Visualizing Time Segmentation of Space

Josh Cullen

September 27, 2019

Background

After running the initial time segmentation model on snail kite visitation to different grid cells (at 5 km resolution), the output is difficult to interpret with regard to underlying spatial patterns. To gain a better understanding of these patterns, segments will be plotted in multiple ways to discern how the time series has been partitioned.

The first plot will show the standard heatmap that we have initially used to plot mean changes in location and the calculated breakpoints. Next, the centroids of grid cells that were visited by each individual will be used to plot connections between relocations on a map over time. This will then be broken down further into centers of attraction (COAs) and peripheral locations. A 3D plot of space use over time will also be demonstrated for another perspective.

Heatmaps

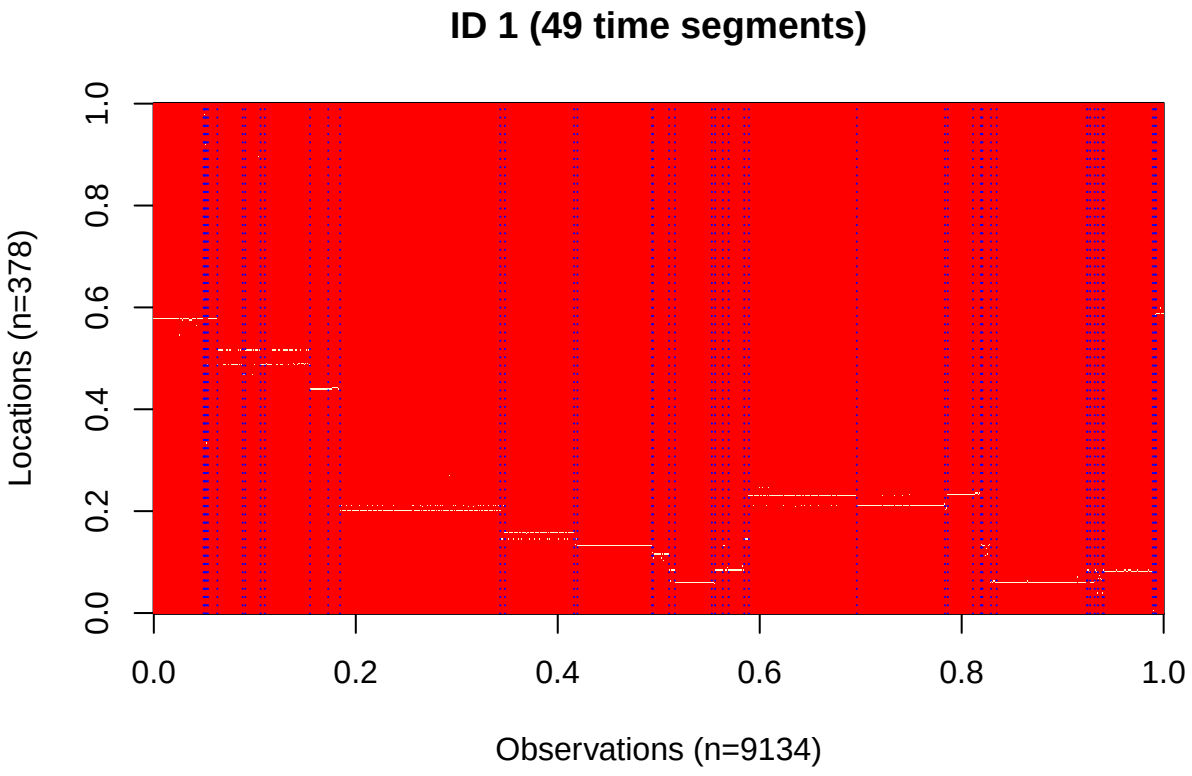


Figure 1: Heatmap of grid cell use over time in ID 1. Breakpoints calculated by model are denoted by vertical blue dashed lines.

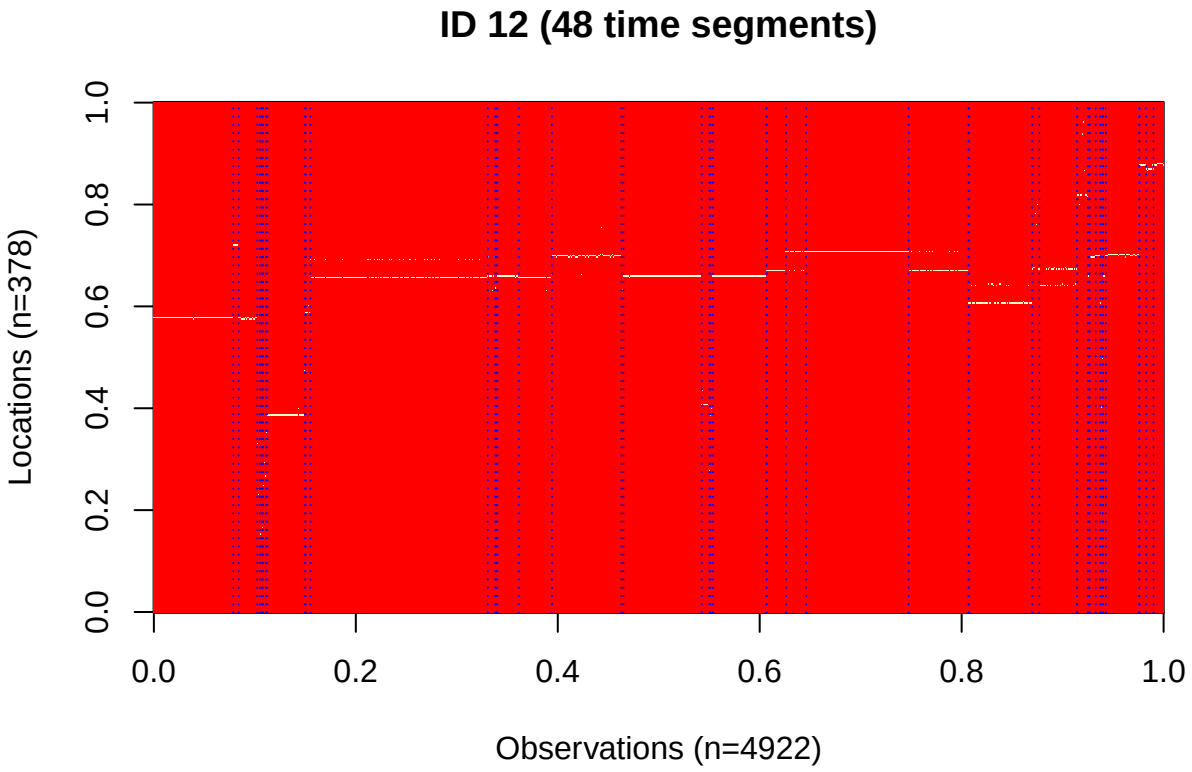


Figure 2: Heatmap of grid cell use over time in ID 12. Breakpoints calculated by model are denoted by vertical blue dashed lines.

