CYRENE ARCHAEOLOGICAL PROJECT
FIELD SURVEY, GIS AND ASSESSMENT 2006

Richard Cuttler
Vincent Gaffney
Helen Goodchild
Jeremy Rossiter
Gareth Sears

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SUMMARY

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Digital mapping, topographic and settlement survey at the World Heritage Site of Cyrene and its hinterland, Libya.
26th June – 4th of July 2006-07-31

Work carried out as part of an archaeological assessment of the American concession, the urban area of Cyrene and the town hinterland.

Summary of results.
Preliminary GIS-based mapping of the area of the World Heritage Site of Cyrene and its hinterland was carried out prior to a field visit during June-July 2006. During the site visit further topographic survey was carried out over the area of the White concession and visible archaeological features were noted. Preliminary field investigations were carried out within the hinterland of Cyrene and the data used to prepare an archaeological assessment of the site and region.
1 Introduction
The Cyrenaica Archaeological Project (CAP) is an international mission under the direction of Professor Susan Kane, Oberlin College. CAP comprises experts from a range of universities and scientific establishments in North America and Europe who are committed to the investigation of Cyrene and the surrounding area using a range of archaeological techniques. CAP is the successor to the American archaeological mission in Cyrene that excavated the Sanctuary of Demeter and Persephone in the Wadi Bel Gadir between 1969 and 1981 under the direction of Professor Donald White. Following the renewal of relations between the United States and Libya in 2004, Professors Susan Kane and Donald White met with the Libyan Department of Antiquities in July 2004 and CAP was granted a renewable license to resume work in Libya.

In June/July 2006 a small team of archaeologists from the University of Birmingham and the University of Alberta travelled to Cyrene to undertake a topographical survey of the CAP concession area. The fieldwork itself was conducted over eight days between the 26th June and 4th July. The CAP team, working alongside staff of the Department of Antiquities in Cyrene and members of the Department of Archaeology, University of Omer al-Mukhtar at el-Beida, examined an area of 127,000m², using a differential GPS producing a GIS topographical model (see figure 2). The aims of the project will be discussed in more detail in section 4 but it is important to note here that alongside the key archaeological objectives of the project there was an important training element whereby staff from the University of Birmingham demonstrated the use of GPS systems and the interpretation of the data collected from this work to the staff of the Department of Antiquities and Department of Archaeology.

The June/July 2006 season was possible due to the generous support of several sponsors including the National Geographic Society. Dr Gareth Sears and Miss Helen Goodchild’s travel to Libya was supported by generous grants from the University of Birmingham’s School of Historical Studies’ Overseas Research and Conference Grant. Dr Jeremy Rossiter's travel to Libya was made possible by a grant from the Social Sciences and Humanities Research Council of Canada. Further funding for the University of Birmingham staff was provided by The HP Visual and Spatial Technology Centre (a division of Birmingham Archaeology/Institute of Archaeology and Antiquity, University of Birmingham).

2 Background
The American Archaeological Mission’s excavations were conducted between 1969 and 1978 when excavation work was suspended to allow for the study of the material that had been revealed. Two further study seasons took place in 1979 and 1981 before political problems between the US and Libya led to the project’s suspension. The results of the project were presented in a series of articles in Libya Antiqua and the American Journal of Archaeology between 1971 and 1977 and, from 1984, a seven volume Final Report published by the University Museum, University of Pennsylvania.
The excavation concentrated on the Upper, Middle and Lower Terraces of the Sanctuary of Demeter and Persephone and revealed a complex of shrines, walls, doorways, water installations and stairways that made up the complex as well as numerous votive deposits and elements of statuary (see figure 3). In addition to the excavation of the three terraces, an area of 9,000m$^2$ was surveyed including the excavated sanctuary, the wadi area and the line of the city’s defences. The excavations and their results are fully recorded in the publications mentioned above.
Figure 2. Cyrene and area of concession

Figure 3. Sanctuary of Demeter and Persephone from the North Bank of the Wadi Bel Gadir
3 Description of the Site Topography

The present character of the site is defined to its north by the valley of the Wadi Bel Gadir, separating the sanctuary complex from the main city of Cyrene. The valley drops steeply away from the cliffs on the north side, upon which were built the city walls, and less steeply from the steadily rising ground to the south that comprises the site. The sanctuary itself is on steep ground, at the top of the wadi, with the lower sanctuary being approximately 17m below the level of the upper sanctuary. The steep ground coupled with the vegetation and the archaeological remains made survey difficult in some areas of the wadi. Moving away from the valley a series of terraces gradually rise up to the south; along and in between these terraces a series of stone features were discovered and recorded. This terrain on the wadi’s south bank continues to the east and west of the study area, although to the west of the study area subsidiary wadis cut into the Bel Gadir from the south.

