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TROPICAL TIMBER CERTIFICATION: PROBLEMS AND POTENTIAL

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Poverty, political instability and mistrust of unfamiliar methods may create barriers to information and technology. These barriers undermine the effectiveness of even the most innovative solutions to environmental problems. Central to the mission of the Tropical Resources Institute is the realization that effective environmental management must address the social context of resource consumption.

On 5-6 February 1993, TRI and the Yale chapter of the International Society of Tropical Foresters will host **Timber Certification: Implications for Tropical Forest Management,** a conference which will examine one of the most exciting recent applications of social and economic tools to promote sound forest management: timber certification. A wood producer who wishes to market goods as environmentally responsible can hire a certification organization. A consulting firm or a non-governmental organization will audit the management, harvesting, and often, post-harvest processing and accounting procedures. If certain minimum standards are met, the producer's operations and products are then given a label, often more symbolic than literal, certifying sustainability, or at least good management.

Certification standards vary greatly among individual organizations and management contexts, but common basic criteria include adherence to a long-term management plan, minimum-impact harvesting methods, and efficient utilization of all forest products, including non-timber products. Many certification programs also include positive contributions to local community development, as well as respect for traditional use-rights of local people.

Increasing consumer demand for goods with minimal environmental impact creates the possibility of a new market for "green" goods: in effect, a market for sustainability, or perceived sustainability. Certification provides wood producers access to this new market as an incentive for responsible management. In contrast, responsible timber producers are excluded from the market. Retailers and environmental organizations see a bright future for certified timber goods, and the number of certification programs is increasing rapidly. The recent founding of the Forest Stewardship Council, an umbrella organization for certifiers, promises to accelerate this trend.

Though the success of timber certification seems promising, critical questions regarding its implementation remain unanswered. Discussion at the TRI/ISTF Conference will focus on three broad questions:

Feasibility: *Is a good certification system technically possible and economically feasible?*

Critics of certification have noted that some important forest management issues do not lend themselves well to auditing. For example, how can a certifier accurately

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assess an operator's respect for local rights and traditional forest use? Is it possible and economically feasible to reliably trace final-market goods back to their producers? If not, certification of a producer will hold little weight and may make certification unprofitable. Critics have also argued that the consumer market for more expensive, certified goods does not exist or is too small to make certification an attractive goal of timber producers--particularly small operators. If consumers are unwilling to pay its costs, certification is unlikely to succeed.

Equity: *Will certification criteria be created for the good of some and the harm of many?*

Certifiers hope to exclude producers who cannot or will not meet their standards. For producers with limited access to capital or standardization processes, critical questions of equity arise: Who creates the certification criteria? And will these criteria be appropriate in the social context of developing economies? Will there be an appeals process for producers denied certification? Who will make the final decisions?

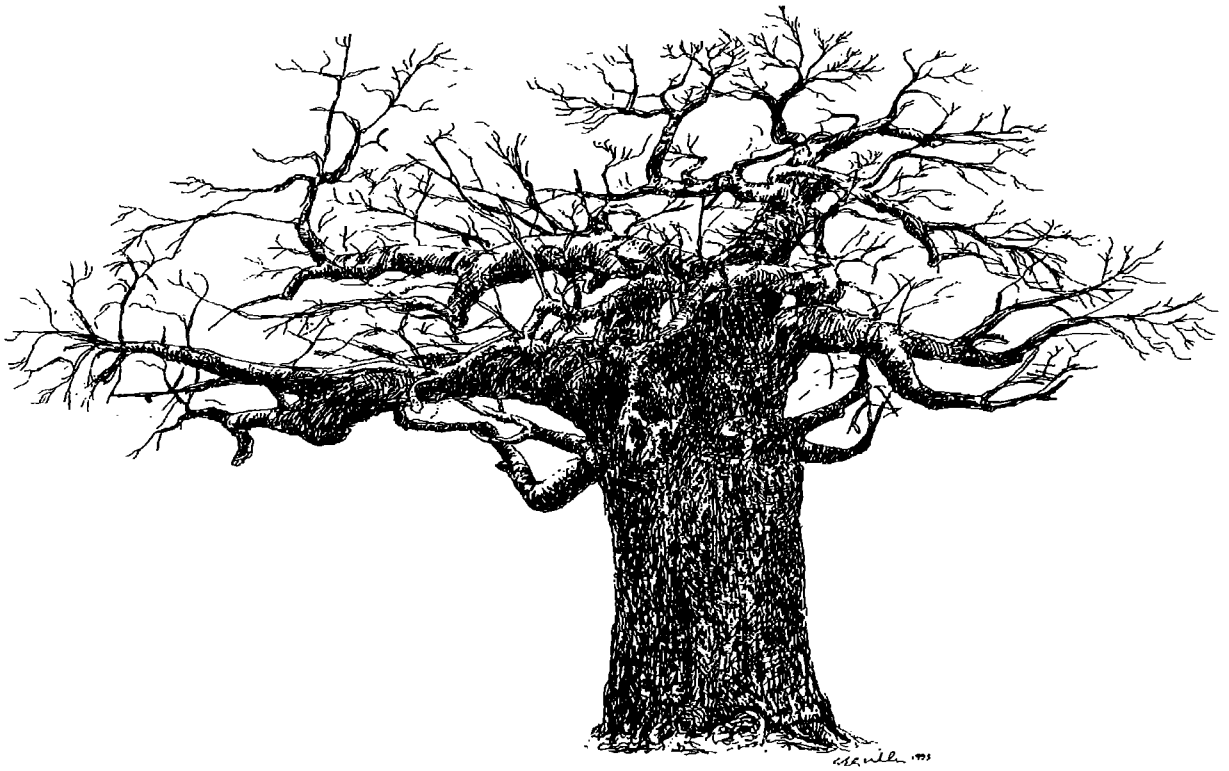
Furthermore, certification may represent a unilateral barrier to free trade in many countries. This raises the question of national sovereignty and poses the risk of politicization of the certification process.

Effectiveness: *Will certification be successful in promoting sustainable forest use?*

Even if a practical, equitable large-scale certification system becomes established, it may be ineffective in promoting sustainability in tropical forestry. Certification addresses issues of forest management, but the root causes of deforestation may only be approachable through certification of entire countries, or through policy entirely unrelated to the consumer market. In addition, certification only affects international timber trade. In some countries, less than 20% of the timber harvested is targeted for export; certification would then have little impact on domestic harvest. If the real factors driving forest destruction and degradation are not addressed, certification may become little more than the next in the long line of green marketing gimmicks.

Despite its uncertain future, certification signals a promising trend in environmental policy: economic, political, and social tools are being used to address issues previously treated as purely ecological. It is hoped that the conference in February will provide such a framework for the successful implementation of timber certification.

For more information about the conference, please contact: Jennifer O'Hara/ ISTF, Yale School of Forestry & Environmental Studies/ 205 Prospect Street/ New Haven,CT 06511, USA.



FACULTY RESEARCH PROFILE: KRISTIINA VOGT

Collaborative Research: Structure and functional roles of coarse woody debris in tropical stream-riparian-upslope forest ecosystems

Along with Daniel J. Vogt, Thomas G. Siccama, Whendee Silver (Yale School of Forestry and Environmental Studies); Sandra Brown (University of Illinois); and Alan P. Covich (Colorado State University)

Compiled by
E. Binney Girdler

In September of this year an interdisciplinary team of scientists led by Kristiina Vogt received a National Science Foundation grant to support research in the Luquillo Experimental Forest, Puerto Rico, USA. The study will examine how tropical ecosystems respond to major transfers of woody debris to the decomposition process.

Vogt and her colleagues believe that the importance of woody debris to nutrient conservation has often been overlooked because of the assumption that it decays rapidly. The fundamental hypothesis under consideration is that disturbances such as hurricanes and landslides, which have occurred every thirty to forty years, can add woody debris to the landscape and may be responsible for spatial patterns of productivity and community composition.

Tropical storms with high winds and intense rains significantly increase the input of tree trunks and branches into stream channels and riparian areas. The large debris, in turn, increases retention of leaf debris and smaller woody debris. Extreme disturbances may also transport woody debris laterally from the stream channel to the land-based riparian forest. This flood-generated deposition of organic detritus may allow the growth of riparian vegetation at great distances from the stream bank. Thus a related question will be whether the impact of woody debris varies depending upon site--streams, riparian zones, and upslope areas.

Vogt et al. will use a manipulative experimental design, removing woody debris from study sites to determine the specific mechanisms that affect aquatic and terrestrial detrital processing. As part of this objective, a number of hypotheses will be tested in lowland Tabonuco forests in the Luquillo Experimental Forest, Puerto Rico (see inset, center.)

RESEARCH HYPOTHESES

The rate at which a landscape unit responds to either an addition or removal of coarse woody debris will vary among streams, riparian, and upslope areas.

At the ecosystem level, coarse woody debris has similar functional roles in conserving carbon and nutrients in streams, riparian, and upper slope areas of the forest.

The magnitude of impacts of coarse woody debris on ecosystem production, biotic composition, and nutrient processes will vary among tree species because of their different secondary chemical compositions which control decay rates.

In both the stream and terrestrial ecosystems, woody materials retained in specific microhabitats become "hot spots" of nutrient immobilization from sources outside the wood, e.g., nitrogen increases locally through mineralization by microbes during the decomposition process.

To assess site response to treatments, Vogt et al. will measure carbon dioxide evolution, soil oxygen levels, net primary production, and nutrient pools and fluxes. The total net movement of nutrients in the riparian zone will be an important, dynamic variable. A measure of net nutrient exchange will allow the researchers to evaluate if the riparian trees and the stream detrital consumers are tightly coupled. Alan Covich, an aquatic biologist at Colorado State University, will monitor populations of shrimp: detritivores which serve as indicators of stream productivity.

The research at the Luquillo Experimental Forest in Puerto Rico builds upon earlier work conducted by Kristiina and Daniel Vogt, Alan Covich, Fred Scatena and Ariel Lugo under the auspices of the Puerto Rican Long-Term Ecological Research Project. This research has examined the effects of disturbance frequency and magnitude on tropical forest structure and function. The newly funded Puerto Rican project is a direct offshoot of the long-term study.

Kristiina Vogt's interest in tropical ecosystems extends from the functional roles of ecosystem components to issues of forest sustainability and resilience to human and natural disturbances. In Malaysian forests, Vogt's doctoral student Peter Palmiotto is attempting to identify

the ecosystem components that produce extremely high species diversity. Her research in the Amazon, managed by doctoral student Miguel Finedo-Vasquez, is examining the effect of agricultural land use on carbon and nutrient capitals after the clearing of secondary forests (see *TRI News* 12(1), p.3). Other research in the Amazon is documenting the timber and non-timber forest products that are being used by indigenous people (see *TRI News* 11(2),p.16).

The newly funded Puerto Rican project will continue Kristiina Vogt's ecosystem approach to tropical research. The interdisciplinary nature of this project will allow specialists in various aspects of ecosystem ecology to collaborate in the effort to identify system-level processes.

Kristiina Vogt examines woody debris in a stream bed in the Luquillo Forest.

RESOURCE USE BY THE LESSER MOUSE LEMUR *(MICROCEBUS MURINUS*, LEMURIDAE)
A Preliminary Report

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INTRODUCTION

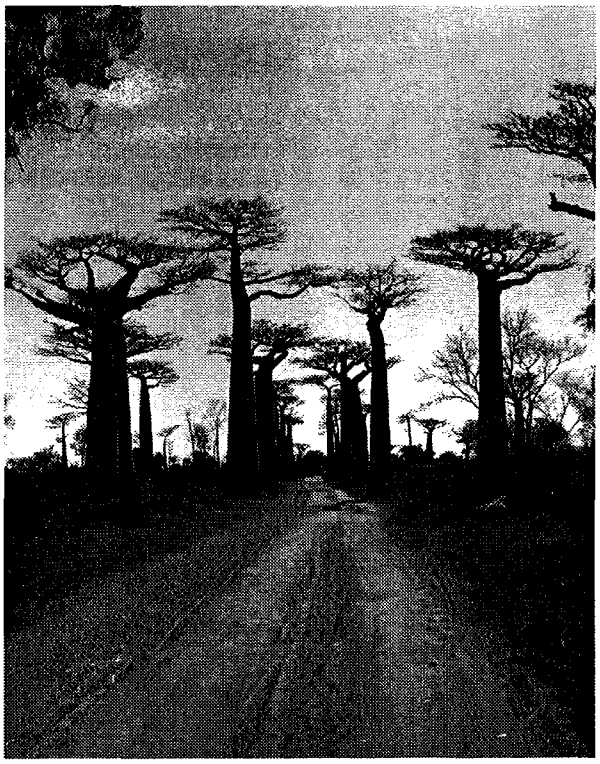
Hladik et al. (1980) speculate that nocturnal lemur species in the western forests of Madagascar are able to exist in sympatry by distinct separations of diet and habitat use patterns.

The lesser mouse lemur (*Microcebus murinus*) is a small (average weight 60g) nocturnal prosimian (Order: Primates) found in primary and secondary forest throughout the west and south of Madagascar (Tattersall 1982). *Microcebus murinus* is relatively abundant compared to other lemurs (Harcourt and Thornback 1985). However, populations of *M. murinus* are threatened by habitat destruction and are probably in decline (Richard et al. 1985, Harcourt and Thornback 1985).

Microcebus murinus is classified as an omnivore that feeds primarily on insects and fruit but is also known to eat other plant matter and insect secretions (Martin 1972, 1973; Hladik et al. 1980). The use of insect secretions as a major food resource was identified for two nocturnal prosimians sympatric with *M. murinus*: *Mirza coquereli* (Pages 1980) and, to a lesser extent, *Phaner furcifer* (Charles-Dominique and Petter 1980). The importance of insect secretions in shaping the ecology of *M. murinus* has not been considered (Martin 1972, 1973; Hladik et al. 1980).

