Development of Temporal Monitoring Techniques for Benthic Habitat Impacts of Tidal Energy

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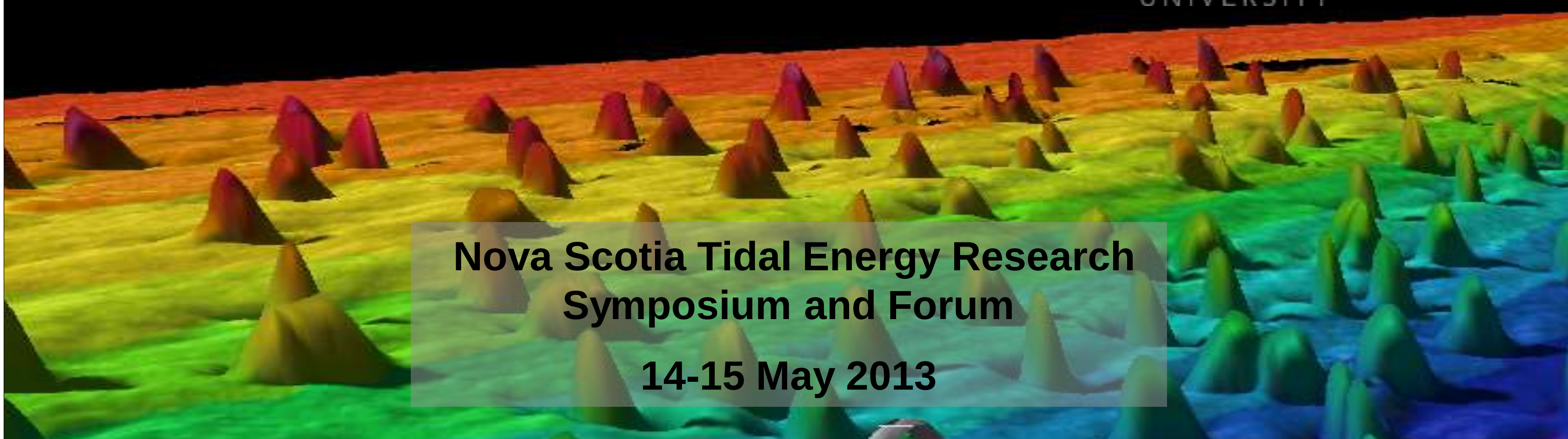
MEMORIAL UNIVERSITY



Nova Scotia Tidal Energy Research Symposium and Forum

14-15 May 2013

Introduction:

Monitoring of the marine (benthic) environment

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underwater TECHNOLOGY

Technical Paper

A review of sublittoral monitoring methods in temperate waters: a focus on scale

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Abstract

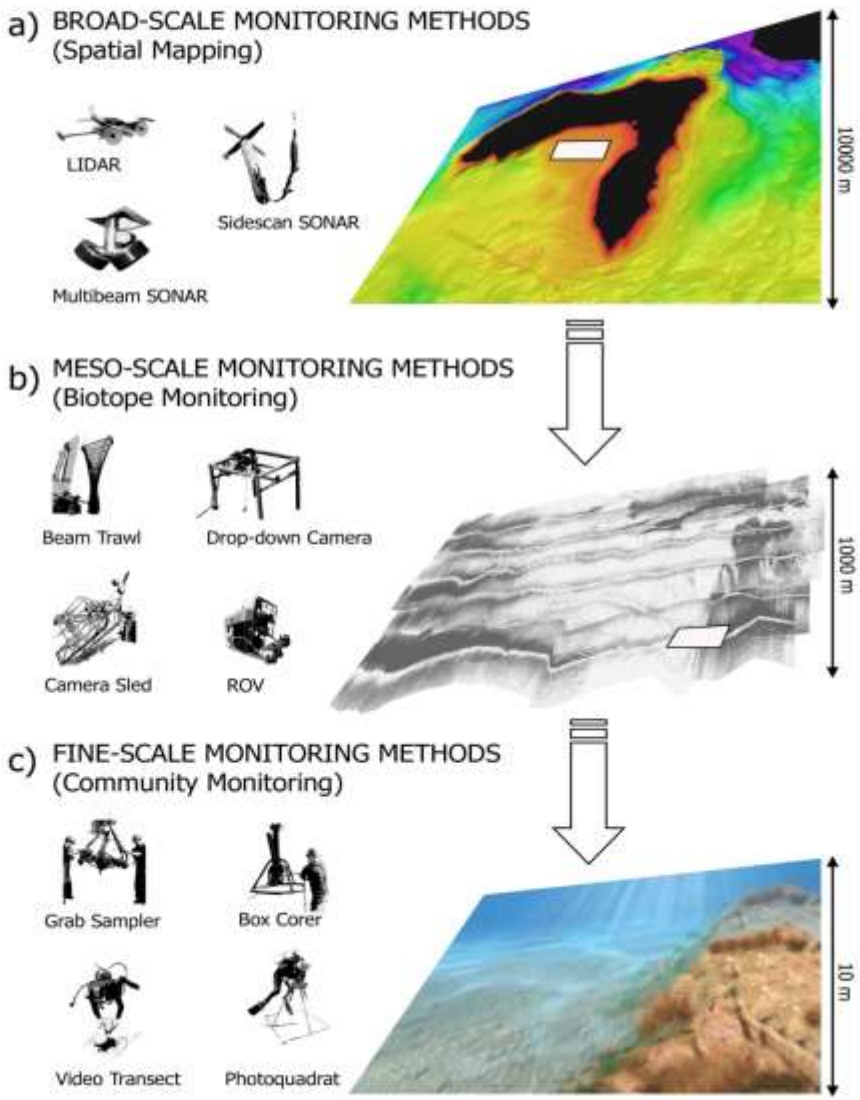
A plethora of methods to monitor shallow sublittoral benthic habitats and communities are available to the marine researcher today. The most widely used methods are reviewed and evaluated, with reference to the spatial scale at which they operate. For ease of comparison, methods are categorised as operating over broad (>1km), meso (10m–1km) and fine scales (<10m). A measure of efficiency and data resolution are

the extent of compliance with a predetermined standard or the degree of deviation from an expected norm.' Monitoring has also been defined as: 'sampling in time with adequate replication to detect variation over a temporal range from short and long time periods, done at more than one location,' (Kingsford and Battershill, 1998). Ecological monitoring programmes are specifically designed to detect trends, or changes from normal

Van Rein, Brown, Quinn, and Breen (2009) A review of sublittoral monitoring methods in temperate waters: a focus on scale. *International Journal of the Society for Underwater technology,* 28 (3): 1-15.

