

# TRI NEWS

Tropical Resources Institute

## Message From the Director

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It is with considerable excitement that I write my first message in the TRI News. Yale's Strategic Advisory Committee to the School of Forestry and Environmental Studies met this Fall. This group includes many of TRI's original supporters and mentors. The concern that this group of distinguished people have for TRI, the directness of their questions, and the strength of their support explains much of TRI's success since it began in 1983.

TRI, as part of the School and Yale University, is going through a major and critical process of strategic thinking. What is TRI's mission in the 1990's? What are its strategic goals? How many resources are required to meet this vision and where do we find them? Our faculty and students are considering these questions. So are our alumni and donors.

One strategic dimension is clear. TRI must remain a catalyst among organizations and individuals worldwide who share common interests and values concerning tropical resources. TRI News is especially directed at that audience. I'd like to hear from you, the readers. What are your answers to these strategic questions?

In the next issue, we will share our 1990-1991 version of our mission and strategy -- after we hear from you.

William R. Bentley

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## ***AN UPDATE ON THE NEPAL INSTITUTE OF FORESTRY PROJECT***

**Bob Clausi - Yale IOFP Home Office Manager**

**Mike Rechlin - IOFP Senior Advisor**

**Don Messerschmidt - IOFP Forestry/Research Specialist**

Yale's School of Forestry and Environmental Studies is now one-third of the way through the five year Nepal Institute of Forestry (IOF) Project. It is therefore an opportune time to review some of our accomplishments to date and to consider some of the opportunities that lie ahead.

The goal of this project, funded by the U.S. Agency for International Development (USAID), is to improve IOF's capability to meet Nepal's need for professionally trained natural resource managers. The project hopes to accomplish this goal by providing short-term and long-term training to the Institute's faculty and staff. Upgrading of the Institute's academic and administrative support facilities, improvement of the research conducted at the Institute, and encouragement of the formation of linkages between the Institute and complementary institutions in Nepal, Asia, and other parts of the world are also incorporated into the overall program goals. Finally, the project assists with the revision of the curriculum at the Institute so that it better supports the social forestry orientation of Nepal's Master Plan for the Forestry Sector. A more detailed description of the project is contained in the Fall 1989 issue of the TRI News (No. 7).

Progress has been made in each of the task areas listed above. Faculty and staff took part in a short-term training course on computer usage in early 1990. Other in-country and regional short-term training programs have been conducted over the past year and a half, and the first of the faculty long-term academic degree trainees began their studies at Asian universities in late 1990. The Institute's library holdings have been augmented, and major purchases of computers, laboratory equipment, and field supplies will begin in the near future. The IOF faculty and administrators have done substantial background work on the curriculum revision, which was the focus of a major workshop held at the Institute in late November, 1990.

The above are some of the "nuts and bolts" accomplishments of the project. The Institute of Forestry is developing in other ways as well. While less readily quantified, these quieter forms of institutional development represent the types of fundamental changes that the Institute of Forestry must experience if our current project is to have a lasting, positive effect. The rise of democracy in Nepal, the development of institutional expertise, and the linkages being forged with the larger forestry profession

are three of the most exciting examples of the evolutionary progress taking place at the Institute of Forestry.

Nepal's democratic revolution, which took place in early 1990, has had a profound effect on everything in the country. Before the revolution, decisions at the Institute of Forestry were made at the top by the Dean, who then passed his decrees down for implementation. This situation changed dramatically when the IOF's Dean resigned as part of the administrative shake-up that accompanied the revolution. The faculty elected one of their colleagues, Dr. I.C. Dutta, to serve as acting dean. Dr. Dutta has since been officially appointed the IOF's Dean and continues to involve the faculty and staff in the decision-making process at the Institute.

Faculty and staff participation in setting the policy at the IOF has resulted in their taking much greater responsibility for the direction in which the Institute is going. Their acceptance of this responsibility, and willingness to make hard decisions, is being demonstrated on a daily basis. For instance, at a recent meeting of the faculty and staff short-term training committee, the committee members had to decide on the allocation of training funds for the rest of the project. Cooperation and compromise were key to the committee's ability to make the hard choices of who will benefit today and who must wait until tomorrow. Dean Dutta capped this process of consensus by concurring with the committee's training and fund allocation plan.

A Social Forestry Systems Study Group (SFSSG), composed of seven faculty members, was formed last year in response to the project's goal of bringing social and community forestry more clearly to the forefront of the Institute's agenda. The members of the SFSSG have shown great initiative in attracting outside sources of funding and expert advice in support of efforts to accomplish this goal. The faculty has already conducted rapid rural appraisal research which includes a study of wood energy use in the Pokhara valley funded by UNDP/FAO/Khon Kaen University, and a FAO/SIDA-funded study of tree tenure in the southern part of Nepal. The SFSSG has secured seed money from the Nepal-Australia Forestry Project to identify a social forestry demonstration and research site near the main IOF campus. The most significant event has been the SFSSG's successful proposal to the Ford Foundation for a substantial grant to

support three years of community forestry management research using rapid rural appraisal techniques. The IOF has also gained wide recognition both at home and in international development circles for its expertise in the application of rapid rural appraisal techniques to the natural resources issues facing the country. The IOF has already been asked to provide rapid rural appraisal training to the staff of several donor agencies and NGOs in Nepal, which bodes well for the long-term success of this line of research at the Institute.

The Institute of Forestry is moving out of its provincial role and is establishing links with the larger natural resources conservation and development community in Nepal and beyond. The Institute is increasingly being approached by national and international organizations interested in forming closer ties, assisting with faculty research, and funding student visits to project sites. The faculty and staff of the IOF recently organized and conducted two workshops that attracted an international audience. IOF faculty are also being invited to attend a great many international workshops and symposia; in the past few months alone, members of the IOF faculty have participated in the International Union of Forestry Research Organizations Congress in Montreal, Canada--a conference presented by the International Association for the Study of Common Property Resources in North Carolina -- and the Second International Congress on

Ethnobiology in Kunming, China. The IOF delegation was particularly successful in Kunming, where the papers presented by faculty members Bhishma R. Subedi and Mohan K. Balla were judged to be among the top four papers submitted to the congress. (See papers listed below.)

The Yale School of Forestry and Environmental Studies is privileged to work with our colleagues at the Institute of Forestry in Nepal. During the balance of the IOF Project, Yale's technical assistance team based in Nepal and support team based in the U.S. will continue to facilitate the types of qualitative development described above as the Institute of Forestry moves toward a self-determined and self-sufficient future.

The two papers presented by IOF faculty members were:

1. Indigenous Knowledge of Tree and Forest Resources in the Eastern Nepal Terai. Subedi, B. P.; Das, C. L.; and Messerschmidt, D. A. 1990.
2. Wood Forestry Management and Knowledge in Pokhara Area, Western Nepal. Balla, M. K.; Chaudhary, S.; and Karkee, T. B., 1990.

Papers presented at the 2nd International Congress of Ethnobiology at Kunming, Yunnan, China, Oct., 1990 are available from IOF Project, Box 43, Pokhara, Nepal.



