The Natural Value of Forest Park

An Ecosystem Services Valuation of America's Premier Urban Forest

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Executive Summary

Forest Park is a natural asset that provides a broad range of public benefits to Portland residents. The ecosystems within the park sequester carbon, purify the air, filter water, provide habitat for an array of species, and offer unparalleled opportunities for Portland residents to recreate outdoors. As one of the largest urban forests in the United States, it takes a considerable effort to protect and maintain the park, particularly as climate change, invasive species, urban growth, and development and recreational pressures take their toll on the Park's environmental health. However, the public benefits that Forest Park provides are well worth the effort. An ecosystem services valuation of Forest Park finds that the park supports between $8 million and $20 million worth of ecosystem services each year. In concert with the Greater Forest Park Conservation Initiative area, roughly 15,000 acres of contiguous land surrounding the park but not formally within the park's boundary, Forest Park and its surrounding ecosystem can contribute between $21 million and $54 million worth of ecosystem services each year. Moreover, Forest Park supports $18.9 million worth of recreation benefits, and has bolstered residential property values surrounding the park by $34.1 million. Thanks to the tireless work of Forest Park Conservancy, these meaningful benefits are likely to continue far into the future.

Introduction

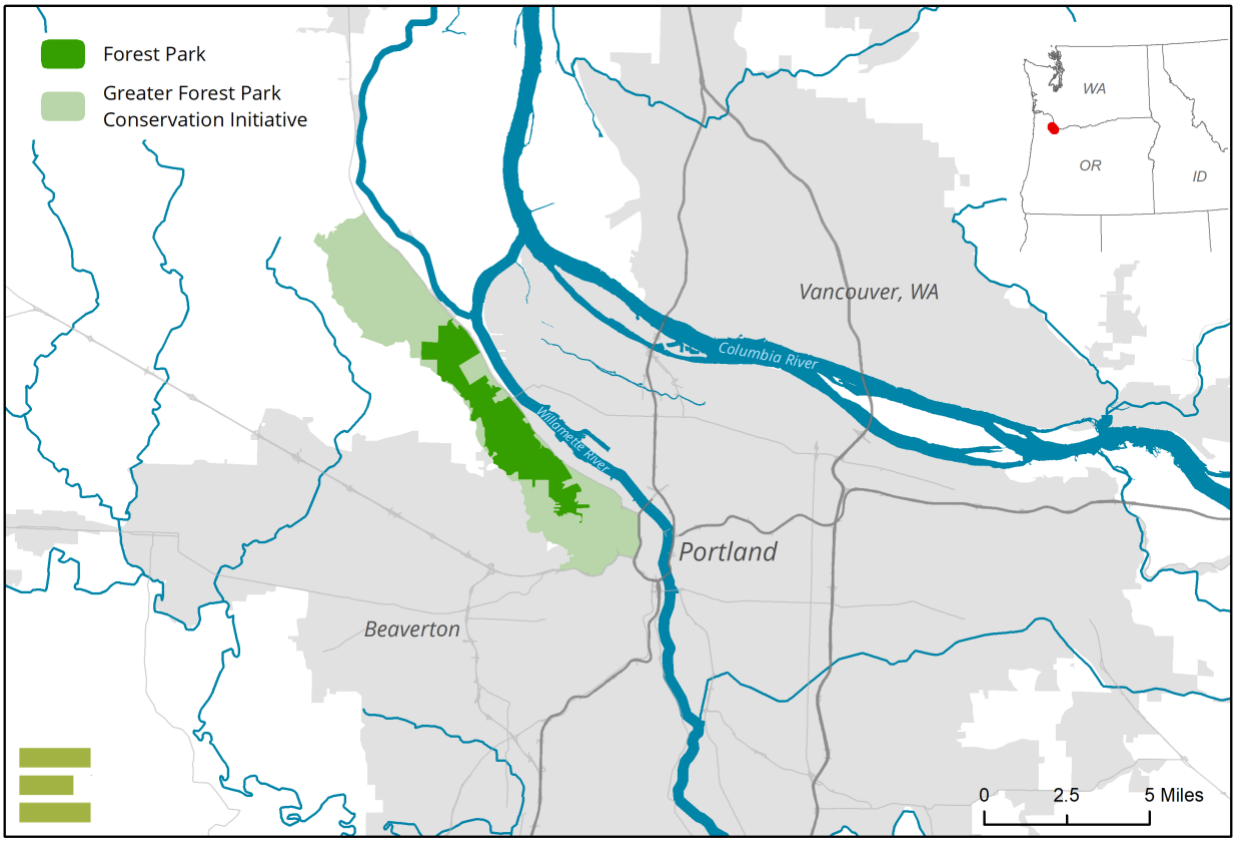
In 1903, John and Frederick Olmsted, sons of the well-known Fredrick Olmstead Sr., designer of New York's Central Park, proposed that the densely wooded hills above northwest Portland be designated by the City as “a forest park." Once a Native American foraging ground known for its densely forested habitat and geologic features, the area was vulnerable to logging, exploration, and development in the 1940’s. But thanks to the dedication of civic-minded individuals with a vision of protecting and preserving public land, the area was formally designated as a public park in 1948. Today, Forest Park remains one of the largest urban parks in the United States.

