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Mountain Protected Areas

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Dedicated to the Protection, Preservation and Management
of Cultural and Natural Parks and Reserves
Through Research and Education

The George Wright Society

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On the Cover: The Páramo de Guamaní, between the Cayambe and the Antisana volcanoes on the Ecuadorian continental divide, Napo province. Photo: Fausto Sarmiento, July 1997.

Letter to the Editor: American Indian Religious Practice on Federal Lands

Dear Editors:

I am deeply disturbed by an article in one of the latest issues of THE GEORGE WRIGHT FORUM [Volume 13, Number 4, 1996] by Frank Buono entitled "American Indian Private Religious Preserves on Public Lands: The Legal Issues." This article presents Frank Buono's personal conclusions regarding how the National Park Service and other federal land-managing agencies should respond to requests by American Indian religious practitioners to accommodate their need to carry out their religious traditions.

I want to make it absolutely clear that Mr. Buono's views do not in any way represent the views or policies of the National Park Service.

In this article, park managers are led to conclude that there is little, if anything, that can be done to accommodate the needs of American Indian religious practitioners without violating the establishment clause of the First Amendment and inviting negative court actions—what Frank Buono would call "stinging rebukes."

Nothing could be further from the truth. Generations of Americans—Catholics, Protestants, Buddhists, and American Indians—have worshipped in national parks, and generations more will continue to do so.

The real question that Frank Buono skirts is "Does the National Park Service have any special responsibility to American Indian tribes and American Indian religious practitioners to accommodate their religious practices on lands that we manage?" The answer clearly is, "Yes."

American Indian tribes are sovereign nations within the United States that have retained all rights that have never been expressly extinguished. The recognition of the sovereignty of Indian tribes predates the Constitution and has been upheld by United States courts since the early 19th century. Tribal sovereignty is the basis of the government-to-government relationship, reaffirmed by President Clinton's Executive Memorandum of April 29, 1994. Carrying out activities on a government-to-government basis is a special responsibility that the National Park Service has toward Indian tribal governments.

Most of us know that Indian sacred sites are often natural features in the landscape, or are structures or ruins, "vanishing treasures" built by Indian people long ago. These places have often been designated as national parks be-

cause of the extraordinary, evocative responses that people have to them. Thus, we in the National Park Service are stewards of places sacred to the American people, but also, and prior to that, sacred to Indian people.

American Indians were stewards of these sites before us. The continuation of their cultural traditions may in many cases depend on our ability to accommodate their practices in these sacred places. We must appreciate that and remember our trust responsibility to those who came before.

Executive Order 13007 on Indian Sacred Sites, signed by President Clinton on May 24, 1996, directs federal land managers to accommodate access to and ceremonial use of sacred sites on federal lands by Indian religious practitioners, and to avoid adversely affecting the physical integrity of Indian sacred sites.

The Executive Order requires that federal land managers take positive actions to accommodate the needs of Indian religious practitioners; examine current policies, procedures, and regulations to identify impediments to accommodation of religious practices; and develop procedures to notify tribal governments of any proposed changes that might limit accommodation of religious practices on sacred sites or might adversely affect the physical integrity of sacred sites. The Executive Order provides strong direction to the National Park Service and to all federal agencies to make the very accommodations that Frank Buono implies cannot be made. Finding an appropriate level of accommodation is what we are attempting at Devils Tower.

I urge park managers to think creatively and positively about how the religious needs of American Indian people can be met in national park units and to rely on orders from our president and the advice of our solicitors, not on the views in this article.

John E. Cook
Director, NPS Intermountain Region
Denver, Colorado

1997 GWS Conference Proceedings Now Available...

Over 100 papers from this spring's Albuquerque conference are now available in *Making Protection Work: Proceedings of the Ninth Conference on Research and Resource Management in Parks and on Public Lands.* The 493-page softbound volume, edited by David Harmon, contains a large selection of papers given in the concurrent sessions as well as some based on poster presentations. The complete table of contents is on the GWS Web site at:

http://www.portup.com/~gws/newpubs.html

with links from there to an on-line order form. Or drop us an note at *gws@mail.portup.com* and we can e-mail you the contents. The cost is $18.00 ($13.50 for GWS members), plus a $2.00 flat rate for shipping up to four copies anywhere in North America. For shipping costs for multiple copies or

for shipping to addresses outside North America, contact us at P.O. Box 65, Hancock, MI 49930-0065 USA; 906-487-9722; fax 906-487-9405.

... And Save These Dates for the 1999 GWS Conference

The 10th Conference will be March 22-26, 1999, in Asheville, North Carolina, at the Holiday Inn Sun Spree Resort. Join us for a week in the heart of the beautiful Blue Ridge Mountains! We will take advantage of the many outstanding parks and historic sites nearby, including the Blue Ridge Parkway, the Biltmore estate, and Great Smoky Mountains National Park. A Call for Papers will be issued in June 1998, so begin making your plans!

Re-announcing the Conference "Wilderness Science in a Time of Change"

Since the first National Wilderness Research Conference in 1985, interest in wilderness has increased, international and societal definitions of wilderness have evolved, and wilderness science has improved. This conference will present research results and synthesize knowledge and its management implications. This conference should result in a state-of-the-art understanding of wilderness-related research. It will also improve our understanding of how research can contribute to the protection of wilderness in the 21st century. Considerable attention will be devoted to the ever-changing role of wilderness in society, and the need to better integrate diverse social and biophysical sciences. Plenary sessions at this conference will explore:

- The values of the transactions between science and wilderness.
- The need to more precisely define what wilderness is, so that the scientific process can be more effectively applied to wilderness management.
- The implications of changing societal definitions of wilderness, increasing technological development, and external pressures. Concurrent sessions will strive to allow specialists within subdisciplines to focus on cutting-edge issues and provide opportunities for participants with diverse specialties to share their perspectives on broad interdisciplinary questions.

Please anticipate a call for papers and further information later this year. Conference proceedings will be published. For more information about this conference, please contact: Natural Resource Management Division, Center for Continuing Education, The University of Montana, Missoula, MT 59812 USA, 406-243-4623, 888-254-2544 (toll-free), or ckelly@selway.umt.edu (e-mail). *[Note that the dates given above represent a change from the previous conference announcement.]*

John J. Reynolds
Christine Schonewald

Box 65: Commentary from the GWS Office and Our Members

Protected Areas, Science, and the 21st Century

This essay was presented by John J. Reynolds at the Third International Conference of Science and the Management of Protected Areas (SAMPA III), Calgary, Alberta, Canada, May 1997. It will appear in the SAMPA III proceedings, due to be published in early 1998. For information on the proceedings, contact Neil Munro at neil_munro@pch.gc.ca.

Universally, parks and other protected areas intend to protect a valued condition of natural and societal processes. This challenge "to protect" exists within the continuously evolving context of dynamic societal cultures in which human demands for resources and space become competitive. In our attempts to learn how to protect effectively, we sometimes find that by drawing on common threads, across sites, we can obtain generalized insights on function and management.

Perhaps the most important common insight is the bonding of citizens to their trust—an emotional and personally valued relationship between people and the areas to be protected. The writers of the 1916 U.S. National Park Service Organic Act helped us greatly, especially Frederick Law Olmsted, Jr. Olmsted was a man of community who understood both viscerally and intellectually that in a society those things that last longest are those most valued by the citizens who compose that society.

Another common insight is that protected areas generate ecological and social contrasts that in turn result in more societal and ecological change associated with protection. These changes spread and take any direction. They spread internally and externally, sometimes across entire regions, following simple paths of least resistance from stressed points to less stressed ones.

Much needs to be learned.

One source to consider is the experience gained from applying the NPS Organic Act in a variety of vastly differing ecological and societal settings. For years, many have discussed the double mandate of the national parks, which is "to conserve the scenery and natural and historic objects and the wild life therein, and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The two mandates—"conserve" and "enjoy"—are often interpreted as being in conflict. Consequently, over

time, the NPS has shifted its interpretations in attempts to accomplish its stewardship *properly*. The NPS is reentering a time when the value of duality is apparent. One mandate cannot be achieved without the other. Responsible stewardship requires paying full and complementary attention to ethical, aesthetic, biological, and societal cultural values in balance at all times, thereby bonding the components inseparably.

The Organic Act of 1916 demands that contemporary citizens provide a similar enjoyment for their descendants, without compromise to deterioration. The NPS is assigned the job of *steward,* specifically charged with setting the limits on what constitutes "enjoyment" and determining what "conserve" entails in the context of enjoyment. As such, the law rejects the option of permanent damage. In fact, the second (and last) amendment to the 1916 act expressly forbids derogation of resources unless specifically approved by the Congress.

The mandate set down in the act fortunately accommodated the future of our parks in additional ways. It anticipated the challenge *to protect* would be responded to by dynamic but stressed social forces that would make increasing demands for resources and space. Combined dual objectives may be a key that saves parks from erosive pressures, such as those resulting from losses of legislative and sustained societal support. That key benefit, when available during times of controversy, manifests itself in systemwide authority, in funding, and in the ability of individual sites to work towards agency goals.

The value and satisfaction gained by a society from its protected areas needs to be felt locally, not just remotely. Otherwise, park qualities inevitably erode or deteriorate because the *costs* of protection become overwhelming. Just as we are able to assert that without societal appreciation of protected areas, there would be no protected areas. It is also important to recognize that the interaction of society and protected areas has a local and very powerful interface.

Building on the field experience of managers worldwide, scientists have proposed that it is the paradigm of a managed "diffusion filter," and not so much an "island," that is the most effective descriptor of park function. Protected areas are not so much independent entities, spatially, ecologically, socially, or temporally, as they are interacting parts of larger ecosystems and societal influences. The boundary filter was proposed to describe the interactive processes associated with protected areas.

The administrative jurisdictional boundary acts as the major filter and passageway *into* and *out of* the park, in all three dimensions plus time. The jurisdictional (or administrative) boundary regulates the capacity of the park to protect and manage its charge, sometimes dramatically. For instance: *what* changes occur, *where* the changes occur, and *how* debilitating, *how* dramatic, and *how* quickly

the system responds to change.

The jurisdictional or administrative boundary of the protected area has always been complex due to internal land holdings, grazing, mines, concessions, road networks, and more. In the last few decades the complexity has increased. Just as before, neighbors can be physically located inside protected areas and protected areas can have numerous neighbors. Worldwide, more and more protected areas have uses inside and adjacent to their boundaries which directly affect resource protection. For example, over 50,000 people live and work inside the crater at Ajo National Park, Japan.

In Poland, many protected areas are surrounded by multiple-use areas managed specifically to reduce adjacency impacts. At Santa Monica Mountains National Recreation Area in the USA, about one-third of the land within the boundary is intended to be left in private ownership. Unless land holdings and authorities are complex, the administrative and jurisdictional boundaries are "one feature."

However, it is imprudent to expect ecological boundaries to be entirely or even barely superimposed directly on their surveyed boundaries. Edges generated by conservation activity and habitat protection extend both to the inside and beyond the protected area's boundary (i.e., inwardly or outwardly).

For example, the spread of elk, bison, and wolf populations surrounding Yellowstone generates a moving "species edge" that migrates across the park boundary. In cooperative settings where a protected area includes parcels that are not under its jurisdiction, jurisdictional and administrative boundaries may be different. The two worlds have different implications: they coincide in simpler protected area designs (one ownership and one boundary). In more complex settings the jurisdictional boundary is the limit of authority. Its rules set down the limits and preferences for human activity on either side of the boundary. On the other hand, the administrative boundary may be a larger set of properties, jurisdictions, and values.

If a boundary has influence on protection and management, it is likely to generate edges or gradients that are both ecological and societal. However, they are not necessarily going to be noticed other than where the differences between uses (or management) inside and outside are obvious. Such gradients can include a huge variety of changes, and work in both directions. Examples include weed seeds blown in, polluted air, wild animals ranging out, and so on.

Unintended boundaries can occur as well, as demonstrated by the effects of the transportation corridor in Banff and Jasper national parks or the water diversion systems of the Everglades. Whether or not these changes (generated edges) are noticed depends on how finely tuned the protected area's monitoring program is to the boundary processes manifested on both sides of this interface.

Protection mandates establish another societal gradient, *one of values,* in which societal values generate social and physical changes in the region. The boundary effects that we observe are influenced by societal, especially political, commitments to protection. At Grand Canyon National Park the pressures of widespread international affluence, the prevalence of cheap technology (aircraft), and societal assumptions—"Seeing is enjoying and doesn't affect others"—cause intense difficulty in protecting what we see as opposed to what we hear. Changing regulations across a boundary is an expression of *change in values.* These can have secondary influences on how land is managed, simply due to the extent of harmony or disharmony between stakeholders.

Rocky Mountain National Park faces growing private development on park boundaries that affects the park's ability to protect its values. Private development represents different sets of values. The park is affected by the elimination of undeveloped private adjacent land, reducing the functional size of the park regarding the capacity to sustain viable populations of species no longer free to move throughout their natural domains.

These same pressures are evident in Tarangire National Park in Tanzania, where adjacent agricultural development from government settlement policies has been resulting in attempts to control elephant migrations, causing ecosystem degradation both within and outside of the park, depredation of agricultural crops, and unnatural elephant control measures. Current work with external communities is showing hopeful progress in respecting migration routes in development activity.

In Yellowstone, the brucellosis and New World mine issues are lightning rods of societal conflict between our modern understanding of the meaning of "park," and what it takes to protect parks in the context of contrasting societal differences. In the case of brucellosis, the science is clear, yet the polarity of local, state, and federal stakeholders is extreme. And supposedly protected bison, carriers of brucellosis, are killed when they cross the park boundary. Many more thousands of elk, equally infected, cross back and forth without controversy. The result is a strong social gradient that increases in stress-intensity towards the park, but only regarding bison.

Generated societal and ecological gradients across protected area boundaries can have serious erosive effects on the ecosystem—and unanticipated but damaging ones to societies living in and near the protected area. The displacement of indigenous people to set up protected areas, such as happened with Ngorongoro Conservation Area, can create some of the most extreme contrasts because of hostilities created by displacement. These hostilities feed back on compliance and usually generate needs for intense management, enforcement, and negotiation. The costs can

be prohibitive and outcomes destructive to the entire system (people included). Other solutions, particularly in Canada, seem to offer greater hope and far more respectable outcomes.

The properties of societal and ecological contrast that are generated by *more* or *less* protection on one side of a border than on the other are not static ones. They are not necessarily symmetrical, spatially continuous, nor synchronous with the establishment and management actions taken at the park boundary. Just as with most things in cultural and ecological systems, change is normal, asymmetry is normal, and discontinuity is common.

Certain assumptions about protected areas can be tossed out when we realize there is too little to support them. For example, there is no reason to assume that the functional size of a park is necessarily the surveyed size (as defined by the jurisdictional responsibilities), simply because of the boundary influences discussed above. The cooperative approaches at Rocky Mountain and the "bison war" at Yellowstone are two manifestations—so is the issue of elephants at Tarangire.

A boundary's social and ecological influences can act in either way: to reduce or increase the protection capacity of the park. This capacity is not only functional, but can be spatial too. The spatial capacity of Tarangire National Park shrinks without external accommodation. The spatial capacity of Yellowstone National Park can be interpreted as being larger where its boundary joins an adjacent U.S. Forest Service wilderness area, or smaller where bison leave the park onto private land. The functional capacities of protected areas are decreased or increased because of their juxtaposition and similar or dissimilar purposes.

Functional size and shape are closely related: there is no reason to assume that the functioning shape of the protected area is similar to the mapped shape. When off-road vehicles damage desert ecosystems, plants or animals are poached along boundaries, roads affect distribution or movement of wildlife, or in-park development alters migration routes—then the functional shape of the protected area is altered. Thus, intrusive and extrusive influences of boundaries are variable and may be wider, denser, or directionally oriented in some places; their properties change. It becomes obvious that the regions across protected area boundaries are important places on which to focus attention and specifically monitor for indications of change.

There is an overriding theme we consider common to most park and protected areas. It is the essential societal tie, or *bond,* between the public and its parks. Inevitably, it is the primary mandate of protection.

Science will and must occupy a crucial center in the management of protected areas in the future. The scope of our paper does not focus on the biological or physical sciences. It would have, even a decade ago,

maybe even five years ago. Rather, it focuses on the interests of people and their values, and the need to bond protected areas to the societies in which they exist. It turns the early-20th-century idea of "boundary" inside out—no longer is a boundary a line of certain demarcation: if it is in, it is protected ... and "we" will do the protecting. No, today a boundary must be seen as something like a "diffusion filter." But what a change! To a traditionalist, it sounds weak, puny, almost like giving up. Man the battlements! Pour oil on the bastards! We will protect *their* park, for *them!*

No, that's not the future. In most places, it isn't even today. Our societies interact with our protected areas in ways Olmsted might not be surprised about, but many protected area managers would be.

What a change!

There is a paper at this conference that's different than all the rest. There's a brave soul out there who's onto something and has guts enough to face his peers with it. It's titled "A Fuzzy Framework for Managing Landscape Modeling Concepts." [Authored by H.J.E. Penna, Departamento de Geografia, Universidad de Buenos Aires.] Fuzzy logic in protected area management? Good Mother of Mary—what in hell is next?

Well, *that's* next. Listen to some of his abstract: "Imprecision, nonspecificity, vagueness and inconsistency are considered undesirable features when trying to define policies or implementations" and "much of the logic used in human reasoning is a logic with fuzzy truths and fuzzy rules of inference."

Does that ring true for managing protected areas? Having just finished three years as Deputy Director of the U.S. National Park Service, it sure rings true for me! There wasn't a park issue that I dealt with that was precise, specific, defined, and consistent, and the superintendents didn't think so either.

So what about science in this kind of world with fuzzy logic, chaos theory, and diffusion filters? We need an explosion in capability. Our technical knowledge must get better. We've got to define our technical research more clearly. We must monitor well and keep records well and analyze the changes well. No difference from a decade ago.

