

### Coming Events

September 12-14, 2002 **Association for Great Lakes Maritime History Annual Meeting**, Michigan Maritime Museum, South Haven, MI. For information check their web site at [www.aglms.org](http://www.aglms.org).

October 12, 2002 **Wisconsin Underwater Archeology Association Fall Meeting**, Madison, WI. For information contact Russ Green at 608-271-8172 or [rtgreen@whs.wisc.edu](mailto:rtgreen@whs.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

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## The Impacts of Zebra Mussels on Shipwrecks

by John Karl

In the March issue of *Underwater Heritage*, we discussed some basic biology of zebra mussels and their invasion into the Great Lakes. Here we'll focus on issues of more direct importance to divers and underwater archeologists: Can zebra mussels be cleared from shipwrecks without damaging the wreck itself or the aquatic environment? Do zebra mussels cause long-term harm to shipwrecks? What other consequences are there when the prolific mollusks completely encrust shipwrecks? It appears that only three studies have addressed these questions. We'll briefly review each of them.

### Canadian government studies

In 1995, Parks Canada and the Ontario Ministry of Citizenship, Culture and Recreation began a multi-year study on the impacts of zebra mussels on submerged archeological

resources and on the effects of various means of removing mussels from shipwrecks (Binnie, 2000).

Over a two-year field season, the project team conducted tests of chemical and physical removal methods. They looked at a variety of tools and chemical compounds, and assessed how they affected the wood and metal of shipwrecks in the Fathom Five National Marine Park in Lake Huron's Georgian Bay and in Deadman Bay, Lake Ontario (near Kingston).

*Physical removal methods.* For the physical tests, they used gloved hands, surgical scalpels, dive knives, garden tools like trowels and hoes, several types of high-pressure water jets and various kinds of combs to lift the mussel shell and byssus (the group of threads that attaches a mussel to a surface) off the shipwreck.

Divers attempted to apply these tools to the byssi or shells only, not

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*A diver inspects a shipwreck part wrapped in tarp to deprive zebra mussels of nutrients. Photo courtesy of Canadian Conservation Institute*

## Underwater Preservation in Wisconsin

by Bob Korth,  
WUAA Director

June 2nd 1969, a gentle swell on Lake Michigan rocks an 18 foot boat cruising a few miles off Two Rivers, Wisconsin. Two divers line up land marks on the distance shore and a Vexlar recording sonar, tracks the bottom looking for the remains of the 500 ton, 180 foot Schooner, *Rouse Simmons*, she sank in this area carrying Christmas trees in 1913.

The sonar traces a flat sand bottom then a black bump stitches across the paper as a object rises off the bottom ... the tell tale sign of a wreck. A grappling hook, goes over the side and in a short time the boat is anchored. The divers suit up and follow line to the three masted schooner below. Hand over hand down the line and shortly they are on the deck and in the few minute of bottom time they methodically go about the business of remove pulleys and picking up a few other artifacts in the galley. Time is short, they head back to the



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# Wisconsin Underwater Archeology Association

## Spring Meeting

The spring meeting of the association was held on Saturday, May 11, 2002, at the Door County Maritime Museum in Sturgeon Bay.

The meeting followed a tour of the Palmer Johnson and Bay Shipbuilding facilities in Sturgeon Bay.

President Russell Green called the meeting to order. The treasurer, Tom Villand reported a balance of \$3850. The workshop at Superior on November 10, 2001 earned \$536. Our thanks go to Mrs. Pat Labadie for preparing the meal.

Russell Green reported that due to the State of Wisconsin budget situation, most of the Historical Society's

field work for this coming season is up in the air.

Work is continuing on the Maritime Trails. This includes applications for buoying six historical shipwrecks, working on a poster of the *Fleetwing* wreck to be posted on shore close to the wreck site and nomination of a twelve stone ships for historical preservation.

Tom Villand needs help in researching the dam on the Yahara River by Madison.

The final mapping of the *Christina Nielson* wreck could be completed by the association this summer.

Dick Boyd reported on his research into the legends of the Poverty Island treasure and the Rock Lake pyramids.

Cathy Green reported that a new WUAA brochure is being completed.

