

Integrated History and future of People on Earth (IHOPE): Building a community data base and testing the resilience - sustainability hypothesis across scales

Short Title: Integrated History

PI Contact Information:

Robert Costanza

Gund Professor of Ecological Economics and Director, Gund Institute for Ecological Economics
The University of Vermont, 617 Main Street , Burlington, VT 05405-1708
Telephone: 802.656.2974 , Fax: 802.656.2995, email: Robert.Costanza@uvm.edu

Lisa J. Graumlich

Professor and Director, School of Natural Resources
The University of Arizona, Tuscon, AZ 85721
Telephone: 520/621-7257, Fax: 520/621-8801, email: lisag@cals.arizona.edu

Sander E. van der Leeuw

Professor and Director, School of Human Evolution & Social Change, Arizona State University
Chair of Archaeology, Institut Universitaire de France, Paris, France
External Faculty Member, Santa Fe Institute, Santa Fe, NM
Arizona State University, PO Box 872402, Tempe, AZ 85287-2402
Phone: (480)965-6215; Fax: (480)965-7671; Email: vanderle@asu.edu

Summary

Understanding the reasons for the emergence, sustainability, decline, or collapse of human societies is a key prerequisite for creating a sustainable and desirable future. A central hypothesis is that the probability of societal collapse, or failure increases with loss of resilience in social-ecological systems. The proposed working group will assemble integrated environmental and human historical data at the global scale for comparative analysis and for a few key case study areas for dynamic analysis in order to help build this understanding. We will develop criteria for integrating and analyzing disparate data across scales and disciplines. Key lessons from an ongoing project titled “Integrated Research Information System (IRIS)” using the ARCHAEOMEDES dataset from southern Europe (van der Leeuw, 1998, 2005) will be incorporated. A key component of this activity will be developing better ways to integrate and visualize data from the broad range of relevant sources (i.e. from historical narratives to ice cores) and with a broad range of spatial and temporal resolution and quality. In assembling the integrated data base the working group will also develop meta-variables and indices that can serve as proxies for environmental predictability and system resilience. We can then test the ability of various proxies of system resilience to explain sustainability or breakdown of social structures, relative to alternative hypotheses. A range of modeling approaches will be applied to the problem.

Problem Statement

Understanding the history of how humans have interacted with the rest of nature can help clarify the options for managing our increasingly interconnected global system. Simple, deterministic relationships between environmental stress and social change are inadequate. Extreme drought, for instance, has triggered both social collapse and ingenious management of water through irrigation. Human responses to change in turn feed into climate and ecological systems, producing a complex web of multidirectional connections in time and space. Integrated records of the co-evolving human-environment system over multiple temporal and spatial scales from millennia to decades and from local to global are needed to provide a basis for deeper understanding of the present and a better basis for forecasting the future.

Our key overarching question can be stated as:

What are the complex and interacting mechanisms and processes resulting in the emergence, sustainability, decline or collapse of social-ecological systems?

Addressing this question requires the major task of assembling and integrating regional and global, archaeological, historical, and paleoenvironmental records. Increasingly, the global environmental change community is realizing that a new, more integrated, transdisciplinary understanding of how humans have interacted with the rest of nature is needed. An increased emphasis on longer term history is needed because much discussion of human-environment interactions continues to lack a long-term, temporal dimension. We need to learn from the more distant past for at least three reasons: 1) Some of the dynamics involved operate at much longer timescales than the models we use; 2) By limiting ourselves to the recent past, we exclude a number of important system states (basins of attraction) from study; and 3) The recent past sample we study is heavily biased towards anthropogenically modified system states, to the detriment of less modified ones. For example, a full understanding of the modern condition requires knowledge of the evolution of the roles of technology, population expansions, cultural mores, climate, disease, institutions, warfare, and other variables in changing human attitudes and responses through time (Crumley 1994, Christian 2004, Redman et al. 2004, Diamond 2005, Mann 2005, Boyd and Richerson 2005, Ostrom 2005, Hornborg et al. 2007, Costanza et al. 2007a). This is especially the case if the past is to be used in more sophisticated ways than as a simplistic analogue of projected future conditions (Dearing et al. 2006). We also know that assessment of the sensitivity or vulnerability of modern landscapes and ecosystems to future human activities and climate can be greatly improved by knowing the rates and directions of past trajectories in key processes such as land cover, soil erosion and flooding, observing how thresholds have been transgressed and deducing the natural or pre-impact patterns of environmental variability (Dearing et al. 2007). Already, such knowledge is leading to the improved formulation of resource management strategies. Linked to this, it is clear that the past provides the means to test the models upon which we depend for future projections and scenarios: for climate, key ecological processes such as deforestation, changing social-environmental conditions and the intensity of impacts (Ostrom and Nagendra, 2006). Such dependence demands sophisticated and creative testing of model outputs against what we already know, in terms of the full range of data from historical narratives to quantitative time-series. This is especially important where numerical models are attempting to capture nonlinear behavior in complex social-ecological systems, like ‘adaptive cycles’ and ‘tipping points.’

