THE LIFE AND TIMES OF *BURSERA GLABRIFOLIA* (H.B.K.) ENGL. IN MEXICO: A PARABLE FOR ETHNOBOTANY

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Peters, Charles M. *(Institute of Economic Botany, The New York Botanical Garden, Bronx, NY 10458-5126; e-mail cpeters@nybg.org),* **Silvia E. Purata** *(Departamento de Ecología Vegetal, Instituto de Ecología, A.C., Apartado Postal 63, Xalapa, Veracruz 91070, México),* **Michael Chibnik** *(Department of Anthropology, 114 Macbride Hall, University of Iowa, Iowa City, IA 52242-1322),* **Berry J. Brosi** *(Institute of Economic Botany, The New York Botanical Garden, Bronx, NY 10458-5126),* **Ana M. López** *(Facultad de Ciencias, UNAM, Circuito Exterior, Cuidad Universitaria, C.P. 04510, México, D.F.),* **and Myrna Ambrosio** *(Facultad de Ciencias, UNAM, Circuito Exterior, Cuidad Universitaria, C.P. 04510, México, D.F.).* THE LIFE AND TIMES OF *BURSERA GLABRIFOLIA* (H.B.K.) ENGL. IN MEXICO: A PARABLE FOR ETHNOBOTANY. *Economic Botany 57(4):431–441, 2003.* Bursera glabrifolia, *a dominant component of the tropical dry forests in southwestern Mexico, is used to illustrate the importance of a broader contextual framework for ethnobotanical studies. The species is currently used as a carving wood to produce small, painted figurines known as* alebrijes. *Over the past hundred years, however,* B. glabrifolia *also has been exploited commercially for resin and essential oil, and over-harvesting has pushed the species to the brink of local extinction several times. The destruction of tropical dry forests threatens the ability of the species to recover from the current wave of exploitation. Eight years of study have highlighted two major aspects of the life and times of* B. glabrifolia. *First, the ethnobotany of the species is extremely complex and, in addition to local artisans and collectors, involves pre-Columbian tributes, resource substitution, NAFTA duty exemptions, and the spread of cattle pastures. Second, a concerted effort to manage the species in its natural habitat would bolster the thriving* alebrije *market and provide a much-needed incentive for conserving tropical dry forests in Mexico.*

Vida y tiempos de Bursera glabrifolia *(H.B.K.) Engl. en México: Un a parábola para la etnobotánica.* Bursera glabrifolia, *un componente dominante de los bosques secos tropicales del sureste de México, se utiliza aquí para ilustrar la impotancia de adoptar un marco conceptual amplio en los estudios etnobotánicos. La madera de esta especie se usa actualmente en la zona de Valles Centrales de Oaxaca para elaborar figuras talladas conocidas como* alebrijes. *Sin embargo, durante los últimos cien años,* B. glabrifolia *ha sido también explotada por su resina y su aceite essecial, y la sobrexplotación la ha colocado cerca de la extinctión local. La destrucción de los bosques secos tropicales pone en riesgo la capacidad de la especie para recuperarse al ritmo actual de explotación. Ocho años de investigación interdisciplinaria nos han permitado reconocer dos aspectos importantes de la historia de* B. glabrifolia. *Primero, que la etnobotánica de la especie es extremadamente compleja, ya que además del uso actual por artesanos e colectores locales, involucra tributos prehispánicos, sustitución de especies, exención de impuestos en el marco del TLC y la expansion de la ganadería. Y Segundo, que un esfuerzo concertado por manejar esta especie en su hábitat natural, le daría un impulse al mercado de los* alebrijes *y significaría un incentivo, muy necesario, para la conservación de los bosques tropicales secos en México.*

Key Words: *Alebrijes*; *Bursera glabrifolia*; conservation; Oaxaca; Mexico; wood carving.

The interaction between people and plants is frequently very complex. Gone are the days when a researcher could go to a remote village, collect a plant species, record its local uses, and assume that the ''ethnobotany'' of that species had been adequately documented. Today, most ethnobotanists realize that the relationship between people and plants embodies a much broader context. Plant use both influences and is influenced by markets, community organization, plant ecology, and local land-use patterns, and the actual status of a useful plant can only be

really understood by examining a multitude of different factors. Failure to takes this complexity into account can lead to wrong conclusions. It is easy to attribute the low density of a valuable market species to over-exploitation alone. In some cases, however, the actual factors responsible for this pattern may have very little to do with the current intensity of resource use. Commercial exploitation of wild populations can indeed have a significant impact on the plant species involved (Peters 1994). Commercial use coupled with burgeoning markets, rampant habitat loss, restricted growth and regeneration potential, NAFTA duty exemptions, and an unfortunate history of spontaneous resource substitution—none of which are directly controlled by the people currently doing the harvesting—is a completely different story altogether. The ethnobotany of quaint local handicrafts is not always what it seems.

