

Identify Path Segments Outside Home Range Kernels

These instructions enable you to analyze animal location data for movement measurements outside their immediate home range. Using ArcGIS 9.x (ARCINFO 9.2) software, a custom ModelBuilder tool, and HawthsTools (www.spatial ecology.com) perform the following steps:

- Create paths from locations maintaining segments (HawthsTools)
- Create kernel polygons (HawthsTools)
- Run custom ModelBuilder tool (OutsidePaths model tool)
- Create outside paths from tool output (HawthsTools)
- Associate kernel home range polygon(s) with points
- Calculate distances and angles through the reverse application of the built-in NEAR tool (requires ARCINFO license)
- Modify angle calculation to represent (compass) azimuth and organize data

ORIGINAL DATA THEME

points.shp	a point shapefile of individual locations
path.shp	a line shapefile of path segments
poly.shp	a polygon shapefile of kernel home range

CREATED DATA THEMES

outpoints.shp	locations outlining the path segments that go outside the polygon with unique identifiers
outpaths.shp	the uniquely identified outside segments
poly_single.shp	singlepart polygons, if the original kernel home range consists of multiple shapes
poly_centroid.shp	the center point(s) of the kernel(s)
outpaths_intersect.shp	points indicating where the outside paths start/end with respect to the kernel(s)
LabelMinFID_poly.dbf	summarized table indicating starting kernel for each outside path
outpoints_Merge.shp	copies of outpoints after NEAR tool calculations have been made
LabelMaxNearDist.dbf	summarized table indicating furthest distance of outpoints for each outpath segment
furthest_points	table or point shapefile of the furthest point along each outside path

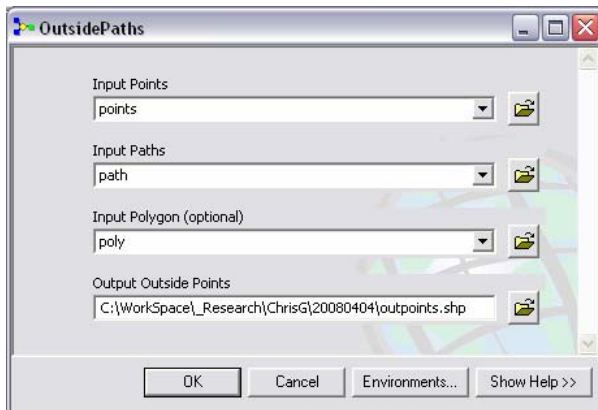
Start with path segments and home range polygon

1. Start a new empty map document
2. ADD DATA: **points.shp**

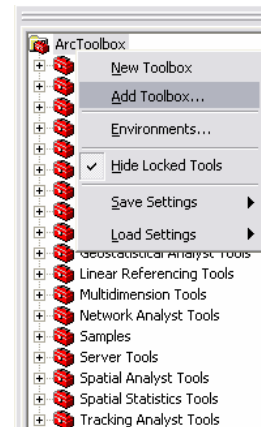
3. Enable and add the toolbar extension for HawthTools (click Tools >>> Extensions and click a check beside Hawth's Analysis Tools, click Tools >>> Customize and click a check beside Hawth's Tools)
4. If previously created, ADD DATA: paths.shp and poly.shp, and skip to next section
5. If not already created, follow web help for HawthTools >>> Animal Movements >>> Convert Locations to Paths tool = **paths.shp**
6. If not already created, follow web help for HawthTools >>> Kernel Tools = **poly.shp**

Identify outside paths

1. SHOW ARCTOOLBOX WINDOW
2. Right-click ArcToolbox and choose ADD TOOLBOX
3. Navigate to the BIOSCI TOOLS toolbox to select and open it
4. Open the OutsidePaths model tool



5. Specify the following parameters:
 - Input Points: **points**
 - Input Paths: **paths**
 - Input Polygon (this is NOT actually optional!): **poly**
 - Output Outside Points: **outpoints.shp**