Major challenges in linking human and environmental change include the development of integrated data bases (including time series GIS data, historical, palaeoenvironmental, and archaeological time series, etc.) and new integrated analytical modeling paradigms that reveal the complex web of causation across multiple spatial and temporal scales, while allowing important emergent properties and generalities to rise above the details.

To develop this integrated understanding, a project of the global change research community has been initiated titled: “Integrated History and future of People On Earth (IHOPE) (Costanza et al. 2007a).

The IHOPE project has three long-term goals:

1. Map the integrated record of biophysical and human system change on the Earth over the last several thousand millennia, with higher temporal and spatial resolution in the last 2000 and the last 200 years.
2. Understand the social-ecological dynamics of human history by testing human–environment system models against the integrated history.
3. Based on these historical insights, develop credible options for the future of humanity.

Coupling the human-environment system with Earth System models is a primary objective of the Analysis, Integration and Modeling of the Earth System (AIMES; <http://www.aimes.ucar.edu/>) project of the International Geosphere/Biosphere Programme (IGBP; <http://www.igbp.kva.se/>). In addition, IHOPE is co-sponsored by both the *Past Global Changes* (PAGES; <http://www.pages.unibe.ch/>) project of the IGBP and the *International Human Dimensions Programme* (IHDP; <http://www.ihdp.org>) with active participation from all communities in planning and implementation. The AIMES IPO is the central node for the IHOPE initiative (<http://www.aimes.ucar.edu/activities/ihope.shtml/>). It is anticipated that IHOPE will soon become a project of the entire Earth System Science Partnership (ESSP; <http://www.essp.org/>). In addition, the new Stockholm Resilience Center (SRC; <http://www.stockholmresilience.su.se/>) at Stockholm University has agreed to host the IHOPE secretariat.

The conceptual framing of IHOPE (Costanza et al. 2007a) combined with our progress in developing institutional linkages are clear indications of the “ripeness” of the IHOPE research agenda. Activities in support of the IHOPE agenda are emerging (e.g., IHOPE paper sessions at the Resilience 2008 Conference and the IHDP Open Science Conference in New Delhi in October 2008). At this juncture, investment by NCEAS in an IHOPE working group will ensure that activities by individual scholars and groups can be optimally integrated into a far more significant undertaking.

Proposed Activities

This NCEAS working group is an initial step in implementing the IHOPE research agenda. The specific goals and activities of this working group include:

1. Assembling integrated records of environmental and human history. We will do this at both the global scale to allow a comparative analysis of cultural evolution across multiple time and space scales, and for two case study sites (the American southwest and the Mediterranean) to allow more detailed dynamic analysis and modeling. NCEAS computing and ecoinformatics capabilities will be essential to this effort.
2. Develop new methods to view, analyze, assess quality, and utilize this integrated data. This project will take full advantage of NCEAS computational and database resources to accomplish this. As mentioned above, an Integrated Research Information System (IRIS)

is currently under development at NCAR, using the ARCHAEOMEDES dataset from southern Europe. We will incorporate the findings and tools developed as part of this effort into the working group.

3. Develop and test hypotheses and models based on this integrated data. A range of modeling approaches will be utilized and integrated, including statistical models, process-based simulation models, spatially-explicit models, and agent-based models (Young et al. 2007). The Multiscale Integrated Modeling of Ecosystem Services (MIMES) project, hosted by the Gund Institute at UVM, will also inform the working group.

While we cannot *a priori* define a clear, specific path to achieve these goals, it has been our experience from previous successful NCEAS working groups that the best strategy is to articulate clear goals and then allow the specific path to reveal itself during the creative interactions and discussions within the group. This is the hallmark of a good NCEAS working group.

