Fostering Collaborative Synthetic Research in Archaeology

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THE CURRENT STATE OF AFFAIRS

In 1966 the U.S. Congress enacted the National Historic Preservation Act (NHPA) 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. Other nations followed with either new or revised legislation protecting historical and

ABSTRACT

While our fascination with understanding the past is sufficient to warrant an increased focus on synthesis, solutions to important problems facing modern society require understandings based on data that only archaeology can provide. Yet, even as we use public monies to collect ever-greater amounts of data, modes of research that can stimulate emergent understandings of human behavior have lagged behind. Consequently, a substantial amount of archaeological inference remains at the level of the individual project. We can more effectively leverage these data and advance our understandings of the past in ways that contribute to solutions to contemporary problems if we adapt the model pioneered by the National Center for Ecological Analysis and Synthesis to foster synthetic collaborative research in archaeology. We propose the creation of the Coalition for Archaeological Synthesis coordinated through a U.S.-based National Center for Archaeological Synthesis. The coalition will be composed of established public and private organizations that provide essential scholarly, cultural heritage, computational, educational, and public engagement infrastructure. The center would seek and administer funding to support collaborative analysis and synthesis projects executed through coalition partners. This innovative structure will enable the discipline to address key challenges facing society through evidentially based, collaborative synthetic research.

Si bien nuestra fascinación por entender el pasado es suficiente justificación para garantizar un mayor enfoque en la síntesis, las soluciones a los problemas importantes que enfrenta la sociedad moderna requieren de conocimientos basados en datos que sólo la arqueología puede proporcionar. Aunque usamos el dinero público para recolectar cantidades cada vez mayores de datos, las distintas formas de investigación que pueden estimular conocimientos emergentes en torno al comportamiento humano han quedado rezagadas. Consecuentemente, la inferencia arqueológica, en gran medida, se queda en el proyecto individual. Podemos aprovechar más eficazmente estos datos y avanzar en nuestros conocimientos en torno al pasado de forma tal que contribuyamos a la solución de problemas contemporáneos si adaptamos el modelo pionero del "Centro Nacional para el Análisis Ecológico y la Síntesis" para fomentar la investigación colaborativa para sintetizar la información arqueológica. Proponemos la creación de la "Coalición para la Síntesis Arqueológica", coordinada a través de un "Centro Nacional para la Síntesis Arqueológica," en los Estados Unidos. La "Coalición" estará compuesta de organizaciones públicas y privadas establecidas, entidades que proporcionarán la infraestructura esencial académica, cultural, computacional, educativa y de participación pública. El "Centro" buscaría y administraría los fondos para apoyar tanto el análisis colaborativo y los proyectos sintéticos, implementado a través de los socios de la Coalición. Esta estructura innovadora permitirá a la disciplina abordar los retos clave que enfrenta la sociedad a través de la investigación sinténtica y colaborativa.

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cultural landmarks. International conventions were forthcoming, including the World Heritage Convention of 1972 and the Council of Europe's European Convention on the Protection of the Archaeological Heritage (the Malta Convention).

Archaeology's Public Compact

Most of these laws and conventions begin with statements about the importance of heritage to a healthy nation. The U.S. Congress, for example, declared in the preamble to the National Historic Preservation Act that

> (1) the spirit and direction of the Nation are founded upon and reflected in its historic heritage; (2) the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people; (3) historic properties significant to the Nation's heritage are being lost and substantially altered, often inadvertently, with increasing frequency; (4) the preservation of this irreplaceable heritage is in the public interest so that its vital legacy of cultural, educational, aesthetic, inspirational, economic, and energy benefits will be maintained and enriched for future generations of Americans (16 U.S.C. 470).

Under NHPA and related mandates, archaeologists in the United States have undertaken hundreds of thousands of field studies, recorded nearly a million archaeological sites, and have spent tens of billions of dollars (Altschul 2016a; Altschul and Patterson 2010). Underlying the extensive public funding of both heritage management and of academic research is a compact between archaeology and the public. Two elements of that compact are (1) that we thoroughly document those components of the archaeological record that we investigate, and (2) that we share the knowledge gained in ways that benefit society (Altschul 2016a:69).

