

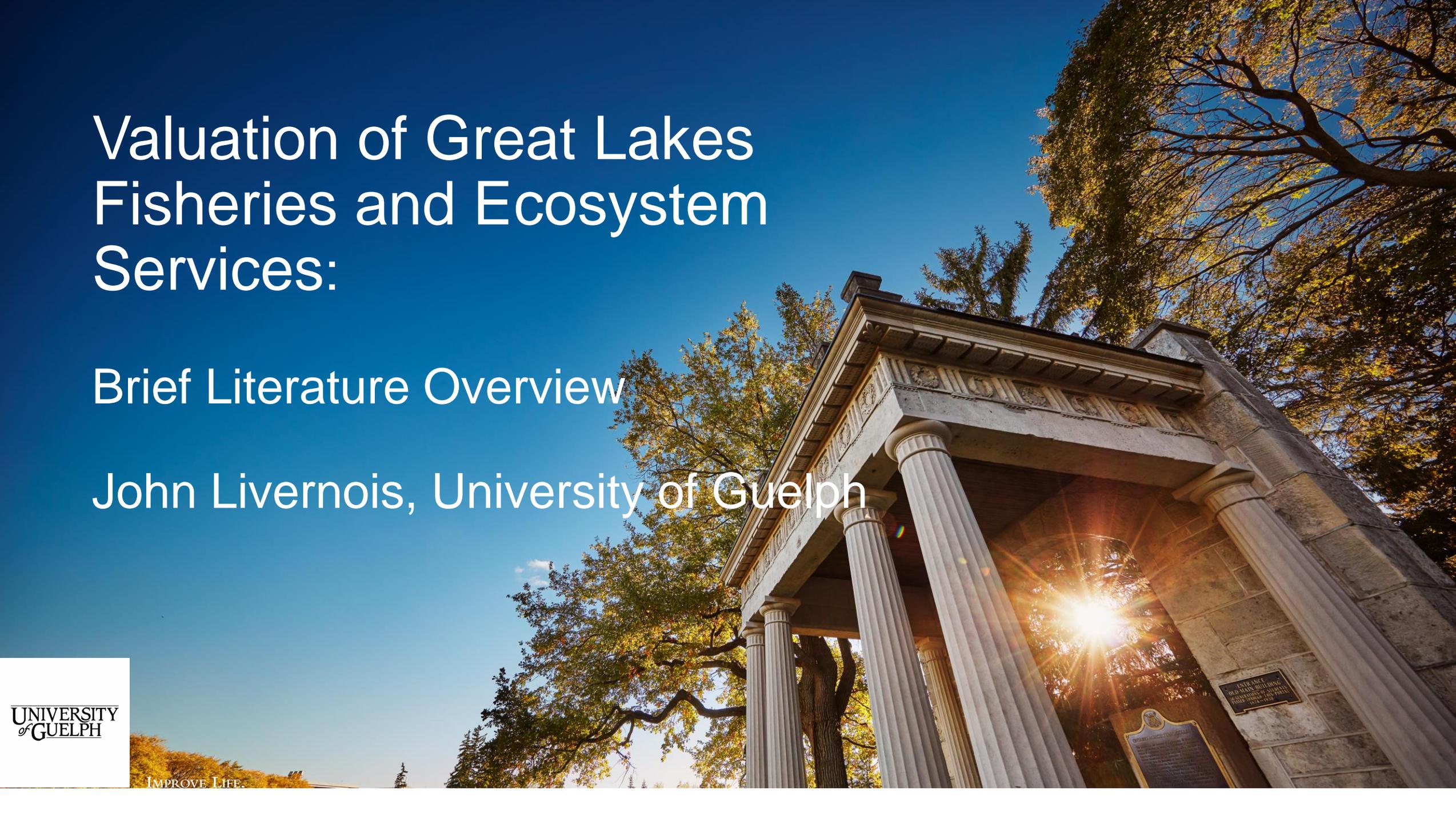
Valuation of Great Lakes Fisheries and Ecosystem Services:

Brief Literature Overview

John Livernois, University of Guelph



IMPROVE LIFE.



GL Fisheries Valuation

**GL Ecosystem Services
Valuation**

GL Fisheries Valuation

- Recreational angling valuation via travel-cost primarily, by species, site etc
- Ideal work links manageable fishing characteristics to value/demand
- No studies of non-use values (with 1 old exception)

GL Ecosystem Services Valuation

- Work limited to specific basins for small subset of ES
- Best work would link manageable ES changes to value/demand
- Very little non-use values estimated
- Benefits-transfer mostly

Intersection of the two literatures

- Fisheries management needs to be done in context of ecosystems and human dimension considerations : Heck et al (2016), Hunt (2013) Brown (1987)
- Tradeoffs between fisheries management and ecosystem services: Pope et al (2016)
- Impact of ANS, acid rain, water flow rates on fishing values

Outline

1. Ecosystem Services in the Great Lakes

- Economic value and economic impact studies
- Other socioeconomic studies
- Studies outside the Great Lakes

2. Recreational Fisheries in the Great Lakes

- Economic value and economic impact studies
- Other socioeconomic studies
- Studies outside the Great Lakes

3. Commercial Fisheries in the Great Lakes

4. Methodology

Note: GLs create/provide value in other important ways (drinking water, transportation, cultural, etc) that are not covered in this review

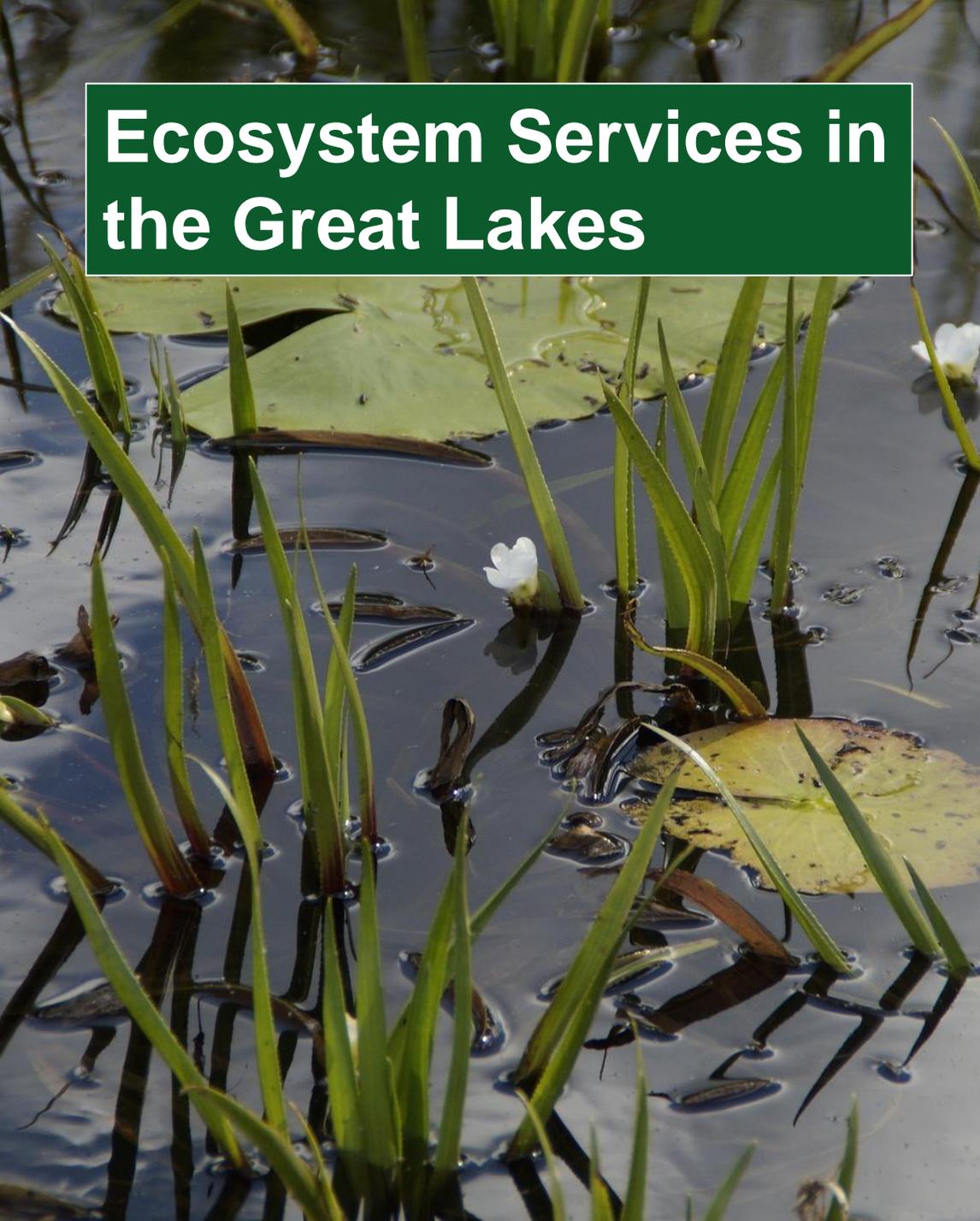
A photograph of a wetland area, likely a Great Lake, featuring water, green reeds, and white flowers. The text "Valuation of Ecosystem Services in the Great Lakes" is overlaid in white. The scene shows a dense growth of reeds with long, narrow leaves and several small, white, star-shaped flowers. The water is dark and reflects the surrounding vegetation. There are also some large, yellowish-green lily pads floating on the water's surface.

Valuation of Ecosystem Services in the Great Lakes



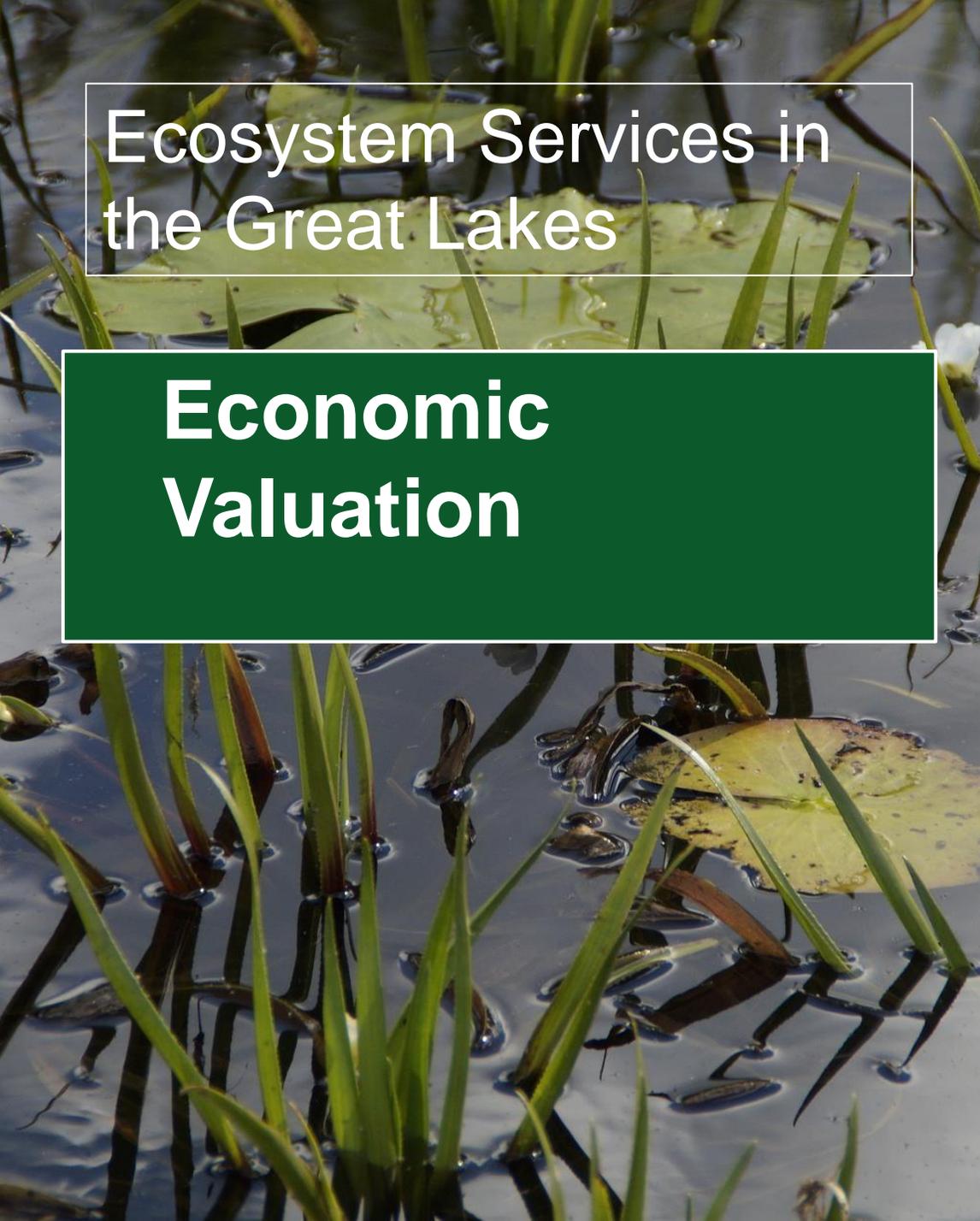
Ecosystem Services in the Great Lakes

- **Economic (“Social”) Value and Economic Impact**
- **Other socioeconomic studies**
- **Studies Outside the Great Lakes**