Research challenges

To address these issues there are a set of research challenges that will need to be met regardless of the time scale or particular aspect of interest. These include:

1. Data on the behavior of social-ecological systems vary enormously in quality, selection, interpretation, resolution, dating/chronologies, and evenness (Costanza 2007). The amount of data rises dramatically as we approach the present, and this could easily distort analyses.
2. There is an issue regarding the balance, quality, and timing between social and environmental data. This makes it more difficult to explore the types or characteristics of environmental variability or change to which various societies are especially vulnerable.
3. There can be differences in research approaches (i.e. reductionist v. whole systems-oriented) that can lead to tension within research teams and thus pose challenges to interdisciplinary research projects (Dearing et al. 2006).
4. In analyzing social-ecological systems or simulating their behavior into the future, biophysical laws governing aspects of nature can give an “envelope of regularities” in projections or analyses (but complex natural systems also have strong nonlinearities). This broad envelope of regularities can define the “environmental space” within which human societies operate, but contingent events, which are difficult or impossible to predict, often determine the specific trajectories of social-ecological systems within that space and are thus crucially important to how the future will actually unfold.
5. Comprehensive models of the Integrated Earth System (or humans-in-nature) are still in their infancy and have a long way to go (Costanza et al. 2007b). There is a need for more balanced, hybrid approaches that can take on the research challenges outlined above.

Logistics

We envision three, one week-long meetings of the group at NCEAS over 18 months: an initial kick-off meeting in late 2008, a mid-term meeting in mid 2009, and a wrap-up meeting in early 2010. Between meetings, work will progress at NCAR, ASU/U of Arizona, UVM, the new Stockholm Resilience Center (SRC), University of Bristol, and other participant locations. The SRC has agreed to host the secretariat for the global IHOPE initiative, and will thus play a key role in the NCEAS activity. A meeting of the IHOPE initiative in conjunction with the SRC in April, 2008 will be another opportunity for the working group participants to meet with the larger community and plan the first NCEAS meeting. Arizona State University and the

University of Arizona are collaborating in hosting graduate students to work on IHOPE related projects. One of these will be invited to participate in the working group. QUEST (Quantifying and Understanding the Earth SysTem) a UK, NERC-funded program hosted at the University of Bristol, has agreed to co-sponsor the working group, and will contribute travel funds for all the non-US participants (see budget and attached letter of support). We may also be able to attract additional outside support for the working group.

Names of Potential Participants (18 persons, 11 US, 7 International):

Participant	Affiliation	Expertise	Conf.
Aulenbach, Steve*	NCAR	Data bases, visualization	yes
Christian, David	San Diego St. U.	Integrated history	yes
Cornell, Sarah	University of Bristol	Earth system science	yes
Costanza, Robert	University of Vermont	Systems modeling, ecological economics	yes
Crumley, Carole	Univ. of North Carolina	Anthropology, Integrated history	yes
Dearing, John	Univ. of Southampton	Paleoecology, Integrated history	yes
Folke, Carl	Stockholm U.	Social-ecological systems dynamics	yes
Grad student	TBD		
Graumlich, Lisa	Univ. of Arizona	Global change, land-use dynamics	yes
Hibbard, Kathy	NCAR	Earth systems modeling	yes
Jackson, Steve	University of Wyoming	Paleoecology	
Leemans, Rik	Wageningen U.	Integrated systems modeling (ESSP)	yes
Ostrom, Elinor	Indiana U., ASU	Political science, Socio-ecological systems	yes
Redman, Charles	Arizona State U.	Anthropology, Integrated history	yes
Schimmel, David	NCAR, NEON	Earth systems modeling	
Sorlin, Sverker	Royal Inst. Tech, SRC	Environmental history	yes
Steffen, Will	Australian Nat. U.	Earth system science	yes
van der Leeuw, Sander	Arizona State U.	Human evolution, Integrated history	yes

*Liaison with NCEAS technical staff and person responsible for ensuring that the requirements of the NCEAS Data and Information Policy are met.

Rationale for NCEAS Support:

NCEAS provides the optimal venue for this transdisciplinary effort. Face-to-face discourse is critical to a successful, creative outcome. Having the NCEAS computer and ecoinformatics facilities available for organization and visualization of the broad range of data this project requires is a critical asset. We also feel that the imprimatur of an NCEAS working group will permit us to bring together the high quality set of qualified persons we need for this project. Several of the project participants have experience both with successful previous NCEAS working groups and as NCEAS SAB members, and are well aware of both the advantages and potential pitfalls of the working group format.

Anticipated Results and Beneficiaries

Results will include:

- A high circulation journal article or series of articles.
- A web-accessible, searchable, integrated data base
- New ways of integrating and visualizing complex multi-resolution data
- New hybrid approaches to analyzing and modeling socio-ecological systems

- A better answer to the question: What are the complex and interacting mechanisms and processes resulting in the emergence, sustainability, decline, or collapse of socio-ecological systems?

