USING THE FUNCTIONAL LINKAGE INDEX GIS TOOL

Note: These instructions assume the user has some operational knowledge of ESRI's ArcGIS software, including the ability to execute geoprocessing functions, edit attribute tables, and create new polygons within a shapefile.

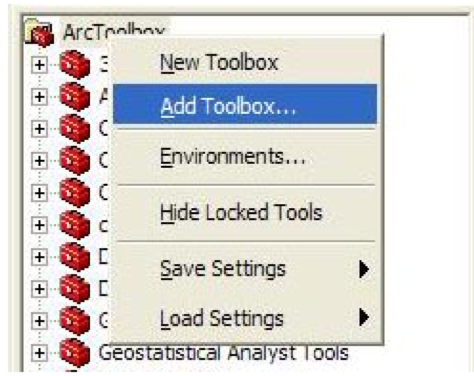

Figure 1. Adding a toolbox.

Software requirements and installation: The Functional Linkage Index (FLI) GIS tool is a Python script that runs through the ArcGIS Toolbox. There are separate scripts for ArcGIS version 9.2 and 9.3. Both versions require the Spatial Analyst extension. If running ArcGIS 9.2, Python version 2.4.x must be installed; the script will not run properly with later versions of Python on ArcGIS 9.2. The tool can be downloaded as a zip file from:
http://el.erdc.usace.army.mil/emrrp/gis.html
Extract the zip file into your C:\ drive. A folder named "Connections tool" will be added to that location. The folder contains a toolbox file (Functional Linkage Index.tbx) and two script files (Connectivity_v92.py or Connectivity_v93.py,). Open ArcToolbox through either ArcCatalog or ArcMap. To add the Connectivity tool, right click on the ArcToolbox heading and select "add toolbox" (Figure 1), then add the "Functional Linkage Index Tool" toolbox file. The default is for the tool to use the 9.2 script. If ArcGIS 9.3 is being used, then the tool will need to be redirected to the Connectitivity_v93.py script instead. To do this, right click on the script in the toolbox, select properties, then go to the "Source" tab and enter the correct script (Figure 2).

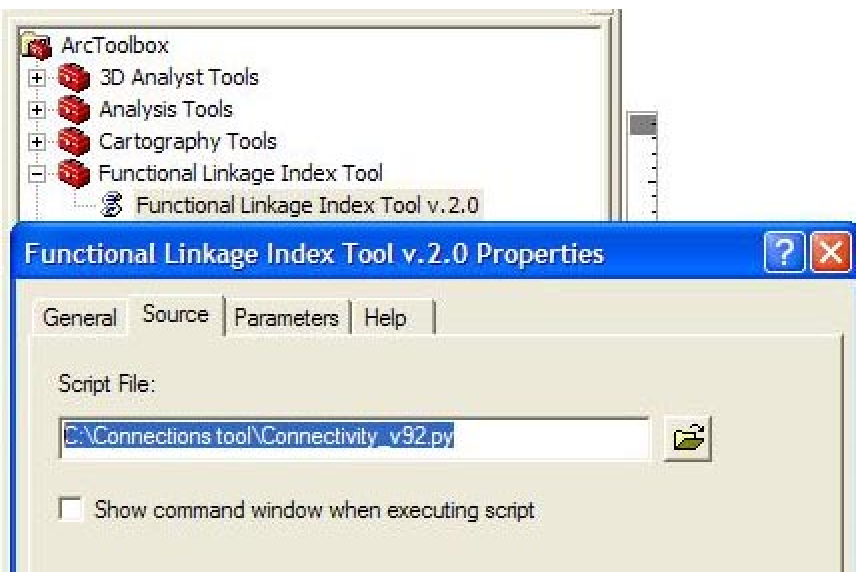

Figure 2. Changing the script source.

Running the tool: Once the toolbox has been added, the FLI tool can be run by expanding the toolbox and double-clicking on the "Functional Linkage Index Tool" script, which will open the tool dialog screen (Figure 3).

