A Scientific Literature Based Review of What is Currently Known About the Adverse Impacts Attributed to the Operation of Wake Enhanced Boats on Inland Lake Ecosystems

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Introduction

The substantive findings of several recent peer reviewed scientific investigations provide unequivocal evidence that the dramatic upsurge in popularity of enhanced wake dependent water sports along with a commensurate increase in the number of wake enhanced water craft operating on the inland lakes of the Laurentian Great Lakes region are having an adverse impact on frequently exposed aquatic ecosystems.

Photo Credit: Fred Krauss

Wake Enhanced Water Craft : Designed for a Singular Purpose…

Wake boats are designed for the sole purpose of enabling enhanced wake dependent water sports participants by generating wakes that are defined by heights and kinetic energy levels that often greatly exceed those that occur naturally.

Photo Credit: Boat U.S.

The Surge in Popularity of Wake Enhanced Boats

- Sales of boats designed to enable enhanced wake dependent water sports have **surged** over the course of the past decade.
- Price ranges from $80,000 to well over $250,000
- Wake boats represent the fastest growing, and most profitable segment of the recreational boating industry.
- The National Marine Manufacturers Association (NMMA) reports that new wake boat sales in the United States were up 13% in 2020 to a total of 13,000 units.

Photo Credit: Wake Boarding Magazine

Upscale 2021 Wake Enhanced Water Craft Model

- Length: 26’ 5" (8 m) Beam: 8’ 6" (2.6 m)
- Ballast capacity: 4,150 lb. (1,882 kg)
- Seating capacity: 18 (yacht certified)
- Fuel capacity: 108 gallons (409 L)
- Dry weight: 6,900 lb. (3,130 kg)
- Starting MSRP: $176,985 USD

Photo Credit : Wakeboarding Magazine

Conventional Ski Boats v. Wake Enhanced Boats: A Basic Comparison

- Conventional styles of water skiing are enabled by water craft designed to minimize water displacement, drag, and wake energy by allowing their hydrodynamic hulls to "plane-out" on the surface, in contrast,

Photo Credit: boatus.com

- Wake boats are especially designed to produce enhanced wakes by maximizing water displacement, drag, and the amount of energy required to propel them through the water at relatively slow speeds (Allen *et al*., 2019).

Photo Credit: Ossipee Lake Alliance

Wake Enhanced Watercraft Operation: Limited to Calm Waters

Ranging from 20 - 26.5 feet (6 - 8 meters) in length, and weighing up to 13,000 pounds (5,897 kg), due primarily to their **inordinate weight**, safe operation of even the largest, well-equipped wake enhanced water craft is primarily restricted to the relatively calm waters of inland lakes, wind protected bays, and large rivers (Ruprecht *et al*., 2015).

Photo Credit: wakeboarder.com

What is Wakeboarding?

- Became popular beginning in the 1990's…
- Riders strive to perform 'aerobatics' during jumps that are achieved by using enhanced wakes as 'launch' ramps (Ruprecht *et al*., 2015; Boyd, 2016).
- Occurs at speeds ranging from 15 - 23 mph (24-37 kph).
- Wake boarders are attached to their board, and are pulled along by a tow rope of up to 85' (26 meters) in length (Allen *et al*., 2019).

Photo Credit: monstertower.com

What is Wake Surfing?

- Enabled by advances in wake enhancing technology that maximize wave height and kinetic energy;
- Requires speeds ranging from 8 - 13 mph (13 - 21 kph);
- Wake surfers are not attached to their boards, or supported by tow ropes (Ruprecht *et al*., 2015).
- By a significant margin, the most popular of the enhanced wake enabled water sports;
- Wake surfing is driving recreational boating industry market growth (Ruprecht *et al*., 2015).

Photo Credit: Christine T. Nguyen, MPR News

Wake Enabled Water Sport Popularity Results in an Increase in Safety Incidents and Damage to Waterfront Property

The surge in popularity of enhanced wake enabled water sports has resulted in a dramatic increase in confirmed reports of incidents involving overturned kayaks, swamped fishing boats, hazardous swimming conditions, and damage to docks, piers, and moored boats.

Photo Credit: Andrew Jowett

The Popularity of Wake Surfing Has Also Resulted in an Increase in Demand for Lakefront Homes

The increasing popularity of wake surfing as a family watersport in the past decade has resulted in a dramatic increase in demand for lakefront homes with docks that are capable of hosting wake enhanced boats.

Photo: LakeHomes.com

The Popularity of Wake Enhanced Water Sports Has Created a Contentious Issue within Many Michigan Lake Associations

The increasing popularity of enhanced wake dependent water sports, and a commensurate increase in the number of wake boats situated at the docks of lakefront homes that are often operated by their owners in a disruptive or careless manner has divided many lake associations in Michigan.

Photo: Operation Wake Surf

Wake Boats v. Kayaks

An increasing source of often intense conflict, wake and paddle sport enthusiasts are inherently drawn to the calm waters of inland lakes and protected bays where the high energy waves created by a steadily increasing number of wake boats poses a serious threat to the safety of those navigating the same waters in small, highly vulnerable lightweight kayaks or paddleboards.

Photo: National Park Service

Shoreline damage, habitat destruction, and safety incidents primarily associated with **irresponsible** operators

Shoreline degradation, shallow water habitat disturbance, safety related incidents, and damage to waterfront property occur primarily as a result of the fact that irresponsible wake boat operators often choose to operate in waters that are too shallow, too close to shore, and/or dangerously close to swimmers, paddle boaters, fisherman, and other vulnerable quiet water users (Ray, 2020; FitzGerald *et al*., 2011).

Photo Credit: Reuters

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Frequency of Occurrence

A growing litany of problems associated with the increase in popularity of wake sport enabling boats have been compounded by the fact that protracted periods of intense near shore wake boat activity involving **two or more** craft that often occurs on popular wake sport lakes results in a steady barrage of high energy wave action (TOTM, 2007; Bilkovic *et al*., 2017).

Photo credit: Boarders Magazine

Techniques Used by Manufacturers to Optimize the Size and Shape of Wakes Generated by Wake Enhanced Watercraft

- Engine mounted backward in the rear of the boat;
- High capacity ballast system comprised of hard tanks or soft bags filled with water;
- Hull specially designed to induce greater water displacement;
- Gate system that allows the operator to shift ballast from one side to the other to maximize wake height and energy for wake surfing;
- Operator controlled wedges, plates, and hydrofoil devices force the hull lower in the water, inducing greater water displacement, and the creation of larger wakes.

❖ Retrieved from Allen *et al*., 2019)

Giant Leaps in Wake Enhancing Technology

Wake shaping / enhancing devices, as illustrated by operator adjustable hull attitude wings, gates, tabs, plates, and wedges, are designed to optimize the ability of wake boats to generate high energy wakes by maximizing their capacity to displace large volumes of water (Marr *et al.*, 2022; Ruprecht *et al*., 2015).