References

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- Costanza, R., Graumlich, L. J., and Steffen W. (eds.). 2007a. Sustainability or Collapse? An Integrated History and future Of People on Earth. Dahlem Workshop Report 96. MIT Press. Cambridge, MA.
- Costanza, R., Leemans, R., Boumans, R., and Gaddis, E. 2007b. Integrated Global Models. Pp. 417-446 in: R. Costanza, L. J. Graumlich, and W. Steffen (eds.). Sustainability or Collapse? An Integrated History and future Of People on Earth. Dahlem Workshop Report 96. MIT Press. Cambridge, MA
- Costanza, R. L. Graumlich, W. Steffen, C. Crumley, J. Dearing, K. Hibbard, R. Leemans, C. Redman, and D. Schimel. 2007c. Sustainability or Collapse: What Can We Learn from Integrating the History of Humans and the Rest of Nature? *Ambio* 36:522-527
- Crumley C. L. (ed.). 1994 Historical Ecology: Cultural Knowledge and Changing Landscapes. School of American Research, Santa Fe, NM.
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- Hornborg, A. and Crumley, C (eds.) 2007. The World System and the Earth System: Global Socioenvironmental Change and Sustainability Since the Neolithic. Left Coast Press. Walnut Creek CA
- Hornborg, A., McNeill, J. R., and Martinez-Alier, J. 2007. Rethinking Environmental History: World-System History and Global Environmental Change: Altamira Press, Lanham MD.
- Kirch, P.V. 2005 Archeology and Global Change: the Holocene Record. *Annual Review of Environmental Resources*. 30: 409
- Mann, C. C. 2005. 1491: new revelations of the Americas before Columbus. Knopf, New York
- Ostrom, E, 2005. Understanding Institutional Diversity. Princeton: Princeton University Press.
- Ostrom, E., and Nagendra, H. 2006. Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory. *Proceedings of the National Academy of the USA* 103: 19224-19231.
- Redman, C. L. 1999. Human impact on ancient environments. University of Arizona Press, Tempe, AZ
- Redman, C. L. James, S. R. Fish, P. R. and Rogers, J. D. 2004. The archaeology of global change: the impact of humans on their environment. Smithsonian Books, Washington, DC.
- Schellnhuber, H. J., Crutzen, P. J., Clark, W. C., Claussen, M., and Held, H. (eds.) 2004. Earth System Analysis for Sustainability. Dahlem Workshop Report 91, MIT Press, Cambridge, MA
- Steffen, W., Sanderson, A. Tyson, P. and Jäger, J. 2004. Global Change and the Earth System: A Planet Under Pressure. IGBP Global Change Series. Springer-Verlag, New York.

- Van der Leeuw, S.E., 1998. The Archaeomedes Project - Understanding the natural and anthropogenic causes of land degradation and desertification in the Mediterranean. Luxemburg: Office for Official Publications of the European Union
- Van der Leeuw, S.E., 2005, Climate, hydrology, land use, and environmental degradation in the lower Rhone Valley during the Roman Period, *C.R. Geoscience*, 337: 9-27.
- Young, M. N., Leemans, R., Boumans, R., Costanza, R., de Vries, B. J. M., Finnigan, J., Svedin, U., and Young M. D., 2007. Future Scenarios of Human-Environment Systems. Pp. 447-470 in: R. Costanza, L. J. Graumlich, and W. Steffen (eds.). Sustainability or Collapse? An Integrated History and future Of People on Earth. Dahlem Workshop Report 96. MIT Press. Cambridge, MA

Robert Costanza

Gund Institute for Ecological Economics
The University of Vermont
617 Main Street
Burlington, VT 05405-0088

Phone: 802.656.2974
Fax: 802.656.2995
Robet.Costanza@uvm.edu

Professional Preparation.

University of Florida, Gainesville, FL	Architecture	B.A.	1973
University of Florida, Gainesville, FL	Architecture/Urban Planning	M.A.	1974
University of Florida, Gainesville, FL	Systems Ecology (minor Econ)	Ph.D.	1979
Louisiana State Univ., Baton Rouge, LA	Coastal Ecology	Postdoctoral	1980

Appointments.

2002-Present: Gordon and Lulie Gund Professor of Ecological Economics, Rubenstein School of Environment and Natural Resources, University of Vermont
2002-Present Director, Gund Institute of Ecological Economics, University of Vermont
1991-2002: Professor, Univ. of Maryland Center for Environmental Science & Dept. of Biology
1991-2002: Director, University of Maryland Institute for Ecological Economics
1988-1991: Associate Professor, Chesapeake Biological Laboratory, University of Maryland,
1984-1988: Associate Professor, Coastal Ecology Institute, Louisiana State University.
1981-1984: Assistant Professor, Coastal Ecology Institute, Louisiana State University.