We've got to do it better, not only so we know what we are talking about, but also so those through the diffusion barrier receive us with credibility, and we communicate results so that they can understand them.

Who's out there through the diffusion filter? What are their values? Do we understand them? Do they understand us? After all, what Theodore Roosevelt's peers thought about parks may not be what the population today feels. We've got to know, and we've got to relate our values to their perceptions of what they need for the future, and help them have the range of information so they can choose wisely. So, science about people, about vox populi, and the

science of education of those whom we serve are essential.

If we are interested in protecting biological diversity and in ecosystem management, the NPS Organic Act of 1916 provides a good reminder: it reminds us that protection is associated with some sort of social pleasure, and that social pleasure, or satisfaction, is essential to the survival of these areas. Social pleasure or satisfaction includes, but is more than, just direct interaction with park resources. In a larger sense, it directly implies a cohesive acceptance throughout the society that the parks are *of value to the society;* that the society perceives itself as being better off by having parks. Can there be any doubt that the 21st century will bring more controversies and problems? We will still be asking: How do we interpret the protection process? How does it affect human behavior? And, How does it affect our ecosystems and cultures? Finally, we need protected area managers who are creative, who can take good biological, physical, landscape, ethnographic, historical, paleontological, social, economic, and political sciences and use them in ways that only few have the temerity—or guts—or intellect to even try today.

Creativity based on good information of all kinds will be the basic requirement of the future. The logic will be fuzzy, the issues imprecise and vague, and the boundaries more diffuse than ever.

It's a huge challenge—but an exciting world, don't you think?

John J. Reynolds is the director of the U.S. National Park Service's Pacific West Region in San Francisco, California. **Christine Schonewald** was president of the George Wright Society from 1986-1989. She is a research scientist with the U.S. Geological Survey's Biological Resources Division stationed at the Cooperative Parks Studies Unit, University of California–Davis.

Reminder: this column is open to all GWS members. We welcome lively, provocative, informed opinion on anything in the world of parks and protected areas. The submission guidelines are the same as for other GEORGE WRIGHT FORUM articles—*please refer to the inside back cover of any issue. The views in "Box 65" are those of the author(s) and do not necessarily reflect the official position of the George Wright Society.*

Fausto O. Sarmiento

Latin American Mountain Protected Areas: An Introduction

Background

This collection of papers summarizes the mountain theme discussed at the First Latin American Congress of National Parks and Protected Areas, held in Santa Marta, Colombia, from May 21-28, 1997. The mountain protected areas (MtPAs) workshop was part of Symposium No. 2 ("Saving Natural and Cultural Capital in Protected Areas," chaired by Bernardo Ortiz) and attended by park professionals, researchers, nongovernmental organizations, practitioners, and conservationists of every Andean country.

The mountain workshop was organized at the initiative of Larry Hamilton, vice-chair of Mountain Theme of IUCN's World Commission on Protected Areas (WCPA), and other montologists who wanted to provide exposure to the important issues surrounding the planning and administration of MtPAs, offering a follow-up of their meeting in Canada at the last World Conservation Congress. As the Andean Mountain Association president-elect, charged with planning the IIIrd International Symposium of Sustainable Mountain Development to be held in Quito, Ecuador, in December 1998, I was given the privilege of coordinating selection of papers, designing the mountain workshop, and editing a special issue for THE GEORGE WRIGHT FORUM. Support from the Center for Latin American and Caribbean Studies of the University of Georgia was instrumental for the task. A selected participation of 49 mountain scholars, researchers, administrators, and parks personnel gave a very active flair to workshop discussions.

The Workshop

The program brought case studies, question-and-answer sessions, debates, and consensus-building for a regional program to support MtPAs in Latin America. The development of a network was stressed anew. A roundtable to share experiences in protected areas of mountainous regions led to the development of a database of people and institutional affiliations, with strengths and constraints facing MtPAs' management.

Important reflections on the characteristics of mountains as centers of endemicity, and on the importance of bioregional processes occurring in mon-

tane landscapes, were offered by Juan Myer, who called for interdisciplinary studies to understand their hydrology and risks, fragility, climatic diversity, and landscape heterogeneity. Cultural landscapes were noted as evolving scenarios of specific human societies which depend on mountains for the supply of resources, especially water. Also, the importance of mountains as magic places that maintain spirituality as a common ethos of mountain dwellers was presented. Several issues of tourism management and impact amelioration tied with erosion control and usage practices of communal lands were also stressed.

With the coordination of Guillermo Rodríguez, from the Fundación Pro Sierra Nevada de Santa Marta, the workshop presentation included contributions on Huascarán (Torres), Tachira park (Rebolledo), Canaima (Sharpe and Rodríguez), páramos of Batallón and La Negra (Sánchez), and the corridor of Serra do Mar (Giardiadis and Campello). Other contributions were not given at the meeting but were considered for publication in the FORUM. Among those are papers about Rio Abiseo (Mendoza), Los Santos reserve (Kappelle and Juárez), Andean lakes of Ecuadorian MtPAs (Steinitz-Kannan), and the Rio Quijos protected landscape initiative (Sarmiento).

The focus of the printed papers has shifted a bit from the mere description of MtPAs to the challenges of MtPA management, experiences in planning, and suggested options of innovative conservation initiatives. The selected papers include an abstract in Spanish and have been edited for consistency of format and style. The contributions to THE GEORGE WRIGHT FORUM, hence, bring a sample of a vibrant group of montologists eager to advance conservation in protected areas to help sustainable development of the bioregions along and across the mountains of Latin American and the Caribbean region.

The Message

The take-home message was the need to exchange experiences and proposals for innovations in MtPAs' management by creating a mechanism to promote research and extension in mountain reserves. Also, workshop participants wanted to find ways to secure strategic alliances to energize their work in progress. Juanita Castaño from IUCN-Suramérica was asked to include a home page on the Internet for the mountain group within IUCN's URL on the Worldwide Web. Guillermo Rodríguez was named coordinator for the diffusion of workshop materials and resolutions, particularly to maintain the newly developed electronic discussion list alive and productive with active networking among members.

The workshop identified the common need of training in conflict resolution and environmental mediation, as well as technical background and training in carbon sequestration, economic valuation of water resources, redistribution of income to warrant park survival, and co-management. Finally, modern ap-

proaches for ecological risk assessment and management of illegal cash crops were called for.

Acknowledgments

We owe a debt of gratitude to workshop participants and many montologists who did not attend the Congress but were in the forefront of electronic discussions and peer-reviewing for this special issue. A particular mention goes to Juan Myer and the Fundación Pro Sierra Nevada de Santa Marta for their facilitation as hosts, to Brent Berlin of the Center for Latin American and Caribbean Studies for his support, to Larry Hamilton of the WCPA Mountain Network for his continuous encouragement and diffusion he gives through his newsletter, "Mountain Protected Areas Update." Last, but not least, many thanks to David Harmon for his willingness to include the edited contributions in THE GEORGE WRIGHT FORUM.

Christopher J. Sharpe
Iokiñe Rodríguez

Discovering the Lost World: Canaima National Park and World Heritage Site, Venezuela

Resumen

El Parque Nacional Canaima está ubicado en el macizo Guayanes y presenta muestras de la biota montana típica de los Tepuis. Canaima se presenta como ejemplo de los paisajes montanos con alto endemismo y con una fauna que está aun por catalogar. La presencia de los grupos indígenas Pemon, de cuyo idioma se ha tomado el nombre de Tepui, que literamente significa meseta, reflejan una adaptación cultural específica a dichos ambientes; también la descripción de los ecosistemas sabaneros asociados a los alrededores de Canaima se discuten dentro de un marco de manejo integral para la conservación del Parque.

Introduction

Canaima National Park is located in the southeast of Venezuela, in the state of Bolívar, close to the borders with Brazil and Guyana. The park protects the northwestern section of the Guyana Shield, an ancient geological formation shared with Brazil, Guyana, and Colombia. The park was established in 1962 with an area of 10,000 sq km, but its size was increased to 30,000 sq km in 1975 in order to safeguard the watershed functions of its river basins. At that time it became the world's largest national park, its area being equivalent to that of Belgium in Europe, or larger than the state of Maryland in the USA. In recognition of its extraordinary scenery and geological and biological values, the park was accorded World Heritage status in 1994, forming one of a select list of natural and cultural sites worldwide. Canaima actually fulfilled all four of UNESCO's criteria for qualification as a World Heritage property. Ironically, the name of the park derives from the novel *Canaima* by Venezuelan author Rómulo Gallegos, according to whom it means "spirit of evil" in the language of the Pemón, local inhabitants of the park.

A Unique Landscape Formed by the Oldest Rocks on Earth

The best-known features of Canaima National Park are its characteristic flat-topped mountain formations, known as *tepuis* from the local indigenous name. These mountains were popularized in sev-

eral novels from the early part of this century, the most widely recognized of which is *The Lost World* by Sir Arthur Conan Doyle, author of the Sherlock Holmes novels. It describes the ascent of a South American plateau inhabited by prehistoric plants and dinosaurs.

The geological history of the area is only superficially understood. There are three main geological formations. The oldest is an underlying igneous-metamorphic basement formed some 1.2–3.6 billion years ago whilst South America was joined to Africa as the super-continent Gondwanaland. Between 1–1.6 billion years ago, this was overlain with a sedimentary cover. The first of these formations is too deeply buried to be visible within the park, but the second one (known as the Roraima Group) forms the basis of the area's extraordinary topography (Huber 1995). It consists of quartzite and sandstone strata which were probably laid down in shallow seas or large inland lakes (Briceño et al. 1990) during the Pre-Cambrian period. Lastly, during Palaeozoic and Mesozoic times magma repeatedly penetrated the existing sediments forming intrusive rocks which are typically diabases, and to a lesser extent granites.

The tepui formations, not unlike those found in the deserts of northern Arizona, came into being by a process of erosion of the surrounding lands over millions of years. The tepuis are sandstone massifs, and it is thought that what are today mountains once formed harder or less-faulted strata which were more resistant to erosion.

There is an impressive array of different soil types. The low mineral content of the parent rocks of the Guyana Shield, the high rates of weathering that occur in tropical climates, and the age of the sediments has produced soils which are generally acid and nutrient-poor. Only where there are more basic igneous intrusions are the soils capable of supporting luxuriant forests or cultivation.

One Third of Plants are Found Nowhere Else

The vegetation of the Canaima national park is quite strikingly divided between the mainly savanna-forest mosaic of the eastern sector of the park, known as the *Gran Sabana,* and evergreen forest in the west. It is still not clear what causes this difference and, in particular, how the savanna originated. While some authors are inclined to believe the savanna to be a product of a rainfall shadow caused by the eastern *tepuis*, others consider the formation to be entirely anthropogenic, being a product of repeated burning by indigenous peoples. The truth undoubtedly lies in a combination of the two (Schubert and Huber 1989). The presence of 107 plant species found only in these savannas (Picón 1995), demonstrates that they have existed at least long enough to allow new species to form.

The **savannas** are dominated by grasses, typically *Trachypogon*

plumosus and *Axonopus pruinosus*, and such fire-resistant sedges as *Bulbostylis paradoxa,* which forms a small cushion on which it raises itself above the ground to avoid the worst of the savanna blazes. Stunted shrubs like *Palicourea rigida* are also found at low densities. The **high meadows**, on the other hand, are composed of typically Guyanan herbs such as the broad-leaved species of the genus *Stegolepis*, a member of the Rapataceae, a family found only in the Guyana Shield and with one genus in West Africa; members of the Xyridaceae and Eriocaulaceae are also typical. The **shrublands** are usually composed of shrubs and bushes up to two metres tall, most of which are hard-leaved (coriaceous) and pertaining to several genera, including *Bonnetia* and *Clusia*. The **evergreen montane forests** are often humid and luxuriant and include tree species of the families Leguminosae, Lauraceae, Vochysiaceae, Myristicaceae, Rubiaceae, Burseraceae and Annonaceae.

The **tepui tops** themselves are sometimes forested, with dwarf forests with members of the Theaceae (particularly *Bonnetia roraimae*), Araliaceae, Ericaceae, Compositae, Melastoataceae, and Rubiaceae being prominent. In other cases, meadows prevail on the tops, typically with the composite *Chimantea*. One feature of these extremely nutrient-poor environments is the presence of carnivorous plants, such as pitcher plants *Heliamphora* and sundews *Drosera*, which trap and digest insects as a supplement to mineral uptake through the roots. **Pioneer vegetation** is found on rocky outcrops, with the bromeliads *Brocchinia*, *Lindmania,* and *Tillandsia* being frequently observed (Schubert and Huber 1989).

An important formation in the lower altitudes closer to the rivers and shallow valley bottoms of the Karuai, Apanwao, and Yuruaní basins are the seasonally flooded palm savannas, or *morichales,* which are dominated by the "moriche" palm *Mauritia flexuosa*. A species-rich herb layer of grasses and sedges, as well as other plants of the lower stratum, are found within these formations (Huber 1995).

Some 9,400 species of higher plants have been recorded from the Venezuelan Guyana, of which 2,320 are registered from the tepuis. This includes more than 700 species of orchids. The flora is highly endemic with two endemic families (Tepuianthaceae and Sacciofoliaceae) and 23 unique genera, including *Quelchia*, *Achnopogon,* and *Chimantea* of the Composite family, the *Connelia* bromeliads, the *Tepuia* heaths, the melastome *Mallophyton*, and *Coryphothamnus* of the bedstraw family. At the species level, approximately 33% of the tepui species are endemic to the region, with 99 species endemic to Chimantá alone (Huber 1995).

The Fauna Needs to be Catalogued

Animal life is generally scarce all over the park and in all habitats, per-

haps because of the extremely nutrient-poor soils, which are unable to support a large biomass (Schubert and Huber 1990). In addition, there are relatively much fewer studies of animals than there are of plants, and thus our knowledge remains sketchy.

Reptiles and amphibians are poorly known. Amongst the frogs there is an endemic genus *Oreophrynella* with several species on the summits of the tepuis. Some 536 bird species have been recorded from the park (Goodwin and Salas 1997). Of these, 42 are endemic to the tepui region. Examples include the Roraiman nightjar *Caprimulgus whitleyi*, which is restricted to a few mountains in the southeast of the park, or the tepui tinamou *Crypturellus ptaritepuiensis,* which is known from only two mountains within the park and has not been recorded for two decades. Near 120 species of mammals have been recorded, but a further 92 are expected to occur in the area (Ochoa et al. 1993). One of the few endemics is a small rodent *Podoxymys roraimae* from the summit of Roraima.

The park, being a large, relatively intact area, is important for the survival of tropical animals that are naturally found at very low densities and are elsewhere threatened with extinction. Thus, it is a refuge for large mammals such as puma *Felis concolor*, jaguar *Panthera onca*, tapir *Tapirus terrestris*, giant anteater *Myrmecophaga tridactyla* and giant armadillo *Priodontes maximus*. Likewise, avian top predators, like the legendary harpy eagle *Harpia harpija*, are also still to be found within the park.

Much more research is still needed in order to classify the full range of species found within the park, let alone to truly understand the complex interrelationships of these basic elements and, therefore, the ecology of the area. This reflection has prompted entomologist Paul Spangler to comment of the tepui flora and fauna that "many of the experts who will study and classify these materials are not yet born" (in George 1989).

The Pémon: Traditional Inhabitants of Canaima

The traditional inhabitants of the southeast of Venezuela, including Canaima National Park, are the Pemón indigenous people, part of the Carib linguistic group. Their entire population approaches 20,000, with about three quarters of these people leaving within the national park.

The date of first occupation of the Gran Sabana is not known, but the Pemón are thought to have immigrated into the region some 200 years ago (Thomas 1980), although there are archeological remains of human settlements which date back 9,000 years (Schubert and Huber 1989). Perhaps this 'late colonisation' of the Gran Sabana is a function of its poor soils: there is certainly some evidence to suggest that low productivity is responsible for the relatively low population density of its present-day inhabitants in relation to the indigenous inhabitants of, for example, the Ama-

zonian lowlands (Huber and Zent 1995). Despite this short history of settlement, the Pemón have an intimate relationship with their landscape. The names of rock formations, waterfalls, rapids, lakes, and streams all have their origins described in myth. Some of these names date from the time of the culture heroes; some from other mythological sequences (Thomas 1982). In particular, the Pemón relationship with the tepuis (actually the Pemón denomination of "table mountain") is complex and profound. The tepuis are sacred mountains for the Pemón. They are the "guardians of the savanna" where the "Mawari"—'spirits in the form of men who may steal the souls of the living' (Thomas 1982)—make their home, and for this reason they are not to be ascended, according to the norms and traditions of Pemón society. Only in the last two decades, with the increase in tourism, have some Pemón begun to disregard these traditional beliefs by taking hikers to some of the more accessible tepuis, such as Roraima, Matawi (Kukenan), and Auyantepuy.

The traditional subsistence activities of the Pemón are swidden agriculture, hunting, and fishing. Today there is increasingly more work to be found in mining and tourism. The settlement pattern of the Pemón has changed since the Catholic missions arrived at the beginning of this century. Formerly living in dispersed communities along watercourses (Thomas 1980), they now tend to concentrate in larger groups of 100-2,000 people. The new road through the Gran Sabana has also attracted larger settlements. This concentration has brought about many changes in lifestyle, some of which affect their relationship with the environment. The traditional swidden plots, for example, once sited only on the richer, more alkaline diabase outcrops where forest regeneration is apt to be swift, are now often cut on poorer acidic soils. The result is that in some areas forest is being lost to secondary scrub or savanna (Fölster 1995).

