

The Wild Orchid Trade in a Mexican Local Market: Diversity and Economics

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In developing countries, the sustainable management of non-timber forest products (NTFP) is promoted as a means to generate benefits in indigenous communities, alleviate poverty, and guarantee forest conservation. However, it is largely unknown whether this practice meets local economic needs. In Mexico, orchids are one of the most widely traded NTFP in local markets, but studies generally only provide lists of the species for sale. We obtained data for orchid richness and abundance from 56 sellers in a Mexican local market over one year. We related sellers' economic status to certain socioeconomic variables and determined possible relationships between orchid prices and abundance. Thirty-seven orchid species were recorded; an estimated 18,740 units were offered for sale, most of them harvested in surrounding forests. The greatest abundance of orchids for sale was recorded in October–December, whereas the greatest richness was found in March–April. The ages of the sellers ranged from 14–70 years, 78.5% were women, 50% had either no formal schooling or did not finish elementary school, and 54% spoke an indigenous language. The orchid trade was not the sellers' main economic activity: to supplement their incomes they traded either agricultural products or other NTFP. Age and speaking an indigenous language were correlated positively with seller poverty and negatively with income obtained in a single sale day. Orchid price had a low, negative relationship with abundance in the market. Mexican law punishes the illegal wildlife trade, but this practice is allowed (at least) at the local level because orchid extraction and trade is a traditional use and custom in the local indigenous community.

En países en desarrollo el manejo sustentable de productos forestales no maderables (PFNM) es promovido como medio para generar beneficios en comunidades indígenas, aliviar la pobreza y garantizar la conservación de los bosques. Sin embargo, se desconoce si esta práctica cumple con las necesidades económicas locales. En México, las orquídeas son uno de los PFNM más comercializados en mercados locales, pero los estudios al respecto generalmente se enfocan en la listas de especies en venta. Durante un año en un mercado local mexicano se obtuvo

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información de riqueza y abundancia de orquídeas a partir de 56 vendedores. Se relacionó el estatus económico de los vendedores con algunas variables socioeconómicas y se determinó una posible relación entre precio y abundancia de las orquídeas. Treinta y siete orquídeas fueron registradas a partir de 18,740 unidades ofrecidas en venta, la mayoría cosechadas en bosques circundantes. La mayor abundancia de orquídeas fue registrada en octubre-diciembre, mientras que la mayor riqueza se encontró en marzo-abril. La edad de los vendedores fue de 14 a 70 años, 78.5% fueron mujeres, 50% no tuvieron educación formal o no terminaron la educación elemental y 54% hablan una lengua indígena. El comercio de orquídeas no es la principal actividad económica de los vendedores: para suplementar sus ingresos venden otros productos agrícolas o PFNM. La edad y hablar una lengua indígena se correlacionaron positivamente con la pobreza del vendedor y negativamente con los ingresos obtenidos en un día de venta. El precio de una orquídea tuvo una relación baja y negativa con la abundancia en el mercado. Las leyes mexicanas sancionan el comercio ilícito de vida silvestre, pero esta práctica es permitida (al menos) a nivel local debido a que la extracción y venta de orquídeas es parte de los usos y costumbres tradicionales en la comunidad indígena.

Key Words: Ethnobotany, indigenous people, non-timber forest products, poverty alleviation, useful plants, wild plants trade.

Introduction

In the past, the sustainable management of non-timber forest products (NTFP) has been promoted in developing countries as a win-win approach for generating benefits in rural communities, alleviating poverty, and guaranteeing biological conservation (Latif et al. 2005; Lewis et al. 2011; Porembski and Biedinge 2001; Wunder 2001). But although NTFP management can promote community development, conservation is not always possible and its success rate therefore is low, which helps explain the continuous loss of tropical forests (Cernea and Schmidt-Soltau 2006; Lewis et al. 2011; Lybbert et al. 2011; Sanderson 2005; Wunder 2001). Most studies in Latin America indicate that extraction practices are environmentally friendly (cf. Guadagnin and Gravato 2013; Lima et al. 2013), although it has not been established whether these activities cover economic necessities. On a global scale (Stanley et al. 2012), economic benefits generated by extraction activities exceed the absolute poverty threshold.

Indigenous communities generate a portion of their livelihood from the use and management of NTFP (Casino 2001; Reuter 2009), often through activities that involve trade in local markets, spaces in which sellers and buyers interact to concentrate, maintain, and transmit traditional knowledge about NTFPs (Bye and Linares 1983; Monteiro et al. 2010; Ugent 2000; Vodouhê et al. 2009). This activity generates economic benefits and at the local level, it helps reduce the poverty of people engaged in it (Delang 2005; Marshall and Newton 2003;

Reuter 2009; Shackleton and Gumbo 2010). However, constraints such as management practices, variations in the availability of NTFP due to environmental factors, and legislation and protection related to conservation areas are all factors that affect this activity's potential economic benefits.

Wild plants with food, medicinal, ornamental, and ceremonial uses are among the most important NTFP sold in local markets (Cabrera et al. 2007, 2012; Flores and Valencia 2007; Giraldo et al. 2009; Monteiro et al. 2010; Munguia et al. 2010; Reuter 2009; Ugent 2000). Unfortunately, this plant trade is one of the main threats to conservation because in the majority of cases, it relies on the extraction of plants from their habitats without the use of sustainable management techniques. Moreover, overharvesting schemes affect ecological processes at different levels: demographic population parameters, interactions between species, and the structure of the ecosystem's vegetation (Delang 2005; Naranjo and Dirzo 2009; Ticktin 2004).

