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Plants of Local Interest for Medicinal and Conservation Purposes in Morelos, Mexico

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ABSTRACT This study attempts to test whether local selection of species, whose conservation is considered a priority at the community level, has the potential of contributing to public health care showing vegetal species valuable in traditional medicine. This work was carried out in Temimilcingo, a community immersed in the deciduous forest in the Sierra de Monte Negro State Reserve, Morelos, Mexico. Interviews and workshops were used to register Traditional Ecological Knowledge of participants. Distribution of knowledge related to plants used by informants and its social valuation was estimated, and later on compared using Multivariate Methods (Classification and Ordination). Participants selected 14 late and mid serial species distributed in the deciduous forest whose future conservation they felt should be guaranteed. Twelve species have a traditional medicinal use that is closely related to the Morelos´s state main causes of morbidity and mortality, and 10 of them have been already corroborated by scientific protocols. Therefore, these species should be promoted in the plans for sustainable development of indigenous communities.

INTRODUCTION

The forms of local and indigenous utilization of natural resources are multiple and integral. Berkes et al. (2000) establish that these forms of use are supported on Traditional Ecological Knowledge (TEK), which is characterized by mechanisms that originate, conserve and transmit this knowledge from generation to generation. According to Toledo et al. (2003), traditional knowledge is linked to community institutions and to the way in which the local and indigenous peoples perceive reality and relate to it to manage ecological complexity in a holistic way.

Based on their TEK, the participation of local and indigenous communities in conservation and development projects has been promoted. To improve the implementation of local participation, it is necessary to build up the policies pertaining to environmental conservation since an intercultural perspective considers local perceptions; values and interests; context of conservationist proposals; intra-community het-

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erogeneity; and ability to recuperate and adapt to local conservation institutions (Law and Salick 2007; Shengji et al. 2010). Shengji et al. (2010) suggest that the government should support local institutions, local rights to property and local utilization of resources. Kareiva et al. (2007) explain that domesticated environments, where nature has been used and controlled, are modeled for social welfare, and that local utilization of resources constitutes a kind of adaptive management of domestic forests. These environments demand management with conceptual and technical foundations of their own (Berkes et al. 2000; Toledo et al. 2003; Michon et al. 2007). In addition, Walker et al. (2004) recommend establishing an adaptive policy that allows normative flexibility to ease their persistence.

One of the opportunities generated by local participation is the integration of TEK to scientific knowledge in conservation and development projects. This has resulted in the identification of convergences and complementarities between both kinds of knowledge in the design of resource sampling, inventory, systematic recording, analysis of information, and generation of hypotheses regarding its utilization. Another area of opportunity for this integration is the determination of species that require continuous observation for their conservation, which are selected locally because they satisfy basic needs or have some cultural value for inhabitants of the community (Danielsen et al. 2005; Law and Salick 2007). Moreover it should be recognized that local valued resources have contributed to social welfare; such as medicinal plants whose traditional use have been positively associated to the development of nowadays medicine (Farnsworth et al. 1985; Vasisht and Kumar 2002; Gurib-Fakim 2006; Sahu et al. 2010; Pérez et al. 2011).

In this sense, this study is an attempt to test that selection of species whose conservation is considered a priority at the local level which can contribute to public health care. With this goal in mind, the researchers selected informants of the Temimilcingo community to answer the following questions: Which are the species whose conservation is a priority for the community's informants? Which are the characteristics of the TEK related to these species, specially their distribution, social valuation and contribution to public health care?

METHODOLOGY

Study Area

Temimilcingo is located in the municipality of Tlaltizapán, in the central area of the state of Morelos (99º09'41" N and 18º43'42" W, at 1, 010 m asl) (Fig. 1) and in the vicinity of the Sierra de Monte Negro State Reserve (SMNSR). This Reserve was declared in 1998; it has an area of 7,328 hectares subject to strong pressures caused by urban sprawl of Cuernavaca, Yautepec and Cuautla cities since 1970.

The main type of vegetation of the SMNSR is a tropical deciduous forest (TDF), with biological and ecological importance for the state of Morelos because it is part of the Balsas River Basin, a center of endemism and diversification of plant species which provides environmental services, such as climate regulation, water capture and non-timber forest species (NTFS) for the inhabitants, who use them based on their TEK. This kind of knowledge has been generated and transmitted since pre-Columbian times by inhabitants of Temimilcingo, influenced by *Nahuatl* and *Otomi* culture.

Information Gathering

The objective of the work was shared in a meeting with the local authorities in order to ask permission for consulting with inhabitants in Temimilcingo community. Subsequently, the researchers carried out nine semi-structured interviews and three workshops.

A local promoter, for whom the researchers have been working for 10 years introduced them to the community to carry out the semi-structured interviews: 1) One household: mother, father and their son, 65, 71 and 34 years old, respectively. 2) Three males, one 50 years old, two 65 years old. 3) A 45-year-old traditional healer, and 4) A 71-year-old herbalist and his 68 years old wife. Each one of the nine interviewees was asked to elaborate a freelist of the name and medicinal uses of plants, their effectiveness and availability. Once the plant list was obtained, interviewees selected and organized hierarchically a freelist of Species of Local Interest for Conservation (SLIC).

