Archaeological applications of the Joint Irish Bathymetric Survey (JIBS)

Researchers from the University of Ulster, the Marine Institute, Memorial University Newfoundland and the Northern Ireland Environment Agency report on the processing and archaeological interpretation of the JIBS high-resolution sonar data from the north coast of Ireland.

To address the need for high-resolution bathymetric data off the north coast of Ireland, JIBS was instigated as a partnership between the Maritime and Coastguard Agency (MCA), the Marine Institute (MI) and the Northern Ireland Environment Agency (NIEA), under INTERREG IIA (€2,133,508). The JIBS project commenced in April 2007 and was completed in September 2008, providing 100% multi-beam bathymetry coverage within the 3nm coastal strip from the Fanad Peninsula (Co. Donegal) to Fair Head (Co. Antrim).

Under the Irish National Strategic Archaeology Research [INSTAR] Programme 2008 and 2009, this research project was funded to assess the JIBS data for archaeological applications. Processing of the JIBS data resulted in a DEM at 1m resolution for the 1000km² study area, backscatter data corrected for range and acquisition artefacts and an automated segmentation of these data to characterize seafloor material types.

Initial work was also conducted on integrating high-resolution seismics with the JIBS data in SMT Kingdom Suite. The potential for the discovery of submerged archaeological material related to the early colonization of Ireland has been confirmed through this investigation. Through the spatial mapping and interpretation of sonar, archaeological, sea level and glacio-isostatic data, ten areas of high archaeological potential are identified on the basis of the following criteria:
Overview map showing areas identified as having archaeological potential alongside known terrestrial SMR records and overlaid onto JIBS multibeam.

[1] Whether a given area was attractive to past humans, providing shelter, access to inland and coastal resources, freshwater and raw material sources.

[2] The likelihood of burial rather than erosion of palaeo-land surfaces as sea level rose. Likely areas should presently be characterized by sediment deposition and smooth seabed surfaces with few traces of the underlying bedrock.

Of these ten areas, two sites were the focus of a scientific cruise onboard RV Celtic Explorer in December 2009: (a) Ballycastle Bay and Church Bay, (b) The Skerries. Palaeo-geographic reconstructions derived for these sites indicate that:

- When relative sea level (RSL) was lower, easy access was allowed to the exposed coastal lowland and resources therein.
- Travel to the interior would have been facilitated by adjacent rivers.
- The surrounding highlands provided a measure of shelter compared to the open lowstand coast and a vantage point for resource monitoring.

- Environmental conditions promoted deposition instead of erosion, promoting material conservation.

**Impact of the project**

 Provision of the JIBS data is transforming geo-archaeological research and teaching at the University of Ulster. These data represent an unrivalled opportunity to contribute to the understanding of post-glacial sea-level change and colonization of Ireland and afford the opportunity to produce models for site formation at a resolution previously unachievable.

JIBS case studies are now being used in the delivery of undergraduate and postgraduate modules, providing the next generation of earth- and archaeological-scientists graduating from the University of Ulster with data processing and interpretation skills to meet the demands of a range of employers within the marine sector in Ireland.

Results from this study will address heritage management issues ensuring that the Northern Ireland Environment Agency (NIEA) and the Republic of Ireland’s Department of Environment, Heritage and Local Government (DEHLG) will be able to supplement the known archaeological record, prioritize which sites need immediate attention and aid the development of longer term management plans through the adaptation of site formation models.
In December 2009, the University of Ulster (UU) and the Marine Institute (MI) ran a week-long student training cruise to the JIBS study area funded through the MI Shiptime Programme.

The over-arching objective of this training programme was to provide marine scientists graduating from the University of Ulster with seabed survey and data processing skills to meet the demands of a range of employers within the marine sector in Ireland.

Specifically, the training programme was divided into two main sets of objectives; a) field-based survey skills training and b) post-cruise data processing and interpretation skills training. Rory Quinn, Ruth Plets, Kieran Westley, Alex Callaway, Henk van Rein and Fabio Sacchetti report on the scheme.

a) Field-based survey skills training


b) Post-cruise data processing and interpretation skills training

Benefits

As integrated marine surveys utilising modern acoustic survey techniques become more widely used for a diverse range of applications in the marine sector, the need for trained graduates with the skills to collect, process, interpret and apply the information collected from such surveys will steadily increase. The benefits of these spatial data sets in marine archaeology are now widely recognised and undoubtedly future survey work will increasingly turn to integrated, multidisciplinary research to address policy needs.