The formation of savanna is also accelerated by the traditional practice of burning amongst the Pemón. Burning is practised for a number of sociocultural reasons, including communication, maintaining clear paths, eliminating dangerous animals (i.e., rattlesnakes), hunting, removing weeds, stimulating new growth of pasture for grazing, and—more recently—as a protest against unpopular management decisions. Although burning is more frequent in savanna, fire often reaches forest, shrublands, or scrub. Where there is extensive burning of this type of vegetation, the poor soils impede regeneration and a savanna or secondary scrub results (Fölster 1995).

According to some Pemón, burning is today practised with less awareness of its environmental consequences than in the past. The cultural aspects of burning in the Pemón have not been studied, but it would be interesting to ascertain the extent to which burning is influenced by the effects of transculturation which have

occurred since the 1930s.

Management: Reconciling Needs with Conservation Goals

The Canaima National Park was created to safeguard the geological, biological, and cultural values described above, but its major economic importance has been the production of water for the Guri Dam, which provides some 77% of the nation's electricity.

There were no management activities until 1981, when EDELCA, a government electricity company, began a fire-fighting programme. Only in 1990 did the park receive its first park warden, and it remained with only one staff member until 1992 when eleven more staff were assigned and a zoning and use plan for the eastern sector was approved.

Thirty-five years after the creation of Canaima National Park, the area continues to be managed on a shoestring budget: the operational management allocation for the eastern sector during 1996 was $1,171. Although the conditions for staff have improved in the last five years, the budget does not cover even the most basic management necessities: for example, the Gran Sabana has one vehicle in poor condition and there is no radio system. The western sector of the park is still lacking a zoning and use plan.

Active park management has become more of a necessity in recent years given the growing threats to Canaima. These threats have been analysed in participatory rural appraisal run by a non-governmental organization together with several Pemón communities and parks agency personnel. A résumé of threats is shown in Table 1.

The main pressures on the park come from two sources. On the one hand, the demands of the Pemón population resident in the park have increased. The Pemón population has increased five times over the last twenty years, and there is clearly a demographic effect of sheer numbers, which has brought about increasing demands on the park's natural resources. However, the situation is more complex, as changes in settlement pattern have led to new land-use regimes and changes in resource consumption. The best management approach must surely be found in adjusting to recent patterns of resource use by addressing the underlying causes of current resource use and identifying ways in which resources can be more sustainably used, rather than prohibiting undesirable activities. On the other hand, the tourism industry, which almost doubled between 1991 and 1995, continues to develop within the park without adequate planning control. As the Pemón have become more dependent on income generated from tourism, the problem of tourism management has increased, as have its environmental and cultural impacts. Two urgent priorities are to develop management guidelines for tourism in the national park, and to strengthen the capacity of the Pemón to manage and take advantage of

Table 1. Current threats to the Canaima National Park by component, identified through workshops with local communities and parks agency staff (Rodríguez 1996)

Park Component	Threat
Tepuis	Tourism: accumulation of garbage, faecal pollution, extraction of flora, extraction of crystals, introdcution of exotic plant species, deforestation for firewood, burning to clear trails
Rivers and waterfalls	Tourism: faecal pollution. Mining: pollution Deforestation: flow reduction Burning and wildfires
Palm savannas (morichales)	Overexploitation of *Mauritia* palm Burning and wildfires
Forests	Felling for agriculture Wildfires Mining (potential)
Fauna	Overhunting Wildfires
Savanna	Wildfires Tourism: opening of new trails, erosion
Pemón	Population increase Increase in requirements Loss of traditional knowledge Change in settlement pattern
Management	Institutional weakness Lack of management programmes National government policy incompatible with conservation and park management Bureaucracy

tourism in a way compatible with the conservation objectives of the area.

In addition to this is the latent threat of gold and diamond mining. Mining is one of the major activities in the lands adjacent to the park, and it is well known that the park itself has considerable mineral wealth. Although mining is currently prohibited, there have been sudden illegal 'booms' in, for example, the Kamarata Valley in 1994. The physical presence of mining operations on the park's borders provides a constant

reminder to the park's inhabitants of what may be obtained from their lands in the short term. With government policy now aimed at promoting mining throughout the region, the park will require increased vigilance to safeguard its natural resources over its 3 million hectare extent.

One particular project which is shortly to be realised is the construction of a high-tension power line through the national park in order to supply electricity to mining operations to the north and south of the park. Although the project is opposed by local inhabitants and considered unwise by conservation scientists, it seems likely to succeed due to the powerful lobby whose interests it serves.

With moves to open Venezuelan protected areas to mining already under way, perhaps the legend of El Dorado will finally come true in the Canaima National Park as mining proponents would wish. However, standing in this, one of the world's last remote wildlands, surrounded by vistas of table mountains, one cannot help but feel that the riches conserved by Canaima National Park are worth incalculably more than all the gold or diamonds that can be extracted from its sub-soil. It is to be hoped that the efforts of the many individuals and organizations dedicated to conserving Canaima will ensure that future generations will not blame us for having lost the "Lost World."

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Advances in the Management of Recreational Use of Huascaran National Park, Peru

Resumen

La situación del turismo y la recreación en el Parque Nacional Huascarán se presenta dentro del proceso de planificación participativa del plan de uso del Parque. Con innovadoras opciones de comunicación horizontal y alejándose del esquema de "expertos", el proceso de planificación turística de Huascarán presenta los puntos positivos y negativos de una gestión de diseño planificador en la que varios organismos y personalidades han jugado un papel muy importante. La ejecución del plan, sin embargo, nos recuerda el hecho de que las recomendaciones técnicas de manejo se ven supeditadas a las decisiones de los políticos de turno que muy rara vez reflejan las necesidades locales sino las de sus electores en las ciudades de los distritos administrativos del servicio de Parques.

Introduction

This paper describes the process of elaborating the tourist and recreational use plan of the Huascarán National Park, in west-central Peru. The technical principles of the plan are discussed, as are interinstitutional relations and approaches—aspects so fundamental to this or any other proposal for mountain conservation. It reflects the point of view of one of the members of the planning team, and so includes personal insights on the process.

General Aspects of Tourism in the Park

The major tourism advancement of the last few years in protected natural areas of Peru has been the elaboration of the tourist and recreational use plan of the Huascarán National Park, between September 1995 and February 1996. This process was cosponsored by the Embassy of the Netherlands in Peru and the U.S. Agency for International Development (USAID). For the task, a mixed team was assembled from the Huascarán National Park Service and the Mountain Institute, a U.S.-based nongovernmental organization, under an agreement with National Institute for Natural Resources (INRENA), the organization in charge of administering the Peruvian protected natural areas.

Huascarán National Park protects almost the entire Cordillera Blanca, one of the world's most popular mountain tourist destinations in the

1980s. After a recessive period in the early 1990s, from 1994 onward, the area has again seen increased tourist usage, even more so than that registered last decade. It is also one of the most innovative tourist destinations close to Lima, the capital and largest city. This makes Huascarán an important center of tourism on the national level, second only to the famous National Sanctuary of the Machu Picchu.

The park encompasses lands used by ancient Indian communities and small farmers and ranchers, whose rights for grazing and for the use of the flora are acknowledged by the formal acceptance of the Park Service. A growing number of these "fuelwood, medicinal flora or grassland users" also participate in the tourist activities that are developed within the park. Since 1990, the Park Service has had a zoning and a general management plan to guide its actions. Before the elaboration of the tourist use plan, the park had basic guidelines for general aspects of tourism management, a proposal for a code of use by tourists, and specific guidelines for local associations for basic tourist services. The tourist use plan of the park is the most comprehensive attempt to manage tourism in the history of natural protected areas in Peru, and the first one specifically tied to a master management plan for any unit within the National System of Natural Protected Areas (SIN ANPE, *Sistema Nacional de Areas Naturales Protegidas)* in the country.

Tourist Activity at the Beginning of the Plan

The tourist use plan is based on priorities identified by the administration, as evidenced by the following problems:

- The overcrowding of visitors into a very few sites of tourist operations. This irregular distribution of visitors increased the potential impacts in some places and prompted the concentration of benefits in the hands of a few.
- The irregular or total lack of coordination among different groups dealing with tourism. There were governmental offices of tourism, private companies, guides, and local communities that themselves maintained a very irregular level of coordination with the authorities of the park, with a cyclical repetition of problems during the high season and special activities.
- The small economic benefit that the park obtained from tourism. This was due to a lack of park rangers at access points for hikers and climbers (Huascarán only had 3 check-in points for more than 45 entrances), an inadequate entrance fee schedule, a lack of control systems to requested alternatives to fees at the point of entry; and a total lack of concessions that allow income generation to the park and better services for park visitors.

Clearly, the solution to these problems was to implement adequate visitor services, with the goal of both diminishing negative impacts and en-

couraging enjoyable visitor experiences—and thus support for conservation efforts in the park.

Producing the Plan

From the beginning of the work, the team shared its vision on the fundamental character of the items discussed above, then designed first steps toward solving them. The participatory process ratified the validity of the base-line diagnostic of the problem.

The working team consisted of members from the park and the Mountain Institute, with supervision by INRENA officials. An important challenge faced by the team in the planning process was making sure the plan was integrated: the development of a common vision about tourism at Huascarán, the analyses of team members' roles, the definition of strategies that would allow them to maintain such roles and yet work as a unified team, and the renewal of alliances and commitments involved in each and every aspect of the process.

The team decided to shun the "experts" approach, adopting rather a horizontal framework of opinions, analyses, and learning opportunities, both within the park staff and at the interface with park users. In this approach, the first and foremost team decision was to amplify the draft plan to elaborate more on the its diagnostics, allow park personnel to increase their direct knowledge of the sites with data on visitor concentration, and to include information on proposed new sites for visitor redistribution.

This option was born from the perspective of strengthening the decision-making capacity of the park personnel during both the planning phase and, ultimately, during actual tourism management. Doing this would also fortify the staff's self-respect and their relationship with other enterprises associated with tourism activities. These points were kept as internal objectives of the process, and of the Mountain Institute as a cooperative entity with the park administration.

Figure 1 shows the initial concept to guide the plan. The graphic resulted from an internal workshop that started the teamwork and defined the different steps of the process.

A basic need clearly identified by the team members from the beginning was that the plan should be developed through a collaborative process. Several issues had to be resolved while designing the plan. The planners had to decide how to:

- Balance different interests and deal with "power games" among the incumbents;
- Create confidence that the suggestions from workshop participants would be truly analyzed and would constitute the basis for the plan proposals;
- Generate confidence among park personnel so they could "risk" their decision-taking power;
- Leave out of the process other aspects of park management that did not touch on the topic of tourism

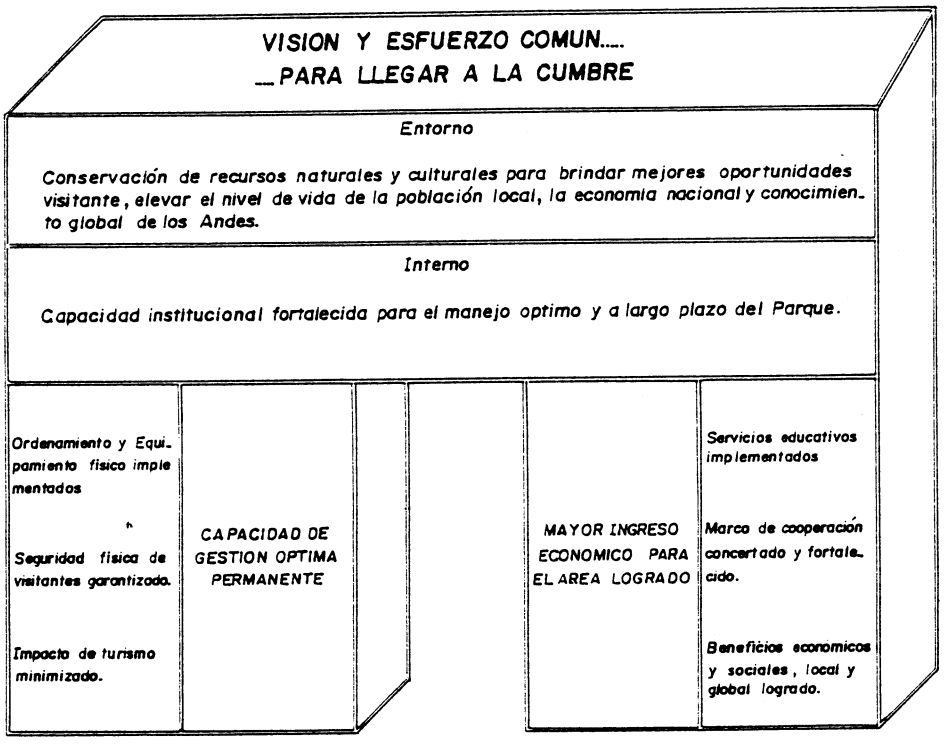

Figure 1. Plan de manejo de turismo del Parque Nacional Huascarán [Tourism management plan for Huascarán National Park]

but could jeopardize its planning; and

- Balance the needs and expectations about this process and INRENA policies (since it was initially unclear up to what point a truly analytical space could be guaranteed for the local proposals, and that there were no high-level decisions without consultation).

In one way or another, these questions were answered during the process, which not only implied a level of formal working relationship between the Mountain Institute, INRENA and park rangers, but also a constant process of compromise and maintaining interpersonal relations. As far as this process sought to strengthen the local agreement level for management, we learned that it is very important to develop alliances and relationships with external levels that have an important influence on the ratification of local decisions. Another important task was to keep open conversations and individual contacts with those people who have a great deal of influence in the tourist operation in the area, but who hardly presented their points of view during the working sessions.

Two fundamental aspects of the methodology were to cover the emo-

tional–affective aspects that a rearrangement such as this one entails, acknowledging and respecting everyone's hopes and the worries about the future of their individual activities. This helped to recover those more positive aspects from people and organizations, favoring the development of a common vision. The second important aspect was that each participant was given all the information resulting from a meeting just after it ended. All information was, hence, "exposed," with no chance for keeping confidential information or routing it only to a few or selected groups. So, everyone had the chance to correct the information gathered, and discuss it with others. This was a constant effort each day of the month-long series of discussions. Concomitant with the elaboration of the plan, the basic infrastructure that should be in place regardless of the plan's outcome was being implemented, including the placing of signs at guard posts and latrines in those places. These small actions helped to show the participants that the decision to improve services to users was in place and not only in paper.

The Plan's Contents and Technical Aspects

The plan identifies tourist use as one of the viable options in the protected area management, helping therefore to comply with the central objectives of the park's creation. It stresses tourism's benefits to the park in regard to finances, creating a conservation consciousness among numerous users, and providing an alternative source of income by non-extractive practices to local populations, especially the rural ones who, in one way or another, see their options of direct use of the park as being very limited.

Equally, the concept focuses on those strategic areas where the efforts of tourism management in protected areas should be directed; on the formulation of a vision of tourism in Huascarán, both from the point of view of the administration and of the affected sectors; on the development of facilities for tourism management, both in the protected natural area and in the sectors of influence; on helping the financial operation by exercising the primary objectives of conservation; and on management based on mutual trust. Without leaving aside the corollary actions, the framework attempts to stress the need for a more organic character to tourism management in Huascarán and other areas, stressing the importance of participatory action. Figure 2 shows the conceptual framework.

Inter-institutional tourism cooperation was identified as the highest priority by the members of the team. It represents a continuity of the effort from the planning stages through implementation.. The emphasis on coping with bureaucratic aspects before opening a space for true collaboration among institutions was clear. Here, it is important to note a need

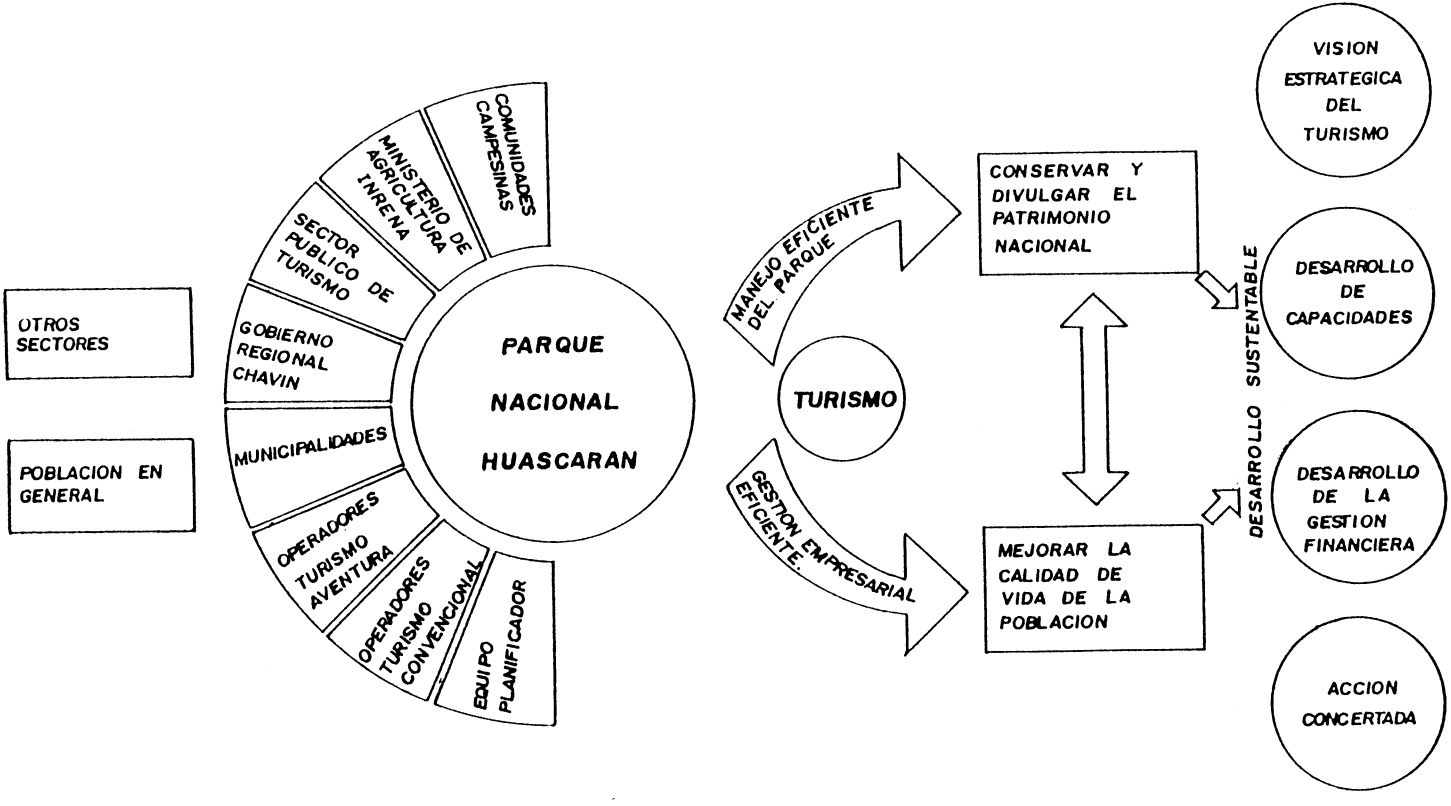

Figure 2. Conceptual framework of Huascarán tourism management.

for special support to the administration of the protected natural area so its personnel can achieve the technical confidence needed to continue with horizontal and participatory management models. This had to encompass a special effort in the central levels of administration of the protected natural areas system in Peru, where the potential resistance to change could be found.