Trading wild plants in local Mexican markets is common, but studies on this theme generally consist of species inventories and records of traditional uses (Arellano and Ortiz 2004; Bye and Linares 1983; Cabrera et al. 2007; Lesscyynska-Borys et al. 1994; Linares and Bye 1987; Munguia et al. 2010; Rees 1976). Few studies have estimated the volume of plants sold, identified extraction areas, described harvest and management practices, examined the socioeconomic context of people involved in this activity or analyzed its income in respect to NTFP dependence

(Casino 2001; Flores and Valencia 2007; Salazar et al. 2010; Ticktin et al. 2002). Focusing on these questions allows us to perform the following tasks: 1) identify the areas where plants are an abundant resource by estimating the amount extracted per locality; 2) identify expensive and in-demand species by diversifying the market offering; 3) uncover the factors that determine sellers' economic gains; and 4) identify the traditional management techniques used by people who depend on NTFP for their livelihood.

At the national level, the Mexican Ministry of Environment and Natural Resources is responsible for the regulatory framework of wildlife conservation and management (SEMARNAT 2010–2014), which is designed: 1) to achieve the protection and sustainable use of wildlife and its habitats; 2) to ensure the continuity of biological, ecological, and evolutionary processes; 3) to increase social welfare; 4) to sanction illicit trade; and 5) to preserve traditional biological knowledge. This framework also alleviates poverty by establishing regulatory criteria for NTFP extraction by indigenous people. Additionally, it designates federal, state, and municipal authorities as responsible for enforcing this regulation.

Orchids, along with bromeliads, cacti, ferns, and mosses, are the most frequently sold plants in Mexican local markets. The extraction of wild orchids for this trade is one of the primary threats to their conservation, followed by habitat loss due to agricultural and livestock activities (Flores and Valencia 2007; Solano et al. 2012; Soto et al. 2007a). Additionally, in México the orchid trade is an informal business, sanctioned by laws but poorly regulated. In this study, we examined the orchid trade in a Mexican local market over the course of one year focusing on four goals: 1) to determine the richness and abundance of orchids being sold; 2) to evaluate seller economic status and dependence on the orchid trade; 3) to determine whether there is a relationship between orchid prices and availability; and 4) to identify the management practices involved in this trade. We hypothesize the following: a) orchid sellers' degree of poverty is related to variables such as indigenous status, schooling, age, gender, sale income, or species traded; and b) there is a relationship between the supply elasticity of the orchids traded and the abundance of their populations; in other words, the more common an orchid, the lower its price, and the more rare an orchid, the higher its price.

Materials and Methods

ZONE STUDIED

The study was carried out in the market and *tianguis* (weekly, open-air street markets traditionally held on a particular day of the week) of Tlaxiaco City, in the Mixteca region of Oaxaca, Mexico (Fig. 1). According to 2010 data (INEGI 2011), Tlaxiaco has 34,587 inhabitants, with an average educational level of 8.4 years. The main economic activities are agriculture (corn, beans, and wheat), livestock (cattle, sheep, and swine), forestry, and trade and services. The municipal market and *tianguis* are the principal centers of commercial activity. In Tlaxiaco, 27% of the population speak an indigenous language (Mixteco or Triqui) and live in towns and villages near the city.

SAMPLING TECHNIQUES

With the help of local authorities, the orchid sellers' locations were identified and a route was designed through the market and *tianguis*, which was visited every Saturday (*tianguis* day) between September 2011 and August 2012 (for a total of 52 weekly visits). Fifty-six orchid sellers were identified and invited to provide information about their activities; all agreed to participate. These sellers were asked to answer a semistructured questionnaire implemented using active participation and interview-buy methods (Bye and Linares 1983; Martin 2001), which imply establishing a rapport with the seller and making purchases to promote interaction and therefore to obtain information.

The information obtained from sellers during the sampling year allowed us to discover the following information: a) orchid richness as the number of taxa sold; b) abundance as the number of units for each taxon sold; c) sale frequency as the number of weeks in which each taxon was offered for sale; and d) the harvest localities identified by respondents. Additionally, respondents were asked about the sale unit, price, uses, and sales frequency for each orchid species. Some socioeconomic variables were recorded for each seller: age, sex, schooling, place of origin, knowledge of an indigenous language, time spent in the activity, parent and grandparent involvement in the orchid trade, orchid selling

