Introduction

The Norfolk District funded Joe Burnett, from the St. Louis District, to come and demonstrate the capabilities of the RoxAnn Seabed Identification System (Bottom Classification) at some of the Norfolk District's Oyster Bed Restoration sites, in order to evaluate the possible purchase and usage of the RoxAnn System at these and other sites.

Equipment

The RoxAnn Seabed Identification System is a system that uses the intensity values from the first and second echo returns of a single-beam echo sounder to determine the "roughness" and "hardness" of the sonar's reflection off the bottom.

The RoxAnn System comes in two (2) different configurations: 1) a stand-alone model and 2) a "piggy-back" model. The first, the stand-alone version, comes complete with its own built-in transmit and receive echosounder and transducer, and comes fully calibrated from the factory ready to collect the bottom classification information. The second, the "piggy-back" version, receives the return signal from a standard stand-alone Single Beam Echosounder, such as the Innerspace 448, by using a junction box in the transducer cable. The junction box allows the return signal to be split and sent to the receiver boards on both the Echosounder and RoxAnn. The "piggy-back" version was used for this demonstration and evaluation.

The RoxAnn receiver board breaks down the return signal, from the Single Beam Echosounder, into intensities values for the first and second echo returns. The first echo provides the RoxAnn System the "roughness" values for the bottom, or **e1**'s, and the second echo provides the "hardness" values for the bottom, or **e2**'s. Once these values are recorded, a simple XY Grid can be modeled with inner rectangles that are used to categorize and delineate between the different bottom classifications. (See Figure 1)

The RoxAnn System is a useful tool for identifying the different strata that cover a body of water's bottom. A key point to remember, however, is that the RoxAnn System only identifies the material that is covering the bottom, it does not identify sub-bottom material or characteristics. For example, if a storm surge has caused an unusual amount of silt or sand or other material to migrate into an area where a known Oyster Bed is located, the RoxAnn System may show that the Oyster Bed does not exist, due to the material that now covers it. It may take another hydraulic event or time and "topsoil dissipation" to uncover the Oyster Bed, in order that the RoxAnn System can properly determine its characteristics.

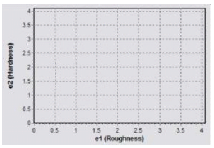


Figure 1

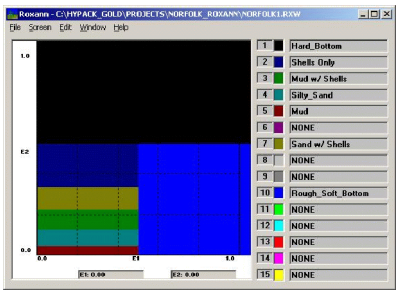
Demonstration

On Monday, 25 August 2003, the St. Louis District's RoxAnn System and Innerspace 448 Single Beam Echosounder were installed on Waterway Surveys and Engineering survey boat for initial testing. The initial testing was done in the near vicinity to the Norfolk's District Fleeting Dock. Two (2) different and distinct bottom materials were identified by the RoxAnn System and verified with actual bottom samples that were gathered by the Waterway's crew. The first sample was a silty, organic-based sediment material. The RoxAnn System depicted this sample as a very soft and very smooth material. The second sample was full of broken Oyster Shells that ranged from 1"-3" in diameter. The RoxAnn System depicted this sample as being much harder and rougher than the first sample. Since no other known bottom classifications indigenous to this area existed, the testing phase was considered complete, and the system was packed up and mobilized to the Piankatank and Great Wicomico River Areas.

On Tuesday, 26 August 2003, the system was re-installed on Waterway's survey boat and two (2) sites on the Piankatank River were surveyed and "ground-truthed" (ie. bottom samples taken). At each "ground-truthing" site, a calibration file was also collected, in order to better establish the inner rectangles that comprise the RoxAnn Square.

