# A Collaboratory for GIS and Mediterranean Archaeology (CGMA): An undergraduate teaching and research program

**PIs:**

Dr. Rebecca K. Schindler
Assistant Professor of Classical Studies
East College L-40
DePauw University
Greencastle, IN 46135

Dr. Pedar W. Foss
Assistant Professor of Classical Studies
East College L-40
DePauw University
Greencastle, IN 46135

**co-PIs:**

Dr. Michael Galaty
Assistant Professor of Anthropology
Millsaps College
Jackson, MS 39210

Dr. Paul Nick Kardulias
Associate Professor of Anthropology
and Archaeology
The College of Wooster
1189 Beall Avenue
Wooster, OH 44691

Dr. Kenneth S. Morrell
Associate Professor
of Greek and Roman Studies
Rhodes College
2000 N. Parkway
Memphis, TN 38112

## Introduction

Since 1998, the ACS Archaeology program, with significant funding from the Mellon Foundation, has provided archaeological instruction and field experience for undergraduate students at ACS member institutions, DePauw University, and the College of the Holy Cross. The program has featured an on-line course in the spring to introduce students to theory, method and practice in archaeology, and has invited certain students to participate directly in fieldwork on the Hacımusalar Project in southwestern Turkey.[1] This program has proved mutually beneficial. It has offered students classroom and hands-on instruction, as well as a unique cultural learning opportunity in Turkey. Students have provided project faculty with motivated and talented assistants in their various specialties, together making the operation of a major international research project possible.

We believe that this model can be extended to provide more students in the ACS and GLCA with a chance to learn and practice archaeology while contributing to scholarship. In particular, students can learn about an important new technology with applications in numerous fields, i.e., GIS (Geographic Information Systems), and particularly how this technology is transforming spatial studies in archaeology. By combining the efforts of students and faculty, moreover, this project proposes to begin construction of the first Mediterranean-wide GIS system for archaeology, providing a functional framework for broad studies of the interactions of humans and their environment in antiquity.

[1] The ACS Archaeology Program and on-line publication of the Hacımusalar Project can be accessed at: http://www.choma.org. The fieldwork project is directed by Prof. Dr. Ilknur Özgen of Bilkent University in Ankara.

During the past fifteen years, archaeologists in the Mediterranean have accumulated large amounts of computerized data that have remained trapped in localized and often proprietary databases. Few efforts have been made to facilitate ways in which such data might be brought together and shared between researchers, with students, and with the general public. It is now possible to change that situation. Archaeological data always includes an intrinsic geographic component, and the compilation and sharing of geographic data through GIS has become increasingly important in the governmental, private-sector and academic worlds during the past ten years. New technologies and the expansion of the Internet now make it possible to share geographic information quickly, widely and effectively. That sort of exchange is required should archaeologists, anthropologists or historians wish to study regional or Mediterranean-wide patterns and draw historical conclusions that are broader than their own study areas.

This proposal advocates the development of a Collaboratory for GIS and Mediterranean Archaeology (CGMA, pronounced *Sigma*)[2] to begin facilitating the coordination and exchange of data that can be queried, analyzed and distributed over the World Wide Web. This construction will be a product of close student-faculty collaboration through a program of teaching and research. Undergraduate students will be involved in CGMA's construction at all levels. First, they can participate in a for-credit seminar in archaeology. Such a seminar will rotate between faculty PIs and co-PIs from DePauw, Rhodes, Wooster and Millsaps. It will be offered once a year, with class sessions conducted on-line for *all* students at participating institutions. The curriculum is described in more detail below. This seminar is similar to the on-line course offered by the ACS for its Archaeology Program, except that it carries a full (4 hours of) course-credit. At a more advanced level, competitive summer internships will be made available for students in the class who wish to continue work on the project (with support built-in for supervising faculty members). Finally, basic maintenance and support of CGMA will continue in semesters opposite the course by work-study students at these schools. They will include students who had taken the class in a previous term. We intend to develop a group of students with varying levels of experience who can keep the project moving forward, gain valuable research experience for themselves, and help instruct and assist other students in the program.

