Valuing a Lake Amenity: 
An Upper and Lower Bound

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Abstract

An interesting if unusual claim for economic damages can occur when an environmental amenity enjoyed by particular individuals is wrongfully impacted. Such a tort may be thought of as analogous to a commercial claim of loss, but that sort of analysis would not apply because the lost amenity does not have a market value in and of itself. Valuing a useable but not market-traded asset has historically been difficult. The development of willingness-to-pay studies has allowed for two different techniques: stated preference technique, which uses the contingent valuation method, and a revealed preference technique, using existing markets (such as the housing market) to analyze differences in prices. We use existing literature on both techniques to estimate a lower- and upper-bound value for adversely-impacted lake amenities in northeast United States.
I. Introduction

An interesting if unusual claim for economic damages can occur when an environmental amenity enjoyed by particular individuals is wrongfully impacted. Such a tort may be thought of as analogous to a commercial claim of loss, but that sort of analysis would not apply because the lost amenity does not have a market value in and of itself.¹

This paper is the result of work we performed in a case involving loss of an environmental amenity. To make our analysis tangible, we present a hypothetical lakeside community of one-hundred (100) homes in northeastern United States, having an average value of $350,000, where the community had access to clean and useful lake amenities, and then lost those amenities due to environmental harm caused by another party. The harm prevented community residents from using the lake for over a year, with continuing residual problems extending for possibly several additional years. We address the questions: Is it possible to measure the impact of the loss of use of the lake amenities? And, is it possible to put this loss in terms of a dollar value?

The value of amenities, especially environmental amenities, is generally difficult to put in monetary terms. Further, these valuations have been shown to be different based on the perceived property rights of the amenity (Kahneman and Tversky, 1979). Hanemann (1991) confirms that alternative willingness estimates can vary widely and are often not easily substitutable. For example, when an individual owns an environmental amenity, like lake access, its perceived value is often different from the stated value of those who do not own the amenity and have to pay per visit. This study explores alternative willingness-to-pay measures of the value of a lake amenity.

¹ Note that we are discussing the estimation of use value, not existence value (as found in Nelson 1997).
We look at different, previously published, measures to evaluate the value of access to clean and usable lake amenities and, inversely, the valuation of a loss in use of these amenities. We extend the literature by analyzing the lake amenity value using willingness-to-pay methods, through stated preferences and revealed preferences. There are differences between the two measures, but within each there are lower- and upper-bound estimates that depend on the assumptions used. These are each discussed individually and provide different estimates that can be used to value lake amenities.

The next section values lake amenities under the stated preferences technique. The revealed preferences, market based approach is analyzed in the subsequent section. The final section concludes with a summary of the estimated values.

II. Stated Preferences Methods

Facing the difficulties in valuing non-market resources, Mitchell and Carson (1989) employ a contingent valuation method to value non-market resources. This method is based on the assumption that individuals reveal their true willingness-to-pay for a non-monetary good through their behavior in hypothetical markets and/or survey responses. As different questions are asked, the average willingness-to-pay can be deduced through analysis of the responses.

As an example, Carson and Mitchell (1993, p. 2447) asked respondents how much they would be willing to pay “to keep the nation’s freshwater bodies from falling below the boatable (minimum) level where they are now.” These values are then based on the willingness-to-pay for a minimum level, but do not reveal the willingness-to-pay for qualities above this minimum level.

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2 As defined by Freeman (2003), willingness to pay “is the maximum sum of money the individual would be willing to pay rather than do without an increase in some good such as an environmental amenity. … [It] is constrained by the individual’s income ….” (p. 9)

3 The use of contingent valuation method is debated as an appropriate measure of non-market values; see Hausman 2012.
When looking at a lake amenity, there are two different values the lake brings: the value of water quality and the recreational use value.

i. **The Value of Water Quality**

Carson and Mitchell (1993, p. 2449, table 3) reported measures of the willingness-to-pay for water quality at different levels. Moving from non-boatable to boatable is valued between $106 and $141 in total annual household willingness-to-pay. This is the minimum level of water quality. They also provided estimates for higher qualities of water. Moving from boatable to fishable is valued at between $80 and $108, and moving from fishable to swimmable is valued at between $89 and $116, both per household.

