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Management, biology and cultural importance of a wild food species in the Tehuacán Cuicatlán Valley, Mexico: The case of *Enterolobium cyclocarpum*[1]

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Key words: *Enterolobium cyclocarpum*, *in situ* plant management, wild food, Tehuacán-Cuicatlán valley, Mexico

Plant management is a form of human-plant interaction comprising a set of specific human practices manipulating plant species. *In situ* management (i.e. within a species' natural *habitat* and populations) includes strategies such as gathering, tolerance, enhancement, and protection (Casas et al. 1997a).

Casas and Caballero (1996) showed that artificial selection, carried out on *in situ* managed species, can modify the phenotypic and genotypic structures of plant populations. They suggested that *in situ* artificial selection could be a possible route of domestication for species that are not prone to be domesticated under cultivation (*ex situ* management) because of biological characteristics such as long life cycle and cross-pollination. In some cases species that are scarcely available in the wild are managed more intensively (Casas et al. 1997b).

In this paper I focus on a specific case study of *in situ* plant management in order to answer the following questions: Does *in situ* management modify the phenotypic and genotypic structures of plant populations? Or do different grades of intensity exist, and therefore different effects on its populations, even within the same form of plant management? What are the effects of *in situ* management on a species of secondary economic importance? How do biological and cultural constraints limit and shape plant management? This case study focuses on the management of the tree *Enterolobium cyclocarpum* (ENCY) in two communities of the Tehuacán-Cuicatlán valley, Oaxaca, Mexico. In the study area ENCY seeds are eaten and its wood used for construction.

Methods

Open interviews were carried out in the communities of Santa Maria Tecomavaca and San Martin Toxpalan in order to determine the local uses of ENCY, and to determine if cultural preferences existed for certain morphological variants. A free-listing exercise on wild food plants was used to assess the relative importance of ENCY as a wild food in the two communities (n=32 in S.M. Tecomavaca, n=36 in S.M. Toxpalan). Finally, in a survey wild and managed ENCY were identified and localized, and a set of morphological characters of both wild and managed ENCY were sampled. The ethnobotanical information collected in the first phase served as a guide to establish the set of biological characters to be sampled (Table 1).

The measurement of the biological characters (Table 1), was conducted on wild trees growing in San Martin Toxpalan (n=20) and tolerated trees growing in Santa Maria Tecomavaca (n=19). Wild trees growing in San Martin Toxpalan were chosen since in Santa Maria Tecomavaca, where the study was started, the fertile wild population was too small (n=8). Ten randomly selected fruits were measured for each tree sampled. The canopy was assumed to have an elliptic shape and its area

[1] This paper is a summary of a thesis (Giovannini 2004) submitted in partial fulfilment of the requirements for the degree of Master of Science in Ethnobotany at Department of Anthropology, University of Kent at Canterbury.

calculated by means of a mathematical formula. These data were used to build a basic data matrix of 39 trees * 10 state characters. The mean values of the measures were used as state characters. A Principal Component Analysis (PCA) was performed on the standardized basic data matrix by means of the computer program NTSYS-PC 1.8 (Rohlf 1993).

Table 1. Set of biological characters of wild and tolerated *E. cyclocarpum* sampled in Santa Maria Tecomavaca and San Martin Toxpalan

Biological character
Pod perimeter
Pod weight
Pod thickness
Number of seeds per pod
Maximum seed height
Maximum seed width
Maximum seed thickness
Maximum seed chamber height
Maximum seed chamber width
Canopy of the tree

Results

Wild food plants in the study area and survey of wild and tolerated populations of ENCY

The free-listing data in both communities gave an overview of the most important wild food plants for each community. When the plants listed by all the informants are ranked according to Smith's index[2] (Smith 1993), ENCY (locally known as "Nacastle") ranks 19th in San Martin Toxpalan, and 44th in Santa Maria Tecomavaca. Consensus analysis shows high consensus between informants of the same community (Table 2). Wild and tolerated populations of ENCY counted during the surveys are also shown in Table 2.

Table 2. The results of the Freelisting on wild food plants and of the survey

	S.M. Tecomavaca	S.M. Toxpalan
Freelist ranking	44th	19th
Agreement (ratio of 1st to 2nd Eigen value)	18.9	18.9
Wild *E. cyclocarpum*	8	27
Tolerated *E. cyclocarpum*	27	40

Biological sampling (PCA)

The Eigen-values of the first three principal components, calculated by means of multivariate analysis, explain 48%, 20%, and 10% of the biological character's total variance, respectively. In total, the first three principal components explain about 77% of the total variance observed in the variables, while each one of the other components computed account for less than 10% of the total variance.

Table 3. The loading of the characters measured in each principal component

Character	Component		
	C1	C2	C3
Fruit weight	0.84	0.48	0.14
Pod perimeter	0.84	0.40	0.22
Pod thickness	0.62	-0.00	0.36
Seed chamber height	0.83	-0.27	-0.30
Seed chamber width	0.82	-0.41	-0.03
Number of seeds per pod	0.20	0.93	0.17
Maximum seed width	0.87	-0.35	0.07
Maximum seed height	0.87	-0.23	-0.17
Maximum seed thickness	0.22	0.41	-0.49
Canopy	0.14	0.36	-0.62

The loading of the characters measured in each principal component (Table 3) suggests that:

- The first principal component is correlated with pod and seed sizes. It groups together pod weight, pod perimeter, maximum seed width, maximum seed height, seed chamber width, and seed chamber height.
- The number of seeds per pod is the character that has a major weight in the second principal component.
- The third principal component is mainly determined by canopy and seed thickness characters.

