

Boaters—Slow the spread of zebra mussels, and protect your boat too

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Since their initial "invasion," zebra mussels (*Dreissena polymorpha*) have spread throughout the Great Lakes and connecting water channels such as the Mississippi River. Biologists believe that eventually the zebra mussel will be dispersed, via human and natural methods, throughout the United States and southern Canada. For more information about the zebra mussel, the invasion, and associated concerns, request the publication *Zebra mussels in the Great Lakes: The invasion and its implications*, FS-045, from Ohio Sea Grant.

Why a concern exists

Reproduction occurs annually and female mussels can produce 30,000 to 300,000 eggs per year. An adult mussel will attach to virtually any solid underwater surface, including other mussels, to form colonies in excess of 100,000 mussels per square meter. For this reason, the zebra mussel is referred to as a "biofouler." These colonies can clog intake systems for water and power plants, cover and sink navigation buoys, litter beaches, and create maintenance problems for docks. By slowing the spread of the zebra mussels, costs incurred because of their colonization may be reduced and will be delayed.

Zebra mussels consume phytoplankton (microscopic plant life), which forms the base of the aquatic food chain. With adult mussels filtering one liter or more of water per day and colony concentrations in the tens of thousands per square meter, there is a significant potential for negative impact on aquatic food chains. Zebra mussels may also have the potential to impact the spawning success of certain fish species, due to their high rate of colonization of spawning substrate (rocky bottom areas).

Zebra mussels may also serve as a host for parasites that are harmful to various fish and waterfowl. Fortunately, no parasitic diseases have yet been linked to zebra mussels in North America. These reasons should more than justify the concern for the spread of the zebra mussel.

Slow the spread

How the spread can occur

The range of the zebra mussel will increase naturally where water systems are connected. Flowing water carries the zebra mussel larvae (veligers) to downstream locations. Commercial and recreational vessels plying these waters can transport both adults and veligers to other locations.

Inland streams and lakes not connected to these systems by downstream flow, or connected by tributaries too narrow or shallow to allow commercial or recreational vessels, are also at risk of infestation by zebra mussels.

Zebra mussel veligers may be transported by waterfowl or fur-bearing mammals in wet feathers or fur. They can attach to, grow on, and be transported by freshwater crayfish. But the biggest contributor to the inland spread will be *people*.

The most obvious means of transportation are *recreational boats*. Zebra mussels attach themselves to any solid surface not protected by antifouling paints, such as unprotected boat hulls, motors, swim platforms, trim tab plates, and electronic transducers. Veligers can be transported in live wells, bilge water, marine toilets, water trapped in trailer frames and safety light compartments, and in water collected inside the boat's decking. Water trapped in the lower portion of boat motor cooling systems can also harbor veligers. When boats are moved by trailer from infested waters to uninfested inland lakes or rivers, unwanted introduction of the zebra mussel may occur.

Anglers can transport veligers in bait buckets, even in the small amount of water remaining in an emptied bucket. If an angler fishes off a pier in Lake Erie (or another infested area) using minnows kept alive in a floating bait bucket, then decides to keep the remaining minnows for an outing the next day on an inland lake not infested with zebra mussels, the angler may possibly introduce zebra mussels into that lake.

Pontoons of float planes, scuba diving equipment, live commercial fish shipments, fish stocking (both public and private), and water haulers/suppliers are examples of other potential means of transportation for the zebra mussel. Careless disposal of adult mussels or water containing veligers from school *science projects* or from university or governmental agency *research studies* is yet another potential for spread.

Zebra mussels are not just a temporary inconvenience; they are here indefinitely and we must learn to live with them.



How you can help prevent the spread

The first step in prevention of spread is to *develop* an individual attitude of concern. Second, *accept* the fact that YOU are a potential means of transportation for the spread, and third, *adhere* to the recommendations in this publication.

Zebra mussel veligers can be present in the water column from May through October. Adults attached to solid objects (boats, docks, etc.) can be transported every day of the year.

Equipment

- * Thoroughly rinse wetsuits, SCUBA gear, and any other items used in the lake with hot water and allow to dry before using in an uninfested lake.

