Appendix 2: Random Plots Workbook: Unstratified Sample

These instructions will help users of all skill levels create a random sample of i-Tree Eco plot centers, plot areas, and the associated i-Tree Eco-required data files for their study area. ESRI ArcGIS software with the Spatial Analyst extension is used. The instructions are generic and applicable with modification to different versions of ArcGIS as well as other GIS software in terms of basic operations.

These instructions comprise three basic steps:

    1 Prepare project area data.

    2 Generate sample plots.

    3 Create Eco-ready output.

When finished, you will have created the following:

- Area-of-interest (AOI) map layer composed of a single (or multi-part) polygon.
- Random sample plot centers point map layer with Eco-required fields added and
- populated.
- Sample plot areas polygon map layer.
- Eco-ready Strata Area text file.
- Eco-ready Plot List text file.
- Eco-ready Projection prj file.

Tips

- The Spatial Analyst extension for ArcGIS is required.
- Field names and types are important.
- Obtain projection system and map unit information from the map data provider first.
- All map data must have valid projection information for proper alignment.
- AOI map data must be in a projection system that uses feet or meters – NOT degrees.
- Final Eco-required map units will be metric.

- AOI examples are polygons such as a city boundary, park areas, or management zones.

- ESRI shapefiles are easiest to use.

- "Pin" open ArcToolbox when starting – pushpin icon, upper right of ArcToolbox panel.

- Practice good file management: folders to hold copies of original data, folders to hold output, employ logical file naming, etc.

- ArcGIS should add the geoprocessed map layers to the view automatically. If not, use the File > Add Data > Add Data… menu to load them.

Project Area Data Preparation

Overview

- Obtain a GIS map layer representing the area-of-interest (AOI) polygon(s) for your project area.

- Launch the ArcMap application of ArcGIS.

- Load the AOI map layer into the data view.

- Define the projection/coordinate system of the AOI if needed.

- Reproject the AOI to a system using feet or meters if needed.

- Dissolve the AOI into a single polygon (a single, multi-part polygon if more than one polygon).

- Add Eco-required fields and calculate appropriate values for them.

Detailed instructions

1 Obtain an area-of-interest (AOI) polygon from your GIS Department or an online resource. Several options can be found here: http://www.esri.com/data/free-data.

2 Launch ArcMap.

3 Save your project with an appropriate name at a new location via the **File** > **Save As** menu. Save periodically while working to avoid data loss.

4 Use the **File > Add Data > Add Data…** menu to browse to and load the AOI polygon map layer to the current view.

    a If your data are properly projected, ArcGIS should handle projection differences between the AOI and subsequent map layers on-the-fly.

    b If your data lack projection information, an "Unknown Spatial Reference" message may appear. Click **OK** to move past it and use ArcToolbox to

define the projection of the AOI map layer according to your data provider's specifications.

Navigate to **ArcToolbox > Data Management Tools > Projections and Transformations > Define Projection** and complete the **Define Projection** form:

For **Input Dataset**, choose the AOI map layer from the drop-down list.

For **Coordinate System**, click the **Properties** button to the right.

In the **Spatial Reference Properties** window that appears, click **Select** and choose the coordinate system indicated by your data provider.

5 If necessary, use ArcToolbox to reproject your AOI map layer to a system using feet or meters, ideally selecting a projection system already in use by your organization or a commonly used system such as State Plane or UTM in the United States.

6 Navigate to ArcToolbox > Data Management Tools > Projections and Transformations > Feature > Project and complete the **Project** form:

a For **Input Dataset**, select the AOI map layer from the drop-down menu.

b **Input Coordinate System** should be grayed out based on your work in the previous step or per your data provider.

c For **Output Dataset or Feature Class**, use the **Browse** button to the right and navigate to a suitable location to save the output file and give it a name.

d For **Output Coordinate System**, click the **Properties** button to the right

e In the **Spatial Reference Properties** window that appears, click the **Select** button and navigate to the proper coordinate system.

f For **Geographic Transformation**, select the first choice in the drop-down list if prompted with an "Undefined Geographic Transformation" message.

g Click **OK** when you've completed all the boxes.

7 If your AOI has more than one polygon, you must use ArcToolbox to dissolve them.

a Navigate to **ArcToolbox > Data Management Tools > Generalization > Dissolve** and complete the **Dissolve** window:

b For **Input Features**, select the projected AOI map layer from the list.

    c For **Output Feature Class**, use the **Browse** button to navigate to a suitable location and give the file a name.

    d For **Dissolve Field**, check the data field attribute value that unifies the AOI. Example: a "Name" field containing the city name of an AOI, even across physically separate city sections. You may need to peruse the layer's attribute table to find this.

    e Leave the **Statistics** field blank.

    f Ensure the **Create Multipart Features** box is checked.

    g Click **OK** to finish.