The projection of the sampled trees in the space defined respectively by the first and second, and the first and third, principal component shows clusters of trees that are both wild and managed (Fig. 1).

[2] Smith's index is a measure of salience that takes into account both the frequency, and the order with which items are listed (Borgatti 1996).

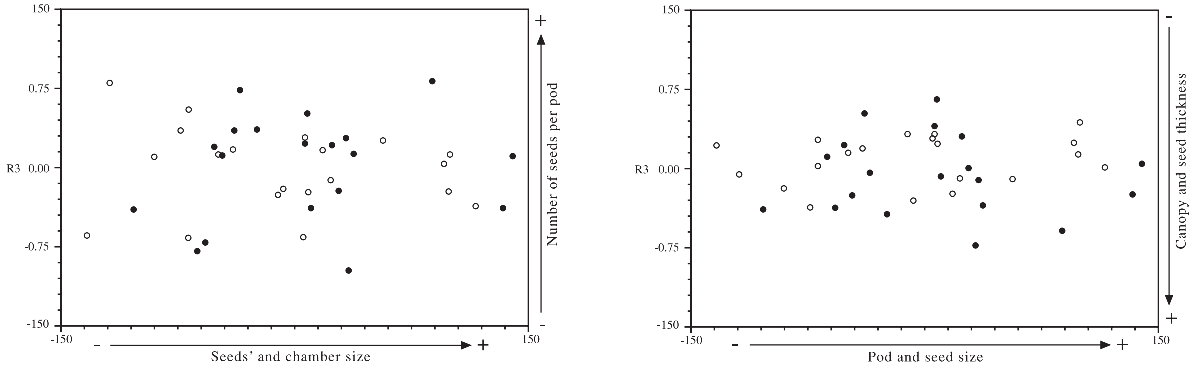

Fig. 1 Principal component analysis on the 39 sampled trees: Each sampled individual of *E. cyclocarpum* is projected in the space defined by the first and second principal component (on the left) and by the first and third principal component (on the right). Each empty dot represents a wild tree, each black (filled) dot represents a tolerated tree. The variation of the biological characteristics of the trees within the two dimensions, indicated by the arrows, are deduced from the basic data matrix containing the mean values of the morphological characters measured in managed and wild individuals of *E. cyclocarpum*, and from the eigen vector matrix with the loading of each character in the three principal components. The scales on the X and Y axis do not refer to these variations.

Discussion

In both communities there is little management of ENCY and this largely relates to tolerating some as shade-trees on cultivated land. When peasants decide to tolerate or cut a tree they are not considering fruit or seed characteristics. Accordingly, the biological sampling showed that tolerated trees of ENCY in Santa Maria Tecomavaca do not show any pattern of morphological variation of the edible fruit when compared to wild trees. Rather, it seems that trees with a larger canopy are preferred. These spared trees are probably older than the wild trees, rather than genetically different.

In spite of the intraspecific variability of ENCY, as shown in the analysis of the biological samples, peasants do not show any interest in "improving" the species by means of artificial selection. Informants claimed that there is no need to select for or against characters such as size, colour, and taste, because for them "they are all the same". Moreover, as one informants pointed out, because of its scarce commercial value, "there is no need to make it more attractive or appealing to the people. On the contrary of cash crops such as lemon and mango, where characters such as colour and size can influence their market value" (Hernandez, personal communication).

The species' long lifecycle, and its mode of reproduction by means of insect pollination, are further elements that do not provide an incentive for the artificial selection of desired phenotypes. This is probably the reason why a processing technique, the roasting of ENCY seeds by means of hot embers and ashes, has been elaborated to overcome the hardness of the seed coat, instead of selecting against this character. The surveys indicated that both wild and tolerated ENCY are more abundant in San Martin Toxpalan than in Santa Maria Tecomavaca, this is probably due to both slightly different climatic and ecological conditions and different patterns of use (where the edible fruit is less appreciated, the tree has been apparently logged for wood). Moreover, qualitative data suggested that local production of ENCY fruits largely meet local demand in both communities. Further support for this interpretation is given by informants when enquiring about the scarce management of ENCY: "there always are enough fruits left in the soil" and no need for more. The Mazatec lexeme for ENCY "ya-to-ffa", meaning literally "tree of many seeds", is an indication of the perceived abundance of seeds produced by this species. In this case the biological characteristics of the species, its high productivity, and their perception by local people, create an adequate *supply* of the resource and no incentive for more intensive management.

In conclusion, this case studies shows that "biological constraints and human motivation" (Johns 1996:198) are both key factors in shaping plant management. The cultural significance of a species influences people's *demand* for it, while biological characteristics determine its spatial and temporal availability (the *supply*) and the kind of management that people can exert on it. *In situ* management of a plant species, even if not necessarily leading to genotypic changes, could help to conserve its genetic pool and populations. Indeed the species was found to be more abundant in the community were its economic importance was higher.

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