Recreational Wake Boating Facts

Benefits of Wake Boating

Wake surfing significantly broadens access to water sports in Wisconsin, especially for older adults and individuals with physical limitations. It provides a valuable alternative for those who can't engage in activities like water skiing. Unlike traditional water skiing or wakeboarding, wake surfing doesn't require towing, making it ideal for those with shoulder or upper body injuries. Operating at slower speeds and without bindings lowers the risk of injury while enhancing balance and flexibility. This inclusivity not only makes water sports more accessible but also adds a unique attraction for visitors to Wisconsin.

Claims of Shore Erosion Unfounded.

Boat wakes and shore erosion has been studied for over 40 years. Research consistently shows that shore erosion is primarily caused by factors such as ice, runoff, changes in lake levels, natural wave action, and development—not by boat wakes, except for large watercraft (ferries, etc.).

Water naturally seeks to be flat. A wake is generated by a boat's speed and displacement of water, but gravity quickly diminishes the wave's energy. As the wave travels away from the boat, it disperses into multiple smaller waves. After just 100 feet, the maximum wave height is the same whether or not the boat is using ballast. Effective shore erosion assessment focuses on wave energy derived from wave height and period. (Cox and McFarlane 2019) This energy dissipates rapidly: more than 70% of a wake's energy is dissipated within 200 feet in shallow water, falling below the impact of waves produced by a 20 mph wind over a mile of water (Goudey and Girod 2015). Ski boats operating 100 feet from shore are widely accepted. The waves 200 feet from a wake boat will have the same or less energy as the max wave from a Malibu Response ski boat 100 feet from shore.

Shorelines are adapted to their natural environments. Maintaining a distance of 200 feet from shore ensures that wake energy decays sufficiently so the waves do not differ significantly from natural conditions and do not contribute notably to shore erosion. At this distance, wake boat waves are 8-10 inches high with a period of about 2 seconds, similar to waves produced by a 20 mph wind over a mile. However, the total energy from wind is far greater, as wind waves continuously impact the shore. The average wind speeds in April and May exceed 20 mph on more than 20% of days and over 25 mph on 10% of days. Unlike the brief 45-60-second impact of boat wakes, these wind-driven waves last for hours and even days. To match the energy of a 20-mph wind, a wake boat would need to pass 200 feet from shore every minute—an unrealistic scenario for any shoreline. Long-term studies have shown that boat wakes contribute less than 5% of the total wave energy impacting shores. (Knudson 1990).

Nanson et al. (1994) determined erosion conditions on the Gordon River in Tasmania. For the protected shorelines subjected to wind-driven waves, he determined thresholds of 9.8" wave height and 2.7 seconds period. Wake surfing boats 200 feet from will produce wakes below these thresholds (8-10 and 1.8-2 s) further proving wake boats do not contribute to shore erosion.

Any sufficiently large and heavy boat, such as deck boats and cruisers, can produce substantial wakes. Research (McFarlane, 2018) indicates that even a fishing boat generates similar energy at 200 feet as many wake boats. Activities like tubing, which involve slower speeds and repetitive patterns, also produce large wakes. Singling out wake boats is unjustified and overlooks the broader context of watercraft impacts.

No Water Turbidity and Sediment Resuspension >10 ft

The Indiana National Academy of Science published a definitive study measuring lakebed disturbance in 2022 (Daeger et al. 2022). This experimental work examined sediment resuspension from several different boat types, including ballasted wake boats. The results show that all boat types can disturb lake beds in 3-5 feet of water, but once wake boats operate at depths of 10 feet or greater, lake sediment does not resuspend.

Computational studies have examined the potential impact of propeller wash on lake beds, with conflicting conclusions. These studies estimate water flow at various depths and then speculate on the effect. All these studies require multiple assumptions, and the conclusions still need to be verified. For example, one study (Raymond & Galvez-Cloutier) suggested that water velocities of 0.2 mph would be observed below 10 feet. The authors speculate this would disturb sediment, but the actual diver did not observe any impact.

Data from Wisconsin lakes do not support claims that wake boats increase turbidity and algae blooms. The WI water quality data is excellent and shows no deterioration in lake clarity since wake boats were introduced.

Spread of Aquatic Invasive Species. Not Highest Risk

The spread of invasive species is a significant concern for all types of watercraft, but wake boats are not uniquely problematic. The main issue is that wake boats' internal ballast systems are difficult to inspect, which could potentially contribute to the spread of invasive species. However, all watercraft and trailers can retain water, thus posing a risk. It is arbitrary to single out wake boats.

