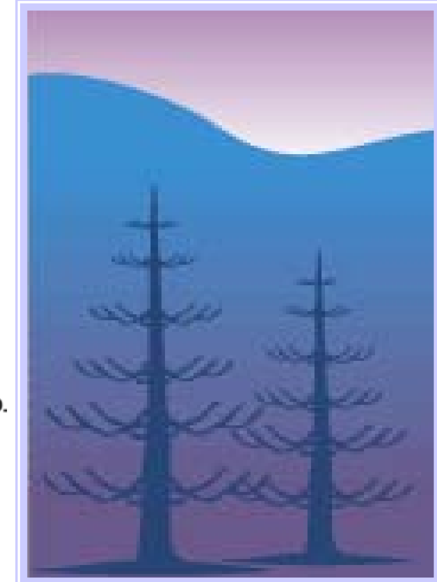
PROJECT DROWNED FOREST

A Study of Prehistoric Underwater Forests in Lake Huron, Michigan.

A joint project of Oakland University, Inter-Seas Exploration, and the Great Lakes Division of the U.S. Naval Sea Cadet Corps.

Supported by grants from the Coastal Management Program, Michigan Department of Environmental Quality, and the Oakland University Research Committee



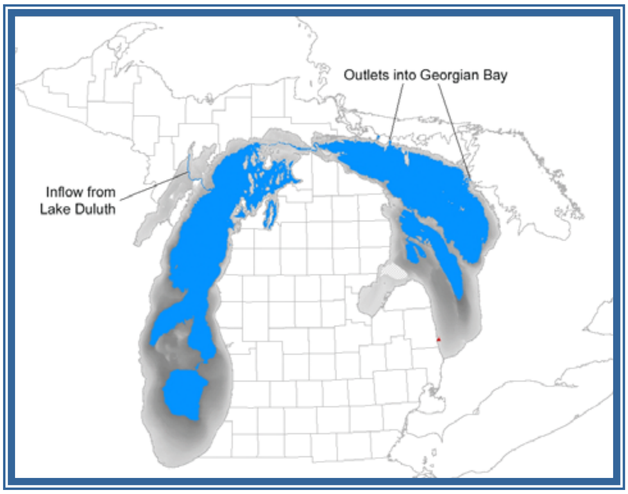
Imagine you are a SCUBA diver exploring the bottom of southern Lake Huron. In the gloomy light near the bottom, you see what appears to be a log, some branches, and other wood debris. You take little notice of these until you see a stump, with some obvious roots penetrating into the bottom. This seems impossible since it suggests this tree once grew here, a few miles offshore in 40 ft of water. Although the logs and branches could have floated out from shore and sunk once they became waterlogged, the stump could have grown in this position only if this area was once dry land.

Scenes like this are found in several areas of the Great Lakes. They represent undeniable evidence that water levels in the Great Lakes were once radically lower than they are today, making some of our concerns about recent low water levels pale in comparison. Imagine 300 feet lower!

Divers examine a stump rooted on the bottom of Lake Huron

At various periods during the past 11,000 years (the **Holocene Epoch**) the levels of Lakes Michigan and Huron were higher as well as lower than at present. During the last period of low water, forests spread over much of the area that was formerly under water. Later, as the lakes refilled from glacial melt-water and experienced redirected drainage, the trees were killed as they became flooded, leaving behind evidence of their existence in the form of logs and stumps comprising a **"drowned forest".**

Before the Holocene Epoch, there were multiple periods of glaciation over the 2 million years known as the **Pleistocene Epoch** or "ice age". During the Pleistocene, geologists have documented that glaciers repeatedly advanced and retreated, often covering major parts of North America, including the Great Lakes, with a kilometer or more of ice. The last of these, known as the **Wisconsin glaciation,** has left behind a number of clues attesting to its existence and extent.



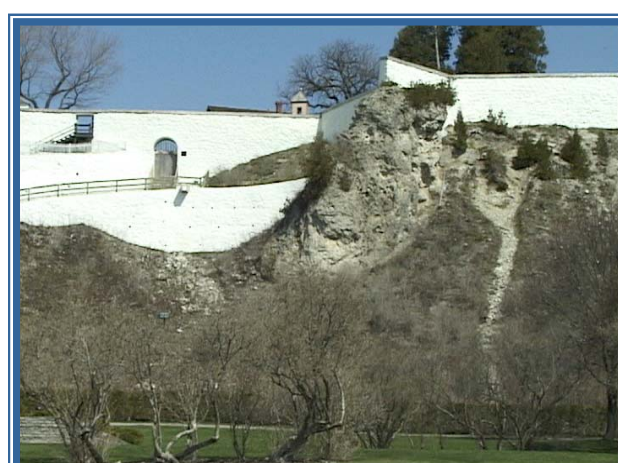
Lakes Michigan & Huron during the Chippewa & Stanley lows, ca. 10,000 years before present.

