

ESTATUS POBLACIONAL Y NIVELES DE APROVECHAMIENTO DEL LAUREL SILVESTRE (*Litsea glaucescens* Kunth) EN AGUASCALIENTES

POPULATION STATUS AND HARVEST LEVELS OF WILD LAUREL (*Litsea glaucescens* Kunth) IN AGUASCALIENTES STATE

Carlos Antonio Dávila Figueroa¹, Francisco José Flores Tena¹, Francisco Morales Domínguez¹,
Ricardo Clark Tapia² y Eugenio Pérez Molphe Balch¹

RESUMEN

Por sus usos tradicionales y su potencial de aprovechamiento, el laurel silvestre (*Litsea glaucescens*) es uno de los recursos forestales no maderables más importantes de México. Sin embargo, el intenso uso no regulado al que se ve sometida, así como el desconocimiento del estatus que presentan las poblaciones naturales han puesto en riesgo su supervivencia. Por lo anterior es oficialmente considerada como especie en peligro de extinción. Los objetivos de este proyecto fueron ubicar y conocer la situación actual de las poblaciones de *L. glaucescens* en Aguascalientes, y determinar el efecto que sobre las mismas tiene la extracción ilegal. Para ello se llevó a cabo una revisión de diversas fuentes y un exhaustivo trabajo de campo para delimitar la distribución de la especie en el estado. Además, se eligieron tres localidades representativas, con base en el régimen de propiedad de la tierra, en las que se cuantificó la extracción para conocer su efecto sobre la estructura poblacional de la especie. Se determinó que aún existen varias poblaciones de *L. glaucescens*, pero sólo una puede considerarse en buenas condiciones. Se observó que la tasa de aprovechamiento se relaciona con el tipo de tenencia de la tierra y con la accesibilidad a la localidad. La sobre-recolecta también responde al uso tradicional de la especie en la ceremonia del "Domingo de Ramos", y afecta de manera directa el reclutamiento sexual en las poblaciones, ya que impide la producción de semilla.

Palabras clave: Aguascalientes, especies amenazadas, especies forestales no maderables, laurel, *Litsea glaucescens*, reclutamiento sexual.

ABSTRACT

For its traditional uses and its potential for exploitation, the Mexican bay or laurel (*Litsea glaucescens*) is one of the most important non-timber forest species in Mexico. However, the unregulated exploitation to which it is subjected as well as the ignorance of the status that its natural populations keep have put its survival at risk. For this reason it is officially considered an endangered species. This project had as objectives to locate and know the current situation of the populations of *L. glaucescens* in Aguascalientes, as well as to determine the effect of illegal harvesting. A thorough review of various sources was made as well as an extensive fieldwork to find the distribution of this species in the state. In addition, three representative localities were chosen, based upon the ownership of land, in which extraction was quantified in order to know its effect over the population structure of the species. Results show that there are still several populations of *L. glaucescens* in the state, but only one can be considered in good conditions. It was also noted that the exploitation rate is related to the tenure of ownership and accessibility of the location. Over-collection is related to the traditional use of the species in the "Domingo de Ramos" ceremony. This affects the sexual recruitment of the populations that are subjected as it inhibits seed production.

Key words: Aguascalientes, endangered species, non-timber forest species, *Litsea glaucescens*, Mexican bay, sexual recruitment.

Fecha de recepción: 10 de junio de 2010

Fecha de aceptación: 28 de marzo de 2011

¹Centro de Ciencias Básicas. Universidad Autónoma de Aguascalientes. Correo-e: eperezmb@correo.uaa.mx

²Instituto de Estudios Ambientales. Universidad de la Sierra de Juárez, Oaxaca.

