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Measuring the Value of Hg and Acid Pollution in New York State through Property Values

Summary Report

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Measuring the Value of Hg and Acid Pollution in New York State through Property Values

Summary Report

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1 Introduction

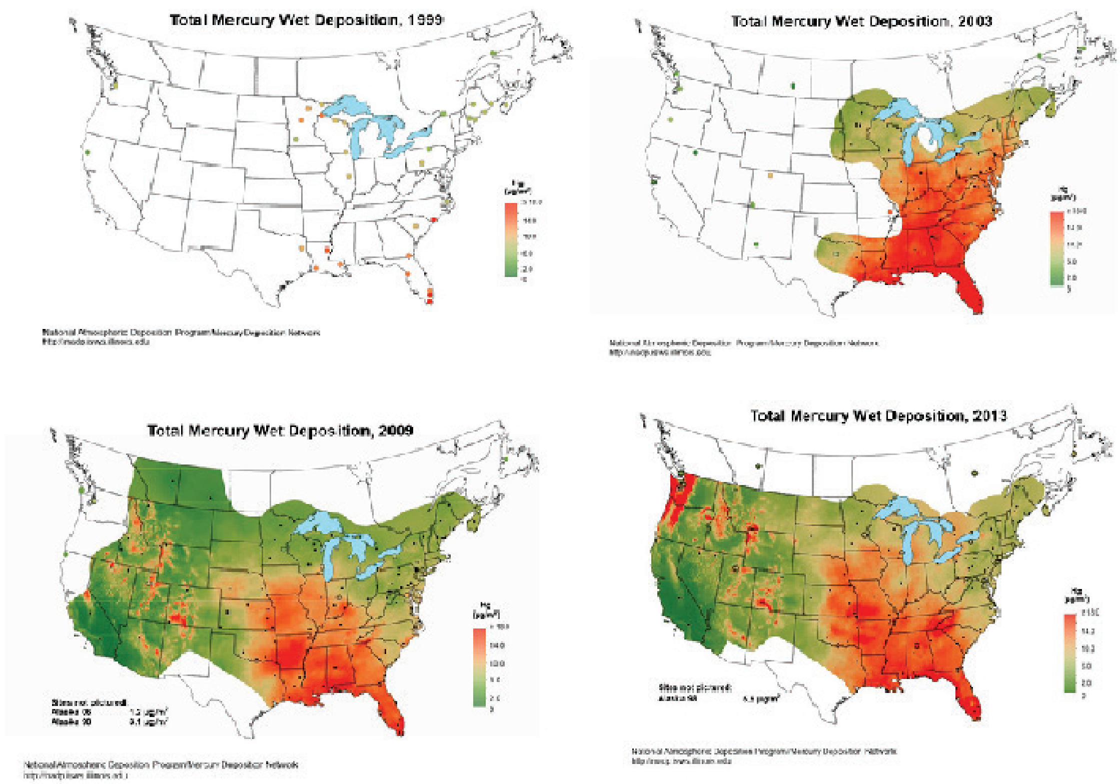
There are 17 major watersheds consisting of thousands of lakes, ponds, and reservoirs, as well as tens of thousands of miles of rivers and streams in New York State. These waterbodies often serve as drinking water supplies for local communities and as habitat for aquatic plants and animals. They also support a wide range of human activities, including recreation, tourism, agriculture, fishing, power generation, and manufacturing. Unfortunately, those waterbodies are also impacted by deposition of mercury and acid species that can originate far upwind (Driscoll et al., 2003a; Krabbenhoft and Sunderland 2013).

In order to address these environmental problems, several regulatory instruments have been proposed and implemented in the United States. The United States acid rain program was enacted in 1990 as part of the 1990 Clean Air Act Amendments (CAAA) and is viewed by some as the most successful "market-based" environmental policy, greatly reducing the deposition of sulfates in New York State and beyond.

