Site Recovery and Far-field Effects of Spectacle Island Salmon Farm Site in Port Mouton Bay – A Study by Dalhousie University Department of Oceanography facilitated by Friends of Port Mouton Bay with the cooperation of Cooke Aquaculture

The data presented in this report have been generated by the Department of Oceanography, Dalhousie University. This information will be further published in research paper(s) by Dr. Jon Grant of Dalhousie University. The background information and interpretation of data in this report have been prepared by Dr. Ron Loucks and Ruth Smith, Friends of Port Mouton Bay.

A study of sediments in Port Mouton Bay was begun in October 2009 by a team led by Dr. Jon Grant of Dalhousie University's Department of Oceanography. Friends of Port Mouton Bay (FPMB) facilitated and coordinated the field surveys with the cooperation of Cooke Aquaculture.

History of Site

The Spectacle Island fish farm site has cultured salmon continuously for 15 years. The farm was operating at reduced capacity by 2009 and feeding of fish ceased on July 20, 2009 before fallowing.

A significant weather event occurred on August 22, 2009 - Hurricane Bill provided resuspension and extreme scouring of the sea floor. This hurricane caused a shift in the course of nearby Carter's River not seen since ~50 years previously. Did it obliterate the evidence of accumulation of waste at the farm site near Spcectacle Island? No, the evidence was still there to be found, but the likelihood is that the effects were diminished by the scouring that did occur, leaving the sediments to indicate a degree of recovery that would not otherwise have been observed so soon after the onset of fallowing.

Methodology

A grid of 40 stations (Figure 1) encompassed sand, gravel and mud bottom and included the site of the salmon farm near Spectacle Island.

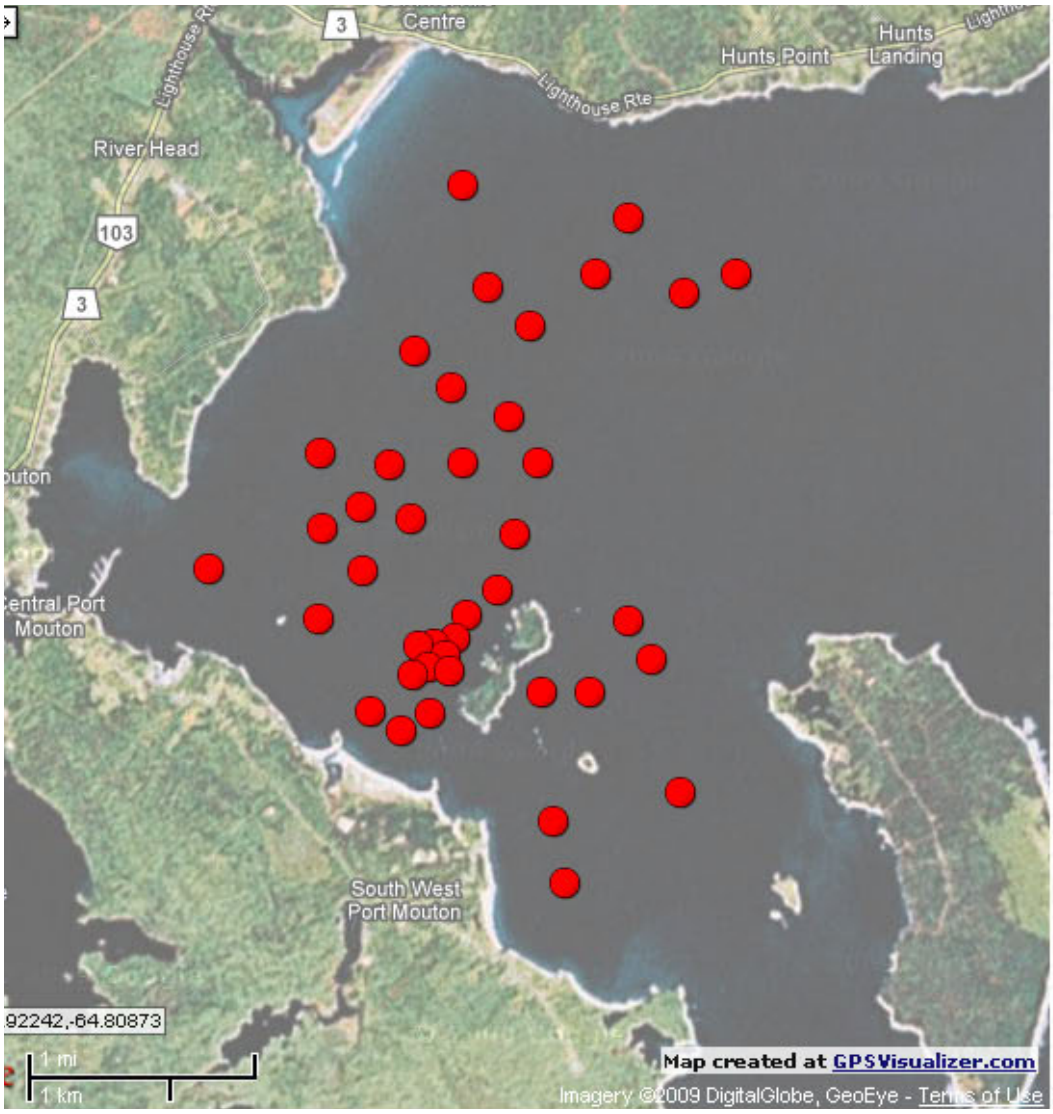

Figure 1. Grid of 40 stations in Port Mouton Bay

Grab samples of sediment were retained at 33 stations on October 7, 2009 and 7 stations on November 7-8, 2009 . Sediment cores using a diver-operated wedge corer were photographed at each station on November 7-8. A portion of the top 2 centimeters of each grab sample was reserved for grain size, organic matter and heavy metal analyses. The remainder of each grab sample was sieved to separate benthic fauna which were preserved for later analysis at Dalhousie University over several months.