After explaining their project to principals of elementary and high schools the researchers

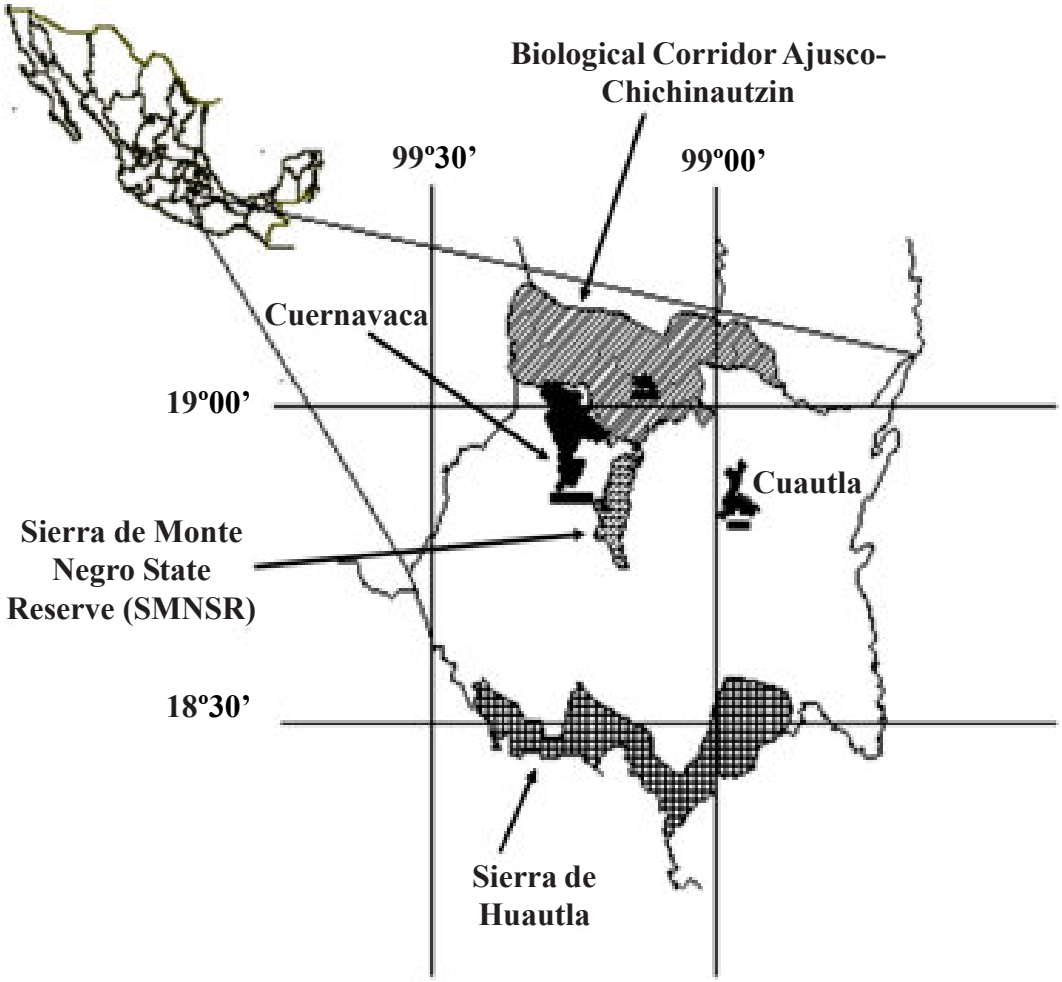

Fig. 1. Location of three Natural Protected Areas: Sierra de Monte Negro, Sierra de Huautla and Biological Corridor Ajusco-Chichinautzin and the biggest cities Cuernavaca and Cuautla of Morelos State

asked them to convene to housewives. Three workshops were carried out with 34 housewives. After explaining the research protocol to the housewives, they were asked about the name of the plants, knowledge and perception of their use, including medicinal qualities and spatial and temporal availability of the plants. Next, participants listed and organized hierarchically the SLIC according to their preference while explaining the reasons for their choice. Selection was done by consensus. At the end of the workshops, a socio-economic questionnaire was handed out to participants that included the question: Which are the plants from the TDF that you use?

Data Analysis

Qualitative Analysis

The interviews were recorded and transcribed. The analysis of their contents was done according to the thematic followed during interviews. In the workshops, information recorded by informants was written on a piece of paper (1 x 1.2 meters) by the researchers following the same thematic categories that in interviews.

Quantitative Analysis

In order to analyze similarities and/or differences between informant's knowledge about

plants species, the researchers accounted the number of quotations received for each species. This number was an indicator of the distribution of TEK by informants. Likewise, a relative distribution was obtained by the proportion of times that a plant was mentioned with regard to the total of participants in interviews and workshops. Social valuation was estimated organizing the species in a hierarchy according to importance given by the informants and counting the number of quotations that a species received from first to third place.

Analysis about some of the causes of differences in TEK related to gender was possible because in the workshops were consulted only women and, we knew gender and age of interviewees too. Based on this information, five indicators of distribution of TEK were estimated with the four lists of species mentioned by the informants: 1) workshops, 2) interviews, 3) workshops and interviews, 4) SLIC and 5) questionnaires. Two obtained with women (1, 5), one with man (2) and, two values which represented a consensus in the TEK of women and men (3, 4).

The social valuation of the species was estimated counting the number of times that a species was mentioned from the first to the third place during the selection of Species of Local Interest for Conservation. Given the importance of collective opinion in workshops, we gave more relevance to the individual opinion of the women separating the plant mentioned in first place vs plants mentioned in second-third place in the questionnaires. As a result, three values were estimated.

The 33 species with the greatest indicators of distribution of TEK and social valuation, SLIC and species registered in questionnaires were used to analyze the distribution of TEK according to gender and age. The researchers followed two complementary methods of multivariate analysis, Classification and Ordination, using the NTSYS-pc program version 2.1 by Rohlf (2000). Application of these methods requires the preparation of a data matrix in whose lines were the 30 common names of the 33 species recorded. Scientific name was not considered in the matrix because informants gave the same name to three pairs of species due to they having the same traditional use. In the columns, the eight indicators, five correlate to the distribution of TEK and three with social valuations.

