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From pre-Hispanic to future conservation alternatives: Lessons from Mexico

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ABSTRACT **In this paper, we review some past and present trends in biodiversity conservation in Mexico and explore possible explanations of why, in spite of this long history of depredation and ineffective conservation policies, the ecosystems have been able to cope with and retain most of their biological components. We suggest a hypothesis based on the persistence of a complex mosaic of past and present traditional land uses as a possible explanation for this resilience. We propose an agenda for the scope of future conservation research and policy, particularly the need to take the socioeconomic context of environmental degradation into account. We put forth a series of questions that we think need to be investigated if the conservation research community is to participate in developing solutions for the future welfare of the human species and of biodiversity on earth.**

In 1995, Mexico had 94 million inhabitants with a growth rate of 2.1% per year (1). In the last 50 years, Mexico has lost most of its mature humid rain forests, and at 500 to 800 thousand hectares of forest lost per year, it has one of the highest deforestation rates in Latin America (2). Most of its rivers are polluted, and many parts of the country suffer from water shortages. Immense areas show environmental degradation and biological impoverishment. In addition, income distribution among the nation's citizens is remarkably polarized, with more than 50% of the population living at the poverty level, 20% at the extreme poverty level, and a small group of individuals who are among the richest people on earth (3).

In this context, it is striking that Mexico is also one of the most biologically diverse countries of the world (4, 5). It has a wealth of raw natural resources, such as oil, timber, range land, and minerals. The nation has adopted and developed various conservation models to establish systems of national parks, wildlife refuges, watershed protected areas, marine sanctuaries, world heritage sites, botanical and zoological gardens, and biosphere reserves (6). The country contains an impressive number of conservation groups and a well recognized ecological scientific community that has influenced the development of a large system of recently protected areas now covering more than 10% of the nation's territory.

In addition, Mexico is a site where remarkable cultures have developed, flourished, and collapsed over the last 3,000 years. The nation boasts an impressive cultural diversity, with more than 8 million people belonging to more than 50 cultures (ref. 7 and www.ine.gob.mx/gacetas/gaceta38/pma12.htm). It has a wealth of empirically based conservation practices stemming from the traditions of indigenous cultures, dynamic and modern descendants of customs that predate Spanish contact. Along with these cultures and practices, Mexico has an impressive number of resilient ecosystems that have coevolved with human activities over thousands of years (8).

Despite this seeming cornucopia of biological, ecological, and cultural diversity, Mexico has not been able to slow present trends of environmental degradation and destruction. Biodiversity losses, however, have not reached predicted levels. In this paper, we examine past and present conservation actions and trends to explore why—in spite of a record of depredation and ineffective conservation policies—the country's ecosystems have been able to adjust and retain most of their biological components.

Conservation as Sustainable. In the last few decades, development—the former antithesis of conservation—has come to encompass concepts of sustainable land and resource use to ensure that development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (9). This concept coincides with the broad concept of conservation championed by Aldo Leopold (10) and followed by most conservation organizations today.

In this paper, however, we suggest a subtle permutation of the definitions of sustainable development and conservation to encompass those actions that provide environmental and biological safeguards for future generations without compromising the needs of present ones. We believe that the world must realize fully its responsibilities and commitment to the individuals and communities of today who, by design or default, maintain the natural resources on which we all rely. In addition, conservation that sacrifices basic human needs at present for those of the future is fundamentally unjust. It provokes righteous resentment among local inhabitants and escalates boundary disputes at the edges of protected areas, an inherently unsustainable approach to biodiversity protection.

The environmental dilemma has become increasingly complex with each successive wave of human expansion, technological advance, and consequent environmental changes. Each change brings on a new set of circumstances to confront and a new sense of urgency as local problems take on global proportions and vice versa. Neither national conservation policies nor local practices have resolved rural development demands or reduced current threats to biodiversity, rampant poverty, and resource depletion. In fact, conservation in Mexico sharply reflects the separation of national policy from the interests of rural communities, as well as the chronic neglect and submergence of indigenous and peasant populations (11).

Modern Descendants of Pre-Hispanic Approaches. Research and public opinion regarding native peoples is filled with conflicting perceptions regarding their impact on the environment. Early native Americans are blamed for the extinction of megafauna (12) but are acclaimed for their skillful management of forests and wildlife (13, 14). For example, the Maya civilization, one of the most successful and well known cultures in tropical America, fed and sustained

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human populations over many centuries in a tropical environment at numbers and densities well beyond those found in the same place today.

However, researchers also claim that the Maya overexploited their environment because of overpopulation (15). The common perception is that Maya mismanagement of forest resources led to the civilization's ultimate collapse about 1,100 years ago (16). The most recent explanation for the collapse of the Maya comes from Hodell, Curtis, and Brenner (17) who suggest that a prolonged dry-period event in the region coincided with the collapse of the classic Maya. It seems that the ecological basis of the Maya's highly efficient food-production technology disappeared as a result of a climatic change.

