Valuing Environmental Education as a Cultural Ecosystem Service at Hudson River Park

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Abstract

The Hudson River and its estuary is once again an ecologically, economically, and culturally functional component of New York City's natural environment. The estuary's cultural significance may derive largely from environmental education, including marine science programs for the public. These programs are understood as "cultural" ecosystem services but are rarely evaluated in economic terms. We estimated the economic value of the Hudson River Park's environmental education programs. We compiled data on visits by schools and summer camps from 32 New York City school districts to the Park during the years 2014 and 2015. A "travel cost" approach was adapted from the field of environmental economics to estimate the value of education in this context. A small—but conservative—estimate of the Park's annual education program benefits ranged between $7,500-$25,500, implying an average capitalized value on the order of $0.6 million. Importantly, organizations in districts with high proportions of minority students or English language learners were found to be more likely to participate in the Park's programs. The results provide an optimistic view of the benefits of environmental education focused on urban estuaries, through which a growing understanding of ecological systems could lead to future environmental improvements.

Keywords

ecosystem services; environmental education; Hudson River; economic benefits; travel cost method; urban

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1. Introduction

1.1 Environmental Education as an Ecosystem Service

Education programs are essential for the development of the public's environmental literacy. A sanguine view is that, over time, environmental education can lead to a deeper understanding of the tradeoffs among protection and development, supporting collective decisions that help to conserve beneficial ecosystem services (Vaughan *et al*., 2002; Sodhi *et al*., 2010; Tisdell, 2013). Too, as a means for promoting environmental stewardship, science-based, outdoor education is recognized as central to sustainable development (Hungerford and Volk, 1990; Chen and Tsai, 2015). With intensifying existential threats to the biosphere, such as climate change, natural hazards, and nutrient deposition and runoff, interest in environmental education has been growing strongly (Sauvé, 1996; AGEDI, 2016).

Environmental education takes place both in formal academic programs, to complement traditional forms of learning, and in less-than-formal settings, such as through the interpretive services offered at public parks or as an aspect of ecotourism (Tisdell and Wilson, 2005; Cable *et al*., 2010; Miller *et al*., 2012). Such experiences have been shown to promote knowledge of the environment and pro-environmental attitudes, including comprehending the sensitivity of the environment to human impacts (Farmer *et al*., 2007; Goldman *et al*., 2007). Despite its often-informal nature, Hill (1994) found that students may benefit significantly from participation in environmental education activities.

Education in general may yield both productive and consumptive benefits, but most research on the economics of education has focused mainly on the former (Shulze, 1967; McMahon, 1987). On the production side, economic benefits are realized as the present value of future incomes resulting from practical learning that is put to use in an occupational or business setting. In contrast, on the consumption side, education may be valued as an enjoyable activity *per se*, much like a recreational experience. With respect to educational programs provided at public parks, zoos or aquaria, or through ecotourism, consumptive benefits may predominate.

Environmental education is understood as a "cultural" ecosystem service (Milcu *et al*., 2013; Martin *et al*., 2016; Mocior and Kruse, 2016). Most efforts undertaken to value education or other, recreational benefits of ecosystems have focused on relatively undeveloped terrestrial environments, such as national or state parks (Lee *et al*., 2009; Haefele *et al*., 2016). In contrast, few studies have sought to estimate recreational ecosystem service values in urban settings (*cf*., Sherer, 2004; Cho *et al*., 2008; Koo *et al*., 2013; Wolf and Robbins, 2015; Forleo *et al*., 2016). Nonetheless, it has been suggested that environmental education activities may promote biological diversity, and the self-organization of social systems surrounding the environment may promote resilience within urban natural systems (Krasny and Tidball, 2009). Further, to our knowledge, published studies valuing the educational ecosystem services relating to estuarine environments in urban settings are almost nonexistent.

1.2 The Travel Cost Method

Although environmental education is well-recognized as an one kind of ecosystem service, it is important to begin to characterize its scale in economic terms. Research on the value of environmental education can help planners and resource managers develop a more complete understanding of the multi-dimensional contributions of a natural area, such as a river or estuary, to human welfare. Further, assessing the economic values of all of the services that flow from a natural area can help support decisions about investments that might enhance those flows, leading to welfare gains in the future.

Unfortunately, without an established market, assessing the economic value of many cultural ecosystem services can be problematic. One approach to valuation without a market, the travel cost method (TCM), has been used extensively to estimate demands for the recreational uses of natural areas (Bockstael 1995; Ward and Beal, 2000; Parsons, 2003). TCM takes observed variations in travel effort across recreational users, as characterized by the costs of traveling and the opportunity costs of time, as a basis for valuing the services provided by an area or program (*cf*., Cable *et al*., 1984 for an early application to an interpretive facility for a national forest in Canada). In an application of TCM concerning cultural services, Willis *et al.* (2012) used booking data from a community theater in the United Kingdom to estimate the demand for theatrical shows. Following the travel cost logic, Wolsink *et al.* (2016) found that the number of field excursions organized by teachers in Amsterdam was positively associated with proximity to an urban green space, although the authors did not estimate the demand for environmental education.

1.3 New York City's Waterways

New York City is surrounded by several historically and ecologically significant waterways. Because of its biological productivity, the Hudson River and its estuary was prominent in the historical development of the NY metropolitan area (Waldman, 2013). Prior to the City's colonization by European settlers, massive oyster reefs lined its shores, forming the foundation of a complex ecosystem and supporting a diverse range of marine life (Kurlansky, 2006). Over the course of several hundred years, however, resource exploitation and urbanization led to the rapid degradation of the Hudson River and its connected estuarine environments. The oyster populations collapsed, and the Hudson's other estuarine resources were depleted or became contaminated.