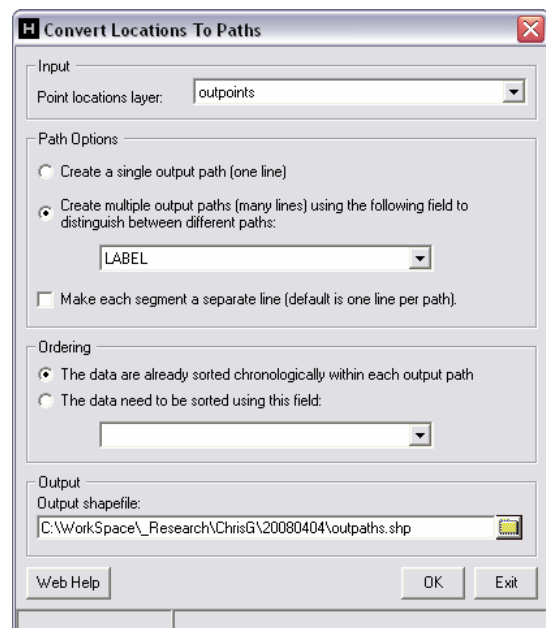


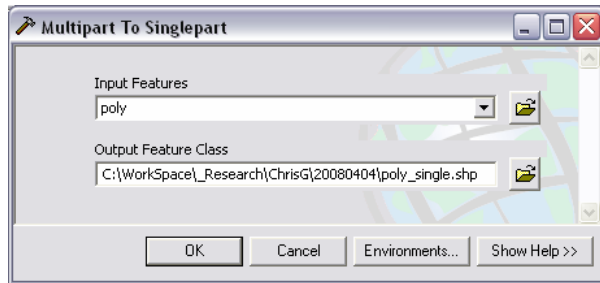
6. Click OK
7. Apply HawthTools >>> Animal Movements >>> Convert Locations to Paths with the following parameters:
 - Input: **outpoints**
 - Path Options: Create multiple... using **LABEL**
 - Output: **outpaths.shp**
8. Click OK

Associate kernel home range polygon(s) with points

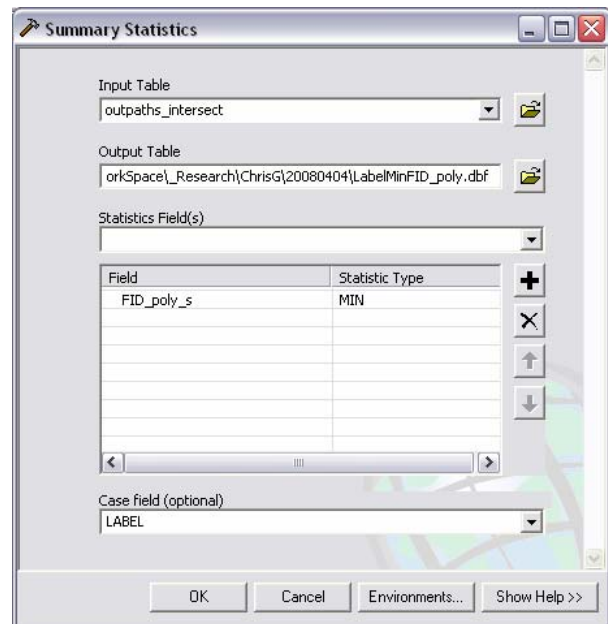
If kernel home range consists of more than one polygon, convert to singlepart. Otherwise, skip to step 4.

