



OPEN FILE 6625

POTENTIAL MARINE BENTHIC HABITATS AND SHADED SEAFLOOR RELIEF

SOUTHERN GULF ISLANDS AND SAN JUAN ARCHIPELAGO

CANADA AND U.S.A.

Haro Strait

Scale 1:50 000/Échelle 1/50 000

Universal Transverse Mercator Projection, Zone 10
North American Datum 1983
© Her Majesty the Queen in Right of Canada 2011
This map is not to be used for navigational purposes

Projeção transversa universal de Mercator, Zona 10
Datum geodésico norte-americano, 1983
© Sua Majestade a Rainha do Canadá 2011
Este cartão não deve ser utilizado aos fins de navegação

1 0 1 2 3 4

kilometres



LOCATION MAP

DESCRIPTIVE NOTES

The San Juan Archipelago-Southern Gulf Islands seafloor-mapping effort is an ongoing mapping program focused on the characterization of marine benthic habitats and the mapping of geology within the Salish Sea. The Salish Sea has suffered a severe decline in several species of bottom fish over the past several decades likely due to environmental degradation and overfishing (Pugnet Sound Ambient Monitoring Program, 2002; Fisheries and Oceans Canada, Rockfish Conservation Areas, 2006). The primary objective of this mapping effort is to characterize potential marine benthic habitats and geology. The final product includes interpretive maps that can be used to identify rocky (Sebastes sp.) habitats, which then can be used by both Canada and the U.S. to manage, conserve and sustain economically significant fisheries (considered outcomes) in the Transboundary region. A mechanism that has been developed to address fisheries conservation and sustainability is the establishment of Marine Protected Areas (MPAs) and voluntary or mandatory no-take zones whose evaluation as a benthic habitat can be done using potential habitat maps. Therefore, a secondary objective of this mapping effort is to provide data where assessment, and if necessary modification, of established MPAs, and the establishment of new MPAs, can be made. Additional mapping objectives that evolved from this project include the identification of specific deep-water foraging habitats such as dynamic bedforms that harbor sand lance (*Ammodytes hexapterus*) and potential siliceous sponge reefs (hexactinellid), although these are not specifically identified in the maps as characterization of these specific habitat types is continuing.

The San Juan Archipelago-Georgia Basin region is an active tectonic province whose physiography and geomorphology reflect both Mesozoic to Cenozoic convergent (subduction/accretion), plate tectonic processes and Pleistocene glacial (glacial scouring/deposition). These processes have juxtaposed and deformed Jurassic-Cretaceous metamorphic rocks with Tertiary-Quaternary sedimentary rocks producing a complex of fracts, grooved and polished bedrock outcrops, and erratic boulders and moraines. Banks of till and glacial advance outwash deposits have also formed and contribute to the variety of relief within the region. Present day tidal action has fashioned much of the relic glacial-marine sediments into dynamic bedforms consisting of sand and gravel wave and dune fields. Modern day sedimentary deposits (sand and mud banks) represent materials being supplied to the region by the Fraser River of British Columbia, Canada.

This tectonic province can be divided into two distinct zones based on bedrock types: a northern sedimentary bedrock zone and a southern metamorphic rock zone separated by the Haro fault (see map sheets 2 and 3). Both zones provide good hard bedrock exposures, however the sedimentary rock type is differentially eroded, thus forming ledges and overhangs while the metamorphic bedrock are highly fractured and faulted forming cracks, crevices, and blocky boulder zones. The severity and variety of tectonic, geologic and physical processes active in the province are directly responsible for forming the large variety of potential marine benthic habitat types mapped in the region.

The habitat classification was done following an existing habitat classification code, which was established to distinguish habitat types for species of interest and to facilitate ease of use and queries in GIS and other database programs. The code used in this map is modified from the scheme developed by Greene et al. (1988, 2007) for deep-water habitat characterization.

KEY TO HABITAT TYPES

Not all units may appear on this map sheet.

Unconsolidated substrate (mud)

- ls(m)_u Unconsolidated sediments
- ls(m)_u Unconsolidated sediment terrace
- ls(m)_h/u Hummocky unconsolidated sediments
- ls(m)_m/u Mound
- ls(m)_h_e/u Pockmark
- ls(m)_h_s/u Scour depression
- ls(m)_h_a-dd/u Hummocky dredge or anchor disturbances
- ls(m)_g_a-dg/u Dredge channel
- ls(m)_t_h/a/u Sawdust terrace

Unconsolidated substrate (sand / mud)

- ls(s)_m_u Unconsolidated sediments
- ls(s)_m_h/u Hummocky unconsolidated sediments
- ls(s)_m_vt_u Vegetative unconsolidated sediment terrace
- ls(s)_m_l_u Linear ridge
- ls(s)_m)_m_u Ice-formed mound
- ls(s)_m)_h_u Depression
- ls(s)_m)_h_s/u Scour depression
- ls(s)_m)_g_s/u Scour gully
- ls(s)_m)_g_w_s/u Scour gully with sediment bedforms
- ls(s)_m)_s_s/u Current-scoured scarp
- ls(s)_m)_s_u Scarp
- ls(s)_m)_h_a-dd/u Hummocky dredge or anchor disturbances

Unconsolidated substrate (sand / gravel)