Introduction:

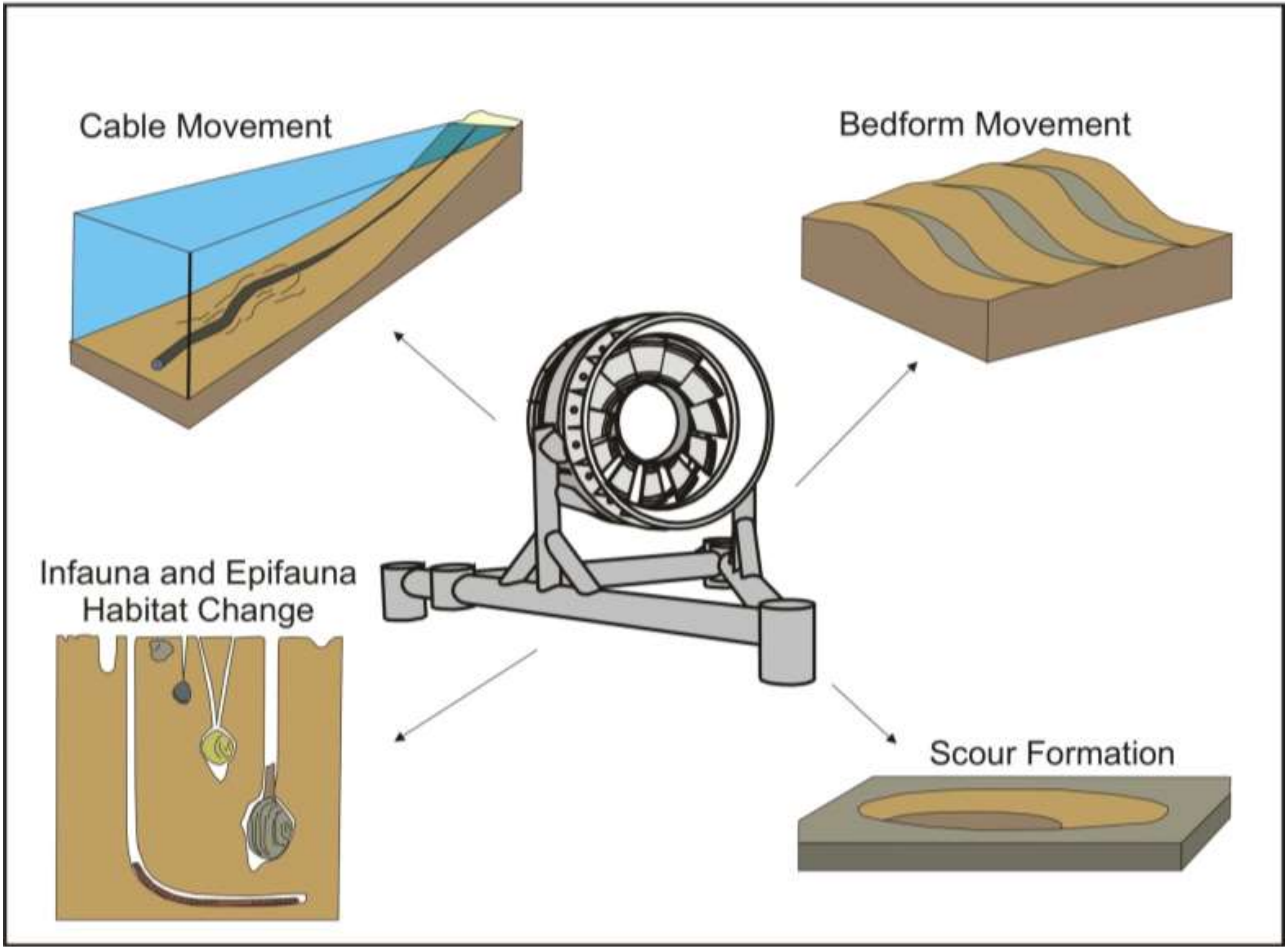
Monitoring of the marine (benthic) environment



Van Rein, Brown, Quinn, and Breen (2009) A review of sublittoral monitoring methods in temperate waters: a focus on scale. *International Journal of the Society for Underwater technology,* 28 (3): 1-15.

Introduction:

Tidal Energy (Benthic) Monitoring Challenges



Project objectives:

“Testing of temporal monitoring techniques for benthic habitat impacts from tidal power developments”

1. Evaluate a suite of acoustic survey techniques (multi beam sonar, sidescan sonar) to measure temporal changes in seafloor characteristics over short (inter-tidal) and longer (inter-annual) time periods **[BROAD-SCALE MONITORING TECHNIQUES]**

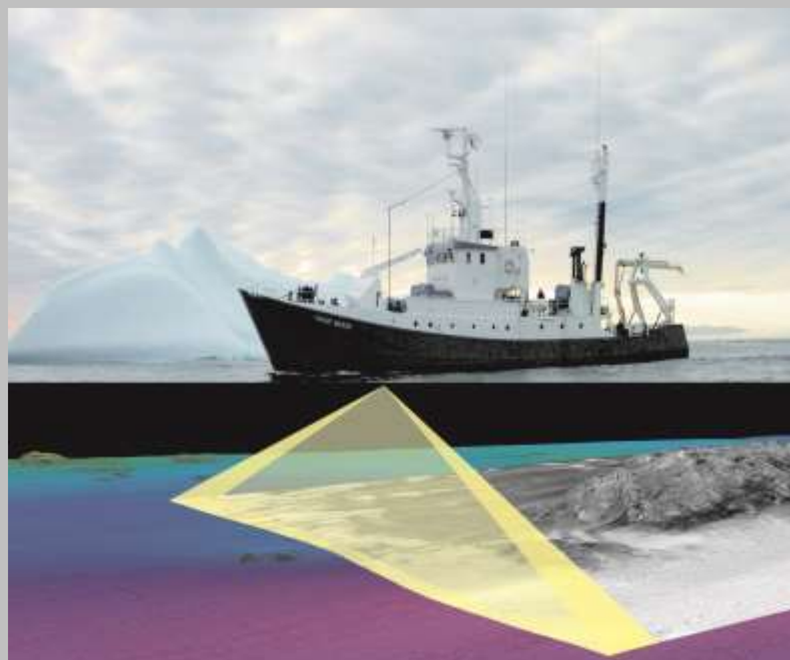
2. Test novel backscatter classification methods (QTC Swathview and Geocoder) for the objective measurement and detection of change in backscatter characteristics over these temporal time-frames at selected case study sites. **[BROAD-SCALE MONITORING TECHNIQUES]**

3. Determine and develop the most appropriate sampling methods for monitoring changes in benthic assemblage structure (both epifaunal and infaunal assemblages). **[MESO- and FINE-SCALE MONITORING TECHNIQUES]**

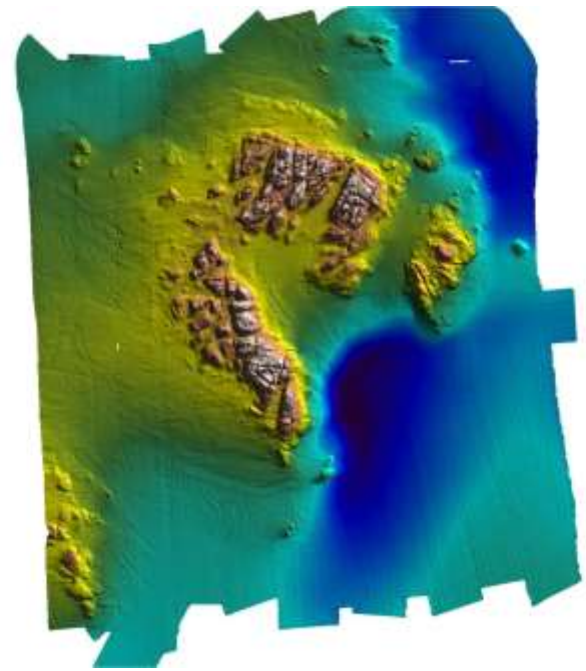
4. Provide recommendations on the most appropriate monitoring techniques (physical and biological) for assessing change in benthic ecosystems in connection with deployment of TISEC devices.