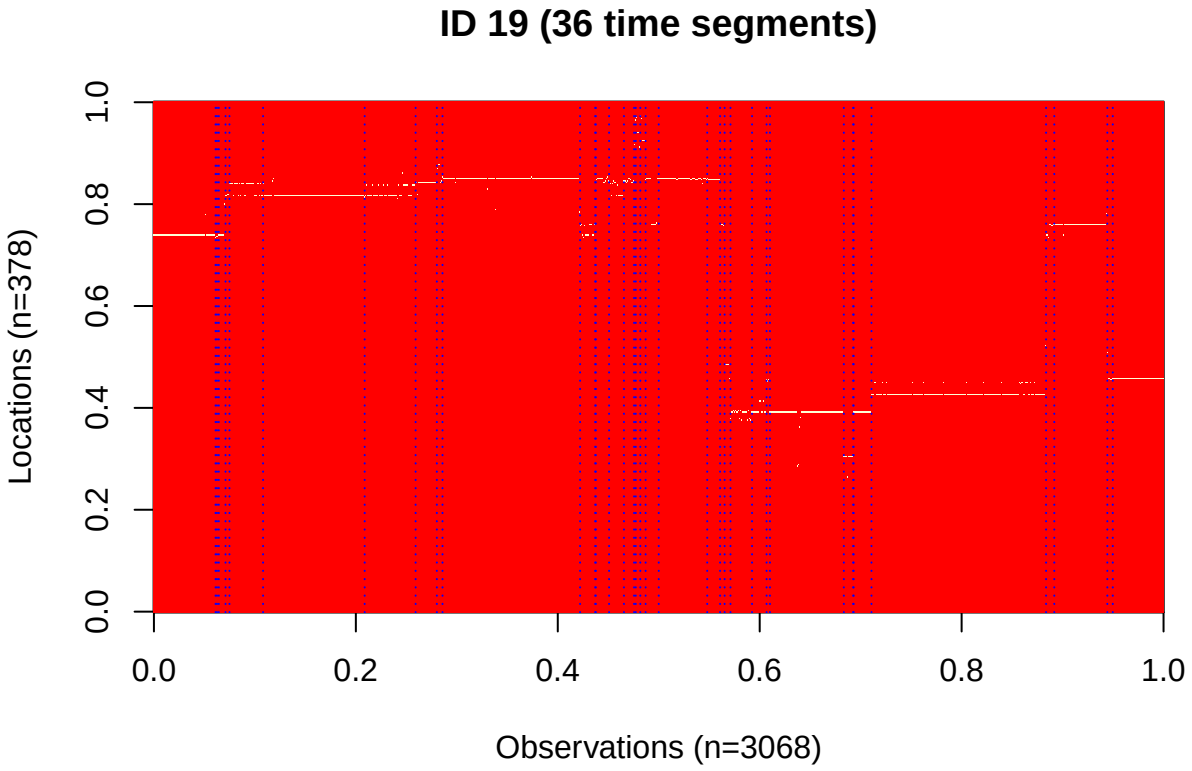


Figure 3: Heatmap of grid cell use over time in ID 19. Breakpoints calculated by model are denoted by vertical blue dashed lines.