The Dalhousie Oceanography analyses include grain size, organic matter, infaunal taxonomy (marine species in bottom sediments), and interpretation of sediment core photographs for sediment profile indices. FPMB undertook requisition of trace metal analysis for samples from 10 stations.

Results

Grain Size of Sediments

The relative grain size of sediments is shown in Figure 2. Largest grain size indicates a greater proportion of sand, smallest grain sizes indicate silt or mud. Smaller grain sizes retain greater amounts of organic matterand indicate depositional areas. The smallest grain sizes are found west of Spectacle Island extending beyond the farm site in north-east, south, and south-west.directions, and are classified as sandy mud (very fine sandy very coarse silt). More distant sites are classified as muddy sand (very coarse silty very fine sand) with largest grain sizes near Hunts Point and near Port Mouton Island classified as sand.

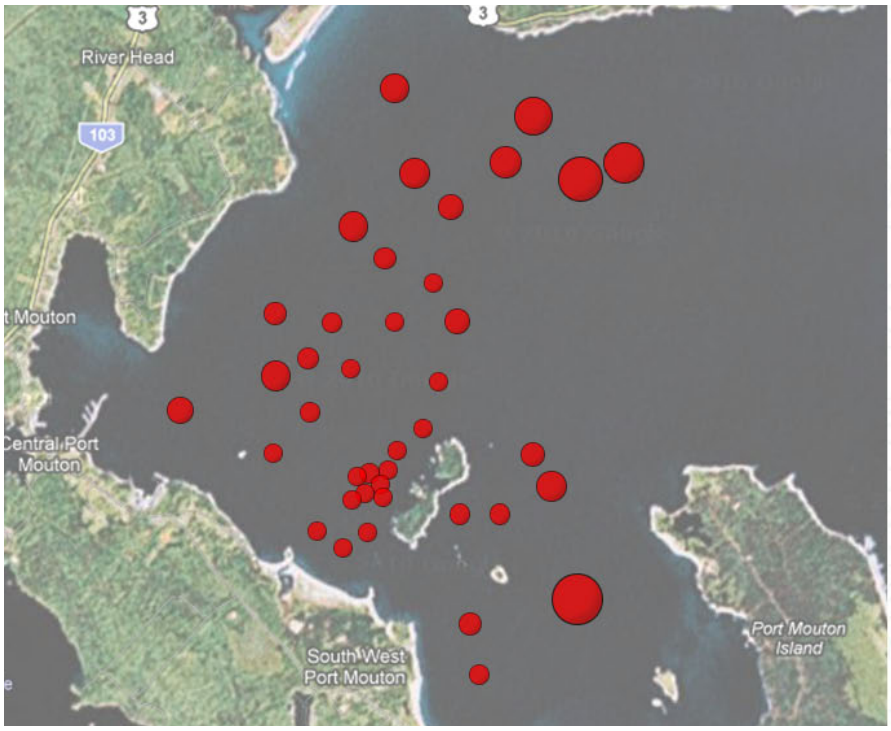

Figure 2 Median grain size of sediments (47 -143 µm) in Port Mouton Bay

Organic Matter

The percent organic matter (Figure 3) reflects the degree of organic enrichment and is naturally a function of grain size. Highest amounts of organic matter (10-12%) are found at the farm site with lesser but elevated amounts extending north, south and south-west at distances from 500 to 1750 m.

A plot of organic matter versus grain size (Figure 4) shows that the amount of organic matter at stations on the farm site and stations north, south and south-west of the farm site is disproportionally greater in relation to grain size and therefore indicates organic enrichment from a source such as aquaculture waste.

