Workshop on R and movement ecology:

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Eric Dougherty, Dana Seidel, Wayne Getz

Lecture 5

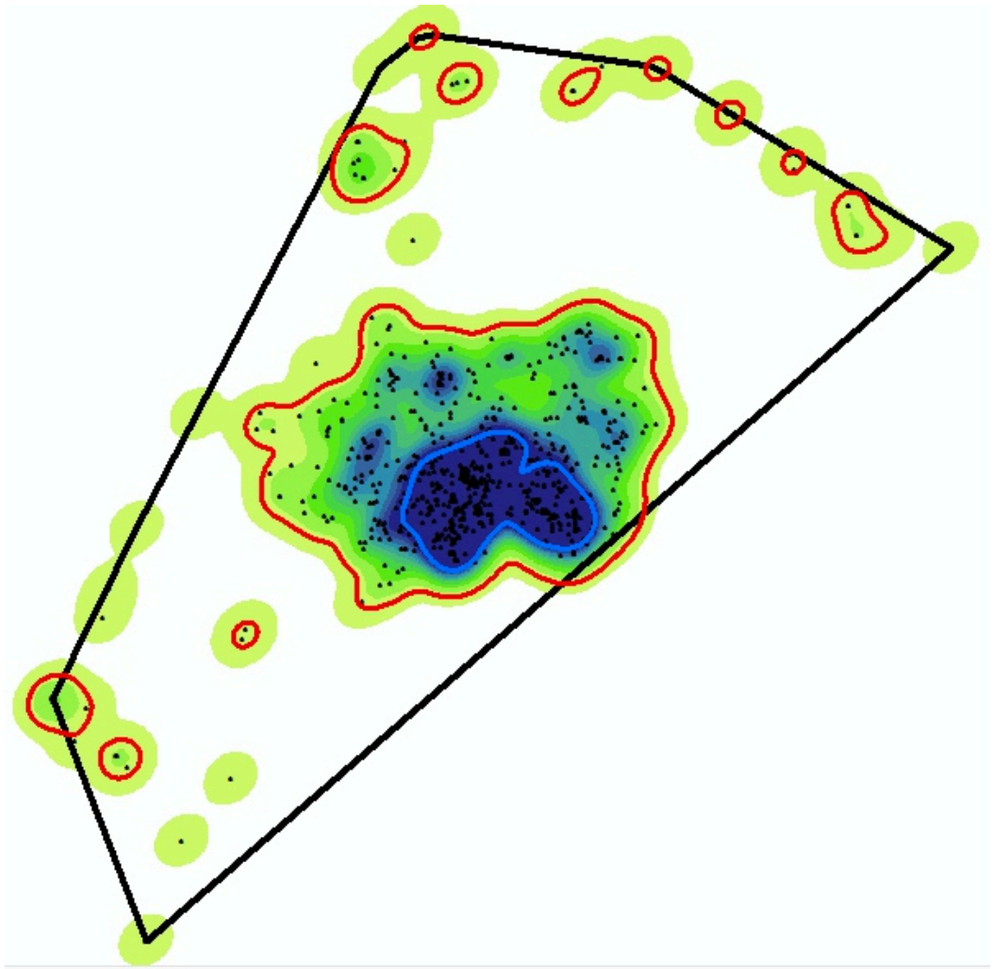
Selection Functions

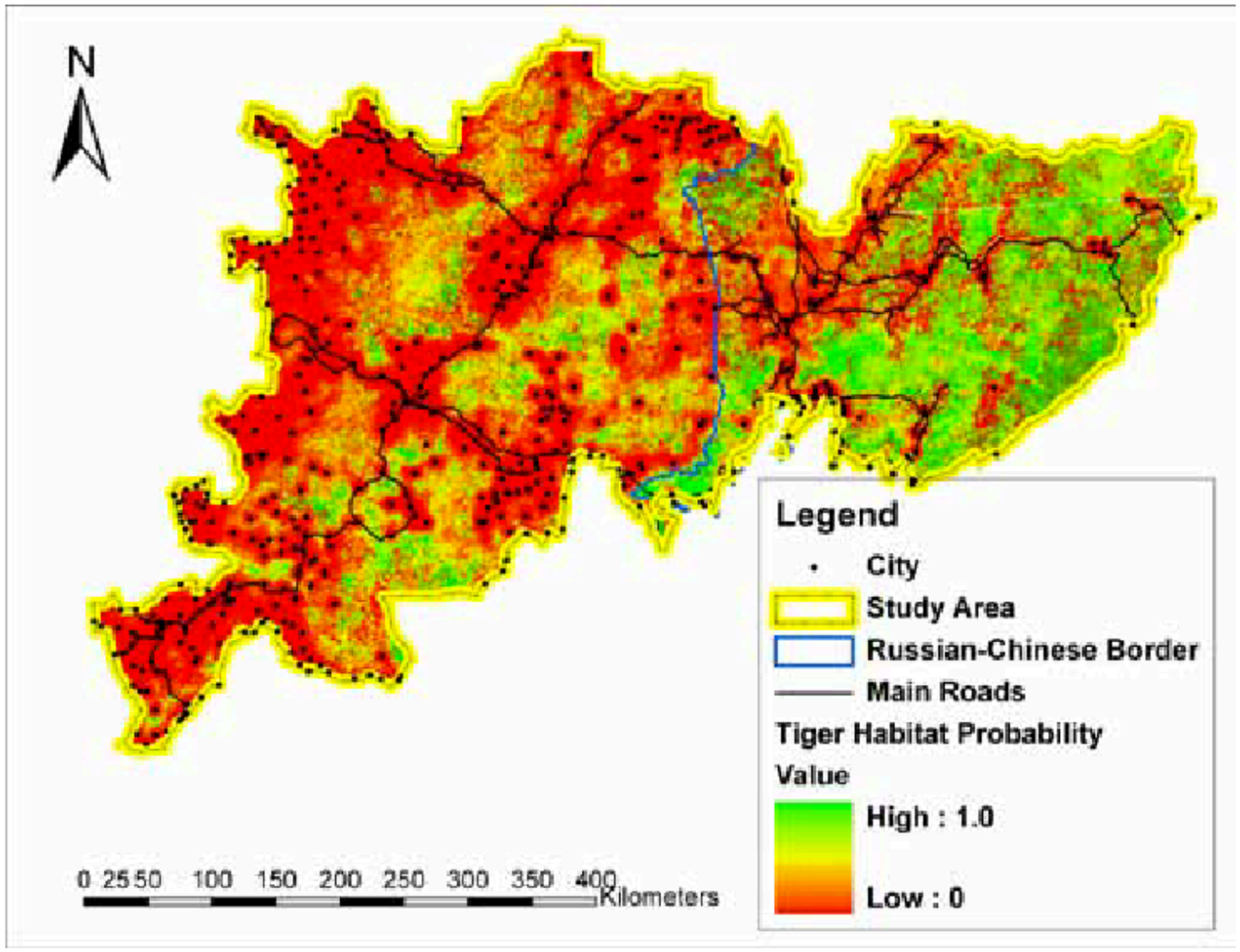
DEPARTMENT *of* ENVIRONMENTAL SCIENCE, POLICY, AND MANAGEMENT

