Papers of the Applied Geography Conferences (2007) 30: 427-436

EXPLORING CONSERVATION: *PIQUIGUA, HETEROPSIS ECUADORENSIS,* IN ECUADOR

Maria Fadiman
Department of Geosciences
Florida Atlantic University
Boca Raton, FL 33431

1. INTRODUCTION

As deforestation in the tropics continues, applied geographers are asking "What can we do?" I propose that one area in which we can have an impact is through recording and analyzing non-timber forest products (NTFPs), which are "all biological materials other than timber which are extracted from forests for human use" (NTFP, 2003). Through looking at plant value, we can explore the potentials of conservation incentives. This study looks at the use, collection, preparation and marketing of *Piquigua, Heteropsis ecuadorensis* Sodiro (Araceae), one of the most important fiber plants for *mestizos*, Afro-Ecuadorians and indigenous people living in the Mache-Chindul Ecological Reserve, Ecuador. This plant is used as an applied case study of the concept that people's use and dependence on a local resource does not, of itself, lead to conservation. However, the study of how that resource is used, and its cultural and economic importance to local people, can help forest residents, researchers and conservationists envision possibilities of how to balance resource utilization and conservation. This paper considers the importance of recording ethnobotanical knowledge in the context of using this information to explore conservation possibilities.

Various studies find that when conservation strategies exclude people, not only do locals lose traditional livelihoods, but tension on the boundaries also arise (see, *e.g.*, Brockington, 2002). Given this understanding, a trend toward including people into conservation plans is growing (Alcorn, 1993; Denevan and Padoch, 1987). Clearly, sustainable resource use is more complicated than "local people's use" or "local people's exclusion" in conservation areas. Thus, this study serves as an on the ground exploration of a situation in which certain individuals who live in a reserve, because of the role that a plant plays in their material culture, are conserving the habitat in which the plant grows.

Deforestation and conservation are complicated issues and cannot be thoroughly examined without contextualizing them in terms of global politics, economics, and development (Ferreira, 2004; Foresta, 1992; Hecht and Cockburn, 1989). Recognizing this reality, the current study explores only one small aspect within this larger scheme, in an attempt to understand what individuals are actually doing where they live, and to see if their actions have potential as a way of examining resource use on a larger scale.

As part of conservation plans, many scholars and environmentalists are including ethnobotanical knowledge (how people use plants) as an integral part of understanding how locals interact with the land (Fondoun and Manga, 2000; Pattanayak and Sills, 2001), especially

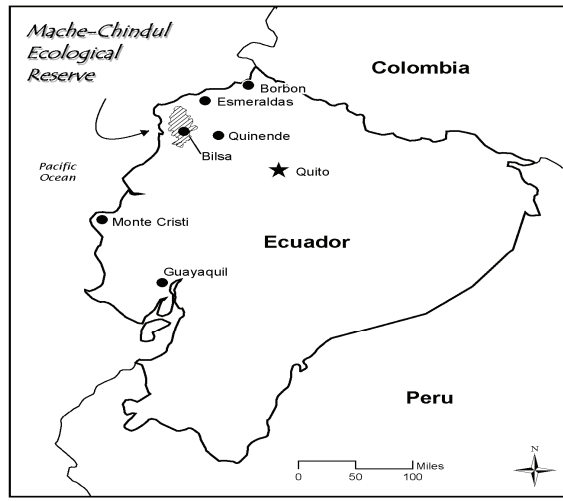
in the neotropics. This study answers the call of researchers who argue for the sciences to pursue case studies that focus on the uses of tropical forest and fauna (Gould *et al.*, 1998; Plowden *et al.*, 2003). The project first looks in detail at how people use *piquigua,* illustrating the importance of the plant to the local people. Understanding the plant can help to contextualize why some villagers protect the forest in which the resource grows. Since there is no panacea for deforestation, this paper highlights how certain residents, at the individual scale, work within an endangered ecosystem in Ecuador.

