

15

The Global Environmental Crisis *An Archaeological Agenda for the 21st Century*

J. DANIEL ROGERS

What is urgently needed is knowledge and a practical ethic based on a time scale longer than we are accustomed to apply. (Wilson 1992:312)

Humans are now transforming their planet at an unprecedented rate and scale. Unfortunately, the changes taking place are seldom for the better, and many have now concluded that the future holds grim environmental consequences. Lands that once supported large agricultural populations are now desert, the biological wealth of rainforests is disappearing at an alarming rate, and the fishing resources in many parts of the world's oceans have declined past the point of easy recovery. The planetary changes taking place have caused the greatest number of animal and plant life extinctions this world has ever known.

The response to this deepening crisis has been significant but uneven. All nations recognize these problems, and governments have come together to chart a global response. Policy makers, resource managers, and scientists have offered a wide but often confusing array of new ideas to combat the problems we collectively face. While we debate our options, the environmental clock keeps ticking and at least for now the economics of the familiar and the immediate hold sway over long-term solutions.

There are several reasons we continue to argue the scope of the problem and its potential solutions without establishing a clear direction in our actions. Four reasons stand out: First, the politics of collective action are extremely difficult to implement on a national scale, much less an international scale, given the many competing economic and social agendas that must be served in our pluralistic world. Second, our understanding of the processes of human-induced environmental change and the resulting problems is far from adequate. Third, knowledge about environmental change is often not translated into effective interdisciplinary-based solutions. Fourth, humans view their surroundings in uniquely personal terms. Unless the consequences of a degraded environment are experienced firsthand it can be very difficult to communicate the true scope of the problem no matter how serious it may be. The fourth issue is the most pressing and difficult to deal with. The irony, of course, is that we have all experienced the negative consequences of human impact on the environment. The quality of our water, the breathability of our air, even the cost of our foods reflects environmental changes far beyond our local community. The second, third, and fourth issues are the areas

with which the contributors to this volume are most directly involved. While we are extremely concerned with the first issue—the politics of implementing solutions—as scientists, our efforts are focused on developing the knowledge base necessary to arrive at solutions.

Deteriorating Environments

The essence of the human role in environmental change has been broadly discussed and analyzed (Chew 2001; Mannion 1991; Redman 1999; Wilson 1992:253). Overkill, habitat destruction, and the introduction of exotic plants and animals are the major human-controlled factors responsible for environmental deterioration. In turn, these factors are driven by population growth (most important), systems of attitudes and beliefs, economic growth, technological change, and political structures. These are highly interrelated forces that will require analysis by new interdisciplinary teams (Stern et al. 1992:2–3). My central concerns here are how to identify the processes of environmental change, construct effective solutions, and communicate these to a broad audience. A few examples will serve to emphasize the urgency of the problems humans face.

Most people are aware that for some time a “greenhouse effect” caused by rising CO₂ accumulations has been trapping heat in the atmosphere. Since the Industrial Revolution, CO₂ concentrations have increased worldwide by about 30 percent (Subcommittee on Global Change Research 1995:59). Such changes threaten to raise temperatures globally, and hence change weather patterns. A consequent melting of the polar ice would cause a rise in sea levels, perhaps high enough to inundate major cities in coastal regions. In other areas, increased CO₂ levels may affect rainfall patterns.

The popular press is now reporting the results of studies showing the first major effects of global warming—most notably, the growth of deserts and decline of rainforests—which are now easily charted in certain regions. North Africa, for example, has experienced pronounced desertification over the past few decades owing to the loss of vegetation, loss of topsoil, and salinization or sedimentation from sand dunes (Rapp 1987). A conservative estimate places the annual loss of potentially productive land worldwide at about 12 million hectares (Myers 1985). However, this process is not confined to the last few years. Roman cities in North Africa, such as Dougga and Lepcis, that once

exported wheat and olive oil stand as long-deserted ruins in a sterile landscape (Hughes 1975:1). In the Middle East, the once-powerful Mesopotamian city of Ur, with an irrigation system large enough to support a dense population more than 3,000 years ago, has vanished. Its once-rich agricultural lands are now a desert, incapable of sustaining a substantial population. The process of desertification has been going on for a long time.