To illustrate the importance of a broader contextual optic for ethnobotany, this article examines the botany, use, ecology, and management of *Bursera glabrifolia* (H.B.K.) Engl., a common component of tropical dry forests in southern Mexico. Our findings, which represent the results of eight years of interdisciplinary research in the Central Valley of Oaxaca, are based on interviews with carvers, middlemen, craft store owners, and exporters, quantitative forest inventories, regeneration surveys, growth studies, and extensive botanical exploration. Voucher specimens of all relevant species were deposited in the herbaria of the Instituto de Ecología at the Centro Regional del Bajio in Pátzcuaro, Michoacán (IEB) and in Xalapa, Veracruz (XAL).

CLASSIFICATION

Bursera glabrifolia (Burseraceae) is one of 80 or so species of *Bursera* that occurs in Mexico (Rzedowski and Kruse 1979). The genus is composed primarily of small, deciduous trees and shrubs with alternate, imparipinnate leaves, and small, unisexual flowers. The bark is smooth, from gray to orange in color, and frequently peels off in thin, papery strips. The trees produce an aromatic resin and the wood and fruits of some species contain a high concentration of essential oils. The genus is divided into two sections, i.e., Bullockia McVaugh & Rzed. and Bursera L., based on bark characteristics, presence of cataphylls, and floral and fruit morphology (McVaugh and Rzedowski 1965). As is shown in Fig. 1, *B. glabrifolia* is a characteristic example of the Bursera, Sect. Bullockia group, with its 4-merous flowers, notable cataphylls, and bivalvate fruit. It is distinguishable from the rest of the species in the section by a petiole and rachis that are covered by soft, brownish hairs.

Different species of *Bursera* look very similar to the untrained eye, and a considerable amount of taxonomic work still needs to be done on the genus. This work is complicated by a general lack of flowering specimens. Like most deciduous species in Mexico, *Bursera* trees begin to flower at the end of the dry season before the new leaves develop. A botanist, therefore, can either collect a sterile specimen with leaves before the dry season or a fertile specimen with no leaves at the end of the dry season. Trying to separate species based on ovary morphology or leaf pubescence using herbarium specimens that have either leaves or flowers, but not both, is clearly a challenge—and most of the specialists who work with this family have been quick to point this out (e.g., Standley 1923; Rzedowski and Guevara-Fefer 1992; Daly 1993; Becerra and Venable 1999). The situation is further complicated by the fact that many species of *Bursera*, including *B. glabrifolia*, appear to hybridize quite easily (McVaugh and Rzedowski 1965).

A useful example of the general taxonomic uncertainty inherent in the genus *Bursera* is provided by *B. glabrifolia*. The species is frequently confused with *Bursera penicillata* (Sessé & Moc. ex DC) Engl., which was thought by Bullock (1936) to include *B. delpechiana* Pois. Ex Engl. as a conspecific. Interestingly, the type specimen of the latter species (Field Mus. Neg. 35857) was later identified by McVaugh and Rzedowski (1965) as *B. glabrifolia*. Both Standley (1923) and Bullock (1936) listed *B. aloexylon* (Schiede ex Schlecht.) Engl. as a synonym for *B. glabrifolia*. Although the importance of these associated species will later become apparent as the story of *B. glabrifolia* unfolds, suffice it to say for now that the genus *Bursera* in Mexico contains many species that look alike and that *B. glabrifolia* can be easily confused with at least three or four other species.

