Coming Events

Mar. 16, 2002 **Ghost Ships Festival**. Clarion Hotel and Conference Center, Milwaukee, contact Brendon Baillod, 414-403-3240(cell), brendon@baillod.com, www.ghost-ships.org.

Apr. 26-28, 2002 **Our World Underwater.** Donald E. Stevens Convention Center, Rosemont, IL. For information check their web site www.ourworldunderwater.com, or email them at info@ourworldunderwater.com.

May 11, 2002 **WUAA Spring Meeting.** Door County Maritime Museum, Sturgeon Bay, WI. Shipyard tour from 10a.m. to noon. Business meeting starts at 1:30 pm. For information contact Russ Green at 608-271-8172, rtgreen@mail.shsw.wisc.edu.

Wisconsin Underwater Archeological Association

P.O. Box 6081

Madison, WI 53716

Wisconsin Underwater Archeology Association

For those interested in the study and preservation of Wisconsin's underwater history and cultural resources.

Wisconsin's
UNDERWATER HERITAGE

Vol.12 No. 1 *A publication of the Wisconsin Underwater Archeology Association* *March 2002*

The Low-Down on Zebra and Quagga Mussels

by John Karl

Of the more than 145 exotic species that have invaded the Great Lakes, none is more commonly encountered by divers than the zebra mussel. This article, the first of a two-part series, provides an overview of the mussel's biology and its ecological and economic impacts. The next article will present the findings of several studies on impacts of zebra mussels on shipwrecks and underwater archeology.

Scientists believe zebra mussels entered the Great Lakes in 1985 or 1986, when one or more transoceanic ships discharged ballast water into Lake St. Clair. The freshwater ballast, picked up in a European port, may have contained zebra mussel larvae and possibly juveniles, or adult mussels may have been carried in a sheltered, moist environment, such as a sediment-encrusted anchor or chain.

Known to scientists as *Dreissena polymorpha*, zebra mussels were followed in 1991 by *Dreissena bugensis*, a close relative commonly called quagga mussels. Quagga mussels have rounder sides and bottoms than the zebra mussel, which is more triangular-shaped and has a flat bottom.

Secrets of their success

The rapid proliferation of both mussels can be partly attributed to their reproductive cycles. A fully mature female mussel may produce up to one million eggs per season. Egg release starts when the water temperature warms to about 54°F (12°C) and continues until the water cools below 54°F.

Eggs are fertilized outside the mussel's body and within a few days develop into free-swimming larvae called veligers. Veligers drift with currents and swim, using their hair-like cilia, for three to four weeks. The vast majority of veligers fail to settle onto firm objects, and they die. It is estimated that only one to three percent survive to adulthood. Those that find a hard surface quickly attach and transform into the typical, double-shelled mussel shape. They are then considered to be juveniles.

Mussels become adults when they reach sexual maturity, usually within a year. They grow rapidly, nearly an inch in their first year, adding another one-half to one inch their second year. In the Great Lakes, they may live three or four years.

Zebra mussels generate a tuft of fibers known as a byssus, or byssal threads, from a gland in their single foot. The byssus protrudes through the two halves of the shell. These threads attach to hard surfaces with a highly sticky secretion that anchors the mussels in place. Small juveniles can actually break away from their attachments and generate new, buoy-

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Zebra mussels on a beach.
Photo by Great Lakes Environmental Research Lab

Wisconsin Underwater Archeology Association Spring Meeting

The spring meeting of the Association will be held in Sturgeon Bay on Saturday, May 11, 2002.

This is also the date of the Sturgeon Bay shipyard tours. Tours of Bay Shipbuilding and Palmer Johnson facilities in Sturgeon Bay are offered from 9 am to 1 pm. Cost for the tours is $5/adults, $2/children. This event is sponsored by the Rotary Club. Call 800-301-6695 for information on the shipyard tours.

At 10:00 a.m. we will gather at the Door County Maritime Museum, 120 North Madison. From there, we will proceed to the start of the shipyard tours. It is probably easiest to park at the Museum and walk to the tour.

From 10:00 a.m.-12:00 p.m. we will be on the tour.

Lunch will be 12:00-1:15 p.m. We will choose a place for lunch, if people want to take lunch together from

The business meeting will start at 1:30 p.m. and will be held at the museum.

There will be time to tour the museum following the meeting.

Please notify Russ Green if you will be attending, so we can make appropriate preparations. Russ can be reached at 608-271-8172 or at rtgreen@mail.shsw.wisc.edu.