## ***BHUTAN: PLANS FOR NATIONWIDE CONSERVATION***

**Gordon T. Geballe, Assistant Dean and Director of Alumni Relations**  
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At the request of the World Wildlife Fund, the Yale School of Forestry and Environmental Studies (F&ES) has hosted three delegations of natural resource managers from Bhutan, a small country nestled in the eastern Himalayas and surrounded by Tibet in the north and India in the west, south and east. The government of Bhutan is undertaking a nation-wide campaign to educate all citizens on the need to protect the environment. Together with the World Wildlife Fund, the Royal Government of Bhutan has begun to plan conservation on a national scale before environmental problems associated with development become unmanageable.

Much of South Asia's distinct flora and fauna are found in the country of Bhutan. Bhutan's environment has remained intact in comparison with the environments of India and Nepal, but a growing population threatens wildlife habitats, and soil erosion, environmental degradation and deforestation are growing problems. To address these problems, Bhutan's government has advocated conservation plans based on new laws and new technologies that will lead to more efficient use of natural resources. Because the success of laws and technologies depend on highly trained, well-educated individuals, the Bhutanese government has made developing the education system a top priority.

The government hopes to incorporate an environmental education curriculum into every primary and secondary school in the country. Training for primary and secondary school teachers as well as government officials from the Departments of Education and Forestry have already begun. In addition, Bhutan's only degree-granting institution, Sherubtse College in Kanglung in Eastern Bhutan, has expressed interest in curriculum development.

In June 1990, Zangley Dukpa, Dean of Sherubtse College, and Neten Zangmo, Vice Principal of the Royal Bhutan Polytechnic, visited Yale. The purpose of this visit was to learn about university administration and curriculum development, discuss U.S. education models and techniques that tie the needs of industry and society with career development in academia, and establish linkages with U.S. institutions. In addition to observing various ongoing research projects at F&ES, discussions were conducted with Professor and Principle Investigator William Burch and Project Manager Bob Clausi concerning the

USAID/Yale Project at the Institute of Forestry in Nepal. Dukpa expressed interest in Yale assisting Sherubtse College with curriculum development that will raise the

awareness of all faculty and students and relate the importance of the environment to their disciplines.

In mid-July, Sherub Tenzin, Director of the Natural Resources Training Institute, stopped in New Haven as part of his joint Bhutan/FAO/Helvetas Mission on Training in Agriculture, Animal Husbandry and Forestry. The Bhutanese are very interested in having their current and future faculty visiting Yale for enrichment courses and degree programs. Tenzin also expressed interest in Yale faculty spending extended time in Bhutanese institutes.

The third visit was by a delegation of five Bhutanese: Jagar Dorji, Assistant Director for Curriculum Development of the Department of Education; Sangey Thinley, Director of Department of Forestry; Tirtha Mongar, Deputy Director for Wildlife in the Department of Forestry; Kesang Dukpa, Divisional Forest Officer; and Zangley Dukpa, Dean of Sherubtse College. Besides introducing the first-time visitors to Yale, Dean Dukpa, Director Dorji, William Burch, Bob Clausi and Mingma Sherpa of the World Wildlife Fund discussed a workshop that was presented at Sherubtse College in mid-November. Burch was a consultant to the organizers and visited Bhutan for two weeks at the time of the workshop.

## RESEARCH ACTIVITIES IN MADAGASCAR

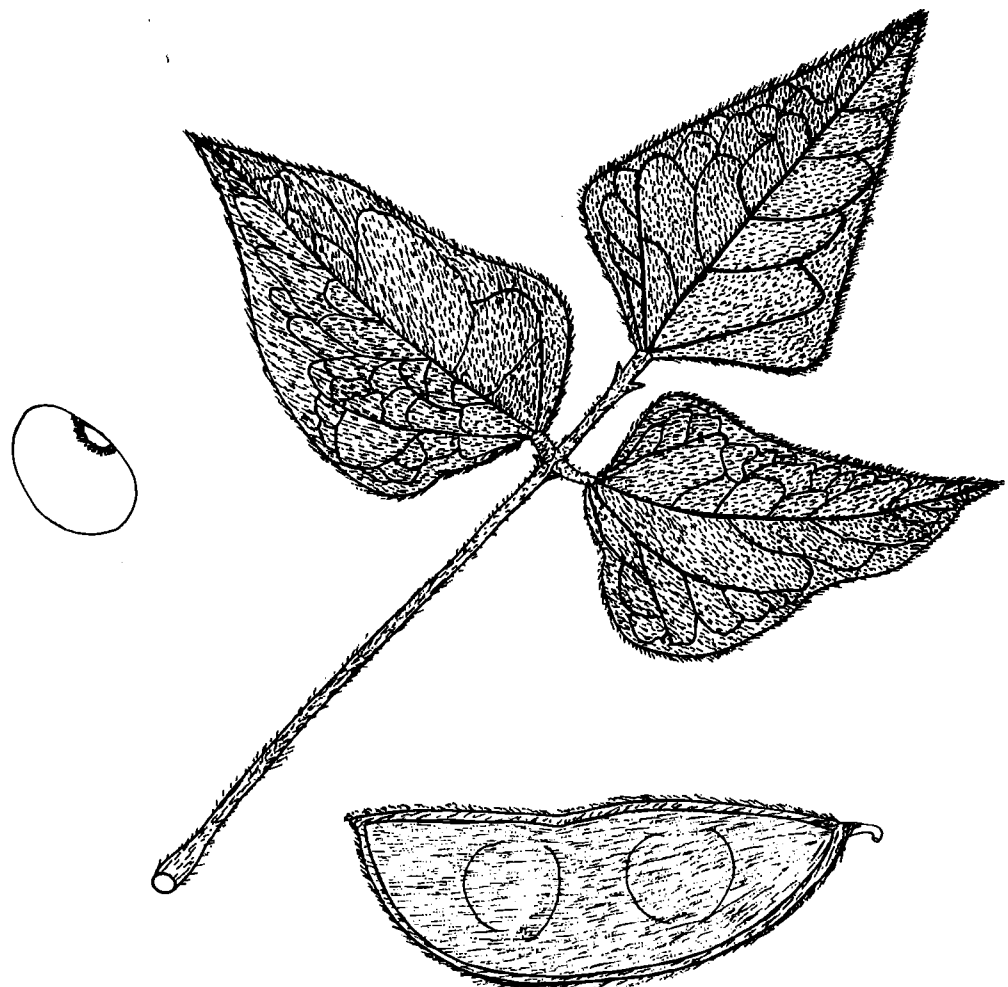
The Forestry School's activities in Madagascar, under the auspices of TRI, continued to expand in 1990. Activities are currently centered at the Beza Mahafaly Special Reserve in southwestern Madagascar, where the Beza Mahafaly project integrates conservation of a rare forest with economic development. Yale's involvement with the project dates from its inception when Dr. Alison Richard, chair of the Anthropology Department, and Dr. Robert Sussman of Washington University of St. Louis joined with researchers from the University of Madagascar to establish the special reserve. Funding has come from World Wildlife Fund (WWF) and USAID.