HABITAT

Bursera glabrifolia is a widespread species that occurs in the states of Michoacan, México, Morelos, Puebla, Guerrero, and Oaxaca at ele-

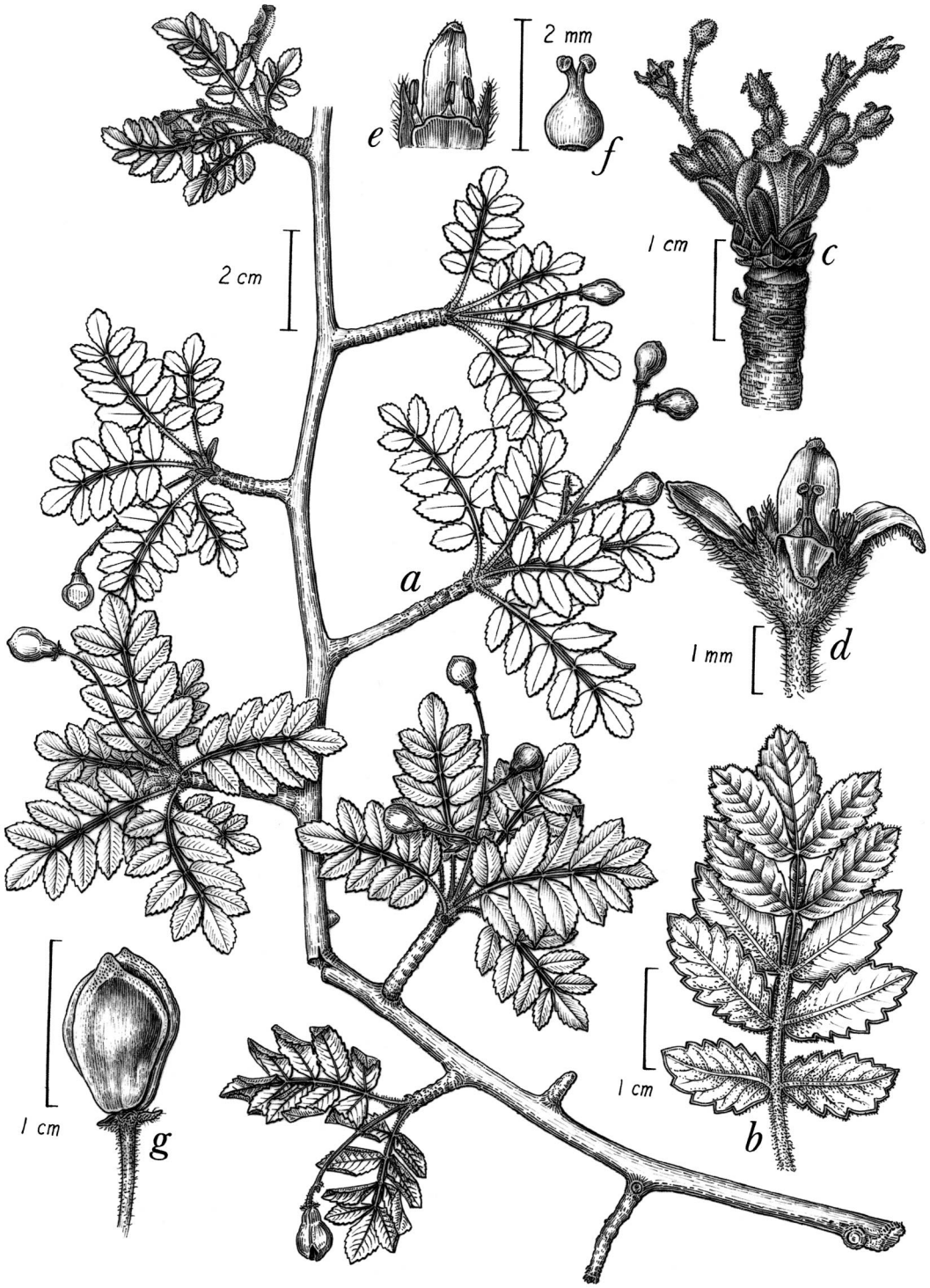

Fig. 1. *Bursera glabrifolia* (H.B.K.) Engl. (Burseraceae): **A.** fruiting branch, **B.** leaf, **C.** flowering branchlet, **D.** perfect flower, **E–F.** flower details, **G.** mature fruit. Illustration by E. Saavedra.