Archaeologists are succeeding in accomplishing the first of those elements. One cannot look back over the last 50 years and not be impressed by what has been accomplished by those who have dedicated their professional careers to cultural resource management (CRM). Yet, today, as in the past, we face continuing challenges in maintaining a strong regulatory framework. The best defense for protecting significant archaeological resources is public outreach and education, which have long been viewed as essential pillars of historic preservation (see Lipe [1974] and Sebastian and Lipe [2010] for archaeological perspectives).

However, despite numerous, important efforts at public outreach and education, few would argue that archaeologists have been as successful in providing the public with the benefits of our research as thoroughly and effectively as we should. Of course, to provide this benefit presupposes we know the answers to two basic questions: What does the public want from archaeology? *And*, what can archaeology offer the public?

In answering these questions we recognize that there is not a unitary "public" (Lowenthal 2015). Nonetheless, we suggest that a key component of what the public wants from us is what Patty Jo Watson once described at an SAA annual meeting as the real story of the past–not just any narrative, but a rigorous, evidentially-based account of the past. This is not just any narrative of the past, but rigorous, evidentially based accounts of the past. We suspect that most archaeologists would agree that archaeology is capable of providing such stories, and further, that doing so is a central responsibility of our discipline.

But what about the second question—what can archaeology offer the public? Archaeologists have recognized that there are many ways to answer this question (Little 2007; Sabloff 2008). Archaeology offers a way to bring to light the lives, struggles, and strengths of disenfranchised individuals, groups, and communities. One such example is the archaeology of slavery and captives (e.g., Agbe-Davies 2017; Cameron 2016; Marshall 2014). To many, it can help answer questions of who they are and where they come from, including research on migrations and diasporas (e.g., Singleton 2010). And for still others, it is about protection of shared heritage (e.g., Parcak 2015; Stein 2015; Stone 2015).

Archaeology can offer perspective, indeed possible solutions, to many problems confronting society today (Hegmon 2016; Kintigh et al. 2014a, 2014b; Martin and Gregory 1973). We contend, as do many other archaeologists, that archaeology's long-term perspective offers the potential of producing knowledge about human societies that is relevant to addressing contemporary problems such as environmental change (e.g., Guedes et al. 2016; Sandweiss and Kelley 2012; Spielmann et al. 2016; Streeter et al. 2015; van de Noort 2014; van der Leeuw and Redman 2002), catastrophic human and natural disasters (e.g., Cooper and Sheets 2012; Grattan and Torrence 2010; Peregrine 2017), and overpopulation (e.g., Smith 2010). It is this goal of providing relevant insight into contemporary issues that has attracted the attention of organizations such as IHOPE (Integrated History and Future of People on Earth; Costanza et al. 2012), the Crow Canyon Archaeological Center (2017), and the Center for Archaeology and Society at Arizona State University (Arizona State University 2017), among others.

Addressing questions of social justice, social identity, human adaptation, migration, warfare, urbanism, and so forth requires that we both produce relevant knowledge and actively work to have it inform public policy. To better accomplish these objectives, we need to move beyond the who, what, where, and when of the past and improve our ability to answer the *how* and the *why* of the past—to transform our extensive and detailed descriptions of the archaeological record into a deeper, explanatory knowledge about the past. We must also come to terms with the transformational changes that are and will continue to affect the archaeological record, our access to it, and our ability to use archaeological data to address questions that will affect our future. Archaeology's potential is great, but we need to do more to realize this potential.

The Data Deluge

With the explosion in the numbers of archaeological investigations around the globe in the last 50 years and the concomitant advances in how we collect and analyze data, archaeology is confronted by a deluge of data (Bevan 2015). The Secretary of the Interior's Report to Congress on the Federal Archaeology Program, for example, documents more than 850,000 field studies, 140,000,000 acres surveyed, 880,000 sites recorded, 35,000

excavations, and 900,000,000 curated items in just the 28 years from 1985 to 2012 (National Park Service Archeology Program 2017). And these numbers actually underestimate the amount of archaeology in the United States because not all federal agencies report (or fully report) all their activities, and the secretary's report does not include projects sponsored by nonfederal agencies at the state, tribal, or municipal level.

