

RAPID AND COST-EFFECTIVE ASSESSMENT FOR WORLD HERITAGE NOMINATIONS

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ABSTRACT:

Heritage places worth being protected by the UNESCO World Heritage convention located in countries with limited financial resources required equal attention and protection that properties in other countries. The world heritage nomination process can be very costly for heritage organizations lacking funding and capacity. This paper presents an approach for carrying out rapid-recording assessments, in order to accelerate the identification, definition and dissemination of essential information about heritage places for the enlisting on UNESCO's World Heritage convention. Additionally, this rapid-recording approach can be used in case of pre-inventory, salvage recording, and recording in case of emergency. The tools presented are freely available and off-the-shelf (COTS) made applications.

1. INTRODUCTION

Cultural Heritage properties are in constant threat of destruction. These threats range from potential environmental calamities (earthquakes, tsunamis, inundations, etc), to indiscriminate development of infrastructure. As well as, armed conflicts, and pure vandalism.

After its adoption in 1972, the UNESCO World Heritage Convention has provided shelter to more than 800 properties around the world, making it is the most effective legal instrument to protect heritage places internationally.

In the past years, the world has witnessed the destruction of important heritage places around the world, ranging from the calamity of the Bamiyan Buddhas in Afghanistan to the devastating looting and destruction of Iraq's Cultural Heritage, as described in the article by Moyer (Moyer: 2003, p. 61) in National Geographic.

Along with the utilization of technology, this paper is based on research at the R. Lemaire International Centre for Conservation (University of Leuven) and the Historic Preservation (University of Pennsylvania); as well as, on direct participation in international projects financed by UNESCO in Afghanistan and Sudan, as well, as the Getty Conservation Institute and World Monuments Fund's Iraq Cultural Heritage Initiative.

This research and field projects have evidenced that identification through rapid-assessment heritage places is among the most important actions towards the protection of properties.

1.1 Heritage Inventories and the role of rapid-assessment

Preparation of inventories is a laborious activity that involves multidisciplinary teams. Inventories need to have consistent forms, glossaries, and instructions to guarantee a concise, homogeneous and adequate classification of heritage information that would allow understanding their significance

and state of conservation. This is already being underlined on The Council of Europe's Guidance on inventory and documentation of the cultural heritage: 'Inventories are indispensable, for the purposes of identification, protection, interpretation, and physical preservation of movable objects, historic buildings, archaeological sites, and cultural landscapes' (Council of Europe, 2005, p. 11).

The approach presented here, making use of available and easy to use technology, is aimed at providing a rapid-assessment tool for heritage places in a relatively short time. The results of this assessment can potentially be used by national, regional and international organizations to collect relevant and sufficient information about heritage places.

1.2 Baseline recording

This paper focuses on gathering information for 'baseline recording' aimed at preparing graphic information for World Heritage Nomination files. The type of baseline required by UNESCO will be further explained in this paper.

2. BACKGROUND

2.1 UNESCO World Heritage property nomination requirements

The nomination of World Heritage sites is governed by the 'Operational Guidelines, which are periodically revised to reflect the decisions of UNESCO's World Heritage Committee' (<http://whc.unesco.org/en/guidelines/>)(accessed: 20/04/2009). According to these guidelines, the following issues need to be provided at submission of a new nomination:

- Identification and description of the Property;
- Justification for Inscription;
- State of conservation and factors affecting the property;
- Protection and management;
- Monitoring;

- Documentation;

The approach presented in this paper will focus on the graphic information for the baseline, required to support a nomination, as stated on the operational guidelines:

“All necessary documentation to substantiate the nomination shall be provided. In addition to what is indicated above, this shall include photographs, 35 mm slides, and image inventory and photograph authorization form. The text of the nomination shall be transmitted in printed form as well as in electronic format (Diskette or CD-Rom)”.