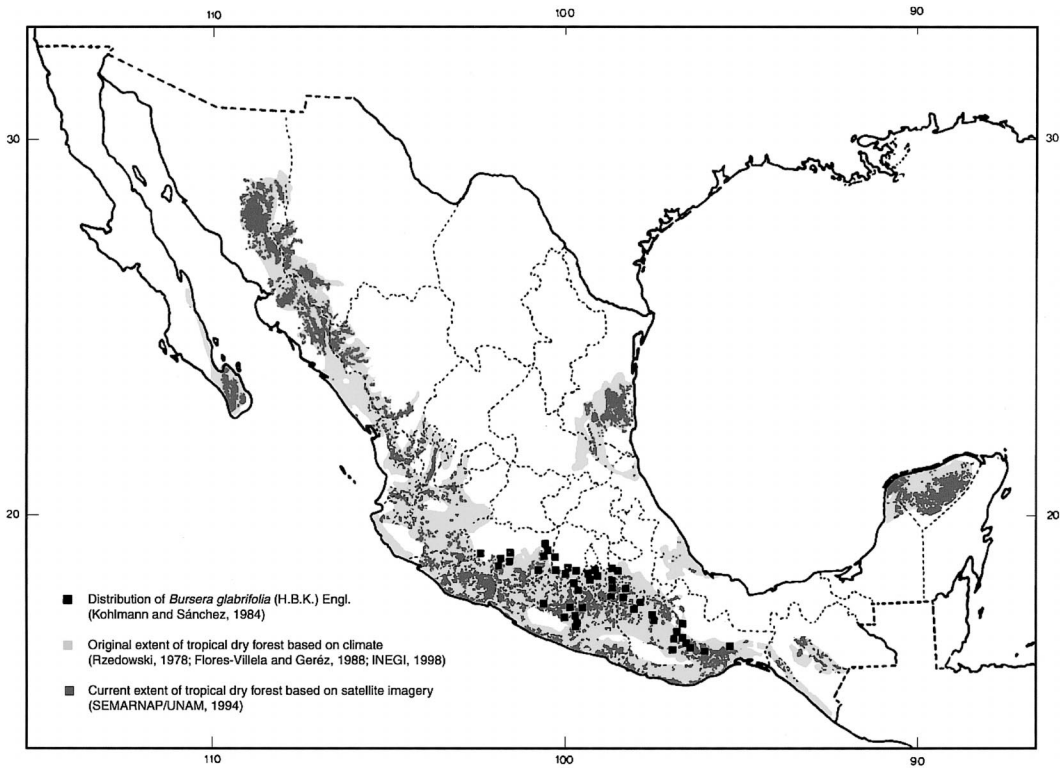

Fig. 2. Map of Mexico showing distribution of *Bursera glabrifolia* based on collection data. The original extent of tropical dry forest (based on climate) as well as the current amount of this habitat remaining are also shown.

vations of from 1000 to 1900 masl (Kohlmann and Sánchez 1984; McVaugh and Rzedowski 1965; see Fig. 2). Its distribution reflects the extension of tropical dry forest (sensu Murphy and Lugo 1986) in southwestern Mexico, and the species is a dominant component of this type of vegetation (Miranda 1947:107–108; Rzedowski 1978:197). This habitat affinity has played a major role in shaping the history and current predicament of *B. glabrifolia*.

On the positive side, dry forest is the most prevalent type of tropical vegetation found in Mexico. Trejo and Dirzo (2000) estimate that these forest may have originally extended over 270 000 km^2, or approximately 14% of the entire country. Given such a large, contiguous habitat, *B. glabrifolia* was able to spread throughout much of Pacific slope of Mexico and develop large populations in those areas where its deciduous habit, floral morphology, protective cataphylls, and leaf pubescence were especially adaptive.

The down side is that the tropical dry forests of southern Mexico are some of the most threatened and least protected ecosystems in the world (WWF 2001). Recent studies suggest that only 27% of the original dry forest area remains, and that over 190 000 km^2 of forest have been altered, degraded, or converted through human activity (Trejo and Dirzo 2000; Fig. 2). The spread of agriculture and the creation of new grazing lands for cattle ranching are the major causes of this deforestation. The six states with tropical dry forest containing *B. glabrifolia*, for example, exhibit a combined total of over 94 000 km^2 of grazing land, and the total area devoted to this land use increases each year (SAGAR 1999). Unfortunately, *B. glabrifolia* has evolved as a species to grow and reproduce in a habitat that is rapidly disappearing in contemporary Mexico.

Species/Habitat Relations

A tropical dry forest is not the easiest place for a plant to grow. These habitats are charac-

terized by high temperatures, low total annual rainfall, and a marked dry season of from five to eight months (Bullock et al. 1995). Levels of herbivory and seed predation can also be quite high (Dirzo and Domínguez 1995; Janzen 1980, 1981). For trees to survive under these climatic conditions they must either avoid or tolerate the physiological effects of moisture stress. Deciduous species like *B. glabrifolia* have opted for an avoidance strategy by dropping their leaves during the dry season—much to the chagrin of botanists. Similarly, the high content of resin and essential oil in the wood and fruit of *B. glabrifolia* undoubtedly acts as a deterrent to folivores and seed predators. Simple survival, however, does not guarantee the continued existence of a species in the forest. To maintain itself over time, the species must be able to grow, reproduce, and continually recruit new seedlings into its population.

