Agroforest of pineapple: ethnoagroforestal system of biological importance for conservation in western Mexico

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INTRODUCTION

America stands out for being the center of origin, domestication and diversification of species, as well as for the use that man has given to a great variety of native and domesticated organisms for thousands of years (Clement *et al*., 2010; González y del Amo, 2012). Outstanding agricultural and cultural development, specialization in the management of their natural resources and social and cultural relations between peoples. The continent's tropical forests played an important role as areas of experimentation, diversification and dispersion of crops (Clement, 1999; Ranere *et al*., 2009; Zizumbo-Villarreal y Colunga-García-Marín, 2010).

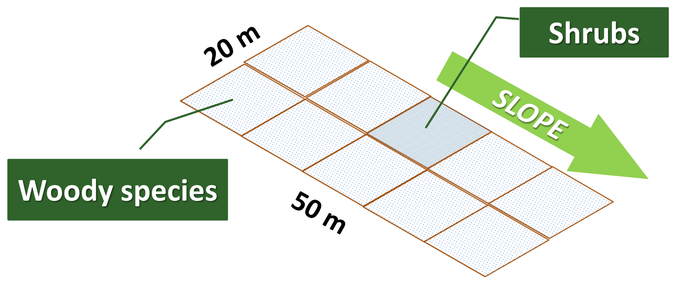
The residents' knowledge of the environment for the management and use of biological diversity resulted in a complex relationship between environmental units, thus identifying what we know as culture (Kirchhoff, 1960; Toledo y Boege, 2010). The Agrobosques could have been environmental units, where man modified aspects of the original structure and composition, mixing domesticated species or in different degrees of domestication, but conserving to a great extent the biodiversity and maintaining the ecosystem services of the original matrix (Wiersum, 2004; Toledo, 2016).

A representative example of an agrobosque is the cultivation of pineapple (*Ananas comosus*) of shade in western Mexico (Rosales *et al*., 2014). Although this tropical fruit is one of the most important worldwide for its production and consumption, it is more recognized for its conventional cultivation model and the negative environmental impacts. With this work we show historical aspects of its cultivation in western Mexico, peasant agroecological management, composition, structure and biodiversity.

METHODOLOGY

For this work, we conducted reviews of historical sources, interviews with producers to know the management of the agroecosystem and inventories in temporary plots (33) of 1,000 m² for eight locations in the states of Jalisco and Nayarit, Mexico (Rosales *et al*., 2014). Each plot was subdivided into 10 subplots of 10 × 10 m (100 m²), identifying and recording, within each of them, all the woody species ≥ 10 cm of normal diameter (DN = 1.30 m height of the base of the soil) or ≥ 3.0 m in height, rooted within the plot.

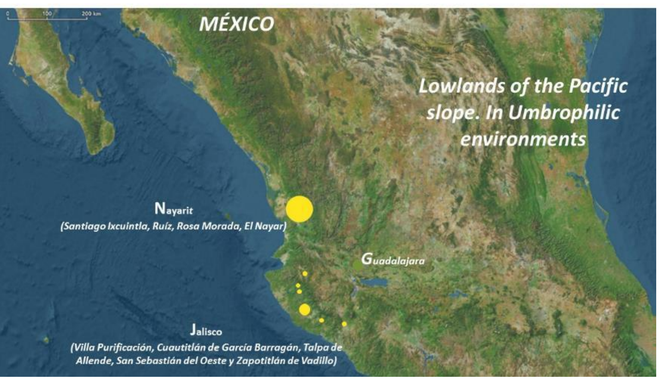
For each species the normal diameter, total height and silvicultural class or position in the canopy was recorded (Olvera *et al*., 1996; Suatunce *et al*., 2003). Wildlife inventories (mammals and birds) were made, in order to know their abundance. In order to obtain information about the management and age of the system, made a review of literature and historical sources, in addition semi-structured interviews were conducted (n=50) to owners of the pineapple Agroforest, communal and Ejidal authorities, agricultural technicians, some merchants (intermediaries) and to government authorities.