Dr. Richard, who becomes Director of the Peabody Museum in January of 1991, was appointed Professor of Environmental Studies at the Forestry School as of July 1, 1990. She spent six weeks at the project site this summer, where she participated in a workshop with faculty from the School of Agronomy at the University of Antananarivo, and continued her research on the demography and social dynamics of the rare lemur, *Propithecus verreauxi*.

Dr. Richard's arrival in Madagascar coincided with that of the two TRI interns, Peter and Robin Maille. She was able to introduce them to the project staff and villagers, and to help them get their projects underway. Funded by WWF, Peter and Robin will spend the next eleven months working with Malagasy collaborators on agroforestry and socio-forestry issues in the villages around the reserve.

In January, Russell Barbour, TRI visiting fellow and project agronomist, returned to Madagascar for four weeks to continue a vegetable production program for farmers in the reserve area and to look at land use in areas that adjoin the reserve. Informal work with *Tamerindus indica*, an important species in the gallery forest, was also completed. A report of this field work was submitted to WWF upon Mr. Barbour's return.

At a meeting on October 4, 1990, Dr. Richard, Mr. Barbour, and Dr. Bentley, the new Director of TRI, began to discuss plans for further involvement of TRI in Madagascar. These plans include the possibility of expanding the intern program and of bringing Malagasy faculty to the Forestry School to develop curriculum for programs at the School of Agronomy in Madagascar.



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# RESEARCH PROFILES

## ***CULTURAL SIGNIFICANCE OF THE PACIFIC FRUIT BAT AMONG THE CHAMORRO PEOPLE OF GUAM***

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### INTRODUCTION

Fruit bats of the Pacific region (*Pteropus* spp.) traditionally have been a highly valued food item among the Chamorros, the indigenous people of the Pacific island of Guam. Primarily as a result of over-hunting, Guam's fruit bat population was virtually extirpated by the 1960s, and the Chamorros began to seek bats from other islands in the region to fulfill their demand. An increasing number of *Pteropus* species and subspecies are now threatened with extinction as a result of this expanding market. To supplement ongoing local and international conservation efforts aimed at protecting Pacific fruit bats, I examined the demand for bats on Guam in the summer of 1990, through a study supported by TRI, World Wildlife Fund (U.S.), Bat Conservation International, and the Guam Division of Aquatic and Wildlife Resources. In doing so, I interviewed various Chamorro individuals and met with local officials, environmentalists, and educators to discuss this and other local environmental issues.

### BACKGROUND

The genus *Pteropus* consists of 57 species, most of which occur in the Pacific with extremely limited distribution. *Pteropus* has a low reproductive rate, and populations may be slow to recover from over-exploitation. They are also highly vulnerable to catastrophic events such as typhoons.

Fruit bats in general play an important ecological role as seed dispersers and pollinators. In the paleotropics, they are known to visit the fruits, flowers, and leaves of over 300 plant species, many of which have economic value for humans (Fujita, 1988). At least 453 products used by humans come from bat-visited plants, including beverages, wood, oils, dyes, medicinals, animal fodder, and fuel (Fujita, 1988).

Two species of fruit bats are indigenous to Guam: the Marianas fruit bat (*Pteropus mariannus mariannus*), and the little Marianas fruit bat (*Pteropus tokudae*), which is an endemic species. The latter has not been observed for more than twenty years, and is now considered to be extinct. Both *P. m. mariannus* and *P. tokudae* were included on Guam's Endangered Species List in 1981. *P. m. mariannus* was subsequently listed as "endangered"

under the U.S. Endangered Species Act in 1984. Prior to World War II, *Pteropus* was hunted on Guam by traditional means - - primarily using hand-held, long-handled hoop nets. The hunter, perched on a simple platform in a tall tree over which the colony was expected to pass en route to evening feeding roosts, swiped at bats with the net as they flew overhead. A helper stood below and picked stunned bats off the ground or removed them from the net. This labor-intensive hunting method was quickly replaced by firearms after the war, when guns were plentiful and easily available. Thus assisted by technology, the bat harvest grew and numbers declined.

By 1978, the estimated population of *Pteropus mariannus mariannus* had dropped to less than one hundred, despite a hunting ban enacted in 1973 (Wheeler and Aguon, 1978). As bats on Guam became less available, imports of species from other Pacific islands swelled through the 1970s and into the 1980s, reaching a high of 24,650 bats imported into Guam in 1980 (Wiles and Payne, 1986).

### PROJECT INITIATION

The purpose of my study was to assess current levels of demand for fruit bats on Guam, and to improve conservationists' understanding of the cultural and practical significance of fruit bats to Chamorros in order to develop conservation strategies that involve, and are supported by, the Chamorros. With the assistance of Dr. Stephen Kellert of the Yale School of Forestry and Environmental Studies, I designed a questionnaire that was administered by myself and a Chamorro assistant, Maria Santos Yatar, during July and August, 1990.

Guam is divided administratively into nineteen districts, or villages, each of which is run by a village mayor. Prior to surveying a village, I met with each mayor to explain my project and enlist their support for my work. With few exceptions, I found the mayors to be supportive. Some mayors who remembered the days when bats were plentiful on the island particularly enjoyed reminiscing about the animals. In fact, I often found that elder Chamorros were full of stories about hunting, watching, or even raising fruit bats, and talked of the animals with some nostalgia.

The target number of survey respondents per village was determined according to the percentage contribution of village Chamorro residents to island Chamorro residents. Northern and central villages, particularly around the capital city of Agana, contain a much larger percentage of non-Chamorro residents, while the more remote and sparsely populated southern villages are almost fully Chamorro. The data are not yet fully analyzed and should not be considered final, but preliminary results suggest some trends.

#### PRELIMINARY RESULTS

When asked how familiar they were with fruit bats, a majority of the respondents said they knew "a little" about the species. Often, however, that knowledge dealt more with culinary than with biological aspects of fruit bats. Nearly 80% of the respondents did not know how many young an individual fruit bat might bear. Approximately 70% believed that fruit bats sleep in caves and not, as is the case with *P. m. mariannus*, in trees.

Half of the respondents stated that they enjoyed eating fruit bats, yet about 85% of all respondents stated that they never eat them. One explanation for this apparent contradiction is the respondent's interpretation of "fanihi" (the Chamorro word for fruit bat used throughout the questionnaire). Many people, particularly older Chamorros, appeared to think in terms of the local bat *P. m. mariannus*, when asked if they like to eat fanihi. They might emphatically respond to that question in the

affirmative, yet later state that they had not actually eaten fanihi in five, ten, or even twenty years. Usually, the reason given was that imported bats were inferior to Guam's bats, i.e. they did not have the same taste or smell. In addition, *P. m. mariannus* is one of the largest bats in the region, providing more meat than many of the imported animals. About 50% of the respondents seemed to feel that eating fanihi was actually an important part of their Chamorro identity.