Ecosystem Services in the Great Lakes

- **Economic Value and Economic Impact**
 - **Restoration (AOCs and habitats)**
 - **Invasive Species**
 - **Beach Closures**
 - **HABs**
 - **General/comprehensive**
- **Other socioeconomic studies**
- **Studies Outside the Great Lakes**



Ecosystem Services in the Great Lakes

Economic Valuation

Restoration of AOCs and habitat

- 3 AOCs (original data); Buffalo River, NY; Sheboygan River, WI; (both general remediation) Muskegon Lake, MI (shoreline stabilization and wetlands restoration)
- Ontario/Marbek – local habitat restoration and protection (benefits transfer)

Braden, J., et al. (2008a).

Braden, J., et al. (2008b).

Isely, P., et al. (2011).

Isely, P., et al. (2018).

Ontario/Marbek (2010).



Ecosystem Services in the Great Lakes

Economic Impact

Restoration of AOCs and habitat

Samonte, G., et al. (2017). [Socioeconomic Benefits of Habitat Restoration](#), US Dept of Commerce, NOAA.

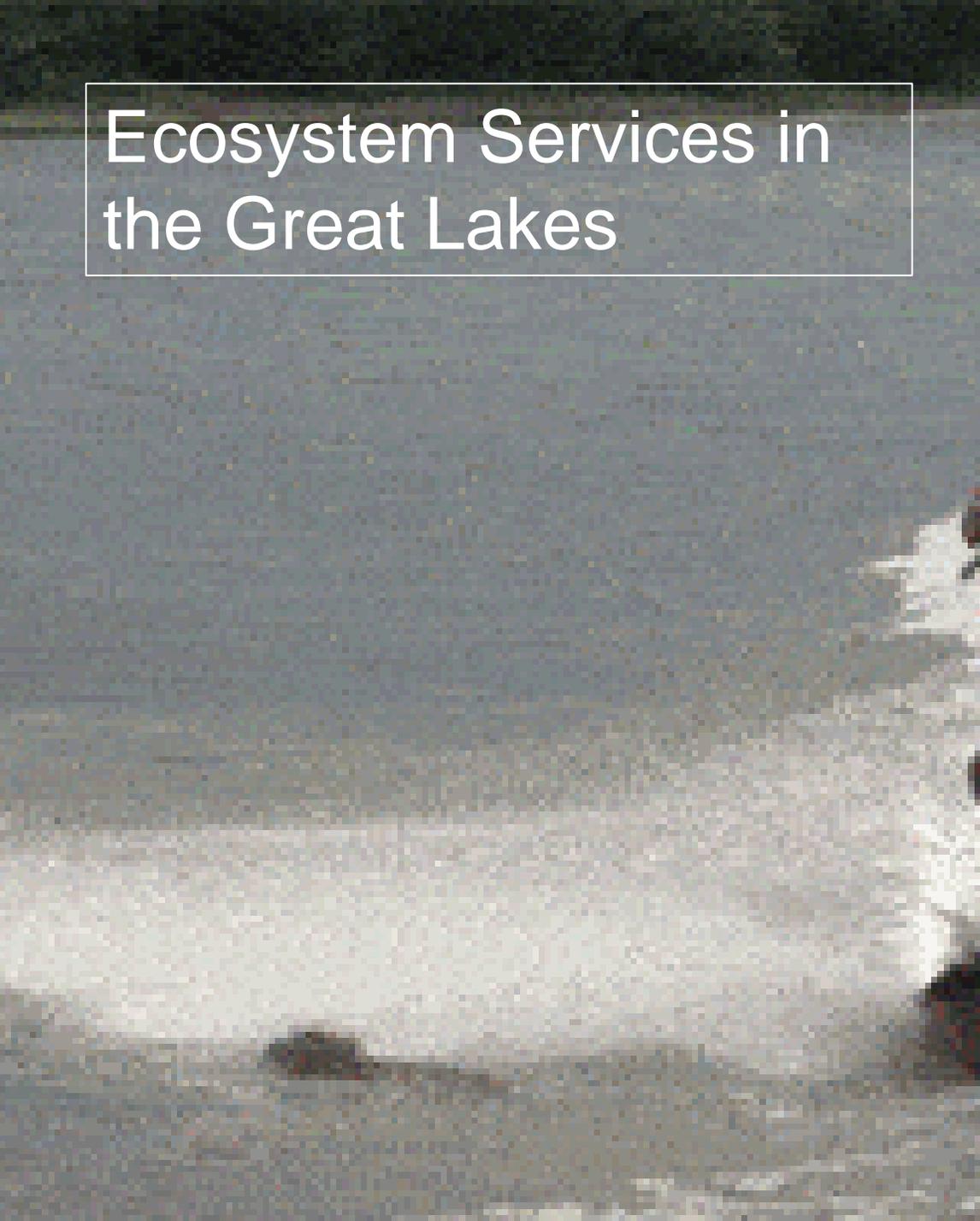
University of Michigan (2018). [The Socioeconomic effects of the Great Lakes Restoration Initiative](#). [University of Michigan Research Seminar in Quantitative Economics](#).

Ecosystem Services in the Great Lakes



Invasive Species

Isely, P., et al. (2017). "Phragmites Removal Increases Property Values in Michigan's Lower Grand River Watershed." Journal of Ocean and Coastal Economics 4(1).



Ecosystem Services in the Great Lakes

Invasive Species

Hayder, S. (2019). Socio-Economic Risk Assessment of the Presence of Grass Carp in the Great Lakes Basin. Winnipeg, Manitoba, Fisheries and Oceans, Canada, Policy and Economics.

Rosaen, A. L., et al. (2012). The Costs of Aquatic Invasive Species to Great Lakes States. East Lansing, MI, Anderson Consulting Group LLC.

Ecosystem Services in the Great Lakes

A scenic view of a beach with a large tree in the foreground and the Great Lakes in the background. The tree is tall and thin, with sparse green leaves. The beach is sandy and has some low-lying vegetation. The water is a deep blue-green color, and the sky is clear and blue. In the distance, a few people can be seen walking on the beach.

Beach Closures

Palm-Forster, L. et al, (2016) Valuing Lake Erie beaches using value and function transfers, Agricultural and Resource Economics Review, 45 (2)

Rabinovici, S., et al. (2003). "Economic and Health Risk Trade-Offs of Swim Closures at a Lake Michigan Beach." Environmental Science and Technology **38**(10).



Ecosystem Services in the Great Lakes

Harmful Algal Blooms

- first four: benefits transfer impacts on property values, tourism, non-users for Lake Erie
- last two: hedonic and stated preference impacts on anglers in Lake Erie

Bingham, M., et al. (2015).

Midsummer Analytics (2015).

Smith, R. et al. (2019).

Wang, S., et al. (2019).

Wolf, D., et al. (2017).

Zhang, W. and B. Sohngen (2018).



Ecosystem Services in the Great Lakes

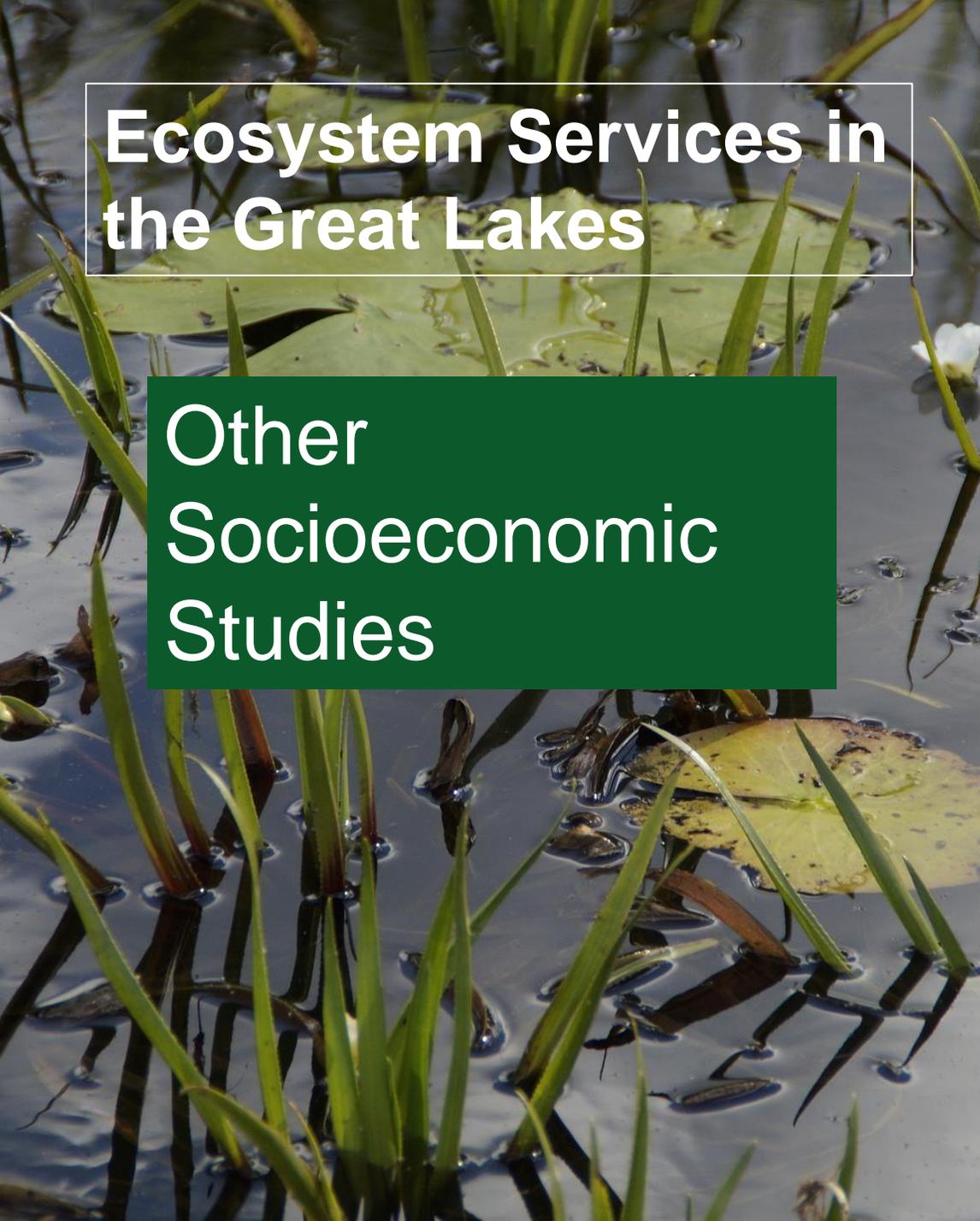
General

Cangelosi, A. and et al (2001). Revealing the Economic Value of protecting the Great Lakes, Northeast-Midwest Institute and NOAA.

