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 Software: Microsoft Excel and ArcGIS 10

## Lesson 4: How to calculate 900m<sup>2</sup> biomass

### Background

This tutorial will walk you through the process of calculating Tamarisk biomass by using height and percent cover values. Before reading any farther, this tutorial is designed specifically to calculate biomass for a 30m x 30m parcel. This is the resolution of Landsat satellite imagery. If you are interested in biomass by square meters please refer to the tutorial “How to Extrapolate Biomass for Tamarisk.” For this tutorial, we will be utilizing both *Microsoft Excel* and *ArcMap* in order to transfer and analyze the data. *ArcGIS version 10* will be used, and some small details may not hold true for other versions. The dataset I will be using for this example is a statewide collection of Colorado tamarisk data which consists of thousands of polygons. The biomass shapefile has been modified to only include polygons with both a *height* and a *percent cover* value. Essentially the steps are the same in this tutorial, but instead a constant value of 900m<sup>2</sup> is used for the area component of *Cover Area*.

The biomass calculations being performed are used in Evangelista 2007, “Modeling aboveground biomass of *Tamarix ramosissima* in the Arkansas River basin of Southeastern Colorado, USA.” Below is a list of some constants being used as well as helpful conversions and the equation to arrive at biomass:

1 acre = 4046.8564 sq meters

Biomass model:

$$\text{Log}_{10}(\text{biomass}) = C + [\alpha \text{Log}_{10}(\text{canopy area})] + [\beta (\text{ave height})] + [\gamma (\text{ave height})^2]$$

C = - 1.1993

$\alpha$  = 1.109

$\beta$  = 0.8595

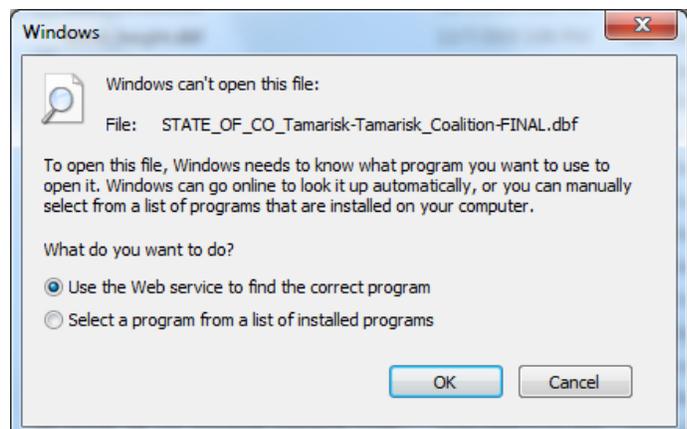
$\gamma$  = - 0.0927

Correction Factor: 1.17

Biomass = (correction factor) \* 10<sup>Log<sub>10</sub>(biomass)</sup>

### Preparing the Biomass Value in Excel

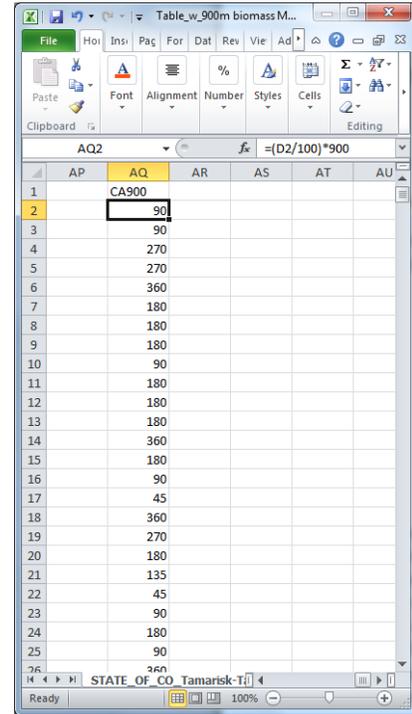
1. Open the .dbf file from your workspace by using *Microsoft Excel*, you may need to navigate to the program on your computer if the below image prompts you to.



2. Create a new column named “CA 900” representing the cover area for a 900m<sup>2</sup> area.
3. Insert an equation for the cells below your title. Take the Percent Cover value corresponding to the given polygon and multiply it by 900. You may need to make sure that the Percent Cover value is a proportion by dividing it by 100 first. The cell should look something like this when you are done (D2 corresponds to the percent cover value):  

$$= (D2/100)*900$$

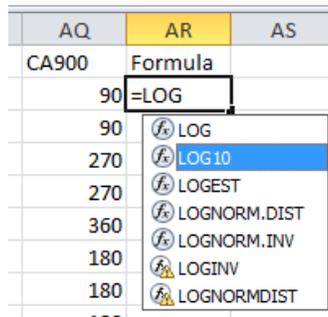
4. Drag the cell equation down to the rest of the values. It will look something like the image to the right.
5. Create another column and name it “Formula.” We will insert the entire equation from Paul Evangelista’s “Modeling aboveground biomass of *Tamarix ramosissima* in the Arkansas River basin of Southeastern Colorado, USA.”