The importance of this project stems partly from the geographical location of the site. The Mache-Chindul Ecological Reserve is a biodiversity hot spot with a high degree of endemism (Dodson and Gentry, 1991; Foster, 1992). This area is of particular interest not only because of its high plant diversity, but also because so little of the forest remains. In the 1970s, timber became an important commodity in northwest Ecuador (Carrasco, 1988) and logging in the region has since been steadily increasing (INEFAN, 1999; Sierra, 1999). Conservationists and the government are trying to protect this land while promoting sustainable resource use by its residents.

2. STUDY AREA AND ETHNOHISTORY

The Mache-Chindul Ecological Reserve in northwest Ecuador covers the southwestern part of the Esmeraldas province and the northern part of the Manabí province (Figure 1). According to the Holdridge scheme (1967) the forest type for most of this area is considered lowland moist to wet forest, characterized by tall, dense and evergreen vegetation. Between 2000 and 3000 mm of precipitation fall in the region each year, and topographical relief ranges from 0 to 800 m (Aguirre *et al.,* 2000; Gavilanes *et al,.* 2000; INEFAN, 1999; Neill, 2003)**.**

FIGURE 1
MAP OF ECUADOR, WITH MARKET CITIES AND MACHE-CHINDUL HIGHLIGHTED



Three groups of people live in and around the reserve, Afro-Ecuadorians, *mestizos*, and the indigenous group, the Chachi. The Afro-Ecuadorian ancestry begins with the Spanish slave trade from Africa to Latin America (Chiriboga, 1992; Novoa, 2001). In search of new land to farm, in the late 1940s a group of these Afro-Ecuadorians migrated inland, arriving at what is now the Mache-Chindul Ecological Reserve (INEFAN, 1999). Approximately 7,600 Chachi live in the Esmeraldas province (Medina, 1997), originally from the highlands on the western

slopes of the Andean Cordilleras, near Ibarra. The Chachi eventually migrated to the lowlands, where they settled into three distinct sites, one of which falls in the Mache-Chindul Reserve region (Alarcón, 2000; Barrett, 1994; INEFAN, 1999; Sierra, 1999). The *mestizo*s were the last group to arrive to the Mache-Chindul Ecological Reserve, beginning in the 1950s. Their numbers continue to grow as more *mestizos* currently colonize the area. Most *mestizos* are migrating from the provinces of Loja and Manabí (INEFAN, 1999).

3. METHOD

Piquigua was identified as the most important forest fiber plant by all three ethnic groups. The importance of the plant and its basic uses are shared by all members of each village. I conducted interviews with 26 families: 11 *mestizo*, nine Afro-Ecuadorian, and seven Chachi, in order to understand weaving, material preparation and collection. Thirty-one communities live in the area: three Chachi, three Afro-Ecuadorian, and 25 *mestizo*. Although all members of the communities noted the importance of the plant, I interviewed the principle weavers of each family in order to speak with people who worked directly with the plant, over a one-year period (December 2000 to December 2001). Additionally, I helped with weaving and processing material, and accompanied locals on collecting trips. The *mestizo* people with whom I worked live in the communities of Cuadrado, Perrera, Tigrillo, and San Pedro. The Afro-Ecuadorian informants were from the community of Chiva and the Chachi are from the community of Río Bravo. Criteria for choosing communities included locations that were within two days walking distance from my research base and where recognized weavers lived.

To evaluate the current and potential market conditions, I interviewed three *piquigua* buyers and sellers in the town of Quiñende, two finished product vendors in Quiñende, three in Esmeraldas, three in Monti Cristi, and one in Borbón. To understand all phases of production, I also interviewed workers in two small furniture factories in Monti Cristi (Figure 1). Most interviews were semi-formal or informal (Bernard, 2002). Almost all interviews were carried out in Spanish, only using Chachi interpreters with those Chachi who spoke only Cha'paalachi. Although Chachi are included in the sample, I emphasize how *mestizos* and Afro-Ecuadorians utilize the plant, because the latter groups incorporate the plant more centrally in their lives.