Krantzberg, G. and C. De Boer (2006). A Valuation of Ecological Services In The Great Lakes Basin Ecosystem to Sustain Healthy Communities and a Dynamic Economy. Prepared for the Ontario Ministry of Natural Resources. McMaster University.

Krantzberg, G. and C. De Boer (2008). "A valuation of ecological services in the Laurentian Great Lakes Basin with an emphasis on Canada." Climate Change/Environmental Issues Journal AWWA **100**(6).

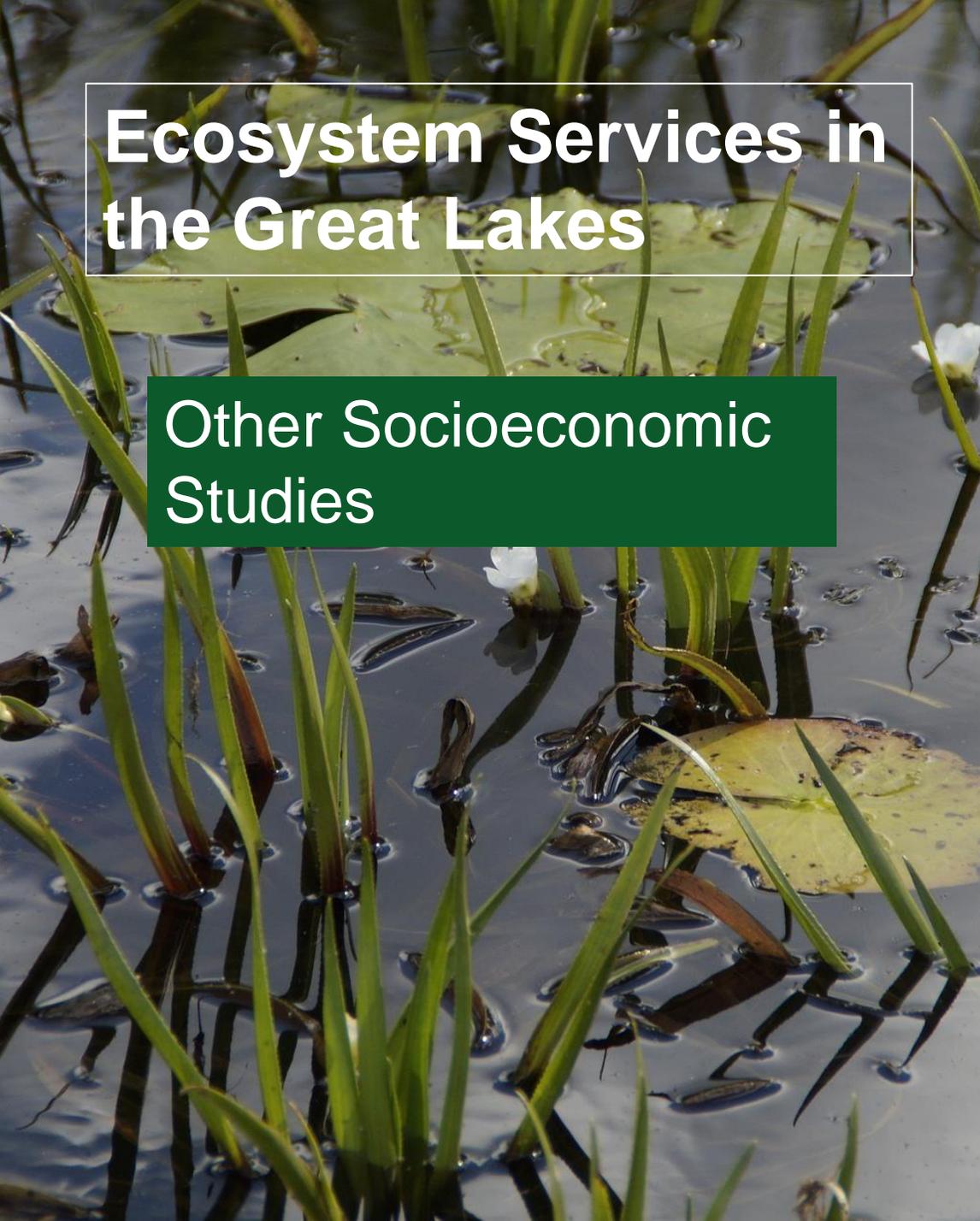
Steinman, A. D. and et al (2017). "Ecosystem services in the Great Lakes." Journal of Great Lakes Research **43**: 161-168.



Ecosystem Services in the Great Lakes

Other Socioeconomic Studies

- Economic Value (8) and Economic Impact (2)
 - Restoration (AOCs and other habitats)
 - Invasive Species
 - Beach Closures
 - HABs
 - General/comprehensive
- **Other socioeconomic studies(5)**
 - **Quantification and Spatial distribution**
 - **Public Perceptions**
 - **Blue Economy**
- **Studies Outside the Great Lakes**

A photograph of a pond with water lilies and green reeds. The water is dark and reflects the surrounding greenery. The lily pads are large and green, with some showing signs of aging or damage. The reeds are tall and thin, with some showing brown tips. The overall scene is a natural, aquatic environment.

Ecosystem Services in the Great Lakes

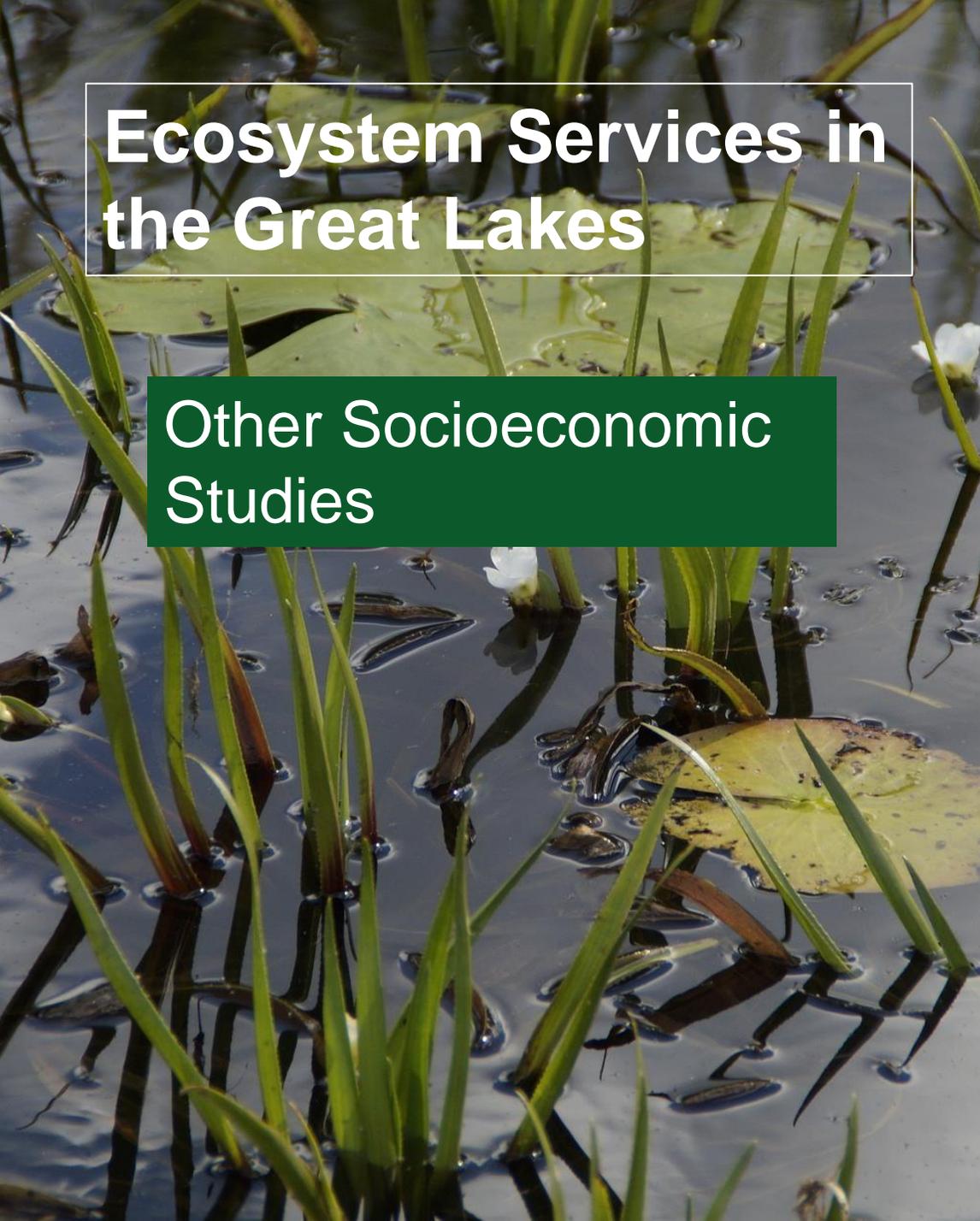
Other Socioeconomic Studies

Quantification and Spatial Distribution

Allan, J. D. and et al (2015). "Using cultural ecosystem services to inform restoration priorities in the Laurentian Great Lakes." Front. Ecol. Environ **13**: 418-424.

Allan, J. D. and et al (2017). "Ecosystem services of Lake Erie: spatial distribution and concordance of multiple services." Journal of Great Lakes Research **43**: 678-688.

Sterner et al. (2020). "Ecosystem services of Earth's largest freshwater lakes." Ecosystem Services **41**.

A photograph of a pond with lily pads and green reeds. The water is dark and reflects the surrounding greenery. The lily pads are large and green, with some showing signs of aging or damage. The reeds are tall and thin, with some showing brown tips. The overall scene is a natural, aquatic environment.

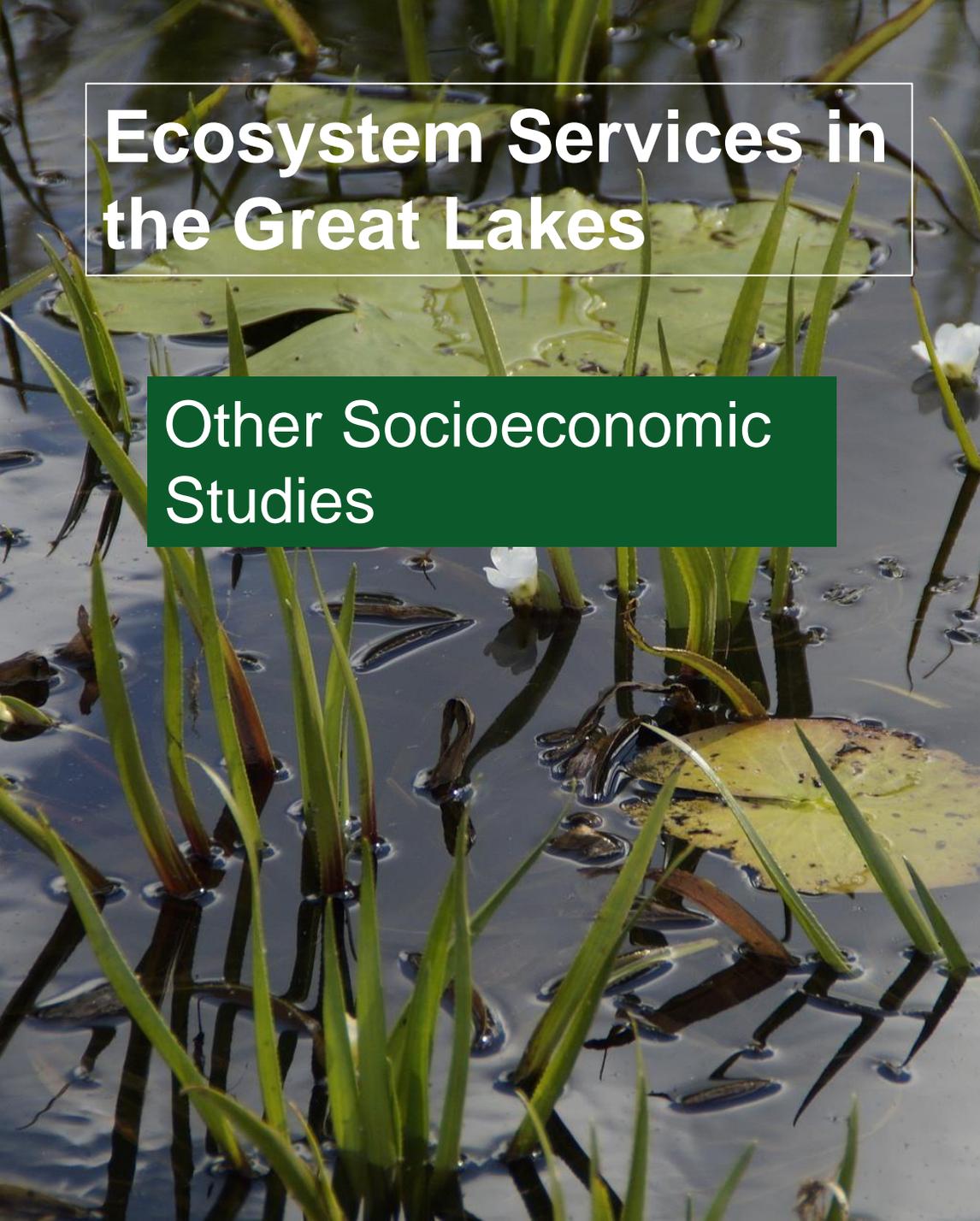
Ecosystem Services in the Great Lakes

Other Socioeconomic Studies

Public Perceptions

Breffle, W., et al. (2013). "Socioeconomic evaluation of the impact of natural resource stressors on human-use services in the Great Lakes environment: A Lake Michigan case study." Resources Policy **38**(2).

