Rethinking Digital Data Collection and Dissemination from a User Perspective

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we appreciate any feedback
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We are immersed in a data-rich environment, however many educational and research programs still emphasize data collection rather than making use of existing archaeological and anthropological data. We argue that simultaneous changes in database/digital data repositories and in methods and educational goals are needed in order to create sustainable digital environments that will encourage archaeologists to take advantage of existing datasets. While digitization has become an integral part of archaeological work, the ability to integrate large datasets for concrete analytical purposes is still in the formative stages. Our work focuses on using geospatial technologies to address issues of data utility from multiple angles including digital tools, data collection, database design, analytical methods.

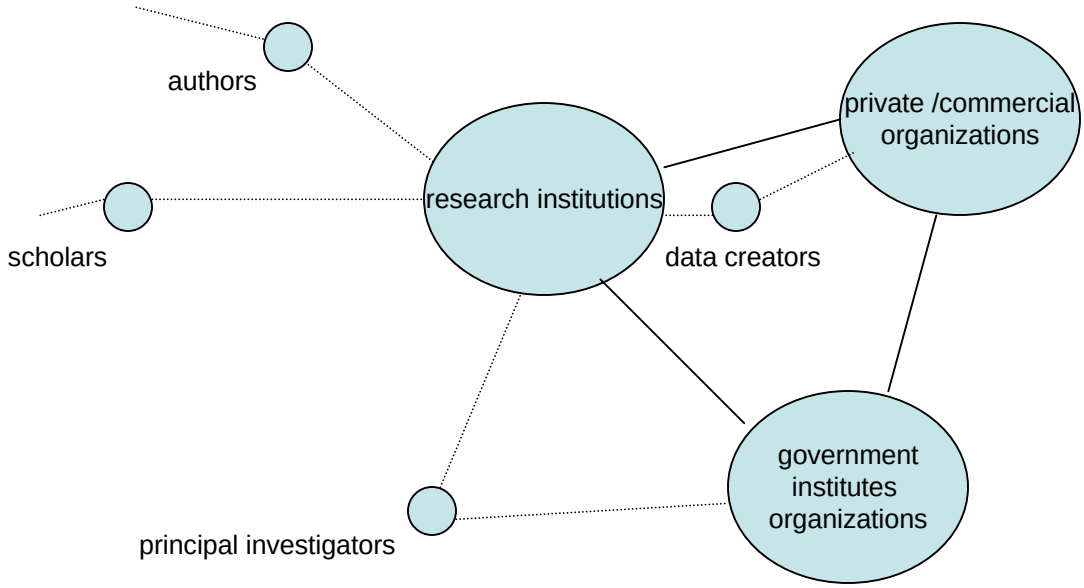
content

Introduction

Current projections indicate that in the near future digital data creation will far exceed the capacity to store that data.This problem requires current practitioners involved in digital data creation to direct attention and undertake action regarding a number of issues that are outlined in the Blue Ribbon Task Force report (BRTF) on digital data management (http://brtf.sdsc.edu): What digital information should we preserve? Who will preserve it? and,Who will pay for it? The Blue Ribbon Task Force report very thoroughly outlines challenges and recommendations from a primarily economic perspective, even though *value* is considered in broader terms than monetary value alone.

We use some of these challenges to frame our paper—a pilot study focusing on user, use, and re-use of digital data in the larger framework of stakeholders in digital heritage. In the course of our study we address data use as a dynamic process, discussing the need for a new paradigm that takes into account methodological implications and brings education to the forefront.

stakeholders in digital heritage data creation and preservation



The diagram is based on the Blue Ribbon Task Force report, which identified leading actors and organizations in digital preservation. According to this report *proxy organizations*,sanctioned by society such as museums and libraries, can act as representatives for the 'public interest'. Elsewhere we have argued that local communities should become equal partners in such models (van der Elst, Richards Rissetto, and Garcia 2010)

Archaeological research as well as research in many other disciplines relies on primary data collected in the field. Increasingly, field and derived data are recorded and archived in digital formats. The assumption that digital archiving only presents advantages, such as the ability to store large datasets for preservation and future analysis, ease of access and dissemination, is premature (see BRTF report). '*Sustainable digital environments'*, the guiding principle for our research, refers not only to good preservation practices, but also to the development of new methods and technologies to make use, re-use, and re-purposing of the increasing volume and diversity of data, that justify investment in storage and preservation efforts. Challenges, especially in cultural research, to develop and maintain sustainable practices are discussed in this paper from several angles and exemplified by a pilot study using data obtained primarily from the National Park Service, Chaco Culture National Historical Park. In the course of the study, we identified several opportunities and challenges related to using data from existing cultural databases, which we place within a broader framework of the current and future use of digital data and technologies in archaeological research and cultural heritage.

Our perspective is primarily from that of the user, however, it is clear that the old paradigm of researchers and public as different entities in respect to cultural content creation and use is no longer valid. " Even in domains with long histories of success in preservations and access, disruptions in the nature of production, dissemination and consumption of information forces reconfiguration strategies." (BRTF p13) The user community of digital (cultural) content is diverse and includes scholars, government and non-governmental organizations, local communities, and the general public and therefore, to give users active roles in content development (e.g., engage diverse users to submit web content) digital heritage web applications need to test the usability of such applications as part of the design process (Nielson 1999). In other words, users need to fulfill active roles. We believe that digital applications and data accessibility has not always been promoted within the discipline of archaeology in ways that enrich and expand research and outreach efforts-this shortcoming is due in part to due to the sensitive nature of archaeological data-and thus, archaeology is somewhat ill-prepared to meet future challenges of the digital information age. We believe that, in part due to the sensitive nature of archaeological data, digital applications and data accessibility has not been promoted within the discipline of archaeology in ways that can enrich and expand research and outreach efforts, within and between communities, and may therefore be ill prepared to meet future challenges of the digital information age.

Traditional collection and preservation strategies are intended to maintain cultural material remains 'in perpetuity' and to facilitate the opportunity for future study. While such strategies are necessary, we believe that new hypotheses and paradigm changes regarding cultural heritage research and management are necessary and that they must use of, not simply create or preserve, digital records and therefore advocate a 'pilot-study program' as part of broader archaeological research goals to incorporate and (user)test digital applications.

digital data creation and preservation however present the following challenges: (brtf p13)

- •uncertainty about selection criteria for assessing long-term value
- •misalignment of incentives between those who preserve and those who benefit
- •lack of clear responsibility for digital preservation
- •little coordination of preservation activities
- •difficulty separating preservation costs from other costs
- •difficulty in valuing or monetizing the cost/benefit of digital preservation

sustainable digital environments

Sustainable digital environments are based on the following characteristics from the BRTF report 2010:

Digital information is inherently fragile, prone to information loss and degradation. Some digital materials require intensive levels of preservation to ensure usability, and other much less, but in all cases, information access tomorrow depends on preservation actions today.

From an economic perspective, sustainability refers to investments and investment returns. This raises the question regarding the tradeoffs between investments to create and use present-day information versus investments that enable future uses. To satisfy both present-day and future needs requires stakeholders to assess both the short-term and long-term value of digital information, the return of which may not be readily apparent today. *Value* needs to be broadly conceptualized; it needs to move beyond commercial value. In addition, decisions need to be made periodically, as the (varying) life cycle of digital information requires maintenance. http://www.life.ac.uk

•The report distinguishes four main information types for which specific preservation needs can be identified in the science and humanities, public policy making, cultural heritage, and the creative sector.

- Scholarly discourse
- Research data
- Commercially owned cultural content
- Collectively created Web content

Broad research objectives should therefore:

•advocate better communication between communities of interest

•identify data already available that can be used in new ways

•identify educational needs to employ and develop methods to use current and future data in innovative ways

•gain insight into changing relationships and dynamics of data creation and preservation

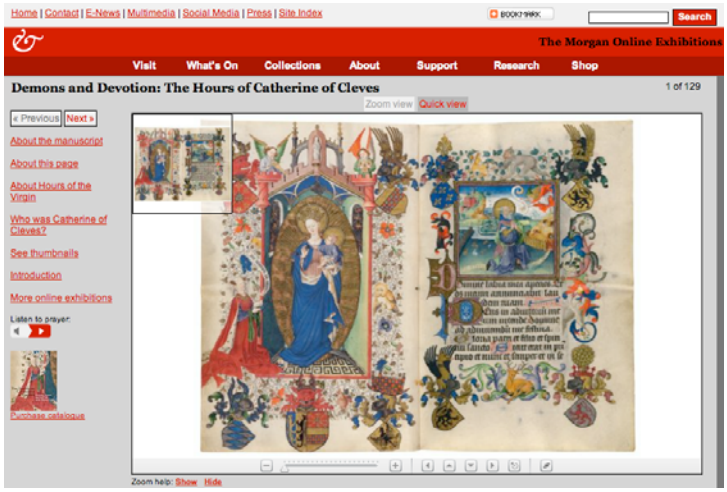
•advocate collaborative projects to explore different conceptualizations, representations and interpretations of cultural and natural heritage for digital applications

Our specific pilot study objective:

To advocate exploration of currently available digital data and use these data in new ways to ensure sustainability. We believe that new technologies allow for reinterpretation of,and can add meaning to existing data, as a form of digital ‘recycling’.

digital data

Digital cultural content is highly diverse, ranging from relatively easily managed formats such as journals to less easily managed formats requiring intensive levels of preservation.Digital Information offers new possibilities to create, share, and communicate data and information and operates under a new paradigm.
Digital heritage comprises a wide range of information from scanned manuscripts to 3D reconstructions of object or monuments to virtual worlds and original artwork, including recorded performances. Some of these are considered replicas or copies of their physical counterpart, however it can be argued that even these so-called copies consists of new artifacts that contain added layers of information that can lead to new insights (Diaz 2002). This information can be intrinsic in the object, extracted through the use of innovative technologies or added layers of meaning through communicative efforts.Examples include digital tools, such as ‘digital magnifying’ enabling research of historic documents at different scales and also allowing scholars simultaneous access to unique documents. (Milekic 2007).
Furthermore, web applications that are driven by user contributed content, such as community communication platforms, can interactively maintain a distributed knowledge base (see http://www.mukurtuarchive.org for instance).
The new digital paradigm raises questions regarding traditional classification schemes in collections and traditional research paradigms and has the potential for increased access to and dissemination of data and endow digital data with added information, which can lead to novel ways of communicating cultural values.