A Few Good Persons

The Association will have a booth at the Ghost Ships Festival, in Milwaukee, on March 16, 2002. Members are needed to man the booth. If you will be at the Festival and can spare some time to help out, please contact Russell Leitz at 920-231-9082 or at rleitz@vbe.com

Wisconsin's **Underwater Heritage** is published quarterly by the Wisconsin Underwater Archeology Association, a nonprofit association of individuals and organizations interested in studying and preserving the underwater cultural resources and historical sites of Wisconsin.

In addition to publishing this newsletter, the Association also holds semiannual meetings and provides support to members' research and publication projects. Annual membership dues are $15. For membership information, contact the secretary or write to the address below.

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The Age Of Sail On The Great Lakes

A new, comprehensive treatise on ships and shipbuilding on the Great Lakes is now available. This 23-page booklet is a "must have" for anyone interested in Great Lakes lore and shipbuilding.

For the serious Great Lakes researcher, this valuable work is the only single source of documented data covering over 230 years of shipbuilding and over 6000 vessels with charts and graphs cross-referencing types of vessels, vessel name, year and port of construction. Types of vessels included are gunboats, scows, schooners, barks, barges, sloops, brigs and others.

For those generally interested in Great Lakes vessels and history, the types of vessels are shown in silhouette figures to differentiate, for example, a Bark and a Brig, along with other interesting information.

The Age of Sail on the Great Lakes represents many years of work by the Wisconsin Marine Historical Society, in researching, compiling and documenting data from nationwide sources. This collection of information on Great Lakes ships and shipbuilding is unavailable from any other source. It is published by the Wisconsin Marine Historical Society, which has additional information on Great Lakes maritime history and thousands of photos available.

To obtain a copy of the Age Of Sail On The Great Lakes ($50.00 + $5.00 S&H) or to get information contact:

Wisconsin Marine Historical Society
814 W. Wisconsin Avenue
Milwaukee, WI 53233-2385
phone: 414-286-3074
email: wmhs@execpc.com

Stories From The Archives

The following stories were uncovered by Russel Leitz during his archival research.

Gas-Lit Buoys

Door County Advocate, Jan. 25, 1896

Our representative in congress is making an effort to secure for these waters a number of gas buoys. This is a recently invented appliance, and takes the place of the ordinary can buoys. It is really a miniature lighthouse with the light fourteen feet above the level of the water and visible six or more miles. Gas is put to the cylinder in the spring under pressure. It cost $26 to fill the buoy and it will then burn six months. The cost of one of these appliances is $1400, and it will not be many years before they come into general use.

Door County Advocate, March 28, 1896

Gas-lit buoys are the latest. The Lighthouse Board is adopting them in an experimental way, and several bills now before Congress provide for the placing of a lot of them in the Great Lakes. They are huge bubbles of metal which float on the water, filled with compressed gas, and their brilliant lamps will burn day and night for more than three months without receiving any attention or replenishment. Before long they are likely to replace lightships to a great extent. A lightship costs $25,000 to begin with and its maintenance comes to $1200 or $1500 a year. One of these buoys can be bought new for $2000 and it may be kept going for $25 a year.

The buoys come from Germany, and a remarkable point about them is that nobody knows how they are made. Imagine a great egg-shaped tank, which serves at once for flotation and to contain the gas. The surface of it is continuous, without a rivet or any sign of joining of parts. How this is accomplished is a mystery, the secret being carefully guarded. It is not only waterproof, but gasproof. The gas which it holds is compressed at six atmospheres – that is to say, at a pressure of about 150 pounds to the square inch. One theory entertained is that the tank is originally a tube and is blown up in some manner like a soap bubble, but this notion can apply correctly to a metal receiver the size of a hall bedroom.

Already five of these buoys have been placed in Massachusetts waters, three in Long Island Sound and along the adjacent Atlantic coast, one off a shoal near Atlantic City, and ten at the northern entrance to Currituck Sound, N.C. The lamps burn from 30 to 120 days without being touched or interfered with in any way. The light they give is always clear, steady and brilliant. The hollow tank, which is anchored, supports a metal tube, at the top of which is the lantern. This lantern is absolutely stormproof. While the air needed to feed the flame is admitted, not a particle of water can enter, no matter how high and violent the sea. Though submerged by waves, the light is undisturbed. It is visible for seven miles in clear weather. When a buoy requires refilling, the compressed gas is fetched in a tank on a scow and is supplied by means of a rubber tube. This novel system has already been adopted by the German and Russian governments and forty of the buoys are now being placed on the waters between Kronstadt and St.Petersburg.

Zebra and Quagga Mussels

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ant threads that allow them to drift again in the currents and find a new surface. Zebra mussels can colonize any firm surface that is not toxic: rock, metal, wood, vinyl, glass, rubber, fiberglass, paper, plants, other mussels. The density of their colonies can reach 70,000-mussels per square meter.