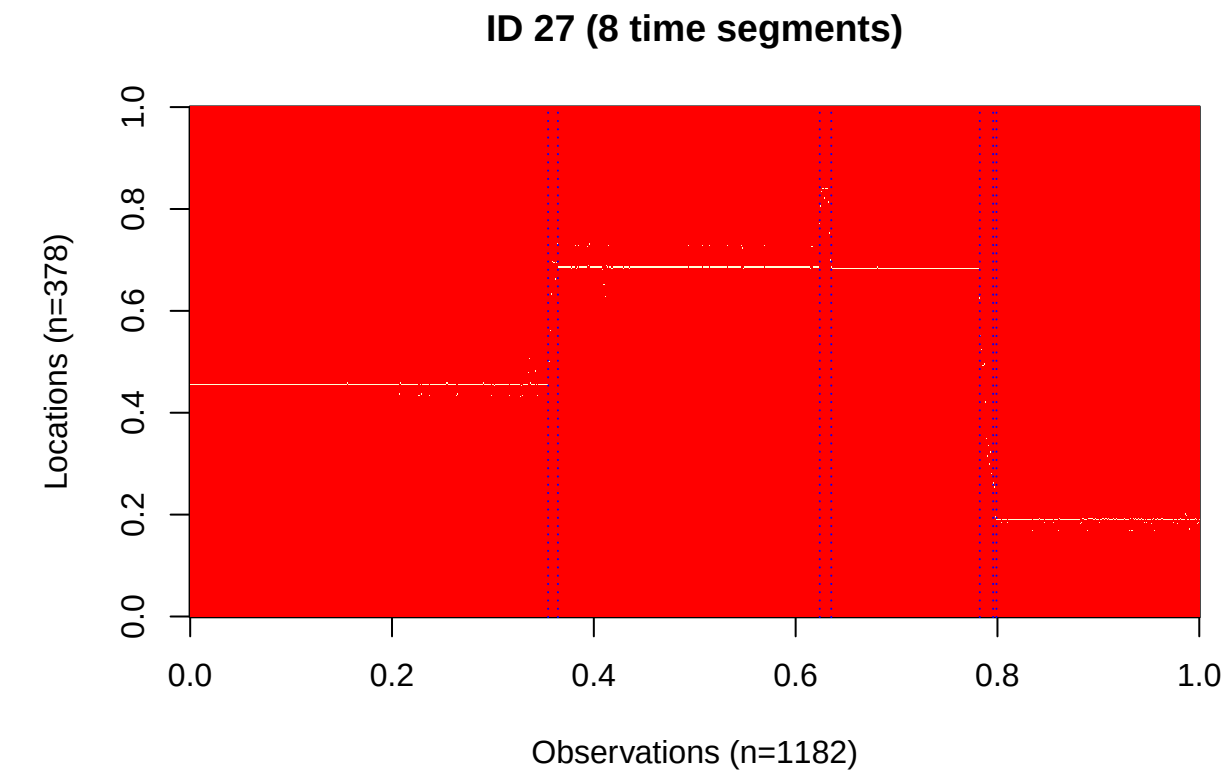
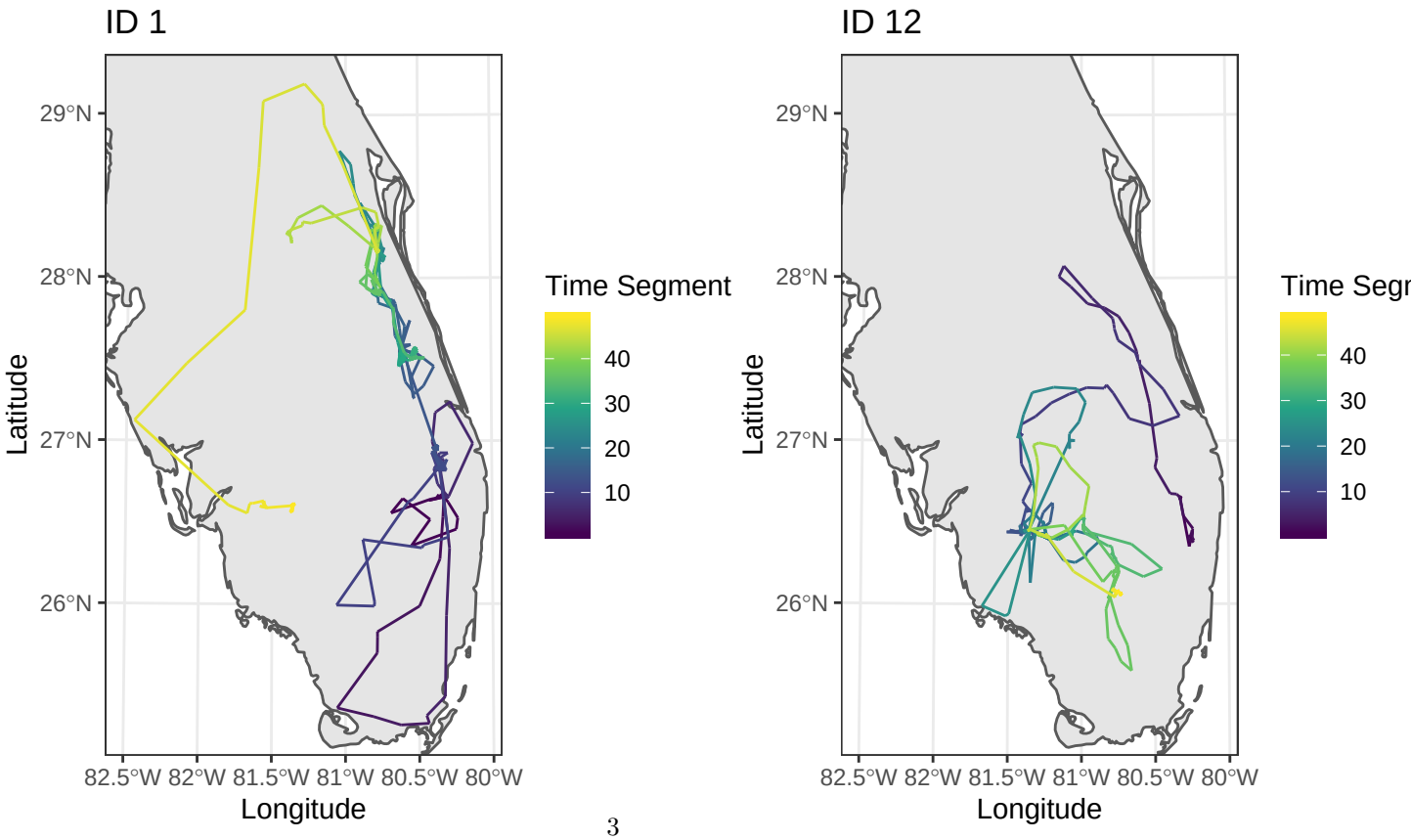
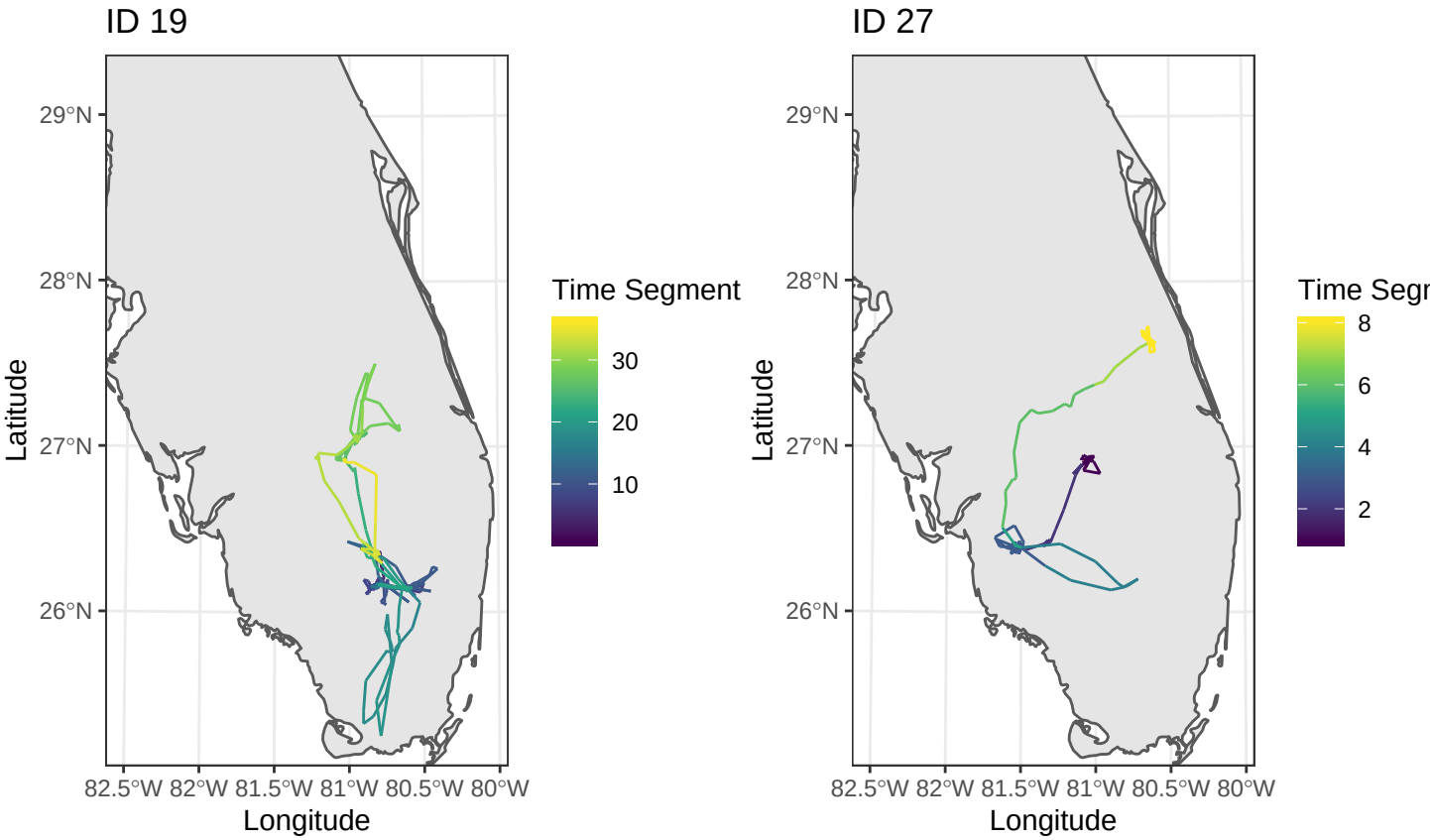