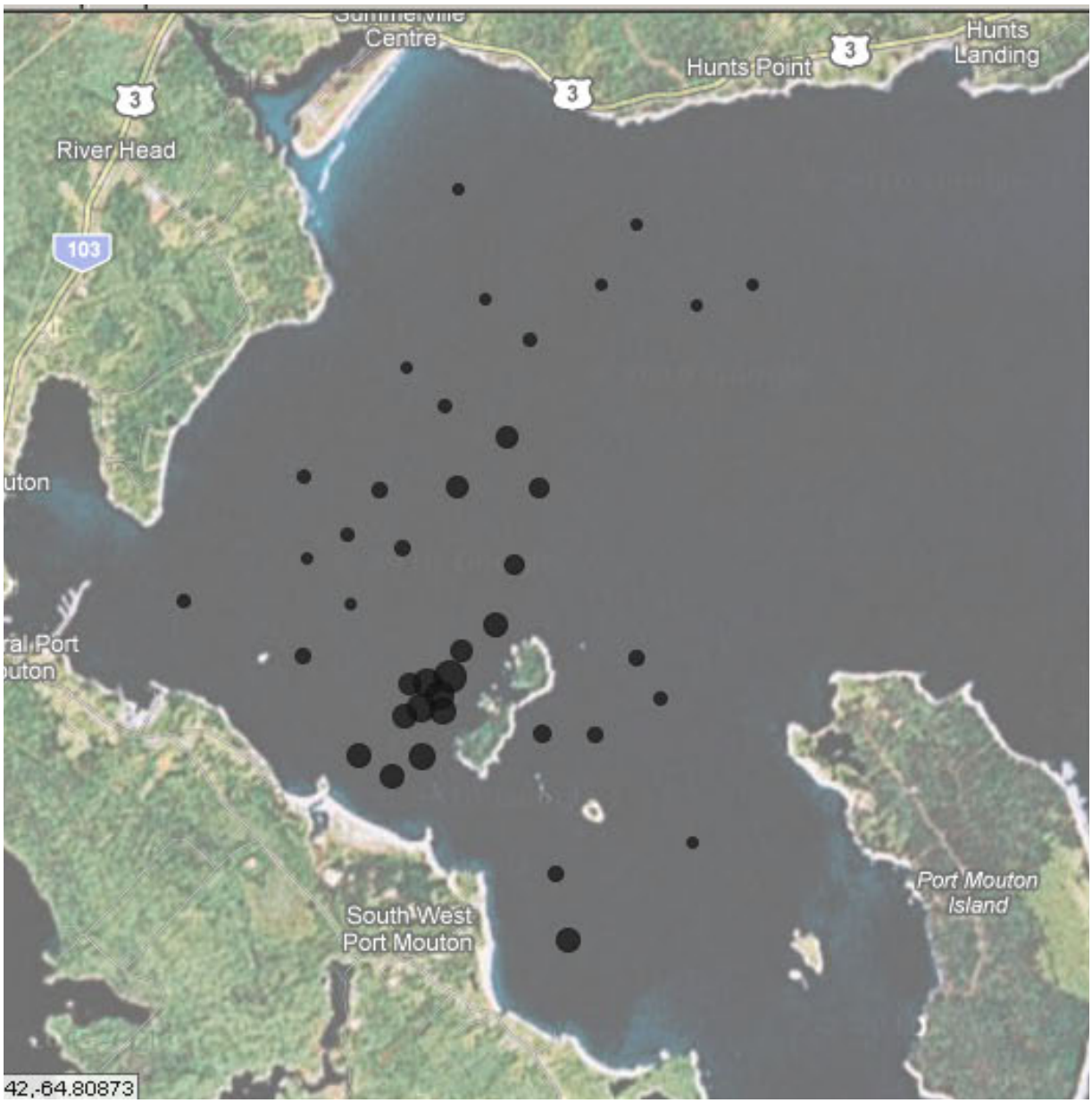

Figure 3. Percent organic matter (<1–12 %) in Port Mouton Bay

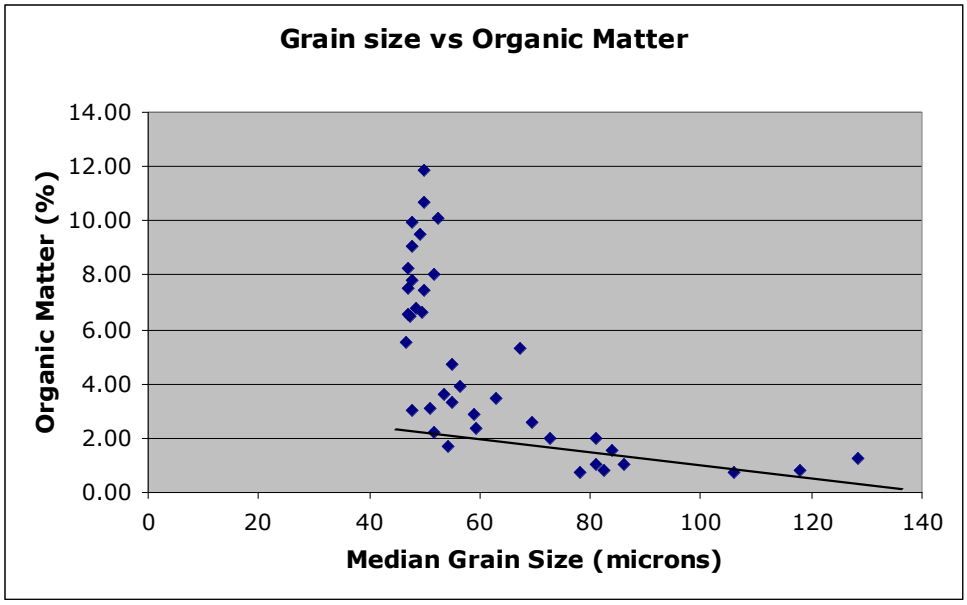

Figure 4. Grain size versus Organic Matter

Benthic Taxonomy

The response of bottom sediment (infaunal) animals to organic enrichment is among the most powerful tools that can be applied to marine environmental assessment. Figure 5 shows the number of different species identified in sediments. A total of 88 species were identified in Port Mouton Bay - ranging from 8 to 37 species at each station. Stations on the farm site exhibit 29% as many species as stations of similar mud bottom most distant from the farm site.

