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Abstract

This study uses the hedonic price method to examine the relationship between the sale price of single-family residential properties in an urban watershed in Portland, Oregon and (1) the amount of riparian vegetation and upland wildlife habitat on a property, and (2) the amount and quality of riparian corridors within ½ mile of a property. Streams on a property are found to increase a property's sale price while streams in the surrounding neighborhood have a negative effect. While increasing the overall percentage of riparian corridors and upland wildlife habitat is found to have a positive but declining effect on sale price, a more detailed analysis concludes that the effect depends on the type and quality of resources. The quality and quantity of riparian corridors within ½ mile of properties is being capitalized into the sale price of properties suggesting that restoration efforts will generate benefits to property owners in the study area.

Introduction

In 1973 the Oregon State Legislature passed statewide land-use planning goals. These goals describe the state's policies on land use and related topics such as citizen involvement, housing, recreation, energy conservation and natural resources. Goal 5 requires local governments to adopt programs to "protect natural resources and conserve scenic, historic, and open space resources for present and future generations" (Oregon Department of Land Conservation and Development 1996).

Metro, the directly elected regional government that includes 25 cities and parts of three counties in the Portland metropolitan area, adopted a long-range growth management plan in 1995 that included the protection of natural areas. In 2001 Metro initiated a three-step process to develop and implement a regional fish and wildlife protection program.

In the first step Metro conducted an inventory of riparian corridors and upland wildlife habitat within its jurisdiction and categorized these areas according to their ecological values (Table 1). Criteria used to evaluate riparian habitat included microclimate and shade, bank stabilization, sediment and pollution control, streamflow and water storage, woody debris and channel dynamics, and organic matter input. Upland wildlife habitat was categorized based on habitat patch size, the habitat area in the center of the patch, the distance between habitat patches (connectivity), access to water, and whether the habitat plays an important role in the overall ecosystem or is vulnerable to being lost (Metro 2005).

In total approximately 80,000 acres were identified as regionally significant habitat representing around 30 percent of the land within Metro's jurisdiction. Half of this land is zoned for residential uses, 20 percent for parks and open spaces, and 14 percent for industrial uses with the remaining 16 percent zoned for rural, mixed-use or commercial uses (Metro 2005a).

The second step examined the economic, social, energy and environmental (ESEE) consequences of allowing, limiting or prohibiting the development of regionally significant habitat. This analysis considered issues such as ecosystem values, the potential consequences on the supply of buildable land from restricting development, and intergenerational equity.

A program for protecting regionally significant habitat – the third and final step in the process – is currently being discussed. The proposed program combines a regulatory approach with education, restoration and stewardship, and a willing-seller acquisition program. Standards to promote habitat-friendly development are proposed for the highest valued riparian corridors (Class I and II) and a voluntary incentive-based program is proposed for upland wildlife habitat and Class III Riparian Corridors. Once Metro's program is adopted, the cities and counties within Metro's jurisdiction have 2-4 years to adopt local programs to implement Metro's fish and wildlife protection program.

Table 1: Fish and Wildlife Habitat Classification System (Adapted from Metro 2003)

Riparian/Wildlife Corridors	**Upland Wildlife Habitat**
Class I riparian/wildlife corridors Rivers, streams, stream-associated wetlands, undeveloped floodplains, forest canopy within 100 feet of a stream, and forest canopy within 200 feet of streams with adjacent steep slopes.	**Class A upland wildlife habitat** Large forest patches, wetland areas, and large contiguous patches.
Class II riparian/wildlife corridors Rivers, streams, 50-foot area along developed streams, forest canopy or low structure vegetation within 200 feet of streams, and portions of undeveloped floodplains extending beyond 300 feet of streams.	**Class B upland wildlife habitat** Forest patches with low structure connector patches along streams and rivers.
Class III riparian corridors Developed floodplains and small forest canopies disassociated from streams.	**Class C upland wildlife habitat** Forest patches and smaller connector patches along streams and rivers.

This study uses the hedonic price method to examine how regionally significant habitat and the quantity and quality of riparian corridors within ½ mile of properties are related to the sale price of single-family residential properties in an urban watershed located in Portland, Oregon.

Literature

While numerous studies have documented the relationship between the sale price of single-family residential properties and water quality (Wilson and Carpenter 1999) and tree canopy (Anderson and Cordell 1988; Tyrvainen and Miettinen 2000; Tyrvainen 1997; Garrod and Willis 1992; Wilson and Carpenter 1999), relatively few papers have explored how property values are affected by riparian vegetation (Mooney and Eisgruber 2001; Colby and Wishart 2002) or the restoration of urban stream corridors (Streiner and Loomis 1995).