Levine, K. J., et al. (2020). "What do our lakes mean to us? An understanding of Michigan coastline communities' perceptions of the Great Lakes." Journal of Great Lakes Research **46**: 1716-1725.

A photograph of a pond with water lilies and green plants. The water is dark and reflects the surrounding greenery. There are several large, round, light green lily pads floating on the surface. Tall, thin green stems with pointed leaves rise from the water. A small white flower is visible in the middle ground.

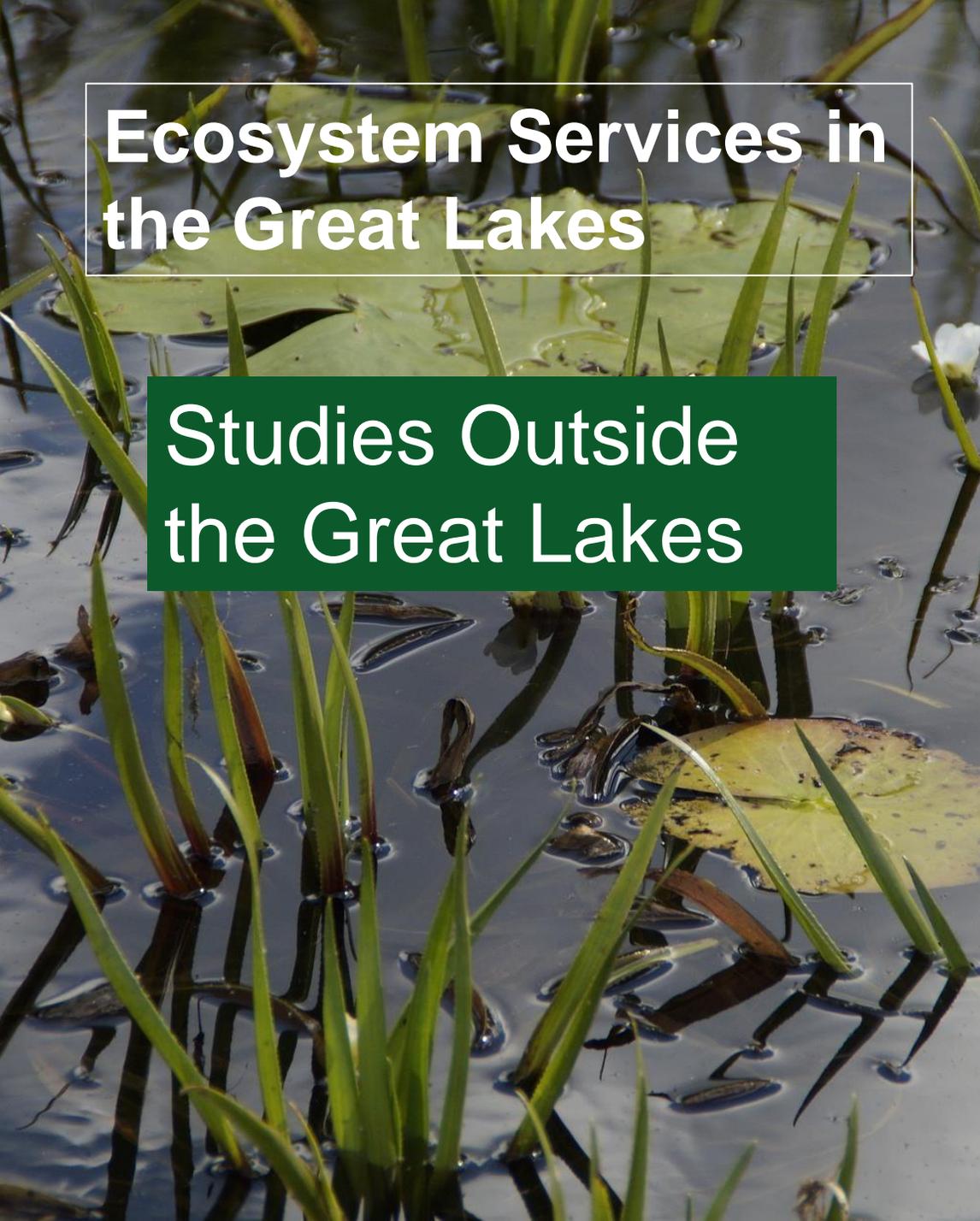
Ecosystem Services in the Great Lakes

Other Socioeconomic Studies

Blue Economy

Graziano, M., et al. (2019). Applied Geography **105**: 111-123.

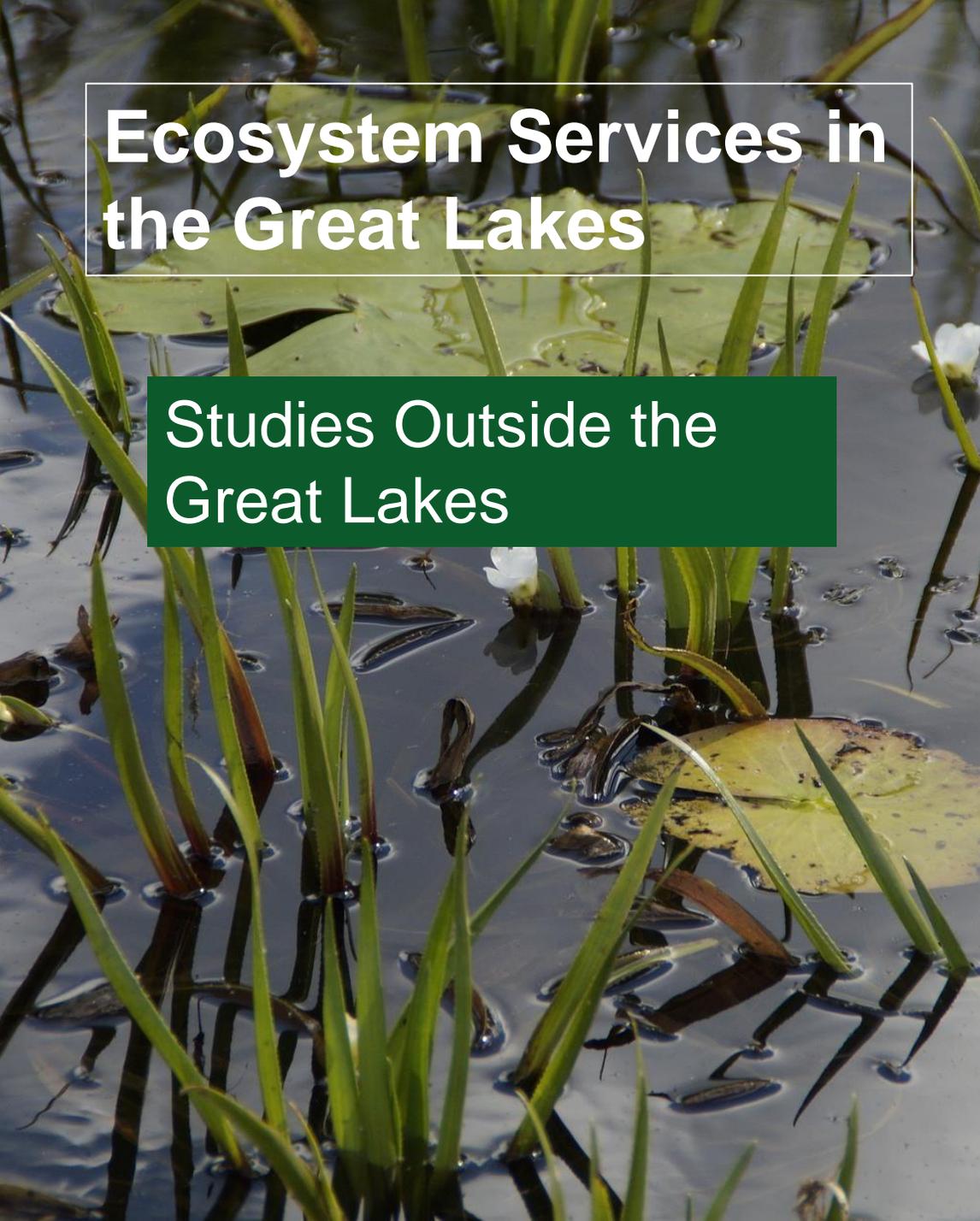
- Uses the Great Lakes basin as a case study to explore the concept of regional Blue Economy
- World Bank: “a concept that seeks to promote economic growth, social inclusion and the preservation of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas.”



Ecosystem Services in the Great Lakes

Studies Outside the Great Lakes

- Economic Value (8) and Economic Impact (2)
 - Restoration (AOCs and other habitats)
 - Invasive Species
 - Beach Closures
 - HABs
 - General/comprehensive
- Other socioeconomic studies(5)
 - Quantification and Spatial distribution
 - Public Perceptions
 - Blue Economy
- **Studies Outside the Great Lakes**

A photograph of a pond with water lilies and green reeds. The water is dark and reflects the surrounding greenery. The lily pads are large and green, with some showing signs of aging or damage. The reeds are tall and thin, with some showing brown tips. The overall scene is a natural, aquatic environment.