INTRODUCCIÓN

Litsea (Lauraceae) comprende alrededor de 400 especies, la mayoría nativas de Asia oriental, Australia y Nueva Zelanda y sólo unas cuantas están presentes en América. Generalmente, son árboles perennes, con hojas muy ricas en compuestos aromáticos. Algunos taxa producen frutos comestibles, como *Litsea thunbergii* Siebold y *L. glutinis* (Lour.) C. B. Rob. of Malasia, y *Litsea graciae* Vidl. Novolo de Indonesia y las Filipinas. En México, el género está representado únicamente por *Litsea glaucescens* Kunth (Schroeder, 1990; Luna-Vega, 2003). Árbol o arbusto de 3 a 12 m de altura, con hojas alternas a opuestas, penninervadas y flores unisexuadas. Habita en los bosques húmedos de encino y de encino-pino, así como de los bosques mesófilos de montaña, por lo regular se localiza en cañadas o a la orilla de arroyos. Crece entre los 800 y 2,830 msnm y se distribuye desde el norte de México hasta Costa Rica. A lo largo del territorio en que se desarrolla, la especie recibe diversos nombres: Aureli (tarahumara), Canelillo, Chico, Ecpatli de Chietla (náhuatl), Laurel chico, Laurelillo, Sufricalla y Zitzuch. En países de habla inglesa se conoce como "Mexican Bay" (Van der Werff y Lorea, 1997; Luna-Vega, 2003; SEMARNAT, 2006).

En México, el Laurel silvestre se encuentra en varios estados, en especial aquellos que son atravesados por las principales cadenas montañosas. Sin embargo, también existe en cordilleras aisladas, aun enclavadas en las zonas semiáridas, como la Sierra de Catorce en San Luis Potosí (González-Costilla *et al.*, 2007). La especie aparece como componente de la vegetación en varios estudios florísticos realizados en diversas zonas del país. No obstante, estos trabajos coinciden en que se trata de un taxón, que si bien, puede ser dominante en una área muy específica, de manera general es poco abundante, por sus especiales requerimientos, en cuanto a su hábitat (Díaz-Gallegos *et al.*, 2002; Newton, 2007).

Aguascalientes es uno de los estados en los que se ha registrado la presencia de laurel silvestre, y que cuenta con un inventario general de biodiversidad (CONABIO, 2008), aunque se carece de información precisa acerca de la distribución y densidad de cada especie en particular, lo cual es una limitante para elaborar programas de manejo que garanticen la eficacia de los esfuerzos de conservación (Granados *et al.*, 2007; Naoki *et al.*, 2006). Esta situación se vuelve más crítica cuando se trata de especies en peligro de extinción, como es el caso de *L. glaucescens*, taxón catalogado como tal en la NOM-059- SEMARNAT-2001 (DOF, 2002). Bazuin (2000) y Dawson *et al.* (2000) indican que la estrategia de conservación *in situ* de los recursos forestales debe basarse siempre en el uso sustentable de los mismos. Sin embargo, también mencionan que esto es imposible si se carece de información sobre las condiciones

INTRODUCTION

Litsea (Lauraceae) includes about 400 species, most native from East Asia, Australia and New Zealand and just only are present in America. Generally, they are perennial trees, with leaves rich in aromatic compounds. Some taxa produce edible fruits, such as *Litsea thunbergii* Siebold and *L. glutinis* (Lour.) C. B. Rob. of Malasia and *Litsea graciae* Vidl. Novolo of Indonesia and the Philippines. In México, the genus is represented only by *Litsea glaucescens* Kunth (Schroeder, 1990; Luna-Vega, 2003).

Litsea glaucescens has been described as a tree or shrub from 3 to 12 m tall, with alternate to opposite leaves, penninerved and unisexual flowers. It lives in the humid oak and oak-pine forests, as well as in the mist mountain forests; it is regularly found in cliffs or at the edge of streams. It grows between 800 and 2,830 masl and extends from the North of Mexico up to Costa Rica. Along the territory in which it grows, the species receives different names: Aureli (Raramuri), Canelillo, Chico, Ecpatli de Chietla (Nahuatl), Laurel chico, Laurelillo, Sufricalla and Zitzuch. In English spoken countries it is known as "Mexican Bay" (Van der Werff and Lorea, 1997; Luna-Vega, 2003; SEMARNAT, 2006).

In Mexico, wild laurel is found in several states, especially in those that are crossed by the major mountain chains. However, it is present too at isolated ranges even located in the semi-arid zones such as Sierra de Catorce in San Luis Potosí (González-Costilla *et al.*, 2007). The species appears as a component of vegetation in several floristic studies made in different zones of the country. In spite of it, these are coincidental in that it is a taxon that, even if it can be dominant in a specific area, it is generally less abundant, due to its particular habitat requirements (Díaz-Gallegos *et al.*, 2002; Newton, 2007).

