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Authors: Bussmann, Rainer W., and Sharon, Douglas

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Markets, Healers, Vendors, Collectors: The Sustainability of Medicinal Plant Use in Northern Peru

Rainer W. Bussmann^{1*} and Douglas Sharon²

* Corresponding author: rainer.bussmann@mobot.org

¹ William L. Brown Center, Missouri Botanical Garden, PO Box 299, St. Louis, MO 63166-0299, USA

² 2328 Dolphin Drive, Richmond, CA 94804, USA

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Northern Peru is the center of the so-called Andean “health axis,” where the continuous use of more than 500 medicinal plants has been documented. Local healers as well as patients purchase a large portion of their plants at

local markets. While scientific studies of medicinal plants are under way, concern has arisen over the preservation of both the large diversity of medicinal plants and the traditional knowledge of healing methods that accompanies them. To promote further conservation work, this study attempted to document the sources of the most popular and rarest medicinal plants sold at the markets of Trujillo (Mayorista and Hermelinda) and Chiclayo (Modelo and Moshoqueque), as well as to create an inventory of the plants sold in these markets. The present paper reports on the complete market flow from

collection to middlemen to vendor from the perspective of an herb collector/vendor. Although prior studies have indicated that at least some plants, mostly introduced species, are grown in home gardens on the coast, this study shows that increasing plant demand in the large coastal markets has not led to significant cultivation of medicinal plants in home gardens. The vast bulk of the plant material sold in the markets of northern Peru consists of plants collected in the wild. Both collection of plants and their transport to the coastal markets require long-distance travel. Low profit margins indicate that the herb trade is very fragile, since collectors might decide to engage in activities that offer higher income or higher turnover. This, coupled with the fact that most plant material is wild-crafted, could easily lead to overharvesting of rare medicinal species in the region.

Keywords: Ethnobotany; medicinal plants; trade; harvest; Andes; Peru.

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Introduction

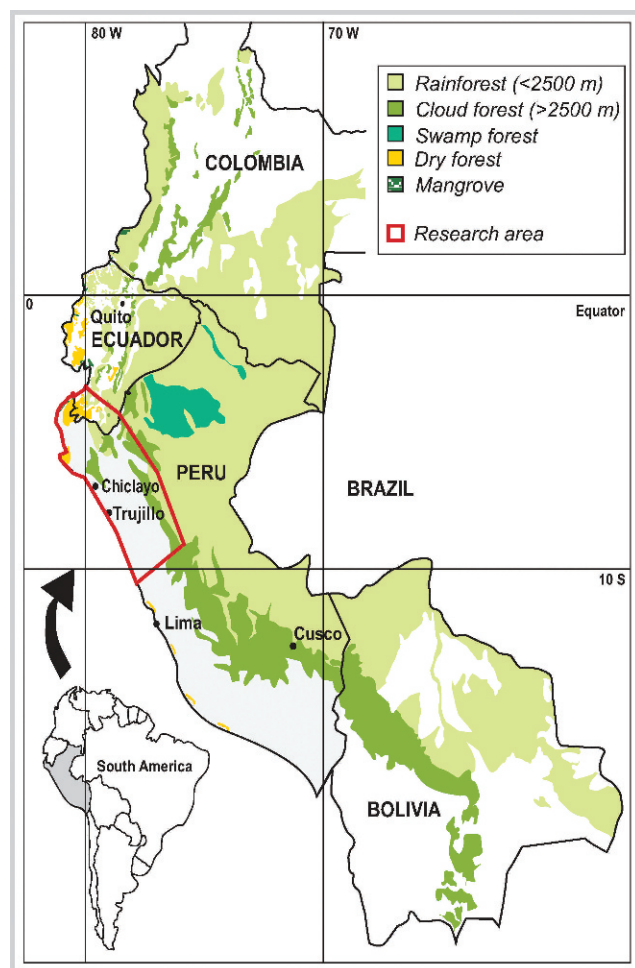
The study region in northern Peru (Figure 1) is at the heart of what Peruvian anthropologist Lupe Camino calls the “health axis” of the old Central Andean cultural area, which stretches from Ecuador to Bolivia (Camino 1992). The traditional use of medicinal plants in this region, which encompasses in particular the Departments of Piura, Lambayeque, La Libertad, Cajamarca, and San Martín, dates back as far as the first millennium BC (north coastal Cupisnique culture) or at least to the Moche period (AD 100–800), as evidenced by healing scenes and healers frequently depicted on ceramics (Sharon 2000). Early ethnobotanically oriented studies focused mainly on the famous “magical” and “mind-altering” flora of Peru (eg Cruz Sánchez 1948; Dobkin de Rios 1968, 1977; Bristol 1969; Martin 1970; Rivier and Lindgren 1972; Dobkin de Rios and Cardenas 1980; Naranjo 1981; Plowman 1981, 1984).