8 Right-click the new dissolved **AOI polygon layer, Open Attribute Table** and verify that there is now a single, multipart polygon present.

9 Use ArcToolbox to add Eco-required fields to the projected, dissolved AOI map layer.

    a Navigate to **ArcToolbox > Data Management Tools > Fields > Add Field** and complete the **Add Field** form:

    b Under **Input Table**, select the dissolved AOI map layer from the dropdown list.

    c For **Field Name**, enter: **Strat_ID**

    d For **Field Type**, select **LONG** from the drop-down list.

    e Skip the following fields:

        Field Precision

        Field Scale

        Field Length

        Field Alias

        Field is Nullable

        Field is Required

        Field Domain

    f Click **OK**.

10 Repeat the steps above as follows for these additional fields:

    a **Field Name**: **Strat_Area** with **Field Type**: Select **DOUBLE**.

    b **Field Name: Strata** with **Field Type**: Select **TEXT**.

11 Use the attribute table Field Calculator to populate values for the Eco-specific fields added to the projected, dissolved AOI map layer. To begin, right-click the projected, dissolved AOI map layer and select **Open Attribute Table**.

    a Right-click the **Strat_ID** field column heading and select **Field Calculator...**

    b In the large text entry box below **Strat_ID =**, enter: 1

    c Click **OK**.

    d Repeat for the **Strata** field.

    e In the large text entry box below **Strata =**, enter: **"Single Strata"** (including quotes!)

    f Click **OK**.

    g Right-click the **Strat_Area** field column heading and select **Calculate Geometry…**

    h For Property: choose **Select Area**. If this is not available, your AOI map layer is not in a projection system using feet or meters; see Steps 4 and 5.

    i For **Coordinate System** choose **Use coordinate system of the data source.**

    j For **Units**, select **Hectares [ha].**

Results

An area-of-interest (AOI) single polygon map layer with Eco-required fields added and populated.

- The AOI polygon map layer is now ready to be used for plot generation.

Sample Plot Generation

Overview

- Run the Create Random Points tool from ArcToolbox for the AOI.
- Add Eco-required fields to the random plots data.
- Calculate field values for the random plots data.
- Buffer the random plots point data to form plot areas.

Detailed instructions

Use the Create Random Points tool in ArcToolbox to generate the desired number of plots for the projected, dissolved AOI.

1 Navigate to **ArcToolbox > Data Management Tools > Feature Class > Create Random Points**.

2 Complete the **Create Random Points** form:

a For **Output Location**, browse to and single-click your working folder to select it and click **Add**.

b For **Output Point Feature Class**, type in an appropriate name with a .SHP extension.

c For **Constraining Feature Class**, select your projected, dissolved AOI polygon map layer.

d For Number of Points [value or field], enter the desired number of sample plots for this selected land cover.

e Skip the remaining inputs.

f Click **OK**.

Use ArcToolbox to add Eco-required fields to the newly created sample plots point map layer.

1 Navigate to **ArcToolbox > Data Management Tools > Fields > Add Field**.

2 Complete the **Add Field** form:

a For **Input Table**, select the newly created sample plots point map layer from the dropdown list.

b For **Field Name**, enter: ID

c For **Field Type,** select **LONG** from the drop-down list.

d Skip the following fields:

  Field Precision
  Field Scale
  Field Length
  Field Alias

Field is Nullable

Field is Required

Field Domain

e Click **OK**.

3 Repeat the steps above as follows for these additional fields:

    a **Field Name**: `LCCode` with **Field Type**: Select **SHORT**.

    b **Field Name**: `X_Coord` with **Field Type**: Select **DOUBLE**.

    c **Field Name**: `Y_Coord` with **Field Type**: Select **DOUBLE**.

Use the attribute table Field Calculator to populate values for the Eco-specific fields added to the sample plots point map layer in the step above.

1 Right-click the sample plots point map layer and select **Open Attribute Table**.

2 Right-click the **ID** field column heading and select **Field Calculator...**

    a In the large text entry box below **ID =**, enter: `[FID]+1`

    b Click **OK**.

3 Repeat step 2 for the **LCCode** field.

    a In the large text entry box below **LCCode =**, enter: `1`

4 Right-click the **X_Coord** field column heading and select **Calculate Geometry…**

    a For **Property**: select **X Coordinate of Point**

    b For **Coordinate System** choose **Use coordinate system of the data source**

    c For **Units**, select **Meters [m]**

    d Click **OK.**

5 Right-click the **Y_Coord** field column heading and select **Calculate Geometry…**

    a For **Property**: select **Y Coordinate of Point**

    b For **Coordinate System** choose **Use coordinate system of the data source**

    c For **Units**, select **Meters [m]**

    d Click **OK.**

6 To verify the attributes have been correctly modified in the sample plots point map layer, right-click the sample plots point map layer in the map layers list, and choose **Open Attribute Table**.

    a Scan through the fields and their values to verify they are correct.