In recent years, increased attention has been paid to expanding the City's environmental education and other recreational uses of urban-natural spaces, placing special emphasis on waterways (NYC Education, 2016; NYC Parks, 2016). At the forefront of these efforts, interest in the potential rejuvenation of the Hudson's estuarine resources has increased. Oyster restoration, conservation measures, and education initiatives have been developed to improve the Hudson estuary and to increase access to its resources (BOP, 2016; USACE, 2016). These efforts are essential for both restoration of and human interactions with the estuary, as other activities, such as channel deepenings, sewage overflows, industrial effluents, hazardous material spills, and shoreline construction, continue to threaten the ecosystem (Bain *et al*., 2007).

These threats persist, in part, due to dated public perceptions of a heavily polluted waterfront (Bain *et al*., 2007). In urban planning contexts, valuation studies serve to raise awareness of ecosystem services and inform land-use decision-making (TEEB, 2011). Valuation of ecosystem services provided by NYC's waterways could be used to better understand the costs associated with harmful activities and, in turn, to promote continued efforts to restore the Hudson River and estuary.

1.4 Hudson River Park

In 1998, the NY Senate and Assembly enacted a bill to establish the Hudson River Park (the Park) in Manhattan, running between the Hudson River and the West Side Highway from

Battery Park to 59th Street. The Act also established an estuarine sanctuary in the Hudson River adjacent to and extending the length of the Park. An environmental education mission for the Park was created through its enabling legislation and given guidance in an Estuarine Sanctuary Management Plan. The Park is funded independently by a Trust, established to "promote knowledge of the Hudson River's ecosystem, prehistory and history by expanding youth and adult educational programs" (HRP, 2016a).

Currently, the Park offers a range of programs for children and adults, many of which focus on the ecology of the Hudson River. Some programs are available to the public on a walk-in basis during the summer; others are organized for schools and camps visiting the park. Many of the Park's programs are marine science-related, designed to educate the public about the estuary and its ecology (HRP, 2016b).

This study sought to estimate a range of plausible cultural ecosystem service values arising from the Park's education programs for K-12 schools and camps that concern the science and ecology of the Hudson River and Estuary. Using visitor data compiled by the Park and additional data from the City's Department of Education and the US Census Bureau, a travel cost model was implemented to estimate the benefits of these services. These estimates should be considered to be conservative in the sense that they comprise neither all of the environmental education services (adults also participate in environmental education at the Park) nor the complete set of the estuary's provisioning, supporting, or regulating services. Nevertheless, we argue that TCM can be useful in developing estimates of cultural ecosystem services for natural areas.

2. Methods and Data

2.1 The Travel Cost Method

A basic TCM estimates the probability of the number of visits to a location over a specified interval of space or time (Parsons, 2003). The mean and variance of nonnegative, discrete data, such as visits, are estimated using a "count data" approach, such as a negative binomial probability model, which is a variant of a Poisson count data model that has been generalized to allow the mean and variance to differ (Greene, 2012). According to this model, the probability of observing y_i visits to the Park from schools or summer camps in school district *i* in a year is:

$$Prob(Y = y_i|\mathbf{x}_i, \tau_i) = \frac{e^{-\lambda_i \tau_i}(\lambda_i \tau_i)^{y_i}}{y_i!}, \qquad y_i = 0, 1, 2, \ldots \tag{1}$$

with

$$E[y_i|\mathbf{x}_i, \tau_i] = \lambda_i \tau_i = e^{\mathbf{x}_i' \boldsymbol{\beta} + \varepsilon_i} \tag{2}$$

where $\tau_i = e^{\varepsilon_i}$ is assumed to follow a gamma distribution with mean 1.0 and variance α; $\boldsymbol{\beta}$ is a vector of coefficients to be estimated; and $\mathbf{x}_i$ is a vector of independent variables, including distance from the school district to the education program, distance to a substitute education program, or other determinants (*e.g.*, income or education).

An economic welfare measure per trip, consumer surplus (*CS*), is the group average travel cost per mile (*TC*) across all school districts, divided by the estimated coefficient for the distance to the Park (β_d):

$$CS = \frac{TC}{-\hat{\beta}_d} \tag{3}$$

where $\hat{\beta}_d$ is expected to be negative (*i.e.*, demand for the Park's environmental education services declines with distance). In the specific application to the educational programs at the Park, described below, distance *per se* was used as a predictor of the number of school group visits, so *TC* constitutes group average travel cost per mile (Englin and Shonkweiler, 1995).

The aggregate consumer surplus, *AS*, for the Park's estuary education program is:

$$AS = CS \cdot Trips \tag{4}$$

where *Trips* is the total number of visits to the Park's estuary education program during one year. The capitalized value of aggregate surplus is:

$$PV = \frac{AS}{r} \tag{5}$$

where *r* is a social discount rate (here 2%).

2.2 Data Collection and Sources

The Park collects data on visits by educational organizations for its school programs (April-June and September-November) and summer camp programs (June-August) (Fig. 1). This data includes each visit to a Park program by a school or camp; the name of the visiting organization; the organization's address; and the location of the relevant Park educational program (on Piers 26, 46, 63, or 84). Data were compiled on participation by schools and camps in the Park's *Go Fish*, *Our Living Estuary*, *Fish Biology*, *Plankton Ecology*, and *Water Quality 101* programs for school-year visitors, and *Estuary Adventures* and *Plankton Discoveries* for summer visitors (HRP, 2016b). Enrollment and demographic data were obtained from the NYC Department of Education's "Demographics Snapshot" for 2015 (NYC Education, 2015)

Organizational visits from the 32 New York City school districts comprised observations for estimating a zonal TCM (Fig. 2). Organizations were attributed to each school district by inputting reported addresses into the Google Maps® search function found with a map of the school districts (NYC Open Data, 2016). Once district information was compiled for each organization, the number of visits from each district was calculated.