Modern wake boats are designed to expel nearly all their ballast water, retaining only about 0.1% (approximately 2 quarts). In contrast, sterndrive boats (inboard/outboards) can retain twice as much water (around 4 quarts) in their stern drive engines, and these systems are also hard to inspect. (Doll 2018) Additionally, unlike fishing boats that frequently move between different

lakes, most wake boats are used primarily on their owner's home lake, which reduces the risk of spreading aquatic invasive species (AIS).

A study in Minnesota (Doll 2018) found that the highest concentration of zebra mussels was in sterndrive boats rather than wake boats. Furthermore, milfoil, often found in shallow water, is not commonly ingested by wake boats as they typically operate in deeper areas. Similarly, sandy fleas are located in the sediment rather than in deeper waters.

While AIS is a valid concern, efforts should be directed towards improving sanitization and certification practices for all types of watercraft rather than focusing solely on wake boats.

Safety

The US Coast Guard has approved Wake boats as safe. Wake Boats have safely operated in Wisconsin for over 10 years. There are no reports of boating accidents or citations from wake boats, yet there are many reports for fishing boats, personal watercraft, and pontoon boats.

References

Cox, G; MacFarlane, Gregor (2019). The effects of boat waves on sheltered waterways – thirty years of continuous study. University of Tasmania. Conference contribution. https://hdl.handle.net/102.100.100/522918

Deager, Adrienne, Bosch, Nathan, and Johnson, Ryan, (2022), Impacts on Nutrient and Sediment Resuspension by Various Watercraft across multiple substrates, Depths, and Operating Speeds in Indiana's Largest Natural Lake. Proceedings of the Indiana Academy of Science 130(2): 112-122

Doll, Adam, MS Thesis University of Minnesota, Dec 2018

Clifford Goudy and Lewis Girod, (2015)Characterization of Wake Sport Wakes and their Potential Impact on Shorelines, https://www.wsia.net/wp-content/uploads/2020/03/WSIA_draft_report_Rev_II.pdf

Knutson PL, Allen HH, Webb JW. (1990). Guidelines for vegetative erosion control on wave-impacted coastal dredged material sites. Technical Report D 90-13. Vicksburg (MS): Army Engineer Waterway Experiment Station, Environmental Laboratory, 33p

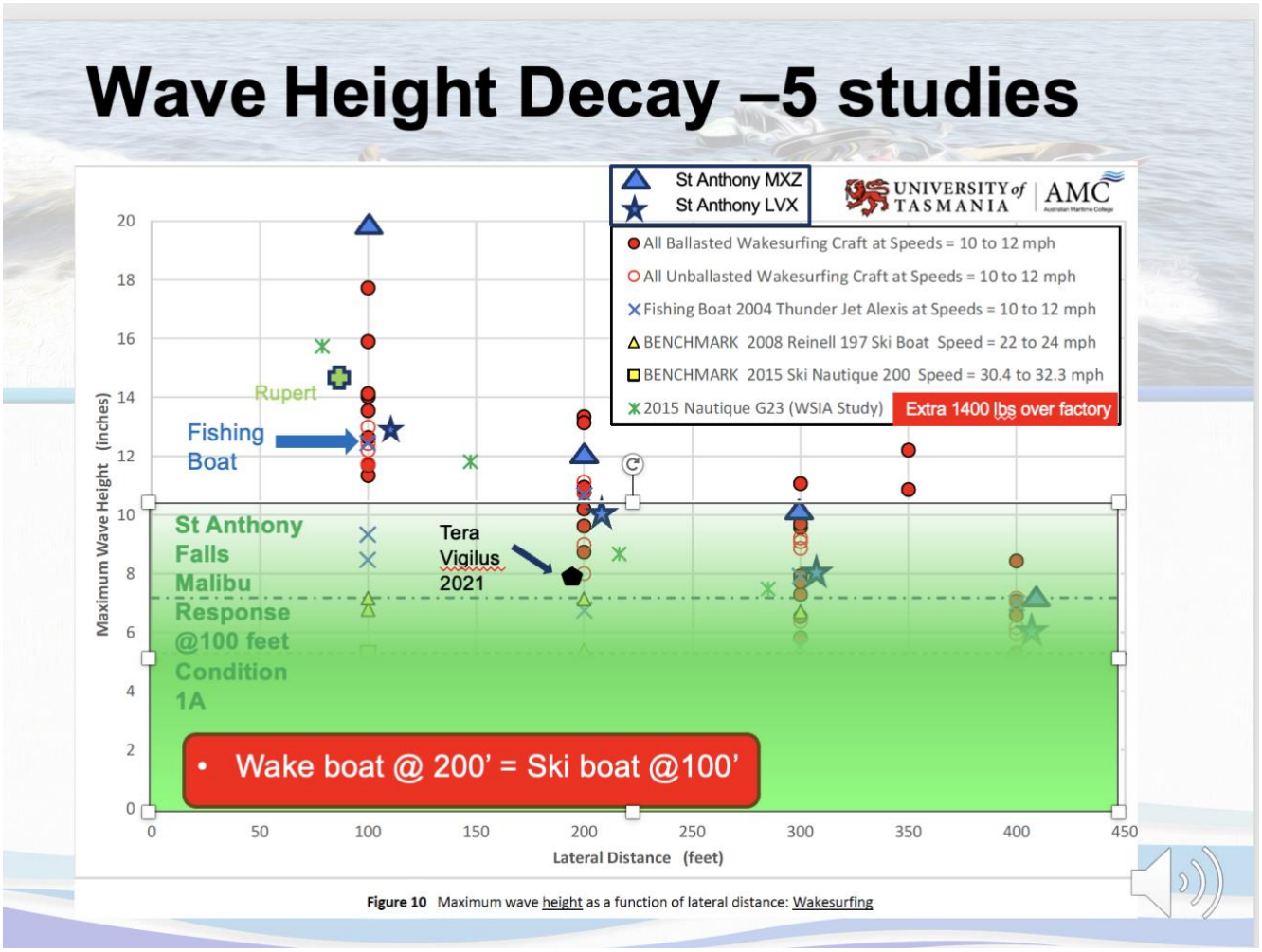
McFarlane, Gregor (2018), Technical Report Wave Wake Study-HB4099 Motorboat Working Group