Publications (n=420, Total Institute for Scientific Information (ISI) citations > 3500), ISI h-index = 31, Named as ISI Highly Cited Researcher (<http://isihighlycited.com/>), 2004-present

5 most closely related to this proposal:

- Costanza, R.,** L. Wainger, C. Folke, and K-G Mäler. 1993. Modeling complex ecological economic systems: toward an evolutionary, dynamic understanding of people and nature *BioScience* 43:545-555.
- Costanza, R.,** B. Low, E. Ostrom, , and J. Wilson (eds). 2001. Institutions, Ecosystems, and Sustainability. Lewis/CRC Press, Boca Raton, FL 270 pp.
- Boumans, R., **R. Costanza,** J. Farley, M. A. Wilson, R. Portela, J. Rotmans, F. Villa, and M. Grasso. 2002. Modeling the Dynamics of the Integrated Earth System and the Value of Global Ecosystem Services Using the GUMBO Model. *Ecological Economics* 41: 529-560
- Costanza, R.,** L. J. Graumlich, and W. Steffen (eds.). 2007. Sustainability or Collapse? An Integrated History and Future of People on Earth. Dahlem Workshop Report 96. MIT Press. Cambridge, MA.
- Costanza, R.** L. Graumlich, W. Steffen, C. Crumley, J. Dearing, K. Hibbard, R. Leemans, C. Redman, and D. Schimel. 2007. Sustainability or Collapse: What Can We Learn from Integrating the History of Humans and the Rest of Nature? *Ambio* 36:522-527

5 other significant:

- Costanza, R.,** R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, S. Naeem, K. Limburg, J. Paruelo, R.V. O'Neill, R. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260
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- Costanza, R.** and S. E. Jørgensen (eds.) 2002. Understanding and Solving Environmental Problems in the 21st Century: Toward a New, Integrated Hard Problem Science. Elsevier, Amsterdam. 324 pp.
- Costanza, R.** and A. Voinov (eds). 2003. Landscape Simulation Modeling: A Spatially Explicit, Dynamic Approach. Springer, New York. 330 pp

Contracts and Grants Summary

Active: 5 projects as principal or co-principal investigator:	\$ 2,363,000
Completed: 39 projects as principal or co-principal investigator:	<u>\$20,660,000</u>
Total	\$23,024,284

Synergistic Activities.

- **Editorships:** Chief Editor, *Ecological Economics* 1/89-9/02; Founding Editor, *Ecological Economics* 9/02 - present; Ed. Advisory Board: *Ecological Modeling*, *Ecological Engineering*, *Ecological Informatics*, *EcoHealth*, *Environmental Management*, *Journal of Industrial Ecology*, *Regional Environmental Change*.
- **Professional Societies:** International Society for Ecological Economics (co-founder and President, 1/88-1/98), International Society for Ecosystem Health (co-founder and Vice-President, 6/94-3/00; President 7/00-12/02); Ecological Society of America (Vice-Chair Washington Area chapter, 1989; Chair, Washington Area chapter, 1990), International Society for Ecological Modeling (Vice President, North American Chapter, 1987-1992),
- **Boards and Panels:** Analysis and Integrated Modeling of the Earth System (AIMES) Task Force (AIMES is a core project of IGBP). 11/05 – 11/08; EPA Science Advisory Board (SAB), Committee on Valuing the Protection of Ecological Systems and Services. 10/03 – present; National Academy of Sciences, Committee on Materials Flow Accounting of Natural Resources, Products, and Residuals. 7/02 – 7/03; National Center for Ecological Analysis and Synthesis (NCEAS) Scientific Advisory Board. 6/01 – 6/04; Scientific Steering Committee, Land-Ocean Interactions in the Coastal Zone (LOICZ). 1/00 – 12/02; NOAA, National Marine Fisheries Service (NMFS) Ecosystem Principles Advisory Panel. 5/97-5/99; US EPA National Advisory Council for Environmental Policy and Technology (NACEPT). 9/94-9/95; National Research Council, Board on Global Change. 1/1/93-12/31/95; US National Committee for the Man and the Biosphere Program. 5/93-12/95;
- **Outreach:** 23 popular articles, 144 published interviews, 391 public presentations.

Lisa J. Graumlich

School of Natural Resources
325 Biosciences East
The University of Arizona
Tucson AZ 85721 USA
<http://www.ag.arizona.edu/snr>

520/621-7257
fax: 520/621-8801
lisag@cals.arizona.edu

Education

B.S., Department of Botany, University of Wisconsin-Madison, 1975
M.S., Department of Geography, University of Wisconsin-Madison, 1978
Ph.D., College of Forest Resources, University of Washington, 1985

Current Position

Professor and Director, School of Natural Resources, The University of Arizona 2007 - present