General ethnobotany studies in Peru and Bolivia have focused mostly on Quechua herbalism in the Cusco area (eg Larco-Herrera 1940; De Ferreyra 1978, 1981; Franquemont et al 1990). Other comprehensive studies have

centered on the border region of Peru and Bolivia around Lake Titicaca (eg Bastien 1987, 1992; Girault 1987; Roersch 1994) and the Amazon (eg Prance 1972; Rutter 1990). Northern Peru, by contrast, has always been in the shadow of these touristically more important regions, and very few studies have been conducted here to date (Polia 1988; De Feo 1992, 2003; Hammond et al 1998). In recent years, the contemporary use of plants by local healers (*curanderos*) in northern Peru has been well documented (Bussmann and Sharon 2006, 2007; Sharon and Bussmann 2006a, 2006b; Bussmann et al 2007a, 2007b, 2008; Revene et al 2008).

However, as in other areas worldwide, healers as well as the population at large frequently buy their medicinal plants on the local market. In contrast to the wealth of available ethnobotanical information, literature on local markets, market flows, and the value of the plant material traded is rather scarce. Although the value of the international market for medicinals arouses great interest (eg Breevort 1998), and ecosystem services as well as nontimber forest products do receive some attention (Grimes et al 1994; Costanza et al 1997; Godoy et al 2000), studies on the trade volumes of local medicinal markets

FIGURE 1 Map of the study area. (Map by Rainer Bussmann; base map by Sigrun Lange)



are rare and focus mostly on the export market (Olsen and Helles 1997; Olsen 1998, 2005).

Latin America is still terra incognita with regard to its medicinal plant markets, and detailed studies are of high importance because even the local health care authorities are beginning to propagate complementary alternative medicine (EsSalud 2000). Macía et al (2005) provided the first study of a high-Andean market, focusing on La Paz, Bolivia. However, that study did not contain any data on plant origin and sales volumes. Very little information exists so far on the composition of the market flora, the origin of the plant material, and the quantities of plant material sold.

Material and methods

Surveys

For this study, surveys focusing on medicinal plants sold and their properties were conducted at the markets in Trujillo (Mayorista and Hermelinda) and Chiclayo

(Modelo and Moshoqueque) from 2001 to 2008. Surveys were conducted in Spanish by fluent speakers. Surveyors would approach the vendors and explain the premise for the study, including the goal of conservation of medicinal plants in the area. All vendors were asked to participate, and from those who gave their prior informed consent, information was collected regarding their inventory of medicinal plants. The vendors were also asked to list the ten most commonly sold plants, and ten plants that were disappearing from the market. Of the plants that were most commonly sold and declining, information was also collected on their location (*montaña*: mountain forest; *costa*: coast; *sierra*: highlands; or *selva*: jungle), origin (*pueblo*: village), cost per unit sold (*soles*), units sold per week (*bultos*: bundles; *paquetes*: packets), the time when the vendors' suppliers distributed goods, and any other information concerning the popularity of the plant. At each market, the number of medicinal plant vendors was counted in order to estimate how representative the vendors who participated in the study were for the entire market.