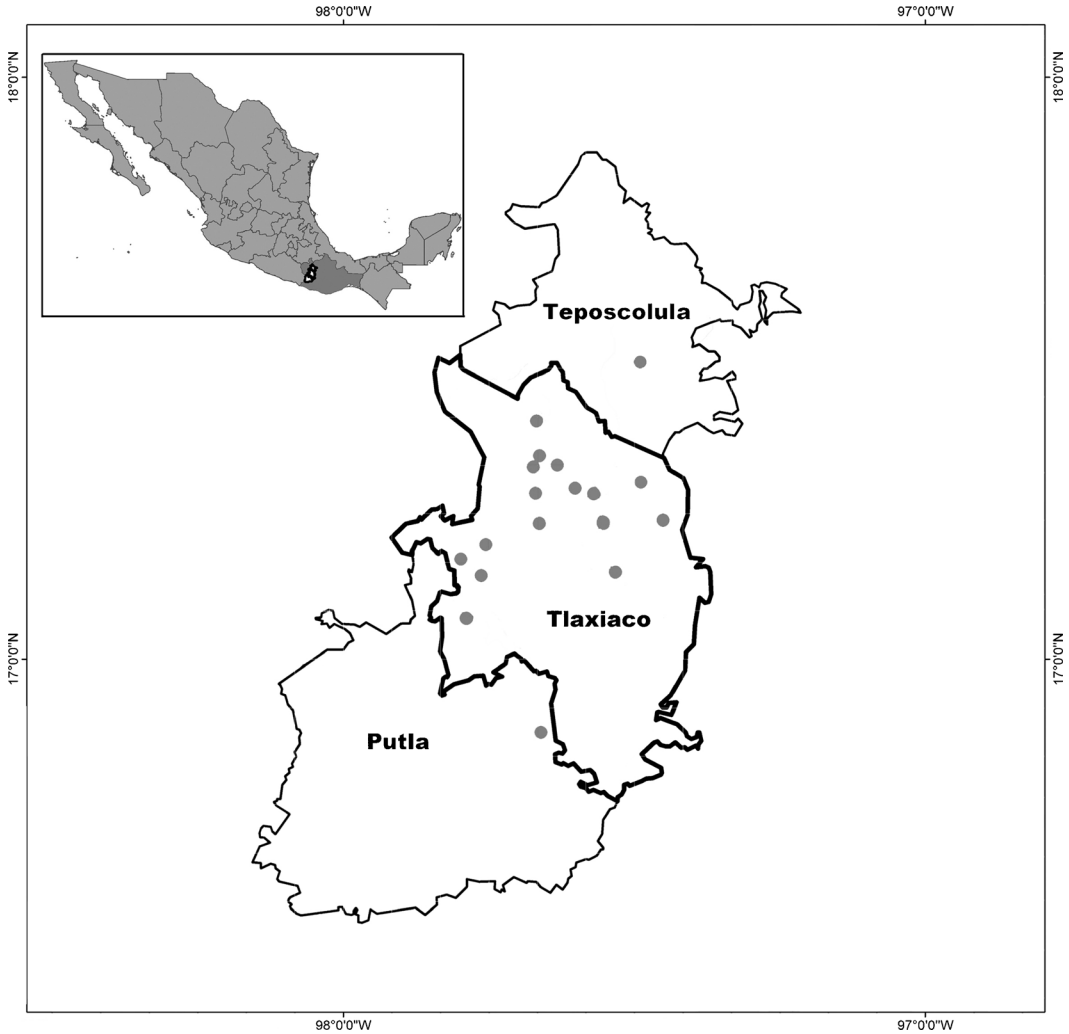


Fig. 1. Map showing the local market studied and harvest zones (gray dots) in the region of Tlaxiaco, Oaxaca, México.

income, and income in a single sales day. Techniques used for harvesting orchids and their rustic cultivation were also documented. For each orchid, at least one specimen was purchased, photographed, herborized, identified, and deposited in the OAX herbarium (Instituto Politecnico Nacional). The assignments of orchid names followed Soto et al. (2007b). Orchid prices, daily income, and sellers' expenses are presented in US dollars using the currency exchange rate for September 30, 2012.

STATISTICAL ANALYSIS

Multivariate analyses were employed to identify a possible relationship among sellers' socioeconomic variables to test the first hypothesis. First, a logistic regression, also called a *logit* model, was used to model dichotomous outcome variables. In this model, the log odds of the outcome were modeled as a linear combination of the predictor variables. Two dummy variables were built: poverty of education and income diversification. Poverty of education was

TABLE 1. LIST OF THE ORCHIDS TRADED BY 56 SELLERS IN THE LOCAL MARKET FROM SEPTEMBER 2011 TO AUGUST 2012. THE LIST INCLUDES PRICES, SALE UNIT (INF = ONLY INFLORESCENCE, PS = PSEUDOBULBS WITH FLOWERS, P = FULL PLANT, SP = SEGMENT OF A PLANT), ABUNDANCE, AND SALE FREQUENCY. ONE ASTERISK INDICATES A MEXICAN ENDEMIC ORCHID, TWO ASTERISKS INDICATE A OAXACAN ENDEMIC ORCHID. ORCHIDS AT RISK ARE INDICATED BY THE SUPERINDEX PR (SUBJECT TO SPECIAL PROTECTION), A (THREATENED), AND P (ENDANGERED).

| Taxon | Price (USD) | Sale unit | Estimated abundance ^a | Sale frequency (No. weeks) ^a |
|--|-------------|-------------|----------------------------------|---|
| <i>Artorima erubescens</i> * (Lindl.) Dressler & G.E.Pollard | 1.14–1.90 | inf/ps/p | 717 | 10 |
| <i>Barkeria scandens</i> * ^{Pr} (La Llave & Lex.) Dressler & Halb. | 0.76–1.14 | inf | 1,250 | 2 |
| <i>Barkeria vanneriana</i> * Rchb.f. | 0.38–1.14 | inf | 3,409 | 4 |
| <i>Bletia campanulata</i> La Llave & Lex. | 0.38 | inf/p | 5 | 2 |
| <i>Brassia verrucosa</i> Bateman ex Lindl. | 2.28 | p | 2 | 1 |
| <i>Camaridium bagsaterianum</i> (Soto Arenas) M.A.Blanco | 3.81 | p | 9 | 5 |
| <i>Cuilauzina pendula</i> * ^A La Llave & Lex. | 1.14–2.28 | inf | 75 | 3 |
| <i>Cyrtopodium macrobulbon</i> (La Llave & Lex.) G.A.Romero & Carnevali | 7.62 | p | 1 | 1 |
| <i>Encyclia kienastii</i> ** ^P (Rchb.f.) Dressler & G.E.Pollard | 7.62–11.43 | p | 3 | 2 |
| <i>Encyclia microbulbon</i> * (Hook.) Schltr. | 0.76 | sp/p | 7 | 1 |
| <i>Encyclia rzedowskiana</i> ** Soto Arenas | 11.43 | p | 3 | 2 |
| <i>Epidendrum camposii</i> ** Hágsater | 1.14–3.04 | p | 6 | 5 |
| <i>Epidendrum cardiochilum</i> L.O.Williams | 0.76 | p | 1 | 1 |
| <i>Epidendrum greenwoodii</i> Hágsater | 0.76–3.04 | p | 15 | 5 |
| <i>Epidendrum juergensii</i> ** Rchb.f. | 0.76 | p | 4 | 1 |
| <i>Epidendrum lignosum</i> * La Llave & Lex. | 1.14 | inf | 52 | 3 |
| <i>Laelia albida</i> * Bateman ex Lindl. | 0.76–1.14 | p/sp/ps/inf | 1707 | 8 |
| <i>Laelia albida</i> x <i>furfuracea</i> | 0.76–1.14 | sp/ps/inf | — | — |
| <i>Laelia anceps</i> subsp. <i>dawsonii</i> * ^P (J.Anderson) Rolfe. | 7.62 | inf | 12 | 1 |
| <i>Laelia furfuracea</i> ** Lindl. | 0.76–1.14 | p/sp/ps/inf | 7854 | 9 |
| <i>Laelia speciosa</i> * ^{Pr} (Kunth) Schltr. | 1.90 | p | — | — |
| <i>Oncidium brachyandrum</i> * Lindl. | 0.76 | p/sp/ps | 10 | 3 |
| <i>Oncidium hastatum</i> * (Bateman) Lindl. | 1.52–3.81 | p | 3 | 2 |
| <i>Oncidium reflexum</i> * Lindl. | 0.76–1.14 | p/sp/ps | 30 | 3 |
| <i>Oncidium unguiculatum</i> * ^A Lindl. | 3.81 | p | 45 | 4 |
| <i>Prosthechea concolor</i> * (La Llave & Lex.) W.E.Higgins | 0.76–1.14 | ps/p | 12 | 2 |
| <i>Prosthechea fragrans</i> (Sw.) W.E.Higgins | 1.14–7.62 | p | 10 | 3 |
| <i>Prosthechea ghesbreghtiana</i> * (A.Rich. & Galeotti) W.E. Higgins | 0.76–1.14 | ps/p | 35 | 3 |
| <i>Prosthechea karwinskii</i> * (Mart.) J.M.H.Shaw | 0.38–1.52 | p/sp/ps/inf | 2164 | 6 |
| <i>Prosthechea michuacana</i> (La Llave & Lex.) W.E.Higgins | 0.38–1.90 | sp/p | 55 | 6 |
| <i>Prosthechea semiaperta</i> * (Hágsater) W.E.Higgins | 0.76–1.14 | sp/p | 25 | 3 |
| <i>Prosthechea varicosa</i> (Lindl.) W.E.Higgins | 0.76 | p | 10 | 1 |
| <i>Rhynchostele cervantesii</i> subsp. <i>membranacea</i> ** ^A (Lindl.) Soto Arenas & Salazar | 1.14–1.90 | p | 4 | 2 |
| <i>Rhynchostele maculata</i> (La Llave & Lex.) Soto Arenas & Salazar | 0.76–1.14 | p/sp/ps/inf | 1200 | 6 |
| <i>Stelis emarginata</i> (Lindl.) Soto Arenas & R.Solano | 2.67 | p | 1 | 1 |
| <i>Stelis ornata</i> (Rchb. f.) Pridgeon & M.W.Chase | 1.14 | p | 3 | 1 |
| <i>Trichocentrum chrysops</i> * (Rchb.f.) Soto Arenas & R.Jiménez | 7.62 | inf | 1 | 1 |