On the other hand, the 1990 Clean Air Act amendments also gave the U.S. EPA broad discretion in crafting regulation to reduce power plant mercury emissions. Under section 112 of the CAAA, Congress identified 189 substances, including mercury, as "hazardous air pollutants." Since then, there have been dramatic reductions in mercury emissions from most municipal waste combustors, medical waste incinerators, and a number of other sources (Simonin et al., 2009). However, regulations on controlling emissions of mercury and other common toxic air pollutants from power plants, the largest single source of anthropogenic mercury emission in the United States (U.S. EPA 2011b), have only recently been adopted.

Figure 1. Mercury deposition over time

Maps of the United States showing how wet Mercury deposition has changed over time between 1999 and 2013. Data has become more available over this period, and deposition is pervasive, especially in the Midwest and southeast.



In 2005, the EPA issued the Clean Air Mercury Rule (CAMR), limiting mercury emissions from new and existing utilities. Similar to the acid rain program, this rule also included a cap-and-trade program to reduce mercury emission in the nation within two phases. However, the U.S. Supreme Court vacated this rule three years after its initialization. In 2011, the. EPA announced the Mercury and Air Toxics Standards (MATS) aiming at limiting mercury, acid gases, and other toxic pollution from power plants exclusively. The U.S. Supreme Court again overturned the MATS, declaring that the EPA should take cost into consideration when finding it is “appropriate and necessary” to regulate electric utilities. Eventually, in April 2016, the EPA provided final evidence including a consideration of cost and maintains their determination in promoting MATS: it is appropriate and necessary to set standards for emissions of air toxics from coal- and oil-fired power plants. Almost at the same time, the U.S. Supreme Court changed its perspective and refused to stay the MATS. Therefore, the MATS has become the first standard in the United States for mercury emissions from power plants and is expected to lead to an extraordinary reduction in nationwide emissions of mercury in the near future.

In crafting and evaluating policies to reduce atmospheric deposition of mercury and acidic compounds, policy makers would be well-served to have information on the costs and benefits of these policies. Since waterbodies, as an important part of the ecosystem, are the direct recipient of those adverse depositions and are highly valued by the public (Keeler et al., 2012), measuring the economic values of water quality and related ecosystem services is an important component to quantifying the benefits of mitigating mercury and acidic emissions. Because there is no established market for surface water quality, it is common to use data on consumer behavior in related markets to estimate the non-market benefits of improving environmental amenities. Housing markets are a great example of prices related to the characteristics of individual homes, including environmental services provided by their location. With sufficient information on property transactions and the market, we can identify the effect of environmental amenities on the prices of surrounding properties.

We conducted a property value analysis to investigate how different levels of fish mercury and acidity in lakes will affect property values in a large swath of New York State. This analysis was based on more than 228,000 property transactions covering 34 counties in New York State from 2004 to 2013, and water quality data for 173 lakes larger than 17.3 ha (43 acres)[1] covering the same time period.

1 The size of included lakes is determined based on water quality data availability. More details about the selection will be discussed below.

Figure 2. Property Value Analysis

Having tested a variety of models we found that:

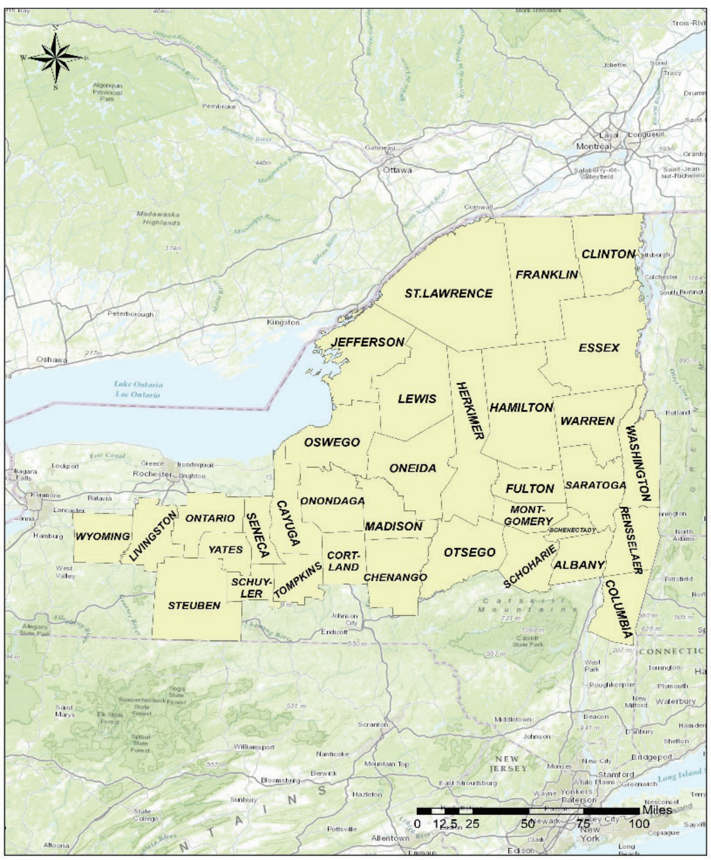
- The effect of lakes with high pH on property values is not significant, while the effect of lakes with low pH on property values is positive and significant, which runs counter to expectations.
- Close proximity to a lake with a fish consumption advisory significantly depreciates property values by approximately three to four percent. This negative effect increases to approximately 15 to 25 percent for waterfront properties and near-waterfront properties within one mile from an affected lake.

These results, when applied to an average home in our sample area, imply a possible gain of about $4,200 from the lifting of fish consumption advisories due to improved water quality.

2 Methods

We collected and compiled 332,652 real residential property transactions from 2004 to 2013 in 34 counties in NYS. All of the 2004–2013 real estate transactions dataset was provided by the New York State Office of Real Property Taxation Services (NYSORPTS). NYSORPTS also provided us with detailed parcel and property characteristics of all transactions. We link this transactions data with data on water quality, fish mercury measurements, and fish consumption advisories in addition to more general information about the location of the home and its characteristics. In order to do this, we first normalize the fish mercury measurements by species, size, and age of the fish.

