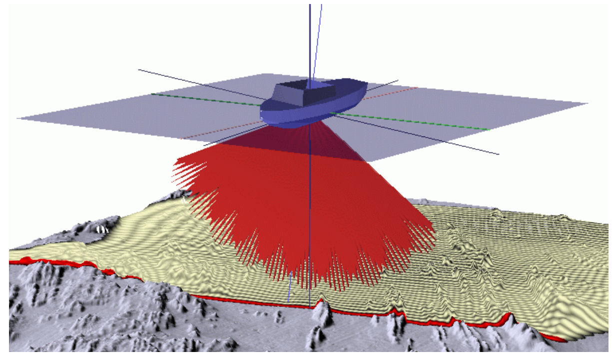
Lakebed Habitat, Ecosystem, and Geologic Mapping in the Great Lakes

A Multi-Agency, Bi-National Program in Development

In conferences held in 1999 and 2000, scientists identified needs for new mapping of lakebed habitat in all of the Great Lakes. The long-term goal is a multi-year, bi-national effort to map lake bathymetry (depth and shape of lake bottom) and to classify lakebed materials (such as reefs, dump sites, mussel beds). The mapping project will use acoustic (sound-based) multibeam technology for offshore portions of the lakes, and airborne-laser (light-based) technology for shallow reefs and nearshore and coastal areas. The international group of biologists, geologists, and hydrographic scientists and engineers recognizes that these new tools can radically improve our knowledge of the lakebeds and provide information to enable better management of Great Lakes resources. The group has drafted a plan for developing and executing a mapping and research effort called the Great Lakes Imaging and Mapping Program to Survey Ecosystems (GLIMPSE).



Multibeam acoustic (sound-based) mapping. A short pulse of sound energy is transmitted toward the lake floor, and a small amount of the total energy is backscattered toward the research vessel. As the vessel moves forward, successive pulses sweep over a swath of lake floor (yellow), and the backscattered energy is recorded in narrow receive apertures (beams) for calculations of bathymetric and backscatter data. Bathymetric data provide information about depth; backscatter data provide information about the materials that make up the lake floor—such as reefs, dump sites, or mussel beds.

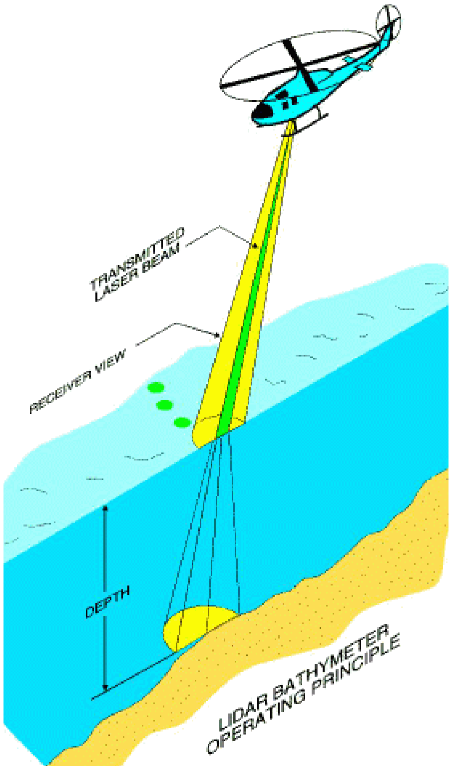
Population and development pressures continue to rise in the Great Lakes on both U.S. and Canadian shores. Impacts on fish, concerns about regional pollution, and recreational and commercial land use are important management issues that would benefit from more detailed views of the lakebeds, the materials that compose them, and the flora and fauna that live on and in them. Managers concerned with groundwater discharge and recharge, lake-level history (climate change), coastal sand deposits, and impacts of human activities (such as dredging, dumping, archeological sites, and coastal structures) will also benefit from more detailed views of the lakebed, or "benthic" habitat.

Great Lakes bottom maps now in use are based on technologies from the 1950s or earlier, and have data densities on a 2-kilometer to 90-meter grid spacing. Current technologies allow accurate, geo-referenced measurements of lakebed bathymetry at decimeter resolution, and they also provide lakebed backscatter data (analogous to black-and-white aerial photographs). These advances will help reveal new details of a lake bottom's geologic make-up (such as rock or sand) and biological make-up (such as mussel beds or key spawning areas).

Limestone outcrop photographed by ROV (remotely operated vehicle) in Lake Huron lake trout reserve on Six-Fathom Bank in south-central Lake Huron. Scale at left indicates that the lake floor here is 49 feet (15 meters) deep.

Scientists in both Canada and the United States have access to new mapping tools that are appropriate and compatible. Recent applications of these tools include successful mapping off the Maritime Provinces and New England, the Florida Keys, Lake Tahoe, and off Los Angeles (see http://walrus.wr.usgs.gov/pacmaps/). Canada is currently developing a national plan (SeaMap) to apply new mapping technologies to their marine and freshwater territory, a plan in which the USGS hopes to collaborate (see http://seamap.bio.ns.ca/).

