



# Portland Urban Coyote Project: Modeling Coyote-Observation Locations (COLs)

Zuriel Rasmussen and Andrew Wuest | Portland State University, Portland, Oregon

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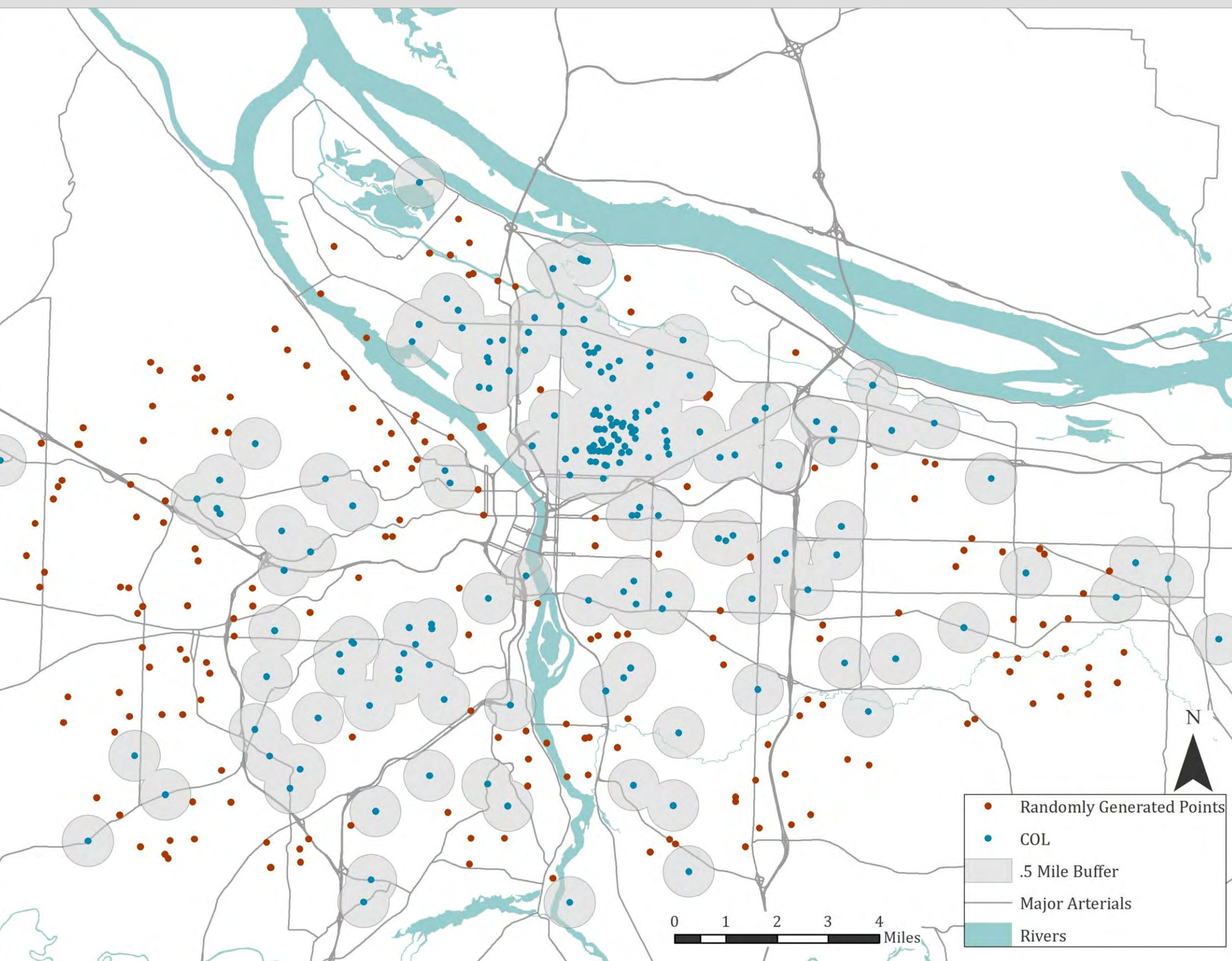
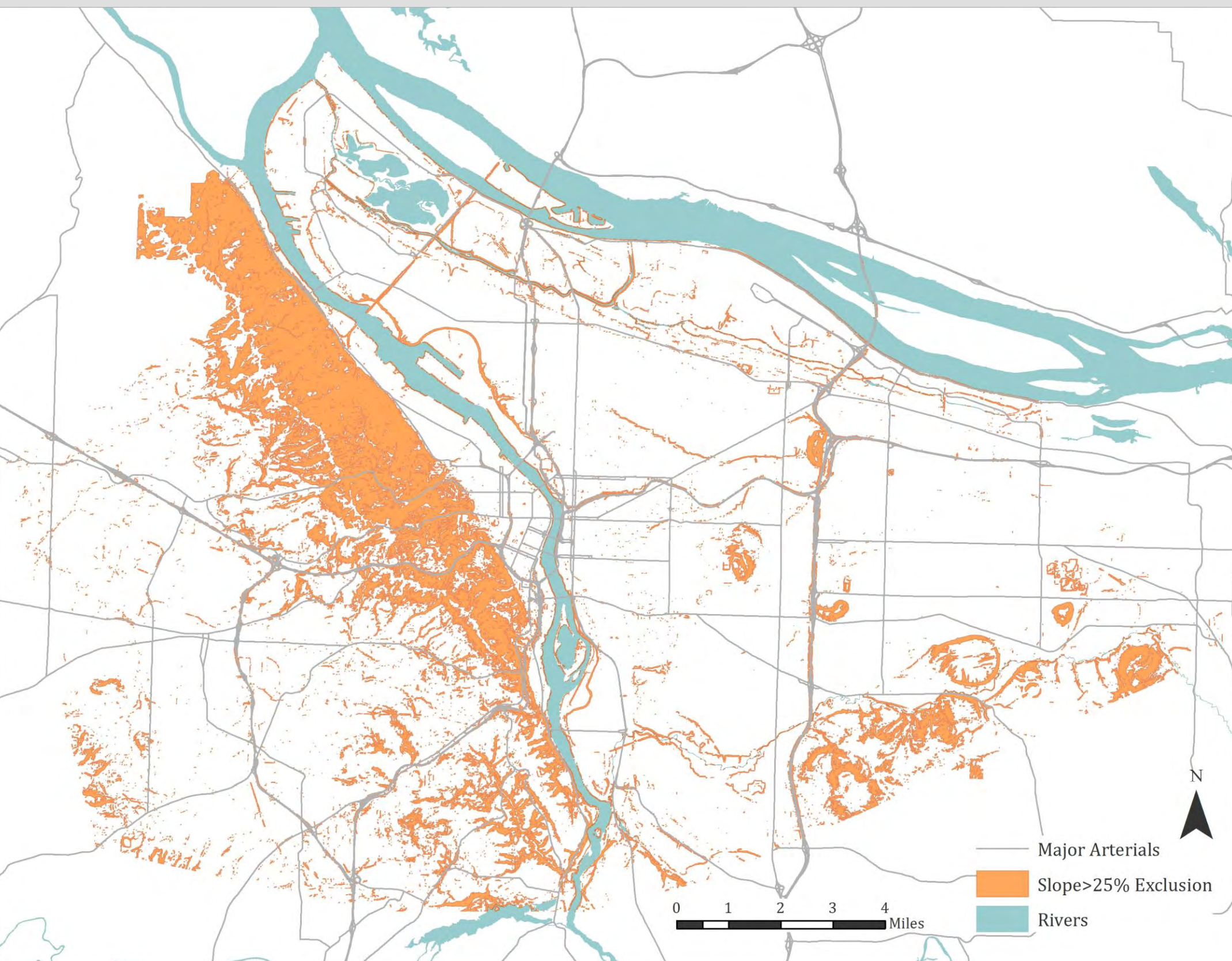
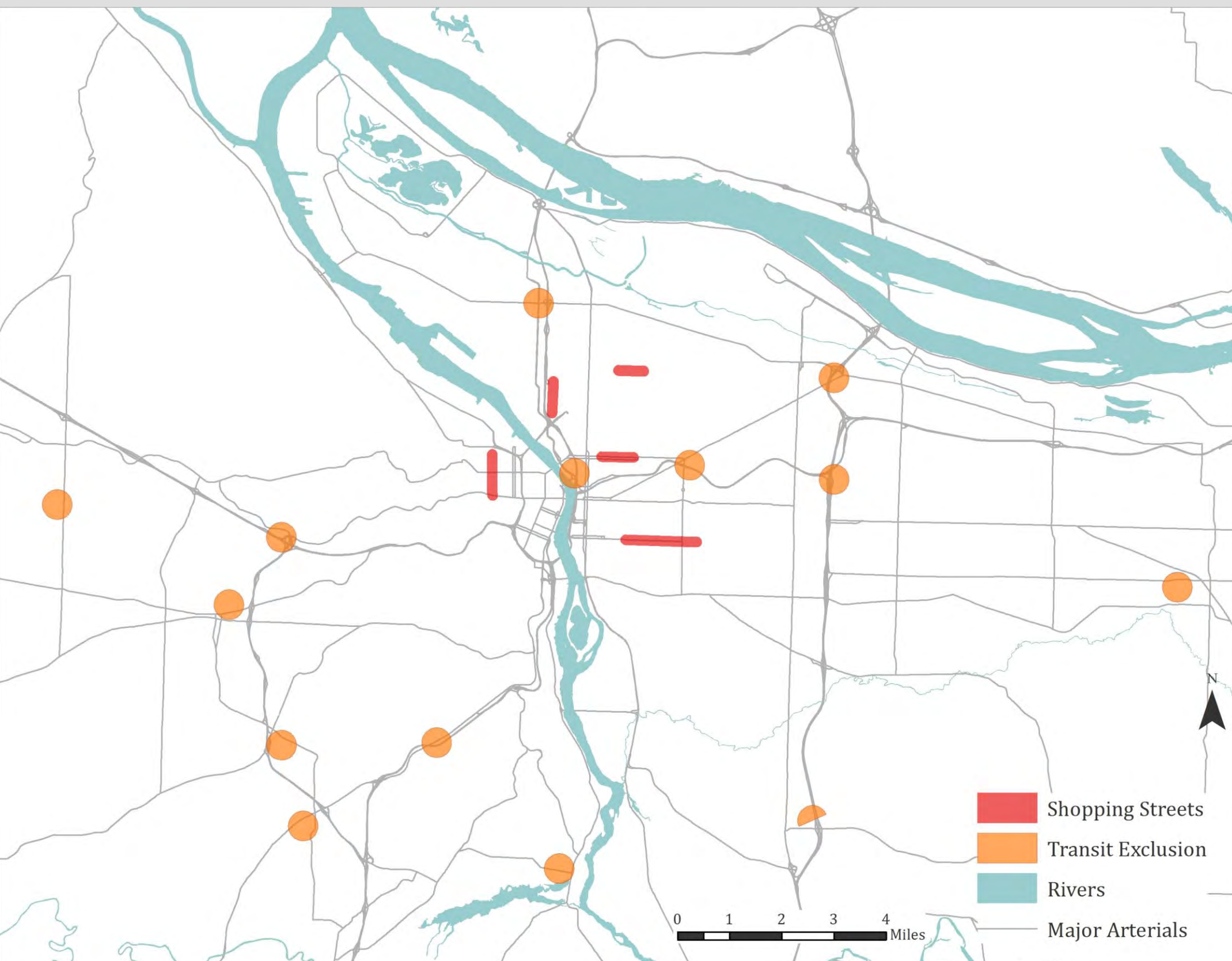
**Introduction:** The Portland Urban Coyote Project (PUCP) is an online citizen science project. From 2011 to early 2014, the PUCP has resulted in 164 coyote-observation locations (COLs) reported as addresses in the Portland Metropolitan Area. In addition to COLs gathered by the PUCP, the Audubon Society of Portland provided us with 30 coyote sightings reported to their organization. We wonder: Can we predict the locations of these COLs based on landscape characteristics such as residence-type, slope, or proximity to transit? Using a landscape modeling approach, we hypothesized that multiple variables might influence COLs (Fuller et al. 2003; Weckel et al. 2010).