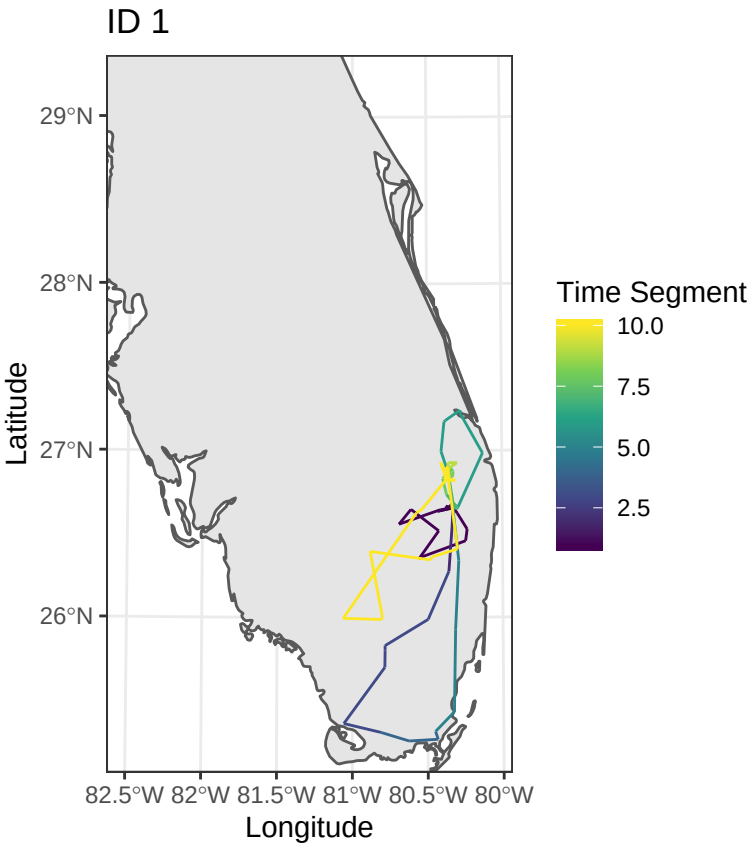
Figure 4: Heatmap of grid cell use over time in ID 27. Breakpoints calculated by model are denoted by vertical blue dashed lines.

