VOLUME 6

RAIN FOREST REGENERATION AND MANAGEMENT

Edited by
A. Gómez-Pompa, T. C. Whitmore and M. Hadley

MAB MAN AND THE BIOSPHERE SERIES UNESCO

CHAPTER 21

LEARNING FROM TRADITIONAL ECOLOGICAL KNOWLEDGE: INSIGHTS FROM MAYAN SILVICULTURE

A. Gómez-Pompa

ABSTRACT

The presence of tropical forests rich in useful trees as dominant species in the Maya area is used as the starting point to reconstruct an hypothetical silvicultural system that the ancient Maya people had for the managing and construction of different types of man-made ecosystems. The reconstruction is based on a series of isolated silvicultural and agricultural techniques that the present-day Maya use in different regions of the area. The ancient Mayan silviculture raises some serious questions about recent trends in the use of the land and resources in tropical regions, and suggests a new research approach for conservation and development that may help to improve the management of forest resources in some tropical lowland areas for the benefit of the local people.

THE MAYAN CULTURE AND USE OF NATURAL RESOURCES

The Mayan culture was one of the few successful cultures that developed and flourished in a tropical forest environment. Much is known about the accomplishments of the Maya (e.g. Coe 1984, Hammond 1982). Though there remain many unresolved problems related to the subsistence systems, land-use and conservation practices of the Maya, some advances have been made in recent years (e.g. Flannery 1982, Gómez-Pompa and Golley 1981, Pohl 1985; see also Gómez-Pompa 1987 for an expanded description with literature sources). It is now known that the Maya had a very efficient and complex shifting agricultural system that many of their descendants still practise very skilfully. We know that the ancient Maya used terraces very

extensively, and that they had extensive hydraulic systems with channels and raised fields. They probably used intensive agriculture similar to the surviving chinampas system of the valley of Mexico. We know that the present-day Maya have very rich and diverse forest gardens, and we assume that they were also extensive in the past.

The Maya knew and used a great diversity of wild plants (Sosa *et al.* 1985). A deep knowledge of the native fauna is suspected from the richness of names applied to that fauna (Hartig 1979). The Maya had, and still have, a profound knowledge of their soils. The classification they made is much better than any known classification of soils for the area (Beltrán 1959). Their decisions on management were based on soil attributes, a method still followed by many present-day farmers. The same applies to their knowledge of vegetation. Their classification of vegetation is based on "ecological" insights from the successional process, particularly from the age of the fallow (Fig. 21.1). It also draws on knowledge of the past management of vegetation (through species indicators), and on the agricultural potentiality of the site based on past yields and soil type (Flores and Ucan Ek 1983).

We believe that the old Maya managed their forest ecosystems (Barrera *et al.* 1977), but we know almost nothing about how they did it. This subject is of great interest because today we are still struggling to find suitable methods for managing tropical forests. Different opinions have been expressed concerning the old Mayan forest management and conservation methods. On the one hand, it has been claimed that the Maya destroyed their forests, and it has even been suggested that the classic collapse of their civilization was caused by the loss of soils produced by shifting agriculture, deforestation, erosion, and siltation of lakes. In contrast, other findings suggest that the Maya protected and probably managed their forests as sources of many plant and animal products. Botanists exploring the region many years ago noted the abundance of useful tropical trees in the Mayan ruins (Lundell 1937) and suggested that the old Maya had something to do with such abundance.

Moreover, there is evidence that one tree species, the *Ramón* or *osh* tree (*Brosimum alicastrum*) may have played a central role in Mayan subsistence (Puleston 1982, Peters 1983) as a complement to, or substitute for, corn, especially in dry years. This species is still used and is widely cultivated by the Maya at the present time. The use of the *osh* tree is not a unique feature of the Maya. The species has been found to be widely used for similar purposes in several other tropical cultures in Mexico and Central America (see also contribution by Peters in this volume). A closely related species, *Brosimum utile*, with its seven varieties, is widely used in northern South America (Berg 1972). In addition to the *osh* tree, the Maya had a great variety of other tropical fruits, including *Acrocomia mexicana*, *Casimiroa edulis* and *Theobroma cacao* (see Gómez-Pompa 1987 for a more complete listing).