Other issues needed, can be found at: <http://whc.unesco.org/archive/opguide08-en.pdf> (accessed: 21/04/2009)

2.1.1 Identification of the property

According to the Operational Guidelines: “The boundaries of the property being proposed shall be clearly defined, unambiguously distinguishing between the nominated property and any buffer zone (when present). Maps shall be sufficiently detailed to determine precisely which area of land and/or water is nominated”

In this rapid assessment approach, it is assumed that “officially up-to-date published topographic maps of the State Party” do not exist or they are old and not reliable. It is important that “A nomination shall be considered incomplete if it does not include clearly defined boundaries”. However, before going any further, the identification of a property is the task of government institutions and should be carried out a interdisciplinary group of experts with sufficient knowledge of the property being recorded.

3. APPROACH

3.1 Needs

Recording appropriate information for World Heritage properties is a laborious process, however, in most cases rapidly photographing and mapping the location, ‘as is’ condition and extend of the heritage place can provide sufficient information for supporting a nomination file.

In more comprehensive heritage place’s documentation projects, a baseline information (measured maps, historical research, condition, threats assessment, etc) should be collected and presented. In the context, baseline information relates to sufficient information about the location, extend and general physical condition of heritage places.

To be concise, in this case, the definition of the level of information required at this stage of a heritage place according to the approach here presented, the following information should be recorded:

- Name: this is the known name of the site in any language;
- Location: the approximate geographical coordinates of the property’s centroid, this is defined by centre of the site in respects to the boundaries;
- Extend: definition of boundaries of the site (core zone), this is defined by tracing a topographic polygon covering the extend of the property, if time permits, also mark a perimeter to define a buffer zone;
- Condition or state of conservation (as-is): take images of the property, covering as much as possible of the

features and condition, follow the 3x3 rules provided by ICOMOS CIPA at <http://cipa.icomos.org>.

3.2 Appropriateness of this approach

The approach presented here is limited in geometric accuracy. The devices and applications proposed guarantee-mapping appropriateness for a preliminary level of detail permitting a rapid assessment of heritage places. Other more expensive tools are required for extensive understanding of the features, landscape and condition of heritage places.

3.3 Methodology

As mentioned previously, this approach is presented to countries lacking sufficient resources to make a comprehensive baseline of their properties, it is an alternative approach to get a preliminary set of information about the heritage place that can be transmitted to UNESCO.

How it works: lets record a heritage place

The process to record the property can be summarized in six steps:

1. Have a clear understanding of the property, collect all background information available online, archives, etc;
2. Organize a workshop with your colleagues and stakeholders on the property in order to define the boundaries of the site;
3. Identify and measure the centroid of the property to locate its geographic coordinates (using a GPS);
4. Identify the immediate boundaries of the property (core zone, read the UNESCO WH Operational Guidelines), by taking a sequence of measurements that allow defining a polygon (using a GPS);
5. Using the same procedure for the core zone, identify the buffer zone of the property (read the UNESCO WH Operational Guidelines);
6. Take a sequence of overlapping photographs of the features of the site (buildings, ruins, landscape, etc), additionally take some measurements of the heritage place to have an idea of the scale of the object, use the 3x3 rules of ICOMOS CIPA;
7. Map with the GPS and photograph threats to the site (read the UNESCO WH Operational Guidelines), use a log to collect information about the photographs made;
8. Upload all the information collected to 3D Earth Viewer (ex. Google Earth), by marking placemarks and defining polygons, save it to your places in the computer;
9. Share the 3D Earth Viewer (ex. Google Earth) information with stakeholders and with UNESCO to agree on the boundaries of the property;
10. Use the photographs to create 3D models (ex. ARC 3D website www.arc3d.be)(accessed: 20 apr. 2009)
11. Visualize the 3D model and produce other drawings;
12. Use a Computer-Aided Drawing (CAD) or other modelling software, such as the free and open source package Meshlab to scale the 3D model (<http://meshlab.sourceforge.net/> accessed 20 apr. 2009).