Broad-scale monitoring:

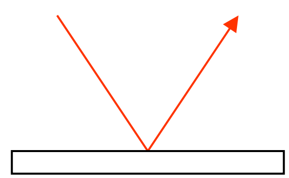
Technological advances – Multibeam Sonar

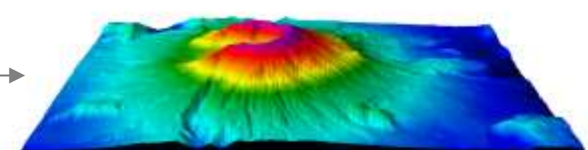


Multibeam Sonar Surveys



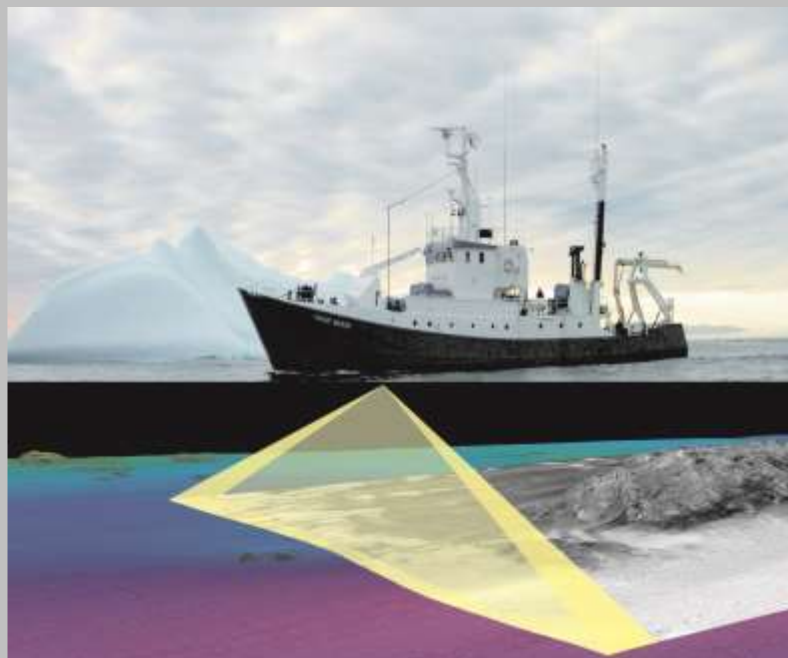
bathymetry





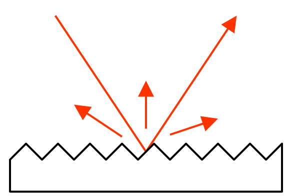
Broad-scale monitoring:

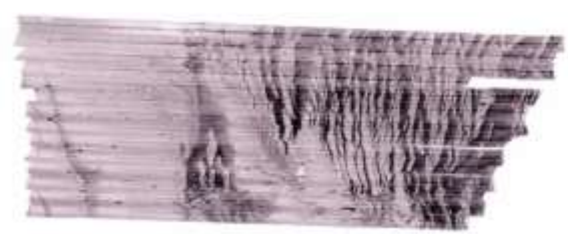
Technological advances – Multibeam Sonar



