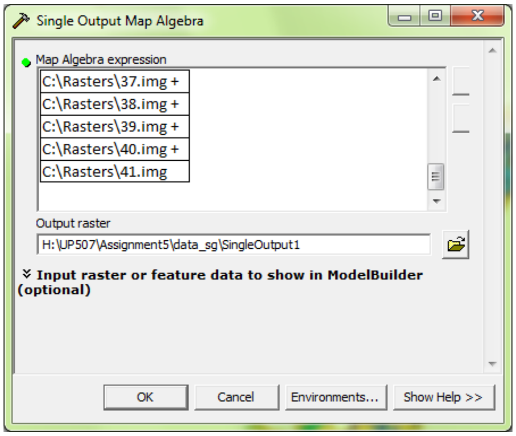
B. If necessary, expand the toolbox to view its contents.

C. Find the **Single output map algebra tool**. Spatial analyst tools > Map Algebra > **Single output map algebra.**

D. Open the Single output map algebra dialogue box and right click in the blank area below **Map algebra expression** and click **"Paste"**.

E. The text from Microsoft Excel is now pasted and creates an expression that will add all of the input rasters.

F. Remove the last **+** sign from the expression.



G. Create a filename for the output raster and click **"OK".**

H. The rasters are now added together to create a single raster.

I. Repeat for remaining categories (e.g., SRank, ESA, CESA, CNPS).

APPENDIX E5 | TRANSMISSION AND GRADING DISTURBANCE PROCESSING

Distance to Transmission

Note: Steps 1 to 4 refer to the specific processing of the transmission data file we used here. If different data is used in its place, begin with Step 5.

Step 1: Download Data

Step 2: Clip file to CDD (See Appendix A)

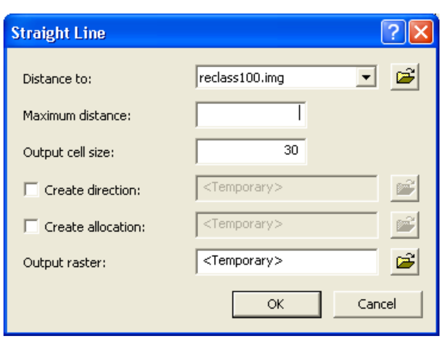
Step 3: Using "Select by Attributes", select power lines

Step 4: Export selected features to new shapefile

Step 5: Perform straight line distance function

A. Set the environments using the Spatial Analyst toolbar:
   1. Add the toolbar to the view: View > Toolbars > **Spatial Analyst.**
   2. Click the dropdown Spatial Analyst > **"Options…"**
   3. Click the tab **"Cell size"** and chose the file DEM_CDD_30.
   4. Click the tab **"Extent"** and chose the file DEM_CDD_30.
   5. Click the tab **"Mask"** and chose the file DEM_CDD_30.

B. Using spatial analyst toolbar, run a straight line distance function. This creates a raster with each cell measuring the distance from the transmission line.
   1. Spatial Analyst dropdown > Distance > **Straight Line…**
      i. Distance to: Add the transmission line file.
      ii. Maximum Distance: Leave blank.
      iii. Output cell size: 30.
      iv. Leave the next two options blank.
      v. Chose a filename and location to save the output raster.
      vi. Click **OK.**



Percent Slope

Step 1: Download DEM pieces of the CDD from <http://seamless.usgs.gov>

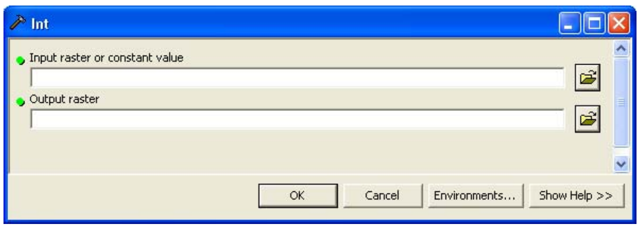
Step 2: Integerize each DEM piece separately