Aguascalientes is one of the states in which wild laurel has been recorded and that has a biodiversity general inventory (CONABIO, 2008), even though there is a lack of precise information about distribution and density in each particular species, which is rather limiting to make management programs that assure the effectiveness of conservation efforts (Granados *et al.*, 2007; Naoki *et al.*, 2006). This situation becomes even more critical when species at risk of extinction are involved; such is the case of *L. glaucescens* which has been cataloged as such by the NOM-059- SEMARNAT-2001 (DOF, 2002). Bazuin (2000) and Dawson *et al.* (2000) point out that the *in situ* conservation strategy of forest resources must be based upon their sustainable use. However, it is mentioned too, that this is impossible to accomplish if the information about the population conditions of the different species that grow in forests is lacking, and, thus, it is not possible either to determine conservation priorities or to plan the use of resources.

L. glaucescens has multiple uses, thus considering it as one of the most important non-timber forest species of Mexico (Tejeda *et al.*, 2000; Luna-Vega, 2003). Its exploitation is dated at Pre-Hispanic times starting from its seasoning abilities, and the great amount of medicinal effects that have been attributed to it (Camou *et al.*, 2007). It is used to prepare an infusion that supposedly helps to cure breast congestion, cough, ear diseases and several gastric illnesses. Frequently, wild laurel is mixed with other plants such as orange, sedge, rue, elder, fennel and clove. Other sources mention their use in case of afterbirth cramps, sterility, dysmenorrhea and several health problems. In some markets of Mexico (for example, Puebla, Puebla State), it is sold at herb shops for stomach irritations, thus giving it an anti-gastritis effect. For seasoning purposes, it is sold in dry bunches together with thyme, marjoram and oregano (Montañez-Armenta, 2006; SEMARNAT, 2006; Waizel-Bucay, 2006). It has always been used as "green fence" in the state of Veracruz (Avendaño and Acosta, 2000).

On the other side, *L. glaucescens* could be of industrial interest since it has compounds that are used in the food and perfume industries (Montañez-Armenta, 2006). Some rituals include regularly *L. glaucescens* as a source for odorous smoke, or in the making of flower arrangement for the Catholic ceremonies of Holly Week, particularly Palm Sunday. The latter gives way to an intensive extraction in the previous days of the afore-mentioned celebration, which has a negative effect upon the size of the examples, as well as a decrease in the reproductive ability of the population because the loss of foliar tissue lessens its productivity. Another factor that affects the stability of populations of *L. glaucescens* is habitat loss, which is a direct consequence of land-use change.

In Aguascalientes State, the authorities responsible for environmental care, as the Environment Institute of Aguascalientes State (IMAE) and the State Attorney General's Office on Environmental Protection (PROESPA) confiscate loads of *L. glaucescens* branches illegally extracted in variable amounts, from a few samples to hundreds of kilograms.

Based upon the previous information, this Project stated two objectives: to describe the distribution and abundance of *Litsea glaucescens* in Aguascalientes State, and to quantify its harvest in three locations with different land-ownership regime.

In this way, it might be known its present situation more precisely and elements could be provided to favor its conservation and a rational harvest of the species, as well as to define the priority areas for the conservation of the forest non-timber resource, as well as the most suitable zones for its reintroduction.

MATERIALES Y MÉTODOS

MATERIALS AND METHODS

A previous study was carried out, from May to June, 2006, bound to determine the locations in Aguascalientes State in which the populations of *L. glaucescens* could exist. Thus, a bibliographic review and of the collection data was carried out; also, an approach to the personnel of the Herbarium and Botanic Garden of the Biology Department of the University of Aguascalientes, as well as interviews to the personnel of IMAE and of PROESPA, and to owners and workers of ranches and particular lands located in the potential habitat of the species. With that information, the selected locations as well as the closest cliffs to them were visited between September 2006 and March 2009.

The land-ownership regime was found in each place where the laurel samples were located; they were classified in four possession types (Table 1). This was accomplished by consulting the data base of the Ministry of Planning and Development of Aguascalientes State (SEPLADE). In each location were counted the total number of individuals of the focus species and were recorded the geographic coordinates in the UTM system, with Datum NAD27 México and an eTrex[®] Legend HCx GPS of Garmin Corporation. Field data were analyzed with the support of MapSource[®] Versión 6.15.3 geographic software of Garmin Corporation. A data base was produced which was used to mark the sites in the 1:50,000 topographic map of INEGI and thus to make a map of the distribution of *L. glaucescens*.