Equipment: Hand-held GPS, Digital camera, Notebook and pencil.

Software: 3D Earth viewer application (ex. Google Earth, eventually Plus version), 3D recording software (ex. ARCD 3D Web software), CAD and 3D Modelling package (ex. MeshLab), and Panorama maker software (ex. Hugin). (Internet is required)

Alternatively (involves additional investment): Geotagging software (ex. RoboGeo), Panorama software (ex. Autodesk Stitcher), photogrammetry (ex. Photomodeler, I-Witness), and a Digital Camera equipped with a GPS.

3.4 Preparation

First of all, read the UNESCO World Heritage Operational Guidelines to know what is required. Organize a workshop with stakeholders to define the boundaries of the property.

Onsite, make a preliminary reconnaissance of the property before taking any measurements and/or photographs; try to get an overall idea of what needs to be recorded and to define the boundaries and from them the centre (centroid) of the property.

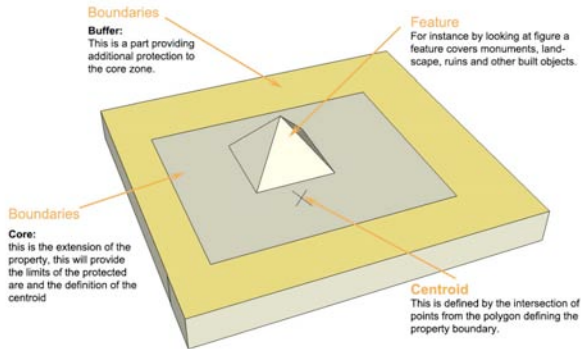









Figure 1: elements to record to prepare a baseline, author

Additionally, if available any information about the property that is found can be useful to understand the location and extend of the site, such as maps, satellite images, photographs, articles, etc.

3.5 Require equipment

	Navigation Global Positioning System (GPS) device : using a simple device, for the purpose of this record the reception accuracy is not that relevant. Use WGS84 projection as standard. A data cable to connect to the computer will be needed. (http://en.wikipedia.org/wiki/WGS84 , accessed: 20/04/2009).
	A digital camera with sufficient resolution and eventually with a wide lens so it is able to cover more of the site with lesser photographs. Alternatively, it is possible to get a camera equipped with GPS and/or an external GPS geotagger unit.
	A notebook and pencil to make sketches of the site, notes on the points, which are measured, and eventually the positions from where the photographs are taken.
	Magnetic compass to annotate the direction that photographs are been taken related to the north.

** Navigation-grade GPS: Map accuracy and absolute accuracy approximately 10m. Good for finding location in relation to maps and relocating sites, but not suitable for site survey. Notoriously bad for height information. English Heritage ‘Where on Earth are We’ (http://www.english-heritage.org.uk/upload/pdf/where_on_earth_are_we.pdf accessed: 26 oct. 2008).

	Tape measure to take some controls to define the scale of the object
	PC equipped with Windows and internet access in order to install the software and upload – process the images taken
	A 3D Earth Viewers (on-line GIS with spatial imagery), ex. Google earth (http://earth.google.com/); download the latest version of this software application; you need the free version only.

3.6 Skills requirements

- Heritage recording experience, a multidisciplinary team is imperative;
- Basic GPS knowledge, understanding on how to measure coordinates (latitude – longitude format);
- Basic understanding of digital photography;
- Computer knowledge, especially in the use of a 3D Earth Viewers.

4. FIELDWORK: RECORDING THE PROPERTY

4.1 Define centroid:

Observe the extension of the property, roughly defined a point in the middle of the boundaries and using the GPS take a measurement (waypoint). Write down the longitude and latitude of the point, if points are not store automatically. Take a photograph of the centroid defined.