The fall meeting will be held Saturday October 12, 2002 in Madison with either a tour of the Historical Society archives or the conservation laboratory.

**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.

**Send correspondence to:**  
WUAA  
PO Box 6081  
Madison, WI 53716  
**email:** [wuaa@mailbag.com](mailto:wuaa@mailbag.com)  
**website:** [www.mailbag.com/users/wuaa/](http://www.mailbag.com/users/wuaa/)

**President**  
Russ Green  
Madison, 608-271-8172

**Vice-President**  
Hank Whipple  
Madison, 608-245-1222

**Secretary**  
Russel Leitz  
Oshkosh, 920-231-9082

**Treasurer**  
Tom Villand  
Madison, 608-221-1996

**Newsletter Editor**  
Danny Aerts  
Middleton, 608-821-0048

**Activities Coordinator**  
Cathy Klecker  
Marshall, 608-655-3769

**Website Manager**  
Colin Zylka  
Waukesha, 262-524-0145

**Directors**  
Richard Boyd  
Delafield, 414-464-2092

Robert Korth  
Gresham, 715-787-4444

Janet Defnet  
Mukwonago, 414-363-9874

Jeff Gray  
Madison, 608-271-1382



*Part of the steamship Mueller is on display at the Leathem & Smith Quarry.*  
Photo by Tom Villand

*WUAA member takes a break during the shipyard tour in Sturgeon Bay.*  
Photo by Tom Villand



## New WUAA Shirts

Just in time for summer, new WUAA shirts are now available. Tastefully designed, with the multi-colored WUAA logo on the front breast pocket area, the shirts come in a variety of styles and sizes. There are white short-sleeved t-shirts and navy long-sleeved t-shirts from medium to XXLarge. The short-sleeved shirts are only \$8.00, while the long-sleeved shirts are a mere \$12.00. Support WUAA, while enhancing your wardrobe. Look for them at the next WUAA event.

For t-shirt orders or information call Cathy Green at 608-271-8172, email her at [cmgreen@whs.wisc.edu](mailto:cmgreen@whs.wisc.edu) or send a check with your order to:

Cathy Green  
WUAA T-Shirts  
P.O. Box 6081  
Madison, WI 53716

Be sure to include your current address, so we can send them to you. Order early to ensure your size is available.

## Jeff Gray Leaving WHS

Jeff Gray, the state underwater archeologist, will be leaving the Wisconsin Historical Society. In July, he will take over as director of NOAA's Thunder Bay Marine Sanctuary in Michigan.

Jeff was a past president of the Wisconsin Underwater Archeology Association and we wish him well at his new position.

## Zebra Mussels on Shipwrecks

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directly to the wreck surface. Despite these efforts, the studies showed that most tools damaged the surface of the wreck. Divers found it difficult or impossible to avoid scraping the wreck surface because it was often obscured by the mussels and the attachment mat.

All the trials using high-pressure water jets resulted in damage to wood or corroded surfaces. Chunks of wood were blasted away even when the jet was aimed across the surface, not directly at the surface.

The tool that caused the least damage was the scalpel. Divers could manipulate it most precisely, cutting the mussels' byssal threads with minimal damage to the wreck surface. However, this method was also among the most laborious.

Other physical removal methods often left the byssal threads attached to the mussels – and pieces of metal and wood from the wrecks attached to the byssal threads. Thus, repeated removal of mussels could cause significant damage to metal parts, according to Nancy Binnie, a conservation scientist at the Canadian Conservation Institute in Ottawa who worked on the project. "If you remove them from corroded metal surfaces, you do actually pull away the corro-

sion on the surface, which can induce accelerated active corrosion on that surface again," Binnie said.

The study found the same thing with wood: pulling zebra mussels off wood surfaces, particularly if they are highly deteriorated, can tear off large chunks of wood with the mussels.

In general, the study concluded that physical removal of zebra mussels causes too much damage to wrecks to be used on a regular basis. "We definitely are telling people, 'don't scrape off zebra mussels,'" Binnie said.