Zebra mussel colonies show little regard for light intensity, hydrostatic pressure (depth), or even temperature when it is within a normal environmental range. Veligers are most sensitive to temperature extremes, juveniles and adults less so. All life stages are sensitive to low levels of dissolved oxygen, particularly as temperature increases. Colonies grow rapidly wherever oxygen and particulate food are available and water currents are not too swift (generally less than six feet per second. Thus, colonies are rare in wave-washed zones, except for sheltered nooks and crevices. In the Great Lakes, they generally colonize hard surfaces up to about 90 feet deep, although they have been reported at greater depths.

Zebra mussels can also colonize soft, muddy bottoms when hard objects deposited in or on the mud – such as pieces of native mussel shells – serve as a substrate (base) for settling veligers. As a few mussels begin to grow, they in turn serve as substrate for additional colonization, forming what is known as a druse.

Quagga mussels can live directly on a muddy or sandy bottom and are more tolerant of low temperatures and extreme depths than zebra mussels. They constitute the majority of mussel populations between 90 and 350 feet.

Zebra mussels can spread from an infested water body to new waters as veligers transported in water or as adults attached to boat hulls, engines, aquatic weeds, scuba gear or other surfaces. Waterfowl and other wildlife can transport veligers and adults in wet fur or feathers. Veligers are small – about the size of the period at the end of this sentence – and may be able to survive in any residual water source.

Adult mussels are very hardy and can survive out of water for extended periods, depending upon temperature, humidity, wind, and sunlight. Maximum out-of-water survival time in ideal conditions is about 10 days for adults and three days for newly-settled juveniles.

Clump of zebra mussels on native clam. Photo by David Jude, Center for Great Lakes Aquatic Sciences

A force of nature

Zebra mussels rank with sea lamprey as the most notorious of the Great Lakes' many invasive species. While lamprey earned their reputation by attacking lake trout at the top of the food web, zebra mussels may radically alter the very foundation of the food web. They obtain their food by filtering enormous quantities of water: each adult filters a liter or more per day. They remove nearly all particulate matter, including phytoplankton (minute aquatic plants) and some small forms of zooplankton (minute aquatic animals), including their own veligers. Instead of passing any undesired particulate matter back into the water, mussels bind it with mucous into loose pellets called pseudofeces that are ejected and accumulate among the shells in the colony.

Zebra mussels stuck on a stick. Photo by S. van Mechelen, University of Amsterdam

By removing significant amounts of phytoplankton from the water, zebra mussels remove the food source for zooplankton, which are

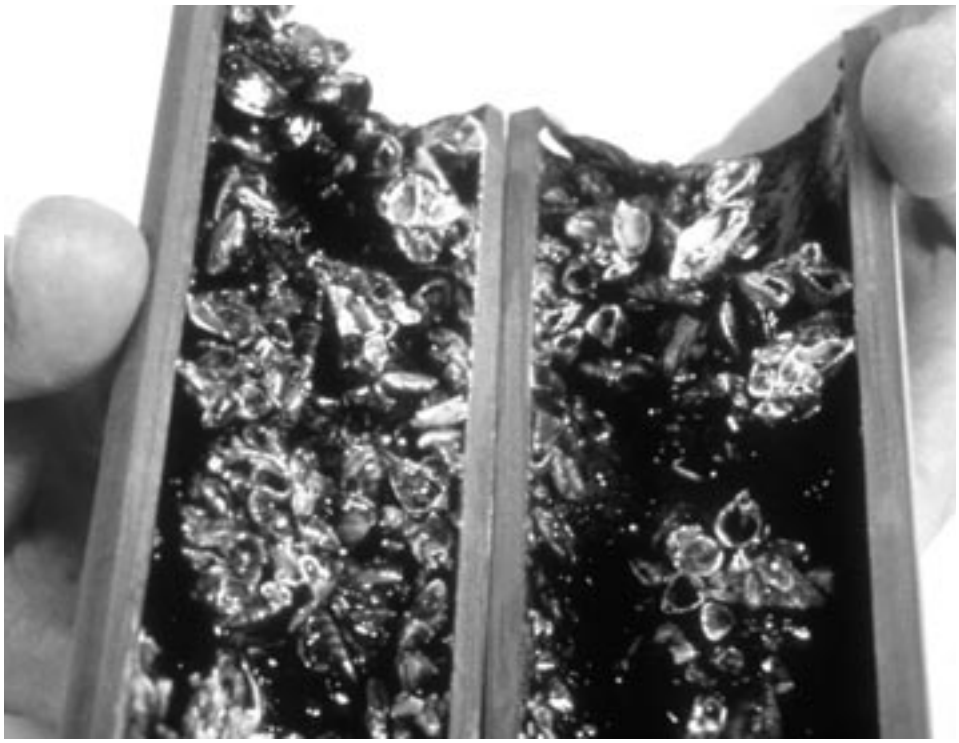
food for larval and juvenile fishes and other plankton-feeding forage fish. These forage fish support sport and commercial fisheries. The full impact of this competition for phytoplankton is not yet known, but many fear it will have long-term negative effects on Great Lakes fisheries. Zebra mussels are primary suspects in the late 1980's collapse of Lake Michigan's yellow perch fishery, which has yet to recover.