An explosion in the volume and complexity of archaeological data provides enormous potential to expand our knowledge of the past. Still, this same volume and complexity make the process substantially more challenging. The number of archaeologists in the United States has grown tenfold with the advent of CRM (Altschul 2016a). Increasing numbers of archaeologists and institutions doing archaeology has led to proliferation of types and means of recording data. Moreover, analyses and interpretations of individual projects have tended to focus on smaller and smaller areas and increasingly restricted time periods.

The Need for Synthesis

For present purposes we can think of "data" as our primary observations; "information" as our relatively direct inferences (e.g., of *who*, *what*, *where*, and *when*); and "knowledge" as explanatory, answering *how* and *why* questions. Given that hierarchy, archaeologists are pretty good at recording data and transforming it into information, and they are prolific in writing it down. Advances in computational analysis and visualization have mediated many of the data-to-information challenges posed by the data deluge, contributing to our successes—so far as they go.

But to fulfill our public compact, archaeologists cannot be content to stop with documentation of the archaeological record. (Kelly [2015] provides a poignant treatment of this issue.) Archaeologists bemoan Diamond's (e.g., 2006) cherry-picking of archaeological data in making his arguments but nonetheless envy his ability to engage the public in his answers to what should be *our* why questions. We often struggle with the transformation of information into knowledge, and we admire its genuine achievement.

As a field we must expand our efforts to answer these important *why* and *how* questions (e.g., Armstrong et al. 2017; Kintigh et al. 2014a, 2014b), and one of the most effective ways to accomplish this is through synthetic archaeological research and broad-scale analyses. Happily, the needed synthetic and comparative research (Smith 2011) requires only a fraction of the money already expended on data collection and reporting and does not further disturb the archaeological record.

Audiences for the kind of syntheses promoted here extend far beyond practicing archaeologists in the academy and heritage management. These audiences include scientists in other fields, journalists, avocational archaeologists, students, members of descendant communities, the public, and policy makers. Synthetic research can showcase archaeology's unique ability to use information about the deep past to improve understandings of our human experience and to assist in addressing the concerns of modern society in the United States and globally.

How Archaeologists Have Done Synthesis

The task of synthesis is, and has always been, essential to the practice of professional archaeology. Professional societies have repeatedly recommended synthesis as a critical component of archaeological practice (for example, the final report of the Society for American Archaeology's Task Force on Renewing Our National Archaeological Program [Lipe 2000:14–15]). What is entailed by synthesis and how we do it has changed over time as data have become more accessible and as the tools to analyze data have become more sophisticated.

Synthesis in archaeology has taken a number of forms. Individuals such as Alfred V. Kidder (2000 [1924]), Gordon R. Willey (1966), and V. Gordon Childe (1936, 1942) single-handedly and effectively synthesized large geographical and temporal swaths of prehistory. Institutions such as the School of American Research (now the School for Advanced Research) have, for decades, sponsored in-depth seminars that bring together scholars working on a specific topic for collaborative interactions resulting in high-impact, edited publications (e.g., Crown and Judge 1991; Culbert 1991; Feinman and Marcus 1998; Gumerman 1994; Longacre 1970). Some federal agencies and states have developed archaeological "historic contexts" that survey the literature and assemble information on particular topics for specific areas and time periods to guide the direction and research focus of future government-mandated archaeological investigations (e.g., Lipe et al. 1999). Individual scholars and graduate students have devoted enormous energy to scouring the literature and have produced important syntheses on specific topics of archaeological interest (e.g., Crown 2016; Lekson 1984) as well as on topics with broad social science appeal (Flannery and Marcus 2012). In some cases groups of scholars have worked to synthesize large amounts of primary data (e.g., Arbuckle et al. 2014; Smiarowski et al. 2017).

Over the last dozen years, the National Science Foundation (NSF) has—through cross-disciplinary competitions—funded several intensive, multiyear, multi-investigator, regionally focused, synthetic projects that relied heavily on primary data from multiple sources (e.g., Kohler and Varien 2012; Mills et al. 2013; Nelson et al. 2016). Similarly, the European Research Council has funded Nexus1492, which synthesizes vast amounts of academic and CRM-generated data to create new understandings of the past in ways to influence locally inspired heritage management systems throughout the Caribbean (Hofman 2015). In all these cases success in synthesis was associated with including researchers from different fields, large amounts of time meeting together (face-to-face and virtually), energetic graduate student collaborators, and the integration of large volumes of CRM data.