Selection of families was purposefully nonrandom. I chose households in which at least one skilled weaver lived. All interviews were conducted with informed consent and each participant was compensated for their time and effort. Each discussion began with outlining the objectives and procedures of the interview (Fraser *et al.,* 2006). Additionally, I helped with weaving and processing of material, and accompanied the consultants on collecting trips, engaging in aspects of participant observation (Bernard, 2002). This qualitative method does not lend itself to statistical analysis, because not all consultants received the exact same questions. However, through these repeated in-depth interviews carried out over a lengthy period of time, collective views emerged from which patterns and results can be gleaned (O' Brien, 2006). Topics covered included what forest resources were most important, how the communities use, collect and prepare these materials, and the current and historical sense of resource availability.

4. PLANT DESCRIPTION

Heteropsis (Kunth) is a monophyletic genus of evergreen hemi-epiphytes with woody fibrous roots. Although there have been shifts in classification since Engler's (1878) description, Mayo *et al.* (1997) and Tam *et al.* (2004) place it in Araceae, subfamily Monsteroideae, and it is sister to *Spathiphyllum*. The neotropical genus contains 13 species, all of which occur in Latin America (Croat, 1988; Dodson and Gentry, 1978). People use *Heteropsis* throughout its range (Bennett *et a.l,* 2002, Goncalves, 2005; Plowden *et al.,* 2003).

Heteropsis ecuadorensis, commonly known as *piquigu,* has subcoriaceous oblong-lanceolate, alternate simple leaves arranged in flat rows along both sides of the stem. It grows in the Pacific Coastal and Amazonian rainforests (Valencia *et al.,* 2000), and has recently been recorded as also growing in Colombia and Costa Rica (Missouri Botanical Garden, 2006). *Piquigua* grows in elevations from 1-2000 m (Jørgensen and León-Yánez, 1999; Valencia *et al.,* 2000). Requiring low light and high moisture, it grows in mature forest.

Piquigua is a secondary hemi-epiphyte. It germinates on the forest floor with initially skototropic (darkness seeking) stems. When reaching a vertical surface (a tree) the stems, sometimes referred to as root climbers (Knab-Vispo *et al.,* 2003), produce leaves and begin to grow up trees towards the light (Ray, 1992; Strong and Ray, 1975). When juvenile stems and roots deteriorate, hemi-epiphytes produce a few short anchor roots, attaching the plant to the tree. They then send down long slender aerial feeder drop roots**,** which grow down to the forest floor and re-establish contact with the soil (Croat, 1988, Knab-Vispo *et al.,* 2003, Madison, 1977; Putz and Holbrook, 1986).

5. RESULTS

The most common and widespread items made in Mache-Chindul from *piquigua* aerial roots are baskets, which I found in every home. Weavers make baskets in two styles. One type of basket (and weave) in Spanish is called "*regular*" (regular). It is a simple plaited weave made by passing an active fiber alternately over one passive fiber and under the next. The second type of basket is called a "*chalo"* or *"canasta de ojo"* (eye basket). A more open weave, with large hexagonal spaces characterizes the latter basket type (Adovasio, 1977; Barrett, 1994).

Almost all weavers in the region are accomplished at making *regular* baskets. The *mestizo*s, Afro-Ecuadorians, and the Chachi make *regular* baskets that are small and simple, measuring less than 15 cm in diameter. The *mestizos* and Afro-Ecuadorians make *regular* baskets only of that size and basic circular shape. The villagers use these containers primarily to store foods such as eggs, potatoes, and onions. Hanging them from the rafters, these baskets offer protection from rats. All three groups weave the large *piquigua chalos* for carrying items.