^a According to its definition in Materials and Methods.

defined as (1) if the seller has no schooling and (0) if he/she has some schooling; this parameter was used as a proxy for poverty. Income diversification was defined as (1) if the seller trades other agricultural products or NTFPs and (0) if orchids are the only

product traded. These variables were used as dependent variables in a *logit* regression. Socioeconomic variables and dummy variables for orchid genera with the highest abundance values in the local market (*Barkeria* Knowles & Westc., *Laelia* Lindl., and

Prosthechea Knowles & Westc.) were used as independent variables. Second, the income for one day of sales was used as dependent variable for an ordinary least squares (OLS) regression. OLS is a method for estimating the unknown parameters in a linear regression model, which minimizes the sum of squared vertical distances between the responses observed in the dataset and the responses predicted by the linear approximation. Once again, socioeconomic variables and dummy variables for the more traded orchid genera (*Barkeria*, *Laelia*, and *Prosthechea*) were used as independent variables.

Finally, to test the second hypothesis—whether the ecology of the resource (abundance in the forest) determines supply elasticity (price requested by sellers)—a linear regression analysis was conducted between the amount of units traded for each orchid during the sampling year (abundance) and its price, or the median value when an orchid's prices fell within a range. This analysis was conducted using the free software Statistica v.10.0 ([statistica.sharewarejunction.com](http://www.statistica.com)) with normalized data.

Results and Discussion

ORCHID DIVERSITY IN THE LOCAL MARKET

Thirty-six orchid species, two of them determined at the intraspecific level and one a natural hybrid, belonging to 15 genera, were recorded in the local market (Table 1). Twenty-three orchids (89%) are endemic to Mexico, six (16%) are endemic to the State of Oaxaca, and seven (19%) are considered at risk in Mexico (SEMARNAT 2010). Two of the orchids traded—*Encyclia kienastii* (Rchb. f.) Dressler & G. E. Pollard and *Laelia anceps* (Lindl.) subsp. *dawsonii* (J. Anderson) Rolfe—are endangered and their distribution is restricted to southern Oaxaca, where their population has a very low density. The orchid richness reported here for Tlaxiaco's market was higher than that reported for other Mexican local markets (Cabrera et al. 2012; Dutra-Elliott and Ticktin 2012; Munguia et al. 2010) except for Xalapa, Veracruz (Flores and Valencia 2007). Most of the orchids traded are harvested in Tlaxiaco's surrounding areas, where 17 of the 20 harvest localities documented are located (Fig. 1). Interestingly, almost 50% of the taxa come from only one locality (Santa Cruz Itundijia), whereas two other localities (Yosonicaje and Santiago Nundiche) each account for 21% of the taxa.

Over the year that we visited, an estimated 18,740 orchid units were offered for sale; these units were traded as whole plants, plant segments (i.e., a portion of a plant consisting of 3–4 pseudobulbs), inflorescences, or pseudobulbs with flowers. This amount was higher than that reported by Flores and Valencia (2007) in Xalapa markets. The best-selling orchids were *Laelia furfuracea* Lindl. (41.9% of units for sale), *Barkeria vanneriana* Rchb. f. (18.2%), and *Prosthechea karwinskii* (Mart.) J. M. H. Shaw (11.5%). These species grow in forests of the region, where their populations are relatively abundant and their flowers are highly valued as adornments by the local people.