Voucher collection

The specimens are registered under the collection series "RBU/PL," "ISA," "GER," "JULS," "EHCHL," "VFCHL," "TRUBH," and "TRUVANERICA." Vouchers of all specimens were deposited at the Herbario Truxillensis (HUT, Universidad Nacional de Trujillo) and Herbario Antenor Orrego (HAO, Universidad Privada Antenor Orrego Trujillo). Identification of the plant material was carried out entirely in Peru. No plant material was exported in any form whatsoever.

Nomenclature

The nomenclature of plant families, genera, and species follows the Catalogue of the Flowering Plants and Gymnosperms of Peru (Brako and Zarucchi 1993). The nomenclature was compared to the TROPICOS database at the Missouri Botanical Garden. Species were identified using the available volumes of the *Flora of Peru* (McBride 1936–1981), the work of Ulloa Ulloa and Jørgensen (1993), Jørgensen and Ulloa Ulloa (1994), and Pestalozzi (1998), and reference material in the HUT and HAO herbaria. For a complete overview on traditional uses, recipes, and botanical vouchers collected, see Bussmann and Sharon (2006, 2007).

Results and discussion

Markets

The inventory of 54 of 110 vendors on the markets of Mayorista (Figure 2) and Hermelindas in Trujillo as well as Modelo and Moshoqueque in Chiclayo yielded a total of almost 400 medicinal plants and preparations sold on any given day (Bussmann et al 2007a, 2007b). This was expectedly lower than the reported medicinal flora of the

FIGURE 2 Market stand, illustrating the quantity of plants sold. (Photo by Rainer Bussmann)



region (Bussmann and Sharon 2006, 512 species), because many healers interviewed in earlier studies relied on additional self-collected species or material bought outside the regular market for their treatments. In order to evaluate whether the above sample size of market vendors represented the complete plant inventory on the various markets, species saturation curves were used. A 95% species saturation in comparison to the final number of species observed was reached on all markets with the number of vendors studied. This indicates that the sample size was sufficient to capture the market inventory.

Exotics played an important role amongst all plants sold. Fifty-nine species (15%) found on all markets were exotics. However, among the species most commonly encountered in the inventories, 40–50% were exotics. *Matricaria recutita* (chamomile) was found in the inventories of approximately 70% of all vendors. The next most popular species sold on these markets included *Equisetum giganteum*, *Phyllanthus urinaria*, *Phyllanthus stipulatus*, *Phyllanthus niruri* (*chanca piedra*: stone breaker), *Eucalyptus globulus* (eucalyptus), *Piper aduncum*, *Uncaria tomentosa* (cat's claw), *Rosmarinus officinalis* (rosemary), *Peumus boldus*, *Bixa orellana* (achiote), and *Buddleja utilis*. However, when taking into account sales volume, *Croton lechleri* (dragon's blood), *Uncaria tomentosa*, and *Eucalyptus globulus* were clearly the most important species.

While it was very easy for all vendors to name their most important and frequently sold species, it proved

impossible to get detailed information about species that vendors observed as “rare” or “disappearing.” In most cases, vendors mentioned species as rare based on the fact that they themselves did not sell them, frequently because these plants were very common outside the market (eg *Plantago major* or common plantain), or because demand was so low that it would not have made sense to carry them in their inventories.

Plant supply

Many plant collectors in northern Peru followed clear harvesting strategies. For example, upon encountering a juvenile specimen of a certain tree that would normally have been partially harvested, informants left it untouched in order to ensure that it would be a more productive and reliable source of plant material in years to come. They also stated that harvesting in the dry season would cause even more damage because trees would have more trouble responding to the physical trauma involved. For small annual plants, conservation strategies seemed to be far less important. Many plants were pulled up completely by the roots. No attention was paid to whether or not a plant had already gone to seed, and in fact, many plants were selected specifically because they were still in flower in order to take advantage of the curative properties inherent in the flower itself (Revene et al 2008).