Population density was calculated by the following model:

$$D = N/A$$

Where:

D = Density

N = Number of individuals in each location

A = Covered area by the *L. glaucescens* population in each location (m²)

In order to quantify the extraction amount, three places with different land-ownership regime or protection regime were chosen: 1) free access ejido property (Barranca Río Blanco); 2) controlled-access ejido property (Barranca Masitas, located in the Environmental Management Unit SEMARNAT-UMA-EX0015-AGS of the Col. Progreso Ejido) and 3) private property of restricted access (Barranca Oscura). In each of them 50 x 20 m lots were established and the vegetation cover by plant of *L. glaucescens* was determined, 15 days before and 15 days after the 2007 "Domingo de Ramos" celebration. Extraction was considered as the loss of vegetal cover between the two measuring periods.

Results were statistically analyzed by the Student's t-test for related samples, through the GraphPad InStat V3.06 software.

Cuadro 1. Densidad poblacional de *Litsea glaucescens* en localidades de Aguascalientes, México.
Table 1. Population density of *Litsea glaucescens* in locations of Aguascalientes State, México.

	2,450,241	766,737	1,980	2,000	6
Barranca El Pilar ^a	2,441,503	733,662	2,490	2,520	7
Barranca Río Blanco ^b	2,459,396	754,201	2,280	2,400	267
Barranca Tinajuelas ^b	2,450,015	748,173	2,340	2,400	184
Barranca Masitas ^c	2,451,645	749,073	2,340	2,450	717
Barranca El Abuelo ^d	2,450,472	747,344	2,330	2,380	580
Barranca Piletas ^d	2,442,174	734,325	2,500	2,520	4
Barranca Verde ^d	2,444,437	736,933	2,390	2,460	392
Barranca Los Alamitos ^d	2,404,856	736,487	2,260	2,340	95
Barranca Oscura ^d	2,410,130	743,917	2,250	2,420	850
Estación Biológica Agua Zarca-U.A.A. ^d	2,444,899	752,252	2,120	2,200	273

^a Terrenos sobre el derecho de vía del camino; ^b Terrenos ejidales; ^c Terreno perteneciente a una UMA; ^d Terrenos de propiedad privada

^a Lands on the road-of-way; ^b Ejido lands; ^c Lands that belong to a UMA; ^d Private property lands

Para cuantificar la extracción, se seleccionaron tres sitios con diferente régimen de propiedad o protección: 1) propiedad ejidal de acceso libre (Barranca Río Blanco); 2) propiedad ejidal de acceso regulado (Barranca Masitas, ubicada en la Unidad de Manejo Ambiental SEMARNAT-UMA-EX0015-AGS del Ejido "Col. Progreso") y 3) propiedad privada de acceso restringido (Barranca Oscura). En cada uno se establecieron parcelas de 50 x 20 m, y se midió la cobertura vegetal relativa por individuo de *L. glaucescens* presente en ellas, 15 días antes y 15 días después de la festividad del "Domingo de Ramos" de 2007. La extracción se consideró como la pérdida de cobertura vegetal entre los dos períodos de medición.

Los resultados se analizaron estadísticamente con la prueba t de Student para muestras relacionadas, mediante el software GraphPad InStat V3.06. En el resto de las distribuciones de la especie se detectaron y registraron indicios visuales de su recolecta; información que se complementó, cuando fue posible, con entrevistas a los vigilantes o personas vinculadas con las localidades estudiadas. También se buscó en todas ellas la presencia de plántulas originadas a partir de semilla, para determinar la existencia de reclutamiento sexual en las poblaciones.

For the rest of the distributions of the species, visual signs of its collection were searched and recorded, information that was complemented, when possible, with interviews to the guards or to people linked to the studied locations. In all of them, too, was tried to find saplings originated from seed, to determine the existence of sexual recruitments in the populations.