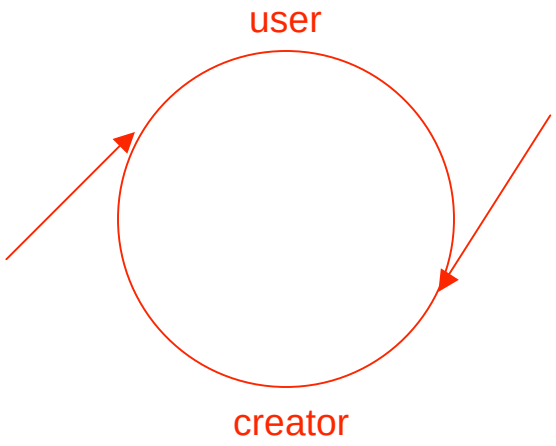
http://www.themorgan.org/exhibitions/defaultExhibOnline.asp

http://cuba-l.unm.edu

the ‘user’ and testing usability

We believe that ‘**the user’** plays an important role and responsibility to test digital content and digital applications. The user is not a passive consumer but considered an active collaborator in digital heritage.

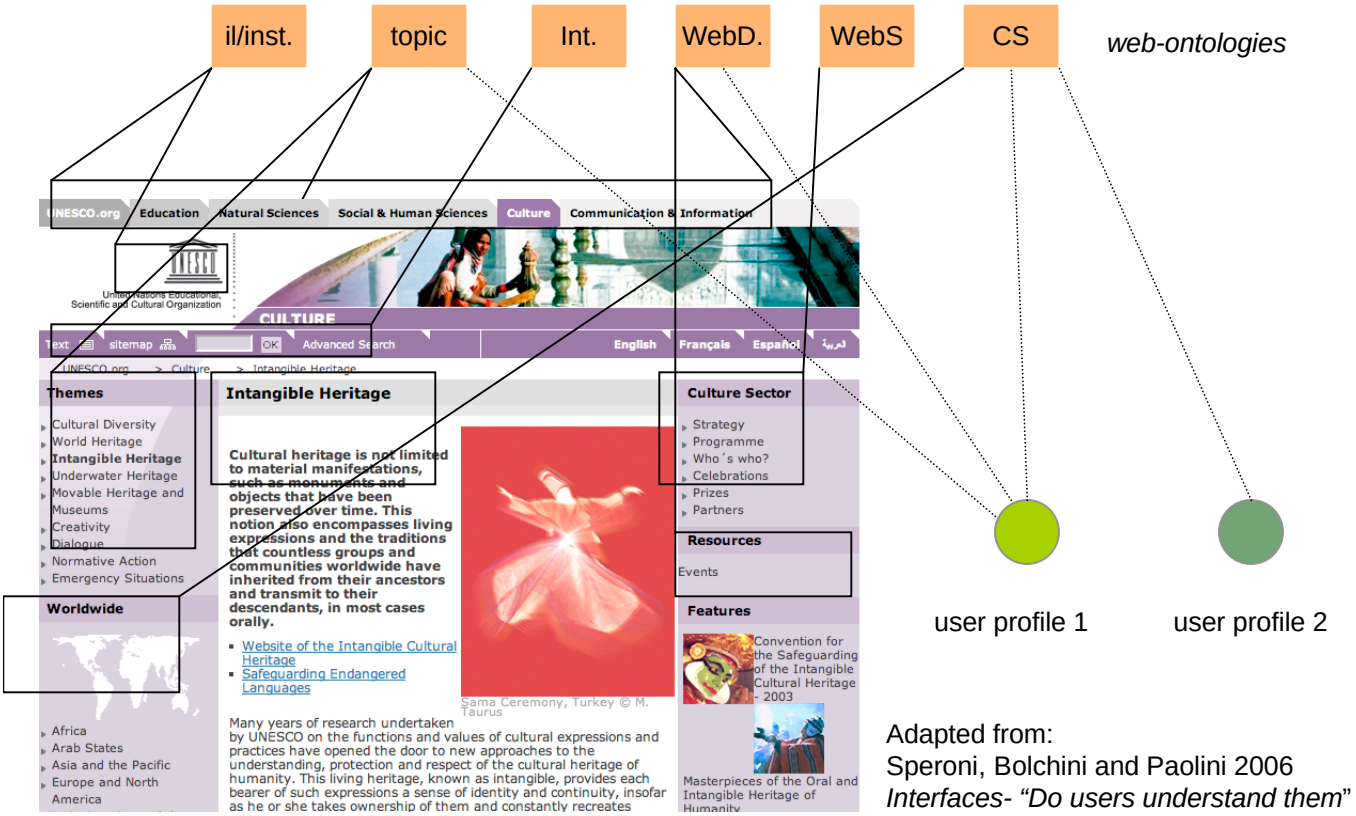
Of the challenges that are identified by the BRTF report, we specifically address the lack of coordination of preservation activities across diffused stakeholder communities. Our immediate concern is the need for better collaboration among researchers, educators, cultural heritage institutions, and communities that can ensure a strong ‘public interest’ in future digital developments.
While number of these challenges with which digital heritage is faced, technical but also technological and methodological, have been identified in the literature and begun to be addressed from from multiple angles. (Cameron and Kenderdine, eds.; 2007, Kalay, Kvan, and Affleck eds. 2008), We focus on an aspect that has received relatively little attention, that is, educating
users (e.g., broad public, scholars, and local communities) on the full potential of digital data and making users partners in a dynamic cycle of digital data creation and use.



As the amount of digital information grows, digital data and information for cultural heritage is increasingly delivered through web applications and communicated through web interfaces. These websites then serve as initial gateways in many present and future research efforts to search and obtain digital information and data.

Usability testing usually refers to the usability of the website, Usability tests examine communicative effectiveness of the interface and content. We, in our pilot project, extend the concept of usability to include the accessibility of digital information and data-can data be downloaded or requested?-and the usability of these data in research (referring to integration and interoperability issues).

interface
content
application



Adapted from:
Speroni, Bolchini and Paolini 2006
Interfaces- "Do users understand them"

http://portal.unesco.org/culture/en/ev.php-URL_ID=34325&URL_DO=DO_TOPIC&URL_SECTION=201.htm l

:

To get an idea of knowledge needed by the user, the pilot study uses the general idea underlying the analytical framework of Speroni et.al. to evaluate the intended ***target audience/ user,*** and assumed skill level needed to access the data.

In addition the pilot study looks at the content and asks, for example, Is the information clear and easy to navigate? Is there other information available on how to apply the data and information? This evaluation helps identify future educational needs.

background

Websites are complex interactive communication systems and thus, testing the usability of websites is thought of as testing two "languages"—that of the interface and that of the content. The **interface** consists of a set of signs that is used to guide or direct users. A sign or semiotic unit , for instance a thumbnail with a label, calls upon the user's pre-existing knowledge, i.e., ontology, to be effectively used. A user's pre-existing knowledge is defined as an ontology, and as the user group is or can be highly varied, user ontologies differ. Ontologies in Information technology refers to a set of concepts from real world experience of the user.

Ontologies of a web site can be categorized in order to assess the ability of different users to navigate the website in order to evaluate the website's usability. The categories of ontologies are: interlocutor/institution ontology; topic ontology; internet ontology; web-domain ontology; web-site ontology; and common-sense ontology. For example, common-sense ontology is expected to be known to any user, whereas interlocutor/institution ontology can refer to the physical components of an institution and may not be readily familiar to every user and is related to cultural background. It is thus important to assess and be able to anticipate the knowledge base of the target audience and/or potential user.

Pilot study

introduction		data access	
data application	scenario 1		
	scenario 2		
		scenario 3	

image credits: http://www.nps.gov/museum/exhibits/chcu/index1.html ; Background: Breternitz et.al. 1982

introduction

Many data, such as archival records are documented and maintained in digital format. Even though these data are not intended for wider use, or initiated as ‘digitization projects’, the data are still part of a growing digital cultural archive that needs to be preserved and can potentially serve wider use needs justifying and contributing to its value.The case study involves NPS in-house electronic archival database and focuses on the Chaco Culture National Historical Park (CC NHP) data. The pilot study seeks to assess the value of these data in geospatial applications and focuses on data access, retrieval, integration, and application.

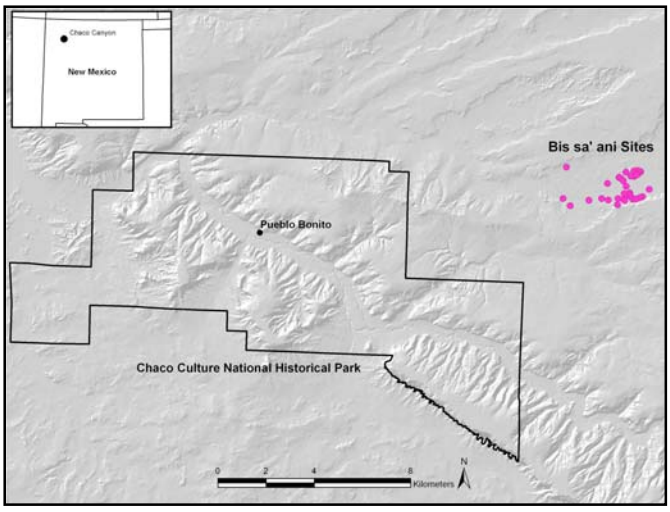
pilot study objectives:

Assess the range of uses for data from an existing database can be of use - assess possible contributions of theses data to cultural research - evaluate the need for and types of user education required to employ these data -evaluate anticipated future uses of diverse digital data and resources - explore the degree to which readily available on-line resources can provide contextual data within a geospatial digital environment.