When asked if they had noticed any decline in the quantity or variety of certain plants in the area, the informants normally responded that the plant populations had always been stable, and that they had always been found in the same areas. It appears that the human impact upon the botanical resources in the area has so far been relatively small.

A network of family and neighbors from whom vendors bought certain plant species proved to be an important component in providing sufficient material for the market. It was this informal network that helped to buffer informants against unusually long treks, and helped to bolster the otherwise dwindling variety that is common during the dry season. The plants that were bought included both cultivated and wild-harvested material.

Another important source of the medicinal plants brokered to the coastal markets was the informal herbal market in the city of Cajamarca. As opposed to formal sales stands where the plants are sold on other markets, the trade here mainly consisted in small-scale suppliers arriving with bundles of 1–7 varieties of plants and selling to the awaiting wholesale buyers. Some collectors came from communities up to 5 hours away. One reason for the long distances that many of these plants traveled was their seasonal scarcity at lower elevations during the dry season. Many of the outlying supply communities are subject to more favorable rainfall conditions, which allows for a longer harvest season (Revene et al 2008).

TABLE 1 Value of medicinal plants traded in Trujillo and Chiclayo markets (adapted from Bussmann et al 2008).

Sales per week (in US\$)	Sales per month (in US\$)	Sales per year (in US\$)
22,790.13	91,160.51	1,185,086.62
207.18 per vendor	828.73 per vendor	10,773.52 per vendor

Almost all of the buyers and sellers were women. Each wholesale buyer—of which there was an average of 3–5 during the duration of the study at this specific market—packaged their wares in large sacks as the morning progressed. Opportunistic sales were sometimes made to passers-by with a specific request, but most of the acquired plants were stowed away, awaiting the more profitable economic gains to be made in the coastal market of Moshoque in the city of Chiclayo.

A look at sustainability

Although prior studies have indicated that at least some plants, mostly introduced species, are grown in home gardens on the coast, the origin of the vast bulk of the plants was unclear. Only 76 species (25 introduced, 51 indigenous) were found in local gardens or were cultivated by vendors. Of these, however, only 5 species were commonly cultivated. All but 3 of the commonly cultivated species were introductions. Contrary to the initial assumption, increasing plant demand in the large coastal markets has not led to significant cultivation of medicinal plants in home gardens. The vast bulk of the plant material sold in the markets of northern Peru consists of plants collected in the wild. Moreover, more than two-thirds of all species sold were claimed to originate from the highlands (*sierra*), above the timberline. These areas are often heavily used for agriculture and livestock grazing.

The overall value of medicinal plants in the coastal markets reaches a staggering US\$ 1.2 million per year (Table 1). This figure only represents the share of market vendors, and it does not include the amount local healers charge for their cure. Thus, medicinal plants contribute significantly to the local economy (Bussmann et al 2007b). Such an immense market raises questions regarding the sustainability of this trade, especially because the market analysis does not take into account any informal sales.

Most striking was the fact that 7 indigenous and 3 exotic species (ie 2.5% of all species traded) accounted for more than 40% of the total sales volume (30% and 12%, respectively) (Figure 3). Moreover, 31 native species accounted for 50% of all sales, while only 16 introduced species contributed to more than one-quarter of all material sold (Figure 4). This means that a little over 11% of all plants on the market accounted for about three-quarters of all sales. About one-third of this sales volume includes all exotic species traded. While none of these is rare or endangered, some of the indigenous species traded are threatened by overharvesting. Additionally, the

rising market demand might lead to increased production of exotics, which in turn could have negative effects on the local flora (Bussmann et al 2007b).