Campesino tourism cooperation provides direct market-contact alternatives to the rural populations that are currently depending on the tourism agencies to offer their services. Looking to improve and adequately utilize these alternatives, the program offers training for interested campesinos, as well as new land use planning for cattle ranching in tourist sites and the re-introduction of llamas for hauling in lieu of donkeys and horses. Considerations of how to diminish the social impact of tourism on campesino populations were also included as part of other programs.

The objective of **strengthening institutional capacity** is to improve the operational capacity and management skills of park administrators to ensure adequate implementation of the plan. This requires the setting of priorities and strategies to improve the financial basis of the park (mainly oriented towards the establishment of concessions, fees, and increasing control points within the park). It also implies the development of training plans for park personnel and the exercise of regulations governing tourism use in the park.

Conventional and adventure tourism programs include not only detailed identification of 24 hiking routes and their variations, 102 destinations for rock climbing, four destinations for skiing, and six trails for mountain bikes (adventure tourism), and the design of nine destinations for different activities of conventional tourism, but also descriptions of locations and facilities for each route, and the maintenance areas needed. This infrastructure includes what the park needs for adequate management of tourism within the whole scope of activities, consistent with the philosophy that, without integrative management approaches, there could never be a healthy development of tourism in the protected natural areas.

Public education and interpretation stress the need to create a visitor center in the city that is the main operations center of the Cordillera, since it is the place where the first contact with the park is initiated, where tourists receive information about guides and companies and other accommodations offered by the population surrounding the park and, of course, where the political authorities of the region have their headquarters.

Assessing the impact of tourism activities may be the least-elaborated aspect of the plan, partly because of the need to advance the basis of information and management first, and then establish an appropriate program with the Park Service and with local authorities. Some of the main

needs in this area are environmental impact assessment studies of the concessions, estimations of optimal carrying capacity, and strategies for managing overshoots. In Peru, there is a dearth of experience in estimating tourist carrying capacity, but what is more important yet is the lack of identified appropriate carrying capacity methodologies for mountain protected areas, such as Huascarán.

Actions After the Plan's Elaboration

The plan was finished in February 1996. After the final workshop, a delicate period of adjustment to the final document followed. One side was trying to maintain the maximum closeness to the agreed-upon approach as approved by the working groups, while the other side was cautious not to lose political viability and official formulation. Only at this point did the central-level authorities realize some details they had not perceived before, and that were very hard for them to agree upon. However, the final approval resolution came in March, only one month after the final workshop.

Despite the plan's approval—almost without changes of the contents arrived at by the participants in the process—the regulations for tourist use in the park were not approved. These bylaws included the guidelines for concessions, the procedure for defining the fee schedule, and alternative mechanisms to park fees. Hence, the park administration was left with few formal tools to face day-to-day operations, and this delayed the start of the charges to adventure tourist operators (those entering via certain areas almost never pay the access fee). Alternate mechanisms for conventional tourism were neither developed nor tested.

The plan's approval, within a participatory framework, ratified by the government of Peru, did not mean that the license for construction of the first park facilities was done following the recommendations for environmental impact assessment. This fact—which to a certain extent diminished the faith of the participants in the process—may be regarded, however, as having only a mild impact because it was clear that the political dimensions of this project were bigger than any single management option, even at the national protected areas level. Thus it was not identified so much as a failure to comply with the compromises reached by the consensus of the participants as it was a special instance involved in the management of tourism in the Huascarán National Park.

Nevertheless, conversations to formulate the regulations and the bylaws have continued, aiming towards a definition of the general basis for tourism throughout the whole protected natural areas system of Peru, to then be applied to individual units.

In the same vein, important advances resulted from the proposals of the plan and the linkages that the planning process generated. By having the description of services, spatial location of sites, etc., the park administration has obtained funding for

sanitary services in one of the critical areas of the park because of the number of visitors and the ecosystem type affected. Also, funding has been assigned to implement part of the conventional tourism infrastructure in this same area, and to build sanitary stations along the longer hiking route.

With the more active and less dependent participation of the park, other important actions are also taking place. The training workshops that are traditionally offered to the Mountain Guides Association of Peru are enriched with a better treatment of conservation topics and quality services, for which there are more collaborating institutions. A sanitary course was implemented for those few members of campesino communities who offer tourist services.

However, the most important advance has come through the project "Llama 2000." This is an initiative of a group of pastoralists using one of the areas identified for the potential redistribution of the visitation load. In concert with the Mountain Institute, the park, and other institutions, Llama 2000 has created a new service of hiking with llamas instead of donkeys. This project is an example of how to link tourism and conservation with cultural recovery, and also an example of development options that conservation offers towards sustainability in the Andes.

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The Lakes in Andean Protected Areas of Ecuador

Resumen

El Ecuador tiene varias lagunas en los páramos altoandinos y en los valles interandinos. La mayoría de las lagunas andinas son parte del Sistema Nacional de Areas Protegidas. El presente artículo describe las lagunas más importantes en cada una de las áreas. Pese a su relativamente pequeño tamaño, las lagunas son atributos hidrológicos muy importantes del paisaje tropandino, ya que regulan la disponibilidad del agua en la cuenca hidrográfica. Las lagunas también son importantes para el turismo, para la pesca de truchas y para la provisión de hábitat acuático y litoral, y de alimento a una gran diversidad de vida silvestre asociada al ecosistema léntico andino.

Introduction

Ecuador established in 1981 a National System of Protected Areas which is outlined in the "Law of Forestry and Conservation of Natural Areas and Wild Life." The law recognizes seven management categories: (1) National Parks, (2) Ecological Reserves, (3) Wildlife Refuges, (4) Biological Reserves, (5) National Recreation Areas, (6) Areas of Fauna Production, and (7) Areas for Hunting and Fishing. The criteria used to classify these areas include size of the area, nature and state of the natural resources, and the human activities that can or cannot be permitted in the area (EcoCiencia 1994).

Figure 1 and Table 1 show the 18 major protected areas of Ecuador. These areas include a most varied geography: rain forests, lowland deserts, the Galapagos Islands, cloud forests, páramo, highland deserts, tundra, etc. Twelve of the eighteen areas are entirely or partly in the Andes mountains, and in ten of these there are lakes. Because of their large number, variety and, often, easy access, the lakes of the Andes of Ecuador also provide opportunities for research and environmental education in the still relatively young field of tropical limnology.

I have been searching all parts of Ecuador for lakes and ponds since 1975. My research is directed not only to a regional limnology of Ecuador, but also to using the biota of lakes for testing ecological theories on species diversity, such as the theory of island biogeography (Colinvaux and Steinitz-Kannan 1980; Steinitz-Kannan 1979). In addition, I have assembled a large diatom database and diatom herbarium for Ecuadorian

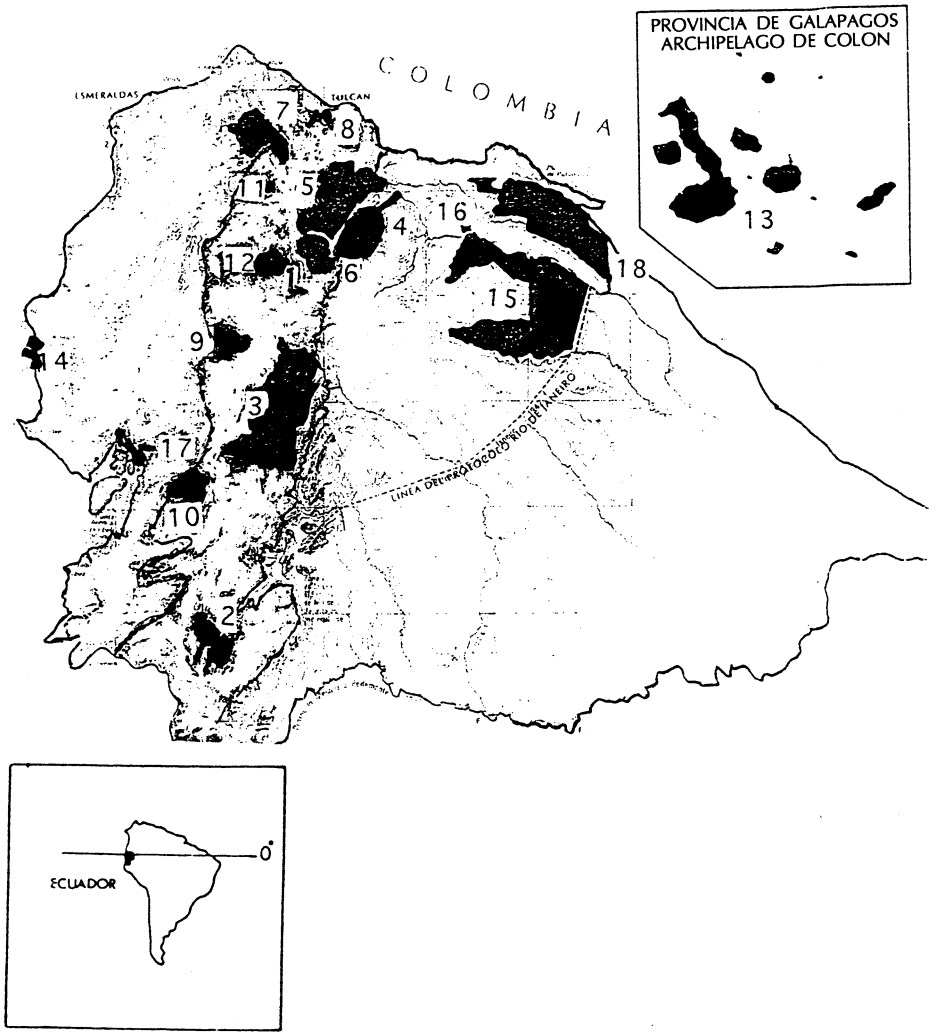

Figure 1. The major protected areas of Ecuador

lakes at Northern Kentucky University, with information that allows the use of the diatom communities as indicators of environmental conditions. Fossil diatoms and pollen from the sediments of many of these lakes are being used for reconstructing short-term and long-term climatic histories of the region (Steinitz-Kannan et al. 1993; Colinvaux et al. 1988; Colinvaux et al. in press; De Oliveira et al. 1986, 1988; De Oliveira and Steinitz-Kannan 1992). The physical and chemical limnology of Ecuador is described in Steinitz-Kannan et al. (1983). Information about individ-

Table 1. List of the major protected areas of Ecuador shown in Figure 1 (adapted from EcoCiencia 1994). The first 12 areas are entirely or partly in the Andes Mountains. Lakes in the first 10 areas are listed in Table 2.

No. in Fig.1	Protected Area	Provinces	Area (hectares)	Altitudinal range (m)
1	Cotopaxi National Park	Cotopaxi, Pichincha, Napo	33,393	3,400 - 5,897
2.	Podocarpus National Park	Loja, Zamora-Chinchipe	146,280	1,000 - 3,600
3.	Sangay National Park	Tugurahua, Chimborazo, Morona Satiago	517,725	900 - 5,230
4.	Sumaco-Galeras National Park	Napo	205,249	600 - 3,732
5.	Ecological Reserve Cayambe-Coca	Pichincha, Imbabura Napo, Sucumbíos	403,103	750 - 5,790
6.	Ecological Reserve Antisana	Pichincha, Napo	120,000	1,400 - 5,076
7.	Ecological Reserve Cotacachi-Cayapas	Imbabura, Esmeraldas	204,420	100 - 4,939
8.	Ecological Reserve El Angel	Carchi	15,715	3,600 - 4,218
9.	Chimborazo Reserve for Faunistic Product.	Chimborazo, Tunguraha Bolivar	58,560	3,800 - 6,310
10.	Cajas National Recreation Area	Azuay	28,808	3,000 - 4,300
11.	Geobotanical Reserve Pululahua	Pichincha	3,383	1,800 - 3,356
12.	Boliche National Recreation Area	Cotopaxi	1,077	3,000 - 3,600
13.	Galapagos National Park	Galapagos	693,700	0 - 1,707
14.	Machalilla National Park	Manabi	55,059	0 - 850
15.	Yasuni National Park	Napo	982,000	300 - 600
16.	Limoncocha Biological Reseve	Sucumbíos	4,613	230
17.	Manglares de Churute Ecological Reserve	Guayas	35,042	0 - 900
18.	Cuyabeno Reserve for Faunistic Production	Sucumbíos, Napo	655,781	200 - 280

Table 2. Lakes of Ecuador's Andean national parks and other protected areas shown in Figure 1.
(* = lakes studied by the author's research team; + = important lakes, not part of protected areas)

No. in Fig. 1	Names of lakes	Province	Latitute	Longitude	Altitude (m)
1	*Lake of Limpiopungo	Cotopaxi	0°36' S	78°28' W	3970
2	Lagunas del Compadre	Loja	4°10'S`	79°09'W	>3000
	Lacustrine complex La Campana	Loja-Zamora	4°20'S	79°10'W	>3400
3	Lacustrine complex Ozogoche:				
	Ozogoche or Cubillín, Laguna de Mactayán	Chimborazo	2°18'S	79°45'W	>4000
	Atillo or Colay-Cocha, L. Azul, L. Verdecocha,	Chimborazo	2°10'S	78°25'W	>4000
	L. Boazo,L. Pichahuiña, L. Jactán, L. Tintillón,				
	L. Cochapunga and others				
4.	Laguna de Sumaco	Napo	0°36'S	77°35'W	2400
5.	Puruantac	Imbabura	0° 12' N	77° 57'W	3471
	*San Marcos	Pichincha	0° 07'N	78°25'W	3414
	*L. de Papallacta, L. Tumiguina	Pichincha	0°24'S	76°37'W	3920
6.	Micacocha, Muerte Pungo	Pichincha	0°36'S	78°12'W	3980
	>25 lakes in Oyacachi paramo: Yanacocha,	Pichincha	0°15'S	78°10'W	>3800
	Nunaluiro, Encantada etc.				
7.	*Cuicocha Lake	Imbabura	0°,17'N	78°21'W	3010
	Mojanda Lakes: *Caricocha (Mojanda Grande)	Imbabura	0°08'N	78°15'W	3716
	*Huarmicocha (M. Chicha),*Yanacocha (M. Negra)	Imbabura	0°07'N	78°15'W	3696-3700
	Lakes of Piñán: Cristococha, La Cocha, Parcacocha,	Imbabura	0°20'N	78°25'W	>3500
	Yambarro, L. de Cubilche, L. Donoso	Imbabura	0°30N	78°24'W	>3500
	*+Laguna de San Pablo	Imbabura	0°13'N	78°14'W	2585
	*+Laguna de Yaguarcocha	Imbabura	0°23'N	78°05'W	2380
8.	Lagunas de Páramo de El Angel, L. El Voladero	Carchi	1°40'N	77°50'W	3700
9.	*L. Pucacocha,*L. Plateriacocha, *L. Cochabamba	Chimborazo	1°29'S	78°42' W	3600 - 3720
	*+Laguna de Cota	Chimborazo	1°45'S	78° 44'W	3420
10.	Cajas Lake district: > 230 glacial lakes:				
	*Toreadora, *Illincocha, *Apicocha	Azuay	2°46'S	79°13'W	3900
	*Surocucho (Llaviucu or Zorrocucho)	Azuay	2°50'S	79°08'W	3260
	*Culebrillas	Cañar	2°25'S	78°51'W	3985
	Osohuayco, Ventana, Mamamag,	Azuay	2°55'S	79°20'W	>3500
	Lluspa, Sunincocha, Lagartococha	Azuay	2°55'S	79°20'W	>3500

ual lakes and their biota is given in Steinitz-Kannan (1983), Steinitz-Kannan et. al (1982, 1986), Miller et al. (1984), De Oliveira and Steinitz-Kannan (1992), and Sarmiento (1988). In addition there are brief references to lakes in books on geography, geology or ecology of Ecuador (Wolf 1934; Sauer 1971; Terán 1975; Sarmiento 1987).

