Potential Marine Benthic Habitats of an Inland Sea, San Juan Islands and the Transboundary Region of Canada and the US: A Successful International Cooperative Program

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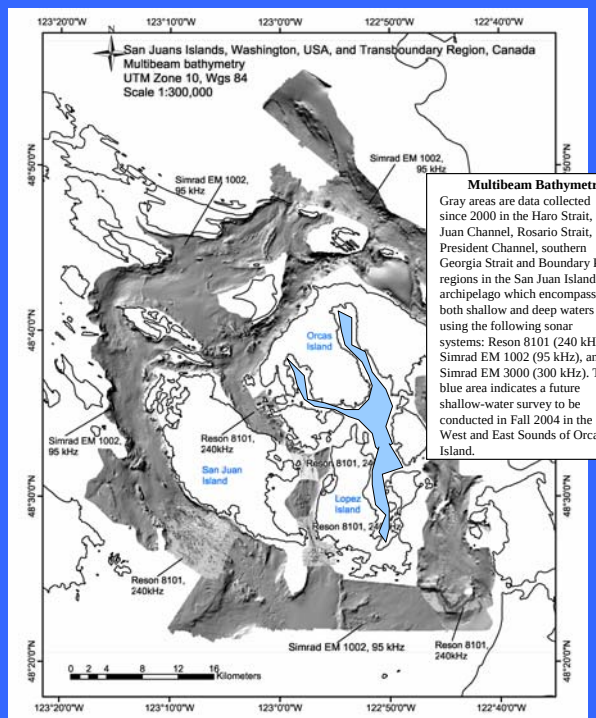
Abstract

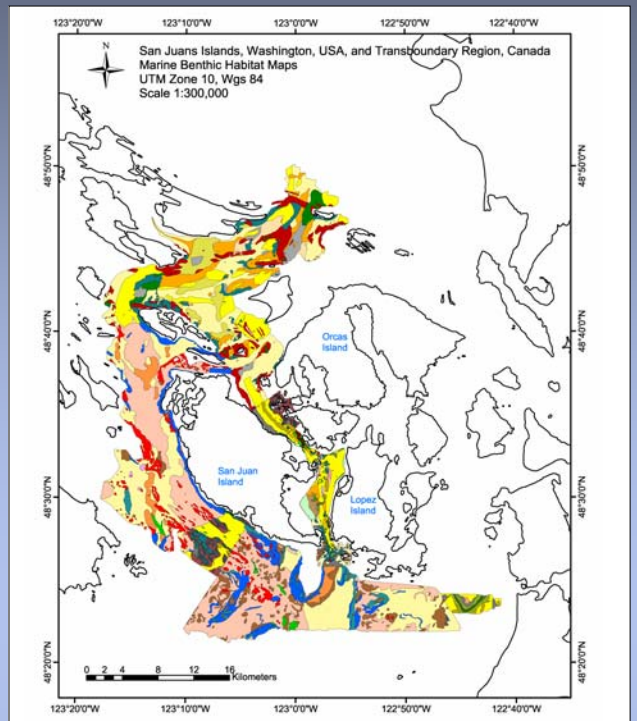
During the past three years extensive mapping of the waterways in and around the San Juan Islands of the US and adjoining areas of Canada has taken place as a joint operation between the Geological Survey of Canada and Moss Landing Marine Laboratories' Center for Habitat Studies. With the use of the Canadian Hydrographic Services Simrad EM1002 and EM3000 multibeam bathymetry systems onboard Canadian Coast Guard vessels and launches high-resolution bathymetry and backscatter data were collected in the geologically complex and glacially scoured inland sea of the San Juan Islands. Active tectonics since the Cretaceous time has resulted in the docking of exotic terranes, formation of nappes, and extensive deformation of metamorphic and sedimentary rock units. Deep ice scoured channels and sounds are remnant glacial features from the last glacial advance. All of this has resulted in highly diverse marine benthic habitat types that are now being characterized for bottom fish fisheries and Marine Protected Area (MPA) designation. Not only are highly rugose and complex bedrock exposures that are important habitats for rockfish (*Sebastes* spp.) imaged, but dynamic mega-bedforms have been mapped that may be significant habitat for migratory species of fish such as salmon and sturgeon. A detailed potential marine benthic habitat of the inland sea of the San Juan Islands is presented.



Multibeam Bathymetry

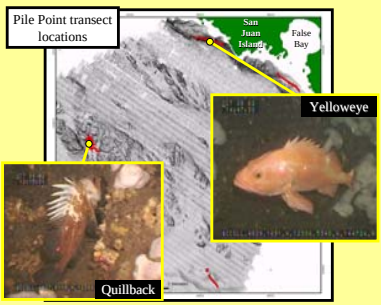
Gray areas are data collected since 2000 in the Haro Strait, San Juan Channel, Rosario Strait, President Channel, southern Georgia Strait and Boundary Pass regions in the San Juan Islands archipelago which encompasses both shallow and deep waters using the following sonar systems: Reson 8101 (240 kHz), Simrad EM 1002 (95 kHz), and Simrad EM 3000 (300 kHz). The blue area indicates a future shallow-water survey to be conducted in Fall 2004 in the West and East Sounds of Orcas Island.