*Chemical removal methods.* The study also looked at the possibility of using various chemical compounds to kill mussels on shipwrecks. The project team recognized from the outset that chemical control of zebra mussels is impractical in open water situations for many reasons. However, they write that, "it was considered necessary to test the feasibility and effects of certain methods at the shipwreck site on a small scale because information on many types of chemical removal strategies is widely available to the public, and reasonable arguments must be formulated in order to discourage their use."

The removal trials assessed salt, bleach and "pool pucks" (trichloro-s-triazinetrione), which generate chlorine as they dissolve in water. The trials involved enclosing mussel-encrusted timber sections in large plastic bags. Small quantities of chemicals were then placed inside for three weeks.

These methods were highly effective at killing zebra mussels and at making them easy to remove. The dead mussels could be removed by

*A diver inspects an experiment on using chemicals to remove zebra mussels.*

*Photo courtesy of Canadian Conservation Institute*

light hand fanning over them without disturbing most surfaces or sediment. However, the study concludes that they are not practical because of the many "undetermined effects on construction materials, and difficulties in preventing leakage of the chemical into the surroundings and subsequent non-target effects." The authors note other problems as well: the compounds may injure or kill other organisms besides zebra mussels; they may be difficult to contain in the desired location; it may be difficult to maintain sufficient concentration to achieve desired mortality; it may be difficult to ensure neutralization of the compounds before removing the barriers; and regulations and general safety concerns may prohibit their use.

"Chemicals do work, but you would never want to use them on an open site," Binnie emphasizes. "You take out every species with them, not just zebra mussels."

Binnie also notes that the chemicals may increase rates of degradation of the shipwreck materials, accelerating corrosion and other processes.

*Nutrient Deprivation.* The project also assessed the effectiveness of wrapping entire wrecks or portions of wrecks in tarps or plastic bags to cover zebra mussel colonies for several months and deprive them of nutrients.

These methods were found to be highly effective, killing all of the mussels in the treatment area and not harming even delicate parts of shipwrecks. As with the chemical removal methods, dead mussels could be removed by light hand fanning. "The byssal threads may remain securely attached to the surface, but this will not create a problem for most archeological recording activities," the researchers wrote.



Despite the effectiveness of these methods, project reports note several practical disadvantages. They are labor intensive, and they may require a long lead time if the water is cold and metabolic rates are slow. Also, wrapping an entire wreck prohibits access to it while the tarp is in place. Finally, zebra mussels will re-colonize the wreck the following year.

In ongoing work, the project is assessing the deterioration rate of wood subject to zebra mussel colonization.

**Conclusions.** The study concluded that zebra mussels should be removed from shipwrecks only when absolutely necessary for archeological study or diagnosis. In these cases, physical removal methods would often be most practical, even though they are slow and can somewhat damage the wreck surface, the authors wrote. Such methods should be used only when necessary, and only on small scales to reveal highly diagnostic features that must be measured or photographed.

These studies did not find evidence that zebra mussels actively degrade metal surfaces on shipwrecks. However, studies by another group in Lake Champlain suggest otherwise.

### Lake Champlain studies

Art Cohn has worried about the effects of zebra mussels on shipwrecks since they invaded the Great Lakes in 1988. Cohn directs the Lake Champlain Maritime Museum in Vermont. He touts Lake Champlain, which runs for 120 miles along the northern border of Vermont and New York, as "arguably the best preserved collection of historical wooden ships in North America."

In 1998, concerned about the effects zebra mussels might have on these historic resources, Cohn and Mary Watzin, a biologist and director of the Rebenstein Ecosystem Science Laboratory at the University of

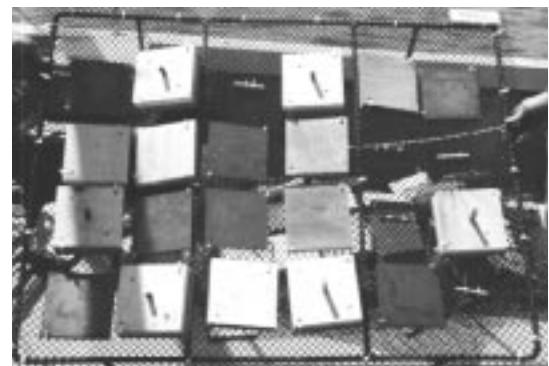
Vermont, launched a six-year study of the effects of zebra mussels on shipwrecks. As of this writing, results from the 1999 and 2000 field season are available (Watzin, 2001, 2002).