https://static1.squarespace.com/static/5a0ba0f9e5dd5bce46ef4ed2/t/5c01dec34d7a9cb0b6f25937/1543626456377/AMC+Wave+Wake+Study_HB4099+Motorboat+Working+Group+REPORT.pdf

Nanson, G,C,; Von Krusenstierna, A.; Bryant, E.A.; Renilson, M.R. (1994) "Experimental Measurements of River Bank Erosion caused by Boat-Generated Waves on the Gordon River, Tasmania", Regulated Rivers, Research and Management Vol. 9, 1-14,

Raymond, S., and Galvez-Cloutier, R., (2015) Impact of Lake Navigation - Sediment Suspension Study: Lake Masson and Sand Lake Cases, Laval University. 30p. (Published in French, English translation)

SLIDES



Sediment Resuspension

2022. Proceedings of the Indiana Academy of Science 130(2):112–122

IMPACTS ON NUTRIENT AND SEDIMENT RESUSPENSION BY VARIOUS WATERCRAFT ACROSS MULTIPLE SUBSTRATES, DEPTHS, AND OPERATING SPEEDS IN INDIANA'S LARGEST NATURAL LAKE[2]

Adrienne Daeger, Nathan S. Bosch[1, 2] and Ryan Johnson: Lilly Center for Lakes & Streams, Grace College, 1 Lancer Way, Winona Lake, IN 46590 USA

ABSTRACT. While a key component of lake recreation, watercraft are capable of impairing water quality, including via resuspension of nutrients and sediments from the lake bottom. As water quality influences the ecological, economic, and recreational capacities of a lake, this study set out to investigate nutrient/sediment resuspension by watercraft on Indiana's largest natural lake, Lake Wawasee. Four experiments were performed to test the following variables in substrate resuspension by watercraft: (1) lake bottom substrate type, (2) water depth, (3) watercraft type, and (4) operating speed. Nutrient/suspended sediment samples were collected before and after the watercraft passed through the sampling area and their averages were compared using t-tests. Nutrient resuspension was observed after the wake boat in 5 ft of water, and no resuspension by any watercraft in 10–15 ft of water. Resuspension was observed after plowing (near plane) in 5 ft of water or idling in 3 ft by multiple watercraft. The results suggest that recreationalists use high impact watercraft and operational styles in water ≥10 ft in Lake Wawasee. Differences in macrophyte assemblage (including non-native invasive starry stonewort, *Nitellopsis obtusa*) likely had a large impact on the resuspension potential of one testing area. Boating restrictions based on speed and water depth can support the recreation that draws people to lakes while protecting the lake from some damage by that recreation. Lake managers should also consider variation in bottom substrate across their lake to identify areas particularly sensitive to boating and nutrient resuspension.