Photo Credit: boatingmag.com

Wake Enhancing Technology Responsible for Market Growth

Competition driven improvements to wake enhancing devices that have "super-charged" the capacity of wake boats to create wakes that are optimal for **wake surfing**, by far the most popular of the enhanced wake enabled water sports (Ruprecht *et al*., 2015), are primarily responsible for the dramatic market growth that has occurred over the past decade.

Photo Credit: boardersmag.com

Factors Determining the Kinetic Energy Level of Enhanced Wakes: **Increased Wave Height = Exponential Increases in Energy**

Kinetic energy associated with water waves grows **exponentially** in response to increases in wave height. A wave that crests at a height of 8-inches (20 cm), for example, possesses four times greater kinetic energy than a 4-inch (10 cm) wave, and sixteen times greater kinetic energy than a 2-inch (5 cm) wave. To learn more about wave physics, visit Exploring our Fluid Earth (EOFL) – Teaching Science as Inquiry at http://manoa.hawaii.edu/exploringourfluidearth/physical/waves

Photo credit: University of Hawaii

Wake Surfing = Wakes of Greater Amplitude and Energy

Resulting from the wake boat operator practice of shifting ballast water to one side, Mercier-Blais and Prairie (2014) observed that both the **amplitude and kinetic energy of wakes created while supporting wake surfers were significantly higher** than those produced while supporting wakeboarders at greater operating speeds.

Photo credit: Rowing, Inc.

Wake Surfing = Wakes of Greater Amplitude and Energy

Ruprecht *et al*., 2015 observed that the highest average wake crest and kinetic energy occur while wake boats operate at a speed of 11.5 mph (10 knots) while enabling wake surfers. The study also found that kinetic energy levels generated during **optimal wake surfing conditions** were **four times greater in magnitude** than the kinetic energy produced during wakeboarding.

Photo credit: alliancewake.com

Wake Surfing = Wakes of Greater Amplitude and Energy

In a recent study designed to “better understand the characteristics of wakes and waves produced by recreational boats common on (Minnesota) lakes and rivers”, Marr *et al.,* 2022 found that waves capable of being generated by wake boats were 2 - 3 times higher, possessed 3 - 9 times more energy, and were 6 - 12 times more powerful than the waves created by typical recreational watercraft.

Wake Surfing = Wakes of Greater Amplitude and Energy

Goudey and Girod (2015) observed that wake boats supporting **wake surfers** are capable of generating waves that crest at heights of **27.83 inches (.71 meter).**

Photo credit: Boarders Magazine

Factors Determining the Kinetic Energy Level of Wakes: **Fetch**

Fetch is defined as the length of the span of open water that wind blows across, and is directly related to the magnitude of wind waves that are capable of being formed by a given wind speed (Ray, 2020; Clawson, 2017). The most significant natural waves occur as sustained high winds emanate from a direction that maximizes the distance, and therefore the duration of their interaction with large areas of open water (Ray, 2020; Clawson, 2017).

Graphic credit: Beth Clawson, MSU Extension

Factors Determining the Kinetic Energy Level of Enhanced Wakes: **Increased Wavelength = Increased Energy**

Ray (2020) found that the energy levels and the potential for enhanced wakes to have a destructive impact upon shorelines is amplified by the fact that their wavelengths are significantly longer than wind produced waves. In contrast to 8-inch (20 cm) wind induced waves defined by wavelengths of 10 feet (3.04 meters), for example, wake enhanced boat generated waves are capable of achieving wavelengths of up to 25 feet (7.62 meters).

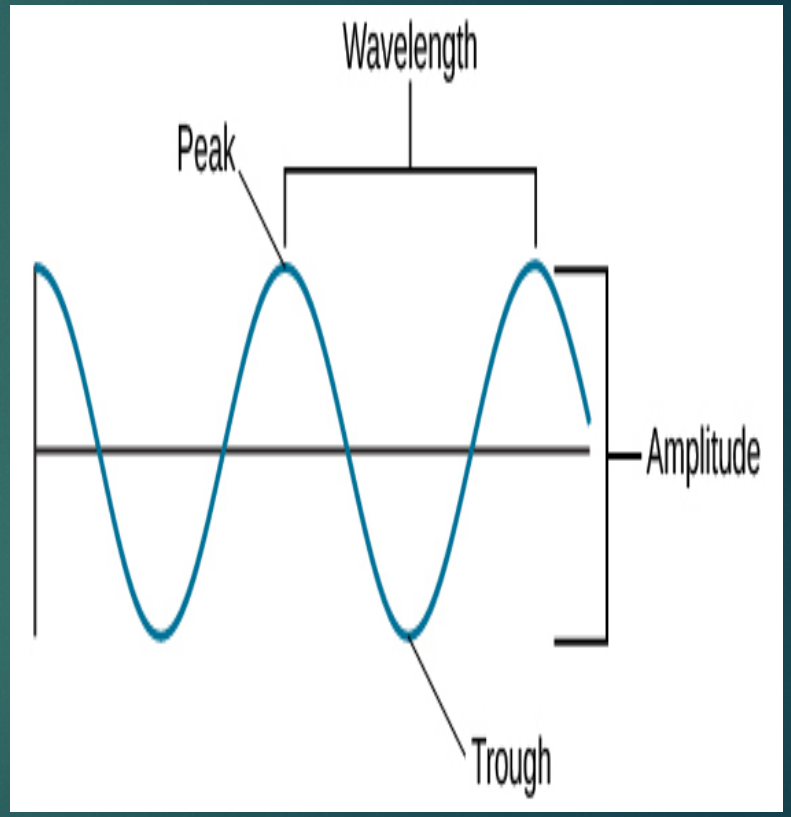


Photo credit: Lumen Learning

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Distance, Time, and Depth

In contrast to wakes created in deep, open waters, high energy waves created by wake boats in near shore waters, and/or in narrow, shallow waterways, are not allotted the **distance**, **time**, or **depth** that is necessary for their kinetic energy to dissipate before disturbing ecologically sensitive aquatic habitat, and/or both natural and developed shorelines (FitzGerald *et al*., 2011).

Photo credit: boardersmag.com

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Distance from Shore

- Ray (2020) found that wake boat generated wakes originating 300 feet (91.5 meters) from shore are capable of a height of 7.75 inches (19. 38 cm) by the time they reach shore;
- Wakes created 135 feet (41 meters) from shore are capable of a height of 9 inches (22.5 cm) by the time they reach shore; and,
- Wakes created 1,000 feet (305 meters) from shore are capable of a height of 4 inches (10 cm) by the time they impact the shoreline.

Photo credit: North Shore Marina

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Distance from Shore

Mercier-Blais and Prairie (2014) found that waves generated by wake boats cause considerable impact on the shore if they occur within 328 feet (100 meters), and that **all** wakes generated within **984 feet (300 meters)** of the shore add significant energy to naturally occurring waves.

Photo credit: Pride Marine Group

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Distance from Shore

Investigators Mercier-Blais and Prairie (2014) concluded that the overall impact of high energy waves created during wake sport enabling boat passes is **directly** and **inversely** related to the distance between the passage and the shore.