Berkeley UNIVERSITY OF CALIFORNIA College of Natural Resources

From Description to Prediction

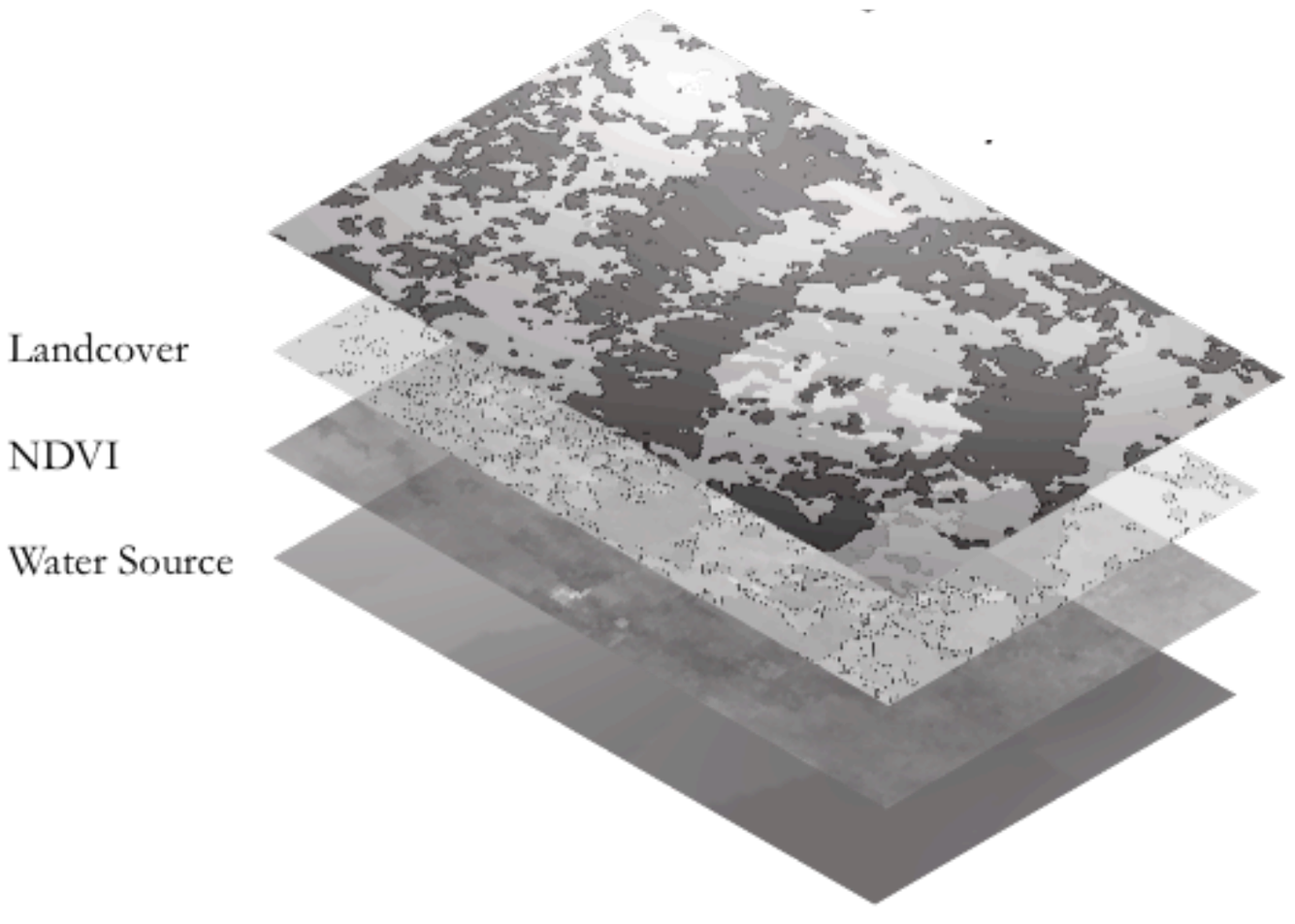
- The home range methods that we have discussed are meant to **describe** the movement patterns of individuals across landscapes based on recorded positional data. But what if we want to **predict** where an animal might be based on previous knowledge of their whereabouts?





Resource Selection Functions

- At a relatively broad-scale (landscape-level), one can consider all of the potential (or at least measurable) contributors to an animal's movement patterns. The resource selection function (RSF) framework was developed to create predictive maps or where we should expect animals to be based on their previous locations.



Resource Selection Functions

- An RSF is a model that yields values proportional to the probability of use of a resource unit. These are often fit using generalized linear models (GLMs), and model selection (i.e., selecting the right predictor variables to consider) is normally done through AIC or BIC approaches.