1. In ArcToolbox, open the data Management Tools >>> Features >>> MULTIPART TO SINGLEPART tool



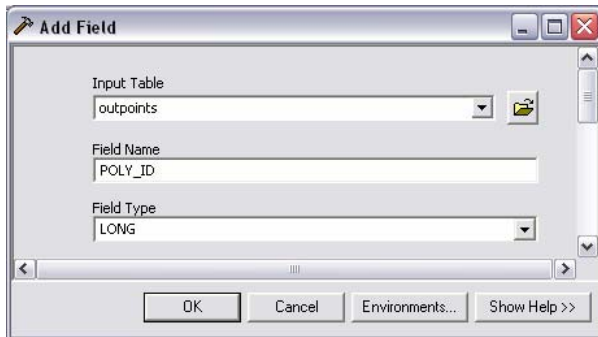


2. Specify the following parameters:
 - Input Features: **poly**
 - Output Feature Class: **poly_single.shp**
3. Click OK
4. In ArcToolbox, open the Analysis Tools >>> Overlay >>> INTERSECT tool
5. Specify the following parameters (use original poly if you skipped the first three steps):
 - Input Features: **outpaths** and **poly_single**
 - Output Feature Class: **outpaths_intersect.shp**
 - Output type: **POINT**
 - Click OK



6. In ArcToolbox, open the Analysis Tools >>> Statistics >>> SUMMARY STATISTICS tool
7. Specify the following parameters:
 - Input Table: **outpaths_intersect**
 - Output Table: **LabelMinFID_poly.dbf**
 - Statistics Field: **FID_poly_s/MIN**
 - Case Field: **LABEL**
8. Click OK
9. In ArcToolbox, open the Data Management Tools >>> Fields >>> ADD FIELD tool
10. Specify the following parameters:
 - Input Table: **outpoints**
 - Field name: **POLY_ID**
 - Field Type: **LONG**

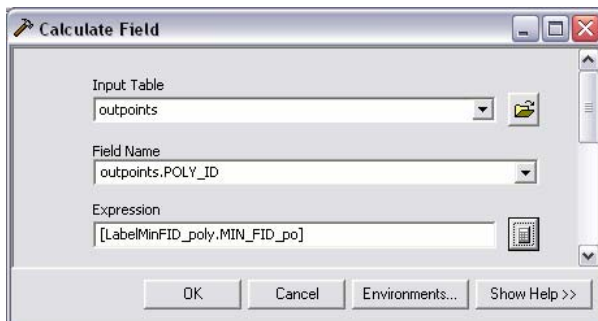
11. Click OK



13. Specify the following parameters:

- Layer Name: **outpoints**
- Input Join Field: **LABEL**
- Join Table: **LabelMinFID_poly**
- Output Join Field: **LABEL**

14. Click OK



17. Click OK

18. In ArcToolbox, open the Data Management Tools >>> Joins >>> REMOVE JOIN tool

19. Specify the following parameters:

- Layer Name: **outpoints**
- Join: **LabelMinFID_poly**

20. Click OK

The outpoints now have an attribute indicating which polygon FID it originated from.

12. In ArcToolbox, open the Data Management Tools >>> Joins >>> ADD JOIN tool



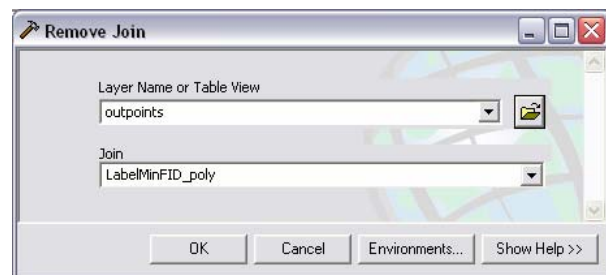
15. In ArcToolbox, open the Data Management Tools >>> Fields >>> CALCULATE FIELD tool

16. Specify the following parameters:

- Input Table: **outpoints**
- Field Name: **POLY_ID**
- Expression:

[LabelMinFID_poly.MIN_FID_po]