These synthetic projects serve as a foundation for the discipline's next steps in synthetic archaeological research that will use data from multiple cultures and at multiple spatial and temporal scales to address important social issues and problems. This collaborative, cross-cultural, and cross-historical research involves the direct analysis of empirical data from these multiple, wide-ranging sources. Regularities in patterns can be discerned as well as deviations from patterns contingent on cultural histories and trajectories. This collaborative synthetic research is performed by groups of individuals with diverse skills, experiences, and perspectives—individuals who may have not worked together

before, resulting in new, innovative synergies. This collaborative, multidisciplinary approach to synthesis considers "what we know and generates new knowledge from novel combinations of existing information" (Carpenter et al. 2009:699).

WHERE WE NEED TO GO

Archaeology is now poised to benefit from advances in collaborative research. Recently, significant effort has been devoted to studying the most effective ways of conducting collaborative synthetic scientific research. The National Research Council's (2015) "team science" approach, combined with the lessons learned from synthesis centers in ecology and other fields, needs to be heeded in archaeology as we consider the best way forward for our field.

A New Mode of Synthesis

The mode of problem-oriented synthesis we propose to institutionalize relies on the integration of primary data from multiple sources and perspectives to yield emergent explanations that would be impossible to achieve through studying a single case or from a single perspective. The National Center for Ecological Analysis and Synthesis (NCEAS), established by NSF in 1995, pioneered a new model for synthetic research. That model has been so successful that it has been adopted by over a dozen research organizations around the world across a wide range of disciplines (e.g., the National Evolutionary Synthesis Center, the National Institute for Mathematical and Biological Synthesis; see also the international Synthesis Consortium).

Synthesis centers produce knowledge by employing NCEAS's distinctive mode of collaboration—synthesis working groups. In this model a researcher develops a proposal to convene experts from different disciplines, institutions, and professions into a temporary working group of between eight and 15 members to focus on a particular research topic. The proposal then is vetted by the center's steering committee. If successful, the center funds the group to meet for three to four in-person working group sessions, each lasting between five and 10 days during a period of two to three years. Working group members collaborate intensively during the face-to-face working group sessions. In between these face-to-face meetings, e-mail, data-sharing platforms, and videoconferencing facilitate computer-mediated cooperation. Synthesis centers support these working groups by providing funding for travel to the center, conference facilities, expert guidance in the collaborative process, and analytical and computational support. They explicitly *do not* fund the collection of additional field or laboratory data.

NCEAS and other synthesis centers modeled after it have had demonstrable success in creating new and influential forms of scientific knowledge (Carpenter et al. 2009; Lynch et al. 2015; Rodrigo et al. 2013). For instance, working groups reliably produce high-impact, highly cited science, and participation in working groups has been demonstrated to have enduring career benefits for both junior and senior scientists (Hampton and Parker 2011). Research conducted by working groups has also contributed to the development of evidence-based policy and practice (Specht et al. 2015) and increases substantially the probability of serendipitous discoveries and transformative research (Hackett et al. 2008). Moreover, the deeply immersive and engaging interactions within working groups significantly increase the velocity at which new ideas are generated, evaluated, and vetted (Hackett and Parker 2016). Finally, synthesis centers act as infrastructures that support the incubation of new specialties and research communities and have the potential to transform scientific disciplines (Baron et al. 2017).

Research also has illuminated the characteristics of the more successful working groups. Briefly, the most effective working groups benefit from incorporating members across multiple institutions, from having a mixture of junior and senior scientists, and from ensuring that all members have the chance to contribute their distinctive forms of knowledge. The successful working groups also undergo group processes that foster high levels of trust and group solidarity. Trust is what enables members to cooperate effectively, to develop an operational division of labor, and to constructively criticize each other without undue offense (Hackett and Parker 2016; Hackett et al. 2008; Hampton and Parker 2011).