For participating faculty, CGMA will offer the opportunity to involve students in their research while building a significant and tangible resource not only for themselves, but for the scholarly world at large. Annual workshops and colloquia for scholars and students will be held to evaluate and critique the progress of the project, and as *fora* for suggesting protocols and standards for data-sharing. This project will, as a first step, compile a GIS inventory for archaeological survey metadata, i.e., a registry of Mediterranean archaeological survey projects. We believe that this phase of CGMA will be a prototype for sharing raw archaeological data from dozens of different projects via a Web-based GIS.

This proposal explains how the CGMA project can serve as a model for student-faculty collaboration and break down barriers between ‘teaching’ and ‘research’. It begins with a description of the scholarly problem behind the project.

[2] Sigma of course is the Greek letter symbolizing the summation of a series of operations in mathematical notation.

**The Problem**

Archaeological projects produce massive amounts of data. These include primary data-sets built from excavations or surface surveys as well as secondary data-sets from specialized studies concerned with ceramics, small finds, architecture, etc. In the infancy of the discipline, archaeological projects tended to concentrate on a specific site in a specific period. During the last 35 years, however, there has been a shift in emphasis. Projects now often investigate multiple sites in a region, and they ask diachronic as well as synchronic questions. This larger-scale collection of data has been facilitated by technological advances in data collection, storage, and analysis. One of the most important of these advances has been the use of GIS, which permit the cartographic presentation and analysis of data having a spatial dimension. All archaeological data have a spatial dimension, and *context* is one of the primary means by which archaeologists are able to *interpret* that data.

Unfortunately, these data-sets — even highly sophisticated GIS data-sets — have remained largely isolated from each other. Individual scholars have pursued pan-Mediterranean studies of archaeological data, but their compilations have largely remained in analog (often catalog) form, making it difficult for other researchers to experiment directly with the same data.[3]
In 1994, the European Union-funded POPULUS project began to address problems of data comparability for studies in landscape archaeology. Its mission statement was: "to investigate the feasibility of establishing a common series of research goals and standards in Mediterranean landscape archaeology so as to advance the study of the ancient demography of the region on a broad comparative front."[4] The colloquia and volumes that have emerged from the project are the most comprehensive assessment and exploration of field-survey issues in the Mediterranean to date. The final component of that project, the forthcoming publication of a Manual of Best Practice for landscape archaeology, will provide an important set of guidelines for survey methodology, data preparation, analysis and publication. Yet a challenge remains: *how might scholars actually work with data from many different survey projects in a comparative format, using the geographic analysis and cartographic output made possible by GIS, and make it universally available?* This is the essential problem.

Also in 1994, a Federal Executive Order requested government entities, private enterprise and academia to work together to define standards for sharing geographic data.[5] Several broad initiatives to construct GIS networks have subsequently emerged. In 1998, NASA commenced the 'Digital Earth' project, which "will be a virtual representation of our planet that enables a

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[3] S. Alcock ("Concluding comments", *Extracting meaning from ploughsoil assemblages* [Archaeology of Mediterranean Landscapes 5] Oxbow 2000, 265) speaks of the 'hound of hell' syndrome: "the salutary concern that somewhere, sometime, someone will want to use your data for their own purposes." It is for this reason that she stresses both 'explicitness' and 'publication' as desiderata. Certainly archaeologists should prepare data for use outside their own research questions at the time of publication, but it is not certain that traditional book publications are the best way to make that data available to other scholars (see below, re: Stoa.org). Alcock seems to be speaking here of scholars re-examining a set of published data in order to reinterpret it on a local scale. However, the principle can be extended to larger regional or pan-Mediterranean studies. See also S. Alcock, "Breaking up the Hellenistic world: survey and society," in I. Morris (ed.), *Classical Greece: ancient histories and modern archaeologies*, Cambridge 1994, 171-190.

[4] G. Barker and D. Mattingly, "General Editors' Introduction: the POPULUS Project", *Reconstructing past population trends in Mediterranean Europe* (Archaeology of Mediterranean Landscapes 1) Oxbow 1999, iv.

[5] As noted in "Geography Network supports open standards," *ArcNews* vol. 23, no. 1, Spring 2001, published by ESRI, p. 2.

person to explore and interact with the vast amounts of natural and cultural information gathered about the Earth."[6] And ESRI, the leading private publisher of GIS software, has now unveiled the 'Geography Network', its portal for the publication of geographic data, maps and services over the World Wide Web.[7] A crucial component of these initiatives is that they are committed to Open Source protocols that facilitate interoperable geoprocessing across software packages and platforms.[8] None of these initiatives has dealt directly with archaeological data, but they can serve as models for this project.