General Characteristics of Mountain Lakes of Ecuador

The majority of mountain lakes in Ecuador are located at altitudes above 3,000 m. Most have basins that are clearly of glacial origin, being kettles, depressions in till, or behind moraine dams or small fjords. A few occupy volcanic explosion craters (maars) or collapsed calderas. A few have formed by lava dams blocking the flow of rivers. The páramo lakes are cold year-round with maximum temperatures seldom reaching 12°C, and minimum temperatures close to freezing (1-2° C). Since there is no winter, they do not freeze. Most are deficient in dissolved ions, the water being in consequence poorly buffered so the pH fluctuates with photosynthesis from a very acidic pH of 4 at sunrise to neutral or even slightly alkaline by afternoon on sunny days. Such fluctuations are more dramatic in the more productive lakes that receive organic matter, whether from animals grazing near their shore, agricultural runoff, or trout hatcheries. The many blackwater lakes in the region have the lowest pH because of the high concentrations of humic acids. The lakes in general are polymictic, with only brief periods of thermal stratification, if any. Oxygen levels are generally high, except in the bottom most waters. In contrast to the páramo lakes, lakes of the Interandean Plateau, between 2,000 and 3,000 m in altitude, are usually nutrient-rich, of high pH, and eutrophic. The average water temperature is around 17°C. Exotic fish, mainly trout (*Salmo trutta, S. gairdnerii,* and others) have been introduced to every accessible lake in the Ecuadorian Andes and, with few exceptions, have today healthy populations. Most of the lakes occupy closed basins so that they probably had no fish before the introductions.

There is a very high diversity of microscopic algae in these lakes. We have identified up to 106 species of diatoms coexisting in one lake *(Surucucho)* alone, and have 750 different diatom taxa in our herbarium from this region. In addition there is an interesting diversity of microscopic invertebrates (ostracods, cladocerans, rotifers {Koste & Böttger 1992}; Boeckellid copepods, endemic in páramo lakes {Loeffler, 1963}; water bears {Tartigrades}; nematodes; water mites; and insect larva). The shallow areas of most of these lakes have macrophytes such as *Scirpus totora, Myriophyllum, Ceratophyllum, Potamogaeton* and, in a few, *Chara*. The lakes attract a great variety of birds and mammals, many of which depend on them for water, food or nesting sites, as is the case of

the Andean lapwing, or *ligle (Vanellus resplendens),* the lacustrine avian guardian of the páramos.

Mountain Protected Lakes

The names and location of lakes of the protected areas of the Ecuadorian Andes are given in Table 2. Below is a brief description of lakes in specific protected areas.

1—Cotopaxi National Park. The lake of *Limpiopungo* is one of the main attractions of the park. It is easily accessible by a 6-km gravel road that branches off the Pan-American Highway. It occupies a very shallow basin in flat land at the intersection of a system of valleys immediately below the snow-capped, 5,897-m peak of the Cotopaxi volcano. Both the depth (13-65 cm) and the area of the lake vary dramatically with rainfall and amount of snow-melt. The bottom is carpeted with gelatinous masses of blue-green algae (Cyanobacteria) of the genus *Phormidium*, forming mats with 48 other species of benthic algae (Steinitz-Kannan et. al. 1983). In addition to Limpiopungo, there are several very small glacial basins around the Cotopaxi volcano. Most are of difficult access and are yet to be studied.

2—Podocarpus National Park. The lakes in this park are accessible through a hiking trail that branches off the main administration building of the park, goes over a luscious cloud forest to the páramo, where the lakes are. There are several basins of glacial origin. The most accessible set of lakes are known collectively as *Lagunas del Compadre.* There is another set known as the lacustrine complex of *La Campana.*

3—Sangay National Park. The lakes in this park are formed from melting glaciers of three volcanoes: the Altar, the Sangay, and the Tungurahua. The lacustrine complex of Ozogoche is one of the most spectacular and largest group of lakes of glacial origin in the Andes of Ecuador. The largest lake in the complex is *Ozogoche* or *Cubillín* which is 12 km long in its south-to-east direction. Just north of Ozogoche is *Laguna Mactayán,* and south of Ozogoche are at least 11 smaller lakes. All these lakes are connected by streams, forming a typical "paternoster" chain. About 12 km north of Mactayán are the lakes of *Atillo* or *Colay-Cocha,* famous as the place used by the ancient Puruhaes to punish condemned criminals to death by freezing or drowning. A series of paternoster lakes also come out of Laguna de Atillo.

4—Sumaco-Galeras National Park. There are only a few lakes in this park; most are small glacial ponds at altitudes above 3,000 m. There is one lake in a maar (explosion crater), at an altitude of 2,400 m on the eastern flanks of the Sumaco volcano of potential interest for paleoecological studies.

5—Cayambe-Coca Ecological Reserve. There are a very large number of lakes in this reserve. The following have been studied: *Laguna de Puruhanta* (Sarmiento 1988), also known as *Laguna de Chique*, is in the southeastern Imbabura province.

Laguna de San Marcos (Steinitz-Kannan et. al. 1982, 1983) is located on the southern slope of the Cayambe. Both lakes occupy long, deep, U-shaped valleys surrounded by glacial end and lateral moraines, and appear to be true fjord lakes. The lacustrine complex of *Papallacta* (Steinitz-Kannan et. al. 1983) contains the closest lakes to the capital city of Quito. *Laguna de Rumicocha* is located directly off the road from Quito to Baeza. It occupies a channel of the river Papallacta, 1300 m long by 200 m wide, that was dammed by a lava flow from the Antisana volcano. Not far from Rumicocha and not as accessible, is *Laguna Tumiguina,* a lake somewhat smaller than Rumicocha (Papallacta). The páramo in this region is saturated with water and there are innumerable *Sphagnum* bogs and small ponds.

6—Antisana Ecological Reserve. From a hydrological standpoint this reserve could be considered an extension of the Papallacta lacustrine system. The páramo in this region is also saturated with water and there are numberless *Sphagnum* bogs and small ponds. Two notable lakes are *Laguna La Mica* or *Micacocha* and *Laguna Muerte Pungo*, both formed by damming of rivers by lava flows on the foothills of Antisana volcano.

7—Cotacachi-Cayapas Ecological Reserve. The predominant feature of this reserve is *Lake Cuicocha* in a spectacular caldera (collapsed crater), roughly 4 km by 2.5 km and 180 m deep on the flank of Cotacachi volcano. Two islands near the center of the lake are separated by a sill only 15 m deep and are apparently the remains of an old volcanic cone rising from the crater floor. Mountain forests cover both islands. The lake is highly oligotrophic, with a transparency of 18 m. Attempts to plant trout in this lake have failed due to the lack of shallow habitats for spawning, and to the low productivity of the system. The chemistry of Cuicocha (Steinitz-Kannan et. al. 1983), is that of a marl lake, with very hard water high in Ca and Mg. The margins support populations of the macro-algae *Chara,* characteristic of marl lakes and noted for its ability to inhibit the reproduction of mosquito larvae. Although not as spectacular as Cuicocha, several small crater lakes (mainly maars) can be found in this reserve. The Lakes of Piñan—*La Cocha, Cristococha, Parcacocha,* and *Yambaro*—are in the páramo of the eastern cordillera, north of Cuicocha. They are rather inaccessible. *Laguna Donoso*, and *Laguna de Cubilche* are on the western side of the park. In this region are also the Lakes of Mojanda. *Mojanda* is a broad volcanic chain which separates the basin of Quito from that of Ibarra, and forms the geographic and legal limit between the provinces of Imbabura and Pichincha. There are three lakes in this chain: *Caricocha* or *Laguna Mojanda Grande, Huarmicocha* or *Laguna Mojanda Chica,* and *Yanacocha* or *Laguna Mojanda Negra.* The lakes occupy the floor of a very large collapsed caldera. Caricocha, the largest, is 2 km across and highly

oligotrophic, with a transparency of 21.5 m. It has the lowest content of dissolved ions of any lake studied in Ecuador (Steinitz-Kannan et. al. 1983). Huarmicocha occupies a shallow oval depression about 400 m across. Its level is maintained only by rain water and can fluctuate dramatically. Yanacocha has a more permanent basin that appears to have been separated from Caricocha by a volcanic dam. Close to this reserve, although not in it, are *Lago San Pablo* and *Laguna de Yaguarcocha,* two well-known large eutrophic lakes that have earned the province of Imbabura the name of *Provincia de los Lagos,* also known as "the Switzerland of Ecuador."

8—Ecological Reserve of El Angel. The very wet páramo in this park is characterized by the presence of *Espeletia hartwegiana* (commonly known as *Freilejón).* The super-saturated soil gives rise to a large number of bogs and small lakes; all are yet to be studied. The largest is *Laguna el Voladero.* These lakes are an important hydrological reserve that provides water for the settlements located just below the reserve.

9—Chimborazo Reserve for Faunistic Production. Unlike the páramo in the Reserve of El Angel, the páramo in this reserve is very dry, a semi-desert. We have studied three small basins. Lake *Pucacocha* and Lake *Plateriacocha* are less than 1 km apart, and Lake *Cochabamba* is a vernal pond located 3 km south of Lake Pucacocha in a shallow depression. These lakes occupy a plateau between Mount Chimborazo and Loma Grande, not far from the Pan-American Highway. The terrain appears to have been glaciated, and the lakes collect melt-water from Chimborazo. All three are very shallow and abandoned shore-lines indicate the lake levels fluctuate. Pucacocha and Plateriacocha probably never dry out completely since they support dense stands of *Potamogeton* and *Myriophyllum.* Cochabamba certainly dries out periodically. These very shallow basins lack fish, and have water of high mineral content. Cochabamba is the only high-altitude lake where we have collected fairy shrimps (*Eubrachipus* spp.). These ponds provide an important source of water for the vicuña that has been introduced into this park. Just south of the reserve is the biggest lake of the province of Chimborazo, *Laguna de Colta.*

10—Cajas National Recreation Area. By far the most interesting region of Ecuador from the point of view of lakes is the Cajas National Recreation Area, also known as the "Cajas Lake District." It is only about 34 km from the city of Cuenca. The terrain has a peculiar knob and depression surface reminiscent of the "kame and kettle" topography of glacial landscapes. Over 230 glacial lakes dot the landscape. The largest and best-known ones are *Surucucho* (or *Llaviucu), La Toreadora, Lagartococha, Osohuayco, Mamamag* (or *Taita Chugo), Lluspa, Sunincocha, Ventana, Apicocha, Culebrillas* and *Illincocha.* Many of these lakes form

chains connected by small streams, being classic examples of a paternoster formation. Others are kettles (such as Toreadora) or cirque lakes (such as Lluspa and Surucucho). From these lakes originate the rivers Tomebamba and Yanuncay that supply the city of Cuenca with water. Trout has been introduced into most of these lakes, and one of them, Surucucho, has a trout hatchery. Because of their proximity to Cuenca, some of these lakes have been studied extensively. Surucucho is surveyed on a regular basis by the province's water quality laboratories (ETAPA) and faculty and students from the Department of Environmental Biology of the Universidad del Azuay. A detailed record of chemical and physical parameters and chlorophyll values are available from all months of the year for this lake since 1995. Sediment cores raised in June 1988 from Surucucho have yielded a detailed history of the region from full glacial times to the present (Colinvaux et. al., in press).

Conclusion

The above-described lakes are among the most important features of the landscape in all the mountain protected areas of Ecuador. They attract tourism because of their beauty and their trout fisheries. They play a major hydrological function, regulating both water flow and water availability. They attract wildlife from the surrounding area, and themselves contain a large biological diversity, particularly at the microbial level. Many of the lakes in the Andes of Ecuador are of historical, cultural, and archeological importance. Many pre-Inca people settled around lakes, and some of the lakes are still considered sacred by native people of the Andes, with the god *Catequil* as a limnic inhabitant.

Even though the lakes are in protected areas, they are under continuous threat from an expanding human population that may divert the water for irrigation or other uses, or may contaminate it with agricultural runoff or other pollutants. It is essential that all regulations and management efforts to protect the national parks and reserves of Ecuador consider lakes as an integral part of the landscape worth preserving for future generations to enjoy.

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Land Use Changes Directed Towards Sustainable Development in Los Santos Forest Reserve, Costa Rica

Resumen

Este artículo discute brevemente los cambios presentes y del pasado que los sistemas de uso de la tierra que suceden en una área de bosque tropical montano en Costa Rica. Desde el inicio de la colonización hace medio siglo, el área ha sufrido por la conversión de los bosques a la ganadería. A finales de los años 1970s ocurrieron cambios en el uso de la tierra, estimulados por la presencia de la Reserva Forestal Los Santos. La producción comercial de frutales en las parcelas pequeñas y la introducción del ecoturismo han causado el abandono de los pastizales poco productivos en las zonas altas de la Reserva. Los bosques secundarios que se desarrollan en las tierras degradadas por medio de recuperación natural parecen ofrecer posibles usos de la tierra alternativos en un largo plazo. El manejo del bosque maduro, la agroforestería y la reforestación con especies nativas pueden convertirse en opciones serias de usos alternativos de la tierra. Se cree que los cambios recientes y los que se esperan en el cambio de uso de la tierra contribuirán a una gestión sonora como parte del proceso regional hacia el desarrollo sustentable.

Introduction

The 62,000-ha Los Santos Forest Reserve (LSFR) in south-central Costa Rica is an interesting example of a protected tropical montane cloud forest area in which land patterns have been changing over the past two decades from inappropriate, often destructive, short-term agricultural practices, towards ecologically more wise land management options. Indeed, as in many tropical areas, deforestation in the LSFR had been taking place at alarming rates during the 1950s, 1960s, and early 1970s. However, since the establishment of the forest reserve in 1975 and the introduction of fruit trees and ecotourism activities in the early 1980s, regions such as the upper Río Savegre watershed area have shown an increase in socioeconomic development on an ecologically sound basis (Kappelle and Juárez 1995). The present paper puts these land use changes in a historical context and discusses the different sustainable land use options that have been implemented.

Administrative Status

The LSFR is administered by the Costa Rican Ministry of Environment and Energy. It is situated on the pacific slope of the Cordillera de Talamanca, where it borders the 612,570-ha Amistad Biosphere Reserve (ABR) (see Figure 1). Declared a biosphere reserve in 1982 by UNESCO, ABR has also been partially classified as a World Heritage Site (Whitmore 1990), and has been recognized as an 'Endemic Bird Area' (Long 1996) and a 'Centre of Plant Diversity' (Groombridge 1992). The LSFR is actually functioning as a buffer zone vital to the ABR, as it separates the densely populated central valley of Costa Rica from the remote largely undisturbed core areas of the ABR (Kappelle and Juárez 1994). Recently, the LSFR and the ABR have been included in the Amistad Conservation Area (ACA), which covers 7.8% of the Costa Rican territory and forms part of the National System of Conservation Areas (SINAC), which was created in 1989 to facilitate the administrative management of forest areas and the biodiversity conservation of the country in an integrated manner.

Ecological Characterization

The LSFR (9°25'–9°45' N; 83°40'–84°00' W) is located in the Cordillera de Talamanca, which is formed of intrusive and Tertiary volcanic rocks, alternated with marine sediments (Weyl 1980). Elevation ranges from about 500 m up to 3,500 m. Soils (Andosols: Histi Hapluland) are of volcanic origin, rich in organic matter, well-drained, and rather acidic, with pH values ranging from 3.7 to 5.0 (Kappelle et al. 1989; van Uffelen 1991) The climate is humid to perhumid with a relative humidity varying from 30% to 95% and an average annual rainfall of 2,812 mm at

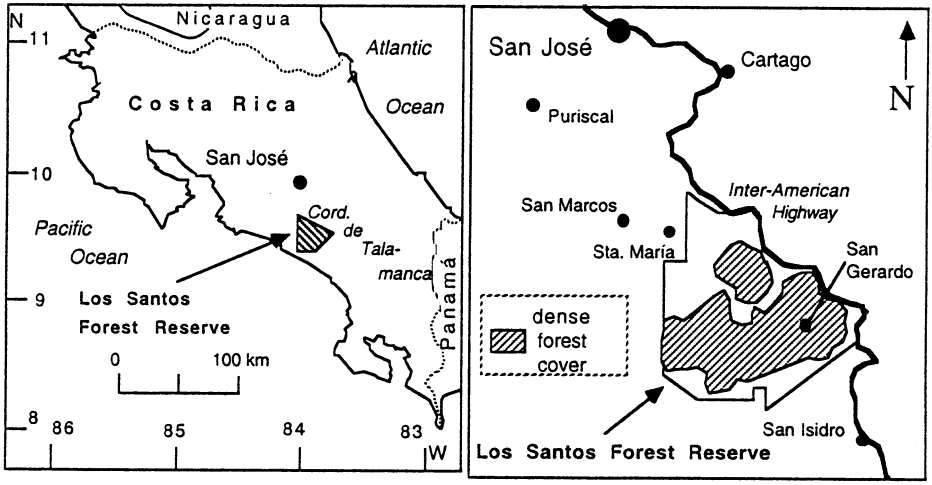

Figure 1. Location of the Los Santos Forest Reserve in central Costa Rica (left) with the reserve's dense forest cover as estimated in 1992 (right)

3,000 m altitude. The dry season lasts from December to April. Average annual temperature range from 14.5°C at 2300 m to 10.9°C at 3,000 m (IMN 1988; Kappelle 1992).

The vegetation of the upper Savegre watershed in the northeastern comer of the LSFR is characterized by patches of mature primary forest and 10- to 33-year-old recovering (secondary) forests, dense inaccessible shrublands, fern brakes, pasturelands with isolated trees, and fruit tree orchards (Kappelle et al. 1994, 1995). This diverse multifaceted landscape mosaic is the result of a past history of intensive logging and burning, and subsequent changes in land use (Kappelle and Juárez 1995).

Scattered and shredded tracts of mature tropical montane cloud Forest *(sensu* Hamilton et al. 1995) are still present throughout the LSFR. They are dominated by different 30- to 35-m-tall oak species: *Quercus costarricensis, Q. copeyensis, and Q. seemannii.* The subcanopy is characterized by tree species belonging to genera such as *Ardisia, Cornus, Ilex, Ocotea, Oreopanax, Nectandra, Myrsine, Persea, Styrax, Symplocos, Vaccinium, Viburnum, Weinmannia, and Zanthoxylum.* The understory consists of Chusquea bamboo clumps, geonomoid dwarf palms, cyclanths and shrubs within the Asteraceae, Ericaceae, Melastomataceae, Rubiaceae and Solanaceae. Epiphytic bromeliads, orchids, ferns, mosses, liverworts, and lichens blanket the branches of canopy and subcanopy trees (Kappelle et al. 1989).

