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[1] Archaeological applications of the Joint Irish Bathymetric Survey (JIBS) data

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Under the Irish National Strategic Archaeological Research Programme (2008), SLAN researchers were awarded funding to assess the Joint Irish Bathymetric Survey (JIBS) data for archaeological applications (see Newsletter 4). JIBS was instigated as a partnership between the Maritime and Coastguard Agency (MCA) and the Marine Institute (MI), under INTERREG IIIA (€2,133,508) to address the need for high-resolution bathymetric data off the north coast of Ireland. Archaeological analysis of these data has been ongoing since mid 2008, having successfully catalogued and identified palaeo-landscape features (including a series of geomorphic signatures relating to submerged palaeo-landscapes) and simulated coarse palaeo-geographic reconstructions for the study area.
Case study: Ballintoy and White Park Bay

Topographic complexity around Ballintoy is key to its classification as an area of high archaeological potential. At present it consists of a rocky headland with offshore reefs, islets and a sheltered harbour that is flanked to the west by an extensive beach and dune complex at Whitepark Bay. When relative sea-level (RSL) dropped to -30m, Whitepark Bay did not exist; instead the shoreline was more open and exposed. However, reefs at Ballintoy headland would have provided shelter to the east, particularly when RSL was between -30 and -10m. It is notable that this area in the lee of the reefs appears smooth on the JIBS data, suggesting a high degree of sediment deposition and possibly burial of palaeo-landscape remnants. The arrangement of the reefs could also have created a small area of sheltered water just north of the headland when RSL rose to above -10m.

Smooth surfaces here also suggest a degree of infilling. Whitepark Bay itself may not have been as a favorable area for settlement until the RSL rise was well underway. It was probably only after RSL had risen above c. -20m and the palaeo-shoreline had moved into the lee of Benmore Head that it became increasingly sheltered.

Importantly, Mesolithic and Neolithic finds have been made from the dune complex backing the modern beach. One reason for the importance of this area is the availability of flint nodules from limestone cliffs that fringe the beach, a resource that was also available when RSL was lower. Extensive smooth seabed surfaces and the presence of the modern beach could imply that palaeo landsurfaces have been buried offshore.

For further details, see the project web-site at:

http://www.science.ulster.ac.uk/cma/instar/
[2] Impact assessment of future sea-level rise on coastal archaeological resources around Newfoundland

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Future climate change is predicted to result in rising sea-levels and increased storminess. As well as affecting coastal communities, this has the potential to destroy or damage coastal archaeological sites and cultural landscapes. To be able to deal with this problem in an effective and coherent manner, we need to be able to assess the vulnerability of coastal archaeological sites in order to inform management practices and prioritize resources accordingly. To this end, SLAN researchers have been working on a desk-based vulnerability assessment that incorporates information on future sea-level rise (SLR) and coastal characteristics (e.g. topography, geology) to predict the impact of rising sea-levels on coastal archaeological sites.

Modelled maximum values of sea-level rise for 2025, 2050 and 2100. Grey dots show study areas.

The study region used is Newfoundland, which has a known archaeological record spanning 8000 years and encompassing a range of societies from prehistoric hunter-gatherers to modern fishing communities. Within this region, smaller case study areas have been chosen on the basis of archaeological importance (e.g. unique sites, dense multi-period occupation).
So far two case study areas have been examined: Port au Choix, which has 46 sites from a range of periods including one of only two Maritime Archaic cemeteries on the island and one of the largest Palaeo-Eskimo sites in the western Arctic (Philips Garden), and L'Anse aux Meadows, which has 28 sites including the only confirmed Viking site in North America. The assessment itself makes extensive use of GIS, digital datasets and can be subdivided into three stages:

[1] The first step is to model the likely SLR over the next century. Although global predictions have been made by the IPCC these cannot be directly applied to Newfoundland due to its ongoing isostatic rebound, a legacy of its glaciation during the last Ice Age. Therefore we have adapted the Newfoundland Glacio-Isostatic Adjustment (GIA) model previously used in reconstructing past sea-level history to model future SLR. Effectively, the GIA model output is combined with appropriate rates of global eustatic SLR taken from the IPCC, with an additional correction to account for the possibility of accelerated ice cap melting. It was clear from this analysis that Newfoundland will experience rising sea-levels over the next century despite its isostatic rebound.