Piquigua brooms, although less overtly prized than the baskets, sit against the wall of every *mestizo* and Afro-Ecuadorian home I entered. Each broom lasts two to three years, even when used with water. Hat making and bottle covers are crafts to which skilled *mestizo* and Afro-Ecuadorian *piquigua* artisans devote themselves. On the other hand, although the Chachi with whom I worked do not make brooms or hats, they do weave articles that the *mestizo*s and Afro-Ecuadorian do not. These pieces include containers to store plates and silverware, and most notably, fans for their cooking fires. The popularity of the fans extends beyond the community. The neighboring Afro-Ecuadorian communities trade rice for fans, as a *piquigua* fan will last for at least two years. Finally, another aspect of *piquigua* invaluable to all three groups is its use as lashing material. The villagers tie together balsa log rafts, fences, sugar cane presses, structural members of the house, livestock, and fish traps. One informant summed it up by saying "It is our nail."

To collect *piquigua* roots, the harvester cuts the aerial root at ground level with a machete, and then with both hands, grabs and pulls until the root falls to the ground from the branches. *Piquigua* roots grow in patches throughout the forest, and all three groups know of specific areas where they can collect. Most families identified a minimum of four collecting locations. *Mestizos* and Afro-Ecuadorians will sometimes even search out a particular plant.

Most groups were conscientious about protecting this resource. The *mestizos* and Afro-Ecuadorians pull carefully, taking great pains to ensure that the entire plant does not fall out of the tree. Collectors also make a point to leave a sufficient number of roots growing from each

stem, so that the plant maintains adequate connection to the ground and will continue to send down future roots.

The residents of the Mache-Chindul Ecological Reserve communities generally collect and weave the root for their own personal use. However, there are those who demonstrate more skill and interest in weaving than others. Thus, especially with the *mestizo*s and Afro-Ecuadorians, there exists a limited amount of buying and selling of *piquigua* articles between members of the same community, and sometimes with neighboring villages as well. Bartering is common within the communities, and people will usually trade a chicken for a basket. If there is a money exchange, a large *chalo* costs from three to four dollars, and small simple plaited baskets can be sold for one to two dollars. However, weavers are more likely to give the latter as gifts, or informal repayment for favors. They also sell brooms from one to two dollars; however, these are more likely to be given as gifts as well. Although the Chachi groups in other areas of Ecuador do sell items to tourist markets, in the Mache-Chindul region, few engage in selling and this aspect of their artisan work remains minimal. Furthermore, they sell little between each other, because the majority of families already know how to weave.

Although not the primary motivation for collection of people within the Mache Chindul Reserve, a successful market for the raw material of *piquigua* exists in various cities, one of which is Quiñende**.** High quality roots sell from 17 to 24 dollars for 100 pounds. In Quiñende, merchants sell the raw material for commercial furniture and broom making**.** *Piquigua* furniture is durable and popular throughout Ecuador, and a set of high quality furniture costs $600.

Villagers protect the trees on which, and sections of forest in which, the root grows. One kind of management involves leaving trees that have *piquigua* on them in the field when farmers clear forest. These cultivators say that the *piquigua* will only grow for a few years without the surrounding forest, but that it is worth it to save a tree that has *piquigua* on it for at least that amount of time. Furthermore, in San Pedro the villagers have an area of forest that they cleared right up to the area where a *piquigua* patch grows. These farmers scouted the land beforehand, not wanting to clear where the hemi-epiphyte is present. They organized their forest cutting and field planting and production around the location of *piquigua*, thus preserving about two hectares. Clearly, managing for the plant itself can involve larger scale conservation oriented management of an entire section of forest.

Also of interest in looking at conservation through use, is the care that people take in managing not just the general ecosystem in which the plant grows, but caring for the continued growth of each root. I witnessed a few specific instances in which people were actively managing the plant. One man, when he saw a *piquigua* root that was dropping down into the creek, pulled it onto the bank, and buried the growing tip into the soil. Another time, while walking through a *piquigua* patch, a woman absently removed a stick that was putting weight on a climbing stem that was growing between two trees. On a different occasion, this same woman saw a stem dangling from a tree, and tied it securely to the trunk with another plant (Fadiman, 2004).