Recent estimates suggest a total of about 3,300 vascular plant species in the LSFR (Kappelle 1996); Gómez (1989) indicated that some 1,000 species of vascular plants are to be expected in the ABR, most of which are non-tree species such as orchids and ferns. Probably about 30-40% of this vascular flora is endemic to the region. Zoological studies in the LSFR and ABR are scarce but the following native mammal species are known to reside in these protected areas: the ocelot *(Felis pardalis),* the puma *(Felis concolor),* the jaguar *(Panthera onca),* the coyote *(Canis latrans),* the tapir *(Tapirus bairdii),* the brocket deer *(Mazama americana),* two species of rabbits *(Silvilagus brassiliensis and S. dicei),* five species of mice (in *Oryzomys, Peromyscus, Reithrodomys, and Scotinomys),* the white-faced monkey *(Cebus capuchinus),* the howler monkey *(Alouatta palliata),* and the spider monkey *(Ateles geofroyi),* as well as a number of indigenous bats (Mora and Moreira 1994). Bird life is extraordinarily rich (Wilms and Kappelle, in preparation), the resplendent quetzal *(Pharomachrus mocinno costaricensis)* being the most spectacular of all.

Patterns in Land Use History

Ureña (1990) discussed the start of the colonization and deforestation process which took place in the 19th century with the introduction of coffee cultivation in the northeastern corner of the LSFR. Subsequently, migration of farmer families occurred

in a southeasterly direction into the greater part of today's LSFR, as a consequence of an increase in the area's population. The construction of the Pan-American highway by U.S. engineers in the 1940s boosted the development of small villages created in the early 1920s and 1930s when landless peasants settled down in the central part the LSFR. In the 1930s, the areas were colonized and cleared for land (Ureña 1990). Farmers dwelling at elevations of about 2,000 m dedicated themselves principally to timber extraction fuelwood collection, charcoal production, and blackberry cultivation. Forest lands were converted into extensive grasslands for low-intensity dairy-cattle ranching as well as for potato croplands. Indiscriminate deforestation by both local colonists and commercial lumber companies took place during the 1950s, 1960s, and early 1970s (Kappelle and Juárez 1995).

In order to halt further forest conversion, the Costa Rican government created the LSFR in 1975 (Bonilla 1983). As forest clearing became prohibited by law, lumber companies left and local peasants changed their inappropriate land use practices. Accidentally, fruit trees (apple, peach, plum) were introduced to the region at the same time as the establishment of the LSFR. Fruit tree orchards were established successfully from the beginning of the 1980s in several of the region's river valleys, such as the upper Rio Savegre watershed area.

Recovery Potential of Degraded Land

It has been demonstrated that most of the land use systems implemented between the 1950s and 1980s have been far from sustainable (Kappelle and Juárez 1995). Environmental mismanagement has included indiscriminate clearing and uncontrolled burning, leading to local fuelwood scarcity and severe land degradation, including irreversible soil erosion. Tropical montane forest habitats have become shredded and fragmented throughout the LSFR. Water resources for irrigation purposes have been reduced, limiting potato cultivation on arable lands. Water pollution from overuse of pesticides may have caused a decrease in the supply of good drinking water and an increase in health problems in the southeastern region of the LSFR (Kappelle and Juárez 1995). In the past, reforestation efforts were scanty, with plantations being less than a few hectares in size. In general, plantations made use of exotic tree species of the genera *Cupressus, Eucalyptus,* and *Pinus*. Unfortunately, plantations of promising native species, such as *Alnus accuminata* ssp. *arguta* are much less often seen. Agroforestry systems, such as the innovative combination of the native alder and different indigenous blackberry shrubs, are still in an experimental stage.

Recent research has shown that abandoned pastureland may recover from degradation through a process of secondary succession (Kappelle et

al. 1994, 1995). Ecological data from a chronosequential sere, including 8- to 32-year-old secondary forest and mature montane oak-dominated cloud forests in the LSFR, have shown that maximum canopy height and basal area increased linearly during the first three decades of recovery. A period of at least 80 years was estimated as the theoretically minimum time needed for structural recovery. However, the maximum canopy height and basal area recover two to five times slower in upper montane cloud forest than in lowland neotropical forest (Kappelle et al. 1996). Terrestrial vascular plant diversity as measured by Shannon-Wiener's index appeared to be equal or even higher in secondary forests compared with primary montane forests due to downslope migration of numerous subalpine species into cleared and recently abandoned montane sites. Using linear regression, the minimum time required for floristic recovery following disturbance and abandonment was estimated at about 65 years. A comparison with other studies shows that secondary forests in the upper-montane forests of the LSFR can be as diverse as those in the tropical lowlands (Kappelle et al. 1995).

Some key factors influencing the rate of forest recovery on abandoned lands are the nearness of seed sources, the presence and success of seed dispersers, and the size and composition of seed banks. Ten Hoopen and Kappelle (in press) studied the effects of forest vicinity on soil seed banks in pasturelands at forest edges in oak-dominated forests of the LSFR. They took soil seed-bank samples along four 50-m-long forest interior–edge–exterior transects and placed the samples in a greenhouse for a germination experiment. After a four-month period, a total of 4,096 seedlings in 50 species had emerged. Significantly fewer species germinated from soil seed-bank material collected in mature forest in comparison with pastureland, stressing the recovery potential of the latter.

Research on frugivorous bird species' diets, behaviour, distribution, diversity, and habitat preferences in the LSFR's mature and secondary montane cloud forests and pasturelands has demonstrated the presence of a number of avian seed dispersers playing a key role in forest restoration (Wilms and Kappelle, in preparation). Data suggest that fragmented forest depends on seed dispersal by birds for a successful recovery and regeneration process. Indeed, the presence of isolated ornithochorous tree species in open successional plant communities seems to be an important factor for attracting birds from mature forests and accelerating the process of forest restoration. Bird attracted to lauraceous tree species have been recommended for the restoration process.

Towards Sustainable Development

During the last two decades many changes in land use have occurred in the LSFR. These changes have made this forest reserve into a better func-

tioning buffer zone bordering the megadiverse ABR. New land use options directed towards an environmentally sound socioeconomic progress are presently being developed. One of these options concerns sustainable mature forest management. This has been proposed for the Costa Rican montane oak forests by different authors (e.g., Aus der Beek and Sáenz 1992; Jiménez and Picado 1992; Chaverri and Hernández 1995). Jiménez and Picado (1992) propose silvicultural treatments at two levels: (a) felling and extraction of some overmature and mature canopy trees, and (b) felling and extraction of subcanopy individuals, with the aim to improve the proportion of commercial species in relation to non-commercial ones. According to Chaverri and Hernández (1995), such a silvicultural treatment must be selective, thus ensuring the actual age structure, and must include two different felling intensities in order to utilize 8% of the trees with dbh values over 90 cm. Of course, damage to the remaining vegetation should be minimized and extraction should be monitored. Stadmüller and Aus der Beek (1992) did experiments during which 20-30% of the basal area was extracted in the LSFR bordering Rio Macho Reserve. However, Stadmüller (1993), in his study on the impact of selective logging on the herbaceous vegetation, showed that these treatments probably need refinements, as pioneer species seem to have taken most advantage of the disturbance, suppressing the establishment of primary forest species, at least temporarily.

Another possible land use option concerns the management of secondary forests. Recently, there has been an increase in knowledge about tropical lowland secondary forest management (Finegan 1992; Sips 1993); still, little is known on the potential of second growth in the montane tropics (Kappelle 1994). As has been pointed out earlier, montane secondary forests in the LSFR may establish on old abandoned fields and extensively used pasturelands through a process of succession. Their area is rapidly expanding as pasturelands are becoming abandoned. During the last decades, dairy-cattle ranching has become relatively less profitable, since yields from recently established fruit orchards were increasing substantially and farmers needed less area for fruit cultivation. Secondary forest management in the LSFR appears to be a low-cost and high-benefit socioeconomic option, because these recovering forests can grow without much human labor. After clearing, a decade of grazing and subsequent abandonment, a still healthy forest recovery process may start—given nearby seed sources and seed dispersers. In this way, ecosystem recovery and restoration of key ecological functions are stimulated, and a new, natural resource with a socioeconomically high potential value is created. Initially, the second growth's vegetation cover protects the fragile soils against erosion and restores the area's hydro-

logic function, while in the longer term they may be used for timber production and fuelwood collection. They also may form corridors connecting isolated patches of pristine primary forests, and thus increase the survival chances of numerous animal species. As succession proceeds, the usefulness of recovering forests may be improved by favouring desirable native tree genera such as *Alnus, Buddleja, Cornus,* and Lauraceae through thinning and enrichment practices. In this manner, a high-yield, multipurpose forest resource may be obtained, which in the long run takes away the pressure from the mature montane forests.

A serious alternative for development may be reforestation with native species. At this moment, exotic species dominate reforestation programs, despite that their often negative effect on soils and herbaceous vegetation is well known (cf. Lines and Foutnier 1979; Morris 1985). Arnáez et al. (1992) have demonstrated the reforestation potential that have species native to the LSFR, such as *Brunellia costaricensis, Cleyera theaeoides, Cornus disciflora, Drymis granadensis, Laplaceae* sp., *Magnolia poasana, Nectandra whitei, Ocotea* spp., *Podocarpus macrostachyus, Prumnopityus standleyi, Schefflera rodriguesiana, Weinmannia pinnata,* and different species of *Quercus.* However, the presence of soil ectomycorrhiza is a fundamental condition for a successful planting programme which include *Quercus* spp., *Alnus acuminata,* and *Salix* sp. (I. Rojas and G. Mueller, personal communication).

Agroforestry is another land use system promising a high level of sustainability in the region. Mata (1992) mentions the combination of *Alnus* and *Rubus* as a land use type with a high potential for the more elevated parts of the LSFR. Such an agroforestry system may help control soil erosion on steep slopes as the combination of different vegetation layers at one point strongly reduces the erosive impact of local rainfall.

Over the last ten years, ecotourism has been booming in Costa Rica and its montane cloud forest areas (Aylward et al. 1996). Presently, the upper Río Savegre watershed area is one of the main centers of ecotourism activities in the LSFR. As this watershed area, including the village of San Gerardo de Dota, is situated along the Pan-American highway at a two-hour drive from the capital San José, it has become an excellent site for nature-loving visitors, especially bird-watchers. Today, local farmers are earning an additional income as guides, taking tourists on a trip along nature trails through the bird-watcher's paradise, the tropical montane cloud forests. Spectacular birds include the resplendent quetzal and the emerald toucan. It is believed that ecotourism may become a significant alternative source of income for many farmer families in the near future; however, it is stressed that ecotourist activities should be controlled, taking into account the maximum capacity of the area and the number of

visitors the LFSR's montane cloud forest can bear. Only in this way can the requirements of a truly sustainable form of ecotourism be met, promoting economic development which is socially just and ecologically sound.

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The Rio Abiseo National Park, Peru

Resumen

El artículo presenta una visión de uno de los parques de montaña más espectaculares del Perú, en el Río Abiseo. Cuna de culturas preincaicas y sitio de ciudadelas arqueológicas todavía cubiertas por selvas de neblina, el Parque Nacional Río Abiseo ha sido declarado Patrimonio Mundial de la Humanidad. Sin embargo, los riesgos de un mal manejo en las zonas de amortiguamiento y la construcción de caminos se presenta como una amenaza real a la integridad del Parque. Un llamado especial para fomentar la investigación científica, especialmente en lo que se refiere a la fisiología del paisaje se presenta junto con la necesidad de mayores estudios de flora y fauna.

Introduction

The territory of Peru is one of the most diversified within the Neotropical realm. It encompasses littoral and coastal deserts, punas (barren, windswept high-elevation tablelands and basins), highland plateaus, tall mountains, ice-capped volcanoes, and tropical rain forests that extend from the Andean piedmont of the eastern flanks down towards the Amazonian flood plains. In this vast and complex scenery it is easy to find a variety of climatic and physiographic conditions, soils, flora and fauna associations that define montane habitats, as well as numerous mountain ecosystem types that create dynamic landscapes within the ecoregions that follow the longitudinal axis of the Andean cordillera.

According to latitude, Peru is a tropical country; hence, the Andes determine the country's special bioclimatic structure, which is marked by strong contrasts. It is the complexity and altitudinal variation of the relief which allows the high biodiversity so typical of Tropandean landscapes. Biodiversity still thrives despite the ancient influence of humans in montane environments, even after the depredations of recent years. If this trend persists, its consequences will affect the whole of humankind at a global scale.

The Peruvian Andes are not only a melting pot of biological richness and other natural resources, but are also rich from the standpoint of human history. Here, one of the most important centers of civilization developed, and greatly contributed to the universal quest for technological advancement. It suffices to mention the Inca's architecture, with spectacular designs of irrigation channels, fortresses, and temples that amazed the Spaniards upon their arrival. Today, some ruins

have been discovered and reconstructed as museums (e.g., Macchu Picchu), but there are many ruins that underlie the jungle, hidden by the exuberant growth of the tropical montane forest.

In a geographical and sociohistorical context, we present some background on the Río Abiseo National Park (RANP), one of the most impressive mountain protected areas of Peru, located in the eastern flanks of the Andes, on very steep terrain of the San Martín Department.

Historical Outline of the Park

In the 1960s, after archaeological work in the area provided precise evidence of ancient artifacts and ruins still in place beneath the jungle (in particular of the complexes at the headwaters of the Abiseo River), interest in the area grew rapidly, motivating more scientific expeditions as well as explorations of a different nature: speculative treasure hunting.

Between 1979 and 1981, preliminary studies about the area's fauna and flora were conducted in order to establish a national park, with the name "El Gran Pajatén," covering an area of approximately 574,800 hectares. One year later, the National Agrarian University of La Molina presented another park proposal, this one leaving out the Pajatén river basin, because that area was to be included in a future road construction project to link several towns of the east with the cities of Trujillo and Huamacucho. The rural development priorities of the central government determined that the road proposal was approved. So a Supreme Decree of August 11, 1983, created a new, smaller protected area in lieu of the previous Pajatén park. This was Río Abiseo National Park, which covers over 274,500 hectares in the department of San Martín.

Highlights of the Park

The Abiseo River basin has enough natural features to qualify it as one of the more interesting units of the Peruvian Park System from the scientific point of view. It is probably one of the best examples of the cloud forest ecosystem in the Tropandean region of Peru. To the biological richness of the area, proper to the rain forest biome, the addition of spectacular archaeological sites of small pre-Conquest cities ("ciudadelas") adds an immense cultural value to the landscape.

The RANP is located in the district of Huicupungo, in the province of Mariscal Cáceres of the department of San Martín. The RANP ranges from puna (4,200 m elevation) to lowland pluvial forested plains (500 m elevation), in the area known as cloud forest. The Yunga formation of the park encompasses the whole Abiseo River basin, which drains to the Huallamba river on a route to the bigger Huallaga river. The territory is mountainous and very steep, with deep brooks and gorges and inclined slopes, where the sequence of hills and mountains ascend to the páramos of the Cordillera. Altitudinal belts are not

obvious due to a thick continual forest cover that minimizes ecotonal properties.

The most spectacular formation of the cloud forests is the abundance of mosses, that in some cases cover entire trees, where they are supported with other species of the forb community in the "hanging gardens" of epiphytes. The sponge-like function of the "mossy forest" of the Abiseo River is a perpetual water tower that supplies and stores water in permanently saturated water tables, feeding major hydrological collectors in the Montecristo river to the north, and the Abiseo river to the south. In the center of the park, the catchment is collected by the Tamac river that drains to the Abiseo river.

In the park, studies have identified five major tropical life zones, namely:

- Subalpine pluvial páramo;
- Montane pluvial forest;
- Lower montane pluvial forest;
- Pre-montane pluvial forest; and
- Pre-montane rain forest.

Geomorphology is closely linked with orogenic and tectonic events of the Andean cordillera, started in the Tertiary Eo-Palaeocene, or maybe earlier, as supported by some authors. The presence of sandstone and limestone, both of sedimentary origin, tell stories of depositional environments; however, igneous rocks are observed in segments of the river bottom, and metamorphic rocks have been washed downstream.

Importance of the RANP for Conservation

The value and importance of the RANP was signified on December 14, 1990, when UNESCO declared the park as a World Heritage Site. From then on, efforts for its preservation, conservation, and management have been much better, with encouraging results. At present, the RANP is administered by INRENA (Instituto Nacional de Recursos Naturales) and the INC (Instituto Nacional de Cultura) as well as by other collaborating institutions. Because of its extreme fragility, the Park is one of the few areas in Peru yet not open to the public, which is also a direct result of both the difficult access and the lack of infrastructure for administration and protection.

There are several proposals for the use of the park. Tourism use is one of the most appealing. However, in the territory we are describing, any action should follow strict rules from technical recommendations of environmental impact assessments and serious research. It would be also important to consider the sociopolitical and economic advice of cost-benefit analyses. Two of the most important recommendations to preserve the richness of the RANP is to avoid the settlement of population centers around the reserve, as well as the licensing of rights for timber exploitation. Road construction is another risk to the integrity of the RANP. However, the interest in the area should allow the government of Peru and several international development agencies to

succeed in the conservation of relicts of nature and culture in the Tropandean piedmont of the Peruvian Amazon.