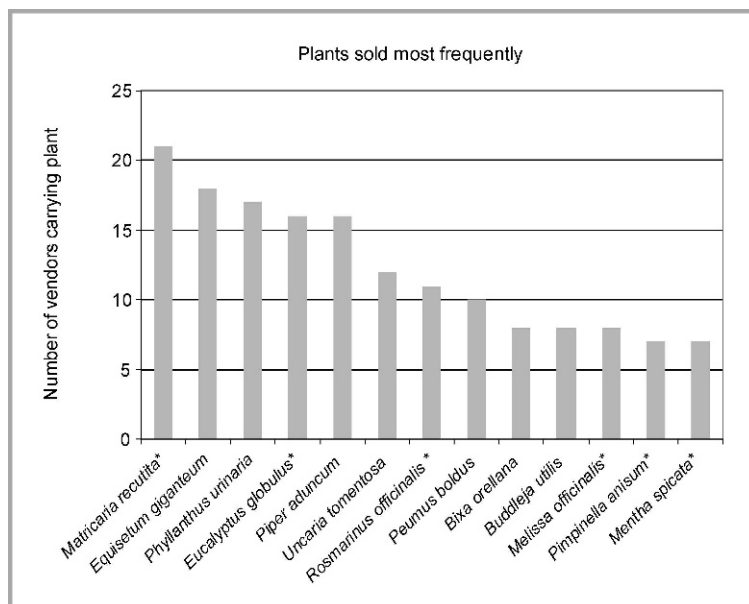
A look at the indigenous species traded highlights important conservation threats. *Croton lechleri* (dragon's blood) and *Uncaria tomentosa* (cat's claw) are immensely popular at a local level, and each contributes to about 7% to the overall market value. Both species are also widely traded internationally. The latex of *Croton* is harvested by cutting or debarking the whole tree. *Uncaria* is mostly traded as bark, and again debarking normally involves the whole plant. *Croton* is a pioneer species, and apart from *C. lechleri*, a few other species of the genus have found their way onto the market. Sustainable production of this genus seems possible, but the process needs to be closely monitored. The current practice does not appear sustainable, given that the bulk of *Croton* is wild-harvested. Trade in cat's claw involves such a large volume that, in fact, collectors of this primary forest liana started complaining about a lack of resources years ago. During the study years, other *Uncaria* species and even *Acacia* species have appeared on the market under the label of "cat's claw" (own observation). These are clear indicators of the fact that trade in *Uncaria* is not sustainable (Bussmann et al 2007b).

Some of the other "most important" species are either common weeds (eg *Desmodium molliculum*), or have large populations (eg *Equisetum giganteum*). However, a number of species are very vulnerable. *Tillandsia cacticola* grows in small areas of the coast as an epiphyte. The habitat, coastal dry forest and shrubs, is heavily impacted by urbanization and mechanized agriculture, and the impact of the latter is worsened by the current biofuel boom. *Gentianella alborosea*, *Gentianella bicolor*, *Gentianella graminea*, *Geranium ayacacense*, and *Laccopetalum giganteum* are all high-altitude species with very limited distribution. Their large-scale collection is clearly unsustainable, and, in the case of *Laccopetalum* collectors, it indicates that supply is harder and harder to find. The fate of a number of species with similar habitat requirements raises comparable concern. The only species under cultivation at this point are exotics and a few common indigenous species (Bussmann et al 2007).

Conclusions

When analyzed, the distances traveled, time spent, and energy expended during the commerce of medicinal

FIGURE 3 Plants carried most frequently by vendors in Trujillo and Chiclayo (* marks exotic species).