The Bis sa’ani community and collection is part of what is considered in archaeological terms, the Chaco Phenomenon. Even though the location of the architectural components is outside the Chaco Culture National Historical Park boundaries, the material collection was accessioned by the Chaco museum collection, as a permanent loan from the Navajo Nation. Research collaboration between CC NHP and the University of New Mexico Anthropology Department (UNM) has a long history and for instance a large scale project, known as the Chaco Project,was initiated during the 1970’s, significantly contributing to the collection held at the Chaco Culture NHP museum archive. The long-standing tradition of collaboration between CC NHP and UNM, i.e. government and academy, is therefore ideally suited to explore technological and methodological challenges of digital data preservation, dissemination and especially re-purposing of data for novel educational and research models.

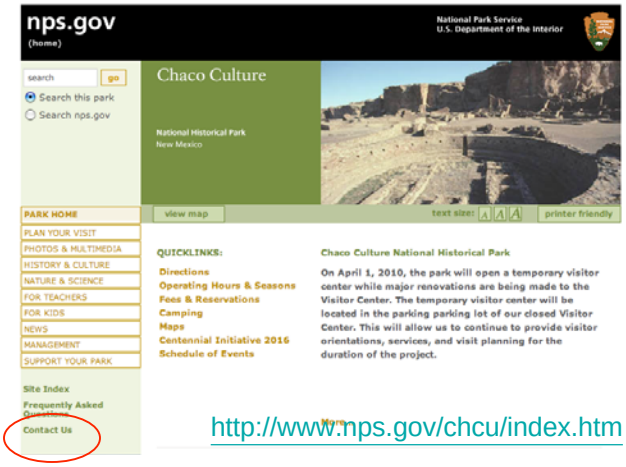
Bis sa’ani community research project

The Bis sa’ani community is considered unique for its late and temporally short and confined context and important for archaeological studies on dynamic occupation and migration patterns (Wills 2009). The Bis sa’ani collection is housed at the NPS archive, conducted as part of a pipeline survey during 1980-1981. The project consisted of a complete survey and partial excavation of the Greathouse and a large number of community sites and is well documented. (Breternitz, Doyel,and Marshall eds. 1982).



data access and retrieval

The study is organized around two data types, cultural/archaeological and non-cultural. Although our main focus is the CC NHP data, other relevant -on-line- available archaeological and natural resource data are briefly assessed.



http://www.nps.gov/chcu/index.htm

Step 1:
contact the museum collection

procedures:
•write a 1 page proposal; data request, project objectives, desired data format, site and attribute list.
•after approval, data are delivered electronically in requested text format

NPS electronic database records are for management purposes that can facilitate research access to the material collection and are not intended for external use. Obtaining access to the database record in digital format thus requires prior knowledge regarding the existence of these data. The data cannot be found via an internet search; they must be requested by contacting the curator of the museum collection. Because the NPS data are not intended for external use they must be assessed differently than the other data sources used in the pilot study, which are intended for on-line access and retrieval.

data request:Bis sa'ani community sites that met the following criteria: (1) excavated and (2) represent different site-types

attribute data: selected attributes from standard NPS recorded object attribute list: NPS catalog number, object type, material type, time period, measurements, project name and date, state and field site number, in-site provenience

Catalog #	Class 1	Class 2	Class 3	Class 4	Object
CHCU 79653	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	SLAB
CHCU 79654	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	METATE FRAGMENT, FRAGMENTED
CHCU 79655	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	STONE ARTIFACT
CHCU 79656	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	GROUNDSTONE
CHCU 79657	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	SLAB
CHCU 79658	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	SLAB
CHCU 79659	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	STONE ARTIFACT
CHCU 79660	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	STONE ARTIFACT
CHCU 79661	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	BEAD, SHALE
CHCU 79662	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	HAMMERSTONE
CHCU 79663	ARCHEOLOGY	PREHISTORIC	MINERAL	SOIL	MORTAR SAMPLE
CHCU 79664	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CHIPPED STONE
CHCU 79665	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CORE
CHCU 79666	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CHIPPED STONE
CHCU 79667	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	HAMMERSTONE
CHCU 79668	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CORE
CHCU 79669	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	STONE ARTIFACT
CHCU 79670	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CHIPPED STONE
CHCU 79671	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	STONE ARTIFACT
CHCU 79672	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CHIPPED STONE
CHCU 79673	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	CHIPPED STONE
CHCU 79674	ARCHEOLOGY	PREHISTORIC	MINERAL	STONE	FLAKE

data access and retrieval

The primary data source was CCNHP. Two additional digital data sources provided cultural data: (1) the New Mexico Cultural Records Information System (NMCRIS) at the Archaeological Records and Management Section (ARMS) and (2) the Chaco Digital Initiative (CDI). Data from these two websites are available via a password protected web-interface and readily available and at request, respectively.

In order to assess the data available in data tables we received we visited the archive for additional information. Reviewing the documents and records regarding the Bis sa'ani community project did not result in significant new material such as field maps that were not published in the original report. The availability of the published report is only limited and a digital copy would have been useful in this case. In addition, we requested digital photographs of some of the objects on the list. Currently, the Chaco Culture museum collection does not have standard procedures set for these kinds of requests.

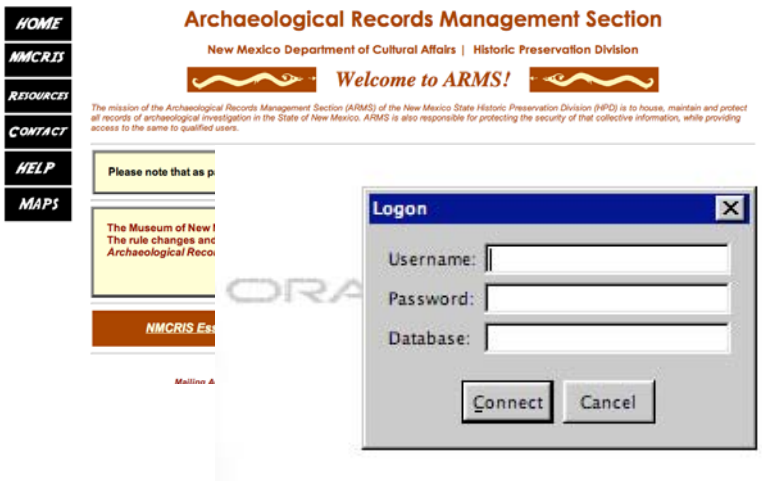
NPS online

Mission of Chaco Culture National Historical Park
"to recognize, preserve and interpret the archaeological resources associated with the prehistoric Chacoan culture in the San Juan Basin and surrounding area, so as to preserve these resources unimpaired for the enjoyment of present and future generations." (CC NHP'foundation document '-available online)

Some information about the museum collection is on-line.
http://www.nps.gov/museum/exhibits/chcu/index1.html

Geospatial data available for the park is related to park infrastructure management.

data access and retrieval other cultural resources



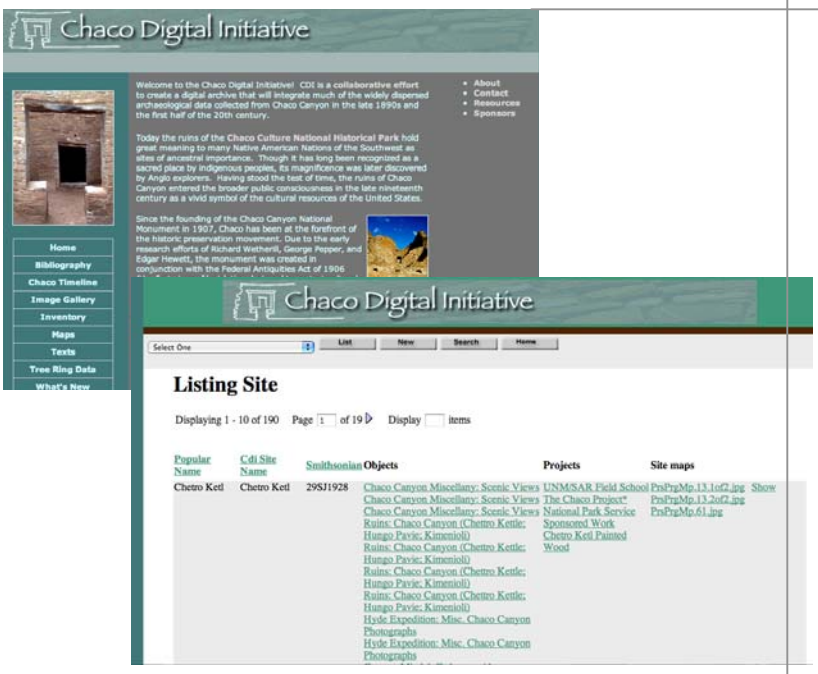
http://stubbs.arms.state.nm.us/arms

Target audience /user:

archaeologists and cultural resources professionals

The New Mexico Cultural Resources Information System at the Archaeological Records Management Section provides site and project summary information and locational information accessible through its database. GIS files can be requested containing site location and attribute data. The data base is password protected. Access is granted to qualified users. Information on how to gain access is provided on its website.