RESULTS AND DISCUSSION

L. glaucescens was found in 11 locations, with population densities that varied from 4 to 850 individual ha⁻¹ (Table 1, Figure 1). It was confirmed that its distribution is limited to cliffs with active rivers and places in which organic matter is accumulated on the ground. In all cases, wild laurel was observed in oak (*Quercus* spp.) zones, from 1,980 to 2,520 masl. The population with best general status and with the highest density (850 individuals/ ha⁻¹), was Barranca Oscura, also known as (Dark Mouth) that is in Sierra del Laurel, Calvillo municipality at the SW of the state. This locality is found very close to the limits with Jalisco State. In a situation less convenient, populations were recorded as well in El Pilar and Piletas cliffs, in the so-called Sierra Fría, in which values were very low (7 and 4 individuals ha⁻¹, respectively). This could be explained by the fact that they are located at the

RESULTADOS Y DISCUSIÓN

Se identificó la presencia de *L. glaucescens* en 11 localidades, con densidades poblacionales que variaron entre 4 y 850 individuos ha^{-1} (Cuadro 1, Figura 1). Se confirmó que su distribución se restringe a las barrancas con cauces activos y sitios en donde se acumula materia orgánica en el suelo. En todos los casos, el laurel silvestre se observó en zonas con encinos (*Quercus* spp.), en altitudes que van desde 1,980 a los 2,520 m. La población en mejor estado general, y con la más alta densidad (850 individuos ha^{-1}), fue Barranca Oscura (también llamada Boca Oscura), que se localiza en la Sierra del Laurel, municipio de Calvillo al suroeste del estado. Esta localidad se ubica muy cerca del límite con el estado de Jalisco. En una situación menos favorable, se registraron poblaciones en las barrancas El Pilar y Piletas, en la denominada Sierra Fría, las cuales tuvieron valores muy bajos de la especie (7 y 4 individuos ha^{-1} , respectivamente). La razón podría ser que se encuentran en el límite altitudinal superior de la distribución de *L. glaucescens* (van der Werff y Lorea, 1997), por lo que soportan condiciones climáticas menos favorables para su desarrollo (Aguirre *et al.*, 2003); condición que hace al laurel más vulnerable a la extracción. Las otras poblaciones estudiadas, tanto en la Sierra Fría, como en la Sierra del Laurel, se sitúan en una condición intermedia, con respecto a las antes descritas.

highest altitudinal limit of the *L. glaucescens* distribution (van der Werff and Lorea, 1997), thus they endure less favorable climatic conditions for its development (Aguirre *et al.*, 2003), a situation that makes laurel mores susceptible to extraction. The other assessed populations at Sierra Fría and at Sierra del Laurel, are in an in-between condition in regard to the formerly described.

One population of special interest is present at Agua Zarca Biological Station, a 254 ha land bound for research and conservation and that belongs to the University of Aguascalientes. There, an average wild laurel density of 273 samples ha^{-1} was estimated; it is located at the altitudinal low limit of the distribution range for the species in the State. In this particular case, there is not an illegal harvest, due to the protection it has, and is ideal for field studies.

The examples present in Barranca El Palmito, at the base of the water curtain of Presidente Calles hydraulic press, are a particular case, since, apparently, they do not conform a natural population as such. They constitute an atypical location, as they are so far from other populations, as well as for the physical and biotic environment in which they develop. Probably they were planted by the inhabitants of San José de Gracia municipality, which neighbors the cliff, since all the trees of the area were removed when the press was built (1928), in order to

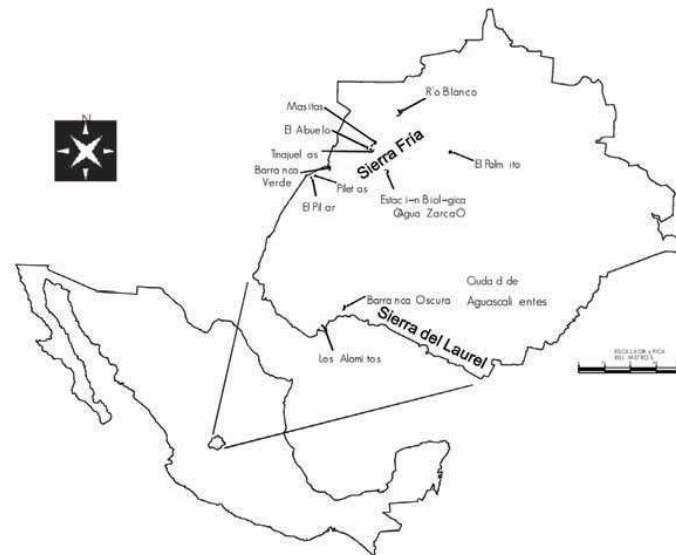


Figura 1. Localización de las poblaciones de *Litsea glaucescens* en Aguascalientes.
Figure 1. Populations of *Litsea glaucescens* in Aguascalientes State.

favor the public works. As it is located near housing, damages can be observed as a result of overharvesting and so, the lack of young specimens is evident, which suggests its imminent extinction.