**Methods:** Our model focused on the city of Portland, with borders of the analysis area limited to the extent of a minimum bounding polygon created from all COLs merged with the city of Portland boundary. We made this decision because we did not want to eliminate any of our (limited) point data by only considering points within the city boundary. However, this model is part of a preliminary study that will ultimately be limited to the Portland city limits, so we wanted to also include all parts of the Portland city limit, even those that extended past the minimum bounding polygon.

We created our model by determining plausible predictive landscape characteristics by using visual inspection of our COLs over the landscape, research about coyote behavior, and an understanding of the nature of citizen-reported data. Ultimately, we decided on four variables to analyze for our model. Below is a description of each variable, with a justification of its inclusion or exclusion in the model.

**Null Hypothesis:** No combination of variables in our model will predict COLs at a statistically significant (95%) level as evaluated through a binary logistic regression.

**Hypothesis:** Some combination of variables in our model will predict COLs at a statistically significant (95%) level as evaluated through a binary logistic regression.



## Variable 1: Tax Lot Factors

**Proximity to Single Family Residences (SFRs):** COLs appeared to be near or within SFR tax lots. This is consistent with research that coyotes tend to be closer to residential areas (associated with SFRs) than apartments (MFR) or commercial (COM) areas (Gehrt et al. 2009). We modeled this by applying a 100-foot buffer (to include street areas around SFRs) to all SFRs and dissolving these buffers into one multipart polygon.

**Inclusion of Rural (RUR) tax lots:** The inclusion of RUR tax lots (cemeteries, Portland parks, country clubs, golf courses, etc.) is motivated by research that urban coyotes are often found in cemeteries, golf courses, and sometimes in public parks (Gehrt et al. 2009). Additionally, upon visual inspection of the points, coyotes appear to be sighted near or on these lots. We did not buffer these areas because they tended to border SFRs; we wanted to keep the model as minimally inclusive as possible.