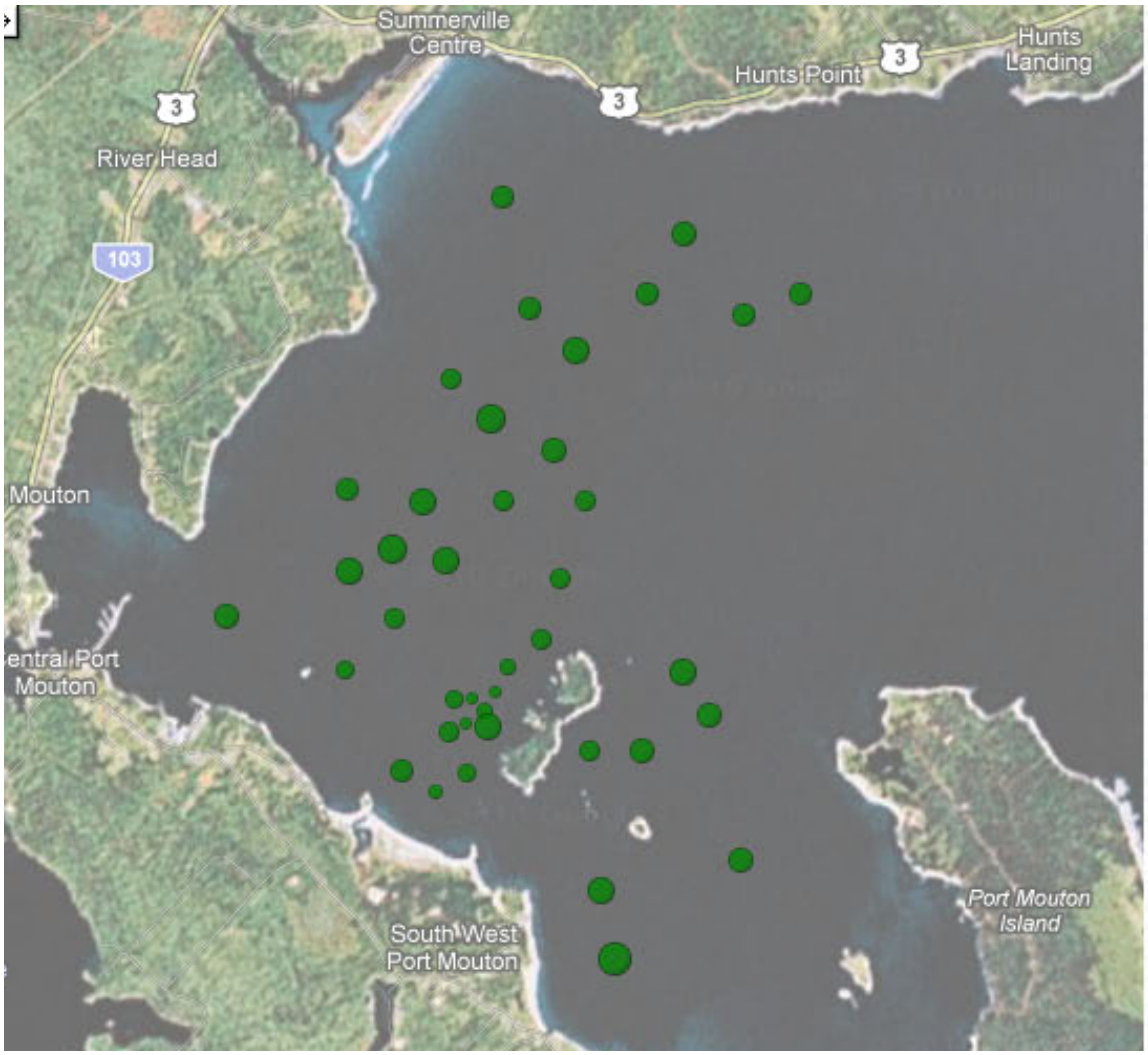

Figure 5. Number of infaunal species (8-37) at stations in Port Mouton Bay

Benthic Biodiversity

- **Shannon-Weiner Index**

This index measures biodiversity of species or 'species richness' (Figure 6). Lowest indices are at the farm site.and some locations north of the farm site.