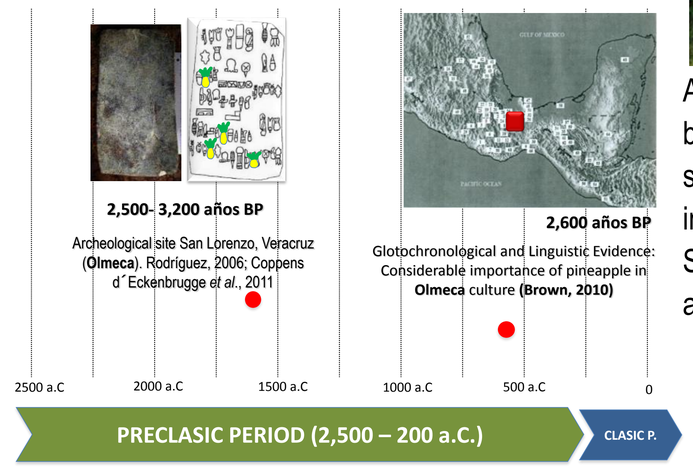
Temporary plots of 1,000 m²: Woody, shrubs and weeds species inventory.

RESULTS

Mexico grows pineapple under two modalities: Conventional (mainly improved varieties) and ancestral ethnoagroforestal management (Agroforest) with variety "Criolla or Red Spanish“ (first national production). Indigenous and mestizo peasants of western Mexico, has been managing for centuries (perhaps millennia) in an extensive scheme, with technology and local knowledge. It was registered in two states of the country (Jalisco and Nayarit) and nine municipalities of the Pacific slope, from sea level to 800 m height.



Main activities of sustainable management of pineapple Agroforest



Alpha diversity there were differences between sites and localities, explained by the management of structure for "shade", assemblages with introduced species and preference of native taxa useful by the producer. It can be similar in diversity with ecosystems of Tropical Mountain Cloud Forest and Subdeciduous Tropical Forest (Mexico) and similar agroecosystems (coffee and cacao) in Costa Rica (Turrialba) and Nicaragua (Carazo and Estelí).

We have registered more than 75 species of woody perennials (67 native and eight introduced). More than 62 species of Subdeciduous Tropical Forest. **Practically 8-9 out of 10 woody species are native.**

List of species, families and importance value index of pineapple Agrobosque in western Mexico

Specie	Family	Important Value Index (IVI)/Localities					
		R	C	V	Z	P	A
Astronium graveolens Jacq	Anacardi	0	0	0	2.86	0	4.62
***Mangifera indica* L.**[a]	Anacardi	2.92	1.98	4.63	2.77	0	2.33
Spondias mombin L.	Anacardi	0	0	0	8.48	1.3	0
***Enterolobium cyclocarpum* (Jacq.) Griseb.**	**Fabac**	**107.45**	**0**	**0**	**0**	**0**	**0**
Gliricidia sepium (Jacq.) Kunth. ex Walp	Fabac	0	0	3.44	0	0	4.10
***Hymenaea courbaril* L.**	**Fabac**	**0**	**111.20**	**62.27**	**74.76**	**154.28**	**195.79**
Inga laurina (Sw.) Willd.	Fabac	**24.83**	1.57	0	**31.59**	4.51	0

Canopy reaches up to 30 m in height, covers of 75-85% and densities of up to 800 individual/ha

Animal Diversity (Birds and Mammals): 39 species of mammals (41-42 expected species). Belonging to 7 orders and 15 families. We registered 47 bird species, who use the Agrobosque as an extension of the natural ecosystems and source of food available all year round.

CONCLUSIONS

- Pineapple Agroforest, opposed to the conventional model. It has been established for centuries (possibly millennia), prior to the development of improved varieties (negative environmental and social impacts). Composition, structure and diversity is very similar to a natural ecosystem, but the anthropized management makes it an agroecological, sustainable, resilient Etnoagroforestal system and represents an alternative to biocultural conservation for adaptation and mitigation to the Global Climate Change.

- It is a complement in the conservation of woody biodiversity in western Mexico, offers connectivity and buffer conditions between areas of intensive agricultural production and areas of native vegetation (agroecological landscapes), promote biological corridors and wildlife refuges, as happens with other agroecosystems under the shadow of the tropics (Perfecto *et al*., 2003; Montagnini, 2006).