Based on the results from 33 km of 10-m wide inventory transects run through the Central Valley, and the foothills of the Sierra Juárez in the state of Oaxaca, *B. glabrifolia* would appear to be quite successful at fulfilling these basic ecological functions in undisturbed dry forest. Under optimal conditions, the species can develop populations with over 40 adult trees/hectare. Averaging the results from all transects reveals that a ''typical'' hectare of dry forest in central Oaxaca contains 31.5 adult *B. glabrifolia* trees. It would seem, however, that these densities were built up gradually over a long period of time because existing levels of regeneration at most sites, as well as the annual growth rates of adult trees, are very low. In spite of careful searching, *B. glabrifolia* seedlings ($\leq$1.0 m tall) were found in only 16% of the sample area, i.e., 27.7 ha of dry forest exhibited no regeneration whatsoever. The current annual diameter growth of *B. glabrifolia* was assessed through the use of stainless-steel dendrometer bands placed around the trunk of 28 adult trees of varying size. Total radial growth over a 12 month period averaged only 0.191 $\pm$ 0.004 cm; five trees exhibited no measurable diameter increment.

It is important to point out that the slow growth and apparent lack of regeneration exhibited by *B. glabrifolia* populations in central Oaxaca are, in the strictest sense, representative only of the time period within which these data were collected (mid-1999 to 2001). To build up dense populations and attain diameters of greater than 40 cm DBH in such an adverse environment, the species clearly was able to establish seedlings and grow in diameter at a faster rate at some point in the past. Regardless of the factors ultimately responsible for limiting the regeneration and growth of the species, the salient feature of the current relationship between *B. glabrifolia* and its habitat is that the species has only a very limited ability to increase its numbers or respond to disturbance, e.g., uncontrolled harvesting. In the short term, it is hindered by a miniscule growth rate that affects the speed at which individuals attain reproductive size, develop a healthy crown, and recover from damage. In the long term, it is threatened by the failure of adult trees to adequately replace themselves.

UTILIZATION

Bursera glabrifolia has been exploited continually as a source of useful products since pre-Columbian times. The species has been collected sporadically at low levels for subsistence use, harvested commercially in large quantities for export, purposely substituted for other, more valuable, members of its genus, and, in all probability, mistakenly identified and felled in place of a tree that looked the same. The use history of *B. glabrifolia* is long, complicated, and extremely dynamic, with changing markets, booms and busts, and, when warranted, deliberate resource substitution and adulteration.

RITUAL AND MEDICINAL USES

Traditionally, the most widespread use of *B. glabrifolia,* and other related species of *Bursera,* was for its aromatic resin. As an indication of the local importance of this resin, the common name for all species in the section Bullockia of Bursera, copal, is derived from the Nahuatl word for the exudate produced by these trees (Standley 1923). The dried resin is burned and used ritually as incense. Historical sources suggest that the use of copal resin by pre-Hispanic societies may have been quite large. The *Codex Mendoza* (1978:54–57), or *Matricula de tributos,* for example, states that ''800 baskets of white copal incense (possibly *B. jorullensis*) and 16,000 balls of unrefined copal wrapped in palm leaves'' were sent in tribute to Moctezuma Xocoyotzin, the ninth and last ruler of Tenochtitlan, every eighty days. These tributes were collected by 24 separate villages from ''hot country,'' i.e.,

dry forest. Given the magnitude of the tribute and the abundance of *B. glabrifolia* in local dry forests, this species was almost certainly tapped as a resin source during this period. The ritual use of copal resin has continued to the present, and the dried exudate is available in bulk from local markets throughout southwestern Mexico for use as incense.

The resin from numerous species of *Bursera* is also used medicinally. Martínez (1990) reports that copal is good for treating scorpion bites, for making ointments, and for relieving cold symptoms. Inhaling the smoke from the smoldering resin is a remedy for headaches. Ximenez (1615) summarizes the medicinal importance of the resin simply as ''a great remedy for all illnesses caused by cold and humid conditions.''