Classification started from the standardization of characters, anticipating an equal contribution to the analysis through the algorithm of linear transformation. A similarity matrix was calculated between the species using the standardized matrix and the Correlation Coefficient. A cluster analysis was performed on the resulting matrix with the sequential, agglomerative hierarchical and nest method (SAHN) using the Unweighted Pair Group Method with Arithmetic Mean (UPGMA); the grouping derived was represented in a dendrogram. The cophenetic correlation coefficient was calculated, which indicated the robustness of the cluster.

Ordination of the matrix was carried out using Principal Component Analysis (PCA) to determine the relations between the species based on distribution of TEK and social valuations, through their arrangement in a graph and the importance of the variables. First, the data matrix was standardized and the correlation coefficient between characters was estimated. This matrix was analyzed with the EIGEN module, which produced two matrixes: 1) eigenvalues, which explained the accumulated load of each ordination axis, and 2) eigenvectors, which contained the weight of each character in each one of the ordination axes. The eigenvector matrix was multiplied by the standardized matrix to project the species in the character space with the PROJECTION program and graphs were made with the MATRIX PLOT program to represent the species in a bi-dimensional space with the first and second ordination axes.

Moreover, the researchers carried out a statistical test of independence to analysed if there is relationship between gender and age of the informants with the selection of the Species of Local Interest for Conservation. They tested next hypotheses: 1) Ho = Selection of SLIC is independent of age considering old (more than 60 years) and young people and, 2) Ho = Selection of SLIC is independent of gender. They applied a X_i^2 with $\alpha = 0.05$ as level of significance.

Medicinal Uses and Contribution for Conservation of Species Selected by TEK

Characteristics that would sustain the contribution of SLIC to public health and environmental preservation were searched bibliographically in specialized journals.

The health aspect of this study implied the registry of the traditional medicinal uses mentioned by the informants for the SLIC and the review of the main causes for morbidity (2000-2009) and mortality in Morelos (2000-2008), as recorded by Morelos Health System (2011) in Statistical Annual Records. Pharmacological information was gathered regarding the SLIC through the search of specialized papers Google and Scirus to establish coincidences in the traditional medicinal use of the SLIC with what has been proven scientifically and with the main causes of morbidity-mortality in Morelos. Also, consultations were carried out in the analysis of an historical ethnobotany source (the Florentine Codex, which have information from 1548 to 1585) and in other, more recent sources regarding the importance of the SLIC at the national, regional and state level.

In addition, official policy and local perception regarding the importance of species for conservation were compared. Considering this target the researchers consulted: the IUCN Red List of Threatened Species; the Convention on International Trade in Endangered Species (CITES); the Official Mexican Norm for Environmental Protection; the Information System for Reforestation; and the Morelos Forest Diagnosis.

RESULTS

Species Widely Known by Participants

Some of the species widely interviewed were: brasil (*Haematoxylum brasiletto)*, quinas (*Hintonia latiflora*, *Exostema caribaeum*), pegahueso (*Euphorbia tanqua-huete*), hierba rasposa (*Tournefortia densiflora*) and verbena (*Verbena carolina*). To the informants who participated in workshops stood out the knowledge about: chichihua (*Euphorbia graminea*), hongo de cazahuate (*Pleorotus ostreatus*), paima (*Brahea dulcis*), anona (*Annona squamosa*), biznaga (*Coryphantha elephantidens*) and cuatecomate (*Crescentia alata*). Arnicas (*Galphimia glauca, Heterotheca inuloides*), cuachalalate (*Amphipterygium adstringens*) and palo dulce (*Eysenhardtia polystachya*) were widely known by participants if we considered together interviews and workshops.

Based on the traditional knowledge registered in the 22 questionnaires recovered (65%), two species were widely known, cuachalalate with 14 quotations and arnica with 10. These values were five or more times higher than those given for the rest of the species. As a result of the selection of Species of Local Interest for Conservation, cuachalalate was the most widely mentioned species, followed by arnica, pegahueso and quinas (Table 1).

Some Biological and Ecological Characteristics of the Widely Known Species

Informants mentioned 131 species, 97 of which are collected from the SMNSR. The 33 most widely known species belonged to 20 families and one fungus; the most abundant were: Fabaceae with six species and Asteraceae with three. 56% of these were trees, 26% herbs and 12% shrubs. 71% of them were medicinal (Table 1).

The 13 Species of Local Interest for Conservation are natives of America and include eight trees, an arborescent species, a shrub, two herbs and a vine. With the exception of pipiscas (*Porophyllum calcicola*), which are edible, and a palm (*Brahea dulcis*), which is used in construction, the rest of the plants are medicinal (Table 1). They are distributed in habitats that are subject to different levels of intervention; cuachalalate, palo dulce, brasil, cacaloxochitl (*Plumeria rubra*), palms and quinas occupy late and intermediate serial stages of the TDF. Cuatecomate grows primarily in the early serial stages, as arnica (*Heterotheca inuloides*) and prodigiosa (*Calea zacatechichi*), which are distributed in the side of the roads and agricultural fields. There are some pipiscas, cuachalalate, pegahueso, cacaloxochitl and cuatecomate individuals fostered in the gardens and agricultural fields.