Increased distance = Increased Time = Decreased energy

Decreased distance = Decreased Time = Increased energy

Photo credit: Boardco Boats

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Distance from Shore

The potential for wakes generated by passing boats to harm nearby shorelines is clearly demonstrated by the fact that Zabawa and Ostrum (1980) found that even small outboard motor propelled aluminum fishing boats passing within 500 feet (152 meters) are capable of creating wakes of sufficient magnitude to inflict damage to shoreline property and natural habitat.

Photo credit: Lowe Boats

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: Distance from Shore

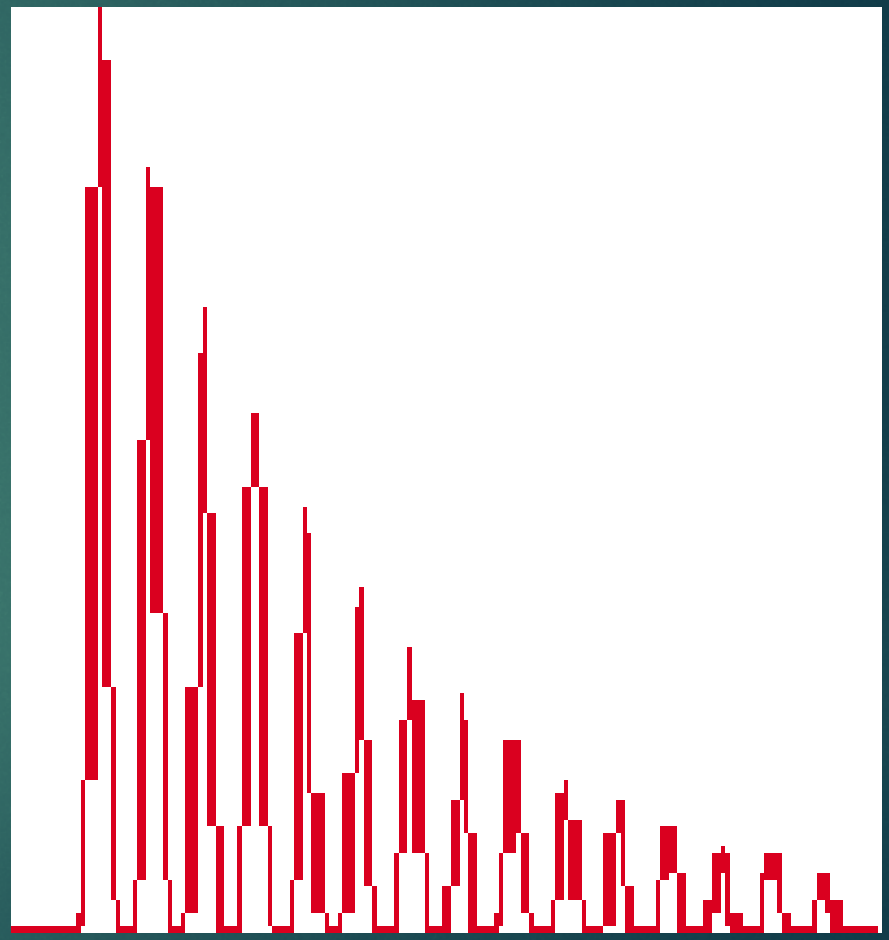
Marr *et al.* (2022) found that waves, as measured by wave height, energy, and power, created by wake boats required substantially more time and distance to dissipate in comparison to waves created by typical watercraft.

<u>Distance to fully attenuate</u>:

Wave height = greater than 500 feet

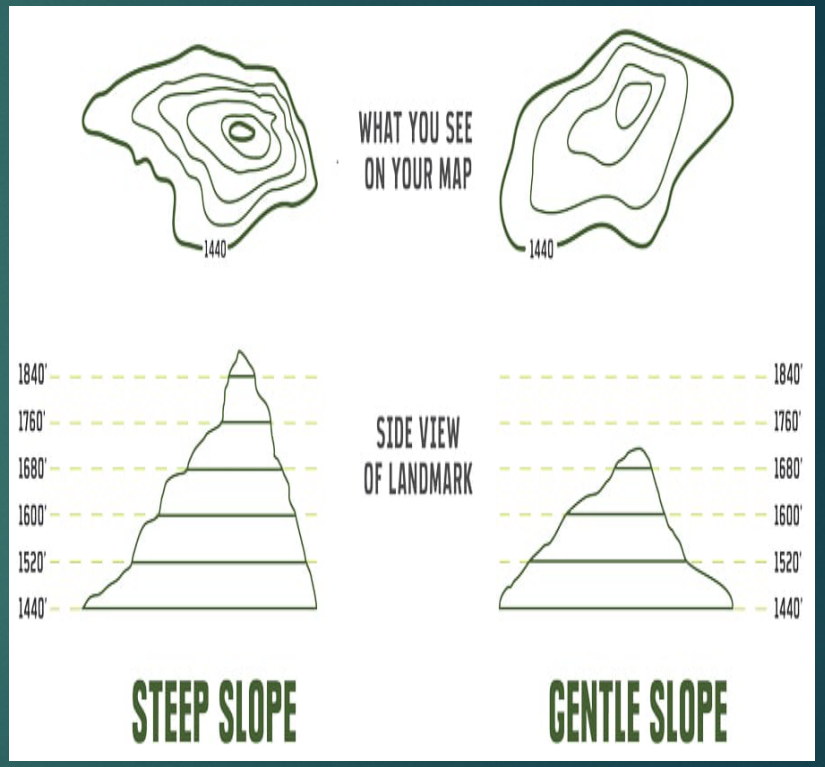
Energy = greater than 575 feet

Power = greater than 600 feet



Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: The Slope of Bottom Contours