Sixty-six per cent of the respondents were aware that it is illegal to hunt fruit bats on Guam, and about 40% offered overhunting or poaching as the primary cause of decline in local bat populations. Other frequently suggested reasons for the decline included rampant development and predation by an introduced species of snake.

Some of the most heated comments from respondents came not with regard to fruit bats, but to the rapid development of Guam's remaining forest and coastline. Close to 80% felt that protecting the forest was at least as important as developing Guam further, if not more so. In conversation, Chamorros often expressed resentment over proliferating development projects, such as resorts, golf courses, and condominium complexes. Many of the Chamorros commented that these developments provide more benefits to tourists, foreigners, and other non-Chamorros, while the average Chamorro family finds it increasingly difficult to afford land for homes or farm plots.



## DISCUSSION

Currently, most residents of Guam--both Chamorro and non-Chamorro--have little environmental awareness. However, a grass-roots environmental movement is beginning to stir, stimulated by the threat of severe environmental destruction of the island's natural resources. Reef fishing, traditionally an important subsistence and, more recently, recreational activity, is threatened by heavy siltation of coral reefs. Recreational activity, primarily by tourists on jet skis, also appears to impact coral reef productivity. The water supply, consisting of a water lens under the northern half of the island, faces degradation and over-utilization as a result of numerous development projects. In addition, on an island with little recycling activity, the single landfill is nearly filled to capacity. Finally, at least 24 species of flora and fauna are considered threatened or endangered under U.S. and/or Guam listings. Most of these occur in the last pieces of undisturbed habitat remaining on the island: heavily restricted U.S. military land. Much of this land may be returned to private owners in the future.

As I continue to analyze the results of the survey and

additional anecdotal information I gathered, it becomes clear that long-term fruit bat conservation will not take place successfully without an emphasis on basic environmental education. Conservation of Pacific fruit bats, if approached as a single isolated issue, will not achieve the popular support it needs to succeed if the general public ignores other concerns.

## LITERATURE CITED:

Economic importance of bat/plant interactions in paleotropical regions. Fujita, M.S. Summary report to World Wildlife Fund-US, 1988.

The current status and distribution of the Marianas fruit bat on Guam. Wheeler, M.E., and C. Aguon. Aquatic and Wildlife Resources Division, Department of Agriculture, Guam, Technical Report No. 1, 1978.

The trade in fruit bats *Pteropus* spp. on Guam and other Pacific islands. Wiles, G.J., and N.H. Payne. *Biological Conservation* 38: 143-161, 1986.

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## ***BETWEEN THE CARIBBEAN COAST AND THE HIGH ANDEAN MOUNTAINS: COMMUNITY PARTICIPATION AND INTERDISCIPLINARY APPROACHES FOR NATURAL RESOURCES MANAGEMENT***

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### INTRODUCTION

In the summer of 1990, TRI and the John D. and Catherine T. MacArthur Foundation supported studies in Colombia and Puerto Rico, respectively. The Colombian study, conducted by Juan P. Ruiz, involved an examination of the relationship between the Cocuy National Park and the local peasants as well as the socioeconomic conditions in the conservation area. Soil erosion and its effect on agricultural productivity were a special focus. The Puerto Rico study, conducted by Fernando Silva, involved an examination of the historical and traditional land uses of the Cabezas de San Juan Natural Reserve, the management of the Reserve by the Puerto Rican Conservation Trust (PRCT), and the current and future impact of the Reserve on the local community of Cabezas. Emphasis was placed on the relationship between the community and the reserve before and after its purchase by the PRCT.

The intent here is to identify the common elements found in both experiences and their general application to natural resources management in the tropics.

### DESCRIPTION OF WORKING AREAS

#### **The Cocuy Region, Colombia**

Colombia, a South American country with a population of 26.5 million (Census 1985) and per capita income of US \$1,400 per year, is divided politically into Departments, which are further divided into municipalities. Currently, Colombia is experiencing large migrations from the populated Andes to urban areas as well as to the previously uninhabited tropical forested areas. According to the Colombian National Geographic Institute, over 50% of the mountainous countryside has eroded and poverty is causing the increased migration to the isolated forested



areas (Ocampo, 1987). Forty-six percent of Colombia is comprised of natural tropical forest (P.A.F.C., 1989) and is thought to contain almost 10% of the world's fauna and flora (Hernandez, 1984) yet the deforestation rate is higher than that of Brazil (Leyva, 1987).

The Cocuy region of Colombia, located in the Andes mountains, is an area from which steady migrations are taking place. Its total population is 129,736 (Census, 1985). In 1985, the rural population represented 79% of Cocuy's inhabitants, while the rural population in all of Colombia was 30% of the total population (Dane, 1986). Most of the study area is under peasant agricultural production. The production units are small: 70% of the land properties are 3 ha or less and 96.6% of the production units are under 20 ha. These occupy less than half (45%) of the surface of Cocuy region. The other 3.4% of the properties are from 20 to 100 ha and occupy 55% of the surface (González, 1987). Within this region lies the Cocuy National Park in the watershed highland, over 4,000 meters above sea level.

The Cocuy Project seeks to develop links between conservation, natural resource use, and economic growth. The goal is to stabilize the population in the area and to halt increased migration from the area. It will do this by trying to break the cycle of poverty and environmental degradation that forces people to move to new areas.

### **The Cabezas Region, Puerto Rico**

Puerto Rico is the smallest of the three Caribbean Great Antilles islands. The political division of the country is by municipalities, which are further divided into barrios and sectors. The study took place in the Cabezas de San Juan Natural Reserve located in Barrio Cabezas in the northeast corner of the island. The population of Barrio Cabezas is approximately 1,216 people (Census, 1980). The main local economic activities are fishing, tourism, and marine recreation.

The Cabezas de San Juan Natural Reserve represents many coastal and marine environments: mangrove ecosystems, natural coastal lagoons, evergreen coastal woodland, sandy and rocky shores, sea-grass beds, and coral reefs. The secondary vegetation and old coconut groves, which remain as indicators of past land uses, provide habitat to the coastal wildlife (Rivera, 1981). In the reserve area today, traditional land use practices maintain the historical relationship between a portion of the local population and their surrounding environment (Silva, 1990). Cabezas de San Juan was purchased by the Puerto Rico Conservation Trust (PRCT) in 1976. PRCT is a non-profit, non-governmental organization, dedicated to the purchase of important natural and historical sites

for conservation purposes. In 1984 the Department of Natural Resources of Puerto Rico (DNR) designated the area a Natural Reserve. The area of the reserve is 180 ha, 128 ha of which are the property of the PRCT. The PRCT property does not include the shore area, the mangrove, and the coastal lagoon and its channel. The management of this mangrove and lagoon is under the DNR.

The economy of Puerto Rico was transformed in the middle of this century from an agricultural economy to an industrial model of development. As a result, a strong internal and external migration of the population took place. The internal migration was oriented to the urban centers mostly in the coastal regions. Industry, urban development, and tourist infrastructure thus began to share the same space with degenerating sugar cane fields in the coastal valleys. The conservation of coastal areas became an important issue with regard to critical habitats for flora and fauna, development for tourism, and meeting the increasing demand for marine recreational activities.