For the pilot project we obtained summary pdf files for each of the sites, which provided UTM NAD 27 coordinate pairs.



http://www.chacoarchive.org

Target audience / user:

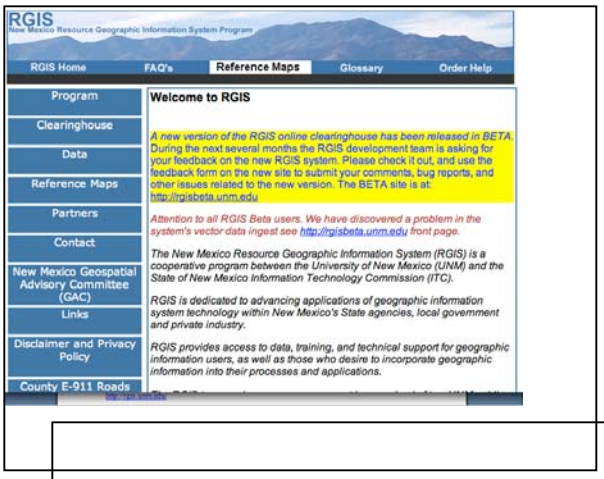
'Chaco research scholar'

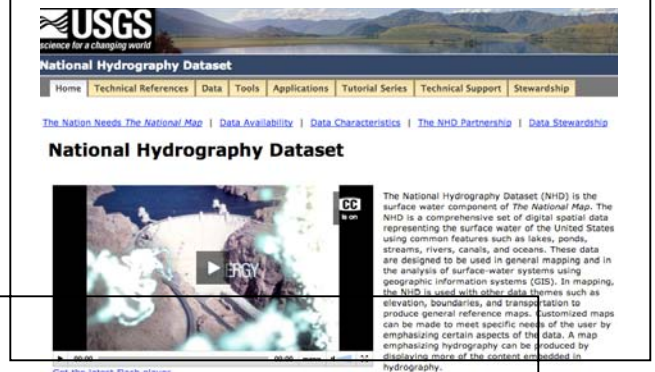
This Chaco Digital Initiative database is publicly accessible and its mission is to preserve and maintain digital copies of photos and field records related to Chaco research, which are physically located at diverse institutions.

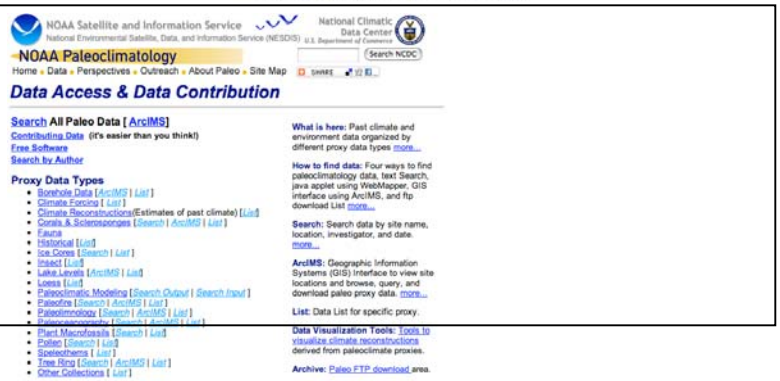
The image gallery is easy to navigate; however the inventory database is not-, a more user-friendly interface could improve database access not only for 'Chaco scholars' but also for other interested scholars and users as.

While we did not use any of the available information for the pilot project, we examined the site's data Some data are available online and other data needs to be requested. Some of the scanned field-notes were difficult to read in, warranting the need for user-testing and quality control.

non-cultural data







Target audience /user: *geospatial community*
The purpose of the New Mexico Resource Geographic Information System Program website is to provide geospatial data to the GIS community in NM. the site is easy to navigate and locate data that can be downloaded as standard GIS files. It does not provide information on how to use the data. The user is assumed to be educated as GIS user http://rgis.unm.edu .

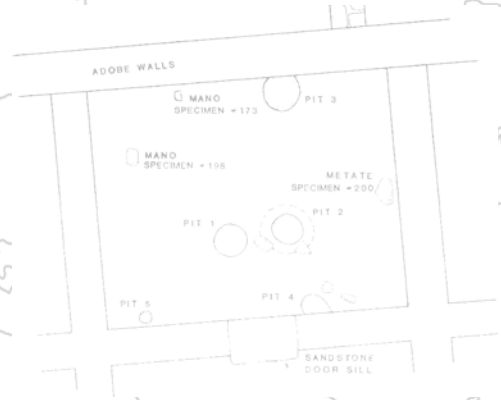
Target audience /user: *water resource specialists, geospatial specialists*
While some information on how to access the data on the USGS website is provided, e.g., directions on 'how to find a watershed', prior knowledge is typically required. The data need to be requested and can be accessed through FTP. The file is industry standard GIS and thus intended for a skilled specialist.
http://nhd.usgs.gov

Target audience /user: *natural resource specialist, GIS specialist*
The NRCS website includes many online resources for natural resource specialists. Specific GIS data requests require knowledge on user data requirements; data are available in different formats
http://soildatamart.nrcs.usda.gov

Target audience /user:
climate specialist. Many datasets are available on the NOAA website. Users can contribute resources and data.Downloadable data are available in different formats and provide references to associated research papers. Often requires file format conversion for integration purposes .http://www.ncdc.noaa.gov/paleo/data.html

data application

This part of the pilot study uses geospatial technologies to address data utility issues related to the application of analytical methods to digital data retrieved/downloaded from cultural databases.

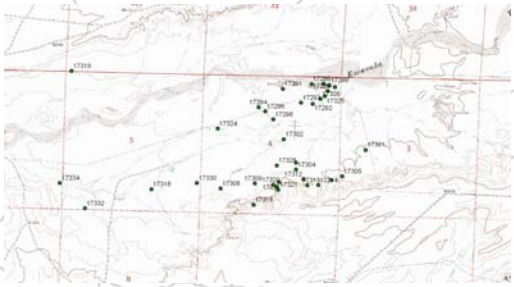


Objectives:

1) show the possibilities and limitations of currently available data used for geospatial applications

2) illustrate the untapped analytical potential of pre-existing digital data as a way to promote sustainable digital environments. We present three scenarios that serve to exemplify several issues involved in using existing digital data for analytical purposes. They are: data integration, interoperability,and analytical potential.

While these scenarios focus on traditional archaeological research, we believe that digital data has application for broader cultural research, especially in re-thinking research epistemologies and digital collection strategies.



The data application is not meant to be an in-depth analysis of Bis sa'ani, but an exploration of how these data can be used and re-used in cultural research and management.

scenario 1: intra-site application

scenario 2: inter-site application

scenario 3: landscape approaches

scenario 1

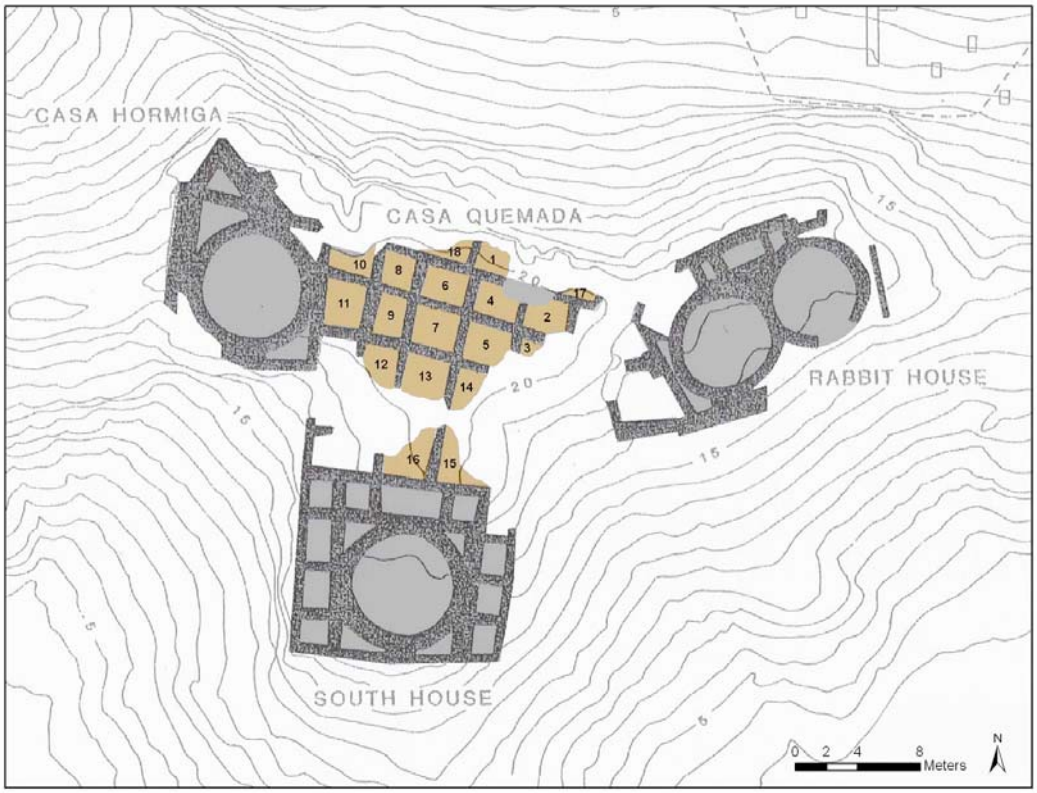
Intra-site analysis

Goal: identify data utility issues associated with integrating and querying *intra-site* data from cultural databases for geospatial purposes

Opportunities:
Integrate database tables within geospatial application (ArcGIS) and relate attributes from these tables to spatial data in an interactive map. Create frequency tables to quickly explore (1) the kind and numbers of artifacts that were recovered during fieldwork, (2) how artifacts are distributed within sites, (3) room use, (5) the presence of local and non-local materials, and (6) the presence of materials that were not analyzed during the project, such as float and soil samples that provide future research opportunities.