Zebra mussels readily encrust native North American mussels, and they have severely reduced populations of some native mussels. Some native mussel species are more tolerant of fouling than others, but even for these resistant species, zebra mussel encrustation leads to reduced energy reserves and vulnerability to other environmental stressors, such as extreme water temperatures, lack of food, or parasites and disease.

The prodigious filtering of water by zebra mussels may increase human and wildlife exposure to organic pollutants (PCBs and PAHs). Zebra mussels can rapidly accumulate organic pollutants within their tissues to levels more than 300,000 times greater than concentrations in the environment. They also deposit these pollutants in their pseudofeces. These persistent contaminants can be passed up the food chain so that any fish or waterfowl consuming zebra mussels will also accumulate these organic pollutants. Likewise, human consumption of these same fish and waterfowl could result in further risk of exposure.

Industrial, commercial, and recreational impacts

The huge economic impact of zebra mussels is equally responsible for their notoriety among exotic species. Their proclivity for hard surfaces and their need to filter water makes water intake structures, such as those used for power and water treatment plants, ideal habitat. They can easily clog these structures, severely reducing pumping capacity and causing shutdowns. The costs of research, control, and public outreach to combat these problems has reached into the billions of dollars.



A 2-inch pipe clogged with zebra mussels. Photo by Don Schloesser, Great Lakes Science Center, National Biological Services

Of course, shipwreck diving and other recreational activities are also impacted by zebra mussels. Unprotected docks, breakwalls, boat bottoms, engine outdrives, and cooling water inlets can all be colonized. The weight of zebra mussels can sink small navigation buoys. The sharp-edged mussel shells along swimming beaches can be a hazard to unprotected feet. The extent of these deposits varies with successive periods of high wave activity.

It must be said that zebra mussels have brought one distinct benefit for divers: increased water clarity. Visibility has increased dramatically in the lower four Great Lakes, making it easier to see shipwrecks and other attractions and to conduct underwater archeological investigations. In southern Lake Michigan, one observer has reported sechi disc readings of about six feet before the invasion and 30 feet after. (This is a standard water clarity measurement. It is the depth at which the black and white sechi disc can be seen in the water.)

However, greater water clarity also allows aquatic vegetation to grow deeper and more densely in some places, sometimes causing taste and odor problems in drinking water. Increased clarity also may affect food webs by altering predator-prey relationships. Many would agree that the total ecological and economic costs of the zebra mussel invasion have been high prices to pay for increased water clarity.

Controlling the problem

Because most shipwrecks are located in open water, lake-wide control of zebra mussels would be necessary to permanently clear them of the pests.

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Zebra and Quagga Mussels

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However, this is not feasible. The European community, after two centuries of infestation, and the Great Lakes community, after more than a decade of infestation, have not been able to develop a chemical toxicant for lake-wide control that is not also deadly to other aquatic life forms.

Control of zebra mussels is currently possible only in localized environments. Control methods include prechlorination, ozone, potassium permanganate injection and sand bed filtration. Prechlorination has been the most common treatment used to date, because it is approved for use by the Environmental Protection Agency; but it also raises concerns about the toxicity of chlorinated compounds to other aquatic organisms. Investigations continue into possible uses of electrical and acoustic shock control measures. Some thermal electric plants currently are experimenting with the diversion of waste heat into intake structures to kill zebra mussels or prevent settlement.

Natural controls

In North America, zebra mussels face few predators. The waterfowl most likely to prey on relatively deep beds of zebra mussels are scaup, canvasbacks and old squaws. But populations of these species are too low to have an appreciable effect on mussel populations. Mallard ducks also are frequently observed foraging on zebra mussels on shoreline rocks and shallow structures.

Freshwater drum, or sheepshead, are known to feed substantially on zebra mussels, and pumpkinseed and yellow perch have been observed feeding on juveniles.

The zebra mussel is now a permanent resident of the Great Lakes, the St. Lawrence Seaway, the Hudson, Ohio, Illinois, Tennessee, Mississippi and Arkansas rivers, as well as other streams, lakes and rivers, which altogether cross 19 states and the Province of Ontario. Twelve new Wisconsin lakes were infested in 2001, bringing the total to 36.