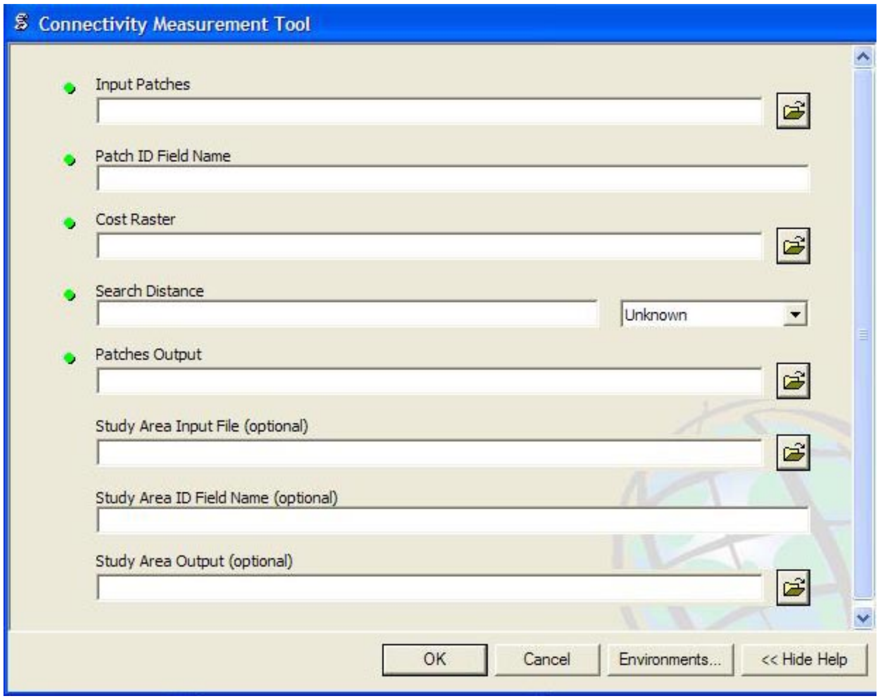

Figure 3. FLI Tool dialog box.

The first line (Input Patches) asks for the shapefile containing the patches being analyzed. The shapefile attribute table must have a column labeled "HV" that contains the habitat value for each patch, and an additional column that assigns each patch a unique, non-zero, identification number. The field name of the column containing the patch identification number is entered into the second line (Patch ID Field Name). Enter the field name exactly as it appears in the attribute table. The third line (Cost Raster) is for entering the study's cost raster and the fourth line (Search Distance) is for entering the dispersal distance. For the distance, enter the number in the first box and then specify the measurement units in the second box. The fifth line is for entering the name and location to save the patches output file that is created by the tool.

The sixth, seventh, and eight lines (Study Area Input File, Study Area ID Field Name, and Study Area Output) are used if you have a shapefile depicting multiple study areas by which you want the results summarized. If you do not need the results summarized by study area, leave these last three lines blank. If a patch belongs to multiple study areas, its connectivity value will be used in the summary value for each study area it is part of. The study area shapefile attribute table should contain a column which assigns each study area a unique identification number. The field name of that column should be entered in the "Study Area ID Field Name" line, enter the field name exactly as it appears in the attribute table. The last line is for entering the name and location to save the study area output file that is created by the tool.

Creating the cost raster: The simplest method for creating the cost raster is to use the Spatial Analyst "Reclassify" tool on a land cover or other appropriate raster (Figure 4).