The great majority of the study area, 370m by 340m, was covered in low, sparse, thorny scrub. At the time of the expedition the southern and western extents of the study area were covered in a wheat crop, while the eastern quarter was planted with widely spaced fruit trees. In the valley of the wadi itself the vegetation was denser than the rest of the site with trees lining its banks. A farmhouse, associated buildings and a garden occupied part of the southwest of the study area. The owners of the farm generously gave permission for CAP to conduct the survey within the gardens and spaces between the structures but obviously the survey did not take place in the immediate area of the house or farm buildings.

The majority of the study area contains traces of former buildings, tombs and walls. Most of these features were standing to a height of less than half a metre but a few of them were closer to a metre. These features will be discussed in greater detail in section seven. In the area of the sanctuary itself the excavated remains stand to a considerable height with the main retaining wall that defines the break between the middle and lower sanctuaries standing to a height of 5m.
4 Aims of the 2006 Survey

The principle aim of the project was to assess the survival and potential significance of any archaeology within the study area by collating existing archaeological and historical information for the site, and its immediate environs, and placing it in its local, regional and national context.

More specific aims were to:

- Define study area boundaries
- Resolve topological survey data with White’s site plan and section drawings
- Close resolution GPS-derived kinematic survey of the project area, constituting approximately 127,000 m²
- Map standing remains and topographic features within the concession area with a view to providing ground control points for aerial photographs and a DEM for the entire site
- Train staff of the Department of Antiquities at Cyrene and the Department of Archaeology in the use of GPS and GIS
- Assess the archaeological resource in order to ensure an effective and informed targeting of future resources

All of the aims of the 2006 CAP season were to be achieved in close co-operation with the Department of Antiquities and the Department of Archaeology at Omer al-Mukhtar University.

5 Survey Methodology

The survey element of the project was undertaken by all members of the CAP project, including staff from the Department of Antiquities and staff and students from the University of Omer al-Mukhtar. This was done using a Leica SR530 Differential GPS (base station and rover) to provide a close resolution topographic survey and to map visible features. A control point was established on high ground, away from physical obstructions, close to the southern extent of the project area. This served as the "base station" for the duration of the survey. The base station (Leica SR530 receiver) logged data from the GPS satellite constellations and broadcast real time corrections to the SR530 rover. This allowed the collection of survey data providing a relative positional accuracy of ± 0.02m.

With the exception of the Wadi Bel Gadir, most of the vegetation within the project area was fairly low and did not present any significant problems. This provided the opportunity to rapidly map thousands of spot heights using real-time kinematic survey. The rover can record X, Y, Z, data points at set time or distance intervals, the shorter the set period the greater the resolution, (and size) of the final data set. The rover was set to automatically log points at intervals of 1 second. Ranging rods were placed as markers at distances of approximately 50m and the GPS operator walked between these markers. This ensured that equal coverage of each area was maintained. The markers were moved at intervals of 2.5m after each traverse.

Satellite reception proved to be problematic in the areas of higher vegetation, particularly in the Wadi Bel Gadir. Here the ground is much steeper and points were only taken in areas where it was safe to survey. These were mostly static rather than kinematic observations, which resulted in a slightly reduced resolution of points in this area.
In addition, a walkover of the study area was undertaken in order to assess the topography and any above ground archaeological remains. On completion of the topographic survey all visible archaeological features were mapped using the SR530 rover (figure 5). Due to the density of remains only stonework that appeared to be *in situ* was mapped. This mostly comprised wall foundations from former buildings, and most were no higher than the current ground level. A few of the walls survived to one or two courses, and in some instances the ground plans of entire buildings could be observed. This was particularly evident in the eastern half of the project area where wall lines have been defined by very recent excavation. Each archaeological feature was sequentially numbered, photographed and a brief description provided.