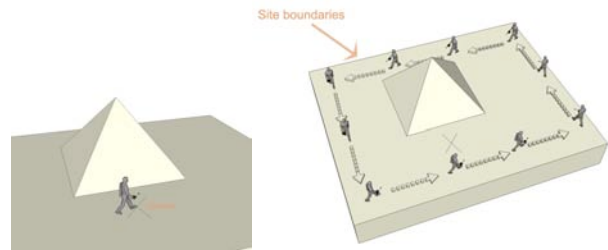


Figure 2: property centroid, author.

Figure 3: mapping the property boundaries, author.

4.2 Property boundaries (Core and Buffer zone)

A first glance of the extension of the property should be already understood by defining the centroid. Therefore, now reach all those points defining a polygon[†] and covering the extension of the property, write down each polygon vertex on your notebook obtained from the GPS. Alternatively you could use the tracking feature of the GPS. While defining the boundary, take a look at potentials factors affecting the property, as described previously, like development pressures (agriculture, construction, etc), if necessary take a GPS reading of it and a picture, write down the number of the picture and its coordinates. Later on, this information can be transferred to 3D Online Earth Viewers (ex. Google Earth).

[†] Polygon: in geometry a polygon (IPA: /'pɒlɪɡɒn, 'pɒlɪɡɒn/) is a plane figure that is bounded by a closed path or circuit, composed of a finite sequence of straight-line segments (i.e., by a closed polygonal chain). <http://en.wikipedia.org/wiki/Polygon> accessed 07 dec. 2008.

4.3 Rapid-assessment of the state of conservation or “as is” condition of the property

4.3.1 Basic recording approach

Using the digital camera, look at the feature to be recorded, make sure that the object fits into the camera frame. Centre the camera to one central point of the object, and walk around it taking overlapping photographs, keep the same central point defined. A good explanation on how to take sites can be found on the EPOCH web service manual[‡] and on the 3x3 Rule by CIPA[§].

Try covering each of the main features of the property; this involves taking photographs of historic structures, accessibility, facilities, landscape, etc. Prepare a photograph form, include for each photograph:

- GPS coordinate of the location (use WGS84 projection);
- With a compass take direct to the north from where the photo have been taken;
- Description of the photograph;
- Photographer.

These can be uploaded later to a 3D Earth viewer and linked. More advanced cameras are equipped with a GPS, which writes the location directly to the image ‘exif’^{**} file, which can be read by low cost software and produce maps.

Besides taking photographs of the features, do not forget to also take images of threats (factors affecting) the property, such as indiscriminate development, visitors pressure, weathering decay, vandalism, etc to the site. Be organized, use an additional form for these photographs, taking the same information mentioned above and complementing it, by classifying the photos by different factors affecting the site.

4.3.2 Advanced recording approach

Using the photographs explained in ‘Basic recording approach’, complete the image record and using a tape measure, triangulate* a couple of points of the elevation of the object, look at the example in Figure 4, this will allow to obtain the scale of the object when using the software package to extract the 3D information from photographs.

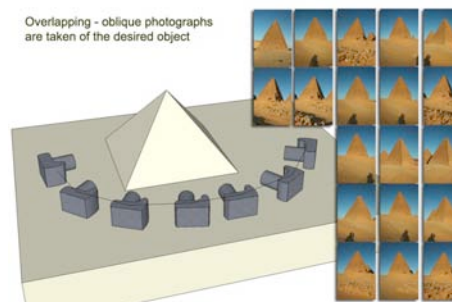


Figure 4: overlapping-oblique photographs of a pyramid at the Gebel Barkal World Heritage Site in Sudan, author.

5. SHARING INFORMATION TO THE INTERNET

Before starting to transfer the records collected (coordinates and photographs) to the Internet, install the recommended software.

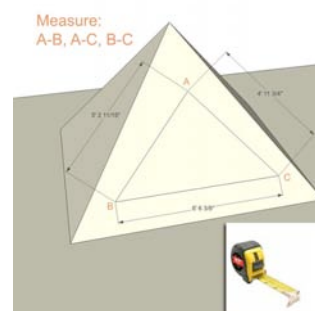


Figure 5: measurements made by hand to scale and orientate the model measured with photographs, author.