I studied the use of insect secretions produced by the larval stage of *Flatida coccinea* (Order: Homoptera), as a food resource for *M. murinus* in a western dry deciduous forest of Madagascar during July and August of 1993. This resource may play a key role in the ecology of *M. murinus* during times of resource scarcity because the secretion is produced during the austral winter when other resources have decreased in abundance. The secretions are usually found in large patches whose white color is easily identified. The ease of identification and static nature of the resource makes this food supply well suited for sampling and manipulation. The objectives of this study were to determine:

1) if *M. murinus* used insect secretions as a food resource;
2) the distribution of insect secretions during the austral winter; and
3) whether presence of insect secretions influences habitat use by *M. murinus*.



Baobabs (Adansonia spp.) line the road to the study site.

METHODS

Study Area

The study site was a four hectare plot in a dry deciduous forest 60 kilometers northeast of Morondava on the 10,000 ha forestry concession of the Centre de Formation Professionelle Forestière. I conducted this project in conjunction with a group of German researchers currently engaged in a long term study of the entire prosimian community at this site. Site elevation is less than 100 meters above sea level. The forest is characterized by a closed canopy at 15 meters with baobabs (*Adansonia* spp.) emergent above the canopy. Lianas are prevalent throughout the area and are sometimes dense. This region of Madagascar receives an average precipitation of 770 mm (Rakotonirina 1985, cited in Ganzhorn et al. 1990). The climate is dry with a humid season from November to April. Average monthly temperatures range from 17.5°C to 35.2°C. The forestry concession is subdivided by logging trails at 100 meter intervals. In one region of the forest, a 500 x 500 meter grid system was cut with foot trails every 25 meters parallel and perpendicular to the logging trails. The western edge is delineated by a large logging road creating a distinct forest edge.

Animal Observations

We trapped *Microcebus murinus* in Sherman traps baited with banana and set at trail intersections overnight for a total of 400 trapping nights. Captured animals were sexed, measured for morphometric analysis, and then released. Of these animals, one male and one female were radio-collored prior to release. I followed the collared animals for a minimum of 2 hours per night for 7 nights. Few behavioral observations were recorded because of the difficulty in observing arboreal primates in dense forest. To establish use of a food resource, I offered the resource to captive *M. murinus* and recorded if it was eaten; however, use of a food in captivity is not conclusive of use in the wild.

Resource Distribution

I sampled resource patches along five transects running 225 meters into the forest from the logging road. At each trail intersection, I recorded size and number of patches in a 25 x 2 meter area parallel to the logging road. Because the line transect technique was biased by following trails, I employed a random sampling technique for verification. Twenty five random plots ($2m^2$) were sampled in three areas for a total of 75 plots, encompassing the entire study area.

Radio-Tracking and Resource Removal

I tracked the female lemur for seven nights to determine her home range. Once a core area was established, I chose a $25m^2$ grid cell from which to remove the insect secretions. I removed leaves covered with secretions and scraped secretions off all branches without altering the structure of the forest. The animal was radio-tracked again for three complete nights. As a control, I repeated the procedure for an adjacent grid cell, removing the same volume of leaves without secretions.

The author holding a lesser mouse lemur.

RESULTS

Line transect samples of 25 x 2 meters show a distinct difference between area covered by insect secretions on the forest edge and in the interior (Fig.1). Mean leaf area covered by secretions at the forest edge averaged over 2400 cm^2 while no other sample exceeded 480 cm^2. Results from the random plots confirmed this trend: leaf area cover was higher for the area with forests edge ($\cong$2800 cm^2) than in the forest interior ($\cong$700 cm^2) or an area encompassing both edge and interior ($\cong$800cm^2).

Of the four study hectares, two have a sharp forest edge associated with a logging road, and two are surrounded by contiguous forest. Five *M. murinus* were trapped in only the north-west corner, an area with an edge. Tracking data indicated that the female spent most of each night in a 25 meter wide strip along the forest edge. I also observed that *M. murinus* were often found in areas with a high concentration of Homopteran secretions. Further evidence of insect secretion use came from offering secretion covered leaves to captive animals. The secretions were completely licked off the leaves before other food items in the enclosure were eaten.

In the resource removal experiment, the female spent an average of 55% of her time in the experimental plot prior to any disturbance of the resource. Following removal of the secretions she spent only 18% of her time in the grid cell, a difference of 37%. This is compared to 17% and 21% for the control before and after treatment (Fig. 2).

DISCUSSION

Use of insect secretions by two other nocturnal lemurs in a similar area is well documented (Hladik et al. 1980). During the austral winter *Mirza coquereli* relies heavily on Homopteran secretions although its home range choice may be correlated with total arthropod abundance instead of specific insect secretions (Pages 1980). The importance of this resource in shaping the behaviour of *Mirza coquereli, Phaner furcifer,* and *Microcebus murinus* is poorly known. In this study area *M. murinus* are found predominantly within 25 meters of the forest edge. The liana (*Elachyptera minimiflora*), on which *Flatida coccinea* feeds (Hladik et al. 1980), is common in this area and distribution of secretion patches shows a strong clumping of the insect resource along the forest edge. This suggests that during the austral winter, female *M. murinus* identify their home range based on the distribution of insect secretions. Although sample size is small, the strongest support for this relationship comes from the shift in home range use following experimental removal of the resource. It is only through such experimental work that evidence beyond correlations can be established for the role of a resource in shaping animal behavior. Often this is an unrealistic approach in the study of primate ecology (Richard 1985).

The role of niche separation in defining the relations of sympatric nocturnal prosimians in Africa and Madagascar has been emphasized by various authors (reviewed by Hladik et al. 1980). The partitioning of available resources by the five nocturnal prosimian species found at

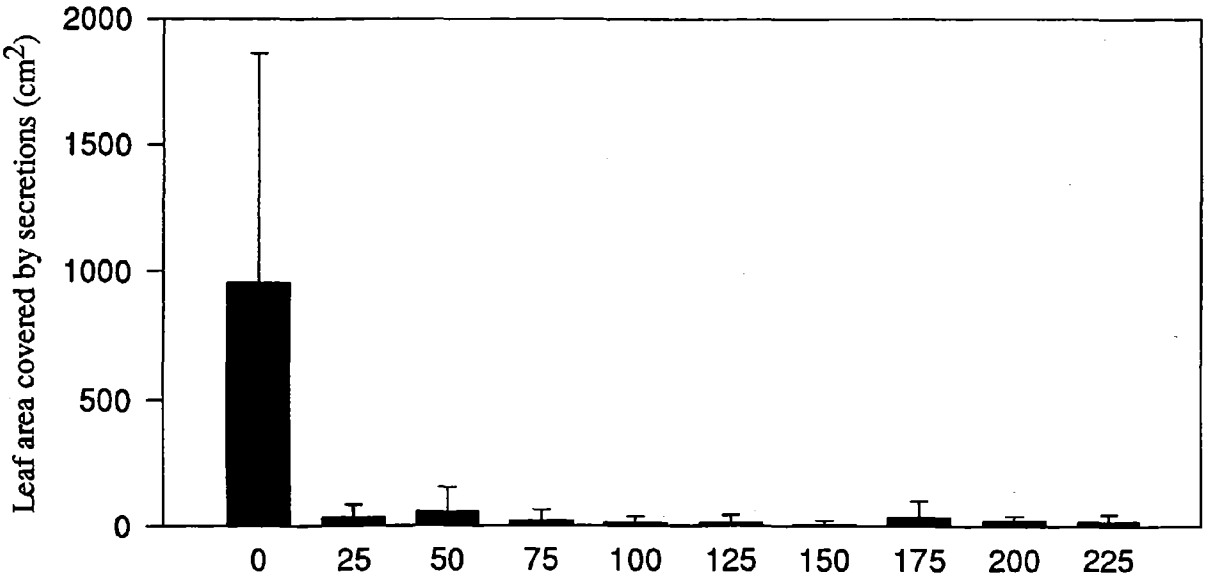


Figure 1. Results of line transect samples. Large bars show mean leaf area (cm^2) covered by insect secretions at 25 meter intervals along transects. Small bars show upper 95% confidence interval.

result of habitat stratification and differing dietary choices. However, the driving force behind niche separation has yet to be adequately investigated for most mammals, including primates (Richard 1985). *Microcebus murinus* presents a unique opportunity to experimentally test niche separation in primates because of its high density, relative abundance and ease of manipulation compared to other primates (Harcourt and Thornback 1985).

The results reported here are preliminary. However, the strong association between the animals ranging pattern and resource distribution provides compelling evidence that insect secretions are indeed important in shaping the behavior of *M. murinus* during the austral winter. Niche overlap with *Mirza coquereli* and *Phaner furcifer* and subsequent competitive interactions may be important in shaping current community structure of nocturnal prosimians; however, further experimentation is necessary to fully understand these relations.

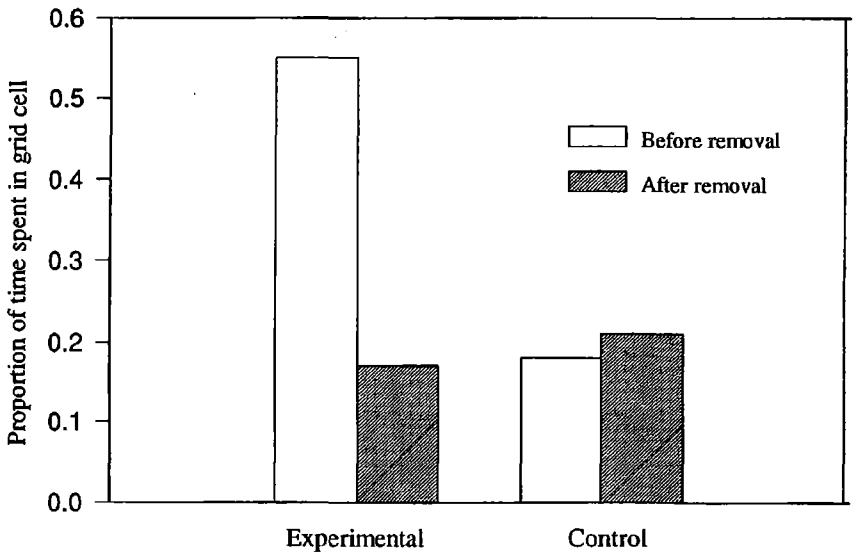


Figure 2. Results of resource removal experiment. Bars show proportion of time spent in experimental and control plots three days before and after resource removal.

ACKNOWLEDGMENTS

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TOWARD VALUATION OF PROTECTION IN A CARIBBEAN CORAL REEF: A Bio-Economic Study of Environmental Change in the Bay Islands, Honduras

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INTRODUCTION

In theory, a marine park provides benefits by sustaining non-consumptive recreational uses over time (see vant Hoft 1985, 1992, and Goodwin and Wilson 1986.) Previous valuations of tropical marine parks have measured park protection inaccurately because they use the value of the resource as a proxy for the value of the protection itself: Posner et al. (1981), van't Hoft (1989), Post (1992), and Dixon et al. (1993) estimate the gross annual value of the reef resource for a single year, attributing all or part of this value to protection. These studies then conclude implicitly that all benefits would be lost without the park. An examination of the case of the Bonaire Marine Park, in the Netherlands Antilles, shows that this is not necessarily true.

One of the largest economic benefits of the Bonaire Marine Park comes from its role in sustaining park recreation. Dixon et al. (1993) credit the Bonaire Marine Park with island-wide scuba tourism revenues, and in doing so imply that tourism would disappear in the absence of the marine park. During the late 1980's, the Bonaire Marine Park ceased to exist as an effective protected area (Post 1992, Dixon et al. 1993). Nevertheless, tourism--primarily scuba tourism--continued to grow each year. Between 1980 and 1988 growth in stayovers increased 4.4% annually; cruise ship visitation increased 21.1% annually (McElroy and Albuquerque 1991). Clearly, the cessation of park activities did not result in a total loss of the resource and hence did not result in the loss of all tourism, although the sustained absence of the park could have led to a gradual loss of tourism over time.

This paper proposes that the economic value of protection should be measured as the savings from avoided losses in reef value that would result from the absence of protection (see Pendleton 1993). Many of the authors cited above recognize this fact, yet still justify marine protection in terms of total tourism expenditures. As a result, large investments in marine park infrastructure and operations are based on analyses that may overvalue the true impact of marine protection. Scarce development funds are potentially being spent in an economically inefficient manner.

VALUING MARINE PROTECTED AREAS

The value of a marine park comes from the protection it provides for the marine resource. The park must not be confused with the resource that it protects. A marine park, or any protected area, acts to slow the predicted rate of negative environmental change in a habitat and possibly to enhance environmental quality. In pristine areas, protection would not be warranted if there were no signs of impending negative environmental change. Even with threatening negative change, it is unlikely that the resource or its economic benefit stream will disappear overnight. Yet this is the implicit assumption of past studies. More correctly, one should expect the environmental quality of the resource to change over time. The quality of the environment is expected to decline faster in the absence of park protection. Figure 1 depicts the flow of environmental/economic benefits from a single reef resource *with* and *without* a marine park. The value of the park is the difference in economic flows *with* and *without* the park.