There are some signs of bridges being built across the existing archipelago of archaeological projects. These early efforts have endeavored to archive digital information from archaeology projects on the World Wide Web. For the Mediterranean, the most extensive efforts so far have been made by the Archaeological Data Service (ADS) in Britain,[9] and the Archaeological Data Archive Project (ADAP) in America.[10] The latest addition to the ADS site allows users to search catalogue holdings in Britain and Northern Ireland for archaeological data from sites, surveys and excavations by various criteria. Basic descriptive and categorical results, in tabular form, are linked to an aerial photograph and an Ordnance Survey map generated on the fly. Other links allow for the download of raw data from selected projects. Users can also use an interactive map to view the density of *catalogue holdings* across the islands, but not the densities of any archaeological data *per se*. Neither are the archives set up to integrate data across projects. Nevertheless, epistemology, methodology and technology are converging. We now have the ability to ask and answer archaeological questions which have never been possible before because their scope has exceeded our ability to compile and correlate the reference data.

We believe that it is time to bring disparate data-sets together in a collaborative GIS databank for Mediterranean Archaeology. We argue that it is essential to start combining, integrating, comparing and contrasting data collected by individual archaeological projects. Certain (especially demographic and economic) questions of supra-regional scope and significance can no longer be reliably addressed without drawing upon collated archaeological survey-data. Using CGMA, for example, scholars could compare (statistically) the relative developments of Iron Age settlement patterns in Turkey, Greece, Italy, France, Spain, Libya and Tunisia, towards analyzing the impact, rate, and nature of colonization during that period. The distribution of stone tool types and materials, or pottery wares and forms, from surveys in various periods could refine our knowledge of trade and technology patterns across the Mediterranean.[11] The impact of human settlement and resource extraction upon the environment in mountain climates could be approached, towards solving the problem of deforestation and erosion in the ancient world and the relationship between the environment of the Mediterranean in antiquity and the state of that environment today. Finally, *historians* could add such collected survey data to the other sets of information they use to build large-scale, long-term explanations of Mediterranean polities and societies.

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[6] http://www.digitalearth.gov/vision.html.
[7] http://www.geographynetwork.com/.
[8] http://www.opengis.org/. GIS Freeware and map data can be found at: http://www.freegis.org/.
[9] http://ads.ahds.ac.uk/ahds/.
[10] http://csa.brynmawr.edu/archive/adap/.
[11] The problems of comparing ceramic chronologies from project to project is addressed by M. Millett, "Dating, quantifying and utilizing pottery assemblages from surface survey," *Extracting meaning from ploughsoil assemblages* (Archaeology of Mediterranean Landscapes 5) Oxbow 2000, 53-59.

The technology — secure, long-term and high-capacity storage, powerful relational databases, GIS and the Internet for delivery — exists to make such a large-scale project feasible and productive. Working with a GIS-ready databank could assist archaeologists, anthropologists, and historians interested in questions of social and political development, cultural interaction and diffusion and economic exchange, by making possible geographic visualizations of masses of data through querying over the Internet.

In sum, CGMA intends to provide:

- A model for scholarly compilation, exchange and discussion of data with a geographical component, using open-source technology over the World Wide Web.
- Interdisciplinary cooperation among classicists, archaeologists, geologists, geographers, anthropologists, computer scientists and historians on a focused project that can offer immediate tangible results.
- Inter-institutional student-faculty participation in the construction and maintenance of the databank, both as research and classroom experience, using established technologies.

This document proposes building the *first* stage of CGMA as a joint student-faculty endeavor.

**A GIS inventory of archaeological survey metadata**

During the last 50 years, millions of hectares have undergone some kind of archaeological survey across the Mediterranean. There have been hundreds of survey projects, but no count has ever been made, nor any catalog of exactly what geographic areas, chronological periods, methodologies or research questions have been covered. Only a few regional efforts have been made to bring together and compare data from disparate projects. Alcock's study of Greece from the Hellenistic-Roman periods is the most prominent.[12] As of 1991, she had selected data from 21 different published projects, covering over 2 million hectares. Her compiled data, however, has itself never been made available except as summarized and analyzed in her book.