The sustainability of collecting the resource is crucial for overall conservation. When collecting, skilled harvesters snap the root in such a way that the growing stem does not come down. They exercise control in harvesting to prevent pulling down the entire growing plant. On one occasion, I witnessed a mother scolding her inexperienced children for pulling too roughly and endangering the stem. On a different collecting trip, I watched a man make a ladder out of surrounding trees, so that he could reach up higher on the root and better control the connection to the stem. Most groups also make a point to leave a sufficient number of roots growing from each stem, so that the plant maintains adequate connection to the ground and will continue to send down future roots. In the economic arena, *Piquigua* buyers are also conscious that the collectors need to leave the stem intact, and preserve growing roots. Buyers say that when

collectors sell the roots, they usually collect little by little until they have enough to bring to the buyer. This prevents them from denuding an area all at one time

6. DISCUSSION AND CONCLUSIONS

This study explores the idea that understanding cultural, utilitarian and economic aspects of *piquigua,* an NTFP used for baskets, brooms, lashing, bottle covers, fans and furniture, can aid in comprehending why some people choose to protect parts of the forest where this resource grows. Clearly a few trees, and two hectares out of a 111 hectare preserve is not enough land to save a whole forest. However, the attitude of wanting to preserve the resource is notable. The significance of recording local plant use goes beyond understanding people's interaction with their environment, but can aid in striking a balance between forest use and conservation. (Bennett, 2002; Coomes, 2004; Shanley *et al.,* 2002).

Although there are legitimate concerns that NTFP over collection can affect not only the resource, but the surrounding forest as well (Anderson, 1990), this paper explores how the use and collection of a specific plant can potentially have the opposite effect of protecting areas of forest. In order to overcome the barriers of using NTFPs the collection and processing need to occur within a system that integrates utilization with good ecological management (Bennett, 2002). If, indeed, plant protection can arise through plant use, the concept relies on the sustainability of collection methods. Harvesters can collect *piquigua* both sustainably and unsustainably. In order for future generations to find the ecosystem useful without destroying that which they use, individuals need access to knowledge about how to use and harvest materials effectively.

Although these findings support the idea that some villagers choose to protect the forest because of the resources, I am not saying that locals are inherently conservationist in nature. No people should be inappropriately idealized, as happened with indigenous groups in Xingu Park in Brazil (Garfeld, 2004). The same needs drive us all; with incentives, people can be motivated to protect that which provides. Seeing people protect their land because of what they can use leads to the well-documented concept of extractive reserves. Extractive reserves began in Brazil with Chico Mendes and the rubber tappers (Godoy and Bawa, 1993), and follow the thinking that people will care for and protect the forest if there is an item that is particularly valuable to them, and can be collected sustainably (Goeschl and Igliori, 2004; Robinson *et al.,* 2002). Both extractive reserves and biosphere reserves, (protected areas with concentric circles of varying use levels) (Andrade, 1999; Menezes, 1994; UNESCO, 1995), have had numerous problems. Some of the negatives include migration out of the reserves to the cities and the inability to find equitable markets for NTFPs (Brown and Rosendo, 2000; Goeschl and Igliori, 2004; Rao *et al.*, 2000). Recognizing the complexities of reserves and extraction, this paper addresses, for the most part, non-monetary value using new data.

Furthermore, this study draws from the argument that deforestation is connected to personal forest use. However, it is understood that there is a debate as to whether or not deforestation stems from individual use at all, but rather is a result of greater geopolitical forces (Geist and Lambin, 2001). Although recognizing these distinct points of view, this paper is not written with the intention of resolving these arguments. Instead it does delve into the concept of individual use and attitude as one of numerous important factors in terms of forest destruction and protection (Denevan and Padoch, 1987; Hecht, 1990).