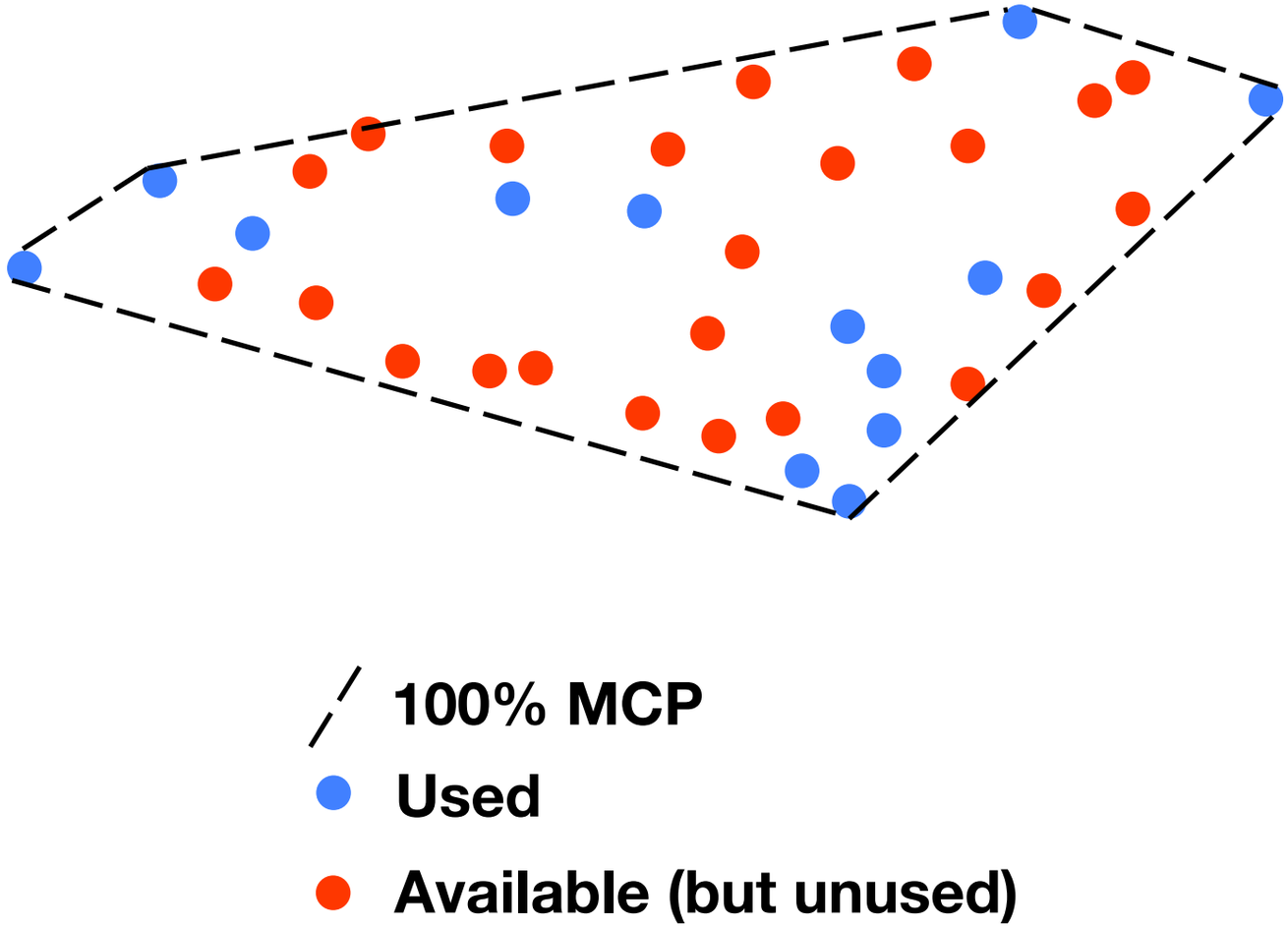
$$w(x) = \exp(\beta_0 + \beta_1 X_1 + \ldots + \beta_i X_i)$$

Where w(x) is the relative probability of a pixel being selected, β_0 is the intercept, and β_1 is the estimated coefficient for variable χ_1.