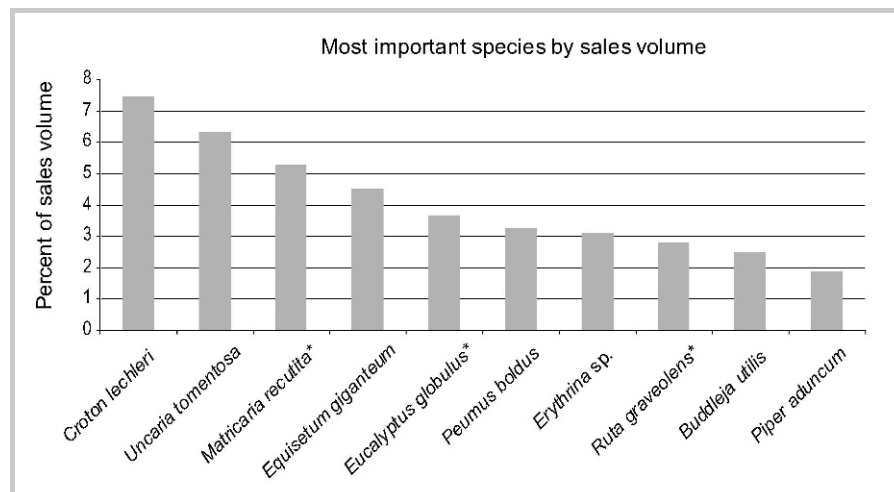
plants in northern Peru is astounding. The individual's role is a labor-intensive endeavor. It can also become a risky financial investment, depending upon market conditions on a given day. Low profit margins indicate how delicate the different links in this network can be. The interconnectivity of primary suppliers/harvesters, wholesale buyers/vendors, and consumers is as far-reaching as it is complex.

Although there were no negative human impacts identified during visits to harvest sites, this does not preclude the possibility that such effects could manifest themselves at the same locations in the future. Data on

the medicinal plant selection available from nonspecialized vendors show a prevalence of introduced species in the marketplace. The population of Cajamarca is mostly mestizo, and the belief that "wild" plants are more potent than cultivated species, often encountered in indigenous populations, was not observed in the region.

The majority of medicinal plant species sold by nonspecialized vendors were introduced species. Even though a variety of native species were also available among nonspecialized vendors, the medicinal plants that recurred among nonspecialized vendors were *Matricaria chamomilla*, *Organum vulgare*, *Petroselinum crispum*, and

FIGURE 4 Most important medicinal plant species by sales volume (* marks exotic species).



Coriandrum sativum, all of which are introduced species. Although there is a significant amount of medicinal plant collection in the Cajamarca highlands, introduced species dominate as the ingredients of homemade remedies. While many native species were found in home gardens, it is crucial to note that most of these species grew spontaneously in minute quantities and did not constitute cultivation of significant importance in terms of potential for sale in the marketplace. The selection of medicinal plants and their sale in small quantities by nonspecialized vendors, often alongside other goods of alimentary value, indicate that individuals usually engage in a variety of activities as primary income-generating tactics, incidentally cultivating small amounts of medicinal

plants. In other cases, individuals purchase small quantities of medicinal plants from other vendors in the marketplace to diversify product variety. Few individuals, however, cultivate or collect plants; most purchase from others. Overharvesting may become an issue as demand for traditional healing and medicinal plants rises. In addition, pressure on natural resources from activities such as agriculture and mining are issues of escalating concern in Cajamarca. These potentially threaten the habitats of plant species traditionally used for medicinal purposes. To date, there has been little academic research on the habitat requirements and regeneration potential of many plant species of medical value that are native to the Peruvian highlands.