In general, it was determined that the distribution is discontinuous in several of the analyzed sites and that its abundance is greater in the undergrowth (Figure 2a), in particular, in places in which organic matter is accumulated on the ground (Figure 2b). Discontinuity is a normal phenomenon in the species with wide distribution, which is a reflection of the geologic diversity and the irregular distribution of the edaphological elements (Rzedowski and Calderón, 1998; Brown *et al.*, 2002), and is particularly evident in endemic taxa or with very specific habitat requirements (Casazza *et al.*, 2005). On the other side, since habitat fragmentation is a process by which an extensive and continuous surface keeps divided in two or more patches that are separated by a landscape matrix highly modified or disturbed, it has been documented that discontinuity increases while dividing natural populations (Williams, 2002; Rowden *et al.*, 2004).

It was found that in the most abundant populations all the phenologic stages are present, from seedlings that come from sexual recruitment (Figure 2c) to adult samples of great size (Figure 2d), which occurs in populations with less density. This is important, since the examples of tree size favors sexual reproduction, as individuals reach maturity that lets them produce flowers, fruits and seeds (Figure 2f).

The populations located in El Abuelo, Masitas and Tinajuelas cliffs belong to the unique topographic system known as "El Abuelo", where it was confirmed that the oak forest has fragmentation in the nearest places to the access roads, which results in the extraction of wood. As in other species of the Lauraceae family, *L. glaucescens* shows a close relation to the genus *Quercus* (Sri-Ngernyuan *et al.*, 2003); that is why in oak forests with disturb symptoms, its specimens become more scarce and even disappear. This means that individuals in such cliffs could be patches or parts of the same fragmented or discontinuous population, which are 718 m appart (average) following a straight line.

Clear signs of harvesting of the resource were recorded in all the studied locations, regardless of the land-ownership regime (Table 2). This makes clear that its status as species at risk of extinction and, thus, its illegal harvest, do not stop the phenomenon. However, its extraction in private properties was highly lower compared to what takes place at roads-of-way or ejidos. The reason might be that the owners use laurel only for self-consumption and not for the commercialization or of restricted access, as was later confirmed through interviews applied to some of the owners of these lands and their employees. Another factor that influences the extraction of the



Figure 2. (a) *L. glaucescens* habitat; (b) Organic matter accumulation site; (c) Seedling; (d) Adult sample; (e) Flowering; (f) Fruit and seed production.

único conocido como "El Abuelo", en donde se constató que el bosque de encino presenta fragmentación en los sitios más cercanos a las vías de acceso, resultado de la extracción de madera. Al igual que otras especies de la familia Lauraceae, *L. glaucescens* muestra una estrecha relación con el género *Quercus* (Sri-Ngernyung et al., 2003), por lo que en los bosques de encino con síntomas de disturbio, sus ejemplares se vuelven más escasos o incluso desaparecen. Esto indica que los individuos en dichas barrancas pudieran ser parches, partes de una misma población fragmentada o con discontinuidad, los cuales están separados 718 m en línea recta, en promedio.

Se registraron señales claras de aprovechamiento del recurso en todas las localidades estudiadas, independientemente del régimen de propiedad de la tierra del que se tratara (Cuadro 2). Lo anterior evidencia que su estatus como especie en peligro de extinción, por lo tanto la condición ilegal de su aprovechamiento, no detienen este fenómeno. Sin embargo, la extracción en las propiedades privadas fue significativamente menor comparada con la existente en los derechos de vía o ejidales. La razón puede ser que los propietarios utilizan al laurel sólo con fines de autoconsumo o bien que el paso a los predios está restringido, como se confirmó a través de las entrevistas hechas a algunos de los dueños de esos terrenos y a sus empleados. Otro factor que influye sobre la extracción es la accesibilidad a las áreas donde se ubican las poblaciones, lo que coincide con lo citado por Castillo et al. (2007).

species is the accessibility of the areas where the populations are, which is coincidental with what Castillo et al. (2007) stated.

In this study, the *L. glaucescens* sites of easy Access (Table 2). Branch, leaves or sample collection is mainly carried out in lands where security or access restriction are minimal, as is the case of Barranca Río Blanco, only location with significant differences in vegetation cover before and after the Holly Week harvest (Figure 3).

