Spatial Analysis

We collected data to test the effects of park size, canopy cover within parks, impervious surface within parks, number of surrounding buildings, surrounding building heights, distance to closest major road, surrounding road surface area, and park temperature on population dynamics of melanic squirrels. First, to assess park size we downloaded the City of Montreal’s park database (<https://donnees.montreal.ca/dataset/grands-parcs-parcs-d-arrondissements-et-espaces-publics>) and extracted the polygon areas for all study parks found within the dataset. For parks not found in the dataset (i.e., parks outside of the island of Montreal), we used Open Street Map data to extract their boundaries via the osmdata package (<https://cran.r-project.org/web/packages/osmdata/index.html>). After extracting the polygons for each park, we calculated the area using the *st\_area* function from the sf package (<https://cloud.r-project.org/web/packages/sf/index.html>). To calculate canopy cover and impervious cover within the parks, we used the Metropolitan Canopy Index dataset provided by the Communauté Métropolitaine de Montréal (<https://observatoire.cmm.qc.ca/produits/donnees-georeferencees/#indice_canopee>). We intersected each of the park boundaries with the Canopy Index dataset and calculated the number of pixels that were canopy and impervious surface and then divided by the total number of pixels in the park to calculate canopy cover and impervious surface cover, respectively. Number of buildings surrounded the park was calculated by first producing a 100 m buffer surrounding each park, using the *st\_buffer* function and then extracting and counting all the building polygons that fell within that zone (<https://github.com/microsoft/CanadianBuildingFootprints>). We also calculated the area occupied by buildings surrounding the park by calculating and summing the area of each building footprint within the buffer zone. To find the proportional measure of building area, we took the total building footprint area and divided it by the buffer area. To calculate surrounding building height, the same building layer was used. All building footprints were extracted within the 100 m buffer, then the Canadian High Resolution Digital Elevation Model (<https://gee-community-catalog.org/projects/hrdem/?h=canadian+ele>) was used to extract the height at each of the building centroids. Mean surrounding building height was then calculated for each of the parks. To calculate distance to nearest major road, we defined major roads as Trans-Canada highways, highways that are part of the National highway system, all major highways, and all secondary highways or major streets. We extracted all major roads from the National Road Network (<https://open.canada.ca/data/en/dataset/3d282116-e556-400c-9306-ca1a3cada77f>) and calculated the distance to the nearest major road from each of the parks using the *st\_nearest\_feature* function. We calculated surrounding road surface area using the roadway asset database published by the City of Montreal (<https://donnees.montreal.ca/dataset/voirie-actif>). Since this dataset was only available for the island of Montreal, not all parks were included in the calculations. We selected all road, alleyway, intersection, and sidewalk polygons within 100 m of the parks. We then calculated the sum area of each of these polygons within the buffer for each park and reported the total area for each park. Finally, we calculated land surface temperature using Landsat 8 data and a published coding framework (<https://developers.google.com/earth-engine/datasets/catalog/LANDSAT_LC08_C02_T1_L2>, <https://developers.google.com/earth-engine/datasets/catalog/LANDSAT_LC08_C02_T1_TOA>, Ermida et al., 2020). We extracted Landsat data in each park across each month in 2022. We then used the extracted imagery and calculated the mean land surface temperature for each month in each park. Surrounding building height and land-surface temperature were calculated using Google Earth Engine (Gorelick et al., 2017). The rest of the spatial analysis and data cleaning was performed in R 4.3.0 (R Core Team, 2023). All code for this analysis can be found here: <https://github.com/zule-lab/McGillSquirrels>.

Literature Cited

Ermida, S.L., Soares, P., Mantas, V., Göttsche, F.-M., Trigo, I.F., 2020. Google Earth Engine open-source code for Land Surface Temperature estimation from the Landsat series.

Remote Sensing, 12 (9), 1471; https://doi.org/10.3390/rs12091471

Gorelick, N., Hancher, M., Dixon, M., Ilyushchenko, S., Thau, D., & Moore, R. (2017). Google Earth Engine: Planetary-scale geospatial analysis for everyone. *Remote Sensing of Environment*.

R Core Team (2023). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.