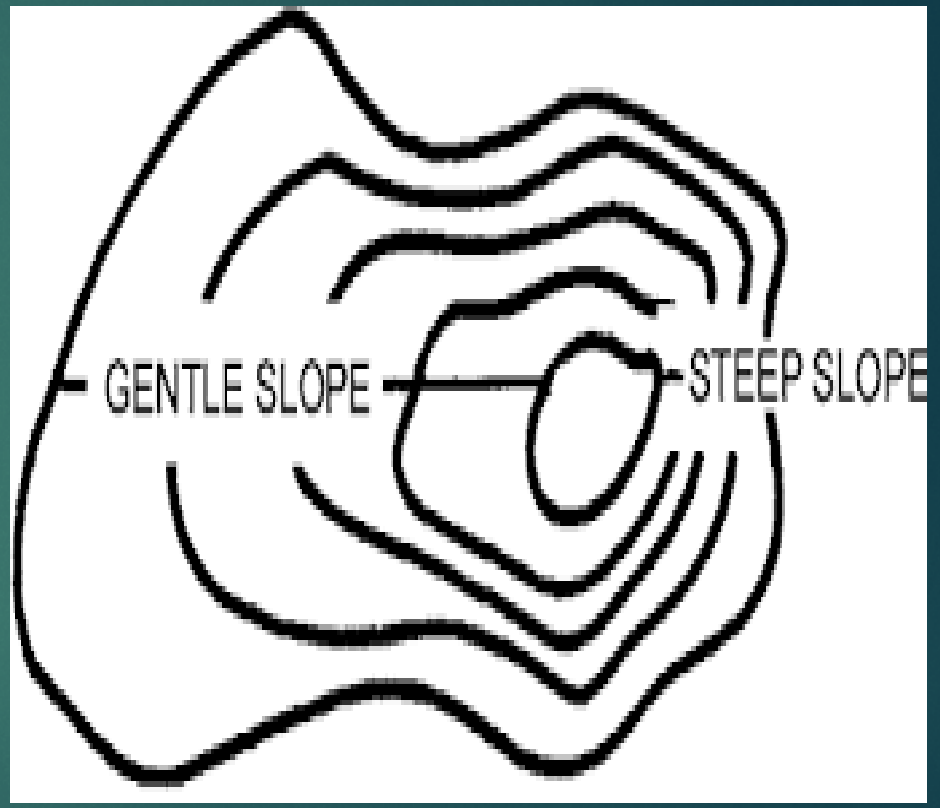
Mercier-Blais and Prairie (2014) concluded that significantly more enhanced wake energy dissipates before it reaches the shore in lakes defined by gently sloping bottom contours in contrast to the greater amount of wake energy that reaches the shore on lakes characterized by steeply sloping bottom contours.



Graphic credit: REI

Factors Regulating the Potential of Enhanced Wakes to Impact Shorelines: The Slope of Bottom Contours

Waves travelling through gently sloping, shallow areas gradually reduce their energy due to contact with the bottom which causes them to rise up, and eventually collapse (break) when the waves height is greater than three fourths of water depth - resulting in near instantaneous dissipation of their remaining kinetic energy (EOFE, 2021).



Graphic credit: RAMP Interactive

Factors Regulating the Potential of Wake Boats to Impact Bottom Habitat: Especially Designed Propellers

Capable of producing jet engine-like thrust, wake boat propellers are designed to set dense water in motion at extremely high velocities. Usually possessing four blades, wake boat propellers have been especially engineered to convert the immense mechanical energy created by wake boat engines into the capacity to push extraordinarily heavy boats through the water at speeds that are required to enable wake dependent water sports.

Photo: Acme

Factors Regulating the Potential of Wake Boats to Impact Bottom Habitat: Jet Engine Like Propeller Turbulence

Raymond and Galvez (2015) observed that the **jet engine-like propeller turbulence** produced by wake boats while engaging wake surfers is capable of disturbing lake bed sediments situated in water depths of up to **16.4 feet (5 meters).**

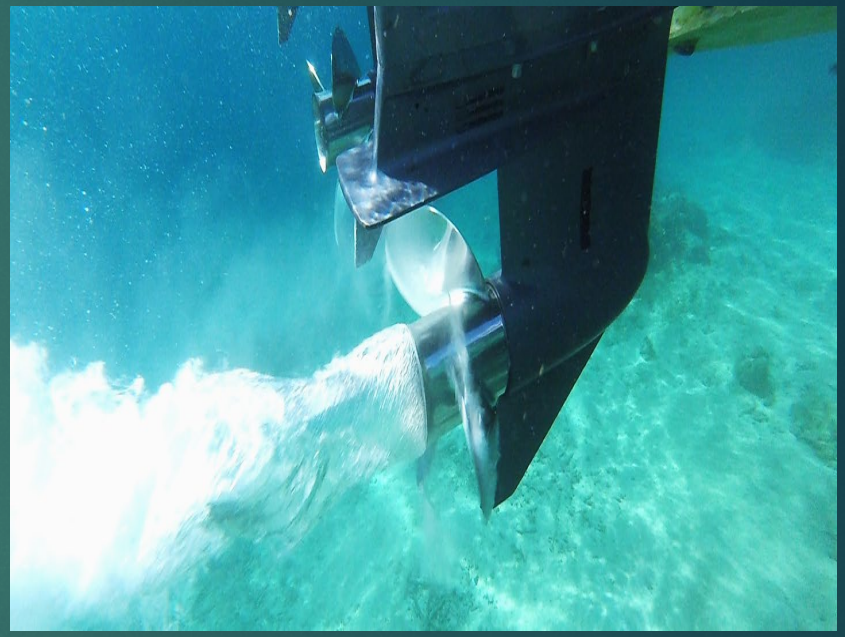


Photo: Boat Gold Coast

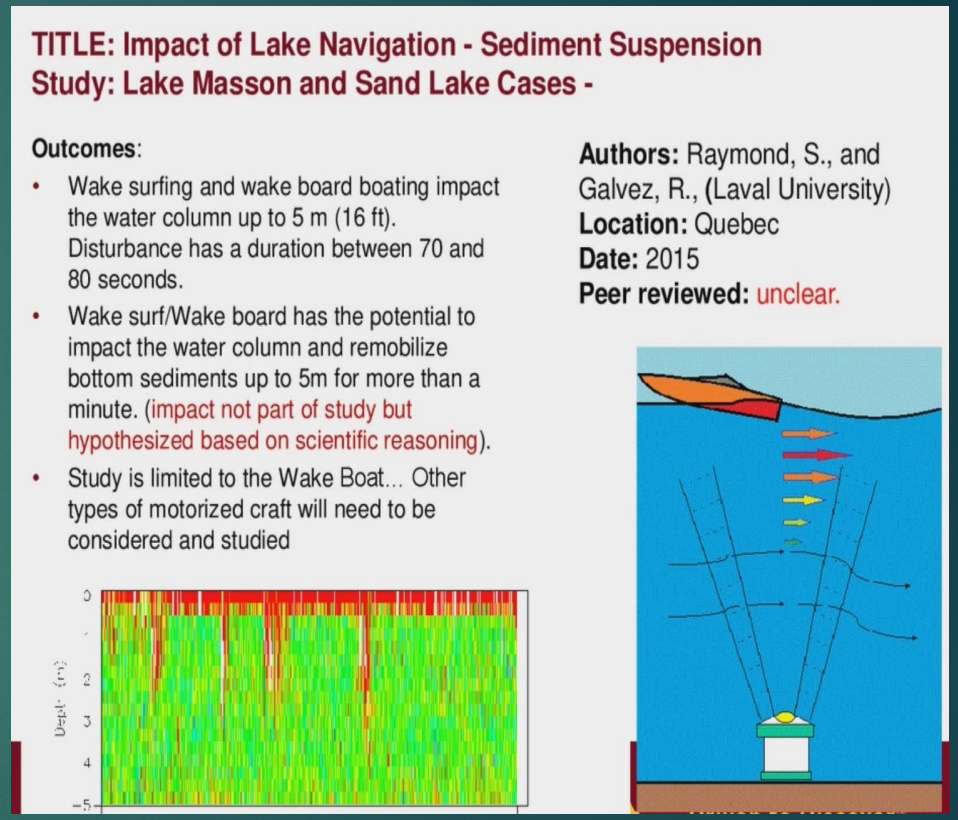
Factors Regulating the Potential of Wake Boats and Enhanced Wakes to Impact Bottom Habitat: Depth

Ray (2020) observed that in contrast to wind generated waves that disturb lake bed sediments at depths of up to 5 feet (1.5 meters), wake boat produced wakes are capable of disturbing lake bed sediments at water depths of up to **12 feet (3.65 meters).**

Graphic: The Ski Monster

The Impacts of Shallow Water Wake Boat Operation: Disruption of Ecologically Sensitive Critical Habitat

Capable of having a destructive influence on critical fish spawning habit, and of "re-mobilizing" bottom sediments, Raymond and Galvez (2015) found that the high energy created by wake sport enabling water craft is capable of impacting the water column to depths of up to 5 meters (16.4') for periods of up to **80 seconds**.