A. Open ArcGIS and find the “Int” tool in ArcToolbox: Spatial Analyst > Math > **Int.**

B. Add the first DEM file to the “**Input raster or constant value”** box.

C. In the **“Output raster”** box, name the file and chose a location to save it.

D. Click **“OK”**. Repeat steps A-D for each raster.



Step 3: Mosaic all DEM pieces together

A. Locate the tool “mosaic to new raster” in the data management toolbox: Data Management tools > Raster > Raster Dataset > **Mosaic to New Raster.**

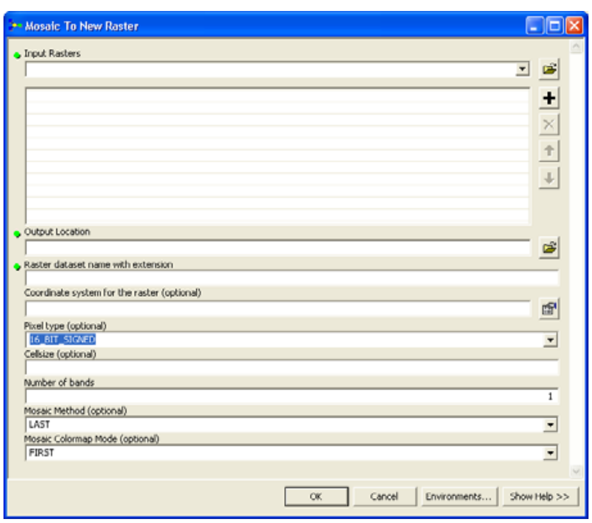
B. Add the input rasters to the space provided.

C. Output location: Name the file and chose a location to save it.

D. For **Pixel** Type, Use **16-bit signed.**

E. Leave everything else as the default.

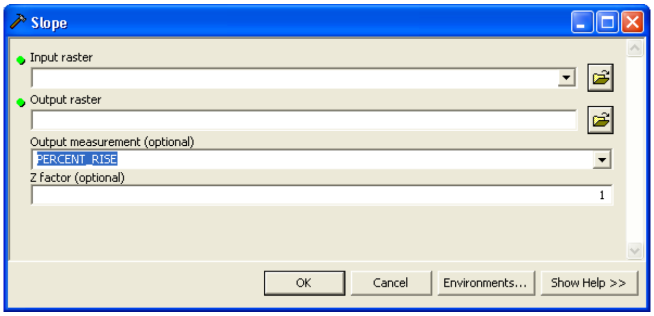
F. Click **“OK”**.



Step 4: Convert elevation to percent rise

A. Add the newly created DEM to a new or existing ArcMap session.

B. Open the **Slope** tool: Arc toolbox > Spatial Analyst > Surface > **Slope.**



C. Add the DEM to the box: **"Input Raster".**

D. Name the output raster and chose a place to save it.

E. Set the output measurement to "**PERCENT_RISE**".

F. Leave everything else as the default.

G. Click "**OK**".

Step 5: Display elevation with a classified color scheme

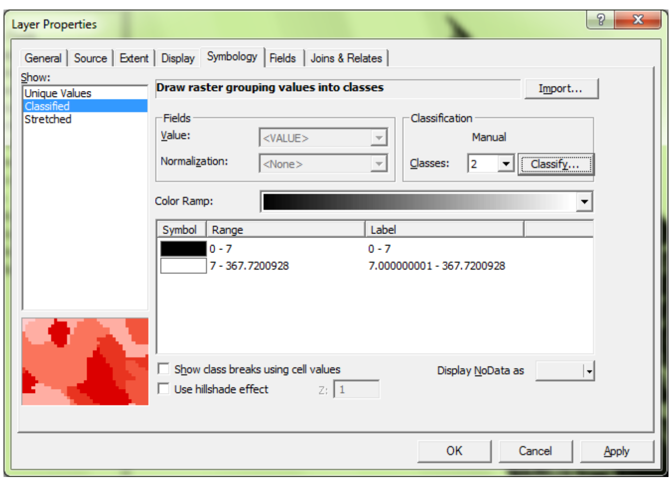
A. In ArcMap, add the percent rise layer.