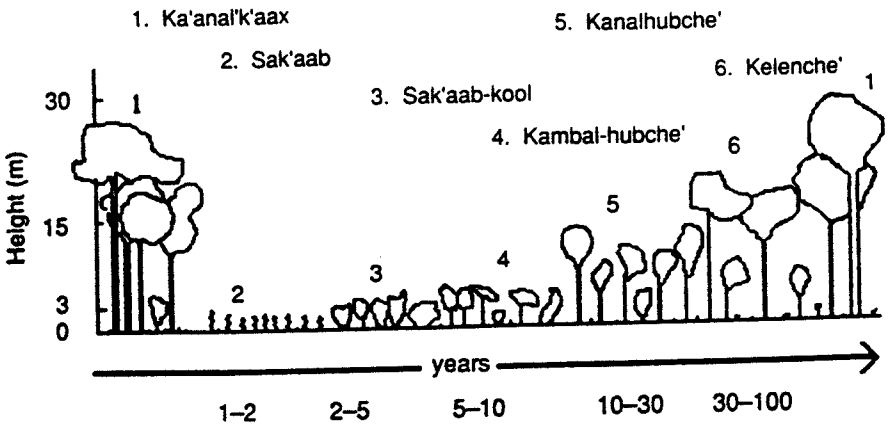

Fig. 21.1 Vegetation classification based on successional process.1. Ka'anal'k'aax. Old tropical forest (30 or more years old). 2. Sak'aab (or Sak'ab). 2nd year *milpa*. 3. Sak'aab-kool. Recently abandoned *milpa*. Early succession. 3–6. Hubche'. Secondary vegetation. 4. Kambal-hubche'. 5–10-year-old succession. 5. Kanalhubche'. 10–15-year-old succession. 6. Kelenche'. 15–30-year-old succession.

It is assumed that all of these trees were present in the native flora. These species were, and are (until recently), very abundant in the different natural ecosystems of the region, and many of them are dominants in a number of communities. If this is indeed so, then it would seem to refute the assertion that the old Maya cut down all these valuable forests to plant the annual crops used in shifting (*milpa*) cultivation. I do not think that was the case, and evidence is available that supports the idea that the Maya probably not only protected these forests but planted them for their future use (Gómez-Pompa *et al.*1987).

SILVICULTURAL METHODS, NATURAL FORESTS AND CONSERVATION

The question is "How did they do it?" From a series of isolated clues that have been accumulating in the past years of research on the old and modern Maya, a new concept of the Mayan silviculture has emerged. This Mayan silviculture has a series of methods and techniques, many of which still exist and are practised in different parts of the area. These isolated techniques (Table 21.1) are not all practised in any one place, but all occurred in the Maya area, and, for this reason, I assume that they were integrated at times in the past. They explain the presence of useful "natural" forests in the zone and their role in Mayan subsistence.

Table 21.1 Silvicultural techniques of the Maya (after Gómez-Pompa 1987)

Cenotes
Introduction of useful trees

Dooryard (Orchard) gardens
Germination of seeds in *caanchés* (elevated soil beds constructed with wood and organic soil)
Tree planting, contributing to greater abundance and diversity of tree species in gardens and producing shade, firewood, useful flowers, fruits, seeds, and green forage. Many of the most common trees are the same species found in "natural" vegetation (such as *Brosimum*, *Manilkara*, *Calocarpum*, *Cordia*, *Sabal*, etc.). In addition, introductions such as lemon, orange and other citrus fruits.

"Natural" forest ecosystems
Conservation of forest patches, selection of useful trees
Introduction of useful species

"Pet Kot"
Circular wall of stones, within which patches of useful plants concentrated
Selection of forested sites
Selection and protection of useful wild trees
Introduction of useful trees

Raised fields
Trees in borders of fields
Tree plantations (*cacao?*)

Trees in shifting agriculture
Selection and protection of trees on site chosen for shifting cultivation (best individuals protected, remain standing). Selection for usefulness probably included many properties in addition to food values (e.g. hardness of wood, toxicity of bark and wood). Religion also played a role in selection and protection of tree species (e.g. *Ceiba* species)
Coppicing of selected species in slash at about 50 cm height, leaving stumps ready to take advantage of fallow when area abandoned after 2–3 years
Tree planting before fallow, including shade trees (mainly legumes) and (at a later date) *cacao* and coffee

"Tolché"
Different sizes and forms of forested belts surrounding the *milpa* – a key factor in the regeneration process of the fallow

Tree plantations
Fruit trees
Cacao plantations with shade legume trees

Other
Living fences
Trees in urban and religious centres
Sacred groves
Trees in terraces?

The Mayan silviculture consisted of a series of activities of protection, cultivation, selection, and introduction of trees in their *milpas*, fallows, plantations, natural forests, houses, living fences, *cenotes*, and urban centres. Selection for usefulness probably included many properties in addition to food values, such as hardness of the wood and toxicity of bark and wood. Religion also played a role in the selection and protection of tree species; that is the case, to the present, of several species of *Ceiba*.