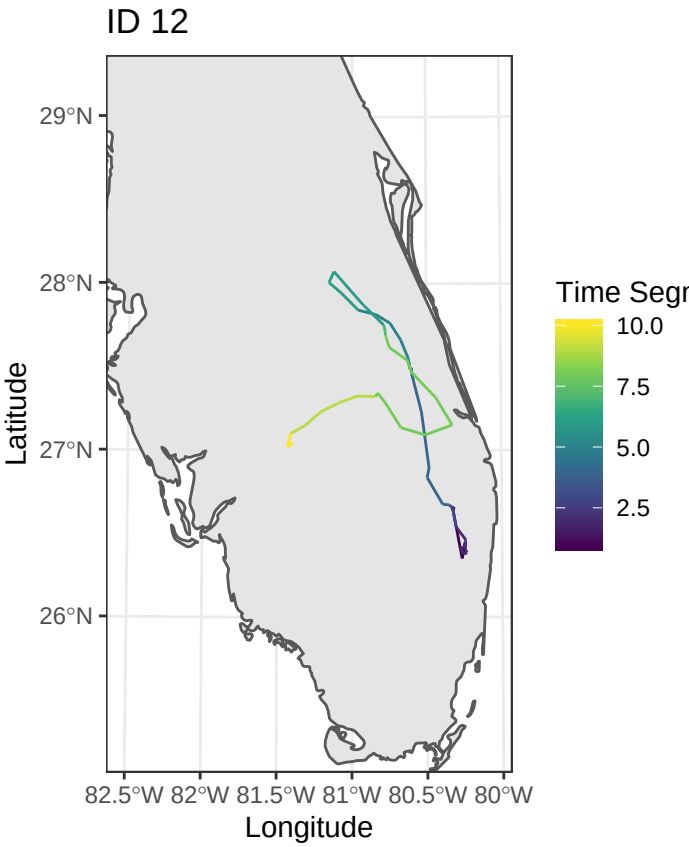
Spatial Maps

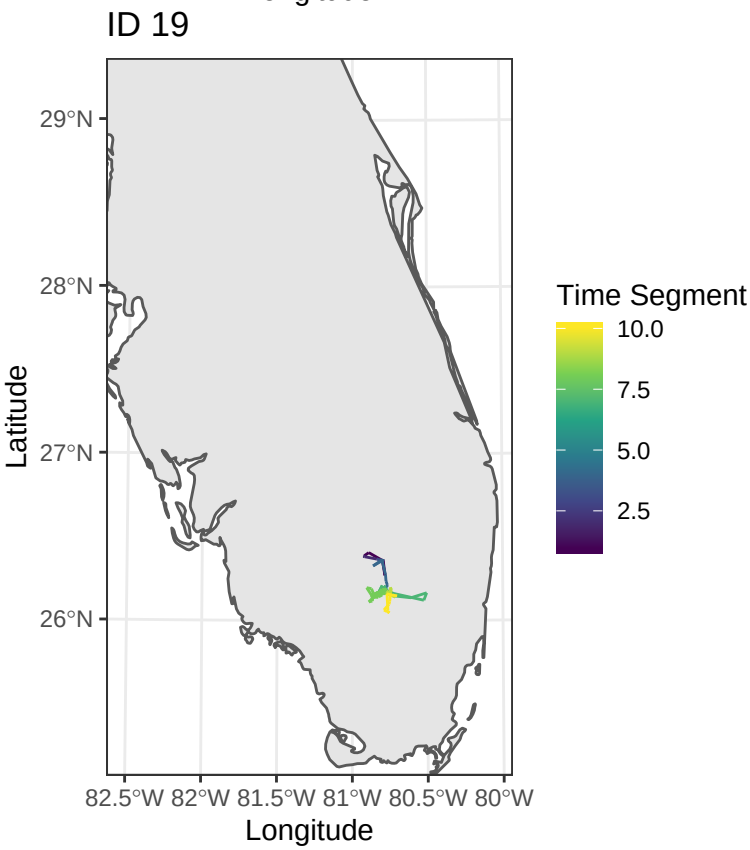


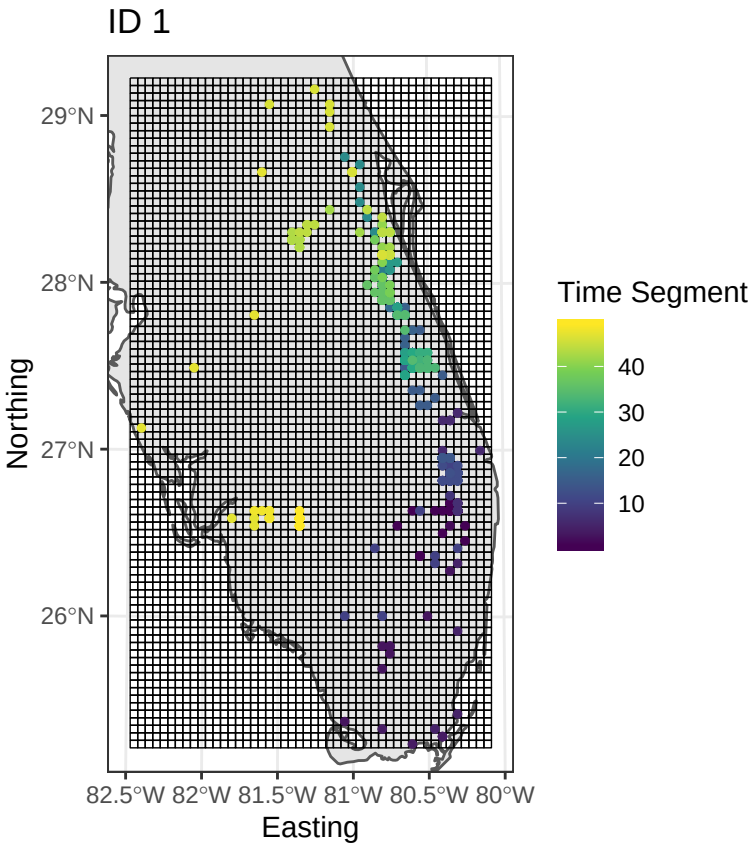


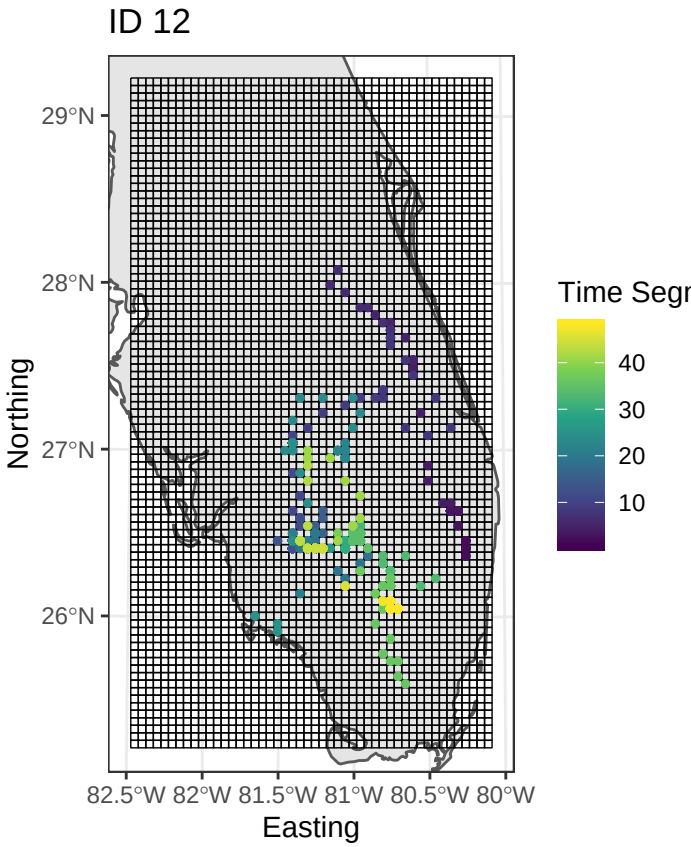
To view the differences among time segments from IDs with a large number of breakpoints (**IDs 1, 12, 19**), this is also plotted using only the first 10 time segments for better differentiation. As can be gleaned from this comparison, there is a large variety of movement patterns exhibited within only this short time period, therefore highlighting inter-individual differences in behavior.

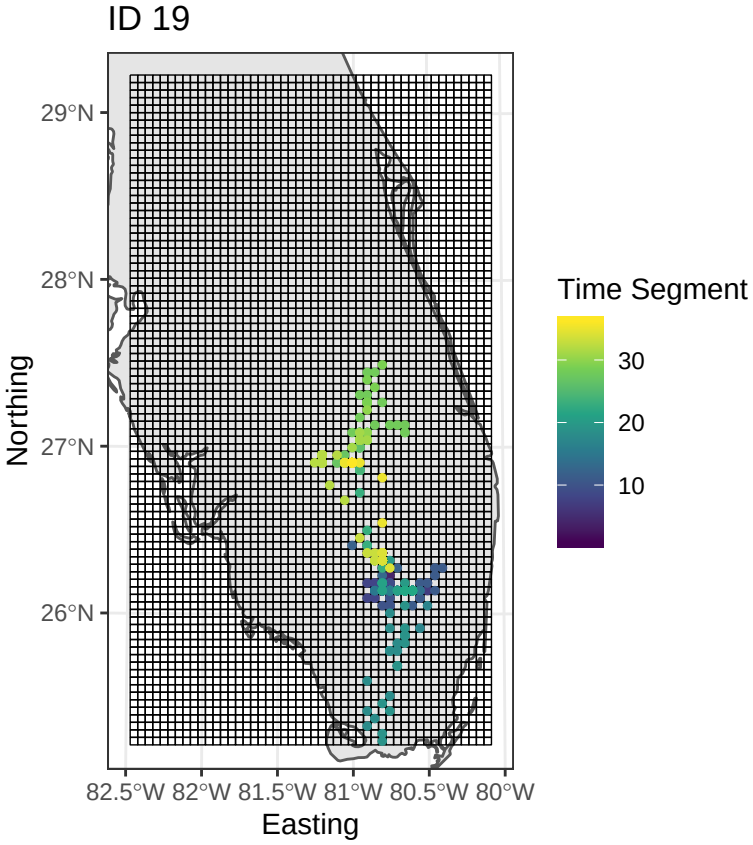

ID 1
29°N
28°N
27°N
26°N
Latitude
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Longitude
Time Segment
10.0
7.5
5.0
2.5