B. Double click on the layer to open the layer properties dialogue box.

C. Click the symbology tab and click **"classified"** on the left panel.

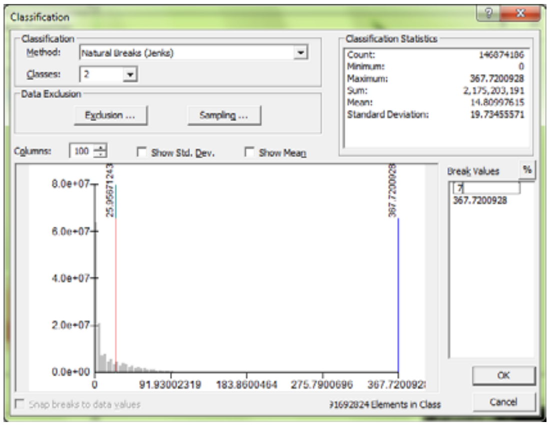
D. When a box appears that asks if you want to generate unique values, click **"Yes"**.

E. Change the number of classes to **2.**



F. Click **"Classify".**

G. Replace the first break value with 7. Click **"OK".**



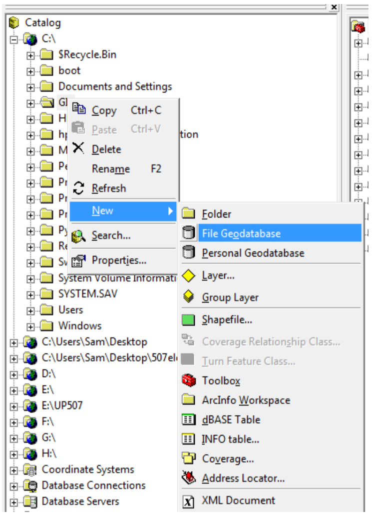
H. Click **"OK"** again**.** The map now shows suitable areas based on percent rise of slope as one color, and all other areas a different color.

APPENDIX E6 | VISUAL IMPACT PROCESSING

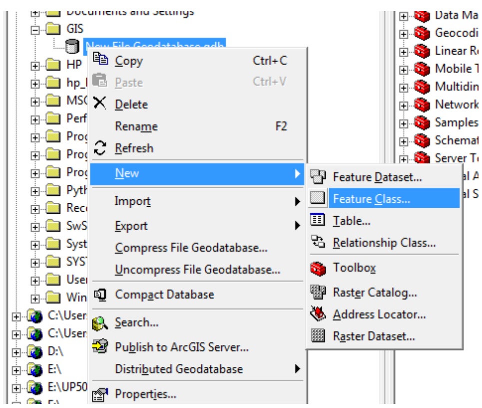
Step 1: Create the observation point

A. In ArcCatalog, create a geodatabase in which the points will be added:

1. Right click on a folder and chose: New > **File Geodatabase.**



2. Add points to the new geodatabase: Right click on the newly created geodatabase and chose: New > **Feature class:**



i. This is where the point is created. In the **"New Feature Class"** dialogue box, name the point feature and change **Type** to **Point Feature**.

ii. Click **"Next".**

iii. Chose the coordinate system based on the location of the points.

iv. Click **"Next"** though the screens and finally click **Finish**. There is no need to make any other changes in the dialogue box.

v. The point has been created but it still needs to be located on the map. Close Arc Catalog and open ArcMap.

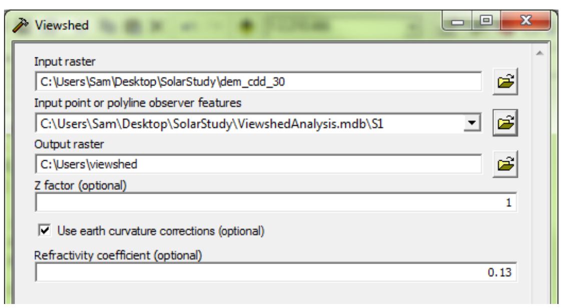
B. Locate the observation point:

1. In ArcMap, add the spatial data layers needed to locate the observation point. In this case, add the layer of proposed solar facilities.
2. Add the Editor toolbar to the map, and click Editor > **Start Editing**.
3. Make sure the Task is set to **"Create New Feature"**.
4. Make sure the Target is set to the newly created point.

5. Click the pencil tool, and using the tool click on the map where you want to locate the observation point.
6. The point is now located. Save the edits and stop editing.