Keywords: boat recreation, sediment and nutrient resuspension, lake bottom substrate, water quality

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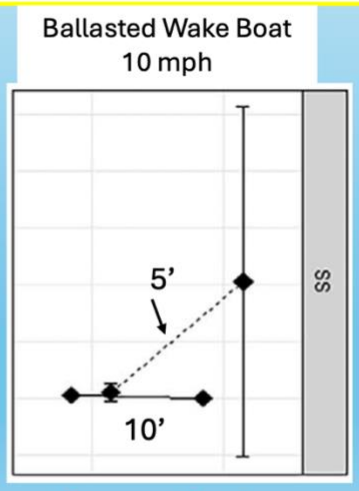
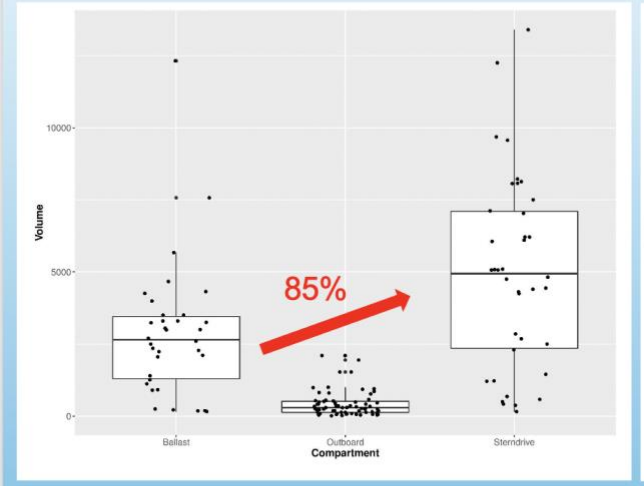
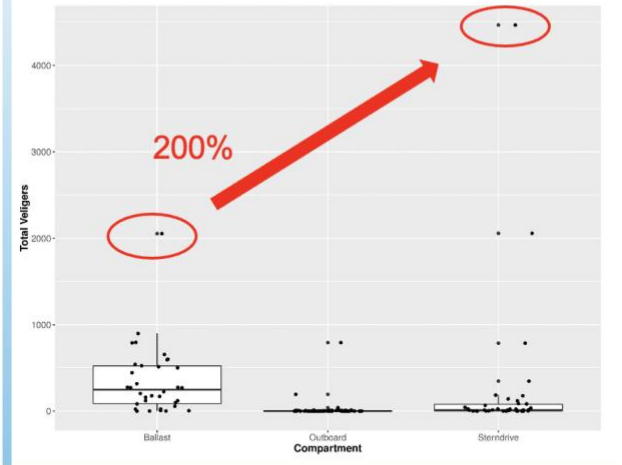


"Increase Risk of AIS"- Wrong





SternDrive (inboard/outboard) have 85% more residual volume and the largest # of Veligers observed
Wake Boat operate in deeper water where Milfoil less prevalent

Occurrence and Survival of Zebra Mussel (*Dreissena polymorpha*) Veliger Larvae in Residual Water Transported by Recreational Watercraft, Adam Doll, Uminn thesis 2018

Claims vs Facts

CLAIM	FACTS
Wake Boats Cause Shore Erosion	Boat wakes, and shore erosion has been studied for over 40 years. Research consistently shows that shore erosion is primarily caused by factors such as ice, runoff, changes in lake levels, natural wave action, and development—not by boat wakes. At 200 feet the waves impacting a shore have the same total energy as a fishing boat or ski boats at 100 feet and less than a 20 mph wind blowing over a mile.
Wake Boat waves destabilize shorelines	200 feet from a wake boat the waves are very similar to what the shoreline experience naturally. The waves are not significantly different. The wave heights for wake boats are 8-10 inches vs 7.5 inch for a 20 mph wind, and the periods are both around 2 seconds.
Wake Boats generate a 16 inch wave 200 feet from the boat.	This is one extreme case from a boat that is overloaded with more ballast than the factory configuration, operating in deep water that is not typical of most Wisconsin lake shorelines. That same study showed that the wave is 9” 200 feet from the boat in shallower water. No other study found a 16” wave. Five other studies report 8-10” 200 feet from the boat.
Wake Boats generate waves that are 3-9 the energy of other boats. At 100 feet.	The energy of the initial wave right at the boat is higher than other boats but wave energy degrades rapidly as it breaks up into multiple smaller waves. The larger the initial wave the faster it attenuates. At 200 feet the max wave energy of a wake boat is similar to fishing and ski boats. The SAF study claims at 100 feet the waves have 3-9 time more energy but their energy calculations are 2-8 times higher than more experienced researchers demonstrating their analysis is flawed.