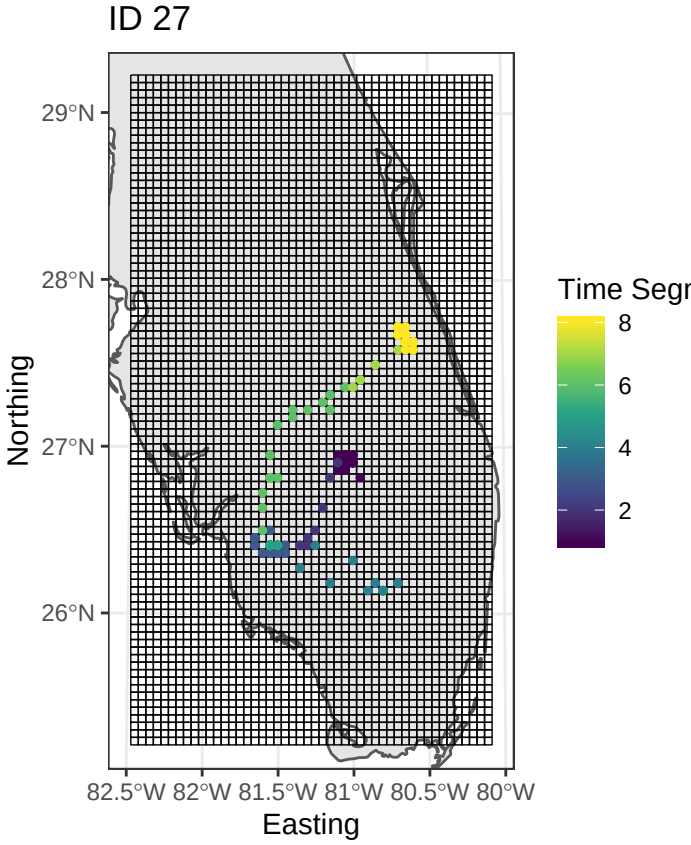

ID 12
29°N
28°N
27°N
26°N
Latitude
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Longitude
Time Segr
10.0
7.5
5.0
2.5


ID 19
29°N
28°N
27°N
26°N
Latitude
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Longitude
Time Segment
10.0
7.5
5.0
2.5