The purchase of Cabezas de San Juan area by PRCT played an important role at a time when this land was selected for a multi-million dollar tourist and residential development which would have resulted in a complete modification of the land. Without PRCT intervention and designation of the area as a natural reserve, the environment would have been severely degraded and these natural resources would not be available for use by current and future generations.

The PRCT policy concerning the reserve area, however, has been characterized by total control of access (by private security personnel) to those without official authorization. Yet access to the Reserve and the use of old trails as short cuts is required in order to conduct many economic and cultural activities such as fishing, land crab catching, guided tours, religious and family meetings. As a result, conflicts have arisen over those areas inside the PRCT property between the PRCT representatives and fishermen within the local community.

The PRCT is now developing a plan for the Reserve that will include three program areas: research, public education and interpretation programs for visitors, and recreation. The lighthouse will provide research facilities, natural and lighthouse history exhibition areas, and a lookout on the rooftop. In addition, an integrated system of nature trails and a boardwalk will be built for individual and guided tours, including night tours to the bioluminescent lagoon.

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## DIFFERENCES AND SIMILARITIES BETWEEN THE REGIONS

There are distinct differences between land use in the Cabezas region of Puerto Rico and the Cocuy region of Colombia. The mountain slopes of the Cocuy region, are affected by years of intensive agricultural use. Human populations are decreasing in the area as a consequence of soil erosion and lack of water availability. Some areas inside the Cocuy National Park are also currently under strong human influence. In the Cabezas region, changes seen during the last 50 years are characterized by a significant recuperation of the land vegetation originally used for agriculture. This includes the reserve area which was once private land with such diverse uses as cattle and goat grazing, coconut plantations, and firewood. In addition, the population has grown, showing a higher urban concentration.

Local power distribution also differs between these regions. In the Cocuy region of Colombia, the political actors are the local governments and the national institute branches which reside over the "public issues" of education, police, water distribution, and infrastructure development. Peasant community organizations work on guild or brotherhood issues as well as local infrastructure development such as small roads and water channels. Radical guerrilla groups work for political dominance in upland areas and fight against the Colombian army for regional military domination. In addition, traditional political parties seek to conserve political power and benefits. The Catholic Church also has considerable clout and supports political parties.



In the Cabezas region of Puerto Rico, decisions concerning the use of the Cabezas de San Juan Natural Reserve are made in the forest division of DNR Headquarters in the Sanctuaries and Reserves Office in San Juan. At the PRCT Headquarters in San Juan, the Executive Director and members of the Board of Trustees have the authority to address decisions over PRCT properties. The Fishermen's Association of Croabas is a local organization which represents a fishermen's cooperative. The Association also deals with fishing rights.

In both regions, technologies in use (often in the form of know-how) are derived from outside sources. Multi-national agencies and banks have strong influence over political and social behavior and economic activities. International loans and investments are based on technological changes which do not take local ecological, social, and economic factors into account. These technologies are inappropriate for natural resource use and management in these regions as they do not come from local cultural frameworks and ecological conditions. In many developed countries, technology is a result of social change, so it reflects the character of the culture. In developing countries new technologies are in many ways an expression of northern hemispheric intervention. As a result, these countries lose ecological and socio-cultural diversity. Furthermore, these technologies cause increased polarization between the wealthy and the poor.

The governments of both regions treat natural resource conservation as a secondary issue. There is no national policy to incorporate natural resources conservation with the economic development. They fail to see a relationship among economic, social, and ecological aspects of the population's well being. In addition, these governments and the private sector manage conservation via police, guard or legislation. Coercion, rather than cooperation, is used for natural resources management.

Population growth in these regions results in more pressure over natural resources. While population migration is occurring in both countries, in Puerto Rico population migration is toward urban centers and the U.S., and in Colombia migration is toward urban centers, forests, the amazon basin, and neighboring countries.

## MUTUAL FINDINGS FOR NATURAL RESOURCE MANAGEMENT

All Natural Resource Management Plans (NRMPs) incorporate natural and social sciences. Interdisciplinary understanding is necessary between ecological, economic and social fields. Although emphasis on each field is different according to project goals and circumstances, an interdisciplinary approach is always a requirement.

In addition to requiring understanding among various fields, the management of natural resources entails managing diverse social values over limited resources. Community participation is important because the perceptions and ideology of the local community may be different from that of policy makers, managers, scientists, and academics.

It must be remembered that all communities consist of different groups with different interests, different understandings of reality, and different modes of action. NRMPs should identify social structure, groups of interest, natural resource perceptions and use, and power distribution. All are relevant issues for understanding the situation and making useful solutions.

Working with the community to identify links between natural landscape and socioeconomic changes is important. Landscape changes within a lifetime confront people with the reality that biophysical changes have a strong relationship with socioeconomic changes. A very good exercise in this diagnostic stage is to rebuild, with the participation of the local community, the historical landscape taking into consideration the socio-cultural and biophysical aspects. Photographic and any other graphic information is very useful.

Lastly, specific skills and strategies must be developed to achieve effective dissemination of information. Ongoing discussion among researchers and community groups as to each other's understanding of the project under consideration must be stressed, and all possible contributions in the definition of the problems, development of the project and the potential solutions must be given adequate consideration. This type of discussion may also be useful in pointing out different understandings of the problem at hand, and highlighting potential conflicts and possible ways to address them.

## CONCLUSIONS

When we think of natural resources management in human terms, NRMPs in the tropics face many similar problems. This is true not only because the goals are the same -- natural resource use and conservation with an aim to improving the quality of life -- but because of the role that poverty plays in the environmental dynamics. Similarities and differences must be understood and local perspectives and realities considered as we work to overcome some of the social, economic and ecological stresses on the tropics. We do not encourage homogenization. Approaches should vary and solutions should be based on power distribution. Finally, an international interdisciplinary approach is necessary if development of the tropics is to be sustainable.



As Professor Guhl of the National University of Colombia states, "natural resources use, management and conservation has its roots in a moral problem". Technical skills are necessary but not enough for solving natural resource management problems. We must try to work on man - nature relationships. To create a new paradigm, we need new "windows" through which we perceive new methods with better possibilities for finding solutions to contemporary problems.

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## ***STUDY FOR THE ESTABLISHMENT OF AN EXOTIC ANIMAL SPECIES CONTROL INSTITUTE***

**Peter Schuyler, MES Candidate**

Yale School of Forestry and Environmental Studies

Throughout the world, increasing loss of diversity of both plant and animal species as well as their natural habitats is an issue of concern to natural resource managers and planners. The causes for decline are as varied as the situations and species under threat. In recent years, there has been an increasing awareness of the issues and impacts caused by the presence of exotic or introduced animal species in both disturbed and undisturbed ecosystems. The term, "introduced animal species" (also known as exotic, non-native, feral or alien species), refers to a vertebrate or invertebrate species introduced through either accidental or deliberate means by humans and/or human related activities to ecosystems or environments outside of its historic range. Species, especially those capable of successful reproduction and survival in their new environment, may (although not always) cause significant harmful changes to the new ecosystem. Examples of introduced animal species include goats (*Capra hircus*), pigs (*Sus scrofa*), rabbits (*Oryctolagus cuniculus*), rats (*Rattus rattus*), starlings (*Sturnus vulgaris*), the brown tree snake (*Boiga irregularis*) and the Gypsy moth (*Lymantria dispar L.*).