Thus, the total annual household’s willingness to pay for moving from non-boatable water to swimmable water is between $275 and $365. These values are all expressed in 1990 dollars. Converting to today’s (2013) dollars generates values of between $490.15 and $650.57.\(^4\)

The results of the national sample in Carson and Mitchell (1993) are consistent with the local valuation in Gramlich (1977) on the value of water quality increases to the Charles River in Boston, and the national valuation in Mitchell and Carson (1981) who used a national sample estimating the value of swimmable water. The results are also close to, but slightly higher than, the valuation found in Smith and Desvousges (1986) who analyzed the water quality value for the Monongahela River.

ii. **The Recreational Use Value**

The New Jersey Department of Environmental Protection (NJDEP, 2006) analyzed the economic literature as it applies to state parks in New Jersey, finding that the research supports values for a 4-hour visit ranging from $17 to $26 per person, with a central estimate of $21 in

\(^4\) We use the Consumer Price Index (All Consumers) calculator through the BLS: http://data.bls.gov/cgi-bin/cpicalc.pl.
recreation value alone. This value is consistent with Kaval’s (2007) working paper: a 12-hour visit to a park is valued at $60.50 per day (in 2006). In 2013 dollars this is equivalent to $69.91 for a twelve-hour visit, equating to $23.30 for a four-hour visit. We note here that Kaval’s estimates are close to the average NJDEP value of $21, which is $24.27 in 2013 dollars for a four-hour visit.

The Kaval (2007) study looked at a variety of activities and provided different values for these activities. Of the twenty-five activities assessed, the range of the value of benefits varied considerably, from a low of $6 to a high of $174/person/day (for Mountain Biking) in 2006 dollars (per day estimates are based on a 12-hour visit).

Given the wide range of benefits, Kaval (2007) divided the activities into groups of high value (> $100/person/day; examples: mountain biking, canoeing, kayaking, and rafting), moderate value ($35 to $100/person/day; examples: motor boating, sight-seeing, fishing, swimming, and going to the beach), and low value (< $35/person/day; examples: hiking, snorkeling, and visiting environmental education centers). The lowest valued activities were visiting environmental education centers, valued at $6/person/day, and horseback riding, valued at $19/person/day. The next lowest valued benefit was $31/person/day (snorkeling).

Kaval’s (2007) estimates come from an analysis of 36 years of studies (1968-2003) and include consumer surplus non-market recreational benefits. These results are separated by type of recreational activity and represent the average estimated value of the activity converted to 2006 dollars. Kaval’s data include 1,229 observations on 25 types of activities in 106 locations. These are average figures. Because they are averages, the use of local cost of living, or local amenity costs, should be taken into account when applied to different locations.
Among the different activities, we identify the lake-related activities estimated in Kaval (2007; figure 1, page 7) to include: canoeing, kayaking, and rafting, $140; motor boating, $60; fishing, $53; waterskiing, $50; swimming, $44; going to the beach, $40; scuba diving, $37; and snorkeling, $31 (All figures are per person per day). The average water amenity in the Kaval study had a daily use value of $56.88 per person per day ($65.73 in 2013 dollars).

Shrestha, Stein, and Clark (2007) estimated the value of nature-based recreation, finding that the average visitor would pay $74.18 per visit-day for nature-based recreation ($85.72 in 2013 dollars). Use of the two studies gives a range of estimates for daily use value of $65.73 to $85.72 per person for these types of amenities, both in 2013 dollars.

Hannon (1994) examined geographic discounting: the further away people live from a lake, the less they are willing to pay for the lake itself. Thus, houses that are located on, or within walking distance, exhibit an increased value relative to those houses that require travel to the lake. This is confirmed by Pate and Loomis (1997).

Given that the estimates above apply to state or national parks, and given the findings in Hannon and Pate and Loomis regarding geographic discounting, the range of values cited above represents lower bounds for any properties that have immediate lake access (either lake homes or homes in a lake community).

Having identified a range of values per person per day, for both water quality and recreational use of a water amenity, the next step is to apply the values to our lake users.

iii. Total Value

Depending on the location of the lake community, there are differing amounts of time the lake can be used. In colder climates the lake can be used for four months, whereas in warmer climates the lake can be used for eight or more months. As noted above, the water quality value
itself has a lower-bound estimate of $490.15 per household and an upper bound of $650.57 per household. The recreational amenity use value also has lower and upper bounds, as explained in the previous section.

