Appendix B. Details on example analyses

A link will be provided to all data and analysis code according to our Data Availability statement upon acceptance after anonymous review.

B.1. *Home Range Analyses*

Minimum Convex Polygon

The 100% minimum convex polygon was calculated using the *mcp* function within the `adehabitatHR` package in R.

Kernel Utilization Distribution

The 95% kernel utilization distribution was calculated using the *kernelUD* and *getverticeshr* functions within the `adehabitatHR` package in R. The *kernelUD* function was implemented using the default bivariate normal kernel and default smoothing parameter calculation. Please see the adehabitatHR manual for more information regarding this functions implementation. 'getverticeshr' was then used to extract the 95th percentile contour for plotting.

Local Convex Hull

The 95% local convex hull union was constructed using the `tlocoh` package in R with parameters $a = 75000$ and s=0. The a-LoCoH method creates convex hull sets from the maximum number of nearest neighbor points such that the sum of their distances from the point of interest is less than or equal to a. To select the appropriate a value, we examined the resulting hullsets and investigated plots of a vs. isopleth area and a vs. isopleth edge-area ratio for a values from 30,000 to 80,000 at intervals of 5,000. For more information about the appropriate selection of LoCoH parameter values, please see Getz *et al.* (2007), Lyons *et al.* (2013), Dougherty *et al.* (2017).

B.2. *Behavioral State Analysis*

After projecting the zebra trajectory (WGS84 UTM Zone 33S), the step lengths were transformed from meters to kilometers. A two-state model with no additional environmental covariates (a "two-state, no-covariate" model) was fit to the data. The initial values for the Gamma (step length) and von Mises (turning angle) distributions are in Table B1 whereas the final estimates are displayed in Table B2.

Table B1. Initial parameter values for the Hidden Markov Model

Step Lengths (Gamma)			**Turning Angles (vonMises)**	
mu	sigma	zero-mass	mean	concentration
0.1	0.1	1	π	1
1	1	0.05	0	1

Table B2. Parameter estimates for the Hidden Markov Model

Step Lengths (Gamma)			Turning Angles (von Mises)	
mu	sigma	zero-mass	mean	concentration
0.049	0.062	0	0.096	0.286
0.381	0.338	0	0.010	2.728

B.3. *Step Selection Analysis*

Selection of available points:

Step length and turning angles were calculated for each step in the empirical trajectory of AG256 using the `adehabitatLT` package. To inform the regression analysis, five 'available' points were sampled for each 'used' point. Sampling was achieved by randomly selecting paired sets of step lengths and turning angles observed in the empirical trajectory. By maintaining the step lengths and turning angles in pairs, we can maintain the behavioral mode underlying each step.

Environmental layers:

- **Landsat 4-5 TM - Greenness** Calculated based on the tasseled-cap transformation equation presented by Crist and Cicone (1984), which utilizes 6 of the 7 bands in a regression framework to calculate several measures, including Greenness, Wetness, and Brightness. Resolution: 30 meter.
- **Landsat 4-5 TM - Normalized Difference Vegetation Index (NDVI)** Resolution: 30 meter
- **distance to functional water**
- **distance to primary roads**

Regression:

Available and used points were given a binary variable for identification (1 for used, 0 for available) and combined into a single dataset. Values of each of the 4 environmental layers were extracted at each point using the extract function in the `raster` package. The resulting dataframe was passed to the *glm* function in package `lme4` and a binomial logistic regression with a logit link was run:

$$Used \sim \beta_0 + \beta_1 * distRD + \beta_2 * distH2O + \beta_3 * Greeness + \beta_4 * NDVI$$

The resulting model fit was fed into the *predict* function (in the package `raster`) and used to predict the selection ratio for the full extent of all 4 environmental layers. This predicted layer is what is displayed in Figure 3. Fitted coefficients of the model can be seen in Table B3.

Table B3. Fitted coefficients from example SSF

Coefficients:	**Estimate**	**Std. Error**	**z value**	**P value**
(Intercept)	-1.859e+00	5.558e-02	-33.447	<2e-16 ***
Dist_PrimaryRoads	5.863e-06	5.698e-06	1.029	0.30353
Dist_Water	-5.785e-06	2.195e-06	-2.636	0.00839 **
Mean_Greenness_2010	7.462e-03	1.328e-03	5.618	1.93e-08 ***
Mean_Wetness_2010	-6.962e-03	1.174e-03	-5.931	3.00e-09 ***

[1] Significance codes: 0 ***' 0.001 **'

Appendix B. - References

Crist, E.P. and Cicone, R.C., 1984. A physically-based transformation of Thematic Mapper data—The TM Tasseled Cap. *IEEE Transactions on Geoscience and Remote sensing*, (3), 256–263.

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Lyons, A.J., Turner, W.C., and Getz, W.M., 2013. Home range plus: a space-time characterization of movement over real landscapes. *Movement Ecology*, 1 (1), 2.