Mooney and Eisgruber (2001) examine how the assessed value of residential properties in the Mohawk Watershed in western Oregon are related to the size of treed riparian buffers. The study was motivated by a voluntary program, the Oregon Plan for Salmon and Watersheds, that was created to head off the listing of coastal salmon populations. In addition to its focus on agriculture and industry the program encouraged private property owners to plant riparian buffers.

The authors estimate that a one-foot increase in a treed riparian buffer decreases a property's assessed value by 0.06 percent. A different model that includes an interaction term for riparian corridors that are greater than or less than the median riparian buffer width (30 feet) estimates a decline in assessed property value from adding another foot to a buffer that is less than 30 feet wide that is four times greater than the decline from adding another foot to a buffer that is wider than 30 feet.

Colby and Wishart's (2002) study looks at how a home's sale price is affected by its proximity to a 15 mile-long stretch of the Tanque Verde Wash and nearby riparian corridors in the northeast Tucson metropolitan area. The authors' estimate premiums of 6 percent for homes located within 0.1 miles of a riparian corridor, 3.5 percent for homes 0.3 miles from a corridor and 2.4 percent for homes within 0.5 miles of a corridor. Riparian corridors are estimated to increase the value of vacant land by 10 to 27 percent.

Streiner and Loomis (1995) present results from a hedonic analysis of urban stream restoration projects using seven projects located in three counties in California. The authors' estimate that restoration projects that reduce flood damage and improve fish habitat increase property values by 3 to 13 percent of the mean property price in the study area.

Research conducted in Portland, Oregon includes hedonic studies by Mahan, Polasky and Adams (2000) on the size, type and proximity of wetlands and research on open spaces (Bolitzer and Netusil 2000, Lutzenhiser and Netusil 2001), environmental zoning (Netusil 2005a), and the ownership of land on which water resources and open spaces are located (Netusil 2005b). These studies provide evidence that tree canopy and water resources are being capitalized into the sale price of properties in the study area.

Study Area and Property Characteristics

The study area is the part of the Fanno Creek Watershed located within the City of Portland, Oregon (Figure 1). Eighty-two percent of the 4,529 acres in the study area are zoned single-family residential and seven percent are classified as parks and open space (BES 2004).

The watershed contains steep slopes and, because it is heavily developed, approximately 33 percent of the watershed is classified as impervious surfaces (BES 2004). Twenty-three miles of open streams are in the study area with an additional five miles in culverts and pipes. Riparian corridors are described as narrow and are populated with native species such as western red cedar and swordfern and nonnative species such as English ivy. Biological communities are limited although steelhead and cutthroat trout are present in the upper part of Fanno Creek.