During recession of the last glacier about 10,000 years before the present, Lakes Michigan and Huron were at extremely low levels. The map to the left depicts those lakes levels. Geologists refer to the low period in Lake Michigan as the **Chippewa low** and that of Lake Huron as the **Stanley low**. Water flowed into Northern Green Bay from Lake Duluth, a portion of Lake Superior that had recently been exposed by the retreating glacier. Flow into Lake Huron was through the Mackinac Channel, passing through the present Straits of Mackinac. Water from Lake Huron exited through a river flowing east from northern Georgian Bay. Bathymetry of the Georgian Bay was unavailable at press time. The small red triangle indicates the Sanilac site.

At that time, there was no outlet through the St. Clair River to the south, and the edge of the receding glacier covered part of Lake Superior to the north. Nearly the entire southern basin of Lake Huron was land. After release from the enormous weight of the glacier, the land rebounded, cutting off the outlet in Georgian Bay, which led to the refilling of Lakes Huron and Michigan with glacial melt-water. As the water level rose during the **Nipissing transgression**, previously forested areas were flooded, killing the trees and creating drowned forests in many areas. By using carbon-14 (^{14}C) methods on samples from the remains of these trees, the dates when the water level reached specific elevations can be determined.

Both before and after the Stanley low, lake levels were higher than today. Evidence for these higher levels exists as wave-cut beaches, caves, and water-eroded features visible in several areas near the shore. Some outstanding examples of these high water features are now popular tourist attractions on Mackinac Island where stacks made of re-aggregated limestone known as **breccia** are visible near the eastern shore (Sugarloaf) as well as caves (e.g. Skull Cave) and Arch Rock.

Arch Rock on Mackinac Island, Michigan, a wave-cut arch formed during the Nipissing high water.



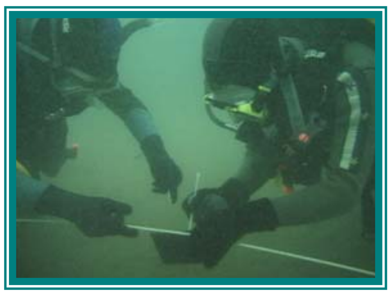
Outcrop made of breccia on a cliff at Fort Mackinac that was wave-cut during the Nipissing high water.

The main focus of our studies has been a recently discovered drowned forest remnant called the **Sanilac Site**, located in southwestern Lake Huron in about 40 ft of water. This site was discovered in 1988 by SCUBA divers. Our study of the site from 1999-2001 has documented tree remains scattered in patches over at least 3 hectares (~ 7.4 acres). In 2001 an area of 100x100 meters was marked off as a grid with 100 cells each measuring 10x10 meters. SCUBA divers have done an inventory of the visible wood remains in each cell. The diagram at the right shows the distribution and density of wood remains in the grid. In total, 500 discreet pieces were counted including logs, branches, roots, and 10 stumps rooted in growth position. Near the grid, we have observed stump remains as large as five feet in diameter and logs up to two feet in diameter.

0	0	0	0	0	2	0	0	2	0
8	0	0	0	1	7	0	0	1	8
0	0	0	0	16	42*	9*	15*	8*	2
0	0	0	0	13	41	17*	8	2*	0
0	0	0	0	7	25	20	6	0	0
0	0	0	0	10	21	47*	24	4	0
0	3	0	0	0	5	33	16	7*	0
2	0	0	0	8	9	3	11	6	0
0	0	0	2	7*	2	10	16*	6	0
0	0	0	0	6	2	6	4	6	0

Wood density in each 10x10 meter square of the grid. Asterisks indicate a stump.