If $\beta > 1$, a preference for that resource is indicated, whereas $\beta < 1$ indicates avoidance of that resource relative to its availability on the landscape

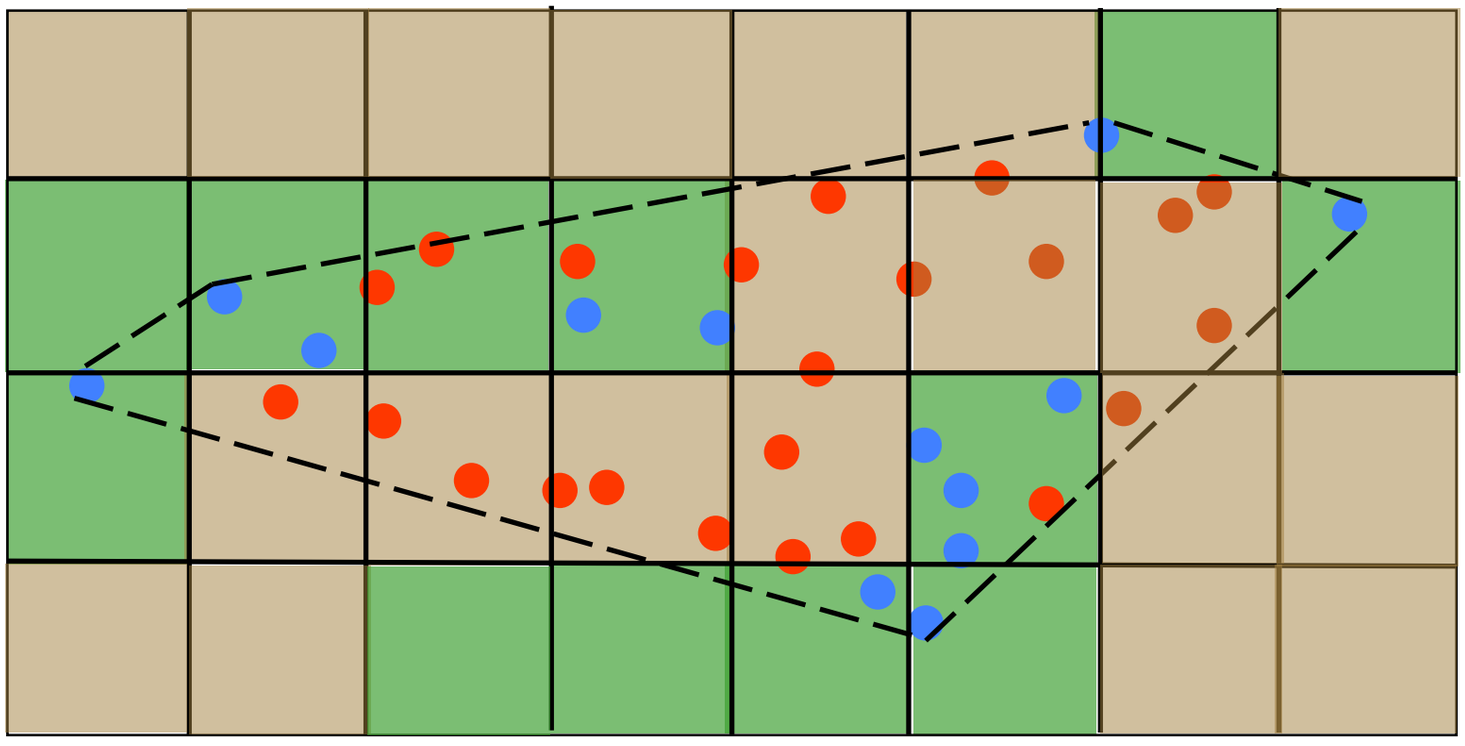
Used vs. Available Framework

- In order to use a logistic regression model, we must have a binomial response variable and a set of associated predictor variables. We can use presence (1) versus pseudo-absence (0; we don't know with with 100% certainty that an animal didn't go there, but we know we did not record them there)



