

Fostering synthesis in archaeology to advance science and benefit society

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In 1966 the US Congress passed the National Historic Preservation Act. Its intent: to ensure that the values embedded in historic buildings, archaeological sites, and other important places of the past honored all Americans in ways that would inspire and motivate present and future generations. In the intervening 50 years, archaeologists have diligently discovered, documented, analyzed, and curated our collective past.

However, this rich store of data has untapped potential beyond documenting long-term trajectories of numerous human societies. Archaeological data can be key to expanding scientific understandings of human social dynamics, redressing injustices of the past, empowering local and descendant communities, and aiding in the formulation of solutions to contemporary problems. Collaborative synthetic research, as practiced in ecology and other sciences, has been a powerful driver for advancing interdisciplinary science. But to utilize these advances, archaeologists, as a community, need a means to bring disparate datasets together and interpret them. This entails creating a vehicle by which collaborative synthetic research becomes a routine and institutionalized practice in archaeology—a budding effort we call the Coalition for Archaeological Synthesis. It's an initiative that will not only benefit the discipline but will also enable researchers to communicate to the public the richly detailed stories of humanity itself.

A Problem of Some Complexity

Many nations have laws protecting cultural heritage, and as a result, archaeologists have access to far more data than ever before. In the United States alone, since the federal government started keeping systematic records in 1985, archaeologists have surveyed more than 140,000,000 acres, recorded more than 880,000 archaeological sites and excavated more than 35,000 of them, curated more than 900,000,000 artifacts and related items (1), and spent tens of billions of dollars (2). In the United States, archaeological investigations are



Fig. 1. Public support can expand archeological finds and help tell the stories of people and places. Here, archaeological surveyors work in the Western Papaguera of Arizona. After laws protecting archaeological sites were passed in 1966, the number of recorded sites in the region ballooned from 100 to more than 2,000, which allowed researchers to document 10,000 years of human occupation in one of the hottest, driest parts of the United States.

overwhelmingly performed by private-sector firms to comply with historic preservation laws and mandates, whereas only a small proportion are projects funded by public or private research grants. This chasm is best highlighted by comparing the main provider of academic research grants, National Science Foundation's (NSF's) archaeology program, which has an annual budget of about \$15 million, with the annual \$1 billion estimate of US cultural resource management services, most of it on archaeology.

Even in the face of sustained, and recently heightened, attacks on National Monuments and environmental regulations that underlie protection of

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earth's ecosystem services (12). By any measure, NCEAS has been extremely successful (13), and its model has been copied wholly or in large part in a number of scientific fields (e.g., the National Evolutionary Synthesis Center, the National Socio-Environmental Synthesis Center, and the National Institute for Mathematical and Biological Synthesis).

Although archaeology has never tried an NCEAS-type approach, several intensive, multiyear, multiinvestigator, NSF-funded, archaeology-focused projects (6, 14, 15) illustrate the power of a team-oriented synthesis for the field. In these cases, success entailed integrating large amounts of primary data from multiple sources and with collaboration of researchers from different fields who worked together from research design to interpretation. These projects achieved remarkable results.

For example, across several archaeologically documented cases Nelson and her coauthors (6) assessed the societal vulnerability to food shortage before a challenging climate event and found a consistent relationship with the severity of its observed impact. Mills et al. (14) showed how population aggregation and long-distance migration reshaped social networks across large areas of the late pre-Hispanic US Southwest. Combining an interdisciplinary analysis of large amounts of data with agent-based modeling, Kohler and his colleagues (15) revealed how climate change, population size, interpersonal conflict, resource depression, and changing social organization explain the dramatic depopulation of the Mesa Verde region of Southwestern Colorado in the mid-to-late AD 1200s. Similarly, the European Research Council Synergy project, Nexus1492, was a collaborative, multidisciplinary project focused on Amerindian-European-African dynamics at different spatial-temporal scales across the 1492 divide, resulting in locally inspired, evidentially based heritage-management strategies (16).

Characteristically, these synthetic projects were expensive and regionally focused, and each had to work out, for itself, how to find, transform, and analyze large, complex datasets. We see the next logical step to be development of institutionalized support for collaborative synthetic research. Such an effort should leverage data from multiple cultures and from multiple spatial and temporal scales to address important social issues and problems.

