# Housing Market Capitalization of Freshwater Fisheries: Evidence from Oneida Lake, NY

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## ABSTRACT

- Evaluating the economic values of fishery related ecosystem services would provide critical information for project evaluation and decision making.
- In this paper, we establish a linkage between fishery population and lakefront housing prices and quantify the economic value of freshwater lake fish species using hedonic property value model.
- Using Oneida lake as a case study, our empirical results suggest a statistically significant capitalization effect for an increase warmwater gamefish, the main attraction for anglers in Oneida Lake according to the New York State Angler Survey.
- A one-standard-deviation in the abundance of warmwater gamefish increases housing price by 8.8%. Our results suggest that fish abundance generate significant economic values for lakefront homeowners: the aggregated capitalized value for a one-standard-deviation increase in warmwater gamefish amounts to $51.9 million.

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## INTRODUCTION

- Human societies benefit in numerous ways from ecosystem services generated by fish populations, from recreational fishery to biodiversity and ecosystem health. Evaluating the economic values of fishery related ecosystem services would provide critical information for project evaluation and decision making,
- In this paper, we propose to quantify the economic value of freshwater lake fish species using the hedonic property value method. The intuition underlying hedonic model is that property buyers would evaluate the bundle of attributes that defines the houses, including house, neighborhood, and environmental characteristics in the house search process and reveal their preferences for each attribute. Thus, property buyers' willingness to pay for environmental amenities, i.e., water quality and fish population would be captured in the housing sales prices
- Our empirical framework identifies the capitalization effect of fish populations on the change in housing price premiums between lake-front and non-lake-front houses in response to fish population changes. Changing in fish populations would bring the biggest impacts to lakefront homeowners due to their year-around access to angling, boating, or visiting.
- We use Oneida Lake in New York State, USA as a case study for exploring relationships between fish abundance and lakefront property values. Oneida Lake nurtures a diverse fish community and has seen a long history of recreational fishery activities. By leveraging a rich dataset of housing transactions of four counties in New York State, annual fish population observations of over 40 fish species, and spatially explicit water quality monitoring data, we are able to capture the spatial and temporal changes of fish population, water quality, and property values spanning nearly three decades (1990-2018).

## Empirical Model

- Estimating the relationship between fish abundance and lakefront price premium
  Intuition: favorable fishing site conditions increase the premium of lakefront properties relative to other properties

- Estimating equation:

$$\log(\text{SalePrice})_{it} = \alpha + \beta_1 \text{LakeFront}_i + \boldsymbol{\beta_2} \text{LakeFront}_i \times \text{FishSpecies}_t + \beta_3 \text{Water Quality} + \beta_4 \text{LakeFront}_i \times \text{Water Quality}_t + \text{Controls}_{it} + \lambda_d + \lambda_c + f(t) + \varepsilon_{it}$$

with controls for property characteristics, neighborhood demographics, spatial fixed effects at the school district and county levels, and flexible time trends.

## Data and Summary Statistics

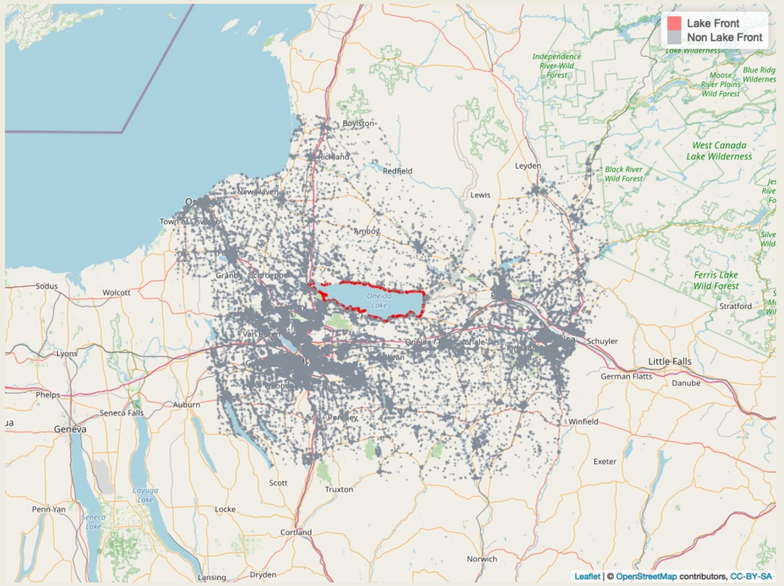



*Figure 1: Property Sales Near Oneida Lake.*

**Table 1 Summary Statistics of Properties**

| | Lakefront Properties | | Non-lakefront Properties | | Difference | Significance |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Real Sales Price ($1,000) | 168.476 | 79.232 | 129.581 | 68.453 | 38.895 | *** |
| Distance to Oneida Lake (km) | 0.045 | 0.029 | 20.863 | 11.692 | -20.818 | *** |
| No. Bedrooms | 2.787 | 0.843 | 3.179 | 0.736 | -0.392 | *** |
| No. Bathrooms | 1.544 | 0.664 | 1.467 | 0.6 | 0.077 | *** |
| Square Footage | 1593.487 | 650.84 | 1599.896 | 585.566 | -6.409 | |
| Lot Size (acres) | 0.541 | 0.857 | 1.824 | 53.001 | -1.283 | |
| Property Age | 46.753 | 31.045 | 51.301 | 36.521 | -4.548 | *** |
| % Senior (age>60) | 0.268 | 0.081 | 0.254 | 0.092 | 0.014 | *** |
| % White | 0.971 | 0.027 | 0.894 | 0.136 | 0.077 | *** |
| % College and Above | 0.528 | 0.134 | 0.657 | 0.144 | -0.129 | *** |
| Distance to Nearest Walmart (km) | 12.449 | 4.299 | 7.408 | 6.158 | 5.041 | *** |
| Distance to Nearest Post Office (km) | 3.904 | 2.418 | 2.268 | 1.579 | 1.636 | *** |
| N | 1447 | | 180469 | | | |

Note: Pairwise mean difference test reported between lakefront and non-lakefront properties. ***p<0.01, **p<0.05, *p<0.1.