Industrial Uses

The wood and fruit of several species of *Bursera* contain a fragrant essential oil, known commercially as Mexican linaloe oil that is a valuable raw material for making perfumes, lotions, cosmetics, and soaps (Bullock 1936). The most important oil-producing species have been described by various authors (e.g., Bullock 1936; Guenther 1950; Holmes 1910; Standley 1923) as *B. delpechiana* (a synonym for *B. glabrifolia*), *B. aloexylon*, (originally thought to be a synonym of *B. glabrifolia*), *B. penicillata* (frequently confused with *B. glabrifolia*), and *B. glabrifolia.* Although the exact taxonomic identification of the key species is still in question, *B. glabrifolia* is clearly a participant to some degree in this market.

The exploitation of *Bursera* trees for oil started in the latter half of the 19th century in the state of Guerrero (Altamirano 1904). At first, the copal wood was shipped to England and France for distillation, but it wasn't long before primitive stills began popping up along the banks of rivers in the states of Puebla, Oaxaca, and Guerrero for extracting the oil in the country. In spite of the poor quality of the oil produced by these rustic stills, the demand for Mexico linaloe oil grew extremely fast and collectors began to indiscriminately fell *Bursera* trees, of whatever species, to provide the raw material for distillation. The wood oil was also frequently mixed, i.e., adulterated, with *Bursera* seed oil which is of inferior quality and aroma (Guenther 1950). In response to the general lack of quality control and a rapidly declining supply of copal trees, international buyers in the perfume industry lost confidence with the Mexican product and started buying Brazilian rosewood oil (*Aniba rosaeodora* Ducke) to use in their products.

Another factor which hastened the demise of the linaloe oil market in Mexico was the establishment of *Bursera* plantations in southern India in the early 1900s. These plantings were originally thought to have been started using *B. penicillata* or *B. delpechiana* seeds collected in Mexico (Simmons 1934). Bullock (1936), however, reported that many of the living plants that he examined from the plantations were actually *B. glabrifolia.*

With the outbreak of World War II, demand was created once again for Mexican linaloe oil due to the difficulty of obtaining rosewood oil from the Amazon Basin. Apparently, several decades without harvesting copal trees allowed natural populations of *Bursera* to replenish themselves, because the production of linaloe wood oil during the early 1940s reached levels of up to 88 metric tons/year. After the end of the war, production dropped to only 5 metric tons, and currently the production of linaloe oil in Mexico is limited to a few areas in the state of Puebla (Lopez 2001). The small amount of oil that is currently produced is used locally to scent wooden handicrafts.

Handicrafts

Currently, the most widespread use of *B. glabrifolia* is as a raw material for carving small, painted figurines known as *alebrijes.* These carvings, which usually portray fanciful animals, dragons, mermaids, or human-animal hybrids (Fig. 3), are somewhat unique relative to other Mexican handicrafts. They are not a traditional craft item embodied with a long history of cultural significance, nor are they produced by artisans from a particular indigenous ethnic group. They are, nonetheless, extremely well-accepted commodities in both the national and international craft market, and the demand for *alebrijes* carved from *Bursera* wood has increased steadily over the last thirty years.

*Alebrije*s are a recent introduction to the ethnic art market in Mexico. The tradition began almost simultaneously in three communities, i.e., San Antonio Arrazola, San Martín Tilcajete and La Unión Tejalapam, in the Central Valley of Oaxaca in the early 1960s (Chibnick 1999; Serrie 1964). Carvers initially sold a few pieces to

Fig. 3. An assortment of *alebrijes* from Oaxaca, Mexico. Photo by D. Roberts.

craft stores in Oaxaca City to supplement their income. In 1970, a prominent local carver was named head of the FONART (Fomento Nacional de Artesanía) buying office in Oaxaca, and an increasing number of *alebrijes* were purchased and channeled into the network of craft stores operated by this national agency. In the mid-1980s, wholesalers from the United States began to visit the carving communities and purchase directly from them. This burgeoning commerce was stimulated by the potential for high profit margins caused by a weakening peso. The *alebrijes* became more intricate and the painting more ornate as the carvers sought to distinguish themselves in an increasingly competitive marketplace. By the 1990s, most of the households in Arrazola and San Martín Tilcajete were earning at least part of their income from the sale of carvings; some families had abandoned agriculture completely to work as full-time carvers (Chibnik 2001). Most of the carvings are bought directly from the villages to be sold in markets and craft stores in Oaxaca City or to be exported to the United States, Canada, and, to a lesser extent, Europe and Japan. U.S. buyers are especially active in the *alebrije* trade because of NAFTA duty exemptions on handicrafts, the easy transportability of the pieces, and the existence of a sizable, high-end market in major cities with large Latino populations.