Spanning 5,200 acres, Forest Park is home to over 100 species of birds, 60 species of mammals, and countless native plants that thrive in the parks ecosystem. As a wildlife corridor, watershed buffer, and wilderness area in an otherwise densely populated metropolitan area, Forest Park is truly a remarkable community asset. But while the threats of logging and development dissipated with the dedication of Forest Park in 1948, the park faces new challenges today, including climate change, increased park use, and invasive species.

At the forefront of the movement to protect and maintain Forest Park is The Forest Park Conservancy (FPC), an organization responsible for maintaining the park’s trails, removing invasive species, restoring native habitat, and leading a variety of recreation and education programs. In addition, FPC leads the Greater Forest Park Conservation Initiative (GFPCI), a movement to restore and protect not just Forest Park, but its entire surrounding ecosystem totaling 15,000 acres. To date, the GFPCI has conserved more than 15,000 acres of land surrounding Forest Park.

While Forest Park is known to be an unparalleled community asset, questions remain about the true value of the diverse and varied services the park provides. So, to better understand the value of the park and the GFPCI area, FPC partnered with Earth Economics to conduct a rapid ecosystem services valuation using a benefit transfer methodology. This preliminary assessment places a monetary value on the environmental benefits of the entire GFPCI area as well as additional recreational and economic benefits of Forest Park. The results of the valuation are presented below.

Figure 1. Forest Park and the Greater Forest Park Conservation Initiative.



Environmental Valuation

Ecosystem Services Valuation Methodology

Ecosystem services are the goods and services that humans receive from nature, including breathable air, drinkable water, nourishing food, and climate stabilization. While the services provided by nature are as diverse as ecosystems themselves, the bottom line is that humans benefit from these services and value them.

The goods and services provided by an ecosystem are similar to the goods and services provided in a traditional market in that they can be valued as a dollar figure. In the same way that economists can determine the value of a home as a private asset, economists can also determine the value of ecosystems as a natural public asset. The process of valuing the goods and services provided by an ecosystem is called ecosystem services valuation (ESV). Building on decades of research that values ecosystem services, this study involves three major steps:

Step 1. Identification and Quantification of Land Cover Classes

Geographic Information Systems (GIS) data, including land cover and hydrography, were used to calculate the extent of each land cover type (e.g. forest, grassland, river) within Forest Park and GFPCI

study areas.[1] The base land cover for this analysis is the 2011 National Land Cover Database (NLCD)[i], which provides 30x30m resolution categorization of land cover. Due to resolution, creeks and upland streams are often not captured in NLCD data, particularly in areas of high tree canopy cover. To better represent the ecosystems of Forest Park, the National Hydrography Dataset (NHD)[ii] was used to identify streams within the study area and adjust land cover accordingly. Spatial attributes further refine land cover types for valuation. This analysis incorporates two spatial attributes to differentiate within ecosystems - urban and riparian. Due to the area's proximity to the Portland metro area, the forest ecosystems present are considered urban forests. To classify riparian forests, freshwater ecosystems were buffered by 100ft and forests within the buffer characterized as riparian forests. The resulting land cover and attributes are presented in Table 1.