- ls(s)_g)_u Unconsolidated sediments
- ls(s)_g)_h/u Hummocky unconsolidated sediments
- ls(s)_g)_w_u Sediment bedforms
- ls(s)_g)_w_s/u Current-scoured sediment bedforms
- ls(s)_g)_m_u Mound or linear ridge
- ls(s)_g)_m)_u Ice-formed mound, esker or moraine
- ls(s)_g)_m)_h_u Hummocky ice-formed mound
- ls(s)_g)_h_u Depression
- ls(s)_g)_h_s/u Dropstone depression
- ls(s)_g)_h_s/u Scour depression
- ls(s)_g)_g_s/u Scour gully
- ls(s)_g)_l_h/u Hummocky landslide deposit
- ls(s)_g)_s_s/u Current-scoured scarp
- ls(s)_g)_a-dm/u Dredge disposal
- ls(s)_g)_h_a-dd/u Hummocky dredge or anchor disturbances
- ls(s)_g)_g_a-dg/u Dredge channel
- ls(s)_h_a-h_u Ferry-wash scour

Unconsolidated substrate (sand)

- ls(s)_u Unconsolidated sediments
- ls(s)_t_u Unconsolidated sediment terrace
- ls(s)_w_u Sediment bedforms
- ls(s)_m_u Mound or linear ridge
- ls(s)_m_s/u Scour ridge
- ls(s)_h_s/u Scour depression

Unconsolidated substrate (gravel)

- ls(g)_u Unconsolidated sediments
- ls(g)_h/u Hummocky unconsolidated sediments
- ls(g)_m_u Mound or linear ridge
- ls(g)_l_m/u Ice-formed mound or moraine
- ls(g)_h_s/u Scour depression
- ls(g)_s_s/u Current-scoured scarp

Unconsolidated substrate (boulders)

- ls(b)_m)_u Moraine

Sediment covered bedrock

- lme_c/u Sediment covered bedrock

Hard substrate

- lh_l Rock fall
- lh(b)_p Pinnacle or boulder
- lh_e)_f_s Fractured bedrock
- lh_e)_g_s Granitic bedrock
- lh_e)_d_s Sedimentary bedrock
- lh_a)_w Anthropogenic structure - Shipwreck
- lh_a)_p Anthropogenic structure - Supports
- lh_a)_s Anthropogenic structure - Pipeline
- lh_a)_g Anthropogenic structure - Former vessel loading facility, jetty or riprap

REFERENCES

Barrie, J.V. and Hill, P.R., Conway, K.W., Iwanowski, K. and Picard, K., 2005. Environmental Marine Geoscience 4: Georgia Basin Seafloor features and geomarine geobasins. Geoscience Canada, 32(4), p. 145-150.

Barrie, J.V., Conway, K.W., Picard, K. and Greene, H.G., 2009. Large-scale sedimentary bedforms and sediment dynamics on a glacial tectonic continental shelf: Examples from the Pacific margin of Canada. Continental Shelf Research 29, p. 796-806.

Fisheries and Oceans Canada, 2006. Rockfish Conservation Areas, Fisheries and Oceans Canada, Pacific Region, 177 p.

Greene, H.G., Yoklavich, M.M., Starr, R.M., O'Connell, V.M., Wakefield, W.W., Sullivan, D.E., McRea, Jr., J.E., and Callist, G.M., 1999. A classification scheme for deep seafloor habitats. Oceanologica Acta, 22(3), p. 693-697.

Greene, H.G., Bazzani, J.J., O'Connell, V.M., and Byliniuk, C.K., 2007. Construction of digital potential marine benthic habitat maps using a coded classification scheme and its application in the San Juan de Fuca Strait: a digital geological and geophysical atlas. Characterization. Geological Association of Canada, Special Paper 47, p. 141-155.

Mosher, D.C. and Johnson, S.Y. (eds.), Rathwell, G.J., Kung, R.B., and Rhies, S.B. (compilers), 2000. Neotectonics of the western Juan de Fuca Strait: a digital geological and geophysical atlas. Geological Survey of Canada Open File 3621.

Pugnet Sound Ambient Monitoring Program, 2002. 2002 Pugnet Sound Update: Eighth Report of the Pugnet Sound Ambient Monitoring Program. Pugnet Sound Water Quality Action Team.

Thompson, R.E., 1981. Oceanography of the British Columbia Coast. Canadian Fisheries and Aquatic Sciences, Special Publication 55, 281 p.

AUTHORS: K. Picard, C. Endris, H.G. Greene, and J.V. Barrie

Compilation by K. Picard and C. Endris

Edited by H.G. Greene and J.V. Barrie

ACKNOWLEDGEMENTS: Canadian Hydrographic Service participants R. Harn, K. Zlotter, E. Sargent, P. Milne, J. Gagne, C. Lessels, D. Cartwright, K. Lyngberg, and Canadian Coast Guard participants G. Allison and A. Keene

This map was produced by the Center for Habitat Studies at Moss Landing Marine Laboratories in cooperation with Tomolo, the Seafloor Society, Natural Resources Canada, and the Canadian Hydrographic Service

Digital Cartography by C. Endris, Center for Habitat Studies

OPEN FILE
DOSSIER PUBLIC
6625

GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA

2011

SHEET 1 OF 4
FEUILLET 1 DE 4

Open files are products
that are made available
through the GSC formal
publication process.

Les dossiers publics sont
des produits qui sont
mis en vente au
processus officiel de
publication de la GSC.

Map Index

Sheet 1 of 4, Haro Strait
Picard, K., Endris, C.

Recommended citation:
Greene, H.G. and Barrie, J.V., 2011. Potential marine benthic habitats and shaded seafloor relief, southern Gulf Islands and San Juan Archipelago, Canada and U.S.A., Geological Survey of Canada, Open File 6625, scale 1:50 000. doi:10.4095/28230