**Results:** By coding each model variable with 0 for an expected non-COL and 1 for an expected COL, we were able to evaluate our model in SPSS with a binomial logistic regression. Our aim was to determine whether our model variables were successful in predicting the presence or absence of coyotes. The results of our analysis showed us that tax lots and slopes over 25% were statistically significant variables in our model, while transit centers and shopping areas were not good predictors of COLs.

| Parameter       | p-value | Exp(B) |
|-----------------|---------|--------|
| Tax lots        | .002    | 2.109  |
| Slope           | .002    | 4.867  |
| Shopping Areas  | .613    | .532   |
| Transit Centers | .448    | 2.442  |

This table displays the p-values and Exp(B) of the variables in our model. The Exp(B) field represents the odds ratio of each variable. For example, the odds that a COL falls within the designated tax lot layer is 2.109 times greater than the odds that a random point will fall within the tax lot layer (Institute for Digital Research and Education). After evaluating our results, we were able to reject the null hypothesis that no variables in our model were significant at a 95% significance level.

Our final model will include variable 1: tax lots (2.109 times more likely for COLs) and variable 4: slope>25% (4.867 times more likely for non-COLs), both at a significance level of 95%.

**Limitations:** When working with citizen-reported data, there are significant specific limitations. It is important to keep in mind that all COLs used in this study are representative of instances in which: (1) a coyote was present; (2) a coyote was observed by a human; (3) the human observing the coyote was aware of our project or called the Portland Audubon Society; and (4) the person opted to report the sighting of the coyote. Additionally, it is unknown how accurate citizen-reported data is; individuals might be mistaken in their observation or may report inaccurate locational information. These COLs are concentrated in the Alameda neighborhood, where the citizen science project was most highly promoted; however, if the project were promoted more widely, the distribution of COLs would likely be different.

**Conclusion:** If we can predict the location of COLs based on landscape characteristics, then Portland parks and recreation, nature conservation groups, and other related organizations could target areas with these landscape characteristics for increased educational programs or other measures to mitigate negative human-coyote interactions.

With this model, we were able to determine that coyotes are less likely to be observed on slopes over 25% and more likely to be observed in areas near single-family residences and rural tax lots. We were not able to identify a significant transportation factor or congestion factor in this model. In future studies, we may be able to build upon the landscape characteristics identified by this model and add greater complexity, detail, and predictive ability to our landscape model. Alternatively, it is possible that the city of Portland is generally a welcoming habitat for coyotes, and so modeling for observations is difficult because an individual can see a coyote in many parts of the city and across many types of landscapes.

The strength of this project lies in its community engagement, and in order to build a better model in the future, we need to gather even more COLs. If you see a coyote, please be sure to report it at [www.urbancoyoteproject.weebly.com](http://www.urbancoyoteproject.weebly.com).

## References

Fuller, D.O., Williamson, R., Jeffe, M., and James, D. 2003. Multi-criteria evaluation of safety and risks along transportation corridors on the Hopi Reservation. *Applied Geography*, 23 (2-3): 177-188.

Gehrt, S.D., C. Anchor, and L.A. White. 2009. Home range and landscape use of coyotes in a metropolitan landscape: Conflict or coexistence. *Journal of Mammalogy*, 90(5): 1045-1057.

Weckel, M.E., D. Mack, C. Nagy, R. Christie, and A. Wincorn. 2010. Using Citizen Science to Map human-coyote interaction in suburban New York, USA. *Journal of Wildlife Management*, 74(5): 1163-1171.

Institute for Digital Research and Education. SPSS FAQ: How do I interpret odds ratios in logistic regression? UCLA: Statistical Consulting Group. <http://www.ats.ucla.edu/stat/spss/faq/oratio.htm> (accessed March 14, 2014).

## Data Sources

Data consulted for model creation included: OpenStreetMap; RLIS; ESRI

All of the data that was ultimately used in this model was gathered from RLIS

Shapefiles used: Taxlots, Arterials, City\_Fill, City\_Boundary, Slope\_25, Rivers

## Variable 4: Ecological Factor

**Slope over 25%:** Research suggests that coyotes tend to remain on flat, open areas when possible (Gehrt et al. 2009). Additionally, human presence on slopes over 25% was hypothesized as unlikely. The conjunction of limited human and coyote presence resulted in our justification of exclusion of slopes over 25% in the model.

## Binomial Logistic Regression

In order to evaluate the accuracy of our model, we used a binomial logistic regression, performed in Statistical Package for Social Science (SPSS). We needed to create a set of random points that were not near our COLs so that the locations of each type of point could be compared. We coded COLs with (1) and non-COLs with (0). The non-COL points were created by forming half-mile buffers around all COLs to simulate a conservative estimate of urban coyote range (Gehrt et al. 2009).

## Final Model

The map below displays the two statistically significant model parameters (tax lots and slope>25%) as one layer (displayed in green). The COLs and randomly generated points for comparison show where the model did and did not accurately predict.