Whether the use of *piquigua* can lead to local mobilization to conserve land, though an important question, goes beyond the scope of what this research can determine. Furthermore, the data show that only certain *piquigua* users are protecting the ecosystem in which the hemi-epiphyte lives. Thus, in order to test the concept that people indeed will protect a habitat in which useful plants grow on a larger scale, further studies would need to include a control-

group of non-users, and also people who were excluded from lands where the plant grows. However, as demonstrated by the data presented, recording ethnobotanical knowledge both informs researchers and creates a record for local people. This information can further develop the understanding about the possibilities that plant utilization can inspire people to protect their own land.

7. REFERENCES

Adovasio, J.M. 1977. *Basketry technology: A Guide to Identification and Analysis*. Chicago: Aldine.

Aguirre, N.M., M.A. Gavilanes, R. Hofstede, and J. Sevink 2000. Sistemas forestales en la Costa del Ecuador: Una Propuesta para La Zona de Amortiguamiento de La Reserva Mache-Chindul. *Ecopar*, Quito, Ecuador.

Alarcón, H.P. 2000. *Diseño Final del Subproyecto de Aapacitación y Comercialización de Artesanía Chachi de La Zona Norte de La Provincia de Esmeraldas*. Esmeraldas: FECCHE.

Alcorn, J.B. 1993. Indigenous Peoples and Conservation. *Conservation Biology* 7(3):424-426.

Anderson, A.B. 1990. Extraction and Forest Management by Rural Inhabitants in The Amazon Estuary. In: *Alternative to Deforestation: Steps Toward Sustainable Use of the Amazon Rainforest*, ed. A.B. Anderson, 264-272. New York: Columbia University Press.

.

Andrade, A.G. 1999. Reservas Extratavistas e Desenvolvimiento Florestal sustentable. In: *Third Annual Meeting of the Braziliam Society of Ecological Economics, Recife.* 11-13 November.

Barrett, S.A. 1994. *Los Indios Cayapas del Ecuador*. Quito: Abya-Yala.

Bennett, B.C. 2002. Forest Products and Traditional Peoples: Economic, Biological and Cultural Considerations. *Natural Resources Forum* 26:293-301.

Bennett, B.C., M.A. Baker, and P. Gómez. 2002. Ethnobotany of the Shuar of Eastern Ecuador. *Advances in Economic Botany* 14:1-299.

Bernard, H. R. 2002. *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. 3rd Edition. Walnut Creek, CA: AltaMira.

Brockington, D. 2002. *Fortress Conservation: The Preservation of the Mkomzi Game Reserve, Tanzania.* Oxford: International African Institute in association with James Curry.

Brown, K,, and S. Rosendo. 2000. Environmentalisa, Rubber Tappers and Empowerment: The Politics and Economics of Extractive Reserves. *Development and Change* 31(1):201-227.

Carrasco, E. 1988. *El pueblo Chachi*. Quito: Abya-Yala.

Chiriboga, L.A. 1992. Raices Africanas en La Nacionalidad Ecuatoriana. In: *El Negro en La Historia: Raices Africanas en La Nacionalidad Ecuatorian,* ed. L. Savoia, 129-140. Quito: Centro Cultural Afroecuatoriano..

Coomes, O.T. 2004. Rain Forest 'Conservation-Through-Use'? Chambira Fibre Extraction and Handicraft Production in a Land-Constrained Community, Peruvian Amazon. *Biodiversity and Conservation* 13 (2):351-360.

Croat, T.B. 1979. The Distribution of Araceae. In: *Tropical Botany*, ed. K. Larsen and L.B Holm-Nielsen, 291-308. Bronx: New York Botanical Garden.