Río Abiseo Flora and Fauna

All visitors are surprised and astonished by both the scenic beauty and the ruins of ancient cultures in the park, as well as by the biological richness and exuberance of mountain jungles. Many species of plants and animals are endemic to the area. Probably the most famous inhabitant of the park is the yellow-tailed monkey *(Lagotrix flavicauda),* an endangered primate (Leo 1995). The entire area of the park is new ground for biological inventories. Also, ecological studies of reciprocal dependency and other attributes that may have application to biotechnology remain to be done. This is important if we consider that the cloud forests are sites of great endemicity for life on the planet. They are possibly the last refuges of innovative evolutionary adaptations and unknown life forms to be yet found in Tropandean landscapes.

Preliminary studies made by the Museum of Natural History of the Universidad Mayor de San Marcos, Lima, and collaborators at the University of Colorado, Boulder, have registered an impressive list of animals. A summary list shows the contribution to science and the important endemic component of the groups: herpetofauna: 21 species, 7 new to science; birds: 132, species, 3 endemic; mammals: 46 species, 6 new to science; fishes: 3 species, 1 introduced.

Most of these species are to be found in the eastern flank of the Andean crescent and the Amazonian lowlands. Nevertheless, the endemics are a result of individual microclimates and geological history of episodic events in rather isolated hilltops.

Human Occupation of the Area

One of the aspects that offers exceptional historical and cultural value to the RANP is the presence of archaeological small cities (or "ciudadelas") in the upper reaches of the Montecristo river, in the midst of the cloud forest, in an area known by experts as the archaeological complex of "El Gran Pajatén." A closer look to the Pajatén reveals a urban complex built strategically on the summits of hills and in the cliffs of the area, where the access must be through passages along slopes and menacing walls in the gorges ("hoyadas"). All buildings have a circular design, and are made of limestone carved with elaborated fine ornaments in the form of rhomboids and anthropomorphic and zoomorphic figures. They reveal a unique symbolism found in a syncretism of Andean and tropical (i.e., mountain and plains) motifs.

Without a doubt, the monumental signs of past human occupation and the increased modern presence in the area enriches a true perspective to understand Andean civilizations and the important role of the montane

tropical forests of Amazonia. Populations settled there discovered their own pathway of development needs, expressed their means of dominion, land-use and knowledge of appropriate technology for mountain architecture and urban design.

Current debates on sustainable development in the Andes should heed the lessons left us by the inhabitants of the Gran Pajatén complex in the RANP. The whole of the Andean world might have reached the true apex of its development in these mountain societies whose complicated constructions on steep slopes brought forth—in comparison with the Iberian landscapes of the newcomers—images of the scaffolds ("andenes" for the Spaniards) used to erect the relatively high buildings of Europe. Although the native Quechua name of "Anti" (meaning "copper") is thought by some scholars to be the origin of the name of the Andes mountains, linguists now recognize the possible origin of the word in "andenes"—that description of impressive hanging gardens, steep fortresses, and irrigated agricultural terraces which can be seen only in such places as Río Abiseo.

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Fausto O. Sarmiento

The Quijos River Valley:
A Protected Landscape as Best Management Practice for Conservation and Development in Tropandean Ecuador

Resumen

Tres importantes áreas protegidas en las montañas de Ecuador nororiental han dejado una franja de terreno sin clasificación de conservación. Curiosamente, estas áreas y el valle del río Quijos en la mitad, siempre han sido utilizadas por los humanos; incluso desde antes de la Conquista, las rutas comerciales de montaña hacia la Amazonia entrecruzaban el área. El conocimiento de estas rutas fue usado por Francisco de Orellana y su famosa expedición que descubrió el río Amazonas. Con la construcción de caminos de penetración y la sucesiva explotación de la base de recursos del área, la ciudad de Baeza y su zona agrícola asociada experimentaron ciclos de abundancia y escasez que reflejaban la explotación de madera, de naranjilla, de caña de azúcar, de árboles frutales y de la ganadería. Por último, luego del influjo petrolero de los años 1980s, Baeza y el valle del Río Quijos soportan el influjo de bienes transeúntes y de servicios esporádicos asociados al trabajo del petróleo. Más recientemente, una industria incipiente de ecoturismo esta emergiendo, de tal suerte que se espera un nuevo ciclo dependiendo de la explotación de truchas y destinos turísticos. Sin embargo, para que este vaivén sea sustentable, se debe desarrollar una planificación integral a nivel de paisaje. Se propone considerar al valle del río Quijos como un Paisaje Protegido, consolidando un corredor de conservación andino en las cabeceras amazónicas, de gran trascendencia para la conservación de la ecodiversidad de la región.

Introduction

The Quijos River drains the tertiary watersheds of the Cayambe and Antisana mountain complexes, flowing east to form the Coca river, which in turn drains to the Napo river and then to the Amazon. The mountain pass of Guamaní, with its characteristic *Polylepis* woodlands, is located straight east from the capital, Quito. Ancient mountain routes facilitated trade between the Amazonian lowlands with the interandean plateaus. A famous one, for instance, is the mountain trail or "culunco" connecting the towns of Pifo and Oyacachi on each side of the continental divide. Other well-known routes connect Saraurco in the cisandean domain to Cayambe; yet other runs towards Puruhanta Lake and Pimampiro in the interandean domain.

The strategic importance of this natural corridor was always understood by the local inhabitants, people of mountain jungles who developed a strong cultural presence at the sites of Cosanga and Baeza. Indeed, the Quijos Indians were famous for their hunting abilities and artistic productions, including pottery and ornaments of gold and silver. The Quijos salt trade was legendary, and the chiefdom of Quijos was a very important component of the Yumbos (a name used by the Spaniards to refer to mountain people) of the Eastern Quito kingdom. The importance of the cultural center in Cosanga, for instance, rivals that of other settlements in montane environments, having had numbers even greater than today's population, much like a case reported for the Tairona Indians in the Sierra Nevada de Santa Marta, Colombia (Kendall 1997). Archaeologists have estimated that about 25,000 people lived in the Quijos river valley during the Cosanga phase (Porras 1961).

The Quijos Indians were brave warriors who were not subdued by the Incas during their brief presence of 80 years in Ecuadorian territory. Also, chroniclers wrote about fierce resistance put up by the Quijos Indians towards the Spaniards, and tales of the leader Jumandi, who commanded a bloody rebellion, are told even today (Sarmiento 1955). It is said that after expelling the Spaniards from the montane site of Cosanga and Baeza, Jumandi went to seek refuge in caves nearby, part of a network of limestone formations that extend southward into the Tayos cave complex, the largest in the country.

The Door to the Amazon

The potential richness of the mythical "El Dorado" envisioned by the Spaniards was seemingly closer in the Quijos territory. By means of the Orellana entrance through the Quijos valley, the "door to the Amazon" was open in such a way that its large Indian settlement and strategic location motivated the Spanish rulers to bestow a title of nobility on the newly created city of Baeza. Only two other cities in the country, Quito and Cuenca, held such an honorary title, signifying nobility and loyalty to the crown of Spain. The foundation of the "Muy Noble y Muy Leal Ciudad Baeza de los Quijos" was a landmark in the expansion of western culture into mountain jungles and, later, into the Amazon territory. From many accounts, all through the Colonial era penetration to the "Oriente" was done through this mountain pass (Sarmiento 1958).

The city of Baeza de los Quijos, now known simply as Baeza, is the administrative center of Quijos county. (The other county with jurisdiction in the valley is El Chaco.) In 1994, Baeza was formally named as an Ecuadorian Cultural Heritage Site, in recognition of its historical significance. Several towns—as old as the attempts to colonize the Amazonian piedmont—exist along this mountain pass. They tell a story of forest frontier expansion based in re-

ligious creed (San Francisco de Borja, Santa Rosa, San Rafael del Reventador, San José de Dahuano, San Vicente de Huaticocha, etc.). This epistemographic effect also has been described for the mountain forests of northwestern Ecuador (Sarmiento 1995). The rich flora and fauna associated with the nearby protected areas is now rare amidst the surrounding open pasture land (Figure 1); they are to be managed in a private protected forest of the Cumanda Reserve (Vivanco 1996) and the Ecological Corridor Borja-Sumaco.

Three Surrounding Protected Areas

The Quijos River valley is located between three important national conservation areas (Figure 2):

- The oldest, to the north and west, is the Cayambe-Coca Ecological Reserve (CCER), protecting ecosystems from the snow-capped mountain of Cayambe, right on the Equator, down to the piedmont of the Coca river.
- The Sumaco-Galeras National Park (SGNP), towards the east, which encompasses mountain forests and isolated montane formations of tepui-like antiquity on the eastern Andean cordillera, protecting headwaters of important tributaries of the upper Napo River, such as the Cosanga, Machacuyacu, Payamino, Misahuallí, and Hollín rivers.
- The newest conservation unit is the Antisana Ecological Reserve (AER), towards the south, which

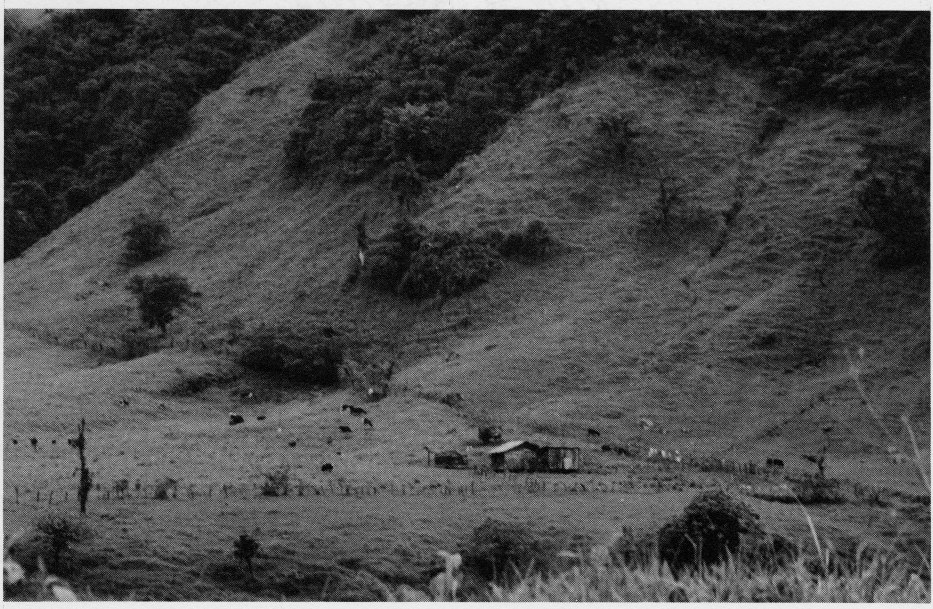

Figure 1. Pasture land typical of the Quijos River valley

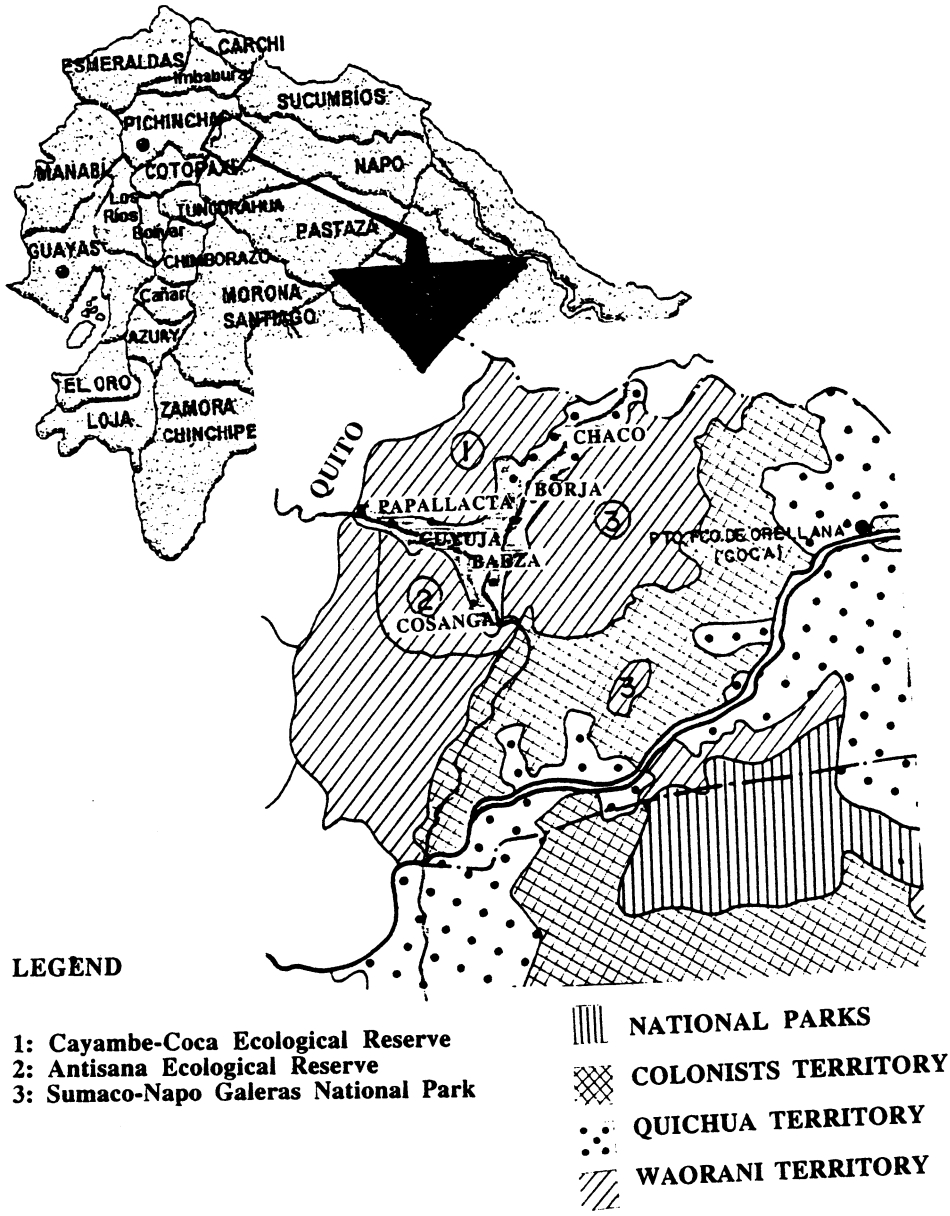

Figure 2. Protected areas in the vicinity of the Quijos River valley

actually touches the limits of the previous reserve at the Osayacu ridge, contouring the 2,500 m altitude mark towards the perpetual glaciers of the Antisana volcano, over 5,000 m in elevation (Sarmiento 1992; Ulloa et al. 1997).

Table 1 shows a synopsis of the protected areas conveying the obvious connection through a conservation corridor.

The juxtaposition of the boundaries of the SGNP and AER, and their proximity to the CCER, provides for the connectivity of dispersed wildlife populations and the maintenance of local biota. From the Las Antenas summit, near Baeza, you can see the three areas in a single glimpse. The space in between the reserves is threatened by expanding agricultural practices and cattle ranching on sloped terrain. As in many other governmental protected areas, the limits are not established on the ground and people do not respect the conservation status. A common sight in the valley is a brand-new cut ("desmonte"), followed by more pasture, a problem of habitat conversion reported elsewhere (Aide and Cavalier 1994; Churchill et al. 1995; Sarmiento 1997a, 1997b) for montane environments.

Table 1. A comparison of the protected areas around the Quijos River valley. It shows the convenience of developing a conservation corridor among them. A proposed protected landscape management category is set forth in this paper.

Protected Area	Management Category	Area (ha)	Date Created	Altitude Range (m)	Forest Type
Cayambe-Coca	Ecological reserve	120,000	1970	600-5,790	montane cloud
Antisana	Ecological reserve	403,103	1993	300-5,076	montane cloud
Sumaco-Galeras	National park	205,249	1994	300-3,732	montane cloud
Borja-Sumaco	Conservation corridor	50	In progress	1,650-3,200	montane cloud
Cumanda	Protected Forest	330	1994	1,800-2,500	montane cloud

Note: Although the forest type is the same throughout, the montane cloud forest formation may be considered as encompassing the following life zones: montane tropical humid forest, montane tropical rain forest, subalpine rain forest, subalpine and nival forest, premontane tropical rain forest, lower montane humid forest, and upper montane humid forest (Cañadas 1983).

Population Pressure in the Area

Along the valley of the Quijos river very old settlements can be listed: Papallacta, Cuyuja, Baeza, Borja and El Chaco are towns located in the valley's plateaus along the penetration road towards the cisandean foothills to the north. From Baeza, other small towns are located following the road towards the sugar cane and tea fields of the central eastern Andean foothills. Along the road, several small "caceríos" have been established; these small urban nuclei are affecting the likelihood of conservation of the reserves. Poaching of animals from inside the protected areas and mature forest conversion to pasture is rampant (Wesche 1995).

After an earthquake that affected the area in 1987, infrastructure development received attention, with a view towards constructing better roads and safer buildings. The city of Baeza was relocated to a peneplain nearby, where residences, schools, hotels and open markets are laid out in a grid. However, waste is directly dumped to the Machángara river nearby. It is possible to find traces of solid waste down the river into the Quijos.

The classical steep-slope erosion process of "pie-du-vache" is noticeable all around Baeza, where a milk-collecting and dairy-processing facility of Nestlé, Inc., is located. The current vogue is to import a variety of foxtail grass developed to resist tropical weathering in sloped terrain, because of the low maintenance cost of *Setaria sphacelata* pastures, due to the effect of expanded tillers and massive root-mass production. The tussock of the grass is very competitive and reduces the chances for natural regeneration of abandoned pastures. Recalcitrant seeds of nurse trees in nearby patches are not able to establish conventional successional pathways (Sarmiento 1997b).

A Protected Landscape Candidate

The status of "protected landscape" is unknown in Ecuador. Integrating the people's needs and biodiversity conservation is the approach for this, the fifth category in IUCN's protected area classification. However, in the most recent survey of Ecuadorian protected areas (Ulloa et al. 1997), those areas which could correspond to an IUCN Category V protected landscape are instead forced to fit under the local appellation "national recreational area." This designation lacks the protected landscape's emphasis on understanding and involving local communities as a priority, and instead targets ephemeral tourists or other recreational users.