**Water sampling.** A major part of the study focused on determining whether zebra mussels increase the corrosion rate of metal fasteners on wooden ships. To get at this question Cohn, Watzin and their colleagues sampled the water above the six wrecks to measure levels of dissolved iron. The idea was to compare iron concentrations above mussel colonies to points above the wrecks that were free of mussels. Higher levels of dissolved iron above the colonies than above the mussel-free portions of the wrecks would indicate that the mussels are causing the iron fasteners to corrode. In both kinds of locations, water samples were taken at 0, 2, 4, 10 and 20 cm from the surface of the wreck to allow the researchers to detect a gradient of iron concentrations.

Analysis of the samples showed that water above the mussel colonies did in fact contain more dissolved iron than the water above the mussel-free portions of the wrecks. They also showed that the concentrations of iron were highest close to the wrecks and they decreased away from the wrecks. Such diffusion would be expected if the source of the iron is the zebra mussel colonies.

These findings strongly suggest that the dissolved iron is coming from the zebra mussel colonies, and thus from the iron fastenings to which they are attached, Watzin and Cohn argue. The researchers note, however, that these studies do not offer information on the rate of corrosion. Ongoing studies will assess these rates.

*Settlement Experiments.* Cohn and



*A settlement table with wood and metal substrates before deployment.  
Photo courtesy of Lake Champlain Maritime Museum*

Watzin also conducted experiments to quantify rates of zebra mussel colonization on materials typical of those found on shipwrecks in the lake. The team set out six "tables" of mesh wire at each wreck, to which blocks and rods of various materials were attached. The materials included hard wood (white oak), soft wood (white pine), wrought iron recovered from Lake Champlain, hot-rolled steel and polyvinyl chloride (PVC), a standard monitoring material. They are recovering one table from each wreck per year, for six years.

So far they have pulled up tables for two years. They found that zebra mussels settled on all of the plates, but the largest number settled on the wrought iron and steel rods. The fewest mussels settled on the hot-rolled steel plates.

Most of the plates and rods on the tables showed general corrosion and pitting of up to 1.0 mm deep. The researchers noted that the length of their reporting period was insufficient to allow an estimate of the rate of corrosion.

The researchers also looked for evidence that zebra mussels are enhancing reduction reactions, which produce faster corrosion than oxidation reactions. They found only slight evidence of reduction reactions.

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## Zebra Mussels on Shipwrecks

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However, they suspect these reactions will increase in prominence over time.

**Conclusions.** The study to date "strongly suggests that zebra mussels are accelerating the corrosion of the iron fasteners and fittings on the submerged shipwrecks in Lake Champlain and probably elsewhere as well," the authors write.

The implications of these findings for the structural integrity of the wrecks are still not clear, the report said. "Because of the patchiness of the chemical environment and the large array of biological processes and chemical reactions at work, additional research is necessary to project an iron loss rate."

However, the findings to date clearly suggest that zebra mussels are having more deleterious effects on shipwrecks than merely obscuring their construction details from view.

"If wooden ships on the bottom of Lake Champlain are primarily iron fastened, and the fastenings contribute to the vessels' structural integrity, it follows that anything which might affect that integrity could significantly affect the projected life-span of these cultural resources" Cohn said.

### Concentrating toxic metals

A third study looked at whether zebra mussels concentrate toxic metals near shipwrecks. Because each mussel filters up to a quart of water per day, there has been some concern that their waste and pseudofeces may contain elevated levels of trace contaminants.

Three scientists from the department of Earth Sciences at the University of Windsor sampled the sediments surrounding five mussel encrusted shipwrecks in western Lake Erie, when the ErieQuest Marine Heritage Area was being developed (La Valle, 1999).

The study found that all of the shipwrecks were contaminated with arsenic, cadmium, chromium, copper, lead, nickel, vanadium and zinc. At four of the wrecks concentrations of lead, nickel, vanadium and zinc exceeded Canadian Council of Ministers of the Environment (CCME) standards on the concentrations of toxic metals in soils and sediments. Sediments at three wrecks also exhibited concentrations above CCME standards for cadmium or copper.