Past Positions

Post-Doctoral Research Associate, Department of Ecology, Evolution and Behavior, University of Minnesota, 1986
Assistant Professor, Department of Geography, UCLA, 1986-1988
Assistant Professor, Laboratory of Tree-Ring Research, University of Arizona, 1988 to 1993
Associate Professor, Laboratory of Tree-Ring Research, University of Arizona, 1993 to 1999
Director, Institute for the Study of Planet Earth, University of Arizona, 1993 to 1997
Deputy Director and Dean of the Earth Learning Center, Biosphere 2 Center, Columbia, University, 1997 to 1998
(on leave of absence from University of Arizona)
Adjunct Associate Professor, Earth and Environmental Sciences, Columbia University, 1998 to 2000
Director, Mountain Research Center, Montana State University, June 1999 to 2001
Executive Director, Big Sky Institute for Science and Natural History, Montana State University,
2001 to 2006

Awards, and Special Appointments

W.J. Cooper Award, Ecological Society of America, 1998 (for outstanding paper)
Distinguished Researcher in Residence, Mountain Research Center, Montana State University, 1997
Fellowship, Udall Center for Studies in Public Policy, University of Arizona 1996-97
Fellow, American Association for the Advancement of Science, 2004

Five closely related publications

Costanza, R., **L. J. Graumlich**, and W. Steffen (eds.). 2007. Sustainability or Collapse? An Integrated History and Future of People on Earth. Dahlem Workshop Report 96. MIT Press. Cambridge, MA.
Costanza, R. **L. Graumlich**, W. Steffen, C. Crumley, J. Dearing, K. Hibbard, R. Leemans, C. Redman, and D. Schimel. 2007. Sustainability or Collapse: What Can We Learn from Integrating the History of Humans and the Rest of Nature? *Ambio* (in press).
Pederson, GT, S.T. Gray, D.B. Fagre, and L.J. **Graumlich**. 2006. Long-Duration Drought Variability and Impacts on Ecosystem Services: A Case Study from Glacier National Park, Montana USA. *Earth Interactions* 10: 1-28
Hessl, A. and L.J. **Graumlich**, 2002. Interactive effects of human activities, herbivory, and fire on quaking aspen (*Populus tremuloides*) age structures in western Wyoming. *Journal of Biogeography* 29, 889-902.
Gorham, E., G.S. Brush, L.J. **Graumlich**, M.L. Rosenzweig, and A.H. Johnson. 2001. The value of paleoecology as an aid to monitoring ecosystems and landscapes, chiefly with reference to North America. *Environmental Reviews* 9, 99-126.

Five other significant publications

- Graumlich, L.J., M.F.J. Pisaric, L.A. Waggoner, J.S. Littell, and J.C. King.** 2003. Upper Yellowstone River flow and teleconnections with Pacific basin climate variability during the past three centuries. *Climatic Change* 59, 245-262.
- Gray, S.T., L.J. **Graumlich**, J.L. Betancourt, and G.T. Pederson. 2004. A tree-ring based reconstruction of the Atlantic Multidecadal Oscillation since 1567 A.D. *Geophysical Research Letters*, 31, No. 12, L12205 10.1029/2004GL019932
- Sheppard, P.R., Tarasov, P.E. **Graumlich**, L.J., Heussner, K.-U., Wagner, M. Osterle, H. and Thompson, L.G. 2004. Annual precipitation since 515 BC reconstructed from living and fossil juniper growth of northeastern Qinghai Province, China. *Climate Dynamics*, 23, 869-881.
- Bunn, A.G., L.J. **Graumlich**, and D.L. Urban. 2005. Interpreting the climatic significance of trends in twentieth-century tree growth at high elevations. *The Holocene* 15(4): 481-488.
- Ramankutty, N., L. **Graumlich**, F. Achard, D. Alves, A. Chhabra, R. DeFries, J. Foley, H. Geist, R. Houghton, K.K. Goldewijk, E. Lambin, A. Millington, K. Rasmussen, R. Reid, and B.L. Turner II. 2006. Global Land Cover Change: Recent Progress, Remaining Challenges, in *Land Use and Land Cover Change: Local Processes, Global Impacts*, edited by E. Lambin, and H. Geist, Springer Verlag, New York.

Synergistic Activities

Service to the scientific community:

- As Vice-Chair of the Scientific Steering Committee of the Land Use and Land Cover Core Project of the International Geosphere Biosphere Program (IGBP) and member of the Land Transition Team of IGBP, I worked to define the role of land-use/cover research in the newly reformulated IGBP and to enhance the linkages with global change scholars working from paleoecological and ecological perspectives (1997 – 2005).
- As co-organizer of the Integrated History and future of People on Earth (IHOPE) Dahlem Workshop, I collaborated with scholars from a wide range of disciplines to define a framework for integrating social, physical and ecological data streams at time scales from decades to millennia. Subsequently I worked with others to gain sponsorship for IHOPE by the International Geosphere Biosphere Project (IGBP) and International Human Dimensions Project (IHDP).