SALE UNITS, FREQUENCY, AND PRICES FOR ORCHIDS

Most orchids are bought as temporary adornments during their flowering season; however, almost 27% of species are bought to be cultivated and their sale units consist of whole plants or plant segments, either with or without flowers. For orchids bought as temporary adornments, their sale units consist of plant segments (27%), solitary inflorescences (43%), bouquets of inflorescences (16%), or individual pseudobulbs with flowers and without roots (35%). In the latter case, five pseudobulbs are wound with a cord, palm leaves or, more commonly, with Spanish moss (*Tillandsia usneoides* [L.] L.). Some orchids that are traded as adornments sometimes are also cultivated in rustic conditions by sellers.

The sales frequency for most orchids in the market is approximately one month or less; a few species lasted between one and one-half and two and one-half months throughout the year of sampling, such as *Artorima erubescens* (Lindl.) Dressler & G. E. Pollard (ten weeks), *Laelia furfuracea* (seven weeks) and *Prosthechea karwinskii* (six weeks). Over this period, the amount of orchids traded increased both in species and abundance during two seasons (Fig. 2). In October–December 35% of the orchids' richness and 76.3% of their abundance were recorded, whereas during March–April higher richness (54%) but lower abundance (15.3%) were recorded. Both seasons coincide with important religious celebrations: the Day of the Dead (November) and Christmas (December), when *Artorima erubescens*, *Barkeria vanneriana*, *Laelia albida* Bateman ex Lindl., and *L. furfuracea* are abundant in the market; and Easter (April), when the orchid trade consists primarily of *Prosthechea karwinskii* and

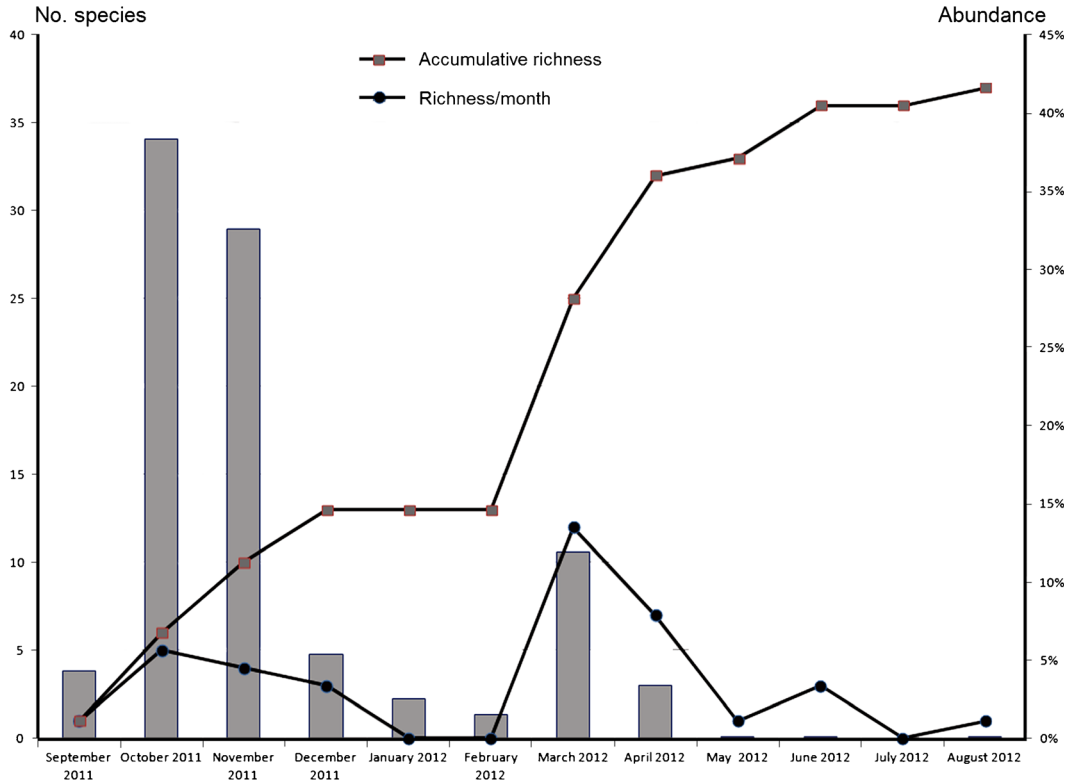


Fig. 2. Accumulative orchid richness (continuous line with gray squares) and number of orchids registered monthly (continuous line with black circles) from September 2011 to August 2012.

Rhynchostele maculata (La Llave & Lex.) Soto Arenas & Salazar.

The orchid price depends on the unit on sale, flower size, showiness, and rarity (Table 1). *Barkeria vanneriana*, *Prosthechea concolor* (La Llave & Lex.) W. E. Higgins, *P. karwinskii*, and *P. michuacana* (La Llave & Lex.) W. E. Higgins are among the least expensive orchids at USD 0.40 per unit. These species were among the most traded during the year studied (Fig. 3). The most expensive orchids were *Cyrtopodium macrobulbon* (La Llave & Lex.) G. A. Romero-González & Carnevali, *Laelia anceps* subsp. *dawsonii*, *Prosthechea fragrans* (Sw.) W. E. Higgins, and *Trichocentrum chrysops* (Rchb. f.) Soto Arenas & R. Jiménez, at USD 7.70, whereas *Encyclia rzedowskiana* Soto Arenas and *E. kienastii* reached a price of USD 11.50. These six orchids were among the least abundant during the year of sampling, with only 1–12 sale units.