Although natural resource managers recognize exotic or introduced animal species as an important factor in species extinctions and loss of habitat diversity, the challenge of addressing the problem usually has been localized and site specific. Many resource managers throughout the world (e.g. Australia, New Zealand, Hawaii, the Galapagos Islands and many parts of the

United States), are making progress in dealing with the biological as well as the social, economic, and political ramifications of introduced species. However, successful implementation of control programs or mitigation measures is often problematic and difficult to achieve.

As a result of ten years involvement with feral animal control programs on the California Channel Islands with The Nature Conservancy and numerous discussions with colleagues, I proposed a feasibility study for the establishment of an introduced animal species institute. This proposal was put forward to and consequently supported by The Nature Conservancy and TRI. The project was launched in June 1990 and is ongoing under the advisement of Dr. Stephen Kellert, Professor of Social Ecology at the Yale School of Forestry and Environmental Studies.

The goal of this study is to investigate the establishment of an interdisciplinary, multi-national introduced animal control center/institute to address the issues raised by the presence of introduced animals. The issues involving introduced animals require input and consideration from people not only in the scientific arena but in the social, political, and economic disciplines. The objectives of the study were to: specifically focus on establishing and better defining the scope of the introduced animal species problem, evaluate the status of current research and management alternatives, provide an analysis and enumeration of the potential goals of the proposed introduced animal species institute, and analyze logistic and adminis-

trative procedures required for the establishment of an institute. Consideration will also be given to utilizing and/or supporting existing groups and institutions rather than setting up a new center.

If established, the center would facilitate the gathering and dissemination of current information, the evaluation of alternative control techniques and mitigation measures, and the initiation of research and training programs.

The methods used to study the feasibility of establishing the institute were: written surveys, personal contact and visits to active program areas, and a review of current literature. A written survey was sent to approximately 875 people both in the United States (75%) and abroad (25%). Survey recipients included resource managers as well as people from other varied disciplines (e.g. academic researchers, animal rights activists) with an interest in introduced animal issues. Initial returns from the survey indicate it will be a difficult task to establish a common *a priori* perception of the issues. An examination of existing programs to determine common attributes (if any) may prove to be a more fruitful way to establish if there is a need for the creation of an introduced species institute.

Trips to the Channel Islands National Park and several of the Hawaiian National Parks and Nature Conservancy preserves provided a first hand opportunity to discuss the proposal and receive feedback. Additional useful information was also obtained by participation in a three day "feral animal brainstorming" session sponsored by the CS Fund, with participants from all parts of the United States, including animal rights activists, rare breed preservationists and members of international conservation groups.

Review of the literature is currently underway and is proving to be useful not only in documenting species introductions and control programs, but also in identifying researchers, managers and institutions that are actively involved with the issues. One of the most valuable potential functions of an introduced animal species institute would be to act as a clearing-house to provide information of past and current successes and failures. Knowledge of these efforts would serve to focus and refine new attempts in the mitigation of introduced animal species issues.

The feasibility continues to evolve as more information is gathered. Preliminary results and recommendations should be available by the end of calendar year 1990.

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## ***VEGETABLE PRODUCTION AS A MEANS OF INTENSIFYING AGRICULTURE IN AN ENVIRONMENTALLY SENSITIVE AREA***

**Russell C. Barbour, TRI Visiting Fellow**

As described in a previous article (TRI News No. 7 Fall 1989), the Yale School of Forestry and Environmental Studies is currently working at the Beza Mahafaly Special Reserve in Madagascar. A large part of the Beza Mahafaly reserve is situated on land that could be agriculturally productive. The reserve includes about one hundred hectares of gallery forest which rests mostly on a sandy loam soil that is high in organic matter and moisture. According to interviews with local farmers these soils are considered among the most agriculturally productive. An important part of this project has been the effort to compensate local farmers for the loss of lands that could have been converted to productive agricultural fields. The original participants, the University of Madagascar, Washington University in St. Louis, and the Department of Anthropology at Yale, have shown considerable foresight by looking beyond conservation goals and considering the well-being of the population surrounding the reserve. The World Wildlife Fund has supported this position by

funding the project.

In 1988 a small vegetable program was started. Unintentionally, the vegetable program has become one of the most visible parts of the project and is considered a useful activity by the local population according to an evaluation done in 1989. The project's original intent was to concentrate on maize production, but a series of problems with importation of suitable new genetic material caused by phyto-sanitary regulations has delayed its implementation. Originally the program was intended to determine if some vegetables could be grown locally, given the nearest produce market in the nearest large city, Tulear, is about five hundred miles away.

In 1989, vegetables from the program were marketed for the first time. At their own initiative,

farmers took carrots from a village near the reserve to sell at Tulear. The price received was not particularly good due to poor marketing strategies. However, the vegetables were not selected nor cleaned before sale. It is believed that with better preparation, a better price could be obtained.

Vegetable production had an additional number of setbacks and difficulties in this year. Attempts to grow sweet corn failed due to insect damage. Also, of three test plots of new onion types, the two at Beza Mahafaly were destroyed by unexpected flooding. The third field at another site was very productive and there was enough seed from this field for replanting in 1990. Additional onion seed was distributed at four locations, including seed to a women's group at Maisarivo. The success of some of the introduced vegetables, carrots, beets, and lettuce, and the surprisingly enthusiastic local response, in spite of early failures, has led to a rethinking of the program.

In 1990 seed for lettuce, beets, carrots, squash, watermelon, and cantaloupe were distributed to approximately seventy-five households. At the farmers' request, seed for cabbage was again provided, although past attempts to grow cabbage had failed. Farmers wanted to try growing it at several new locations during the wet season.

For the first time, seed for two staple crops, lima beans and a dual purpose bean that is similar to the local dried "Tamaraso" bean, were introduced. Both of these are genetically stable crops with seed that can be saved from year to year. In theory, they are both shorter season varieties than those presently grown and should reduce the risk of yield losses due to damage by drought.

Guides for the new growing techniques for the vegetables were distributed along with the new seeds as an alternative to traditional growing methods. Local Mahafaly terms were used. Farmers could use the methods they thought would be best.

Local farmers have not been passive recipients of this program. They seem to enjoy experimenting with new crops such as sweet corn and cabbage. Successes to date are due to their persistence in replanting and changing location or densities to suit the local conditions. For example, in 1989, replanting after the original seeding failed resulted in a good crop of snow peas. Local farmers have also experimented with the timing of plantings. In 1990, several farmers expressed disagreement with the recommended planting densities for the two new bean crops, and will surely

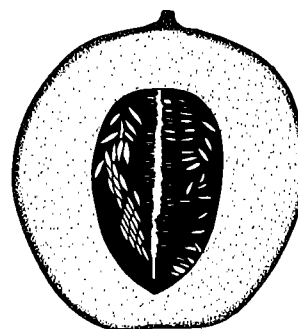
experiment with seeding rates. These are encouraging signs and indications of the interest in change in the local community.