Points were collected in WGS84 latitude and longitude then converted to the UTM 34 N projected co-ordinate system using Leica SKI-Pro software. X, Y, Z, data points were exported from SKI-Pro as comma delimited files. This is a database format where each record is a single line and each field in the record is indicated by a comma (Comma-Separated Value). In total approximately 70,000 points were collected over a project area totalling more than 127,000m² (figure 6).

This work has demonstrated that large areas can be accurately mapped in detail relatively quickly making this the most suitable method, particularly for the detailed survey of single features. In the absence of LiDAR (*Light Detection And Ranging*) data this is also an efficient way of undertaking a base-mapping programme. The survey enabled the creation of a Digital Elevation Model (DEM) and spatial reference system against which the ground plans of the surviving structures, remote sensing data and future results can be accurately mapped.
6  GIS Modelling Methodology

A small-scale GIS project had been undertaken prior to the field season in order to provide context for the concessions area, the city of Cyrene, and its surrounding area.

A low resolution DEM for the whole area of Cyrenaica had been obtained from the Shuttle Radar Topography Mission. This had a resolution of approximately 30m and so, whilst it had limited value for assessing the detailed topography of the concession area, was extremely useful for looking at the wider region, in particular in identifying potential areas for future survey.

QuickBird satellite images, at a resolution of approximately 0.5m, provided an excellent base map, and were used in the first instance to identify the concession area. The original paper map showing the area was scanned and then rectified to its proper coordinates by aligning the known points from the map to the satellite image. Once the area was defined it was then possible to use the satellite image to identify the limits of the study area on the ground once fieldwork had commenced (figure 2).
Scanned aerial photographs from the Huntington survey were also rectified using the satellite images. However, it was noted that a complete run was not available and only part of the concession area was covered. This will be followed up and the missing photographs hopefully obtained.

Also available prior to the field season were the scanned Istituto Geografico Militare maps of Cyrene and the surrounding region. These dated from the 1920s and illustrated the significant development of the urban areas as well as showing the topography.

During the field season the data collected was regularly added to the project. This had the dual benefit of checking the resolution of the model and adding more points where necessary, and acting as a continuous check on whether we were staying within the confines of the concession area. The point data, already in csv format, was converted to dbf and added as a table to the GIS. The X and Y data was then used to automatically plot the points onto the map. This point data was then interpolated using the Inverse Distance Weighted module to create a 3-dimensional surface. It was apparent from this model that the terraces were built in an L-shape, with the apex to the south-east (figure 7).

Once the terrain model was complete, the mapped features in situ were added to the project. The walls were shown as polygons and, as such, could be compared with any features visible on the satellite images. This gave a very useful overview of the whole complex and its relation to features outside the concession area that were also highly visible on the satellite image. These included a small theatre just outside the concession area to the east, and the recently excavated temple buildings a further 150m to the east. A series of mausolea and a probable road just to the south of the concession area were also visible in the satellite image (figure 8).

All of the data collected was overlaid onto the DEM created by the GPS survey. This highlighted certain features and their relation to the topography. In particular, a probable temple podium with staircase and plaster-lined drainage channel was discovered during the walkover. Once overlaid it was apparent that this temple was situated on a small rise mid-way up the main terrace system (figure 9).

As well as the main differential GPS survey, a handheld GPS was also used to map the location of the rock-cut tombs in the side of the wadi. These tombs were numbered and photographed, and the points entered into the GIS. The photographs will be linked to each point via hyperlinks to enable the visualisation of each tomb within the GIS. The same process will be carried out for each feature mapped in the survey to enable interpretation of the features in situ. A terracotta head was found during site inspection which, presumably, represents
Demeter (see cover illustration for a sketch of the object). The find was presented to site staff and deposited in store.