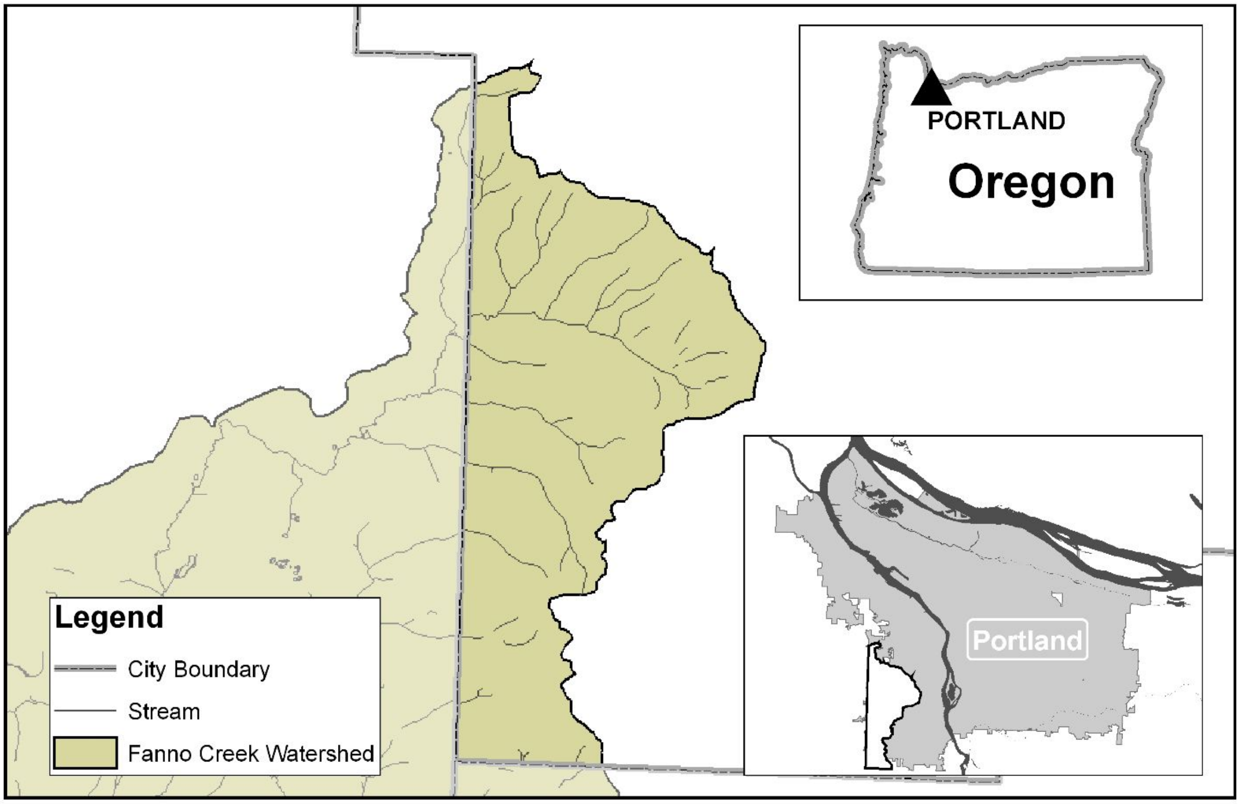

Figure 1: Fanno Creek Watershed in Portland, Oregon

Between January 1, 1999 and December 31, 2001 there were 1,667 single-family residential property sales in the study area. Summary statistics on sale price, age, lot square footage and building square footage are provided in Table 2 (see Netusil 2005 for data sources).

Table 2: Summary Statistics Sales Price and Home Characteristics

	Average	Standard Deviation	Maximum	Minimum
Real Sale Price (2000 dollars)	226,423	114,086	1,685,393	58,174
Age (years)	38	21	107	0
Lot Square Footage	10,295	6,946	134,036	2,053
Building Square Footage	1,790	762	8,000	480

Two-hundred and sixty properties have some riparian habitat (class I, II, III) on the property with an average coverage of 46.38 percent. Three-hundred and eighty six properties have upland wildlife habitat with an average coverage of 41.92 percent. Sixty-nine properties in the study area have a stream on the property and 224 properties were identified as having a slope. Properties can have multiple resources, for example, 122 properties have both Riparian Class I and Class II habitat. Properties can also have multiple site characteristics, for example, twenty-one properties with Riparian Class I habitat have a stream and are sloped. A more detailed breakdown of the number of properties with riparian habitat, upland wildlife habitat, slope, stream, and environmental zoning is provided in Table 3.

Table 3: Goal 5 Resources and Property Characteristics

	Riparian Class I	Riparian Class II	Riparian Class III	Upland Wildlife A	Upland Wildlife B	Upland Wildlife C
Number of Properties with Characteristic	151	185	54	80	260	49
Average Percentage Coverage (std deviation)	40.64% (25.24)	22.25% (21.87)	33.57% (29.30)	47.84% (31.79)	39.63% (32.83)	41.90 (28.71)
Number of Properties with a Stream	58	57	0	3	14	2
Number of Properties with a Slope	43	41	5	55	54	7
Number of Properties with Environmental Zoning	125	124	4	20	93	8

A variable was created to capture the quantity and quality of riparian corridors within ½ mile of each property. Values were assigned to ten-by-ten meter cells based on whether the riparian corridor within a cell had one or more ecological functions: microclimate and shade, bank stabilization, sediment and pollution control, streamflow and water storage, woody debris and channel dynamics. For example, cells with one ecological function were assigned a value of 1, cells with two functions were assigned a value of 2, etc. The sum of the functional values within ½ mile of each cell was calculated; summary statistics are presented in Table 4.

Table 4: Sum of Riparian Functional Score

	Average	Standard Deviation	Maximum	Minimum
Sum of Riparian Functional Values	7,153	2,707	14,315	733

Hedonic Price Method

The hedonic price method uses the price of a marketed good, such as a property, to value a characteristic of the good that is not formally traded on a market (Freeman 2003). This technique has been used to estimate the value of different types of open spaces, air and water pollution, and scenic views.

The hedonic function can be represented by:

$$P_i = P(Q_{S,} Q_{N,} Q_E)$$

where P_i is the sale price of a property, Q_S is a vector representing the structural attributes of a property, Q_N represents neighborhood attributes, and Q_E includes environmental attributes such as regionally significant habitat on a property and the quantity and quality of riparian corridors within ½ mile of the property.

Two models were estimated. The first looks at the relationship between sale price and the percentage of a lot with regionally significant habitat. The second is a more detailed specification that includes the percentage of different habitat types on a lot. Both models control for home characteristics, base zoning, elevation and environmental zoning. Additionally, the percentage of the area within a ½ mile radius of the property with tree canopy, different open space types and streams is included. A variable was created to capture properties that are sloped and have a stream.