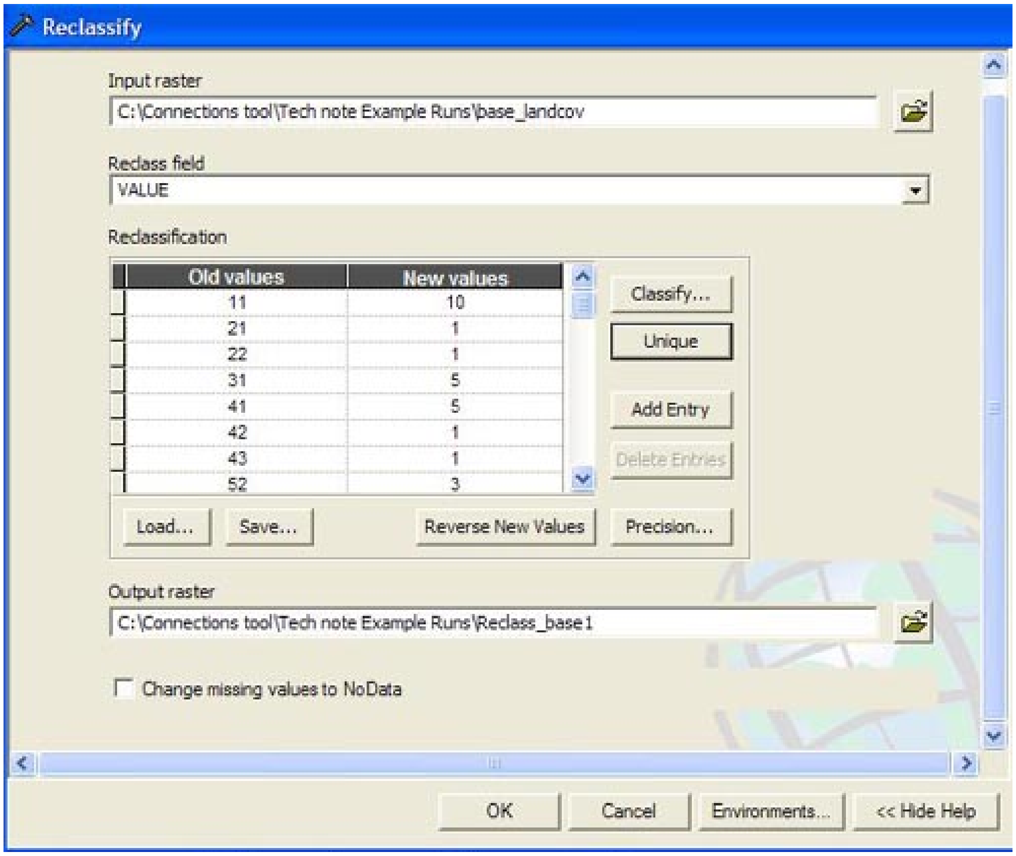

Figure 4. Reclassification tool dialog box.

The “old values” in Figure 4 represent the original land cover codes and the “new values” represent the cost assigned to each land cover. The land cover types that are most easily traversed by the target species should be assigned a cost of 1. with other land cover types assigned a greater value relative to their suitability for a particular species’ dispersal. If a particular land cover type is deemed to be completely impassable for the species it should be assigned a cost of 100,000.

The baseline cost raster can be created using the existing land cover data. A new cost raster must be created for any alternative scenario which results in any changes in land cover. The alternative design cost raster can be created using the following steps:

1. Create a polygon shapefile depicting the proposed land cover changes.
2. Create a new column labeled “Value” in the shapefile. Each polygon in the shapefile with a distinct movement cost should be given a value that is higher than the maximum value assigned to a land cover code in the original land cover raster. If the shapefile contains land covers with different movement costs, the assigned values should be at least an order of magnitude different from one another. For example, if the shapefile contains two land covers with different costs (say, light urban and heavy urban) and the highest land cover code in the land cover raster is 99, then light urban can be assigned a value of 100, and heavy urban can be assigned a value of 1000.
3. Use the “Polygon to Raster” tool to convert the shapefile into a raster. Use “Value” as the value field and set the cell size so that is the same as the resolution of the original land cover raster.

4. Use the "Reclassify" tool on this new raster. Make the new values the same as the old values, except change the old value "NoData" to a new value of 0. Before running the reclassification, click on the "Environments" button at the bottom of the dialog box, and under "General Settings" and under "Extent" enter the original land cover raster.
5. Use the Spatial Analyst "Plus" tool to combine this new reclassified raster with the original land cover file, creating a new land cover file.
6. Reclassify the new land cover file in the same manner that you did to create the baseline cost raster. The changed areas will have values that correlate to the values assigned in step 2. Using the example values, the new light urban areas will have values between 101 – 199, and the heavy urban areas will have values between 1001 – 1099.

Processing time: The amount of time it takes to run the tool will depend on the number of patches being analyzed, the complexity of their shapes, the cell size of the cost raster, and the processing power of the computer being used. For instance, on a 3.2 GHZ processor/3.5GB RAM computer, using a 5 m x 5 m cell size, it takes approximately 1 minute to process each patch.

Outputs: The tool will output a patches shapefile and, if a study area input file was entered, a study area shapefile. The patches output file will have a "Patch" column that contains the patch ID number, a "Connect" column that contains the connectivity score for each patch, and a "Total" column, which contains the combined connectivity score for all the input patches. The study area output file will have a column (the field name will be the same as that of the ID column in the input file) containing the study area ID numbers and a "Connect" column which contains the total connectivity score for each study area. Columns other than the one containing the study area ID in the input file will also appear in the output file, but the original field names will be slightly altered.

Miscellaneous tool notes:

- It is recommended that ArcMap or ArcCatalog (whichever one the script is being executed from) is shut down and restarted prior to re-running the tool.
- The minimum polygon size should be greater than the cost grid cell size. For instance, if a 10 m x 10 m cell size is being used, then polygons should be greater than 100 m^2.
- These instructions describe version 2.0 of the tool. Questions or problems running the tool should be addressed to the author at jeff.p.lin@usace.army.mil.