An extension of the vegetable program has been approved by WWF. The project will renew seed stock on a scheduled basis. We hope to place an emphasis on nitrogen fixing legumes, although we have not studied local legume seed availability. Drawing on experience in the Sahel, bean crops are generally less drought tolerant than either cereals or root crops, and seed viability of beans declines rapidly with age. Thus, a regular local source of hardier seed would help to encourage intercropping of improvement, further stabilizing agricultural fields and ultimately reducing pressure for new land. In addition, beans have good commercial value and if surpluses are generated, they will be a source of cash.

Other vegetables like melons and cabbage that have been introduced by the project must be viewed as amenities, (melons, lettuce, etc.) with little commercial or nutritional value. The popularity of these programs with the villagers means that seed will be provided for these crops to maintain good community relations.

In the future, we hope that local Malagasy seed sources may be found. Presently, local vegetable seed is developed mostly for the cooler, wetter high plateau and lack the assurance that no plant diseases will be introduced. So far the project has used only imported seed that is certified free of pathogens. Although there is some question of sustainability, this is justified by the extremely low cost, approximately \$3.40 per participating household, and the concept of compensating local farmers for lost land.

In the next year, we will be examining the impact of vegetable production in terms of nutrition, household income, and ways to incorporate it into agroforestry systems.



## **PROVIDING PLANNING ALTERNATIVES FOR PUNTA BALLENA, GUANICA, PUERTO RICO**

**Christopher T. Rogers, MFS Candidate**  
Yale School of Forestry and Environmental Studies

A summer research grant took me to Guanica, Puerto Rico, to conduct a natural history inventory for Punta Ballena, a 160 acre peninsula that was recently threatened by plans for hotel development. The results of the study will be used to prepare an environmental and social impact assessment of the site for the Puerto Rico Conservation Foundation.

Punta Ballena contains a number of distinct ecosystems, including: sandy beach and dune associations, mangroves, salt flats, coral reef, limestone rock-plate forest, and an abandoned coconut plantation. The sandy beach extends for nearly a mile along the western end of Bahía de la Ballena, culminating in a narrow peninsula whose form and dimension shift with seasonal tidal changes. Although buffered from constant wave action by an offshore coral reef, the peninsula and beach are prone to flooding and erosion by annual tropical storms. Directly west of the point are several mangrove island cays that form a calm-water bay filled with extensive sea-grass beds. Between the point and the mangrove cays is a narrow, yet deep passage that allows artisanal fishermen a safe and easy access between the inner bay and productive fishing grounds found at the coral reef and in Bahía Ballena.

Although the property is privately owned, fishermen, land-crab trappers, and others dependent on the site for small-scale economic activities have always considered it a part of the adjacent Guanica Commonwealth Forest and Biosphere Reserve (UNESCO), that allows fishing and trapping, and does not limit public access. Punta Ballena is extremely popular among local and regional surfers, swimmers, picnickers and campers year-round. It is just one of Guanica's spectacular beaches that attract an estimated 30,000 people per summer month.

It came then as a shock when plans were unveiled for construction of an exclusive resort that would disrupt current patterns of human use, threaten the health of the fishing industry, and affect the survivability of endangered, threatened or endemic species found on the property. With help from Comité Pro Rescate de Guanica, a local grass-roots organization, a suit was filed by local fishermen against the Puerto Rican Planning Board, who had approved the project. The fishermen were able to prove that the Planning Board had violated their own regulations by not requiring a comprehensive

environmental impact assessment. Although Club Med threatened to appeal the decision, growing community disdain for the project forced them to formally withdraw their proposal in August of this year. The property is still for sale and interest has been expressed by both environmental organizations and development companies. My personal interests in environmental planning, in which human communities and local economies are considered in the balance between conservation and development, made this a perfect opportunity to initiate creative problem-solving.

Small towns like Guanica have suffered as the nation has abandoned its agriculture-based economy to one based largely on industrial production. A recent study revealed that Guanica suffers from a higher rate of unemployment, and higher levels of crime and drug abuse than any other town of comparable size in the southwest. The Puerto Rican government feels that development of large-scale tourism, designed to attract foreign vacationers, is the best solution for easing current economic conditions and the resultant social ills in Guanica and other depressed rural areas.

Because the site provides seasonal or year-round habitat to a large number of endemic, endangered or threatened animal species, and is literally imbedded in the western portion of the internationally-recognized Guanica State forest, there is a great deal of interest from environmental organizations to identify and estimate the environmental impacts of tourism development based on the government's model.

In my analysis, I propose probable development alternatives within a complete range of tourism and recreation-based planning and estimate the ecological, social and economic impacts of each. I have chosen four development models within that range: large hotel or resort complex, small-scale country inn modeled after the Puerto Rican Parador system, the development and promotion of nature-based recreation centered around the Guanica Biosphere Reserve, and a no-action alternative where use of the site remains unplanned and unmanaged. Estimation of the impacts of each alternative depends on a thorough inventory of the site's natural history. This includes biophysical, social, cultural, and economic features.

The collection of biophysical data took place during my twelve-week summer stay. Data was gathered from prior ecological research sponsored by private, commonwealth or federal agencies, and via site visits with island specialists or forest employees. Specific features addressed were soils and geology, water resources, plant associations, particular fauna (especially noteworthy, endangered or threatened species), and the surrounding marine environment. An inventory of sociocultural features include human settlement and use patterns beginning with pre-Columbian peoples and following through to present use by outdoor recreationalists and fishermen. Information was gathered by systematic user-surveys, through interviews with local residents, and through a literature review of local history. Economic information will be gathered from U.S. Census Data, statistics published by the Tourism Company of Puerto Rico, and from other information centers in the Caribbean.

Based on the natural history inventory, each alternative will be measured on its ability to sustain the local to the most people, and to provide the best protection to

the natural resource base. A preferred option will be recommended on these criteria.

A final document will be published as a working paper by the Tropical Resources Institute at Yale University's School of Forestry and Environmental Studies. This document will serve as one basis for a continuing discussion about the future of the site by residents, scientists, community leaders, and conservation organizations as they seek a means for land-use planning that balances development interests and ensures conservation of Puerto Rico's natural wealth.

#### ACKNOWLEDGEMENTS

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A.U.V.S



# TRI NOTES

## INTERNSHIPS

TRI has received a \$400,000 endowment from an anonymous donor for tropical studies. This gift will provide about \$20,000 a year to support what many students and faculty believe to be the most exciting part of the Yale experience. With matching funds from other donors, employers and the students themselves, this endowment leverages \$40,000 to \$60,000 a year in

funding for internships

A variety of other sources for internship funding are being explored as well. The outlook for the TRI Internship Program for 1991 is excellent, given the diverse distribution of funds to other TRI activities.