Graphic: Raymond and Galvez, 2015

The Impacts of Near Shore Wake Boat Operation: Severe Shoreline Erosion

Accelerated rates of shoreline erosion facilitated by high energy wakes induced by frequent exposure to near shore wake boat operation are capable of having a profound environmental impact by dramatically reducing the physical stability and bio-productivity of ecologically sensitive shoreline habitat (TOTM, 2007).

Photo: Scott Brown

The Impacts of Near Shore Wake Boat Operation: Severe Shoreline Erosion

The most significant wake induced shoreline erosion occurs during periods marked by high water levels due to the fact that wakes are capable of travelling closer to shore before they break (Harwood, 2017).

Photo: niagragazette.com

The Impacts of Near Shore Wake Boat Operation: Severe Shoreline Erosion

Frequent exposure to high energy waves created by wake boats operating near shore are capable of causing rapid and severe erosion that results in exposing the roots of vulnerable shoreline plants and trees, degradation or destruction of critical plant and animal habitat, and dramatic increases in the overall rate of accumulation of sediment (Allen *et al*., 2019; Bilkovic *et al*., 2017; Mercier-Blais and Prairie, 2014; TOTM, 2007).

Photo: Fred Krauss

The Impacts of Near Shore Wake Boat Operation: Severe Shoreline Erosion Promotes Seawalls

Causing extensive damage to waterfront property and natural shorelines, frequent near shore wake boat activity is likely to intensify the desire of waterfront property owners to construct seawalls or other forms of ecologically unfriendly shoreline armoring to protect their property from the highly erosive influences of unrelenting wake energy (Harwood, 2017).

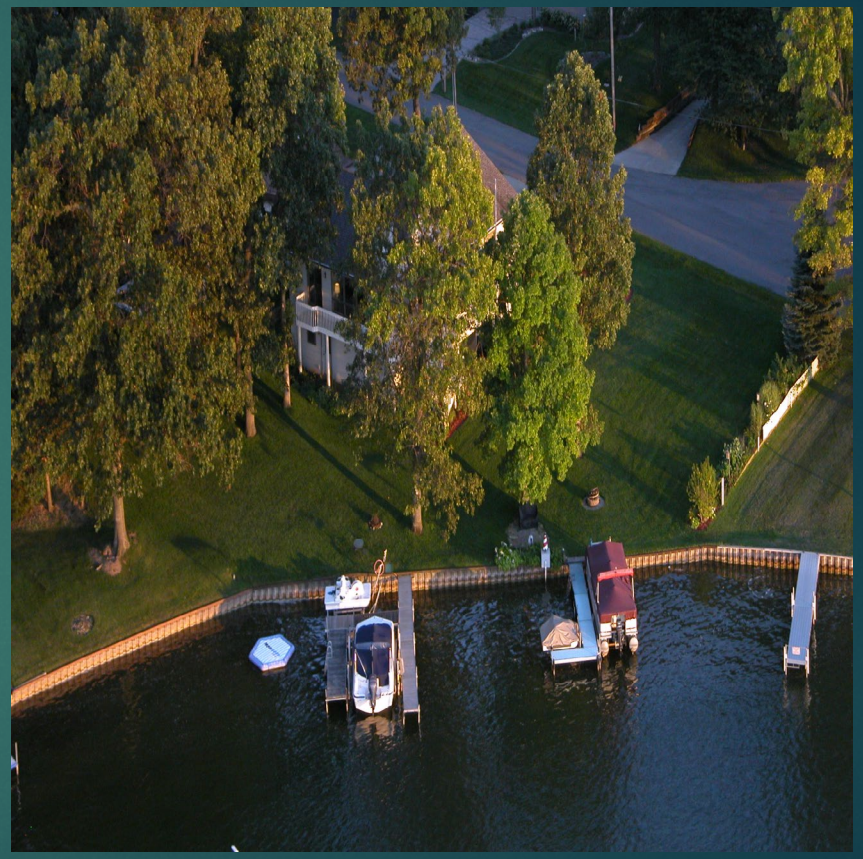


Photo: Scott Brown

The Impacts of Near Shore Wake Boat Operation: Natural Lakeshore Habitat Destruction

The overall importance of increased rates of enhanced wake induced natural shoreline habitat destruction is exacerbated by the fact that the **2012 United States Environmental Protection Agency National Lakes Assessment** found that over 50% of the inland lakes in our fresh water resources inundated region have experienced significant natural lakeshore and physical habitat complexity loss.

Photo: everlastseawalls.com

The Impacts of Near Shore Wake Boat Operation: Destruction or Disruption of Waterfowl Nesting Areas

The threat posed to nesting loons, for example, by near shore wake boat operation is associated with the fact that passing wake boats are capable of inducing a temporary rise in water levels that dramatically increases the probability of flooded loon nests (Similuk, 2020). Frequent near shore passages by recreational water craft are also capable of disturbing mating loon pairs to the extent that they abandon their nests, resulting in the death of their eggs, or of their chicks (Genier, 2019).

Photo: National Park Service

The Impacts of Near Shore Wake Boat Operation: Severe Erosion = Sediment Deposition and Accumulation

Enhanced wake facilitated severe erosion leads to proportional increases in the rate of deposition and accumulation of sediment (TOTMWC, 2007). Resulting from the dislodgement and transport of soil due to the powerful influences of wave action, sedimentation occurs as eroded soil is transported, and later deposited into affected waterways (TOTMWC, 2007).

Graphic: nps.gov

The Impacts of Near Shore Wake Boat Operation: Sediment Deposition and Accumulation

Sediment deposition and accumulation contributes to the degradation of desirable natural features such as firm sandy bottoms situated in shallow gradually sloping beach areas of inland lakes such as areas designated for public swimming by covering the bottom in a thick layer of easily resuspended soft sediment (TOTMWC, 2007).

Photo: Leelanau Vacation Rentals

The Impacts of Near Shore Wake Boat Operation: High Volume Sediment Resuspension = Loss of Water Clarity and Quality

Research conducted by Asplund (1996) and Anthony and Downing (2003) found that in lakes defined by relatively shallow basins, recreational boating induced high volume sediment resuspension is capable of contributing to significant increases in turbidity, increases in phytoplankton production, decreased water clarity, suppression of aquatic macrophyte and fish communities, and overall decreases in water quality.

