EnviroAtlas

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Near Road Tree Cover in the Portland, ME EnviroAtlas Community Area

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Abstract

This poster shows the amount of woody vegetation near heavily-travelled roads, and the population living along them, for greater Portland, ME, an EnviroAtlas pilot community. Land cover was classified from 1-meter resolution aerial photography, and was then used to quantify the amount of tree cover along interstates, arterial roads, and connectors within the focal community. The amount of tree cover within twenty-six meters (m) from the edges of these busy roadways was calculated using a moving window approach. The final products include both a visual representation of the near-road tree cover summarized into five percentage classes, and summaries at the census block group scale of the road length and the population with and without significant tree buffer. One purpose of these analyses is to identify areas that could benefit from additional tree buffers to screen near-road populations. These data can be assessed with other socio-economic factors to identify areas of greater vulnerability. The study area examined in this analysis (Figure 1) is defined as the EnviroAtlas Study Area for Portland, ME. The area was defined using 2010 Census Urban Area Boundaries and 2010 Census Block Groups.

Figure 1. Study Area

Methods – Data and Pre-Processing

Data Sources:

- 2010 1-m EnviroAtlas Land Cover for Portland, ME
- 2010 30-m EnviroAtlas Dasymetric Population Map
- 2010 US Census Bureau Block Groups and block group -level Population Data
- 2011 NAVTEQ Streets for the United States

Pre-Processing:

1. Convert land cover to forest binary where forest = 1, all else = 0.
2. Perform moving window analysis on forest binary to calculate number of forest pixels within a 29m x 29m window centered on the pixel.
3. Extract heavily travelled roads from NAVTEQ Streets (Func_Class <5).
4. Create road width polygons by buffering roads by half of the number of lanes (To_Lanes + From_Lanes) multiplied by 3.6576 meters (12ft lane width).
5. Create second road buffer 11.5m from road edges for further analysis. (Figure 2).
6. Extract moving window pixels along 11.5m buffer edge. (Figure 3).

Moving Window Analysis

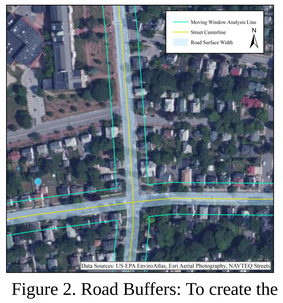

Figure 2. Road Buffers: To create the moving window analysis line, the road centerline (yellow) was buffered by the road width to create the road surface (transparent blue). The road surface was then buffered to create the analysis line (aqua).

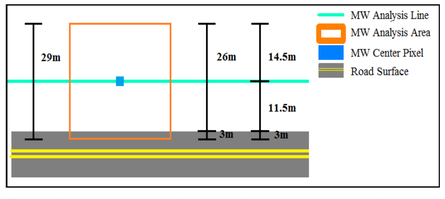

Figure 3. Illustration of Moving Window Analysis: Each 1m pixel (blue) was attributed with the total number of tree-cover pixels within the surrounding window (orange, 29m x 29m). By retaining only the pixels along a set distance (aqua) from the road edges, the analysis captured tree cover beyond the road shoulder, cleared the right-of-way, and avoided any tree cover in the median. The moving window analysis was set to overlap the road surface by 3m to account for error in the centerline placement or road width calculation. Not to scale.

Methods and Results – Block Group Summaries

Objective:

The objective of this analysis is to summarize the near road tree cover data by block group. This includes length of road buffered by sufficient and insufficient tree cover as well as a quantification of the population living in both environments.

Processing:

1. Reclassify extracted moving window pixels into sufficient or insufficient based on a 25% cut off threshold described in Figure 4.
2. Calculate the total length of heavily travelled road (in each direction) as well as the length of sufficiently and insufficiently buffered road (in each direction).
3. Create 300m buffers beyond the insufficient (<25% tree cover) and sufficient sections of road such that the buffers are not overlapping (Figure 5).
4. Extract the dasymetric population pixels from the insufficient and sufficient buffers separately and summarize by block group.
5. Use the census block group population to estimate the total and percent population by block group that is within 300m of a road with sufficient tree buffer and without sufficient tree buffer. These layers are all available on EnviroAtlas (Figure 6).

Population with Sufficient and Insufficient Tree Buffer Analysis

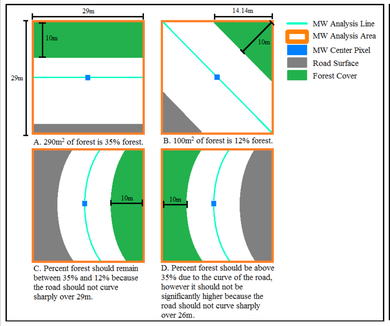

Figure 4. Sufficient Tree Cover Threshold: For this analysis, sufficient tree cover was defined as a depth of three trees (approximately 10m) across the analysis window. Depending on the justification of the road within the analysis window, 10m of trees represents between 12% and 35% tree coverage within the analysis window. We use a 25% threshold which is the average of these two values, plus 1% for ease of communication. Not to scale.