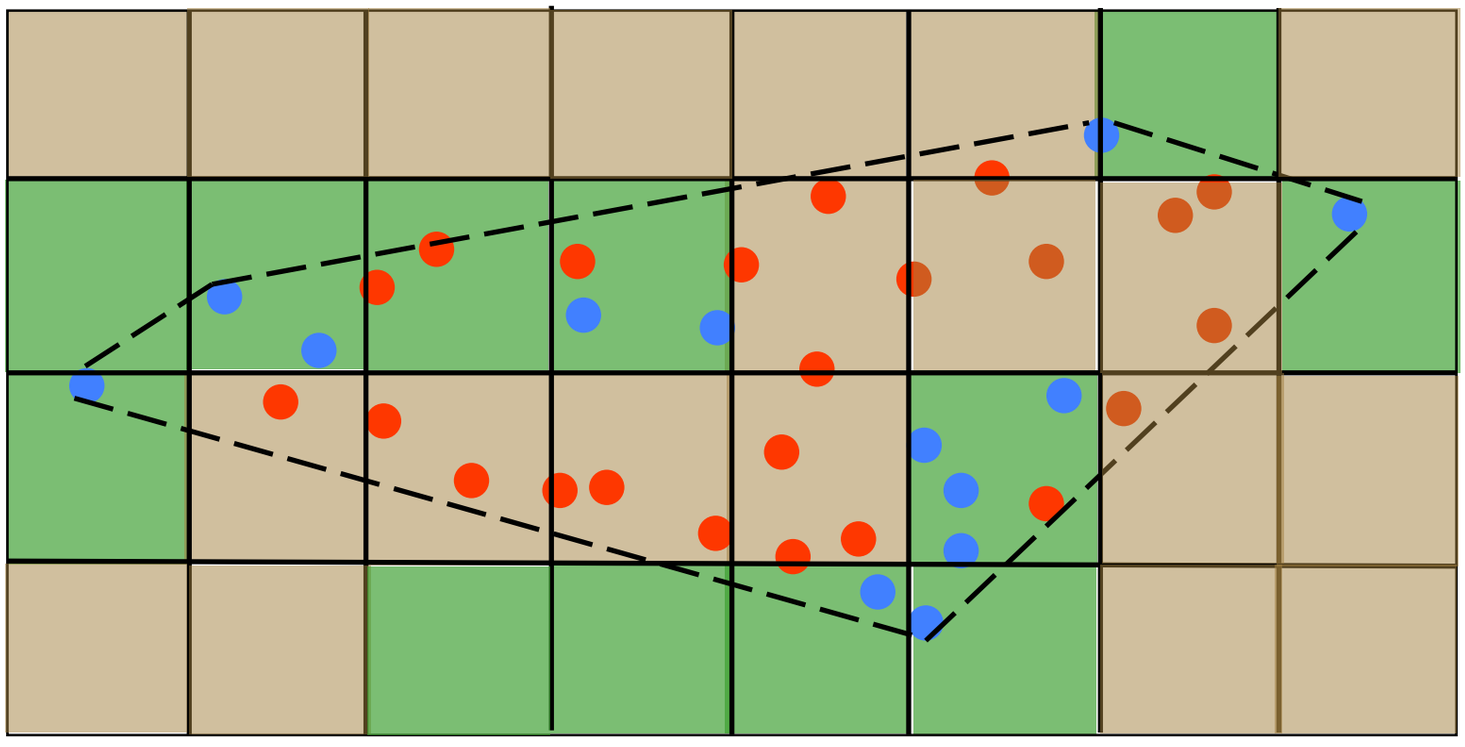
Used vs. Available Framework

- By extracting the values of various predictor variables (say, NDVI, distance to water, land cover type, elevation, and predator density) associated with these 1s and 0s, we can ascertain a pattern that can be extended to predict the probability of an animal being in each cell based on the predictors there.



Used vs. Available Framework

- In this very simplistic schematic, it is evident that the blue (used) points tend to fall on the greener resource units and the red (available) points tend to fall on the browner units. Assuming that greener indicates higher NDVI, this would suggest that the animal is selected for ($\beta > 1$) high NDVI.