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REFERENCES

- Bastien J.** 1987. *Healers of the Andes: Kallawayas Herbalists and Their Medicinal Plants*. Salt Lake City, UT: University of Utah Press.
- Bastien J.** 1992. *Drum and Stethoscope: Integrating Ethnomedicine and Biomedicine in Bolivia*. Salt Lake City, UT: University of Utah Press.
- Brako L, Zarucchi JL, editors.** 1993. Catalogue of the flowering plants and gymnosperms of Peru. *Monographs in Systematic Botany from the Missouri Botanical Garden* 75:1–1178.
- Breevort P.** 1998. The booming U.S. botanical market: A new overview. *HerbalGram* 44:33–46.
- Bristol ML.** 1969. Tree Datura drugs of the Colombian Sibundoy. *Botanical Museum Leaflets* 22:165–227.
- Bussmann RW, Sharon D.** 2006. Traditional plant use in northern Peru: Tracking two thousand years of health culture. *Journal of Ethnobiology and Ethnomedicine* 2:47. <http://www.ethnobiomed.com/content/2/1/47>; accessed on 15 January 2009.
- Bussmann RW, Sharon D.** 2007. *Plants of the Four Winds—The Magic and Medicinal Flora of Peru. Plantas de los Cuatro Vientos—La Flora Mágica y Medicinal del Perú*. Trujillo, Peru: Graficart.
- Bussmann RW, Sharon D, Lopez A.** 2007a. Blending traditional and western medicine: Medicinal plant use among patients at Clinic Anticona in El Porvenir, Peru. *Ethnobotany Research and Applications* 5:185–199.
- Bussmann RW, Sharon D, Ly J.** 2008. From garden to market? The cultivation of native and introduced medicinal plant species in Cajamarca, Peru, and implications for habitat conservation. *Journal of Ethnobotany Research and Application* 6:351–361.
- Bussmann RW, Sharon D, Vandebroek I, Jones A, Revene Z.** 2007b. Health for sale: The medicinal plant markets in Trujillo and Chiclayo, northern Peru. *Journal of Ethnobiology and Ethnomedicine* 3:37. <http://www.ethnobiomed.com/content/3/1/37>; accessed on 15 January 2009.
- Camino L.** 1992. *Cerros, Plantas y Lagunas Poderosas: La Medicina al Norte del Perú*. Lima, Peru: Lluvia Editores.
- Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paruelo J, Raskin RG, Sutton P, van den Belt M.** 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253–260.
- Cruz Sánchez G.** 1948. Informe sobre las aplicaciones populares de la cimora en el norte del Perú. *Revista de Farmacología y Medicina Experimental*, Lima 1: 253–258.
- De Feo V.** 1992. Medicinal and magical plants on northern Peruvian Andes. *Fitoterapia* 63:417–440.
- De Feo V.** 2003. Ethnomedicinal field study in northern Peruvian Andes with particular reference to divination practices. *Journal of Ethnopharmacology* 85: 243–256.
- De Ferreyra EC.** 1978. Plantas medicinales alto-andinas. *Boletín de la Colonia Suiza en el Perú* 1–6.
- De Ferreyra EC.** 1981. Plantas que curan las heridas del hombre y los animales. *Boletín de Lima* 1–12.
- Dobkin de Rios M.** 1968. *Trichocereus pachanoi*: A mescaline cactus used in folk healing uses in Peru. *Economic Botany* 22:191–194.
- Dobkin de Rios M.** 1977. Plant hallucinogens and the religion of the Mochica, an ancient Peruvian people. *Economic Botany* 31:189–203.
- Dobkin de Rios M, Cardenas M.** 1980. Plant hallucinogen, shamanism and Nazca ceramics. *Journal of Ethnopharmacology* 2:233–246.
- EsSalud/Organización Panamericana de Salud.** 2000. *Estudio Costo-Efectividad: Programa Nacional de Medicina Complementaria. Seguro Social de EsSalud*. Lima, Peru: EsSalud/Organización Panamericana de Salud.
- Franquemont C, Plowman T, Franquemont E, Niezgoda C, King S, Sperling C, Davis W.** 1990. The ethnobotany of Chinchero, an Andean community in southern Peru. *Fieldiana Botany New Series* 24:1–126.
- Girault L.** 1987. *Kallawayas: Curanderos itinerantes de los Andes*. La Paz, Bolivia: UNICEF-OPS-OMS.
- Godoy R, Wilkie D, Overman H, Cubas A, Cubas G, Demmer J, McSweeney K, Brokaw N.** 2000. Valuation of consumption and sale of forest goods from a Central American rain forest. *Nature* 406:62–63.
- Grimes A, Loomis S, Jahnige P, Burnham M, Onthank K, Alarcón R, Cuenca WP, Martinez CC, Neill D, Balick M, Bennett B, Mendelsohn R.** 1994. Valuing the rain forest: The economic value of non-timber forest products in Ecuador. *Ambio* 23:405–410.
- Hammond GB, Fernández ID, Villegas L, Vaisbeerg AJ.** 1998. A survey of traditional medicinal plants from the Callejón de Huaylas, Department of Ancash, Perú. *Journal of Ethnopharmacology* 61:17–30.
- Jørgensen PM, Ulloa Ulloa C.** 1994. Seed plants of the high Andes of Ecuador—A checklist. *AAU Reports* 34:1–443.
- Larco-Herrera F.** 1940. Plantas que curan y plantas que matan de la Flora del Cusco. *Revista del Museo Nacional Lima IX* 1:74–127.
- Macía JM, García E, Vidaurre PJ.** 2005. An ethnobotanical survey of medicinal plants commercialized in the markets of La Paz and El Alto, Bolivia. *Journal of Ethnopharmacology* 97:337–350.
- Martin RT.** 1970. The role of coca in the history, religion, and medicine of South American Indians. *Economic Botany* 24:422–438.
- McBride JF, editor.** 1936–1981. *Flora of Peru*. Fieldiana Botany. Chicago, IL: Field Museum of Natural History.
- Naranjo P.** 1981. Social function of coca in pre-Columbian America. *Journal of Ethnopharmacology* 3:161–172.
- Olsen CS.** 1998. The trade in medicinal and aromatic plants from central Nepal to northern India. *Economic Botany* 52:279–292.
- Olsen CS.** 2005. Quantification of the trade in medicinal and aromatic plants in and from Nepal. *Acta Horticulturae* 678:29–35.