Evidence in the field suggests that the extraction of branches is done by breaking them by hand (Figure 4a) or well with diverse tools such as: knives (Figure 4b), pruning shears (Figure 4c), saws (Figure 4d), machetes (Figure 4e) and axes. When small-size examples are involved, the whole plant is removed (Figure 4e). It was observed that the preferred parts by the collectors are the apical extremes of the branches (Figure 4f), in which the flowering meristems develop, which limits, in good extent, flower production in this species and handicaps the size of the plant. The greatest extraction period is coincidental with the major laurel flowering stage. This explains why sexual recruitment is very scarce or non-existent, in the locations with higher harvest (Table 2).

The number of samples was determined by the population densities in each of the locations. Results suggest that there exists around 4 in Barrancas Piletas, 6 in El Palmito, 7 in El

Table 2. Accessibility, extraction and sexual recruitment of *L. glaucescens* in the distribution locations of Aguascalientes State, Mexico.

Localidad	Accesibilidad	Extracción	Reclutamiento sexual
Barranca El Palmito	+++	xxx	0
Barranca El Pilar	+++	xxx	0
Barranca Río Blanco	+++	xxx	0
Barranca Tinajuelas	+++	xxx	0
Barranca Masitas	++	xx	1
Barranca El Abuelo	+	x	2
Barranca Piletas	+++	xxx	0
Barranca Verde	++	xx	1
Barranca Los Alamitos	+	x	2
Barranca Oscura	+	x	2
Estación Biológica Agua Zarca-UAA.	++	x	1

+ = Difícil; ++ = Moderada; +++ = Fácil; x = escasa; xx = Moderada; xxx = Abundante; 0 = No se detectó; 1 = Escaso; 2 = Moderado.

+ = Difficult; ++ = Middle; +++ = Easy; x = Scarce; xx = Reasonable; xxx = Abundant; 0 = Not detected; 1 = Limited; 2 = Moderate.

Pilar, 95 in Los Alamitos, 302 in Río Blanco, 378 in Agua Zarca (Agua Zarca Biologic Station -U.A.A.), 469 in Tinajuelas, 638 in El Abuelo, 896 in Verde, 2409 in Masitas and 2975 in Oscura, relevant numbers as it has been reported that a species with small population numbers or with low effective sizes is more prone to have genetic problems in the future, such as endogamy or allele loss, and thus, puts at risk its adaptability and survival (Hartl and Clark, 2007); thus, it is necessary to increase the protection measures for

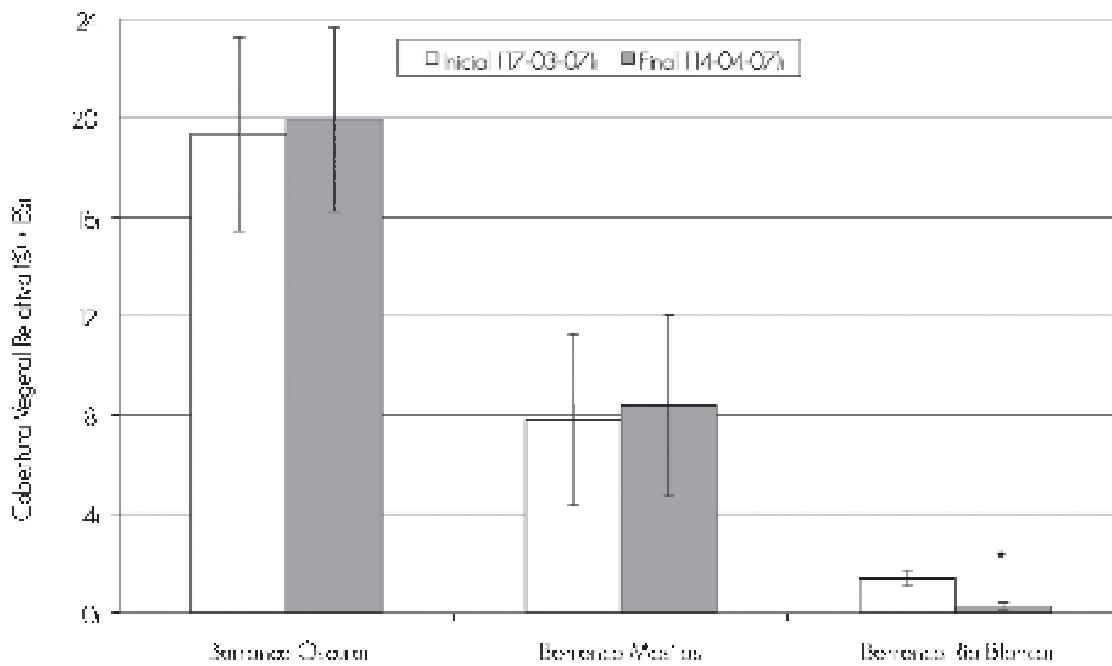


Figure 3. *L. glaucescens* harvest rate, measured in terms of relative cover before and after the Holly Week collection (* $p < 0.05$).