Water transport

- * Check with appropriate state and federal agencies prior to transporting live fish or hauling water from a zebra mussel infested water body. Water additives for transported water are currently being developed that will kill zebra mussel larvae but be safe for fish and human exposure.
- * Never transport minnows from an infested area. Release them after fishing or give to another angler going out. Thoroughly wash minnow buckets with hot water and allow to dry.

Research projects

- * If involved in any research project involving zebra mussels, be sure to discard adults in trash containers and kill any veligers by adding salt to the water before discarding. You may also heat the water to 110°F or hotter to destroy veligers. Wash all containers with hot water and allow to dry.

Boats and Engines

- * Use appropriate antifouling paints on boat hulls and motors in infested waters. Properly treated boats discourage the attachment of zebra mussels and reduce the risk of transport if trailering to uninfested areas.
- * *Always* inspect and clean your boat before transporting it to another lake or river.
- * *Thoroughly* drain and flush all boat compartments including bilge, live wells, marine toilets, anchor rope compartment, engine cooling systems, and *any other areas that get wet*. Use *hot water* to wash these areas. Veligers are killed in water at least 110°F and adults at 140°F. High pressure hot car washes, tap water (generally 120 to 140°F), or high pressure hot steam units found at most marinas are acceptable methods. Don't forget the boat trailer, inside the trailer frame and lights, and your car's bumper.
- * Allow boats and trailers to dry *thoroughly* in the sun for at least 4 days prior to placing in uninfested water.
- * A boat hull that feels "gritty" probably has attached young, microscopic zebra mussels. Scrape the hull, use a high pressure (250 p.s.i.) hot water sprayer, wash with *hot water* and allow to dry for 4 days in the sun.
- * All visible zebra mussels should be physically scraped off. Be sure to check around trim tabs, I/O rubber boots, transducers, outdrives and lower units, and inside thru-hull water intakes, including the toilet, sink, live well, and ports. *Sweep up and discard mussels in trash can*. Remember, adult zebra mussels can live 10 to 14 days out of

water. Small attached veligers, in the proper environment (shaded, damp area) can live for 3 to 5 days out of water. Don't take chances, and do it right.

- * Run hot (140°F+) water through your engine intake system to kill any adults or veligers in the system. Have a hose fitting installed on intake system for hot water or investigate current commercial "engine boot" systems that contain lower unit water and recirculate the heated water through engine.
- * An alternative to hot water flushing and washing is a concentration of 1/2 cup salt to 1 gallon of hot water. Salt will kill the mussels. *However*, you must *thoroughly flush* with fresh water to prevent corrosion from the salt.
- * An earlier method for disinfecting was to thoroughly scrub and wash everything with a solution of *one tablespoon chlorine (household bleach) to one gallon of water*. This disinfectant works well in killing mussels but is *extremely harmful to aquatic environments* if allowed to drain back into the water. In addition, chlorine *can damage engine hoses, impeller pumps, and bilge pumps*. This method is *not advised*; hot water is effective, easy to use and is 'environmentally friendly.'
- * If *still in doubt*, dry boat thoroughly, open all compartments, and allow to sit out of the water in full sunlight for 14 days. Any unobserved veligers or adults will die and fall off.

Remember, it only takes *one* viable adult female and male zebra mussel, or a bait bucket with veligers, to start a new colony. Do *your part* to help reduce the spread of the zebra mussel.

**Veligers are killed in water at least 110°F
and adults at 140°F.**

Protect your boat and motor

Zebra mussels can cause extensive damage to boats and motors if you do not take precautions to prevent their attachment.

Boats docked or moored are the most vulnerable to zebra mussels. They will attach to *unprotected* boat hulls, and to accessories such as transducers, trim tabs, water ports for marine toilets, and deck drain fittings. They can increase friction, thus decreasing speed and efficiency, and can interfere with proper performance of accessories. Damage to paint surfaces can occur, resulting in increased maintenance and repair.