The survivors from this period continued their activities in the same region and began a new cycle of population growth that lasted 600 years until the arrival of the Spanish. Far from a pristine environment, the first explorers found a forest region that was densely populated. Cristobal Colon described Hispaniola (Haiti and the Dominican Republic) and Tortuga as densely populated and "completely cultivated like the countryside around Cordoba" (18).

Although the evidence indicates that the two cycles of population growth profoundly affected the environment and altered the composition of the forest vegetation, there is no record of any major floristic changes in the lowland Maya region caused by the ancient—or the modern—Maya. The few studies available on the vegetation history of the lowland Yucatecan Maya area, as suggested by the palynological record in lakes, show no major changes in floristic composition at a genus level in the last 5 to 6 thousand years. In fact, the data indicate that the Maya were able to maintain a managed mosaic of forested and agricultural areas simultaneously, as they do today, without an apparent decrease in biodiversity (19). There is no evidence of any major biological collapse, only of a population collapse.

There must be an explanation for the unchanged flora in the Maya lowlands in the last 5 to 6 thousand years. There is no evidence (archaeological, historical, or iconographic) of areas purposefully dedicated to preservation in the Maya region, such as sacred groves or untouched reserve sites in other regions of the world (20), with the exception of the sacred cacao groves in sinkholes (21). However, we have learned that in between ceremonial sites and dense rural settlements, there were areas of less-managed forests, complex agroforestry systems, and abandoned agricultural land with secondary vegetation such as we find today (22–24). This managed mosaic was—and remains—the provider of important niches for a large number of organisms. They are "keystone" sites for the recovery of biodiversity after abandonment. It is as much a clue to the conservation practices of the ancient Maya as it is a key for the present.

The Maya are not unique in this regard. Ecological and anthropological evidence indicates that many other indigenous groups in different geographic regions had their own approaches to natural resource management that resulted in deliberate or de facto conservation strategies (8, 25, 26). Each group in each geographical site was able to manage its resources with the knowledge accumulated over millennia and under different population pressures; however, we do not want to suggest that aboriginal populations have not also overexploited particular resources or degraded their environments. It is the range of indigenous transformations of the environment, from conservationist to exploitative, from high to low population densities, that needs to be understood if the past is to provide an informed perspective for the future.

Two Mexicos. The New World was peopled by civilizations that were not understood by the Spanish; subsequently, these civilizations were decimated, weakened, and suppressed by arms, religion, and disease. Mexico was depopulated, and immense areas were abandoned to undergo natural regeneration. Two Mexicos, indigenous Mexico and colonial Mexico, emerged, and they coexisted and intermingled for nearly 4 centuries, albeit one was subjugate to the other. The former was comprised of the rural, still largely indigenous population descendent from pre-Hispanic cultures; the later was what Bonfil (11) calls "México imaginario," a minority but dominant society structured around the norms, aspirations, and beliefs of Western civilization.

Today, however, the two Mexicos overlap geographically, as mass production techniques of forestry and agribusiness clash with smaller local practices, many of them based on traditional systems of shifting agriculture. Remote no longer means removed. Bulldozers and chain saws cut into formerly isolated regions. Cattle graze over former milpas. Ranches displace rancherías. Subsistence agriculture merges the traditional milpa with livestock production, and valuable natural resources are exported to far-off urban centers.

However, a basic division remains between the two Mexicos with respect to policy and regulation. One is the oft-forgotten rural Mexico, a locus of poverty and also a well recognized "keeper of the forest." The other is the Mexico of national policy and global commerce, which is the financial "miracle" or "disaster" and also the major force behind resource depletion. Even though local natural resource management practices, whether ancient remnants or recent inventions, have been the focus of intensive ethnoecological, ethnobotanical, and anthropological research for many decades, the scientific community still has only an inkling of how local populations interact with the natural environment. It has been even less successful in transferring this understanding to modern conservation policy.

However, we caution against the trap of seeing conservation issues as only a distinction between indigenous or Western approaches. Not only would this view be simplistic, it contains the danger of setting indigenous populations and approaches apart from other local populations and land-use practices. Such a dichotomy runs the risk of reincarnating a contemporary version of romantic primitivism regarding indigenous society (27, 28) and placing other local peoples in categories of lesser worth (29). Human land-use practices change depending on circumstances. Decisions to change are based on an empirical understanding of the environment, which, in turn, has different degrees of historical continuity in that particular area. The distinction we wish to make here instead is between local conservation practices, based on a deep understanding of a particular site, and national policies, based on a broad understanding of wider impacts and external threats.