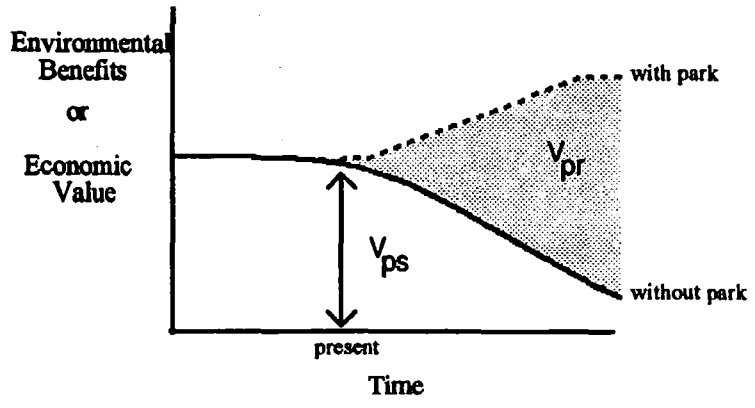

Figure 1. Two potential paths for environmental and economic benefit flows. Dotted line gives a hypothetical benefit path with a park. In this case, the with park benefits increase over time due to management or due to the increasing scarcity of the resource globally. The benefits without a park, solid line, are expected to fall over time. The net benefit of park protection is equal to the difference in the two benefit paths (V_{pr}= proposed value). The annual value of the park, as given by previous studies, would be equal to the current annual value of the resource (V_{ps}).

This study is the preliminary phase of a doctoral research project designed to estimate and model the economic value of environmental changes in a coral ecosystem. This initial work examines the role of environmental quality in determining the frequency of site-specific diver visitation within the newly expanded Sandy Bay/West End Marine Reserve in Roatán, Honduras. A second study, not presented here, examines the ability of divers to perceive different levels of four environmental parameters.

STUDY SITE

The study examines divers and reef quality in the Sandy Bay/West End Marine Reserve, located on the island of Roatán, Honduras. The Marine Reserve stretches along approximately eight kilometers of Roatán's North West coast. The coral formation, part of the Belize barrier reef system, consists of platform/barrier reef walls and isolated patch reefs. The climate is wet tropical with approximately 2,500 mm of rain annually and an average temperature of 27°C (Calderon 1992). The principle tourist attraction of the reef is its easy access to deep water wall diving. Drop-offs in excess of 60m can be found within 150m of shore.

All diver data are for divers at Anthony's Key Resort (AKR), located in the heart of the former Sandy Bay Reserve. AKR accommodates approximately 90% of all "package divers" visiting the Sandy Bay/West End Marine Reserve. (Package divers come to the island primarily to dive. Casual divers, or travelers, come to the island for other reasons and dive infrequently).

METHODS

Estimating the Demand for Dive Sites: The Impact of Environmental Characteristics

The study examines the role of environmental characteristics in the demand for dive sites (i.e., dive site visitation). A multiple regression is used to test the hypothesis that environmental parameters do not affect the demand for dive sites. Mathematically, the regression is represented as:

$$V = a + \beta Z + \gamma D + \delta X,$$

where V is the visitation to dive sites, a is a constant, Z is a matrix of environmental parameters (percent live coral cover and topographic features), D is distance from the resort to the dive site (measured as time), and X is a matrix of terrestrial physical parameters. β, γ, and δ are coefficients to be estimated. The regression then tests whether specific environmental, topographical, and time parameters play a role in determining the visitation rate to a dive site.

Dive site visitation data are from a single resort, Anthony's Key Resort (AKR). The number of divers and the dive boat destination was recorded for all day dives between July 30 and August 22, 1993. The number of divers per dive site per boat trip, number of visits to a dive site by dive boats, and the time each dive occurred (morning or afternoon) were recorded.

Regression Parameters

Four environmental parameters (% live coral cover, % algal cover, parrot fish (Scaridae) abundance, and surgeon fish (Acanthuridae) abundance were measured for each dive site using standard marine ecology techniques. All environmental measures are indicative of the status of reef health. The presence of topographically interesting attributes (caves, tunnels, etc.) were evaluated using a dummy variable. Time from the resort to the dive site was measured (minutes). At the suggestion of dive masters, the number of houses within view of the dive site also were included in the analysis.

PRELIMINARY RESULTS

The regression analysis shows that time to dive site, topography, and certain environmental parameters are important predictors of dive site visitation (boat visits/ site). The results, presented in Table 1 (below), show that time to the dive site, the percent live coral cover at a dive site, and the presence of interesting topographic features are all significant at the 95% level or better. Indicators of coral health, other than percent live coral cover, are not significant. The number of houses within view is not significant in the analysis, but the inclusion of this variable does increase the corrected R^2 statistic. The analysis includes the house variable in order to avoid an omitted variable bias.

variable	coefficient	t-statistic	significance level
constant	2.897	1.533	>90%
coral	0.0701	1.786	>95%
topography	0.0417	2.945	>99.5%
time	-0.133	-2.183	>97.5%
houses	0.173	1.16	<90%
R-squared=0.82		Adjusted R-squared=0.77	

Table 1: Regression Results

CONCLUSION

This paper posits that the benefit of marine protection comes from the value of avoided environmental degradation. Environmental degradation ought to lead to a reduction in the demand for reef recreation and thus a loss to divers and the local dive tourism industry. A marine park benefits the economy to the extent that it prevents a reduction in the level of environmental quality. This study demonstrates that both time and marine environmental quality are important factors in predicting dive site visitation in the Sandy Bay/West End Marine Reserve.

The decision to visit a given dive site is a joint decision by both the divers and the dive master. Economic theory suggests that divers want to maximize their utility, in this case dive enjoyment. Theory also predicts that dive masters try to maximize the level of diver utility. The negative relationship between time and dive site visitation confirms these theoretical predictions. Transit time to the dive site is a cost to divers because it reduces their vacation time. The positive relationship between live coral cover and visitation indicates that environmental quality is important in the demand for dive site visitation.

Implications for the scuba industry, economic theory, and marine policy

The study has shown that both cost (in terms of time) and environmental quality play a significant role in recreation demand, at least at the level of dive site choice. The implications for the local dive industry are clear. Since diver utility appears to be a positive function of environmental quality, dive masters can improve their product by choosing sites that have more coral cover. Loss of live coral cover in nearby waters will reduce diver satisfaction and may reduce dive tourism revenues.

The results of this study point the way toward the proper valuation of marine protection. The statistical relationship between dive site visitation, time, and coral quality indicates that a class of estimation techniques known as revealed preference methods might be used to value reef protection. The revealed preference methods permit the direct estimation of the value of environmental change by considering the travel cost to a destination and the environmental quality of that destination.

My doctoral research will use both revealed preference methods and survey techniques to attempt a more accurate estimation of the benefits of marine protection. In turn, better valuation of marine protection will help to ensure more efficient allocation of funding for protected areas in marine policy.

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A CASE STUDY ON THE ROLE OF INDIGENOUS CHILDREN'S ECONOMIC ACTIVITIES IN COMMUNITY DEVELOPMENT

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INTRODUCTION

In many low income rural societies, the economic activities of children may contribute substantially to family incomes, and are a source of pride, and status, for the children themselves (Rodgers et al. 1981). In the world summit for children by UNICEF, it was concluded that the "empowerment of children with knowledge and resources to meet their basic human needs and to grow to their full potential should be a primary goal of development." Nevertheless, development projects frequently do not account for the role of children as *active* agents in the economic development process. A study was conducted in the Bolivian Chaco among the indigenous Mataco-Nocten people to determine if the extent of the involvement of children in economic activity warranted their incorporation into regional development strategies.

Fishing, hunting and gathering have been the traditional means of subsistence among the Mataco. In recent years, the production and sale of woven bags has expanded at the expense of hunting. Attempts by non-governmental agencies to introduce horticulture have met with little success. Currently, the semiarid ecosystem where the Mataco live is subject to uncontrolled hunting by chaqueños (mestizo cattle ranchers), overgrazing by cattle and goats, deforestation by foreign companies, and intensive fishing by the army, the Mataco, and other local inhabitants (Alvarsson 1992). In response, the United Nations Development Program, in conjunction with the Bolivian government, has developed project BOL/91/021 to assist the social groups which inhabit the region, and avert ecological degradation. The present study was conducted as part of a strategy for the incorporation of indigenous peoples in the project.

METHODS

My study took place in the village of Yuchan (300 meters elevation), located 120 kilometers southwest of Villamontes in the province of Tarija in Bolivia. This is a semi-arid region (annual precipitation: 600mm) with mixed xerophytic forest cover. The study lasted through the dry winter months of June and July. Fishing and bag weaving are the main economic activities during this season.

After examining written records in Villamontes, and explaining the purpose of the study to the village leader, or Captain, in Yuchan, I conducted a census, and mapped the area. The census was facilitated by a local school teacher, who served as translator, and by a local woman who had been responsible for registering newborns for the last decade. The age of the elders was estimated according to historical events they remembered. Initially, I collected data in the local school during schooling hours, which allowed the children and I to get acquainted. Once children were identified by household, sex, age and kinship ties, I conducted routine, direct observations of their behavior, facilitated by residence in the study area and participation in daily activities. The data gathered was limited to random individual and group observations of the children, due to their mobility within and outside the village. I conducted interviews with heads of all households regarding the family/household environment of children. I also interviewed children regarding their participation in daily tasks. All direct observations were limited to the activities practiced by the Mataco during the winter months of June and July.

PRELIMINARY RESULTS

The Mataco population of Yuchan consisted of 88 individuals living in nine house clusters. Each cluster is essentially a kin group cooperating for economic and social purposes. Decision-making authority rests with the oldest male of the group. When the latter dies, the oldest female of the group succeeds him. In Yuchan two clusters were headed by women. Mandatory military service for males at fifteen years of age, combined with the practice of exogamy, typically results in adult males infrequently returning to their native village to live. Generally, young female adults will remain in their home village and live with their spouses in the house cluster of the female's parents. Divorce and the abandonment of wives are becoming more frequent. The population under 16 years of age was 55% of the total. Of these, 59% were fatherless, and lived with their mothers or grandparents. Forty percent of the children are reportedly malnourished, due primarily to vitamin A deficiency from lack of vegetables in their diet (Esperanza 1993).

The formal education of children is carried out according to a multigrade program for rural schools designed by UNICEF and the Bolivian Government. Language and mathematics are emphasized in this program. Though the

children are introduced to agronomy, animal husbandry, health, home economics, crafts, social and natural science, the course material is theoretical and bears little relation to the surrounding environment. Courses are taught bilingually by two Mataco teachers, one teaching first grade in the morning, and the other teaching second grade in the afternoon. Both teachers are trained by the Swedish Free Mission in Villamontes. All girls between 5 and 17 years of age attend school regularly (4 hours a day), as do all boys between 5 and 11 years. Boys older than 11 were intensively engaged in fishing, attending school irregularly or not at all. Table 1 shows the contribution of children to the family economy according to gender and age.

Task	Girls	Boys	Age
Small net fishing		x	>11
Large net fishing	x	x	> 7
Hunting		x	> 7
Honey Gathering		x	> 7
Fruit Gathering	x		> 7
Fiber Gathering	x	x	> 7
Weaving bags	x		>11
Collect water	x		> 5
Collect firewood	x	x	> 5
Taking care of domestic animals	x		> 5
Child care	x	x	> 5

Table 1. Children's tasks, according to gender and age.

Fishing, the main economic activity during this season, was done either with small individual nets, called *tijeras* (Fig.1), or with large nets owned by a Mataco from a nearby village who had kin ties with two home clusters in Yuchan. All fishing took place at a local fishing ground in the Pilcomayo river, located 2 hours by foot from the village. Sábalo (*Prochildus platensis*) and Dorado (*Salmius maxillosus*) are the main fish caught. Individual fishing was done by four of the five Mataco boys above 11 years of age, who spend on an average 4-5 days a week fishing with varying success. Three of the latter were responsible for feeding their family, typically including a single mother and three younger siblings. When fishing with the large net, eight or more children of both sexes, between 7-11 years of age, assisted adults in netting, handling, cleaning, and carrying fish.

Children were also involved in hunting, with boys seven years of age frequently accompanying adults or older siblings, and assisting in the use of trained dogs, slingshots and clubs. Typical game included armadillos (*Priodontes maximus*), rabbits (*Lagostomus maximus*), iguanas (*Iguanu iguana*), and birds such as Charata (*Ortalis canicollis*).

Collecting honey was another key activity, typically involving a younger male smoking out a hive while an older boy or adult cut down the branch where the hive rested. Both girls and boys assisted their elders in gathering chagua, a plant from which fiber is extracted for fishing bags, nets and crafts (Fig.2). The children learn from observation, and participation in assigned tasks. This participation seems to teach responsible behavior, while giving the children a sense of worth. Male children were observed to be adept in the identification of fruit and medicinal plants found in the field and collected on these expeditions, and often pointed these out to their elders. Limited observations of female children on these gathering trips precluded analysis of similar skills among them.

Older girls weave chagua bags, which are sold to the missionaries or other institutions for marketing. The price of one bag is equivalent to that of five fish. Once the fiber necessary to make one bag has been collected (two large chagua plants), weaving may take from one to three days. Water collection from the well, which is done exclusively by girls, is very time consuming and demands considerable physical effort. In one case it took 40 minutes for two girls, 8 and 5 years old, to fill up two 5 gallon buckets and two 5 liter bottles with water, and take it to their homes one hundred meters from the well. Young girls also help their mothers take care of domestic animals, by herding them, watering them, and cleaning corrals.

Figure 1. A boy fishes with a tijera.

One last important traditional task is child care. Older children typically take care of the younger, enabling adults to engage in other activities.

DISCUSSION

In Yuchan, children of all ages and sex are involved in a variety of economic activities that contribute to the overall well-being of their families. This was more salient in the case of children with no fathers, where older boys (11-15 years) were responsible for feeding their families. As the population continues to rise (Alvarsson 1992), and the Mataco territory diminishes in extent and quality, children will be forced to spend more time searching for food sources. Already, the Mataco are over-fishing to compensate for the loss of other traditional means of subsistence. A recent report from a governmental organization in Villamontes indicates that the quantity of fish caught has constantly decreased for the last past five years (Pyanov 1992). If this trend continues, the consequences for the Mataco could be devastating. Non-government organizations operating in the region have attempted to alleviate these pressures by introducing alternative subsistence strategies, including homegardens, yet these have met with little success. The failure of homegardens was due in large part to lack of enthusiasm on the part of adult Mataco, who were the designated participants but who were also unaccustomed to horticultural and agricultural techniques. As an experiment, I had male and female children participate in the establishment of a homegarden. They responded with enthusiasm and interest. While this could be attributed to fleeting youthful fascination with things new and different, it does stand in direct contrast to the response of adults.

