

The Transect Sampling Methodology

Purpose of Data Collection

The following methodology is used to collect data which can then be used to generate *risk or probability of occurrence* maps for individual plant species. These maps enable managers to: 1) Find new populations of the target species more effectively, 2) Establish frameworks for monitoring the target species before and/or after management is applied, 3) Prioritize management activities based on risk or probability of occurrence, and 4) Establish a framework for modifying land uses based on risk or probability of occurrence of the target species.

Purpose of Specific Methodology

Creating an informative risk or probability of occurrence map for a plant species requires the collection of good data. This data needs to be unbiased (collected from across the landscape without concentrating on any one specific area or environmental condition) and it needs to be collected efficiently. The transect sampling methodology presented here incorporates both of the above concerns. First, since transects are randomly placed and 2km long, data will be collected from across a broad range of environmental conditions and thus be unbiased. Second, since data is collected continuously along any given transect, this allows for maximization of the amount of data collected for any given distance traveled. The transect sampling protocol is divided into four steps: 1) Modifying the data dictionary, 2) Placement of random transects in a GIS and generation of start and end points for each transect, 3) Exporting transect start and end points to be used as waypoints on a GPS, and 4) Surveying transects in the field. Steps I – III are completed in an office environment prior to engaging in step IV in the field.

Transect Sampling Protocol:

This protocol steps you through how to modify our basic data dictionary to include your species of interest, how to develop transect lines and start points, and how to survey in the field. We have made the steps specific to ArcGIS 9.3, Trimble Pathfinder Office 5.1 and Microsoft Excel software, as well as Trimble GPS Units. (The same approach can be used using different software versions and GPS but some of the details may vary).

I. Modify Data Dictionary

- 1) Open the '**transect_collection.dbf**' file with GPS pathfinder office
- 2) In the '**Features**' column, click on '**Plants**'
- 3) In the '**Attributes**' column highlight '**SPECIES_1**', and then click the '**Edit Attribute**' button below
- 4) In the '**Menu Attribute Values**' field (where it says 'add species names'), you will need to enter the names of the species that you are surveying for. This can be a short list of target non-native or rare native species of concern, or it could be a long list of all of the non-native or rare native species you might encounter while surveying. If you only intend to make maps for certain species, we suggest only including those species on your list. To add species to the list:
 - a) Click the '**New**' button
 - b) In the pop up window that appears, enter your first species name in the '**Attribute Value**' Field
 - c) Click the '**Add**' button
 - d) Repeat for each species you want on your list
- 5) Repeat steps 3 and 4 above so that the same list is available under the SPECIES_2, SPECIES_3, and SPECIES_4 attributes (This will allow you to mark more than one species at any one location)
- 6) Save your modified dbf file
- 7) Close the dbf file and **transfer it** to your Trimble GPS unit using the data transfer utility in Pathfinder Office

II. Creating Sampling Transects

To complete the steps below, you must download and install Hawth's tools software for ArcGIS version 9.x (<http://www.spataleecology.com/htools/download.php>)

- 1) Open a map of your area of interest in ArcMap
- 2) Ensure that the ArcMap view is in UTM coordinate system
- 3) Import the layer(s), such as roads or riparian corridors, which you wish to use as the start of your transects. **These need to also be in the UTM coordinate system, so convert if necessary.**
- 4) In ArcMap, select **view > toolbars > Hawth's Tools** to turn on the Hawth's tools toolbar
- 5) From the Hawth's tools dropdown menu, select **Animal Movements > Convert Paths to Points** – *(Here we are making it possible to find the start points of your transects)*
- 6) When the **Convert Paths to Points** window appears proceed as follows:
 - a) In the **Input > Input line feature (path) layer** field , select the layer upon which you wish to start your transects (e.g. roads)
 - b) Select FID for a Unique ID field for your layer
 - c) In the **Options** section, set the interval between points to 10, and uncheck the **'Add turning angles to output table'** box
 - d) In the **Output** section, name the new points layer file **'points'** and select where you want the resulting file to be stored
 - e) Click **OK** and wait for the program to process the data
 - f) Click **OK** when the 'processing complete' message appears (this may take a few minutes depending on the spatial extent and number of roads etc.)
 - g) Your new points layer should appear on your map as well as in the list of layers for the map
- 7) Open the attributes table for your new points layer, and note the number of points in the table
- 8) Using a random number generator (such as in Microsoft Excel), generate as many random numbers between 1 and the number of points in your layer as you want. For example, if your new points layer contains 2000 points, and you want 15 transects, you would generate 15 random numbers between 1 and 2000.
- 9) Open ArcCatalog
- 10) In ArcCatalog, select **File > New > Shapefile**
- 11) In the 'Create New Shapefile' window that appears, name your new shapefile 'transects', select **'polyline'** as the feature type *(Here we are creating a file so that can be edited in steps 17-29 below to create transects)*
- 12) Click the **Edit** button in the spatial reference section
- 13) When the spatial reference properties window appears, click the **'import'** button
- 14) Select your points file from the list and click **OK**. The resulting coordinate system should be UTM
- 15) Click OK again
- 16) Add the 'transects' shapefile to your ArcMap
- 17) Select **editor > start editing** from the ArcMap menu bar
- 18) In the 'Start Editing' window that appears, select the 'Transects' file