Some sellers have a fixed stand in the market and tianguis, but most sellers peddle their

plants. The buyers are regular visitors to the market and for the most part live in Tlaxiaco, although some buyers also come from nearby communities. Orchids are bought primarily for religious purposes (i.e., to decorate religious images in houses, commercial stands, churches, or cemeteries) and, less frequently, for use in traditional medicine. Except for one seller from Veracruz State, the remaining sellers are inhabitants of Tlaxiaco and its surrounding areas. Most of the sellers extract orchids from their community forests and they need not travel long distances to gather their product. However, a few sellers do not harvest orchids in their communities either because they lack nearby forests or because orchids do not grow in those forests. In such cases, sellers must travel to other communities looking for orchids. In this situation, the trade is essentially a direct activity because the sellers also harvest orchids. Half of the sellers have been engaged in the orchid trade from one

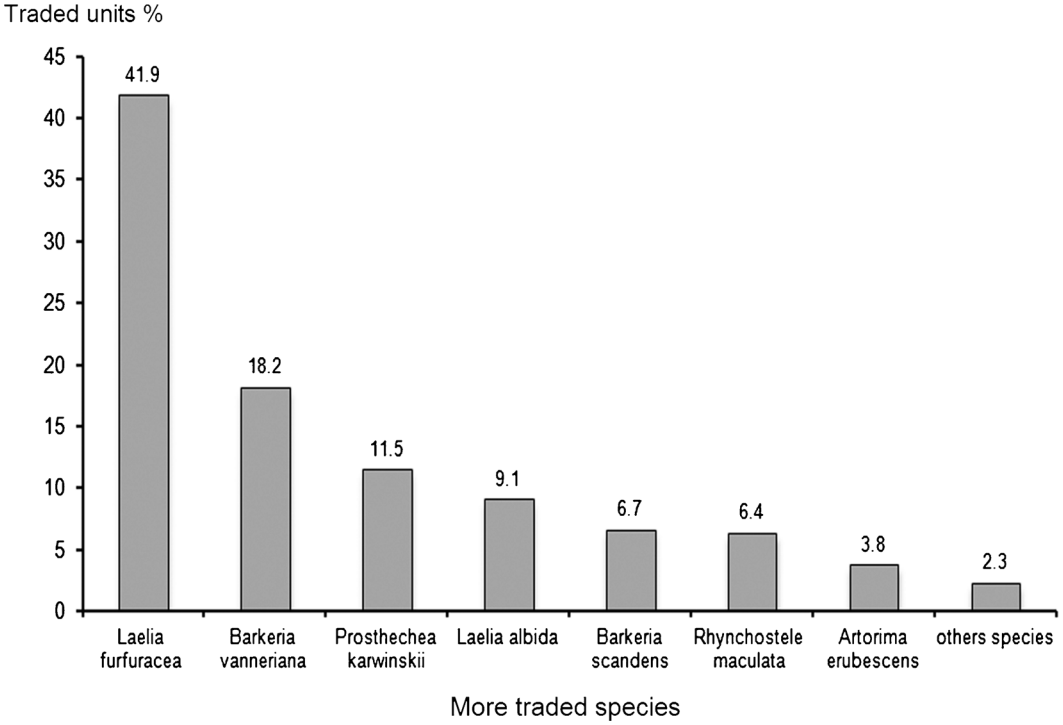


Fig. 3. Percentage of units for the most-traded orchids from September 2011 to August 2012.

to ten years and 3.5% have been engaged in the trade for more than 40 years. Moreover, 50% of sellers mentioned that their parents or grandparents also harvested orchids for sale to complement their domestic incomes.

SELLERS' RELATIVE POVERTY AND INCOME OBTAINED FROM THE ORCHID TRADE

The age of the 56 sellers ranged from 14–70 years old, with 55% between 26–45; 78.5% of sellers are

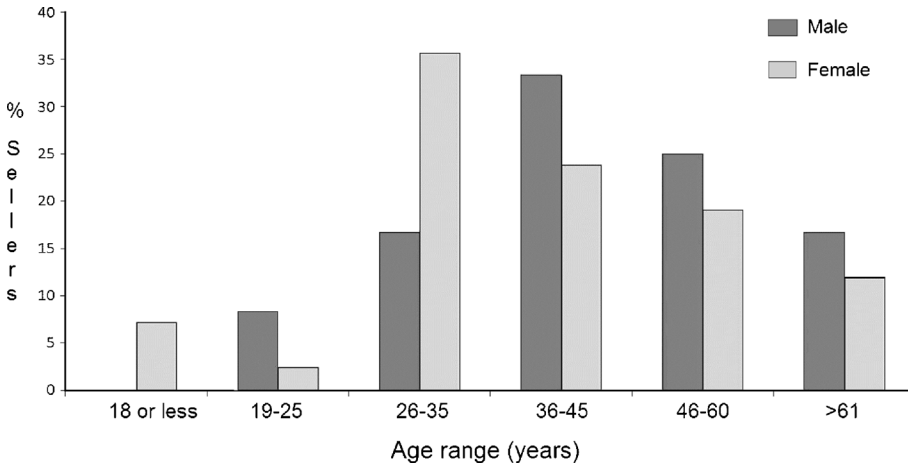


Fig. 4. Percentages of orchid sellers according to gender and age categories.

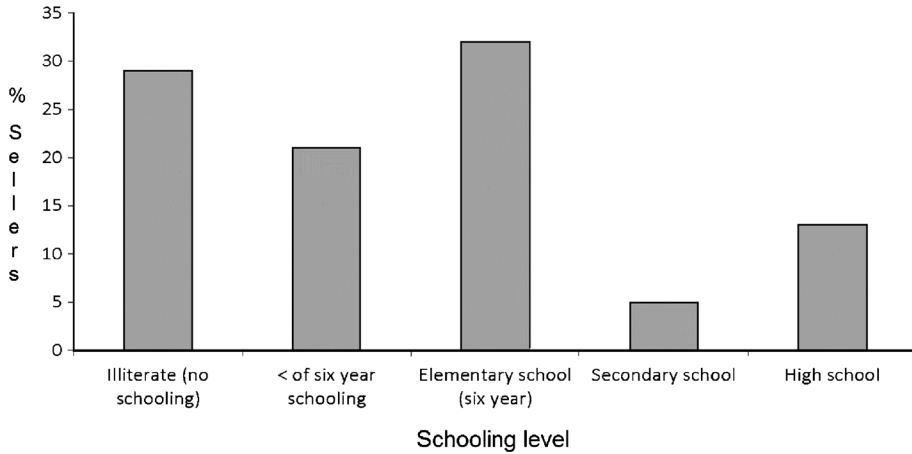


Fig. 5. Percentages of orchid sellers according to their education levels.

women and 21.5% are men (Fig. 4). Half of the sellers are either illiterate or spent very few years in school; 29% have no formal schooling, and 21% did not finish six years of elementary school; only 18% of the sellers have an education beyond elementary school (Fig. 5). Furthermore, 54% of sellers speak an indigenous language (29 speak Mixteco and one speaks Nahuatl) in addition to Spanish. Thus, as in other cases involving the NTFP trade, most people involved in the Tlaxiaco orchid trade are women with little or no schooling who are members of an ethnic group.