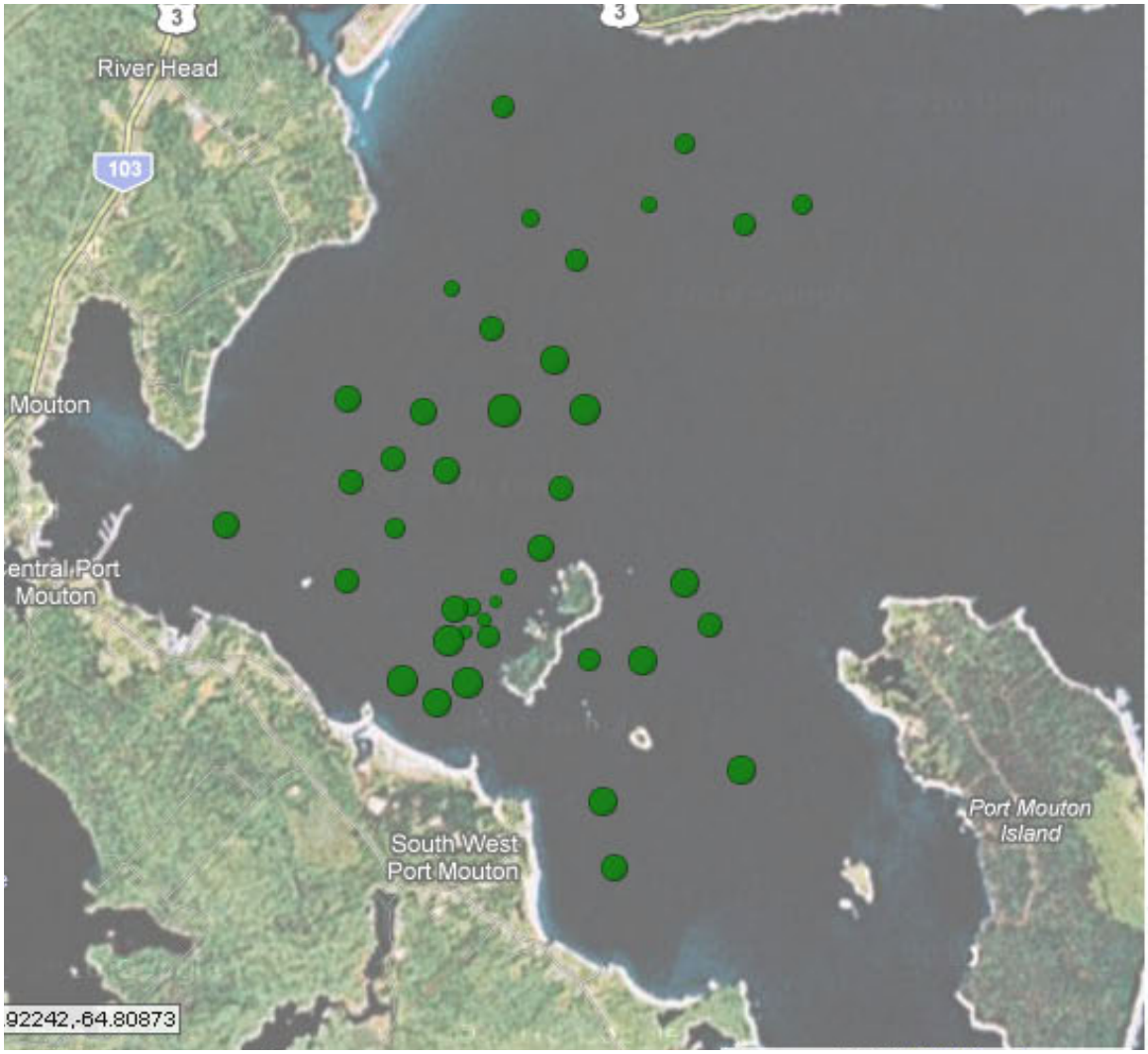

Figure 6. Biodiversity (Shannon-Weiner) Index – 0.8 to 2.6 in Port Mouton Bay

- **M-AMBI**

This Multivariate Assessment of Marine Benthic Index (M-AMBI) is an index of sediment health, including the number of species, abundance of species and a ranking of species from opportunist (scavenger) to more sensitive types. Lowest indices are at the farm site indicating a moderately polluted state.