**Table 2 Summary Statistics of Ecological Variables**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| | Average Gillnet Catches | | | |
| Walleye | 19.046 | 6.93 | 5 | 31.8 |
| Smallmouth Bass | 2.73 | 1.032 | 1.133 | 5 |
| Largemouth Bass | 0.008 | 0.029 | 0 | 0.133 |
| Yellow Perch | 42.41 | 11.784 | 21.067 | 70.733 |
| White Perch | 25.419 | 12.896 | 2.467 | 51.4 |
| Channel Catfish | 1.032 | 0.561 | 0.133 | 2.933 |
| White Bass | 0.31 | 0.368 | 0 | 1.533 |
| Northern Pike | 0.017 | 0.034 | 0 | 0.133 |
| Green Sunfish | 0.018 | 0.089 | 0 | 0.467 |
| Brown Trout | 0.011 | 0.025 | 0 | 0.067 |
| Rainbow Trout | 0 | 0 | 0 | 0 |
| Atlantic Salmon | 0.005 | 0.017 | 0 | 0.067 |
| | Aggregate Gillnet Catches by Species Types | | | |
| warmwater gamefish | 21.801 | 7.147 | 7 | 33.8 |
| coldwater gamefish | 0.016 | 0.033 | 0 | 0.133 |
| panfish | 70.484 | 16.813 | 25.867 | 103.867 |
| | Water Quality Indicators | | | |
| Secchi Disk Reading (m) | 3.614 | 0.484 | 2.371 | 4.796 |
| Avg Temp (degree C) | 19.777 | 0.715 | 17.73 | 21.41 |
| pH | 8.231 | 0.171 | 7.913 | 8.592 |
| Bottom DO (mg/L) | 6.422 | 0.67 | 5.024 | 8.286 |
| Chlorophyll a | 4.768 | 1.452 | 2.185 | 11.762 |
| Total Phosphorus | 21.922 | 4.822 | 13.475 | 35.748 |
| NOx | 172.054 | 61.809 | 67.548 | 333.841 |

## Results

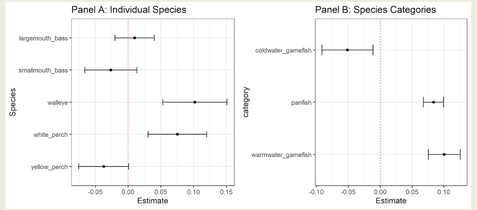



*Figure 2: Parameter Estimates of the Impact of Species Abundance on Lakefront Premium. Panel A (left) estimates equation (1) and plots the point estimates of individual species abundance (standardized into z-scores) interacted with the lakefront dummy variable. Panel B (right) estimates equation (1) and plots the point estimates of species categories (standardized into z-scores) interacted with the lakefront dummy variable. Red dotted line displays zero, and error bars show 95% confidence intervals.*

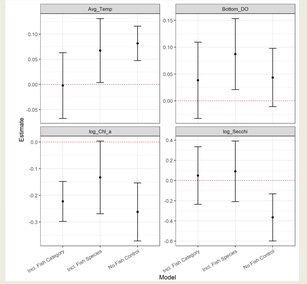
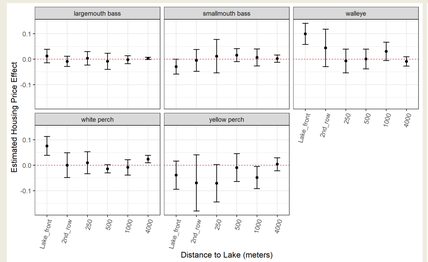



*Figure 3: The impact of fish abundance on water quality valuation*



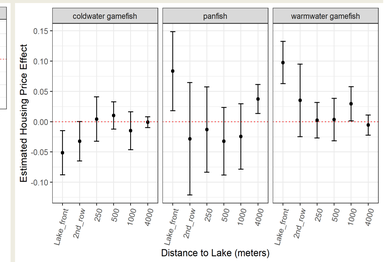




*Figure 4: Spatial Spillover of the Impact of Species Abundance on Lakefront Premium. Panel A (left) estimates equation (2) and plots the point estimates of individual species abundance (standardized into z-scores) interacted with proximity dummy variables. Panel B (right) estimates equation (2) and plots the point estimates of species categories (standardized into z-scores) interacted with proximity dummy variables`. Red dotted line displays zero, and error bars show 95% confidence intervals.*

## CONCLUSIONS

- Fishery abundance significantly capitalizes into lakefront housing prices
- Back-of-envelope analysis suggests that:
  ~3300 total lakefront houses around Oneida Lake
  - $168k average housing price
  - 8.8% increase in lakefront premium for every 1sd increase in walleye abundance

  That leads to:
  - $48.8 million increment in property valuation
  - ~$1 million increment in annual property tax revenue