Challenges: Joining NPS data tables to shapefiles; georeferencing scanned field maps to correct geographic location; it is unclear how the site UTM coordinate pair obtained through ARMS corresponds with the field map.

Case Study:
Casa Quemada in the eastern component of LA 17286, Bis an' ani Community, New Mexico

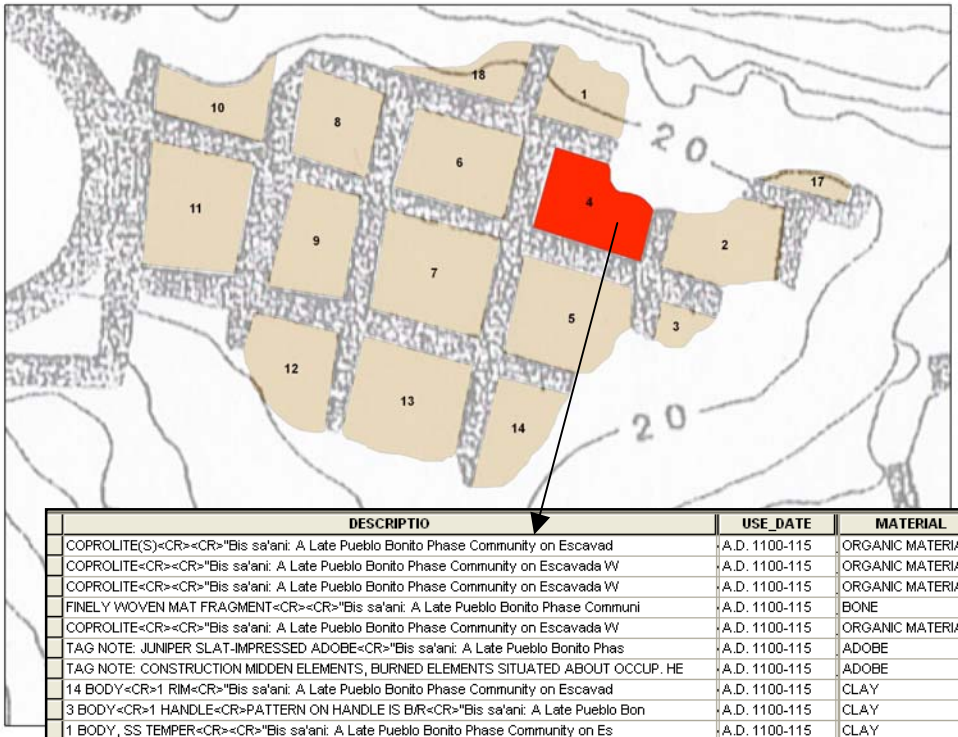


Map represents Eastern Component of LA 17286, Bis an' ani Community and shows a georeferenced map, scanned from the report. Rooms were digitized using ArcGIS software

process

Objective: link attributes from NPS database tables to map of LA 17286

1. Import excel tables into ArcGIS
2. Scan and Import site map into ArcGIS
3. Georeference site map
4. Digitize site features (i.e. structures and rooms) to create a shapefile
5. Create new fields in attribute table of newly digitized shapefile
6. Query data in NPS data tables
7. Populate attribute table (shapefile) using data from NPS data tables
8. Query data from shapefile to create simple thematic maps
9. Relate data from shapefile to NPS data table, for further exploration (image below)



DESCRIPTIO	USE_DATE	MATERIAL	WITHIN_SIT
COPROLITE(S)<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escavad	A.D. 1100-115	ORGANIC MATERIAL	.RM 4
COPROLITE<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escavada W	A.D. 1100-115	ORGANIC MATERIAL	.RM 4 BWN FLOORS 1-2
COPROLITE<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escavada W	A.D. 1100-115	ORGANIC MATERIAL	.RM 4 MIDDEN BWN FLOORS 1-2
FINELY WOVEN MAT FRAGMENT<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Communi	A.D. 1100-115	BONE	.RM 4 MIDDEN, BWN FLOORS 1 AND 2
COPROLITE<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escavada W	A.D. 1100-115	ORGANIC MATERIAL	.RM 4 MIDDEN, BWN FLOORS 1 AND 2
TAG NOTE: JUNIPER SLAT-IMPRESSED ADOBE<CR>"Bis sa'ani: A Late Pueblo Bonito Phas	A.D. 1100-115	ADOBE	.RM 4, ABOVE OCCUP. SFC BLOWN SAND IN SW COR
TAG NOTE: CONSTRUCTION MIDDEN ELEMENTS, BURNED ELEMENTS SITUATED ABOUT OCCUP. HE	A.D. 1100-115	ADOBE	.RM 4, BURNED ELEMENTS SITUATED ABOUT OCCUP.
14 BODY<CR>1 RIM<CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escavad	A.D. 1100-115	CLAY	.RM 4, FLOOR MIDDEN
3 BODY<CR>1 HANDLE<CR>PATTERN ON HANDLE IS B/R<CR>"Bis sa'ani: A Late Pueblo Bon	A.D. 1100-115	CLAY	.RM 4, FLOOR IN MIDDEN
1 BODY, SS TEMPER<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Es	A.D. 1100-115	CLAY	.RM 4, IN SUBFLOOR PIT AT SOUTH WALL
MANO ANALYZED<CR><CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escava	A.D. 1100-115	BONE	.RM 4, INTRUSIVE HEARTH AREA, 1.47M FROM SE CO
TAG NOTE: VIGA MOLDS<CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Esc	A.D. 1100-115	ADOBE	.RM 4, MIDDEN
1 WORKED SHERD<CR>"Bis sa'ani: A Late Pueblo Bonito Phase Community on Escavada	A.D. 1100-115	CLAY	.RM 4, UPPER FILL, ROOF FALL, FROM SW CORNER, 2
TAG NOTE: EXAMPLES OF IMPACTED BLOWN SAND ELEMENTS-WHICH FACE ABOUT MIDDEN MOUND	A.D. 1100-115	ADOBE	.RM 4, UPPER FILL, SEE PROFILE FOR LOCUS
INDENTED CORRUGATED, SS TEMPER: 38 BODY<CR>2ND BAG HAD SAME ID-C96216<CR>"Bis sa	A.D. 1100-115	CLAY	.RM 4,FLOOR MIDDEN
INDENTED CORRUGATED, SS TEMPER: 25 BODY, 1 HAS MENDING HOLE<CR>2ND BAG HAD SAME	A.D. 1100-115	CLAY	.RM 4,FLOOR MIDDEN
TAG NOTE: "CHUSKA VESSEL" APPEARS TO BE INCOMPLETE<CR>10 BODY<CR>"Bis sa'ani: A	A.D. 1100-115	CLAY	.RM 4,FLOOR MIDDEN
TAG NOTE: "1 VESSEL" <CR>33 BODY<CR>"Bis sa'ani: A Late Pueblo Bonito Phase Comm	A.D. 1100-115	CLAY	.RM 4,FLOOR MIDDEN

Record: 0 Show: All Selected Records (0 out of 183 Selected) Options

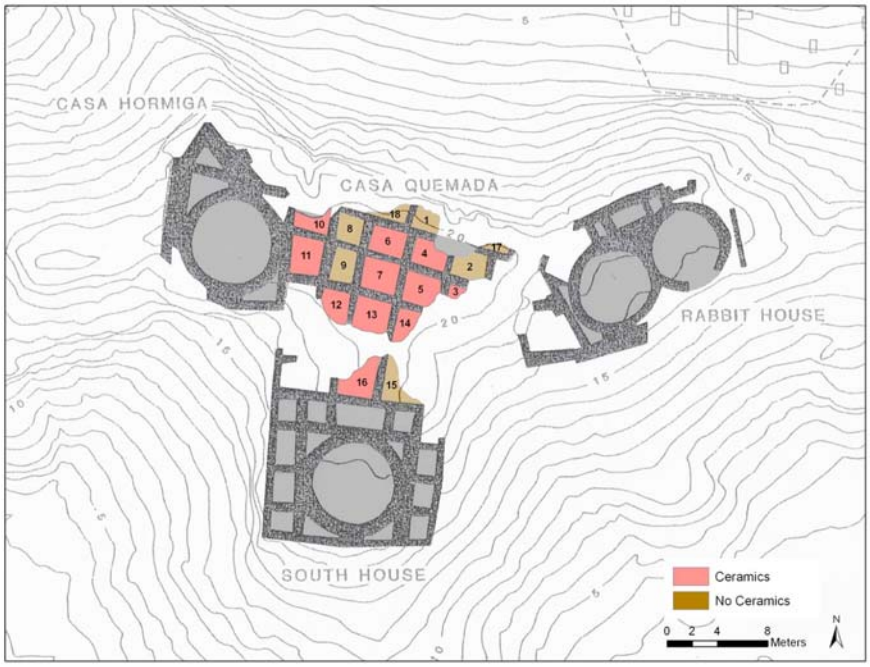
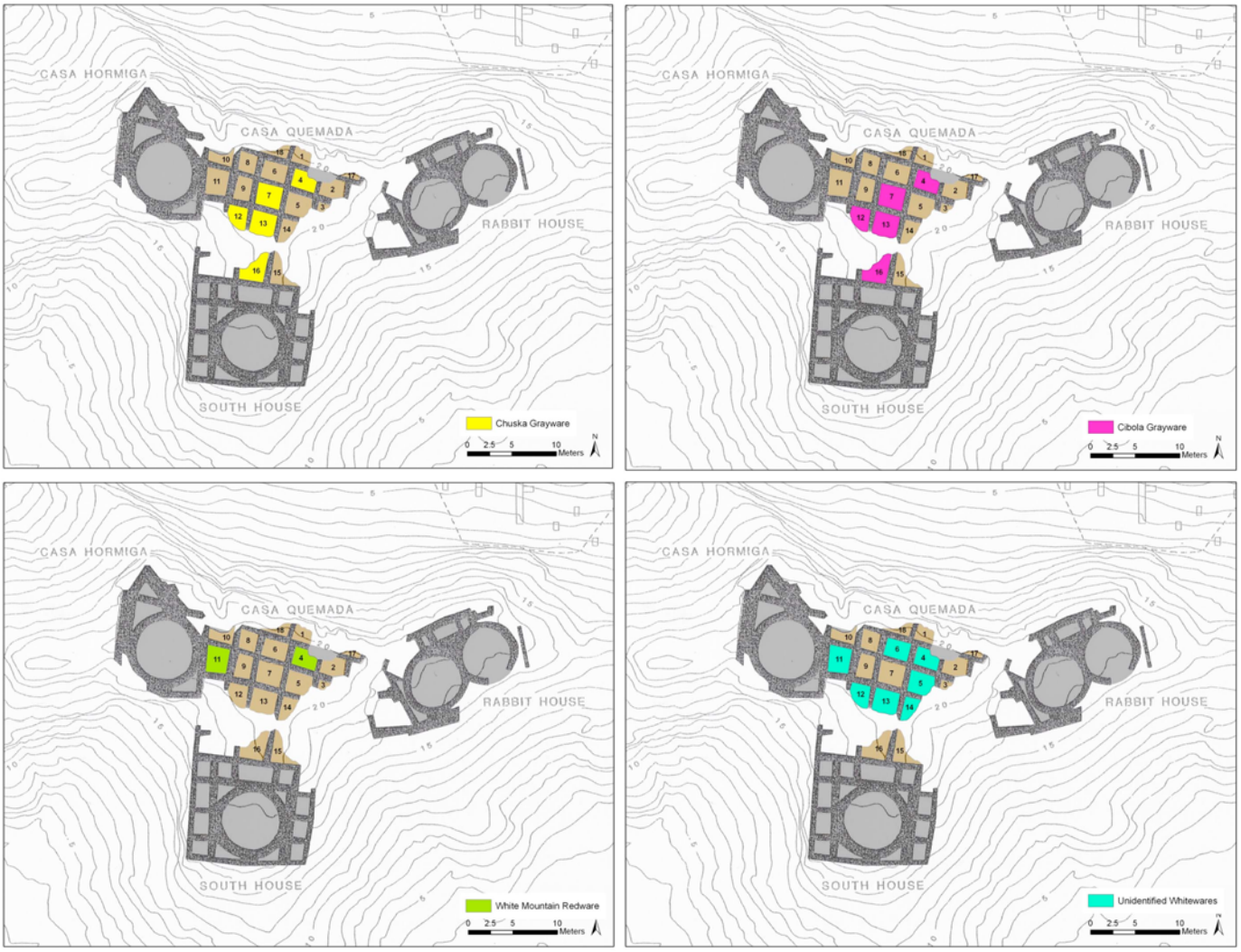