The PIs' current survey project, the Hacımusalar Survey in southwest Anatolia — like many recent surveys — makes extensive use of GIS.[13] We would very much like to be able to compare our results with those of other surveys carried out in inter-montane basins, as a means of asking broader questions about strategies for environmental adaptation, resource-exploitation, settlement and trade patterns, etc., during all periods of human presence. Yet, although methodological improvements and technological aids such as GIS have facilitated a more intense and detailed collection of data as well as the possibility of analyzing and storing that data, these data-sets have remained largely isolated from each other.[14] It is difficult to acquire the *raw data*

[12] S. Alcock, *Graecia Capta*, Cambridge 1993, table 2). Hers is hardly the only example, but it is one of the most successful. Numerous smaller studies in the POPULUS volumes also compare methodologies and data amongst a few select survey projects.

[13] The field survey Foss is presently directing as part of the Hacımusalar Project in northern Lycia (Turkey) covers a sample area of 32.6 $km^2$. The Hacımusalar Project is available at: http://www.choma.org. We are currently building our GIS for distribution over the World Wide Web.

[14] Some initiatives have been taken on a nation-wide basis to formulate working-groups to discuss these issues; the Landscape Archaeology Group (LAG) in Greece is one example: http://www.omart.gr/. This effort is in its early stages, however.

(much less a full understanding of the methodologies used to acquire that data) necessary to undertake a careful comparison of results from place to place.[15]

As a first stage of this project at relatively low cost and with a relatively high payoff, we suggest a basic GIS delivered over the Internet that simply acts as a geo-database of metadata for Mediterranean survey projects. This would form an inventory of all survey projects that have been undertaken in the Mediterranean basin, from Morocco to Egypt in North Africa, from Jordan to Iraq and Turkey in the Near East, and from the Balkans to Belgium in Europe, as well as all of the Mediterranean islands.

We intend to use the free open-source GRASS GIS.[16] Publicly-available GTOPO30 elevation data (1-km. resolution) can be used for an initial digital topographic base map of the Mediterranean, until such time as topographic data from the SRTM (Shuttle Radar Topography Mission) is made available (at 30 m. resolution).[17] Layered over that base map will be the boundary-lines of completed (and current) 'extensive' and 'intensive' survey projects. These areas will then be hot-linked to entries in the meta-database that name, categorize and describe each survey in terms of its principal investigators, dates of operation, chronological coverage, methodology, and primary research questions. Complete bibliographies will be included for each project.[18] Even this modest endeavor would have several benefits:

- An immediate visual impression of what areas, and what proportions, of various Mediterranean countries have been subject to archaeological survey. At present there is no 'central clearinghouse' for such information.
- An updatable bibliographic resource (especially useful for scholars and students at small institutions without extensive library holdings or complete research tools).[19]
- Searches can be made for surveys whose data includes certain environmental parameters, chronological periods, artifact or building categories, etc., providing a set of projects meeting the goals of a particular research issue. This would not be dissimilar from what the ADS does for Britain and Northern Ireland (see above).
- Provision of contact information for principal investigators of surveys, so as to facilitate lines of communication and cooperation for direct data-sharing.
- Integration of undergraduate students in a major interdisciplinary and inter-institutional research initiative; providing them with both theoretical and methodological instruction as they learn how to apply their knowledge and skills.

Ross Scaife and Anne Mahoney, the editors of http://www.stoa.org, a web-consortium dedicated to refereed scholarly Internet publication for classical studies, have agreed that the first stage of the CGMA project meets their criteria. They will make available their development server (zeno.stoa.org) for test versions of the project, and eventually will publish the completed first

[15] Although this is changing, by virtue of the (both preliminary and intended full) publication of raw data by such projects as the Pylos and Nemea Valley Regional Archaeological Projects: http://classics.lsa.umich.edu/PRAP.html; http://classics.lsa.umich.edu/NVAP.html.
[16] GRASS: http://www.baylor.edu/grass/index2.html.
[17] GTOPO30: http://edcdaac.usgs.gov/gtopo30/gtopo30.html; SRTM: http://www.jpl.nasa.gov/srtm/.
[18] After CGMA is constructed, bibliographies and metadata will be kept up-to-date by work-study students at the participating institutions, along the model of NESTOR, the bibliography for Bronze-Age Aegean studies at the University of Cincinnati: http://ucaswww.mcm.uc.edu/classics/nestor/nestor.html.
[19] Such an effort has been begun for Greece by the LAG's 'Work group for Landscape Archaeology Literature'.

stage on their public server. Stoa already has all of the software and development tools necessary to implement the project, including the GIS and database software. The project is also open to exploiting economies of scale by cooperating or synergizing with the Mellon technology infrastructure project and/or the GIS initiative.