Of equal concern is the damage sustained by the rainforests of the world as modern nations push to provide more and more economic opportunities for their growing populations. The loss of forests signals the general decline of species diversity. In 1989 it was estimated that every year 1.8 percent of the area of all rainforests was being destroyed (Wilson 1992:276), while untold numbers of species of animal life were also becoming extinct. For thousands of years people have lived in and exploited the rainforests, but it is only in recent times that their numbers and technology have given them the power to destroy this vast resource completely. Quite apart from natural cycles of environmental change—including mass extinctions of animals—the changes described here are conclusively the results of increasing human intervention.

Using the Past

One of the most difficult issues for modern environmental planners and policy makers is how to assess the consequences of well-intentioned policies that affect large parts of the landscape. Is it better to prevent fires in national forests or to let the blazes go unchecked? Should major rivers be channelized and levies be built, or should flood waters run their course? What are the consequences of developing huge irrigation systems in arid regions? A growing cadre of researchers maintains that the study of the distant and the recent past through archaeological analyses can help planners address these concerns. There is really no substitute for analysis of past examples.

Archaeology is also a useful way of assessing the human role in creating a variety of biodiversity concerns. As an example, many researchers studying the biodiversity of rainforests have described the La Selva preserve in Costa Rica as a “pristine” wilderness. However, recent archaeological work there has found evidence of human occupation going back hundreds of years. Deborah Clark at the La Selva pre-

serve was quoted in the *New York Times* (Yoon 1993:C1) as saying, "This is really a grand conceptual change for ecologists from the idea that tropical rainforests are stately, stable cathedrals to recognizing how much they change at all different scales of time." The archaeological evidence helps chart to what extent rainforests can rebound from human disturbances, how patterns of human distribution affect the distribution of other species, and what theories of ecological succession should include humans as a powerful force.

In another example, permanent impact on ecosystems can be seen in the role humans have played in species extinction. Throughout the Pacific islands, from Palau to Hawai'i, there is clear evidence that the Lapita ancestors of the Polynesians who first colonized the islands beginning around 6000 B.C. were responsible for the rapid extinction of many indigenous bird species (Dye and Steadman 1990:212; Kirch and Hunt 1997; Olson 1989). This long-term record of species loss has become a critical source of information for interpreting how the island ecosystems changed.

Archaeological and historical data can also be very useful in determining how to manage wildlife (Lyman 1996) and to reconstruct environmental characteristics that are not human-induced yet may be very important in understanding such processes as global warming. For example, climatic trends that exist at regional and global scales can be reconstructed through several important approaches (e.g., Wigley et al. 1981), as has been done in charting historical information on Nile flooding for the period A.D. 640–1921 (Hassan 1981; Hassan and Stucki 1987). The frequency of flooding in that case served as a proxy measure of the amount of rainfall in equatorial East Africa and provided evidence of a correlation with the "Little Ice Age" of the 15th through 19th centuries in Europe.

This and many other examples indicate that archaeology is a powerful and largely untapped source of information in the quest for a better understanding of the workings of ecosystems and of ways to ensure their long-term sustainability. Archaeology has not only the ability and proven competence to record the history of environmental disasters such as species extinctions and the collapse of agricultural systems in the Maya lowlands of Guatemala, but also environmental successes through its documentation of centuries of sustained agricultural production in several areas of the world.

How well do archaeologists understand human adaptation and its modification of disparate environments on both

local and global scales? Right now, our ability to identify the mechanisms of interaction and their consequences is far from adequate, in part because our data sets are still not large and diverse enough to elucidate the nature of change, even though archaeologists already possess considerable information on the human use of many different environments. They now need to work more closely with those who can provide an additional perspective—with biologists, in particular, who study species density and diversity over time to capture the scope of large-scale ecological trends. To be sure, they work with different data sets, but the points of articulation and areas of overlap are greater than most biologists or archaeologists realize. To maximize the relevance of this information there must be more cooperation between archaeologists, anthropologists, geographers, geologists, and biologists.

Until quite recently, only a few research projects have been multidisciplinary efforts specifically concerned with modeling processes such as how humans and other components of the ecosystem react to long-term climatic change. Archaeologists in concert with other scientists are now beginning to provide information on how humans affect specific environments by altering ecosystem relationships through plant and animal domestication, direct modification of landscapes, and many other mechanisms. To date, these few interdisciplinary projects have made little impact on the larger and admittedly critical environmental issues the entire planet faces. One reason for this is that the scientific community has not yet come to recognize the potential of truly interdisciplinary projects, another that archaeologists have failed to make their findings known to policy makers and the public.