Figure left: shows that archaeologists found ceramics in 11 of 18 rooms at Casa Quemada. This simple map provides a quick way to help archaeologists to think about room functions.

Figures below: subdivide the ceramics by type allowing archaeologists to ask questions about the distribution of ceramic types by room. For example, why does the distribution of Chuska Graywares and Cibola Graywares overlap?

Distribution of ceramics at Casa Quemada



Distribution of ceramic types at Casa Quemada

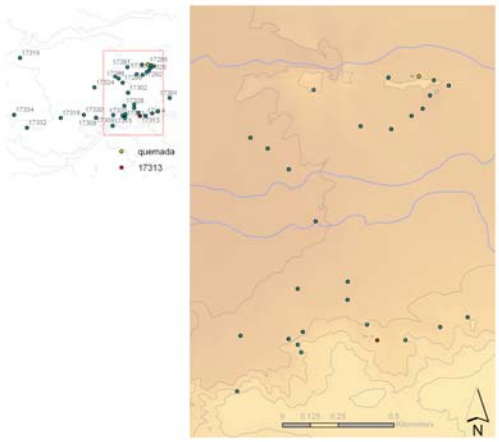
scenario 2

inter-site analysis

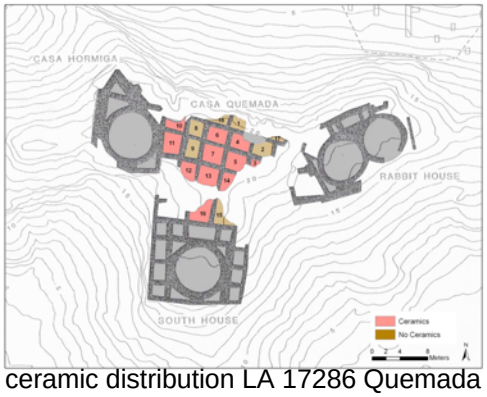
objective:compare object types and material types between sites to address questions such as site function and seasonal or year-round occupation

opportunities: type and frequency of ceramics are easily explored for sites across a landscape

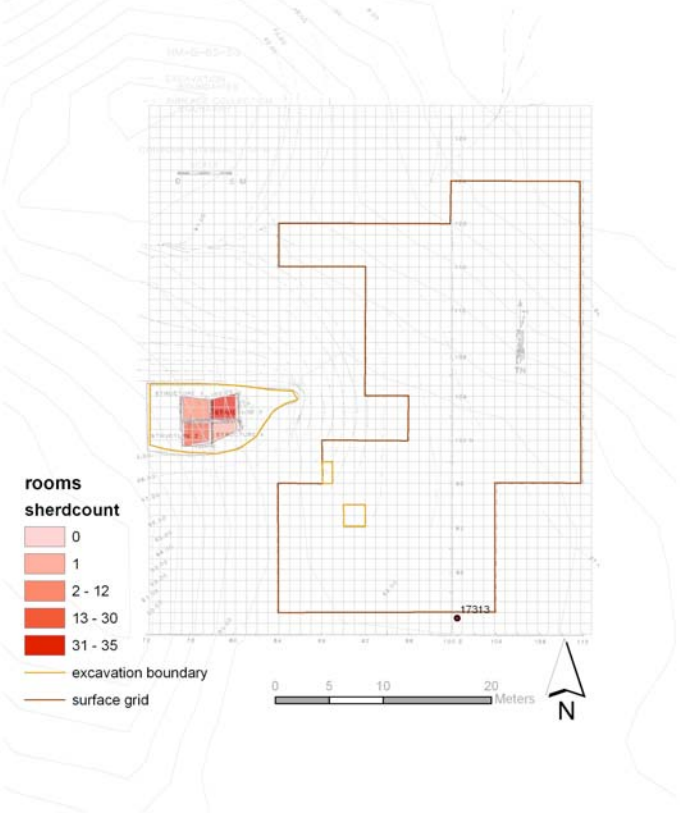
challenges: integrate survey surface finds



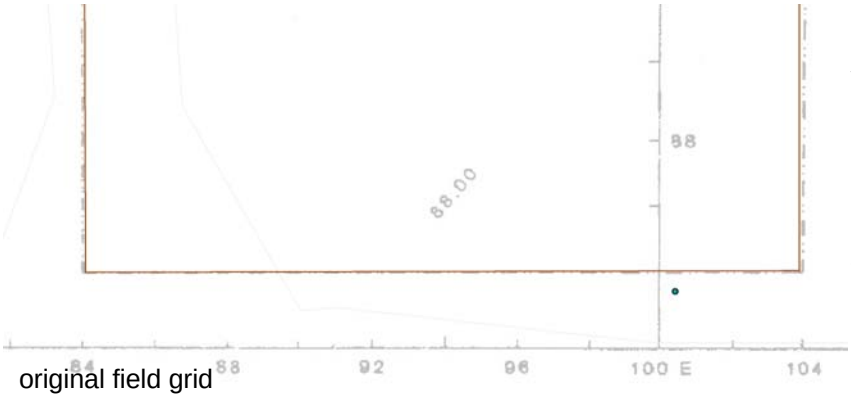
Spatial relation between LA 17286 and LA17313



ceramic distribution LA 17286 Quemada



The map to the right shows a georeferenced field map of LA 17313 overlaid on a topo line file; similar to LA 17286, this map has the correct scale but may not be accurately located. Excavation units and survey grid and outline are digitized as a polygon shape file.
In addition to exploring ceramic distribution within rooms and comparing these among sites, the distribution of surface finds can be analyzed. The challenge is to match the provenience information in the data table with a new shapefile representing the field grid.