A protected landscape designation would fit perfectly for the Quijos river valley, where a great deal of concern exists within several nongovernmental organizations, including the Fundación FunRAE, the Fundación Rumicocha, the Fundación Antisana, and the Fundación San Rafael Lodge, among others. Local governments are also in favor of the adoption of new approaches for development. For example, the municipality

and the provincial council favor ideas for an ethnobotanical garden as well as for an on-site ecomuseum. Since the Ecuadorian government declared the city of Baeza a national cultural heritage site for its historical importance, restorations of local architecture and historical landmarks of the conquest of the Amazon may be easily found in the town. The designation of Baeza as a national heritage site is a strong indicator of the need for a management category that considers a cultural landscape–lifescape approach. Also, the Quijos River valley has been the site for international development programs, such as SUBIR. Several failed attempts from SUBIR to link economic development and nature conservation are present in the area; despite this, the people of the region are hungry for alternative, environmentally friendly options, now that a rapport between conservation and development has been established in the communities (Chaverri et al. 1997).

Forest-cover maintenance is a priority for the upper reaches of the valley, where the Rumicocha lake is located near the town of Papallacta. This area serves as a reservoir for the potable water supply to Quito. Other attempts to alter the drainage of the basins to provide water to the ever-growing needs of the capital are underway, threatening the integrity of the ecosystems of the Quijos valley. A comprehensive plan for environmental assessment is needed to review the fee schedule of the conservation corridor and complex, considering that it provides such an enormous environmental service to Quito. Moreover, considering the Quijos valley as a protected landscape will foster conservation in an ecoregional context, promoting the biggest consolidated protected area in the country. The natural corridor that the complex would create should be a pioneer for the new approach of conservation biology, and for the restoration of degraded landscapes, providing longer-term economic and cultural incentives to local people. Declaring the first Ecuadorian protected landscape in the Quijos River valley would be the best management practice to allow for restoration projects and sustainable enterprises.

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Environmental Values and Ethics in the Kola Peninsula, Russia

Based on information published in 1996 in THE GEORGE WRIGHT FORUM (Robert E. Manning, William A. Valliere, and Ben A. Minteer, "Environmental Values and Ethics: An Empirical Study of the Philosophical Foundations for Park Policy," Volume 13, No. 2, pp. 20-31), we have distributed the following questionnaire (Table 1) among school teachers and pupils in the higher forms in the community around the Lapland Biosphere Reserve, which occupies part of the Kola Peninsula in Murmansk Province in far northeastern Russia. Two hundred ninety-five completed questionnaires were returned. Each questionnaire contained 16 assertions about reserve values. Respondents were asked to indicate which of these assertions they agree with. Each person could agree with as many assertions as he or she wanted, as long as the responses did not contradict one another. The total number of responses was 1,011, which were distributed as follows.

Aesthetic values (assertions number 1 and 8) were identified in 9.3% of the responses. Ethical assertions (numbers 4, 6, 14, and 15) constituted 29.1% of the responses. Belief that reserves are important for better knowing the world (numbers 3 and 5) was expressed in 9.7% of the responses.

The idea that humans are responsible for caring for the rest of nature (numbers 2, 7, 10, and 16) garnered the most responses: 47.9%. Assertions expressing merely consumer treatment of nature (number 12 and 13) made up only 3.7% of the responses. Finally, no one agreed with the negative assertion that "reserves are not necessary" (number 9) and only three responses (0.3%) considered that humans and nature are fundamentally different (number 11)

The "champion" assertion (number 10), forming 13.4% of the responses, was that "as a part of nature, humans have a responsibility to care for the rest of nature."

The results of the questionnaire are amazing and wonderful. For decades, Communist propaganda drummed into people's heads from childhood such slogans as "We cannot wait for favors from nature, our aim is to take them from her" or "The best nature protection is a use of her riches," etc. Striving to promote a primitive consumption ethic was the official attitude to nature in the former USSR, and was valid until now in Russia. It is really amazing how

few supporters there are for such points of view among the respondents.

When examining the results of the questionnaire one has to take into account that visits to and most uses of Russian reserves are strictly controlled, in contrast to American national parks. If it were otherwise, it seems that those who would like to enjoy the beauty of nature and outdoor recreation activities in reserves would be in the majority.

It is highly encouraging that ordinary people, especially teenagers, manifest a more enlightened and mature attitude to environmental problems than decision makers. This suggests reason for optimism and hope.

Table 1. Questionnaire concerning reserve values

I consider reserves as a place:	
1. to enjoy the beauty of nature & outdoor recreation activities	6.7%
2. to protect the environment in order to ensure our own survival	10.0%
3. to conduct scientific studies on the natural environment	6.2%
4. to express our ethical obligations to care for other forms of life	7.2%
5. that is important to the history of our country	3.5%
6. to get closer to God	5.3%
I consider reserves to be important because:	
7. they will be valuable for future generations of humans	13.0%
8. I simply like knowing they exist	2.6%
I consider that:	
9. reserves are not necessary	0.0%
10. as part of nature, humans have a responsibility to care for the rest of nature	13.4%
11. humans and nature are fundamentally different	0.3%
12. nature is the store of raw materials	1.5%
13. humans should manage nature as efficiently as possible	2.2%
14. humans should protect nature because it is God's creation and it is sacred	8.3%
15. humans should not cause needless pain and suffering to animals, because all living things have a spirit	8.3%
16. protecting of nature is necessary to human survival	11.5%

Percentages are of the total number of responses (n = 1,011)

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Vlado Vancura

Land Ownership and Park Management:

A Note on the Experience of Tatra National Park, Slovak Republic

The American Model

National parks usually represent the prime examples of each country's natural heritage. Their uniqueness is often the subject of unique legislation and government policy. The main goals of national park designation are to endeavor to protect remnants of nature in its more or less pristine state, to follow international standards for protected areas, and to find a framework for dealing with local people, landowners, visitors, and other park users.

During the emergence of the modern protected area movement in North America, at the turn of 19th and in the early 20th century, planners generally tried to exclude private property from park territory. As this approach developed, the planners very soon found out two things. First, that parks were getting surrounded by private land which complicated or even made impossible the enlargement of the park for ecological reasons (such as to include wildlife migratory routes, or set to the boundary more logically at the limits of a watershed, mountain ridges, rivers, etc.). Second, that creating parks in heavily populated parts of the country would very soon become almost impossible because of a lack of federal property and the unwillingness of private owners to share or sell their rights to the federal government.

The logical solution can be summed up in a single word: "cooperation." Easily said, but hard to do. In the American park model, to cooperate and find compromise was and still is very difficult. To find an accommodation between the mandate of protecting nature in the park and the desires of landowners—which can usually be formulated along the lines of "Let us do the same things that we were doing before," or, "Let us live the same way of life that we lived before"—is a very, very difficult task.

The Early European Experience

The development of parks in Europe was quite different. The end of the 19th century found Europe with a relatively high density of population and more or less depleted natural resources. But most importantly, Europe largely lacked large, pristine tracts of country, uninhabited and untouched by human activity. The different scale of the continent, the different density of human population, and the much, much more complicated ownership situation were all reasons why it was not possible to simply transfer the American model to Europe.

The first national park in Europe, for example, was the Parc National Suisse, created in 1914 in the Swiss Alps. The park planners chose about 16,800 hectares of community land in a high part of the Alps along the Swiss–Italian border. This land was very heavily used in the past. Most of the native forest was almost gone by the 15th and 16th centuries, having been cut for timbers used in the building of salt mines in Austria and for manufacturing charcoal used in industry.

The Swiss League for Nature Protection, the government, and local communities and landowners signed an agreement for a long-term (25-year) rental of future park territory. Since the park's inception, the land has been left unaltered, giving it a unique chance to recover from prolonged human interference. Underlining this unusual approach was the fact that each Swiss inhabitant donated one Swiss franc as the first rent installment. Since then (i.e., for more than 80 years), the agreement has been periodically prolonged, and the park has become part of local tradition and history—indeed, a part of Switzerland's heritage. From a scientific point of view, the park is a rare place in the Alps where nature has gotten a chance to recover itself.

Tatra National Park in the Slovak Republic

A few years after the Second World War, the transboundary Tatra National Park was established at the northern edge of Slovakia, together with lands over the Polish side of the border. The idea for an international park dated back to the founding of the modern republic of Czechoslovakia at the end of World War I. At that time, a park project prepared by a Czechoslovak–Polish team of experts failed because of a number of complicated issues related to land ownership, such as the fear that a park would mean restrictions on such traditional economic activities as grazing, logging, mining, and hunting. Thus, the idea to transfer the North American park experience to Czechoslovakia failed. It was premature to expect to replicate the Glacier–Waterton experience in the initial Tatra proposal. Land users and landowners simply would not accept the idea of sharing their property and their rights with the general public. In spite of this situation, in the 1930s the Czechoslovak government, looking forward to the day when a park might be created, gradually purchased a few thousand hectares of private and community land in the most valuable parts of the park project area.

The Second World War passed and, in 1947, Communism emerged victorious in Czechoslovakia. At a single stroke the problem of recalcitrant landowners was solved: the new government simply nationalized all the land in the country. Less than a year later, Tatra National Park was established.

Forty years later, after Czechoslovakia was partitioned into the Czech and Slovak republics in the aftermath of the 1989 "Velvet Revolution," the

situation was again turned on its head. The new, democratically elected parliament passed a law dealing with reprivatization of land, thereby returning it to its original owners—including land within the national park. However, the park itself was not disestablished, and the rules and regulations governing land use within Tatra remained intact, applying equally to both publicly and privately held park lands.

Most of the newly repatriated owners had, in the first flush of excitement, some strong ideas about how they should be able to manage their property in the park. Their approach can be simply expressed in one sentence: "This is my property and I can do what I want." The gap in their minds, more than 40 years long, was difficult to overcome. Yet slowly, very slowly, they have changed their attitudes. They have learned that everybody has to respect legislation, not only that which pertains to reprivatization, but also the law creating Tatra National Park. This act means many restrictions for them and almost no compensation (except for tax-deductible ownership status).

After more than 40 years, it was time to change management practice. Park managers had to assume the new task of educating owners, explaining to them not only about the uniqueness of Tatra's natural features, but also about their rights and, above all, their responsibilities. Today, managers generally look for compromises, but compromises that do not hurt the park. Rangers have become more diplomats than naturalists, interpreters, or managers. Even so, the last few years in Tatra National Park have been harder for owners than for park managers.

But both sides have had to find a way of understanding, of cooperating. In the last year, more and more owners have found that the beauty of the mountains behind their homes attract ever-increasing numbers of tourists every year. They bring money, but more than this they spread news about Tatra's mountains throughout the world. The growing mass of tourists also has brought new troubles—troubles which are very common and well-known in parks around the world. All these troubles can only be solved with mutual tolerance, understanding, and cooperation.

In any event, for the foreseeable future Tatra's managers can only expect more visitors—more and more people who are looking for that relatively pristine piece of nature which is so rare in Central Europe.

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"America's Best Idea":

A Review of *Preserving Nature in the National Parks: A History*

Richard West Sellars. Yale University Press, New Haven, Connecticut. 364 pp., clothbound.

Reviewed by Gary E. Davis

The concept of national parks, setting aside unbroken tracts of land and sea for the enjoyment of people, has been called America's best idea. In *Preserving Nature in the National Parks*, Richard West Sellars meticulously traces the evolution of the national park concept and America's national park system from 1870 to the present. From beginning to end, he confronts readers with evidence that disputes tradition. Among other beliefs, he authoritatively challenges the romantic campfire myth of an altruistic birth of Yellowstone National Park and the national park concept. He offers in its place a pragmatic rationale more consistent with the times. This book is a scholarly presentation of carefully researched and documented facts, woven into an unbroken story.

The tale unfolds from the perspective of the National Park Service, the primary governmental agency responsible for conserving parks. It starts with the campfire myth and then follows with renowned landscape architect Frederick Law Olmsted, Jr., crafting and shaping the National Park Service's mission "to conserve the scenery and the natural and historic objects and the wild life [in parks] unimpaired for the enjoyment of future generations." It ends with the 1993 creation of the National Biological Survey and the sweeping reorganization of the National Park Service in 1995. Throughout, readers get an insider's view of America's favorite government agency. As the story approaches the present, it necessarily shallows to encompass ever more territory, losing its rich historical texture, but gaining a journalistic perspective that serves readers well.

Great new ideas always create tension and elicit vigorous debate. Sellars skillfully draws our attention to a series of tensions created by the national park idea that shaped the concept and its manifestations in the 20th century. Born as a dream of profit from limitless recreational tourism, the creation of national parks was an attempt to resolve the conflict over how to wrest the greatest good and profit from the land: consumption through private exploitation or through public tourism. Sellars also examines the tension between development in parks to facilitate access, lodging, and consumptive recreation versus wilderness preservation. Landscape architects, engi-

neers, and biologists expressed conflicting interpretations of "unimpaired" during the 1920s and 1930s. This tension has evolved into a continuing discussion of scenery or façade versus ecosystem management.

Clearly, early promoters of national parks had no qualms about developing facilities in parks and consuming park resources. In promoting the creation of the National Park Service in 1916, Robert Sterling Yard wrote in *The Nation's Business:* "We want our national parks developed.... We want good fishing. We want our wild animal life conserved and developed." The first two directors of the National Park Service, businessman Stephen Mather and lawyer Horace Albright, both believed the public needed to be enticed into parks with roads, lodges, and enhanced fishing, in addition to the parks' scenery and other natural assets. They set about building facilities, including fish hatcheries, and planting alien fish in parks as their first order of business for the new agency. They also believed they should 'enhance' the parks by suppressing fires, eradicating predators, and controlling forest pests and diseases, which they did vigorously.

At its inception, national park management was a new human endeavor. No one before had tried to preserve intact large tracts of wild land- and seascapes for public enjoyment and to pass them on to future generations. Unlike forest and fisheries management that had centuries of precedent and practice, what park managers needed to do had no precedent. They were truly exploring the unknown, and thus relied on extant professions for guidance. Foresters, landscape architects, and engineers who used land to produce commodities and who molded landscapes to fit human perceptions of idyllic and pastoral settings came the closest to fitting the new paradigm, so they got the job: directed by businessmen and lawyers. However, national park management is more than a simple combination of these early professions: it also requires applied sciences, particularly ecology. Adding ecologists to this mix was like combining oil and water. We're still looking for an emulsification agent.

Sellars makes it clear that the tension between scientists and non-scientists regarding national park management was the same in the 1930s as it is today. In part, the differences arise from non-scientists' reliance on untestable, belief-based consensus versus scientists' adherence to a testable, knowledge-based system of learning from experience. If one believes that fire destroys forests, or that wolves threaten elk populations, there is no reason to waste time and money testing the concepts. One simply acts on these beliefs and suppresses fire and kills wolves. Testing such beliefs threatens the belief and the believers, and thus creates a perception that science would make park management more costly, difficult, and time-consuming. This may be at the root of the issue that creates the

tension between so-called traditional and ecological approaches to park stewardship.

Science as a way of knowing should make attainment of the National Park Service mission more certain and cost-effective. The true costs of ecological restoration and of losing America's heritage to unfounded beliefs is vastly greater than the costs associated with learning first how ecosystems work and doing the job right the first time. We paid dearly for early misguided forest fire suppression. First we paid the unnecessary costs of suppression. Now we are paying the costs of restoring fire, with the risk of losing the very assets we sought to protect if we delay any longer. We paid to eradicate wolves and other predators, then paid to reduce elk and deer, then lost soil and vegetation, and now we must pay to restore wolf populations. This kind of cost dwarfs the minimal costs of using science to learn what is in parks, how to restore impaired assets, how to maintain restored parks, and how to protect parks from pollution, unsustainable uses, fragmentation, and alien species. In short, using science to learn from our experience reduces uncertainty and costs.

In the last century, the parks could afford the boosterism, "enhancements," and facilities of Mather and Albright and still recover, because parks were not the islands in a fragmented and diminished landscape they are today. Few refugia exist today, outside legislated wilderness, from which to find replacement genomes and species to repair the damage wrought by misguided policies. We are already beginning to lose our heritage in the marine environment where we have no wilderness and no refugia, and denial of human impact is rampant even in the National Park System. Time is short. Options to conserve and pass unimpaired parks on to future generations become more limited every year.

Change is inevitable. Will we use science to learn from experience, or continue to blindly accept and act on unsubstantiated beliefs? The National Park Service will not accept a change from its primary goal of recreational tourism to science-guided resources protection until its leaders personally experience success with science. As a result, people such as Richard Sellars run great risk of being attacked by opponents vested in the old system and only moderately supported by skeptics of the new, science-based system. Since the national park concept is new, unique, few have the necessary personal experience, yet. Perhaps the introspection in this book will lead to trying new ways to conserve parks.

In interpretive jargon, scenery is the hook. Once enticed into the parks by the scenery, the public can personally experience the wonders they contain, beyond the view. Mather and Albright believed they had to entice the public to visit parks and support the park concept. The National Park Service did that during the 20th century. The public has found and loves their park system and the Na-

tional Park Service. Now the hard work begins—learning what is in the parks and how they work, restoring impaired assets, maintaining impaired processes, and protecting parks as islands of wilderness in a landscape dominated by human activities.

Until we learn our history, how we came to where we are, and where we thought we were going, we risk endlessly repeating the same mistakes. This account illuminates our path. Read it. You will like it. You may not agree with everything in it, but you will learn from it. We and our national parks will all be better for it.

Gary E. Davis is Senior Scientist at Channel Islands National Park, Ventura, California. He was president of The George Wright Society from January 1993 to December 1995.

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