ID 1
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segment
40
30
20
10

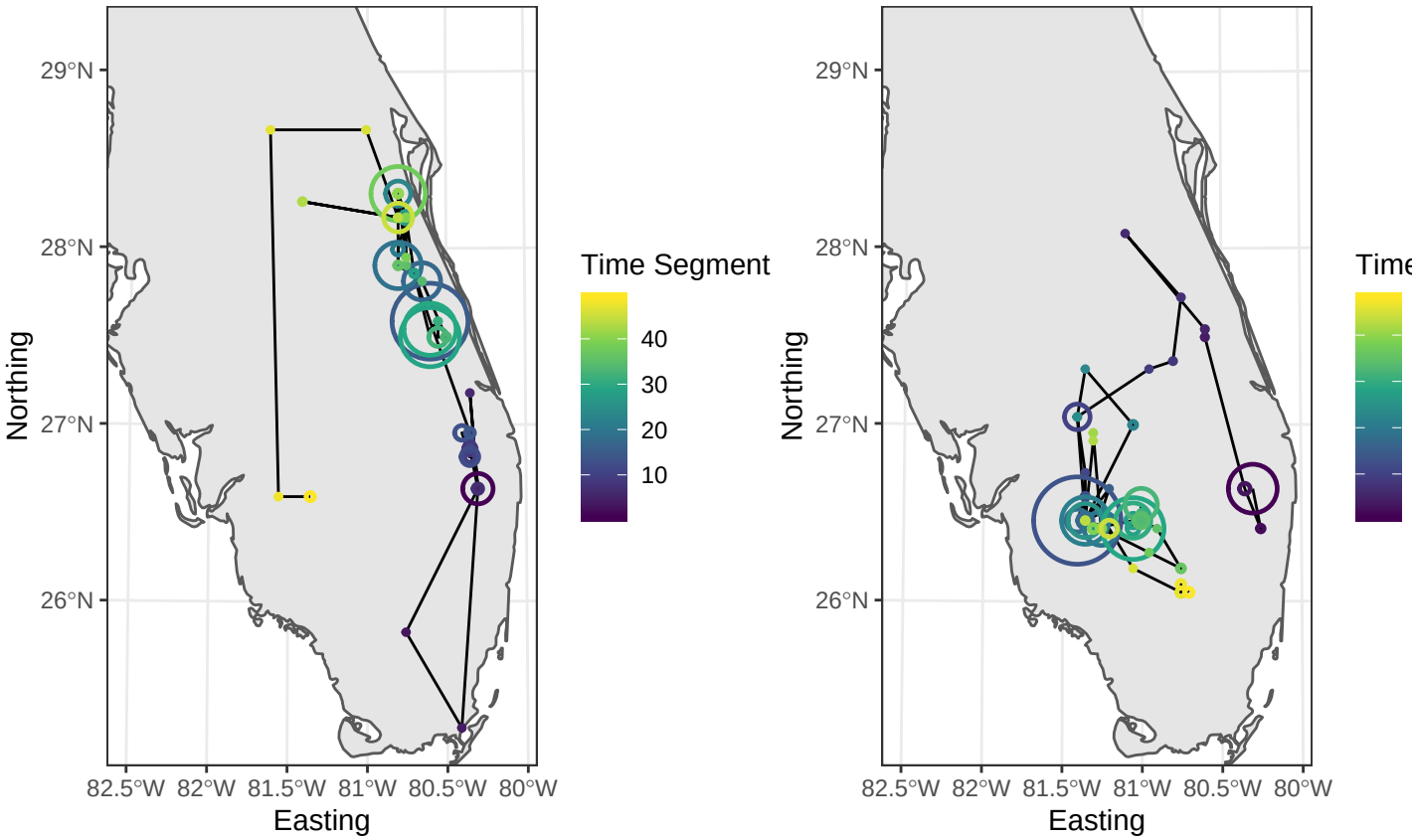

ID 12
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segr
40
30
20
10

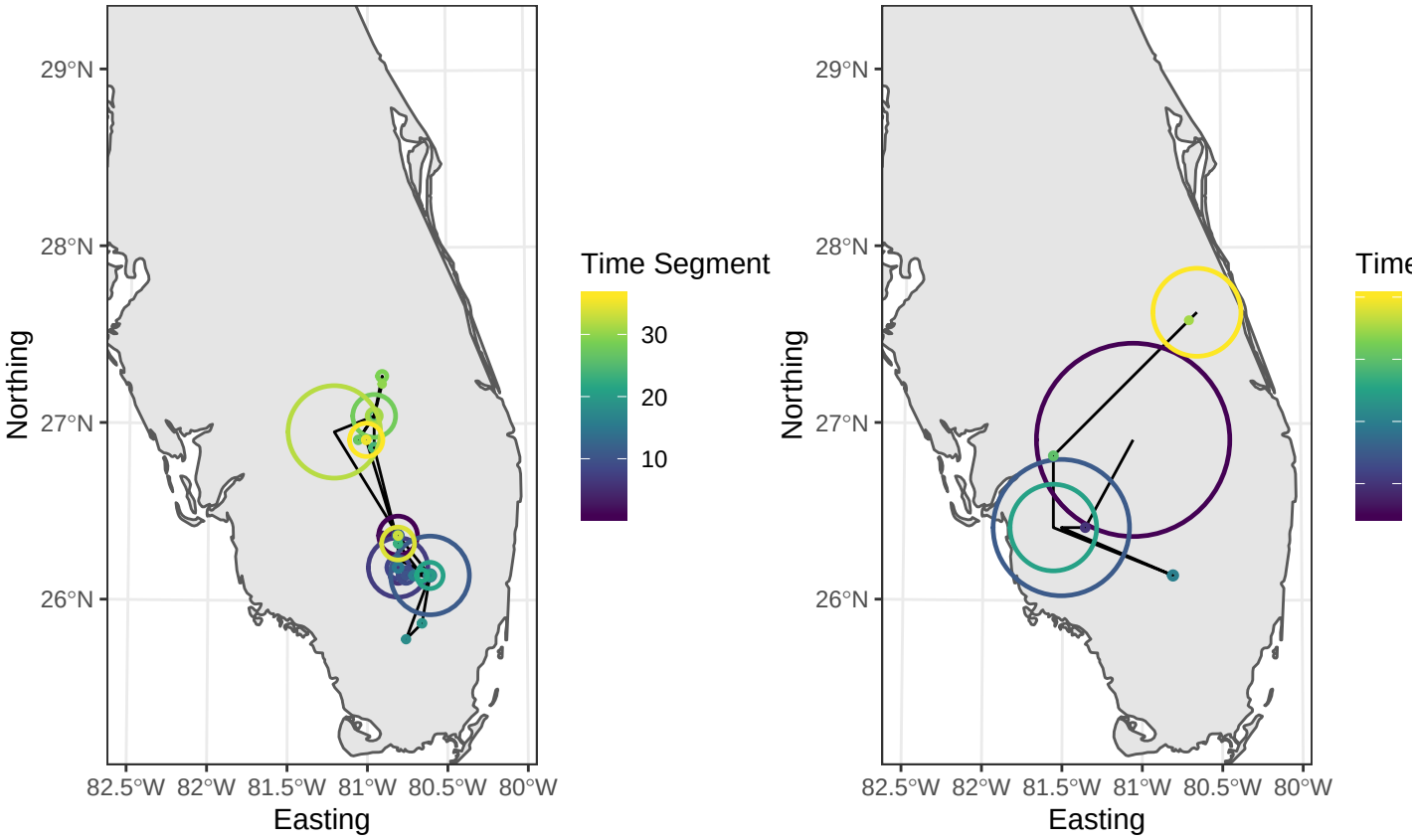

ID 19
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segment
30
20
10

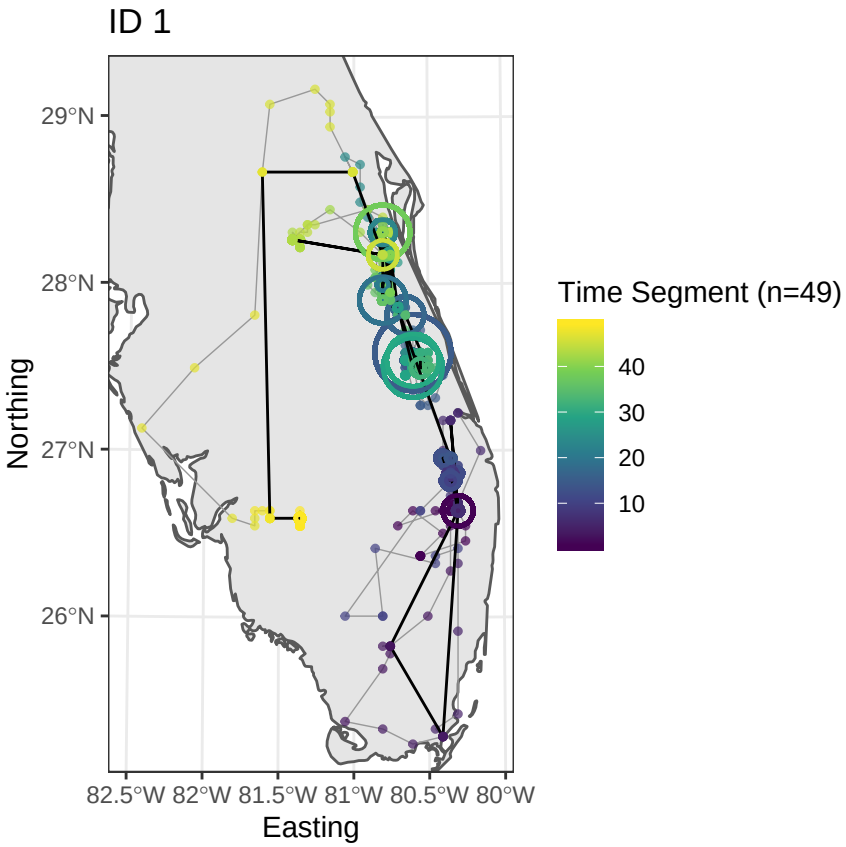

ID 27
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segr
8
6
4
2

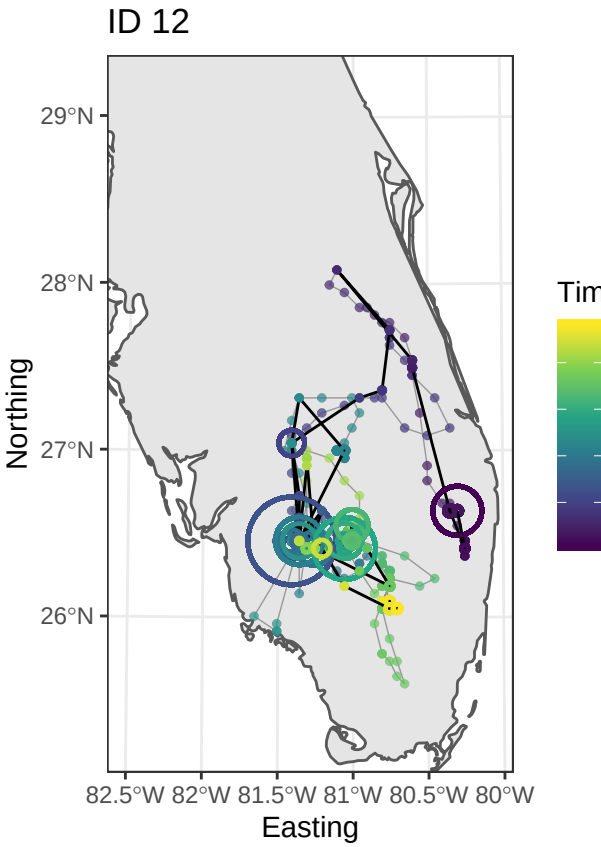
Centers of Attraction

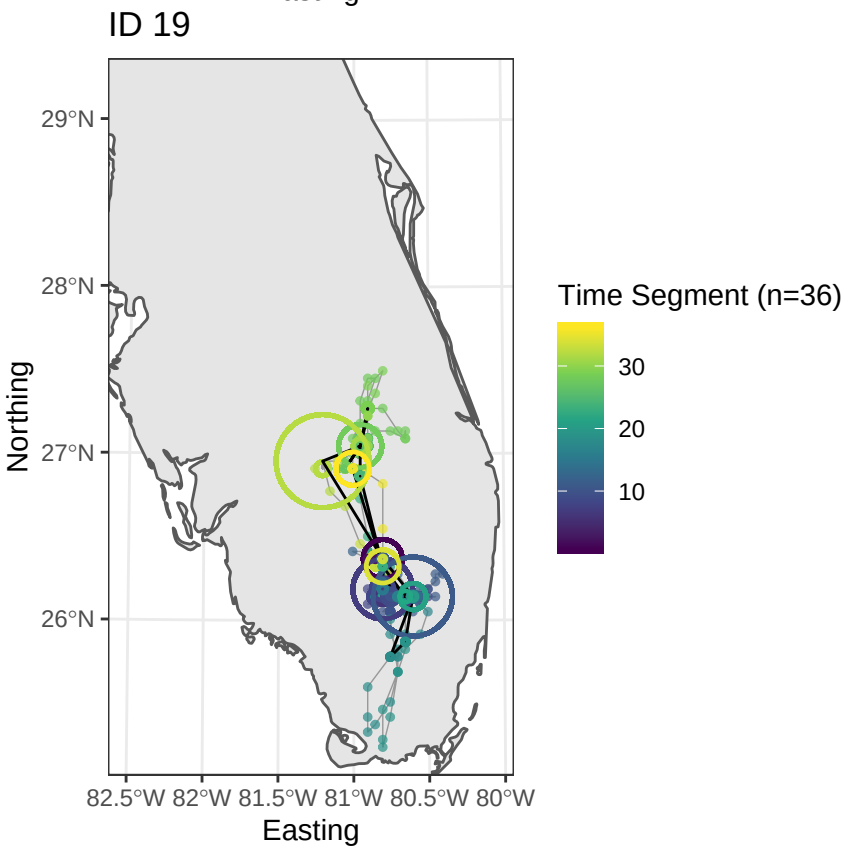
To improve upon the previous set of maps, the next step is to determine the location(s) used within each time segment and accentuate which cells/locations are used the most. To support this visualization, locations that are used to a lesser extent will also be included to show the full extent of areas visited. By scaling the point size proportionally at each location per individual, these maps seek to relay a quick understanding of the primary relationship between the observed snail kite movements with space and time.

