Marine Biological Survey of Rapidly Eroding Coastal Environments, Sachs Harbour, NWT

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INTRODUCTION

Understanding Arctic benthic marine habitats is a fundamental step for monitoring environmental change and for assessing the environmental impacts of climate change. Increased ground temperatures and permafrost degradation reduces slope stability and increases the frequency of slumping (Aylsworth et al. 2001) (*see Figure 1*). Erosion rates are increased by sea-level rise, reduced sea ice cover, and increased late summer storm activity (Solomon et al. 1993). Climate change and erosion induce greater wave disturbance and increases flux of fine sediment into nearshore benthic environments, with potential effects on nutrient availability, grain-size distribution, and organic content. Change in substrates affects benthic biota with possible consequences for predator species including Arctic Char and other species consumed by the local community. Sachs Harbour residents who fish for sea-run char have noted a significant decline in catch over the last four to five years (*see Figure 2*). The purpose of this study is to assess the impact of climate change and sedimentation on benthic communities in southwestern Banks Island.

Figure 1. Thaw slumping along the southwestern shoreline near the community of Sachs Harbour.

Figure 2. Checking Arctic Char nets in the Sachs estuary

OBJECTIVES

Objectives:
1) To survey nearshore sedimentary environments and their associated biota in vicinity of Sachs Harbour, N.W.T.
2) To assess the influence of coastal erosion induced sedimentation on benthic communities.

METHODS

Benthic biota, water column structure, and plankton abundance data from seventy stations around Sachs Harbour, on the southwest coast of Banks Island, NWT, were collected during thirty surveys in July-August 2005. Stations sampled were mostly 100 m to 1000 m from shore, along bathymetric profiles measured directly offshore from coastal profiles (*see Figure 5*). Biological sampling included benthic grab samples, drop video camera, surface plankton tows, and CTD profiles (conductivity, temperature, depth, and light transmissivity) (*see Figure 6*). Suspended particulate matter (SPM) concentrations were measured at each station; SPM concentrations at some stations were re-sampled immediately after a rainfall and minor wind event. Benthic environments were distinguished on substrate type (grain size and sediment organic content), and depth. Relationships between sediment and benthic biota will be analyzed by ordination using PRIMER.

Figure 5. Measuring coastal profile, Duck Hawk Bluff southwestern Banks Island.

Figure 6. Mini-ponar grab sampler used to sample marine benthos.

RESULTS

Overall, benthic biodiversity was generally low, and appear to be dominated by sedentary tube-dwelling polycheate worms, along with a few species of errant polychaetes (*see Figure 8a,b*). Shallow (<10 m) nearshore highly mobile rippled sand sheets with low benthic abundance and biodiversity were the dominant habitat sampled within the study area (*see Figure 9c*). Deeper (10-30 m) offshore gravely sand environments hosted a more diverse fauna of infaunal bivalves, polychaetes, and sand dollars (*see Figure 9b*). The most diverse environments in the study area were deep (>20 m) submerged thermokarst lake basins in the outer harbour, which hosted tube-dwelling anemones in addition to bivalves, polychaetes, and echinoderms (asteroids and ophiuroids) (*see Figure 9d,e*). Several tunicates (*Molgula sp.*) were located in the shallow (<5 m) sandy environment of the inner basin (*see Figure 9f,g*). Deep (>20 m) poorly circulated thermokarst lake basins in the inner Sachs estuary were devoid of benthic life. These deep lake basins, located in the inner potion of the Sachs Estuary were hypersaline and anoxic at depth, possibly a result of brine exclusion and estuarine circulation. Benthos around Cape Kellett, (<15 m) cobble-pebble environment hosted a few polychaete species with very low abundance (*see Figure 9a*).

A rainfall and minor wind event from August 8 to 10 caused increased sedimentation in the nearshore zone. Average SPM concentrations within 24 hours after this event increased by 69% (*see Figure 7*). Sediment plumes from small streams suggested that suspended sediment was derived mainly from overland flow and not from resuspension or erosion of material in the littoral zone.

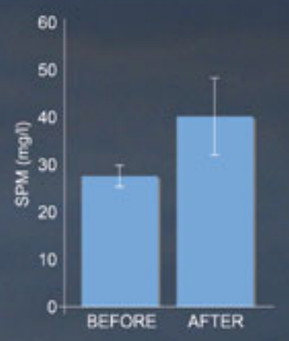

Figure 7. SPM concentration for water samples collected at 10 stations 100 m from shore before and after a rain and minor wind event (August 8-10, 2005) $t_{(1,18)}=2.86$, $p=0.019$.