Ecosystem Services in the Great Lakes

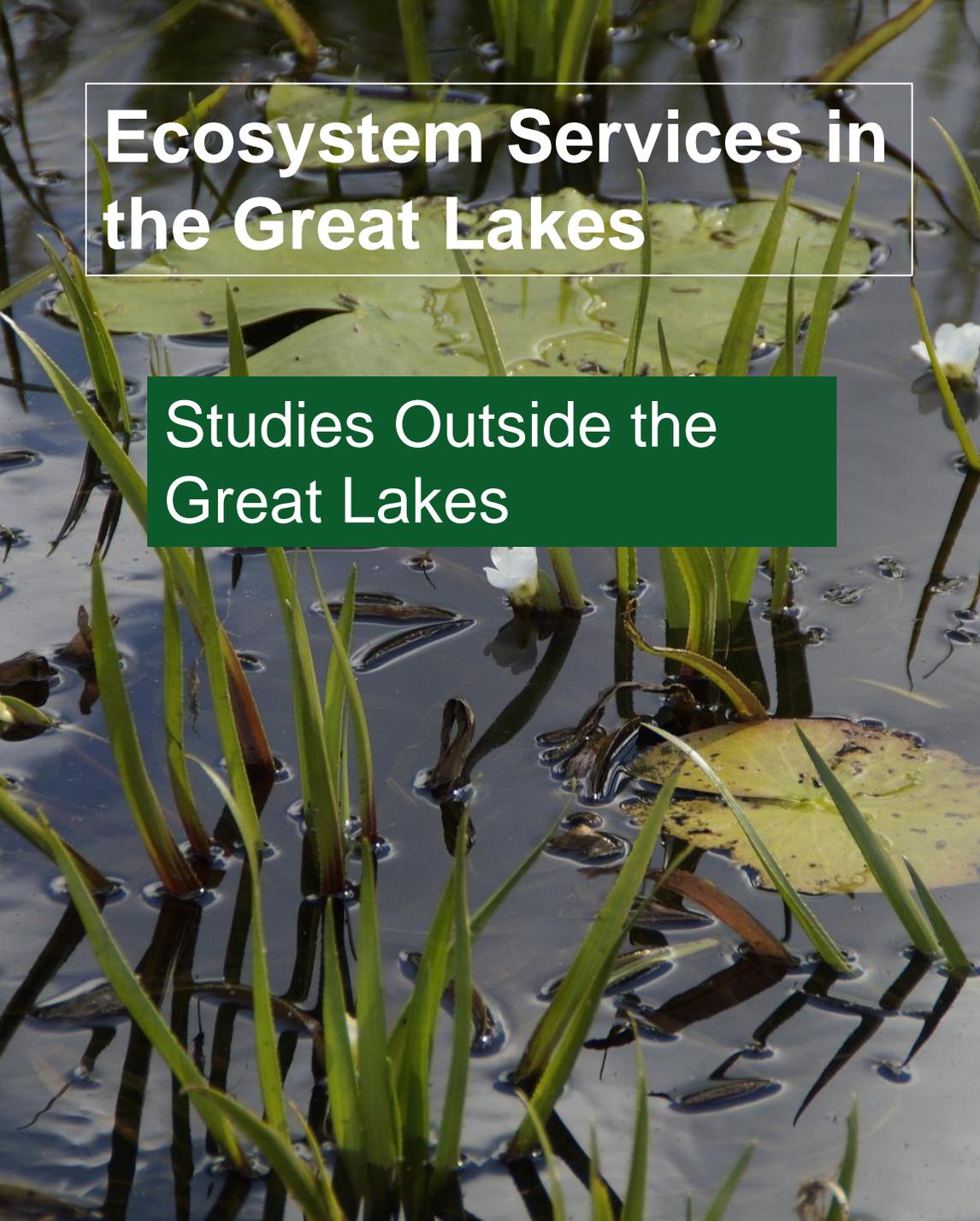
Studies Outside the Great Lakes

Bergstrom, J. C. and J. B. Loomis (2016). Survey and analysis of literature on ecosystem valuation of river restoration

Fletcher et al. (2015). Benefits transfer method of ES provided by St. Louis River watershed

Golet, G., et al. (2006). Argues for addressing stakeholder concerns before undertaking restoration (California)

Knoche, S. and T. Ihde (2018). Estimate impacts on harvest and economic impacts from oyster reef restoration in the Choptank River complex Chesapeake



Ecosystem Services in the Great Lakes

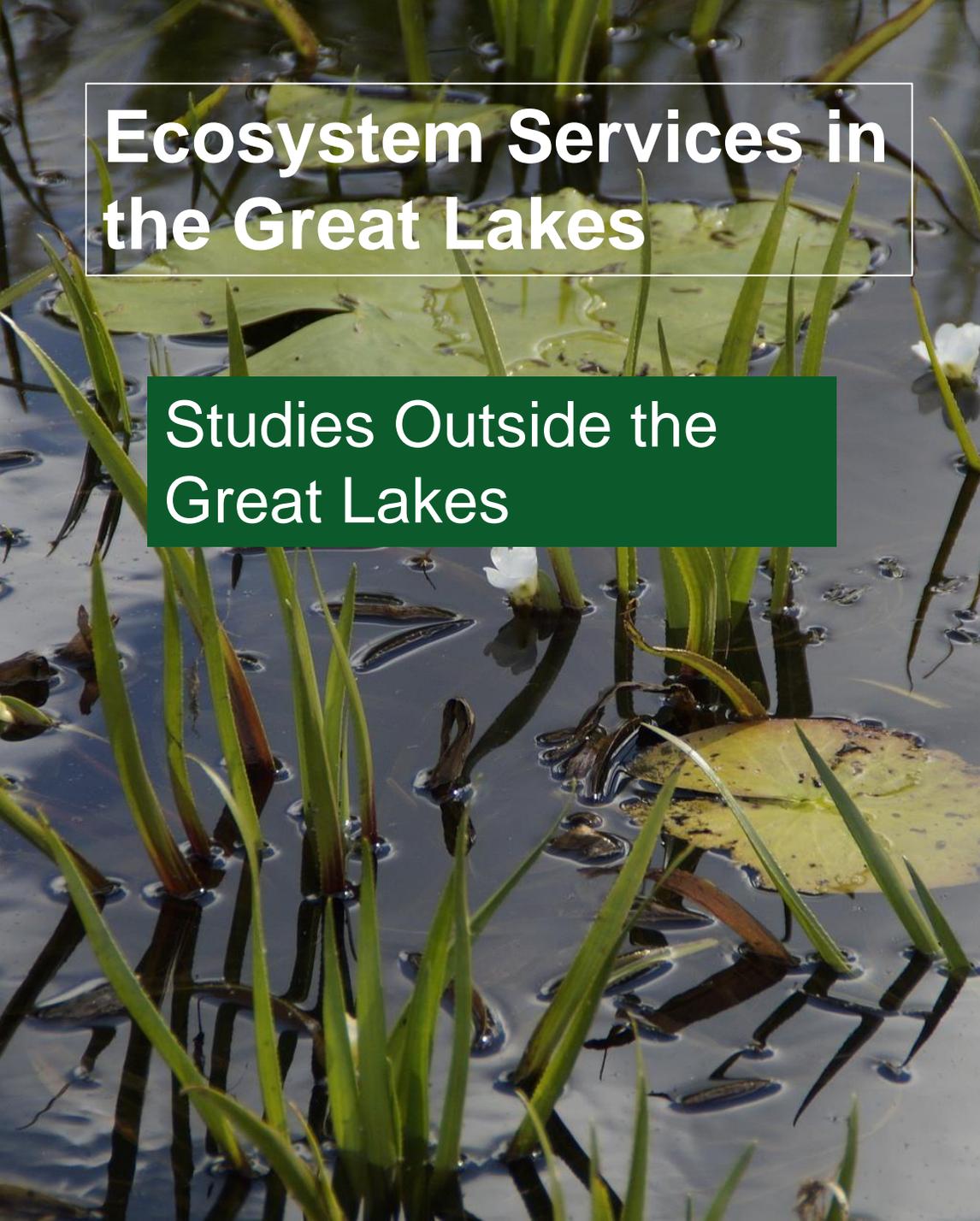
Studies Outside the Great Lakes

Lee-Hsueh, L. (2016). Survey of tourists to assess satisfaction with water clarity

Loomis, J. B., et al. (2000). Stated preference study to value ES restoration on Platte River US

Richardson, L., et al. (2014). Benefits transfer method to value restoration in Central Everglades.

Vesterinen et al. (2009). Travel cost method to value improved water quality in Finland

A photograph of a pond with water lilies and green reeds. The water is dark and reflects the surrounding greenery. The lily pads are large and green, with some showing signs of aging or damage. The reeds are tall and thin, with some showing brown tips. The overall scene is a natural, aquatic environment.

Ecosystem Services in the Great Lakes

Studies Outside the Great Lakes

Alternative Approaches to Valuation

- Chan et al (2012)
 - Framework to address intangible benefits of ecosystems
- Mitchell et al (2020)
 - New methods that integrate capacity of ecosystems to provide services with indicators of human demand

Valuation of Recreational Fisheries in the Great Lakes



Recreational Fisheries in the Great Lakes

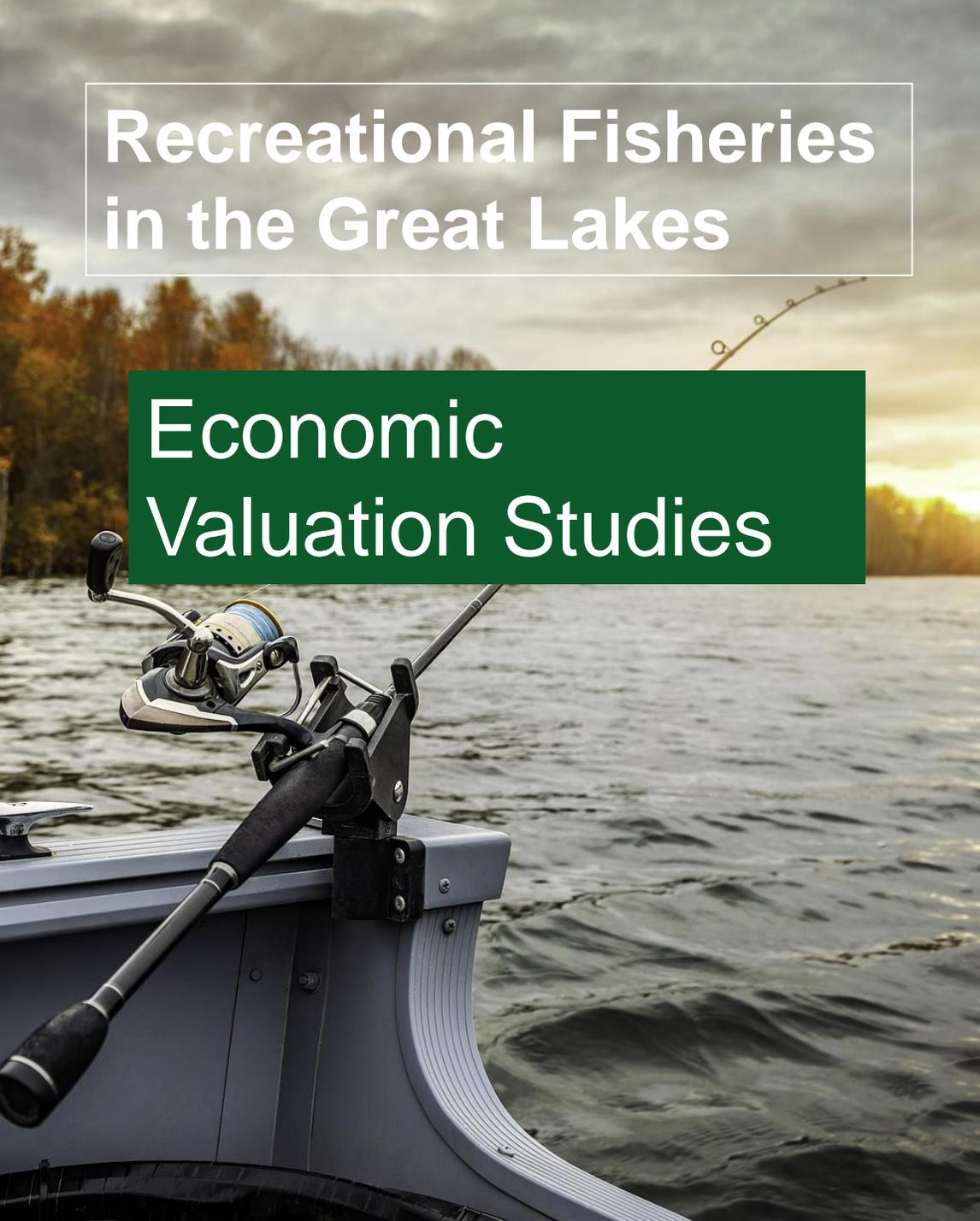


- **Economic valuation and economic impact studies**
- **Other socioeconomic studies**
- **Studies outside the Great Lakes**