Multibeam Sonar Surveys

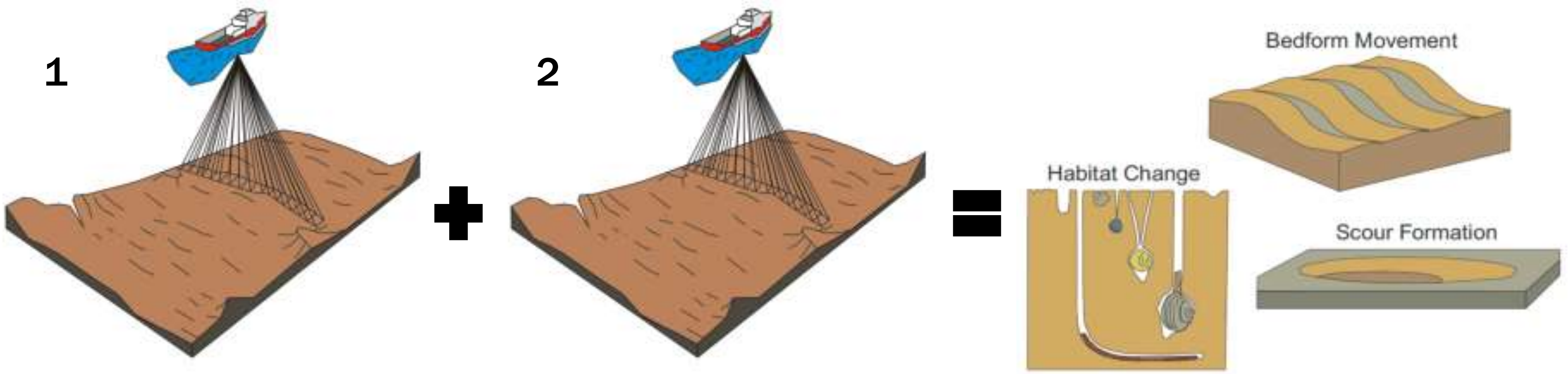
backscatter





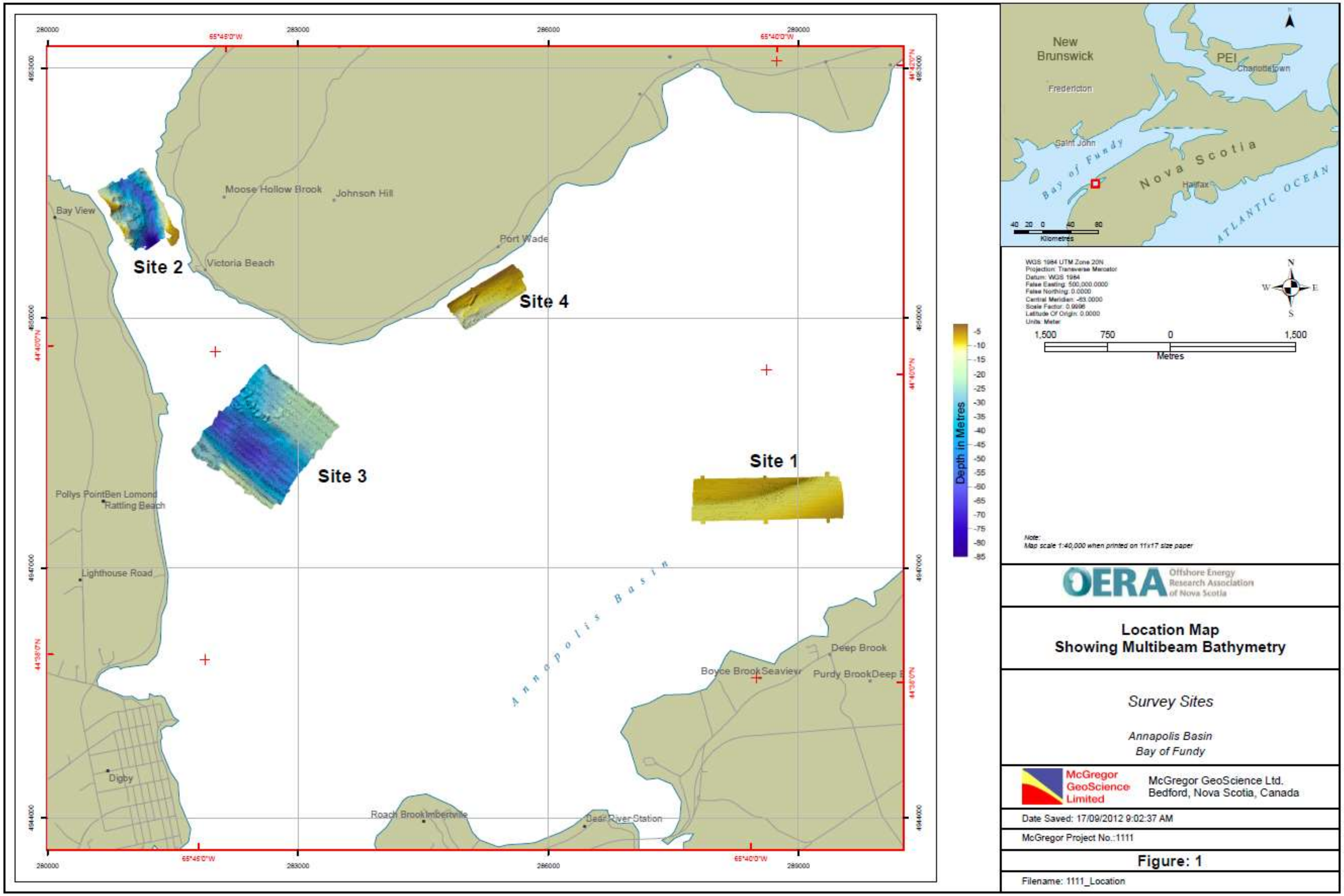
Broad-scale monitoring:
Technological advances – Multibeam Sonar

Objective 1 and 2: Repeat surveys - comparison of bathymetric and backscatter data sets over different temporal time frames



i.e. How successful/useful/sensitive is the approach for detecting changes in geomorphology, sediment composition and benthic habitat change in seafloor habitats?

Study Sites



Site 1
Site 2
Site 3
Site 4
Bay View
Moose Hollow Brook
Johnson Hill
Port Wade
Victoria Beach
Pollys PointBen Lomond
Rattling Beach
Lighthouse Road
Digby
Roach BrookImbertville
Bear River Station
Boyce BrookSeaview
Deep Brook
Purdy BrookDeep B