Education level and household median income data were compiled for New York by zipcode from the US Census Bureau in 2010 (Cubit Planning, 2016). Some zipcode-level data spanned multiple school districts, necessitating an approach to the assignment of zipcode data to school district data. A zipcode was assigned to a school district if the zipcode area's geographic center was closer to that district's geographic center than to any other. Centroids and distances were calculated using qGIS© software (ver. 2.16.1). Zipcode data was weighted by the ratio of a zipcode area's population to the aggregate population of all zip code areas assigned to a district (NYC Planning, 2016). The sum of the weighted zipcode data was assumed to represent the income and educational characteristics of the population within each school district.

Distances from each school district to the Park (Distance to Hudson River Park) and to a substitute site, the Brooklyn Bridge Park (Distance to Brooklyn Bridge Park), were calculated using the point distance function in qGIS. Euclidean distances from district centers to each site were assumed to approximate average distances of organizations within a district to each education site. Brooklyn Bridge Park's Education Center was used as the destination point for distances to the substitute site (BBPC, 2016). The distance from a school district center to the nearest pier in Hudson River Park constituted the measure of distance from the district to the Park.

2.3 Count Data Models

Count data models were estimated to test for the effects of distance on trips taken to the Park's environmental education programs (*cf.*, Englin and Shonkweiler, 1995). Distance served as a proxy for travel costs. Apart from distance, other variables were expected to affect the amount trips to the Park. These variables, which shift demand, included distance to the substitute site, measures of median income, the percent of a school district's population that was college educated, and other demographic characteristics. Descriptive statistics of data used for regression analyses are presented in Table 1. Because of issues with multicollinearity among covariates, five models were estimated. All five models included predictors representing distance to the Park and distance to the substitute, but each alternative included one additional unique covariate to show the effect of that measure on the likelihood of group trips.

Count data models were selected based on model diagnostics, including the dispersion parameter, chi-square, and AICc measures, as well as models' ability to capture the effects of covariates. After calculating the consumer surplus value for each model, we calculated a weighted average of model estimates, using AICc values as weights (Burnam and Anderson, 2004). Weighting was chosen as a reasonable alternative to undertaking qualitative comparisons between models, and it avoids the arbitrariness of selecting a preferred model for the calculation of welfare estimates.

2.4 Travel Cost Calculation

The distances and travel times for all educational organizations traveling to the park were calculated using estimates from Google Maps®. Both the mode of transport and the choice of Pier were used, if they were reported by the relevant educational organization. If these characteristics were left unreported, a default choice of travel to Pier 46 (approximately the center of the park) via subway was used. If an educational organization reported multiple choices of Piers or modes of transport for different trips, then its travel distances and times were averaged.

The average number of students per visit was calculated using on-site data provided by the Park. Groups traveled to the park via foot, bus, and subway. According to data compiled by the Park in 2016, most groups took the subway, while a few groups travelled by bus. The cost of round-trip subway fare was used as a conservative estimate for transportation costs, at $5.25 per student, compared to the price of school bus charter, which we estimated to be $15.00 per student (Bus Bank, 2018; First Student, 2018; MTA, 2015). We calculate surplus estimates based upon the more conservative assumption that all students took the subway, but we also present the approximate change in surplus on the assumption that all groups took a chartered bus.

The average travel cost per mile (TC) in Equation (3) was calculated by first calculating an average cost per student per trip. This cost is the sum of the constant cost of round-trip subway fare ($5.25) plus the product of an opportunity cost of time ($8.33/hr) and the average total hours spent on round trip travel (1.24 hr) and onsite (1.50 hr). This average cost ($28.07 per student per trip) is divided by the average distance from a school district to the Park (17 mi) to yield an average cost per mile per student ($1.65). By multiplying this average cost by the average number of students per group (27), an average cost per mile per group ($44.59) can be obtained.

There continues to be a debate in the economic literature about the choice of an appropriate opportunity cost of time (Hynes *et al*., 2009), even for gainfully employed adults, and assigning an opportunity cost to individuals who are not yet participants in the labor market could be perceived as problematic. Instead, a budgetary cost per-student-hour was assumed to be the relevant opportunity cost. Following this approach, an output (the lost value of classroom learning) is measured with the cost of an input (the school budget). With this assumption, a visit to an environmental education program would involve lost opportunities for classroom-based academic instruction and training, which would be valued at the actual (budgetary) cost of providing that mode of education.

Budgets for each school district were found in the NYC Department of Education's "School Allocation Memorandum" (SAM) for the 2015-2016 school year (NYC Education, 2016). An estimate of the opportunity costs of time using this approach was $8.32 ± $0.36/hr. To qualify this approach, the convention in the literature was followed by using only one-third of the calculated labor-leisure tradeoff rate, and a range of surplus estimates from five different model specifications was reported. Estimates for which the opportunity cost of time is zero or is incurred only during the period of round-trip transportation were also developed. For the surplus estimates, the total time spent during each visit was used, calculated as the sum of an average travel time across districts (1.24 hr or 74 min) and the duration of the Park's education programs (1.50 hr or 90 min).

3. Results

3.1 Travel Cost Model Outputs

The results of five separate models for educational visits to the Park appear in Table 2. In all cases, the models fit the data better than an intercept-only model. For example, the chi-squared statistics range from 30.19 to 34.33, well above the critical values necessary for significance at the 1% level. In all models, except for Model IV, the dispersion parameter is significantly different from zero at the 95% level, justifying the use of a negative binomial model. Even for Model IV, there is a less than 4% likelihood of the dispersion parameter being at or below zero.

Different models were specified to describe the effects of distance on the number of trips to the Park (averaged during 2014-15), each with a unique set of demand shifters. Estimated coefficients and associated standard errors for independent variables in each of the models are listed in Table 2. AICc values for the models, which trade off degrees of freedom against log-likelihood scores, suggest that Model IV with its focus on controlling for the number of students in each school district (a significant, positive effect) may provide the best fit.

Estimates for the effect of distance on the number of trips were found to be negative and significant at the 1% level for all five models. Estimates for the effect of distance to the Brooklyn Bridge Park were found to be positive and significant at the 1% level for all five models. This latter result was as anticipated, because an increase in distance from a school district to the substitute site, *ceteris paribus*, should result in an increase the number of trips to the Park.