At one wreck, which lies close to shore in an area of strong currents and ice action, no metals exceeded

CCME standards. The researchers suggest this is because the currents break down and resuspend the particulate matter containing the metal and because the ice action removes some

particulate matter, reduces the number of mussels on the wreck and scatters the wreck pieces.

The study report concludes, "Without doubt, those responsible for promoting marine parks and diving tourism must become fully cognizant of the role of zebra mussels in depositing sediments which are contaminated with heavy metals." However, the report does not discuss the degree to which divers are exposed to those metals under normal diving conditions. ■

*Note: A more detailed version of this article will soon be available at [www.seagrant.wisc.edu/shipwrecks](http://www.seagrant.wisc.edu/shipwrecks).*

### References

Binnie, Nancy E., Engelbert, Peter, Murdock, Lorne D. and Moore, Jon. *Shipwrecks, Archaeology and Zebra Mussels: Is Mussel Attachment a Threat to Our Submerged Cultural Resources?* Proceedings of the 10th International Aquatic Nuisance and Zebra Mussel Conference, Feb. 13-17, 2000, Toronto.

La Valle, Placido D., Brooks, Andre w and Lakhan, V.C., "Zebra Mussel Wastes and Concentrations of Heavy Metals on Shipwrecks in Western Lake Erie." *Journal of Great Lakes Research*, 25(2):330-338, 1991.

Watzin, Mary C., Cohn, Arthur B., and Emerson, Brian P., *Zebra Mussels, Shipwrecks and the Environment*, May 2001.

Watzin, Mary C., Cohn, Arthur B. and Lescaze, Miranda M., *Zebra Mussels, Shipwrecks and the Environment: Final Report*, January 2002. Lake Champlain Maritime Museum.



*Researchers inspect a settlement table retrieved after two years of submersion.*  
Photo courtesy of Lake Champlain Maritime Museum

## Underwater Preservation

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surface with the "prizes". A few hours later at a marina in Manitowoc they share their story and show their treasures to curious onlookers.

This was a common scenario around the Great Lakes in the late 50's and on into the early 80's. It seemed the reasonable thing to do. The new SCUBA equipment opened up a whole world of possibilities. With the proper equipment one could actually locate those ghost ships that had disappeared with little trace. For those that were a bit daring, there was adventure to be had, and a treasure to discover.

Now ... if you were going to stick the time and effort into finding a shipwreck it made since that you would bring back proof that you were there. Dive business promoted wreck diving. Shipwrecks were exciting and a great way to keep people diving locally instead of just trips to salt water. Some divers made and sold furniture out of wreck parts, others sold artifacts, and the business was booming.

Something started to change. Some time in the late 70's a few divers started to rethink the philosophy of wreck diving. The great wrecks in shallow water were starting to disappear, item by item board by board, artifacts and ship parts were rotting away in back yards and crumbling in basements. Divers started to recognize that Great Lakes shipwrecks were a priceless time capsule and heritage of another era. In 1985 with support from divers and historians Ester Walling proposed a bill that would protect our marine heritage. In 1988 Congress passed the Abandoned Shipwreck Act. Times were changing, over the next decade a fundamental change in why we dive on shipwrecks came to pass. For the

most part new divers and more importantly veteran divers changed their ways.

In 1988 Wisconsin got its first Underwater Archeologist. David Cooper. In 1991 Larry Swoboda sponsored a bill to create the state Submerged Cultural Resources Council. Also in 1991, the Wisconsin Underwater Archeology Association was formed at a meeting in Oshkosh. All of these great achievements happened because of the dedication and vision of citizen volunteers ready and willing to give of their time and talents to preserve some things they believe in ... Wisconsin and Great Lakes Marine Heritage.