Annapolis Basin
Depth in Metres
New Brunswick
PEI
Charlottetown
Fredericton
Saint John
Bay of Fundy
Nova Scotia
Halifax
ATLANTIC OCEAN
Kilometres
WGS 1984 UTM Zone 20N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -63.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Metres
Note:
Map scale 1:40,000 when printed on 11x17 size paper
OERA Offshore Energy Research Association of Nova Scotia
Location Map
Showing Multibeam Bathymetry
Survey Sites
Annapolis Basin
Bay of Fundy
McGregor GeoScience Limited
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Bedford, Nova Scotia, Canada
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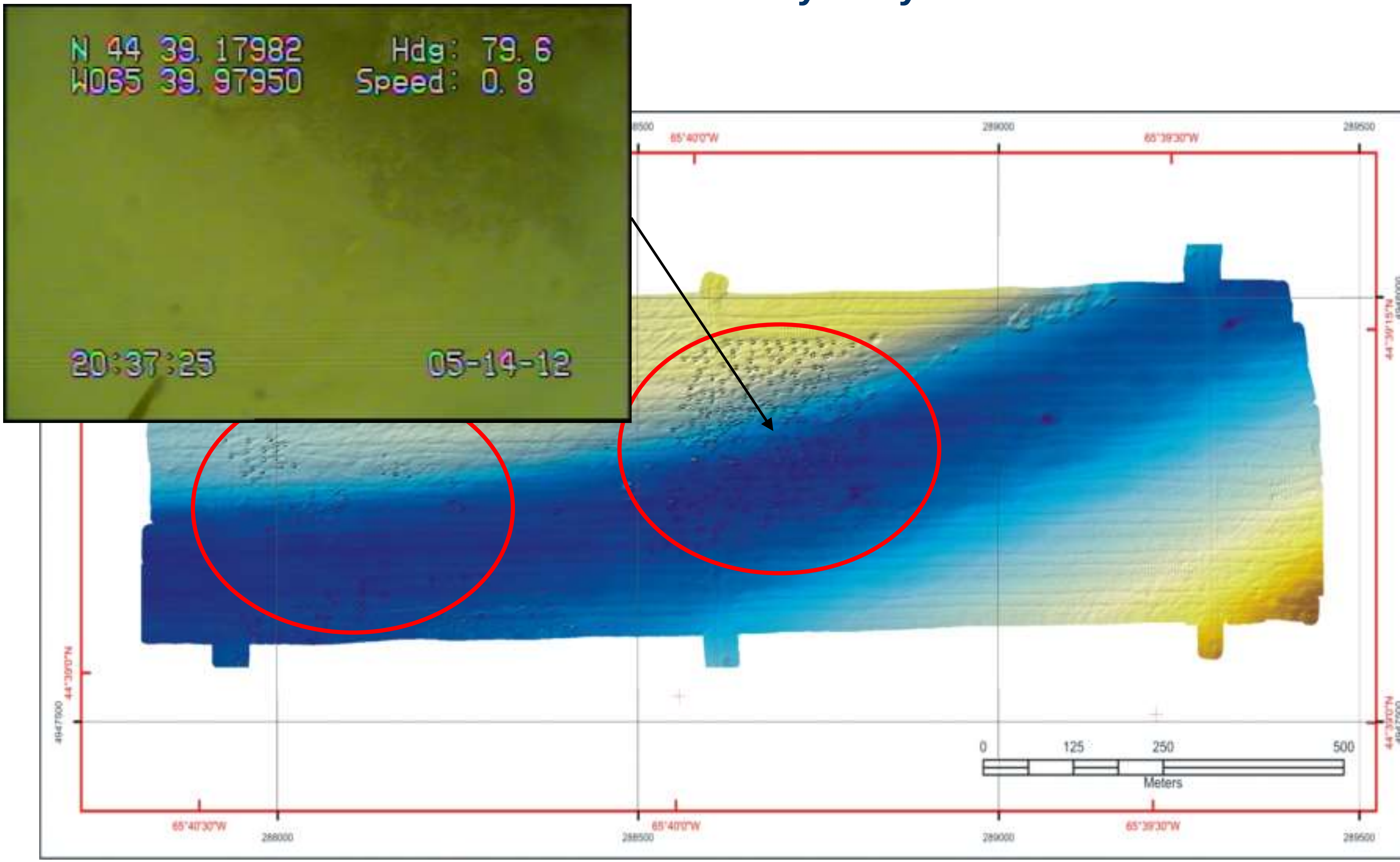
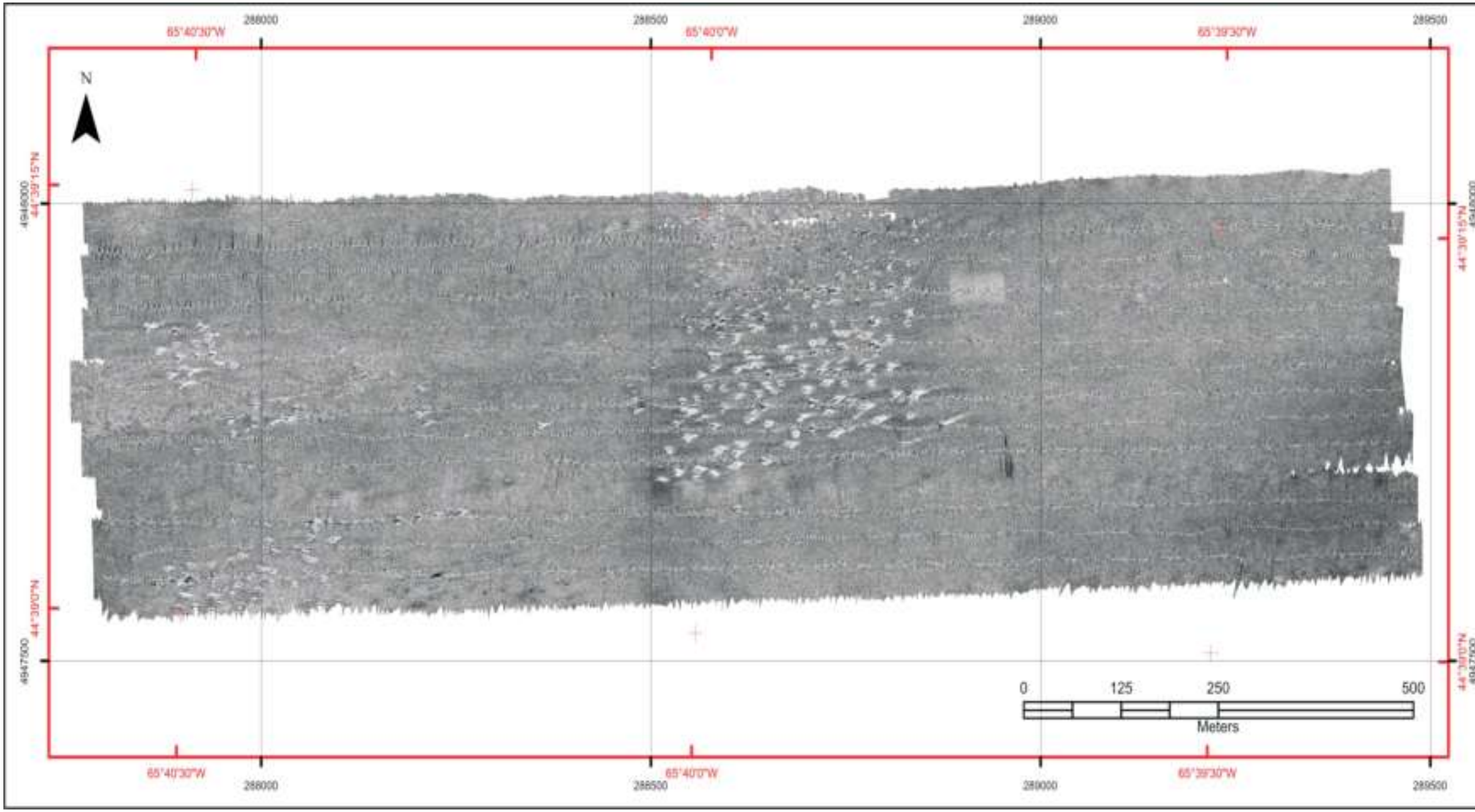
Broad-scale monitoring