The median income of residents in each school district was significant and positive in model II. This result was expected, as students (and teachers) from higher income districts are more likely to participate in environmental education programs. The percent of 4^{th} graders meeting or exceeding state science standards was positive and significant in model III, suggesting that environmental education programs are valued by school districts with strong science programs. The percent of college-educated residents in each school district was significant and positive in model IV. This supports the expectation that populations with higher levels of education may be more likely to make trips to participate in environmental education. Both the percent of English-language-learning students and the percent of African-American students in each school district were significant and positive in model V, revealing that groups exhibiting these characteristics are taking advantage of environmental education at the Park.

3.2 Consumer Surplus Estimates

Using an opportunity cost of $8.33/hr, the average school or camp group of 27 students incurred a cost of approximately $758/trip to travel by subway for 1.24 hr and to participate in an educational program at the Park for 1.50 hr. For an average distance between a school district and the Park of 17 miles, these costs translate into costs per mile of $44.59. Schools and camps averaged 118 trips/yr from 2014-15. The estimated annual ecosystem service values for the Park's estuary education programs ranged from $9,478 to $14,395 across the five models (Table 3 shows the estimates per student, group, and all trips). Fig. 3 depicts these results, showing for each model a range based upon two standard errors for the estimated coefficient on distance to the Park. If students are assumed to take a chartered bus, instead of the subway, these estimates would be about 35% higher. These estimates would be about 45% lower if student opportunity costs are assumed to be zero for the time on-site at the Park and about 81% lower if opportunity costs are assumed to be zero during the entire trip, demonstrating the large effect of opportunity costs on surplus estimates.

All five models find that distance from the park is positive and significant, indicating that there are measurable benefits arising from the educational services of the Park. Although these benefits appear to be small, ranging from $3-6.00 per student per trip, they are of the same order of magnitude as some of the other limited but relevant literature on environmental education (*e.g.*, the Cable *et al*. [1984] estimate $7-16.00 per visitor to a national forest interpretive facility). Using a discount rate of 2%, the capitalized value of the Parks' educational services ranged from $0.5-0.7 million. The calculated information criteria across models are very similar, suggesting that there may be no preferred model. A weighted benefit estimate across models, using the AICc values as weights, where weights comprise each AICc value divided by the sum of all AICc values (*cf*., Burnham and Anderson 2004), is $11,500/yr, ranging from $7,500 to $25,500, with an associated capitalized value of $0.6 million. Note that these estimates, while small, should be regarded as conservative, comprising benefits only to organized student groups; they do not include educational benefits to other Park visitors.

4. Discussion

Education about the Hudson River and its estuary is one of the central purposes of the Hudson River Park. Our study developed a range of benefit estimates for its K-12 estuarine environmental education programs, comprising a cultural ecosystem service of the estuary located in and around Hudson River Park. On a local scale, this study showed that the Park's programs provided small but tangible benefits to student groups attending such programs. Albeit small, the study's estimates are also conservative, and they included neither educational benefits to non-school visitors nor other consumptive recreational services provided by the Park. Further, the educational enrichment comprising programs at the Park and other environmental venues is likely to lead to productive benefits beyond the quasi-consumptive benefits observed here. Productive benefits may include a greater appreciation for nature and natural areas, improved performances in school, higher educational attainments, more responsible decision-making, and wider possibilities for successful occupations and livelihoods in the future.

Various other public programs at the Park allow participants to learn about the ecology of the estuary, take part in the Park's oyster restoration project, or even engage in catch-and-release fishing. For example, the Park's education department hosts an annual marine science festival, known as *Submerge*, where visitors of all ages can participate in marine science activities and in programs organized by other organizations from the metropolitan area (HRP, 2016b). The Park also is working currently with Clarkson University to create an *Estuarium* on Pier 25 to serve as a new platform for education (CU, 2014). Consequently, our estimate of education services likely comprises only a minor contribution to the overall value of the Park's estuary education offerings.

On a broader scale, the results of our study augment ecosystem service values for the lower Hudson River. They show that, even in impacted urban environments, the ecological functions of natural areas can serve as the focus of hands-on environmental education. Degraded estuarine environments in urban settings often are treated as eyesores, and their very existence may be threatened by those who would rather pave the problem over. Such scenarios, comprising those at the Sawmill River, the Gowanus Canal, and the failed Westway Project, have been only narrowly averted in New York City (Waldman, 2013). Unfortunately, to date, little or no effort has been made to value the ecosystem services of these environments. The emergence of an urban environmental ethic, fostered through environmental education, could begin to uncover the potential ecosystem services of these natural areas, thereby enhancing the potential for their conservation and eventual restoration.

In high-need communities of New York City, characterized by higher proportions of young people, people of color, and below-average median income, only 9% of the waterfront is thought to be publicly accessible (Boicourt et al., 2016). Moreover, communities of color or low income populations faced higher threats of environmental discrimination, such as through limited access to green spaces and elevated exposures to hazardous waste (UCCCRJ, 1987; Heynan et al., 2006). In contrast to these observations, our study found that the Park's estuary education programs were well-attended by organizations in school districts with high proportions of minority students or English-language-learners. Programs uniting education with conservation form the foundation for relationships between urban communities and the natural environment around them. In so doing, such programs provide the potential to sustain community growth alongside environmental conservation (Saldivar-tanaka and Krasny, 2003; Tidball and Krasny, 2007; Krasny and Tidball, 2009).

Our study provides an optimistic view therefore of the importance of environmental education focused on urban estuaries. Creating increased public access to waterways in the NY metropolitan area could unlock additional educational benefits for residents, and benefits from programs similar to those at Hudson River Park may be worth investigating further in other locations. School and camp groups, as well as communities with higher proportions of young people, people of color, and low-income households could emerge as primary stakeholders in the pursuit of such efforts.