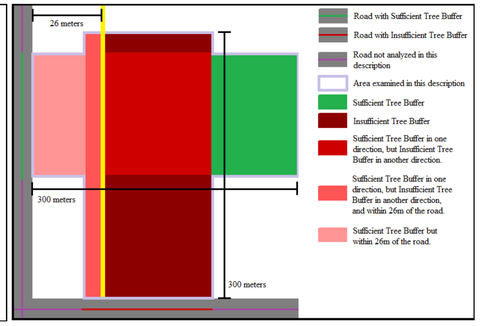

Figure 5. Determining Tree Buffer Classification: Residents are considered insufficiently buffered if they live within 300m of a road with insufficient tree cover (<25% of moving window). Residents were also considered insufficiently buffered if they live within 26m of a road with sufficient tree cover (>25%) because the location of the tree cover within the first 26m beyond a road edge is unknown and may not actually be buffering those residents. Residents are considered to be sufficiently buffered only if they live between 26.1m and 300m from a road that is sufficiently buffered and not within 300m of an insufficiently buffered road. Not to scale.

Near Road Tree Cover Block Group Summaries

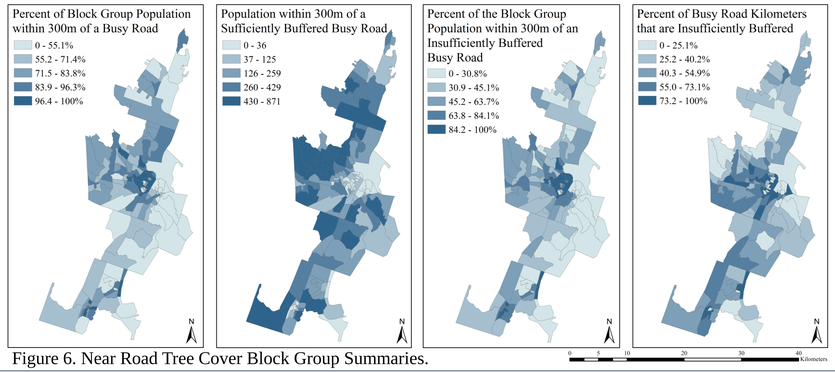

Figure 6. Near Road Tree Cover Block Group Summaries.

Methods and Results – Foundational Layer

Objective:

The objective of this analysis is to develop a spatially explicit layer describing near road tree cover for easy interpretation at street-level (Figures 7 and 8).

Processing :

1. Reclassify extracted moving window pixels into 5 percentage classes: 0 – 12.5%, 12.51 – 25%, 25.1 – 50%, 50.1 – 75%, 75.1 – 100%.
2. Convert the reclassified pixels into a line file attributed with the percentage classes.

Percent Tree Cover within 26m of a Busy Road

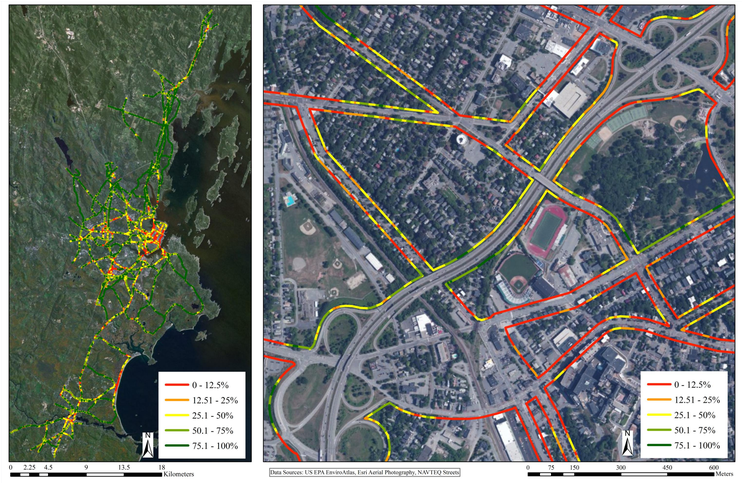

Figure 7. Percent Tree Cover within 26m of a Busy Road: Left: Portland, ME EnviroAtlas Study Area. Right: Close up including Deering Oaks Park, and I-295 from Foe River Pkwy to Forest Ave.

Moving Window Recap

Figure 8. Moving Window Analysis with Percent Forest: This figure recreates Figure 2 with the near-road tree buffer layer added to the image. The translucent orange area represents the approximate area analyzed for forest cover by the moving window analysis. The Percent Tree in 26m of a Road line (red to green) replaces the moving window analysis line (aqua in Figure 2) and represents the amount of forest within each moving window analysis area for each pixel, summarized into 5 percentage classes.

Conclusions

These layers estimate the amount of near road tree buffer along busy roads in Portland, ME, as well as the population living near those roads. These layers can be used to assess the extent of buffered roadways across a community, and disparities in benefits between neighborhoods. When overlaid with socio-economic layers available in EnviroAtlas, this map can highlight specific age groups and other populations who are differentially vulnerable to the adverse health effects of near road air pollution, and for whom near-road tree buffers could be especially beneficial. These data are not meant to be used for inferring numbers or types of residents that are at risk for developing specific health conditions. The threshold value and buffer depth are based on plausible assumptions and preliminary field studies. Further research is necessary to validate or refute these estimates.

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