Results

The estimated coefficients for the variables that are of interest are presented in Table 5 (full results are available from the author). The percentage of a lot with a stream is statistically significant and positive in both models. The estimated coefficients for the percentage of tree canopy, trails, and specialty parks within ½ mile of a property are significant and positive while the percentage of streams within ½ mile is significant and negative. These results are consistent with earlier studies (Netusil 2005a, 2005b).

Table 5: Regression Results – Estimated Coefficients and Robust Standard Errors

Variable	Model I	Model II
Percentage of Lot with Stream	2,847.31*** (785.21)	2,668.92*** (812.87)
Percentage of Lot with Regionally Significant Resources	352.45* (190.73)	
Percentage of Lot with Regionally Significant Resources Squared	-6.41*** (2.18)	
Percentage of Lot with Riparian Class I		280.00 (313.76)
Percentage of Lot with Riparian Class I Squared		-5.58 (3.92)
Percentage of Lot with Riparian Class II		-256.02** (110.50)
Percentage of Lot with Riparian Class III		-285.34 (217.31)
Percentage of Lot with Upland Wildlife Habitat Type A		2,234.07** (915.86)

Percentage of Lot with Upland Wildlife Habitat Type A Squared		-29.14*** (9.69)
Percentage of Lot with Upland Wildlife Habitat Type B		-140.24* (72.71)
Percentage of Lot with Upland Wildlife Habitat Type C		-164.79 (166.00)
Sum of Riparian Functional Value within ½ mile	4.44** (2.23)	3.93* (2.36)
Percentage of Tree Canopy with ½ mile	669.00** (342.86)	700.53** (352.63)
Percentage of Streams within ½ mile	-62,300.49*** (22,683.17)	-58,737.70** (23,935.14)
Percentage of Trails within ½ mile	159,519** (63,197.86)	149,519.5** (64,406.02)
Percentage of Specialty Parks within ½ mile	6,080.12*** (1,871.15)	6,038.67*** (1,801.13)
R^2	0.7732	0.7769
Observations	1,667	1,667

***Indicates significance at the 1% level, ** the 5% level, and * the 10% level

In Model I, a property's sale price is estimated to increase as the percentage of regionally significant habitat on the lot increases, but at a decreasing rate. The percentage of lot coverage that maximizes a property's sale price is approximately 28 percent, while the average coverage for properties with these resources in the study area is almost 50 percent.

Upland Wildlife Habitat Type A is estimated to have a positive but declining effect on sale price in Model II. The maximum impact on sale price is when upland wildlife habitat coverage on a property is around 38 percent. The average coverage for properties with Type A habitat in the study area is almost 48 percent.

Riparian Corridor Class I has a positive but declining effect on sale price although the coefficients are not statistically significant. This may be caused by the omission of a floodplain variable. Results indicate that the maximum impact on sale price is when riparian corridor coverage on a property is around 25 percent.

The Upland Wildlife Habitat B & C and Riparian Corridor Classes II & III coefficients are negative although only Upland Wildlife Habitat type B and Riparian Class II are statistically significant. Interestingly, the estimated coefficients increase in magnitude when moving from the higher to lower habitat classification.

The riparian score is highly correlated with the percentage of streams within ½ mile of properties. Both variables are included since percentage stream reflects the quantity of streams and the riparian score measures the "quality" of riparian corridors. The coefficients on the riparian score variable are positive and statistically significant in both specifications. The estimated increase in sale price from a one standard deviation increase in riparian score is $12,032 in Model 1 and $10,637 in Model II.

Streams within ½ mile of properties are found to decrease sale price in both models. Earlier research has shown that the ownership of land on which streams are located is an important factor with streams on private land reducing surrounding property values and streams on public land increasing surrounding property values (Netusil 2005b). The study area has a relatively small percentage of publicly owned land, so the estimated coefficients are consistent with earlier research.

Conclusions

The empirical analysis shows that habitat identified by the regional government as "regionally significant" is being capitalized into the sale price of single-family residential properties in the Fanno Creek watershed in Portland, Oregon. Property owners are placing a premium on lots with habitat providing the highest ecological values (Upland Wildlife Type A, Riparian Class I) and a discount on lots with lower-valued habitat (Upland Wildlife Types B and C; Riparian Class II and III). The amount and quality of riparian corridors within ½ mile of properties is also being capitalized into the sale price of properties.

The program being considered by Metro will regulate development on properties with Riparian Class I and II habitat and will use education, restoration and stewardship, and a willing-seller acquisition program to protect and restore properties with Riparian Class III and Upland Wildlife Habitat. Metro's program, to the extent that it focuses on projects that are valued by private landowners, will likely increase the sale price of properties in the study area. Many of the benefits from preserving these resources are, however, public goods such as improved air and water quality, reductions in the severity and frequency of flooding, and carbon sequestration and are unlikely to be fully capitalized into the sale price of properties.

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