5. Conclusions

Although some studies of urban parks have included interpretive services as a covariate of willingness-to-pay for their environmental amenities, for the most part, the valuation literature has paid little attention to environmental education as an important cultural ecosystem service. Our small but conservative estimate suggests that methods from environmental economics could be used to evaluate education programs that are viewed predominantly as consumptive in nature. In the longer term, a deeper appreciation of the importance of ecosystem services is an expected consequence of environmental education programs. Further, possible evaluations of the productive benefits of environmental education in urban environments could supplement assessments of the consumptive benefits of recreation in natural areas, thereby expanding the value of this cultural service and providing a clear focus for future research.

References

Abu Dhabi Global Environmental Data Initiative (AGEDI). (2016). Eye on environmental education. Retrieved August 19th, 2016 from http://www.eoesummit.org/blog/initiative/eye-on-environment-education/.

Bain, M., Lodge, J., Suszkowski, D.J., Botkin, D., Diaz, R., Farley, K., Levinton, J.S., Steimle, F., & Wilber, P. (2007). Target ecosystem characteristics for the Hudson Raritan Estuary: Technical guidance for developing a comprehensive ecosystem restoration plan. A report of the Port Authority of NY/NJ. *Hudson River Foundation*. 106pp

Billion Oyster Project (BOP). (2016). About BOP. Retrieved August 19th, 2016, from http://www.billionoysterproject.org/about/.

Bockstael, N. E. 1995.Travel Cost Models. *In* Bromley, D. W. (ed.), *Handbook of Environmental Economics*. Cambridge, MA: Blackwell Publishers.

Boicourt, K., Pirani, R., Johnson, M., Svendsen, E., & Campbell, L. (2016). Connecting with Our Waterways: Public Access and Its Stewardship in the New York – New Jersey Harbor Estuary. *New York – New Jersey Harbor & Estuary Program, Hudson River Foundation*. 36pp.

Brooklyn Bridge Park Conservancy (BBPC). (2016). School programs. Retrieved August 19th, 2016, from http://www.brooklynbridgepark.org/activities/school-programs.

Burnham KP, Anderson DR. 2004. Multimodel inference: understanding AIC and BIC in model selection. *Sociological Methods & Research* 33: 261–304.

Bus Bank. (2018). School Bus Pricing. Retrieved January 31st, 2018, from https://www.busbank.com/charter-bus-pricing/school-bus-rentals/.

Cable, T. T., Knudson, D. M., & Stewart, D. J. (1984). The economic benefits to visitors of an interpretive facility. *Journal of Environmental Education*, 15(4), 32-37. doi:10.1080/00958964.1984.9942689

Chen, C-L, & Tsai, C-H. (2015). Marine environmental awareness among university students in Taiwan: A potential signal for sustainability of the oceans. *Environmental Education Research*, 22(7), 958-977. doi:10.1080/13504622.2015.1054266

Cho, S. H., Poudyal, N. C., & Roberts, R. K. (2008). Spatial analysis of the amenity value of green open space. *Ecological Economics*, 66(2-3), 403-416. doi:10.1016/j.ecolecon.2007.10.012

Clarkson University (CU). (2014). Hudson River Park Trust names Clarkson University & Consortium Partners for new state-of-the-art Environmental Research Estuarium & River Discovery Center at Pier 26 in Manhattan. Retrieved August 19th, 2016, from http://www.clarkson.edu/news/2014/news-release_2014-12-05-1.html .

Cubit Planning. (2016). US Census income and education data by zip code. [Data File]. Austin, Texas: Cubit Planning Inc.

Englin, J., & Shonkwiler J. S. (1995). Estimating social welfare using count data models: An application to long-run recreation demand under conditions of endogenous stratification and truncation. *The Review of Economics and Statistics*, 77(1), 104-112. doi:10.2307/2109996

Farmer, J., Knapp, D., & Benton G. M. (2007). An elementary school environmental education field trip: Long-term effects on ecological and environmental knowledge and attitude development. *Journal of Environmental Education*, 38(3), 33-42. doi:10.3200/JOEE.38.3.33-42

First Student, Inc. (2017). First Student charter bus rental. Retrieved January 31, 2018 from http://www.firstcharterbus.com.

Forleo M. B., Gagliardi N., & Romagnoli L. (2015). Determinants of willingness to pay for an urban green area: A contingent valuation survey of college students. *International Journal of Management, Knowledge and Learning*, 4(1), 7-25. http://issbs.si/press/ISSN/2232-5697/4-1.pdf

Goldman, D., Assaraf, O. B. Z., & Shaharabani, D. (2013). Influence of a non-formal environmental education programme on junior high-school students' environmental literacy. *International Journal of Science Education*, 35(3), 515-545. doi:10.1080/09500693.2012.749545

Greene, W. H. 2012. *Econometric analysis*. 7th edition. New York: Prentice Hall.

Haefele, M., Loomis, J., & Bilmes L. J. (2016). Total economic valuation of the National Park Service lands and programs. Report. Fort Collins, Colorado: Colorado State University (30 June).

Heynen, N., Perkins, H. A., & Roy, P. (2006). The political ecology of uneven urban green space: The impact of political economy on race and ethnicity in producing environmental inequality in Milwaukee. *Urban Affairs Review*, 42(1), 3-25. doi:10.1177/1078087406290729

Hill, A. (2013). The place of experience and the experience of place: Intersections between sustainability education and outdoor learning. *Australian Journal of Environmental Education*, 29(1), 18-32. doi:10.1017/aee.2013.13

Hudson River Park (HRP). (2016a). Hudson River Park Trust. Retrieved August 19, 2016 from https://www.hudsonriverpark.org/about-us/hrpt.

Hudson River Park (HRP). (2016b). Education and environment. Retrieved August 19th, 2016 from https://www.hudsonriverpark.org/education-and-environment.

