Gulf of Maine Council on the Marine Environment
SCIENCE TRANSLATION PROJECT

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Mapping the Undersea Landscape

Technologically advanced maps of sea floor habitats are becoming vital tools for ocean management

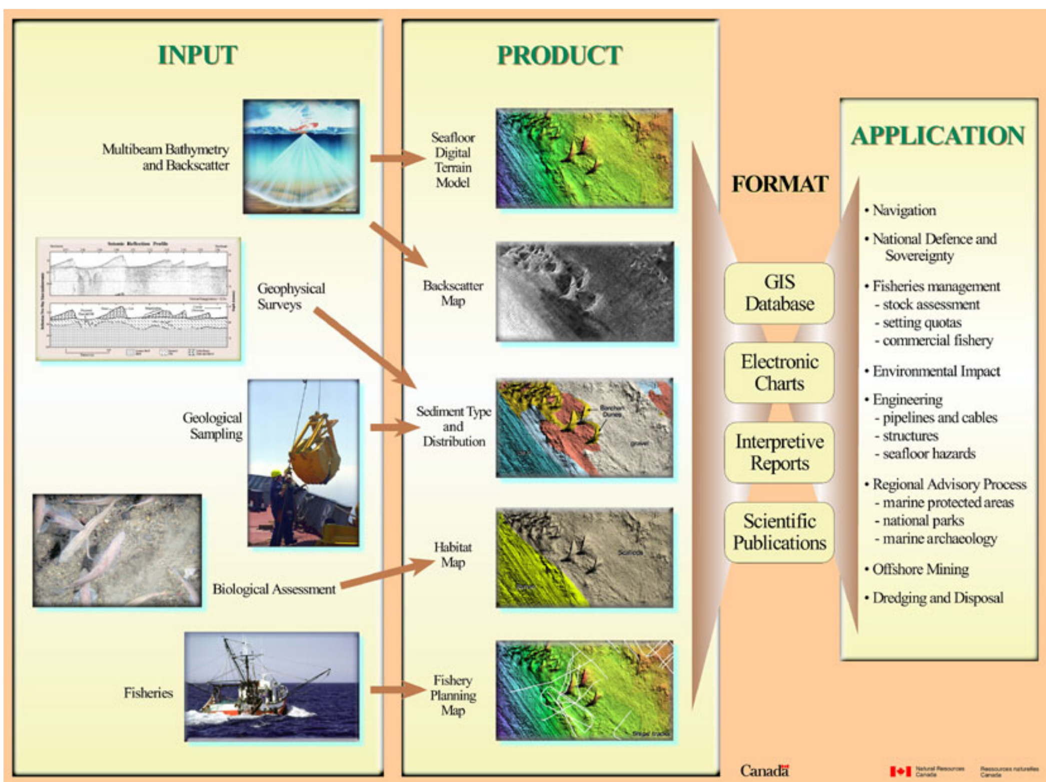
By Peter H. Taylor

When the earliest European explorers and settlers arrived in North America, they immediately began drawing maps of the mountains, shoreline and waterways of the New World. The Gulf of Maine's coastline and surrounding landscape can be discerned on many of these first maps. Offshore, however, the seabed shows up as a blank, unknown expanse. Over the intervening five centuries, technology has advanced to a point where we can use satellite imagery, aerial photography, geographic information systems (GIS) and the global positioning system (GPS) to plot locations of wetlands, streams, towns, roads and even individual trees in the Gulf of Maine watershed with astounding precision. Now, on a day-to-day basis, natural resource managers, planners, and other environmental professionals rely on detailed terrestrial maps as they formulate management and policy decisions.

The picture is quite different underwater. Maps simply have not been incorporated into marine management like they have on land. Adequate, reliable maps of sea floor habitats currently exist for only a fraction of the Gulf of Maine, including portions of Stellwagen Bank, Browns Bank and Georges Bank. For the most part, sea floor habitats in the Gulf of Maine remain a void on maps - just like on those early explorers' crude depictions of the New World. This deficiency of information hinders effective management of marine resources and ecosystems.

As a result of focus groups with managers, planners, policy makers and leaders of non-government organizations in the region, the Gulf of Maine Council's Science Translation Project has identified sea floor mapping as a priority for our work. For our target audience of coastal decision-makers, I am gathering and disseminating information about existing sea floor mapping data, how to access the maps and use them to improve management and how to obtain new data.

