

Annual Losses to Great Lakes Region by Ship-borne Invasive Species at least \$200 Million

Preliminary research suggests that the annual cost to the Great Lakes region from invasive species introduced by shipping may be upwards of \$200 million dollars a year because invasions limit the ability of the natural ecosystem to support fisheries, raw water uses, and wildlife watching.

The establishment of invasive species can affect the services provided by the Great Lakes ecosystem. This study examined how four kinds of ecosystem services were impacted by invasive species from ocean-going vessels arriving since the St. Lawrence Seaway opened in 1959. It examined only U.S. data, but similar impacts are likely experienced in Canada. These results are preliminary and unpublished, and represent the low end of the range of estimated impacts for reasonable parameter combinations. A more complete economic analysis is underway.

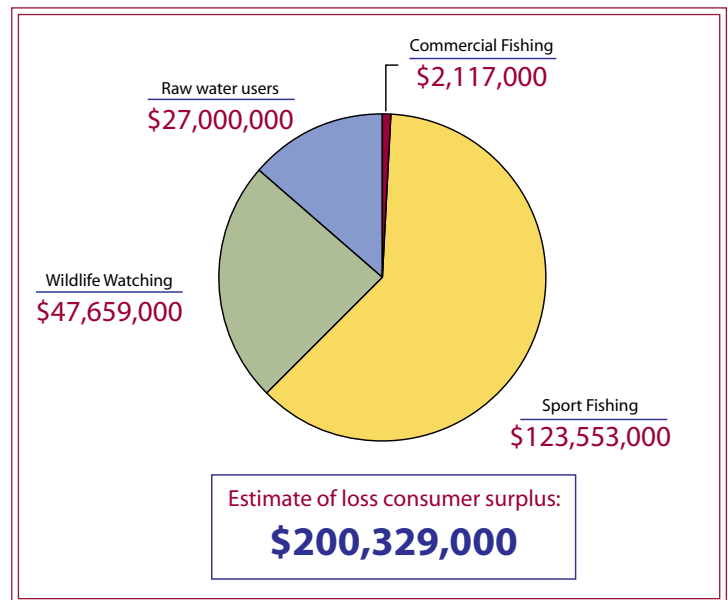
KEY FINDINGS

The data reflect findings for 2006. Considering that new invasive species are being discovered every year, and species already present are spreading, it is likely that the losses experienced in 2006 will increase in following years.

- Results from the study indicate that reductions in Great Lakes commercial fishery landings attributable to ship-borne invasive species range from 13% to 33%, depending on lake.
- Participation in recreational fishing on the Great Lakes was estimated to be 11%-35% less than it would have been without ballast-introduced invasive species, depending on lake.
- Effects of ship-borne invasions on participation in wildlife watching for the entire 8-state region (this analysis could not be limited to the Great Lakes proper) were lower, about 1%.
- There was a wide range of costs to raw water users (facilities like power plants, industries, or municipal suppliers who require fresh water from the lakes), from \$30,000 to \$118,000 per year, depending on facility type. The facilities using the most water were impacted most strongly.
- Impacts varied according to ecosystem service – monetary losses to sport fishing were greatest, followed by wildlife watching, raw water supply services, and then commercial fishing.

METHODOLOGY

Most studies focus on the impact of one or two high-profile invasive species. Considering, too, that traditional ecological research is not done at a large enough spatial scale to address



Preliminary results, based on a set of conservative parameters, show that in 2006, ship-borne invasive species may have cost upwards of \$200 million in lost economic benefits to consumers by reducing sport and commercial fisheries, reducing wildlife watching, and increasing the operating costs for raw water users, compared to a scenario of no ship-borne invasions. Dollar values rise for less conservative parameter combinations and fall when parameter combinations are more stringent. A fuller economic analysis will incorporate a complete range of values and interactions among these and other sectors within the Great Lakes economy.

economic impacts, few inferences about economic impacts could be derived from the scientific literature.

To address this gap, Structured Expert Judgment was used to assess the uncertainty around the ecological impact from ship-borne invasive species. The lost economic benefit to consumers was then estimated from the ecological changes predicted by experts. When scientific research is uncertain or sparse, this methodology is commonly used to provide policy guidance..

Experts from a variety of fields including fishery biologists, environmental economists, and Great Lakes food web ecologists were asked about a suite of ecosystem services that ship-borne invasive species could affect. These included commercial fish landings, recreational fishing effort, raw water usage, and non-consumptive uses like wildlife watching. These four ecosystem services were selected because they are important to the regional economy, reliable historical data for each is available, and invasive species are known to or could plausibly impact each one.

WHAT IS AN 'ECOSYSTEM SERVICE'?