Table 1. Land Cover of Forest Park and the GFPCI Area

	Attributes		Forest Park	Forest Park and the GFPCI Area
	Riparian	Urban		
Forests				
Forests (Deciduous)		U	451	1,386
	R	U	208	753
Forests (Evergreen)		U	753	1,925
	R	U	507	1,110
Forests (Mixed)		U	1,163	2,940
	R	U	834	2,066
Grassland				
Grassland		U	5	254
	R		1	32
Shrublands				
Shrubland			10	447
Water				
River			440	1,295
Wetlands			0	7
Developed and Barren Land (Not Valued)				
Not Valued			800	3523
Totals			5,172	15,738

Step 2. Identification and Valuation of Ecosystem Services

For each land cover type, the ecosystem services provided by that land cover were identified. For example, evergreen forests comprise a large portion of Forest Park, and each acre of evergreen forest provides a suite of ecosystem services unique to that land cover (e.g., water quality, carbon sequestration, habitat). [2]

Earth Economics valued these services using the benefit transfer method (BTM). BTM is broadly defined as "the use of existing data or information in settings other than for what it was originally collected." BTM begins by identifying peer reviewed studies that value ecosystem services in locations similar to

[1] For a detailed land cover map please see Appendix A.
[2] For a comprehensive list of possible ecosystem services, please see Appendix B.

Forest Park using a variety of well accepted valuation methods.[3] Each value estimate in these studies is then transformed into a dollars-per-acre-per-year format to ensure "apples-to-apples" comparisons, as these estimates are "transferred" to the study site. In this sense, BTM is similar to a home appraisal, in which the features and pricing of similar nearby homes are used to estimate the appraised value of other homes. While neither process is perfect, they are able to quickly and efficiently generate reasonable values for policy and project analysis.

Table 2 reports the ecosystem services that could be valued for each land cover type. Where valuation estimates for particular ecosystem service–land cover combination were not available, the cell has been left blank. This is not meant to suggest that such ecosystem services contribute no value at all—only that rigorous research on those contributions provided by specific land cover types were not available at the time research was conducted.

Table 2. Ecosystem Services by Land Cover Type

	Attributes									
	Riparian	**Urban**	Air Quality	Carbon Sequestration	Disaster Risk Reduction	Habitat	Soil Retention	Water Capture, Conveyance, & Supply	Water Quality	Water Storage
Forests										
Forests (Deciduous)		U	x	x		x	x	x	x	
	R	U	x	x		x	x	x	x	
Forests (Evergreen)		U	x	x		x	x	x	x	
	R	U	x	x		x	x	x	x	
Forests (Mixed)		U	x	x		x	x	x	x	
	R	U	x	x		x	x	x	x	
Grassland										
Grassland		U		x					x	
	R			x						
Shrublands										
Shrubland				x	x					
Water										
River						x		x		
Wetlands				x	x	x			x	x

Step 3. Annual Value of Ecosystem Services

The sum of all annual estimates for the ecosystem services provided per-acre by each land cover type was then scaled by the extent of corresponding land cover classes within the study area to calculate the total annual contribution of ecosystem services within the study area. The annual contributions of all land cover types were then combined to calculate the total annual value contributed by ecosystem services to the local economy.

[3] For a comprehensive list of valuation methods, please see Appendix C.

Ecosystem Services Valuation Results

For this analysis, eight ecosystem services were valued across seven land cover types present at Forest Park (Table 2). Table 3 summarizes the values of ecosystem services across all land cover types except for Impervious material, barren land, and developed areas which were not valued as a part of this study. The values reported are the aggregate of all ecosystem service values associated with a given land cover. The services provided by Forest Park each year are valued between $7.7 million and $20.6 million.

Table 3. Value of Ecosystem Services – Forest Park

	Attributes			USD/Acre/Year		USD/Year	
	Riparian	Urban	Acres	Low	High	Low	High
Forests							
Forests (Deciduous)		U	451	$1,330	$3,170	$600,000	$1,428,000
	R	U	208	$1,330	$6,400	$277,000	$1,332,000
Forests (Evergreen)		U	753	$1,450	$3,290	$1,093,000	$2,476,000
	R	U	507	$1,450	$6,530	$736,000	$3,308,000
Forests (Mixed)		U	1163	$1,690	$3,760	$1,961,000	$4,375,000
	R	U	834	$1,690	$7,000	$1,406,000	$5,838,000
Grassland							
Grassland		U	5	$10	$20	$40	$110
	R		1	$460	$480	$460	$480
Shrublands							
Shrubland			10	$70	$90	$1,000	$1,000
Water							
River			440	$3,660	$4,280	$1,609,000	$1,883,000
Totals			**4372**			**$7,685,000**	**$20,642,000**