To apply these recreational use values to our hypothetical lake residents, we first note that the average U.S. household consists of 2.55 people. We further assume that lake community residents use the amenity two times a week for either four hours (lower bound) or 12 hours (upper bound). By combining these facts and assumptions, we arrive at the following calculations:

<table>
<thead>
<tr>
<th></th>
<th>Value of Amenity Use</th>
<th>Average Household Size in U.S.</th>
<th>Visits per Week</th>
<th>Number of useable weeks per year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Bound</td>
<td>$23.30</td>
<td>2.55</td>
<td>2</td>
<td>16</td>
<td>$1,901.28</td>
</tr>
<tr>
<td>Upper Bound</td>
<td>$85.72</td>
<td>2.55</td>
<td>2</td>
<td>32</td>
<td>$13,989.50</td>
</tr>
</tbody>
</table>

The lower bound is estimated by taking the estimate of a four-hour visit ($23.30), times the average household size in the U.S. (2.55), times two visits per week, times the lower number of useable weeks per year (16). This yields an estimated lower bound of $1,901.28 per household for homes that have four months of usable time and whose members use the amenity four hours per visit. Adding this use value to the water quality value ($490.15) gives a total lower bound estimate of $2,391.43 per household per year.

A recreational amenity value’s upper bound is based on a twelve-hour visit, two times a week, with eight months of useable time. Thus, multiplying the value of the amenity for a twelve-hour visit ($85.72), times the average household size, times two visits per week, times the number of useable weeks (32) yields a total amenity value of $13,989.50 per household and a total value, including water quality (the upper bound estimate of $650.57 per household), of $14,640.07.
One caveat to these measures is that they do not include a monetary value of the travel time component of the cost of a visit to an environmental amenity (Randall, 1994). However, in our case study, given the close and ready access to the community’s lake by its residents, travel cost is a relatively trivial part of the value of the lake amenities.

The stated preferences technique is one type of measure that reflects a given person’s willingness-to-pay to obtain access to a stated benefit, which in this case are a lake and its corresponding amenities. As we have shown, based on various studies, these willingness-to-pay estimates provide lower- and upper-bound estimate values for lake amenities.

A second approach to measuring willingness to pay for an environmental amenity is the market-based revealed preferences method, which involves “the estimation of value from observations of behavior in the markets for related goods….” (Freeman, 2003, p. 95). Further, as Kahneman and Tversky (1979) state, there is a difference in the enjoyment gained by obtaining a new asset, and in the enjoyment of an asset that is already owned. The new asset’s value is, in general, smaller than the already-owned asset. In our case study, the lake community residents already “own” use of the lake amenities, so the revealed preferences method would tend to yield higher values than for persons who do not have such lake access.

Thus, for our purposes, a market-based approach, using housing prices, is applied. The next section develops valuation based on market transactions.

III. Market-Based Approach

The first approach looked at stated preferences. We now look at revealed preferences by analyzing the values of lake amenities through the value of housing and the increased value of a home that includes lake amenities. Palmquist, Roka, and Vukina (1997) show that housing values can be used as a proxy for amenity (or environmental) values.
When looking at the residential value of a home that includes an existing lake amenity, the value includes both the home and the value of lake use. This value includes not just the value of the lake use at present, but the ability to use the lake in years to come. Thus, determining the increased cost of housing with lake amenities provides a good measure of the value of the amenity itself.  

Benson, Hanson, Schwartz, and Smersh (1998) researched the value of water views, both for oceans and lakes. In particular, those houses with lake views were estimated to increase the value of a property by 18.1%. However, they expanded their research to include lake-front homes with lake amenities in addition to lake views. They found that having both lake views and a lake with amenities on it increased the average home’s value by 126.7% (with 18.1% of that value being from the lake view itself). The lake-view estimate is consistent with Luttik’s (2000) estimate of a 28% increase in value for a yard touching a lake and an 8% to 10% increase in values to homes with a view of a lake (this study did not value the use value of the lake).