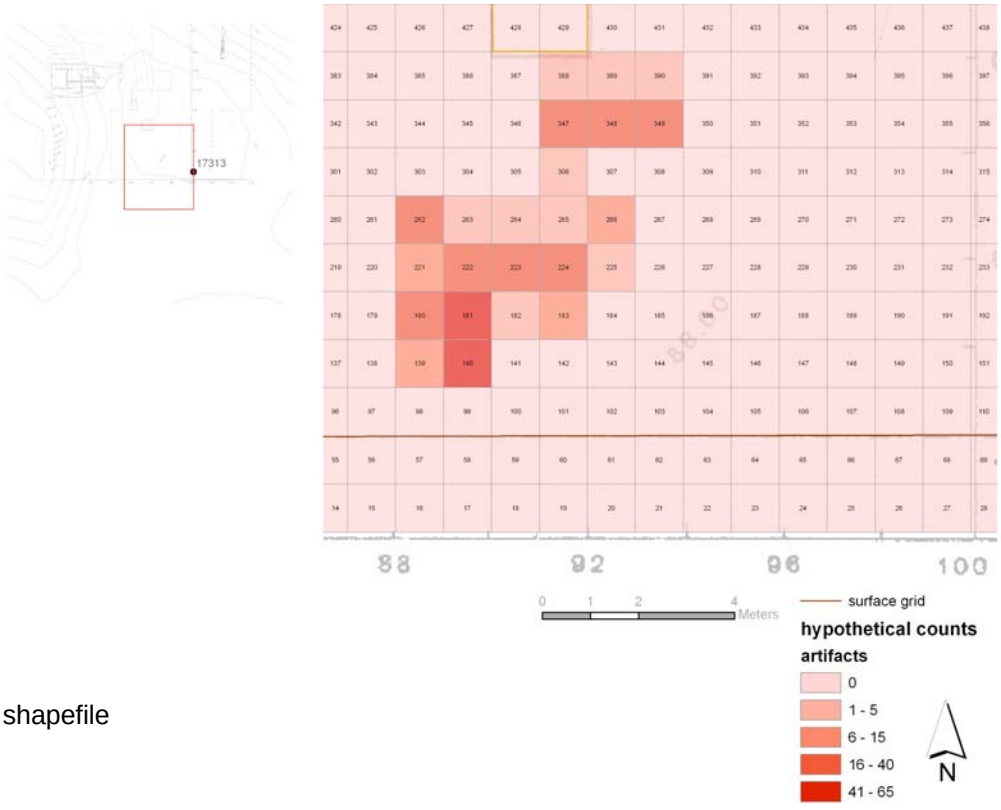


original field grid

To integrate surface finds that have a site grid provenience, a grid polygon file can be easily generated to match the grid in the original field-map. However, the field grid is in Northing /Easting format, whereas for the generated (shapefile) grid each 1 m grid has a single number. Once the corresponding grids in the two systems are matched, frequencies can be entered. (frequencies in the examples are hypothetical due to integration challenge)

R 2<CR>(FLOOR SURFACE, 100.09 - 99.23)
STRU 1<CR>STRA I
GSQ: 116N, 100E<CR>SURF
GSQ: 104N, 100E<CR>SURF
GSQ: 104N, 100E<CR>SURF
GSQ: 116N, 92E<CR>SURF
GSQ: 116N, 88E<CR>SURF
GSQ: 112N, 96E<CR>SURF
GSQ: 116N, 92E<CR>SURF
GSQ: 116N, 92E<CR>SURF
GSQ: 108N, 100E<CR>SURF
GSQ: 112N, 96E<CR>SURF
GSQ: 112N, 96E<CR>SURF
GSQ: 112N, 96E<CR>SURF
GSQ: 108N, 104E<CR>SURF
GSQ: 108N, 104E<CR>SURF

provenience information from NPS data table



grid shapefile

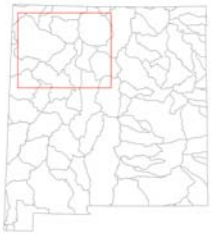
scenario 3

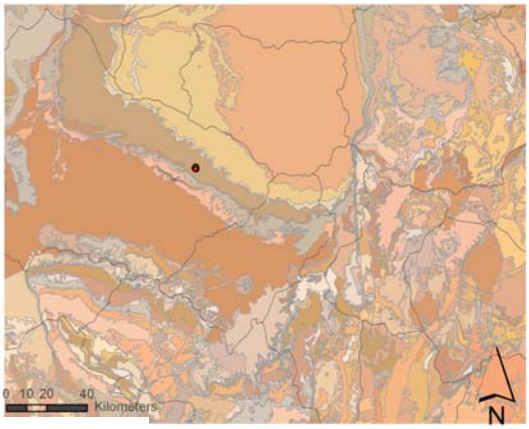
landscape archaeology approaches

Landscape archaeology has a long history. While early approaches focused strictly on the environment and its role in ancient societies, current landscape approaches have broadened their focus to include social, political, economic, and ideological aspects of society. For example, archaeologists have embraced new landscape approaches to investigate production and trade exchange relationships using such methods as chemical analysis of archaeological materials. In recent years, landscape approaches have also begun to consider the importance of cultural heritage management and public archaeology, the role of 'style', and indigenous critiques (David and Thomas 2008).

Landscape archaeology studies that employ geospatial technologies have traditionally focused on the environment; however, archaeologists have begun to use such technologies to address social and humanistic issues because they realize that socio-economic organization and human experience in the landscape are important variables underlying the patterns in archaeological materials (Llobera 2007; Zubrow 2006). This section briefly explores some ways that the NPS data can be used for questions related to landscape archaeology.

Sourcing studies





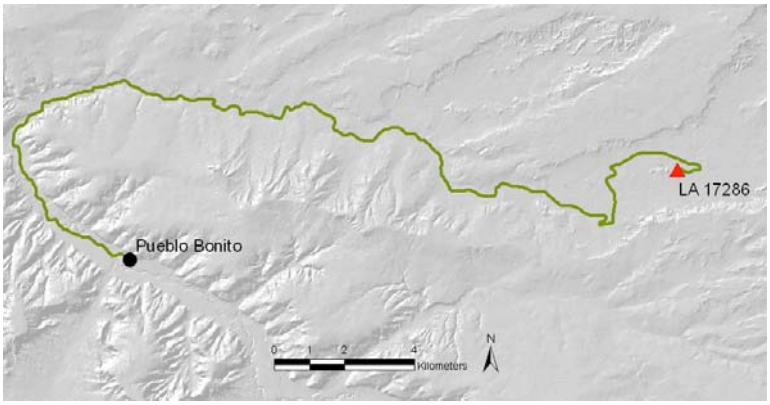
geology in an around the San Juan Basin

potential for investigating source locations and distance to these locations, of lithic materials present at the different sites

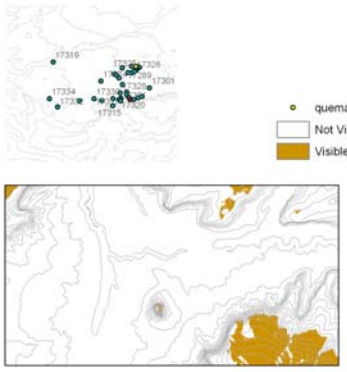
SANDSTONE	
SANDSTONE	
SANDSTONE	
SANDSTONE	
CHERT	
CHERT	
CHERT	
TURQUOISE	
SHALE	
QUARTZITE	
HEMATITE	
LIMONITE	
PETRIFIED WOOD	
CHERT	

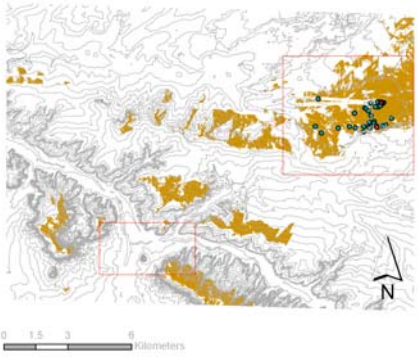
lithic material in room 16, in NPS data table

Least-Cost-Path and Viewshed analyses



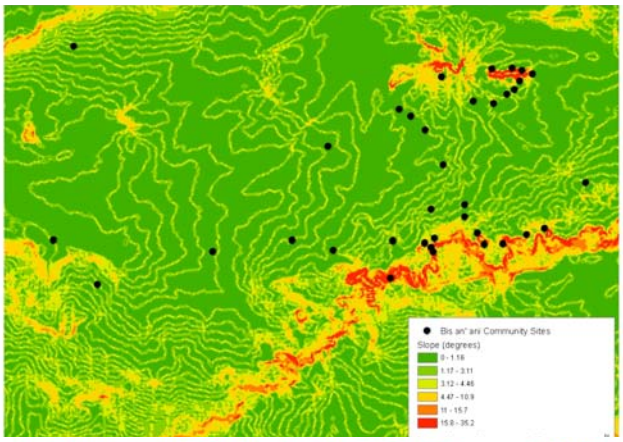
LCP and Viewshed analysis can be used in sourcing studies and also in a variety of other landscape approaches.
Diverse routes for instance can be explored using a number of different variables such as visual landmarks.

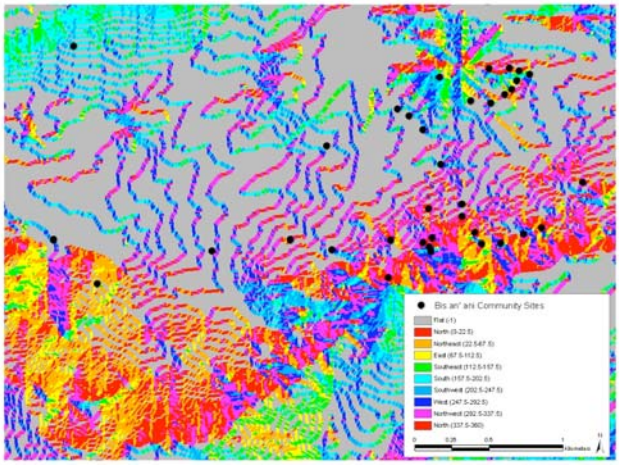


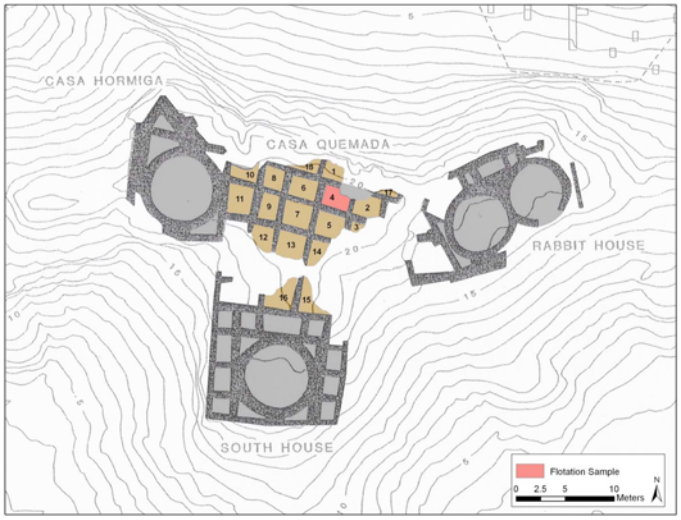


Faunal and botanical remains can be used in climate and subsistence studies. Landscape information such as slope and aspects can aid in these studies to gain insight in, for instance, agricultural potential.