La evidencia en campo sugiere que la extracción de las ramas se lleva a cabo trozándolas con la mano (Figura 4a) o bien con diversas herramientas como: navajas (Figura 4b), tijeras para podar (Figura 4c), sierras (Figura 4d), machetes (Figura 4e) y hachas. En ejemplares de menor talla se llega, incluso a extraer la planta completa (Figura 4e). Se observó que las partes preferidas por los recolectores son los extremos apicales de las ramas (Figura 4f), en los cuales se desarrollan los meristemos florales, lo que limita, en gran medida, la producción de flores en esta especie y evita el incremento de talla de la planta. El período de mayor extracción en Aguascalientes coincide con la principal época de floración del laurel. Esto explica por qué el reclutamiento sexual es muy escaso o nulo, en las localidades con mayor aprovechamiento (Cuadro 2).

L. glaucescens in the locations with greater extraction, or, in due case, to achieve restoration and conservation actions. In regard to this, the intensive and controlled cultivation of the species with productive endings would be very advisable, since it would less the pressure upon wild populations.

However, the previous proposal is not easy to accomplish, since the observed field evidence indicates that laurel requires an organic matter-rich substrate for its development, with oak leaves in particular, and with good drainage. Also, it is necessary to protect the excess of sun shine, at least during the first stages, which can be provided artificially with shade nets. Also, regular watering that keep soils permanently with some humidity content. In addition, the relevance of association with other species could be investigated, such as that



Figure 4. Traces of extraction. (a) Hand-cut branches; (b) Knife-cut ;(c) Pruning shear-cut; (d) Saw-cut; (e) Machete-cut; and (f) Apical and floral meristems.

observed with the *Quercus* genus, or the possible relations with soil microorganisms, such as micorrhizae.

The situation described above for the wild laurel is not an isolated case; probably about half of the components of the Lauraceae family that live in Mexico suffer are somehow threatened (Loreca-Hernández, 2002). Asian taxa of the same genus face similar problems, as a response to the loss and fragmentation of their habitat; *Litsea szemaois* (H. Liu) J. Li *et al.* H. W. Li, endemic of Yunnan in China (Ci *et al.*, 2008) is an example.

CONCLUSIONS

There are some *Litsea glaucescens* wild populations in Aguascalientes State. However, there is only one location whose population can be considered in good condition (Barranca Oscura); thus, its conservation must be a priority. The land-ownership regime and the accessibility to the places influence the harvest of this species in the State, in such a way that those sites of community ownership or of easy access show worse disturb symptoms. In good extent, overexploitation is limiting the reproductive ability and sexual recruitment in the populations subject to a greater pressure, which affects its abundance. In addition to the harvest of *L. glaucescens* in its distribution area, the whole disturb of the oak forest in some locations, as a consequence of wood extraction, is another decisive factor in the process of removal of this important non-timber forest species. 🍷

ACKNOWLEDGEMENTS

The authors thank PROMEP-SEP (Project Number 103.5/07/2408) and to the University of Aguascalientes for having provided the economic support to accomplish the "Estudio Ecológico y Biotecnológico del Laurel (*Litsea glaucescens*) en Aguascalientes, México" Project. To CONAGYT for having afforded the grant for doctoral studies to CADF. To the personnel of IMAE and PROESPA for their help to get into some locations, as well as to the Herbarium and Botanical Garden ascribed to the Department of Biology, of the University of Aguascalientes; as well as to the personnel of that institution that contributed with information and to the Biologists José Silvestre Delgadillo Díaz de León and Gabriel González Adame for their valuable cooperation during field work. To Roberto Rico Martínez for having reviewed this paper.

End of the English version

CONCLUSIONES

GRADECIMIENTOS

REFERENCIAS