- 19) Select **editor > snapping**, and make sure that the vertex, edge, and end boxes are checked for your points layer
- 20) In ArcMap, open the attributes table for your new points layer
- 21) In the table, select your first random point by selecting/highlighting one of the rows whose FID corresponds with your first random number
- 22) This point should now be highlighted on your map as well
- 23) Zoom in to the highlighted point on your map
- 24) Click on the **Sketch tool** (looks like a pencil)
- 25) Move the cursor over the highlighted random start point on the map and left click. Now when you move your cursor away from the highlighted point, a line should appear
- 26) Right click and select 'length' from the menu. Specify 2000 for the length and hit enter (this will give you a transect length of 2km or 2000 meters; *(This is our preferred length but in some cases (e.g. where the property area is small) 1000 m can be used if absolutely necessary. Do not go shorter than 1000 m as you would be unlikely to generate a good unbiased sample.)*)
- 27) Move the cursor to orient your transect so that it is perpendicular to the feature that you are using as the start of your transect (road or stream etc)
- 28) Make sure that the cursor is over the end point of the line and left click
- 29) With the cursor still over the end point of the line, right click, and select '**finish sketch**' from the menu
- 30) Repeat steps 21-29 above for each random transect. Remember to save your edits frequently!
- 31) When you have completed placement for all of your random transects, **save your edits** and select editor > stop editing
- 32) Bring up the Hawth's tools toolbar again – *(Now we are converting those 2000 m lines into spatially referenced start and end points, which will help you follow the exact transect line in the field and allow for more accurate locations for the weeds you observe)*
- 33) From the Hawth's tools dropdown menu, select **Animal Movements > Convert Paths to Points**
- 34) When the **Convert Paths to Points** window appears proceed as follows:
 - a) In the **Input > Input line feature (path) layer** field , select the transects layer. Select FID for the Unique ID field for your layer
 - b) In the **Options** section, set the interval between points to **2000**, and **uncheck the 'Add turning angles to output table'** box
 - c) In the **Output** section, name the new points layer file '**transect points**' and select where you want the resulting file to be stored
 - d) Click **OK** and wait for the program to process the data
 - e) Click **OK** when the 'processing complete' message appears
 - f) Your new **transect points** layer should appear on your map as well as in the list of other layers for the map

- 35) Open the attributes table for **the transect points** layer – *(This is where you can give the transects a name that will make sense to you)*
- 36) Click options > add field
- 37) In the add field window, name your new field TranID and specify its type as text
- 38) Click OK
- 39) Click Editor > start editing
- 40) In the editing source window, select the source which contains your **transect points** file and click OK
- 41) In the transect points attribute table, fill in the TranID field for each entry:
 - a) Highlight the first row and note the position of the point on the map, it should be the start of a transect
 - b) Double click on the space for TranID in that row and enter *T1 start (or some other naming convention)*
 - c) Highlight the next row and note the point on the map. **Make sure that it is the endpoint for the same transect** and fill in the TranID field with *T1 end (or some other naming convention)*
 - d) Repeat steps a-c for each transect
 - e) Save your edits
 - f) Select editor > stop editing
 - g) On the attributes table for transect points, select **options >export** and select the name and location for the dbf file to be saved
 - h) Click OK
 - i) **Save your ArcMap** file and close ArcMap

III. Creating Transect Waypoints and Exporting to GPS

The aim of this part is to convert the transect points you just created into a file you can upload onto your Trimble GPS.

- 1) Open Microsoft Excel
- 2) Open the dbf file that you exported in step 41g above
- 3) Delete all columns except the X, Y, and TranID columns
- 4) Save the Excel file first, then save it again as a **CSV (comma delimited)** file (in the list of options for file type while saving)
- 5) An error message will appear informing you that 'the selected file type does not support workbooks....' just click **OK**
- 6) Another warning message may appear informing you that your file 'may contain features that are not compatible with CSV....' Just click **YES**