The orchid trade is not the sellers' main economic activity, but rather a supplementary activity (Fig. 6). Half of the sellers also sell other products

in the market: 32% sell fruits, vegetables, or medicinal plants, and 18% sell other flowers. Other sellers work on farms in their communities, 14% as farmers (cultivation of corn and beans) and 11% in livestock (sheep, goat, and cattle breeding). This indicates that orchid sales represent an additional source of income for sellers, which is primarily supplemented by other commercial and agricultural activities, as previously reported by other studies (Delang 2005; Marshall and Newton 2003). Eighteen percent of the sellers bought plants and then resold them at a higher price; even at the local level, intermediaries work in the trade. However, all brokers are also orchid harvesters who do so to acquire a wider variety of plants to sell.

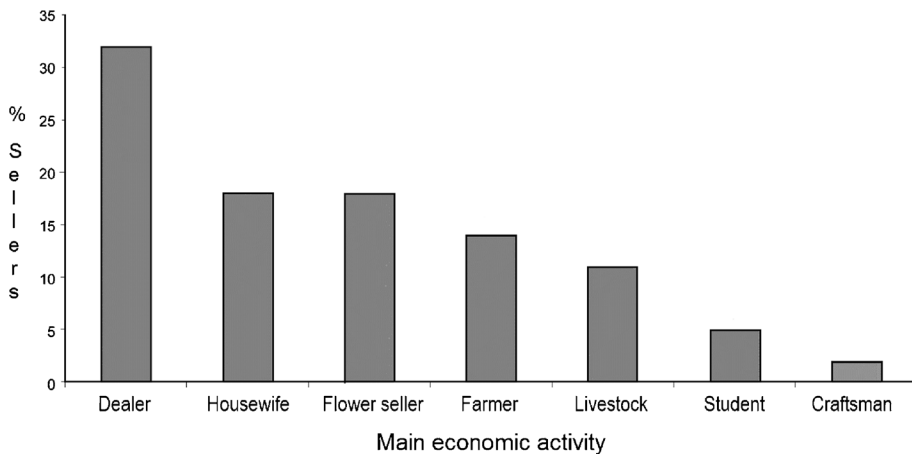


Fig. 6. Percentages of orchid sellers engaged in other activities for their main source of income.

TABLE 2. DATA FROM THE MULTIVARIATE ANALYSES EMPLOYED TO DETERMINE THE RELATIONSHIP BETWEEN THE SELLERS' SOCIAL AND ECONOMIC VARIABLES. AN ASTERISK INDICATES A SIGNIFICANT CORRELATION BETWEEN THE VARIABLES COMPARED.

| Orchids, Poverty, and Income | | | |
|-----------------------------------|-----------------------|------------------------|-----------------------------|
| Dependent Variables | Independent Variables | | |
| | Poverty of education | Income diversification | Income for Sales (1 day) |
| Poverty of education | -- | -2.14 (-1.53) | 77.22 (0.92) |
| Income diversification | -2.04 (-1.4) | -- | -22.19 (-0.30) |
| Income for Sales (1 day) | 0.003 (0.99) | -0.0004 (-0.14) | -- |
| Gender | 2.11 (1.22) | 1.43 (1.18) | -85.67 (-1.12) |
| Age | 0.151 (2.52)* | 0.063 (1.37) | -1.65 (-0.63)* |
| Mixteco speaker | 2.62 (1.76)* | 0.282 (0.24) | -142.47 (-2.05)* |
| Price of orchids in the market | -0.037 (-0.37) | -0.04 (-0.61) | 24.36 (8.82) |
| <i>Prosthechea</i> | Dropped | -3.41 (-2.03)* | 25.96 (0.21) |
| <i>Barkeria</i> | 2.38 (1.34) | 0.0021 (0.00) | -26.23 (-0.29) |
| <i>Laelia</i> | 1.17 (0.70) | -1.48 (-1.19) | 34.00 (0.42) |
| Constant | 10.49 (-2.31) | -0.478 (-0.19) | 128.90 (0.86) |

The daily sales reported by sellers varied from USD 2.3 to 159.3. This income appears to be above the international absolute poverty line, estimated as USD 2 PPP (Purchasing Power Parity)/day (World Bank 2011). With respect to earnings, however, there are two aspects to consider: 1) orchid sales only occur one day a week, and 2) the majority of orchids are traded during five months of the year divided in two periods—September–December (81%) and March–April (15%)—with 22 effective sale days.

The wild orchid trade can be considered a strategy to escape from poverty. Table 2 shows two logit regressions and one minimum square regression used to test hypothesis 1. A lack of schooling was considered as a form of poverty; no schooling was used as a proxy for poverty of education. The variables of age and speaking an indigenous language (Mixteco or Nahuatl) were found to be correlated with poverty of education. However, the level of income for a single sales day was also used as an indicator of poverty. Once again, age and speaking

an indigenous language had a statistically significant negative correlation with income level. No causation is proved here, only correlation. In this way, the first hypothesis was confirmed because the sellers' poverty, measured according to education and income for one day of sales, was related to the socioeconomic parameters of being indigenous (speaking an indigenous language) and of age.

