Chapter 1

Research Challenges for the Lowland Maya Area: An Introduction

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When I was asked to organize the 21 st Symposium of Plant Biology, I saw a great opportunity to bring together a group of scientists from different disciplines in order to address the complex topic of human-plant-environment interactions over time. My proposal was approved; this approval then provided an opportunity to explore a wide variety of topics of relevance to plant biology.

The focus of this symposium is the ongoing research of one culture, the Maya, and the geographical area that they have inhabited for more than 3,000 years. This is the second symposium that the University of California at Riverside has organized on the Maya. The last one, in 1991, was on ancient Maya agriculture and resource use; from that symposium came the outstanding book, *The Managed Mosaic* (Fedick 1996).

One question you might be wondering is the following: Why another symposium on the Maya? The Maya culture and the region in which they live have attracted the continuous attention of a distinguished set of scholars and institutions from many different disciplines over the years. This continued attraction is fully justified for several well-known reasons. The Maya, according to Coe (1984:7), were "in degree of cultural development... head-and-shoulders above the rest of the American Indians in the hemisphere." In spite of more than 25 Mayan dialects known to exist, the Maya had an astonishing fundamental unity in their subsistence techniques, religion, cosmovision, mathematical time calculation, and hieroglyphic writing" (Coe 1984). The Maya are the best-known cultures in tropical America. Archaeological research has produced an impressive body of knowledge about the ancient Maya and their magnificent monumental centers.

The Maya civilization has captured the imagination of writers who either have exaggerated and glorified their accomplishments, or vilified their

failures (Fash 1994). The disparity of these views can be explained by the great amount of things that we ignore about the Maya culture and its environment. Although we possess a great deal of knowledge about their elites and rulers, little is known about the majority of the population—that is, the rural Maya people and their environs. These people did not leave written records of their lives and their agricultural systems and resource management activities did not leave clear archaeological clues regarding the plants and animals they used, or their techniques and methods of food production. But it was the technological innovations of these people that allowed the spectacular cultural centers to establish and flourish.

The Maya civilization evolved mainly in the tropical lowlands. This is a historical anomaly because few advanced civilizations evolved in such a challenging environment. The tropical lowlands remain a hostile, often unhealthy, and difficult environment for human development and agricultural production. It is in this "hostile" environment, however, that the Maya developed one of the most sophisticated and advanced civilizations in the ancient world.

Based on archaeological evidence (Turner 1990), the Maya reached a high population density (up to 200 people per square kilometer in rural areas) that is found today only in a few highly populated regions within Central America and Asia. This figure remains unchallenged and suggests that the Maya were able —for centuries— to feed a population several times larger than the population of today in a tropical environment with soils that most agronomists would describe as marginal for agricultural purposes. There are two alternatives: either we assume that the population density figure is exaggerated, or we accept the figure and look for an explanation. Both options are challenging. The first alternative remains uncontested by archaeologists, but the second has been explored by scientists from different disciplines.

How did the Maya feed their people? Although several research projects and symposia have explored this question, the answer is still unknown. We know that the Maya practiced intensive agriculture, but we are not sure what species they used or how they managed them. Was corn-bean-squash shifting cultivation the principal food production system? Did they practice intensive rain-fed agriculture or agrosilviculture? What other staple foods did they cultivate in addition to corn, beans, and squash? What was the importance of chinampa-like agriculture? One approach to answer these questions has been the study of present-day traditional agriculture. From the bulk of data available, we have been able to propose many hypotheses on ancient systems of Maya agriculture and resource utilization, but we have very few projects that actually have tested them (Gómez-Pompa et al. 1982; Jimenez-Osornio and Rorive 1999).

The Maya culture reached its peak in the years 300–900 A.D. (i.e., the Classic Maya period) in the tropical lowlands of the Yucatán Peninsula, ranging from Tabasco and northern Chiapas to the lowlands of Guatemala, Belize, and Honduras. They created a network of population centers with spectacular architectural stone buildings and monuments. At their peak, the Maya were feeding several million people—most of whom lived in a transformed environment that challenges our imaginations. This surplus is not evident even today.

What were the environmental and cultural conditions that favored the development of this civilization in a lowland tropical environment? We do not know for certain the reasons for their success. The Maya were able to create surplus in the face of increasing demands for food and materials through a continuous process of agricultural innovation that enabled them to change from an extensive shifting agriculture to an unknown intensive agriculture. The production of surplus food was a necessity in order to feed nonproducers such as rulers, priests, warriors, builders, artists, poets, and scientists.

This remarkable culture experienced a major collapse during the first half of the ninth century. Monuments ceased to be constructed, and population centers were deserted. Many hypotheses have been suggested to explain this collapse. The most well-known hypothesis suggests an ecological collapse brought on by overexploitation of the environment; nutrient depletion of agricultural soils; deforestation and defaunation; pollution of water sources, erosion, and siltation of water bodies; and major diseases affecting humans and crops (Rice and Rice 1984). This ecological collapse has been the most popular hypothesis for the Maya Collapse, and it is used over and over again as an example of a culture that overused their resources because of overpopulation. However, this explanation may be grossly oversimplified.

A recent explanation for the Maya Collapse (Hodell, Curtis, and Brenner 1995) suggests that an arid event in the region coincided with the collapse of the Maya civilization. This timing is congruent with other hypotheses that attribute the collapse to warfare between powerful chiefdoms (Demarest 1993), which was brought about by the breakdown in agricultural production. We do not need great imaginations to picture a rebellion involving masses of hungry peasants urged to increase food production to feed the elites, or efforts by the elites to secure food supplies from other neighbors. Climate change in the Maya region is a very important topic of research that is helping us understand the large picture of the ecological history of the region.