In the slash process of Mayan *milpa* cultivation, the farmer does an additional and more massive selection. He will identify some useful species, mainly fast-growing secondary ones that he will slash at a height of 50 cm or so (a sort of pruning and coppicing), leaving the stumps ready to take advantage of the fallow that will occur when the area is abandoned after 2 to 3 years.

All the various silvicultural activities and techniques assume the existence of some kind of natural ecosystems from which they could draw the species that they needed from time to time. It is clear that the first colonizers of the Maya area, whoever they were, found a rich and diverse mosaic of ecosystems in which they lived and from which they derived their subsistence. They managed and used them for an unknown length of time, starting a selection process that the Maya have continued up to the present.

In order to accomplish this hypothetical silviculture, there must have been a biological conservation strategy entailing a system of resource management that included intensive crop cultivation in raised fields, the creation of artificial forests, and the conservation of some natural ecosystems. They had many intermediate production systems with high biological diversity. This probably helps to explain why no evidence is available that mass extinctions of species occurred due to past actions, or that species diversity or richness was diminished by Mayan activities, in spite of the fact that the Maya area was a highly populated and intensively used area in the past. The proof of this can be found in the flora of the Maya area (Sosa *et al.* 1985), rich in endemic species, from the humid areas of the Lacandone rain forest to the drier tropical deciduous forests and swamps of the Yucatan Peninsula. It is important to mention the special richness of the secondary successional flora, and this may be another gift that the old Maya gave us that is worthy of research (Gómez-Pompa 1971).

The regeneration of the ecosystems of the Maya area after successive abandonments (the last one after the Conquest), was possible only because of the existence of seed-banks in managed and protected "natural" ecosystems in the area (Gómez-Pompa *et al.*1972), and of land-uses that did not cause irreversible damage to the soils. It is clear that Mayan silviculture played an important role in the success of Mayan society and also in the biological and ecological conservation of the area and its resources. We still do not know the cause of the Mayan collapse, but we

have enough evidence to discard the hypothesis of poor management of soils and deforestation. Most of the techniques that the Maya used to manage their forests are not unique; they have been found scattered in many other traditional cultures, not only of the New World, but also in the Old World. This is not surprising, since we know that efficient subsistence techniques and useful species spread very rapidly, and it is not improbable that they might also have been discovered independently.

LESSONS FROM THE PAST

It is clear that there are more questions than answers in relation to the hypothetical silvicultural system of the old Maya. But, from the available information, there are several conclusions that emerge that may be of importance for the future conservation and management of tropical forests. From the research side, each abandoned *milpa* can be considered as an empirical experiment in directed succession.

Shifting agriculture, as practised by the Maya, can feed more people than we had assumed, while conserving a biological diversity for future use. It should be seen as a starting point for future permanent agriculture and silviculture in the lowland tropics, and it should not be seen as only a destructive technology. Secondary successions (fallows) in the lowland tropics can be managed in "the Mayan way" to produce a combination of useful species for multiple purposes.

Biological diversity can be conserved, even in densely populated tropical lowland areas, if appropriate resource use practices are followed. Regenerating rain forests from heavily used areas is possible if germplasm pools are conserved. Small forest patches (natural or managed) can help to maintain a high level of diversity in the lowland tropics. They should be considered as areas that can contribute to the conservation of biological diversity. Artificial forest gardens for biological conservation can be designed and created by man if he wishes to do so, in order to preserve species that he chooses to preserve.

Many tropical traditional cultures that still exist today have a great knowledge of their environment and resources. This knowledge is a human heritage that we should not lose. It has been valuable in the past, and it could be of utmost importance for the present and the future. Present-day agriculture is the result of an accumulated folk knowledge obtained from hungrily watching thousands of generations of food plants. When studying a tropical area that has been inhabited in the past, we should play close attention to the distributional patterns of abundance of species, since these are likely to be the result of man's actions.

A final point concerns the population density found in the lowland

tropical areas of south-
as a problem. Rather,
incorrect technology,
land-use planning. Th
projects, extensive graz
old Maya had temples,
agriculture, and artificia
wisdom and our congru