The wild-orchid trade is not without risk. Uncertainty arises not only from dependence on collecting orchids from the forest but also from market conditions. Successfully coping with risk can be the difference between bare-bones subsistence and a certain level of comfort. Thus sellers extract other NTFP or trade other agricultural products to diversify their incomes. This is an important strategy both for risk diversification and as an alternative strategy to escape from poverty. Interestingly, sellers who harvest orchids from the *Prosthechea* genus appear to diversify their income more than those who do not. *Prosthechea* was the richest genus in this local market, representing six of the 37



Fig. 7. Photos showing aspects of the orchid trade in the local market (above and middle left) and harvest techniques (middle right and bottom).

orchids traded. Orchids belonging to this genus are common in the region's forests and may present abundant populations. Some species such as *P. karwinskii*, *P. michuacana*, and *P. varicosa* (Bateman ex Lindl.) W. E. Higgins are appreciated as ornamental or medicinal plants; accordingly, they are harvested to meet this demand and their trade has a higher correlation with sellers' income diversification. This analysis provides important information for conservation and poverty-eradication policies. Elderly and indigenous sellers are more likely than younger sellers—and sellers who do not speak an indigenous language—to experience higher levels of poverty. Although further inquiries should be made, statistically significant evidence shows that this group deserves special attention.

In the local market, the price for an orchid ranged from USD 0.77–1.64 (average = USD 2.83, standard deviation = 3.26), and the abundance for each

species ranged from 1–7,854 sales units (average = 507.02 units, standard deviation = 144.66). In the lineal regression, the price for an orchid species had a low, negative relationship with its abundance ($r = -0.184$, $p = 0.05$). In this way, the second hypothesis was not fully corroborated: the more common an orchid in the market, the lower its price; and the less frequent an orchid in the market, the higher its price. Orchid price is only slightly determined by the abundance in which it is sold; not all orchid species with the lowest abundance in the local market command the highest price. Accordingly, the rarity of an orchid (indicative of a low density for its population) does not necessarily determine its price.

MANAGEMENT PRACTICES AND REGULATIONS

There are two ways in which orchid sellers practice management techniques that could be

considered favorable to orchid conservation (SEMARNAT 2011). The first is *in situ* management, which consists of the removal of specimens using techniques to encourage orchid growth. In this practice, the collector only harvests pseudobulbs with flowers using a knife or a stick with a blade attached (Fig. 7), leaving roots and renewal buds so that the plant can produce new shoots. Although this practice maintains population size, it can affect reproductive success. Annual extraction of *Laelia speciosa* (Kunth) Schltr. shows that cutting a single pseudobulb significantly affects an individual's flowering the next year, whereas cutting 2–4 pseudobulbs drastically affects the individual's growth and shoot number produced by the mutilated exemplars (Perez 2003).

The second harvest practice involves *ex-situ* management, which is based on the extraction of wild plants and subsequent cultivation in orchards. The following species are cultivated in orchards: *Brassia verrucosa* Lindl., *Cuitlauzina pendula* La Llave & Lex., *Cyrtopodium macrobulbon*, *Encyclia rzedowskiana*, *Laelia anceps* subsp. *dawsonii*, *Oncidium hastatum* (Bateman) Lindl., *Prosthechea fragrans*, *P. varicosa*, and *Trichocentrum chrysops*. Other cultivated orchids, such as *Laelia speciosa* and *Oncidium unguiculatum* Lindl., are not native to Oaxaca and therefore are acquired elsewhere. The propagation techniques used by sellers are passed down from previous generations. When an orchid is collected without roots, placing the pseudobulbs in a plastic bag with substrate promotes the regeneration of the radicular system and results in a whole plant. With minimal care, inflorescences or plant segments can be sold within a few years.

All of the sellers except for two reported that they harvest orchids on Friday and sell them on Saturday. Nearly half of the sellers reported that they use a tool for harvesting (knife, machete, or stick) and generally look for epiphytic orchids, whereas others take orchids from the forest floor for their orchards.

The sellers are unaware of any laws or regulations governing the extraction or protection either of the orchids they sell or of any other NTFP (SEMARNAT 2011, 2012). Although Mexico punishes the illegal wildlife trade, it also authorizes wildlife removal for commercial purposes by indigenous communities or forest owners, once they meet certain requirements and ensure both that extraction does not affect the biological, ecological, and evolutionary processes of the wildlife and that species under federal protection are not

extracted (SEMARNAT 2010, 2011, 2012). Nonetheless, in Oaxaca's Mixteca region, prevailing laws based on the traditional uses and customs of indigenous communities have constitutional validity (Canedo 2008). These laws are also practiced in other Mexican states that have a strong indigenous presence. In this context, the extraction of wild orchids (as well other NTFP) for trade in the market and tianguis of Tlaxiaco, where there is an important indigenous population, is part of these customary uses, long practiced, and deeply rooted in the community, and at least at the local level, this activity does not require permission from federal, state, or municipal authorities, according to comments from a representative of Tlaxiaco's municipal authority.

Conclusions

Thirty-seven orchid species were recorded in this local market. Most are endemic to Mexico and two are both endangered and restricted to southern Oaxaca. Most of the orchids are harvested in the surrounding areas. During the year sampled, there were two periods during which orchids witnessed the highest sales. October–December was the period with the highest orchid abundance, but the largest variety of species was recorded in March–April. Both periods coincide not only with the peak flowering time in the region but also with important religious holidays. Most orchid sellers are women with little or no schooling who are members of an ethnic group. Orchids represent an additional source of income for sellers that supplement the sale of other commercial NTFP or agricultural products and are used as a strategy to escape from poverty. Both age and speaking an indigenous language are correlated positively with the sellers' education level and negatively with sellers' daily earnings. Price has a low and negative relationship with orchids' abundance in the market. Management practices for traded orchids include both *in situ* (removing flowering exemplars but leaving roots and renewal buds) and *ex situ* (extracting wild plants for cultivation in orchards and obtaining exemplars for sale) techniques. Mexican law punishes the illegal wildlife trade, but in the studied region, the law is based on indigenous people's traditional uses and customs. The extraction of wild orchids for local trade is one of those

customs, and at least at the local level, its practice is allowed.

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