I observed Mataco children to be energetic, open to new ideas, and to have developed specific labor skills for a variety of tasks. There is also a high rate of literacy among children, especially in comparison to adults. Considering the above, and that children represent more than 50% of the total population, their incorporation into regional development strategies as active agents in the economic development of their community should be taken into account. Appropriate tools that enhance a child's ability to perform tasks, to grow, and to develop in their particular environment, should be given a priority. While schooling has had a positive impact in terms of literacy, the educational program is nevertheless deficient in terms of its practical relevance to the children. In this sense the creation of a school farm and school workshop, where children could *practice* animal husbandry and agronomy, as well as develop skills such as weaving, would be beneficial. Such strategies would not only empower children and allow them to more fully interact with their environment, but also alleviate the typically overburdening workload of parents.

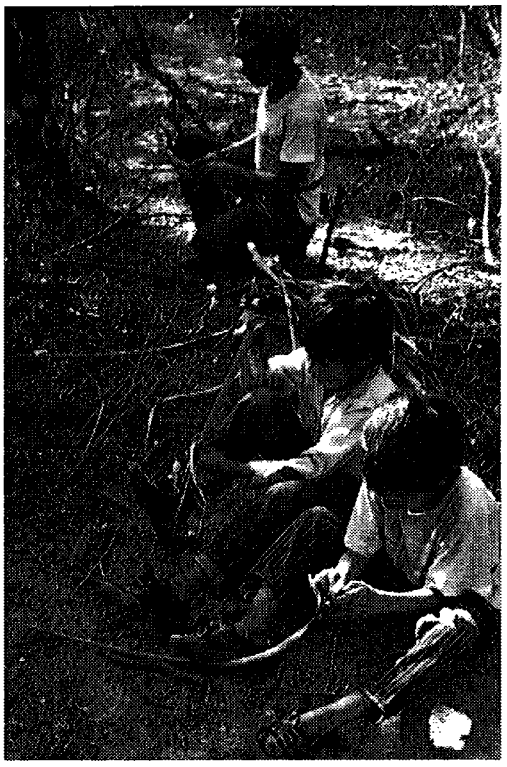

Figure 2. Yuchan children collect chagua

CONCLUSION

In Yuchan, Mataco children were observed to be very active and contributed directly with their daily tasks to the well being of their family and community. Although the extent of children's economic contribution requires broader and more intensive quantitative evaluation and measurement, this study shows that it should not be ignored. Indeed, the contribution of children warrants full consideration in plans for development and ecological remediation in the region.

ACKNOWLEDGMENTS

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STATUS, PROPERTY AND FOREST MANAGEMENT: WOMEN'S ROLE IN COMMUNITY FORESTRY IN NEPAL

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Generally unexplored are the linkages between the women's ability to gain access to or exercise control over the management, use and production of land and existing economic, political and social factors (Agrawal, 1989).

INTRODUCTION

This paper explores the relationships between culture, social status and property rights within the context of an all-female community forestry group in Nepal. It is often asserted that community forestry addresses issues of equity by involving local people in resource management. Women (as well as other marginalized groups) however, are often excluded from participating in local forestry activities. The case study presented here suggests that even when women are involved in forestry activities, their role is marginal. Women of Sejuwal Takura in Salayan District, Nepal, have formed their own forest management committee. Yet, the forest that the women control is degraded. The women's status and the value of the land that they control are inextricably linked.

Overview

Community forestry, the primary forest policy of Nepal, transfers management and responsibility of forest lands from the government to local users (CFDD 1991). In Nepal, the government maintains ownership of the land but shifts usufruct to the users. This method of resource management is promoted to maximize productivity of the forest and sustainability of the ecosystem. Moreover, some proponents see community forestry as a means by which to offer more equitable control and distribution of forest products. In community forestry, the issue of equity is often examined in terms of product distribution, decision making, and allocation of funds generated from the sale of forest products (Chhetri and Nurse 1992). Some believe that participation of local residents in management yields greater equity of the resource (Gilmour and Fisher 1991).

To engage local people's participation in community forestry in Nepal, rangers and other forestry officials help create user groups and committees. Committees consist of 7-15 people, and are responsible for facilitating user group meetings (open to all users of the forest) and deciding how the forest will be managed. The forestry committee is the link between the government forest office and the community. Generally, members of forest committees are literate and are required to speak in public.

Women are the primary agents in managing subsistence households, including child care, cooking, agricultural production, and animal husbandry. Forests provide 75% of Nepal's energy needs and 40% of livestock nutrition (Master Plan for the Forestry Sector 1988). Women, therefore, are the principal users of forest products of fuelwood and fodder. Despite the women's extensive forest use, they are noticeably absent from community forestry user group committees (Regmi 1992; Inserra 1988). In general, they have been excluded from managing the forests that they use.

Property and Social Relations

Women's marginalized position within forestry management in Nepal can be understood by examining the relationship between property rights and social status.

Community forestry entails redistribution of property rights, where the control of the forest resources is given to local people. Property theorists explain that a property right is not the possession of an object, but is a social relation (Macpherson 1978). To have a property right is to have the ability to enforce a claim to a stream of benefits by excluding others (Macpherson 1978, Bromley 1991). In other words, property is an enforceable claim, where other people's actions can be controlled (Macpherson 1978). Thus, it follows that rights are held by those who have the power to exclude others.

The ability to protect one's property is often assumed in societies where laws protect property owners and where there is equal access to government services and enforcement. In the absence of state enforcement, property rights are defined in terms of power relations within a society. Property rights are likely to be held by those who have access to government institutions and services that legitimate people's claim.

Cultural norms define who has access to such government institutions. Culture is created by a society, but at the same time it shapes people's behavior and values. Cultural norms may restrict and deny individual's access to institutions and services. In this case, culture influences who will be educated, who will have access to government services, and ultimately, shapes social relations and reinforces one's social status.

In sum, the enforceability of property rights is dependent upon one's position in society and one's access to institutional structures to legitimate property claims. Social relations and status determine resource control (Berry 1989). Marginalized groups often are prevented from gaining power within their society, and hence from access to resources. Thus even if "local" people are given rights to manage the forest, we need to understand who, at the local level has rights and to what. Women have control of a degraded forest, but because of their marginalized position in society, it is likely that they will not be able to maintain control as the resource improves.

METHODS

Research was conducted during the summer of 1993 in Sejuwal Takura, Salayan District. In depth, open-ended interviews were conducted with members of the all-woman forest committee and their husbands. In addition, semi-structured interviews with residents of each household in Sejuwal Takura were conducted. The District Forest Officer and staff of the Women's Development Office in the nearby District Center of Khalanga were also interviewed. Supplementary socio-economic data was obtained from the USAID funded Rapti Zone Project.

THE CASE STUDY

Sejuwal Takura is a village of approximately 200 people in the Mid-Hills (at 900m) in the Mid Western Region of the country. The thirty-one houses of the village are surrounded by non-irrigated fields (*bhari*) where the villagers raise corn, millet and fruit trees. In addition to these land holdings, most residents also own a parcel of irrigated (*khet*) land in a valley 1.5 hours walk away, where rice, wheat and mustard (for oil) are grown. Livestock is kept for power (plowing), fertilizer (dung), consumption (milk and meat), and investment. Cattle and goats are the preferred animals. This subsistence economy depends on access to grasses and fodder leaves to feed the livestock. People gather forest products from trees on their own land but require access to forests, which are primarily used for fodder (leaves from trees and grasses from the forest floor), fuel wood, and timber. In addition to several forests that are shared with other villages, one forest lies within the boundary of Sejuwal Takura (Fig.1). This is degraded forest land, comprised of scattered shrubs, grass, and newly planted saplings. The forest's appearance is *indistinguishable* from the grazing land, yet it is legally classified by the government as forest. This discussion centers around the control of this land.

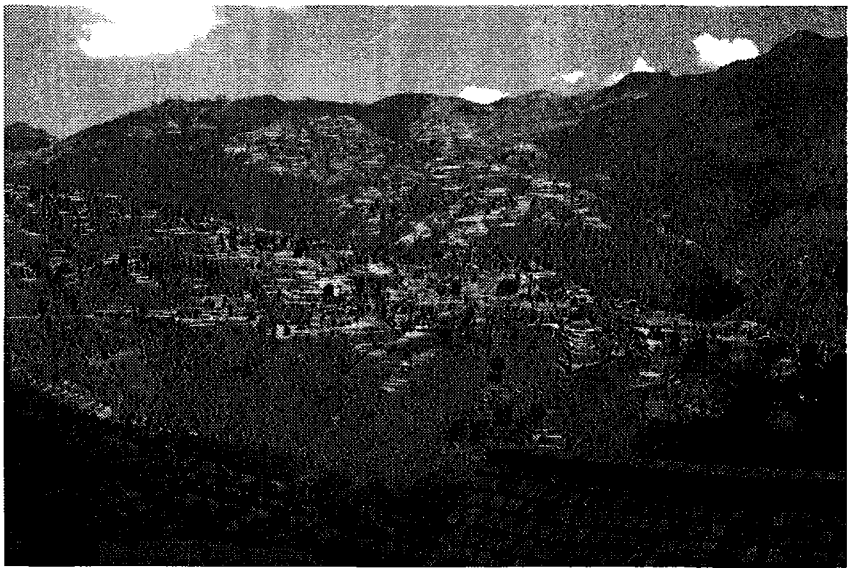

Figure 1. The village of Sejuwal Takura. Degraded forest managed by the women's forestry committee is shown in the foreground.

Culture and Status

Traditionally, within this Chettri community, strong cultural norms shape women's public behavior and prevent them from becoming involved in the public arena, including forest committees. According to one survey, only four out of 121 women interviewed were literate (Rapti Zone Panchayet Resource Inventory Data 1988). Most of the women I interviewed did not send their daughters to school, while all sons attended school. Girls are kept from attending school because their labor is too valuable at home. One woman explained:

"What can I do? To run a household we need to raise goats, cows and water buffalo. Grass needs to be cut [for the animals to eat], fodder needs to be collected. If my daughter does not stay home to work, we will not make it."

Moreover, daughters are married at an early age (from age 14) and leave their parent's household. Prospective brides are valued for their working skills, not for their ability to read and write. One informant commented that it was not good to educate women. Normative social values have kept women not only from access to education, but also from access to the skills necessary to advance their social standing.

Women are inhibited from partaking in activities with men. It is not considered appropriate for women to have eye contact with men, to speak to men, nor to speak in public: "A woman who knows and talks too much is considered excessive and loose. An ideal woman is close-lipped and active in looking after the household" (Bista 1991). Women interviewed would not speak their husbands' names for fear of being disrespectful. In this culture, husbands are considered to be deities.

All of these factors contribute to exclusion of women from community management activities outside the home. Traditionally, women do not have jobs, are not involved in local politics and rarely participate in community activities. This limits their access to production, and therefore material well being: reproducing similar patterns from generation to generation.

Women's Forestry Committee

Seven years ago the Women's Development Office (WDO) began literacy classes in Sejuwal Takura. Classes were held in the evening, and those with their husband's permission attended the class. Women learned the Nepali script, and each woman learned to sign her name. Several other activities evolved from this program. The WDO also facilitated training sessions on agricultural and horticultural techniques, livestock raising, and cooperative loan formation. The women planted orange and fodder trees on their private land. A livestock cooperative was implemented to provide loans, using the group's collateral, for agriculture or livestock development. Most recently the WDO helped form the women's forestry committee. They started to protect and restore the local degraded forest.

Sejuwal Takura's Forestry Committee is comprised of seven women between the ages of thirty-five and sixty (Fig.2). They hold village meetings, organize plantings, and protect the forest. User group meetings are attended by both men and women. From these meetings a management plan was agreed upon. The forest is open for five days a year during November. One person from each household is allowed to cut unlimited amounts of grass during this period. During July they organize plantings, and the Department of Forestry provides seedlings and technical advice. The forest has no fencing, nor any forest guards. Instead, the women watch the land, with most of the responsibility falling on those living in closest proximity to the land. Owners whose livestock is found grazing in the forest are fined. Problems tend to be from members within the community. Peer pressure takes on an important role in enforcing the plan.

Female committee members felt more at ease working on a committee with only women. They were more likely to contribute to discussions and felt a sense of importance, autonomy and identity within their group. While they did not object to the idea of men on the committee, in practice they felt that the presence of men would limit their own participation and control. Some doubted whether they would remain on the committee if men also became members.

Overall, the members of the village were pleased with the presence of the forestry committee. Women of the village who were not involved in the WDO activities felt more comfortable having an all-woman committee. According to the men of the village, the committee was a

Figure 2. Four members of the women's forestry committee in Sejuwal Takura.

good thing: it was good that the land was being improved. However, each man interviewed thought that it would be better if men also sat on the committee. Similarly, the District Forest Officer said that the committee should be representative of its community users, and should therefore include men. Eventually men will be accepted as committee members or, as the Forestry Official said, the Forestry Office would cease to recognize this forestry committee as legitimate (it is not officially recognized at this point) and will support another committee.

DISCUSSION

The women's forestry committee has been operating for four years. The formation of the committee has greater cultural than environmental implications. The women involved in these activities feel that their attitudes and perceptions have changed. Through the literacy classes and trainings they have become confident in themselves. The women on the committee say that before their "wisdom was hidden": they were "asleep and unaware." Since their interaction with the WDO, they are not afraid to speak in public nor to go to government offices. Without the influence of the literacy classes, the women would not have become involved in the forestry committee.