Establishing a synthesis center for archaeology has been identified previously as having the potential to catalyze important research. In 2004 NSF funded a workshop in which the 31 participants assessed archaeology's needs for cyberinfrastructure, formulated a vision, and developed recommendations toward realizing that vision. Its report, endorsed by the Society for American Archaeology, the Society for Historical Archaeology, and the American Association of Physical Anthropologists, recommended creation of a synthesis center modeled on NCEAS (Kintigh 2006:577–578).

In a 2013 workshop held at NSF, a group of 15 participants developed recommendations for infrastructure investments for archaeology that would allow NSF to more effectively support work that answers the field's big questions, such as the "grand challenges" (Kintigh et al. 2014a, 2014b). The report on that workshop (Kintigh et al. 2015) identified five major impediments to synthetic research and, among other things, recommended the establishment of an archeological synthesis center modeled on NCEAS.

Advancing Synthesis in Archaeology

The stage is set for archaeology to make important advances through collaborative research:

NCEAS and other NSF-supported synthesis centers have established a proven model for accomplishing a new kind of synthesis that is applicable to archaeology. Archaeology faces similar challenges in facing a deluge of data, in professional hyperspecialization, and in recognizing the value of incorporating diverse perspectives in solving intellectual and practical problems. And we can productively leverage the lessons learned in these other synthesis centers (e.g., Baron et al. 2017; Hackett et al. 2008; Hampton and Parker 2011).

Some essential and expensive computational infrastructure needed to support synthesis is now in place. The robust, disciplinary digital repositories or data publishing platforms established over the last 20 years, notably the Digital Archaeological Record (tDAR) and Open Context in the United States (McManamon et al. 2017) and the Archaeology Data Service (ADS) in the

United Kingdom (Richards 2002, 2017), provide key infrastructure for data discovery, access, integration, and preservation that need not be duplicated. Other needed types of computational infrastructure can build on the foundation formed by these existing components. The statistical, visualization, and computing resources needed for all but the most demanding kinds of archaeological analysis are now ubiquitous. Methods of remote communication that can support collaboration between face-to-face meetings are also now widely available. An ever-increasing amount of our data are also born digital or available digitally.

In order for archaeology use collaborative, synthetic research to make the important advances of which we are capable:

Archaeology must develop an institutionalized infrastructure for transformative synthetic research that enables our unique, long-term, large-scale, and comparative perspective to contribute to answering compelling questions facing society. The infrastructure must be inclusive so that it empowers a broad range of archaeologists to participate with researchers from related fields in achieving productive synthesis. It should democratize data and access to synthesis processes and tools and foster collaborative modes of research. The synthesis infrastructure should leverage existing physical, computational, outreach, educational, and social infrastructures.

It is imperative that archaeology incorporates the mode of synthesis pioneered by NCEAS now. In the current political and economic environment, archaeology and other sciences must demonstrate their value to policy makers and to the public who fund the majority of the archaeological investigations conducted in the United States and around the world. In addition, the societal problems that we can help address continue to grow.

We must develop institutionalized ways of communicating the results of archaeological synthesis in ways that can influence policies on important social issues and provide benefits to the publics that we serve, including descendant communities. At its best, archaeology can help right injustices of the past, identify forms of organization and structure to minimize social inequality, inform debates about sustainable futures, and inspire disenfranchised communities, genders, and ethnic groups. Honing our message in ways that resonate with policy makers, publics, and affected communities is as essential as improving the scientific process. In this vein the Wenner-Gren Foundation for Anthropological Research's sapiens.org initiative provides an instructive example and potential partner.

We must instill the aspiration to contribute to collaborative synthesis throughout the profession and infuse archaeological and bureaucratic workflows with processes that produce research syntheses. This would entail providing professional training in methods for comparative and synthetic research and on digital data management throughout a research project life cycle. This could happen, for example, through university on-campus training (perhaps certificate) programs and by providing online seminars through available professional education initiatives including those of the American Cultural Resources Association, the Society for American Archaeology, the Register of Professional Archaeologists, and the American Anthropological Association. Further, we should work with professional organizations to pursue changes in the how cultural heritage monies are allocated in ways that can systematically direct funding to synthesis through alternative mitigation, landscape-level resource management, long-range planning, and related means (Advisory Council on Historic Preservation 2009; Altschul 2016b; U.S. Department of the Interior 2016).