Recreational Fisheries in the Great Lakes



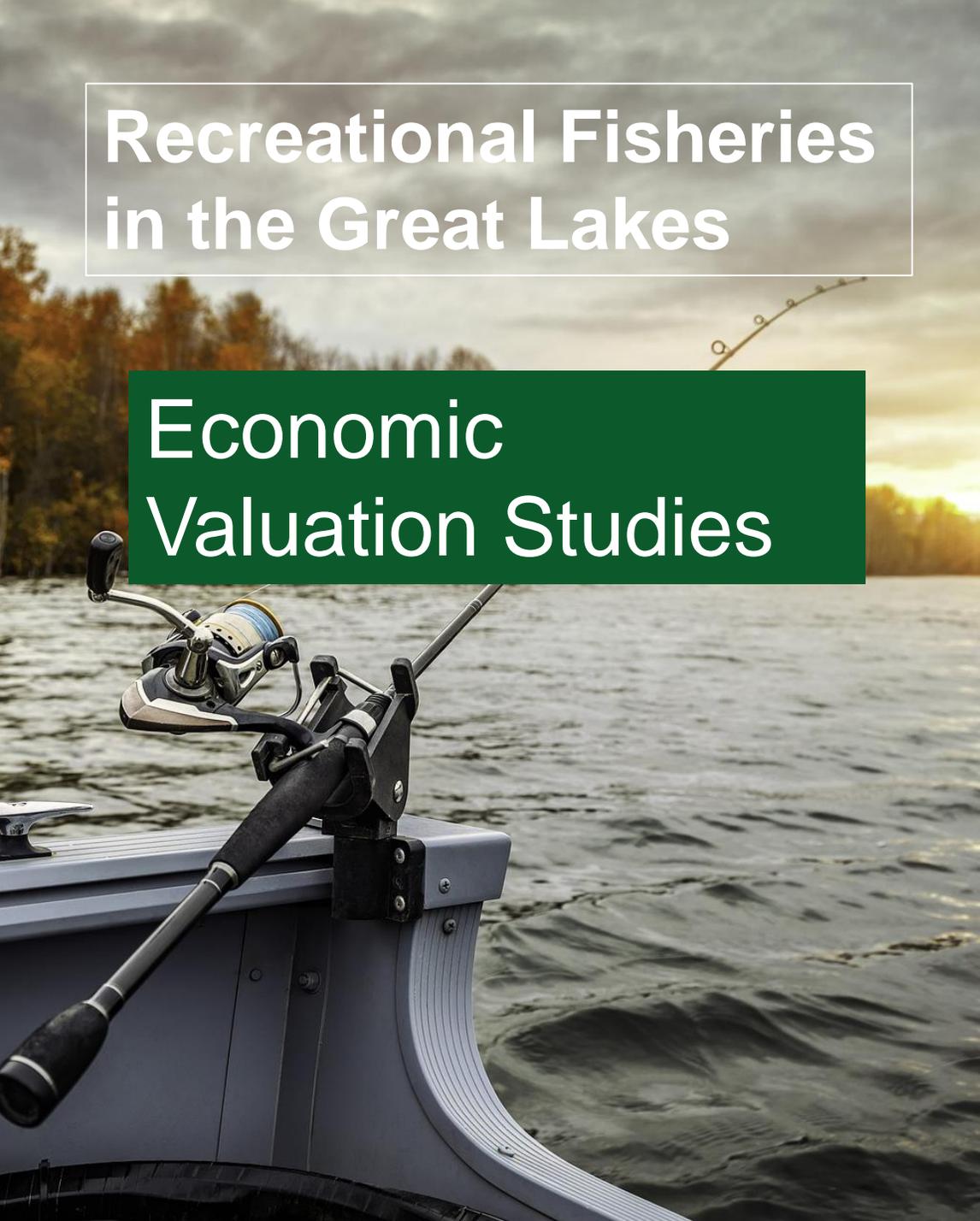
- Economics valuation studies: estimate value placed on angling by anglers
 - ... by estimating consumers' surplus (i.e surplus WTP over and above expenditure)
 - Revealed preference methodology primarily (travel-cost demand studies)
- Economic impact studies: document expenditures by anglers (usually multiplied to account for secondary effects)

A photograph of a fishing boat on a lake at sunset. The sky is overcast with a soft glow from the setting sun. A fishing rod is mounted on the boat in the foreground, and the water shows ripples. The background features a line of trees with autumn foliage.

Recreational Fisheries in the Great Lakes

Economic Valuation Studies

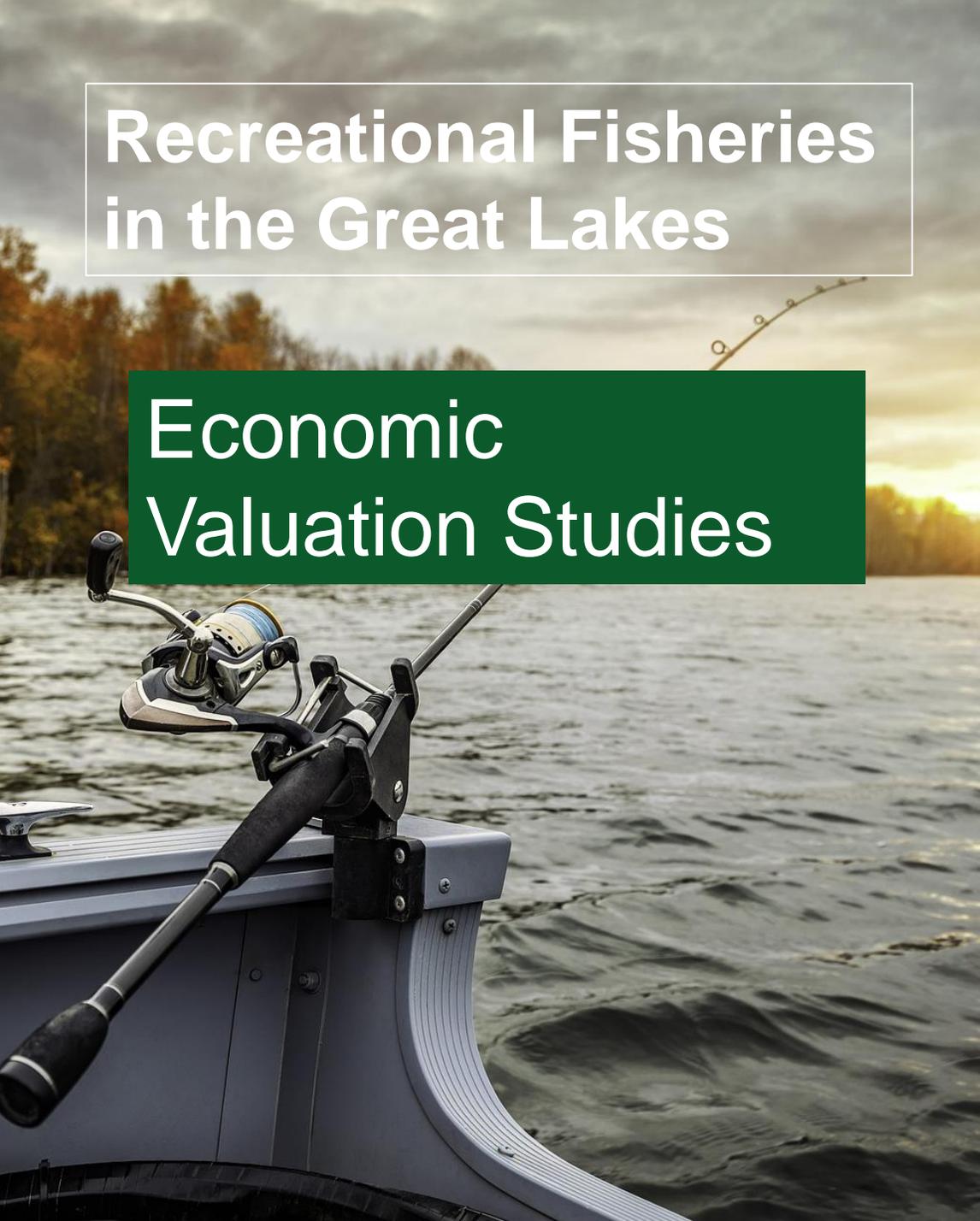
- Survey papers
 - Poe et al (2013), Hunt et al (2019)
- Impact of ANS (aquatic nuisance species)
 - Poe et al (2013); Ready et al (2012)
- Determinants of participation decisions
- Determinants of valuation
- Impact of other external events
 - HABs, dams, species composition, sea lamprey
- Other (bioeconomic models, non-use valuation, commentary)

A photograph of a fishing boat on a lake at sunset. The sky is overcast with a hint of orange from the setting sun. A fishing rod is visible in the foreground, and the water shows ripples. The background features a line of trees with autumn foliage.

Recreational Fisheries in the Great Lakes

Economic Valuation Studies

- Survey papers
 - Poe et al (2013), Hunt et al (2019)
- Impact of ANS (aquatic nuisance species)
 - Poe et al (2013); Ready et al (2012)

A photograph of a fishing boat on a lake at sunset. The sky is overcast with a hint of orange from the setting sun. A fishing rod is mounted on the boat in the foreground, and the water shows ripples. A white box with black text is overlaid on the top left, and a green box with white text is overlaid on the middle left.

Recreational Fisheries in the Great Lakes

Economic Valuation Studies

Determinants of participation decisions and value (via WTP)

- Link demand for angling to site characteristics, catch rates, demographics, substitute site options, etc
- → determinants of participation decisions and valuation

Valuation of Recreational Fishing

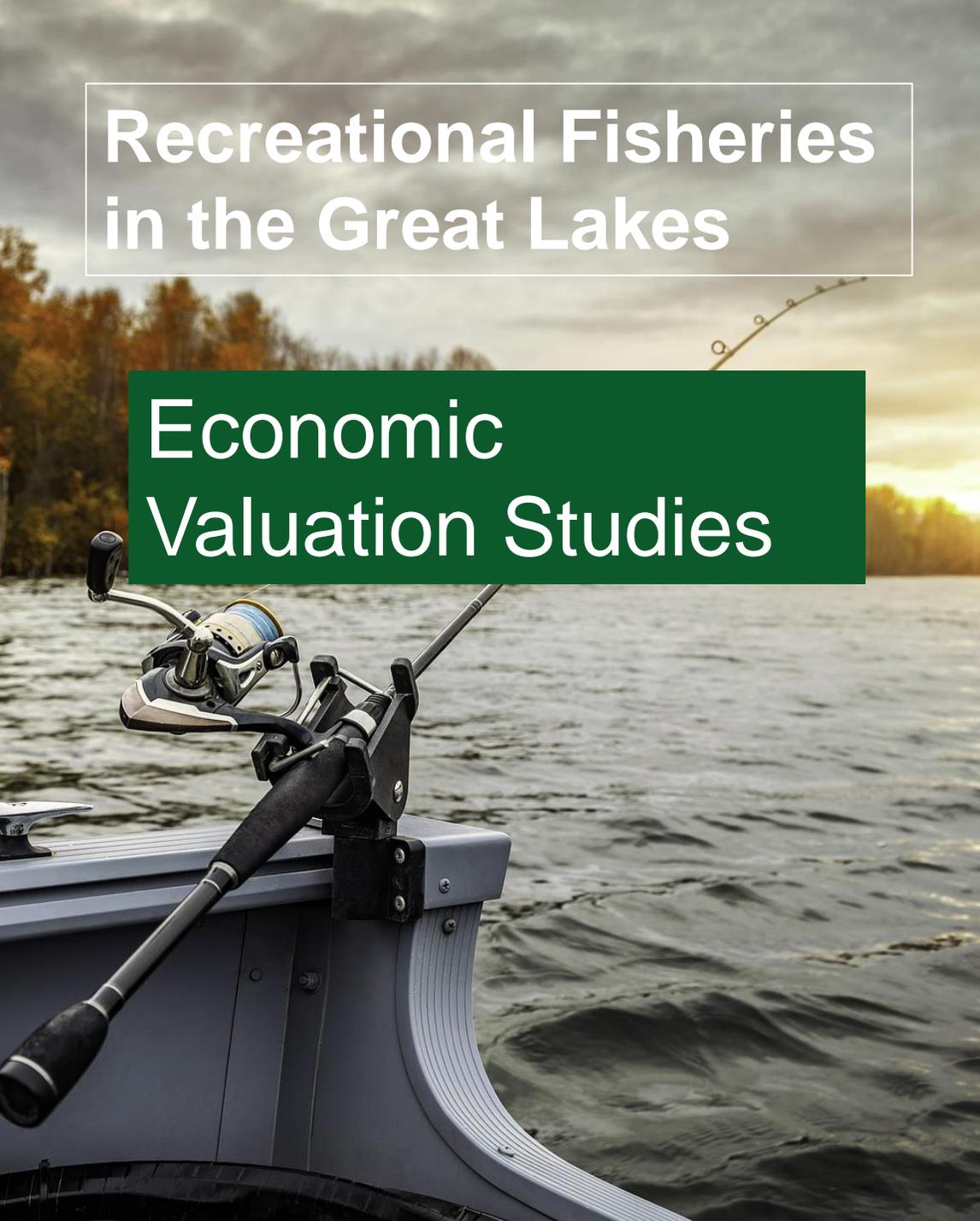
- Melstrom and Lupi (2013) estimated model of the demand for GL recreational fishing by Michigan anglers
- Day trip to typical site valued at ~ \$30 per trip
- Poe et al (2013) survey finds range likely falls between \$20 and \$75 (\$2012) per trip (multiplied by the USFWS estimate of about 19.661 million angler days in the Great Lakes in 2011), it is estimated that the aggregate annual net value of recreational fishing in the Great Lakes lies in the range of \$393 million to \$1.47 billion (\$2012).
- However, knowing the aggregate value of recreational fishing is not particularly useful