Table 4 summarizes the values of ecosystem services across all land cover types within Forest Park, as well as the GFPCI area. When including the contiguous conserved areas that are a part of the park's ecosystem, but not formally within its boundaries, the annual ecosystem services provided by Forest Park and the GFPCI area are valued between $20.5 million and $54.0 million.

Table 4. Value of Ecosystem Services – Forest Park and the GFPCI Area

	Attributes			USD/Acre/Year		USD/Year	
	Riparian	Urban	Acres	Low	High	Low	High
Forests							
Forests (Deciduous)		U	1386	$1,330	$3,170	$1,843,380	$4,393,620
	R	U	753	$1,330	$6,400	$1,001,490	$4,819,200
Forests (Evergreen)		U	1925	$1,450	$3,290	$2,791,250	$6,333,250
	R	U	1110	$1,450	$6,530	$1,609,500	$7,248,300
Forests (Mixed)		U	2940	$1,690	$3,760	$4,968,600	$11,054,400
	R	U	2066	$1,690	$7,000	$3,491,540	$14,462,000
Grassland							

Grassland		U	254	$10	$20	$2,540	$5,080
		R	32	$460	$480	$14,720	$15,360
Shrublands							
Shrubland			447	$70	$90	$31,290	$40,230
Water							
River			1295	$3,660	$4,280	$4,739,700	$5,542,600
Wetlands			7	$2,197	$8,897	$15,379	$62,279
Totals			**12215**			**$20,509,389**	**$53,976,319**

Recreation Valuation

Economists can measure the value of recreating at a park by measuring a consumer's surplus. Consumer surplus is calculated by estimating a park visitor's willingness to pay for recreation and subtracting the actual cost incurred. While consumer surplus studies to value recreation specifically at Forest Park do not exist, Earth Economics' analysis relies on consumer surplus values from studies at similar regional parks throughout the Pacific Northwest.

Table 5 reports that the consumer surplus value associated with recreation at Forest Park is $34.21 per visit in 2018 dollars.[iii] This value is derived from the consumer surplus associated with hiking, biking, and participating in other recreational activities in national forests in the Pacific Northwest. The consumer surplus for each activity was divided by the average number of hours a national forest visitor spends on each activity, then multiplied by the average length of stay for a visitor to Forest Park.[iv] Total consumer surplus per visit was then weighted by the percent of forest park visitors that participated in each activity to arrive at the average consumer surplus value for a visit to Forest Park. [2]

Table 5. Consumer Surplus Value at Forest Park

Primary Activity	Consumer Surplus Estimate - (2018 USD)	Average Hours Participating	Consumer Surplus Per Hour	Average Visit Length at Forest Park (hours)	Total Consumer Surplus Per Visit	Percent of Visitors Participating in Activity	Consumer Surplus Weighted by Activity
Hiking	$88.73	3.9	$22.75	1.8	$40.95	57%	$23.23
Biking	$88.91	3.1	$28.68	1.8	$51.62	4%	$2.31
Other Recreation	$68.30	5.5	$12.42	1.8	$22.35	39%	$8.67
					Average Consumer Surplus Per Visit		**$34.21**

In 2011, FPC estimated that there were 500,000 park visits per year. Assuming the visitation rates paced the city's rapid population growth, the estimate for park visits in 2018 would be 553,000. Multiplying the visitation by a consumer surplus value of $34.21, Forest Park provides $18.9 million in recreation benefits every year.