5.1.1 For the property location

Use the selected 3D Earth Viewers, in this case Google Earth, type the coordinates defining the location of the centroid into the search box (using longitude and latitude format) and locate the site (see figure 7). Mark this point using the placemark icon, provide the name of the site and save into your places, this will write an KMZ file that can be later shared.



Figure 6: finding a site using google earth and coordinates obtained from the GPS, this example shows how the centroid is defined in the Gebel Barkal World Heritage site, author.

5.1.2 Property extension (Core and Buffer zone)

Using a 3D Earth viewer, in this case Google Earth with the ‘add polygon’ icon, you can define a boundary describing the core and buffer zone of the site.

Lets map, keep the polygon windows open (active) (see figure) and start typing the coordinates into the search box, a polygon while start appearing, alternatively, you can add vertex by the square provided if the image provided by Google Earth is of sufficient resolution. Type the last vertex and close the polygon by clicking ok. Save this polygon into your places. As with the centroid, this file can be shared later. For more information

[‡] <http://homes.esat.kuleuven.be/~visit3d/websevice/html/> (accessed 20 apr. 2009)

[§] <http://www.univie.ac.at/Luftbildarchiv/wgv/3x3.htm> (accessed 20 apr. 2009)

^{**} Exchangeable image file format (EXIF), http://en.wikipedia.org/wiki/Exchangeable_image_file_format (accessed: 20 apr. 2009)

^{*} Triangulation: In **trigonometry** and **geometry**, **triangulation** is the process of finding **coordinates** and distance to a point by calculating the length of one side of a **triangle**, given measurements of angles and sides of the triangle formed by that point and two other known reference points, using the **law of sines**. <http://en.wikipedia.org/wiki/Triangulation> accessed: 07 dec. 2008.

consult the Google Earth manual, available online at <http://earth.google.com/userguide/v4/> (accessed: 20/04/2009).

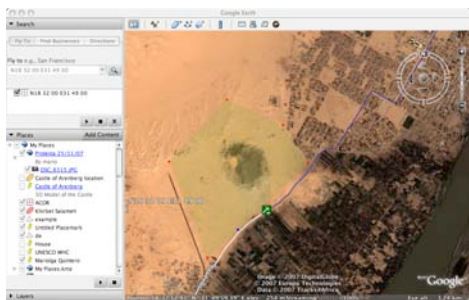


Figure 7: definition of the Gebel Barkal World Heritage Property (Sudan) boundaries, using a polygon, author

5.2 Factors affecting the property

For the ‘Factors affecting the property’, transfer the GPS coordinates of issues and/or areas into Google Earth, which allows as with the boundaries to define polygons covering the extension of threats that will potentially affect. On the example shown on figure about factors affecting the boundaries of the Gebel Barkal World Heritage Property in Sudan, such as agricultural activity and urban developed are mapped, this allows anybody to share this information with others.

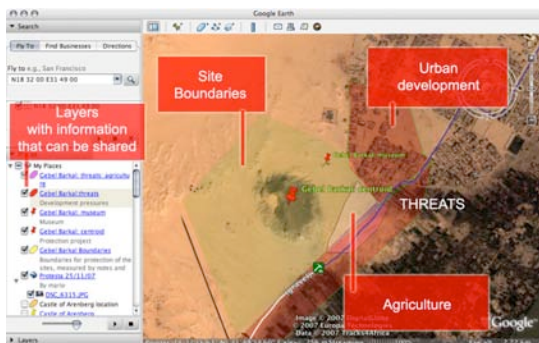


Figure 8: polygon showing boundaries and potential site threats, example of Gebel barkal in Sudan, author.

Make sure to structure the 3D Earth viewer layers are correctly reference, in this case Google earth, indicating each of the factors affecting the property.

5.3 State of Conservation “as is” condition of the property

The photographs illustrating the state of conservation of the property can be uploaded to the Internet and linked into Google Earth using low cost and simple tools. This allows stakeholders to evaluate the arguments given about the state of conservation.