7 Results and Discussion

The results illustrated in figure 8 illustrate the extent of remains that can be traced above the ground and within the area of the White concession. Several points should be made in respect of this survey:

- Although it is difficult to construe the significance of the majority of stone features in terms of individual structures one group of features has been interpreted as, potentially, the remains of a temple podium (figure 9).
- The extent of visible features suggests that ancient structures were distributed across the majority of the concession.
- It is very unlikely, given the results of earlier excavation, that these visible remains are the total of surviving structures. The nature of terracing must suggest that the existing structures may be linked to features that remain buried within terraces and that other structures probably remain to be discovered. The potential for exceptional survival at the site is perhaps best illustrated by the presumed entrance to the sanctuary of the recently excavated temple of Demeter. Here several metres of infill appear to have preserved the structure to roof height. The potential of such deposits for geomorphological or environmental sequences cannot be underestimated.
- The majority of the extramural areas would be amenable to remote sensed survey (magnetometry, conductivity or ground penetrating radar).

![Figure 8. In situ features and their relationship to remains outside the concession area](image)
Survey in the Cyrene Hinterland

CAP team discussions prior to the 2006 field visit concluded that further work on the primary settlement at Cyrene would benefit from the provision of a hinterland survey. To this end a provisional survey region was selected on the basis of available map data. This comprised a transect running roughly east-west from Cyrene to the town of Lamluda, an area of c. 31 x 10-km. A range of settlements ranging from substantial towns to minor settlement and processing or collection centres indicated that the hinterland possessed a developed settlement hierarchy. Brief study of the fields associated with specific settlements indicated the survival of associated agricultural features including terracing and field walls. The results of these preliminary site visits suggested that a directed survey including extensive aerial photographic analysis, directed surface and remote sensed survey, in combination with a programme of palaeoenvironmental sampling, might:

- Provide settlement data that can inform the Department of the Antiquities regional development plan
- Clarify the rural settlement sequence in terms of chronology, function and hierarchy
- Provide data on associated landscape architecture including new evidence for the extent and nature of ancient agricultural practice and irrigation systems in the region.
- Provide an associated palaeoenvironmental sequence that might be tied into the urban sequence at Cyrene itself
Figure 10. Potential hinterland study area, including location of sites visited during field trip

Figure 11. Oil press at Lamluda
Observations on the archaeological area of Cyrene

During the field visit all the team took the opportunity to visit the archaeological area of Cyrene and to record their observations on the site and its potential for mapping. The team concluded that aside from areas already excavated:

- Significant areas of the Acropolis and the adjacent hilltop and hillsides were amenable to, and available for, remote sensed survey and that provision of data for this area would aid analysis of the urban form and formation process.
- Other areas aside from the Acropolis and Agora were available for remote sensed survey including the area around the circus and the Temple of Zeus.
- The remaining area of the town had been landscaped and planted with trees but these appeared to be wide spaced and shallow rooted. It is likely that geophysical survey could take place within the wooded areas.

The team concluded that the majority of the unexcavated area of the city could be surveyed using non-invasive technologies, along with much of the extra-mural area. Survey of the area of the town would appear to be a priority activity for any management plan associated with the world heritage site at Cyrene.

8 Proposals

The primary recommendations following the 2006 field visit were:

- That the primary requirement of the world heritage site at Cyrene is an adequate base map of contemporary and ancient features to assist in the management and development of the site
  - Methodology
Mapping from aerial photography
- Mapping from high resolution satellite imagery
- Mapping from existing archaeological mapping
- Mapping from existing urban planning and developmental records

That the value of data from current and future excavations at Cyrene would be significantly enhanced by provision of remote sensed data for the settlement as a whole and that this would support the provision of a management plan for the world heritage site.

► Methodology
- Magnetometry
- Ground penetrating radar
- High resolution satellite imagery
- Existing archaeological mapping
- Targeted surface survey

That historical and archaeological data from the town would be enhanced by a regional survey

► Methodology;
- Analysis of available aerial photographic or air and satellite remote sensed data to locate features associated with settlement and land use
- Targeted surface survey to locate, characterise and date the range of settlements within the hinterland
- Targeted geophysical survey to ascertain structural characteristics of a range of sites or landscape features
- Targeted palaeoenvironmental studies to tie valley sediments and erosional histories with site specific data
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Ahmed Hussin

University of Birmingham, Institute of Archaeology and Antiquity
Mr Richard Cuttler
Professor Vince Gaffney
Miss Helen Goodchild
Dr Gareth Sears

Department of Antiquities, Cyrene:
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![Image of Large limestone cave collapse, east of Cyrene]