Despite the great changes and effects that the committee and the WDO activities have had on the women's lives, the forestry committee has very little power. The women's committee has control of the forest *because* the land is degraded. At this time, no one contests their claim to manage the land simply because it has no value. In terms of property rights, this "forest" has no benefit stream and it is not difficult to enforce rights.

The forestry committee is improving its land through planting trees and protection. As the value of the land increases, it is likely that the women will not maintain control. As the forest official noted, the forestry committee needs the support of the Forestry Department, and will have to accept men to achieve legitimation and recognition by the government office. In this case, it is likely that the women do not have enough power within society to maintain their autonomy of the all-woman committee, and their control over the forest land.

CONCLUSION

Community forestry attempts to redistribute property rights, and thus create more equitable outcomes. Property rights, however, are fluid and constantly changing arrangements. As the value of the resource shifts so do property rights. Access to and control of resources are determined by the distribution of power within society and influenced by the value of the resource. Socially constructed institutions and norms prevent some groups from having access to resources (Agarwal 1989). Thus, if equity is a goal of community forestry, then it is important to recognize that participation alone does not result in more equal distribution of goods and benefits. We need also to understand who participates and how; who does not participate and why.

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REPRODUCTIVE BIOLOGY OF *PHILODENDRON GIGANTEUM*, *ANTHURIUM CRENATUM*, AND *ANTHURIUM DOMINESCENSE* (ARACEAE) IN A SUBTROPICAL MOIST FOREST IN PUERTO RICO

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INTRODUCTION

Recent studies of the reproductive biology of the family Araceae, the aroids, have concentrated on the plants' distinctive physiology and mechanisms for pollination. The family is largely tropical, represented by perennial herbs and vines such as *Philodendron* and *Anthurium*. Floral architecture in the family is characterized by the spadix, a stalk on which the flowers are borne, and its subtending spathe, a modified leaf or bract.

Like various other members of the family, *Philodendron* species have the capacity to use a cyanide-resistant respiration (Elthon and McIntosh 1986; Guy et al. 1989; Raskin 1992; Raskin et al. 1987, 1989, 1990) to generate heat (Cook and Commack 1985; Urdentlich et al. 1991) and thus to volatilize various highly scented compounds to attract pollinators (Kibota and Courtney 1991).

In the summer of 1993 I studied aroids at El Verde, on the western slopes of the Luquillo Experimental Forest in northeastern Puerto Rico. Research focused on the following topics:

1) the flowering phenology of *Philodendron giganteum*, *Anthurium crenatum* and *A. dominicense*;
2) insect visitors to the three study species; and
3) the possibility of thermogenesis in *P. giganteum*.

METHODS

I followed floral development in *P. giganteum*, *A. crenatum*, and *A. dominicense* from 15 June through 20 August 1993 in selected plots at El Verde. *Philodendron giganteum* was studied in three sites: one in a periodically inundated swamp, and two on rocks above a stream. *Anthurium crenatum* and *A. dominicense* were monitored in rocky sites, one of which had no aroids but *A. crenatum*, and one which had a mixture of both *Anthurium* species.

At one site, I recorded both flowering and non-flowering individuals. Otherwise, individuals were flagged and numbered as they came into bloom. A census was taken every three days, and the stage of development of each inflorescence was recorded, as were time of day and weather conditions. For each inflorescence, I noted color, size, and the presence of scent, insect visitors, and heat.

Insect sampling was carried out by placing sticky traps at and away from inflorescences within each plot. Total numbers of visitors were recorded, and representative specimens from each visiting species were preserved in a solution of 80% ethanol with glycerin for later identification.

Temperature changes within three *P. giganteum* inflorescences were measured with copper-constantan thermocouples and recorded in a data logger (Fig.1). Readings were

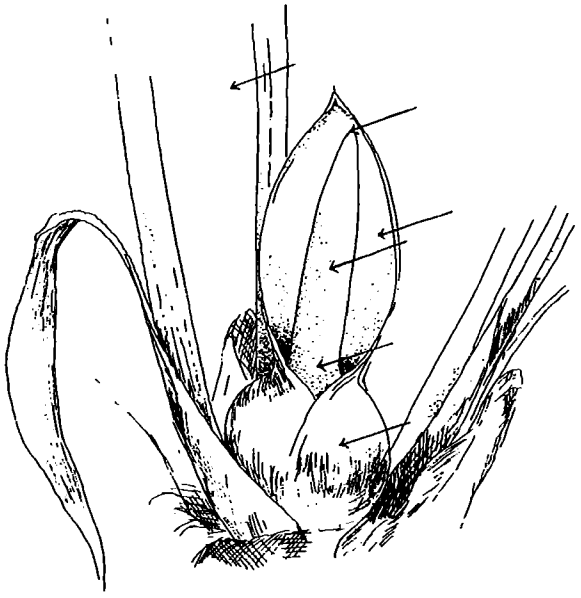


Figure 1. Diagrammatic representation of Philodendron giganteum. Arrows denote points of thermocouple insertion.

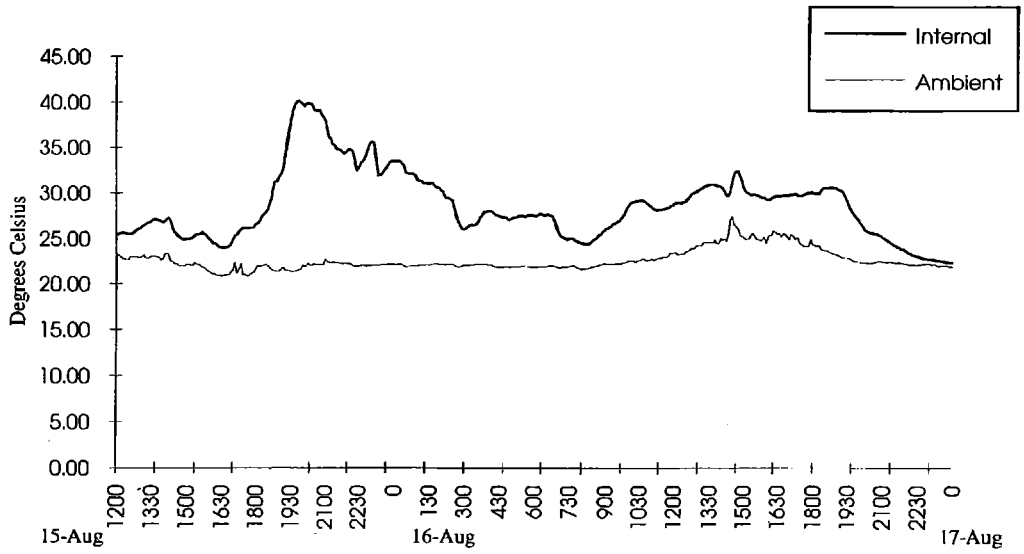


Figure 2. Changes in internal spadix temperature of Philodendron giganteum compared to ambient temperature.

initiated 24 hours prior to the opening of the spathe and continued until 14 hours after the spathe had completely closed. Measurements were taken from the spathe and from various parts of the spadix. In each trial, one thermocouple was maintained in the ambient air.

Voucher specimens of the three study species and other local aroids have been deposited in the herbaria at the Luquillo Experimental Forest and the University of Puerto Rico at Rio Piedras (*cf* Prance et al. 1987).

RESULTS

Individuals of *P. giganteum* in the swampy site appeared in equal numbers as both large erect herbs (ht>2m) and as woody vines, whereas there were only a few vines at one stream-side site and none at the other. The swamp individuals, both vines and herbs, appeared to be clones, sprouting out of the runners of older plants.

Philodendron giganteum was not in bloom at El Verde at the beginning of the study, although there were rotting inflorescences on the ground at the periodically flooded plot. Flowering began with the appearance of a closed inflorescence on 4 July. Thereafter, increasing numbers of inflorescences developed, but at any one time, no more than two inflorescences in any plot were open. Both *A. crenatum* and *A. dominicense* were in bloom throughout the study period.

An inventory of insect visitors showed that species of the order Diptera visited all three study species. When approaching *P. giganteum* inflorescences from a distance, Diptera species flew in a zig-zag pattern typical of a scent-guided path (Gottsberger and Silberbauer-Gottsberger 1991). They were observed approaching from the back of the inflorescence, away from the spathe opening. Sticky trap data supported this observation. Ants (Formicidae) and spiders (Salticidae) were also found on several individuals of *A. crenatum.*

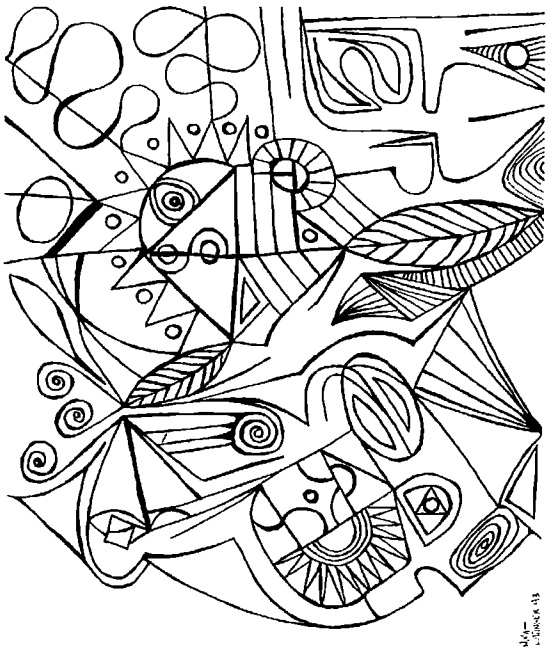
Scent production varied from species to species. *A. dominicense* produced no scent at all; *A. crenatum* gave off a yeasty odor; and *P. giganteum* produced a sweet odor (see Croat 1980 for scent classification). Scent production in *A. crenatum* peaked in the late afternoon. In *P. giganteum* scent production was enhanced by the plant's ability to produce heat internally (Kibota and Courtney 1991) and thus was most noticeable during the heating peak, between 1930 and 2130.

I demonstrated thermogenesis in *P. giganteum* by recording an internal spadix temperature as high as 40.13°C in an ambient temperature of 21.59°C (Fig.2). Elevated temperatures were never recorded in the spathe, but only in the spadix. Temperature change in the spadix followed a stereotypic pattern within the flowering phenology of the species.

The spathes opened between 1100 and 1300 on the first day of flowering and did not close until late the second night, about 36 hours later. Internal temperatures during the twenty-four hours prior to this opening were close to ambient. During the afternoon of the first day, the internal temperature of the spadix rose, reaching a peak just before 2000 that evening. Temperatures above 30°C were maintained until just after 0200 the next morning. Internal temperature of the spadix rose again in the afternoon and evening of day two, in the same pattern as on day one but not as high.

DISCUSSION

Both structure and physiology in the Araceae seem intended to promote outcrossing. Thermogenesis, widespread but not universal in the family, may allow a plant to emit scent effectively in darkness and to distant pollinators. In addition to giving off scent, the *P. giganteum* populations examined also produced showy ivory and purple inflorescences that averaged 30 centimeters in height. Despite intricately coordinated mechanisms for sexual reproduction, the *P. giganteum* individuals at these sites appeared to be reproducing vegetatively, thus raising questions about the relative contribution of sexual versus asexual reproduction. Further research will quantify the presence or absence of viable pollen and the genetic composition of these apparently clonal groups.



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SOCIO-ECONOMIC IMPACTS OF GOVERNMENT AGROFORESTRY PROGRAMS ON FARMERS IN TWO RURAL COMMUNITIES COCLÉ PROVINCE, PANAMÁ

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INTRODUCTION

Rural Panamá has become dependent on a cash economy in response to increasing population pressure, transportation facilities, communication, and educational opportunities. Consequently, young farmers (14-35 years) tend to migrate to cities and wealthy farms in search of subsistence opportunities unavailable in agricultural fields (Charkroff 1980). This migration is exacerbating already critical levels of unemployment in urban areas. Farmers who do work their own fields can no longer subsist from traditional swidden agriculture due to low yields and poor resources. Markets do not provide farmers with incentives for investment in agriculture. Were opportunities in rural Panamá available, the migration might be curtailed and the burdens of farmers and cities alleviated; there is, therefore, an eminent need for economic alternatives to agriculture in rural Panamá.

In an attempt to decrease migration and increase opportunities for rural farmers, INRENARE, the government agency responsible for the management and protection of natural renewable resources in Panamá, and CARE initiated INRENARE/CARE/COMUNIDAD in 1987, a development project in agroforestry. The project's objective is promotion of agroforestry practices in rural communities on a self-help basis, where farmers learn and practice alternative and sustainable land uses in group plots and then apply those practices they prefer on their individual parcels. The project closely follows guidelines of other CARE development projects in agroforestry (Conway 1989), and uses multiple purpose tree species (MPTS) recommended by a previous international reforestation and firewood program.

INRENARE/CARE started in the province of Coclé as a pilot program in 10 communities (CARE Internacional en Panamá 1989). To date, two project evaluations have been carried out. CARE completed one in 1989 which did not evaluate the project's socio-economic impacts on the communities, concentrating instead on adoption rates of introduced agroforestry techniques. INRENARE carried out the other evaluation in 1992, focusing on three communities and following a rapid rural appraisal format. Results are still in preparation. Presumably, it is a more comprehensive evaluation of the ecologic and socio-economic aspects involved in project adoption. In order to address the INRENARE/CARE project's effectiveness in providing alternative land practices to farmers and its socio-economic impacts on rural communities, a preliminary study was carried out in two separate communities (of the original 10), Santa Cruz de Perecabeicito and Llano Grande de Antón (Fig. 1, next page). For four weeks, the daily chores, needs, and resources of communities were observed, each using semi-structured interviews, visits to individual and group plots, and participation in field work.