On Wednesday, 27 August 2003, ten (10) sites were surveyed and "ground-truthed" on the Great Wicomico River. That evening, the 24 "ground-truth" samples were analyzed, along with their respective calibration files, and six (6) distinct bottom classifications were identified. A new RoxAnn Square was created (See Figure 2), according to these identifications, in order that all future data collected in these areas could be properly classified and displayed during real-time data collection and post-processing.

On Thursday, 28 August 2003, we returned to the Piankatank River area and collected RoxAnn data at two (2) additional sites. Thirteen (13) additional "ground-truthing" samples were also collected. However, before each sample was collected, Joe Burnett would tell everyone what the RoxAnn System expected to be in the sample. It was correct on all



thirteen (13) samples. This was verified by Bob Taliaferro of Waterway.

On Friday, 29 August 2003, Joe Burnett processed the RoxAnn data in preparation for the final plots of each area.

Figure 2

Evaluation

Ray Williams, POC for the Norfolk District on this Project, provided Joe Burnett with electronic charts of the areas surveyed. These charts included the geo-referenced locations of the identified hard-bottom areas as provided by VIMS (Virginia Institute of Marine Science). The results from the RoxAnn generated plots show that they match the areas identified by VIMS with high precision and accuracy.

The plots from the RoxAnn System are contained in the following pages. A legend is provided is provided on each plot. There are two (2) plots for each site, one that shows the actual tracklines of the data collected using the RoxAnn Square Colors and one that has the triangulated RoxAnn Colors for showing possible full coverage of the area surveyed. I t should be noted that the triangulation was across lengths as great as 600' and may not accurately depict the true overall orientation of the bottom materials, but could be considered to be very close.

The RoxAnn System can provide much higher resolution and accurate plots, but additional parallel data collection lines (transects) would have to be performed.

Summary

Overall, the RoxAnn System performed well. There were some minor glitches with the initial first echo intensity values (**e1**'s). This was remedied by increasing the draft of the transducer in the water. A full system check will be done to verify that that was the problem.

The RoxAnn Square, that was created from the calibration files and their corresponding “ground-truth” samples, appeared to accurately classify and identify the bottom materials. It should be noted once again, that the RoxAnn System only identifies the top layer of the bottom and does not penetrate in the underlying layers.

The “piggy-back” version of the RoxAnn System was used for this demonstration and evaluation. The “piggy-back” system requires that the Single Beam Echosounder that it is being integrated with, be tuned to the exact frequency that the RoxAnn is set to. If not, attenuation differences will arise and the RoxAnn Square will have to be re-done for each Echosounder that it is connected to. That is why the Innerspace 448 and transducer from the St. Louis District was also used in this demonstration. It was already tuned and calibrated to the RoxAnn System. The transducer that was in the Waterway’s survey boat was tried with the RoxAnn System, but it was noticed that because it was “glassed” into the hull of the boat, that the fiberglass was attenuating the signal and causing significantly different e1 and e2 values in the RoxAnn Square.

Therefore, it is my recommendation that a stand-alone system be utilized in the future. The stand-alone system is already calibrated to itself and would be much more portable than the “piggy-back” system.