Motor damage is the biggest concern. Zebra mussel veligers can be taken up into cooling systems where attachment and growth can occur. Intake screens, internal passages, hoses, seacocks, and strainers can become blocked. Entire shells or shell fragments can break off and be drawn into the water pump impeller. Extensive engine damage can result from damage to moving parts or from overheating. Most insurance companies *will not pay* for zebra mussel induced damage since it is listed as a preventable problem. Mussels can even accumulate around propeller shafts resulting in increased wear and possible damage to drive shafts or shaft seals.

What you can do

Storage

- * The best prevention is to remove the boat from the water and store on a trailer or in dry-rack storage. Understandably, this is not feasible for most boaters, who are permanently docked at the lake.

Usage

- * Running your boat *twice per week* at high speed for 10 to 15 minutes will help minimize zebra mussel impacts. Zebra mussels cannot attach when water velocity exceeds 1.5 meters/second; many will be washed off at speeds exceeding 2 meters/second. This high-speed running will also help flush any attached young zebra mussels inside motor water intake systems, and heat generated past the water pump will kill any veligers that may have been drawn into the system. It's also the perfect excuse to get out on your boat.

Antifouling products

- * Maintain a good quality antifouling bottom paint on the hull and other accessories. These hull coatings work by releasing toxins to whatever they contact. Most marine algae and slime growths, and zebra mussels, are sensitive to these chemicals and will not attach to them.
- * Copper-based antifouling paints are used on fiberglass and wooden hulled boats. A primer may be necessary on some surfaces and the old coating must be removed first. Copper-based paints can be used on aluminum boats, but *a primer coat is necessary* first, as aluminum and copper react with each other (electrolytic action) and cause corrosion. Copper-based paints generally are viable for one to two seasons at most.
- * Several types of bottom paints exist, including copolymer, vinyl/epoxy binder, resin binder, and hard- and soft-film types. Copolymer coatings are best for high-speed boats because they are thinner and smoother than the others. They are also recommended for trailered or rack storage boats because they only react when immersed in water. Other coatings oxidize and become useless when exposed to air for as little as one week. Vinyls, epoxies, and resin coatings allow biocides to leach to the surface. Soft-film types result in a soft residue remaining after the biocide is leached out. Hard-film types can be sanded to restore effectiveness. Most soft-film resin types are well suited for boats that remain in the water. Consult your manufacturer or boat dealer to determine the type best suited for your hull.
- * Tributyltin (TBT)-based antifoulants can be applied to any boat hull, yet are restricted by law to *only aluminum boats* or boats exceeding 82 feet in length. Some states, and provinces including Michigan and Ontario, have banned the use of TBT paints altogether. TBT is very other marine organisms, and can last two to three seasons. However, this compound is *extremely toxic* to nontarget organisms. Early forms of TBT antifoulant paints were found to leach biocides into the water. Paint that chipped off settled to the bottom and contaminated nontarget organisms. In 1988, a federal law restricted the use of TBT antifoulant. Some states have approved for use new 'slow-release' TBT paints (bulk-brush on) *but* the appli-

cator is required to obtain a pesticide applicators license and certification through the state Department of Agriculture. For more information about licensing and regulations for TBT-based paints, contact your nearest Sea Grant Extension Specialist or your state's Department of Agriculture. In states and provinces that allow this paint to be used, you cannot purchase TBT-based paint without a license, *except* for a limited use spray paint, which is restricted for lower units and outdrives. If in doubt of applicability or legality, *always* check with the boat/motor manufacturer or dealer and state/federal regulatory agencies; mistakes can be *costly*.

- * Various nontoxic hull protectants (waxes) are also available. Most are not effective in preventing zebra mussel attachment, though they generally reduce hull cleaning efforts at season's end.
- * Remember to coat accessories (trim tabs, etc.) with a primer if they are aluminum *prior* to applying copper-base antifoulants. TBT-based sprays are *not* permitted for use on accessories.
- * Always check with the manufacturer of accessories prior to coating with antifoulants as some loss in performance may be experienced (transducers, trim tabs). Periodic inspection and scraping may be an alternative.
- * *Never* apply a new antifoulant over an existing coating of another type. Remove old paint and read container labels for compatibility.

