LASERS, CAMERAS, ACTION!

Conor Brady and **Kevin Barton** report on a successful international remote sensing field school on the Hill of Slane.

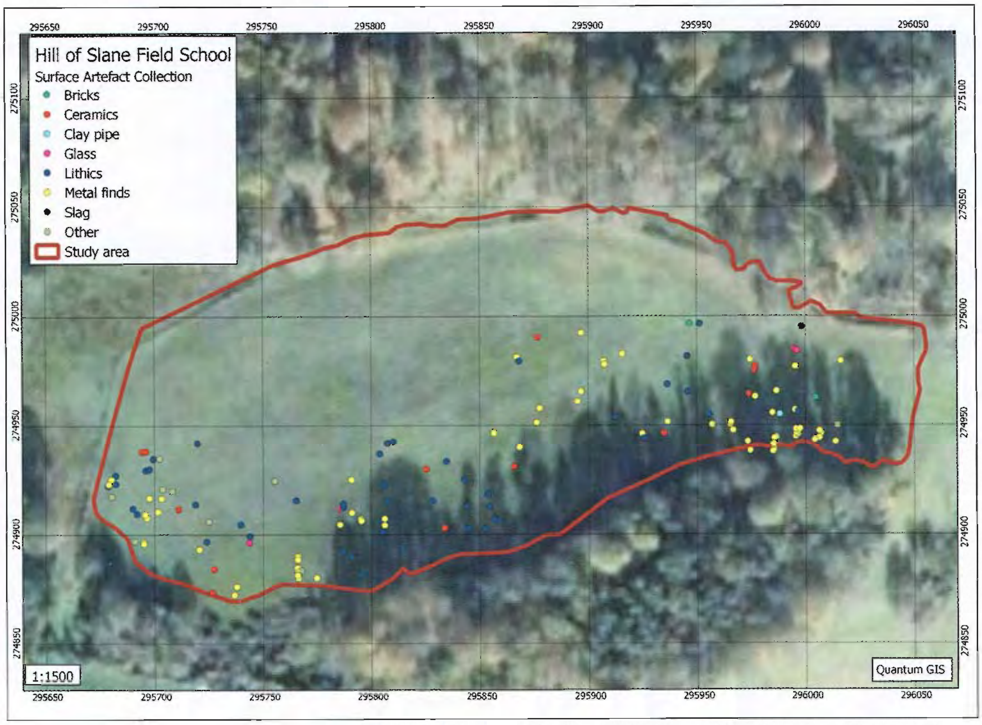
This unique international field school was run over six days from 8 to 13 April 2012 and was organised with the help of the ArchaeoLandscapes Europe Project (www.arcland.eu), whose aims include encouraging cooperation and collaboration among institutions across Europe interested in promoting the use of archaeological remote sensing. The field school was delivered by tutors who are involved in the ArcLand Project, thereby addressing a key aim of providing education and training for individuals interested in improving their knowledge and skills, particularly in new technologies.

The programme was designed to introduce a range of archaeological site survey and remote sensing techniques to postgraduate students from an archaeology/earth sciences background. The main objective was to give participants an understanding of the principles as well as hands-on practical experience of the field operation of a range of techniques. A basic introduction to data-processing and interpretation was also given using open-source software. Eighteen students, from Bolivia, Denmark, Estonia, Finland, Germany, Greece, Latvia, Poland, Slovakia, the USA and Ireland, participated in the course.

Above: **Fig. 1—Surface collection survey in progress** (Conor Brady).

Right: **Fig. 2—Grid layout using a total station** (Conor Brady).

Fieldwork took place on the Hill of Slane, where there is an ongoing research project under way—the Hill of Slane Archaeological Project (HoSAP). The site's rich archaeological remains and long history of use (Brady *et al.* 2013; Seaver and Brady 2011) made it an ideal setting for the field school. The students stayed in the local hostel; many arrived on Easter Saturday



Left: **Fig. 3—The QGIS plot of all find-spots recorded during surface collection and metal-detecting** (Piotr Wroniecki).

evening in time to attend the first Flame of Slane Festival on the Hill, which celebrates St Patrick's traditional lighting of the Pascal Fire. The next day we had a field trip to the Brú na Bóinne WHS, which seems to have been a big part of the attraction of the course for many of the students. Over the course of the field trip students were introduced to the long history of settlement in the area, as well as the long history of research.

We also visited the Hill of Slane itself, where we discussed the aims and results of the recent surveying by the HoSAP. There was a discussion of the archaeological potential of the site and the kinds of questions that could be addressed by the application of the techniques to be covered during the course.

The field school was organised into four modules:

(1) surface collection and reconnaissance geophysics;
(2) kite aerial photography;
(3) terrestrial laser scanning;
(4) multi-method geophysical survey.

Surface collection and reconnaissance geophysics

This was carried out in a large tillage field on the southern slope of the hill, a couple of hundred metres from the main archaeological complex. The main objective was to identify and explore any evidence for past activity in an area outside the core of the archaeological complex. The techniques used were surface collection survey (Fig. 1), magnetic susceptibility survey and metal-detector survey. All were carried out on a reconnaissance basis using a site grid set out using a differential Global Positioning System (dGPS) and a total station (Fig. 2).

Conditions were ideal for a surface collection survey, with a well-weathered harrowed surface offering excellent visibility. A range of material was identified, from prehistoric lithic artefacts and medieval ceramic fragments to modern brick, glass, metal and shotgun cartridges, all indicating various types of activity in the past (Fig. 3). The artefacts were not collected; instead, find-spots were flagged, coded and recorded using a dGPS. Plots were produced using Quantum GIS (QGIS) open-source software.