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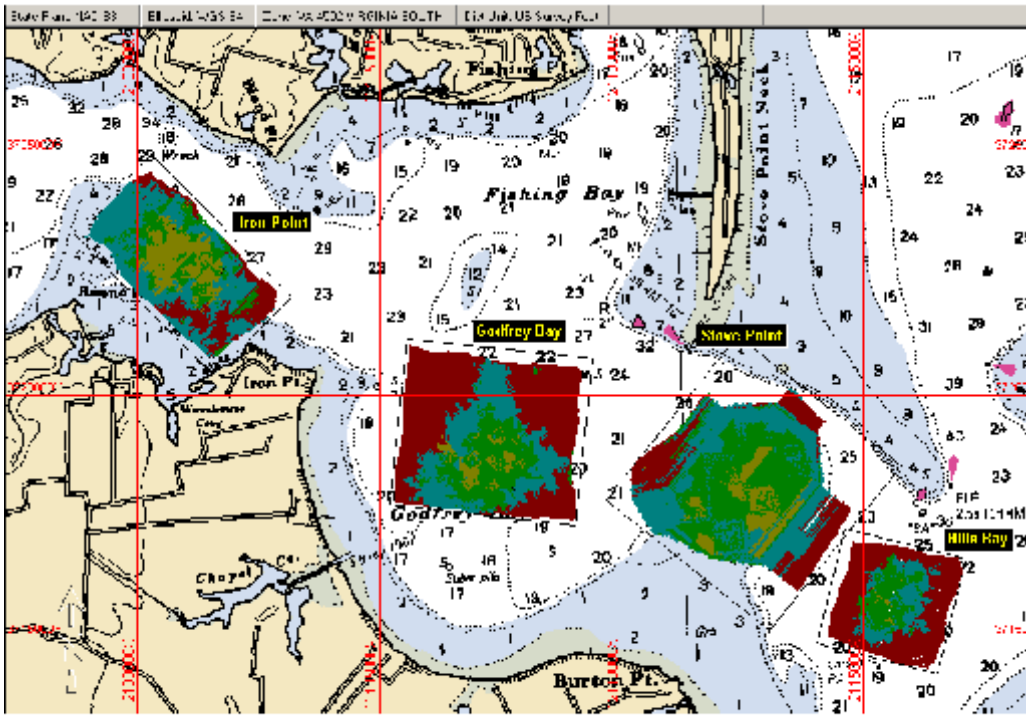
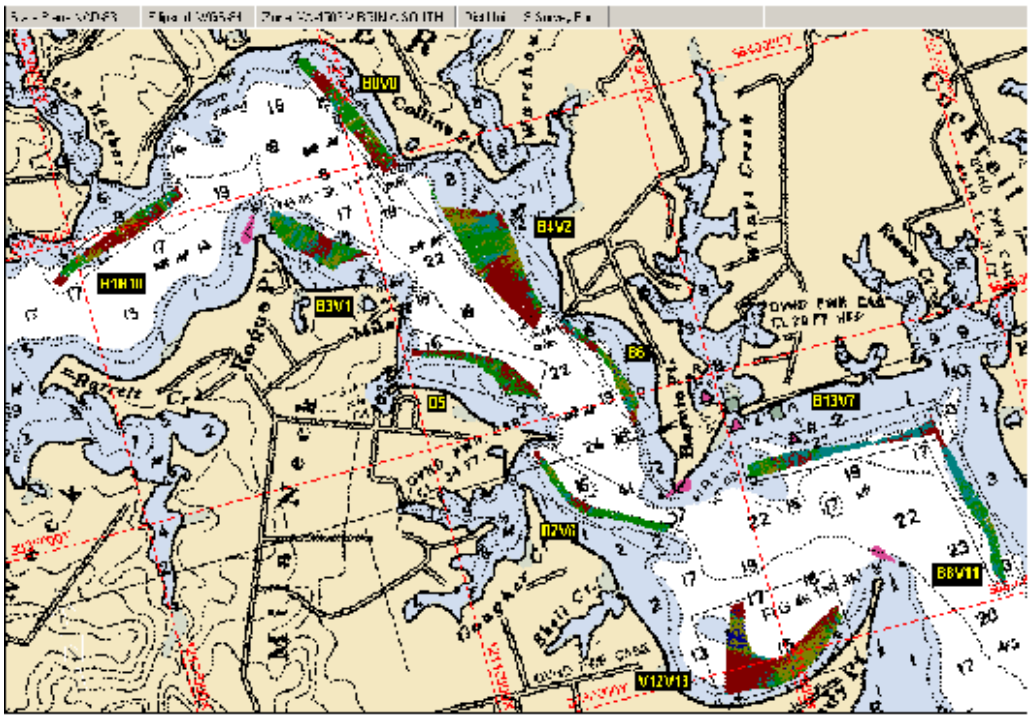
RoxAnn Seabed Identification
Demonstration and Evaluation

Data Collected on the Piankatank and Wicomico Rivers



Piankatank River -- RoxAnn Data Plots



Wicomico River — RoxAnn Data Plots