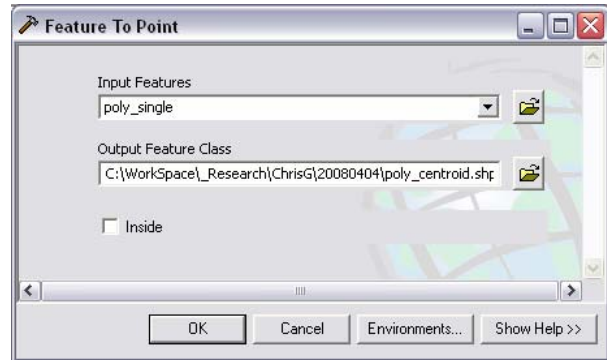
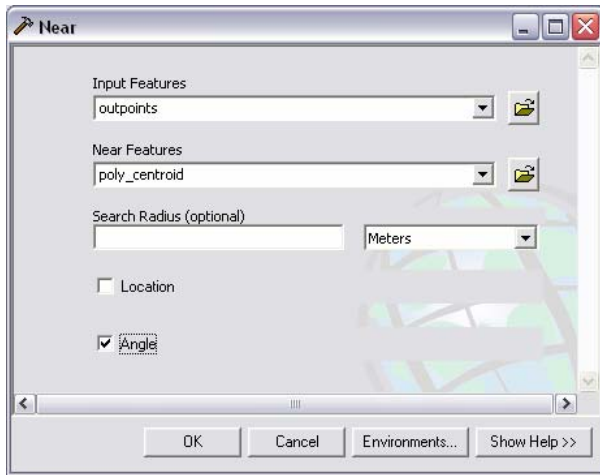
TIP: Click the calculator icon to access the handy field calculator for no typing required.



Calculate measurements of outside path points to home range centroids

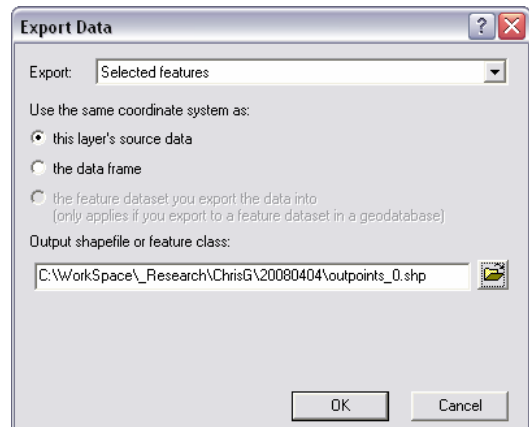
1. In ArcToolbox, open the Data Management Tools >>> Features >>> FEATURE TO POINT tool
2. Specify the following parameters:
 - Input Features: **poly_single** (or original poly if it has only one feature)
 - Output Feature Class: **poly_centroid.shp**

3. Click OK
4. Use ArcToolbox or the SELECTION pull down menu or the attribute table OPTION button to SELECT BY ATTRIBUTES:
 - outpoints: "POLY_ID" = 0
 - poly_centroid: "FID" = 0

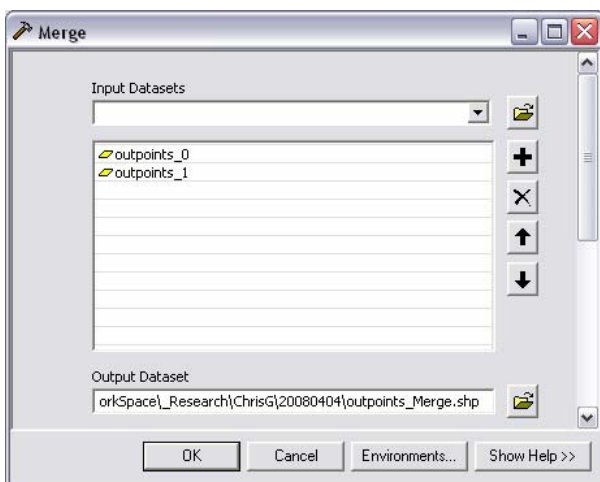


5. In ArcToolbox, open the Analysis Tools >>> Proximity >>> NEAR tool
6. Specify the following parameters:
 - Input Features: **outpoints**
 - Near features: **poly_centroid**
 - Check beside **Angle**
7. Click OK