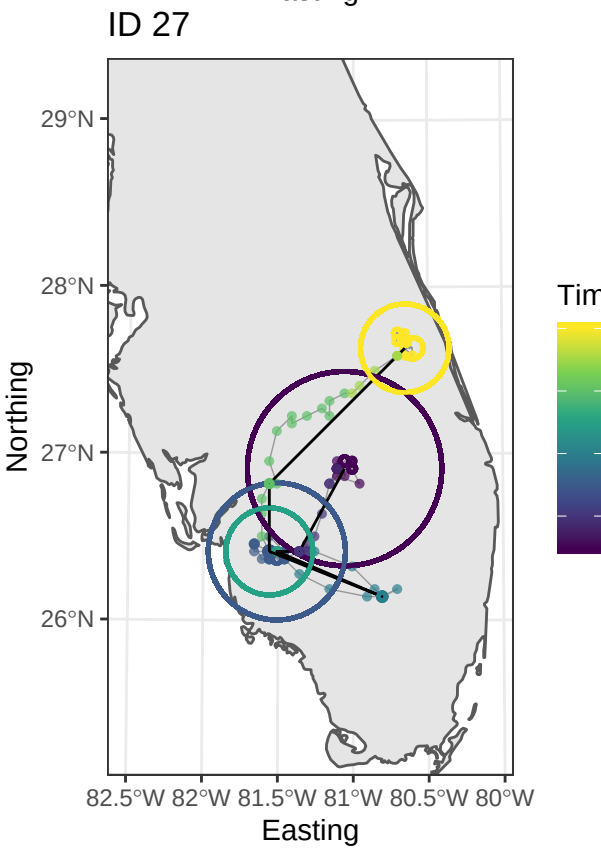

29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segment
40
30
20
10


29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segment
30
20
10


ID 1
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segment (n=49)
40
30
20
10


ID 12
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Tim


ID 19
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Time Segment (n=36)
30
20
10


ID 27
29°N
28°N
27°N
26°N
Northing
82.5°W 82°W 81.5°W 81°W 80.5°W 80°W
Easting
Tim

3D Plot

Another potential method to view these time series data is by a 3D scatter plot. Since the static version of these plots is not as useful as the dynamic/interactive form, the online hosted version of these plots for ID 1, ID 12, ID 19, and ID 27 have been included.