The training exercise successfully equipped undergraduate marine science students with a broad range of survey skills and off-shore survey experience on which to build a career in the marine sector. Focusing on new technological survey methodologies addressed the urgent need within Ireland to increase the skill base in this area and provide a pool of skilled graduates from which individuals can be drawn to undertake further training to work on the enormous quantities of data generated through past, current (e.g. INSS, INFOMAR, JIBS etc.) and future national seabed survey initiatives.

Archaeological training

The investigation was run as a research cruise, with 24-hour ops resulting in students working 4-on 8-off shifts. They experienced first-hand the acquisition of new multi-beam echo-sounder, seismic and ground-truthing data based on previous interpretations of the JIBS data set.

New seismic data were acquired over interpreted palaeo-shoreline features, targeting high-potential areas around The Skerries and between Rathlin Island and Ballycastle Bay.

Undergraduate dissertation projects

A series of undergraduate dissertation projects will be completed based on the data acquired during the 2009 cruise. Dissertation topics include projects on the integration of seismic, bathymetric, backscatter and ground-truth data for time-stepped palaeogeographic reconstructions of specific areas and on the classification of backscatter and bathymetric data with a view to producing site formation models for the north coast.

These opportunities allow undergraduate students to engage in all stages of research, from data acquisition, through data processing to spatial integration of data sets and interpretation of multi-element data from a geo-archaeological perspective.

2010 training plans

Rory Quinn, Ruth Plets and Kieran Westley successfully bid for 2010 funding through the Marine Institute shiptime programme and will run a similar training exercise in the JIBS area in November 2010 on RV Celtic Voyager.

Acknowledgements

We thank the Marine Institute for funding and support throughout the training scheme, with special thanks to Captain Philip Baugh and crew of RV Celtic Explorer for patience and perseverance off the north coast in December.
**EAA Conference 2009 review/reflections**

**Underwater archaeology and the future of submerged European prehistory**

Kieran Westley and Ruth Plets attended the “Underwater archaeology and the future of submerged European prehistory” session at the European Association of Archaeologists annual conference (Riva del Garda, 15-20th September 2009). They presented a paper demonstrating preliminary research on the Joint Irish Bathymetric Survey (JIBS) dataset and a poster outlining the overall SLAN methodology. Other papers in the session illustrated a diversity of research currently ongoing in Europe from the Black Sea to the Baltic and covering time periods from Middle Palaeolithic to the Bronze Age. The session was well-organized and highly informative, and it was good to hear the variety of work carried out across Europe by both established and new researchers.

From the SLAN perspective it was particularly gratifying to see papers from Nic Flemming and Geoff Bailey which emphasized the need for collaboration between archaeologists and other marine scientists and stakeholders and which highlighted the role that geophysical and acoustic data can play in submerged landscape investigation. A recurrent theme which came out of the other papers presented was the role of diving investigations. This was best illustrated in the papers by Jonathan Benjamin, Jon Henderson, Gary Momber, Anders Fischer, Albert Ammerman and Harald Lübke. Indeed, many of the questions and post-paper discussions centred on dive-based methodologies and diver training. This was an interesting comparison to the “Underwater prehistoric archaeology” session at WAC-6 (Dublin, July 2008), where the papers had focussed more on landscape-scale investigations and geophysical and geological techniques rather than dive-based survey and prospection for individual sites.

