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# A socioeconomic analysis of habitat restoration in the Muskegon Lake area of concern

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ABSTRACT

As part of the 2009 American Recovery and Reinvestment Act (ARRA), a $10 million grant was awarded to restore wetlands and stabilize shoreline along the south shore of Muskegon Lake (MI), a Great Lakes Area of Concern. A socioeconomic analysis was conducted as part of this award, which included a travel cost survey for lake recreation and a hedonic housing valuation to estimate return on investment. The value of a trip to Muskegon Lake was estimated to be $39.76; when applied to the anticipated increase in post-restoration recreational trips to Muskegon Lake, and using a conservative 7% discount rate, the Net Present Value over 20 years is $38.1 million. The hedonic analysis examined values for houses between 100 and 800 m from the shoreline, using both the current shoreline distances and the new shoreline distances after restoration; this resulted in a predicted $11.9 million in additional housing value as a result of the improved shoreline features. Summing the hedonic value and travel cost estimates, along with the original $10 million spent, the result is that over 20 years, the total value generated for the local region is nearly six times the initial ARRA spending. In other words, of the $60 million of value created on the Muskegon Lake restoration, $50 million is increased environmental value over the 20 year period.


## Introduction

The Great Lakes provide an enormous array of ecosystem services, although currently they have not been inventoried in a comprehensive fashion (Steinman et al., 2017). Allan et al. (2013) mapped cumulative stress throughout the Great Lakes and concluded that heavily populated sites experience the greatest stress, but they also would generate the greatest return on restoration investment in terms of ecosystem services. Ecosystem restoration efforts are currently underway throughout the Great Lakes region to undo some of these past abuses, but there is limited quantitative analysis on the value associated with these efforts. Valuation of ecosystem services can be done through revealed preference methods, such as travel cost analysis, hedonics, and opportunity cost analysis, or through stated preference methods, such as contingent valuation. Generating rigorous valuations for these restoration projects can be a powerful tool in assessing their socioeconomic effectiveness and justifying their implementation, although some argue that valuation demeans nature (cf. McCauley, 2006).

In 1985, Muskegon Lake was designated a Great Lakes Area of Concern (AOC) because of historic abuses, including the loss of critical littoral zone habitat and coastal wetlands, excessive nutrients, and toxic pollutant discharges that contaminated the lake bottom (Steinman et al., 2008; USEPA, 2009). Despite Muskegon Lake's history of environmental problems, it is still an important recreational resource for West Michigan (Alexander, 2006). This ~17 $km^2$ lake is a drowned river mouth system with the Muskegon River flowing into it from the east and a navigation channel flowing from the lake into Lake Michigan to the west (Steinman et al., 2008) (Fig. 1). Muskegon Lake offers opportunities for boating, kayaking, angling, sailing, and wildlife-watching. A newly created trail along its south shore offers opportunities for walking, jogging, rollerblading, skateboarding, and cycling. While market-based data may exist for some of these activities (e.g., charter boat fishing, boat launch or marina fees, bicycle rentals, and fishing licenses), there are other nonmarket-based values and benefits that to date have not fully been taken into account (Daily et al., 2009; Heal, 2000).

In 2009, with the creation of the American Recovery and Reinvestment Act (ARRA), awards were made throughout the United States to restore damaged wetlands, shellfish beds, coral reefs, and to reopen fish passages that boost the health and resilience of U.S. coastal and Great Lakes communities. For Muskegon Lake – one of only three such projects in the Great Lakes region – $10 million was awarded to restore wetlands and stabilize shoreline along the south shore of the lake (NOAA, 2009). The ecological goals included softening ~3 km of hardened shoreline, restoring ~11 ha of wetland habitat, and removing or improving ~10 ha of unnatural lake fill (~103,250 $m^3$). A separate project included environmental and socioeconomic monitoring. We focus here on the economic benefits measured via hedonic property values and a travel cost survey for lake-based recreation.