The tiny zebra mussel has caused billions of dollars of damage since it arrived in North America. Photo by Charles Ramcharan, Wisconsin Sea Grant

Theoretically, zebra mussel populations should peak some time after initial infestation and then decline, depending upon predation and upon each water body's carrying capacity. While it is unclear whether populations have yet peaked, it is certain that zebra mussels will continue to play a significant role in the ecology and economy of the Great Lakes region for the foreseeable future.

This article was prepared by John Karl of Wisconsin Sea Grant. Much of it is reprinted from *Zebra Mussels in North America: The Invasion and its Implications*, a fact sheet from Ohio Sea Grant (OHSU-FS-045) by Fred L. Snyder, Maran Brainard Hilgendort, and David W. Garton. The fact sheet is available at http://www.sg.ohio-state.edu/publications/topics/fts-nuisance.html or by calling 614-292-8949.

For More Information

Order Zebra Mussel Watch cards and help friends and family identify and report zebra mussels. Public assistance in reporting sightings at new locations is essential to help prevent their spread to other lakes and rivers. Up to 250 free. Call Wisconsin Sea Grant, (608) 263-3259 or email linda@seagrant.wisc.edu.

Sea Grant Non-Indigenous Species Site – fact sheets, research papers and more: http://www.sgnis.org/

Please Help Prevent the Spread of Aquatic Nuisance Species

The following guidelines are from the intergovernmental Aquatic Nuisance Species Task Force, www.anstaskforce.gov.

Scuba Divers:

Inspect and remove any plants, animals or mud from suit and equipment.

Drain water from bc, regulator, tank boot and other equipment.

Dry your suit and equipment for at least 5 days.

or

Rinse the inside of bc with hot (>104°F) or salted water (1/2 cup per gallon water) and wash your suit in a tote of salted water followed by a clean water rinse.

Boaters/Anglers:

Remove any plants and animals from boat, motor, trailer and equipment.

Drain lake or river water from livewell, bait bucket and bilge.

Dispose of unwanted live bait on shore or in the trash.

Rinse boat and equipment with high pressure, hot water (>104°F), especially if moored for more than a day.

or

Dry everything for at least 5 days.

System of Classification of the Inland Lloyds – 1895

Classes and Grades

Section 1

Vessels shall be classed and graded solely for adjusting the rates of insurance, according to their intrinsic qualities for safe navigation of the Lakes, depending on design, materials, workmanship, equipment and general condition.

Section 2

There shall be two classes, known as A and B, with five grades to A and three to B. The grades are as follows: A½, A1, A1½, A2, A2½, and B1, B1½, and B2. Vessels below B2, considered as uninsurable, to be marked double 00*. These grades are comparable by the following scale of numbers.

A½ = 105
A1 = 100
A1½ = 95
A2 = 85
A2½ = 80
B1 = 70
B1½ = 60
B2 = 50

Years Section 3

The original grade of oak-built vessels shall hold for not exceeding seven years: if not oak-built, five years: if composite with metal decks, or metal shell with double bottom and metal decks, 15 years. The terms thus given are conditioned upon the continuance of the original state and qualities of the vessel.

A½ Section 4

The grade of A½ shall be given to all vessels new built of perfectly sound materials, in strictly workmanlike manner, fully and thoroughly fastened, the scantlings of materials, model and plans, equipment and freeboard, all conforming **to the best general practice on the Lakes**. New vessels not filling these conditions shall be classed and graded to correspond with their merits. Old vessels cannot be restored to A½: and if at any time a vessel holding class in any of the grades shall be found injured, impaired, inadequate or relapsed from any cause whatever, such as dragging the bottom, going ashore, collision, decay, want of new planking, refastening, recalking or other repairs: or losing form and sheer for lack of strength: or feeble in power and incomplete in equipment: or with sails and gear worn out: or repairs made in unworkmanlike manner: or overloaded and therefore unfit and disentitled to hold her class, the same shall be withdrawn or a lower class assigned, unless the disqualification be promptly removed.

A1 Section 5

A1 is the standard grade. The star is added to indicate that the hull is diagonally strapped with iron or steel, from a like band at the heads of the frames to the heads of the floors: or has the ceiling edge-bolted and if two-decked, has upper and lower, with inner and outer iron or steel arches of equivalent and proportionate strength secured to the frames (*) planking and ceiling. Vessels thus strengthened (*) retain original shape and sheer, (*) kept in first-class condition, shall be (*) extension (*) original term.

A1½ Section 6

New vessels not equal to the requirements for A1, but coming within five per cent and all vessels regularly lapsing from that grade shall be classed A1½. When this is not the original grade, its terms shall be three years, providing there is (*) in frame, ceiling or any other part.