[2] The second step is to examine coastal retreat stemming from the predicted SLR. This primarily utilises slope mapping of terrestrial 1:50,000 Digital Elevation Models (DEMs) to roughly assess where flooding will be greatest (i.e. gentle slopes will flood to a greater extent that steep ones). An additional correction for erosion is incorporated by using maps of surficial geology to identify areas with unconsolidated sediments where erosion will be greatest. This results in a generalized map of the sensitivity of the coastline to the predicted SLR. For both the case study areas it was clear that a range of coastal sensitivities could be identified within a relatively small (<5 kilometres) regions on account of localized variations in coastal geology and topography.

[3] The third step is to overlay known archaeological sites and contour map the DEM to the predicted future sea-levels, effectively 'flooding' it. Three timesteps were modelled – 2025, 2050 and 2100 – while the effect of 2m and 3m storm surges were also considered. This then allows identification of those locations at greatest risk from destructive coastal changes. For the case study areas, a range of risk levels were identified. Some sites, particularly those situated directly on the coast are at high risk at present, while those landward of the high water mark are vulnerable to storm surges and sea-level rise over the next 50-100 years. Crucially, the important sites of L’Anse aux Meadows and Philips Garden were identified as being at moderate risk; vulnerable to storm surges and future sea-levels from 2025 onwards.

Estimates of archaeological site vulnerability overlaid onto general coastal vulnerability map for L’Anse aux Meadows.
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Ruth joined the CMA at the University of Ulster in January 2009 as a Research Associate in Marine Geoarchaeology after completing a postdoc with Trevor Bell at Memorial University. Ruth did her first degree in marine geology at Ghent University (Belgium) before studying for an MSc in Oceanography and PhD at Southampton University. As part of her PhD, she looked at how high-resolution marine geophysical techniques can be used to image, characterize and visualize archaeological material, including both shipwrecks and submerged landscapes. Her research interests lie in sedimentology, high-resolution geophysics and marine geoarchaeology.

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Kieran joined the CMA at the University of Ulster in January 2009 as a Research Associate in Maritime Archaeology after completing a postdoc with Trevor Bell and Priscilla Renouf at Memorial University. Kieran studied for his undergraduate degree in Archaeology and Anthropology at Cambridge University, before going to Southampton University to do an MA in Maritime Archaeology. His PhD focussed on coastal environmental change and the migration and dispersal patterns of prehistoric humans. Kieran’s broader research interests lie in the archaeology of continental shelves, in particular the role of coastlines in prehistory and the archaeological potential of submerged landscapes. Common to both is the extensive use of palaeo-environmental data alongside archaeological evidence in order to examine the effect of changing climates, sea-levels and landscapes on prehistoric societies.

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Rory joined the CMA at the University of Ulster in December 2008 as a Research Associate in Freshwater Archaeology after working with the Discovery Programme in Dublin for 5 years. He majored in History at Trinity College Dublin before studying for an MSc in Maritime Archaeology at UU. Rory’s research is currently focused on freshwater landscapes - quantifying riverine and lacustrine archaeological resources, measuring the negative effects of orthodox river management and devising management strategies for its protection. This research focus will contribute to the SLAN network, providing vital riverine and lacustrine expertise.

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Sara joined the School of Environmental Sciences at the University of Ulster in January 2009 as a Lecturer in Environmental Change after two years working as a marine geoscientist with the Marine Institute. Her research interests include abrupt and long-term climatic change and its effects on sedimentological processes in the context of glacial/interglacial cycles. Sara has previous experience with the British Antarctic Survey, the National Oceanography Centre (UK), Woods Hole (USA) and the Bedford Institute of Oceanography (Canada). Sara is an AI on the INSTAR-funded archaeological applications of the JIBS data.

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View across ice-covered Moreton’s Harbour, New World Island, in February 2009.

The postglacial sea-level lowstand on the northeast coast of Newfoundland was established ca. 9000 years before present (BP) and is recorded by submerged shoreline features (e.g. wave-cut terraces) and truncated glacial landforms (e.g. drumlins) at roughly 18m water depth on the modern seabed. The configuration of this palaeo-coastline is being reconstructed using high-resolution seabed bathymetry, generated from multibeam sonar data collected in partnership with the Canadian Hydrographic Service. It reveals in places a coastal landscape markedly different from today with former freshwater lakes and river valleys now submerged in saltwater bays and channels. One such example is Moreton’s Harbour on New World Island.