Transfer of knowledge:

Fellow, Aldo Leopold Leadership Program, 1999-2000. I was one of twenty scientists chosen to participate in the first cohort of this program. As a Fellow, I participated in a set of training workshops designed to improve the flow of accurate, credible scientific information to policy makers and the general public on critical issues of the environment

Research Funding

Over \$5M in peer-reviewed grant funding over past 10 years; current grants include:

- A novel approach for improving records of long-term, multi-scale snowpack variability in western North America, National Science Foundation, \$89,267, 8/1/06-7/30/08 (Graumlich is PI)
- Climate-Induced Shifts in Alpine Diatom Communities: Past Mechanisms and Future Predictions under Enhanced Nitrogen Deposition, National Science Foundation, \$533,179, 3/1/07 – 2/28/10 (Graumlich is co-I)
- Climatic and biotic co-limitation of conifer establishment at treelines: addressing uncertainty in bio-climatic model forecasts of forest change, DoE NICCR, \$461,585, 7/07-6/10 (Graumlich is co-I)

SANDER E. VAN DER LEEUW

Professor and Director, School of Human Evolution & Social Change, Arizona State University
Chair of Archaeology, Institut Universitaire de France, Paris, France
External Faculty Member, Santa Fe Institute, Santa Fe, NM
Arizona State University, PO Box 872402, Tempe, AZ 85287-2402
Phone: (480)965-6215; Fax: (480)965-7671; Email: vanderle@asu.edu

PROFESSIONAL PREPARATION

Fulbright Undergraduate Fellowship, University of Arizona, 1963-1964
University of Amsterdam, History, Kandidaatsexamen (equiv. to B.A.), 1968
University of Amsterdam, Medieval History/Prehistory, Doctoraalexamen (equiv. to ADB/M. Litt.), 1972
University of Amsterdam, Archaeology, Ph.D., 1976
University of Michigan, Ann Arbor, Fulbright Post-Doctoral Fellow, 1976-1977
Cambridge University, M.A., 1990

APPOINTMENTS

January 2004-present, Professor and Director, Department of Anthropology (now School of Human Evolution and Social Change), Arizona State University; 2002-2004, Deputy Scientific Director, *Institut National des Sciences de l'Univers*, Paris; 2002-2004, Deputy Scientific Director, Department of Social Sciences and Humanities, *Centre National de la Recherche Scientifique*, Paris; 2002-2006, Chair of Archaeology, *Institut Universitaire de France*; 1995-2004, Professor, Archaeology and History of Techniques, Université de Paris I (Panthéon-Sorbonne); 1988-1995 Lecturer, Cambridge University; 1985-1988, Assistant Lecturer, Cambridge University; 1976-1985, Assistant Lecturer and Lecturer, University of Amsterdam; 1972-1976, Co-PI of research project on pottery technology in Euphrates Valley, NW Syria, Netherlands Organisation of Scientific Research; 1969-1972, Graduate Research Assistant, University of Amsterdam.

RELATED PUBLICATIONS

Kohler, T.K. and S.E. van der Leeuw (eds.), 2007 *The Model-Based Archaeology of Socionatural Systems*, Santa Fe, NM: School of American Research.
van der Leeuw, S.E., "Information Processing and Its Role in the Rise of the European World System", 2007, In: *Sustainability or Collapse?* (R. Costanza, L.J. Graumlich, W. Steffen, eds.), pp. 213-241. Cambridge, Mass: MIT Press (Dahlem Workshop Reports).
van der Leeuw, S.E., 2005, "Climate, hydrology, land use, and environmental degradation in the lower Rhone Valley during the Roman Period", *C.R. Geoscience*, 337 (1-2), 9-27.
van der Leeuw, S. E., 1998, *The Archaeomedes Project – Understanding the natural and anthropogenic causes of land degradation and desertification in the Mediterranean*. Office for Official Publications of the European Union, Luxemburg, 440 pp.
van der Leeuw, S. E., and J. McGlade, eds., 1997, *Archaeology: Time, process and structural transformations*. Routledge, London. 484 pp.

OTHER SIGNIFICANT PUBLICATIONS

Young, O.R., F. Berkhout, G.C. Gallopin, M.A. Janssen, E. Ostrom, S.E. van der Leeuw, 2006 "The Globalization of socio-ecological systems: An agenda for scientific research", *Global Environmental Change* vol 16 (3), pp. 304-316
van der Leeuw, S.E., 2004 "Why Model?", *Cybernetics and Systems* 35 (2-3), 117-128.