Hungerford H. R., & Volk T. L. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education*, 21(3), 8-21. doi:10.1080/00958964.1990.10753743

Hynes, S., Hanley, N., O'Donoghue, C. (2009). Alternative treatments of the cost of time in recreational demand models: An application to whitewater kayaking in Ireland. *Journal of Environmental Management*, 90(2), 1014-1021. doi:10.1016/j.jenvman.2008.03.010

Koo J. C., Park M. S., & Youn Y. C. (2013). Preferences of urban dwellers on urban forest recreational services in South Korea. *Urban Forestry & Urban Greening*, 12(2), 200-210. doi:10.1016/j.ufug.2013.02.005

Krasny, M.E., & Tidball, K.G. (2009). Applying a resilience systems framework to urban environmental education. *Environmental Education Research* 15(4): 465–482

Kurlansky, M. (2006). *The big oyster: History on the half shell*. New York: Random House Inc.

Lee, C-K., Lee, J. H., Mjelde, J. W., Scott, D., & Kim, T-K. (2009). Assessing the economic value of a public birdwatching interpretative service using a contingent valuation method. *International Journal of Tourism Research*, 11(6), 583-593. doi:10.1002/jtr.730

Martin, C. L., Momtaz, S., Gaston. T., Moltschaniwskyj, N. A. (2016). A systematic quantitative review of coastal and marine cultural ecosystem services: Current status and future research. *Marine Policy*, 74(2016), 25-32. doi:10.1016/j.marpol.2016.09.004

McMahon, W. W. 1987. Consumption and other benefits of education. In G. Psacharopoulos (Ed.). *Economics of education: Research and studies* (pp. 129-133). Elmsford, New York: Pergamon Books.

Metropolitan Transit Authority (MTA). (2015). New Fare Information. Retrieved August 19th, 2016, from http://web.mta.info/nyct/fare/NewFareInformation.htm.

Milcu, A. I., Hanspach, J., Abson, D., & Fischer, J. (2013). Cultural ecosystem services: A literature review and prospects for future research. *Ecology and Society*, 18(3), 44. doi:10.5751/ES-05790-180344

Miller, L. J., Zeigler-Hill, V., Mellen, J., Koeppel, J., Greer, T., & Kuczaj, S. (2013). Dolphin shows and interaction programs: Benefits for conservation education? *Zoo Biology*, 32(1), 45-53. doi:10.1002/zoo.21016

Mocior, E., & Kruse, M. (2016). Educational values and services of ecosystems and landscapes–an overview. *Ecological Indicators*, 60(2016), 137-151. doi:10.1016/j.ecolind.2015.06.031

NYC Education. (2015). Demographic Snapshot. [Data File]. Retrieved from http://schools.nyc.gov/NR/rdonlyres/20056B95-8351-4E45-B8A1901-B4B6A93B/0/DemographicSnapshot201112to201516Public_FINAL.xlsx.

NYC Education. (2016). School Allocation Memmorandum by School District. [Data File]. Retrieved from http://schools.nyc.gov/offices/d_chanc_oper/budget/dbor/ allocation-memo/fy15_16/FY16_PDF/SAM1_03_SBD/All.xls.

NYC Open Data. (2016). School Districts. Retrieved August 19th, 2016, from https://data.cityofnewyork.us/Education/School-Districts/r8nu-ymqj.

NYC Parks. (2016). About the New York City Department of Parks and Recreation. Retrieved August 19th, 2016, from https://www.nycgovparks.org/about.

NYC Planning. (2016). Total Population by Single Years of Age and Sex, 2010. [Data File]. Retrieved from http://www1.nyc.gov/assets/planning/download/office/data-maps/nyc-population/census2010/t_sf1_p6_zip.xlsx.

Parsons, G. R. (2003). The travel cost model. In P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.). *A primer on nonmarket valuation* (pp. 269-329). Boston: Kluwer Academic Publishers.

Saldivar-tanaka, L. & Krasny, M. E.. (2003). Culturing community development, neighborhood space, and civic agriculture: The case of Latino community gardens in New York City. *Agriculture and Human Values*, 21(4), 399-412. doi:10.1007/s10460-003-1248-9

Sauvé, L. (1996). Environmental education and sustainable development: A further appraisal. *Canadian Journal of Environmental Education*, 1(1), 7-34. https://cjee.lakeheadu.ca/article/view/490/380

Schultz, T. W. (1967). The rate of return in allocating investment resources to education. *Journal of Human Resources*, 2(3), 293-309. doi:10.2307/144836

Sheppard, J. A. C. (1995). The black-white environmental concern gap: An examination of environmental paradigms. *Journal of Environmental Education*, 26(2), 24-35. doi:10.1080/00958964.1995.9941437

Sherer, P. M. (2003). Why America needs more city parks and open space. White paper. San Francisco: The Trust for Public Land.

Sodhi, N. S., Lee, T. M., Sekercioglu, C. H., Webb, E. L., Prawiradilaga, D. M., Lohman, D. J., Pierce, N. E., Diesmos, A. C., Rao, M., & Ehrlich, P. R. (2010). Local people value environmental services provided by forested parks. *Biodiversity and Conservation*, 19(4), 1175-1188. doi:10,1007/s10531-009-9745-9

The Economics of Ecosystems and Biodiversity (TEEB). (2011). Manual for Cities: Ecosystem Services in Urban Management. UNEP and the European Commission.

Tidball, K. G. & Krasny, M. E. (2007). From risk to resilience: What role for community greening and civic ecology in cities. In A. E. J. Wals (Ed.). *Social learning: Towards a sustainable world* (pp. 149-164). The Netherlands: Wageningen Academic Publishers.

Tisdell, C. (2013). Ecotourism experiences promoting conservation and changing economic values: the case of Mon Repos turtles. In R. Ballantyne, J. Packer (Eds.). *International handbook on ecotourism* (pp. 382-393). Northampton, Massachusetts: Edward Elgar Publishing Inc.