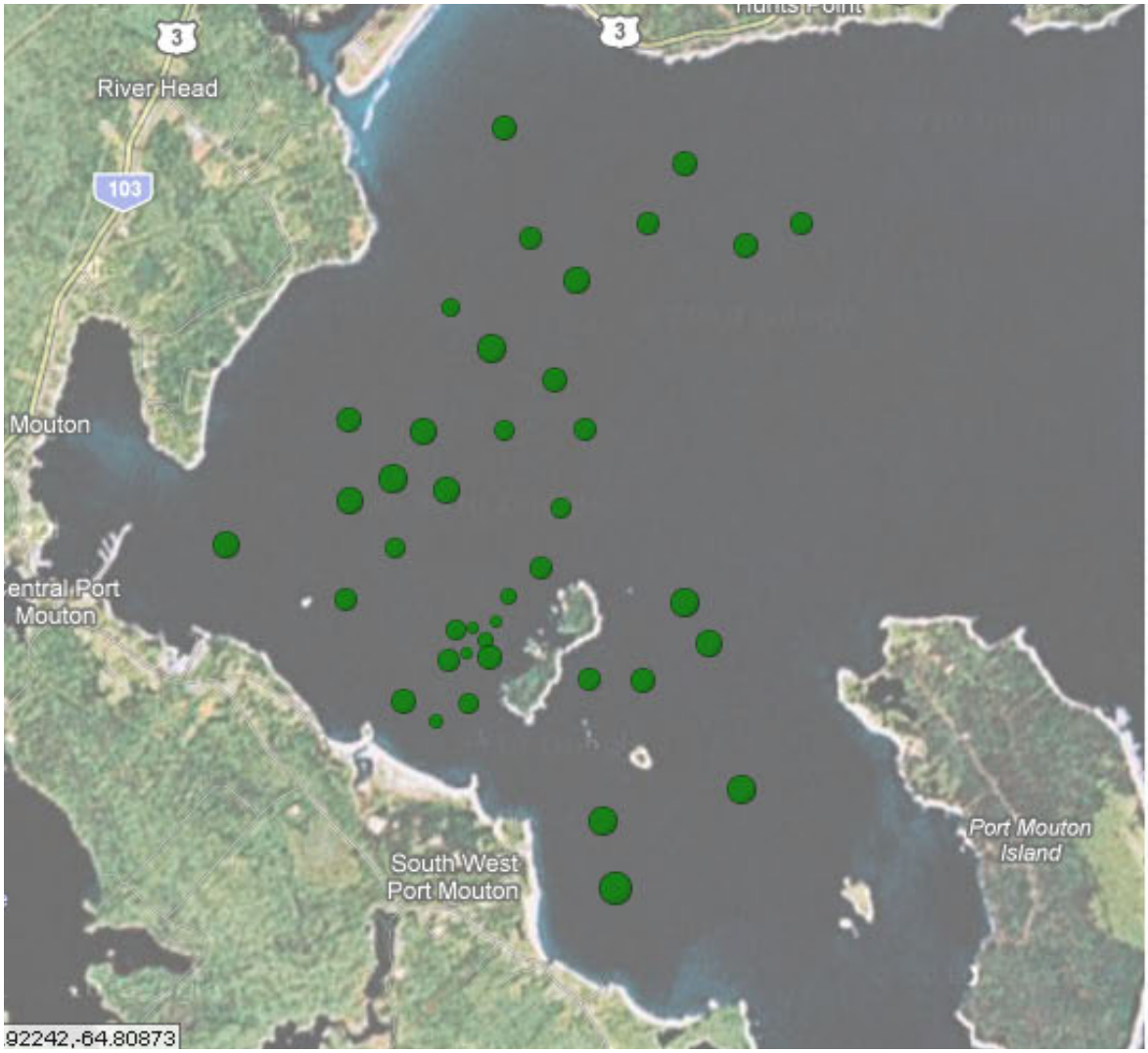

Figure 7. M-AMBI - Index of Sediment Health (0.48 to 0.89) in Port Mouton Bay

Sediment Profile Images

Core samples were digitally photographed to record the sediment profiles. A sediment profile index (SPI).was determined by measuring the area of oxidized sediment from the surface downward in a standarized image width. Dividing the area by the width yielded the average depth of oxidized sediment.

Figure 7 shows the sediment profile index - reversed to indicate a *lack* of oxidized sediment. The three sediment profiles on the farm site exhibited no oxidized sediment. Figure 8 shows a core with oxidized surface sediment and Figure 9 shows one of the cores from the farm site with no oxidized sediment.