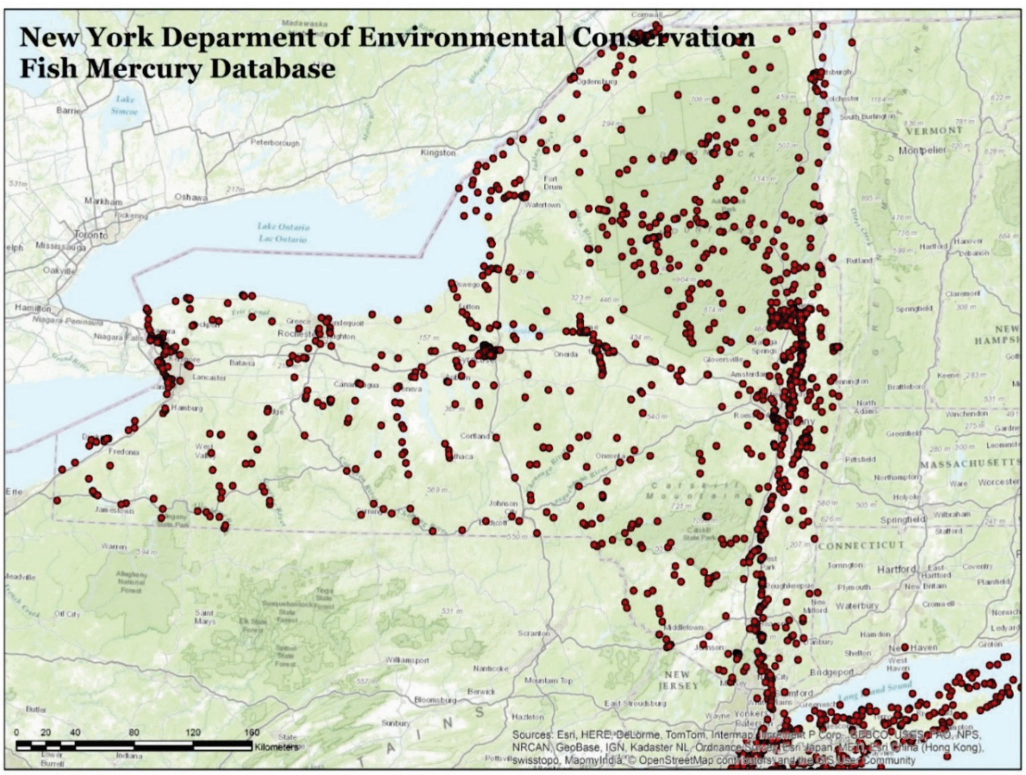
Figure 3. Map of Study Area



Since fish mercury data are derived from different monitoring programs, there are differences in the characteristics of fish samples collected over time and across different lakes, which presents a challenge in comparing pollution levels. For example, a larger fish (e.g., Walleye) caught in a lake A may contain higher mercury than a smaller one (e.g., yellow perch) sampled from a lake B. However, based on those two fish samples, it would be inappropriate to conclude that lake A is more polluted than lake B since the fish have different characteristics. The objective of standardization is to find the most accurate and comparable fish mercury level for each sampling event (i.e., combination of sampling site and year). We deployed four different methods to standardize the fish mercury data considering variation in fish length, species, sampling sites, and time. After standardization, the annual average of fish mercury concentration was calculated as the fish mercury level for each lake.

Figure 4. Map of Mercury Sampling Sites

Sources: Esri, HERE, DeLorme, TomTom, Intermap, Increment P Corl, CEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, MET, Esri China (HongKong), Swisstopo, MapmyIndia, ©OpenStreetMap contributors and the CIS User Community



Type of Data: Total mercury in fish tissue
Data period: Back from 1970 to 2011, but not consistent
Number of Sites: 1851 sampling sites state-wide

The goal of the property value analysis is to estimate how different home and property characteristics, including location, affect home prices. To do this we apply a relatively simple multiple regression analysis with some additional controls to help curb some biases commonly seen in this sort of analysis.

3 Results

We performed the property value analysis using a basic ordinary least squares model, and then add additional controls for unobserved characteristics which are correlated with a property's location. We do this at four different levels to have more confidence in our results.

As mentioned above, the three variables in which we are especially interested are fish Hg, lake pH, and the presence of a fish consumption advisory. In the OLS model, a lake with unknown fish mercury level or with unsafe fish mercury level poses significant negative impacts on property values compared to lakes with safe fish mercury level (≤0.3 ppm). As to estimation of effects of acidity, all else equal, a lake with high pH (pH>8) or with unknown pH level negatively affects property values compared to lakes with a pH level in normal range. In contrast, it is surprising to observe that lakes with low pH (pH<6.5) add a premium to property values. However, this result is explainable. Though lake acidification directly impacts ecosystems (Driscoll et al., 2003a; Driscoll et al., 2003b), to a certain extent, lakes that are stressed by acidification become clear and may deliver a false implication to property owners about the water quality.

Regarding fish consumption advisories, we find negative impacts on property values in three of our five specifications, and these are statistically significant in two of these models. The remaining two models are less reliable due to bias introduced through omitted variables in one case and through a lack of variation in the other, but find positive impacts. This provides a bit of a mixed result, but our preferred models indicate negative and significant impacts from fish consumption advisories.

In the process of designing policy to mitigate mercury pollution, fish mercury levels of a lake is a measurable and meaningful parameter. However, our statistical analysis suggests that this scientific measure is not taken into consideration by property markets. Therefore, we performed the property value prediction based on several hypothetical policy scenarios around the elimination of fish consumption advisories based on water quality improvements.