6. Similar to the equation stated in the Background, the cell should look like this once the entire equation is set:  

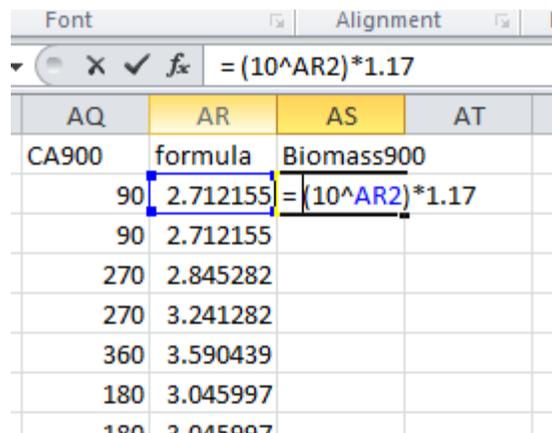
$$=(-1.1993)+(1.109*\text{LOG}_{10}(\text{AG}2))+(0.8595*\text{H}2)+(-0.0927*(\text{H}2*\text{H}2))$$

7. To insert a **LOG10** function, start typing **LOG** in the cell and select **LOG10** from the drop down list that appears. The **H2** in the above equation is a place holder for whatever cell holds your *height* data in meters.



8. Once the cell matches the above substituting **H2** for your corresponding height cell, press **Enter**. A number should appear in the low digit range (1-5).

9. Drag the equation so it applies to all values as before



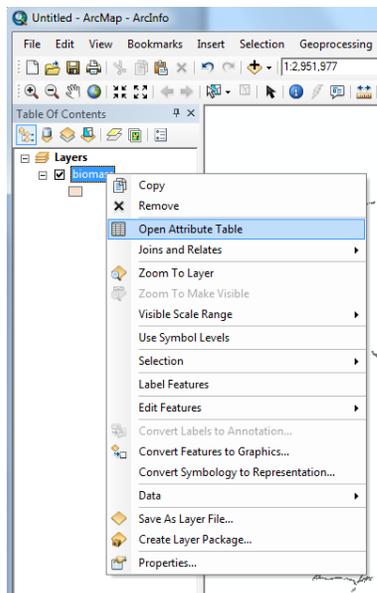
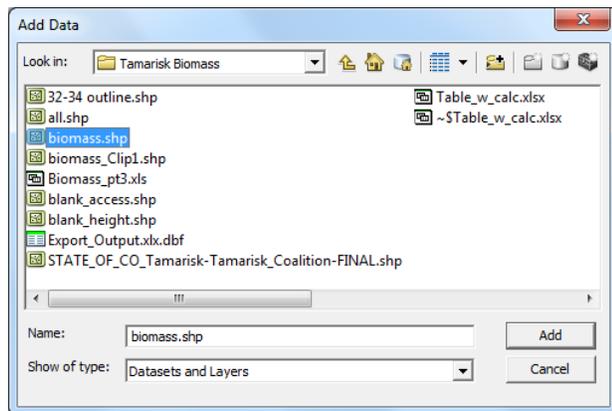
10. Create another column and name it “Biomass900”

11. Set this column equal to:  $(10^{AR2}) * 1.17$
12. It should look like the image to the right but notice that **AR2** is referring to my formula column value.
13. We are raising 10 to the exponent of the formula because this will get rid of the  $\text{Log}_{10}$  function and the 1.17 is the correction factor as stated previously.
14. Press **Enter** and drag the equation cell down as before.

Congratulations! You now have biomass values for each polygon based on  $900\text{m}^2$ .  
**REMEMBER:** this is not the biomass for the whole polygon, just one Landsat resolution portion of that polygon ( $30\text{m} \times 30\text{m}$ ).

### Retrieving Biomass values for $900\text{m}^2$ in ArcMap

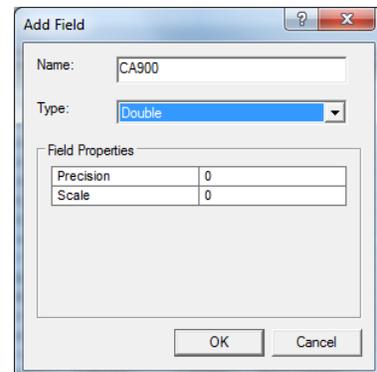
1. Now that we have values to reference, we can move onto manipulating data within the attribute table within ArcMap.
2. First, open ArcMap and select a **Blank Map** template and click **Ok**.
3. Add the shapefile you intend to manipulate using the add data icon  and browse to the file then click **Add**.
4. In this case my file name is labeled **biomass.shp**
5. Right click on the layer in the table of contents on the left side of the screen and select **Open Attribute Table**.



