Assessments of the Ecological and Economic Functions of Urban Parks in Hamilton County, Ohio, through a Modeling Approach

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InVEST integrated valuation of ecosystem services and tradeoffs

Abstract

The role of city parks is becoming more important in our crowded society, especially in providing wildlife habitats and recreation activities. This research focuses on ecological and economic functions of city parks. Using the Habitat Quality Model and Recreation Model in InVEST, habitat quality for woodpeckers and passage flow volume (representing the economic profits) for recreation are modeled. According to the different land-use types (Water, Developed & Barren, Forest & Shrub, Cultivated, Wetlands, Parks), the study area can be divided into habitats or threats for woodpeckers with various degree in sensitivity. Altitude, road density, edge effect, etc. are treated as threats. Based on existing threats, predictive maps of habitat degradation and quality are produced. Trails, benches, reaction area, waterbody, vegetation coverage, etc. are considered as factors attractive to park visitors. With the population of visitors as the dependent variable, a regression model is used to explore the potential factors contributory to park visits. Maps generated from this study reveal the places that attention is warranted to combat the degradation trend, and the regression model provides information to help us promote park visits. We believe this study will be useful not only to academia but also to the city park managers as they want to further park development.

Study Area

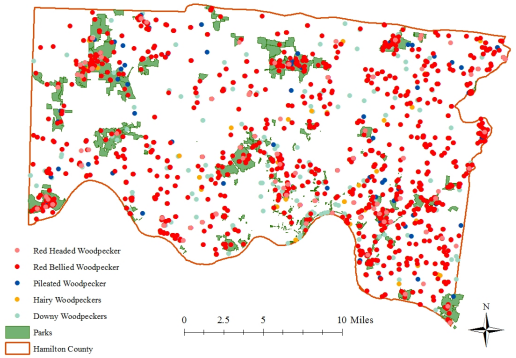

Figure 1. Woodpeckers recorded in Hamilton County

Habitat Quality

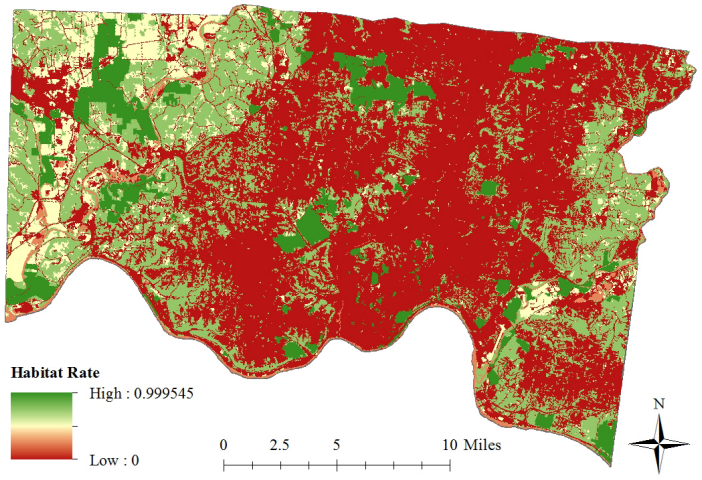

Figure 2.1. Original Habitat Quality

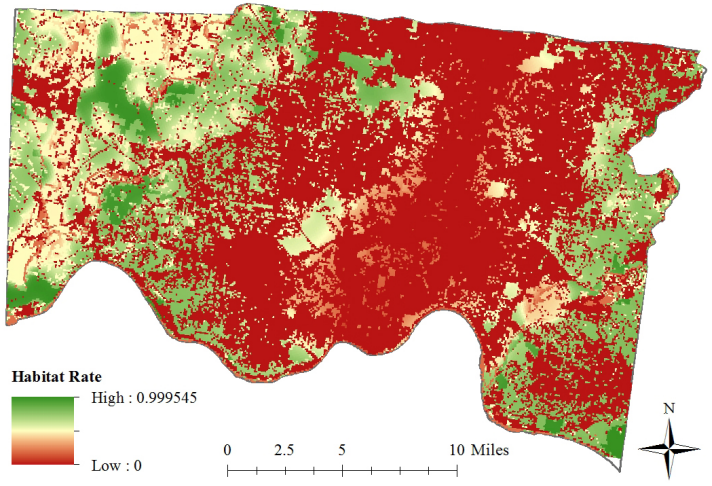

Figure 2.2. Predicted Habitat Quality

(Deteriorated habitat quality is denoted by a decreasing habitat quality rate)

LULC Code	LULC Types	Habitat	Threats			
			Urban	Agric	DEM	Road
11	Water	0.2	0.5	0.1	0.4	0.5
21,22,23,24,31	Developed & Barren Area	0	0	0	0	0
41,42,43,52	Forest & Shrub	0.8	0.8	0.6	0.3	0.7
71,81,82	Cultivated Area	0.5	0.7	0.05	0.6	0.5
90, 95	Wetlands	0.2	0.6	0.3	0.4	0.8
100	Parks	1	0.8	0.6	0.5	0.4

Table 1. Sensitivity of Habitat Quality and Threats; the value ranging from 0 to 1 depicts the weight used in the calculations

Recreation Model

	Estimate	StdErr	T Value
(Intercept)	5.07E+08	6.26E-05	8.10E+12
Benches	1.86E-02	4.20E-03	4.44E+00
Area	-5.07E+06	6.26E-03	-8.10E+08
Recreation Facilities	6.33E-02	5.98E-02	1.06E+00
Water	4.77E-02	1.54E-02	3.10E+00
Trails	8.90E-06	5.06E-06	1.76E+00
DEM	-1.03E-03	2.97E-03	-3.48E-01
Playground	3.00E-01	1.44E+00	2.09E-01

Table 2. Coefficients of Factors

$$\begin{aligned} &Number\ of\ Visitors \\ &= 5.07\times10^{8} + 0.0186\times Benches(num) \\ &- 5.07\times10^{6}\times Area(coverage) \\ &+ 0.0633\times RecreationFacilities\ (coverage) \\ &+ 0.0477\times WaterBody\ (coverage) \\ &+ 8.9\times10^{-6}\times Trails(length) \end{aligned}$$

Equation 1. Linear Regression Equation for Recreation Analysis

Results

- Parks that were surrounded by developed area will have a higher degree of degradation than others. Some smaller parks can be completely degraded (Figure 2).
- The habitat quality for woodpeckers can be improved if the land can connect to enough high-quality lands (Figure 2).
- The number of benches, the availability of recreation facilities/water, and the length of trails had a positive relationship with the population of visitors (Table 2 & Equation 1).
- The areal extent of parks has a negative correlation with the number of visitors (Table 2 & Equation 1).
- The t values of DEM and the availability of playground were so small; it seems that they are not important in attracting visitors (Table 2).

Reference

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