A reconnaissance magnetic susceptibility (MS) survey was carried out on a 10m x 10m grid, using the same grid as for the other activities. Each point was recorded with a dGPS connected to a mini-laptop and the MS values were input directly at each point. An area of intense burning was identified at the western end, corresponding with an area of blackened soil, and is possibly the site of a prehistoric burnt mound.

A metal-detector survey was carried out on a sampling basis using the survey grid along lines set 10m apart. 'Hits' were indicated using flags and each find-spot was later recorded using a dGPS. Results were plotted along with the lithic and other artefacts using QGIS.

Kite aerial photography (KAP)

The KAP module was delivered by students from the University of Warsaw. Students had the opportunity to experiment with flying the kite in various wind conditions and to control the operation of the camera with a remote control unit from ground level.

Some excellent oblique aerial photographs were obtained, including of the surface collection area, St Patrick's Church and graveyard and the College (Fig. 4). The location of ground targets was captured with a dGPS, allowing the aerial photographs to be geo-rectified.

Terrestrial laser scanning

This module was delivered by the Discovery Programme, who provided three types of terrestrial scanner to demonstrate the principles and practice of laser scanning. Scanning was carried out in time of flight,

Below: **Fig. 4—Aerial view of the College and graveyard taken with the KAP rig** (Asia Balcerzak/Michael Pisz).

Left: **Fig. 5—Instructing the students in the finer points of terrestrial laser scanning** (Anthony Corns).

Right: **Fig. 6—The twin-sensor magnetic gradiometer** (Conor Brady).

Below: **Fig. 7—Earth resistance survey under way** (Jaroslava Panisova).

triangulation and phase comparison modes. Detailed scanning took place on the College and a three-dimensional model was produced (Fig. 5). Some additional scanning was carried out on St Patrick's Church in the graveyard.

Multi-method geophysical survey

This module involved fieldwork immediately to the east of the graveyard. Eight 20m x 20m survey grids were positioned using a dGPS. The archaeological objective here was to investigate possible archaeological features noted or monitored in a narrow trench, 30cm wide and up to 60cm deep, dug by machine in 1997 to lay a power cable for floodlighting St Patrick's Church and the College. The second objective was to provide the opportunity for hands-on experience of data collection using a range of geophysical instruments and techniques, including magnetic gradiometry, earth resistance, magnetic susceptibility, electrical resistivity tomography and ground-penetrating radar.

Magnetic gradiometry surveys were carried out using single- and twin-sensor fluxgate gradiometer instruments (Fig. 6). The objective was to investigate cut features recorded in the trench to see whether they extended away from the line of the trench. In addition, each student had the opportunity to experiment with using a number of sampling densities and acquisition modes. During this survey it was found that there was some interference from the underlying bedrock, which is volcanic tuff and is magnetic, especially where outcrops occurred. Although interference was recorded, it was not serious enough to hinder the identification of other anomalies in the data. The electrical cable and floodlights subsequently installed do, however, interfere significantly with the magnetic surveys that were carried out. The positions of the outcrops were confirmed during magnetic susceptibility surveys over the same areas. Data were gathered using an instrument with a field loop and these were then input into a mini-laptop connected to a dGPS receiver.

The objective of the earth resistance and electrical resistivity tomography (ERT) surveys was to investigate whether the trench and large-scale cut features had a resistance response (Fig. 7). In addition, the ERT survey allowed us to assess the underlying geological structure of the area. Ground-penetrating radar surveys were also carried out over each grid to provide a comparative geophysical dataset (Fig. 8).

Conclusion

From the point of view of a teaching exercise, the field school seems to have achieved its objectives. Although the course was very intensive over the six days, we received very positive feedback from participants.

As the time during the course was limited, particularly for data-processing, interpretation and presentation, a series of live 'webinars' were organised and delivered to students who wished to learn more. These sessions were particularly effective, as students had already gathered real datasets in the field on which to work. This added enormously to the 'reality' of the exercises, brought closure to the field school and gave the students a sense of participation in the wider research project.

There was benefit to the local community from the field school too. Accommodation and facilities were provided by Slane Farm Hostel, and one of the local pubs hosted a traditional music session for the students. We were lucky to receive coverage from RTÉ News, who did a piece on the field school, showcasing not only Irish archaeology but also the rich heritage of Slane. This gave the local community a sense of the importance of the heritage on their doorstep and has led to discussions of the possibility of developing other similar heritage tourism offerings.

The data gathered during the course of the field school were very valuable to the HoSAP and add significant new knowledge of the time-depth of activity on and around the hill. The discovery of new evidence in the form of the lithics distribution, as well as the

Left: **Fig. 8—The ground-penetrating radar survey, with control/data-logger console, control/data cable and transmitting/receiving antenna mounted on a sled.**

Below: **Fig. 9—The survey grid in context, with a preliminary interpretation of the magnetic gradiometry data superimposed on a geo-referenced aerial photograph** (Piotr Wroniecki).

burnt spread in the tillage field on the southern slope of the hill, confirms that the area was occupied and used from at least the Neolithic to modern times. The remote sensing element of the field school was also very successful, as a series of high-quality geophysical datasets were obtained for an area of the hill that had not been previously surveyed. It was possible to trace the extent of the features that were initially identified during the monitoring of the cable trench, thus making a valuable contribution to the overall HoSAP research project (Fig. 9).

The Hill of Slane provided an ideal location for a field school, with multi-period archaeology and real archaeological questions that could be addressed using field-walking and a range of remote sensing techniques. ■

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