A2 Section 7

New vessel's considerably below the

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System of Classification of the Inland Lloyds

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standard for A1, but coming within fifteen per cent in timbering, planking, fastening, outfit and power, all vessels regularly lapsing from higher grades and all rebuilt or largely repaired in a workmanlike manner, shall be classed A2, provided that the fame is free of dry rot or interior decay: that the (*) timbers of the bow and stern does not exceed in depth (*) of the square moulding where (*) and the ceiling is sound except at the back over the affected frames. Vessels lapsing into this grade may hold it until no longer qualified by deterioration, as in section four provided. Vessels restored to this grade by rebuilding, large or essential repairs, shall hold it for five years, if all parts of hull, engine and equipment are kept in good condition.

A2½ Section 8

New vessels twenty per cent below the standard of A1: all vessels regularly passing from higher grades: all rebuilt or largely repaired with inferior materials, soft wood timber, work roughly done, fastening scanted or otherwise not up to A2, shall be graded A2½, provided the frame is free of dry rot or interior decay: that the usual rot on ten timbers forward or aft does not exceed the average depth of one-sixth of the moulding, and the ceiling is sound except at the back. Vessels lapsing into this grade may hold it until disqualified: those restored by rebuilding or repairs shall hold it for five years, if no disqualification presents.

B1 Section 9

New vessels not filling the requirements for either of the preceding grades and coming within thirty per cent of A1 standard: or having very full ends and bad steering qualities: or flat bottom with short knuckle bilges: or scow-formed bow or stern, but frame built with fore and aft planking: or built of defective material: or not fully throughfastened or of poor workmanship, large seams and butts, not caulked full and hard, short shifts of butts and scarphs, stepping of plank or ceiling and light fastening: all vessels regularly lapsing from higher grades: or rebuilt or repaired for restoration but not filling the requirements for A2 or A2½, by reason it may be, of the work being done afloat, the shape not restored, the hull not refastened or recalked: or new timbers put alongside of old or decayed and the new not throughbolted, shall be graded B1: provided that the frame is free of rot, except the usual surface decay forward and aft, and which does not exceed on ten timbers an average depth of one-fourth of the moulding and the ceiling is sound on the face and well caulked. Vessels lapsing into this grade may hold it until disqualified: those restored by rebuilding or suitable repairs shall hold it four years, unless some incompetence occurs.

B1½ Section 10

All vessels in lake trade above 100 tons, with ceiling not properly caulked or wedged: new or sound scows cross-planked in the bottom or ends: vessels unfit from any cause to carry safely full cargoes of grain, coal or ore: or keel dropped at the ends exceeding an inch in sixty feet: or have large seams or butts, or thin, worn planking in the bottom, topsides or decks, or old tender sails, or ten per cent inferiority to the standard of B1: shall be classed B1½: providing the rot on inside frames does not exceed on ten timbers an average depth of one-third of the moulding, and the keelson, bilge, strakes, clamps, deck frame, deck and other essential parts are fairly preserved. Vessels lapsing in this grade may hold it one year, but no longer, unless repairs be made: and those restored to it by reparation, not exceeding three years.

B2 Section 11

All vessels in a fair seaworthy condition, but unfit to hold any of the higher grades, shall be classes B2: providing the rot on the frames, on ten timbers, both sides forward or aft, does not exceed the depth of half the moulding and all the essential parts of the hull and equipment come within ten per cent of B1½, and all timber is sound enough to hold fastening and the state of the caulking is believed to be good for one year.

00 Section 12

The 00 characters shall be assigned to all vessels manifestly too unsound, imperfect, impaired, weak or worn out to express confidence in, although if carefully navigated, they may carry moderate cargoes of wood or lumber.

Section 13

Vessels shall be credited with permanent repairs made in a workmanlike manner, and have the grade raised to correspond with condition under the rules, but credit will not be given for "rebuilding" unless the cost of the same equals two-thirds of new tonnage: nor for "large repairs" unless costing one-third of new tonnage.

Repairs

Section 14

Materials and workmanship for repairs must be equal in quality to the standard for new vessels of the grade to be given.

Short pieces of keel, forward and aft, only allowable below grade of A 2, must overlap the deadwood ends

five times the siding size besides the scarph. Keels worn off but not split, not exceeding two inches of depth, may be repaired for any grade by trimming off fair with plank, clenching or refastening, and spiking on a shoe.

Stems may have fore-foot pieces: but lower pieces of stem proper, for vessels of class A, must be scarphed above the bob stays. Also, for this class, sternposts and masts must not be spliced. Scarphed rudder stocks disallowed in all grades.