Local Perception of the Species by Their Social Valuation

Cuachalalate had the highest social valuation because it was mentioned 14 times in the first to third place followed by arnicas, which were chosen three times in the same position. A similar pattern was observed in the questionnaires answered by the housewives, cuachalalate was registered seven times in the first place and arnica three times. In the selection of Species of Local Interest for Conservation the positions were exchanged, cuachalalate was recorded four

Table 1: Widely known species by informants in Temimilcingo

Vernacular name/Scientific name (Botanic family)	*Functional group*	*Local traditional use*	*Distribution of TEK(No. quotations)*				
			I	*W*	*I+W*	*Q*	*SLIC*
Anona/*Annona squamosa* L. (Annonaceae)	T	F		3	3		
Árnica/*Galphimia glauca* Cav. (Malpighiaceae), *Heterotheca inuloides* Cass. (Asteraceae)	SH	M	6	3	9	10	3
Biznaga/*Coryphantha elephantidens* (Lem.) Lem. (Cactaceae)	Su	M		3	3		
Bonete/*Jacaratia mexicana* A. DC. (Caricaceae)	T	F, M	3	2	5	2	
Brasil/*Haematoxylum brasiletto* H. Karst. (Fabaceae)	T	B, M	6	2	8		1
Cacaloxochitl/*Plumeria rubra* L. (Apocynaceae)	T	M	1		1		1
Caña fistula/*Cyrtopodium punctatum* (L.) Lindl. (Orchidaceae)	H	M	1	1	2	1	
Chapulixtle/*Dodonaea viscosa* Jacq. (Sapindaceae)	S	R	4		4	2	
Chichihua/*Euphorbia graminea* Jacq. (Euphobiaceae)	H	F	1	3	3		
Cuachalalate/*Amphipterygium adstringens* (Schltdl.) Standl. (Julianaceae)	T	M	7	3	10	14	8
Cuahulote/*Guazuma ulmifolia* Lam. (Sterculiaceae)	T	E, M		2	2	2	
Cuatecomate/*Crescentia alata* Kunth (Bignoniaceae)	T	M	3	3	6	2	1
Guaco/*Aristolochia elegans* Mast. (Aristolochiaceae)	V	M	2	1	3		1
Guachocote/*Malpighia mexicana* A. Juss. (Malpighiaceae)	T	F, M	1	3	4		
Guajes/*Leucaena esculenta* (Moc. and Sessé ex DC.) Benth., *Leucaena leucocephala* (Lam.) de Wit (Fabaceae)	T	E, F	1	1	2	1	
Guamuchil/*Pithecellobium dulce* (Roxb.) Benth. (Fabaceae)	T	E, F		2	2	1	
Hierba del golpe/*Asterohyptis stellulata* (Benth.) Epling (Lamiaceae)	H	M	1		1	2	
Hierba rasposa/*Tournefortia densiflora* M. Martens and Galeotti (Boraginaceae)	H	M	5	2	7	1	
Huizache/*Acacia farnesiana* (L.) Willd. (Fabaceae)	T	E, M		2	2	1	
Hongo de cazahuate/*Pleorotus ostreatus* (Tricholomataceae)	H	F	1	3	4		
Injerto de huizache/*Psittacanthus calyculatus* (DC.) G. Don (Lorantaceae)	S	M	2		2	1	
Mezquite/*Prosopis laevigata* (Humb. and Bonpl. Ex Willd.) M.C. Johnst. (Fabaceae)	T	E		1	1	1	
Palma/*Brahea dulcis* (Kunth) Mart. (Arecaceae)	S	B, H, M	2	3	5		1
Palo de 3 costillas/*Serjania schiedeana* Schltdl. (Sapindaceae)	V	M	2		2	3	
Palo dulce/*Eysenhardtia polystachya* (Ortega) Sarg. (Fabaceae)	T	B, M, Fe	5	3	8	3	2
Pegahueso/*Euphorbia tanquahuete* Sessé and Moc. (Euphorbiaceae)	T	M	5	2	7	1	3
Pipiscas/*Porophyllum calcicola B.L. Rob. and Greenm.* (Asteraceae)	H	F	3	2	5		
Prodigiosa/*Calea zacatechichi* Schltdl. (Asteraceae)	H	M	4	2	6	3	1
Quina/*Hintonia latiflora* (Sessé and Moc. ex DC.) Bullock, *Exostema caribaeum* (Jacq.) Roem. and Schult. (Rubiaceae)	T	M	5	2	7		3
Verbena/*Verbena carolina* L. (Verbenaceae)	H	M	6	0	6		

Functional groups: Su = Succulent, H = Herb, S = Shrub, T = Tree, V = Vine Uses: B = Building, E = Firewood, Fe = Fence, F = Food, H = Home, M = Medicinal, R = Reforestation Information Acquisition: I = Interviews, W= Workshops, I+ Q = Interviews+Workshops, Q= Questionnaires, SLIC = Species of Local Interest for Conservation, F=Fungus, E=Egiphyte, A=Arborescent

times in the first place and arnica six times (Table 1).

Multivariate Analysis

Classification of the species conformed two main groups. The first (a) included cuacha-lalate and arnicas, the most widely known species (Fig. 2). The second is subdivided into two sets (b, c), the first set included some of the SLIC: palo dulce, prodigiosa, cuatecomate, quinas, pega-hueso, and brasil.

In the ordination, PC1 (Principal Component) explained 66% of the variation, PC2 13% and PC3 12%. The variables that contributed the most to PC1 were social valuation (0.96) and the distribution of TEK (0.93) obtained in the selection of Species of Local Interest for Conservation. The next variables were the distribution of TEK (0.89) and the social valuation in the first place (0.86) registered in the questionnaires. In PC2 stood out the distribution of TEK obtained by the sum of interviews and workshops (0.58).