You cannot compare wind waves to wake boat waves. The form of the energy is important. ~~)~~	The form of energy is indeed important but wind and recreational boat wakes are similar. Statements like you cannot compare boat wakes refers to large vessels. Waves have intrinsic characteristics whether they are created from boats or wind. Comparing the height, period and duration allow direct comparison of wave energy. A 20-mph wind blowing over a mile will create a 7.5' tall wave with a period of ~1.8-2 seconds. A wake boat 200 feet from shore will generate 45-60 seconds of waves with a maximum height of 8-10" and a period of 2 seconds. These waves have similar energy, consequently, wake boat waves will not present a substantially different form of energy to the shore. Cox and McFarlane (2019) conclude "*Wave wake studies are inevitably a study of orders of magnitude and not small percentages*". While the wave energy and period for wake boats and wind waves are similar, the total energy a shoreline receives from wind is 20X or more higher since wind wave impact every 2 seconds vs. a packet of boat waves which only last 40-60 seconds. To match the energy of a 20-mph wind over a mile requires a wake boat to pass a shoreline every minute.
Cox and McFarlane say "*It is not the quantity but the form in which it is delivered [2]. For that reason, we now believe that comparisons of annualized boat wave energy and wind wave energy are meaningless for comparing the impacts of different wave regimes.*"	This is true when wind and wakes have significantly different characteristic and we meant to address attempts to compare the wake from large ferries to wind. In WI the wind and boat wakes ARE similar so comparing energy is reasonable.
The Houser study in Canada showed >60% of the wave energy was from boats.	This study is not consistent with prior studies that find wake contribute <5% of the energy a shoreline experiences. Even the authors admit their findings are not consistent with prior work and offer no explanation.

The St Anthony Fall Study showed wake boats need to be 700 feet from shore	The St Anthony falls paper was severely flawed and has been criticized by the reviewer. Their data has massive variability making any meaningful interpretation impossible. For example, at 200 feet from the MXZ boat they report wave heights of 9" and 18". There should not be more than 10-20% difference in data points to be considered acceptable. They authors try to hide this lack of precision by using regression to fit a curve, but the coefficients of this equation are not consistent with all prior work The paper ~~It~~ did not follow the peer review protocol which requires the reviewers agree it is suitable for publication- it is not peer reviewed in the true sense. Boat Wakes have been studied for over 40 years. The St Anthony Fall (MN) study does not present any new information. In addition to the poor quality of the data, they incorrectly calculate wave energies. The rational for the 700 feet setback is based incorrect energy calculations. Many experimental studies show at 200 feet wake boat wake is equivalent to ski boats at 100 feet.
Adding Ballast makes large waves which cause shore erosion	Adding ballast increase the size of the initial wave at the boat, but larger waves decrease quicker. By 100 feet the wave produced by a boat with and without ballast are the same. (SAF, McFarlane)
Wake Boats scourer lake bottom resuspending sediment and destroying plans.	The Study published by Dreager in the Proceedings of the Indiana Academy of Science definitely shows in >10 feet of water there is no sediment resuspension.
Tera Vigilis, and Raymond and Galvez say boat prop jet impact lake beds down to 33 feet.	The definitive study on lakebed disturbance was Dreager, et, al in 2022. They measured the suspended solid, phosphorus, SiO_2 and nitrates and found

	that after 10 feet a ballast wake boat does not create any disturbance of the lake bed for even fine sediment. In shallow water (3-5') all boat types can resuspend sediment. Raymond and Galvez in 2015 used acoustical probes to measure water speed down to 0.1 m/s at 15 feet, and speculated this would be sufficient to disturb lake beds, but their diver "did not notice any material suspended as a result of boat passage. Tera Vigilis study claiming a 25% increase in P 30 minutes after passing was on extremely low numbers and is not statistically significant. They even acknowledge "sediment deposition could not be solely attributed to only wake boats)
Not being able to inspect wake boat ballast tanks will cause the spread of invasive species.	SEE EXPLAINATION ABOVE. Wake boats are not unique. You also can't inspect the residual water in any stern drive and they have been show to trap 85% more water than ballast tanks.
The bow up boat attitude impairs vision and is a safety risk.	Wake boats are not the only boats that operate with bow up attitudes. There are no records of safety incidents for wake boats but there are many for PWC, fishing and pontoon boats. The Coast Guard has certified these boats are safe to operate. In attentive driving is an issue with any boat.
Wake Boats Hog the lake and everyone has to get off.	Wake boats operate at ~11 mph vs ski boats that go >30 mph. Ski boats cover 3 X the distance of a wake boat. Even pontoons tubing go 2 X as far. At 200 feet the waves of a wake boat are the same as a water ski boat at 100 feet but the ski boat will travel 3X as far.