Given that housing prices reflect the value of the property (land and structure) and the amenities available to the homeowners, the price reflects both the property itself and the amenities available. Other things being equal, an increase in home values from amenities, expressed on an annual basis, reflects the yearly value of these amenities. Thus, finding the one-year value for a house’s amenities represents the lost value to a homeowner for that year’s lost use.

5 “Because the environmental amenities of interest are location specific but not part of the structure, the values of the environmental amenities should be reflected in the price of land alone. However, at least in the United States, land is not usually traded separately from the structures placed upon it, so the observed prices reflect the values of both the land and its structural improvements.” (Freeman 2003, p. 360). In our study, therefore, we made some simplifying assumptions regarding the average value of the house structures themselves, and the comparability of households in the region regarding their socioeconomic characteristics.
For this purpose, we examined the increased annual cost of a mortgage for a home with a lake amenity, relative to the mortgage cost of a house without a lake amenity. If all houses in a given lake community have the equivalent of these like-style amenities, then the median home value would already reflect approximately a 126.7% increase in value for these amenities.

This assumption is based on the lake value being the average lake quality in the area where the housing prices are calculated. Alternatives to this assumption can be calculated and need to be taken into account. For example Boyle, Poor, and Taylor (1999), Michael, Boyle, and Bouchard (2000), and Gibbs et al. (2002) all find that the clarity of the lake’s water also impact the housing price for lake homes. Any variants from the average need to be taken into account when solving for the value of the asset, or used to value the impact of changing the value of the asset (i.e., estimating the value lost for a less-clear lake).

In our hypothetical lake community example, there are 100 homes with a median house price of $350,000. The following table shows the house price differential, representing the value of the lake amenities:

<table>
<thead>
<tr>
<th>lake-community median house price</th>
<th>Increased house value</th>
<th>Value of non-lake-community house</th>
<th>Value of lake amenities + view</th>
<th>Value only of lake view</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3) = (1) − {1+[(1)/(1+(2))]}</td>
<td>(4) = (1) − (3)</td>
<td>(5) = (4) x (18.1%/126.7%)</td>
</tr>
<tr>
<td>$350,000</td>
<td>126.7% (of which 18.1% for lake view)</td>
<td>$195,611</td>
<td>$154,389</td>
<td>$22,056</td>
</tr>
</tbody>
</table>

By applying an assumed 30-year mortgage rate of 4.5%, the values calculated above would represent an increase of $825.75 per monthly mortgage payment for lake access with a view and a $707.79 increase in monthly mortgage payments for houses with lake access but no lake view. Thus, for each home with a lake view and access, our estimate using the market-based
approach is this value increase times twelve months, or $9,909 per house per year.\(^6\) And for each home with no lake view but with access, our estimated annual value is $8,493. The mean value of the two is $9,201.

IV. Summary Valuations

Using both stated preferences and market-based approaches provides different estimates for the value of lake amenities. The lower bound of the stated preference is $2,391.43 per household per year in comparison to an upper-bound estimate of $14,640.07. For revealed preferences we estimate the yearly value of a lake amenity at $9,201 per house per year, a value that falls within the stated preferences range, providing further support of establishing a reasonable value of the loss of the lake amenities.

Although these estimates can vary widely, the ability to analyze lower- and upper-bound estimates, and establishing values using both stated preferences and revealed preferences techniques, provides a relatively clear understanding of the overall valuation process for lake access in the U.S. in the event that the use of these lake amenities is impacted by another party.

In our example of 100 homes in the lake community, the aggregated value of loss could range from a low of $239,143 to a high of $1,464,007, based on stated preferences. Use of revealed preferences generates a loss figure of $920,100. Such figures would be very helpful to a trier of fact in determining a reasonable value of loss due to the adverse effects of a third party upon the community lake.

Since our analysis is presented as dollars per household, and bearing in mind the caveats presented in this paper, the methodology explained here can be applied to any sized lake community that has experienced interruption in its access to lake amenities.

\(^6\) Even in areas where the use of the lake is seasonal, the value of lake access is paid in the price of the house of the full year’s increased mortgage costs.
Works Cited


New Jersey Department of Environmental Protection Division of Science, Research & Technology (2006), June 2004 (with November 2006 revisions), *The Economic Value of New Jersey State Parks and Forests.*