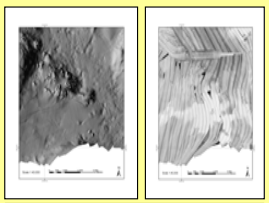
A 3D map of San Juan Islands was created in ArcScene®.



A potential benthic habitat map is constructed from multibeam bathymetry and backscatter data. This map shows the diversity of habitats located in the San Juan Islands. Many of the hard, steep relief and complex habitat types appear to be rockfish habitat and are presently being confirmed using ROV groundtruthing methods.

Hard, higher relief and complex bedrock exposure produce ideal habitats for rockfish.





Backscatter

Multibeam backscatter data, or, *pseudo-sidescan*, is acquired by sampling an individual time series for each beam in the sonar system. Backscatter is derived from energy on the seafloor and is scattered forward (Blondel and Murton, 1997). Backscatter data provide seafloor texture and roughness information, seafloor composition, and sediment properties and is greatly enhanced with the presence of multibeam bathymetry data. Backscatter data can overlay multibeam bathymetry data which is valuable when interpreting and characterizing geologic features on the seafloor.

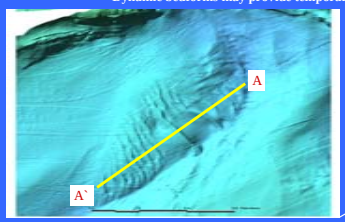
Groundtruthing

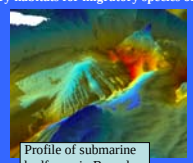
ROVs and cameras provide in situ observations of marine benthic habitats and associated biota, such as Quillback and Yelloweye Rockfish.

Technology

A variety of technologies were used to collect data in the San Juan Islands Archipelago, including multibeam bathymetry sonar systems, ROVs and seismic reflection profilers, as shown to the left.

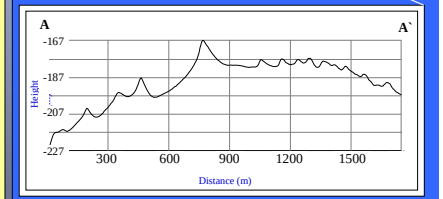
Dynamic bedforms may provide temporary habitats for migratory species of fish.

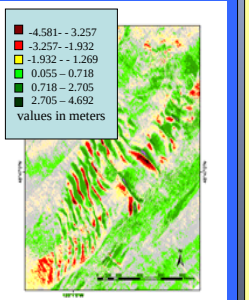




Profile of submarine bedforms in Boundary Pass. Figure created in ArcView®.

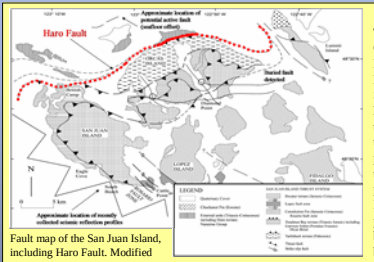
The GIS program, ArcScene®, was used to create this 3D image of the Boundary Pass sand waves where the 2003 gridded data overlays the 2001 gridded data. Vertical exaggeration is 5 m





Silver hake have been observed using sand waves as habitat. (Auster et al., 2003). There is the possibility that migrating fish, such as salmon, use sand waves in the San Juan Islands for habitat.

Using the GIS ArcMap®, two 5 m grids were subtracted using *Raster Calculator* which calculates differences at each pixel location. These grids are comprised of data collected in 2001 and 2003 in the Boundary Pass region. The red and green colors represent migration of the sand waves. Red = crests, green = troughs.



Fault map of the San Juan Island, including Haro Fault. Modified after Bergh (2002).

Geologic Setting

The San Juan Islands were formed in Late Cretaceous time as a result of a collision of the Insular Superterrane with the western margin of North America (Feehan and Brandon, 1999). The San Juan Islands region has a complex tectonic history which has experienced convergence, thrust faulting and uplift, subsidence, glaciations, tidal scour and sediment transport. These processes have changed and shaped both the terrestrial and marine environment. Metamorphic, plutonic and sedimentary rocks in the San Juan Islands region have been affected by these tectonic processes and, thus, have produced diverse marine benthic habitats. These habitats vary from dynamic bedforms and glacially scoured moraines to fractured and faulted bedrock outcrops.

Conclusion

The morphology of the seafloor in the San Juan Islands provide opportunities for exploring diverse marine benthic habitats. Dynamic bedforms not only provide a mechanism for sediment transport, but have the potential to provide habitat for commercially important migrating fish. Further studies of dynamic bedforms will provide useful information regarding both geological and biological relationships.

References

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