8. EXPORT DATA (COPY FEATURES in ArcToolbox) for the selected, calculated features – name the output as **outpoints_0.shp** (i.e. the POLY_ID)
9. SWITCH SELECTION for both **outpoints** and **poly_centroid**
10. Apply the NEAR tool again using the exact same parameters
11. EXPORT DATA (COPY FEATURES in ArcToolbox) for the new selected features – name the output as **outpoints_1.shp**

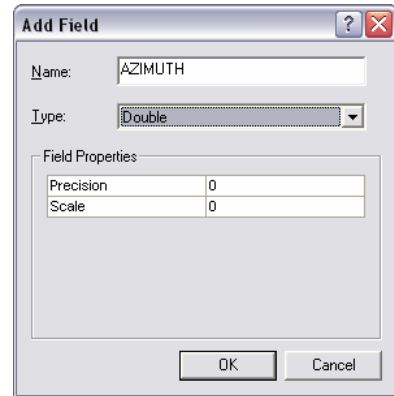


12. In ArcToolbox, open the Data Management Tools >>> General >>> MERGE tool
13. Specify the following parameters:
 - Input Datasets: **outpoints_0** and **outpoints_1**
 - Out[put] Dataset: **outpoints_merge.shp**
14. Click OK

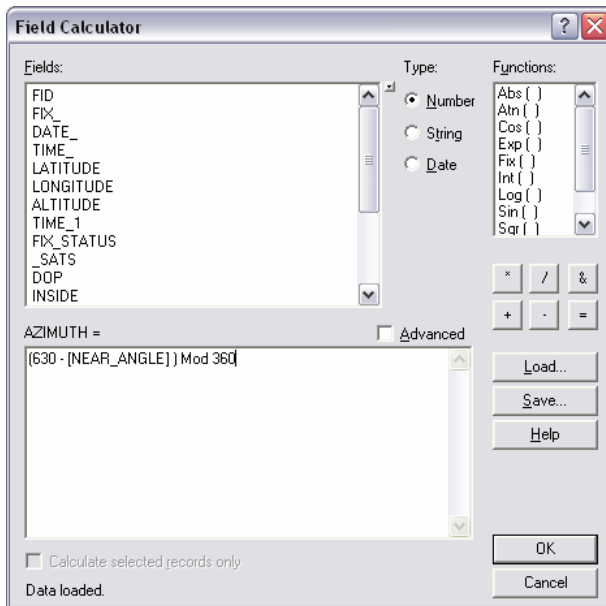


The NEAR tool calculates the direction in as the reverse angle offset from actual compass directions. Apply the following formula to convert to azimuth.

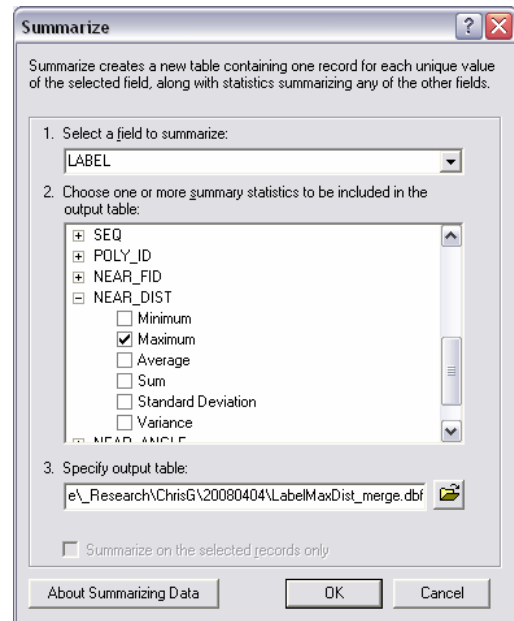
15. OPEN ATTRIBUTE TABLE for **outpoints_merge.shp**
16. Click the OPTIONS button and ADD FIELD
17. Specify the following:
 - Name: **AZIMUTH**
 - Type: **Double**
18. Click OK