National Conservation Strategies. Modern Mexico, the inheritor of colonial Mexico's philosophies, has taken a progressive approach to conservation, following the trend initiated in the United States at the end of last century by creating different kinds of parks and other national protected areas throughout the country. More than 500 protected areas have been declared officially in the last 80 years, covering more than 50% of the nation's territory. Unfortunately, the majority of them are "paper parks"—parks in name only—and do not exist anymore. Today, the nation recognizes the decrees of 111 protected areas, which cover close to 10% of the territory (Table 1).

A system of protected areas represented perhaps a visionary move for the country, but the government has treated these sites as if they exist in a vacuum, unperturbed by human intervention or ecological change. It presumed the absence of humans before the establishment of the parks, land tenures issues were not resolved, and plans or funds for management were mostly nonexistent. As paper parks, however, the sites protected the environment by dint of their legal status and the low population densities in the regions when they were established. The government discovered one of the unfortunate

Table 1. Active protected areas of Mexico, 1998

Category of protected area	No.	Area, hectares	Percentage of total protected area
Biosphere reserve	21	8,115,730	68.8
National park	63	1,385,334	11.7
Natural monument	3	13,023	0.1
Natural resources area	7	203,439	1.7
Area of flora and fauna	9	1,660,502	14.1
In process	8	418,941	3.6
Total	111	11,796,969	100

Data were provided by the Consejo Nacional de Areas Protegidas.

truths regarding the protection of nature in most developing countries: ''Decrees cost nothing, they hurt no one and provide adornment; and in some cases, they even protect nature'' (6). Unfortunately this problem exists in many other tropical countries (30).

In 1977, Mexico became one of the first and few countries to adopt and develop the biosphere reserve system proposed Man and the Biosphere Program of the United Nations Educational Science and Cultural Organization. Mexican scientists felt that science, rather than urban sentiment or a sense of aesthetics, needed to be the basis of environmental protection for human and ecological welfare alike. They thought that the biosphere reserve concept would be a good solution, reconciling the contradictions of overlapping land use and conservation goals. In many ways, Mexico took the lead for developing countries, particularly in the effort to include local people and local needs in the biosphere reserve management and research (31–34).

Despite the success of surface area coverage and increased research opportunities, the basic principles underlying the biosphere reserve concept have not been followed, and the reserves suffer from the same problems of neglect and mismanagement as do national parks. We do not want to suggest that the idea of protected areas or the biosphere reserve concept in themselves were wrong, but they have had little chance of working implemented as they were. Beyond their establishment, little was done to maintain or manage biosphere reserves or other forms of protected areas. That is, the only management ''decision'' was to keep the areas as they were, in the hands of the people living there. In that serendipitous ''action'' perhaps lies the real success of the biosphere reserve.

Beyond Protected Area Management. How can the different Mexican approaches to conservation—one that is based on local empirical knowledge and another that is based on national policy—be reconciled to face current and future threats to the environment? Neither by itself is enough. National policies have been unable to stop trends of deforestation, deterioration, desertification, and resource depletion. These alarming trends continue despite the fact that over 50% of the country's surface area has been under some form of environmental protection at one time or another (6). In part, the problem is that conservation programs are designed and implemented without understanding or accommodating local needs and aspirations.

Local traditional practices are not the ''silver bullet'' for conservation either. They are site-specific, were developed under earlier environmental conditions, and cannot control for externalities that arise from global demands and free market policies as well as local demands from a growing population. For instance, timber in the Yucatán peninsula does not supply the population centers there; instead, it goes to build houses and furniture in Europe or the United States or railroad ties in Mexico. Worse yet, the timber goes unprocessed; thus, its highest value as lumber is exported as well.

In turn, the integration of conservation and development as a legacy of the biosphere reserve concept has not succeeded in the manner that it was intended either. Funding agencies, convinced that this approach is the answer, have poured money into such programs without thinking out the details or consequences. In trying to meet development needs, well meaning conservation programs often lose sight of the link between development and environmental protection (35). Focus may be placed on peripheral activities such as certain agriculture techniques, handicrafts, or cottage industries without making the explicit connection to reduction of deforestation and other environmental pressures or taking into consideration the perspectives of the local land users (36).

So what is the answer? Who has an answer at all, and what is the appropriate and ethical level for making decisions about future conservation practices? Out of this morass of failed and half-tried conservation options, several things seem clear.

First, protecting surface area is not enough. Today's conservation sites are faced with the basic needs and rights of local populations for food, water, shelter, and fundamental social services. In addition, these sites are subjected to the demands of a world that is hungry for raw resources and the demands of a country that must balance economic debt against environmental protection and that depends on the subsidies of nature to do so. Relying on the encirclement of wilderness to meet conservation needs now or in the future is short-sighted, regardless of how we personally feel about the need for untrammeled wild places.

Second, if predictions of large climatic shifts are correct, these sites may not be located in critical areas for the conservation of biodiversity. Conservation requires the management and preparation for change, not the maintenance of the status quo. We need to emphasize *ex situ* as well as *in situ* conservation efforts to keep the basic building blocks of biodiversity for future restoration.