Photo: Minnesota Pollution Control Agency

High Volume Sediment Resuspension = Increased Phytoplankton Growth, Loss of Water Clarity & Eutrophication

Reducing water clarity, and therefore the amount of light penetrating the water column by providing the nutrients that are required to stimulate rapid phytoplankton growth (Cowan *et al*., 1996), Fanning *et al*. (1982) found that resuspension of as little as one millimeter of the upper layer of lake bed sediment is capable of doubling phytoplankton abundance. Resuspension of sediment is capable of contributing to accelerated rates of eutrophication (Anthony and Downing, 2003; Yousef *et al*., 1980).

Photo: International Association of Dredging Companies

High Volume Sediment Resuspension = May Result in the Formation of Cyanobacteria Blooms

High volume sediment resuspension may also contribute to conditions that favor the formation of cyanobacteria (NALMS, 2016; Rastogi *et al*., 2015; Merel *et al*, 2013). Cyanobacteria is an ancient form of highly toxic unicellular **bacteria** that is known for their ability to deprive aquatic flora and fauna of critical resources such as sunlight and oxygen (NALMS, 2016).

Photo: Clean Lakes Alliance

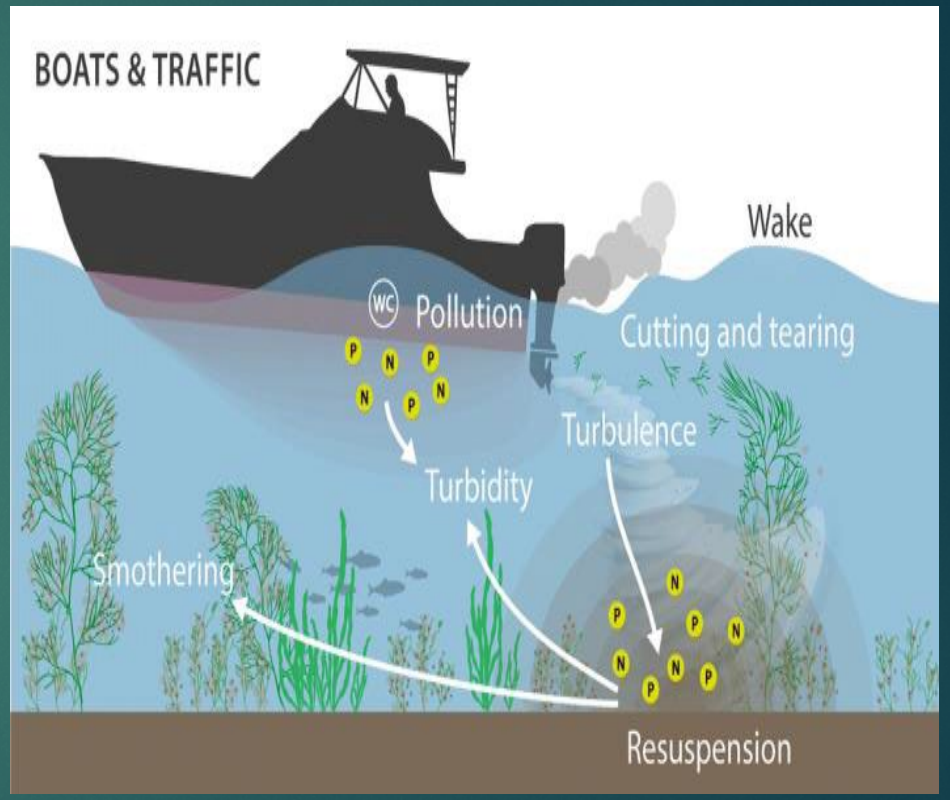
The Impacts of Shallow Water Wake Boat Operation: Sediments Resuspension = Loss of Aesthetic Qualities

Perceived to be a critical surrogate measure of how safe lake water is for swimming, and for other full contact water sports (Angradi *et al*., 2018), water clarity is considered a reliable indicator of trophic status, and is the most important water quality characteristic due to its important role in supporting diverse recreational uses, and enhanced lakefront property values.

Photo: Twitter

The Impacts of Shallow Water Wake Boat Operation: Resuspension of Contaminated Bottom Sediments

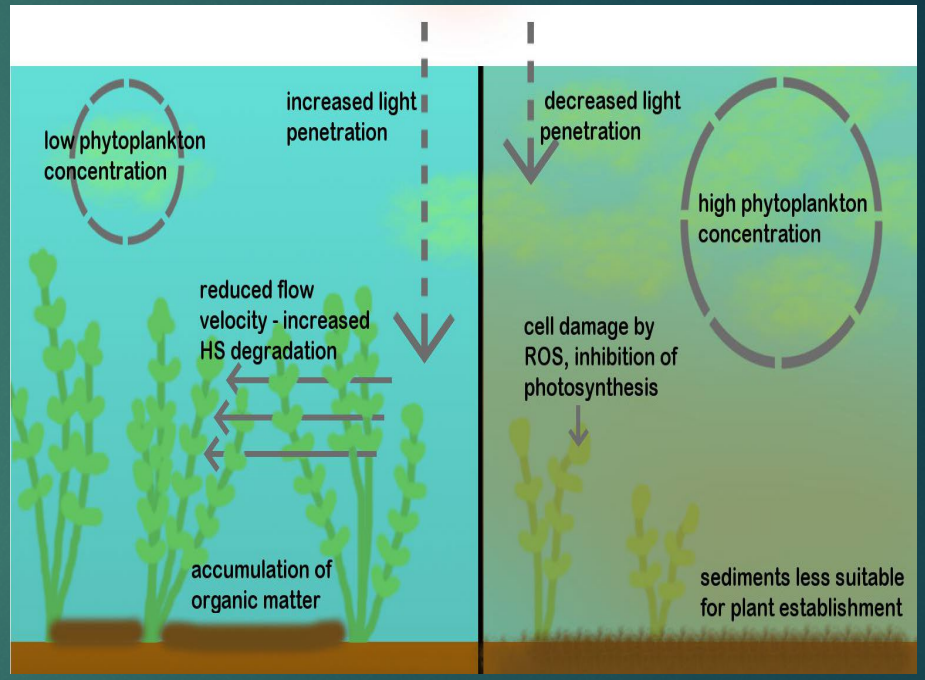
Resulting in a decline of water clarity and quality as well as a potential threat to public health and safety, sediment resuspension caused by high energy wake related turbulence may also result in the release and recirculation of high concentrations of pollutants such as fecal coliforms, total coliforms, and other toxic contaminants (Alexander and Wigart, 2013).



Graphic: Azote

The Impact of Wake Boating on Native Aquatic Plant Communities: Loss of Photosynthesis Enabling Light

Increased sediment resuspension results in a decrease in the amount of photosynthesis enabling sunlight that is capable of penetrating the water column, and of supporting the growth of submerged macrophyte communities (Wetzel, 1990; Madsen *et al*. 2001).