Moreton’s Harbour is a sheltered bay surrounded by steep rocky slopes with a narrow passage to Notre Dame Bay. The harbour has a broad, flat bottom up to 20 m deep and a shallow rocky sill at its entrance. During the sea-level lowstand, it is proposed that the harbour was isolated from the open bay by the emergence of the rocky sill and a freshwater lake drained to the sea through a narrow stream channel. Sub-bottom acoustic profiling of the harbour in August 2008 revealed a thick sequence of basin-fill sediments onlapping an acoustic basement.
Fieldwork in late March 2009 focused on ground-truthing of the acoustic stratigraphy in the harbour basin using a 100-mm-diameter percussion coring system deployed from the sea-ice surface. Only the inner harbour remained ice-covered at the time of coring, with ice thicknesses between 30 and 38cm. A strong gale had recently broken up the ice in the narrows and outer third of the harbour. Coring targets were selected to sample (1) a thick acoustically transparent to faintly stratified upper sedimentary unit and (2) an underlying acoustically stratified unit with dipping reflectors. In addition to sampling the basin fill, it is anticipated that the cores should penetrate the proposed lacustrine component of the sediment sequence dated to the period between isolation and inundation of the freshwater basin during the sea-level lowstand.

In total, 5 cores were successfully retrieved ranging in length from 40 to 225 cm. The shortest core was recovered from 14 m water depth at the southeastern margin of the basin. It was composed of a stony diamicton, possibly representing a glacial deposit. The remaining cores recovered at least 1.25 m of mud in water depths of 14 to 16 m. Sediment smeared on the exterior of core tubes consisted of clayey silt with shell fragments and terrestrial organics.

Core splitting, sediment logging and sub-sampling and radiocarbon analysis of basal organics will take place over the coming months. In collaboration with Dr. Robin Edwards (Trinity College Dublin), whose participation is supported by an academic grant from the Ireland-Newfoundland Partnership (see News Item 6), microfossil analysis will be undertaken to identify freshwater sediments that may have been deposited in the harbour basin during the sea-level lowstand.

Results will also shed light on local environmental and climatic conditions that persisted during a period of marked coastal landscape change in the region. The Moreton’s Harbour project is an important contribution to the study of submerged prehistoric archaeological landscapes on the northeast coast of Newfoundland.
A) Oblique view looking across the entrance into Moreton’s Harbour using a combination of digital elevation and bathymetry. Red line shows position of seismic profile in D). B) Palaeogeography of Moreton’s Harbour during the sea-level lowstand of -18 m at ca. 9000 BP. The emergence of a rocky sill at the harbour entrance creates a lake within the modern harbour. C) Close-up view of the harbour entrance assuming a lowstand of -18m. Note the emerged rocky sill dividing the lake from the sea and the location of the stream channel that drained the lake. D) Seismic profile through the inner basin of Moreton’s Harbour showing the location of one of the core sites through the basin fill.
[5] Publications news

The current issue of the Journal of Ocean Technology (Volume 3 Number 4, 2008) is a special issue on marine archaeology. Included in the publication is a SLAN article outlining the Newfoundland research, including preliminary results from stages 1 and 2 of the seven-step SLAN research strategy:


[6] Ireland-Newfoundland Partnership funding

Robin Edwards, Natural Sciences [Trinity College Dublin]

The Ireland-Newfoundland Partnership is continuing its valuable support to SLAN activities in 2009. This April, Trevor Bell (Memorial University) will host Robin Edwards (Trinity College Dublin) during his visit to Memorial University, which was funded under the Education and Research Grant Scheme.

The visit will focus on research relating to the reconstruction of post-glacial sea level change and its significance for coastal archaeological heritage. It will also explore potential inter-institution fourth level curriculum development in the areas of Earth and Environmental Science. During his visit, Robin will conduct a series of seminars and training workshops, in addition to supervisory meetings with SLAN postgraduate students. He will also have the opportunity to visit some current sites of sea-level research and work with colleagues at St John’s on the development of future SLAN projects. The outcomes of this visit will be reported in the next SLAN newsletter.