Coalition for Archaeological Synthesis

For reasons both of potential funding and of archaeology's history and culture, we propose, and have started to implement, the NCEAS approach using a "bottom-up" structure predicated on two new, linked institutions: the Coalition for Archaeological Synthesis and the National Center for Archaeological Synthesis (NCAS). The Coalition will use the expertise, services and facilities of existing US and international organizations that are committed to promoting synthesis. The Coalition will be open to all institutions interested in partnering to support archaeological synthesis. These include universities, museums, professional organizations, and nongovernmental organizations as well as government agencies and private cultural resource

management firms. The Coalition's Board of Directors, to be elected from the member organizations, will solicit working group proposals, set the review criteria, and establish a broad-based Review Committee that will evaluate the proposals and recommend working groups for funding.

NCAS will coordinate the efforts of the Coalition. The NCAS host university will house the Center's Executive Director and small staff and will supply administrative and logistical support. With the assistance of the Board and other members, NCAS will seek funds to support the working groups' efforts. NCAS will administer the funding; provide guidance on working group leadership, structure, and operation; as well as coordinate logistical, analytical, and computational support for the individual working groups. Assisted by its partner organizations, NCAS will ensure that the results of the Coalition's research are disseminated in ways that affect both academic research and public policy and that reach descendant communities and other segments of society.

Unlike NCEAS, we do not envision a single locus for meetings. Instead, we intend to leverage the long history of seminars hosted by potential Coalition member organizations, such as the Amerind Foundation or the School for Advanced Research, to provide

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the facilities for teams to meet and advance their research topics. Key cyberinfrastructure support can be provided by other Coalition members that now supply these services, such as Digital Antiquity, the Archaeological Data Service, Open Context, and the Network for Computational Modeling in Social and Ecological Sciences. (All of the above institutions have, through personal correspondence, expressed interest in participating in the Coalition.)

From Concept to Reality

This fall, the Coalition will be formally established. Presentations on collaborative synthesis are scheduled at national and international meetings (17) accompanied by invitations to join the Coalition. Simultaneously, the SRI Foundation, which will serve as the interim host for NCAS, has committed to funding two proof-of-concept working groups. A Review Committee has been established and a request-for-proposal developed, which is scheduled to be released in October 2017 (18) with an award date in early 2018. As these demonstration projects proceed, we expect NCAS will make the transition to a host university that will provide some core support (e.g., for an Executive Director and core staff).

Although start-up funding and administrative support has been secured from the SRI Foundation, additional support for NCAS, and program funding for

the Coalition's synthesis working group efforts, will be sought from multiple sources, including private foundations and individual donors. We will seek program funding for synthesis working groups from the NSF, which has a record of funding major synthetic research projects. In addition, we anticipate support from heritage-management mitigation projects from United States and other national federal agencies as well as international organizations, such as the European Union.

We believe this effort can succeed despite the current administration's apparent hostility toward science and congressional efforts to defund social science over the last several years. Unlike NCEAS and other synthesis centers, we have laid out a path by which the establishment of the Coalition and NCAS are not premised on a large and continuing outlay of federal monies.

Although we are convinced that we are on the right path, we realize that there are major challenges ahead. As students of culture, we know that cultures, including that of archaeology, are resistant to change. If successful, the Coalition will be a major impetus that moves archaeological synthesis from a reliance on individual synthesizers to teams that emphasize collaborative scholarship. Although this transformation is already underway on the project level, to achieve archaeology's potential and to fulfill our end of the public compact, it must be given an institutional foundation.

The success of the Coalition will be measured by how well evidentially based arguments involving archaeology address who we are as a diverse, multicultural

society while at the same time confronting the challenges facing our society today. Collaborative synthetic research in archaeology will illuminate the long-term trajectories associated with alternative societal solutions to problems that humanity has repeatedly faced, such as healing the wounds of slavery and colonialism or adapting to a hotter and drier climate. In this way, contemporary society can benefit from a global set of completed, long-term social experiments.

To succeed, collaborative synthetic research must be embraced not just by archaeologists, but it must incorporate other members of the scientific community and must address issues of concern to civil society. Applied and academic archaeologists need to be equal partners in this endeavor. Members of descendant communities must be engaged as cultural experts. Information regarding complex issues must be conveyed to policy makers and the general public in clear and understandable language. This is a tall task, and none of it will be easy. But for archaeology to move effectively beyond project-by-project interpretation to synthesis, all of it is necessary.

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