- Olsen CS, Helles F.** 1997. Medicinal plants, markets and margins in the Nepal Himalaya: Trouble in paradise. *Mountain Research and Development* 17:363–374.
- Pestalozzi HU.** 1998. *Flora Ilustrada Altoandina*. Cochabamba: Herbario Nacional de Bolivia and Herbario Forestal Nacional Martín Cárdenas.
- Plowman T.** 1981. Amazonian coca. *Journal of Ethnopharmacology* 3:195–225.
- Plowman T.** 1984. The ethnobotany of coca (*Erythroxylum* spp., Erythroxylaceae). *Advances in Economic Botany* 1:62–111.
- Polia M.** 1988. *Las Lagunas de los Encantos—Medicina Tradicional Andina en el Peru Septentrional*. Lima, Peru: CePeSer.
- Prance GT.** 1972. Ethnobotanical notes from Amazonian Brazil. *Economic Botany* 26:221–233.
- Revene Z, Bussmann RW, Sharon D.** 2008. From sierra to coast: Tracing the supply of medicinal plants in northern Peru—A plant collector's tale. *Ethnobotany Research and Application* 6:15–22. www.ethnobotanyjournal.org/vol6/i1547-3465-06-015.pdf; accessed on 15 January 2009.
- Rivier L, Lindgren JE.** 1972. Ayahuasca, the South American hallucinogenic drink: An ethnobotanical and chemical investigation. *Economic Botany* 26:101–129.
- Roersch C.** 1994. *Plantas Medicinales en el Sur Andino del Perú*. Königstein, Germany: Koeltz Scientific Books.
- Rutter RA.** 1990. Catálogo de plantas útiles de la Amazonía Peruana. *Comunidades y Culturas Peruanas* 22:1–349.
- Sharon D, Bussmann RW.** 2006a. Avances de la etnobotánica en Trujillo, Peru: El programa MHIRT. *Arnaldoa* 13(2):398–406.
- Sharon D, Bussmann RW.** 2006b. Plantas medicinales en la obra del Obispo Don Baltasar Jaime Martínez Compagñon (Siglo XVIII). In: Millones L, Kato T, editors. *Desde el Exterior: El Peru y Sus Estudios*. Nagoya: Universidad Major de San Marcos, pp 147–165.
- Sharon D.** 2000. Shamanismo y el Cacto Sagrado—Shamanism and the Sacred Cactus. *San Diego Museum Papers* 37. San Diego, CA: San Diego Museum.
- Ulloa Ulloa C, Jørgensen PM.** 1993. Arboles y arbustos de los Andes del Ecuador. *AAU Reports* 30:1–263.