As the market continued to grow, it became apparent that individual families could not keep pace with the orders using only household labor and the occasional hired worker to help with the painting and sanding. In response to this, at least ten carving workshops, each employing up to 20 workers, have been established recently in the vicinity of Oaxaca City. Most of these *alebrije* ''factories'' are located in the towns of Arrazola and Tilcajete. *Alebrije* carving has also spread to several other communities in Oaxaca, and there are currently at least seven villages that engage in this activity (Lopez 2001). A more detailed account of the history and structure of the *alebrije* trade in Oaxaca is provided by Barbash (1991, 1993) and Chibnik (2000, 2001).

The production of *alebrijes* undoubtedly requires a large amount of *B. glabrifolia* wood. Determining exactly how much wood, however, is complicated by the fact that commercial tree

felling in Mexico is illegal without a permit and/or an approved management plan. Copal harvesters, or *copaleros*, are understandably reticent to talk about their activities. Based on surveys of the number of burro and pick-up truck loads consumed per household in different carving communities, samples of the amount of wood included in each type of load, and counts of the total number of households or workshops per community that carve *alebrijes*, it is estimated that each year San Antonio Arrazola and San Martin Tilcajete consume 184 m^3 and 680.5 m^3 of copal wood, respectively (Lopez 2001:41). In the case of San Martín Tilcajete alone, this represents either 2440 small (≤20 cm DBH) *B. glabrifolia* trees or 65 large (≥30 cm DBH) *B. glabrifolia* trees felled each year. Stated in more general terms, the annual consumption rate of copal wood by San Martín Tilcajete is roughly equivalent to felling all of the *Bursera* trees in 100 hectares of tropical dry forest. It is important to note in this context that the market for *alebrijes* is continuing to expand—as is the deforestation rate in tropical dry forests.

THE PROGNOSIS

Bursera glabrifolia has disappeared completely from the dry forests surrounding most of the carving communities in the Central Valley of Oaxaca. Every year, copal collectors are forced to go further and further into the mountains to find enough wood to supply the carvers. Carvers complain that the quality of the copal wood is not as good as it used to be. All of these are signs of incipient over-exploitation, and there is much to suggest that the species is passing through another of a long series of boom and bust cycles. Local collectors have been foraging through the dry forests of southwestern Mexico for *Bursera* trees for hundreds of years. In some cases they were specifically looking for *B. glabrifolia.* In others, they were simply looking for resin or oil-rich wood and the actual species harvested was a secondary concern. Over the past one hundred years, *B. glabrifolia* seems to have been pushed to the brink of local extinction almost every thirty years. The markets then fell apart, harvesting pressure was relieved, the populations slowly recovered, probably at a lower density than originally maintained but sufficient to supply the new demand that eventually arose. The current situation with *B. glabrifolia,* however, deviates from the historic pattern somewhat in that the species may not be given a chance to recover this time.

Who are the major actors in the people and plant relationship being played out in the tropical dry forests of southern Mexico? What are the salient features of the current ethnobotany of *B. glabrifolia*? In terms of proximate factors, the local elimination of the species, first near carving communities and later at progressively more distant locales, is clearly the result of over-harvesting for the *alebrije* trade. Ultimately, however, the continued existence of *B. glabrifolia* is contingent on a broader, and certainly less tractable, array of factors that includes pasture conversion, rate of growth and establishment of the species, and attractive profit margins resulting from duty exemptions and the current selling price of a Mexican handicraft.

Of special concern is the current rate of conversion of tropical dry forest to pastures and the spread of agricultural land. It is one thing to report that the annual consumption of *B. glabrifolia* wood by a single carving community requires the selective exploitation of over 100 ha of dry forest. It is another thing altogether to point out that the amount of copal wood contained in the 60 000 hectares of dry forests converted to pasture in Oaxaca would have supported the *alebrije* carvers in Arrazola at their current level of production for about 600 years. The controlled, selective exploitation of copal wood from this same area, or even a small fraction of this area, would provide raw material for the carvers as well as conserving many of the associated ecological benefits provided by tropical dry forests. In the overall scheme of things, it is the cows, not the copaleros, that will determine the fate of *B. glabrifolia.*