Patch planking cannot be approved on vessels of class A, but defective planks must be removed from butt to butt, and replaced in whole length. Not more than two graving pieces shall be put in one plank, nor (*) thickness pieces from seam to seam outside in the bottom or bilge.

When frame timbers are to be replaced, for class A, they must be wholly removed, unless the proper lap can be made. New pieces to be well fitted to planking and securely bolted in place. If any of the floors are affected, the keelson must be removed that they may be properly renewed. The old fastening must be backed or drawn out and the holes used for new bolts or spikes. Where the old timbers have the rot cut off and patches or chocks put on: or if they remain and new pieces are put alongside: or if two short laps be made: or if the ceiling be not worked close down upon the timbers to which it is fastened: the grade assigned will not be above B1.

New center-boxes may be built upon old headledges or keelsons, if inspected and approved before the work is done. When center-boxes cannot be made tight to withstand the sea in gales of wind, they must be condemned for all grades. If removed from vessels above B1½, a piece of keel and proper floor timbers should be put in.

New beams must fit close at the ends and may be in two parts, if long lapped in the middle, keyed and well fastened.

New fastenings are required in any part of a vessel where the old is insufficient, or have been strained and become leaky. Where spike and bolt heads have to be caulked around, refastening is necessary.

All component parts that have suffered from age, wear, decay, accident or other cause, and, in vessels of A2 and higher grades, shall be found to have less than seven-eights, and in all other grades less than three-fourths of the thickness and strength required for a new vessel of the same dimensions, must be renewed or resupplied.

When vessels are rebuilt or have large repairs, or such improvements as to call for reclassification, their owners, masters or agents should notify the manager of Inland Lloyds, that he may cause timely visits of inspection, and know in what manner the work is being done, otherwise the merited grade may not be given. Any vessel receiving a promotion of class, of two or more grades, must have the caulking of the entire hull newly done, or in perfect condition, and equipment adequate and in order.

Pumps and Pipes

Section 15

Vessels from twenty to 150 tons to have two single or one double pump: those from 150 to 350 tons to have two double pumps, one forward and another aft: and those over 350 tons to have three double pumps, the third amidships, and of size in proportion to the manning ability of a full crew. All pumps to be cased, and all vessels under 400 tons to have one pump-well aft, and all larger vessels to have a second pump-well forward: and all pump-wells to be at least twenty-two inches square inside, and fitted with a slide gate at the bottom to be opened from the deck. Hawse pipes, scuppers, closet plumbing and pipes of every kind having outlet through the hull, to be passed through chocks of wood, or their equivalent, placed for the purpose between the frames. And all water closet pipes discharging under water to be tightly cased to prevent leakage from accidents.

Gangways, Ports and Hatches

Section 16

Steamers with main deck gangways must have outer and inner shutters, both well fitted with bars.

Vessels having timber ports in the bow or stern, below the main deck, or lumber ports in the sides wholly under the clamps, with butts of planking and ceiling properly shifted to preserve the strength, may be classed as high as A2, but otherwise not above B1, until the cutting is compensated.

Hatches over six feet in length or breadth, to have removable beams for middle supports to the covers and over eight feet fore and aft is disapproved for grades above B1½.

Ground Tackle and Hawsers

Section 17

All vessels shall have anchors, chains and hawsers as specified in the Table following. The length of each chain for vessels exceeding 400 tons to be ninety fathoms: and for all other vessels seventy-five fathoms. Anchors and chains may be equal in weight and size for any vessel above 500 tons. The length of hawsers for vessels of less than 400 tons to be eighty fathoms and for larger vessels 120 fathoms.

Sail Power

Section 18

All cargo-carrying steamers navigat-

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System of Classification of the Inland Lloyds

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ing the Lakes should have masts and rigging, and spread sufficient sail to be helpful in times of danger: and all vessels towed by steamers, in order to be classed in any of the grades, must have sufficient sail to make a port or place of safety in case of being cast adrift.

Section 19

All vessels must have one or more boats, sufficient to carry the crew safely, and not less than two compasses with the charts of the waters to be navigated. And any vessel not carrying a full crew is liable to have her class withdrawn.

Section 20

All vessels, to maintain classification, must preserve the freeboard assigned in the register by the manager of Inland Lloyds. The freeboard of a vessel is one of her qualities or powers the same as her strength or tightness. Without it she is unseaworthy, and neither class nor grade is ever given except upon the condition of its continual presence, whether light or loaded.

Section 21

When in commission, all vessels must have every part of the hull and equipment in perfect sea-going order, and not overloaded, or the class may be withdrawn, since the holding of class depends entirely upon the confidence that may be induced by the good qualities, the ability and condition at all times. And it is to be distinctly understood that the classification of a vessel is only the expression of an expert opinion for the guidance of such underwriters as contribute to the compilation of the Register, and is not intended as a criterion for the appreciation, purchase, sale or chartering of vessels, or for any public purpose.