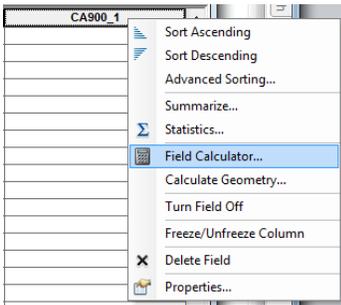
6. The attribute table will display all of the populated fields that are already connected to the polygon data. In the upper left-hand corner of the attribute table click on the  icon. Select **Add Field...**

7. In the prompted window, name the new field **CA900**, and select **Double** from the drop down labeled **Type**.

8. Click **Ok**.



9. A new field will appear at the far right hand side of the attribute table with 0's down the column.



10. Next we will populate the field using the **Field Calculator**.

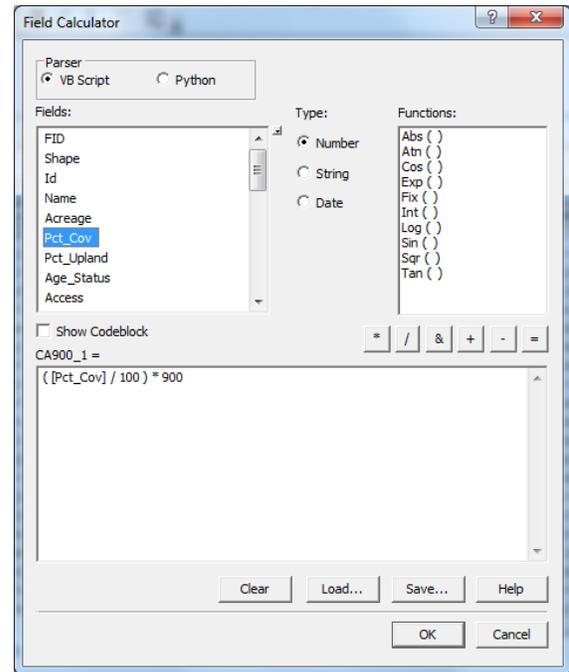
11. Right click the title of the new field (**CA900**) and select **Field Calculator**.

12. We will perform the same calculations as we did in *Excel* by selecting previously created attribute fields and performing calculations.

13. The calculation will appear in the white space at the bottom of the window.

14. Double click the **Percent Cover** field in the list labeled **Fields**:

15. Use the mathematical functions on the right to multiply and divide. You may need to insert ( ) if your percent cover needs to be divided by 100 like the example to the right.



16. Once your field calculator matches the screen to the right click **Ok**.

17. The field should now be populated with values that match your *Excel* table.

**IMPORTANT:** Check your values against the ones in Excel after each calculation.

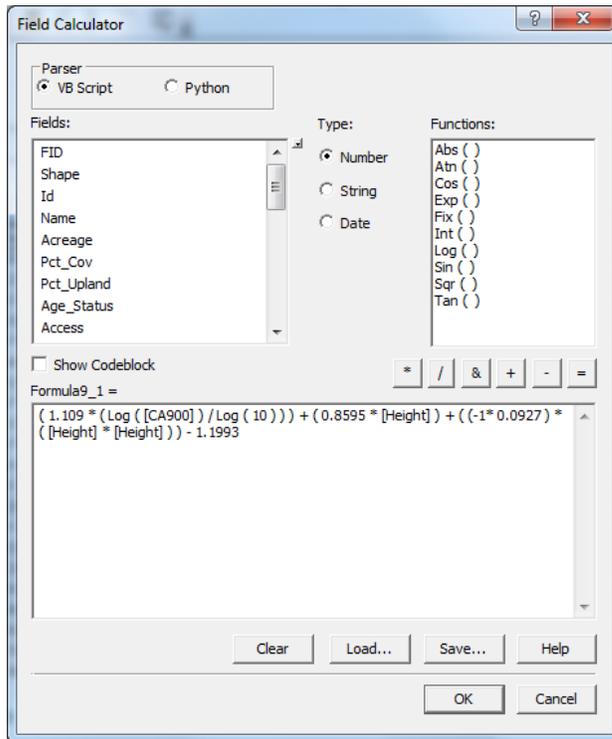
18. Add another field and name it **Formula900** and choose **Double** for the Type.

19. Open **Field Calculator** for the **Formula900** field.\

20. Insert the formula as you did in excel, using the **Fields** list when applicable. In order to produce a  $\log_{10}$ , use the **Functions** list to the right and select **Log ( )**. Insert the field **CA900** within the parentheses and then divide it by **Log (10)**. The end equation should look like this:

$$(1.109 * (\log ([CA900]) / \log (10))) + (0.8595 * [\text{Height}]) + ((-1 * 0.0927) * ([\text{Height}] * [\text{Height}])) - 1.1993$$

In the field calculator it looks like the image below. **IMPORTANT:** if you get an error message check the number of parentheses and spaces between terms.



21. This field will now be populated and match the values in the **Formula** column within *Excel*.

22. Add one more field and name it **Biomass900** with a **Double** Type as well.

23. Open **Field Calculator** and insert the following equation:  
 $(10 \wedge [\text{Formula900}]) * 1.17$

24. Click **Ok**

**Congratulations!** You now have a  $900\text{m}^2$  value for biomass relating to each polygon.