**Structure and implementation**

The first stage of CGMA will be organized and implemented using these components: (a) an undergraduate seminar each fall term; (b) a student-faculty workshop near the middle of the fall term; (c) spring-term student work-study grants; (d) summer student research internships; (e) Web-GIS construction on stoa.org. It is conceived as a 4 calendar-year project. Each year is structured to cycle resources, with the seminar and workshop held in the fall, administrative planning and work-study in the spring, and internships in the summer.

The Web-based seminar is scheduled for the fall term so that it can complement, and not conflict with, the ACS Archaeology course in the spring term. The courses should feed each other's enrollment, and CGMA will offer students who cannot or wish not to travel overseas, to still be able to 'learn by doing' in an archaeological project. CGMA will compliment existing inter-institutional programs for student learning and research in classical studies and the liberal arts:

- Sunoikisis: upper-level Greek and Latin courses shared between institutions, a 'virtual classics department'.
- ACS Archaeology Program: course instruction and field experience in primary data collection at the Hacımusalar Project in Turkey.
- CGMA: course instruction, research and work experience in library research and secondary data collection in GIS and archaeology.

Students can have the opportunity to experience and contribute to the scholarly process all the way through: the development of research questions, the critical processing of published scholarship, primary data collection, the combination, organization and analysis of that information, and its dissemination to other scholars, the public, and to students. By participating in the *process*, the *product* will be made much more meaningful to students.

(a) The undergraduate seminar. Each fall semester, the named principal investigators for this project will offer, on a rotating basis amongst institutions, an upper-level seminar as an archaeological practicum. Each institution will run the seminar for one term over the life of the grant. The limit on the class will be 12 students. Sessions will be held in person at the institution of the supervising faculty member for that term, and conducted live over the Internet for students from other institutions. The ACS archaeology program and the Sunoikisis virtual classics department serve as our models for the operation of the seminar.[20] In the first few weeks, this course will cover basic theory and methodology in the collection of archaeological survey data, and the use of technology in archaeology, with a focus on GIS. This introduction would include both a library and an Internet session about how to use reference resources and databases.

From the start, each student will be assigned to work on a component of the project based on their interests and expertise. Computer science students could work on database, GIS or Internet delivery programming under the supervision of the project programmer; students in classical

[20] ACS archaeology program: http://www.colleges.org/~turkey/; Sunoikisis: http://www.sunoikisis.org/.

studies, anthropology, geography, etc, could work on collecting, organizing and assessing metadata from specific Mediterranean regions. The supervising faculty member and all participating students will to meet twice a week for instruction, and so students can update the group on their progress and share research strategies and results. At the end of the term, each student is expected to write a 5- or 6-page reflective summary of their learning process and their work product, as well as provide the specific programming or data that they have developed. Credit equivalencies will be negotiated between participating institutions, with DePauw University being the credit-issuing body. After the first two years, we envision opening up the seminar to ACS, GLCA or ACM students outside of the institutions of the PIs and co-PIs.

(b) Student-faculty weekend workshop.
One Friday-Saturday session will be scheduled near the mid-point of each fall term in which participating students, PIs, co-PIs and previous summer's interns meet at the institution of the supervising faculty member for that term. This will be an intensive session where faculty members and students share approaches, results, and work out problems in collaboration. In this way, faculty members will be able to model scholarly discussion and cooperative research for the students in person, and students would be able to learn from each other and from students who had advanced through the program to the internship in the previous year.

Overlapping with this session, a Saturday-Sunday meeting and workshop for the CGMA advisory board (listed below) will be held at the same institution. This will consider the progress of the project, future initiatives, issues of data standards and data comparability, and plans for preparing case-studies for phase two of CGMA. For all workshops, grant monies will cover room-and-board for visitors, while individual institutions will be expected to provide transportation funds as part of their cost-sharing in the project.

Also as part of cost-sharing, the project requests that the participating institutions offer small grants for students to travel to the libraries of nearby major research universities to work on their projects, up to 2 visits per student at up to $100 per visit. Students can be reimbursed for transportation, parking, and accommodation if necessary. These grants are particularly important for students of liberal-arts colleges to gain experience with major library collections.