Economic Valuation

In addition to providing ecosystem services, parks also bolster residential property values for nearby homes, proving an opportunity to measure one component of the total economic value of a park. Consider the following scenario: a homebuyer is considering purchasing one of two homes on the market. The properties have the same number of bedrooms, lot size, and amenities. However, one of the homes is across the street from an entrance to Forest Park. On average, a consumer will be willing to pay more for the home that is near Forest Park because the park is considered a desirable amenity, the value of which

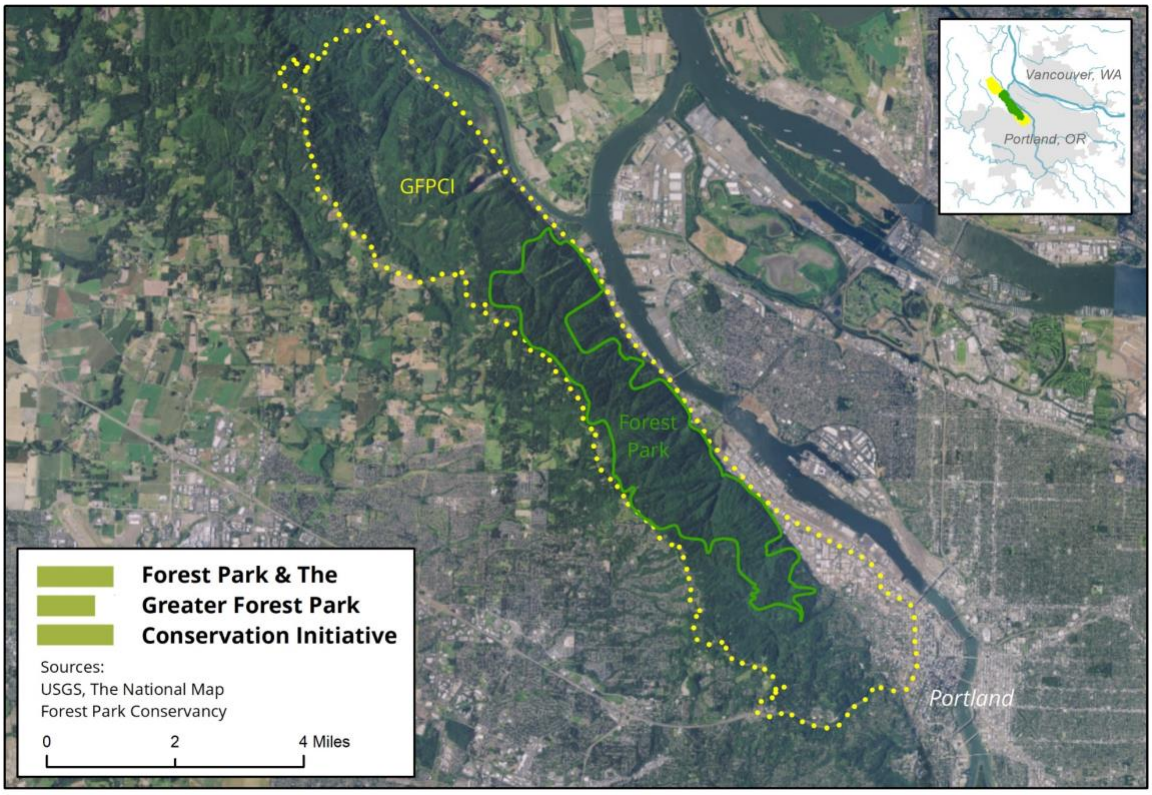
is reflected in a higher property value. Studies suggest that on average 4.84 percent of a home's total value can be attributed to a park if the park and the home are within 500 feet of each other.[v]