ACKNOWLEDGEME

I thank the Regents of
this contribution on a l
Estudios Mexicanos 3 (1

REFERENCES

Barrera, A.M., Gómez-Pompa,
sus implicaciones silvícolas a
Beltrán, E. (1959). (ed.) *Los*
INMERNAR: México, D.F)
Berg, C.C. (1972). *Olmediae. B*
Neotropica, New York Botan
Coe, M.D. (1984). *The Maya.* (
Flannery, K.V. (1982). (ed.)
(Academic Press: New York)
Flores, S. and Ucan, E. Ek. (19
Cuadernos de Divulgación I
Gómez-Pompa, A. (1971). Posi
tropical. *Biotropica*, 3, 125–3
Gómez-Pompa, A. (1987). On
Gómez-Pompa, A., Flores, E. a
the Maya. *Interciencia*, 12(1),
Gómez-Pompa, A. and Golley,
las culturas mesoamericanas
del Simposio CONACYT-NS
Gómez-Pompa, A., Vázquez, C.
resource. *Science*, 177, 762–5
Hammond, N. (1982). The explo
Hartig, H.M. (1979). *Las Aves*
México)
Lundell, C.L. (1937). *The Vegeta*
Peters, C.M. (1983). Observati
American Antiquity, 48, 610–1
Pohl, M. (1985). *Prehistoric L*
University Press: Cambridge)
Puleston, D.E. (1982). The role
Subsistence: Studies in Memor
Sosa, V., Flores, J.S., Rico-Gray
Maya. Etnoflora Yucatanense.

tropical areas of south-eastern Mexico today. This should not be considered as a problem. Rather, the problem lies in certain management practices, incorrect technology, and absence of broad ecological considerations in land-use planning. The present-day activities of dubious agricultural projects, extensive grazing and timber mining on the same sites where the old Maya had temples, towns, intensive hydraulic agriculture, permanent agriculture, and artificial and "natural" forests, should cause us to doubt our wisdom and our congruency.

ACKNOWLEDGEMENTS

I thank the Regents of the University of California for permission to base this contribution on a longer article which appeared in *Mexican Studies/ Estudios Mexicanos* 3 (1), 1–17 (1987).

REFERENCES

Barrera, A.M., Gómez-Pompa, A. and Vázquez, C. (1977). El manejo de las selvas por los Mayas: sus implicaciones silvícolas agrícolas. *Biotica*, 2, 47–60

Beltrán, E. (1959). (ed.) *Los recursos naturales del sureste y su aprovechamiento*. (Ediciones INMERNAR: México, D.F)

Berg, C.C. (1972). *Olmediae, Brosimeae*. Flora Neotropica Monographs 7. (Organization for Flora Neotropica, New York Botanical Garden: New York.)

Coe, M.D. (1984). *The Maya*. (Thames and Hudson: London)

Flannery, K.V. (1982). (ed.) *Maya Subsistence: Studies in Memory of Dennis E. Puleston*. (Academic Press: New York)

Flores, S. and Ucan, E. Ek. (1983). Nombres usados por los Mayas para designar a la vegetación. *Cuadernos de Divulgación INIREB*, 10, 1–33

Gómez-Pompa, A. (1971). Posible papel de la vegetación secundaria en la evolución de la flora tropical. *Biotropica*, 3, 125–35

Gómez-Pompa, A. (1987). On Maya silviculture. *Mexican Studies/Estudios Mexicanos*, 3(1), 1–17

Gómez-Pompa, A., Flores, E. and Sosa, V. (1987). The "pet kot": A man-made tropical forest of the Maya. *Interciencia*, 12(1), 10–15

Gómez-Pompa, A. and Golley, F.B. (eds.) (1981). *Estrategias del uso del suelo y sus recursos por las culturas mesoamericanas y su application para satisfacer las demandas actuales*. Memorias del Simposio CONACYT-NSF. Biótica 5(1,2). (INIREB: Xalapa)

Gómez-Pompa, A., Vázquez, C. and Guevara, S. (1972). The tropical rain forest: A non-renewal resource. *Science*, 177, 762–5

Hammond, N. (1982). The exploration of the Maya World. *American Scientist*, 70, 482–95

Hartig, H.M. (1979). *Las Aves de Yucatán. Fondo Editorial de Yucatán*, Cuaderno 4. (Mérida: México)

Lundell, C.L. (1937). *The Vegetation of Petén*. Carnegie Institute, Washington, D.C. 478, 10

Peters, C.M. (1983). Observations on Maya subsistence and the ecology of a tropical tree. *American Antiquity*, 48, 610–15

Pohl, M. (1985). *Prehistoric Lowland Maya Environment and Subsistence Economy*. (Harvard University Press: Cambridge)

Puleston, D.E. (1982). The role of Ramón in Maya subsistence. In. Flannery, K.V (ed.) *Maya Subsistence: Studies in Memory of Dennis E. Puleston*, pp. 353–66. (Academic Press: New York)

Sosa, V., Flores, J.S., Rico-Gray, V., Lira, R. and Ortiz, J.J. (1985). *Lista Florística y Sinonimia Maya*. Etnoflora Yucatanense, Fascículo 1. (INIREB: México)