Prevent motor damage

As indicated above, weekly operation will help to discourage zebra mussel impacts to motors. However, you must take yet other preventive measures to avoid motor damage.

- * Always tip drive units *up* and *out* of water if possible when at dock. This will prevent mussels from attaching around propellers and *some* water intake screens.
- * Inspect cooling systems and intake screens during pre-season maintenance. Check water pump impeller for damage from shell fragments if adults are found near intake systems.
- * Use TBT-based antifoulant spray coatings on lower units, and around and on propellers. Spray inside water intake passages as far as possible. Some units require an annual break down for lubrication of the drive shaft; this is an excellent opportunity to spray with TBT deep inside otherwise hidden water passages. These TBT spray paints can be purchased over the counter, without a pesticide applicators license, but are *restricted for application* to only outboards, I/O sterndrives, propellers, and internal water intake passages. Although these sprays work well, a 1990 Ohio Sea Grant study revealed a loss of effectiveness after 9 to 12 weeks in the water. Since zebra mussel October, an initial application at first-of-season, followed by another application after three months, is recommended.

WARNING: Some manufacturers advise against applying antifoulant paints to lower units and internal passages, as *improper application* may interfere with heat transfer and cooling. **Always check with the manufacturer or boat dealer** prior to applying antifoulant coatings to your motor. And as stated, some states have banned the use of TBT coatings, so check first.

- * Copper-based antifoulants will *rapidly corrode* aluminum if not covered with a recommended primer coating first. Most lower motor units are aluminum.
- * Frequently inspect the rubber boot that surrounds the I/O unit at the hull. Zebra mussel shells that break when the unit turns can tear the boot, resulting in water entering the hull.
- * Recent commercial products, which attach around the motor lower unit, encapsule and recirculate the water, causing it to heat up. This heated water will kill any veligers present, and will create a "veliger-free" pool of water around your unit in the encapsuled area while at dock. This may be worth investigating.
- * If possible, attach a hose fitting to the lower unit's intake and run tap water (preferably hot) through the system after returning to the dock. This, however, will still not prevent veligers from entering the intake screens while at the dock.
- * Install a temperature gauge and take note of any increase in readings. Watch for any reduction in cooling water discharge during operation.
- * *Never* introduce chlorine into engine cooling systems. This may damage the system, and is harmful to the aquatic environment.
- * Frequently inspect intake screens, lower unit steering and hydraulic controls, propellers, and propeller shaft seals.

With outdrives and inboard units, follow any applicable recommendations for outboards and I/Os. In addition:

- * Run engine at operation temperature for one-half hour minimum per week.
- * Watch temperature gauges and record readings for each use; *any* increase in readings over the previous use warrants disassembly and inspection the cooling system.

- * Consider installing a high-temperature alarm.
- * Routinely remove screens and inspect intakes. At season's end, disassemble and inspect between seacock and engine. Check water pump impellers for shell fragments.

Closing thoughts

Zebra mussels are not just a temporary inconvenience; they are here indefinitely and we must learn to live with them. Costly damage to hulls and motors are only part of the concern. Leakage through I/O rubber boots or propeller shaft seals could result in a sunken vessel. An overheated engine could cause a fire, or a loss of power during rough weather conditions. Don't take the "It can't happen to me" attitude; adopt preventative measures *now* and reduce your chances of future problems.

For more information

Sea Grant is a university-based program in National Oceanic and Atmospheric Administration (NOAA) dedicated to the wise use and conservation of marine and Great Lakes resources. For other publications, newsletters, conference and workshop announcements, or for advice from a local expert, contact the Sea Grant program or state natural resources management office nearest you.

Illinois/Indiana Sea Grant Extension	708/818-2901
Michigan Sea Grant	313/764-1138
Minnesota Sea Grant Extension	218/726-8106
New York Sea Grant Extension	
Zebra Mussel Clearinghouse	800/285-2285
Ohio Sea Grant	614/292-8949
Wisconsin Sea Grant	608/263-5371

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