(c) Spring-term work-study grants for student research associates.
In order to maintain momentum and progress during the spring term when no seminar is held, one student who had taken the seminar at each of the participating institutions will be eligible for 10 hours of work-study per week, continuing some aspect of work begun during the fall term. Funds for this work-study will come as matching monies from the participating institutions.

(d) Summer student research internships.
In order to maintain momentum for the project during the summer months, and to offer students an opportunity to develop their projects beyond the seminar or work-study, the project will offer summer research internships for students who have participated in a seminar. Students will work at their home institution for 40 hours/wk. for 10 weeks, and earn a stipend of $2,500. Four internships will be made available each summer, and they will be competitive, judged by the PIs and co-PIs. These internships will help keep the project moving, and will build up sets of students who can hand down expertise to students entering the next seminar. In fact, we will ask

these interns to participate in the weekend workshop in the following term, so that they can share their experience with students and faculty in a direct manner.

(e) Web-GIS construction on stoa.org.
Programming expertise will be necessary to build the Mediterranean base-map, data structures and definitions for the GIS, and the mark-up language necessary to deliver the product over the World Wide Web. Programmers will be hired under contract and programming will be done on the Stoa servers. Most of the programming costs will be in the first year as we build the Web-site on which the data will be input and maintained.

Once this stage of CGMA is complete, it can be kept updated in subsequent years by work-study students at participating universities, supervised by the PIs and co-PIs.

**Advisory Board and project schedule**
The CGMA advisory board includes the PIs and co-PIs, as well as other classicists, archaeologists, anthropologists and historians:

Advisory Board, membership:
- Eric Cline, Assistant Professor of Classics (Ancient History), George Washington University
- Susan Guttel Cole, Associate Professor of Classics and History, University of Buffalo
- Jack Davis, Carl W. Blegen Professor of Greek Archaeology, University of Cincinnati
- Tom Elliott, Director, Ancient World Mapping Center, The University of North Carolina
- Owen Doonan, R. H. Dyson Post-Doctoral Fellow, University of Pennsylvania
- Hugh Elton, Director, British Institute of Archaeology at Ankara, Turkey
- Sebastian Heath, Director of Information Technology, American Numismatic Society
- Nicholas Rauh, Associate Professor of History, Purdue University
- David Stone, Visiting Assistant Professor in Archaeology, Boston University
- LuAnn Wandsnider, Associate Professor of Anthropology, University of Nebraska

Advisory Board (invited):
- Suzanne Bonefas, Director of Technology Programs, ACS Technology Center, Associated Colleges of the South
- Timothy E. Gregory, Professor of Ancient History, The Ohio State University
- Mark B. Garrison, Professor of Classics, Trinity University and director of the ACS Archaeology Project
- Halford W. Haskell, Professor of Classics, Southwestern University and coordinator of Sunoikisis.

Project Schedule:

*Year 1:* Spring:

Administrator (Schindler) works with the programmer to begin building the Web-GIS on Stoa.org, and organizes, in consultation with the supervising faculty member, the fall seminar. The administrator also plans the fall workshop for students and the CGMA advisory board.

Summer:

Programmer continues to build the Web-GIS, in consultation with the PIs.

Fall:

The first seminar and weekend workshop are conducted by one of the co-PIs at their institution. The programmer finishes the bulk of the Web-GIS, to ready it for data-input and querying.

*Year 2:* Spring:

Administrator (Foss) works with the programmer to fine-tune the Web-GIS on Stoa.org, and organizes, in consultation with the next supervising faculty member, the fall seminar. The administrator plans the fall workshop for students and the CGMA advisory board, and helps to supervise the continuing work of the work-study students. PIs write their annual report for the first year; a committee of the Advisory Board writes its annual internal evaluation of the project.

Summer:

Programmer continues to build/fine-tune the Web-GIS, in consultation with the PIs; the first crop of interns continues work on the project.

Fall:

The seminar and weekend workshop are conducted by one of the PIs or co-PIs. The programmer finishes tuning the Web-GIS, which becomes ready to receive data prepared by the students by the end of the term.