The apparent lack of regeneration and slow growth of *B. glabrifolia* in many areas is also a key feature of this species' ethnobotanical profile. Not all species are equal in terms of their resilience to disturbance and potential for exploitation (Peters 1996a:70–74), and the current demography of *B. glabrifolia* would suggest that the species is somewhat limited in this regard. In spite of their apparent ability to bounce back from over-exploitation at several points in the past, natural populations of *B. glabrifolia* will probably need more than time to rebuild after harvesting given current conditions. The long-term, sustainable exploitation of these populations will inevitably require some type of man-

agement to facilitate the recruitment of new seedlings and to ensure the vigorous growth of residual trees. The sporadic, low-level disturbance caused by the selective removal of trees for medicine and oil may have facilitated these processes in the past and actually allowed the *B. glabrifolia* populations to build up to their current level.

Finally, market factors and consumer preferences will undoubtedly play an important role in the future of *B. glabrifolia.* In spite of Barbash's (1993:40–42) worries about the incipient demise of the *alebrije* market, the demand for this craft item has continued to grow, albeit at a reduced rate, over the past ten years, and the carved wooden figures are now featured prominently in guidebooks, videos, websites, and state tourist pamphlets along with more traditional Oaxacan crafts such as textiles, pottery, and tin ware. It is anyone's guess as to how long the high-end market for ethnic handicrafts and ''Santa Fe style'' home decor will continue in the U.S., but as long as it does, the design sensibilities of American consumers will remain a powerful force in the life of *B. glabrifolia.*

THE PRESCRIPTION

We have always been of the opinion that ethnobotanical research, rather than an end in itself, is really the first step toward effective resource management (Peters 1996b). From our long-term ethnobotanical research on *B. glabrifolia* we have learned several key points. First, the species provides the raw material used to make a valuable handicraft. Second, the habitat in which the species grows is one of the most threatened and least-protected ecosystems in Mexico. Third, the species has been exploited since pre-Columbian times, and apparently natural populations are able to withstand the periodic removal of adult trees if harvesting is conducted on an extensive, rather than, intensive basis.

So what do we do with this information? What can be done to ameliorate the dysfunctional relationship that has developed between *B. glabrifolia* and the people who use it or its habitat? Clearly, any recommended solution will depend largely on perceptions of the nature of the problem. One idea would be to reforest the areas around carving communities with *B. glabrifolia* to provide the artisans with a local source of raw material for *alebrijes*. This has actually been attempted, albeit with little success, at Arrazola and San Martín Tilcajete (Lopez 2001:26–28). The basic shortcomings to this approach are the time required before the material attains a usable size, i.e., several decades, and the relatively small percentage of the total wood needs of the community that will actually be met by the plantings. Local copal plantations also do very little to address the larger issue of the destruction of tropical dry forests and the loss of habitat for *B. glabrifolia*.

Another idea would be to work within a broader ethnobotanical context and promote the sustainable use and management of the species in its native habitat. Such an approach would provide an immediate source of carving wood. It would also enhance the value of standing dry forest relative to competing land-uses, e.g., pastures or agriculture, and act as a potential incentive for conserving these habitats. Perhaps most importantly, however, it would engage local communities in the long-term management of tropical dry forests and offer a mechanism for compensating them for their stewardship. Over time, management operations could be expanded to include other valuable plant resources that are known to occur in tropical dry forests (Bye 1995).

For this to happen, an organized community with several thousand hectares of tropical dry forest containing *B. glabrifolia* is needed. We have found these conditions at San Juan Bautista Jayacatlán north of the city of Oaxaca. This forest will need to be inventoried, preferably by the local people themselves, and growth studies conducted to be able to define a sustainable harvest of carving wood each year. Regeneration studies should be initiated to monitor the effect of harvesting on seedling establishment, a management plan must be written and submitted to SEMARNAT (Secretary of the Environment and Natural Resources) to obtain the necessary permits for harvesting, and preliminary overtures to selected carving communities need to be made concerning the purchase of copal once the management activities have begun. Over the past two years, we have completed all of these tasks as part of our ethnobotanical research.

Murphy and Lugo (1995:27) opine that ''the potential for sustained and profitable management of dry forests for forest products is questionable.'' Proving them wrong would be a fitting tribute to *B. glabrifolia*. This species has

survived repeated waves of uncontrolled harvesting, market crashes, government incentive programs for pasture establishment, devalued pesos, and NAFTA duty exemptions. It is currently the basis of an entire handicraft industry. It would certainly seem to be an appropriate time to give this species a little help.

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