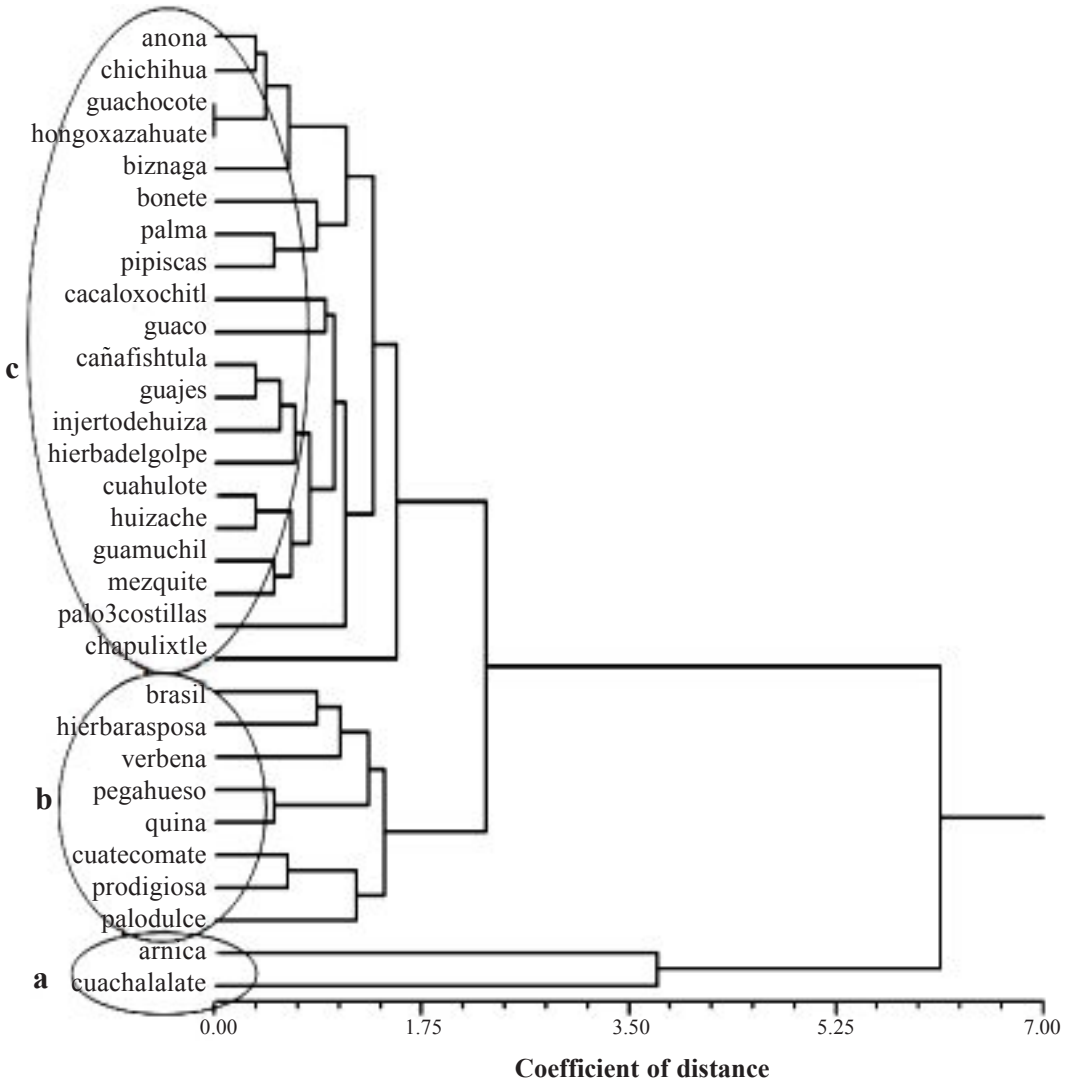

Fig. 2. Classification of the species most widely known and valued

Species dispersion with regard to PC1 shows the separation of arnicas and cuachalalate (Group A) as compared to the rest of the species (Group B2, C) and as compared to the set formed by palo dulce, prodigiosa, pegahueso, quinas and brasil (Group B1) (Fig. 3). All the species mentioned before were selected by the informants because their presence in the near future is at risk. In terms of PC2, two sets can be observed; one near the section of the axis with positive values which included outstanding species by being widely known in any of activities implemented (workshops and interviews) or in the sum of both (Groups B1, B2). The species that did not stand out in either of these activities are found in the negative values (Group C).

Independence Test

Estimated values were lower than critical values, under the significance level established. Thus, in both cases we accepted the null hypothesis and we concluded that the Selection of the Species of Local Interest for Conservation was independent of age and gender of informants who choose the same species to be preserved.

Selected Species for Public Health Care

According to the Morelos Health System (2011) acute respiratory infections were the main cause of illness in Morelos inhabitants in the years 2000 to 2009 (Table 2). During the same period, intestinal infections and urinary tract infections remained respectively in second and third place. Gastric ulcers went up from seventh place in 2000 to fifth starting in 2005 until 2009, while diabetes occupied the eleventh place in 2000 and the eighth since 2006.

