Extent of Hardened Shoreline

Indicator #8131

This indicator report was last updated in 2000.

Overall Assessment

Status:	**Mixed**
Trend:	**Deteriorating**

Lake-by-Lake Assessment

Separate lake assessments were not included in the last update of this report.

Purpose

- To assess the extent (in kilometers) of hardened shoreline along the Great Lakes through construction of sheet piling, rip rap, or other erosion control structures

Ecosystem Objective

Shoreline conditions should be healthy enough to support aquatic and terrestrial plant and animal life, including the rarest species.

State of the Ecosystem

Background

Anthropogenic hardening of the shorelines not only directly destroys natural features and biological communities, it also has a more subtle but still devastating impact. Many of the biological communities along the Great Lakes are dependent upon the transport of shoreline sediment by lake currents. Altering the transport of sediment disrupts the balance of accretion and erosion of materials carried along the shoreline by wave action and lake currents. The resulting loss of sediment replenishment can intensify the effects of erosion, causing ecological and economic impacts. Erosion of sand spits and other barriers allows increased exposure of the shoreline and loss of coastal wetlands. Dune formations can be lost or reduced due to lack of adequate nourishment of new sand to replace sand that is carried away. Increased erosion also causes property damage to shoreline properties.

Status of Hardened Shorelines in the Great Lakes

The National Oceanic and Atmospheric Administration (NOAA) Medium Resolution Digital Shorelines dataset was compiled between 1988 and 1992. It contains data on both the Canadian and U.S. shorelines, using aerial photography from 1979 for the state of Michigan and from 1987-1989 for the rest of the basin.

From this dataset, shoreline hardening has been categorized for each Lake and connecting channel (Table 1). Figure 1 indicates the percentages of shorelines in each of these categories. The St. Clair, Detroit, and Niagara Rivers have a higher percentage of their shorelines hardened than anywhere else in the basin.

Of the Lakes themselves, Lake Erie has the highest percentage of its shoreline hardened, and Lakes Huron and Superior have the lowest (Figure 2). In 1999, Environment Canada assessed change in the extent of shoreline hardening along about 22 kilometers (13.7 miles) of the Canadian shoreline of the St. Clair River from 1991-1992 to 1999. Over the eight-year period, an additional 5.5 kilometers

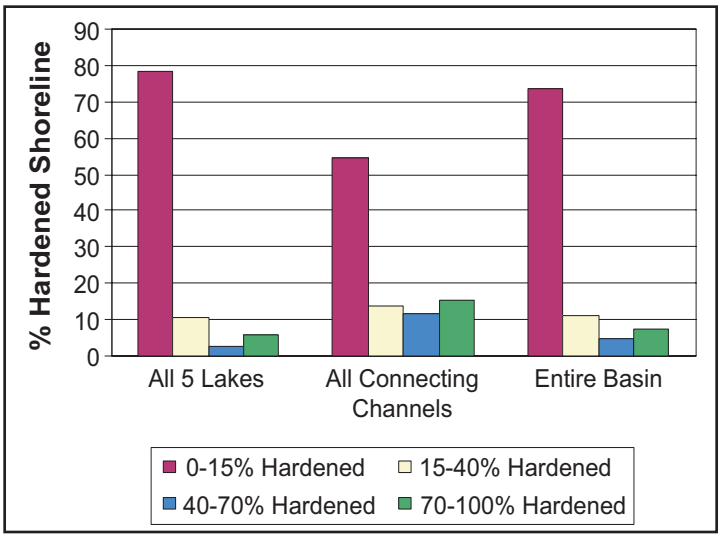

Figure 1. Shoreline hardening in the Great Lakes compiled from 1979 data for the state of Michigan and 1987-1989 data for the rest of the basin.

Source: Environment Canada and National Oceanic and Atmospheric Administration

Lake / Connecting Channel	70 - 100% Hardened	40 - 70% Hardened	15 - 40% Hardened	0 - 15% Hardened	Non-structural Modifications	Unclassified	Total Shoreline (km)
Lake Superior	3.1	1.1	3.0	89.4	0.03	3.4	5,080
St. Marys River	2.9	1.6	7.5	81.3	1.6	5.1	707
Lake Huron	1.5	1.0	4.5	91.6	1.1	0.3	6,366
Lake Michigan	8.6	2.9	30.3	57.5	0.1	0.5	2,713
St. Clair River	69.3	24.9	2.1	3.6	0.0	0.0	100
Lake St. Clair	11.3	25.8	11.8	50.7	0.2	0.1	629
Detroit River	47.2	22.6	8.0	22.2	0.0	0.0	244
Lake Erie	20.4	11.3	16.9	49.1	1.9	0.4	1,608
Niagara River	44.3	8.8	16.7	29.3	0.0	0.9	184
Lake Ontario	10.2	6.3	18.6	57.2	0.0	7.7	1,772
St. Lawrence Seaway	12.6	9.3	17.2	54.7	0.0	6.2	2,571
All 5 Lakes	5.7	2.8	10.6	78.3	0.6	2.0	17,539
All Connecting Channels	15.4	11.5	14.0	54.4	0.3	4.4	4,436
Entire Basin	7.6	4.6	11.3	73.5	0.5	2.5	21,974