An Agenda for Archaeological Action

From the current state of affairs it is easy to identify several interrelated courses of action. Clearly, those concerned with historical human ecology must directly participate in resolving the types of problems mentioned in this discussion. A first essential step is to move toward interdisciplinary synthesis of problem and solution. Second, we must provide policy makers and the public with an intelligible vision of the long-term consequences of human actions. Third, we must actively attempt to affect public policy on issues of the environment. Fourth, we must encourage government agencies and private foundations to make more funding available for interdisciplinary research projects.

As researchers in historical ecology, our primary concern is to carry out an effective analysis of long-term landscape change. Humans play a pivotal role in the formation, maintenance, and destruction of ecosystems and regional climate systems, yet until very recently few scientists or resource managers gave the implications of this impact any systematic attention. Furthermore, little effort has been made to incorporate historical data from anthropologists, geographers, historians, and other social scientists with the findings of physical and biological scientists (Crumley 1994:2).

Despite the vast increase in sophisticated scientific data on global change, little of this information pertains to how humans have changed or been changed by environments (Crumley 1994:1). By way of example, a recent article on the extent of human disturbance to a variety of biomes around the world (Hannah et al. 1995) raises the usual questions about the reliability and comparability of data in synthetic studies, but more importantly fails to use data with significant time-depth. Tables showing biomes classified as having a high percentage of habitat "undisturbed" by humans conflict sharply with evidence from the archaeological literature that shows many of these regions have been inhabited for thousands, if not tens of thousands of years.

A major reason for this lack of integration is the perception that a sharp dichotomy exists between culture and nature, which is routinely reflected in cultural practice (Crumley 1994:14; Ingerson 1994). Whether humans view nature as the stately cathedral of the good and natural or the dark evil forest where chaos rules, they still perceive it as a thing apart from the works of humankind. Perhaps the culture/nature duality is a universal of the human mind, but the important factors here are the connotations we attach to it, which vary from culture to culture and time to time. It is not true that culture, as a system of values and symbolic connotations, is separate from nature. The idea of a nature/culture dichotomy is strictly a human construct, and no matter how unlike other animals we may seem, our behaviors and our consciousness are no less a part of nature than are the social behaviors of ants. As true as this may be, humans in many parts of the world have developed elaborate measures to separate themselves from the perceived natural world. The industrialized nations have been especially successful in developing technologies to fulfill the idea that the world must be subdued and rendered unto the service of humankind.

It seems entirely likely that it is difficult to develop integrated research teams precisely because nature and culture are considered completely different domains subject to unrelated processes of change. This duality is reflected in the way academic disciplines form their boundaries and in comments on the incompatibility of "scientific" versus "narrative" or "historical" approaches. This duality has its seamier side in the petty wars fought over disciplinary boundaries (and who has a right to funding on which topic). Who has the best data and the best theory or the most valid approach is an old and tiresome debate. It is more realistic and constructive to see the issues here as forming a continuum of variability that demands an integrative approach, or at least a methodological pluralism that currently does not exist.

Even the most broad-minded scholars have difficulty synthesizing the wide range of data relevant to a subject. This task is best carried out by truly interdisciplinary teams. In all likelihood, these will take the shape of a network of people working in one region or on one set of problems, but based at different institutions in different nations. Home institutions and funding sources should encourage and reward interdisciplinary research but not restrict the flexibility researchers need. Many research efforts, especially those that provide the basic data building blocks, do not need to be interdisciplinary.

Doing better research by using multiple methodologies and integrating diverse data is unfortunately only a part of the challenge archaeologists face. We must also try to make our information intelligible to a variety of audiences, which is a recurrent theme of archaeology today. Many are rightly concerned that much of what archaeologists say and write is becoming more and more disconnected from anything outside particular fields of specialization. Archaeology is inherently interesting to most people, yet we are in danger of alienating our strongest supporters. In examining global change issues, we have a special duty to present general audiences, other scientists, resource managers, and policy decision makers with the compelling messages that we know emanate from the long-term study of human impact on the environment. Examples of successful efforts exist (Marquardt 1994), but many more are needed.