Croat, T.B. 1988. Ecology and Life Forms of Araceae. *Aroideana* 11:4-55

Denevan, W. M., and C. Padoch, eds. 1987. *Swidden-Fallow Agroforestry in the Peruvian Amazon.* Advances in Economic Botany, 5. Bronx: New York Botanical Garden Press.

Engler, A. 1878. *Heteropsis* (Kunth). *Monographie Phanerogamarum* 2:98-100.

Fadiman, M. 2004 Management, Cultivation and Domestication of Weaving Plants: *Heteropsis* and *Astrocaryum* in the Ecuadorian Rain Forest. *The California Geographer* 44:1-19.

Ferreira, S. 2004. Deforestation, Property Rights, and International Trade. *Land Economics* 80 (2):174-193.

Fondoun, J.M., and T.T. Manga. 2000. Farmers Indigenous Practices for Conserving *Garcinia kola* and *Gnetum africanum* in Southern Cameroon. *Agroforestry Systems* 48:289-302.

Foresta, R. 1992. Amazonia and the Politics of Geopolitics. *Geographical Review* 82(2):128-142.

Foster, R. 1992. Site Description and Vegetation. In: *Status of Forest Remnants in The Cordillera de La Costa and Adjacent Areas of Southwestern Ecuador. Rapid Assessment Program,* ed. T. A. Parker III and J.L. Carr, 24-27. Washington D.C.: Conservation International.

Fraser, D., T. Coon, M.R. Prince, R. Dion, and L. Bernatchez. 2006. Integrating traditional and evolutionary knowledge in biodiversity conservation: A population level case study. *Ecology and Society.* 11(2):4 [http//www.ecologyandsociety.org/vol 11/iss2/art4/].

Garfield, S. 2004. A Nationalist Environment: Indians, Nature and The Construction of Xingu National Park in Brazil. *Luso-Brazilian Review* 41(1):139-167.

Gavilanes, M.R.A., S.M. Delgado, R. Hofstede, and J.C. Ronquillo 2000. *Caracterización de Los Bosques y Zonas de Influencia.* Quito:Ecopar.

Geist, J., and A. Lambin. 2001. *LUCC Report Series No.4*, Louvain-la-Neuve: CIACO.

Gjertsen, H., and C. Barrett. 2004. Context-Dependent Biodiversity Conservation Managmeent Regimes: Theory and Simulation. *Land Economics* 80(3):321-339.

Godoy, R., and K. S. Bawa. 1993. The Economic Value and Sustainable Harvest of Plants and Animals from The Tropical Forest: Assumptions, Hypotheses, and Methods. *Economic Botany* 47:215-219.

Goeschl, T., and D. Igliori. 2004. Reconciling Conservation Development: A Dynamic Hotelling Model of Extractive Reserves. *Land Economics* 80(3):340-354.

Goncalves, E. 2005. Araceae from Central Brazil: Comments on Their Diversity and Biogeography. *Annals of the Missouri Botanical Garden* 91(3):457-463.

Gould, K,, A.F. Howard, and G. Rodriguéz**.** 1998. Sustainable Production of Non-Timber Forest Products: Natural Dye Extraction from El Cruce Dos Aguadas, Petén, Guatemala. *Forest Ecology and Management* 111(1-2):69-82.

Hecht, S., and A. Cockburn. 1990. *The Fate of the Forest: Developers, Destroyers and Defenders of the Amazon.* New York: HarperCollins.

Holdridge, L. 1967. *Life Zone Ecology*. San Jose: Tropical Science Center.

Instituto Ecuatoriano Forestal de Areas Naturales y Vida Silvestre (INEFAN). 1999. *Estudio de Alternativas de Manejo para Las Montañas de Mache, Provincia de Esmeraldas, Ecuador*. Quito: INEFAN.

Jørgensen, P.M., and S. León-Yánez, eds. 1999. *Catalogue of the Vascular Plants of Ecuador.* Monographs in Systematic Botany from the Missouri Botanical Garden 75. St. Louis, MO: Missouri Botanical Garden Press.