Valuation of Recreational Fishing

- What is useful is to:
 - Link demand to characteristics of the resource that can be managed: target species, location, and catch rate
 - → estimate impact of changes in the characteristics on valuation and/or impact on participation choices (where, when, for what) see Hunt (2019)

Valuation of Recreational Fishing

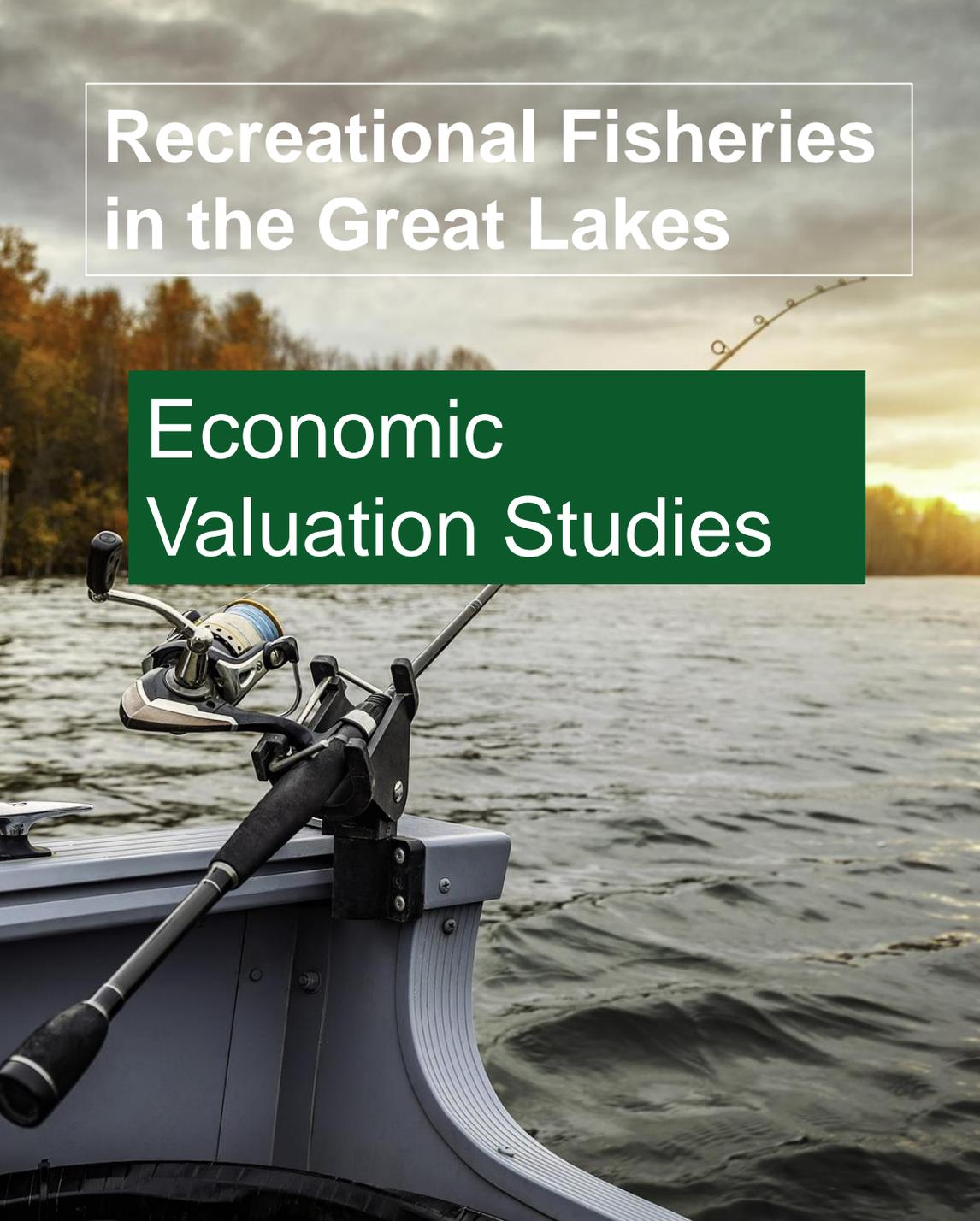
- Eg Melstrom and Lupi (2013):
 - destination is strongly influenced by catch rate
 - Anglers value Chinook, Coho and Steelhead species the highest; wtp = \$49 to \$80 for a one-unit increase in catch rate vs \$1-\$2 for Yellow Perch and \$17-\$23 for Walleye
 - Values also differ substantially across sites
- Hunt et al (2021)
 - Loss of value due to change in target species composition eg \$64 per trip from walleye to bass transition

A photograph of a fishing boat on a lake at sunset. The sky is overcast with a hint of orange from the setting sun. A fishing rod is mounted on the boat in the foreground, and the water shows ripples. The background shows a line of trees with some autumn foliage.

Recreational Fisheries in the Great Lakes

Economic Valuation Studies

- Impact of other external events
 - HABs: Wolf (2017), Zhang et al (2018)
 - Dams: Kotchen et al (2006)
 - Changes to species composition: Hunt et al (2021)
 - Sea lamprey control: Lupi et al (2003)

A photograph of a fishing boat on a lake at sunset. The sky is overcast with a hint of orange from the setting sun. A fishing rod is visible in the foreground, and the water shows ripples. The text is overlaid on the image.

Recreational Fisheries in the Great Lakes

Economic Valuation Studies

- Other (bioeconomic models, non-use valuation, commentary)

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Recreational Fisheries in the Great Lakes

Economic Impact Studies

American Sportfishing Association (2020).

Brown, T. L. and N. Connelly (2009).

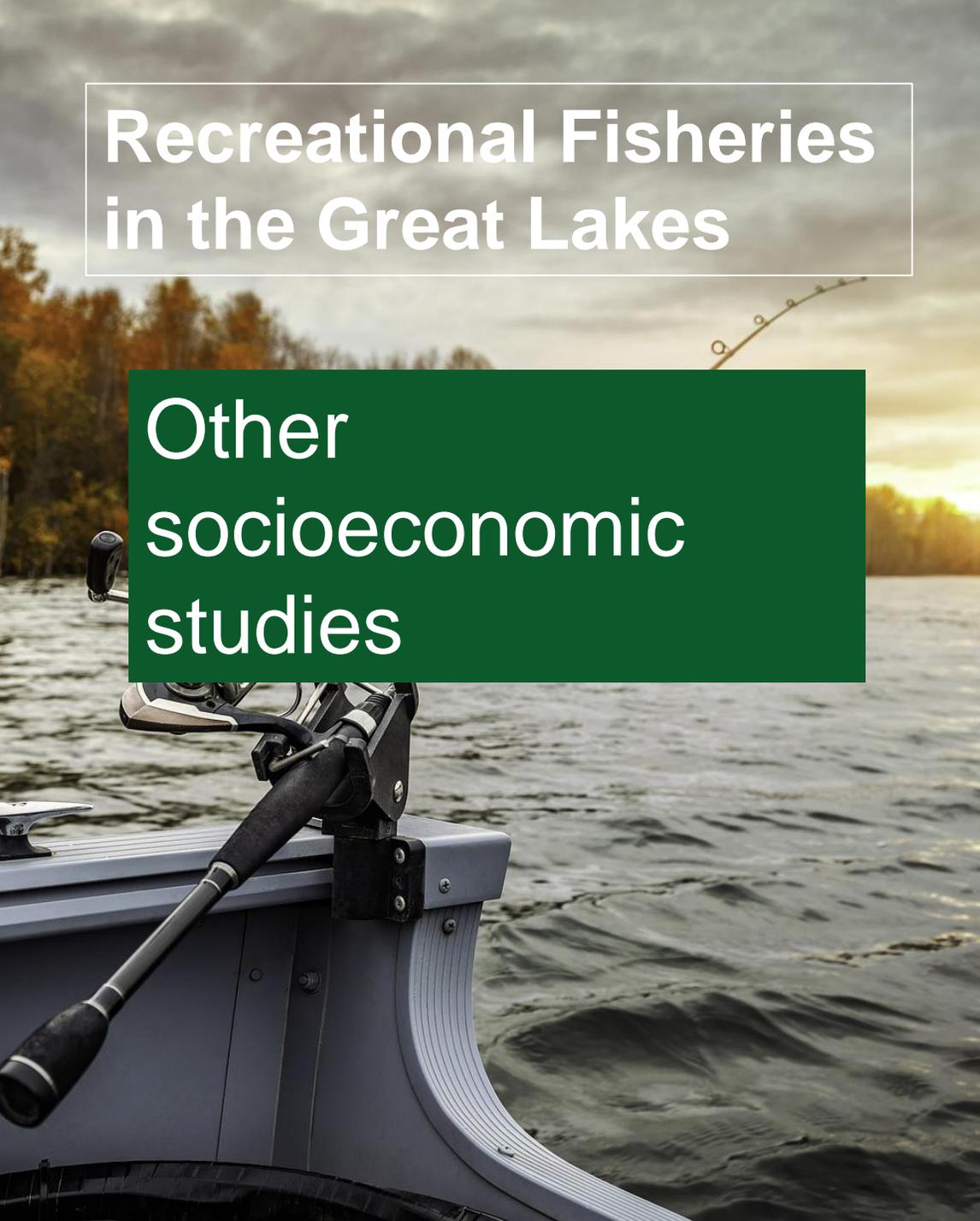
Graefe, A. R., et al. (2018).

Martin, L. (1987).

NOAA. "Socioeconomics."