Since 1993, the EPA has compiled information from states, U.S. territories, Native American tribes, and local governments about fish consumption advisories and safe eating guidelines, and made this information available to the public.

Figure 5. Percentage of total lake acres and river miles under advisory from 1993 to 2011 (U.S. EPA 2013).

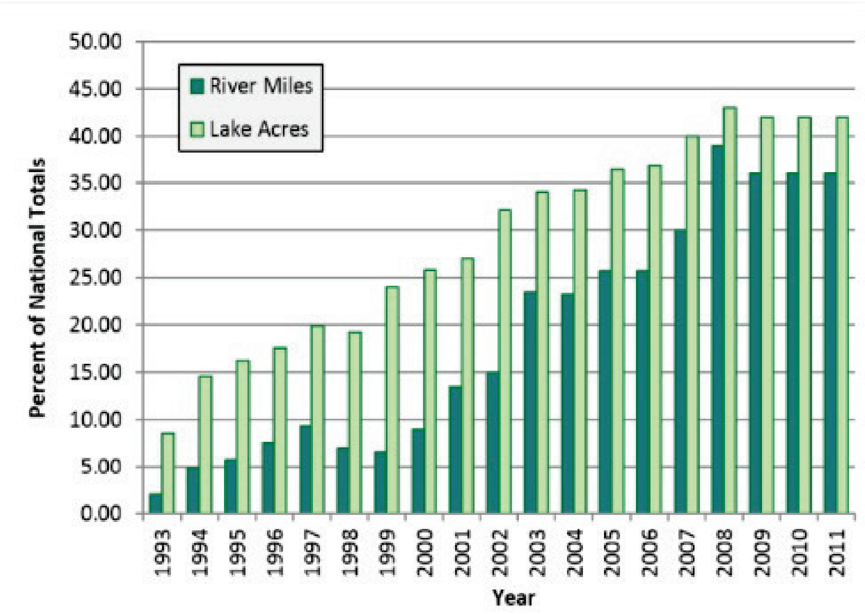


Figure 5 illustrates the changes in fish advisories on lake acres and river miles from 1993 to 2011. The data on fish consumption advisories in the State is provided by the Department of Health (DOH). Based on this, we hypothesize policy scenarios in which a certain percentage of lakes with existing fish advisories are removed from the fish consumption advisory list.

Specifically, the property value prediction was conducted:

1. Based on all parcels within our study region to identify the dollar cost of being close to a lake with individual fish consumption advisory.
2. Based on several hypothetical scenarios when 1%, 3%, 5%, 10%, 15%, 20%, 30%, 50%, and 75% of lakes are removed from the current fish advisory list.

Property value predictions were conducted based on the statistical models described above, but with mercury and pH levels omitted. Information on 968,789 properties in the study area was used for these price predictions. Table 1 shows the results for being close to a lake with a fish advisory in terms of real property values of observed transactions and predicted property values of all properties within the study region.