Figure 8a. Errant marine scale worm (Polynoidae).

Figure 8b. Sedentary agglutinated polychaete worm tubes.

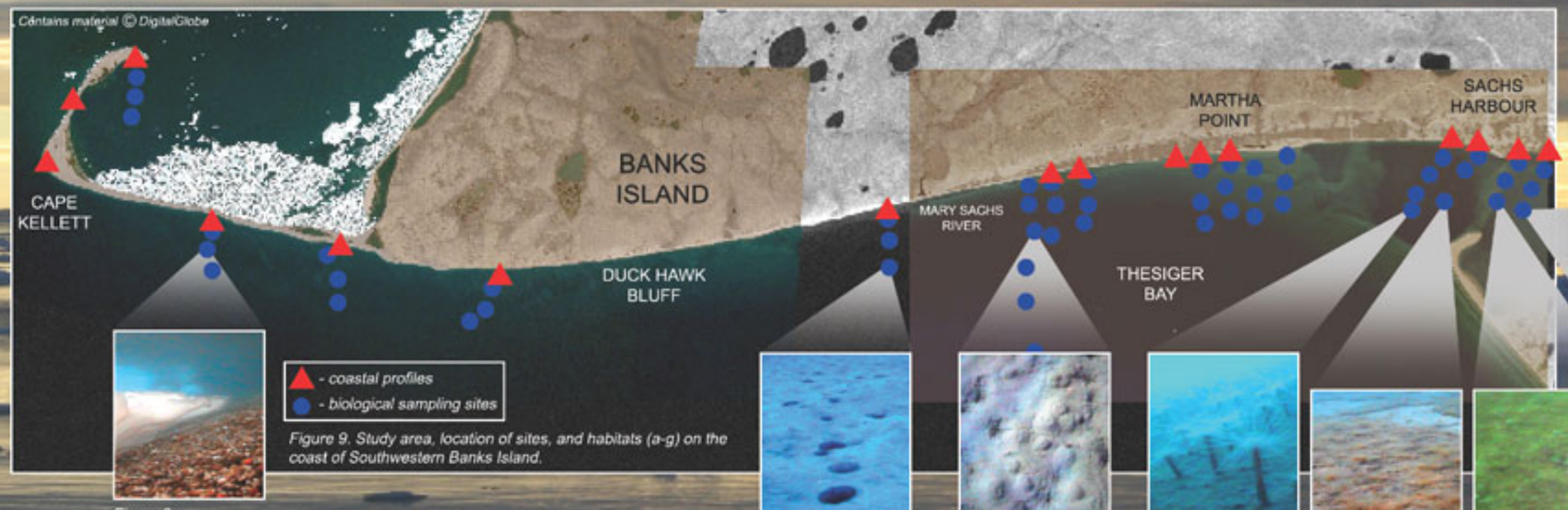

Figure 9. Study area, location of sites, and habitats (a-g) on the coast of Southwestern Banks Island.

Figure 9a. Sea ice resting on cobble-pebbles off Cape Kellett.

Figure 9b. Echinarachnius parma (sand dollars).

Figure 9c. Nearshore sand sheets, with low diversity.

Figure 9d. Cerianthus borealis (tube-dwelling anemones) dominated the deep area of the outer basin.

Figure 9e. Deep silty sand habitat with patches of algae in the outer harbour.

Figure 9f. Shallow sandy habitat with algae in the inner basin.

Figure 9g. Molgula sp. (tunicates) in the inner basin.

GEOLOGICAL SETTING

Sachs Harbour, N.W.T. (71°59' N and 125°14' W), population 153 lies on the southwest coast of Banks Island in the southwestern Canadian Arctic Archipelago (*see Figure 3,4*). Unconsolidated sediments of the Miocene to Pliocene Beaufort formation are overlain by the sandy Sachs Harbour till (Vincent 1983). Continuous permafrost extends to depths greater than 500 m (Harry et al. 1983). Bathymetry of the Sachs Estuary is largely determined by drowned thermokarst lakes in the glacial outwash plain lying southeast of Sachs Harbour. The coastline is characterized as 'highly sensitive' to sea-level rise (Shaw et al. 1998). Current submergence rates of 2.5 mm per year cause coastal retreat due to rapid erosion of coastal cliffs (Solomon 2001, Manson et al. 2005).

Figure 3. Map of Sachs Harbour, Banks Island, N.W.T.

Figure 4. The community of Sachs Harbour, which lies west of the Sachs River Estuary.

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