Tisdell, C., & Wilson C. (2005). Perceived impacts of ecotourism on environmental learning and conservation: turtle watching as a case study. *Environment, Development and Sustainability*, 7(3), 291-302. doi:10.1007/s10668-004-7619-6

United Church of Christ Commission for Racial Justice (UCCCRJ). (1987). Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites. New York: United Church of Christ Commission for Racial Justice.

US Army Corps of Engineers (USACE). (2016). Hudson-Raritan Estuary Comprehensive Restoration Plan.

Vaughan, C., Gack, J., Solorazano, H., & Ray, R. (2003). The effect of environmental education on schoolchildren, their parents, and community members: A study of intergenerational and intercommunity learning. *Journal of Environmental Education*, 34(3), 12-21. doi:10.3200/JOEE.34.3.12-21

Waldman, J. (2013). *Heartbeats in the muck: The history, sea life, and environment of New York Harbor*. Revised edition. New York: Fordham University Press.

Ward, F. A., & Beal, D.. 2000. *Valuing Nature with Travel Cost Models: A Manual*. Cheltenham, UK: Edward Elgar.

Willis, K. G., Snowball, J. D., Wymer, C., & Grisolía, J. (2012). A count data travel cost model of theatre demand using aggregate theatre booking data. *Journal of Cultural Economics*, 36(2), 91-112. doi:10.1007/s10824-011-9157-z

Wolf, K. L., & Robbins, A. S. (2015). Metro nature, environmental health, and economic value. *Environmental Health Perspectives*, 123(5), 390-398. doi:10.1289/ehp.1408216

Wolsink, M. (2016). "Sustainable City' requires 'recognition'—the example of environmental education under pressure from the compact city. *Land Use Policy*, 52(2016), 174-180. doi:10.1016/j.landusepol.2015.12.018

Table 1: Variable Definitions and Descriptive Statistics

Variable	Definition	Mean	Std Dev	Min	Max
Dependent Variable					
Number of visits	mean visits/yr	3.500	6.180	0	28
Explanatory Variable					
Distance HR	mi	8.499	4.163	1.65	17.74
Distance BB	mi	8.469	4.370	1.27	16.58
Income	$\$10^{-4}$	5.207	2.060	1.60	10.14
4^{th} Graders meeting or exceeding state standards for science	proportion	0.806	0.084	0.63	0.97
Students in district	number10^{-3}	29.167	15.026	6.82	61.28
College Education	%	18.845	7.913	8.09	40.89
Asian	proportion	0.139	0.140	0.01	0.52
African American	proportion	0.305	0.235	0.03	0.87
Hispanic	proportion	0.409	0.218	0.07	0.86
Other	proportion	0.021	0.011	0.01	0.05
White	proportion	0.127	0.122	0.01	0.49
English-language-learner	proportion	0.121	0.062	0.04	0.27

Table 2: Park Visitation Estimation Results

Variables	Model I Coefficient (standard error)	Model II Coefficient (standard error)	Model III Coefficient (standard error)	Model IV Coefficient (standard error)	Model V Coefficient (standard error)
Intercept	1.9635*** (0.4391)	0.3389 (0.8862)	-1.9843 (2.2917)	0.7089 (0.4662)	-5.0875** (2.4202)
Distance to Hudson River Park	-0.5221*** (0.1259)	-0.4896*** (0.1207)	-0.5551*** (0.1226)	-0.4208*** (0.0983)	-0.3655*** (0.1301)
Distance to Brooklyn Bridge Park	0.3936*** (0.1097)	0.4164*** (0.1043)	0.4388*** (0.1067)	0.2779*** (0.0876)	0.4288*** (0.1138)
Income	-	0.2119** (0.1070)	-	-	-
Percent of 4th graders meeting or exceeding state standards for science	-	-	4.7168* (2.7272)	-	-
Students in district	-	-	-	0.0418*** (0.0113)	-
% College education	-	-	-	-	0.1454*** (0.0463)
African American proportion	-	-	-	-	3.0667** (1.5414)
English-language-learner proportion	-	-	-	-	13.3684** (6.3808)
Dispersion	0.8620 (0.3077)	0.7097 (0.2729)	0.7195 (0.2814)	0.3866 (0.2135)	0.5518 (0.2307)
Dispersion 95% confidence limits	0.26-1.47	0.17-1.24	0.17-1.27	-0.03-0.81	0.10-1.00
n	32	32	32	32	32
X^2	30.19***	34.23***	33.68***	30.82***	30.81***
AICc	143.62	143.62	141.31	135.81	143.55

*, **, and *** denote significance at 10, 5, 1% significance level, respectively.

Table 3: Average estimated benefits by model per student, group, and year, and asset value with 95% confidence intervals (HI. LO)

MODEL:	***I***	***II***	***III***	***IV***	***V***
$\hat{\beta}_d$: estimated marginal effect of distance to HRP	0.52	0.49	0.56	0.42	0.37
$\hat{s}_{\beta_d}$: estimated standard error	0.13	0.12	0.12	0.10	0.13
CS/student	\$3.16	\$3.37	\$2.98	\$3.92	\$4.52
CS/student (HI)	\$6.00	\$6.53	\$5.25	\$7.24	\$14.94
CS/student (LO)	\$2.15	\$2.27	\$2.08	\$2.69	\$2.66
CS/group	\$85	\$91	\$80	\$106	\$122
HI CS/group (HI)	\$162	\$176	\$142	\$195	\$404
LO CS/group (LO)	\$58	\$61	\$56	\$73	\$72
Total CS/year	\$10,077	\$10,746	\$9,478	\$12,503	\$14,395
Total CS/year (HI)	\$19,109	\$20,794	\$16,713	\$23,063	\$47,613
Total CS/year (LO)	\$6,843	\$7,245	\$6,615	\$8,577	\$8,479
Asset Value	\$503,872	\$537,320	\$473,918	\$625,171	\$719,759
Asset Value (HI)	\$955,457	\$1,039,694	\$835,668	\$1,153,156	\$2,380,654
Asset Value (LO)	\$342,156	\$362,272	\$330,743	\$428,827	\$423,970