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## COOPERATOR NOTES

### COLLABORATION WITH WINROCK INTERNATIONAL

TRI and the School have established a collaborative relationship with Winrock International Institute for Agricultural Development. Work with Winrock has been on going for several years, including several activities in support of agroforestry and social forestry research and development in Asia. The recent Handbook on Management of Agroforestry Research, by John C. Gordon and William Bentley, is an example of this collaboration. William Burch and the TRI staff issued a major study on social sciences in Asian forestry curricula, and he and Kathy Parker have a book in press on the social sciences in agroforestry research.

Under the current collaboration, William Bentley is serving as the TRI director for 1990-1991. He is also teaching two classes, "Forestry, the Environment and Development," and "Economics of Forest Policy and Management Decisions." A number of additional research and service activities are being explored, including a cooperative research agreement on "Forests as Development Assets." TRI is collaborator on a Winrock proposal to the Rockefeller Foundation to add forestry to its Indian Natural Resource Economics Program.

### SANDALWOOD SYMPOSIUM HELD AT THE EAST-WEST CENTER

A two day symposium on Sandalwood (*Santalum spp.*) in the Pacific was held in April 1990 at the East-West Center in Honolulu, Hawaii. It was planned by locals Larry Hamilton, Jim Chamberlain (MFS '86) and Robert Merriam. The symposium was sponsored by the National Tropical Botanical Gardens, the East-West Center, the Hawaii Society of American Foresters, and with the collaboration of the U.S. Forest Service Institute of Pacific Island Forestry. The goal of the symposium was to bring together experts on Sandalwood and provide a forum for the exchange of information concerning this interesting genus in Hawaii and the Pacific. A specific objective of the symposium

was the production of a manual which will provide detailed information on such topics as history, current distribution, ecology, propagation, management and utilization of various species of Sandalwood.

Participating were representatives from India, Nepal, Australia, Vanuatu, Papua New Guinea, and Hawaii. Copies of the papers are available. To order, write Larry Hamilton, East-West Center, Environment and Policy Institute, 1777 East-West Rd., Honolulu, HI 96848 or Gene Conrad, Institute of Pacific Island Forestry, 1151 Punchbowl, Honolulu, HI 96813.

## LITERATURE

Noted below are selected, recent additions to the TRI bibliographic database. Searches and printouts of the database will be available on demand. We can also provide copies of some items. We would welcome any papers or reports you could send for inclusion in this database. These publications will be listed in the next issue of *TRI News*. If you do not have publications to send, please mail us citations of publications you judge to have special importance to tropical resources management.

### AIR, WATER, LAND

**Emissions from burning biofuels in metal cookstoves.** Joshi, V.; and others. *Environmental management*, 13(6):763-772, 1989.

**Environmental and economic implications of rising sea level and subsiding deltas: the Nile and Bengal examples.** Milliman, J. D.; and others. *Ambio*, 18(6):340-345, 1989.

**Patterns of stream channel response to urbanization in the humid tropics and their implications for land use planning.** Ebisemiju, F. *S. Applied geography*, 9(4):273-286, 1989.

**Hydrocarbon weathering and biodegradation in a tropical estuarine system.** Oudot, J.; Dutrieux, E. *Marine Environmental Research*, 27 (3-4):195-214, 1989.

**Reality, harmony and environmental planning in developing countries: a review of recent developments in Nigeria.** Faniran, A. *Third World Planning Review*, 20(2): 1989.

**The evaluation of environmental quality for planning in the 3rd World: a multidimensional scaling approach and a case study of Ibadan, Nigeria.** Chokor, B. A. *Third World planning review*, 20(2): 1989.

**The environmental sustainability of development: coordination, incentives and political will in land use planning for the Jakarta metropolis.** Douglass, M. *Third World planning review*, 20(2): 1989.

**Predicting minimum achievable soil loss in developing countries.** Phillips, J. D. *Applied geography*, 9(4):219-236, 1989.

**Cumulative impact and sequential geographical analysis as tools for land use planning: a case study (Laguna La Reina, Miranda State, Venezuela)** Sebastiani, M.; and others. *Journal of Environmental Management*, 29(3):237-2248, 1989.

### PLANTS, ANIMALS, TREES

**Soil macrofauna and land management in Peruvian Amazonia.** Lavelle, P.; Pashanasi, B. *Pedobiologia*, 33(5):283-292, 1989.

**Recipes for fish with rice.** Durno, J. *New Scientist*, 124:47-49 November 18, 1989.

Tropical farmers who cannot afford pesticides are finding that fish thrive in their uncontaminated rice fields and improve the harvest.

**The Green Revolution revisited.** Andrews, K. L.; ed. *Tropical pest management*, 35(3):227-272, 1989. Nine papers from a symposium.

**The influence of drought on tropical rainforest vegetation in Papua New Guinea.** Johns, R. J. *Mountain research and development*, 9(3) :248-251, 1989.

**Woodfuel situation and deforestation in Zambia.** Kalapula, E. S. *Ambio*, 18(5):293-294, 1989.

**Amazonia: deforestation and its possible effects.** Leopoldo, P. R.; ed. *Interciencia*, 14(6):283-340, 1989.

Seven papers on these topics: agricultural development, cause-and-effect, ethnodevelopment and geopolitics; colonization along the Transamazonia highway; use of Amazonian floodplain; secondary forest dynamics following logging; zero-input alternative to shifting cultivation.

**Seasonal patterns in a tropical lowland forest.** Boinski, S.; Fowler, N. L. *Biotropica*, 21(3):223-233, 1989.

**Elephants and the ivory tower.** Armstrong, S.; Br- idgland, F. *New Scientist*, 123:37-41 August 26, 1989.

A growing number of people think that a ban on the ivory trade would lead to the end of the elephant.

**The future of animal wildlife and its habitat in Botswana.** Mordi, A. R. *Environmental conservation*, 16(2):147-156, 1989.

**Numerical integration of daily growth increments: an efficient means of ageing tropical fishes for stock assessment.** Ralston, S.; Williams, H. A. *Fishery bulletin*, 87(1):1-16, 1989.

**Mammal species richness and relative abundance of small mammals in subtropical wet forest of Central America.** Rabinowitz, A.; Nottingham, B. G., Jr. *Mammalia*, 53(2):217-226, 1989.

**A pest is a pest is a pest: the dilemma of neotropical leaf-cutting ants: keystone taxa of natural ecosystems.** Fowler, H. G. *Environmental management*, 13(6):671-676, 1989.

**Biofuel vs. fossil fuel economics in developing countries: how green is the pasture?** Gowen, M. S. *Energy policy*, 17(5):471-484, 1989.

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**Man and forests: a case study from the dry tropics of India.** Singh, V. P.; Singh, J. S. *Environmental conservation*, 16(2):129-136, 1989.

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**Relocation of tribals from tiger reserves: policies and principles of rehabilitation.** Alexander, K. C.; and others. *Journal of rural development*, 8(5):441-456, 1989.

**The Indonesian log export ban: an estimation of foregone export earnings.** Lindsay, H. *Bulletin of Indonesian economic studies*, 25(2):111-124, 1989.

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