Site 1 – Bathymetry



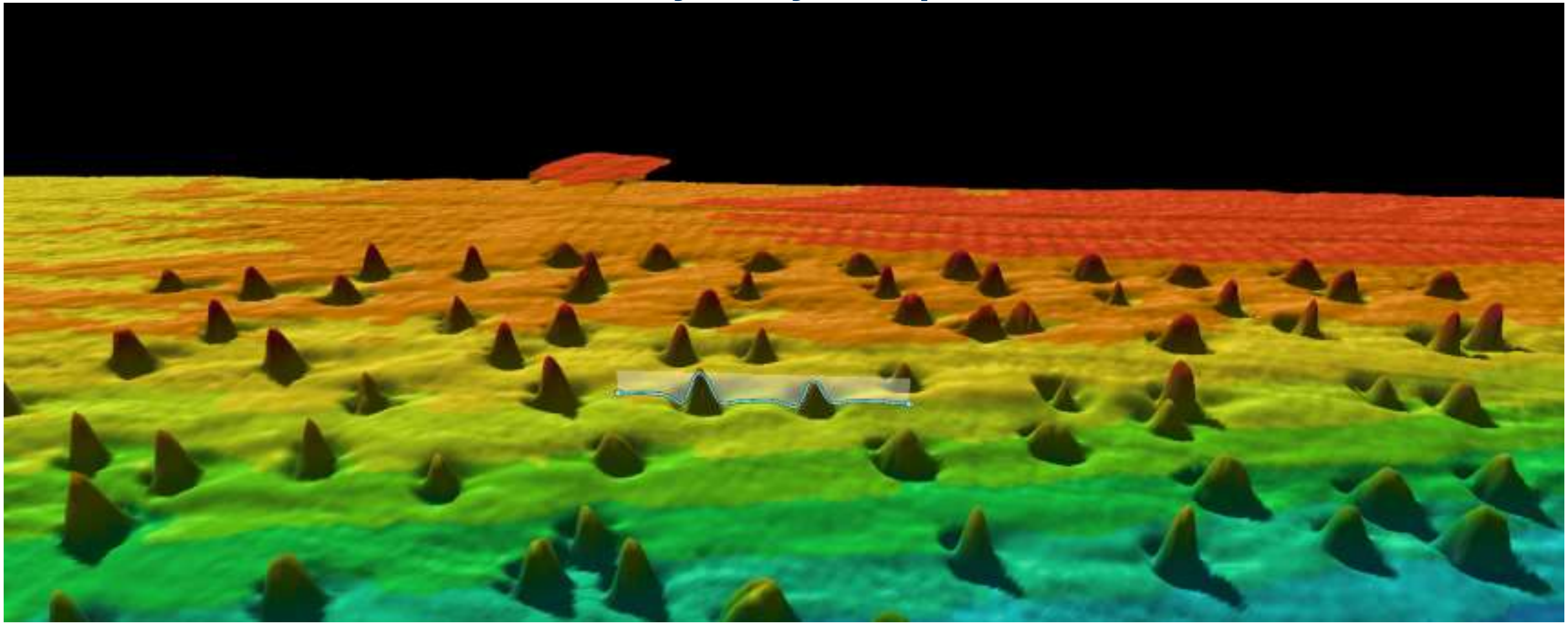
Broad-scale monitoring

Site 1 – Backscatter

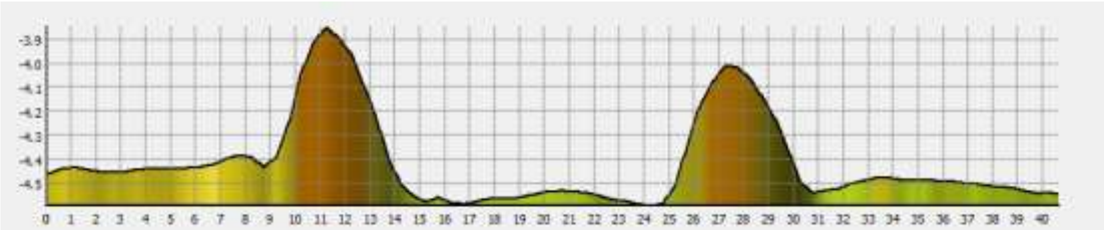


Broad-scale monitoring

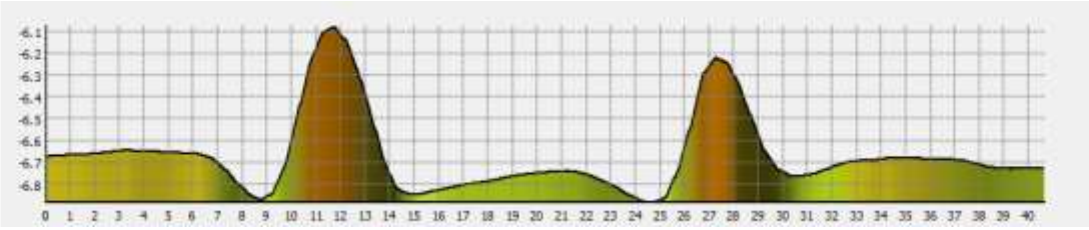
Bathymetry comparison



2012: Site 1 – Survey 1

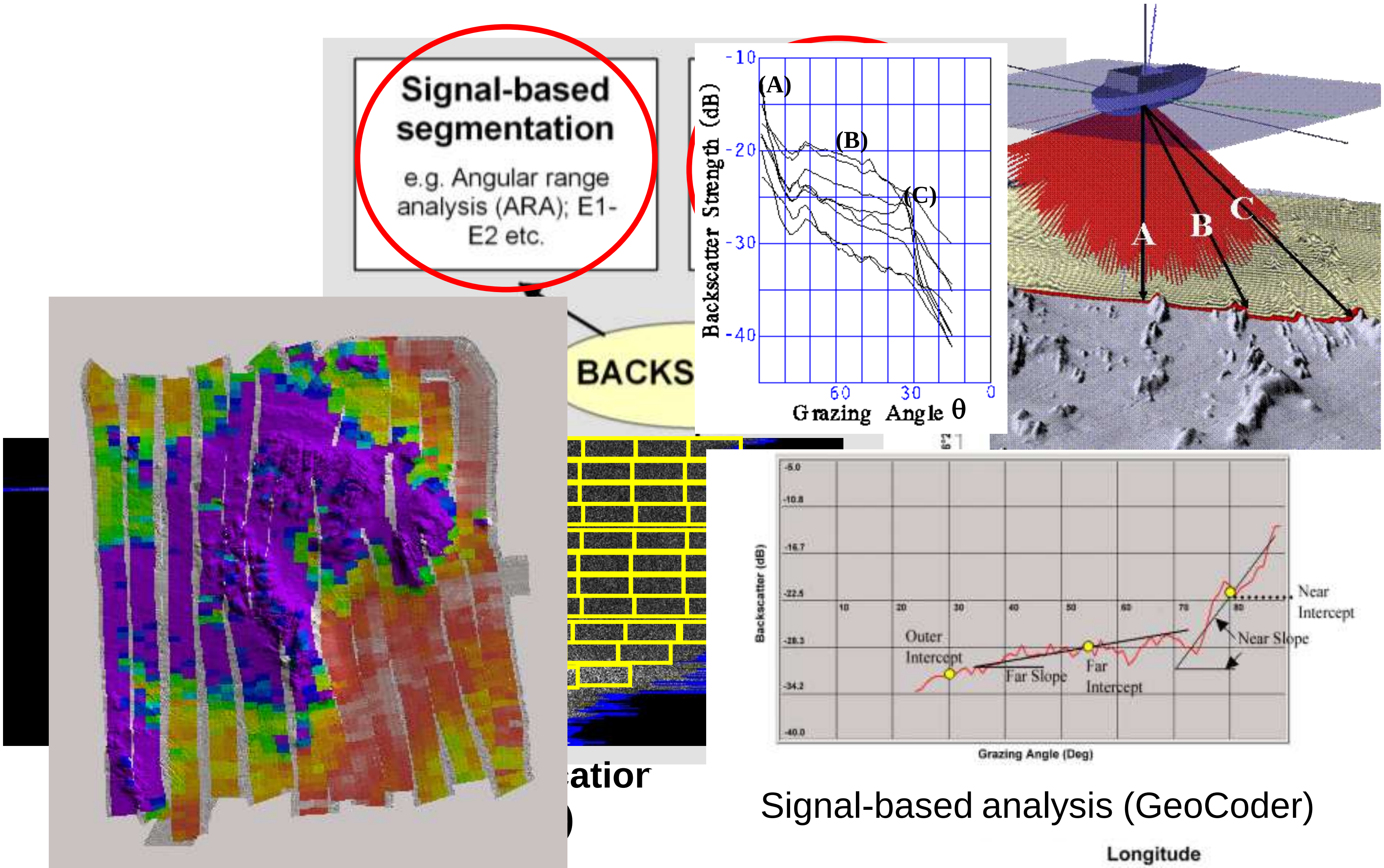


2012: Site 1 – Survey 2



Broad-scale monitoring:

Technological advances – backscatter analysis methods

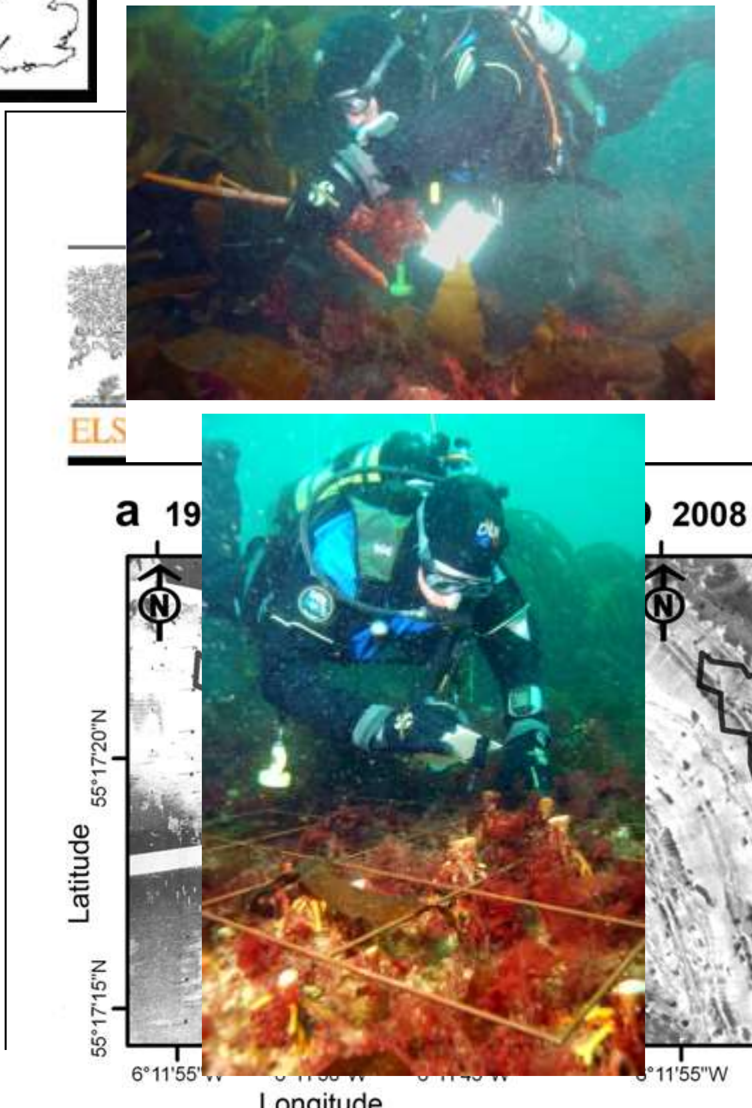


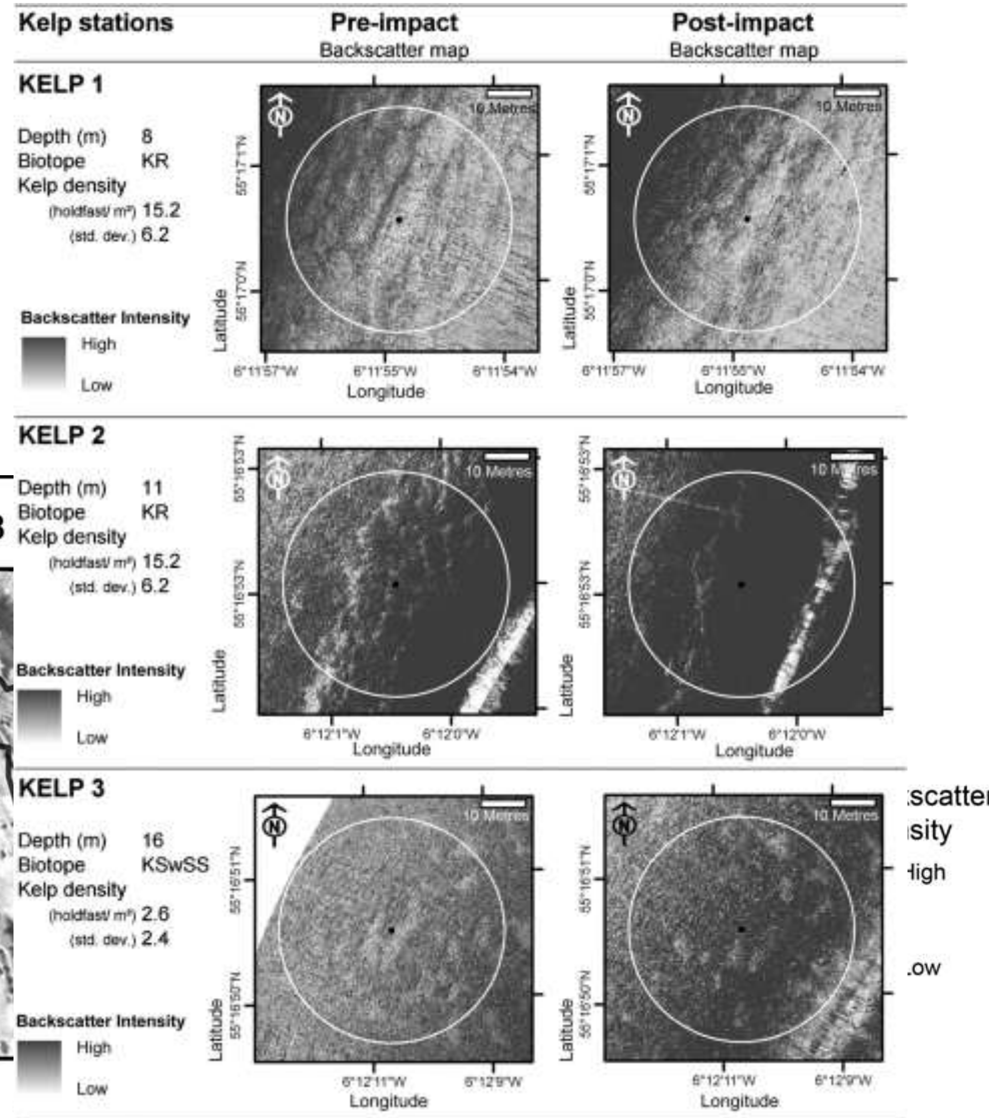
Signal-based analysis (GeoCoder)