*Unfortunately, some words in the original of this article were not legible. These are designated with an asterisk *.*

Minimum Sizes of Chains, Anchors and Hawsers for Lake Vessels

(Weight of Anchors exclusive of wooden stocks)

Register tonnage	**100**	**125**	**150**	**175**	**200**	**250**	**300**	**350**	**400**
Best Bower Chain	3/4	13/16	7/8	15/16	1	1 1/16	1 1/16	1 1/8	1 3/16
Best Bower Anchor	550	650	775	875	1000	1150	1300	1450	1600
2d Bower Chain	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16	1 1/16
2d Bower Anchor	325	425	525	600	675	850	1000	1100	1225
Hawser	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4	6	6 1/4
Weight of both Anchors	875	1075	1300	1475	1675	2000	2300	2550	2825

Register tonnage	**450**	**500**	**550**	**600**	**650**	**700**	**750**	**800**	**900**
Best Bower Chain	1 1/4	1 5/16	1 5/16	1 3/8	1 3/8	1 7/16	1 7/16	1 7/16	1 1/2
Best Bower Anchor	1725	1850	1975	2100	2200	2275	2400	2475	2650
2d Bower Chain	1 1/8	1 1/8	1 3/16	1 3/16	1 1/4	1 5/16	1 5/16	1 5/16	1 3/8
2d Bower Anchor	1325	1425	1525	1600	1700	1800	1850	1950	2050
Hawser	6 1/2	6 3/4	7	7 1/4	7 1/2	7 3/4	8	8 1/4	8 1/2
Weight of both Anchors	3050	3275	3500	3700	3900	4075	4250	4425	4700

Register tonnage	**1000**	**1100**	**1200**	**1400**	**1600**	**1800**	**2000**	**2200**
Best Bower Chain	1 9/16	1 9/16	1 9/16	1 5/8	1 11/16	1 11/16	1 3/4	1 7/8
Best Bower Anchor	2850	2950	3050	3250	3400	3525	3600	3750
2d Bower Chain	1 3/8	1 7/16	1 7/16	1 1/2	1 1/2	1 9/16	1 9/16	1 3/8
2d Bower Anchor	2175	2300	2400	2600	2750	2875	3000	3100
Hawser	8 3/4	9	9 1/4	9 1/2	9 3/4	10	10	10
Weight of both Anchors	5025	5250	5450	5850	6150	6400	6600	6850

Ghost Ships 2002

Ghost Ships 2002 will be held at the Clarion Hotel and Conference Center in Milwaukee on Saturday, March 16, 2002. Sixteen different presenters will be scheduled for a variety of films, seminars, classes and talks.

There will be numerous booths and displays from presenters, equipment manufacturers, dive shops, historical societies, authors, documentary producers and dive clubs all around the Great Lakes.

The Ghost Ships 2002 Raffle will be held at two separate times during the festival to ensure that everyone has a chance to win something. Ticket holders will need to be present to win.

Proceeds from the Ghost Ships are used to support maritime programs.

Directions & Reservations

This year's Festival will be far easier to get to and to park at than in previous years. The Clarion Hotel and Conference Center is located on South Howell Avenue just across from Mitchell field and is easily accessed from I-94. Parking is available in the hotel lots at no cost.

Clarion Hotel & Conference Center
5311 South Howell Avenue
Milwaukee, WI 53207

Call toll free: 1-866-481-2400
Phone: 414-481-2400
Fax: 414-481-4471

Be sure to mention that you are with the Ghost Ships Festival to receive the Festival Discount. Do not use the Clarion online reservation system or the Clarion national 1-800 number to make reservations, or you will not be able to get the Festival Discount.

Tickets & Contacts

Tickets may be ordered at the web site: www.ghost-ships.org. Prices for Ghost Ships 2002 are:

1 - 5 tickets: $20/ea
6 - 10 tickets: $18/ea
11 - 20 tickets: $15/ea

Tickets at the door will be $25/ea

Inquiries regarding the festival program, booths or displays should be made to: Kimm Stabelfeldt at kimms@ghost-ships.org, phone (262) 317-2360.

Inquiries regarding lodging and accommodations should be made to: Bob Jaeck at jaeck@ghost-ships.org.

Inquiries regarding the festival program, grants and grant proposals should be made to: Brendon Baillod at bbaillod@ghost-ships.org, phone (414) 403-3240.

The mailing address for the Foundation is:

Great Lakes Shipwreck Research Foundation, Inc.
7844 St. Anne Ct.
Wauwatosa, WI 53213