*Year 3:* Spring:

Administrator (Schindler) works with the programmer to fine-tune the Web-GIS on Stoa.org, and organizes, in consultation with the next supervising faculty member, the fall seminar. The administrator plans the fall workshop for students and the CGMA advisory board, and helps to supervise the continuing work of the work-study students. PIs write their annual report for the second year; a committee of the Advisory Board writes its annual internal evaluation of the project, and requests external scholars to make a review of the project. Programmer is available to troubleshoot the Web-GIS. PIs and co-PIs begin to plan grants for the next stage of CGMA.

Summer:

The programmer is available to troubleshoot the Web-GIS; the second crop of interns continues work on the project.

Fall:

The seminar and weekend workshop are conducted by one of the PIs or co-PIs. The programmer is available to troubleshoot the Web-GIS.

*Year 4:* Spring:

Administrator (Foss) works with the programmer to fine-tune the Web-GIS on Stoa.org, and organizes, in consultation with the next supervising faculty member, the fall seminar. The administrator plans the fall workshop for students and the CGMA advisory board, and helps to supervise the continuing work of the work-study students. PIs write their annual report for the third year; a committee of the Advisory Board writes its annual internal evaluation of the project. The programmer is available to troubleshoot the Web-GIS. PIs and co-PIs write grants for the next stage of CGMA.

Summer:

The programmer is available to troubleshoot the Web-GIS; the third crop of interns continues work on the project.

Fall:

The seminar and weekend workshop are conducted by one of the PIs or co-PIs. The programmer is available to troubleshoot the Web-GIS.

*Epilogue***:** Spring:

PIs write a final annual report and the CGMA Advisory Board makes its final evaluation.

In sum, this stage of CGMA is scheduled as a 4-year project. Starting in the spring, the data-structure, operational procedures, and preliminary programming are worked out. Full student participation begins the following fall. A working version is available on the Internet after 24 months, so as to solicit corrections, clarifications, additions and other suggestions from the scholarly community at large, and in time for the external evaluation of the project.

Once this first stage has been constructed, the scale and scope of the core problem will be known for the first time. It will be clear how many projects, how much territory, what sort of methodologies, what kind of data and what sort of questions are at stake. It is hoped that this prototype will build support and interest for a full-fledged CGMA to which scholars could contribute their raw data for the larger purposes of reconstructing and re-thinking the ancient landscapes of the Mediterranean. Moreover, it is hoped that the project demonstrate the potential for close student-faculty cooperation in scholarship, and the power of problem-based learning. We believe that CGMA can be an interdisciplinary, inter-institutional opportunity for merging faculty research and student learning with the help of technology, create bridges between the sciences, humanities and social sciences, and provide a specific, tangible contribution to Mediterranean archaeology. It will be a scholarly and educational product designed to facilitate subsequent scholarly and educational products.

Finally, we are building on existing consortia, projects, educational initiatives and technology; only the core research question (see top of p.3) is being addressed *ab novo*. As such, we feel that CGMA can be particularly economical and productive.

**Evaluation**

The PIs and the advisory board will be charged to evaluate the project's progress. An annual internal evaluation will be submitted by a committee of the Advisory Board (not including the PIs or co-PIs). This report will assess progress towards the educational and research goals of the project. That report will be accompanied by a statement by the PIs addressing the same issues.

An external evaluation will take place at the start of the third full year of the grant. This evaluation will address the utility of CGMA and its contribution to the field of Mediterranean Archaeology, as well as its contribution to interdisciplinary, inter-institutional technology-aided student learning and faculty-student research collaboration. The advisory board will solicit evaluations of CGMA's merit and utility from experts in Mediterranean Archaeology and the uses of GIS (excluding any who have served on the advisory board).

Rebecca K. Schindler
Dept. of Classical Studies
East College L-40
DePauw University
Greencastle, IN 46135
Office ph. 765-658-4760
Cell ph. 765-326-3030
rschindler@depauw.edu

Pedar W. Foss
Dept. of Classical Studies
East College L-40
DePauw University
Greencastle, IN 46135
Office ph. 765-658-4597
Cell ph. 317-701-6131
pfoss@depauw.edu

*Institutional Endorsement:*

Neal B. Abraham
Vice President for Academic
Affairs and Dean of the Faculty
DePauw University
Greencastle, IN 46135-0037
Office ph. 765-658-4359
Fax: 765-658-4553
nabraham@depauw.edu

signed: _____