If archaeology fails to communicate its findings broadly, then how is it to affect public policy? Archaeologists are seldom consulted and have had little impact on decisions relating to environmental protection or in the development of

governmental research programs such as the U.S. Global Change Research Program precisely because they shy away from the broader environmental debates. This seems difficult to explain if we consider the strong role human ecology has played in American archaeology. After all, hardly a day goes by without the publication of a new archaeological monograph describing the details of an environment and how humans have adapted to it. For archaeology in the Americas, at least, understanding the environment is a fundamental step in explaining human cultural change. But this does not go far enough. It is essential for us to consider not just how the environment affects humans, but also how humans affect the environment. Typically, perhaps to avoid the taint sometimes associated with applied research, we have preferred to tell the history and let others make of it what they will. And so they have, much to our detriment.

The last agenda concern to address is that of funding. Several federal agencies and private organizations direct some funding toward understanding the human impact on the environment. However, few such agencies have funded or will even accept proposals that look at the archaeological dimensions of landscape change. For some of the same reasons cited earlier, many organizations see a poor match between their goals and the results an archaeological analysis of change can provide. Those funding sources concerned with global change often focus on the relevant human-induced problems in the framework of the past few decades or at most the past century. They believe that the contemporary world is different in scale and content from the ancient world. What relevant message, many ask, does Classic period (A.D. 300–900) Mayan land use hold for a modern, overpopulated world linked by optical fibers and computer chips? As this book shows, the Maya and the many other societies discussed do shed important light on our own dilemmas.

Archaeologists also need to put more effort into soliciting funding from likely as well as unlikely sources. Unless funders that may start out less than amenable to archaeology are presented with good proposals, there is little likelihood of ever seeing agency and foundation support increase.

Future Research Directions

Humans have a great impact on the environment. They have short-term vision, and they measure their surround-

ings in uniquely anthropocentric ways. At the same time, they can learn from their mistakes, are concerned about survival as individuals and as a species, and adjust rapidly to new conditions. So, we have some minuses working against us and some pluses working for us. If the pluses are significant, then it is not enough simply to conclude that the past serves best as a chronicle of human environmental failure. The past provides many important warnings, but there is a much more dynamic set of directions that research on the past can take. Examples of the uses of archaeology that I have cited thus far focus on the “how” of research. Now it is time to describe the “what.”

Given the diversity and complexity of the research that falls under the heading of historical ecology, the following list can only present some general and broadly applicable suggestions for future endeavors.

- Build a global database to allow broad comparability. Do this by documenting the scope of human impacts on the environment in many places and at many times.
- Identify not just the anthropogenic forces that affect landscapes, but also the processes of change that allow humans the technological, demographic, and cultural opportunities to have major impacts.
- Conduct analyses that compare the scale and intensity of modern and ancient impacts to produce interpretations with interdisciplinary consequences.
- Concentrate on regions where the modern-day processes of environmental degradation are most pressing.
- Use faunal and floral data from archaeological sites to help biologists chart species distributions and develop models of ecological change.
- Identify cases of environmental sustainability and degradation that can be used as possible models for present-day action.
- Determine what measures past societies used to cope with human-induced landscape change and natural climatic shifts.
- Identify foods and raw materials and techniques of gathering and food production that may have modern applications in the diversification of resources and sustainability of landscapes.

This list is meant to serve only as a point of departure for specific future research projects. The details of these actions

and more will form the agendas of professional conferences and the core of research projects to come.

Conclusion

A recent annual report of the U.S. Global Change Research Program (Subcommittee on Global Change Research 1995:2) notes that the "Major foci of the USGCRP are: to observe and record what is happening to the Earth's environment; to understand why changes are occurring; to improve prediction of what will happen; to understand the consequences of change; and to develop capabilities for assessing change." The Social Science Research Council advocates a near-term research agenda that emphasizes "processes of human response to the stresses that global environmental change might present" through "interdisciplinary collaboration," "new theoretical tools," "methodological pluralism," and "post hoc analysis" (Stern et al. 1992:4). The agenda of these organizations and many others finds a close match in the views held by the contributors to this volume. There is no question that human-induced modification of the world's environments is of widespread concern. The relevant question for archaeologists is, are we up to the challenge of making a real contribution?