Third, we need to find where conservation is, instead of where it is not. We do not tend to hear about places where outside intervention is unnecessary because of isolation or because of the proactive efforts of local communities or individuals. These are the very places we actively need to seek out, study, and compare to understand what conditions lead to a local conservation ethic. In isolation, such small local actions may seem insignificant, particularly in the face of global-scale pressures, but in sum, local action may hold the basic building blocks for developing conservation programs elsewhere.

Fourth, conservation on a larger scale needs to be based on vertical partnerships between and the mutual accountability of local communities and the nation. Local communities have detailed knowledge of particular sites, whereas national levels have a larger vision and stronger authority. Local communities need to have the ability to hold the nation accountable to their rights, including decisions regarding their resources, but the nation needs to retain the responsibility to watch over the use of critical resources, habitats, and ecosystems (37).

Fifth, rather than focus on population numbers alone, we need to recognize and hold accountable those sectors of the human population that are the key extractors of resources. The growth of the cattle herds, the extent of the agricultural frontier, and the amount of timber harvesting all respond to consumptive demands for beef, produce, wood, and paper products from burgeoning and pampered populations far removed from the supply source. All the terracing, green mulching, selective harvesting, field rotation, crop diversity, and reforesting in the world cannot help if the external consumption of natural resources continues to outpace local sustainable practices and to offer economic incentives that out-compete long-term conservation benefits.

Is such a scenario for effective conservation research utopian? No. Many of these objectives are being explored by several grass roots organizations all over the world. In Mexico,

for example, a small nongovernmental organization, the Programa de Acción Forestal Tropical (PROAFT), with which we have worked since its inception, provides a good example of this trend. Its basic approach is to recognize, encourage, and promote conservation actions of rural communities. Every year, participant communities present their accomplishments and new ideas with members and guests. In these meetings, visits are arranged; problems are presented; and initiatives are suggested by participants. What has been accomplished is a three-way learning process to understand methods for biodiversity conservation, for reinforcing local cultural values, and for dealing with a market society (38).

One PROAFT project undertaken recently by a group of Mixtec peasants from the organization Ecosta Yucui Cuii initiated the creation of a new type of protected area: the "Cellular Campesino Reserve." Each participant contributed a piece of their land—a "cell"—ranging in size from 0.5 to 15 hectares. The total amount of protected area is 167 hectares within an area of more than 2,000 km^2. Hopefully, this step is only the beginning. The campesinos believe that this approach to conservation is more realistic; everybody participates, and all are the protectors of their cells. This approach may mimic a hypothetical conservationist approach of ancient cultures, which would have set up patches of "left-alone" forests throughout the environment from which biodiversity was able to regenerate after abandonment.

PROAFT is not unique. It is encouraging to see that, throughout the world, innovative programs and ideas are arising that directly confront the intertwined problems of ecological and social welfare under the threat of overpopulation (39). Community-based conservation and comanagement regimes are no longer fringe efforts but part of mainstream trends within research and conservation communities alike.

Future Solutions or Future Questions? Before this century of technological and population explosion, people were not as overtly aware or concerned about the need to conserve resources as we are. They relied on the inherent capacity of ecosystems to come back after disturbance. They counted on environmental resilience. The most intriguing support for this resilience hypothesis is our inability to find examples of major mass plant extinctions in the tropics. Rare or endangered species in highly disturbed regions, such as Veracruz and Yucatán, have been found in isolated forest patches in rural areas and in traditional agroforestry systems or other human-impacted systems, such as along roads, in secondary vegetation, or in the few protected areas (40).

The predicted massive extinctions in Mexico have not occurred (41). Is it because we do not have recent surveys? Or is it because we have an unknown system of patches (natural and artificial) where most species hang on in de facto "refuges" until a new human population collapse occurs and ecological regeneration begins one more time? Is the managed mosaic the only option left to face the natural or human threats to biodiversity and human survival? And what happens if the patches disappear? Are we teetering on the edge of nature's resilience? Of course, we need to explore what nature's resilience means in highly populated countries such as India, Rwanda, Mexico, the Netherlands, and Japan. It seems that this exploration will be the real challenge for the next century.

We know that nature has proven its capacity to recuperate under changing conditions. However, humans are running out of time to resolve the obscene inequalities in our societies that go hand in hand with the present state of resource use and conservation and with the disturbing fact that millions of people today are undernourished and impoverished. We are running out of time to find ways to resolve these inequalities within the present capacity of the environment, and there is even less time considering that this capacity diminishes with increasing population and consumption demands. We are running out of time to convince the world of the urgency to find a new vision for population growth, food production, economic development, resource use, and biodiversity conservation. It is not nature that is running out of time; it is the human species.

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