5.3.1 Transferring photographs to the Internet

- Upload all the images to a popular free online photographs repository (ex. Picasa <http://picasa.google.com/> and/or Flickr: <http://www.flickr.com/> accessed: 22 apr. 2009);
- Insert the url of each image to a KML file defining a placemark, follow instructions <http://code.google.com/apis/kml/documentation/> accessed: 22 apr. 2009;
- The resulted images will be linked to the Google Earth map of the property, a user might be able to see the location and image taken.

This solution is cheaper, but involves a lot of processing work. Alternately, with a little more investment, the RoboGeo software (<http://www.robogeo.com/> accessed: 22 apr. 2009) will speed up this approach. This application permits exporting images directly to 3D Earth viewer, CAD and GIS packages.

5.3.2 Extracting 3D information from features

This stage involves preparing a 3D model using the images taken from the different features.

The modelling involves uploading, downloading and visualizing the model created from a 3D Image-Based Recording tool (ex. Arc 3D service).

As illustrated in figures 13 - 14, it is very fast to create a three-dimensional image of the condition of the property. However, this model might not be 100% geometrically accurate, this is a visualization tool; it is useful to provide a preliminary understanding of the property condition.

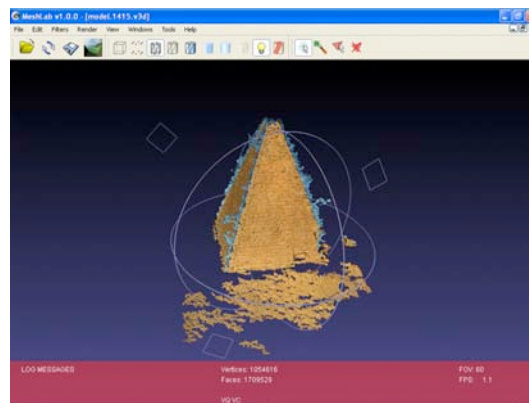


Figure 13: 3d model resulting from the 3D web service and meshlab of a pyramid, author.

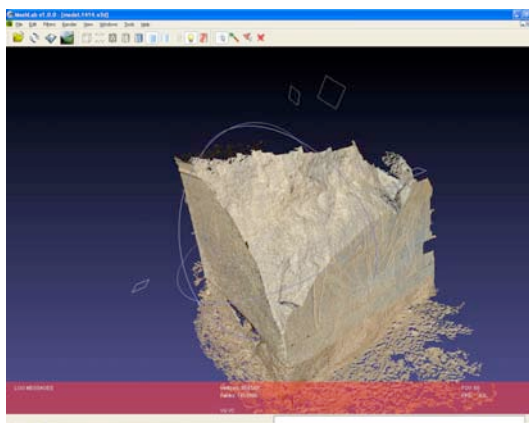


Figure 14: 3d model resulting from the 3D web service and meshlab of a decorated stone, author.

If accurate measurements are to be extracted from the photographs, more expensive photogrammetric application can be used, such as I-Witness, Photomodeler Scanner. These packages offer an alternative to obtain reliable measurements of the heritage place .

The measurements taken with the measuring tape will be use to define the scale of feature. If the photographs and measurements

are taken carefully, relevant information about the condition can be obtained of this feature.

5.4 Online videoclips

Other source of information can be videoclips filmed onsite that illustrate issues relevant to the property. These videos can be posted on social network websites, like youtube. A georeference can be added and linkage to 3D Earth viewer.

6. TRANSMITTING THE DOSSIER TO UNESCO

Currently the World Heritage nomination dossiers are printed (including a PDF file) to be transmitted to UNESCO. This approach will permit prepare the information for the dossiers and make it available online for stakeholders to review.

Make a printed dossier as it is require for submission, plot maps and photographs. However, remember that UNESCO World Heritage nomination files required more than described in this paper.