Madison, M. 1977. Vascular Epiphytes: Their Systematic Occurrence and Salient Features. *Selbyana* 2:1-13.

Mayo, S.J., J. Bogner, and P.C. Boyce. 1997. *The Genera of Araceae*. Belgium: Royal Botanic Gardens.

Medina, H.V. 1992. *Los Chachi: Supervivencia y Ley Tradicional*. Quito: Abya-Yala.

Menezes, M. 1994. As Reservas Extrativistas como Alternativa ao Desmatamento na Amazonia. In: *O Destino da Floresta: Reservas Extratavistas e desenvolvimiento Sustentavel na Amazonia,* ed.. R. Artn. Rio De Janerio: Relume Dumara.

Missouri Botanical Garden. 2006. Specimen list for *Heteropsis ecuadorensis*. VAST (VAScular Tropicos) database. http://mobot.mobot.org/cgi-bin/search_vast. Last accessed 7 July 2006.

Neill, D. 2003. Missouri Botanical Garden Ecuador vegetation page. www.mobot.org/MOBOT/research/ecuador/vegetation.shtml. Last accessed 19 March 2003.

Non-timber Forest Products (NTFP). 2007. NTFP home page. http://www.ntfp.org. Last accessed 19 March 2007.

O'Brien, E. 2006. A question of value: What do trees and forests mean to people in Vermont? *Landscape Research* 31(3):257-275.

Pattananayak, S. and E. Sills. 2001. Do Tropical Forests Provide Natural Insurance? The Microeconomics of Non-Timber Forest Product Collection in the Brazilian Amazon. *Land Economics* 77(4):595-612.

Plowden, C., C. Uhl, and F. Oliveira. 2003. The Ecology and Harvest Potential of Titica Vine Roots (*Heteropsis flexuosa:* Araceae) in the Eastern Brazilian Amazon. *Forest Ecology and Management* 182(1-3):59-73.

Putz, F.E and N.M. Holbrook. 1986. Notes on The Natural History of Hemi-eipiphytes. *Selbyana* 9:61-68.

Rao, K., S. Nautiyal, R. Maikhuri, and K. Saxena. 2000. Management Conflicts in The Nanda Devi Biosphere Reserve, India. *Mountain Research and Development* 20(4):320-323.

Ray, T.S. 1992. Foraging Behavior in Tropical Herbaceous Climbers (Araceae). *Journal of Ecology* 80:189-203.

Robinson, E., C. Williams, and H. Albers. 2002. The Influence of Markets on Spatial Patterns of Non-Timber Forest Product Extraction. *Land Economics*. 78(2):260-271.

Shanley, P., L.Luz, and I.R. Swingland. 2002. The Faint Promise of A Distant Market: A Survey of Belém's, Trade in Non-Timber Forest Products. *Biodiversity and Conservation* 11: 615-636.

Sierra, R. 1999. Traditional Resource-Use Systems and Tropical Deforestation in a Multi-Ethnic Region in North-west Ecuador. *Environmental Conservation* 26: 136-145.

Strong, D.R., and T.S. Ray. 1975. Host Tree Location Behavior of A Tropical Vine (*Monstera gigantea)* by Skototropism. *Science* 190:804-806.

Tam, S.H, P. C. Boyce, T.M. Upson, D. DarabéA. Bruneau, F. Forest, and J.S. Parker. 2004. Intergeneric and Infrafamilial Phylogeny of Subfamily Monsteroideae (Araceae) Revealed by Chloroplast <011>trnL-F sequences1. *American Journal of Botany* 91:490-498.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). 1995. The Seville Strategy for Biosphere Reserves. *Nature and Resources* 31(2):2-17.

Valencia, R., N. Pitman. S. León-Yánez, and P. Jørgensen (eds.). 2000. *Libro Rojo de Las Plantas Endémicas del Ecuador.* Quito: Hojas y Signos.