This poses an interesting question of whether there currently is, or could develop, a split between more archaeologically-focussed, dive-based, site-scale investigations versus more palaeoenvironmentally-orientated, geophysics-based, landscape-scale research. It is clear from the work that we have done in Newfoundland and Ireland that both approaches are valid and indeed, should be seen as complementary, given that each approach has its own limitations. For example, geophysical techniques presently cannot distinguish the majority of prehistoric archaeological evidence (e.g. lithics) from natural geology, while dive-surveys are inherently limited by depth, bottom time and visibility. While the need for both approaches is integral to the overarching SLAN methodology, we nonetheless recognize that in our research to date we have concentrated overwhelmingly on geophysical data and worked to produce landscape-scale reconstructions. We know that to obtain information about past societies and address questions of prehistoric migration patterns, coastal resource use and past human responses to coastal change we must factor in an archaeological component that has hitherto been less apparent in our research. To this end, we hope to start combining our geophysical research with dive-based ground truthing surveys from this summer onwards. Equally, while we recognize that geophysical data may not be always be available, we hope that diving archaeologists are at least aware of the role it can play, and the fact that palaeo-landscape and palaeo-environmental reconstructions provide information which is essential to accurate interpretation of archaeological sites.

Perhaps this is an overly negative view (thought up in a small Italian cocktail bar on the back of a napkin) and that as submerged landscape investigations become more common, greater integration between the various components will follow naturally. Alternatively, perhaps more effort is needed to engage the two communities and demonstrate the value of each other’s work? In this light it will be interesting to see the outcome of the forthcoming SPLASH-COS meeting (10-11 March 2010), hosted at the University of York, where submerged prehistory researchers from across Europe will meet. Hopefully, this will mark the start of fruitful collaborations and the exchange of ideas and expertise between disparate researchers and the development of fully-integrated approaches to the study of submerged landscapes.

**SLAN research was presented at the following conferences**


Journal of the North Atlantic (JONA) call for papers

The Journal of the North Atlantic (JONA) is a multi-disciplinary, peer-reviewed and edited archaeology and environmental history journal focusing on the peoples of the North Atlantic, their expansion into the region over time, and their interactions with their changing environments. The journal publishes a wide diversity of research papers, as well as research summaries and general interest articles in closely related disciplines, which, when considered together, will help contribute to a comprehensive multi-disciplinary understanding of the historical interplay between cultural and environmental changes in the North Atlantic world.

Specifically, the journal's focus includes palaeoenvironmental reconstruction and modelling, historical ecology, archaeology, ecology of organisms important to humans, anthropology, human/environment/climate interactions, climate history, ethnography, ethnohistory, historical analyses, discussions of cultural heritage, and place-name studies. http://www.eaglehill.us/jona

JONA is now offering print versions of both regular and special volumes. When JONA was first announced, it was projected to be an online-only journal. Recent advances in publishing technology for limited edition print runs have made it possible for JONA to offer print versions whenever a volume is considered complete.

JONA is also being reviewed for inclusion in Web of Science by ISI Thomson Reuters. It is unusual for a new journal to be considered for inclusion after only two years.

Publication awards

On a related note, congratulations to Kieran Westley and Ruth Plets who were both ‘Highly Commended’ in the Keith Muckleroy Award for Maritime Archaeology. Kieran for his JONA article, The Solutrean Hypothesis: A View from the Ocean, published in 2008 and Ruth for her 2009 Journal of Archaeological Science paper The use of a high-resolution 3D Chirp sub-bottom profiler for the reconstruction of the shallow water archaeological site of the Grace Dieu (1439), River Hamble, UK.

The Keith Muckleroy award is awarded biennially for the best published work in the preceding two years covering British maritime, nautical or underwater archaeology. Entries are eligible if they address work in Britain, Isle of Man, Jersey, Guernsey or British territorial waters. The award is given for work that best reflects the pioneering ideas and scholarly standards of Keith Muckleroy.
SLAN Research Network: A Solid Start, Now what?

Professor Trevor Bell of Memorial University Newfoundland reflects on 5 years of the SLAN network.

SLAN is celebrating its 5th year as a network in 2010. Our progress and accomplishments so far have exceeded initial expectations; we have developed funded research projects in Ireland and Newfoundland, recruited exceptional post-docs and students into our programs, built new collaborations with government and industry, hosted regional workshops on seabed mapping, facilitated Ireland–Newfoundland faculty and student exchanges, published peer-reviewed papers, and raised awareness of submerged landscapes and archaeology research at an international level. All of these exciting developments have been documented in our biannual newsletter.