Morelos Health System (2011) reported that heart diseases were the first cause of mortality

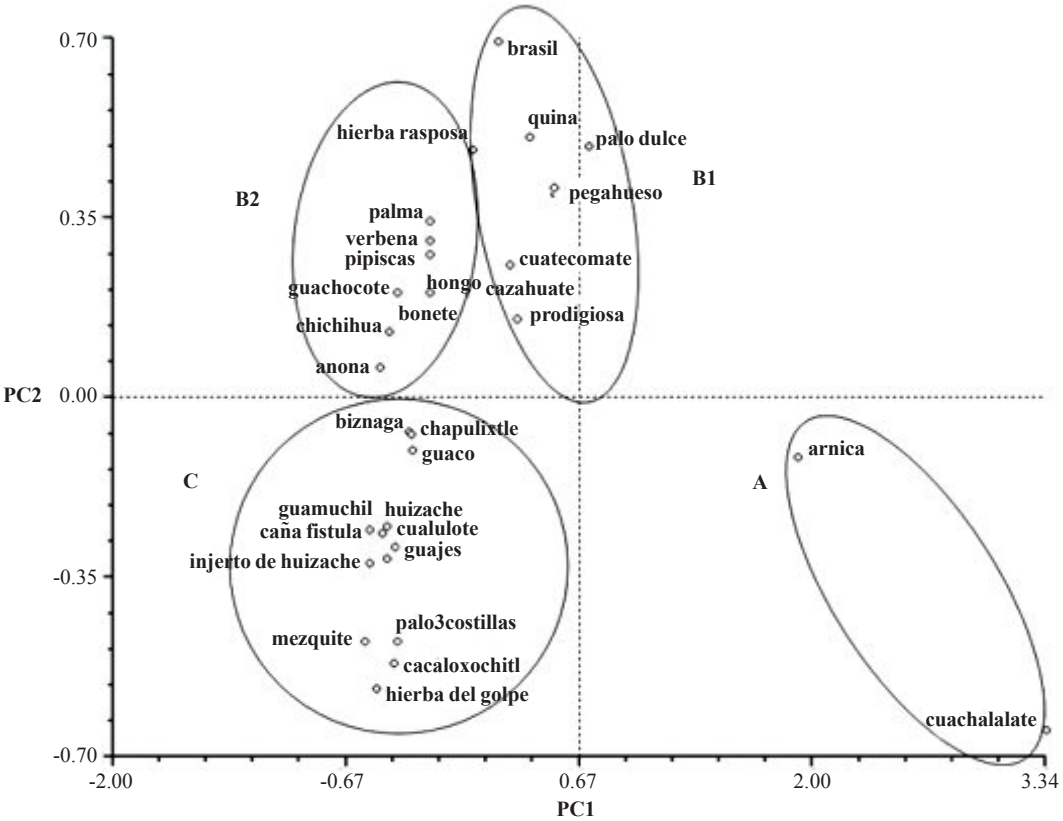

Fig. 3. Ordination of the species most widely known and valued

Table 2: Records of primary causes of illness among inhabitants of the state of Morelos from 2000 to 2009

Cause of illness	*Place occupied as cause of illness/year*									
	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Acute respiratory infections	1	1	1	1	1	1	1	1	1	1
Intestinal infections	2	2	2	2	2	2	2	2	2	2
Urinary infections	3	3	3	3	3	3	3	3	3	3
Scorpion sting	5	5	5	4	4	4	4	4	4	4
Ulcers, gastritis and duodenitis	7	6	6	7	6	5	5	5	5	5
Diabetes mellitus	11	11	11	10	10	9	8	8	8	8
Sore throat and tonsillitis	17	16	14	5	7	7	20	15	15	14
Pneumonia and bronchopneumonia	19	-	18	19	18	17	19	19	18	17

in Morelos from 2000 to 2008. Diabetes occupied the third place among the main causes of mortality from 2000 to 2006; by 2007, it had moved up to second place (Table 3). In fact, the percent of deceases due to diabetes rose from 11.1% to 15.6% (2000-2008). Although malign tumors have fluctuated between the second and the third place as a cause for mortality, the percentage of deaths has increased from 13.9% (2000) to 14.8% (2006).

Informants mentioned that 12 of the 14 SLIC were used in traditional medicine to treat some of the main causes of morbidity and mortality of inhabitants of Morelos, such as in the case of skin, heart, kidney and stomach diseases, as well as diabetes and scorpion stings (Table 4). It was found that the use of 10 species in traditional medicinal was corroborated by experimental protocols, as was the case of cuatecomate for treating respiratory illnesses and brasil and palo dulce for treating urinary illnesses, two of the primary causes of morbidity in Morelos. Moreover, the effectiveness of quinas in treating diabetes, one of the primary causes of death, has been proven effective. It is worth highlighting the usefulness of these medicinal resources in the treatment of diseases that were not mentioned by the informants, for example, the anticancer effects of cuachalalate, arnica, cacaloxochitl and palo dulce.

Classification of the SLIC According to Official Norms

Although none of the 33 species widely known by participants in Temimilcingo were considered at risk by international and national regulations, some of the SLIC have been classified as threatened. In appendix II of the CITES, only families Cactaceae (biznaga) and Orchidaceae (caña fistula, *Cyrtopodium punctatum*) are listed. Meanwhile, Mexican Official Norm for Environmental Protection classifies biznaga as a threatened species in Mexico. Cuachalalate, cuatecomate, palo dulce, brasil and cacaloxochitl were classified threatened in the state of Morelos. These five species have been officially recommended for reforestation in Mexico.