- van der Leeuw, S.E. and B.L. de Vries, 2002, " Empire: the Romans in the Mediterranean " In : B.L. de Vries et J. Goudsblom (eds.) *Mappae Mundi: Humans and their habitats in a long-term socio-ecological perspective* Amsterdam : Amsterdam University Press, pp. 209-256
- Berger, J.F., F. Durand-Dastes, D. Pumain, L. Sanders, S.E. van der Leeuw, 1998, *Des Oppida aux métropoles* Paris : Anthropos (Collection Villes).
- van der Leeuw, S. E. and J. McGlade, 1993 "Information, Cohérence et dynamique urbaines", in *Temporalités Urbaines* (B. Lepetit & D. Pumain, eds.), Paris: Anthropos/Economica, pp. 195-245.

GRANTS

Total of c. \$ 6,000,000 over the last fifteen years, funded by the EU research directorate (1992-2004), the Dutch, French and British national research organizations and various other sources; currently \$ 500,000 in active grants.

Synergistic Activities

Member of the National Advisory Board of the Long-Term Ecological Research Programme of the NSF, 2006-; Member of the Editorial Board of "*Ecology & Society*", 2004 -; Member of the Scientific Council and Treasurer of the International Human Dimensions of Global Change Program, 2004-; Member, Editorial Board of "*Global Environmental Change*", 2004-; Secretary General, National Coordination Council for the Social Sciences and Humanities, France, 2001-2003; Coordinator (with C. Lévêque) of the Program "A European network on long-term socio-environmental research," DG Research of the European Union, 2002–2004; Coordinator (with C. Redman and A. Kinzig, Arizona State University, USA) of the research project "The resilience of urbanized socio-natural systems," funded by the McDonnell Foundation (USA), 2002–2004; Coordinator (with D. Lane and G. West) of the research project "The Information Society as a Complex System (ISCOM)" funded by DG Research of the European Union as part of the Key Action "The user-friendly information society," 2002-2006; Member of the Editorial Board of "*Natures, Sciences, Sociétés*", Paris, 2003-2006; Coordinator, DG XII-Environment, European Union Research Program ARCHAEOMEDES, European Union, 1992-2000; Member, editorial board *Ecosystems*, 2001-2003; Co-Coordinator, Concerted Action "Environmental Communication" of DG XII, European Union, 1998-2001; Visiting Professor, Arizona State University, Tempe, AZ, 2000; Visiting Scholar, Santa Fe Institute, Santa Fe, NM; 2000, Fellow, Royal Anthropological Institute, U.K, 1999-2000; Fellow, Fitzwilliam College, Cambridge, England, 1986-1996; Member, UMR 7041, Centre National de la Recherche Scientifique, 1998-present; Co-Coordinator, European Heritage Laboratory, 1998-present; Director, DEA Environnement et Archéologie, France, 1997-present; Expert, DG X, Commission of the European Union, 1997-present; DG XII, Commission of the European Union, 1997-present; Corresponding Member, Royal Netherlands Academy of Sciences, 1995-present.

COLLABORATORS AND OTHER AFFILIATIONS

Collaborators and Co-Editors: W. Cramer, Free University of Berlin, Germany; F. Favory, Univeristé de Franche-Comté, France; A. Kinzig, Arizona State University, USA; D. Lane, U of Modena, Italy; T. Kohler, Washington State University, USA, S. Oberg, U of Uppsala, Sweden; C. L. Redman, ASU, USA; A.C. Renfrew, U of Cambridge, UK; J. Thornes, Kings College London, UK; B.J. de Vries, U of Utrecht, Holland; J. B. West, Los Alamos National Laboratory, USA; D. White, U of C Irvine, USA; H. T. Wright, University of Michigan, USA.

Graduate and Postdoctoral Advisors: Professor H. H. van Regteren Altena, University of Amsterdam

Thesis and Postdoctoral Scholars Supervised: J.-C. Bats; E. Bourdonneau; M. Châtelet; M. Civet; A. Coutelas; S. Dommelier; C. Dupont; L. Galfo; S. Grouard; G. Klesly; V. Leblan; S. Martin; M.-C. Marinval-Vigne; V. Mistrot; J.-F. Petrucci; N. Serrand; P. Verdin.

Budget

Working Group Budget	YEAR 1	YEAR 2	YEAR 3
	9/08	6/09	2/10
Travel			
Domestic (US)			
Number of participants	11	11	11
Total travel expenses	\$6,600	\$6,600	\$6,600
International (non-US)			
Number of participants	7	7	7
Total travel expenses	\$0 (QUEST)	\$0 (QUEST)	\$0 (QUEST)
Daily expenses			
Number of visitor days	119	119	119
Total daily expenses (\$200/visitor day)	\$ 25,200	\$ 25,200	\$ 25,200
TOTAL	\$ 31,800	\$ 31,800	\$ 31,800