A major hurdle for scientists and managers has been the inherent technological challenge of surveying an underwater landscape that spans 168,000 square kilometers and reaches as deep as 460 meters. In the past, no feasible means existed for large-scale sea floor mapping. During the last decade, however, a new technology called multibeam sonar has emerged as a viable solution. A ship outfitted with multibeam sonar can produce detailed maps of underwater topography and geology with great speed. In a single pass through water 100 meters deep, for example, the multibeam system can map a half-kilometer-wide ribbon of sea floor with resolution fine enough to show patches of boulders. To produce habitat



Mapping technologies and their range of uses. Graphic courtesy of Brian Todd, Geological Survey of Canada

Case study: Scallop Fisheries in Canada

In the 1990s, scallop fishermen approached scientists at the Bedford Institute of Oceanography to learn more about the utility of sea floor mapping to aid the fishery. Along with the Geological Survey of Canada, the scallop industry provided financial support for mapping Browns Bank, an important scallop ground. The project used a combination of multibeam sonar, side-scan sonar and seismic reflection profiling to create four GIS data layers: bathymetry, sediment type, benthic habitat and navigation.

Immediately, the mapping project helped the scallop fishermen improve their efficiency. The captains caught the same amount as in the previous year by dragging only 25 percent as much area, reducing bycatch of juvenile scallops and non-target species. The shorter time at sea translated into lower expenditures for fuel and crew time, as well as reduced wear on fishing gear.

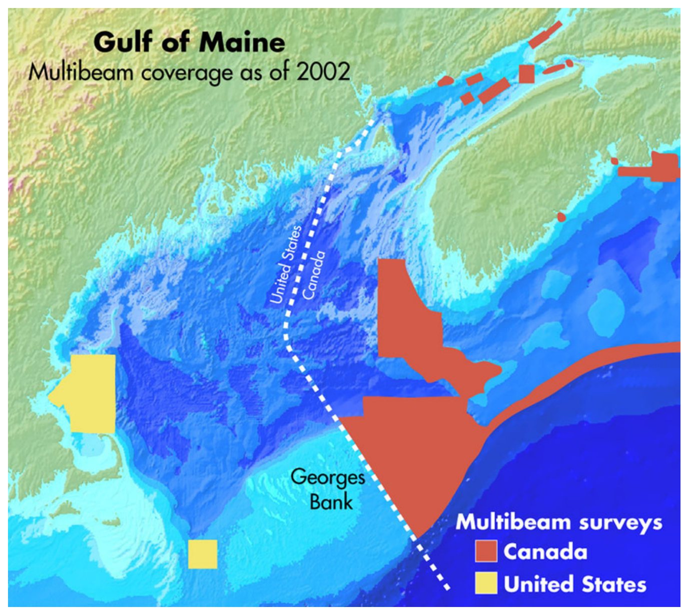
Fisheries managers also benefited. By knowing the distribution of scallop beds, they now can estimate productivity at finer spatial scales, even from some individual beds. The strong association between adult-scallop distribution and substrate type contributed greatly to the success of this mapping effort. Later, the Canadian portions of Georges and German Banks were mapped with multibeam technology. Mapping the three banks took two years and cost $3 million Canadian ($1.9 million U.S.).

By Megan Tyrrell, NOAA Coastal Services Center Fellow, Massachusetts Office of Coastal Zone Management

maps, researchers combine the multibeam data with information obtained by biological and sediment sampling, video and photo surveys and other "ground-truthing" methods.

For management, multibeam sonar already has proven useful. For example, scientists have surveyed the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts, and managers and policy makers can use the data to determine the distribution of habitats, assess impacts on habitats and species and identify places that might be contaminated. In Canada, when the government and the scallop industry formed a partnership to map the Scotian Shelf, agencies gained information with which to manage the fishery, and scallop fishermen use the maps to improve their efficiency and disturb less of the ocean bottom. Nearly 15 percent of the Gulf of Maine has been mapped with multibeam sonar by the United States and Canada.

Although it is rapid, multibeam sonar is not cheap. While some multibeam data is available from government agencies for use by managers, cost has been an obstacle to Gulf-wide sea floor maps. In addition, the primary use of multibeam sonar so far has been to produce hydrographic maps that show only depths and not habitat. Now efforts are underway to produce habitat maps that are more useful than hydrographic maps for resource managers. Last year, the Gulf of Maine Council endorsed the Gulf of Maine Mapping Initiative (GOMMI), a growing collaboration of government and non-government partners who are working to obtain funding and undertake a comprehensive mapping program [see details about the GOMMI Web site in Resources, page 11]. GOMMI will release its peer-reviewed strategic plan in coming months and is already making headway toward mapping sea floor habitats in the Gulf of Maine.



Gulf of Maine multibeam coverage as of 2002. Graphic from GOMC factsheet "Mapping the Undersea Landscape", available at: www.gulfofmaine.org/knowledgebase/seafloor_mapping/docs/seafloor_mapping.pdf

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