The geographical lowland Maya region contain a great diversity of environments, including all kinds of tropical forests (wet to dry), savannas, palm stands, and many kinds of wetland vegetation communities. This region is known to be one of the most important biological regions of

the Americas. It is considered a site of several centers of plant diversity (Davis, Heywood, and Hamilton 1994–1997)—a biodiversity hotspot for its exceptional concentration of endemic species, which is undergoing an exceptional loss of habitat (Myers et al. 2000).

The sustaining of the high biodiversity of this region is an intriguing fact that puzzles conservationists. In spite of its long history of human-environment interactions—some of them extremely intense—there is no evidence of any major biological collapse produced by ancient Maya activities (Gómez-Pompa and Kaus 1999). There is no record of any biological extinction, past or present, in the Lowland Maya region due to ancient or modern Maya traditional agricultural practices.

It is assumed that the biodiversity of the Maya region is well known, but this is far from the truth. Although there are a few good inventories of the vascular plants and vertebrates from certain regions within the Maya area, detailed ecological studies are scarce. Very little is known of the diversity of nonvascular plants and invertebrates. In-depth studies of the biodiversity and ecological history of certain sites may help us better understand the human impact on the biodiversity of the lowland Maya region. In-depth studies of sites where we can integrate biological, archaeological, and environmental data for comparisons are needed.

For this reason, a group of conservationists interested in the topic of Maya subsistence create an experimental protected area that was not only dedicated to research and education on biodiversity conservation and management, but also the additional goal of trying to reconstruct human and ecological history of the site. This was the beginning of the research program of the El Edén Ecological Reserve, a nongovernmental-protected area, approximately 1,500 hectares (ha) in area, in northern Quintana Roo, Mexico, which is run by a not-for-profit Mexican organization <http://maya.ucr.edu/pril/el_eden/home.html>. The El Edén location was chosen because it represented all major ecosystems of the region: different successional stages of a tropical semievergreen dry forests, swamp forests, savannas, and wetlands. Archaeological investigations presented in this symposium show the presence of early Maya populations in this site.

In this symposium, we are including results from this interdisciplinary and multi-institutional research project. We believe that by concentrating our efforts in one site, we will be able to understand better the ecological and biological history of one site. We have not resolved any single problem yet, but we have opened new lines of research and education in archaeology, ecology, and biodiversity of a poorly-known region of the Yucatán Peninsula. It is one more piece of the puzzle concerning the managed ecological mosaic of the ancient Maya.

If the Maya, at their peak, used all available land for agriculture, where have all the rare and endemic species gone? Is the biota that we have today

an impoverished biota that is the product of a few centuries of intense transformation of native habitats? Or is it an astonishing biota, resilient to human actions? These are extremely important questions that are very difficult to answer. Our level of knowledge of the biota of any site in the Maya region is at the level of early alfa taxonomy, with some groups (e.g., flowering plants and large vertebrates) better known than others (e.g., microorganisms, nonvascular plants, and invertebrates). We need to know the in-depth biodiversity of today in order to understand changes that might have occurred in the past.

It has been suggested that the Maya maintained a great diversity of forest gardens where they domesticated, semidomesticated, cultivated, or semi-cultivated many plant and animal species (Wiseman 1978; Gómez-Pompa 1987; Atran 1993). These sites may have been the source areas where many wild species were able to survive. Are these sites the ecological refuges that allowed most of the flora and fauna to survive the intensification of land use at the end of the Classic Maya period? Some recent findings in traditional coffee and cacao plantations seem to support such a hypothesis (Gómez-Pompa 1997).

We know that deer, peccary, and turkeys were used extensively (Pohl and Feldman 1982). We have no idea what management approach the Maya might have used to sustain the abundance of these animals. It was known that deer, peccary, and ocellated turkey were so abundant and tamed in some areas that they seemed domesticated (Díaz del Castillo 1927). The only explanation for this abundance was the existence of large areas of managed forests and secondary forest lands where these animals, plus large carnivores, were able to thrive. These places were likely crucial ecological refuges. Studies on the ecology of regeneration and on the biodiversity of managed forests and secondary forests at different stages of development in the Maya region can help us understand their role as refuges and possible ancient wildlife management approaches. The use of nontraditional taxa as indicators of diversity could be an important contribution.

We may never know what flora existed in pre-Maya times. The pollen and phytolite record gives only some broad taxonomic information at the genus or family level. Great advances have been made in the study of pollen profiles of Maya lakes that have provided insight into the ecological history at a local level (Rice, Rice, and Deevey 1985). A better knowledge of the ecology of local species that are good ecological indicators could help us to have a better interpretation of the pollen and phytolite profiles within certain localities.

Today, we are struggling to find better approaches for a sustainable use of natural resources. We know that the ancient Maya, in spite of their extensive and intensive use of the area, were able to sustain their biological resources over several generations. In this intensively managed mosaic, the

old Maya were able to conserve the biodiversity they used and then pass this diversity to the next generation. This was their conservation strategy (Gómez-Pompa 1996). How can we use this knowledge to develop better and more accepted conservation approaches?

The Maya culture is alive and well. Today, they comprise more than 2 million people who live in the same geographic area as their ancestors: southeast Mexico and northern Central America. These people face similar challenges in food production and other activities as did their ancestors, but most of them face new challenges posed by the activities of dominant cultures. The knowledge of traditional Maya systems of agriculture and resource management is a key to decipher the past, and perhaps a path for the future for us all. Unfortunately, we are losing this knowledge at a rapid rate.

Many of these questions and topics are discussed in this book. It is my hope that these readings will stimulate further research on this unique culture and fascinating ecological region of tropical America.

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