Little by little, bit by bit these folks, divers and non-divers made a difference on a shoe string budget. Giving Wisconsin one of the best Underwater Archeology programs in the nation. Wisconsin's Marine culture is more than a historical curiosity and a sailor on the state flag. At least three Marine Museums in Sturgeon Bay, Manitowoc and Superior have thousands of visitors each year. Volunteers have helped inventory and survey many underwater sites. Many wreck sites are now marked by permanent mooring buoys. A student reader and teachers guide called *Working With Water: Wisconsin Waterways* was developed. A series of Maritime trails is being developed to interpret the submerged resources of various areas in the state. Workshops have been held on subjects like wooden ship construction and the development of the steam engine. Lectures by distinguished maritime historians have been sponsored throughout the state.

Low pay, long hours and limited state support have not been conducive to keeping people in the posi-

tion of underwater archeologist. We have been fortunate in Wisconsin to have had some remarkable, hard-working underwater archeologists, David Cooper was replaced by Jefferson Gray, and now Jeff will be handing the reins to Russ and Cathy Green. All of them give high marks to WUAA members. They understand that citizen support carries on the group memory and can assure the program has continuity and continues.

We can not rest on our laurels, the State budget took a incredible down turn over the past year and budgets are being cut to make up for the loss of state revenues. The language of politics is the language of dollars and strong lobbies. Those programs with little citizen support are the first to feel the pinch. In most cultures the arts and history are the first to go. Wisconsin is no exception.

If we care about the legacy that we hand on to future generations, we need to be advocates for the work of underwater archeology, speaking up and looking for support. If we don't ... all these years of work could disappear much like a great ship in a November squall. We need to gather together the evidence that supports the importance of this work, we need to tell our story to any and all that will listen, neighbors, politicians and the general public.

Shipwrecks and underwater sites are the perfect vehicle for telling our stories. Unbelievable stories, of bravery, danger and mystery, stranger than fiction. When the people of this great state hear the stories, and feel the excitement that unraveling the mysteries an ancient ship can bring they will appreciate it, support it and join our work. ■

## Zebra Mussels, Eurasian Water Milfoil Spread to More Lakes

From an Associated Press story in the *Wisconsin State Journal*, May 28, 2002.

Zebra mussels and another exotic pest, Eurasian water milfoil, have spread to more inland lakes in Wisconsin after hitching rides on boats pulled out of previously infested waters, a state official says.

"They can't fly," said Don Martin, coordinator of the aquatic invasive species control program for the state Department of Natural Resources. Martin said zebra mussels that were once limited to Great Lakes waters spread to 26 inland lakes last year and now are in 32 lakes.

The Eurasian water milfoil plant was found in 18 more lakes, raising its total to 351.

Both species multiply rapidly, choking out native species.

Eurasian water milfoil, a native of Europe, Asia and northern Africa, is a plant that grows into dense mats of vegetation. DNR employees went to some public boat launches over the weekend to tell boaters how to block the spread of the exotic species.

The message is to pump water from bilges, drain water from engines and other containers and clean boat hulls and trailers before leaving launch ramps, Martin says.

Under a new law, it is illegal to launch a boat in any of the state's navigable waters if an aquatic plant or zebra mussel is attached to it. Violators could pay \$50 for a first offense and \$100 for a second.

The eight additional lakes where zebra mussels were found in 2001 are: Elizabeth lake in Kenosha coun-

ty, Little Cedar in Washington county, Ellen and Crystal lakes in Sheboygan county, Metonga in Forest county, Cedar in Manitowoc county, Long in Fond du Lac county and Crooked in Waukesha county.

The 18 new lakes with Eurasian water milfoil are: Forest, North Twin, South Twin, Cranberry, Lynx and Upper Gresham lakes in Vilas county; Lulu in Shawano county; Mohawksin in Lincoln county; Kidney in Barron county; Big Elkhart in Sheboygan county; Bughs and Pine lakes in Waushara county; and Partridge Crop, Lime Kiln, George, Columbia, Taylor and Stratton lakes in Waupaca county.

## X-Ray of Shipwreck Could Save Artifacts

From *Mechanical Engineering*, May 2002.

In 1628, the Swedish warship *Vasa* sank a mere 4,265 feet into her maiden voyage. Merchant vessels of the day were stabilized by the weight of cargo in their holds, but warships carried their cargo – heavy guns – higher up. Although 122 tons of stone had been stowed low in the *Vasa* as ballast, it wasn't enough to counter the weight of the ship's upper hull, three masts, 10 sails and 64 guns. The ship leaned too far and water poured through her open gun ports. She remained at the bottom of Stockholm harbor for 333 years.