Concurrently, Canadian and U.S. scientists have drafted a bi-national initiative to develop and implement a research effort called the Great Lakes Imaging and Mapping Program to Survey Ecosystems (GLIMPSE).



Schematic diagram of a LIDAR (Light Detection And Ranging) airborne-laser mapping system. The aircraft-mounted system transmits a laser beam into the water. Some light is reflected from the lake surface, and some is reflected from both the lake surface and the lake bottom. A computer calculates water depth from the difference between the times that the surface and bottom reflections are received by the system.

The program will focus on:

- integrating geomorphic framework studies related to ecosystems and coastal erosion;
- delineating and characterizing benthic fish spawning and nursery habitats;
- defining geologic attributes related to ground water, lake level, and aggregate resources;
- assessing lakebed evidence of biological and pollutant history;
- mapping offshore archeological sites;
- identifying natural and man-made benthic structures, such as reefs and dump sites; and
- assessing and predicting impacts of pipelines, dredging, dumping, and other human activities.

Such a project would provide benthic-habitat and geomorphic maps for all of the Great Lakes in the United States and Canada over a period of 5 to 10 years.

The products anticipated as funding becomes available are state-of-the-art benthic-habitat maps, digital databases, and interpretive maps for all of the U.S. and Canadian Great Lakes.

A bi-national working committee has been established and is prepared to assess costs, establish timelines, and coordinate cooperation among research and funding partners. Here is a list of the committee members:

Canadian Hydrographic Service
Environment Canada
Fisheries and Oceans Canada
Geological Survey of Canada
Great Lakes Fishery Commission
Great Lakes Research Consortium
National Oceanic and Atmospheric Administration (NOAA)
Ohio Department of Natural Resources
Ontario Ministry of Natural Resources
The Nature Conservancy
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey

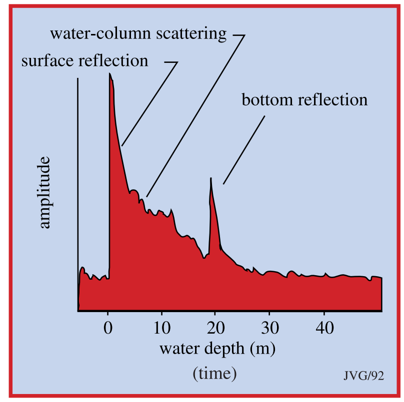


Illustration of an airborne-laser return signal. Depth is calculated from the difference between the time the surface reflection is received and the time the bottom reflection is received. The signal also records strength of the returned energy, which is used to determine the composition of the lake floor.

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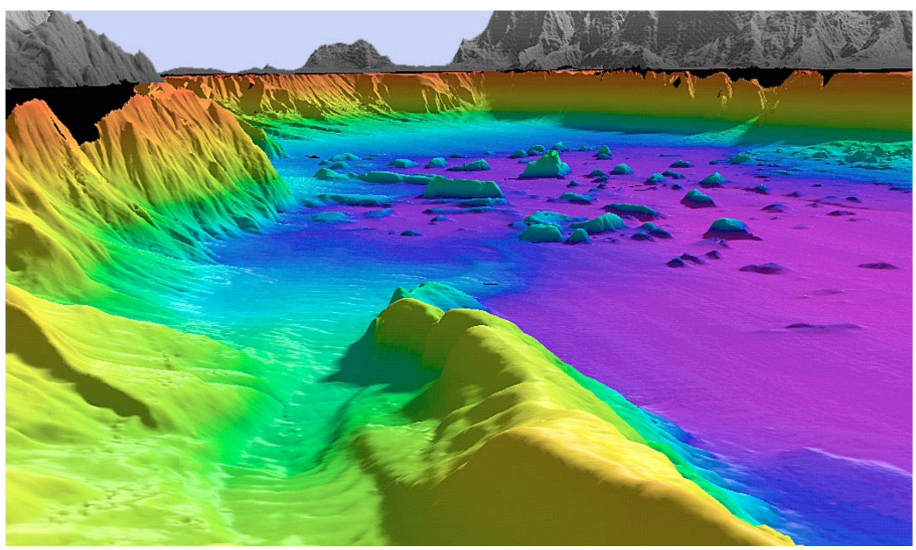

Acoustic multibeam image of bottom of Lake Tahoe, from data collected in 1998. This oblique view looks south-southwest from near Incline Village toward the lake's south shore. Slopes look steeper than they really are; vertical exaggeration is 3:1. Lake depths are shown by color, from magenta (deep) to orange-red (shallow). The black areas were too shallow for multibeam mapping; they were mapped by an airborne-laser system in July 2000. Eventually the two data sets will be merged, providing an example of the combined acoustic and laser mapping that GLIMPSE proposes for the Great Lakes.

This informational handout is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

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