Longitude

Broad-scale monitoring

Challenges of using backscatter data for monitoring…

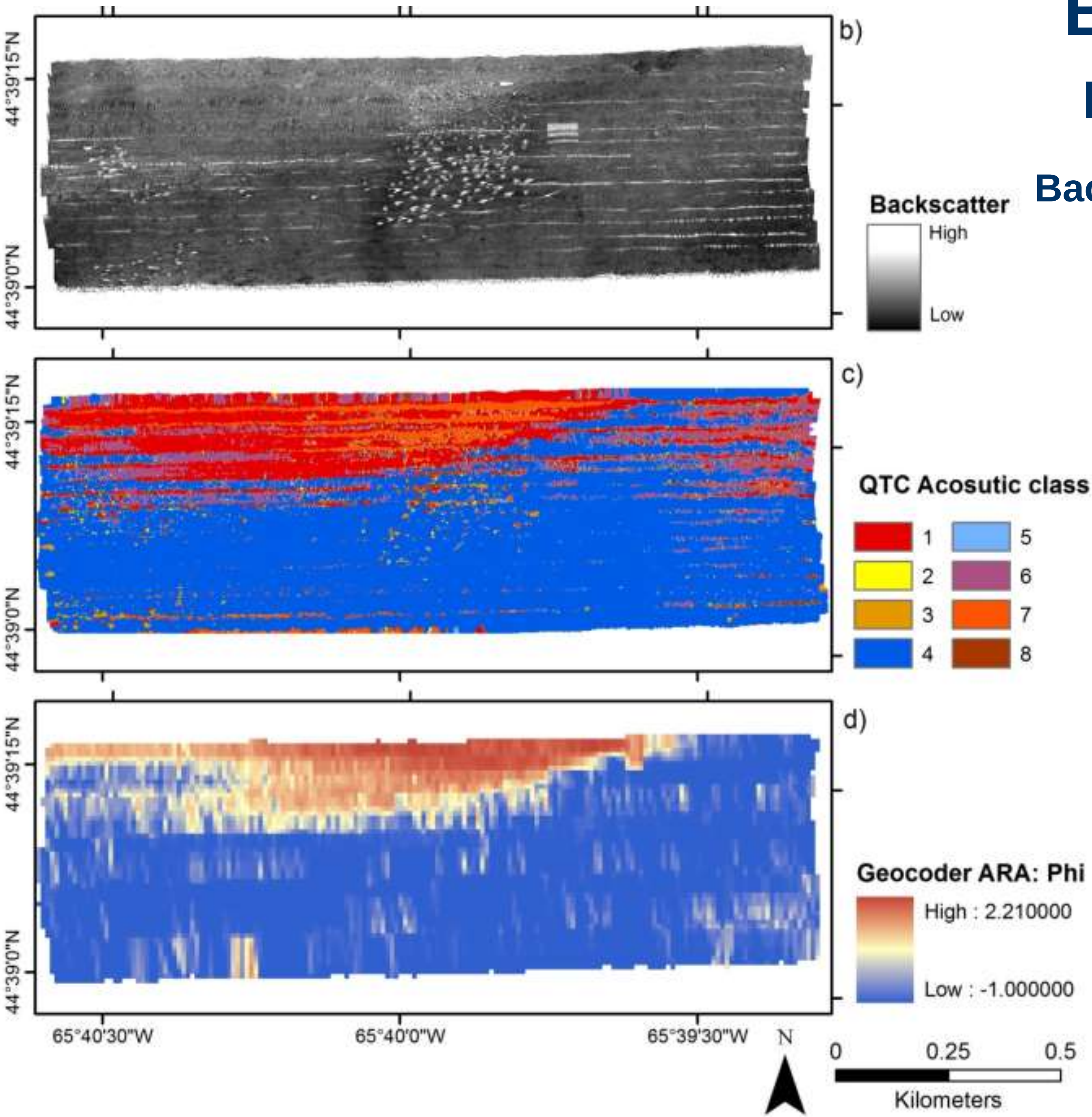




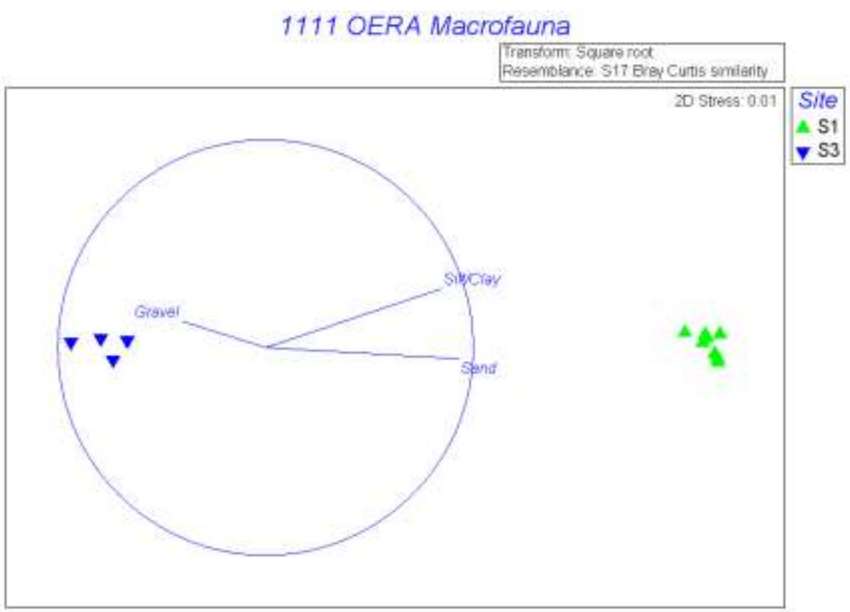
Van Rein, Brown, Quinn, Breen and Shoeman (2011) An evaluation of acoustic seabed classification techniques for marine biotope monitoring over broad-scales (>1 km²) and meso-scales (10 m² - 1 km²) *Estuarine, Coastal and Shelf Science.* 93: 336-349.

Broad-scale monitoring

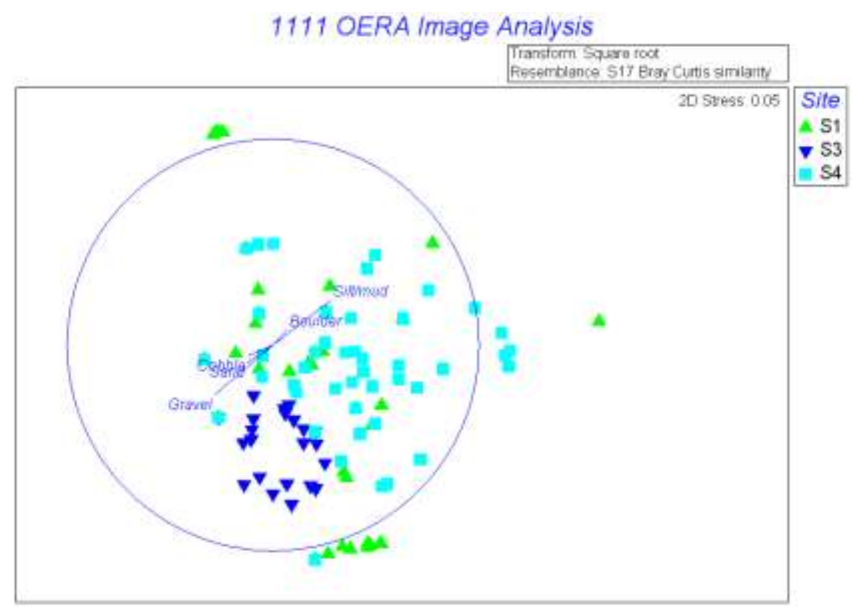
Backscatter comparison



Fine-scale monitoring



4699 individuals comprising 129 taxa were recorded from the 12 benthic grab samples



255 individuals comprising 26 taxa were recorded from the 252 seafloor photographs (54 stations)

Next stages…

1. Collection and analysis of repeat grab samples for benthic macro-infaunal community monitoring – inter-annual comparison (May 2013). NMBAQC Standards (www.nmbaqcs.org)
2. Collection and analysis of repeat underwater video and seafloor photographs for benthic epifaunal community monitoring – inter-annual comparison (November 2013)
3. Collection of repeat acoustic data at the four test sites (multibeam and sidescan sonar) (November 2013)
4. Completion of inter-annual and inter-tidal analysis/comparison of automated backscatter analysis methods for monitoring change (Fall/Winter 2013)
5. Final Report - Provide recommendations on the most appropriate monitoring techniques (physical and biological) for assessing change in benthic ecosystems in connection with deployment of TISEC devices (April 2014)
6. Additional methods, strategies and data sets will be explored and analysed to augment the OERA project through MSc project at MUN (Dimitri Tzekakis) – Object Based Image Analysis (OBIA) methods

THANK YOU!

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- Brian Todd and others at NRCan for advice on site selection, and provision of backscatter and bathymetric maps of the Bay of Fundy
- Troy Green - Centre of Geographical Sciences (COGS) at NSCC for collaboration on field logistics and advice on site selection
- Ann Redden (Acadia University) for advice on site selection and survey logistics
- Seaforth Engineering for access to exiting seafloor images from the FORCE test area