C. Perform the viewshed analysis on the new observation point.

1. In ArcMap, with the newly created point in the map, add the DEM that will be used for the viewshed analysis.
2. Locate the viewshed tool in ArcToolbox: Spatial Analyst Tools > Surface> **Viewshed**
3. Fill in the fields with the DEM and the newly created observation point.
4. Make sure to check "Use earth curvature corrections".



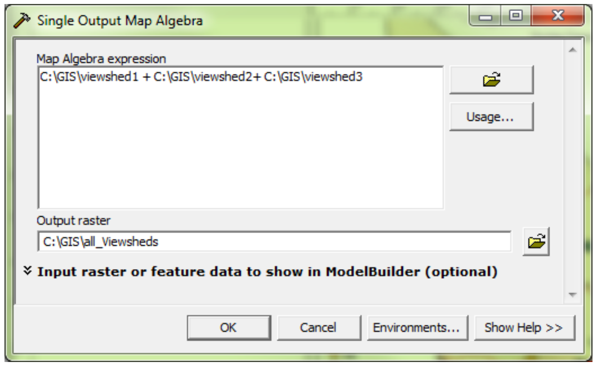
5. Click **"OK"**. The viewshed will be created.

D. Repeat Steps A.2. through C to create an individual viewshed for every point of interest.

E. Add viewsheds together to produce one raster:

1. In ArcCatalog, locate the single output map algebra tool: Spatial Analyst > Map Algebra > **Single output map algebra.**
2. Use the folder symbol to navigate to the viewshed. Double click the file to add it to the dialogue box.
3. Once the file is added to the dialogue box, type **"+".**
4. Add the next viewshed and so on until all desired viewsheds are added.
5. Name and locate the output viewshed.

6. Click **"OK".** A single raster of all the individual viewsheds is created.



APPENDIX E7 | TOTAL ECOLOGICAL IMPACT SCORES BY FACILITY

Identification Number	Total Ecological Impact Score	Category
CACA 049430	0.00	LOW
CACA 049585	0.00	LOW
CACA 049432	0.00	LOW
CACA 049002 **	0.00	LOW
CACA 049008	0.00	LOW
CACA 049424	0.00	LOW
CACA 050117 **	0.00	LOW
CACA 049006	0.00	LOW
CACA 048875	0.00	LOW
CACA 049561 *	0.00	LOW
CACA 049004	0.00	LOW
CACA 048808 **	0.00	LOW
CACA 049493 **	0.00	LOW
CACA 049584	0.00	LOW
CACA 049491 **	0.00	LOW
CACA 049488 **	0.00	LOW
CACA 049423	0.00	LOW
CACA 048742	0.00	LOW
CACA 048810 ***	0.00	LOW
CACA 048880 ***	0.00	LOW
CACA 048811 ***	0.00	LOW
CACA 049813	0.03	LOW
CACA 049494 **	0.04	LOW
CACA 050705	0.08	LOW
CACA 049615	0.27	LOW
CACA 048741	0.36	LOW
CACA 049150	1.01	LOW
CACA 049537 ***	1.14	LOW
CACA 049397 **	1.47	LOW
CACA 049016 *	1.53	LOW
CACA 049511	2.16	LOW
CACA 049539 ***	3.90	LOW
CACA 049097 **	7.03	LOW
CACA 051369	9.58	LOW
CACA 047740 *	12.73	MEDIUM
CACA 049613	18.79	MEDIUM
CACA 050116 **	19.76	MEDIUM
CACA 050704	20.04	MEDIUM
CACA 048649 ***	20.14	MEDIUM
CACA 049431	26.33	MEDIUM
CACA 049884 **	30.12	MEDIUM
CACA 048820	33.12	MEDIUM
CACA 050174 **	40.57	MEDIUM
CACA 049702 **	44.08	MEDIUM
CACA 048818	49.79	MEDIUM
CACA 049490/ 048728 **	52.11	MEDIUM
CACA 050150	93.28	HIGH
CACA 048669	150.45	HIGH
CACA 049017	153.00	HIGH
CACA 050103	153.49	HIGH
CACA 048668 *	155.23	HIGH
CACA 050528	178.60	HIGH

* = Fast Track facility, ** = SESA facility, *** = Both Fast Track and SESA facility