DISCUSSION

Most of the SLIC are characterized for being widely known among informants. This is partially explained by cultural background of participants that support the use of species. In addition, the traditional medicinal use of the SLIC coincides with the primary causes of morbidity and mortality in Morelos. There are also coincidences between local governmental agencies and informants regarding the priority species for conservation, which could be useful for gen-

Table 3: Records of primary causes of death among inhabitants of the state of Morelos from 2000 to 2008

Cause of death	*% deaths*								
	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Hearth diseases	14.5	15.6	15.7	15.8	-	14.5	15.4	15.7	16.1
Malign tumors	13.9	13.3	13.4	13.9	-	13.6	14.8	13.7	12.5
Diabetes mellitus	11.1	11.3	12.4	12.9	-	13.3	13.3	14.1	15.6
Accidents	7.3	7.2	6.3	7.0	-	6.5	7.1	7.5	6.6
Liver diseases	6.6	7.1	6.9	7.1	-	6.9	7.0	6.8	6.9
Brain-vascular disease	5.5	5.4	5.1	5.2	-	5.5	5.0	5.3	5.4

Table 4: Traditional medicinal uses of plants corroborated by scientific protocols

Scientific name	*Local traditional medicinal use corroborated*	*Scientific protocol author(s)*	*Other medicinal uses corroborated*
Heterotheca inuloides Cass.	Injuries	Freixa et al. 1998; Gene et al. 1998	Anti-carcinogenic (Kubo et al. 1996)
Haematoxylum brasiletto H. Karst.	Illnesses of heart and kidneys	Yasunaka et al. 1997	
Plumeria rubra L.	Throat infections		Anti-carcinogenic (Kardono et al. 1990)
Amphipterygium adstringens (Schltdl.) Standl.	Stomach ulcers	Oviedo-Chávez et al. 2004; Navarrete et al. 2005; Castillo-Juárez et al. 2007	Anti-carcinogenic (Chávez et al. 2005)
Crescentia alata Kunth	Respiratory illnesses	Rojas et al. 2001	Anti-inflammatory (Autore et al. 2001)
Aristolochia elegans Mast.	Anti-scorpion venom	Jiménez-Ferrer et al. 2005	
Eysenhardtia polystachya (Ortega) Sarg.	Kidney illnesses	Yasunaka et al. 1997; Perez et al. 2000	Anti-carcinogenic (Alvarez et al. 1998)
Calea zacatechichi Schltdl.	Stomach pain	Venegas-Flores et al. 2002	Malaria (Köhler et al. 2002)
Exostema caribaeum (Jacq.) Roem. and Schult.*Hintonia latiflora* (Sessé and Moc. ex DC.) Bullock	Diabetes	Guerrero-Analco 2007	Malaria, leishmaniasis and Chagas (Camacho et al. 2004, Argotte-Ramos et al. 2006)

erating collaborative projects geared at building community-oriented sustainable development through preservation of the environment and public health care. Walker et al. (2004) suggest that these projects require economic and political conditions to encourage an effective local participation.

Species of Local Interest Widely Known

Fifteen species were noteworthy for interviewees and workshops. If we start from the recognition of heterogeneity within the group of participants, this kind of distribution indicates a consensus which is then shown in the classification and ordination. That is, differences due to age, gender, level of knowledge about the resources and interests of participants, among other factors, seem to be diminished in face of the importance of these species for the community's well-being and survival. This was corroborated by an independent test for age and gender. Such is the case of three species: cuachalalate, arnica and palo dulce; widely known and appreciated as SLIC. The informants recognized this fact, stating: "these are the plants that are most widely used because anybody would want them as medicine".

There were six species interviews and six in workshops. The quinas were listed mainly in the interviews, while cuatecomate in workshops. This shows the diversity of knowledge and interests of informants, for example cuate-comate seems to have a greater importance to housewives who participated in the workshops.

Out of the widely known species, eight were selected by informants as SLIC. Most of them were important for their social valuation too. Six of these eight SLIC make up the Group B1 in ordination and the first set (b) of the second group in the classification. The presence of widely known species that were not selected locally for their conservation (Group B2) lend us to point out that they are not in at risk according to local perception. Law and Salick (2007) report that although this perception does not necessarily coincide with the scientific view it can be useful when designing programs of resource evaluation.

The knowledge of about caña fistula, cacaloxochitl and guaco is limited to some specialized participants like herbalist and traditional healer. Rajadurai et al. (2009) explain how the restricted character of the TEK could make it more susceptible to the process of cultural erosion.

The list of selected species would be enriched if we would have included more social actors in our project. For example, sugar cane farmers would have suggested other kind of species more related with them like trees used as post in fences.

Utility of Anthromes of the SMNSR to Generate Goods that Satisfy Basic Needs

The SLIC are distributed in the environmental mosaic managed and designed throughout time by a specific social group to fulfill its necessities, recently classified as domestic forests, domesticated nature (Kareiva et al. 2007; Michon et al. 2007); or the so-called anthropogenic biomes "anthromes" (Ellis and Ramankutty 2008). These biomes are subject to adaptive management characterized by the multiple and integral utilization of resources described for peoples with Pre-Hispanic roots (Berkes et al. 2000; Toledo et al. 2003).

Influence of Cultural Heritage in the Local Selection of Species

The historical relation established in the Temimilcingo community with the TDF surroundings has promoted the generation and transference of TEK about the plant species found there. This relationship partially explains the importance of plants for inhabitants and their concern about the forest's state of conservation.

Of the SLIC, 12 were medicinal, an essential use for the attention of the medical needs of Temimilncilgo's inhabitants. Plants have always been a source of medical products for local people as a source of raw materials for the pharmaceutical industry (Farnsworth et al. 1985; Gurib-Fakim 2006; Sahu et al. 2010; Pérez et al. 2011). Estrada (1989) reports that in Mexico, medicinal plants have been important since the pre-Columbian times, such is the case of brasil, palo dulce and quina (*Hintonia latiflora*), three Species of Local Interest for Conservation.