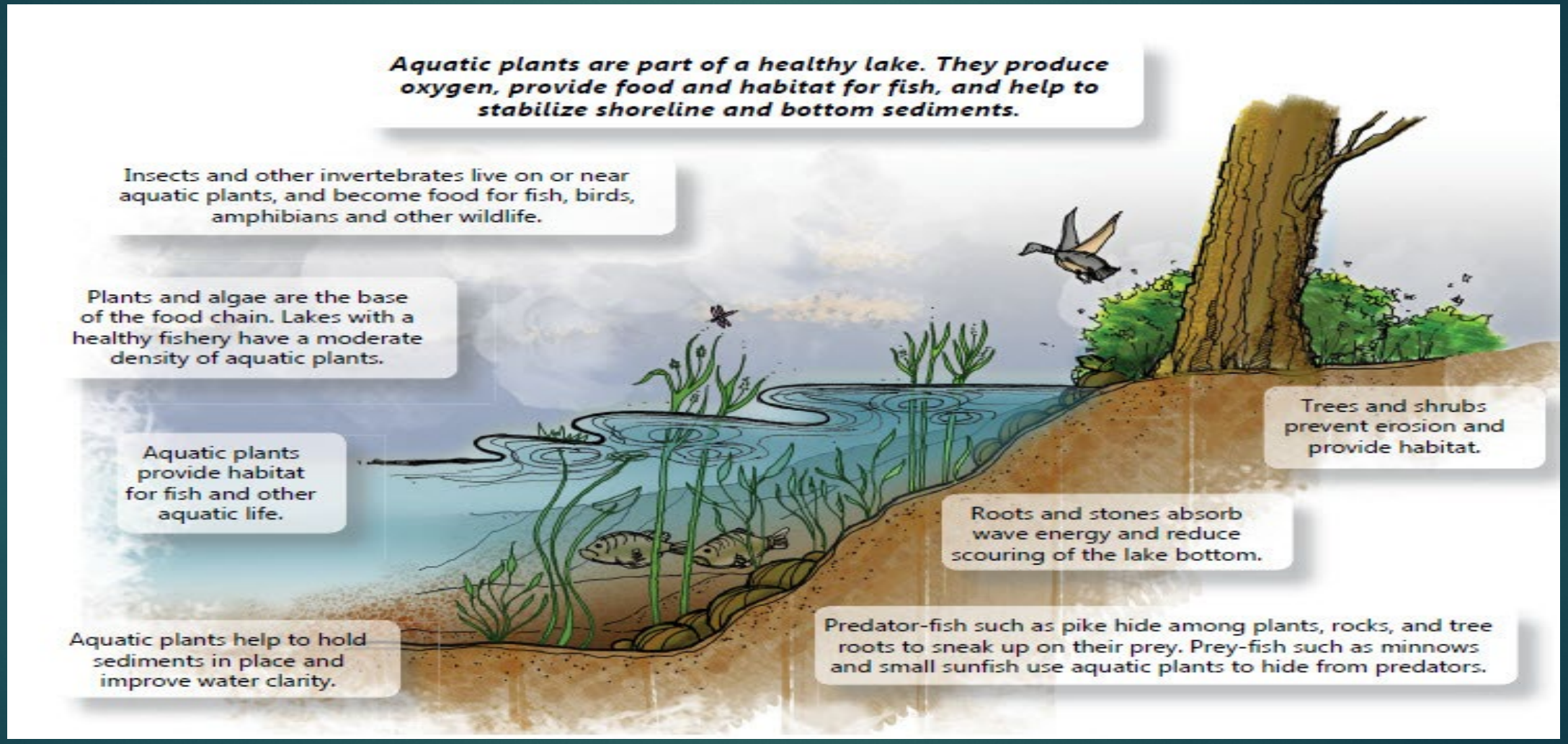
Graphic: Frontiers in Plant Science

Sediment Resuspension & Accumulation = Loss of Submerged Macrophyte Contributions to Aquatic Ecosystem Health

The threat posed to submerged aquatic plants is emphasized by the fact that they play a critical role in fostering and sustaining the health of inland lakes by providing ideal habitat for a diverse array of amphibians, insects, and fish; by storing nutrients, particularly nitrogen, that would otherwise be available for stimulating light attenuating phytoplankton growth; and by preventing the resuspension of water clarity depriving particulate matter (Scheffer *et al*. 1993; Jeppesen *et al*. 1998).

Photo: Scott Brown

The Significant Contributions of Aquatic Plants to Freshwater Ecosystem Health



The Critical Role of Aquatic Plants in Sustaining Healthy Inland Lake Aquatic Ecosystems

Aquatic plant communities play a critical role in promoting and sustaining healthy inland lake ecosystems by storing nutrients that would otherwise be available for phytoplankton growth, by inhibiting the resuspension of water clarity depriving bottom sediments, and by serving as critical complex habitat for a diverse and abundant array of amphibians, insects, and fish (Schloesser, 1986).

Photo: Scott Brown

The Impacts of Shallow Water Wake Boat Operation: Sediment Resuspension and Deposition Degrades Critical Aquatic Habitat

The impacts of wake boat induced high volume sediment resuspension, deposition, and accumulation includes loss or degradation of fish spawning areas, less desirable fish species, loss of fish foraging habitat, impaired or destroyed adjoining wetlands, and a reduction in the capacity of affected lakes, rivers, and wetlands to support diverse recreational opportunities (Johnstone *et al*., 2010).

Photo: Scott Brown

The Impacts of Shallow Water Wake Boat Operation: Sediment Accumulation = Loss of Aquatic Bio-Diversity

Persistent high volume accumulation of sediment is known to be a major contributor to the steep decline in both the diversity and abundance of North American aquatic organisms, and in particular aquatic insects, that has occurred over the course of the past one hundred years (Henley *et al*., 2000).