- 7) Close Microsoft Excel
- 8) When prompted with 'so you want to save the changes...' you can select '**don't save**' since the file has already been saved.
- 9) Open Pathfinder Office
- 10) Select **File > waypoints > ASCII Import**
- 11) Click the **Browse** button and locate the CSV file from step 4 above and double click the file
- 12) Examine the 'Preview of file' window and verify that the first line reads X,Y,TranID
- 13) Select the location and name your output file '**transect waypoints**' in the 'Output File' field
- 14) In the 'input file format field', select the appropriate setting. N = Northing (or Y), E = Easting (or X) and D = designation (TranID in this case). So if the first line in the 'Preview of file' window reads X,Y,TranID, (which is Easting, Northing, Designation) the appropriate setting is END
- 15) Ensure that the 'Fields separated by' field is set to 'comma'
- 16) Set the 'Start importing at row' field to 2
- 17) Set the coordinate system to UTM in the 'Coordinate system of input file' field
- 18) Click OK
- 19) Attach the GPS unit to your computer
- 20) Transfer your '**transect waypoints**' file to your GPS using the data transfer utility in Pathfinder Office

IV. Transect Sampling

Transect sampling is ideally carried out in teams of two, a navigator/data enterer and a target species observer (who looks for the species of interest). This leaves one person to navigate along the transect, and one person to observe the area for the target species. If there are a lot of species it really is faster to do this in teams of two, and not solo.

- 1) Navigate to the start point of a transect by setting a transect start point as your nav target on a GPS unit
- 2) Once you are at the start point, highlight the start point in the list of waypoints on the GPS, and **set it as your Nav Start**. *(Setting your transect start point as your Nav Start will allow for much more precise navigation along the transect because a line will be generated by the GPS between the Nav Start and the Nav Target (set in step 8 below) for you to navigate along.*

- 3) Open a new data collection file, and select the '**transect_collection**' data dictionary from the '**Dictionary Name**' dropdown menu
- 4) Click the '**create**' button, and confirm an antenna height of 1.3 m or 4 ft (*unless you have an external antennae on a post, or you are exceptionally tall or short!*)
- 5) A screen will appear which has the options for the types of points you can collect. The only option will be **Transect Point**
- 6) While standing at the start point that you navigated to, click on the '**Transect Point**' option. In the FEAT_NAME field, choose 'start'. In the TRANSECT field, enter the number of the transect. Collect at least 30 points for this position (you should have data collection set to 1 or 2 per second) and then click '**OK**'.
- 7) Set the transect end point as your new nav target (**and make sure you have the transect start point set as your nav start!!!**)
- 8) Begin navigating to the end of the transect. The person designated as the target species observer should follow a short distance ahead of the navigator, and observe for the target species within a width of 5 m or 15 ft **to either side of the transect**. The total observed width will thus be 10 m or 30 ft.
- 9) When a target species is encountered, stop walking and let the navigator know that data needs to be entered
- 10) If the patch is small, walk to the middle of the patch with the GPS
- 11) If the patch is large (you cannot see the end of it farther down the transect) stay at the edge of the patch with the GPS
- 12) Click on the '**Transect Point**' option and ensure that at least 30 points are collected while you are completing steps 13a-k below:
 - a) **REQUIRED** Enter the Transect ID in the space provided
 - b) **REQUIRED** Select "plants" from the FEAT_NAME attribute menu
 - c) In the **SPECIES_1** field, select your target species from the dropdown menu
 - d) If the species is not on the list, you can make a note of what the species is in the **notes** field at the bottom of the screen
 - e) Select the appropriate patch position in the **PATCH_POS1** field
 - i) If it is a small patch and you are in the middle of the patch, select '**middle**'
 - ii) If it is a large patch, and you are at the edge, select '**start**'

****NOTE:** If you are observing a large patch and collected a '**start**' point for it, you will need to pay attention and look for the end of the patch and collect an '**end**' point for it as well. This is done by repeating steps 9-12 e ii above, and selecting '**end**' from the drop down menu for the **PATCH_POS1** field instead of '**start**'. If the observer keeps track in a notebook, this helps a lot.

- f) For **CANOPY_CO1**, estimate the percent cover of the species per square meter, and enter it in the space provided
- g) For **PATCH_LEN1**, only enter a value if you selected '**middle**' as your patch position in step 12 c above. Enter the patch length (along the transect) in meters

- h) For **PACTH_WID1**, enter the width of the patch (perpendicular to the transect) in meters
- i) For **WEED_DENS1**, select the appropriate density per square meter from the drop down menu
- j) If there is more than one target species at this **Plants** point, repeat steps 12b – 12h above for **SPECIES_2**, **SPECIES_3** and **SPECIES_4** as necessary
- k) If necessary, wait until 30 points have been collected, and click **OK**
- 13) Continue navigating towards the end of the transect while collecting plant points as necessary and making sure to stop and collect **Plant > patch position = end** points for any patch start points you have collected – that is also the best time to add the cover and density data as you will have seen the whole patch by then (see note above)
- 14) When you reach the transect end point, select the **Transect Point** option (selecting 'end' from the FEAT_NAME attribute menu), enter the transect ID in the space provided and any notes you wish to make, and collect at least 30 points for this position and then click '**OK**'
- 15) Navigate to the next transect

****NOTE:** You can collect data from several transects in the same file. We typically start a new file for each day of sampling, and name it according to the date of sampling.