(Optional) Use ArcToolbox to buffer the sample plots point map layer. This step creates the plot of your desired survey size around the plot centers and can be used to make field data collection plot maps.

1 Navigate to **ArcToolbox > Analysis Tools > Proximity > Buffer**.

2 Complete the **Buffer** form:

    a Under **Input Features**, select the sample plots point map layer from the drop-down list.

    b For **Output Feature Class,** use the **Browse** button to navigate to a suitable location and choose a file name for the resulting map layer.

    c For **Distance**, in the **Linear Unit** box, enter the distance value from the list below, based on your desired plot size. (The distance is the radius of the plot).

    Feet:

    For 1/5 acre plots: enter: **52.66**

    For 1/10 acre plots: enter: **37.24**

    For 1/20 acre plots: enter: **26.33**

    For 1/100 acre plots: enter: **11.78**

    Meters:

    For 1/5 hectare plots: enter: **25.23**

    For 1/10 hectare plots: enter: **17.84**

    For 1/20 hectare plots: enter: **12.62**

    For 1/100 hectare plots: enter: **5.64**

    d Select Feet or Meters as appropriate from the units dropdown

    e Skip the following entries:

    Side Type

    End Type

Dissolve Type

Dissolve Field(s)

   f Click **OK**.

3 The buffered sample points layer is added to the map view automatically; zoom in to examine individual plot areas. Note: choose an appropriate equal-area projection system in the layers data view properties if your plot areas appear not to be circular.

Results

Sample plots point map layer

- User-defined number of plots randomly spread throughout the AOI
- Plot points assigned with land cover categories
- Eco-required fields added and populated

(Optional) Sample plot areas polygon map layer

Create Eco-Ready Output

Overview

- Export select fields from the Plot attribute table to a text file.
- Export select fields from the Strata polygons attribute table to a text file.
- Copy and rename the AOI projection file.

Detailed instructions

1 From the **Selection** menu, choose **Clear Selected Features** if available to unselect all features.

2 Right-click the spatially joined sample plot centers *point* map layer in the map layers list and select **Open Attribute Table**.

   a Right-click the **FID** field and select **Turn Field Off.**

   b Repeat for all but the **ID, LCCode, X_Coord**, and **Y_Coord** fields (added in Sample Plot Generation above).

   c Under the upper left **Table Options** drop-down button, select **Export**.

   d Browse to a folder where you wish to save the output file.

    e For **Save the file as** type select **Text File**.

    f Name the export appropriately, such as "myEcoPlots_mmyyyy.txt".

    g Click **No** when asked to add the new table to the current map.

3 Open the text file in a simple editor such as Windows Notepad (avoid using word processing software due to formatting issues).

    a Use the **Search and Replace** function to replace each comma with a space.

    b Save the file

    c Delete the first line containing the field names: "ID","LCCode","X_Coord","Y_Coord"

    d Copy and paste these two lines at the top of the file:

      $ U4PLLS! 1.3 20040728 1549
      1

    e A properly formatted file will look like this:

      $U4PLLS! 1.3 20040728 1549
      1
      1 1 1199094.600650 2095374.121430
      2 1 1202999.760510 2094522.116280
      3 1 1207382.288000 2096877.180300
      4 1 1198150.473980 2101783.086320
      ...

4 Right-click the dissolved land cover polygon layer in the map layers list and select **Open Attribute Table**.

    a Right-click the **FID** field and select **Turn Field Off**.

    b Repeat for all but the **Strat_ID, Strat_Area,** and **Strata** fields (added in Strata Preparation above).

    c Under the **Table Options** drop-down button, select **Export**.

    d Browse to a folder where you wish to save the output file and save as a Text File.

    e Name the export appropriately, such as "myEcoStrata_mmyyyy.txt".

f   Click **No** when asked to add the new table to the current map.

5   Open the text file in a simple editor (avoid using word processing software).

    a   Use the **Search and Replace** function to replace each comma with a space.

    b   Save the file.

    c   Delete the first line containing the field names: "Strat_ID","Strat_Area","Strata"

    d   Copy and paste these two lines at the top of the file:

        $U4STAR! 1.3 20040728 1549
        1

    e   A properly formatted file will look like this:

        $U4STAR! 1.3 20040728 1549
        1
        1 15138.785733 "Developed"
        2 3187.141038 "Open"
        3 217.131072 "Other"
        ...

6   Make a copy of the PRJ file associated with your dissolved land cover polygons layer.

    a   In Windows Explorer, browse to your working folder and copy/paste the PRJ file associated with this shapefile.

    b   Right-click the copied file, and Rename it appropriately, such as "myEcoProjection_mmddyyyy.prj"

Results

Three Eco-ready files:

- Plot List
- Strata Area
- Projection (automatically created in the Define Projection/Reprojection steps above as part of the AOI Shapefile)