Finally, we must work on the right questions. We began this discussion by asking what the public wants from archaeology and what archaeology could offer the public. If collaboration means anything, it must be that the public(s) interested in archaeology and its results are part of the process of selecting those synthetic efforts that move forward, ensuring that the results resonate with their objectives and thus that they are mobilized to act on the results in pursuing public policies and public actions.

HOW DO WE GET THERE

Archaeology is an inclusive field. While the top-down model within NCEAS has been a tremendous advantage in ecology, a system in which one or a small number of institutions dictate or direct others has been resisted in archaeology. Bearing our history and culture in mind, we propose to pursue the NCEAS approach using a more inclusive and agile organizational structure: a Coalition for Archaeological Synthesis (CfAS). The coalition will be composed of established private and public organizations that provide essential scholarly, computational, educational, and outreach infrastructure for archaeology. A core organization, termed the National Center for Archaeological Synthesis (NCAS), will coordinate the efforts of CfAS. It will solicit and administer funding to support collaborative working group synthesis projects that will be largely executed though the coalition's partner organizations (Figure 1).

The coalition's research agenda will be determined by the working group proposals that are submitted by the profession at large. Recommendations on which proposals to fund will be made by a review committee, composed of archaeologists and representatives of interested publics, such as descendant communities and nonprofessional archaeological and cultural heritage societies. The review committee will use guidelines designed to privilege innovation and diversity in the composition and theoretical approaches of the working groups. We expect that proposals will come from different professional constituencies and that future professional cohorts will continually reshape the issues undertaken and the approaches employed. Of course, the members of the individual working groups will determine the ontology structuring their group's efforts and products.

Coalition for Archaeological Synthesis. The authors believe that archaeological synthesis can best and most efficiently proceed by leveraging the expertise, services, and facilities of existing organizations that wish to engage in promoting synthesis. Several different types of coalition partners could contribute to the proposed archaeological synthesis "ecosystem." The coalition will be open to all institutions interested in partnering to support archaeological synthesis. These will include universities, museums, professional societies, and nongovernmental organizations as well as government agencies and private CRM firms.

Each working group will hold its set of face-to-face meetings at the conference facilities of a coalition partner, with the meeting

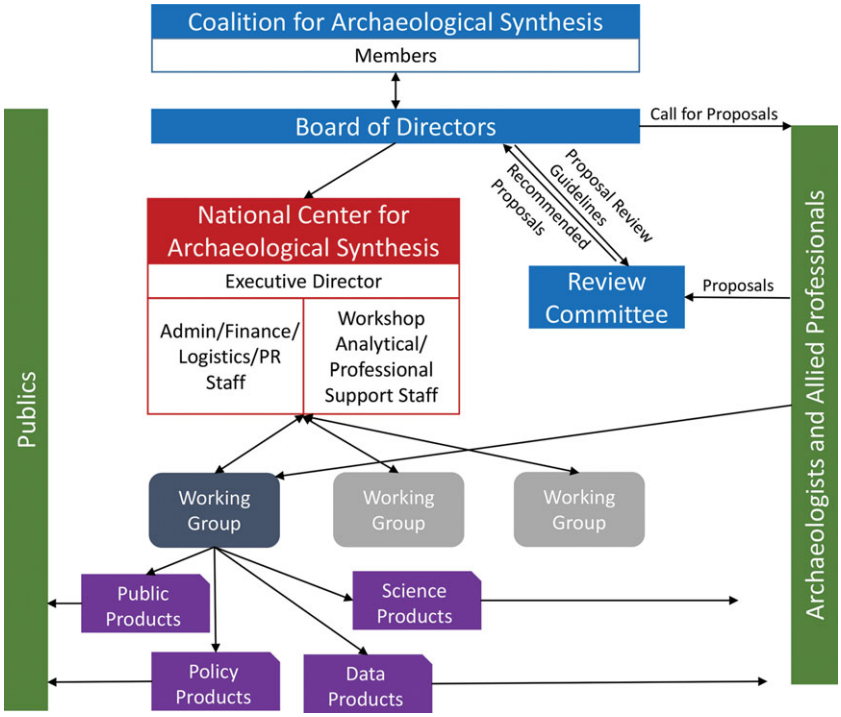

FIGURE 1. Proposed organization for the Coalition for Archaeological Synthesis (CfAS).