RSF Considerations

- When developing a resource selection model, the resolution of the location (presence) points and the scale of the predictor variables can be quite influential. In some cases, different scales will be reveal different patterns of preference.

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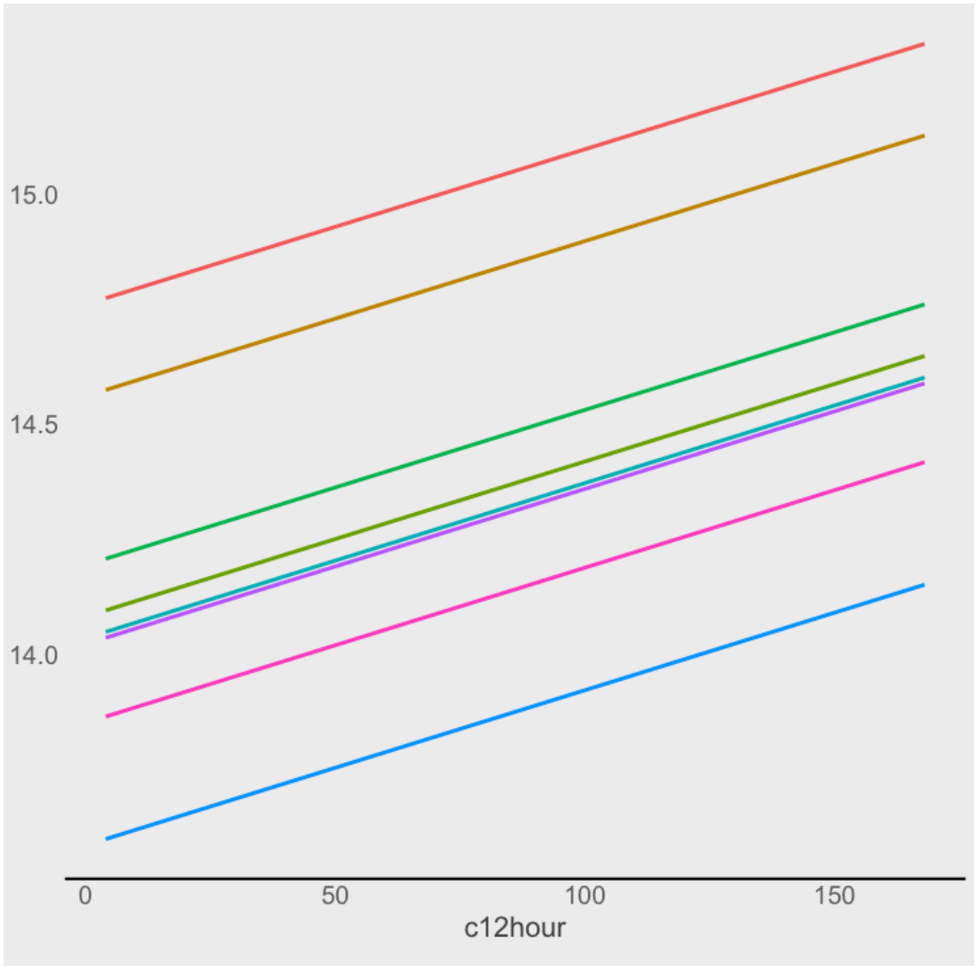
- Decisions must also be made regarding the temporal extent of the trajectory in question. Are there notable shifts in preferences across seasons that one should attempt to account for? Or perhaps individuals of different ages may select resources differently.

Population-Level RSF

- Another important consideration is whether you are trying to predict the selection of an entire population or simply an individual. When the former is the goal, practitioners will often implement a generalized linear MIXED model. The “mixed” refers to the fact that both fixed (standard environmental predictor variables) and random effects. A random effect (say, individual ID) may offer insight into the differences among individuals within the population.



RSF Alternatives (SSF and PSF)

- When fine-scale environmental data is available, it may be useful to use a more biologically realistic means of selecting available points.

- In the case of a step selection function (SSF), the available points are chosen from within a buffer around each point (i.e., readily reachable points). In the case of a path selection function (PSF), sets of points are used and available (but unused) paths are identified.