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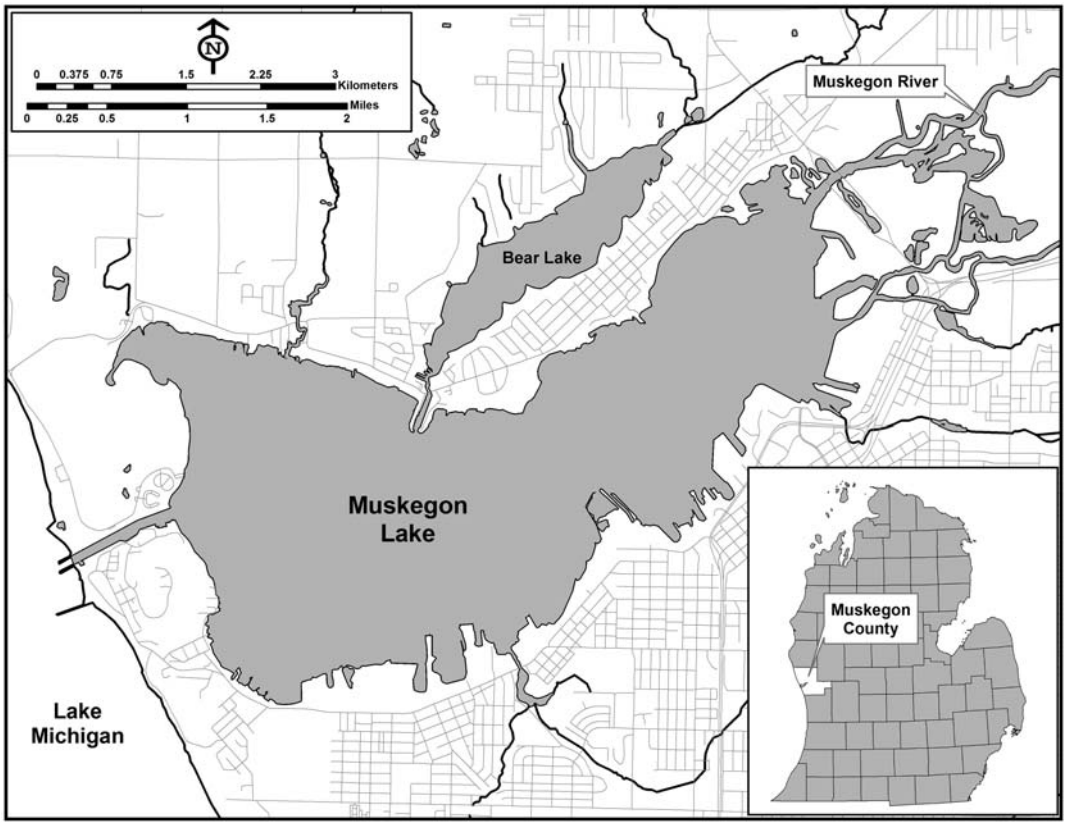


**Fig. 1.** Hydrography and road map of Muskegon Lake. Inset: Muskegon Lake's location in the western portion of Michigan's lower peninsula.

## Conceptual approach

Different economic models have been used to determine the value of recreation-based ecosystem services; the most commonly used method is travel cost. The travel cost method is a revealed preference approach to environmental valuation that uses behavioral data, such as travel distance to recreational sites, frequency of visits, and actual trip expenses, to estimate users' willingness-to-pay for recreational activities and opportunities (Seller et al., 1985; Sutherland, 1982; Whitehead et al., 2009). Knowing the value of recreation on Muskegon Lake and the change in usage allows us to calculate the increased value from the environmental remediation.

In addition to recreation, the softening of the Muskegon Lake shoreline was a highly visible part of the restoration project; therefore, we hypothesized that it would likely affect housing prices. It was anticipated that homeowners would prefer natural shoreline over the aging hardened shoreline on the south side of Muskegon Lake. The effect of proximity to a natural shoreline can be explored using hedonic analysis. Hedonic analysis is a common and well-known method used when examining housing markets, and reveals through actual market transactions the marginally implicit price of individual housing attributes (Rosen, 1974). A house is a composite of many different features, and the price can therefore reveal how much homebuyers are willing to pay for each one. This identifies marginal price for housing attributes, and we are able to determine the values of not only structural features, but also locational and environmental amenities. Hedonic analysis can play a crucial role in environmental valuation assessments, given that there is no actual market for environmental services.

## Methods

To determine the socioeconomic impacts of this shoreline habitat restoration project, we monitored the economic value before, during, and after the restoration project was completed. It was anticipated that the restoration of aquatic habitat and coastal wetlands in this Great Lakes AOC would increase the economic value of ecosystem services associated with these restored wetlands (Steinman et al., 2017), which local government and economic development authorities can use to promote local tourism and commerce. This required a survey of lake users, a survey of possible users of the lake, and housing sales information. These data were then used to find the value of recreation, the number of new visitors, and the increase in housing value from the environmental improvement.

### *Recreation survey*

The "Travel Cost Survey of Recreational Users of Muskegon Lake, MI" (Electronic Supplementary Material (ESM) Table S1) was intended to elicit individual information regarding recreational trip length, purpose (primary recreation activity), frequency of visits to different sites on Muskegon Lake, trip expenses, and demographic information. Utilizing a single-site travel cost model for one recreational site (i.e., Muskegon Lake), we orally administered the survey to recreational users accessing the lake primarily for fishing, boating or jet-skiing, bird/wildlife watching, walking, or biking at six access sites along the south shoreline of the lake (Fig. 2). Survey sites were selected from the targeted restoration areas along the south and east shorelines of Muskegon Lake that also had public access to the lakeshore.

Surveys were administered in 4 hour shifts (in three cases, shifts were shortened due to inclement weather) at each site on two randomly selected weekend days and two randomly selected weekdays (ESM Table S2). To randomize the sample of recreational users, we interviewed every third adult-user at each location (Parsons, 2003). The survey takers were instructed to ask for the estimated number of trips if the frequency of visits was "15 or more", which was the maximum number on the survey, thereby avoiding data truncation.

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