19. Right click the field heading **AZIMUTH** and choose **FIELD CALCULATOR**
20. In the Field Calculator expression box, type the following:
(630 - [NEAR_ANGLE]) Mod 360
21. Click OK

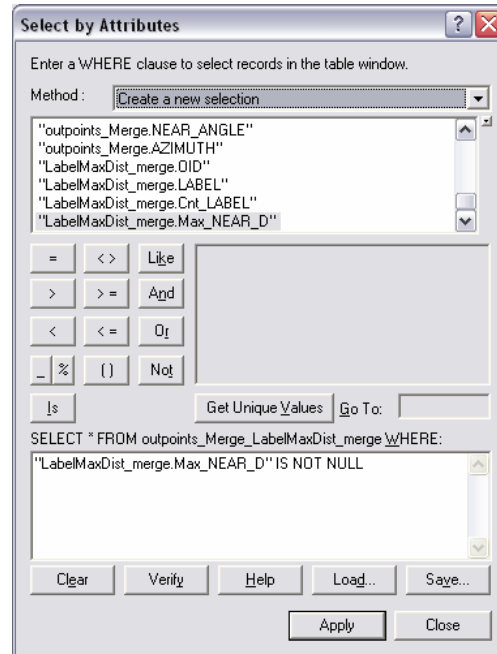
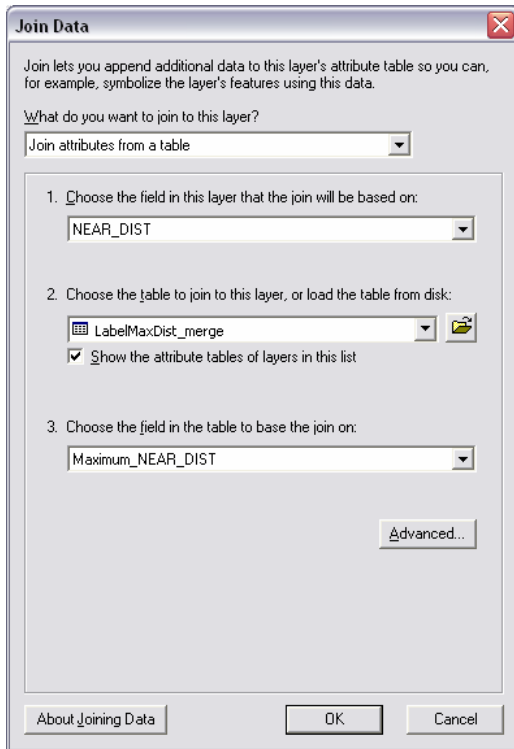


- Now extract the locations that have the maximum distance from the centroid.*
22. Right click on the field heading **LABEL** and choose **SUMMARIZE**



23. Specify the **NEAR_DIST/Maximum** as the summary statistic and **LabelMaxDist_merge.dbf** as the output table (*alternatively, access the Summary Statistics tool in ArcToolbox*)
24. Click OK
Join the maximum distance back to the original outpoints_merge table to identify the furthest most points.
25. Access the ADD JOIN tool or right click the **outpoints_merge** layer name in the table of contents and click **JOINS AND RELATES >>> JOIN**
26. Join the **NEAR_DIST** field of **outpoints_merge.shp** to the **Maximum_NEAR_DIST** field of **LabelMaxDist_merge.dbf**
27. Click OK
28. **SELECT BY ATTRIBUTES** where the joined **outpoints_merge** table **"LabelMaxDist_merge.Max_NEAR_D" IS NOT NULL**

29. Click APPLY



30. ADD FIELD (**FURTHEST**, Short Integer) to the table

31. Calculate selected features = 1

32. Click OK

33. REMOVE JOIN

34. Export to new shapefile or table; e.g. **furthest_points** – *this output represents the distances (NEAR_DIST) and directions (AZIMUTH) of the furthest most locations along the outside paths!*