Ecosystem services are the benefits that the natural environment offers to the communities and economy of the Great Lakes. While these can be difficult to quantify, this research looked at three areas in order to estimate the value of some services the Great Lakes provide.

Sport and Commercial Fisheries

Fish harvests and time spent sport fishing provide benefits, but when invasive species decrease harvests or lower the quality of the recreational opportunities, these benefits may be diminished. This is because there are fewer fish caught and taken to market and what people are willing to pay to sport fish may also decline.

Wildlife Watching

Admiring wildlife and the experience of wildlife watching provide benefits, but when invasive species decrease environmental quality and the quality of the experience, these benefits may decline as people may be willing to pay less to watch wildlife.

Raw Water Uses

Municipalities, power plants, and some industries rely on access to water to function. Invasive species clog and damage intake pipes, increasing maintenance and operational costs.

HOW ECOSYSTEM SERVICES WERE MEASURED

Valuing ecosystem services

Economic valuation of ecosystem services is a challenging task. To generate the preliminary dollar values presented here, simple market models of supply and demand for commercial fishing, recreational fishing and wildlife watching were used. Additional operating costs in dollar units were available for raw water use. If invaders affect the provisioning of ecosystem services, they can result in lost consumer and producer surplus (which are the opportunity costs to society). Consumer surplus is the benefit to consumers of a market outcome and accrue whenever consumers pay less than the maximum amount they would be willing to pay for that unit of a good. Producer surplus is the benefit to producers from the outcome, and accrue whenever producers are paid more for a unit of a good than the minimum that they would be willingly to accept for that unit.

To provide an indication of the lost benefits to society of ship-born invasions, changes in consumer surplus were estimated for commercial fishing, recreational fishing, and wildlife watching. The calculations were made using the median results of the expert elicitation and a range of parameter combinations; the results reported here for a conservative suite of parameters.

For effects on raw water users, additional per facility operating costs arising from biofouling by non-native species were elicited from experts. We then multiplied median per facility estimates by the number of facilities in the region. All the consumer surplus measures provided here were generated without accounting for multi-market, income, and adaptation effects. Incorporating these effects in future analyses will likely generate economic impact estimates different from those presented here.

SIZES OF THE ECONOMIC SECTORS STUDIED

The economic sectors evaluated in this study differ in current size. The estimates below do not include Canada.

Sector	Size
Commercial fishing	\$15 million market value of fish landed from the Great Lakes in 2006. ¹
Recreational fishing	\$1.5 billion in angler expenditures on Great Lakes fishing ²
Wildlife watching	\$9.3 billion in participant expenditures for the eight Great Lakes states. ³
Raw water users	826 facilities, including 13 nuclear power plants. ⁴

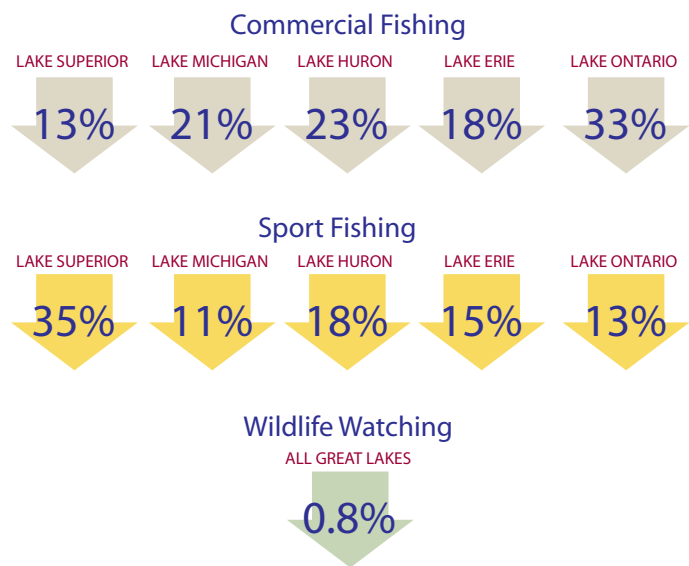
¹ The United States Geological Survey Great Lakes Science Center

² United States Fish and Wildlife Service, *The 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*

³ United States Fish and Wildlife Service (2006)

⁴ Deng (1996); O'Neill (1996); Northeast Midwest Institute

ESTIMATED REDUCTIONS TO FISHERIES AND WILDLIFE WATCHING



Median reductions estimated by Structured Expert Judgment by lake. Impacts to commercial fishing is based on reductions in weight of fish harvest from the Great Lakes. Impacts to sport fishing is based on reductions in number of person-days spent sport fishing on the Lake. Impacts to wildlife watching is based on reductions in person-days spent wildlife watching.

To produce the dollar estimates presented in the pie-graph on page 1, these percent impacts were converted into estimates of lost consumer surplus in dollars, using simple economic models with conservative assumptions.

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