Grid assembly: driving stakes



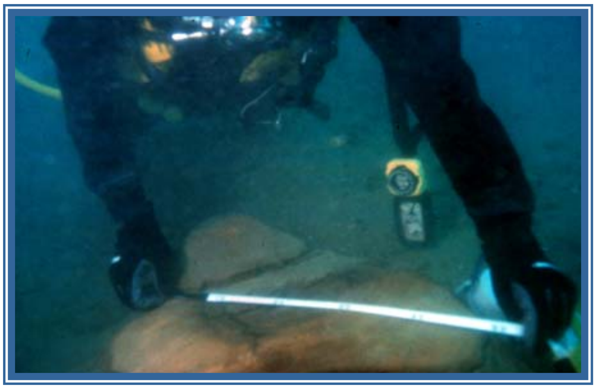
Attaching numbered tags

Table 1 gives the ^{14}C dates and species identification for some of the trees. They range in age from 7409 – 7936 calendar years before present. Most of the samples processed thus far are familiar species of evergreens. A few stumps were cut for **dendrochronological** (tree ring dating) analysis. One spruce stump was 157 years old when the tree died; a hemlock, 112 years. Only a few hardwoods have been found here although they are common at sites elsewhere in the Great Lakes.

Table 1. Wood samples from the Sanilac Site have been carbon-14 dated and identified. Age is in terms of calendar years before present.

Sample no.	**Species**	**Calendar years BP**
1.	Spruce (*Picea*)	7662
2.	Hemlock (*Tsuga*)	7789
5.	White pine (*Pinus strobus*)	7936
6.	Hemlock (*Tsuga*)	7555
13.	Eastern white cedar (*Thuja*)	7612
20.	Ash? (*Fraxinus*?)	7409

Why are we fairly certain that these trees died of submergence due to a rising lake? Trees die from a variety of causes including storm damage (blowdown), insect attack, general scenescence, disease, etc. Logs and stumps on land, once dead, quickly deteriorate from fungal attack, especially if moist, and rot within a few years. In drier environments, logs may last for decades. Typically, trees located on eroding shorelines or on beaches where they may be reached by unusually high water, e.g. during a severe storm, are uprooted and moved away from the area. Little remains at the site, not even a stump. For this reason we believe it is likely that these drowned forest remains were preserved because of two processes: 1) rapid lake level rise due to massive glacial meltwater release from the receding glacier to the north and 2) burial in sediment around the time of flooding.



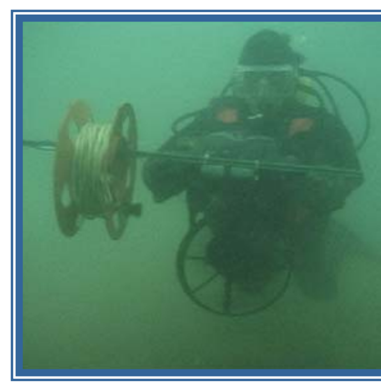
SCUBA diver measuring a cut spruce stump

Examining tree ring data at the LTRR

Preservation of wood in a relatively intact condition requires anaerobic (no oxygen) conditions as would occur with burial in water-saturated sediment. The rise in water level is unlikely to have been entirely uniform, but probably was punctuated by episodes of rapid rise due to the release of meltwater lakes from the glacier to the north. It is also possible that the trees were first buried by advancing sand dunes on the lake shore, dunes that were subsequently flooded. Once underwater, the sand could have been redistributed over the lake bottom, eventually exposing the tree remains.

Some of our stump sections have been subjected to tree ring dating (dendrochronology) which involves establishing a calendar date range for wood samples. Tree ring data can also be used to make inferences about climate and climate changes that have occurred in the past. Our samples will form a part of this record for southern Lake Huron.

Financial support: Coastal Management Program, Land & Water Mgt. Div., Michigan Department of Environmental Quality. Research Committee, Oakland U.
Logistic Support: InterSeas Exploration, Ltd., Great Lakes Div., U.S. Naval Sea Cadet Corps.
Technical Support: University of Arizona Laboratory of Tree Ring Research, University of Arizona Department of Geosciences, EdgeTech Corporation.
Participants and Collaborators: Luke Clyburn, Kathy Trax, Elliott Smith, Irina Panyushkina, Steven Leavitt, Frank Krist, Joe Tabone, Steven Gibbs, and participating Sea Cadets and Officers of the Great Lakes Division, U.S. Naval Sea Cadet Corps.
Photography: Luke Clyburn, Kathy Trax, Steven Leavitt. Designed and written by Doug Hunter.



Grid construction using a scooter

Sea Cadets raise a core sample at the Sanilac site

Some of the larger logs found at the Sanilac Site

For More Information contact Dr. R.D. Hunter, Biological Sciences, Oakland University, 2200 N. Squirrel Rd., Rochester, MI 48309-4476 hunter@oakland.edu (248) 370-3552