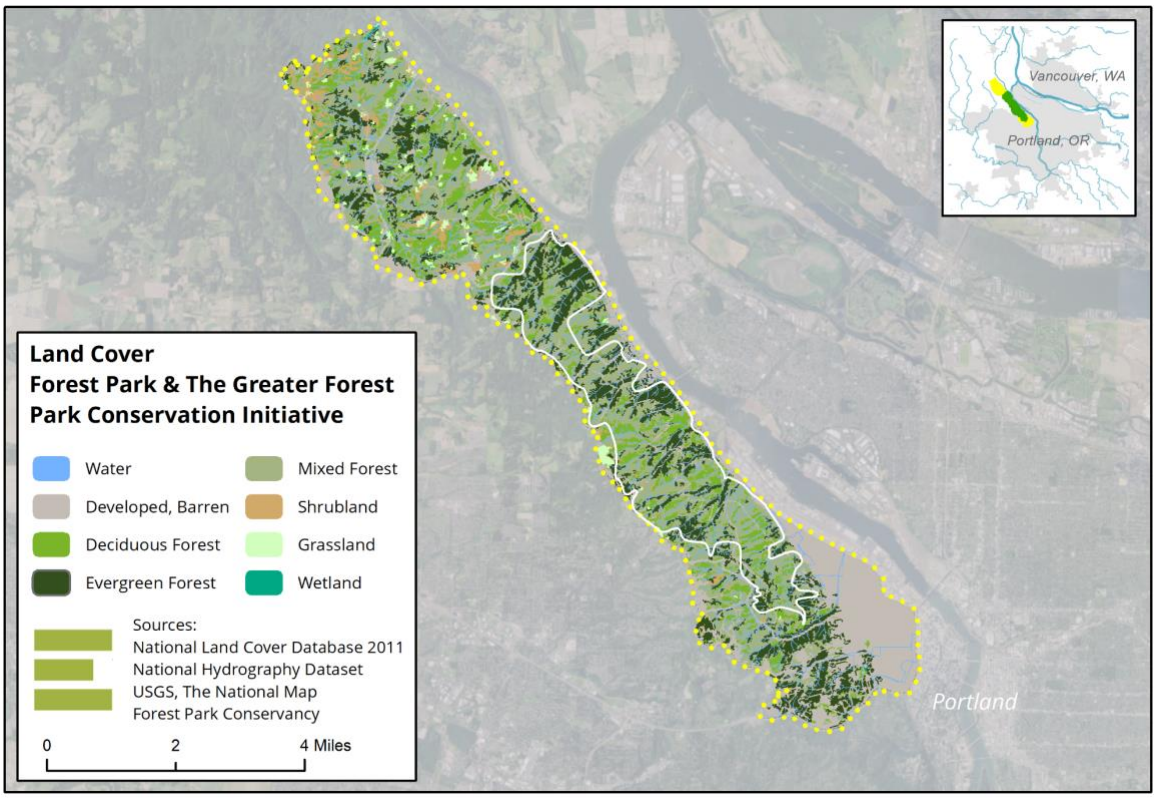
To understand the contribution of Forest Park to the local real-estate market, GIS data, provided by Metro, was used to select all properties within 500 feet of the park. Using the assessed value of the properties selected (2017 dollars), provided by the Multnomah County Assessor's Office, and a 4.86 percent attribute rate, we estimate that Forest Park currently supports $34.1 million worth of value in the local housing market.

Conclusion

This report provides a preliminary valuation of Forest Park, with emphasis on the non-market benefits. Earth Economics' valuations shows that park supports between $8 million and $20 million worth of ecosystem services each year and when combined with the surrounding GFPCI area, that value skyrockets to between $21 million and $54 million worth of ecosystem services each year. Earth Economics' analysis also revealed that recreation benefits received through the 553,000 park visits that are expected to occur in 2018 are valued at $18.9 million. Many of these park visits come from nearby property owners whose properties can collectively attribute $34.1 million of their total value to the parks presence near their homes. While these values highlight the significant contributions of Forest Park, additional site-specific data and more focused valuation studies would refine values by better accounting for functions and attributes unique to the study region.

Appendix A. Land Cover Maps





Appendix B. Ecosystem Services and Contributions

Table 6. Ecosystem Services and Contributions [vi, vii]

Good/Service	Economic Benefit to People
Provisioning Services	
Food	Producing crops, fish, game, and fruits
Medicinal Resources	Providing traditional medicines, pharmaceuticals, and assay organisms
Ornamental Resources	Providing resources for clothing, jewelry, handicrafts, worship, and decoration
Energy and Raw Materials	Providing fuel, fiber, fertilizer, minerals, and energy
Water Storage	The quantity of water held by a water body (surface or ground water) and its capacity to reliably supply water
Regulating Services	
Air Quality	Providing clean, breathable air
Biological Control	Providing pest and disease control
Climate Stability	Supporting a stable climate at global and local levels through carbon sequestration and other processes
Disaster Risk Reduction	Preventing and mitigating natural hazards such as floods, hurricanes, fires, and droughts
Pollination and Seed Dispersal	Pollination of wild and domestic plant species
Soil Formation	Creating soils for agricultural and ecosystems integrity; maintenance of soil fertility, sediment transport for fish spawning areas
Soil Quality	Improving soil quality by decomposing human and animal waste and removing pollutants
Soil Retention	Retaining arable land, slope stability, and coastal integrity
Water Quality	Improving water quality by decomposing human and animal waste and removing pollutants
Water Capture, Conveyance, and Supply	Providing natural irrigation, drainage, groundwater recharge, river flows, drinking water supply, and water for industrial use
Navigation	Maintaining water depth that meets draft requirements for recreational and commercial vessels
Supporting Services	
Habitat and Nursery	Maintaining genetic and biological diversity, the basis for most other ecosystem functions; promoting growth of commercially harvested species
Information Services	
Aesthetic Information	Enjoying and appreciating the presence, scenery, sounds, and smells of nature
Cultural Value	Using nature as motifs in art, film, folklore, books, cultural symbols, architecture, media, and for religious and spiritual purposes
Recreation and Tourism	Experiencing the natural world and enjoying outdoor activities
Science and Education	Using natural systems for education and scientific research