structure organized according to the NCEAS model described above. A number of potential partner organizations have some combination of conference facilities, participant housing, ability to provide meals, and logistical support personnel to coordinate location-specific arrangements with working groups. Some also have public relations staffs or publishing partnerships to help disseminate scholarly and public products. In the United States such organizations include the Amerind Foundation and School for Advanced Research, both of which have joined the coalition as partners.

Organizations that provide critical computational infrastructure for data discovery, access, integration, and preservation, such as Digital Antiquity (which operates tDAR), Open Context, and ADS, would offer essential tools for the coalition members to employ in synthesis efforts. Similarly, the Network for Computational Modeling in Social and Ecological Sciences (CoMSES Net) provides computational model library services. These organizations have all joined as coalition partners.

We see significant potential for international collaboration (Altschul and Kintigh 2017). In many cases the working groups will include members from other countries, and they will often be addressing questions with data from outside the United States. The coalition can foster significant collaboration and operate with negligible infrastructure and without significant financial investment.

The National Center for Archaeological Synthesis. A nimble core organization with a director and a small staff are essential to the success of this enterprise. The center will coordinate efforts to seek funding for both core activities and working group synthesis efforts. It will administer funding for selected working groups and will provide guidance on working group leadership, structure, and operation; provide or coordinate analytical and computational support for working group efforts; and facilitate working groups' remote collaboration between face-to-face meetings.

The center will provide an agile and scalable hub for overall coordination among the coalition partners and will match working group efforts with appropriate organizations in the coalition. The center will be incubated within a university or a similar robust organizational structure that can provide space, access to employee benefits and other human relations support, grant and gift administration, and accounting and legal support.

The center, working within the host institution's public relations and government affairs offices, professional associations, and other coalition partners, will promote policy-relevant and public outcomes of the working groups. To make synthesis a normal and expected part of the overall archaeological workflow, in both the heritage management and academic sectors, the center on its own, and through its coalition partners, will provide accessible training in synthesis and associated activities.

Board of Directors. The CfAS board of directors, selected by the coalition members, will be the governing body of the coalition. The board will oversee the operations of the National Center for Archaeological Synthesis, assist in fundraising for the coalition, and set the guidelines by which working group proposals are evaluated.

Review Committee. Using the established guidelines, the CfAS review committee will evaluate the proposals and recommend

proposals to be funded. The review committee will be constituted by the board of directors to ensure that both the scholarly values and public benefits of the proposed projects are adequately considered. Care will be taken to ensure that the diversity of views surrounding cultural heritage and archaeology are represented on the review committee.

Working Group Projects. Working groups will focus on topics with compelling public *and* scholarly payoffs. Proposals for working groups will identify and present plans for achieving both the expected scholarly and public objectives. Working groups will be funded for travel and lodging for three or four face-to-face meetings spread over two or three years. Salary buyouts will be provided, as needed, for CRM practitioners and other nonacademic participants. The center will coordinate working group efforts with an appropriate coalition partner digital repository, such as tDAR, Open Context, or ADS, so that both their source data and their resulting data and analysis and other research products are publicly available (with temporary restrictions, as appropriate). To the extent possible the center or other partners will provide or coordinate other kinds of postdoctoral support or technical assistance (e.g., for modeling) for working groups.

Working groups, generally of 5–12 members, will incorporate the diversity in professional seniority, gender, institutions, work setting, and theoretical perspectives that research has shown to be most productive. Indigenous perspectives, in particular, will be essential for many such efforts. It will be important that junior scholars are credited in ways and on time scales that are consistent with their career trajectories. Working group proposals will only be considered if the working group's target data are analysis-ready (i.e., no new data collection or major data cleaning are needed for the working group to proceed).

HYPOTHETICAL EXAMPLE

With our proposed adaptation of the NCEAS model in mind, we offer the following hypothetical example of how our vision of collaborative synthetic archaeological research might be implemented.