As we look to the next 5 years what goals have we set for the network? The following reflect some of our thoughts and intentions.

1. **Advance our research strategy:** To date we have had opportunities to carry out various stages of our 7-step research plan at study sites in Ireland and Newfoundland; however, we have not conducted the entire program at a single site. Future prospects look promising in this regard for the JIBS study region off Northern Ireland (see progress reports in this newsletter for more details) and we continue to exploit opportunities when they arise off the northeast coast of Newfoundland.

2. **Map greater range of submerged landscapes:** With new collaborations and access to more nearshore datasets, we are able to map and sample a greater variety of submerged landscapes. We plan to document and catalogue a broad range of geomorphic and sedimentary environments that may potentially preserve submerged archaeological material. The approach will test the flexibility of our research strategy across a range of prehistoric landscapes and under varying modern nearshore environments. It will also likely inform and challenge our assumptions about the prehistoric occupation, preservation potential, and future prospection of these submerged archaeological landscapes.

3. **Refine our models of sea-level history:** SLAN projects have relied heavily on glacio-isostatic adjustment (GIA) models to predict the depth of submerged shorelines at specified time intervals. It is the most efficient approach to kick-start local projects where high-resolution seabed maps are available. We acknowledge the assumptions and discrepancies inherent in this approach and have resolved to collect sea-level index points to constrain GIA models where and when the opportunities present themselves. Our application of the GIA model output is an attractive secondary use of these data and we continue to be welcomed by our colleagues in the modeling community.

4. **Develop and refine archaeological landscape models:** Our network has always championed the landscape approach to prehistoric maritime archaeology and it is no surprise then that we tend to focus our research efforts at the landscape to landform scale for assessing archaeological potential (see progress reports in this newsletter for more details). We also recognize the need to develop regionally and culturally specific models for classifying archaeological potential. We will continue to focus our efforts at this scale of investigation while paying attention to crosscutting themes and recurring patterns.
5. **3D evolutionary models of submerged landscapes:** In the next five years we plan that that all study sites will integrate 2D sub-bottom profiles so that buried layers can be integrated with multibeam bathymetry to more fully characterize the submerged landscape. In areas of high sedimentation, post-submergence sediment blankets may be digitally removed to expose the original landsurface. These more technical approaches will ultimately provide more accurate palaeogeographic reconstructions that improve archaeological modeling and prospection.

6. **Preliminary archaeological testing:** Small-scale underwater surveys are planned in summer 2010 for areas off the north of Ireland and northeast Newfoundland, where coarse predictions of archaeological potential and known finds suggest the preservation of submerged landscapes. At this preliminary stage, coring will be combined with snorkel and scuba surveys in shallow nearshore areas. This is an exciting step for us but one that is approached cautiously and iteratively to benefit from outcomes, whether positive or negative.

7. **Interdisciplinary and inter-institutional training:** Through various Ireland-Newfoundland and Ireland-Canada initiatives, we have been able to move researchers and students between network institutions for short to long periods of instruction and training. We plan to more formally establish this exchange program through available funding opportunities, such as the Canada - European Community Program for Cooperation in Higher Education, Training and Youth.

8. **Build new collaborations and network partners:** As the importance of submerged archaeological landscapes continues to grow in the heritage, government and industrial sectors, we will continue to host productive collaborations with public, private and not-for-profit organizations that share common goals or utilize new technologies for seabed mapping and visualization. We have already benefited from such partnerships and national funding agencies now recognize the need for such knowledge translation and mobilization. Our graduate students (national and international) can now access a broad variety of industrial and community internships to complement their academic training.
Past issues of the newsletter are available from the SLAN web site.

The Submerged Landscapes Archaeological Network (SLAN) is a consortium of researchers from universities and government agencies in Ireland and Newfoundland with the aim of providing an understanding of Ireland’s and Newfoundland’s submerged archaeological landscapes.

SLAN was established in 2006 to take advantage of advanced technologies for the benefit of North Atlantic archaeology and palaeo-environmental research.

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Submerged Landscapes Archaeological Network
http://www.science.ulster.ac.uk/cma/slan/