

# upwellings

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## Research Will Provide Recommendations for Improving Grand Marais Harbor

Underwater video, aerial photographs and high resolution sonar play an important role in research that began in August on Grand Marais Harbor in Michigan's Upper Peninsula. The images will help document the condition of the Lake Superior harbor, which has been gradually filling with sand. Deterioration of a century-old wooden breakwater has led to extensive shoaling in some areas and erosion in others.

SEA GRANT ARCHIVES



An aerial photograph of Grand Marais Harbor taken in 1994 shows the harbor jetties on the west shore (left); a timber pile dike breakwater once extended from the southern end of the jetties across the harbor.

Researchers funded by Michigan Sea Grant will use images of the harbor in conjunction with computer modeling techniques to investigate and predict the effectiveness of potential solutions and provide practical recommendations for revitalizing the harbor.

"Grand Marais is a unique harbor that has experienced enormous changes," said University of Michigan marine engineer Guy Meadows, who will lead the project. "The natural deep-water harbor is very valuable as a natural resource. Today the water is ankle deep in some places. People who used to be on the water no longer are."

### HISTORIC PERSPECTIVE

A federally-designated harbor of refuge, Grand Marais Harbor once accommodated commercial vessels. In 1884, the U.S. Army Corps of Engineers constructed two jetties on the western shore, which provided a deep-water entrance channel, and a mile-long timber pile-dike breakwater that extended from the jetties east across the harbor to Lonesome Point.

Although the structures worked together to provide a useable harbor, they also impacted their surroundings. When the jetties were completed, they acted as a sediment block, said Meadows. "The strongest waves come from west to east, moving the sand," he explained. "The jetties are equivalent to putting a dam across this river of sand."

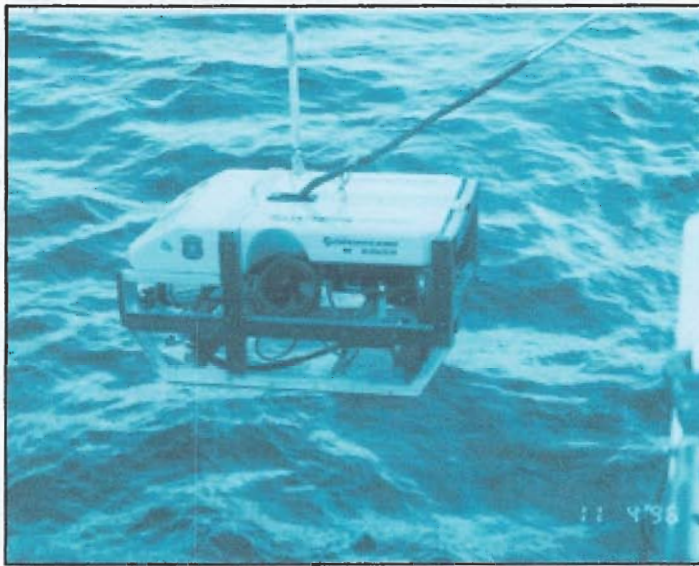
As sand accumulated, the shoreline west of the jetties had progressed 900 feet lakeward by 1960, at a rate of 33 feet per year from 1894 to 1912 and at a rate of about five feet per year from 1912 to 1945, according to a Corps of Engineers report. (The decrease in the rate through the first half of this century

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was attributed to sand flowing around the west jetty.)

"In some way we've got to reinstate that conveyor belt of sand," said Meadows, who estimates the amount to be approximately 6,000 semi truckloads per year.

While the jetties impede the flow of sand from the west, the extensive breakwater once blocked sand from entering the harbor from the north and northeast. Problems arose when the structure fell into disrepair. An examination of all structures by the Corps of Engineers in 1960 revealed that wooden sections of the breakwater were in extremely poor condition. At the time, repair of the pile dike was not recommended because the breakwater was not required for present or anticipated recreational harbor use, according to a 1966 Corps report.

Today, all that remains of the breakwater are the remnants of the piles protruding a few feet off the bottom. Sand—driven by Lake Superior's powerful currents—began filling the harbor as the breakwater deteriorated. Maximum harbor depth has reportedly decreased from 55 to 25 feet.

#### EVALUATING CHANGES

As part of their research, Meadows and colleagues will review historical survey data and

photographs from previous studies conducted by the U.S. Army Corps of Engineers and the Michigan Department of Natural Resources. The information details the progression of the harbor degradation and surrounding shoreline change. Aerial photographs commissioned by Meadows in July will be compared with historic photos to accurately determine the magnitude of recent shoreline and bluff recession rates.

Field work will consist of detailed offshore surveys and conventional land survey techniques to map the current shape of the harbor. Using the University of Michigan's Remote Operated Vehicle for Education and Research (M-ROVER), the researchers will also photograph the existing harbor structures as well as the morphology of the surrounding lake floor.

A suite of state of the art numerical models will be used to integrate this information into a "hind-cast" simulation of the long-term changes that have occurred in the vicinity of the structures. Once models are calibrated (based on historical changes), the models will test potential solutions to see how they perform. Ultimately, the models will be used as predictive tools for future harbor design.

Results of the research will provide estimates of the scope and extent of effort required to restore Grand Marais harbor to a functional, stable and environmentally balanced state. According to Meadows, potential solutions will likely include some combination of dredging, mechanical structures (such as pumping stations that re-route water and sand) and a long-term maintenance program.

One year from now, researchers will provide local officials and residents with an evaluation of the quantities of sediment to be relocated, recommended structural alterations, long-term predictions of shoreline change, impact of significant storm events on the harbor and estimated long-term maintenance costs.

*by Joyce Daniels*