Photo: Digital Commons@ Michigan Technological University

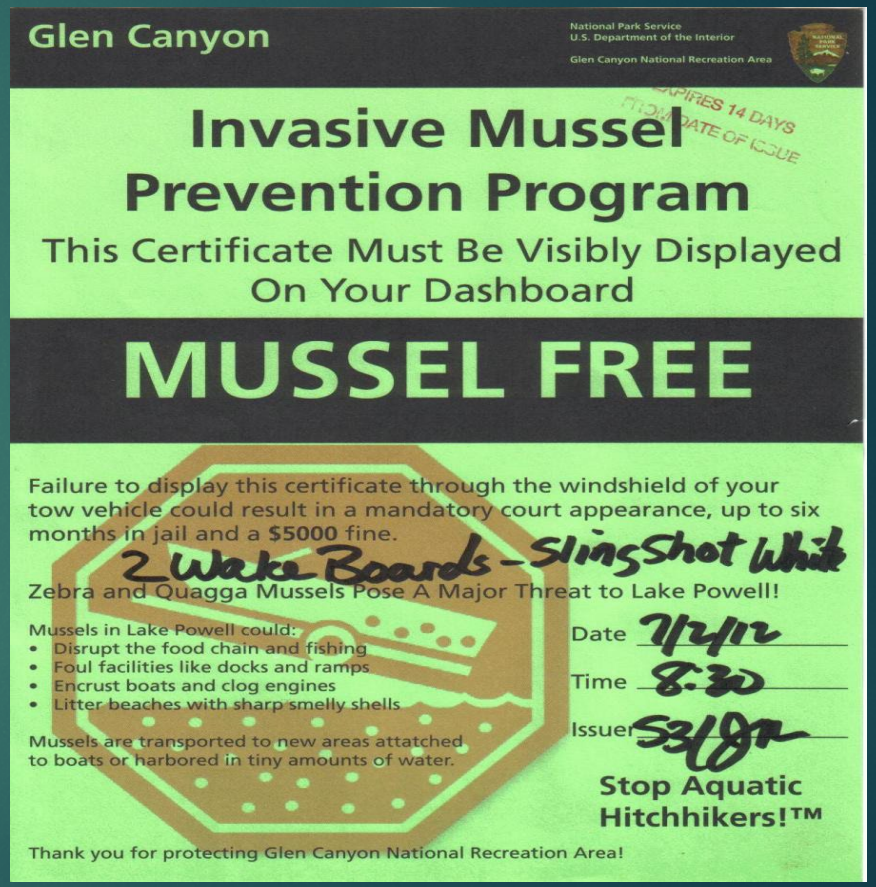
The Impact of Wake Boating on Native Aquatic Plant Communities: Promoting the Spread of Invasive Macrophytes

Resulting in a decline of native aquatic plant diversity and abundance, both the coverage area and density of meadows formed by exotic invasive macrophytes such as Eurasian watermilfoil (*Myriophyllum spicatum*) are likely to increase due to enhanced rates of asexual reproduction via fragmentation caused by the propellers and intense wave action created by wake boats (Madsen *et al*., 2001).

Photo: Scott Brown

The Impact of Wake Boating on Inland Lake Aquatic Ecosystems: Lake-to-Lake Spread of Exotic Aquatic Invasive Species

The high volume ballast water systems of wake boats are known to be capable of acting as a vector for the introduction of exotic aquatic invasive species (Doll, 2018). Wake boat owners that tow their water craft to two or more lakes hosting public boating access sites in relatively quick succession are vulnerable to inadvertently contributing to the spread of aquatic invasive plant and animal species (Doll, 2018).



Graphic: Wake World

The Impact of Wake Boating on Inland Lake Aquatic Ecosystems: Lake-to-Lake Spread of Exotic Aquatic Invasive Species

Recreational boaters engaged in overland transport of their ballast water laden watercraft are primarily responsible for the increasingly widespread and abundant presence of highly invasive exotic aquatic animals, including species that have managed to achieve a high degree of success in the waters of the region, such as the now ubiquitous zebra and quagga mussels (*Dreissena spp.*) (Doll, 2018; Rothlisberger *et al.*, 2010).

Photo: David Jude

Wake Boat Operator Perpetrated Incidents Fuel Controversy and Intense Public Debate

Intense debate focused on the difficult public policy question of whether operation of wake enhanced boats should be restricted or even banned in certain cases has now migrated from the waterfront to state capitols where legislators and lobbyists representing a diverse and powerful group of stakeholders remain deeply divided on the important issue.

Photo Credit: Detroit Free Press

Scientific Research Provides the Knowledge Upon Which to Base the Passage of State Laws and Local Ordinances

Scientific research conducted by Ray (2020), Goudey and Girod (2015), Raymond and Galvez (2015), Ruprecht *et al*. (2015), Mercier-Blais and Prairie (2014), and Marr *et al.* (2022) has provided a cogent, science-based body of knowledge that may now be referenced by state legislators, and/or by local officials in order to enact laws and/or ordinances that should be implemented and enforced in order to help mitigate the harmful influences attributed to frequent exposure to nearshore, and/or shallow water wake boat operation.

Graphic: grassodefense.com

Challenges to Passing Michigan State Laws and/or Local Ordinances Regulating the Operation of Wake Enhanced Boats

- A majority of state senators and representatives believe that passage of laws regulating the operation of wake boats will stifle sales, and cause loss of profits and jobs within Michigan's lucrative recreational boating industry;
- Michigan Boating Industries Association is one of the most effective and powerful lobbying groups in Michigan;
- State and local government elected officials who hold "**libertarian**" beliefs that emphasize freedom of choice, and are philosophically opposed to any sort of regulation;
- Lack of knowledge regarding the negative impacts of wake boats on affected inland lakes;
- Township officials who refuse to admit that they have the power to pass local ordinances regulating the operation of watercraft on lakes within their political jurisdiction;
- Passive voters who do not communicate with their state and local elected officials;
- An increasing number of state and local elected officials own and operate wake boats.

In an Ideal World…

Science-based state legislation, and/or local ordinances written and passed into law in order to establish enforceable minimum distance-from-boat-to-shore, and minimum operating depth standards would serve to provide a modicum of definitive guidance to wake boat operators and law enforcement agencies, and ultimately contribute to reducing the overall potential for wake enhanced boats to inflict harm to ecologically sensitive inland lake ecosystems.

Suggested Individual and Collective Actions…

- Contact your state representative. Find contact info for your state representatives by visiting https://www.house.mi.gov/mhrpublic/frmFindaRep.aspx
- Contact your state senator. Find contact info for your state senator by visiting https://www.senate.michigan.gov/fysbyaddress.html
- Contact your township Supervisor, and local township Board representatives.
- Educate your lakefront neighbors who own and operate wake boats on your lake in regards to the importance of :
  - **Operating a minimum of 300 feet from the shoreline and wetlands**;
  - **Operating a minimum of 300 feet from swimmers, fisherman, wildlife, and those navigating in kayaks, canoes, paddleboats, and other quiet water users ;**
  - **Operating in a minimum water depth of 16 feet;**
  - **Minimizing repetitive passages - diversify your operating track;**
  - **Minimizing loud music, and the use of alcoholic beverages;**
  - **Operating in a manner that respects all other lake users, and lakefront home owners**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WAVES HARM WETLANDS & SHORELINES
DEEPER WATER MEANS BETTER WAKE
AVOID THE BAYS & SHALLOW WATER
PLANE THE BOAT IN SHALLOW WATER
BE WAKE COOL!™
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WAKE RESPONSIBLY
1 Stay at least 200 feet away
from the shoreline, docks, or other structures.
2 Keep music at reasonable levels.
Sound travels well over water. If it's loud enough to hear at 80 feet back, it is likely loud enough for homeowners to hear, too.
3 Minimize repetitive passes
on any one portion of shoreline. Once you've run the same line for a while, move on to another area.
REMEMBER, YOU ARE RESPONSIBLE FOR YOUR OWN WAKE.
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