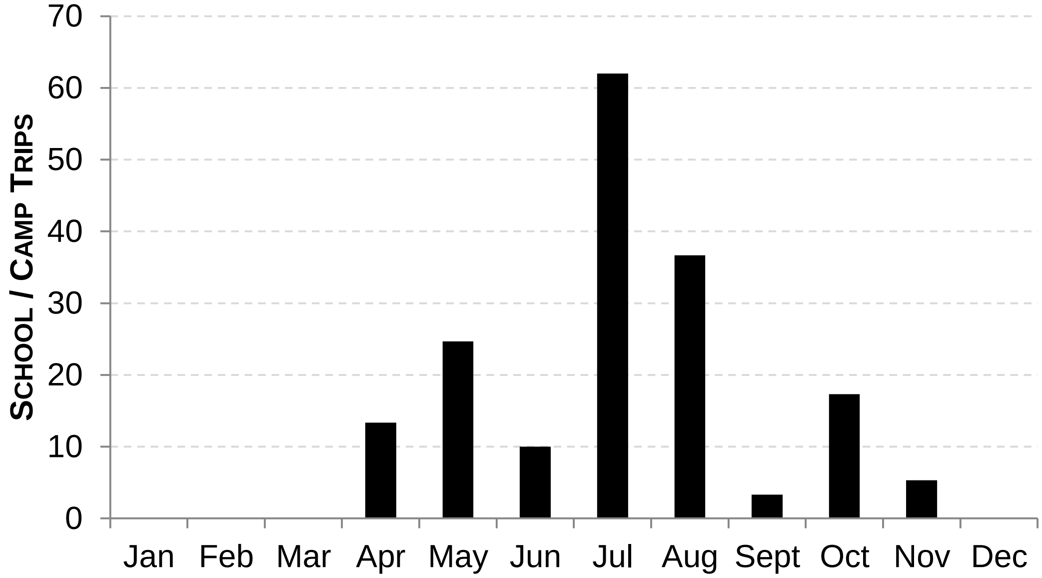

Fig. 1: Average trips per month by organizations to Hudson River Park during 2014-15.

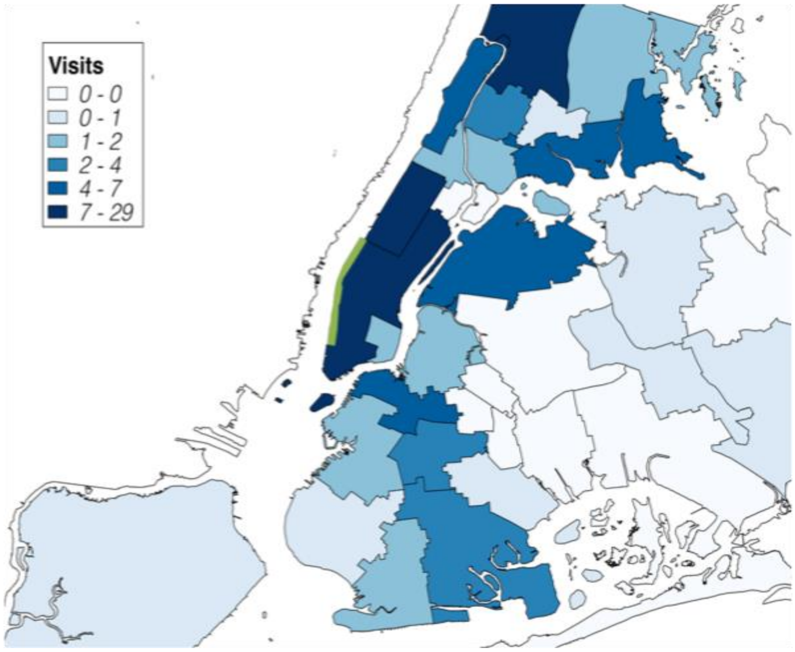

Fig. 2: Map of visits to the Hudson River Park from New York City school districts. The Park is represented as a light green polygon on the lower west side of Manhattan.

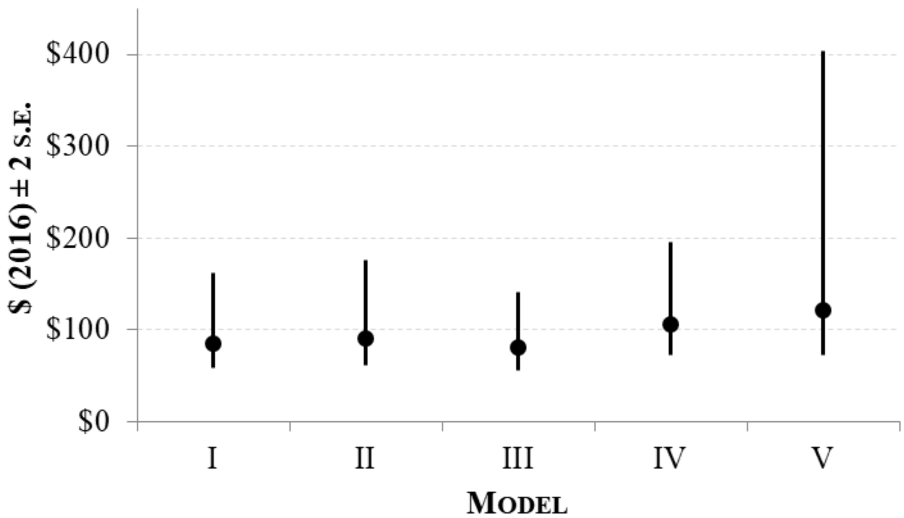

Fig. 3: Estimated mean benefits (2016 $) per school or camp trip to the Park's environmental education programs. The whiskers reflect plus-or-minus two standard errors (a 95% confidence interval) around the estimate for the coefficient on the measure for the distance to the Park in each model.