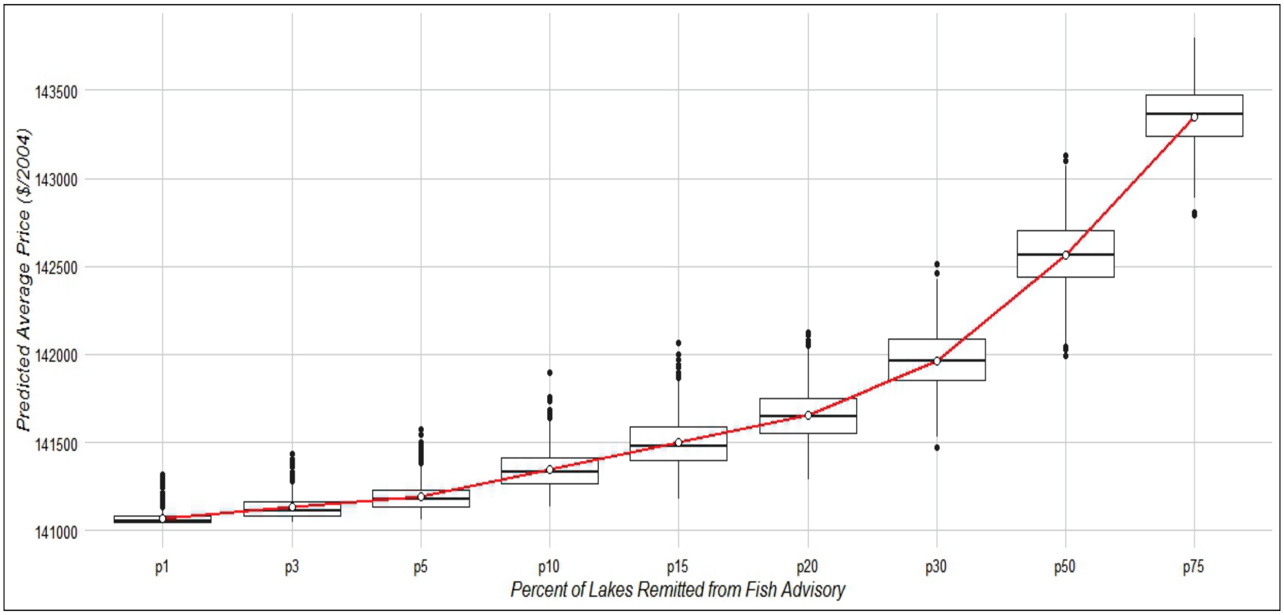
Table 1. Prediction of Property Values Impact

	Observations	Mean Property Value Impact($/2004)	Median Property Value Impact($/2004)
Real Price	218,833	-3,853	-3,164
Predicted Price	968,789	-4,231	-3,708

This table suggests that, all else equal, a house with average real sale price of $128,441 could restore up to $3,900 in value if the nearest lake is removed from individual fish advisory list. Because the average price in our sample is somewhat lower than the average predicted price in the larger regional dataset, we predict a premium of approximately $4,200 in that sample. Following the scientific literature, this calculated increase of property value is an upper bound to the benefits of a widespread improvement in water quality resulting in the rescinding of an existing fish advisory on a lake (Bartik 1988; Leggett and Bockstael 2000).

As mentioned above, the hypothetical policy scenarios were constructed based on the percentage of lakes with existing fish advisories removed from the fish advisory list. We make no further assumptions on which specific lakes are going to be removed under those scenarios, but instead use a randomizer to randomly remove fish advisories on lakes in our sample, and then estimate the mean property values effects across a series of these randomizations. Figure 6 shows the prediction results under all hypothetical scenarios.

Figure 6. Predicted average property value (in 2004 dollars) based on different scenarios that certain percentage of lakes are remitted from fish advisory list



The red line shows how the predicted mean property value increases as a higher portion of lakes are removed from the fish advisory list, along with confidence intervals (the boxes) and outlier estimates. For example, when only one percent of lakes are removed from the fish advisory list, the mean property value increases to just slightly more than $141,000 while the mean property value increases by nearly an additional $1,000 dollars (to about $142,000) if 30 percent of lakes are removed from the fish advisory list. Aggregating this across all affected properties yields aggregated property value increases of $30 million at a one percent decrease in listed lakes and $898 million at a 30 percent decrease.

4 Conclusion

Based on more than 228,000 transaction observations covering 34 counties in the State from 2004 to 2013, and water quality data of 173 big lakes (greater than 17ha) covering 2004 to 2013, we conducted a property value analysis to investigate how different levels of fish mercury and acidity in lakes will impact the local economy as measured through the property value metric. The results are consistent and indicate that, all else equal, lakes with elevated fish mercury level or high pH level pose very little impact on property values on their own. However, we found that, *ceteris paribus*, a lake with a fish consumption advisory depreciates the property values nearby by approximately three to four percent. This negative impact rises to about 15 to 25 percent of the average value of waterfront property and near-waterfront property within one mile away from the lake.

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