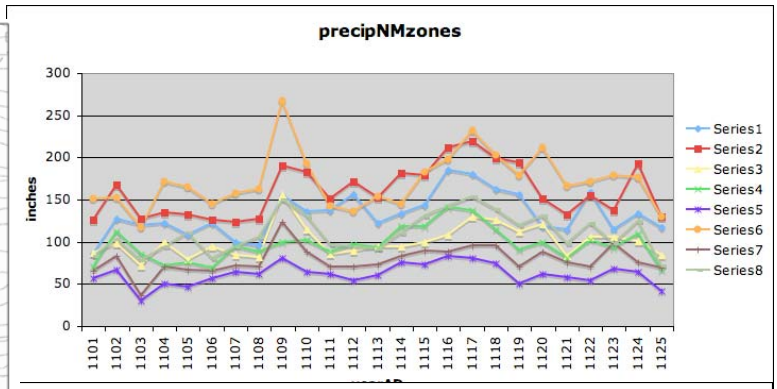
climate and subsistence studies

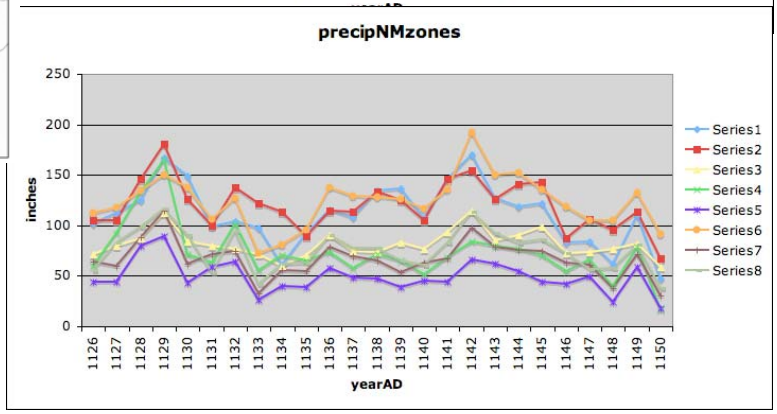






The NPS catalog lists flotation samples as part of its records. These samples can still be used in future analysis and it is important to identify these records and define potential study projects. Other available data such as the reconstructed precipitation records for each of the climate zones in NM (Ni et.sl. 2002 - data source NOAA) can provide contextual information.





pilot study summary

The main issues encountered in the study were related to data integration, data interoperability, and analytical potential. Some of the opportunities for using pre-existing digital data include the ability to quickly link digital data to spatial data to create interactive maps to explore a range of archaeological interests such as the spatial distribution and frequency of artifacts, room use, and proportions of local versus non-local materials, both at the intra- and inter-site levels. Other opportunities involved the ability to quickly and easily integrate the existing cultural data with other digital data types, e.g., hydrology, soil, and topography, in order to address questions related to understanding sites in relation to the broader landscape issues including climate and subsistence.

Some of the challenges include joining the existing data tables to other existing data (shapefiles) because of differences in terminology. Other challenges involved linking individual artifacts to specific locations because the digital data did not include point provenience or grid data in a format that allowed easy integration into a GIS. In sum, the pilot study offered insight into some of the opportunities and challenges involved in the sustainability of digital environments, specifically those involving cultural databases and repositories. It can be demonstrated that these advantages can benefit research and education providing exploratory research opportunities and create learning tools through ‘reconstructing’, evaluating, and enriching previous research. It addition, benefits for cultural resource management include the identification of untapped research possibilities using physical, analog and digital material. Employing the data in ways explored in this paper can therefore strengthen current and stimulate new partnerships in digital heritage.

We believe that the challenges and opportunities encountered in the pilot study serves as a model to help archaeologists to design new database/digital data repositories or interfaces that not only expands research opportunities (using existing data), but also meets the needs of diverse users. We propose that to meet these needs requires new educational goals in the realm of sustainable digital environments.

Broader research context

With the development of Information and Communication Technologies (ICT) a new paradigm for information exchange and communication at different scales is emerging in which the traditional roles of experts and non-experts are no longer valid. For instance, recent platform developments are changing crisis management and response, which now often relies on global communities of cell phone users. The validation of information in this system is not based on authority status but on the ‘average’ of all responses from the community of users (Giridharadas, 2010). As people become more conversant in technology, community involvement increases—a trend that is evident in participatory research, especially participatory GIS. This trend is allowing communities to become active partners in decision and policy-making process and become recognized stakeholders.

Our personal experience with community collaboration is from a GIS project focused on *acequias*, the traditional water-management system widely used in New Mexico. These *acequias* help sustain agricultural practice in many rural, and some urban settings, but they are threatened by increasing urban water demands. The project had two major goals: (1) to provide education and training in geospatial technologies to community members in order to ensure information access for the community regarding and anticipating policy changes impacting the *acequias* and (2) to create a GIS to help community members maintain and share cultural values associated with agricultural practices. The development of the GIS proved to be the most challenging aspect of the project, as information systems are developed based on specific western values.
A major challenge for community-research-education partnerships that was identified through this project concerns securing funding sources and accountability measures for continuation and maintenance of digital information systems, highlighting the need for clear definitions of expectations and responsibilities of the partners involved.

Important issues within spatial information theory include ontology and assumed universal space-time conceptualization in human spatial cognition. These issues are pertinent in studies of the usability of digital databases because research by cognitive scientists, linguists, and others has shown that the assumption of universality is flawed and therefore, development of information systems needs to take into account cultural diversity in order to represent and communicate cultural differences and values (Levinson 2003 ;Mark and Turk and Stea 2007).

The challenge in digital cultural heritage is to ensure that different cultural values are represented, maintained, and preserved. Cameron and Robinson (2007) lay out two major problems associated with rapid digital development in museums and cultural heritage. They are: (1) theoretical underpinnings and quality control have not received adequate attention; (2) classification schemes that underlie the organization of museum archives and collections often lack diversity in the values and worldviews they represent (Agrawal 2002; Cameron and Robinson 2007). For example, many local and indigenous communities have begun to address issues surrounding knowledge representation and communication, employing digital technologies in new way to include multiple perspectives (Brown 2007).

Research in Chaco canyon has been largely conducted by non-indigenous scholars using traditional archaeological approaches. Thus, the history of the people who lived at Chaco, recognized by many contemporary indigenous communities as their ancestors, is primarily constructed using archaeological research. However, indigenous scholars have shown that purely archaeological-based interpretations only tell part of a story (Kuanwisiwma 2004; Ortiz 1972; Swentzell 2004), and collaboration between cultural heritage professionals and indigenous communities has in some cases already led to changes in preservation practices (Balenquah 2008). We believe, following Cameron and Kenderdine's general topic (2007), that the move into the digital realm for cultural heritage presents a number of epistemological challenges specifically related to cultural diversity that have not been addressed sufficiently, but it also provides exciting opportunities for collaboration and broadening knowledge exchange.

Our pilot study shows that digital data currently available in archaeological collections can be used to conduct traditional archaeological analysis as well as be used with geospatial systems to address issues at multiples scales—spatially, temporally, and thematically. Furthermore, the exploration of digital data shows allows archaeologists to identify datasets that have not been previously analyzed and thus presents new research opportunities. Archaeological research has played a major role in creating the histories of indigenous communities and with the use and re-use of digital information that tradition can not only continue but be expanded. While archaeology provides valid information for reconstructing indigenous histories, we believe that digital heritage provides means to expand our understanding of the relationship between archaeological materials and cultural values. By rethinking the role of digital heritage and preservation, updating collection and preservation strategies, and forging new partnerships between stakeholders, especially local and indigenous communities, future challenges of digital heritage can be met.(van der Elst, Richards-Rissetto, and Garcia 2010).

Summary and findings

The goal of the pilot study was to illustrate the availability and utility of pre-existing digital data for archaeological research, the need to facilitate access to these data through and advocate educational programs to encourage archaeologists to take advantage of existing datasets in their research. Our work focused on (1) using geospatial technologies to illustrate the opportunities and limitations of using currently available digital data for geospatial applications in archaeology and (2) addressing how digital tools, database design, data collection, and analytical methods impact sustainability of digital environments. We specifically stress the important role of the user in the dynamic process of digital preservation.

The differences between the life cycles of traditional preservation, which is linear, and that of digital preservation enforces us to address the use and re-use of digital data in order to justify its long-term preservation. Within the larger context of pursuing sustainable digital environments several recommendations presented in the Blue Ribbon Task Force report directly referred to the user role, in summary these are:

1. decision makers will recognize benefits of preservation if case studies that exemplify use and at-risk materials are presented
2. decision makers need strong incentives to act in the public interest; incentives must be aligned among different stakeholders
3. need ongoing and efficient allocation of resources for preservation; funding models must reflect norms and expectations of anticipated users and be flexible.

These recommendations raise important questions on how users norms and expectations can be anticipated and how data use can be encouraged if users are not educated adequately. We suggest that in order to address these challenges pilot study programs can be initiated based on collaborative partnerships representing different stakeholders that can become test-beds for usability testing of available data and development of new methods to use the growing and changing digital data sources. In sum, the following identified needs provide a starting point :

Need to identify available resources in current databases

Need for quality control of digitization projects

Need for user testing and pilot studies (to test methodological issues)

Need for standards to test longevity and value of digital data.

Need for education: in order to expand the user group;in order to develop innovate methods in which existing and future digital data can be used, re-used, and repurposed; in order to streamline research and preservation efforts across stakeholders' boundaries.

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Feedback

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