An individual, working with a group of colleagues, proposes a synthesis workshop to address one of the grand challenges of archaeology (Kintigh et al. 2014a, 2014b): *What factors have allowed for differential persistence of societies?* The proposal provides plans of work for the research and for the development of public products. The proposal elects to focus on the United States and identifies six researchers (female and male, junior and senior, academic and CRM) working in different parts of the country representing archaeological cases with long and short persistence in the past. The review committee recommends the working group but asks for the addition of two Native Americans knowledgeable about the traditional histories of their tribes and others in their regions. The National Center for Archaeological Synthesis identities a coalition partner institution willing to host three weeklong workshop meetings over two years.

At their first meeting the participants refine the questions and decide on the data needed to address them. For example, what constitutes "persistence" of a society, what potential "factors" will be considered, what kinds of observations are needed to indicate societal identity and persistence, and what data are needed to assess the factors to be considered? Over the following eight months, each participant assembles the identified primary data from their own and at least three additional archaeological cases and uploads it all to tDAR with assistance of a project postdoc.

At a second meeting, with the assistance of the postdoc and an expert visualization and data analyst, the team uses the data assembled to agree on a tentative assignment of societal persistence for the 25 cases with data that are considered sufficiently robust. By proposing, arguing, and preliminarily testing ideas, they begin to explore the influence of factors to be considered. Each participant leaves with an analysis and writing assignment to explore one or two potential factors across all the cases. Following the second meeting, the group has monthly virtual meetings to assess progress and further test out ideas. E-mail exchanges among particular participants clarify issues pertaining to inferences about the roles of individual factors in specific empirical cases.

At their final meeting, eight months later, the group works through the position papers pertaining to the individual factors and assembles a set of conclusions supported by robust data and careful analysis. By the end of the meeting participants have drafts, of one or more articles, and leave with final assignments for their completion and submission for publication. In this meeting the working group also implements its plans for producing public products resulting from its work. With the assistance of a professional society's government affairs staff member, included by videoconference, the group outlines a brief white paper highlighting the policy implications of the results that the societies can distribute to lawmakers and regulatory agencies as a prelude to face-to-face meetings. With support from the host institution public relations staff, a science reporter meets with the working group on their penultimate meeting day, resulting in an article in a national newspaper and a press release from the host institution that is picked up by several regional media outlets.

Conclusion

This article is the result of a two-day workshop held at the School for Advanced Research in Santa Fe, New Mexico. Its goal was to chart a path that will enable archaeology more frequently and more effectively to leverage the enormous amounts of data that we have collected in order to advance scientific research and to assist in addressing compelling needs of modern society. The participants concluded that a substantial, sustained, and institutionalized commitment to collaborative synthetic research is essential for archaeology to contribute its unique perspectives for the benefit of the public in all its diversity.

Through this article (see also Altschul et al. 2017), we have sought to make the case for the importance of synthesis and for the value of a collaborative mode of synthesis. We provide concrete recommendations to advance this cause to stimulate support for vigorous disciplinary action to foster synthesis.

As we see it, public benefits of collaborative synthetic research are many and varied. They could take several forms and could address different segments of the public in different ways and at different scales. Using archaeological knowledge to influence

public policy could benefit the public broadly. Or, results of a synthesis project might be incorporated in museum exhibits and programs that answer how and why questions of particular significance to a community.

The success of the Coalition for Archaeological Synthesis will be measured by how well evidentially based arguments involving archaeology shape the discourse about who we are as a diverse, multicultural society and how we can address the challenges facing our society today. Success will be predicated on the coalition being embraced by all segments of the archaeological community and those segments of the public that are affected by and/or interested in archaeological research. One of our objectives is to continually expand the size and scope of these publics.

While optimistic, we are mindful to the hurdles ahead. The coalition will not succeed if CRM and the heritage community are not full partners. The coalition will not succeed if it does not serve the interests of descendant communities. The coalition will not succeed if the public does not find archaeology responsive to their questions or if it fails to bring knowledge to bear on issues affecting their lives. None of this will be easy. But for archaeology to move effectively beyond project interpretation to synthesis, all of it is necessary.

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Data Availability Statement

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