Propst, D. and D. Gavrilis (1987)

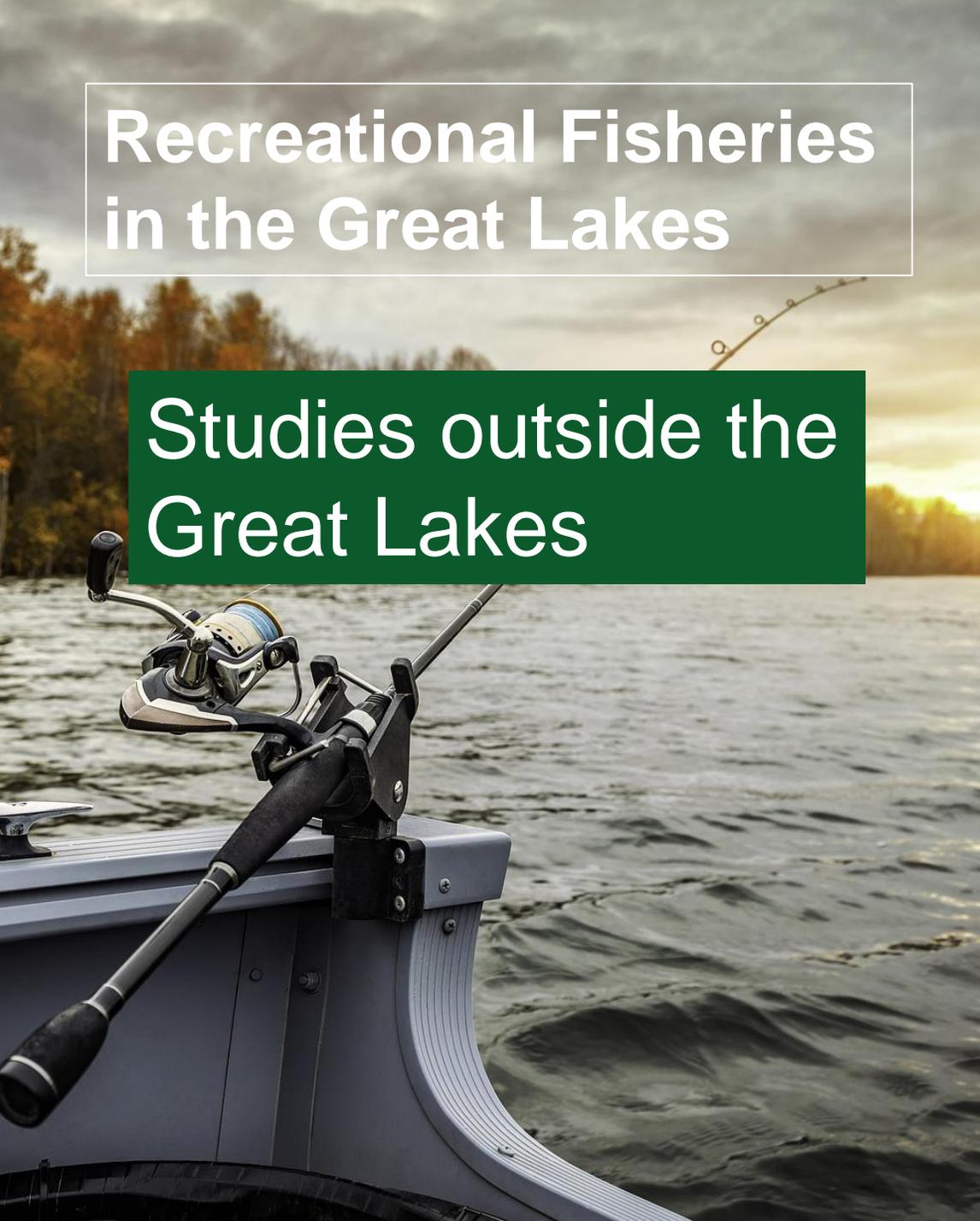
Southwick Associates (2019).



Recreational Fisheries in the Great Lakes

Other socioeconomic studies

- Integration of and appeal for human dimensions considerations in fisheries management (8)
- Demographics and participation trends (5)
- Commercial vs recreational vs ecosystems (3)
- AIS (2)
- Assessing managers' attitudes (2)
- Non-monetary measures of benefits (1)

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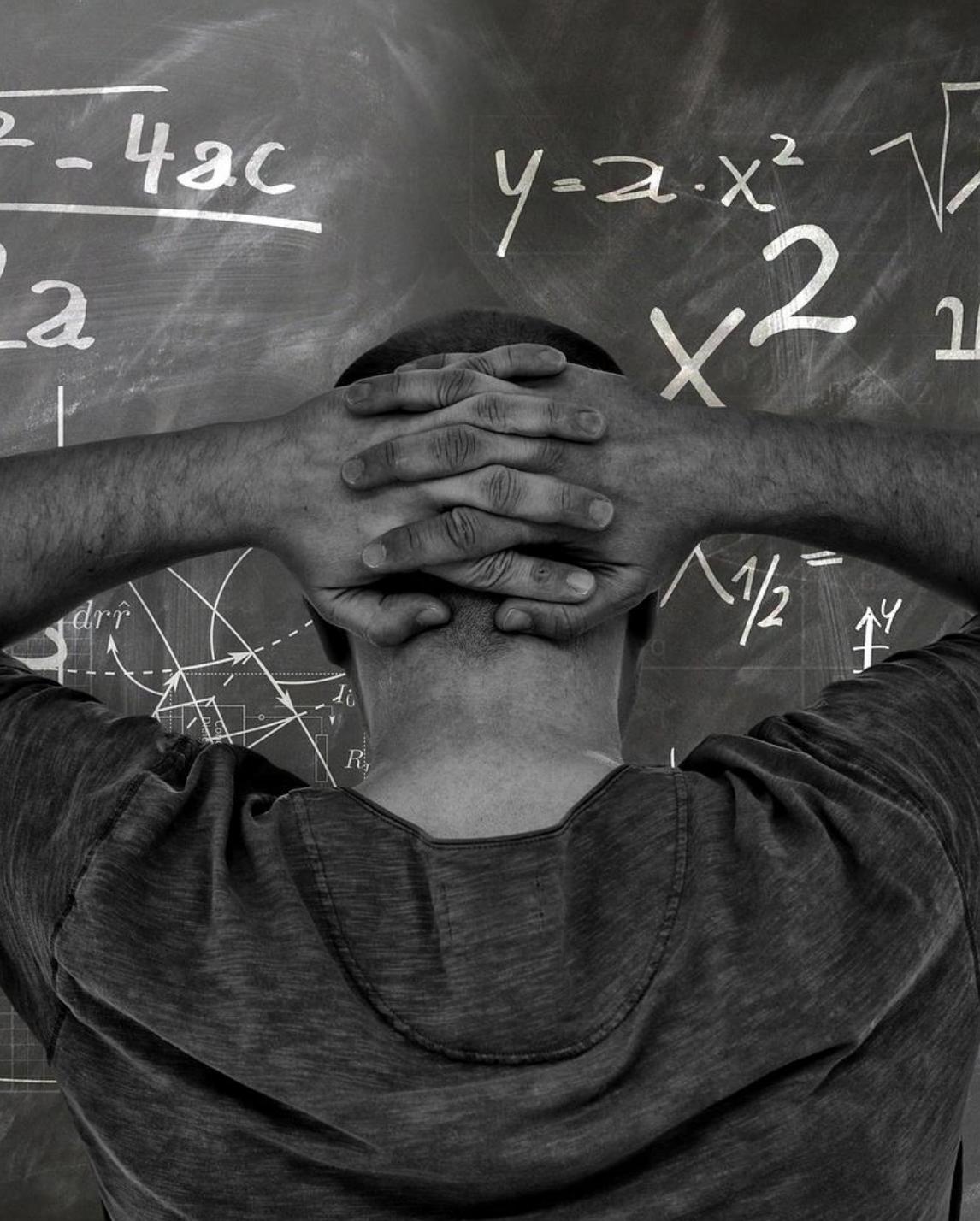
Recreational Fisheries in the Great Lakes

Studies outside the Great Lakes

- Human dimensions (1) Mississippi
- Impact of external events on fisheries valuation (4) (water quality in Wisconsin, cost and catch rate in Alaska, biomass, acid rain)
- Impact of regulatory changes on landings and economic activity (1) (Pearl River)

Commercial Fisheries

- Good data available on landings, prices, employment etc
- Studies tend to focus on policy and local economic impacts and value of fishery to communities
 - Historical review of fisheries and prognoses
 - Historical analysis of management
 - Quota management
 - Fisheries and economic statistics

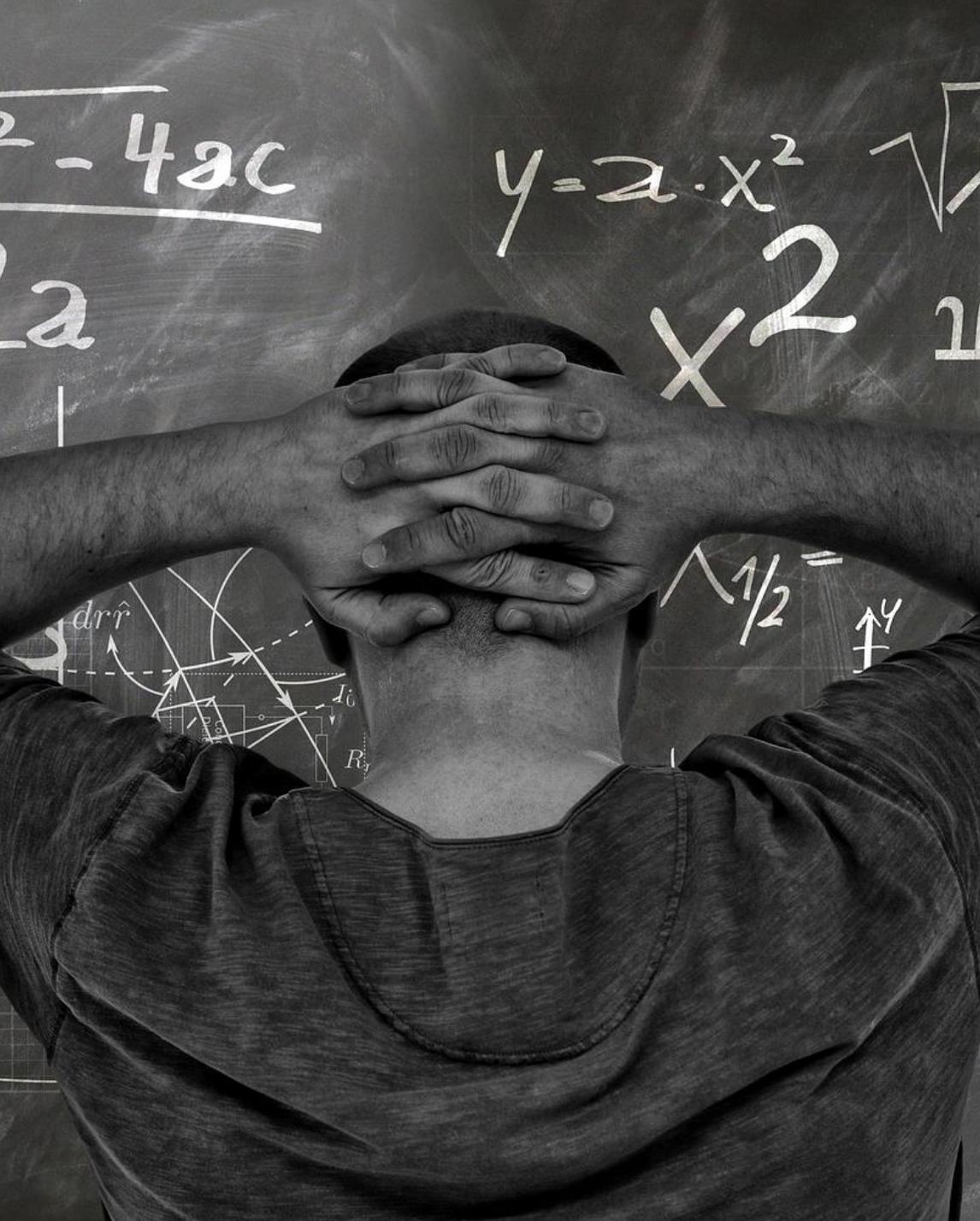


Methodology

Adamowicz, W., et al. (1994). "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities." Journal of Environmental Economics and Management **26**(3): 271-292.

Hunt et al. (2005). Recreational fishing site choice models: insights and future opportunities, human dimensions of wildlife." Human Dimensions of Wildlife **10**(3).

Johnston, R. J., et al. (2017). "Contemporary Guidance for Stated Preference Studies." Journal of the Association of Environmental and Resource Economists **4**(2).



Methodology continued

Keeler, Bonnie et al. (2012). “Linking water quality and well-being for improved assessment and valuation of ecosystem services.” Proceedings of the National Academy of Sciences **109**(45)

Parsons, G. (2017). Travel Cost Models. A primer on nonmarket valuation. P. Champ, K. Boyle and T. Brown, Springer Science and Business Media: 187-233.

Thank You