In 1961, the *Vasa* was raised in good condition and, after extensive treatment to stabilize and dry the timbers, was put on display in 1990 at the Vasa Science Museum in Stockholm. In 2000, conservators

noticed that powdery salts were rapidly forming on her surfaces and that the wood in her holds was growing soft and acidic. In short, the ship was disintegrating.

Collaborators in Sweden and at Stanford University in Stanford, California have since analyzed the chemistry of wood decay in the *Vasa*, using a new technique – x-ray absorption spectroscopy. It employs high-energy synchrotron beams, produced when electrons accelerate around rings, to make chemical fingerprints that identify different oxidation states in a sample. The team's findings may help conservators worldwide preserve wooden artifacts retrieved from the ocean.

The problem is formation of corrosive sulfuric acid inside wood beams. The *Vasa* had sunk to 105 feet and

the dearth of oxygen there inhibited wood-metabolizing microbes. But the environment favors bacteria that convert sulfate ions in seawater to hydrogen sulfide. In the hundreds of years the *Vasa* was submerged, hydrogen sulfide penetrated the deepest layers of the wood. Under the sea, chemical reactions turn hydrogen sulfide into elemental sulfur or pyrite, depending on the amount of available iron ions.

The researchers found that sulfur had accumulated within the beams and that half had already been oxidized. Based on their findings, they recommend strict regulation of a wooden marine artifact's environment, including a relative humidity of 55 percent and a temperature of less than 68°F.

## ***Denis Sullivan* Tours**

Here's a different kind of wreck dive; an opportunity to see a traditional three masted schooner in action, in fact, to be part of the action.

### **Embracing our Past – Educating for our Future**

Sail in Lake Michigan and beyond. Come out for the opportunity to feel the wind against your face, haul a line like a traditional sailor, take a turn at the wheel of an historic Great Lakes schooner, learn about our GREAT Lake Michigan, or just relax and enjoy! Get a taste of the sailing lifestyle with our three hour sail, or experience one of our Overnight Adventures!

Three-hour public sails are offered at numerous times between May 1 and September 30. Sailing aboard the *Denis Sullivan* gives you and your family or friends the opportunity to share a unique experience. While aboard you will be able to participate in raising sail, take a turn at the helm, tack through the wind, learn

something new, or simply relax, unwind and sail!

Activities while underway could include hands-on learning stations about Lake Michigan water quality (sampling & analysis), Lake Michigan biological systems (zooplankton tow & examination), local ecology (weather data collection & analysis) or marlinespike seamanship (knot tying, block & tackle systems).

Discussion periods could focus on Wisconsin Maritime History & Heritage, or the current State of the Lakes.

Cost: \$50.

Reservations are recommended.

Sails rain or shine (foul-weather gear available). Capacity is limited to 50 passengers. Captain reserves the right to cancel any sail for reasons of safety.

Check the web site for the sail schedule:

<http://www.lakeschooner.org/>

For more information contact:

Wisconsin Lake Schooner Education Association  
500 N. Harbor Drive  
Milwaukee, WI 53202  
414-276-7700  
FAX 414-276-8838  
[schooner@lakeschooner.org](mailto:schooner@lakeschooner.org)



*The Denis Sullivan*  
Wisconsin Lake Schooner Education Association

## **Ship Sinking Plans On Hold**

Plans to sink the *Straits of Mackinac* to create a dive site in Lake Michigan have run into trouble. The Kewaunee harbor area where the vessel is moored has been sold and the boat must be moved. However it is not yet ready for sinking, and a new home may not be available.

Neptune's Nimrods Dive Club in Green Bay, who have been working on the project for the past two years, are searching for a solution to the dilemma. A dive group in Illinois is interested in the boat but no decisions have been finalized.

## ***Meteor* In Trouble**

The whaleback *Meteor*, a museum ship in Superior, is reportedly in very poor shape. A restoration plan is being developed to save this unique vessel. Look for details in the next issue of Wisconsin's Underwater Heritage.