STUDY SITES

Study sites were chosen according to accessibility and length of participation in the project. It was assumed that participation from the project's onset would provide for better assessment of project impacts; the community of Santa Cruz was therefore chosen. Two groups at Llano Grande de Antón, formed in 1992, were also studied.

Geographic and climatic regimes vary significantly in the two communities. Santa Cruz de Perecabeicito (80°30'N, 8°40'W) is located in the central highland area of Coclé (240m altitude). It is classified as humid tropical premontane forest in the Holdridge system (Tosi 1971, IGNTG 1988). Precipitation fluctuates between 2000-3000mm, irregularly distributed from May to November. Llano Grande de Antón lies in a lowland zone (80° 15'N, 8°20'W, 80m altitude), and is classified as dry tropical forest (Tosi 1971). Precipitation varies from 1100-1650mm a year, with a definite dry season lasting 4-5 months (December to April). 1993 was a particularly dry year, with minimal rainfall until early August.

Llano Grande de Antón has 80 families (400 people), a large elementary school, electricity (not evenly distributed), telephone lines, a government district office, a health center, and a main dirt road. Houses are mostly one to two rooms made of concrete with tin roofs, and although some have access to gas stoves, wood stoves predominate. Fruit trees, such as coconuts, mangoes, and bananas, are customarily planted for household consumption and fertilized with green manure. Llano Grande is quite dry, and fruit trees do not regenerate or grow naturally: they require planting and maintenance. Llano Grande is located 6 km from the only interstate highway in the country, resulting in increased interaction with urban zones, and high migration for jobs or schooling. Most young adults in Llano Grande have received high school degrees and a few even had university degrees.

The population of Santa Cruz consists of some 300 people, comprising 60 families . Access to the community is by a paved road, and the nearest large town is located approximately 30.5 km away. Electricity, telephone lines, and health care facilities are absent. Houses are small, one to two rooms, built from clay and hay mixtures over wood pole frames with thatched roofs. There is a small elementary school (three grades per room per teacher). Few in the community have high school education.

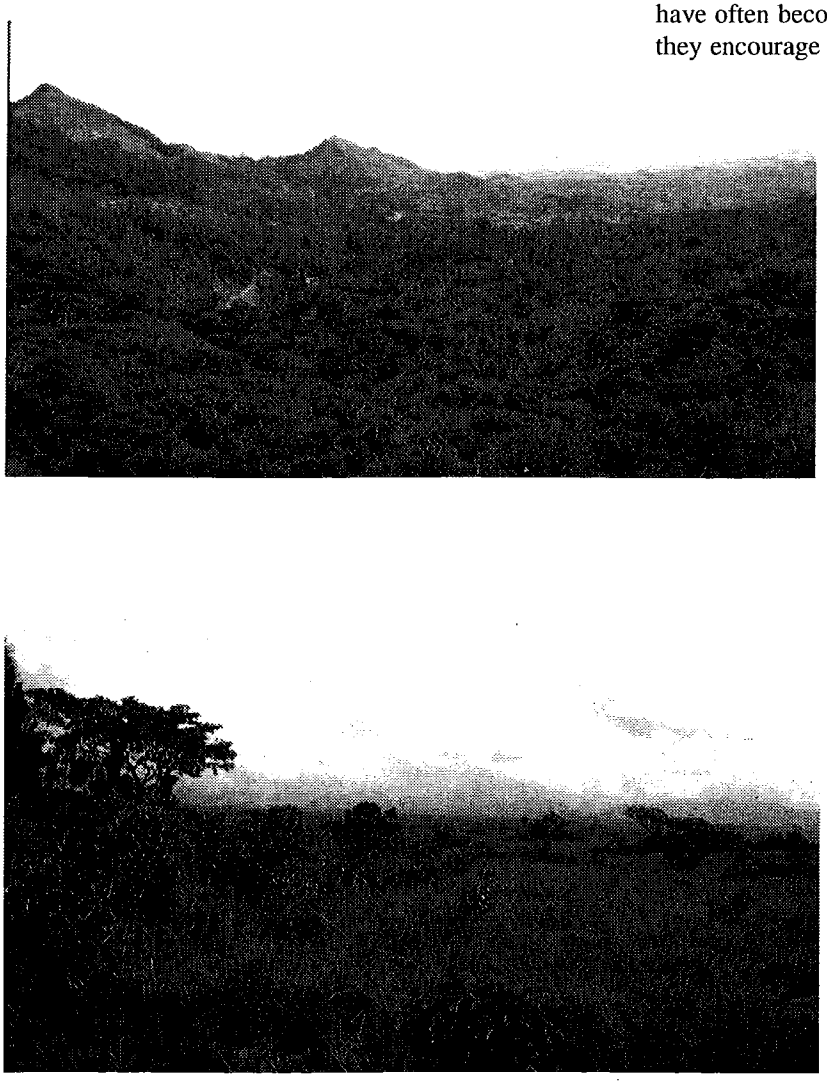

Figure 1. Study sites Santa Cruz de Perecabeicito (top) and Llano Grande de Antón (bottom).

COMMUNAL AGROFORESTRY SYSTEM

The organizational structure of the project at the regional level consists of INRENARE extensionists, "promoters" (selected and trained community members), and communal agroforestry groups. The extensionists recruit personnel, monitor the project, and budget activities. The promoters organize local agroforestry groups, establish communal nurseries, and apply soil conservation and agroforestry practices on the group plots. The groups are small, comprised of 10-15 participants.

Material incentives (seeds, seedlings, nursery building materials, tools) are provided by INRENARE. Food-for-work incentives come from the Programa Mundial de Alimentos (PMA), a program sponsored by FAO (Food and Agriculture Organization) to promote participation in development projects in rural communities. Incentives have often become a hindrance to the program because they encourage dependency and cloak the long term benefits of agroforestry (CARE Internacional en Panamá 1989, Conway 1989).

EVALUATION PROCEDURE

Evaluation of the socio-economic and ecologic impacts of the agroforestry program was based on observation of daily chores, field work, semi-structured interviews of agroforestry group participants and non-participants, and visits to individual homes and plots. The observation of daily chores highlighted the farmers' and communities' needs and resources. Field work provided an idea of farmers' tasks. Interviews assessed the individual's knowledge of land use, perceptions of group work and dynamics, views on community and farm priorities and needs, and whether any of the learned agroforestry practices had been applied. More specifically it surveyed demographics, human, animal, and plant resources, tree planting customs, group work experience, perceptions of needs, and attitudes towards the land. Fourteen community members and the school teacher were interviewed in Santa Cruz de Perecabeicito. All five agroforestry group members were interviewed. The rest of the interviewees were chosen by selecting every fifth house in the community, including those houses located far away from the main road. In Llano Grande, a total of 25 agroforestry group members were interviewed: 15 from Llano Grande Abajo, the more recently formed group (1992), and 10 from Llano Grande Arriba, the group that started with the project in 1987. Finally, visits to individual plots analyzed the spatial use and productivity of farms. Visits allowed comparisons between farmers'

planting habits, and what percentage of each farm was utilized for agroforestry.

The study period coincided with the rainy and planting season (June-July 1993). Each community was evaluated for four weeks. The first week was dedicated to community reconnaissance, getting acquainted with the villagers and their location, mapping roads and houses in the community, and observing in detail their daily chores. The second and third week were allocated to interviews and visits to individual group member plots. Field work was also included in these weeks. The fourth week was used to cover miscellaneous issues, revisit certain farmers or plots, and confirm statements made or events that unfolded during the evaluation.

RESULTS

Social Observations - Demographics

Sixty percent of Llano Grande and Santa Cruz community members are over 50 or under 21 years of age. The average family has 8 members. Approximately 25-33% of the population migrate to cash economies, i.e., 2-3 members per family. The higher percentages correspond to Llano Grande due to its proximity to the Interamericana Highway. Economically, Llano Grande seems to be supported by community members working in cities. Migrants tend to retire between the ages of 57 to 65 in their home communities and take care of their parents. Farmers who remain in the community all their lives--approximately 20% of the rural population--practice swidden agriculture. Ownership patterns vary in the communities. Llano Grande is characterized by ownership of large abandoned rice fields, 6-20 ha, by a few families. These lands were claimed through possessor's rights when they were cultivated with rice, although some are now trying to get titles for their properties. Farmers in Santa Cruz, on the other hand, generally have lands under 5 ha. The old established families have their lands under possessor's rights, whereas newly established families have purchased their properties.

Gender Roles

Gender roles in community/family chores are well defined. Men do the field work. Typically they clear 0.5 to 1.0 ha, burn, and plant in anticipation of rain. Traditional crops include maize, rice, manioc, and beans (and sugar cane in Llano Grande). Clearings are not cultivated for more than 1 year because the soil is nutrient poor. Typically low yields, 0.9-1.2 mT/ha for maize and rice and 0.4 mT/ha for beans (INRENARE extensionist, personal communication), demand a minimization of labor intensity. Men also collect firewood, mostly from secondary forests located 15 to 40 minutes by foot from their homes. In a few instances in Llano Grande, however, women gathered firewood from felled trees or from live fences.

Women tend the house (cook, clean, wash clothes), children, elderly, animals and garden. These daily chores occupy women from 4:30 am to 9:00 pm, almost non-stop. Women and children harvest fruits for sale and for their own consumption (e.g., mangoes, nance). When time permits, or when pressed for cash, women and some men in Santa Cruz braid hats and baskets from native herbaceous plants (e.g. *Cardulovica* spp.)

Agroforestry Program Impacts

The INRENARE/CARE project's main foci are tree nursing and planting. All groups are dependent on INRENARE for seeds, guidance in planting, cleaning, and thinning activities. Agroforestry is actively practiced in the Llano Grande group plots. The agroforestry practices applied in the group plots, however, are generally labor intensive (e.g., contour planting, ponds for rice and fish), and therefore farmers have not integrated them in their private plots. The most frequently adopted agroforestry practice is taungya planting, annual crops cultivated among MPTS seedlings. Because MPTS grow rapidly, taungya systems can only be used for only 1-2 consecutive years in a given plot before trees shade out the annual crops.

The group in Santa Cruz is not active because the affiliated INRENARE extensionist never visits the community. Lack of supervision from INRENARE allowed the group promoter to exploit the project's name and organization in building a small kiosk business to sell items such as drinks, candy, cigarettes, kerosene, and bread. He has convinced the group members of the financial benefits this business will bring, when in reality, the kiosk will not provide much cash to the group members. A kiosk already exists in Santa Cruz which yields little return to its owners. Though the most probable outcome will be a more distinct community division, all group members have agreed to build the store instead of maintaining and improving their group and individual plots.

The groups in Llano Grande are very active and motivated. Perhaps some of their motivation stems from food-for-work incentives rather than from actual interest in agroforestry (Jeff Luoma, Peace Corps Volunteer, personal communication). Llano Grande Arriba has been active since 1987, and has a close-knit core of members. Group work includes maintenance of member's plot

(cleaning weeds, thinning), nursery upkeep and reforestation. There is an on-going group effort to reforest abandoned rice fields with *Pinus caribaea* and mixed species plantations. Many of their MPTS are maturing and require thinning, but there are neither facilities nor markets for the product. INRENARE extensionists do not play a visible role in this group, but do visit each week for updates on group activities, deliver seeds, propose new activities, or inform the group of future visitors.

Llano Grande Abajo formed in 1992. The group is still learning techniques, working on nurseries and planting group plots. In a few random instances the Abajo group was able to sell MPTS seedlings. Last July (1993), their INRENARE extensionist arranged the sale of 4,000 *Pinus caribaea* seedlings to an independent buyer. The group seemed enthusiastic about the sale.

Group tasks are often defined by gender and age. Men take charge of field chores: making holes in the soil for the trees, tilling the soil for cereal, planting, and cleaning trees and crops. Ages of men range from 14 to 74, the majority being in their 50's and 60's. The younger members are typically assigned the more strenuous chores. Approximately half the members in the Llano Grande groups are women, ranging in age from mid 20's to early 60's. Older women generally cook lunch for the group, and younger women clean and water in the nursery. Occasionally, they participate in "men's" chores if there is a need for it.

All groups started with at least 30 participants. The number of participants decreased to 5 in Santa Cruz, 14 in Llano Grande Abajo and 10 in Llano Grande Arriba. Interest in the groups tends to wane when incentives are not reliable, e.g., food-for-work incentives arrive late or not at all, and when members have other priorities such as job opportunities in the city or sick relatives. Only those with strong attraction to agriculture, community participation or devotion to project organizers remain as permanent members in the group.

DISCUSSION

Results indicate that the communities of Santa Cruz and Llano Grande are not benefitting from the INRENARE/CARE program. The program does not achieve its development objective because it does not address the communities' needs or realities. This failure can be traced to the top-down approach of the project; it was not tailored to the specific subsistence strategies and socio-economic situations of target communities. Agroforestry is not perceived as a viable subsistence tool in these communities.

Agroforestry is more appropriate for communities that have strong traditions of land work, and where natural regeneration is mild. Where natural regeneration is minimal, subsistence farmers need to tend their plants to ensure their survival. Perhaps this is part of the reason the Llano Grande groups have remained active: environmental conditions are harsh and natural regeneration is poor. In Santa Cruz, however, the native vegetation is rich and farmers unaccustomed to intensive maintenance, introducing labor intensive practices appears inappropriate.

To increase genuine farmer's interest and participation in the project, a more holistic approach is necessary in future projects or project modifications. The need to consider social values and market opportunities was exhibited in this study. However, there are other social factors, both at the micro level, such as community size, resources, traditions, and at the macro level, such as property rights and enforcement of law and order, that also require attention (Conway 1989, Burch and Parker 1992). Farmers need to be involved in the program design and decision processes. Likewise, government and supporting organizations must secure viable and fair markets for goods, so that the program becomes independent from them and productive for farmers (Conway 1989, Burch and Parker 1992).