The ability to remember the past is a transitory human phenomenon. The ability to draw lessons from the past is often lost altogether. As historians, geographers, and anthropologists, the contributors to this volume are working toward a lessening of these human characteristics. At the current rate of change, a few decades or even a few years can spell doom for an environment or a species. But on an evolutionary and global scale the cycles of change are much longer and demand a deeper understanding of the processes involved. To understand changes that may take decades, hundreds, or even thousands of years we must understand the human role on a similar scale.

Literature Cited

Chew, S. C.

- 2001 *World Ecological Degradation: Accumulation, Urbanization, and Deforestation 3000 B.C.—A.D. 2000*. Altamira Press, Walnut Creek, Calif.

Crumley, C. L.

- 1994 *Historical Ecology: A Multidimensional Ecological*

Orientation. In *Historical Ecology: Cultural Knowledge and Changing Landscapes*, edited by C. L. Crumley, 1–66. School of American Research Press, Santa Fe.

Dye, T., and D. W. Steadman

- 1990 *Polynesian Ancestors and Their Animal World*. *American Scientist* 78:207–215.

Hannah, L., J. L. Carr, and A. Lankerani

- 1995 *Human Disturbance and Natural Habitat: A Biome-Level Analysis of a Global Data Set*. *Biodiversity and Conservation* 4:128–155.

Hassan, F. A.

- 1981 *Historical Nile Floods and Their Implications for Climatic Change*. *Science* 212:1142–1145.

Hassan, F. A., and B. R. Stucki

- 1987 *Nile Floods and Climatic Change*. In *Climate: History, Periodicity, and Predictability*, edited by M. R. Rampion and others, 37–46. Van Nostrand Reinhold, New York.

Hughes, J. D.

- 1975 *Ecology in Ancient Civilizations*. University of New Mexico Press, Albuquerque.

Ingerson, A. E.

- 1994 *Tracking and Testing the Nature/Culture Dichotomy in Practice*. In *Historical Ecology: Cultural Knowledge and Changing Landscapes*, edited by C. L. Crumley, 43–66. School of American Research Press, Santa Fe.

Kirch, P. V., and T. L. Hunt (editors)

- 1997 *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change*. Yale University Press, New Haven, Conn.

Lyman, R. L.

- 1996 *Applied Zooarchaeology: The Relevance of Faunal Analysis to Wildlife Management*. *World Archaeology* 28:110–125.

Mannion, A. M.

- 1991 *Global Environmental Change: A Natural and Cultural Environmental History*. Longman Scientific and Technical and John Wiley and Sons, New York.

Marquardt, W. H.

- 1994 *The Role of Archaeology in Raising Environmental Consciousness: An Example from Southwest Florida*. In *Historical Ecology: Cultural Knowledge and*

- Changing Landscapes*, edited by C. L. Crumley, 203–221. School of American Research Press, Santa Fe.
- Myers, N. (editor)
 1985 *Gaia Atlas of Planet Management*. Pan Books, London.
- Olson, S.
 1989 Extinction on Islands: Man as a Catastrophe. In *Conservation for the Twenty-First Century*, edited by D. Western and M. Pearl, 50–53. Oxford University Press, New York.
- Rapp, A.
 1987 Desertification. In *Human Activity and Environmental Processes*, edited by K. J. Gregory and D. E. Walling, 425–443. John Wiley, New York.
- Redman, C. L.
 1999 *Human Impact on Ancient Environments*. University of Arizona Press, Tucson.
- Stern, P. C., O. R. Young, and D. Druckman (editors)
 1992 *Global Environmental Change: Understanding the Human Dimensions*. National Academy Press, Washington, D.C.
- Subcommittee on Global Change Research
 1995 *Our Changing Planet: The FY1995 U.S. Global Change Research Program*. Executive Office of the President, Office of Science and Technology Policy, Washington, D.C.
- Wigley, T. M. L., M. J. Ingram, and G. Farmer (editors)
 1981 *Climate and History: Studies in Past Climates and Their Impact on Man*. Cambridge University Press, Cambridge.
- Wilson, E. O.
 1992 *The Diversity of Life*. Belknap Press, Cambridge, Mass.
- Yoon, C. K.
 1993 Rain Forests Seen as Shaped by Human Hand. Science Section, *New York Times*, July 27.

THE ARCHAEOLOGY OF GLOBAL CHANGE

The Impact of Humans
on Their Environment

Edited by Charles L. Redman, Steven R. James,
Paul R. Fish, and J. Daniel Rogers

SMITHSONIAN BOOKS

Washington