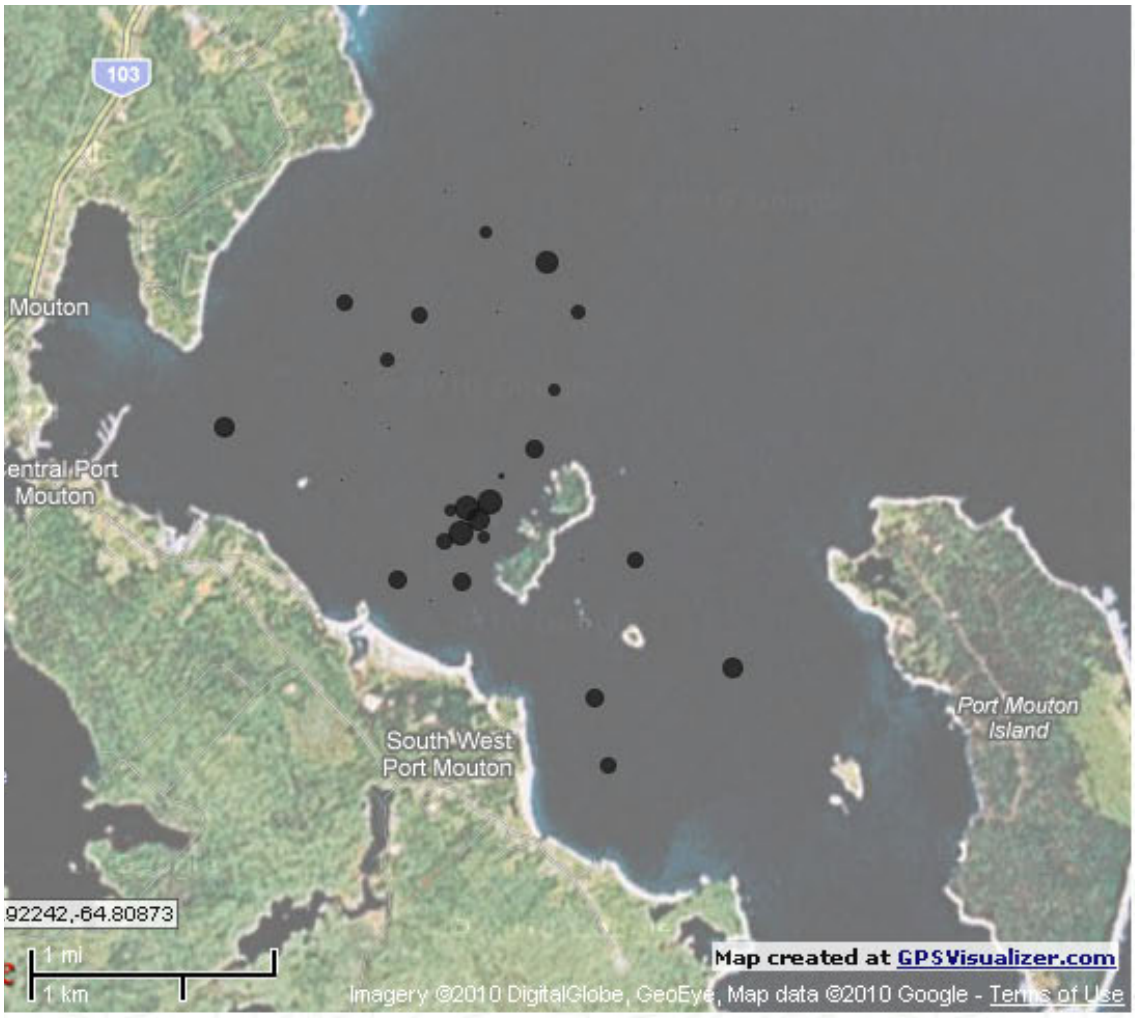

Figure 7. Sediment Profile Index (SPI) in Port Mouton Bay. Chart reflects lack of oxic layer at sediment surface. Oxic layer depths range from 0-7.7 cm. Largest circles indicate little or no oxic layer.

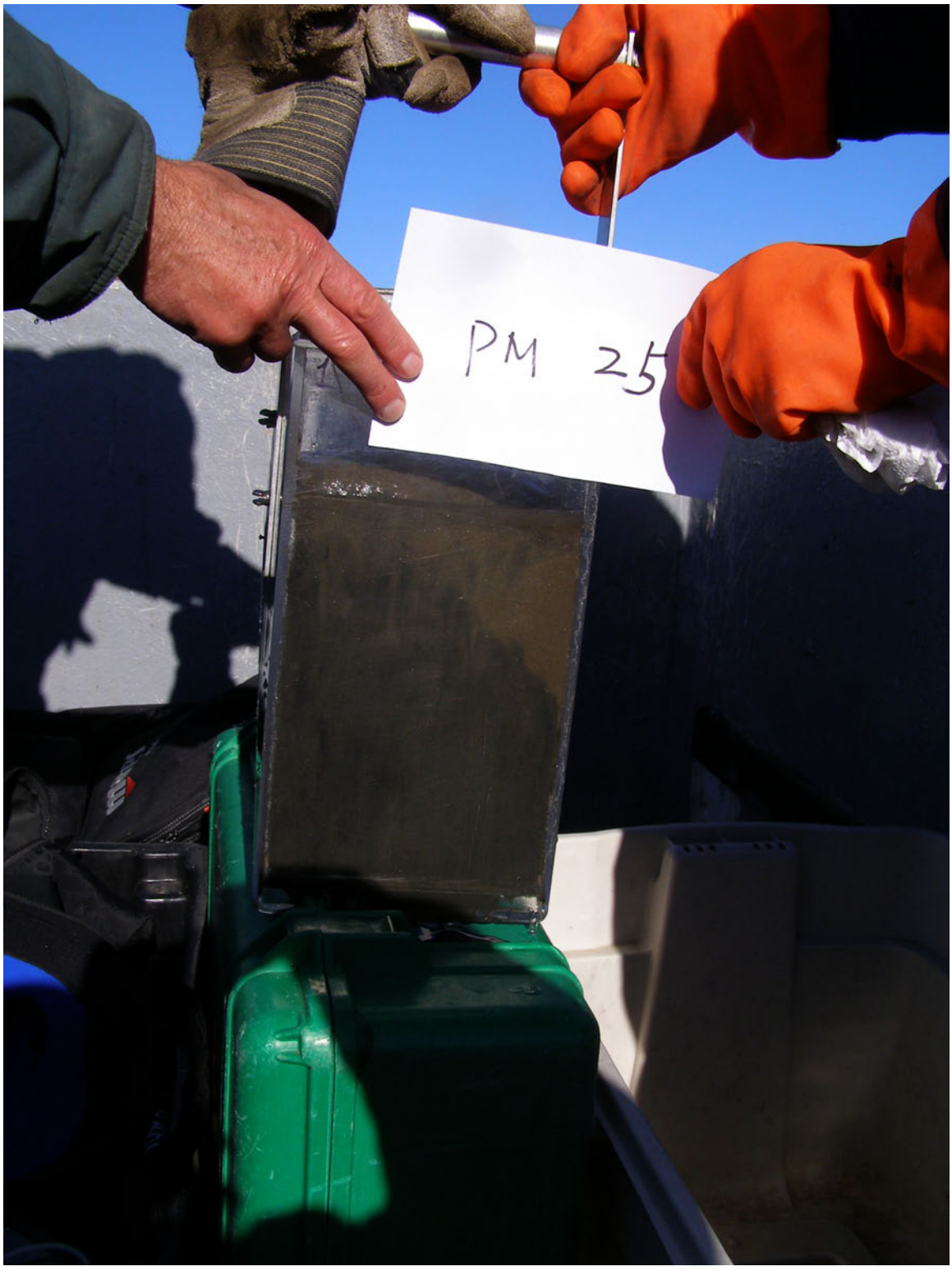

Figure 8. A sediment profile with oxidized surface sediment

A yardstick measure at a station adjacent to the farm site determined that soft silty sediment was deeper that the yardstick. Fishermen report that previous to the fish farm there was 'bottom' here suitable for setting traps and gill nets.