Small modifications to the INRENARE/CARE project could significantly improve its effectiveness. For example, a focus on forest plantations, with which farmers are familiar through agroforestry group activities, will provide a cash influx to the communities, given market access. This will also provide the ecological benefits of agroforestry (soil enrichment, erosion control). The addition of a woodworkers' cooperative, where farmers have access to tools, learn carpentry, and have a secure market for their products, would also give young farmers incentives to stay in their communities. By the same token, wage opportunities in rural Panamá would help alleviate the increasing unemployment rates in the cities.

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PATTERNS OF SUCCESSION IN A NORTH YUCATECAN TROPICAL DECIDUOUS FOREST

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INTRODUCTION

For generations the Mayan village of Sahcaba, like most villages in northern Yucatan, relied on the cultivation and sale of Henequen (*Agave* sp.) for much of its income. This came to an end in 1992 when almost all Henequen fields were abandoned due to the elimination of government subsidies for Henequen processing plants. The cessation of Henequen cultivation has eliminated a major source of income for Sahcaba's residents. Mayan families, struggling to replace this lost income, have been forced to intensify swidden farming of their milpas (traditional agricultural fields). However, seasonal milpa harvests, while providing important food staples and limited cash income, cannot adequately replace the former lucrative trade in Henequen.

A potential source of income might come from enhanced utilization of Sahcaba's montes (communal secondary forests), which are currently exploited only for firewood, materials for construction of thatched huts, and a few medicinal plants. The community has expressed a desire to create a forest management plan, but the lack of quantitative data on the composition and structure of Sahcaba's forest has slowed planning efforts. This research project is an attempt to provide the framework for a forest management plan.

The Autonomous University of Yucatan (UADY), through its Program for Management and Conservation of Tropical Natural Resources (PMCRNT), is working with community leaders in Sahcaba to develop environmentally sustainable sources of income and subsistence. Out of several potential projects, a project to develop a forest management plan was chosen for immediate implementation. It is hoped the plan will provide a wide range of management options.

SITE DESCRIPTION

Sahcaba is located approximately 60 kilometers SE of Merida city in northern Yucatan, Mexico (20° 27'N and 88° 59'W). The village's population of 1483 own 1400 hectares of land (most communally), which is a mosaic of milpa (agricultural fields) and monte (secondary forest). This land is managed under a swidden system. Forested areas up to two hectares (depending on family size) are cleared and planted with corn, beans and squash. After two years, nutrients are depleted, the site is abandoned, and a new site is cleared. Secondary forests growing in fallow areas range from 1 to 30 years, but average fallow length is 8 years.

Roldan (1985) classified the forest in this zone as a low-height tropical deciduous forest (Selva baja caducifolia). Climate is warm sub-humid with a dry season in winter and early spring. Mean annual temperature is 27.5°C, and mean annual precipitation is 978mm. The rainy season is between June and October (Rico-Gray et al. 1988 after Roldan 1985).

METHODS

Field work was performed in July and August 1993. Three montes 2, 10, and 30 years old were chosen for study. The research goal was to document successional

changes in forest species composition and structure. Compositional and structural changes are more frequent during early stages of succession in northern Yucatan (Negreros-Castillo, Olmstead, personal communication). For this reason the first two montes chosen were under 10-years-old; the third was 30-years-old.

In each of the three montes five 10 x 20 m plots were selected, the first plot chosen randomly with the succeeding four plots oriented to be contiguous with each other. This layout was chosen in order to accommodate the small size of two of the montes and to avoid double-counting individuals within montes. Together, the 5 plots in each monte encompassed 1,000 m^2. This area was judged sufficient to encounter the majority of species in this region by Rico-Gray et al. (1992). Scattered plots in distinct montes of the same age class would have been preferable, but an insufficient number of montes of the appropriate ages were available for study (permission from land owners was not always granted). In each 10 x 20 meter plot, all woody stems with a diameter at breast height (dbh) of $\geq$ 1 cm were identified by species and measured for height and dbh. Groups of coppice sprouts from the same individual counted as one individual.

RESULTS

Forest Composition

A total of 69 distinct species with a minimum dbh of 1.0 cm were observed in the fifteen 10m x 20m study plots, represented by 2531 individuals. The 2 year old monte contained 33 species; the 10 and 30 year old montes contained 51 and 38 species, respectively. Species-area curves approach a plateau in all instances, indicating the size of the study areas (1000m^2 per monte) may reasonably encompass an adequate sample of the woody plant species in the region (Fig. 1). This is especially true in the 30-year-old monte.

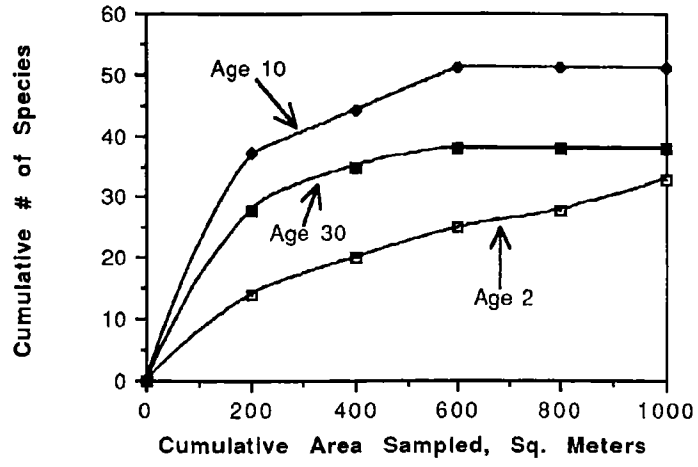

Figure 1. Species-area curves for three montes aged 2, 10 and 30 years.

Table 1 (facing page) summarizes the density, relative density, and mean dbh for the ten most numerous species in each age class. Density is estimated per hectare based on 1000m^2 (0.1 ha) sample areas.

Relative densities of the species sampled changed as a function of age. The relative density of *Lonchocarpus yucatanensis* is 13.6 (i.e., 13.6% of all trees $\geq$ 1.0 cm dbh are members of this species) at age 2, rising to 15.2 by age 10, then dropping to 9.7 by age 30. The relative density of *Gymnopodium floribundum* is only 4.0 at age 2, rising dramatically to 19.7 by age 10, and to an overwhelmingly dominant 31.3 by age 30.

Successional Processes

The number of individuals present in the 10-year-old monte greatly exceeds those sampled in montes aged 2 and 30. This relationship is a result of normal successional processes. In the 2-year-old monte the majority of woody stems did not reach the minimum allowable dbh of 1.0 cm for inclusion in the study; only 358 individuals met or exceeded 1.0 cm dbh. In the 10-year-old monte, most woody stems had grown to 1.0 cm dbh or greater, increasing the number included in the sample (1,581 individuals). In the 30-year-old monte, crown closure had become a factor in increased competition among individuals of the same or different species, thereby eliminating many individuals and leaving a sample size smaller in number (592 individuals-- 1/3 the number of the 10-year-old monte) but larger in dbh and height.

Coppice versus Seed Reproduction

Several researchers have noted the importance of coppicing as a method of reproduction in the dry tropics (Ewel 1977, 1980, Murphy and Lugo 1986a, b). This presumably results from the difficulty of reproduction from seed in the dry tropics, which is a function of soil and water constraints and human activity.

It is likely that human activity plays a very important role in determining the coppice/seed ratio of reproduction in Sahcaba's forests. Forest is cleared under a swidden system as frequently as possible to allow maximum crop area. As a result, the average age of montes is only 8 years (the 30-year-old study site is not part of the milpa/monte system). Frequent cuttings and burnings have presumably favored species that reproduce through coppicing rather than from seed. Eight of ten species with highest densities in

Age 2			Rel.	$\bar{X}$	St.
	Species	Den.	Den.	dbh	Dev.
1	Lonchocarpus yucatanensis	480	13.6	1.28	0.25
2	Piscidia piscipula	420	11.9	2.64	1.20
3	Bourreria pulchra	410	11.6	1.99	0.52
4	Bauhinia divaricata	400	11.4	1.24	0.19
5	Bursera simaruba	310	8.8	1.95	0.76
6	Colubrina greggii	190	5.4	1.42	0.24
7	Diospyros cuneata	180	5.1	1.46	0.45
8	Gymnopodium floribundum	140	4.0	1.42	0.35
9	Mimosa bahamensis	120	3.4	1.32	0.24
10	Colubrina ferruginosa	120	3.4	1.53	0.20
Total:		**2270**	**78.7**		

Age 10			Rel.	$\bar{X}$	St.
	Species	Den.	Den.	dbh	Dev.
1	Gymnopodium floribundum	3100	19.7	2.62	0.99
2	Mimosa bahamensis	2740	17.4	2.44	0.92
3	Lonchocarpus yucatanensis	2390	15.2	1.66	0.46
4	Lysiloma latisiliquum	2190	13.9	4.40	2.67
5	Senna racemosa	800	5.1	2.23	0.99
6	Machaonia sp.	490	3.1	2.73	1.63
7	Bourreria pulchra	420	2.7	3.05	1.43
8	Guettarda elliptica	380	2.4	1.76	0.47
9	Piscidia piscipula	370	2.3	3.99	2.35
10	Diospyros cuneata	370	2.3	1.86	0.64
Total:		**13250**	**84.1**		

Age 30			Rel.	$\bar{X}$	St.
	Species	Den.	Den.	dbh	Dev.
1	Gymnopodium floribundum	1830	31.3	3.97	1.85
2	Lonchocarpus yucatanensis	570	9.7	3.88	2.88
3	Bunchosia glandulosa	510	8.7	2.29	1.90
4	Hippocratea celestroides	470	8.0	4.79	3.50
5	Eugenia mayana	350	6.0	2.78	1.54
6	Parathesis cubana	330	5.6	2.13	0.78
7	Bourreria pulchra	230	3.9	4.43	2.39
8	Croton reflexifolius	220	3.8	2.90	1.46
9	Guettarda elliptica	160	2.7	3.68	1.50
10	Pithecellobium albicans	130	2.2	14.16	5.02
Total:		**4800**	**82.1**		

Table1. Summary of the ten most numerous species per age class. (Den.= Denisty; Rel. Den.= Relative Density.)

the 2-year-old monte arose predominantly in groups of coppice. For example, in the most common species in this age class, *Lonchocarpus yucatanensis*, 80% of individuals arose in groups of coppice. For this reason, the densities of individuals of each species in Table 1 should not be confused with the number of woody stems per acre, the latter being far greater than the former. This is because only the largest stem from coppice groups (individual plants) was counted.

DISCUSSION

This study is a necessary first step in generating background data for a forest management plan. A full report in English and Spanish will be submitted to the joint team of Mayan community leaders and members of the Program for Management and Conservation of Tropical Natural Resources by the end of December, 1993.

The relatively small sample size (1000m^2 per monte) and choice of contiguous plots instead of replicate samples may limit the accuracy of the data in providing a fully representative sample of each age class. For this reason, further study may be desirable. However, the immediate need for a preliminary forest management plan may render sampling inconsistencies insignificant.

ACKNOWLEDGMENTS

The project was made possible by grants from the Tropical Resources Institute, the Council for Latin American Studies, and the Yale Center for International and Area Studies. I would like to thank Juan Bautista Chin Chi, Edilburto Ucan Ek, Luz Maria Ortega Torres, and Francisco Javier Xuluc Tolosa for their assistance in the field; Juan Jimenes-Osornio, Director of the Program for Management and Conservation of Tropical Natural Resources who, togther with Aliza Mizrahi, supported and assisted me throughout the project; Salvador Flores for his invaluable assistance in identifying samples from the field; and Mark Ashton for his guidance throughout the project.

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BOOK REVIEWS

Plantation Forestry in the Tropics, (2nd ed.) Julian Evans. Clarendon Press, Oxford,1992, 403 pp.

The socio-economic and ecological significance of tropical forest resources has assumed critical importance in the context of increasing economic hardship and environmental degradation. Tropical tree plantations have figured as a key element in strategies of development and ecological remediation, and interest in the subject has broadened and intensified, particularly since the early 1980s. In response to this trend, Dr. Julian Evans has produced an extensively revised edition of Plantation Forestry in the Tropics, which presents the essential elements of plantation silviculture couched in a broader socio-economic and ecological framework. As Evans makes clear in his introduction, the book is neither a manual nor a bibliographic reference: it is a coherent, reader-friendly and useful introductory text. Evans covers a large and complex subject in clear, concise style, effectively incorporating details but not overburdening the reader with them. He successfully outlines areas of concern as a baseline for awareness and further study, endowing the reader with a sound, holistic familiarity with the subject. Evans' modest intentions notwithstanding, numerous examples from diverse tropical locales and abundant citations provide the reader with a firm grasp of procedure and exhaustive source material.

In Part I, Evans introduces the reader to the tropics and plantations. While this may sound simplistic, it is not. In the minds of many, the tropics are associated with rain forest and plantations with industrial timber production. In reality, the tropics encompass extensive arid and semi-arid zones as well as cooler highland regions, and much plantation work is aimed at subsistence needs and amelioration of degraded sites. These areas of concern receive substantial emphasis throughout the book. Also included in this section are an overview of the developmental history of plantation work in the tropics and a general outline of the plantation framework.

The importance of socio-economic analysis and planning is emphasized in Part II. The lessons of the past are not lost on Evans, and he notes that insufficient rigor in these aspects has contributed to failures in tropical plantations. The appropriateness, capability and accessibility of lands available for planting are important considerations here. A discussion of tenure and usufruct leads to an examination of the role of local people, in terms of their skills as potential participants and their needs as intended beneficiaries. These are all crucial concerns in the planning process, which Evans then analyzes in its entirety in concluding the section. From the level of the international aid or development agency to that of the local NGO or extension agency, steps must be taken to ensure the thoroughness of planning. Beyond considerations of land and people, there are the matters of potential markets, transportation networks and the actual steps in the establishment and maintenance of the plantation itself, as neglect of any one of these may spell ruin.