Table 1. Percentages of shorelines in each category of hardened shoreline.

The St. Clair, Detroit and Niagara Rivers have a higher percentage of their shorelines hardened than anywhere else in the basin. Lake Erie has the highest percentage of its shoreline hardened, and Lakes Huron and Superior have the lowest.

Source: National Oceanic and Atmospheric Administration

(32%) of the shoreline had been hardened. This is clearly not representative of the overall basin, as the St. Clair River is a narrow shipping channel with high volumes of Great Lakes traffic. This area also has experienced significant development along its shorelines, and many property owners are hardening the shoreline to reduce the impacts of erosion.

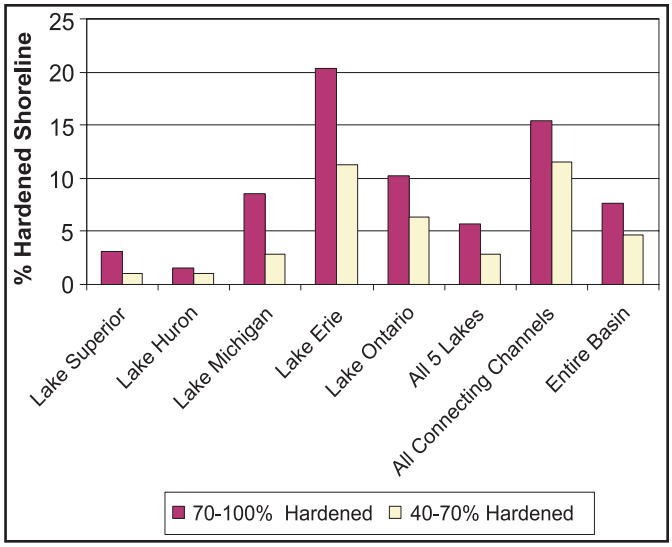

Figure 2. Shoreline hardened by lake compiled from 1979 data for the state of Michigan and 1987-1989 for the rest of the basin.

Source: Environment Canada and National Oceanic and Atmospheric Administration

Pressures

Shoreline hardening is generally not reversible, so once a section of shoreline has been hardened it can be considered a permanent feature. As such, the current state of shoreline hardening likely represents the best condition that can be expected in the future. Additional stretches of shoreline will continue to be hardened, especially during periods of high lake levels. This additional hardening in turn will starve the down current areas of sediment to replenish that which eroded away, causing further erosion and further incentive for additional hardening. Thus, a cycle of shoreline hardening can progress along the shoreline. The future pressures on the ecosystem resulting from existing hardening will almost certainly continue, and additional hardening is likely in the future. The uncertainly is whether the rate can be reduced and ultimately halted. In addition to the economic costs, the ecological costs are of concern, particularly the percent further lost or degradation of coastal wetlands and sand dunes.

Management Implications

Shoreline hardening can be controversial, even litigious, when one property owner hardens a stretch of shoreline that may increase erosion of an adjacent property. The ecological impacts are not only difficult to quantify as a monetary equivalent, but difficult to perceive without an understanding of sediment transport along the lakeshores. The importance of the ecological process of sediment transport needs to be better understood as an incentive to reduce new shoreline hardening. An educated public is critical to ensuring wise decisions about the stewardship of the Great Lakes basin ecosystem, and better platforms for getting understandable information to the public is needed.

Comments from the author(s)
It is possible that current aerial photography of the shoreline will be interpreted to show more recently hardened shorelines. Once more recent data provides information on hardened areas, updates may only be necessary basin-wide every 10 years, with monitoring of high-risk areas every 5 years.

Acknowledgments
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Sources
The National Geophysical Data Center, National Oceanic and Atmospheric Administration (NOAA). Medium resolution digital shoreline, 1988-1992. In *Great Lakes Electronic Environmental Sensitivity Atlas*, Environment Canada, Environmental Protection Branch, Downsview, ON.

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