Nowadays, the validity of the medicinal use of plants at the national level is evidenced by Caballero and Cortés (2001) who estimated that out of the 3,500 useful species in Mexico 2,140 are medicinal; that is, more than 60%. A figure similar to the one obtained in the Sierra Norte de Puebla (Martinez-Alfaro et al. 2001). This proportion is higher by 10 percent than the figures reported by Monroy-Ortiz and Castillo-España (2007) in the Sierra de Huautla Biosphere Reserve located to the south of the study area. They registered 818 medicinal plants in the state of Morelos, which is almost 40% of those registered for Mexico.

The DTF which is the type of vegetation present in Temimilcingo, is the first source of medicinal plants in Mexico. Moreover, the importance of some SLIC goes beyond the local level. For example, arnica, palo dulce, prodigiosa, cuatecomate and quina are some of the primary medicinal plants used in Morelos and Mexico (Argueta 1994; Aguilar-Contreras et al. 1996; Aguilar-Contreras et al. 1998; Monroy-Ortiz and Castillo-España 2007).

Contribution of SLIC for Public Health Care

The effectiveness of some uses suggested for the SLIC has been tested through experimental protocols (Table 4). Vasisht and Kumar (2002) point out that three quarters of Western drugs derived from plants are directly related to their traditional medicinal use.

The SLIC are important for health care because: a) some species are used traditionally in the treatment of diseases that are the main cause of morbidity and mortality in Morelos, b) some species have noteworthy uses not mentioned by informants (for example, plants possess anticancer effects) and, c) the importance of these medicinal resources for the population in Mexico. According to the WHO (2002), this relevance supports popular participation in primary health care and in the integration of health systems present in nations. So it is necessary to preserve the environment and TEK related with them in order to get this integration. Toxicity, secondary effects of medicinal plants, and their interaction with drugs should be tested in order to develop safer and efficient therapies.

Medicinal plants and herbalists must be revalued by society; children and teenagers should learn how this kind of resources and persons solve health problems as good as an occidental doctor (Rajadurai et al. 2009; Sidhu and Pannu 2010). Moreover, the ecology, effect of harvest and marketing of useful plant species must be known (Shanley and Luz 2003; Dalle and Potvin 2004).

Local Conservationist Perceptions Emphasize the Importance of Useful Species

Although none of the SLIC are protected by Mexican law, five are classified as "threatened"

in the State Forest Inventory, which proves a partial agreement of the governmental evaluation with local perceptions regarding the risk of persistence and the need for conservation of some species; this becomes an area of opportunity in which both interests could come together to promote resource conservation. In fact, joint proposals have allowed diversification in the utilization of Mexico's forests and the implementation of actions directed to conservationist management in other parts of the world (Dalle and Potvin 2004; Danielsen et al. 2005). Shengji et al. (2010) explain how these proposals avoid the local rejection of governmental actions.

From the local people´s point of view useful species that guarantee the availability of services that satisfy basic needs and the preservation of cultural values should be maintained (Danielsen et al. 2005; Kaimowitz and Sheil 2007), including those that provide seasonal and temporary income, which are important for marginal communities such as the NTFS. Dalle and Potvin (2004) show how indigenous communities of Panama expressed interest in initiating efforts to restore populations of useful species.

In this case, institutions and official policies should consider the SLIC selected in Temimilcingo because they represent a valuable traditional medicinal resource for health care even at the national level. Shanley and Luz (2003) report that the loss of species implies the loss of the unique health care option for many people in Amazonia. Thus, the selection of species would become a way of incorporating perception, values, worldwide and local interests into environmental conservation strategies that could contribute to social well-being and the achievement of sustainable development.

When Temimilcingo participants were asked about the species whose conservation should be a priority, they would suggest one species, then meditate, talk among themselves and suggest others, accompanied with arguments about their importance. Their decision-making process was complex because local culture regulates the acquisition of goods that satisfy basic needs in terms of the temporal distribution of resources and their availability in the environmental mosaic. From the local perspective, it is not enough to conserve the best preserved area. It is also necessary to protect domestic forests (Kaimowitz and Sheil 2007; Kareiva et al. 2007; Michon et al. 2007). This represents an area of opportunity area in Mexico because according to Portillo-Quintero and Sánchez-Azofeita (2010) only the 0.2% of the TDF area is under legal protection.

A viable and effective local participation in the environmental conservation can be achieved protecting resources utilized by local people, equity among the stakeholders and an equilibrium between conservation and satisfaction of local needs (Kaimowitz and Sheil 2007; Shengji et al. 2010). Moreover, the legal recognition of collective property rights over resources demands the generation of adapted laws and policies to avoid deterioration of sustainable traditional practices, and the excessive regulation which promotes corruption, marginalization of local communities, a decrease in product prices and the exhaustion of resources, especially when coupled with a lack of governmental support (Walker et al. 2004; Kaimowitz and Sheil 2007).

CONCLUSION

Temimilcingo informants mentioned 131 useful species, 14 out of these were selected for conservation. They included plants with different life forms that grow in mid and late serial deciduous forest in the Sierra de Monte Negro State Reserve. Although most of the species selected were widely known, this was not the case for cacaloxochitl or guaco. 12 out of the species selected, had a traditional medicinal use; 10 have been corroborated with experimental protocols as recorded in specialized bibliographical information. These uses coincide with some of the main causes of morbidity and mortality among the inhabitants of the state of Morelos. In addition, there are species whose importance dates back to Columbian times and are important today, even at the state, regional and national level. Furthermore, some of the species selected coincide with those classified as "threatened" in the state forest inventory.

RECOMMENDATIONS

The agreements between the TEK of Temimilcingo informants and scientific knowledge generate an area of opportunity for local participation in public health care and conservation of priority species for achieving community sustainable development. This participation should be taken into account by authorities in

different levels of government whose decisions directly influence the community's future.

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