Plantation silviculture is the subject of Part III, providing a step-by-step review of physical establishment and maintenance procedures. Appropriate species selection, seed sourcing and nursery requirements are discussed. Various site preparation strategies and planting methods are analyzed. The need for thoroughness, precision and economy is stressed in regard to cleaning, weeding, thinning and pruning regimes. The pros and cons of fertilization are presented. Efficiency of rotation length and regeneration strategies are then considered, followed by a call for constant vigilance in the area of forest health. While Part III is straightforward and by necessity rudimentary, it effectively highlights the level of practical complexity involved in plantation silviculture versus silviculture in the natural forest.

Importantly, in Part IV Evans devotes substantial time to the "non-industrial" potential of tropical plantations. Though the tropical moist forest receives the lion's share of attention in the media, many regions of the tropics are afflicted with drought, degraded soils, sparse vegetation and erosion. Deforestation in these areas due to the combined effect of clearing for agriculture, cutting for fuelwood and overgrazing by livestock entails a spiralling degradation of the environment. In some areas this has contributed to desertification and the exacerbation of food shortages. Evans presents a fairly extensive presentation of the remediation capacity of plantations for lands beset by drought, erosion, salinity and even contamination. In addition, the role of plantations in agroforestry systems and fuelwood supplies is described.

Evans closes the book with an investigation of some frequent criticisms of plantation systems. These include the vulnerability of monoculture to pests and disease, lack of diversity and potential deterioration of productive capacity over time. These concerns are treated in a straightforward, honest fashion, and Evans acknowledges the basis for them, though he does not consider them absolutes.

In *Plantation Forestry in the Tropics*, Julian Evans effectively introduces the student to his subject, while

also providing the seasoned veteran with useful reminders and perhaps a broader horizon. The complexities of plantation systems in the tropical context are effectively conveyed to the reader, including negative aspects and drawbacks, accompanied by a holistic exposure to ongoing developments. This is an essential text for students and agents of the development of tropical forest resources.

--Steven Harrington

Risk and Tenure in Arid Lands: the Political Ecology of Development in the Senegal River Basin. Thomas E. Park (ed.) University of Arizona Press, Monographs on arid lands development, 1993. 383 pp.

Ongoing drought in the Sahel has rendered much of Mali, Mauritania and Senegal unproductive for pastoralism. This has led to sedentarization of people, increased emphasis on flood recession agriculture, and subsequent disputes over land tenure in the Senegal River basin. This book summarizes the issues regarding economic development, common property rights and agriculture and provides a useful critique of recent development projects in the region.

The first four chapters provide an excellent overview of political ecology in the Senegal River basin. An entire chapter is devoted to soils of the region, correlating indigenous soil classification schemes with soil taxonomy and summarizing local soil uses, value and degrees of fertility. It is stressed that because rainfall and flooding patterns are erratic, there is great annual variation in productive regions, and risk is, therefore, an inherent part of flood recession agriculture. Traditional tenure systems, in which nuclear families inherited rights to allocation of a specific *amount* but not to a specific *area* of land, were best adapted to these risks. These chapters discuss the current relations between traditional tenure systems and modern development efforts and the movement from long-term risk management to short-term optimal growth. The authors discuss recent conflicts between Senegalese cultivators and Mauritanian Peul herders, and crises resulting from governmental shifts in land tenure and property rights.

The second section of the book contains a collection of five case studies. The first two studies focus on land tenure: its impact on income generation and its relationship to local social structures. The remaining three case studies evaluate development projects in the basin and their relation to land tenure. These critiques are constructive in form, addressing the degree to which each plan is realistic and appropriate. For example, a project in the Dirol Plain would allow for irrigation development on high lands and flood recession agriculture on lower lands. Editor Thomas Park discusses how even this promising system--which would minimally impact traditional tenure systems while improving production--oversimplifies the intricacies and benefits of traditional systems.

A useful glossary of technical and regional terms and a comprehensive bibliography of government and organization reports, press reports, and scholarly works are included. Useful maps and diagrams are also incorporated into the chapters.

This book emphasizes the social and cultural implications of risk as well as appropriate forms of agriculture for arid lands, particularly the Senegal River Basin. Though these critiques discuss case studies only in a single basin, they should be extremely useful for those interested in arid or semi-arid regions. Conflicts over land tenure are not unique to a particular region, and often result from failure to consider common property, political and ecological processes in development projects. As delimited pastural migration, denudation of land, and lost productivity increase pressure on arid lands, it will become increasingly important to understand that social, political and ecological processes are inexticably linked. *Risk and Tenure in Arid Lands* serves not only as a reminder, but also a guide toward sounder management and development of arid lands.

--Victoria Derr

Biodiversity Prospecting: Using Genetic Resources for Sustainable Development. W. V. Reid, S.A. Laird, C.A. Meyer, R. Gamez, A. Sittenfeld, D.H. Janzen, M.A. Gollin, and C. Juma. 1993. World Resources Institute. Washington, D.C. *ix* + 341 pp.

Biodiversity prospecting--"the exploration of biodiversity for commercially valuable genetic and biochemical resources"-- has received much attention in the wake of the signing of the Convention on Biological Diversity at in 1992. This book offers a timely analysis of the potential benefits of biodiversity prospecting for the protection of biodiversity, economic development in the developing world, and the equitable sharing of the profits to be derived from diverse genes, species, and ecosystems. Included are analyses of both the arguments in favor of biodiversity prospecting and the empirical evidence and procedural recommendations necessary for its success. These analyses provide a crucial tool for governments, biotechnology companies, researchers, and rural communities as they struggle to develop the first biodiversity prospecting agreements. The book's format consists of separately authored chapters and appendices addressing two basic themes: theoretical discussions of biodiversity prospecting in the context of property rights, equity and utility; and suitable procedures and strategies for initiating biodiversity prospecting.

Recognizing the political considerations which have stalled agreement on the use of biodiversity, the authors provide numerous arguments detailing the advantages of biodiversity prospecting agreements. Developing countries may benefit from opportunities to participate in research activities, technology transfer, and the financial income to be derived from biotechnology products. Particular attention is paid to strategies which promote long term development goals, such as technology transfers and a percentage of royalties on biotechnology products. Without this approach, the authors argue, biodiversity prospecting runs the risk of becoming simply another resource extraction industry with few benefits for developing countries. The importance of established agreements is also noted for the developed world, which will benefit from a system that promotes conservation and ensures access to the natural diversity which has supplied 25% of the pharmaceuticals used today and made possible the immense gains in worldwide agricultural productivity of the post-war era.

Having argued their advantages, the authors then present a detailed analysis of the specific structures required for successful biodiversity prospecting agreements. The much cited INBio-Merck agreement is examined as a case study (several of the authors are INBio officials). The book also provides information on pharmaceutical companies, botanical gardens, and others involved in biodiversity prospecting; a sample prospecting agreement; and an examination of relevant laws, including a thorough discussion of the Convention on Biological Diversity. The discussion of laws relevant to biodiversity prospecting covers trade secrets, utility and petty patents, plant breeder's rights, trademarks, and copyright and should be of particular interest both to those formulating agreements and to those who wish to understand the ongoing debate between North and South over the meaning of the Convention on Biological Diversity.

While the authors do an admirable job of explaining the benefits and methods of biodiversity prospecting, I find their discussion of the impact and distribution of benefits to be incomplete. As they mention several times in passing, the total benefits to be gained from biodiversity prospecting agreements amount to no more than several hundred million dollars. In the face of estimated costs in the tens of billions of dollars for worldwide biodiversity protection, it is hard to see how these agreements will substantially change national policies toward protection of areas of high biodiversity or provide the important long-term national development gains indicated by the authors. In addition, their discussion of the desirability for many nations to actively pursue biotechnology industries fails to adequately address the impact this competition will have on the economic value of biodiversity. On another front, the book's lack of discussion of the distribution of benefits within developing nations is a glaring omission. The authors note, rightly, the importance of local/indigenous groups to any scheme for protecting areas of high biodiversity, but then fail to offer any realistic strategy for insuring that these groups benefit from biotechnology agreements. Repeated references to national governments as potential proxies for these groups ignores a well-established pattern of exploitation of marginal groups by elites in many developing countries.

The weaknesses of the book are, nonetheless, minor points in an otherwise excellent and comprehensive study of the structure of biodiversity prospecting and its place within the global effort to preserve biodiversity, equitably allocate its benefits, and spur development in the developing world. Portions of the book will appeal only to those directly involved in biodiversity prospecting. Because of the quality of writing and research on a variety of biodiversity issues this book is recommended to any interested in the fractious relations between the developing and developed worlds.

--Brad Auer

TRI NOTES

An **International Workshop on the genus *Dalbergia*** was held in Hetauda, Nepal from 31 May to 4 June 1993. *Dalbergia* researchers and practitioners shared information on the diversity of the genus; management and use of the different species; and the potential for genetic improvement of *Dalbergia sissoo*. Participants assessed current knowledge on various *Dalbergia* species and produced: 1) recommendations for further research on *Dalbergia* species, 2) a draft field manual on the use and production of *D. sissoo*, and 3) draft copies of Nitrogen Fixing Tree Highlights on *D. latifolia* and *D. melanoxylon*. The manual, highlights, and workshop proceedings will be available in 9 to 12 months. Contact: James Roshetko/Nitrogen Fixing TreeAssociation/1010 Holomua Road/Paia, Hawaii 96778/USA

Following the success of two previous courses, a third **course on fodder tree legumes** will be held in November/December 1994 in Queensland, Australia. This six-week course will provide a mix of lectures, field and farm visits, participant seminars and workshops. The objectives of the course are to inform particpants of the range

of fodder tree species available to agriculture, to review their environmental adaptions, and to examine their role in animal production, soil fertility improvement and erosion control. Emphasis will be placed on the multi-purpose nature of both exotic and native tree species. Please contact: Dr. Ross Gutteridge or Dr. Max Shelton/ Department of Agriculture/University of Queensland/ Queensland 4072/AUSTRALIA

BioResources '94, a conference aimed at speeding the successful management of biomass resources, will be held from 3-7 October 1994 in Bangalore, India. The conference will focus on future issues of environment and development, including energy, sustainability, and environment and health. For more information contact: LaRocco Associates/2 Erié Street/Montclair, NJ 07042/ USA

IUFRO and the Japan Society of Forest Planning are sponsoring the **IUFRO International Symposium on Growth and Yield of Tropical Forests**, to be held 27 September - 1 October 1994 in Fuchu, Tokyo, Japan. Participants of the Symposium will evaluate current knowledge and define research needs for tropical forests. Those interested in participating in the symposium or presenting a paper should contact: Dr. Yukichi Konohira/Tokya University of Agriculture and Technology/3-5-8 Saiwaicho Ruchu/Tokyo 183/JAPAN

A **short course on rural project planning** will be held in Canberra, Australia from 18 April - 27 May 1994. If you are interested, please contact the course co-ordinator/ANUTECH Pty Ltd/GPO Box 4/Canberra/ACT 2601/AUSTRALIA.

The International Symposium on Measuring and Monitoring Biodiversity in Tropical and Temperate Forests will be held in Chiang Mai, Thailand from 28 August - 3 September 1994. Please contact: Secretariat, Forest Biodiversity Symposium/ c/o Royal Forest Department/Silviculture Research Sub-Division/61 Paholyothin Road/Bangkok, THAILAND 10900

A **Conference on Resources and Environmental Monitoring** will run from 3-7 October 1994 in Rio de Janeiro, Brazil. Interested parties should contact: Roberto Pereira da Cunka/INPE/PO Box 515/12201 Sao Jose dos Campas/BRAZIL

Current Indian Forestry, Environment & Wildlife Abstracts. A new, comprehensive Indian forestry database, *CIFEWA*, provides abstracts of published Indian research in forestry, systematic botany, soil science, wildlife conservation, environment and ecology. Published quarterly, *CIFEWA* systematically compiles a considerable body of knowledge which was previously scattered and not readily accesible. Each issue includes roughly 300 abstracts, which include full details of title, author(s) and source. In addition to being grouped into 50 subject headings, they are indexed by author, habitat, subject, and species. Sources include 34 journals in addition to symposia and workshop proceedings. Subscription rates are US$50 (UK£30) for air mail and US$35 (UK£20) for surface mail. *CIFEWA* is published by Agrim Publishers, Anekant Place, 29 Rajpur Road, DEHRA DUN-248 001 INDIA.

LETTERS

To the editor:
I refer to the paper on p.23 of TRI NEWS, Vol.12, No.1 ["The determination of age and growth rate of four tree species in an evermoist forest in southwestern Sri Lanka," by Patrick Baker], more specifically to the site description. The manner in which the important Sinharaja forest was saved from destruction is not properly stated. The battle for this last remaining rainforest of some size in Sri Lanka started in 1972 and came to a successful conclusion in 1977 when newly elected President J.R.Jayewardene stopped any further logging. The designation as Man and Biosphere Reserve came later. Today the area is protected under the National Heritage Wilderness Areas Act administered by the Forest Department, and it is also a World Heritage Site.

T.W. Hoffman, Ceylon Bird Club
Colombo, Sri Lanka

We apologize for the oversight. Mr. Baker acknowledges the grass roots efforts which brought about the protection of the Sinharaja. He recognizes that its designation as a UNESCO Man and Biosphere Reserve was the culmination of a series of measures which will further ensure the protection of Sinharaja for generations to come. --Editors

To the director:
Recently I have returned from adventures in South and SE Asia, and just had a chance to peruse the TRI NEWS (Spring 1993) for the first time in several years. Congratulations on what you have obviously shaped into an active and very exciting program! I was most interested to read about the new Center for Human Ecology, Environment and Infectious Disease, and the diverse range of studies being undertaken by students. The journal reads very well, and has come a long way!

Betsy McGean
Yale F&ES, MES 1986

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TRI NEWS

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