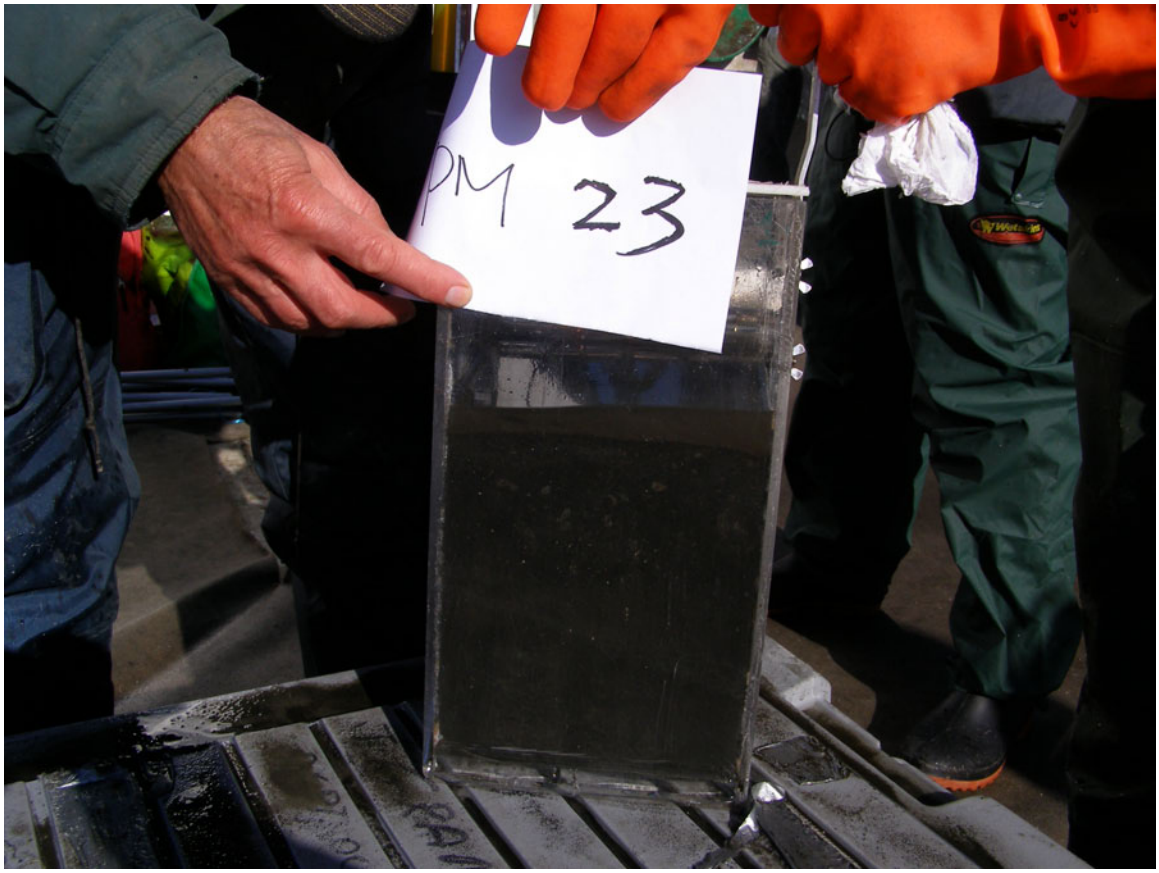

Figure 9. A sediment profile without oxidized sediment at farm site (surface layer is water)

Trace Metals

An analysis of trace metals in sediments is found in a separate report Trace Metals in Sediments of Port Mouton Bay.

Conclusions

Results from analysis of sediment surveys in Port Mouton Bay in October and November, 2009 for organic matter, species numbers, species diversity, indices of sediment health, sediment profile indices, and trace metals show a consistent pattern – the sediments at the farm site were not recovered and were moderately polluted. Levels of organic matter and trace metals indicated an aquaculture footprint at considerable distances from the farm site.

A further sediment survey in Fall 2010 is planned to monitor the rate of recovery since October/November 2009..

A lobster trap survey conducted by FPMB in late May 2010, Port Mouton Bay Lobster Trap Survey – May 2010 indicates that abundance of market and seed lobsters was negligible in the vicinity of the fish farm and significantly lower in the entire inner bay than in other regions of Port Mouton Bay which experienced marked increases.

A further trap survey is necessary in May 2011 to monitor the rate of recovery of lobster habitat in the inner bay