Appendix C. Valuation Methods

The primary studies from which values are drawn employ a range of valuation techniques depending on the specific circumstances, including:

- **Market Pricing:** The current market value of goods produced within an ecosystem (e.g., food, fiber).
- **Replacement Cost:** The cost of replacing the services provided by functional natural systems with man-made infrastructure (e.g. a water treatment plant to replace natural water filtration).
- **Avoided Cost:** Ecosystem services can help communities avoid harm that would have incurred in the absence of those services (e.g. flooding reduction by wetlands and riparian buffers).

- **Production Approaches:** Ecosystem services which enhance output (e.g. rain-fed irrigation can increase crop productivity).

- **Travel Cost:** Demand for some ecosystem services may require travel, the cost of which reflects the implicit value of those services.

- **Hedonic Pricing:** Property values vary by proximity to some ecosystem services (e.g., homes with water views often sell for higher prices than similar homes without such views).

- **Contingent Valuation:** Estimates of value based on surveys of the values assigned to certain activities (e.g., willingness-to-pay to protect water quality).

The valuation of some ecosystem services is well-understood and straightforward. For others, no generally accepted methodologies exist, although their significance may be described qualitatively.

Appendix D. Study Limitations

The benefit transfer method (BTM), used in this study to value ecosystem services, has limitations. Yet, these limitations should not detract from the core finding that ecosystems produce significant economic value for society. Some limitations include:

- Every ecosystem is unique; per-acre values derived from another location may be of limited relevance to the ecosystems under analysis.

- Even within a single ecosystem, the value per acre depends on the size of the ecosystem; in most cases, as the size decreases, the per-acre value is expected to increase, and vice versa. (In technical terms, the marginal cost per acre is generally expected to increase as the quantity supplied decreases; a single average value is not the same as a range of marginal values).

- Gathering all the information needed to estimate the specific value for every ecosystem within the study area is not currently feasible. Therefore, the full value of all of the shrubland, grassland, et cetera in a large geographic area cannot yet be ascertained. In technical terms, far too few data points are available to construct a realistic demand curve or estimate a demand function.

- The prior studies upon which calculations are based encompass a wide variety of time periods, geographic areas, investigators, and analytic methods. Many of them provide a range of estimated values rather than single-point estimates. The present study preserves this variance; no studies were removed from the database because their estimated values were deemed too high or too low. In addition, only limited sensitivity analyses were performed. This approach is similar to determining an asking price for a piece of land based on the prices of comparable parcels (“comps”): Even though the property being sold is unique, realtors and lenders feel justified in following this procedure to the extent of publicizing a single asking price rather than a price range.

- In response to the study by Costanza et al. (1997) of the value of all of the world's ecosystems, critics objected to the absence of imaginary exchange transactions. However, including exchange transactions is not necessary if one recognizes the purpose of valuation at this scale—a purpose that is more analogous to national income accounting than to estimating exchange values.[viii]

This report displays study results in a way that allows one to appreciate the range of values and their distribution. It is clear from viewing the tables that the final estimates are not precise. However, they are much better estimates than the alternative of assuming that ecosystem services have zero value, or, alternatively, of assuming they have infinite value. Pragmatically, in estimating the value of ecosystem services, it is better to be approximately right than precisely wrong.

Appendix E. Ecosystem Services Valuation References

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