7. SHARING INFORMATION

The main objective of this approach is to explain an approach to share information with stakeholders and UNESCO in order to prepare an adequate nomination file that will allow protecting the property.

To share the baseline information collected thru this approach is simple, just send an e-mail with the enclosed 3D Earth viewer files (ex. KMZ for Google earth) institution with a mandate to protect cultural heritage, below a list of useful organizations is provided:

- UNESCO World Heritage Centre: <http://whc.unesco.org>;
- ICOMOS: <http://www.icomos.org>: the International Council of Monuments and Sites, official advisory to the UNESCO World Heritage Convention about the protection of cultural heritage, they also produce a yearly publication called heritage at risk;

8. FURTHER DEVELOPMENT

Other more advanced technologies can be applied, but there are considerable more expensive and for purposes of recording heritage places in more detailed. For instance photogrammetry, remote sensing using satellite imagery, and laser scanning.

As technology evolves, the contribution from off-the-shelves technologies, such as Photomodeler, Arc 3D Webservice, meshlab, and other image-based recording techniques, as well as 3D Earth Viewers will become more developed and accepted by the heritage community, new approaches should emerge from this.

Additionally, another relevant challenge is the availability of social applications on the Internet. These applications allows any person to share ideas very easily, perhaps it is worthwhile to investigate the way of using these techniques for the benefit and awareness in the protection of cultural heritage.

9. CLOSING REMARKS

This approach allows making a preliminary record of a heritage place and share this information with other using the Internet. Knowledge of our cultural heritage resources is vital for their

protection and enjoyment of future generations. Inventory is a crucial activity and it should be encourage around the world. In many cases the lack of knowledge of heritage places have caused their destruction.

It will be beneficial for UNESCO's World Heritage Committee to investigate low cost approaches for preparing nominations, along with the current available technology; online free videos can be offer thru social networks (ex. Youtube educational) to provide guide to organizations lacking resources to conduct assessments for potential world heritage properties.

10. ACKNOWLEDGMENTS

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11. REFERENCES

Ainsworth, S. - Thomason, B. Where on Earth are We? The Global Positioning System (GPS) in archaeological field survey, English Heritage, 2003.

CyberTracker, <http://www.cybertracker.co.za/index.html> (accessed: 21/04/2009) and <http://whc.unesco.org/en/ctc> (accessed: 21/04/2009)

Eppich, E. Chabbi, A. ed. Illustrated Examples Recording, Documentation, and Information Management for the Conservation of Heritage Places, The Getty Conservation Institute, 2007 J. Paul Getty Trust (available at: http://www.getty.edu/conservation/publications/pdf_publication/s/recordim.html)

ICOMOS charters: (<http://www.international.icomos.org/> accessed 02/02/09)

Letellier, R. Schmid, W. LeBlanc, F. Guiding Principles Recording, Documentation, and Information Management for the Conservation of Heritage Places, Getty Conservation Institute, 2007 J. Paul Getty Trust (http://www.getty.edu/conservation/publications/pdf_publications/recordim.html accessed 02/02/09)

Moyer, M. 'Beyond the Looting'. National Geographic, 204: 58-75, Oc. 2003. Web reference: <http://ngm.nationalgeographic.com/ngm/0310/feature3/> (accessed: 21/04/2009)

Wikipedia 'A new World Geodetic System: WGS 84' <http://en.wikipedia.org/wiki/WGS84> (accessed: 21/04/2009)

The Council of Europe 'Guidance on inventory and documentation of the cultural heritage' Council of Europe Publishing, Strasbourg 2001.

UNESCO World Heritage 'Safeguarding of the Bamiyan Site, Phase II' <http://whc.unesco.org/en/activities/249> (accessed: 21/04/2009)

UNESCO World Heritage 'Threats: Cultural Landscape and Archaeological Remains of the Bamiyan Valley' <http://whc.unesco.org/en/list/208/threats/> (accessed: 21/04/2009)