THE CONNECTION BETWEEN FORESTS AND INLAND WATERS: AN ESSENTIAL PARTNERSHIP

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INTRODUCTION

Our inland lakes and streams are under constant threat from forces such as land development. These threats are often accompanied by loss of wetlands or forests (Figure 1). Like wetlands, forests provide numerous benefits that include bank stabilization, wildlife habitat, nutrient reductions to waters, fishery habitat, flood control, and timber for construction. Deforestation is a global issue that has led to substantial loss of biodiversity and declines in water quality. Many trees within a forest have undergone growth for several decades and replacement is slow once the stands have been removed. Sometimes removal of forest trees has been necessary to prevent the spread of certain tree diseases or for the harvest of timber for construction. Some states such as New Hampshire have laws such as the Shoreland Water Quality Protection Act that regulates removal of all cover within 150 feet of public waters. The scientific literature is scant on specific recommendations for the width of a forest or vegetation buffer as impacts likely vary with latitude and depth of the water resource. Cao et al., (2018) cite a forest buffer width of at least 23 meters (~75 feet) is needed to reduce nutrients such as phosphorus and nitrogen by 50%. Some states may rely on local governments and planning commissions to adopt ordinances or waterfront overlay districts for protection of forests or trees near waterways. A better understanding of the unique attributes and functions of forests may therefore help with land-use development decision making, especially on inland lakes and along rivers and streams.

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FIGURE 1. DEFORESTATION ADJACENT TO A LAKE

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FOREST CLASSIFICATION AND FUNCTIONS

Forest is a type of land classification that provides the highest level of protection to a watershed. Many forests, especially hardwoods, are multi-storied (Figure 2). This allows the energy of falling precipitation to be intercepted (dissipated) as it falls from layer to layer and reduces any erosive force that can result in gully erosion or transport of soils into nearby waters. Erosion is a primary source of solids that enter waterways and contribute to increased turbidity (Figure 3). Beneath the forest canopy is a layer of leaf litter which accumulates from year to year, and below that exists the duff layer, which is leaf litter that is decomposing into organic matter that enriches the mineral soil. The litter and duff layers allow efficient infiltration and percolation of precipitation into the soil profile. Here it moves downward and laterally to become part of the local or regional groundwater system. Because of this absorption and slow movement, overland flow and resulting erosion is a rare occurrence under managed forest stands.

Forests generally yield large amounts of water of the highest quality (de la Crétz and Barten, 2007) that is released slowly into rivers and lakes in

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FIGURE 2. A MULTI-STORIED FOREST ADJACENT TO A LAKE

FIGURE 3. UPSTREAM EROSION RESULTING IN HIGH TURBIDITY THAT ENTERS AN INLAND LAKE

Forests adjacent to lakes and streams help to protect the shoreline from erosion due to the strong root systems.

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the watershed. Forests adjacent to lakes and streams help to protect the shoreline from erosion due to the strong root systems (Figure 4). Tree roots can extend out up to twice the tree height, which is significant and allows for erosion control over distances that may overlap with other trees (New Hampshire Extension). Canopy removal through deforestation can result in increased water temperature, decreases in dissolved oxygen, and accelerated nutrient loading (Sabater et al., 2000). There are predictive models that can be applied to large ecoregion landscapes to predict how preservation of forested areas can protect water quality over time, and this information can be a good resource for possible future development decisions (Seilheimer et al., 2013).

IMPORTANCE OF FORESTS FOR FISHERIES

Good forest management is good fisheries management. Forests provide shading that cools the water temperature. Undercut root systems provide overhead protection for many shallow water fish species. As trees fall into the water through erosion or storm events, the wood itself becomes a structure that offers protection (Figure 5) as well as an energy source for numerous macroinvertebrate species as it decomposes. Water quality under forest management tends to be low in nutrients. Because water under forest management enters water bodies through the groundwater system, it tends to produce stable stream systems and cool water springs in lakes. Fish spawning habitat is very important for lakes. In addition to providing suitable habitat for spawning, lakes also benefit from the fish populations by controlling various types of phytoplankton (algae), zooplankton, and other fish species. Fish also add nutrients in the form of waste to the carbon, nitrogen, and phosphorus cycles for other plants and animals in the lake. Habitat degradation around lakes has harmed fish populations. Pesticides, fertilizers, and soil from farm fields drain into lakes and rivers, killing aquatic insects, depleting dissolved oxygen, and smothering fish eggs. With the removal of forests, leaves, grass, and fertilizers wash off urban and suburban lawns into sewers and then enter lakes, where these excessive nutrients fuel algal blooms and contribute to accelerated eutrophication.

FIGURE 4. STRONG TREE ROOT SYSTEMS STABILIZING SOILS NEAR A LAKE SHORELINE

Adjacent to many forested lands are emergent shrubs or aquatic vegetation which serve as important shelter during high air temperatures. Without this forest protection, many of these shrubs are overexposed to ultraviolet light and may decay over time. Disruption of this vegetation buffer means that fish have fewer places to hide and grow. It is important for riparians to realize how important the synergy between forests and adjacent riparian buffers can be for maintaining healthy fish populations.

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To restore the natural features of lakeshores that provide fish habitat, a new approach replaces some or all lakeside lawns and beaches with trees, native wildflowers, shrubs, grasses, and emergent aquatic plants. A growing number of lakeshore owners are learning that restoring natural vegetation can cut maintenance costs, prevent unwanted pests such as Canada geese, attract butterflies and songbirds, and improve fish spawning habitat in shallow water. The integrity of a bordering forest or buffer is important since sparsely positioned trees may not provide the necessary benefits to prevent runoff and erosion from negatively impacting adjacent waters (Figure 6). Preventing erosion and sedimentation around lakes through promoting adequate tree or forest growth is important because excess sediment can smother fish eggs. St-Onge and Magnan (2000) cite a reduction in the abundance of juvenile fish in areas where forest harvesting occurs. This can lead to reduced fish populations in a waterbody over time.

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FIGURE 5. WOODY DEBRIS RESULTING FROM FALLEN FOREST TREES THAT SERVE AS FISHERY HABITAT

FIGURE 6. A POOR TREE BUFFER ADJACENT TO A LAKE

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IMPORTANCE OF FORESTS FOR OTHER AQUATIC BIOTA

In addition to exotic and invasive macroinvertebrate species, macroinvertebrate assemblages can be affected by land-use changes such as deforestation. Stewart et al. (2000) showed that macroinvertebrates were negatively affected by surrounding developed land uses. They also indicated that mitigation of these land-use practices are important to the restoration and management of lakes. Schreiber et al., (2003) found that disturbance and anthropogenic land-use changes are usually considered to be key factors facilitating biological invasions. Thus, deforested lands are inherently more susceptible to the influx of invasive species. In addition to macroinvertebrates, other biota that form the fishery food chain base such as zooplankton may be affected. Patoine et al. (2000) found that the biomass of calanoid copepods, a class of zooplankton, declined with the presence of forest harvesting. Overall, short-term impacts of forest harvesting on zooplankton communities are not well understood and thus long-term variability studies are needed to confirm direct impacts.

FOREST PROTECTION RESOURCES

There are resources available that provide a wealth of information for protection of trees and forests that may be followed in the presence of sensitive habitats such as lakes and streams. The resources are specific to Michigan as our forests are unique relative to boreal (Canada, Alaska) or southern latitude forests. Links to these resources will be available in *The Michigan Riparian* companion e-newsletter.

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